

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

Test Report No. : OT-193-RWD-056

AGR No. : A18DA-151R

Applicant : LG Electronics USA

Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, United States, 07632

Manufacturer : LG Electronics Inc.

Address : 222 LG-ro, Jinwi-Myeon, Pyeongtaek -Si, Gyeonggi-Do, 451-713, Korea

Type of Equipment : Car Navigation

FCC ID. : BEJ-MIB3OI

Model Name : MIB3 OI

Serial number : N/A

Total page of Report : 13 pages (including this page)

Date of Incoming : January 11, 2019

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SUMMARY

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

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.

Reviewed by:



Yu-Seog Sim / Assistant Manager
ONETECH Corp.

Approved by:



Jae-Ho Lee / Chief Engineer
ONETECH Corp.

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REVISION HISTORY

Issued Report No.	Issued Date	Revisions	Effect Section
OT-193-RWD-056	March 26, 2019	Initial Issue	All

DOCUMENT HISTORY

Revision No.	Issued Date	Revisions	Effect Section
Original	April 28, 2017	Initial Issue	-
Rev. 01	May 30, 2019	4. MAXIMUM PERMISSIBLE EXPOSURE	-

1. VERIFICATION OF COMPLIANCE

Applicant : LG Electronics USA
Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, United States, 07632
Contact Person : Kyung-Su Han / Director
Telephone No. : (201) 266-2215
FCC ID : BEJ-MIB3OI
Model Name : MIB3 OI
Brand Name : LG, Volkswagen, Seat
Serial Number : N/A
Date : March 26, 2019

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM NII – Unlicensed National Information Infrastructure(UNII)
E.U.T. DESCRIPTION	Car Navigation
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 FCC PART 15 SUBPART E Section 15.407 KDB 558074 D01 DTS Meas Guidance
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 MIB3 OI (referred to as the EUT in this report) is a Car Navigation. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Car Navigation			
FREQUENCY RANGE	Bluetooth	2 402 MHz ~ 2 480 MHz		
	WLAN 2.4 GHz Band	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))		
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11a/n/ac(HT20))	
			5 190 MHz ~ 5 230 MHz (802.11n/ac(HT40))	
			5 210 MHz (802.11ac(VHT80))	
		5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11a/n/ac(HT20))	
			5 755 MHz ~ 5 795 MHz (802.11n/ac(HT40))	
			5 775 MHz (802.11ac(VHT80))	
MAX. RF OUTPUT POWER	Bluetooth	1 Mbps	-1.40 dBm	
		2 Mbps	-0.61 dBm	
		3 Mbps	-0.07 dBm	
	WLAN 2.4 GHz Band	Wi-Fi 802.11b (15.43 dBm) Wi-Fi 802.11g (17.26 dBm) Wi-Fi 802.11n(HT20) (15.97 dBm)		
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	Antenna 0	Wi-Fi 802.11a (10.49 dBm) Wi-Fi 802.11n(HT20) (10.44 dBm) Wi-Fi 802.11n(HT40) (8.21 dBm) Wi-Fi 802.11ac(VHT80) (7.34 dBm)
			Antenna 1	Wi-Fi 802.11a (10.15 dBm) Wi-Fi 802.11n(HT20) (10.07 dBm) Wi-Fi 802.11n(HT40) (8.35 dBm) Wi-Fi 802.11ac(VHT80) (7.68 dBm)
			Multiple transmit	Wi-Fi 802.11n(HT20) (13.24 dBm) Wi-Fi 802.11n(HT40) (11.29 dBm) Wi-Fi 802.11ac(VHT80) (10.52 dBm)

MAX. RF OUTPUT POWER	WLAN 5 GHz Band	5 725 MHz ~ 5 850 MHz Band		Antenna 0	Wi-Fi 802.11a (9.37 dBm) Wi-Fi 802.11n(HT20) (9.39 dBm) Wi-Fi 802.11n(HT40) (7.29 dBm) Wi-Fi 802.11ac(VHT80) (6.34 dBm)		
				Antenna 1	Wi-Fi 802.11a (10.42 dBm) Wi-Fi 802.11n(HT20) (10.52 dBm) Wi-Fi 802.11n(HT40) (8.49 dBm) Wi-Fi 802.11ac(VHT80) (7.74 dBm)		
				Multiple transmit	Wi-Fi 802.11n(HT20) (12.84 dBm) Wi-Fi 802.11n(HT40) (10.94 dBm) Wi-Fi 802.11ac(VHT80) (10.11 dBm)		
MODULATION TYPE	Bluetooth			GFSK for 1 Mbps, $\pi/4$ -DQPSK for 2 Mbps, 8-DPSK for 3 Mbps			
	WLAN 2.4 GHz Band			DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)			
	WLAN 5 GHz Band			OFDM Modulation(BPSK/QPSK/16QAM/64QAM)			
ANTENNA TYPE	Bluetooth			PCB Antenna			
	WLAN (2.4GHz Band)			Chip Antenna			
	WLAN (5GHz Band)	Antenna 0		PCB Antenna			
		Antenna 1		Chip Antenna			
ANTENNA GAIN	Bluetooth			2.5 dBi			
	WLAN 2.4 GHz Band			3.8 dBi			
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz		ANT0	3.8 dBi		
				ANT1	1.6 dBi		
		5 725 MHz ~ 5 850 MHz	ANT0	5.5 dBi			
			ANT1	2.4 dBi			
	5 GHz Band (ANT 0 + 1)	5 150 MHz ~ 5 250 MHz		5.78 dBi			
		5 725 MHz ~ 5 850 MHz		7.10 dBi			
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)				31.25 MHz, 28.63636 MHz			
RATED SUPPLY VOLTAGE				DC 12.0 V			

- Directional Gain Calculations

$$\text{Directional gain} = 10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{\text{ANT}}] \text{ dBi}$$

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

-. The following lists consist of the added config and their differences.:

Brand	Model	Config	Feature							Tested
			BT	Wi-Fi	RVC	DAB	Amp	Tuner Configuration	Platform	
LG Volkswagen Seat	MIB3 OI	L91VW3-N200	O	O	O	O	4CH	Mercury,Merlin	MQB	☒
		L91VW3-N20A	O	O	O	O	4CH	Titan,Merlin	MQB	☐
		L91VW3-N320	O	O	O	X	4CH	Mercury,Merlin	MQB	☐
		L91VW3-N160	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91VW3-N16A	O	O	O	O	4CH	Titan,Merlin	MQB	☐
		L91VW3-N740	O	O	O	X	4CH	Titan,Merlin	MQB	☐
		L91VW3-N760	O	O	O	X	4CH	Mercury,Merlin	MQB	☐
		L92VW3-N200	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92VW3-N20A	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92VW3-N320	O	O	X	X	4CH	Titan,Merlin	MQB37	☐
		L92VW3-N160	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92VW3-N16A	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92VW3-N740	O	O	X	X	4CH	Titan,Merlin	MQB37	☐
		L92VW3-N760	O	O	X	X	4CH	Titan,Merlin	MQB37	☐
		L91SE3-N200	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91SE3-N20A	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91SE3-N320	O	O	O	X	4CH	Titan,Merlin	MQB	☐
		L91SE3-N620	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91SE3-N62A	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91SE3-N670	O	O	O	X	4CH	Titan,Merlin	MQB	☐
		L91SE3-N680	O	O	O	X	4CH	Titan,Merlin	MQB	☐
		L92SE3-N620	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92SE3-N62A	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92SE3-N670	O	O	X	X	4CH	Titan,Merlin	MQB37	☐
		L92SE3-N680	O	O	X	X	4CH	Titan,Merlin	MQB37	☐

Note: 1. Applicants must delegate only the models with all features applied to be tested, Therefore, this test report only guarantees the unit tested.

2. The Applicant/manufacture is responsible for the compliance of all configs.

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 $f/1500 \text{ mW/cm}^2$ for the frequency range between 300 MHz and 1 500 MHz and 1.0 mW/cm^2 for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm^2 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/cm^2 , Z = Impedance of free space, 377Ω

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 $P (\text{mW}) = P (\text{W}) / 1 000$, $d (\text{cm}) = 0.01 * d (\text{m})$

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

Where

d = distance in cm , P = Power in mW , G = Numeric antenna gain, and S = Power density in mW/cm^2

4.2 EUT Description

Kind of EUT	Car Navigation
Operating Frequency Band	☐ Wireless Microphone: 494.000 MHz ~ 501.000 MHz and 498.200 MHz ~ 505.200 MHz ☒ WLAN: 2 412 MHz ~ 2 462 MHz ☐ WLAN: 2 422 MHz ~ 2 452 MHz ☒ WLAN: 5 180 MHz ~ 5 240 MHz ☒ WLAN: 5 190 MHz ~ 5 230 MHz ☒ WLAN: 5 210 MHz ☒ WLAN: 5 745 MHz ~ 5 825 MHz ☒ WLAN: 5 755 MHz ~ 5 795 MHz ☒ WLAN: 5 775 MHz ☒ FHSS: 2 402 MHz ~ 2 480 MHz ☐ GFSK Modulation: 2403 MHz , 2443 MHz , 2478 MHz
Device Category	☐ Portable (< 20 cm separation) ☒ Mobile (> 20 cm separation) ☐ Others
Exposure Evaluation Applied	☒ MPE ☐ SAR ☐ N/A

5. Calculated MPE Safe Distance

5.1 Test data (2.4 GHz Band)

According to above equation, the following result was obtained.

Operating Freq. Band	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11b	14.93 ± 0.5	15.43	34.91	3.8	2.399	2.87	0.016 7	1.00
2 400 ~ 2 483.5	802.11g	16.76 ± 0.5	17.26	53.21	3.8	2.399	3.19	0.025 4	1.00
2 400 ~ 2 483.5	802.11n(HT20)	15.47 ± 0.5	15.97	39.54	3.8	2.399	2.75	0.018 9	1.00

According to above table, for 2 400 ~ 2 483.5 MHz Band, safe distance,

$$D = 0.282 * \sqrt{(34.91 * 2.399)/1.00} = 2.87 \text{ cm}$$

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

$$S = P * G / (4\pi * R^2) = 34.91 * 2.399 / (4 * 3.14 * 20^2) = 0.016 7$$

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



Tested by: Ha-Ram Lee / Assistant Manager

5.2 Test data (5 GHz Band)

According to above equation, the following result was obtained.

Operating Freq. Band	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
5 150 ~ 5 250	802.11a	9.99 ± 0.5	10.49	11.19	3.80	2.399	1.46	0.005 3	1.00
5 150 ~ 5 250	802.11n(HT20)	12.74 ± 0.5	13.24	21.09	5.78	3.784	2.52	0.015 9	1.00
5 150 ~ 5 250	802.11n(HT40)	10.79 ± 0.5	11.29	13.46	5.78	3.784	2017	0.010 1	1.00
5 150 ~ 5 250	802.11ac(VHT80)	10.02 ± 0.5	10.52	11.27	5.78	3.784	1.84	0.008 5	1.00
5 725 ~5 850	802.11a	9.92 ± 0.5	10.42	11.02	2.40	1.738	1.23	0. 003 8	1.00
5 725 ~5 850	802.11n(HT20)	12.34 ± 0.5	12.84	19.23	7.10	5.129	2.80	0.019 6	1.00
5 725 ~5 850	802.11n(HT40)	10.44 ± 0.5	10.94	12.42	7.10	5.129	2.25	0.012 7	1.00
5 725 ~5 850	802.11ac(VHT80)	9.61 ± 0.5	10.11	10.26	7.10	5.129	2.05	0.010 5	1.00

According to above table, for 5 150 ~ 5 250 MHz Band, safe distance,

$$D = 0.282 * \sqrt{(11.19 * 2.399)/1.00} = 1.46 \text{ cm}$$

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

$$S = P * G / (4\pi * R^2) = 11.19 * 2.399 / (4 * 3.14 * 20^2) = 0.005 3$$

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



Tested by: Ha-Ram Lee / Assistant Manager

5.3 Calculation Result Of Maximum Conducted Power

Operating Freq. Band	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2.4G WLAN	802.11g	16.76 ± 0.5	17.26	53.21	3.80	2.399	3.19	0.025 4	1.00
BT	3 Mbps	-0.57 ± 0.5	-0.07	0.98	2.5	1.778	0.37	0.000 348	1.00
5 150 ~ 5 250	802.11n(HT20)	12.74 ± 0.5	13.24	21.09	5.78	3.784	2.52	0.015 9	1.00
5 725 ~5 850	802.11n(HT20)	12.34 ± 0.5	12.84	19.23	7.10	5.129	2.80	0.019 6	1.00

- Bluetooth transmit simultaneously with 2.4 GHz and 5 GHz WiFi.

2.4 GHz band + Bluetooth + 5 GHz band =

$(0.025\ 4 / 1) + (0.000\ 348 / 1) + (0.015\ 9 / 1) + (0.019\ 6 / 1) = 0.061\ 248$

- Therefore the maximum calculations of above situations are less than the “1” limit.



Tested by: Ha-Ram Lee / Assistant Manager