

# FCC/IC TEST REPORT

for

DONGGUAN MEILOON ACOUSTIC EQUIPMENTS CO., LTD.

active loudspeaker

Model Number:TRANSPARENT ZERO

FCC ID:2AJAA-T0

IC: 21761-T0

Prepared for : DONGGUAN MEILOON ACOUSTIC EQUIPMENTS CO., LTD.  
Address : 77 Yuanlin Road Fenghuanggang Ind Estate, Tangxia Town,  
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Report No. : 16KWE114710F  
Date of Test : Nov.11-Nov.21, 2016  
Date of Report : Nov.22, 2016

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## Keyway Testing Technology Co., Ltd.

<b>Applicant: Address:</b>	DONGGUAN MEILOON ACOUSTIC EQUIPMENTS CO., LTD. 77 Yuanlin Road Fenghuanggang Ind Estate, Tangxia Town, 523727 Dongguan City, Guangdong Province, China		
<b>Manufacturer: Address:</b>	Vanatoo LLC 1600B SW Dash Point Rd #51 Federal Way, WA 98023, USA		
<b>E.U.T:</b>	active loudspeaker		
<b>Model Number:</b>	TRANSPARENT ZERO		
<b>Serial Model:</b>	N/A		
<b>Trade Name:</b>	Vanatoo	<b>Serial No.:</b>	-----
<b>Date of Receipt:</b>	Nov. 10, 2016	<b>Date of Test:</b>	Nov.11-Nov.21, 2016
<b>Test Specification:</b>	FCC Part 15, Subpart C Section 15.247: 2015 ANSI C63.10:2013		
<b>Test Result:</b>	The equipment under test was found to be compliance with the requirements of the standards applied.		
		<b>Issue Date: Nov.22, 2016</b>	
<b>Tested by:</b>	<b>Reviewed by:</b>	<b>Approved by:</b>	
 _____	 _____	 _____	
Keven Wu / Engineer	Mike Xu / Supervisor	Andy Gao / Supervisor	
<b>Other Aspects:</b>	None.		
<i>Abbreviations: OK/P=passed    fail/F=failed    n.a/N=not applicable    E.U.T=equipment under tested</i>			
<i>This test report is based on a single evaluation of one sample of above mentioned products. It is not permitted to be duplicated in extracts without written approval of Keyway Testing Technology Co., Ltd.</i>			

## 1. TEST SUMMARY

Test Items	Test Requirement	Result
Conducted Emissions	15.207	PASS
Radiated Emissions	15.205(a)/15.209 15.247(d)	PASS
20dB Bandwidth	15.247(a)(1)	PASS
Frequency Separation	15.247(a)(1)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Number of Hopping Frequency	15.247(a)(1)(iii)	PASS
Dwell time	15.247(a)(1)(iii)	PASS
Emissions from out of band	15.247(d)	PASS
Antenna Requirement	15.203	PASS

## 2.GENERAL PRODUCT INFORMATION

### 2.1. Product Function

Refer to Technical Construction Form and User Manual.

### 2.2. Description of Device (EUT)

Product Name:	active loudspeaker
Model No.:	TRANSPARENT ZERO
Serial Model:	N/A
Model Difference	N/A
Operation Frequency:	2402MHz ~2480MHz
Channel numbers:	79 Channels
Channel spacing	1MHz
Modulation technology:	BT(1Mbps): GFSK BT EDR(2Mbps): $\pi/4$ -DQPSK BT EDR(3Mbps): 8-DPSK
Bit Rate of Transmitter	1Mbps/2Mbps/3Mbps
Antenna Type:	PCB antenna
Antenna gain:	1.0 dBi
Power supply:	DC 24V from adapter
Adapter	Model:DYS602-240250W I/P:AC 100~240V 50/60Hz 1.5A MAX O/P:DC 24V 2.5A

### 2.3. Independent Operation Modes

The basic operation modes are:

2.3.1. EUT work BT mode and Test mode as below:

Pretest Mode	Description
Mode 1	CH00
Mode 2	CH39
Mode 3	CH78
Mode 4	BT link

### 2.4. Product Version

Product SW version	V1.0
Product HW version	V1.0
Radio SW version	V3.0
Radio HW version	BTM_59_V01A
Test SW Version	BlueTest3
RF power setting in TEST SW	1.0 dBm

## 2.5. Test Facilities

Lab Qualifications : 944 Shielded Room built by ETS-Lindgren, USA  
Date of completion: March 28, 2011

966 Chamber built by ETS-Lindgren, USA  
Date of completion: March 28, 2011

Certificated by TUV Rheinland, Germany.  
Registration No.: UA 50207153  
Date of registration: July 13, 2011

Certificated by UL, USA  
Registration No.: 100567-237  
Date of registration: September 1, 2011

Certificated by Intertek  
Registration No.: 2011-RTL-L1-31  
Date of registration: October 11, 2011

Certificated by Industry Canada  
Registration No.: 9868A  
Date of registration: December 8, 2011

Certificated by FCC, USA  
Registration No.: 370994  
Date of registration: February 21, 2012

Certificated by CNAS China  
Registration No.: CNAS L5783  
Date of registration: August 8, 2012

Name of Firm : Keyway Testing Technology Co., Ltd.

Site Location : Building 1, Baishun Industrial Zone, Zhangmutou  
Town, Dongguan, Guangdong, China

## 2.6. List of Test and Measurement Instruments

### 2.6.1. For conducted emission at the mains terminals test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 09,16	Apr. 09,17
Artificial Mains Network	Rohde&Schwarz	ENV216	101315	Apr. 09,16	Apr. 09,17
Artificial Mains Network (AUX)	Rohde&Schwarz	ENV216	101314	Apr. 09,16	Apr. 09,17
RF Cable	FUJIKURA	3D-2W	944 Cable	Apr. 09,16	Apr. 09,17

### 2.6.2. For radiated emission test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESCI	101156	Apr. 09,16	Apr. 09,17
Bilog Antenna	ETS-LINDGREEN	3142D	135452	Apr. 09,16	Apr. 09,17
Spectrum Analyzer	Agilent	E4411B	MY4511304	Apr. 09,16	Apr. 09,17
Spectrum Analyzer	Agilent	N9020A	MY56070279	Jul.26,16	Jul.25,17
3m Semi-anechoic Chamber	ETS-LINDGREEN	966	KW01	Apr. 09,16	Apr. 09,17
Signal Amplifier	SONOMA	310	187016	Apr. 09,16	Apr. 09,17
Signal Amplifier	Agilent	8449B	3008A00251	Apr. 09,16	Apr. 09,17
RF Cable	IMRO	IMRO-400	966 Cable 1#	N/A	N/A
MULTI-DEVICE Controller	ETS-LINDGREEN	2090	126913	N/A	N/A
Horn Antenna	SCHWARZBECK	BBHA9170	9170-068	Apr. 09,16	Apr. 09,17
Spectrum Analyzer	Agilent	E4408B	MY44211125	Apr. 09,16	Apr. 09,17
High Pass filter	Micro	HPM50111	324216	Apr. 09,16	Apr. 09,17
Constant temperature and humidity box	GF	GTH-800-40-1P	MAA9906-005	Apr. 09,16	Apr. 09,17
Attenuation	MCE	24-10-34	BN9258	Apr. 02,16	Apr. 02,17
Loop Antenna	ARA	PLA-1030/B	1029	Apr. 02,16	Apr. 02,17
Power Meter	Anritsu	ML2495A	1204003	Apr. 24,16	Apr. 24,17
Power Sensor	Anritsu	MA2411B	1126150	Apr. 24,16	Apr. 24,17

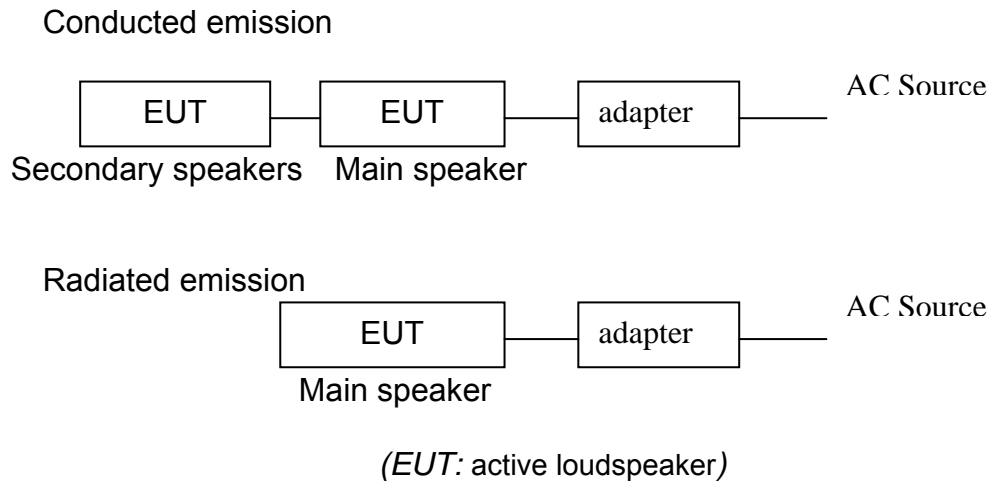
### 3. TEST SET-UP AND OPERATION MODES

#### 3.1. Principle of Configuration Selection

**Emission:** The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the Operating Instructions.

#### 3.2. Block Diagram of Test Set-up

System Diagram of Connections between EUT and Simulators



#### 3.3. Test Operation Mode and Test Software

Pretest Mode	Description
Mode 1	CH00
Mode 2	CH39
Mode 3	CH78
Mode 4	BT link

Test Software: e3 and bluetest3

#### 3.4. Special Accessories and Auxiliary Equipment

Adapter:	Model:DYS602-240250W I/P:AC 100~240V 50/60Hz 1.5A MAX O/P:DC 24V 2.5A
----------	-----------------------------------------------------------------------------

#### 3.5. Countermeasures to Achieve EMC Compliance

N/A.

#### 3.6. Test Environment:

Ambient conditions in the test laboratory:

Items	Actual
Temperature (°C)	20~30
Humidity (%RH)	50~65



## 4. MAXIMUM PEAK OUTPUT POWER

### 4.1. Limits

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247 (b)(i)	Peak Output Power	0.125 w or 20.96dBm	2400-2483.5	PASS

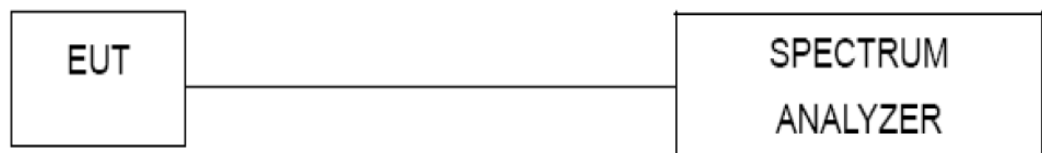
### 4.2. Test Procedure

For Peak power

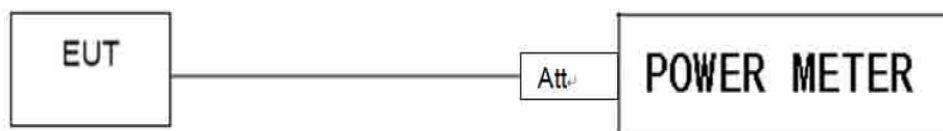
- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below,
- b. Spectrum Setting : RBW > the 20 dB bandwidth of the emission being measured  
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel  
VBW ≥ RBW  
Sweep = auto  
Detector function = peak  
Trace = max hold  
For AV power
  1. The Transmitter output (antenna port) was connected to the power meter.
  2. Turn on the EUT and power meter and then record the power value.
 Repeat above procedures on all channels needed to be tested.

### 4.3. Test setup

Peak power



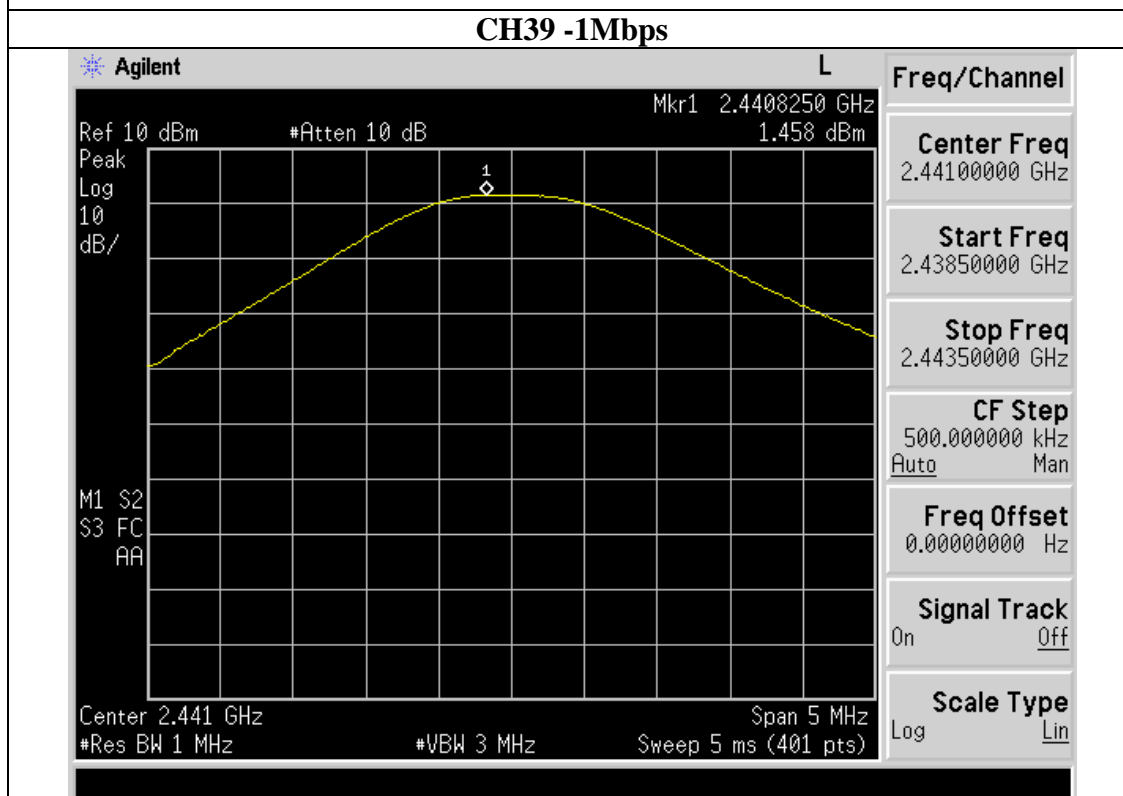
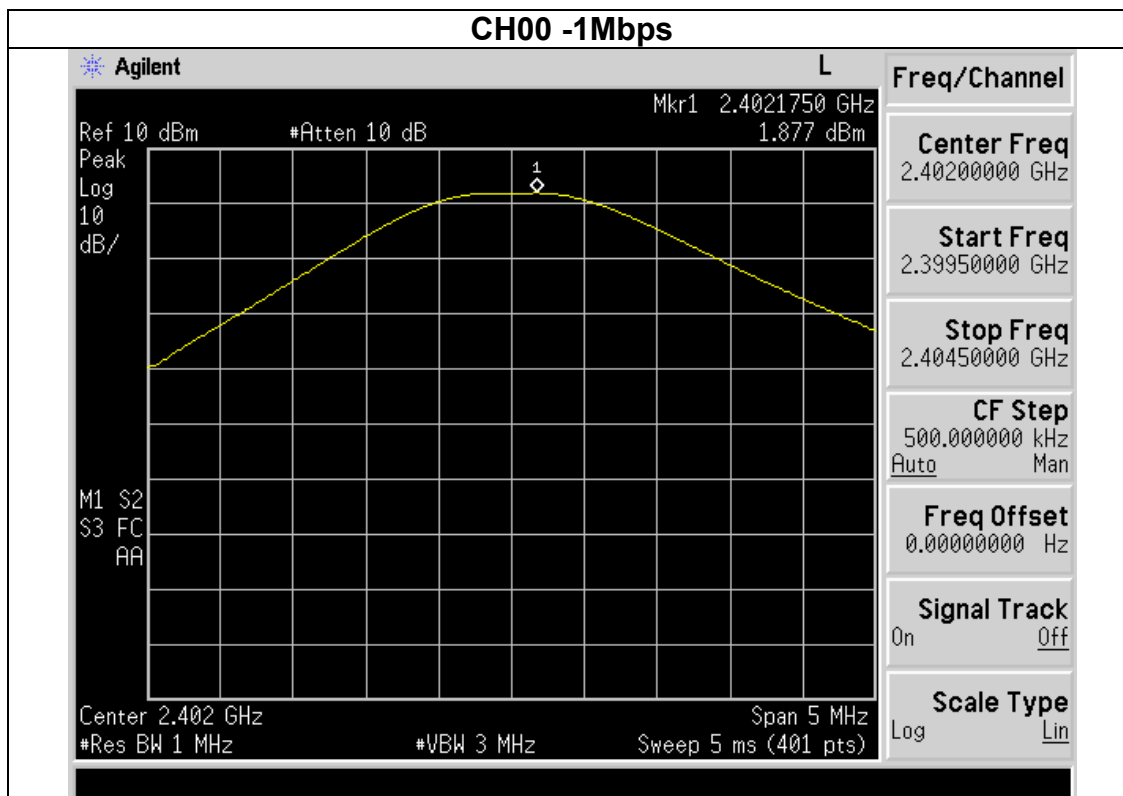
AV power

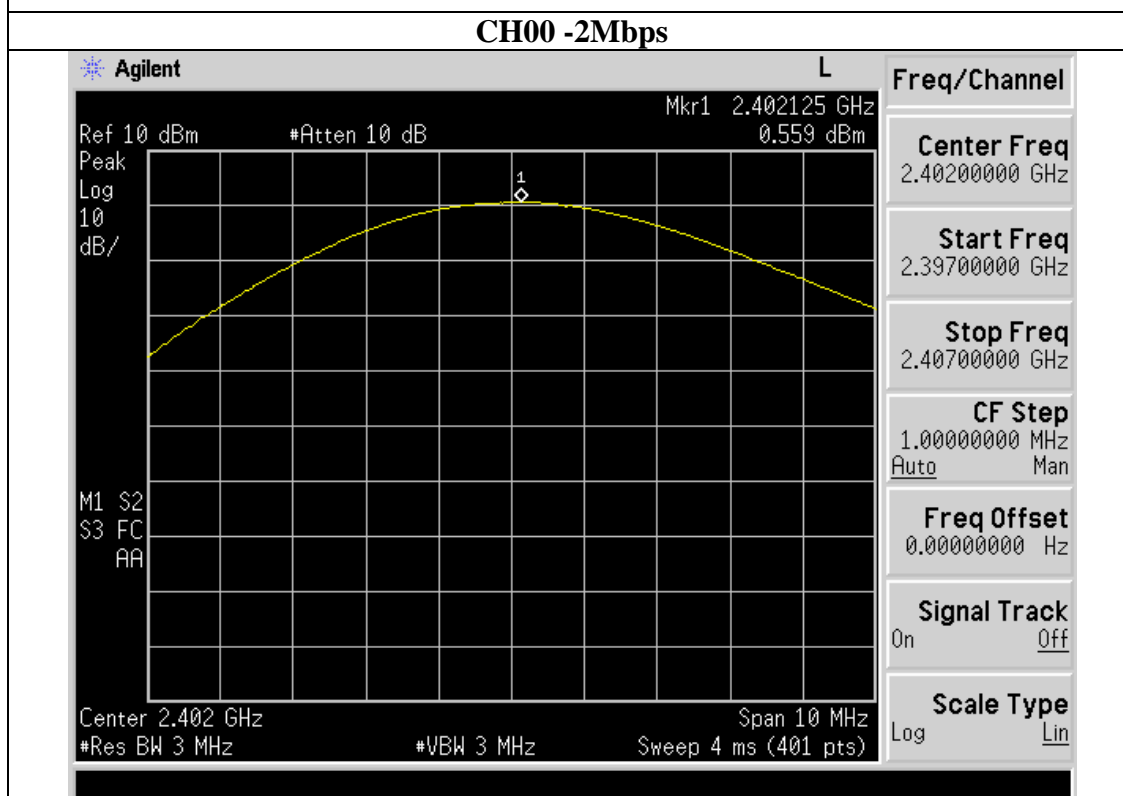
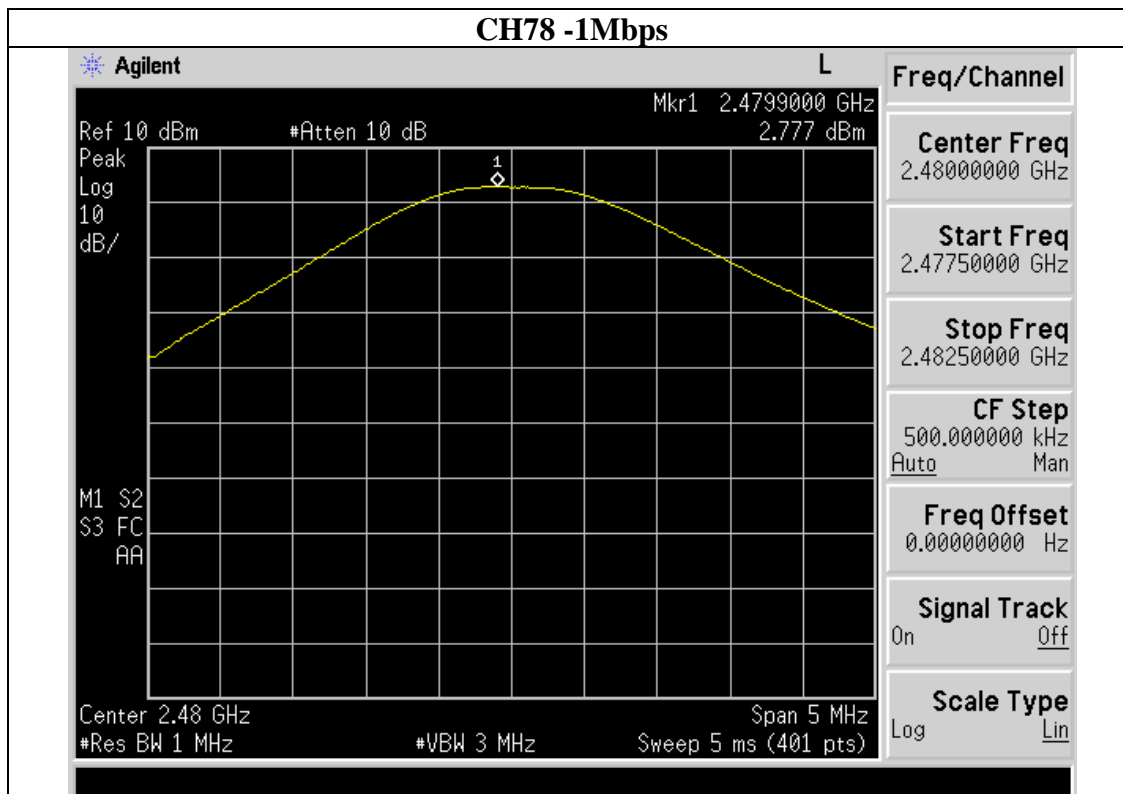


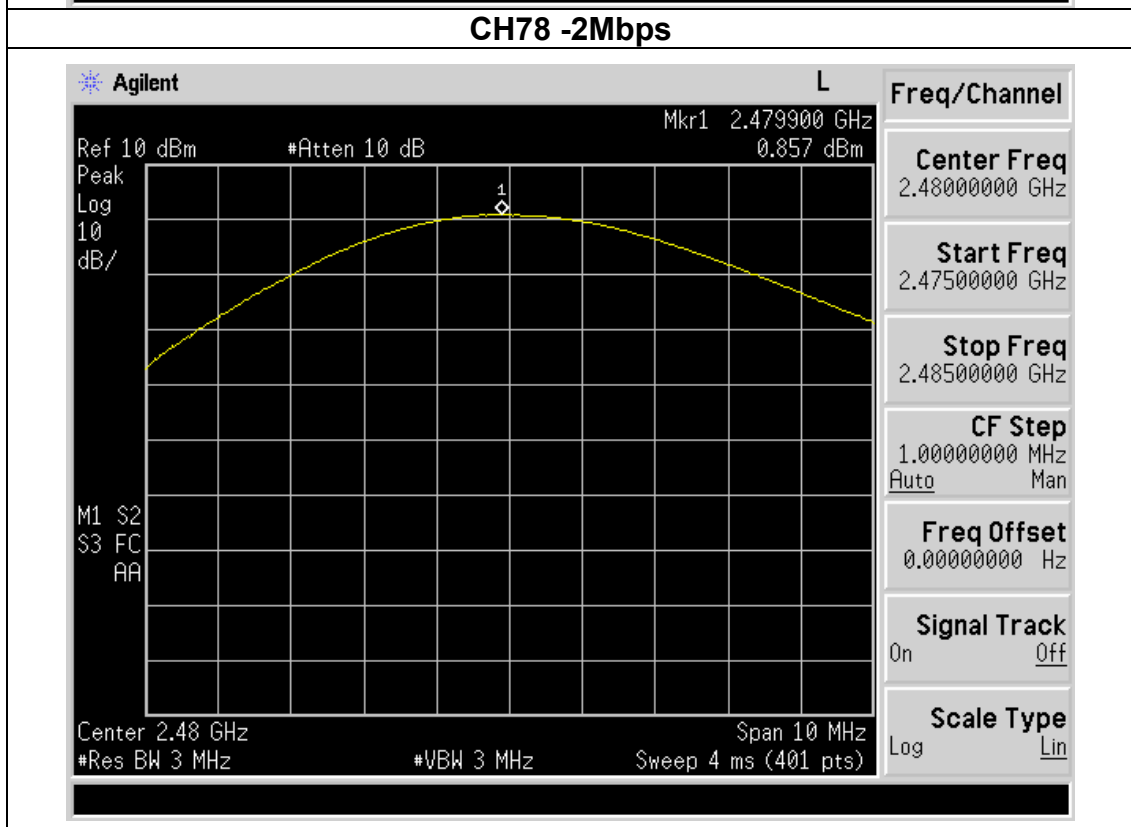
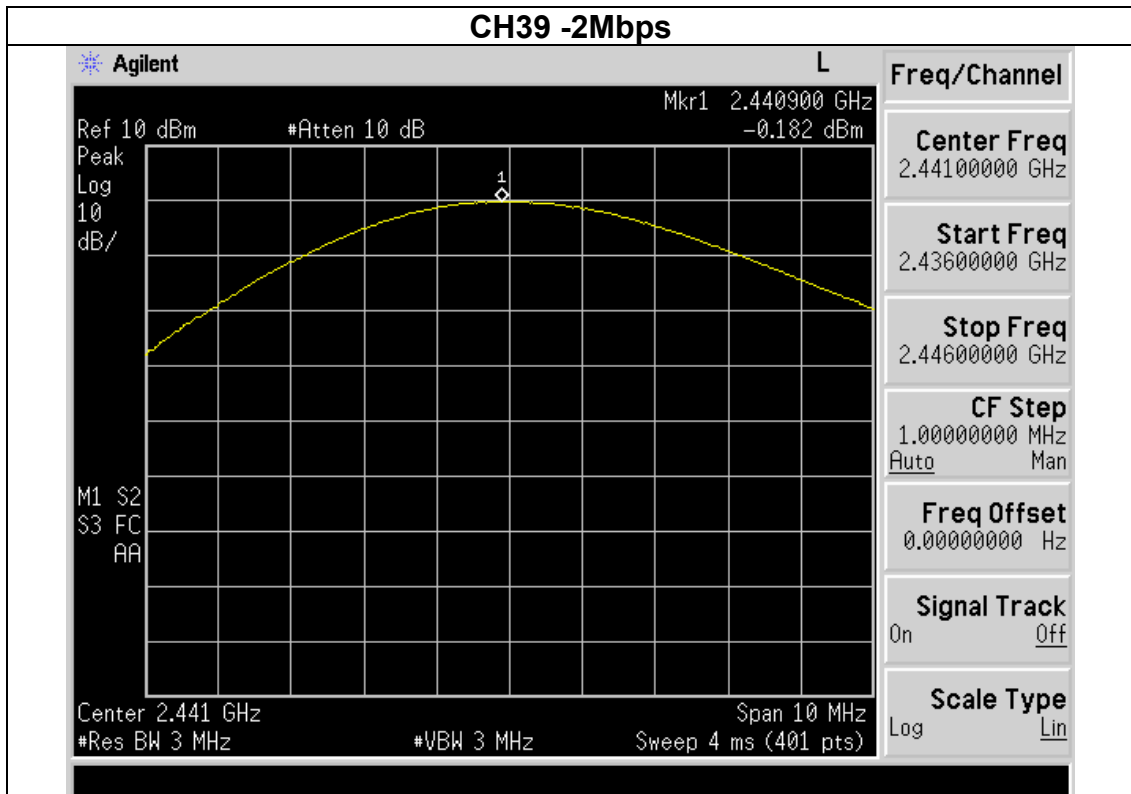
Test data:

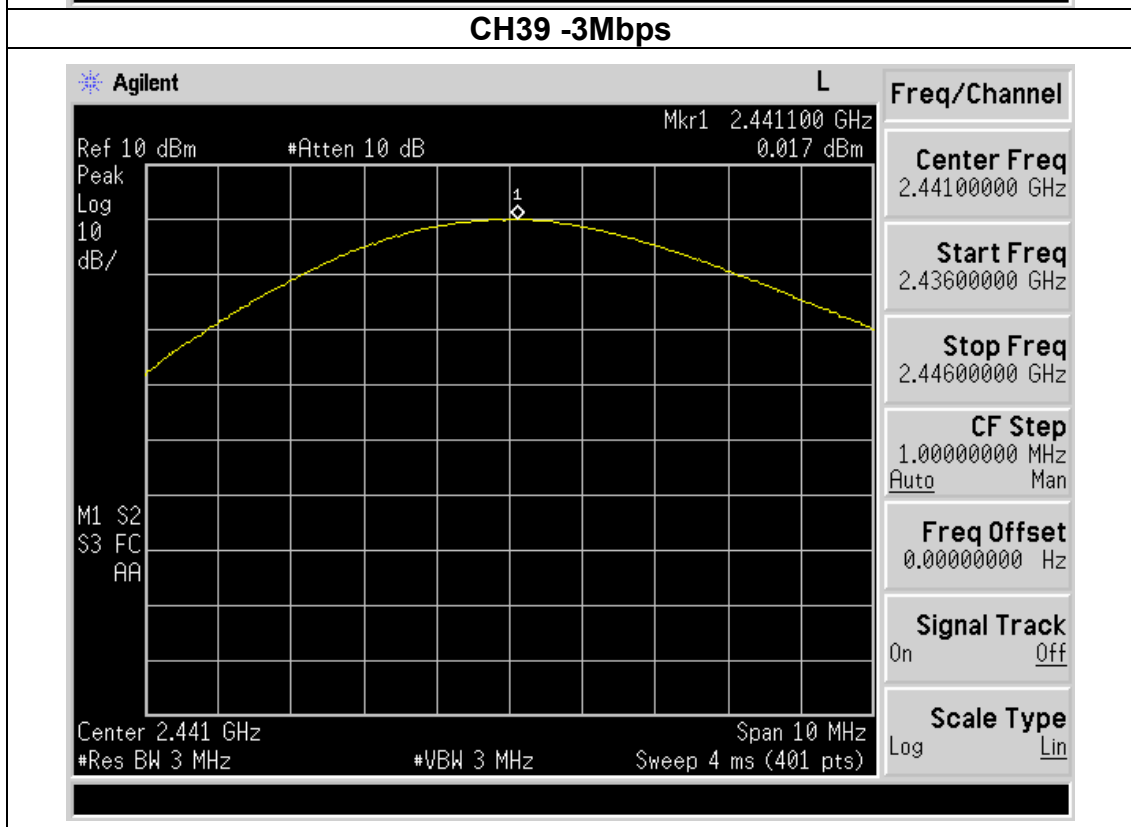
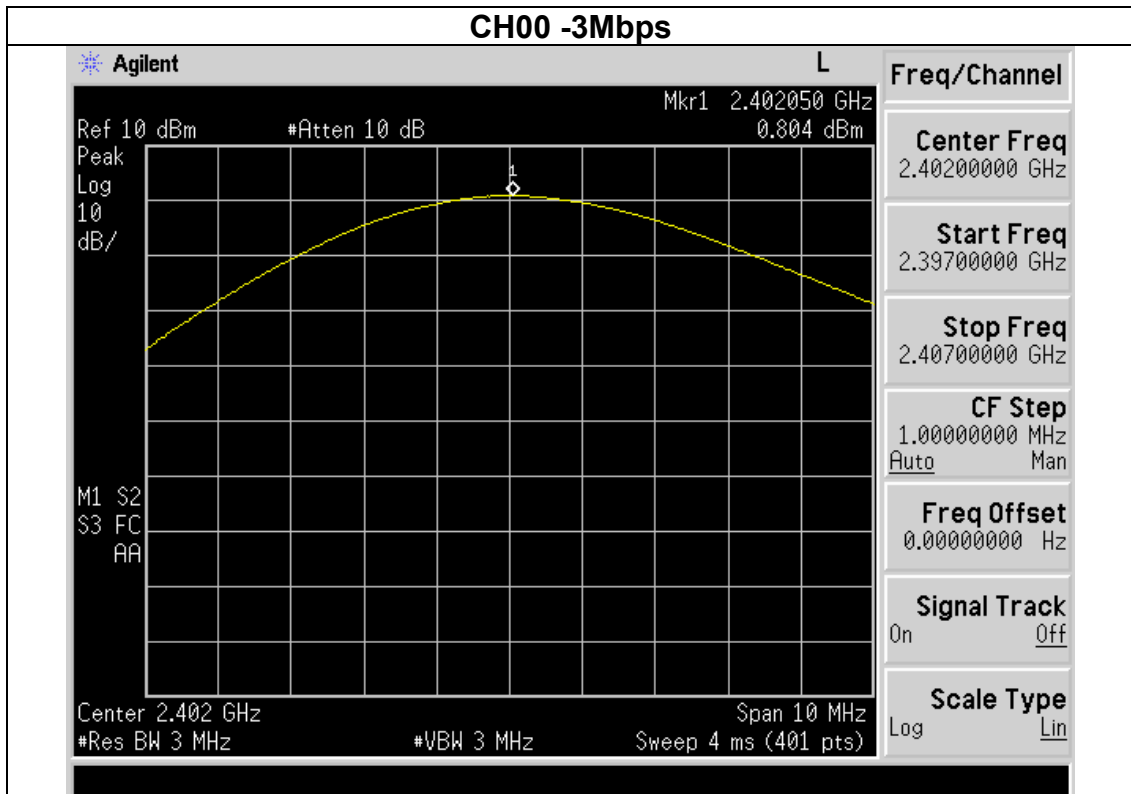
For FCC

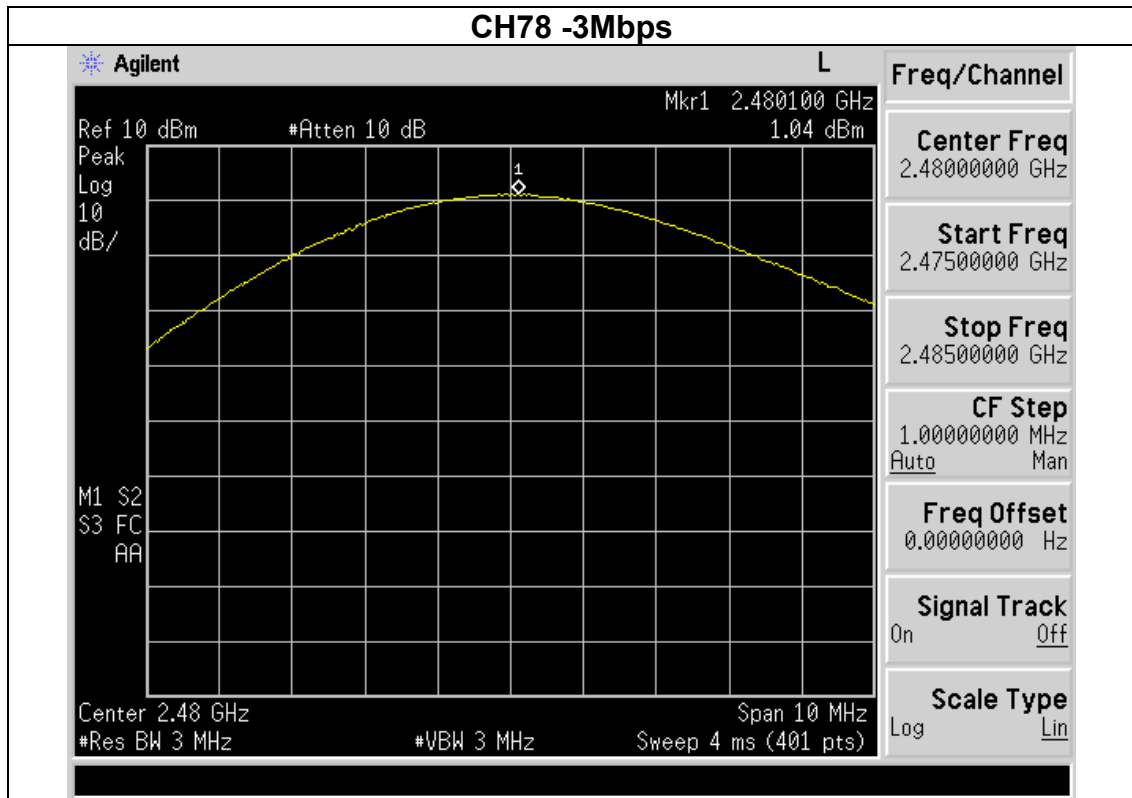
1Mbps			
Test Channel	Frequency (MHz)	Peak Output Power (dBm)	LIMIT (dBm)
CH00	2402	1.877	30
CH39	2441	1.458	30
CH78	2480	2.777	30
2Mbps			
CH00	2402	0.559	20.96
CH39	2441	-0.182	20.96
CH78	2480	0.857	20.96
3Mbps			
CH00	2402	0.804	20.96
CH39	2441	0.017	20.96
CH78	2480	1.040	20.96











## 5. EMISSION TEST RESULTS

### 5.1. Conducted Emission at the Mains Terminals Test

#### 5.1.1. Limit 15.207

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

#### 5.1.2. Test Setup

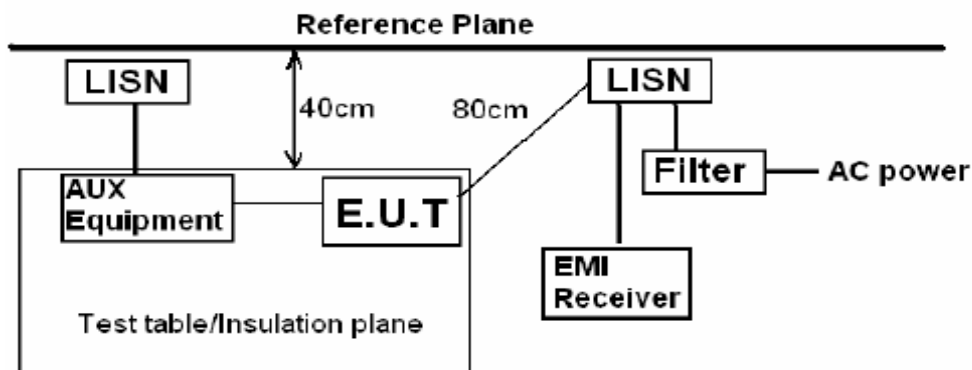
The EUT was put on a wooden table which was 0.8 m high above the ground and connected to the AC mains through the Artificial Mains Network (AMN). Where the mains cable supplied by the manufacture was longer than 0.8 m, the excess was folded back and forth parallel to the cable at the center so as to form a bundle no longer than 0.4 m.

The EUT was kept 0.4 m from any other earthed conducting surface. Both sides of AC line were checked to find out the maximum conducted emission levels according to the test procedure during the conducted emission test.

The frequency range from 150 kHz to 30 MHz was investigated.

The bandwidth of the test receiver was set at 9 kHz.

Pretest for all mode, The test data of the worst case condition(s) was reported on the following page. We pretest AC 120V and AC 240V, the worst voltage was AC 120V and the data recording in the report.

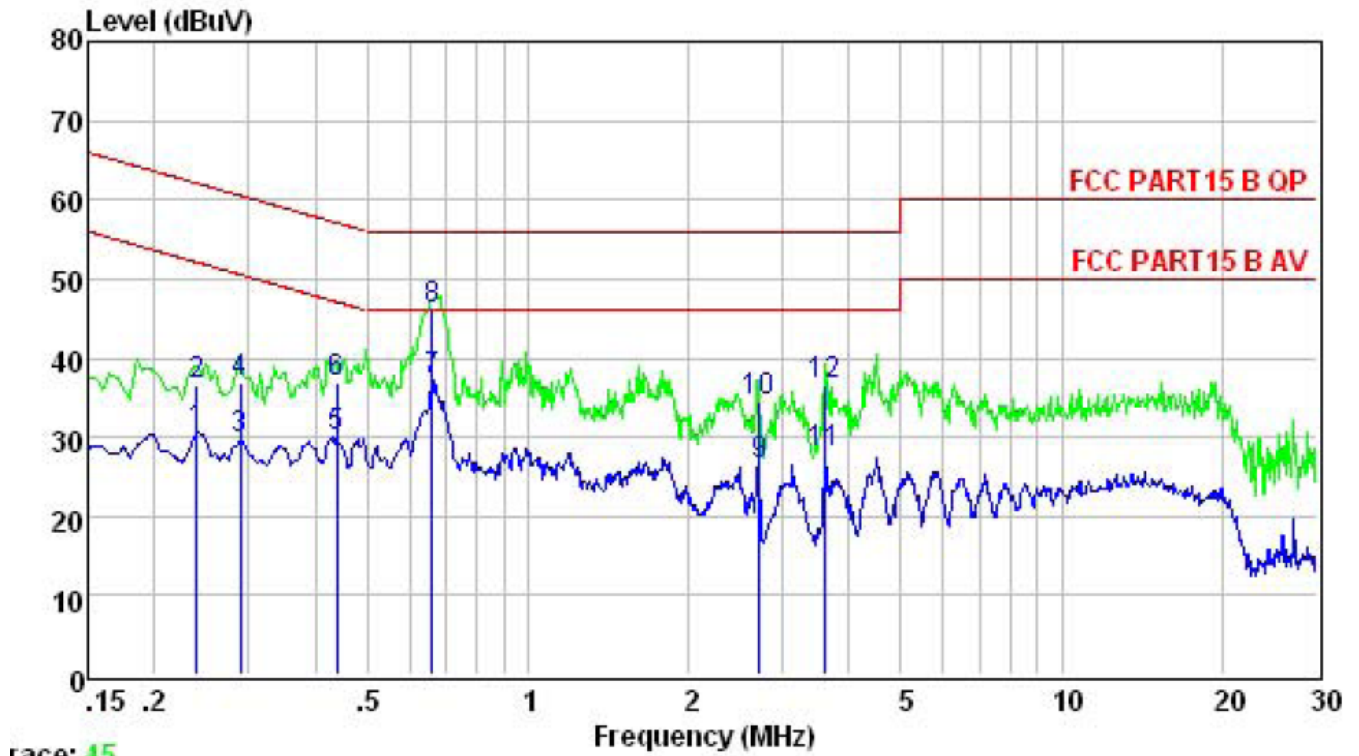


*Remark:*  
E.U.T: Equipment Under Test  
LISN: Line Impedance Stabilization Network  
Test table height=0.8m



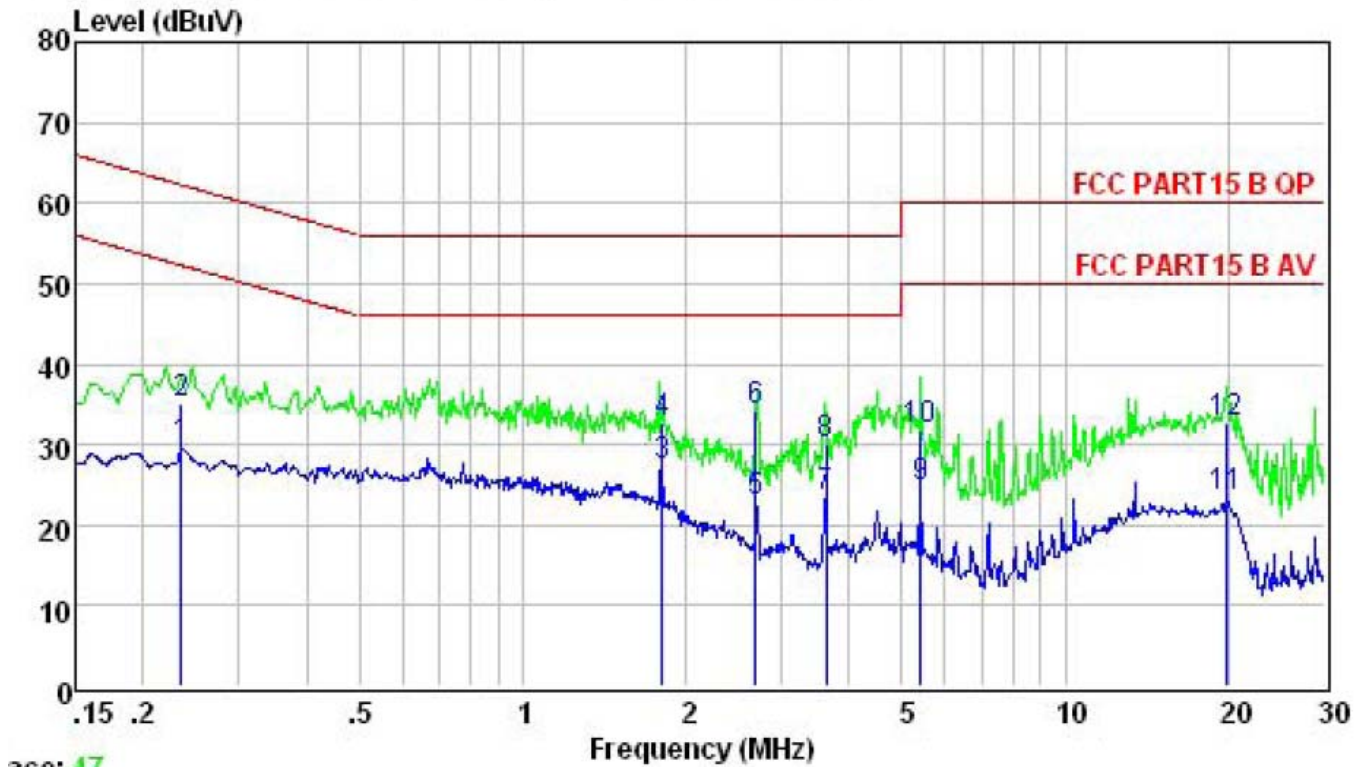
5.1.3. Test result

EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 24.0V from Adapter AC 120V/60Hz	Test Mode :	Mode 4



	Freq	Level	Limit	Over	Remark
	MHz	dBuV	dBuV	dB	
1	0.240	30.69	52.08	-21.39	Average
2	0.240	36.69	62.08	-25.39	QP
3	0.289	29.88	50.54	-20.66	Average
4	0.289	36.89	60.54	-23.65	QP
5	0.440	30.11	47.07	-16.96	Average
6	0.440	36.89	57.07	-20.18	QP
7	0.661	37.13	46.00	-8.87	Average
8	0.661	46.23	56.00	-9.77	QP
9	2.707	26.57	46.00	-19.43	Average
10	2.707	34.59	56.00	-21.41	QP
11	3.603	27.86	46.00	-18.14	Average
12	3.603	36.59	56.00	-19.41	QP

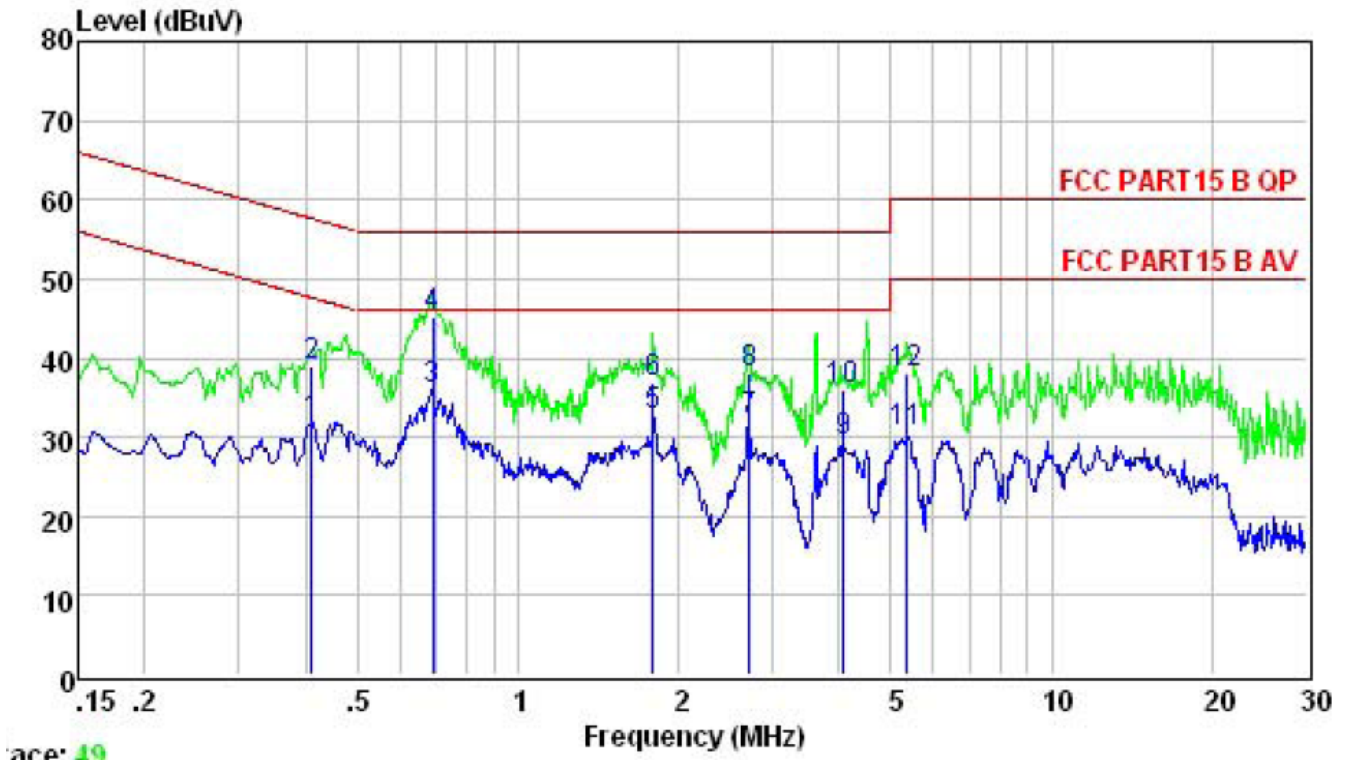
EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 24.0V from Adapter AC 120V/60Hz	Test Mode :	Mode 4



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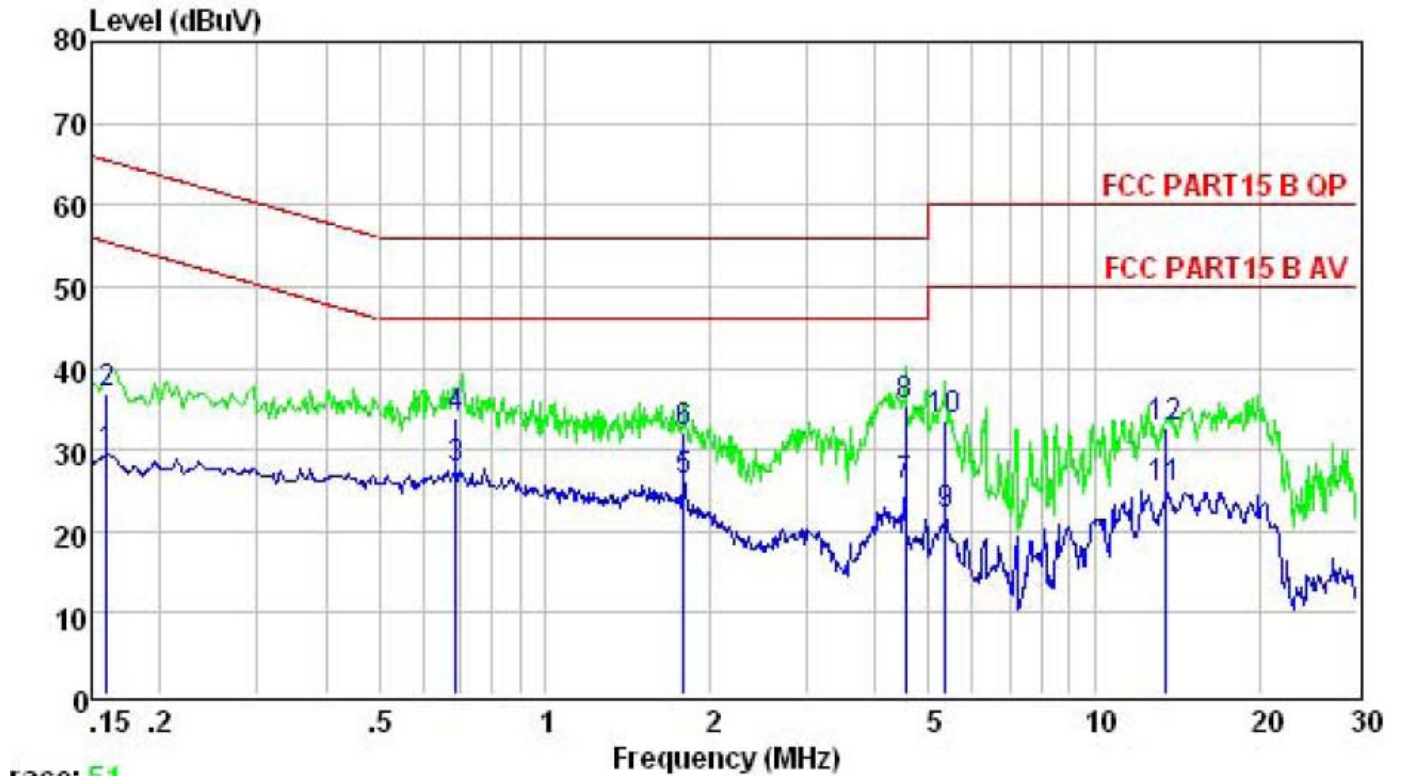
	Freq	Level	Limit	Over	Remark
	MHz	dBuV	dBuV	dB	
1	0.235	29.61	52.26	-22.65	Average
2	0.235	35.12	62.26	-27.14	QP
3	1.810	27.40	46.00	-18.60	Average
4	1.810	32.63	56.00	-23.37	QP
5	2.692	22.93	46.00	-23.07	Average
6	2.692	34.12	56.00	-21.88	QP
7	3.623	23.56	46.00	-22.44	Average
8	3.623	30.12	56.00	-25.88	QP
9	5.419	24.72	50.00	-25.28	Average
10	5.419	31.85	60.00	-28.15	QP
11	19.845	23.53	50.00	-26.47	Average
12	19.845	32.63	60.00	-27.37	QP

EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 24.0V from Adapter AC 240V/60Hz	Test Mode :	Mode 4



	Freq	Level	Limit	Over	Remark
	MHz	dBuV	dBuV	dB	
1	0.410	31.73	47.64	-15.91	Average
2	0.410	38.96	57.64	-18.68	QP
3	0.694	35.97	46.00	-10.03	Average
4	0.694	45.12	56.00	-10.88	QP
5	1.790	32.80	46.00	-13.20	Average
6	1.790	36.89	56.00	-19.11	QP
7	2.707	32.19	46.00	-13.81	Average
8	2.707	38.12	56.00	-17.88	QP
9	4.070	29.38	46.00	-16.62	Average
10	4.070	35.96	56.00	-20.04	QP
11	5.362	30.75	50.00	-19.25	Average
12	5.362	38.12	60.00	-21.88	QP

EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 24.0V from Adapter AC 240V/60Hz	Test Mode :	Mode 4



	Freq	Level	Limit	Over	Remark
	MHz	dBuV	Line	Limit	
			dBuV	dB	
1	0.160	29.37	55.47	-26.10	Average
2	0.160	36.89	65.47	-28.58	QP
3	0.690	27.80	46.00	-18.20	Average
4	0.690	33.96	56.00	-22.04	QP
5	1.790	26.21	46.00	-19.79	Average
6	1.790	32.12	56.00	-23.88	QP
7	4.525	25.48	46.00	-20.52	Average
8	4.525	35.25	56.00	-20.75	QP
9	5.362	21.94	50.00	-28.06	Average
10	5.362	33.69	60.00	-26.31	QP
11	13.479	25.18	50.00	-24.82	Average
12	13.479	32.59	60.00	-27.41	QP

## 5.2. Radiated Emission Test

### 5.2.1. Limit 15.209

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		$\mu\text{V}/\text{m}$	$\text{dB}(\mu\text{V})/\text{m}$
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 $\text{dB}(\mu\text{V})/\text{m}$ (Peak) 54.0 $\text{dB}(\mu\text{V})/\text{m}$ (Average)	

### 5.2.2. Restricted bands of operation

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	( <sup>2</sup> )

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

### 5.2.3. Test setup

The EUT was placed on a turn table which was 0.8 m above the ground below 1G and 1.5m above 1G. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was set 3 m away from the receiving antenna which was mounted on an antenna tower. The measuring antenna moved up and down to find out the maximum emission level. It moved from 1 m to 4 m for both horizontal and vertical polarizations.

The EUT was tested in the Chamber Site. It was pre-scanned with a Peak detector from the spectrum, and all the final readings from the test receiver were measured with the Quasi-Peak detector.

The bandwidth of the EMI test receiver is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's VBW is set at 3MHz and RBW is set at 1MHz for peak emissions measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emissions measure above 1GHz, the EUT was placed on a turn table which was 1.5 m above the ground, for all test, used peak detector.

The frequency range from 30MHz to 10<sup>th</sup> harmonic (25GHz) are checked. and no any emissions were found from 18GHz to 25 GHz, So the radiated emissions from 18GHz to 25GHz were not record.

Notes: 1. Emission Level = Antenna Factor + Cable Loss + Meter Reading-Preamp Factor.

2. Measurement Uncertainty:  $\pm 3.2$  dB at a level of confidence of 95%.

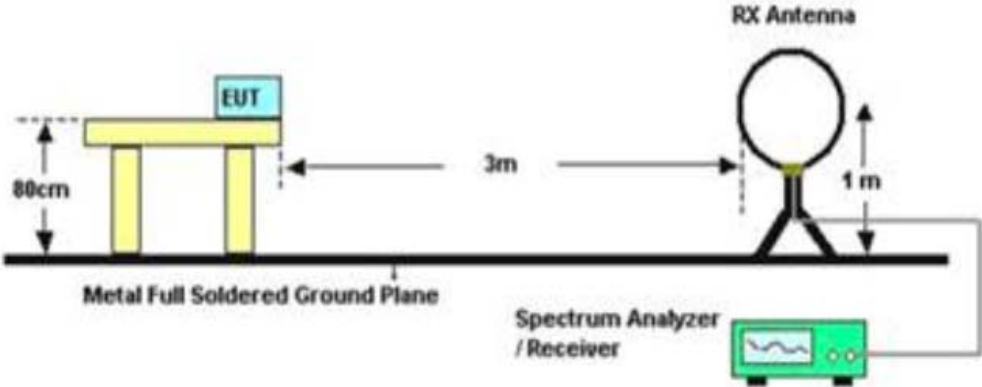
3. For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.

4. For emissions below 1GHz, pretest for all mode, The test data of the worst case condition(s) was reported on the following pages.

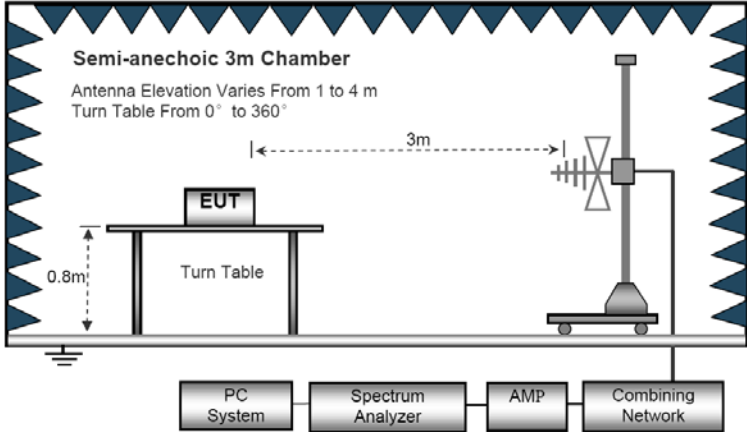
5. EUT Pre-scan X/Y/Z orientation, only worst case is presented in the report (Z orientation).

6. We pretest all modulation, The worst was GFSK, the worst data was show in the report.

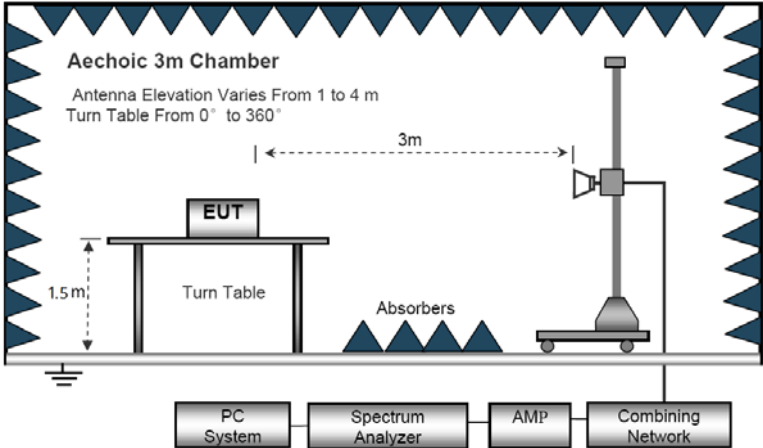
### Radiated Emission Test-Up Frequency Below 30MHz



### 30MHz- 1GHz



### Above 1GHz



EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010hPa	Test Mode :	TX
Test Voltage :	DC 24.0V from Adapter		

**Below 30MHz**

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	P
--	--	--	--	P

**Note:**

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

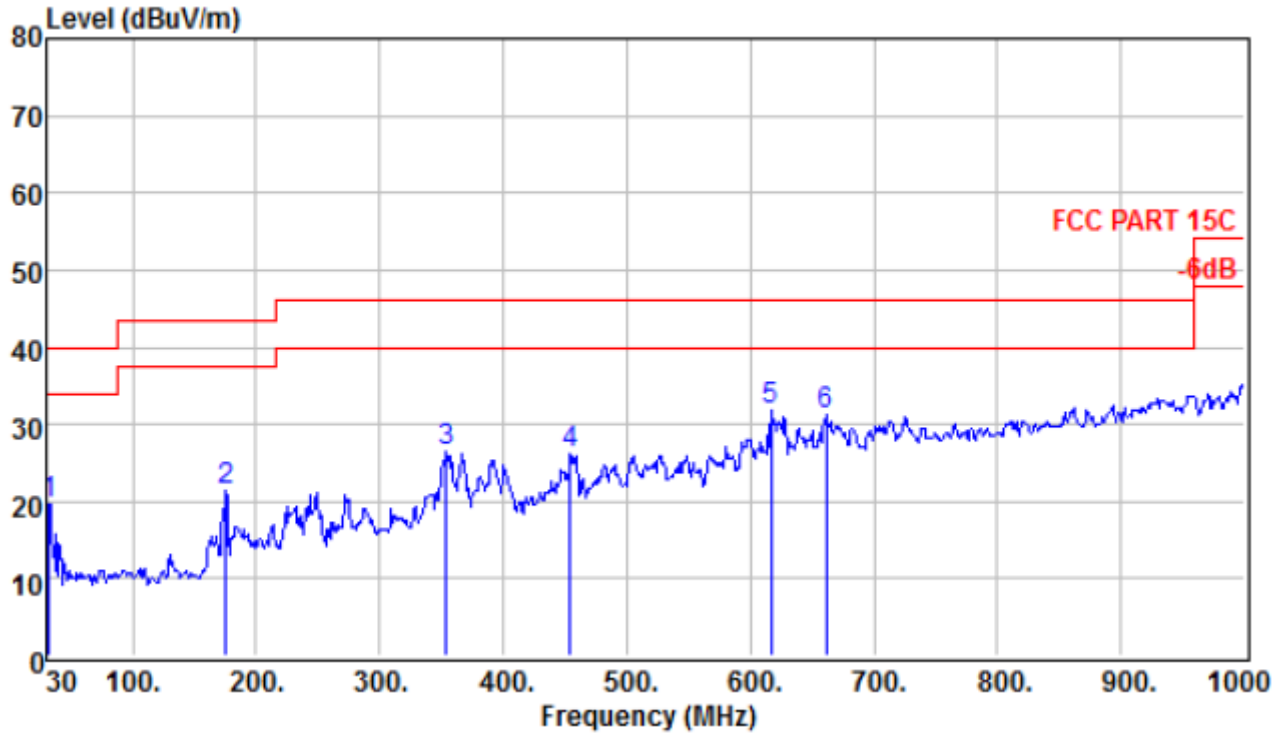
Distance extrapolation factor =  $40 \log (\text{specific distance}/\text{test distance})(\text{dB})$ ;

Limit line = specific limits(dBuv) + distance extrapolation factor.



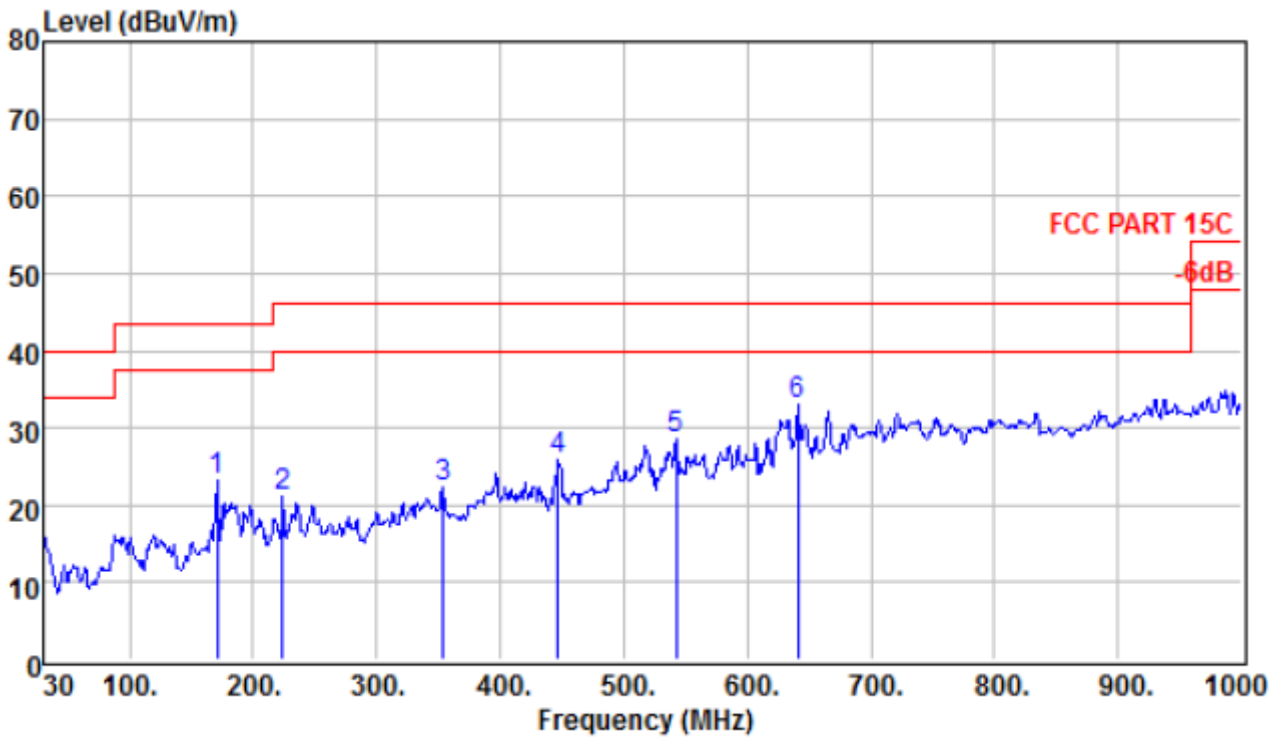
EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010hPa	Test Mode :	TX
Test Voltage :	DC 24.0V from Adapter		

30- 1GHz  
Vertical



	Freq	Level	Read Preamp	CableAntenna	Limit	Over		
	MHz	dBuV/m	Level	Loss	Line	Limit	Remark	
			dBuV	Factor	dB	dB/m	dBuV/m	dB
1	31.940	19.58	32.76	31.40	0.56	17.66	40.00	-20.42 QP
2	175.500	21.39	40.90	31.17	1.39	10.27	43.50	-22.11 QP
3	353.980	26.58	39.21	30.65	2.18	15.84	46.00	-19.42 QP
4	453.890	26.05	36.33	30.61	2.62	17.71	46.00	-19.95 QP
5	616.850	31.97	38.16	30.64	3.38	21.07	46.00	-14.03 QP
6	661.470	31.24	36.69	30.82	3.69	21.68	46.00	-14.76 QP

Horizontal



	Read	Preamp	CableAntenna	Limit	Over				
Freq	Level	Level	Factor	Line	Limit	Remark			
MHz	dBuV/m	dBuV	dB	dB	dB/m	dBuV/m	dB		
1	170.650	23.25	43.02	31.19	1.30	10.12	43.50	-20.25	QP
2	224.000	21.21	38.48	30.95	1.53	12.15	46.00	-24.79	QP
3	353.980	22.30	34.93	30.65	2.18	15.84	46.00	-23.70	QP
4	447.100	25.88	36.33	30.61	2.62	17.54	46.00	-20.12	QP
5	542.160	28.58	36.96	30.82	3.03	19.41	46.00	-17.42	QP
6	641.100	33.01	38.84	30.77	3.58	21.36	46.00	-12.99	QP

NOTE:

Absolute Level= ReadingLevel+antenna Factor+cable loss-preamp factor,

Over Limit= Absolute Level – Limit

1Mbps(High channel) is the worst mode, only worst case is presented in the report.

Above 1GHz

EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010hPa	Test Mode :	TX
Test Voltage :	DC 24.0V from Adapter		

Frequency (MHz)	Meter Reading (dBµV)	Antenna Factor (dB)	Cable loss (dB)	Preamp factor (dB)	Emission Level (dBµV/m)	Limits (dBµV/m)	Margin (dB)	Detector Type	Comment
TX-2402									
4804	29.33	32.94	11.96	27.49	46.74	54	-7.26	Average	Vertical
4804	41.07	32.94	11.96	27.49	58.48	74	-15.52	peak	Vertical
7206	30.87	25.28	16.61	27.94	44.82	54	-9.18	Average	Vertical
7206	41.11	25.28	16.61	27.94	55.06	74	-18.94	peak	Vertical
17100	26.35	24.76	21.42	30.14	42.39	54	-11.61	Average	Vertical
17100	40.36	24.76	21.42	30.14	56.40	74	-17.60	peak	Vertical
4804	29.44	32.94	11.96	27.49	46.85	54	-7.15	Average	Horizontal
4804	42.24	32.94	11.96	27.49	59.65	74	-14.35	peak	Horizontal
7206	32.54	25.28	16.61	27.94	46.49	54	-7.51	Average	Horizontal
7206	39.05	25.28	16.61	27.94	53.00	74	-21.00	peak	Horizontal
17100	24.78	24.76	21.42	30.14	40.82	54	-13.18	Average	Horizontal
17100	38.16	24.76	21.42	30.14	54.20	74	-19.80	peak	Horizontal
TX-2441									
4882	31.65	32.11	12.14	27.53	48.37	54	-5.63	Average	Vertical
4882	42.65	32.11	12.14	27.53	59.37	74	-14.63	peak	Vertical
7323	33.22	24.33	16.62	27.96	46.21	54	-7.79	Average	Vertical
7323	42.42	24.33	16.62	27.96	55.41	74	-18.59	peak	Vertical
17245	27.74	23.92	23.76	29.64	45.78	54	-8.22	Average	Vertical
17245	41.52	23.92	23.76	29.64	59.56	74	-14.44	peak	Vertical
4882	31.00	32.11	12.14	27.53	47.72	54	-6.28	Average	Horizontal
4882	42.32	32.11	12.14	27.53	59.04	74	-14.96	peak	Horizontal
7323	31.13	24.33	16.62	27.96	44.12	54	-9.88	Average	Horizontal
7323	44.33	24.33	16.62	27.96	57.32	74	-16.68	peak	Horizontal
17245	25.18	23.92	23.76	29.64	43.22	54	-10.78	Average	Horizontal
17245	38.93	23.92	23.76	29.64	56.97	74	-17.03	peak	Horizontal
TX-2480									
4960	29.97	31.32	12.36	27.58	46.07	54	-7.93	Average	Vertical
4960	41.97	31.32	12.36	27.58	58.07	74	-15.93	peak	Vertical
7440	31.23	24.38	16.62	27.99	44.24	54	-9.76	Average	Vertical
7440	42.96	24.38	16.62	27.99	55.97	74	-18.03	peak	Vertical
17384	26.86	23.61	22.67	29.85	43.29	54	-10.71	Average	Vertical
17384	39.12	23.61	22.67	29.85	55.55	74	-18.45	peak	Vertical
4960	30.32	31.32	12.36	27.58	46.42	54	-7.58	Average	Horizontal
4960	41.87	31.32	12.36	27.58	57.97	74	-16.03	peak	Horizontal
7440	30.32	24.38	16.62	27.99	43.33	54	-10.67	Average	Horizontal
7440	40.11	24.38	16.62	27.99	53.12	74	-20.88	peak	Horizontal
17384	25.36	23.61	22.67	29.85	41.79	54	-12.21	Average	Horizontal

**NOTE:**

Absolute Level= ReadingLevel+antenna Factor+cable loss-preamp factor,

Over Limit= Absolute Level – Limit

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has not to be reported.

GFSK is the worst mode. only worst case is presented in the report.

For radiated bandedge test as follows:

Frequency (MHz)	Meter Reading (dB $\mu$ V)	antenna Factor (dB)	cable loss (dB)	preamp factor (dB)	Emission Level (dB $\mu$ V/m)	Limits (dB $\mu$ V/m)	Margin (dB)	Detector Type	Comment
1Mbps Non-hopping									
2390	35.12	30.44	8.94	26.32	48.18	74	-25.82	peak	Vertical
2390	36.42	30.44	8.94	26.32	49.48	74	-24.52	peak	Horizontal
2483.5	36.56	30.05	9.07	26.34	49.34	74	-24.66	peak	Vertical
2483.5	36.72	30.05	9.07	26.34	49.5	74	-24.5	peak	Horizontal
1Mbps hopping									
2390	35.83	30.44	8.94	26.32	48.89	74	-25.11	peak	Vertical
2390	36.01	30.44	8.94	26.32	49.07	74	-24.93	peak	Horizontal
2483.5	36.96	30.05	9.07	26.34	49.74	74	-24.26	peak	Vertical
2483.5	38.34	30.05	9.07	26.34	51.12	74	-22.88	peak	Horizontal
2Mbps Non-hopping									
2390	35.34	30.44	8.94	26.32	48.4	74	-25.6	peak	Vertical
2390	35.03	30.44	8.94	26.32	48.09	74	-25.91	peak	Horizontal
2483.5	36.25	30.05	9.07	26.34	49.03	74	-24.97	peak	Vertical
2483.5	35.42	30.05	9.07	26.34	48.2	74	-25.8	peak	Horizontal
2Mbps hopping									
2390	37.35	30.44	8.94	26.32	50.41	74	-23.59	peak	Vertical
2390	36.23	30.44	8.94	26.32	49.29	74	-24.71	peak	Horizontal
2483.5	37.24	30.05	9.07	26.34	50.02	74	-23.98	peak	Vertical
2483.5	35.98	30.05	9.07	26.34	48.76	74	-25.24	peak	Horizontal
3Mbps Non-hopping									
2390	35.74	30.44	8.94	26.32	48.8	74	-25.2	peak	Vertical
2390	37.33	30.44	8.94	26.32	50.39	74	-23.61	peak	Horizontal
2483.5	35.21	30.05	9.07	26.34	47.99	74	-26.01	peak	Vertical
2483.5	35.59	30.05	9.07	26.34	48.37	74	-25.63	peak	Horizontal
3Mbps hopping									
2390	35.98	30.44	8.94	26.32	49.04	74	-24.96	peak	Vertical
2390	34.49	30.44	8.94	26.32	47.55	74	-26.45	peak	Horizontal
2483.5	35.34	30.05	9.07	26.34	48.12	74	-25.88	peak	Vertical
2483.5	35.85	30.05	9.07	26.34	48.63	74	-25.37	peak	Horizontal

If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

**Spurious Emission in Restricted Band:(1-25G)**

All the modulation modes have been tested and all other emissions more than 20dB below the limit, the worst result was report as below:

Polar (H/V)	Frequency	Meter Reading	antenna Factor	cable loss	preamp factor	Emission Level	Limits	Margin	Detector Type
	(MHz)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
1Mbps Non-hopping									
Vertical	3262.000	36.43	30.26	10.68	26.63	50.74	74	-23.26	Pk
Horizontal	3262.000	37.23	30.26	10.68	26.63	51.54	74	-22.46	PK
Vertical	4032.000	35.12	31.55	10.52	27.02	50.17	74	-23.83	Pk
Horizontal	4032.000	34.22	31.55	10.52	27.02	49.27	74	-24.73	PK
1Mbps hopping									
Vertical	3351.000	34.23	30.34	10.78	26.67	48.68	74	-25.32	Pk
Horizontal	3351.000	35.46	30.34	10.78	26.67	49.91	74	-24.09	PK
Vertical	4130.000	36.28	30.69	10.95	27.08	50.84	74	-23.16	Pk
Horizontal	4130.000	35.65	30.69	10.95	27.08	50.21	74	-23.79	PK

## 6. 20DB & 99% OCCUPY BANDWIDTH

### 6.1. Limits

According to FCC Section 15.247(a)(1)  
the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB  
bandwidth( $10 \cdot \log_{10} 1\% = 20\text{dB}$ )taking the RF output power.

### 6.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode transmitting.

2. Set the spectrum analyzer:

Span: approximately 2 to 3 times the 20dB bandwidth, centered on a hopping channel

RBW  $\geq 1\%$  of the 20dB bandwidth

VBW  $\geq$  RBW

Sweep=auto

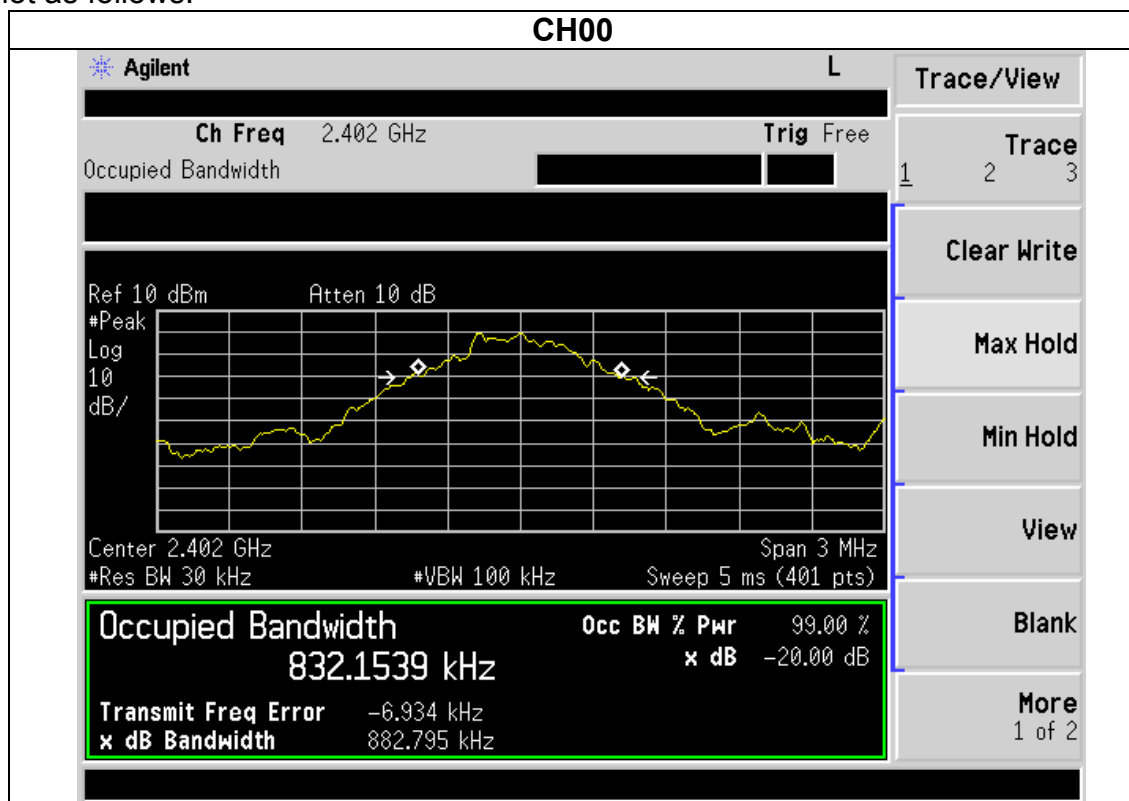
Detector function=peak

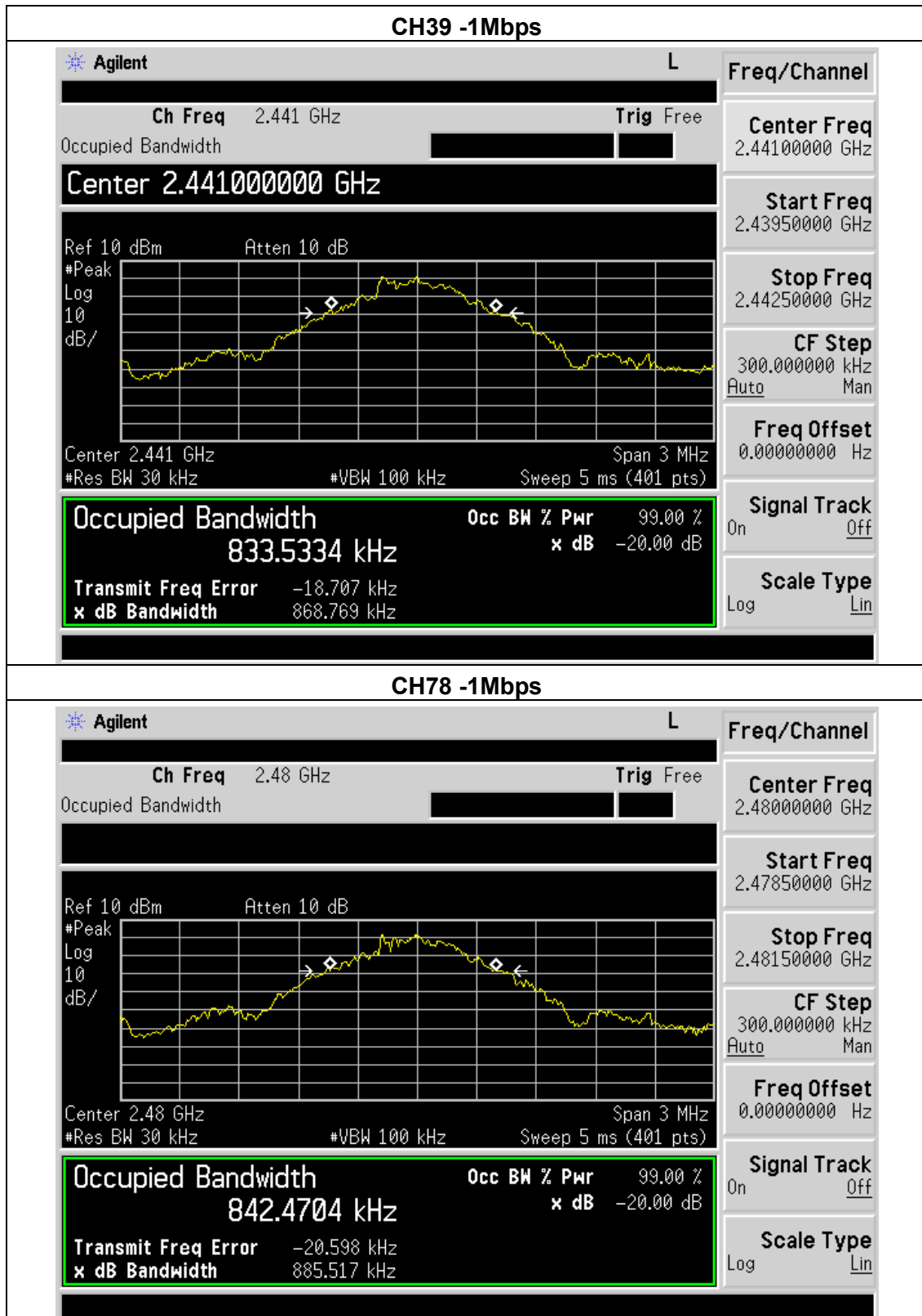
Trace=max hold

EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 24.0V from Adapter
Test Mode :	CH00 / CH39 /C78(1Mbps)		

Frequency	20dB Bandwidth (kHz)	99% Bandwidth (KHz)	Result
2402 MHz	882.795	832.154	PASS
2441 MHz	868.769	833.533	PASS
2480 MHz	885.517	842.470	PASS

Test plot as follows:

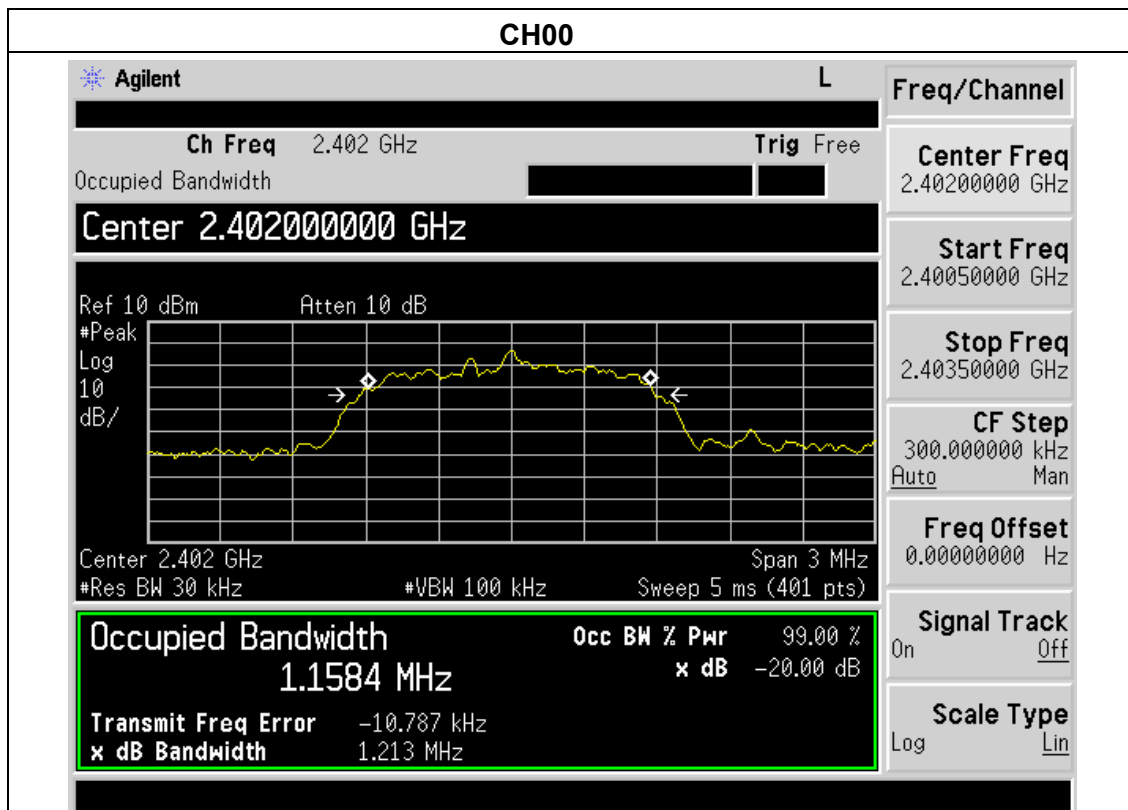


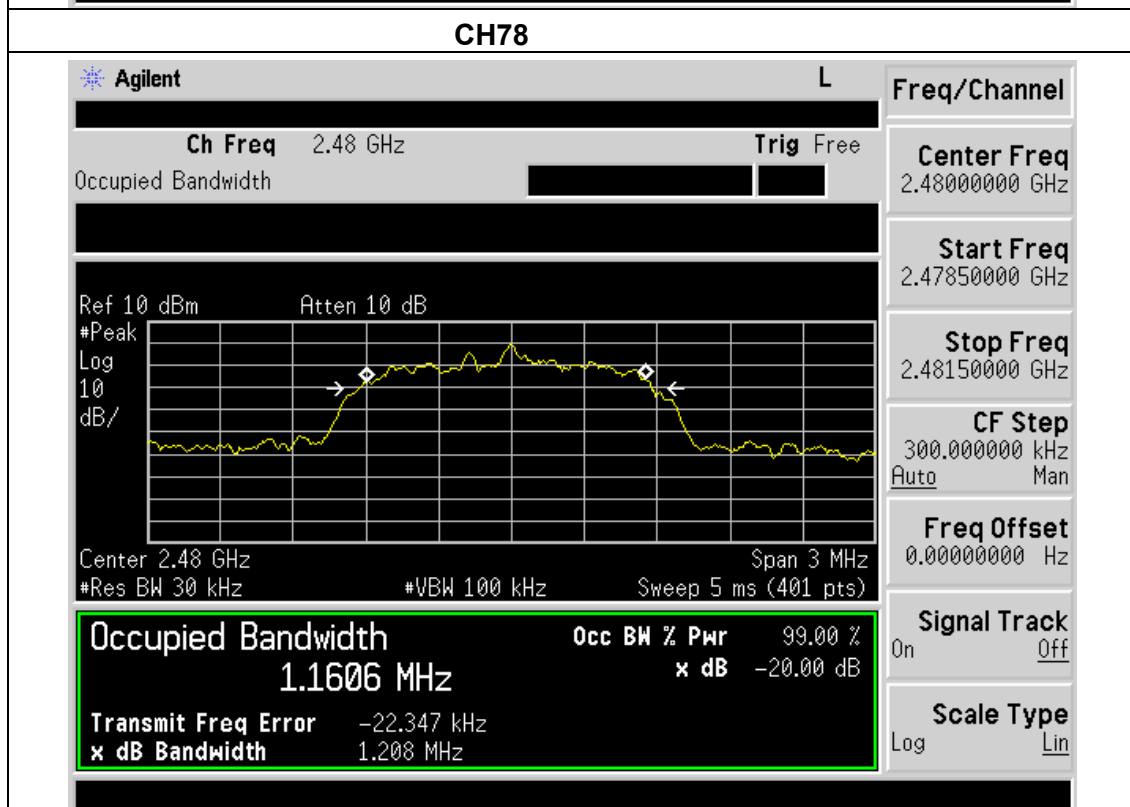
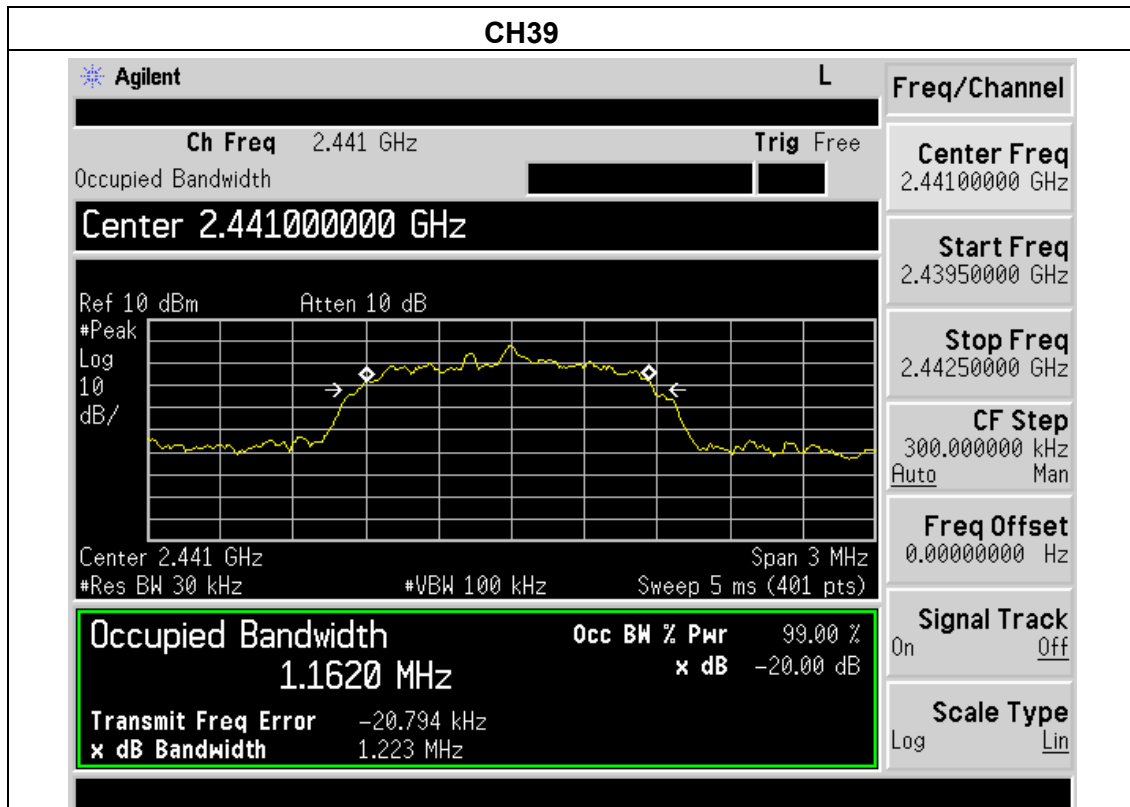




EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 24.0V from Adapter
Test Mode :	CH00 / CH39 /C78(2Mbps)		

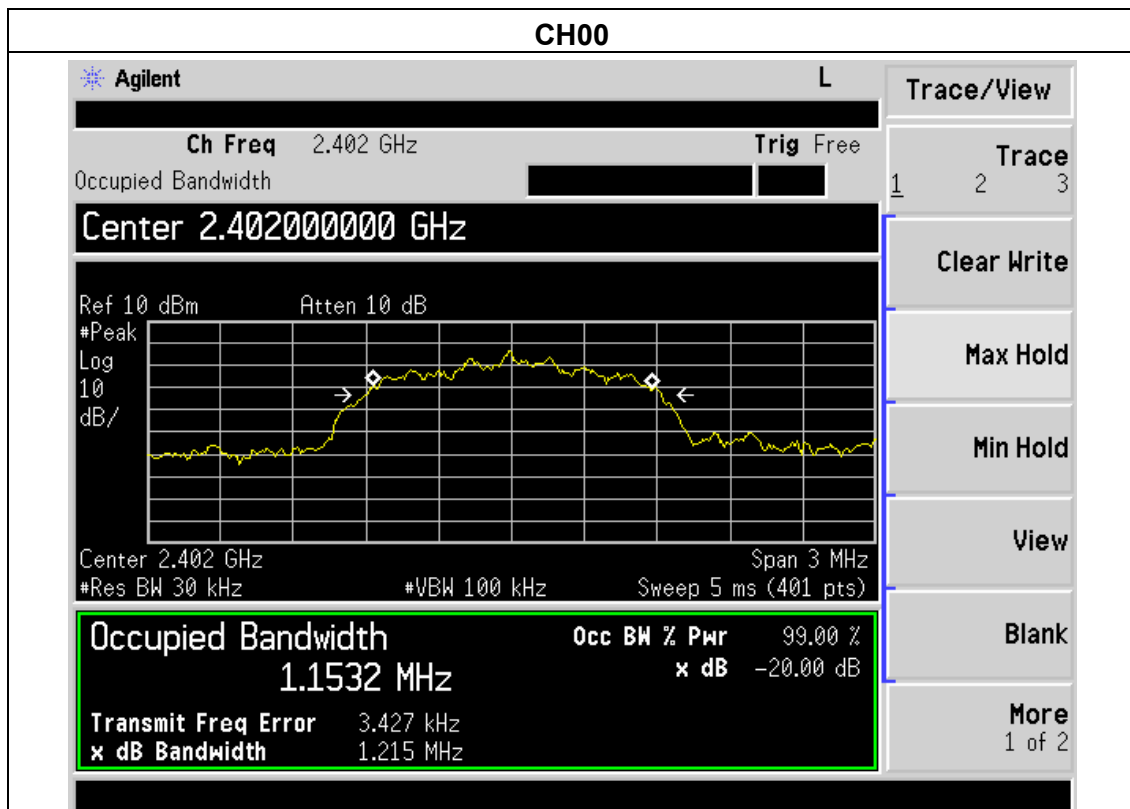
Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.213	1.158	PASS
2441 MHz	1.223	1.162	PASS
2480 MHz	1.208	1.161	PASS

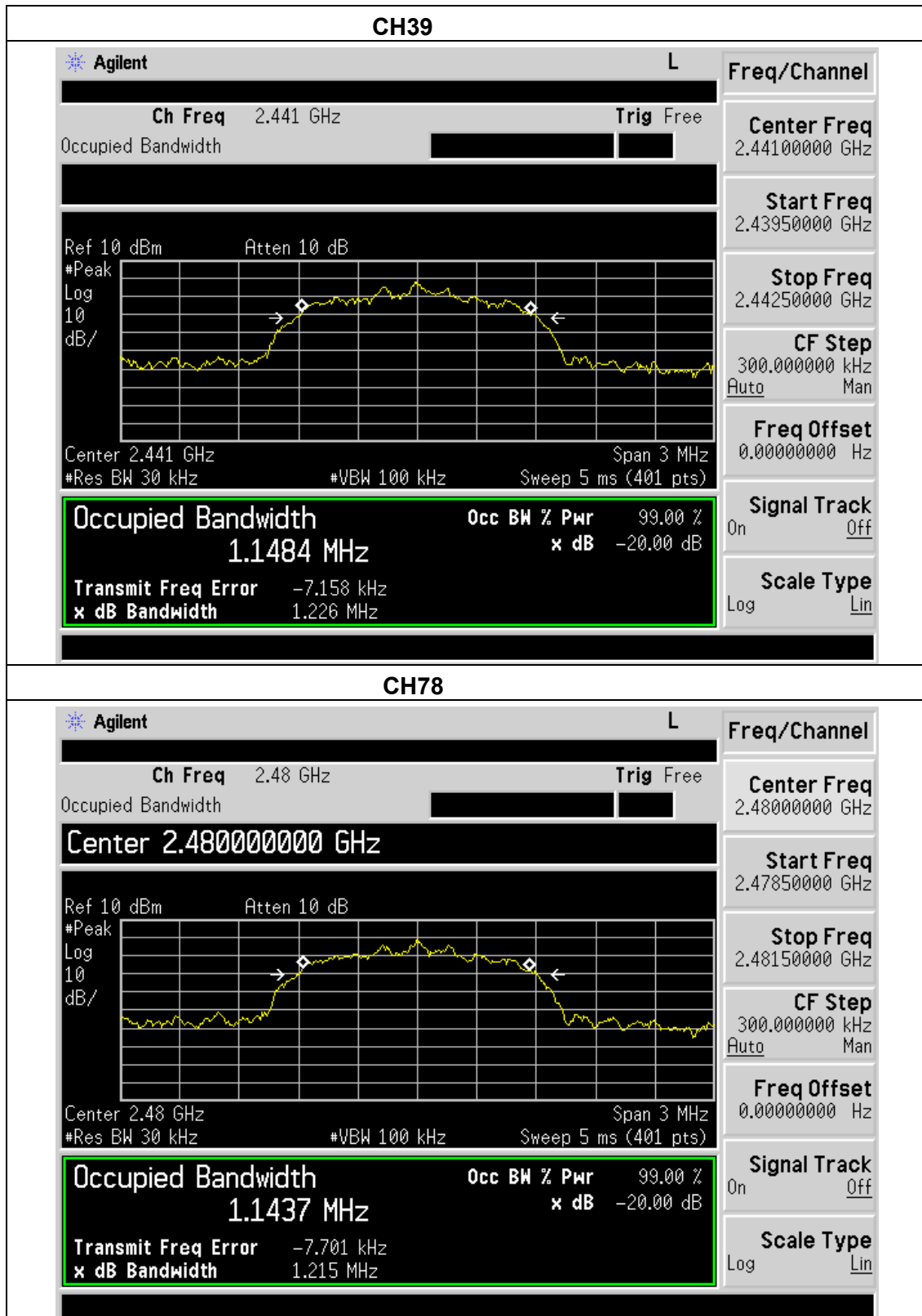




EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 24.0V from Adapter
Test Mode :	CH00 / CH39 /CH78(3Mbps)		

Frequency	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
2402 MHz	1.215	1.153	PASS
2441 MHz	1.226	1.148	PASS
2480 MHz	1.215	1.144	PASS





## 7. FREQUENCY SEPARATION

### 7.1. Limits

According to FCC Section 15.247(a)(1).

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

### 7.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode .

2. Set the spectrum analyzer:

Span: wide enough to capture the peaks of two adjacent channels

RBW  $\geq$  1% of the span(30KHz)

VBW  $\geq$  RBW(100KHz)

Sweep=auto

Detector function=peak

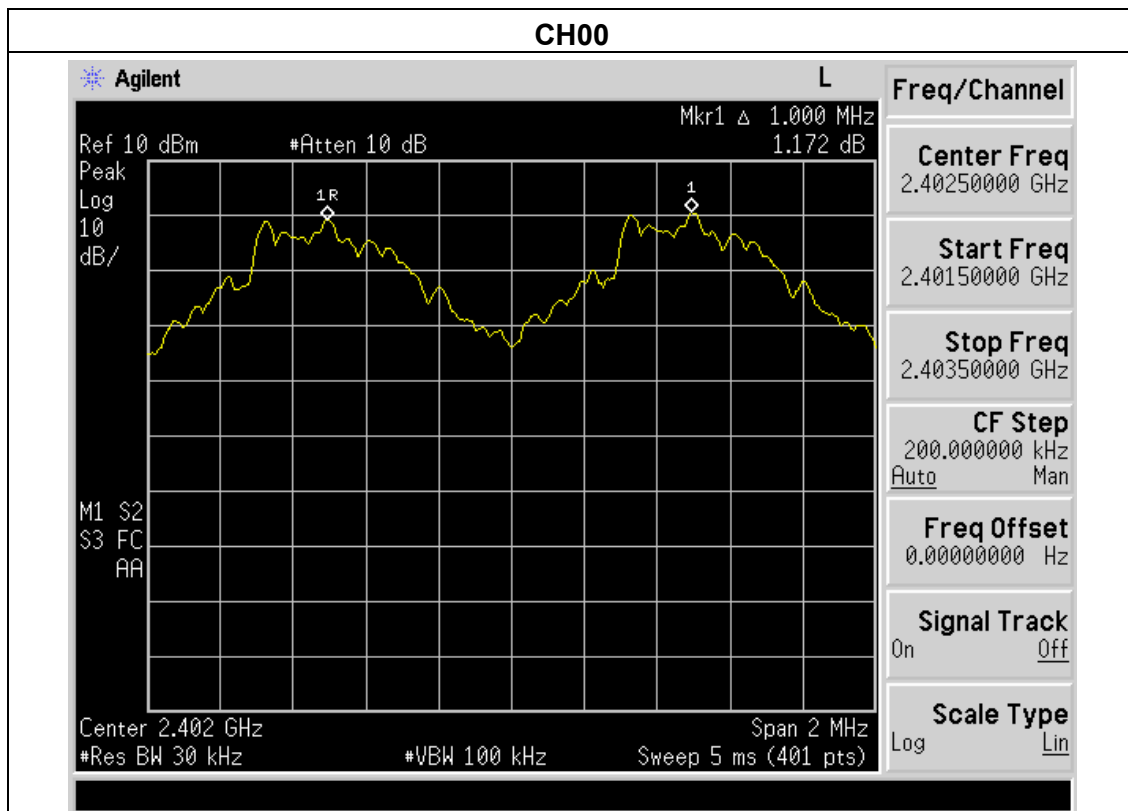
Trace=max hold

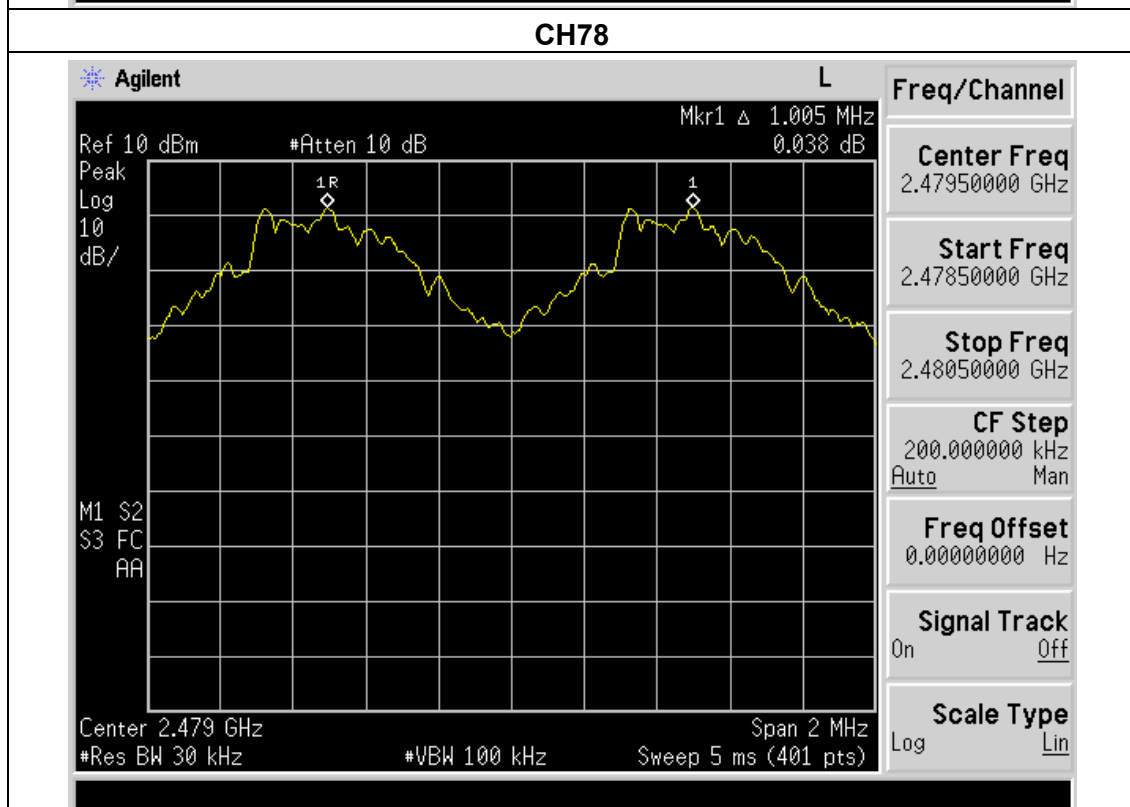
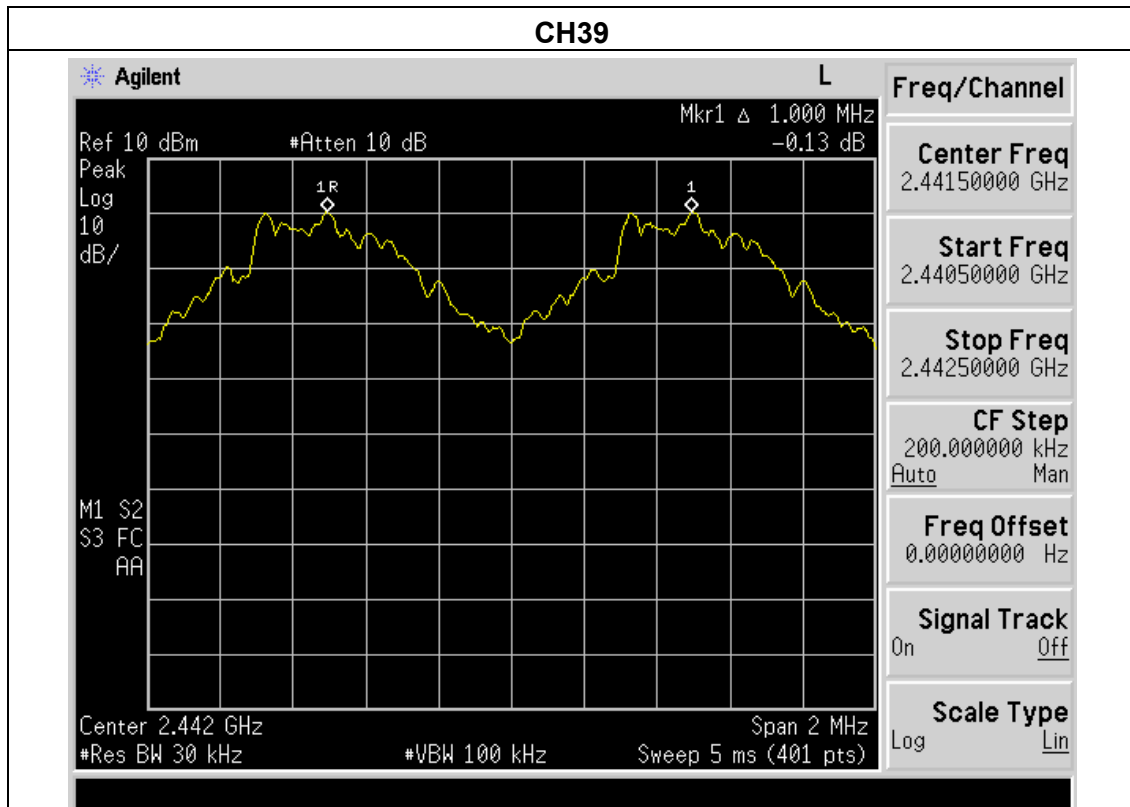
Test data:

EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	24 °C	Relative Humidity :	58%
Pressure :	1010hPa	Test Voltage :	DC 24.0V from Adapter
Test Mode :	CH00 / CH39 /CH78(1Mbps)		

Frequency	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	1.000	0.883	Complies
2441 MHz	1.000	0.869	Complies
2480 MHz	1.000	0.886	Complies

**Ch. Separation Limits: > 20dB bandwidth**  
Test plot as follows:

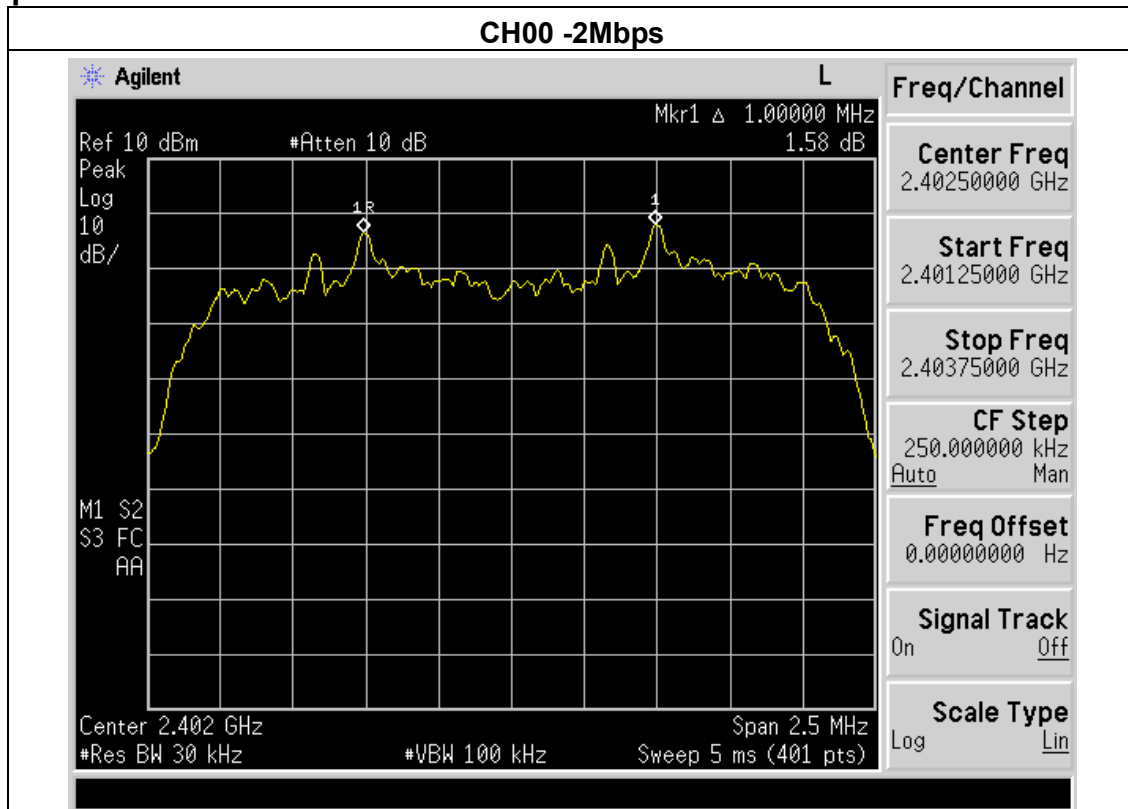




EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	24 °C	Relative Humidity :	58%
Pressure :	1010 hPa	Test Voltage :	DC 24.0V from Adapter
Test Mode :	CH00 / CH39 /CH78(2Mbps)		

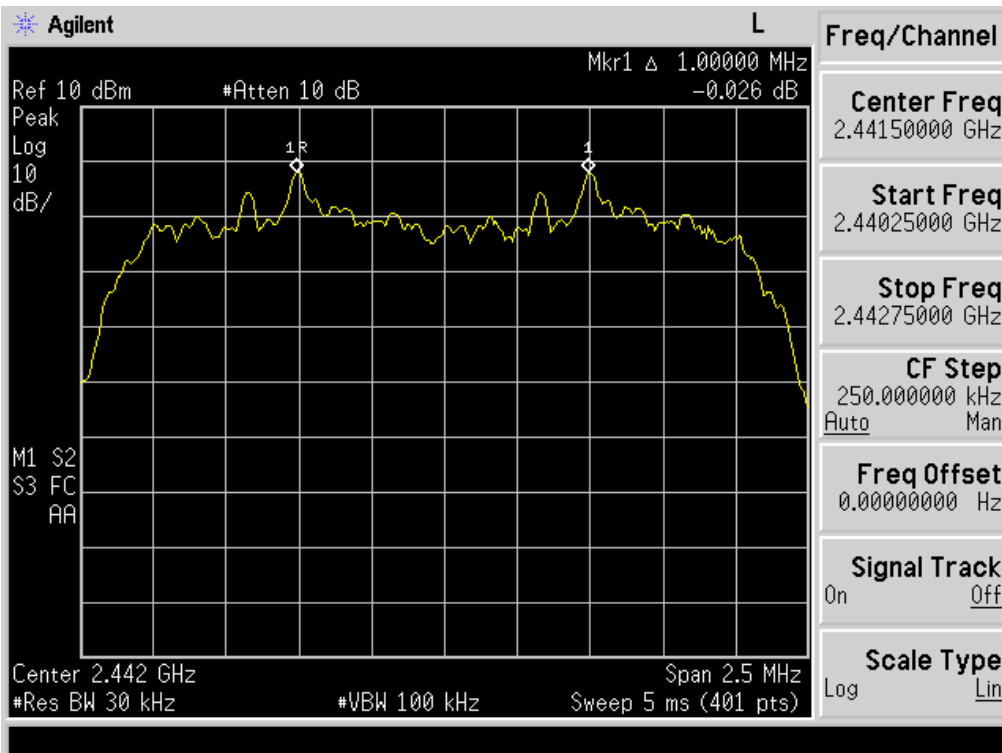
Frequency	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	1.000	0.809	<b>Complies</b>
2441 MHz	1.000	0.815	<b>Complies</b>
2480 MHz	1.000	0.805	<b>Complies</b>

**Ch. Separation Limits: >2/3 of 20dB bandwidth**

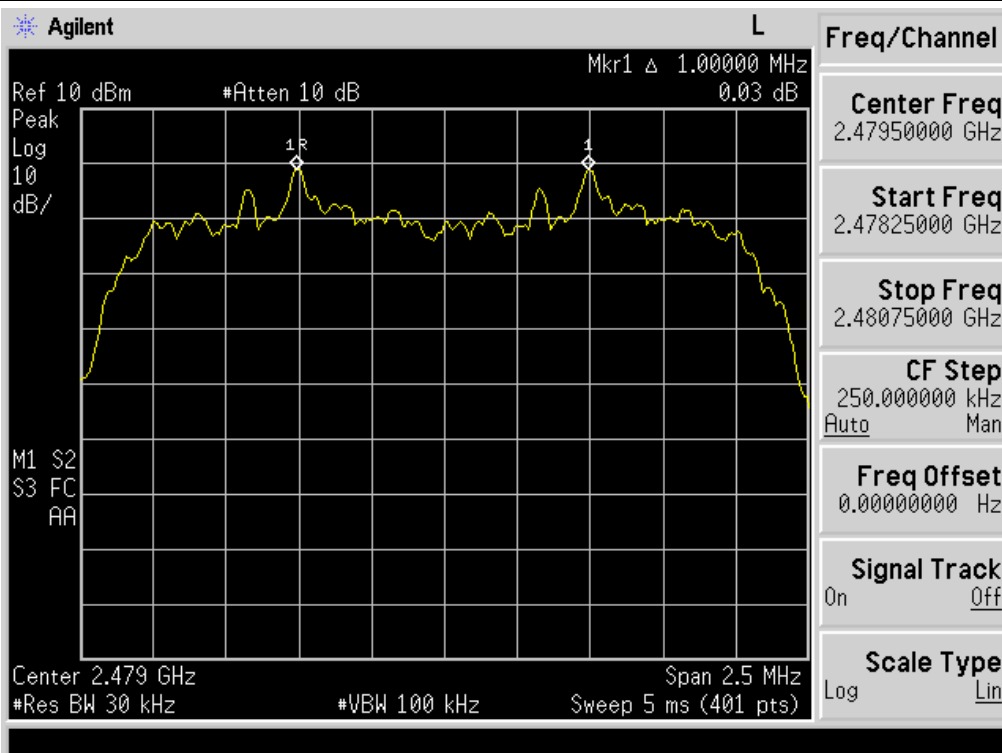




### CH39 -2Mbps



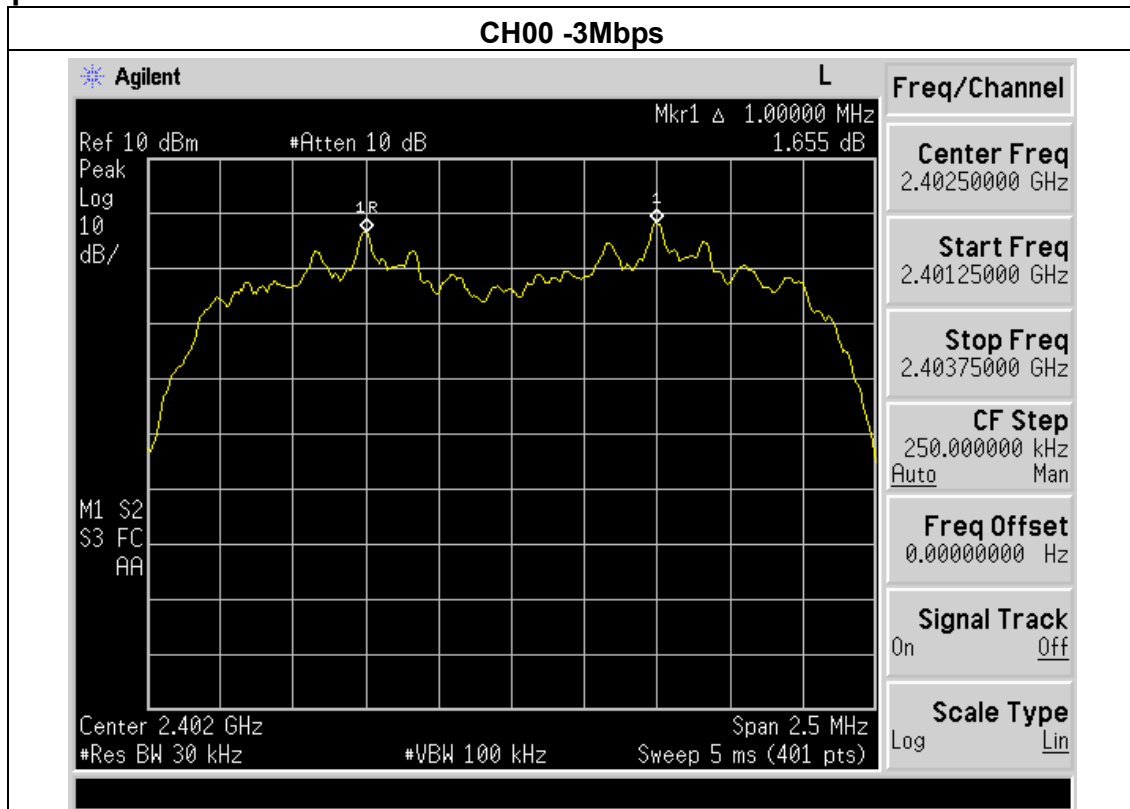
### CH78 -2Mbps

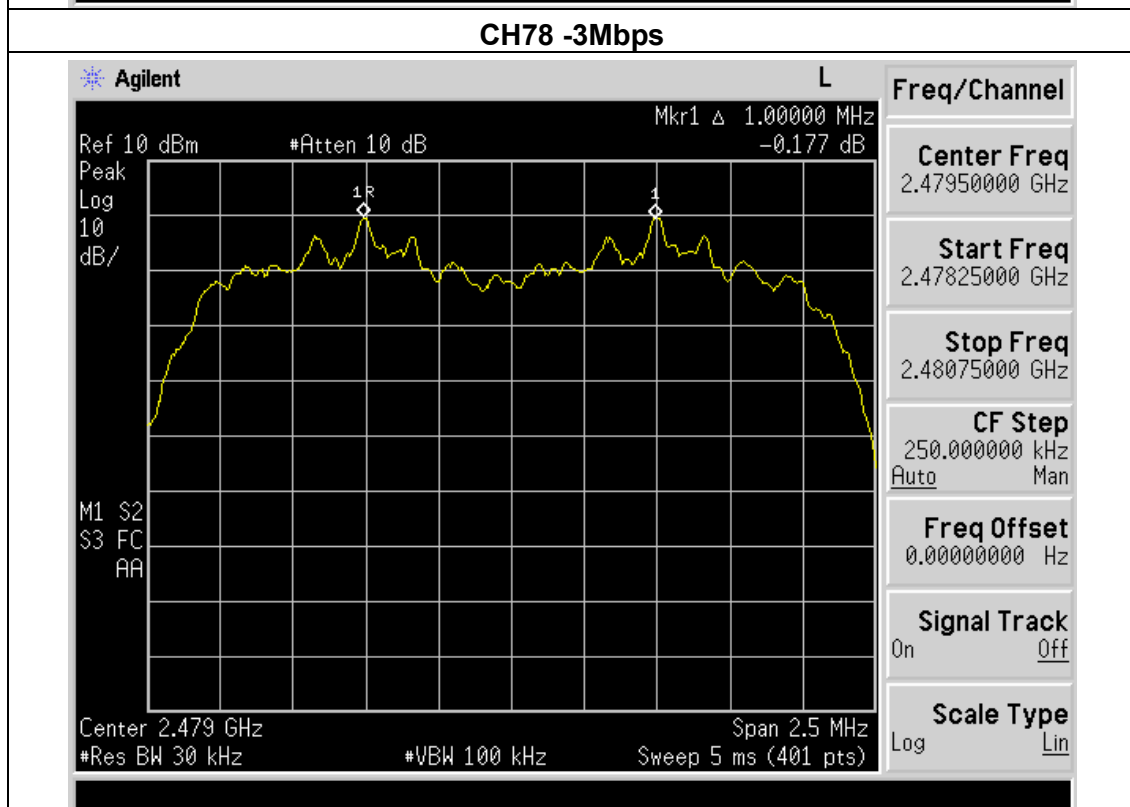
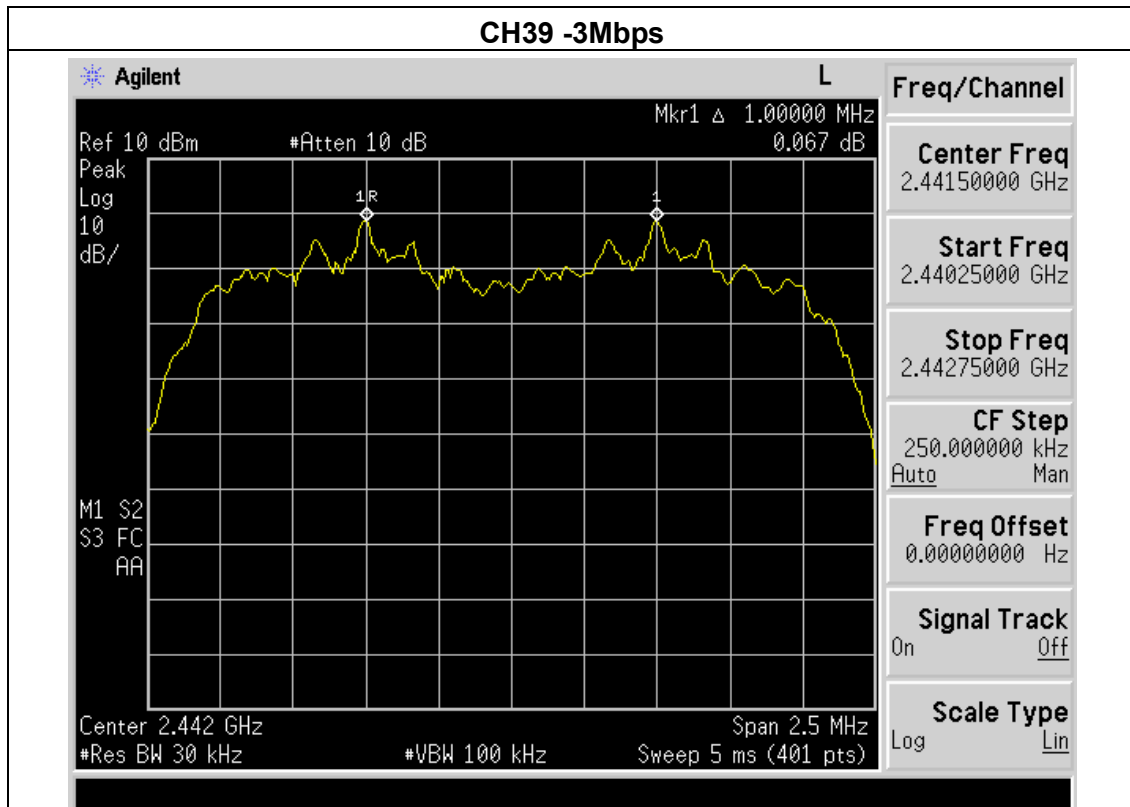


EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	24 °C	Relative Humidity :	58%
Pressure :	1010 hPa	Test Voltage :	DC 24.0V from Adapter
Test Mode :	CH00 / CH39 /CH78(3Mbps)		

Frequency	Ch. Separation (MHz)	Limit (MHz)	Result
2402 MHz	1.000	0.810	Complies
2441 MHz	1.000	0.817	Complies
2480 MHz	1.000	0.810	Complies

**Ch. Separation Limits: >2/3 of 20dB bandwidth**





## 8. NUMBER OF HOPPING FREQUENCY

### 8.1. Limits

According to FCC Section 15.247(a)(1)(iii).

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

### 8.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode .

2. Set the spectrum analyzer:

Span: the frequency band of operation

RBW =100KHz

VBW=300KHz

Sweep=auto

Detector function=peak

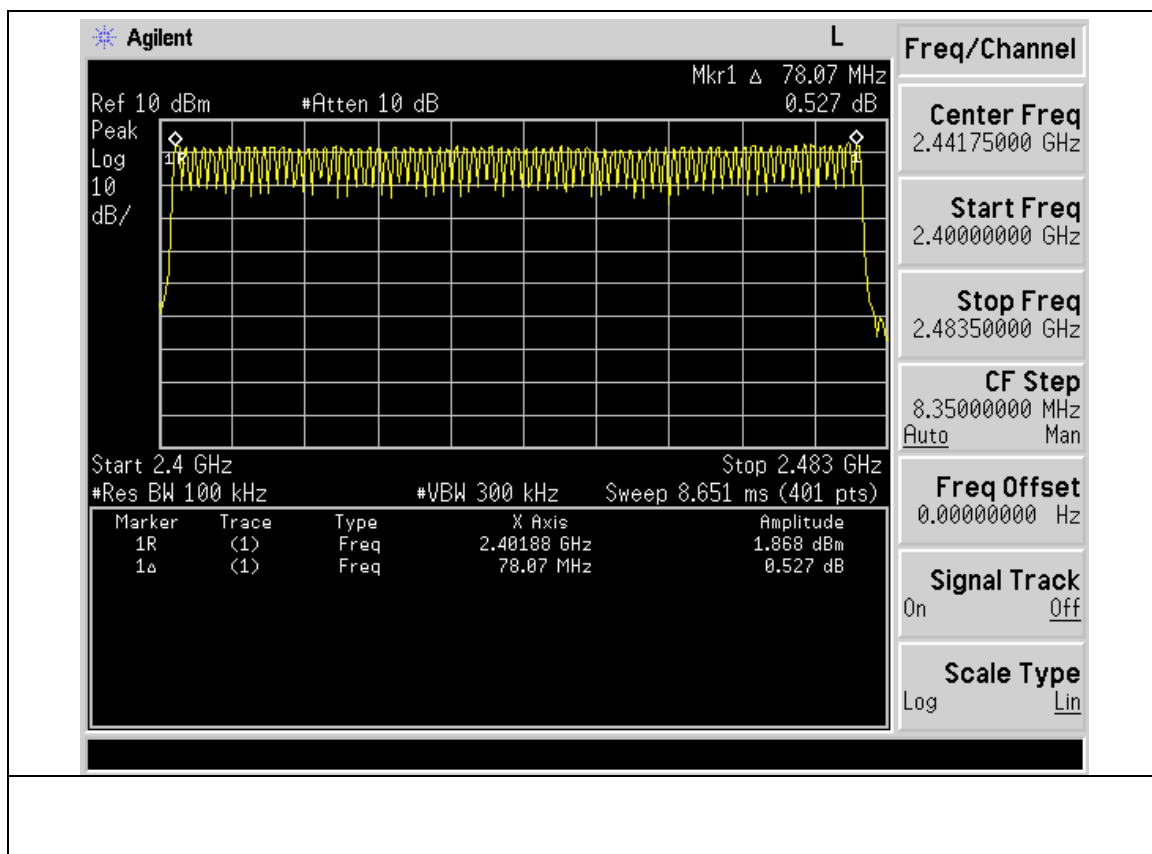
Trace=max hold

EUT :	active loudspeaker	Model Name :	TRANSPARENT ZERO
Temperature :	24 °C	Relative Humidity :	58%
Pressure :	1010 hPa	Test Voltage :	DC 24.0V from Adapter
Test Mode :	1Mbps		

Test data:

Measured channel numbers	Limit	Result
79	≥15	PASS

Test plot as follows:



## 9. DWELL TIME

### 9.1. Limits

According to FCC Section 15.247(a)(1)(iii)&.

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### 9.2. Test setup

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum, During the measurement, the Bluetooth module of the EUT is activated and controlled by the software, and is set to operate under test mode power.

2. Set the spectrum analyzer:

Span= 0Hz, RBW =1000 kHz, VBW = 3000 kHz

Use a video trigger with the trigger level set to enable triggering only on full pulses.

Detector function=peak, Sweep Time is more than once pulse time.

Set the EUT for DH5, DH3 and DH1 packet transmitting

Measure the maximum time duration of one single pulse.

A Period Time = (channel number)\*0.4

DH1 Time Slot: Reading \* (1600/2)\*31.6/(channel number)

DH3 Time Slot: Reading \* (1600/4)\*31.6/(channel number)

DH5 Time Slot: Reading \* (1600/6)\*31.6/(channel number)

For Example:

BT hopping rate is 1600 hops/s with 6 slots in 79 hopping channels.

With channel hopping rate (1600 / 6 / 79) in Occupancy Time Limit (0.4 x 79) (s),

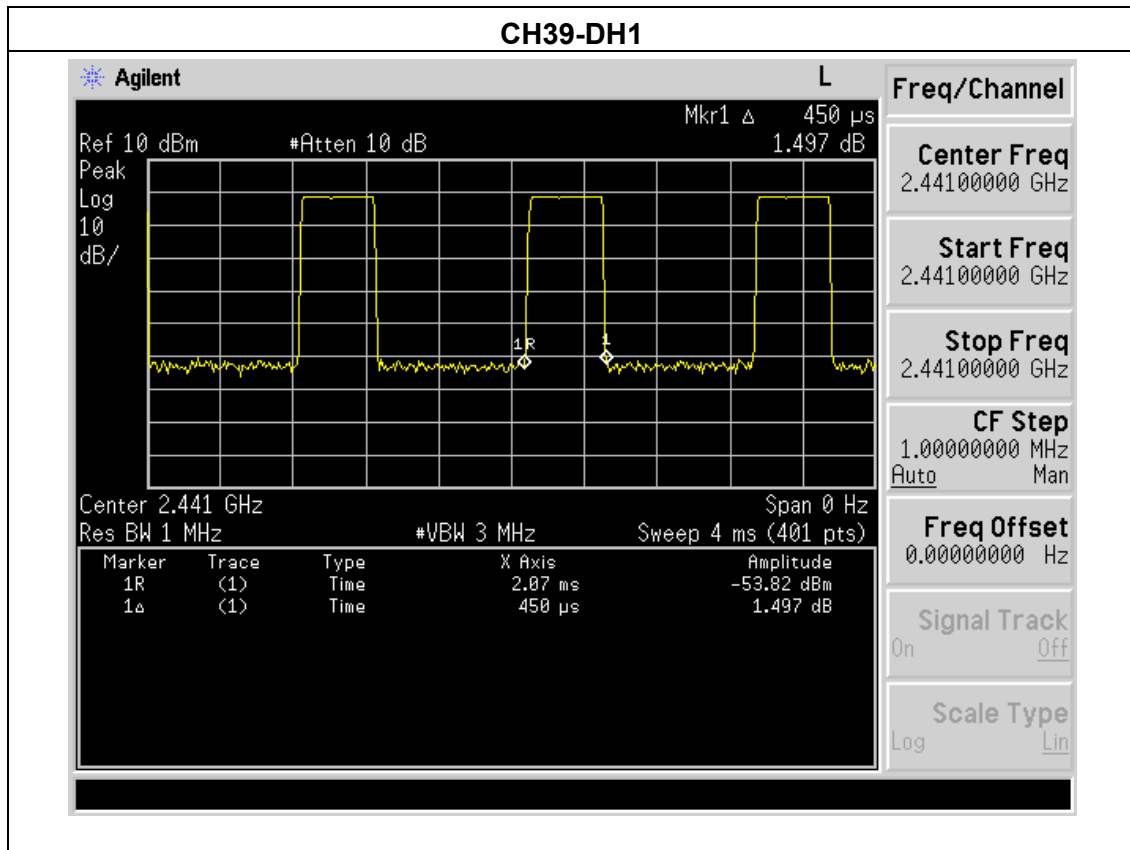
Hops Over Occupancy Time comes to (1600 / 6 / 79) x (0.4 x 79) = 106.67 hops.

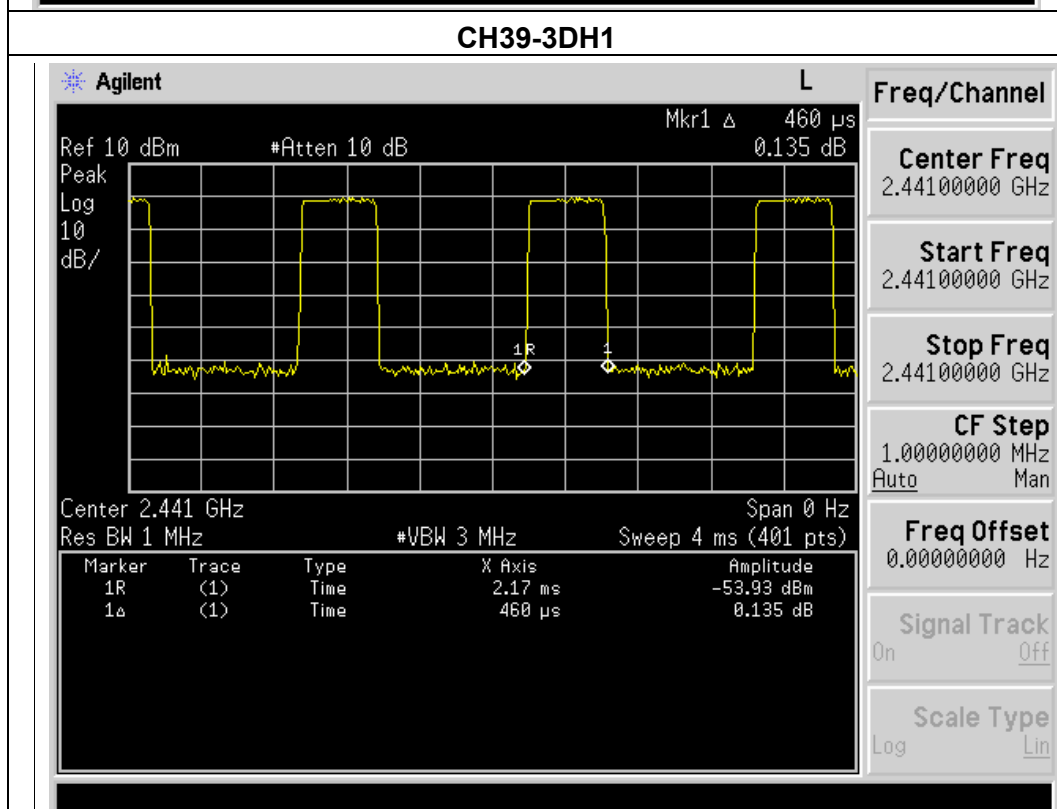
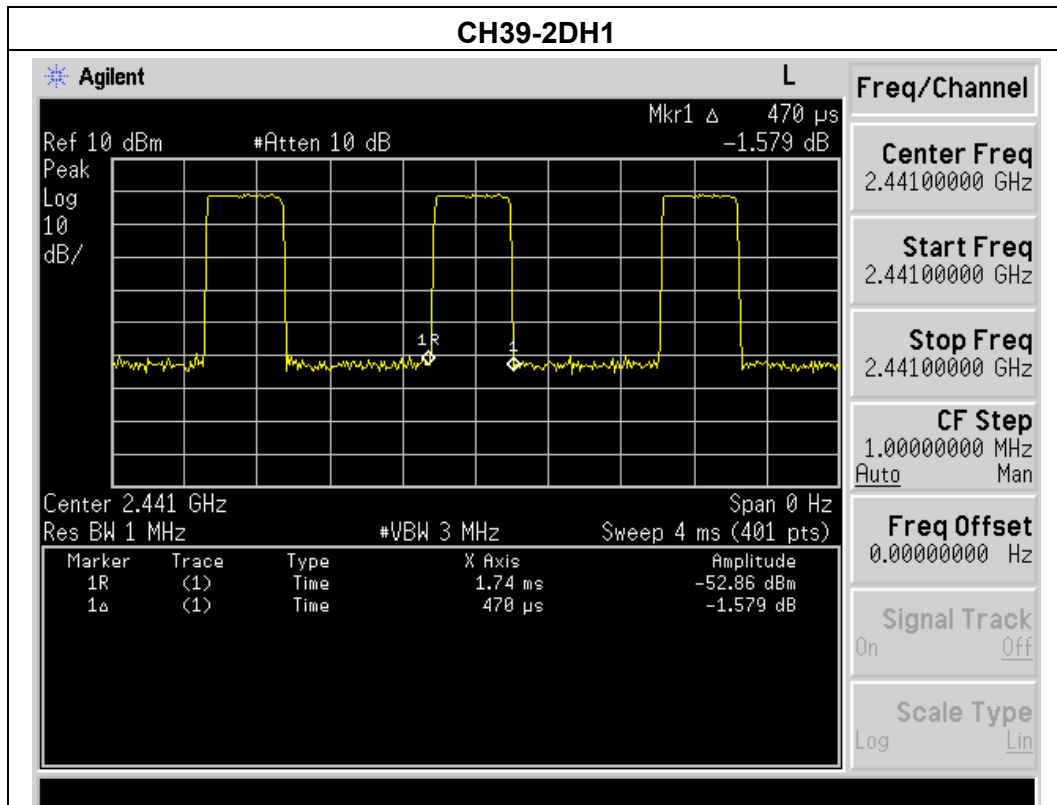
Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time

Test data:

Data Packet	Frequency	Pulse Duration	Dwell Time	Limits
		(ms)	(s)	(s)
DH1	2441 MHz	0.45	0.14	0.4
2DH1	2441 MHz	0.47	0.15	0.4
3DH1	2441 MHz	0.46	0.15	0.4

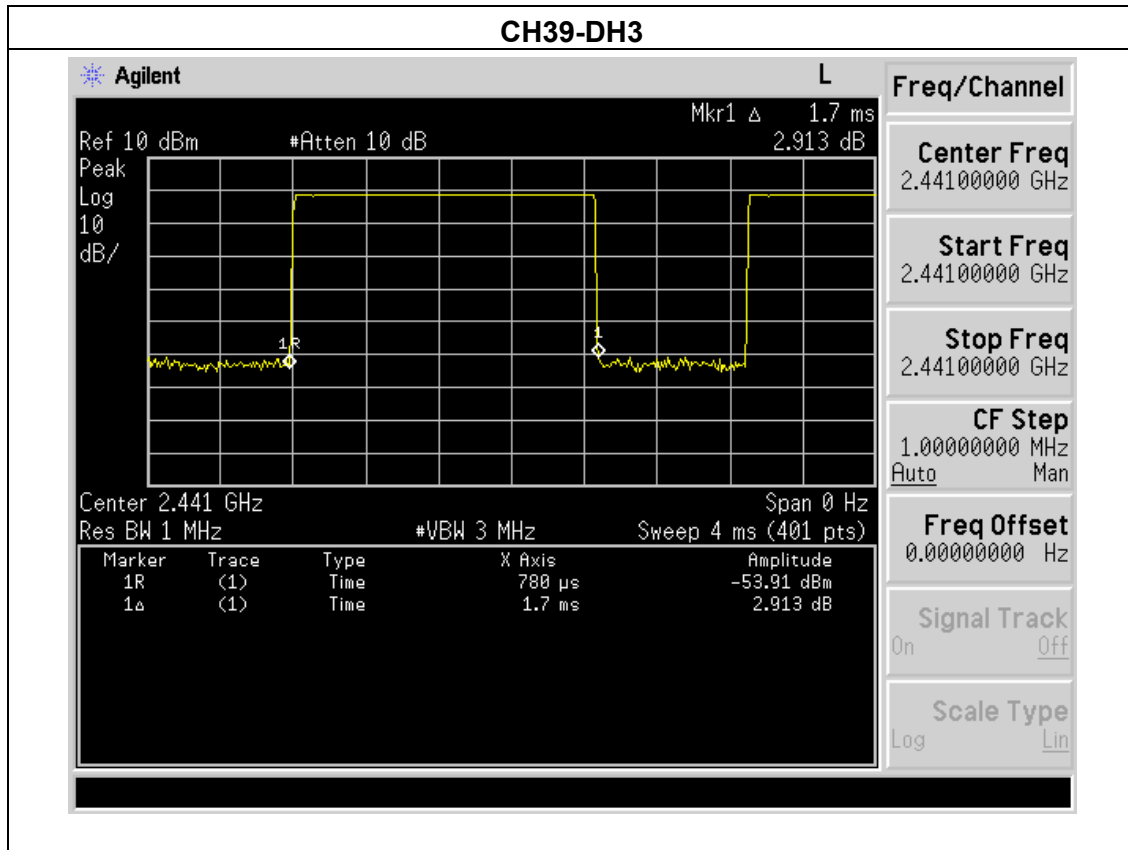
Test plot as follows as below:

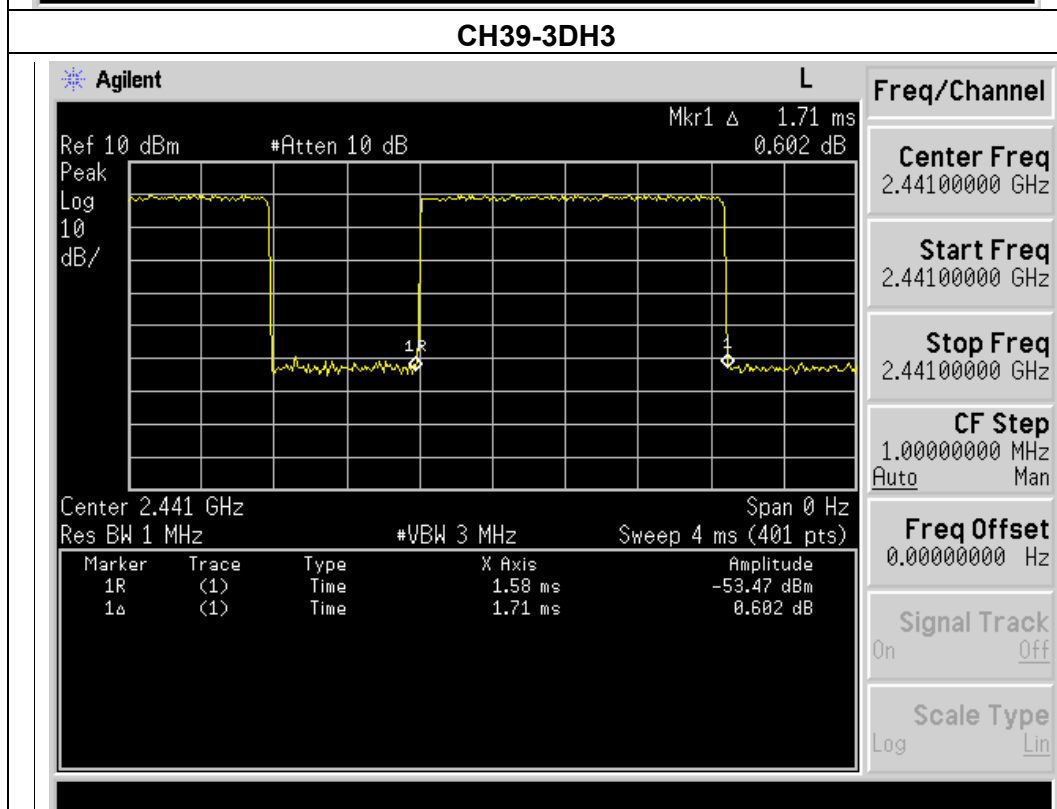
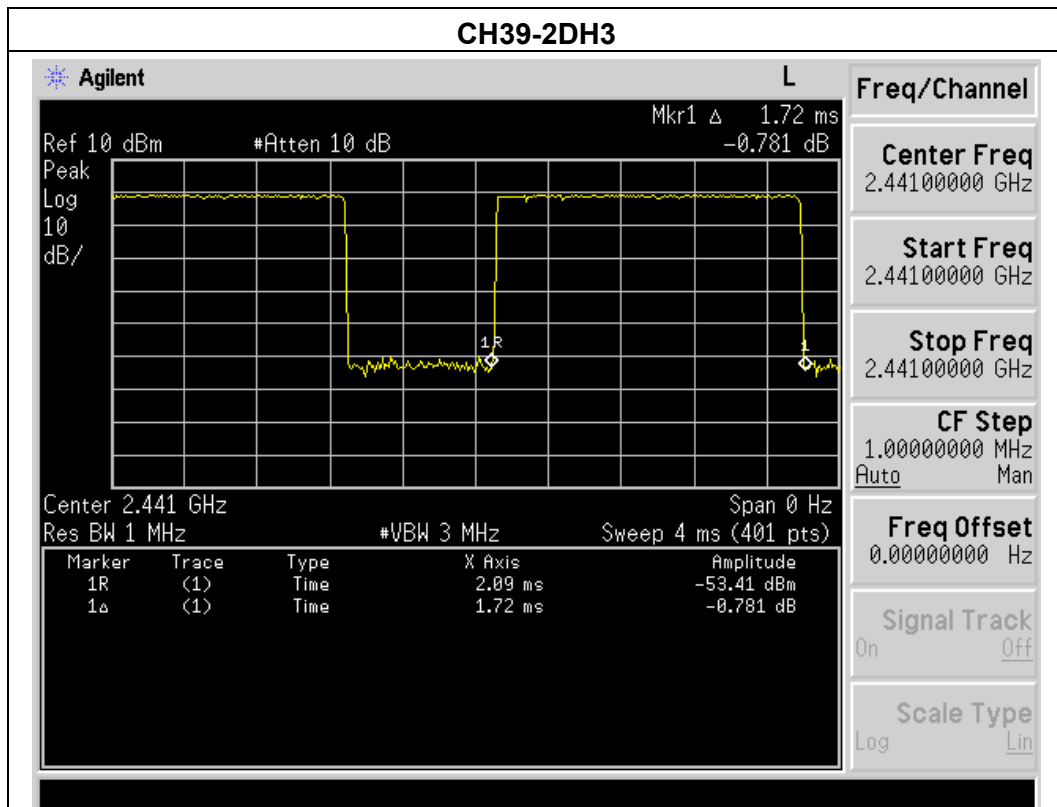




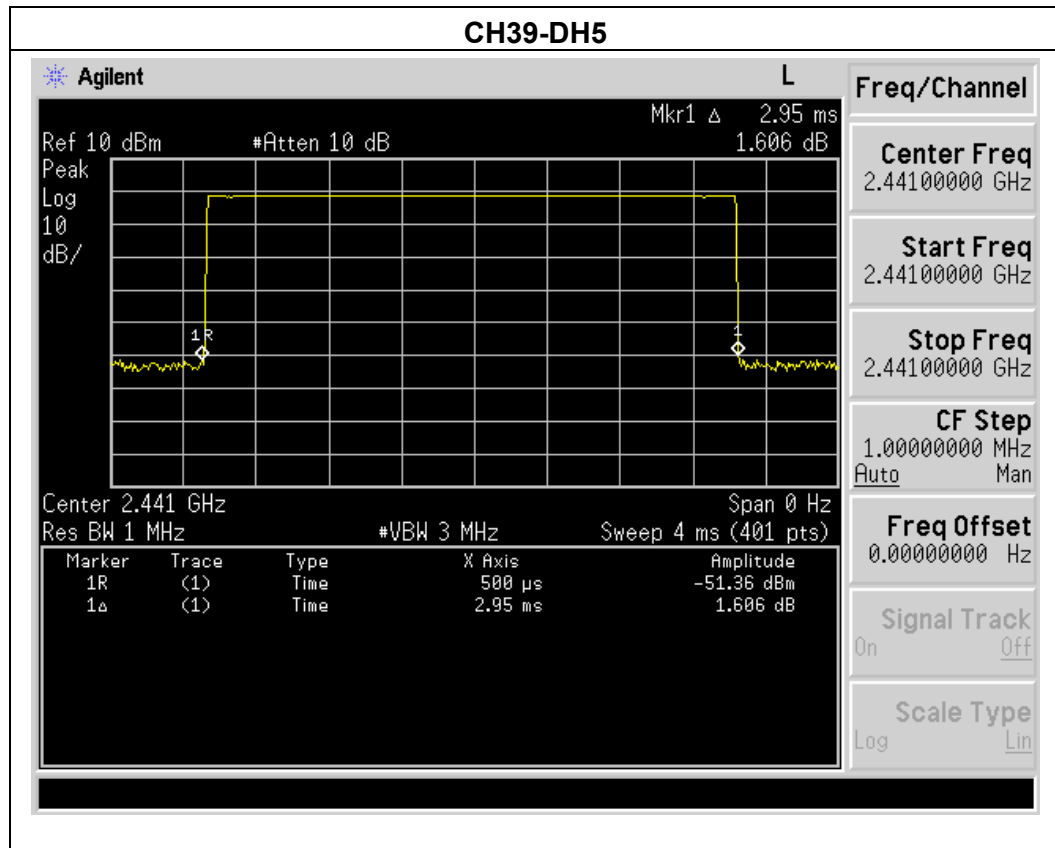


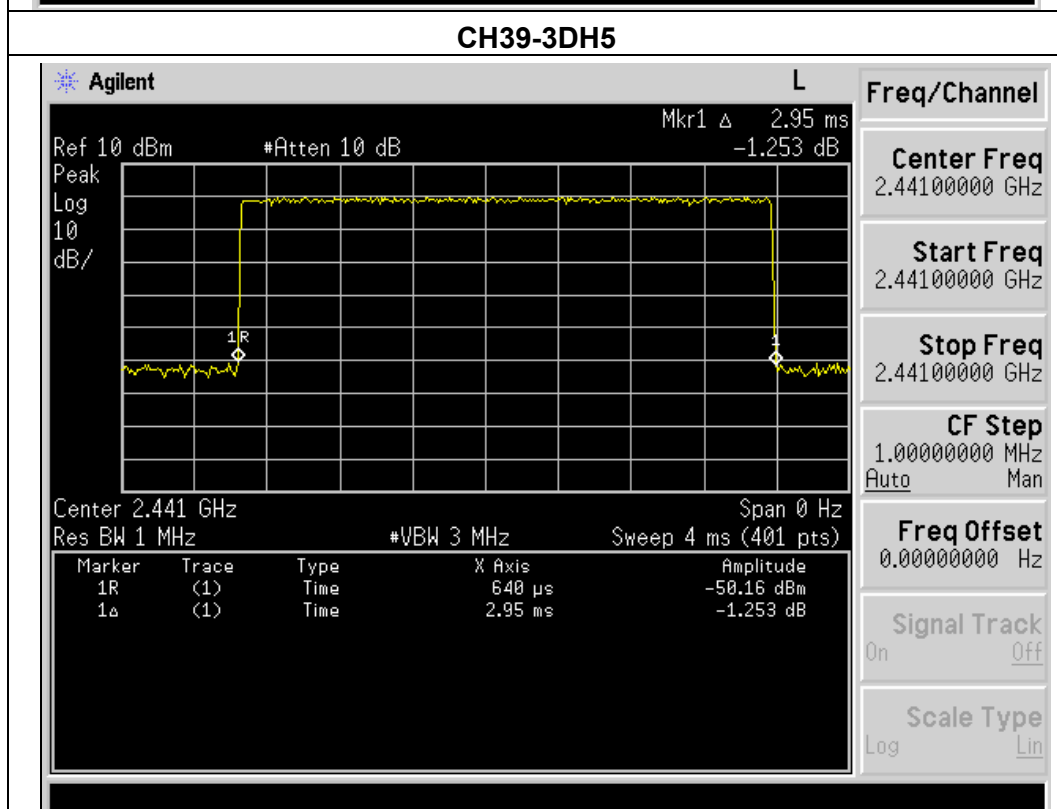
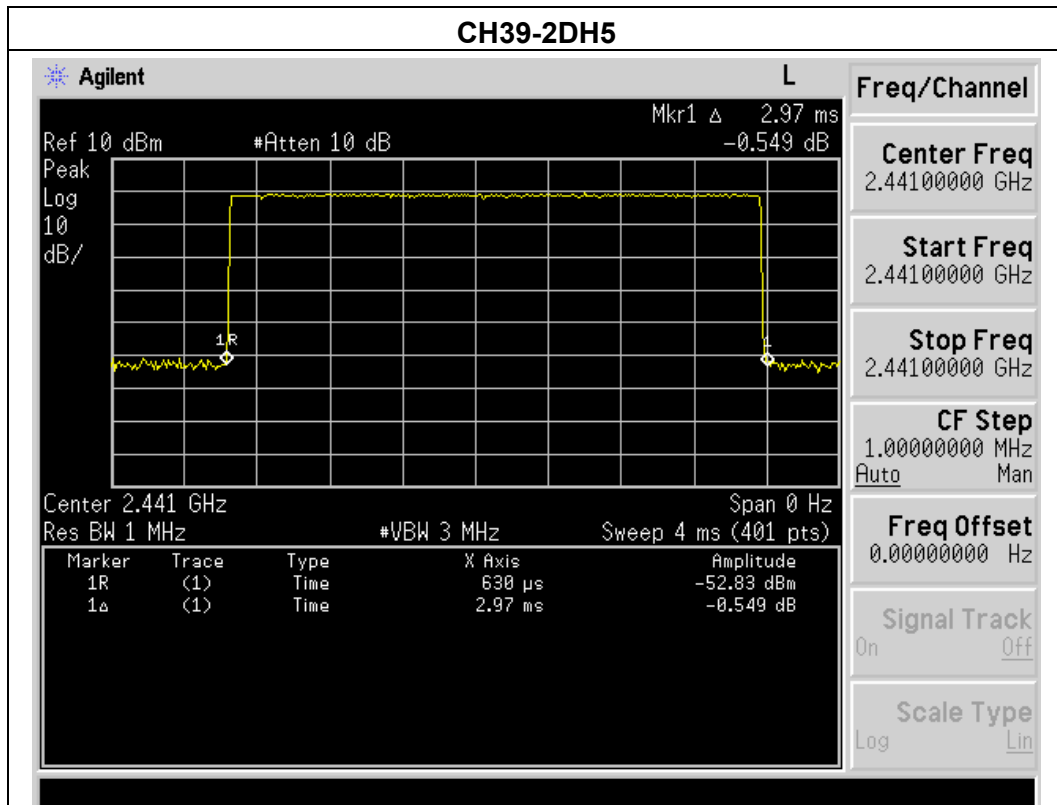
Data Packet	Frequency	Pulse Duration	Dwell Time	Limits
		(ms)	(s)	(s)
DH3	2441 MHz	1.70	0.27	0.4
2DH3	2441 MHz	1.72	0.28	0.4
3DH3	2441 MHz	1.71	0.27	0.4





Data Packet	Frequency	Pulse Duration	Dwell Time	Limits
		(ms)	(s)	(s)
DH5	2441 MHz	2.95	0.31	0.4
2DH5	2441 MHz	2.97	0.32	0.4
3DH5	2441 MHz	2.95	0.31	0.4



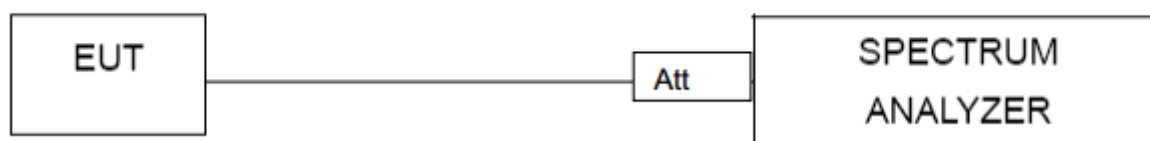


## 10. BAND EDGE COMPLIANCE TEST

### 10.1. Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see §15.205(c)).

### 10.2. Test setup



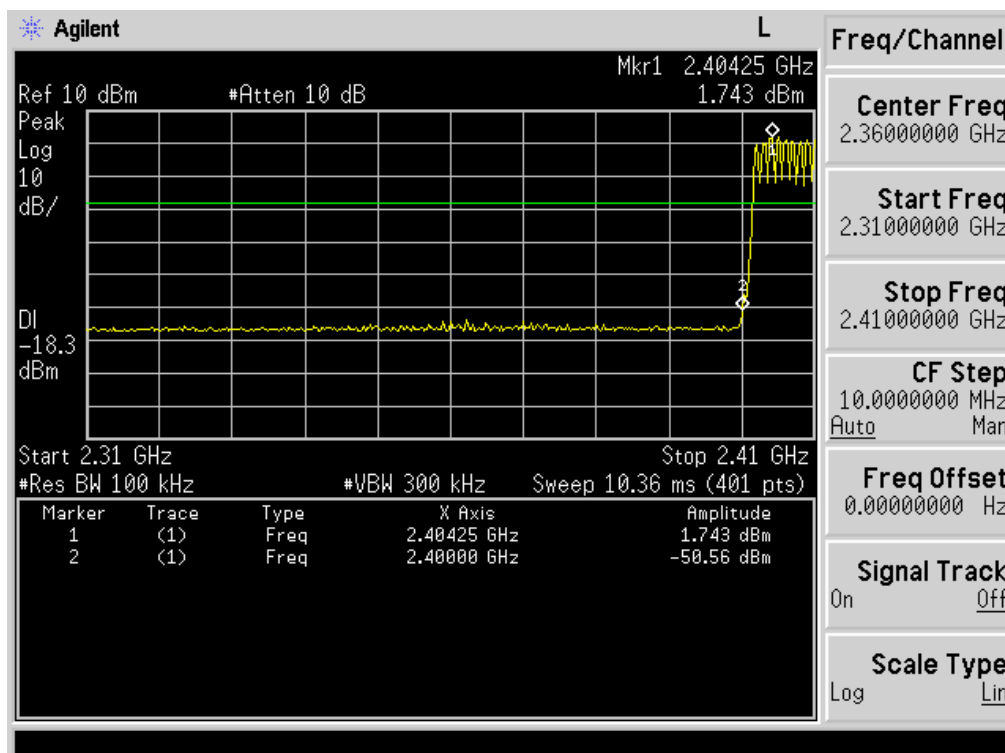
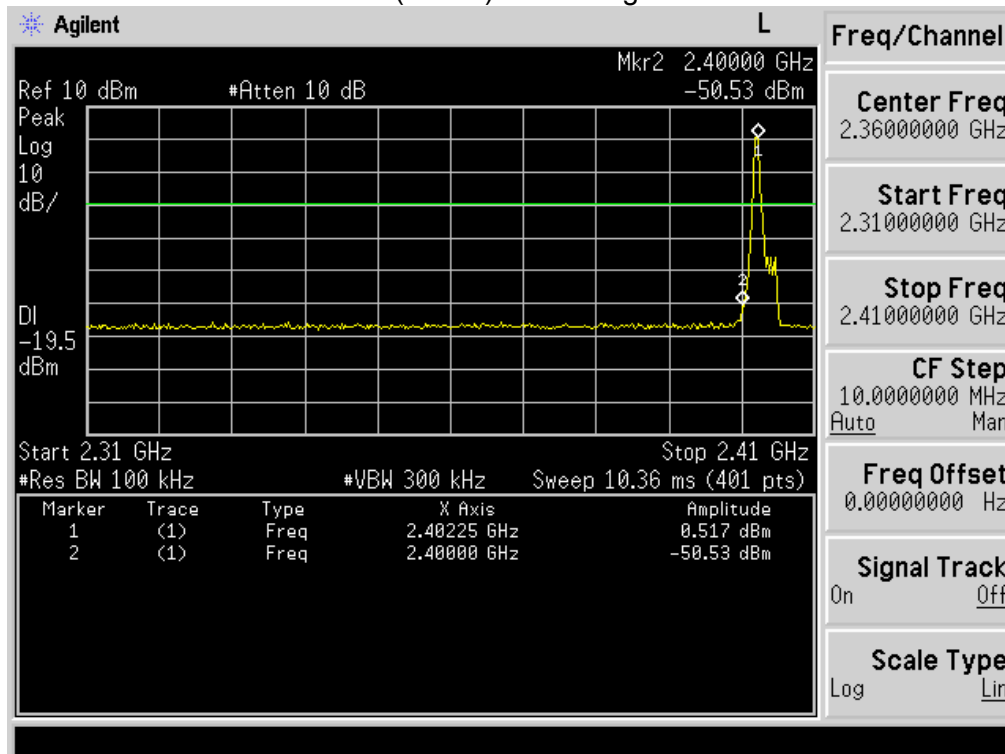
### 10.3. TEST Procedure

- a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b) Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- c) Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- d) Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- e) Repeat above procedures until all measured frequencies were complete

For conducted test:

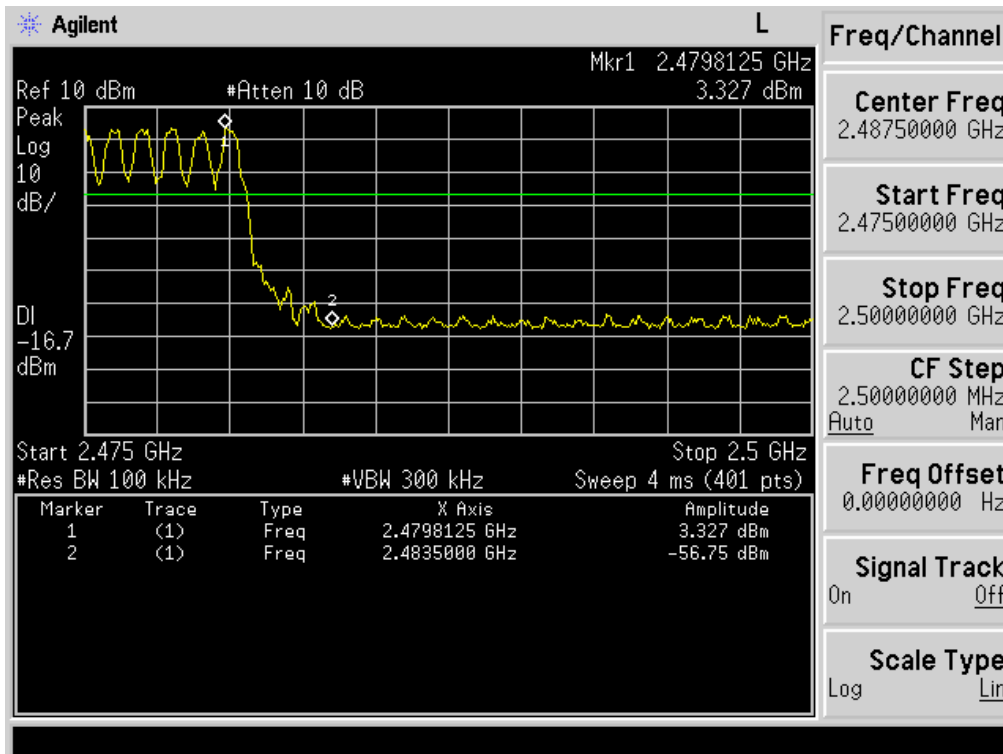
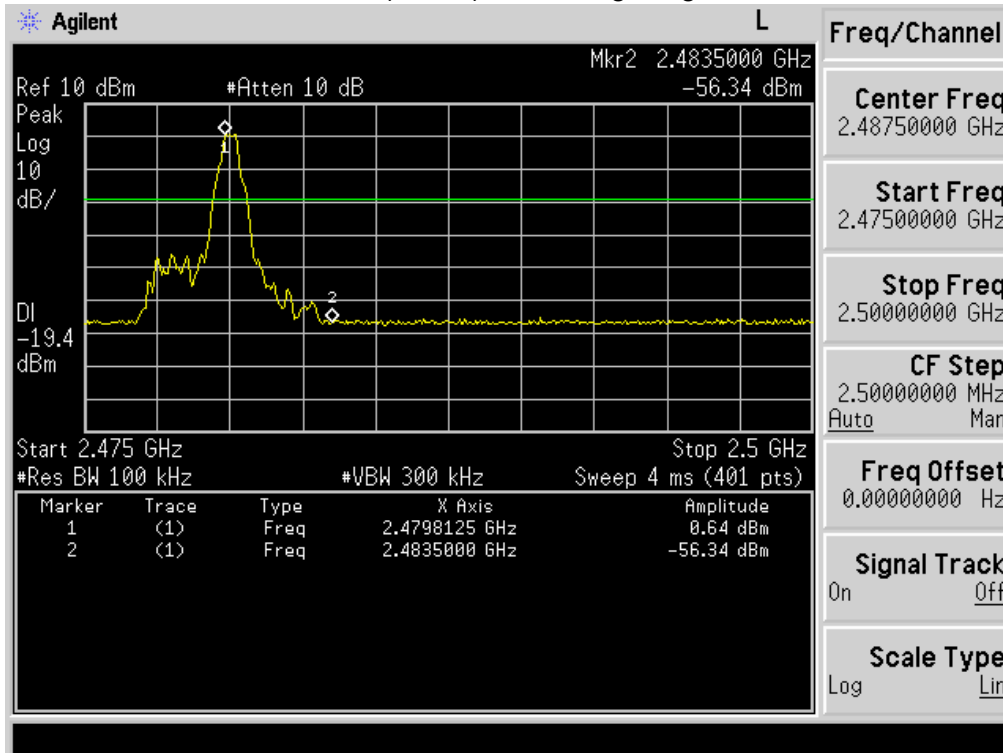
Frequency Band	Delta Peak to band emission (dBc)	> Limit (dBc)	Result
GFSK Non-hopping			
Left Band	51.05	20	Pass
Right Band	56.98	20	Pass
$\pi/4$ -DQPSK Non-hopping			
Left Band	48.32	20	Pass
Right Band	55.53	20	Pass
8DPSK Non-hopping			
Left Band	49.09	20	Pass
Right Band	59.64	20	Pass
GFSK hopping			
Left Band	52.30	20	Pass
Right Band	60.07	20	Pass
$\pi/4$ -DQPSK hopping			
Left Band	52.73	20	Pass
Right Band	55.96	20	Pass
8DPSK hopping			
Left Band	60.72	20	Pass
Right Band	57.42	20	Pass

BDR mode (GFSK): Band Edge-Left Side

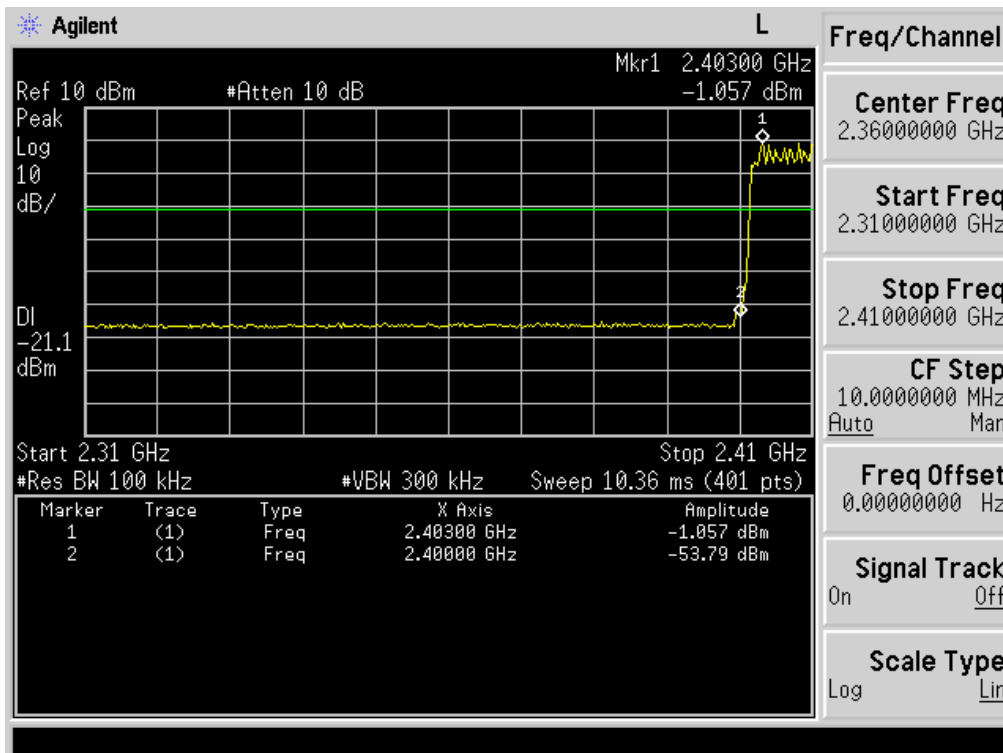
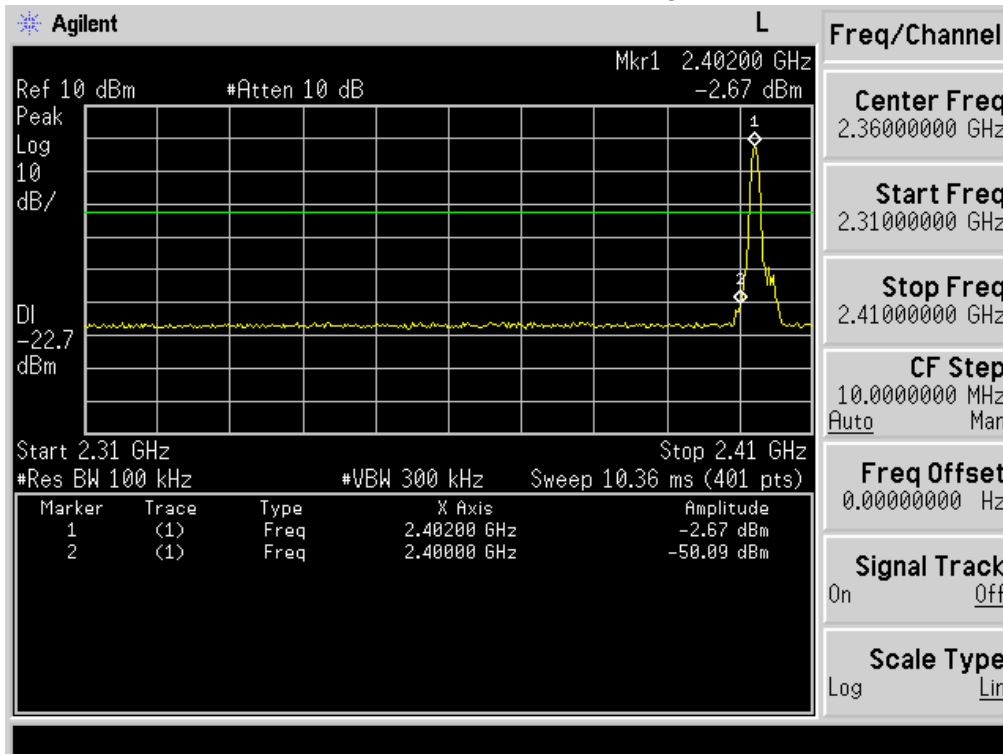




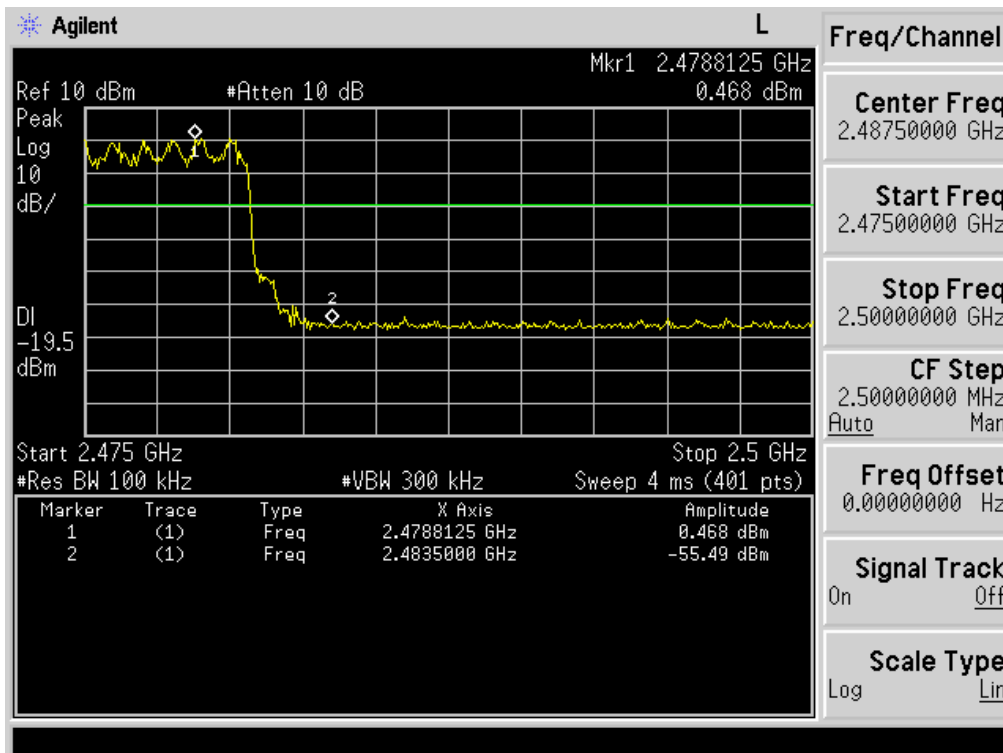
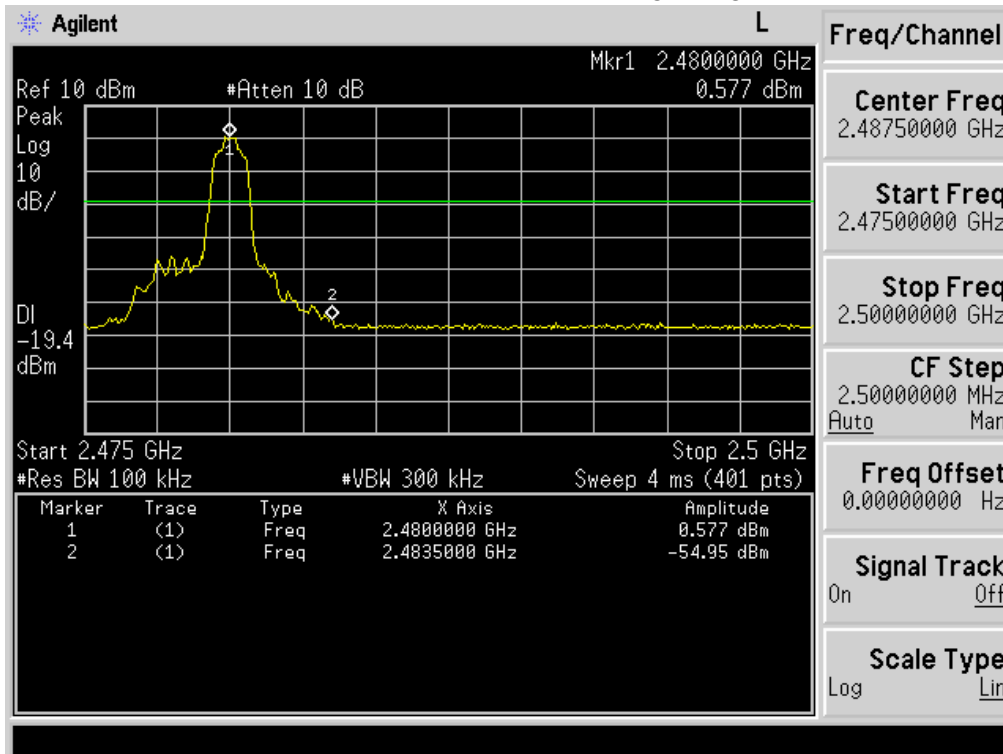
BDR mode (GFSK): Band Edge-Right Side



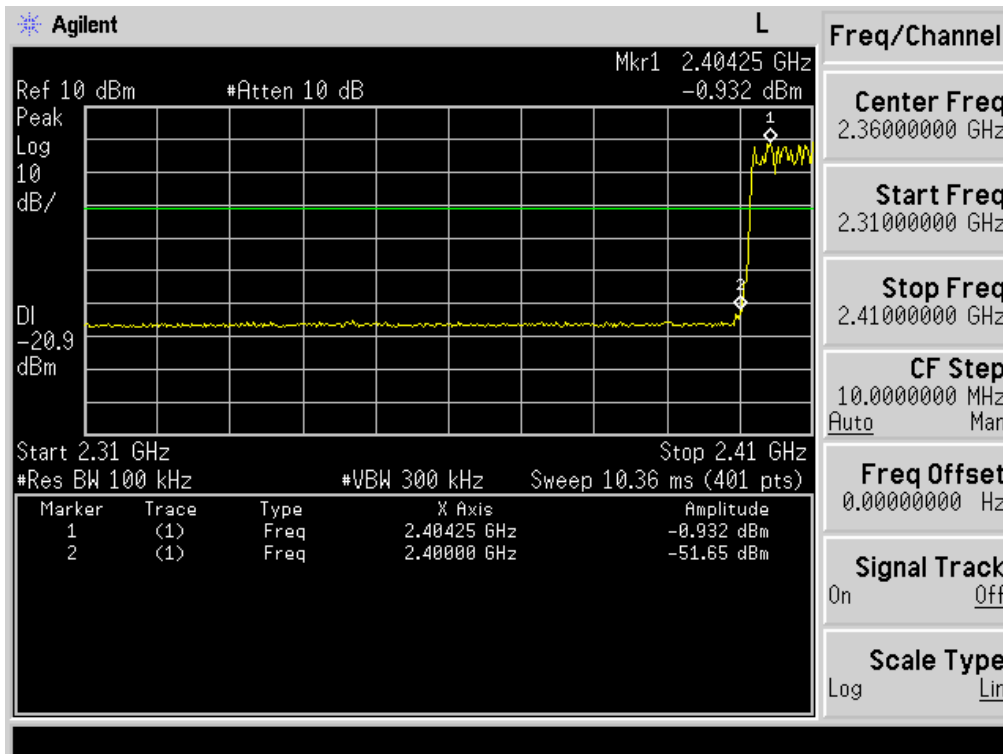
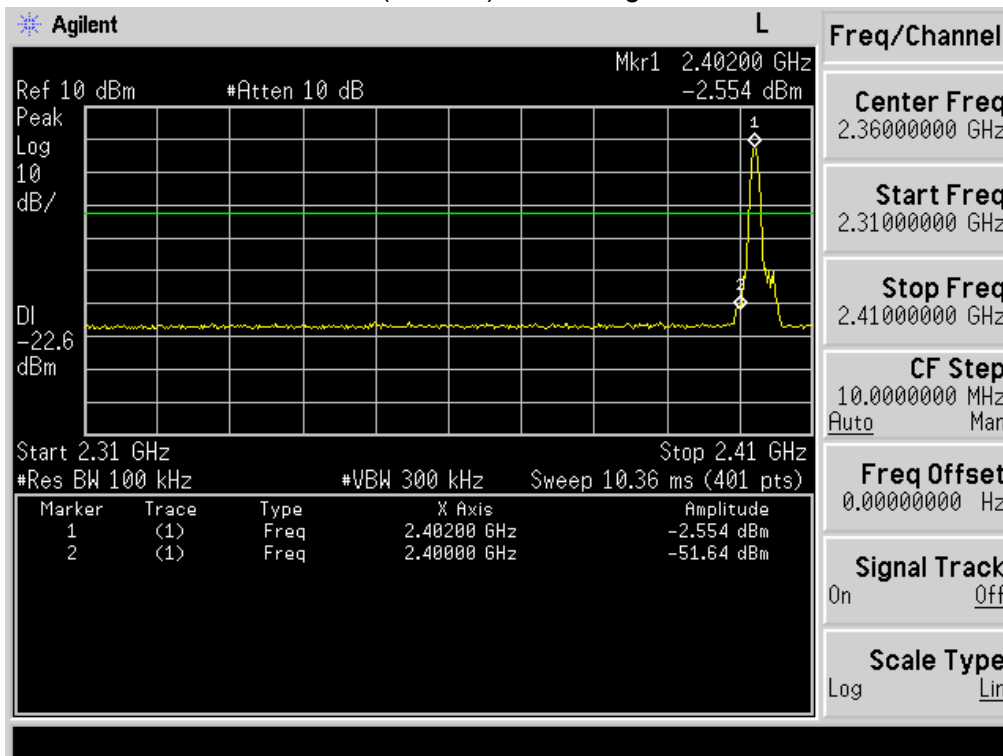
EDR mode ( $\pi/4$ -DQPSK): Band Edge-Left Side



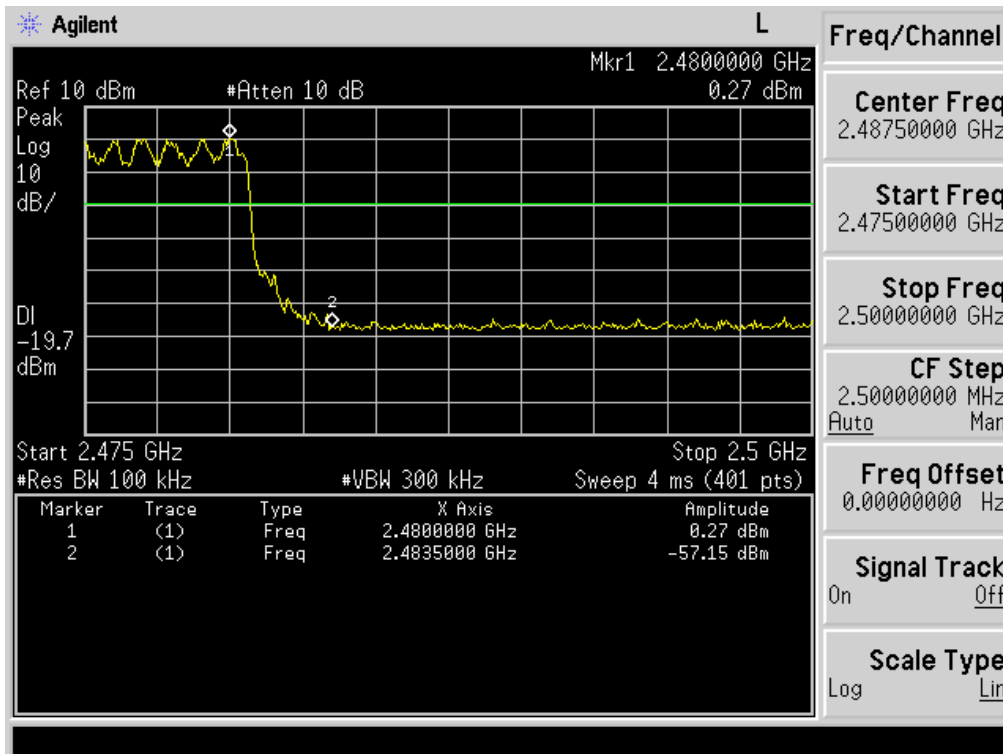
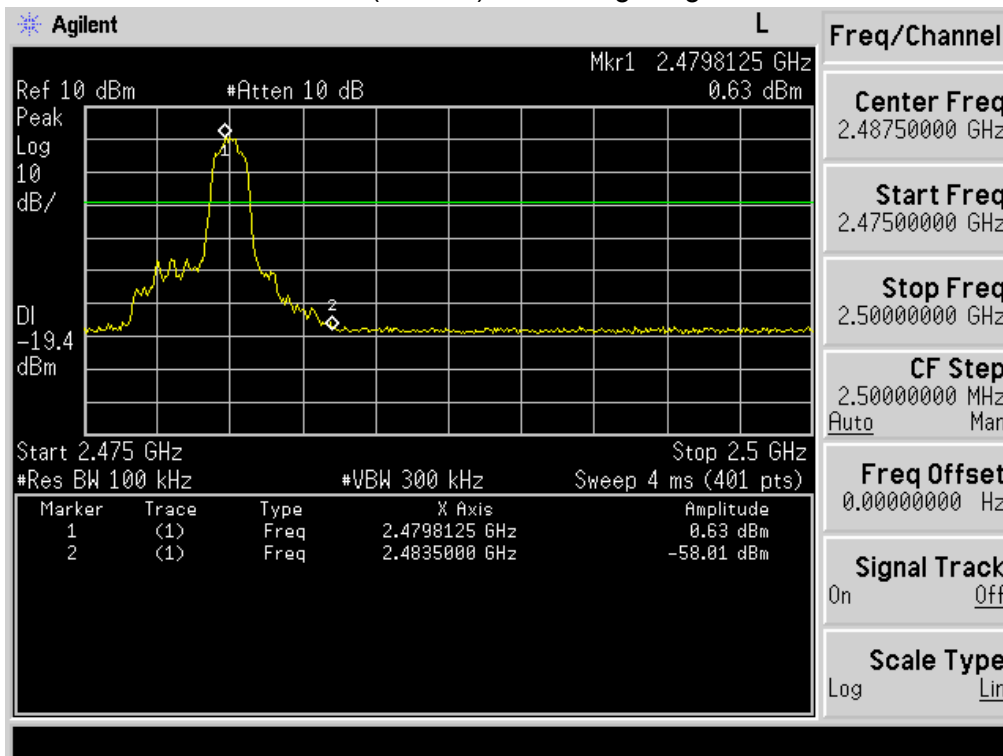
EDR mode ( $\pi/4$ -DQPSK): Band Edge- Right Side



EDR mode(8DPSK): Band Edge-Left Side



EDR mode(8DPSK): Band Edge-Right Side



NOTE:

Hopping enabled and disabled have evaluated, and the worst data was reported

## 11. ANTENNA REQUIREMENTS

### 11.1.Limits

For intentional device, according to FCC 47 CFR Section 15.203, 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. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### 11.2. Result

The antennas used for this product is PCB antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 1.0dBi.

# 12. PHOTOGRAPHS OF TEST SET-UP

Radiated Emission Test

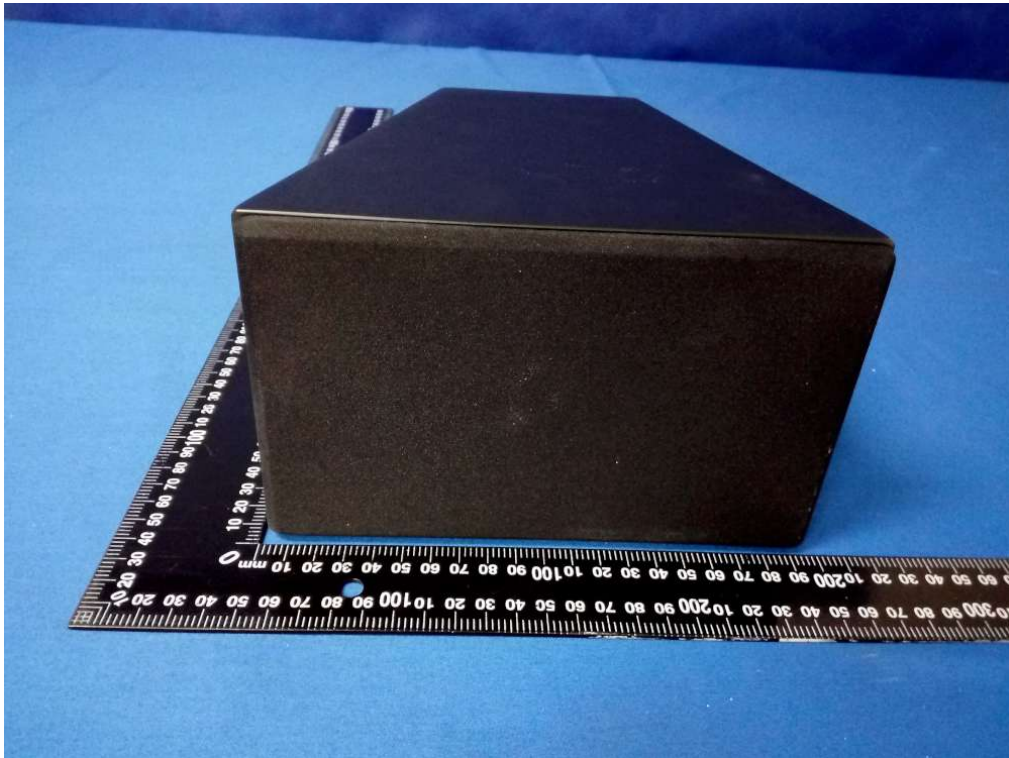


Conducted Emission

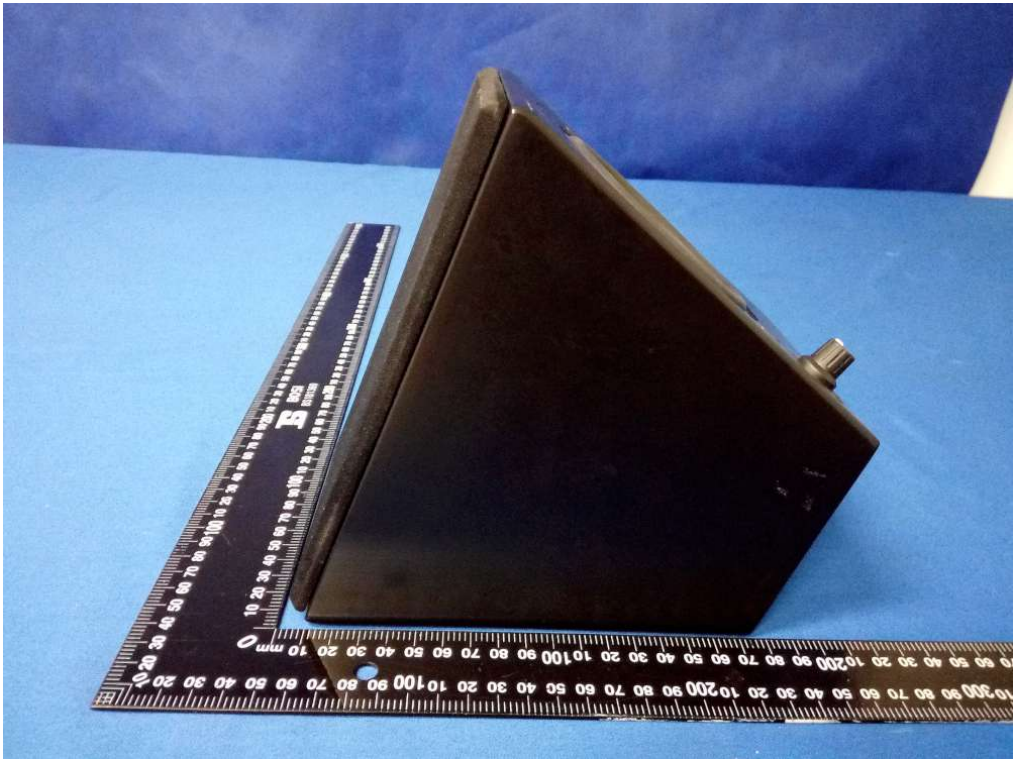


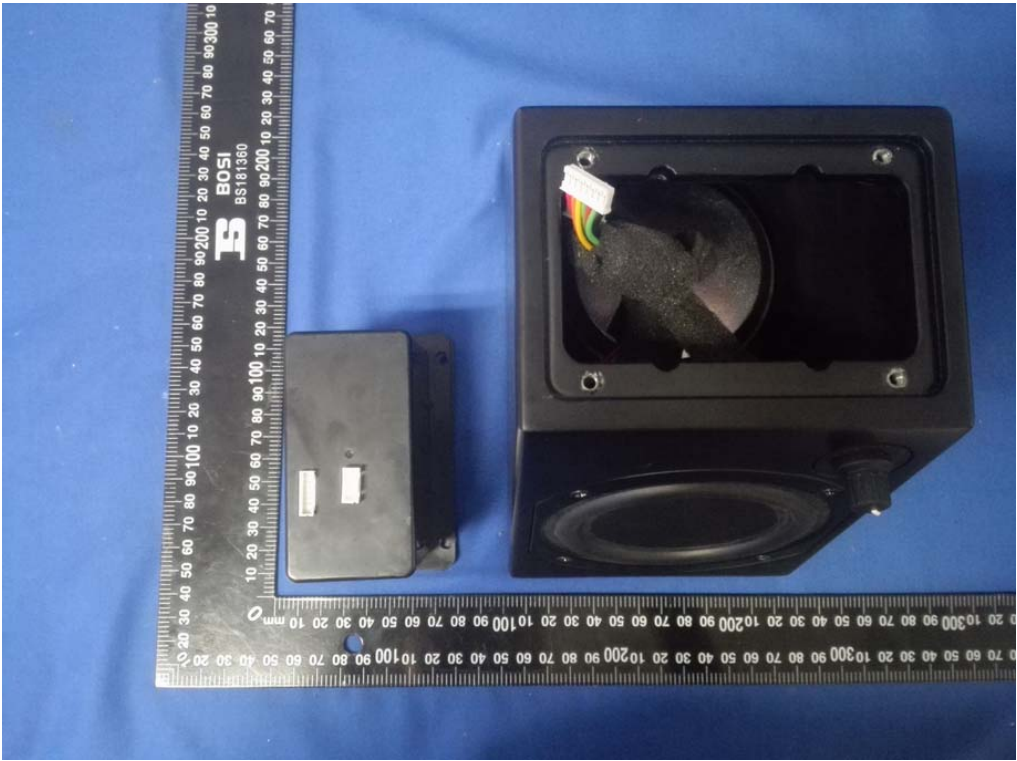


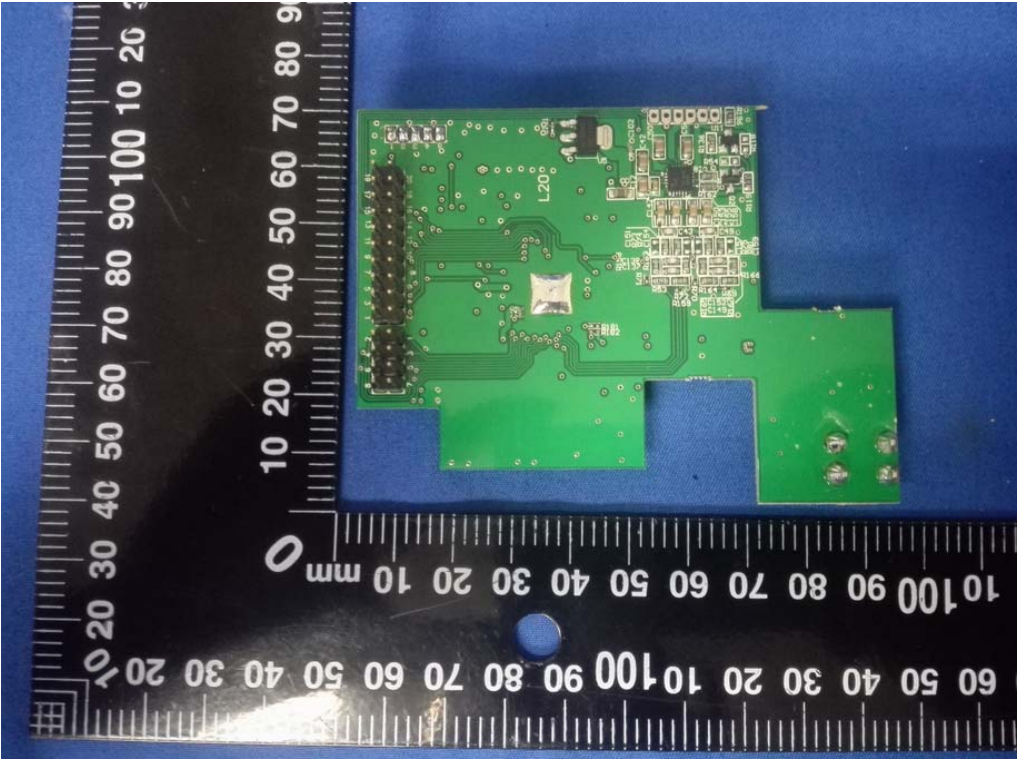
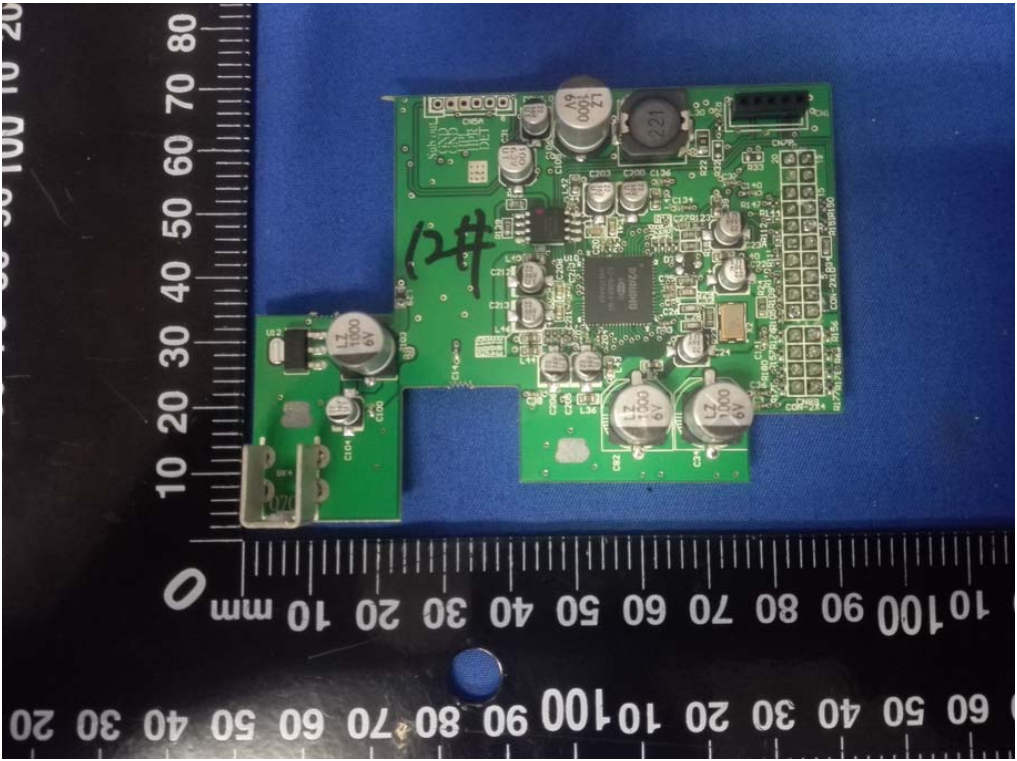
### 13. PHOTOGRAPHS OF THE EUT

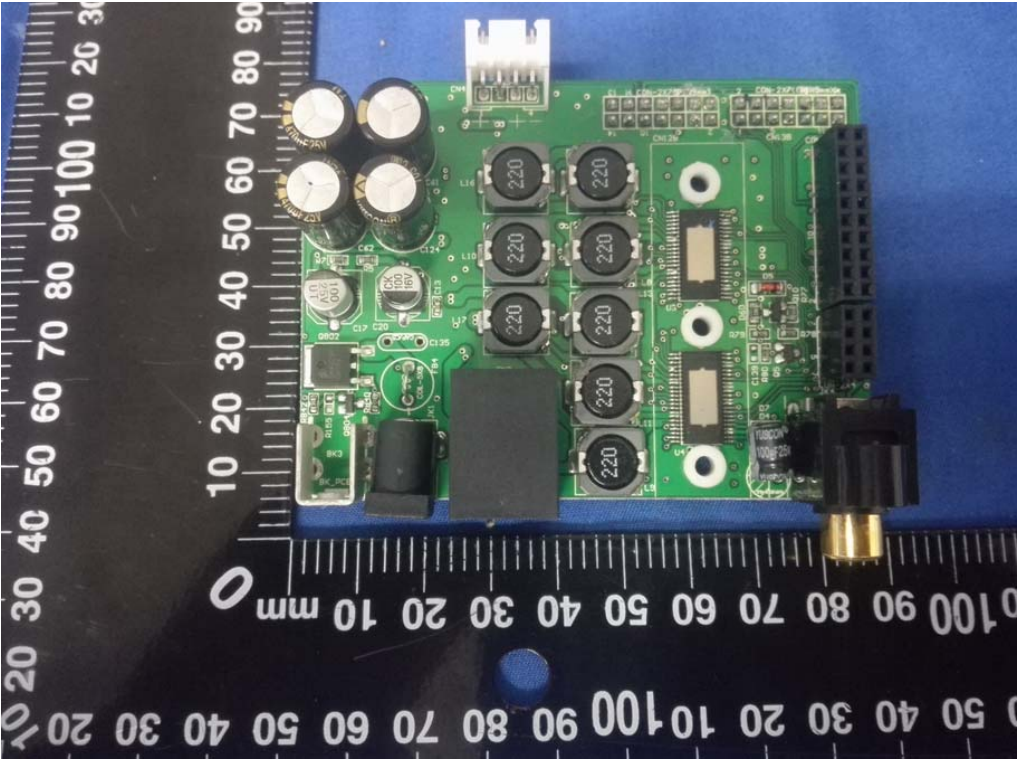
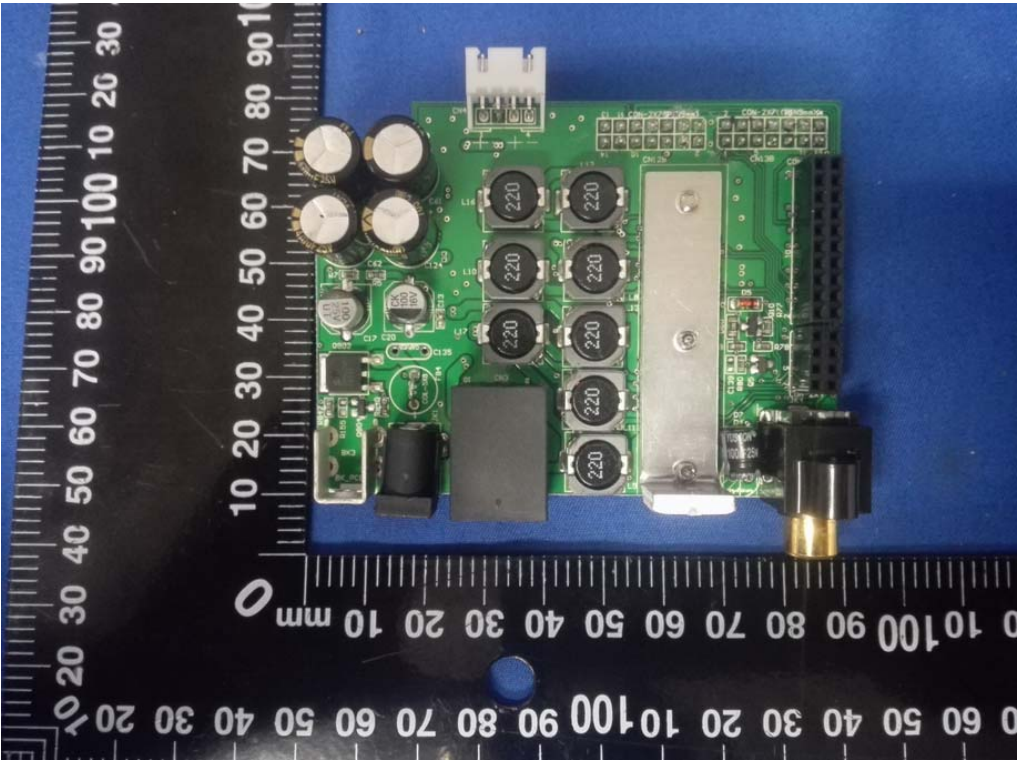


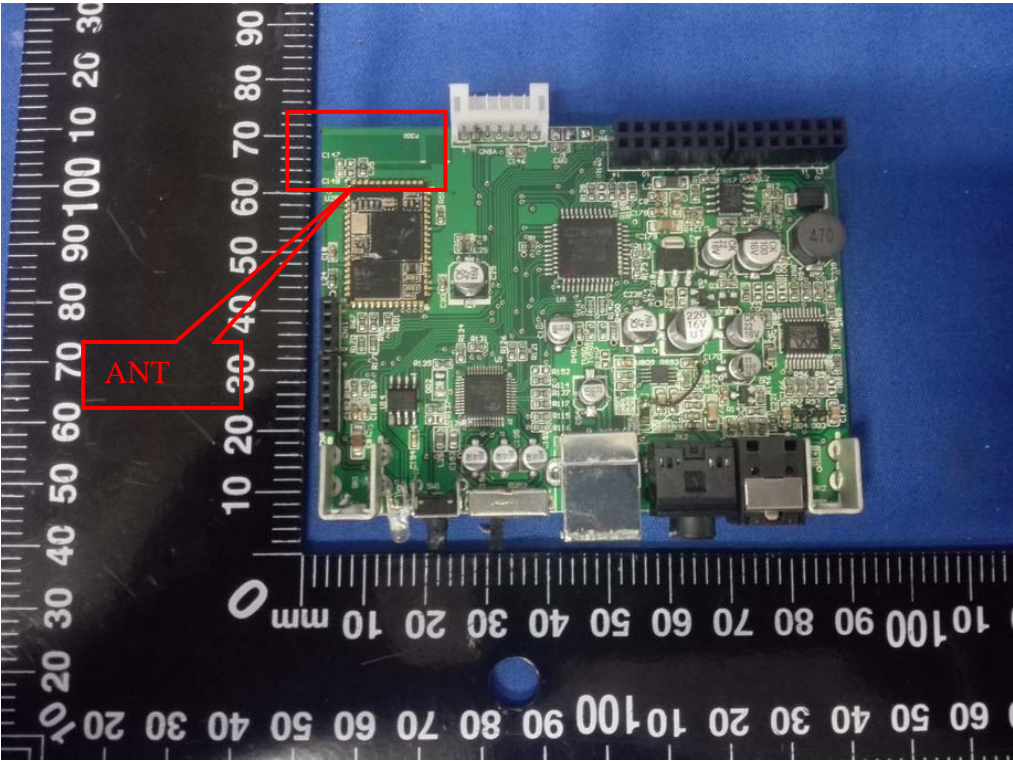
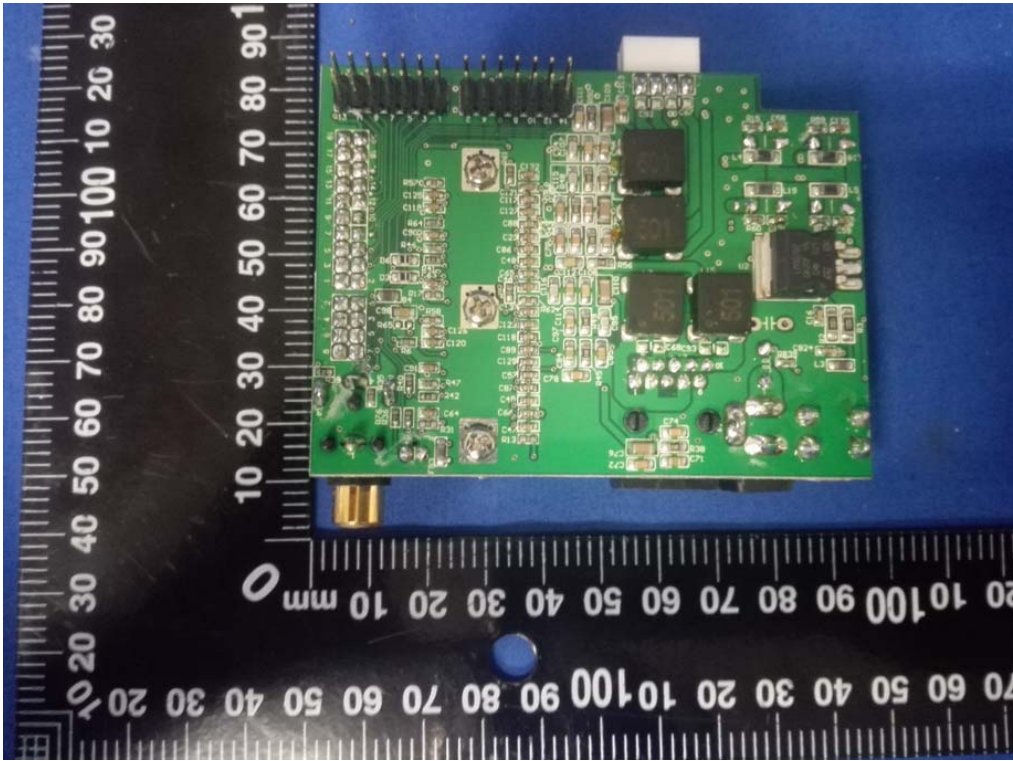


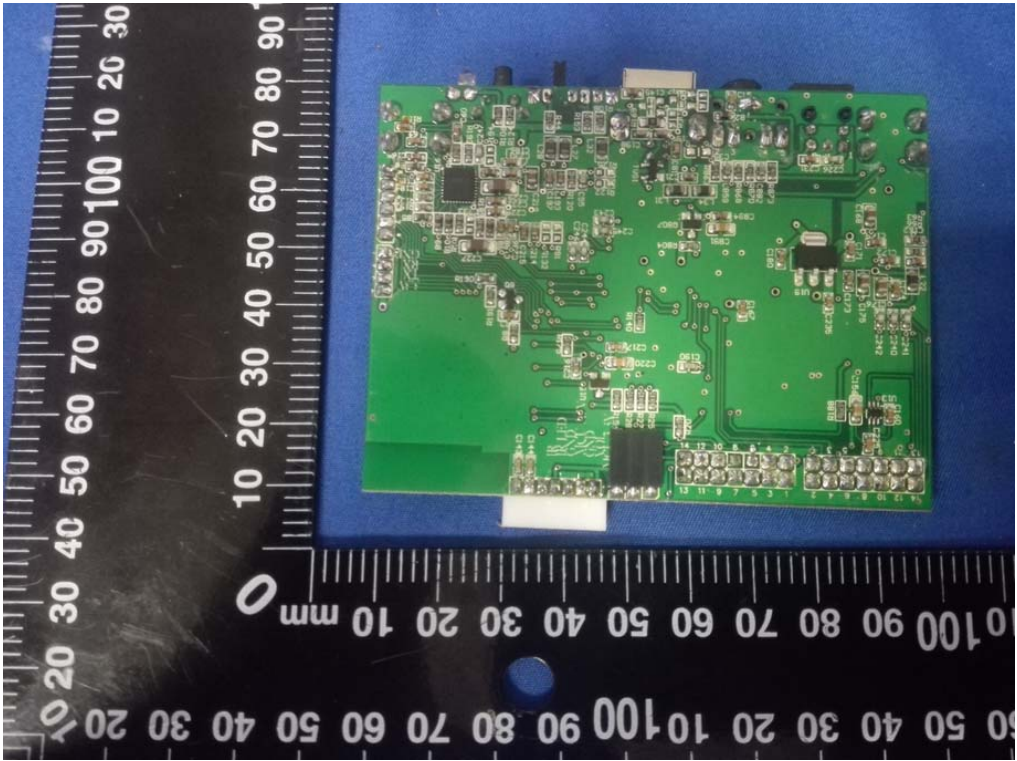












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