

Test report No:  
 NIE: 72779RAN.001A1

## Assessment report

### RF EXPOSURE REPORT ACCORDING TO FCC 47 CFR Part 2.1091; FCC 47 CFR Part 1.1307 FCC 47 CFR Part 1.1310

(*) Identification of item under evaluation	Telematic control unit with wireless technologies, used in automotive industry
(*) Trademark	VW AG
(*) Model and /or type reference	CONBOX HIGH RD
(*) Other identification of the product	FCC ID: T8GCONBOXRD Contains FCC ID: QIPALAS66A-US IC: 6434A-CONBOXRD Contains IC: 7830A-ALAS66AUS
(*) Features	GSM, UMTS, LTE, GNSS, Wi-Fi, BTLE, BT_EDR HW version: 045 SW version: 495
(*) Manufacturer	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16; 76307 KARLSBAD GERMANY
Test method requested, standard	FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices. FCC 47 CFR Part 1.1307: Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared. FCC 47 CFR Part 1.1310: Radiofrequency radiation exposure limits.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager
Date of issue	2023-04-24
Report template No	FAN36_02 (*) "Data provided by the client"

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## Data provided by the client

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The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item under evaluation", "Trademark", "Model and/or type reference", "General description of the device", "Other identification of the product").
2. Maximum output power (from datasheets and measurement reports), maximum antenna gain (from datasheets) and use distance information.
3. The device under evaluation consists of a Telematics control unit with wireless technologies, used in automotive, equipped with one modem, OEM. This unit was designed for automotive usage and contains the following features: GSM, UMTS, LTE, GNSS, Wifi (a, b, g, n, ac), Bluetooth Low Energy (BTLE) and Bluetooth EDR.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

## Identification of the client

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HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH  
BECKER-GOERING-STR. 16; 76307 KARLSBAD GERMANY

## Document history

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Report number	Date	Description
72779RAN.001	2023-10-20	First release
72779RAN.001A1	2023-04-24	Second release. Updated SW/HW versions and clarification about antenna models supported by the device and simultaneous transmission scenarios.

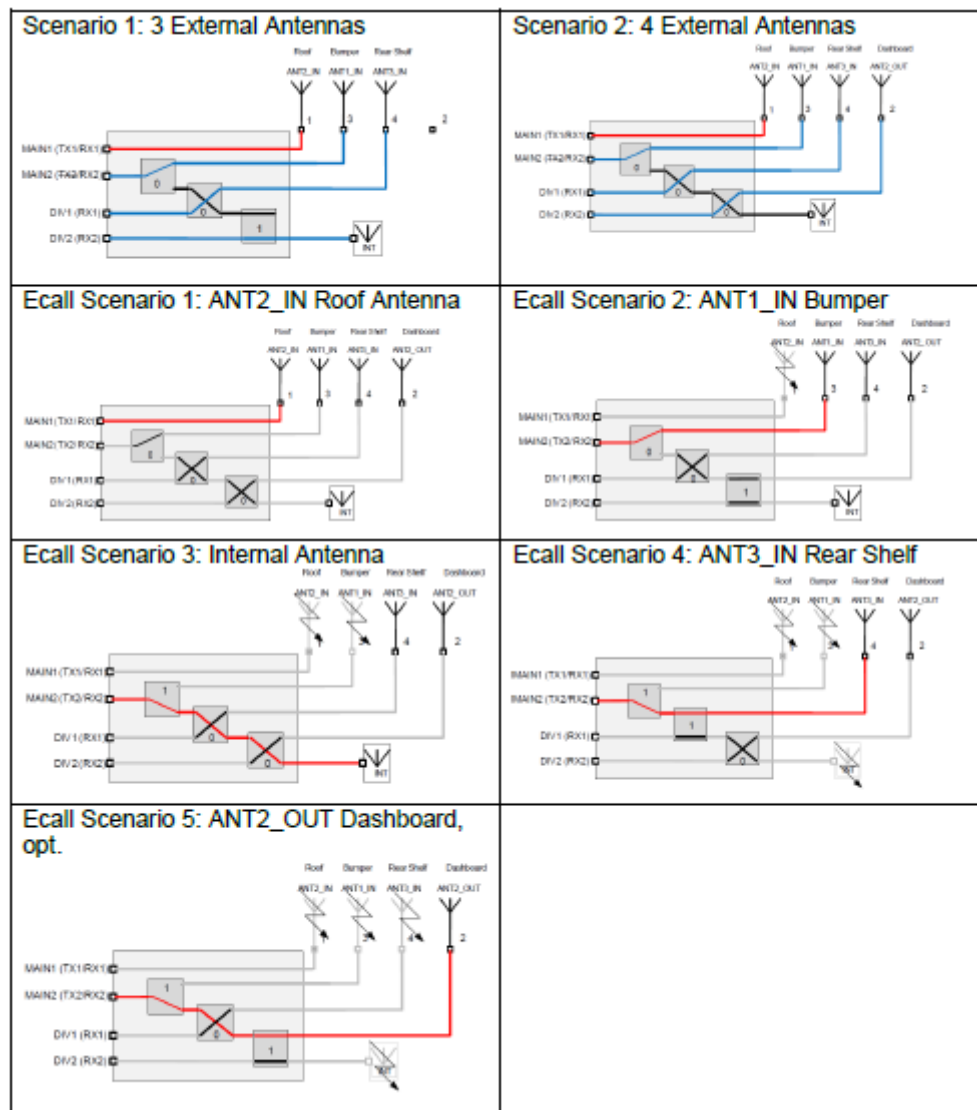
## Appendix A: FCC RF Exposure assessment result

## General description of the device under evaluation

The device under evaluation consists of a Telematics control unit with wireless technologies, used in automotive, equipped with one modem, OEM. This unit was designed for automotive usage and contains the following features: GSM, UMTS, LTE, GNSS, Wi-Fi (a, b, g, n, ac), Bluetooth Low Energy (BTLE) and Bluetooth EDR.

Cellular, Wi-Fi and Bluetooth (only one Bluetooth type, EDR or Low Energy) can transmit simultaneously according to the following scenarios declared by the manufacturer in the “Device technical description” document:

Cellular Scenarios (antenna switching):



WLAN / BT scenarios (antenna operation modes for WLAN / BT / BTLE):

**In normal operation mode (BT/WiFi is active and BTLE inactive) the following antennas are used:**

- WLAN\_BT\_1 → BT and WiFi-5G
- WLAN\_BT\_2 → WiFi 2G4 and WiFi 5G
- WLAN\_P\_2 → unused

**In BTLE Mode the following antennas are used:**

- WLAN\_BT\_1 → BTLE (hard coded depending on car configuration, in this case WLAN\_P\_2 is unused)
- WLAN\_BT\_2 → unused
- WLAN\_P\_2 → BTLE (hard coded depending on car configuration, in this case WLAN\_BT\_1 is unused)

The device support multiples antennas for both Cellular and WLAN technologies and only one antenna per technology is used for transmission. The following table shows the antenna use correspondence according to manufacturer and datasheets:

Antenna name (according to manufacturer device technical specifications)	Antenna Brand and Model	Technology used	External / Internal
ANT1_IN	Hirschmann, model 4M0.035.507	Cellular	External
ANT2_IN	Hirschmann, model 4M0.035.507	Cellular	External
ANT3_IN	Hirschmann, model 4M0.035.507	Cellular	External
ANT4_IN	Hirschmann, model 4M0.035.507	Cellular	External
INT	Harman/Becker, ConBox Internal Backup	Cellular	Internal
WLAN_BT_1	Calearo, model ANTENNAW- LAN 4N0 035 500	BTEDR and Wi-Fi 5GHz / BTLE	External
WLAN_BT_2	Calearo, model ANTENNAW- LAN 4N0 035 500	Wi-Fi 2.4GHz and Wi-Fi 5GHz	External
WLAN_P_2	Calearo, model ANTENNAW- LAN 4N0 035 500	BTLE	External

According to the manufacturer, during its normal use, the separation distance between the radiating structures of the device and nearby users will be greater than **25 cm**. In order to perform the assessment a conservative evaluation distance of **25 cm** has been used.

The equipment specifications for each supported technology are shown in Table 1. Values corresponding to Cellular output power and peak gain of all antennas have been declared by the manufacturer through datasheets. Values corresponding to Wi-Fi, Bluetooth EDR and Low Energy output power have been measured and stated into DEKRA Testing and Certification, S.A.U. test reports nums. 72779RRF.007 and 72779RRF.008.

Technology / Mode	Operating Band	Frequency under evaluation (MHz)	TX config	Maximum Conducted Output Power (Incl. Tune-Up) (dBm)	Duty Cycle (%)	Time Averaged Conducted Power (dBm)	External Cellular Antennas Peak gain (dBi)	Internal Cellular Antenna Peak gain (dBi)	WLAN Antennas Peak gain (dBi)	Maximum Averaged E.R.P (dBm)	Maximum Averaged E.R.P (mW)
GSM	850	824 - 849	SISO	35.00	12.50	25.97	3.97	-0.70	-	27.79	601.05
GPRS 1TX	850	824 - 849	SISO	35.00	12.50	25.97	3.97	-0.70	-	27.79	601.05
GPRS 2TX	850	824 - 849	SISO	35.00	25.00	28.98	3.97	-0.70	-	30.80	1202.10
GPRS 3TX	850	824 - 849	SISO	33.20	37.50	28.94	3.97	-0.70	-	30.76	1191.33
GPRS 4TX	850	824 - 849	SISO	32.00	50.00	28.99	3.97	-0.70	-	30.81	1204.95
EGPRS 1TX	850	824 - 849	SISO	30.00	12.50	20.97	3.97	-0.70	-	22.79	190.07
EGPRS 2TX	850	824 - 849	SISO	30.00	25.00	23.98	3.97	-0.70	-	25.80	380.14
EGPRS 3TX	850	824 - 849	SISO	28.20	37.50	23.94	3.97	-0.70	-	25.76	376.73
EGPRS 4TX	850	824 - 849	SISO	27.00	50.00	23.99	3.97	-0.70	-	25.81	381.04
GSM	1900	1850 - 1910	SISO	32.00	12.50	22.97	6.45	4.40	-	27.27	533.22
GPRS 1TX	1900	1850 - 1910	SISO	32.00	12.50	22.97	6.45	4.40	-	27.27	533.22
GPRS 2TX	1900	1850 - 1910	SISO	32.00	25.00	25.98	6.45	4.40	-	30.28	1066.45
GPRS 3TX	1900	1850 - 1910	SISO	30.20	37.50	25.94	6.45	4.40	-	30.24	1056.89
GPRS 4TX	1900	1850 - 1910	SISO	29.00	50.00	25.99	6.45	4.40	-	30.29	1068.98
EGPRS 1TX	1900	1850 - 1910	SISO	29.00	12.50	19.97	6.45	4.40	-	24.27	267.25
EGPRS 2TX	1900	1850 - 1910	SISO	29.00	25.00	22.98	6.45	4.40	-	27.28	534.49
EGPRS 3TX	1900	1850 - 1910	SISO	27.20	37.50	22.94	6.45	4.40	-	27.24	529.70
EGPRS 4TX	1900	1850 - 1910	SISO	26.00	50.00	22.99	6.45	4.40	-	27.29	535.76
UMTS	II	1850 - 1910	SISO	25.00	100.00	25.00	6.45	4.40	-	29.30	851.14
UMTS	IV	1710 - 1755	SISO	25.00	100.00	25.00	6.45	2.70	-	29.30	851.14
UMTS	V	824 - 849	SISO	25.00	100.00	25.00	3.97	-0.70	-	26.82	480.84
LTE	2	1850 - 1910	SISO	25.00	100.00	25.00	6.45	4.40	-	29.30	851.14
LTE	4	1710 - 1755	SISO	25.00	100.00	25.00	6.45	2.70	-	29.30	851.14
LTE	5	824 - 849	SISO	25.00	100.00	25.00	3.97	-0.70	-	26.82	480.84
LTE	7	2500 - 2570	SISO	25.00	100.00	25.00	6.60	4.30	-	29.45	881.05
LTE	12	699 - 716	SISO	25.00	100.00	25.00	3.82	-3.20	-	26.67	464.52
LTE	13	777 - 787	SISO	25.00	100.00	25.00	3.97	-0.70	-	26.82	480.84
LTE	38	2570 - 2620	SISO	25.00	100.00	25.00	6.60	4.30	-	29.45	881.05
LTE	66	1710 - 1780	SISO	25.00	100.00	25.00	6.45	2.70	-	29.30	851.14
802.11b/g/n	2.4 GHz	2412 - 2484	SISO	13.87	100.00	13.87	-	-	0.11	11.83	15.25
802.11a/n/ac	U-NII-1	5150 - 5250	SISO	17.47	100.00	17.47	-	-	2.38	17.70	58.94
802.11a/n/ac	U-NII-3	5725 - 5850	SISO	14.62	100.00	14.62	-	-	2.38	14.85	30.53
BTEDR	2.4 GHz	2400 - 2483.5	SISO	0.82	100.00	0.82	-	-	0.11	-1.22	0.75
BTLE	2.4 GHz	2400 - 2483.5	SISO	4.21	100.00	4.21	-	-	0.11	2.17	1.65

Table 1: Equipment specifications



## Evaluation Results

### RF Exposure Exemption evaluation:

Technology / Mode	Operating Band	Frequency under evaluation (MHz)	TX config	Distance (cm)	Time Averaged Conducted Power (mW)	Maximum Averaged E.R.P (mW)	§1.1307(b)(3).i.(C) Exposure Limit (mW)	§ 1.1307(b)(3).i.(B) Exposure Limit (mW)	Verdict for exemption § 1.1307(b)(3).i
GSM/GPRS	850	824 - 849	SISO	20.00	N/A	1204.95	-	1731.96	Pass
GSM/GPRS	1900	1850 - 1910	SISO	20.00	N/A	1068.98	-	3060.00	Pass
UMTS	II	1850 - 1910	SISO	20.00	N/A	851.14	-	3060.00	Pass
UMTS	IV	1710 - 1755	SISO	20.00	N/A	851.14	-	3060.00	Pass
UMTS	V	824 - 849	SISO	20.00	N/A	480.84	-	1731.96	Pass
LTE	2	1850 - 1910	SISO	20.00	N/A	851.14	-	3060.00	Pass
LTE	4	1710 - 1755	SISO	20.00	N/A	851.14	-	3060.00	Pass
LTE	5	824 - 849	SISO	20.00	N/A	480.84	-	1731.96	Pass
LTE	7	2500 - 2570	SISO	20.00	N/A	881.05	-	3060.00	Pass
LTE	12	699 - 716	SISO	20.00	N/A	464.52	-	1460.64	Pass
LTE	13	777 - 787	SISO	20.00	N/A	480.84	-	1605.48	Pass
LTE	38	2570 - 2620	SISO	20.00	N/A	881.05	-	3060.00	Pass
LTE	66	1710 - 1780	SISO	20.00	N/A	851.14	-	3060.00	Pass
802.11b/g/n	2.4 GHz	2412 - 2484	SISO	20.00	N/A	15.25	768.00	-	Pass
802.11a/n/ac	U-NII-1	5150 - 5250	SISO	20.00	N/A	58.94	768.00	-	Pass
802.11a/n/ac	U-NII-3	5725 - 5850	SISO	20.00	N/A	30.53	768.00	-	Pass
BTEDR	2.4 GHz	2400 - 2483.5	SISO	20.00	N/A	0.75	768.00	-	Pass
BTLE	2.4 GHz	2400 - 2483.5	SISO	20.00	2.64	1.65	768.00	-	Pass

**Table 2:** FCC Exemption Evaluation Results

The computed value(s) are below the exemption limit(s), so these modes meet the requirements stated in FCC 47 CFR Part 1.1307.

### Simultaneous transmission assessment:

Following scenarios for simultaneous conditions would represent the worst possible cases:

Simultaneous technologies and modes	Result ( $\sum$ of Pout/Pmax ratios)	Verdict ( $\sum \leq 1$ )
GPRS 4TX 850 + 802.11b/g/n 2.4 GHz + 802.11a/n/ac U-NII-1 + BTEDR 2.4 GHz	0.81	Pass
GPRS 4TX 850 + 802.11b/g/n 2.4 GHz + 802.11a/n/ac U-NII-1 + BTLE 2.4 GHz	0.81	Pass

**Table 3:** Simultaneous Transmission assessment

## Appendix B: FCC RF Exposure information

## RF Exposure determination of exemption

According to FCC 47 CFR §1.1307 (b)(3) Determination of exemption:

(i) For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2), a single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or 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:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

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

and

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

$d$  = the separation distance (cm);

(C) Or using Table 1 and the minimum separation distance ( $R$  in meters) from the body of a nearby person for the frequency ( $f$  in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply,  $R$  must be at least  $\lambda/2\pi$ , where  $\lambda$  is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of  $\lambda/4$  or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

TABLE 1 TO §1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$ .
1.34-30	$3,450 R^2/f^2$ .
30-300	$3.83 R^2$ .
300-1,500	$0.0128 R^2 f$ .
1,500-100,000	$19.2 R^2$ .

(ii) For multiple RF sources: Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

(B) 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.

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

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for Pth, including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

Pi = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

Pth,i = the exemption threshold power (Pth) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.

ERPj = the ERP of fixed, mobile, or portable RF source j.

ERPth,j = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least  $\lambda/2\pi$  according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

Evaluated,k = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

Exposure Limit,k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from §1.1310 of this chapter.

## RF Exposure evaluation

Limits for Maximum Permissible Exposure (MPE) for RF sources are defined in FCC 47 CFR “§1.1310 Radiation Exposure limits, paragraph (e)”:

**TABLE 1 TO §1.1310(E)(1)—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(i) Limits for Occupational/Controlled Exposure</b>				
0.3-3.0	614	1.63	*(100)	≤6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	<6
30-300	61.4	0.163	1.0	<6
300-1,500			f/300	<6
1,500-100,000			5	<6
<b>(ii) Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	<30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	<30
30-300	27.5	0.073	0.2	<30
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

f = frequency in MHz. \* = Plane-wave equivalent power density.

Each supported transmission technology will be evaluated to determine if it is in compliance with limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

In order to perform the assessment, the following equations have been used for the calculations; these equations are accurate in the far-field of an antenna and will over-predict power density in the near field, where they could be used for making a "worst-case" or conservative prediction:

$$\text{Power density: } S[\text{mW} / \text{cm}^2] = \frac{P_{E.I.R.P.}[\text{mW}]}{4\pi R[\text{cm}]^2}$$

Where:

$S$  = power density

$P_{E.I.R.P.}$  = Equivalent isotropically radiated power

$R$  = distance to the center of radiation of the antenna (evaluation distance)

$$P_{E.I.R.P.} = P_T + G_T - L_C$$

Where:

$P_T$ = transmitter time-averaged output power (including Duty Cycle and tune-up tolerance, if applicable)

$G_T$ = gain of the transmitting antenna

$L_C$  = signal attenuation in the connecting cable between the transmitter and the antenna if applicable