FCC Test Report

Part 15 subpart C

Client Information:

Applicant: Medfriend Co., Ltd.

Applicant add.: ROOM 216, BUILDING A, NO. 2038 TAIHE ROAD，SHANGHAI 201901, CHINA

Product Information:

EUT Name: Bluetooth crystal Speaker

Model No.: MF1547B

Brand Name: N/A

FCC ID: 2AG5H-MF1547B

Standards: FCC PART 15 Subpart C: 2015 section 15.247

Test procedure used: ANSI C63.4-2009

Prepared By:

Dongguan Yaxu (AiT) Technology Limited

Add. : No.22, Jinqianling Third Street, Jitigang, Huangjiang, Dongguan, Guangdong, China

Date of Receipt:	Dec. 15, 2015	Date of Test:	Dec. 15~26, 2015
Date of Issue:	Dec. 26, 2015	Test Result:	Pass

This device described above has been tested by Dongguan Yaxu(AiT) Technology Limited, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

*This test report must not be used by the client to claim product endorsement by any agency of the U.S. government.

Reviewed by: Seal-Chen **Approved by:**

1 Contents

2 Test Summary

2.1 Compliance with FCC Part 15 subpart C

Test	Test Requirement	Standard Paragraph	Result
Antenna Requirement	FCC Part 15 C:2015	Section 15.247(c)	**PASS**
Conduction Emissions	FCC Part 15 C:2015	Section 15.207(a)	**PASS**
Radiated Emissions	FCC Part 15 C:2015	Section 15.247(d)	**PASS**
Carrier Frequencies Separated	FCC Part 15 C:2015	Section 15.247(a)(1)	**PASS**
Hopping Channel Number	FCC Part 15 C:2015	Section 15.247(a)(1) (iii)	**PASS**
Dwell Time	FCC Part 15 C:2015	Section 15.247(a)(1) (iii)	**PASS**
Maximum Peak Output Power	FCC Part 15 C:2015	Section 15.247(b)	**PASS**
Band edge	FCC Part 15 C:2015	Section 15.247(d)	**PASS**
Conducted Spurious Emissions	FCC Part 15 C:2015	Section 15.247(d)	**PASS**
Note: Reference to the FCC Public Notice DA 00-705			

2.2 Measurement Uncertainty

All measurements involve certain levels of uncertainties, The following measurements uncertainty Levels have estimated based on ANSI C63.4:2009, the maximum value of the uncertainty as below

No.	Item	Uncertainty
1	Conducted Emission Test	1.20dB
2	Radiated Emission Test	3.30dB

3 Test Facility

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

.CNAS- Registration No: L6177

Dongguan Yaxu (AiT) technology Limited is accredited to ISO/IEC 17025:2005 general Requirements for the competence of testing and calibration laboratories (CNAS-CL01 Accreditation Criteria for the competence of testing and calibration laboratories) on Apr. 18, 2013

.FCC- Registration No: 248337

The 3m Semi-Anechoic Chamber, 3m/10m Open Area Test Site and Shielding Room of Dongguan Yaxu (AiT) Technology Limited have been registered by Federal Communications Commission (FCC) on Aug.29, 2014.

.Industry Canada(IC)-Registration No: IC6819A-1 & IC6819A-2

The 3m Semi-Anechoic Chamber and 3m/10m Open Area Test Site of Dongguan Yaxu (AiT) Technology Limited have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing on Oct. 01, 2014.

.VCCI- Registration No: 2705

The 3m/10m Open Area Test Site, Shielding Room and 3m Chamber of Dongguan Yaxu (AiT) Technology Limited have been registered by Voluntary Control Council for Interference on Nov. 21, 2012. The Telecommunication Ports Conducted Disturbance Measurement of Dongguan Yaxu (AiT) Technology Limited have been registered by Voluntary Control Council for Interference on May. 13, 2013.

.TUV NORD

Dongguan Yaxu (AiT) Technology Limited has been assessed on Jun. 13, 2013 that it can carry out EMC tests by order and under supervision of TUV NORD.

.ITS- Registration No: TMPSHA031

Dongguan Yaxu (AiT) Technology Limited has been assessed and included in Intertek Shanghai TMP Program regarding Laboratory facilities and test equipment on Jul.22, 2012.

3.1 Deviation from standard

None

3.2 Abnormalities from standard conditions

None

4 General Information

4.1 General Description of EUT

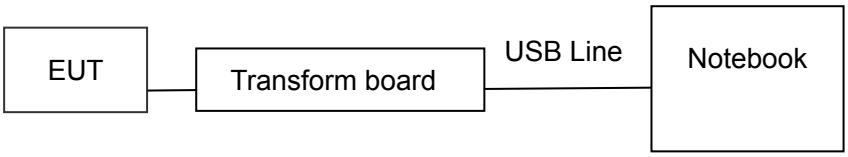
Manufacturer:	PU YAN ELECTRONIC FACTORY
Manufacturer Address:	ROOM 216, BUILDING A, NO. 2038 TAIHE ROAD，SHANGHAI 201901, CHINA
EUT Name:	Bluetooth crystal Speaker
Model No:	MF1547B
Brand Name:	N/A
Derivative model No.:	N/A
Serial No:	N/A
Operation frequency:	2402 MHz to 2480 MHz
NUMBER OF CHANNEL:	79
Modulation Technology:	GFSK, π/4-DQPSK, 8DPSK(1/2/3Mbps)
Bluetooth version:	Bluetooth 2.1+EDR
H/W No.:	V01
S/W No.:	V01
Antenna Type:	PCB antenna
Antenna Gain:	max 0 dBi
Power Supply Range:	DC 5V from adapter DC 3.7V by li-battery
Power Supply:	DC 3.7V by li-battery
Power Cord:	0.6 m DC cable
Output peak power（max）:	1Mbps：5.95dBm
	3Mbps：4.57dBm
Note:	
1.	For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

Description of Channel:					
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		

4.2 Description of Test conditions

(1) EUT was tested in normal configuration (Please See following Block diagram)

1. Block diagram of EUT configuration(TX Mode)



Note: 1. The EUT was fully-charged battery and programmed to be in continuously transmitting mode, the transmit duty cycle is not less than 98%.
2. Using the notebook and the transform board to control the fixed transmitting frequency and other test mode. After finishing the test setting, the notebook and the transform board will be removed during measurements.

(2) EUT test conditions:

15.31(e): For intentional radiators, measurements of the variation of the input power or the adiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

(3) Test frequencies:

According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and. If required reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

(4) Frequency range of radiated measurements:

According to the 15.33, the test range will be up to the tenth harmonic of the highest fundamental frequency.

(5) Pre-test the EUT in all transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet and conducted to determine the worst-case mode, only the worst-case results(1Mbps/3Mbps) are recorded in this report.

4.3 Test Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	Note
1	Adapter	N/A	FCC	TCH-M21	N/A	N/A	Provided by Lab

4.4 EUT Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	signal cable
1	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5 Equipments List for All Test Items

No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal. Due Date
1	Spectrum Analyzer	ADVANTEST	R3182	150900201	2015.06.29	2016.06.28
2	EMI Measuring Receiver	R&S	ESR	101660	2015.06.29	2016.06.28
3	Low Noise Pre Amplifier	Tsj	MLA-10K01-B01-27	1205323	2015.06.29	2016.06.28
4	Low Noise Pre Amplifier	Tsj	MLA-0120-A02-34	2648A04738	2015.06.29	2016.06.28
5	TRILOG Super Broadband test Antenna	SCHWARZBECK	VULB9160	9160-3206	2015.06.29	2016.06.28
6	Broadband Horn Antenna	SCHWARZBECK	BBHA9120D	452	2015.06.29	2016.06.28
7	SHF-EHF Horn	SCHWARZBECK	BBHA9170	BBHA9170367	2015.06.29	2016.06.28
8	50Ω Coaxial Switch	Anritsu	MP59B	6200264416	2015.06.29	2016.06.28
9	EMI Test Receiver	R&S	ESCI	100124	2015.06.29	2016.06.28
10	LISN	Kyoritsu	KNW-242	8-837-4	2015.06.29	2016.06.28
11	LISN	Kyoritsu	KNW-407	8-1789-3	2015.06.29	2016.06.28
12	50Ω Coaxial Switch	Anritsu	MP59B	6200264417	2015.06.29	2016.06.28
13	Loop Antenna	ETS	6512	00165355	2015.06.29	2016.06.28
14	Radiated Cable 1#（30MHz-1GHz）	FUJIKURA	5D-2W	01	2015.12.25	2016.12.24
15	Radiated Cable 2#（1GHz -25GHz）	FUJIKURA	10D2W	02	2015.12.25	2016.12.24
16	Conducted Cable 1#(9KHz-30MHz)	FUJIKURA	1D-2W	01	2015.12.25	2016.12.24
17	SMA Antenna connector	Dosin	Dosin-SMA	N/A	N/A	N/A
Note: The SMA antenna connector is soldered on the PCB board in order to perform conducted tests and this SMA antenna connector is listed in the equipment list.						

6 Test Result

6.1 Antenna Requirement

6.1.1 Standard requirement

15.203 requirement: For intentional device, according to 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.

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

6.1.2 EUT Antenna

The antenna is layout on PCB board and no consideration of replacement. Antenna gain is max 0dbi from 2.4GHz to 2.5GHz.

6.2 Conduction Emissions Measurement

6.2.1 Applied procedures / Limit

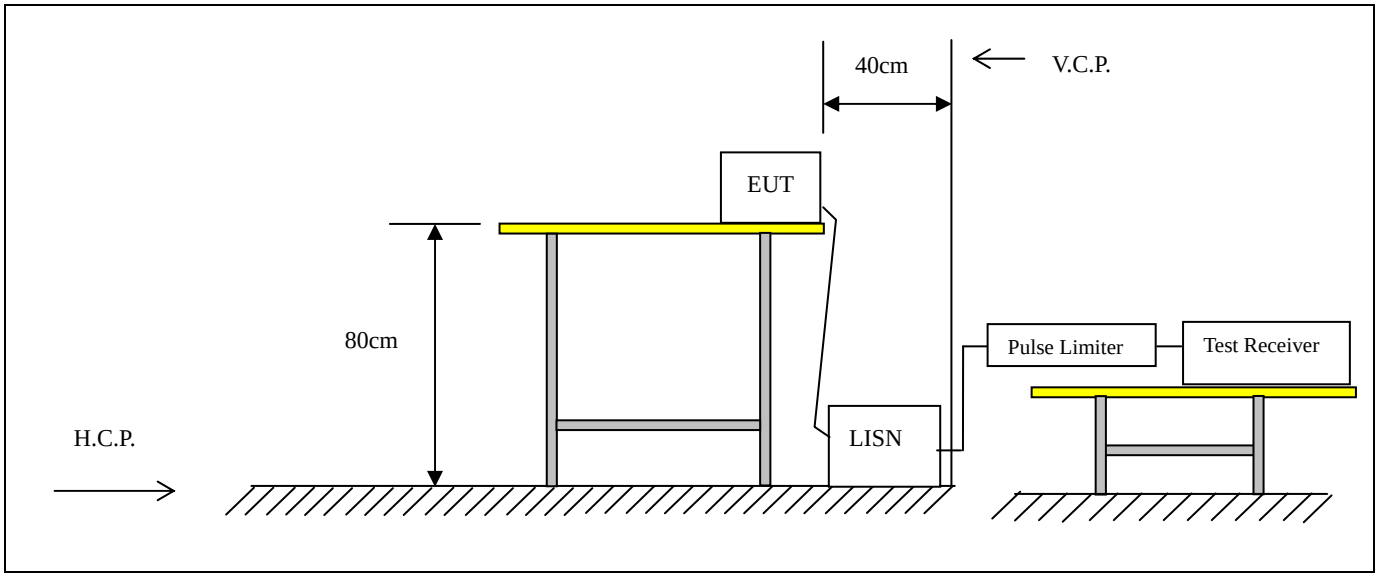
Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

Note: Decreases with the logarithm of the frequency.

6.2.2 Test procedure

EUT was placed upon a wooden test table 0.8m above the horizontal metal reference plane and 0.4m from the vertical ground plane, and it was connected to an AMN. The closest distance between the boundary of the EUT and the surface of the AMN is 0.8m. All peripherals were connected to another AMN, and placed at a distance of 10cm from each other. A spectrum and receiver was connected to the RF output port of the AMN. Both average and quasi-peak value were detected.

6.2.3 Test setup

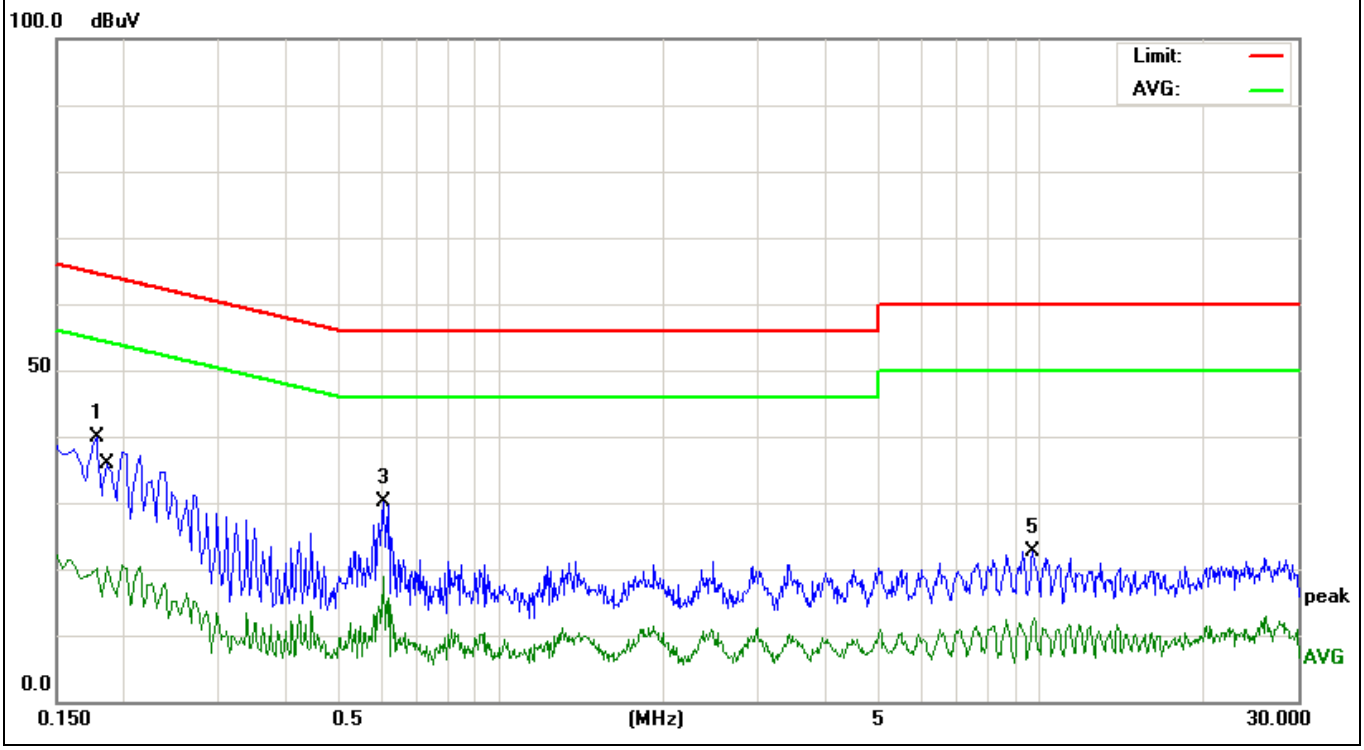


6.2.4 Test results

EUT:	Bluetooth crystal Speaker	Model Name. :	MF1547B
Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	1010hPa	Test Date :	2015-12-18
Test Mode:	TX (1Mbps) (CH00 worst case)	Phase :	Line
Test Voltage :	DC 5V from adapter, AC 120V/60Hz for adapter		

Frequency (MHz)	Meter Reading (dBμV)	Factor(dB)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Detector
0.178	28.42	11.41	39.83	64.57	-24.74	Quasi-Peak
0.186	9.12	11.31	20.43	54.21	-33.78	Average
0.606	20.07	9.99	30.06	56.00	-25.94	Quasi-Peak
0.606	8.76	9.99	18.75	46.00	-27.25	Average
9.658	21.58	1.15	22.73	60.00	-37.27	Quasi-Peak
9.726	11.50	1.16	12.66	50.00	-37.34	Average

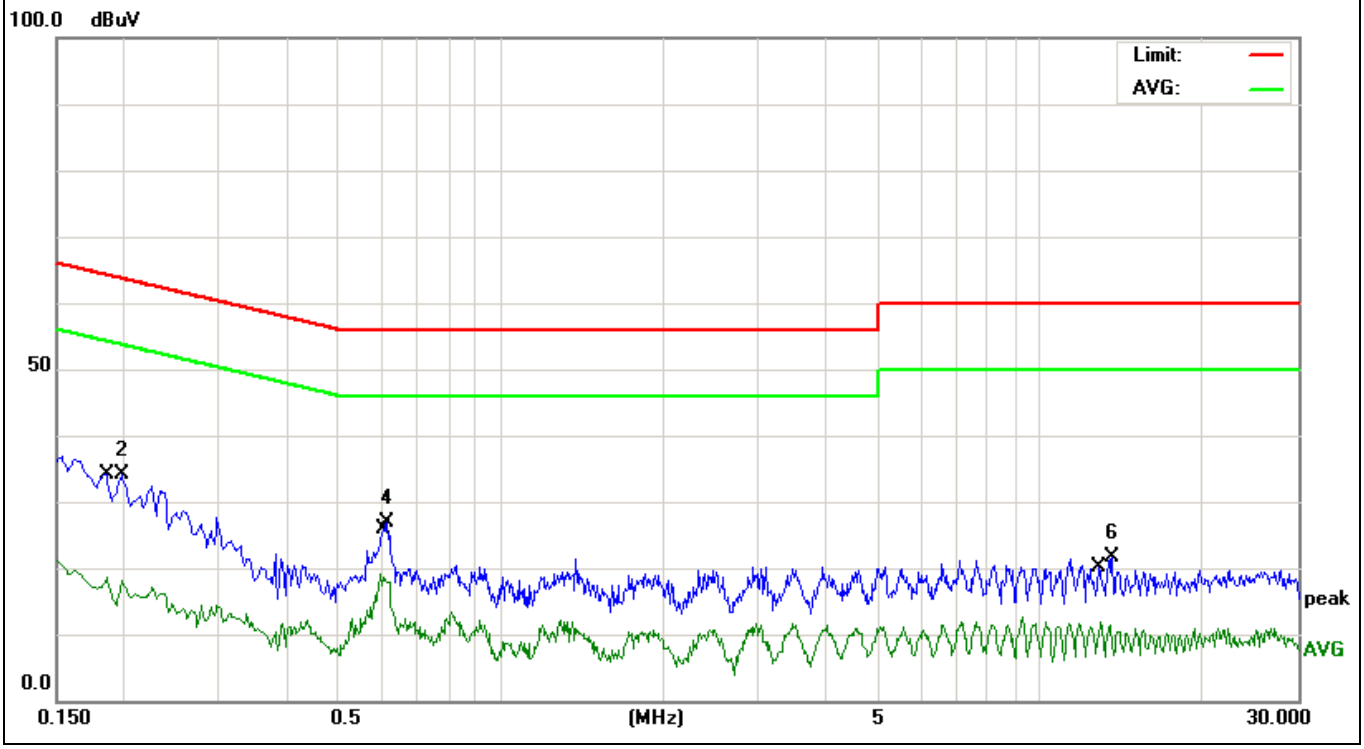
Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.



EUT：	Bluetooth crystal Speaker	Model Name. ：	MF1547B
Temperature：	26 ℃	Relative Humidity：	54%
Pressure：	1010hPa	Test Date :	2015-12-18
Test Mode：	TX (1Mbps) (CH00 worst case)	Phase :	Neutral
Test Voltage ：	DC 5V from adapter, AC 120V/60Hz for adapter		

Frequency (MHz)	Meter Reading (dBμV)	Factor(dB)	Emission Level (dBμV)	Limits (dBμV)	Margin (dB)	Detector
0.186	7.20	11.31	18.51	54.21	-35.70	Quasi-Peak
0.198	22.99	11.16	34.15	63.69	-29.54	Average
0.598	9.02	9.99	19.01	46.00	-26.99	Quasi-Peak
0.614	16.86	9.99	26.85	56.00	-29.15	Average
12.926	10.53	1.35	11.88	50.00	-38.12	Quasi-Peak
13.566	20.27	1.37	21.64	60.00	-38.36	Average

Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.



6.3 Radiated Emissions Measurement

6.3.1 Applied procedures / Limit

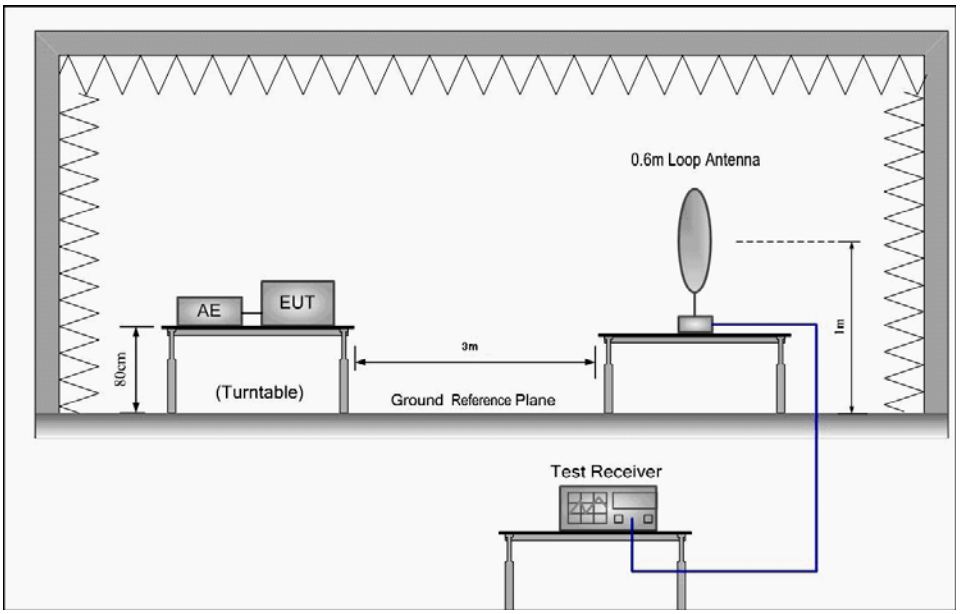
15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Frequency of Emission (MHz)	Field Strength		Measurement Distance (meters)
	μV/m	dBμV/m	
0.009-0.49	2400/F(kHz)		300
0.49-1.705	24000/F(kHz)		30
1.705-30	30		30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

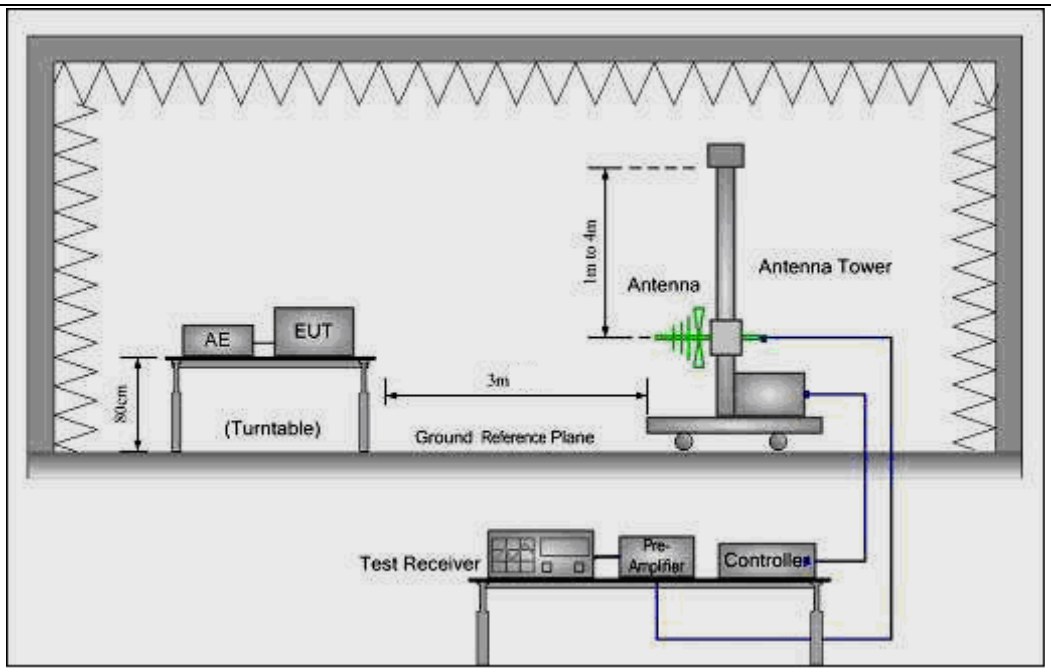
6.3.2 Test setup

Test Configuration:

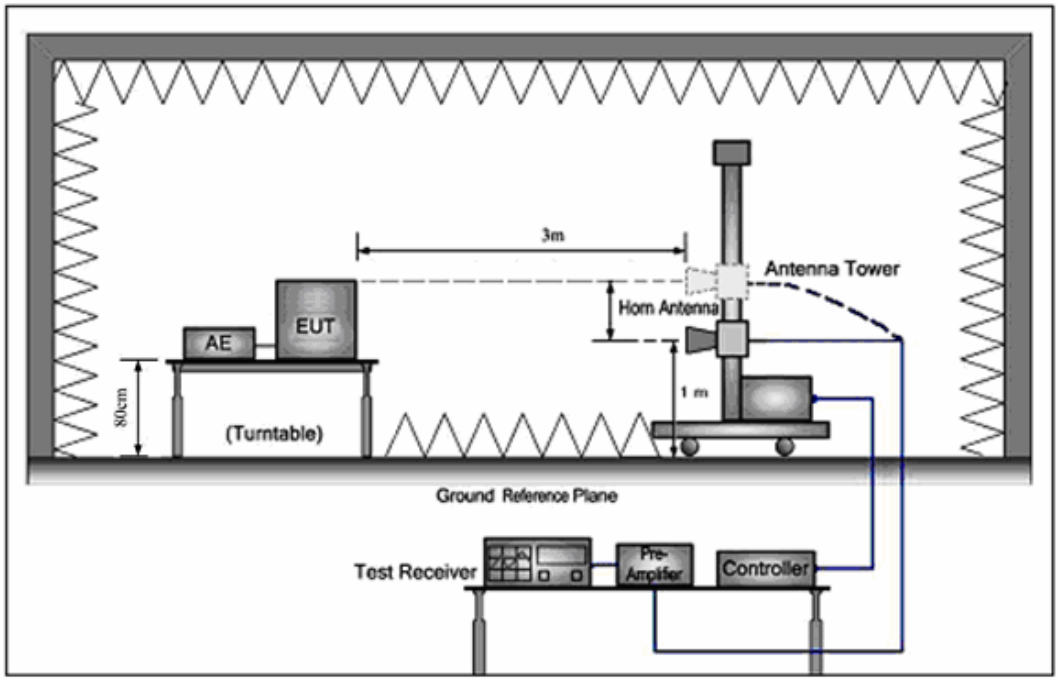
1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 25 GHz emissions:



6.3.3 Test procedure

EUT was placed upon a wooden test table which was placed on the turn table 0.8m above the horizontal metal ground plane, and operating in the mode as mentioned above. A receiving antenna was placed 3m away from the EUT. During testing, turn around the turn table and move the antenna from 1m to 4m to find the maximum field-strength reading. All peripherals were placed at a distance of 10cm between each other. Both horizontal and vertical antenna polarities were tested. The worst case emissions were reported.

For measurement at frequency above 1GHz
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

6.3.4 Test Result

Radiated Emissions Test Data Below 30MHz

EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	25 ℃	Test Data	2015-12-20
Pressure：	1005 hPa	Relative Humidity：	60%
Test Mode ：	TX	Test Voltage ：	DC 3.7V
Measurement Distance	3 m	Frenqucy Range	9KHz to 30MHz
RBW/VBW	9KHz~150KHz/RB 200Hz for QP, 150KHz~30MHz/RB 9KHz for QP		

No emission found between lowest internal used/generated frequencies to 30MHz.

Radiated Emissions Test Data Below 1GHz

EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	25 ℃	Test Data	2015-12-20
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	TX (1Mbps) (CH00 worst case)	Test Voltage ：	DC 3.7V
Measurement Distance	3 m	Frenqucy Range	30MHz to 1GHz
RBW/VBW	100KHz / 300KHz for spectrum, RBW=120KHz for receiver.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
35.8746	35.77	-16.76	19.01	40.00	-20.99	QUASIPEAK
103.4419	36.50	-13.69	22.81	43.50	-20.69	QUASIPEAK
170.1947	38.38	-15.08	23.30	43.50	-20.20	QUASIPEAK
286.9823	36.27	-9.95	26.32	46.00	-19.68	QUASIPEAK
590.9737	36.36	-2.08	34.28	46.00	-11.72	QUASIPEAK
787.8513	35.43	1.51	36.94	46.00	-9.06	QUASIPEAK

(b) Antenna polarization: vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
38.616	35.37	-14.49	20.88	40.00	-19.12	QUASIPEAK
102.7192	35.84	-15.76	20.08	43.50	-23.42	QUASIPEAK
181.2834	36.33	-11.07	25.26	43.50	-18.24	QUASIPEAK
293.0842	35.72	-9.90	25.82	46.00	-20.18	QUASIPEAK
520.8881	35.74	-4.97	30.77	46.00	-15.23	QUASIPEAK
694.4174	36.87	0.03	36.9	46.00	-9.10	QUASIPEAK

Note:

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier

Radiated Emissions Test Data Above 1GHz

EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	25 ℃	Test Data	2015-12-20
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	1Mbps	Test Voltage ：	DC 3.7V
Measurement Distance	3 m	Frenqucy Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/3MHz for Peak, 1MHz/10Hz for Average. non-restricted band: 100KHz/300KHz for Peak.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	51.89	5.06	56.95	74.00	-17.05	PEAK
4804	40.36	5.06	45.42	54.00	-8.58	AVERAGE
7206	46.54	7.03	53.57	74.00	-20.43	PEAK
7206	34.21	7.03	41.24	54.00	-12.76	AVERAGE
9608	42.67	10.63	53.30	74.00	-20.70	PEAK
9608	31.4	10.63	42.03	54.00	-11.97	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	52.24	5.06	57.30	74.00	-16.70	peak
4804	40.56	5.06	45.62	54.00	-8.38	AVG
7206	46.85	7.03	53.88	74.00	-20.12	peak
7206	35.43	7.03	42.46	54.00	-11.54	AVG
9608	42.37	10.63	53.00	74.00	-21.00	peak
9608	31.66	10.63	42.29	54.00	-11.71	AVG

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier

Lowest channel: 2402 MHz

Data rate: 1Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	53.24	5.14	58.38	74.00	-15.62	peak
4882	42.86	5.14	48.00	54.00	-6.00	AVG
7323	47.10	7.54	54.64	74.00	-19.36	peak
7323	36.35	7.54	43.89	54.00	-10.11	AVG
9764	42.92	11.39	54.31	74.00	-19.69	peak
9764	31.43	11.39	42.82	54.00	-11.18	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	53.50	5.14	58.64	74.00	-15.36	peak
4882	41.30	5.14	46.44	54.00	-7.56	AVG
7323	46.21	7.54	53.75	74.00	-20.25	peak
7323	35.67	7.54	43.21	54.00	-10.79	AVG
9764	42.29	11.39	53.68	74.00	-20.32	peak
9764	31.34	11.39	42.73	54.00	-11.27	AVG

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier

Middle Channel: 2441 MHz

Data rate: 1Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	52.88	5.22	58.10	74.00	-15.90	peak
4960	41.56	5.22	46.78	54.00	-7.22	AVG
7440	46.73	8.06	54.79	74.00	-19.21	peak
7440	35.41	8.06	43.47	54.00	-10.53	AVG
9920	41.85	12.10	53.95	74.00	-20.05	peak
9920	30.76	12.10	42.86	54.00	-11.14	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	52.78	5.22	58.00	74.00	-16.00	peak
4960	39.23	5.22	44.45	54.00	-9.55	AVG
7440	46.15	8.06	54.21	74.00	-19.79	peak
7440	34.43	8.06	42.49	54.00	-11.51	AVG
9920	42.80	12.10	54.9	74.00	-19.10	peak
9920	31.62	12.10	43.72	54.00	-10.28	AVG

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier

Highest Channel: 2480 MHz

Data rate: 1Mbps

EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	25 ℃	Test Data	2015-12-20
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	3Mbps	Test Voltage ：	DC 3.7V
Measurement Distance	3 m	Frenqucy Range	1GHz to 25GHz
RBW/VBW	Spurious emission: 1MHz/3MHz for Peak, 1MHz/10Hz for Average. non-restricted band: 100KHz/300KHz for Peak.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	52.47	5.06	57.53	74.00	-16.47	peak
4804	40.61	5.06	45.67	54.00	-8.33	AVG
7206	47.52	7.03	54.55	74.00	-19.45	peak
7206	35.96	7.03	42.99	54.00	-11.01	AVG
9608	43.08	10.63	53.71	74.00	-20.29	peak
9608	31.27	10.63	41.90	54.00	-12.10	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804	52.35	5.06	57.41	74.00	-16.59	peak
4804	41.71	5.06	46.77	54.00	-7.23	AVG
7206	46.60	7.03	53.63	74.00	-20.37	peak
7206	35.42	7.03	42.45	54.00	-11.55	AVG
9608	42.39	10.63	53.02	74.00	-20.98	peak
9608	31.46	10.63	42.09	54.00	-11.91	AVG

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier

Lowest Channel: 2402 MHz

Data rate: 3Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	52.26	5.14	57.4	74.00	-16.6	peak
4882	41.35	5.14	46.49	54.00	-7.51	AVG
7323	46.81	7.54	54.35	74.00	-19.65	peak
7323	34.39	7.54	41.93	54.00	-12.07	AVG
9764	43.4	11.39	54.79	74.00	-19.21	peak
9764	32.53	11.39	43.92	54.00	-10.08	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882	53.42	5.14	58.56	74.00	-15.44	peak
4882	42.39	5.14	47.53	54.00	-6.47	AVG
7323	45.85	7.54	53.39	74.00	-20.61	peak
7323	34.64	7.54	42.18	54.00	-11.82	AVG
9764	42.48	11.39	53.87	74.00	-20.13	peak
9764	30.52	11.39	41.91	54.00	-12.09	AVG

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier

Middle Channel: 2441 MHz

Data rate: 3Mbps

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	52.14	5.22	57.36	74.00	-16.64	peak
4960	41.65	5.22	46.87	54.00	-7.13	AVG
7440	46.27	8.06	54.33	74.00	-19.67	peak
7440	35.87	8.06	43.93	54.00	-10.07	AVG
9920	43.5	12.1	55.6	74.00	-18.4	peak
9920	31.36	12.1	43.46	54.00	-10.54	AVG

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960	52.21	5.22	57.43	74.00	-16.57	peak
4960	41.39	5.22	46.61	54.00	-7.39	AVG
7440	46.42	8.06	54.48	74.00	-19.52	peak
7440	34.87	8.06	42.93	54.00	-11.07	AVG
9920	42.37	12.10	54.47	74.00	-19.53	peak
9920	31.6	12.10	43.70	54.00	-10.30	AVG

Note:

10~25GHz at least have 20dB margin. No recording in the test report.

Measurement Level = Reading Level + Factor

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier

Highest channel: 2480 MHz

Data rate: 3Mbps

6.3.5 TEST RESULTS (Restricted Bands Requirements)

EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	25 ℃	Test Data	2015-12-20
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	TX 1Mbps\ 3Mbps	Test Voltage ：	DC 3.7V
Note：	1. The transmitter was setup to transmit at the lowest channel. Then the field strength was measured at 2310-2390 MHz. 2. The transmitter was setup to transmit at the highest channel. Then the field strength was measured at 2483.5-2500 MHz. 3. The data of 2390MHz and 2483.5MHz was the worst.		

Test Mode	Ant.Pol. H/V	Freq. (MHz)	Reading		Ant/CF CF(dB)	Act		Limit	
			Peak (dBuv)	AV (dBuv)		Peak (dBuv/m)	AV (dBuv/m)	Peak (dBuv/m)	AV (dBuv/m)
Data rate 1Mbps	V	2390	59.35	40.35	5.16	64.51	45.51	74	54
	H	2390	57.85	37.45	5.16	63.01	42.61	74	54
	V	2483.5	58.69	35.68	5.75	64.44	41.43	74	54
	H	2483.5	57.66	38.14	5.75	63.41	43.89	74	54
Data rate 3Mbps	V	2390	55.12	35.28	5.16	60.28	40.44	74	54
	H	2390	57.33	36.85	5.16	62.49	42.01	74	54
	V	2483.5	59.38	37.15	5.75	65.13	42.9	74	54
	H	2483.5	55.75	33.46	5.75	61.5	39.21	74	54

Remark：

(1) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode.

(2) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna

(3) Corr.Factor = Antenna Factor + Cable Loss – Pre-amplifier.

6.4 BANDWIDTH TEST

6.4.1 Applied procedures / Limit

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dBbandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

6.4.2 Test procedure

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 1% of the 20 dB bandwidth, VBW ≥ RBW, Sweep = auto, Detector function = peak
Trace = max hold

6.4.3 Deviation from standard

No deviation.

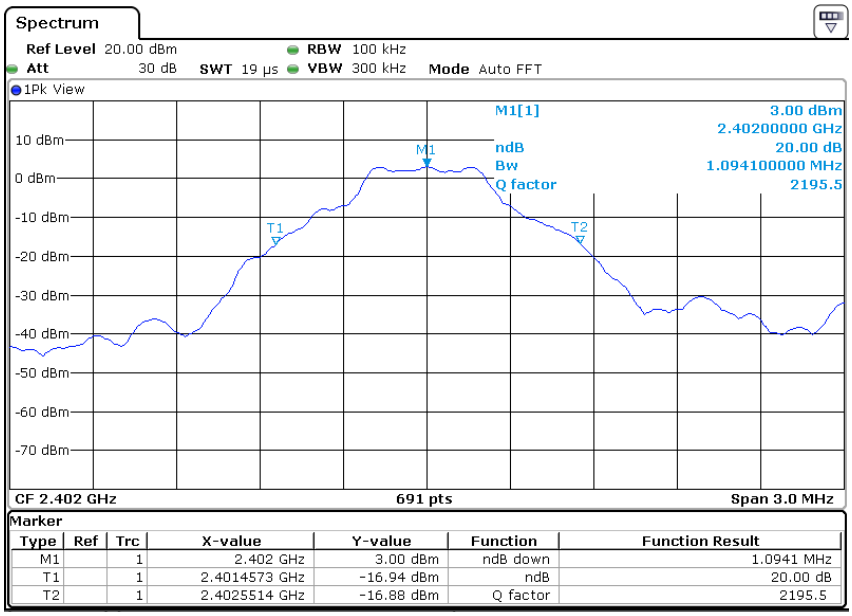
6.4.4 Test setup

6.4.5 Test results

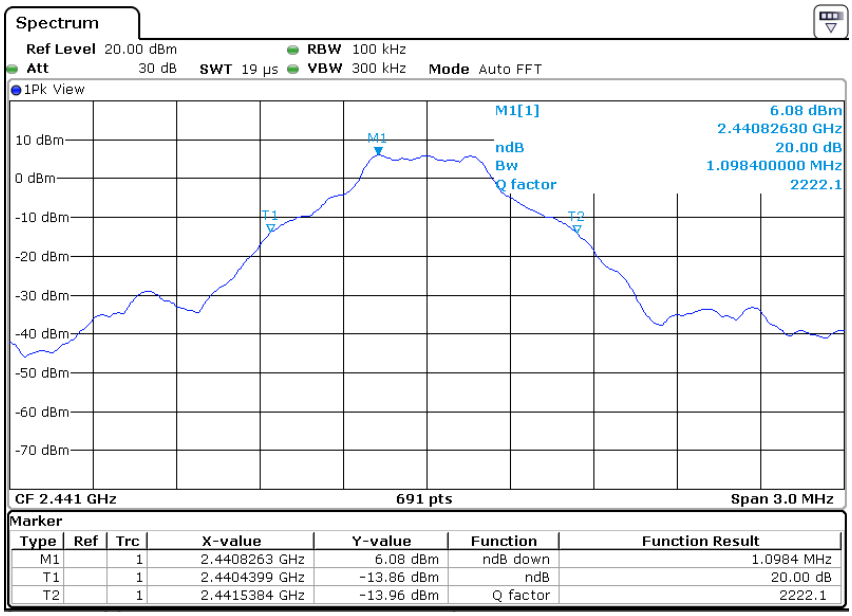
EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1010 hPa	Test Power ：	DC 3.7V
Test Mode ：	TX 1Mbps/ 3Mbps		

Channel		Channel frenqucy (MHz)	20dB bandwidth (KHz)	Limit (KHz)	Conclusion
1Mbps	Low	2402	1094.1	N/A	Pass
	Middle	2441	1098.4	N/A	Pass
	High	2480	1098.4	N/A	Pass
3Mbps	Low	2402	1332.9	N/A	Pass
	Middle	2441	1389.3	N/A	Pass
	High	2480	1341.5	N/A	Pass

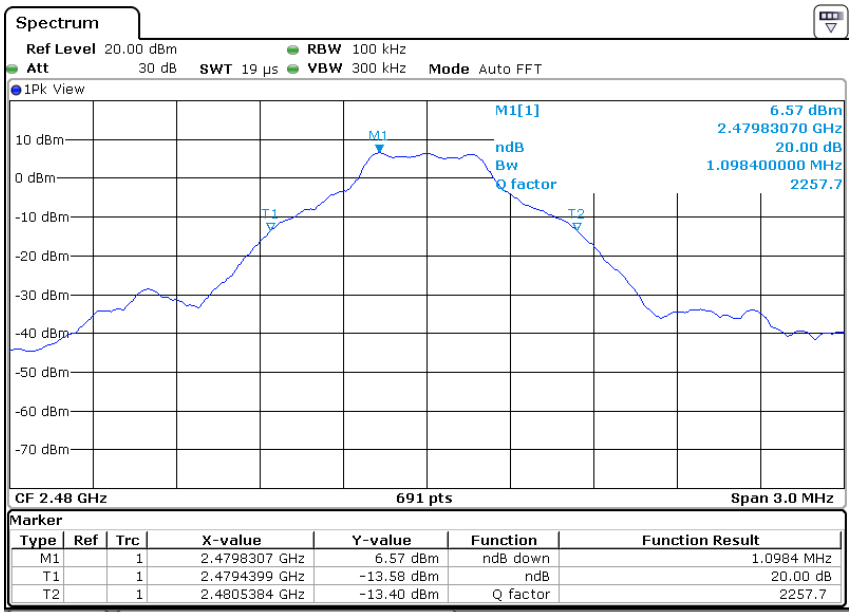
CH00-1Mbps



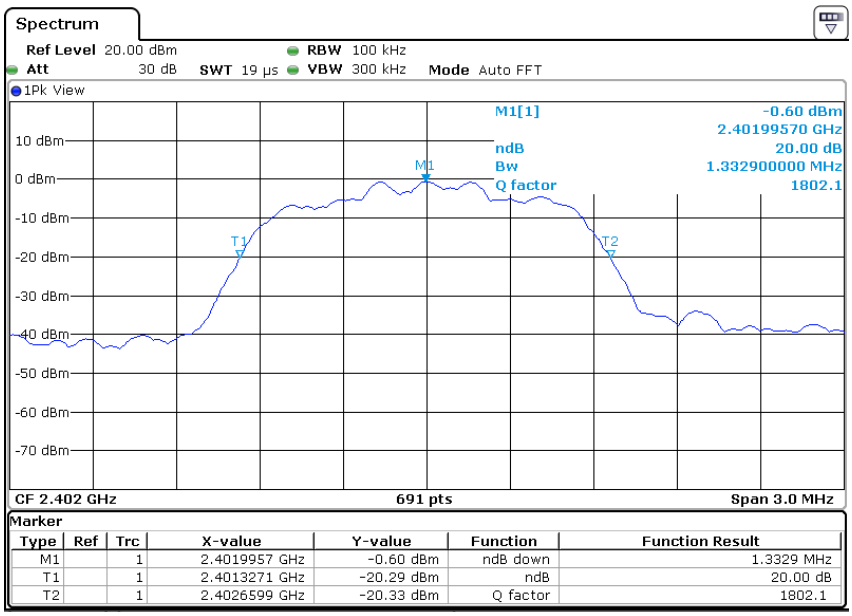
CH 39-1Mbps



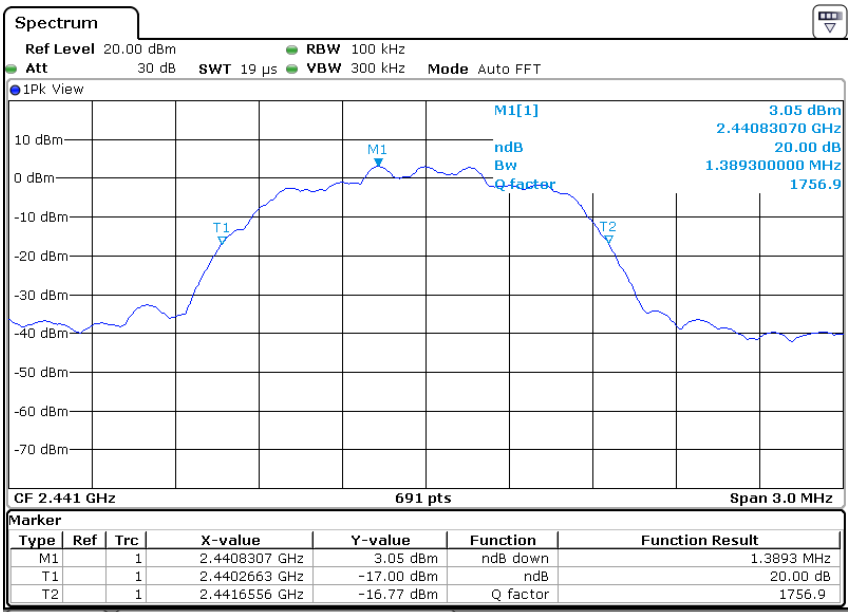
CH 78-1Mbps



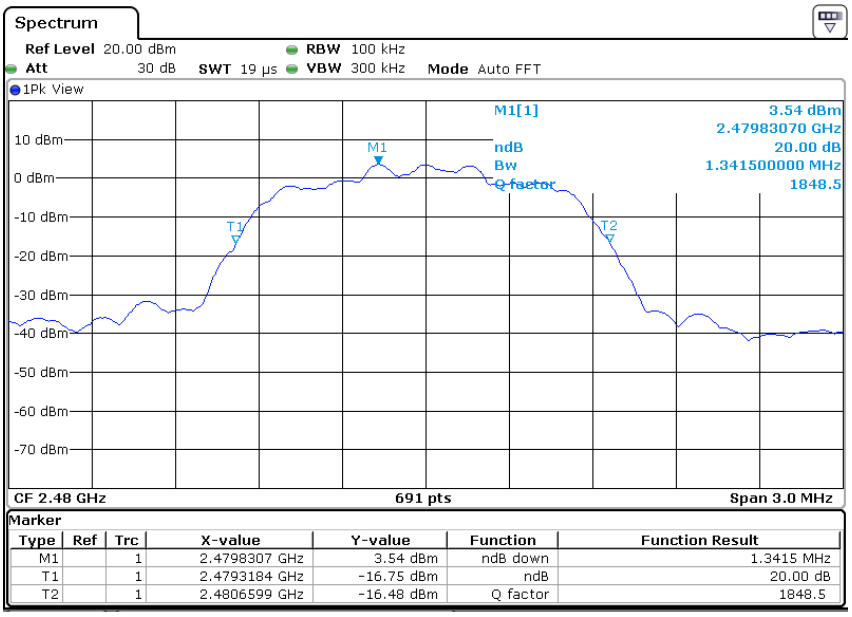
CH 00-3Mbps



CH 39-3Mbps



CH 78-3Mbps



6.5 Carrier Frequencies Separated

6.5.1 Applied procedures / Limit

15.247(a) (1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

6.5.2 Test procedure

(1) Connected the antenna port to the Spectrum Analyzer, set the Spectrum Analyzer as Span = wide enough to capture the peaks of two adjacent channels, Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span, Video (or Average) Bandwidth (VBW) ≥ RBW Sweep = auto, Detector function = peak, Trace = max hold

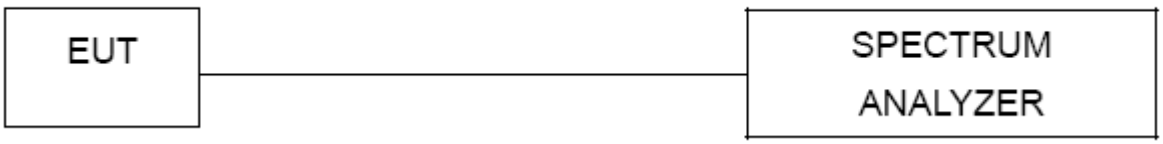
(2) The EUT should be transmitting at its maximum data rate. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

(3) The above procedure shall be repeated at the lowest, the middle, and the highest frequency of the stated frequency range with modulated mode. also shall be performed at different modes of operation.

6.5.3 Deviation from standard

No deviation.

6.5.4 Test setup



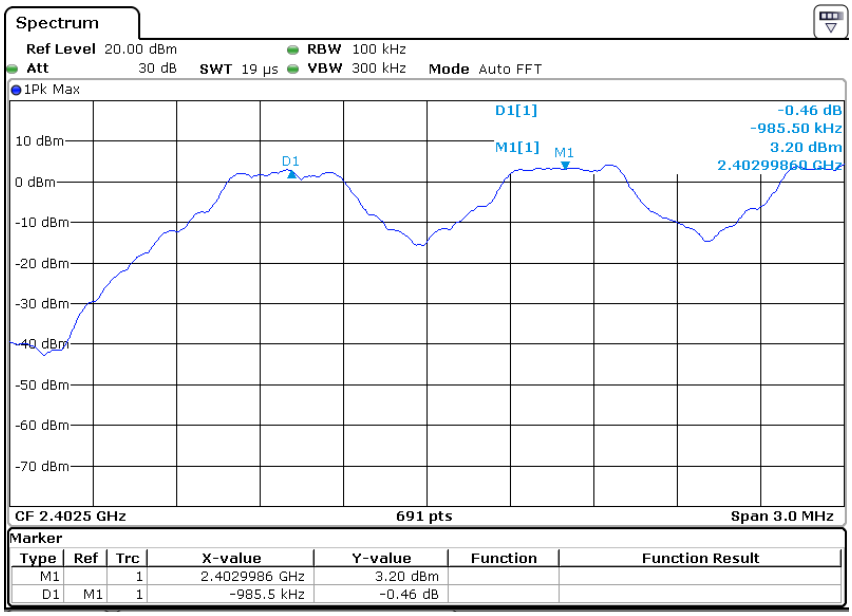
6.5.5 Test results

EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1010 hPa	Test Power ：	DC 3.7V
Test Mode ：	TX 1Mbps/ 3Mbps		

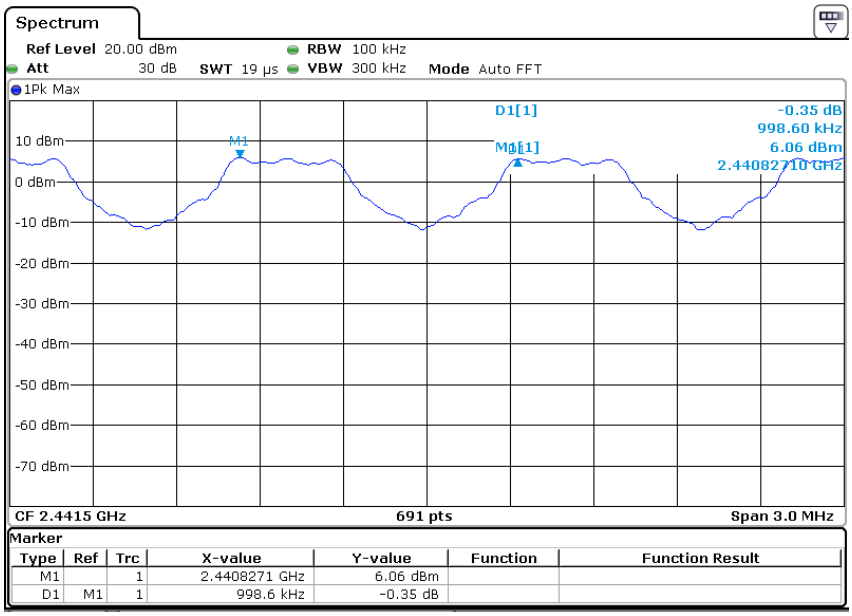
Channel		Channel frenqucy (MHz)	Channel Separation (kHz)	Conclusion
1Mbps	Low	2402	985.5	Pass
	Middle	2441	998.6	Pass
	Highest	2480	994.2	Pass
3Mbps	Low	2402	1002.9	Pass
	Middle	2441	1007.2	Pass
	Highest	2480	1011.6	Pass

Ch. Separation >2/3(20dB bandwidth)

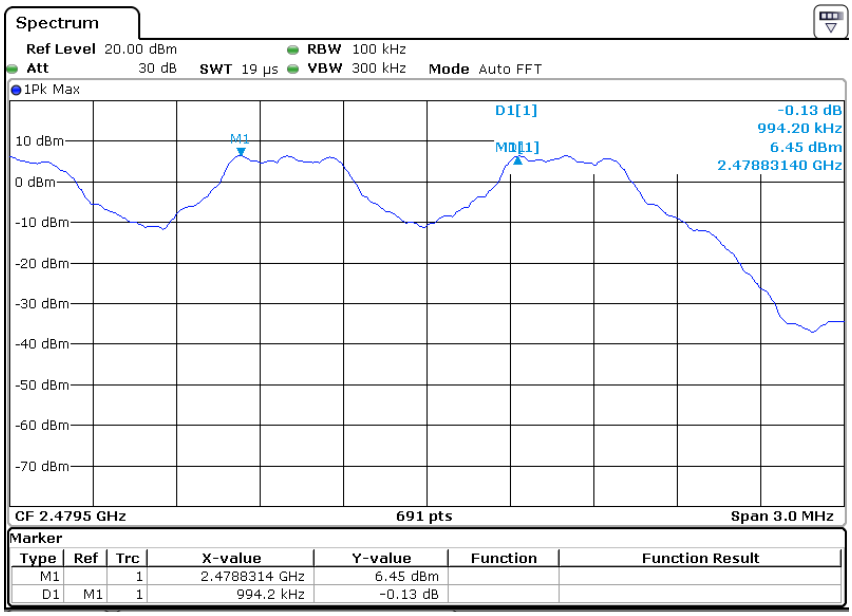
CH 00-1Mbps



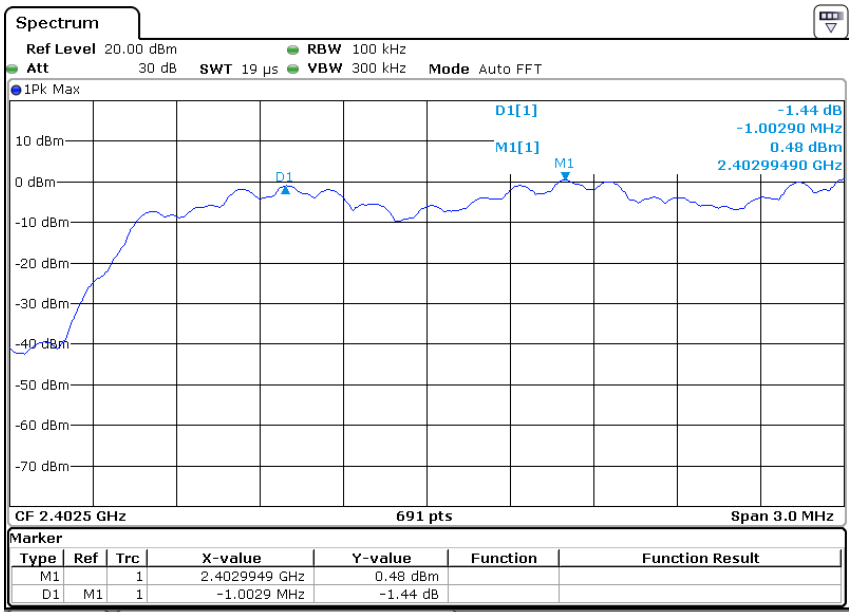
CH 39-1Mbps



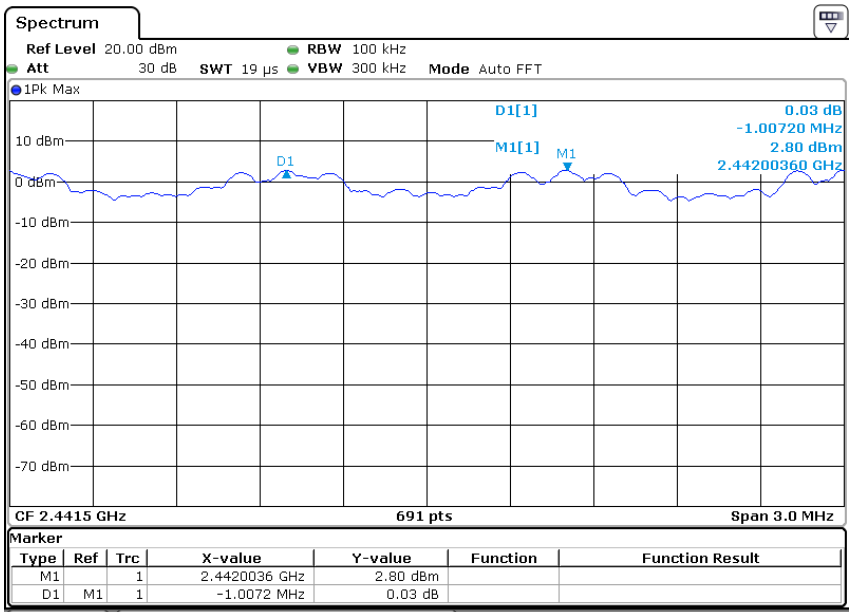
CH 78-1Mbps



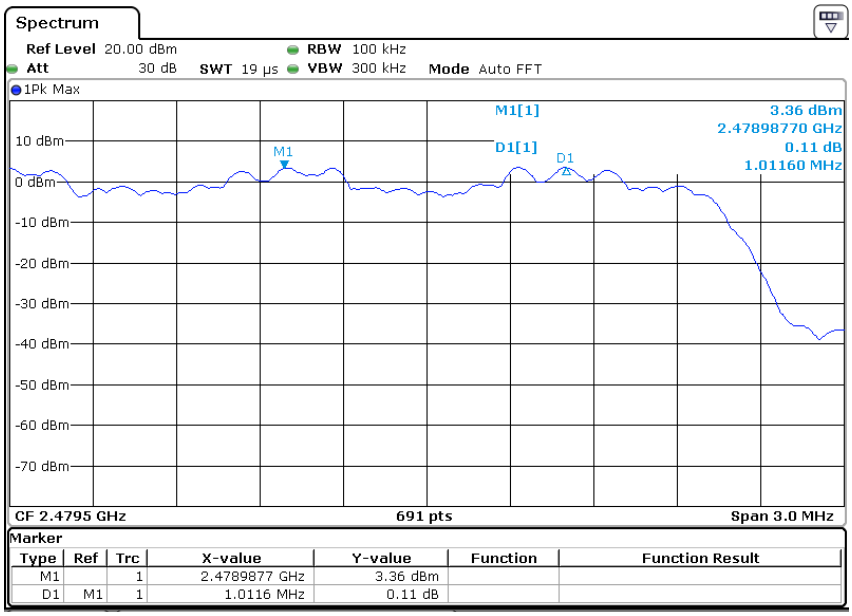
CH 00-3Mbps



CH 39-3Mbps



CH 78-3Mbps



6.6 Hopping Channel Number

6.6.1 Applied procedures / Limit

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.

6.6.2 Test procedure

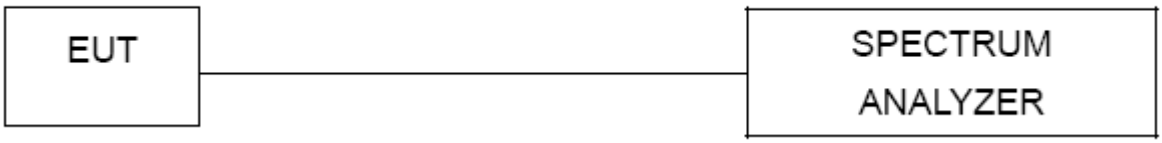
(1) Connected the antenna port to the Spectrum Analyzer , set the Spectrum Analyzer as Span = the frequency band of operation, RBW ≥ 1% of the span, VBW ≥ RBW Sweep = auto Detector function = peak, Trace = max hold

(2) The EUT should be have its hopping function enabled. Maxhold and record hopping channels It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

6.6.3 Deviation from standard

No deviation.

6.6.4 Test setup

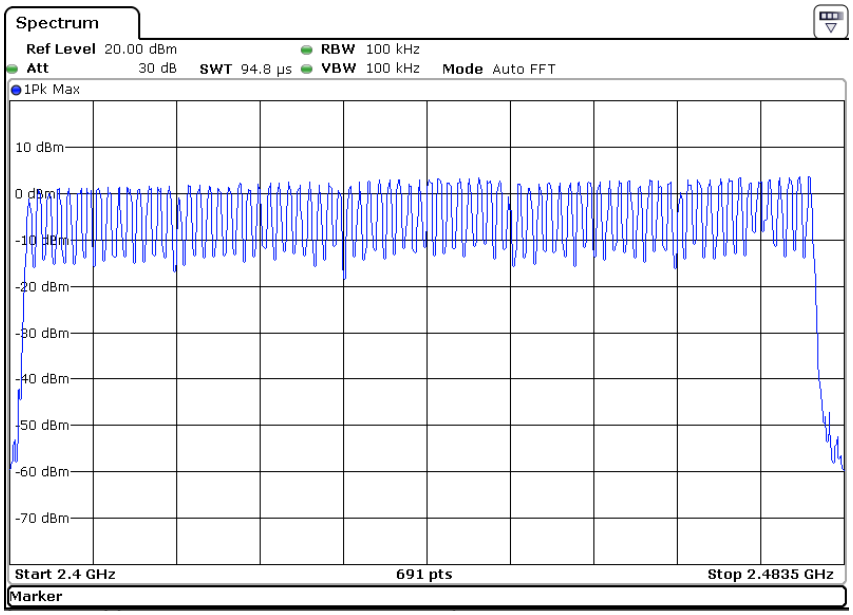


6.6.5 Test result

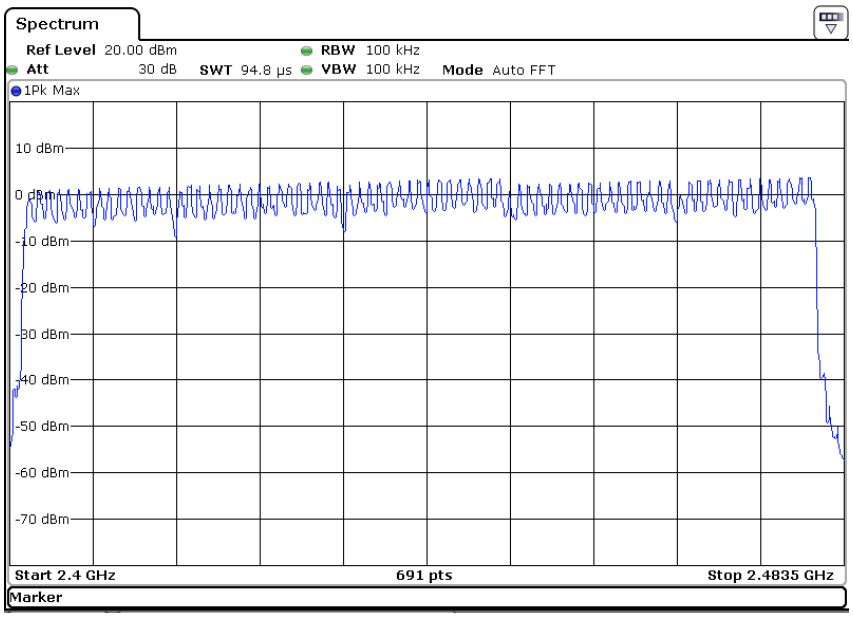
Hopping Channel Number result		
Operating Mode: 1Mbps/ 3Mbps Mode	Test date:	
Result	Limit	Conclusion
79	15	Pass

EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1010 hPa	Test Power ：	DC 3.7V
Test Mode ：	TX 1Mbps/ 3Mbps		

1Mbps



3Mbps



6.7 Dwell time

6.7.1 Applied procedures / Limit

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.

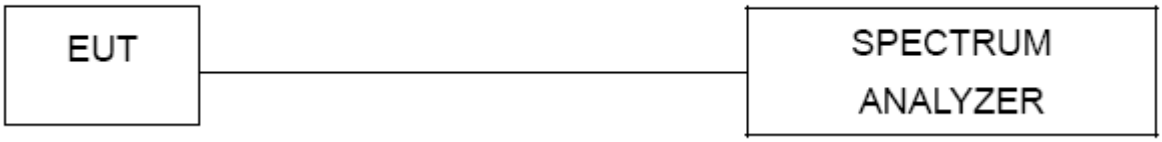
6.7.2 Test procedure

(1) Place the EUT on the table in the chamber or connect the antenna port of the EUT to spectrum analyzer and set it in transmitting mode.
(2) Set RBW of spectrum analyzer to 1MHz, VBW ≥ RBW
(3) Use a 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 span.
(6) Measure the maximum time duration of one single pulse.
(7) Set the EUT for DH5, DH3 and DH1 packet transmitting.
(8) Measure the maximum time duration of one single pulse.
(9) A Period Time = 79*0.4=31.6 S
DH1 Time Slot: Reading * (1600/2)*31.6/79
DH3 Time Slot: Reading * (1600/4)*31.6/79
DH5 Time Slot: Reading * (1600/6)*31.6/79

6.7.3 Deviation from standard

No deviation.

6.7.4 Test setup

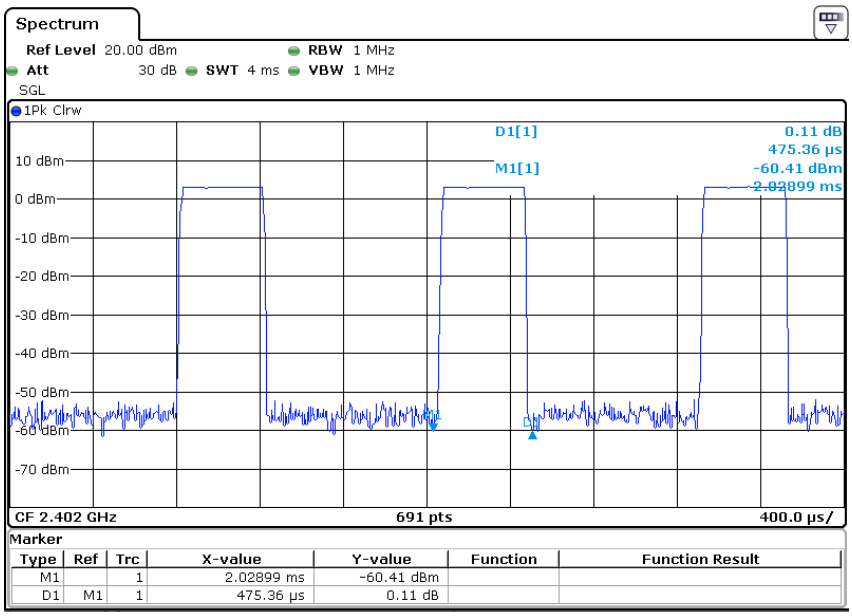


6.7.5 Test result

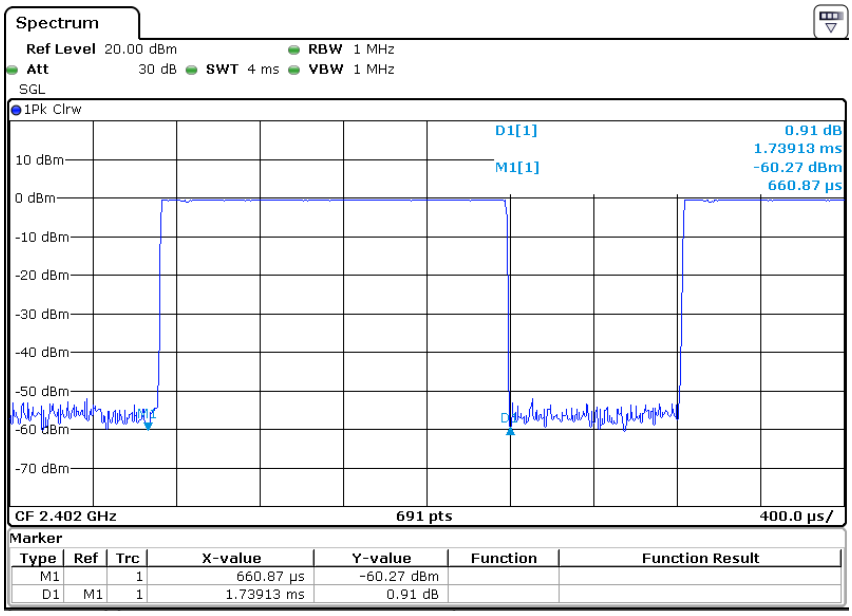
EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1010 hPa	Test Power ：	DC 3.7V
Test Mode ：	CH00-DH1/DH3/DH5 (1Mbps Mode)		

Data Packet	Frequency	Pulse Duration (ms)	Dwell Time (ms)	Limits (s)
DH1	2402 MHz	0.475	0.152	0.4000
DH3	2402 MHz	1.739	0.278	0.4000
DH5	2402 MHz	2.962	0.315	0.4000

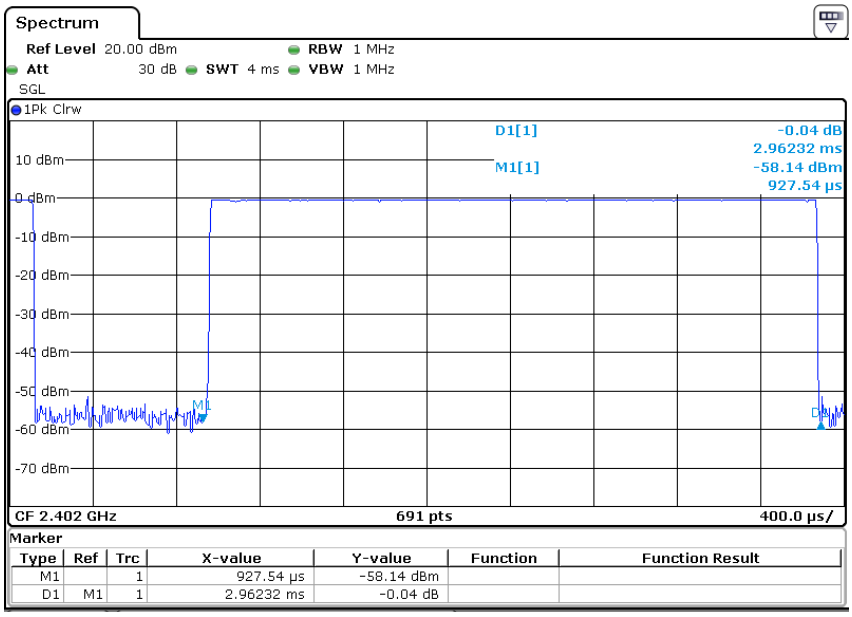
CH 00- DH1



CH 00- DH3



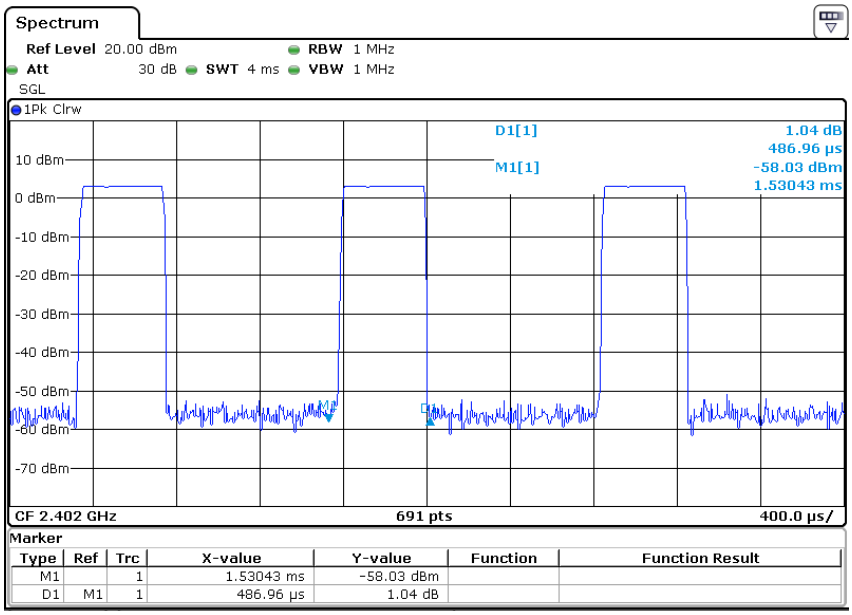
CH 00- DH5



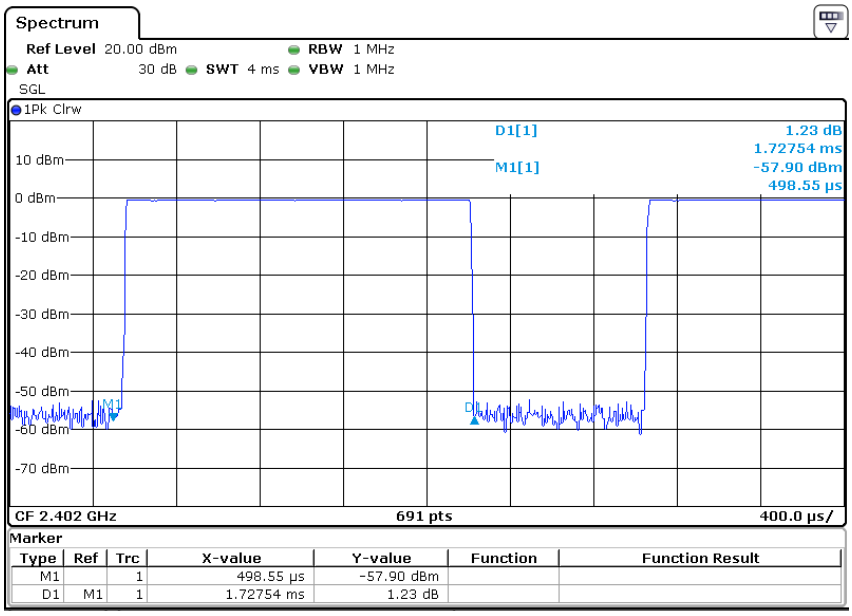
EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1010 hPa	Test Power ：	DC 3.7V
Test Mode ：	CH00-3DH1/3DH3/3DH5 (3Mbps Mode)		

Data Packet	Frequency	Pulse Duration (ms)	Dwell Time (ms)	Limits (s)
3DH1	2402 MHz	0.487	0.156	0.4000
3DH3	2402 MHz	1.728	0.276	0.4000
3DH5	2402 MHz	2.974	0.317	0.4000

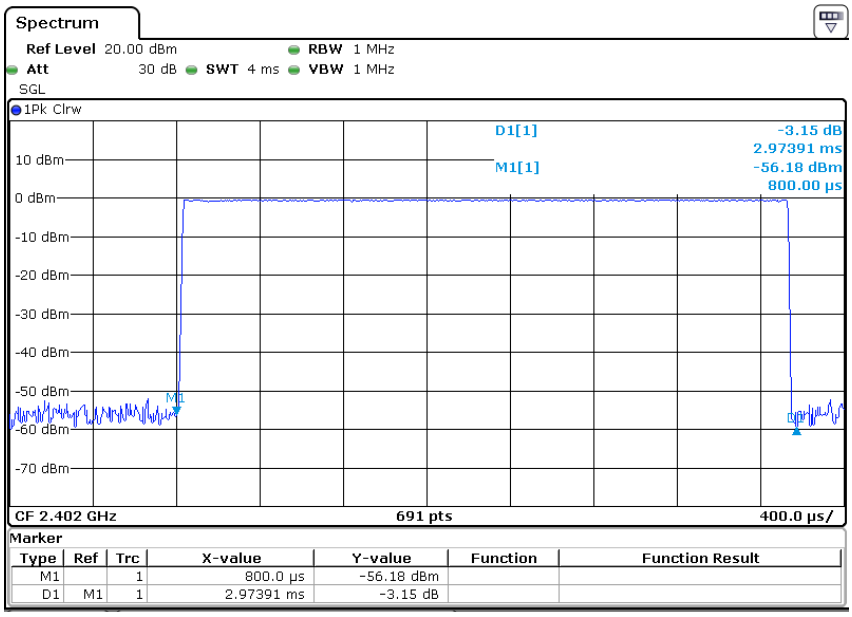
CH 00- 3DH1



CH 00- 3DH3



CH 00- 3DH5



6.8 Maximum Peak Output Power

6.8.1 Applied procedures / Limit

15.247(a) (1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
15.247(b) (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

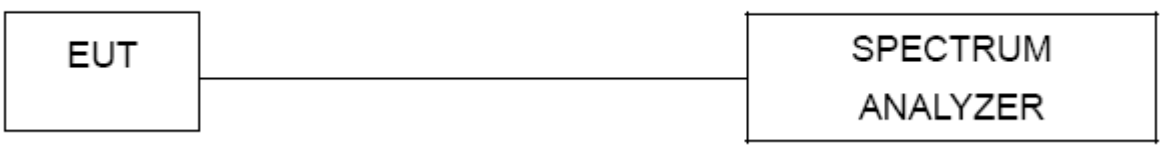
6.8.2 Test procedure

(1) Connected the antenna port to the Spectrum Analyzer, set the Spectrum Analyzer as Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured, VBW ≥ RBW, Sweep = auto Detector function = peak, Trace = max hold
(2) The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.
(3) The above procedure shall be repeated at the lowest, the middle, and the highest frequency of the stated frequency range with modulated mode. Also shall be performed at different modes of operation.

6.8.3 Deviation from standard

No deviation.

6.8.4 Test setup

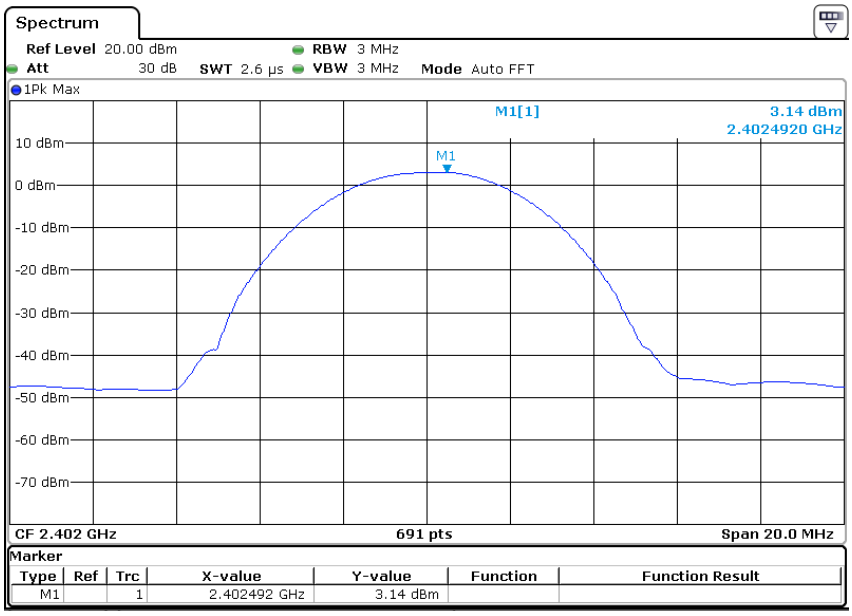


6.8.5 Test results

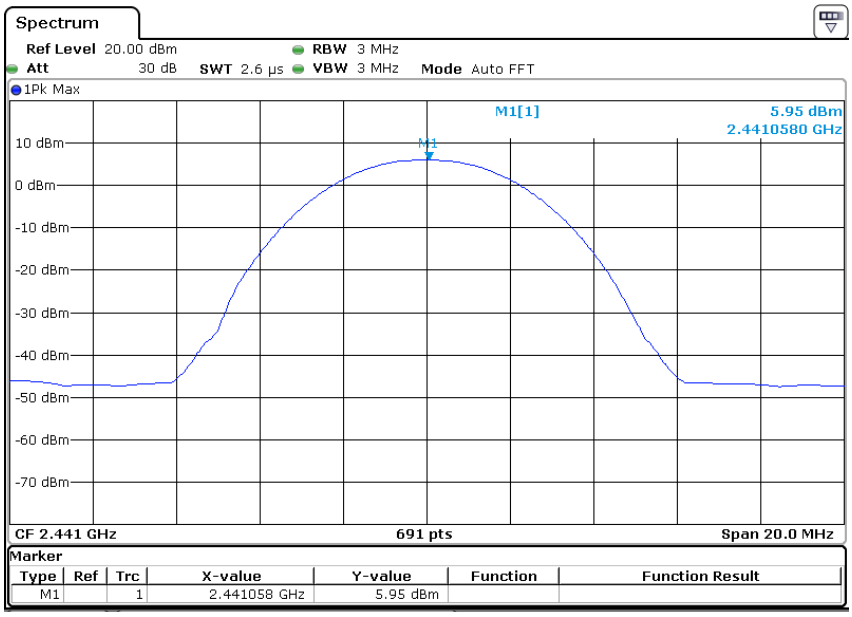
EUT：	Bluetooth crystal Speaker	Model Name ：	MF1547B
Temperature：	26 ℃	Relative Humidity：	60%
Pressure：	1010 hPa	Test Voltage ：	DC 3.7V
Test Mode ：	TX		
Note: All the data rates have be tested and the worst-case as the table below.			

Test Mode	Frequency	Peak Output Power (dBm)	Limit (dBm)	Result
Data rate 1Mbps	2402 MHz	3.14	21	Pass
	2441 MHz	5.95	21	Pass
	2480 MHz	3.52	21	Pass
Data rate 3Mbps	2402 MHz	0.63	21	Pass
	2441 MHz	3.98	21	Pass
	2480 MHz	4.57	21	Pass
Cable loss = 1.0 dBm				

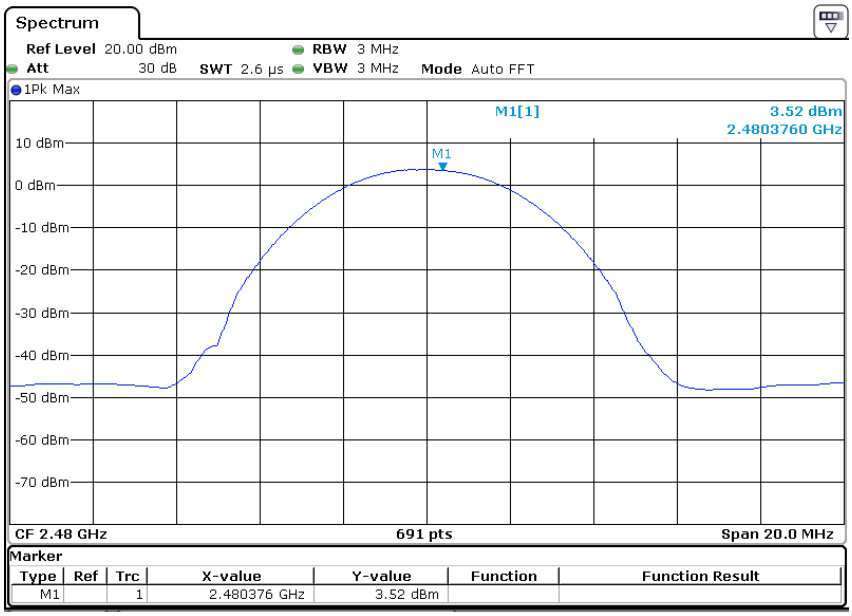
CH 00-1Mbps



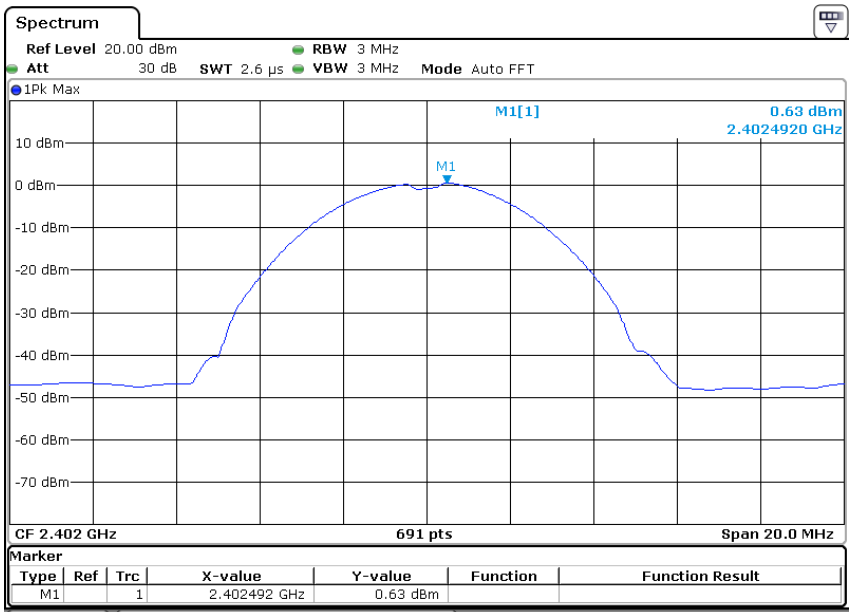
CH 39-1Mbps



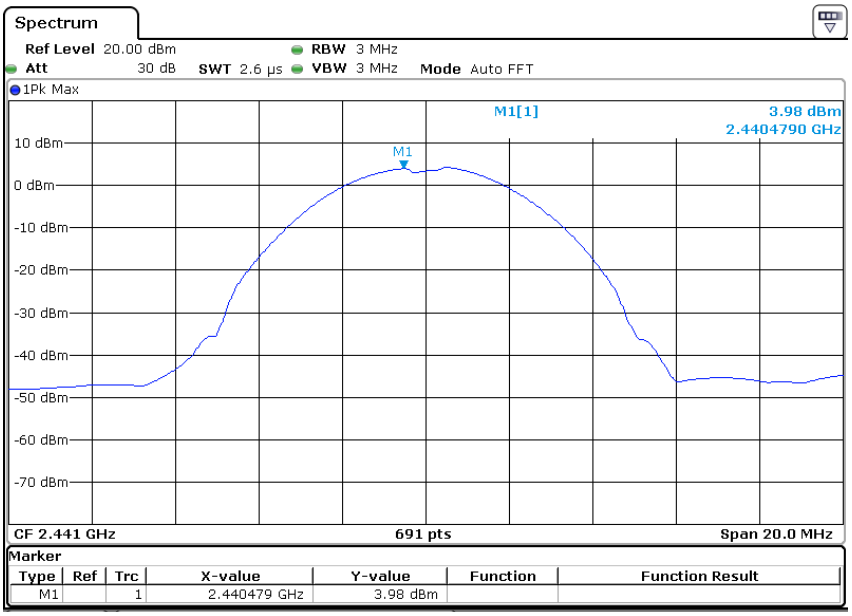
CH 78-1Mbps



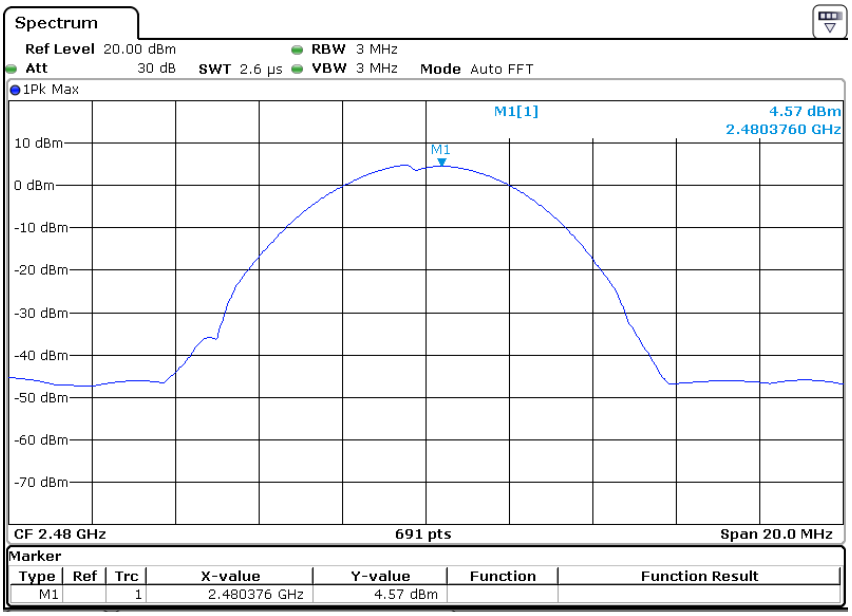
CH 00-3Mbps



CH 39-3Mbps



CH 78-3Mbps



6.9 Band edge

6.9.1 Applied procedures / Limit

15.247(d) 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

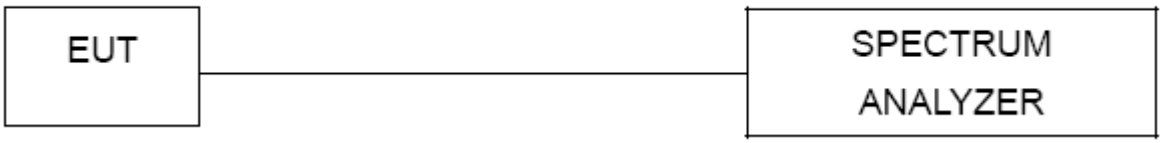
6.9.2 Test procedure

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation, RBW ≥ 1% of the span, VBW ≥ RBW, Sweep = auto,
Detector function = peak, Trace = max hold

6.9.3 Deviation from standard

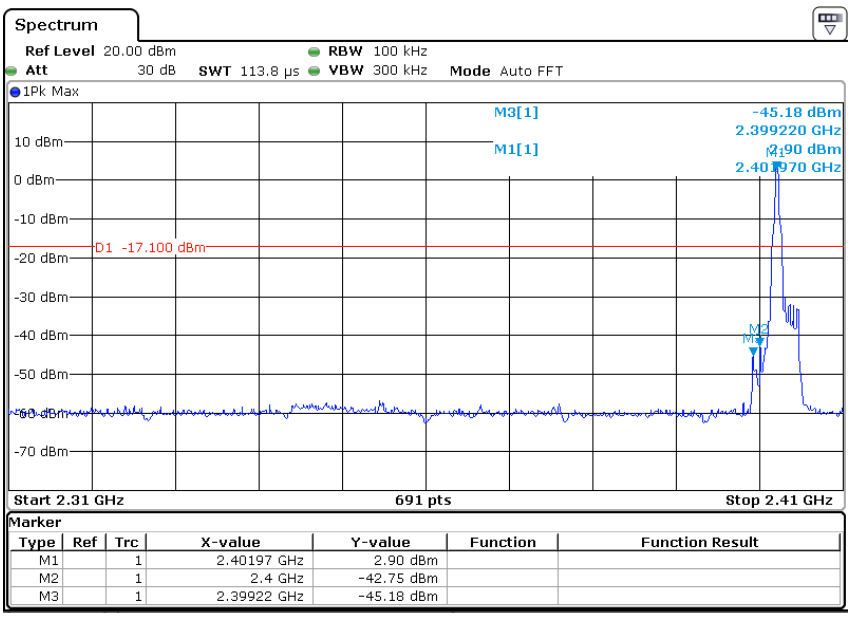
No deviation.

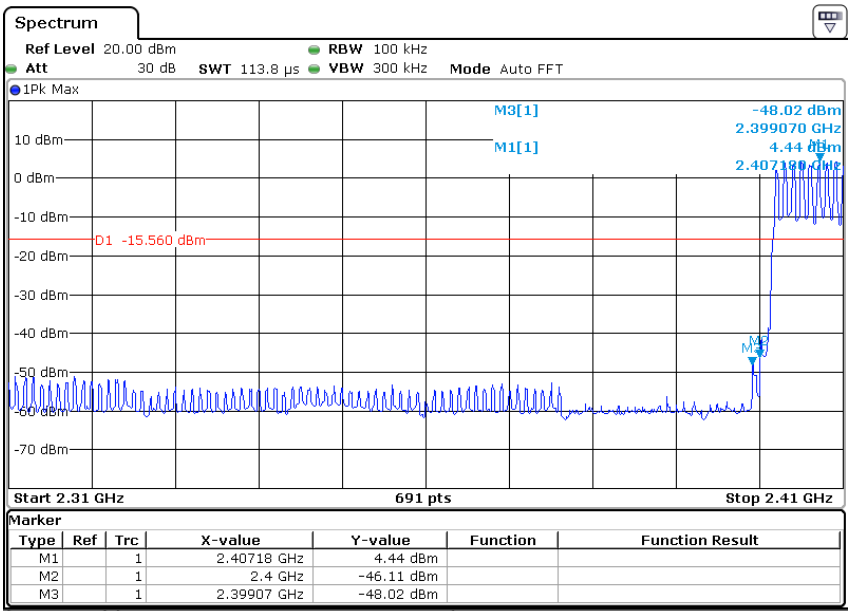
6.9.4 Test setup



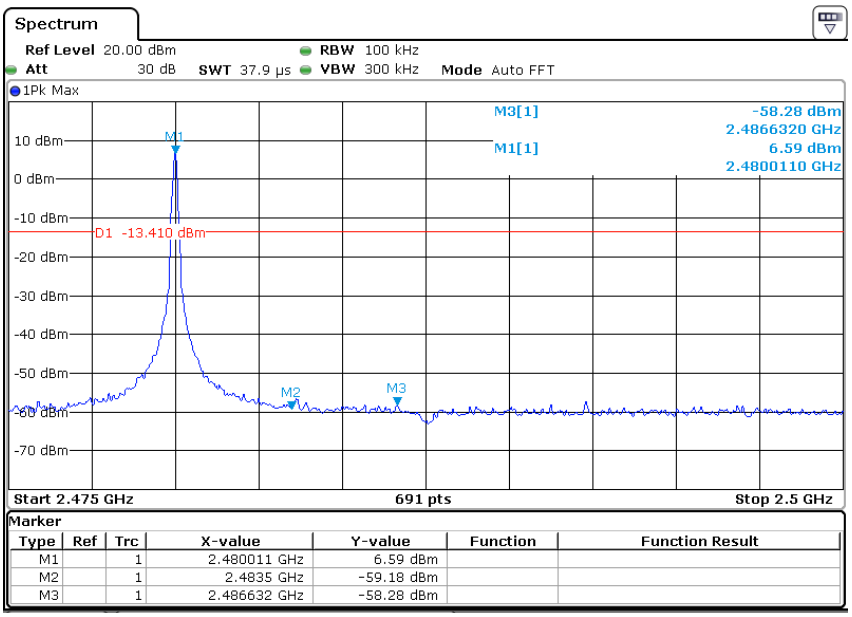
6.9.5 Test results

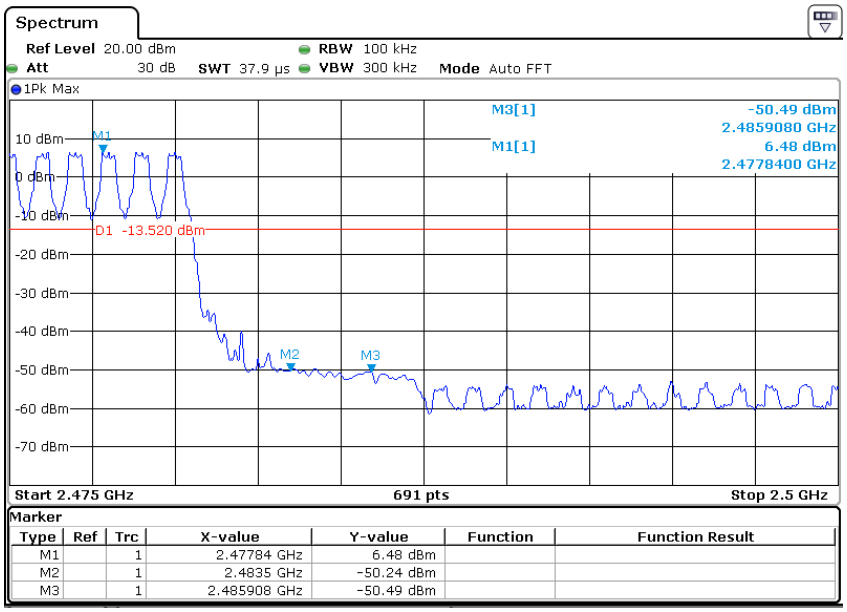
CH00 (Lower) Data rate 1Mbps



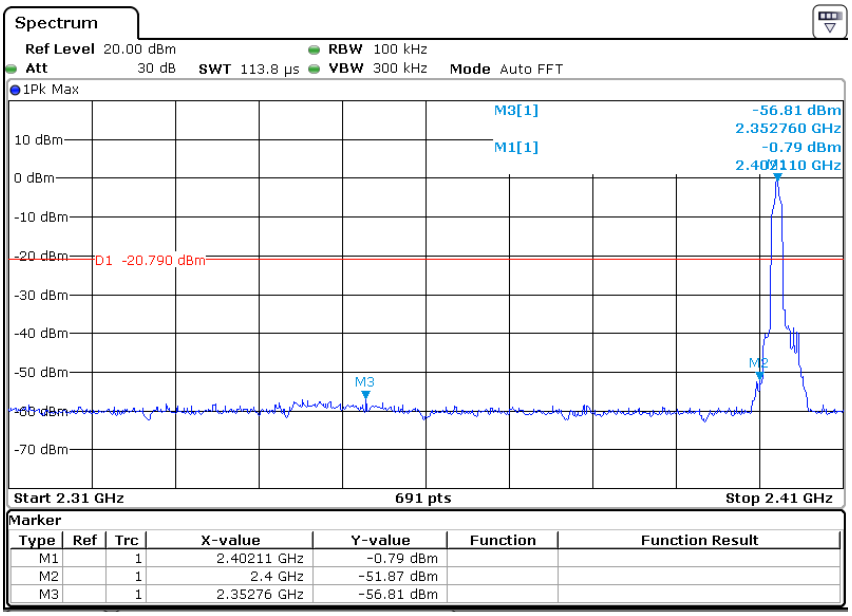


CH 78 (Upper) Data rate 1Mbps



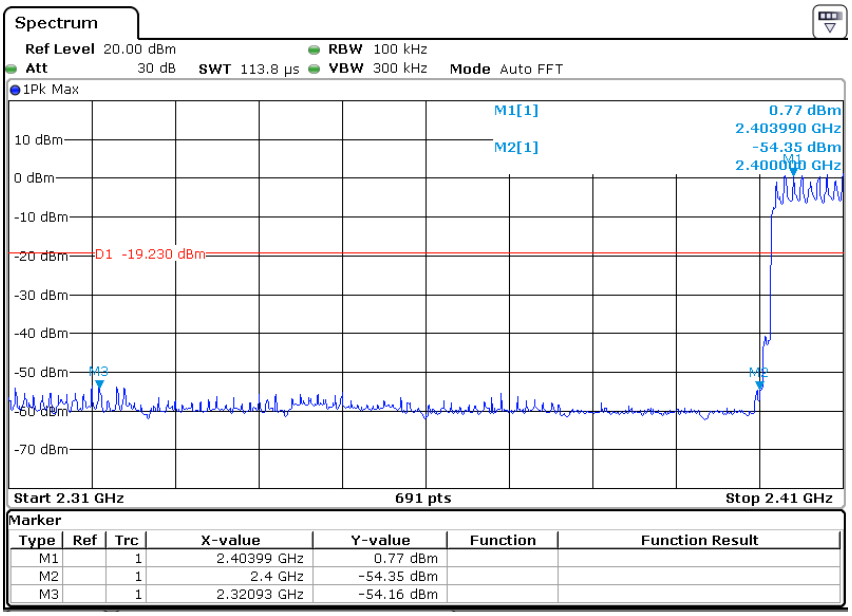


CH00 (Lower) Data rate 3Mbps



Marker

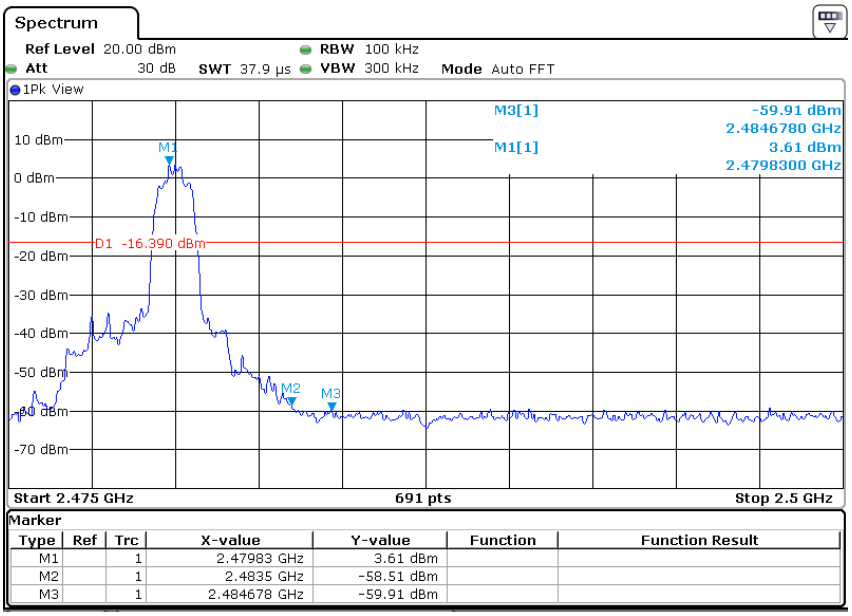
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40211 GHz	-0.79 dBm		
M2		1	2.4 GHz	-51.87 dBm		
M3		1	2.35276 GHz	-56.81 dBm		



Marker

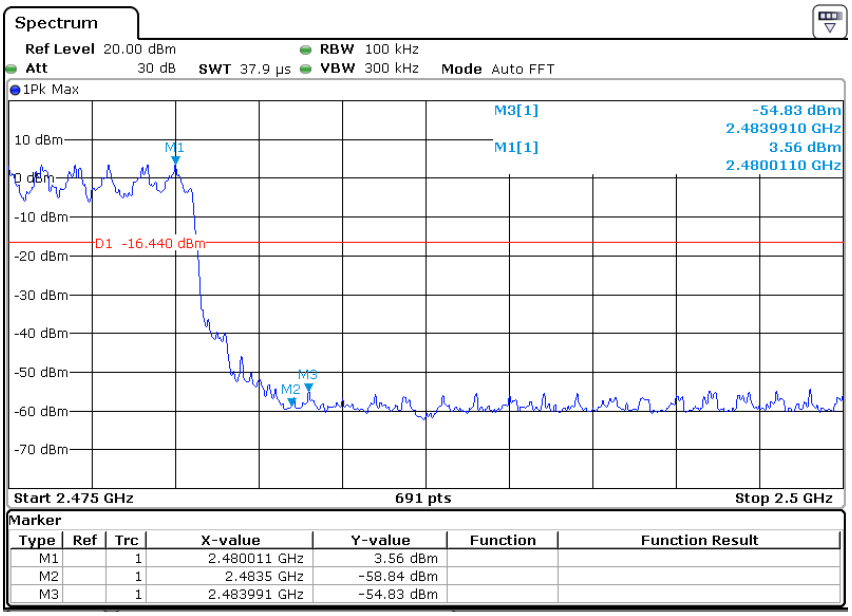
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40399 GHz	0.77 dBm		
M2		1	2.4 GHz	-54.35 dBm		
M3		1	2.32093 GHz	-54.16 dBm		

CH 78 (Upper) Data rate 3Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47983 GHz	3.61 dBm		
M2		1	2.4835 GHz	-58.51 dBm		
M3		1	2.484678 GHz	-59.91 dBm		



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480011 GHz	3.56 dBm		
M2		1	2.4835 GHz	-58.84 dBm		
M3		1	2.483991 GHz	-54.83 dBm		

6.10 Conducted Spurious Emissions

6.10.1 Applied procedures / Limit

15.247(d) 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

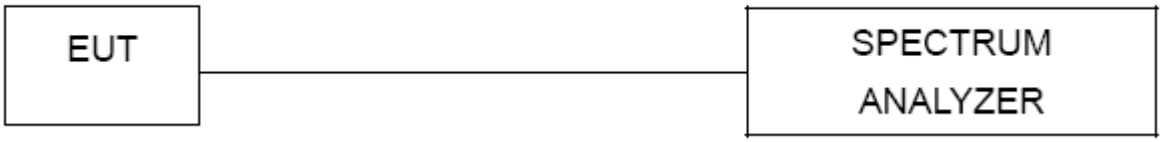
6.10.2 Test procedure

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span. RBW = 100 kHz
VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold
sweep points ≥ investigated frequency range/RBW.

6.10.3 Deviation from standard

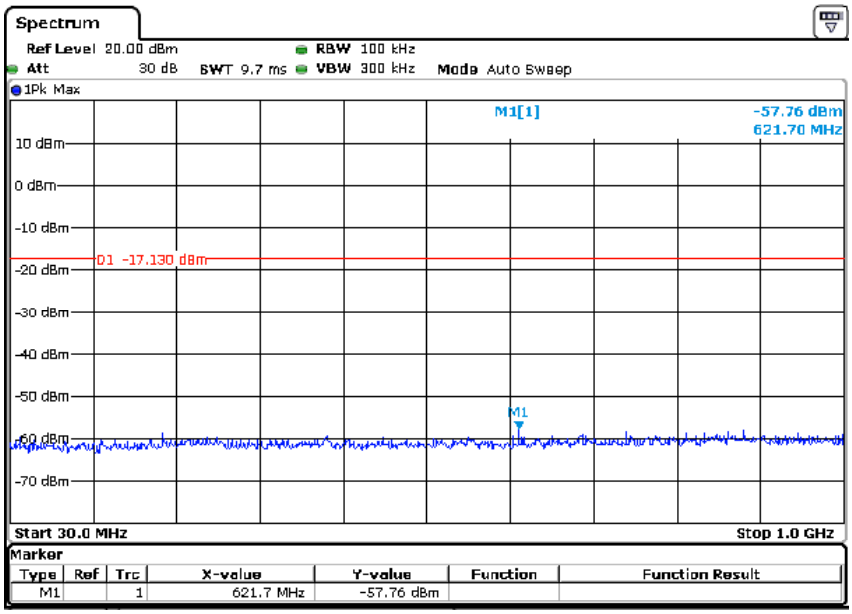
No deviation.

6.10.4 Test setup



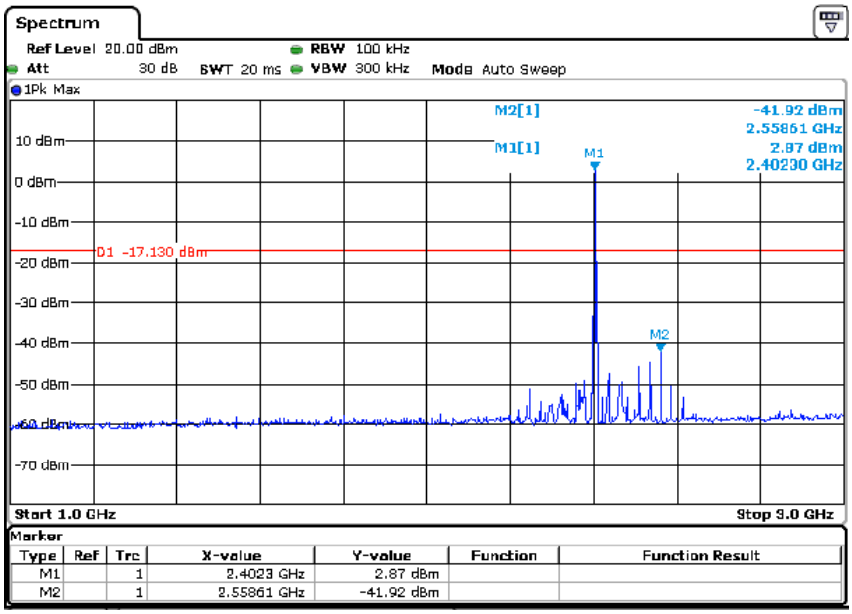
6.10.5Test results

CH00 Data rate 1Mbps



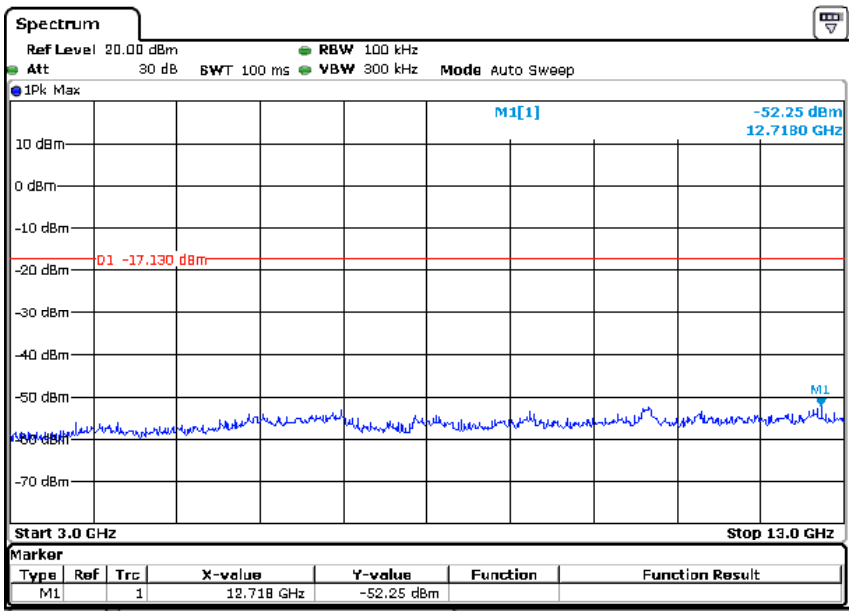
Note: Sweep Points=9700

CH00 Data rate 1Mbps



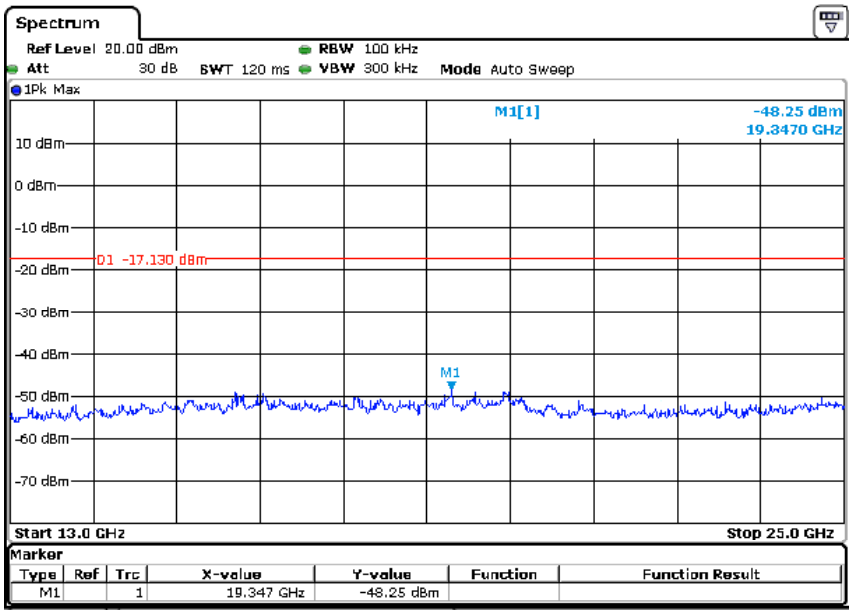
Note: Sweep Points=20000

CH00 Data rate 1Mbps



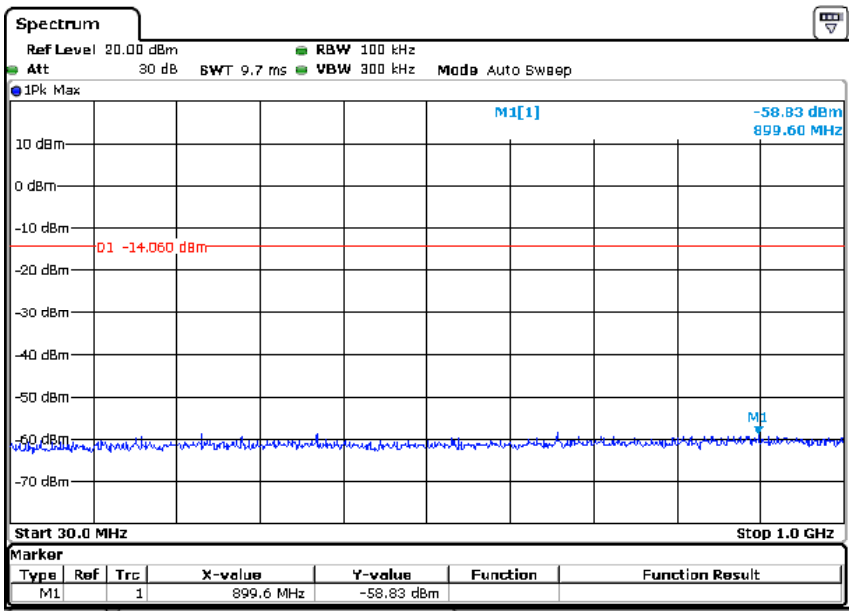
Note: Sweep Points=100000

CH00 Data rate 1Mbps



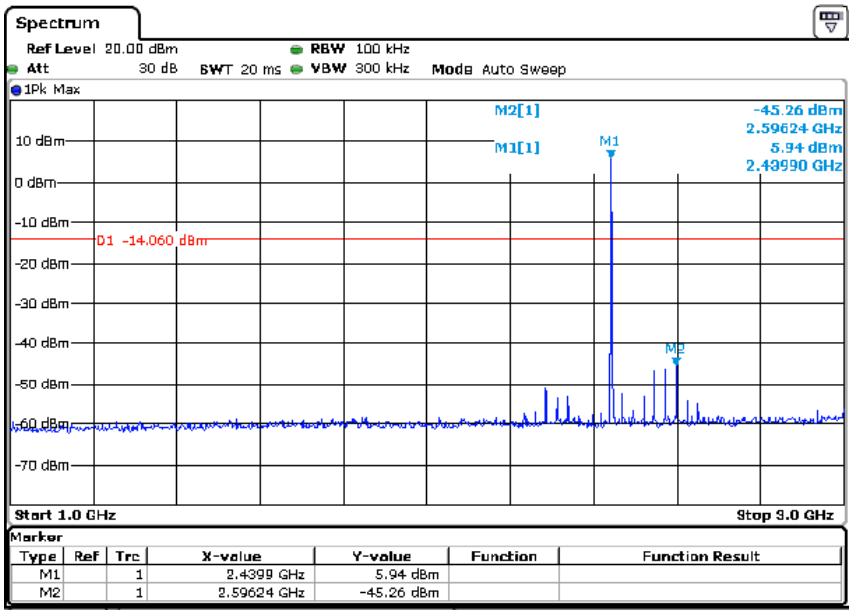
Note: Sweep Points=120000

CH39 Data rate 1Mbps



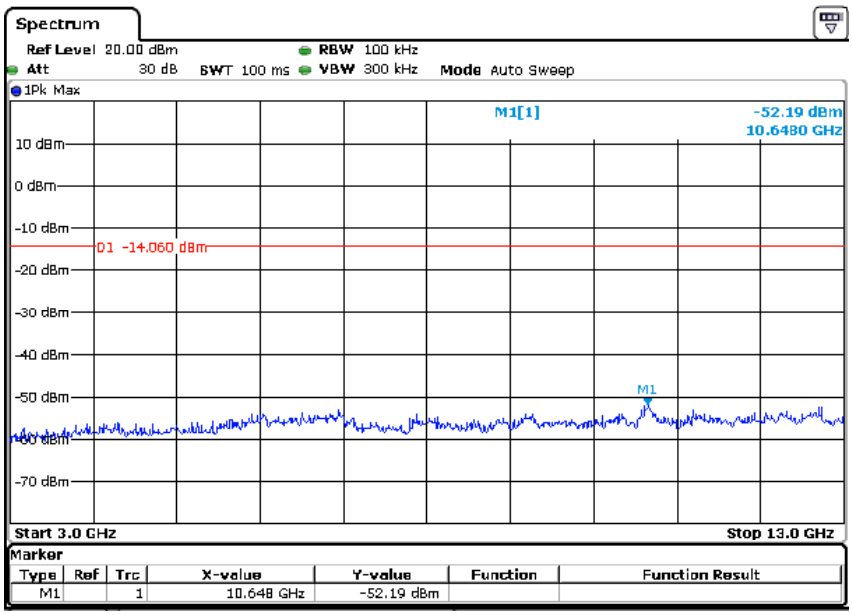
Note: Sweep Points=9700

CH39 Data rate 1Mbps



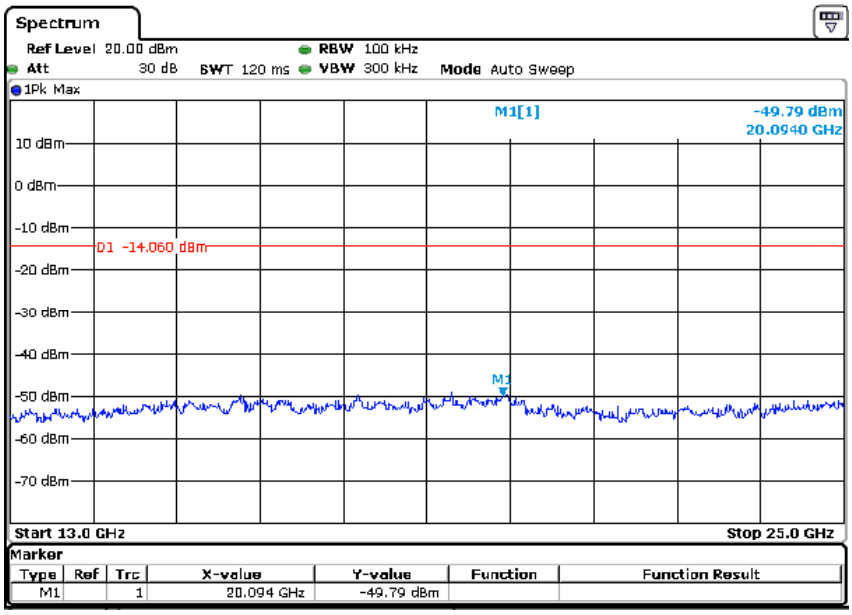
Note: Sweep Points=20000

CH39 Data rate 1Mbps



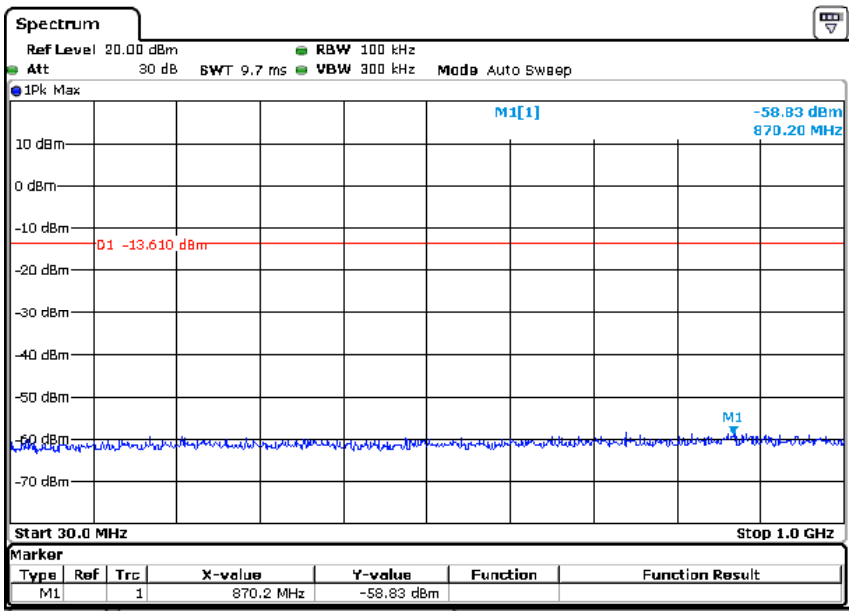
Note: Sweep Points=100000

CH39 Data rate 1Mbps



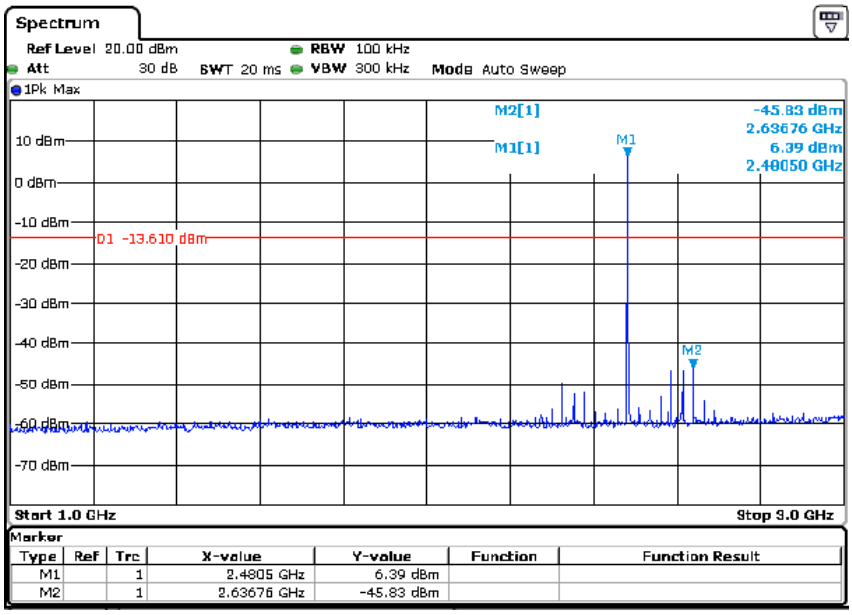
Note: Sweep Points=120000

CH78 Data rate 1Mbps



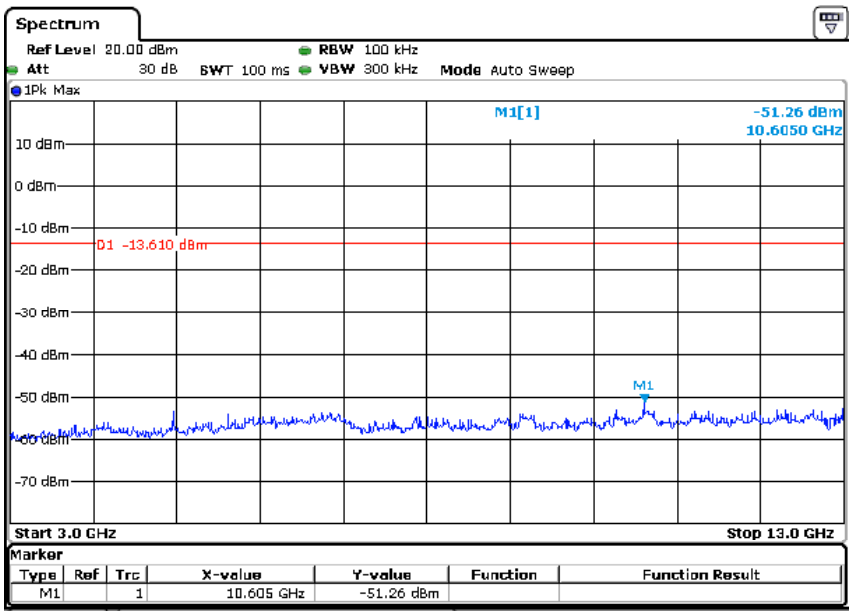
Note: Sweep Points=9700

CH78 Data rate 1Mbps



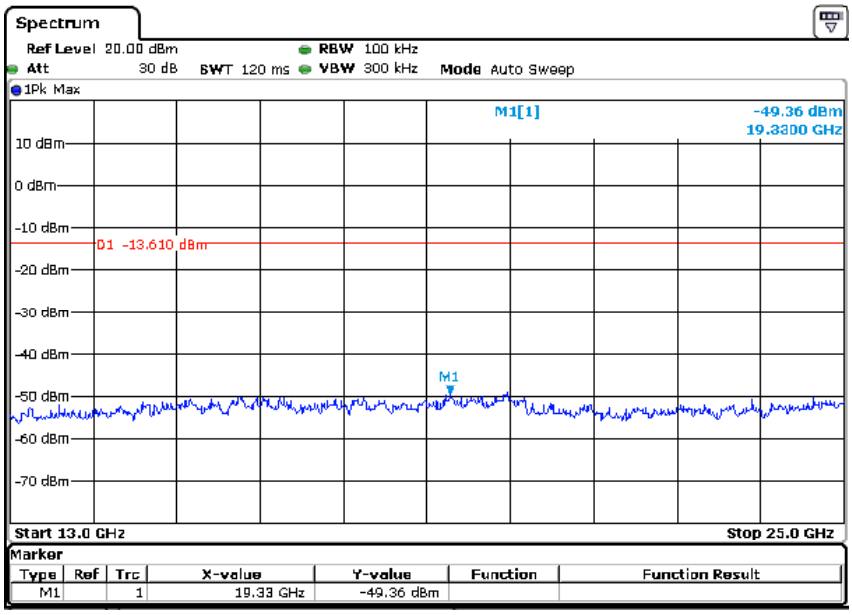
Note: Sweep Points=20000

CH78 Data rate 1Mbps



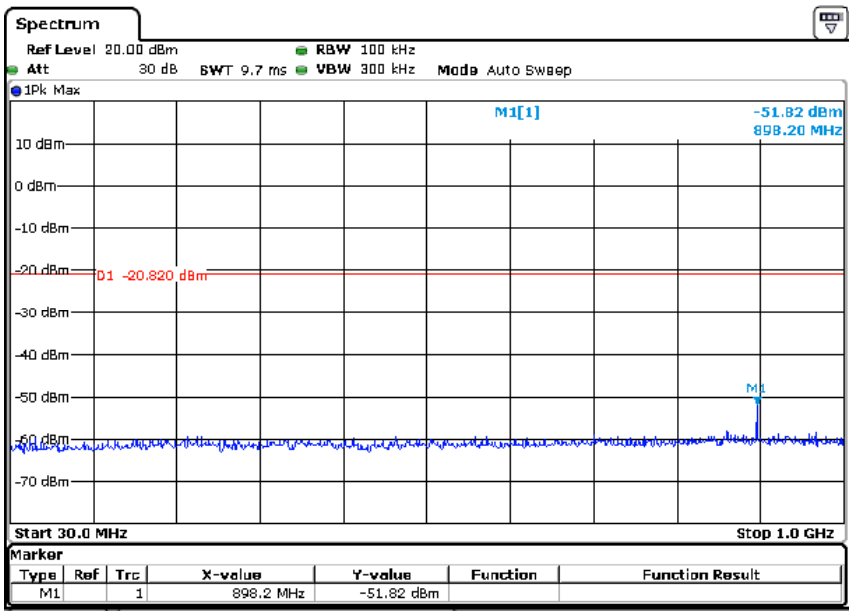
Note: Sweep Points=100000

CH78 Data rate 1Mbps



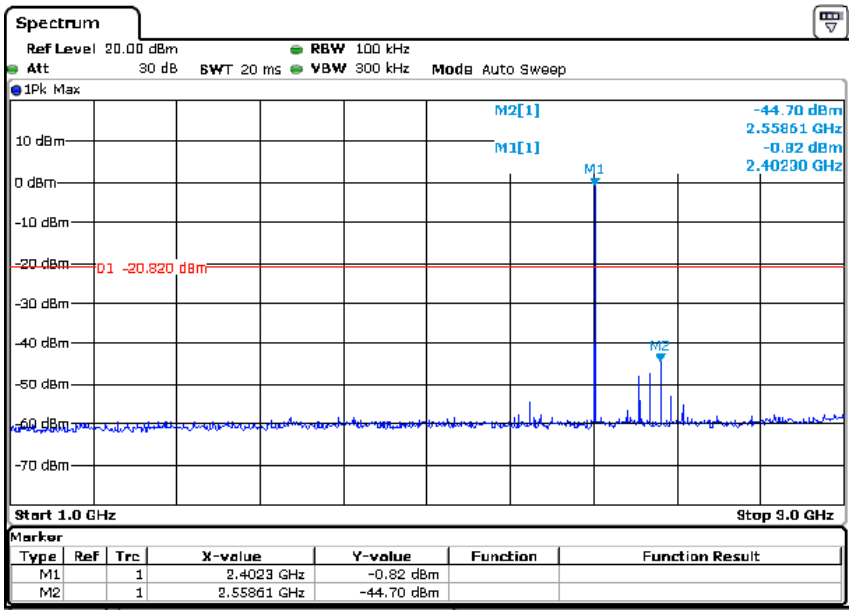
Note: Sweep Points=120000

CH00 Data rate 3Mbps



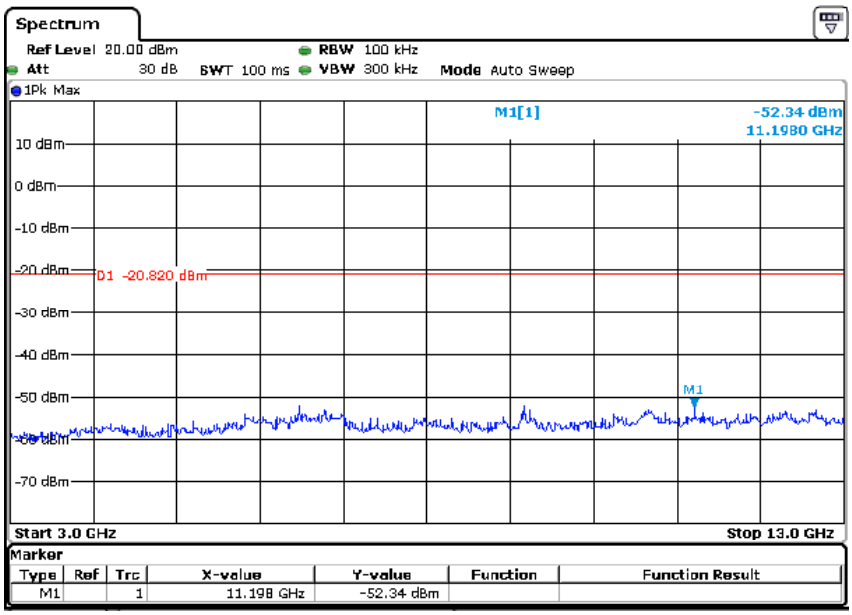
Note: Sweep Points=9700

CH00 Data rate 3Mbps



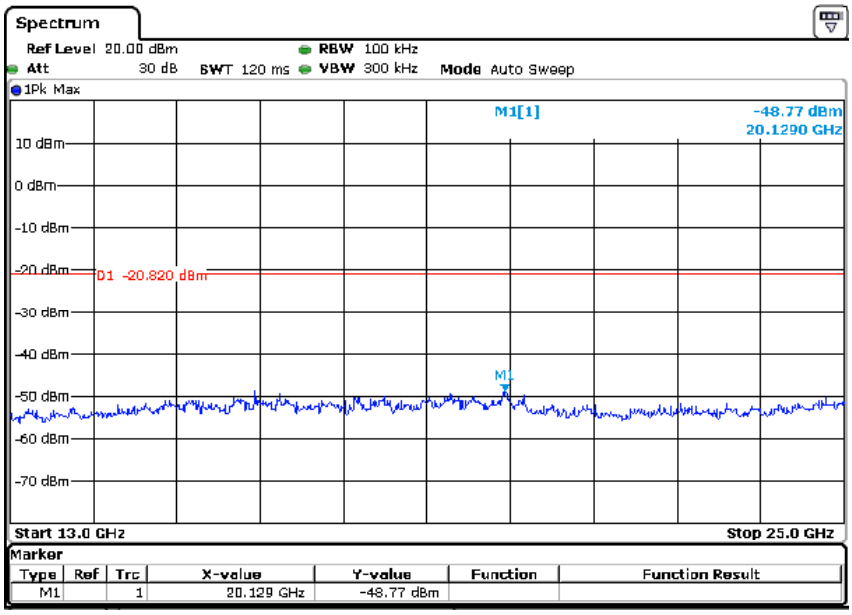
Note: Sweep Points=20000

CH00 Data rate 3Mbps



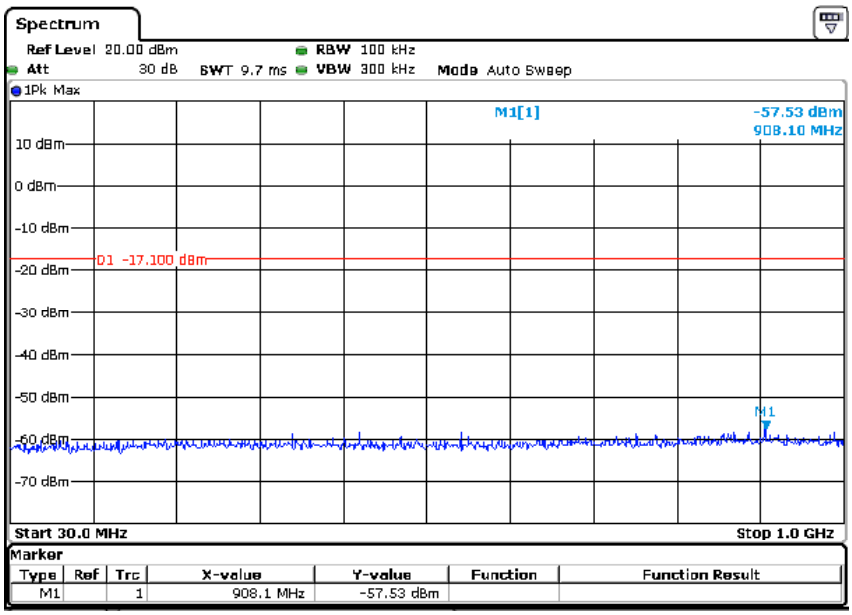
Note: Sweep Points=100000

CH00 Data rate 3Mbps



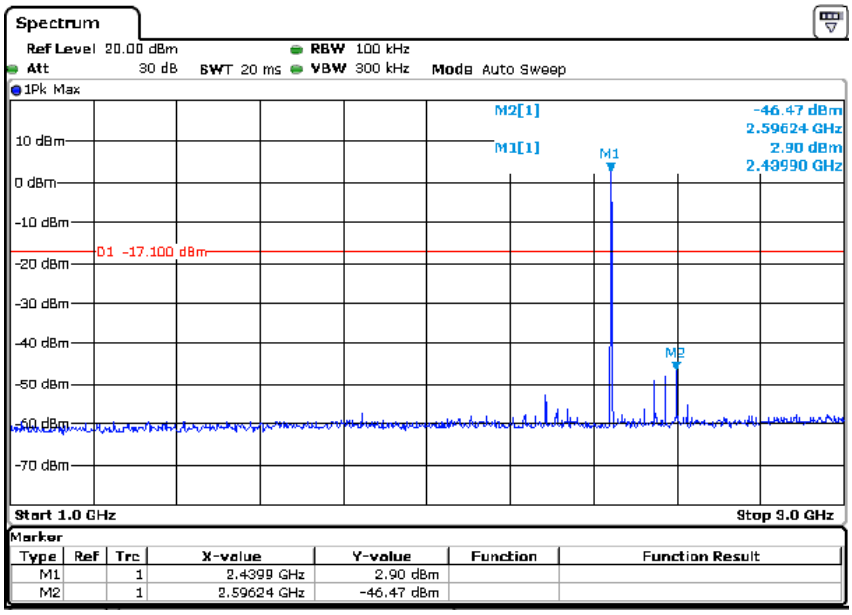
Note: Sweep Points=120000

CH39 Data rate 3Mbps



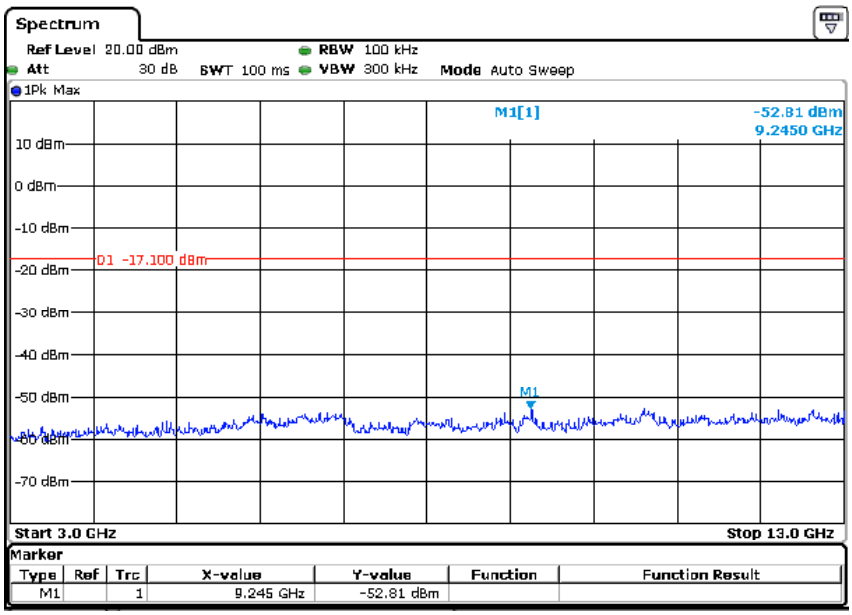
Note: Sweep Points=9700

CH39 Data rate 3Mbps



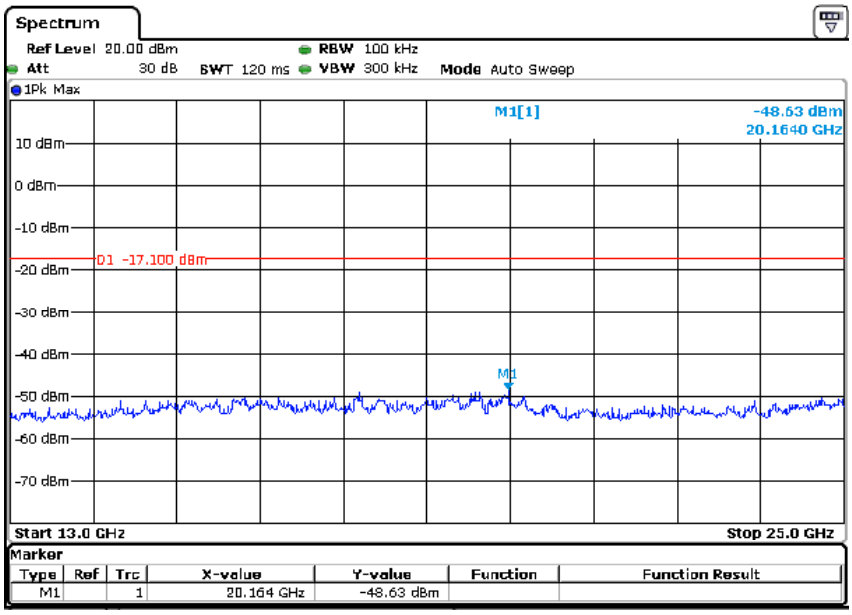
Note: Sweep Points=20000

CH39 Data rate 3Mbps



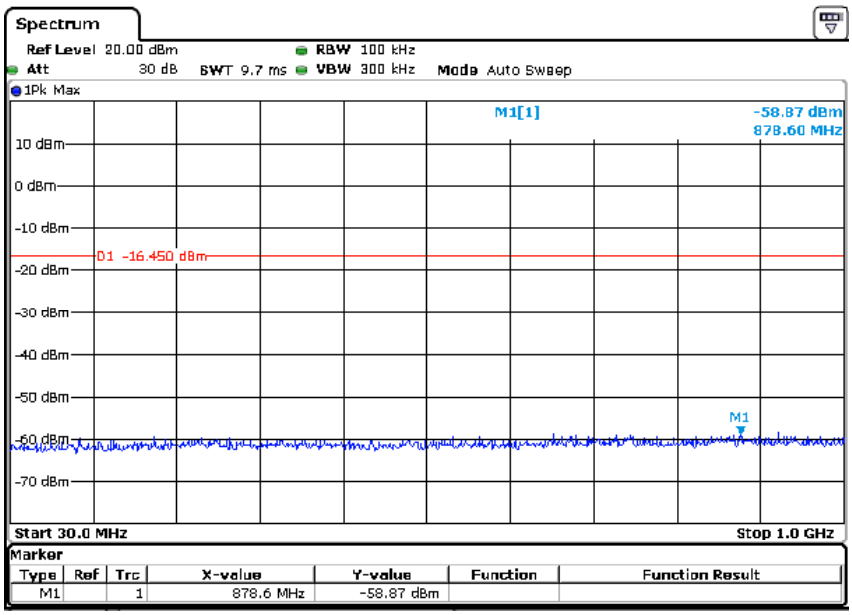
Note: Sweep Points=100000

CH39 Data rate 3Mbps



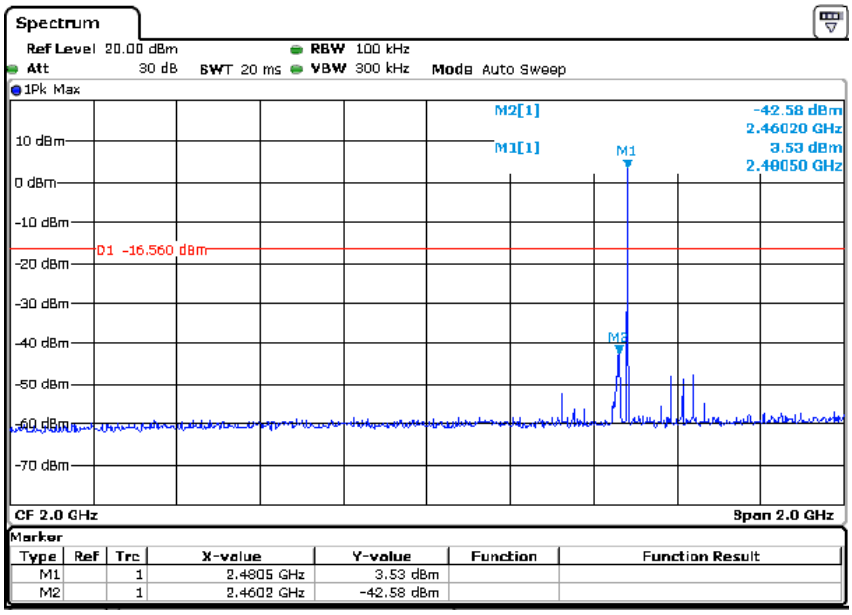
Note: Sweep Points=120000

CH78 Data rate 3Mbps



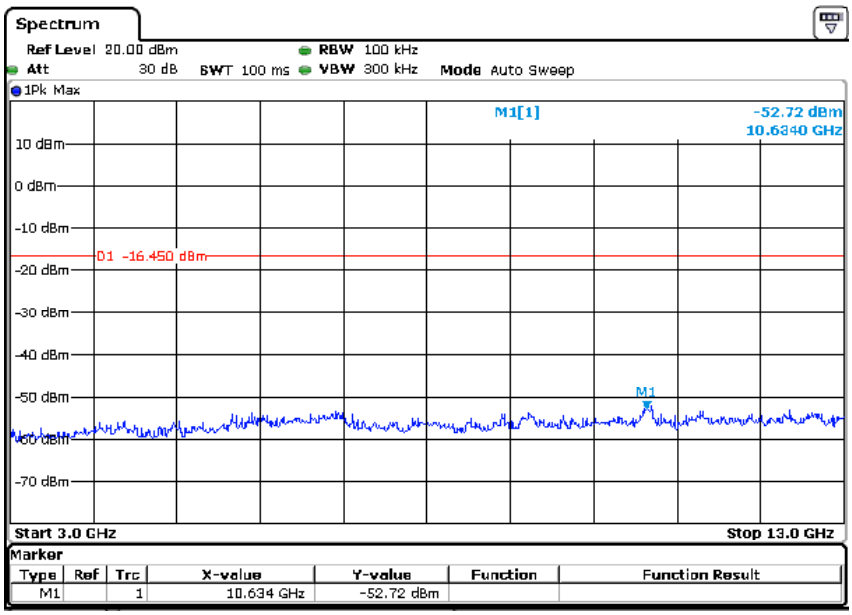
Note: Sweep Points=9700

CH78 Data rate 3Mbps



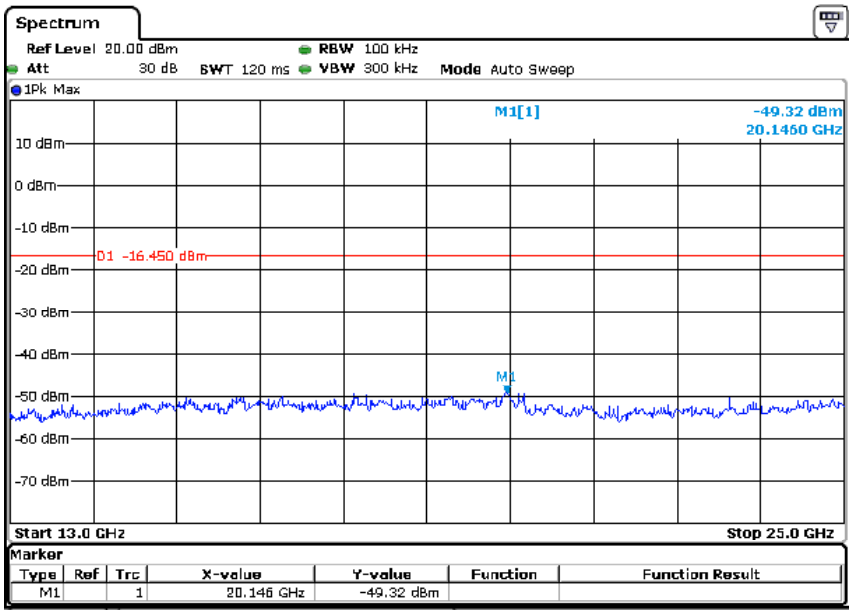
Note: Sweep Points=20000

CH78 Data rate 3Mbps



Note: Sweep Points=100000

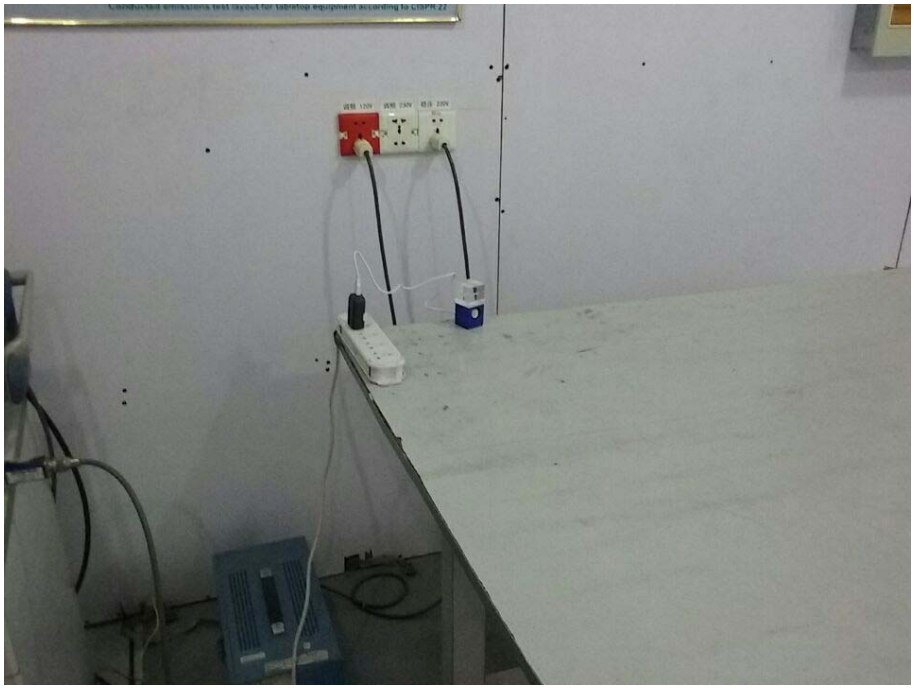
CH78 Data rate 3Mbps



Note: Sweep Points=120000

7 Test setup photo

CE TEST SETUP PHOTO



RE TEST SETUP PHOTO