



RF - TEST REPORT

- Human Exposure -

Type / Model Name : M2

Product Description : Radio Module 802.11a/b/n/ac & BLE

Applicant : BSH Hausgeräte GmbH

Address : Carl-Wery-Straße 34

81739 München

Manufacturer : BSH Hausgeräte GmbH

Address : Carl-Wery-Straße 34

81739 München

Test Result according to the standards
listed in clause 1 test standards:

POSITIVE

Test Report No. : 80091012-08 Rev_1

07. June 2022

Date of issue



Deutsche
Akkreditierungsstelle
D-PL-12030-01-03
D-PL-12030-01-04

FCC ID: 2AHES-M2

IC ID: 21152-M2

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ATTACHMENT A as separate supplement

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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310 Radiofrequency radiation exposure limits

Part 1, Subpart 2, Section 2.1091 Radiofrequency radiation exposure evaluation: **mobile devices**.

KDB 447498 D01 v06 RF Exposure procedures and equipment authorisation policies for mobile and portable devices, April 20, 2021.

ANSI C95.1: 2005 IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

ETSI TR 100 028 V1.3.1: 2001-03, Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2

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2 EQUIPMENT UNDER TEST

2.1 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according his/her instructions.

2.3 Photo documentation of the EUT – See Attachment A

2.4 General remarks

As requested by the manufacturer all tests were performed with the highest possible power setting to still comply with the applying regulations and limits. Used power settings are listed under 2.13. of this test report.

2.5 Equipment type, category

WLAN - Client, BLE device, mobile equipment.

2.6 Short description of the equipment under test (EUT)

The EUT is a communication module for assembling into household devices. The firmware does not support ad-hoc modes and gives the user no possibility to choose the data transmission or power setting. The EUT is compatible with IEEE 802.11b, g, n, a, ac Standard and 802.15. It supports the 2.4 GHz and 5 GHz frequency band and supports no beam forming.

Tested samples	: 1 (radiated) with maximum power settings
Serial number	: 80012117280000440335000001789
SW	: BSH Embedded Linux Platform (SMM M2 default) - debug [HWTEST] 40.0.0-204-g45fedbf \n \l
Firmware	: 1.28 RC0.0 wl0: Apr 15 2021 03:04:08 version 7.45.234 (4ca95bb CY WLTEST) FWID 01-67595eaa
Tested samples	: 1 (conducted) with final power setting
Serial number	: 80012117280000440335000001781
SW	: BSH Embedded Linux Platform (SMM M2 default) - debug [HWTEST] 51.0.2-166-g265f5d5 bsh-smm-m2 ttytxc3
Firmware	: 1.28 RC0.0 wl0: Apr 15 2021 03:04:08 version 7.45.234 (4ca95bb CY WLTEST) FWID 01-67595eaa

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2.7 Variants of the EUT

There are no variants.

2.8 Operation frequency

The operating frequency is 2400 MHz to 2483.5 MHz. For BLE and WLAN Standard 802.11b/g/n.
The operating frequency is 5150 MHz to 5350 MHz and 5470 MHz to 5850 MHz. For WLAN Standard 802.11a/n/ac.

Detailed channel plan can be viewed in the CSA Test Reports 80091012-01 to 80091012-06.

2.9 Transmit operating modes

BLE:

The EUT uses GFSK modulation and may provide following data rates:
1000 kbps

WLAN 2.4 GHz:

The EUT use DSSS or OFDM modulation and provide following data rates with auto-fall-back:

- 802.11b 11, 5.5, 2, 1 Mbps
- 802.11g 54, 48, 36, 24, 18, 12, 9, 6 Mbps
- 802.11n HT20, MCS 0 - 7
- 802.11n HT40, MCS 0 - 7

WLAN 5 GHz:

The module uses OFDM modulation and is capable to provide following data rates:

- 802.11a 54, 48, 36, 24, 18, 12, 9, 6 Mbps
- 802.11n HT20, MCS 0 – 7
- 802.11n HT40, MCS 0 – 7
- 802.11ac VHT20, MCS 0 – 9
- 802.11ac VHT40, MCS 0 – 9
- 802.11ac VHT80, MCS 0 – 9

2.10 Antennas

The following antennas shall be used with the EUT:

Number	Characteristic	Model number	Plug	Frequency range (GHz)	Gain (dBi)
1	Omni	PCB antenna	-	2.4	2.1
				5	4.3

2.11 Power supply system utilised

Power supply voltage, V_{nom} : 5 V_{DC}

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3 TEST RESULT SUMMARY

WLAN device using digital modulation:

Operating in the 2400 MHz – 2483.5 MHz and 5725 MHz – 5850 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
KDB 447498, 7.1	RSS 102, 2.5.2	MPE	passed
KDB 447498, 4.3.1	RSS 102, 2.5.1	SAR exclusion consideration	not applicable
KDB 447498, 7.2	RSS102, 3.2	Co-location, Co-transmission	not applicable

Co-location is no applicable because transmitter can not transmit simultaneously.

The mentioned RSS Rule Parts in the above table are related to:
RSS 102, Issue 5, March 2015

3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80091012-08	0	18 January 2022	Initial test report
80091012-08	1	07 June 2022	Changed evaluation according to measurements with final settings

The test report with the highest revision number replaces the previous test reports.

3.2 Final assessment

The equipment under test fulfills the requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 18 January 2022

Testing concluded on : 03 June 2022

Checked by:

Tested by:


Jürgen Pessinger
2022.06.07 15:41:22
+02'00'


Lukas Scheuermann
2022.06.07 09:38:22
+02'00'

Jürgen Pessinger
Radio Team

Lukas Scheuermann
Radio Team

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4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15 - 35 °C

Humidity: 30 - 60 %

Atmospheric pressure: 86 - 106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report on basis of the ETSI Technical Report TR 100 028 Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1 and Part 2. The results are documented in the quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

4.4 Conformity Decision Rule

The applied conformity decision rule is based on ILAC G8:09/2019 clause 4.2.1 Binary Statement for Simple Acceptance Rule ($w = 0$).

Details can be found in the procedure CSA_B_V50_29.

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5 HUMAN EXPOSURE

5.1 Maximum permissible exposure (MPE)

5.1.1 Description of the test location

Test location: NONE

5.1.2 Applicable standard

According to FCC Part 15, Section 15.247(i):

Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

The test methods used comply with ANSI/IEEE C95.1, "IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz".

This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

5.1.3 Description of Determination

The maximum rated output power conducted included the tune up tolerance is used to calculate the EIRP. Through the Friis transmission formula, the known maximum gain of the antenna and the maximum power, can be calculated the MPE in a defined distance away from the product.

Friis transmission formula:

$$P_d = \frac{P_{out} * G}{4 * \pi * r^2}$$

Where:

P_d = power density (mW/cm²)

P_{out} = output power to antenna (mW)

G = gain of antenna (linear scale)

r = distance between antenna and observation point (cm)

According to FCC Rules 47CFR 2.1093(b) the EUT is not a portable device. The EUT is designed to be used that radiating structures are 20 cm outside of the body of the user. ($r = 20$ cm)

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5.1.4 Determination of MPE according FCC
5.1.4.1 BLE

BLE							
Channel	measured EIRP	Tune-up Tolerance	max. EIRP	P _d	Limit	Margin	Exposure ratio
No.	(dBm)	(dB)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
37	3.3	1.5	3.01	0.0006	1.0	-0.9994	0.06
17	2.0	1.5	2.26	0.0004	1.0	-0.9996	0.04
39	1.4	1.5	1.97	0.0004	1.0	-0.9996	0.04

5.1.4.2 WLAN 2.4 GHz

Manufacturer stated data for the EUT:

2.4 GHz WLAN

Rated cond. output power (peak):	25.5 dBm	354.8 mW
Tune-up tolerance:	1.5 dB	
Antenna gain max 2.4 GHz:	2.10 dBi	
Maximum EIRP (peak):	29.1 dBm	812.8 mW
Minimum distance r:	20.0 cm	

802.11b							
Channel	measured EIRP	Tune-up Tolerance	max. EIRP	P _d	Limit	Margin	Exposure ratio
No.	(dBm)	(dB)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
1	20.2	1.5	147.23	0.0293	1.0	-0.9707	2.93
6	20.2	1.5	147.57	0.0294	1.0	-0.9706	2.94
11	22.4	1.5	246.04	0.0489	1.0	-0.9511	4.89

802.11n HT20							
Channel	measured EIRP	Tune-up Tolerance	max. EIRP	P _d	Limit	Margin	Exposure ratio
No.	(dBm)	(dB)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
1	24.0	1.5	356.45	0.0709	1.0	-0.9291	7.09
6	26.3	1.5	598.41	0.1191	1.0	-0.8809	11.91
11	26.1	1.5	574.12	0.1142	1.0	-0.8858	11.42

802.11n HT40							
Channel	measured EIRP	Tune-up Tolerance	max. EIRP	P _d	Limit	Margin	Exposure ratio
No.	(dBm)	(dB)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
3	23.5	1.5	313.33	0.0623	1.0	-0.9377	6.23
6	25.0	1.5	447.71	0.0891	1.0	-0.9109	8.91
11	21.5	1.5	200.91	0.0400	1.0	-0.9600	4.00

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5.1.4.3 WLAN 5 GHz

Manufactuerer stated data for the EUT:

5 GHz WLAN

Rated cond. output power (RMS): 16.0 dBm

Tune-up tolerance: 1.50 dB

Antenna gain max 5 GHz: 4.30 dBi

Maximum EIRP (RMS): 21.8 dBm

151.4 mW

Minimum distance r: 20.0 cm

802.11n HT20

Channel	measured EIRP	Tune-up Tolerance	max. EIRP	P _d	Limit	Margin	Exposure ratio
No.	(dBm)	(dB)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
36	14.6	1.5	40.55	0.0081	1.0	-0.9919	0.81
44	18.0	1.5	89.95	0.0179	1.0	-0.9821	1.79
48	15.7	1.5	52.72	0.0105	1.0	-0.9895	1.05
52	16.5	1.5	63.53	0.0126	1.0	-0.9874	1.26
56	16.6	1.5	64.71	0.0129	1.0	-0.9871	1.29
64	15.7	1.5	52.84	0.0105	1.0	-0.9895	1.05
100	12.9	1.5	27.61	0.0055	1.0	-0.9945	0.55
116	18.5	1.5	100.93	0.0201	1.0	-0.9799	2.01
140	13.9	1.5	34.91	0.0069	1.0	-0.9931	0.69
144	11.2	1.5	18.54	0.0037	1.0	-0.9963	0.37
149	8.8	1.5	10.59	0.0021	1.0	-0.9979	0.21
157	9.8	1.5	13.34	0.0027	1.0	-0.9973	0.27
165	10.0	1.5	14.19	0.0028	1.0	-0.9972	0.28

802.11n HT40

Channel	measured EIRP	Tune-up Tolerance	max. EIRP	P _d	Limit	Margin	Exposure ratio
No.	(dBm)	(dB)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
38	12.0	1.5	22.18	0.0044	1.0	-0.9956	0.44
46	17.0	1.5	70.79	0.0141	1.0	-0.9859	1.41
54	17.0	1.5	70.96	0.0141	1.0	-0.9859	1.41
62	13.2	1.5	29.31	0.0058	1.0	-0.9942	0.58
102	13.9	1.5	34.75	0.0069	1.0	-0.9931	0.69
110	19.2	1.5	118.03	0.0235	1.0	-0.9765	2.35
134	16.6	1.5	64.57	0.0128	1.0	-0.9872	1.28
142	10.8	1.5	16.87	0.0034	1.0	-0.9966	0.34
151	4.7	1.5	4.20	0.0008	1.0	-0.9992	0.08
159	11.0	1.5	17.91	0.0036	1.0	-0.9964	0.36

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

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802.11ac VHT80							
Channel	measured EIRP	Tune-up Tolerance	EIRP	P _d	Limit	Margin	Exposure ratio
No.	(dBm)	(dB)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
42	11.8	1.5	21.58	0.0043	1.0	-0.9957	0.43
58	14.4	1.5	39.26	0.0078	1.0	-0.9922	0.78
106	13.0	1.5	28.25	0.0056	1.0	-0.9944	0.56
122	19.7	1.5	131.22	0.0261	1.0	-0.9739	2.61
138	18.5	1.5	100.93	0.0201	1.0	-0.9799	2.01
155	10.6	1.5	16.03	0.0032	1.0	-0.9968	0.32

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)
(B) Limits for General Population / Uncontrolled Exposure				
0.3 – 1.34	614	1.63	100	30
1.34 – 30	824/ <i>f</i>	2.19/ <i>f</i>	180/ <i>f</i> ²	30
30 - 300	27.5	0.073	0.2	30
300-1500	---	---	<i>f</i> /1500	30
1500-100000	---	---	1.0	30

f = Frequency in MHz

The requirements are **FULFILLED**.

Remarks:

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5.1.5 Determination of MPE according ISED
5.1.5.1 BLE

BLE							
Frequency	measured EIRP	Tune-up Tolerance	max. EIRP	Factor	$f_{0.6834}$	Limit	Margin
MHz	(dBm)	(dB)	(mW)		(W)	(W)	(W)
2402	3.3	1.5	3.01	0.0131	204.3072	2.676	-2.6734
2440	2.0	1.5	2.26	0.0131	206.5105	2.705	-2.7030
2480	1.4	1.5	1.97	0.0131	208.8182	2.736	-2.7336

5.1.5.2 WLAN 2.4 GHz

Manufactuerer stated data for the EUT:

2.4 GHz WLAN

Rated cond. output power (peak):	25.5 dBm	354.8 mW
Tune-up tolerance:	1.5 dB	
Antenna gain max 2.4 GHz:	2.10 dBi	
Maximum EIRP (peak):	29.1 dBm	812.8 mW
Minimum distance r:	20.0 cm	

802.11b							
Frequency	measured EIRP	Tune-up Tolerance	max. EIRP	Factor	$f_{0.6834}$	Limit	Margin
MHz	(dBm)	(dB)	(mW)		(W)	(W)	(W)
2412	20.2	1.5	147.23	0.0131	204.8881	2.684	-2.5368
2437	20.2	1.5	147.57	0.0131	206.3370	2.703	-2.5554
2462	22.4	1.5	246.04	0.0131	207.7812	2.722	-2.4759

802.11n HT20							
Frequency	measured EIRP	Tune-up Tolerance	max. EIRP	Factor	$f_{0.6834}$	Limit	Margin
MHz	(dBm)	(dB)	(mW)		(W)	(W)	(W)
2412	24.0	1.5	356.45	0.0131	204.8881	2.684	-2.3276
2437	26.3	1.5	598.41	0.0131	206.3370	2.703	-2.1046
2462	26.1	1.5	574.12	0.0131	207.7812	2.722	-2.1478

802.11n HT40							
Frequency	measured EIRP	Tune-up Tolerance	max. EIRP	Factor	$f_{0.6834}$	Limit	Margin
MHz	(dBm)	(dB)	(mW)		(W)	(W)	(W)
2422	23.5	1.5	313.33	0.0131	205.4682	2.692	-2.3783
2437	25.0	1.5	447.71	0.0131	206.3370	2.703	-2.2553
2462	21.5	1.5	200.91	0.0131	207.7812	2.722	-2.5210

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5.1.5.3 WLAN 5 GHz

Manufactuerer stated data for the EUT:

5 GHz WLAN

Rated cond. output power (RMS): 16.0 dBm

Tune-up tolerance: 1.50 dB

Antenna gain max 5 GHz: 4.30 dBi

Maximum EIRP (RMS): 21.8 dBm

151.4 mW

Minimum distance r: 20.0 cm

802.11n HT20

Frequency	measured EIRP	Tune-up Tolerance	max. EIRP	Factor	$f_{0.6834}$	Limit	Margin
MHz	(dBm)	(dB)	(mW)		(W)	(W)	(W)
5180	14.6	1.5	40.55	0.0131	345.4403	4.525	-4.4847
5220	18.0	1.5	89.95	0.0131	347.2610	4.549	-4.4592
5240	15.7	1.5	52.72	0.0131	348.1697	4.561	-4.5083
5260	16.5	1.5	63.53	0.0131	349.0773	4.573	-4.5094
5280	16.6	1.5	64.71	0.0131	349.9839	4.585	-4.5201
5320	15.7	1.5	52.84	0.0131	351.7937	4.608	-4.5557
5500	12.9	1.5	27.61	0.0131	359.8851	4.714	-4.6869
5580	18.5	1.5	100.93	0.0131	363.4543	4.761	-4.6603
5700	13.9	1.5	34.91	0.0131	368.7779	4.831	-4.7961
5720	11.2	1.5	18.54	0.0131	369.6617	4.843	-4.8240
5745	8.8	1.5	10.59	0.0131	370.7651	4.857	-4.8464
5785	9.8	1.5	13.34	0.0131	372.5273	4.880	-4.8668
5825	10.0	1.5	14.19	0.0131	374.2857	4.903	-4.8890

802.11n HT40

Frequency	measured EIRP	Tune-up Tolerance	max. EIRP	Factor	$f_{0.6834}$	Limit	Margin
MHz	(dBm)	(dB)	(mW)		(W)	(W)	(W)
5190	12.0	1.5	22.18	0.0131	345.8959	4.531	-4.5091
5230	17.0	1.5	70.79	0.0131	347.7155	4.555	-4.4843
5270	17.0	1.5	70.96	0.0131	349.5307	4.579	-4.5079
5310	13.2	1.5	29.31	0.0131	351.3416	4.603	-4.5733
5510	13.9	1.5	34.75	0.0131	360.3321	4.720	-4.6856
5550	19.2	1.5	118.03	0.0131	362.1178	4.744	-4.6257
5670	16.6	1.5	64.57	0.0131	367.4503	4.814	-4.7490
5710	10.8	1.5	16.87	0.0131	369.2199	4.837	-4.8199
5755	4.7	1.5	4.20	0.0131	371.2060	4.863	-4.8586
5795	11.0	1.5	17.91	0.0131	372.9673	4.886	-4.8680

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802.11ac VHT80							
Frequency	measured EIRP	Tune-up Tolerance	max. EIRP	Factor	$f^{0.6834}$	Limit	Margin
MHz	(dBm)	(dB)	(mW)		(W)	(W)	(W)
5210	11.8	1.5	21.58	0.0131	346.8062	4.543	-4.5216
5290	14.4	1.5	39.26	0.0131	350.4367	4.591	-4.5515
5530	13.0	1.5	28.25	0.0131	361.2255	4.732	-4.7038
5690	18.5	1.5	100.93	0.0131	368.3356	4.825	-4.7243
5775	10.6	1.5	16.03	0.0131	372.0871	4.874	-4.8583

Exemption limits for routine Evaluation – RF exposure evaluation according RSS102, 2.5.2:

At or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834} \text{ W}$ (adjusted for tune-up tolerance), where f is in MHz;

At or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance)

The requirements are **FULFILLED**.

Remarks:
