



RF - TEST REPORT

- FCC Part 15.247, RSS-247 -

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. : 80091012-01 Rev_2

08. April 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

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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1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2021)

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 2021)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204 modifications	External radio frequency power amplifiers and antenna
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.

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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 General remarks

None.

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

2.5 Equipment type

BLE device

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)
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 wI0: Apr 15 2021 03:04:08 version 7.45.234 (4ca95bb CY WLTEST) FWID 01-67595eaa
Tested samples	: 1 (conducted)
Serial number	: 80012117280000440335000001793
SW	: BSH Embedded Linux Platform (SMM M2 default) - debug [HWTEST] 40.0.0-204-g45fedbf \n \l
Firmware	: 1.28 RC0.0 wI0: 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 and channel plan

The operating frequency band is 2400 MHz to 2483.5 MHz.

Channel plan:

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

Note: The marked frequencies are used for testing.

2.9 Transmit operating modes

The EUT uses GFSK modulation and may provide following data rates:
 - 1000 kbps (kbps = kilobits per second)

2.10 Antenna

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

The EUT has only an integrated PCB antenna, no temporary connector and no external antenna to be connected.

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2.11 Power supply system utilised

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

2.12 Peripheral devices and interface cables

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

- Debug Adapter _____ Model: _____
- Micro USB cable _____ Model: _____
- Laptop _____ Model: _____

2.13 Determination of worst-case conditions for final measurement

Preliminary tests are performed in all three orthogonal axes of the EUT 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 this position.

The tests are carried out in the following frequency band:

2400 MHz – 2483.5 MHz

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

Wireless system	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
802.15.1	0 - 39	37, 17, 39	default	DSSS	GFSK	1000 kbps

2.13.1 Test jig

No test jig is used.

2.13.2 Test software

The test software is controlled by a terminal program (PuTTY). The test software allows to set the EUT into RX and TX continuous modulated mode and set different channel by command.

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3 TEST RESULT SUMMARY

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, 6.2.4(1)	-6 dB EBW	passed
15.247(b)(3)	RSS-247, 6.2.4(1)	Maximum peak conducted output power	passed
15.247(b)(4)	-	Defacto limit	passed
15.247(d)	RSS-247, 6.2.4(2)	Out-of-band emission, radiated	passed
15.247(d)	RSS-Gen, 8.9	Emissions in restricted bands	passed
15.247(e)	RSS-247, 6.2.4(1)	PSD	passed
15.35(c)	RSS-Gen, 6.10	Pulsed operation	passed
15.203	RSS-Gen, 6.6	Antenna requirement	passed
-	RSS-Gen, 6.11	Transmitter frequency stability	passed
-	RSS-Gen, 6.6	99 % Bandwidth	passed

The mentioned new RSS Rule Parts in the above table are related to:
 RSS-Gen, Issue 5 + Amendment 1 + Amendment 2, March 2019
 RSS-247, Issue 2, February 2017

3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80091012-01	0	18 January 2022	Initial test report
80091012-01	1	21 February 2022	Added missing power setting.
80091012-01	2	08 April 2022	Updated OBW99 measurement with RBW 1%-5%

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 : 24 August 2021

Testing concluded on : 30 November 2021

Checked by:



Klaus Gegenfurtner
 2022.04.08 12:23:46
 +02'00'

Tested by:



Lukas Scheuermann
 2022.04.08 11:26:27
 +02'00'

Klaus Gegenfurtner
 Teamleader Radio

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.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
20 dB Bandwidth	Center frequency of EUT	95%	$\pm 2.5 \times 10^{-7}$
99% Occupied Bandwidth	Center frequency of EUT	95%	$\pm 2.5 \times 10^{-7}$
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
Peak conducted output power	902 MHz to 928 MHz	95%	± 0.35 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB

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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.

4.5 Measurement protocol for FCC and ISED

4.5.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011

ISED: DE0009

4.5.2 General Standard information

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

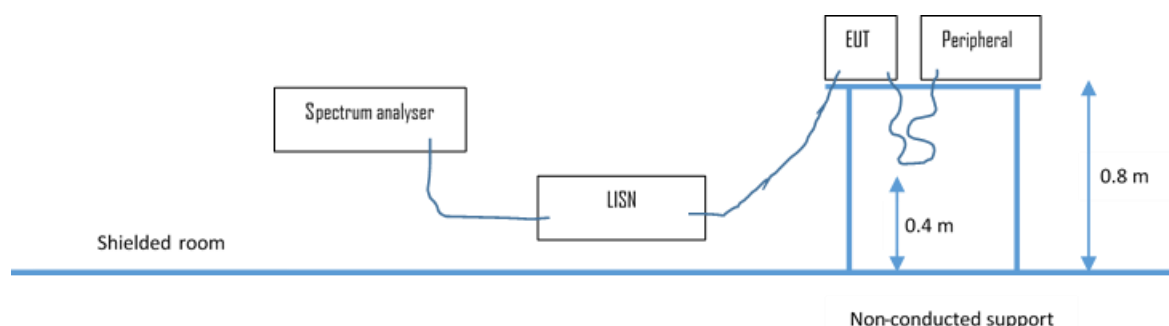
4.5.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions.

4.5.3 Details of test procedures

4.5.3.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dB μ V, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

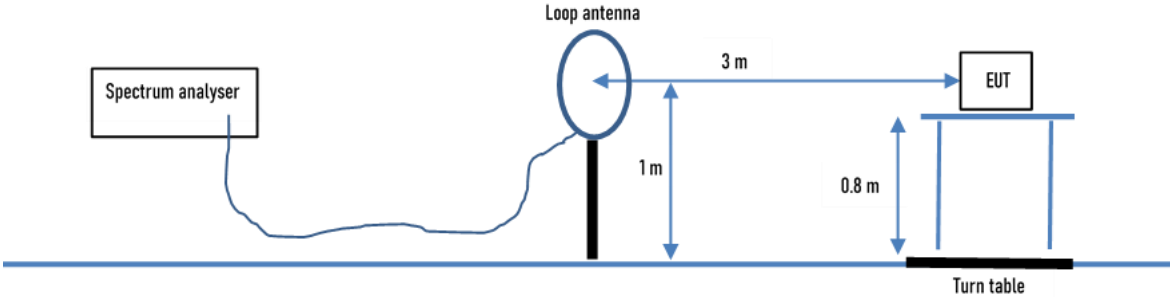
Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50 Ω / 50 μ H (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

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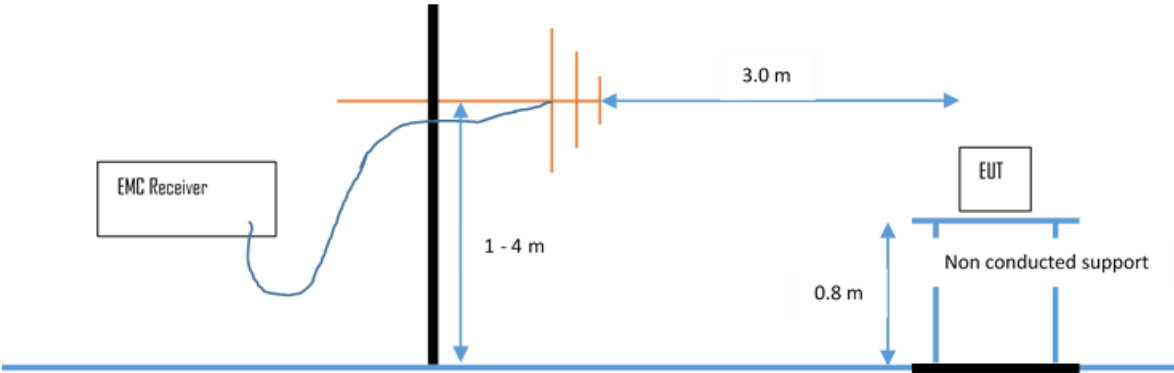
4.5.3.2 Radiated emission

4.5.3.2.1 OATS1 test site (9 kHz - 30 MHz):
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above 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 along the site axis and the EUT is rotated 360 degrees.

4.5.3.2.2 OATS1 test site (30 MHz - 1 GHz):
Test setup according ANSI C63.10.



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. 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. 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:

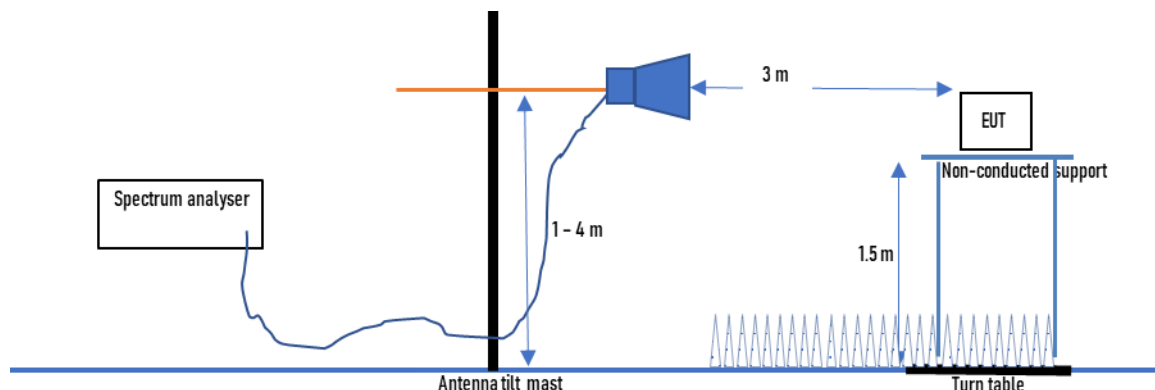
Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	Limit (dBµV/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

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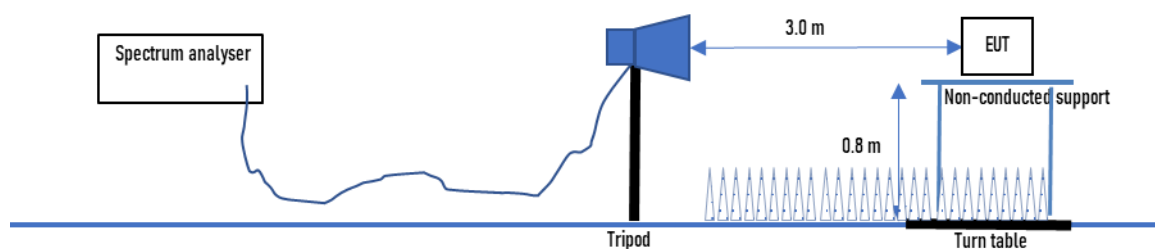
IC ID: 21152-M2

4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)

Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz 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 non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the centre, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

4.5.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)

Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz 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 non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the centre, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limit is adopted.

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5 TEST CONDITIONS AND RESULTS

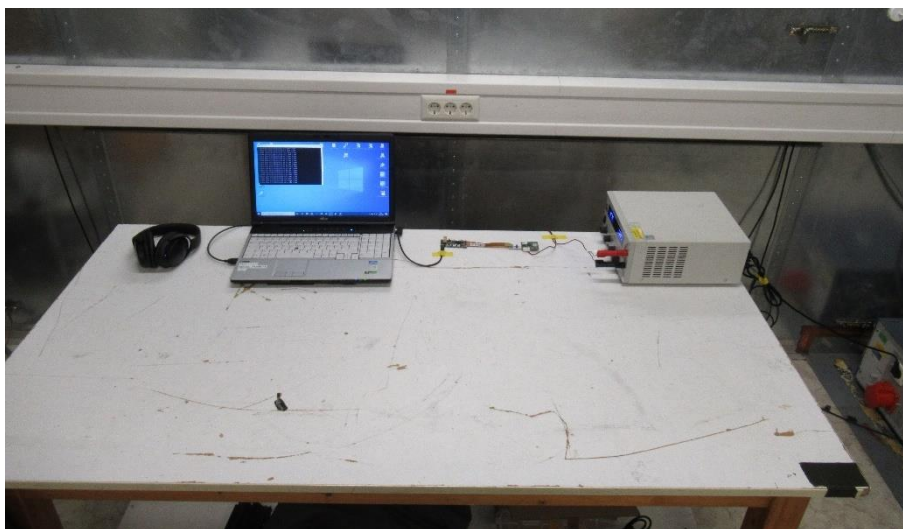
5.1 AC power line conducted emissions

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

5.1.1 Description of the test location

Test location: Shielded Room S3

5.1.2 Photo documentation of the test set-up



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 given limits.

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.

EUT is connected via BLE to wireless headphones.

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5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz
 Min. limit margin -10.46 dB at 23.988 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 see the following test protocols

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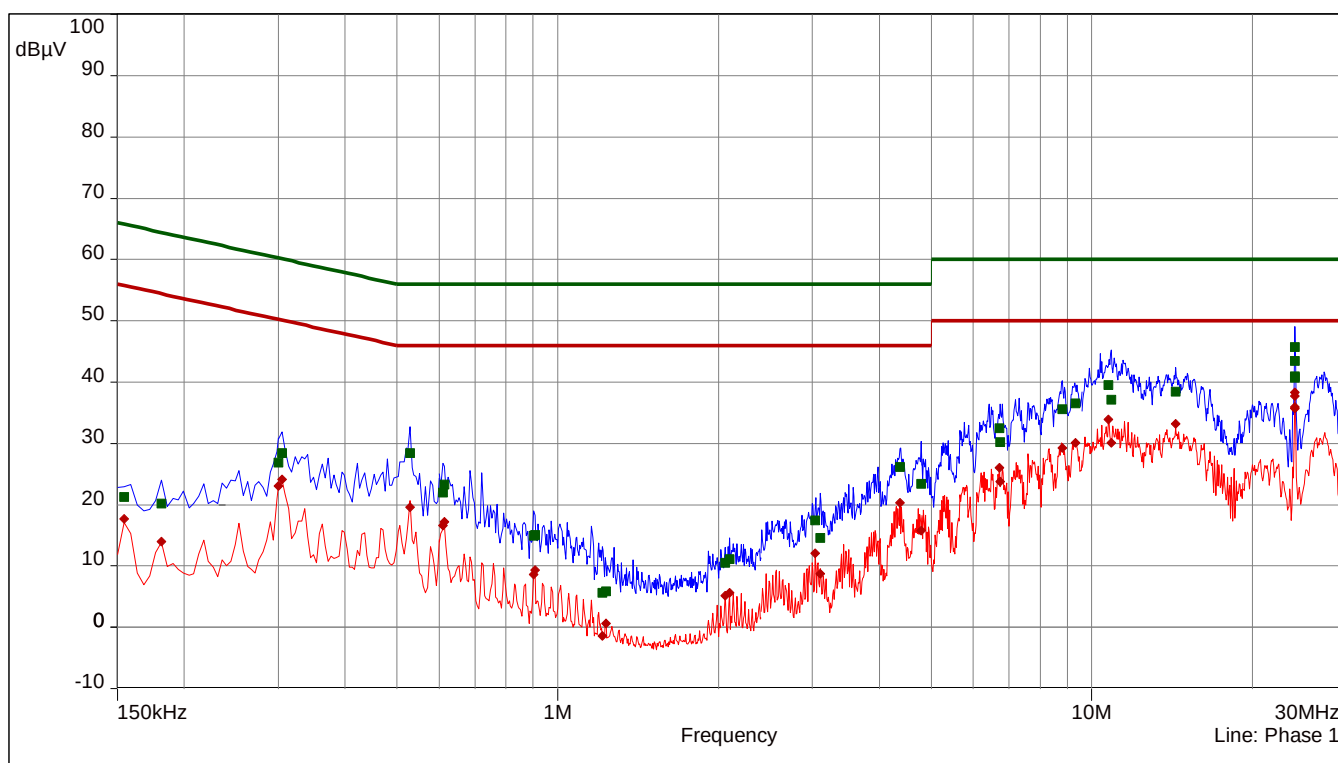
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5.1.6 Test protocol

Test point L1
 Operation mode: Transmission at 2.4 GHz (BLE)
 Remarks:

Result: passed

- FCC/FCC Part 15C (15.207) B - Avg/
- FCC/FCC Part 15C (15.207) B - Q-Peak/
- Peak (Phase 1)
- CISPR.AVG (Phase 1)
- QuasiPeak (Finals) (Phase 1)
- ◆ CISPR AV (Finals) (Phase 1)



FCC/FCC Part 15C (15.207)B

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freq	SR	QP	margin	limit	AV	margin	limit	line	RBW	Measure time	corr
MHz		dBμV	dB	dBμV	dBμV	dB	dBμV		Hz	sec	dB
0.1545	1	21.24	-44.52	65.75	17.67	-38.09	55.75	Phase 1	9k	1.00	10.10
0.1815	1	20.19	-44.23	64.42	14.02	-40.40	54.42	Phase 1	9k	1.00	10.10
0.3	1	26.91	-33.33	60.24	23.01	-27.24	50.24	Phase 1	9k	1.00	10.14
0.3045	2	28.49	-31.63	60.12	24.10	-26.02	50.12	Phase 1	9k	1.00	10.14
0.5295	2	28.37	-27.63	56.00	19.65	-26.35	46.00	Phase 1	9k	1.00	10.16
0.609	3	22.03	-33.97	56.00	16.64	-29.36	46.00	Phase 1	9k	1.00	10.17
0.6135	3	23.31	-32.69	56.00	17.22	-28.78	46.00	Phase 1	9k	1.00	10.17
0.9015	3	14.91	-41.09	56.00	8.61	-37.39	46.00	Phase 1	9k	1.00	10.20
0.906	3	15.05	-40.95	56.00	9.38	-36.62	46.00	Phase 1	9k	1.00	10.20
1.2135	4	5.62	-50.38	56.00	-1.35	-47.35	46.00	Phase 1	9k	1.00	10.23
1.2315	4	5.82	-50.18	56.00	0.65	-45.35	46.00	Phase 1	9k	1.00	10.23
2.0595	4	10.51	-45.49	56.00	5.16	-40.84	46.00	Phase 1	9k	1.00	10.28
2.0955	4	11.14	-44.86	56.00	5.64	-40.36	46.00	Phase 1	9k	1.00	10.28
3.0345	5	17.44	-38.56	56.00	12.13	-33.87	46.00	Phase 1	9k	1.00	10.35
3.102	5	14.55	-41.45	56.00	8.70	-37.30	46.00	Phase 1	9k	1.00	10.35
4.371	5	26.17	-29.83	56.00	20.34	-25.66	46.00	Phase 1	9k	1.00	10.42
4.794	5	23.36	-32.64	56.00	15.79	-30.21	46.00	Phase 1	9k	1.00	10.43
6.717	6	32.43	-27.57	60.00	26.10	-23.90	50.00	Phase 1	9k	1.00	10.58
6.744	6	30.19	-29.81	60.00	23.77	-26.23	50.00	Phase 1	9k	1.00	10.59
8.814	6	35.63	-24.37	60.00	29.24	-20.76	50.00	Phase 1	9k	1.00	10.69
9.318	6	36.57	-23.43	60.00	30.11	-19.89	50.00	Phase 1	9k	1.00	10.71
10.752	7	39.54	-20.46	60.00	33.95	-16.05	50.00	Phase 1	9k	1.00	10.81
10.8735	7	37.09	-22.91	60.00	30.07	-19.93	50.00	Phase 1	9k	1.00	10.82
14.3385	7	38.49	-21.51	60.00	33.17	-16.83	50.00	Phase 1	9k	1.00	11.13
23.988	8	45.68	-14.32	60.00	38.34	-11.66	50.00	Phase 1	9k	1.00	11.64
23.9925	8	43.45	-16.55	60.00	37.68	-12.32	50.00	Phase 1	9k	1.00	11.64
24.006	8	40.94	-19.06	60.00	35.90	-14.10	50.00	Phase 1	9k	1.00	11.64
24.0105	8	40.71	-19.29	60.00	35.65	-14.35	50.00	Phase 1	9k	1.00	11.64

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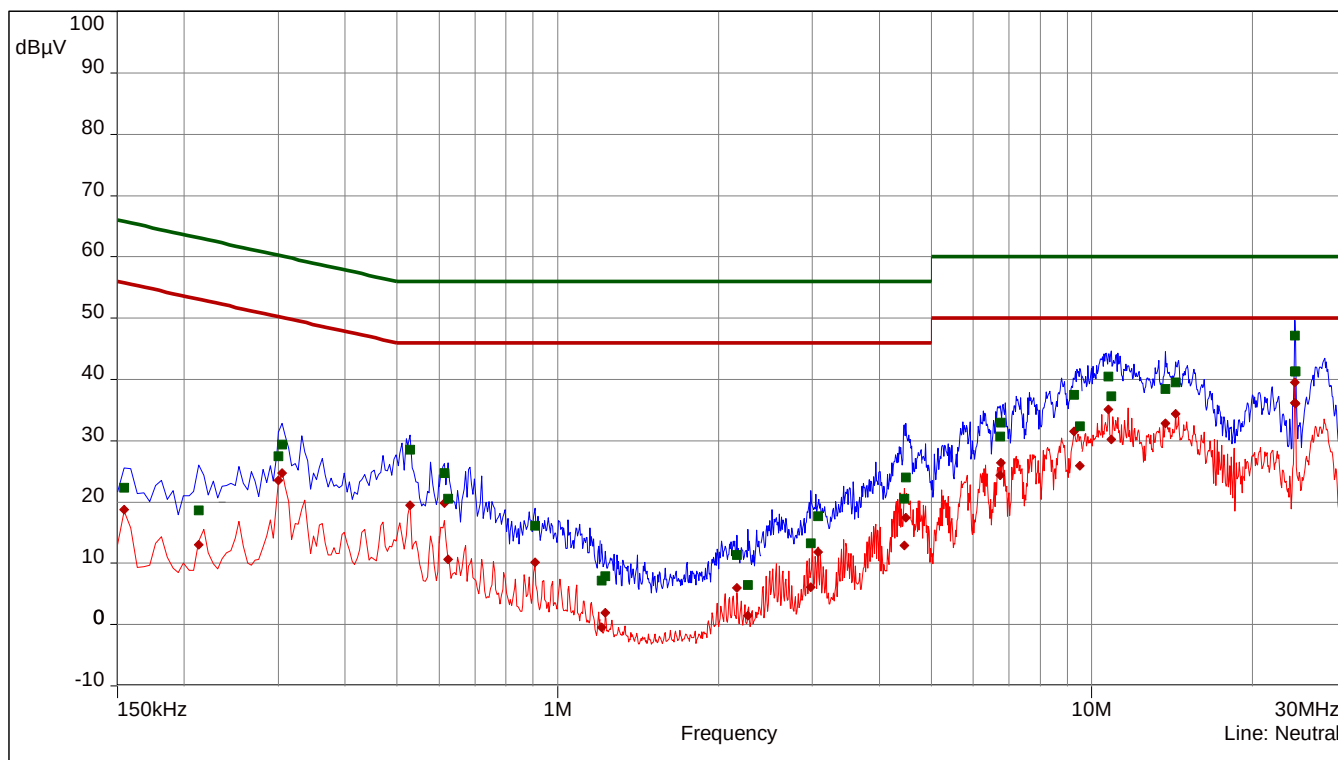
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Test point N
 Operation mode: Transmission at 2.4 GHz (BLE)
 Remarks:

Result: passed

- FCC/FCC Part 15C (15.207) B - Avg/
- FCC/FCC Part 15C (15.207) B - Q-Peak/
- Peak (Neutral)
- CISPR.AVG (Neutral)
- QuasiPeak (Finals) (Neutral)
- ◆ CISPR AV (Finals) (Neutral)



FCC/FCC Part 15C (15.207)B

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-M2

IC ID: 21152-M2

freq	SR	QP	margin	limit	AV	margin	limit	line	RBW	Measure time	corr
MHz		dBμV	dB	dBμV	dBμV	dB	dBμV		Hz	sec	dB
0.1545	9	22.35	-43.40	65.75	18.75	-37.01	55.75	Neutral	9k	1.00	10.10
0.213	9	18.61	-44.48	63.09	13.02	-40.07	53.09	Neutral	9k	1.00	10.13
0.3	9	27.46	-32.78	60.24	23.52	-26.72	50.24	Neutral	9k	1.00	10.14
0.3045	10	29.38	-30.74	60.12	24.68	-25.44	50.12	Neutral	9k	1.00	10.14
0.5295	10	28.56	-27.44	56.00	19.52	-26.48	46.00	Neutral	9k	1.00	10.16
0.6135	11	24.74	-31.26	56.00	19.82	-26.18	46.00	Neutral	9k	1.00	10.17
0.6225	11	20.59	-35.41	56.00	10.63	-35.37	46.00	Neutral	9k	1.00	10.18
0.906	11	16.18	-39.82	56.00	10.17	-35.83	46.00	Neutral	9k	1.00	10.20
1.209	12	7.21	-48.79	56.00	-0.49	-46.49	46.00	Neutral	9k	1.00	10.23
1.227	12	7.88	-48.12	56.00	1.91	-44.09	46.00	Neutral	9k	1.00	10.23
2.1675	12	11.36	-44.64	56.00	5.98	-40.02	46.00	Neutral	9k	1.00	10.29
2.271	12	6.52	-49.48	56.00	1.44	-44.56	46.00	Neutral	9k	1.00	10.30
2.9805	13	13.28	-42.72	56.00	6.10	-39.90	46.00	Neutral	9k	1.00	10.34
3.0705	13	17.66	-38.34	56.00	11.89	-34.11	46.00	Neutral	9k	1.00	10.35
4.4565	13	20.54	-35.46	56.00	12.88	-33.12	46.00	Neutral	9k	1.00	10.41
4.479	13	24.04	-31.96	56.00	17.46	-28.54	46.00	Neutral	9k	1.00	10.41
6.744	14	30.70	-29.30	60.00	24.33	-25.67	50.00	Neutral	9k	1.00	10.56
6.753	14	32.98	-27.02	60.00	26.45	-23.55	50.00	Neutral	9k	1.00	10.56
9.246	14	37.45	-22.55	60.00	31.47	-18.53	50.00	Neutral	9k	1.00	10.65
9.507	14	32.37	-27.63	60.00	25.97	-24.03	50.00	Neutral	9k	1.00	10.66
10.752	15	40.42	-19.58	60.00	35.09	-14.91	50.00	Neutral	9k	1.00	10.73
10.878	15	37.24	-22.76	60.00	30.24	-19.76	50.00	Neutral	9k	1.00	10.74
13.7265	15	38.49	-21.51	60.00	32.82	-17.18	50.00	Neutral	9k	1.00	10.93
14.3385	15	39.52	-20.48	60.00	34.39	-15.61	50.00	Neutral	9k	1.00	10.96
23.988	16	47.22	-12.78	60.00	39.54	-10.46	50.00	Neutral	9k	1.00	11.26
24.0195	16	41.36	-18.64	60.00	36.21	-13.79	50.00	Neutral	9k	1.00	11.26
24.024	16	41.34	-18.66	60.00	36.01	-13.99	50.00	Neutral	9k	1.00	11.26

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-M2

IC ID: 21152-M2

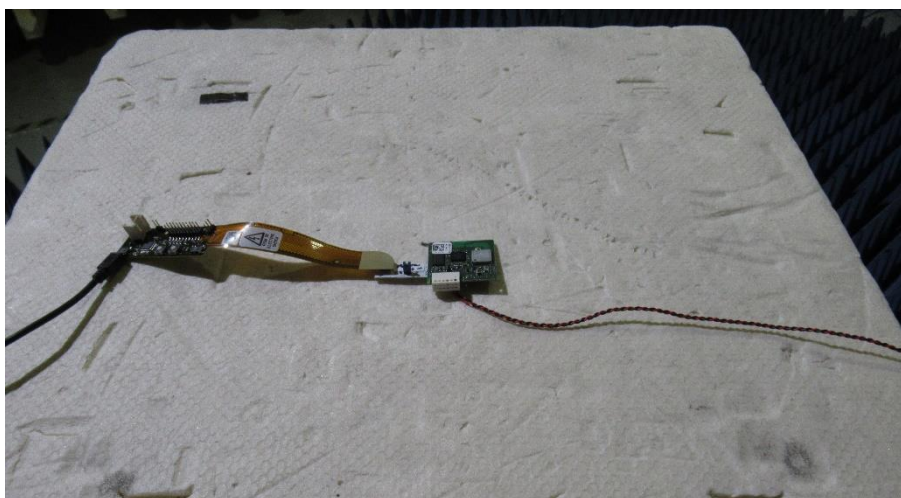
5.2 DTS-Bandwidth and OBW

For test instruments and accessories used see section 6 Part MB.

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



5.2.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(2):

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. An alternative is to use the bandwidth measurement of the analyser.

Spectrum analyser settings for EBW:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Sweep time: 5 s, Span: 2 EBW;

Spectrum analyser settings for OBW:

RBW: 1-5% OBW, VBW: 3 RBW, Detector: Max peak, Sweep time: 5 s, Span: 2 OBW;

FCC ID: 2AHES-M2**IC ID: 21152-M2****5.2.5 Test result**

Bluetooth Low Energy; DTS Bandwidth			
Channel	Frequency	DTS Bandwidth	minimum Limit
	MHz	kHz	kHz
37	2402	723.3	500
17	2440	719.3	500
39	2480	725.3	500

Bluetooth Low Energy; OBW99		
Channel	Channel Frequency	OBW 99%
	MHz	MHz
37	2402	1.052
17	2440	1.052
39	2480	1.052

The requirements are **FULFILLED**.

Remarks: For detailed test result please see the following test protocols. The RSS Gen defines no limit for the occupied bandwidth.

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.

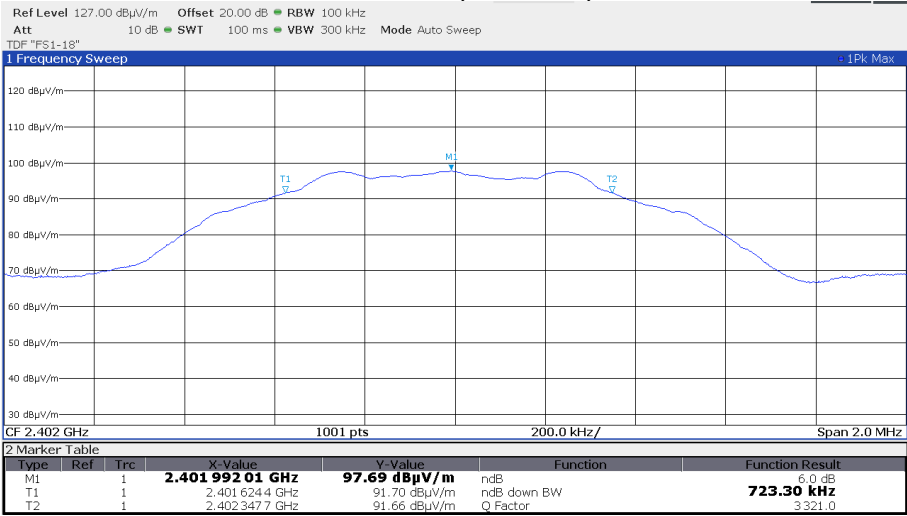


FCC ID: 2AHES-M2

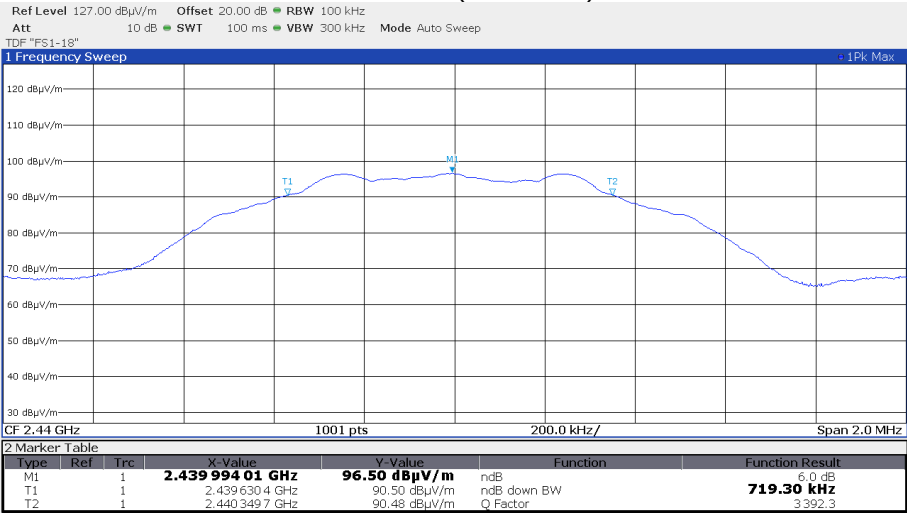
IC ID: 21152-M2

5.2.6 Test protocols DTS-Bandwidth

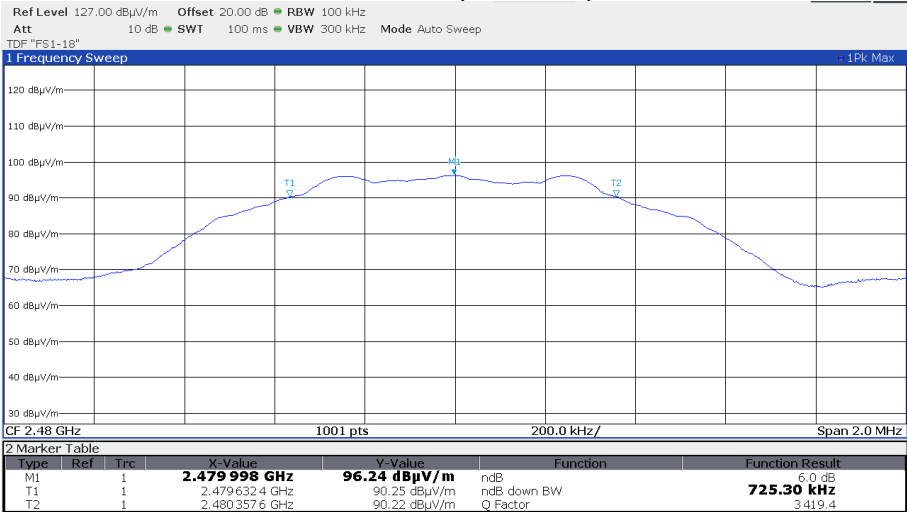
Channel 37 (2402 MHz)



Channel 17 (2440 MHz)



Channel 39 (2480 MHz)

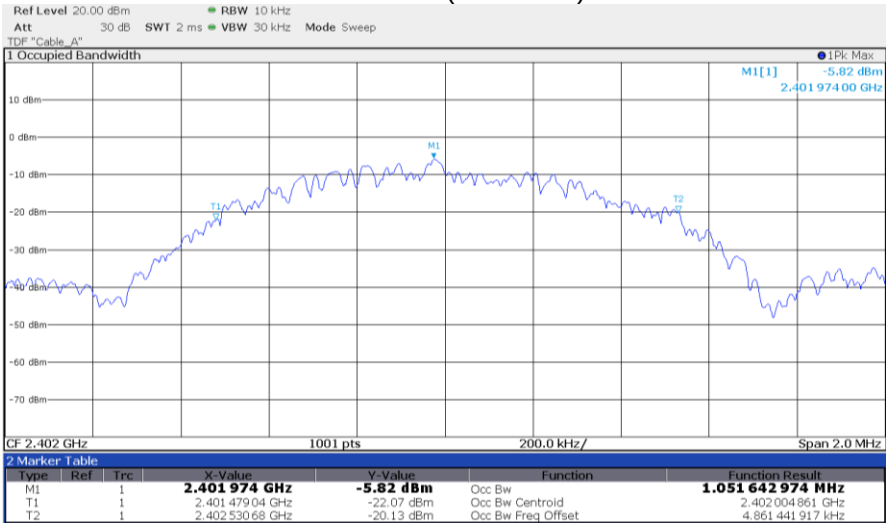


FCC ID: 2AHES-M2

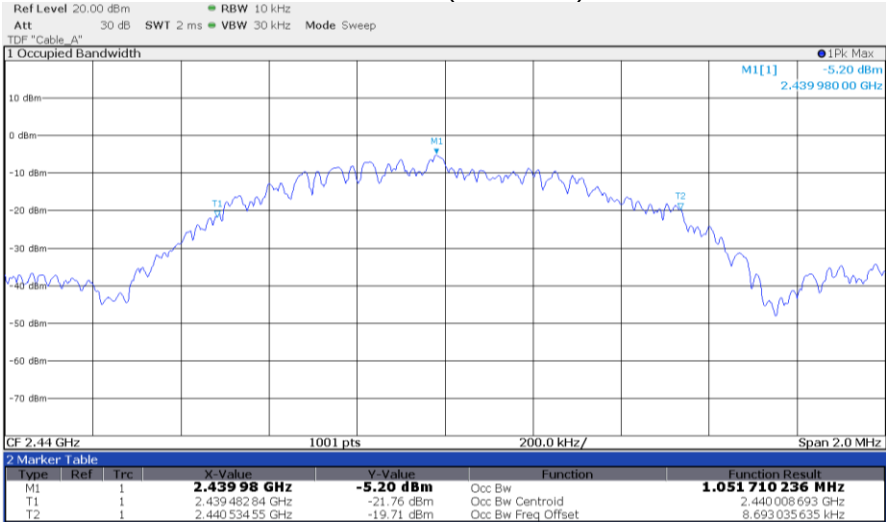
IC ID: 21152-M2

5.2.7 Test protocols OBW

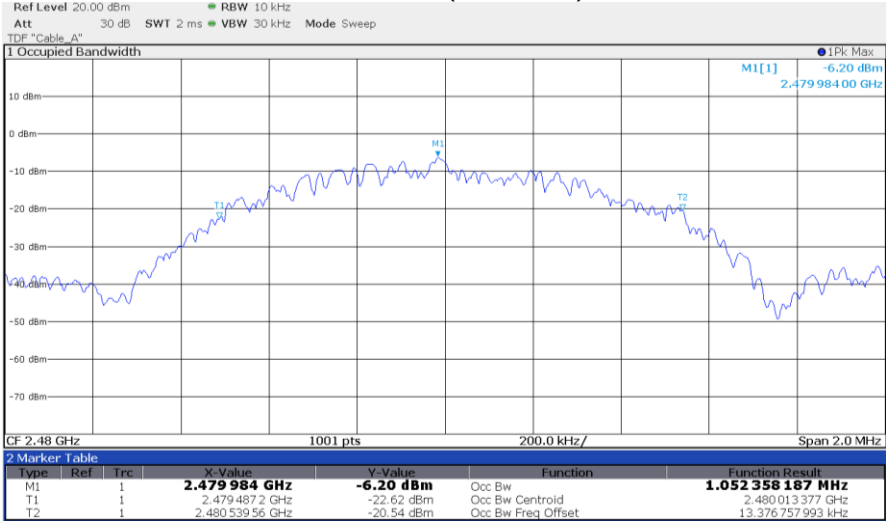
Channel 37 (2402 MHz)



Channel 17 (2440 MHz)



Channel 39 (2480 MHz)



FCC ID: 2AHES-M2

IC ID: 21152-M2

5.3 Maximum peak conducted output power

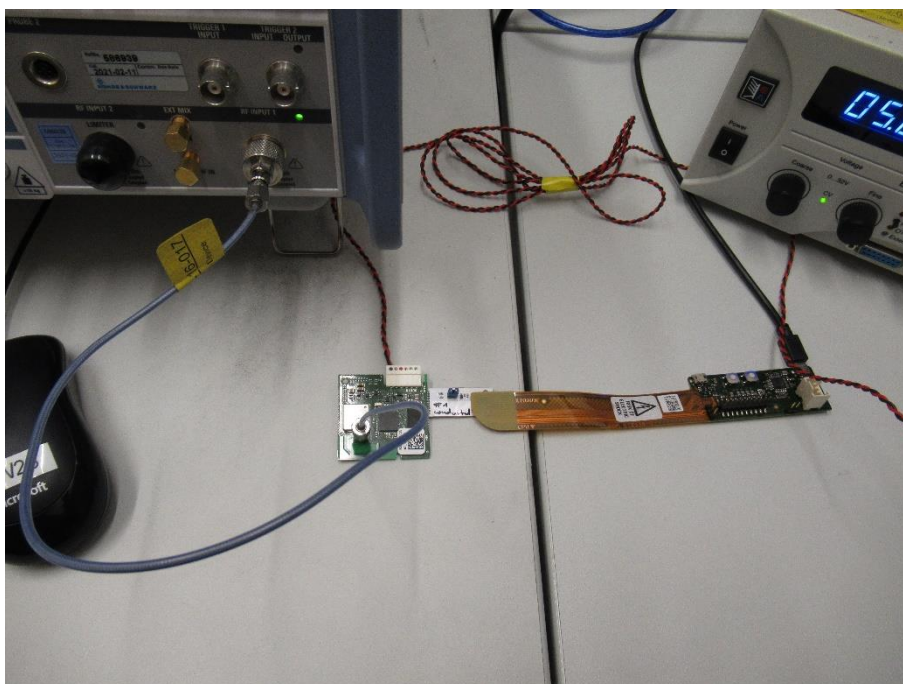
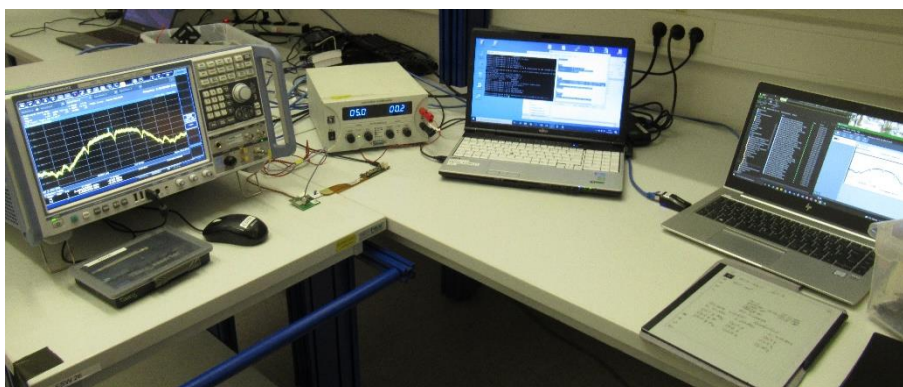
For test instruments and accessories used see section 6 Part CPR 3.

5.3.1 Description of the test location

Test location: Shielded Room S6

5.3.2 Photo documentation of the test set-up

Conducted Setup:

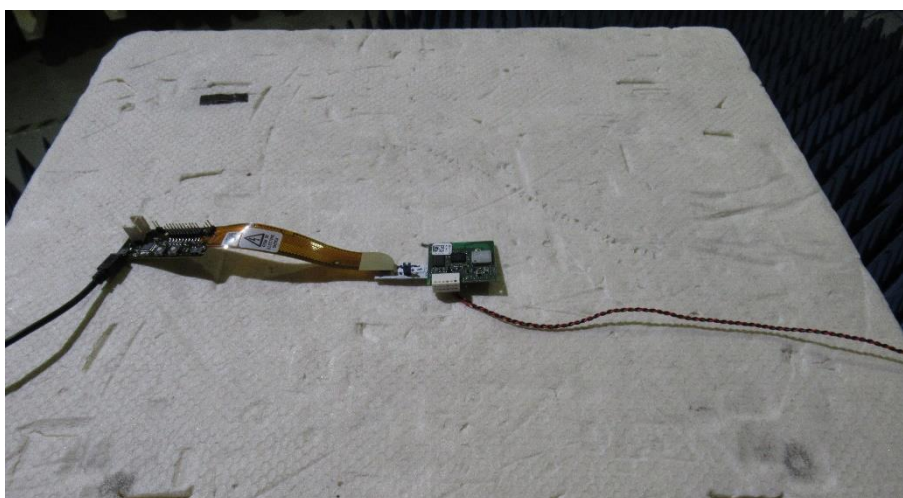


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

FCC ID: 2AHES-M2

IC ID: 21152-M2

Radiated Setup:



5.3.3 Applicable standard

According to FCC Part 15, Section 15.247(b)(3):

For systems using digital modulation in the 2400 – 2483.5 MHz 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.

5.3.4 Description of Measurement

The maximum peak conducted output power is measured using a spectrum analyser following the procedure set out in ANSI C63.10, item 11.9.1.1. The EUT is set in TX continuous mode while measuring.

The maximum peak radiated output power is measured using a spectrum analyser following the procedure set out in ANSI C63.10, item 11.9.2.2. The EUT is set in TX continuous mode while measuring. The radiated measurement was performed in terms of fieldstrength. Therefore, the formula set out in ANSI C63.10, item 9.5 (Equation 22) is changed into the following term:

$$\text{EIRP} = E - 95.2 \text{ dB}$$

FCC ID: 2AHES-M2

IC ID: 21152-M2

5.3.5 Test result

Conducted Measurement				
802.15 Bluetooth Low Energy				
Channel	Frequency	Measured Conducted TX Power	Conducted Tx Power Limit	Margin
	MHz	dBm	dBm	dB
37	2402	3.6	30	-26.4
17	2440	4.2	30	-25.8
39	2480	2.9	30	-27.1

Radiated Measurement					
802.15 Bluetooth Low Energy					
Channel	Frequency	Measured fieldstrength	Calculated EIRP	EIRP Limit	Margin
	MHz	dB(μV/m)	dBm	dBm	dB
37	2402	98.5	3.3	36.0	-32.7
17	2440	97.2	2.0	36.0	-34.0
39	2480	96.6	1.4	36.0	-34.6

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

Frequency (MHz)	Peak conducted Power Limit	
	(dBm)	(W)
902-928	30	1.0
2400-2483.5	30	1.0
5725-5850	30	1.0

Frequency (MHz)	Peak Radiated Power Limit	
	(dBm)	(W)
902-928	36	4.0
2400-2483.5	36	4.0
5725-5850	36	4.0

The requirements are **FULFILLED**.

Remarks: N/A

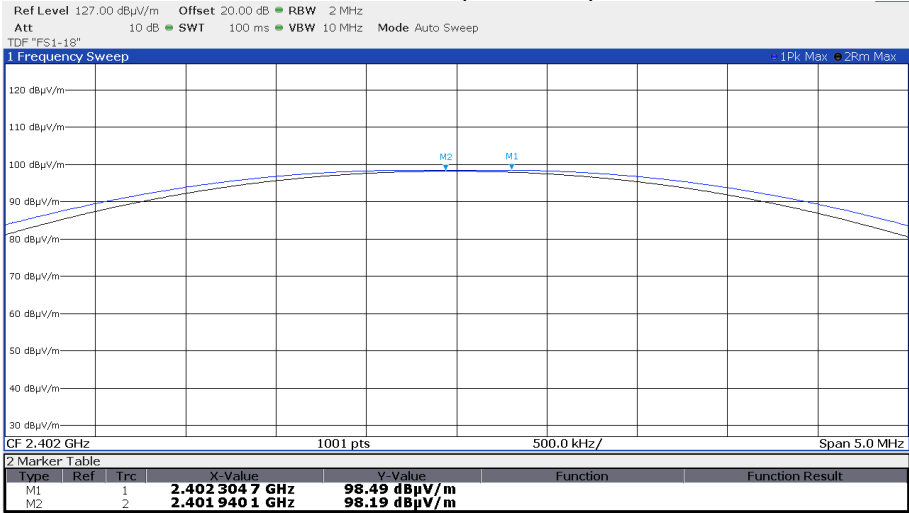


FCC ID: 2AHES-M2

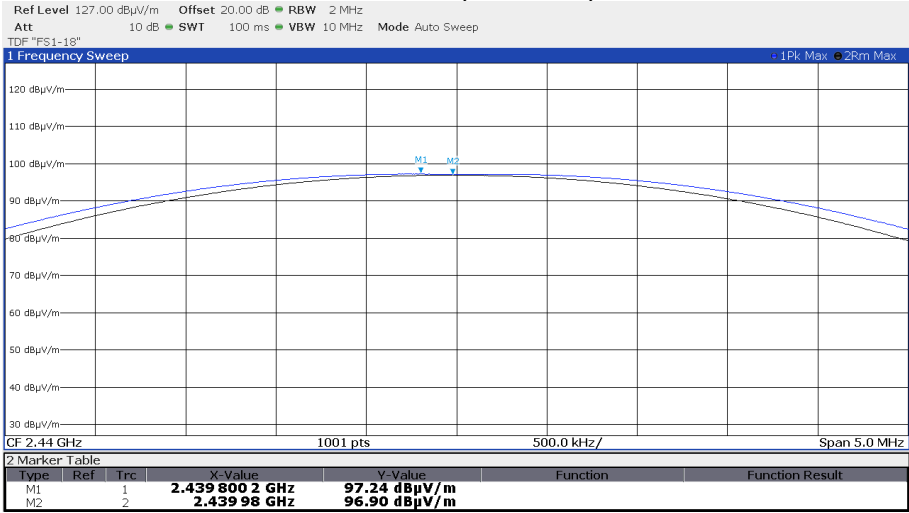
IC ID: 21152-M2

5.3.6 Radiated power measurement plots

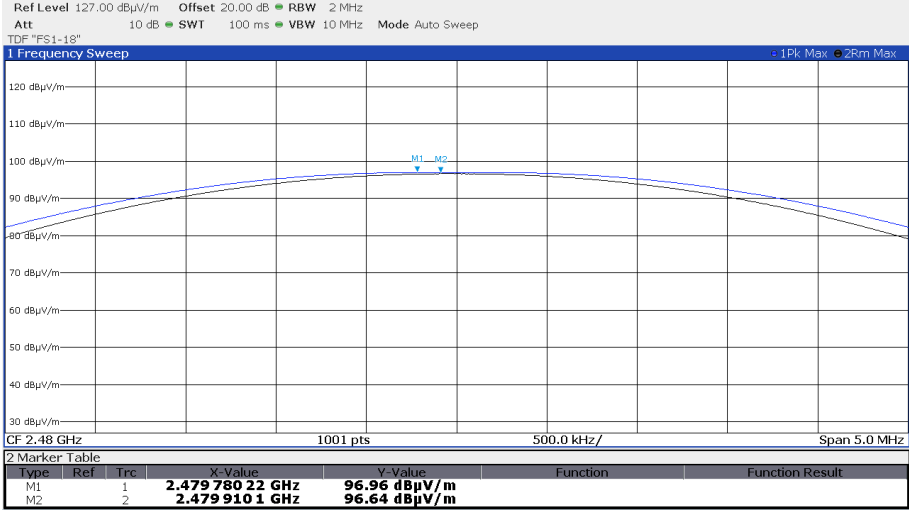
Channel 37 (2402 MHz)



Channel 17 (2440 MHz)



Channel 39 (2480 MHz)

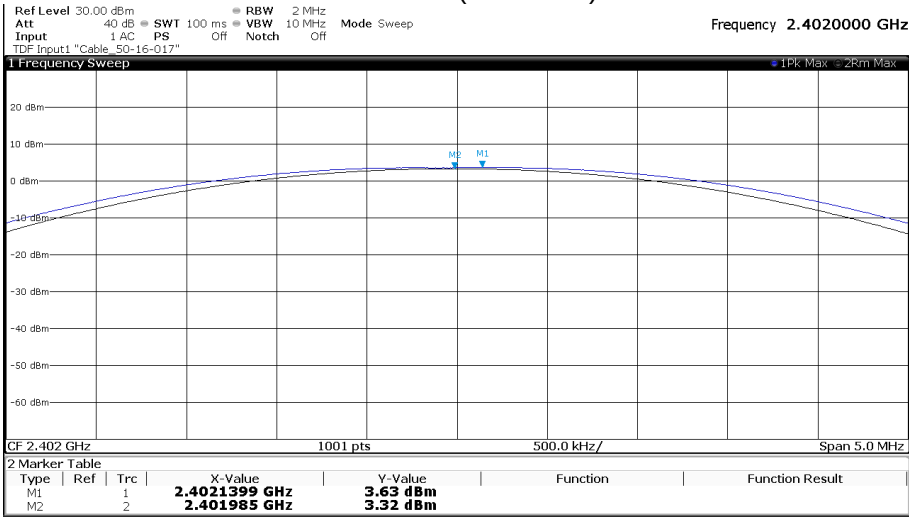


FCC ID: 2AHES-M2

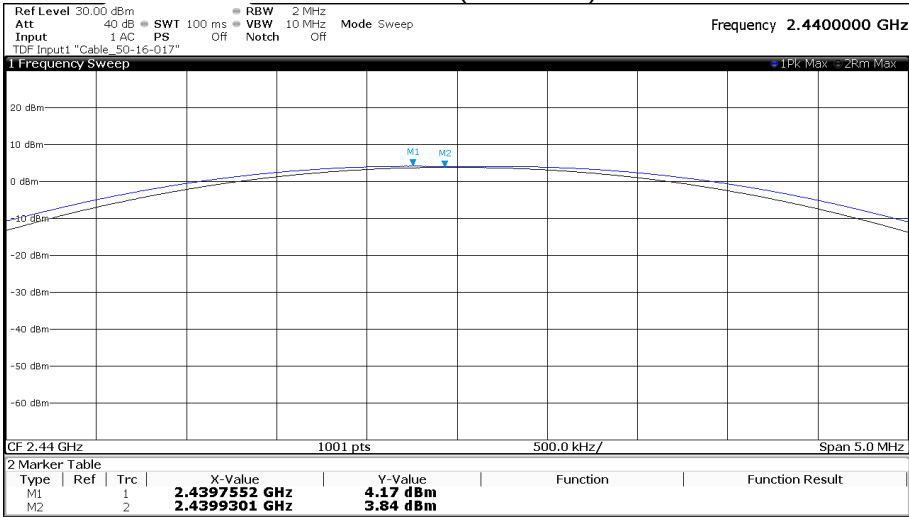
IC ID: 21152-M2

5.3.7 Conducted power measurement plots

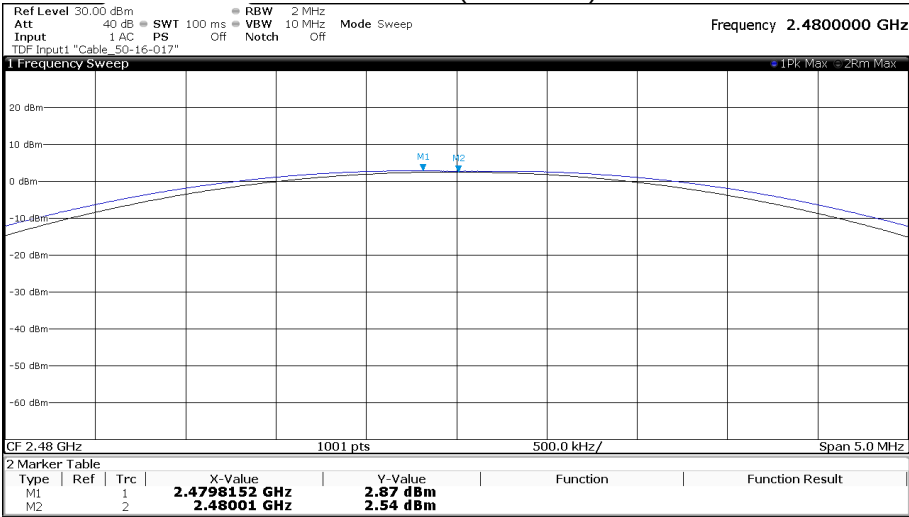
Channel 37 (2402 MHz)



Channel 17 (2440 MHz)



Channel 39 (2480 MHz)



FCC ID: 2AHES-M2

IC ID: 21152-M2

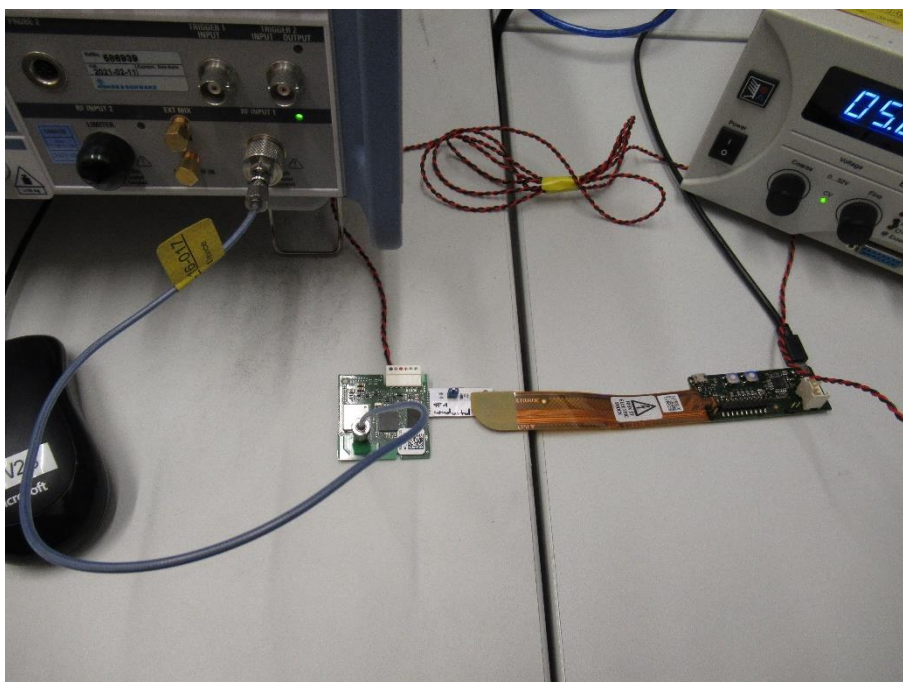
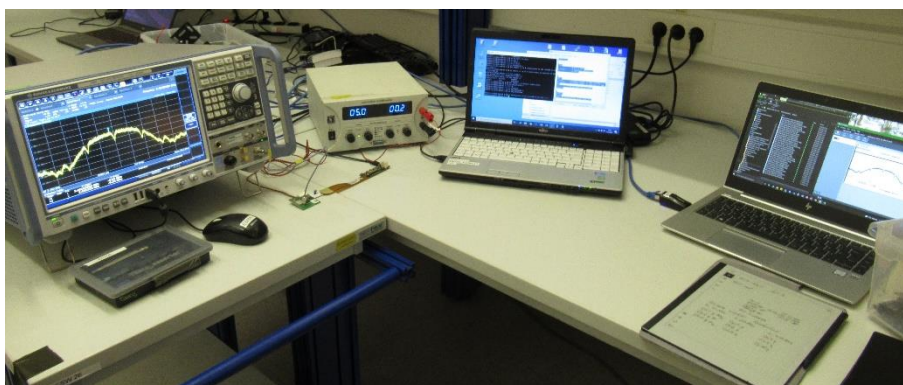
5.4 Power spectral density

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

5.4.1 Description of the test location

Test location: Shielded Room S6

5.4.2 Photo documentation of the test set-up



5.4.3 Applicable standard

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

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

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-M2**IC ID: 21152-M2****5.4.4 Description of Measurement**

The measurement is performed using the procedure set out in ANSI C63.10, item 11.10.21. The power measurement was done as peak power measurement. Therefore, the PKPSD is measured. The max peak was located and with the spectrum analyser and a marker set to peak.

Spectrum analyser settings:

RBW: 3 kHz,

VBW: 10 kHz,

Detector: Peak,

Sweep time: Auto

5.4.5 Test result

Conducted Measurement				
802.15 Bluetooth Low Energy				
Channel	Channel Frequency	Measured conducted PSD	conducted PSD Limit	Margin
	MHz	dBm/3kHz	dBm/3kHz	dB
37	2402	-10.7	8	-18.7
17	2440	-10.1	8	-18.1
39	2480	-11.6	8	-19.6

Power spectral density limit according to FCC Part 15, Section 15.247(e):

Frequency (MHz)	Power spectral density limit
	(dBm/3 kHz)
2400 - 2483.5	8

The requirements are **FULFILLED**.

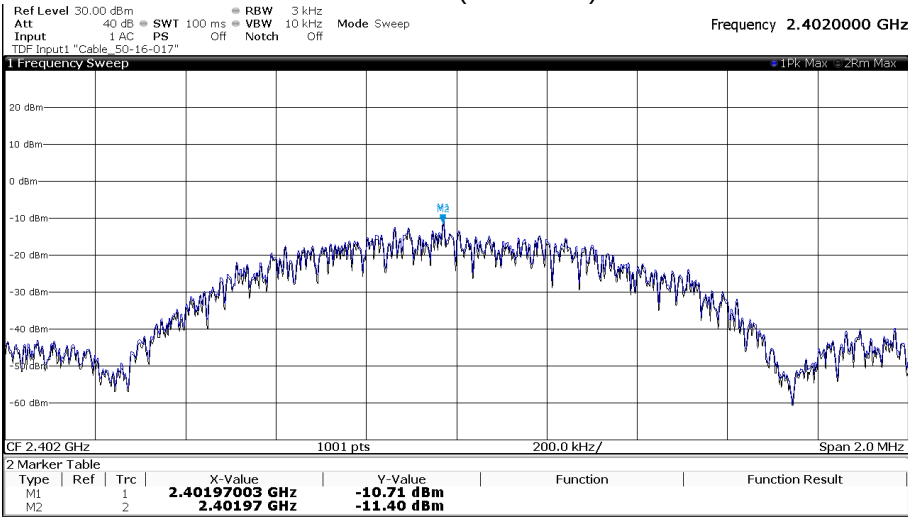
Remarks: For detailed test result please see the following test protocols

FCC ID: 2AHES-M2

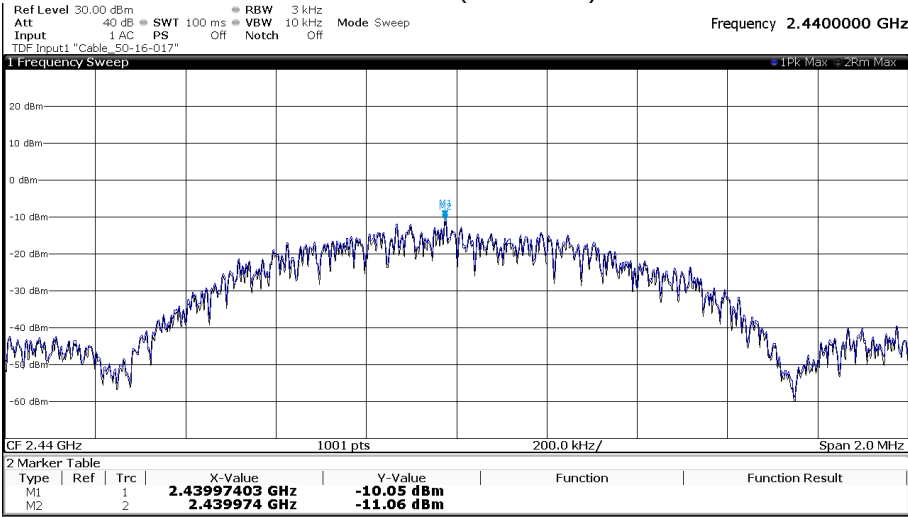
IC ID: 21152-M2

5.4.6 Test protocols

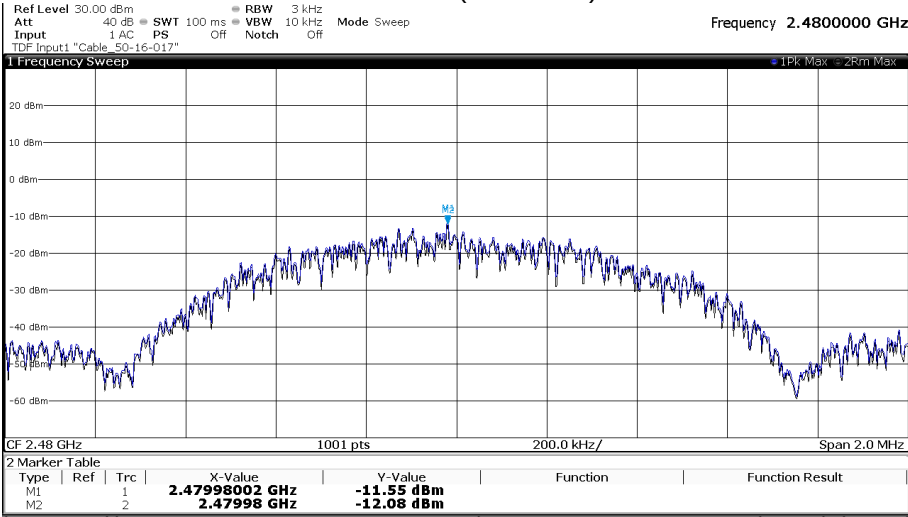
Channel 37 (2402 MHz)



Channel 17 (2440 MHz)



Channel 39 (2480 MHz)



FCC ID: 2AHES-M2

IC ID: 21152-M2

5.5 Radiated emissions in restricted bands

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

5.5.1 Description of the test location

Test location: OATS 1
Test location: Anechoic chamber 1
Test distance: 3 m

5.5.2 Photo documentation of the test set-up

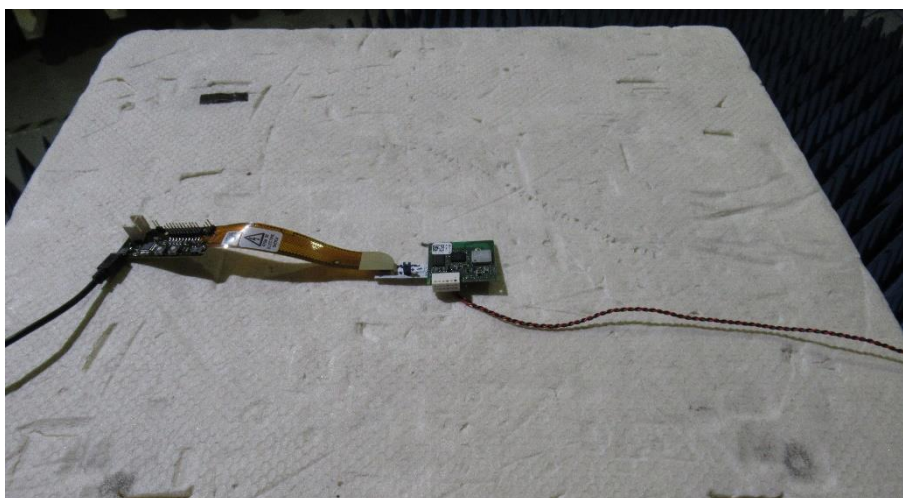
Test location: OATS 1
Emissions < 1 GHz



FCC ID: 2AHES-M2**IC ID: 21152-M2**

Test location:
Emissions > 1 GHz

Anechoic chamber 1



5.5.3 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).

5.5.4 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.

Test receiver settings for SER2:

RBW: 120 MHz, Detector: Quasi peak, Mes. Time: 1 s,

Spectrum analyser settings for SER3:

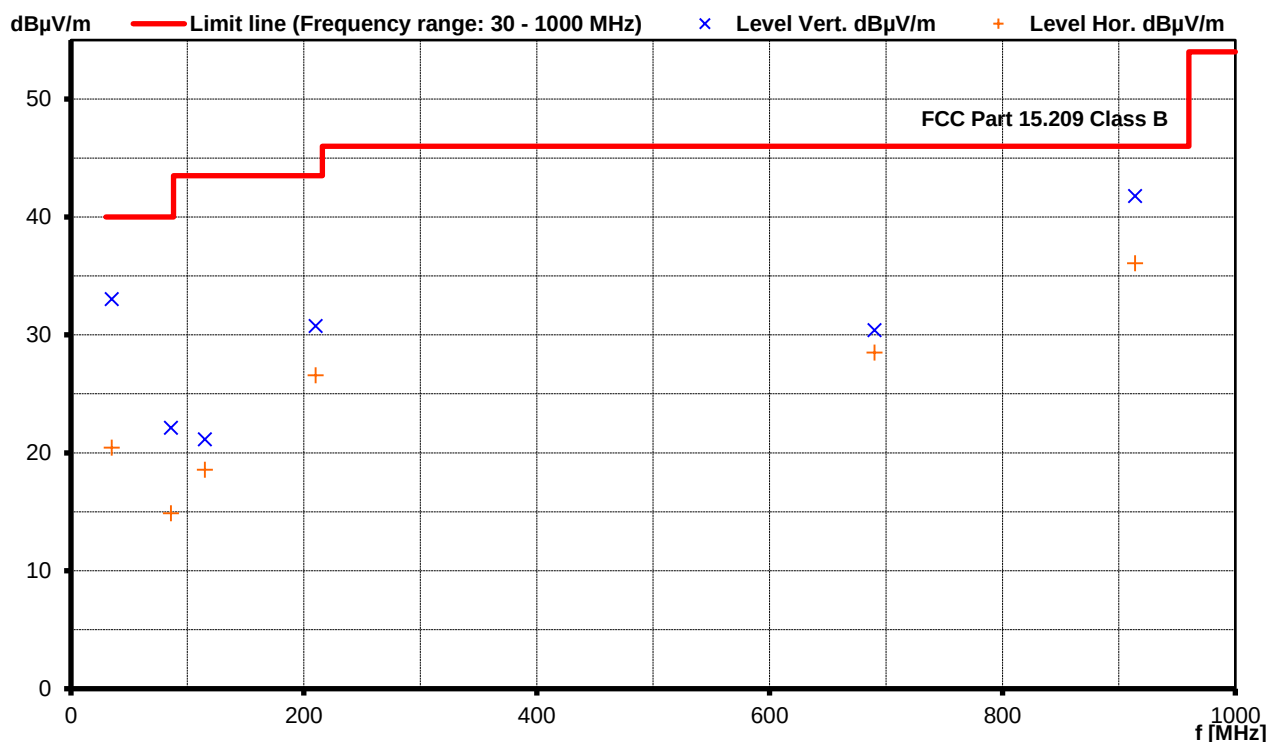
RBW: 1 MHz, VBW: 3 MHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto

FCC ID: 2AHES-M2

IC ID: 21152-M2

5.5.5 Test result

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)
35.00	16.8	3.3	16.2	17.2	33.0	20.5	40.0	-7.0
86.00	8.3	1.6	13.8	13.3	22.1	14.9	40.0	-17.9
115.00	4.3	2.5	16.9	16.1	21.2	18.6	43.5	-22.3
210.00	13.5	9.8	17.3	16.8	30.8	26.6	43.5	-12.7
690.00	0.9	-1.6	29.5	30.1	30.4	28.5	46.0	-15.6
914.00	8.8	2.7	33.0	33.4	41.8	36.1	46.0	-4.2

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.

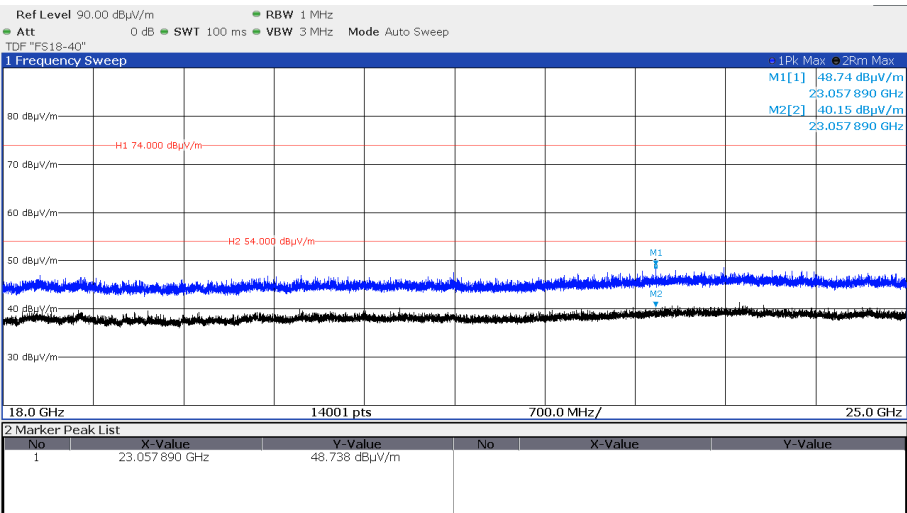
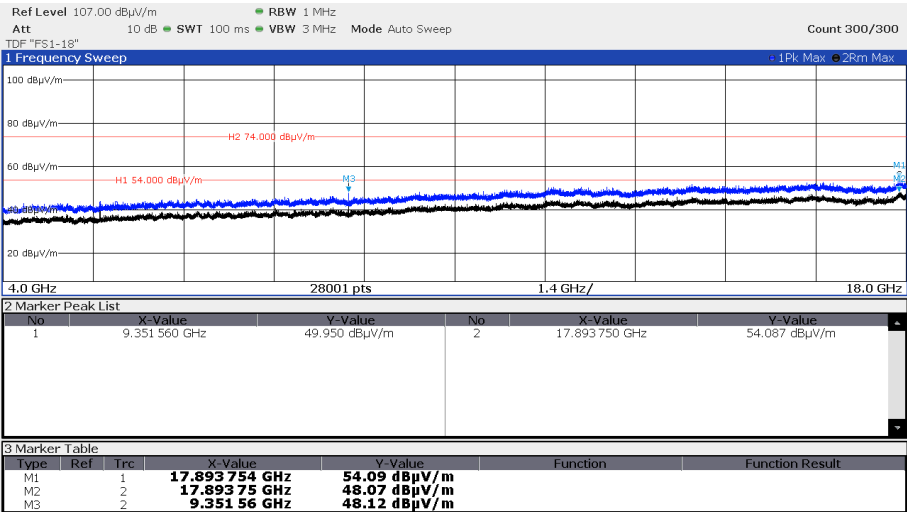
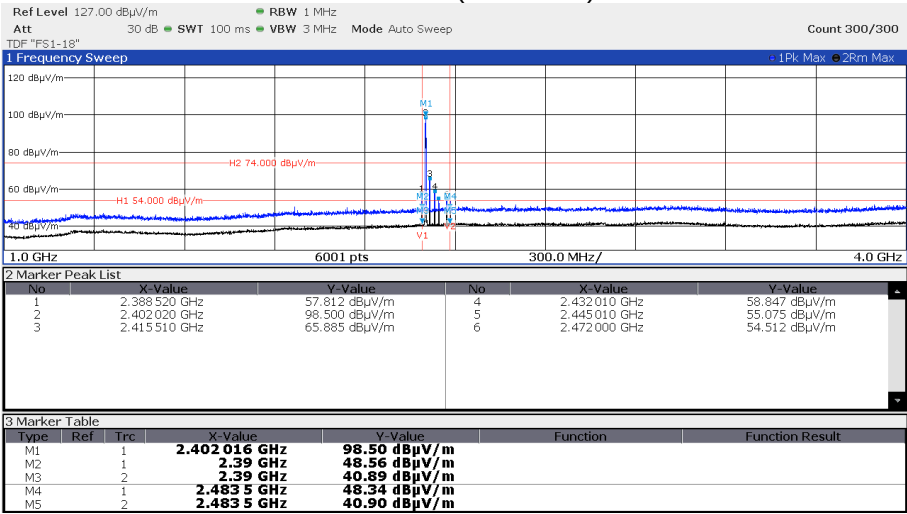


FCC ID: 2AHES-M2

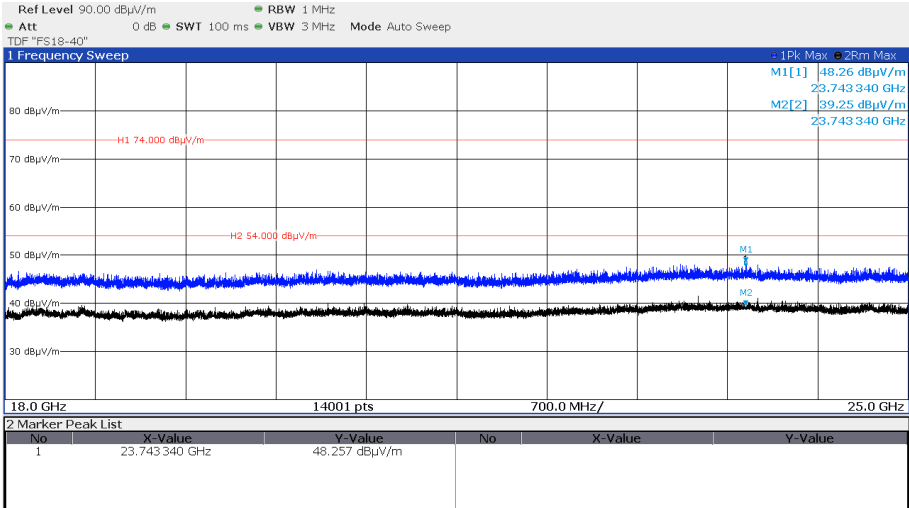
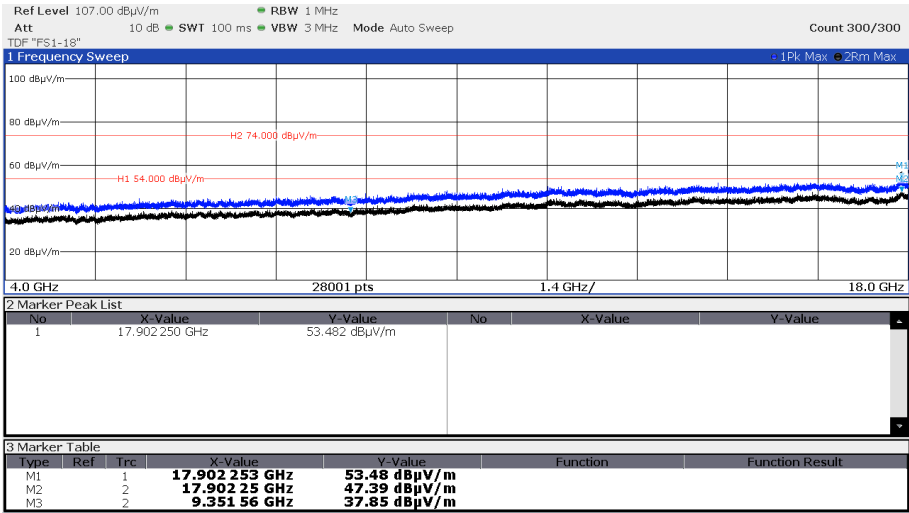
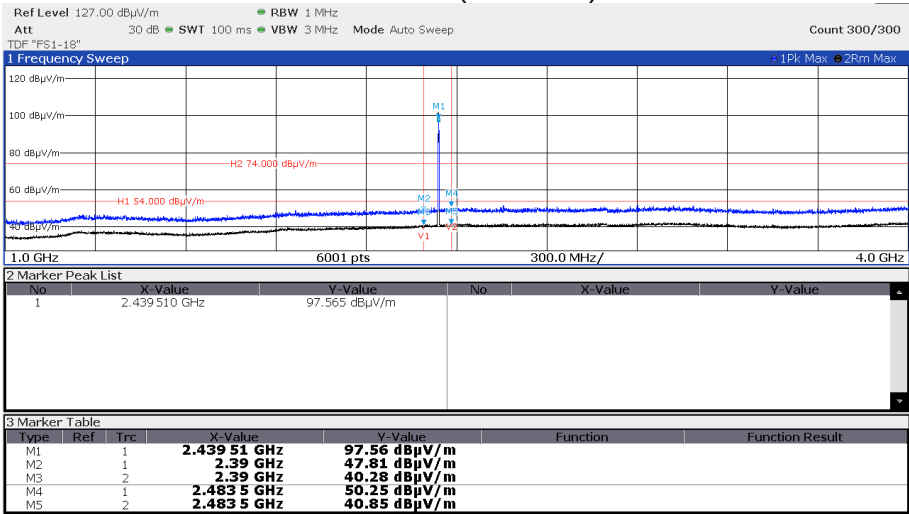
IC ID: 21152-M2

f > 1000 MHz

Channel 37 (2402 MHz)

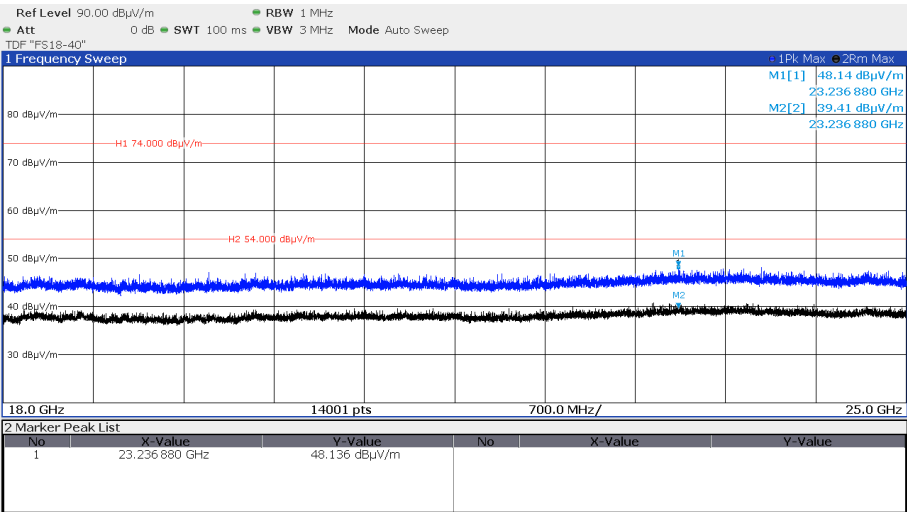
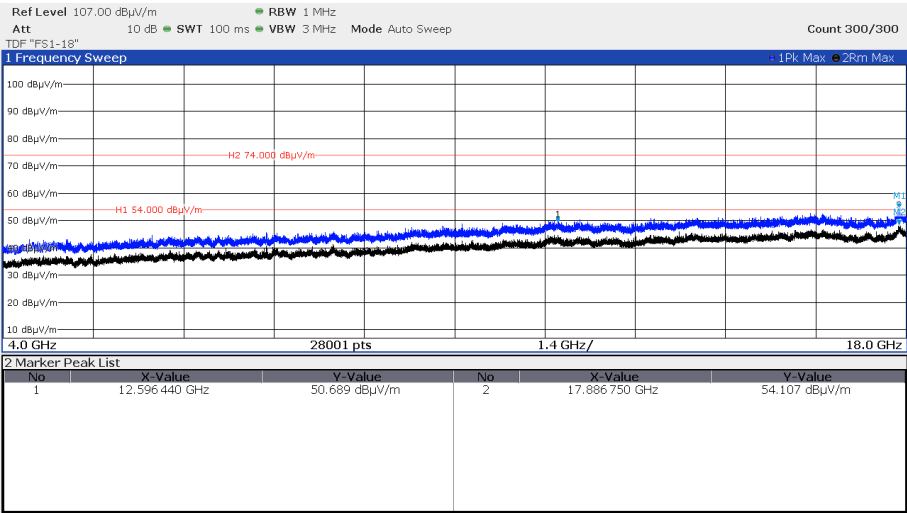
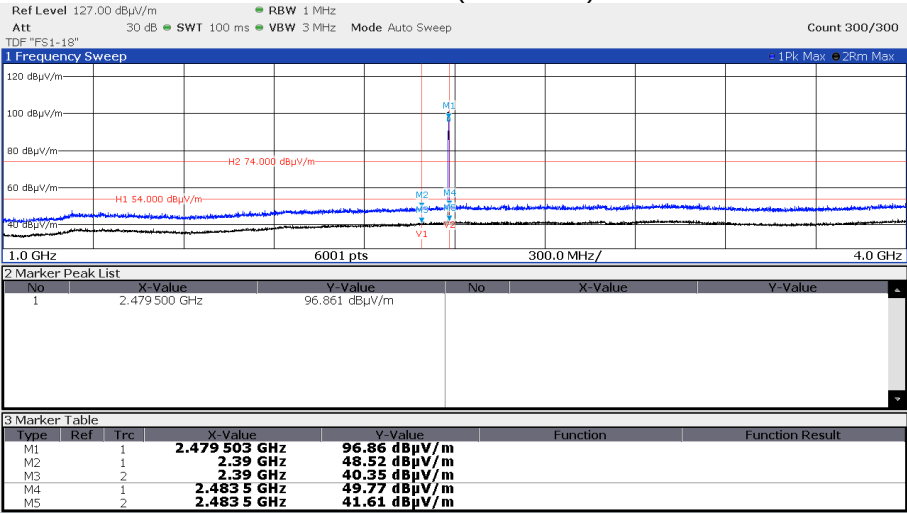


FCC ID: 2AHES-M2 IC ID: 21152-M2
Channel 17 (2440 MHz)





FCC ID: 2AHES-M2 IC ID: 21152-M2
Channel 39 (2480 MHz)



FCC ID: 2AHES-M2**IC ID: 21152-M2**

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

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	($\mu\text{V/m}$)	dB($\mu\text{V/m}$)	
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

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	

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The requirements are **FULFILLED**.

Remarks: The measurement was performed up to the 10th harmonic. Only the worst-case plots with
horizontal antenna polarization is listed.

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-M2

IC ID: 21152-M2

5.6 Spurious emissions radiated

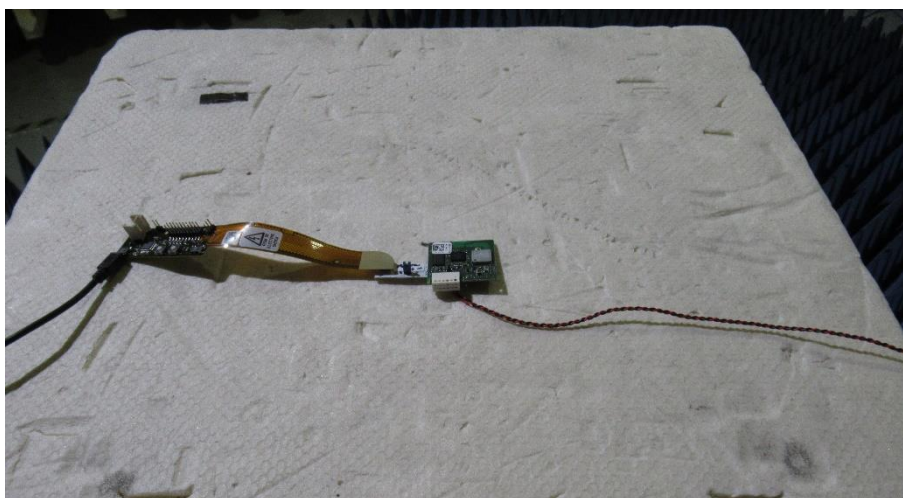
For test instruments and accessories used see section 6 Part **SER 2**, **SER 3**.

5.6.1 Description of the test location

Test location: Anechoic chamber 1

Test distance: 3 m

5.6.2 Photo documentation of the test set-up



FCC ID: 2AHES-M2**IC ID: 21152-M2****5.6.3 Applicable standard**

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

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

5.6.4 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.10. If the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured in average mode again and reported.

Test receiver settings for SER2:

RBW: 120 MHz, Detector: Quasi peak, Mes. Time: 1 s,

Spectrum analyser settings for SER3:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto



FCC ID: 2AHES-M2

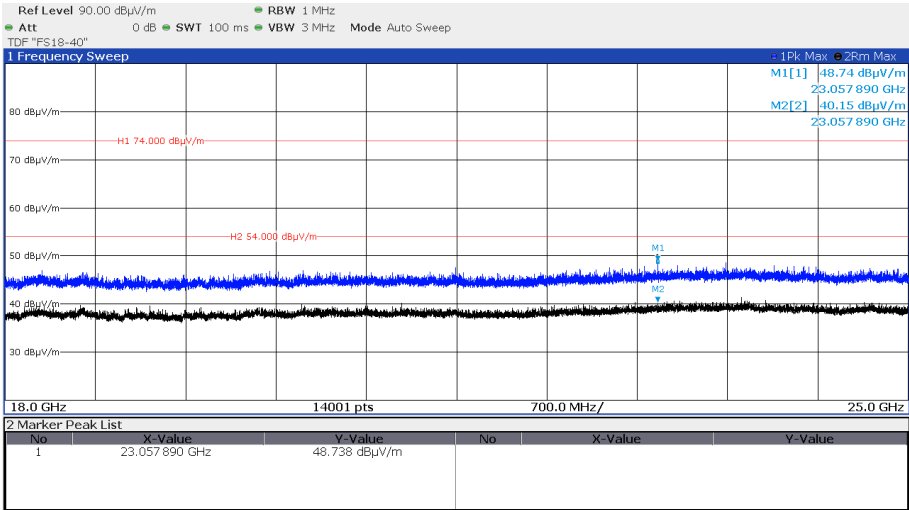
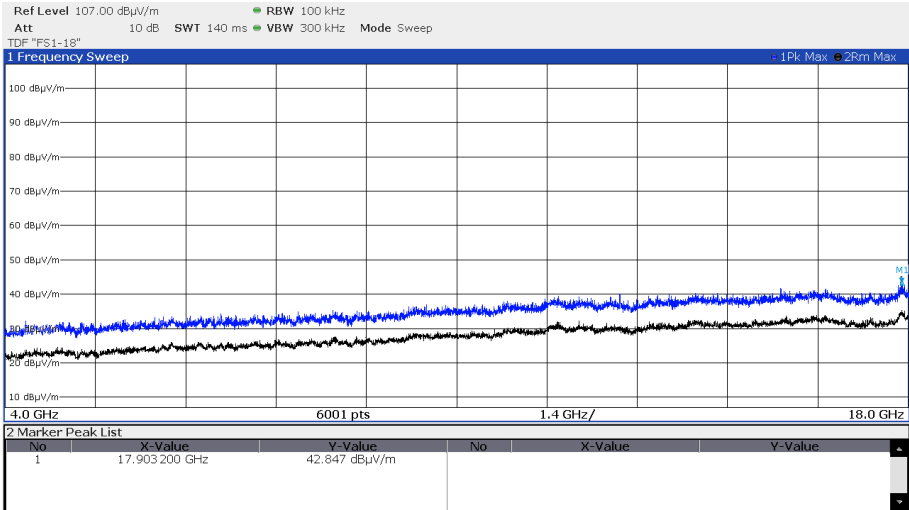
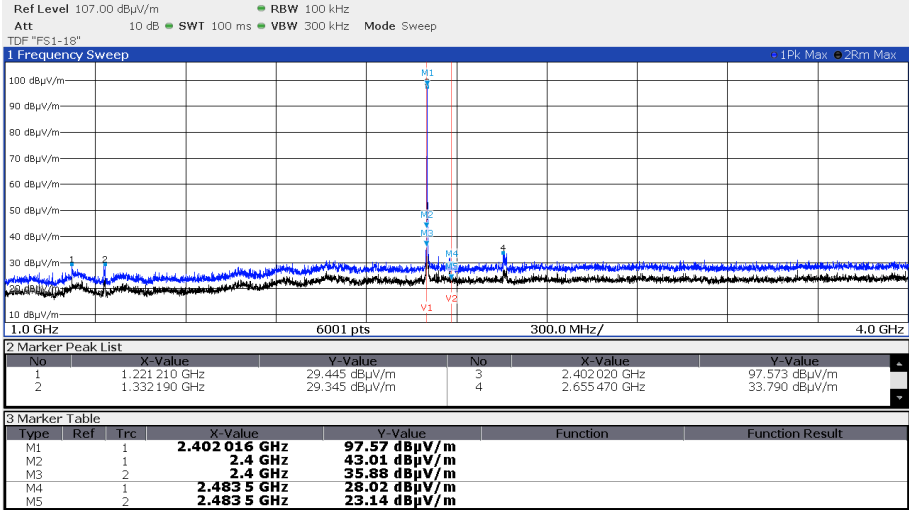
IC ID: 21152-M2

5.6.5 Test result

For measurement $f < 1000$ MHz see 5.5.5 of this test report.
No emissions $f < 1$ GHz could be detected.

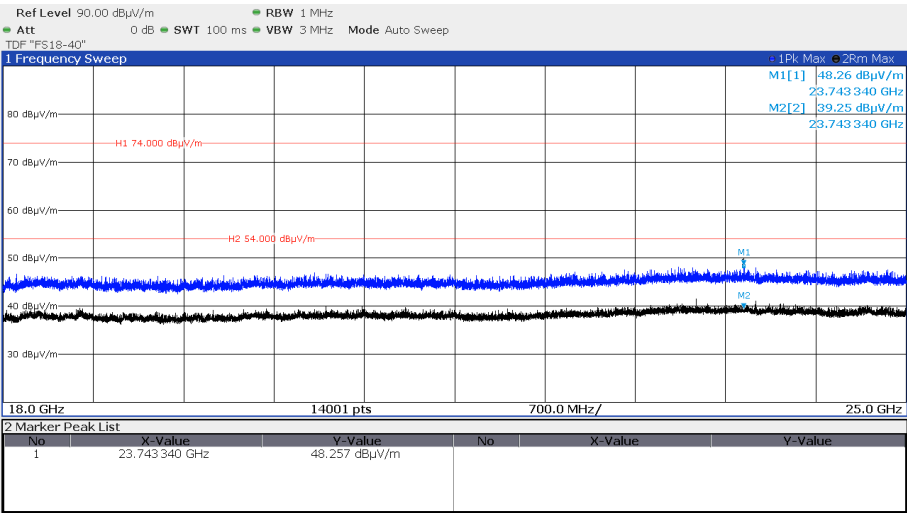
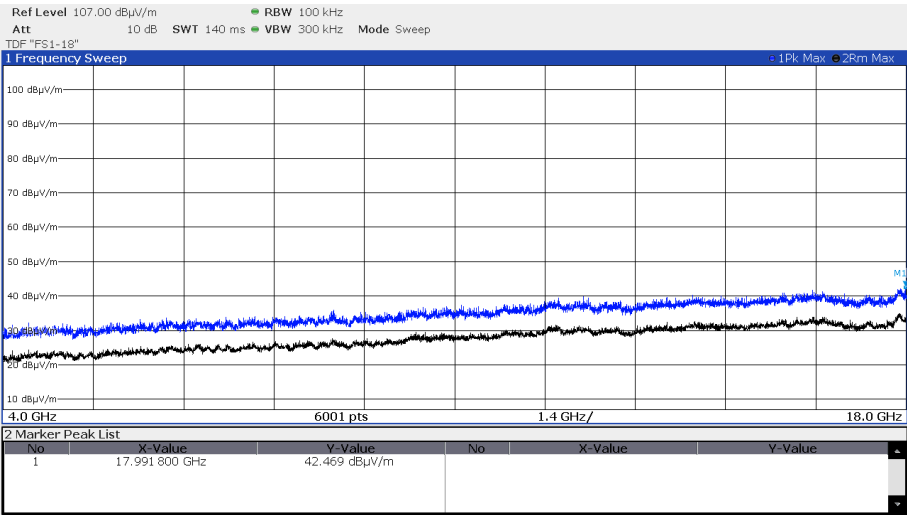
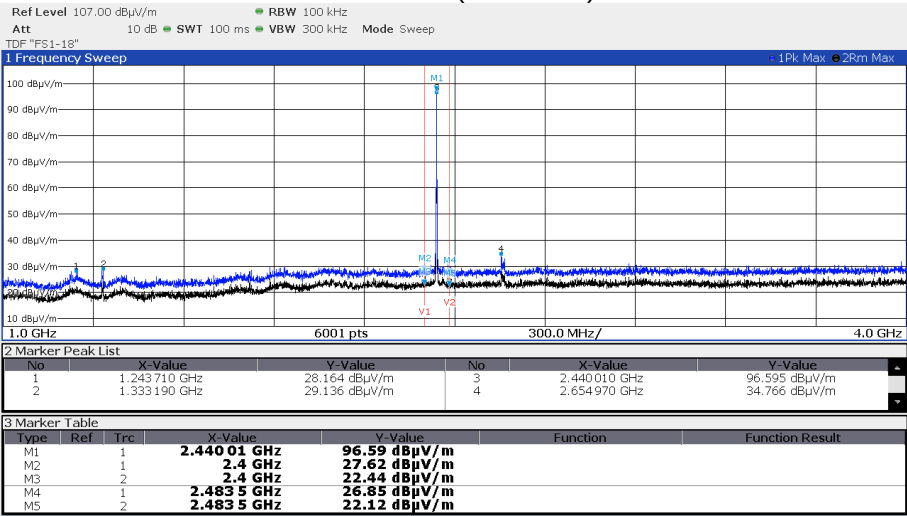
$f > 1000$ MHz

Channel 37 (2402 MHz)



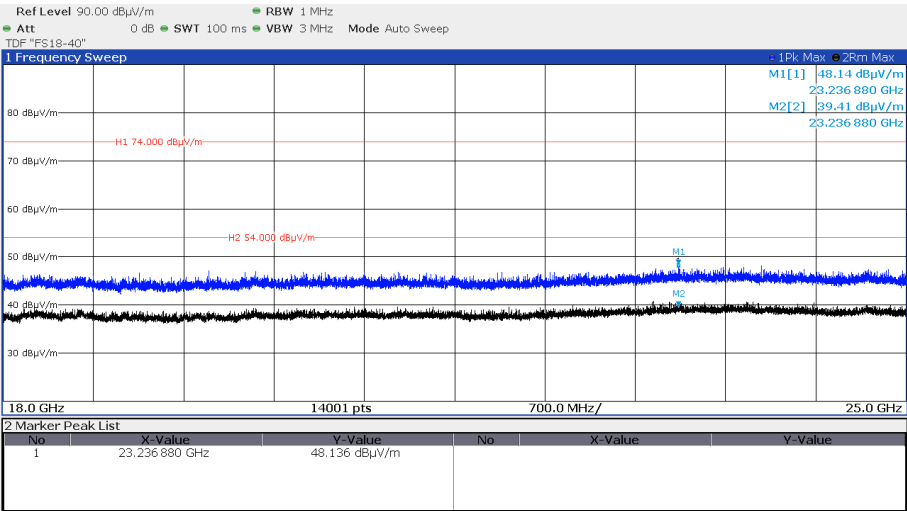
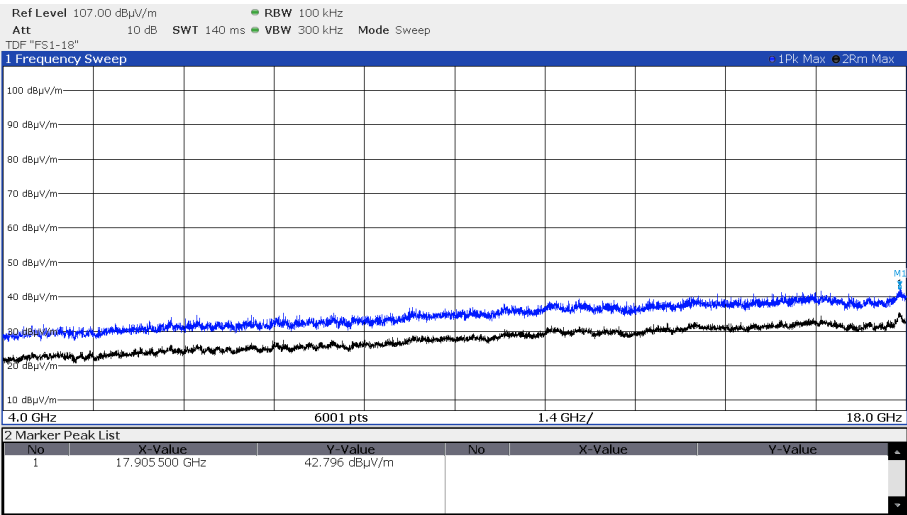
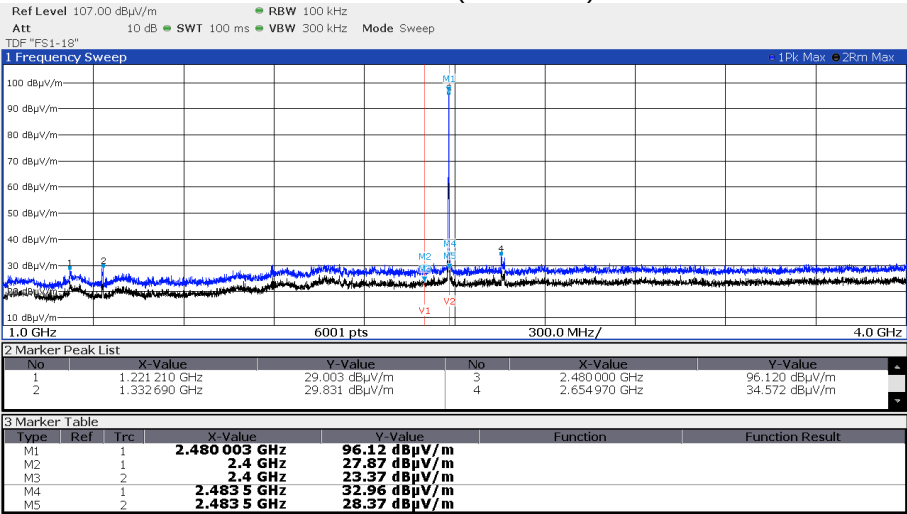


FCC ID: 2AHES-M2 IC ID: 21152-M2
Channel 17 (2440 MHz)





FCC ID: 2AHES-M2 IC ID: 21152-M2
Channel 39 (2480 MHz)



FCC ID: 2AHES-M2**IC ID: 21152-M2**

Limit according to FCC Part 15, Section 15.247(d) for emissions falling not in restricted bands:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in Section 15.209(a) is not required.

Frequency (MHz)	Spurious emission limit
Below 1000	20 dB below the highest level of the desired power
Above 1000	20 dB below the highest level of the desired power

The requirements are **FULFILLED**.

Remarks:

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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IC ID: 21152-M2

5.7 Antenna application

5.7.1 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 antenna. No other antenna can be used with the device.

The supplied antenna meets the requirements of part 15.203 and 15.204.

Remarks:

5.8 Defacto EIRP-Limit

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:

$$P_{out} = 30 - (G_x - 6);$$

The antenna is < 6 dBi gain, no Defacto limit applies.

The requirements are **FULFILLED**.

Remarks:

None.

FCC ID: 2AHES-M2

IC ID: 21152-M2

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 3.21.0.24	01-02/68-13-001				
	ESCI	02-02/03-15-001	21/06/2022	21/06/2021		
	ESH 2 - Z 5	02-02/20-05-004	31/10/2022	31/10/2019	19/04/2022	19/10/2021
	N-4000-BNC	02-02/50-05-138				
	ESH 3 - Z 2	02-02/50-05-155	13/11/2022	13/11/2019	12/04/2022	12/10/2021
CPC 3	ESW26 EMI Test Receiver	02-02/03-17-002	10/02/2022	10/02/2021		
	minibend KR-16	02-02/50-16-014				
	EA-PS 3032-05 B	02-02/50-20-008				
CPR 3	FSW43	02-02/11-15-001	06/04/2022	06/04/2021		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	28/06/2022	28/06/2021		
	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				
	EA-PS 3032-05 B	02-02/50-20-008				
	18N-20	02-02/50-21-009				
	BAT-EMC 3.21.0.24	02-02/68-13-001				
MB	FSW43 Spectrum Analyser	02-02/11-15-001	06/04/2022	06/04/2021		
	WK-340/40	02-02/45-05-001	05/08/2022	05/08/2021		
	KK-SF104-11SMA-11N-2M	02-02/50-14-003				
	minibend KR-16	02-02/50-16-014				
SER 2	FSP 30 Spectrum Analyser	02-02/11-05-001				
	VULB 9168	02-02/24-05-005	20/12/2022	20/12/2021	07/07/2022	07/07/2021
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	EA-PS 3032-05 B	02-02/50-20-008				
	50F-003 N 3 dB	02-02/50-21-010				
SER 3	FSW43	02-02/11-15-001	06/04/2022	06/04/2021		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	LNA-40-18004000-33-5P	02-02/17-20-002				
	3117	02-02/24-05-009	28/06/2022	28/06/2021		
	BBHA 9170	02-02/24-05-013	19/05/2023	19/05/2020	04/02/2022	04/02/2021
	WHKX 7.5/18G-8SS	02-02/50-07-010				
	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				
	EA-PS 3032-05 B	02-02/50-20-008				
	KMS116-GL140SE-KMS116	02-02/50-20-026				
	BAT-EMC 3.21.0.24	02-02/68-13-001				

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.