

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No. : OT-212-RWD-019

Reception No. : 2101000274

Applicant : LG Electronics USA

Address : 111 Sylvan Avenue, North Building, Englewood Cliffs, New Jersey, 07632, United States

Manufacturer : LG Electronics Inc

Address : 10, Magokjungang 10-ro, Gangseo-gu, Seoul, Republic of Korea

Type of Equipment : NAVIGATION RADIO

FCC ID. : BEJLANR21

Model Name : LANR21

Serial number : N/A

Total page of Report : 10 pages (including this page)

Date of Incoming : January 28, 2021

Date of issue : February 08, 2021

SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART C Section 15.247 and FCC PART 15 SUBPART E Section 15.407**

This test report only contains the result of a single test of the sample supplied for the examination.

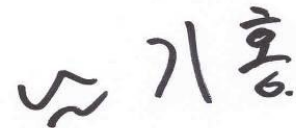
It is not a generally valid assessment of the features of the respective products of the mass-production.



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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-212-RWD-019	February 08, 2021	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : LG Electronics USA

Address : 111 Sylvan Avenue, North Building, Englewood Cliffs, New Jersey, 07632, United States

Contact Person : Dae Woong Kim / Director, Regulatory and Environmental Affairs

Telephone No. : 201-266-2215

FCC ID : BEJLANR21

Model Name : LANR21

Brand Name : -

Serial Number : N/A

Date : February 08, 2021

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM Unlicensed National Information infrastructure(UNII)
E.U.T. DESCRIPTION	NAVIGATION RADIO
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02 FCC PART 15 SUBPART E Section 15.407 789033 D02 General UNII Test Procedures New Rules v02r01
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. GENERAL INFORMATION

2.1 Product Description

The LG Electronics USA, Model LANR21 (referred to as the EUT in this report) is a NAVIGATION RADIO. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	NAVIGATION RADIO	
Temperature Range	-40 °C ~ 80 °C	
OPERATING FREQUENCY	Bluetooth LE	2 402 MHz ~ 2 480 MHz
	Bluetooth	2 402 MHz ~ 2 480 MHz
	WLAN 2.4 GHz	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))
	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11a/n(HT20)/ac(VHT20))
		5 190 MHz ~ 5 230 MHz (802.11n(HT40)/ac(VHT40))
		5 210 MHz (802.11ac(VHT80))
	5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 805 MHz (802.11a/n(HT20)/ac(VHT20))
		5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40))
		5 775 MHz (802.11ac(VHT80))
MODULATION TYPE	Bluetooth LE	GFSK for 1 Mbps / 2 Mbps
	Bluetooth	GFSK for 1 Mbps, $\pi/4$ -DQPSK for 2 Mbps, 8-DPSK for 3 Mbps
	WLAN 2.4 GHz	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK)
		802.11g/n(HT20): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
	WLAN 5 GHz	802.11a/n(HT20)/n(HT40)/ac(VHT80): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)

RF OUTPUT POWER	Bluetooth LE	1 Mbps	-3.31 dBm
		2 Mbps	-3.65 dBm
	Bluetooth	1 Mbps	-2.69 dBm
		2 Mbps	-4.40 dBm
		3 Mbps	-4.06 dBm
	WLAN 2.4 GHz	16.23 dBm(802.11b) 16.45 dBm(802.11g) 15.46 dBm(802.11n_HT20)	
	5 150 MHz ~ 5 250 MHz Band	12.83 dBm(802.11a) 8.73 dBm(802.11n_HT20) 8.01 dBm(802.11n_HT40) 6.00 dBm(802.11ac_VHT80)	
	5 725 MHz ~ 5 850 MHz Band	11.26 dBm(802.11a) 11.12 dBm(802.11n_HT20) 11.98 dBm(802.11n_HT40) 8.99 dBm(802.11ac_VHT80)	
ANTENNA TYPE	Bluetooth LE	Chip Antenna	
	Bluetooth	Chip Antenna	
	WLAN 2.4 GHz	PCB Antenna	
	WLAN 5 GHz	Chip Antenna	
ANTENNA GAIN	Bluetooth LE	2.86 dBi	
	Bluetooth	2.86 dBi	
	WLAN 2.4 GHz	-2.91 dBi	
	5 150 MHz ~ 5 250 MHz Band	2.75 dBi	
	5 725 MHz ~ 5 850 MHz Band	2.13 dBi	
	List of each Osc. or crystal Freq.(Freq. >= 1 MHz)		32.768 kHz, 20 MHz, 25 MHz, 28.636 36 MHz, 38.4 MHz, 55.466 67 MHz

2.2 Alternative type(s)/model(s); also covered by this test report.

-. None

3. EUT MODIFICATIONS

-. None

4. MAXIMUM PERMISSIBLE EXPOSURE

4.1 RF Exposure Calculation

According to the FCC rule 1.1310 table 1B, the limit for the maximum permissible RF exposure for an uncontrolled environment are $f/1500$ mW/cm² for the frequency range between 300 MHz and 1 500 MHz and 1.0 mW/cm² for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm² exposure is calculated as follows:

$$E = \sqrt{(30 * P * G) / d}, \text{ and } S = E^2 / Z = E^2 / 377, \text{ because } 1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$$

Where

S = Power density in mW/cm², Z = Impedance of free space, 377 Ω

E = Electric field strength in V/m, G = Numeric antenna gain, and d = distance in meter

Combining equations and rearranging the terms to express the distance as a function of the remaining variable

$$d = \sqrt{(30 * P * G) / (377 * 10 S)}$$

Changing to units of mW and cm, using P (mW) = P (W) / 1 000, d (cm) = 0.01 * d (m)

$$d = 0.282 * \sqrt{(P * G) / S}$$

Where

d = distance in cm, P = Power in mW, G = Numeric antenna gain, and S = Power density in mW/cm²

4.2 EUT Description

Kind of EUT	NAVIGATION RADIO
Device Category	☐ Portable (< 20 cm separation) ☐ Mobile (> 20 cm separation) ☒ Others
Exposure Evaluation Applied	☒ MPE ☐ SAR ☐ N/A

4.3 Calculated MPE Safe Distance for WLAN

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
			(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11b	15.5 ± 1.0	16.50	44.67	-2.91	0.51	1.35	0.004 5	1.00
	802.11g	16.0 ± 1.0	17.00	50.12			1.43	0.005 1	1.00
	802.11n_HT20	15.0 ± 1.0	16.00	39.81			1.27	0.004 1	1.00
5 150 ~ 5 250	802.11a	12.5 ± 1.0	13.50	22.39	2.75	1.88	1.83	0.008 4	1.00
	802.11n_HT20	8.5 ± 1.0	9.50	8.91			1.16	0.003 3	1.00
	802.11n_HT40	8.0 ± 1.0	9.00	7.94			1.09	0.003 0	1.00
	802.11ac80	6.0 ± 1.0	7.00	5.01			0.87	0.001 9	1.00
5 725 ~ 5 850	802.11a	10.5 ± 1.0	11.50	14.13	2.13	1.63	1.35	0.004 6	1.00
	802.11n_HT20	10.5 ± 1.0	11.50	14.13			1.35	0.004 6	1.00
	802.11n_HT40	11.5 ± 1.0	12.50	17.78			1.52	0.005 8	1.00
	802.11ac80	9.0 ± 1.0	10.00	10.00			1.14	0.003 3	1.00

According to above table, for 2 400 ~ 2483.5 MHz Band(802.11 g), safe distance,

$$D = 0.282 * \sqrt{(50.12 * 0.51)/1.00} = 1.43 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 50.12 * 0.51 / (4 * \pi * 20^2) = 0.005 1$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna

4.4 Calculated MPE Safe Distance for Bluetooth LE

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
			(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	1 Mbps	-3.5 ± 1.0	-2.50	0.56	2.86	1.93	0.29	0.000 2	1.00
	2 Mbps	-3.5 ± 1.0	-2.50	0.56			0.29	0.000 2	1.00

According to above table, for 2 402 ~ 2480 MHz Band(1 Mbps), safe distance,

$$D = 0.282 * \sqrt{(0.56 * 1.93)/1.00} = 0.29 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 0.56 * 1.93 / (4 * \pi * 20^2) = 0.000 2$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna

4.5 Calculated MPE Safe Distance for Bluetooth

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
			(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	1 Mbps	-3.0 ± 1.0	-2.00	0.63	2.86	1.93	0.31	0.000 2	1.00
	2 Mbps	-4.5 ± 1.0	-3.50	0.45			0.26	0.000 2	1.00
	3 Mbps	-4.5 ± 1.0	-3.50	0.45			0.26	0.000 2	1.00

According to above table, for 2 402 ~ 2480 MHz Band(1 Mbps), safe distance,

$$D = 0.282 * \sqrt{(0.63 * 1.93)/1.00} = 0.31 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 0.63 * 1.93 / (4 * \pi * 20^2) = 0.000 2$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna

4.6 DATA for Intermodulation Transmit

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	Max tune up power		Power Density (mW/cm ²) @ 20 cm Separation	Sum Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
			(dBm)	(mW)			
Bluetooth + WLAN 2 G	Bluetooth (1 Mbps)	-3.0 ± 1.0	-2.00	0.63	0.000 2	0.005 3	1.00
	WLAN 2 G (802.11 g)	16.0 ± 1.0	17.00	50.12	0.005 1		
Bluetooth + WLAN 5 G	Bluetooth (1 Mbps)	-3.0 ± 1.0	-2.00	0.63	0.000 2	0.008 6	1.00
	WLAN 5 G (UNII 1_ 802.11 a)	12.5 ± 1.0	13.50	22.39	0.008 4		
Bluetooth LE + WLAN 2 G	Bluetooth LE (1 Mbps)	-3.5 ± 1.0	-2.50	0.56	0.000 2	0.005 3	1.00
	WLAN 2 G (802.11 g)	16.0 ± 1.0	17.00	50.12	0.005 1		
Bluetooth LE + WLAN 5 G	Bluetooth LE (1 Mbps)	-3.5 ± 1.0	-2.50	0.56	0.000 2	0.008 6	1.00
	WLAN 5 G (UNII 1_ 802.11 a)	12.5 ± 1.0	13.50	22.39	0.008 4		