SGS Korea Co., Ltd.
4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
Tel. +82 31 428 5700 / Fax. +82 31 427 2370
http://www.sgsgroup.kr

TEST REPORT

of

FCC CFR 47 part 1, 1.1307(b), 1.1310

FCC ID: BEJTM16FNNABM0

Equipment Under Test	:	Telematics Module
Model Name	:	TM16FNNABM0
Variant Model Name(s)	:	-
Applicant	:	LG Electronics USA
Manufacturer	:	LG Electronics Inc.
Date of Receipt	:	2023.12.13
Date of Test(s)	:	2023.12.13 ~ 2024.03.27
Date of Issue	:	2024.03.27

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

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Tested by: Murphy Kim

Technical Manager: Jinhyoung Cho

SGS Korea Co., Ltd. Gunpo Laboratory

INDEX

Table of Contents

1. General Information ---------- 3

2. RF Exposure Evaluation ---------- 7

1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- CAB Identifier: KR0150

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Phone No. : +82 31 688 0901
Fax No. : +82 31 688 0921

1.2. Details of Applicant

Applicant	:	LG Electronics USA
Address	:	111 Sylvan Avenue, North Building, Englewood Cliffs, New Jersey, United States, 07632
Contact Person	:	Kim, David
Phone No.	:	+1 201 470 2696

1.3. Details of Manufacturer

Company	:	LG Electronics Inc.
Address	:	128, Yeoui-daero, Yeongdeungpo-gu, Seoul, Republic of Korea, 07336

1.4. Description of EUT

Kind of Product	Telematics Module		
Model Name	TM16FNNABM0		
Serial Number	Conducted: FCC_04 Radiated: FCC Rad_02		
Power Supply	DC 4.10 V		
Rated Power	WCDMA Ⅱ, Ⅴ: 24 ㏈m LTE Band 2, 4, 5, 7, 12, 13, 17, 25, 26, 38, 66, 71: 23 ㏈m LTE Band 48: 22 ㏈m NR Band 2, 5, 7, 12, 25, 41, 66, 71, 77, 78: 23 ㏈m NR Band 48: 22 ㏈m		
Frequency Range	WCDMA Ⅱ: 1 850 ㎒ ~ 1 910 ㎒ WCDMA Ⅴ: 824 ㎒ ~ 849 ㎒ LTE Band 2: 1 850 ㎒ ~ 1 910 ㎒ LTE Band 4: 1 710 ㎒ ~ 1 755 ㎒ LTE Band 5: 824 ㎒ ~ 849 ㎒ LTE Band 7: 2 500 ㎒ ~ 2 570 ㎒ LTE Band 12: 699 ㎒ ~ 716 ㎒ LTE Band 13: 777 ㎒ ~ 787 ㎒ LTE Band 17: 704 ㎒ ~ 716 ㎒ LTE Band 25: 1 850 ㎒ ~ 1 915 ㎒ LTE Band 26: 814 ㎒ ~ 849 ㎒ LTE Band 38: 2 570 ㎒ ~ 2 620 ㎒ LTE Band 48: 3 550 ~ 3 700 ㎒ LTE Band 66: 1 710 ㎒ ~ 1 780 ㎒ LTE Band 71: 663 ㎒ ~ 698 ㎒	NR Band 2: 1 850 ㎒ ~ 1 910 ㎒ NR Band 5: 824 ㎒ ~ 849 ㎒ NR Band 7: 2 500 ㎒ ~ 2 570 ㎒ NR Band 12: 699 ㎒ ~ 716 ㎒ NR Band 25: 1 850 ㎒ ~ 1 915 ㎒ NR Band 41: 2 496 ㎒ ~ 2 690 ㎒ NR Band 48: 3 550 ~ 3 700 ㎒ NR Band 66: 1 710 ㎒ ~ 1 780 ㎒ NR Band 71: 663 ㎒ ~ 698 ㎒ NR Band 77: 3 450 ㎒ ~ 3 550 ㎒ NR Band 77: 3 700 ㎒ ~ 3 980 ㎒ NR Band 78: 3 450 ㎒ ~ 3 550 ㎒ NR Band 78: 3 700 ㎒ ~ 3 800 ㎒	
Modulation Technique	BPSK, QPSK, 16QAM, 64QAM, 256QAM		
Antenna Type	Ant. 1: PIFA Antenna	Ant. 2: PIFA Antenna	Ant. 3: PIFA Antenna
Antenna Gain※	Refer to the clause 1.6		
H/W Version	Rev.D		
S/W Version	IN25XA03		

1.5. Manufacturer Declaration

The EUT has three antennas, antennas 1 and 2 are the main antennas, and antenna 3 can be switched to the main antenna. Each antenna can't transmit simultaneously.

1.6. Antenna Information

Ant. No.	Ant. Type	Frequency Range	Support Band		
			LTE	NR	WCDMA
Ant. 1	PIFA	Below 3 ㎓	2, 4, 5, 7, 12, 13, 17, 25, 26, 38, 66, 71	2, 5, 7, 12, 25, 41, 66, 71	Ⅱ, Ⅴ
Ant. 2	PIFA	Above 3 ㎓	48	48, 77, 78	
Ant. 3	PIFA	Below 3 ㎓	2, 4, 5, 7, 12, 13, 17, 25, 26, 38, 66, 71	2, 5, 7, 12, 25, 41, 66, 71	Ⅱ, Ⅴ

Band	Operating Frequency (㎒)	Antenna Peak Gain (dBi)		
		Ant. 1	Ant. 2	Ant. 3
LTE 25/2 WCDMA Ⅱ NR 25/2	1 850 ~ 1 915	**1.86**		-0.32
LTE 66/4 NR 66	1 710 ~ 1 780	**1.37**		-0.03
LTE 26/5 WCDMA Ⅴ NR 5	824 ~ 849	**-2.43**		-3.16
LTE 7 NR 7	2 500 ~ 2 570	0.92		**2.79**
LTE 12/17 NR 12	699 ~ 716	-3.98		**-1.20**
LTE 13	777 ~ 787	-4.60		**-3.16**
LTE 26	814 ~ 824	**-2.43**		-3.16
LTE 38	2 570 ~ 2 620	0.92		**2.79**
LTE 48 NR 48	3 550 ~ 3 700		**-1.37**	
LTE 71 NR 71	663 ~ 698	-2.45		**-1.60**
NR 41	2 496 ~ 2 690	0.92		**2.79**
NR 77	3 450 ~ 3 550		**0.12**	
	3 700 ~ 3 980		**0.12**	
NR 78	3 450 ~ 3 550		**0.12**	
	3 700 ~ 3 800		**0.12**	

Note;

Antenna gains were compared between antennas and mark the worst gain of each band.

1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 1		
Section	**Test Item(s)**	**Result**
1.1307(b)(3)	RF Exposure Evaluation	Complied

1.8. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL004919	2024.03.27	Initial

2. RF Exposure Evaluation

Test exemptions apply for devices used in general population/uncontrolled exposure environments, according to the SAR-based, or MPE-based exemption thresholds.

2.1. Blanket 1 ㎽ Blanket Exemption

The 1 ㎽ Blanket Exemption of § 1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 ㎽, regardless of separation distance.
The 1 ㎽ blanket exemption applies at separation distances less than 0.5 ㎝, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph § 1.1307(b)(3)(ii)(A).
The 1 ㎽ exemption is independent of service type and covers the full range of 100 ㎑ to 100 ㎓, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

2.2. MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 ㎑ through 100 ㎓.

Table 1: THRESHOLDS FOR SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source Frequency			Minimum Distance			Threshold ERP
f_L (㎒)		f_H (㎒)	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	-	1.34	159 m	-	35.6 m	1 920 R2
1.34	-	30	35.6 m	-	1.6 m	3 450 R^2/f^2
30	-	300	1.6 m	-	159 mm	3.83 R^2
300	-	1 500	159 mm	-	31.8 mm	0.012 8 R^2f
1 500	-	100 000	31.8 mm	-	0.5 mm	19.2 R^2
Subscripts L and H are low and high; λ is wavelength. From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.						

The table applies to any RF source (i.e., single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least λ/2π. The thresholds are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.
For mobile devices that are not exempt per Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] at distances from 20 ㎝ to 40 ㎝ and in 0.3 ㎓ to 6 ㎓, evaluation of compliance with the exposure limits in § 1.1310 is necessary if the ERP of the device is greater than ERP 20 ㎝ in Formula (B.1) [repeated from § 2.1091(c)(1) and § 1.1307(b)(1)(i)(B)].

$$P_{\text{th}}\,(\text{mW}) = ERP_{20\,\text{cm}}\,(\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases} \qquad \text{(B.1)}$$

If the ERP is not easily obtained, then the available maximum time-averaged power may be used (i.e., without consideration of ERP only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole.
SAR-based exemptions are constant at separation distances between 20 ㎝ and 40 ㎝ to avoid discontinuities in the threshold when transitioning between SAR-based and MPE-based exemption criteria at 40 ㎝, considering the importance of reflections.

2.3. SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.
If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of λ/4.
As for devices with antennas of length greater than λ/4 where the gain is not well defined, but always less than that of a half-wave dipole (length λ/2), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known.
The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.
The SAR-based exemption formula of § 1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (㎽).
This method shall only be used at separation distances from 0.5 ㎝ to 40 ㎝ and at frequencies from 0.3 ㎓ to 6 ㎓ (inclusive). P_{th} is given by Formula (B.2).

$$P_{\text{th}}\,(\text{mW}) = \begin{cases} ERP_{20\text{ cm}}(d/20\text{ cm})^{x} & d \le 20\text{ cm} \\ ERP_{20\text{ cm}} & 20\text{ cm} < d \le 40\text{ cm} \end{cases} \qquad \text{(B.2)}$$

where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\text{ cm}}\sqrt{f}}\right)$$

and f is in ㎓, d is the separation distance (㎝), and ERP 20 ㎝ is per Formula (B.1).

2.4. Simultaneous Transmission SAR Test Exemption with Respect to Multiple Exemption Criteria

Either SAR-based or MPE-based exemption may be considered for test exemption for fixed, mobile, or portable device exposure conditions; therefore, the contributions from each exemption in conjunction with the measured SAR ($Evaluated_k$ term) shall be used to determine exemption for simultaneous transmission according to Formula (C.1) [repeated from § 1.1307(b)(3)(ii)(B)].

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}} + \sum_{j=1}^{b}\frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c}\frac{Evaluated_k}{Exposure\ Limit_k} \le 1$$

3. Test Result

3.1. MPE-based Exemption

Mode	Frequency Range (㎒)	Maximum Average Power (dB m)	Worst Antenna Gain (dB i)	Minimum Separation Distance (cm)	Maximum Average Power (㎽)	ERP (㎽)	Threshold ERP (㎽)	Ratio	Result
WCMDA Ⅱ	1 850 ~ 1 910	25.5	1.86	20	354.81	331.89	768.00	0.43	Pass
WCDMA Ⅴ	824 ~ 849	25.5	-2.43	20	354.81	123.59	434.69	0.28	Pass
LTE Band 25/2	1 850 ~ 1 915	24.5	1.86	20	281.84	263.63	768.00	0.34	Pass
LTE Band 66/4	1 710 ~ 1 780	24.5	1.37	20	281.84	235.50	768.00	0.31	Pass
LTE Band 26/5 Part 22	824 ~ 849	24.5	-2.43	20	281.84	98.17	434.69	0.23	Pass
LTE Band 26 Part 90	814 ~ 824	24.5	-2.43	20	281.84	98.17	421.89	0.23	Pass
LTE Band 7	2 500 ~2 570	24.5	2.79	20	281.84	326.59	768.00	0.43	Pass
LTE Band 12/17	699 ~ 716	24.5	-1.20	20	281.84	130.32	366.59	0.36	Pass
LTE Band 13	777 ~ 787	24.5	-3.16	20	281.84	82.99	402.94	0.21	Pass
LTE Band 38	2 570 ~ 2 620	24.5	2.79	20	281.84	326.59	768.00	0.43	Pass
LTE Band 48	3 550 ~ 3 700	23	-1.37	20	199.53	88.72	768.00	0.12	Pass
LTE Band 71	663 ~ 698	24.5	-1.60	20	281.84	118.85	357.38	0.33	Pass
5G NR Band 25/2	1 850 ~ 1 915	24.5	1.86	20	281.84	263.63	768.00	0.34	Pass
5G NR Band 5	824 ~ 849	24.5	-2.43	20	281.84	98.17	434.69	0.23	Pass
5G NR Band 7	2 500 ~ 2 570	24.5	2.79	20	281.84	326.59	768.00	0.43	Pass
5G NR Band 12	699 ~ 716	24.5	-1.20	20	281.84	130.32	366.59	0.36	Pass
5G NR Band 41	2 496 ~ 2 690	24.5	2.79	20	281.84	326.59	768.00	0.43	Pass
5G NR Band 48	3 550 ~ 3 700	23	-1.37	20	199.53	88.72	768.00	0.12	Pass
5G NR Band 66	1 710 ~ 1 780	24.5	1.37	20	281.84	235.50	768.00	0.31	Pass
5G NR Band 71	663 ~ 698	24.5	-1.60	20	281.84	118.85	357.38	0.33	Pass
5G NR Band 77/78	3 450 ~ 3 550	24.5	0.12	20	281.84	176.60	768.00	0.23	Pass
5G NR Band 77/78	3 700 ~ 3 980	24.5	0.12	20	281.84	176.60	768.00	0.23	Pass

Note;

- Maximum average target power is the manufacturer's declared rated power.
- Maximum average output power = Maximum average target power (dB m) + Maximum tune up (dB).
- ERP (dB m) = Maximum average power (dB m) + Antenna gain (dB i) - 2.15 (dB)

3.2. Simultaneous Transmission SAR Test Exemption with Respect to Multiple Exemption Criteria

Mode	Band	P_i/P_{th} Ratio Mode A	P_i/P_{th} Ratio Mode B	$\Sigma P_i/P_{th}$ Ratio Mode A+B	Result
Inter band CA	2A-12A	0.34	0.36	0.70	Pass
	12A-66A	0.36	0.31	0.67	Pass
EN-DC	NR 2 LTE 5, 12, 13, 48	0.34	0.36	0.70	Pass
	NR 5 LTE 2, 66	0.23	0.34	0.57	Pass
	NR 66 LTE 5, 12, 13, 48	0.31	0.36	0.67	Pass
	NR 71 LTE 2, 7, 66	0.33	0.43	0.76	Pass
	NR 77 LTE 2, 5, 7, 12, 13, 25, 66	0.23	0.43	0.66	Pass
	NR 78 LTE 2, 7, 12, 25, 66	0.23	0.43	0.66	Pass

Note;

- The Antenna gain was considered both External and Internal and only worst gain was calculated for RF exposure.
- Total power of simultaneous mode (Inter CA, and EN-DC) not exceed single mode output power.
- In case of EN-DC mode, only one combination was reported as worst case.

Conclusion: No SAR is required.

- End of the Test Report -