

Partial FCC Test Report

Report No.: RF181222C02D-2

FCC ID: PPD-QCNFA344AH

Test Model: QCNFA344A

Received Date: Oct. 25, 2018

Test Date: Dec. 18, 2018 ~ Jan. 27, 2019

Issued Date: Feb. 01, 2019

Applicant: Qualcomm Atheros, Inc.

Address: 1700 Technology Dr San Jose, CA 95110

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan
(R.O.C)

Test Location: No. 19, Hwa Ya 2nd Rd, Wen Hwa Tsuen, Kwei Shan Hsiang, Taoyuan
Hsien 333, Taiwan, R.O.C.

FCC Registration /
Designation Number: 788550 / TW0003



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Release Control Record

Issue No.	Description	Date Issued
RF181222C02D-2	Original Release	Feb. 01, 2019

1 Certificate of Conformity

Product: 802.11a/b/g/n/ac + BT 4.1 M.2 2230 Type Card

Brand: Qualcomm Atheros

Test Model: QCNFA344A

Sample Status: Engineering Sample

Applicant: Qualcomm Atheros, Inc.

Test Date: Dec. 18, 2018 ~ Jan. 27, 2019

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
ANSI C63.10:2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : Gina Liu, **Date:** Feb. 01, 2019
Gina Liu / Specialist

Approved by : Dylan Chiou, **Date:** Feb. 01, 2019
Dylan Chiou / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -12.53 dB at 0.55080 MHz.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	N/A	Refer to Note 1
15.247(a)(1)(iii)	Dwell Time on Each Channel	N/A	Refer to Note 1
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	N/A	Refer to Note 1
15.247(b)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	N/A	Refer to Note 1
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -8.91 dB at 307.42 MHz.
15.247(d)	Band Edge Measurement	N/A	Refer to Note 1
15.247(d)	Antenna Port Emission	N/A	Refer to Note 1
15.203	Antenna Requirement	N/A	Refer to Note 1

Note:

- This report is a partial report, only test item of Conducted Emissions, Radiated Emissions and Average Power were performed for this report. Other testing data please refer to BV CPS report no.: RF150107E06B-2 for module (Brand: Qualcomm Atheros, Model: QCNFA344A).
- Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	802.11a/b/g/n/ac + BT 4.1 M.2 2230 Type Card
Brand	Qualcomm Atheros
Test Model	QCNFA344A
Status of EUT	Engineering Sample
Power Supply Rating	3.3 Vdc (host equipment)
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8DPSK
Transfer Rate	1/2/3 Mbps
Operating Frequency	2402 ~ 2480 MHz
Number of Channel	79
Output Power	7.89 mW
Antenna Type	Refer to Note as below
Antenna Connector	N/A
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

1. The EUT was installed in a specific End-product.

Equipment Name	Brand Name	Model Name	Difference
Notebook Computer	Lenovo	Lenovo 14w*****, 81MQ*****, Lenovo 14e Chromebook*****, 81MH***** (*=0~9, A~Z, a~z, "-" or blank, for marketing use only, with no impact on RF compliance of the product)	All models are electrically identical, different model names are for marketing purpose.

2. The antenna information is listed as below.

Antenna Type	Manufacturer	Parts Number	Antenna Gain			
			BT/WLAN 2.4 GHz	WLAN 5.15~5.35 GHz	WLAN 5.47~5.725 GHz	WLAN 5.725~5.85 GHz
PIFA	High-Tek Electronics Co., Ltd.	Main Ant.: 0ACCN018024N Aux Ant.: 0ACCN018025N	Main: -0.56 Aux.: -2.41	Main: -0.05 Aux.: -1.14	Main: -0.73 Aux.: -1.79	Main: -1.98 Aux.: -3.33
PIFA	Yageo Corporation	Main Ant.: ANTA0LC13081WLAN1 (DC330029600) Aux Ant.: ANTA0LC13081WLAN2 (DC330029610)	Main: -0.59 Aux.: -0.69	Main: -0.34 Aux.: -0.08	Main: -2.43 Aux.: -0.76	Main: -2.01 Aux.: -4.32

3. The End-product contains following accessory devices.

Product	Brand	Model	Description
Adapter	Lenovo	ADLX45YLC3D	I/P: 100-240 Vac, 50-60 Hz, 1300 mA O/P: 20 Vdc, 2.25 A / 15 Vdc, 3.0A / 9Vdc, 2.0 A / 5 Vdc, 2.0 A
Battery	Lenovo	L18D3PG2	11.52 Vdc, 4955 mAh

4. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or User's Manual.

3.2 Description of Test Modes

79 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE \geq 1G	RE<1G	PLC	APCM	
-	√	√	√	√	-

Where **RE \geq 1G**: Radiated Emission above 1 GHz

RE<1G: Radiated Emission below 1 GHz

PLC: Power Line Conducted Emission

APCM: Antenna Port Conducted Measurement

Note:

1. For Radiated emission test, pre-tested GFSK, $\pi/4$ -DQPSK, 8DPSK modulation type and found GFSK was the worse, therefore chosen for the final test and presented in the test report.
2. The EUT had been pre-tested on the positioned of Laptop mode and Tablet mode. The worst case was found when positioned on **Laptop mode**.
3. "-" means no effect.

Radiated Emission Test (Above 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Radiated Emission Test (Below 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	78	FHSS	GFSK	DH5

Power Line Conducted Emission Test:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	78	FHSS	GFSK	DH5

Antenna Port Conducted Measurement:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested by
RE≥1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Jisyong Wang
RE<1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Jisyong Wang
PLC	25 deg. C, 65 % RH	120 Vac, 60 Hz	Jisyong Wang

3.3 Duty Cycle of Test Signal

GFSK: Duty cycle = $2.88/3.76 = 0.766$, Duty factor = $10 * \log(1/0.766) = 1.16$

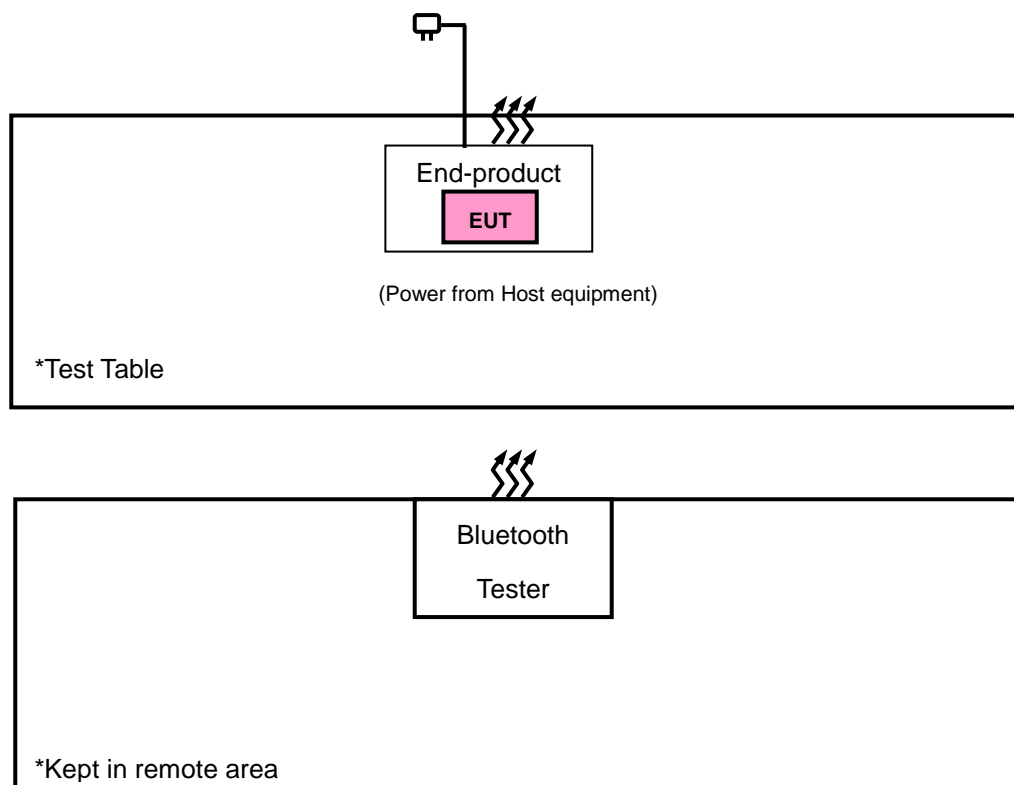
8DPSK: Duty cycle = $2.90/3.76 = 0.771$, Duty factor = $10 * \log(1/0.771) = 1.13$



3.4 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.4.1 Configuration of System under Test



3.5 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247)

KDB 558074 D01 15.247 Meas Guidance v05

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

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

Note:

- The lower limit shall apply at the transition frequencies.
- Emission level (dBuV/m) = 20 log Emission level (uV/m).
- For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY51210203	Mar. 16, 2018	Mar. 15, 2019
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 13, 2018	Dec. 12, 2019
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Jan. 11, 2018	Jan. 10, 2019
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-969	Nov. 25, 2018	Nov. 24, 2019
BILOG Antenna SCHWARZBECK	VULB 9168	9168-472	Nov. 23, 2018	Nov. 22, 2019
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 16, 2018	Apr. 15, 2019
Bluetooth Tester	CBT	100946	Aug. 09, 2018	Aug. 08, 2020
Preamplifier EMCI	EMC 012645	980115	Oct. 12, 2018	Oct. 11, 2019
Preamplifier EMCI	EMC 330H	980112	Oct. 12, 2018	Oct. 11, 2019
Power Meter Anritsu	ML2495A	1012010	Sep. 05, 2018	Sep. 04, 2019
Power Sensor Anritsu	MA2411B	1315050	Sep. 04, 2018	Sep. 03, 2019
RF Coaxial Cable HUBER+SUHNNER	EMC104-SM-SM-8 000&3000	140811+170717	Oct. 12, 2018	Oct. 11, 2019
RF Coaxial Cable HUBER+SUHNNER	SUCOFLEX 104	EMC104-SM-SM- 1000(140807)	Oct. 12, 2018	Oct. 11, 2019
RF Coaxial Cable WOKEN	8D-FB	Cable-Ch10-01	Oct. 12, 2018	Oct. 11, 2019
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower & Turn Table Controller MF	MF-7802	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. The test was performed in HwaYa Chamber 10.
3. The FCC Site Registration No. is 690701.
4. The IC Site Registration No. is 7450F-10.

4.1.3 Test Procedures

For Radiated Emission below 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. 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. Both Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz at frequency below 30 MHz.

For Radiated Emission above 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30 MHz ~ 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. 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 height of antenna 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 and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

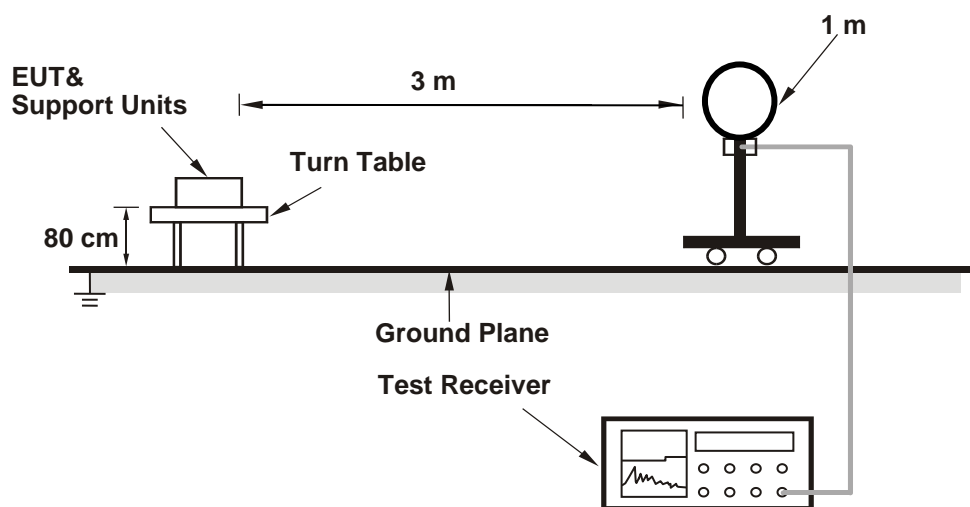
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98 %) or 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz. (RBW = 1 MHz, VBW = 3 kHz)
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

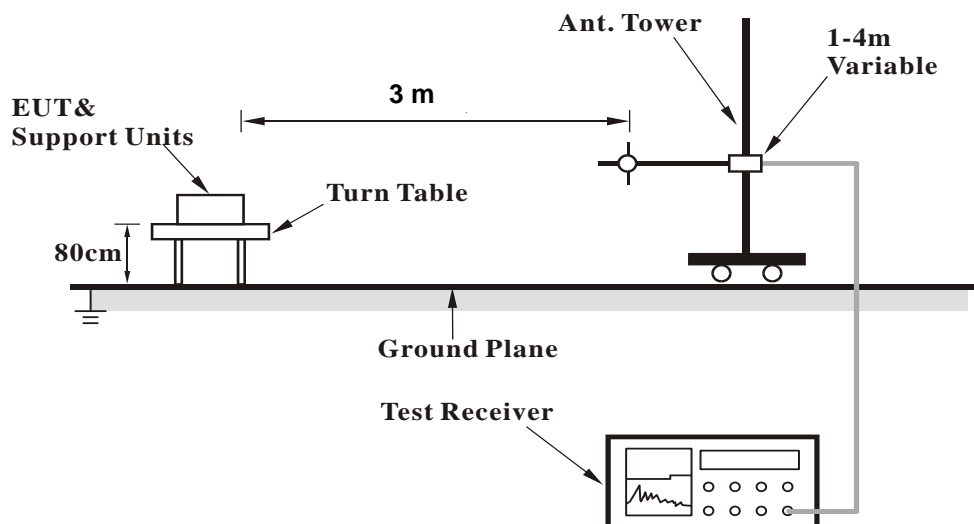
No deviation.

4.1.5 Test Set Up

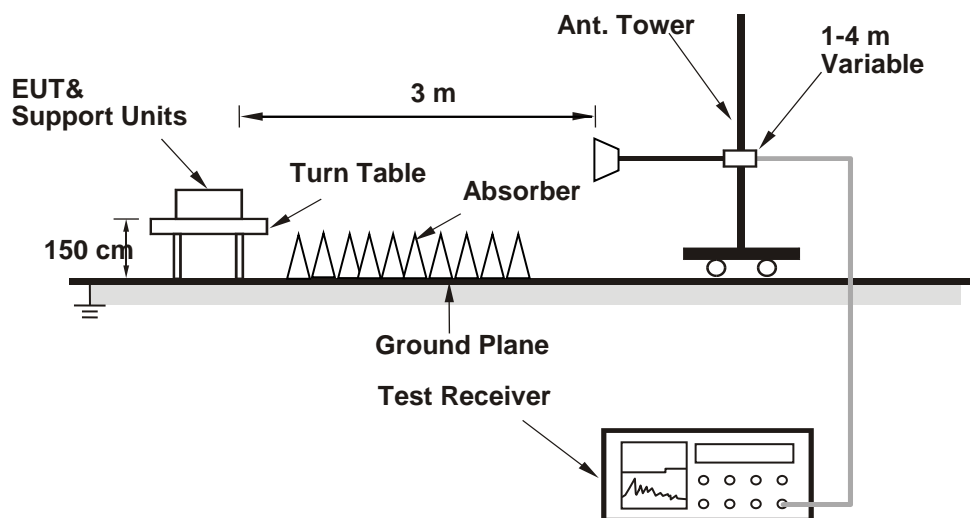
<Radiated Emission below 30 MHz>



<Radiated Emission 30 MHz to 1 GHz>



<Radiated Emission above 1 GHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

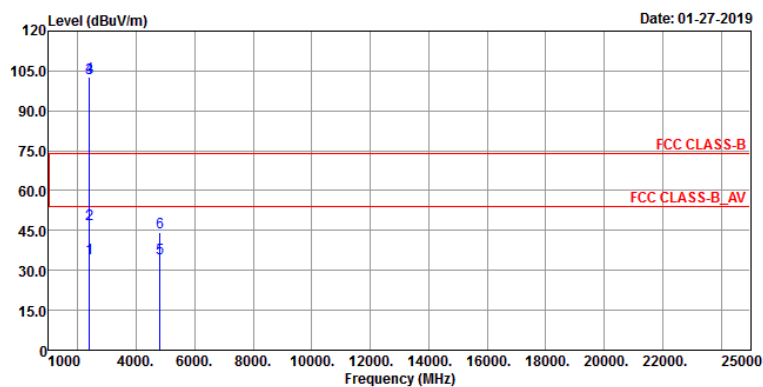
Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

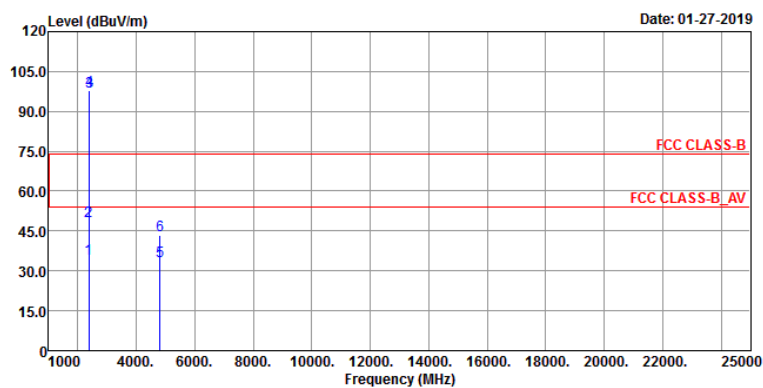
Above 1 GHz Data: GFSK

EUT Test Condition		Measurement Detail	
Channel	Channel 0	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Jisyong Wang

Horizontal



Vertical



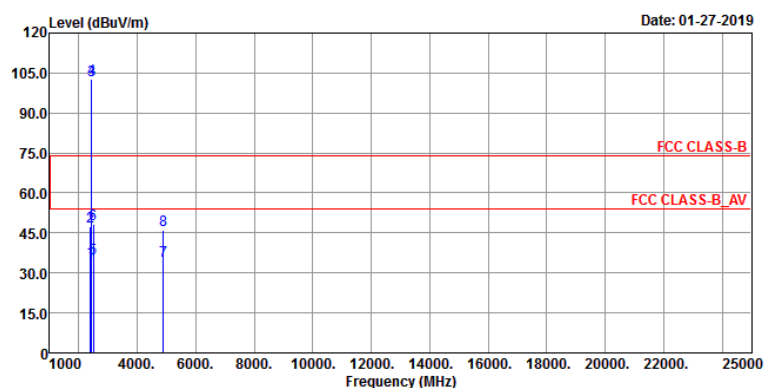
Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2386.72	34.59	40.57	54	-19.41	27.16	4.36	37.5	156	14	Average
2386.72	47.56	53.54	74	-26.44	27.16	4.36	37.5	156	14	Peak
2402	102.23	108.22			27.16	4.37	37.52	156	14	Average
2402	102.62	108.61			27.16	4.37	37.52	156	14	Peak
4804	34.36	49.33	54	-19.64	31.14	6.79	52.9	131	201	Average
4804	44.13	59.1	74	-29.87	31.14	6.79	52.9	131	201	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2377.48	34.57	40.64	54	-19.43	27.08	4.35	37.5	123	58	Average
2377.48	48.92	54.99	74	-25.08	27.08	4.35	37.5	123	58	Peak
2402	97.23	103.22			27.16	4.37	37.52	123	58	Average
2402	97.68	103.67			27.16	4.37	37.52	123	58	Peak
4804	33.64	48.61	54	-20.36	31.14	6.79	52.9	154	103	Average
4804	43.47	58.44	74	-30.53	31.14	6.79	52.9	154	103	Peak

Remarks:

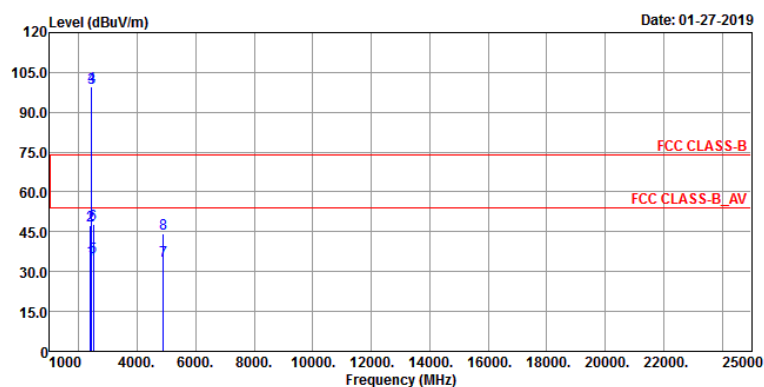
1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
2. 2402 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 39	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Jisyong Wang

Horizontal



Vertical



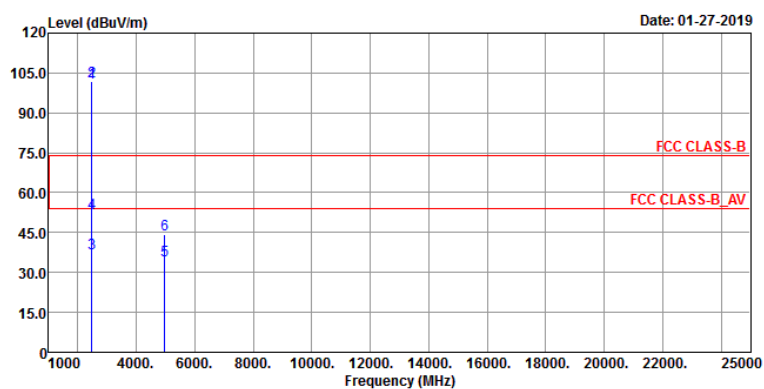
Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2386.72	34.47	40.45	54	-19.53	27.16	4.36	37.5	110	16	Average
2386.72	47.51	53.49	74	-26.49	27.16	4.36	37.5	110	16	Peak
2441	102.18	107.79			27.38	4.4	37.39	110	16	Average
2441	102.61	108.22			27.38	4.4	37.39	110	16	Peak
2488.92	35.47	40.75	54	-18.53	27.61	4.43	37.32	110	16	Average
2488.92	48.13	53.41	74	-25.87	27.61	4.43	37.32	110	16	Peak
4882	34.72	49.47	54	-19.28	31.25	6.86	52.86	149	225	Average
4882	45.84	60.59	74	-28.16	31.25	6.86	52.86	149	225	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.1	34.48	40.46	54	-19.52	27.16	4.36	37.5	195	53	Average
2389.1	47.44	53.42	74	-26.56	27.16	4.36	37.5	195	53	Peak
2441	99.38	104.99			27.38	4.4	37.39	195	53	Average
2441	99.75	105.36			27.38	4.4	37.39	195	53	Peak
2494.2	35.3	40.5	54	-18.7	27.61	4.44	37.25	195	53	Average
2494.2	48.04	53.24	74	-25.96	27.61	4.44	37.25	195	53	Peak
4882	34.26	49.01	54	-19.74	31.25	6.86	52.86	163	151	Average
4882	44.25	59	74	-29.75	31.25	6.86	52.86	163	151	Peak

Remarks:

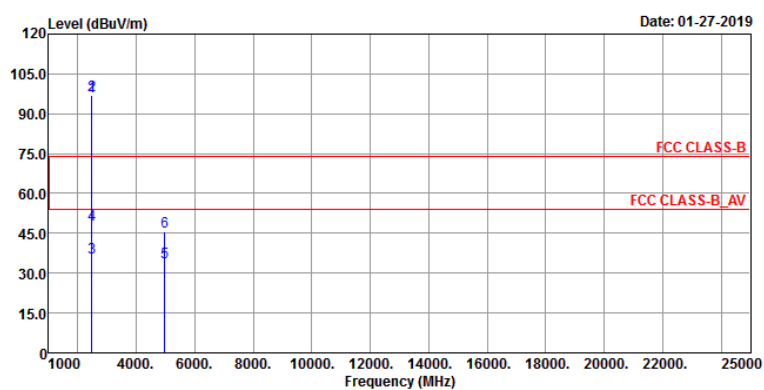
1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
2. 2441 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 78	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Jisyong Wang

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	101.58	106.94			27.53	4.43	37.32	150	16	Average
2480	102.01	107.37			27.53	4.43	37.32	150	16	Peak
2483.56	37.31	42.67	54	-16.69	27.53	4.43	37.32	150	16	Average
2483.56	52.13	57.49	74	-21.87	27.53	4.43	37.32	150	16	Peak
4960	34.65	49.27	54	-19.35	31.4	6.9	52.92	166	211	Average
4960	44.48	59.1	74	-29.52	31.4	6.9	52.92	166	211	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	96.56	101.92			27.53	4.43	37.32	102	358	Average
2480	96.93	102.29			27.53	4.43	37.32	102	358	Peak
2483.52	35.91	41.27	54	-18.09	27.53	4.43	37.32	102	358	Average
2483.52	48.33	53.69	74	-25.67	27.53	4.43	37.32	102	358	Peak
4960	34.3	48.92	54	-19.7	31.4	6.9	52.92	172	241	Average
4960	45.5	60.12	74	-28.5	31.4	6.9	52.92	172	241	Peak

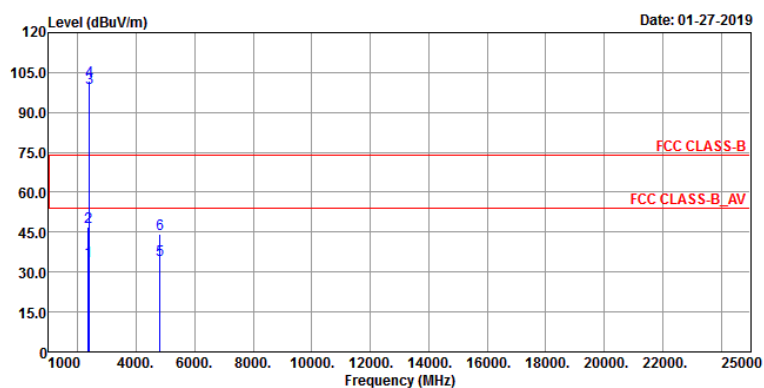
Remarks:

1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
2. 2480 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

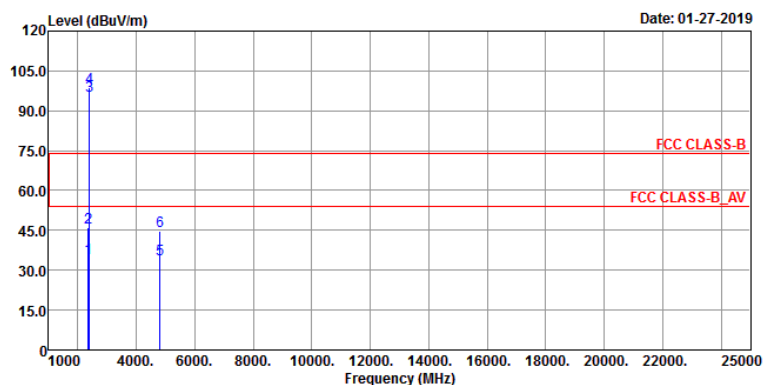
8DPSK

EUT Test Condition		Measurement Detail	
Channel	Channel 0	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Jisyong Wang

Horizontal



Vertical



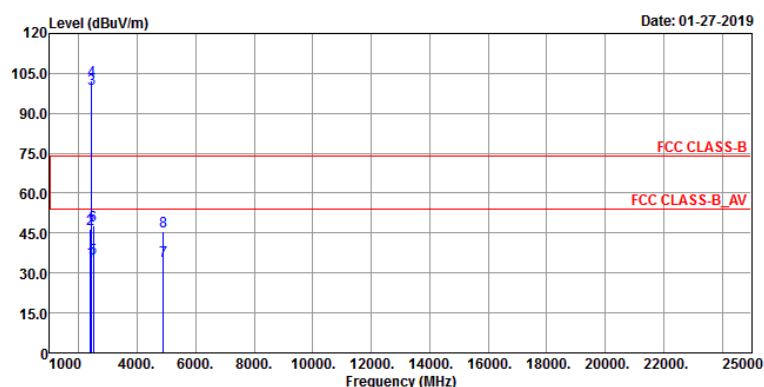
Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2347.94	34.31	40.56	54	-19.69	26.93	4.31	37.49	154	18	Average
2347.94	47.02	53.27	74	-26.98	26.93	4.31	37.49	154	18	Peak
2402	99.18	105.17			27.16	4.37	37.52	154	18	Average
2402	101.89	107.88			27.16	4.37	37.52	154	18	Peak
4804	34.46	49.43	54	-19.54	31.14	6.79	52.9	161	267	Average
4804	44.48	59.45	74	-29.52	31.14	6.79	52.9	161	267	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2360.82	34.34	40.49	54	-19.66	27.01	4.33	37.49	126	55	Average
2360.82	46.08	52.23	74	-27.92	27.01	4.33	37.49	126	55	Peak
2402	95.56	101.55			27.16	4.37	37.52	126	55	Average
2402	98.84	104.83			27.16	4.37	37.52	126	55	Peak
4804	34.18	49.15	54	-19.82	31.14	6.79	52.9	181	220	Average
4804	44.62	59.59	74	-29.38	31.14	6.79	52.9	181	220	Peak

Remarks:

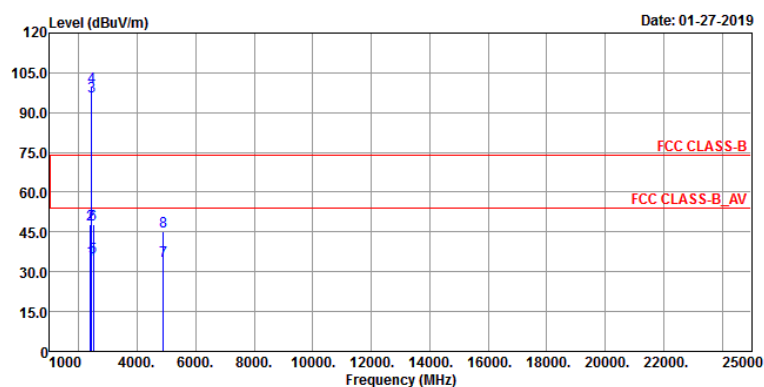
1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
2. 2402 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 39	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Jisyong Wang

Horizontal



Vertical



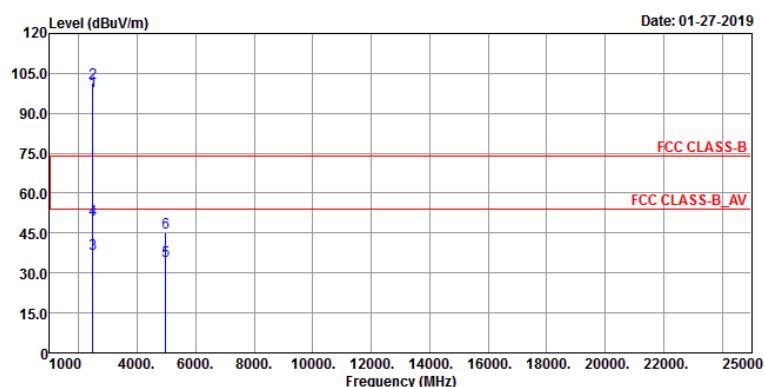
Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2385.04	34.52	40.59	54	-19.48	27.08	4.35	37.5	111	20	Average
2385.04	46.58	52.65	74	-27.42	27.08	4.35	37.5	111	20	Peak
2441	99.29	104.9			27.38	4.4	37.39	111	20	Average
2441	102.33	107.94			27.38	4.4	37.39	111	20	Peak
2497.44	35.26	40.46	54	-18.74	27.61	4.44	37.25	111	20	Average
2497.44	47.78	52.98	74	-26.22	27.61	4.44	37.25	111	20	Peak
4882	34.64	49.39	54	-19.36	31.25	6.86	52.86	129	277	Average
4882	45.39	60.14	74	-28.61	31.25	6.86	52.86	129	277	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2387.7	34.74	40.72	54	-19.26	27.16	4.36	37.5	131	56	Average
2387.7	47.74	53.72	74	-26.26	27.16	4.36	37.5	131	56	Peak
2441	96.25	101.86			27.38	4.4	37.39	131	56	Average
2441	99.55	105.16			27.38	4.4	37.39	131	56	Peak
2489.88	35.21	40.49	54	-18.79	27.61	4.43	37.32	131	56	Average
2489.88	47.63	52.91	74	-26.37	27.61	4.43	37.32	131	56	Peak
4882	34.23	48.98	54	-19.77	31.25	6.86	52.86	146	93	Average
4882	45.08	59.83	74	-28.92	31.25	6.86	52.86	146	93	Peak

Remarks:

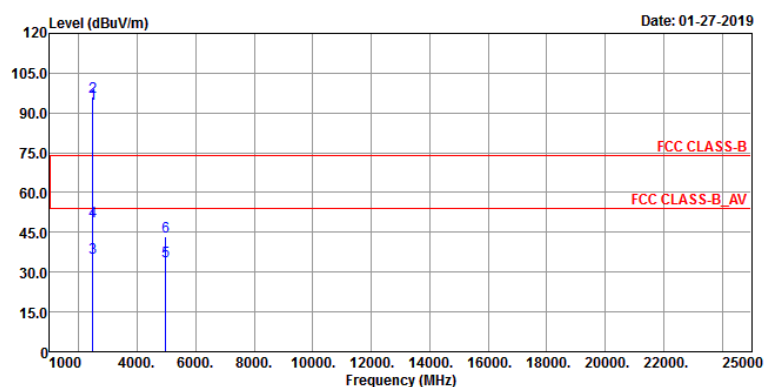
1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
2. 2441 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 78	Frequency Range	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Jisyong Wang

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	98.49	103.85			27.53	4.43	37.32	150	16	Average
2480	101.43	106.79			27.53	4.43	37.32	150	16	Peak
2483.52	37.15	42.51	54	-16.85	27.53	4.43	37.32	150	16	Average
2483.52	49.84	55.2	74	-24.16	27.53	4.43	37.32	150	16	Peak
4960	34.74	49.36	54	-19.26	31.4	6.9	52.92	154	236	Average
4960	45.13	59.75	74	-28.87	31.4	6.9	52.92	154	236	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	93.26	98.62			27.53	4.43	37.32	102	357	Average
2480	96.28	101.64			27.53	4.43	37.32	102	357	Peak
2483.52	35.61	40.97	54	-18.39	27.53	4.43	37.32	102	357	Average
2483.52	49.22	54.58	74	-24.78	27.53	4.43	37.32	102	357	Peak
4960	34.1	48.72	54	-19.9	31.4	6.9	52.92	175	264	Average
4960	43.41	58.03	74	-30.59	31.4	6.9	52.92	175	264	Peak

Remarks:

1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
2. 2480 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

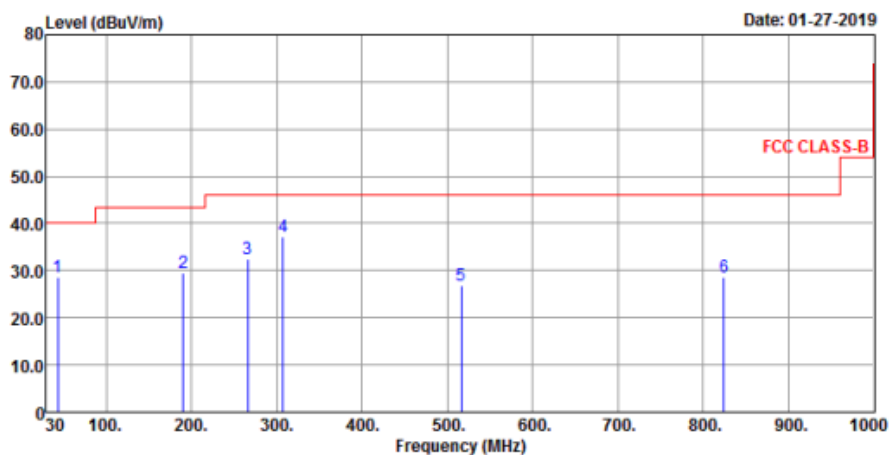
9 kHz ~ 30 MHz Data:

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

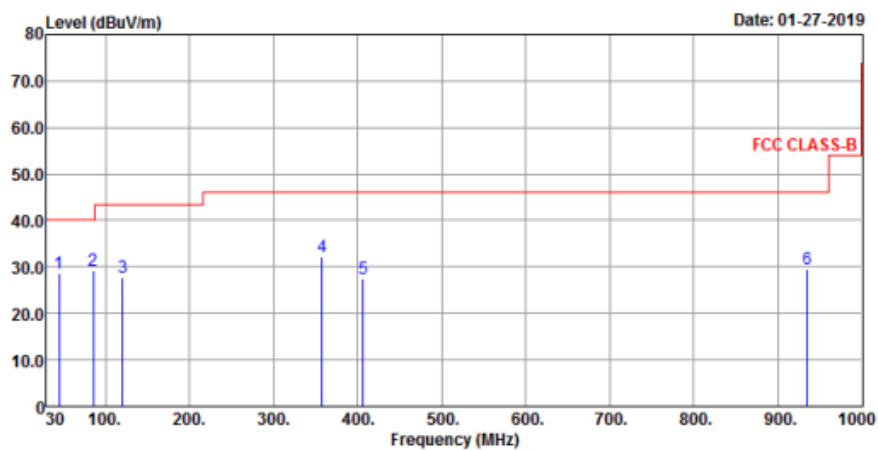
30 MHz ~ 1 GHz Worst-Case Data:

EUT Test Condition		Measurement Detail	
Channel	Channel 78	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Jisyong Wang

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m

Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
43.58	28.55	45.57	40	-11.45	13.59	0.5	31.11	277	315	Peak
190.05	29.62	50.07	43.5	-13.88	10.05	1.17	31.67	241	256	Peak
265.71	32.52	51.03	46	-13.48	11.94	1.51	31.96	201	184	Peak
307.42	37.09	54.19	46	-8.91	13.13	1.69	31.92	167	155	Peak
515.97	26.73	38.06	46	-19.27	17.68	2.57	31.58	142	118	Peak
824.43	28.55	33.9	46	-17.45	22.54	3.76	31.65	114	51	Peak

Antenna Polarity & Test Distance: Vertical at 3 m

Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
44.55	28.49	45.52	40	-11.51	13.6	0.51	31.14	115	77	Peak
85.29	29.32	52.15	40	-10.68	8.22	0.69	31.74	165	137	Peak
120.21	27.77	47.81	43.5	-15.73	11.02	0.84	31.9	187	191	Peak
357.86	32.17	47.86	46	-13.83	14.33	1.92	31.94	236	198	Peak
406.36	27.41	41.88	46	-18.59	15.46	2.11	32.04	255	267	Peak
935.01	29.53	33.61	46	-16.47	23.71	4.17	31.96	276	290	Peak

Remarks:

1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor

Margin value = Emission level – Limit value

2. The emission levels of other frequencies were very low against the limit.

4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver ROHDE & SCHWARZ	ESR3	102412	Feb. 08, 2018	Feb. 07, 2019
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Sep. 05, 2018	Sep. 04, 2019
V-LISN/AMN SCHWARZBECK (EUT)	NNBL 8226-2	8226-142	Jul. 23, 2018	Jul. 22, 2019
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Aug. 13, 2018	Aug. 12, 2019
Software ADT	BV ADT_Cond_ V7.3.7.4	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
 2. The test was performed in HwaYa Shielded Room 2.
 3. The VCCI Site Registration No. is C-2047.

4.2.3 Test Procedures

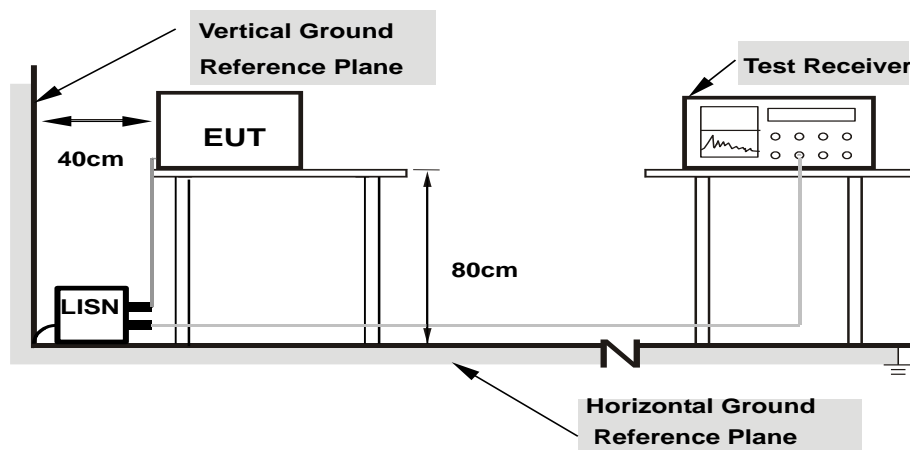
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz - 30 MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.2.6 EUT Operating Condition

Set the EUT under transmission condition continuously at specific channel frequency.

4.2.7 Test Results

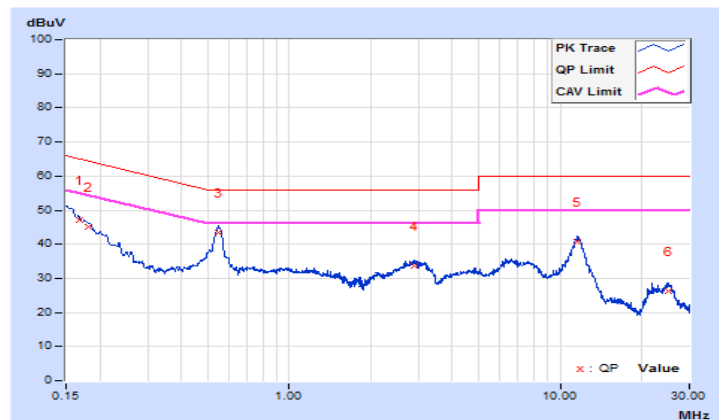
CONDUCTED WORST-CASE DATA : GFSK

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Jisyong Wang	Test Date	2019/1/27

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16800	10.05	37.00	19.49	47.05	29.54	65.06	55.06	-18.01	-25.52
2	0.18219	10.06	34.95	18.35	45.01	28.41	64.39	54.39	-19.38	-25.98
3	0.55080	10.06	33.41	15.32	43.47	25.38	56.00	46.00	-12.53	-20.62
4	2.89904	10.11	23.51	10.00	33.62	20.11	56.00	46.00	-22.38	-25.89
5	11.60475	10.33	30.44	13.90	40.77	24.23	60.00	50.00	-19.23	-25.77
6	24.99450	10.39	15.73	2.47	26.12	12.86	60.00	50.00	-33.88	-37.14

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

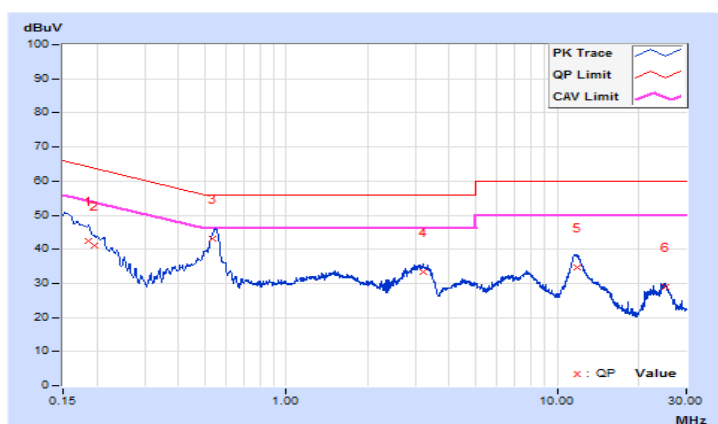


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Jisyong Wang	Test Date	2019/1/27

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.18608	10.07	32.31	17.17	42.38	27.24	64.21	54.21	-21.83	-26.97
2	0.19500	10.07	30.90	16.72	40.97	26.79	63.82	53.82	-22.85	-27.03
3	0.53644	10.07	33.16	18.60	43.23	28.67	56.00	46.00	-12.77	-17.33
4	3.19655	10.14	23.03	8.81	33.17	18.95	56.00	46.00	-22.83	-27.05
5	11.80725	10.42	24.18	9.02	34.60	19.44	60.00	50.00	-25.40	-30.56
6	25.20825	10.52	18.28	4.07	28.80	14.59	60.00	50.00	-31.20	-35.41

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

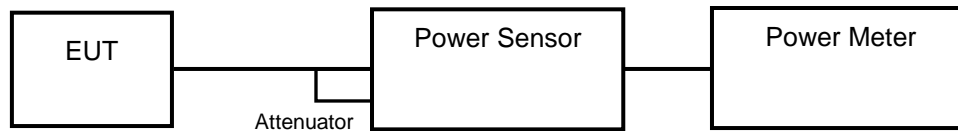


4.3 Maximum Output Power

4.3.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125 mW.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.3.7 Test Results

<Peak Power>

GFSK

Mode	Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)
Bluetooth EDR	0	2402	5.02	7.01
	39	2441	5.78	7.62
	78	2480	6.10	7.85

8DPSK

Mode	Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)
Bluetooth EDR	0	2402	6.78	8.31
	39	2441	7.53	8.77
	78	2480	7.89	8.97

<Average Power>

GFSK

Mode	Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
Bluetooth EDR	0	2402	4.23	6.26
	39	2441	4.88	6.88
	78	2480	5.00	6.99

8DPSK

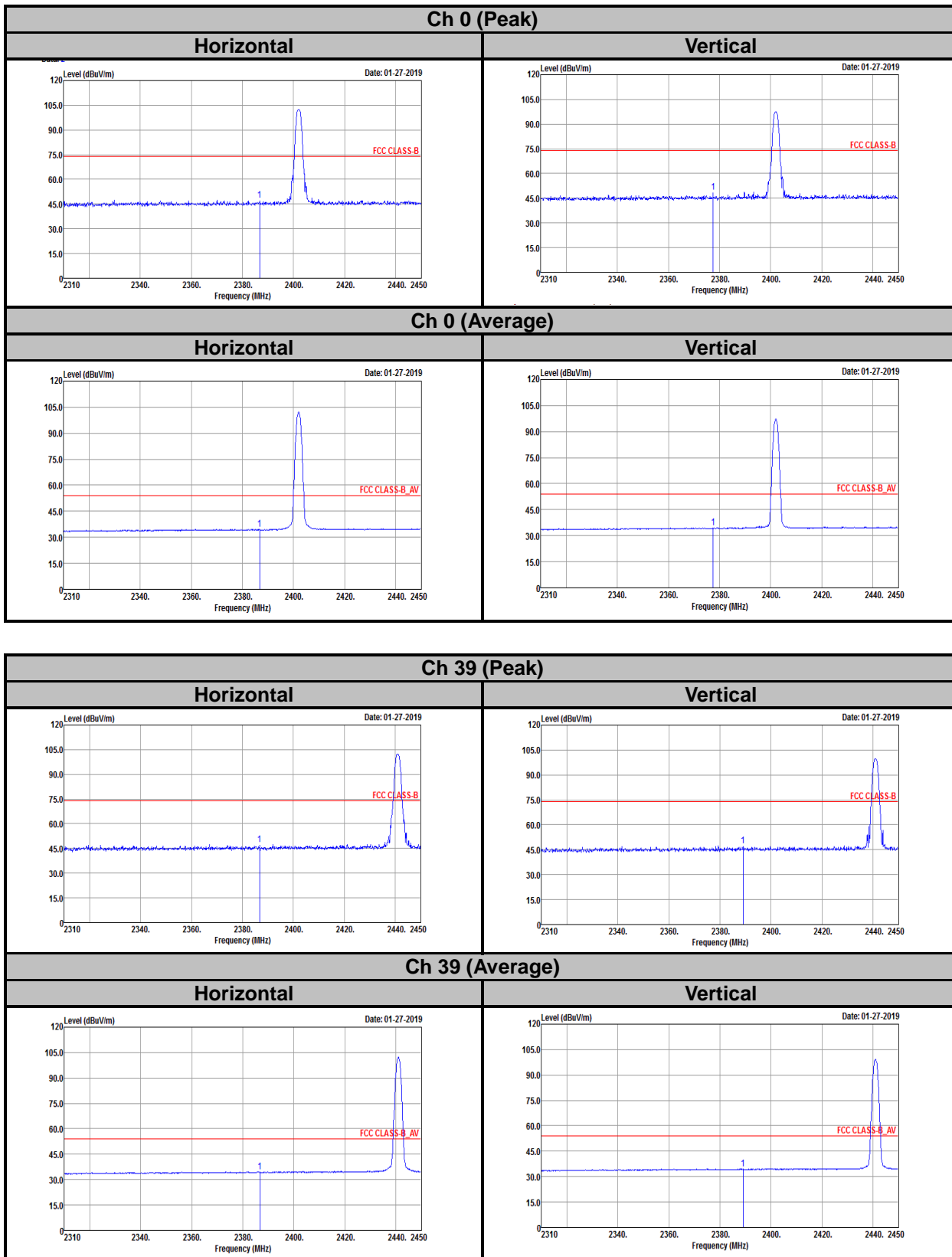
Mode	Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
Bluetooth EDR	0	2402	3.70	5.68
	39	2441	4.29	6.32
	78	2480	4.60	6.63

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

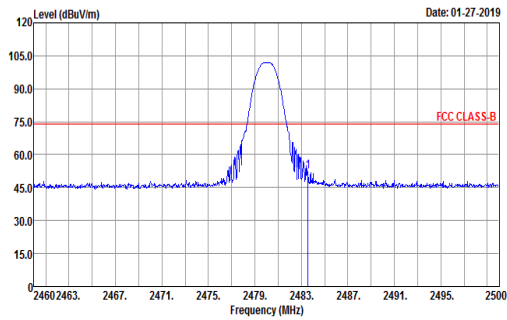
Annex A- Radiated Bandedge Plots

GFSK

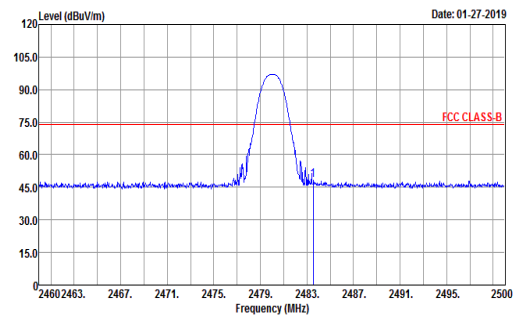


Ch 78 (Peak)

Horizontal

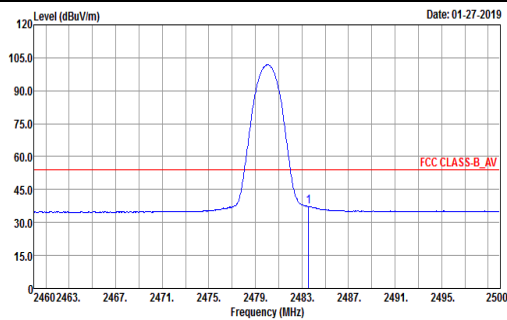


Vertical

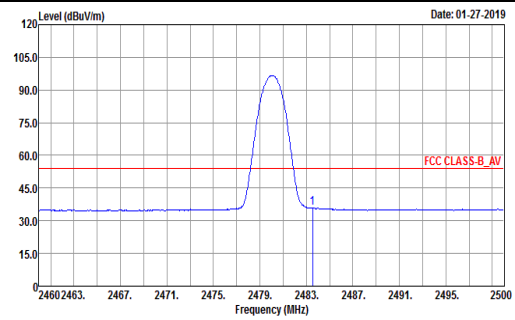


Ch 78 (Average)

Horizontal



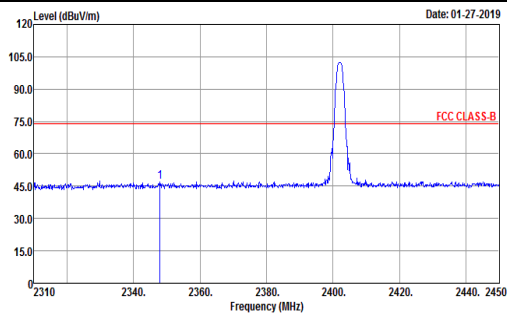
Vertical



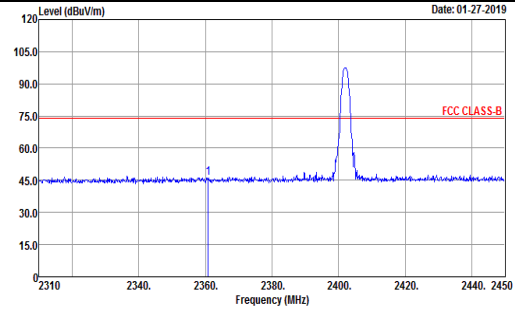
8DPSK

Ch 0 (Peak)

Horizontal

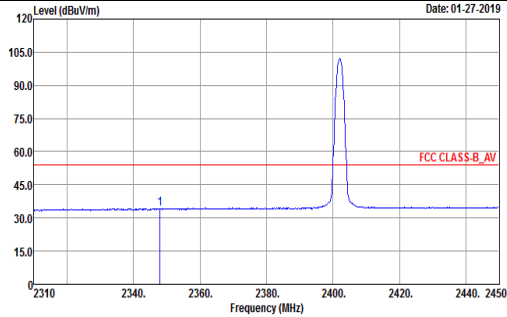


Vertical

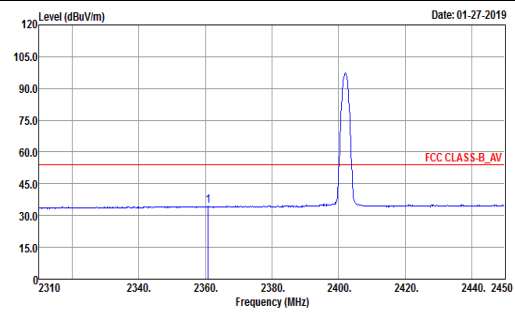


Ch 0 (Average)

Horizontal

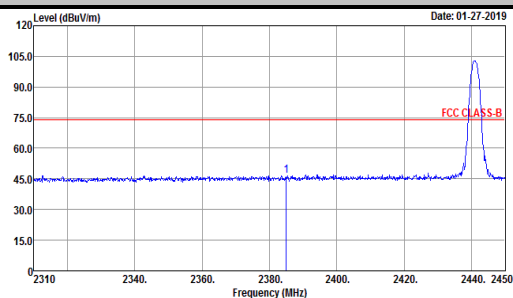


Vertical

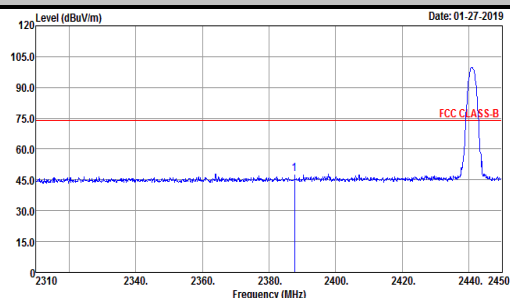


Ch 39 (Peak)

Horizontal

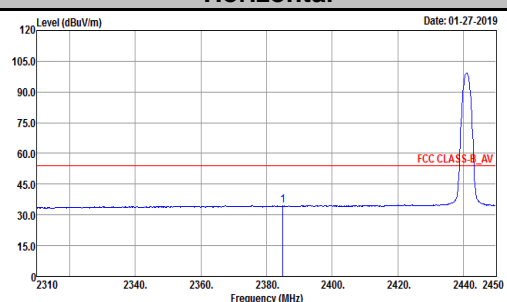


Vertical

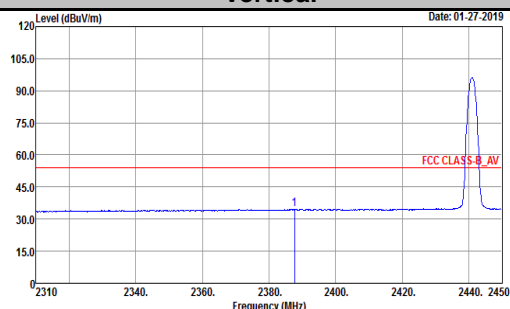


Ch 39 (Average)

Horizontal

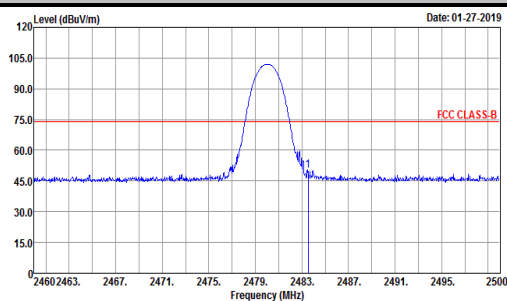


Vertical

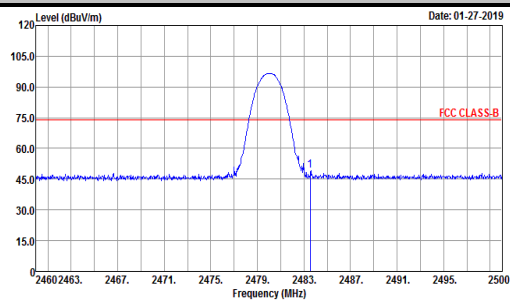


Ch 78 (Peak)

Horizontal

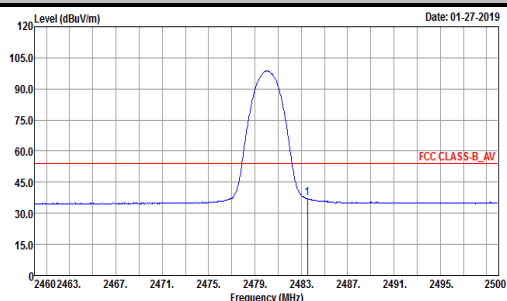


Vertical

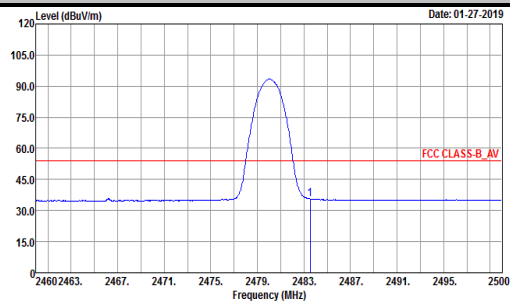


Ch 78 (Average)

Horizontal



Vertical



Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

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