

## Partial FCC Test Report

**Report No.:** RF201027C01

**FCC ID:** PPD-QCNFA324

**Test Model:** QCNFA324

**Received Date:** Oct. 27, 2020

**Test Date:** Nov. 11 ~ Dec. 01, 2020

**Issued Date:** Dec. 07, 2020

**Applicant:** Qualcomm Atheros, Inc.

**Address:** 1700 Technology Drive, San Jose, CA 95110 , U.S.A

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

**Lab Address:** No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

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33383, Taiwan

**FCC Registration /**  
**Designation Number:** 788550 / TW0003



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### Release Control Record

Issue No.	Description	Date Issued
RF201027C01	Original Release	Dec. 07, 2020

## 1 Certificate of Conformity

**Product:** 2x2 802.11A/B/G/N/AC WIFI + BLUETOOTH MODULE

**Brand:** Qualcomm Atheros

**Test Model:** QCNFA324

**Sample Status:** Engineering Sample

**Applicant:** Qualcomm Atheros, Inc.

**Test Date:** Nov. 11 ~ Dec. 01, 2020

**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:** Dec. 07, 2020  
Gina Liu / Specialist

**Approved by :** Dylan Chiou, **Date:** Dec. 07, 2020  
Dylan Chiou / Senior 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 -11.39 dB at 0.16955 MHz.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	N/A	Refer to Note
15.247(a)(1)(iii)	Dwell Time on Each Channel	N/A	Refer to Note
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	N/A	Refer to Note
15.247(a)(1)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	N/A	Refer to Note
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -0.51 dB at 241.46 MHz.
15.247(d)	Band Edge Measurement	N/A	Refer to Note
15.247(d)	Antenna Port Emission	N/A	Refer to Note
15.203	Antenna Requirement	N/A	No antenna connector is used.

### Note:

1. This report is a partial report, only test item of Conducted Emission, Radiated Emissions and Maximum Peak Output Power were performed for this report. Other testing data please refer to BV CPS report no.: RF140808E04-2 for module (Brand: Qualcomm Atheros, Model: QCNFA324).
2. For 2.4G band compliance with rule 15.247(d) of the band-edge items, the test plots were recorded in Annex A. Test Procedures refer to report 4.1.3.
3. 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) ( $\pm$ )
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.79 dB
Radiated Emissions up to 1 GHz	9 kHz ~ 30 MHz	3.04 dB
	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

<b>Product</b>	2x2 802.11A/B/G/N/AC WIFI + BLUETOOTH MODULE
<b>Brand</b>	Qualcomm Atheros
<b>Test Model</b>	QCNFA324
<b>Status of EUT</b>	Engineering Sample
<b>Power Supply Rating</b>	3.3Vdc form host equipment
<b>Modulation Type</b>	GFSK, $\pi/4$ -DQPSK, 8DPSK
<b>Transfer Rate</b>	1/2/3 Mbps
<b>Operating Frequency</b>	2402 ~ 2480 MHz
<b>Number of Channel</b>	79
<b>Output Power</b>	5.093 mW
<b>Antenna Type</b>	Refer to Note as below
<b>Antenna Connector</b>	N/A
<b>Accessory Device</b>	N/A
<b>Data Cable Supplied</b>	N/A

Note:

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

Equipment Name	Brand Name	Model Name
Tarantino (11.6"/Chromebook x 360)	HP	TPN-Q259

2. The antenna information is listed as below.

Antenna Type	Manufacturer	Parts Number	Mode	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	Tx1/ Rx1 (Ant. 1): DQ60ACQD091 (0ACQD020015N)	Tablet	TX1: -2.97 TX2: -0.93	TX1: -2.73 TX2: -2.26	TX1: -2.71 TX2: -2.76	TX1:-2.25 TX2: -3.61
		Tx2/ Rx2 (Ant. 2): DQ60ACQD091 (0ACQD020015N)	Laptop	TX1: -0.11 TX2: 1.15	TX1: 1.01 TX2: -1.83	TX1: -1.40 TX2: -2.36	TX1:-1.40 TX2: -2.73
	Wistron Neweb Corporation	Tx1 (Ant. 1): DQ6B15GC100 (81EABB15.GC1)	Tablet	TX1: -0.54 TX2: -1.32	TX1: -1.10 TX2: -0.74	TX1: -0.72 TX2: -1.06	TX1:-1.43 TX2: -2.07
		Tx2 (Ant. 2): DQ6B15GC100 (81EABB15.GC1)	Laptop	TX1: 0.24 TX2: 1.56	TX1: 0.31 TX2: 1.04	TX1: -0.29 TX2: -0.03	TX1:-2.24 TX2: -1.38

\*The WNC antenna of Laptop mode were chosen for final test.

1. The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.
2. 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	Power	
-	√	√	√	√	-

Where **RE $\geq$ 1G**: Radiated Emission above 1 GHz **RE<1G**: Radiated Emission below 1 GHz  
**PLC**: Power Line Conducted Emission **Power**: Maximum Output Power Measurement

**Note:**

1. For Radiated emission test, pre-tested GFSK,  $\pi/4$ -DQPSK, 8DPSK modulation type and found 8DPSK was the worse, therefore chosen for the final test and presented in the test report.
2. "-" 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	0	FHSS	8DPSK	3DH5

#### **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	0	FHSS	8DPSK	3DH5

### Maximum Output Power 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.

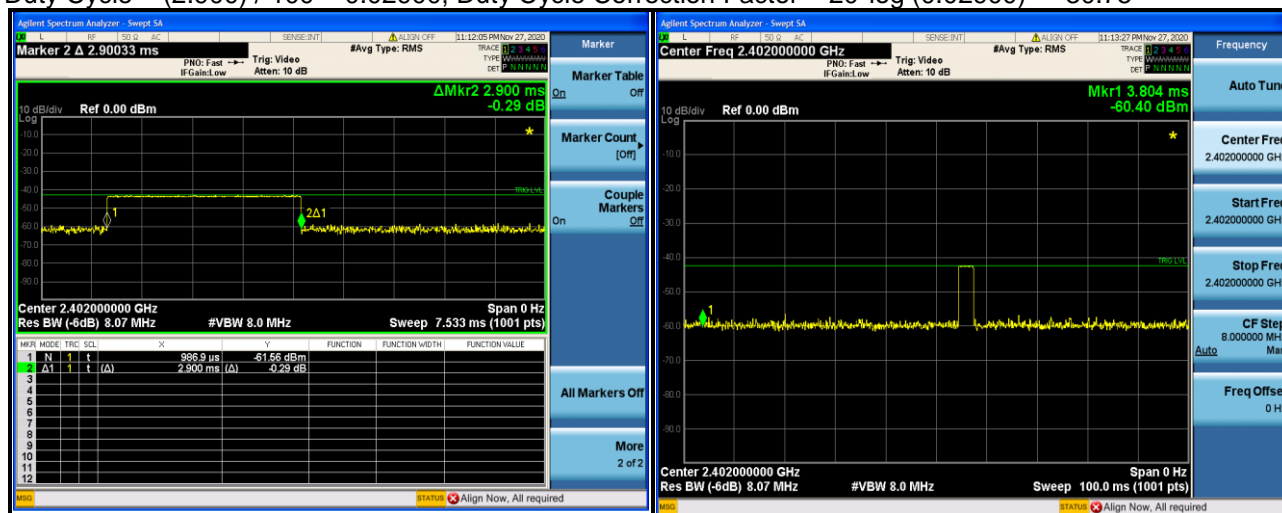
EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	$\pi/4$ - DQPSK	2DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

### Test Condition:

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

### 3.3 Duty Cycle of Test Signal

Duty Cycle = (2.900) / 100 = 0.02900, Duty Cycle Correction Factor = 20\*log (0.02900) = -30.75



### 3.4 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

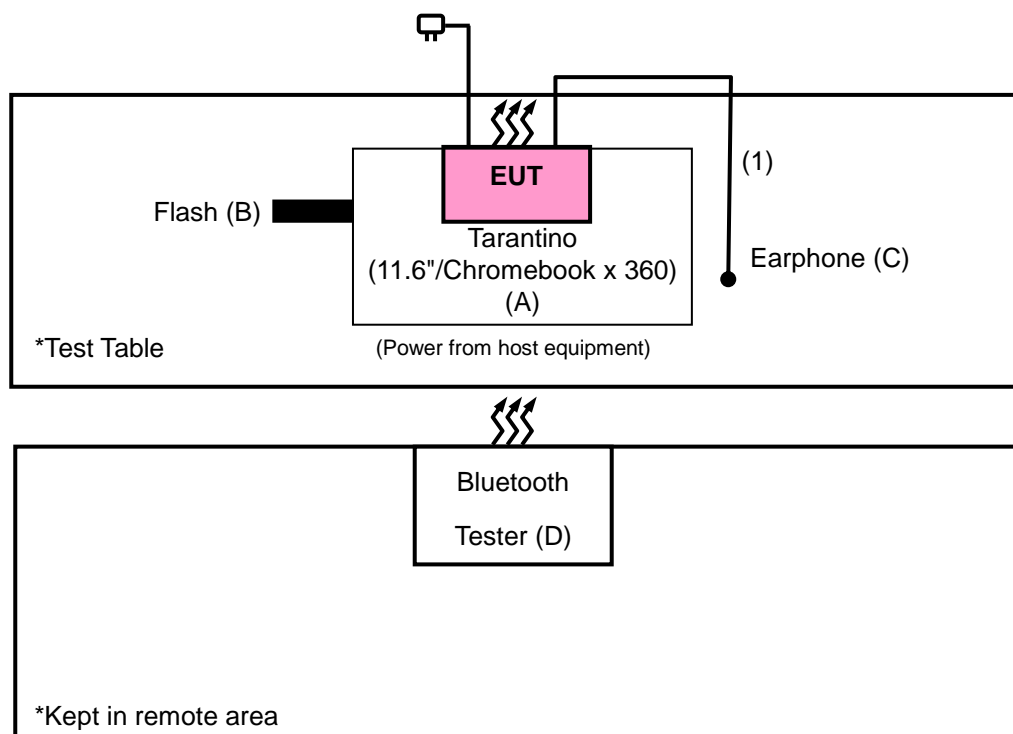
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Tarantino (11.6"/Chromebook x 360)	HP	TPN-Q259	N/A	N/A	Provided by client
B.	USB 2.0 FLASH	HP	v250W	N/A	N/A	--
C.	Earphone	AIWA	EW101BK	N/A	N/A	--
D.	Bluetooth Tester	R&S	CBT	100980	N/A	--

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Earphone Cable	1	12	N	0	-

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items D acted as communication partners to transfer data.

#### 3.4.1 Configuration of System under Test



### 3.5 General Description of Applied Standards and References

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

#### Test Standard:

##### **FCC Part 15, Subpart C (15.247)**

ANSI C63.10-2013

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

#### References Test Guidance:

##### **KDB 558074 D01 15.247 Meas Guidance v05r02**

All test items have been performed as a reference to the above KDB test guidance.

## 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. 18, 2020	Mar. 17, 2021
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 12, 2019	Dec. 11, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Apr. 16, 2020	Apr. 15, 2021
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-969	Nov. 24, 2019 Nov. 22, 2020	Nov. 23, 2020 Nov. 21, 2021
BILOG Antenna SCHWARZBECK	VULB 9168	9168-472	Nov. 06, 2020	Nov. 05, 2021
Fixed Attenuator WORKEN	MDCS18N-10	MDCS18N-10-01	Apr. 14, 2020	Apr. 13, 2021
Loop Antenna	EM-6879	269	Sep. 17, 2020	Sep. 16, 2021
Bluetooth Tester	CBT	100946	Aug. 06, 2020	Aug. 05, 2022
Preamplifier EMCI	EMC 330H	980112	Oct. 07, 2020	Oct. 06, 2021
Power Meter Anritsu	ML2495A	1012010	Sep. 01, 2020	Aug. 31, 2021
Power Sensor Anritsu	MA2411B	1315050	Sep. 01, 2020	Aug. 31, 2021
RF Coaxial Cable EMCI	EMC104-SM-SM-8000	171005	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable HUBER+SUHNNER	SUCOFLEX 104	EMC104-SM-SM-1000(140807)	Oct. 07, 2020	Oct. 06, 2021
RF Coaxial Cable Worken	8D-FB	Cable-Ch10-01	Oct. 07, 2020	Oct. 06, 2021
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.

#### 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. 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:**

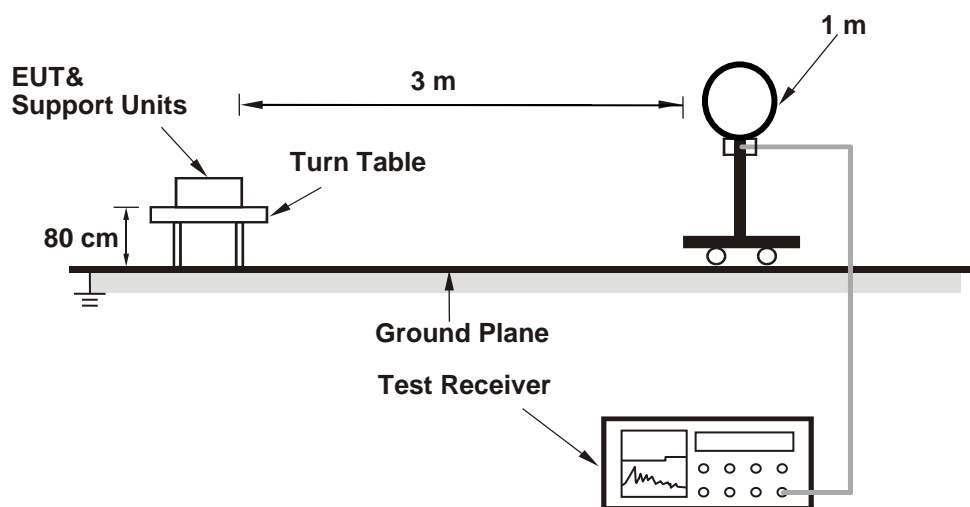
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) and Average detection (AV) at frequency above 1 GHz. For fundamental and harmonic signal measurement, according to ANSI C63.10 section 7.5, the average value = peak value + duty cycle correction factor. The duty cycle correction factor refer to Chapter 3.3 of this report.
3. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

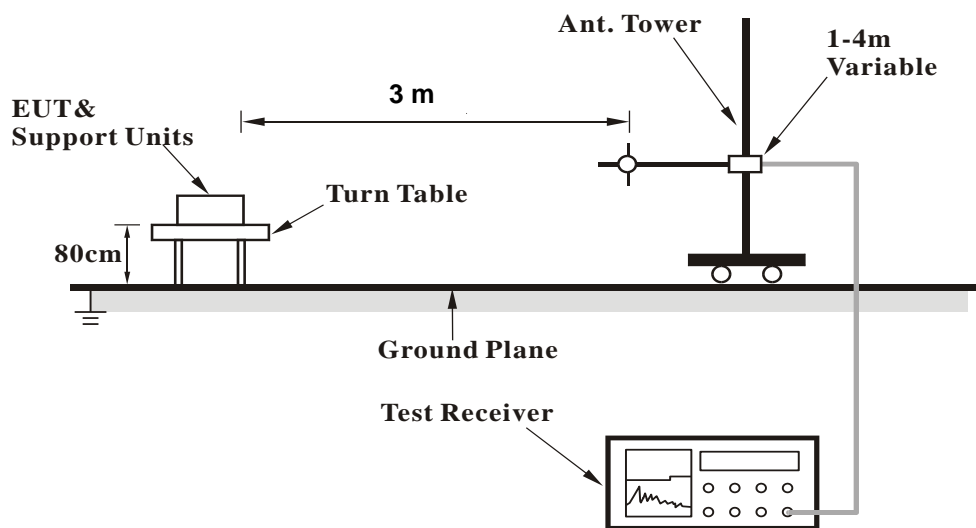
No deviation.

#### 4.1.5 Test Set Up

##### <Radiated Emission below 30 MHz>

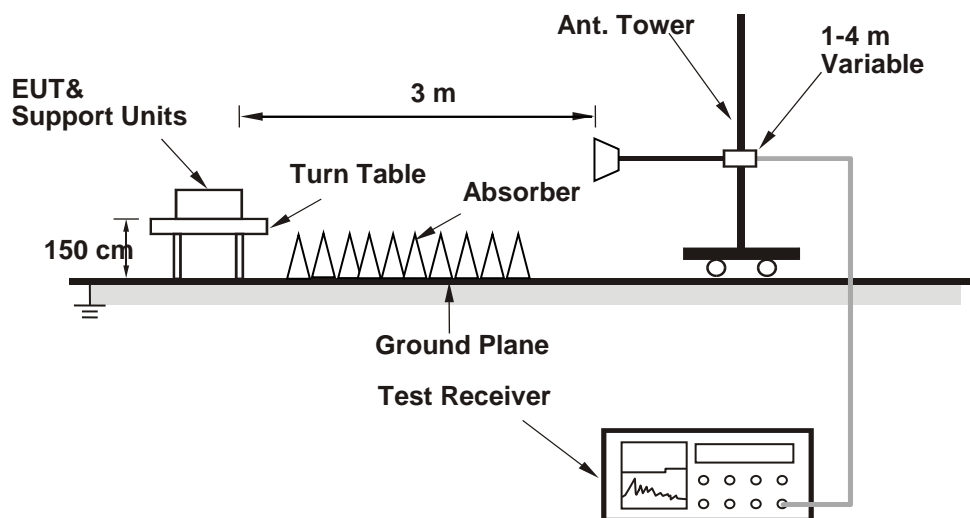


##### <Radiated Emission 30 MHz to 1 GHz>





# <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	Cyril Chen

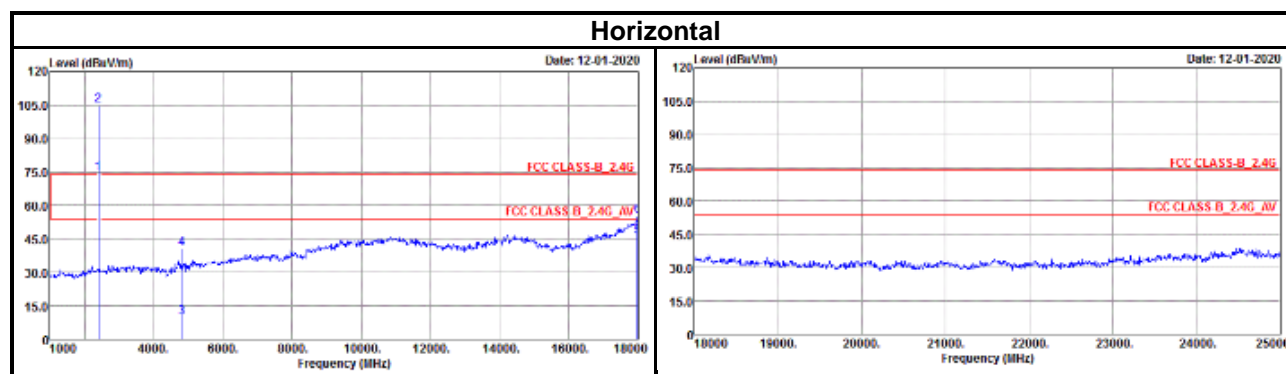
Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	37.24	43.16	-5.92	54	-16.76	134	232	Average
2390	47.55	53.47	-5.92	74	-26.45	134	232	Peak
2402	74.39	80.33	-5.94	-----	-----	134	232	Average
2402	105.14	111.08	-5.94	-----	-----	134	232	Peak
4804	9.92	25.56	-15.64	54	-44.08	144	115	Average
4804	40.67	56.31	-15.64	74	-33.33	144	115	Peak

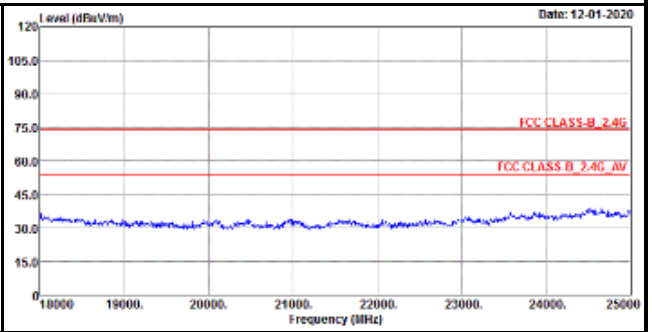
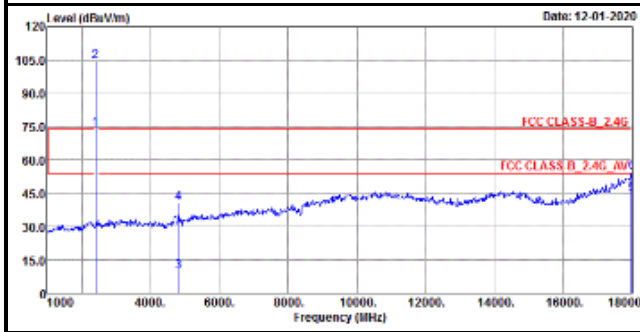
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	37.07	42.99	-5.92	54	-16.93	292	264	Average
2390	47.1	53.02	-5.92	74	-26.9	292	264	Peak
2402	73.85	79.79	-5.94	-----	-----	292	264	Average
2402	104.6	110.54	-5.94	-----	-----	292	264	Peak
4804	9.86	25.5	-15.64	54	-44.14	167	183	Average
4804	40.61	56.25	-15.64	74	-33.39	167	183	Peak

Remarks:

1. Emission Level = Read Level + 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.



## Vertical



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	Cyril Chen

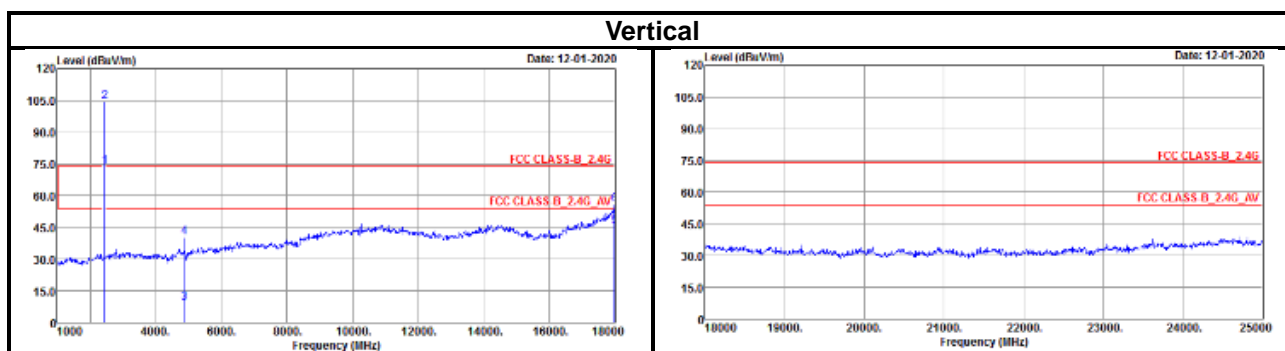
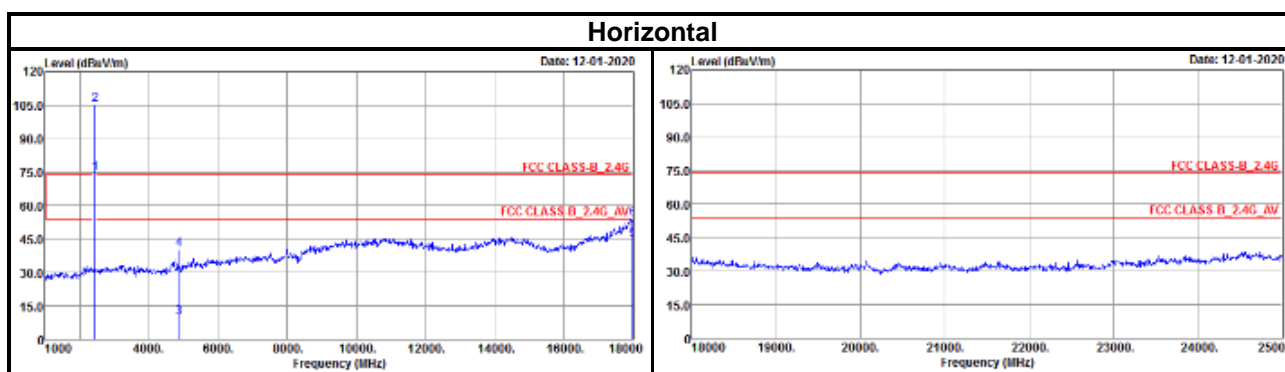
Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2441	74.43	80.24	-5.81	-----	-----	141	240	Average
2441	105.18	110.99	-5.81	-----	-----	141	240	Peak
4882	9.62	25.18	-15.56	54	-44.38	192	186	Average
4882	40.37	55.93	-15.56	74	-33.63	192	186	Peak

Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2441	73.76	79.57	-5.81	-----	-----	259	262	Average
2441	104.51	110.32	-5.81	-----	-----	259	262	Peak
4882	9.43	24.99	-15.56	54	-44.57	164	163	Average
4882	40.18	55.74	-15.56	74	-33.82	164	163	Peak

Remarks:

1. Emission Level = Read Level + 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	Cyril Chen

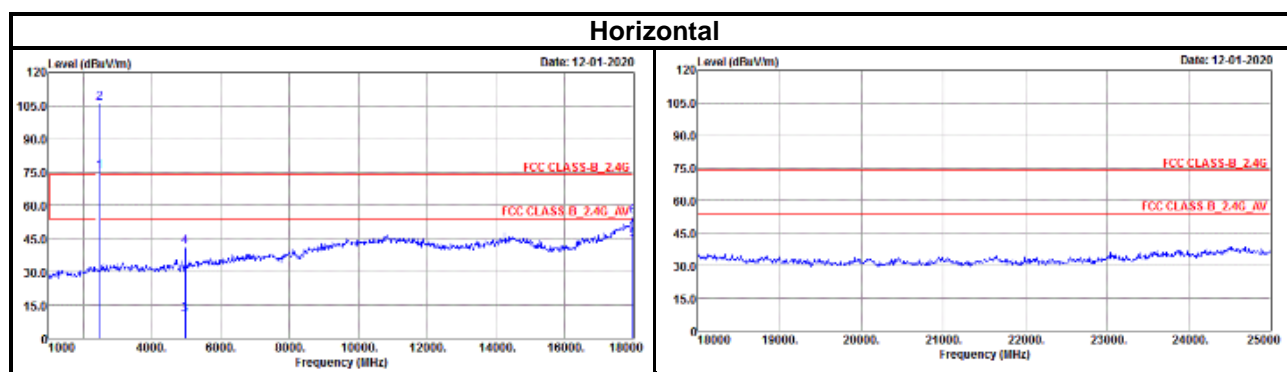
Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	75.34	81.04	-5.7	-----	-----	136	237	Average
2480	106.09	111.79	-5.7	-----	-----	136	237	Peak
2483.5	24.37	30.07	-5.7	74	-49.63	136	237	Average
2483.5	55.12	60.82	-5.7	74	-18.88	136	237	Peak
4960	10.57	26.02	-15.45	54	-43.43	136	165	Average
4960	41.32	56.77	-15.45	74	-32.68	136	165	Peak

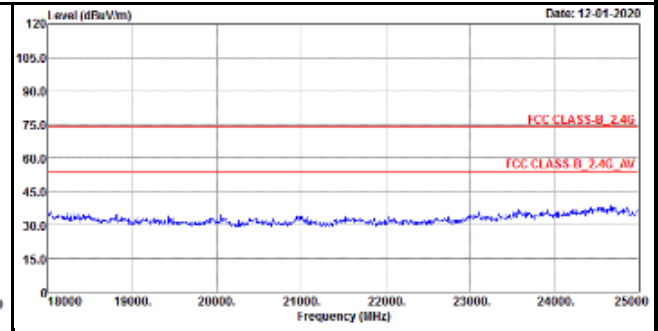
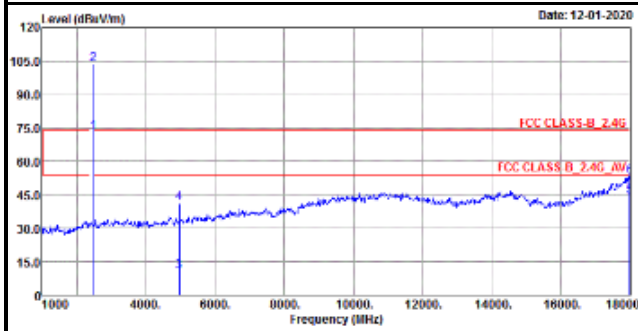
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	73.04	78.74	-5.7	-----	-----	252	260	Average
2480	103.79	109.49	-5.7	-----	-----	252	260	Peak
2483.5	28.09	33.79	-5.7	74	-45.91	252	260	Average
2483.5	52.84	58.54	-5.7	74	-21.16	252	260	Peak
4960	10.65	26.1	-15.45	54	-43.35	171	159	Average
4960	41.4	56.85	-15.45	74	-32.6	171	159	Peak

Remarks:

1. Emission Level = Read Level + 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.



### Vertical



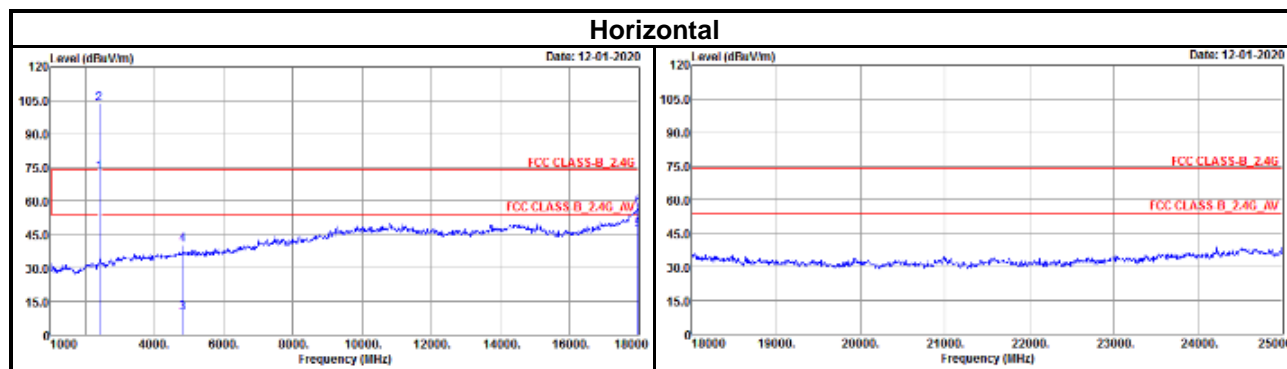
## 8DPSK

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	Cyril Chen

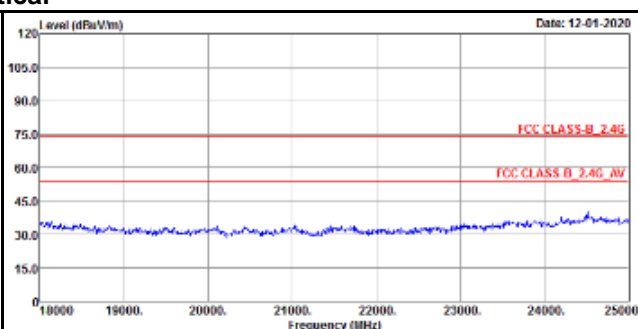
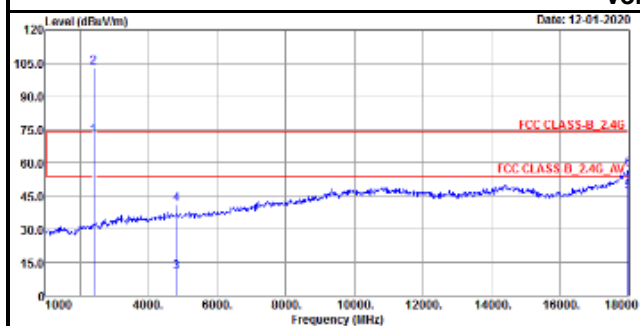
Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	37.87	43.79	-5.92	54	-16.13	132	230	Average
2390	48.65	54.57	-5.92	74	-25.35	132	230	Peak
2402	72.78	78.72	-5.94	-----	-----	132	230	Average
2402	103.53	109.47	-5.94	-----	-----	132	230	Peak
4804	9.75	25.39	-15.64	54	-44.25	140	175	Average
4804	40.5	56.14	-15.64	74	-33.5	140	175	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2390	37.84	43.76	-5.92	54	-16.16	287	266	Average
2390	48.5	54.42	-5.92	74	-25.5	287	266	Peak
2402	72.31	78.25	-5.94	-----	-----	287	266	Average
2402	103.06	109	-5.94	-----	-----	287	266	Peak
4804	10.43	26.07	-15.64	54	-43.57	177	164	Average
4804	41.18	56.82	-15.64	74	-32.82	177	164	Peak

### Remarks:

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



## Vertical





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	Cyril Chen

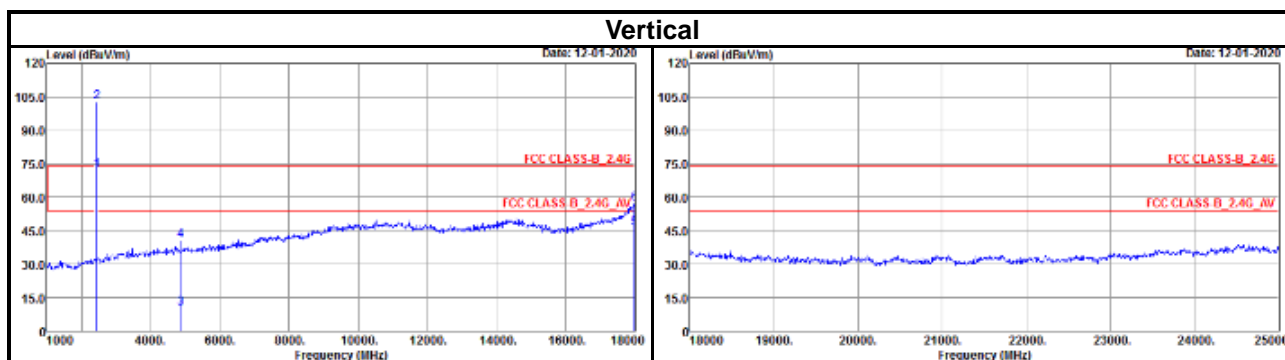
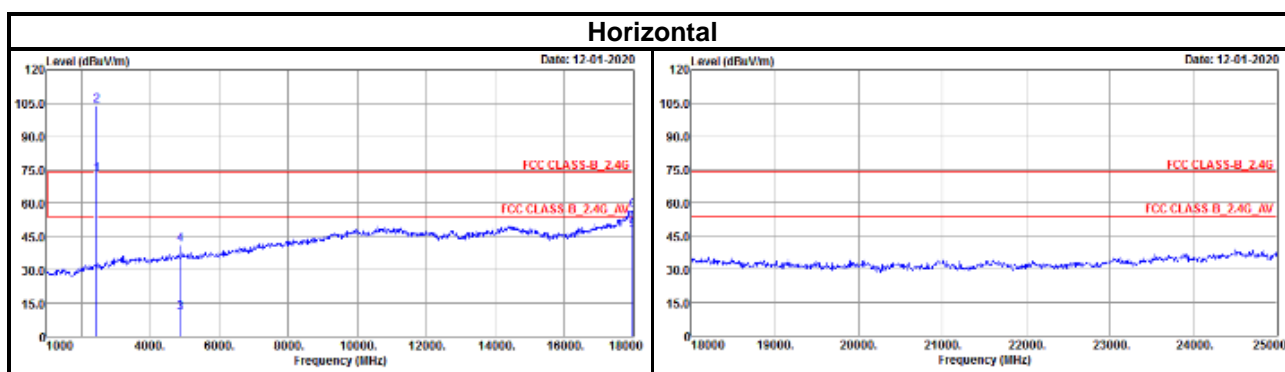
Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2441	73.12	78.93	-5.81	-----	-----	119	240	Average
2441	103.87	109.68	-5.81	-----	-----	119	240	Peak
4882	10.55	26.11	-15.56	54	-43.45	171	150	Average
4882	41.3	56.86	-15.56	74	-32.7	171	150	Peak

Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2441	72.03	77.84	-5.81	-----	-----	260	263	Average
2441	102.78	108.59	-5.81	-----	-----	260	263	Peak
4882	10.09	25.65	-15.56	54	-43.91	158	198	Average
4882	40.84	56.4	-15.56	74	-33.16	158	198	Peak

Remarks:

1. Emission Level = Read Level + 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	Cyril Chen

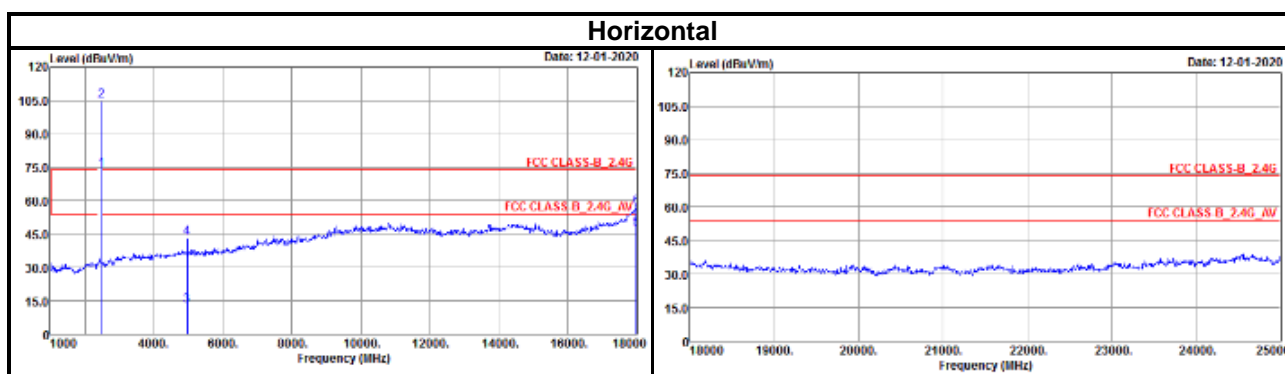
Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	74.03	79.73	-5.7	-----	-----	121	242	Average
2480	104.78	110.48	-5.7	-----	-----	121	242	Peak
2483.5	26.1	31.8	-5.7	74	-47.9	121	242	Average
2483.5	56.85	62.55	-5.7	74	-17.15	121	242	Peak
4960	12.75	28.2	-15.45	54	-41.25	151	147	Average
4960	43.5	58.95	-15.45	74	-30.5	151	147	Peak

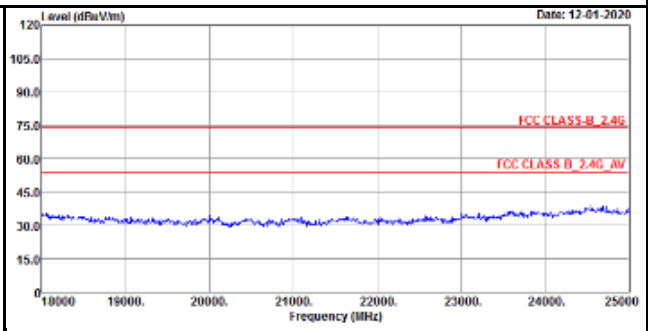
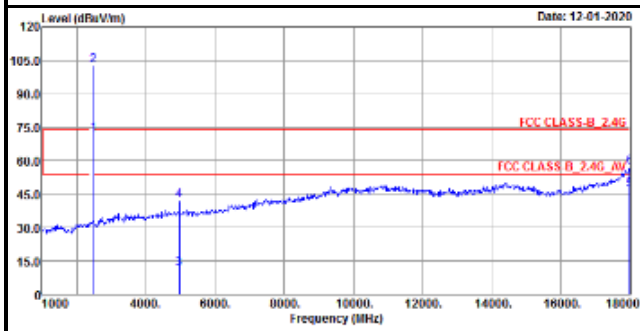
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2480	71.78	77.48	-5.7	-----	-----	251	245	Average
2480	102.53	108.23	-5.7	-----	-----	251	245	Peak
2483.5	22.8	28.5	-5.7	74	-51.2	251	245	Average
2483.5	53.55	59.25	-5.7	74	-20.45	251	245	Peak
4960	11.31	26.76	-15.45	54	-42.69	161	179	Average
4960	42.06	57.51	-15.45	74	-31.94	161	179	Peak

Remarks:

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



## Vertical



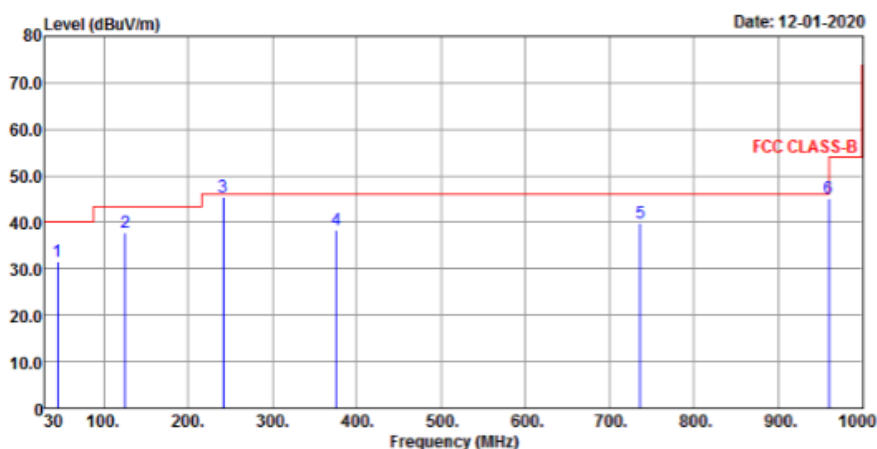
### 9 kHz ~ 30 MHz Data:

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

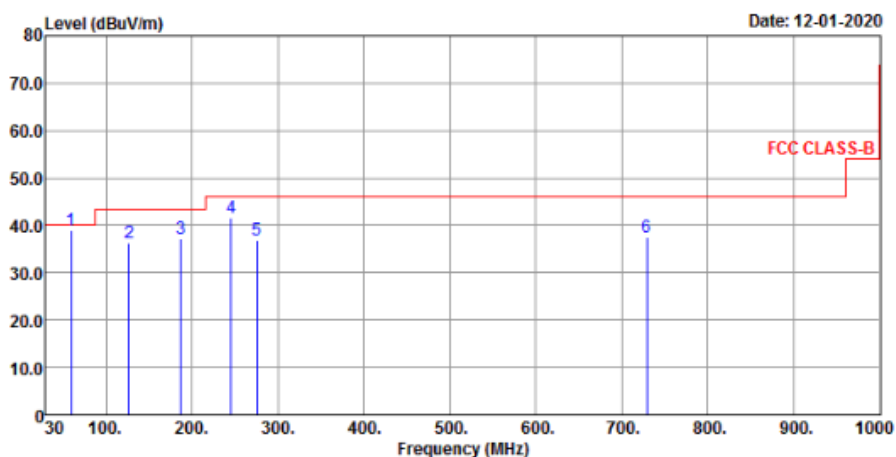
### 30 MHz ~ 1 GHz Worst-Case Data:

EUT Test Condition		Measurement Detail	
Channel	Channel 0	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	Cyril Chen

#### Horizontal



#### Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
44.55	31.73	43.6	-11.87	40	-8.27	111	267	QP
125.06	37.68	51.03	-13.35	43.5	-5.82	154	18	QP
241.46	45.49	58.79	-13.3	46	-0.51	177	254	QP
375.32	38.41	47.25	-8.84	46	-7.59	154	82	QP
736.16	39.81	39.09	0.72	46	-6.19	144	139	QP
960.23	45.08	41.37	3.71	54	-8.92	156	158	QP
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
59.1	39	51.14	-12.14	40	-1	154	239	QP
127	36.2	49.47	-13.27	43.5	-7.3	138	148	QP
187.14	37.24	51.5	-14.26	43.5	-6.26	141	128	QP
245.34	41.73	54.88	-13.15	46	-4.27	147	158	QP
275.41	36.89	48.79	-11.9	46	-9.11	133	269	QP
729.37	37.42	37.13	0.29	46	-8.58	188	262	QP

Remarks:

- Emission Level = Read Level + Factor  
Margin value = Emission level – Limit value
- 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	ESCI	100613	Dec. 11, 2019	Dec. 10, 2020
RF signal cable Woken	5D-FB	Cable-cond1-01	Sep. 04, 2020	Sep. 03, 2021
LISN ROHDE & SCHWARZ (EUT)	ENV216	101826	Feb. 20, 2020	Feb. 19, 2021
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Aug. 28, 2020	Aug. 27, 2021
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 1 (Conduction 1).  
 3. The VCCI Site Registration No. is C-12040.

#### 4.2.3 Test Procedures

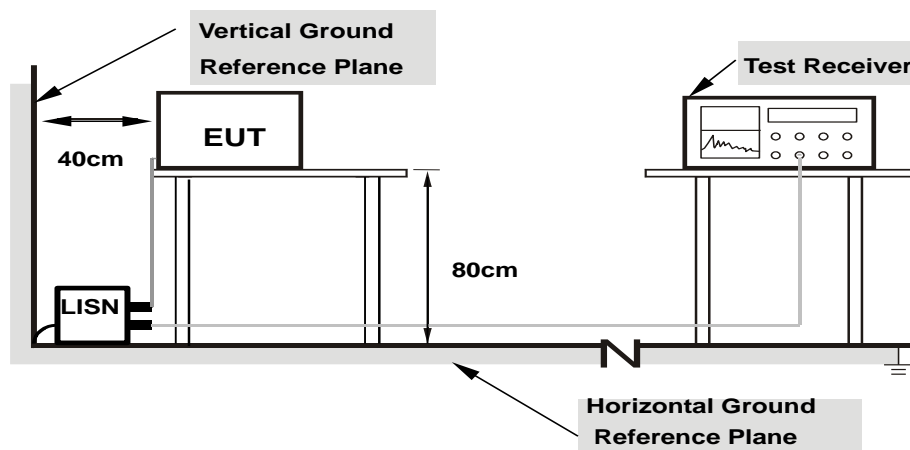
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH of coupling 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

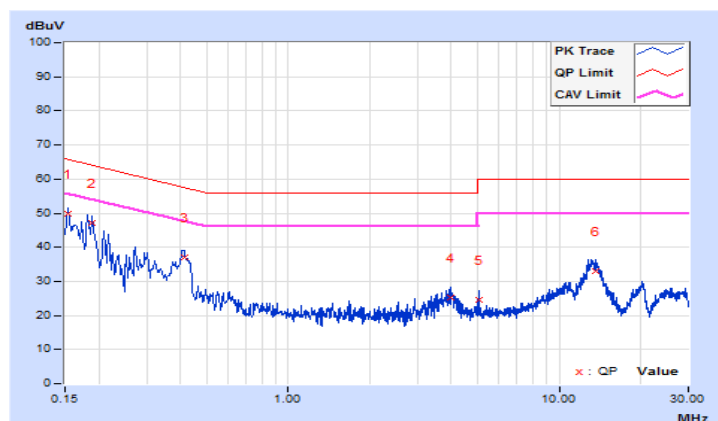
##### CONDUCTED WORST-CASE DATA : 8DPSK

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	21°C, 65%RH
Tested by	Cyril Chen	Test Date	2020/12/1

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	0.15391	9.65	40.31	34.21	49.96	43.86	65.79	55.79	-15.83	-11.93
2	0.18910	9.66	37.62	30.71	47.28	40.37	64.08	54.08	-16.80	-13.71
3	0.41197	9.66	27.35	19.26	37.01	28.92	57.61	47.61	-20.60	-18.69
4	3.95834	9.74	15.36	8.23	25.10	17.97	56.00	46.00	-30.90	-28.03
5	5.07269	9.75	14.69	7.46	24.44	17.21	60.00	50.00	-35.56	-32.79
6	13.65514	9.83	23.27	15.59	33.10	25.42	60.00	50.00	-26.90	-24.58

#### 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



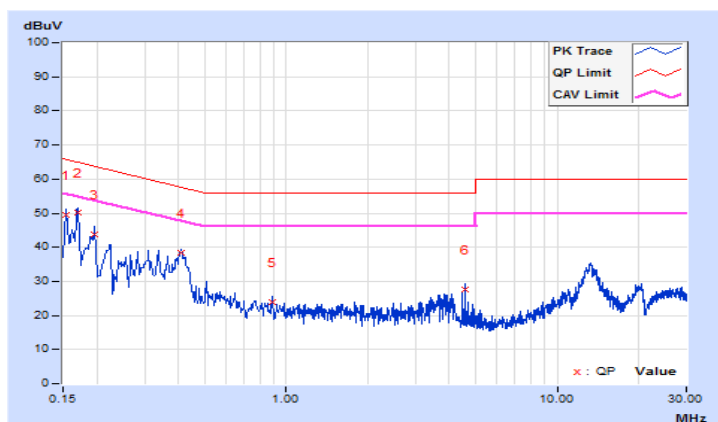


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	21°C, 65%RH
Tested by	Cyril Chen	Test Date	2020/12/1

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	0.15391	9.68	39.86	32.79	49.54	42.47	65.79	55.79	-16.25	-13.32
2	<b>0.16955</b>	<b>9.68</b>	<b>40.59</b>	<b>33.91</b>	<b>50.27</b>	<b>43.59</b>	<b>64.98</b>	<b>54.98</b>	<b>-14.71</b>	<b>-11.39</b>
3	0.19692	9.68	33.94	28.49	43.62	38.17	63.74	53.74	-20.12	-15.57
4	0.40800	9.68	28.80	20.87	38.48	30.55	57.69	47.69	-19.21	-17.14
5	0.88899	9.69	14.14	7.72	23.83	17.41	56.00	46.00	-32.17	-28.59
6	4.57221	9.78	17.92	10.80	27.70	20.58	56.00	46.00	-28.30	-25.42

**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



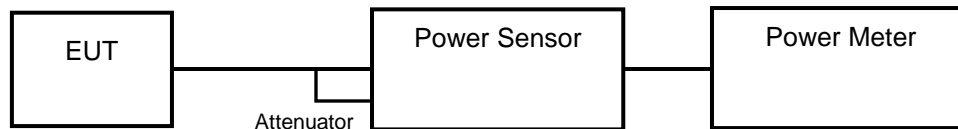
### 4.3 Maximum Output Power

#### 4.3.1 Limits of Maximum Output Power Measurement

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

#### 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.

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

#### 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

##### <GFSK>

Channel	Freq. (MHz)	Peak Power		Average Power		Pass / Fail
		(mW)	(dBm)	(mW)	(dBm)	
0	2402	5.093	7.07	4.887	6.89	Pass
39	2441	5.047	7.03	4.808	6.82	Pass
78	2480	5.023	7.01	4.786	6.80	Pass

##### < $\pi/4$ - DQPSK>

Channel	Freq. (MHz)	Peak Power		Average Power		Pass / Fail
		(mW)	(dBm)	(mW)	(dBm)	
0	2402	4.198	6.23	2.449	3.89	Pass
39	2441	4.169	6.20	2.427	3.85	Pass
78	2480	4.140	6.17	2.410	3.82	Pass

##### <8DPSK>

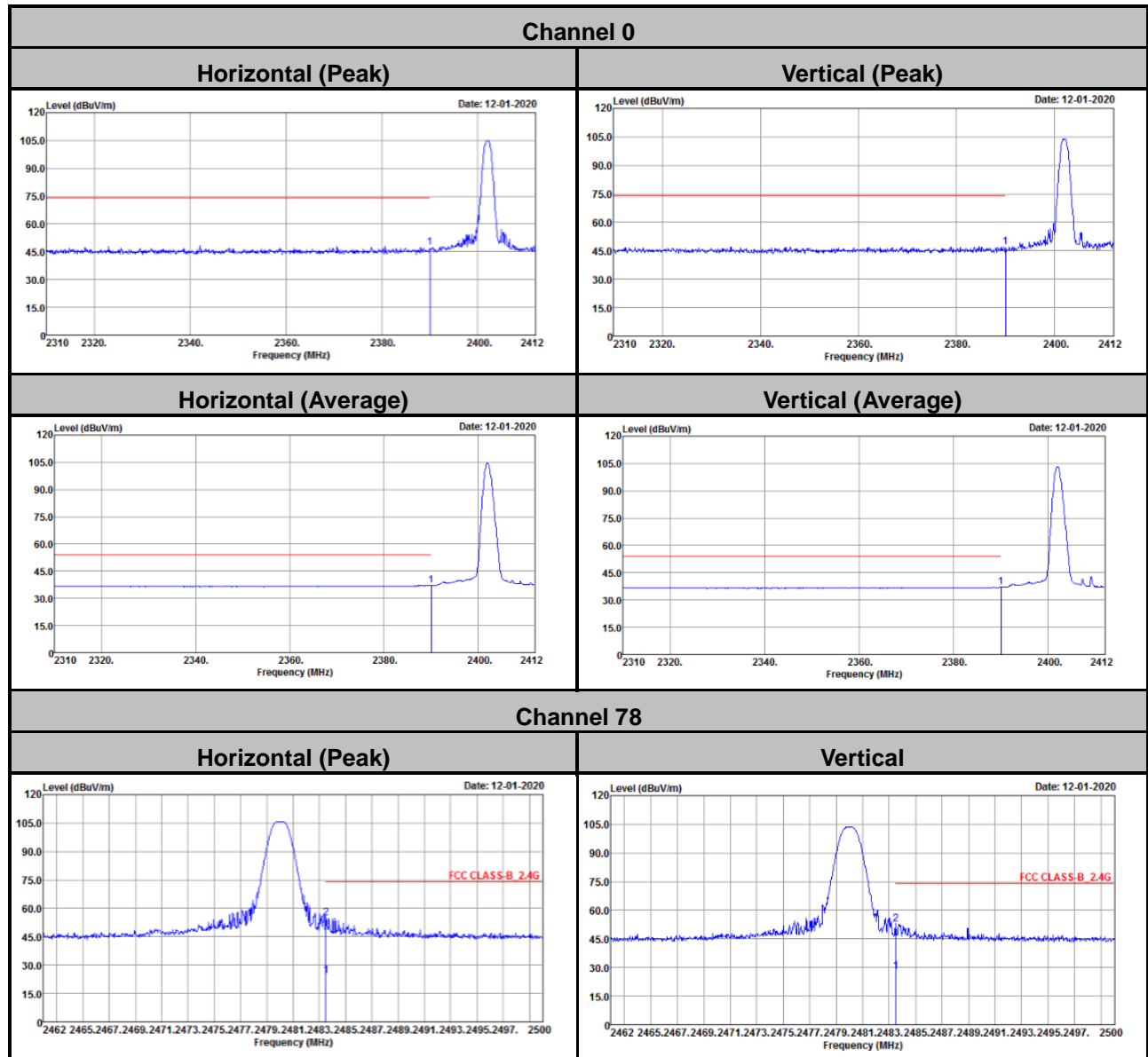
Channel	Freq. (MHz)	Peak Power		Average Power		Pass / Fail
		(mW)	(dBm)	(mW)	(dBm)	
0	2402	4.178	6.21	2.410	3.82	Pass
39	2441	4.150	6.18	2.399	3.80	Pass
78	2480	4.130	6.16	2.388	3.78	Pass

## 5 Pictures of Test Arrangements

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

## Annex A- Band-edge Measurement

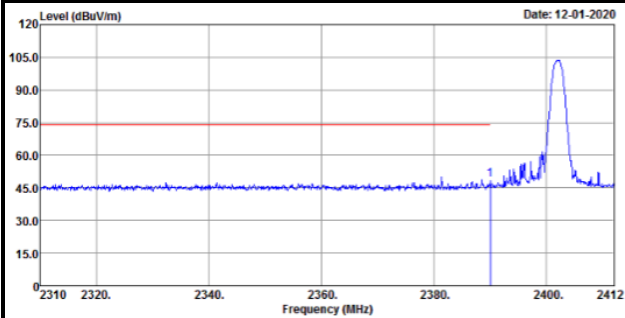
GFSK



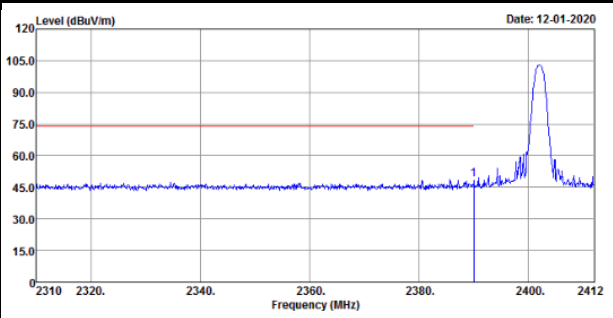
# 8DPSK

## Channel 0

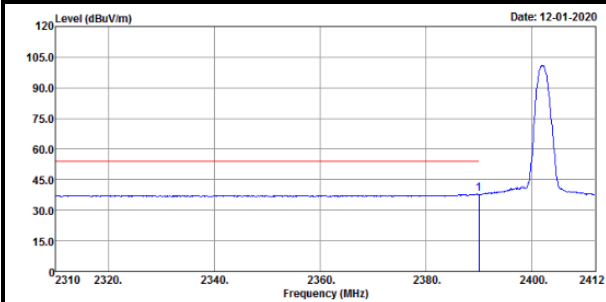
### Horizontal (Peak)



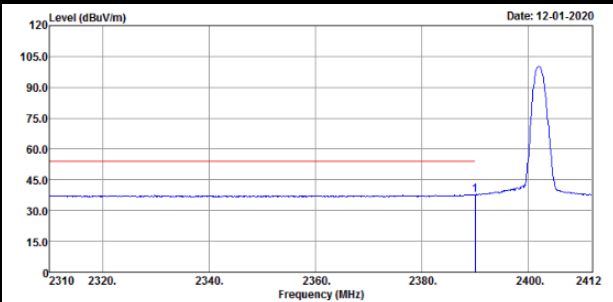
### Vertical (Peak)



### Horizontal (Average)

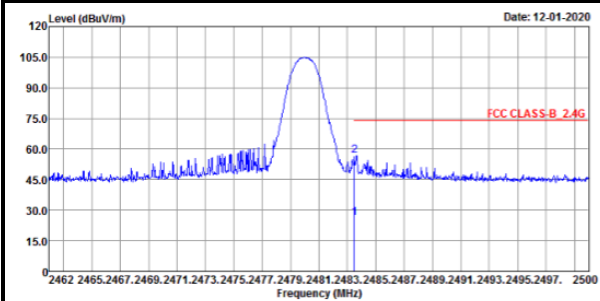


### Vertical (Average)

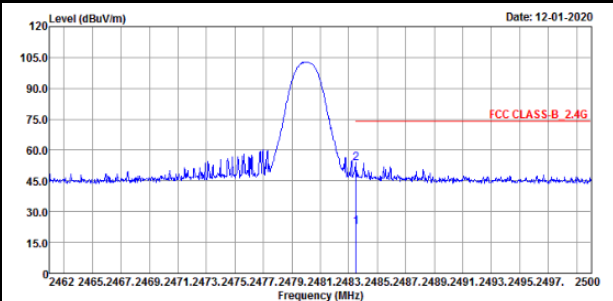


## Channel 78

### 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.

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

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