

Partial FCC Test Report

Report No.: RF170927C20B

FCC ID: B949260NGWM

Test Model: TPN-Q200

Received Date: Oct. 27, 2017

Test Date: Nov. 24, 2017 ~ Nov. 26, 2017

Issued Date: Nov. 30, 2017

Applicant: HP Inc.

Address: 3390 East Harmony Road, Fort Collins, Colorado 80528, United States

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

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

Test Location (1): No. 19, Hwa Ya 2nd Rd, Wen Hwa Tsuen, Kwei Shan Hsiang, Taoyuan
Hsien 333, Taiwan, R.O.C.

Test Location (2): No.215, Sec. 3, Beixin Rd., Xindian Dist., New Taipei City 231, Taiwan,
R.O.C

**FCC Registration /
Designation Number:** 427177 / TW0011



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification.

Table of Contents

Release Control Record	3
1 Certificate of Conformity	4
2 Summary of Test Results.....	5
2.1 Measurement Uncertainty.....	5
2.2 Modification Record	5
3 General Information	6
3.1 General Description of EUT	6
3.2 Description of Test Modes.....	7
3.2.1 Test Mode Applicability and Tested Channel Detail.....	8
3.3 Description of Support Units	9
3.3.1 Configuration of System under Test	9
3.4 General Description of Applied Standards.....	9
4 Test Types and Results	10
4.1 Radiated Emission and Bandedge Measurement	10
4.1.1 Limits of Radiated Emission and Bandedge Measurement	10
4.1.2 Test Instruments	11
4.1.3 Test Procedures.....	12
4.1.4 Deviation from Test Standard	12
4.1.5 Test Set Up	13
4.1.6 EUT Operating Conditions.....	14
4.1.7 Test Results	15
4.2 Conducted Output Power Measurement	28
4.2.1 Limits of Conducted Output Power Measurement.....	28
4.2.2 Test Setup.....	28
4.2.3 Test Instruments	28
4.2.4 Test Procedures.....	28
4.2.5 Deviation from Test Standard	28
4.2.6 EUT Operating Conditions.....	28
4.2.7 Test Results	29
5 Pictures of Test Arrangements.....	30
Appendix – Information on the Testing Laboratories	31

Release Control Record

Issue No.	Description	Date Issued
RF170927C20B	Original Release	Nov. 30, 2017

1 Certificate of Conformity

Product: Notebook Computer

Brand: HP

Test Model: TPN-Q200

Sample Status: Production Unit

Applicant: HP Inc.

Test Date: Nov. 24, 2017 ~ Nov. 26, 2017

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 EMC characteristics under the conditions specified in this report.

Prepared by : Evonne Liu, **Date:** Nov. 30, 2017
Evonne Liu / Specialist

Approved by : Dylan Chiou, **Date:** Nov. 30, 2017
Dylan Chiou / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	N/A	Refer to Note
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -1.01 dB at 2389.83 MHz.
15.247(d)	Antenna Port Emission	N/A	Refer to Note
15.247(a)(2)	6 dB Bandwidth	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: Only test item of Radiated Emissions and Conducted power were performed for this report. For other test data, please refer to BV Report No.: 170524-01.TR04 for WLAN module (Brand: Intel, Model: 9260NGW).

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	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	Notebook Computer
Brand	HP
Test Model	TPN-Q200
Status of EUT	Production Unit
Power Supply Rating	19.5 Vdc (Adapter)
Modulation Type	CCK, DQPSK, DBPSK for DSSS 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 MCS7
Operating Frequency	2412 ~ 2462 MHz
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40)
Antenna Type	Refer to Note as below
Antenna Connector	N/A
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

- The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

Modulation Mode	Tx Function
802.11b	1TX
802.11g	1TX
802.11n (HT20)	2TX
802.11n (HT40)	2TX

- The antenna information is listed as below.

Antenna Type	Mode	Manufacturer	Parts Number	Antenna Gain			
				WLAN 2.4 GHz	WLAN 5.15~5.35 GHz	WLAN 5.47~5.725 GHz	WLAN 5.725~5.850 GHz
PIFA	NB	WNC	WLAN Main Antenna: DQ6415GB200 WLAN Aux Antenna: DQ6415GB200	2.48	2.39	-0.16	-1.17
	Tablet	WNC	WLAN Main Antenna: DQ6415GB200 WLAN Aux Antenna: DQ6415GB200	1.21	2.38	1.45	0.82

* Only the antenna which has the worst gain is chosen as a representative for final test.

- The above EUT information is declared by manufacturer and for more detailed features description, please refer 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 $\geq$ 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. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on Y-plane.
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	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	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	MCS0
	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	MCS0

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)
-	802.11g	1 to 11	6	OFDM	BPSK	6.0

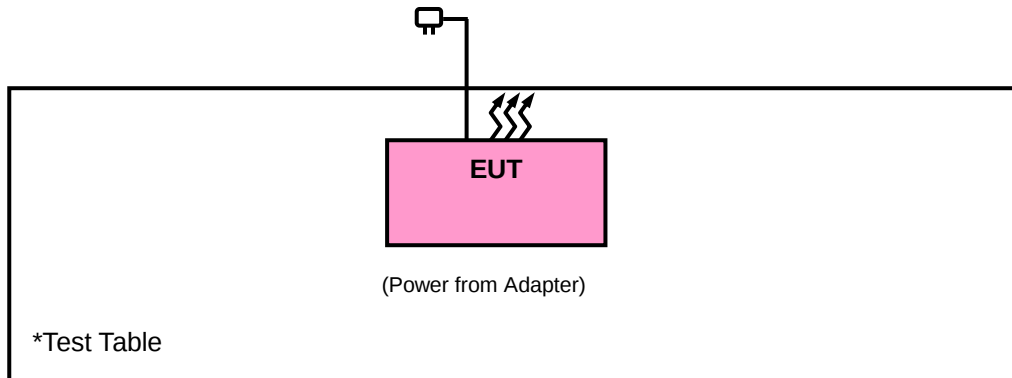
Test Condition:

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

3.3 Description of Support Units

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

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

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

FCC Part 15, Subpart C (15.247)

558074 D01 DTS Meas Guidance v04

662911 D01 Multiple Transmitter Output v02r01

ANSI C63.10-2013

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

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

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

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

NOTE:

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 Agilent Technologies	N9038A	MY52260177	Jul. 05, 2017	Jul. 04, 2018
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Dec. 13, 2016	Dec. 12, 2017
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Dec. 16, 2016	Dec. 15, 2017
HORN Antenna ETS-Lindgren	3117	00143293	Dec. 29, 2016	Dec. 28, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	9170-480	Dec. 14, 2016	Dec. 13, 2017
Fixed Attenuator Mini-Circuits	MDCS18N-10	MDCS18N-10-01	Apr. 17, 2017	Apr. 16, 2018
Bluetooth Tester	CBT	100980	Jun. 28, 2017	Jun. 27, 2019
Loop Antenna	HLA 6121	45745	May 19, 2017	May 18, 2018
Preamplifier Agilent	310N	187226	Jun. 23, 2017	Jun. 22, 2018
Preamplifier Agilent	83017A	MY39501357	Jun. 23, 2017	Jun. 22, 2018
Power Meter Anritsu	ML2495A	1012010	Aug. 15, 2017	Aug. 14, 2018
Power Sensor Anritsu	MA2411B	1315050	Aug. 15, 2017	Aug. 14, 2018
RF signal cable ETS-LINDGREN	5D-FB	Cable-CH1-01(R FC-SMS-100-SM S-120+RFC-SMS -100-SMS-400)	Jun. 23, 2017	Jun. 22, 2018
RF signal cable ETS-LINDGREN	8D-FB	Cable-CH1-02(R FC-SMS-100-SM S-24)	Jun. 23, 2017	Jun. 22, 2018
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 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HsinTien Chamber 1.
3. The horn antenna and preamplifier (model: 83017A) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The IC Site Registration No. is IC7450I-1.

4.1.3 Test Procedures

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 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:

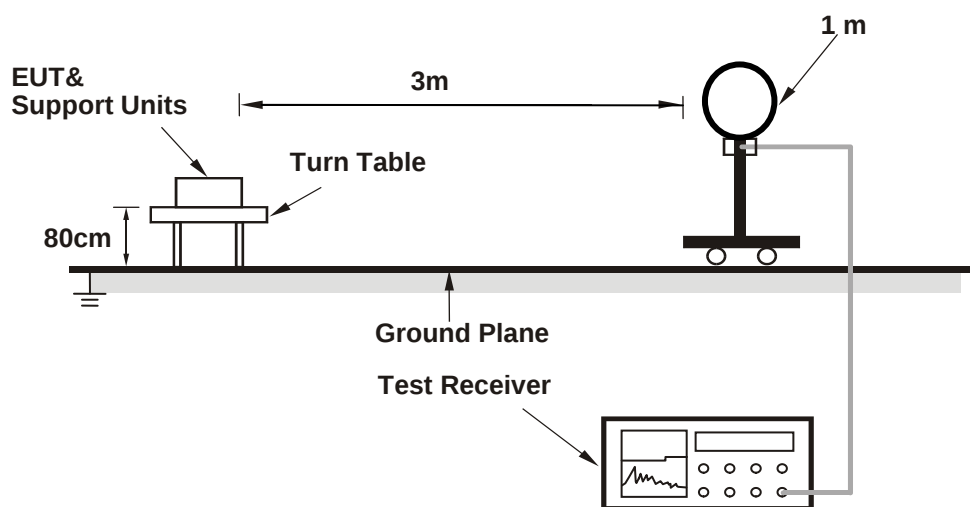
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 KHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for Average (Duty cycle < 98 %) detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

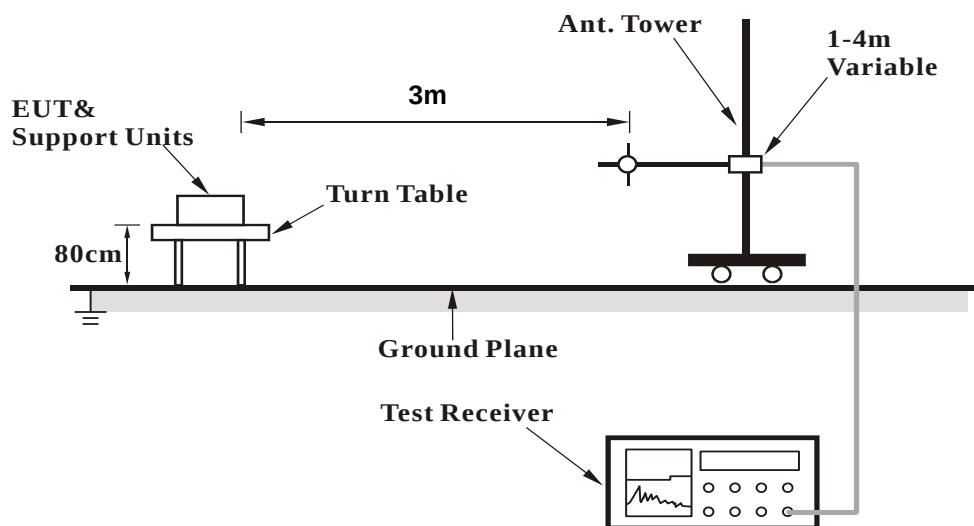
No deviation.

4.1.5 Test Set Up

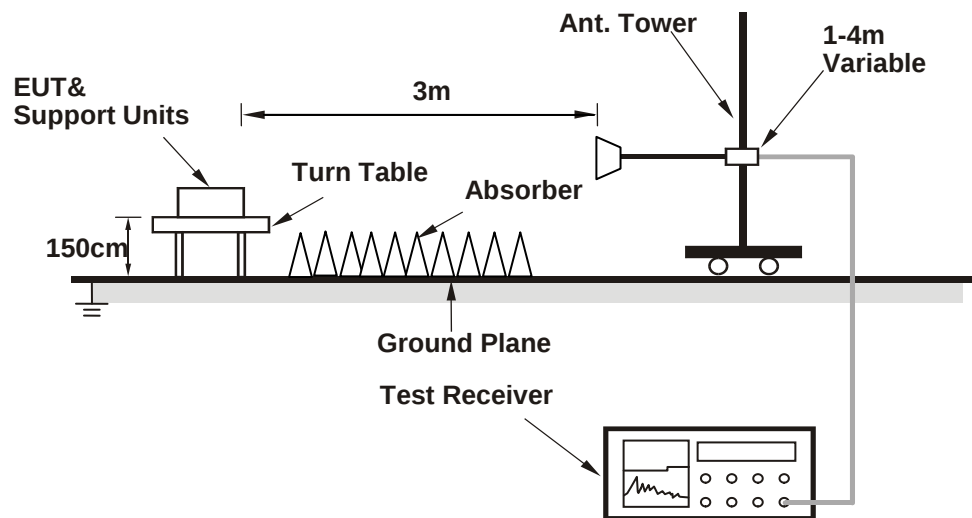
<Radiated emission below 30 MHz>



<Frequency Range below 1 GHz>



<Frequency Range above 1 GHz>



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

4.1.6 EUT Operating Conditions

- Placed the EUT on a testing table.
- 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

EUT Test Condition		Measurement Detail	
Channel	Channel 1	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.47	52.86	51.15	54	-1.14	31.8	5.4	35.49	202	69	Average
2389.47	57.85	56.14	74	-16.15	31.8	5.4	35.49	202	69	Peak
2412	107.07	105.3			31.81	5.43	35.47	202	69	Average
2412	109.63	107.86			31.81	5.43	35.47	202	69	Peak
4824	38.37	30.24	54	-15.63	33.97	8.26	34.1	128	114	Average
4824	48.27	40.14	74	-25.73	33.97	8.26	34.1	128	114	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.2	45.99	44.28	54	-8.01	31.8	5.4	35.49	103	64	Average
2389.2	53.6	51.89	74	-20.4	31.8	5.4	35.49	103	64	Peak
2412	98.77	97			31.81	5.43	35.47	103	64	Average
2412	101.27	99.5			31.81	5.43	35.47	103	64	Peak
4824	38.06	29.93	54	-15.94	33.97	8.26	34.1	183	334	Average
4824	47.89	39.76	74	-26.11	33.97	8.26	34.1	183	334	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2412 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.92	47.37	45.64	54	-6.63	31.8	5.4	35.47	198	73	Average
2389.92	55.53	53.8	74	-18.47	31.8	5.4	35.47	198	73	Peak
2437	108.13	106.28			31.85	5.46	35.46	198	73	Average
2437	110.58	108.73			31.85	5.46	35.46	198	73	Peak
2485.88	42.98	40.99	54	-11.02	31.88	5.53	35.42	198	73	Average
2485.88	53.28	51.29	74	-20.72	31.88	5.53	35.42	198	73	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2388.84	42.49	40.78	54	-11.51	31.8	5.4	35.49	114	69	Average
2388.84	52.54	50.83	74	-21.46	31.8	5.4	35.49	114	69	Peak
2437	99.94	98.09			31.85	5.46	35.46	114	69	Average
2437	102.3	100.45			31.85	5.46	35.46	114	69	Peak
2489.16	41.01	39	54	-12.99	31.9	5.53	35.42	114	69	Average
2489.16	52.89	50.88	74	-21.11	31.9	5.53	35.42	114	69	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 11	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	107.34	105.41			31.87	5.5	35.44	191	74	Average
2462	109.75	107.82			31.87	5.5	35.44	191	74	Peak
2483.52	52.95	50.99	54	-1.05	31.88	5.5	35.42	191	74	Average
2483.52	59.03	57.07	74	-14.97	31.88	5.5	35.42	191	74	Peak
4924	39.74	31.49	54	-14.26	33.99	8.28	34.02	164	170	Average
4924	48.69	40.44	74	-25.31	33.99	8.28	34.02	164	170	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	98.98	97.05			31.87	5.5	35.44	111	69	Average
2462	101.76	99.83			31.87	5.5	35.44	111	69	Peak
2483.52	44.27	42.31	54	-9.73	31.88	5.5	35.42	111	69	Average
2483.52	53.69	51.73	74	-20.31	31.88	5.5	35.42	111	69	Peak
4924	38.75	30.5	54	-15.25	33.99	8.28	34.02	123	243	Average
4924	49.25	41	74	-24.75	33.99	8.28	34.02	123	243	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2462 MHz: Fundamental frequency.

802.11g

EUT Test Condition		Measurement Detail	
Channel	Channel 1	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.92	50.73	49	54	-3.27	31.8	5.4	35.47	202	69	Average
2389.92	66.11	64.38	74	-7.89	31.8	5.4	35.47	202	69	Peak
2412	101.42	99.65			31.81	5.43	35.47	202	69	Average
2412	110.09	108.32			31.81	5.43	35.47	202	69	Peak
4824	38.52	30.39	54	-15.48	33.97	8.26	34.1	141	175	Average
4824	48.39	40.26	74	-25.61	33.97	8.26	34.1	141	175	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.83	44.41	42.68	54	-9.59	31.8	5.4	35.47	103	64	Average
2389.83	59.36	57.63	74	-14.64	31.8	5.4	35.47	103	64	Peak
2412	93.07	91.3			31.81	5.43	35.47	103	64	Average
2412	101.9	100.13			31.81	5.43	35.47	103	64	Peak
4824	38.17	30.04	54	-15.83	33.97	8.26	34.1	187	145	Average
4824	48.31	40.18	74	-25.69	33.97	8.26	34.1	187	145	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2412 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.83	52.99	51.26	54	-1.01	31.8	5.4	35.47	198	73	Average
2389.83	70.4	68.67	74	-3.6	31.8	5.4	35.47	198	73	Peak
2437	104.44	102.59			31.85	5.46	35.46	198	73	Average
2437	112.79	110.94			31.85	5.46	35.46	198	73	Peak
2483.52	51.15	49.19	54	-2.85	31.88	5.5	35.42	198	73	Average
2483.52	69.29	67.33	74	-4.71	31.88	5.5	35.42	198	73	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.92	46.35	44.62	54	-7.65	31.8	5.4	35.47	114	69	Average
2389.92	61.02	59.29	74	-12.98	31.8	5.4	35.47	114	69	Peak
2437	96.64	94.79			31.85	5.46	35.46	114	69	Average
2437	104.99	103.14			31.85	5.46	35.46	114	69	Peak
2483.88	42.86	40.9	54	-11.14	31.88	5.5	35.42	114	69	Average
2483.88	57.78	55.82	74	-16.22	31.88	5.5	35.42	114	69	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 11	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	101.01	99.08			31.87	5.5	35.44	191	74	Average
2462	109.58	107.65			31.87	5.5	35.44	191	74	Peak
2483.6	46.35	44.39	54	-7.65	31.88	5.5	35.42	191	74	Average
2483.6	64.36	62.4	74	-9.64	31.88	5.5	35.42	191	74	Peak
4924	38.33	30.08	54	-15.67	33.99	8.28	34.02	148	236	Average
4924	48.76	40.51	74	-25.24	33.99	8.28	34.02	148	236	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	92.51	90.58			31.87	5.5	35.44	111	69	Average
2462	100.7	98.77			31.87	5.5	35.44	111	69	Peak
2484.36	41.42	39.43	54	-12.58	31.88	5.53	35.42	111	69	Average
2484.36	52.71	50.72	74	-21.29	31.88	5.53	35.42	111	69	Peak
4924	38.61	30.36	54	-15.39	33.99	8.28	34.02	107	294	Average
4924	48.74	40.49	74	-25.26	33.99	8.28	34.02	107	294	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2462 MHz: Fundamental frequency.

802.11n (HT20)

EUT Test Condition		Measurement Detail	
Channel	Channel 1	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.92	52.07	50.34	54	-1.93	31.8	5.4	35.47	205	64	Average
2389.92	64.67	62.94	74	-9.33	31.8	5.4	35.47	205	64	Peak
2412	103.51	101.74			31.81	5.43	35.47	231	64	Average
2412	111.58	109.81			31.81	5.43	35.47	231	64	Peak
4824	38.58	30.45	54	-15.42	33.97	8.26	34.1	125	187	Average
4824	48.4	40.27	74	-25.6	33.97	8.26	34.1	125	187	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.65	45.17	43.46	54	-8.83	31.8	5.4	35.49	130	60	Average
2389.65	56.7	54.99	74	-17.3	31.8	5.4	35.49	130	60	Peak
2412	96.41	94.64			31.81	5.43	35.47	130	60	Average
2412	104.86	103.09			31.81	5.43	35.47	130	60	Peak
4824	39.01	30.88	54	-14.99	33.97	8.26	34.1	132	325	Average
4824	48.8	40.67	74	-25.2	33.97	8.26	34.1	132	325	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2412 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.74	48.18	46.47	54	-5.82	31.8	5.4	35.49	229	68	Average
2389.74	59.35	57.64	74	-14.65	31.8	5.4	35.49	229	68	Peak
2437	107.56	105.71			31.85	5.46	35.46	258	66	Average
2437	115.8	113.95			31.85	5.46	35.46	258	66	Peak
2483.56	45.2	43.24	54	-8.8	31.88	5.5	35.42	229	68	Average
2483.56	56.1	54.14	74	-17.9	31.88	5.5	35.42	229	68	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.2	42.2	40.49	54	-11.8	31.8	5.4	35.49	121	60	Average
2389.2	53.09	51.38	74	-20.91	31.8	5.4	35.49	121	60	Peak
2437	99.77	97.92			31.85	5.46	35.46	121	60	Average
2437	108.18	106.33			31.85	5.46	35.46	121	60	Peak
2483.92	42.17	40.21	54	-11.83	31.88	5.5	35.42	121	60	Average
2483.92	53.29	51.33	74	-20.71	31.88	5.5	35.42	121	60	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 11	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	104.15	102.22			31.87	5.5	35.44	258	66	Average
2462	111.85	109.92			31.87	5.5	35.44	258	66	Peak
2483.52	47.89	45.93	54	-6.11	31.88	5.5	35.42	258	66	Average
2483.52	61.01	59.05	74	-12.99	31.88	5.5	35.42	258	66	Peak
4924	38.29	30.04	54	-15.71	33.99	8.28	34.02	176	137	Average
4924	48.3	40.05	74	-25.7	33.99	8.28	34.02	176	137	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2462	96.8	94.87			31.87	5.5	35.44	104	60	Average
2462	104.39	102.46			31.87	5.5	35.44	104	60	Peak
2483.72	44.91	42.95	54	-9.09	31.88	5.5	35.42	104	60	Average
2483.72	55.85	53.89	74	-18.15	31.88	5.5	35.42	104	60	Peak
4924	38.46	30.21	54	-15.54	33.99	8.28	34.02	144	103	Average
4924	48.75	40.5	74	-25.25	33.99	8.28	34.02	144	103	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2462 MHz: Fundamental frequency.

802.11n (HT40)

EUT Test Condition		Measurement Detail	
Channel	Channel 3	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.83	50.75	49.02	54	-3.25	31.8	5.4	35.47	227	64	Average
2389.83	60.58	58.85	74	-13.42	31.8	5.4	35.47	227	64	Peak
2422	98.57	96.77			31.83	5.43	35.46	248	64	Average
2422	107.79	105.99			31.83	5.43	35.46	248	64	Peak
2483.56	44.19	42.23	54	-9.81	31.88	5.5	35.42	248	64	Average
2483.56	54.11	52.15	74	-19.89	31.88	5.5	35.42	248	64	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.92	44.07	42.34	54	-9.93	31.8	5.4	35.47	121	60	Average
2389.92	54.64	52.91	74	-19.36	31.8	5.4	35.47	121	60	Peak
2422	90.92	89.12			31.83	5.43	35.46	121	60	Average
2422	99.67	97.87			31.83	5.43	35.46	121	60	Peak
2483.64	42.04	40.08	54	-11.96	31.88	5.5	35.42	121	60	Average
2483.64	52.63	50.67	74	-21.37	31.88	5.5	35.42	121	60	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2422 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 6	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.92	50.8	49.07	54	-3.2	31.8	5.4	35.47	249	43	Average
2389.92	64.94	63.21	74	-9.06	31.8	5.4	35.47	249	43	Peak
2437	100.31	98.46			31.85	5.46	35.46	258	66	Average
2437	109.35	107.5			31.85	5.46	35.46	258	66	Peak
2483.6	45.97	44.01	54	-8.03	31.88	5.5	35.42	249	43	Average
2483.6	57.29	55.33	74	-16.71	31.88	5.5	35.42	249	43	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.38	44.22	42.51	54	-9.78	31.8	5.4	35.49	157	60	Average
2389.38	57.29	55.58	74	-16.71	31.8	5.4	35.49	157	60	Peak
2437	93.42	91.57			31.85	5.46	35.46	161	60	Average
2437	101.9	100.05			31.85	5.46	35.46	161	60	Peak
2483.68	41.04	39.08	54	-12.96	31.88	5.5	35.42	161	60	Average
2483.68	52.35	50.39	74	-21.65	31.88	5.5	35.42	161	60	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2437 MHz: Fundamental frequency.

EUT Test Condition		Measurement Detail	
Channel	Channel 9	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	Karl Lee

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2389.38	44.77	43.06	54	-9.23	31.8	5.4	35.49	253	66	Average
2389.38	54.75	53.04	74	-19.25	31.8	5.4	35.49	253	66	Peak
2452	99.63	97.76			31.85	5.46	35.44	253	66	Average
2452	107.68	105.81			31.85	5.46	35.44	253	66	Peak
2483.72	49.73	47.77	54	-4.27	31.88	5.5	35.42	273	59	Average
2483.72	59.69	57.73	74	-14.31	31.88	5.5	35.42	273	59	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
2374.62	41.41	39.75	54	-12.59	31.78	5.37	35.49	114	60	Average
2374.62	51.67	50.01	74	-22.33	31.78	5.37	35.49	114	60	Peak
2452	91.34	89.47			31.85	5.46	35.44	114	60	Average
2452	99.89	98.02			31.85	5.46	35.44	114	60	Peak
2485.56	44.37	42.38	54	-9.63	31.88	5.53	35.42	114	60	Average
2485.56	54.52	52.53	74	-19.48	31.88	5.53	35.42	114	60	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 2452 MHz: 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:

802.11g

EUT Test Condition		Measurement Detail	
Channel	Channel 6	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

Antennal Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
101.82	22.02	40.66	43.5	-21.48	12.34	1.28	32.26	137	125	Peak
146.91	14.36	36.72	43.5	-29.14	8.39	1.52	32.27	164	216	Peak
225.48	22.72	41.47	46	-23.28	11.59	1.85	32.19	137	354	Peak
416.9	14.98	29.57	46	-31.02	15.2	2.41	32.2	136	137	Peak
549.2	16.15	28.53	46	-29.85	17.06	2.76	32.2	146	107	Peak
760.6	20.2	29.19	46	-25.8	19.92	3.22	32.13	198	254	Peak
Antennal Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
54.84	18.06	35.25	40	-21.94	14.14	0.9	32.23	197	326	Peak
85.08	17.06	38.72	40	-22.94	9.19	1.11	31.96	157	128	Peak
232.5	15.27	33.73	46	-30.73	11.86	1.85	32.17	166	204	Peak
382.6	16.15	31.33	46	-29.85	14.65	2.34	32.17	134	216	Peak
566	17.57	29.55	46	-28.43	17.4	2.82	32.2	177	268	Peak
750.8	18.99	28.09	46	-27.01	19.82	3.22	32.14	185	279	Peak

Remarks:

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

Margin value = Emission level – Limit value

4.2 Conducted Output Power Measurement

4.2.1 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,

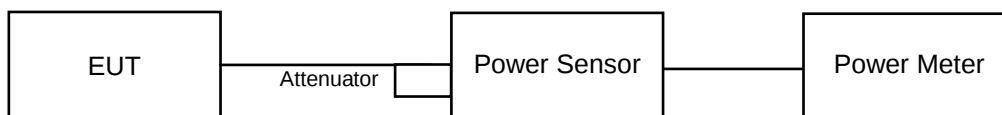
Array Gain = 0 dB (i.e., no array gain) for $NANT \leq 4$;

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 $NANT \geq 5$.

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

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 Test Procedures

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

4.2.5 Deviation from Test Standard

No deviation.

4.2.6 EUT Operating Conditions

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

4.2.7 Test Results

802.11b

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	149.62	21.75	30	Pass
6	2437	173.38	22.39	30	Pass
11	2462	165.58	22.19	30	Pass

802.11g

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	129.42	21.12	30	Pass
6	2437	215.77	23.34	30	Pass
11	2462	136.46	21.35	30	Pass

802.11n (HT20)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	15.54	15.67	72.78	18.62	30	Pass
6	2437	19.45	19.71	181.55	22.59	30	Pass
11	2462	16.12	16.34	83.95	19.24	30	Pass

802.11n (HT40)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	14.34	14.55	55.72	17.46	30	Pass
6	2437	16.71	16.98	96.83	19.86	30	Pass
9	2452	14.98	15.15	64.27	18.08	30	Pass

5 Pictures of Test Arrangements

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

Appendix – Information on 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:

Linko 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

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

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

--- END ---