Partial FCC Test Report

(Spot Check)

Report No.:	RF200204C07
FCC ID:	KA2BA3621PA1
Test Model:	DBA-3621P
Received Date:	Feb. 04, 2020
Test Date:	May 27, 2020 ~ Jun. 09, 2020
Issued Date:	Jun. 22, 2020
Applicant:	D-Link Corporation
Address:	17595 Mt. Herrmann, Fountain Valley, California, United States, 92708
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
Test Location:	No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan
FCC Registration / Designation Number:	788550 / TW0003

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Release Control Record

Issue No.	Description	Date Issued
RF200204C07	Original Release	Jun. 22, 2020

1 Certificate of Conformity

Product:	Business Cloud Wave 2 Access Point / Nuclias Cloud-Managed AC1300 Wave 2 Outdoor Access Point
Brand:	D-Link
Test Model:	DBA-3621P
Sample Status:	Engineering Sample
Applicant:	D-Link Corporation
Test Date:	May 27, 2020 ~ Jun. 09, 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 : Lena Wang , **Date:** Jun. 22, 2020

Lena Wang / Specialist

Approved by : , **Date:** Jun. 22, 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 -19.95 dB at 0.45800 MHz.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -1.4 dB at 2390.00 MHz.
15.247(d)	Antenna Port Emission	N/A	Refer to Note
15.247(a)(2)	6 dB Bandwidth	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	N/A	Refer to Note
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	N/A	Refer to Note
15.203	Antenna Requirement	N/A	Refer to Note

Note:

1. This report is a supplementary report to the original BV CPS report no.: RF200116C09 (The difference compared with the report (RF200116C09) is changing test model (DBA-3621P), the model have the same appearance, circuit, layout, and RF characteristic with DWL-8720AP).Exhibit prepared for FCC Spot Check Verification report, the format, test items and amount of spot-check test data are decided by applicant's engineering judgment, for more details please refer to declaration letter exhibit. Therefore, only Output Power, AC Power Conducted Emission and Radiated Emissions were verified and recorded in this report. AC Power Conducted Emission and Radiated Emission tests according to original report radiated emission worst channel, 6 dB Bandwidth and Conducted power were re-test.
2. 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	2.93 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	Business Cloud Wave 2 Access Point / Nuclias Cloud-Managed AC1300 Wave 2 Outdoor Access Point
Brand	D-Link
Test Model	DBA-3621P
Status of EUT	Engineering Sample
Power Supply Rating	54Vdc (PoE)
Modulation Type	CCK, DQPSK, DBPSK for DSSS 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: 11.0 / 5.5 / 2.0 / 1.0 Mbps 802.11g: 54.0 / 48.0 / 36.0 / 24.0 / 18.0 / 12.0 / 9.0 / 6.0 Mbps 802.11n: up to 400 Mbps
Operating Frequency	2412 ~ 2462 MHz
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20), 802.11n (VHT20) 7 for 802.11n (HT40), 802.11n (VHT40)
Output Power	CDD Mode: 596.678 mW Beamforming Mode:206.821 mW
Antenna Type	Refer to Note as below
Antenna Connector	Refer to Note as below
Accessory Device	Refer to Note as below
Data Cable Supplied	Refer to Note as below

Note:

1. This report is a supplementary report to the original BV CPS report no.: RF200116C09 (The difference compared with the report (RF200116C09) is changing test model (DBA-3621P), the model have the same appearance, circuit, layout, and RF characteristic with DWL-8720AP).Exhibit prepared for FCC Spot Check Verification report, the format, test items and amount of spot-check test data are decided by applicant's engineering judgment, for more details please refer to declaration letter exhibit. Therefore, only Output Power, AC Power Conducted Emission and Radiated Emissions were verified and recorded in this report. AC Power Conducted Emission and Radiated Emission tests according to original report radiated emission worst channel, 6 dB Bandwidth and Conducted power were re-test.
2. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

Modulation Mode	Beamforming Mode	Tx Function
802.11b	Not Support	2TX
802.11g	Not Support	2TX
802.11n (HT20)	Support	2TX
802.11n (HT40)	Support	2TX
802.11n (VHT20)	Support	2TX
802.11n (VHT40)	Support	2TX

* The bandwidth and modulation are similar for HT20/HT40 on 802.11n mode and VHT20/VHT40 on 802.11n mode. Therefore the investigated worst case is the representative mode in test report. (Final test mode refer section 3.2.1)

* For 802.11n, CDD mode is the worst case for final radiated emission and power line conducted emission tests after pretesting CDD mode and beamforming mode.

3. The following antennas were provided to the EUT.

No.	Type	Connector	Gain (dBi)							
			2400 MHz	2450 MHz	2500 MHz	4900 MHz	5150 MHz	5350 MHz	5725 MHz	5825 MHz
1	Dipole	R-N type(F)	3.5	3.4	3.1	5.1	6.0	5.8	5.5	5.3
2	Dipole	R-N type(F)	3.5	3.4	3.1	5.1	6.0	5.8	5.5	5.3

4. The EUT contains following accessory devices.

Product	Brand	Model	Description
Console Cable	N/A	N/A	1 m non-shielded without core
GND Cable	N/A	N/A	1m non-shielded ground cable without core

5. The test support unit which provided by client is listed as below.

Product	Brand	Model	Description
POE	LEADER ELECTRONICS INC.	NU90-J540167-I1	I/P: 100-240 Vac, 50/60 Hz, 1.2 A O/P: 54 Vdc, 1.67 A Power Cord: 1.5m non-shielded power cord without core

6. **There're 2 configurations for the EUT listed as below.**

   Mode A: Flat Type iron frame

   Mode B: C Type iron frame

7. Spurious emission of the simultaneous operation (2.4GHz and 5GHz) has been evaluated and no non-compliance was found.
8. 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.
9. 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

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

7 channels are provided for 802.11n (HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	7	2442
4	2427	8	2447
5	2432	9	2452
6	2437		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE≥1G	RE<1G	PLC	APCM	
A	√	√	√	√	For Flat Type iron frame
B	-	√	√	-	For C Type iron frame

Where **RE≥1G:** Radiated Emission above 1 GHz **RE<1G:** Radiated Emission below 1 GHz
PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Z-plane**.
NOTE: "-"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	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
A	802.11b	1 to 11	6	DSSS	DBPSK	1.0

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	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
A、B	802.11b	1 to 11	6	DSSS	DBPSK	1.0

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	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
A、B	802.11b	1 to 11	6	DSSS	DBPSK	1.0

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	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
A	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5
	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	13.5

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested by
RE≥1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Titan Hsu
RE<1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Titan Hsu
PLC	25 deg. C, 65 % RH	120 Vac, 60 Hz	Titan Hsu
APCM	25 deg. C, 65 % RH	54 Vdc	Jisyong Wang

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.

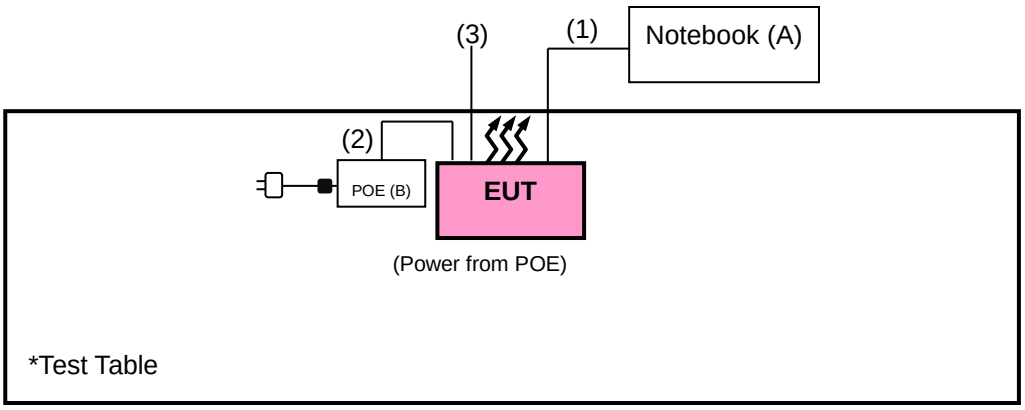
No.	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Notebook	DELL	E5420	33MJMQ1	FCC DoC Approved	Provided by Lab
B	POE	LEADER ELECTRONICS INC.	NU90-J540167-I1	N/A	N/A	Provided by Client

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	LAN Cable	1	10	N	0	RJ45, Cat5e
2.	LAN Cable	1	1.5	N	0	RJ45, Cat5e, Provided by client.
3.	GND Cable	1	1	N	0	Provided by client.

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items A acted as communication partners to transfer data.
3. Items B 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 Meas Guidance v05r02
KDB 662911 D01 Multiple Transmitter Output v02r01

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:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. 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 KEYSIGHT	N9038A	MY55420137	Apr. 16, 2020	Apr. 15, 2021
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100039	Jun. 12, 2019	Jun. 11, 2020
BILOG Antenna SCHWARZBECK	VULB9168	9168-160	Nov. 07, 2019	Nov. 06, 2020
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1169	Nov. 24, 2019	Nov. 23, 2020
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 24, 2019	Nov. 23, 2020
Preamplifier Agilent (Below 1GHz)	8447D	2944A10638	Jul. 11, 2019	Jul. 10, 2020
Preamplifier Agilent (Above 1GHz)	8449B	3008A02367	Feb. 18, 2020	Feb. 17, 2021
RF signal cable HUBER+SUHNER&EMCI	SUCOFLEX 104 & EMC104-SM-SM8000	CABLE-CH9-02 (248780+171006)	Jan. 18, 2020	Jan. 17, 2021
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-(250795/4)	Jul. 11, 2019	Jul. 10, 2020
RF signal cable Woken	8D-FB	Cable-CH9-01	Jul. 30, 2019	Jul. 29, 2020
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower EMCO	2070/2080	512.835.4684	NA	NA
Turn Table EMCO	2087-2.03	NA	NA	NA
Antenna Tower &Turn BV ADT	AT100	AT93021705	NA	NA
Turn Table BV ADT	TT100	TT93021705	NA	NA
Turn Table Controller BV ADT	SC100	SC93021705	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55190004/MY55190007/MY55210005	Jul. 15, 2019	Jul. 14, 2020

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 Chamber 9.

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:

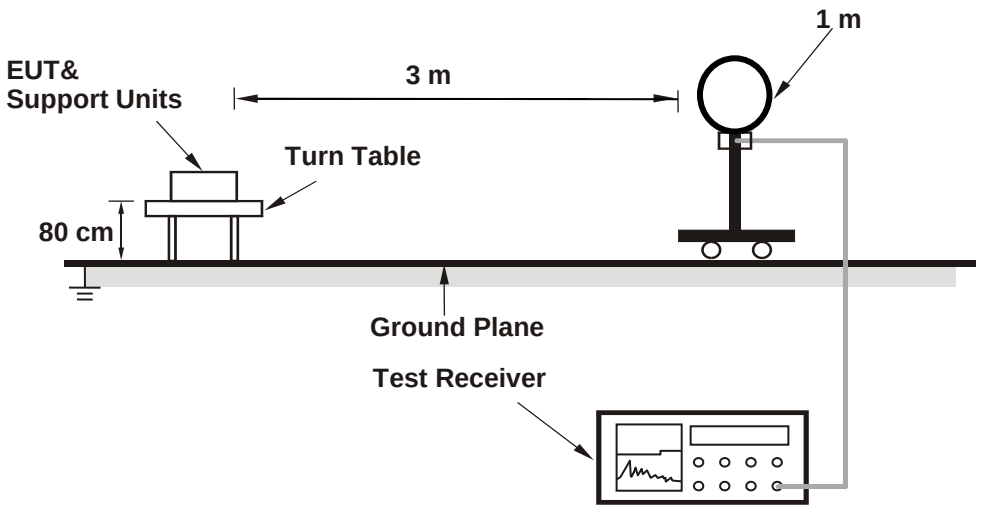
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98 %) or 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz. (11b: RBW = 1 MHz, VBW =10 Hz ; 11g: RBW = 1 MHz, VBW = 1 kHz ;
   11n (HT20): RBW = 1 MHz, VBW = 1 kHz ; 11n (HT40): 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

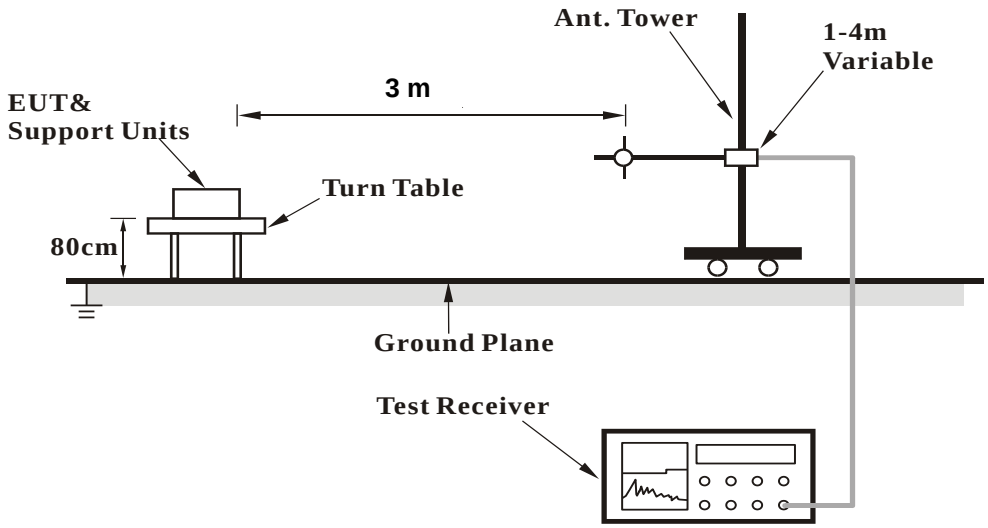
No deviation.

4.1.5 Test Set Up

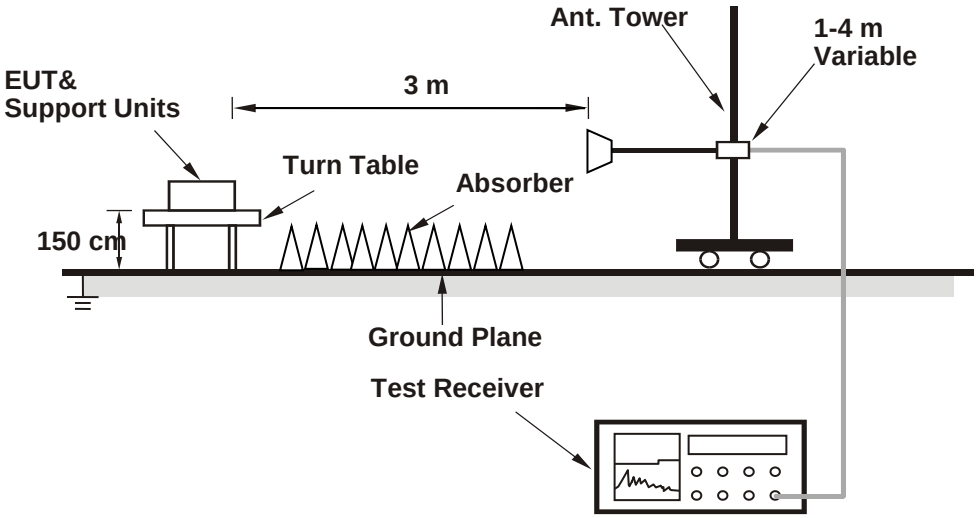
<Radiated Emission below 30 MHz>



<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

a. Placed the EUT on a testing table.
b. Use the software to control the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1 GHz Data：

802.11b

CHANNEL	TX Channel 6	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	58.9 PK	74.0	-15.1	2.01 H	155	26.6	32.3
2	2390.00	48.2 AV	54.0	-5.8	2.01 H	155	15.9	32.3
3	*2437.00	106.4 PK			2.01 H	155	74.1	32.3
4	*2437.00	102.5 AV			2.01 H	155	70.2	32.3
5	4874.00	45.7 PK	74.0	-28.3	2.20 H	342	42.0	3.7
6	4874.00	41.3 AV	54.0	-12.7	2.20 H	342	37.6	3.7
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	62.5 PK	74.0	-11.5	1.87 V	335	30.2	32.3
2	2390.00	52.6 AV	54.0	-1.4	1.87 V	335	20.3	32.3
3	*2437.00	117.1 PK			1.87 V	335	84.8	32.3
4	*2437.00	113.5 AV			1.87 V	335	81.2	32.3
5	4874.00	47.8 PK	74.0	-26.2	2.42 V	33	44.1	3.7
6	4874.00	43.2 AV	54.0	-10.8	2.42 V	33	39.5	3.7

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

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:

802.11b

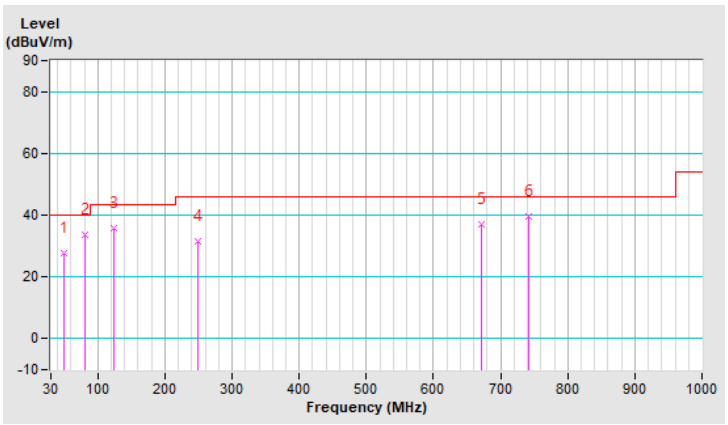
Mode A

CHANNEL	TX Channel 6	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	49.68	27.6 QP	40.0	-12.4	2.00 H	105	36.4	-8.8
2	80.61	33.6 QP	40.0	-6.4	2.00 H	170	46.9	-13.3
3	124.19	35.9 QP	43.5	-7.6	1.51 H	246	46.5	-10.6
4	249.30	31.6 QP	46.0	-14.4	1.01 H	314	41.1	-9.5
5	671.04	36.9 QP	46.0	-9.1	1.01 H	236	35.2	1.7
6	742.74	39.7 QP	46.0	-6.3	1.51 H	64	36.8	2.9

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

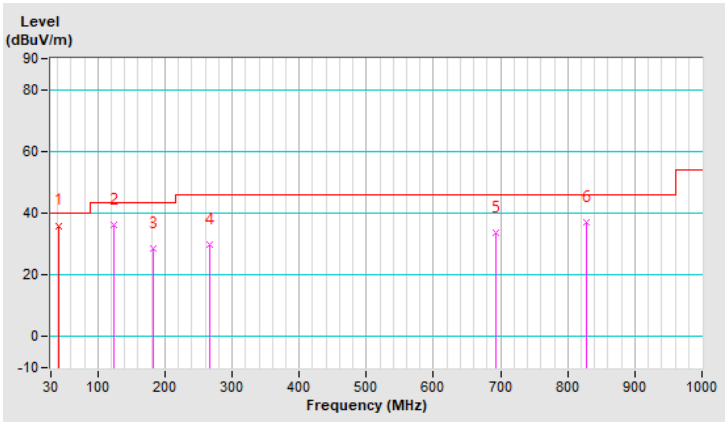


CHANNEL	TX Channel 6	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	41.67	36.0 QP	40.0	-4.0	1.00 V	262	45.2	-9.2
2	124.19	36.2 QP	43.5	-7.3	2.00 V	38	46.8	-10.6
3	183.23	28.4 QP	43.5	-15.1	1.00 V	192	38.6	-10.2
4	267.58	29.9 QP	46.0	-16.1	1.49 V	213	38.5	-8.6
5	693.54	33.8 QP	46.0	-12.2	2.00 V	173	31.8	2.0
6	827.09	37.2 QP	46.0	-8.8	1.49 V	356	33.9	3.3

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



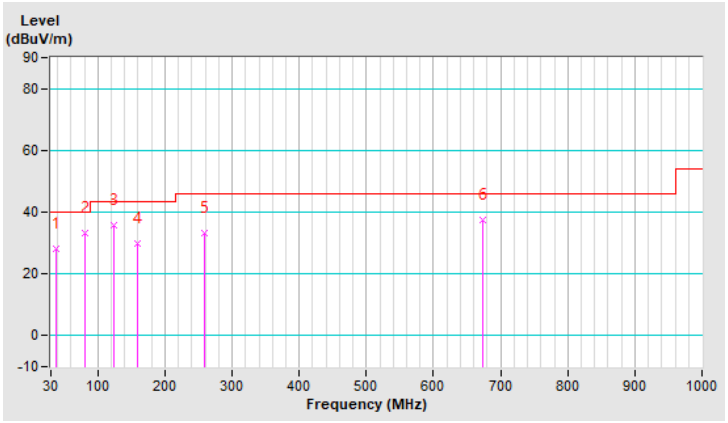
Mode B

CHANNEL	TX Channel 6	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	38.43	28.3 QP	40.0	-11.7	1.99 H	83	38.0	-9.7
2	80.61	33.2 QP	40.0	-6.8	1.99 H	181	46.5	-13.3
3	124.19	35.9 QP	43.5	-7.6	1.50 H	249	46.5	-10.6
4	159.33	29.8 QP	43.5	-13.7	1.99 H	140	38.3	-8.5
5	259.14	33.2 QP	46.0	-12.8	1.00 H	279	42.3	-9.1
6	673.86	37.3 QP	46.0	-8.7	1.00 H	238	35.6	1.7

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

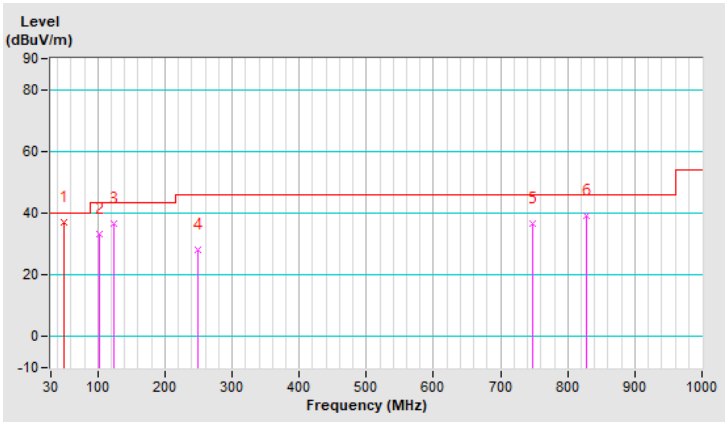


CHANNEL	TX Channel 6	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	49.97	37.2 QP	40.0	-2.8	1.00 V	294	46.0	-8.8
2	101.70	33.1 QP	43.5	-10.4	1.01 V	169	46.0	-12.9
3	124.19	36.5 QP	43.5	-7.0	1.01 V	34	47.1	-10.6
4	249.30	28.2 QP	46.0	-17.8	1.01 V	16	37.7	-9.5
5	746.96	36.5 QP	46.0	-9.5	1.50 V	16	33.7	2.8
6	828.49	39.1 QP	46.0	-6.9	1.50 V	134	35.7	3.4

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



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 (with 10dB PAD) 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 (Conduction 1).
3. The VCCI Site Registration No. is C-12040.

4.2.3 Test Procedures

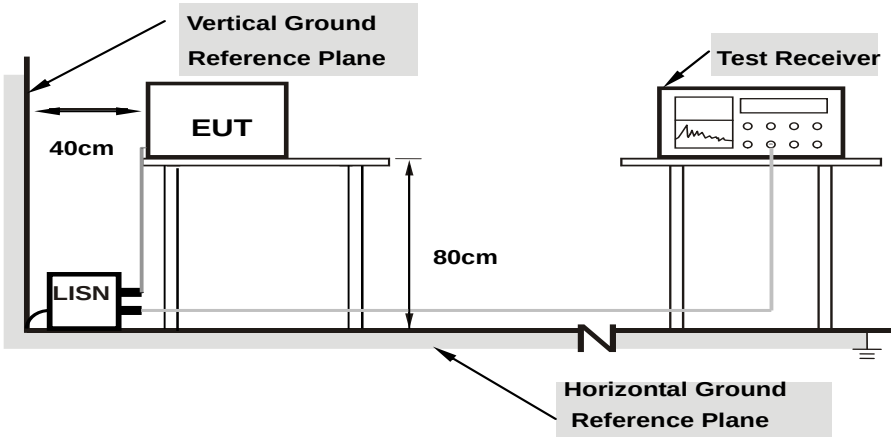
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50 uH of coupling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

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

4.2.6 EUT Operating Conditions

a. Placed the EUT on a testing table.
b. Use the software to control the EUT under transmission condition continuously at specific channel frequency.

4.2.7 Test Results

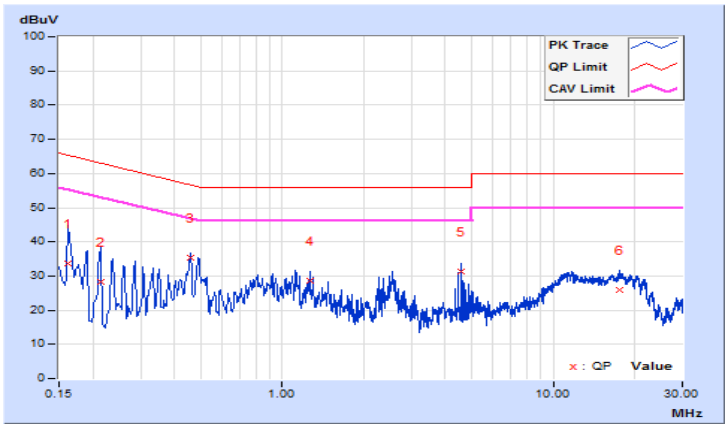
Mode A

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23℃, 66%RH
Tested by	Titan Hsu	Test Date	2020/6/9

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	0.16200	9.63	24.17	2.64	33.80	12.27	65.36	55.36	-31.56	-43.09
2	0.21400	9.62	18.67	2.42	28.29	12.04	63.05	53.05	-34.76	-41.01
3	0.45800	9.65	25.75	16.87	35.40	26.52	56.73	46.73	-21.33	-20.21
4	1.27000	9.69	19.07	7.71	28.76	17.40	56.00	46.00	-27.24	-28.60
5	4.56600	9.80	21.58	6.35	31.38	16.15	56.00	46.00	-24.62	-29.85
6	17.50600	9.91	15.86	3.01	25.77	12.92	60.00	50.00	-34.23	-37.08

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

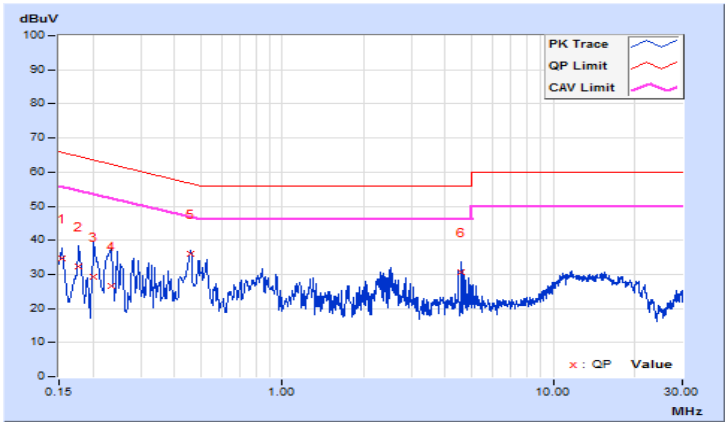


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23℃, 66%RH
Tested by	Titan Hsu	Test Date	2020/6/9

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	0.15400	9.66	25.02	3.88	34.68	13.54	65.78	55.78	-31.10	-42.24
2	0.17754	9.65	22.70	11.67	32.35	21.32	64.60	54.60	-32.25	-33.28
3	0.20148	9.64	19.69	2.39	29.33	12.03	63.55	53.55	-34.22	-41.52
4	0.23351	9.65	16.94	5.63	26.59	15.28	62.32	52.32	-35.73	-37.04
5	**0.45800**	**9.67**	**26.20**	**17.11**	**35.87**	**26.78**	**56.73**	**46.73**	**-20.86**	**-19.95**
6	4.56600	9.83	20.75	5.87	30.58	15.70	56.00	46.00	-25.42	-30.30

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



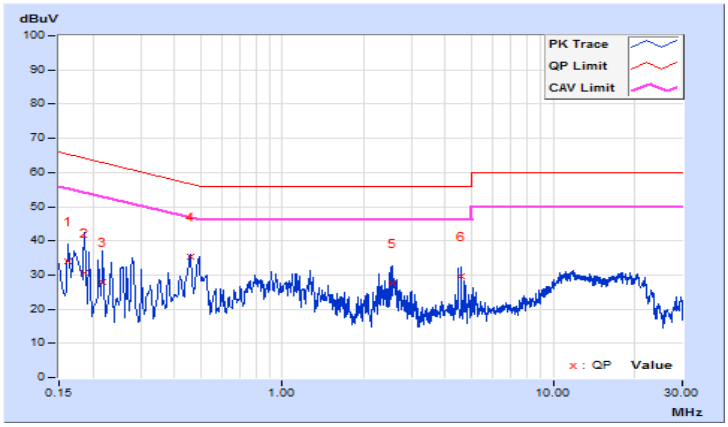
Mode B

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23℃, 66%RH
Tested by	Titan Hsu	Test Date	2020/6/9

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	0.16200	9.63	24.24	2.72	33.87	12.35	65.36	55.36	-31.49	-43.01
2	0.18600	9.62	20.91	0.79	30.53	10.41	64.21	54.21	-33.68	-43.80
3	0.21800	9.62	18.19	1.23	27.81	10.85	62.89	52.89	-35.08	-42.04
4	0.45716	9.65	25.67	16.97	35.32	26.62	56.74	46.74	-21.42	-20.12
5	2.53800	9.75	18.01	2.76	27.76	12.51	56.00	46.00	-28.24	-33.49
6	4.56600	9.80	19.94	4.49	29.74	14.29	56.00	46.00	-26.26	-31.71

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

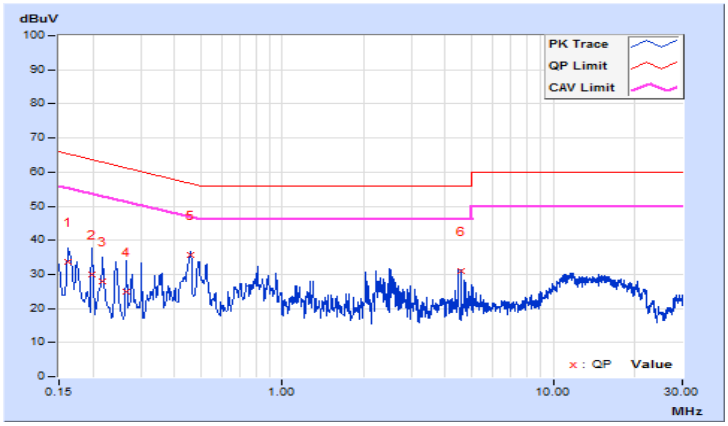


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	23℃, 66%RH
Tested by	Titan Hsu	Test Date	2020/6/9

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	0.16200	9.66	24.05	2.14	33.71	11.80	65.36	55.36	-31.65	-43.56
2	0.19800	9.64	20.32	0.42	29.96	10.06	63.69	53.69	-33.73	-43.63
3	0.21800	9.64	18.37	0.29	28.01	9.93	62.89	52.89	-34.88	-42.96
4	0.26600	9.65	15.28	0.51	24.93	10.16	61.24	51.24	-36.31	-41.08
5	0.45800	9.67	26.03	16.93	35.70	26.60	56.73	46.73	-21.03	-20.13
6	4.56600	9.83	21.12	5.51	30.95	15.34	56.00	46.00	-25.05	-30.66

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

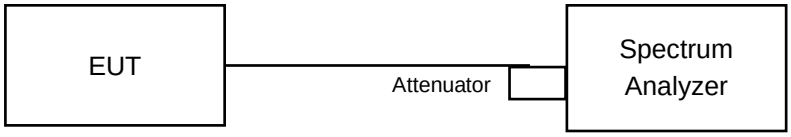


4.3 6 dB Bandwidth Measurement

4.3.1 Limits of 6 dB Bandwidth Measurement

The minimum of 6 dB Bandwidth Measurement is 0.5 MHz.

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. Set resolution bandwidth (RBW) = 100 kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW, Detector = Peak.
c. Trace mode = max hold.
d. Sweep = auto couple.
e. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 Test Results

802.11b

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	8.05	8.08	0.5	Pass
6	2437	8.57	9.53	0.5	Pass
11	2462	8.07	8.08	0.5	Pass

802.11g

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	16.39	16.38	0.5	Pass
6	2437	16.37	16.35	0.5	Pass
11	2462	16.38	16.38	0.5	Pass

802.11n (HT20)

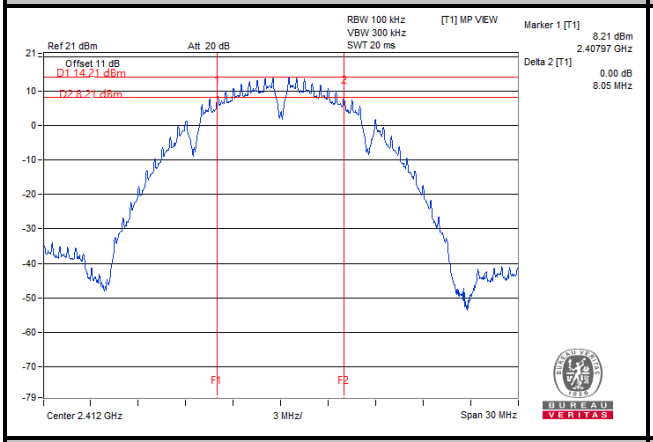
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	17.62	17.61	0.5	Pass
6	2437	17.59	17.58	0.5	Pass
11	2462	17.60	17.62	0.5	Pass

802.11n (HT40)

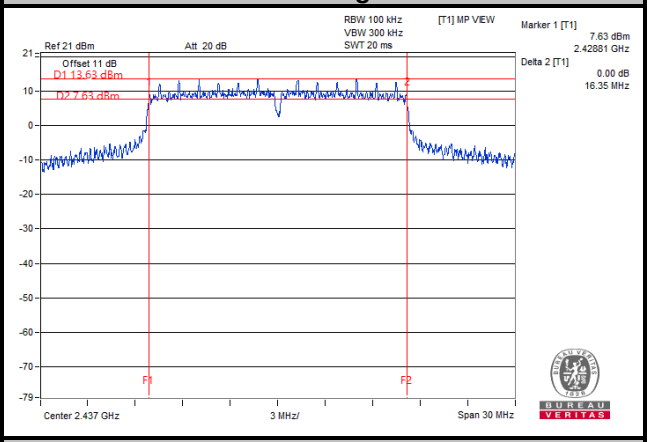
		Chain 0	Chain 1		
3	2422	35.21	35.23	0.5	Pass
6	2437	35.22	35.36	0.5	Pass
9	2452	35.20	35.38	0.5	Pass

Spectrum Plot of Worst Value

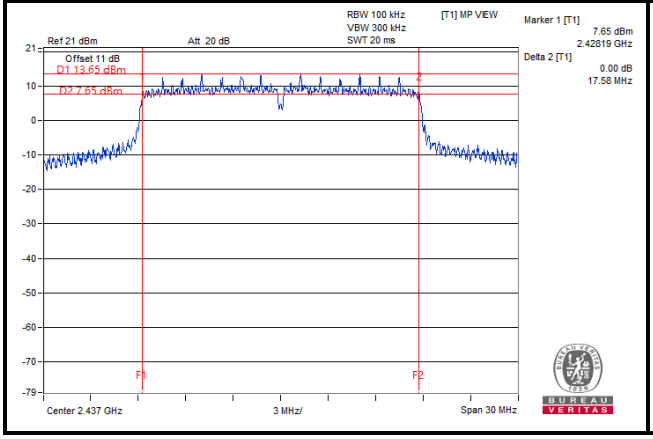
802.11b



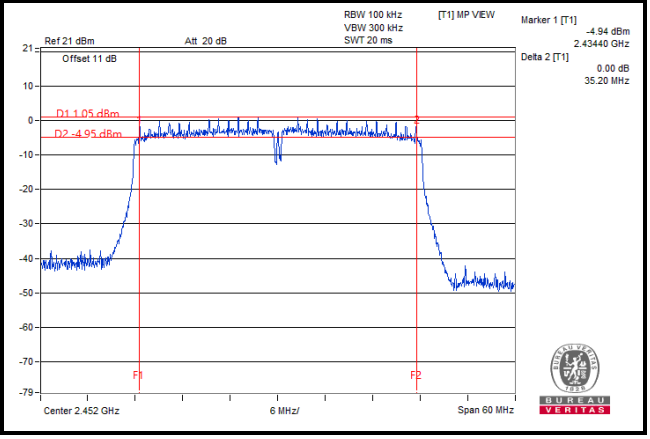
802.11g



802.11n (HT20)



802.11n (HT40)



4.4 Conducted Output Power Measurement

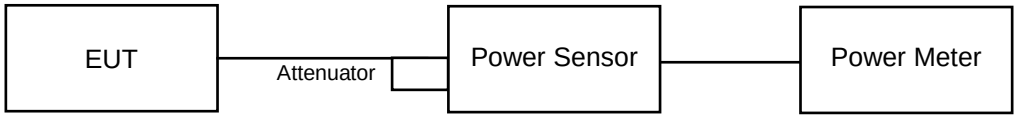
4.4.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30 dBm)
Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for NANT ≤ 4;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any NANT;
Array Gain = 5 log(NANT/NSS) dB or 3 dB, whichever is less for 20 MHz channel widths with NANT ≥ 5.

For power measurements on all other devices: Array Gain = 10 log(NANT/NSS) dB.

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedures

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.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.4.7 Test Results

CDD Mode

802.11b

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	20.90	20.65	239.172	23.79	30	Pass
6	2437	24.88	24.61	596.678	27.76	30	Pass
11	2462	22.91	22.69	381.214	25.81	30	Pass

802.11g

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	15.57	15.37	70.493	18.48	30	Pass
6	2437	23.49	23.24	434.22	26.38	30	Pass
11	2462	16.84	16.53	93.284	19.70	30	Pass

802.11n (HT20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	13.12	12.96	40.281	16.05	30	Pass
6	2437	23.08	23.23	413.614	26.17	30	Pass
11	2462	14.68	14.42	57.046	17.56	30	Pass

802.11n (HT40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	10.48	10.46	22.286	13.48	30	Pass
6	2437	16.41	16.46	88.011	19.45	30	Pass
9	2452	12.65	12.31	35.429	15.49	30	Pass

Beamforming Mode

802.11n (HT20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	10.11	9.95	20.142	13.04	29.49	Pass
6	2437	20.07	20.22	206.821	23.16	29.49	Pass
11	2462	11.67	11.41	28.525	14.55	29.49	Pass

NOTE:

1. Directional gain = 3.5 dBi + 10log(2) = 6.51 dBi > 6 dBi, so the power density limit shall be reduced to 30-(6.51-6) = 29.49 dBm.

802.11n (HT40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	7.47	7.45	11.144	10.47	29.49	Pass
6	2437	13.40	13.45	44.009	16.44	29.49	Pass
9	2452	9.64	9.30	17.716	12.48	29.49	Pass

NOTE:

1. Directional gain = 3.5 dBi + 10log(2) = 6.51 dBi > 6 dBi, so the power density limit shall be reduced to 30-(6.51-6) = 29.49 dBm.

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:

Lin Kou EMC/RF Lab
Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab
Tel: 886-3-3183232
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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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