

Test Report

FCC PART 15 Subpart C

Product Name : iPal
Model No. : iPal-B (iPal-P/ iPal-S/ iPal-GD/ iPal-GN)
FCC ID/IC ID : 2APZJ-IPAL/23929-IPAL

Applicant : Nanjing AvatarMind Robot Technology Co., Ltd.
Address : 3 Gutan Road, Gaochun Economic Development Zone,
Nanjing, Jiangsu

Date of Receipt : 26/02/2018
Test Date : 26/03/2018~25/04/2018
Issued Date : 25/04/2018
Report No. : YZ180129-AFDJ-0001-2
Report Version : V1.0

The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standards through the calibration of the equipment and evaluated measurement uncertainty herein.

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Test Report Certification

Issued Date : 25/04/2018

Report No. : YZ180129-AFDJ-0001-2

**江苏扬子检验认证有限公司**
Jiangsu Yangtze Testing and Certification Co., Ltd

Product Name : iPal

Applicant : Nanjing AvatarMind Robot Technology Co., Ltd.

Address : 3 Gutan Road, Gaochun Economic Development Zone,
Nanjing, Jiangsu

Manufacturer : Nanjing AvatarMind Robot Technology Co., Ltd.

Address : 3 Gutan Road, Gaochun Economic Development Zone,
Nanjing, Jiangsu

Model No. : iPal-B (iPal-P/ iPal-S/ iPal-GD/ iPal-GN)

Brand Name : AvatarMind

EUT Voltage : +24V, 3.75A

Applicable : FCC CFR Title 47 Part 15 Subpart C: 2017

Standard : ANSI C63.4: 2014
ANSI C63.10: 2013
ICES-003 Issue 6
RSS 247 Issue 2
RSS-Gen Issue 4

Test Result : Complied

Performed : JIANGSU YANGTZE TESTING, CERTIFICATION AND

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Documented By

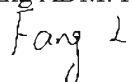
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(Engineering ADM: Ke Chen)

Reviewed By

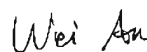
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(Senior Engineer: Fang Li)

Approved By

:



(Manager: Wei An)

Laboratory Information

We, **YTC Corporation**, are an independent EMC and safety consultancy that was established the whole facility in our laboratories. The test facility has been accredited/accepted(audited or listed) by the following related bodies in compliance with ISO 17025 and specified testing scope:

The address and introduction of YTC Corporation's laboratories can be founded in our Web site : <http://www.yztcic.com/>

If you have any comments, Please don't hesitate to contact us.

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1. General Information

1.1. EUT Description

Product Name	iPal
Brand Name	AvatarMind
Model No.	iPal-B (iPal-P/ iPal-S/ iPal-GD/ iPal-GN)
EUT Voltage	+24V, 3.75A
Frequency Range	For 2.4GHz Band 802.11b/g/n(20MHz): 2412~2462MHz For 5.0GHz Band 802.11a/n/ac(20MHz): 5180~5240MHz, 5745~5825MHz 802.11n/ac(40MHz): 5190~5230MHz, 5755~5795MHz 802.11ac(80MHz): 5210~5775MHz Bluetooth v3.0 + EDR 2402MHz~2480MHz Bluetooth v4.0 + LE 2402MHz~2480MHz
Channel Number	For 2.4GHz Band 802.11b/g/n(20MHz): 11 For 5.0GHz Band 802.11a/n/ac(20MHz): 9 802.11n/ac(40MHz): 4 802.11ac(80MHz):2 Bluetooth v3.0 + EDR: 79 Bluetooth v4.0 + LE: 40
Type of Modulation	Bluetooth v3.0 + EDR: GFSK, $\pi/4$ -DQPSK, 8-DPSK Bluetooth v4.0 + LE: GFSK 802.11a/g: 6/9/12/18/24/36/48/54 Mbps 802.11b: 1/2/5.5/11 Mbps
Data Rate	802.11n: up to 300 Mbps 802.11ac: MCS 0/1/2/3/4/5/6/7/8/9 Bluetooth v3.0 + EDR: 1/2/3 Mbps Bluetooth v4.0 + LE: 1Mbps Bluetooth v3.0 + EDR: GFSK, $\pi/4$ -DQPSK, 8-DPSK Bluetooth v4.0 + LE: GFSK
Channel Control	Auto
Antenna Delivery	Tx + Rx
Antenna Type	Integral antenna

Peak Antenna Gain	2dBi
Components	
Adapter	Brand Name: Channel Well Technology Model: 2AAL090m Input: 100-240V~1.5A 50/60Hz Output: 24V, 3.75A

Bluetooth Working Frequency of Each Channel:							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
00	2402 MHz	01	2403 MHz	02	2404 MHz	03	2405 MHz
04	2406 MHz	05	2407 MHz	06	2408 MHz	07	2409 MHz
08	2410 MHz	09	2411 MHz	10	2412 MHz	11	2413 MHz
12	2414 MHz	13	2415 MHz	14	2416 MHz	15	2417 MHz
16	2418 MHz	17	2419 MHz	18	2420 MHz	19	2421 MHz
20	2422 MHz	21	2423 MHz	22	2424 MHz	23	2425 MHz
24	2426 MHz	25	2427 MHz	26	2428 MHz	27	2429 MHz
28	2430 MHz	29	2431 MHz	30	2432 MHz	31	2433 MHz
32	2434 MHz	33	2435 MHz	34	2436 MHz	35	2437 MHz
36	2438 MHz	37	2439 MHz	38	2440 MHz	39	2441 MHz
40	2442 MHz	41	2443 MHz	42	2444 MHz	43	2445 MHz
44	2446 MHz	45	2447 MHz	46	2448 MHz	47	2449 MHz
48	2450 MHz	49	2451 MHz	50	2452 MHz	51	2453 MHz
52	2454 MHz	53	2455 MHz	54	2456 MHz	55	2457 MHz
56	2458 MHz	57	2459 MHz	58	2460 MHz	59	2461 MHz
60	2462 MHz	61	2463 MHz	62	2464 MHz	63	2465 MHz
64	2466 MHz	65	2467 MHz	66	2468 MHz	67	2469 MHz
68	2470 MHz	69	2471 MHz	70	2472 MHz	71	2473 MHz
72	2474 MHz	73	2475 MHz	74	2476 MHz	75	2477 MHz
76	2478 MHz	77	2479 MHz	78	2480 MHz	N/A	N/A

1.2. Mode of Operation

YTC has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Test Mode
Mode 1: Transmit by Bluetooth v3.0 + EDR(DH1)
Mode 2: Transmit by Bluetooth v3.0 + EDR(DH3)
Mode 3: Transmit by Bluetooth v3.0 + EDR(DH5)

Note:

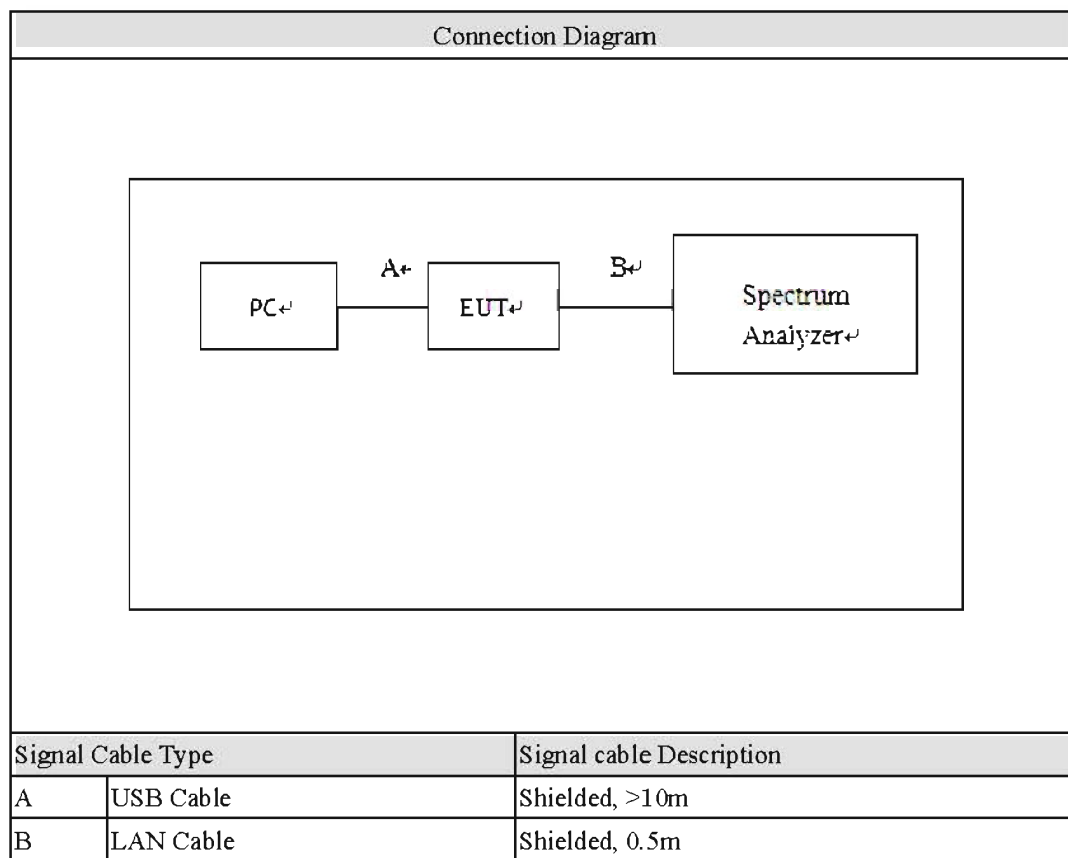
1. Regards to the frequency band operation: the lowest, middle and highest frequency of channel were selected to perform the test, then shown on this report.

1.3. Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	PC	Lenovo	B41	/	Non-Shielded, 1.8m

1.4. Configuration of Tested System



1.5. EUT Exercise Software

1	Setup the EUT and simulators as shown on above.
2	Turn on the power of equipment.
3	Execute some commands on the PC provided by applicant.
4	Setup the test channel and the test mode press ok to start the continue transmit.

2. Technical Test

2.1. Summary of Test Result

☒ No deviations from the test standards

☐ Deviations from the test standards as below description:

Performed Test Item	Normative References	Test Performed	Deviation
Conducted Emission	FCC CFR Title 47 Part 15 Subpart C: 2017 Section 15.207 RSS Gen Issue 4	Yes	No
Radiated Emission	FCC CFR Title 47 Part 15 Subpart C: 2017 Section 15.209 RSS Gen Issue 4	Yes	No
20dB Bandwidth	FCC CFR Title 47 Part 15 Subpart C: 2017 Section 15.247(a)(1) RSS 247 Issue 2	Yes	No
99% Bandwidth	RSS 247 Issue 2	Yes	No
Carrier Frequency Separation	FCC CFR Title 47 Part 15 Subpart C: 2017 Section 15.247(a)(1) RSS 247 Issue 2	Yes	No
Number of Hopping Frequencies	FCC CFR Title 47 Part 15 Subpart C: 2017 Section 15.247(a)(1)(iii) RSS 247 Issue 2	Yes	No
Time of Occupancy (Dwell Time)	FCC CFR Title 47 Part 15 Subpart C: 2017 Section 15.247(a)(1)(iii) RSS 247 Issue 2	Yes	No
Peak Output Power	FCC CFR Title 47 Part 15 Subpart C: 2017 Section 15.247(b)(1) RSS 247 Issue 2	Yes	No
Band-edge Compliance of RF Conducted Emissions	FCC CFR Title 47 Part 15 Subpart C: 2017 Section 15.215(c), 15.247(d) RSS 247 Issue 2	Yes	No
Spurious RF Conducted Emissions	FCC CFR Title 47 Part 15 Subpart C: 2017 15.247(d) RSS 247 Issue 2	Yes	No

2.2. Test Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	21
Humidity (%RH)	25-75	50
Barometric pressure (mbar)	860-1060	950-1000

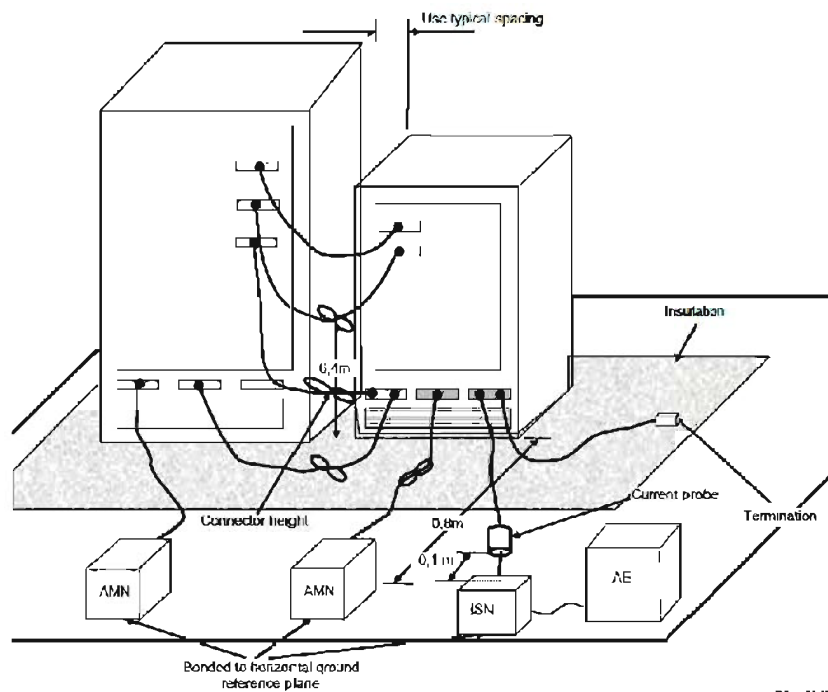
3. Conducted Emission

3.1. Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
EMI Test Receiver	R&S	ESCI	100862	2017.10.23
Two-Line V-Network	R&S	ENV216	102024	2017.10.23
Temperature/Humidity Meter	/	HTC-1	/	2017.11.08
Shielding Room No. 2	EMC	8m*4m*3m	/	2016.08

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

3.2. Test Setup



3.3. Limit

FCC Part 15 Subpart C Paragraph 15.207 Limits		
Frequency (MHz)	QP (dB μ V)	AV (dB μ V)
0.15 - 0.50	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

3.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2014 and tested according to ANSI C63.10: 2013 for compliance to FCC 47CFR 15.247 requirements. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 10 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs) Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.

The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

3.5. Uncertainty

The measurement uncertainty is defined as ± 2.02 dB

Note. Conducted emission was conducted at both 120V and 230V, and emission at 230V represents the worst case.

3.6. Test Result

Test Mode: Mode 1					Phase: L				
Frequency (MHz)	QuasiPeak (dB; i V)	CAve rage (dB; i V)	Limit (dB; i V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.182000	—	40.47	54.39	13.93	1000.0	9.000	L1	ON	10.1
0.186000	42.66	—	64.21	21.55	1000.0	9.000	L1	ON	10.1
0.310000	—	31.14	49.97	18.83	1000.0	9.000	L1	ON	10.1
0.310000	37.01	—	59.97	22.97	1000.0	9.000	L1	ON	10.1
0.858000	—	29.75	46.00	16.25	1000.0	9.000	L1	ON	10.2
0.858000	44.83	—	56.00	11.17	1000.0	9.000	L1	ON	10.2
0.918000	—	30.68	46.00	15.32	1000.0	9.000	L1	ON	10.2
0.922000	45.84	—	56.00	10.16	1000.0	9.000	L1	ON	10.2
2.230000	35.89	—	56.00	20.11	1000.0	9.000	L1	ON	10.2
2.230000	—	27.97	46.00	18.03	1000.0	9.000	L1	ON	10.2
12.234000	39.56	—	60.00	20.44	1000.0	9.000	L1	ON	10.5
12.246000	—	33.85	50.00	16.15	1000.0	9.000	L1	ON	10.5
Test Mode: Mode 1					Phase: N				
Frequency (MHz)	QuasiPeak (dB; i V)	CAve rage (dB; i V)	Limit (dB; i V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.186000	—	39.32	54.21	14.89	1000.0	9.000	N	ON	10.1
0.186000	44.10	—	64.21	20.11	1000.0	9.000	N	ON	10.1
0.306000	—	34.76	50.08	15.32	1000.0	9.000	N	ON	10.1
0.306000	42.79	—	60.08	17.29	1000.0	9.000	N	ON	10.1
0.794000	—	28.39	46.00	17.61	1000.0	9.000	N	ON	10.2
0.794000	42.68	—	56.00	13.32	1000.0	9.000	N	ON	10.2
0.922000	39.77	—	56.00	16.23	1000.0	9.000	N	ON	10.2
0.922000	—	28.32	46.00	17.68	1000.0	9.000	N	ON	10.2
12.134000	43.09	—	60.00	16.91	1000.0	9.000	N	ON	10.5
12.134000	—	38.32	50.00	11.68	1000.0	9.000	N	ON	10.5
28.894000	—	38.48	50.00	11.52	1000.0	9.000	N	ON	10.8
28.894000	40.55	—	60.00	19.45	1000.0	9.000	N	ON	10.8

4. Radiated Emission

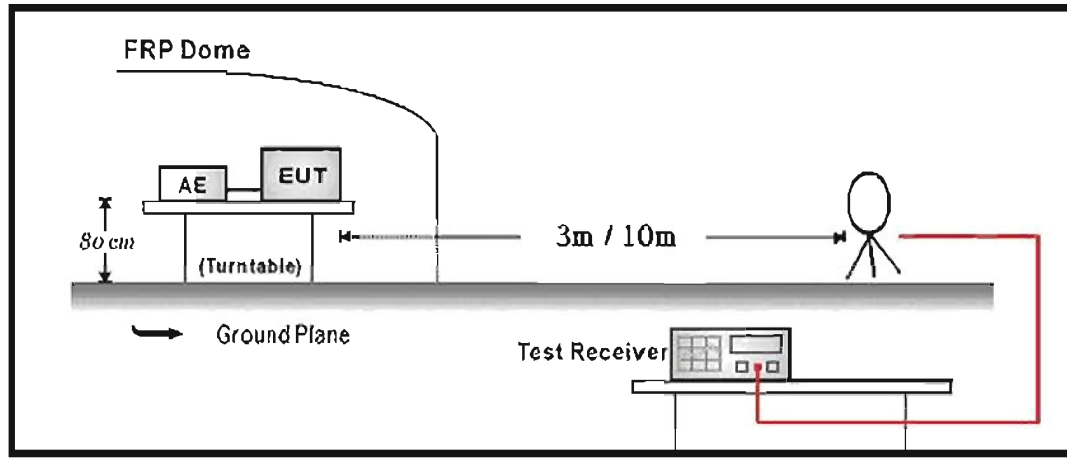
4.1. Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
EMI Test Receiver	R&S	ESR7	100573	2017.10.24
Loop Antenna	R&S	HFH2-Z2	100477	2017.11.05
Ultralog Antenna	R&S	HL562E	100833	2017.02.28
Broad-Band Horn Antenna	R&S	HF907	102500	2017.11.28
Chamber No. 1	EMC	9m*6m*6m	/	2016.08
Temperature/Humidity Meter	/	HTC-1	/	2017.11.08

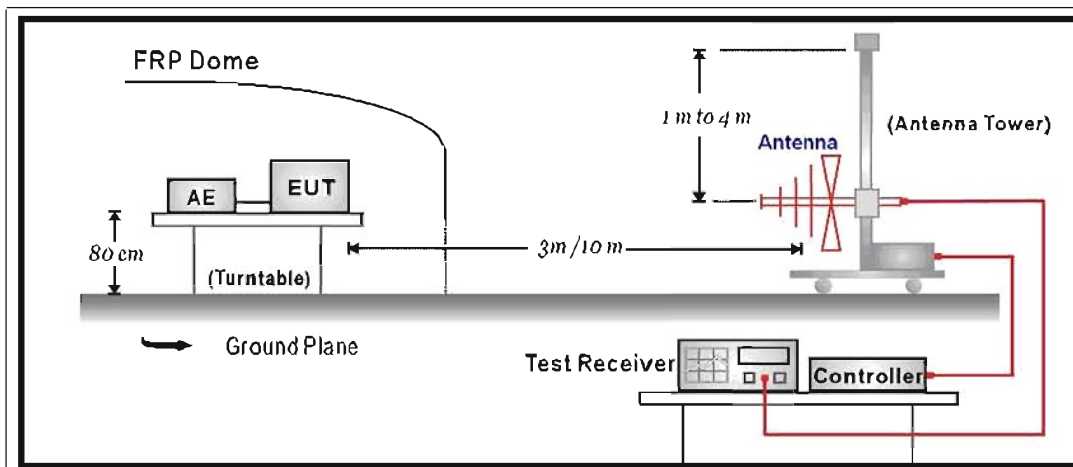
Note 1: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

4.2. Test Setup

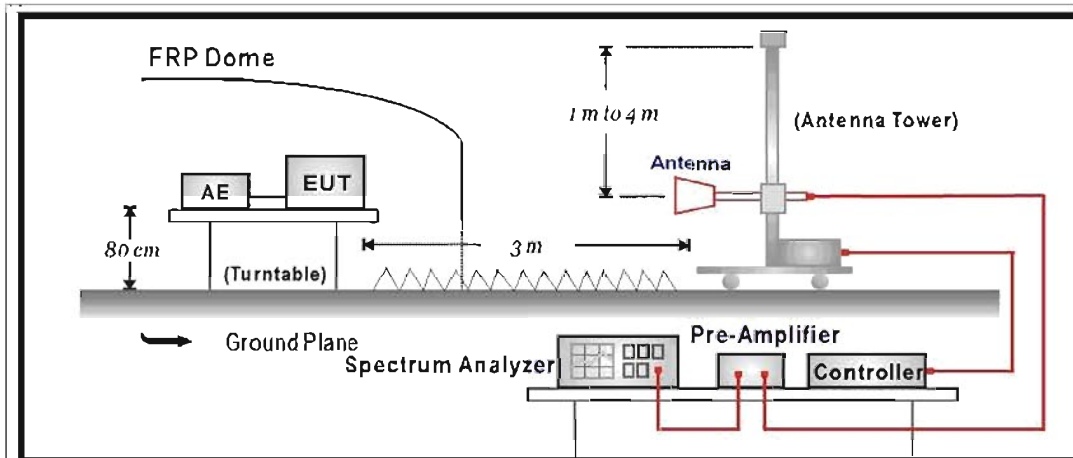
Below 30MHz Test Setup:



Below 1GHz Test Setup:



Above 1GHz Test Setup:



4.3. Limit

FCC Part 15 Subpart C Paragraph 15.209		
Frequency (MHz)	Distance (m)	Level (dB μ V/m)
30 - 88	3	40
88 - 216	3	43.5
216 - 960	3	46
Above 960	3	54

Note 1: The lower limit shall apply at the transition frequency.

Note 2: Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

Note 3: E field strength (dB μ V/m) = 20 log E field strength (μ V/m)

4.4. Test Procedure

The EUT was setup according to ANSI C63.4: 2014 and tested according to ANSI C63.10: 2013 and KDB 558074 for compliance to FCC 47CFR 15.247 requirements.

The EUT is placed on a turn table which is 0.1 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4: 2014 on radiated measurement.

The resolution bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.

The frequency range from 30MHz to 10th harmonic is checked.

Note: When doing emission measurement above 1GHz, the horn antenna will be bended down a little (as horn antenna has the narrow beamwidth) in order to keeping the antenna in the “cone of radiation” of EUT. The 3dB beamwidth is 60 degrees for H-plane and 90 degrees for E-plane.

4.5. Uncertainty

The measurement uncertainty above 1G is defined as ± 3.9 dB

below 1G is defined as ± 3.8 dB

4.6. Test Result

All of the test result shown indicates the worst case, and spectrum analyzer parameters setting as shown below:

Peak detector: RBW = 1MHz, VBW = 3MHz, sweep time = 200ms;

Average detector: RBW = 1MHz, VBW = 10Hz, sweep time = auto.

Measure Level = Reading Level + Cable Loss + Antenna Factor - Preamplifier Gain

9kHz-30MHz

Frequency(MHz)	Reading(dB μ V/m)	Limit(dB μ V/m)	Margin(dB)	Pass/Fail
—	—	—	—	Pass
—	—	—	—	Pass

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

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

Limit line = specific limits(dB μ V) + distance extrapolation factor.

30MHz-1GHz

Polar (H/V)	Frequency (MHz)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
V	72.4538	36.58	40.00	-3.42	QP
V	111.4316	39.01	43.50	-4.49	QP
V	167.0894	39.57	43.50	-3.93	QP
V	255.2815	41.98	46.00	-4.02	QP
V	340.9031	37.10	46.00	-8.9	QP
V	676.9398	39.04	46.00	-6.96	QP
H	77.7086	35.92	40.00	-4.08	QP
H	153.9347	39.67	43.50	-3.83	QP
H	216.1673	37.73	43.50	-5.77	QP
H	337.8845	37.26	46.00	-8.74	QP
H	420.1071	35.53	46.00	-10.47	QP
H	612.0326	38.82	46.00	-7.18	QP

Note: DH1 mode is the worst mode.

Above 1GHz

DH1

Polar (H/V)	Frequency (MHz)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
Low Channel(2402MHz)					
V	1189.678	59.97	74	-14.03	Pk
V	4804	60.93	74	-13.07	Pk

V	4804	47.15	54	-6.85	Av
V	7206	58.84	74	-15.16	Pk
V	7206	46.96	54	-7.04	Pk
H	1189.678	58.74	74	-15.26	Pk
H	4804	60.98	74	-13.02	Pk
H	4804	47.32	54	-6.68	Av
H	7206	60.03	74	-13.97	Pk
H	7206	45.77	54	-8.23	Av
Mid Channel(2440MHz)					
V	1189.678	61.08	74	-12.92	Pk
V	1637.834	60.36	74	-13.64	Pk
V	4880	59.01	74	-14.99	Pk
V	7320	60.57	74	-12.43	Pk
H	1189.678	60.11	74	-13.89	Pk
H	2099.787	59.83	74	-14.17	Pk
H	4880	60.87	74	-13.13	Pk
H	4880	49.67	54	-4.33	Av
H	7320	62.13	74	-11.87	Pk
High Channel(2480MHz)					
V	1189.678	60.10	74	-13.90	Pk
V	2453.938	59.71	74	-14.29	Pk
V	4960	61.14	74	-13.86	Pk
V	7440	60.77	74	-13.23	Pk
H	1189.678	58.99	74	-15.01	Pk
H	2453.938	61.67	74	-12.33	Pk
H	4960	61.44	74	-12.56	Pk
H	7440	59.92	74	-14.08	Pk

DH3

Polar (H/V)	Frequency (MHz)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
Low Channel(2402MHz)					
V	1189.678	58.97	74	-13.03	Pk
V	4804	60.73	74	-13.27	Pk
V	4804	47.05	54	-6.95	Av
V	7206	58.64	74	-15.36	Pk
V	7206	46.72	54	-7.28	Pk
H	1189.678	58.41	74	-15.59	Pk
H	4804	60.80	74	-13.20	Pk
H	4804	47.49	54	-6.51	Av
H	7206	59.03	74	-14.97	Pk
H	7206	45.07	54	-8.93	Av
Mid Channel(2440MHz)					

V	1189.678	60.07	74	-13.93	Pk
V	1637.834	60.16	74	-13.84	Pk
V	4880	58.91	74	-15.09	Pk
V	7320	60.42	74	-12.58	Pk
H	1189.678	60.01	74	-13.99	Pk
H	2099.787	59.04	74	-14.96	Pk
H	4880	60.27	74	-13.73	Pk
H	4880	48.67	54	-5.33	Av
H	7320	61.03	74	-12.97	Pk
High Channel(2480MHz)					
V	1189.678	60.10	74	-13.90	Pk
V	2453.938	59.63	74	-14.37	Pk
V	4960	60.14	74	-14.86	Pk
V	7440	60.51	74	-13.49	Pk
H	1189.678	59.09	74	-14.91	Pk
H	2453.938	60.67	74	-13.33	Pk
H	4960	61.74	74	-12.26	Pk
H	7440	58.92	74	-13.08	Pk

DH5

Polar (H/V)	Frequency (MHz)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
Low Channel(2402MHz)					
V	1189.678	59.07	74	-14.93	Pk
V	4804	60.73	74	-13.27	Pk
V	4804	47.35	54	-6.65	Av
V	7206	58.48	74	-15.52	Pk
V	7206	47.06	54	-6.94	Pk
H	1189.678	58.44	74	-15.56	Pk
H	4804	60.18	74	-13.82	Pk
H	4804	47.02	54	-6.98	Av
H	7206	59.03	74	-14.97	Pk
H	7206	45.67	54	-8.33	Av
Mid Channel(2440MHz)					
V	1189.678	60.01	74	-13.99	Pk
V	1637.834	59.76	74	-14.24	Pk
V	4880	59.01	74	-14.99	Pk
V	7320	60.55	74	-12.45	Pk
H	1189.678	60.21	74	-13.79	Pk
H	2099.787	59.73	74	-14.27	Pk
H	4880	60.57	74	-13.43	Pk
H	4880	48.67	54	-5.33	Av
H	7320	61.14	74	-12.86	Pk

High Channel(2480MHz)					
V	1189.678	60.07	74	-13.93	Pk
V	2453.938	58.91	74	-15.09	Pk
V	4960	61.04	74	-13.96	Pk
V	7440	60.41	74	-13.59	Pk
H	1189.678	59.01	74	-14.99	Pk
H	2453.938	60.68	74	-13.32	Pk
H	4960	61.11	74	-12.89	Pk
H	7440	59.29	74	-14.71	Pk

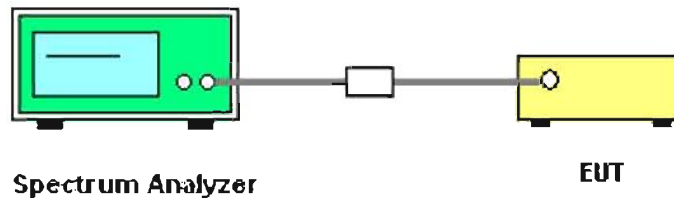
5. 20dB Bandwidth

5.1 Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
Spectrum Analyzer	R&S	FSV40	101155	2017.10.24
Shielding Room No. 1	EMC	9m*4m*3m	/	2016.08
Temperature/Humidity Meter	/	HTC-1	/	2017.11.08

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

5.2 Test Setup



5.3 Limit

- For frequency hopping systems operating in 2400-2483.5 MHz band, no limitation.
- For frequency hopping systems operating in 902-928 MHz band, the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
- For frequency hopping systems operating in 5725-5850 MHz band, the maximum 20 dB bandwidth of the hopping channel is 1MHz.

5.4 Test Procedure

According to ANSI C63.10: 2013.

Use the following spectrum analyzer settings:

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

RBW 1% of the 20dB bandwidth

VBW RBW

Sweep = auto

Detector function = peak

Trace = max hold

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. Use the

marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

5.5 Uncertainty

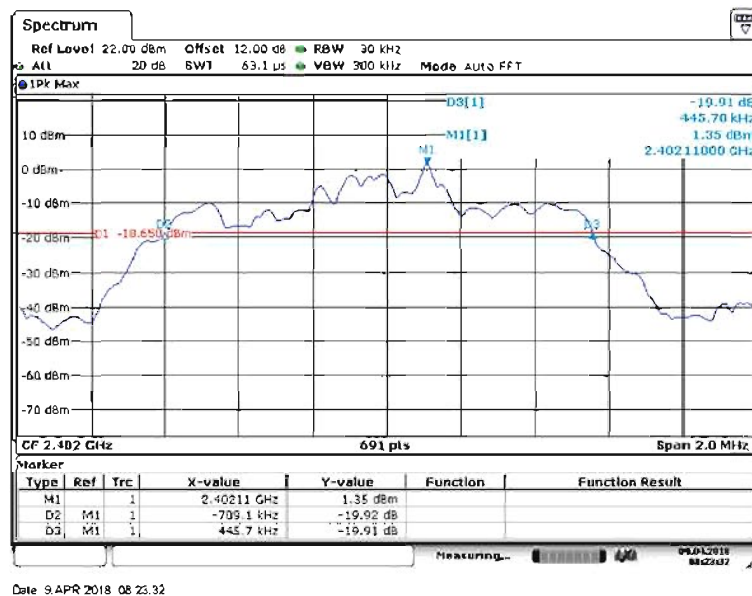
The measurement uncertainty is defined as ± 1 kHz.

5.6 Test Result

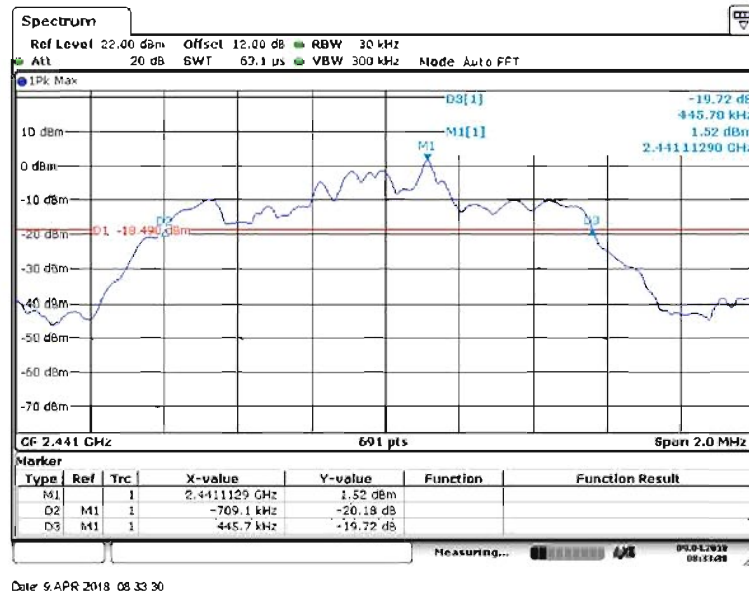
Test Item	: 20 dB Bandwidth
Test Mode	: Mode 1: Transmit by Bluetooth v3.0 + EDR(DH1)

Channel	Frequency(MHz)	20dB Bandwidth(kHz)	99% Bandwidth(kHz)
00	2402	1154.8	1082.3
39	2441	1154.8	1092.4
78	2480	1154.8	1099.3

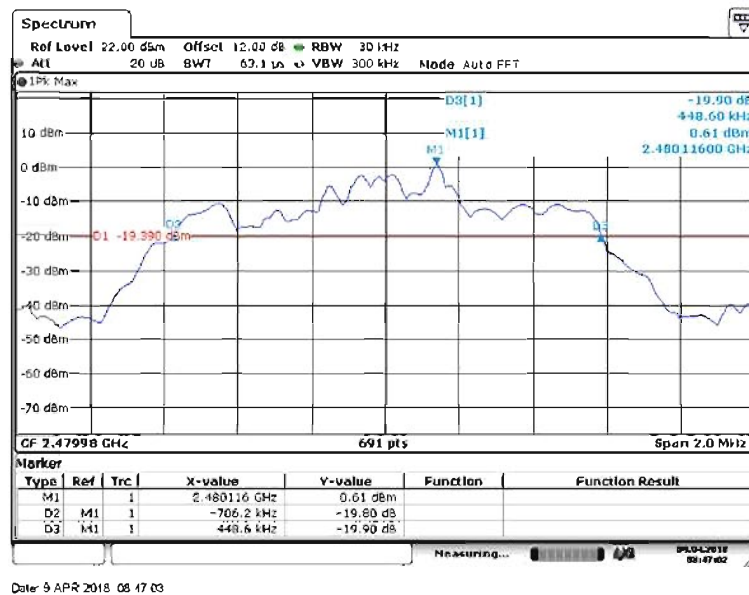
Channel 00 (2402MHz)



Channel 39 (2441MHz)



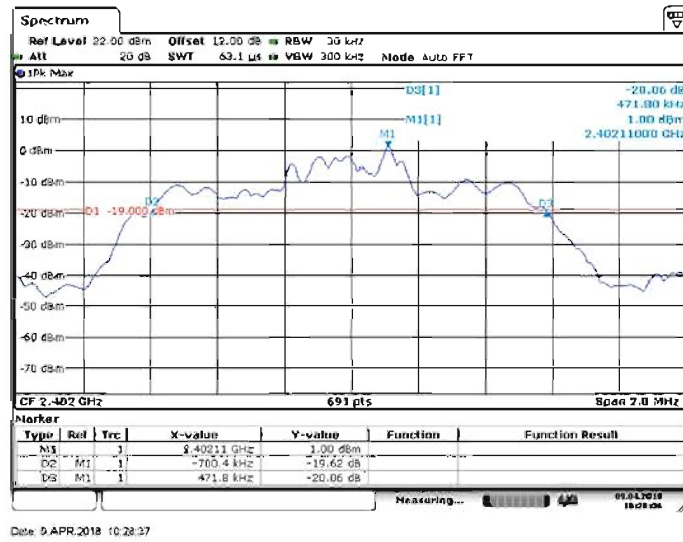
Channel 78 (2480MHz)



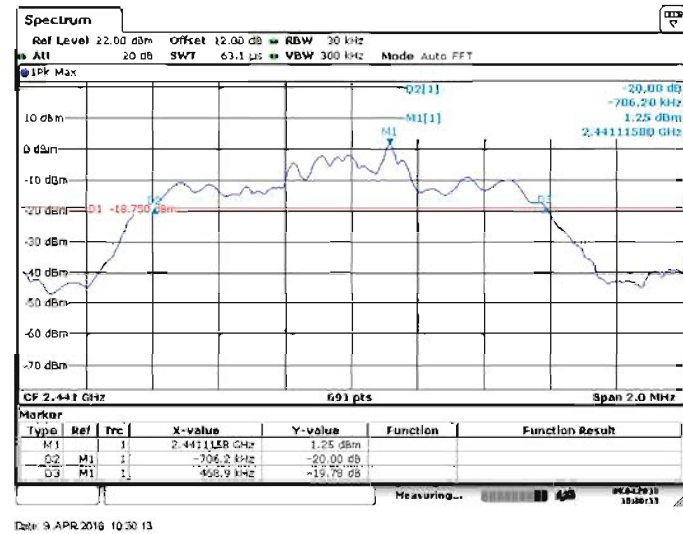
Test Item	: 20 dB Bandwidth
Test Mode	: Mode 2: Transmit by Bluetooth v3.0 + EDR(DH3)

Channel	Frequency(MHz)	20dB Bandwidth(kHz)	99% Bandwidth(kHz)
00	2402	1172.2	1083.6
39	2441	1175.1	1091.5
78	2480	1175.1	1088.4

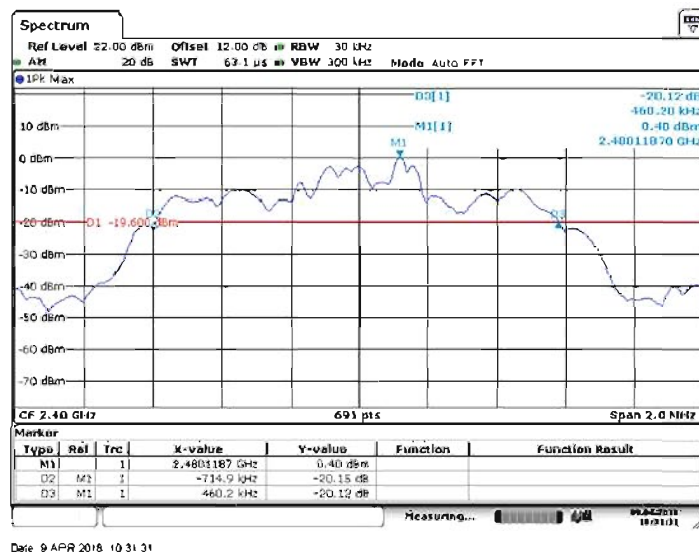
Channel 00 (2402MHz)



Channel 39 (2441MHz)



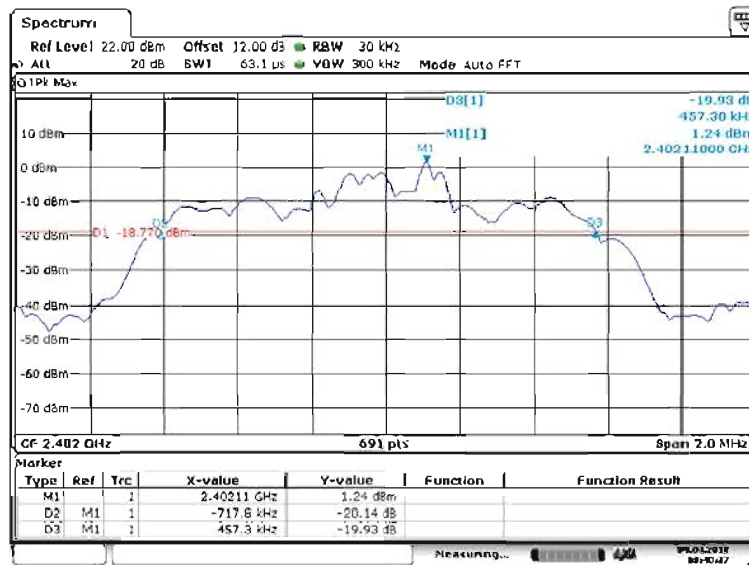
Channel 78 (2480MHz)



Test Item	: 20 dB Bandwidth
Test Mode	: Mode 3: Transmit by Bluetooth v3.0 + EDR(DH5)

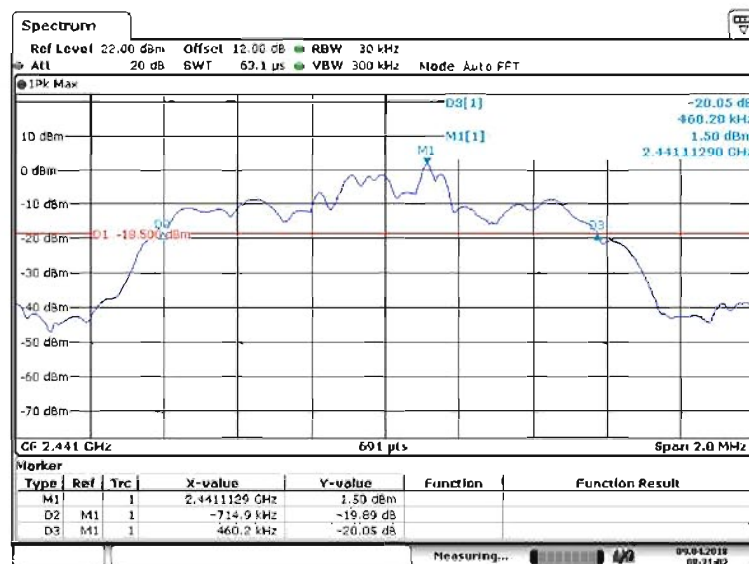
Channel	Frequency(MHz)	20dB Bandwidth(kHz)	99% Bandwidth(kHz)
00	2402	1175.1	1102.4
39	2441	1175.1	1099.8
78	2480	1175.1	1103.2

Channel 00 (2402MHz)



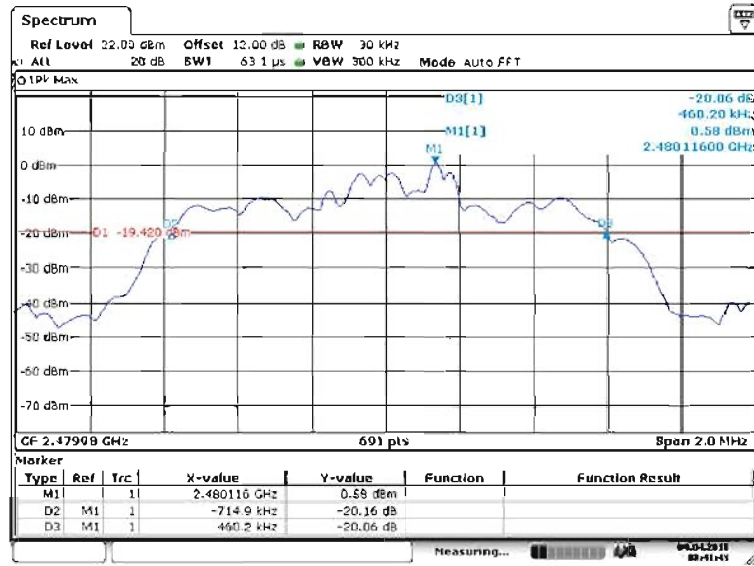
Date: 9 APR 2018 05:40:37

Channel 39 (2441MHz)



Date: 9 APR 2018 08:31:02

Channel 78 (2480MHz)



Date: 9 APR 2018 08:41:44

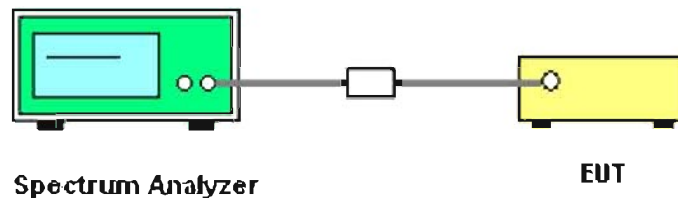
6. Carrier Frequency Separation

6.1 Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
Spectrum Analyzer	R&S	FSV40	101155	2017.10.24
Shielding Room No. 1	EMC	9m*4m*3m	/	2016.08
Temperature/Humidity Meter	/	HTC-1	/	2017.11.08

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

6.2 Test Setup



6.3 Limit

- 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 125mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.
- For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

- Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

6.4 Test Procedure

According to ANSI C63.10: 2013

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

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

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

6.5 Uncertainty

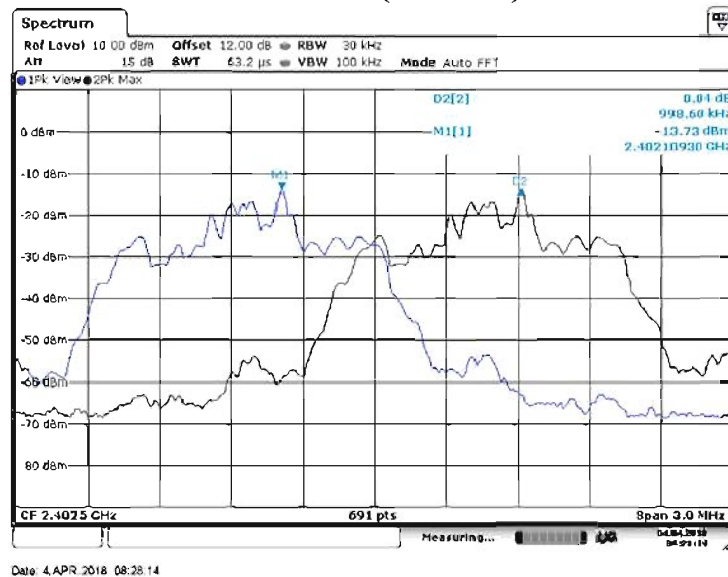
The measurement uncertainty is defined as ± 1 kHz.

6.6 Test Result

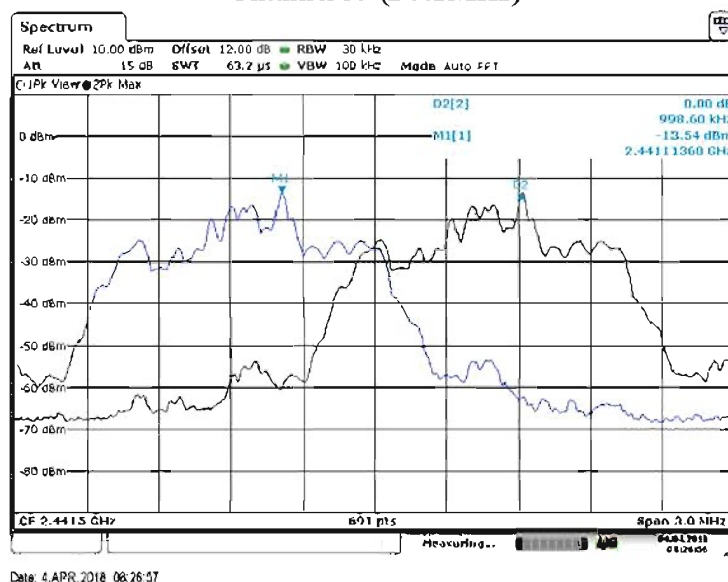
Test Item	: Carrier Frequency Separation
Test Mode	: Mode 1: Transmit by Bluetooth v3.0 + EDR(DH1)

Channel	Frequency(MHz)	Carrier Frequency Separation (kHz)	Limit(kHz)	Pass/Fail
00	2402	998.60	>25 kHz or 2/3 of 20 dB BW	Pass
39	2441	998.60	>25 kHz or 2/3 of 20 dB BW	Pass
78	2480	998.60	>25 kHz or 2/3 of 20 dB BW	Pass

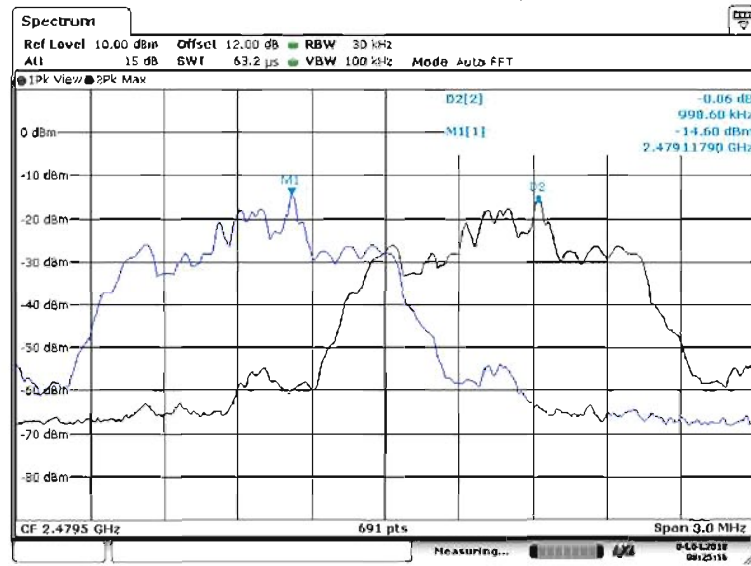
Channel 00 (2402MHz)



Channel 39 (2441MHz)



Channel 78 (2480MHz)

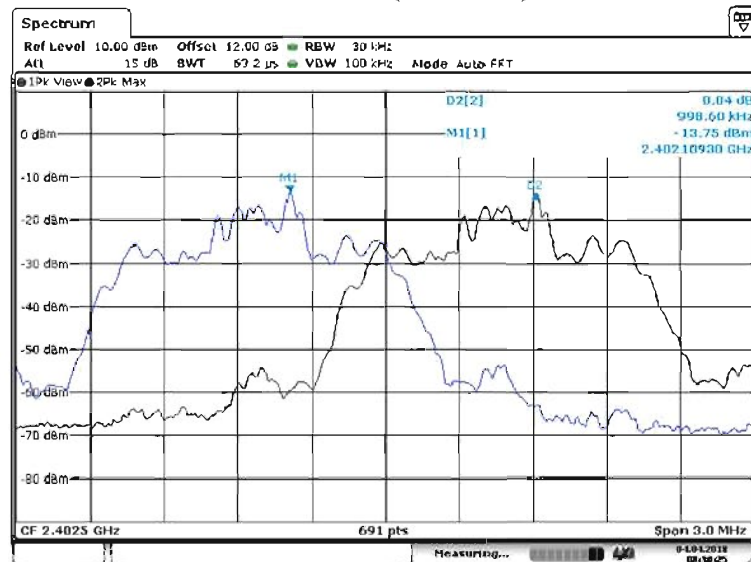


Date: 4 APR 2018 08:25:17

Test Item	: Carrier Frequency Separation
Test Mode	: Mode 2: Transmit by Bluetooth v3.0 + EDR(DH3)

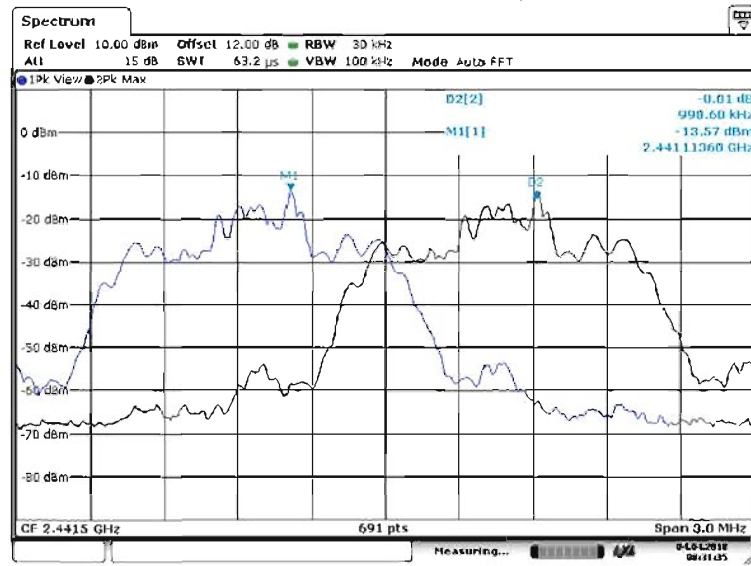
Channel	Frequency(MHz)	Carrier Frequency Separation (kHz)	Limit(kHz)	Pass/Fail
00	2402	998.60	>25 kHz or 2/3 of 20 dB BW	Pass
39	2441	998.60	>25 kHz or 2/3 of 20 dB BW	Pass
78	2480	998.60	>25 kHz or 2/3 of 20 dB BW	Pass

Channel 00 (2402MHz)



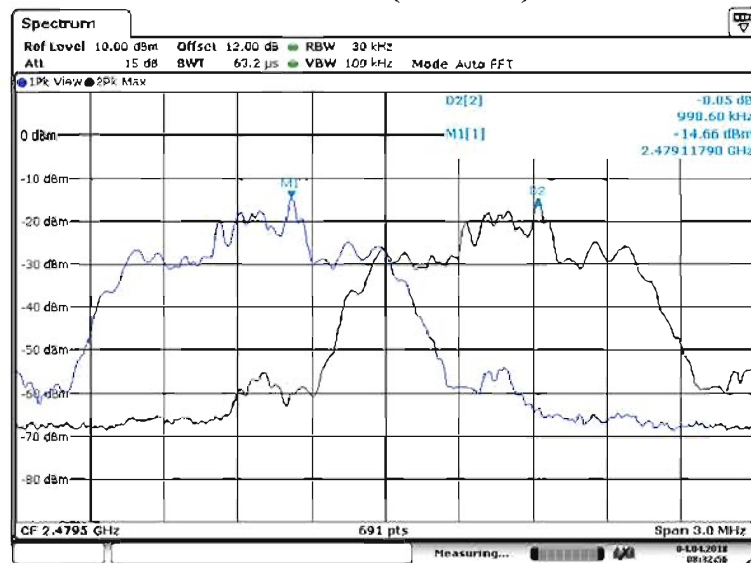
Date: 4 APR 2018 08:30:25

Channel 39 (2441MHz)



Date: 4 APR 2018 08:31:35

Channel 78 (2480MHz)

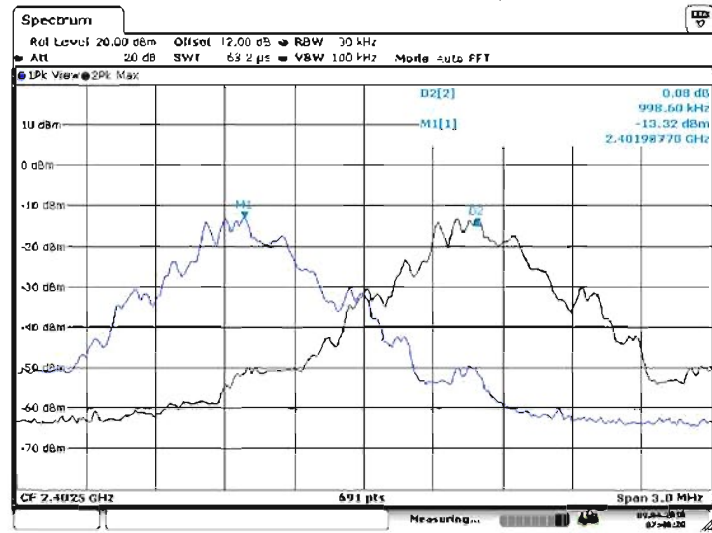


Date: 4 APR 2018 08:32:57

Test Item	: Carrier Frequency Separation
Test Mode	: Mode 3: Transmit by Bluetooth v3.0 + EDR(DH5)

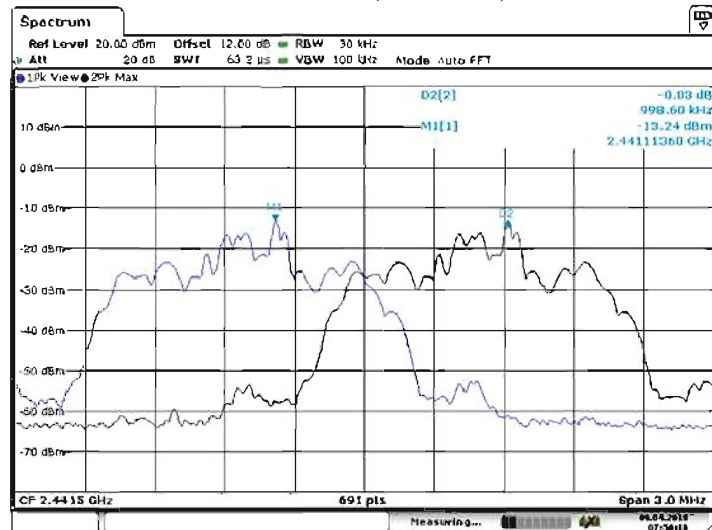
Channel	Frequency(MHz)	Carrier Frequency Separation (kHz)	Limit(kHz)	Pass/Fail
00	2402	998.60	>25 kHz or 2/3 of 20 dB BW	Pass
39	2441	998.60	>25 kHz or 2/3 of 20 dB BW	Pass
78	2480	998.60	>25 kHz or 2/3 of 20 dB BW	Pass

Channel 00 (2402MHz)



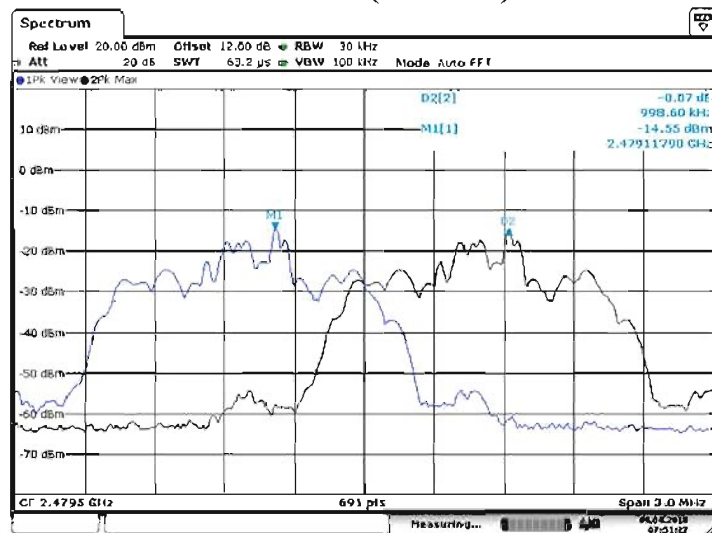
Date: 9 APR 2016 01:43:20

Channel 39 (2441MHz)



Date: 9 APR 2016 07:50:19

Channel 78 (2480MHz)



Date: 9 APR 2016 07:51:22

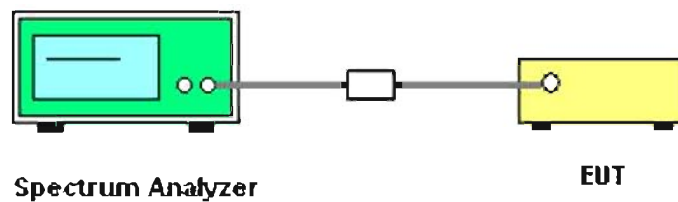
7. Number of Hopping Frequencies

7.1 Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
Spectrum Analyzer	R&S	FSV40	101155	2017.10.24
Shielding Room No. 1	EMC	9m*4m*3m	/	2016.08
Temperature/Humidity Meter	/	HTC-1	/	2017.11.08

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

7.2 Test Setup



7.3 Limit

- For frequency hopping systems operating in the 2400-2483.5 MHz band shall use at least 15 hopping frequencies.
- For frequency hopping systems operating in 902-928 MHz band shall use at least 50 hopping frequencies.
- For frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies.

7.4 Test Procedure

According to ANSI C63.10: 2013

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW 1% of the span

VBW RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. It may prove necessary to bread the span up to sections, in order to clearly show all of the hopping frequencies.

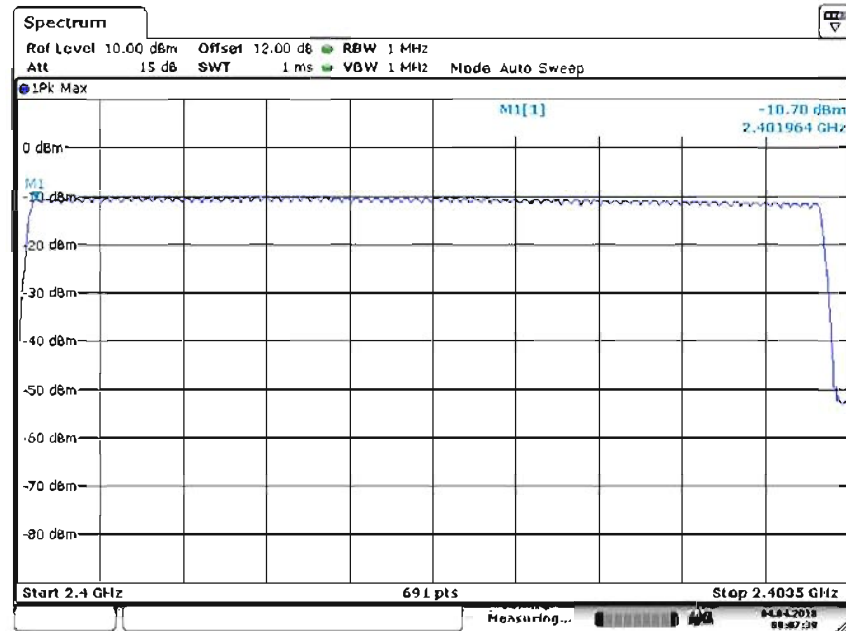
7.5 Uncertainty

The measurement uncertainty is defined as ± 1 kHz.

7.6 Test Result

Test Item	: Number of Hopping Frequencies
Test Mode	: Mode 1: Transmit by Bluetooth v3.0 + EDR(DH1)

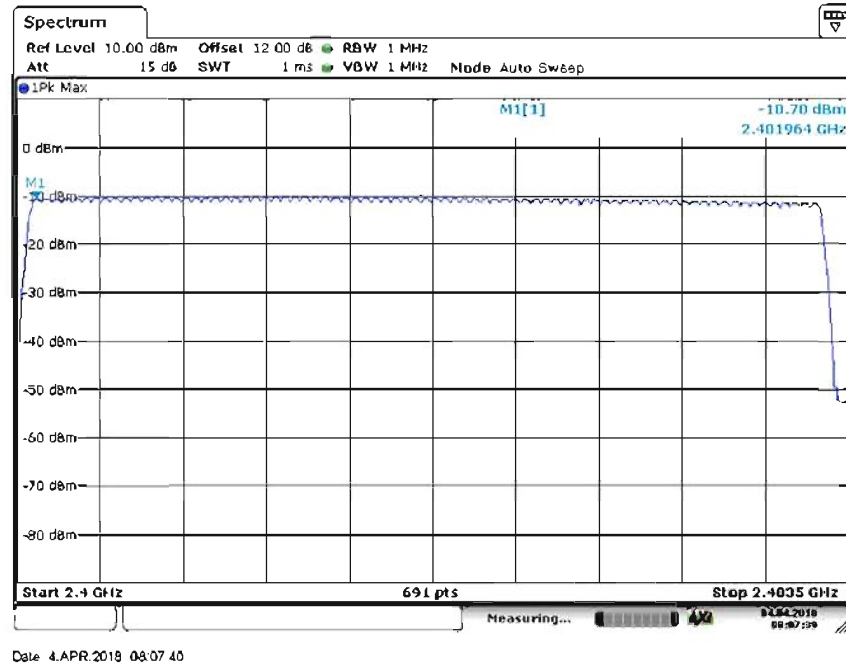
Frequency Band(MHz)	Number of Hopping Frequencies	Limit	Pass/Fail
2400 - 2483.5	79	>15	Pass



Date: 4.APR.2018 08:07:40

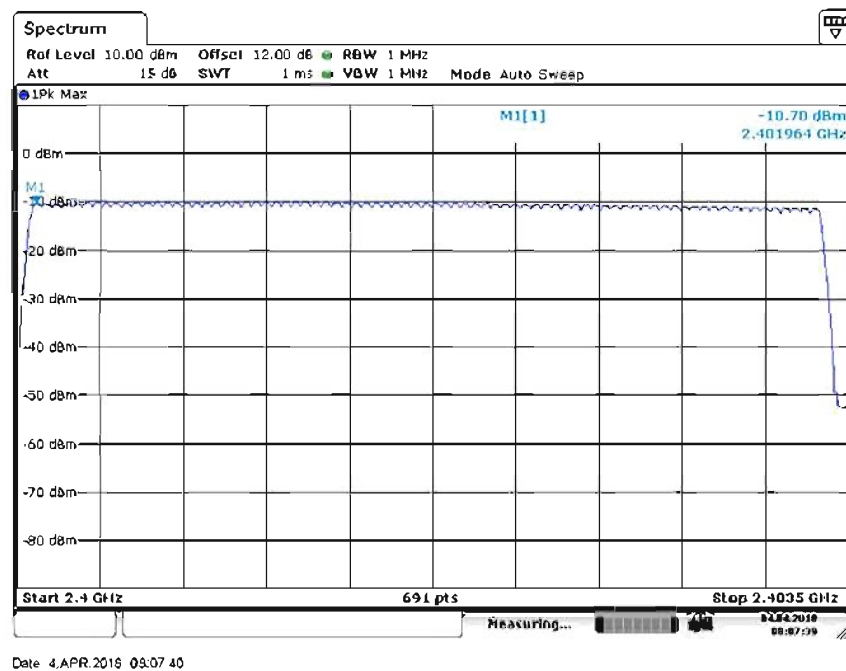
Test Item	: Number of Hopping Frequencies
Test Mode	: Mode 2: Transmit by Bluetooth v3.0 + EDR(DH3)

Frequency Band(MHz)	Number of Hopping Frequencies	Limit	Pass/Fail
2400 - 2483.5	79	>15	Pass



Test Item	: Number of Hopping Frequencies
Test Mode	: Mode 3: Transmit by Bluetooth v3.0 + EDR(DH5)

Frequency Band(MHz)	Number of Hopping Frequencies	Limit	Pass/Fail
2400 - 2483.5	79	>15	Pass



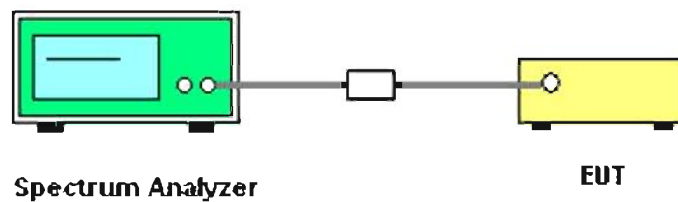
8. Time of Occupancy (Dwell Time)

8.1 Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
Spectrum Analyzer	R&S	FSV40	101155	2017.10.24
Shielding Room No. 1	EMC	9m*4m*3m	/	2016.08
Temperature/Humidity Meter	/	HTC-1	/	2017.11.08

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

8.2 Test Setup



8.3 Limit

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.

8.4 Test procedure

According to ANSI C63.10: 2013

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel

RBW = 1MHz

VBW RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

DH1: Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second

DH3: Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second

DH5: Dwell time=Pulse Time (ms) $\times$ (1600 $\div$ 6 $\div$ 79) $\times$ 31.6 Second

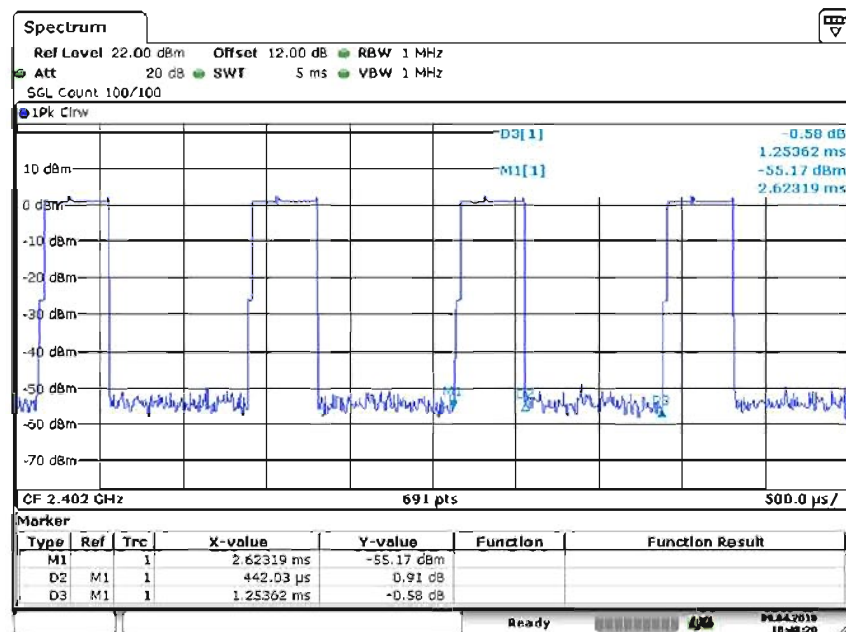
8.5 Uncertainty

The measurement uncertainty is defined as ± 0.1 us.

8.6 Test Result

Test Item	: Time of Occupancy (Dwell Time)
Test Mode	: Mode 1: Transmit by Bluetooth v3.0 + EDR(DH1)

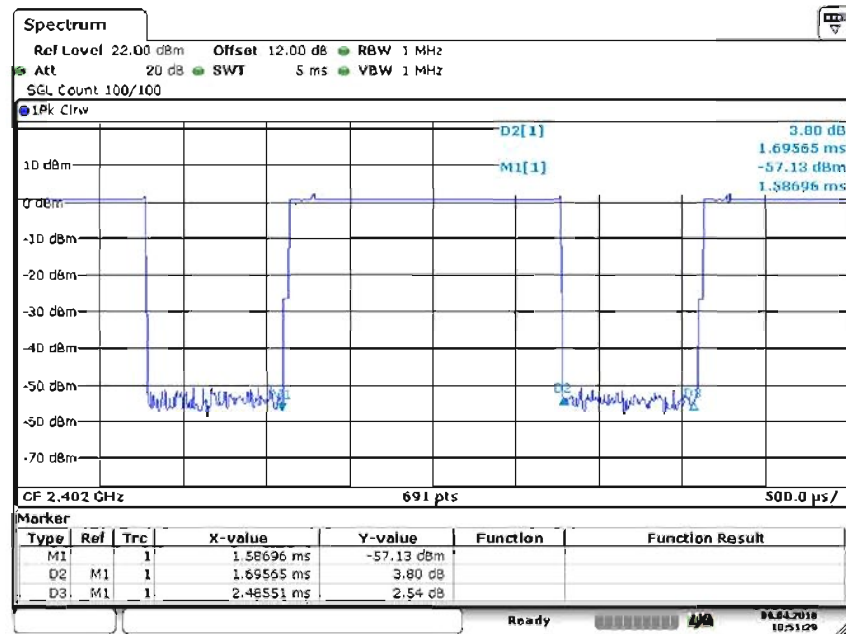
Channel	Frequency(MHz)	Time of Occupancy (ms)	Limit (ms)	Pass/Fail
00	2402	141.45	< 400	Pass



Date: 8 APR 2019 10:48:20

Test Item	: Time of Occupancy (Dwell Time)
Test Mode	: Mode 2: Transmit by Bluetooth v3.0 + EDR(DH3)

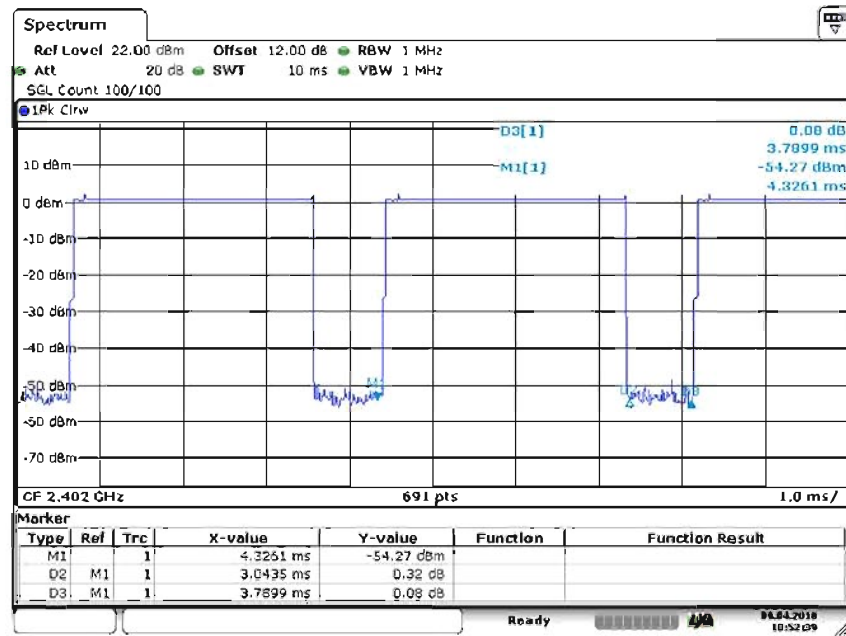
Channel	Frequency(MHz)	Time of Occupancy (ms)	Limit (ms)	Pass/Fail
00	2402	271.304	< 400	Pass



Date: 9 APR 2018 10:51:29

Test Item	: Time of Occupancy (Dwell Time)
Test Mode	: Mode 3: Transmit by Bluetooth v3.0 + EDR(DH5)

Channel	Frequency(MHz)	Time of Occupancy (ms)	Limit (ms)	Pass/Fail
00	2402	324.64	< 400	Pass



Date: 9 APR 2018 10:52:39

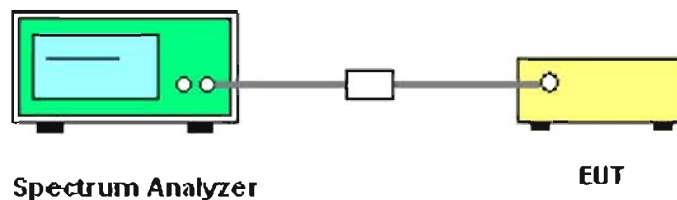
9. Peak Output Power

9.1 Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
Spectrum Analyzer	R&S	FSV40	101155	2017.10.24
Shielding Room No. 1	EMC	9m*4m*3m	/	2016.08
Temperature/Humidity Meter	/	HTC-1	/	2017.11.08

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

9.2 Test Setup



9.3 Limit

- 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: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
- For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

Note: the conducted output power limit specified above is based on the use the antennas with directional gains that do not exceed 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values above, as appropriate, by the amount in dB that the directional gain of antenna exceeds 6dBi.

9.4 Test Procedure

According to ANSI C63.10: 2013

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20dB 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

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 (don't forget added the external attenuation and cable loss).

9.5 Uncertainty

The measurement uncertainty is defined as ± 1.0 dB.

9.6 Test Result

Test Item	: Peak Output Power
Test Mode	: Mode 1: Transmit by Bluetooth v3.0 + EDR(DH1)

Channel	Frequency(MHz)	Peak Output Power(dBm)	Max Limit(dBm)	Pass/Fail
00	2402	3.16	30	Pass
39	2441	3.31	30	Pass
78	2480	2.41	30	Pass

Test Item	: Peak Output Power
Test Mode	: Mode 2: Transmit by Bluetooth v3.0 + EDR(DH3)

Channel	Frequency(MHz)	Peak Output Power(dBm)	Max Limit(dBm)	Pass/Fail
00	2402	3.08	30	Pass
39	2441	3.24	30	Pass
78	2480	2.33	30	Pass

Test Item	: Peak Output Power
Test Mode	: Mode 3: Transmit by Bluetooth v3.0 + EDR(DH5)

Channel	Frequency(MHz)	Peak Output Power(dBm)	Max Limit(dBm)	Pass/Fail
00	2402	3.06	30	Pass
39	2441	3.21	30	Pass
78	2480	2.33	30	Pass

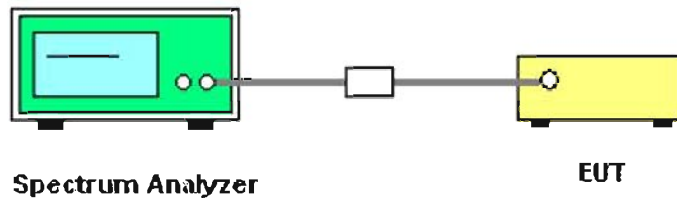
10. Band-edge Compliance of RF Conducted Emissions

10.1 Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
Spectrum Analyzer	R&S	FSV40	101155	2017.10.24
Shielding Room No. 1	EMC	9m*4m*3m	/	2016.08
Temperature/Humidity Meter	/	HTC-1	/	2017.11.08

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

10.2 Test Setup



10.3 Limit

- Intentional radiators operating under the alternative provisions to the general emission limits as contained in 15.217 through 15.257 and in Subpart E of FCC part 15, must be designed to ensure that 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.
- 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 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, 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) of FCC part 15 is not required.

10.4 Test Procedure

According to ANSI C63.10: 2013

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, 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

Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section.

Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

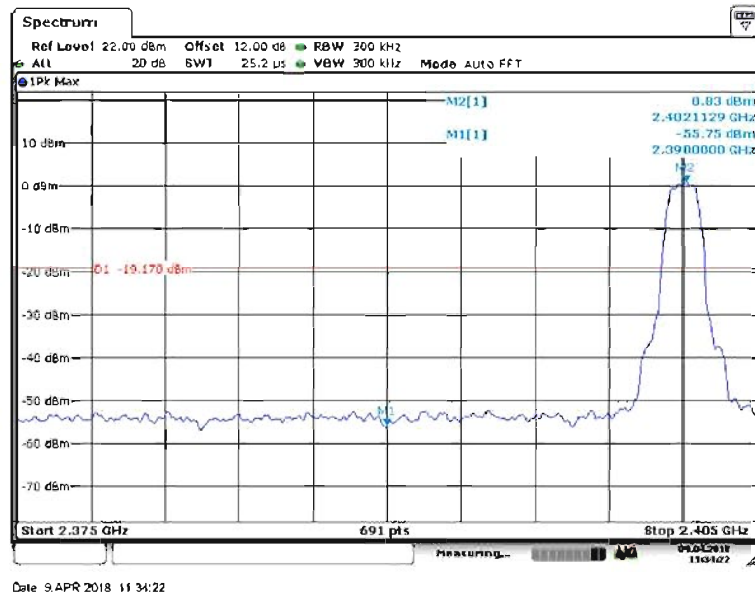
10.5 Uncertainty

The measurement uncertainty is defined as ± 1.0 dB.

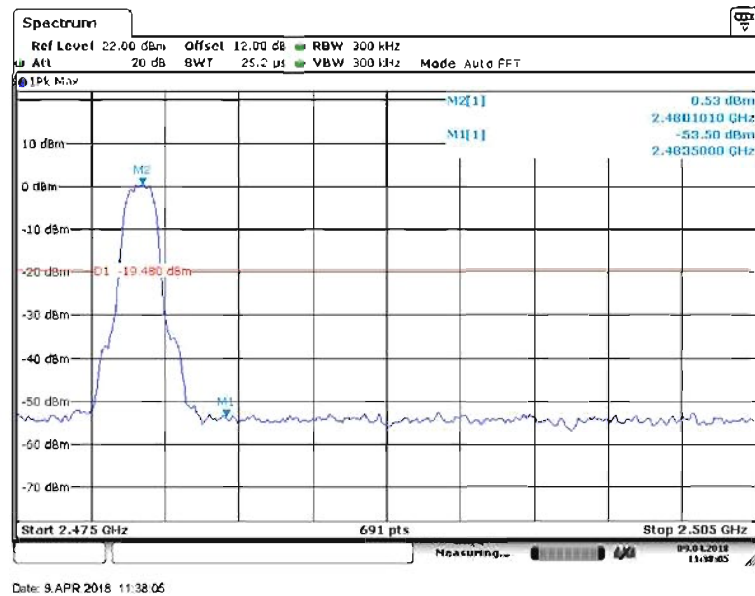
10.6 Test Result

Test Item	: Band-edge Compliance of RF Conducted Emissions
Test Mode	: Mode 1: Transmit by Bluetooth v3.0 + EDR(DH1)

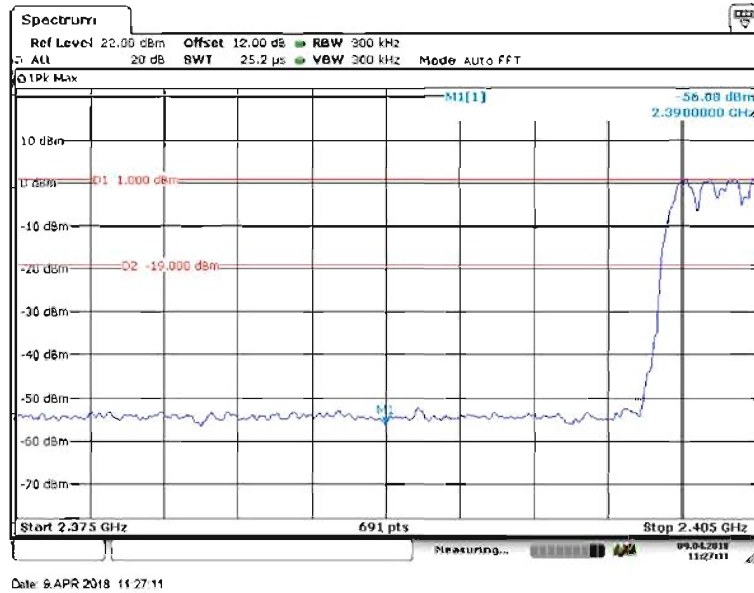
Channel 00 (2402MHz)



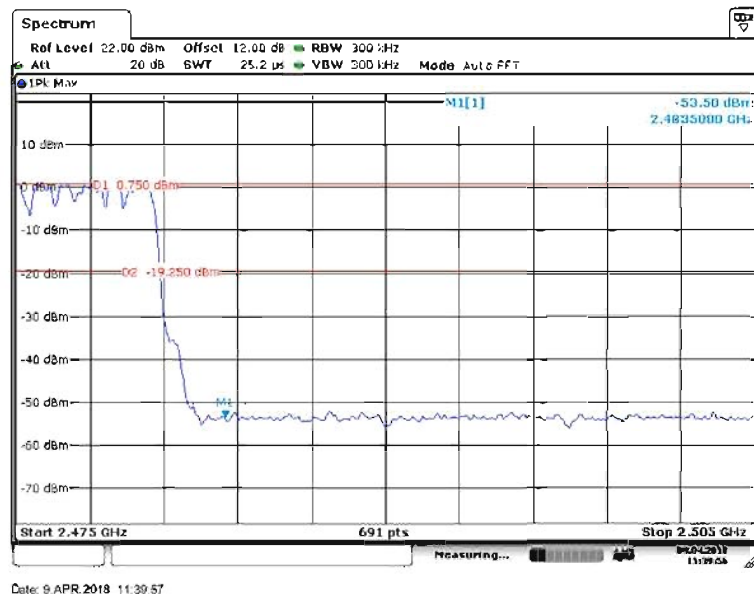
Channel 78 (2480MHz)



Hopping Mode: Channel 00 (2402MHz)

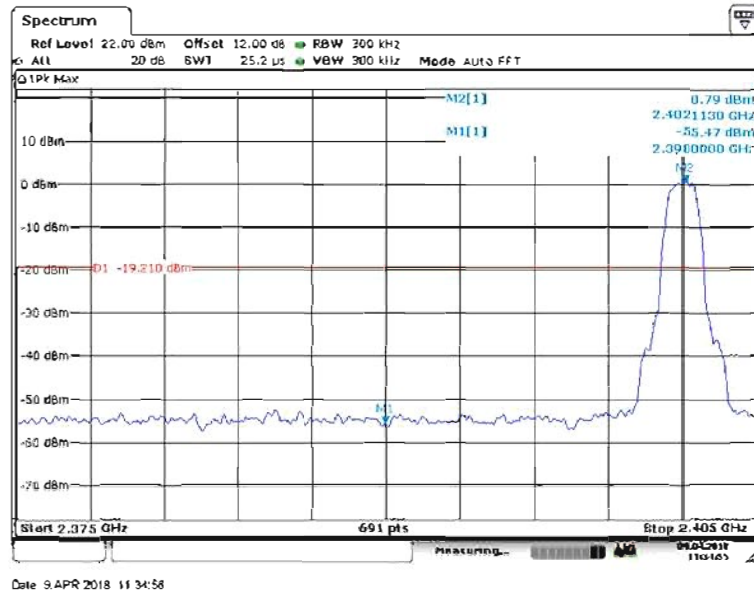


Channel 78 (2480MHz)

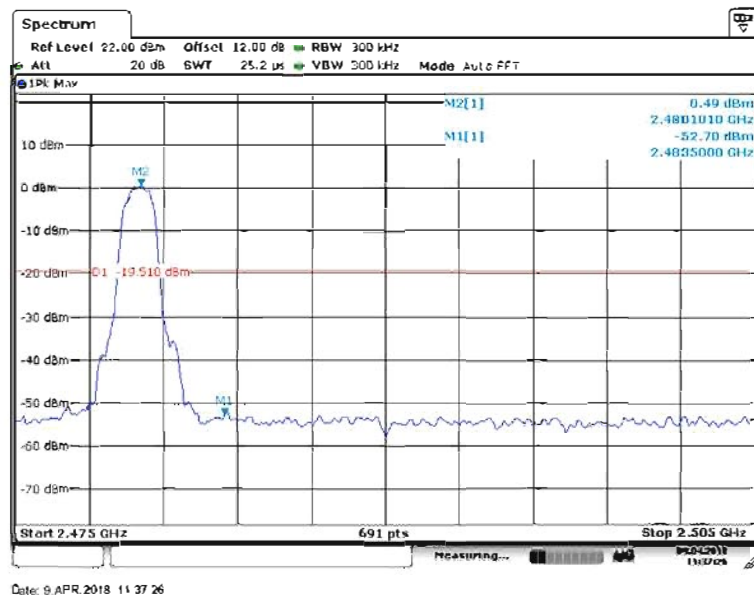


Test Item	: Band-edge Compliance of RF Conducted Emissions
Test Mode	: Mode 2: Transmit by Bluetooth v3.0 + EDR(DH3)

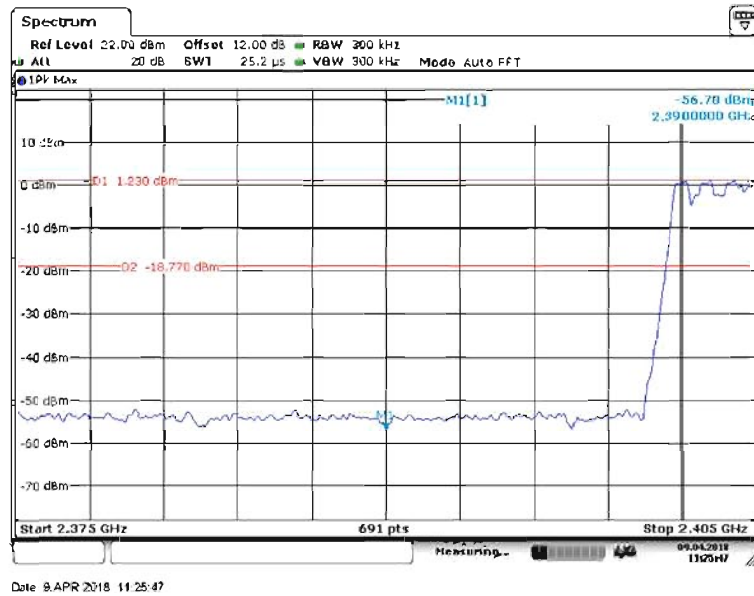
Channel 00 (2402MHz)



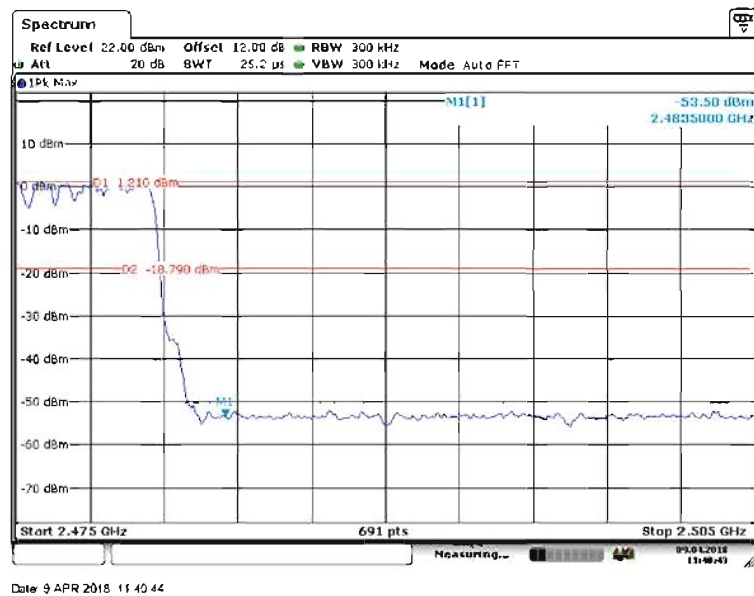
Channel 78 (2480MHz)



Hopping Mode: Channel 00 (2402MHz)

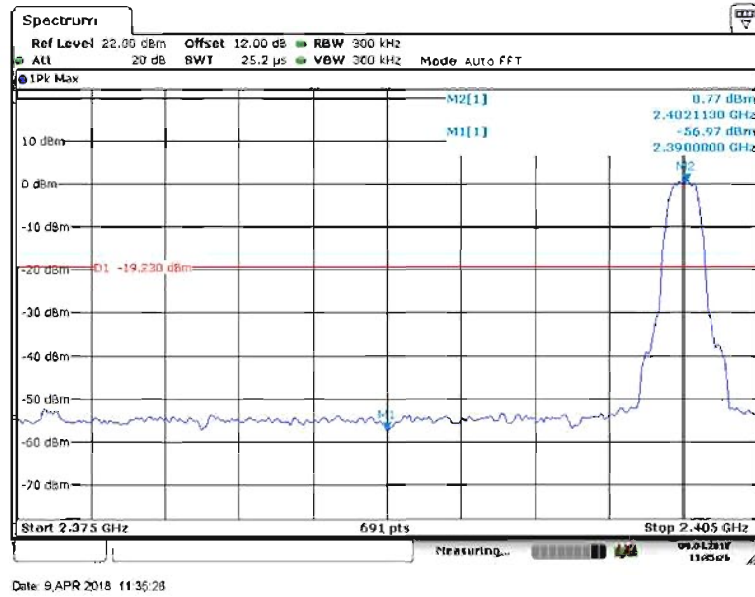


Channel 78 (2480MHz)

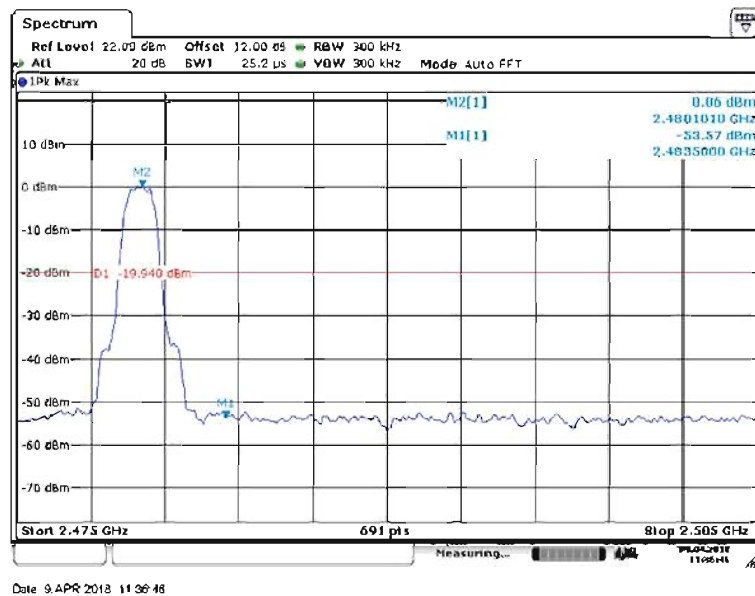


Test Item	: Band-edge Compliance of RF Conducted Emissions
Test Mode	: Mode 3: Transmit by Bluetooth v3.0 + EDR(DH5)

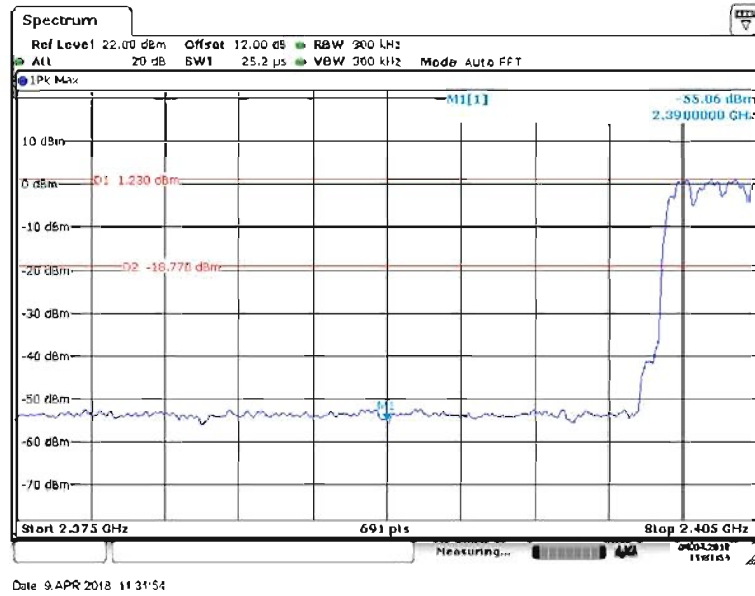
Channel 00 (2402MHz)



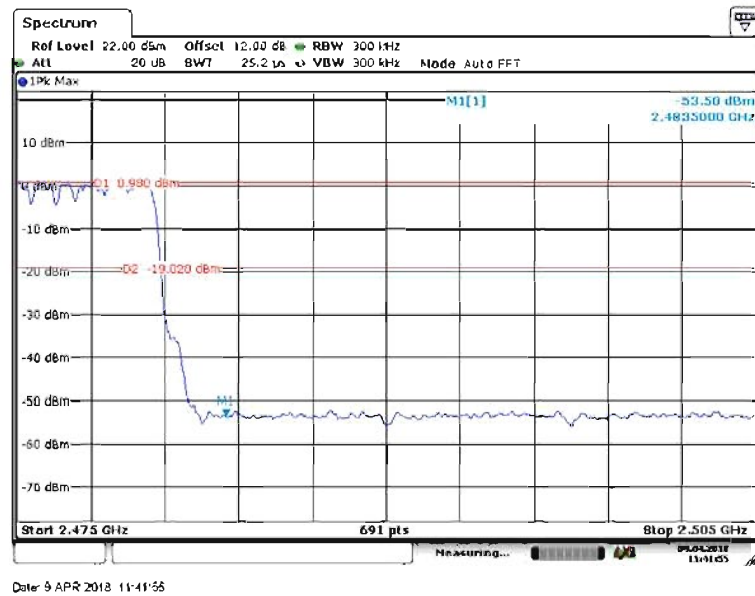
Channel 78 (2480MHz)



Hopping Mode: Channel 00 (2402MHz)



Channel 78 (2480MHz)



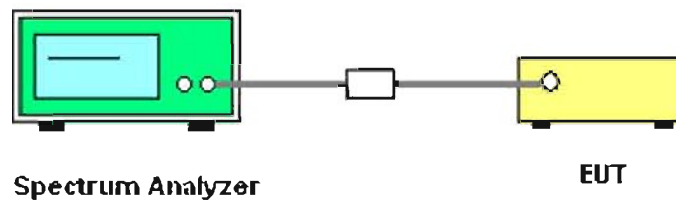
11. Spurious RF Conducted Emissions

11.1 Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
Spectrum Analyzer	R&S	FSV40	101155	2017.10.24
Shielding Room No. 1	EMC	9m*4m*3m	/	2016.08
Temperature/Humidity Meter	/	HTC-1	/	2017.11.08

Note: All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.

11.2 Test Setup



11.3 Limit

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 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, 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) of FCC part 15 is not required.

11.4 Test Procedure

According to ANSI C63.10: 2009.

Use the following spectrum analyzer settings:

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

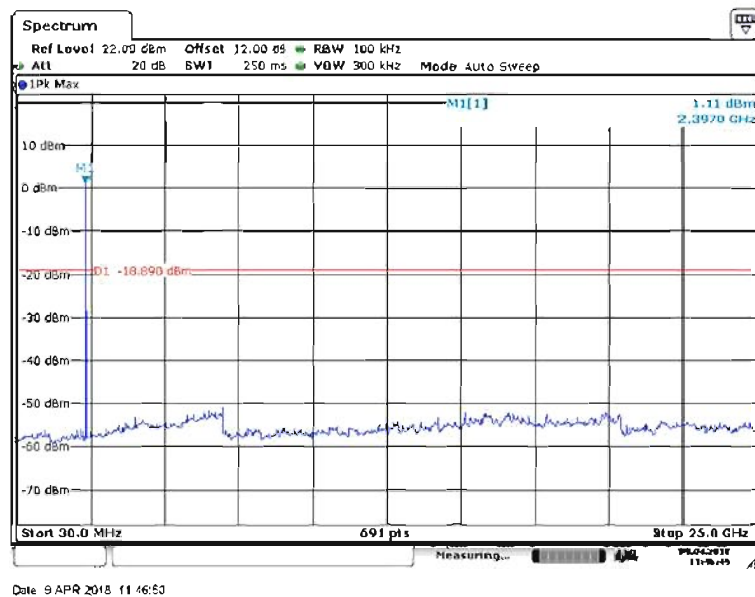
Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this section.

11.5 Uncertainty

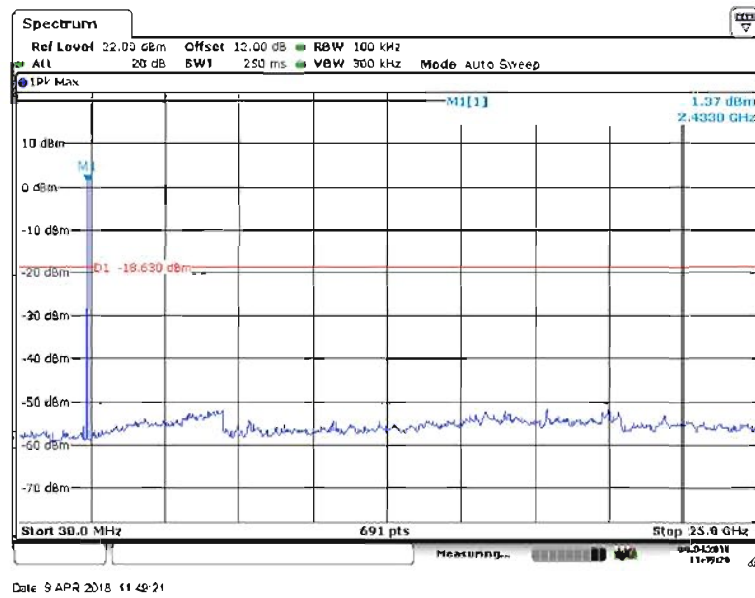
The measurement uncertainty is defined as ± 1.0 dB.

11.6 Test Result

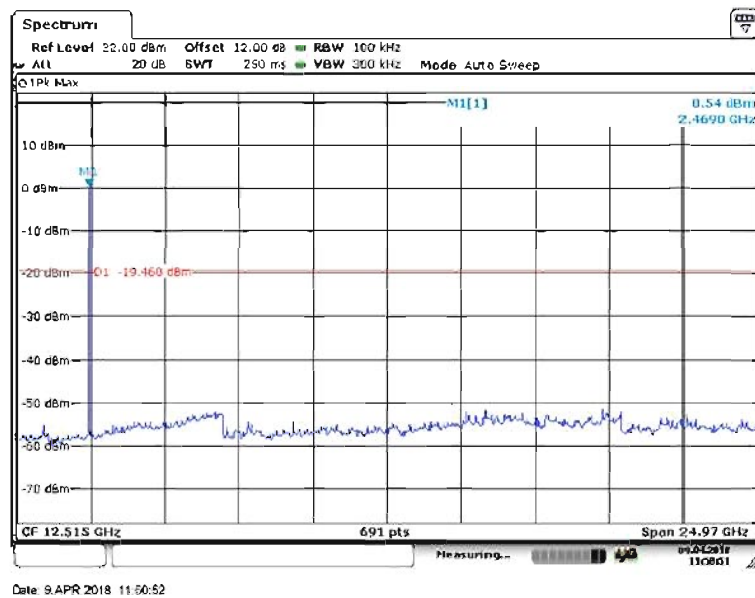
Test Item	: Spurious RF Conducted Emissions
Test Mode	: Mode 1: Transmit by Bluetooth v3.0 + EDR(DH1)



Test Item	: Spurious RF Conducted Emissions
Test Mode	: Mode 2: Transmit by Bluetooth v3.0 + EDR(DH3)



Test Item	: Spurious RF Conducted Emissions
Test Mode	: Mode 3: Transmit by Bluetooth v3.0 + EDR(DH5)



12. Antenna requirement

12.1 The requirement

According to section 15.203, an intentional radiator shall be designed to ensure that no antenna other than the furnished by the responsible party shall be used with the device.

12.2 Antenna construction

Device is equipped with permanent attached antenna, which isn't displaced by other antenna. The max antenna gain of EUT is 2dBi. Therefore, the equipment complies with the antenna requirement of section 15.203.