FCC Test Report

Part 15 subpart C

Client Information:

Applicant: The Ketchum Group Inc., DBA Outdoor Tech

Applicant add.: 25231 Paseo De Alicia, Ste. 200, Laguna Beach, CA 90301, United States

Product Information:

Product Name: OT2800

Product description : BT SPEAKER

Model No.: TURTLE SHELL® 3.0

Derivative model No.: N/A

Brand Name: OUTDOOR TECH.

FCC ID: PGWOT2800

Standards:

CFR 47 FCC PART 15 SUBPART C:2016 section 15.247

Prepared By:

UL-CCIC Company Limited

Add. : Electronic Building, Parage Electronic Industrial Park, No. 8 Nanyun Er Road, Guangzhou Science Park, Guangzhou, 510663 China

Date of Receipt:	Jul. 01, 2016	Date of Test:	Jul. 01~ Jul. 08, 2016
Date of Issue:	Jul. 08, 2016	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: Lambert Tang **Approved by:** Richard Li

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2 Test Summary

2.1 Compliance with FCC Part 15 subpart C

Test	Test Requirement	Standard Paragraph	Result
Antenna Requirement	FCC Part 15 C:2016	Section 15.247(c)	**PASS**
Conduction Emissions	FCC Part 15 C:2016	Section 15.207(a)	**PASS**
Radiated Emissions	FCC Part 15 C:2016	Section 15.247(d)	**PASS**
Carrier Frequencies Separated	FCC Part 15 C:2016	Section 15.247(a)(1)	**PASS**
Hopping Channel Number	FCC Part 15 C:2016	Section 15.247(a)(1) (iii)	**PASS**
Dwell Time	FCC Part 15 C:2016	Section 15.247(a)(1) (iii)	**PASS**
Maximum Peak Output Power	FCC Part 15 C:2016	Section 15.247(b)	**PASS**
Band edge	FCC Part 15 C:2016	Section 15.247(d)	**PASS**
Conducted Spurious Emissions	FCC Part 15 C:2016	Section 15.247(d)	**PASS**

Note:

	(1)Reference to the FCC Public Notice ANSI C63.10:2013.
	(2)The product support for Bluetooth basic rate / EDR and low energy connections Bluetooth 4.2 Dual-mode, this report is basic rate / EDR connection test mode, for low energy connection please refers to the report number 4787483744-2.

2.2 Test Location

All tests were performed at:

Dongguan Yaxu (AiT) Technology Limited
No.22, Jinqianling Third Street, Jitigang, Huangjiang,Dongguan, Guangdong, China
Tel.: +86.769.82020499 Fax.: +86.769.82020495

2.3 Measurement Uncertainty

All measurements involve certain levels of uncertainties, the maximum value of the uncertainty as below:

No.	Item	Uncertainty
1	Conducted Emission Test	1.20dB
2	Radiated Emission Test	3.30dB
3	RF power,conducted	0.16dB
4	RF power density,conducted	0.24dB
5	Spurious emissions,conducted	0.21dB
6	All emissions,radiated(<1G)	4.68dB
7	All emissions,radiated(>1G)	4.89dB

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

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. 12, 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.

3.1 Deviation from standard

None

3.2 Abnormalities from standard conditions

None

4 General Information

4.1 General Description of EUT

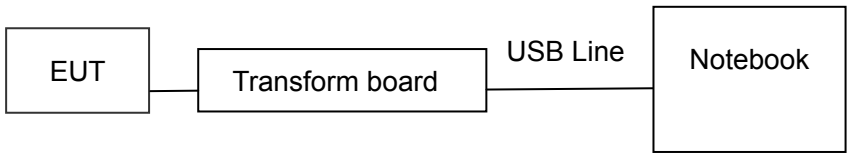
Manufacturer:	The Ketchum Group Inc., DBA Outdoor Tech
Manufacturer Address:	25231 Paseo De Alicia, Ste. 200, Laguna Beach, CA 90301, United States
EUT Name:	OT2800
Model No:	TURTLE SHELL® 3.0
Brand Name:	N/A
Serial No:	N/A
Operation frequency:	2402 MHz to 2480 MHz
NUMBER OF CHANNEL:	79
Modulation Technology:	GFSK, π/4-DQPSK, 8DPSK(1/2/3Mbps)
Bluetooth version:	BT4.2 Dual-mode
H/W No.:	V0.2
S/W No.:	00
Antenna Type:	PCB antenna
Antenna Gain:	maximum 0dBi
Power Supply Range:	AC 120V/60Hz from adapter or DC 3.7V from battery
Power Supply:	The same as above.
Power Cord:	0.4 m USB cable
Output power（max）:	1Mbps：5.36dBm
	3Mbps：4.56dBm
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 used fully-charged battery and programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

2.Set EUT as above block diagram, run the software CSR 2.4.8, set the transmit serial port/power/channel/packet type/data type/hopping or not, send configuration, than EUT enter the TX mode. After finishing the test setting, the notebook and the transform board will be removed during measurements.

(2) E.U.T. 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	signal cable
1	Laptop	ASUS	N/A	X401A	X16-96072	N/A	N/A
2	Adapter (laptop)	ASUS	N/A	EXA070 3YH	N/A	1.8m/unshielded /detachable	N/A
3	USB line	N/A	N/A	N/A	N/A	N/A	1.2m/unshielded /detachable
4	Transform board	N/A	N/A	N/A	N/A	N/A	N/A
5	Adapter	HTC	N/A	TC P900-US	N/A	N/A	N/A

4.4 EUT Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	signal cable
1	USB line	N/A	N/A	N/A	N/A	N/A	0.4m/ detachable
2	Audio line	N/A	N/A	N/A	N/A	N/A	1.0m/unshielded /detachable

5 Equipments List for All Test Items

No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal. Due Date
1	SIGNAL ANALYZER	R&S	FSV40	101470	2016.06.29	2017.06.28
2	EMI Measuring Receiver	R&S	ESR	101660	2016.06.29	2017.06.28
3	Low Noise Pre Amplifier	Tsj	MLA-10K01-B01-27	1205323	2016.06.29	2017.06.28
4	Low Noise Pre Amplifier	Tsj	MLA-0120-A02-34	2648A04738	2016.06.29	2017.06.28
5	TRILOG Super Broadband test Antenna	SCHWARZBECK	VULB9160	9160-3206	2016.06.29	2017.06.28
6	Broadband Horn Antenna	SCHWARZBECK	BBHA9120D	452	2016.06.29	2017.06.28
7	SHF-EHF Horn	SCHWARZBECK	BBHA9170	BBHA9170367	2016.06.29	2017.06.28
8	50Ω Coaxial Switch	Anritsu	MP59B	6200264416	2016.06.29	2017.06.28
9	EMI Test Receiver	R&S	ESCI	100124	2016.06.29	2017.06.28
10	LISN	Kyoritsu	KNW-242	8-837-4	2016.06.29	2017.06.28
11	LISN	Kyoritsu	KNW-407	8-1789-3	2016.06.29	2017.06.28
12	50Ω Coaxial Switch	Anritsu	MP59B	6200264417	2016.06.29	2017.06.28
13	Loop Antenna	ETS	6512	00165355	2016.06.29	2017.06.28
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 in the EUT 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

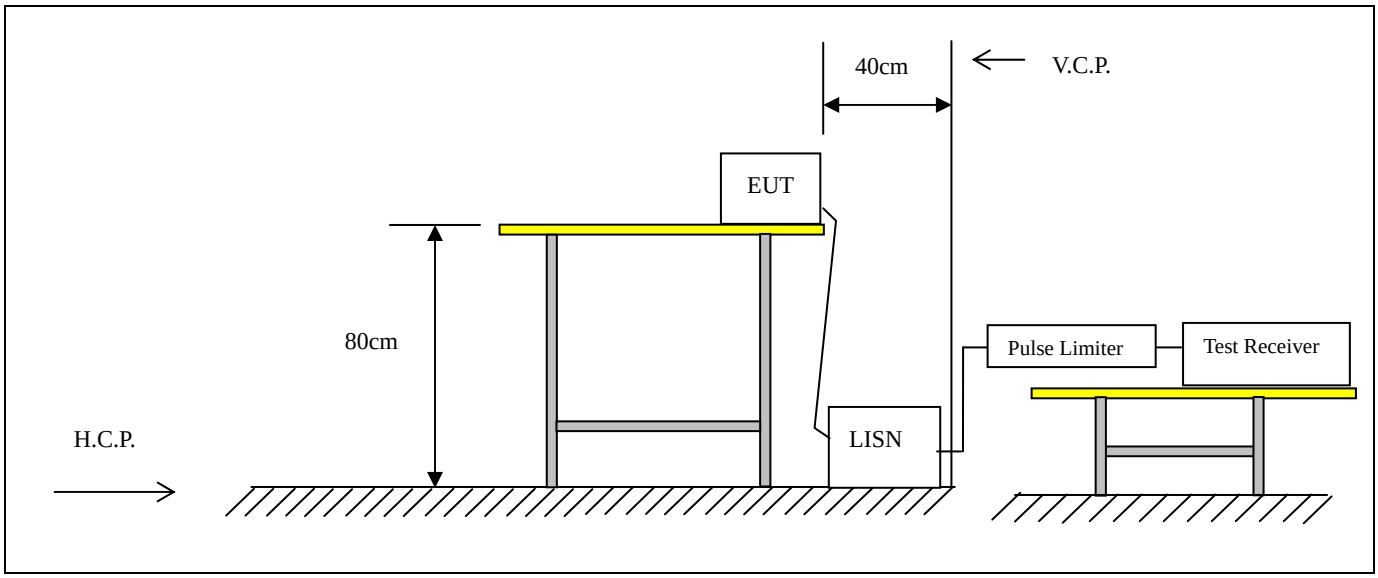
Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

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

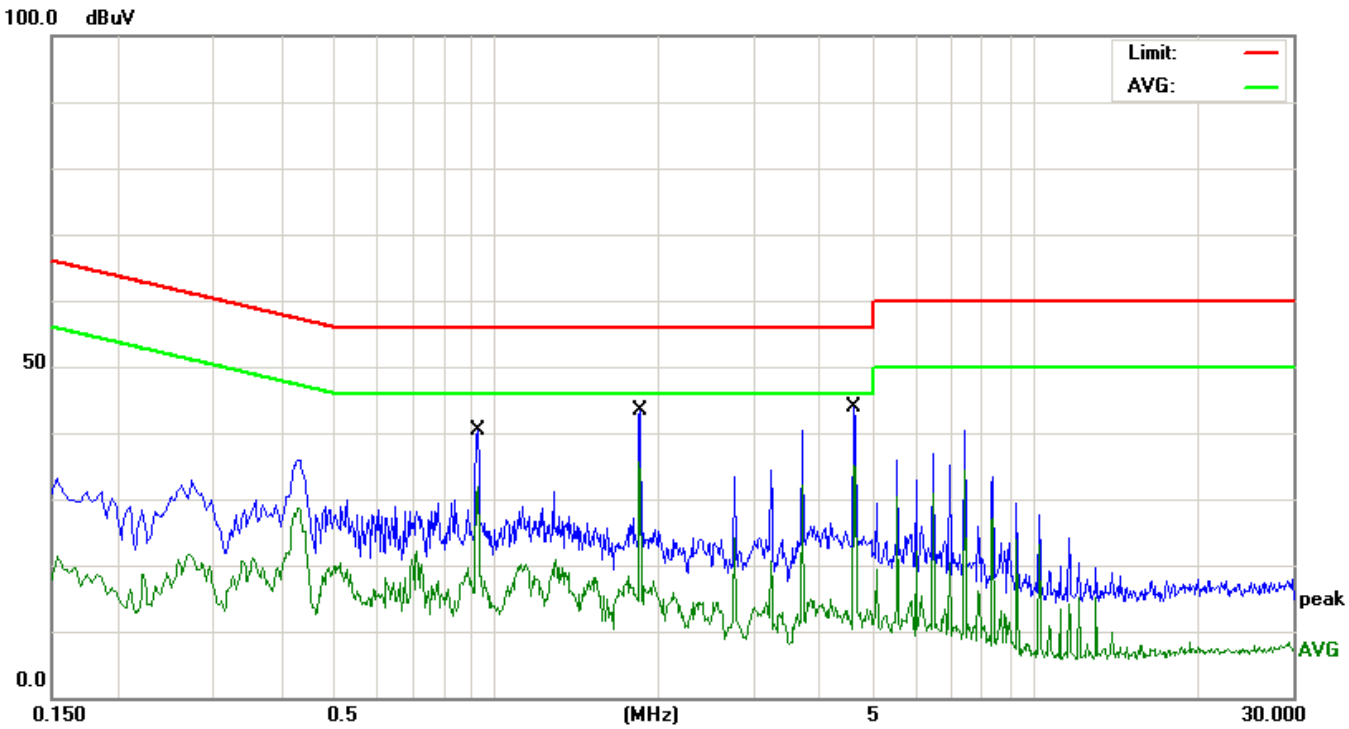


6.2.4 Test results

EUT:	OT2800	Model Name. :	TURTLE SHELL® 3.0
Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	1010hPa	Test Date :	2016-07-03
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
0.9260	30.34	9.93	40.27	56.00	-15.73	Quasi-Peak
0.9260	21.98	9.93	31.91	46.00	-14.09	Average
1.8500	33.27	9.99	43.26	56.00	-10.43	Quasi-Peak
1.8460	25.58	9.99	35.57	46.00	-12.74	Average
4.6220	33.69	10.09	43.78	56.00	-12.22	Quasi-Peak
4.6220	25.06	10.09	35.15	46.00	-10.85	Average

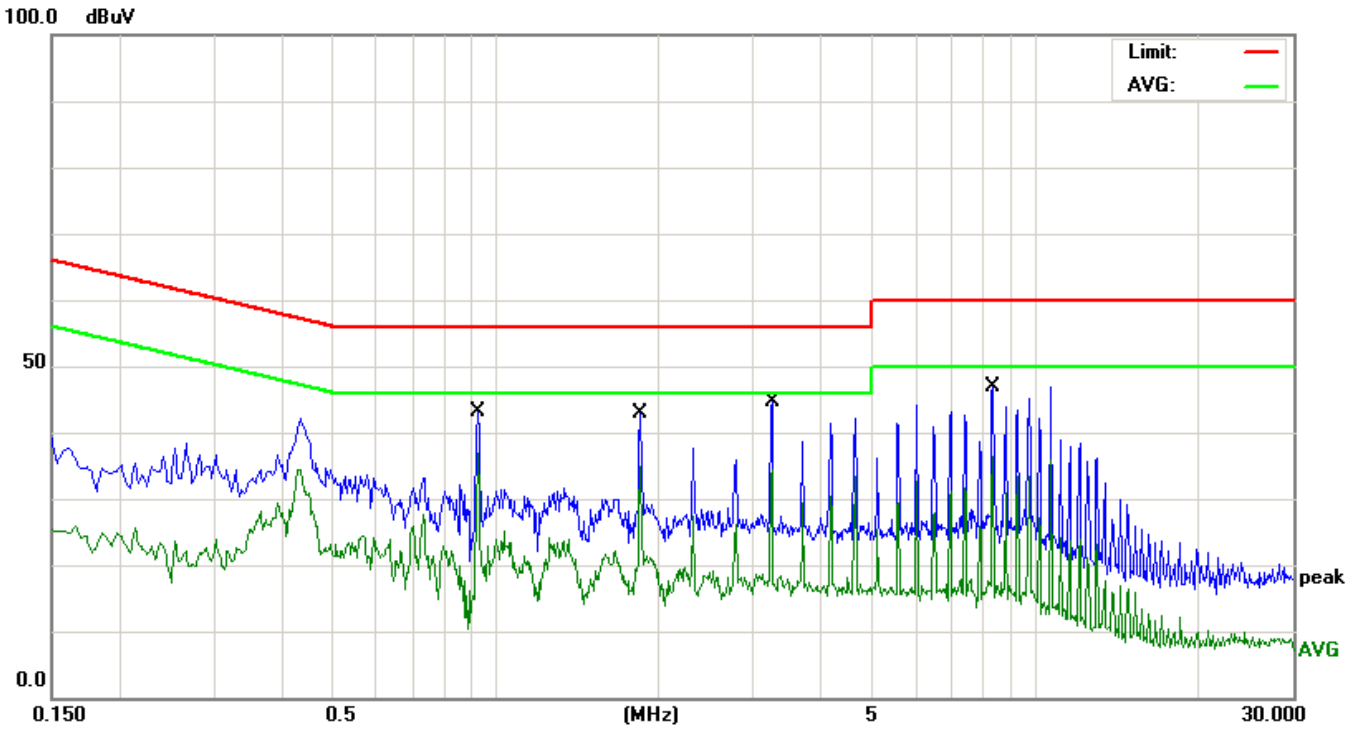
Remark: Factor = LISN factor + Cable Loss + Pulse limiter factor.



EUT：	OT2800	Model Name. ：	TURTLE SHELL® 3.0
Temperature：	26 ℃	Relative Humidity：	54%
Pressure：	1010hPa	Test Date :	2016-07-03
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
0.9260	33.25	9.93	43.18	56.00	-12.82	Quasi-Peak
0.9260	26.99	9.93	36.92	46.00	-9.08	Average
3.2500	34.56	10.03	44.59	56.00	-11.41	Quasi-Peak
1.8540	24.84	9.99	34.83	46.00	-11.17	Average
8.3539	36.76	10.20	46.96	60.00	-13.04	Quasi-Peak
8.3539	26.08	10.20	36.28	50.00	-13.72	Average

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



6.3 Radiated Emissions Measurement

6.3.1 Applied procedures / Limit

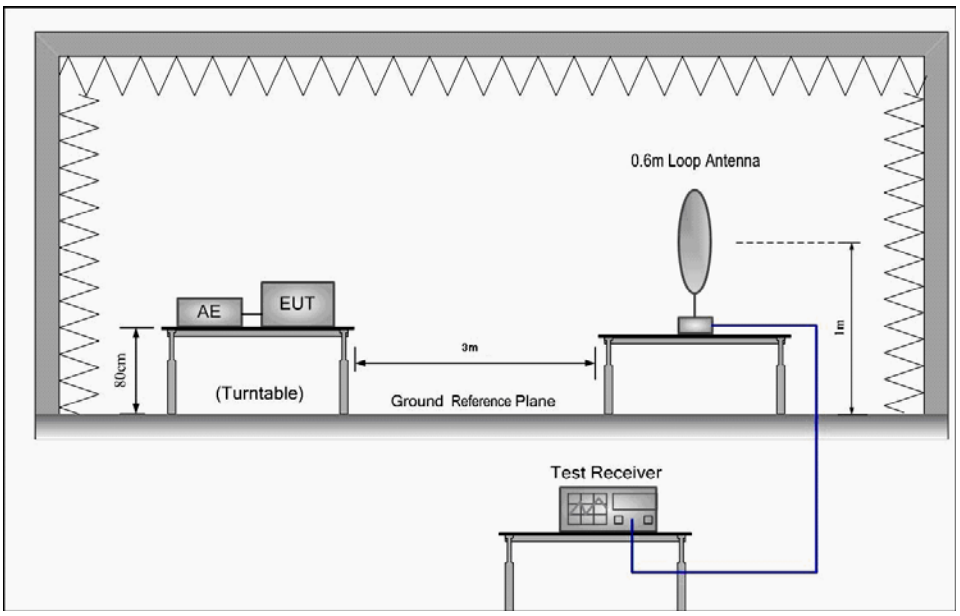
15.247(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that 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

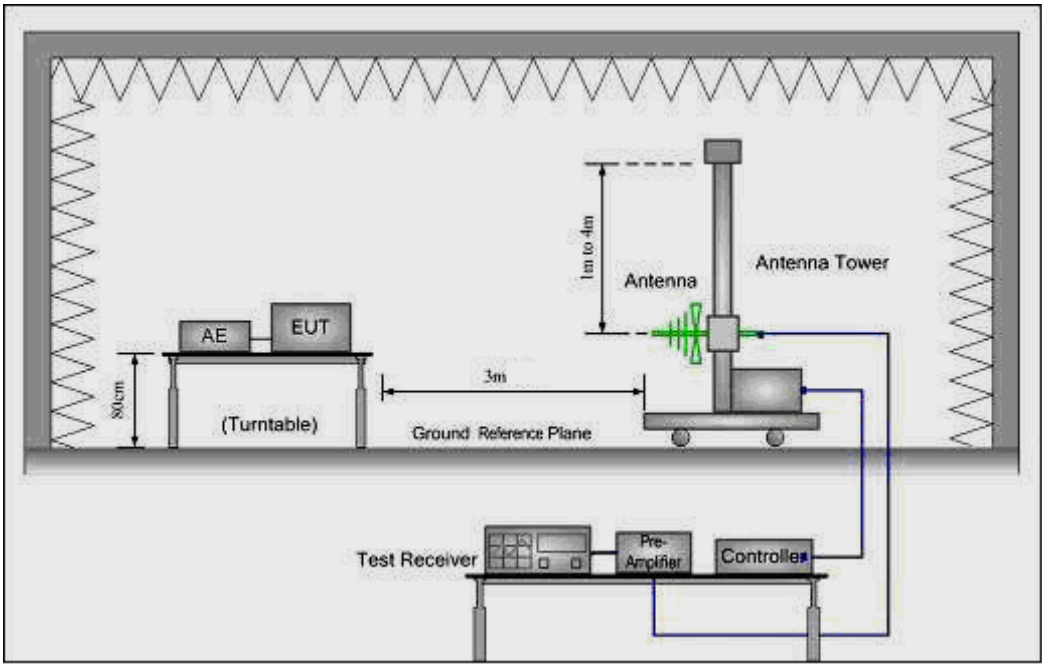
6.3.2 Test setup

Test Configuration:

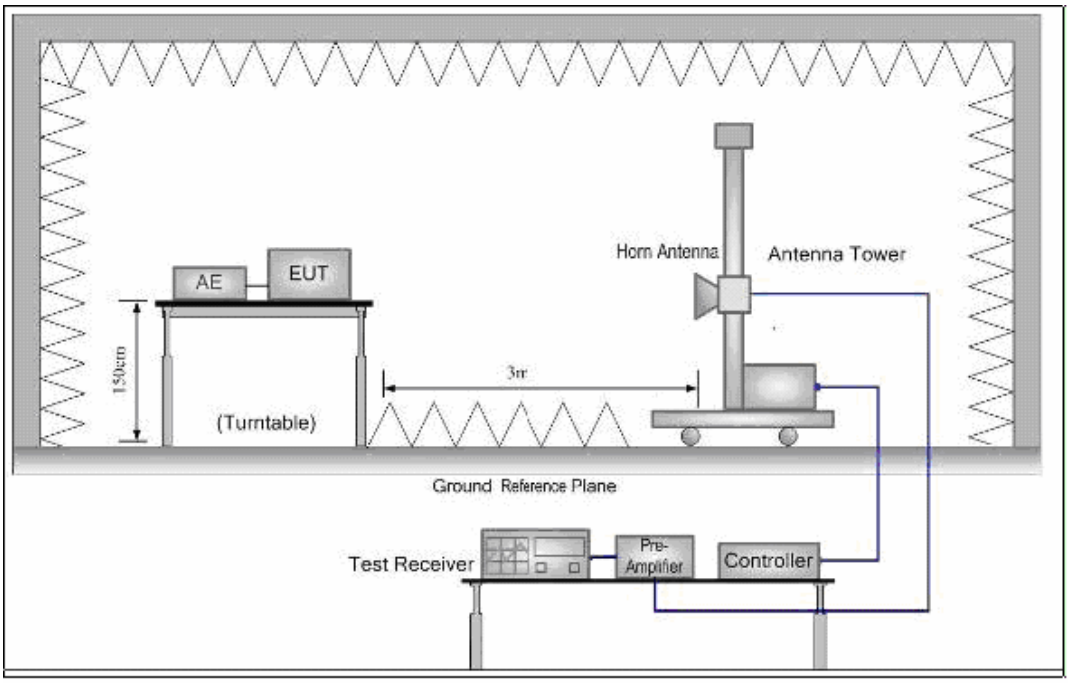
1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 25 GHz emissions:



6.3.3 Test procedure

a. The EUT was placed on the top of a wooden table 0.8 meters (for measurement at frequency below 1GHz) and a wooden table 1.5 meters (for measurement at frequency above 1GHz) above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter, for the test frequency of above 1GHz, horn antenna opening in the test would have been facing the EUT when rise or fall) and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. The resolution bandwidth and video bandwidth of the test receiver was 1MHz and 1MHz for Peak detection at frequency above 1GHz.
g. Test the EUT in the lowest channel (2402MHz), the middle channel (2440MHz), the Highest channel (2480MHz)
h. Repeat above procedures until all frequencies measured was complete.

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.

In 18GHz to 25GHz, The EUT was checked by Horn ANT. But the test result at least have 20dB margin.
The EUT was tested in Chamber Site.

6.3.4 Test Result

Radiated Emissions Test Data Below 30MHz

EUT：	OT2800	Model Name ：	TURTLE SHELL® 3.0
Temperature：	25 ℃	Test Data	2016-07-03
Pressure：	1005 hPa	Relative Humidity：	60%
Test Mode ：	TX	Test Voltage ：	DC 3.7V from battery
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：	OT2800	Model Name ：	TURTLE SHELL® 3.0
Temperature：	25 ℃	Test Data	2016-07-03
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	TX (1Mbps) CH00 (worst case)	Test Voltage ：	DC 3.7V from battery
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
47.3255	29.80	-14.26	15.54	40.00	-24.46	QUASIPEAK
121.1231	30.85	-14.96	15.89	43.50	-27.61	QUASIPEAK
183.8440	30.73	-11.72	19.01	43.50	-24.49	QUASIPEAK
517.2480	33.21	-5.00	28.21	46.00	-17.79	QUASIPEAK
699.3046	30.59	0.44	31.03	46.00	-14.97	QUASIPEAK
952.0937	34.35	3.77	38.12	46.00	-7.88	QUASIPEAK

(b) Antenna polarization: vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
41.7129	30.29	-17.01	13.28	40.00	-26.72	QUASIPEAK
100.9339	31.71	-13.92	17.79	43.50	-25.71	QUASIPEAK
159.2251	31.75	-15.08	16.67	43.50	-26.83	QUASIPEAK
286.9823	30.65	-10.60	20.05	46.00	-25.95	QUASIPEAK
434.0651	29.82	-6.61	23.21	46.00	-22.79	QUASIPEAK
798.9797	30.15	3.44	33.59	46.00	-12.41	QUASIPEAK

Note:

Measurement Level = Reading Level + Factor

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

Radiated Emissions Test Data Above 1GHz

EUT：	OT2800	Model Name ：	TURTLE SHELL® 3.0
Temperature：	25 ℃	Test Data	2016-07-03
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	1Mbps	Test Voltage ：	DC 3.7V from battery
Measurement Distance	3 m	Frenqucy Range	1GHz to 25GHz
RBW/VBW	1MHz/1MHz for Peak, 1MHz/10Hz for Average.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804.000	55.18	5.06	60.24	74.00	-13.76	PEAK
4804.000	43.62	5.06	48.68	54.00	-5.32	AVERAGE
7206.000	45.51	7.03	52.54	74.00	-21.46	PEAK
7206.000	33.46	7.03	40.49	54.00	-13.51	AVERAGE
9608.000	44.96	10.63	55.59	74.00	-18.41	PEAK
9608.000	33.21	10.63	43.84	54.00	-10.16	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804.000	52.27	5.06	57.33	74.00	-16.67	PEAK
4804.000	41.64	5.06	46.70	54.00	-7.30	AVERAGE
7206.000	46.89	7.03	53.92	74.00	-20.08	PEAK
7206.000	34.27	7.03	41.30	54.00	-12.70	AVERAGE
9608.000	43.61	10.63	54.24	74.00	-19.76	PEAK
9608.000	32.94	10.63	43.57	54.00	-10.43	AVERAGE

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
4882.000	53.78	5.14	58.92	74.00	-15.08	PEAK
4882.000	42.30	5.14	47.44	54.00	-6.56	AVERAGE
7323.000	45.58	7.54	53.12	74.00	-20.88	PEAK
7323.000	34.76	7.54	42.30	54.00	-11.70	AVERAGE
9764.000	46.68	11.39	58.07	74.00	-15.93	PEAK
9764.000	35.29	11.39	46.68	54.00	-7.32	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882.000	54.92	5.14	59.24	74.00	-14.76	PEAK
4882.000	43.87	5.14	47.61	54.00	-6.39	AVERAGE
7323.000	44.27	7.54	53.89	74.00	-20.11	PEAK
7323.000	36.31	7.54	42.82	54.00	-11.18	AVERAGE
9764.000	45.46	11.39	55.84	74.00	-18.16	PEAK
9764.000	33.25	11.39	43.70	54.00	-10.30	AVERAGE

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
4960.000	55.57	5.22	60.79	74.00	-13.21	PEAK
4960.000	43.16	5.22	48.38	54.00	-5.62	AVERAGE
7440.000	45.71	8.06	53.77	74.00	-20.23	PEAK
7440.000	34.36	8.06	42.42	54.00	-11.58	AVERAGE
9920.000	42.60	12.10	54.70	74.00	-19.30	PEAK
9920.000	31.84	12.10	43.94	54.00	-10.06	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960.000	54.09	5.22	59.31	74.00	-14.69	PEAK
4960.000	42.63	5.22	47.85	54.00	-6.15	AVERAGE
7440.000	44.67	8.06	52.73	74.00	-21.27	PEAK
7440.000	33.72	8.06	41.78	54.00	-12.22	AVERAGE
9920.000	43.53	12.10	55.63	74.00	-18.37	PEAK
9920.000	32.46	12.10	44.56	54.00	-9.44	AVERAGE

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：	OT2800	Model Name ：	TURTLE SHELL® 3.0
Temperature：	25 ℃	Test Data	2016-07-03
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	3Mbps	Test Voltage ：	DC 3.7V from battery
Measurement Distance	3 m	Frenqucy Range	1GHz to 25GHz
RBW/VBW	1MHz/1MHz for Peak, 1MHz/10Hz for Average.		

(a) Antenna polarization: Horizontal

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804.000	54.35	5.06	59.41	74.00	-14.59	PEAK
4804.000	42.78	5.06	47.84	54.00	-6.16	AVERAGE
7206.000	45.59	7.03	52.62	74.00	-21.38	PEAK
7206.000	34.07	7.03	41.10	54.00	-12.90	AVERAGE
9608.000	44.63	10.63	55.26	74.00	-18.74	PEAK
9608.000	33.18	10.63	43.81	54.00	-10.19	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4804.000	55.46	5.06	60.52	74.00	-13.48	PEAK
4804.000	43.73	5.06	48.79	54.00	-5.21	AVERAGE
7206.000	46.86	7.03	53.89	74.00	-20.11	PEAK
7206.000	33.41	7.03	40.44	54.00	-13.56	AVERAGE
9608.000	42.29	10.63	52.92	74.00	-21.08	PEAK
9608.000	31.28	10.63	41.91	54.00	-12.09	AVERAGE

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
4882.000	54.37	5.14	59.51	74.00	-14.49	PEAK
4882.000	43.66	5.14	48.80	54.00	-5.20	AVERAGE
7323.000	45.83	7.54	53.37	74.00	-20.63	PEAK
7323.000	33.26	7.54	40.80	54.00	-13.20	AVERAGE
9764.000	42.93	11.39	54.32	74.00	-19.68	PEAK
9764.000	31.39	11.39	42.78	54.00	-11.22	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4882.000	55.17	5.14	60.31	74.00	-13.69	PEAK
4882.000	43.49	5.14	48.63	54.00	-5.37	AVERAGE
7323.000	46.68	7.54	54.22	74.00	-19.78	PEAK
7323.000	35.34	7.54	42.88	54.00	-11.12	AVERAGE
9764.000	44.82	11.39	56.21	74.00	-17.79	PEAK
9764.000	32.44	11.39	43.83	54.00	-10.17	AVERAGE

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
4960.000	53.70	5.22	58.92	74.00	-15.08	PEAK
4960.000	42.61	5.22	47.83	54.00	-6.17	AVERAGE
7440.000	45.85	8.06	53.91	74.00	-20.09	PEAK
7440.000	34.26	8.06	42.32	54.00	-11.68	AVERAGE
9920.000	43.87	12.10	55.97	74.00	-18.03	PEAK
9920.000	32.41	12.10	44.51	54.00	-9.49	AVERAGE

(b) Antenna polarization: Vertical

Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measure Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector Type
4960.000	54.77	5.22	59.99	74.00	-14.01	PEAK
4960.000	43.21	5.22	48.43	54.00	-5.57	AVERAGE
7440.000	45.65	8.06	53.71	74.00	-20.29	PEAK
7440.000	33.98	8.06	42.04	54.00	-11.96	AVERAGE
9920.000	44.28	12.10	56.38	74.00	-17.62	PEAK
9920.000	33.37	12.10	45.47	54.00	-8.53	AVERAGE

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:	OT2800	Model Name :	TURTLE SHELL® 3.0
Temperature:	25 ℃	Test Data	2016-07-03
Pressure:	1010 hPa	Relative Humidity:	60%
Test Mode :	TX 1Mbps/3Mbps	Test Voltage :	DC 3.7V from battery
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	2390.00	45.24	34.19	-5.79	39.45	28.40	74.00	54.00
	H	2390.00	45.65	33.67	-5.79	39.86	27.88	74.00	54.00
	V	2483.50	46.82	35.25	-4.98	41.84	30.27	74.00	54.00
	H	2483.50	45.33	34.28	-4.98	40.35	29.30	74.00	54.00
Data rate 3Mbps	V	2390.00	46.50	35.81	-5.79	40.71	30.02	74.00	54.00
	H	2390.00	45.87	34.35	-5.79	40.08	28.56	74.00	54.00
	V	2483.50	46.12	34.62	-4.98	41.14	29.64	74.00	54.00
	H	2483.50	45.54	33.54	-4.98	40.56	28.56	74.00	54.00

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.

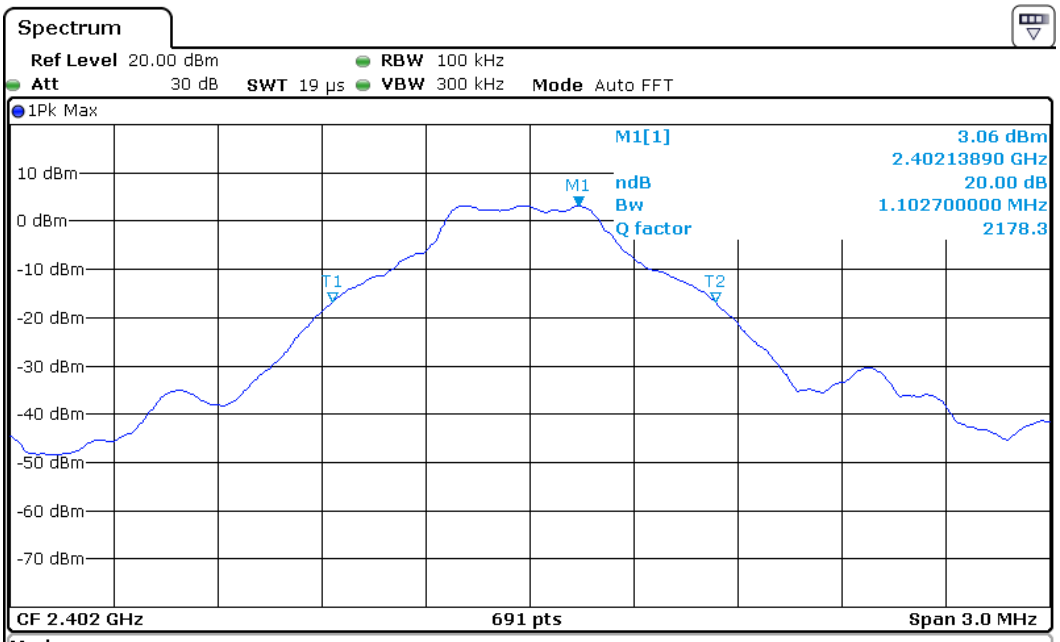
6.4.4 Test setup

6.4.5 Test results

EUT：	OT2800	Model Name ：	TURTLE SHELL® 3.0
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1010 hPa	Test Power ：	DC 3.7V from battery
Test Mode ：	TX 1Mbps/ 3Mbps		

Channel		Channel frenqucy (MHz)	20dB bandwidth (KHz)	Limit (KHz)	Conclusion
1Mbps	Low	2402	1102.7	N/A	Pass
	Middle	2441	1111.4	N/A	Pass
	High	2480	1111.4	N/A	Pass
3Mbps	Low	2402	1350.2	N/A	Pass
	Middle	2441	1350.2	N/A	Pass
	High	2480	1345.9	N/A	Pass

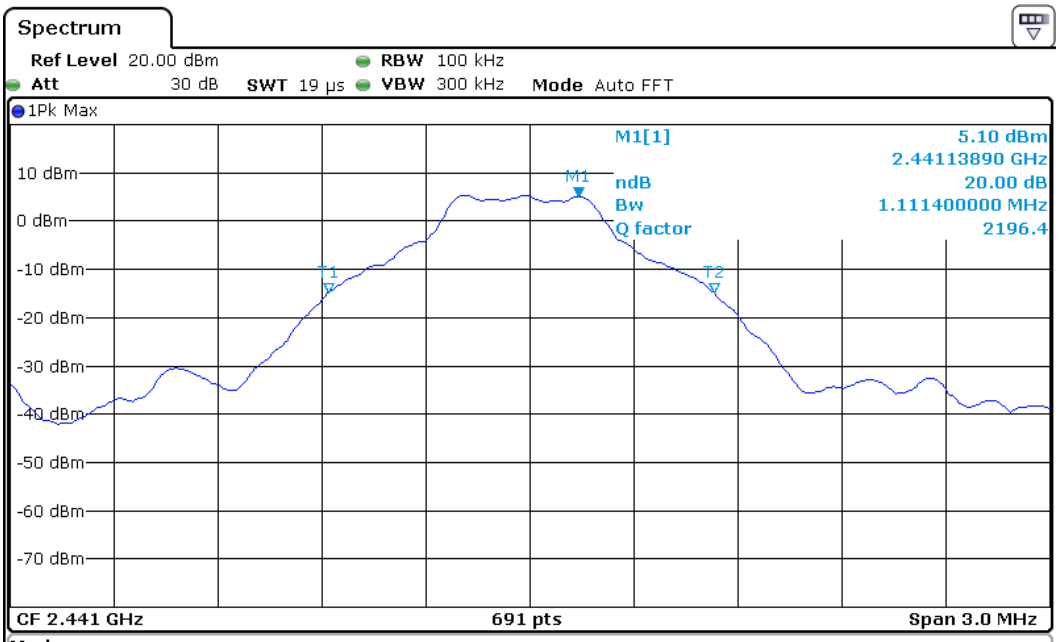
CH00-1Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4021389 GHz	3.06 dBm	ndB down	1.1027 MHz
T1		1	2.4014313 GHz	-16.83 dBm	ndB	20.00 dB
T2		1	2.402534 GHz	-16.79 dBm	Q factor	2178.3

CH 39-1Mbps



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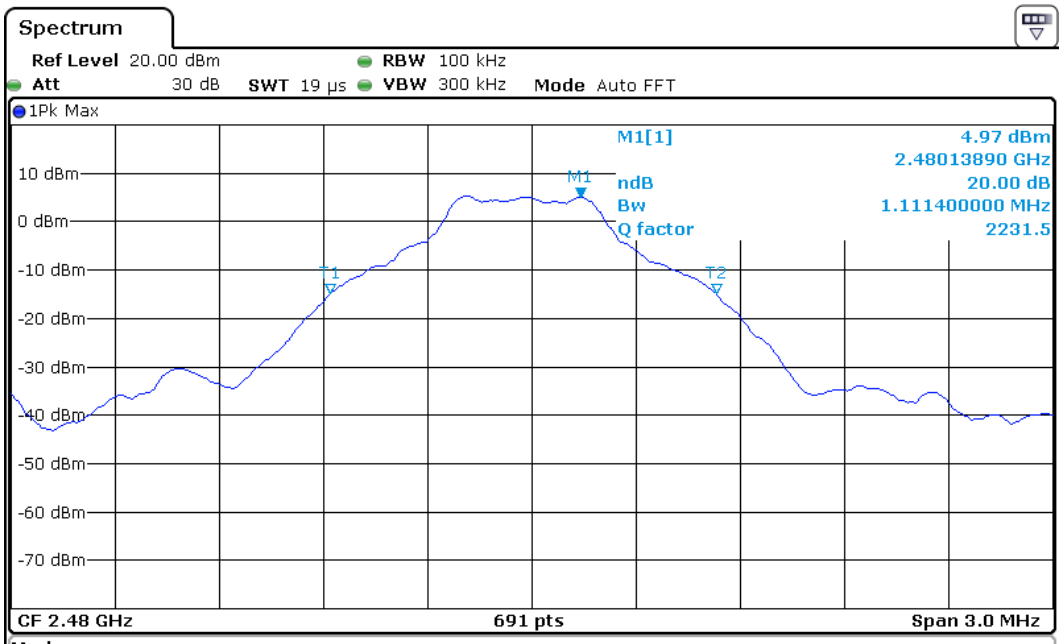
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4411389 GHz	5.10 dBm	ndB down	1.1114 MHz
T1		1	2.4404182 GHz	-14.96 dBm	ndB	20.00 dB
T2		1	2.4415297 GHz	-14.95 dBm	Q factor	2196.4

CH 78-1Mbps



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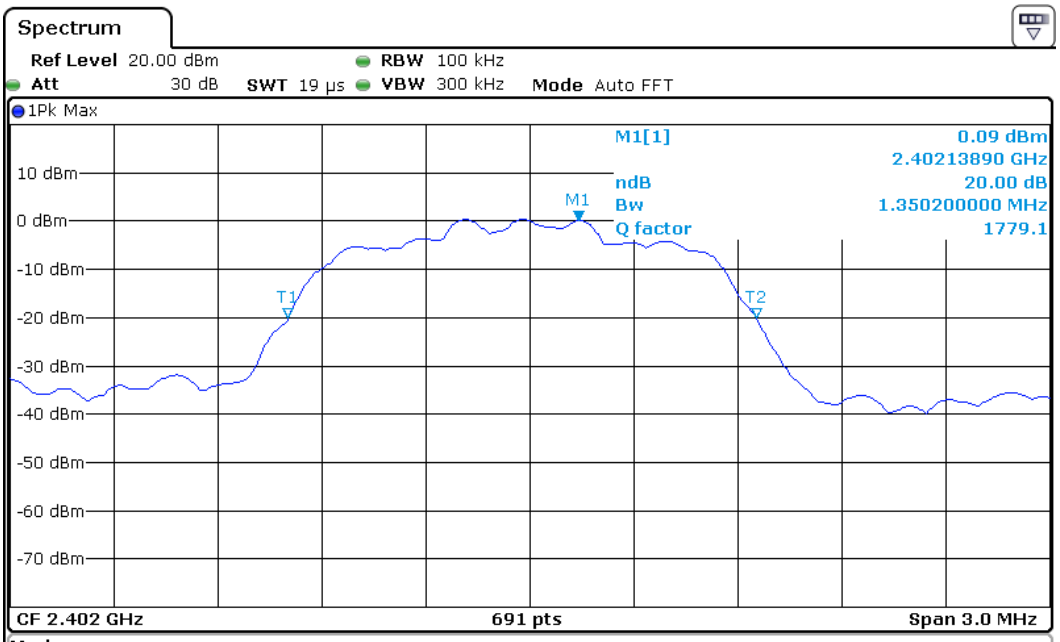
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4801389 GHz	4.97 dBm	ndB down	1.1114 MHz
T1		1	2.4794182 GHz	-15.00 dBm	ndB	20.00 dB
T2		1	2.4805297 GHz	-15.00 dBm	Q factor	2231.5

CH 00-3Mbps



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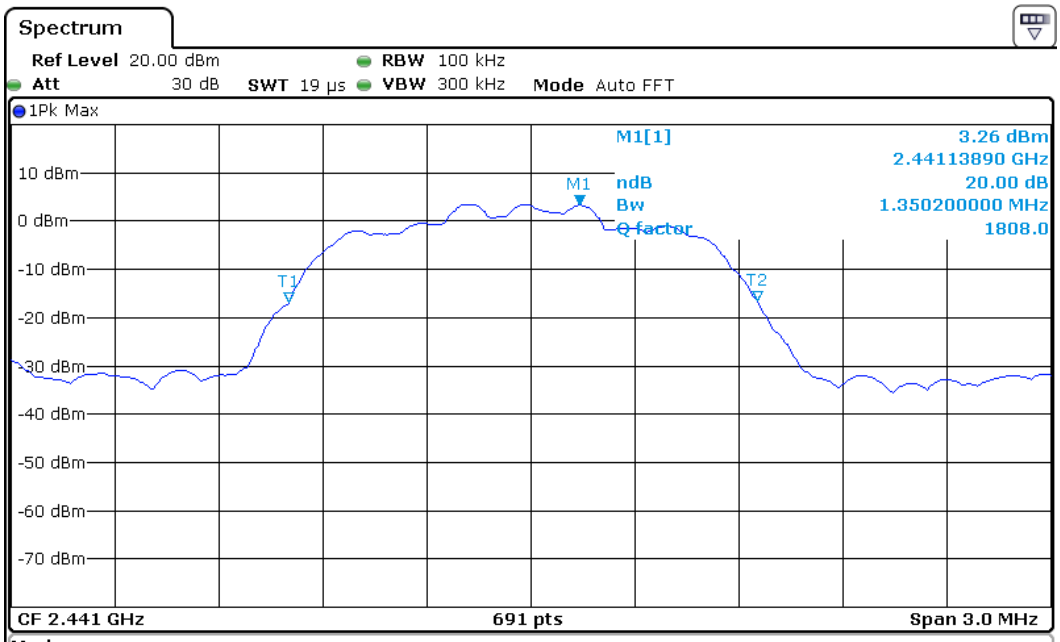
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4021389 GHz	0.09 dBm	ndB down	1.3502 MHz
T1		1	2.401301 GHz	-20.08 dBm	ndB	20.00 dB
T2		1	2.4026512 GHz	-19.98 dBm	Q factor	1779.1

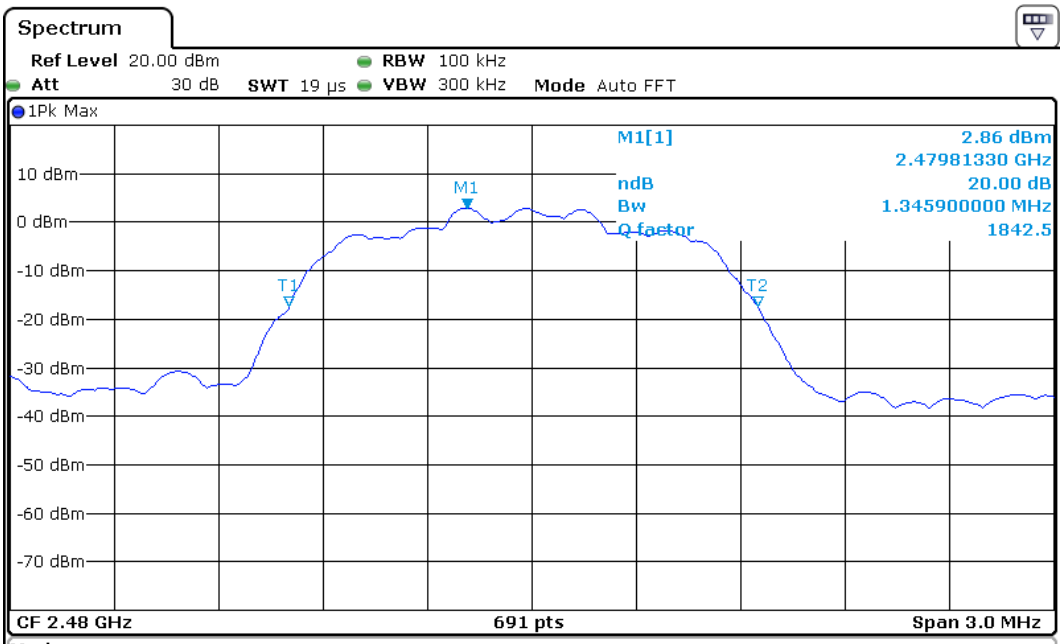
CH 39-3Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4411389 GHz	3.26 dBm	ndB down	1.3502 MHz
T1		1	2.440301 GHz	-16.75 dBm	ndB	20.00 dB
T2		1	2.4416512 GHz	-16.55 dBm	Q factor	1808.0

CH 78-3Mbps



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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4798133 GHz	2.86 dBm	ndB down	1.3459 MHz
T1		1	2.479301 GHz	-17.33 dBm	ndB	20.00 dB
T2		1	2.4806469 GHz	-17.32 dBm	Q factor	1842.5

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

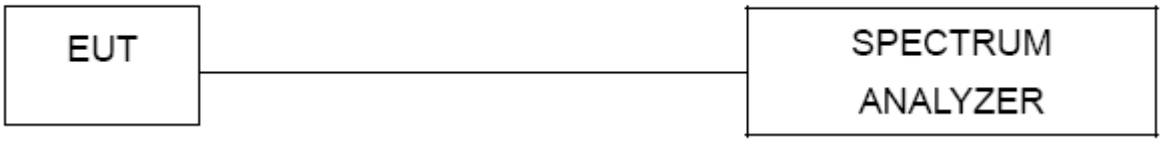
(2) The EUT should be transmitting at its maximum data rate. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

(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



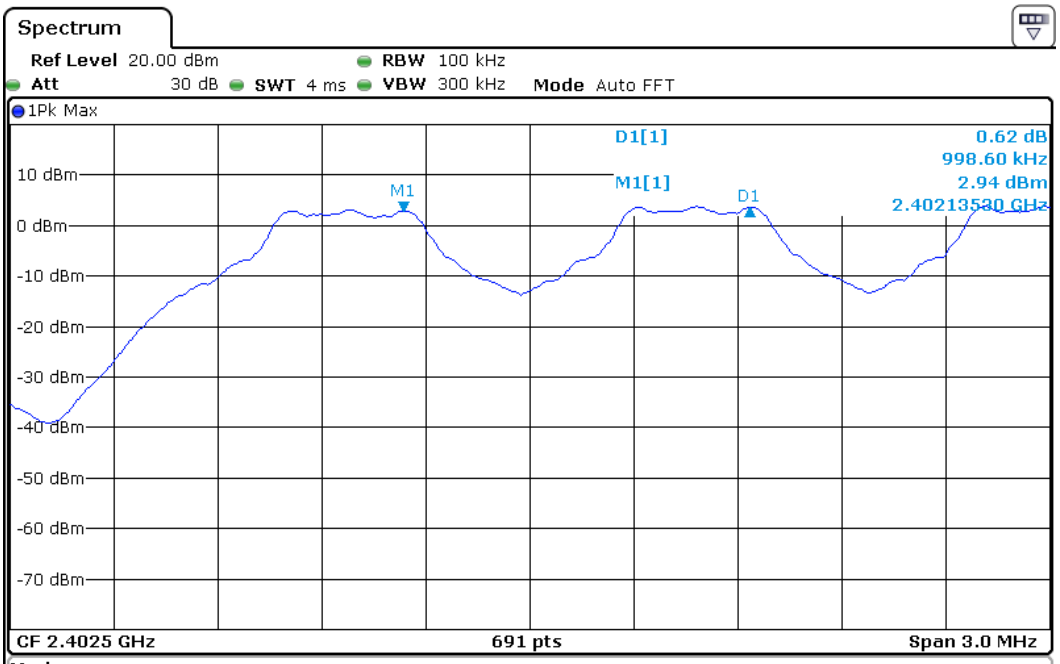
6.5.5 Test results

EUT：	OT2800	Model Name ：	TURTLE SHELL® 3.0
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1010 hPa	Test Power ：	DC 3.7V from battery
Test Mode ：	TX 1Mbps/ 3Mbps		

Channel		Channel frenquy (MHz)	Channel Separation (MHz)	Conclusion
1Mbps	Low	2402	0.9986	Pass
	Middle	2441	0.9986	Pass
	Highest	2480	0.9986	Pass
3Mbps	Low	2402	1.0029	Pass
	Middle	2441	1.0072	Pass
	Highest	2480	1.0029	Pass

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

CH 00-1Mbps



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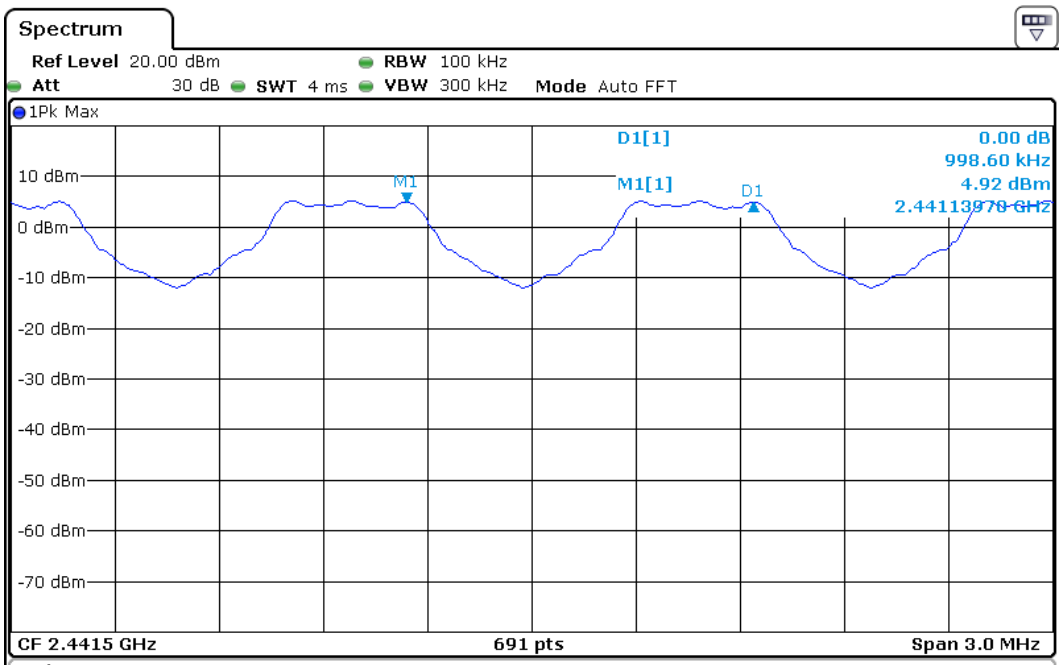
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4021353 GHz	2.94 dBm		
D1	M1	1	998.6 kHz	0.62 dB		

CH 39-1Mbps



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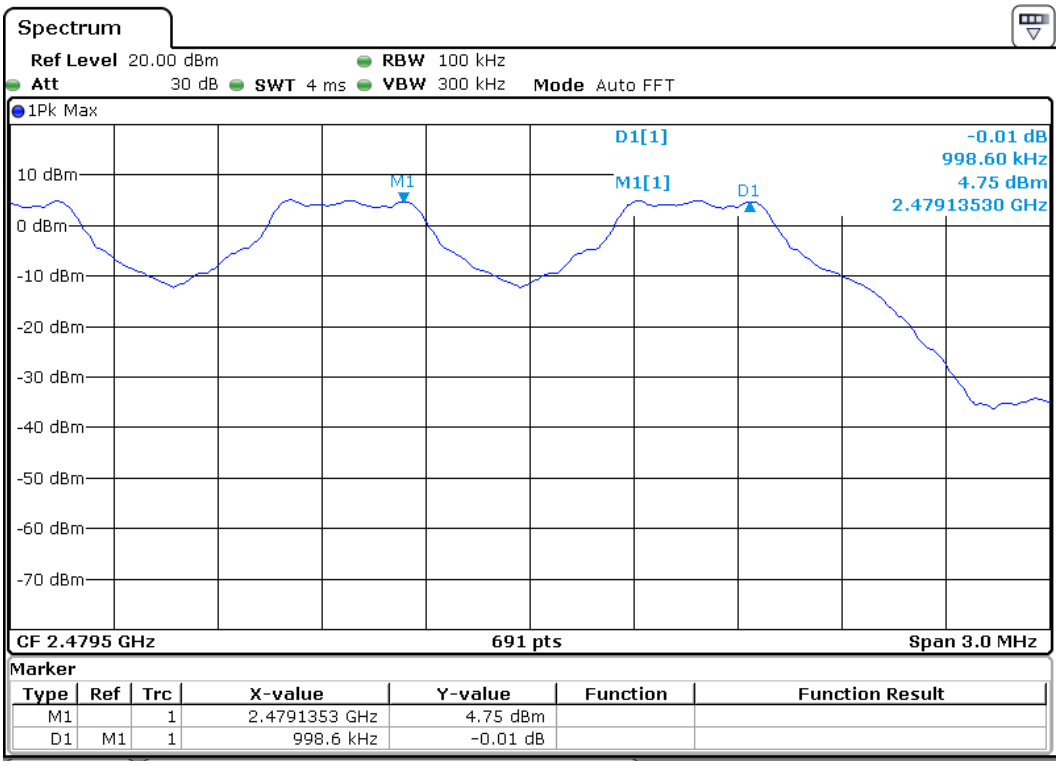
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4411397 GHz	4.92 dBm		
D1	M1	1	998.6 kHz	-0.00 dB		

CH 78-1Mbps



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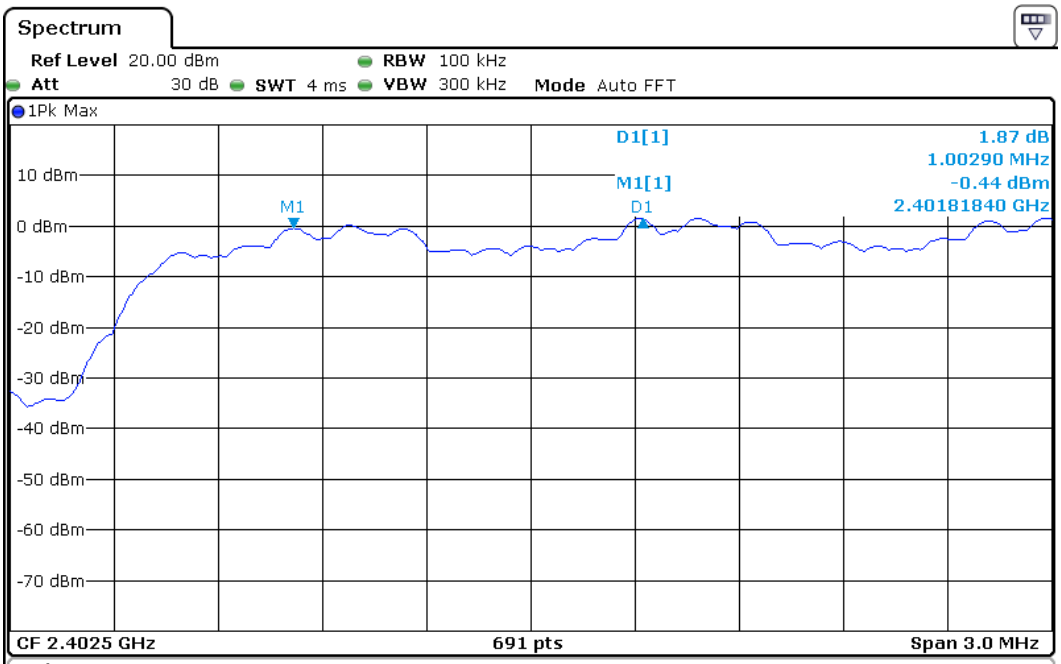
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4791353 GHz	4.75 dBm		
D1	M1	1	998.6 kHz	-0.01 dB		

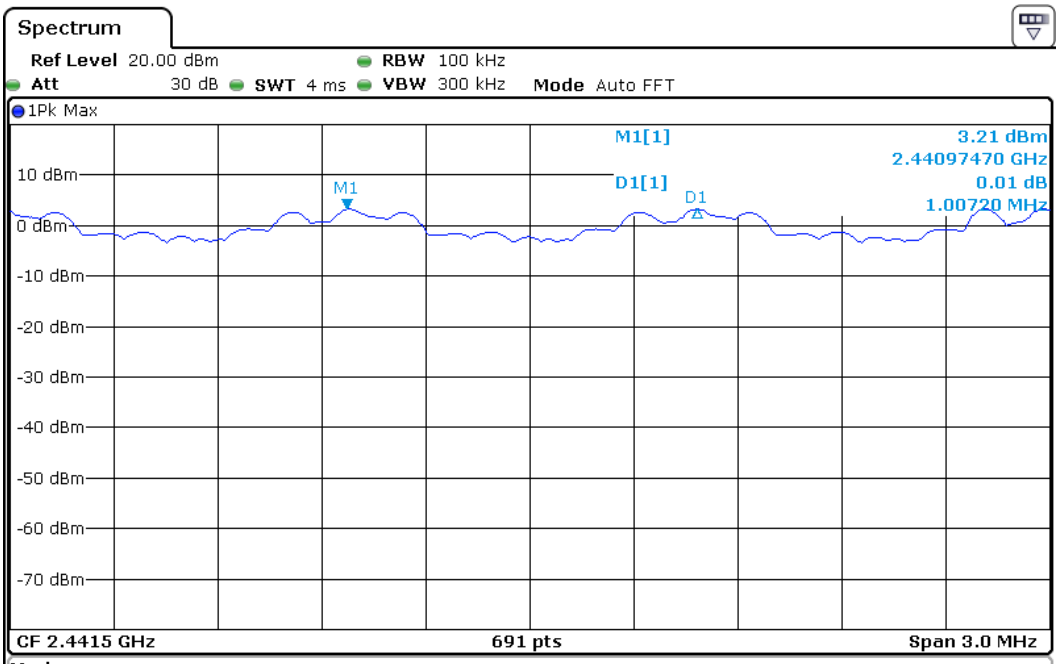
CH 00-3Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4018184 GHz	-0.44 dBm		
D1	M1	1	1.0029 MHz	1.87 dB		

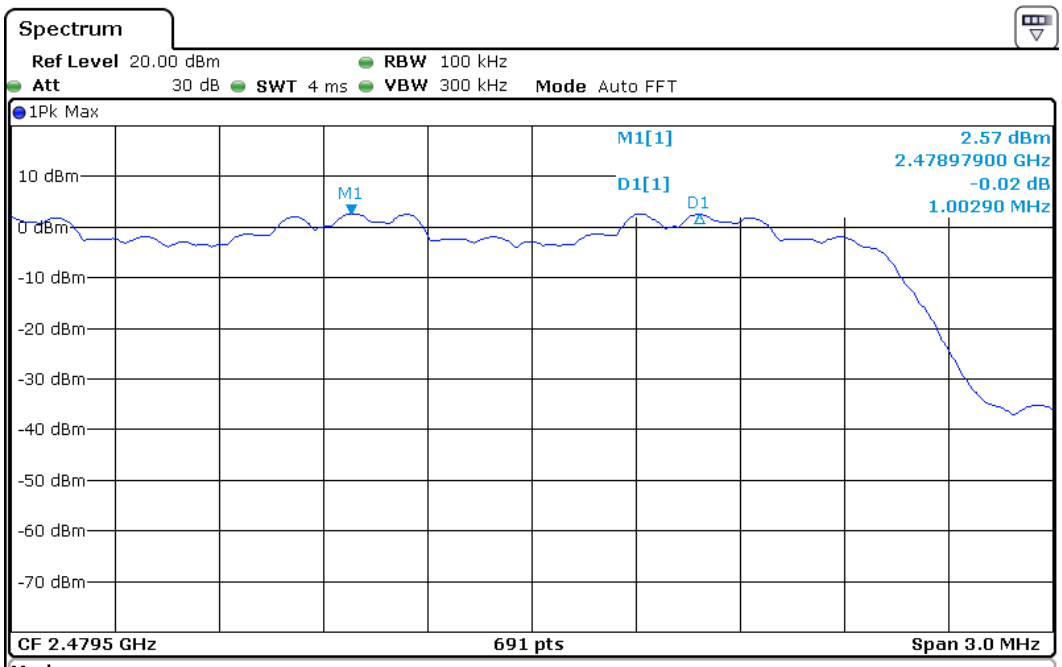
CH 39-3Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4409747 GHz	3.21 dBm		
D1	M1	1	1.0072 MHz	0.01 dB		

CH 78-3Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.478979 GHz	2.57 dBm		
D1	M1	1	1.0029 MHz	-0.02 dB		

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

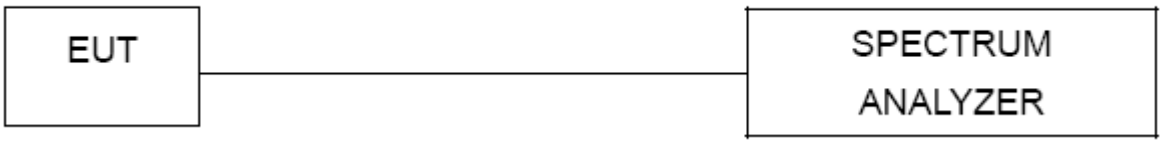
(1) Connected the antenna port to the Spectrum Analyzer , set the Spectrum Analyzer as Span = the frequency band of operation, RBW ≥ 1% of the span, VBW ≥ RBW Sweep = auto Detector function = peak, Trace = max hold

(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

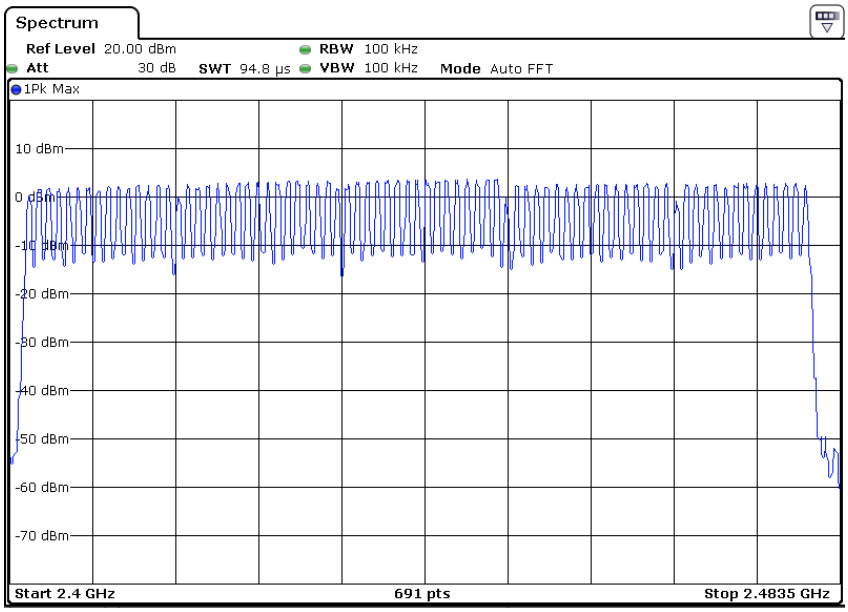


6.6.5 Test result

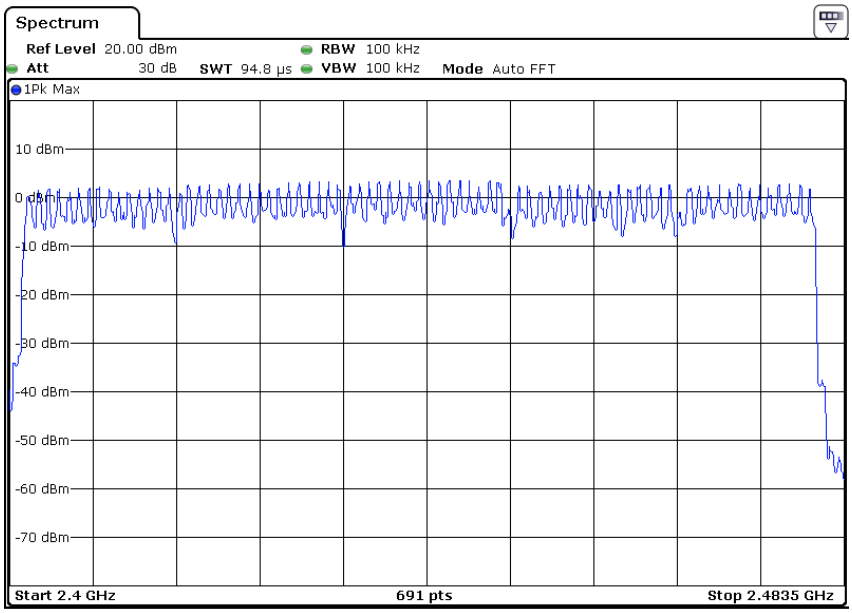
Hopping Channel Number result		
Operating Mode: 1Mbps/ 3Mbps Mode	Test date:2016-07-03	
Result	Limit	Conclusion
79	15	Pass

EUT：	OT2800	Model Name ：	TURTLE SHELL® 3.0
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1010 hPa	Test Power ：	DC 3.7V from battery
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.

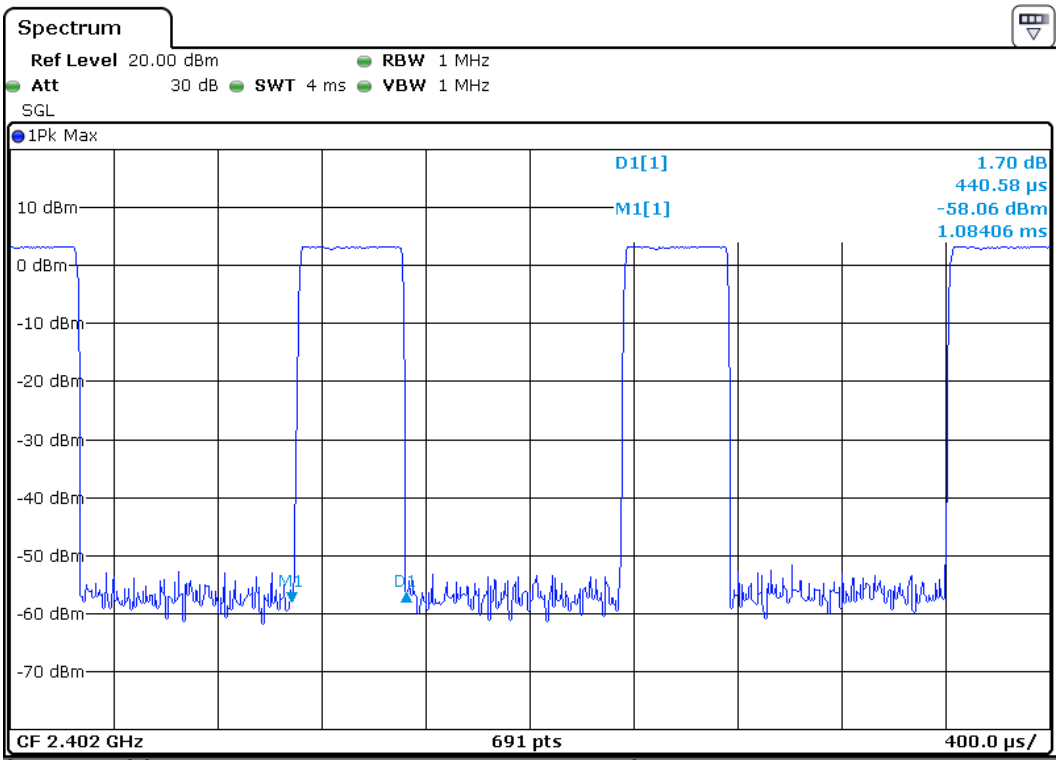
6.7.4 Test setup

6.7.5 Test result

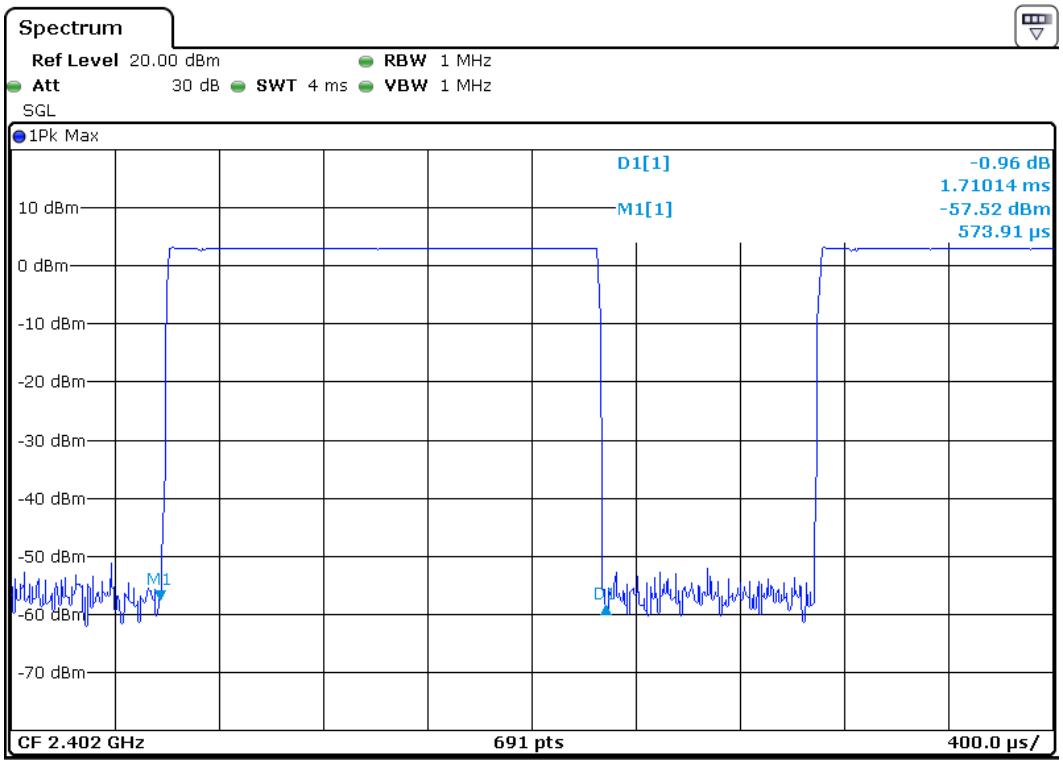
EUT:	OT2800	Model Name :	TURTLE SHELL® 3.0
Temperature:	26 ℃	Relative Humidity:	53%
Pressure:	1010 hPa	Test Power :	DC 3.7V from battery
Test Mode :	CH00-DH1/DH3/DH5 (1Mbps Mode)		

Data Packet	Frequency	Pulse Duration (ms)	Dwell Time (ms)	Limits (s)
DH1	2402 MHz	0.440	140.800	0.4000
DH3	2402 MHz	1.710	273.600	0.4000
DH5	2402 MHz	2.956	315.306	0.4000

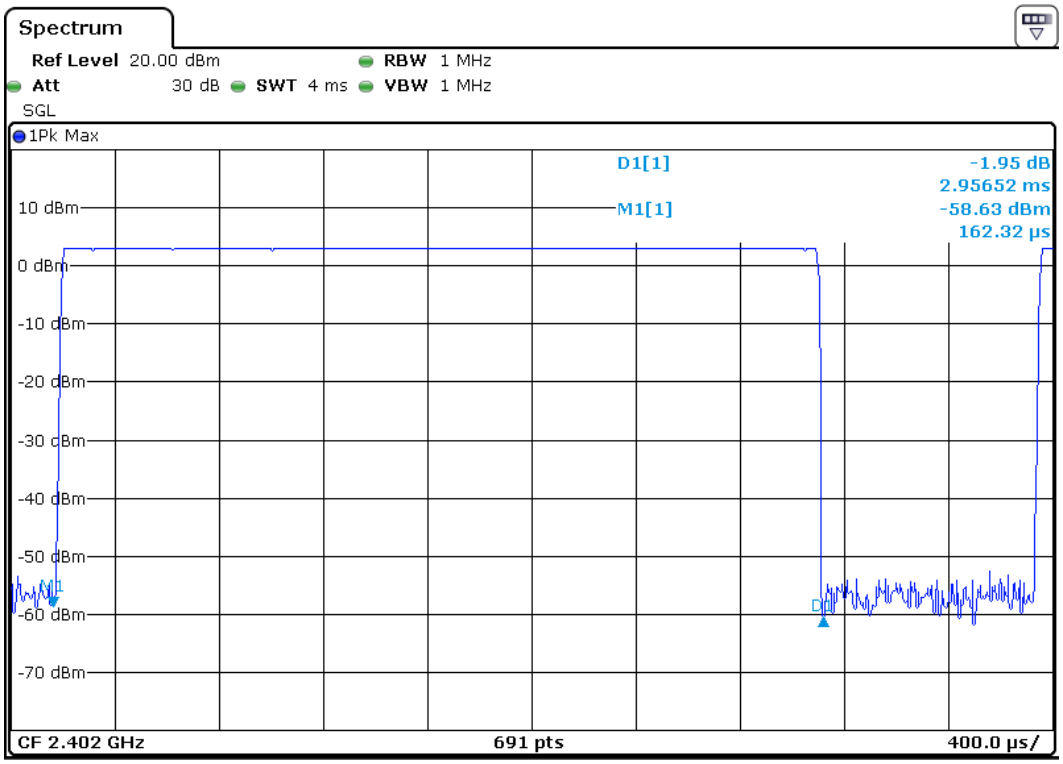
CH 00- DH1



CH 00- DH3



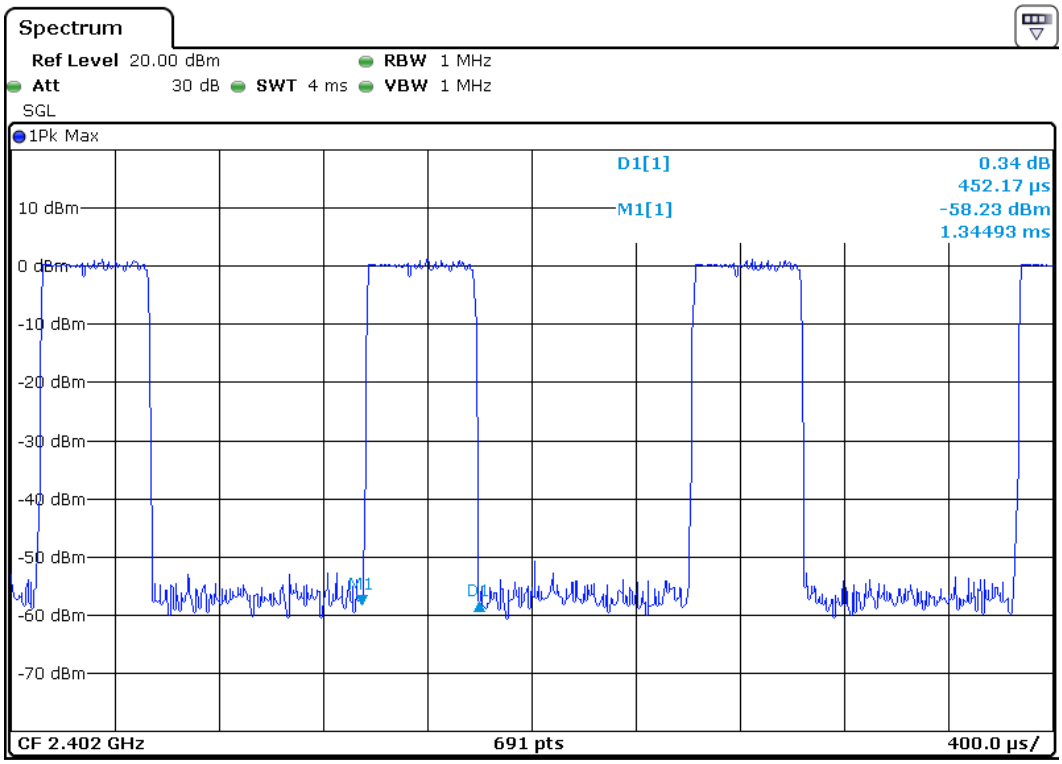
CH 00- DH5



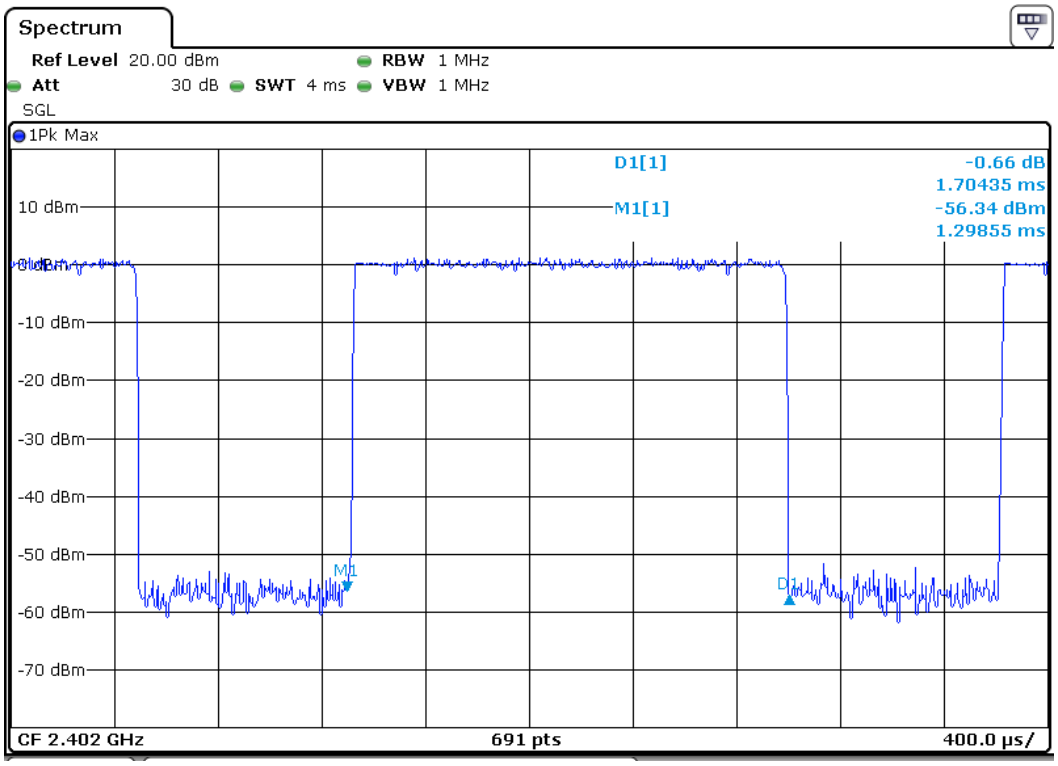
EUT：	OT2800	Model Name ：	TURTLE SHELL® 3.0
Temperature：	26 ℃	Relative Humidity：	53%
Pressure：	1010 hPa	Test Power ：	DC 3.7V from battery
Test Mode ：	CH00-3DH1/3DH3/3DH5 (3Mbps Mode)		

Data Packet	Frequency	Pulse Duration (ms)	Dwell Time (ms)	Limits (s)
3DH1	2402 MHz	0.452	144.64	0.4000
3DH3	2402 MHz	1.704	272.64	0.4000
3DH5	2402 MHz	2.973	317.12	0.4000

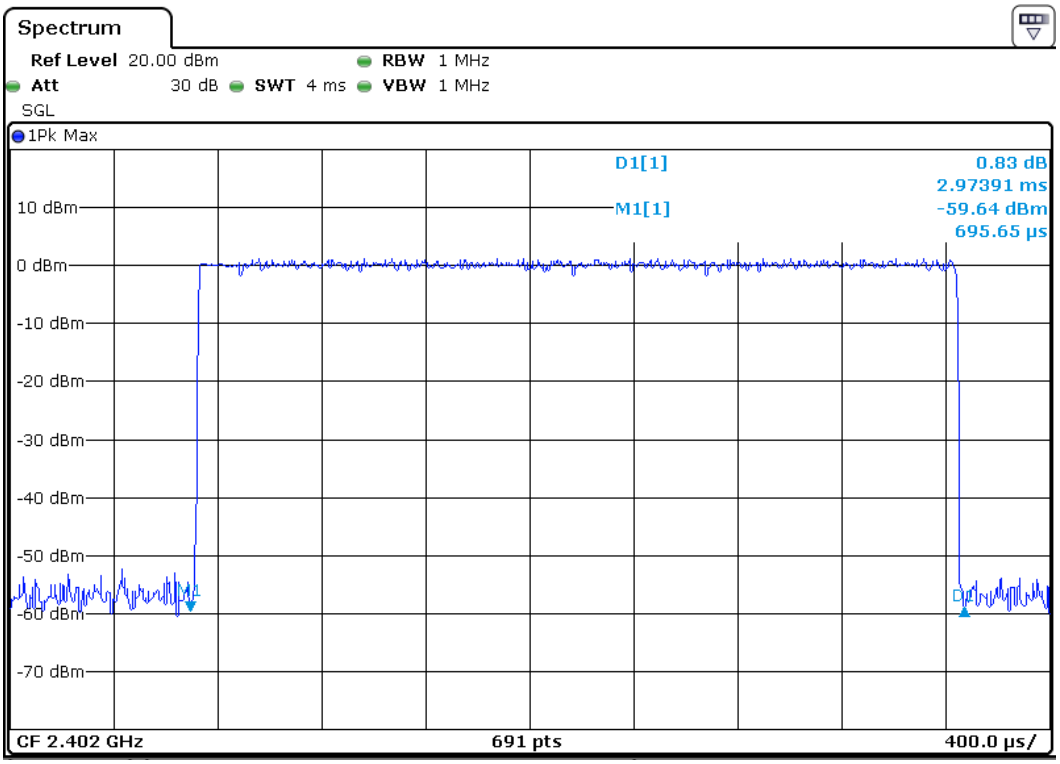
CH 00- DH1



CH 00- DH3



CH 00- DH5



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.

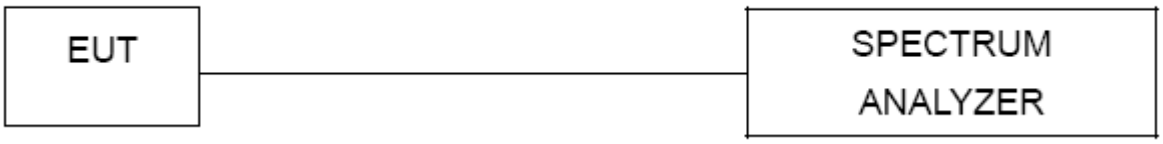
(3) The above procedure shall be repeated at the lowest, the middle, and the highest frequency of the stated frequency range with modulated mode. Also shall be performed at different modes of operation.

(4)

6.8.3 Deviation from standard

No deviation.

6.8.4 Test setup

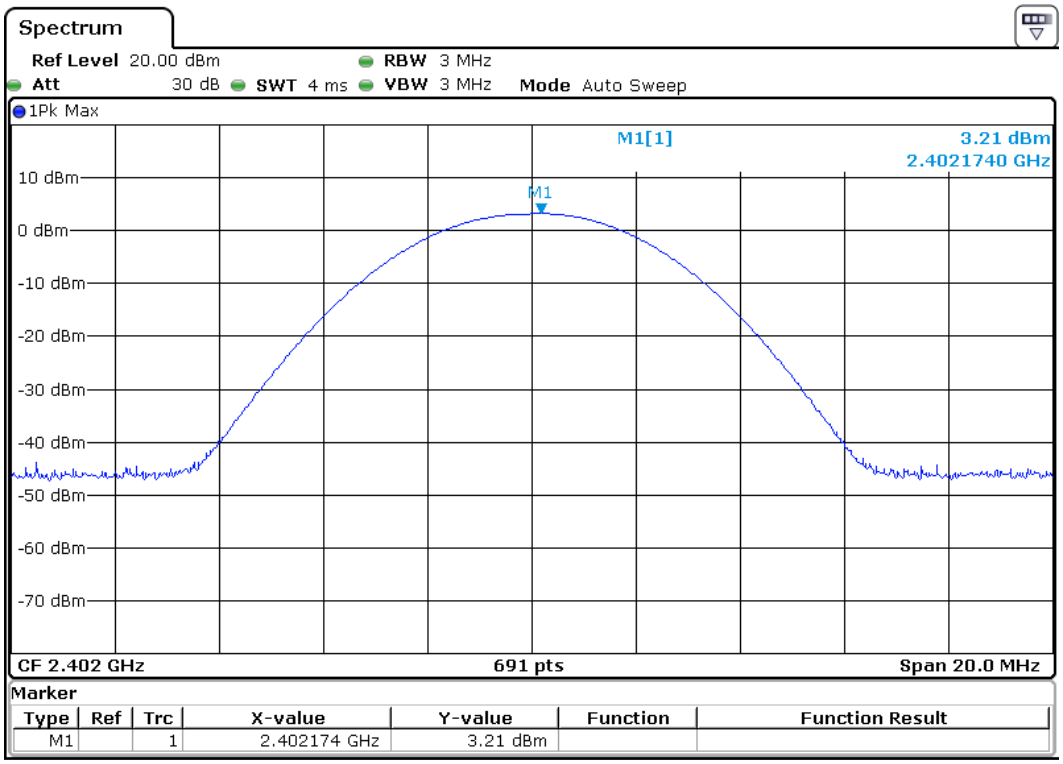


6.8.5 Test results

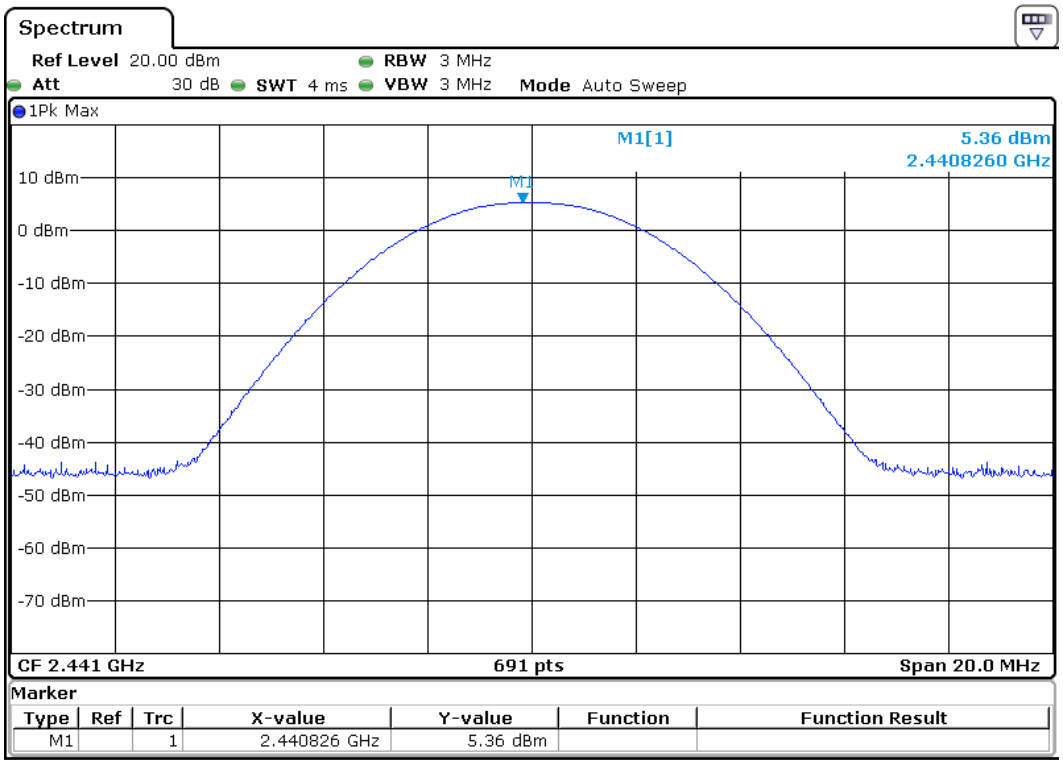
EUT:	OT2800	Model Name :	TURTLE SHELL® 3.0
Temperature:	26 ℃	Relative Humidity:	60%
Pressure:	1010 hPa	Test Voltage :	DC 3.7V from battery
Test Mode :	TX		
Note: All the data rates have be tested and the worst-case as the table below.			

Test Mode	Frequency	Peak Output Power (dBm)	Limit (dBm)	Result
Data rate 1Mbps	2402 MHz	3.21	21	Pass
	2441 MHz	5.36	21	Pass
	2480 MHz	2.93	21	Pass
Data rate 3Mbps	2402 MHz	1.83	21	Pass
	2441 MHz	4.56	21	Pass
	2480 MHz	4.06	21	Pass
Cable loss = 0.5 dBm				

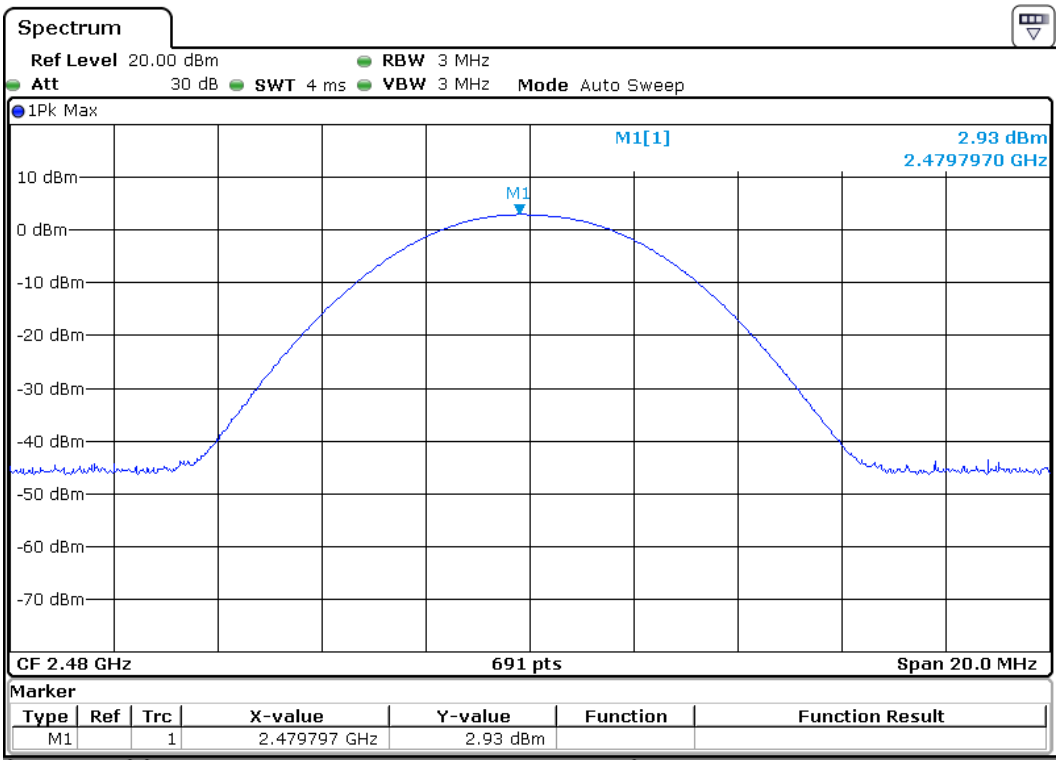
CH 00-1Mbps



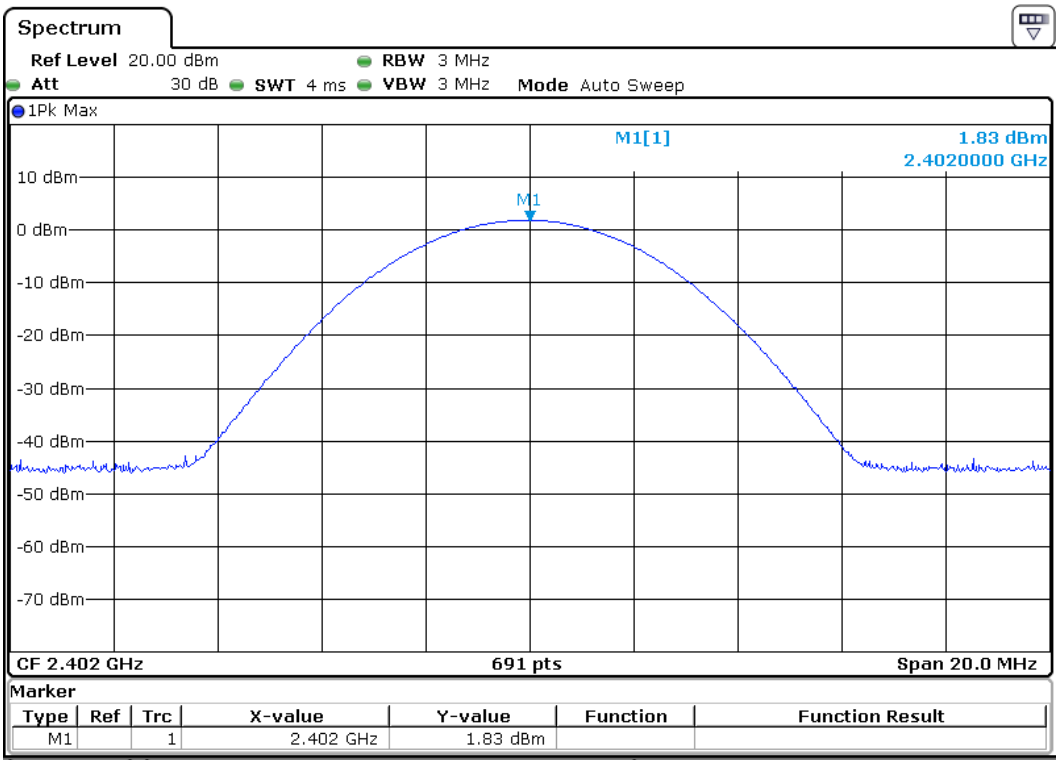
CH 39-1Mbps



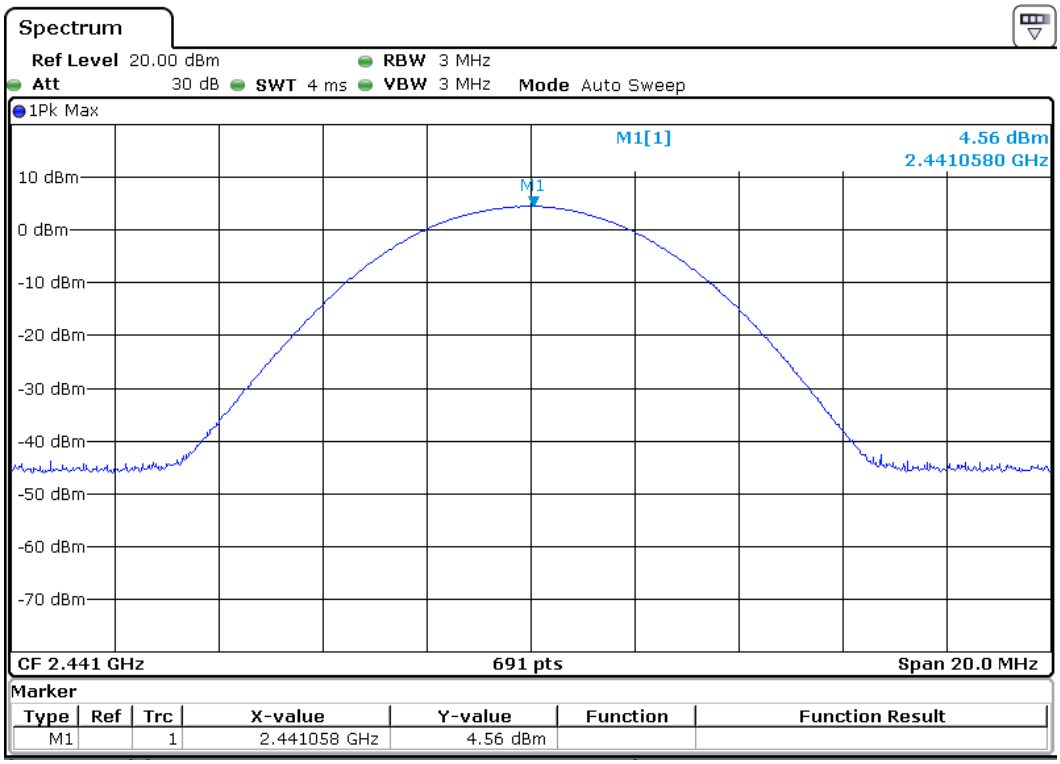
CH 78-1Mbps



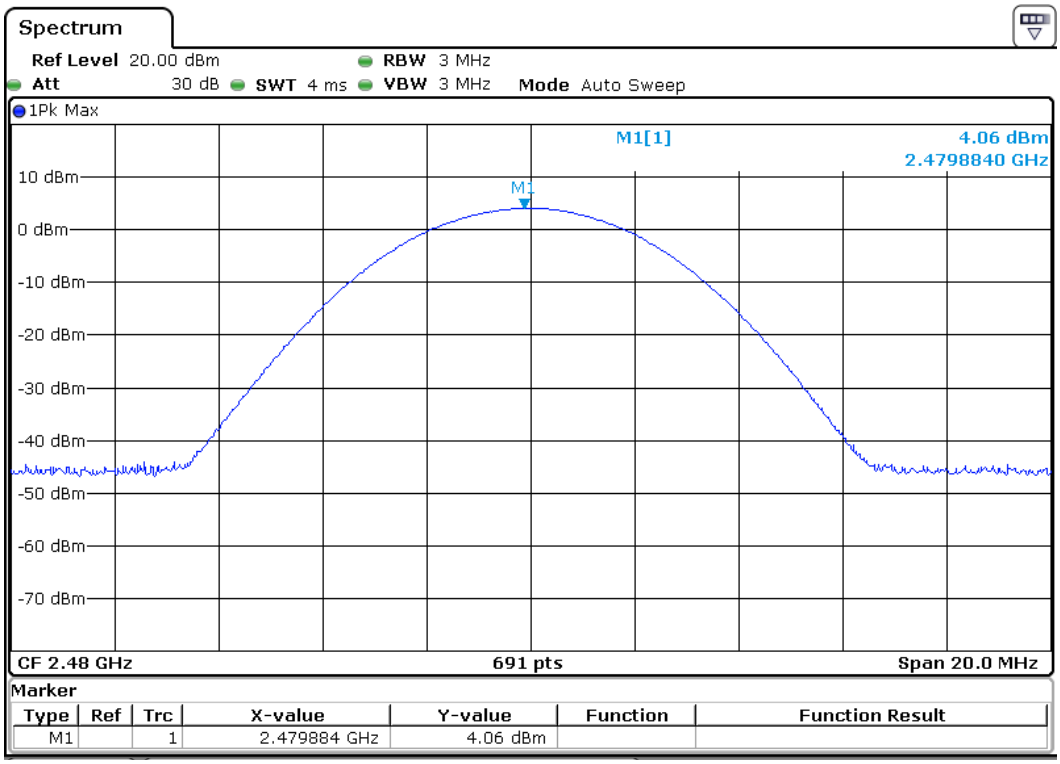
CH 00-3Mbps



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)).

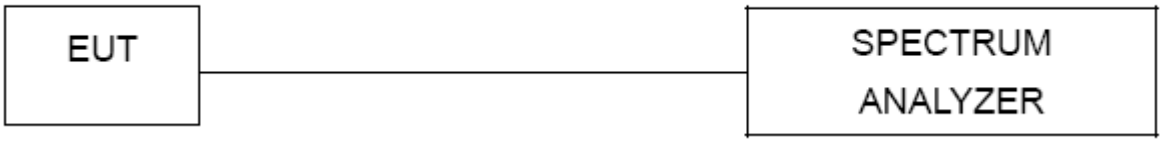
6.9.2 Test procedure

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

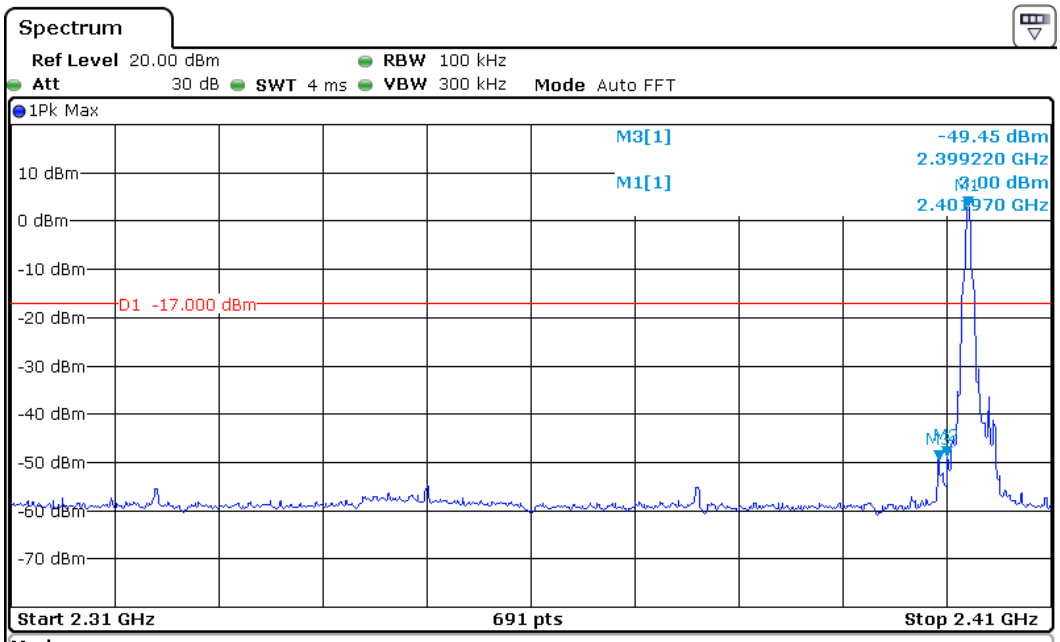
No deviation.

6.9.4 Test setup



6.9.5 Test results

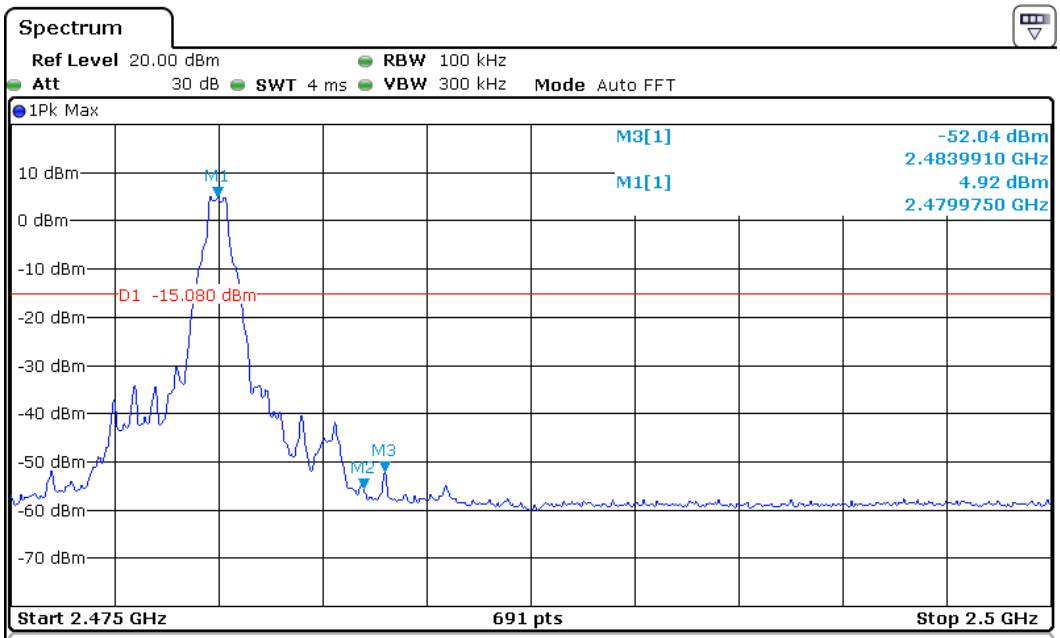
CH00 (Lower) Data rate 1Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40197 GHz	3.00 dBm		
M2		1	2.4 GHz	-48.72 dBm		
M3		1	2.39922 GHz	-49.45 dBm		

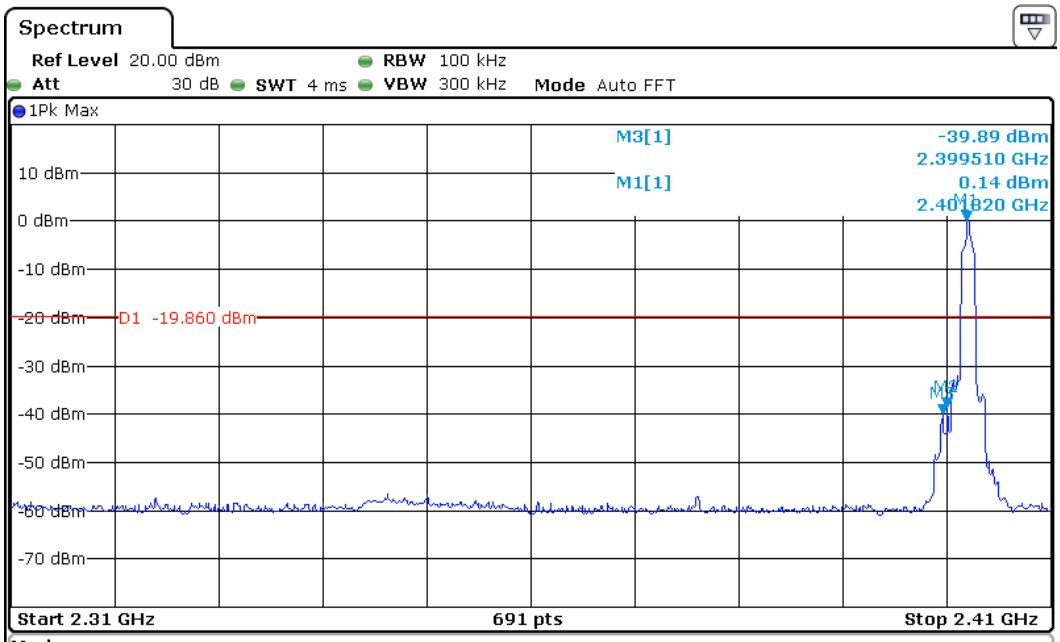
CH 78 (Upper) Data rate 1Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479975 GHz	4.92 dBm		
M2		1	2.4835 GHz	-55.45 dBm		
M3		1	2.483991 GHz	-52.04 dBm		

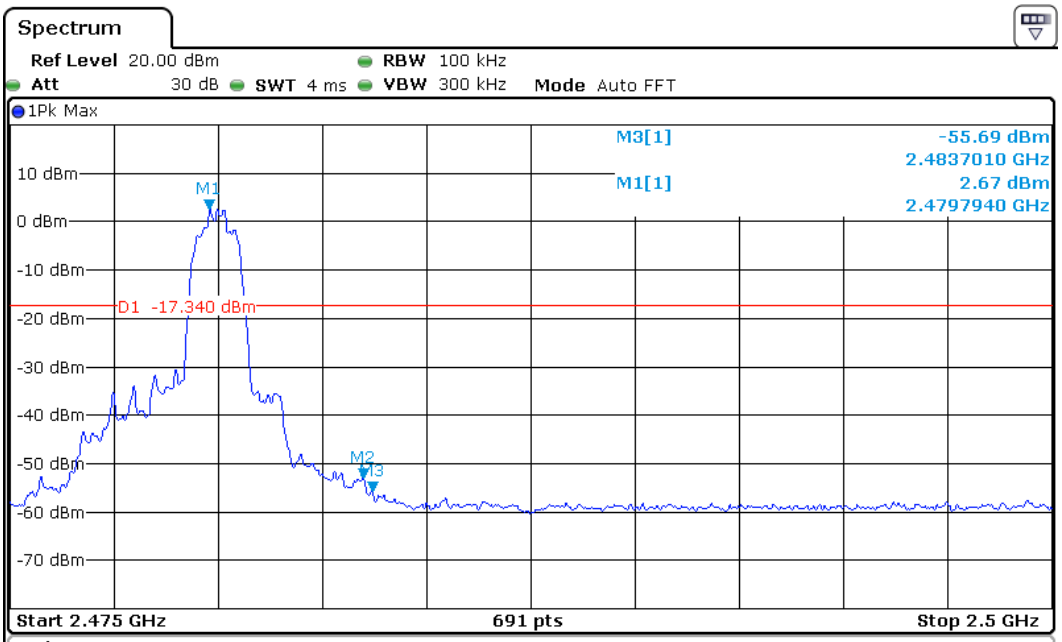
CH00 (Lower) Data rate 3Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40182 GHz	0.14 dBm		
M2		1	2.4 GHz	-38.53 dBm		
M3		1	2.39951 GHz	-39.89 dBm		

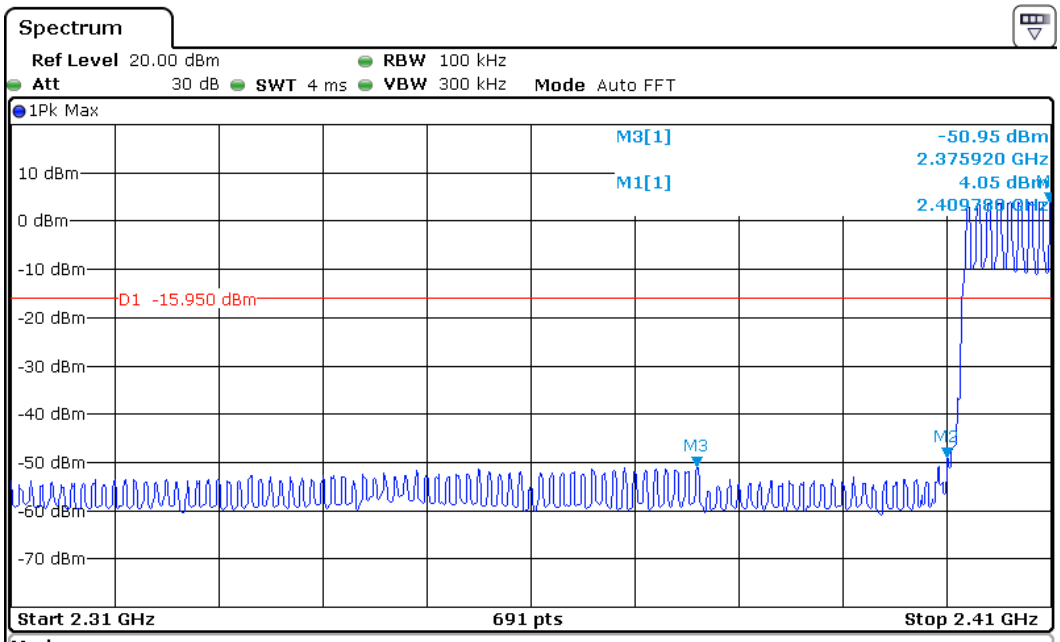
CH 78 (Upper) Data rate 3Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.479794 GHz	2.67 dBm		
M2		1	2.4835 GHz	-53.01 dBm		
M3		1	2.483701 GHz	-55.69 dBm		

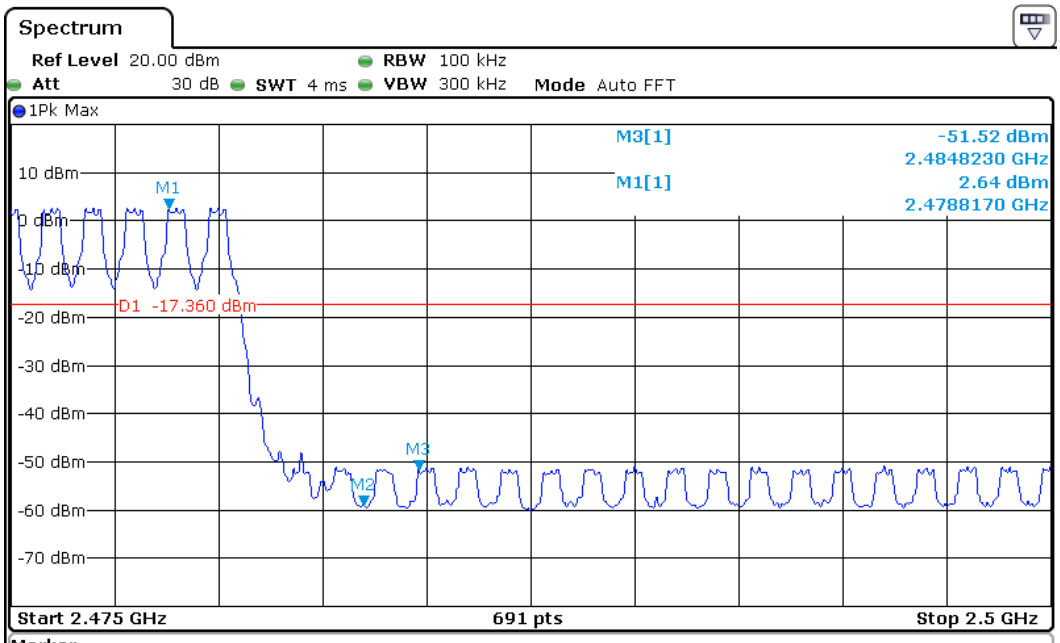
CH00 (Lower) Data rate 1Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40978 GHz	4.05 dBm		
M2		1	2.4 GHz	-49.02 dBm		
M3		1	2.37592 GHz	-50.95 dBm		

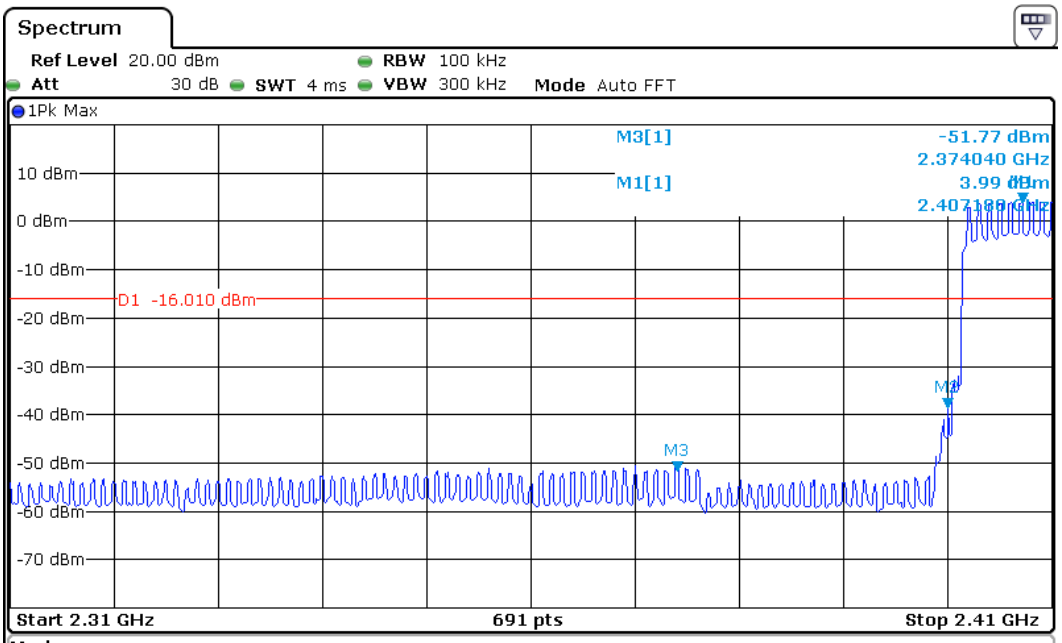
CH 78 (Upper) Data rate 1Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.478817 GHz	2.64 dBm		
M2		1	2.4835 GHz	-59.12 dBm		
M3		1	2.484823 GHz	-51.52 dBm		

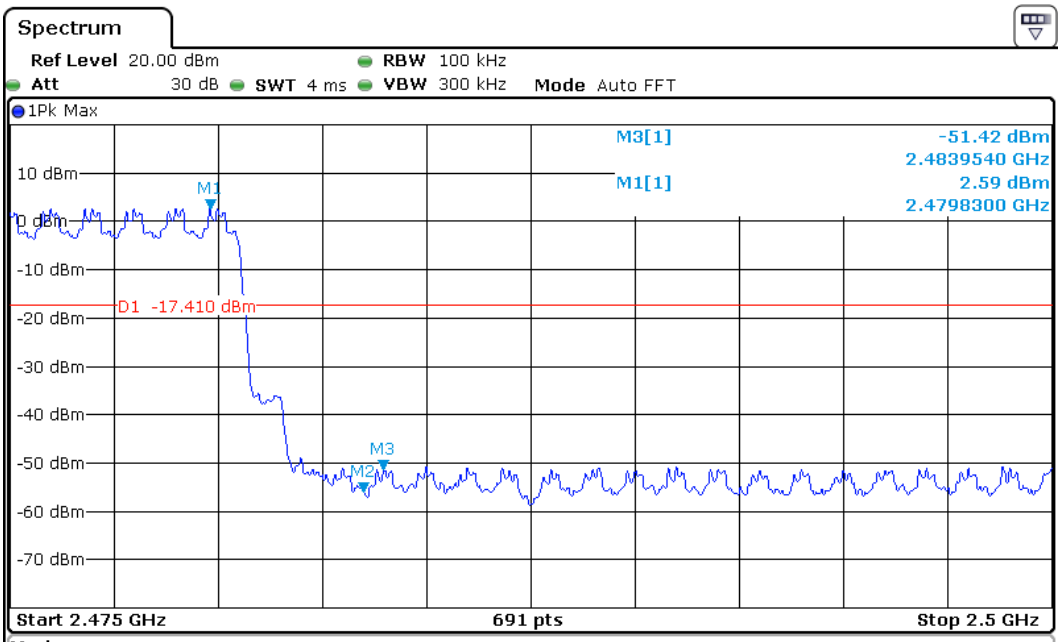
CH00 (Lower) Data rate 3Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40718 GHz	3.99 dBm		
M2		1	2.4 GHz	-38.66 dBm		
M3		1	2.37404 GHz	-51.77 dBm		

CH 78 (Upper) Data rate 3Mbps



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47983 GHz	2.59 dBm		
M2		1	2.4835 GHz	-56.12 dBm		
M3		1	2.483954 GHz	-51.42 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)).

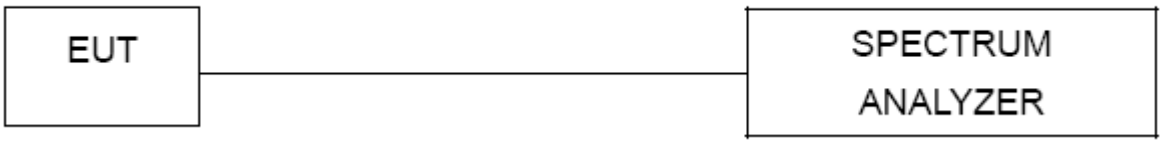
6.10.2 Test procedure

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

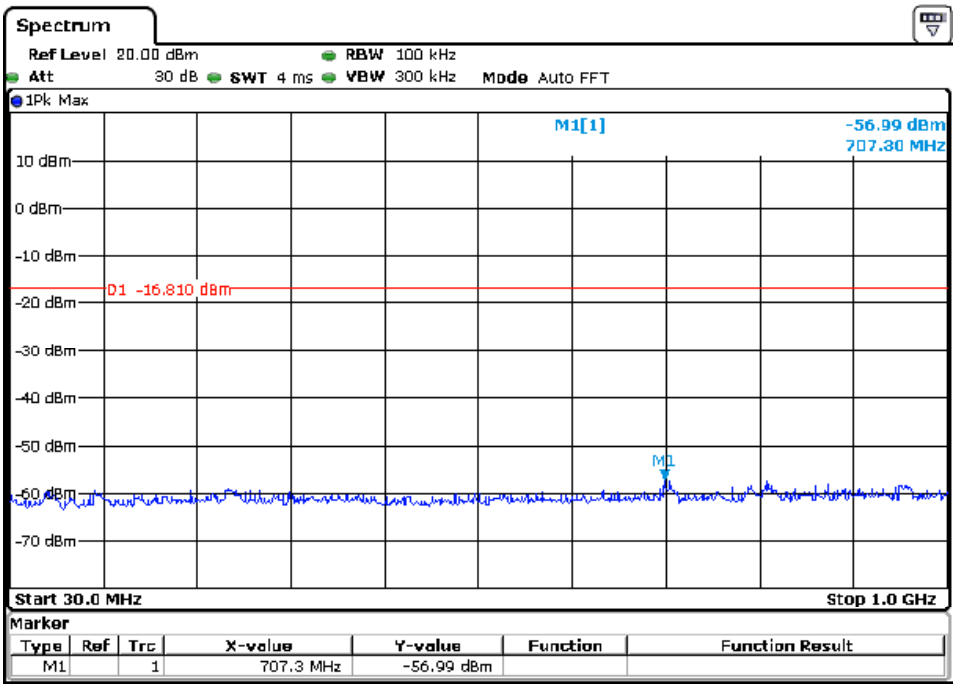
No deviation.

6.10.4 Test setup



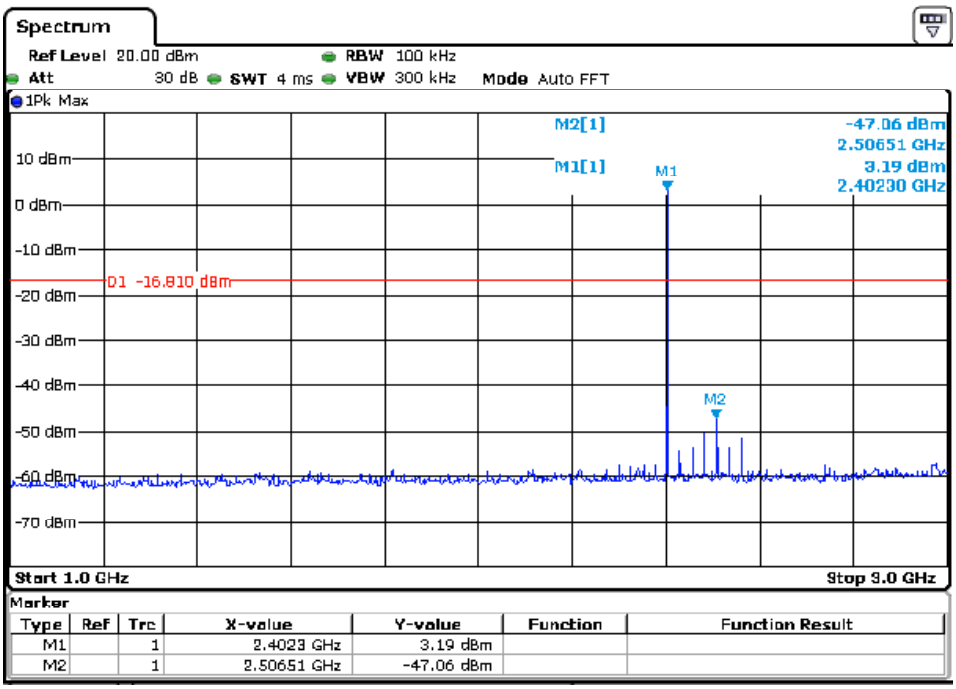
6.10.5Test results

CH00 Data rate 1Mbps



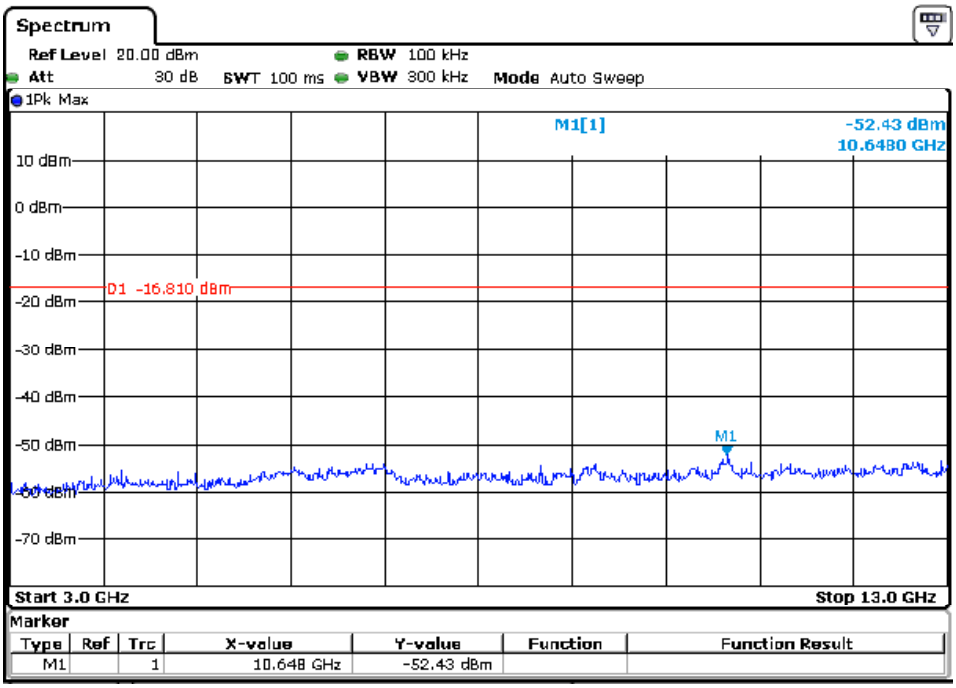
Note: Sweep Points=9700

CH00 Data rate 1Mbps



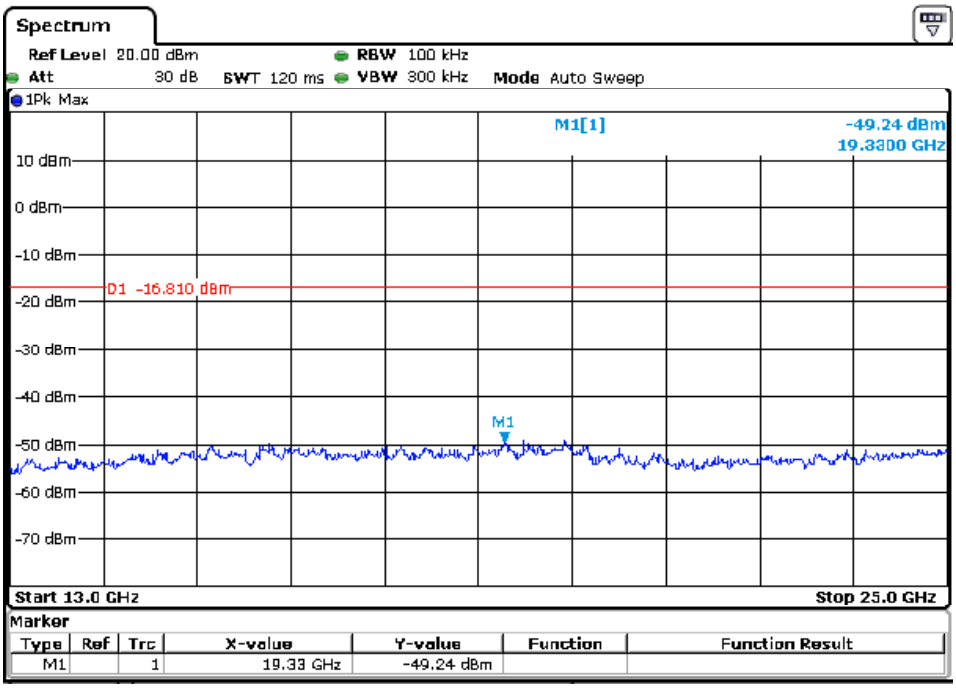
Note: Sweep Points=20000

CH00 Data rate 1Mbps



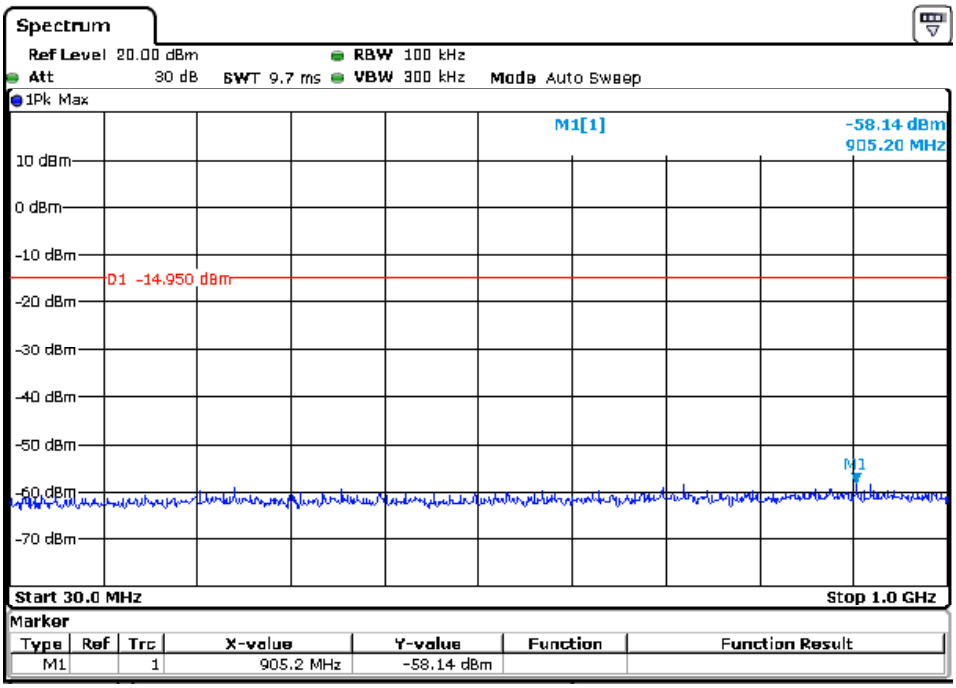
Note: Sweep Points=100000

CH00 Data rate 1Mbps



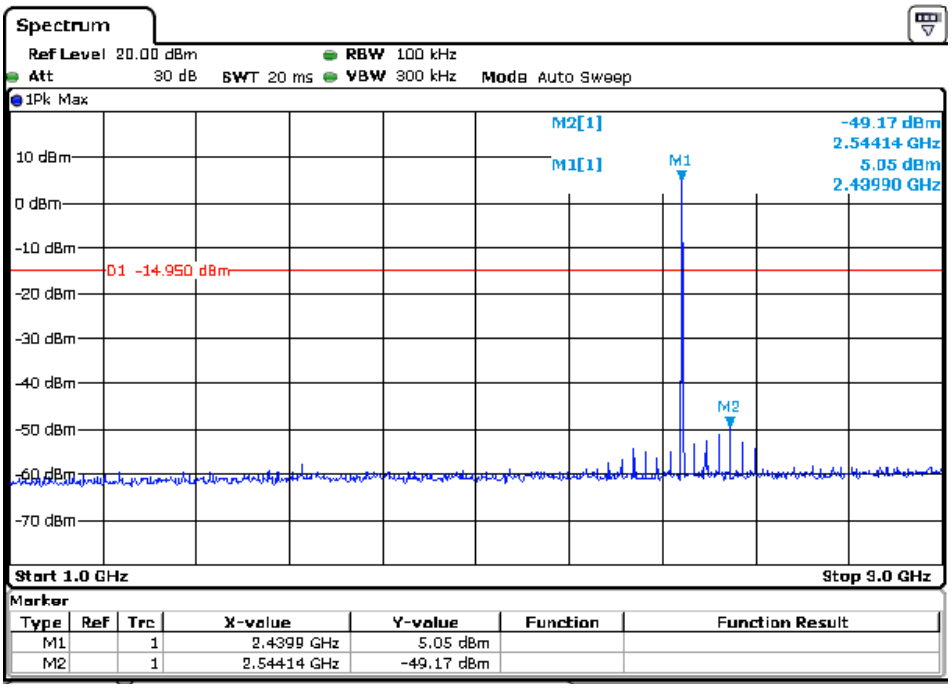
Note: Sweep Points=120000

CH39 Data rate 1Mbps



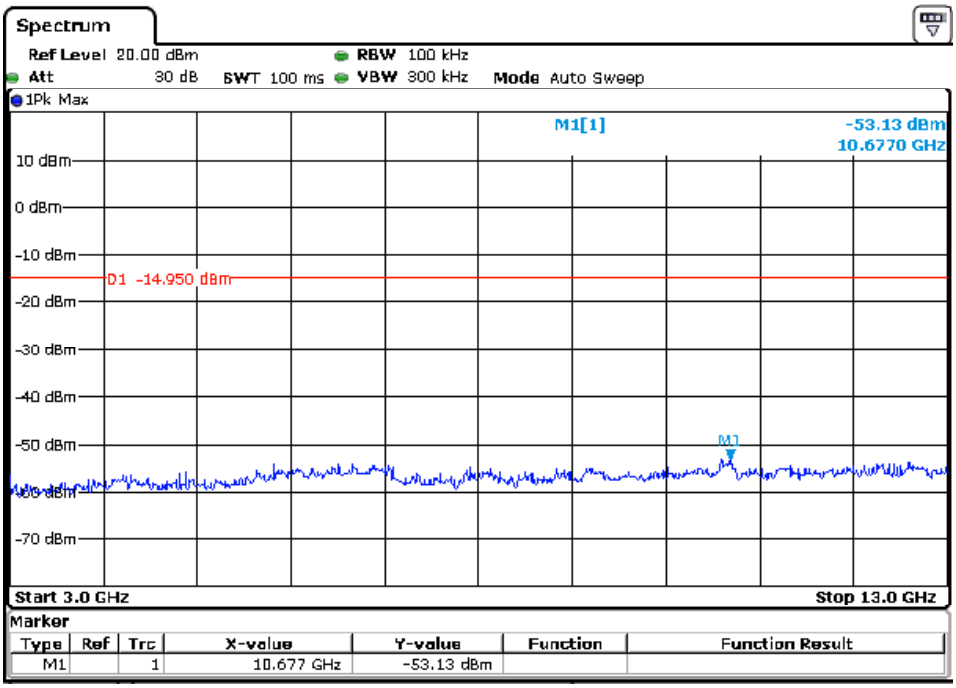
Note: Sweep Points=9700

CH39 Data rate 1Mbps



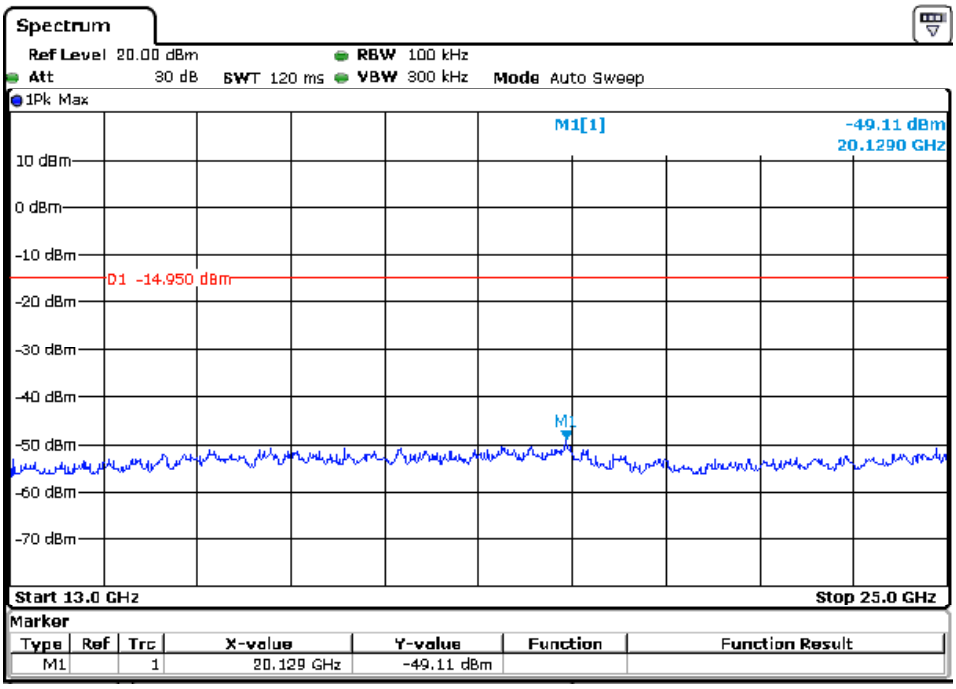
Note: Sweep Points=20000

CH39 Data rate 1Mbps



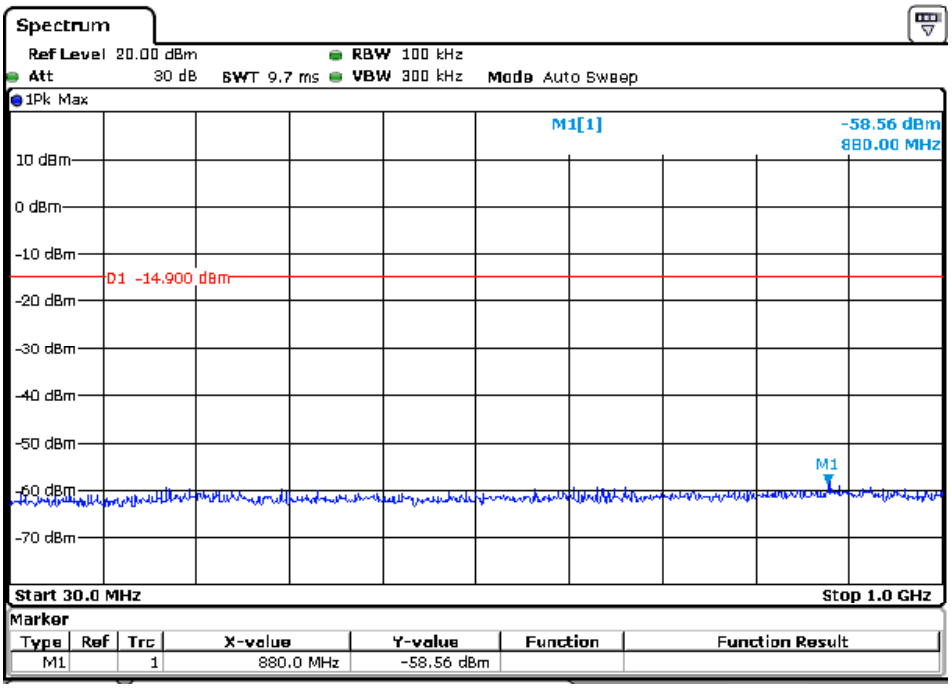
Note: Sweep Points=100000

CH39 Data rate 1Mbps



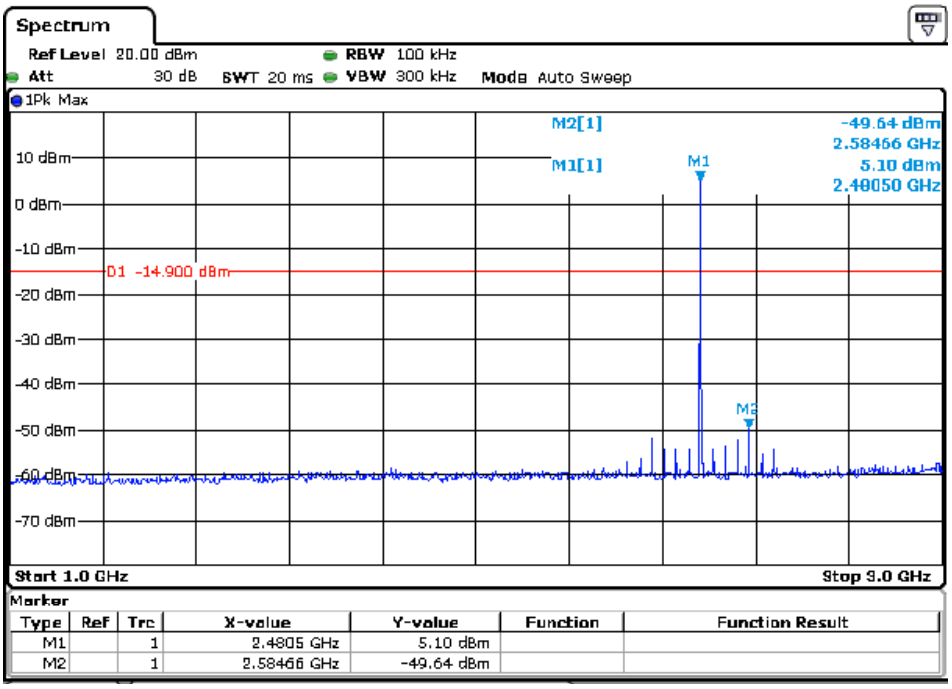
Note: Sweep Points=120000

CH78 Data rate 1Mbps



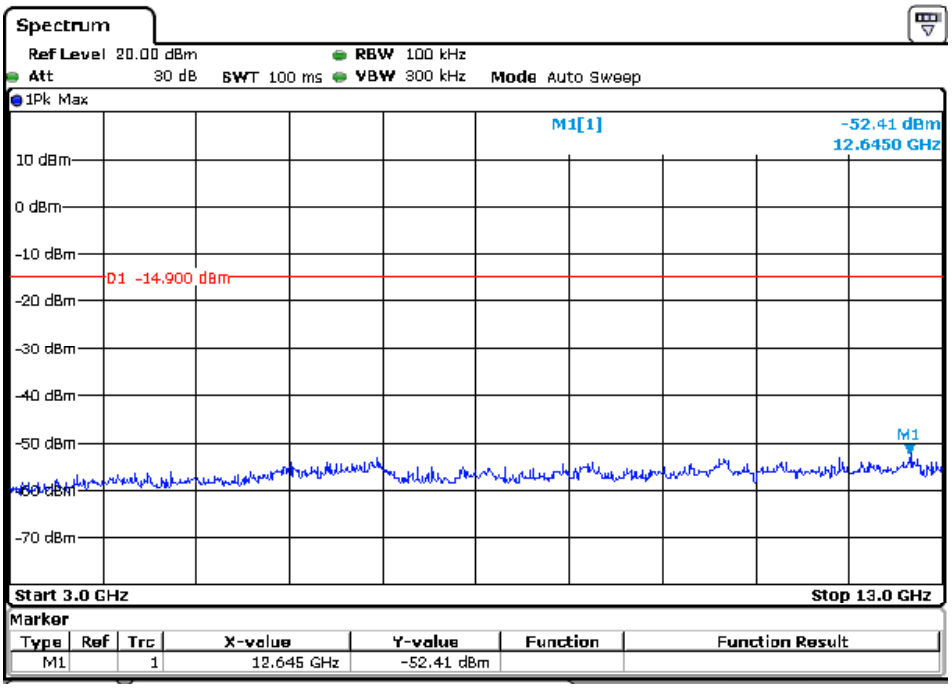
Note: Sweep Points=9700

CH78 Data rate 1Mbps



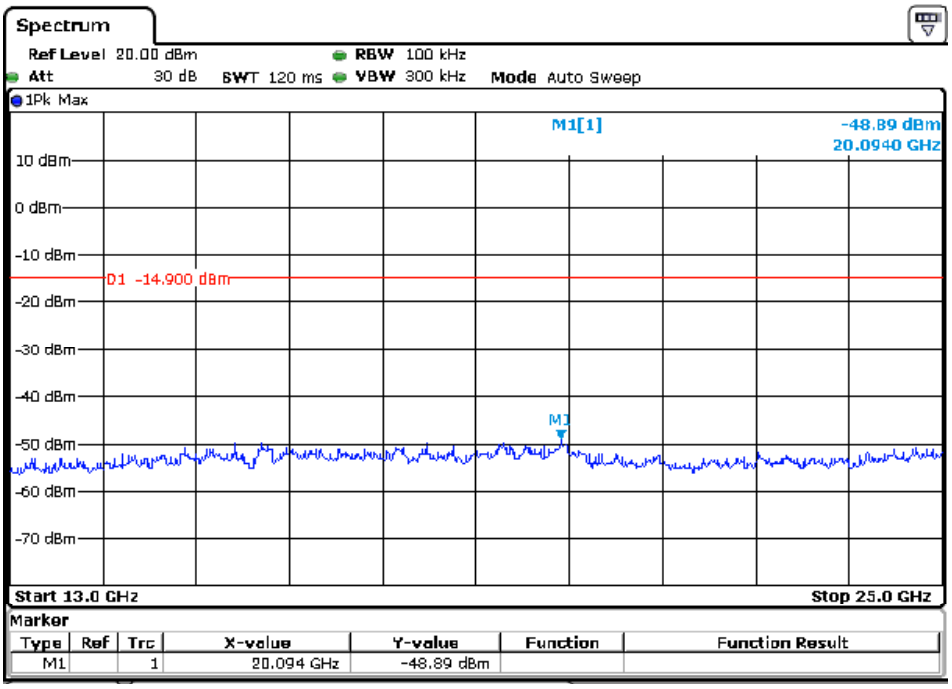
Note: Sweep Points=20000

CH78 Data rate 1Mbps



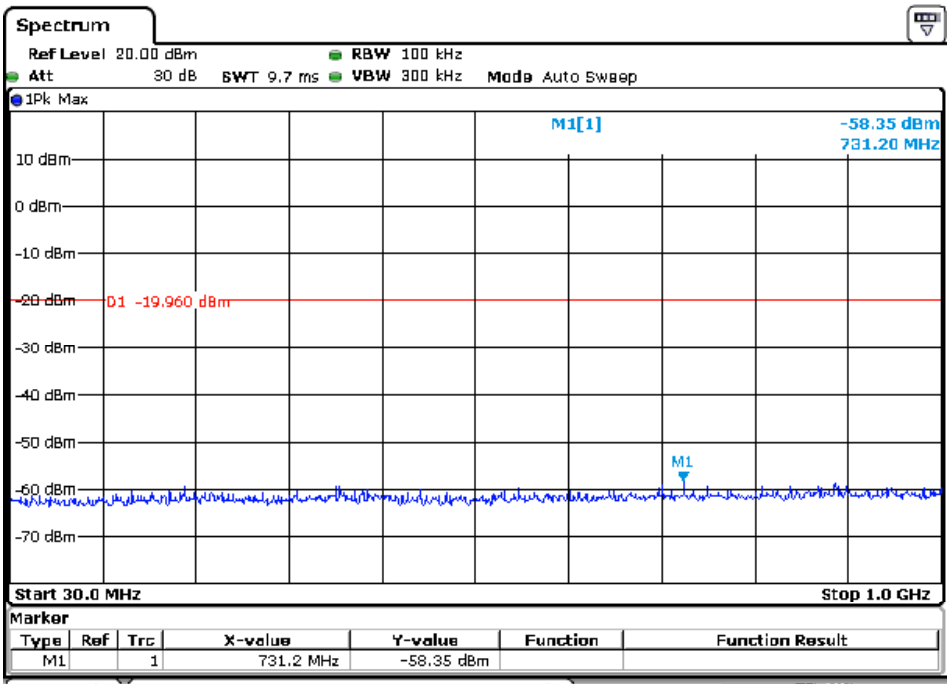
Note: Sweep Points=100000

CH78 Data rate 1Mbps



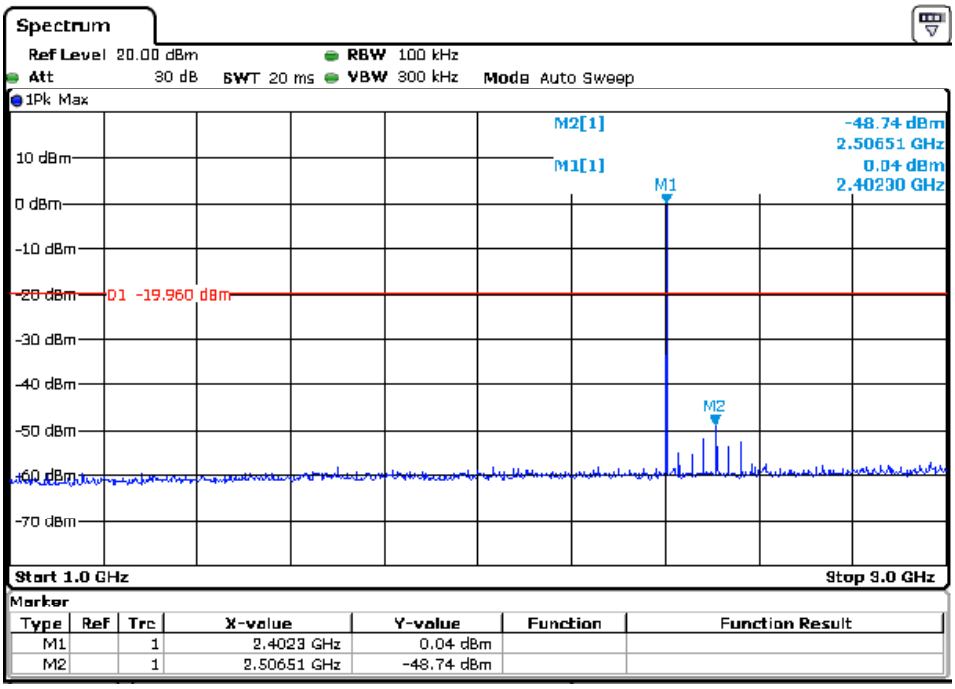
Note: Sweep Points=120000

CH00 Data rate 3Mbps



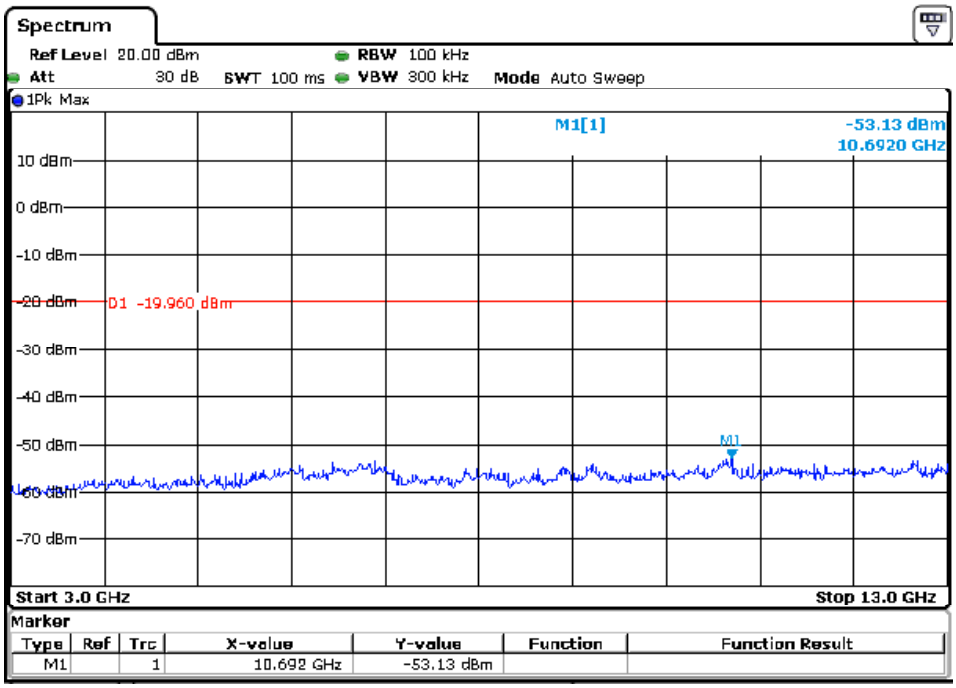
Note: Sweep Points=9700

CH00 Data rate 3Mbps



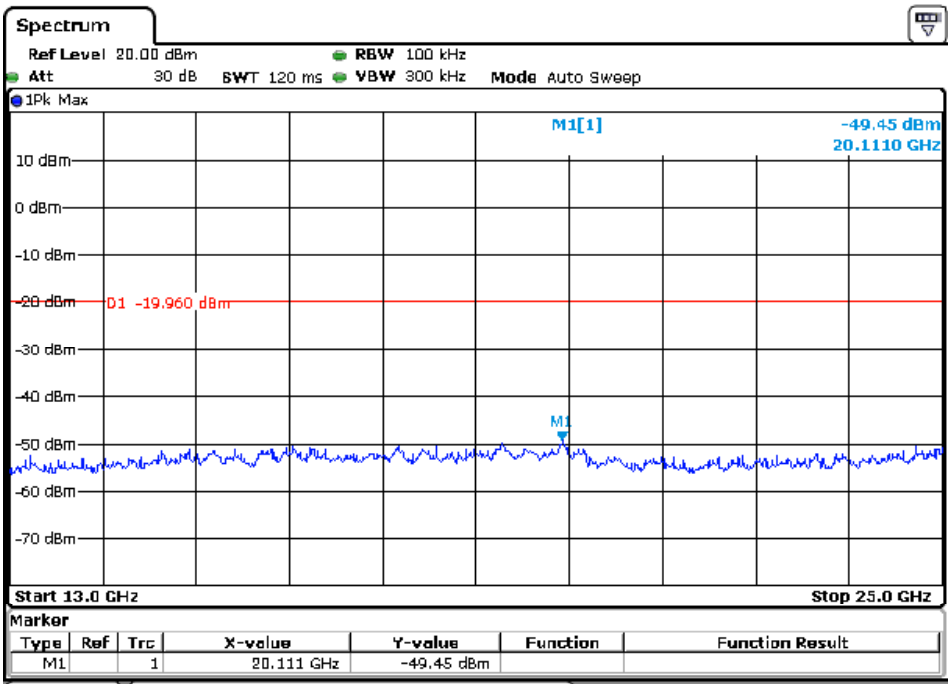
Note: Sweep Points=20000

CH00 Data rate 3Mbps



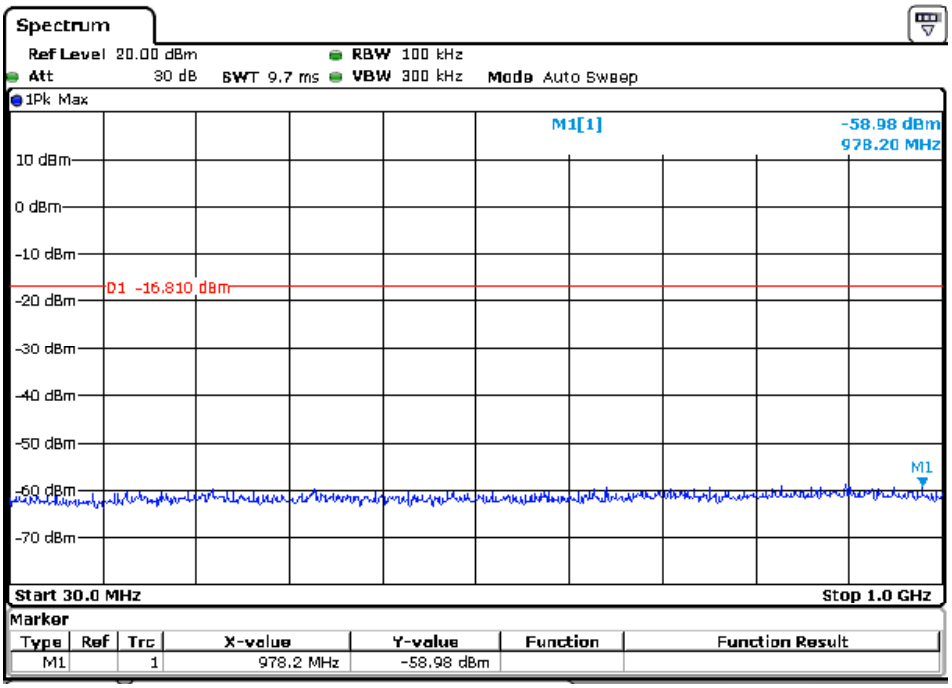
Note: Sweep Points=100000

CH00 Data rate 3Mbps



Note: Sweep Points=120000

CH39 Data rate 3Mbps



Note: Sweep Points=9700

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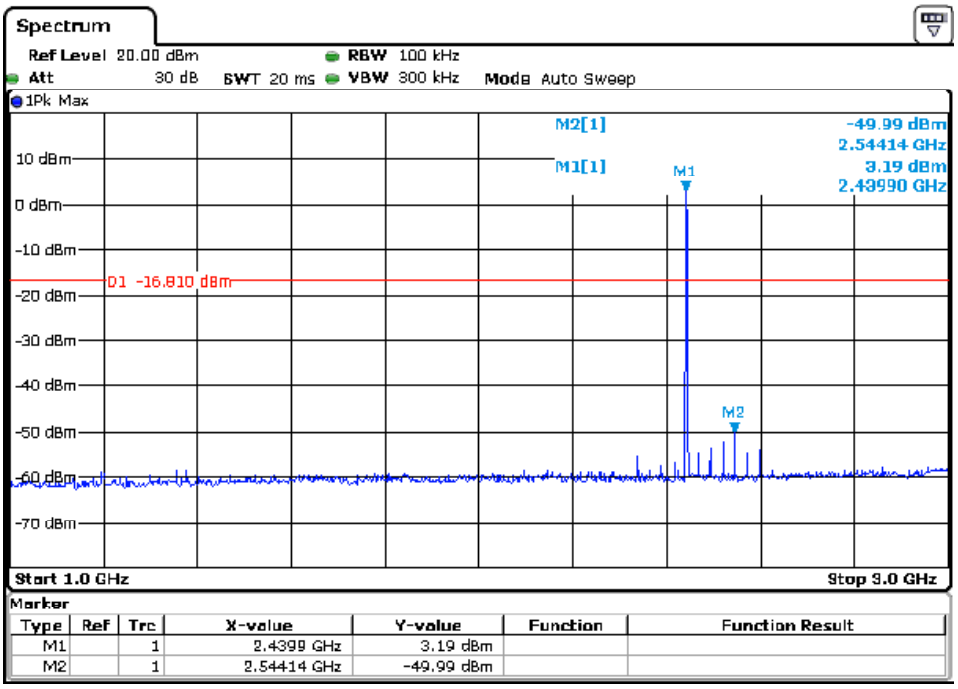
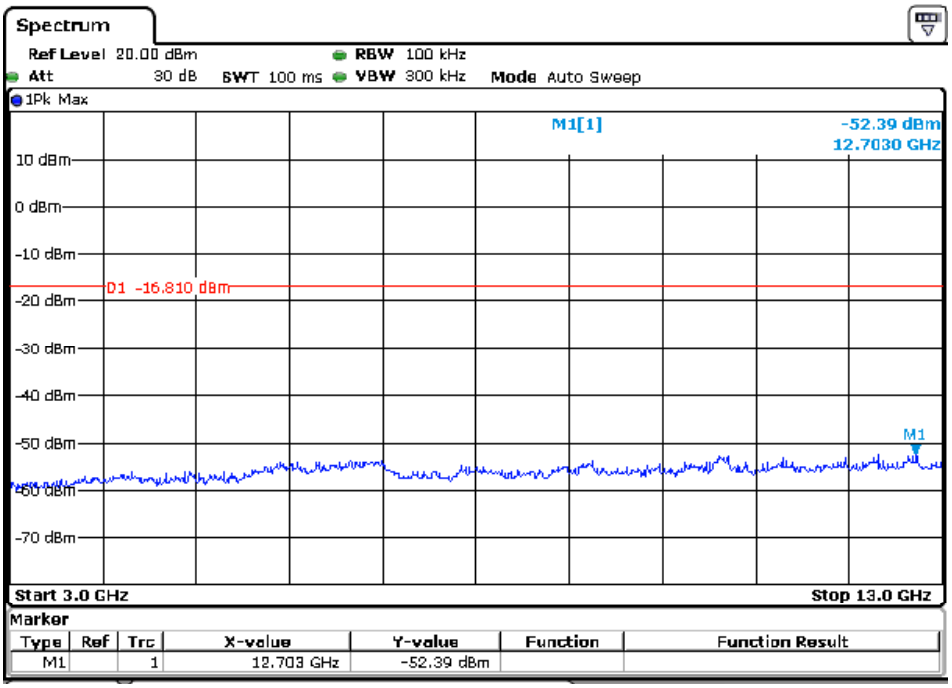


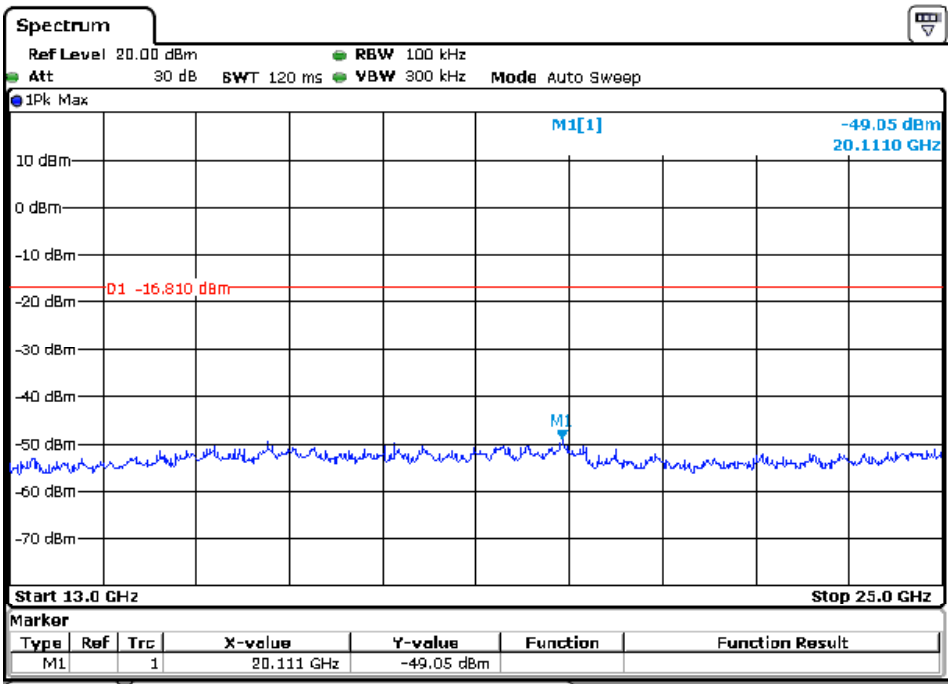
Note: Sweep Points=20000

CH39 Data rate 3Mbps



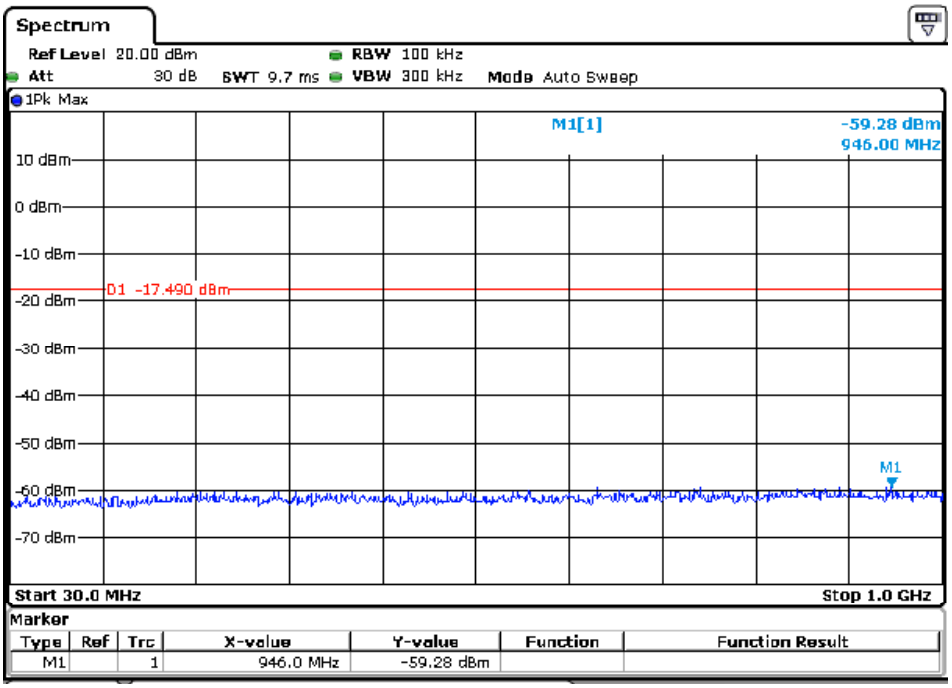
Note: Sweep Points=100000

CH39 Data rate 3Mbps



Note: Sweep Points=120000

CH78 Data rate 3Mbps



Note: Sweep Points=9700

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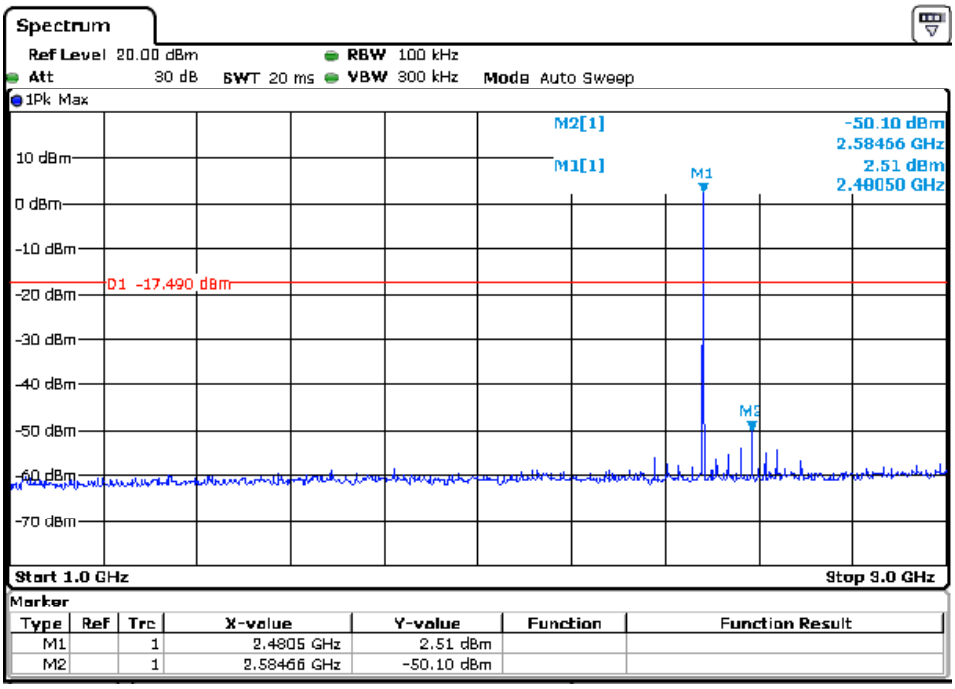

Note: Sweep Points=20000

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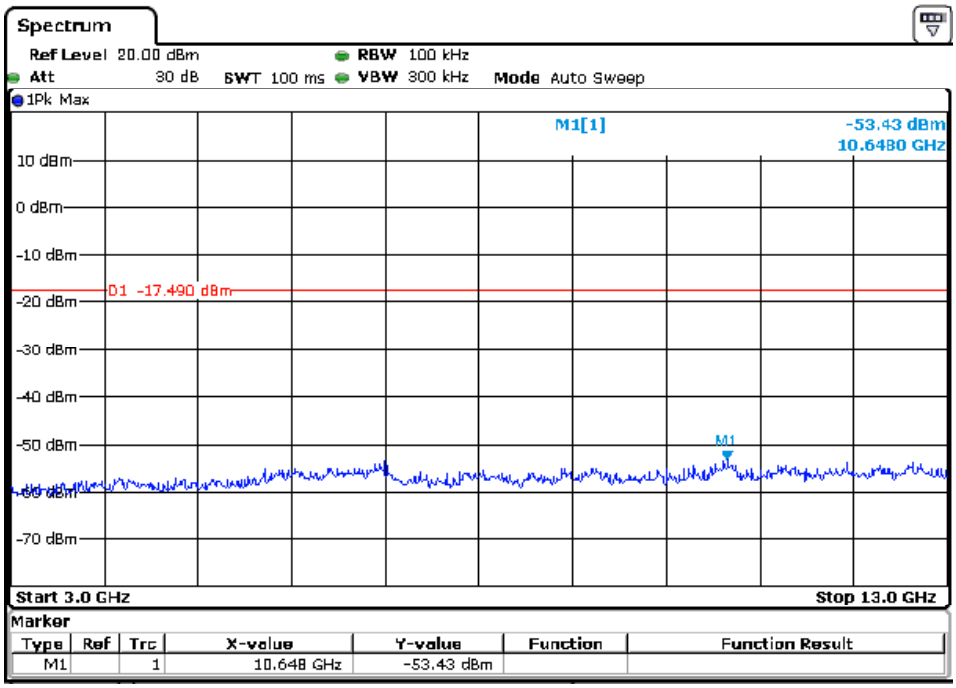
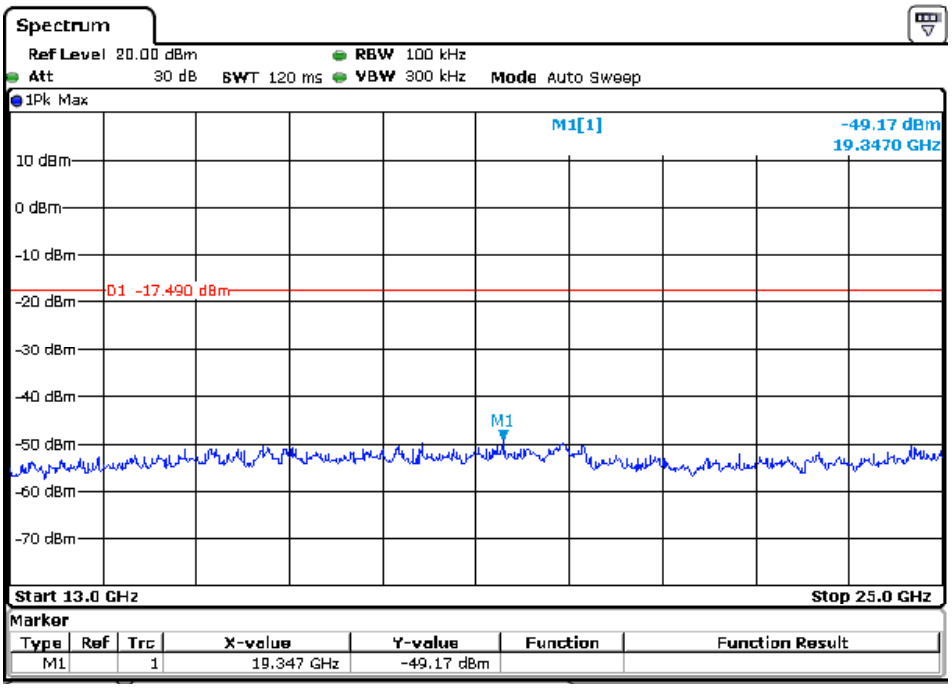


Note: Sweep Points=100000

CH78 Data rate 3Mbps

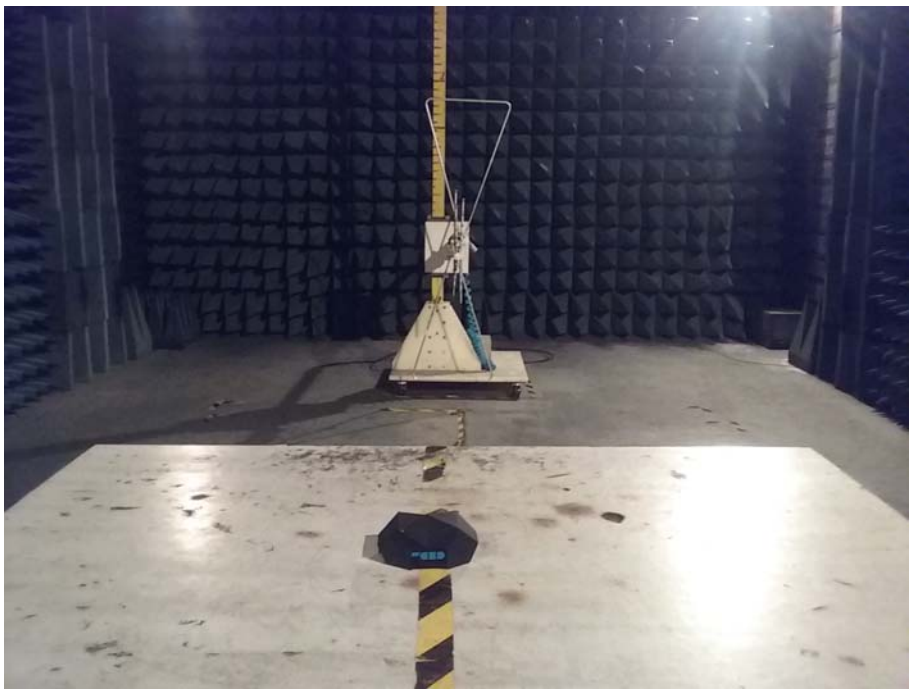


Note: Sweep Points=120000

7 Photographs

7.1 Radiated Emission Test Setup

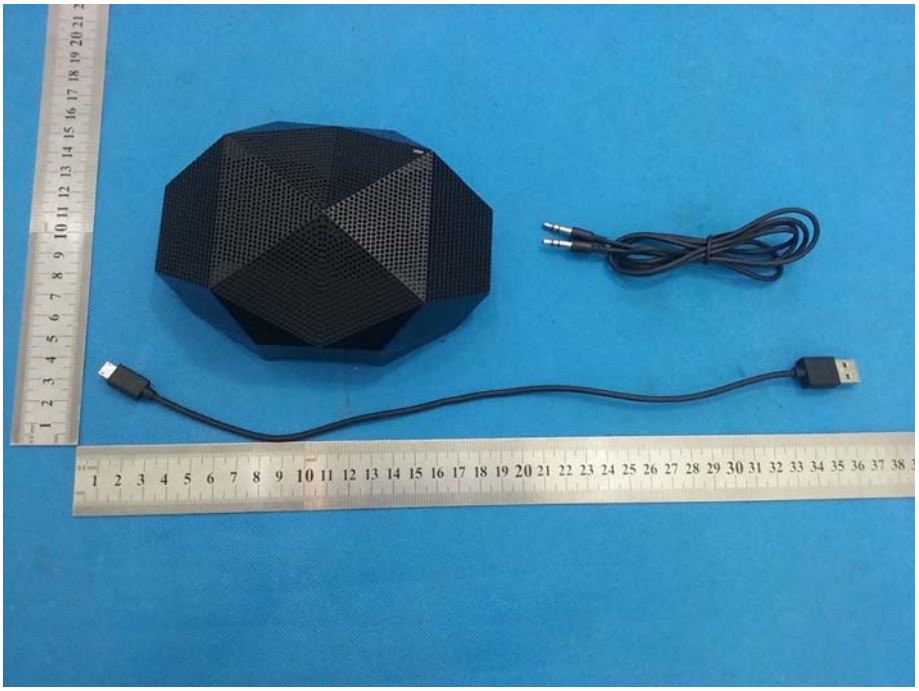
Below 1G

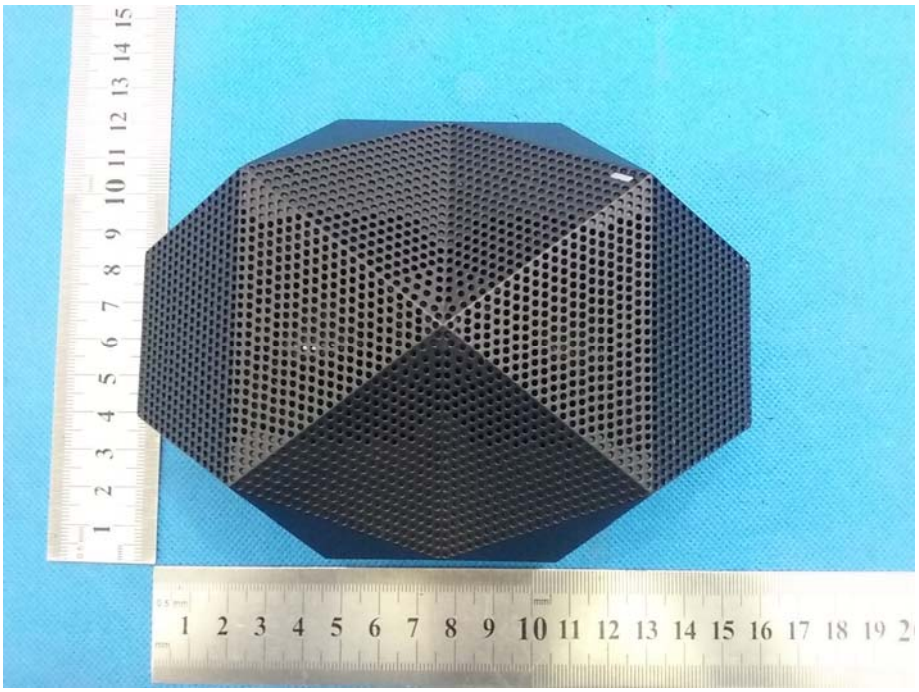


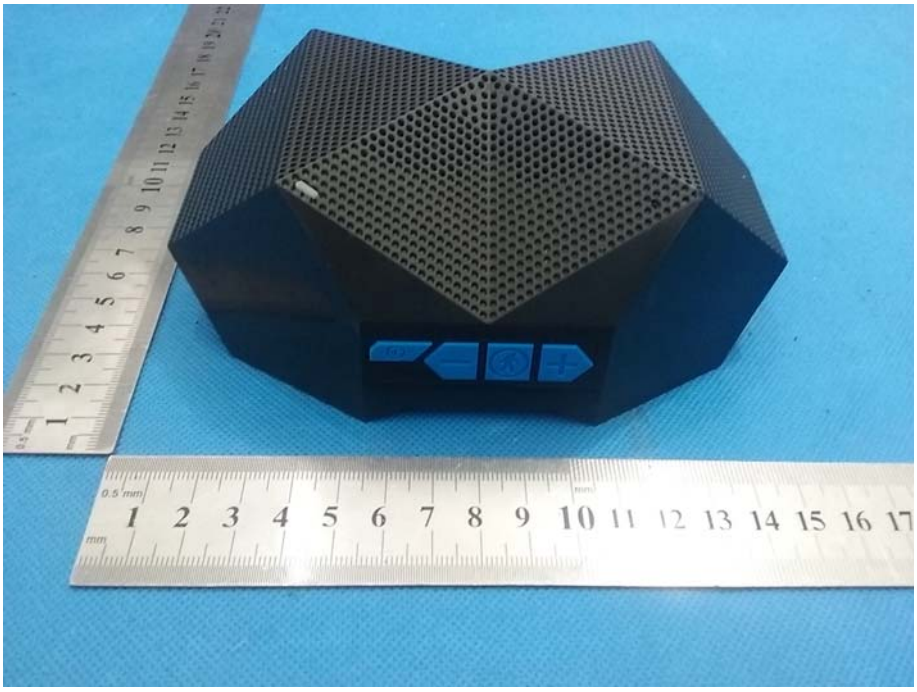
Above 1G

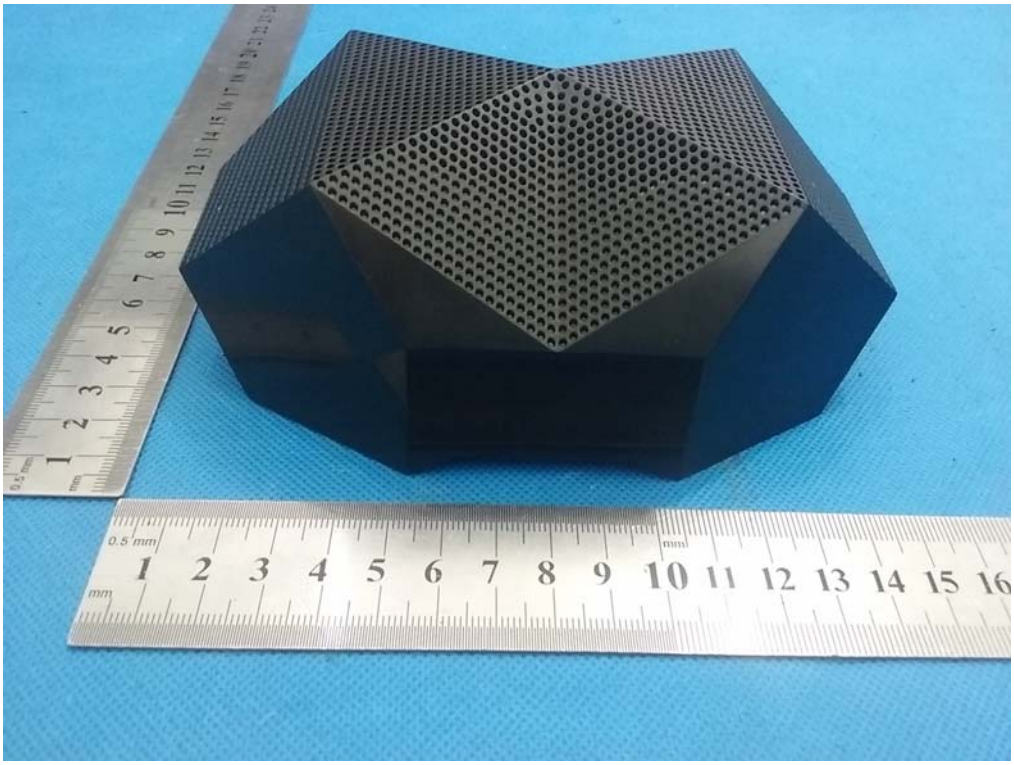
7.2 Conducted Emissions Test Setup

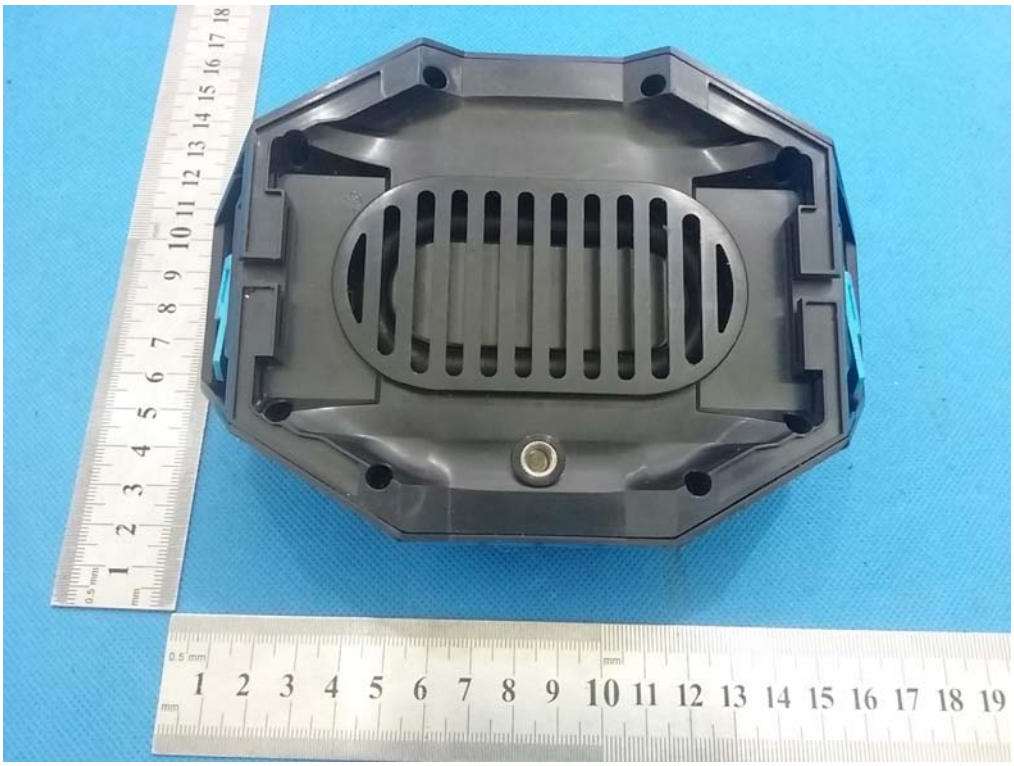
7.3 EUT Constructional Details

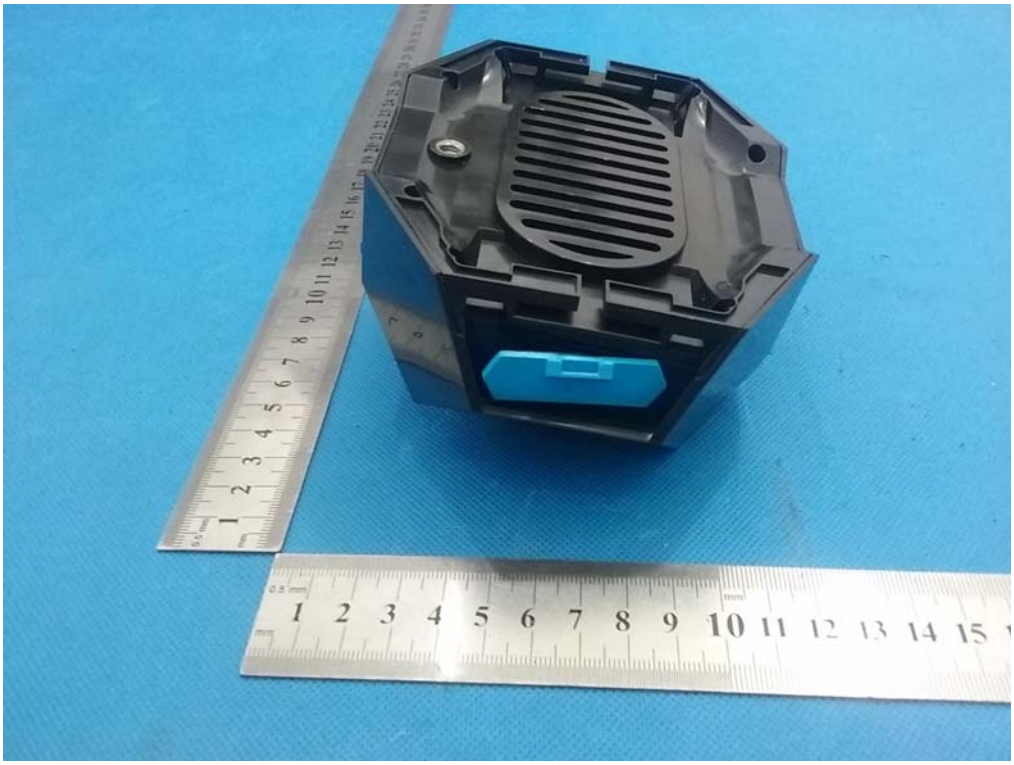




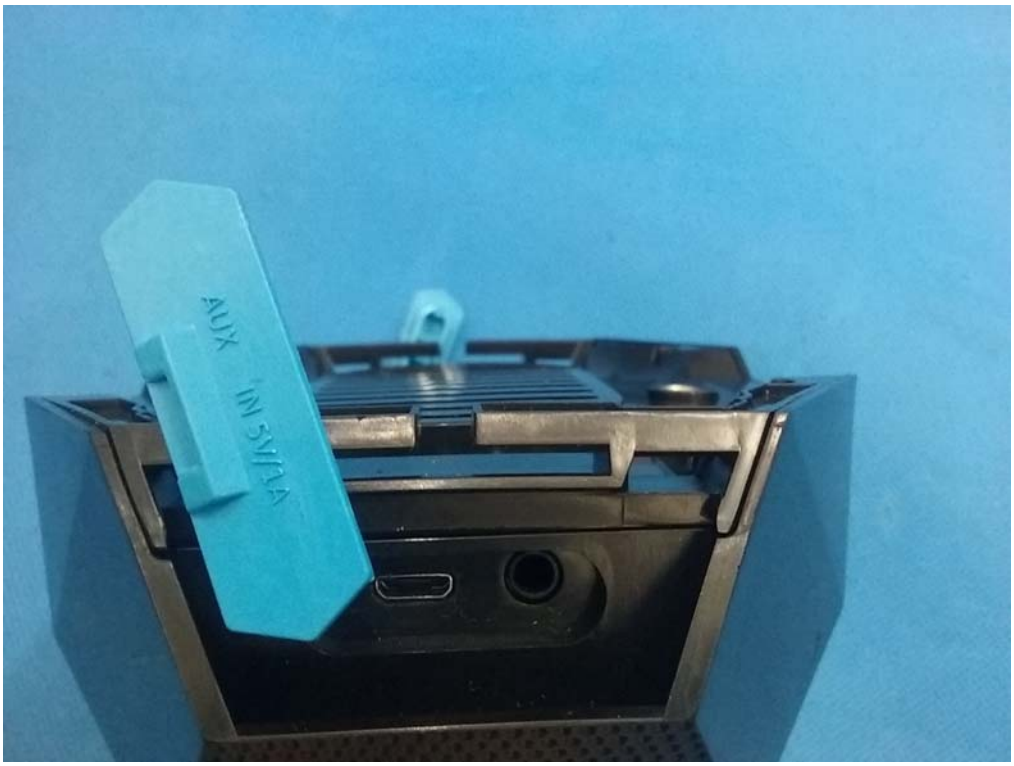


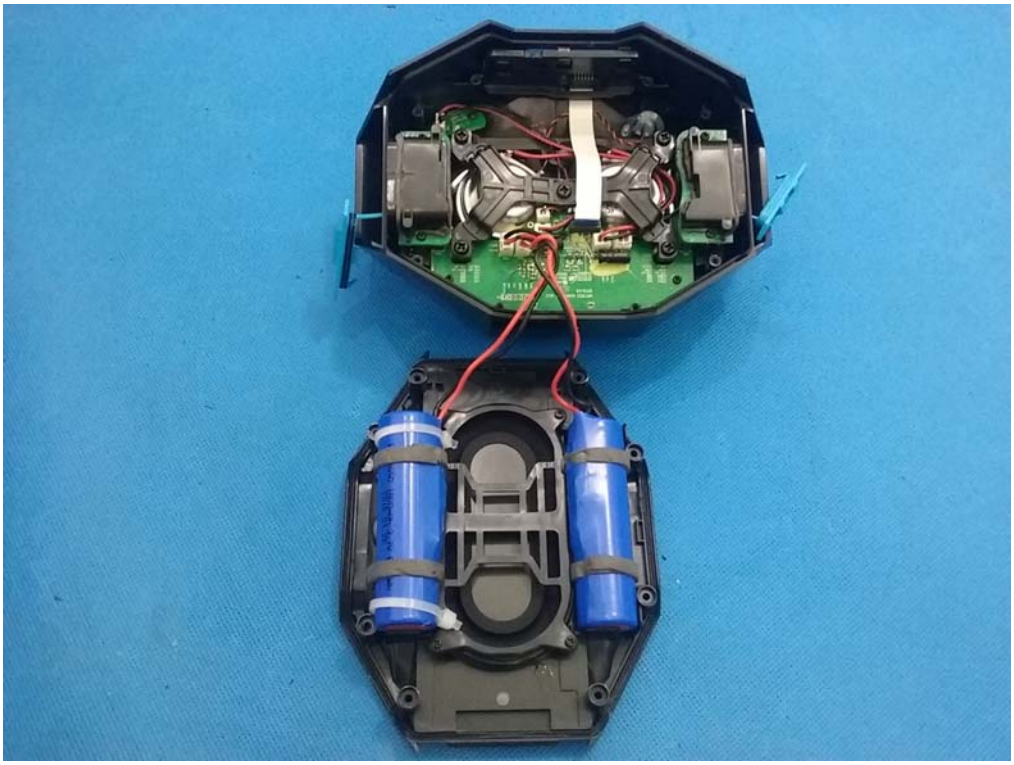


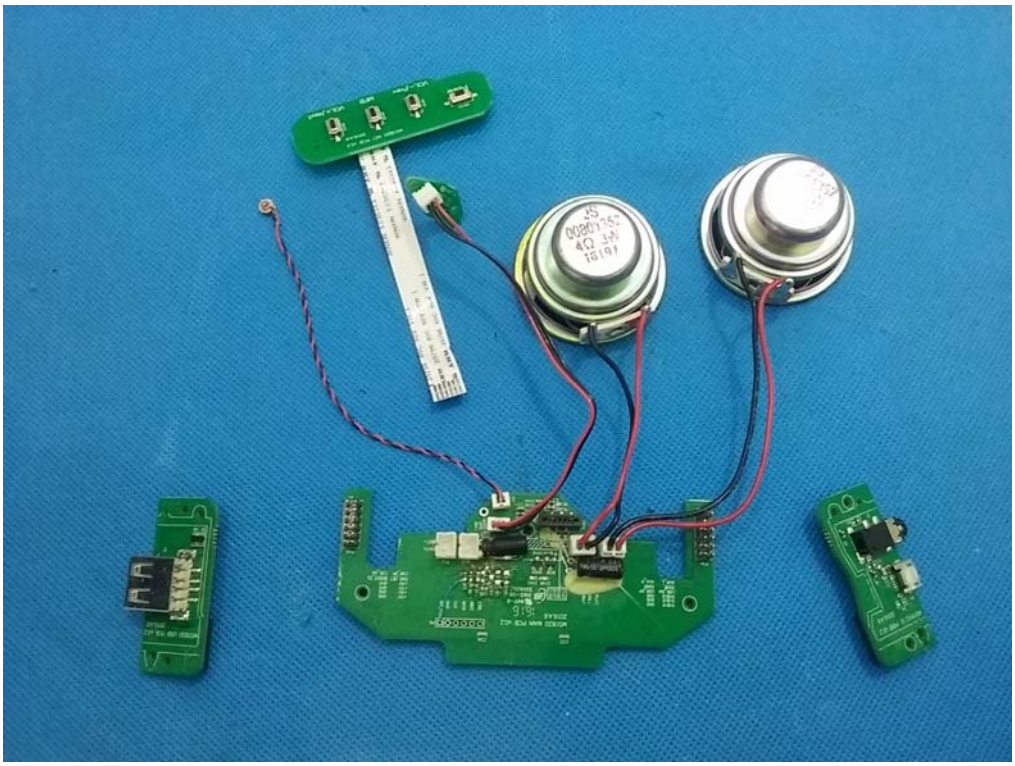


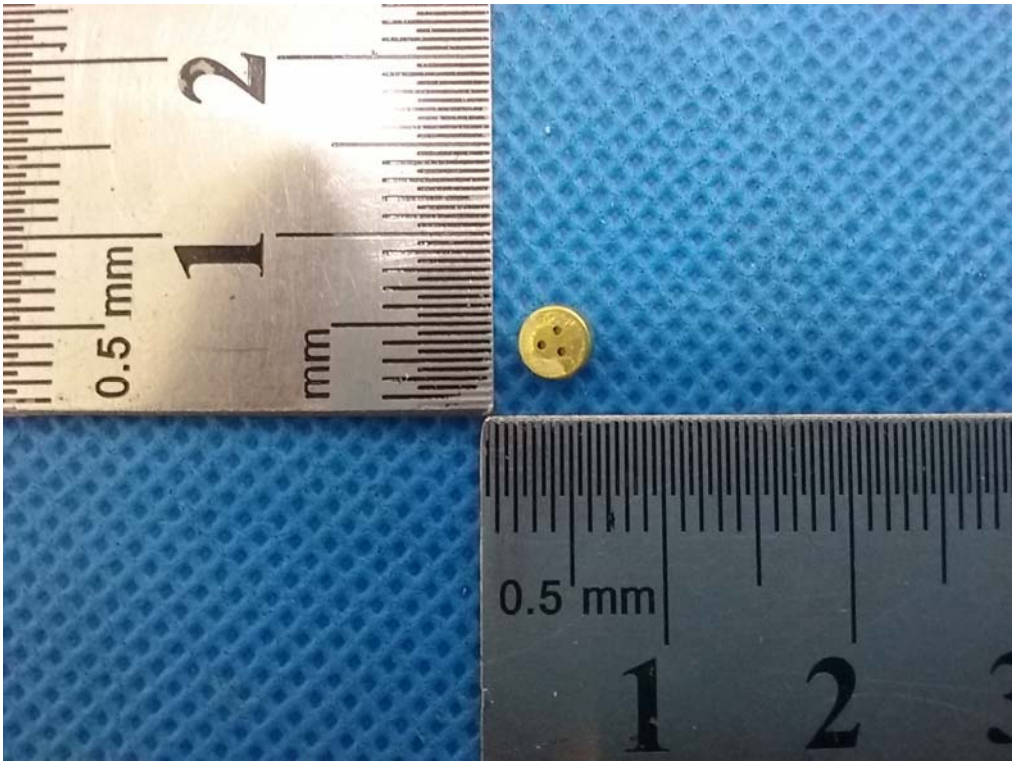


OUT 5V/1A


AUX IN 5V/1A



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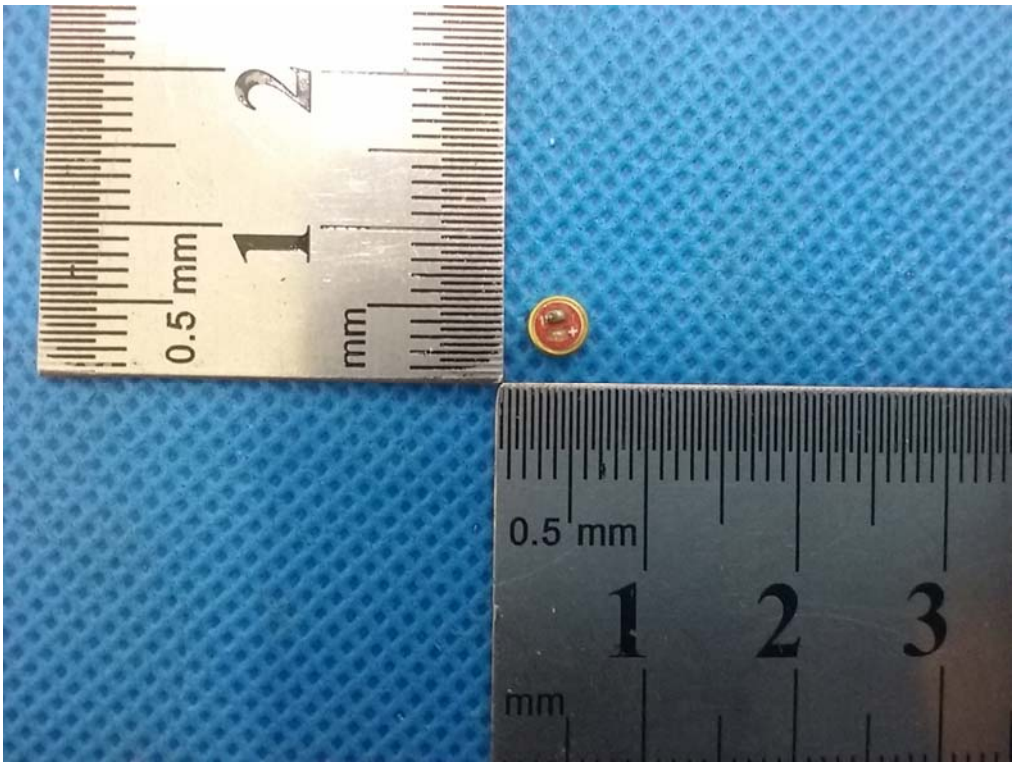
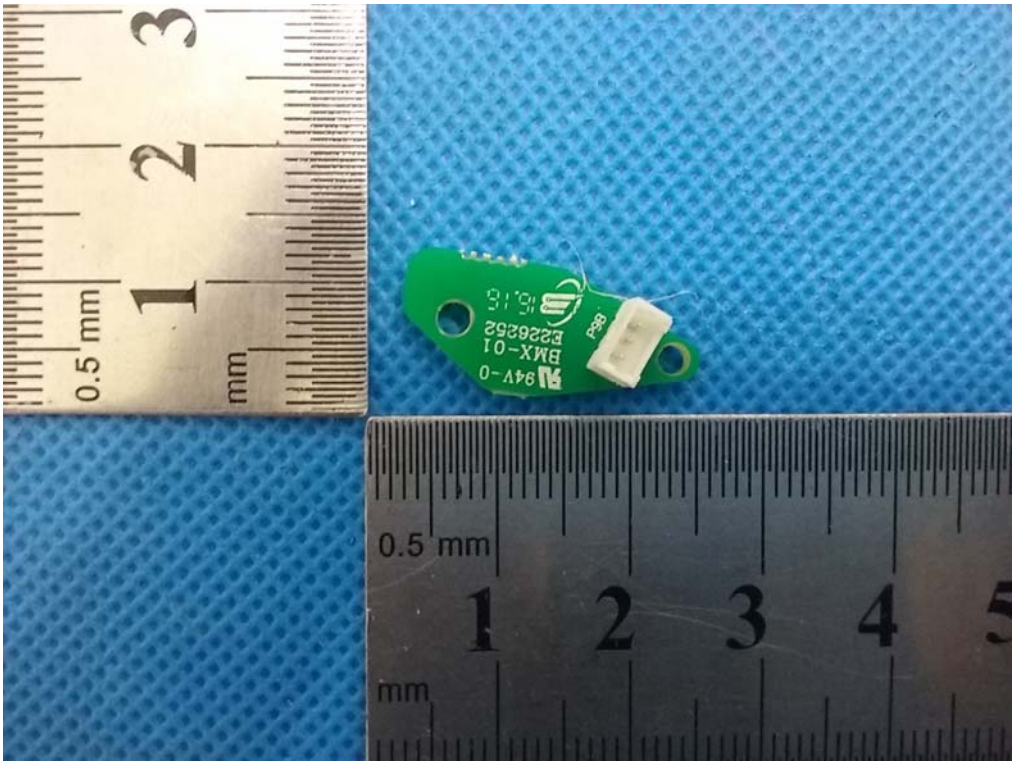
0.5 mm


0.5 mm
mm
0.5 mm
mm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mm
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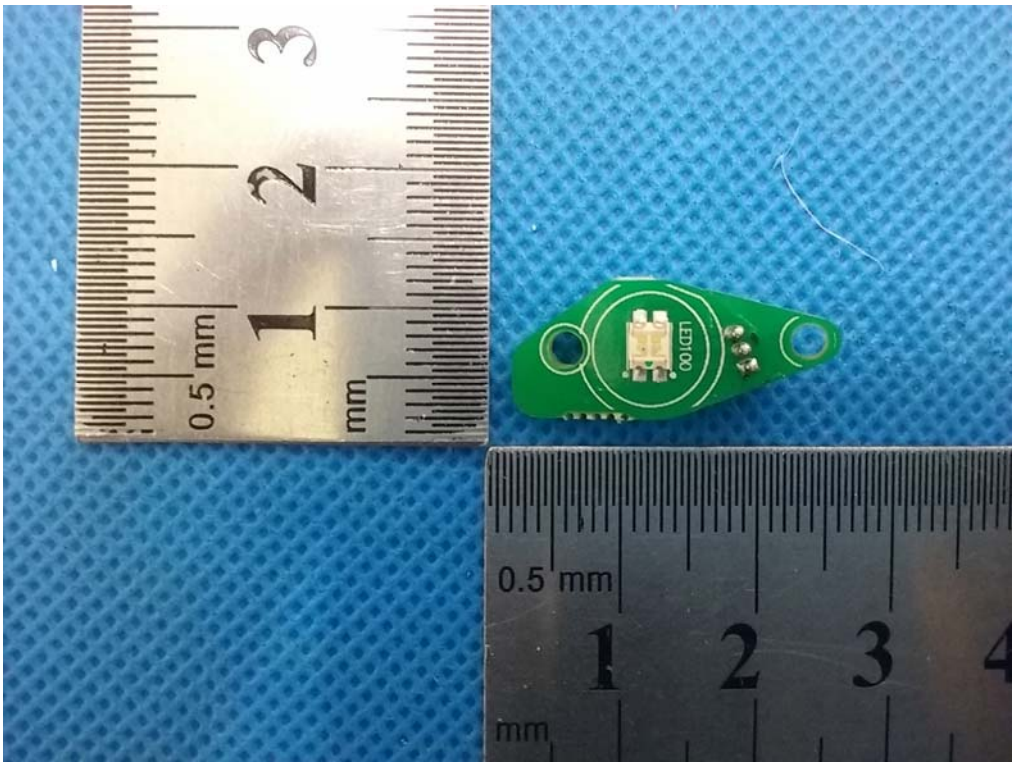
LED100
0.5 mm
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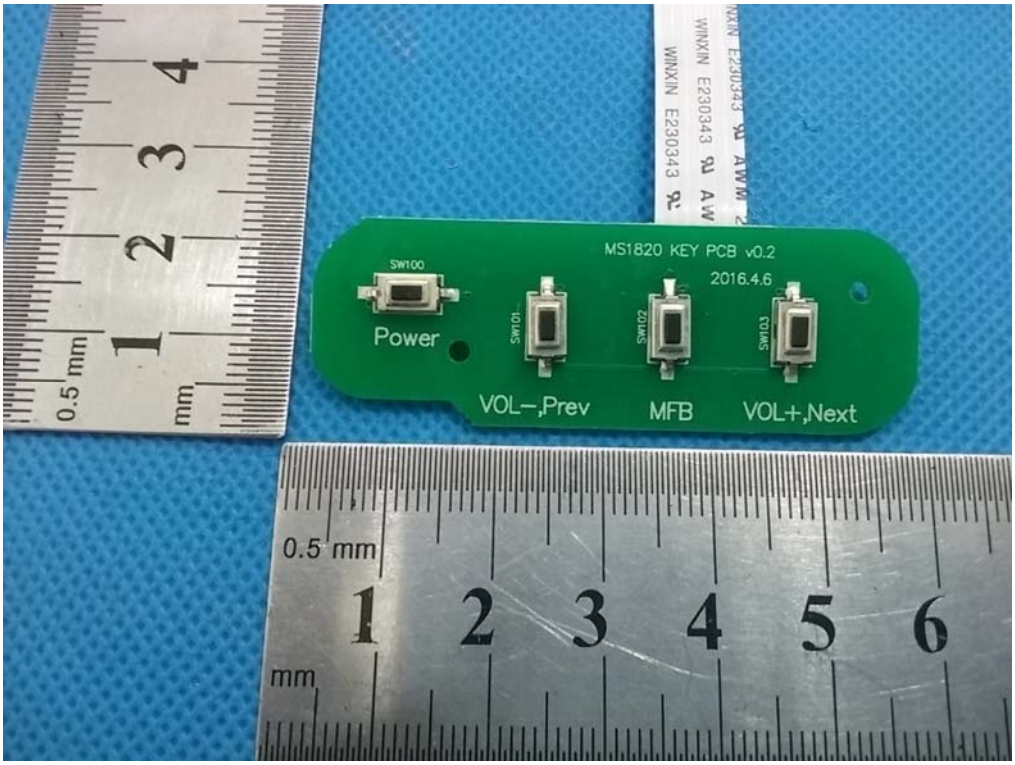
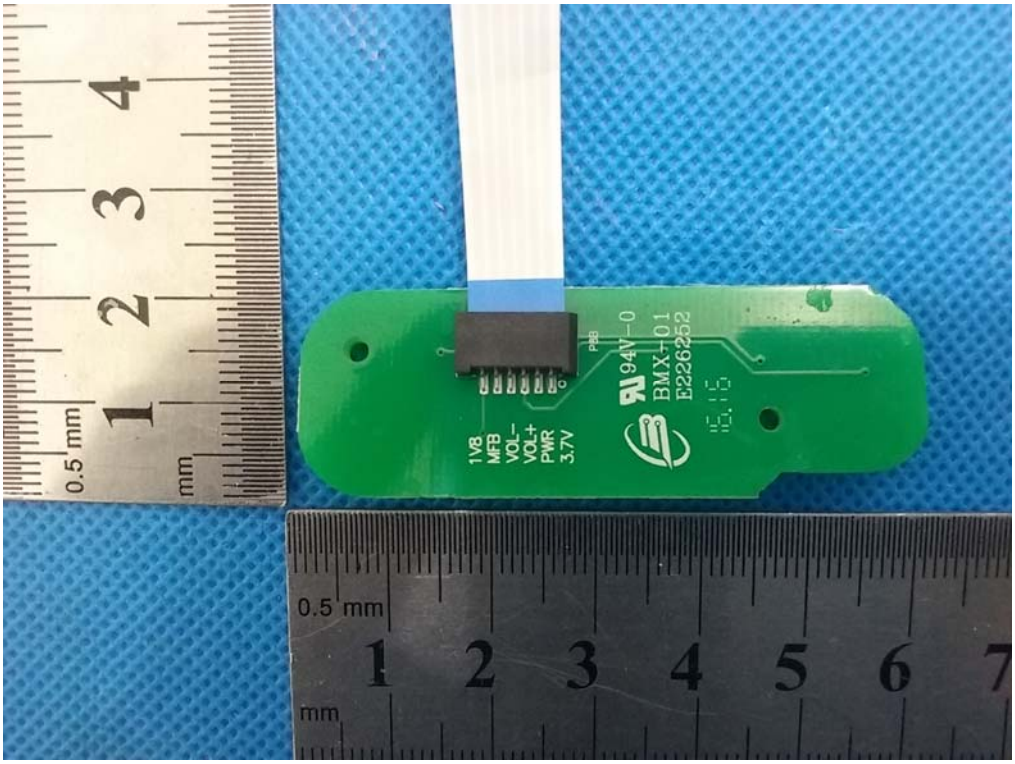
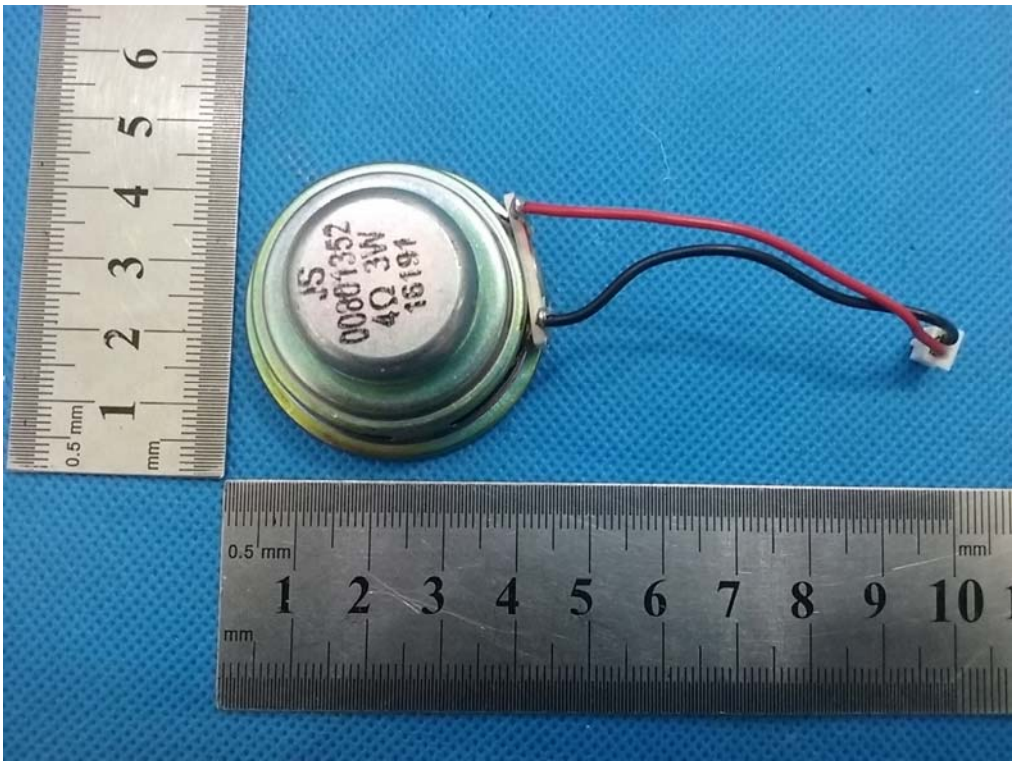
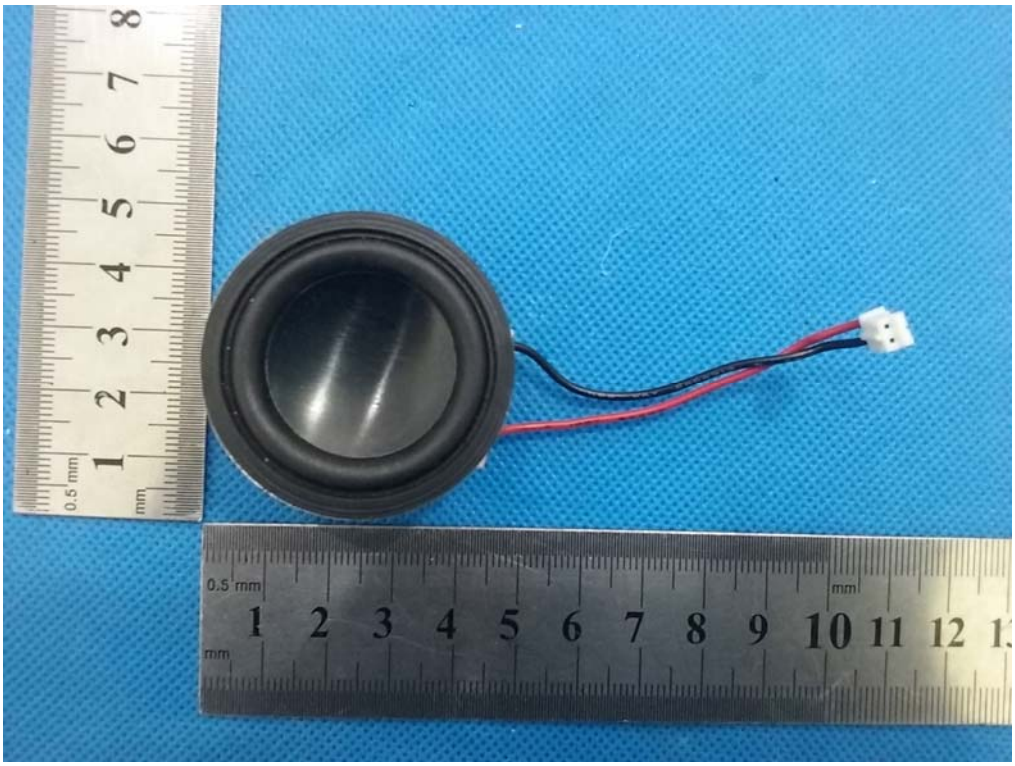
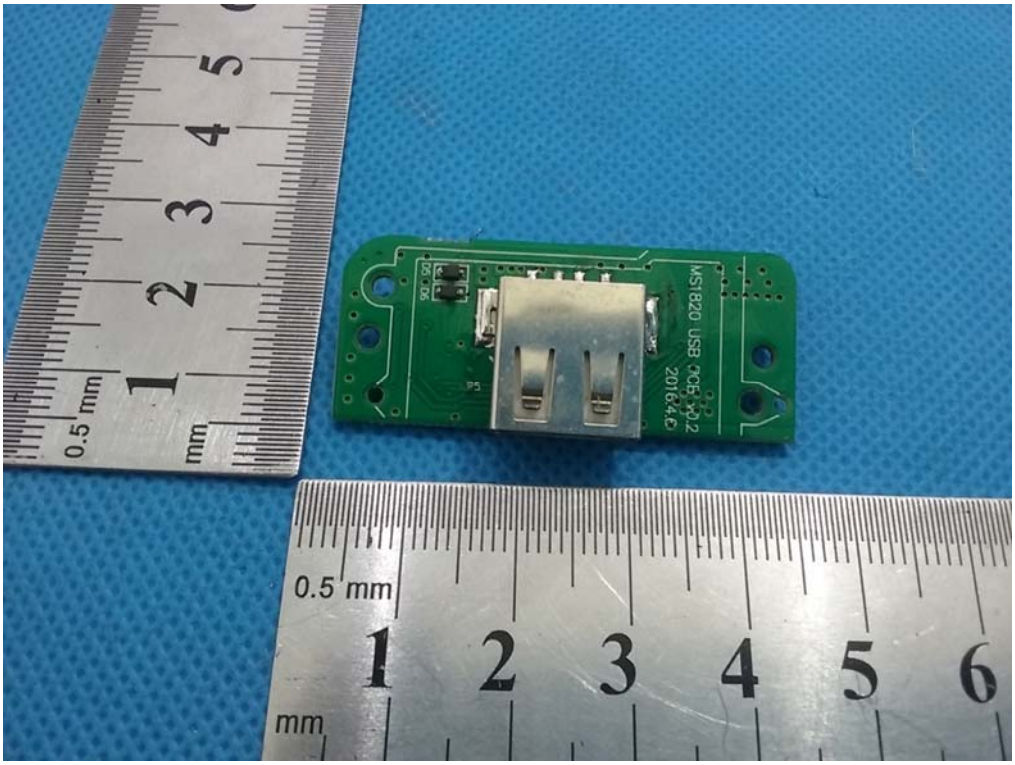
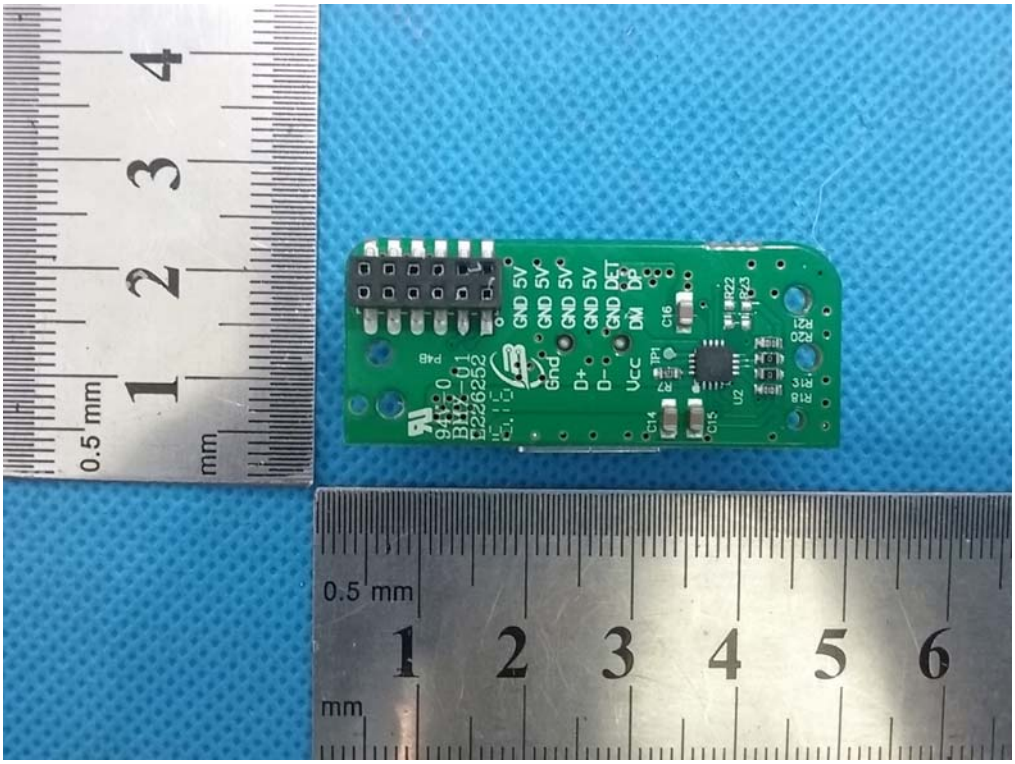

MS1820 KEY PCB v0.2
2016.4.6
SW100
Power
SW101
SW102
SW103
VOL−,Prev
MFB
VOL+,Next
0.5 mm
mm

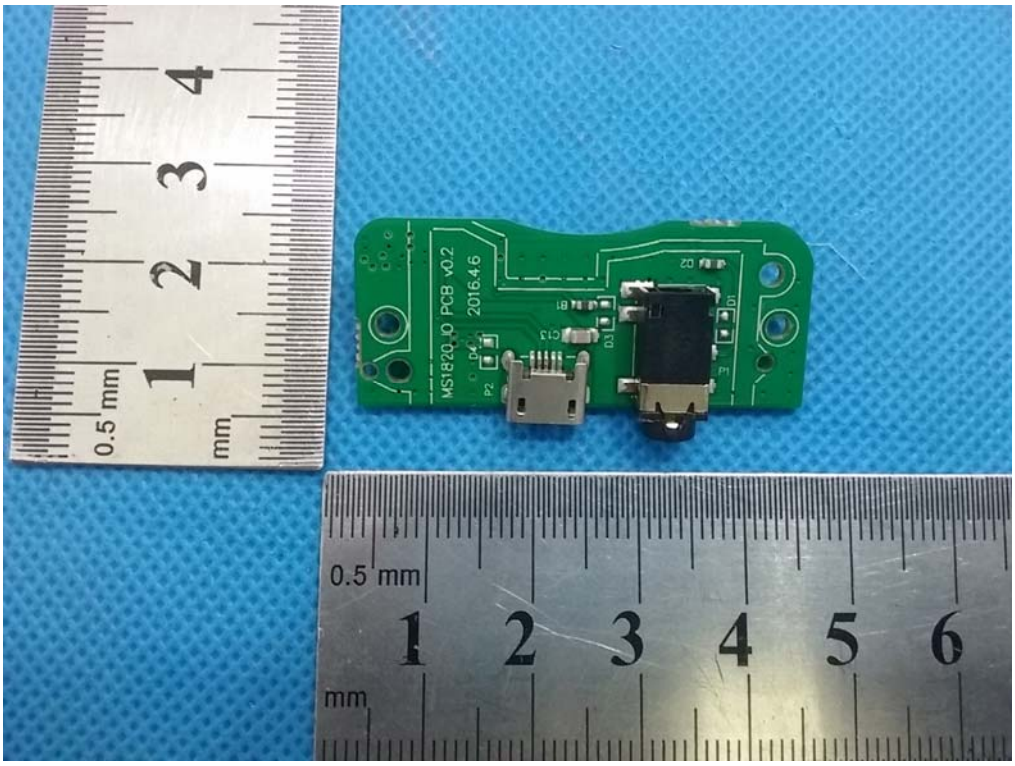

1V8
MFB
VOL-
VOL+
PWR
3.7V
94V-0
BMX-01
E226252

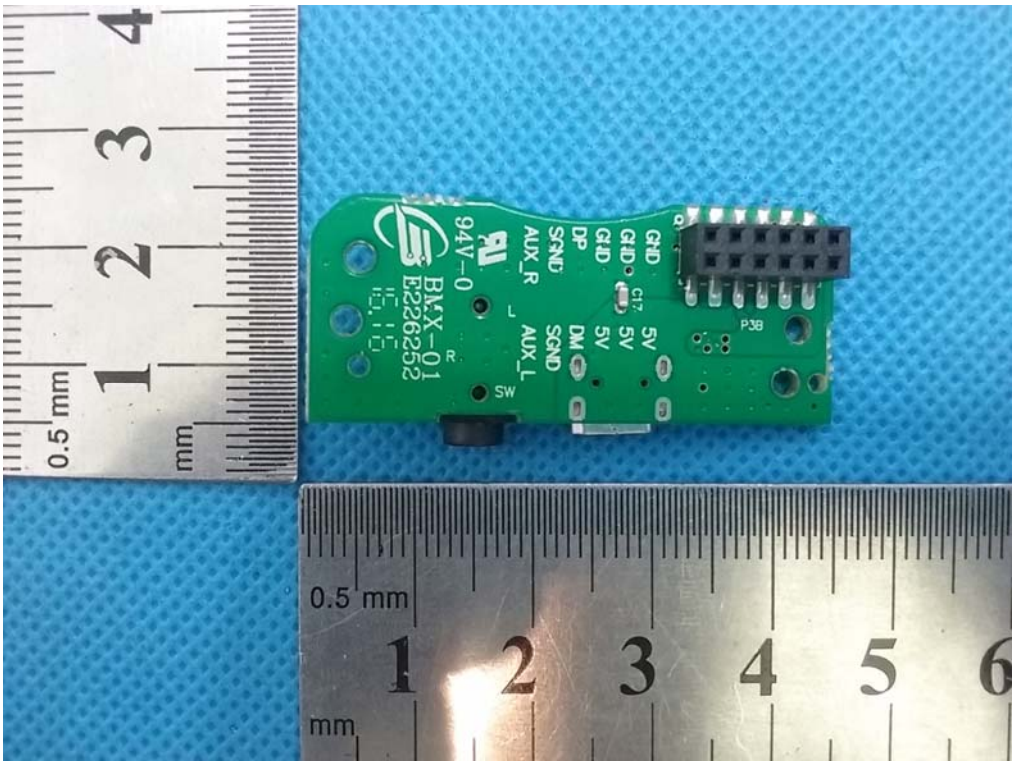





MS1820 USB


0.5 mm
mm
1 2 3 4 5 6
GND 5V
GND 5V
GND 5V
GND 5V
GND DET
DM DP
Gnd
D+
D-
Vcc


0.5 mm
mm
1 2 3 4 5 6
MS1820_IO PCB v0.2
2016.4.6


0.5 mm
mm
1 2 3 4 5 6
94V-0
BMX-01
E226252
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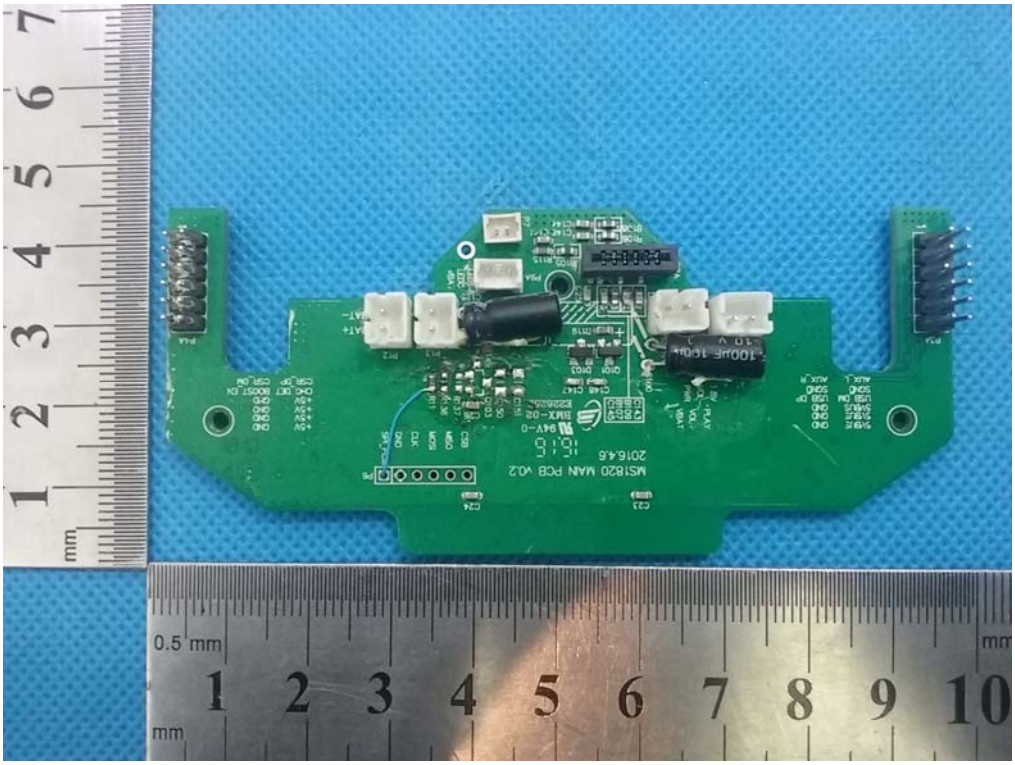
GND
GND
DP
SGND
AUX_R
AUX_L
DM
5V
5V
5V
SW
P3B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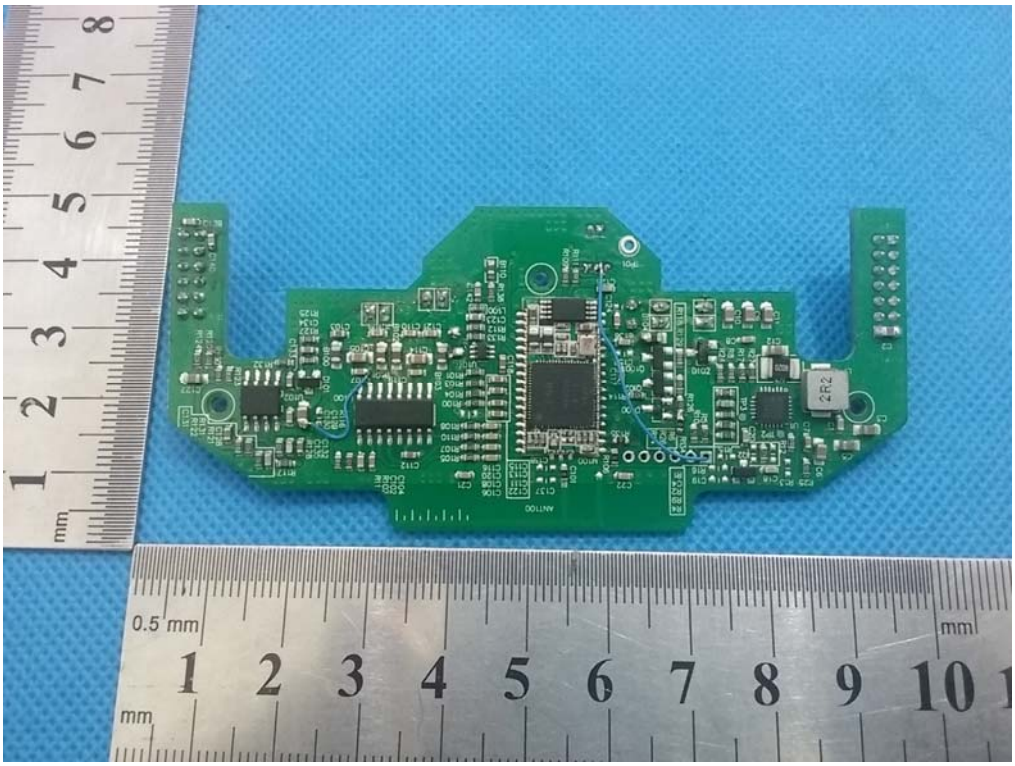
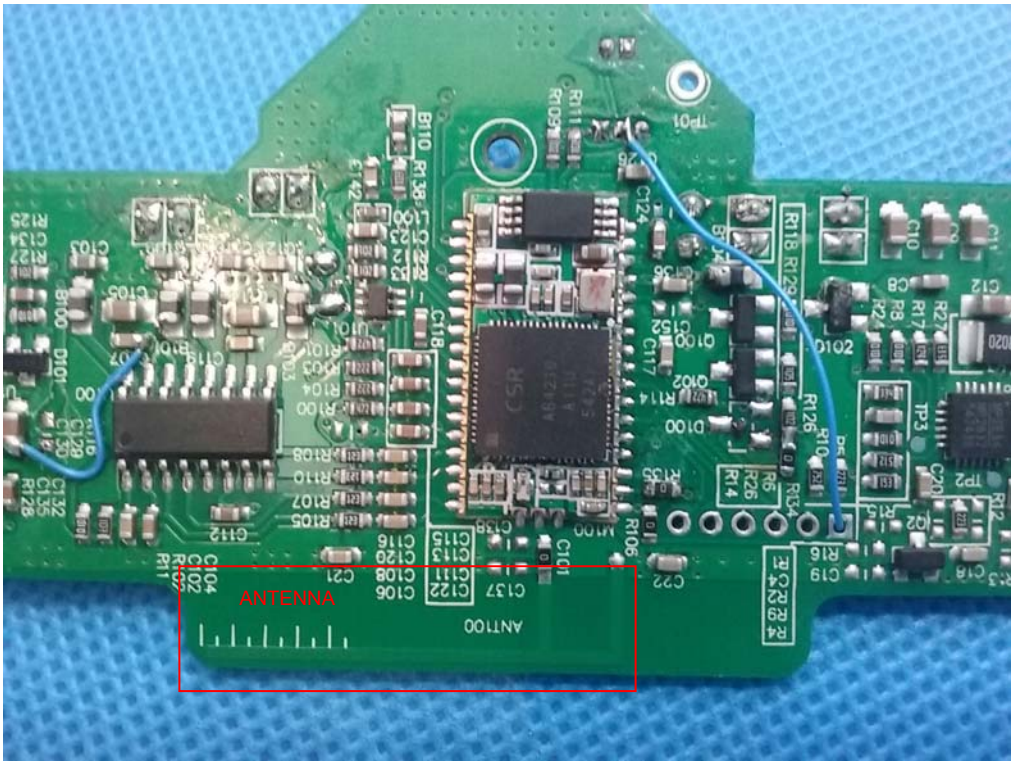
MS1820 MAIN PCB v0.2
2016.4.6




ANTENNA

End of report