

**FCC 15.407 NII
(Class II Permissive Change)
5 GHz Test Report**

for

LG Electronics Inc.

**222, LG-ro Jinwi-myeon, Pyeongtaek-Si, Gyeonggi-Do,
451-713, Korea**

Product Name : Wi-Fi module
Model Name : WN8122E1
Brand : LG
FCC ID : BEJWN8122E1

**Prepared by: : AUDIX Technology Corporation,
EMC Department**



The test report is based on a single evaluation of one sample of the above-mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, TAF or any agency of the Federal Government.

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APPENDIX A TEST DATA AND PLOTS

APPENDIX B TEST PHOTOGRAPHS

TEST REPORT CERTIFICATION (Class II Permissive Change)

Applicant : LG Electronics Inc.
Factory : Compal Networking (Kunshan) Co., Ltd.
EUT Description
(1) Product : Wi-Fi module
(2) Model : WN8122E1
(3) Brand : LG
(4) Power Supply: DC 3.3V

Applicable Standards:

47 CFR FCC Part 15 Subpart E

ANSI C63.10:2013

KDB 789033 D02 General UNII Test Procedures New Rules v01r04

Audix Technology Corp. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Audix Technology Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Report: 2018. 02. 08

Reviewed by:

Annie Yu (Annie Yu/Administrator)

Approved by:

Ben Cheng (Ben Cheng/Manager)

1. REVISION RECORD OF TEST REPORT

Edition No	Issued Data	Revision Summary	Report Number
0	2018. 02. 08	Original Report	EM-F180034

2. SUMMARY OF TEST RESULTS

Rule	Description	Results
15.207	Conducted Emission	N/A, Note
15.205	Radiated Band Edge and Radiated Spurious Emission	PASS
15.407(a)(5)/15.407(e)	Emission Bandwidth Measurement	PASS
15.407(a)	Maximum Output	PASS
15.407(b)	Conducted Band Edges and Conducted Spurious Emission	PASS
15.407(a)	Power Spectral Density	PASS
15.203	Antenna Requirement	Compliance
Note: The Class II Change Permissive is not influence on this test.		

3. GENERAL INFORMATION

3.1. Description of Application

Applicant	LG Electronics Inc. 222, LG-ro Jinwi-myeon, Pyeongtaek-Si, Gyeonggi-Do, 451-713, Korea
Factory	Compal Networking (Kunshan) Co., Ltd. No.520, Nanbang Rd., Economic & Technical Development Zone, Kunshan, Jiangsu Province, China.
Product	Wi-Fi module
Model	WN8122E1
Brand	LG

3.2. Description of EUT

Test Model	WN8122E1																		
Serial Number	N/A																		
Power Rating	DC 3.3V																		
RF Features	802.11 a/b/g/n																		
Transmit Type	<table><tr><th colspan="2">2.4 GHz</th></tr><tr><td>802.11b</td><td>1T1R</td></tr><tr><td>802.11g</td><td>1T1R</td></tr><tr><td>802.11n-HT20</td><td>2T2R</td></tr><tr><td>802.11n-HT40</td><td>2T2R</td></tr><tr><th colspan="2">UNII Bands</th></tr><tr><td>802.11a</td><td>2T2R</td></tr><tr><td>802.11n-HT20</td><td>2T2R</td></tr><tr><td>802.11n-HT40</td><td>2T2R</td></tr></table>	2.4 GHz		802.11b	1T1R	802.11g	1T1R	802.11n-HT20	2T2R	802.11n-HT40	2T2R	UNII Bands		802.11a	2T2R	802.11n-HT20	2T2R	802.11n-HT40	2T2R
2.4 GHz																			
802.11b	1T1R																		
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802.11n-HT40	2T2R																		
UNII Bands																			
802.11a	2T2R																		
802.11n-HT20	2T2R																		
802.11n-HT40	2T2R																		
Device Category	☐ Outdoor Access Point ☐ Fixed point-to-point Access Point ☐ Indoor Access Point ☒ Mobile and Portable client device																		
Sample Status	Production																		
Date of Receipt	2018. 01. 30																		
Date of Test	2018. 01. 31 ~ 02. 08																		
Interface Ports of EUT	None																		
Accessories Supplied	None																		
Information for Class II Change Permissive	The EUT is an addition version with original FCC ID: BEJWN8122E1. The difference with original report is as follow: 1. To apply U-NII band III for new rule (Reference FCC FIRST report and order: FCC 14-30).																		

3.3. Antenna Information

No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Max Gain (dBi)
1.	Ant./120800003400J	arcadyan	PIFA Antenna	2.4GHz	-0.91dBi (peak)
				2.45GHz	-0.79dBi (peak)
				2.5GHz	-0.68dBi (peak)
				5.15GHz	0.47dBi (peak)
				5.25GHz	0.54dBi (peak)
				5.35GHz	0.12dBi (peak)
				5.47GHz	-0.84dBi (peak)
				5.725GHz	0.00dBi (peak)
				5.85GHz	0.52dBi (peak)
2.	Ant./120800003500J	arcadyan	PIFA Antenna	2.4GHz	-1.46dBi (peak)
				2.45GHz	-1.54dBi (peak)
				2.5GHz	-1.29dBi (peak)
				5.15GHz	0.62dBi (peak)
				5.25GHz	0.57dBi (peak)
				5.35GHz	0.50dBi (peak)
				5.47GHz	-0.18dBi (peak)
				5.725GHz	-0.77dBi (peak)
				5.85GHz	-0.51dBi (peak)

3.4. EUT Specifications Assessed in Current Report

Mode	UNII Band	Fundamental Range (MHz)	Channel Number
802.11a	III	5745-5825	5
802.11n-HT20	III	5745-5825	5
802.11n-HT40	III	5755-5795	2

Mode	Modulation	Data Rate (Mbps)
802.11a	OFDM (BPSK/QPSK/16QAM/64QAM)	Up to 54
802.11n-HT20	OFDM (BPSK/QPSK/16QAM/64QAM)	Up to 144.4
802.11n-HT40		Up to 300

Channel List					
802.11a/802.11n-HT20			802.11n-HT40		
UNII Band	Channel Number	Frequency (MHz)	UNII Band	Channel Number	Frequency (MHz)
III	149	5745	III	151	5755
	153	5765		159	5795
	157	5785			
	161	5805			
	165	5825			

Note Test modes are presented at section 3.8.

3.5. Description of Key Components

None

3.6. Data Rate Relative to Output Power

802.11a				802.11n-HT20			
Channel	Modulation	Date Rate	Power (dBm)	Channel	Modulation	Date Rate	Power (dBm)
149	BPSK	6	19.42	149	BPSK	6.5	19.36
149	BPSK	9	19.37	149	QPSK	13	19.22
149	QPSK	12	19.33	149	QPSK	19.5	19.24
149	QPSK	18	19.28	149	16-QAM	26	19.27
149	16-QAM	24	19.40	149	16-QAM	39	19.24
149	16-QAM	36	19.28	149	64-QAM	52	19.28
149	64-QAM	48	19.32	149	64-QAM	58.6	19.30
149	64-QAM	54	19.39	149	64-QAM	65	19.32

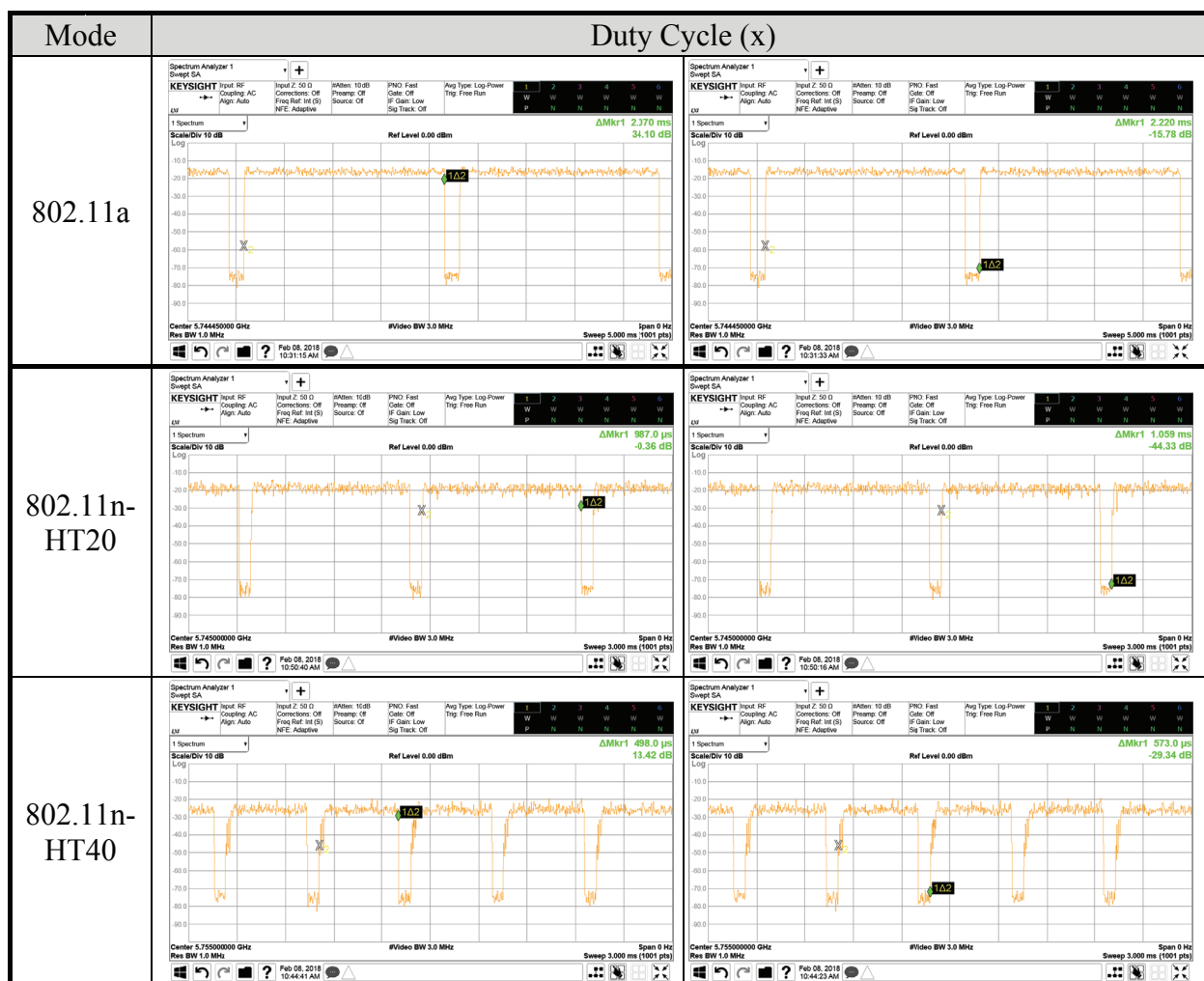
802.11n-HT40			
Channel	Modulation	Date Rate	Power (dBm)
151	BPSK	13.5	19.54
151	QPSK	27	19.50
151	QPSK	40.5	19.47
151	16-QAM	54	19.51
151	16-QAM	81	19.49
151	64-QAM	108	19.47
151	64-QAM	121.5	19.43
151	64-QAM	135	19.51

Note: Above results are assessed in average power.

3.7. Test Configuration

Mode	Duty Cycle (x)	T (ms)	Duty Cycle Factor (dB)
802.11a	0.93	2.070	0.32
802.11n-HT20	0.93	0.987	0.32
802.11n-HT40	0.87	0.498	0.60

Note: When duty cycle is less than 98% (0.98) that duty cycle factor 10log(1/x) is needed to add in conducted test items measured in average detector.



AC Conduction

Test Case	Normal operation
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Item		Mode	Data Rate	Test Channel
Radiated Test Case	Radiated Spurious Emission ^{Note 1 & 2}	802.11a	6 Mbps	149
		802.11n-HT20	HT MCS8	151
		802.11n-HT40	HT MCS8	157
Conducted Test Case	Emission Bandwidth	802.11a	6 Mbps	149/157/165
		802.11n-HT20	HT MCS8	149/157/165
		802.11n-HT40	HT MCS8	151/159
	Maximum output power	802.11a	6 Mbps	149/157/165
		802.11n-HT20	HT MCS8	149/157/165
		802.11n-HT40	HT MCS8	151/159
	Emission Limitations	802.11a	6 Mbps	149/157/165
		802.11n-HT20	HT MCS8	149/157/165
		802.11n-HT40	HT MCS8	151/159
	Power spectral density	802.11a	6 Mbps	149/157/165
		802.11n-HT20	HT MCS8	149/157/165
		802.11n-HT40	HT MCS8	151/159

Note 1: ☐ Mobile Device☒ Portable Device, and 3 axis were assessed. The worst scenario for Radiated Spurious Emission as follow: ☒ Lie ☐ Side ☐ Stand

Note 2: Low, mid, and high channels were measured, only the worst channel of each modulation was presented in this report.

3.8. Tested Supporting System List

3.8.1. Support Peripheral Unit

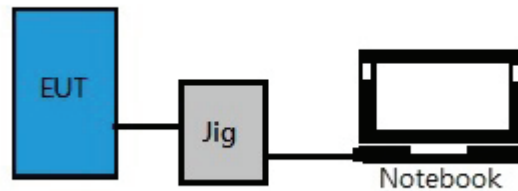
No.	Product	Brand	Model No.	Serial No.	Approval
1.	Notebook PC	ASUS	ASUS N20A	N/A	FCC ID: TLZ-BT253
2.	Test JIG	N/A	N/A	N/A	N/A

3.8.2. Cable Lists

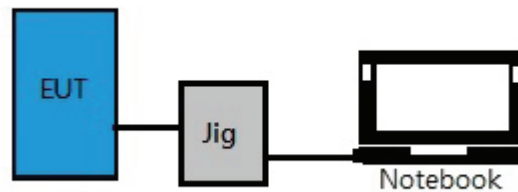
No.	Cable Description Of The Above Support Units
1.	Adapter: ACBEL, M/N AA90PM111 DC Cord: Shielded, Undetachable, 1.8m, Bonded a ferrite core AC Power Cord: Unshielded, Detachable, 1.8m
2.	Bus Cable: Unshielded, Undetachable, 0.3m

3.9. Setup Configuration

3.9.1. EUT Configuration for Power Line & Radiated Emission



3.9.2. EUT Configuration for RF Conducted Test Items



3.10. Operating Condition of EUT

Test program “cmd” is used for enabling EUT RF function under continues transmitting and choosing channel.

3.11. Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: attemc_report@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2005 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724 (3) FCC OET Designation No. TW1004 & TW1090 & TW1724
Test Facilities	(1) Semi-Anechoic Chamber (IC Test Site Registration No.: 5183B-1) (2) Fully Anechoic Chamber (IC Test Site Registration No.: 5183B-4)

3.12. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Radiation Test (Distance: 3m)	30MHz~1000MHz	± 3.68dB
	Above 1GHz	± 5.82dB

Remark : Uncertainty = $ku_c(y)$

Test Item	Uncertainty
Emission Bandwidth	± 0.2kHz
Maximum output power	± 0.33dB
Power spectral density	± 0.13dB
Conducted Emission Limitations	± 0.13dB

4. MEASUREMENT EQUIPMENT LIST

4.1. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2017. 09. 13	1 Year
2.	Spectrum Analyzer	R&S	FSV40	101425	2017. 11. 16	1 Year
3.	Test Receiver	R & S	ESCS30	100338	2017. 06. 19	1 Year
4.	Amplifier	HP	8447D	2944A06305	2017. 02. 16	1 Year
5.	Amplifier	HP	8449B	3008A02678	2017. 03. 06	1 Year
6.	Bilog Antenna	CHASE	CBL6112D	33821	2018. 01. 21	1 Year
7.	Loop Antenna	R&S	HFH2-Z2	891847/27	2017. 12. 18	1 Year
8.	Double-Ridged Waveguide Horn	ETS-Lindgren	3117	00135902	2017. 03. 08	1 Year
9.	Horn Antenna	COM-POWER	AH-840	101092	2017. 05. 04	1 Year
10.	5G Notch Filter	Microwave Circuits	N0257881	459776	2017. 02. 03	1 Year
11.	Test Software	Audix	e3	V.6.110601	N.C.R.	N.C.R.

4.2. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9010B-544	MY55460198	2017. 04. 18	1 Year

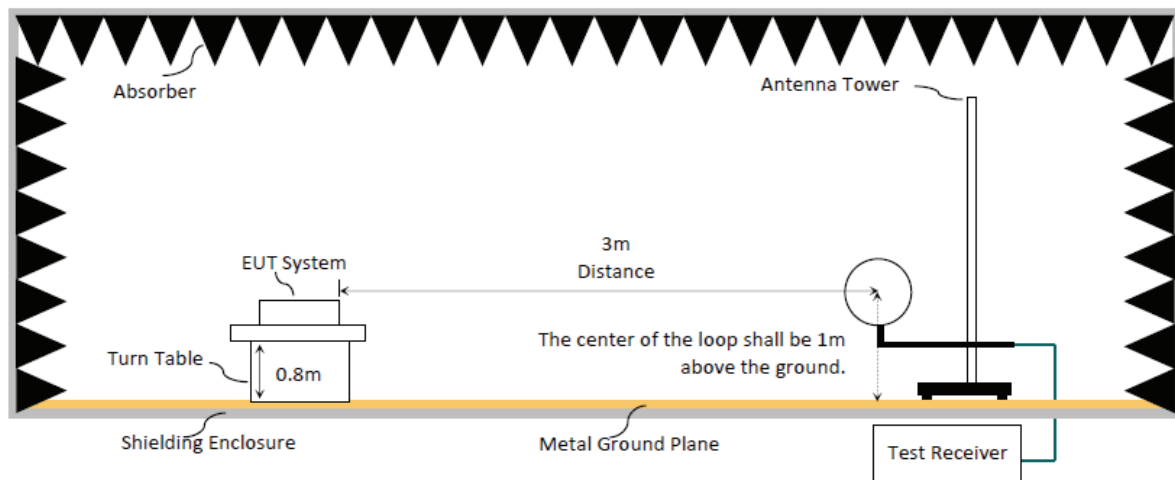
5. RADIATED EMISSION

5.1. Block Diagram of Test Setup

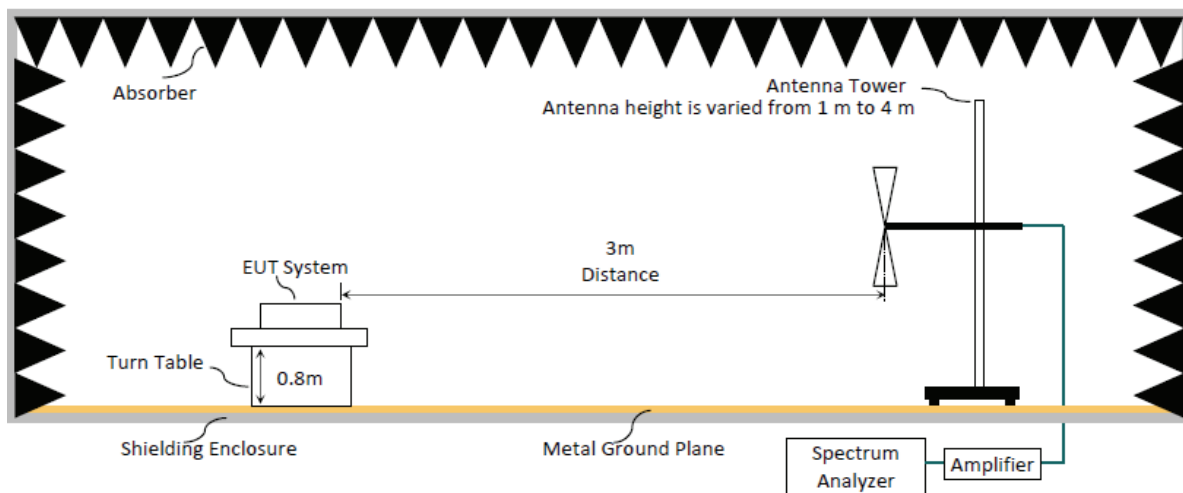
5.1.1. Block Diagram of EUT

Indicated as section 3.10

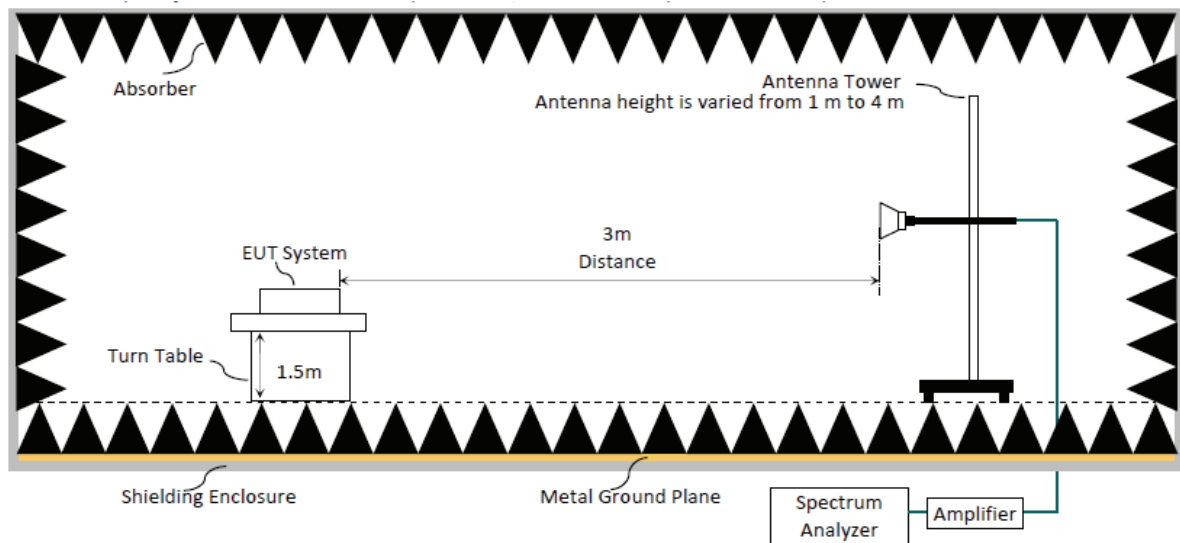
5.1.2. Setup Diagram for 9kHz-30MHz



5.1.3. Setup Diagram for 30-1000 MHz



5.1.4. Setup Diagram for above 1GHz



5.2. Radiated Emission Limits

Radiated emissions fall in restricted bands, as defined in Section 15.205 must be in compliance with the radiated emission limits specified in 15.209 as below.

5.2.1. General Limit

Frequency (MHz)	Distance (m)	Limits	
		dB μ V/m	μ V/m
0.009 - 0.490	300	67.6	2400/kHz
0.490 - 1.705	30	87.6	24000/kHz
1.705 - 30	30	29.5	30
30 - 88	3	40.0	100
88- 216	3	43.5	150
216- 960	3	46.0	200
Above 960	3	54.0	500
Above 1000	3	74.0 dB μ V/m (Peak) 54.0 dB μ V/m (Average)	

Remark : (1) dB μ V/m = 20 log (μ V/m)

(2) The tighter limit applies to the edge between two frequency bands.

(3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

(4) Fundamental and emission fall within operation band are exempted from this section.

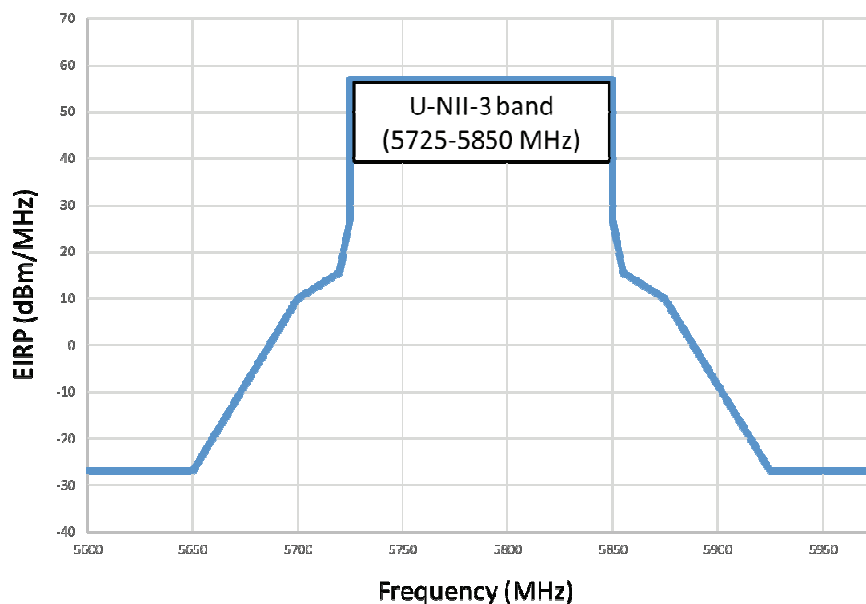
(5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

5.2.2. Limit for non-restricted frequency above 1 GHz

Frequency Band (MHz)	E.I.R.P. Limit	Field Strength Limit at 3 m
5150 to 5250	-27 dBm	68.2
5250 to 5350		68.2
5470 to 5725		68.2

Note: Field Strength at 3 m= E.I.R.P. + 95.2 dB

Frequency Band (MHz)	Field Strength Limit at 3 m	
5725 to 5850	☒	15.407(b)(4)(i) All emissions shall be limited to a level of 68.2 dB μ V/m at 75 MHz or more above or below the band edge increasing linearly to 105.2dB μ V/m at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 110.8 dB μ V/m at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 68.2 dB μ V/m at the band edge.
	☐	15.407(b)(4)(ii) ,compliance with the emission limits in § 15.247(d) Shall be at least 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power,. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))



5.3. Test Procedure

Frequency Range 9kHz~30MHz:

The EUT setup on the turn table which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

(1) RBW = 9kHz with peak and average detector.

(2) Detector: average and peak (9kHz-490kHz)

Q.P. (490kHz-30MHz)

Frequency Range 30MHz ~ 40GHz:

The EUT setup on the turn table which has 80 cm (for 30-1000 MHz) and 1.5m (for above 1GHz) height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

Frequency below 1 GHz:

Spectrum Analyzer is used for pre-testing with following setting:

(1) RBW = 120KHz

(2) VBW $\geq 3 \times$ RBW.

(3) Detector = Peak.

(4) Sweep time = auto.

(5) Trace mode = max hold.

(6) Allow sweeps to continue until the trace stabilizes.

(7) When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required. Otherwise using Q.P. for finally measurement.

Frequency above 1GHz to 10th harmonic (up to 40 GHz):**Peak Detector:**

(1) RBW = 1MHz

(2) VBW $\geq 3 \times$ RBW.

(3) Detector = Peak.

(4) Sweep time = auto.

(5) Trace mode = max hold.

(6) Allow sweeps to continue until the trace stabilizes.

(7) When peak-detected value is lower than limit that the measurement using the average detector is not required. Otherwise using average detector for finally measurement.

Average Detector:☒ **Option 1:**

(1) RBW = 1MHz

(2) VBW $\geq 1/T$.

Modulation Type	T (ms)	1/T (kHz)	VBW Setting (kHz)
802.11a	2.070	0.483	470Hz
802.11n-HT20	0.987	1.014	1kHz
802.11n-HT40	0.498	2.008	2kHz

N/A: 1/T is not implemented when duty cycle presented in section 3.7 is $\geq 98\%$.

(1) Detector = Peak.

(2) Sweep time = auto.

(3) Trace mode = max hold.

(4) Allow sweeps to continue until the trace stabilizes.

☐ **Option 2:**

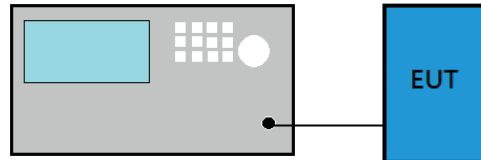
Average Emission Level = Peak Emission Level + D.C.C.F.

5.4. Measurement Result Explanation☒ Peak Emission Level = Antenna Factor + Cable Loss + Meter Reading☒ Average Emission Level = Antenna Factor + Cable Loss + Meter Reading☐ Average Emission Level = Peak Emission Level + DCCFDuty Cycle Correction Factor (DCCF) = $20\log(TX_{on}/TX_{on+off})$ presented in section 3.7☐ ERP = Peak Emission Level - 95.2dB - 2.14dB**5.5. Test Results**

Please refer to Appendix A.

6. EMISSION BANDWIDTH

6.1. Block Diagram of Test Setup



6.2. Specification Limits

Frequency Band (MHz)	Limit
5150 to 5250	Reference only
5250 to 5350	
5470 to 5725	
5725 to 5850	$\geq 500\text{kHz}$

6.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v01r04:

■ Applicable to all bands except to 5725 MHz- 5850 MHz

- (1) Set RBW= 1% of the emission bandwidth
- (2) Set VBW > RBW
- (3) Detector = Peak
- (4) Trace mode = max hold
- (5) Setting channel bandwidth function x dB to -26 dB to record the final bandwidth.

■ 5725 MHz- 5850 MHz

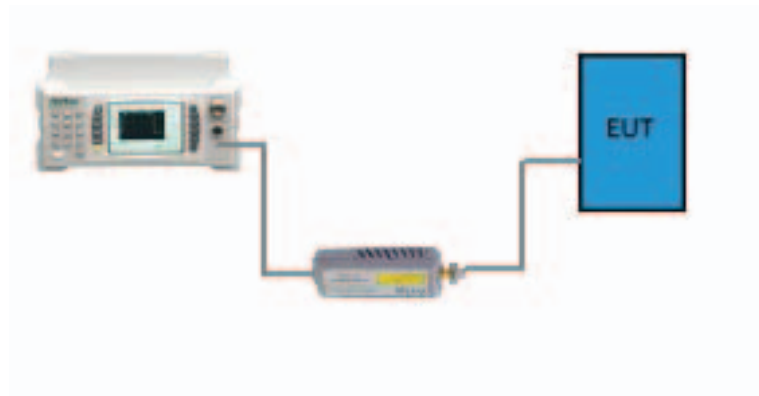
- (1) Set RBW = 100 kHz.
- (2) Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$.
- (3) Detector = Peak.
- (4) Trace mode = max hold.
- (5) Sweep = auto couple.
- (6) Allow the trace to stabilize.
- (7) Setting channel bandwidth function x dB to -6 dB to record the final bandwidth.

6.4. Test Results

Please refer to Appendix A

7. MAXIMUM OUTPUT POWER

7.1. Block Diagram of Test Setup



7.2. Specification Limits

Frequency Band (MHz)	Category	Limit
5150 to 5250	Outdoor Access Point	1 W(30 dBm)/ Max e.i.r.p. ≤ 125 mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon
	Fixed point-to-point Access Point	1 W(30 dBm)
	Indoor Access Point	1 W(30 dBm)
	Mobile and Portable client device	250 mW(24 dBm)
5250 to 5350	N/A	250 mW or $11 \text{ dBm} + 10 \log B$ ^{Note1}
5470 to 5725		250 mW or $11 \text{ dBm} + 10 \log B$ ^{Note1}
5725 to 5850		1 W(30 dBm)

Note 1: B is the 26 dB emission bandwidth, which presented in section 7 and appendix A.1.

7.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v01r04:

■ **Method AVGPM (Measurement using an RF average power meter):**

EUT is connected to power sensor and record the maximum average output power and duty cycle factor is added when duty cycle presented in section 3.7 is < 98%.

□ **Method AVGSA-2 (Spectrum channel power)**

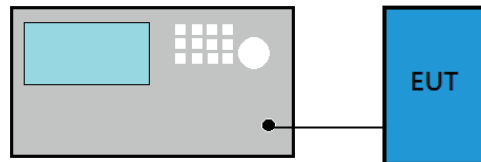
- (1) Set span to at least 1.5 times the OBW
- (2) Set RBW = 1 MHz
- (3) Set the video bandwidth (VBW) $\geq$ 3 MHz.
- (4) Detector = RMS.
- (5) Trace mode = trace average at least 100 traces
- (6) Sweep = auto couple.
- (7) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.
- (8) Duty cycle factor is added when duty cycle presented in section 3.7 is < 98%.

7.4. Test Results

Please refer to Appendix A

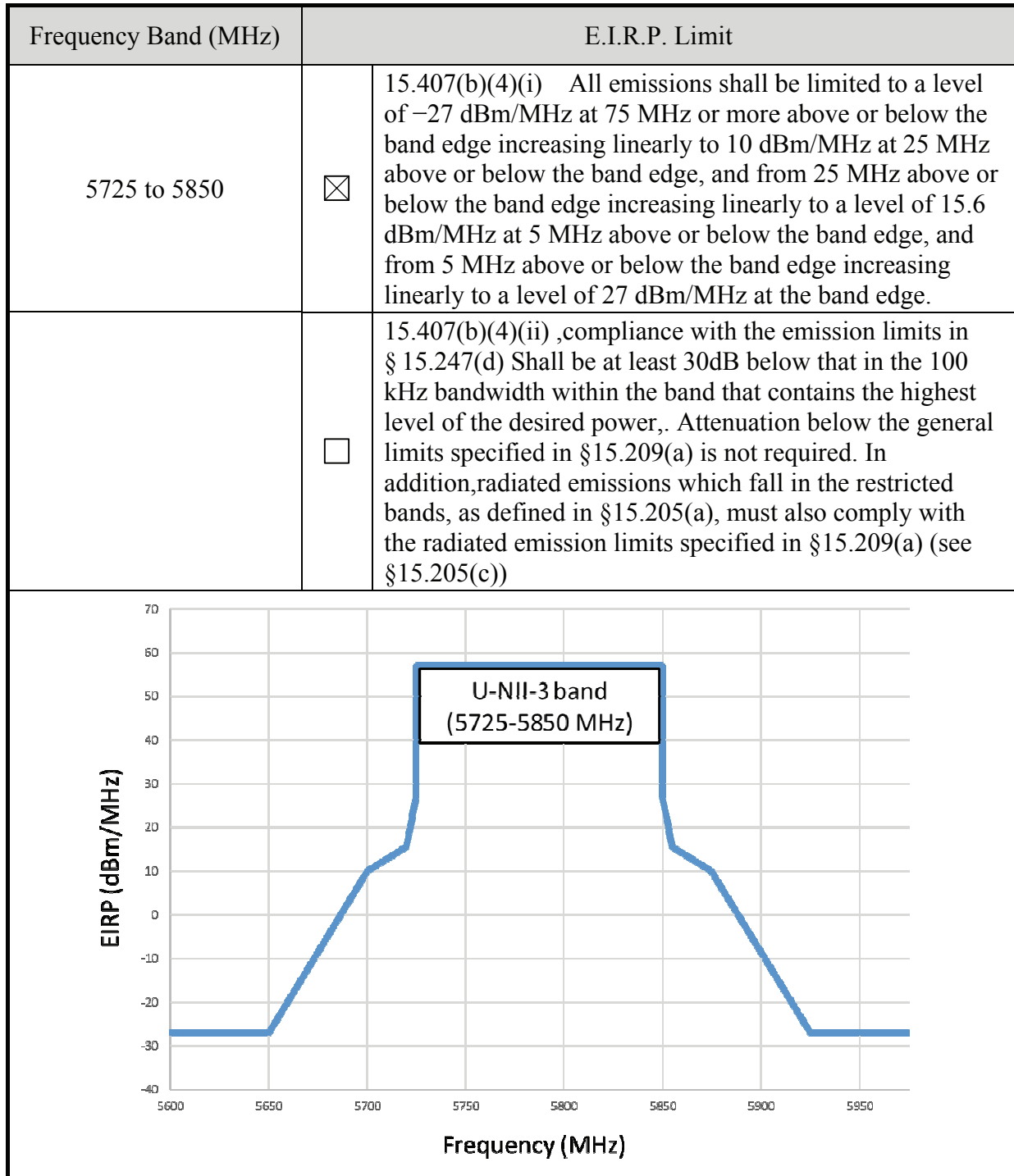
8. EMISSION LIMITATIONS MEASUREMENT

8.1. Block Diagram of Test Setup



8.2. Specification Limits

Frequency Band (MHz)	E.I.R.P. Limit
5150 to 5250	-27 dBm
5250 to 5350	
5470 to 5725	



8.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v01r04:

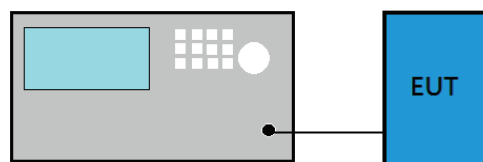
- (1) RBW = 1 MHz
- (2) VBW $\geq 3 \times$ RBW
- (3) Detector = Peak
- (4) Sweep time = auto
- (5) Trace mode = max hold
- (6) Allow sweeps to continue until the trace stabilizes.

8.4. Test Results

Please refer to Appendix A

9. POWER SPECTRAL DENSITY

9.1. Block Diagram of Test Setup



9.2. Specification Limits

Frequency Band (MHz)	Category	Limit
5150 to 5250	Outdoor Access Point	17dBm
	Fixed point-to-point Access Point	
	Indoor Access Point	
	Mobile and Portable client device	11 dBm/MHz
5250 to 5350	N/A	11 dBm/MHz
5470 to 5725		11 dBm/MHz
5725 to 5850		30dBm/500 kHz

9.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v01r04:

■ Method AVGSA-2 (Spectrum channel power)

- (1) Set span to at least 1.5 times the OBW
- (2) Set RBW = 1 MHz
- (3) Set the video bandwidth (VBW) ≥ 3 MHz.
- (4) Detector = RMS.
- (5) Trace mode = trace average at least 100 traces
- (6) Sweep = auto couple.
- (7) Use peak search function to find out the maximum power density.
- (8) Duty cycle factor is added when duty cycle presented in section 3.7 is $< 98\%$.

9.4. Test Results

Please refer to Appendix A

10.DEVIATION TO TEST SPECIFICATIONS

【NONE】



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APPDNDIX A

TEST DATA AND PLOTS

(Model: WN8122E1)



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APPENDIX B

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APPDNDIX B

TEST PHOTOGRAPHS

(Model: WN8122E1)