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RF EXPOSURE EVALUATION Maximum Permissible Exposure (MPE)

Applicant Name:

Continental Automotive Systems Inc.
21440 West Lake Cook Rd.
Deer Park, IL 60010
USA

Date of Testing:

April 23 - 30, 2013

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Test Report Serial No.:

0Y1304190676.LHJ

FCC ID: LHJ-LNAD**APPLICANT:** Continental Automotive Systems Inc.**EUT Type:** Wireless Modem Module**FCC Rule Part(s):** FCC Part 1 (§1.1310) and Part 2 (§2.1091)**FCC Classification:** PCS Licensed Transmitter (PCB)**Test Procedure:** OET Bulletin 65

The device bearing the FCC Identifier specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in FCC OET Bulletin 65 (See Test Report). These measurements were performed with no deviation from the standards. Test results reported herein relate only to the item(s) tested.

I authorize and attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President

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1.0 RF EXPOSURE EVALUATION – MAXIMUM PERMISSIBLE EXPOSURE (MPE)

1.1 Introduction

This document is prepared on behalf of Continental Automotive Systems Inc. to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC Rules and Regulations and RSS-102 of Industry Canada.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1. According to FCC §1.1310 and RSS-102: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	...	...	f/300	6
1500-100,000	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	...	...	f/1500	30
1500-100,000	...	...	1.0	30

Table 1-1. Limits for Maximum Permissible Exposure (MPE)

1.2 EUT Description

The Continental Model: LNAD is a wireless modem module containing LTE and WCDMA. This module is intended for integration into mobile applications used in the automotive industry. For this MPE evaluation, RF exposure is evaluated individually for each mode.

EUT:

Model: LNAD
Grantee: Continental Automotive Systems Inc.
FCC ID: LHJ-LNAD
Bands Supported: 850/1900 WCDMA, Band 2, 4, 5, 17 LTE

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1.3 MPE Requirements Overview

Three different categories of transmitters are defined by the FCC in OET Bulletin 65. These categories are fixed installation, mobile, and portable and are defined as follows:

- **Fixed Installations:** fixed location means that the device, including its antenna, is physically secured at a permanent location and is not able to be easily moved to another location. Additionally, distance to humans from the antenna is maintained to at least 2 meters.
- **Mobile Devices:** a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located, such as a wireless modem operating in a laptop computer, are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR §2.1091.
- **Portable Devices:** a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user. Portable device requirements are found in Section 2.1093 of the FCC's Rules (47 CFR§2.1093).

The FCC also categorizes the use of the device as based upon the user's awareness and ability to exercise control over his or her exposure. The two categories defined are Occupational/ Controlled Exposure and General Population/Uncontrolled Exposure. These two categories are defined as follows:

- **Occupational/Controlled Exposure:** In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. Awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of a RF safety program. If appropriate, warning signs and labels can also be used to establish such awareness by providing prominent information on the risk of potential exposure and instructions on methods to minimize such exposure risks.
- **General Population/Uncontrolled Exposure:** The general population / uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

The Continental Wireless Modem Module FCC ID: LHJ-LNAD is evaluated to the Mobile Device requirements and is considered a device to be used by the General Population/Uncontrolled Exposure.

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1.4 Procedure

The procedure used to determine the RF power density was based upon a calculation for determining compliance with the MPE requirements.

The power generated by the transmitter used in this product was initially measured using a CMW500 LTE Call Box and CMU200 WCDMA Call Box, and the powers were recorded. The measured powers were confirmed to be within the appropriate power tolerance range of each band of operation. For MPE calculations, the maximum allowed tune-up power was used for determining compliance and maximum antenna gain. Through use of the Friis transmission formula and knowledge of the maximum antenna gain to be used, the power density level is calculated at a distance of 20cm.

Friis Transmission Formula

$$\text{Friis transmission formula: } P_d = (P_{\text{out}} * G) / (4\pi r^2)$$

Where,

P_d = Power Density (mW/cm²)

$\pi = 3.1416$

P_{out} = output power to antenna (mW)

r = distance between observation point and center of the radiator (cm)

G = gain of antenna in linear scale

Calculated MPE

The power density limit for General Population/Uncontrolled Exposure at each frequency is determined based on the information in Table 1-1.

Frequency	706.5 MHz		
Limit	0.471 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	24.5 dBm	281.84 mW	
TX Ant Gain (dBi), G =	9.24 dBi		
Power Density (S) =	0.471 mW/cm ²	(at 20cm)	
Minimum Distance =	20.0 cm		

Table 1-2. Calculated MPE Data for LTE Band 17

Frequency:	826.5 MHz		
Limit:	0.551 mW/cm ²		
Distance (cm), R =	20 cm		
Power (dBm), P =	24.5 dBm	281.84 mW	
TX Ant Gain (dBi), G =	9.921 dBi		
Power Density (S) =	0.551 mW/cm ²	(at 20cm)	
Minimum Distance =	20.0 cm		

Table 1-3. Calculated MPE Data for LTE Band 5

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Frequency	1712.5	MHz		
Limit	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	24.5	dBm	281.84	mW
TX Ant Gain (dBi), G =	5.5	dBi		
Power Density (S) =	0.199	mW/cm^2	(at 20cm)	
Minimum Distance =	8.9	cm		

Table 1-4. Calculated MPE Data for LTE Band 4

Frequency:	1852.5	MHz		
Limit:	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	24.5	dBm	281.84	mW
TX Ant Gain (dBi), G =	8.51	dBi		
Power Density (S) =	0.398	mW/cm^2	(at 20cm)	
Minimum Distance =	12.6	cm		

Table 1-5. Calculated MPE Data for LTE Band 2

Frequency	826.4	MHz		
Limit	0.551	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	25	dBm	316.23	mW
TX Ant Gain (dBi), G =	9.421	dBi		
Power Density (S) =	0.551	mW/cm^2	(at 20cm)	
Minimum Distance =	20.0	cm		

Table 1-6. Calculated MPE Data for WCDMA850

Frequency:	1852.4	MHz		
Limit:	1.000	mW/cm^2		
Distance (cm), R =	20	cm		
Power (dBm), P =	25	dBm	316.23	mW
TX Ant Gain (dBi), G =	8.01	dBi		
Power Density (S) =	0.398	mW/cm^2	(at 20cm)	
Minimum Distance =	12.6	cm		

Table 1-7. Calculated MPE Data for WCDMA1900

Note:

The frequencies shown in the tables above were chosen because they calculated the most stringent MPE limits at 20cm and the highest maximum antenna gain.

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1.5 Summary of Results

Frequency Band [MHz]	Maximum Antenna Gain [dBi]	MPE @ 20cm (mW/cm ²)	MPE Limit (mW/cm ²)	Test Result
706.5 (LTE Band 17)	9.24	0.471	0.471	PASS
826.5 (LTE Band 5)	9.92	0.551	0.551	PASS
1712.5 (LTE Band 4)	5.50	0.199	1.000	PASS
1852.5 (LTE Band 2)	8.51	0.398	1.000	PASS
826.4 (WCDMA)	9.42	0.551	0.551	PASS
1852.4 (WCDMA)	8.01	0.398	1.000	PASS

Table 1-8. Maximum Permissible Exposure Summary Table

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2.0 CONCLUSION

The device meets the mobile RF exposure limit at a 20cm separation distance as specified in §2.1091 of the FCC Rules and Regulations and Health Canada Safety Code 6. An appropriate RF exposure compliance statement will be placed in the user's manual.

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