



RF Exposure Evaluation Report

FOR

Manufacturer: Delphi Electronics & Safety

Model Number: VRM

FCC ID: L2C0060TR

FCC CFR 47 Part 1.1310, 2.1091

TEST REPORT #: RFE_x_DELPH-004-15001_FCC

DATE: February 25, 2016



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1 Assessment


The following equipment, as detailed in section 3 of this test report, meets the RF exposure limits and/or the conditions for exemption from routine evaluation as defined in the following standards.

Standard	Version
FCC CFR 47 Part 1.1310	Current as of February 25, 2016
FCC CFR 47 Part 2.1091	Current as of February 25, 2016
FCC KDB 447498, D01	v06
OET Bulletin 65	Edition 97-01, August 1997

Responsible for Testing Laboratory:

February 25, 2016	Compliance	Franz Engert (Compliance Manager)	 <small>Digitally signed by Franz Engert DN: cn=Franz Engert, o=US, o=CETECOM, ou=Compliance, email=franz.engert@cetecom. com</small>
Date	Section	Name	Signature

Responsible for the Report:

February 25, 2016	Compliance	Josie Sabado (Test Lab Manager)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section 3. CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name	CETECOM Inc.
Department	Compliance
Address	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone	+1 (408) 586 6200
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Test Lab Manager	Franz Engert
Project Manager	James Devasia
Test Engineer	Josie Sabado

2.2 Identification of the Client and Manufacturer

	Client	Manufacturer
Company	Delphi Electronics & Safety	Same as client
Street Address	One Corporate Center, M/S CTC4W	
City/Zip Code	Kokomo, IN 46904	
Country	USA	

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Model Number	VRM
Hardware Version	28531001AG
Software Version	1602.11
FCC ID	L2C0060TR
Technical Product Description	In-Vehicle Entertainment System with 5 GHz WLAN and Bluetooth LE
Device Category	<input type="checkbox"/> Fixed Installation <input checked="" type="checkbox"/> Mobile <input type="checkbox"/> Portable
Exposure Category	<input type="checkbox"/> Occupational/ Controlled <input checked="" type="checkbox"/> General Population/ Uncontrolled
Exposure Conditions	User greater than 20 cm from the body
Supported Radios	<ul style="list-style-type: none"> • Bluetooth v4.1, Power Class 2 • 802.11 a/n (HT20, HT40)/ac (VHT20, VHT40, VHT80); SISO, MIMO using CDD
Simultaneous Transmission Configurations	None

3.2 Antenna Information

Antenna	Type	Internal / External	Frequency (MHz)	Manufacturer Stated Max Peak Gain (dBi)
Antenna 1: 5 GHz WLAN Bluetooth	PiFA	Internal	2400 – 2480	2.02
			5700 - 5900	5.16
Antenna 2: 5 GHz WLAN	PiFA	Internal	5700 - 5900	-0.17

3.3 Technical Specification of Supported Radios

Signal Type	Duty Cycle	Type(s) of Uplink Modulation	Band	Uplink Transmit Frequency Range (MHz)	Declared Maximum EIRP (dBm)
Bluetooth 4.0	65%	GFSK	N/A	2400 – 2483.5	6.0
802.11 a/n/ac (SISO)	100%	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM	UNII-3	5725 - 5850	11.2
802.11 a/n/ac (MIMO)	100%	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM	UNII-3	5725 - 5850	14.9

3.4 Miscellaneous Information

1. Antenna 1 supports Bluetooth LE and 5 GHz 802.11 a/n/ac WLAN.
2. Antenna 2 supports 5 GHz 802.11 a/n/ac WLAN.

4 FCC RF Exposure Evaluation Requirements

Calculations can be made to predict RF field strength and power density levels around typical RF sources using the general equations (3) and (4) on page 19 of the following FCC document:

“OET Bulletin 65, Edition 97-01 - Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”

The table below is an excerpt from Table 1B of CFR 47 Part 1.1310 titled Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure:

Frequency Range (MHz)	E-field strength (V/m)	H-field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
1,500 – 100,000	---	---	1.0	30

Using the equation from page 19 of OET Bulletin 65, Edition 97-01:

$$S = \frac{PG}{4\pi R^2}$$

Where: S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Additionally, according to § 2.1091:

The limit for mobile operations greater than 1.5 GHz where no routine evaluation is required is 3 W ERP.

5 RF Exposure Analysis

5.1 Stand Alone Analysis

Radiated power is calculated as

$$\text{Peak EIRP (dBm)} = \text{Maximum average output power (including tune-up tolerance) (dBm)} + \text{Antenna Gain (dBi)}$$

$$\text{Time-Averaged ERP (dBm)} = \text{Peak EIRP (dBm)} + 10 * \log(\text{Maximum Duty Cycle}) - 2.15$$

Tune-up tolerance is taken from the tune-up tolerance document of the EUT.

Antenna gain is taken from the operational description document of the EUT.

Analysis to Exclude Routine RF Exposure Evaluation for Stand Alone Operation					
Band of Operation	Max Duty Cycle	Peak EIRP	Time-Averaged EIRP		FCC Limit
MHz	%	dBm	dBm	W	W
802.11 a/n/ac (SISO); Ant 1 5725 to 5850	100	11.2	9.1	0.01	3
802.11 a/n/ac (SISO); Ant 2 5725 to 5850	100	5.8	3.7	0.00	3
802.11 a/n/ac (MIMO) 5725 to 5850	100	14.9	12.8	0.02	3
Bluetooth LE 2400 to 2483.5	65	6.0	2.0	0.00	3

Power Density Calculation for MPE Compliance						
Band of Operation	Peak EIRP	Maximum Duty Cycle	Distance	Power Density	FCC Limit	Verdict
MHz	dBm	%	cm	mW/cm ²	mW/cm ²	
802.11 a/n/ac (SISO); Ant 1 5725 to 5850	11.2	100	20	0.003	1.000	Pass
802.11 a/n/ac (SISO); Ant 2 5725 to 5850	5.8	100	20	0.001	1.000	Pass
802.11 a/n/ac (MIMO) 5725 to 5850	14.9	100	20	0.006	1.000	Pass
Bluetooth LE 2400 to 2483.5	6.0	65	20	0.001	1.000	Pass

All operating modes are below the threshold to exclude routine RF exposure evaluation and the limits for MPE. Further RF exposure evaluation is not required.

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6 Revision History

Date	Report Number – Changes to Report	Report prepared by
February 25, 2016	REx_DELPH-004-15001_FCC 1. First Version	J. Sabado