

FCC 15.247 & RSS-247 2.4 GHz Test Report

for

LG Electronics Inc.

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

Product Name : Notebook Computer
**Model Name : (1)15Z990 (2)15ZD990 (3)15ZB990
(4)15ZG990 (5)LG15Z99**
Brand : LG
FCC ID : BEJNT-15Z990
IC : 2703H-15Z990

**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, or any agency of the U.S. Government.

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Audix Technology Corp.
No. 53-11, Dingfu, Linkou, Dist.,
New Taipei City 244, Taiwan

Tel: +886 2 26099301
Fax: +886 2 26099303

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TEST REPORT CERTIFICATION

Applicant : LG Electronics Inc.
Factory : LG Electronics Nanjing New Technology Co., Ltd.
EUT Description
(1) Product : Notebook Computer
(2) Model : (1)15Z990 (2)15ZD990 (3)15ZB990 (4)15ZG990 (5)LG15Z99
(3) Brand : LG
(4) Power Rating : DC 19V, 2.53A

Applicable Standards:

47 CFR FCC Part 15 Subpart C
RSS-Gen (Issue 5), April 2018
RSS-247 (Issue 2), February 2017
ANSI C63.10:2013
KDB 558074 D01 DTS Meas Guidance v05

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. 11. 02

Reviewed by: Annie Yu (Annie Yu/Administrator)

Approved by: Ben Cheng (Ben Cheng/Manager)



Audix Technology Corp.
No. 53-11, Dingfu, Linkou, Dist.,
New Taipei City 244, Taiwan

Tel: +886 2 26099301
Fax: +886 2 26099303

1. REVISION RECORD OF TEST REPORT

Edition No	Issued Data	Revision Summary	Report Number
0	2018. 11. 02	Original Report	EM-F180488

2. SUMMARY OF TEST RESULTS

Rule		Description	Results
FCC	IC		
15.207	RSS-Gen §8.8	Conducted Emission	PASS
15.247(d)/ 15.205	RSS-Gen §8.9 RSS-247 §5.5	Radiated Band Edge and Radiated Spurious Emission	PASS
15.247(a)(2)	RSS-247 §5.2(1)	6dB Bandwidth	PASS
15.247(b)(3)	RSS-247 §5.4(4)	Maximum Peak Output	PASS
15.247(d)	RSS-247 §5.5	Conducted Band Edges and Conducted Spurious Emission	PASS
15.247 (e)	RSS-247 §5.2(2)	Peak Power Spectral Density	PASS
15.203	RSS-Gen §8.3	Antenna Requirement	Compliance

3. GENERAL INFORMATION

3.1. Description of Application

Applicant	LG Electronics Inc. 222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do 451-713 Korea.
Manufacturer	LG Electronics Nanjing New Technology Co., Ltd. No.346, Yaoxin Road, Economic & Technical Development Zone, Nanjing, China.
Product	Notebook Computer
Brand	LG
Model	(1)15Z990 (2)15ZD990 (3)15ZB990 (4)15ZG990 (5)LG15Z99 The difference between all models is different in the sales customers.

3.2. Description of EUT

Test Model	15Z990	
Serial Number	N/A	
Power Rating	DC 19V, 2.53A	
RF Features	WLAN: 802.11a/b/g/n/ac Bluetooth: BT and BLE	
Transmit Type	2.4 GHz	
	802.11b	1T1R
	802.11g	1T1R
	802.11n-HT20	2T2R
	802.11n-HT40	2T2R
	BT/BLE	1T1R
	UNII Bands	
	802.11a	1T1R
	802.11n-HT20/ 802.11ac-VHT20	2T2R
	802.11n-HT40/ 802.11ac-VHT40	2T2R
	802.11ac-VHT80	2T2R
	802.11ac-VHT160	2T2R
Sample Status	Production	
Date of Receipt	2018. 10. 15	
Date of Test	2018. 10. 16 ~ 11. 02	
Interface Ports of EUT	<ul style="list-style-type: none">• One Micro SD Card Slot• One Earphone Port• Three USB 3.0 Ports• One USB Type C Port• One HDMI Port• One DC Input Port	
Accessories Supplied	<ul style="list-style-type: none">• AC Adapter• LAN Gender	

3.3. Antenna Information

2.4G Antenna					
No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Max Gain (dBi)
1	WA-F-LBLB-04-056 (Main)	INPAQ	FPCB	2400	1.39
				2450	1.54
				2500	2.06
2	WA-F-LBLB-04-056 (AUX)	INPAQ	FPCB	2400	1.41
				2450	1.40
				2500	1.83
3	15Z980 ANTENNA ASM (Main)	LUXSHARE-ICT	PIFA	2400-2500	-1.21
4	15Z980 ANTENNA ASM (AUX)	LUXSHARE-ICT	PIFA	2400-2500	-0.8

5G Antenna					
No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Max Gain (dBi)
1	WA-F-LBLB-04-056 (Main)	INPAQ	FPCB	5100	2.49
				5400	2.93
				5800	1.59
2	WA-F-LBLB-04-056 (AUX)	INPAQ	FPCB	5100	2.57
				5400	2.97
				5800	2.84
3	15Z980 ANTENNA ASM (Main)	LUXSHARE-ICT	PIFA	5150-5350	-2.1
				5470-5725	-1.3
				5725-5850	-1.1
4	15Z980 ANTENNA ASM (AUX)	LUXSHARE-ICT	PIFA	5150-5350	-2.8
				5470-5725	-2.0
				5725-5850	-3.5

3.4. EUT Specifications Assessed in Current Report

Mode	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate (Mbps)
802.11b	2412-2472	13	DSSS (DBPSK/DQPSK/CCK)	Up to 11
802.11g		13	OFDM (BPSK/QPSK/16QAM/64QAM)	Up to 54
802.11n-HT20				Up to 144.4
802.11n-HT40	2422-2462	9		Up to 300
BLE	2402-2480	40	GFSK	1

Channel List			
802.11 b/g/n-HT20		802.11n-HT40	
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
1	2412	3	2422
2	2417	4	2427
3	2422	5	2432
4	2427	6	2437
5	2432	7	2442
6	2437	8	2447
7	2442	9	2452
8	2447	10	2457
9	2452	11	2462
10	2457		
11	2462		
12	2467		
13	2472		

Channel List							
BLE							
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
37	2402	09	2422	18	2442	28	2462
00	2404	10	2424	19	2444	29	2464
01	2406	38	2426	20	2446	30	2466
02	2408	11	2428	21	2448	31	2468
03	2410	12	2430	22	2450	32	2470
04	2412	13	2432	23	2452	33	2472
05	2414	14	2434	24	2454	34	2474
06	2416	15	2436	25	2456	35	2476
07	2418	16	2438	26	2458	36	2478
08	2420	17	2440	27	2460	39	2480



Audix Technology Corp.
No. 53-11, Dingfu, Linkou, Dist.,
New Taipei City 244, Taiwan

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Fax: +886 2 26099303

RMS Output Power (dBm)				
Channel	802.11b	802.11g	802.11n-HT20	802.11n-HT40
1	18.52	16.19	18.27	---
2	19.04	16.82	19.44	
3	19.58	17.49	19.92	16.38
4	20.46	18.58	20.06	16.96
5	20.98	19.24	20.48	17.08
6	21.06	20.49	20.64	17.41
7	21.02	18.85	20.45	17.32
8	20.95	18.24	20.05	16.95
9	20.42	17.92	19.58	16.35
10	19.36	16.82	18.75	12.08
11	18.74	16.47	17.87	4.43
12	14.31	13.25	15.53	---
13	12.80	-5.57	-3.29	

3.5. Descriptions of Key Components

3.5.1. For the All Component Lists

Item	Supplier	Model / Type	Character
System	Microsoft	Win10 Home	---
	Microsoft	Win10 Pro	---
Main Board	LG	14/15Z990 Main B/D PCB	(without Thunderbolt) Manufacturer: #1 Hannstar Board Tech(Jiang Yin)Corp.,Ltd. #2 Elec & Eltek Company (MCO) Limited
	LG	14/15Z990 Main B/D PCB	(with Thunderbolt) Manufacturer: #1 Hannstar Board Tech(Jiang Yin)Corp.,Ltd. #2 Elec & Eltek Company (MCO) Limited
SUB Board	LG	15Z990 WLAN SUB B/D	(with Finger Printer) Manufacturer: #1 Hannstar Board Tech(Jiang Yin)Corp.,Ltd. #2 Elec & Eltek Company (MCO) Limited
	LG	15Z990 WLAN SUB B/D	(without Finger Printer) Manufacturer: #1 Hannstar Board Tech(Jiang Yin)Corp.,Ltd. #2 Elec & Eltek Company (MCO) Limited
CPU (Socket: BGA1528)	Intel	i7-8565U	1.8GHz, up to 4.6GHz
	Intel	i5-8265U	1.6GHz, up to 3.9GHz
15.6" LCD Panel	LG Display	LP156WFA(SP)(G1)	Resolution: 1920 x 1080, 60Hz FHD IPS Touch (Touch)
	LG Display	LP156WF9(SP)(N1)	Resolution: 1920 x 1080, 60Hz FHD IPS (Normal Non touch)
Storage (SSD)	Samsung	MZ-NLN128C (P/N MZNLN128HAHQ-0000)	128GB (SATA)
	SK Hynix	P/N HFS512G39TNF	512GB (SATA)
		P/N HFS128G39TNF	128GB (SATA)
		P/N HFS256G39TNF	256GB (SATA)

Item	Supplier	Model / Type	Character
Memory (RAM)	Samsung	K4AAG16 5WB MCRC	8GB DDR4(On Board)
		K4A8G16 5WC-BCTD	4GB DDR4(On Board)
	SK hynix	H5ANAG6NAMR	8GB DDR4 (On Board)
		H5AN8G6NAFR	4GB DDR4(On Board)
	Samsung	M471A5244CB0-CRC	4GB DDR4 SODIMM(on Card)
		M471A5244CB0-CTD	4GB DDR4 SODIMM(on Card)
		M471A1K43CB1-CTD	8GB DDR4 SODIMM (on Card)
		M471A1K43CB1-CRC	8GB DDR4 SODIMM (on Card)
SK hynix	HMA81GS6AFR8N-UH	8GB DDR4 2400MHz SODIMM (on Card)	
	HMA851S6AFR6N-UH	4GB DDR4 2400MHz SODIMM (on Card)	
Battery Pack	LG	LBS1224E	72Wh, DC7.7V, 9450mAh
WLAN Combo Card	Intel	9560D2W	802.11a/b/g/n/ac 2.4GHz/5GHz + BT+BLE 5.0
WLAN Combo Antenna	LG (INPAQ)	WA-F-LBLB-04-056	FPCB Type Main: Black, Aux: Gray
	LG (LUXSHARE-ICT)	15Z980 ANTENNA ASM	PIFA Type Main: Black, Aux: Gray
Keyboard	LG	SN3870BL	15Z980 Black KBD
		SN3870BL1	15Z980 White KBD
Web Camera	Chicony	CKFIH2821005290LH	With two microphones
		CKFIH28-121005290LH	With One microphone
	Luxvisions	7BF109N2DC	With two microphones
		7BF109N2DD	With One microphone
Finger Print	SUNTEL	SFPA-L002STA(White)	---
	SUNTEL	SFPA-L002STB(Black)	---
LANGender (Type C to LAN)	SUZHOU MEC ELECTRONICS	80-5946-111 (White)	10/100 Megabit Ethernet
		80-5946-101 (Black)	
	ARIN TECH CO. LTD	GD-08MF-36-WH-LP10 (White)	10/100 Megabit Ethernet
		GD-08MF-36-BK-LP11 (Black)	
	Type C to LAN: Shielded, Undetached, 0.12m		
AC Adapter (48W)	LG (HONOR)	ADS-48MS-19-2 19048E	I/P: AC 100-240V, 50-60Hz, 1.5A, O/P: DC 19V, 2.53A
	DC Power Cord: Non-Shielded, Undetached, 1.8m		
	AC Power Cord: Non-Shielded, Detached, 1.0m (2C) (For Other Countries)		
	AC Power Cord: Non-Shielded, Detached, 1.55m (2C) (For US, Canada, Mexico)		

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

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

SKU	
Main Board	LG, 14/15Z990 Main B/D PCB (with Thunderbolt)
SUB Board	LG, 15Z990 WLAN SUB B/D (with Finger Printer)
CPU	Intel, i7-8565U
15.6" LCD Panel	LG Display, LP156WFA(SP)(G1) (Touch)
Storage (SSD)	Sk hynix, 512GB
	Sk hynix, 128GB
Memory (RAM)	Sk hynix, 8GB (On Board)
	SK hynix, 8GB (On Card)
Battery Pack	LG, LBS1224E
WLAN Combo Card	Intel, 9560D2W
WLAN Combo Antenna	LG (INPAQ), WA-F-LBLB-04-056
	LG (LUXSHARE-ICT), 15Z980 ANTENNA ASM
Keyboard	LG, SN3870BL1
Web Camera	Chicony, CKFIH2821005290LH (With two microphones)
Finger Print	SUNTEL, SFPA-L002STA(White)
LAN Gender (Type C to LAN)	SUZHOU MEC ELECTRONICS, 80-5946-111 (White)
AC Adapter	LG (HONOR), ADS-48MS-19-2 19048E

3.6. Data Rate Relative to Output Power

802.11b			
Channel	Modulation	Date Rate(Mbps)	Power(dBm)
1	DBPSK	1	20.23
1	DQPSK	2	20.04
1	CCK	5.5	19.89
1	CCK	11	19.74

802.11g			
Channel	Modulation	Date Rate(Mbps)	Power(dBm)
1	BPSK	6	22.57
1	BPSK	9	22.41
1	QPSK	12	22.28
1	QPSK	18	22.13
1	16-QAM	24	22.04
1	16-QAM	36	19.94
1	64-QAM	48	19.78
1	64-QAM	54	19.62

802.11n-HT20				802.11n-HT40			
Channel	Modulation	Date Rate (Mbps)	Power (dBm)	Channel	Modulation	Date Rate (Mbps)	Power (dBm)
1	BPSK	MCS8	23.20	3	BPSK	MCS8	21.94
1	QPSK	MCS9	23.02	3	QPSK	MCS9	21.78
1	QPSK	MCS10	22.92	3	QPSK	MCS10	21.56
1	16-QAM	MCS11	22.79	3	16-QAM	MCS11	21.32
1	16-QAM	MCS12	22.67	3	16-QAM	MCS12	21.18
1	64-QAM	MCS13	22.54	3	64-QAM	MCS13	21.02
1	64-QAM	MCS14	22.42	3	64-QAM	MCS14	20.85
1	64-QAM	MCS15	22.31	3	64-QAM	MCS15	20.68

BLE			
Channel	Modulation	Date Rate(Mbps)	Power(dBm)
0	GFSK	1	8.32

Note: Above results are assessed in peak power.

3.7. Test Configuration

Mode	Duty Cycle (x)	T (ms)	Duty Cycle Factor (dB)
802.11b	0.99	12.320	0
802.11g	0.98	2.050	0
802.11n-HT20	0.96	0.980	0.18
802.11n-HT40	0.92	0.495	0.36
BLE	0.62	0.390	2.08

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



AC Conduction	
Test Case	Normal operation

Item	Antenna	Mode	Data Rate	Test Channel
Radiated Test Case	WA-F-LBLB-04-056	802.11b	1Mbps	1/11/12/13
		802.11g	6Mbps	1/11/12/13
		802.11n-HT20	MCS8	1/11/12/13
		802.11n-HT40	MCS8	3/9/10/11
		BLE	1Mbps	37/39
	15Z980 ANTENNA ASM	802.11b	1Mbps	1/2/11/12/13
		802.11g	6Mbps	1/2/11/12/13
		802.11n-HT20	MCS8	1/2/11/12/13
		802.11n-HT40	MCS8	3/9/10/11
		BLE	1Mbps	37/39
	WA-F-LBLB-04-056	802.11b	1Mbps	1/6/11
		802.11g	6Mbps	1/6/11
		802.11n-HT20	MCS8	1/6/11
		802.11n-HT40	MCS8	3/6/9
		BLE	1Mbps	37/17/39
	15Z980 ANTENNA ASM	802.11b	1Mbps	1/6/11
		802.11g	6Mbps	1/6/11
		802.11n-HT20	MCS8	1/6/11
		802.11n-HT40	MCS8	3/6/9
		BLE	1Mbps	37/17/39
Conducted Test Case	6dB Bandwidth	802.11b	1Mbps	1/6/11/13
		802.11g	6Mbps	1/6/11/13
		802.11n-HT20	MCS8	1/6/11/13
		802.11n-HT40	MCS8	3/6/9/11
		BLE	1Mbps	37/17/39
	Peak Output Power	802.11b	1Mbps	1/6/11/13
		802.11g	6Mbps	1/6/11/13
		802.11n-HT20	MCS8	1/6/11/13
		802.11n-HT40	MCS8	3/6/9/11
		BLE	1Mbps	37/17/39
	Band Edge	802.11b	1Mbps	1/11/13
		802.11g	6Mbps	1/11/13
		802.11n-HT20	MCS8	1/11/13
		802.11n-HT40	MCS8	3/9/11
		BLE	1Mbps	37/39

Item		Mode	Data Rate	Test Channel
Conducted Test Case	Spurious Emission	802.11b	1Mbps	1/6/11/13
		802.11g	6Mbps	1/6/11/13
		802.11n-HT20	MCS8	1/6/11/13
		802.11n-HT40	MCS8	3/6/9/11
		BLE	1Mbps	37/17/39
	Peak Power Spectral Density	802.11b	1Mbps	1/6/11/13
		802.11g	6Mbps	1/6/11/13
		802.11n-HT20	MCS8	1/6/11/13
		802.11n-HT40	MCS8	3/6/9/11
		BLE	1Mbps	37/17/39

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

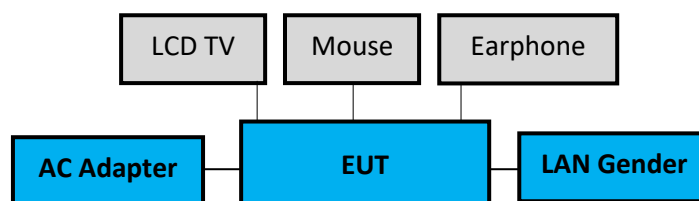
No.	Product	Brand	Model No.	Serial No.	Approval
1.	LCD TV	LG	22LK330-DB	N/A	N/A
2.	USB Mouse	DELL	MS111-L	CN-09RRC7-48723-2B7-0H3M	FCC By DoC
3.	Earphone	SAMPO	EK-Y1251MP	N/A	N/A

3.8.2. Cable Lists

No.	Cable Description Of The Above Support Units
1.	HDMI Cable: Shielded, Detachable, 1.8m AC Power Cord: Unshielded, Detachable, 1.8m
2.	USB Cable: Unshielded, Undetachable, 1.8m
3.	Earphone Cable: Unshielded, Undetachable, 2.0m

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 “DRTU” is used for enabling EUT BT or WLAN function under continues transmitting and choosing data rate/ 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
Test Facilities	FCC OET Designation Number under APEC MRA by NCC is : TW1724 (1) No. 8 Shielding Room (2) Semi-Anechoic Chamber (IC Test Site Registration No.:5183B-1) (3) Fully Anechoic Chamber (IC Test Site Registration No.:5183B-4)

3.12. Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conduction Test	150kHz~30MHz	$\pm 3.50\text{dB}$
Radiation Test (Distance: 3m)	30MHz~1000MHz	$\pm 3.68\text{dB}$
	Above 1GHz	$\pm 5.82\text{dB}$

Remark : Uncertainty = $ku_c(y)$

Test Item	Uncertainty
6dB Bandwidth	$\pm 0.05\text{kHz}$
Maximum peak output power	$\pm 0.33\text{dB}$
Power spectral density	$\pm 0.13\text{dB}$
Conducted Emission Limitations	$\pm 0.13\text{dB}$

4. MEASUREMENT EQUIPMENT LIST

4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Test Receiver	R&S	ESR3	101774	2018. 01. 24	1 Year
2.	A.M.N.	R&S	ENV4200	100169	2017. 11. 12	1 Year
3.	L.I.S.N.	Kyoritsu	KNW-407	8-855-9	2017. 12. 14	1 Year
4.	Pulse Limiter	R&S	ESH3-Z2	100354	2018. 01. 16	1 Year
5.	Signal Cable	Yeida	RG/58AU	CE-08	2018. 09. 21	1 Year
6.	Digital Thermo- Hygro Meter	iMax	HTC-1	No.8 S/R	2018. 04. 20	1 Year

4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2018. 09. 12	1 Year
2.	Spectrum Analyzer	Agilent	N9030A-526	MY53310269	2018. 02. 01	1 Year
3.	Test Receiver	R & S	ESCS30	100338	2018. 06. 20	1 Year
4.	Amplifier	HP	8447D	2944A06305	2018. 01. 30	1 Year
5.	Amplifier	HP	8449B	3008A02678	2018. 03. 06	1 Year
6.	Loop Antenna	R&S	HFH2-Z2	891847/27	2017. 12. 18	1 Year
7.	Bilog Antenna	CHASE	CBL6112D	33821	2018. 01. 21	1 Year
8.	Horn Antenna	COM-POWER	AH-840	101092	2018. 05. 07	1 Year
9.	Horn Antenna	ETS-Lindgren	3117	00135902	2018. 03. 08	1 Year
10.	2.4GHz Notch Filter	K&L	7NSL10-2441.5E130.5-00	1	2018. 07. 24	1 Year
11.	3GHz High-Pass Filter	Microwave	H3G018G1	484796	2018. 08. 22	1 Year
12.	Digital Thermo-Hygro Meter	iMax	HTC-1	No.1 3m A/C	2018. 04. 20	1 Year
13.	Digital Thermo-Hygro Meter	iMax	E-512	RF-02	2018. 04. 20	1 Year
14.	Test Software	Audix	e3	V.6.110601	N.C.R.	N.C.R.

4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
1.	Spectrum Analyzer	Keysight	N9010B-544	MY55460198	2018. 04. 26	1 Year
2.	Power Meter	Anritsu	ML2495A	1145008	2017. 11. 03	1 Year
3.	Power Sensor	Anritsu	MA2411B	1126096	2017. 11. 03	1 Year
4.	Digital Thermo-Hygro Meter	Shenzhen Datronn Electronics	KT-905	RF	2018. 04. 20	1 Year

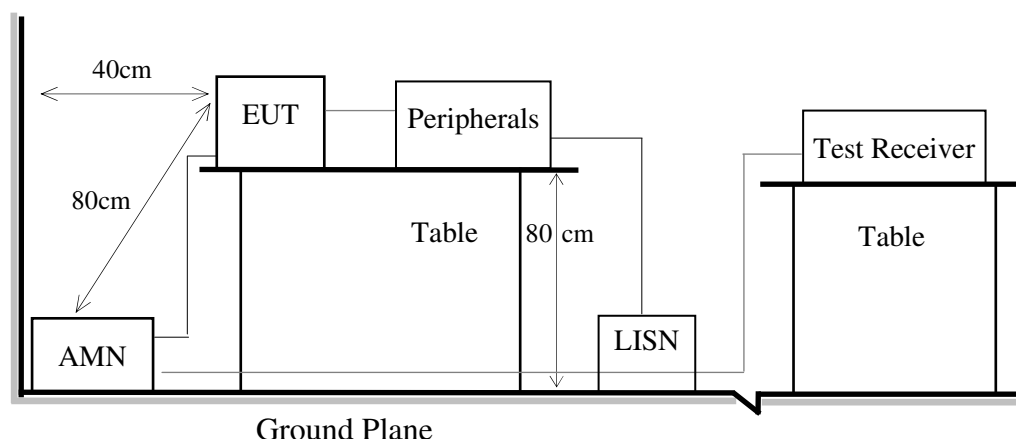
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.9

5.1.2. Shielded Room Setup Diagram



5.2. Conducted Emission Limit

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

Remark 1.: 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 C 63.10. 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 150 kHz to 30 MHz and record the emission which does not have 20 dB below limit.

5.4. Test Results

Please refer to Appendix A.

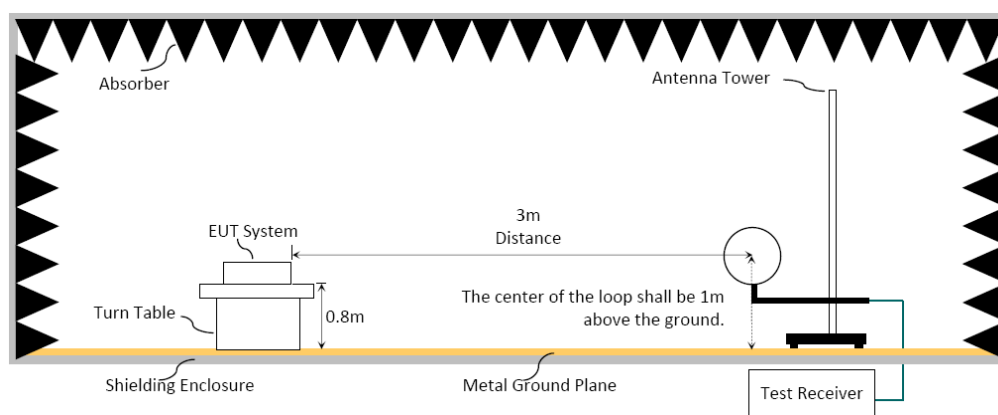
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

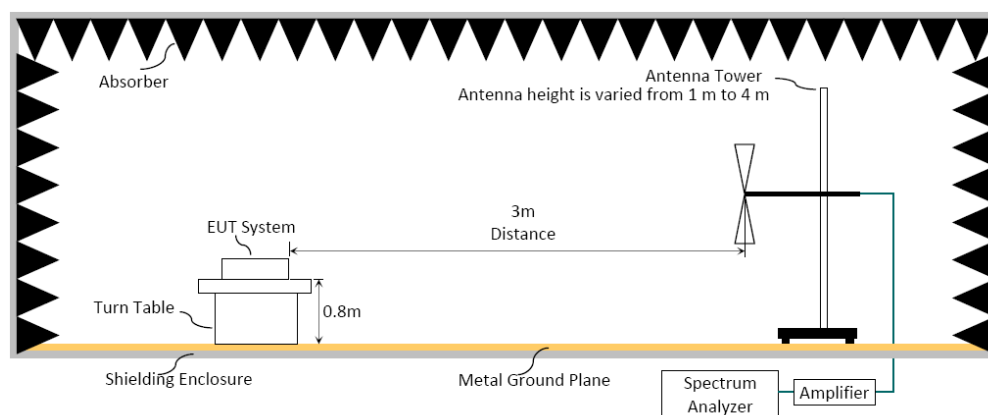
6.1.1. Block Diagram of EUT

Indicated as section 3.9

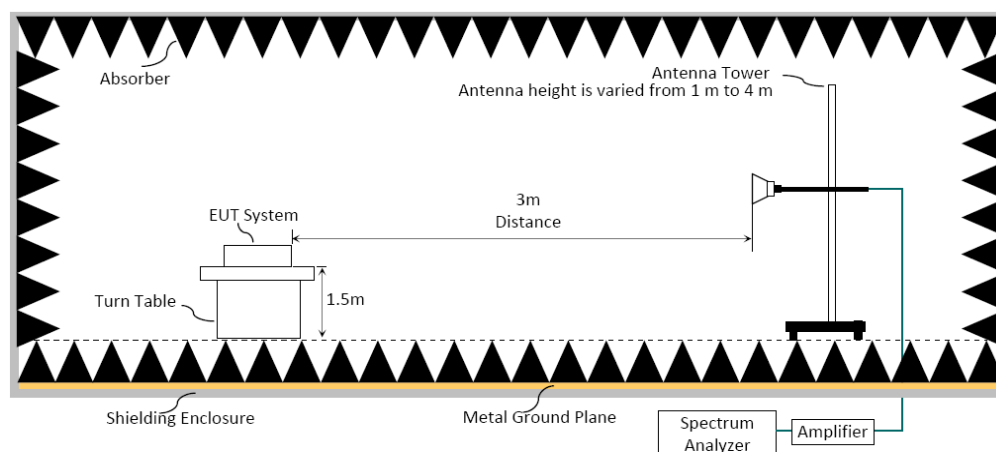
6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000 MHz



6.1.4. Setup Diagram for above 1GHz



6.2. Radiated Emission Limits

In any 100kHz bandwidth outside the frequency band, the radio frequency power produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205/RSS-Gen Section 8.10 table 6, must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance (m)	Limits	
		dB μ V/m	μ V/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 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.

6.3. 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 ~ 25GHz:

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 final measurement.

Frequency above 1GHz to 10th harmonic (up to 25 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 final measurement.

Average Detector:

☒ Option 1:

(1) RBW = 1MHz

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

Modulation Type	T (ms)	1/T (kHz)	VBW Setting (kHz)
BLE	12.320	0.081	10Hz
802.11b	2.050	0.488	10Hz
802.11g	0.980	1.020	1kHz
802.11n-HT20	0.495	2.020	2kHz
802.11n-HT40	0.390	2.564	2.7kHz

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.

6.4. 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 + DCCF

Duty Cycle Correction Factor (DCCF) = $20\log(TX_{on}/TX_{on+off})$ presented in section 3.7

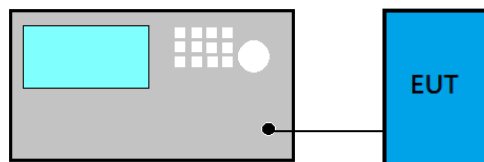
☐ ERP = Peak Emission Level - 95.2dB - 2.14dB

6.5. Test Results

Please refer to Appendix A.

7. 6dB BANDWIDTH

7.1. Block Diagram of Test Setup



7.2. Specification Limits

The minimum 6dB bandwidth shall be at least 500kHz.

7.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v05:

- (1) Set RBW = 100 kHz.
- (2) Set the video bandwidth (VBW) $\geq 3 \times$ 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.

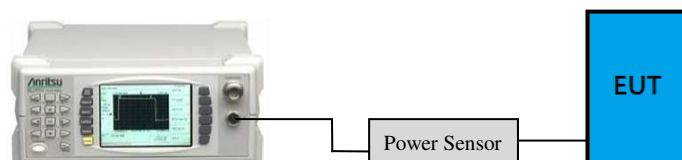
7.4. Test Results

Please refer to Appendix A

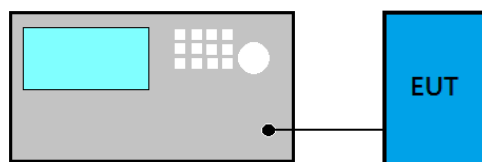
8. MAXIMUM PEAK OUTPUT POWER

8.1. Block Diagram of Test Setup

- For WLAN Function



- For BLE Function



8.2. Specification Limits

The Limits of maximum Peak Output Power for digital modulation in 2400-2483.5MHz is : 1Watt. (30dBm), and E.I.R.P.: 4Watt (36dBm)

8.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v05:

■ PKPM1 Peak power meter method:

EUT is connected to power sensor and record the maximum output power.

■ Maximum peak conducted output power method:

- (1) Set the RBW \geq DTS bandwidth
- (2) Set VBW $\geq 3 \times$ RBW
- (3) Set span $\geq 3 \times$ RBW.
- (4) Sweep time = auto couple
- (5) Detector = peak.
- (6) Trace mode = max hold.
- (7) Allow trace to fully stabilize.
- (8) Use peak marker function to determine the peak amplitude level.

■ 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)

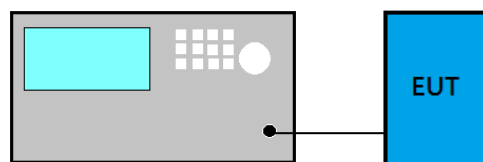
- (1) Set span to at least 1.5 times the OBW
- (2) Set RBW = 1 -5% of OBW
- (3) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- (4) Detector = RMS.
- (5) Trace mode = trace average at least 100 traces
- (6) Sweep = auto couple.
- (7) Compute power by integrating the spectrum across the OBW of the 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

9. EMISSION LIMITATIONS

9.1. Block Diagram of Test Setup



9.2. Specification Limits

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, that the required attenuation shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in Section 15.209(a)/RSS-Gen Section 8.9 table 4 is not required. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a)/RSS-Gen Section 8.10 table 6, must also comply with the radiated emission limits specified in Section 15.209(a)/RSS-Gen Section 8.9 table 4 (See Section 15.205(c)).

9.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v05:

■ Reference Level

- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: 100 kHz.
- (4) Set the VBW $\geq 3 \times$ RBW.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully stabilize to find the max PSD as reference level.

■ Emission Level Measurement

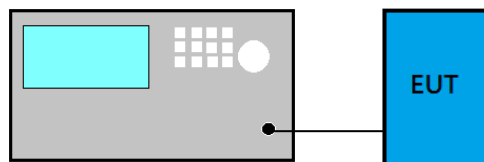
- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: 100 kHz.
- (4) Set the VBW $\geq 3 \times$ RBW.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully stabilize to find the max level.

9.4. Test Results

Please refer to Appendix A

10. POWER SPECTRAL DENSITY

10.1. Block Diagram of Test Setup



10.2. Specification Limits

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band.

10.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v05:

☒ Method PKPSD (peak PSD)

- (1) Set analyzer center frequency to DTS channel center frequency.
- (2) Set the span to 1.5 times the DTS bandwidth.
- (3) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- (4) Set the VBW $\geq 3 \times \text{RBW}$.
- (5) Detector = peak.
- (6) Sweep time = auto couple.
- (7) Trace mode = max hold.
- (8) Allow trace to fully stabilize.
- (9) Use the peak marker function to determine the maximum amplitude level.
- (10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

☐ Method AVGPSD-2

- (1) Using peak PSD procedure step 1 to step 4.
- (2) Detector = RMS detector
- (3) Sweep time = auto couple
- (4) Trace mode = trace averaging over a minimum of 100 traces
- (5) Use the peak marker function to determine the maximum amplitude level.
- (6) Duty cycle factor is added when duty cycle presented in section 3.7 < 98%.
- (7) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

10.4. Test Results

Please refer to Appendix A



Audix Technology Corp.
No. 53-11, Dingfu, Linkou, Dist.,
New Taipei City 244, Taiwan

Tel: +886 2 26099301
Fax: +886 2 26099303

11.DEVIATION TO TEST SPECIFICATIONS

【NONE】



Audix Technology Corp.
No. 53-11, Dingfu, Linkou, Dist.,
New Taipei City 244, Taiwan

APPENDIX A

Tel: +886 2 26099301
Fax: +886 2 26099303

APPENDIX A

TEST DATA AND PLOTS

(Model: 15Z990)



Audix Technology Corp.
No. 53-11, Dingfu, Linkou, Dist.,
New Taipei City 244, Taiwan

APPENDIX B

Tel: +886 2 26099301
Fax: +886 2 26099303

APPENDIX B

TEST PHOTOGRAPHS

(Model: 15Z990)