# RF Exposure Evaluation Report

**FOR:**

**Harman International**

**Model Number: VP3 NA, VP4 NA, VP3 CA, VP4 CA**
**Product Description: Automotive Infotainment Unit**

**FCC ID: QNG-BE2800**
**IC ID: 6434C-BE2800**

**References:**


1. FCC OET Bulletin 65 Supplement
2. FCC CFR Part 1 (1.1307 &1.1310), Part 2 (2.1091)
3. RSS-102- Radio Frequency Exposure Compliance of Radiocommunication Apparatus Issue 4 March 2010, Ch, 2.5 and Ch. 4

# 1 Administrative Data

## 1.1 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 Director:** | Heiko Strehlow |
| **Responsible Project Leader:** | Josie Sabado |

## 1.2 Identification of the Client

| | |
|---|---|
| **Applicant's Name:** | Harman International |
| **Street Address:** | 26500 Haggerty Road |
| **City/Zip Code** | Farmington Hills, MI 48331 |
| **Country** | USA |
| **Contact Person:** | Shain E. Chmura |
| **Phone No.** | +1 (248) 592-3157 |
| **e-mail:** | schmura@harman.com |

## 1.3 Identification of the Manufacturer

Same as above client.

# 2 Equipment under Test (EUT)

## 2.1 Specification of the Equipment under Test

| | |
|---|---|
| **Marketing Name:** | Uconnect |
| **Model No:** | VP3 NA, VP4 NA, VP3 CA, VP4 CA |
| **HW Revision:** | PV |
| **SW Revision:** | 11.48.1 |
| **FCC-ID:** | QNG-BE2800 |
| **IC-ID:** | 6434C-BE2800 |
| **Product Description:** | Automotive Infotainment Unit |
| **Frequency Range / number of channels:** | Bluetooth: 2402 – 2480 MHz / 79 Channels<br>802.11 b/g: 2412 – 2462 MHz / 11 Channels<br>GPS: 1.575 GHz / 1 Channel |
| **Type(s) of Modulation:** | Bluetooth: GFSK, π/4 DQPSK, 8DPSK<br>802.11 b/g: BPSK, QPSK |
| **Modes of Operation:** | Bluetooth 2.1 + EDR<br>802.11 b/g |
| **Antenna Gain:** | Bluetooth Gain (As stated by manufacturer):<br>Low Channel: -3.37 dBi<br>Mid Channel: -3.67 dBi<br>High Channel: -2.03 dBi<br>802.11 b/g Gain (Stated by manufacturer):<br>Low Channel: -1.98 dBi<br>Mid Channel: -1.69 dBi<br>High Channel: -1.38 dBi |
| **Co-located Transmitters/ Antennas?** | ■ Yes<br>☐ No |
| **Power supply:** | 12 VDC |
| **Operating temperature range:** | -40°C to 85°C |
| **Prototype / Production unit:** | Pre-Production |
| **Device Category:** | ☐ Fixed Installation<br>■ Mobile<br>☐ Portable |
| **Exposure Category:** | ☐ Occupational/ Controlled<br>■ General Population/ Uncontrolled |

## 3 Assessment

**This report serves as the Technical Information regarding RF Exposure evaluation of the below identified device according to the rules as stipulated in the documents listed under References above.**

**The device meets the RF exposure limits, or - for some of its radio functions / bands - the conditions for exemption from routine evaluation as defined in the referenced FCC and IC rule parts.**

| Company | Description | Model # |
|---|---|---|
| Harman International | Automotive Infotainment Unit | VP3 NA, VP4 NA, VP3 CA, VP4 CA |

| Date | Section | Name | Signature |
|---|---|---|---|
| 2012-09-06 | Compliance | Josie Sabado (EMC Test Engineer) | |

# 4 RF Exposure Evaluation Requirements

## 4.1 FCC:

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 excerpted from Table 1B of 47 CFR 1.1310 titled Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure:

| Frequency Range (MHz) | Power density ($mW/cm^2$) | Averaging time (minutes) |
|---|---|---|
| 300 – 1500 | f (MHz) /1500 | 30 |
| 1500 – 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. $mW/cm^2$)
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)

Note: This device is to be used only for fixed and mobile applications.

**Additionally, according to § 2.1091:**
The limit for <1.5 GHz mobile operations where no routine evaluation is required is: 1.5W ERP
The limit for >1.5 GHz mobile operations where no routine evaluation is required is: 3W ERP

## 4.2 IC:

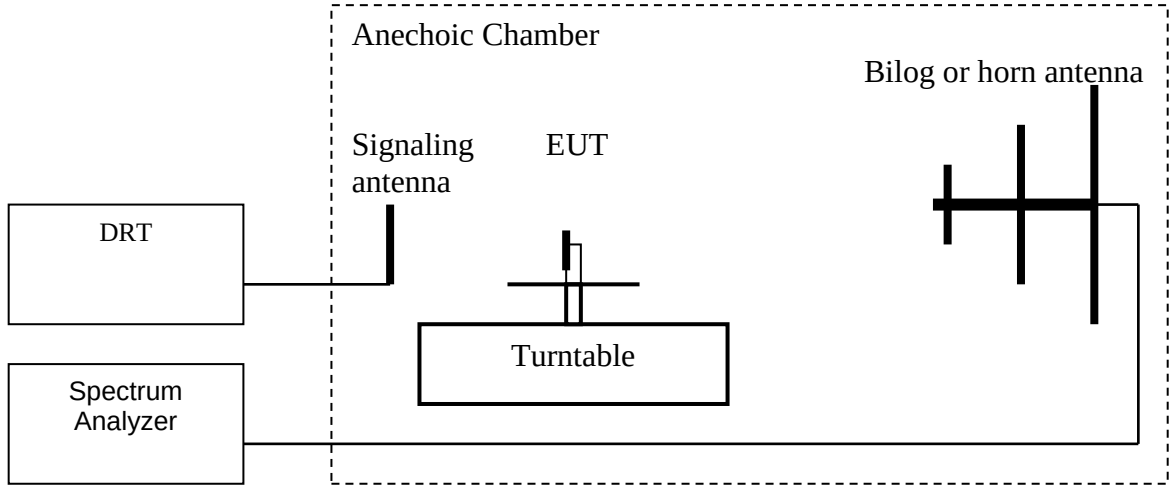
**RSS-102 Section 2.5.2**
RF exposure evaluation is required if the separation distance between the user and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 1.5 GHz and the maximum EIRP of the device is equal to or less than 2.5 W;
- at or above 1.5 GHz and the maximum EIRP of the device is equal to or less than 5 W.

**RSS-102 4.2: RF Field strength limits for devices used by the General Public (Uncontrolled Environment):**
Power density
300MHz- 1500 MHz= f/150 $W/m^2$
1500 MHz- 1500000 MHz= 10 $W/m^2$

## 5 Measurement procedure:

### 5.1 Radiated power measurement- ERP/EIRP-

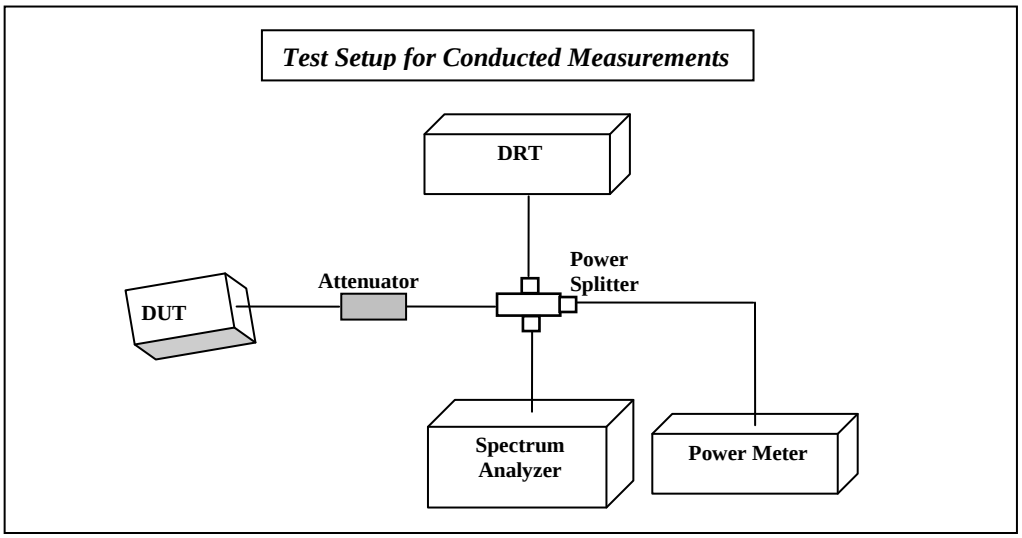



1. Connect the equipment as shown in the above diagram with the EUT's antenna in center of the turn table.
2. Adjust the settings of the Digital Radio Communication Tester (DRT) to set the EUT to its maximum power at the required channel.
3. Set the spectrum analyzer to the channel frequency. Set the analyzer to measure peak hold with the required settings.
4. Rotate the EUT 360°. Record the peak level in dBm (**LVL**).
5. Replace the EUT with a vertically polarized half wave dipole or known gain antenna. The center of the antenna should be at the same location as the center of the EUT's antenna.
6. Connect the antenna to a signal generator with known output power and record the path loss in dB (**LOSS)**. **LOSS** = Generator Output Power (dBm) – Analyzer reading (dBm).
7. Determine the ERP using the following equation:
   **ERP** (dBm) = **LVL** (dBm) + **LOSS** (dB)
8. Determine the EIRP using the following equation:
   **EIRP** (dBm) = **ERP** (dBm) + 2.14 (dB)
9. Measurements are to be performed with the EUT set to the low, middle and high channel of each frequency band.

Measurement uncertainty: +/-3.0 dB

(**Note:** Steps 5 and 6 above are performed prior to testing and **LOSS** is recorded by test software. Steps 3, 4, 7 and 8 above are performed with test software.)

## 5.2 Radiated power Calculation- ERP/EIRP-




1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the Digital Radio Communication Tester (DRT) to connect the EUT at the required channel (OR) alternatively use the EUT to set to transmit at a specific mode.
3. Measure conducted power using the power meter or the Spectrum Analyzer.
4. ERP/EIRP is calculated by adding the antenna gain to the measured conducted power.
   **EIRP= Measured conducted power+ Antenna Gain (dBi)**
   (Antenna gain based on measurement or data from the antenna manufacturer.)
   **ERP= EIRP- 2.14**

## 5.3 Measurement Equipment information:

| Instrument/Ancillary | Model | Manufacturer | Serial No. | Cal Date | Cal Interval |
|---|---|---|---|---|---|
| Radio Communication Tester | CMU 200 | Rohde & Schwarz | 101821 | May 2011 | 2 Years |
| EMI Receiver/Analyzer | ESIB 40 | Rohde & Schwarz | 100107 | May 2011 | 2 Years |
| Spectrum Analyzer | FSU | Rohde & Schwarz | 200302 | May 2011 | 2 Years |
| Loop Antenna | 6512 | EMCO | 00049838 | Aug 2011 | 3 years |
| Biconilog Antenna | 3141 | EMCO | 0005-1186 | Apr 2012 | 3 years |
| Horn Antenna (1-18GHz) | 3115 | ETS | 00035114 | Mar 2012 | 3 years |
| Horn Antenna (1-18GHz) | 3115 | ETS | 00035111 | Apr 2012 | 3 years |
| Horn Antenna (18-40GHz) | 3116 | ETS | 00070497 | Aug 2011 | 3 years |
| Communication Antenna | IBP5-900/1940 | Kathrein | n/a | n/a | n/a |
| High Pass Filter | 5HC2700 | Trilithic Inc. | 9926013 | Part of system calibration | |
| High Pass Filter | 4HC1600 | Trilithic Inc. | 9922307 | Part of system calibration | |
| Pre-Amplifier | JS4-00102600 | Miteq | 00616 | Part of system calibration | |
| Power Smart Sensor | R&S | NRP-Z81 | 100161 | May 2011 | 2 Years |

## 5.4 Measurement Summary:

Measured ERP/EIRP values as taken from test report #
"EMC_HARMA_018_11001_BE2800_DTS_FCC_IC_Rev1" and
"EMC_HARMA_018_11001_BE2800_FHSS_FCC_IC_Rev1" issued by CETECOM Inc on Sep 6, 2012.

| **Band/Mode of operation** | **Peak Radiated Power- EIRP** | | **Limits (IC)** (where no routine evaluation is required) | **Peak Radiated Power ERP** | | **Limits (FCC)** (where no routine evaluation is required) |
|---|---|---|---|---|---|---|
| | dBm | mW | W | dBm | mW | W |
| 802.11 g | 19.26 | 84.33 | 5 | 17.12 | 51.52 | 3 |
| Bluetooth | 1.2 | 1.32 | 5 | -0.94 | 0.81 | 3 |

**Since the Peak ERP <3W (FCC) and Peak EIRP <5W (IC), this device is exempt from Routine evaluation.**

**Power Density calculations @ 20cm:**

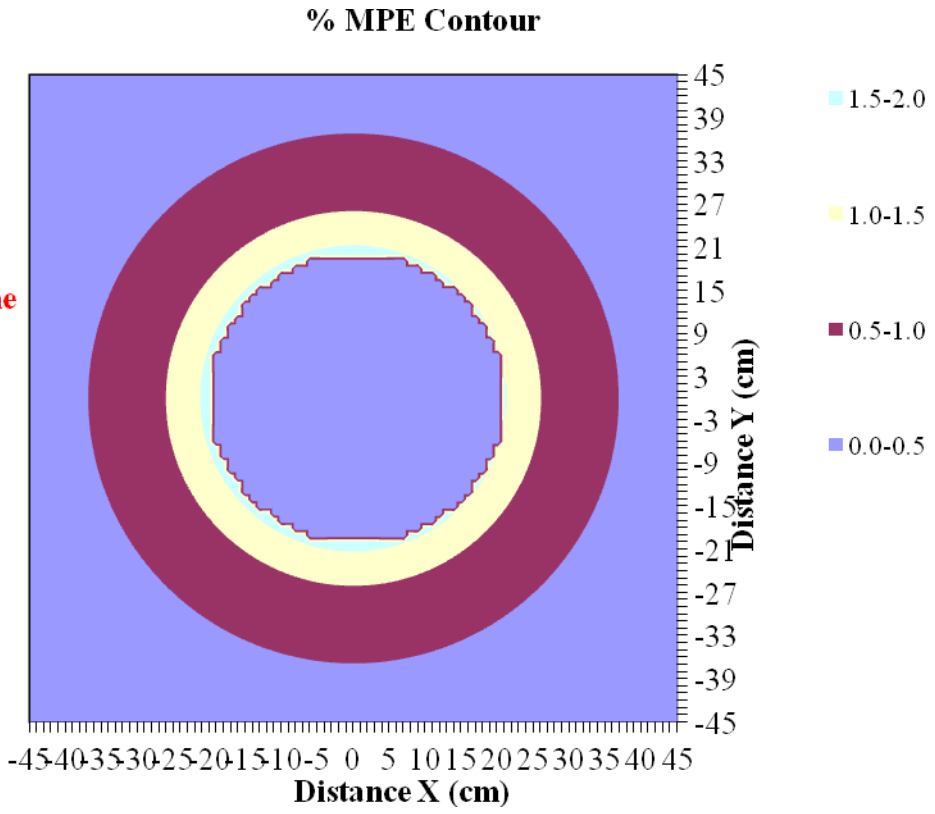
| **Band/Mode of operation** | **Peak Radiated Power- EIRP** | | **Duty Cycle** | **Distance (R)** | **Power Density** $(EIRP*DutyCycle)/(4\pi R^2)$ | **Limit** | **Verdict** |
|---|---|---|---|---|---|---|---|
| | dBm | mW | | cm | $mW/cm^2$ | $mW/cm^2$ | |
| 802.11g | 19.26 | 84.33 | 100 | 20 | 0.017 | 1 | Pass |
| Bluetooth | 1.2 | 1.32 | 100 | 20 | 0.0003 | 1 | Pass |

## Prediction for Simultaneous Transmission

The MPE limit was made using a separation distance of 1 cm to represent the worse case.

| Antenna No. | | Total | 1 | 2 |
|---|---|---|---|---|
| Tx Status | | | On | On |
| Frequency | MHz | | 2440 | 2440 |
| MPE Limit | $mW/cm^2$ | | 1.00 | 1.00 |
| Max % MPE | % | 1.7 | 1.7 | 0.0 |
| Power | (W) | 0.085 | 0.084 | 0.001 |
| Antenna Gain | dBi | | 0.00 | 0.00 |
| EIRP | (W) | 0.09 | 0.084 | 0.001 |
| X | (cm) | | 0.0 | 1.0 |
| Y | (cm) | | 0.0 | 0.0 |
| Sector | | | FALSE | FALSE |
| Arc | | | FALSE | FALSE |
| $\theta_1$ | degs | input | -120 | -120 |
| $\theta_2$ | | | 60 | 60 |
| $\theta_1$ | | actual | -120 | -120 |
| $\theta_2$ | | | 60 | 60 |

**Note: The 0% contour surrounding the antennas**




**Verdict:** Since the max MPE is <100%, the device is compliant in simultaneous transmission mode for BT and 802.11b/g.