EMI – TEST REPORT

- FCC Part 15.247, RSS-247 -

Type / Model Name : System master basic

Product Description : WLAN module

Applicant : BSH Hausgeräte GmbH

Address : Im Gewerbepark B10

93059 REGENSBURG, GERMANY

Manufacturer : BSH Hausgeräte GmbH

Address : Im Gewerbepark B10

93059 REGENSBURG, GERMANY

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

Test Report No. : T44223-01-00HS	25. October 2019 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

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.

FCC ID: 2AHES-SMB IC: 21152-SMB

Contents

1 TEST STANDARDS 3

2 EQUIPMENT UNDER TEST 4

2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A 4
2.3 Equipment type 4
2.4 Short description of the equipment under test (EUT) 4
2.5 Variants of the EUT 4
2.6 Operation frequency and channel plan 4
2.7 Transmit operating modes 5
2.8 Antenna 5
2.9 Power supply system utilised 5
2.10 Peripheral devices and interface cables 6
2.11 Determination of worst case conditions for final measurement 6

3 TEST RESULT SUMMARY 7

3.1 Final assessment 7

4 TEST ENVIRONMENT 8

4.1 Address of the test laboratory 8
4.2 Environmental conditions 8
4.3 Statement of the measurement uncertainty 9
4.4 Measurement protocol for FCC and ISED 10

5 TEST CONDITIONS AND RESULTS 12

5.1 AC power line conducted emissions 12
5.2 Maximum peak conducted output power 16
5.4 Unwanted emissions in restricted bands, radiated 18
5.5 Antenna application 28

6 USED TEST EQUIPMENT AND ACCESSORIES 29

ATTACHMENT A 30

FCC ID: 2AHES-SMB **IC: 21152-SMB**

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2019)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September 2019)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
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
KDB 558074 D01 v05r02	Guidance for compliance measurements on DTS; FHSS and hybrid system devices operating under Section 15.247 of the FCC rules, April 2, 2019.

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.2 General remarks

The EUT is a communication module consist of a fully tested and approved WLAN-, BT- and BLE- Module according the FCC 15247 with a manufacturer designed host and PCB antennas. This test report shows the further compliance to the FCC 15247 after integration. Therefore, the re-test is partly done to the following requirements, only.

- RF output power (radiated)
- Transmitter unwanted emissions, radiated

2.3 Equipment type

BLE device

2.4 Short description of the equipment under test (EUT)

The EUT is a communication module for assembling into house hold devices.

Number of tested samples:	1
Serial number:	Muster 286
Firmware version WLAN:	7.45.165

EUT configuration:
(The CDF filled by the applicant can be viewed at the test laboratory.)

2.5 Variants of the EUT

There are no variants.

2.6 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

FCC ID: 2AHES-SMB IC: 21152-SMB

Channel plan BLE:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	2440	39	2480

Note: The marked frequencies are determined for final testing.

2.7 Transmit operating modes

The EUT use GFSK modulation and may provide the following data rates:

- 250 kbps (kbps – kilobits per second)
- 500 kbps
- 1000 kbps

2.8 Antenna

The following antennas shall be used with the EUT:

Number	Characteristic	Model number	Plug	Frequency range (GHz)	Gain (dBi)	Cable loss (dB)	Effective gain (dBi)
1	Omni	PCB antenna (Ant0)	-	2.4	2.25	0	2.25
2	Omni	PCB antenna (Ant1)	-	2.4	1.64	0	1.64

The EUT is equipped with 1 internal WLAN antenna for SISO. The second antenna is for diversity.

2.9 Power supply system utilised

Power supply voltage, V_{nom} : 12 VDC

2.10 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- LAN cable Model : Common
- - Model : -

2.11 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.

The tests are carried out in the following frequency band:

2400 MHz – 2483.5 MHz

Preliminary tests are performed to find the worst case mode from all possible combinations between available modulations and data rates. The maximum output power depends on used data rate.

For the final test the following channels and test modes are selected:

BLE	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
-	0 to 38	0, 19, 38	P6	DSSS	GFSK	1 Mbps

2.11.1 Test jig

No test jig is used.

2.11.2 Test software

The test software for the EUT provides free power setting, the special test mode TX continuous mode, modulated. The EUT was set with test modulation to transmit data during the tests with a maximum duty cycle (x) from an internal packet generator.

FCC ID: 2AHES-SMB **IC: 21152-SMB**

3 TEST RESULT SUMMARY

BLE device using digital modulation:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	passed
15.247(a)(2)	RSS-247, 5.2(a)	-6 dB EBW	Not tested
15.247(b)(3)	RSS-247, 5.4(d)	Maximum peak conducted output power	passed
15.247(b)(4)	RSS-247, 5.4(d)	Defacto limit	not applicable
15.247(d)	RSS-247, 5.5	Unwanted emission, radiated	passed
15.247(d)	RSS-Gen, 8.10	Emissions in restricted bands	passed
15.247(e)	RSS-247, 5.2(b)	PSD	Not tested
15.35(c)	RSS-Gen, 6.10	Pulsed operation	Not tested
15.203	-	Antenna requirement	passed
	RSS-Gen, 6.11	Transmitter frequency stability	Not tested
	RSS-Gen, 6.6	99 % Bandwidth	Not tested

The mentioned RSS Rule Parts in the above table are related to:
RSS-Gen, Issue 5, April 2018
RSS-247, Issue 2, February 2017

3.1 Final assessment

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

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

Testing commenced on : 20 September 2019

Testing concluded on : 11 October 2019

Checked by:

K. Gegenfurtner

Klaus Gegenfurtner
I confirm the correctness and integrity of this document.
2019.10.25 11:31:46 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

H. Smetana

I am the author of this document
2019.10.25 11:30:35 +02'00'

Hermann Smetana
Radio Team

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

FCC ID: 2AHES-SMB IC: 21152-SMB

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 acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. 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.

Measurement Type	Range	Confidence Level	Calculated Uncertainty
AC power line conducted emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
EBW and OBW	2400 MHz to 3000 MHz	95%	± 2.5 x 10^{-7}
Maximum peak conducted output power	2400 MHz to 3000 MHz	95%	± 0.62 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB
Conducted Spurious Emissions	10000 MHz to 40000 MHz	95%	± 3.47 dB
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Field strength of the fundamental	100 kHz to 100 MHz	95%	± 3.53 dB

FCC ID: 2AHES-SMB IC: 21152-SMB

4.4 Measurement protocol for FCC and ISED

4.4.1 General information

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-1

The Anechoic chamber is a listed test site under the Canadian Test-Sites File-No:

IC 3009A-2

4.4.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

4.4.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.2.2 Radiated emission (electrical field 30 MHz - 1 GHz)

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.10.The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.
The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	Limit (dBµV/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.4.2.3 Radiated emission (electrical field 1 GHz - 40 GHz)

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table, 1.5 metre above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the centre in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyser set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

5 TEST CONDITIONS AND RESULTS

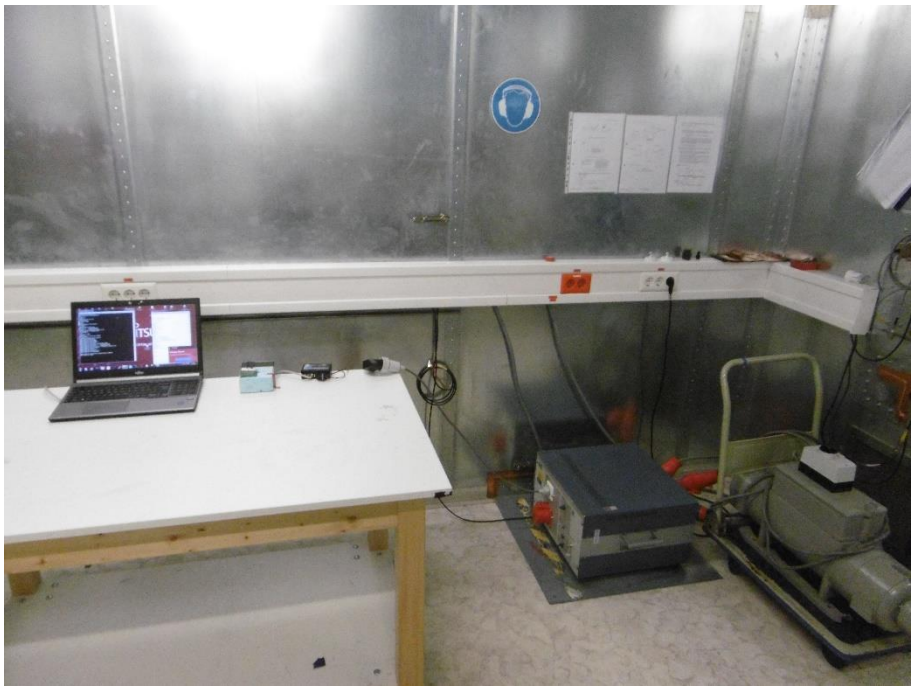
5.1 AC power line conducted emissions

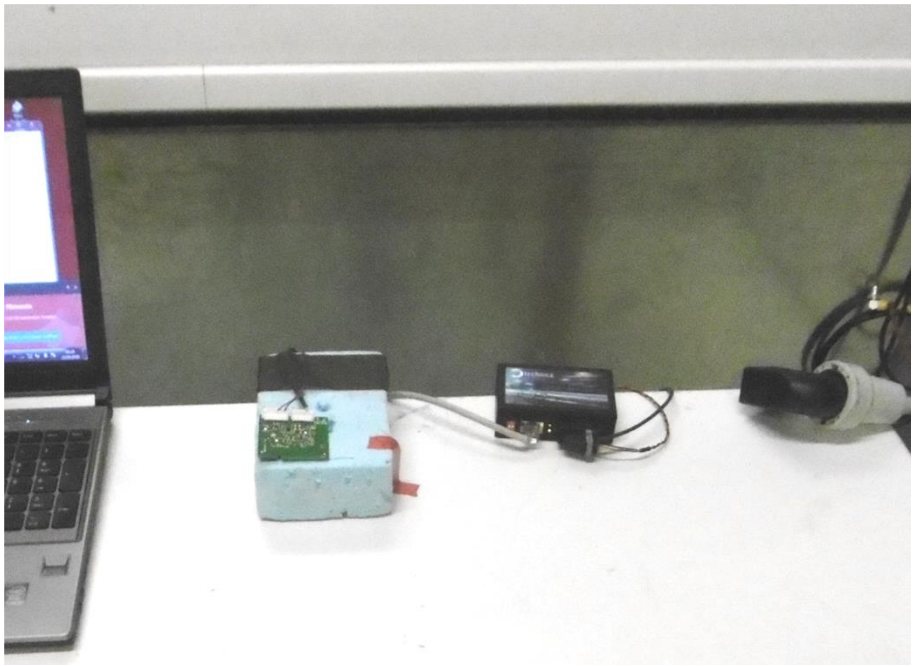
For test instruments and accessories used see section 6 Part **A 4**.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up





FCC ID: 2AHES-SMB IC: 21152-SMB

5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):
Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits under FCC 15.207(a).

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.10 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin 10.8 dB at 0.186 MHz

Limit according to FCC Part 15, Section 15.207(a):

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

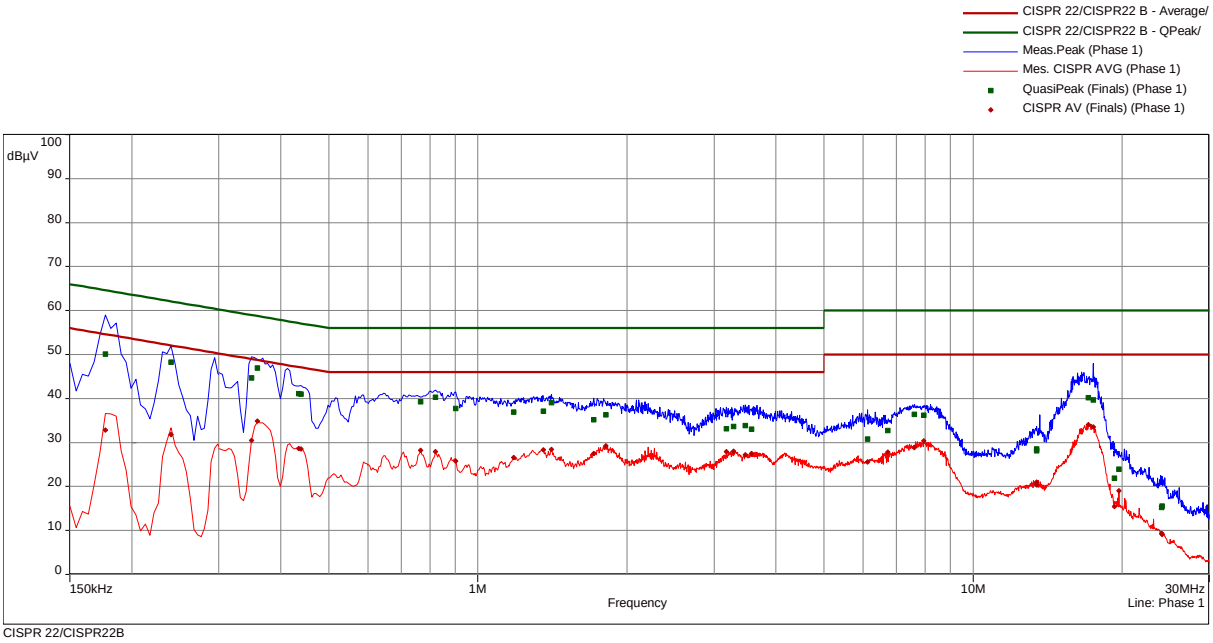
The requirements are **FULFILLED.**

Remarks: For detailed test result please refer to following test protocols.

FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.1.6 Test protocol

Test point L1 Result: passed
Operation mode: Transmission 2.4 GHz
Remarks:

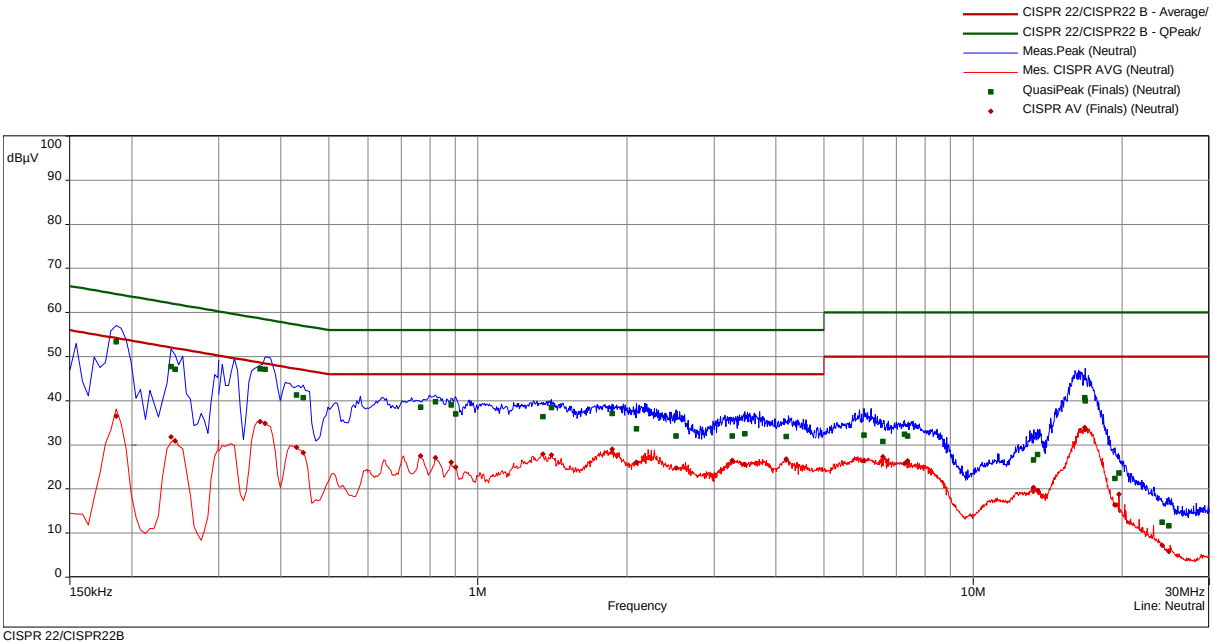


CISPR 22/CISPR22B

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.177	1	50.1	-14.5	64.6	32.9	-21.8	54.6	Phase 1	10.1
0.240	1	48.3	-13.8	62.1	31.9	-20.3	52.1	Phase 1	10.1
0.350	2	44.7	-14.3	59.0	30.5	-18.5	49.0	Phase 1	10.1
0.359	2	47.0	-11.8	58.8	34.8	-13.9	48.8	Phase 1	10.1
0.435	2	41.1	-16.1	57.2	28.7	-18.5	47.2	Phase 1	10.1
0.440	2	41.0	-16.1	57.1	28.5	-18.6	47.1	Phase 1	10.1
0.767	3	39.2	-16.8	56.0	28.3	-17.7	46.0	Phase 1	10.2
0.821	3	40.3	-15.7	56.0	28.0	-18.0	46.0	Phase 1	10.2
0.902	3	37.7	-18.3	56.0	25.7	-20.3	46.0	Phase 1	10.2
1.181	3	37.0	-19.0	56.0	26.6	-19.4	46.0	Phase 1	10.2
1.358	4	37.1	-18.9	56.0	28.3	-17.7	46.0	Phase 1	10.2
1.407	4	39.1	-16.9	56.0	28.4	-17.6	46.0	Phase 1	10.2
1.713	4	35.2	-20.8	56.0	27.5	-18.5	46.0	Phase 1	10.3
1.812	4	36.3	-19.7	56.0	29.2	-16.8	46.0	Phase 1	10.3
3.179	5	33.1	-22.9	56.0	27.9	-18.1	46.0	Phase 1	10.4
3.282	5	33.6	-22.4	56.0	28.0	-18.0	46.0	Phase 1	10.4
3.467	5	33.8	-22.2	56.0	27.2	-18.8	46.0	Phase 1	10.4
3.570	5	33.0	-23.0	56.0	27.5	-18.5	46.0	Phase 1	10.4
6.128	6	30.8	-29.2	60.0	25.6	-24.4	50.0	Phase 1	10.6
6.731	6	32.8	-27.2	60.0	27.8	-22.2	50.0	Phase 1	10.6
7.617	6	36.5	-23.6	60.0	28.9	-21.2	50.0	Phase 1	10.6
7.946	6	36.2	-23.8	60.0	30.4	-19.6	50.0	Phase 1	10.7
13.439	7	28.5	-31.5	60.0	21.0	-29.0	50.0	Phase 1	11.1
13.443	7	28.2	-31.8	60.0	20.3	-29.7	50.0	Phase 1	11.1
17.084	7	40.2	-19.8	60.0	34.0	-16.0	50.0	Phase 1	11.3
17.475	7	39.7	-20.3	60.0	33.5	-16.5	50.0	Phase 1	11.3
19.299	8	21.9	-38.1	60.0	15.5	-34.5	50.0	Phase 1	11.4
19.709	8	23.9	-36.1	60.0	19.1	-30.9	50.0	Phase 1	11.4
24.051	8	15.3	-44.7	60.0	9.4	-40.7	50.0	Phase 1	11.6
24.096	8	15.6	-44.4	60.0	9.2	-40.9	50.0	Phase 1	11.7

FCC ID: 2AHES-SMB IC: 21152-SMB

Test point N Result: passed
Operation mode: Transmission 2.4 GHz
Remarks:



CISPR 22/CISPR22B

freq	SR	QP	margin	limit	AV	margin	limit	line	corr
MHz		dB(µV)	dB	dB	dB(µV)	dB	dB		dB
0.186	9	53.4	-10.8	64.2	36.5	-17.7	54.2	Neutral	10.1
0.240	9	47.8	-14.3	62.1	31.8	-20.3	52.1	Neutral	10.1
0.245	9	47.2	-14.8	61.9	30.9	-21.0	51.9	Neutral	10.1
0.363	10	47.2	-11.4	58.7	35.3	-13.4	48.7	Neutral	10.1
0.372	10	47.2	-11.3	58.5	34.9	-13.6	48.5	Neutral	10.1
0.431	10	41.4	-15.9	57.2	29.4	-17.8	47.2	Neutral	10.1
0.444	10	40.7	-16.3	57.0	28.3	-18.7	47.0	Neutral	10.1
0.767	11	38.5	-17.5	56.0	27.5	-18.5	46.0	Neutral	10.2
0.821	11	39.7	-16.3	56.0	27.1	-18.9	46.0	Neutral	10.2
0.884	11	39.1	-16.9	56.0	26.1	-19.9	46.0	Neutral	10.2
0.902	11	37.1	-19.0	56.0	25.0	-21.0	46.0	Neutral	10.2
1.353	12	36.4	-19.6	56.0	27.9	-18.1	46.0	Neutral	10.2
1.407	12	38.4	-17.6	56.0	27.8	-18.3	46.0	Neutral	10.2
1.866	12	37.2	-18.8	56.0	29.0	-17.0	46.0	Neutral	10.3
2.091	12	33.6	-22.4	56.0	26.1	-19.9	46.0	Neutral	10.3
2.513	13	32.0	-24.0	56.0	24.7	-21.3	46.0	Neutral	10.3
3.264	13	32.1	-23.9	56.0	26.5	-19.5	46.0	Neutral	10.4
3.462	13	32.6	-23.4	56.0	25.6	-20.5	46.0	Neutral	10.4
4.191	13	31.9	-24.1	56.0	26.8	-19.2	46.0	Neutral	10.4
6.024	14	32.2	-27.8	60.0	26.5	-23.5	50.0	Neutral	10.5
6.578	14	30.8	-29.2	60.0	27.3	-22.7	50.0	Neutral	10.6
7.262	14	32.5	-27.5	60.0	25.8	-24.3	50.0	Neutral	10.6
7.374	14	32.1	-27.9	60.0	26.4	-23.6	50.0	Neutral	10.6
13.245	15	26.6	-33.4	60.0	20.3	-29.7	50.0	Neutral	10.9
13.502	15	27.8	-32.2	60.0	19.6	-30.4	50.0	Neutral	10.9
16.827	15	40.7	-19.3	60.0	33.9	-16.1	50.0	Neutral	11.1
16.832	15	40.0	-20.0	60.0	33.4	-16.6	50.0	Neutral	11.1
19.358	16	22.4	-37.6	60.0	16.3	-33.7	50.0	Neutral	11.2
19.709	16	23.6	-36.4	60.0	18.8	-31.2	50.0	Neutral	11.2
24.105	16	12.5	-47.5	60.0	7.3	-42.7	50.0	Neutral	11.3
24.866	16	11.7	-48.3	60.0	5.9	-44.1	50.0	Neutral	11.3

FCC ID: 2AHES-SMB **IC: 21152-SMB**

5.2 Maximum peak conducted output power

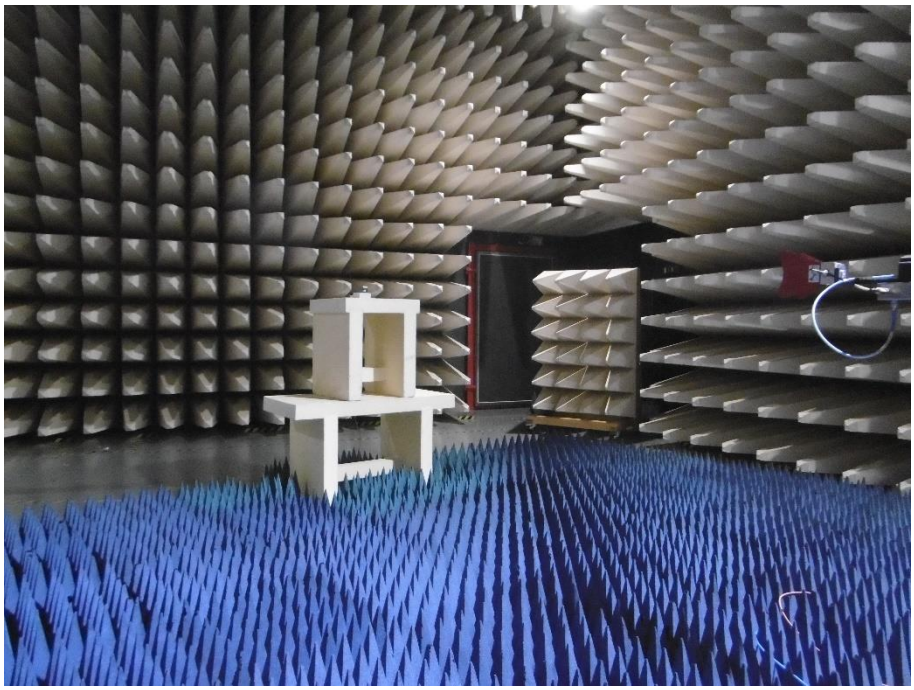
For test instruments and accessories used see section 6 Part **CPR 3**.

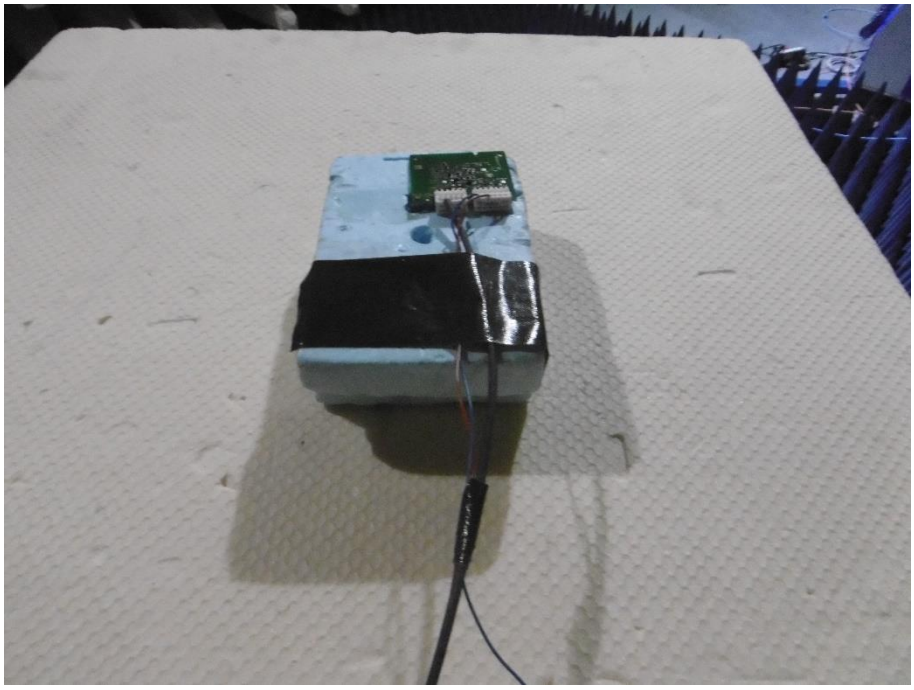
5.2.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.2.2 Photo documentation of the test set-up

Anechoic chamber





5.2.3 Applicable standard

According to FCC Part 15, Section 15.247 (b)(3):
For systems using digital modulation in the 2400 – 2483.5 MHz and 5725 – 5850 MHz bands, the maximum peak output power of the transmitter shall not exceed 1 Watt. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

5.2.4 Description of Measurement

The maximum peak conducted output power is measured using a peak power meter following the procedure set out in KDB 558074, item 8.3.2.3. The EUT is set in TX continuous mode while measuring.

5.2.5 Test result

BLE	ANT0					
Channel	Power set	P [EIRP] (dBm)	G (dBi)	A [Pmax] (dBm)	EIRP limit (dBm)	Margin (dBm)
CH0	P6	2.8	2.25	0.6	30.0	-27.2
CH19	P6	1.8	2.25	-0.5	30.0	-28.2
CH38	P6	-0.3	2.25	-2.6	30.0	-30.3

BLE	ANT1					
Channel	Power set	P [EIRP] (dBm)	G (dBi)	A [Pmax] (dBm)	EIRP limit (dBm)	Margin (dBm)
CH0	P6	2.1	1.64	0.5	30.0	-27.9
CH19	P6	1.2	1.64	-0.4	30.0	-28.8
CH38	P6	0.0	1.64	-1.7	30.0	-30.1

Peak Power Limit according to FCC Part 15, Section 15.247 (b)(3):

Frequency (MHz)	Peak Power Limit	
	(dBm)	(Watt)
2400-2483.5	30	1.0

The requirements are **FULFILLED.**

Remarks: The measured values are AV values.

FCC ID: 2AHES-SMB IC: 21152-SMB

5.4 Unwanted emissions in restricted bands, radiated

For test instruments and accessories used see section 6 Part **SER 2, SER 3**.

5.4.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 1

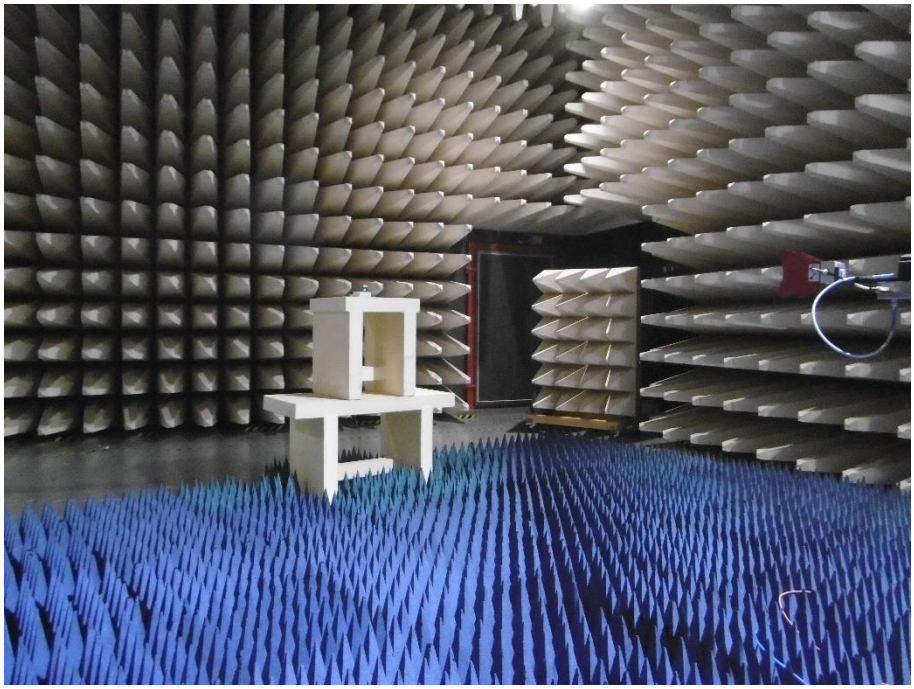
Test distance: 3 m

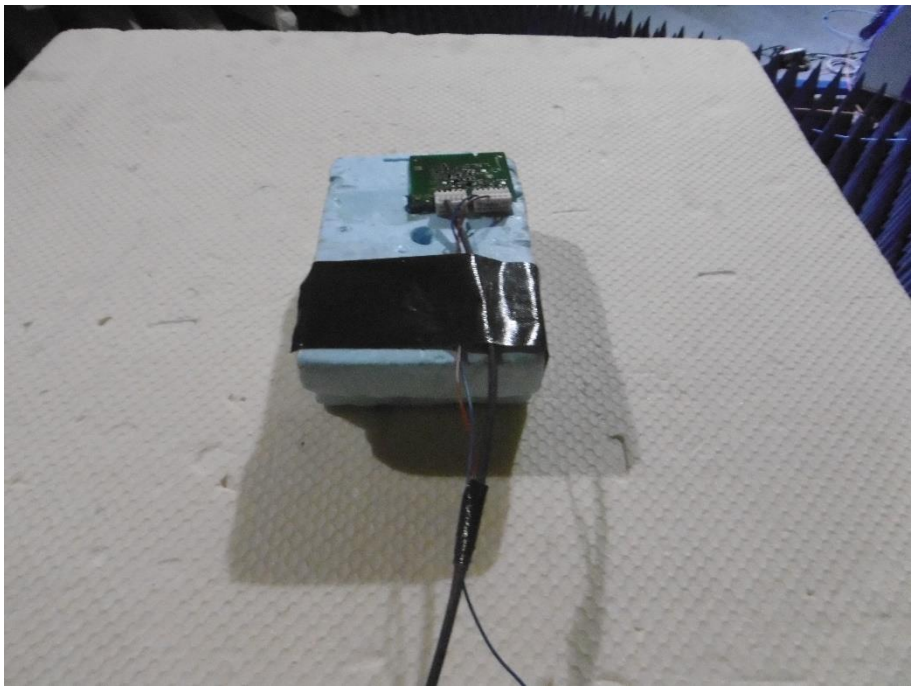
5.4.2 Photo documentation of the test set-up

Open area test site

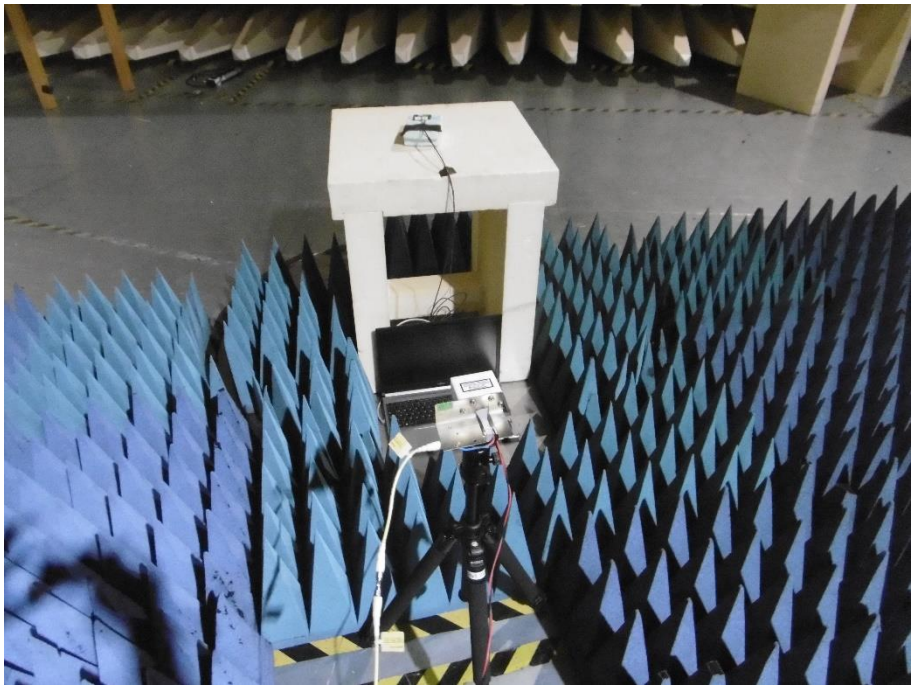
FCC ID: 2AHES-SMB **IC: 21152-SMB**

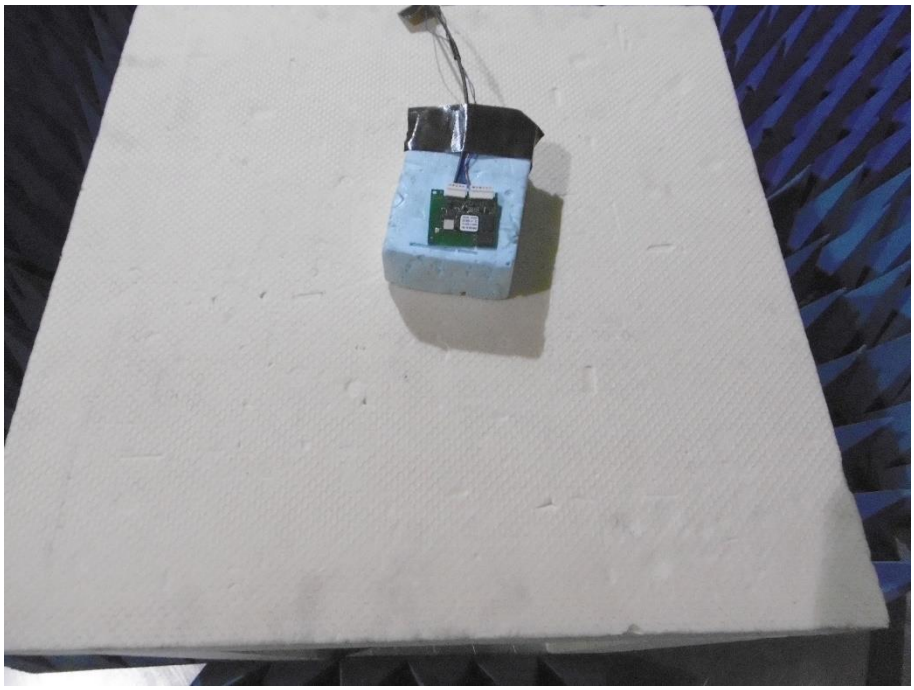
Anechoic chamber





FCC ID: 2AHES-SMB IC: 21152-SMB





5.4.3 Applicable standard

According to FCC Part 15, Section 15.205(a):
In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

5.4.4 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

Spectrum analyser settings:
30 MHz – 1000 MHz: RBW: 120 kHz
1000 MHz – 26 GHz: RBW: 1 MHz, VBW: 3 MHz, Sweep: Auto, Detector function: Max Peak

5.4.1 Test result

For the radiated test a test jig with the PCB antennas is used. The antenna gain is 2.25 dBi. The emission at Ant0 are measured only because of the highest output power.

f < 1000 MHz:

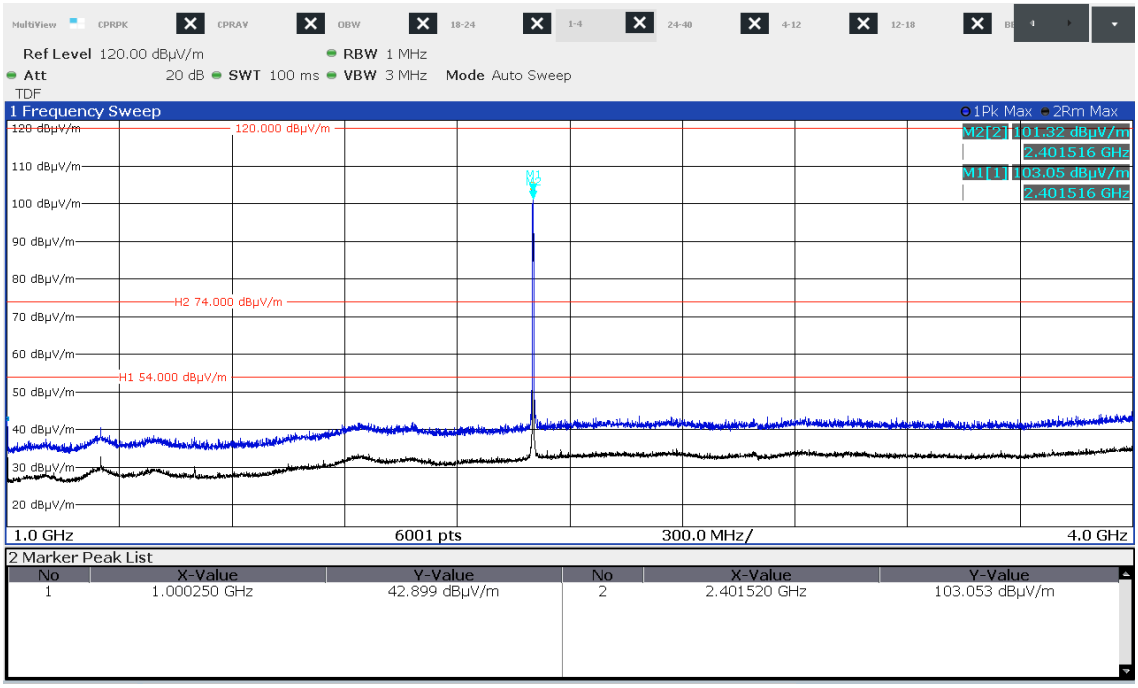
Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
54.00	9.2	3.3	14.1	13.1	23.3	16.4	40.0	-16.7
125.00	20.7	27.0	12.0	12.5	32.7	39.5	43.5	-4.0
250.00	11.6	20.0	12.9	13.1	24.5	33.1	46.0	-12.9
500.00	10.6	20.7	21.4	21.1	32.0	41.8	46.0	-4.2
875.00	1.4	8.8	28.7	28.2	30.1	37.0	46.0	-9.0

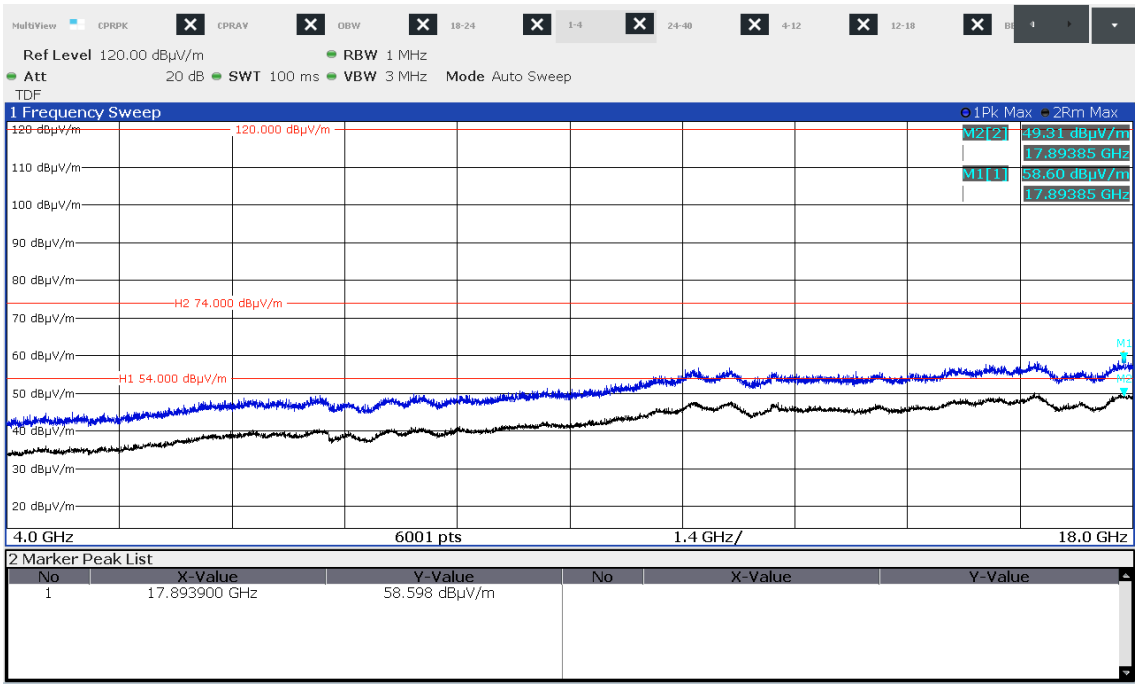
FCC ID: 2AHES-SMB **IC: 21152-SMB**

f > 1000 MHz:

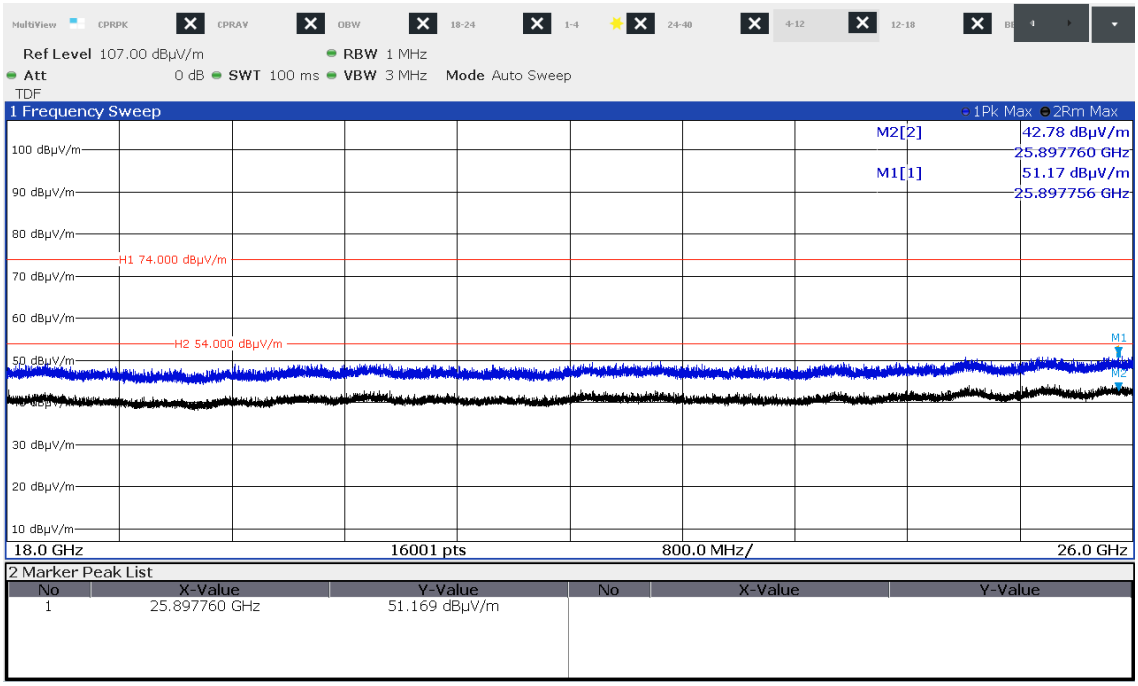
5.4.1.1 BLE, P6, Ant0

CH0:

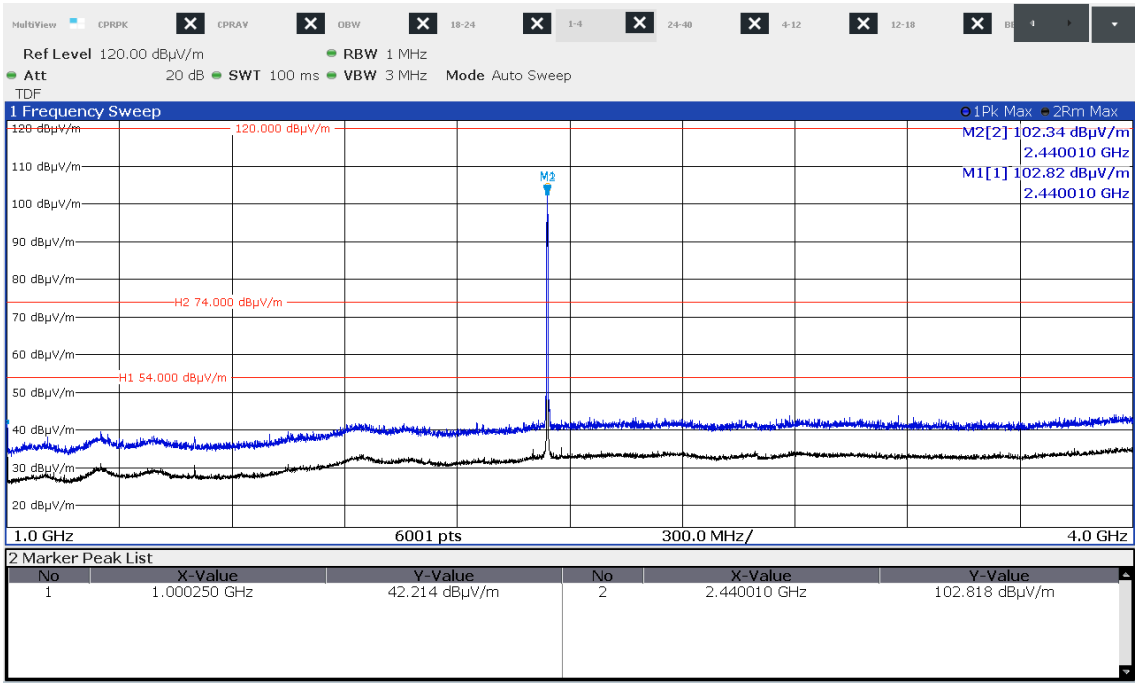




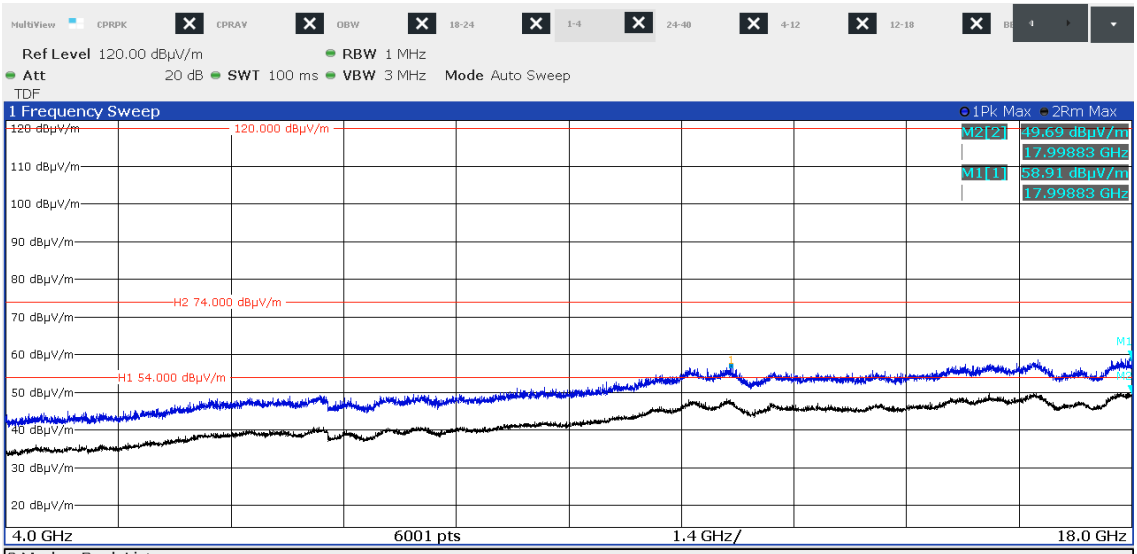
FCC ID: 2AHES-SMB **IC: 21152-SMB**



CH19:

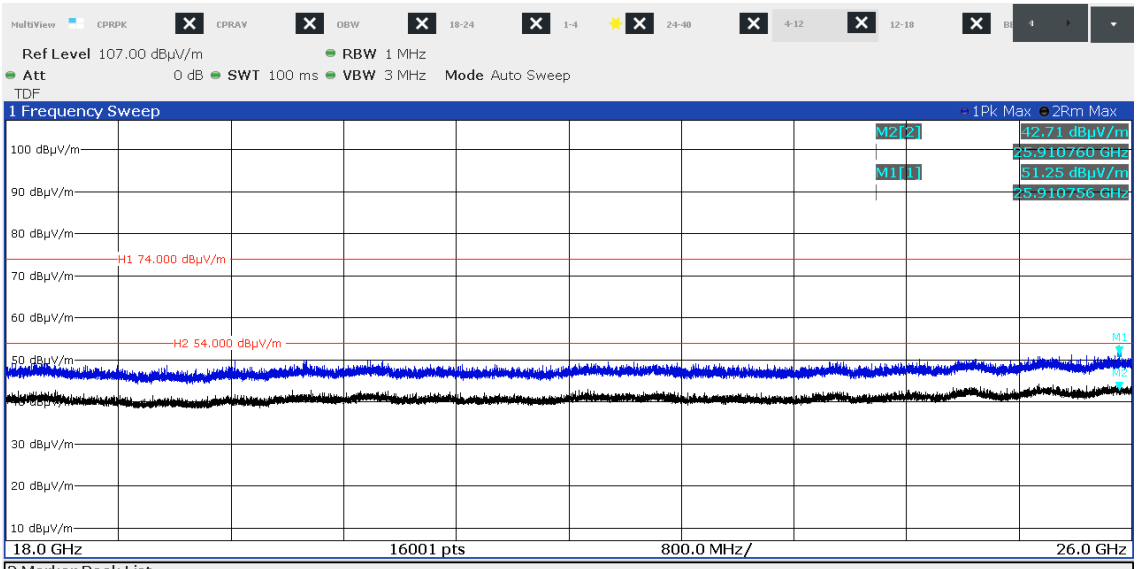


FCC ID: 2AHES-SMB **IC: 21152-SMB**



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	13.013300 GHz	57.083 dBµV/m	2	17.998800 GHz	58.908 dBµV/m

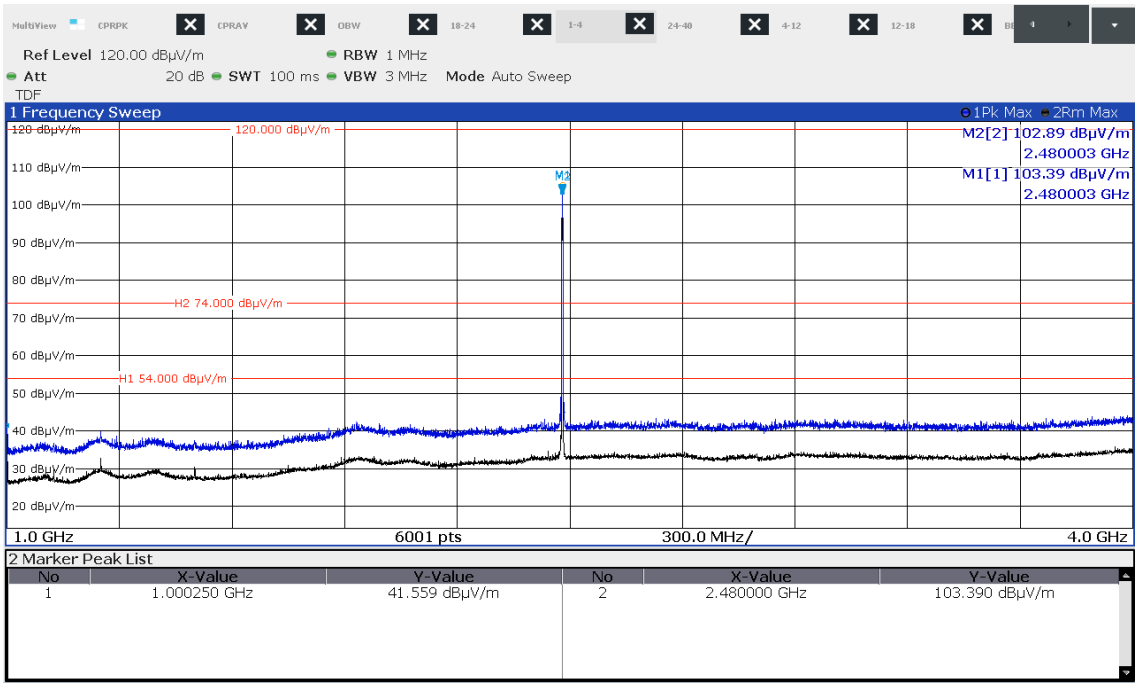


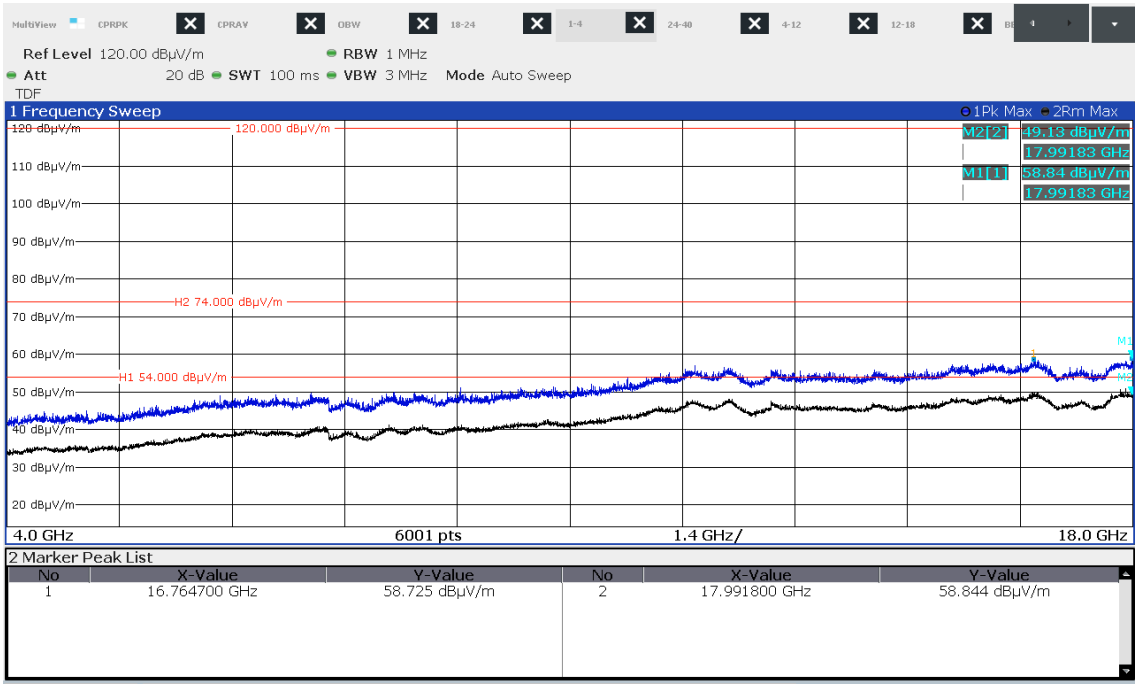
2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	25.910760 GHz	51.251 dBµV/m			

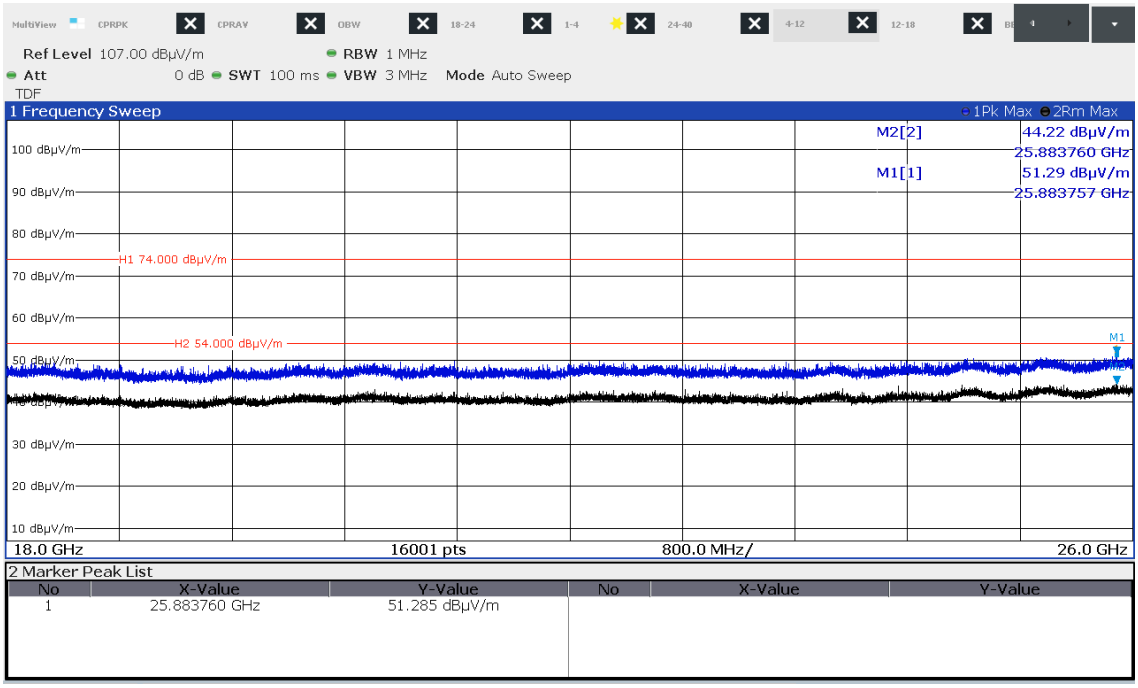
FCC ID: 2AHES-SMB **IC: 21152-SMB**

CH38:





FCC ID: 2AHES-SMB **IC: 21152-SMB**



Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

Frequency	Field strength of spurious emissions		Measurement distance
(MHz)	(µV/m)	dB(µV/m)	(metres)
0.009-0.490	2400/F (kHz)		300
0.490-1.705	24000/F (kHz)		30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Restricted bands of operation:

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

FCC ID: 2AHES-SMB **IC: 21152-SMB**

RSS-Gen, Table 6 – Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	12.57675 - 12.57725	399.9 - 410	7.250 - 7.750
0.495 - 0.505	13.36 - 13.41	608 - 614	8.025 – 8.500
2.1735 - 2.1905	16.42 - 16.423	960 - 1427	9.0 - 9.2
3.020 - 3.026	16.69475 - 16.69525	1435 - 1626.5	9.3 - 9.5
4.125 - 4.128	16.80425 - 16.80475	1645.5 - 1646.5	10.6 - 12.7
4.17725 - 4.17775	25.5 - 25.67	1660 - 1710	13.25 - 13.4
4.20725 - 4.20775	37.5 - 38.25	1718.8 - 1722.2	14.47 - 14.5
5.677 - 5.683	73 - 74.6	2200 - 2300	15.35 - 16.2
6.215 - 6.218	74.8 - 75.2	2310 - 2390	17.7 - 21.4
6.26775 - 6.26825	108 – 138	2483.5 - 2500	22.01 - 23.12
6.31175 - 6.31225	149.9 - 150.05	2655 - 2900	23.6 - 24.0
8.291 - 8.294	156.52475 - 156.52525	3260 – 3267	31.2 - 31.8
8.362 - 8.366	156.7 - 156.9	3332 - 3339	36.43 - 36.5
8.37625 - 8.38675	162.0125 - 167.17	3345.8 - 3358	Above 38.6
8.41425 - 8.41475	167.72 - 173.2	3500 - 4400	
12.29 - 12.293	240 – 285	4500 - 5150	
12.51975 - 12.52025	322 - 335.4	5350 - 5460	

The requirements are **FULFILLED.**

Remarks: The measurement was performed up to the 10th harmonic.

5.5 Antenna application

5.5.1 Applicable standard

According to FCC Part 15C, Section 15.203:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has an integrated PCB antennas. No other antennas can be used with the device.

All supplied antennas meet the requirements of part 15.203 and 15.204.

5.5.2 Antenna requirements

According to FCC Part 15C, Section 15.247(b)(4):
The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Defacto EIRP-Limit:

$$Pout = 30 – (Gx – 6);$$

The EUT use antennas smaller that 6 dBi. No defacto limit results.

Remarks: No power reduction results from the defacto limit.

FCC ID: 2AHES-SMB **IC: 21152-SMB**

6 USED TEST EQUIPMENT AND ACCESSORIES

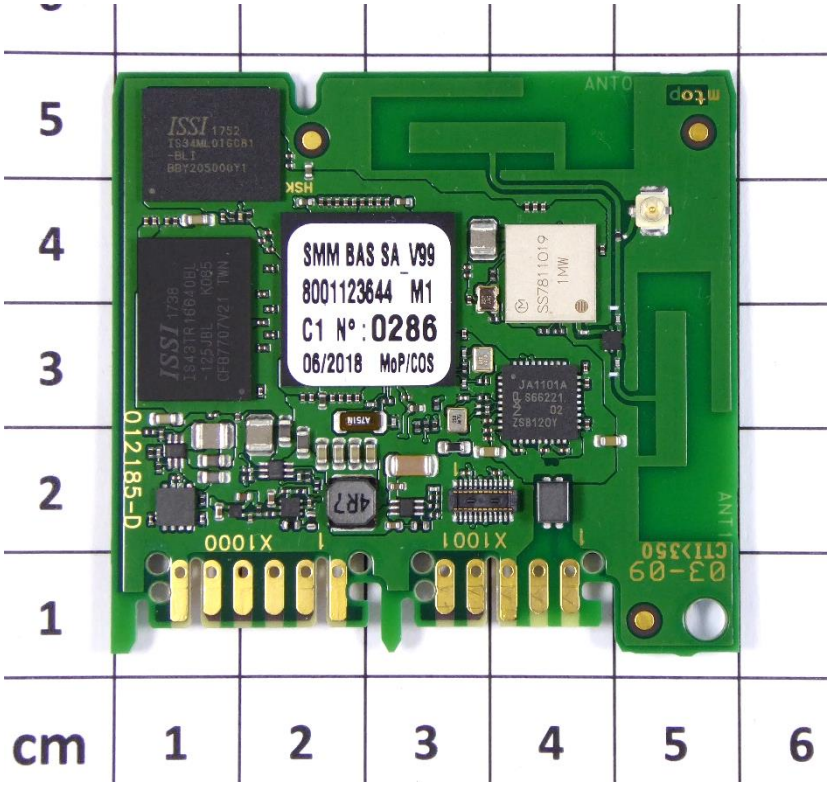
All test instruments used are calibrated and verified regularly. The calibration history is available on request.

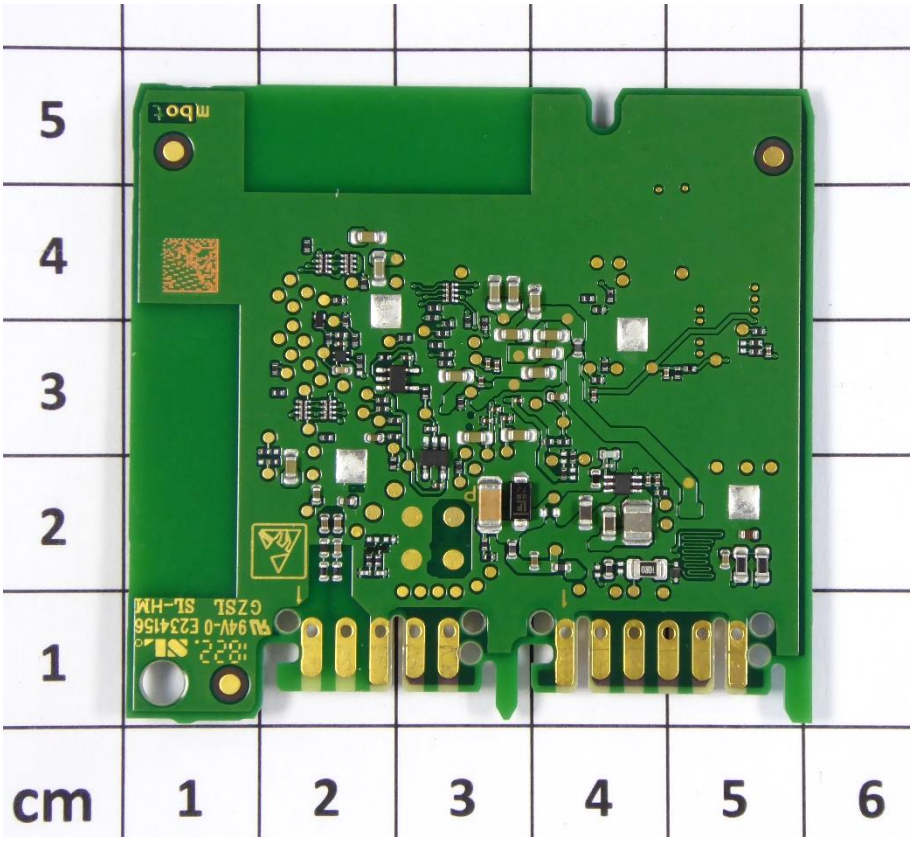
Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	BAT-EMC 3.18.0.26	01-02/68-13-001				
	ESCI	02-02/03-15-001	02/07/2020	02/07/2019		
	ESH 2 - Z 5	02-02/20-05-004	25/10/2019	25/10/2017	30/10/2019	30/04/2019
	EMV D 30000/PAS	02-02/30-05-006	21/02/2020	21/02/2017	25/02/2020	25/02/2019
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	18/11/2019	18/11/2016	13/11/2019	13/05/2019
	EA-PS 3032-20B	02-02/50-11-013				
CPR 3	FSW43	02-02/11-15-001	08/04/2020	08/04/2019		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	06/06/2020	06/06/2019		
	EA-PS 3032-20B	02-02/50-11-013				
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
SER 2	ESVS 30	02-02/03-05-006	19/08/2020	19/08/2019		
	VULB 9168	02-02/24-05-005	19/07/2020	19/07/2019		
	NW-2000-NB	02-02/50-05-113				
	EA-PS 3032-20B	02-02/50-11-013				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSW43	02-02/11-15-001	08/04/2020	08/04/2019		
	JS4-18004000-30-5A	02-02/17-05-017				
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	06/06/2020	06/06/2019		
	BBHA 9170	02-02/24-05-014	12/06/2021	12/06/2018	12/12/2019	12/12/2018
	EA-PS 3032-20B	02-02/50-11-013				
	KMS102-0.2 m	02-02/50-11-020				
	18N-20	02-02/50-17-003				
	NMS111-GL200SC01-NMS11	02-02/50-17-012				
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				

FCC ID: 2AHES-SMB **IC: 21152-SMB**

ATTACHMENT A

A1) Photo documentation of the EUT





- End of attachment A -