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Test report No:
NIE: 60320RAN.002

Assessment report
RF EXPOSURE REPORT ACCORDING TO
FCC 47 CFR Part 2.1091
ISED RSS-102 Issue 5:2015

(*) Identification of item under evaluation	Automotive infotainment System
(*) Trademark	Mercedes-Benz
(*) Model and /or type reference	NTG7RSU
Other identification of the product	FCC ID: T8GNTG7RSU IC: 6434A-NTG7RSU HW Version: C0 SW Version: E13.205
(*) Features	Bluetooth, WLAN
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. ISED RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) IEEE Std C95.3™ -2002 (R2008). IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz–300 GHz
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager  MIGUEL LACAVE GARCÍA 2019.10.25 11:37:20 +02'00'
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Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. Maximum output power and maximum antenna gain information.

3. The sample consists of an Automotive Rear Seat Unit (RSU) for installation in cars. Features: BT, WLAN, Display interface, interface to Head Unit.

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

Harman Becker Automotive Systems GmbH

Becker Göring Strasse 16.

76307. Karlsbad.

Germany.

Document history

Report number	Date	Description
60268RAN.002	2019-10-25	First release

General description of the device under evaluation

The device under evaluation consists of an Automotive Rear Seat Unit (RSU) for installation in cars. Features: BT, WLAN, Display interface, interface to Head Unit.

According to the manufacturer, during its normal use, the separation distance between the device and the body of nearby users will be greater than 20 cm. In order to perform the assessment a conservative evaluation distance of 20 cm has been used.

The rear seat unit contains two Bluetooth/WLAN module based on Broadcom´s BCM89359 chip.

It provides the following features:

- WLAN 2,4 GHz
- WLAN 5 GHz (MIMO)
- BT 2.0 + EDR
- BT 3.0

The equipment specifications declared by the manufacturer for each supported technology and band are:

WLAN Chip	Technology / Mode	Band	Frequency (MHz)	Maximum Conducted Output Power (dBm)	Antenna peak gain (dBi)	Cable loss (dBm)	Maximum E.I.R.P. (dBm)	Maximum E.I.R.P. (mW)
1	WLAN (SISO)	2.4 GHz	2412 - 2484	20.00	0.30	2.51	17.80	60.19
	WLAN (SISO/MIMO)	5.7 GHz	4910 - 5825	20.00	0.30	2.31	17.99	62.95
	WLAN (MIMO)	5.7 GHz	5745 - 5825	20.00	-0.10	2.51	17.40	54.89
	Bluetooth	2.4 GHz	2402 - 2480	10.00	0.50	2.31	8.19	6.59
2	WLAN (SISO)	2.4 GHz	2412 - 2484	20.00	0.70	2.12	18.58	72.11
	WLAN (SISO/MIMO)	5.7 GHz	5745 - 5825	20.00	1.10	1.82	19.29	84.82
	WLAN (MIMO)	5 GHz	4910 - 5825	20.00	0.60	2.12	18.48	70.47
	Bluetooth	2.4 GHz	2405 - 2470	10.00	1.00	1.82	9.19	8.29

Table 1: Equipment specifications

RF Exposure Assessment result and verdict

FCC assessment:

Limits for Maximum Permissible Exposure (MPE) to comply with FCC 47 CFR § 2.1091 are defined in "§1.1310 Radiation Exposure limits, paragraph (e)":

WLAN Chip	Technology / Mode	Band	Frequency (MHz)	Distance (cm)	Power density (mW/cm^2)	FCC General Population Limit (mW/cm^2)	Verdict
1	WLAN (SISO)	2.4 GHz	2412 - 2484	20.00	0.01	1.00	**Pass**
	WLAN (SISO/MIMO)	5.7 GHz	5745 - 5825	20.00	0.01	1.00	**Pass**
	WLAN (MIMO)	5.7 GHz	5745 - 5825	20.00	0.01	1.00	**Pass**
	Bluetooth	2.4 GHz	2402 - 2480	20.00	0.00	1.00	**Pass**
2	WLAN (SISO)	2.4 GHz	2412 - 2484	20.00	0.01	1.00	**Pass**
	WLAN (SISO/MIMO)	5.7 GHz	5745 - 5825	20.00	0.02	1.00	**Pass**
	WLAN (MIMO)	5 GHz	4910 - 5825	20.00	0.01	1.00	**Pass**
	Bluetooth	2.4 GHz	2405 - 2470	20.00	0.00	1.00	**Pass**

Table 2: Assessment result and verdict

Simultaneous Transmission assessment:

The device supports simultaneous transmission for the following technology combinations:

1. Chip1 (WLAN 2.4 GHz SISO and WLAN 5 GHz SISO) and Chip 2 (WLAN 2.4 GHz SISO and WLAN 5 GHz SISO)
2. Chip 1 (WLAN 2.4 GHz SISO and WLAN 5 GHz SISO) and Chip 2 (WLAN 5 GHz MIMO)
3. Chip1 (WLAN 2.4 GHz SISO and Bluetooth) and Chip 2 (WLAN 5 GHz MIMO)
4. Chip1 (WLAN 2.4 GHz SISO and Bluetooth) and Chip 2 (WLAN 2.4 GHz SISO and Bluetooth)
5.

Simultaneous technologies and modes	Result	Limit	Verdict
Chip 1 (WLAN 2.4 GHz (SISO) + WLAN 5 GHz (SISO/MIMO)) + Chip 2 (WLAN 2.4 GHz (SISO) + WLAN 5 GHz (SISO/MIMO))	0.06	1	**Pass**
Chip 1 (WLAN 2.4 GHz (SISO) + WLAN 5 GHz (SISO/MIMO)) + Chip 2 (WLAN 5 GHz (SISO/MIMO) + WLAN 5 GHz (MIMO))	0.06	1	**Pass**
Chip 1 (WLAN 2.4 GHz (SISO) + Bluetooth) + Chip 2 (WLAN 5 GHz (SISO/MIMO) + WLAN 5 GHz (MIMO))	0.04	1	**Pass**
Chip 1 (WLAN 2.4 GHz (SISO) + Bluetooth) + Chip 2 (WLAN 2.4 GHz (SISO) + Bluetooth)	0.03	1	**Pass**

Table 3: Simultaneous Transmission assessment

ISED assessment:

Limits for RF Field Strength to comply with RSS-102 Issue 5 are defined in “Health Canada’s RF exposure guideline, Safety code 6”:

WLAN Chip	Technology / Mode	Band	Frequency (MHz)	Distance (cm)	Power density (W/m^2)	ISED General Public Limit (W/m^2)	Verdict
1	WLAN (SISO)	2.4 GHz	2412 - 2484	20.00	0.12	5.37	**Pass**
	WLAN (SISO/MIMO)	5.7 GHz	5745 - 5825	20.00	0.13	8.72	**Pass**
	WLAN (MIMO)	5.7 GHz	5745 - 5825	20.00	0.11	9.71	**Pass**
	Bluetooth	2.4 GHz	2402 - 2480	20.00	0.01	5.35	**Pass**
2	WLAN (SISO)	2.4 GHz	2412 - 2484	20.00	0.14	5.37	**Pass**
	WLAN (SISO/MIMO)	5.7 GHz	5745 - 5825	20.00	0.17	9.71	**Pass**
	WLAN (MIMO)	5 GHz	4910 - 5825	20.00	0.14	8.72	**Pass**
	Bluetooth	2.4 GHz	2405 - 2470	20.00	0.02	5.36	**Pass**

Table 4: Assessment result and verdict

Simultaneous Transmission assessment:

The device supports simultaneous transmission for the following technology combinations:

1. Chip1 (WLAN 2.4 GHz SISO and WLAN 5 GHz SISO) and Chip 2 (WLAN 2.4 GHz SISO and WLAN 5 GHz SISO)
2. Chip 1 (WLAN 2.4 GHz SISO and WLAN 5 GHz SISO) and Chip 2 (WLAN 5 GHz MIMO)
3. Chip1 (WLAN 2.4 GHz SISO and Bluetooth) and Chip 2 (WLAN 5 GHz MIMO)
4. Chip1 (WLAN 2.4 GHz SISO and Bluetooth) and Chip 2 (WLAN 2.4 GHz SISO and Bluetooth)

Simultaneous technologies and modes	Result	Limit	Verdict
Chip 1 (WLAN 2.4 GHz (SISO) + WLAN 5 GHz (SISO/MIMO)) + Chip 2 (WLAN 2.4 GHz (SISO) + WLAN 5 GHz (SISO/MIMO))	0.08	1	**Pass**
Chip 1 (WLAN 2.4 GHz (SISO) + WLAN 5 GHz (SISO/MIMO)) + Chip 2 (WLAN 5 GHz (SISO/MIMO) + WLAN 5 GHz (MIMO))	0.07	1	**Pass**
Chip 1 (WLAN 2.4 GHz (SISO) + Bluetooth) + Chip 2 (WLAN 5 GHz (SISO/MIMO) + WLAN 5 GHz (MIMO))	0.06	1	**Pass**
Chip 1 (WLAN 2.4 GHz (SISO) + Bluetooth) + Chip 2 (WLAN 2.4 GHz (SISO) + Bluetooth)	0.05	1	**Pass**

Table 5: Simultaneous Transmission assessment

Appendix A: FCC RF Exposure information

FCC RF Exposure evaluation

Devices operating in standalone mobile device exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be at least 20 cm and fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile device exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When a device qualifies for the categorical exclusion provision of § 2.1091(c), the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to §1.1310 Radiofrequency radiation exposure limits, paragraph (e), the limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields are:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	*100	6
3.0–30	1842/f	4.89/f	$*900/f^2$	6
30–300	61.4	0.163	1.0	6
300–1,500	.....	.....	f/300	6
1,500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*100	30
1.34–30	824/f	2.19/f	$*180/f^2$	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

FCC MPE Evaluation

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:

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

Minimum compliance distance: $R_{\min}[cm] = \sqrt{\frac{P_{E.I.R.P.}[mW]}{4\Pi S[mW/cm^2]}}$

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)

$R_{\min}$ = distance to the center of radiation of the antenna

Multiple frequencies assessment

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} < 1$$

Where

S_i is the power flux density of each source;

MPE_i is the power flux density basic restriction of each source.

Appendix B: ISED RF Exposure information

ISED RF Exposure evaluation for mobile devices

According to RSS-102 Issue 5, Paragraph "4. Exposure Limits", Industry of Canada has adopted the RF field strength limits established in Health Canada's RF exposure guideline, Safety code 6:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

Table 6: RF Field Strength Limits for Controlled Use Devices (Controlled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10[23]	170	180	-	Instantaneous*
0.1-10	-	$1.6/f$	-	6**
1.29-10	$193/f^{0.5}$	-	-	6**
10-20	61.4	0.163	10	6
20-48	$129.8/f^{0.25}$	$0.3444/f^{0.25}$	$44.72/f^{0.5}$	6
48-100	49.33	0.1309	6.455	6
100-6000	$15.60 f^{0.25}$	$0.04138 f^{0.25}$	$0.6455 f^{0.5}$	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	$616000/f^{1.2}$
150000-300000	$0.354 f^{0.5}$	$9.40 \times 10^{-4} f^{0.5}$	$3.33 \times 10^{-4} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

ISED MPE Evaluation

Each supported transmission technology will be evaluated to determine if it is in compliance with RSS-102 Issue 5, RF Field Strength Limits for devices used by the General Public.

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:

Power density: $S[W/m^2] = \frac{P_{E.I.R.P.}[W]}{4\Pi R[m]^2}$

Minimum compliance distance: $R_{\min}[m] = \sqrt{\frac{P_{E.I.R.P.}[W]}{4\Pi S[W/m^2]}}$

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)

$R_{\min}$ = distance to the center of radiation of the antenna

Multiple frequencies assessment

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} < 1$$

Where

S_i is the power flux density of each source;

MPE_i is the power flux density basic restriction of each source.