Calculation:
RF-Exposure for a Virtual Cockpit Unit

Type identification: VCUNM1
FCC ID: 2AUXS-VCUNM1

Subject of Investigation

The EUT is a Virtual Cockpit Unit (VCU), providing interfaces to Displays, Speakers, Sensors and optional components of the VCS and includes Bluetooth and WiFi capabilities. This is a product produced in collaboration with OEM. This device will be fitted in different OEM vehicles.

According the 47CFR §2.1093 the VCUNM1 from Robert Bosch GmbH (FCC ID: 2AUXS-VCUNM1) is defined as portable device since the separation distance which is maintained between the device antennas and the user is < 20cm.

The EUT contains two antennas. The internal Antenna maintain a separation distance of 197 mm, the external maintain a separation distance of 47mm to the human body. Bluetooth signals are sent over the internal antenna, Wifi signals are sent over the internal antenna and external antenna.

For the internal Antenna the following procedure applies:

The internal Antenna provide Bluetooth and WLan at a separation distance of 0.197m between the internal antenna and a human body.
According Table 1 of §1.1307 (b)(1)(i)(C) this qualifies for MPE-based exemption:

Radiofrequency (MHz)	Wavelength (m)	FCC minimum separation Distance (m)
2462	*0,121767855*	***0,019389786***
5250	*0,057103325*	***0,009092886***
5850	*0,051246574*	***0,008160282***

With Threshold ERP Calculation:

RF Source frequency [MHz]	Separation Distance R [m]	f [MHz]	Threshold ERP [W]
1500-100000	0.197	*2450*	***0.7451328***
	0.197	*5250*	***0.7451328***
	0.197	*5850*	***0.7451328***

For the internal Antenna the following output power values are applicable:

Service	f [MHz]	Conducted Output Power [W]	Antenna Gain [dBi]	Output Power ERP* [W]
BT (DTS)	2402 - 2480	0.0012	3.0	**0.0016**
BT (DSS)	2402 - 2480	0.0023	3.0	**0.0028**
WLan (DTS)	2412 - 2462	0.0355	3.0	**0.0431**
WLan (UN-II)	5180 - 5240	0.0117	4.9	**0.0142**
WLan (UN-II)	5745 - 5825	0.0832	4.9	**0.1011**

*ERP= EIRP-2.15

For the external Antenna the following procedure applies:
The external Antenna provide WLan only, at a separation distance of 0.047m between the external antenna and a human body. To show compliance with the RF-Exposure requirements, SAR measurements are conducted for the external antenna.

The overall worst case scenario show a SAR result of 0.05 W/kg:

MEASUREMENT RESULTS

Plot	Gap	Position	Frequency		Modulation	Antenna	End Power	Measured SAR	Reported SAR
			MHz	Ch.			(dBm)	(W/kg)	(W/kg)
3	47 mm	Back	5775	155	QPSK	Main	17.3	0.0318	0.05
-----		Front	5775	155	QPSK		17.3	0.0179	0.03
-----		Left	5775	155	QPSK		17.3	0.0284	0.04
-----		Right	5775	155	QPSK		17.3	0.0293	0.04
-----		Top	5775	155	QPSK		17.3	0.0132	0.02
-----		Bottom	5775	155	QPSK		17.3	0.0121	0.02
-----	Test Jig	Top	5775	155	QPSK		17.3	$4.25e^{-05}$	<<0.01
-----		Back	5775	155	QPSK		17.3	$4.43e^{-05}$	<<0.01
-----		Front	5775	155	QPSK		17.3	0	0

Head
1.6 W/kg (mW/g)
averaged over 1 gram

Limits and calculated results

To show compliance for the Simultaneous Transmission mode of the internal and external antenna, the formula as shown in 47 CFR 1.1307(b)(3)(ii)(B) and output power values based on the power measurements shown in the 2nd Versions of the Phoenix Testlab Reports F212286E1+E3 and the RF exposure results from SAR Report Nr.: SAR.20230711, issued by RF Exposure Lab, has been used:

$$\sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,i}} + \sum_{k=1}^{c} \frac{Evaluated_k}{ExposureLimit_k} = \frac{0.1011}{0.7451328} + \frac{0.05}{1.6} \leq 1$$

$$0{,}136 + 0{,}031 = 0.167 \leq 1$$

The Virtual Cockpit Unit from Robert Bosch GmbH (FCC ID: 2AUXS-VCUNM1) is exempted according § 1.1307(b)(1)(i)(C) from routine evaluation. SAR assessment for the external antenna show compliance to 47 CFR 1.1310(c) and SAR limits for general public. The overall compliance for simultaneous transmission has been shown by applying the formula above according 47 CFR 1.1307(b)(3)(ii)(B).