



# 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 #: RFEx\_DELPH-004-15001\_FCC

DATE: February 25, 2016



**CETECOM Inc.**

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## 1 Assessment

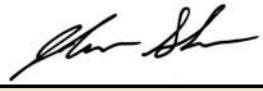
The following equipment, as detailed in section 3 of this test report, meets the RF exposure limits and/or the conditions for exemption from routine evaluation as defined in the following standards.

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

### Responsible for the Report:

| February 25, 2016 | Compliance | Josie Sabado<br>(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<br>Milpitas, CA 95035<br>U.S.A. |
| Telephone        | +1 (408) 586 6200                                      |
| Fax              | +1 (408) 586 6299                                      |
| 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

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

#### 3.2 Antenna Information

| <b>Antenna</b>                        | <b>Type</b> | <b>Internal / External</b> | <b>Frequency (MHz)</b> | <b>Manufacturer Stated Max Peak Gain (dBi)</b> |
|---------------------------------------|-------------|----------------------------|------------------------|------------------------------------------------|
| Antenna 1:<br>5 GHz WLAN<br>Bluetooth | PiFA        | Internal                   | 2400 – 2480            | 2.02                                           |
|                                       |             |                            | 5700 - 5900            | 5.16                                           |
| Antenna 2:<br>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 <sup>2</sup> ) | 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/cm<sup>2</sup>)

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

**Peak EIRP (dBm)** = Maximum average output power (including tune-up tolerance) (dBm) + Antenna Gain (dBi)

**Time-Averaged ERP (dBm)** = Peak EIRP (dBm) + 10 \* log (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<br>5725 to 5850                                  | 100            | 11.2      | 9.1                | 0.01 | 3         |
| 802.11 a/n/ac (SISO); Ant 2<br>5725 to 5850                                  | 100            | 5.8       | 3.7                | 0.00 | 3         |
| 802.11 a/n/ac (MIMO)<br>5725 to 5850                                         | 100            | 14.9      | 12.8               | 0.02 | 3         |
| Bluetooth LE<br>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 <sup>2</sup> | mW/cm <sup>2</sup> |         |
| 802.11 a/n/ac (SISO); Ant 1<br>5725 to 5850  | 11.2      | 100                | 20       | 0.003              | 1.000              | Pass    |
| 802.11 a/n/ac (SISO); Ant 2<br>5725 to 5850  | 5.8       | 100                | 20       | 0.001              | 1.000              | Pass    |
| 802.11 a/n/ac (MIMO)<br>5725 to 5850         | 14.9      | 100                | 20       | 0.006              | 1.000              | Pass    |
| Bluetooth LE<br>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<br>1. First Version | J. Sabado          |