

Test report No:
NIE: 66440RAN.002

Assessment report

RF EXPOSURE REPORT ACCORDING TO FCC 47 CFR Part 2.1093 ISED RSS -102 Issue 5:2015

(*) Identification of item under evaluation	Automotive Infotainment System
(*) Trademark	BMW
(*) Model and /or type reference	MGU21
(*) Other identification of the product	HW version: 1.3 SW version: 20w27.4-1-15 FCC ID: T8GMGU21 IC: 6434A-MGU21
(*) Features	USB 2.0 (including support for Apple Devices), Bluetooth, WLAN Modul 2.4 / 5 GHz, GNSS, AR-CAM input, Video-out APIX3, CAN, 100Base-T1 and 1000Base-T1
(*) Manufacturer	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16; 76307 KARLSBAD, GERMANY
Test method requested, standard	FCC 47 CFR Part 2.1093. Radiofrequency radiation exposure evaluation: portable devices. ISED RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager
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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 tested", "Trademark", "Model and/or type reference tested", "General description of the device" and "Other identification of the product").
2. Maximum antenna gain and use distance information

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Identification of the client

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

Document history

Report number	Date	Description
66440RAN.002	2020-10-14	First release

General description of the device under evaluation

The device under evaluation consists of an Automotive infotainment System MGU Head-Unit. The main functionalities are: Navigation, USB, voice recognition and several interfaces to the vehicle and Bluetooth / WLAN.

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 5.1 cm. In order to perform the assessment a conservative evaluation distance of 5.1 cm has been used.

The equipment specifications for each supported technologies are shown in Table 1. Values corresponding to antenna gain are declared by the manufacturer. Values corresponding to conducted output power have been measured and stated into DEKRA Testing and Certification, S.A.U. test reports numbers 63175RRF.005 and 63175RRF.006.

Technology / Mode	Band	Frequency (MHz)	Maximum Conducted Output Power (dBm)	Antenna peak gain (dBi)	Maximum E.I.R.P. (dBm)	Maximum E.I.R.P. (mW)
WLAN (802.11b/g/n)	2.4 GHz	2412 - 2484	11.60	-6.20	5.40	3.47
WLAN (802.11a/an/ac)	5 GHz	5150 - 5850	11.88	-5.40	6.48	4.45
Bluetooth	2.4 GHz	2400 - 2483.5	8.54	-5.40	3.14	2.06

Table 1: Equipment specifications

Assessment summary

Radiofrequency radiation exposure limits			
FCC 47 CFR § 2.1093 & ISSED RSS-102 Issue 5 (2015-03)			
Technology / Mode	Band	Frequency (MHz)	Verdict
WLAN (802.11b/g/n)	2.4 GHz	2412 - 2484	Pass
WLAN (802.11a/an/ac)	5 GHz	5150 - 5850	Pass
Bluetooth	2.4 GHz	2400 - 2483.5	Pass
Simultaneous WLAN 2.4 GHz + Bluetooth			Pass
Simultaneous WLAN 5 GHz + Bluetooth			Pass
Simultaneous WLAN 2.4 GHz + WLAN 5 GHz			Pass
Simultaneous WLAN 2.4 GHz + WLAN 5 GHz + Bluetooth			Pass

Table 2: Assessment summary

Evaluation Results

FCC evaluation:

The evaluation according to the minimum intended use distance of 5.1 cm will be as follow:

Technology / Mode	Band	Frequency (MHz)	Max Output Power (dBm)	Distance (cm)	Max Output Power (mW)	Limit 1-g SAR (mW)	SAR Test Exclusion
WLAN (802.11b/g/n)	2.4 GHz	2412 - 2484	11.60	5.10	14.45	105.17	Pass
WLAN (802.11a/an/ac)	5 GHz	5150 - 5850	11.88	5.10	15.42	72.02	Pass
Bluetooth	2.4 GHz	2400 - 2483.5	8.54	5.10	7.14	105.18	Pass

Table 3: FCC Evaluation Result

The computed value(s) are lower than de limits, so according to KDB 447498 D01 – General RF Exposure Guidance, these modes qualify for Standalone SAR test exclusion for 1-g SAR and 10-g Extremity SAR.

Simultaneous transmission assessment

The device under evaluation is able to transmit simultaneously using Bluetooth, WLAN 802.11b/g/n and WLAN 802.11a/an/ac transmitters, therefore the most conservative approach for the evaluation of the simultaneous transmission will be:

Simultaneous technologies and modes	Result	Limit	Verdict
WLAN 2.4 GHz + Bluetooth	0.21	1	Pass
WLAN 5 GHz + Bluetooth	0.28	1	Pass
WLAN 2.4 GHz + WLAN 5 GHz	0.35	1	Pass
WLAN 2.4 GHz + WLAN 5 GHz + Bluetooth	0.42	1	Pass

Table 4: Simultaneous Result

ISED evaluation:

Exemption limits for the applicable separation distance have been calculated by linear interpolation for the applicable operating frequencies according to paragraph “RSS-102 Issue 5 (2015-03), 2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation”.

The device has a transmitting antenna with a negative gain; therefore the maximum conducted output power has been used for the evaluation as a worst-case condition.

For an intended use distance of 5.1 cm, the evaluation for the applicable output power levels and exemption limits for each operating frequency will be as follow:

Technology / Mode	Band	Frequency (MHz)	Distance (cm)	Maximum E.I.R.P. (mW)	SAR Low-power exclusion level (mW)	SAR Test Exclusion
WLAN (802.11b/g/n)	2.4 GHz	2412 - 2484	5.10	14.45	308.94	Pass
WLAN (802.11a/an/ac)	5 GHz	5150 - 5850	5.10	15.42	106.00	Pass
Bluetooth	2.4 GHz	2400 - 2483.5	5.10	7.14	308.94	Pass

Table 5: ISED Evaluation Result

As all operating frequencies comply with ISED Exemption Limits, according to the standard “ISED RSS-102 Issue 5 (2015-03)”, SAR testing is not required. See Appendix A/B for additional information.

Simultaneous transmission assessment:

The device under evaluation is able to transmit simultaneously using Bluetooth, WLAN 802.11b/g/n and WLAN 802.11a/an/ac transmitters, therefore the most conservative approach for the evaluation of the simultaneous transmission will be:

Simultaneous technologies and modes	Result	Limit	Verdict
WLAN 2.4 GHz + Bluetooth	0.07	1	Pass
WLAN 5 GHz + Bluetooth	0.17	1	Pass
WLAN 2.4 GHz + WLAN 5 GHz	0.19	1	Pass
WLAN 2.4 GHz + WLAN 5 GHz + Bluetooth	0.22	1	Pass

Table 6: Simultaneous Result

Appendix A: FCC RF Exposure information

FCC SAR test exclusion considerations for portable devices

As stated by the FCC (47 CFR §2.1093), human exposure to RF emissions from portable devices, which are defined as transmitting devices to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user, must be evaluated with respect to the FCC-adopted limits for SAR.

According to FCC OET KDB 447498 D01 General RF Exposure Guidance:

Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition is satisfied.

- For distances ≤ 50 mm

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot \sqrt{f(\text{GHz})} \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR}$$

Where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table:

MHz	5	10	15	20	25	30	35	40	45	50	mm
150	39	77	116	155	194	232	271	310	349	387	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	164	192	219	246	274	
450	22	45	67	89	112	134	157	179	201	224	
835	16	33	49	66	82	98	115	131	148	164	
900	16	32	47	63	79	95	111	126	142	158	
1500	12	24	37	49	61	73	86	98	110	122	
1900	11	22	33	44	54	65	76	87	98	109	
2450	10	19	29	38	48	57	67	77	86	96	
3600	8	16	24	32	40	47	55	63	71	79	
5200	7	13	20	26	33	39	46	53	59	66	
5400	6	13	19	26	32	39	45	52	58	65	
5800	6	12	19	25	31	37	44	50	56	62	

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

- For distances > 50 mm

For 100 MHz to 6 GHz frequencies and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following:

- 1) [Power allowed at numeric threshold for 50 mm in table 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz
- 2) [Power allowed at numeric threshold for 50 mm in table 1) + (test separation distance - 50 mm)·10] mW, at > 1500 MHz and ≤ 6 GHz

Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table

MHz	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	mm
100	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	SAR Test Exclusion Threshold (mW)
150	387	397	407	417	427	437	447	457	467	477	487	497	507	517	527	
300	274	294	314	334	354	374	394	414	434	454	474	494	514	534	554	
450	224	254	284	314	344	374	404	434	464	494	524	554	584	614	644	
835	164	220	275	331	387	442	498	554	609	665	721	776	832	888	943	
900	158	218	278	338	398	458	518	578	638	698	758	818	878	938	998	
1500	122	222	322	422	522	622	722	822	922	1022	1122	1222	1322	1422	1522	
1900	109	209	309	409	509	609	709	809	909	1009	1109	1209	1309	1409	1509	
2450	96	196	296	396	496	596	696	796	896	996	1096	1196	1296	1396	1496	
3600	79	179	279	379	479	579	679	779	879	979	1079	1179	1279	1379	1479	
5200	66	166	266	366	466	566	666	766	866	966	1066	1166	1266	1366	1466	
5400	65	165	265	365	465	565	665	765	865	965	1065	1165	1265	1365	1465	
5800	62	162	262	362	462	562	662	762	862	962	1062	1162	1262	1362	1462	

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and > 50 mm

- For frequencies below 100 MHz

The following may be considered for SAR test exclusion:

- 1) For test separation distances > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by $[1 + \log(100/f(\text{MHz}))]$
- 2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by $\frac{1}{2}$

Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table

MHz	< 50	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	mm
100	237	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	mW
50	308	617	625	634	643	651	660	669	677	686	695	703	712	721	729	738	
10	474	948	961	975	988	1001	1015	1028	1041	1055	1068	1081	1095	1108	1121	1135	
1	711	1422	1442	1462	1482	1502	1522	1542	1562	1582	1602	1622	1642	1662	1682	1702	
0.1	948	1896	1923	1949	1976	2003	2029	2056	2083	2109	2136	2163	2189	2216	2243	2269	
0.05	1019	2039	2067	2096	2125	2153	2182	2211	2239	2268	2297	2325	2354	2383	2411	2440	
0.01	1185	2370	2403	2437	2470	2503	2537	2570	2603	2637	2670	2703	2737	2770	2803	2837	

SAR Test Exclusion Thresholds for frequencies < 100 MHz

Simultaneous transmission 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 towards 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:

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

Where

S_i is the calculated SAR tests exclusion value of each source.

$P_{\max_i}$ is the SAR test exclusion threshold.

Appendix B: ISED RF Exposure information

ISED SAR test exclusion considerations

According to “RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)”, paragraph “2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation”, the device operates below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1:

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

Simultaneous transmission 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 towards 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:

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

Where

S_i is the output power of each source.

$P_{\max_i}$ is the power limit for test exclusion threshold.