

Partial FCC Test Report

Report No.: RF191205C07

FCC ID: J9C-QCNFA524

Test Model: QCNFA524

Received Date: Dec. 31, 2019

Test Date: Feb. 11 ~ Feb. 26, 2020

Issued Date: Mar. 05, 2020

Applicant: Qualcomm Technologies, Inc.

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

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Taiwan

FCC Registration / 788550 / TW0003

Designation Number: 427177 / TW0011



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Release Control Record

Issue No.	Description	Date Issued
RF191205C07	Original Release	Mar. 05, 2020

1 Certificate of Conformity

Product: Wi-Fi 6 + BT 5.1 M.2 1216 Module

Brand: Qualcomm

Test Model: QCNFA524

Sample Status: Engineering Sample

Applicant: Qualcomm Technologies, Inc.

Test Date: Feb. 11 ~ Feb. 26, 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 : _____, **Date:** Mar. 05, 2020
Lena Wang / Specialist



Approved by : _____, **Date:** Mar. 05, 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 -5.77 dB at 0.15000 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 -7.13 dB at 33.78 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	Refer to Note

Note:

1. This is a partial report. Only test item of AC Power Conducted Emission, Maximum Peak Output Power and Radiated Emissions tests were performed for this report. Other testing data please refer to BV CPS report no.: RF190716E01-2 for module (Brand: Qualcomm, Model: QCNFA524)
2. If the Frequency Hopping System operating in 2400-2483.5 MHz band and the output power less than 125 mW. The hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of hopping channel whichever is greater.
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) (±)
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	2.0153 dB
	200 MHz ~ 1000 MHz	2.0224 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	1.0121 dB
	18 GHz ~ 40 GHz	1.1508 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Wi-Fi 6 + BT 5.1 M.2 1216 Module
Brand	Qualcomm
Test Model	QCNFA524
Status of EUT	Engineering Sample
Power Supply Rating	3.3 Vdc (host equipment)
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
Transfer Rate	1/2/3 Mbps
Operating Frequency	2402 ~ 2480 MHz
Number of Channel	79
Output Power	22.284 mW
Antenna Type	Refer to Note as below
Antenna Connector	N/A
Accessory Device	Refer to Note as below
Data Cable Supplied	Refer to Note as below

Note:

1. The EUT is authorized for use in specific End-product. Please refer to below table for further details.

Product Name	Brand Name	Model	Description
Portable Computer	DELL	P91F	--

2. The antenna information is listed as below.

Color White	Antenna Type	Antenna Mode	Manufacturer	Parts Number	Antenna Gain (dBi)			
					BT / WLAN 2.4 GHz	WLAN 5.15~5.35 GHz	WLAN 5.47~5.72 5 GHz	WLAN 5.725~5.8 5 GHz
Black	Slot	0	Speedwire	Main Antenna: F.0G.FH-6101-004-00 (DC33002CW3L) Aux. Antenna: F.0G.FH-6101-003-00 (DC33002CW2L)	Main: -3.46 Aux.: -2.31	Main: 2.38 Aux.: -2.47	Main: 0.35 Aux.: -3.33	Main: -2.01 Aux.: -3.24
		1			Main: -3.53 Aux.: -2.41	Main: 0.11 Aux.: -1.31	Main: -1.56 Aux.: -1.61	Main: -1.56 Aux.: -2.78
White	Slot	0	Speedwire	Main Antenna: F.0G.FH-6101-008-00 (DC33002CW7L) Aux. Antenna: F.0G.FH-6101-007-00 (DC33002CW6L)	Main: -2.78 Aux.: -1.56	Main: 2.77 Aux.: -1.86	Main: 1.32 Aux.: -2.68	Main: -1.36 Aux.: -2.68
		1			Main: -2.97 Aux.: -1.88	Main: 0.96 Aux.: -0.70	Main: -0.61 Aux.: -0.97	Main: -0.61 Aux.: -1.95
Black	Slot	0	Wistron Neweb Corporation	Main Antenna: 81ELAS15.G34 (DC33002CV3L) Aux. Antenna: 81ELAS15.G33 (DC33002CV2L)	Main: -3.46 Aux.: -2.31	Main: 2.38 Aux.: -2.47	Main: 2.21 Aux.: -3.33	Main: -2.01 Aux.: -3.24
		1			Main: -3.53 Aux.: -2.41	Main: 0.11 Aux.: -1.31	Main: -1.56 Aux.: -1.61	Main: -1.56 Aux.: -2.78
White	Slot	0	Wistron Neweb Corporation	Main Antenna: 81ELAS15.G69 (DC33002CV7L) Aux. Antenna: 81ELAS15.G70 (DC33002CV6L)	Main: -5.12 Aux.: -1.78	Main: -3.01 Aux.: 2.26	Main: -4.82 Aux.: -0.47	Main: -4.82 Aux.: -4.31
		1			Main: -2.47 Aux.: -1.69	Main: -0.61 Aux.: 0.91	Main: -4.87 Aux.: -2.96	Main: -5.17 Aux.: -5.07

3. The End-product contains following accessory devices.

Product	Brand	Model	Description
Adapter	DELL	HA130PM170	I/P: 100-240Vac, 50-60Hz, 1.8A O/P: 20Vdc, 6.5A or 5Vdc, 1A
Battery 1	DELL	8FCTC	11.4Vdc, 4650mAh, 56Wh
Battery 2	DELL	69KF2	11.4Vdc, 7167mAh, 86Wh

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)						
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. “-” 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	39	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	39	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 \geq 1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Karl Lee
RE<1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Karl Lee
PLC	25 deg. C, 65 % RH	120 Vac, 60 Hz	Jones Chang
APCM	25 deg. C, 65 % RH	120 Vac, 60 Hz	Wayne Lin

3.3 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.

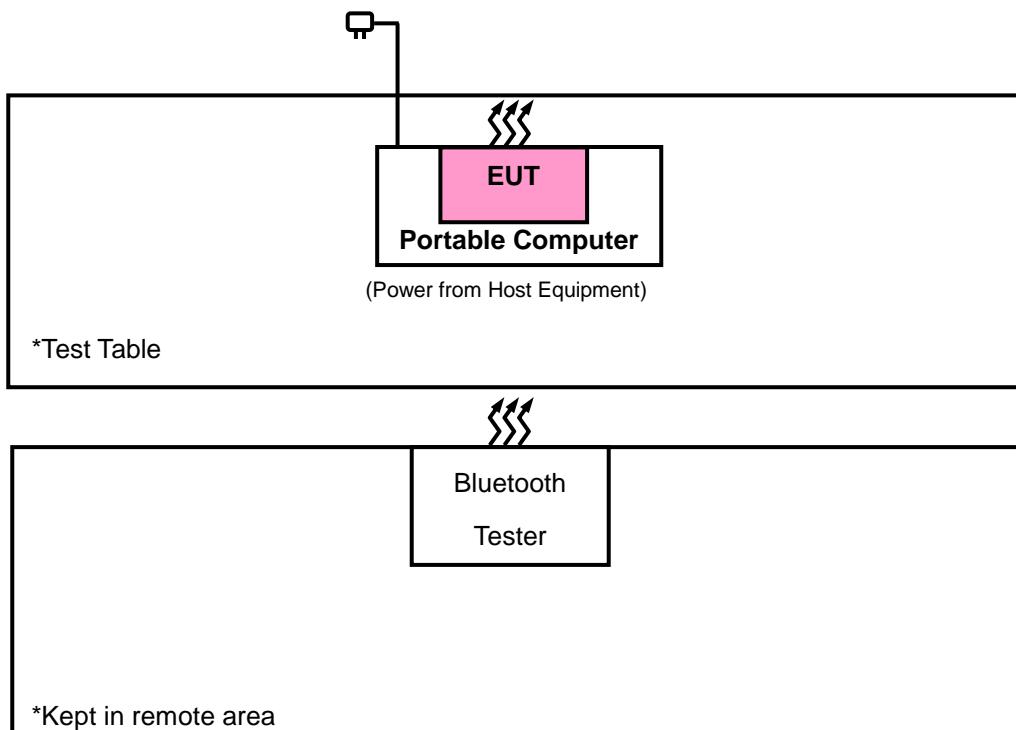
No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Bluetooth Tester	R&S	CBT	100980	N/A
2.	Adapter	DELL	HA130PM170	NA	NA
3.	Portable Computer	DELL	P91F	NA	FCC DoC Approved

No.	Signal Cable Description Of The Above Support Units
1.	Type C cable: 0.85m

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item 2, 3 was provided by client

3.3.1 Configuration of System under Test



3.4 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 (dB_{uV/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 Technologies	N9038A	MY52260177	Aug. 26, 2019	Aug. 25, 2020
HORN Antenna ETS-Lindgren	3117	00143293	Nov. 24, 2019	Nov. 23, 2020
BILOG Antenna SCHWARZBECK	VULB 9168	9168-616	Nov. 12, 2019	Nov. 11, 2020
HORN Antenna SCHWARZBECK	BBHA 9170	9170-480	Nov. 24, 2019	Nov. 23, 2020
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 15, 2019	Apr. 14, 2020
Bluetooth Tester	CBT	100980	Jul. 14, 2019	Jul. 13, 2020
Loop Antenna	EM-6879	269	Sep. 16, 2019	Sep. 15, 2020
Preamplifier Agilent	310N	187226	Jun. 18, 2019	Jun. 17, 2020
Preamplifier Agilent	83017A	MY39501357	Jun. 18, 2019	Jun. 17, 2020
Power Meter Anritsu	ML2495A	1012010	Sep. 04, 2019	Sep. 03, 2020
Power Meter Anritsu	MA2411B	1315050	Sep. 04, 2019	Sep. 03, 2020
RF signal cable ETS-LINDGREN	5D-FB	Cable-CH1-01(RFC-SMS-100-SMS-120+RFC-SMS-100-SMS-400)	Jun. 18, 2019	Jun. 17, 2020
RF signal cable ETS-LINDGREN	8D-FB	Cable-CH1-02(RFC-SMS-100-SMS-24)	Jun. 18, 2019	Jun. 17, 2020
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Software BV ADT	E3 8.130425b	NA	NA	NA
Antenna Tower MF	NA	NA	NA	NA
Turn Table MF	NA	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 HsinTien Chamber 1.

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:

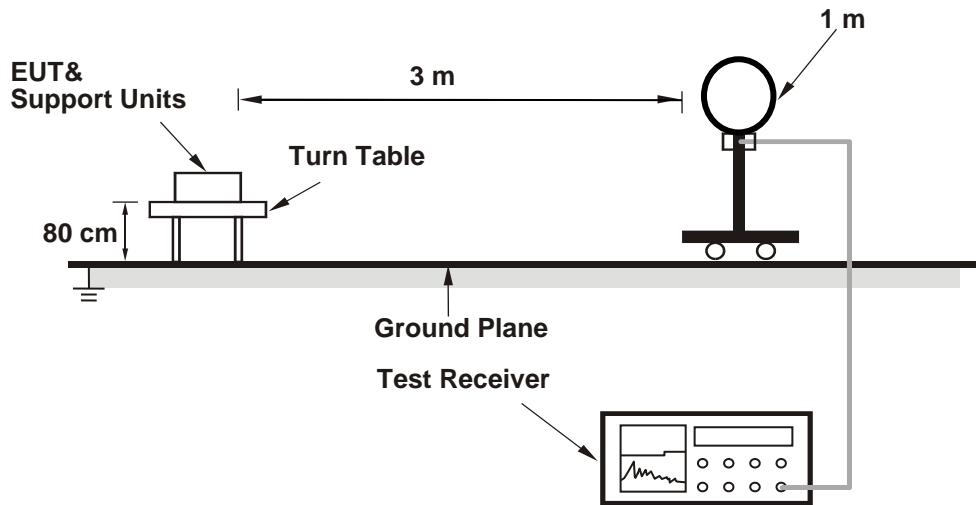
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK)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

4.1.4 Deviation from Test Standard

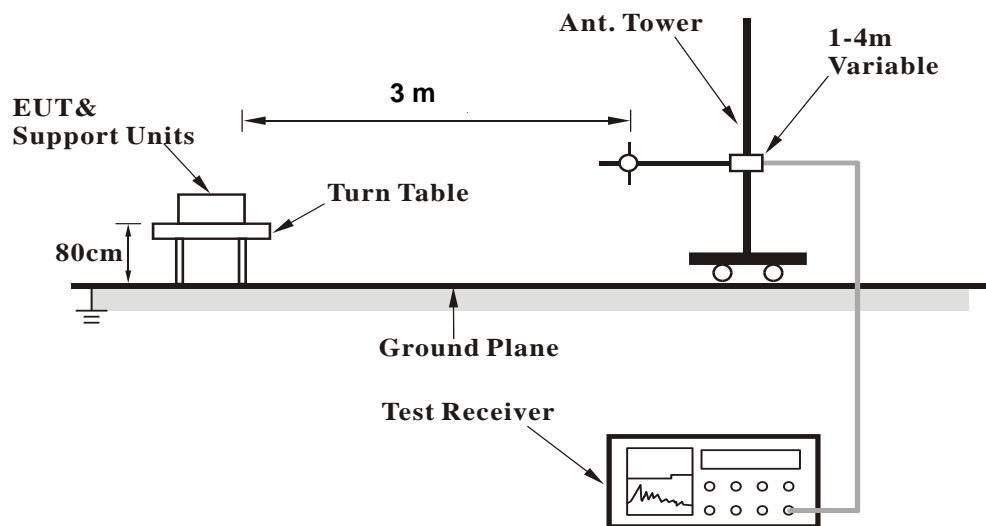
No deviation.

4.1.5 Test Set Up

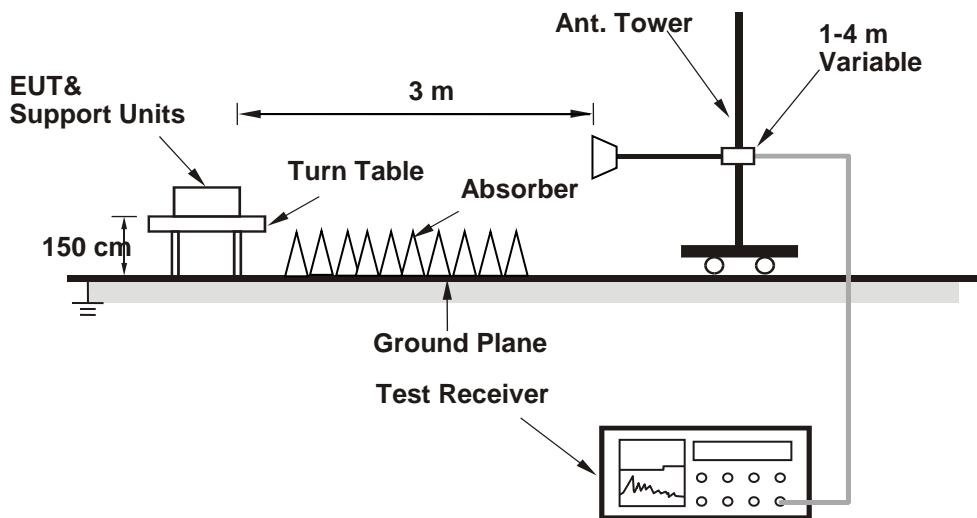
<Radiated Emission below 30 MHz>



<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		Frequency Range		1 GHz ~ 25 GHz
Input Power		Detector Function		Peak (PK) Average (AV)
Environmental Conditions		Tested By		Karl Lee

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
2380.02	41.14	36.67	4.47	54	-12.86	362	356	Average
2380.02	50.84	46.37	4.47	74	-23.16	362	356	Peak
2402	96	91.48	4.52			362	356	Average
2402	96.38	91.86	4.52			362	356	Peak
4804	42.11	31.76	10.35	54	-11.89	162	23	Average
4804	48.64	38.29	10.35	74	-25.36	162	23	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
2386.95	41.36	36.87	4.49	54	-12.64	287	294	Average
2386.95	51.53	47.04	4.49	74	-22.47	287	294	Peak
2402	103.07	98.55	4.52			287	294	Average
2402	103.38	98.86	4.52			287	294	Peak
4804	43.21	32.86	10.35	54	-10.79	132	178	Average
4804	49.53	39.18	10.35	74	-24.47	132	178	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.

EUT Test Condition		Measurement Detail		
Channel		Frequency Range		1 GHz ~ 25 GHz
Input Power		Detector Function		Peak (PK) Average (AV)
Environmental Conditions		Tested By		Karl Lee

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
2354.82	41.2	36.8	4.4	54	-12.8	362	356	Average
2354.82	50.94	46.54	4.4	74	-23.06	362	356	Peak
2360.67	41.14	36.72	4.42	54	-12.86	362	356	Average
2360.67	51.16	46.74	4.42	74	-22.84	362	356	Peak
2441	96.48	91.9	4.58			362	356	Average
2441	96.96	92.38	4.58			362	356	Peak
4882	41.03	30.82	10.21	54	-12.97	107	214	Average
4882	47.38	37.17	10.21	74	-26.62	107	214	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
2345.1	45.51	41.13	4.38	54	-8.49	287	294	Average
2345.1	52.39	48.01	4.38	74	-21.61	287	294	Peak
2441	103.55	98.97	4.58			287	294	Average
2441	103.95	99.37	4.58			287	294	Peak
2487.04	41.47	36.81	4.66	54	-12.53	287	294	Average
2487.04	52.14	47.48	4.66	74	-21.86	287	294	Peak
4882	41.53	31.32	10.21	54	-12.47	154	171	Average
4882	47.84	37.63	10.21	74	-26.16	154	171	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		Frequency Range		1 GHz ~ 25 GHz
Input Power		Detector Function		Peak (PK) Average (AV)
Environmental Conditions		Tested By		Karl Lee

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	96.93	92.29	4.64			362	356	Average
2480	97.33	92.69	4.64			362	356	Peak
2493.76	41.46	36.79	4.67	54	-12.54	362	356	Average
2493.76	52.57	47.9	4.67	74	-21.43	362	356	Peak
4960	43.17	32.81	10.36	54	-10.83	136	295	Average
4960	49.61	39.25	10.36	74	-24.39	136	295	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	103.79	99.15	4.64			287	294	Average
2480	104.17	99.53	4.64			287	294	Peak
2483.56	41.67	37.01	4.66	54	-12.33	287	294	Average
2483.56	52.92	48.26	4.66	74	-21.08	287	294	Peak
4960	41.26	30.9	10.36	54	-12.74	172	134	Average
4960	48.1	37.74	10.36	74	-25.9	172	134	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.

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EUT Test Condition		Measurement Detail		
Channel		Frequency Range		1 GHz ~ 25 GHz
Input Power		Detector Function		Peak (PK) Average (AV)
Environmental Conditions		Tested By		Karl Lee

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
2384.79	41.07	36.6	4.47	54	-12.93	362	356	Average
2384.79	50.92	46.45	4.47	74	-23.08	362	356	Peak
2402	94.23	89.71	4.52			362	356	Average
2402	96.54	92.02	4.52			362	356	Peak
4804	41.74	31.39	10.35	54	-12.26	168	49	Average
4804	47.91	37.56	10.35	74	-26.09	168	49	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
2381.19	41.21	36.74	4.47	54	-12.79	287	294	Average
2381.19	51.7	47.23	4.47	74	-22.3	287	294	Peak
2402	101.01	96.49	4.52			287	294	Average
2402	103.25	98.73	4.52			287	294	Peak
4804	40.39	30.04	10.35	54	-13.61	146	217	Average
4804	46.59	36.24	10.35	74	-27.41	146	217	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.

EUT Test Condition		Measurement Detail		
Channel		Frequency Range		1 GHz ~ 25 GHz
Input Power		Detector Function		Peak (PK) Average (AV)
Environmental Conditions		Tested By		Karl Lee

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
2370.66	41.12	36.67	4.45	54	-12.88	362	356	Average
2370.66	51.64	47.19	4.45	74	-22.36	362	356	Peak
2441	94.17	89.59	4.58			362	356	Average
2441	96.68	92.1	4.58			362	356	Peak
2485.44	41.79	37.13	4.66	54	-12.21	362	356	Average
2485.44	51.82	47.16	4.66	74	-22.18	362	356	Peak
4882	42.03	31.82	10.21	54	-11.97	125	78	Average
4882	48.26	38.05	10.21	74	-25.74	125	78	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
2344.92	43.37	38.99	4.38	54	-10.63	287	294	Average
2344.92	51.73	47.35	4.38	74	-22.27	287	294	Peak
2441	101.54	96.96	4.58			287	294	Average
2441	103.97	99.39	4.58			287	294	Peak
2486.6	42.22	37.56	4.66	54	-11.78	287	294	Average
2486.6	51.73	47.07	4.66	74	-22.27	287	294	Peak
4882	41.07	30.86	10.21	54	-12.93	136	296	Average
4882	47.32	37.11	10.21	74	-26.68	136	296	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		Frequency Range		1 GHz ~ 25 GHz
Input Power		Detector Function		Peak (PK) Average (AV)
Environmental Conditions		Tested By		Karl Lee

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	94.5	89.86	4.64			362	356	Average
2480	97.1	92.46	4.64			362	356	Peak
2484.12	41.46	36.8	4.66	54	-12.54	362	356	Average
2484.12	51.57	46.91	4.66	74	-22.43	362	356	Peak
4960	41.28	30.92	10.36	54	-12.72	127	46	Average
4960	47.53	37.17	10.36	74	-26.47	127	46	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	101.67	97.03	4.64			287	294	Average
2480	104.13	99.49	4.64			287	294	Peak
2483.68	41.66	37	4.66	54	-12.34	287	294	Average
2483.68	51.69	47.03	4.66	74	-22.31	287	294	Peak
4960	40.86	30.5	10.36	54	-13.14	145	182	Average
4960	47.07	36.71	10.36	74	-26.93	145	182	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.

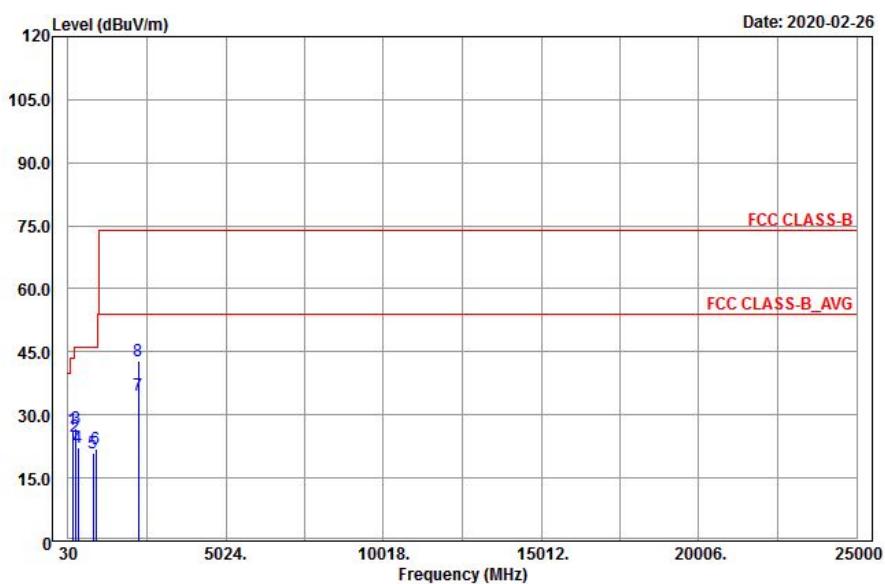
9 kHz ~ 30 MHz Data:

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

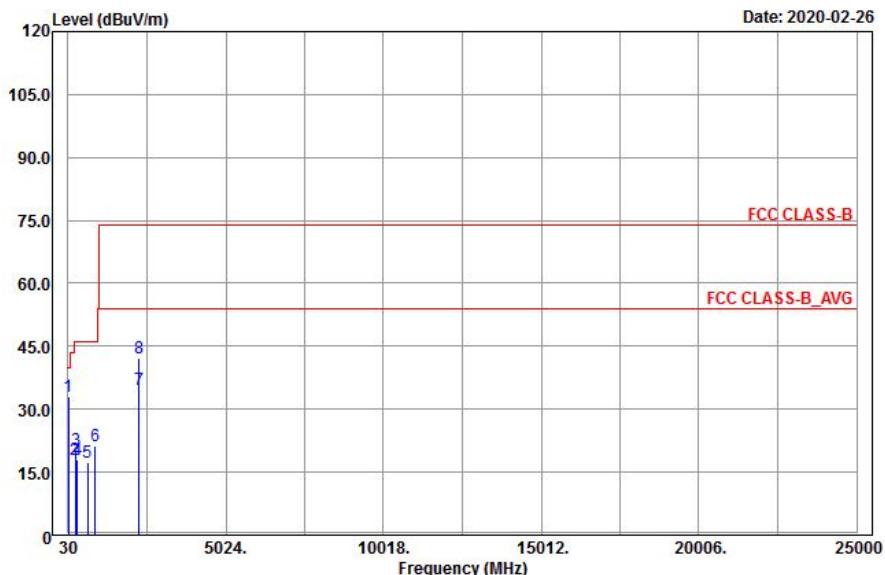
30 MHz ~ 1 GHz Worst-Case Data:

EUT Test Condition		Measurement Detail	
Channel	Channel 39	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	Karl Lee

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
163.11	26.54	48.43	-21.89	43.5	-16.96	188	258	Peak
260.58	24.97	42.63	-17.66	46	-21.03	162	60	Peak
288.93	26.94	44.19	-17.25	46	-19.06	157	91	Peak
343.4	22.09	37.86	-15.77	46	-23.91	134	275	Peak
825	20.85	28.68	-7.83	46	-25.15	149	355	Peak
917.4	21.88	28.15	-6.27	46	-24.12	117	174	Peak
2248	34.53	32.99	1.54	54	-19.47	119	145	Average
2248	42.99	41.45	1.54	74	-31.01	119	145	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
33.78	32.87	52.54	-19.67	40	-7.13	163	266	Peak
258.15	17.87	35.57	-17.7	46	-28.13	178	198	Peak
283.53	20.41	37.72	-17.31	46	-25.59	127	203	Peak
332.2	17.91	33.95	-16.04	46	-28.09	147	77	Peak
644.4	17.28	28.09	-10.81	46	-28.72	153	285	Peak
890.1	21.26	27.91	-6.65	46	-24.74	198	111	Peak
2272	34.5	32.87	1.63	54	-19.5	128	227	Average
2272	42.28	40.65	1.63	74	-31.72	128	227	Peak

Remarks:

1. Emission Level = Read Level + 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	ESCI	100613	Dec. 11, 2019	Dec. 10, 2020
RF signal cable Woken	5D-FB	Cable-cond1-01	Sep. 05, 2019	Sep. 04, 2020
LISN ROHDE & SCHWARZ (EUT)	ENV216	101826	Feb. 20, 2020	Feb. 19, 2021
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Aug. 22, 2019	Aug. 21, 2020
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.
 3. The VCCI Site Registration No. is C-12040.

4.2.3 Test Procedures

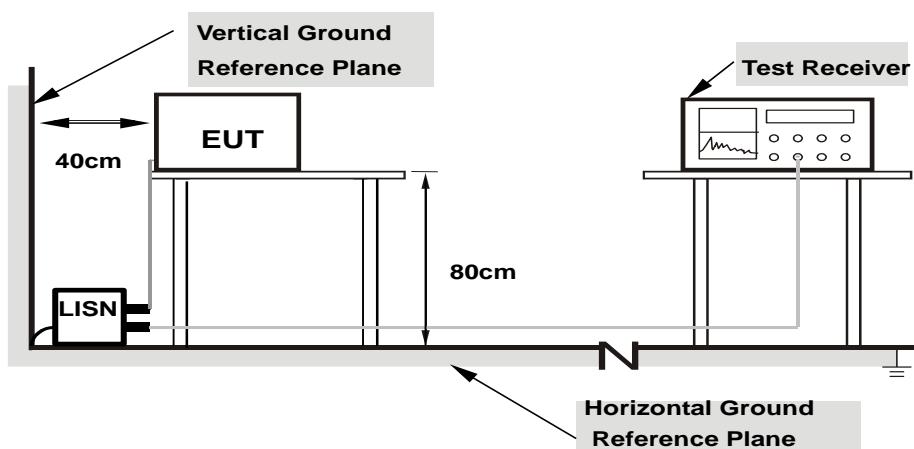
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. 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.

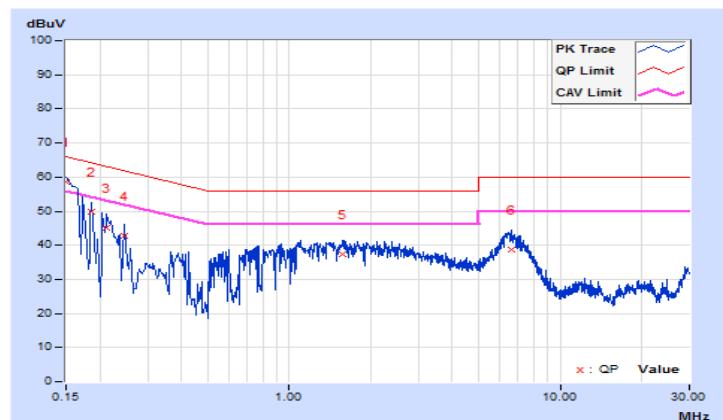
4.2.7 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 75%RH
Tested by	Jones Chang	Test Date	2020/2/26

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	0.15000	9.63	48.83	40.60	58.46	50.23	66.00	56.00	-7.54	-5.77
2	0.18519	9.62	40.35	19.94	49.97	29.56	64.25	54.25	-14.28	-24.69
3	0.21256	9.62	35.66	17.79	45.28	27.41	63.10	53.10	-17.82	-25.69
4	0.24775	9.63	33.08	21.09	42.71	30.72	61.83	51.83	-19.12	-21.11
5	1.57715	9.71	27.57	15.22	37.28	24.93	56.00	46.00	-18.72	-21.07
6	6.58586	9.82	28.97	22.34	38.79	32.16	60.00	50.00	-21.21	-17.84

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

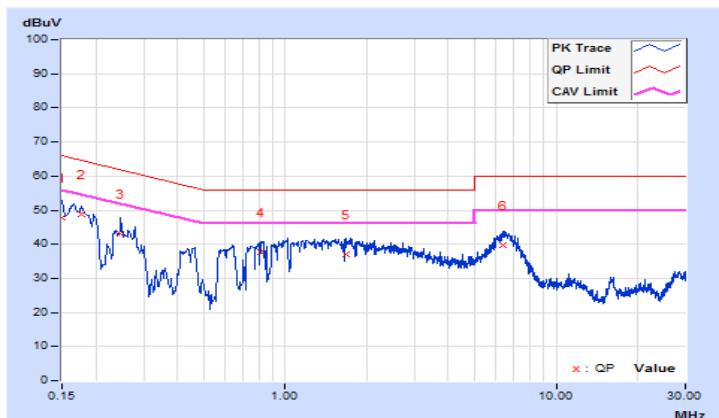


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 75%RH
Tested by	Jones Chang	Test Date	2020/2/26

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	9.66	37.99	17.65	47.65	27.31	66.00	56.00	-18.35	-28.69
2	0.17737	9.65	39.01	29.14	48.66	38.79	64.61	54.61	-15.95	-15.82
3	0.24775	9.65	33.45	21.58	43.10	31.23	61.83	51.83	-18.73	-20.60
4	0.81079	9.69	27.92	13.64	37.61	23.33	56.00	46.00	-18.39	-22.67
5	1.67061	9.74	27.31	16.50	37.05	26.24	56.00	46.00	-18.95	-19.76
6	6.39036	9.86	29.72	23.54	39.58	33.40	60.00	50.00	-20.42	-16.60

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

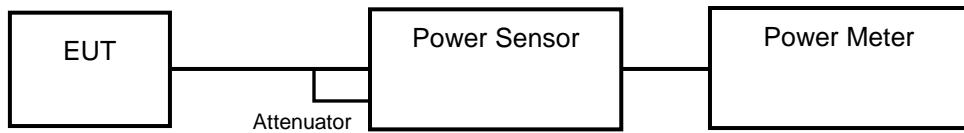


4.3 Maximum Output Power

4.3.1 Limits of Maximum Output Power Measurement

Refer to Regulation 15.247 (a)(1), 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.

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

Peak Power

<GFSK>

Channel	Freq. (MHz)	Peak Power (mW)	Peak Power (dBm)	Power Limit (mW)	Pass / Fail
0	2402	5.212	7.17	125	Pass
39	2441	4.932	6.93	125	Pass
78	2480	4.498	6.53	125	Pass

<8DPSK>

Channel	Freq. (MHz)	Peak Power (mW)	Peak Power (dBm)	Power Limit (mW)	Pass / Fail
0	2402	19.543	12.91	125	Pass
39	2441	21.979	13.42	125	Pass
78	2480	22.284	13.48	125	Pass

Average Power

<GFSK>

Channel	Freq. (MHz)	Average Power (mW)	Average Power (dBm)	Power Limit (mW)	Pass / Fail
0	2402	4.667	6.69	125	Pass
39	2441	4.385	6.42	125	Pass
78	2480	4.853	6.86	125	Pass

<8DPSK>

Channel	Freq. (MHz)	Average Power (mW)	Average Power (dBm)	Power Limit (mW)	Pass / Fail
0	2402	9.750	9.89	125	Pass
39	2441	11.143	10.47	125	Pass
78	2480	11.588	10.64	125	Pass

5 Pictures of Test Arrangements

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

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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