

Test Report

Report Number:

F241001E5 2nd Version

Equipment under Test (EUT):

Einschub UI Fortis

Applicant:

Fronius International GmbH

Manufacturer:

Fronius International GmbH



Deutsche
Akkreditierungsstelle
D-PL-17186-01-00

References

- [1] **ANSI C63.10-2020 + Cor. 1-2023 + C63.10a-2024 + Errata to C63.10a-2024***, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
*Remark: This standard is not in the annex of the laboratory yet
- [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 4 (2025-07)** Digital Transmission Systems, Frequency Hopping Systems and Licence-Exempt Local Area Network Devices in 902-928 MHz, 2400-2483.5 MHz, 5150-5350 MHz, and 5470-5895 MHz bands
- [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 [1]. However, the measurement uncertainty is calculated and shown in this test report.

Tested and written
by:

Signature

Reviewed and
approved by:

Signature

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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

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Applicant represented during the test by the following person:	Mr. Jan Herndler

1.2 Manufacturer

Name:	Fronius International GmbH
Address:	Günter-Fronius-Straße 1, 4600 Wels-Thalheim
Country:	Austria
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Phone:	+43-7242-241-0
eMail address:	herndler.jan@fronius.com
Applicant represented during the test by the following person:	Mr. Jan Herndler

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)

Test object: *	User Interface for welding machines
Model name: *	Einschub UI Fortis
Model number: *	43,0001,1753
Order number: *	NA
FCC ID: *	QKWACU1
IC certification number: *	12270A-ACU1
PMN: *	Einschub UI Fortis
HVIN: *	V0.5A_C
FVIN: *	N/A

	EUT number		
	1	2	3
Serial number: *	None (marked as "Sample 1")	-	-
PCB identifier: *	ACU1/ V0.5A_C & ENCO3/ V0.4A_A	-	-
Hardware version: *	V0.5A_C	-	-
Software version: *	MML_1.1.0-36571.40861-RD	-	-

* Declared by the applicant

One EUT was used for all tests.

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: *	DC		
Supply voltage EUT: *	$U_{nom} = 24 \text{ V}_{DC}$	$U_{min} = 21.6 \text{ V}_{DC}$	$U_{max} = 26.4 \text{ V}_{DC}$
Temperature range: *	-20°C to +65°C		
Lowest / highest internal clock frequency: *	20 kHz / 2480 MHz		

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Ethernet	HSD	RJ45	3 m	Yes
Speednet	HSD	RJ45	3 m	Yes
DC mains	Customized	4 mm laboratory plug	≥ 1 m	No

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

Bluetooth® low energy radio mode	
Fulfills radio specification: *1	Bluetooth® low energy (BLE) 5.2
Radio chip: *1	u-blox MAYA-W166
Antenna type: *1	Dipole antenna
Antenna name: *1	Taoglas FXP831
Antenna gain: *2	Peak: +3.28 dBi Average: -2.44 dBi
Antenna connector: *1	UFL
Supply voltage BLE module: *1	$U_{nom} = 3.3V_{DC}$ $U_{min} = 3.14 V_{DC}$ $U_{max} = 3.46 V_{DC}$
Type of modulation: *1	BLE (1 Mbps PHY) GFSK
	BLE (2 Mbps PHY) GFSK
	BLE (500 kbps coded PHY) GFSK
	BLE (125 kbps coded PHY) GFSK
Operating frequency range: *1	BLE (1 Mbps PHY) 2402 – 2480 MHz
	BLE (2 Mbps PHY) 2402 – 2480 MHz
	BLE (500 kbps coded PHY) 2402 – 2480 MHz
	BLE (125 kbps coded PHY) 2402 – 2480 MHz
Number of channels: *1	BLE (1 Mbps PHY) 40 (2 MHz channel spacing)
	BLE (2 Mbps PHY) 40 (2 MHz channel spacing)
	BLE (500 kbps coded PHY) 40 (2 MHz channel spacing)
	BLE (125 kbps coded PHY) 40 (2 MHz channel spacing)

*1 declared by the applicant

*2 according to the document “FXP831.07.0100C” from Taoglas antenna solution provided by the applicant

1.5.1 Ancillary Equipment / Equipment used for testing

Equipment used for testing	
Laptop PC*1	Fujitsu Lifebook U Series

*1 Provided by the laboratory

1.6 Dates

Date of receipt of test sample:	04.12.2024
Start of test:	08.01.2025
End of test:	06.02.2025

2 Operational States

2.1 Description of function of the EUT

The EUT is a steering unit for welding inverters.

For the radio tests the following settings were used:

A connection to the EUT was established via ethernet to a laptop. The respective test modes were set via console commands. During all tests the EUT was supplied by 24V DC.

2.1.1 Operation modes

Operation mode #	Radio technology	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate	Power setting
1	Bluetooth® LE	2402	0	GFSK	1 Mbit/s	"10 dBm"
2	Bluetooth® LE	2440	19	GFSK	1 Mbit/s	"10 dBm"
3	Bluetooth® LE	2480	39	GFSK	1 Mbit/s	"10 dBm"
4	Bluetooth® LE	2402	0	GFSK	2 Mbit/s	"10 dBm"
5	Bluetooth® LE	2440	19	GFSK	2 Mbit/s	"10 dBm"
6	Bluetooth® LE	2480	39	GFSK	2 Mbit/s	"10 dBm"
7	Bluetooth® LE	2402	0	GFSK	0.5 Mbit/s	"10 dBm"
8	Bluetooth® LE	2440	19	GFSK	0.5 Mbit/s	"10 dBm"
9	Bluetooth® LE	2480	39	GFSK	0.5 Mbit/s	"10 dBm"
10	Bluetooth® LE	2402	0	GFSK	0.125 Mbit/s	"10 dBm"
11	Bluetooth® LE	2440	19	GFSK	0.125 Mbit/s	"10 dBm"
12	Bluetooth® LE	2480	39	GFSK	0.125 Mbit/s	"10 dBm"

3 Additional Information

The EUT was not labeled as required by FCC / IC. The tests were done with an unmodified sample.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [4] RSS-Gen [5]	Tested EUT	Status
Maximum conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	6.3.2 [4]	1	Passed
DTS Bandwidth / 99% Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	6.3.1 [4]	1	Passed
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	6.3.1 [4]	1	Passed
Average Power Spectral Density	2400.0 - 2483.5	15.247 (e)	6.3.1 [4]	1	Passed
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	6.6 [4]	1	Passed* ¹
Maximum unwanted emissions	0.009 – 26,500	15.247 (d) 15.205 (a) 15.209 (a)	8.9 [5]	1	Passed* ^{1*2}
Antenna Requirement	-	15.203 15.247 (b)	6.8 [5] 6.5 (c) (ii) [4]	-	-
Conducted emissions on supply line	0.15 – 30	15.207 (a)	8.8 [5]	1	Passed

*¹ As pre-tests have shown only the worst cases were tested.

*²: As declared by the applicant the highest radio clock frequency is 2.48 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.

5 Results

5.1 Test setups

5.1.1 Radiated: 9 kHz to 30 MHz

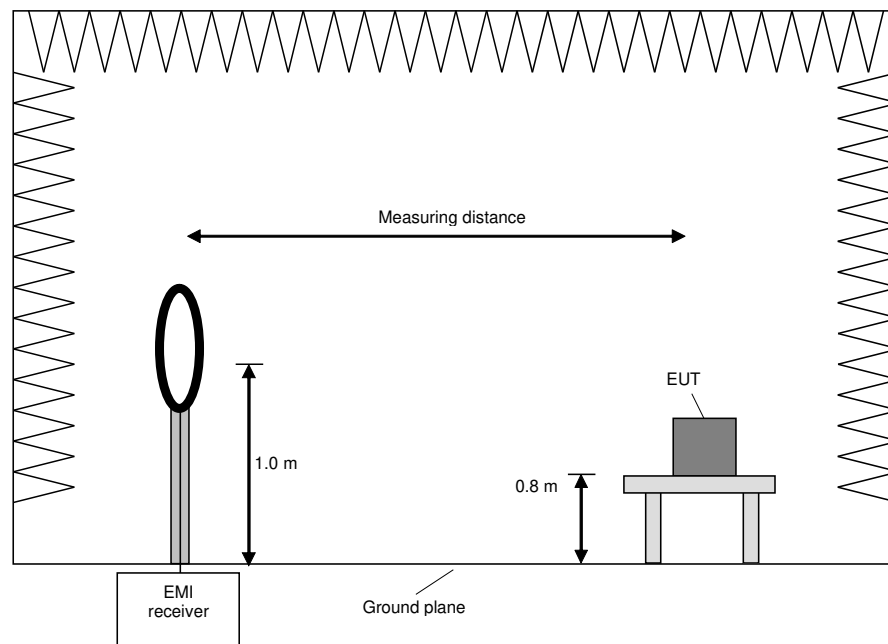
5.1.1.1 Preliminary measurement 9 kHz to 30 MHz

In the first stage a preliminary measurement is performed in a semi-anechoic chamber at a measuring distance of 3 meters. 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. Floor-standing devices are placed directly on the turntable / ground plane. The setup of the equipment under test is in accordance with [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.

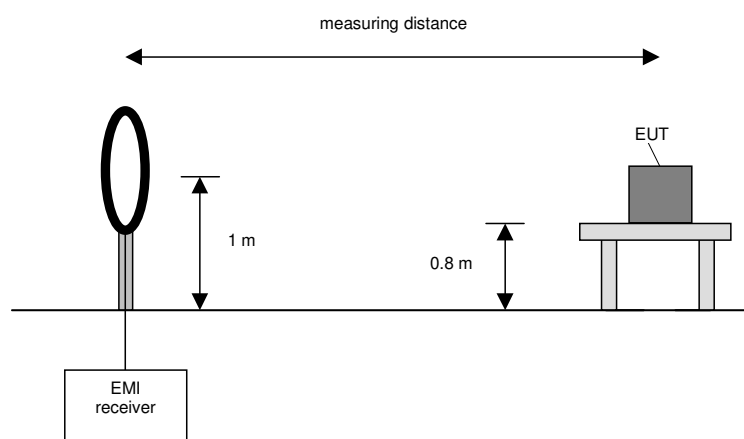
5.1.1.2 Final measurement 9 kHz to 30 MHz

In the second stage a final measurement is performed on an open area test site with no conducting ground plane at a measuring distance of 3 m, 10 m, or 30 m. If the standard requires larger measuring distances for a given frequency, the results are extrapolated 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	Measuring time
9 kHz to 150 kHz	200 Hz	1 s
150 kHz to 30 MHz	9 kHz	1 s



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.

5.1.2 Radiated: 30 MHz to 1 GHz

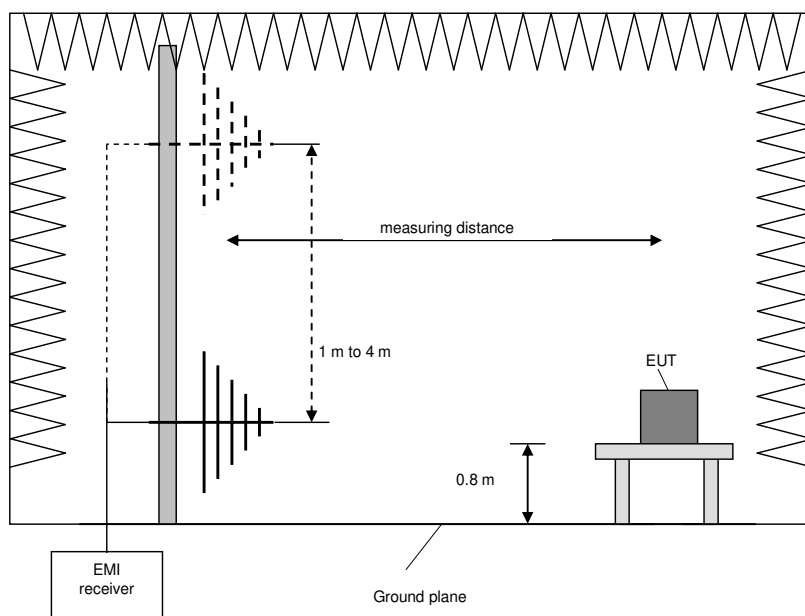
5.1.2.1 Preliminary and final measurement 30 MHz to 1 GHz

The preliminary and final measurements are performed in a semi-anechoic chamber with a metal ground plane at a measuring distance of 3 meters. 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. Floor-standing devices are placed directly on the turntable / ground plane. The setup of the equipment under test is in accordance with [1].

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	Measuring time	Detector
Preliminary measurement	30 MHz to 1 GHz	30 kHz	120 kHz	-	Peak Average
Frequency peak search	± 120 kHz	10 kHz	120 kHz	1 s	Peak
Final measurement	30 MHz to 1 GHz	-	120 kHz	1 s	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.

5.1.3 Radiated: 1 GHz to 40 GHz

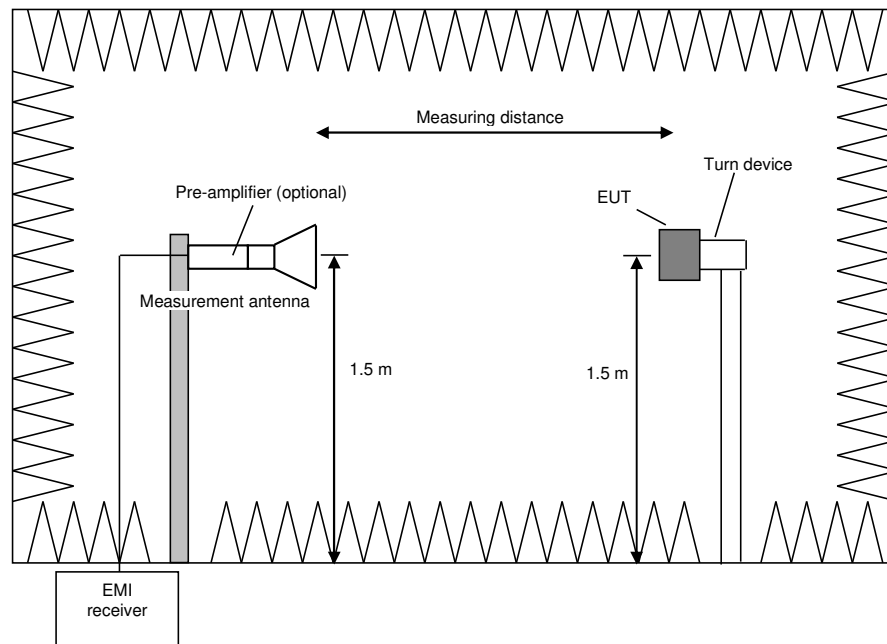
5.1.3.1 Preliminary and final measurement 1 GHz to 40 GHz

The preliminary and final measurements are performed in a fully anechoic chamber at a measuring distance of 3 meters. Table-top devices are set up on a non-conducting turn device at the height of 1.5 m. The setup of the equipment under test is in accordance with [1].

During the tests the EUT is rotated in the range of 0 ° to 360 ° and the measuring antenna is set to horizontal and vertical polarization to find the maximum level of emissions. After these steps, the measurement is repeated after reorientating the EUT in 30 ° steps.

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

Test	Frequency range	Step-size	Resolution bandwidth	Measuring time	Detector
Preliminary measurement	1 GHz - 40 GHz	250 kHz	1 MHz	-	Peak Average
Final measurement	1 GHz - 40 GHz	-	1 MHz	100 ms	Peak Average



Procedure preliminary measurement:

The following procedure is used:

- 1) Monitor the frequency range at horizontal polarisation of the measuring antenna and an EUT / turntable azimuth of 0 °.
- 2) Rotate the EUT by 360° to maximize the detected signals.
- 3) Repeat steps 1 to 2 with the vertical polarisation of the measuring antenna.
- 4) Repeat steps 1 to 3 with the EUT reorientated by an angle of 30° (60°, 90°, 120° and 150°), according to 6.6.5.4 in [1].
- 5) The highest values for each frequency are saved by the software, including the measuring antenna polarization, the turntable azimuth and the turn device elevation for that value.

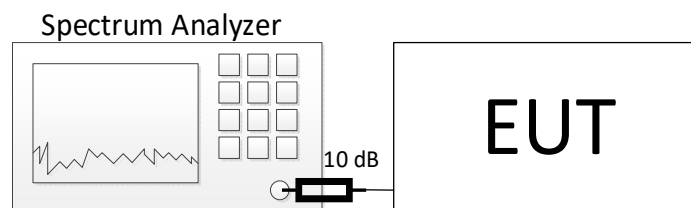
Procedure final measurement:

The following procedure is used:

- 1) Set the turntable and the turn device to the position which leads to the highest emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna to the polarisation which leads to the highest emission for the first frequency identified in the preliminary measurements.
- 3) Set the spectrum analyser to EMI mode with Peak and Average detector activated.
- 4) 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.
- 5) The final measurement is performed at the worst-case turntable azimuth.
- 6) Repeat steps 1 to 5 for each frequency detected during the preliminary measurements.

5.1.4 Conducted: Antenna port

Test setup (conducted)		
Used	Antenna connector	Comment
<input checked="" type="checkbox"/>	Temporary antenna connector	As provided by the applicant
<input type="checkbox"/>	Normal antenna connector	-



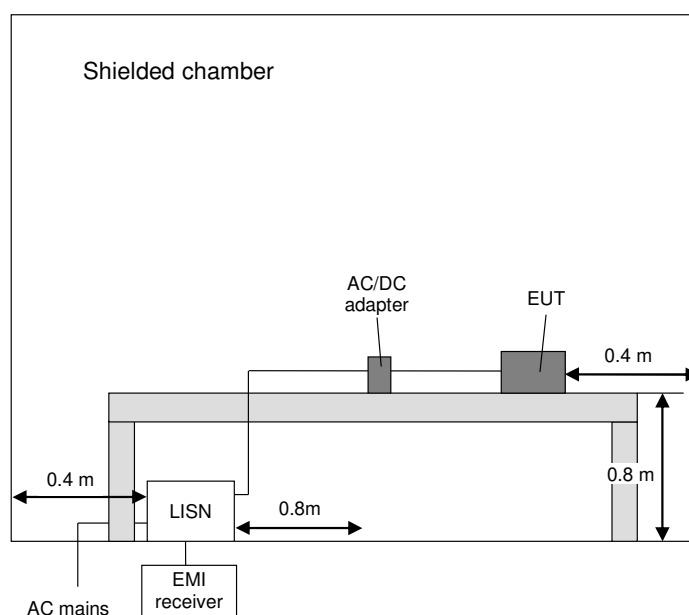
The 10 dB external attenuation are considered in all relevant plots

5.1.5 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 appropriate 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



5.2 Duty cycle

5.2.1 Test setup (Duty cycle)

Test setup (Duty cycle)			
Used	Setup	See sub-clause	Comment
<input type="checkbox"/>	Radiated: 1 GHz to 40 GHz	5.1.3	-
<input checked="" type="checkbox"/>	Conducted: Antenna port	5.1.4	-

5.2.2 Test method (Duty cycle)

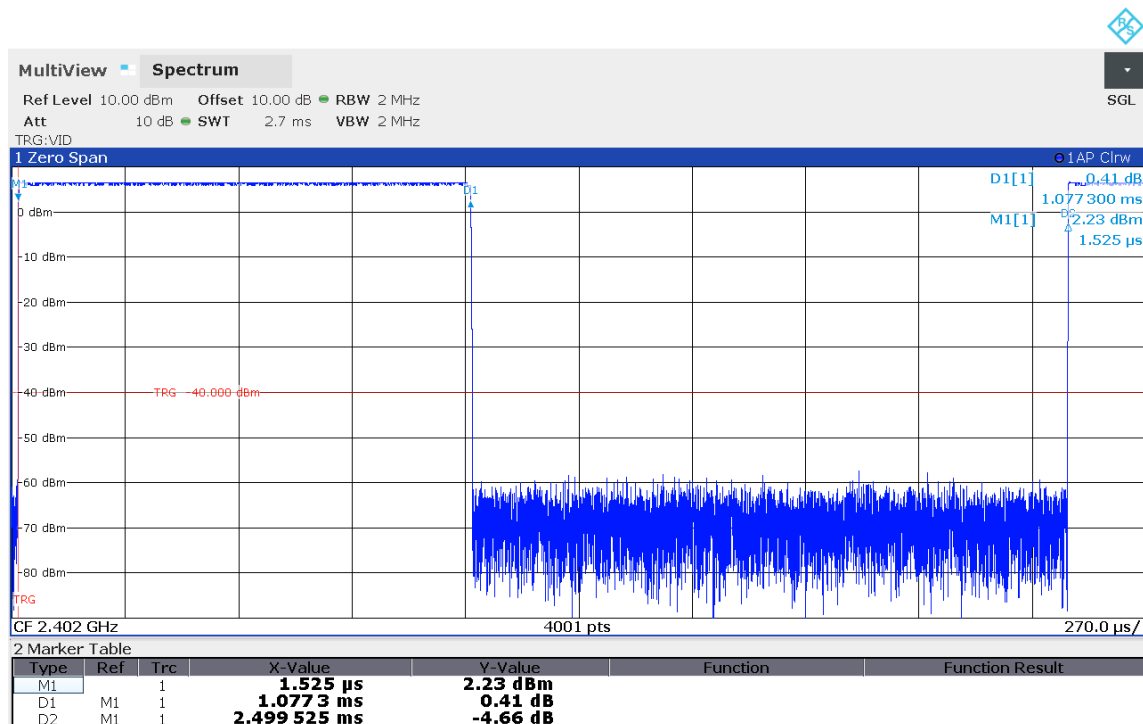
Test method (Duty cycle)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input type="checkbox"/>	11.6. a)	Diode detector	No limitation	-
<input checked="" type="checkbox"/>	11.6. b)	Zero span	No limitation	-

5.2.3 Test results (Duty cycle)

Ambient temperature:	21.6 °C
Relative humidity:	24 %

Date:	08.01.2025
Tested by:	P. NEUFELD

Worst case plot (operation mode 5):



Operation Mode #	Sweep time [ms]	Meas points >100?	Duty cycle %	DCCF _{Fieldstrength} [dB]	DCCF _{Power} [dB]
1 – 3	2.7	☒	85.3	1.38	0.69
4 – 6	2.7	☒	43.1	7.31	3.66
7 – 9	10.5	☒	45.6	6.82	3.41
10 – 12	20.5	☒	85.2	1.39	0.69

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

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

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

For average measurements a correction factor of 1.38 dB or 0.69 dB is used for all tests in test mode 1 – 3.
 For average measurements a correction factor of 7.31 dB or 3.66 dB is used for all tests in test mode 4 – 6.
 For average measurements a correction factor of 6.82 dB or 3.41 dB is used for all tests in test mode 7 – 9.
 For average measurements a correction factor of 1.39 dB or 0.69 dB is used for all tests in test mode 10 – 12.

Test equipment (please refer to chapter 7 for details)

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5.3 DTS bandwidth

5.3.1 Test setup (DTS bandwidth)

Test setup (DTS bandwidth)			
Used	Setup	See sub-clause	Comment
<input type="checkbox"/>	Radiated: 1 GHz to 40 GHz	5.1.3	-
<input checked="" type="checkbox"/>	Conducted: Antenna port	5.1.4	-

5.3.2 Test method (DTS bandwidth)

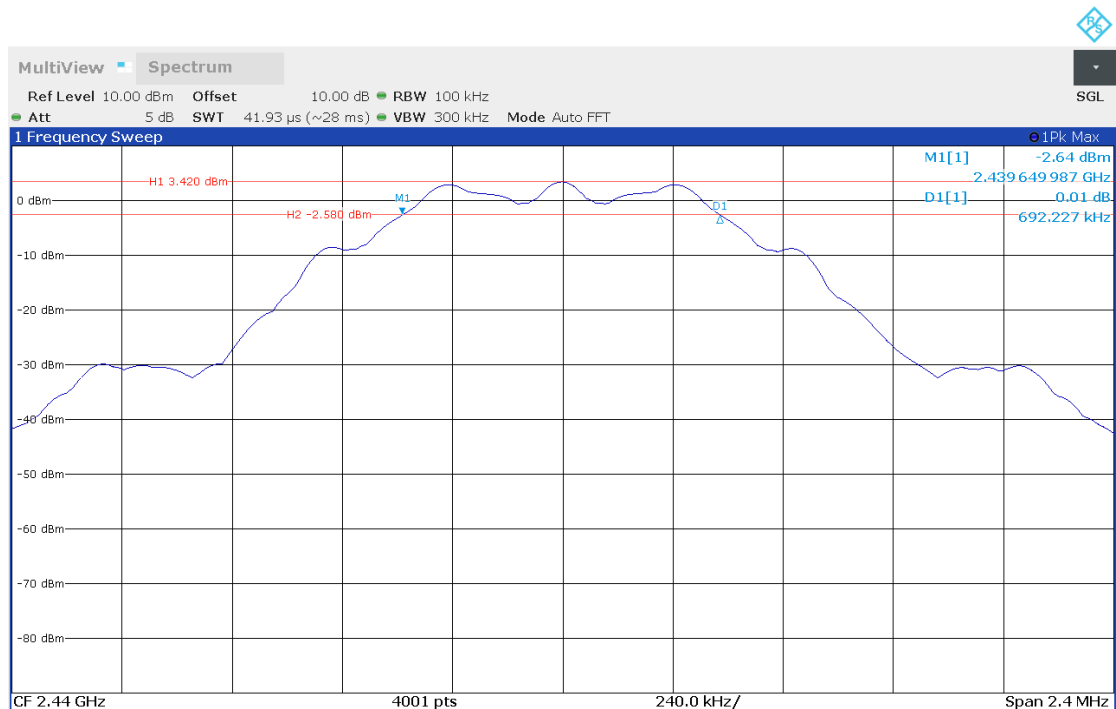
Test method (DTS bandwidth)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	11.8.1	Option 1	No limitations	-
<input type="checkbox"/>	11.8.2	Option 2	No limitations	6 dB down function

5.3.3 Test results (DTS bandwidth)

Ambient temperature:	21.6 °C
Relative humidity:	24 %

Date:	08.01.2025
Tested by:	P. Neufeld

Worst case plot (operation mode 11):



Operation mode #	DTS bandwidth [MHz]	Minimum DTS bandwidth Limit [MHz]
1	0.759410	0.5
2	0.765409	0.5
3	0.764809	0.5
4	1.446138	0.5
5	1.429643	0.5
6	1.428543	0.5
7	0.764209	0.5
8	0.730617	0.5
9	0.748613	0.5
10	0.697026	0.5
11	0.692227	0.5
12	0.694027	0.5

Test result: Passed

Test equipment (please refer to chapter 7 for details)

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5.4 Occupied bandwidth – power bandwidth (99%)

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

Test setup (Occupied bandwidth – power bandwidth (99%))			
Used	Setup	See sub-clause	Comment
<input type="checkbox"/>	Radiated: 1 GHz to 40 GHz	5.1.3	-
<input checked="" type="checkbox"/>	Conducted: Antenna port	5.1.4	-

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

Test method (Occupied bandwidth – power bandwidth (99%))				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input type="checkbox"/>	6.9.2	Relative measurement procedure	-	n-dB down
<input checked="" type="checkbox"/>	6.9.3	Power bandwidth (99%)	*1	99% power function

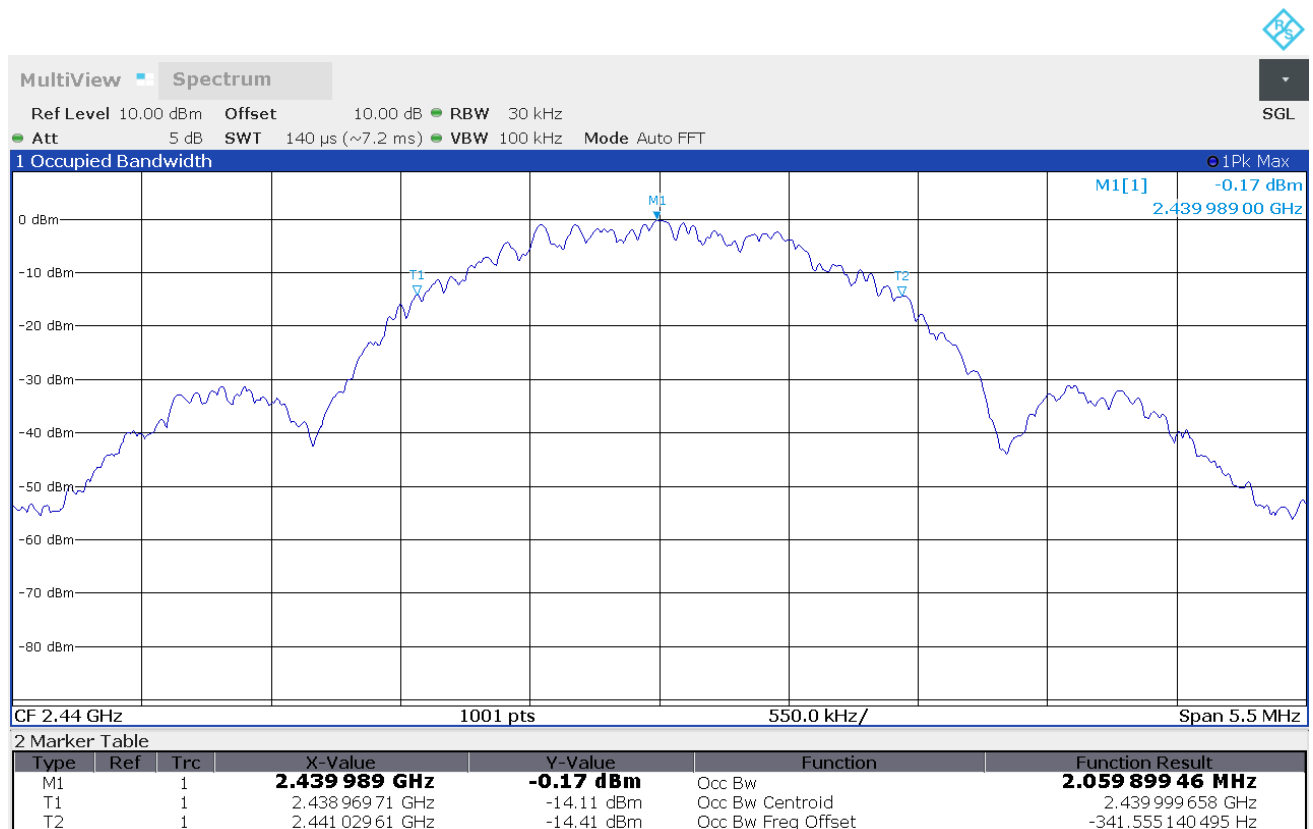
*1 See RSS-GEN Issue 5 (2018-05) sub-clause 6.7 for details.

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

Ambient temperature:	21.6 °C
Relative humidity:	24 %

Date:	08.01.2025
Tested by:	P. Neufeld

Worst case plot (operation mode 5):



Operation mode #	99% bandwidth [MHz]
1	1.030387
2	1.031765
3	1.032309
4	2.058928
5	2.059899
6	2.059466
7	1.022374
8	1.021909
9	1.021666
10	1.061356
11	1.062201
12	1.062702

Test result: Passed

Test equipment (please refer to chapter 7 for details)

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5.5 DTS fundamental emission output power

5.5.1 Test setup (DTS fundamental emission output power)

Test setup (DTS fundamental emission output power)			
Used	Setup	See sub-clause	Comment
<input type="checkbox"/>	Radiated: 1 GHz to 40 GHz	5.1.3	-
<input checked="" type="checkbox"/>	Conducted: Antenna port	5.1.4	-

5.5.2 Test method (DTS fundamental emission output power)

Test method (Maximum peak conducted output power)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	11.9.1.1	RBW \geq DTS bandwidth	-	Zero span mode
<input type="checkbox"/>	11.9.1.2	PKPM1 Peak power meter method* ¹	-	-

*¹ VBW of the peak power meter has to be $>$ OBW of the fundamental.

Test method (Maximum conducted (average) output power)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input type="checkbox"/>	11.9.2.2.2	Method AVGSA-1	$D \geq 98\%$	-
<input type="checkbox"/>	11.9.2.2.3	Method AVGSA-1A (alternative)	$D \geq 98\%$	-
<input checked="" type="checkbox"/>	11.9.2.2.4	Method AVGSA-2	Constant D ($\pm 2\%$)	-
<input type="checkbox"/>	11.9.2.2.5	Method AVGSA-2A (alternative)	Constant D ($\pm 2\%$)	-
<input type="checkbox"/>	11.9.2.2.6	Method AVGSA-3A	-	-
<input type="checkbox"/>	11.9.2.2.7	Method AVGSA-3A (alternative)	-	-
<input type="checkbox"/>	11.9.2.3.1	Method AVGPM	Constant D ($\pm 2\%$)	-
<input type="checkbox"/>	11.9.2.3.2	Method AVGPM-G	-	-

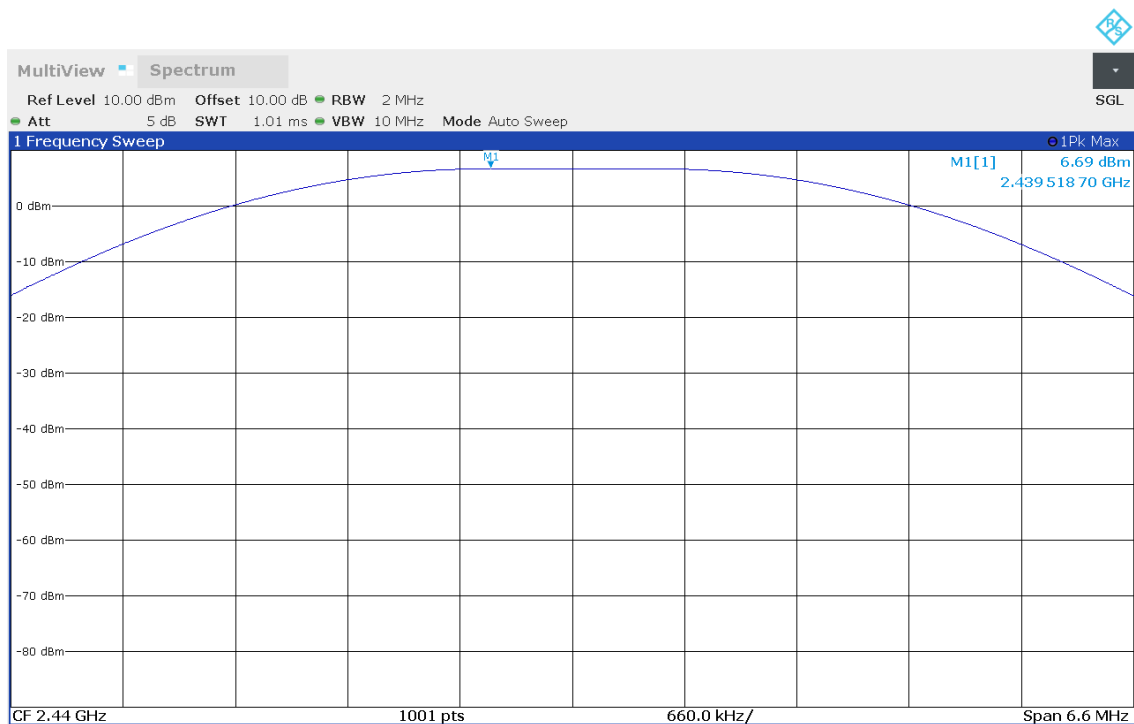
5.5.3 Test results (DTS fundamental emission output power)

Ambient temperature:	21.6 °C
Relative humidity:	24 %

Date:	08.01.2025
Tested by:	P. Neufeld

5.5.3.1 Maximum peak conducted output power:

Worst case plot (operation mode 5):



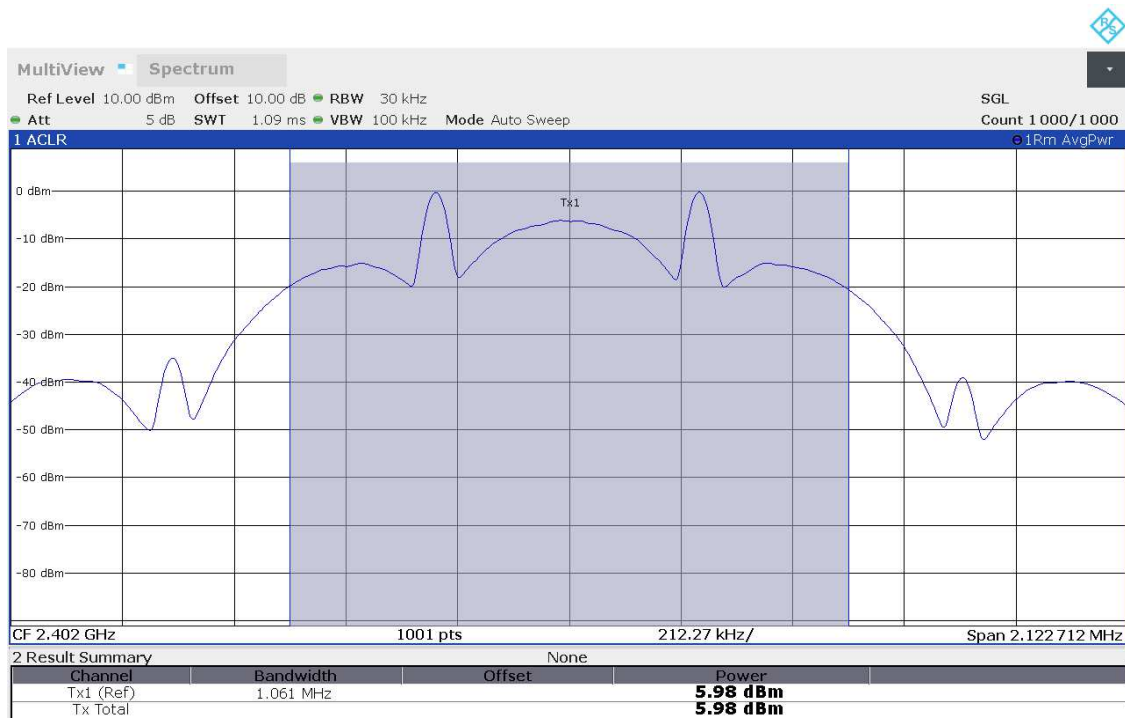
Operation mode	Reading [dBm]	Corr. Fact.* [dB]	Result [dBm]	Limit [dBm]	Antenna Gain [dBi]	e.i.r.p. [dBm]	Limit e.i.r.p. [dBm]
1	6.7	0.3	7.0	30	3.3	10.3	36
2	6.6	0.3	6.9	30	3.3	10.2	36
3	6.6	0.3	6.9	30	3.3	10.2	36
4	6.7	0.3	7.0	30	3.3	10.3	36
5	6.7	0.3	7.0	30	3.3	10.3	36
6	6.7	0.3	7.0	30	3.3	10.3	36
7	6.7	0.3	7.0	30	3.3	10.3	36
8	6.6	0.3	6.9	30	3.3	10.2	36
9	6.6	0.3	6.9	30	3.3	10.2	36
10	6.7	0.3	7.0	30	3.3	10.3	36
11	6.6	0.3	6.9	30	3.3	10.2	36
12	6.6	0.3	6.9	30	3.3	10.2	36

* The correction factor is the attenuation of the external cable, which was used for the testing. The correction factor for the external attenuator was taken into account by the offset in the measurement settings of the spectrum analyzer.

Test result: Passed

5.5.3.2 Maximum conducted (average) output power

Worst case plot (operation mode 10):



Operation mode	Reading [dBm]	Corr. Fact.* [dB]	DCCF [dB]	Result [dBm]	Limit [dBm]	Antenna Gain [dBi]	e.i.r.p. [dBm]	Limit e.i.r.p. [dBm]
1	5.9	0.3	0.7	6.9	30	3.3	10.2	36
2	5.8	0.3	0.7	6.8	30	3.3	10.1	36
3	5.9	0.3	0.7	6.9	30	3.3	10.2	36
4	3.0	0.3	3.7	7.0	30	3.3	10.3	36
5	2.9	0.3	3.7	6.9	30	3.3	10.2	36
6	2.9	0.3	3.7	6.9	30	3.3	10.2	36
7	3.2	0.3	3.4	6.9	30	3.3	10.2	36
8	3.2	0.3	3.4	6.9	30	3.3	10.2	36
9	3.1	0.3	3.4	6.8	30	3.3	10.1	36
10	6.0	0.3	0.7	7.0	30	3.3	10.3	36
11	5.9	0.3	0.7	6.9	30	3.3	10.2	36
12	5.8	0.3	0.7	6.8	30	3.3	10.1	36

* The correction factor is the attenuation of the external cable, which was used for the testing. The correction factor for the external attenuator was taken into account by the offset in the measurement settings of the spectrum analyzer.

Test result: Passed

Test equipment (please refer to chapter 7 for details)

33

5.6 DTS maximum power spectral density

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

Test setup (DTS fundamental emission output power)			
Used	Setup	See sub-clause	Comment
<input type="checkbox"/>	Radiated: 1 GHz to 40 GHz	5.1.3	-
<input checked="" type="checkbox"/>	Conducted: Antenna port	5.1.4	-

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

Test method (Maximum <i>peak</i> power spectral density level in the fundamental emission)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	11.10.2	Method PKPSD (peak PSD)	No limitations	-

Test method (Maximum <i>average</i> power spectral density level in the fundamental emission)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	11.10.3	Method AVGPSD-1	D ≥ 98%	-
<input type="checkbox"/>	11.10.4	Method AVGPSD-1A (alternative)	D ≥ 98%	-
<input type="checkbox"/>	11.10.5	Method AVGPSD-2	Constant D (±2%)	-
<input type="checkbox"/>	11.10.6	Method AVGPSD-2A (alternative)	Constant D (±2%)	-
<input type="checkbox"/>	11.10.7	Method AVGPSD-3	No limitations	-
<input type="checkbox"/>	11.10.8	Method AVGPSD-3A (alternative)	No limitations	-

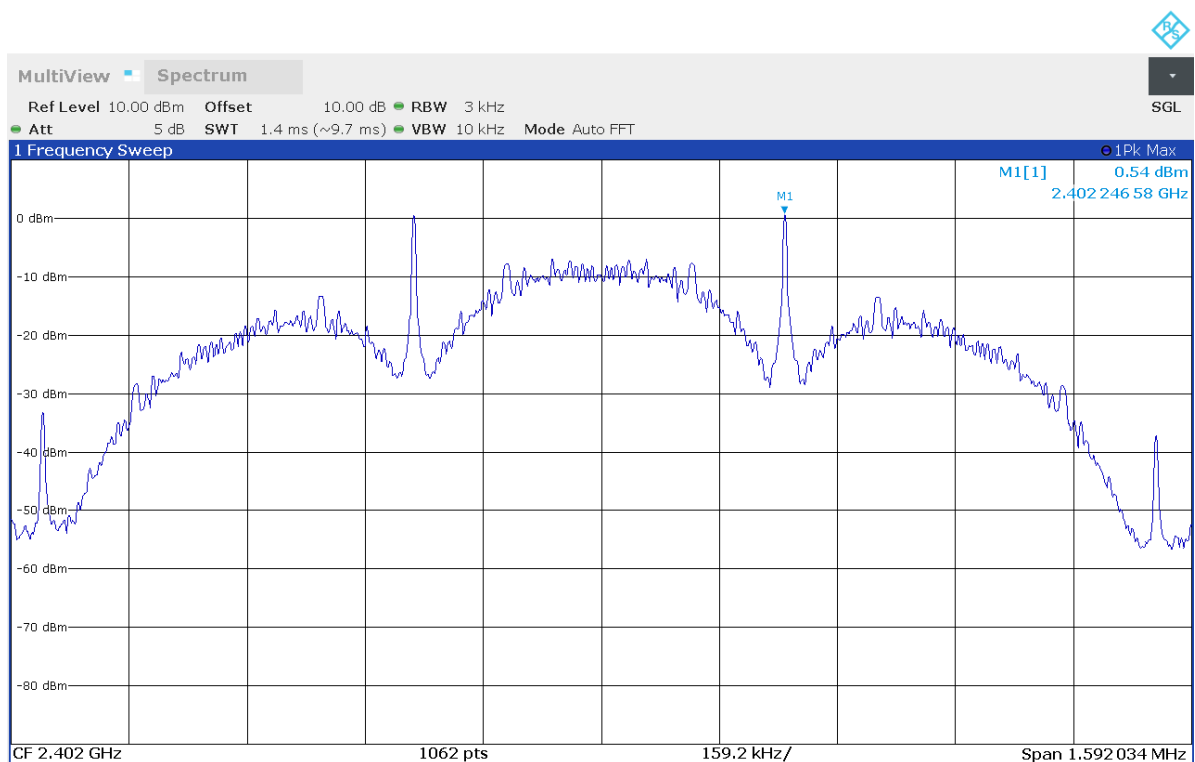
5.6.3 Test results (DTS maximum PSD level in the fundamental emission)

Ambient temperature:	21.6 °C
Relative humidity:	24 %

Date:	08.01.2025
Tested by:	P. Neufeld

5.6.3.1 Maximum peak PSD:

Worst case plot (operation mode 10):



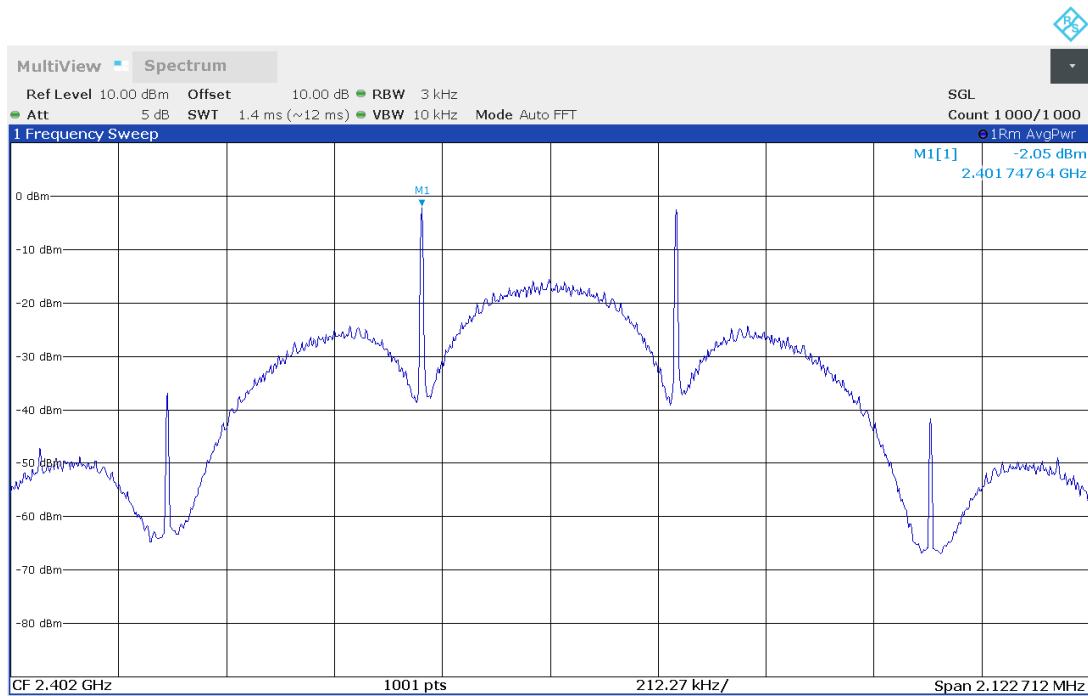
Operation mode	Reading [dBm/3 kHz]	Corr. Fact. [dB]*	Result [dBm/3 kHz]	Limit [dBm/3 kHz]
1	-7.8	0.3	-7.5	8.0
2	-7.9	0.3	-7.6	8.0
3	-7.9	0.3	-7.6	8.0
4	-9.5	0.3	-9.2	8.0
5	-9.6	0.3	-9.3	8.0
6	-9.7	0.3	-9.4	8.0
7	-5.3	0.3	-5.0	8.0
8	-2.7	0.3	-2.4	8.0
9	-1.9	0.3	-1.6	8.0
10	0.5	0.3	0.8	8.0
11	0.4	0.3	0.7	8.0
12	0.5	0.3	0.8	8.0

* The correction factor is the attenuation of the external cable, which was used for the testing. The correction factor for the external attenuator was taken into account by the offset in the measurement settings of the spectrum analyzer.

Test result: Passed

5.6.3.2 Maximum average PSD

Worst case plot (operation mode 10):



Operation mode	Reading [dBm/3 kHz]	Corr. Fact. [dB]*	DCCF [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]
1	-12.8	0.3	0.7	-11.8	8.0
2	-13.0	0.3	0.7	-12.0	8.0
3	-13.4	0.3	0.7	-12.4	8.0
4	-22.1	0.3	3.7	-18.1	8.0
5	-23.7	0.3	3.7	-19.7	8.0
6	-24.1	0.3	3.7	-20.1	8.0
7	-17.6	0.3	3.4	-13.9	8.0
8	-17.0	0.3	3.4	-13.3	8.0
9	-16.2	0.3	3.4	-12.5	8.0
10	-2.0	0.3	0.7	-1.0	8.0
11	-2.8	0.3	0.7	-1.8	8.0
12	-2.6	0.3	0.7	-1.6	8.0

* The correction factor is the attenuation of the external cable, which was used for the testing. The correction factor for the external attenuator was taken into account by the offset in the measurement settings of the spectrum analyzer.

Test result: Passed

Test equipment (please refer to chapter 7 for details)
33

5.7 DTS band-edge emission measurements

5.7.1 Test setup (Band edge – restricted bands)

Test setup (Band edge – restricted bands)			
Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Radiated: 1 GHz to 40 GHz	5.1.3	
<input type="checkbox"/>	Conducted: Antenna port	5.1.4	

5.7.2 Test method (Band edge – restricted bands)

Test method (Band edge – restricted bands)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	11.12.1	Standard method	No limitations	
<input type="checkbox"/>	11.12.3.1	Marker-delta method		See 6.10.6 [3] 2 MHz from band
<input type="checkbox"/>	11.12.3.2	Integration method		2 MHz from band

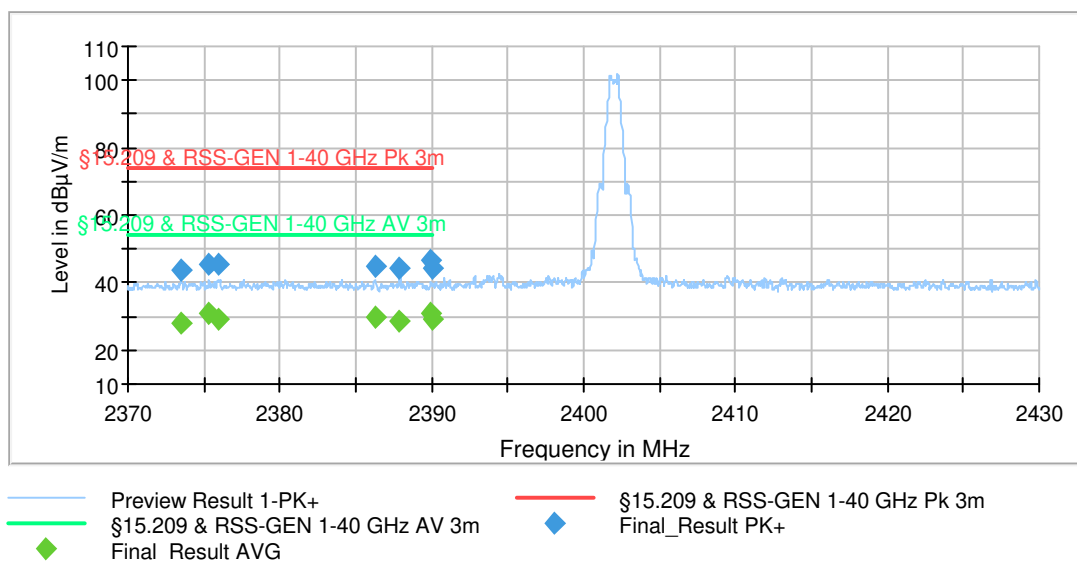
5.7.3 Test results (Band edge – restricted bands)

Ambient temperature:	21.8 °C
Relative humidity:	18 %

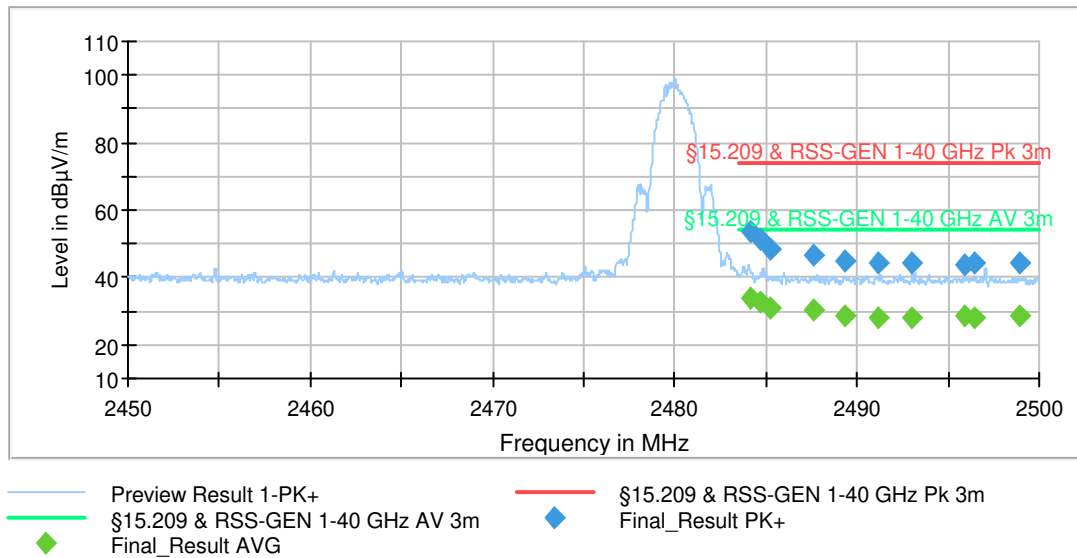
Date:	13.01.2025
Tested by:	M. Eppinger

Conducted pre-tests at the antenna port have shown, that the emissions at the band-edge for operation modes 4 and 6 resulted in the worst-case emissions. Therefore, only these emissions were tested radiated.

Worst case plot lower band edge (operation mode 4):



Worst case plot upper band edge (operation mode 5):



Lower band edge (operation mode 4):

Frequency [MHz]	Result (Pk) [dB(µV/m)]	Result (Avg) [dB(µV/m)]	Limit [dB(µV/m)]	Margin [dB]	Polarization	Elevation [deg]	Azimuth [deg]
2373.480	43.4	---	74.0	30.6	V	60	346
2373.480	---	27.7	54.0	26.3	V	60	346
2375.310	45.6	---	74.0	28.4	V	150	140
2375.310	---	31.0	54.0	23.0	V	150	140
2375.940	---	29.0	54.0	25.0	H	120	80
2375.940	45.5	---	74.0	28.5	H	120	80
2386.230	44.6	---	74.0	29.4	V	150	117
2386.230	---	29.5	54.0	24.5	V	150	117
2387.880	---	28.7	54.0	25.3	V	150	38
2387.880	44.1	---	74.0	29.9	V	150	38
2389.920	---	30.9	54.0	23.1	V	0	351
2389.920	46.4	---	74.0	27.6	V	0	351

Worst case plot upper band edge (operation mode 6):

Frequency [MHz]	Result (Pk) [dB(μV/m)]	Result (Avg) [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Polarization	Elevation [deg]	Azimuth [deg]
2484.175	---	33.7	54.0	20.3	V	90	4
2484.175	53.7	---	74.0	20.3	V	90	4
2484.675	51.5	---	74.0	22.5	H	0	0
2484.675	---	32.9	54.0	21.1	H	0	0
2485.225	48.6	---	74.0	25.4	H	30	0
2485.225	---	30.8	54.0	23.2	H	30	0
2487.625	46.7	---	74.0	27.3	V	90	359
2487.625	---	30.1	54.0	23.9	V	90	359
2489.325	44.7	---	74.0	29.3	H	60	294
2489.325	---	28.6	54.0	25.4	H	60	294
2491.150	---	28.1	54.0	25.9	H	90	153
2491.150	44.1	---	74.0	29.9	H	90	153
2493.025	44.0	---	74.0	30.0	V	150	284
2493.025	---	28.1	54.0	25.9	V	150	284
2495.900	43.8	---	74.0	30.2	V	30	136
2495.900	---	28.3	54.0	25.7	V	30	136
2496.475	44.6	---	74.0	29.4	H	30	151
2496.475	---	28.2	54.0	25.8	H	30	151
2498.875	44.4	---	74.0	29.6	V	60	0
2498.875	---	28.5	54.0	25.5	V	60	0

Test result: Passed

Test equipment (please refer to chapter 7 for details)
4 – 7, 10 – 14, 17

5.8 Radiated emissions

5.8.1 Test setup (Maximum unwanted emissions)

Test setup (Maximum unwanted emissions)			
Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Radiated: 9 kHz to 30 MHz / 30 MHz to 1 GHz / 1 GHz to 40 GHz	5.1	-
<input type="checkbox"/>	Conducted: Antenna port	5.1.4	-

5.8.2 Test method (Maximum unwanted emissions)

☒ Test method (radiated) see sub-clause 5.1 as described herein

5.8.3 Test results (Maximum unwanted emissions)

5.8.3.1 Test results preliminary measurement 9 kHz to 30 MHz

Ambient temperature:	21.6 °C	Date:	16.01.2025
Relative humidity:	26 %	Tested by:	M. Eppinger

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)

Calculations:

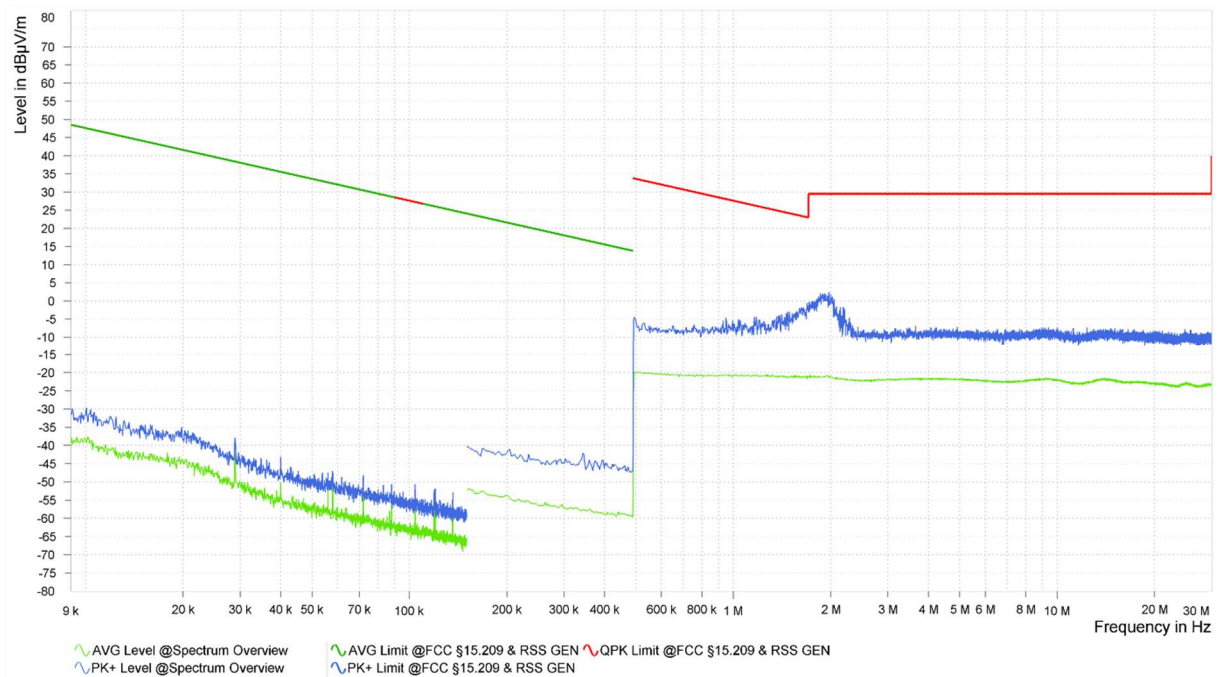
Result @ norm. dist. [dBμV/m] = Reading [dBμV] + AF [dB/m] + Distance corr. fact. [dBμV/m]

Result @ norm. dist. [dBμA/m] = Result @ norm. dist. [dBμV/m] – 20 x log₁₀ (377 Ω)

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

Worst case plot:

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



Remark: No emissions close than 20 dB to the limit for all operation modes, so no final measurement will be carried out.

Test equipment (please refer to chapter 7 for details)

20 – 26, 34

5.8.3.2 Test results (30 MHz – 1 GHz)

Ambient temperature:	21.6 °C
Relative humidity:	26 %

Date:	16.01.2025
Tested by:	M. Eppinger

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.
Only the worst-case modulation from the antenna port conducted pre-tests were tested radiated.

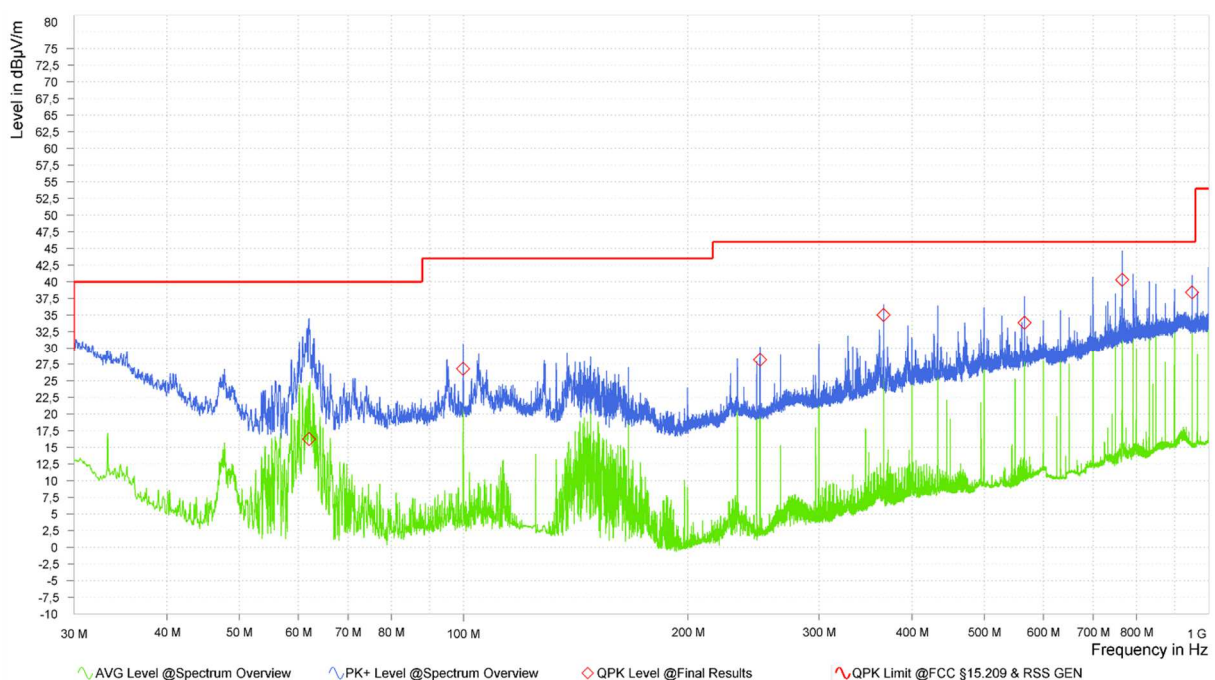
Calculations:

Result [dBμV/m] = Reading [dBμV] + Correction [dB/m]
 Correction [dB/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 1):



Result tables:

(Operation mode 1):

Frequency [MHz]	Result (QP) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [m]
62.040	16.24	40.00	23.76	12.74	V	184	1.36
99.900	26.78	43.50	16.72	17.31	V	173	1.06
249.990	28.16	46.00	17.84	17.15	H	104	1.12
366.300	35.02	46.00	10.98	20.73	V	339	1.37
566.100	33.85	46.00	12.15	25.04	V	358	1.08
765.900	40.29	46.00	5.71	27.89	V	347	1.47
950.010	38.42	46.00	7.58	29.86	V	163	1.90

(Operation mode 2):

Frequency [MHz]	Result (QP) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [m]
71.490	18.89	40.00	21.11	14.84	V	274	1.15
99.900	26.62	43.50	16.88	17.31	V	245	1.01
249.990	28.41	46.00	17.59	17.15	H	191	1.04
366.300	35.53	46.00	10.47	20.73	V	79	1.40
566.100	34.54	46.00	11.46	25.04	V	114	1.06
765.900	38.73	46.00	7.27	27.89	V	100	1.39

(Operation mode 3):

Frequency [MHz]	Result (QP) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [m]
71.460	12.00	40.00	28.00	14.83	V	43	1.38
99.900	27.28	43.50	16.22	17.31	V	76	1.02
249.990	27.89	46.00	18.11	17.15	H	17	1.16
366.300	35.47	46.00	10.53	20.73	V	276	1.44
566.100	34.07	46.00	11.93	25.04	V	271	1.00
765.900	39.16	46.00	6.84	27.89	V	270	1.49
950.010	38.68	46.00	7.32	29.86	V	38	1.16

Test result: Passed

Test equipment (please refer to chapter 7 for details)
18 – 26

5.8.3.3 Test results (radiated 1 GHz to 40 GHz)

Ambient temperature:	21.8 °C
Relative humidity:	18 %

Date:	13.01.2025
Tested by:	M. Eppinger

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.
Only the worst-case modulation from the antenna port conducted pre-tests were tested radiated.

Remark: -

Calculation:

Max Peak [dBμV/m] = Reading [dBμV] + Correction [dB/m]

Average [dBμV/m] = Reading [dBμV] + Correction [dB/m]

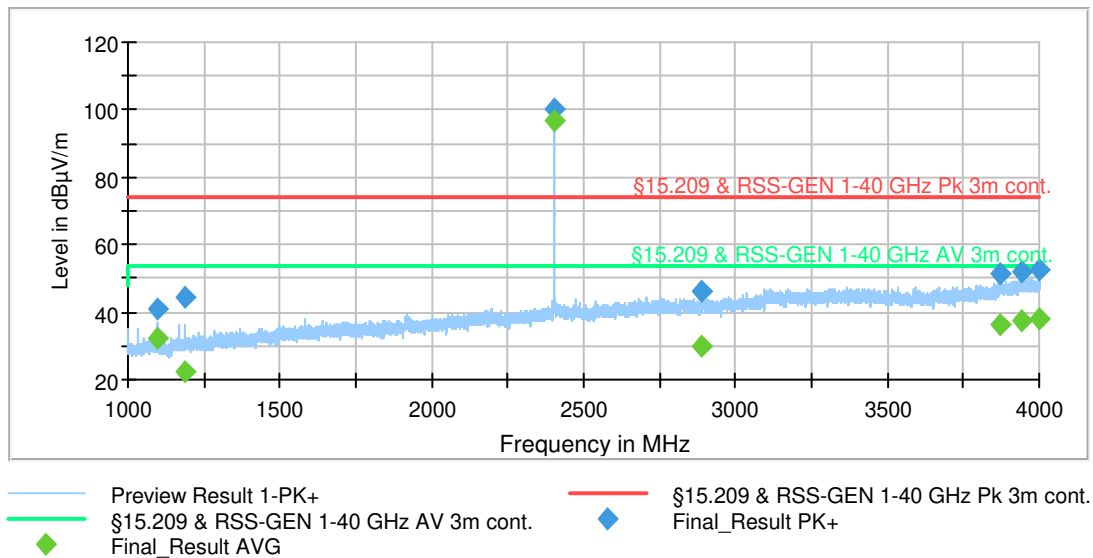
Correction [dB/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB] + DCCF* [dB]
* (if applicable – only for Average values, that are fundamental related)

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

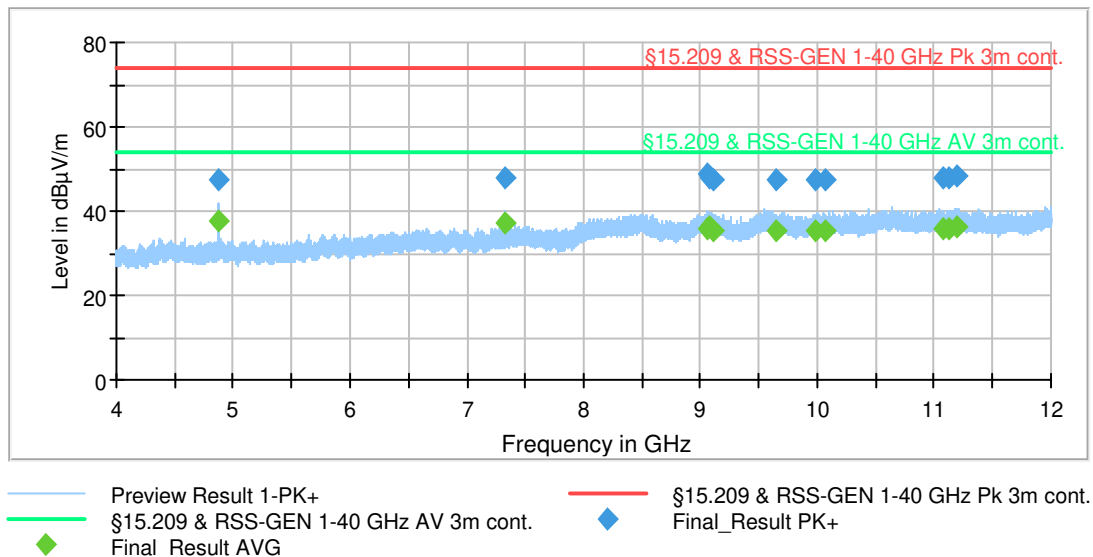
The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna positions.
The top measured curve represents the peak measurement. The measured points marked with "◆" are frequency points 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:

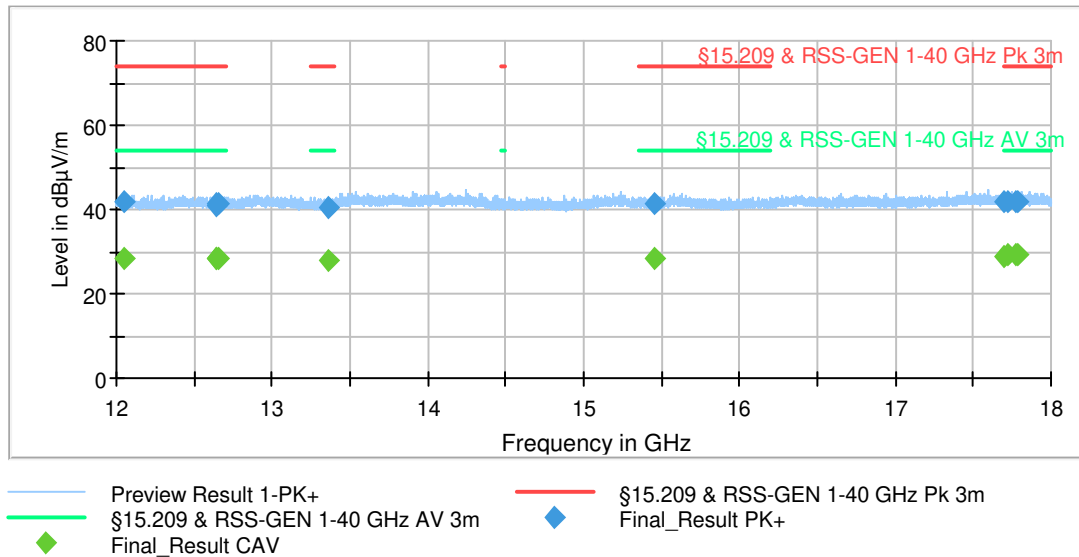
Spurious emissions from 1 GHz to 4 GHz (operation mode 1):



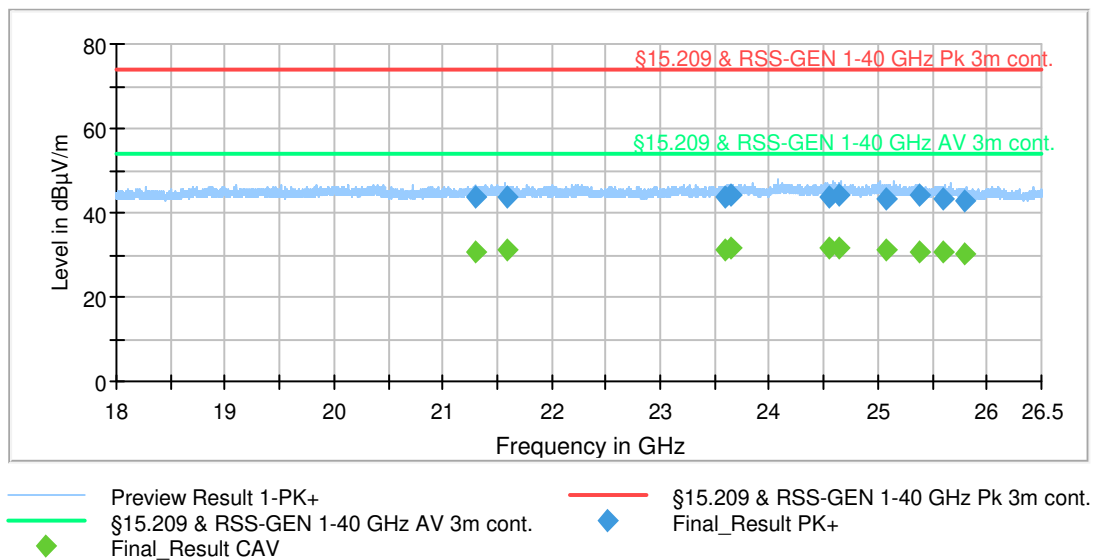
Spurious emissions from 4 GHz to 12 GHz (operation mode 2):



Spurious emissions from 12 GHz to 18 GHz (operation mode 3):



Spurious emissions from 18 GHz to 26.5 GHz (operation mode 3):



Result tables:

Operation mode 1:

Frequency [MHz]	MaxPeak [dB(μV/m)]	Average [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Pol [H/V]	Azimuth [deg]	Elevation [deg]	Corr. [dB]
1098.850	---	33.78	54.0	20.22	V	270	150	25.2
1098.850	40.9	---	74.0	31.72	V	270	150	25.2
1187.950	---	23.58	54.0	30.42	H	225	0	25.9
1187.950	44.3	---	74.0	28.32	H	225	0	25.9
2402.250*	100.3	---	Fund.	Fund.	V	359	120	33.2
2402.250*	---	98.08	Fund.	Fund.	V	359	120	33.2
2888.650	46.2	---	74.0	26.42	V	19	150	35.1
2888.650	---	31.18	54.0	22.82	V	19	150	35.1
3873.700	---	37.68	54.0	16.32	H	1	120	37.4
3873.700	51.7	---	74.0	20.92	H	1	120	37.4
3939.800	51.8	---	74.0	20.82	V	229	60	37.8
3939.800	---	38.68	54.0	15.32	V	229	60	37.8
3999.350	52.6	---	74.0	20.02	V	229	30	38.0
3999.350	---	39.28	54.0	14.72	V	229	30	38.0
4879.467	48.2	---	74.0	24.42	H	342	150	-1.6
4879.467	---	39.58	54.0	14.42	H	342	150	-1.6
4880.444	47.7	---	74.0	24.92	V	335	60	-1.6
4880.444	---	39.58	54.0	14.42	V	335	60	-1.6
7319.200	48.0	---	74.0	24.62	H	0	0	4.1
7319.200	---	38.08	54.0	15.92	H	0	0	4.1
7320.800	---	37.38	54.0	16.62	H	0	150	4.1
7320.800	47.5	---	74.0	25.12	H	0	150	4.1
9599.644	---	36.88	54.0	17.12	V	0	0	7.4
9599.644	47.3	---	74.0	25.32	V	0	0	7.4
9718.533	---	36.88	54.0	17.12	H	0	150	6.8
9718.533	47.9	---	74.0	24.72	H	0	150	6.8
9997.511	47.0	---	74.0	25.62	H	0	120	7.1
9997.511	---	36.48	54.0	17.52	H	0	120	7.1
10821.156	47.9	---	74.0	24.72	V	0	90	6.2
10821.156	---	36.58	54.0	17.42	V	0	90	6.2
11194.667	48.6	---	74.0	24.02	H	0	0	7.0
11194.667	---	37.48	54.0	16.52	H	0	0	7.0
11971.022	---	38.28	54.0	15.72	H	0	150	6.4
11971.022	48.8	---	74.0	23.82	H	0	150	6.4
12195.500	40.5	---	74.0	32.12	V	0	120	10.1
12195.500	---	29.58	54.0	24.42	V	0	120	10.1
12693.000	---	29.88	54.0	24.12	V	271	150	10.5
12693.000	40.6	---	74.0	32.02	V	271	150	10.5

13296.000	---	29.28	54.0	24.72	H	356	60	10.4
13296.000	40.8	---	74.0	31.82	H	356	60	10.4
14483.000	39.8	---	74.0	32.82	V	47	120	10.1
14483.000	---	29.38	54.0	24.62	V	47	120	10.1
15391.000	---	29.78	54.0	24.22	V	2	120	9.9
15391.000	39.9	---	74.0	32.72	V	2	120	9.9
15439.000	---	29.88	54.0	24.12	H	208	0	9.9
15439.000	40.7	---	74.0	31.92	H	208	0	9.9
16090.000	41.6	---	74.0	31.02	V	200	30	9.7
16090.000	---	29.38	54.0	24.62	V	200	30	9.7
17900.000	---	30.48	54.0	23.52	H	53	0	9.6
17900.000	42.1	---	74.0	30.52	H	53	0	9.6
17949.500	---	30.38	54.0	23.62	V	52	150	9.5
17949.500	41.6	---	74.0	31.02	V	52	150	9.5
19272.639	---	31.98	54.0	22.02	V	0	0	3.6
19272.639	42.8	---	74.0	29.82	V	0	0	3.6
19895.972	43.0	---	74.0	29.62	H	0	0	3.8
19895.972	---	32.18	54.0	21.82	H	0	0	3.8
20335.139	---	31.98	54.0	22.02	V	264	150	3.7
20335.139	42.8	---	74.0	29.82	V	264	150	3.7
20422.500	---	32.18	54.0	21.82	H	0	30	3.6
20422.500	43.1	---	74.0	29.52	H	0	30	3.6
21832.556	43.5	---	74.0	29.12	H	0	90	4.0
21832.556	---	32.38	54.0	21.62	H	0	90	4.0
23111.333	43.0	---	74.0	29.62	V	0	0	4.0
23111.333	---	31.98	54.0	22.02	V	0	0	4.0
24210.194	---	32.78	54.0	21.22	V	0	60	4.2
24210.194	43.4	---	74.0	29.22	V	0	60	4.2
24242.306	43.4	---	74.0	29.22	H	0	90	4.1
24242.306	---	32.78	54.0	21.22	H	0	90	4.1
25009.194	43.5	---	74.0	29.12	V	0	0	3.9
25009.194	---	32.48	54.0	21.52	V	0	0	3.9
25419.556	44.1	---	74.0	28.52	H	0	150	3.5
25419.556	---	30.7	54.0	21.92	H	0	150	3.5

Remark *: These are the wanted Bluetooth emission and are therefore omitted from the final evaluation.

Operation mode 2:

Frequency [MHz]	MaxPeak [dB(μV/m)]	Average [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Pol [H/V]	Azimuth [deg]	Elevation [deg]	Corr. [dB]
1098.850	41.8	---	74.0	30.82	V	304	150	25.2
1098.850	---	35.48	54.0	18.52	V	304	150	25.2
1165.450	40.7	---	74.0	31.92	H	161	120	25.7
1165.450	---	33.68	54.0	20.32	H	161	120	25.7
2440.000*	103.0	---	Fund.	Fund.	H	358	0	33.6
2440.000*	---	102.08	Fund.	Fund.	H	358	0	33.6
3305.350	48.9	---	74.0	23.72	H	55	30	36.8
3305.350	---	35.28	54.0	18.72	H	55	30	36.8
3804.350	49.8	---	74.0	22.82	V	281	90	37.0
3804.350	---	36.38	54.0	17.62	V	281	90	37.0
3940.150	---	38.78	54.0	15.22	H	53	90	37.8
3940.150	52.3	---	74.0	20.32	H	53	90	37.8
3971.300	52.2	---	74.0	20.42	V	52	0	37.9
3971.300	---	39.08	54.0	14.92	V	52	0	37.9
4880.444	---	38.98	54.0	15.02	V	348	60	-1.6
4880.444	47.5	---	74.0	25.12	V	348	60	-1.6
7320.533	---	38.48	54.0	15.52	H	5	0	4.1
7320.533	47.7	---	74.0	24.92	H	5	0	4.1
9062.444	---	37.18	54.0	16.82	V	0	150	8.3
9062.444	48.8	---	74.0	23.82	V	0	150	8.3
9075.022	---	37.48	54.0	16.52	H	0	30	8.3
9075.022	47.8	---	74.0	24.82	H	0	30	8.3
9105.556	---	36.68	54.0	17.32	V	0	30	8.0
9105.556	47.6	---	74.0	25.02	V	0	30	8.0
9653.822	---	36.68	54.0	17.32	V	0	150	7.2
9653.822	47.4	---	74.0	25.22	V	0	150	7.2
9987.911	---	36.58	54.0	17.42	H	0	60	7.0
9987.911	47.2	---	74.0	25.42	H	0	60	7.0
10070.933	---	36.58	54.0	17.42	H	0	90	7.3
10070.933	47.2	---	74.0	25.42	H	0	90	7.3
11083.511	---	37.28	54.0	16.72	H	0	0	7.1
11083.511	48.1	---	74.0	24.52	H	0	0	7.1
11134.178	---	37.38	54.0	16.72	H	0	60	7.2
11134.178	47.9	---	74.0	24.72	H	0	60	7.2
11195.422	---	37.58	54.0	16.42	H	0	150	7.0
11195.422	48.3	---	74.0	24.32	H	0	150	7.0
12635.500	40.7	---	74.0	31.92	H	0	60	10.5
12635.500	---	29.58	54.0	24.42	H	0	60	10.5
12650.000	---	29.78	54.0	24.22	V	23	30	10.5

12650.000	41.1	---	74.0	31.52	V	23	30	10.5
13341.500	40.3	---	74.0	32.32	V	230	90	10.4
13341.500	---	29.28	54.0	24.72	V	230	90	10.4
15423.500	---	29.78	54.0	24.22	V	0	30	9.9
15423.500	42.1	---	74.0	30.52	V	0	30	9.9
15924.000	40.5	---	74.0	32.12	H	299	120	9.8
15924.000	---	29.38	54.0	24.62	H	299	120	9.8
16114.500	---	29.68	54.0	24.32	H	248	30	9.7
16114.500	41.8	---	74.0	30.82	H	248	30	9.7
17700.000	---	30.28	54.0	23.72	H	189	60	9.5
17700.000	41.7	---	74.0	30.92	H	189	60	9.5
17773.000	---	30.68	54.0	23.32	V	320	0	9.6
17773.000	41.5	---	74.0	31.12	V	320	0	9.6
17886.000	41.5	---	74.0	31.12	V	224	150	9.6
17886.000	---	30.48	54.0	23.52	V	224	150	9.6
17989.500	---	30.08	54.0	23.92	V	262	30	9.5
17989.500	41.0	---	74.0	31.62	V	262	30	9.5
19195.667	---	31.88	54.0	22.12	H	0	30	3.6
19195.667	42.4	---	74.0	30.22	H	0	30	3.6
19504.500	---	31.88	54.0	22.12	H	0	90	3.7
19504.500	42.7	---	74.0	29.92	H	0	90	3.7
19956.889	43.8	---	74.0	28.82	V	0	30	3.8
19956.889	---	32.28	54.0	21.72	V	0	30	3.8
20936.278	43.3	---	74.0	29.32	H	0	120	3.8
20936.278	---	32.08	54.0	21.92	H	0	120	3.8
21921.806	43.6	---	74.0	29.02	V	0	60	3.9
21921.806	---	32.28	54.0	21.72	V	0	60	3.9
23329.500	42.7	---	74.0	29.92	V	0	60	4.0
23329.500	---	31.88	54.0	22.12	V	0	60	4.0
23982.111	---	32.08	54.0	21.92	V	0	150	4.0
23982.111	42.9	---	74.0	29.72	V	0	150	4.0
24412.778	43.6	---	74.0	29.02	V	303	30	4.2
24412.778	---	32.58	54.0	21.42	V	303	30	4.2
24750.889	43.4	---	74.0	29.22	V	0	30	3.8
24750.889	---	32.58	54.0	21.42	V	0	30	3.8
25326.528	---	31.88	54.0	22.12	V	0	150	3.6
25326.528	42.3	---	74.0	30.32	V	0	150	3.6

Remark *: These are the wanted Bluetooth emission and are therefore omitted from the final evaluation.

Operation mode 3:

Frequency [MHz]	MaxPeak [dB(μV/m)]	Average [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]	Pol [H/V]	Azimuth [deg]	Elevation [deg]	Corr. [dB]
1098.850	42.4	---	74.0	30.22	H	128	90	25.2
1098.850	---	35.78	54.0	18.22	H	128	90	25.2
2480.050*	---	101.08	Fund.	Fund.	V	342	90	33.2
2480.050*	102.0	---	Fund.	Fund.	V	342	90	33.2
3309.900	49.3	---	74.0	23.32	V	112	60	36.8
3309.900	---	35.38	54.0	18.62	V	112	60	36.8
3726.400	48.8	---	74.0	23.82	V	0	30	36.8
3726.400	---	35.68	54.0	18.32	V	0	30	36.8
3851.050	51.0	---	74.0	21.62	H	198	120	37.2
3851.050	---	37.18	54.0	16.82	H	198	120	37.2
3874.300	---	37.68	54.0	16.32	H	114	30	37.4
3874.300	51.0	---	74.0	21.62	H	114	30	37.4
3941.950	---	38.78	54.0	15.22	H	141	90	37.8
3941.950	52.4	---	74.0	20.22	H	141	90	37.8
7439.244	---	37.58	54.0	16.42	H	349	30	4.6
7439.244	47.8	---	74.0	24.82	H	349	30	4.6
7440.489	---	38.18	54.0	15.82	V	0	120	4.6
7440.489	47.5	---	74.0	25.12	V	0	120	4.6
8516.800	46.4	---	74.0	26.22	V	0	0	6.7
8516.800	---	36.28	54.0	17.72	V	0	0	6.7
8541.733	46.9	---	74.0	25.72	V	0	120	6.6
8541.733	---	35.58	54.0	18.42	V	0	120	6.6
9620.578	---	36.88	54.0	17.12	V	0	60	7.4
9620.578	47.8	---	74.0	24.82	V	0	60	7.4
9999.289	47.1	---	74.0	25.52	H	0	90	7.1
9999.289	---	36.48	54.0	17.52	H	0	90	7.1
10020.489	---	36.38	54.0	17.62	V	0	60	7.3
10020.489	47.0	---	74.0	25.62	V	0	60	7.3
11095.600	47.8	---	74.0	24.82	H	0	90	7.2
11095.600	---	36.98	54.0	17.02	H	0	90	7.2
11198.089	48.3	---	74.0	24.32	H	0	90	7.0
11198.089	---	37.58	54.0	16.42	H	0	90	7.0
11198.533	48.0	---	74.0	24.62	H	0	60	7.0
11198.533	---	37.48	54.0	16.52	H	0	60	7.0
12053.500	41.6	---	74.0	31.02	H	63	60	10.2
12053.500	---	29.88	54.0	24.12	H	63	60	10.2
12644.500	---	29.68	54.0	24.32	V	197	30	10.5
12644.500	40.9	---	74.0	31.72	V	197	30	10.5
12648.500	41.5	---	74.0	31.12	H	83	150	10.5

12648.500	---	29.78	54.0	24.22	H	83	150	10.5
12655.500	---	29.78	54.0	24.22	H	125	60	10.5
12655.500	41.5	---	74.0	31.12	H	125	60	10.5
13360.000	40.4	---	74.0	32.22	H	162	120	10.4
13360.000	---	29.38	54.0	24.62	H	162	120	10.4
15448.000	---	29.78	54.0	24.32	V	345	150	9.9
15448.000	41.3	---	74.0	31.32	V	345	150	9.9
17700.500	41.6	---	74.0	31.02	V	65	30	9.5
17700.500	---	30.28	54.0	23.72	V	65	30	9.5
17719.000	41.9	---	74.0	30.72	H	0	0	9.5
17719.000	---	30.58	54.0	23.42	H	0	0	9.5
17773.000	---	30.68	54.0	23.32	V	157	150	9.6
17773.000	41.9	---	74.0	30.72	V	157	150	9.6
17783.500	42.0	---	74.0	30.62	V	288	60	9.6
17783.500	---	30.68	54.0	23.32	V	288	60	9.6
21305.556	---	32.18	54.0	21.82	V	0	0	3.9
21305.556	43.9	---	74.0	28.72	V	0	0	3.9
21594.083	43.8	---	74.0	28.82	H	0	30	4.2
21594.083	---	32.58	54.0	21.42	H	0	30	4.2
23588.278	---	32.58	54.0	21.42	V	82	90	4.1
23588.278	43.6	---	74.0	29.02	V	82	90	4.1
23643.528	---	33.08	54.0	20.92	V	204	150	4.1
23643.528	44.2	---	74.0	28.42	V	204	150	4.1
24542.639	---	33.08	54.0	20.92	H	0	120	4.1
24542.639	43.5	---	74.0	29.12	H	0	120	4.1
24642.278	---	33.18	54.0	20.82	V	0	90	4.0
24642.278	44.4	---	74.0	28.22	V	0	90	4.0
25076.722	---	32.68	54.0	21.32	V	0	0	3.8
25076.722	43.4	---	74.0	29.22	V	0	0	3.8
25387.917	---	32.08	54.0	21.92	V	0	120	3.5
25387.917	44.2	---	74.0	30.22	V	0	120	3.5
25597.583	---	32.28	54.0	18.22	V	345	120	3.4
25597.583	43.0	---	74.0	-47.08	V	345	120	3.4
25795.444	43.0	---	74.0	-29.38	V	0	0	3.5
25795.444	---	31.68	54.0	23.32	V	0	0	3.5

Remark *: These are the wanted Bluetooth emission and are therefore omitted from the final evaluation.

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1 – 17

5.9 AC power-line conducted emissions

5.9.1 Test setup (Conducted emissions on power supply lines)

Test setup (Conducted emissions on power supply lines)			
Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Conducted: AC power line	5.1.5	-
<input type="checkbox"/>	Not applicable	-	-

5.9.2 Test method (Conducted emissions on power supply lines)

Test setup (Conducted emissions on power supply lines)				
Used	Clause [3]	Name of method	Sub-clause	Comment
<input checked="" type="checkbox"/>	6.2.3.2	Tabletop equipment testing	5.1.5	-
<input type="checkbox"/>	6.2.3.3	Floor-standing equipment testing	-	-

The AC power adaptor which was used for the tests was provided by the laboratory:

Phoenix Contact MINI-PS-100-240AC/24DC/1.3

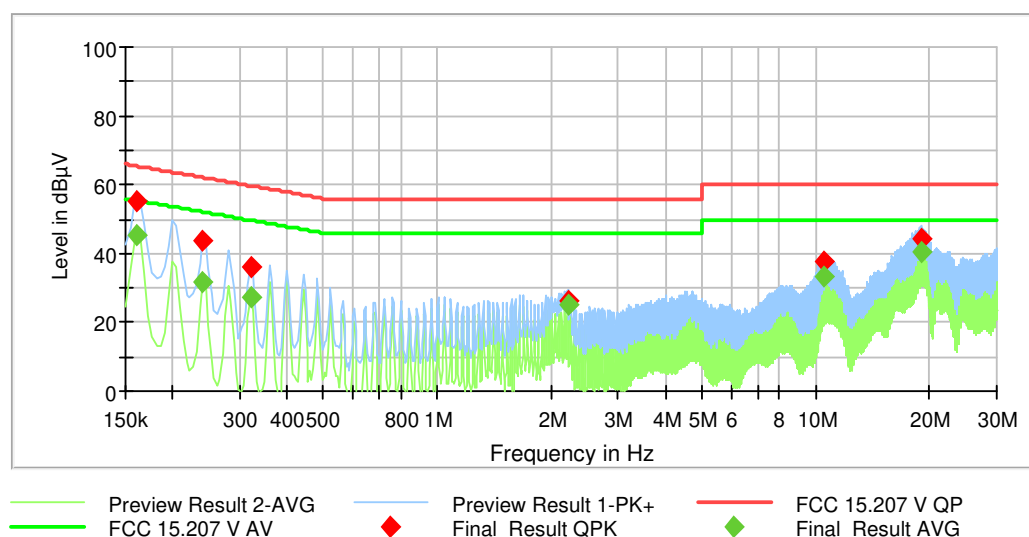
The power adaptor itself was supplied by 120V_{AC} 60Hz.

5.9.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	21.4 °C
Relative humidity:	30 %

Date:	06.02.2025
Tested by:	D. Bruschinski

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	Corr. [dB]
0.160800	55.21	---	65.42	10.21	N	GND	9.8
0.160800	---	45.36	55.42	10.06	N	GND	9.8
0.240900	---	31.80	52.07	20.26	N	GND	9.9
0.240900	43.54	---	62.07	18.52	N	GND	9.9
0.321000	---	27.52	49.68	22.17	L1	GND	9.9
0.321900	36.17	---	59.66	23.49	N	GND	9.9
2.210100	---	25.35	46.00	20.65	L1	GND	10.1
2.211900	26.48	---	56.00	29.52	L1	GND	10.1
10.528800	---	33.35	50.00	16.65	L1	GND	10.6
10.528800	37.79	---	60.00	22.21	L1	GND	10.6
19.047300	44.45	---	60.00	15.55	N	GND	10.9
19.048200	---	40.31	50.00	9.69	N	GND	10.9

Test result: Passed

Test equipment (please refer to chapter 7 for details)
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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 12 – 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 12 – 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	Standard gain horn 12 GHz - 18 GHz	18240-20	Flann	483	480294	Calibration not necessary	
2	Standard gain horn 18 GHz - 26 GHz	20240-20	Flann	411	480297	Calibration not necessary	
3	Microwave cable 2m	Insulated Wire Inc.	Insulated Wire	KPS-1533-800-KPS	480302	Calibration not necessary	
4	Fully anechoic chamber M20	B83117-E2439-T232	Albatross Projects	103	480303	Calibration not necessary	
5	Turntable	DS420 HE	Deisel	420/620/00	480315	Calibration not necessary	
6	Antenna support	AS620P	Deisel	620/375	480325	Calibration not necessary	
7	Preamplifier 100 MHz - 13 GHz	JS3-00101200-23-5A	MITEQ Hauppauge N.Y.	681851	480337	Calibration not necessary	
8	Preamplifier 18 GHz - 26 GHz	JS4-18002600-20-5A	MITEQ Hauppauge N.Y.	658697	480342	19.02.2024	02.2026
9	Preamplifier 12 GHz - 18 GHz	JS3-12001800-16-5A	MITEQ Hauppauge N.Y.	571667	480343	19.02.2024	02.2026
10	RF-cable No.3	Sucoflex 106B	Suhner	0563/6B / Kabel 3	480670	Calibration not necessary	
11	Multiple Control Unit	MCU	Maturo GmbH	MCU/043/97110 7	480832	Calibration not necessary	
12	Log.-Per. antenna 850 MHz - 26.5 GHz	HL050	Rohde & Schwarz	100438	481170	Calibration not necessary	
13	RF-Cable No. 40	Sucoflex 106B	Suhner	0708/6B / Kabel 40	481330	Calibration not necessary	
14	Software	EMC32 V10.60.20	Rohde & Schwarz	---	483261	Calibration not necessary	
15	High-pass filter	WHKX4.0/18G-8SS	Wainwright	1	480587	Calibration not necessary	
16	Positioner	TDF 1.5- 10Kg	Maturo	15920215	482034	Calibration not necessary	
17	EMI receiver / Spectrum analyser	ESW44	Rohde & Schwarz	101635	482467	27.02.2024	02.2026
18	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
19	Ultralog antenna	HL562E	Rohde & Schwarz	101079	482978	24.04.2024	04.2027
20	EMC test software	Elektra V5.10.00	Rohde&Schwarz		483755	Calibration not necessary	
21	RF Switch Matrix	OSP220	Rohde & Schwarz	101391	482976	Calibration not necessary	
22	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
23	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
24	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
25	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
26	EMI receiver / Spectrum analyser	ESW44	Rohde & Schwarz	101828	482979	21.02.2024	02.2026
27	LISN	NSLK8128	Schwarzbeck	8128155	480058	28.02.2024	02.2026

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
28	AC power supply	AC6803A AC Quelle 2000VA	Keysight	JPVJ002509	482350	Calibration not necessary	
29	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
30	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
31	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	22.02.2024	02.2026
32	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	28.03.2024	03.2026
33v	Signal & Spektrum analyser	FSW43	Rohde & Schwarz	102954	483957	10.07.2024	07.2026
34	Loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	21.02.2024	02.2026

8 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	08.11.2022	07.11.2025
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA	ANSI C63.4-2014 ANSI C63.4a-2017	01.03.2023	28.02.2026
Fully anechoic chamber M20	480303	1 -18 GHz	SVSWR	CISPR 16-1-4 Amd. 1	04.02.2025	03.02.2028

9 Report History

Report Number	Date	Comment
F241001E5	06.05.2025	Initial Test Report
F241001E5 2 nd Version	16.09.2025	<ol style="list-style-type: none"> 1. Removed and changed Annex B and Annex C and added them to different files 2. Page 57: Updated the List of Annexes 3. Page 2: Updated reference [1] + [4] 4. Page 7: Updated internal clock frequency 5. Page 9: Updated the date for the End of test 6. Page 31: Added the correct plot for the worst case maximum peak PSD 7. Page 20: Updated cross references 8. Page 10: Removed *, changed description for *¹ and updated table 9. Page 6: Updated Test Object
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10 List of Annexes

Annex A	Test Setup Photos	9 pages
Annex B	Void	
Annex C	Void	
Annex D	Void	

----- end of test report -----