PHOENIX TESTLAB

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Test Report

Report Number:

F231636E1

Equipment under Test (EUT):

Dual band Wi-Fi 6 / Bluetooth 5.3 low energy module

IRIS-W1

Applicant:

u-blox AG

Manufacturer:

u-blox AG

ilac-MRA

DAkkS
Deutsche
Akkreditierungsstelle
D-PL-17186-01-00

References

[1] **ANSI C63.10-2020**, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

[2] **FCC CFR 47 Part 15**, Radio Frequency Devices

[3] **558074 D01 15.247 Meas Guidance v05r02 (April 2019),** GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

[4] **RSS-247, Issue 3 (2023-08)** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

[5] **RSS-Gen, Issue 5 Amendment 2 (2021-02)** General Requirements for Compliance of Radio Apparatus

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.
“Passed” indicates that the equipment under test conforms with the relevant limits of the testing standard without taking any measurement uncertainty into account as stated in clause 1.4 of ANSI C63.10 (2020). However, the measurement uncertainty is calculated and shown in this test report.

Tested by:		Daniel BRUSCHINSKI 18.07.2024
	Signature	
Tested and written by:		Paul NEUFELD 18.07.2024
	Signature	
Reviewed and approved by:		Thomas Kühn 18.07.2024
	Signature	

This test report is only valid in its original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

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1 Identification

1.1 Applicant

Name:	u-blox AG
Address:	Zürcherstrasse 68, 8800 Thalwil
Country:	Switzerland
Name for contact purposes:	Mr. Filip Kruzela
Phone:	+46 733 20 71 70
eMail address:	filip.kruzela@u-blox.com
Applicant represented during the test by the following person:	Partly: Mr. Olof Viklund

1.2 Manufacturer

Name:	u-blox AG
Address:	Zürcherstrasse 68, 8800 Thalwil
Country:	Switzerland
Name for contact purposes:	Mr. Filip Kruzela
Phone:	+46 733 20 71 70
eMail address:	filip.kruzela@u-blox.com
Manufacturer represented during the test by the following person:	Partly: Mr. Olof Viklund

1.3 Test Laboratory

The tests were carried out by:

PHOENIX TESTLAB GmbH
Königswinkel 10
32825 Blomberg
Germany

accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) according to DIN EN ISO/IEC 17025:2018. The accreditation is only valid for the scope of accreditation listed in the annex of the certificate D-PL-17186-01-00. FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

EUT	
Test object: *	Dual band Wi-Fi 6 / Bluetooth 5.3 low energy module
Model name: *	IRIS-W1
Model number: *	IRIS-W101-00B IRIS-W106-00B
Order number: *	IRIS-W101-00B IRIS-W106-00B
FCC ID: *	XPYIRISW1
IC certification number: *	8595A-IRISW1
PMN: *	IRIS-W101-00B IRIS-W106-00B
HVIN: *	IRIS-W101-00B IRIS-W106-00B
FVIN: *	922600.0200.000 922700.0200.000
HMN: *	not applicable

	EUT number		
	1*[2] (IRIS-W101-00B)	2*[3] (IRIS-W106-00B)	3
Serial number: *	D601E8	F00360	-
PCB identifier: *	UBXH60-0001009	UBXH60-0001008	-
Hardware version: *	922600.0200.000	922700.0200.000	-
Software version: *	MFG-RW61X-1.0.0.12.0-18.80.2.p55.1	MFG-RW61X-1.0.0.12.0-18.80.2.p55.1	-

* Declared by the applicant

*[2] This EUT was used for all antenna port conducted tests and for radiated tests with terminated antenna port.
*[3] This EUT was used for all radiated measurements with the on-board antenna

2 EUTs were used for the tests. In the overview (chapter 4) is shown which EUT was used for each test case.

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical Data of Equipment

General EUT data			
Power supply EUT / evaluation board: *	DC		
Supply voltage EUT: *	U_{Nom}= 3.3 V_{DC}	U_{Min}= 3.15 V_{DC}	U_{Max}= 3.45 V_{DC}
Supply voltage Evaluation board: *	U_{Nom}= 5.0 V_{DC}	U_{Min}= 4.0 V_{DC}	U_{Max}= 6.0 V_{DC}
Temperature range: *	-40°C to +85°C		
Lowest internal clock / radio radio frequency: *	40 MHz		
Highest internal clock / radio radio frequency: *	5825 MHz		

Ports / Connectors - EUT				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
J41, U.FL Antenna connector (IRIS-W101 only)	EVB-IRIS-W1	SMA 50Ω termination / Spectrum analyzer	120 mm	Yes
-	-	-	-	-

Ports / Connectors Evaluation board				
Identification	Connector		Length during test	Shielding (Yes / No)
	Evaluation board	Ancillary		
J101, USB-C power supply, MCU-link serial interface	USB-C	USB-C (Laptop computer)	1.8 m	No
J98, USB-C power supply, FTDI 4 x serial interface	USB-C	Not connected	NA	No
J72, USB-C power supply, USB OTG (On The Go)	USB-C	Not connected	NA	No
T1, RJ45 connects to RMII Ethernet phy	RJ45	Not connected	NA	No
-	-	-	-	-
-	-	-	-	-

IEEE 802.11 frequencies (2.4 GHz)	
20 MHz	
Channel 1	2412 MHz
Channel 2	2417 MHz
Channel 3	2422 MHz
Channel 4	2427 MHz
Channel 5	2432 MHz
Channel 6	2437 MHz
Channel 7	2442 MHz
Channel 8	2447 MHz
Channel 9	2452 MHz
Channel 10	2457 MHz
Channel 11	2462 MHz

Bluetooth® low energy frequencies			
Channel 00	2402 MHz	Channel 01	2404 MHz
Channel 02	2406 MHz	Channel 03	2408 MHz
…	…	…	…
Channel 18	2438 MHz	Channel 19	2440 MHz
…	…	…	…
Channel 36	2474 MHz	Channel 37	2476 MHz
Channel 38	2478 MHz	Channel 39	2480 MHz

802.15.4 frequencies			
Channel 11	2405 MHz	Channel 12	2410 MHz
…	…	…	…
Channel 18	2440 MHz	Channel 19	2445 MHz
Channel 25	2475 MHz	Channel 26	2480 MHz

IEEE 802.11 radio mode (2.4 GHz)		
Fulfils radio specification: *	IEEE 802.11 b IEEE 802.11 g IEEE 802.11 n (20 MHz) IEEE 802.11 ax (20 MHz)	
Radio IC: *	NXP RW612ET	
Type of modulation: *	IEEE 802.11 b	BPSK, DQPSK, CCK (1/2/5.5/11 Mbit/s)
	IEEE 802.11 g	BPSK, QPSK, 16-QAM, 64-QAM (6/9/12/18/24/36/48/54 Mbit/s)
	IEEE 802.11 n20	BPSK, QPSK, 16-QAM, 64-QAM (up to 72.2 Mbit/s 1 spatial stream) (up to 144.4 Mbit/s 2 spatial stream) (up to 72.2 Mbit/s 1 spatial stream) (up to 144.4 Mbit/s 2 spatial stream)
	IEEE 802.11 ax20	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, 1024-QAM (up to 143.4 Mbit/s 1 spatial stream) (up to 286.8 Mbit/s 2 spatial stream)
Operating frequency range: *	IEEE 802.11b	2412 – 2462 MHz
	IEEE 802.11g	2412 – 2462 MHz
	IEEE 802.11n 20 MHz	2412 – 2462 MHz
	IEEE 802.11ax 20 MHz	2412 – 2462 MHz

IEEE 802.15.4 radio mode		
Fulfils radio specification: *	IEEE 802.15.4	
Radio IC: *	NXP RW612ET	
Type of modulation: *	O-QPSK	250 kbps
Operating frequency range: *	2405 – 2480 MHz	

* Declared by the applicant

Bluetooth® low energy radio mode		
Fulfils radio specification: *	Bluetooth® Low Energy (BLE) 5.3	
Radio IC: *	NXP RW612ET	
Type of modulation: *	BLE (1 Mbps PHY)	GFSK
	BLE (2 Mbps PHY)	GFSK
	BLE (0.5 Mbps PHY)	GFSK
	BLE (0.125 Mbps PHY)	GFSK
Operating frequency range: *	BLE (1 Mbps PHY)	2402 – 2480 MHz
	BLE (2 Mbps PHY)	2402 – 2480 MHz
	BLE (0.5 Mbps PHY)	2402 – 2480 MHz
	BLE (0.125 Mbps PHY)	2402 – 2480 MHz
Number of channels: *	BLE (1 Mbps PHY)	40 (2 MHz channel spacing)
	BLE (2 Mbps PHY)	40 (2 MHz channel spacing)
	BLE (0.5 Mbps PHY)	40 (2 MHz channel spacing)
	BLE (0.125 Mbps PHY)	40 (2 MHz channel spacing)

* Declared by the applicant

Antenna list			
Antenna type	Antenna name	Antenna gain	Antenna connector
PCB trace*	Abracon	+1.74 dBi (2.4 GHz) / +1.63 dBi (5 GHz)	None
PCB Patch	PRO-IS-432 by Abracon	+0.8 dBi (2.4 GHz), +3.4 dBi (5 GHz)	U.FL
PCB patch	ANTX100P002B24553 by Pulse Electronics / Yageo	+0.7 dBi (2.4 GHz), +1.9 dBi (5 GHz)	U.FL
Monopole (¼ wave)	W1039B030 by Pulse Electronic / Yageo	+1.5 dBi (2.4 GHz), +3.2 dBi (5 GHz)	U.FL
Monopole (½ wave)	GW.59.3153 by taoglas	+2.37 dBi (2.4 GHz), +2.93 dBi (5 GHz)	Reverse Polarity SMA plug*2
All antenna data were declared by the applicant			

* On-board antenna on the IRIS-W106-00B
*2 Inner thread and pin receptacle; Connection only possible with appropriate adapter cable (U.FL to Reverse polarity SMA)

Ancillary Equipment / Equipment used for testing

99	
Evaluation board*1	EVB-IRIS-W1
Laptop computer*1	Latitude 7280 by Dell
-	-

*1 Provided by the applicant

Ancillary Equipment	
-	-

1.6 Dates

Date of receipt of test sample:	13.11.2023
Start of test:	13.11.2023
End of test:	10.04.2024

2 Operational States

2.1 Description of function of the EUT

The u-blox IRIS-W1 is a dual-band Wi-Fi 6 (802.11ac/ax/a/b/g/n), Bluetooth Low Energy 5.3 and Thread connectivity module for country specific specifications.

2.2 Test Setup

For the radio tests, the EUT was soldered to an evaluation board. To activate the test modes and to power the EUT, the evaluation board was connected to a laptop computer via USB. With the softwaretool named "labtool" the radio test modes were activated. The test laptop and the test software were provided by the applicant.

2.3 Power Settings WLAN 2.4 GHz

Channel	1	2	3	4	5	6	7	8	9	10	11
802.11b	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	15.5
802.11g	14.0	15.0	15.0	15.0	16.0	16.0	16.0	16.0	14.0	14.0	13.0
802.11n20	11.5	12.5	13.5	14.0	14.5	15.5	14.0	13.0	11.5	12.0	11.0
802.11ax20	11.5	12.5	13.5	14.0	14.5	15.5	14.0	13.0	11.5	12.0	11.0
802.11ax20 RU Modes	11.5	13.0	13.5	12.5	13.5	14.5	14.5	13.5	11.5	11.5	11.0

2.4 Power Settings Bluetooth Low Energy

Channel	0 - 39
1 Mbps	14
2 Mbps	14
500 kbps	14
125 kbps	14

2.5 Power Settings 802.15.4

Channel	0 - 39
11 – 25	14
26	0

2.6 Operation modes (802.11 IRIS-W101 – antenna port)

Operation mode #	Radio technology*	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate*	Power setting
1	802.11b	2412	1	BPSK	1 Mbps	17.0
2	802.11b	2437	6	BPSK	1 Mbps	17.0
3	802.11b	2462	11	BPSK	1 Mbps	15.5
4	802.11b	2412	1	CCK	11 Mbps	17.0
5	802.11b	2437	6	CCK	11 Mbps	17.0
6	802.11b	2462	11	CCK	11 Mbps	15.5
7	802.11g	2412	1	BPSK	6 Mbps	14.0
8	802.11g	2437	6	BPSK	6 Mbps	16.0
9	802.11g	2462	11	BPSK	6 Mbps	13.0
10	802.11g	2412	1	BPSK	9 Mbps	14.0
11	802.11g	2437	6	BPSK	9 Mbps	16.0
12	802.11g	2462	11	BPSK	9 Mbps	13.0
13	802.11g	2412	1	QPSK	12 Mbps	14.0
14	802.11g	2437	6	QPSK	12 Mbps	16.0
15	802.11g	2462	11	QPSK	12 Mbps	13.0
16	802.11n20	2412	1	MCS0	6.5 Mbps	11.5
17	802.11n20	2437	6	MCS0	6.5 Mbps	15.5
18	802.11n20	2462	11	MCS0	6.5 Mbps	11.0
19	802.11n20	2412	1	MCS3	26 Mbps	11.5
20	802.11n20	2437	6	MCS3	26 Mbps	15.5
21	802.11n20	2462	11	MCS3	26 Mbps	11.0
22	802.11ax20	2412	1	MCS0	6.5 Mbps	11.5
23	802.11ax20	2437	6	MCS0	6.5 Mbps	15.5
24	802.11ax20	2462	11	MCS0	6.5 Mbps	11.0
25	802.11ax20	2412	1	MCS5	68.8 Mbps	11.5
26	802.11ax20	2437	6	MCS5	68.8 Mbps	15.5

27	802.11ax20	2462	11	MCS5	68.8 Mbps	11.0
28	802.11ax20 RU242	2412	1	MCS5	68.8 Mbps	11.5
29	802.11ax20 RU242	2437	6	MCS5	68.8 Mbps	14.5
30	802.11ax20 RU242	2462	11	MCS5	68.8 Mbps	11.0
31	802.11ax20 RU106_Low	2412	1	MCS5	68.8 Mbps	11.5
32	802.11ax20 RU106_Low	2437	6	MCS5	68.8 Mbps	14.5
33	802.11ax20 RU106_Low	2462	11	MCS5	68.8 Mbps	11.0
34	802.11ax20 RU26_Mid	2412	1	MCS5	68.8 Mbps	11.5
35	802.11ax20 RU26_Mid	2437	6	MCS5	68.8 Mbps	14.5
36	802.11ax20 RU26_Mid	2462	11	MCS5	68.8 Mbps	11.0
37	802.11ax20 RU26_Low	2412	1	MCS0	6.5 Mbps	11.5
38	802.11ax20 RU26_Low	2437	6	MCS0	6.5 Mbps	14.5
39	802.11ax20 RU26_Low	2462	11	MCS0	6.5 Mbps	11.0

* Pre-tests have shown that these data rates and RU modes produced in the worst-case results.

2.7 Operation modes (Bluetooth LE IRIS-W101 – antenna port)

Operation mode #	Radio technology*	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate*	Power setting
40	Bluetooth Low Energy	2402	0	GFSK	1 Mbps	14
41	Bluetooth Low Energy	2440	19	GFSK	1 Mbps	14
42	Bluetooth Low Energy	2480	39	GFSK	1 Mbps	14
43	Bluetooth Low Energy	2402	0	GFSK	2 Mbps	14
44	Bluetooth Low Energy	2440	19	GFSK	2 Mbps	14
45	Bluetooth Low Energy	2480	39	GFSK	2 Mbps	14
46	Bluetooth Low Energy	2402	0	GFSK	0.5 Mbps	14
47	Bluetooth Low Energy	2440	19	GFSK	0.5 Mbps	14
48	Bluetooth Low Energy	2480	39	GFSK	0.5 Mbps	14
49	Bluetooth Low Energy	2402	0	GFSK	0.125 Mbps	14
50	Bluetooth Low Energy	2440	19	GFSK	0.125 Mbps	14
51	Bluetooth Low Energy	2480	39	GFSK	0.125 Mbps	14

2.8 Operation modes (802.15.4 IRIS-W101 – antenna port)

Operation mode #	Radio technology*	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate*	Power setting
52	802.15.4	2405	11	O-QPSK	250 kb/s	14
53	802.15.4	2440	18	O-QPSK	250 kb/s	14
54	802.15.4	2475	25	O-QPSK	250 kb/s	14
55	802.15.4	2480	26	O-QPSK	250 kb/s	0

2.9 Operation modes (802.11 IRIS-W106 – on-board antenna)

Operation mode #	Radio technology*	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate*	Power setting
56	802.11ax20	2412	1	MCS5	68.8 Mbps	11.5
57	802.11ax20	2462	11	MCS5	68.8 Mbps	11.0
58	802.11ax20 RU26_Mid	2412	1	MCS5	68.8 Mbps	11.5
59	802.11ax20 RU26_Mid	2437	6	MCS5	68.8 Mbps	14.5
60	802.11ax20 RU26_Mid	2462	11	MCS5	68.8 Mbps	11.0
61	802.11b	2412	1	BPSK	1 Mbps	17
62	802.11b	2437	6	BPSK	1 Mbps	17
63	802.11b	2462	11	BPSK	1 Mbps	15.5

* Pre-tests have shown that these data rates and RU modes produced in the worst-case results.

2.10 Operation modes (Bluetooth LE IRIS-W106 – on-board antenna)

Operation mode #	Radio technology*	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate*	Power setting
64	Bluetooth Low Energy	2402	0	GFSK	2 Mbps	14
65	Bluetooth Low Energy	2480	39	GFSK	2 Mbps	14
66	Bluetooth Low Energy	2402	0	GFSK	1 Mbps	14
67	Bluetooth Low Energy	2440	19	GFSK	1 Mbps	14
68	Bluetooth Low Energy	2480	39	GFSK	1 Mbps	14

2.11 Operation modes (802.15.4 IRIS-W106 – on-board antenna)

Operation mode #	Radio technology*	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate*	Power setting
69	802.15.4	2405	11	O-QPSK	250 kb/s	14
70	802.15.4	2440	18	O-QPSK	250 kb/s	14
71	802.15.4	2475	25	O-QPSK	250 kb/s	14
72	802.15.4	2480	26	O-QPSK	250 kb/s	0

3 Additional Information

The EUT was not labeled as required by FCC / IC.
All radiated tests were performed using an unmodified EUT.

This test report contains the results of the WLAN 2.4 GHz mode, Bluetooth low energy mode and 802.15.4 mode only.

Spurious emissions were tested conducted at the antenna port for IRIS-W101 for the worst case modes listed in 2.6 and all modes listed in 2.7 and 2.8 using the worst case antenna gain. Since all emissions were below the limit, the worst case emissions from these tests were tested radiated for the IRIS-W106 and the IRIS-W101 (with terminated antenna port). Test results can be obtained from the laboratory.

4 Overview

Application	Frequency range in MHz	FCC 47 CFR Part 15 section [2]	RSS-247 [4] RSS-Gen [5]	Tested EUT	Status
Maximum peak conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [4]	1	Passed
Maximum average conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [4]	1	Passed
DTS Bandwidth / 99% Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [4]	1	Passed
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [4]	1	Passed
Average Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [4]	1	Passed
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [4]	1, 2	Passed
Maximum unwanted emissions	0.009 – 26,500*	15.247 (d) 15.205 (a) 15.209 (a)	8.9 [5]	1, 2	Passed*
Antenna Requirement	-	15.203 15.247 (b)	6.8 [5] 5.4 (f) (ii) [4]	-	Passed
Conducted emissions on supply line	0.15 – 30	15.207 (a)	8.8 [5]	1, 2	Passed

*: As declared by the applicant the highest radio clock frequency for the 2.4 GHz radio part is 2.462 GHz. Therefore the radiated emission measurement must be carried out up to 10th of the highest radio clock frequency in this case 26.5 GHz. As declared by the applicant the highest emission of the 5 GHz part is 5.865 GHz, therefore the emissions for the 15.407 part are carried out up to 40 GHz.

5 Results

5.1 Test setups

5.1.1 Test setup (radiated)

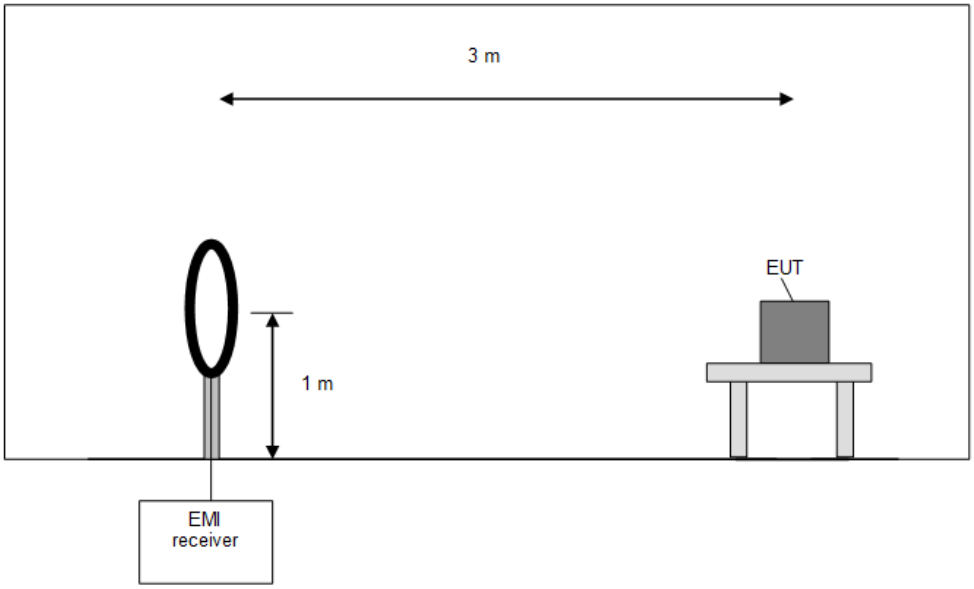
5.1.1.1 Preliminary measurement 9 kHz to 30 MHz

In the first stage a preliminary measurement is performed in an anechoic chamber with a measuring distance of 3 meters. Table-top and portable devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices are placed directly on the turntable / ground plane. The setup of the equipment under test is in accordance to [1].

The frequency range 9 kHz to 30 MHz is monitored with an EMI receiver while the system and its cables are manipulated to find out the configuration with the maximum emission levels if applicable. The EMI receiver is set to MAX hold mode. The EUT and the measuring antenna are rotated around their vertical axis to find the maximum emission levels.

The resolution bandwidth of the EMI receiver is set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Procedure preliminary measurement:

Pre-scans are performed in the frequency range 9 kHz to 150 kHz and 150 kHz to 30 MHz.
The following procedure is used:

1) Monitor the frequency range with the measuring antenna facing the EUT and an EUT / turntable azimuth of 0 °.
2) Manipulate the system cables to produce the maximum levels of emissions.
3) Rotate the EUT by 360 ° to maximize the detected signals.
4) Measure the frequencies of the highest detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency values.
5) If the EUT is portable or ceiling mounted, repeat steps 1 to 4 with other orientations (x,y,z) of the EUT.
6) Rotate the measuring antenna and repeat steps 1 to 5.

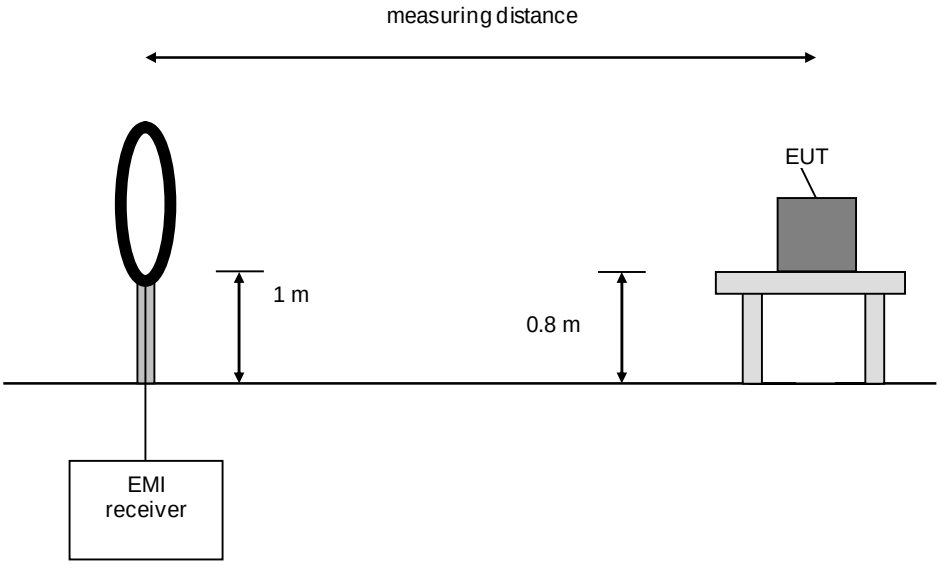
5.1.1.2 Final measurement 9 kHz to 30 MHz

In the second stage a final measurement is performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m or 30 m. In the case where larger measuring distances are required the results are extrapolated based on the values measured on the closer distances according to section 15.31 (f) (2) [2]. The final measurement is performed with an EMI receiver set to Quasi-Peak detector, except for the frequency bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where an Average detector is used according section 15.209 (d) [2].

At the frequencies, which were detected during the preliminary measurements, the final measurement is performed while rotating the EUT and the measuring antenna in the range of 0 ° to 360 ° around their vertical axis until the maximum level value is found.

The resolution bandwidth of the EMI receiver is set to the following values:

Frequency range	Resolution bandwidth
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



Procedure final measurement:

The following procedure is used:

1) Monitor the selected frequencies from the preliminary measurement with the measuring antenna facing the EUT and an EUT azimuth of 0 °.
2) Rotate the EUT by 360 ° to maximize the detected signals.
3) Rotate the measuring antenna and repeat steps 1 to 2 until the maximum value is found and note it.
4) If the EUT is portable or ceiling mounted, repeat steps 1 to 3 with other orientations (x,y,z) of the EUT.

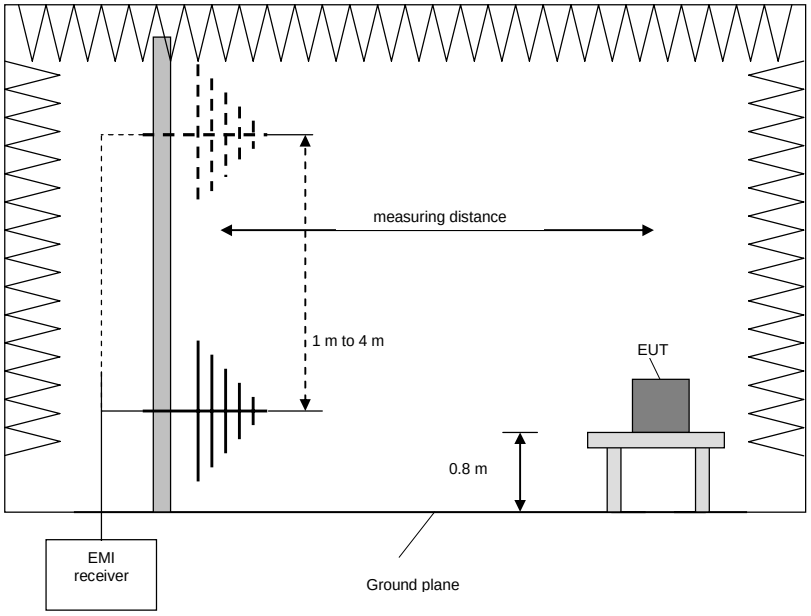
5.1.1.3 Preliminary and final measurement 30 MHz to 1 GHz

The preliminary and final measurements are performed in a semi-anechoic chamber with a metal ground plane in a 3 m distance. Table-top and portable devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm. Floor-standing devices are placed directly on the turntable / ground plane.

During the tests the EUT is rotated in the range of 0° to 360°, the measuring antenna is set to horizontal and vertical polarization and raised and lowered in the range from 1 m to 4 m to find the maximum level of emissions.

The resolution bandwidth of the EMI Receiver is set to the following values:

Test	Frequency range	Step-size	Resolution bandwidth	Detector
Preliminary measurement	30 MHz to 1 GHz	30 kHz	120 kHz	Peak Average
Frequency peak search	± 120 kHz	10 kHz	120 kHz	Peak
Final measurement	30 MHz to 1 GHz	-	120 kHz	QuasiPeak



Procedure preliminary measurement:

The following procedure is used:

1) Set the measuring antenna to 1 m height.
2) Monitor the frequency range at horizontal polarization of the measuring antenna and an EUT / turntable azimuth of 0 °.
3) Rotate the EUT by 360° to maximize the detected signals.
4) Repeat steps 2 to 3 with the vertical polarization of the measuring antenna.
5) Increase the height of the measuring antenna for 0.5 m and repeat steps 2 to 4 until the final height of 4 m is reached.
6) The highest values for each frequency are saved by the software, including the measuring antenna height and polarization and the turntable azimuth for that value.

Procedure final measurement:

The following procedure is used:

1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
2) The software determines the exact peak frequencies by doing a partial scan with reduced step size of the pre-scan of the selected peaks.
3) If the EUT is portable or ceiling mounted, find the worst-case EUT orientation (x,y,z) for the final test.
4) The worst-case measuring antenna height is found via varying the height by +/- 0.5 m from the value obtained in the preliminary measurement while monitoring the emission level.
5) The worst-case turntable position is found via varying the turntable azimuth by +/- 30° from the value obtained in the preliminary measurement while monitoring the emission level.
6) The final measurement is performed at the worst-case measuring antenna height and the worst-case turntable azimuth.
7) Steps 2 to 6 are repeated for each frequency peak selected in step 1.

5.1.1.4 Preliminary and final measurement > 1 GHz (Normal procedure 6.6.4 in [1])

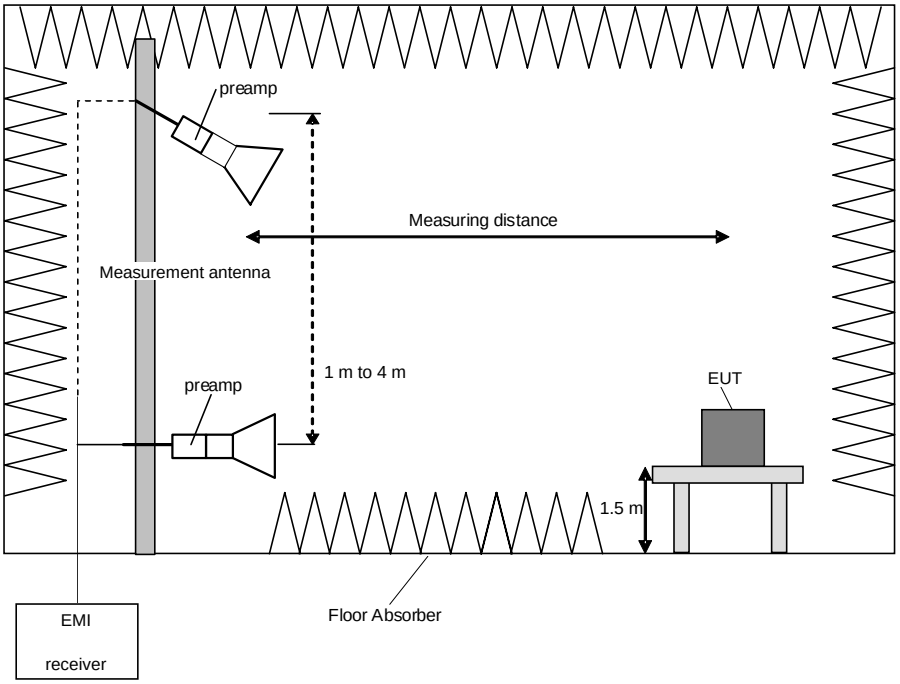
This measurement will be performed in a fully anechoic chamber or in a semi-anechoic chamber with ground absorbers between antenna and EUT. Tabletop and portable devices will set up on a non-conducting turn device on the height of 1.5m. Floor standing devices will be placed directly on the turntable. The set-up of the Equipment under test will be in accordance to [1].

Preliminary measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending on the frequency range of the used antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 1 MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated with antenna-height-steps of 50 cm starting from 1 m up to 4m. When the EUT is manipulated through three different orientations, the scan height upper range for the measurement antenna is limited to 2.5 m or 0.5 m above the top of the EUT, whichever is higher. At the different height positions, the EUT is always directed at the EUT.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure preliminary measurement:

Pre-scans were performed in the frequency range 1 to 40 GHz.
The following procedure will be used:

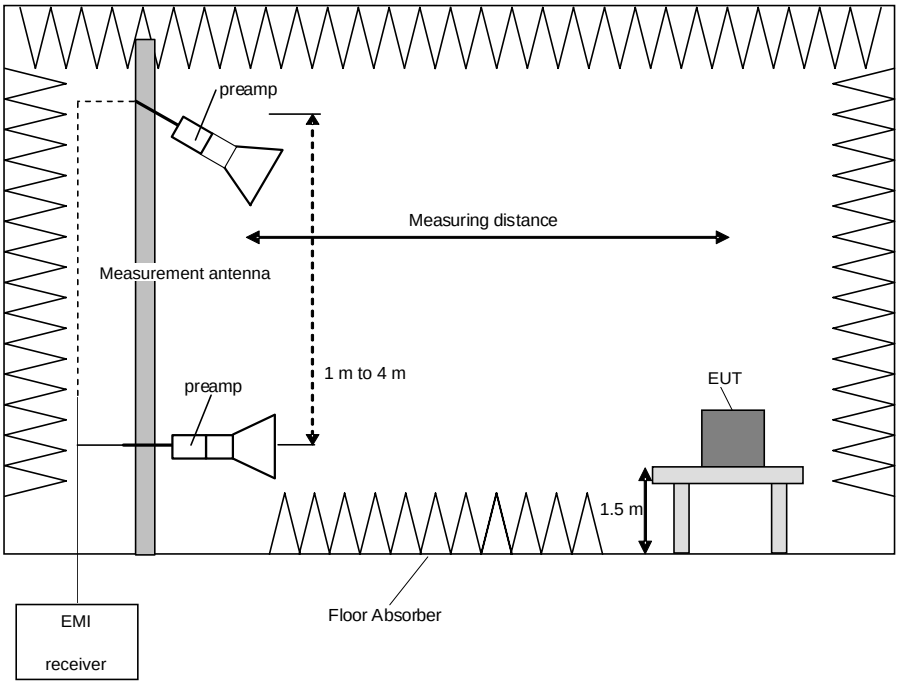
1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarisation and a EUT azimuth of 0 °.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat steps 1. and 2. with the horizontal polarisation of the measuring antenna.
5. Increase the height of the antenna for 0.5 m and repeat steps 2 – 4 until the final height of 4 m is reached. (If the EUT is tested in 3 orientations, the maximum height is 2.5 m or or 0.5 m above the top of the EUT, whichever is higher.)
6. The highest values for each frequency will be saved by the software, including the antenna height, measurement antenna polarization and turntable azimuth for the for each frequency step.

Final measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending on the frequency range of the used antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 25 /26.5 GHz and 26.5 GHz to 40 GHz.

The following procedure is used:

1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst case EUT orientation (x,y,z) for the final test.
4. The worst measurement antenna height is found by the measurement software by varying the measurement antenna height by +/- 0.5 m from the worst-case value obtained in the preliminary measurement, and to monitor the emission level.
5. The worst azimuth turntable position is found by varying the turntable azimuth by +/- 30° from the worst-case value obtained in the preliminary measurement, and to monitor the emission level.
6. The final measurement is performed at the worst-case antenna height and the worst case turntable azimuth.
7. Steps 2 – 6 will be repeated for each frequency peak selected in step 1.

5.1.1.5 Preliminary and final measurement > 1 GHz (Alternative procedure 6.6.5 in [1])

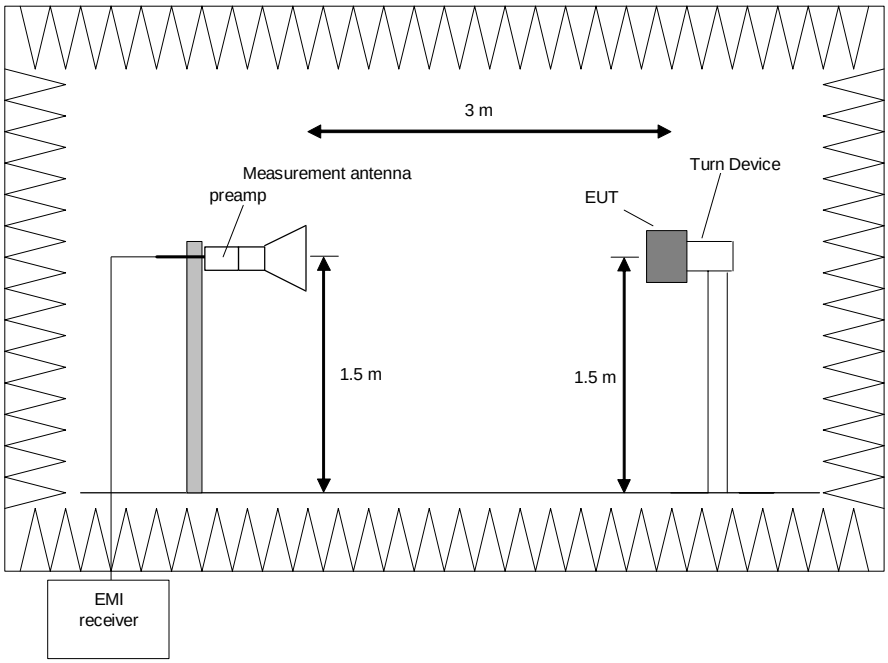
This measurement will be performed in a fully anechoic chamber or in a semi-anechoic chamber with ground absorbers between antenna and EUT. Tabletop and portable devices will set up on a non-conducting turn device on the height of 1.5m. The set-up of the Equipment under test will be in accordance to [1]. Devices with any dimension larger than the beamwidth of the measurement antenna are not suitable for testing with this method; such devices shall be evaluated as tabletop equipment (see procedure 5.1.1.4 above).

Preliminary measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending on the frequency range of the used antenna. The spectrum analyser set to MAX Hold mode and a resolution bandwidth of 1 MHz. The measurement will be performed in horizontal and vertical polarisation of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 ° to 360 °. This measurement is repeated after raising the EUT in 30° steps according to 6.6.5.4 in [1].

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure preliminary measurement:

Pre-scans were performed in the frequency range 1 to 40 GHz.
The following procedure will be used:

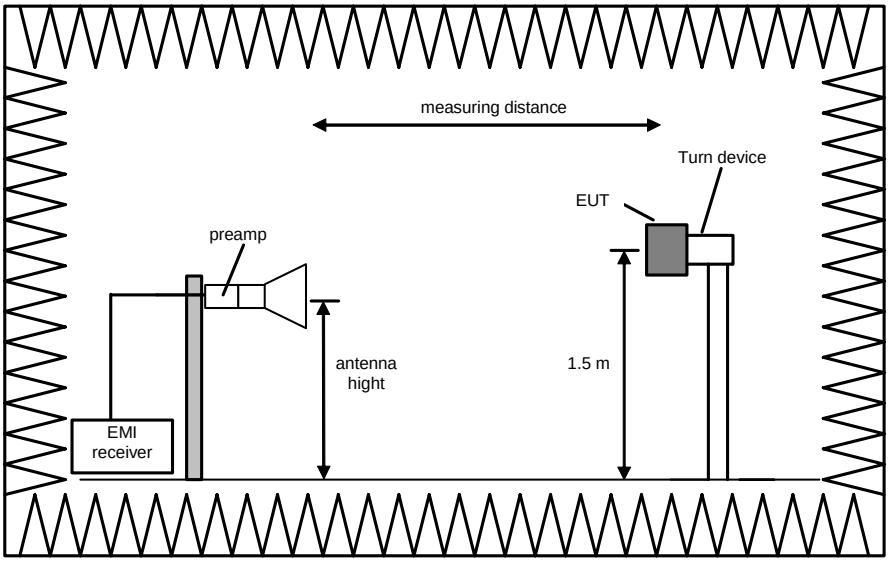
1. Monitor the frequency range at horizontal polarisation and a EUT azimuth of 0 °.
2. Rotate the EUT by 360° to maximize the detected signals.
3. Repeat 1) to 2) with the vertical polarisation of the measuring antenna.
4. Make a hardcopy of the spectrum.
5. Repeat 1) to 4) with the EUT raised by an angle of 30° (60°, 90°, 120° and 150°) according to 6.6.5.4 in [1].
6. Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
7. The measurement antenna polarisation, with the according EUT position (Turntable and Turn device) which produces the highest emission for each frequency will be used for the final measurement. The six closest values to the applicable limit will be used for the final measurement.

Final measurement (1 GHz to 40 GHz)

The frequency range will be divided into different sub ranges depending on the frequency range of the used antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1 MHz. The measurement will be performed by rotating the turntable through 0 to 360° in the worst-case EUT orientation which was obtained during the preliminary measurements.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Procedure of measurement:

The measurements were performed in the frequency ranges 1 GHz to 4 GHz, 4 GHz to 12 GHz, 12 GHz to 18 GHz, 18 GHz to 25 /26.5 GHz and 26.5 GHz to 40 GHz.
The following procedure will be used:

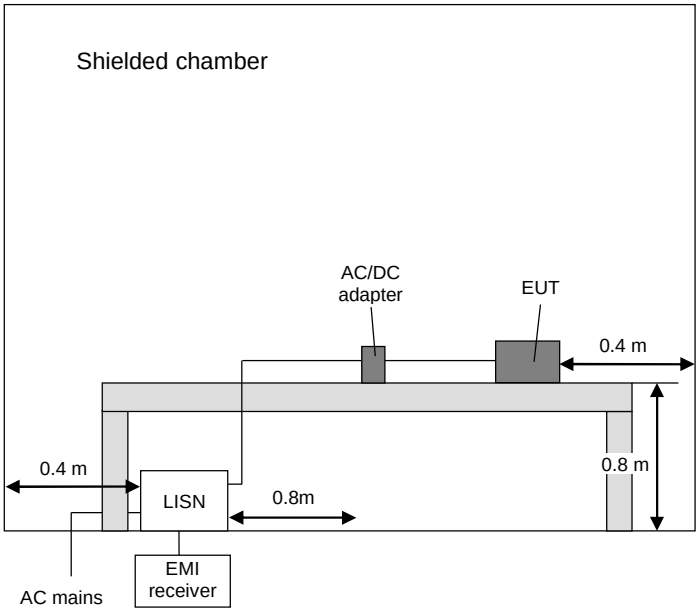
1) Set the turntable and the turn device to obtain the worst-case emission for the first frequency identified in the preliminary measurements.
2) The worst-case turntable position is found via varying the turntable azimuth by +/- 30° from the value obtained in the preliminary measurement while monitoring the emission level.
3) Set the measurement antenna polarisation to the orientation with the highest emission for the first frequency identified in the preliminary measurements.
4) Set the spectrum analyser to EMI mode with peak and average detector activated.
5) Rotate the turntable from 0° to 360° to find the TT Pos. that produces the highest emissions.
6) Note the highest displayed peak and average values
7) Repeat the steps 1) to 5) for each frequency detected during the preliminary measurements.

5.1.1 Conducted: AC power line

The test is carried out in a shielded chamber. Table-top devices are set up on a non-conducting support with a size of 1 m by 1.5 m and a height of 80 cm above the ground plane. Floor-standing devices are placed directly on the ground plane. In case of DC powered equipment, which is not exclusively powered by a battery, it is connected to the LISN via a suitable AC/DC adaptor. The setup of the equipment under test is in accordance with [1].

The frequency range 150 kHz to 30 MHz is measured with an EMI receiver set to MAX hold mode with Peak and Average detectors and a resolution bandwidth of 9 kHz. A scan is carried out on the phase and neutral line of the AC mains network. If emissions less than 10 dB below the appropriable limit are detected, these emissions are measured with an Average and Quasi-Peak detector on all lines.

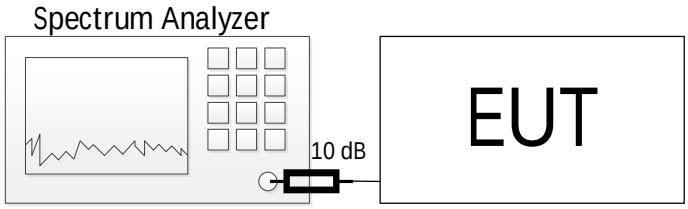
Frequency range	Resolution bandwidth	Measuring time
150 kHz to 30 MHz	9 kHz	5 s



5.1.2 Test setup (conducted)

Test setup (conducted)		
Used	Antenna connector	Comment
☐	Temporary antenna connector*1	As provided by the applicant
☒	Normal antenna connector*2	

*1 for the internal antenna, a temporary antenna connector was used for the conducted tests
*2 for the external antenna, the normal antenna connector was used for the conducted tests



The 10 dB external attenuation is considered in all relevant plots

5.2 Duty Cycle

5.2.1 Test setup (Duty cycle)

Test setup			
Used	Setup	See sub-clause	Comment
☐	Test setup (radiated – normal procedure)	5.1.1.4	-
☐	Test setup (radiated – alternative procedure)	5.1.1.5	-
☒	Test setup (antenna port conducted)	5.1.2	-

5.2.2 Test method (Duty cycle)

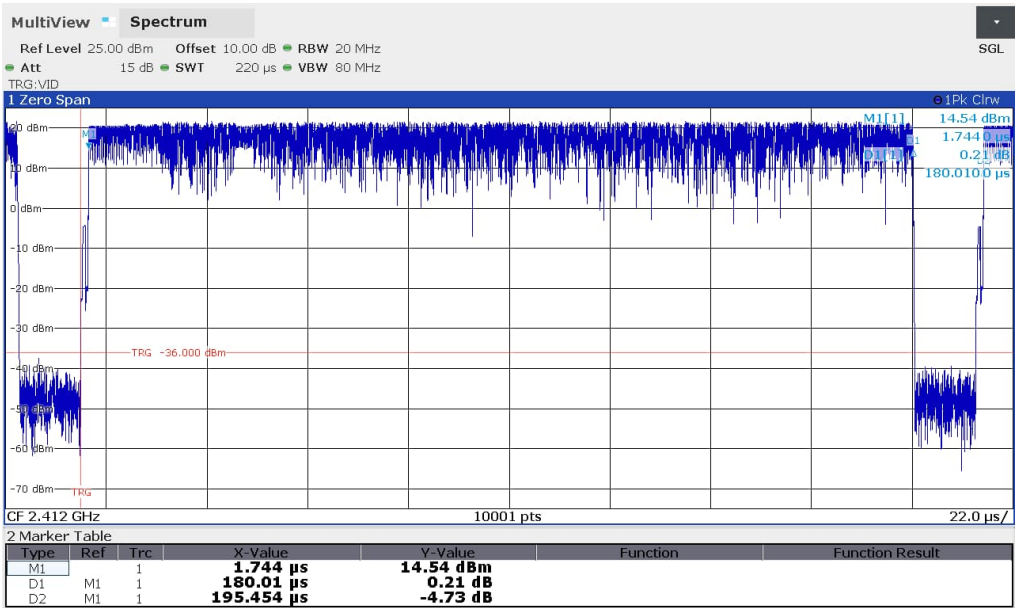
Test method (Duty cycle)				
Used	Sub-Clause [6]	Name of method	Applicability	Comment
☐	II B. 2. a)	Diode detector	No limitation	-
☒	II B. 2. b)	Zero span (analyzer or EMI receiver)	No limitation	-

5.2.3 Test results (Duty cycle – 802.11 IRIS-W101 – antenna port)

Ambient temperature:	22 °C
Relative humidity:	37 %

Date	16.11.2023
Tested by	P. NEUFELD

Worst-case plot (IEEE 802.11ax20 MCS5):



Radio technology	TX_{On} [µs]	TX_{Cycle} [µs]	RBW [MHz]	50/T [kHz]	50/T < RBW?
IEEE 802.11b 1Mbps	8625	8635	20	5.797	☒ Yes
IEEE 802.11b 11Mbps	959	969	20	52.138	☒ Yes
IEEE 802.11g 6Mbps	1432	1447	20	34.916	☒ Yes
IEEE 802.11g 9Mbps	960	975	20	52.083	☒ Yes
IEEE 802.11g 12Mbps	728	744	20	68.681	☒ Yes
IEEE 802.11n20 MCS0	1340	1356	20	37.313	☒ Yes
IEEE 802.11n20 MCS3	472	488	20	105.932	☒ Yes
IEEE 802.11ax20 MCS0	1045	1060	20	47.847	☒ Yes
IEEE 802.11ax20 MCS5	180	196	20	277.778	☒ Yes

Operation Mode #	Sweep points	Sweep time [µs]	Meas points For TX_{On}	Meas points >100?	Duty cycle %	DCCF Power [dB]	DCCF Voltage [dB]
IEEE 802.11b 1Mbps	10001	9000	9584	☒ Yes	99.88	-*	-*
IEEE 802.11b 11Mbps	10001	1000	9591	☒ Yes	98.97	-*	-*
IEEE 802.11g 6Mbps	10001	1550	9240	☒ Yes	98.96	-*	-*
IEEE 802.11g 9Mbps	10001	1050	9144	☒ Yes	98.46	-*	-*
IEEE 802.11g 12Mbps	10001	800	9101	☒ Yes	97.85	0.1	0.2
IEEE 802.11n20 MCS0	10001	1400	9572	☒ Yes	98.82	-*	-*
IEEE 802.11n20 MCS3	10001	520	9078	☒ Yes	96.72	0.1	0.3
IEEE 802.11ax20 MCS0	10001	1100	9501	☒ Yes	98.58	-*	-*
IEEE 802.11ax20 MCS5	10001	220	8183	☒ Yes	91.84	0.4	0.7

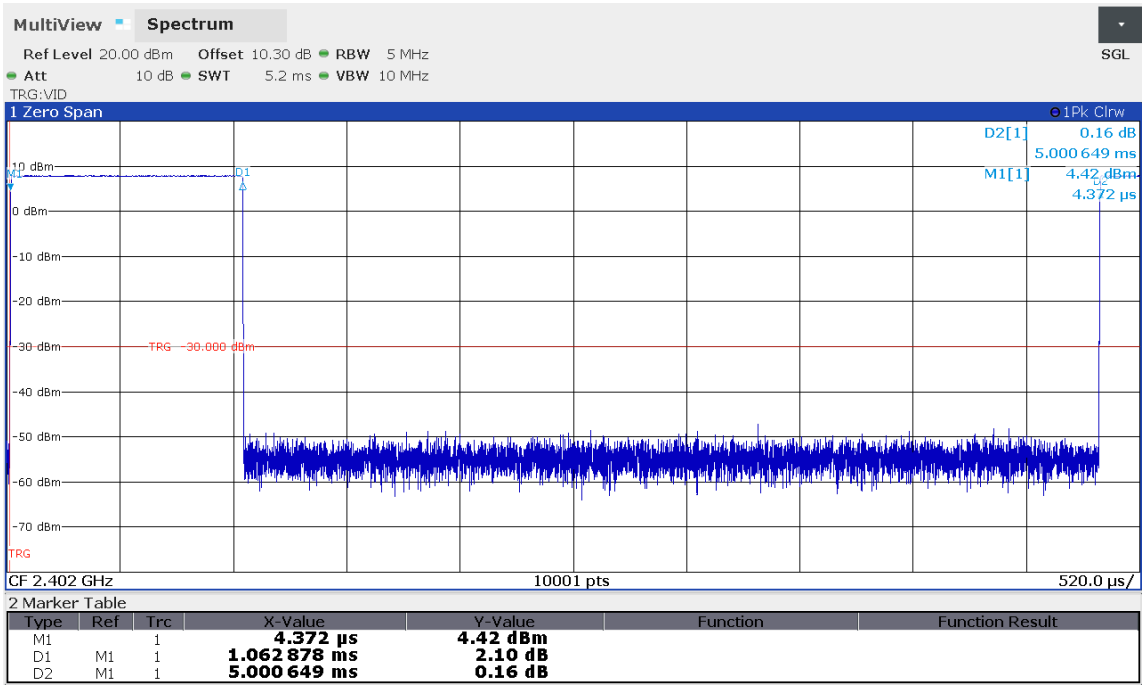
* No duty cycle correction necessary because the duty cycle is above 98%. See 11.9.2.1 in [1] for details.

5.2.4 Test results (Duty cycle – Bluetooth LE IRIS-W101 – antenna port)

Ambient temperature:	22 °C
Relative humidity:	43 %

Date	20.11.2023
Tested by	P. NEUFELD

Worst-case plot (BT LE 500 kbps):



Radio technology	TX_{On} [µs]	TX_{Cycle} [µs]	RBW [MHz]	50/T [kHz]	50/T < RBW?
BT LE 1 Mbps	385	625	5	129.870	☒ Yes
BT LE 2 Mbps	203	627	5	246.305	☒ Yes
BT LE 500 kbps	1063	5001	5	47.037	☒ Yes
BT LE 125 kbps	3098	3751	5	16.139	☒ Yes

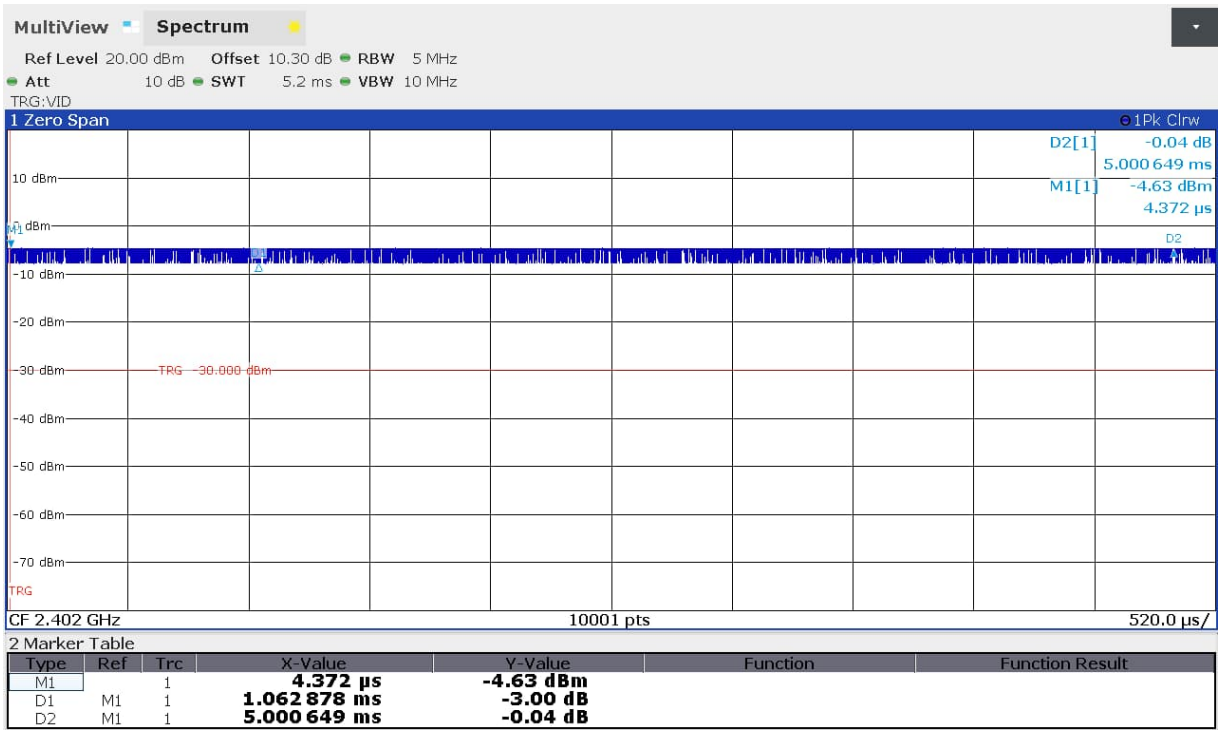
Operation Mode #	Sweep points	Sweep time [µs]	Meas points For TX_{On}	Meas points >100?	Duty cycle %	DCCF Power [dB]	DCCF Voltage [dB]
BT LE 1 Mbps	10001	660	5834	☒ Yes	61.60	2.1	4.2
BT LE 2 Mbps	10001	660	3076	☒ Yes	32.38	4.9	9.8
BT LE 500 kbps	10001	5200	2044	☒ Yes	21.26	6.7	13.5
BT LE 125 kbps	10001	3900	7944	☒ Yes	82.59	0.8	1.7

The DCCF (duty cycle correction factor) is calculated by:

$$DCCF_{Power} = 10 * log_{10}\left(\frac{1}{Duty\ cycle}\right)$$

$$DCCF_{Fieldstrength} = 20 * log_{10}\left(\frac{1}{Duty\ cycle}\right)$$

5.2.5 Test results (Duty cycle – 802.15.4 IRIS-W101 – antenna port)



No DCCF for 802.15.4 necessary, because the EUT transmits with a duty cycle of 100% without pauses.

Test equipment (please refer to chapter 7 for details)
1

5.3 DTS bandwidth

5.3.1 Test setup (DTS bandwidth)

Test setup			
Used	Setup	See sub-clause	Comment
☐	Test setup (radiated – normal procedure)	5.1.1.4	-
☐	Test setup (radiated – alternative procedure)	5.1.1.5	-
☒	Test setup (antenna port conducted)	5.1.2	-

5.3.2 Test method (DTS bandwidth)

Test method (Maximum peak conducted output power)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	11.8.1	Option 1	No limitations	-
☐	11.8.2	Option 2	No limitations	6 dB down function

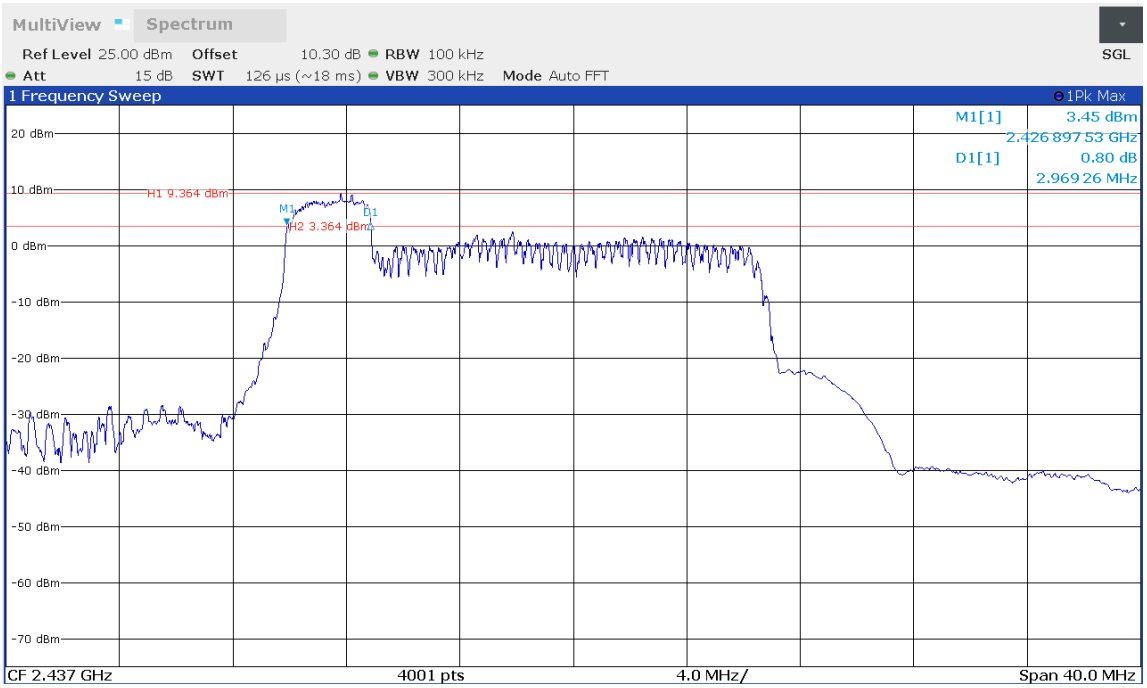
5.3.3 Test results (DTS bandwidth)

5.3.3.1 DTS bandwidth (802.11 IRIS-W101 – antenna port):

Ambient temperature:	21 - 22 °C
Relative humidity:	27 - 43 %

Date	20.11 – 08.12.2023
Tested by	P. Neufeld

Worst case plot (operation mode 38):



Operation mode #	DTS bandwidth [MHz]	Minimum DTS bandwidth Limit [MHz]	Result
1	10.087478	0.5	Passed
2	10.077481	0.5	Passed
3	10.067483	0.5	Passed
7	16.465884	0.5	Passed
8	16.365909	0.5	Passed
9	16.425894	0.5	Passed
16	17.585604	0.5	Passed
17	17.575606	0.5	Passed
18	17.575606	0.5	Passed
22	18.275431	0.5	Passed
23	18.075481	0.5	Passed
24	18.525369	0.5	Passed
37	3.169208	0.5	Passed
38	**2.969258**	0.5	Passed
39	11.317171	0.5	Passed

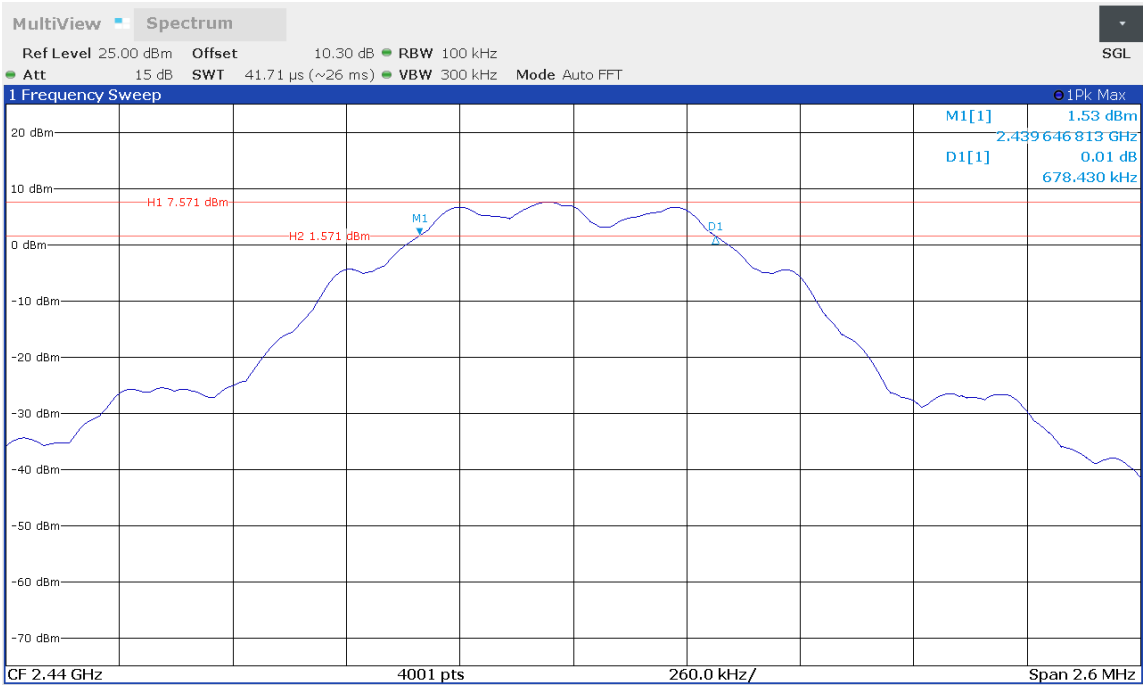
Test: Passed

5.3.3.2 DTS bandwidth (Bluetooth LE IRIS-W101 – antenna port):

Ambient temperature	22 °C
Relative humidity:	32 - 41 %

Date	23.11.2024 + 24.11.2023
Tested by	P. Neufeld

Worst case plot (operation mode 50):

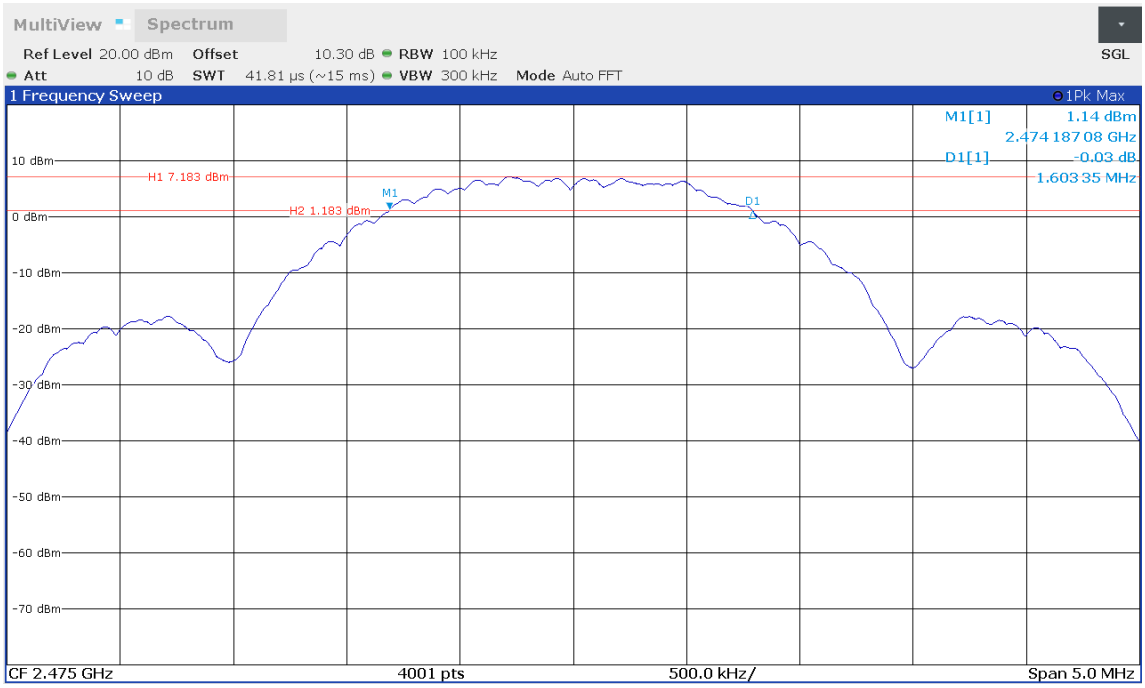


Operation mode #	DTS Bandwidth [MHz]	Minimum DTS bandwidth Limit [MHz]	Result
40	0.751862	0.5	Passed
41	0.755111	0.5	Passed
42	0.727818	0.5	Passed
43	1.269283	0.5	Passed
44	1.352062	0.5	Passed
45	1.257786	0.5	Passed
46	0.738865	0.5	Passed
47	0.713522	0.5	Passed
48	0.744064	0.5	Passed
49	0.684279	0.5	Passed
50	**0.678430**	0.5	Passed
51	0.684929	0.5	Passed

Test: Passed

5.3.3.1 DTS bandwidth (802.15.4 IRIS-W101 – antenna port):

Worst case plot (operation mode 54):



Operation mode #	DTS Bandwidth [MHz]	Minimum DTS bandwidth Limit [MHz]	Result
52	1.625844	0.5	Passed
53	1.624594	0.5	Passed
54	**1.603349**	0.5	Passed
55	1.607098	0.5	Passed

Test: Passed

Test equipment (please refer to chapter 7 for details)
1

5.4 Transmit Antenna Performance considerations (WLAN)

Test setup (Transmit antenna performance considerations)			
Integral and/or dedicated antenna	Antenna gain ≥ 6dBi	Result	Comment
☒	☐	Passed	No output power reduction necessary

5.5 Transmit Antenna Performance considerations (Bluetooth LE)

Test setup (Transmit antenna performance considerations)			
Integral and/or dedicated antenna	Antenna gain ≥ 6dBi	Result	Comment
☒	☐	Passed	No output power reduction necessary

5.6 Transmit Antenna Performance considerations (802.15.4)

Test setup (Transmit antenna performance considerations)			
Integral and/or dedicated antenna	Antenna gain ≥ 6dBi	Result	Comment
☒	☐	Passed	No output power reduction necessary

5.7 Occupied bandwidth – power bandwidth (99%)

5.7.1 Test Setup (Occupied bandwidth – power bandwidth (99%))

Test setup			
Used	Setup	See sub-clause	Comment
☐	Test setup (radiated – normal procedure)	5.1.1.4	-
☐	Test setup (radiated – alternative procedure)	5.1.1.5	-
☒	Test setup (antenna port conducted)	5.1.2	-

5.7.2 Test method (Occupied bandwidth – power bandwidth (99%))

Test method (Maximum peak conducted output power)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☐	6.9.2	relative measurement procedure		n-dB down
☒	6.9.3	power bandwidth (99%)	*1	99% power function

*1 See RSS-GEN Issue 5 (2018-05) sub-clause 6.7 for details.

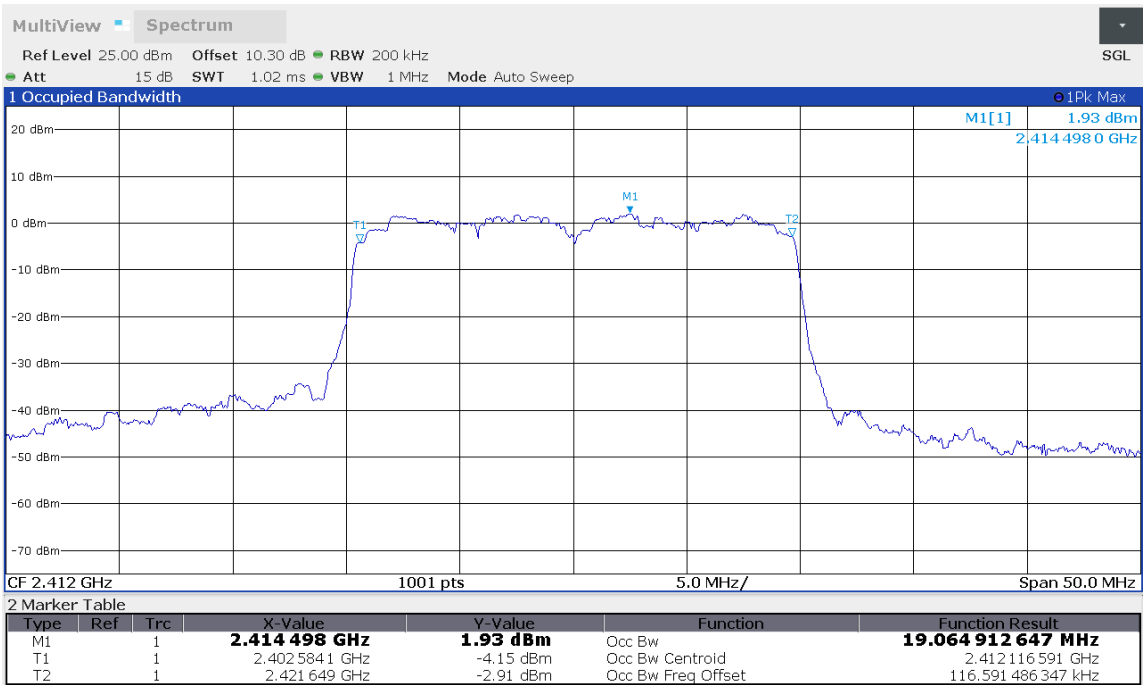
5.7.3 Test results (Occupied bandwidth – power bandwidth (99%))

5.7.3.1 Occupied bandwidth (802.11 IRIS-W101 – antenna port):

Ambient temperature:	21 - 22 °C
Relative humidity:	27 - 43 %

Date	20.11.2023 – 08.12.2023
Tested by	P. Neufeld

Worst case plot (operation mode 28):



Operation mode #	99% bandwidth [MHz]
1	13.182241
2	13.208115
3	13.250750
13	18.836331
14	18.846223
15	18.837102
19	18.836207
20	18.849580
21	18.846311
25	18.831937
26	18.839441
27	18.853573
28	**19.064913**
29	18.873970
30	18.948996

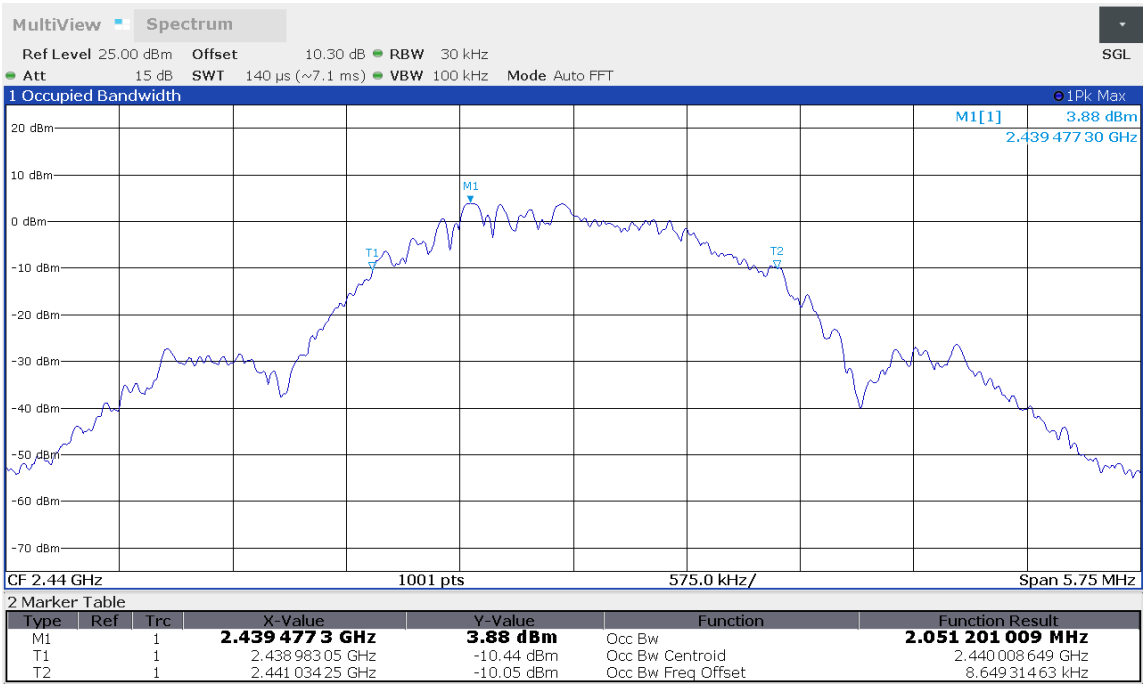
Test: Passed

5.7.3.2 Occupied bandwidth (Bluetooth LE IRIS-W101 – antenna port):

Ambient temperature	22 °C
Relative humidity:	32 - 41 %

Date	23.11.2023 + 24.11.2023
Tested by	P. Neufeld

Worst case plot (operation mode 47):



Operation mode #	99% bandwidth [MHz]
40	1.0325090
41	1.0314980
42	1.0342130
43	2.0498370
44	**2.0512010**
45	2.0490840
46	1.0262450
47	1.0276080
48	1.0270930
49	1.0670280
50	1.0725940
51	1.0696950

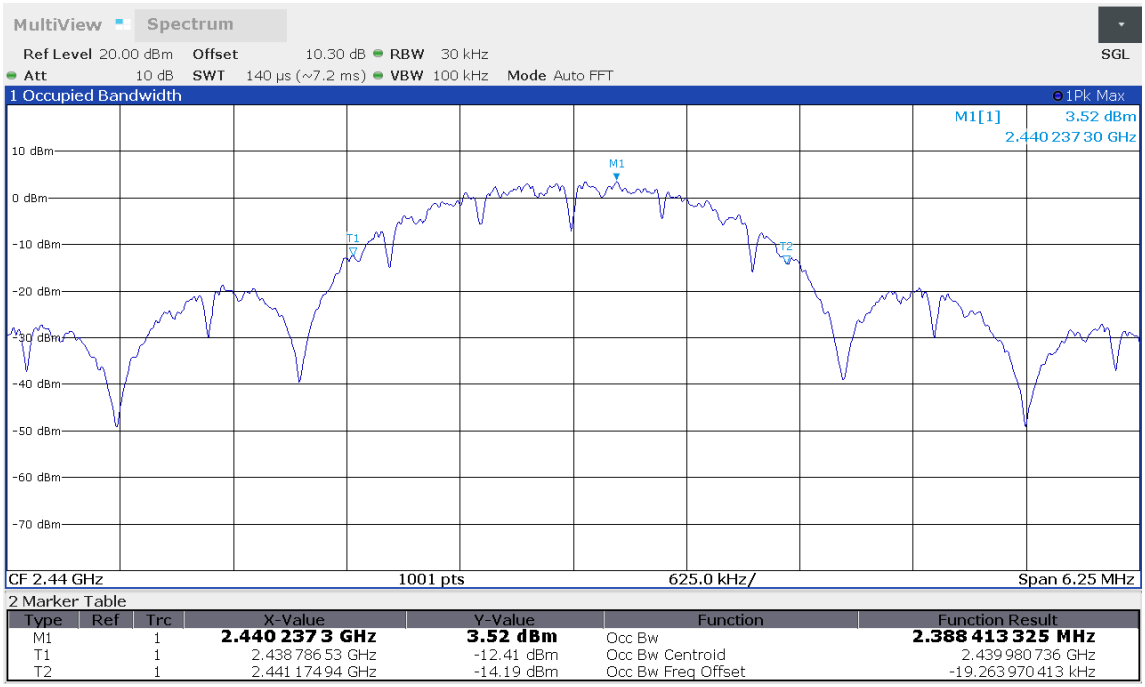
Test: Passed

5.7.3.1 Occupied bandwidth (802.15.4 IRIS-W101 – antenna port):

Ambient temperature	21 °C
Relative humidity:	25 %

Date	22.11.2023
Tested by	P. Neufeld

Worst case plot (operation mode 53):



Operation mode #	99% bandwidth [MHz]
52	2.386839
53	**2.388413**
54	2.257277
55	2.255414

Test: Passed

Test equipment (please refer to chapter 7 for details)
1

5.8 DTS transmitter output power

5.8.1 Test setup (DTS transmitter output power)

Test setup			
Used	Setup	See sub-clause	Comment
☐	Test setup (radiated – normal procedure)	5.1.1.4	-
☐	Test setup (radiated – alternative procedure)	5.1.1.5	-
☒	Test setup (antenna port conducted)	5.1.2	-

5.8.2 Test method (DTS transmitter output power)

Test method (Maximum (peak) conducted output power)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☐	11.9.1.1	RBW ≥ DTS bandwidth	For BLE tests	
☐	11.9.1.2	Integrated band power method	Not for DTS	-
☐	11.9.1.3	PKPM1 Peak power meter method*1	For 802.11 tests	-

*1 VBW of the peak power meter must be > OBW of the fundamental.

Test method (Maximum (average) conducted output power)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	11.9.2.2.2	Method AVGSA-1	D ≥ 98%	
☐	11.9.2.2.3	Method AVGSA-1A (alternative)	D ≥ 98%	-
☐	11.9.2.2.4	Method AVGSA-2	Constant D (±2%)	-
☐	11.9.2.2.5	Method AVGSA-2A (alternative)	Constant D (±2%)	-
☐	11.9.2.2.6	Method AVGSA-3A		-
☐	11.9.2.2.7	Method AVGSA-3A (alternative)		-
☐	11.9.2.3.1	Method AVGPM	Constant D (±2%)	-
☐	11.9.2.3.2	Method AVGPM-G		-

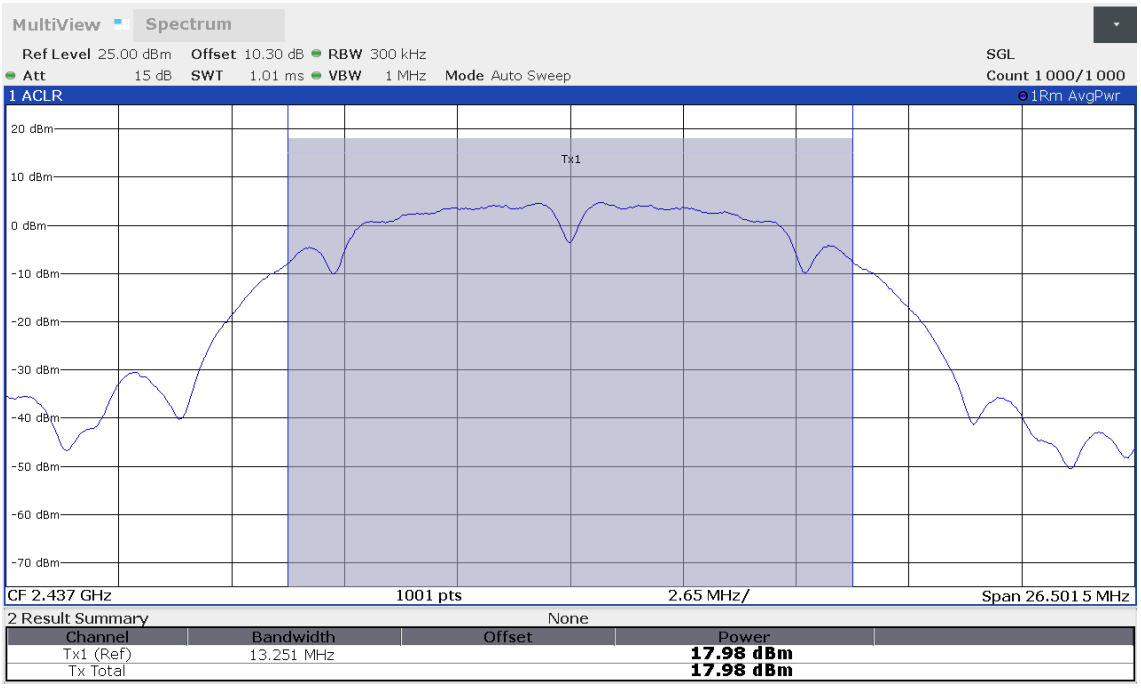
5.8.3 Test results (DTS transmitter output power)

5.8.3.1 Average conducted output power (802.11 IRIS-W101 – antenna port):

Ambient temperature:	21 - 22 °C
Relative humidity:	27 - 43 %

Date	20.11.2023 – 08.12.2023
Tested by	P. Neufeld

Worst-case plot (operation mode 2):



Calculations:
Result Cond. [dBm]= Reading [dBm] + DCCF [dB] + Ext. Att. [dB]

Operation mode	Reading [dBm]	DCCF [dB]	Ext. Att.* [dB]	Cond. [dBm]	Limit [dBm]
1	17.2	0.0	0.0	17.2	30.0
2	**18.0**	0.0	0.0	**18.0**	30.0
3	16.1	0.0	0.0	16.1	30.0
7	13.4	0.0	0.0	13.4	30.0
8	16.1	0.0	0.0	16.1	30.0
9	13.0	0.0	0.0	13.0	30.0
16	10.8	0.0	0.0	10.8	30.0
17	15.6	0.0	0.0	15.6	30.0
18	10.7	0.0	0.0	10.7	30.0
22	10.9	0.0	0.0	10.9	30.0
23	15.7	0.0	0.0	15.7	30.0
24	10.8	0.0	0.0	10.8	30.0
31	10.5	0.0	0.0	10.5	30.0
32	14.6	0.0	0.0	14.6	30.0
33	10.9	0.0	0.0	10.9	30.0

* The external attenuation of the external attenuator and the measurement cable is already taken into account with the reference level offset of 10.3 dB in the spectrum analyzer plot, which represents the attenuation of the 10 dB external attenuator and 0.3 dB for the measurement cable.

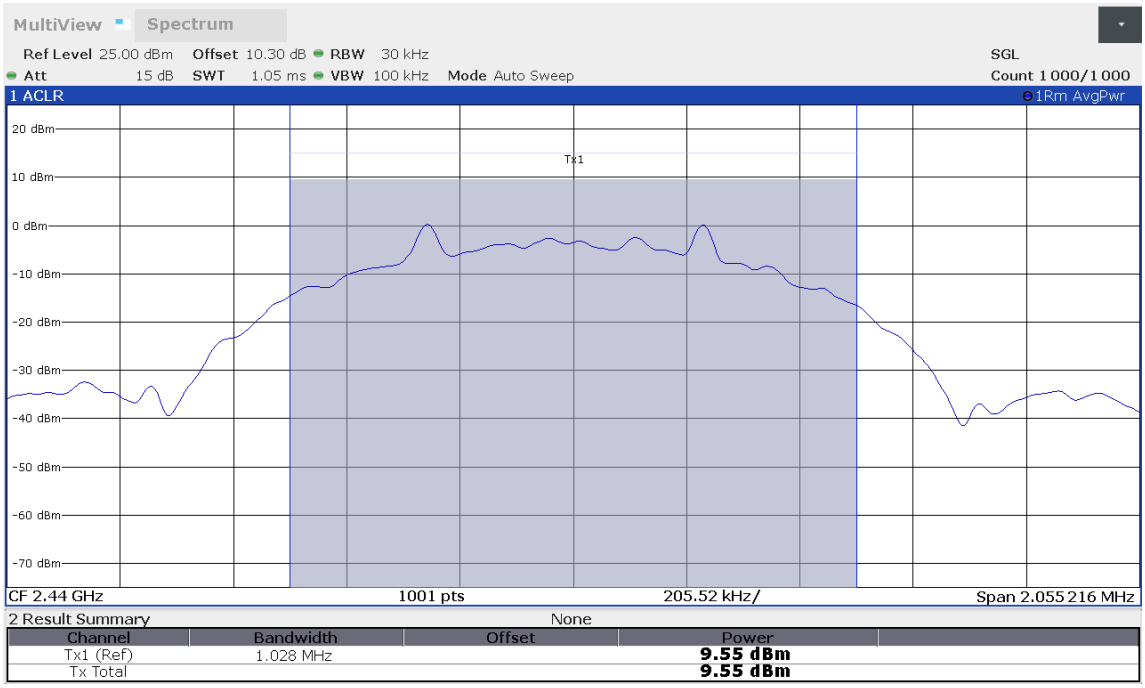
Maximum conducted output power + Maximum antenna gain = Maximum EIRP
Maximum conducted output power = 18.0 dBm
Maximum antenna gain = 2.37 dBi
Maximum EIRP = 20.37 dBm

5.8.3.2 Average conducted output power (Bluetooth LE IRIS-W101 – antenna port):

Ambient temperature	22 °C
Relative humidity:	32 - 41 %

Date	23.11.2023 + 24.11.2023
Tested by	P. Neufeld

Worst-case plot (operation mode 43):



Calculations:
Result Cond. [dBm]= Reading [dBm] + DCCF [dB] + Ext. Att. [dB]

Operation mode	Reading [dBm]	DCCF [dB]	Ext. Att.* [dB]	Cond. [dBm]	Limit [dBm]
40	10.0	2.1	0.0	12.1	30.0
41	9.3	2.1	0.0	11.4	30.0
42	8.5	2.1	0.0	10.6	30.0
43	7.3	4.9	0.0	12.2	30.0
44	6.5	4.9	0.0	11.4	30.0
45	5.6	4.9	0.0	10.5	30.0
46	7.0	6.7	0.0	13.7	30.0
47	**9.6**	6.7	0.0	**16.3**	30.0
48	9.0	6.7	0.0	15.7	30.0
49	10.0	0.8	0.0	10.8	30.0
50	9.4	0.8	0.0	10.2	30.0
51	8.8	0.8	0.0	9.6	30.0

* The external attenuation of the external attenuator and the measurement cable is already taken into account with the reference level offset of 10.3 dB in the spectrum analyzer plot, which represents the attenuation of the 10 dB external attenuator and 0.3 dB for the measurement cable.

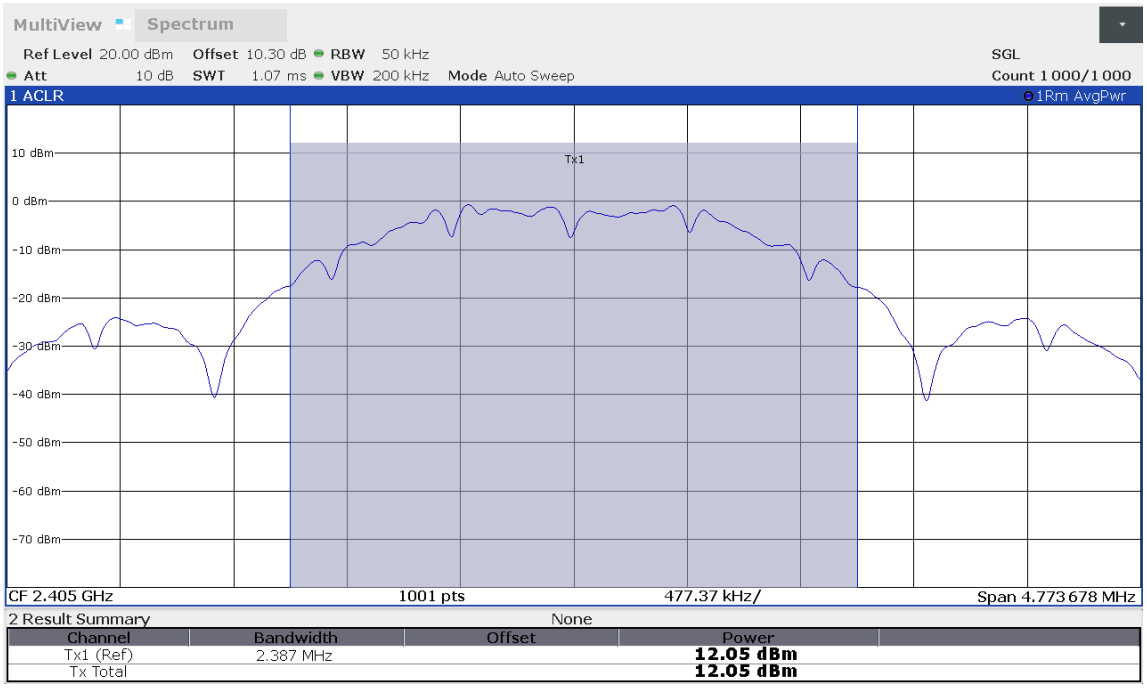
Maximum conducted output power + Maximum antenna gain = Maximum EIRP
Maximum conducted output power = 16.3 dBm
Maximum antenna gain = 2.37 dBi
Maximum EIRP = 18.67 dBm

5.8.3.3 Average conducted output power (802.15.4 IRIS-W101 – antenna port):

Ambient temperature	21 °C
Relative humidity:	25 %

Date	22.11.2023
Tested by	P. Neufeld

Worst-case plot (operation mode 52):



Calculations:
Result Cond. [dBm]= Reading [dBm] + DCCF [dB] + Ext. Att. [dB]

Operation mode	Reading [dBm]	DCCF [dB]	Ext. Att.* [dB]	Cond. [dBm]	Limit [dBm]
52	**12.0**	0.0	0.0	**12.0**	30.0
53	11.4	0.0	0.0	11.4	30.0
54	10.8	0.0	0.0	10.8	30.0
55	-5.0	0.0	0.0	-5.0	30.0

* The external attenuation of the external attenuator and the measurement cable is already taken into account with the reference level offset of 10.3 dB in the spectrum analyzer plot, which represents the attenuation of the 10 dB external attenuator and 0.3 dB for the measurement cable.

Maximum conducted output power + Maximum antenna gain = Maximum EIRP
Maximum conducted output power = 12.0 dBm
Maximum antenna gain = 2.37 dBi
Maximum EIRP = 14.37 dBm

Test: Passed

Test equipment (please refer to chapter 7 for details)
1

5.9 DTS maximum power spectral density

5.9.1 Test setup (DTS maximum PSD level in the fundamental emission)

Test setup			
Used	Setup	See sub-clause	Comment
☐	Test setup (radiated – normal procedure)	5.1.1.4	-
☐	Test setup (radiated – alternative procedure)	5.1.1.5	-
☒	Test setup (antenna port conducted)	5.1.2	-

5.9.2 Test method (DTS maximum PSD level in the fundamental emission)

Test method (Maximum *peak* power spectral density level in the fundamental emission)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☐	11.10.2	Method PKPSD (peak PSD)	No limitations	-

Test method (Maximum *average* power spectral density level in the fundamental emission)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	11.10.3	Method AVGPSD-1	D ≥ 98%	-
☐	11.10.4	Method AVGPSD-1A (alternative)	D ≥ 98%	-
☐	11.10.5	Method AVGPSD-2	Constant D (±2%)	-
☐	11.10.6	Method AVGPSD-2A (alternative)	Constant D (±2%)	-
☐	11.10.7	Method AVGPSD-3	No limitations	-
☐	11.10.8	Method AVGPSD-3A (alternative)	No limitations	-

5.9.3 Test results (DTS maximum PSD level in the fundamental emission)

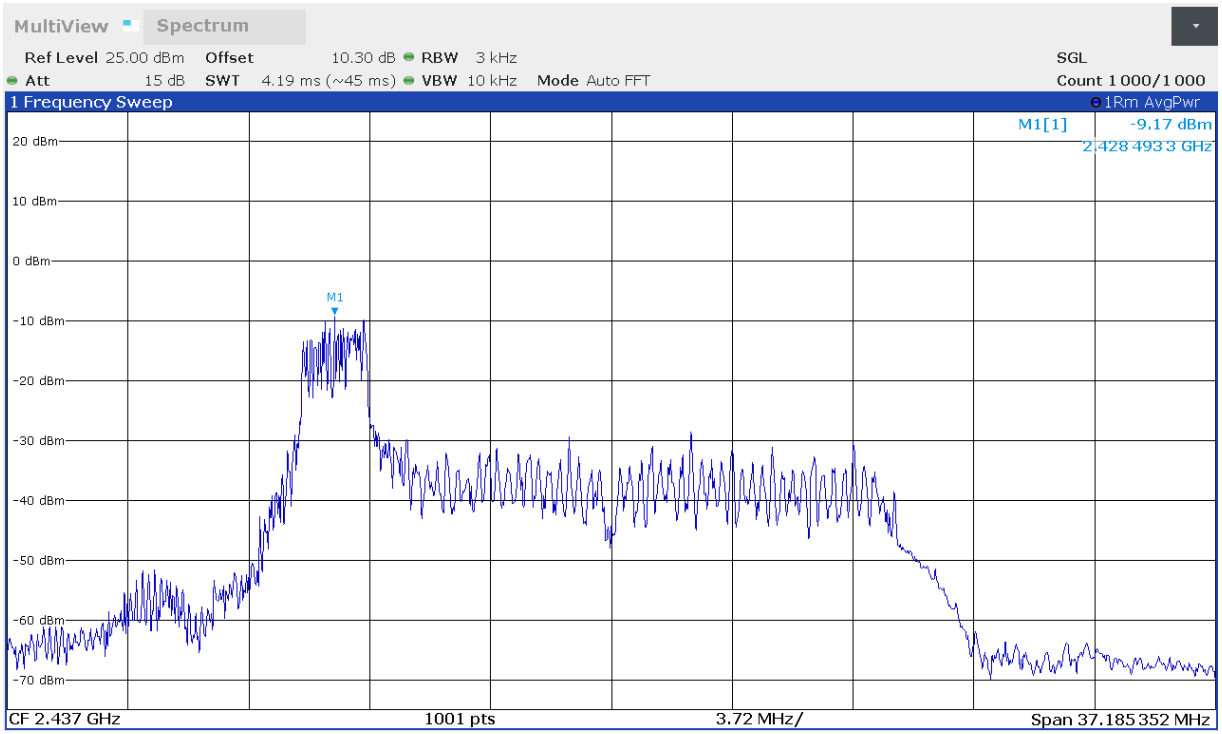
5.9.3.1 Maximum average PSD (802.11 IRIS-W101 – antenna port):

Ambient temperature:	21 - 22 °C
Relative humidity:	27 - 43 %

Date	20.11.2023 – 08.12.2023
Tested by	P. Neufeld

Calculations:
Result [dBm/3 kHz] = Reading [dBm/3kHz] + Ext. Att. [dB] + DCCF [dB]

Worst case plot (operation mode 38):



Operation mode	Reading [dBm/3 kHz]	Ext. Att.* [dB]	DCCF [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]
1	-15.9	0.0	0.0	-15.9	8.0
2	-15.3	0.0	0.0	-15.3	8.0
3	-17.1	0.0	0.0	-17.1	8.0
7	-21.4	0.0	0.0	-21.4	8.0
8	-18.6	0.0	0.0	-18.6	8.0
9	-21.6	0.0	0.0	-21.6	8.0
16	-24.0	0.0	0.0	-24.0	8.0
17	-19.4	0.0	0.0	-19.4	8.0
18	-24.2	0.0	0.0	-24.2	8.0
22	-24.8	0.0	0.0	-24.8	8.0
23	-19.9	0.0	0.0	-19.9	8.0
24	-24.8	0.0	0.0	-24.8	8.0
37	-15.9	0.0	0.0	-15.9	8.0
38	**-9.2**	0.0	0.0	**-9.2**	8.0
39	-14.1	0.0	0.0	-14.1	8.0

* The external attenuation of the external attenuator and the measurement cable is already taken into account with the reference level offset of 10.3 dB in the spectrum analyzer plot, which represents the attenuation of the 10 dB external attenuator and 0.3 dB for the measurement cable.

Test: Passed

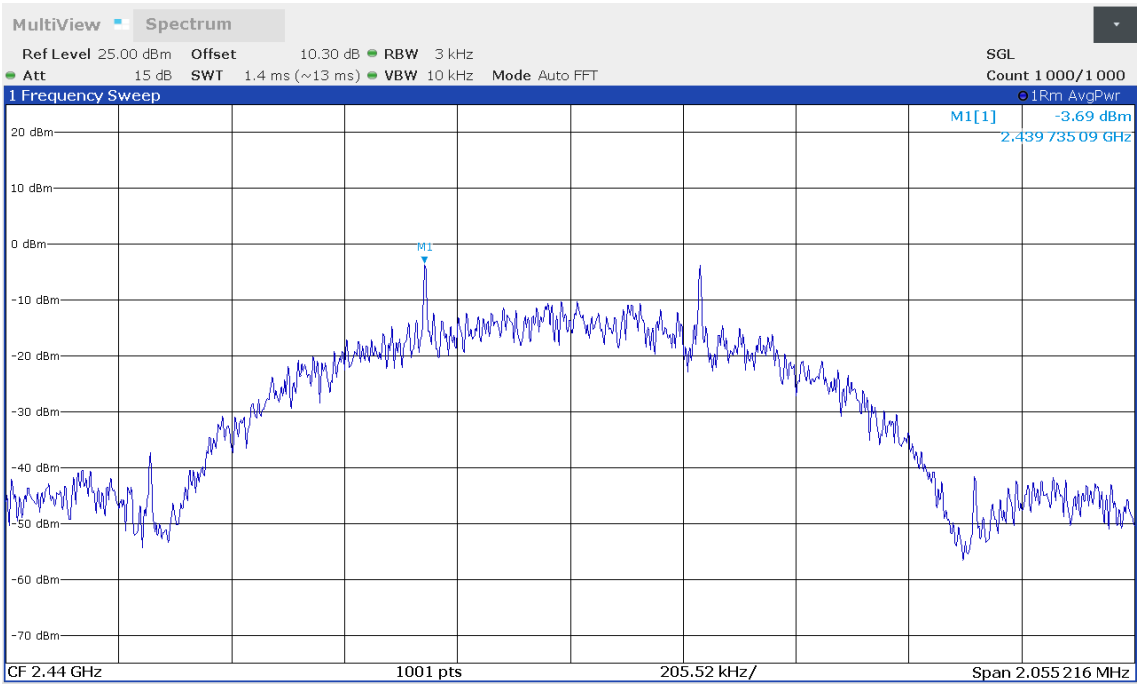
5.9.3.2 Maximum average PSD (Bluetooth LE IRIS-W101 – antenna port):

Ambient temperature	22 °C
Relative humidity:	32 - 41 %

Date	23.11.2023 + 24.11.2023
Tested by	P. Neufeld

Calculations:
Result [dBm/3 kHz] = Reading [dBm/3kHz] + Ext. Att. [dB] + DCCF [dB]

Worst case plot (operation mode 47):



Operation mode	Reading [dBm/3 kHz]	Ext. Att.* [dB]	DCCF [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]
40	-7.9	2.1	0.0	-5.8	8.0
41	-8.6	2.1	0.0	-6.5	8.0
42	-9.3	2.1	0.0	-7.2	8.0
43	-12.6	4.9	0.0	-7.7	8.0
44	-13.2	4.9	0.0	-8.3	8.0
45	-14.1	4.9	0.0	-9.2	8.0
46	-13.3	6.7	0.0	-6.6	8.0
47	**-3.7**	6.7	0.0	**3.0**	8.0
48	-4.5	6.7	0.0	2.2	8.0
49	1.8	0.8	0.0	2.6	8.0
50	1.5	0.8	0.0	2.3	8.0
51	0.0	0.8	0.0	0.8	8.0

* The external attenuation of the external attenuator and the measurement cable is already taken into account with the reference level offset of 10.3 dB in the spectrum analyzer plot, which represents the attenuation of the 10 dB external attenuator and 0.3 dB for the measurement cable.

Test: Passed

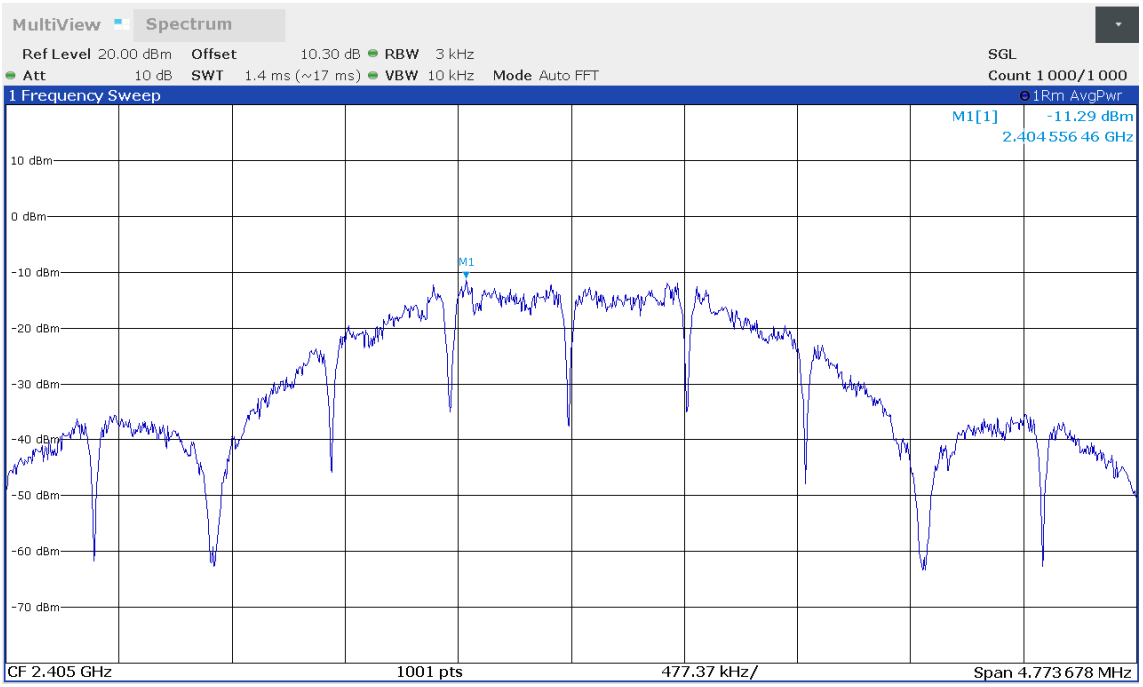
5.9.3.3 Maximum average PSD (802.15.4 IRIS-W101 – antenna port):

Ambient temperature	21 °C
Relative humidity:	25 %

Date	22.11.2023
Tested by	P. Neufeld

Calculations:
Result [dBm/3 kHz] = Reading [dBm/3 kHz] + Ext. Att. [dB] + DCCF [dB]

Worst case plot (operation mode 52):



Operation mode	Reading [dBm/3 kHz]	Ext. Att.* [dB]	DCCF [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]
52	**-11.3**	0.0	0.0	**-11.3**	8.0
53	-11.9	0.0	0.0	-11.9	8.0
54	-12.8	0.0	0.0	-12.8	8.0
55	-28.5	0.0	0.0	-28.5	8.0

* The external attenuation of the external attenuator and the measurement cable is already taken into account with the reference level offset of 10.3 dB in the spectrum analyzer plot, which represents the attenuation of the 10 dB external attenuator and 0.3 dB for the measurement cable.

Test: Passed

Test equipment (please refer to chapter 7 for details)
1

5.10 DTS band-edge emission measurements

5.10.1 Test setup (Band edge – unrestricted bands)

Test setup			
Used	Setup	See sub-clause	Comment
☐	Test setup (radiated – normal procedure)	5.1.1.4	-
☐	Test setup (radiated – alternative procedure)	5.1.1.5	-
☒	Test setup (antenna port conducted)	5.1.2	-

5.10.2 Test method (Band edge – unrestricted bands)

Test method (Band edge – unrestricted bands)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☐	11.11.	20 dBc (Peak)	Peak power	*1
☒	11.11.	30 dBc (Average)	RMS power	*2

*1 As declared in “47 CFR 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

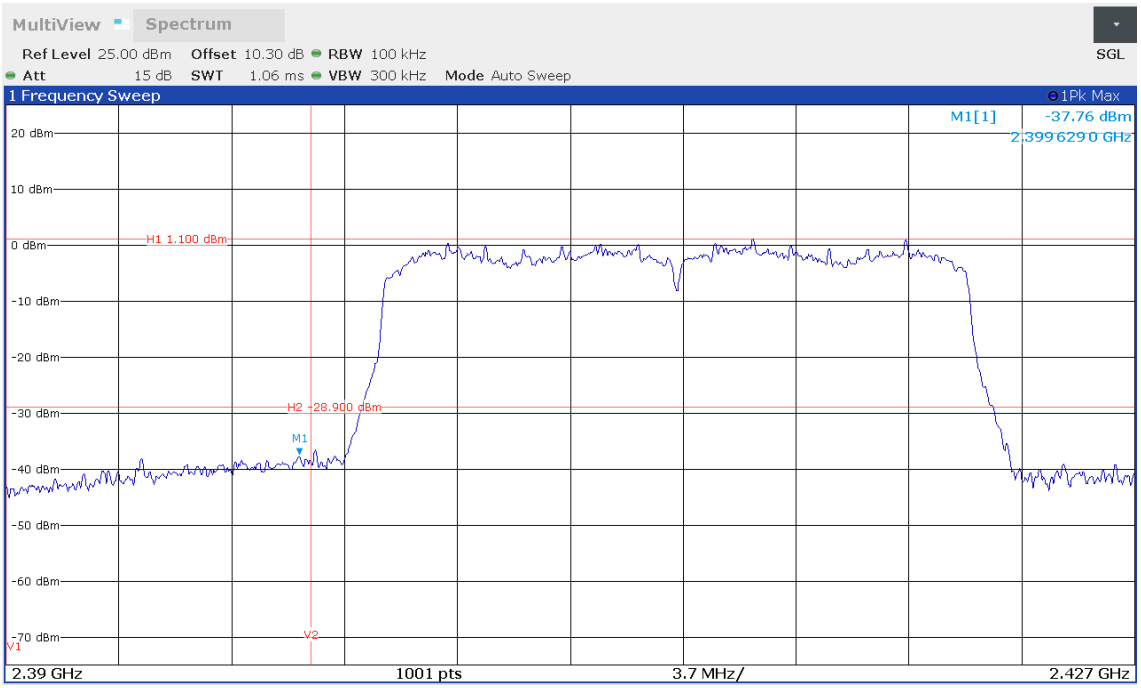
*2 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

5.10.3 Test results (Band edge – unrestricted bands) – 30 dBc (802.11 IRIS-W101 – antenna port)

Ambient temperature:	21 - 22 °C
Relative humidity:	27 - 43 %

Date	20.11.2023 – 08.12.2023
Tested by	P. Neufeld

Worst case plot (operation mode 19):



Operation Mode #	Emission Frequency [MHz]	Reference [dBm]	Limit [dBm]	Emission level [dBm]	Margin [dB]
4	2399.1	8.2	-21.8	-32.1	10.3
13	2398.7	1.1	-28.9	-38.0	9.1
19	**2399.6**	**1.1**	**-28.9**	**-37.8**	**8.9**
25	2398.6	1.2	-28.8	-38.2	9.4
31	2399.6	1.5	-28.5	-38.3	9.8

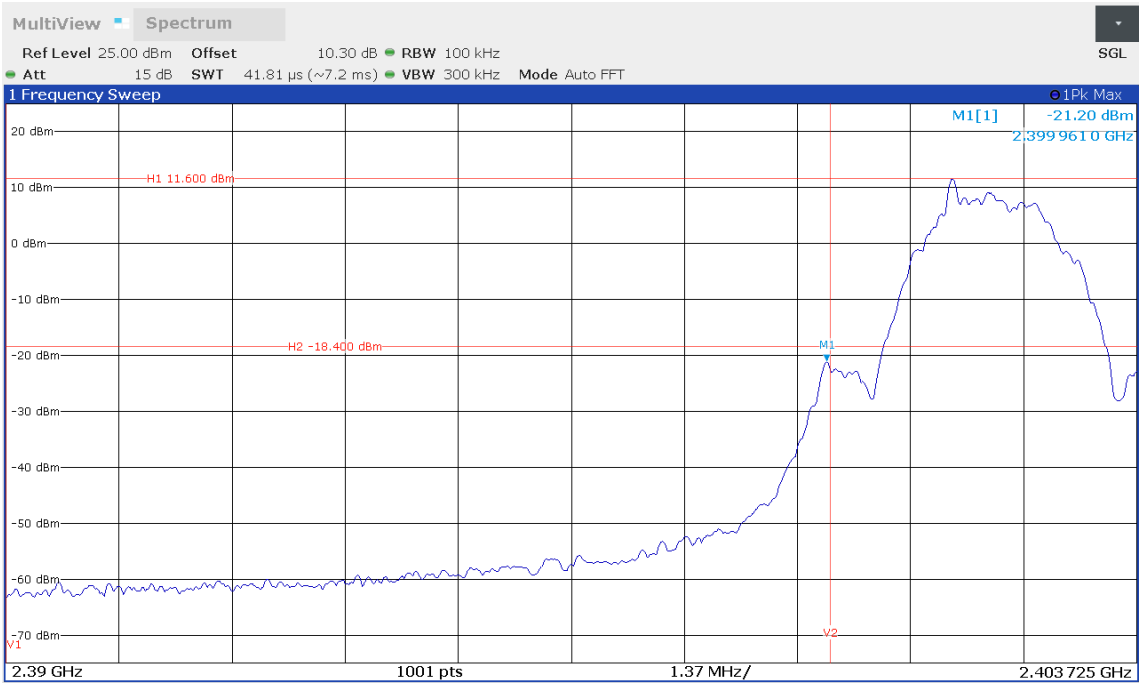
Test: Passed

5.10.4 Test results (Band edge – unrestricted bands) – 30 dBc (Bluetooth LE IRIS-W101 – antenna port)

Ambient temperature	22 °C
Relative humidity:	32 - 41 %

Date	23.11.2023 + 24.11.2023
Tested by	P. Neufeld

Worst case plot (operation mode 43):



Operation Mode #	Emission Frequency [MHz]	Reference [dBm]	Limit [dBm]	Emission level [dBm]	Margin [dB]
40	2399.961	11.4	-18.6	-47.4	28.8
43	**2399.961**	**11.6**	**-18.4**	**-21.2**	**2.8**
46	2400.000	9.3	-20.7	-48.7	28.0
49	2399.987	8.0	-22.0	-49.1	27.1

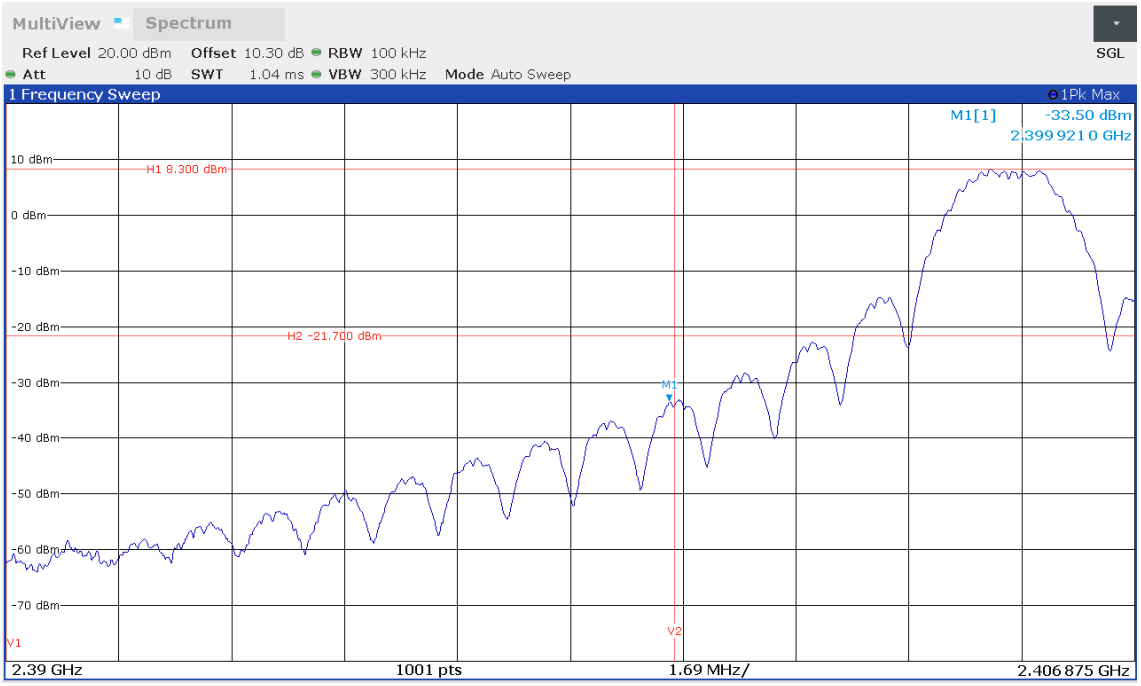
Test: Passed

5.10.5 Test results (Band edge – unrestricted bands) – 30 dBc (802.15.4 IRIS-W101 – antenna port)

Ambient temperature	21 °C
Relative humidity:	25 %

Date	22.11.2023
Tested by	P. Neufeld

Worst case plot (operation mode 52):



Operation Mode #	Emission Frequency [MHz]	Reference [dBm]	Limit [dBm]	Emission level [dBm]	Margin [dB]
52	2399.921	8.3	-21.7	-33.5	11.8

Test: Passed

Test equipment (please refer to chapter 7 for details)
1

5.10.6 Test setup (Band edge – restricted bands)

Test setup			
Used	Setup	See sub-clause	Comment
☐	Test setup (radiated – normal procedure)	5.1.1.4	-
☒	Test setup (radiated – alternative procedure)*1	5.1.1.5	-
☐	Test setup (antenna port conducted)	5.1.2	-

*1 Only worst-case modes from the antenna port conducted pretests were tested as radiated tests.

5.10.7 Test method (Band edge – restricted bands)

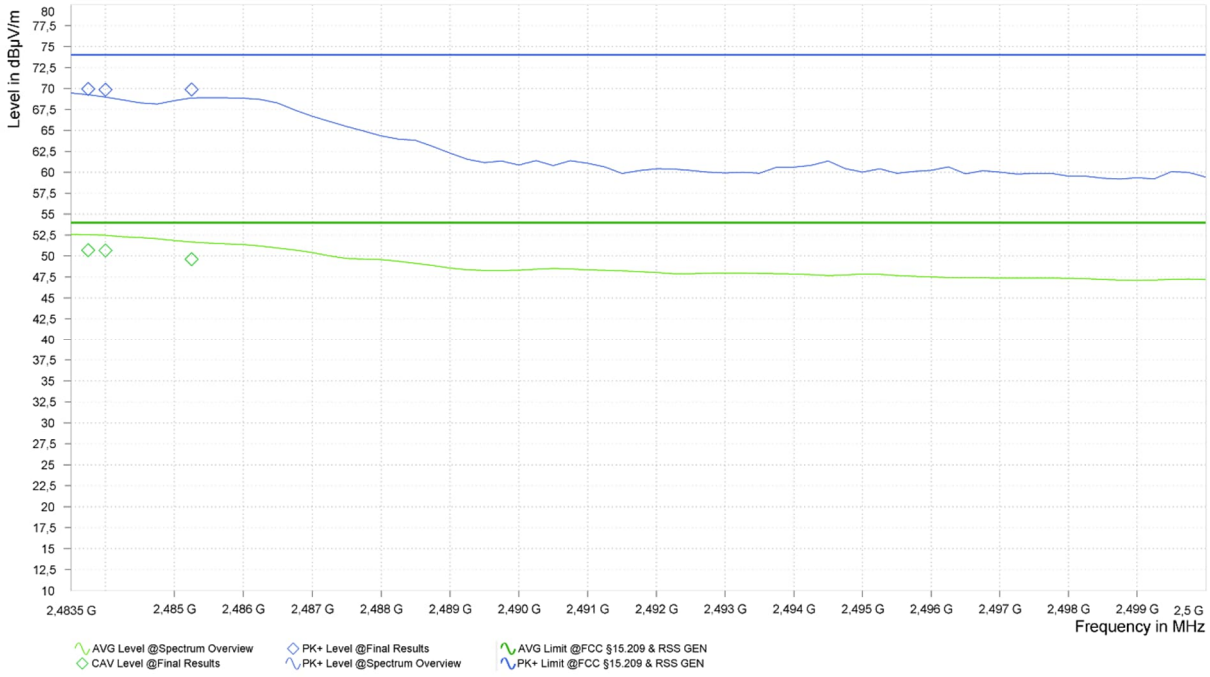
Test method (Band edge – restricted bands)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	11.13.1	Standard method	No limitations	-
☐	11.13.2	Marker-delta method		See 6.10.6 [1]
☐	11.13.3.2	Peak detection	Not for DTS testing	2 MHz from band
☐	11.13.3.3	Trace averaging with cont. EUT	D ≥ 98%	2 MHz from band
☐	11.13.3.4	Trace averaging with cont. EUT & D	Constant D (±2%)	2 MHz from band
☐	11.13.3.5	Reduced VBW		2 MHz from band

5.10.8 Test results (Band edge – restricted bands – radiated - 802.11 IRIS-W106 – on-board antenna)

Ambient temperature:	23 °C
Relative humidity:	38 %

Date	09.02.2024
Tested by	P. Neufeld

Worst case plot WLAN (operation mode 57):



(operation mode 56):

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2389.750	61.6	74.0	12.4	39.9	54.0	14.1	35.2	V	90	357
2390.000	61.3	74.0	12.7	39.5	54.0	14.5	35.2	V	90	365

(operation mode 57):

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2483.750	69.9	74.0	4.1	50.7	54.0	**3.3**	35.4	V	90	19
2484.000	69.8	74.0	4.2	50.7	54.0	3.3	35.4	V	90	19
2485.250	69.9	74.0	4.1	49.6	54.0	4.4	35.4	V	90	21

Test: Passed

5.10.9 Test results (Band edge – restricted bands – radiated - Bluetooth LE IRIS-W106 – on-board antenna)

Ambient temperature:	23 °C
Relative humidity:	38 %

Date	09.02.2024
Tested by	P. Neufeld

Worst case plot WLAN (operation mode 61):

(operation mode 64):

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2375.000	49.1	74.0	24.9	34.2	54.0	**19.8**	35.2	V	150	186
2389.750	48.0	74.0	26.0	32.6	54.0	21.4	35.2	V	60	87

(operation mode 65):

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2484.000	49.1	74.0	24.9	33.2	54.0	20.8	35.4	V	90	46
2489.750	48.8	74.0	25.2	33.1	54.0	20.9	35.4	V	150	364
2500.000	50.2	74.0	23.8	33.6	54.0	20.4	35.4	V	150	304

Test: Passed

5.10.10 Test results (Band edge – restricted bands – radiated – 802.15.4 IRIS-W106 – on-board antenna)

Ambient temperature:	23 °C
Relative humidity:	38 %

Date	09.02.2024
Tested by	P. Neufeld

Worst case plot WLAN (operation mode 69):

(operation mode 69):

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2375.000	48.6	74.0	25.4	33.2	54.0	20.8	35.2	V	120	198
2390.000	48.5	74.0	25.5	33.3	54.0	20.7	35.2	V	90	126

(operation mode 71):

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2494.750	48.7	74.0	25.3	33.4	54.0	20.6	35.4	V	120	24
2500.000	49.3	74.0	24.7	35.0	54.0	19.0	35.4	V	90	191

(operation mode 72):

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2483.500	53.3	74.0	20.7	40.7	54.0	**13.3**	35.4	V	90	7
2484.000	51.5	74.0	22.5	37.4	54.0	16.6	35.4	H	0	369
2499.750	48.9	74.0	25.1	33.9	54.0	20.1	35.4	V	120	341

Test: Passed

Test equipment (please refer to chapter 7 for details)
3 – 9, 15

5.11 Radiated emissions

Test setup (Maximum unwanted emissions)			
Used	Setup	See sub-clause	Comment
☒	Test setup (radiated – normal procedure)	5.1.1.4	f < 1 GHz
☒	Test setup (radiated – alternative procedure)	5.1.1.5	f > 1 GHz
☐	Test setup (antenna port conducted)	5.1.2	-

5.11.1 Test results (Maximum unwanted emissions)

5.11.1.1 Test results preliminary measurement 9 kHz to 30 MHz

Ambient temperature:	22 °C
Relative humidity:	20 %

Date	26.03.2024
Tested by	D. Bruschinski

Position of EUT: For tests for f between 9 kHz to 30 MHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: The measurement value was already corrected by 40 dB/decade as described in 47 CFR 15.31(f)(2) regarding to the measurement distance as requested in 47 CFR 15.209(a)

Remark: All 3 orthogonal planes were tested separately

Calculations:

Result @ norm. dist. [dBµV/m] = Reading [dBµV] + AF [dB/m] + Distance corr. fact. [dBµV/m]

Result @ norm. dist. [dBµA/m] = Result @ norm. dist. [dBµV/m] – 20 x $\log_{10}$ (377 Ω)

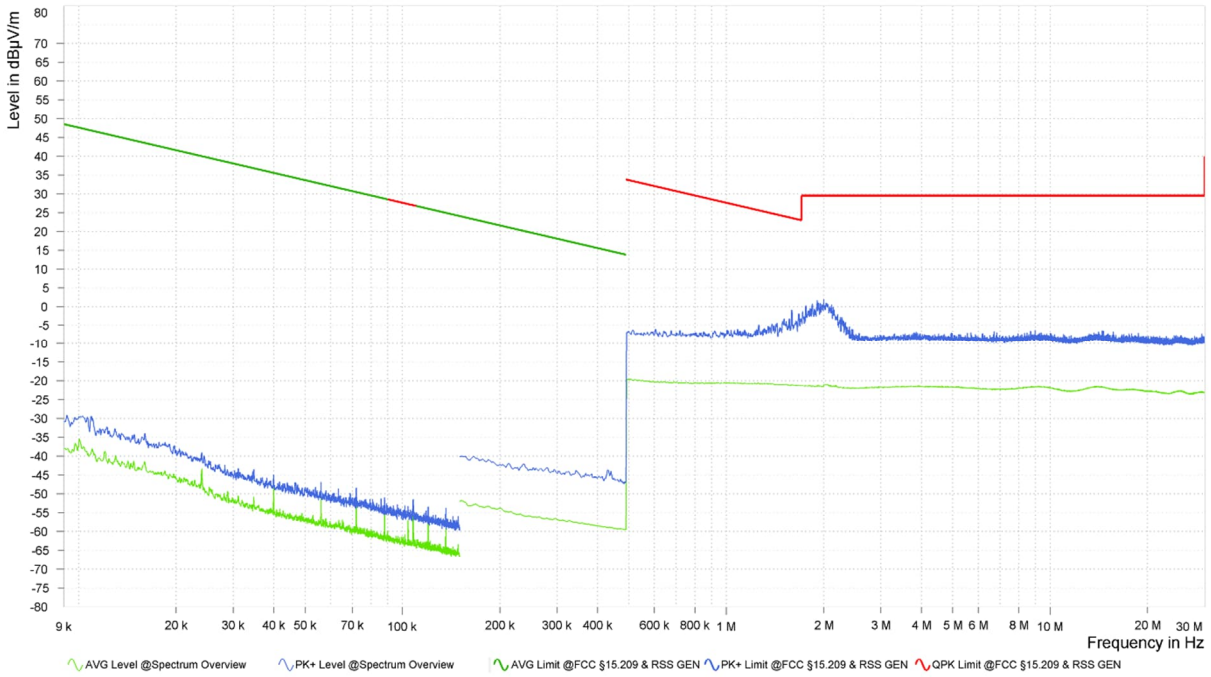
Margin [dB] = Limit [dB(µV|µA)/m] - Result [dB(µV|µA)/m

Worst case plot (802.11 WLAN IRIS-W106):

Spurious emissions from 9 kHz to 30 MHz (operation mode 59 - Pos 3):

Worst case plot (Bluetooth Low Energy IRIS-W106):

Spurious emissions from 9 kHz to 30 MHz (operation mode 67 - Pos 2):

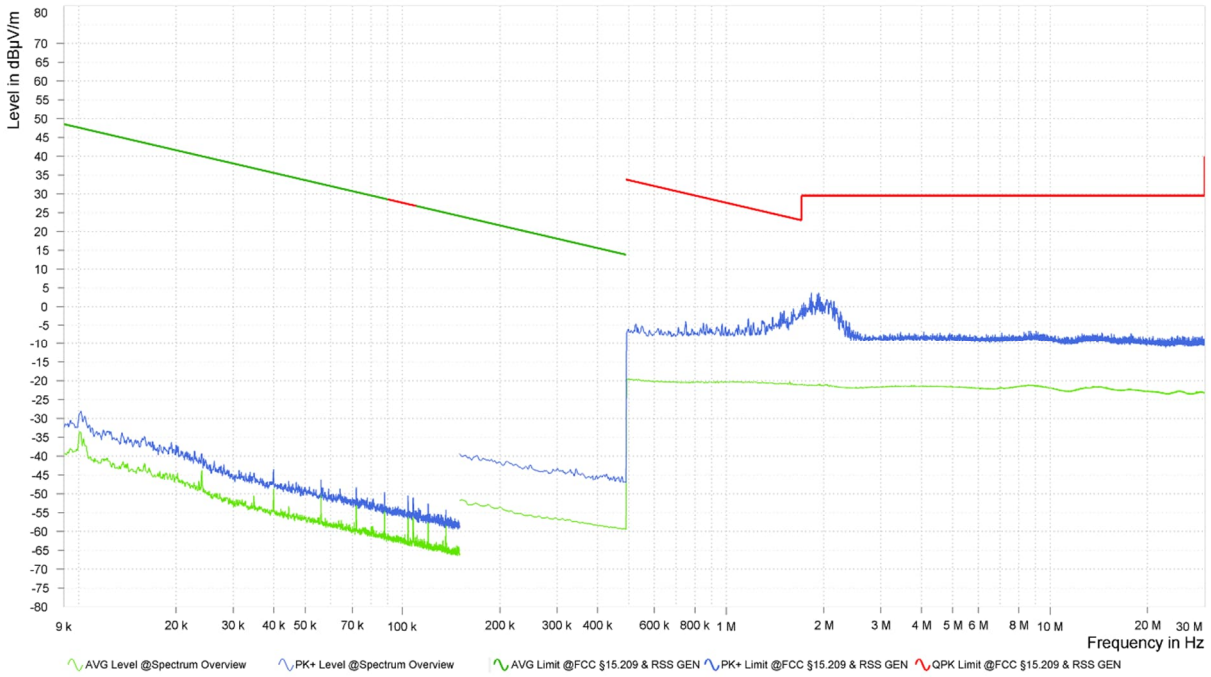


Worst case plot (802.15.4 IRIS-W106):

Spurious emissions from 9 kHz to 30 MHz (operation mode 70 - Pos 1):

Worst case plot (802.11 WLAN IRIS-W101):

Spurious emissions from 9 kHz to 30 MHz (operation mode 35 - Pos 3):



5.11.1.2 Worst case plot (Bluetooth Low Energy IRIS-W101):

Spurious emissions from 9 kHz to 30 MHz (operation mode 41 - Pos 2):

Worst case plot (802.15.4 IRIS-W101):

Spurious emissions from 9 kHz to 30 MHz (operation mode 53 - Pos 1):

Remark: No emissions closer than 20 dB to the limit, so no final measurement will be carried out.

Test equipment (please refer to chapter 7 for details)
2 - 9

5.11.1.3 Test results WLAN (30 MHz – 1 GHz) – WLAN 802.11

Ambient temperature:	22 – 23 °C
Relative humidity:	20 – 28 %

Date	26.03.2024 - 28.03.2024
Tested by	P. Neufeld

Position of EUT: For tests for f between 30 MHz to 1 GHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Plots for each frequency range are submitted below.

Remark: All 3 orthogonal planes were tested separately

Calculations:

Result [dBµV/m] = Reading [dBµV] + Correction [dBµV/m]

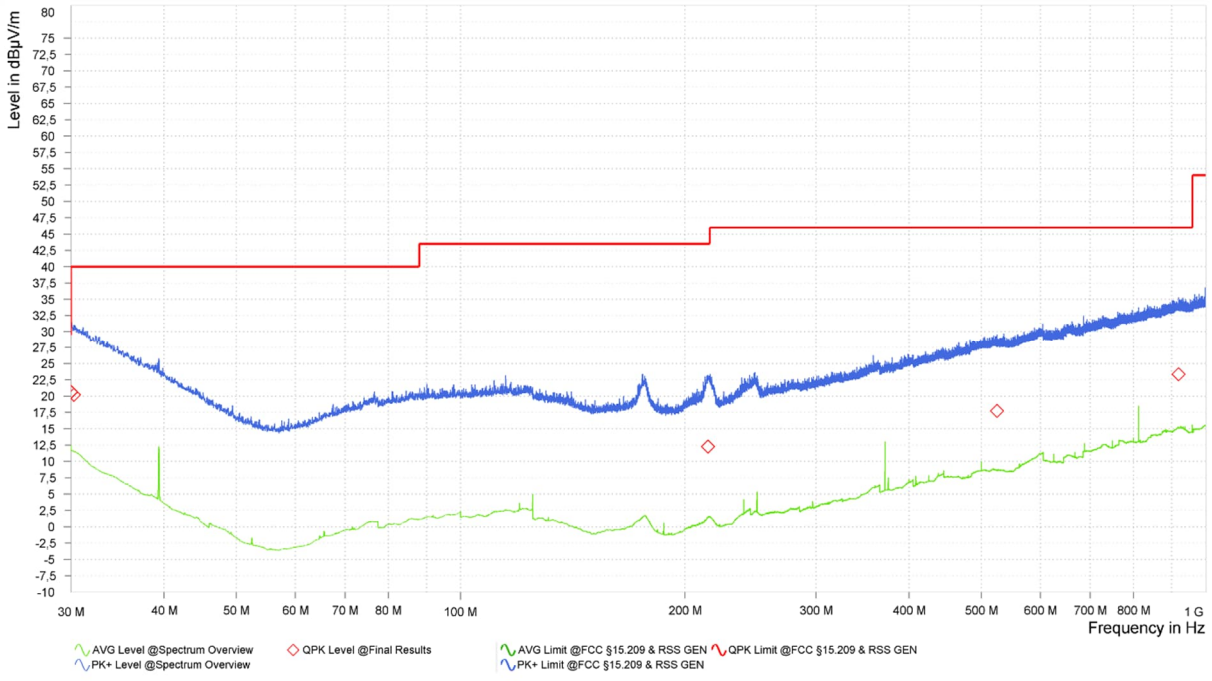
Correction [dBµV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]

Margin [dB] = Limit [dBµV/m] - Result [dBµV/m]

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with "◇" are the measured results of the standard subsequent measurement in a semi-anechoic chamber.

Worst case plot:

Spurious emissions from 30 MHz to 1 GHz (operation mode 58):



Result tables (IRIS-W106)

(operation mode 58):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
30.0	20.7	29.5	8.8	-5.2	25.9	H	241.0	3.7	1
30.0	20.6	29.5	8.9	-5.3	25.9	H	275.0	3.4	1
30.3	20.2	40.0	19.8	-5.5	25.7	H	3.0	3.0	1
214.9	12.3	43.5	31.2	-3.8	16.0	H	269.0	1.6	1
524.9	17.8	46.0	28.3	-6.7	24.4	V	61.0	2.6	1

(operation mode 59):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
30.4	20.1	40.0	19.9	-5.6	25.7	H	41.0	1.5	
140.6	16.7	43.5	26.8	0.9	15.9	H	95.0	2.0	
215.2	17.5	43.5	26.0	1.5	16.0	H	85.0	1.1	
499.1	17.4	46.0	28.6	-6.8	24.1	V	332.0	1.1	
539.0	17.4	46.0	28.6	-7.2	24.6	V	115.0	2.5	
925.560	23.3	46.0	22.7	-6.3	29.7	V	253.0	2.0	

(operation mode 60):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
30.4	20.1	40.0	19.9	-5.6	25.7	H	-17.0	2.9	3
36.1	22.2	40.0	17.9	-0.2	22.3	V	63.0	1.8	3
85.5	9.4	40.0	30.6	-7.4	16.8	H	313.0	1.1	3
175.9	17.0	43.5	26.5	0.5	16.5	V	109.0	1.0	3
213.7	14.2	43.5	29.3	-1.8	16.1	V	200.0	1.2	3
525.900	17.6	46.0	28.4	-6.8	24.4	V	87.0	1.6	3

Result tables (IRIS-W101)

(operation mode 35):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
40.5	12.2	40.0	27.9	-7.5	19.7	V	193.0	1.1	3
124.1	11.0	43.5	32.5	-6.1	17.0	H	270.0	3.1	3
176.5	13.4	43.5	30.1	-3.2	16.6	V	207.0	1.1	3
213.8	15.5	43.5	28.1	-0.6	16.1	V	178.0	1.3	3
396.5	14.6	46.0	31.4	-6.9	21.6	V	371.0	1.5	3
919.710	23.4	46.0	22.6	-6.3	29.7	H	23.0	2.5	3

Test result: Passed

5.11.1.1 Test results WLAN (30 MHz – 1 GHz) – Bluetooth Low Energy

Ambient temperature:	22 – 23 °C
Relative humidity:	20 – 28 %

Date	26.03.2024 - 28.03.2024
Tested by	P. Neufeld

Position of EUT: For tests for f between 30 MHz to 1 GHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Plots for each frequency range are submitted below.

Remark: All 3 orthogonal planes were tested separately

Calculations:

Result [dBµV/m] = Reading [dBµV] + Correction [dBµV/m]

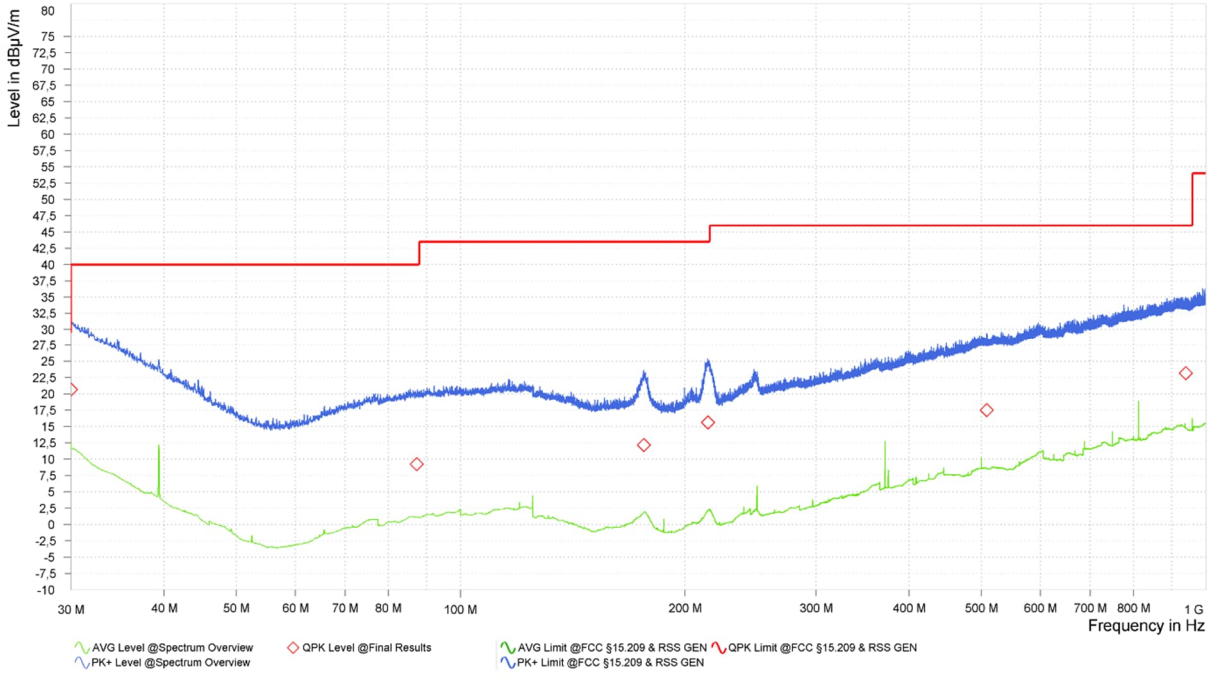
Correction [dBµV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]

Margin [dB] = Limit [dBµV/m] - Result [dBµV/m]

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with "◇" are the measured results of the standard subsequent measurement in a semi-anechoic chamber.

Worst case plot:

Spurious emissions from 30 MHz to 1 GHz (operation mode 66):



Result tables (IRIS-W106)

(operation mode 66):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
30.0	20.7	29.5	8.8	-5.2	25.9	V	47.0	3.2	1
87.4	9.2	40.0	30.8	-7.6	16.9	H	117.0	1.5	1
176.3	12.2	43.5	31.3	-4.4	16.6	H	257.0	1.5	1
214.9	15.6	43.5	27.9	-0.4	16.0	H	121.0	1.1	1
508.5	17.5	46.0	28.5	-6.7	24.2	H	233.0	1.3	1
940.740	23.2	46.0	22.8	-6.5	29.7	H	279.0	4.4	1

(operation mode 67):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
30.0	20.3	40.0	19.7	-5.5	25.9	V	235.0	4.0	2
128.3	14.3	43.5	29.2	-2.5	16.8	H	109.0	2.0	2
141.8	15.7	43.5	27.8	-0.1	15.7	H	105.0	2.2	2
246.2	15.0	46.0	31.0	-1.9	17.0	V	179.0	1.3	2
523.7	17.8	46.0	28.2	-6.6	24.4	V	282.0	3.0	2
947.190	23.3	46.0	22.8	-6.4	29.7	V	336.0	1.6	2

(operation mode 68):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
39.4	22.2	40.0	17.8	1.8	20.4	V	283.0	2.4	3
84.9	9.4	40.0	30.6	-7.4	16.7	H	52.0	3.5	3
176.3	15.2	43.5	28.3	-1.3	16.6	V	134.0	1.2	3
213.6	12.7	43.5	30.8	-3.4	16.1	V	173.0	1.0	3
508.4	17.5	46.0	28.5	-6.7	24.2	H	233.0	3.0	3
539.040	17.4	46.0	28.6	-7.2	24.6	V	51.0	3.9	3
917.250	23.5	46.0	22.6	-6.3	29.7	H	243.0	3.5	3

Result tables (IRIS-W101)

(operation mode 41):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
30.1	20.4	40.0	19.6	-5.5	25.8	V	350.0	2.6	2
40.8	11.9	40.0	28.1	-7.6	19.5	H	41.0	3.1	2
125.0	13.6	43.5	30.0	-3.5	17.0	H	263.0	2.8	2
177.6	15.7	43.5	27.8	-1.1	16.7	V	208.0	1.1	2
734.9	20.7	46.0	25.3	-7.0	27.7	H	342.0	2.1	2
914.130	23.4	46.0	22.6	-6.4	29.8	H	103.0	1.8	2

Test result: Passed

5.11.1.2 Test results WLAN (30 MHz – 1 GHz) – 802.15.4

Ambient temperature:	22 – 23 °C
Relative humidity:	20 – 28 %

Date	26.03.2024 - 28.03.2024
Tested by	P. Neufeld

Position of EUT: For tests for f between 30 MHz to 1 GHz, the EUT was set-up on a table with a height of 80 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Plots for each frequency range are submitted below.

Remark: All 3 orthogonal planes were tested separately

Calculations:

Result [dBµV/m] = Reading [dBµV] + Correction [dBµV/m]

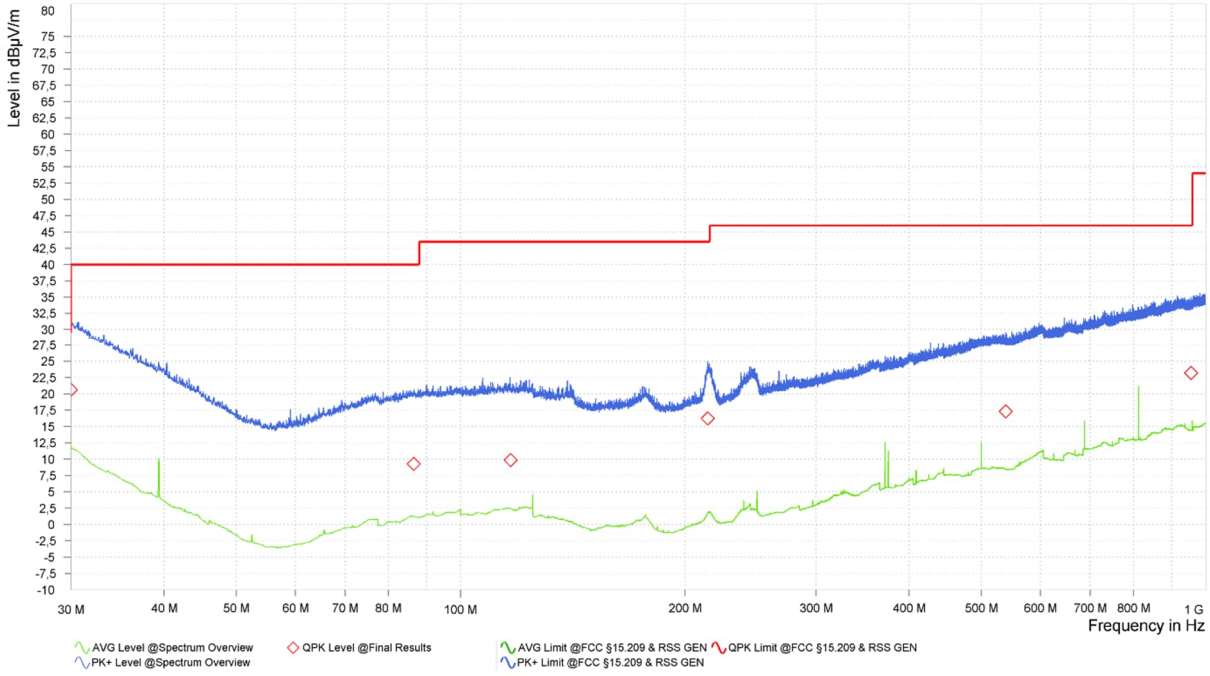
Correction [dBµV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]

Margin [dB] = Limit [dBµV/m] - Result [dBµV/m]

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above-mentioned standard. The measured points marked with "◇" are the measured results of the standard subsequent measurement in a semi-anechoic chamber.

Worst case plot:

Spurious emissions from 30 MHz to 1 GHz (operation mode 69):



Result tables (IRIS-W106)

(operation mode 69):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
30.0	20.6	29.5	8.9	-5.3	25.9	V	252.0	3.8	1
86.6	9.3	40.0	30.7	-7.6	16.9	V	87.0	3.8	1
116.8	9.9	43.5	33.6	-7.7	17.5	H	29.0	4.4	1
214.7	16.2	43.5	27.3	0.2	16.0	H	287.0	1.2	1
539.1	17.3	46.0	28.7	-7.3	24.6	H	123.0	3.1	1
955.830	23.2	46.0	22.8	-6.6	29.8	V	269.0	1.7	1

(operation mode 70):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
30.1	20.3	40.0	19.7	-5.5	25.8	H	253.0	2.5	2
86.8	9.3	40.0	30.7	-7.6	16.8	V	187.0	4.1	2
138.0	15.2	43.5	28.3	-0.8	16.0	H	255.0	2.3	2
214.4	18.2	43.5	25.3	2.1	16.1	H	94.0	1.3	2
521.7	17.8	46.0	28.2	-6.7	24.4	V	-11.0	1.9	2
884.250	23.1	46.0	22.9	-6.3	29.4	V	277.0	3.6	2

(operation mode 71):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
30.5	20.1	40.0	19.9	-5.5	25.6	H	342.0	1.1	3
86.4	9.5	40.0	30.5	-7.3	16.9	V	280.0	1.3	3
177.9	14.7	43.5	28.8	-2.0	16.7	V	153.0	1.0	3
213.8	13.8	43.5	29.7	-2.3	16.1	H	153.0	1.3	3
523.5	17.8	46.0	28.2	-6.6	24.4	V	165.0	1.1	3
556.800	17.4	46.0	28.6	-7.4	24.8	H	103.0	2.2	3
925.320	23.4	46.0	22.6	-6.3	29.7	H	219.0	1.4	3

(operation mode 72):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
35.8	20.7	40.0	19.3	-1.7	22.5	H	129.0	1.7	3
85.7	9.5	40.0	30.5	-7.4	16.8	V	205.0	2.5	3
176.5	16.3	43.5	27.2	-0.3	16.6	V	97.0	1.1	3
214.1	15.5	43.5	28.0	-0.6	16.1	V	329.0	1.3	3
556.9	17.4	46.0	28.6	-7.4	24.8	H	199.0	1.6	3
923.160	23.4	46.0	22.7	-6.3	29.7	V	53.0	4.0	3

Result tables (IRIS-W101)

(operation mode 53):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [cm]	Readings [dBµV/m]	Position #
40.4	12.1	40.0	27.9	-7.6	19.7	H	15.0	3.2	2
125.0	14.3	43.5	29.2	-2.8	17.0	H	274.0	2.0	2
176.6	15.5	43.5	28.0	-1.1	16.6	V	201.0	1.1	2
525.9	17.6	46.0	28.4	-6.9	24.4	H	253.0	1.9	2
716.5	20.4	46.0	25.7	-6.9	27.3	H	249.0	3.5	2
918.960	23.5	46.0	22.5	-6.2	29.7	H	297.0	2.8	2

Test result: Passed

Test equipment (please refer to chapter 7 for details)
3 - 10

5.11.1.3 Test results WLAN (radiated 1 GHz to 26.5 GHz) – 802.11 WLAN

Ambient temperature:	22 – 23 °C
Relative humidity:	18 – 29 %

Date	08.03.2024 - 13.03.2024
Tested by	P. Neufeld

Position of EUT: For tests for f between 1 GHz and the 10th harmonic, the EUT was set-up on a positioner device with a height of 150 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Plots for each frequency range are submitted below.

Remark: No spurious emissions were found during the antenna port conducted pre-tests. Therefore, the emission with the highest power spectral density was used for the radiated emissions tests, namely 802.11ax with MCS7 and 802.11b with 1 Mbps.

When the peak emissions are below the average limit line, no final measurement is performed. Also, when only peak noise is above the average limit, only the highest noise value is measured in the final measurement.

Calculation:

Max Peak [dBµV/m] = Reading (Pk+) [dBµV] + Correction [dBµV/m]

Average [dBµV/m] = Reading (Av) [dBµV] + Correction [dBµV/m]

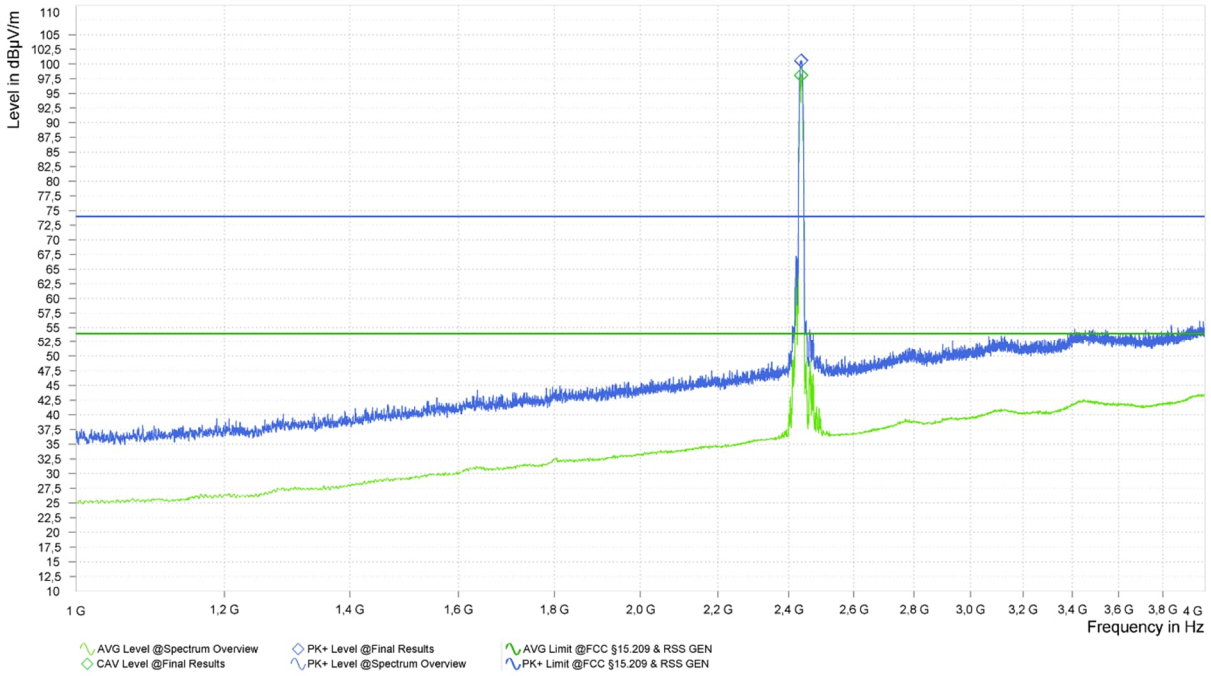
Correction [dBµV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]+DCCF* [dB]
* (if applicable – only for Average values, that are fundamental related)

Margin [dB] = Limit [dBµV/m] – Max Peak | Average [dBµV/m]

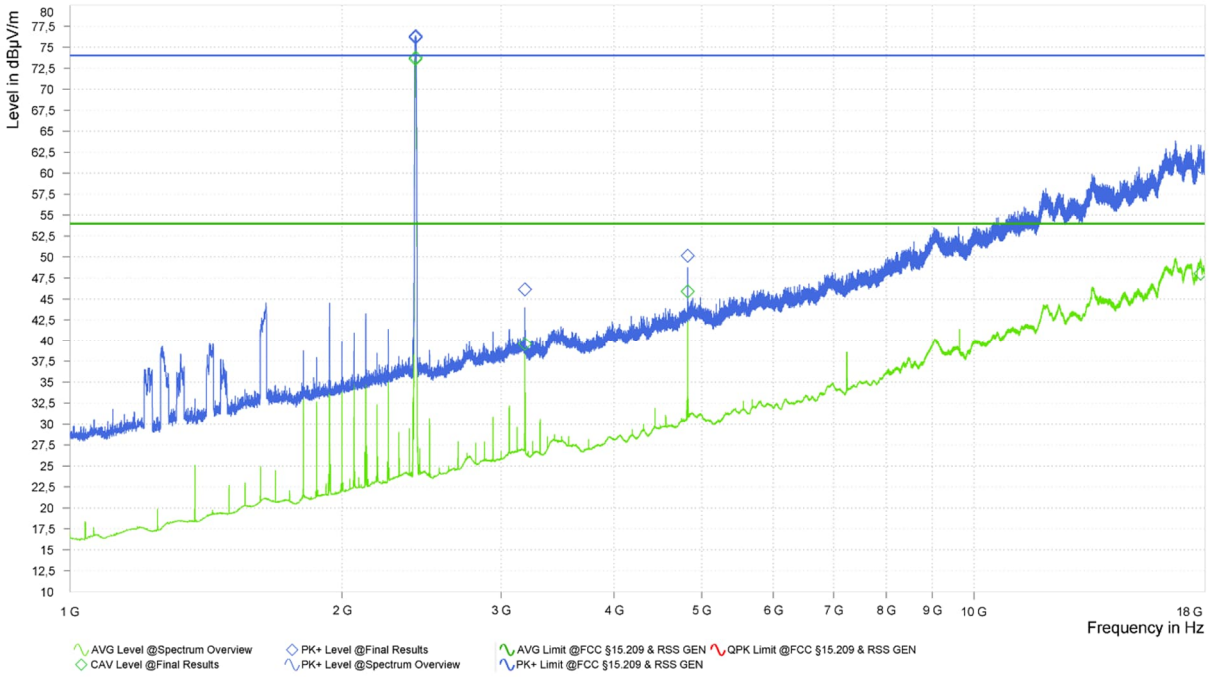
The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna positions.
The top measured curve represents the peak measurement. The measured points marked with "◇" are frequency points for the final peak detector measurement. These values are indicated in the following table. The bottom measured curve represents the average measurement. The measured points marked with "◇" are frequency points for the final average detector measurement.

Worst case plots:

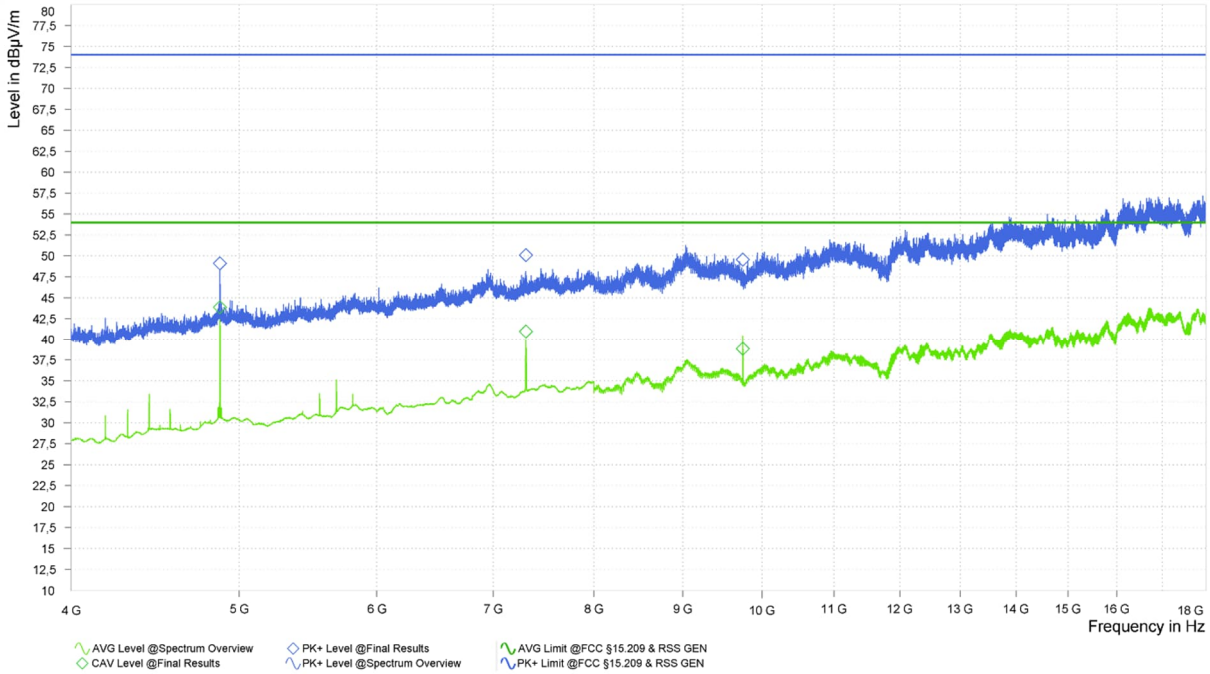
Spurious emissions from 1 GHz to 4 GHz (operation mode 62):



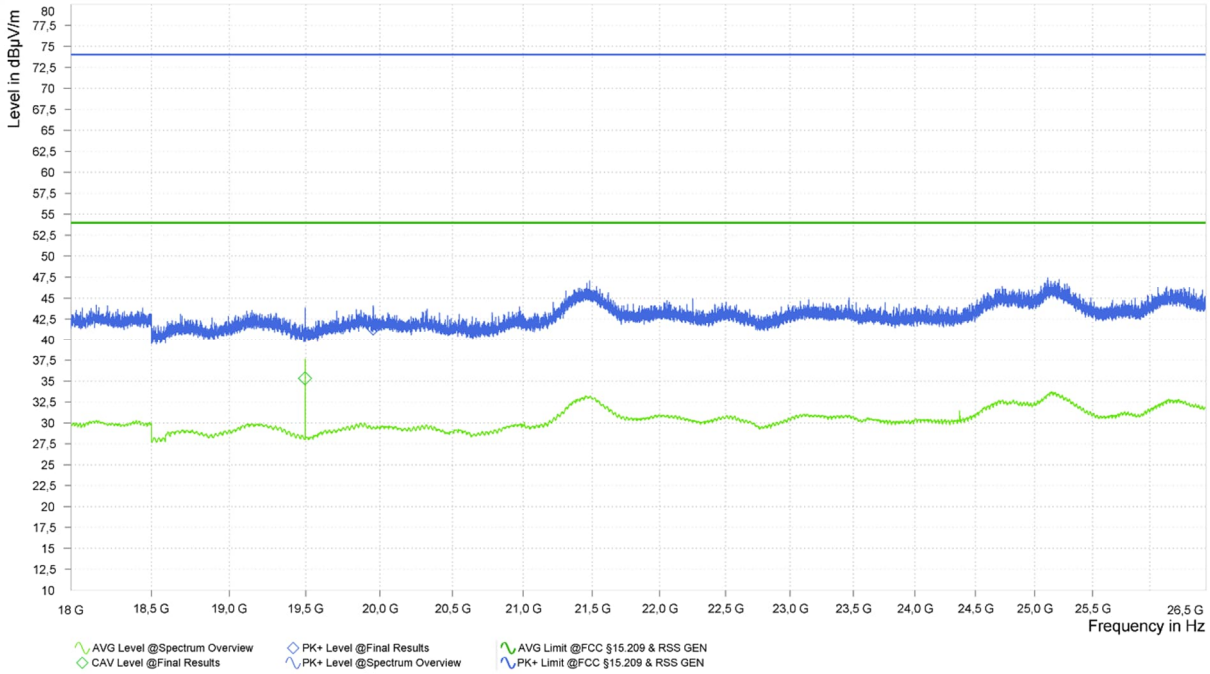
Spurious emissions from 1 GHz to 18 GHz (operation mode 1):



Spurious emissions from 4 GHz to 18 GHz (operation mode 62):



Spurious emissions from 18 GHz to 26.5 GHz (operation mode 62):



5.11.1.3.1 Result tables IRIS-W106

Operation mode 61:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2412.750	98.6	Fund.	-	96.0	Fund.	-	35.3	H	0	10
2414.750	98.8	Fund.	-	95.5	Fund.	-	35.3	H	0	11
4824.000	48.7	74.0	25.3	43.9	54.0	10.1	9.8	V	150	292
5687.500	46.5	74.0	27.5	36.1	54.0	17.9	11.5	H	150	75
7235.250	47.1	74.0	26.9	34.7	54.0	19.3	13.9	H	90	63
9647.750	50.2	74.0	23.8	40.5	54.0	13.5	18.6	H	90	151
19295.750	45.2	74.0	28.8	-	-	-	10.5	H	90	169
19296.000	-	-	-	37.6	54.0	16.4	10.5	H	90	126

Operation mode 62:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2436.250	100.5	Fund.	-	98.1	Fund.	-	35.4	H	0	11
2437.750	100.7	Fund.	-	98.1	Fund.	-	35.4	H	0	10
4874.000	49.1	74.0	24.9	43.9	54.0	10.1	9.9	V	30	95
7311.750	50.1	74.0	23.9	41.0	54.0	13.0	14.5	H	90	47
9748.000	49.6	74.0	24.4	38.8	54.0	15.2	18.5	H	90	156
19496.000	-	-	-	35.3	54.0	18.7	10.5	H	120	155
19954.250	41.4	74.0	32.6	-	-	-	10.7	H	90	85

Operation mode 63:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2461.000	97.5	Fund.	-	94.5	Fund.	-	35.4	V	90	11
2462.750	97.3	Fund.	-	94.8	Fund.	-	35.4	V	90	11
4924.000	44.1	74.0	29.9	33.1	54.0	21.0	10.1	V	90	232
7386.750	47.9	74.0	26.1	36.7	54.0	17.4	14.7	H	90	39
9848.000	49.5	74.0	24.5	38.3	54.0	15.7	19.1	H	90	128
19696.000	45.5	74.0	28.5	38.9	54.0	15.1	10.5	H	90	135

5.11.1.3.2 Result tables IRIS-W101

Operation mode 1:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2411.000	76.2	Fund.	-	-	-	-	-0.4	H	120	220
2411.250	-	-	-	73.6	Fund.	-	-0.4	H	120	220
2412.750	-	-	-	73.8	Fund.	-	-0.4	H	120	218
2413.000	76.3	Fund.	-	-	-	-	-0.4	H	120	218
3187.500	46.2	74.0	27.8	39.6	54.0	14.4	3.4	H	60	148
4824.000	50.2	74.0	23.8	45.9	54.0	8.1	9.8	H	90	226
17810.250	60.8	74.0	13.2	-	-	-	30.7	V	120	176
17814.750	-	-	-	48.0	54.0	6.0	30.7	V	60	331

Operation mode 3:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
19695.750	45.0	74.0	29.0	-	-	-	10.5	H	90	125
19696.000	-	-	-	36.9	54.0	17.1	10.5	H	90	123

Test result: Passed

5.11.1.1 Test results WLAN (radiated 1 GHz to 26.5 GHz) – Bluetooth Low Energy

Ambient temperature:	22 – 23 °C
Relative humidity:	18 – 29 %

Date	08.03.2024 - 13.03.2024
Tested by	P. Neufeld

Position of EUT: For tests for f between 1 GHz and the 10th harmonic, the EUT was set-up on a positioner device with a height of 150 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Plots for each frequency range are submitted below.

Remark: No spurious emissions were found during the antenna port conducted pre-tests. Therefore, the emission with the highest power spectral density was used for the radiated emissions tests, namely BLE mode with 1 Mbps.

When the peak emissions are below the average limit line, no final measurement is performed. Also, when only peak noise is above the average limit, only the highest noise value is measured in the final measurement.

Calculation:

Max Peak [dBµV/m] = Reading (Pk+) [dBµV] + Correction [dBµV/m]

Average [dBµV/m] = Reading (Av) [dBµV] + Correction [dBµV/m]

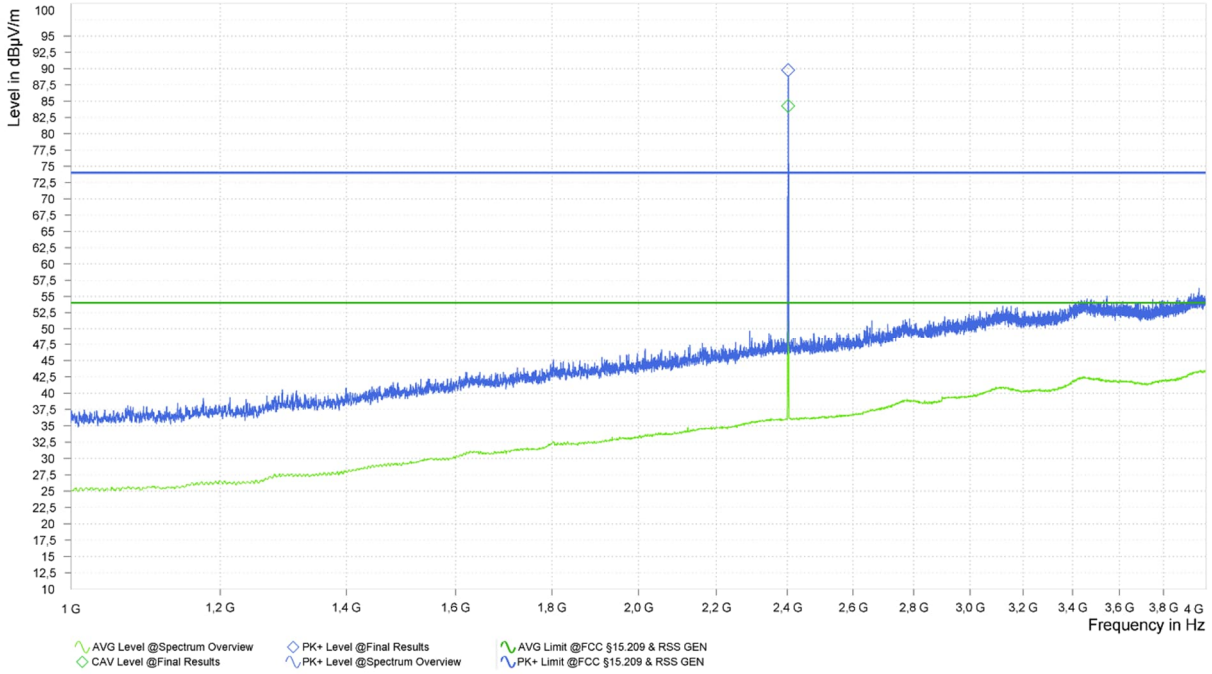
Correction [dBµV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]+DCCF* [dB]
* (if applicable – only for Average values, that are fundamental related)

Margin [dB] = Limit [dBµV/m] – Max Peak | Average [dBµV/m]

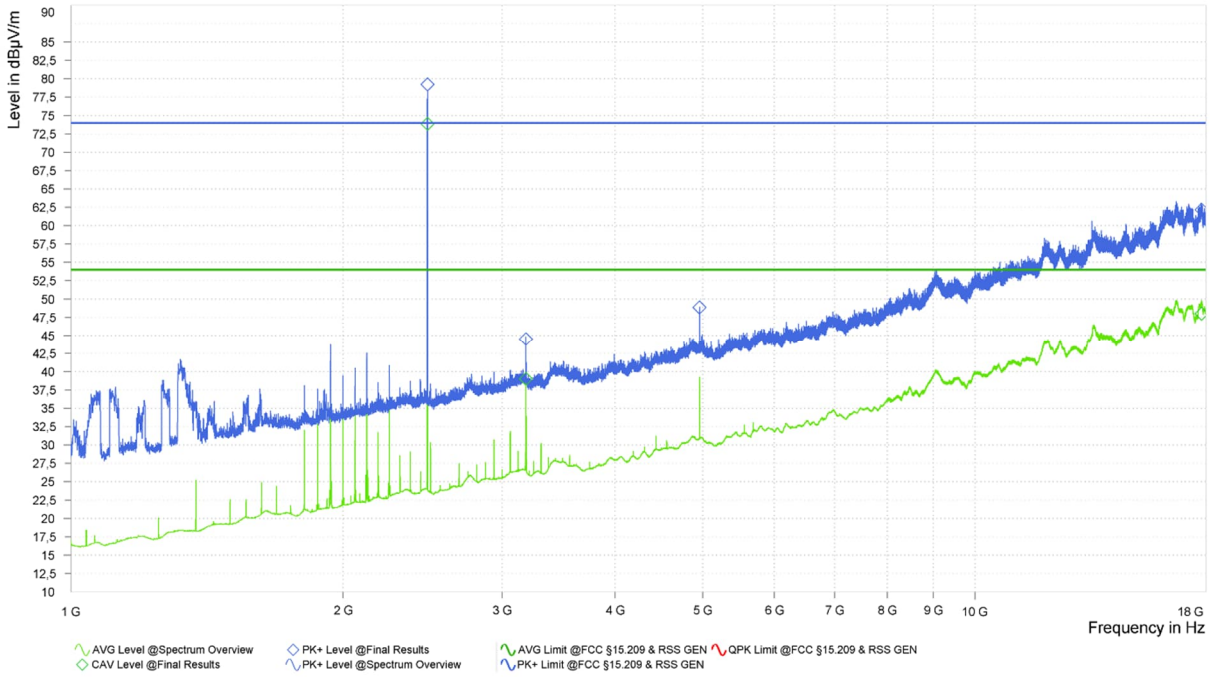
The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna positions.
The top measured curve represents the peak measurement. The measured points marked with "◇" are frequency points for the final peak detector measurement. These values are indicated in the following table. The bottom measured curve represents the average measurement. The measured points marked with "◇" are frequency points for the final average detector measurement.

Worst case plots:

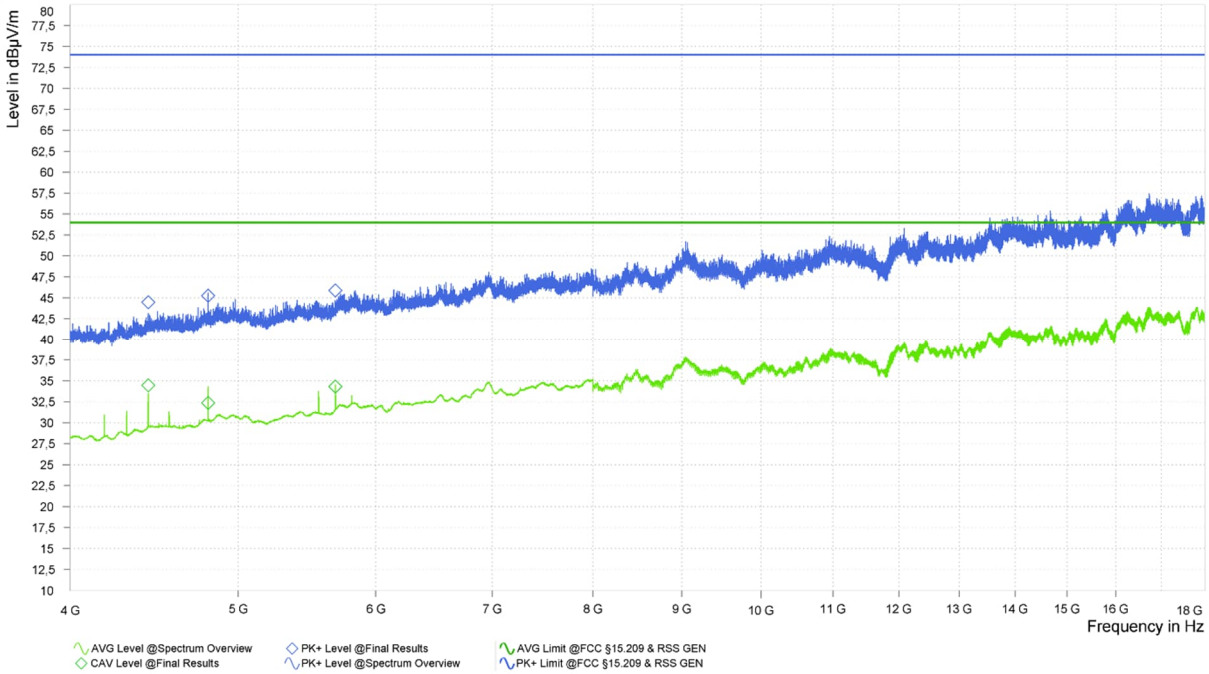
Spurious emissions from 1 GHz to 4 GHz (operation mode 66):



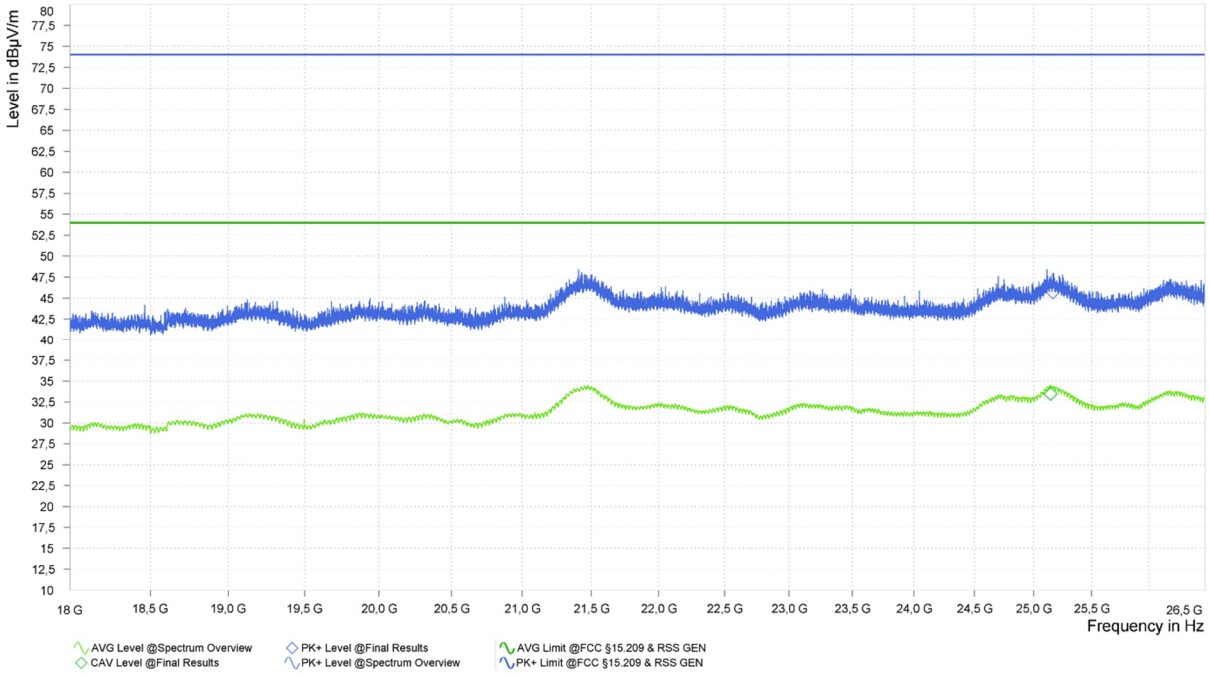
Spurious emissions from 1 GHz to 18 GHz (operation mode 42):



Spurious emissions from 4 GHz to 18 GHz (operation mode 66):



Spurious emissions from 18 GHz to 26.5 GHz (operation mode 67):



5.11.1.1.1 Result tables IRIS-W106

Operation mode 66:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2402.000	89.8	Fund.	-	84.3	Fund.	-	35.3	V	90	41
4437.500	44.5	74.0	29.5	34.5	54.0	19.5	8.0	H	150	119
4803.750	45.3	74.0	28.8	32.3	54.0	21.7	9.7	V	60	73
5687.500	45.9	74.0	28.1	34.3	54.0	19.7	11.5	H	150	83
24696.750	46.1	74.0	27.9	-	-	-	11.2	H	60	186
25141.750	-	-	-	33.2	54.0	20.8	11.5	H	90	23

Operation mode 67:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2440.000	89.6	Fund.	-	84.1	Fund.	-	35.4	V	90	10
4437.500	43.2	74.0	30.8	31.1	54.0	22.9	8.0	V	60	156
4879.750	46.7	74.0	27.3	35.4	54.0	18.6	9.9	V	60	273
5812.500	45.1	74.0	28.9	32.1	54.0	21.9	12.1	V	120	306
12007.250	51.1	74.0	23.0	38.3	54.0	15.7	23.4	V	120	203
25145.750	-	-	-	33.5	54.0	20.5	11.5	H	90	157
25163.250	45.7	74.0	28.3	-	-	-	11.5	V	90	87

Operation mode 68:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2480.000	88.6	Fund.	-	83.1	Fund.	-	35.4	90.0	7	2
4312.500	44.0	74.0	30.0	33.8	54.0	20.2	7.4	V	90	47
4959.750	48.9	74.0	25.1	37.7	54.0	16.3	10.1	V	150	102
5562.500	43.9	74.0	30.1	31.3	54.0	22.7	11.2	H	90	121
5687.500	45.7	74.0	28.3	35.7	54.0	18.3	11.5	H	30	71
25140.500	-	-	-	33.4	54.0	20.7	11.5	V	90	365
25169.750	46.1	74.0	27.9	-	-	-	11.5	V	0	200

5.11.1.1.2 Result tables IRIS-W101

Operation mode 41:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
21423.250	45.3	74.0	28.7	-	-	-	11.3	V	30	253
25140.500	-	-	-	33.1	54.0	20.9	11.5	V	150	-3

Operation mode 42:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2480.000	-	-	-	73.9	Fund.	-	-0.2	H	90	228
2480.250	79.2	Fund.	-	-	-	-	-0.2	H	90	228
3187.500	44.5	74.0	29.5	39.0	54.0	15.0	3.4	H	60	144
4959.500	48.8	74.0	25.2	-	-	-	10.1	V	150	105
17813.750	-	-	-	48.0	54.0	6.0	30.7	H	150	189
17815.500	62.2	74.0	11.8	-	-	-	30.7	H	90	249

Test result: Passed

5.11.1.2 Test results WLAN (radiated 1 GHz to 26.5 GHz) – 802.15.4

Ambient temperature:	22 °C – 23 °C
Relative humidity:	18 % - 29 %

Date	08.03.2024 - 13.03.2024
Tested by	P. Neufeld

Position of EUT: For tests for f between 1 GHz and the 10th harmonic, the EUT was set-up on a positioner device with a height of 150 cm. The distance between EUT and antenna was 3 m.

Cable guide: For detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

Test record: Plots for each frequency range are submitted below.

Remark: No spurious emissions were found during the antenna port conducted pre-tests. Therefore, the emission with the highest power spectral density was used for the radiated emissions tests, namely 802.15.4 with 250 kbps.

When the peak emissions are below the average limit line, no final measurement is performed. Also, when only peak noise is above the average limit, only the highest noise value is measured in the final measurement.

Calculation:

Max Peak [dBµV/m] = Reading (Pk+) [dBµV] + Correction [dBµV/m]

Average [dBµV/m] = Reading (Av) [dBµV] + Correction [dBµV/m]

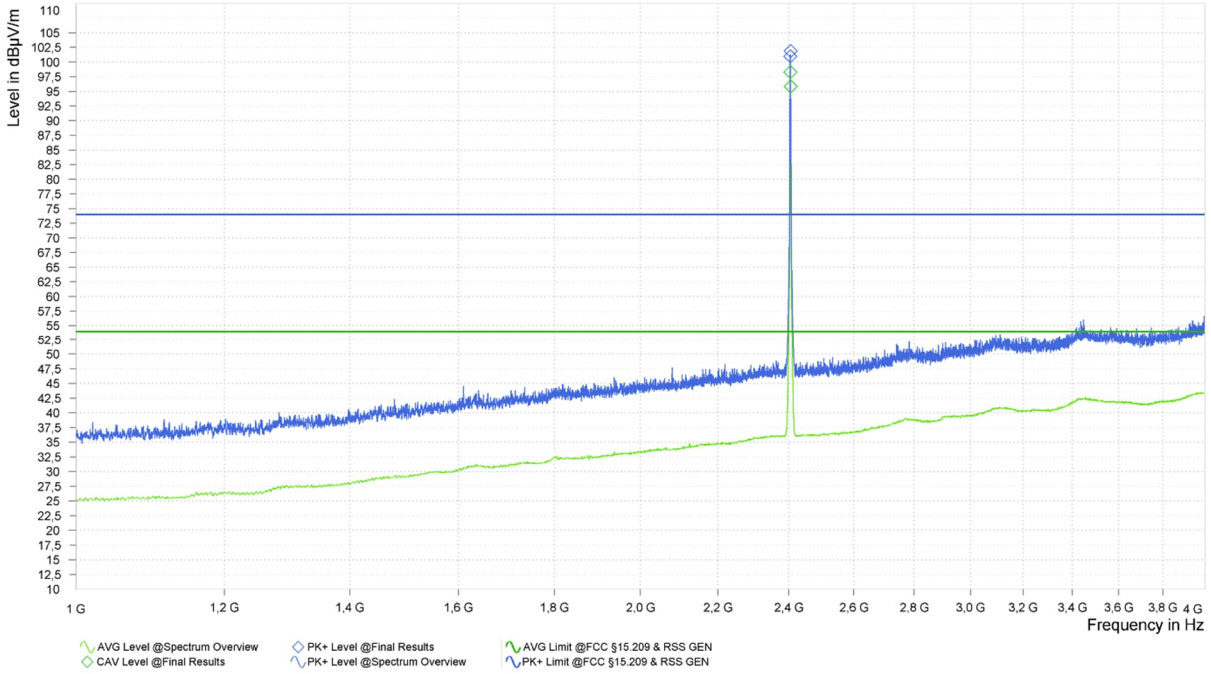
Correction [dBµV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]+DCCF* [dB]
* (if applicable – only for Average values, that are fundamental related)

Margin [dB] = Limit [dBµV/m] – Max Peak | Average [dBµV/m]

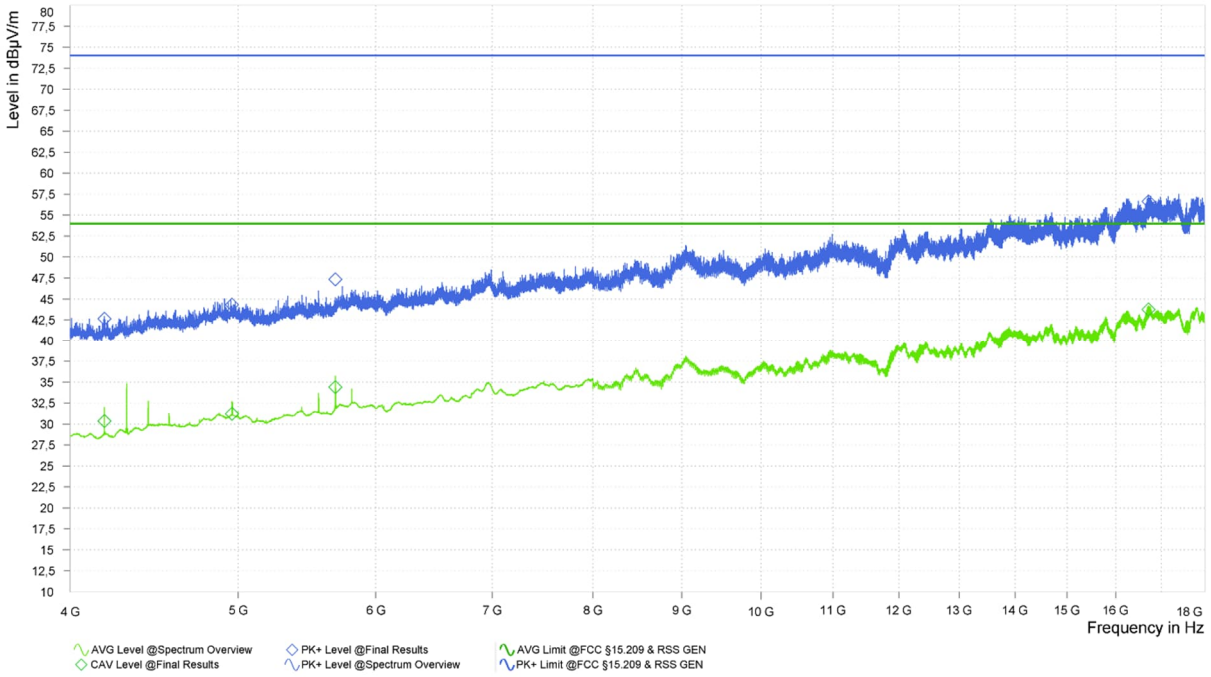
The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna positions.
The top measured curve represents the peak measurement. The measured points marked with "◇" are frequency points for the final peak detector measurement. These values are indicated in the following table. The bottom measured curve represents the average measurement. The measured points marked with "◇" are frequency points for the final average detector measurement.

Worst case plots:

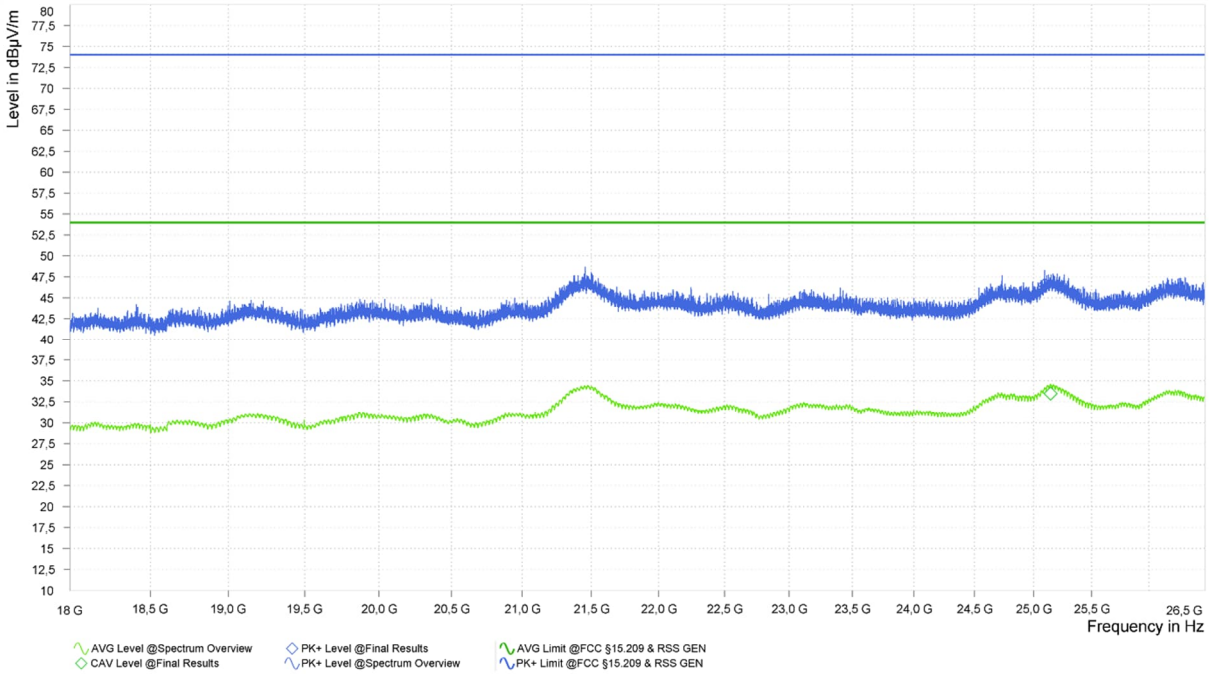
Spurious emissions from 1 GHz to 4 GHz (operation mode 69):



Spurious emissions from 4 GHz to 18 GHz (operation mode 72):



Spurious emissions from 18 GHz to 26.5 GHz (operation mode 72):



5.11.1.2.1 Result tables IRIS-W106

Operation mode 69:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2405.000	101.0	Fund.	-	98.3	Fund.	-	35.3	V	90	40
2405.500	101.9	Fund.	-	95.8	Fund.	-	35.3	V	90	41
4312.500	43.3	74.0	30.7	32.5	54.0	21.5	7.4	V	60	42
4809.000	49.1	74.0	24.9	39.0	54.0	15.0	9.7	V	0	40
4811.000	48.6	74.0	25.4	38.3	54.0	15.7	9.7	V	30	40
5562.500	44.9	74.0	29.1	33.8	54.0	20.3	11.2	H	60	125
5687.500	46.7	74.0	27.3	36.4	54.0	17.6	11.5	H	150	73
21434.750	45.7	74.0	28.3	-	-	-	11.4	V	60	146
21475.000	-	-	-	32.5	54.0	21.5	11.5	V	90	235

Operation mode 70:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2440.000	99.8	Fund.	-	97.2	Fund.	-	35.4	V	90	11
2440.500	100.7	Fund.	-	94.7	Fund.	-	35.4	V	90	11
4312.500	43.4	74.0	30.6	33.1	54.0	20.9	7.4	V	30	49
4879.000	47.9	74.0	26.1	36.7	54.0	17.3	9.9	V	60	278
5562.500	45.0	74.0	29.0	33.4	54.0	20.6	11.2	H	150	124
5687.500	46.1	74.0	28.0	35.2	54.0	18.8	11.5	H	60	123
25141.750	-	-	-	33.3	54.0	20.7	11.5	H	90	11
25149.500	46.3	74.0	27.7	-	-	-	11.5	H	90	224

Operation mode 71:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2475.000	98.7	Fund.	-	95.9	Fund.	-	35.4	V	90	10
2475.500	99.5	Fund.	-	93.4	Fund.	-	35.4	V	90	11
4312.500	43.5	74.0	30.5	33.3	54.0	20.7	7.4	V	120	49
4949.000	47.6	74.0	26.4	36.5	54.0	17.5	10.1	V	150	96
4951.000	46.7	74.0	27.3	36.1	54.0	17.9	10.1	V	150	93
5562.500	44.7	74.0	29.3	31.9	54.0	22.1	11.2	H	60	97
5687.500	46.3	74.0	27.7	36.2	54.0	17.8	11.5	H	150	72
25147.750	46.3	74.0	27.8	-	-	-	11.5	V	30	65
25152.250	-	-	-	33.2	54.0	20.9	11.5	V	30	250

Operation mode 72:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2479.500	85.0	Fund.	-	78.6	Fund.	-	35.4	V	90	7
2480.000	84.3	Fund.	-	80.8	Fund.	-	35.4	V	90	10
4187.500	42.7	74.0	31.3	30.3	54.0	23.7	6.8	H	90	6
4959.000	44.3	74.0	29.7	31.2	54.0	22.8	10.1	V	90	241
5687.500	47.4	74.0	26.6	34.4	54.0	19.6	11.5	H	30	333
16711.000	56.6	74.0	17.4	43.8	54.0	10.3	29.5	V	60	169
25093.500	46.5	74.0	27.5	-	-	-	11.5	H	150	35
25144.750	-	-	-	33.5	54.0	20.5	11.5	H	150	293

5.11.1.2.2 Result tables IRIS-W101

Operation mode 52:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Azimuth [deg]
2405.000	-	-	-	61.0	Fund.	-	-0.4	H	120	216
2405.500	64.8	Fund.	-	-	-	-	-0.4	H	120	217
3187.500	45.0	74.0	29.0	39.8	54.0	14.2	3.4	H	0	150
4809.000	-	-	-	34.3	54.0	19.7	9.7	V	30	109
16710.750	-	-	-	48.0	54.0	6.0	29.5	V	120	131
16712.250	61.5	74.0	12.6	-	-	-	29.5	H	150	132

Operation mode 53:

Frequency [MHz]	PK+ [dBµV/m]	Pk+ Limit [dBµV/m]	PK+ Margin [dB]	AV [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Corr. [dB/m]	Pol	Elevation [deg]	Az//imuth [deg]
21476.000	44.5	74.0	29.5	32.4	54.0	21.6	11.5	H	60	139
25140.500	45.7	74.0	28.4	33.1	54.0	20.9	11.5	H	60	31

Test result: Passed

Test equipment (please refer to chapter 7 for details)
3 – 9, 12 – 16

5.11.2 Test setup (Conducted emissions on power supply lines)

Test setup (Conducted emissions on power supply lines)			
Used	Setup	See sub-clause	Comment
☒	Conducted: AC power line	4.1.1	-
☐	Not applicable, because …	-	-

5.11.3 Test method (Conducted emissions on power supply lines)

Test setup (Conducted emissions on power supply lines)				
Used	Clause [1]	Name of method	Sub-clause	Comment
☒	7.3; 11.5; 11.8	Tabletop equipment testing	4.1.1	Provided AC switching power adaptor
☐	7.3; 11.6; 11.8	Floor-standing equipment testing	-	-

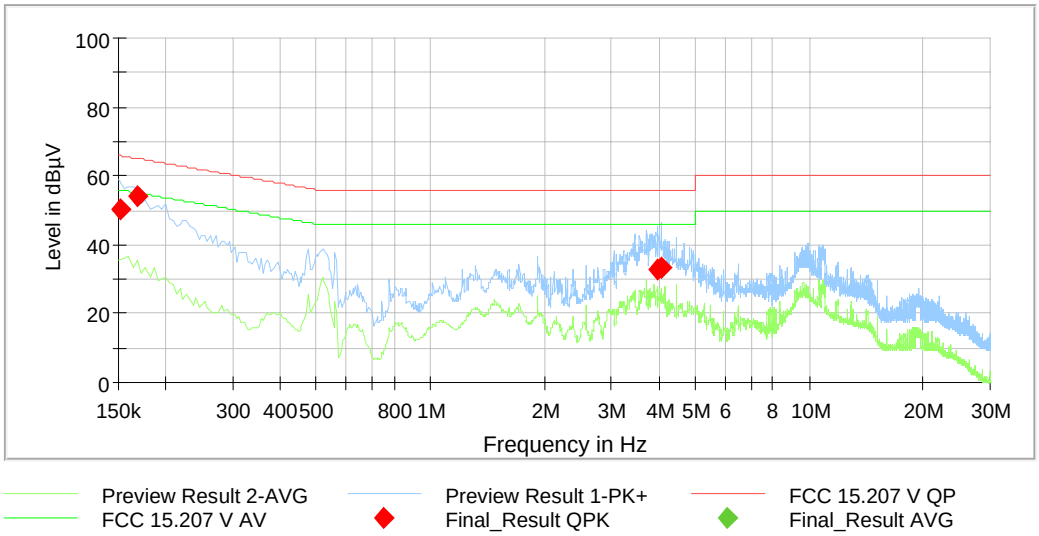
EUT on evaluation board was connected to a Laptop PC “Latitude 7280” by “Dell” during the tests. The Laptop computer was supplied by AC Adapter Model “LA65NM130 LPS” by “Dell” during the tests.
The power adaptor itself was supplied by 120V_{AC} 60Hz.

5.11.4 Test results (Conducted emissions on power supply lines) – IRIS-W106

Ambient temperature:	22 °C
Relative humidity:	42 %

Date:	03.04.2024
Tested by:	P. NEUFELD

The curves in the diagrams below only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The quasi-peak measured points are marked by ◆ and the average measured points by ◆.



Frequency [MHz]	QuasiPeak [dB(µV)]	Average [dB(µV)]	Limit [dB(µV)]	Margin [dB]	Line	PE
0.151800	50.09	---	65.90	15.81	L1	FLO
0.168000	54.30	---	65.06	10.76	N	FLO
3.997500	33.00	---	56.00	23.00	L1	FLO
4.048800	33.46	---	56.00	22.54	L1	GND

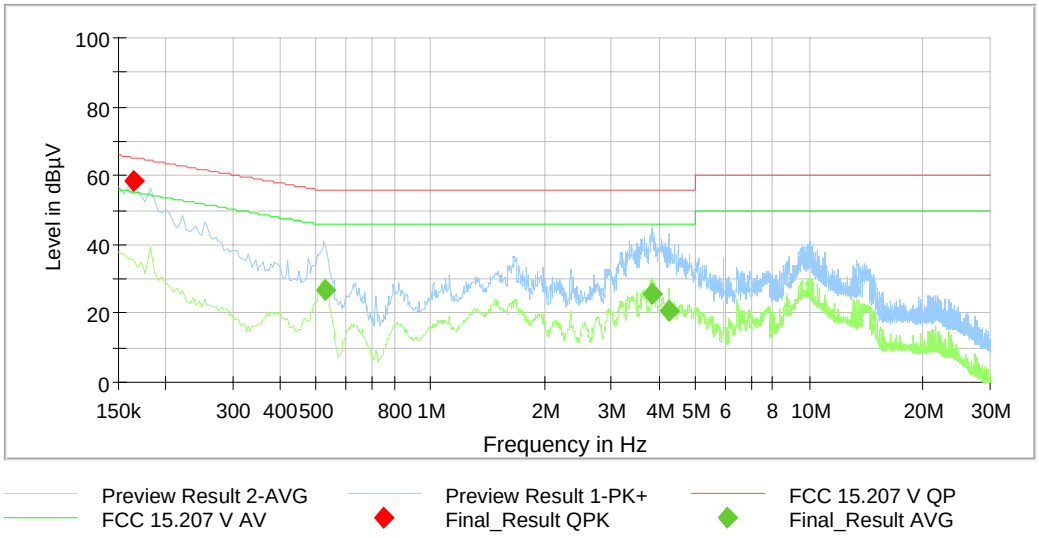
Test result: Passed

5.11.5 Test results (Conducted emissions on power supply lines) – IRIS-W101

Ambient temperature:	22 °C
Relative humidity:	42 %

Date:	03.04.2024
Tested by:	P. NEUFELD

The curves in the diagrams below only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The quasi-peak measured points are marked by ◆ and the average measured points by ◆.



Frequency [MHz]	QuasiPeak [dB(µV)]	Average [dB(µV)]	Limit [dB(µV)]	Margin [dB]	Line	PE
0.164400	58.49	---	65.24	6.75	L1	FLO
0.527100	---	26.79	46.00	19.21	N	FLO
3.844500	---	25.71	46.00	20.29	N	FLO
4.272000	---	20.58	46.00	25.42	L1	GND

Test result: Passed

Test equipment (please refer to chapter 7 for details)
17 - 22

6 Measurement Uncertainties

Conducted measurements:		
Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) U_{lab}
Frequency error	ETSI TR 100 028	4.5×10^{-8}
Bandwidth measurements	-	9.0×10^{-8}
Conducted emissions using a spectrum analyzer		
< 3.6 GHz	ETSI TR 100 028	2.3 dB
3.6 – 8 GHz	ETSI TR 100 028	2.8 dB
8 – 22 GHz	ETSI TR 100 028	3.2 dB
22 – 40 GHz	ETSI TR 100 028	3.6 dB
Power measurements		
Power meter	ETSI TR 100 028	0.9 dB
Conducted emissions from 150 kHz to 30 MHz with LISN	CISPR 16-4-2	2.8 dB
Radiated measurements:		
Frequency error		
(Semi-) Anechoic chamber	ETSI TR 100 028	4.5×10^{-8}
OATS	ETSI TR 100 028	4.5×10^{-8}
Test fixture	ETSI TR 100 028	4.5×10^{-8}
Bandwidth measurements		
(Semi-) Anechoic chamber	-	9.0×10^{-8}
OATS	-	9.0×10^{-8}
Test fixture	-	9.1×10^{-8}
Radiated field strength M20		
CBL6112B @ 3 m 30 MHz – 1 GHz	CISPR 16-4-2	5.3 dB
R&S HL050 @ 3 m		
1 – 6 GHz	CISPR 16-4-2	5.1 dB
6 – 18 GHz	CISPR 16-4-2	5.4 dB
Flann Standard Gain Horns 18 – 40 GHz	-	5.9 dB
Radiated field strength M276		
R&S HL562E @ 3 m 30 MHz – 1 GHz	CISPR 16-4-2	4.8 dB
R&S HL050 @ 3 m	-	
1 – 6 GHz	CISPR 16-4-2	5.1 dB
6 – 18 GHz	CISPR 16-4-2	5.4 dB
Flann Standard Gain Horns 18 – 40 GHz	-	5.9 dB
OATS		
Field strength measurements below 30 MHz on OATS without ground plane	-	4.4 dB

7 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Signal & Spectrum Analyzer	FSW43	Rohde & Schwarz	100586 & 100926	481720	19.11.2021 17.03.2023	11.2023 03.2025
2	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	22.02.2022 21.02.2024	02.2024 02.2026
3	Testsoftware M276	Elektra V5.01	Rohde & Schwarz	101381	483755	Calibration not necessary	
4	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
5	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
6	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
7	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
8	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
9	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	08.12.2021 21.02.2024	02.2024 02.2026
10	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	483152	18.05.2021	05.2024
11	Attenuator 6dB	WA-2	Weinschel Corp	BG0931	483499	Calibration not necessary	
12	Standard Gain Horn 20 dB, 18 GHz -26 GHz	20240-20	Flann	266399	483026	Calibration not necessary	
13	Low Noise Amplifier 18 GHz - 26.5 GHz	LNA-30-18002650-20-10P	Narda Miteq	2110911	482969	18.02.2022 19.02.2024	02.2024 02.2026
14	Low Noise Amplifier 100 MHz - 18 GHz	LNA-30-00101800-25-10P	Narda Miteq	2110917	482967	18.02.2022 20.02.2024	02.2024 02.2026
15	Log.Per Antenna 850 MHz - 26 GHz	HL050	Rohde&Schwarz	100908	482977	22.09.2022 19.02.2024	09.2025 02.2026
16	Highpass Filter	WHK2.8/18G-10SS	Wainwright Instuments GmbH	1	480867	Calibration not necessary	
17	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	05.03.2024	03.2026
18	Artificial mains network	NSLK8128	Schwarzbeck	8128161	480138	28.02.2024	02.2026
19	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	22.02.2024	02.2026
20	Testsoftware M4	EMC32 V10.60.20	Rohde & Schwarz	100061	481022	Calibration not necessary	
21	Power supply AC	AC6803A AC Quelle 2000VA	Keysight	JPVJ002509	482350	Calibration not necessary	
22	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	

8 Test site Validation

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA/RSM	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	03.03.2021 01.03.2023	02.03.2023 28.02.2025
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	25.02.2021* 28.02.2023*	24.02.2023 27.03.2023
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	17.08.2022	16.08.2024
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	08.11.2022	07.11.2025

* All tests were performed during a time period when the SVSWR for the anechoic chamber was valid.

9 Report History

Report Number	Date	Comment
F231636E1	18.07.2024	Initial Test Report
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10 List of Annexes

Annex A	Test Setup Photos (IRIS-W101-00B)	20 pages
Annex B	Test Setup Photos (IRIS-W106-00B)	21 pages