Audix Technology Corp.
No. 491, Zhongfu Rd., Linkou Dist.,
New Taipei City244,Taiwan

Tel: +886 2 26099301
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FCC 15.407 U-NII
5GHz Test Report

for

LG Electronics Inc.

222, LG-ro, Jinwi-myeon Pyeongtaek-Si, Gyeonggi-Do, 17709 Republic of Korea

Product Name	**:**	**Notebook Computer**
Model Name	**:**	**(1)15Z90RT (2)15ZB90RT (3)15ZD90RT (4)15ZG90RT**
Brand		**LG**
FCC ID	**:**	**BEJ-15Z90RT**

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

Testing Laboratory
1724

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.

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TEST REPORT

Applicant	:	LG Electronics Inc.
Manufacturer	:	LG Electronics Inc.
Factory	:	LG Electronics Nanjing New Technology Co., Ltd.
EUT Description		
(1) Product	:	Notebook Computer
(2) Model	:	(1)15Z90RT (2)15ZB90RT (3)15ZD90RT (4)15ZG90RT
(3) Brand	:	LG
(4) Power Supply	:	DC 20V, 3.25A

Applicable Standards:

Title 47 FCC CFR Part 15 Subpart E

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: 2023. 02. 13

Reviewed by: Annie Yu (Annie Yu/Administrator)

Approved by: Johnny Hsueh (Johnny Hsueh/Section Manager)

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1. REVISION RECORD OF TEST REPORT

Edition No	Issued Date	Revision Summary	Report Number
0	2023. 02. 13	Original Report	EM-F230115

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2. SUMMARY OF TEST RESULTS

Rule	Description	Results
15.207	Conducted Emission	**PASS**
15.205/15.209	Undesirable Emissions Limits: Radiated Band Edge and Radiated Spurious Emission	**PASS**
15.407(a)(5)/15.407(e)	Emission/Occupied Bandwidth	**PASS**
15.407(a)	Maximum Output Power	**PASS**
15.407(b)	Conducted Band Edges	**N/A**
15.407(a)	Power Spectral Density	**PASS**
15.407	Frequency Stability	**PASS**
15.407(h)(2)	Dynamic Frequency Selection(DFS)	**N/A**
15.203	Antenna Requirement	**Compliance**
Note: The uncertainties value is not used in determining the result.		

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3. GENERAL INFORMATION

3.1. Description of Application

Applicant	LG Electronics Inc. 222, LG-ro, Jinwi-myeon Pyeongtaek-Si, Gyeonggi-Do, 17709 Republic of Korea
Manufacturer	LG Electronics Inc. 222, LG-ro, Jinwi-myeon Pyeongtaek-Si, Gyeonggi-Do, 17709 Republic of Korea
Factory	Wistron NeWeb (Kunshan) Corporation 789 Yujinxiang Road, Comprehensive Free Trade Zone, Kunshan City, Jiangsu Province, Province 215300, P.R.C
Product	Notebook Computer
Model	(1)15Z90RT (2)15ZB90RT (3)15ZD90RT (4)15ZG90RT
Brand	LG

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3.2. Description of EUT

<table>
<tr><td>Test Model</td><td>15Z90RT</td></tr>
<tr><td>Serial Number</td><td>N/A</td></tr>
<tr><td>Power Rating</td><td>DC 20V, 3.25A</td></tr>
<tr><td>Software Version</td><td>XY (X, Y can be 0 to 9 for different SW version not influence RF parameter)</td></tr>
<tr><td>RF Features</td><td>WLAN:802.11 a/b/g/n/ac/ax
Bluetooth: BT and BLE (BT 5.1)</td></tr>
<tr><td>Transmit Type</td><td>
<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><td>802.11ax-HE20</td><td>2T2R</td></tr>
<tr><td>802.11ax-HE40</td><td>2T2R</td></tr>
<tr><td>BT/BLE</td><td>1T1R</td></tr>
</table>
<table>
<tr><th colspan="2">U-NII Bands</th></tr>
<tr><td>802.11a</td><td>1T1R</td></tr>
<tr><td>802.11n-HT20/802.11ac-VHT20/802.11ax-HE20</td><td>2T2R</td></tr>
<tr><td>802.11n-HT40/802.11ac-VHT40/802.11ax-HE40</td><td>2T2R</td></tr>
<tr><td>802.11ac-VHT80/802.11ax-HE80</td><td>2T2R</td></tr>
<tr><td>802.11ac-VHT160/802.11ax-HE160</td><td>2T2R</td></tr>
</table>
The MIMO is uncorrelated and supported SDM (Spatial Division Multiplexing) mode only. This radio device doesn't support beamforming and Cyclic Delay Diversity (CDD).
</td></tr>
<tr><td>Device Category</td><td>☐Outdoor Access Point
☐Fixed point-to-point Access Point
☐Indoor Access Point
■Mobile and Portable client device</td></tr>
<tr><td>Test Sample</td><td>
<table>
<tr><th>Sample No.</th><th>Test Item</th><th>Firmware</th></tr>
<tr><td>02</td><td>AC Conduction, RSE, RF Conducted</td><td>N/A</td></tr>
</table>
</td></tr>
<tr><td>Sample Status</td><td>Trial sample</td></tr>
<tr><td>Date of Receipt</td><td>2023. 01. 05</td></tr>
<tr><td>Date of Test</td><td>2023. 01. 12 ~ 02. 08</td></tr>
<tr><td>Interface Ports of EUT</td><td>• Three USB Type C Port
• One Earphone Port</td></tr>
<tr><td>Accessories Supplied</td><td>• AC Adapter
• USB C Cable
• LAN Gender</td></tr>
</table>

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3.3. Reference Test Guidance

KDB 789033 D02 General UNII Test Procedures New Rules v02r01
KDB 291074 D02 EMC Measurement v01
ANSI C63.10:2013

3.4. Antenna Information

No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Gain(dBi)	
					Main	AUX
1.	WA-P-LELE-04-044	INPAQ	Mono-Pole	2400	3.20	3.70
				2450	3.60	3.90
				2500	3.30	4.20
				5150	1.90	2.40
				5470	2.70	1.10
				5850	1.30	1.10
				5925	1.60	1.60
				6525	-0.50	0.30
				7125	3.90	3.00

According to KDB 662911 D01 d) ii), transmit signals are completely uncorrelated, then
Directional gain = $10 \log[(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10})/N_{ANT}]$ dBi
Note: WLAN 5G: Directional gain =
5850MHz: Directional gain = $10 \log[(10^{1.3/10} + 10^{1.1/10})/2]$= 1.20dBi
We chose the antenna gain corresponding to the frequency listed on the table which is closer to center frequency of WLAN/BT.

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3.5. EUT Specifications Assessed in Current Report

Mode	U-NII Band	Fundamental Range (MHz)	Channel Number
802.11a	4	5850-5895	3
802.11n-HT20/ 802.11ac-VHT20 802.11ax-HE20	4	5850-5895	3
802.11n-HT40/ 802.11ac-VHT40 802.11ax-HE40	4	5850-5895	2
802.11ac-VHT80 802.11ax-HE80	4	5855	1
802.11ac-VHT160 802.11ax-HE160	4	5815	1

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
802.11ac-VHT20	OFDM (BPSK/QPSK/16QAM/64QAM/256QAM)	Up to 173.3
802.11ac-VHT40		Up to 400
802.11ac-VHT80		Up to 866.7
802.11ac-VHT160		Up to 1733.3
802.11ax-HE20	OFDMA (BPSK/ QPSK/ 16QAM/ 64QAM/ 256QAM/1024QAM)	Up to 287
802.11ax-HE40		Up to 574
802.11ax-HE80		Up to 1201
802.11ax-HE160		Up to 2402

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Channel List					
802.11a/802.11n-HT20/802.11ac-VHT20/ 802.11ax-HE20			802.11n-HT40/802.11ac-VHT40/ 802.11ax-HE40		
U-NII Band	Channel Number	Frequency (MHz)	U-NII Band	Channel Number	Frequency (MHz)
4	169	5845	4	167	5835
	173	5865		175	5875
	177	5885			

Channel List					
802.11ac-VHT80/802.11ax-HE80			802.11ac-VHT160/802.11ax-HE160		
U-NII Band	Channel Number	Frequency (MHz)	U-NII Band	Channel Number	Frequency (MHz)
4	171	5855	4	163	5815

Note: Test modes are presented at section 3.7.

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3.6. Description of Key Components

3.6.1. For the All Component Lists

Item	Supplier	Model / Type	Character
System	Microsoft	Win 11	---
	---	Non-OS	---
Main Board	LG	15Z90RT MAIN B/D PCB	Manufacturer: #1 Hannstar Board Tech (Jiang Yin) Corp.,Ltd. #2 Elec&Eltek Company (MCO) Limited.
WLAN SUB Board	LG	15Z90RT SUB B/D	Manufacturer: #1 Hannstar Board Tech (Jiang Yin)Corp.,Ltd. #2 Elec&Eltek Company (MCO) Limited.
CPU (Socket: BGA1744)	Intel	i7-1360P	2.2GHz
	Intel	i5-1340P	1.9GHz
	Intel	i3-1315U	1.2GHz
15.6” LCD Panel	Samsung	ATNA56YX08-0	Resolution: 1920x1080@60Hz (OLED,FHD)
Storage (SSD) TW USE	SK hynix	HFS256GEJ9X101N	256GB
		HFS512GEJ9X101N	512GB
		HFS001TEJ9X101N	1TB
		HFS002TEJ9X101N	2TB
	Samsung	MZ-VL22560	256GB
		MZ-VLQ256B	256GB
		MZ-VL25120	512GB
		MZ-VL21T00	1TB
		MZ-VL22T00	2TB
Memory (RAM)	Samsung	---	32GB LPDDR5 6000 MHz (On Board)
		---	16GBLPDDR5 6000 MHz (On Board)
		---	8GB LPDDR5 6000 MHz (On Board)
	SK Hynix	---	32GBLPDDR5 6000 MHz (On Board)
		---	16GBLPDDR5 6000 MHz (On Board)
		---	8GB LPDDR5 6000 MHz (On Board)
Battery Pack	LG	LB2122LM	DC15.52V, 60Wh Typ 3866 mAh
WLAN Combo Card	Intel	AX211D2W	WLAN and BT, 2x2 PCle M.2 1216 SD adapter card FCC ID: PD9AX211D2 IC: 1000M-AX211D2
WLAN Combo Antenna	LG (INPAQ)	WA-P-LELE-04-044	PCB, Mono-pole Type Main: Black, Aux: Gray
Touch Pad	Lite on	SP8000(SG-A0620-00A)	---
	Elan	SB068D-26H0	---
Keyboard	TIC	KT0122L2	---
Web Camera	Luxvisions	2BG204N3(2Mic)	---

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Item	Supplier	Model / Type	Character
LAN Gender (Type C to LAN)	SUZHOU MEC ELECTRONICS	80-5946-111	(White) 10/100Megabit Ethernet
		80-5946-101	(Black) 10/100 Megabit Ethernet
	ARIN TECH CO. LTD	GD-08MF-36-WH-LP10	(White) 10/100Megabit Ethernet
		GD-08MF-36-BK-LP11	(Black) 10/100 Megabit Ethernet
	HUIZHOU DEHONG TECHNOLOGY CO.,LTD.	370-50713	(White) 10/100Megabit Ethernet
		370-50714	(Black) 10/100 Megabit Ethernet
	Type C to LAN: Shielded, Undetached, 0.12m		
AC Adapter	LG (PI ELECTRONICS)	LP65WFC20P-NJ W	(White) I/P: AC 100-240V, 1.6A, 50-60Hz O/P: (PDO) DC5V, 3A (15W) or DC9V, 3A (27W) or DC 15V,3A (45W) or DC 20V, 3.25A (65W) O/P: (PPS) DC5V- 20V, 3.25A, Max 65W Wall-Mounted: (2C)
	LG (PI ELECTRONICS)	LP65WFC20P-NJ B	(Black) I/P: AC 100-240V, 1.6A, 50-60Hz O/P: (PDO) DC5V, 3A (15W) or DC9V, 3A (27W) or DC 15V,3A (45W) or DC 20V, 3.25A (65W) O/P: (PPS) DC5V- 20V, 3.25A, Max 65W Wall-Mounted: (2C)
	Type C Cable: Shielded, Detached, 2.0m		

Remark: For more detailed features description, please refer to the manufacturer's specifications or the user manual.

3.6.2. The EUT collocates with following worst components, which are used to establish a basic configuration of system during test:

SKU (Mode)			**1**
Main Board		LG, 15Z90RT MAIN B/D PCB	V
WLAN SUB Board		LG, 15Z90RT SUB B/D	V
CPU		Intel, i7-1360P	V
Memory (RAM)		32GB	V
15.6" LCD Panel		Samsung, ATNA56YX08-0	V
Storage (SSD)		SK hynix, 256GB	V
		Samsung,2TB	V
Battery Pack		LG, LB2122LM, 60Wh	V
Touch Pad		Lite on, SP8000(SG-A0620-00A)	V
WLAN Combo Card		Intel, AX211D2W	V
WLAN Combo Antenna		LG (INPAQ), WA-P-LELE-04-044	V
Type C	AC Adapter	LG(PI ELECTRONICS), LP65WFC20P-NJ W	V
	Link to LAN Gender	10/100Mbps	V
	Link to USB HUB	---	V

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3.7. Test Configuration

Mode	TX_{on} (ms)	TX_{on+off} (ms)	Duty Cycle (x)	Duty Cycle Factor [10log(1/x)] (dB)
802.11a	2.094	2.132	0.982	N/A
802.11n-HT20	4.005	4.050	0.989	N/A
802.11n-HT40	3.990	4.050	0.985	N/A
802.11ac-VHT80	3.975	4.035	0.985	N/A
802.11ac-VHT160	2.780	2.830	0.982	N/A
802.11ax-HE20	3.975	4.020	0.989	N/A
802.11ax-HE40	3.975	4.020	0.989	N/A
802.11ax-HE80	3.975	4.035	0.985	N/A
802.11ax-HE160	2.280	2.330	0.979	0.092
802.11ax-HE20 (RU Config 26)	0.756	0.804	0.940	0.269
802.11ax-HE20 (RU Config 52)	1.460	1.505	0.970	0.132
802.11ax-HE20 (RU Config 106)	3.030	3.080	0.984	N/A
802.11ax-HE40 (RU Config 242)	1.410	1.460	0.966	0.150
802.11ax-HE80 (RU Config 484)	2.780	2.840	0.979	0.092
802.11ax-HE160 (RU Config 996)	1.330	1.390	0.957	0.191

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.

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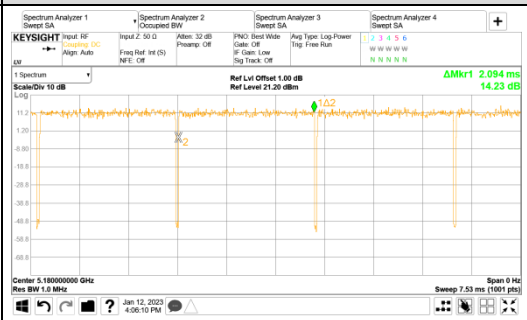
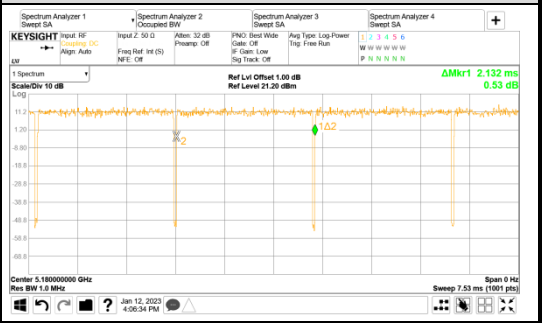
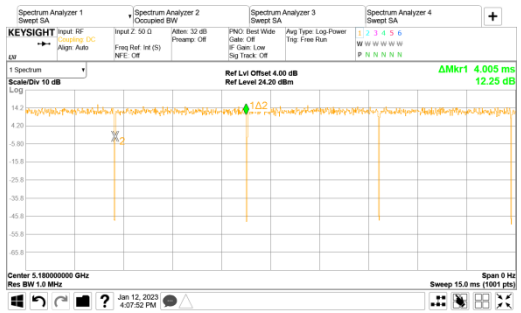
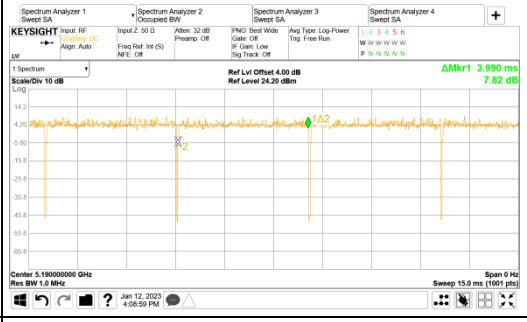
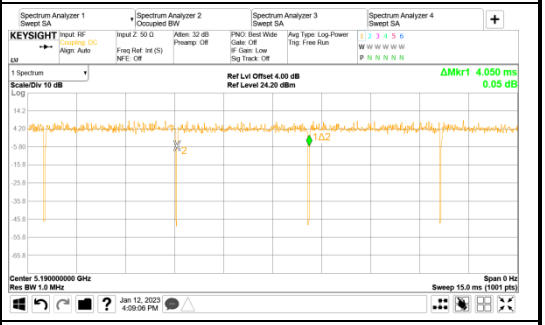
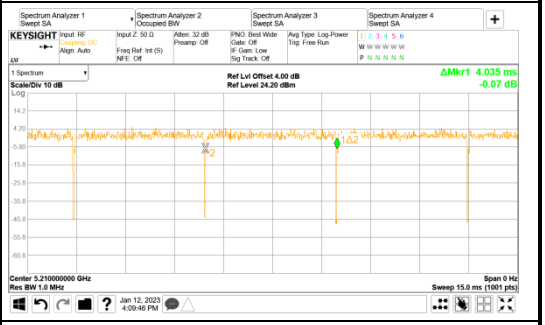
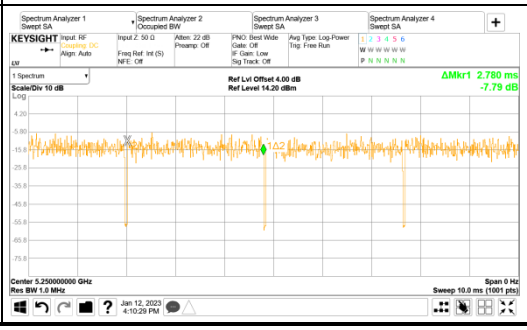
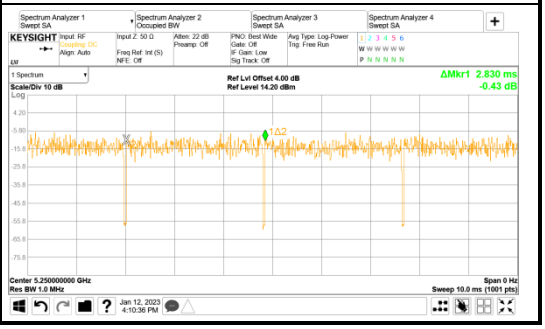
Mode	TX_{on} (ms)	$T_{on}+T_{off}$(ms)
802.11a		
802.11n-HT20		
802.11n-HT40		
802.11ac-VHT80		
802.11ac-VHT160		

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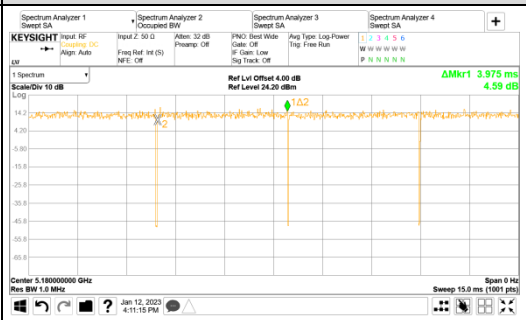
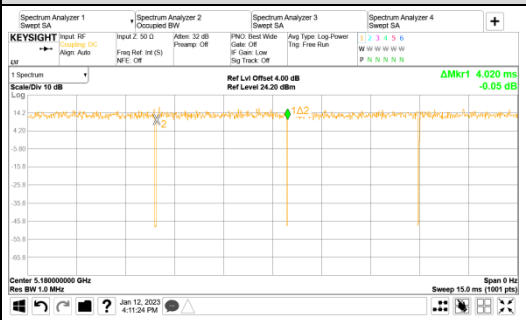
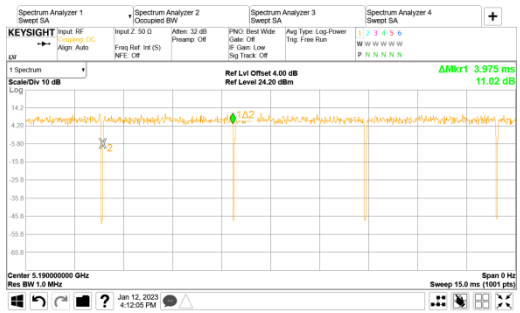
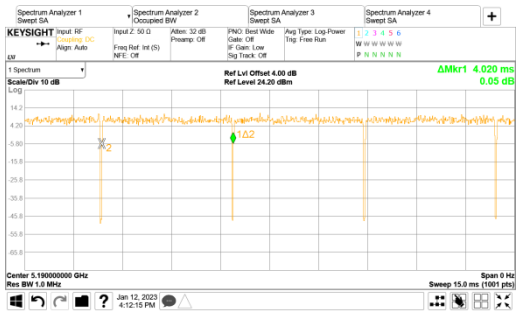
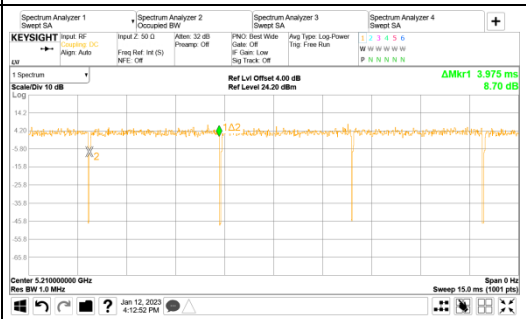
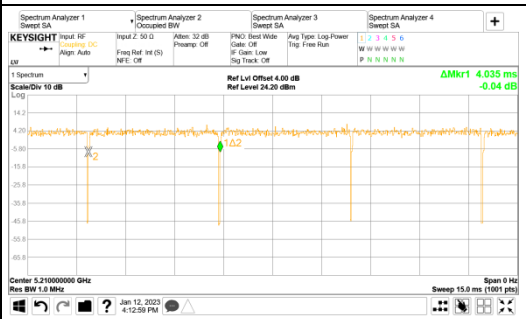
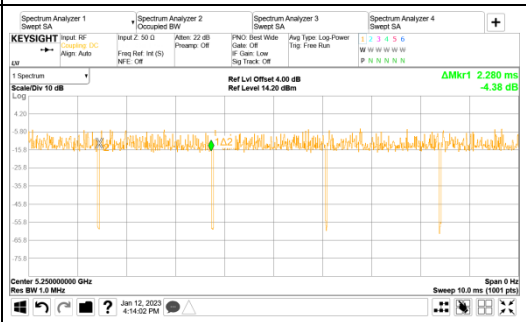
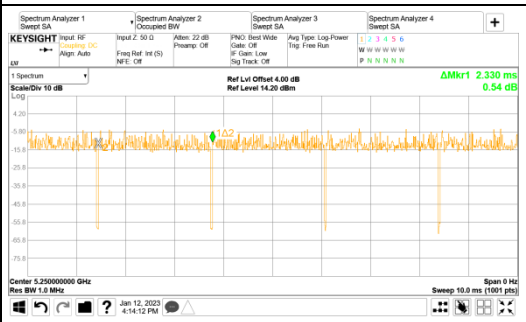
Mode	TX_{on} (ms)	$T_{on}+T_{off}$(ms)
802.11ax-HE20		
802.11ax-HE40		
802.11ax-HE80		
802.11ax-HE160		

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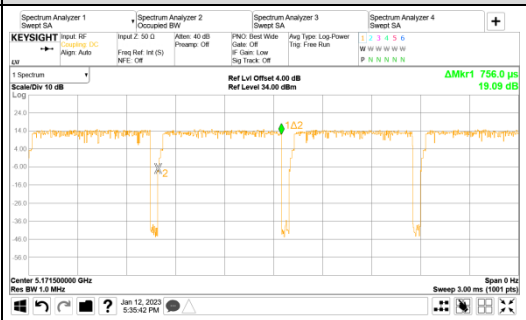
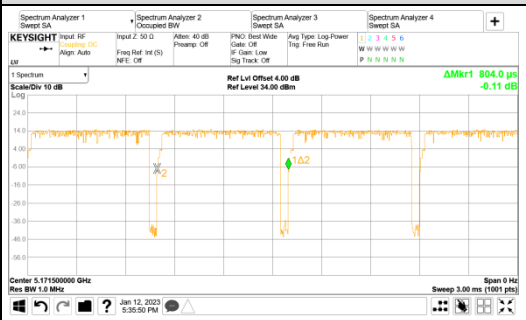
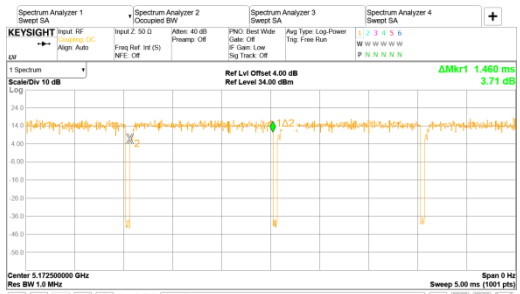
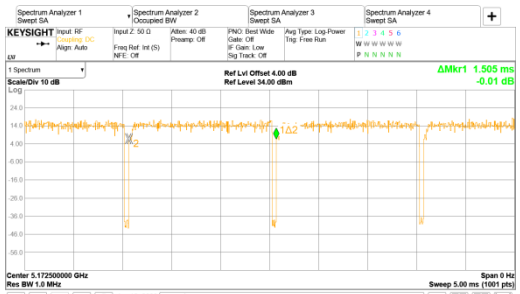
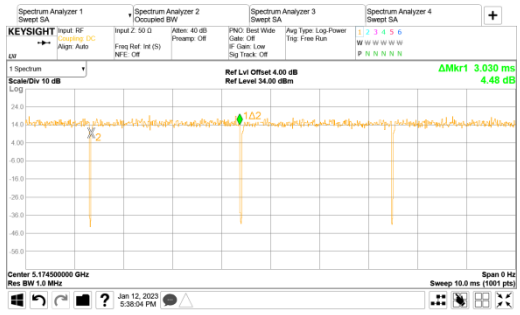
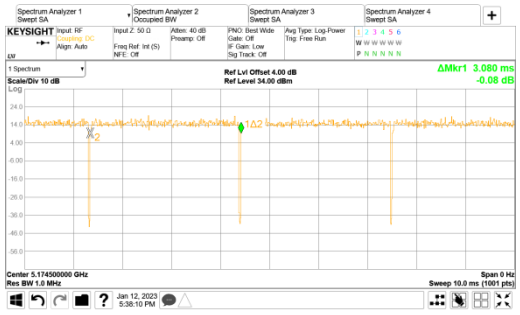
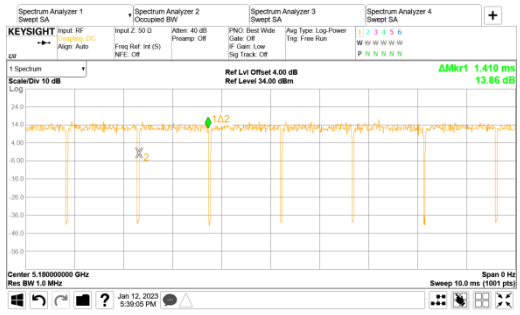
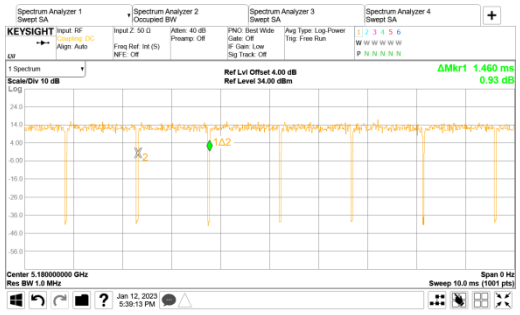
Mode	TX_{on} (ms)	$T_{on}+T_{off}$(ms)
802.11ax-HE20 (RU Config 26)		
802.11ax-HE20 (RU Config 52)		
802.11ax-HE20 (RU Config 106)		
802.11ax-HE40 (RU Config 242)		

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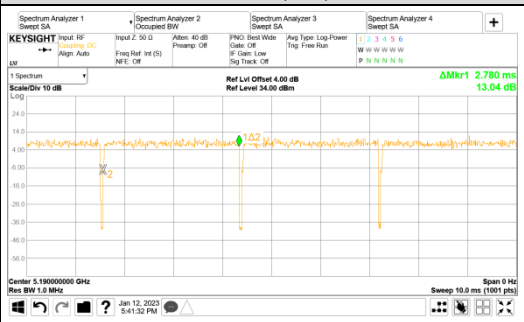
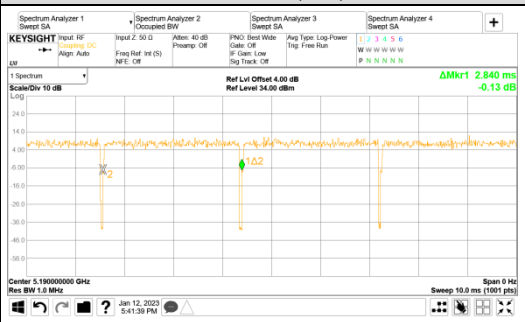
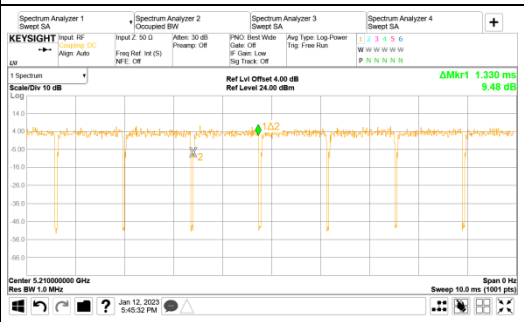
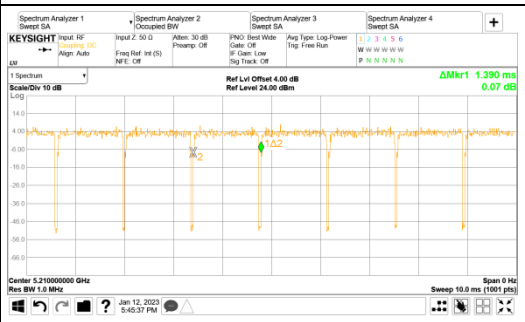
Mode	TX_{on} (ms)	$T_{on}+T_{off}$(ms)
802.11ax-HE80 (RU Config 484)		
802.11ax-HE160 (RU Config 996)		

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AC Conduction
Normal operation

Item		Mode	Data Rate	RU Configuration	Test Channel
Radiated Test Case	Radiated Spurious Emission (30MHz~1GHz)	802.11ax-HE40	HE0	242/61	167

Item		Mode	Data Rate	Test Channel
Radiated Test Case	Radiated Band Edge Note1	802.11a	6 Mbps	177
		802.11n-HT20	MCS8	177
		802.11n-HT40	MCS8	175
		802.11ac-VHT80	MCS0	171
		802.11ac-VHT160	MCS0	163
		802.11ax-HE20	HE0	177
		802.11ax-HE40	HE0	175
		802.11ax-HE80	HE0	171
		802.11ax-HE160	HE0	163
	Radiated Spurious Emission Note1 & 2	802.11a	6 Mbps	177
		802.11n-HT20	MCS8	173
		802.11n-HT40	MCS8	167
		802.11ac-VHT80	MCS0	171
		802.11ac-VHT160	MCS0	163
		802.11ax-HE20	HE0	173
		802.11ax-HE40	HE0	167
		802.11ax-HE80	HE0	171
		802.11ax-HE160	HE0	163

Item		Mode	Data Rate	RU Configuration	Test Channel
Radiated Test Case	Radiated Band Edge Note1	802.11ax-HE20	HE0	26/0	177
				52/37	
				106/53	
		802.11ax-HE40	HE0	242/62	175
		802.11ax-HE80	HE0	484/66	171
		802.11ax-HE160	HE0	996/S67	163
	Radiated Spurious Emission Note1 & 5	802.11ax-HE20	HE0	52/37	169
				106/53	177
		802.11ax-HE40	HE0	242/61	167
		802.11ax-HE80	HE0	484/65	171
				484/66	171
		802.11ax-HE160	HE0	996/67	163
				996/S67	

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Item		Mode	Data Rate	Test Channel
Conducted Test Case	Emission/Occupied Bandwidth	802.11a	6 Mbps	169/173/177
		802.11n-HT20	MCS8	169/173/177
		802.11n-HT40	MCS8	167/175
		802.11ac-VHT80	MCS0	171
		802.11ac-VHT160	MCS0	163
		802.11ax-HE20	HE0	169/173/177
		802.11ax-HE40	HE0	167/175
		802.11ax-HE80	HE0	171
		802.11ax-HE160	HE0	163
	Maximum output power	802.11a	6 Mbps	169/173/177
		802.11n-HT20	MCS8	169/173/177
		802.11n-HT40	MCS8	167/175
		802.11ac-VHT80	MCS0	171
		802.11ac-VHT160	MCS0	163
		802.11ax-HE20	HE0	169/173/177
		802.11ax-HE40	HE0	167/175
		802.11ax-HE80	HE0	171
		802.11ax-HE160	HE0	163
	Power spectral density	802.11a	6 Mbps	169/173/177
		802.11n-HT20	MCS8	169/173/177
		802.11n-HT40	MCS8	167/175
		802.11ac-VHT80	MCS0	171
		802.11ac-VHT160	MCS0	163
		802.11ax-HE20	HE0	169/173/177
		802.11ax-HE40	HE0	167/175
		802.11ax-HE80	HE0	171
		802.11ax-HE160	HE0	163

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Item		Mode	Data Rate	RU Configuration	Test Channel
Conducted Test Case	Maximum output power	802.11ax-HE20	HE0	26/0	169
				52/37	
				106/53	
				26/0	177
				52/37	
				106/53	
		802.11ax-HE40	HE0	242/61	167
				242/62	175
		802.11ax-HE80	HE0	484/65	171
				484/66	
		802.11ax-HE160	HE0	996/67	163
				996/S67	
Conducted Test Case	Power spectral density	802.11ax-HE20	HE0	26/0	169
				52/37	
				106/53	
				26/0	177
				52/37	
				106/53	
		802.11ax-HE40	HE0	242/61	167
				242/62	175
		802.11ax-HE80	HE0	484/65	171
				484/66	
		802.11ax-HE160	HE0	996/67	163
				996/S67	

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.

Note 3: The modulation and bandwidth are similar for 802.11n mode for HT20/HT40 and 802.11ac mode for VHT20/VHT40, therefore investigated worst case to representative mode in the test report.

Note 4: The data rates were selected based on preliminary testing that identified rate as the worst case for output power.

Note 5: Per TCB workshop document, It's necessary to test when RU PSD result greater than FU.

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3.8. Output Power Setting

Mode	U-NII Band	Centre Frequency (MHz)	Power Setting	
			AUX	Main
802.11a	4	5845	19.000	19.000
		5865	19.000	18.750
		5885	17.000	17.250

Mode	U-NII Band	Centre Frequency (MHz)	Power		Mode	U-NII Band	Centre Frequency (MHz)	Power Setting	
			AUX	Main				AUX	Main
802.11n-HT20	4	5845	16.250	16.250	802.11ax-HE20	4	5845	16.250	16.250
		5865	16.500	16.500			5865	16.500	16.500
		5885	14.000	14.000			5885	14.000	14.000

Mode	U-NII Band	Centre Frequency (MHz)	Power		Mode	U-NII Band	Centre Frequency (MHz)	Power Setting	
			AUX	Main				AUX	Main
802.11n-HT40	4	5835	19.500	19.500	802.11ax-HE40	4	5835	19.500	19.500
		5875	17.250	17.250			5875	17.250	17.250

Mode	U-NII Band	Centre Frequency (MHz)	Power		Mode	U-NII Band	Centre Frequency (MHz)	Power Setting	
			AUX	Main				AUX	Main
802.11ac-VHT80	4	5855	18.000	18.000	802.11ax-HE80	4	5855	18.000	18.000

Mode	U-NII Band	Centre Frequency (MHz)	Power		Mode	U-NII Band	Centre Frequency (MHz)	Power Setting	
			AUX	Main				AUX	Main
802.11ac-VHT160	4	5815	15.750	15.750	802.11ax-HE160	4	5815	15.750	15.750

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3.9. Tested Supporting System List

3.9.1. Support Peripheral Unit

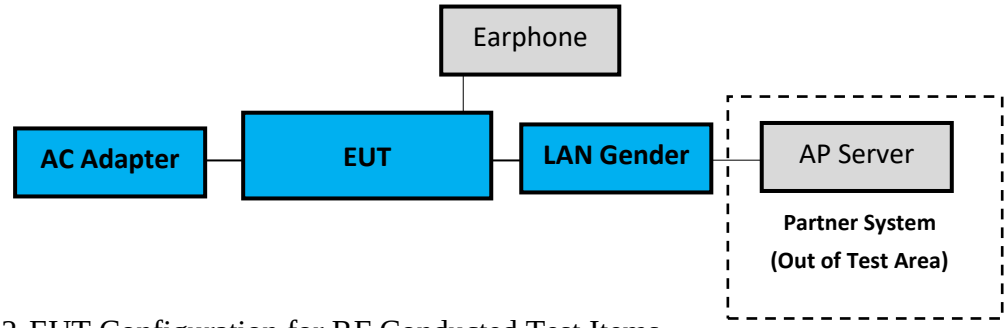
No.	Product	Brand	Model No.	Serial No.	Approval
1.	Earphone	APPLE	N/A	N/A	N/A
Partner System					
2.	AP Server	ASUS	RT-AX88U	N/A	FCC ID: MSQ-RTAXHP00 IC: 3568A-RTAXHP00

3.9.2. Cable Lists

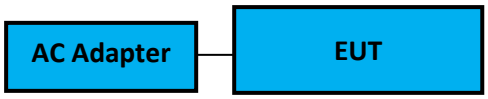
No.	Cable Description Of The Above Support Units
1.	Earphone Cable: Unshielded, Undetachable, 1.2m
2.	AC adapter: M/N:WA-30B12, Cable: Unshielded, Detachable, 1.2m LAN cable: Unshielded, Detachable,3.0m
3.	LAN cable: Unshielded, Detachable, 1.8m

3.10.Setup Configuration

3.10.1. EUT Configuration for Power Line & Radiated Emission



3.10.2. EUT Configuration for RF Conducted Test Items



3.11.Operating Condition of EUT

Test program “DRTU” is used for enabling EUT WLAN function under continues transmitting and choosing data rate/ channel.
[ANT AUX port (A Button in DRTU) and ANT Main port (B Button in DRTU)].

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3.12.Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 491, Zhongfu Rd., 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 17025:2017 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724
Test Facilities	FCC OET Designation Number under APEC MRA by NCC is : TW1724 ISED CAB Identifier Number under APEC TEL MRA by NCC is TW1724 (1) No.8 Shielded Room (2) No.1 3m Semi Anechoic Chamber

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3.13.Measurement Uncertainty

Test Items/Facilities			Frequency Range	Uncertainty
Conduction Test	☐	No. 7 Shielded Room	9kHz-150kHz	±3.7dB
			150kHz-30MHz	±3.4dB
	☒	No. 8 Shielded Room	9kHz-150kHz	±3.7dB
			150kHz-30MHz	±3.5dB
Radiation Test	☒	No.1 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±3.8dB
			200MHz-1000MHz, 3m, Horizontal	±4.4dB
			30MHz-200MHz, 3m, Vertical	±4.5dB
			200MHz-1000MHz, 3m, Vertical	±4.7dB
			1GHz-6GHz, 3m	±4.9dB
			6GHz-18GHz, 3m	±4.5dB
	☐	No.3 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.0dB
			200MHz-1000MHz, 3m, Horizontal	±4.3dB
			30MHz-200MHz, 3m, Vertical	±4.6dB
			200MHz-1000MHz, 3m, Vertical	±4.7dB
			1GHz-6GHz, 3m	±4.8dB
			6GHz-18GHz, 3m	±4.5dB
	☐	No.4 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.3dB
			200MHz-1000MHz, 3m, Horizontal	±4.3dB
			30MHz-200MHz, 3m, Vertical	±4.6dB
			200MHz-1000MHz, 3m, Vertical	±4.7dB
			1GHz-6GHz, 3m	±4.8dB
			6GHz-18GHz, 3m	±4.4dB
	☐	No.5 3m Semi Anechoic Chamber	30MHz-200MHz, 3m, Horizontal	±4.3dB
			200MHz-1000MHz, 3m, Horizontal	±4.3dB
			30MHz-200MHz, 3m, Vertical	±4.5dB
			200MHz-1000MHz, 3m, Vertical	±4.6dB
			1GHz-6GHz, 3m	±4.9dB
			6GHz-18GHz, 3m	±4.1dB
	Radiated emissions (18GHz-40GHz)		18GHz-40GHz, 3m	±3.4dB

Remark：Uncertainty = $ku_c(y)$

Test Items	Uncertainty
Bandwidth	± 0.2kHz
Maximum output power	± 0.33dB
Power spectral density	± 0.13dB

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4. MEASUREMENT EQUIPMENTLIST

4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR3	101774	2023. 01. 11	1 Year
2.	A.M.N.	R&S	ENV432	101567	2022. 05. 26	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2022. 12. 19	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2022. 12. 14	1 Year
5.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.8 S/R	2022. 04. 14	1 Year
6.	Coaxial Cable	Yeida	RG/58AU	CE-08	2022. 09. 07	1 Year
7.	Test Software	Audix	e3	V9 18621a	N.C.R.	N.C.R.

4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2022. 08. 24	1 Year
2.	Test Receiver	R&S	ESCS30	100039	2022. 06. 01	1 Year
3.	Amplifier	HP	8447D	2944A06305	2022. 12. 29	1 Year
4.	Microwave Amplifier	Keysight	83051A	MY56480113	2022. 09. 07	1 Year
5.	Microwave Amplifier	Agilent	8449B	3008A02678	2022. 02. 22	1 Year
6.	Loop Antenna	TESEQ	HLA 6121	60478	2022. 02. 17	1 Year
7.	Bilog Antenna	TESEQ	CBL6112D	33821	2022. 07. 01	1 Year
8.	Double-Ridged Waveguide Horn	ETS-Lindgren	3117	00135902	2022. 03. 21	1 Year
9.	Horn Antenna	COM-POWER	AH-840	101092	2022. 12. 30	1 Year
10.	5G Notch Filter	Microware Circuits	N0257881	459776	2022. 08. 10	1 Year
11.	Coaxial Cable	MIYAZAKI	5D2W	RE-11	2023. 01. 07	1 Year
12.	Coaxial Cable	HUBER+ SUHNER	SUCOFLEX 106	RE-14	2023. 01. 07	1 Year
13.	Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	RE-30	2022. 08. 22	1 Year
14.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.1 3m A/C	2022. 04. 14	1 Year
15.	Test Software	Audix	e3	V9 18621a	N.C.R.	N.C.R.

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4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9020B-544	MY57120357	2022. 03. 02	1 Year
2.	Power Meter	Anritsu	ML2495A	2127005	2022. 12. 01	1 Year
3.	Power Meter	Anritsu	ML2495A	2127004	2022. 12. 07	1 Year
4.	Power Sensor	Anritsu	MA2411B	1911360	2022. 12. 07	1 Year
5.	Power Sensor	Anritsu	MA2411B	1911356	2022. 12. 01	1 Year
6.	Digital Thermo-Hygro Meter	iMax	HTC-1	RF-03	2022. 04. 14	1 Year

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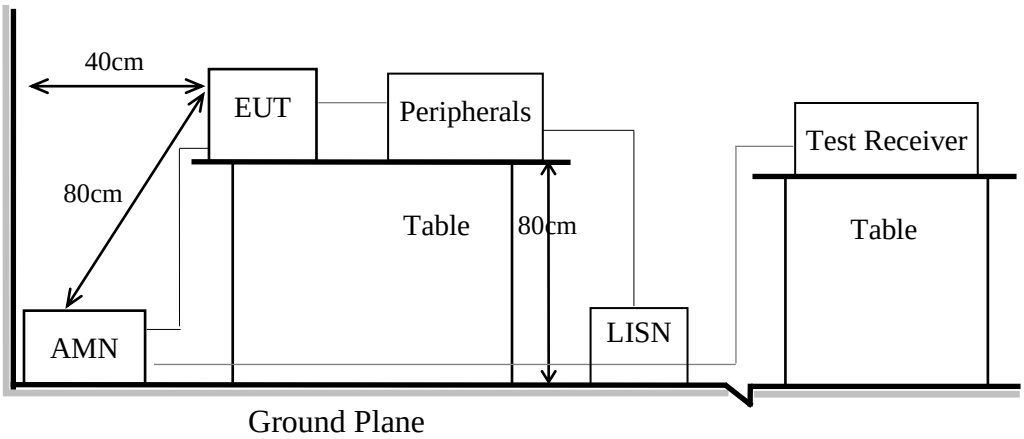
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.10

5.1.2. Shielded Room Setup Diagram



5.2. Conducted Emission Limit

Frequency	Conducted Limit	
	Quasi-Peak Level	Average Level
150kHz ~ 500kHz	66 ~ 56 dBμV	56 ~ 46 dBμV
500kHz ~ 5MHz	56 dBμV	46 dBμV
5MHz ~ 30MHz	60 dBμV	50 dBμV

Remark1.: If the average limit is met when using a Quasi-Peak detector, the measurement using the average detector is not required.
2.: The lower limit applies to the band edges.

5.3. Test Procedure

5.3.1. To set up the EUT as indicated in ANSI C63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.

5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).

5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)

5.3.4. Checking frequency range from 150kHz to 30 MHz and record the emission which does not have 20 dB below limit.

5.4. Test Results

Please refer to Appendix A.

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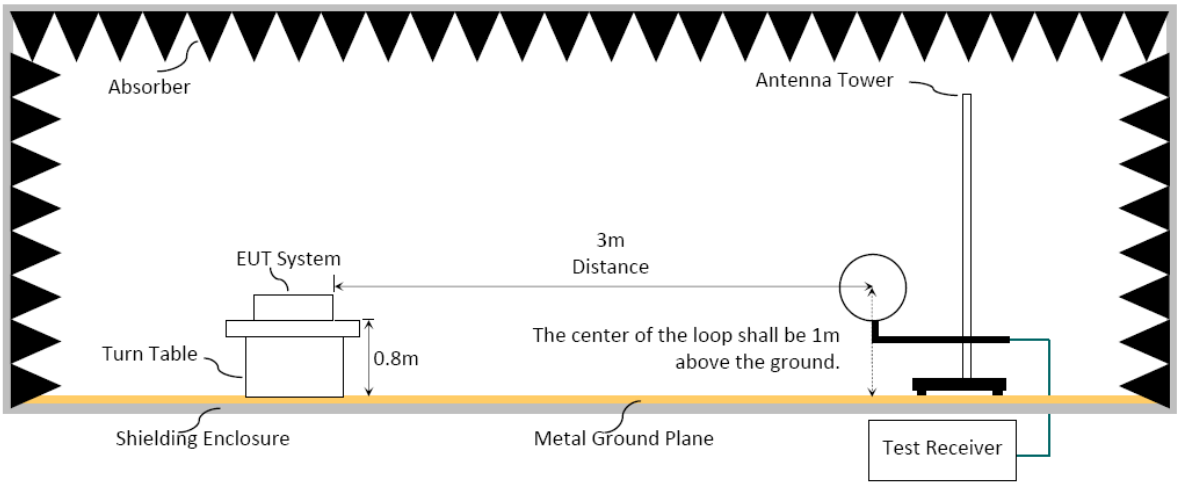
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

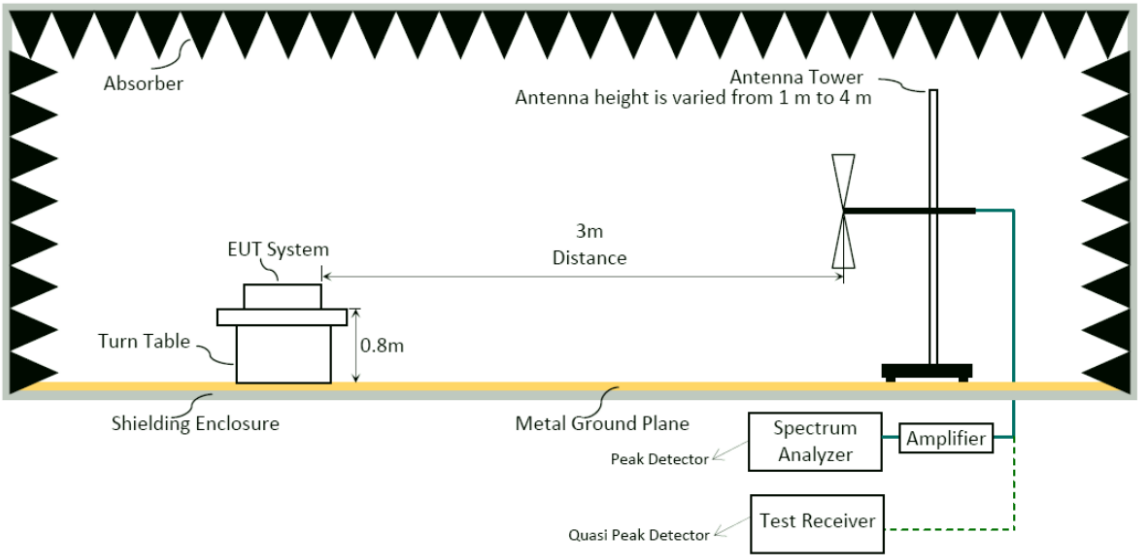
6.1.1. Block Diagram of EUT

Indicated as section 3.10

6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000MHz



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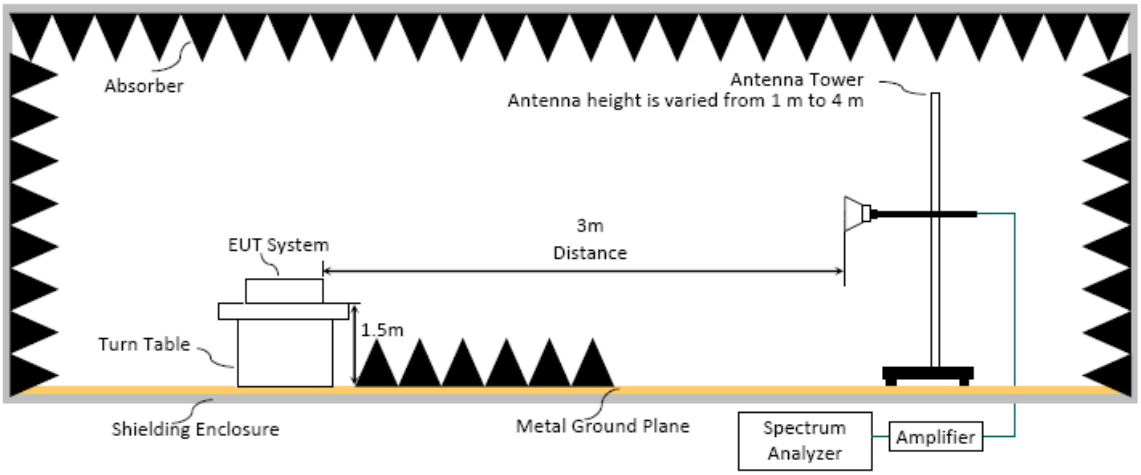
6.1.4. Setup Diagram for above 1GHz



6.2. 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.

6.2.1. General Limit

Frequency (MHz)	Distance(m)	Limits	
		dBμV/m	μV/m
0.009 - 0.490	300	67.6-20 log f(kHz)	2400/f kHz
0.490 - 1.705	30	87.6-20 log f(kHz)	24000/f 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 dBμV/m (Peak) 54.0 dBμV/m (Average)	

Remark：(1) dBμV/m = 20 log (μV/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.

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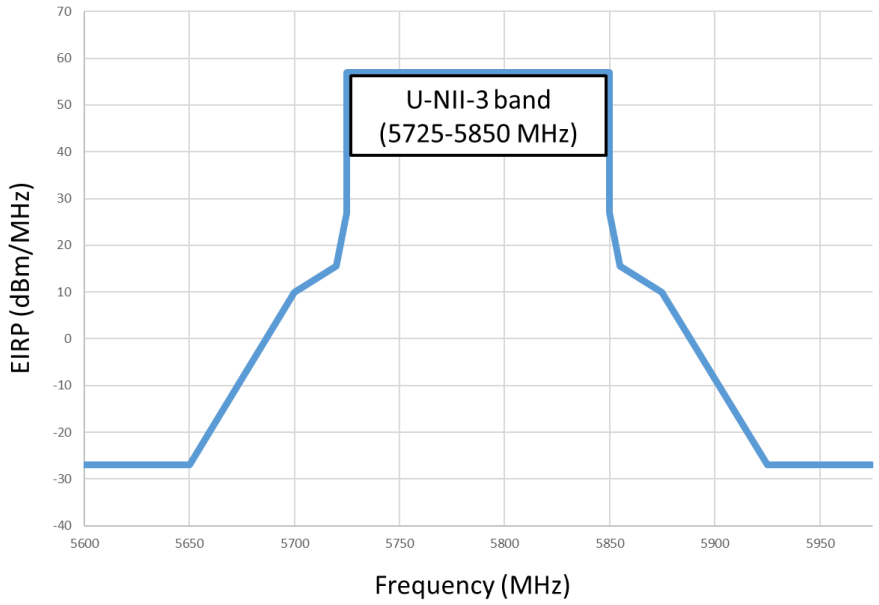
6.2.2. Limit for non-restricted frequency above 1 GHz

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

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 dBμV/mat 75 MHz or more above or below the band edge increasing linearly to 105.2dBμV/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 dBμV/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 122.2 dBμV/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))



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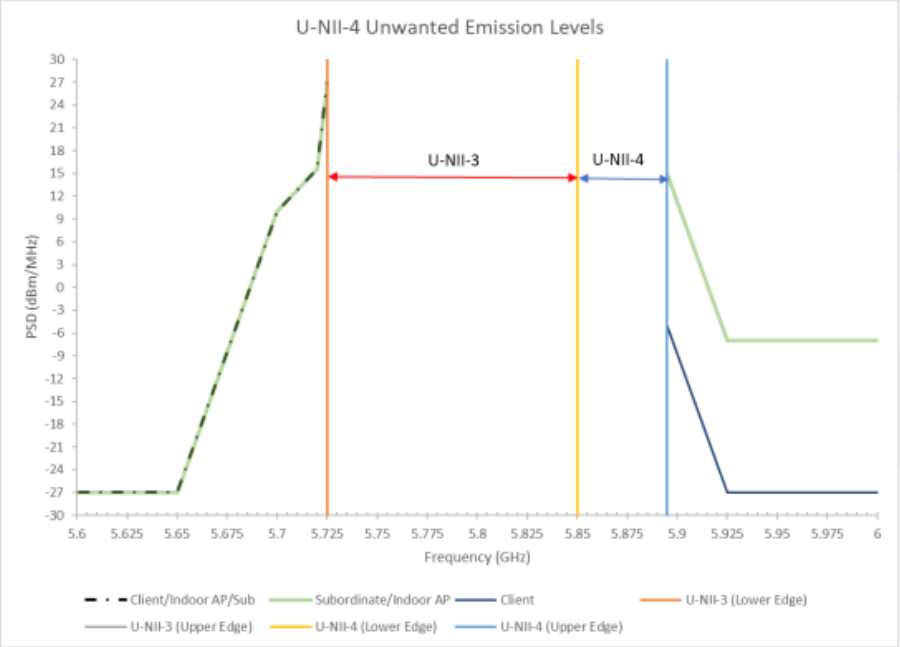
Frequency Band (MHz)	Field Strength Limit at 3 m	
5850 to 5895	☐	15.407(b)(5)(i) For an indoor access point or subordinate device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of 15 dBm/MHz and shall decrease linearly to an e.i.r.p. of −7 dBm/MHz at or above 5.925 GHz.
	☒	15.407(b)(5)(ii) , For a client device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of −5 dBm/MHz and shall decrease linearly to an e.i.r.p. of −27 dBm/MHz at or above 5.925 GHz.
	☒	15.407(b)(5)(iii) , For a client device or indoor access point or subordinate device, all emissions below 5.725 GHz shall not exceed an e.i.r.p. of −27 dBm/MHz at 5.65 GHz increasing linearly to 10 dBm/MHz at 5.7 GHz, and from 5.7 GHz increasing linearly to a level of 15.6 dBm/MHz at 5.72 GHz, and from 5.72 GHz increasing linearly to a level of 27 dBm/MHz at 5.725 GHz.



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6.3. Test Procedure

Frequency Range 9kHz~30MHz:
The EUT setup on the turntable 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 80cm (for 30-1000MHz) 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 1GHz:
Spectrum Analyzer is used for pre-testing with following setting:

(1)RBW = 120kHz

(2)VBW ≥ 3 x RBW.

(3)Detector = Peak.

(4)Sweep time = auto.

(5)Trace mode = max hold.

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

Note 1: When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required, otherwise using Q.P. for final measurement.

Note 2: When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

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

(1)RBW = 1MHz

(2)VBW ≥ 3 x RBW.

(3)Detector = Peak.

(4)Sweep time = auto.

(5)Trace mode = max hold.

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

Note: When peak-detected value is lower than limit that the measurement using the average detector is not required, otherwise using average detector for final measurement.

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Average Detector:

■Option 1:

(1)RBW = 1MHz

(2)VBW ≥ 1/ T. (Duty Cycle < 98%, when duty cycle presented in section 3.7)

Mode	VBW Setting (VBW ≥ 1/ T)
802.11ac-VHT160	470Hz
802.11ax-HE20 (RU Config 26)	1.5kHz
802.11ax-HE20 (RU Config 52)	750Hz
802.11ax-HE40 (RU Config 242)	750Hz
802.11ax-HE80 (RU Config 484)	360Hz
802.11ax-HE160 (RU Config 996)	820Hz

VBW = set VBW≤ RBW / 100, but not less than 10Hz (Duty Cycle ≥ 98%, when duty cycle presented in section 3.7)

Mode	VBW Setting
802.11a	10Hz
802.11n-HT20	10Hz
802.11n-HT40	10Hz
802.11ac-VHT80	10Hz
802.11ac-VHT160	10Hz
802.11ax-HE20	10Hz
802.11ax-HE40	10Hz
802.11ax-HE80	10Hz
802.11ax-HE20 (RU Config 106)	10Hz

(4)Detector = Peak.

(5)Sweep time = auto.

(6)Trace mode = max hold.

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

□Option 2:

Average Emission Level(dBμV/m)= Peak Emission Level(dBμV/m)+ DCCF(dB).

6.4. Measurement Result Explanation

■Peak Emission Level(dBμV/m)=Antenna Factor(dB/m) + Cable Loss (dB)– Preamp Gain (dB)+ Reading(dBμV).

■Average Emission Level(dBμV/m)= Antenna Factor(dB/m) + Cable Loss (dB)– Preamp Gain (dB)+ Reading(dBμV).

□Average Emission Level(dBμV/m)= Peak Emission Level(dBμV/m)+ DCCF(dB)
Duty Cycle Correction Factor (DCCF)(dB)= 20log(TX_{on}/TX_{on+off}) presented in section 3.7.

□ERP(dBm)= Peak Emission Level(dBμV/m) -95.2dB-2.14dB

6.5. Test Results

Please refer to Appendix A.

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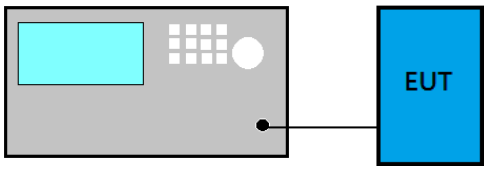
7. EMISSION/OCCUPIED BANDWIDTH

7.1. Block Diagram of Test Setup



7.2. Specification Limits

Frequency Band (MHz)	Limit
5150 to 5250	Reference only
5250 to 5350	
5470 to 5725	
5725 to 5895	≥ 500kHz

7.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 and KDB 291074 D02 EMC Measurement v01:

For Emission Bandwidth

■ Applicable to all bands except to 5725 MHz –5895 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.

■ **Minimum Emission Bandwidth for the band 5725 MHz –5895 MHz.**

(1) Set RBW = 100 kHz.
(2) Set the video bandwidth (VBW) ≥ 3 × 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.

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For 99% Occupied Bandwidth

(1) Set Span range 1.5~5 times the OBW
(2) Set RBW close to1% to 5% of OBW.
(3) Set VBW≥3xRBW.
(4) Detector = Peak.
(5) Trace mode = Max hold
(6) Sweep = Auto couple.
(7) Allow the trace to stabilize.

7.4. Test Results

Please refer to Appendix A

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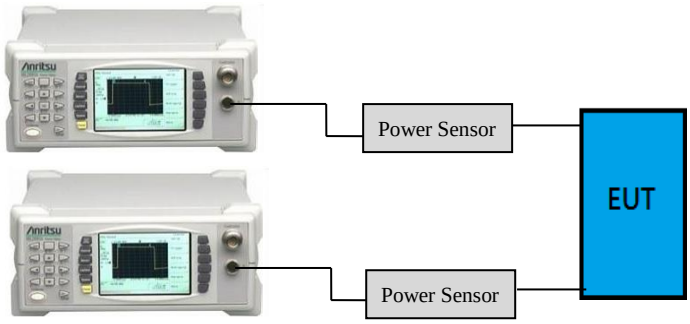
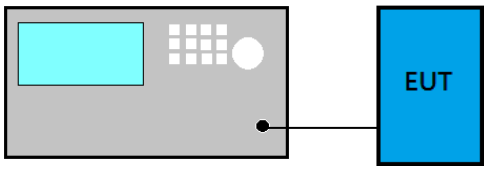
8. MAXIMUM OUTPUT POWER

8.1. Block Diagram of Test Setup



- **For 802.11ac-VHT80/160, 802.11ax-HE160 modes only**



8.2. 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 dBm + 10 log B[Note1]
5470 to 5725		250 mW or 11 dBm + 10 log B [Note1]
5725 to 5850	N/A	1 W(30 dBm)
5850 to 5895	indoor access point	4 W (36 dBm) (e.i.r.p.)
	client devices	1 W (30 dBm) (e.i.r.p.)
	subordinate device	4 W (36 dBm) (e.i.r.p.)

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

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8.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 and KDB 291074 D02 EMC Measurement v01:

■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) for 802.11ac-VHT80/160, 802.11ax-HE80/160 modes only

(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) 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%.

8.4. Test Results

Please refer to Appendix A

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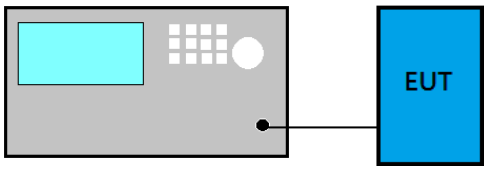
9. POWER SPECTRAL DENSITY

9.1. Block Diagram of Test Setup



9.2. Specification Limits

Frequency Band (MHz)	Category	Limit
5150 to 5250	Outdoor Access Point	17dBm/MHz
	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		30 dBm/500kHz
5850 to 5895	indoor access point	20dBm/MHz(e.i.r.p.)
	client devices	14dBm/MHz(e.i.r.p.)
	subordinate device	20dBm/MHz(e.i.r.p.)

9.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v02r01:

■Method AVGSA-2

(1) Set span to encompass the EBW (or 99% OBW) of the signal.
(2) Set RBW = 1 MHz (Applicable to all bands except to 5725 MHz- 5850 MHz)/ Set RBW=100 KHz(when EUT operate at 5725 MHz- 5850 MHz)
(3) Set the video bandwidth (VBW) ≥ 3 RBW.
(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) Offset BWCF (7dB) when EUT operate at 5725 MHz –5850 MHz.

9.4. Test Results

Please refer to Appendix A

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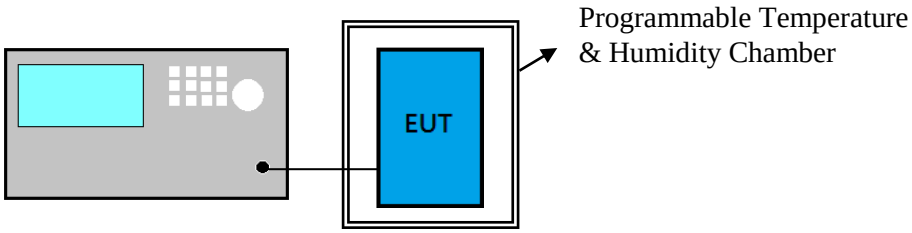
10. FREQUENCY STABILITY

10.1. Block Diagram of Test Setup



10.2. Specification Limits

NONE

10.3. Test Procedure

(1) Frequency: Test frequency.
(2) Span: enough to cover the complete power envelope
(3) RBW: 1MHz(modulation ON) ; 10KHz(CW)
(4) VBW: 1MHz(modulation ON) ; 10KHz(CW)
(5) Detector Mode: Positive Peak
(6) Indication mode: Max hold
(7) Find the peak frequency and take calculate by the formula:
(Measurement Value-declaration frequency)/ declaration frequency)

10.4. Test Results

Please refer to Appendix A

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11. DEVIATION TO TEST SPECIFICATIONS

【NONE】

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APPDNDIX A

TEST DATA AND PLOTS

(Model: 15Z90RT)

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APPDNDIX B

TEST PHOTOGRAPHS

(Model: 15Z90RT)

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