Calculation:
RF-Exposure for a Virtual Cockpit Unit

Type identification: VCUNM1
FCC ID: 2AUXS-VCUNM1

Subject of Investigation

According the 47CFR §2.1307 the VCUNM1 from Robert Bosch GmbH
(FCC ID: 2AUXS-VCUNM1) has been defined by the applicant as a device mounted
in such a way, that a separation distance of at least <u>19.7 cm</u> is normally maintained
between the device and the user.

447498 D04 Interim General RF Exposure Guidance v01 states in 2.1.3 that SAR
based exemption is applicable to the frequency range between 300 MHz and 6 GHz,
with test separation distances between 0.5 cm and 40 cm, and for all RF sources in
fixed, mobile, and portable device exposure conditions.

According to §2.1307 (3)(i)(B) single RF sources are exempted if the available
maximum time-averaged power or effective radiated power (ERP), whichever is
greater, is less than or equal to the threshold P_{th} (mW) described in the following
formula. This method shall only be used at separation distances (cm) from 0.5
centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive).
P_{th} is given by:

$$P_{th}(mW) = \begin{cases} ERP_{20cm} \cdot \left(\dfrac{d}{20cm}\right)^x & d \leq 20cm \\ ERP_{20cm} & 20cm < d \leq 40cm \end{cases}$$

Where

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

and

$$ERP_{20cm}(mW) = \begin{cases} 2040 \cdot f & 0.3GHz \leq f < 1.5GHz \\ 3060 & 1.5GHz \leq f < 6GHz \end{cases}$$

For EUTs with multiple RF sources the exemption procedure §1.1307(3)(ii)(B) is used. In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

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

Calculation SAR based exemption

In accordance with the **CFR Part 47, §2.1307 (3)(i)(B)** the applicable limits for the worst-case RF sources are as follows:

d [cm]	f [GHz]	ERP$_{20cm}$ [mW]	x	P$_{th}$ [mW]
19.7	2.412	3060	1.899	2973.435
19.7	5.755	3060	2.088	2964.961

e.i.r.p.: 802.11b @ 2412 MHz:
15.5 dBm + 3 dB* + 5.6 dBi*[2] = 24.1 dBm / 257.040 mW

802.11ax40 @ 5755 MHz:
19.2 dBm + 2.5 dB*+ 6.9 dBi*[2] = 28.6 dBm / 724.436 mW

ERP: ERP = EIRP / 1.64
257.040 mW (EIRP) = 156.732 mW (ERP)
724.436 mW (EIRP) = 441.729 mW (ERP)

D: Duty cycle: 100 % = 1

* Tune-up range was declared by the applicant.
*[2] Antenna gain for both antennas transmitting simultaneously (including antenna array gain).

Limits and calculated results

The results for EUT are given in the formula below and based on the power measurements shown in the 2nd Versions of the Phoenix Testlab Reports F212286E1+E3.

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,i}} + \sum_{k=1}^{c} \frac{Evaluated_k}{ExposureLimit_k} = \frac{156.732}{2973.435} + \frac{441.729}{2964.961} \leq 1$$

$$0.05 + 0.15 = 0.20 \leq 1$$

The Virtual Cockpit Unit from Robert Bosch GmbH (FCC ID: 2AUXS-VCUNM1) is in compliance with the SAR exemption limits for the limit values calculated with the formulas in §2.1307 (3)(i)(B).