

Test Report

Report Number:

F241002E7

Equipment under Test (EUT):

Control unit for welding inverters

BCU iWave 190/230 Smart 2

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 accreditation scope 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 by:

Signature

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:	Partly: Mr. Jan HERNDLER

1.2 Manufacturer

Name:	Fronius International GmbH
Address:	Fronius Straße 5, 4642 Sattledt
Country:	Austria
Name for contact purposes:	Mr. Jan HERNDLER
Phone:	+43-7242-241-0
eMail address:	herndler.jan@fronius.com
Manufacturer represented during the test by the following person:	Partly: 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: *	Control unit for welding inverters
Model name: *	BCU iWave 190/230 Smart 2
Model number: *	43,0001,1788
Order number: *	N/A
FCC ID: *	QKWBCU2
IC certification number: *	12270A-BCU2
PMN: *	BCU iWAVE 190/230 Smart 2
HVIN: *	V0.2B
FVIN: *	N/A

* Declared by the applicant

	EUT number		
	1	2	3
Serial number: *	00002374	00002375	-
PCB identifier: *	4,071,879	4,071,879	-
Hardware version: *	V0.2B_A	V0.2B_A	-
Software version: *	2.3.0-38650.79495-G2	2.3.0-38650.79495-G2	-

* Declared by the applicant

Two 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: *	DC		
Supply voltage EUT: *	$U_{nom} = 24.0 \text{ V}_{DC}$	$U_{min} = 21.6 \text{ V}_{DC}$	$U_{max} = 26.4 \text{ V}_{DC}$
Temperature range: *	-20 °C to +65 °C		
Lowest / highest internal clock frequency: *	20 kHz / 2480 MHz		

* Declared by the applicant

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Ethernet *	HSD	RJ45	< 100 m	Yes (CAT6)
Speednet *	HSD	Left open	< 100 m	Yes (CAT6)
DC mains *	Customized	4 mm laboratory plug	≈ 2 m	No
Internal port *	Mini-B-USB	Left open	-	Yes
Antenna connector	SMA connector	SMA connector	-	Yes

* Declared by the applicant

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) 5.3		
Radio module: *1	muRata LBEE5PL2DL		
Antenna type: *2	Dipole antenna		
Antenna name: *2	Taoglas GW.40		
Antenna gain: *2	3.15 dBi (peak)		
Antenna connector: *2	SMA		
Supply voltage radio module: *1	$U_{nom} = 3.3 V_{DC}$	$U_{min} = 3.14 V_{DC}$	$U_{max} = 3.46 V_{DC}$
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 based on the data sheet "Type 2DL Wi-Fi® + Bluetooth® Module"

*2 based on the antenna data sheet "SPE-19-8-069-A"

1.5.1 Ancillary Equipment / Equipment used for testing

Equipment used for testing	
AC adapter *1	UE36LCP1-240150SPA
Test laptop *2	Fujitsu Lifebook U748
Test laptop *2	Fujitsu Lifebook S760

*1 Provided by the applicant

*2 Provided by the laboratory

1.6 Dates

Date of receipt of test sample:	08.07.2025
Start of test:	09.07.2025
End of test:	17.09.2025

2 Operational States

2.1 Description of function of the EUT

The EUT is a control unit for welding inverters. Bluetooth® LE is used for data communication.

2.1.1 Operation modes

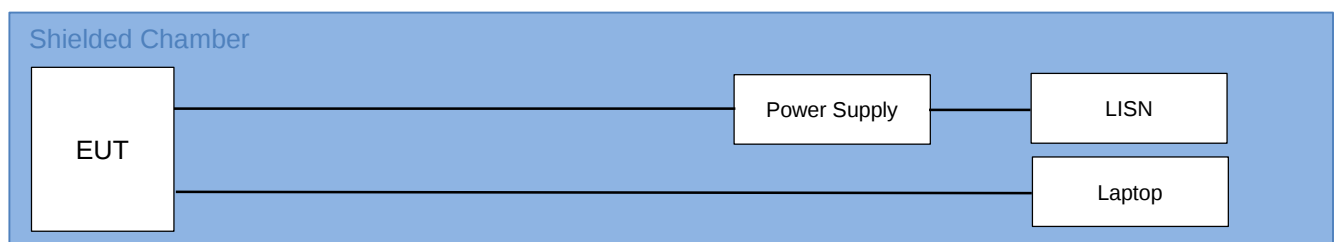
An ethernet connection to the test notebook was established and the test modes were set in a terminal session.

Operation mode #	Radio technology	Frequency [MHz]	Channel / Band	Modulation / Mode	Data rate	Power setting
1	Bluetooth® LE	2402	0	GFSK	125 kbps	"0x03 (3 dBm)"
2	Bluetooth® LE	2440	19	GFSK	125 kbps	"0x03 (3 dBm)"
3	Bluetooth® LE	2480	39	GFSK	125 kbps	"0x03 (3 dBm)"
4	Bluetooth® LE	2402	0	GFSK	500 kbps	"0x03 (3 dBm)"
5	Bluetooth® LE	2440	19	GFSK	500 kbps	"0x03 (3 dBm)"
6	Bluetooth® LE	2480	39	GFSK	500 kbps	"0x03 (3 dBm)"
7	Bluetooth® LE	2402	0	GFSK	1 Mbps	"0x03 (3 dBm)"
8	Bluetooth® LE	2440	19	GFSK	1 Mbps	"0x03 (3 dBm)"
9	Bluetooth® LE	2480	39	GFSK	1 Mbps	"0x03 (3 dBm)"
10	Bluetooth® LE	2402	0	GFSK	2 Mbps	"0x03 (3 dBm)"
11	Bluetooth® LE	2440	19	GFSK	2 Mbps	"0x03 (3 dBm)"
12	Bluetooth® LE	2480	39	GFSK	2 Mbps	"0x03 (3 dBm)"

2.1.2 Block Diagram (Radiated)



2.1.3 Block Diagram (AC powerline conducted)



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 peak conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	6.3.2 [4]	1	Passed
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]	2	Passed * ¹
Maximum unwanted emissions	0.009 – 26500 * ²	15.247 (d) 15.205 (a) 15.209 (a)	8.9 [5]	2	Passed * ^{1 2}
Antenna Requirement	-	15.203 15.247 (b)	6.8 [5] 6.5 (c) (ii) [4]	1	Passed
Conducted emissions on supply line	0.15 – 30	15.207 (a)	8.8 [5]	1	Passed

*¹: Only the worst-case data rate as pretests have shown was tested

*² Only maximum unwanted emissions above 30 MHz were tested.

As declared by the applicant the highest radio frequency is 2.480 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

5.1.1 Radiated: 30 MHz to 1 GHz

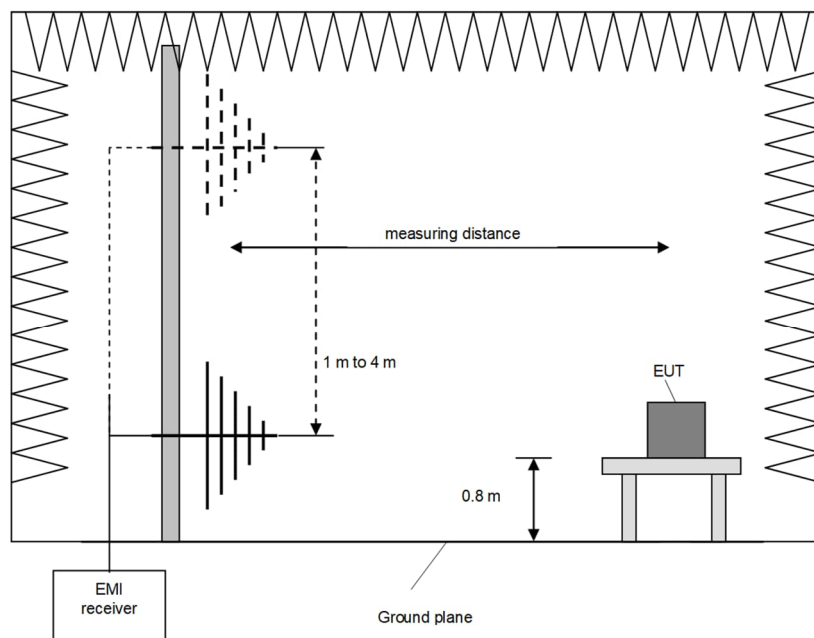
5.1.1.1 Preliminary and final measurement 30 MHz to 1 GHz

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 $\pm 30^\circ$ 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.

5.1.2 Radiated: 1 GHz to 40 GHz

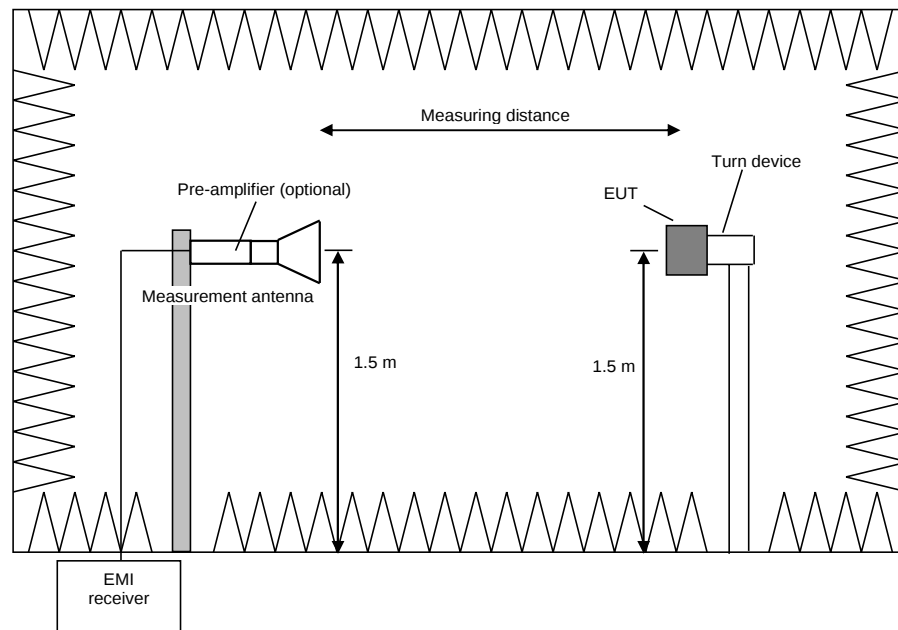
5.1.2.1 Preliminary and final measurement 1 GHz to 40 GHz

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.

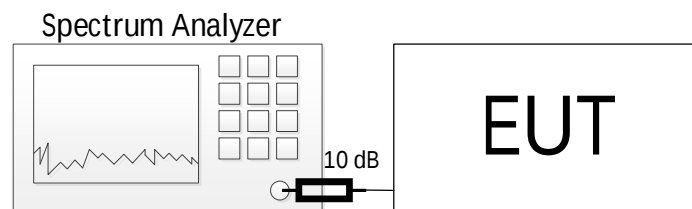
Procedure final measurement:

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 $\pm 30^\circ$ 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.

5.1.3 Conducted: Antenna port

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



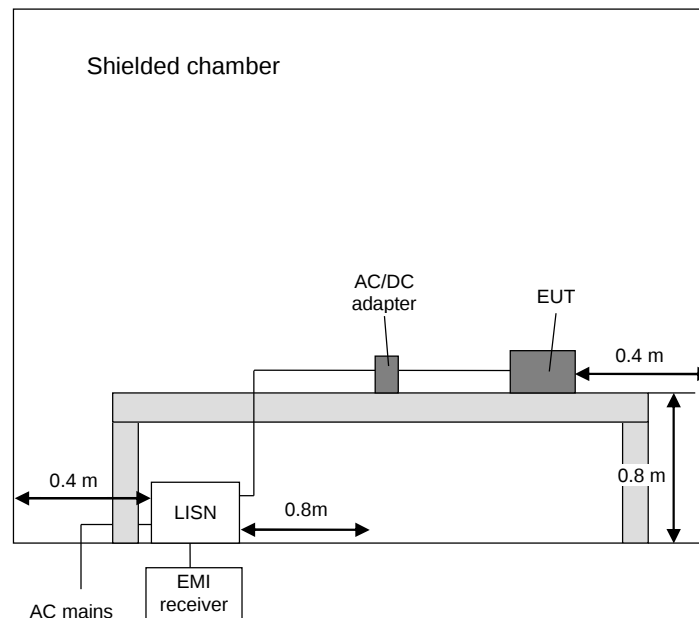
The 10 dB external attenuation is considered in all relevant plots

5.1.4 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
☐	Radiated: 1 GHz to 40 GHz	5.1.2	-
☒	Conducted: Antenna port	5.1.3	-

5.2.2 Test method (Duty Cycle)

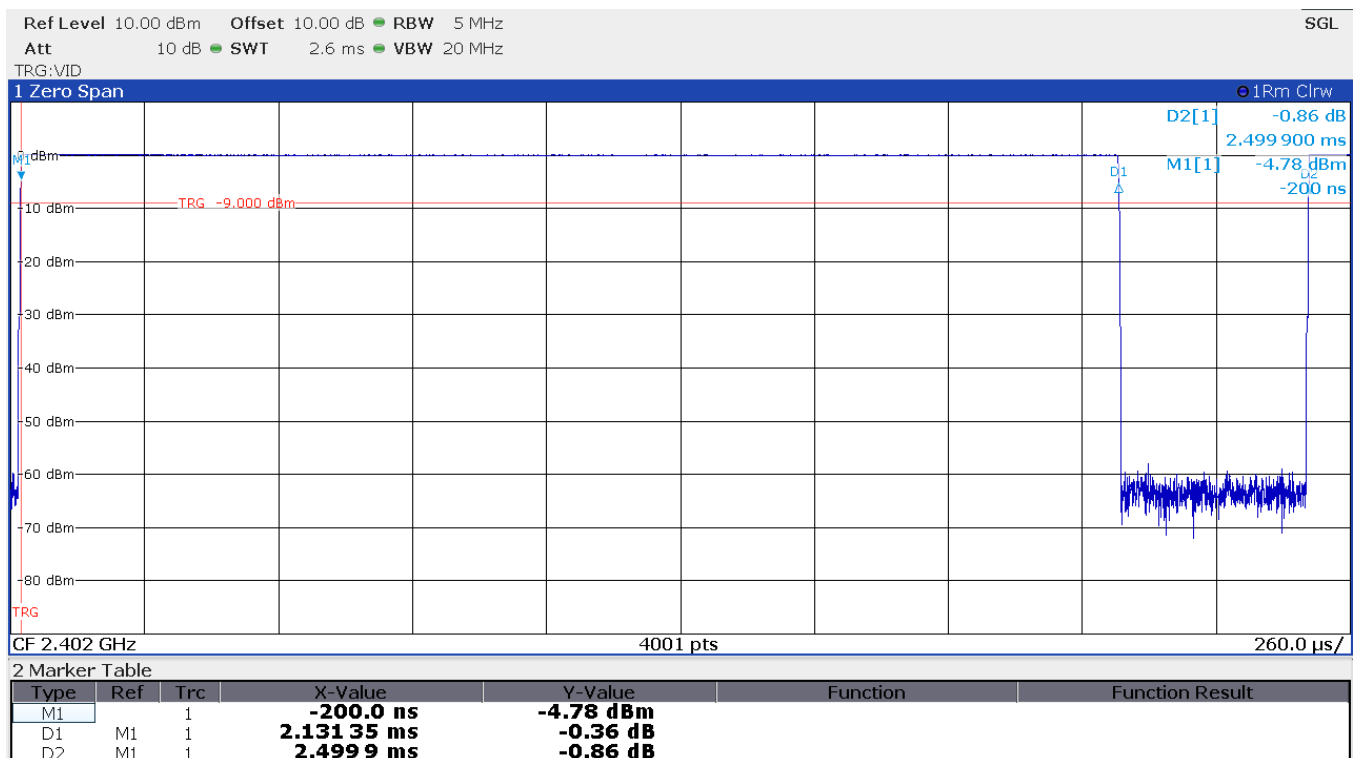
Test method (Duty cycle)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☐	11.6. a)	Diode detector	No limitation	-
☒	11.6. b)	Zero span	No limitation	-

5.2.3 Test results (Duty Cycle)

Ambient temperature:	23 °C
Relative humidity:	50 %

Date:	09.07.2025
Tested by:	P. NEUFELD

Worst case plot (operation mode 7):



Result tables duty cycle:

Operation Mode #	TX _{on} [μs]	TX _{ges} [μs]	RBW [MHz]	50/T [kHz]	50/T < RBW?
1	17052	20008	5	2.5	☒
4	4553	10000	5	5	☒
7	2131	2500	5	20	☒
10	1077	2501	5	20	☒

Operation Mode #	Sweep points	Sweep time [μs]	Meas points	Meas points >100?	Duty cycle %	DCCF _{Power} [dB]	DCCF _{Fieldstrength} [dB]
1	4001	20500	3328	☒	85.2	0.7	1.4
4	4001	10500	1734	☒	45.5	3.4	6.8
7	4001	2600	3279	☒	85.3	0.7	1.4
10	4001	2600	1657	☒	43.1	3.7	7.3

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 radiated average measurements of the fundamental the DCCF_{Fieldstrength} is used.
For conducted average measurements of the fundamental the DCCF_{Power} is used.

The applicable DCCFs are shown below.

Operation modes #	DCCF _{Power} [dB]	DCCF _{Fieldstrength} [dB]
1 – 3	0.7	1.4
4 – 6	3.4	6.8
7 – 9	0.7	1.4
10 – 12	3.7	7.3

Test equipment (please refer to chapter 7 for details)

1

5.3 DTS bandwidth

5.3.1 Test setup (DTS bandwidth)

Test setup (DTS bandwidth)			
Used	Setup	See sub-clause	Comment
☐	Radiated: 1 GHz to 40 GHz	5.1.2	-
☒	Conducted: Antenna port	5.1.3	-

5.3.2 Test method (DTS bandwidth)

Test method (DTS bandwidth)				
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

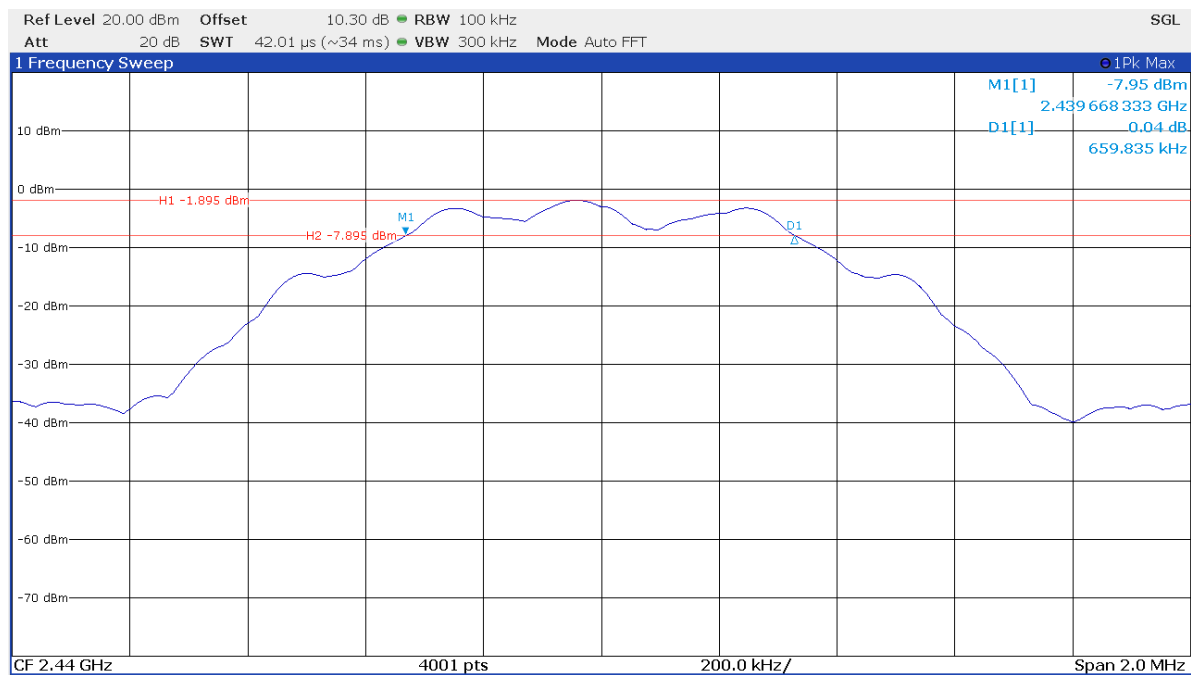
The test results are presented on the following page.

5.3.3 Test results (DTS bandwidth)

Ambient temperature:	23 °C
Relative humidity:	44 %

Date:	12.09.2025
Tested by:	D. BRUSCHINSKI

Worst case plot (operation mode 2):



Operation mode #	DTS bandwidth [MHz]	Minimum DTS bandwidth Limit [MHz]
1	0.661	0.500
2	0.660	0.500
3	0.681	0.500
4	0.761	0.500
5	0.758	0.500
6	0.765	0.500
7	0.789	0.500
8	0.782	0.500
9	0.784	0.500
10	1.455	0.500
11	1.451	0.500
12	1.451	0.500

Test result: Passed

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

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
☐	Radiated: 1 GHz to 40 GHz	5.1.2	-
☒	Conducted: Antenna port	5.1.3	-

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
☐	6.9.2	Relative measurement procedure	-	n-dB down
☒	6.9.3	Power bandwidth (99%)	*1	99% power function

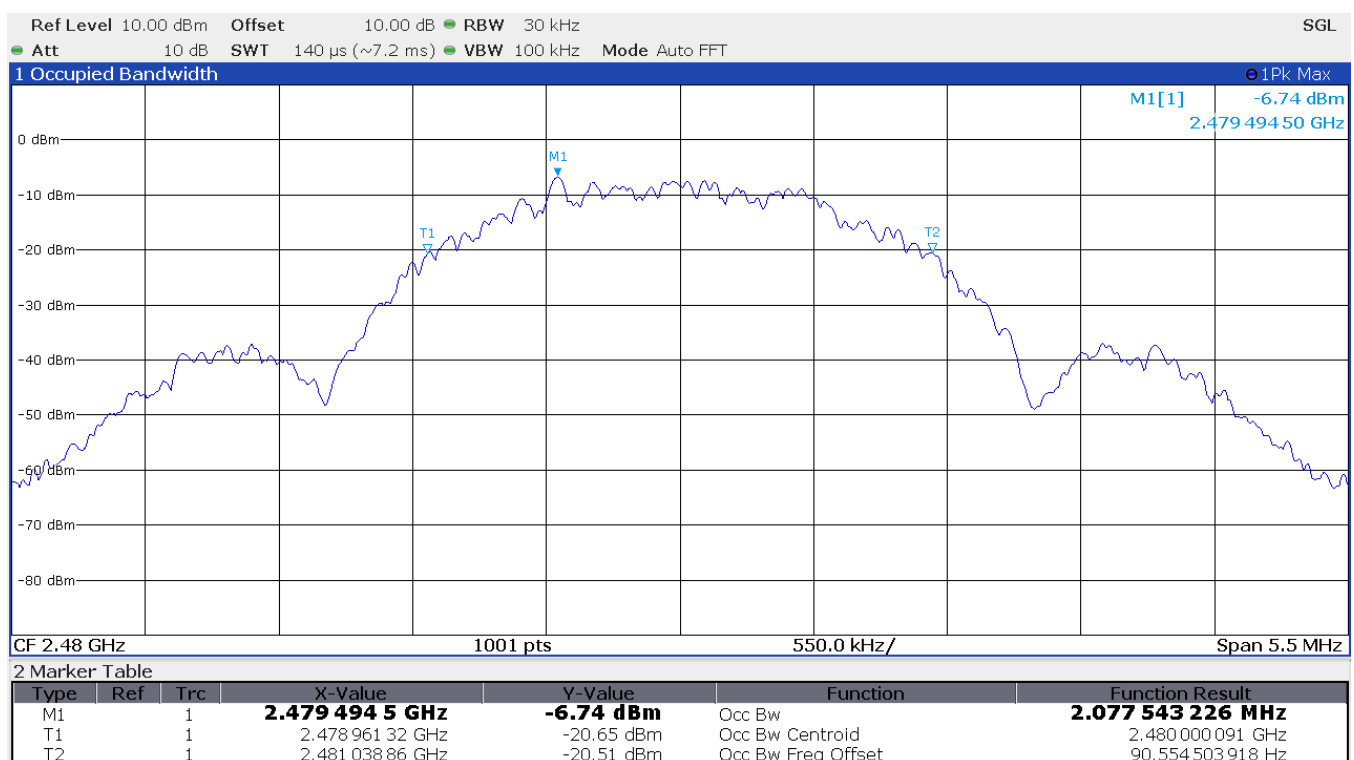
*1 See RSS-GEN Issue 5 (2018-05) sub-clause 6.7 for details.

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

Ambient temperature:	23 °C
Relative humidity:	50 %

Date:	09.07.2025
Tested by:	P. NEUFELD

Worst case plot (operation mode 12):



The result table is presented on the following page.

Result table:

Operation mode #	99% bandwidth [MHz]
1	1.069369
2	1.069287
3	1.069267
4	1.026001
5	1.026302
6	1.025841
7	1.036500
8	1.037228
9	1.037552
10	2.076632
11	2.076644
12	2.077543

Test result: Passed

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

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
☐	Radiated: 1 GHz to 40 GHz	5.1.2	-
☒	Conducted: Antenna port	5.1.3	-

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
☒	11.9.1.1	RBW $\geq$ DTS bandwidth	-	Zero span mode
☐	11.9.1.2	PKPM1 Peak power meter method *	-	-

* 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
☐	11.9.2.2.2	Method AVGSA-1	$D \geq 98\%$	-
☐	11.9.2.2.3	Method AVGSA-1A (alternative)	$D \geq 98\%$	-
☒	11.9.2.2.4	Method AVGSA-2	Constant D ($\pm 2\%$)	-
☐	11.9.2.2.5	Method AVGSA-2A (alternative)	Constant D ($\pm 2\%$)	-
☐	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 ($\pm 2\%$)	-
☐	11.9.2.3.2	Method AVGPM-G	-	-

The test results are presented on the following pages.

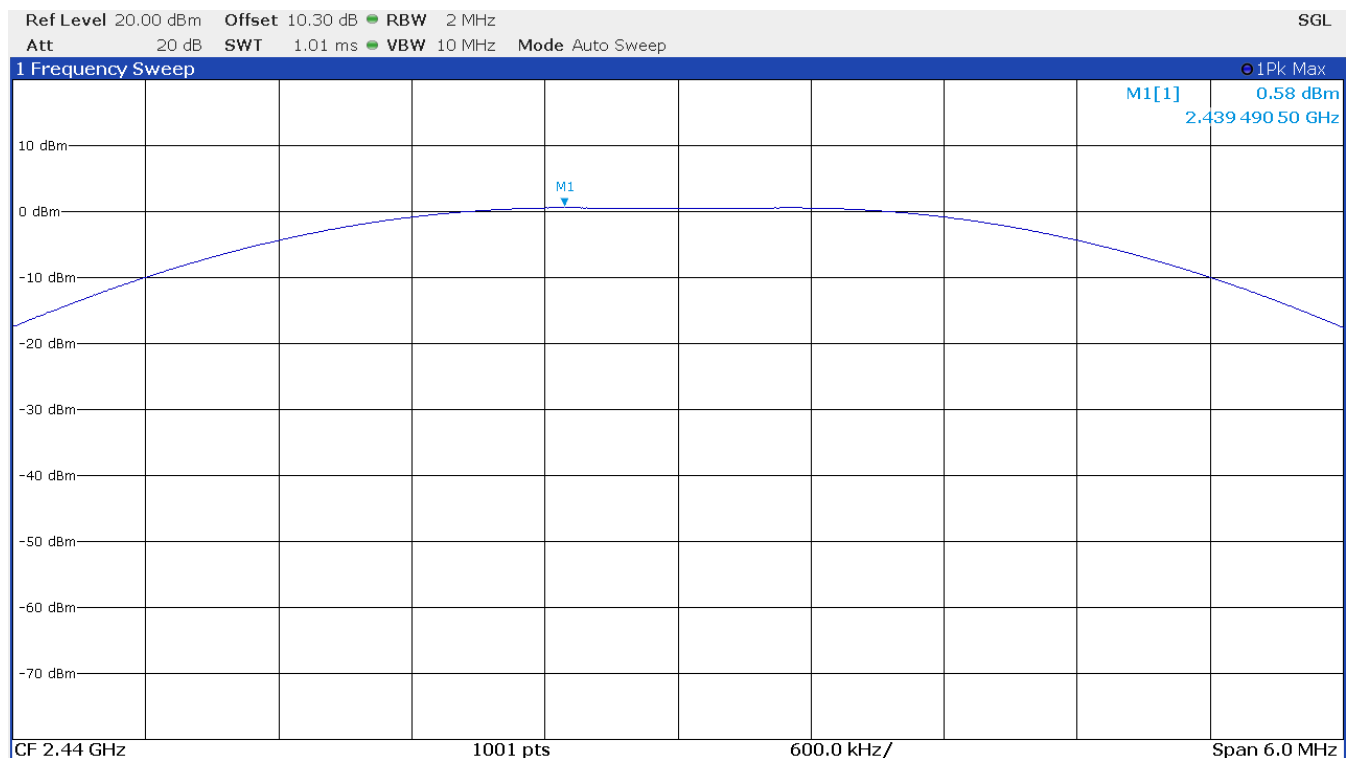
5.5.3 Test results (DTS fundamental emission output power)

5.5.3.1 Maximum peak conducted output power:

Ambient temperature:	23 °C
Relative humidity:	44 %

Date:	12.09.2025
Tested by:	D. BRUSCHINSKI

Worst case plot (operation mode 11):



Remark: The cable attenuation and external attenuation were accounted for by the offset at the spectrum analyzer.

The result table is presented on the following page.

Result table peak conducted output power:

Operation mode	Result [dBm]	Limit [dBm]	Antenna gain [dBi]	Result [dBm e.i.r.p.]	Limit [dBm e.i.r.p.]
1	0.5	30.0	3.2	3.7	36.0
2	0.5	30.0	3.2	3.7	36.0
3	0.5	30.0	3.2	3.7	36.0
4	0.6	30.0	3.2	3.8	36.0
5	0.5	30.0	3.2	3.7	36.0
6	0.5	30.0	3.2	3.7	36.0
7	0.5	30.0	3.2	3.7	36.0
8	0.5	30.0	3.2	3.7	36.0
9	0.5	30.0	3.2	3.7	36.0
10	0.6	30.0	3.2	3.8	36.0
11	0.6	30.0	3.2	3.8	36.0
12	0.5	30.0	3.2	3.7	36.0

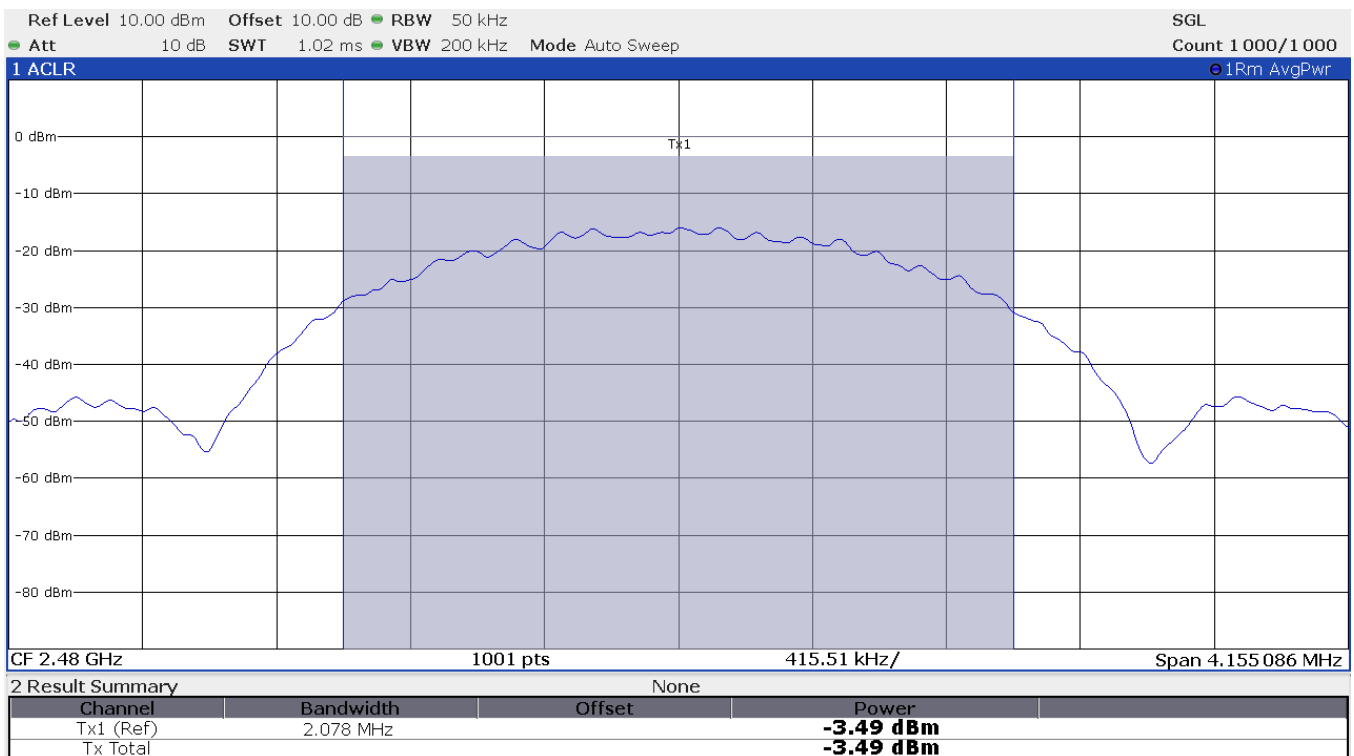
Test result: Passed

5.5.3.2 Maximum conducted (average) output power

Ambient temperature:	22°C - 23 °C
Relative humidity:	50 % - 53 %

Date:	09.07.2025 / 17.09.2025
Tested by:	P. NEUFELD / D. BRUSCHINSKI

Worst case plot (operation mode 12):



Remark: The cable attenuation and external attenuation were accounted for by the offset at the spectrum analyzer and the correction in the table.

The result table is presented on the following page.

Result table conducted (average) output power:

Operation mode	Reading [dBm]	Correction [dB]	DCCF ^{Power} [dB]	Result [dBm]	Limit [dBm]	Antenna gain [dBi]	e.i.r.p. [dBm]	Limit e.i.r.p. [dBm]
1	-0.7	0.1	0.7	0.1	30.0	3.2	3.3	36.0
2	-0.7	0.1	0.7	0.1	30.0	3.2	3.3	36.0
3	-0.6	0.1	0.7	0.2	30.0	3.2	3.4	36.0
4	-3.1	0.0	3.4	0.3	30.0	3.2	3.5	36.0
5	-3.4	0.1	3.4	0.1	30.0	3.2	3.3	36.0
6	-3.4	0.1	3.4	0.1	30.0	3.2	3.3	36.0
7	-0.4	0.0	0.7	0.3	30.0	3.2	3.5	36.0
8	-0.7	0.1	0.7	0.1	30.0	3.2	3.3	36.0
9	-0.7	0.1	0.7	0.1	30.0	3.2	3.3	36.0
10	-3.7	0.1	3.7	0.1	30.0	3.2	3.3	36.0
11	-3.7	0.1	3.7	0.1	30.0	3.2	3.3	36.0
12	-3.5	0.1	3.7	0.3	30.0	3.2	3.5	36.0

Test result: Passed

Test equipment (please refer to chapter 7 for details)

1

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
☐	Radiated: 1 GHz to 40 GHz	5.1.2	-
☒	Conducted: Antenna port	5.1.3	-

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
☒	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
☐	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	-

The test results are presented on the following pages.

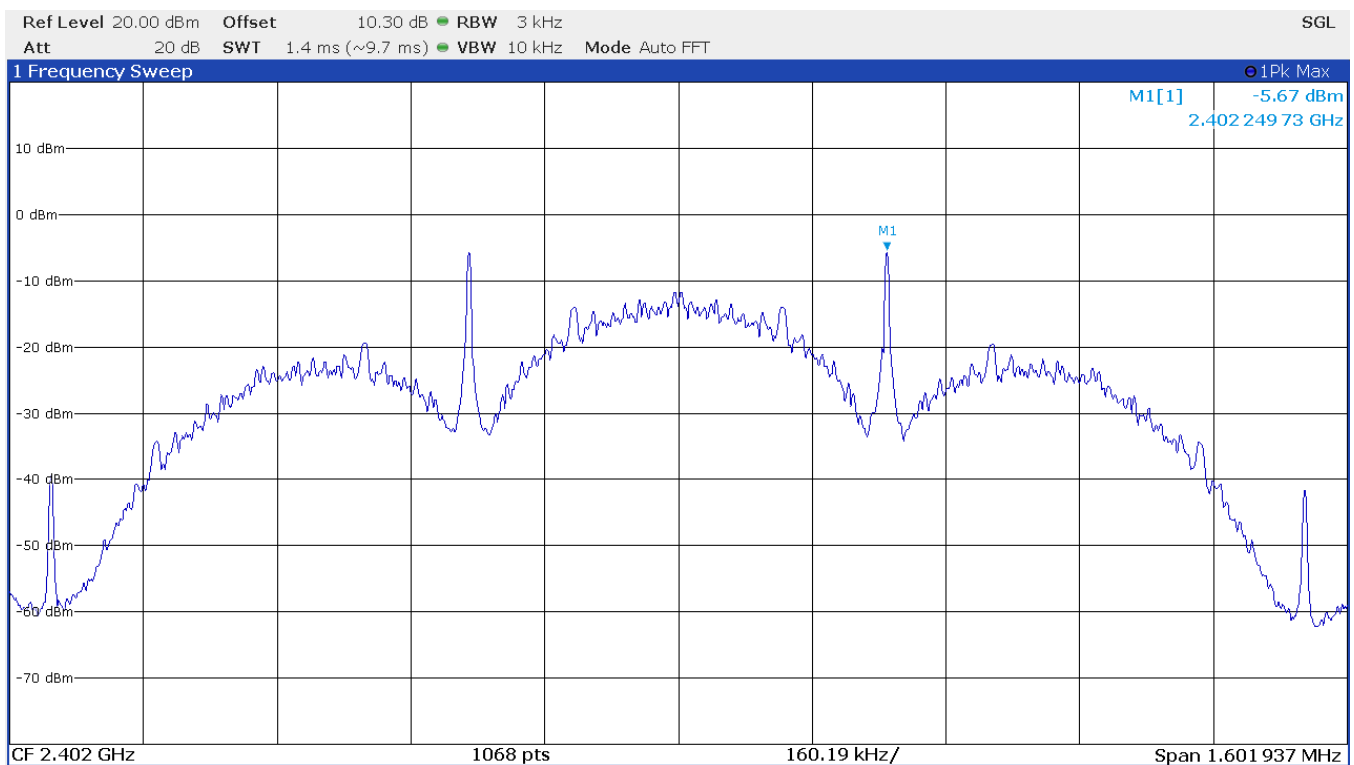
5.6.3 Test results (DTS maximum PSD level in the fundamental emission)

Ambient temperature:	23 °C
Relative humidity:	44 %

Date:	12.09.2025
Tested by:	D. BRUSCHINSKI

5.6.3.1 Maximum peak PSD:

Worst case plot (operation mode 1):



Remark: The cable attenuation and external attenuation were accounted for by the offset at the spectrum analyzer.

The result table is presented on the following page.

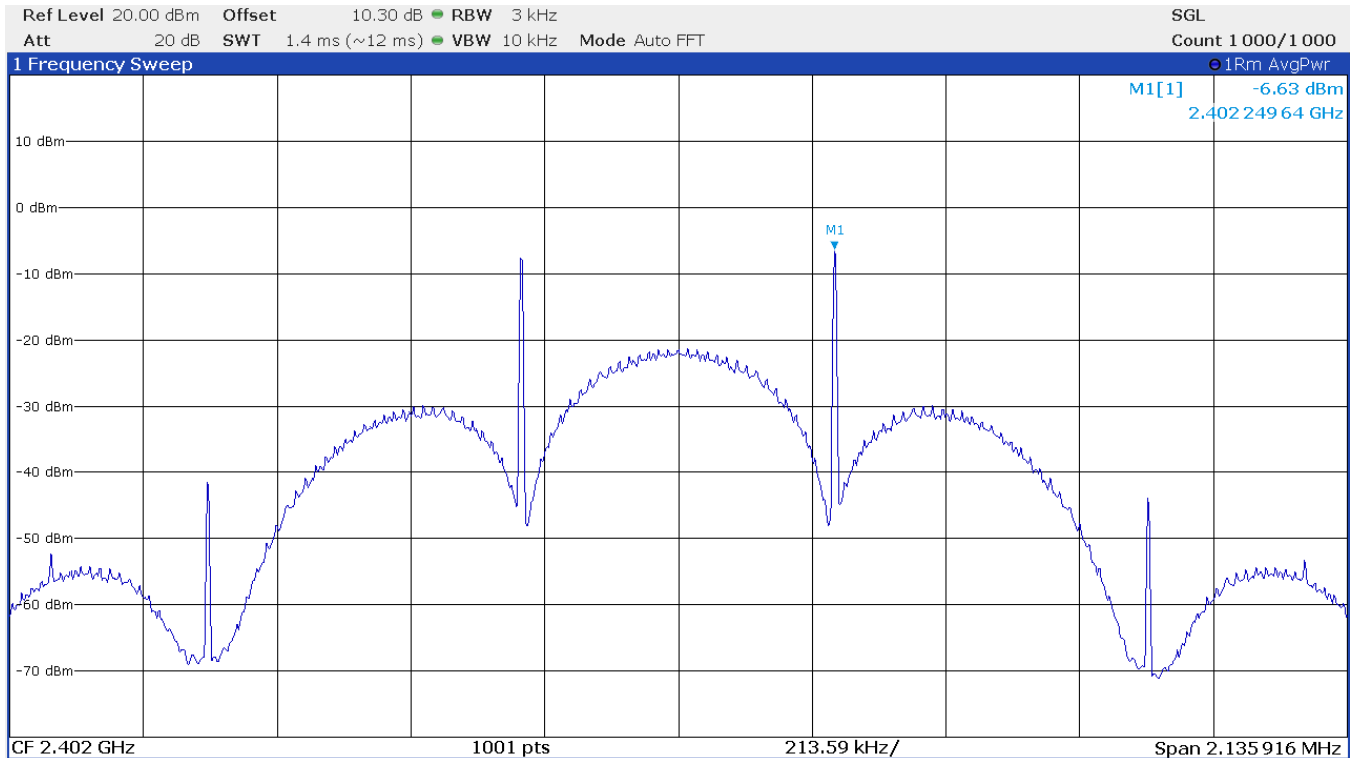
Result table peak PSD:

Operation mode	Result [dBm/3 kHz]	Limit [dBm/3 kHz]
1	-5.7	8.0
2	-5.7	8.0
3	-5.7	8.0
4	-8.8	8.0
5	-8.8	8.0
6	-9.1	8.0
7	-14.1	8.0
8	-14.1	8.0
9	-14.1	8.0
10	-15.8	8.0
11	-15.8	8.0
12	-15.8	8.0

Test result: Passed

5.6.3.2 Maximum average PSD

Worst case plot (operation mode 1):



Remark: The cable attenuation and external attenuation were accounted for by the offset at the spectrum analyzer.

The result table is presented on the following page.

Result table average PSD:

Operation mode	Reading [dBm/3 kHz]	DCCF _{Power} [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]
1	-6.6	0.7	-5.9	8.0
2	-8.6	0.7	-7.9	8.0
3	-8.0	0.7	-7.3	8.0
4	-23.7	3.4	-20.3	8.0
5	-23.8	3.4	-20.4	8.0
6	-24.0	3.4	-20.6	8.0
7	-25.4	0.7	-24.7	8.0
8	-19.5	0.7	-18.8	8.0
9	-19.6	0.7	-18.9	8.0
10	-23.9	3.7	-20.2	8.0
11	-24.0	3.7	-20.3	8.0
12	-24.1	3.7	-20.4	8.0

Test result: Passed

Test equipment (please refer to chapter 7 for details)

1

5.7 DTS band-edge emission measurements

5.7.1 Test setup (Band edge – unrestricted bands)

Test setup (Band edge – unrestricted bands)			
Used	Setup	See sub-clause	Comment
☐	Radiated: 1 GHz to 40 GHz	5.1.2	-
☒	Conducted: Antenna port	5.1.3	-

5.7.2 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.

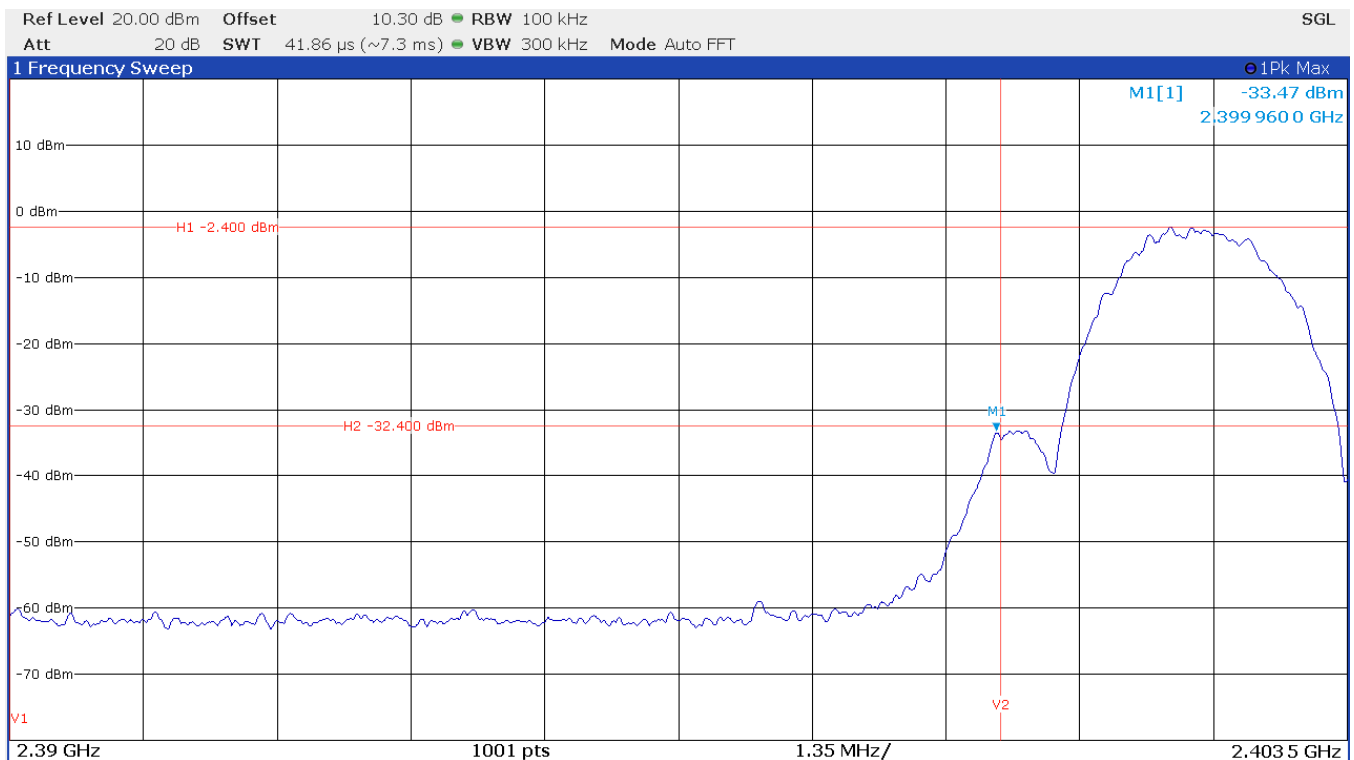
The test results are presented on the following pages.

5.7.3 Test results (Band edge – unrestricted bands)

Ambient temperature:	23 °C
Relative humidity:	44 %

Date:	12.09.2025
Tested by:	D. BRUSCHINSKI

Plot lower band edge (operation mode 10):



The result tables are presented on the following page.

Result table lower band edge (operation mode 1):

Frequency [MHz]	Reference [dBm]	Limit [dBm]	Unrestricted band emission [dBm]	Margin [dB]
2400.005	-2.9	-32.9	-58.6	25.7

Result table lower band edge (operation mode 4):

Frequency [MHz]	Reference [dBm]	Limit [dBm]	Unrestricted band emission [dBm]	Margin [dB]
2400.005	-1.0	-31.0	-58.8	27.8

Result table lower band edge (operation mode 7):

Frequency [MHz]	Reference [dBm]	Limit [dBm]	Unrestricted band emission [dBm]	Margin [dB]
2399.750	-1.1	-31.1	-58.8	27.7

Result table lower band edge (operation mode 10):

Frequency [MHz]	Reference [dBm]	Limit [dBm]	Unrestricted band emission [dBm]	Margin [dB]
2399.960	-2.4	-32.4	-33.5	1.1

Test result: Passed

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

5.7.4 Test setup (Band edge – restricted bands)

Test setup (Band edge – restricted bands)			
Used	Setup	See sub-clause	Comment
☒	Radiated: 1 GHz to 40 GHz	5.1.2	-
☐	Conducted: Antenna port	5.1.3	-

5.7.5 Test method (Band edge – restricted bands)

Test method (Band edge – restricted bands)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	11.12.1	Standard method	No limitations	-
☐	11.12.3.1	Marker-delta method	-	See 6.10.6 [3] 2 MHz from band
☐	11.12.3.2	Integration method	-	2 MHz from band

Only the worst-case data rate as pretests have shown was tested.

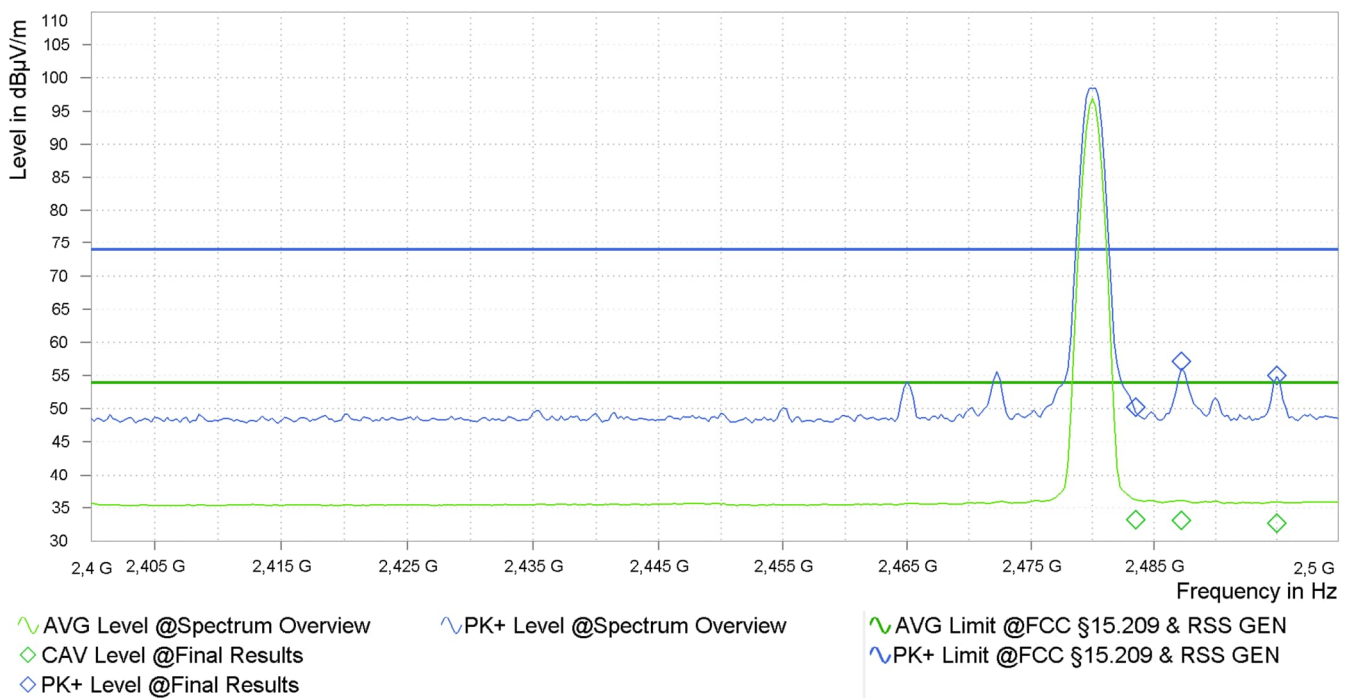
The test results are presented on the following page.

5.7.6 Test results (Band edge – restricted bands)

Ambient temperature:	23 °C
Relative humidity:	52 %

Date:	11.07.2025
Tested by:	D. BRUSCHINSKI

Plot upper band edge (operation mode 9):



Result table upper band edge (operation mode 9):

Frequency [MHz]	MaxPeak [dB(μV/m)]	Average [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB(μV/m)]	Pol [H/V]	Azimuth [deg]	Elevation [deg]	Corr. [dB]
2483.50	50.25	-	74.00	23.75	V	192	102	34.60
2483.50	-	34.60 *	54.00	19.40	V	199	96	36.00
2487.25	57.11	-	74.00	16.89	V	194	105	34.60
2487.25	-	34.52 *	54.00	19.48	V	195	93	36.00
2495.00	55.03	-	74.00	18.97	V	195	108	34.62
2495.00	-	34.01 *	54.00	19.99	V	195	120	36.02

* These results were corrected by the DCCF_{Fieldstrength}.

Test result: Passed

Test equipment (please refer to chapter 7 for details)
2 - 10

5.7.6.1 Test results (30 MHz – 1 GHz)

Ambient temperature:	22 °C
Relative humidity:	64 %

Date:	15.07.2025
Tested by:	D. BRUSCHINSKI

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 detailed information of test set-up and the cable guide refer to the pictures in annex A of this test report.

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

Remark: Only the nominal position and the worst case as pretests have shown were tested.

Calculations:

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

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

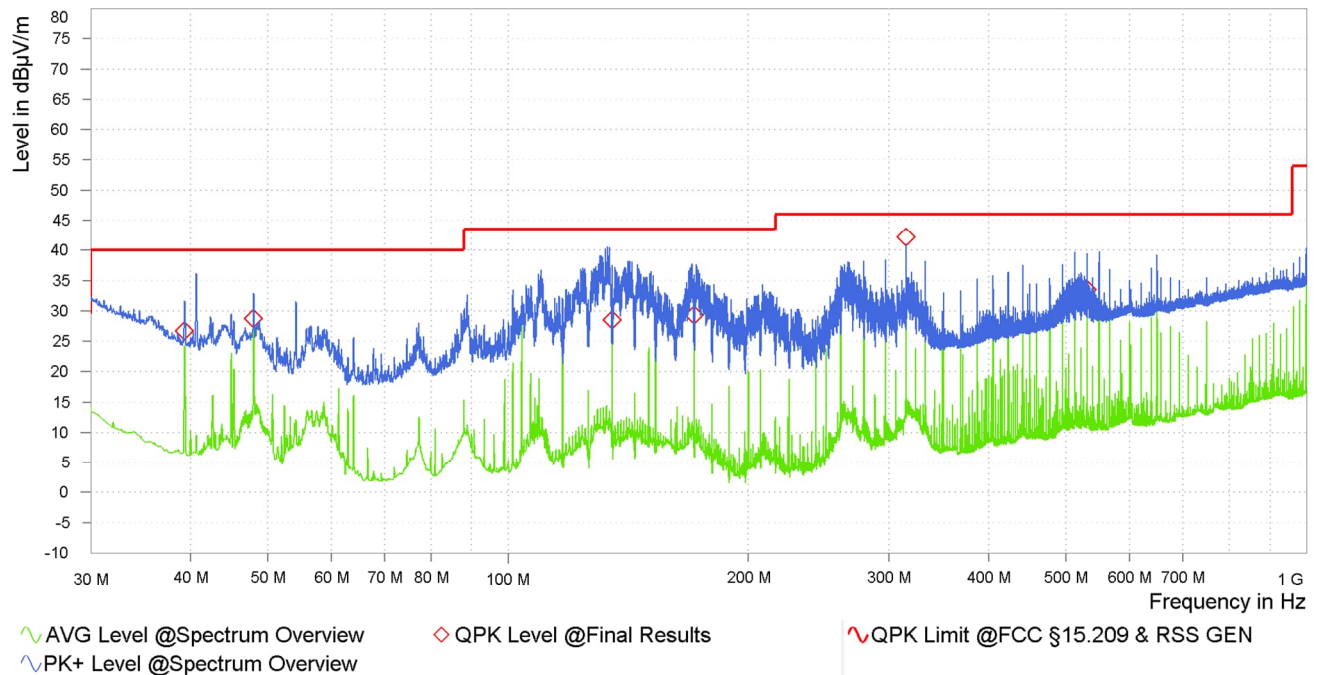
Margin [dB] = Limit [dBμV/m] - Result [dBμV/m]

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.

The results are presented on the following page.

Measurement plot:

Spurious emissions from 30 MHz to 1 GHz (operation mode 11):



Result table:

(Operation mode 11):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Polarization (H/V)	Azimuth [deg]	Height [m]
39.33	26.66	40.0	13.34	20.77	V	163	1.01
48.00	28.68	40.0	11.32	14.90	V	313	1.04
135.00	28.51	43.5	14.99	16.32	H	101	1.79
171.00	29.29	43.5	14.21	15.81	H	107	1.51
315.00	42.20	46.0	3.80	19.37	H	145	1.00
531.00	33.44	46.0	12.56	24.63	V	333	1.09

Test result: Passed

Test equipment (please refer to chapter 7 for details)

3 - 9, 11 - 12

5.7.6.2 Test results (radiated 1 GHz to 40 GHz)

Ambient temperature:	23 °C
Relative humidity:	55 %

Date:	09.07.2025
Tested by:	B. ROHDE

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 detailed information of test set-up and the cable guide refer to the pictures in annex A of this test report.

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

Remark: Only the worst case as pretests have shown was tested.

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]

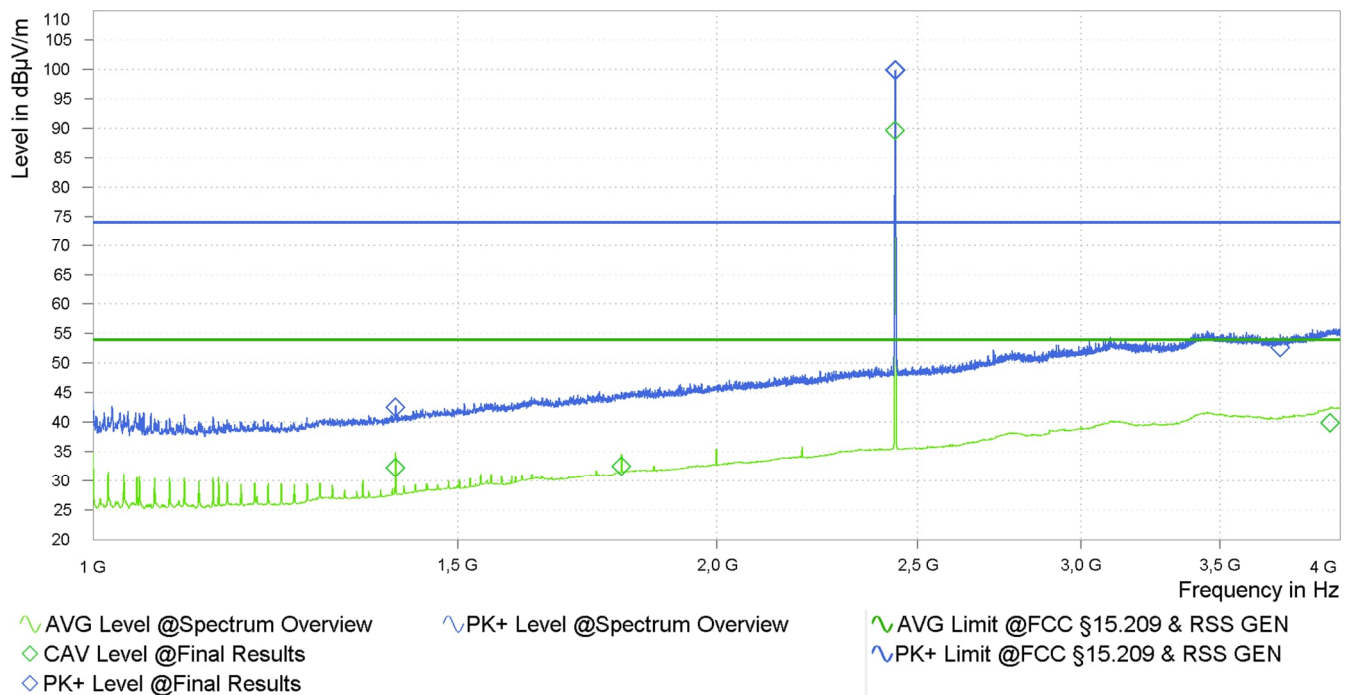
The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna positions.

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.

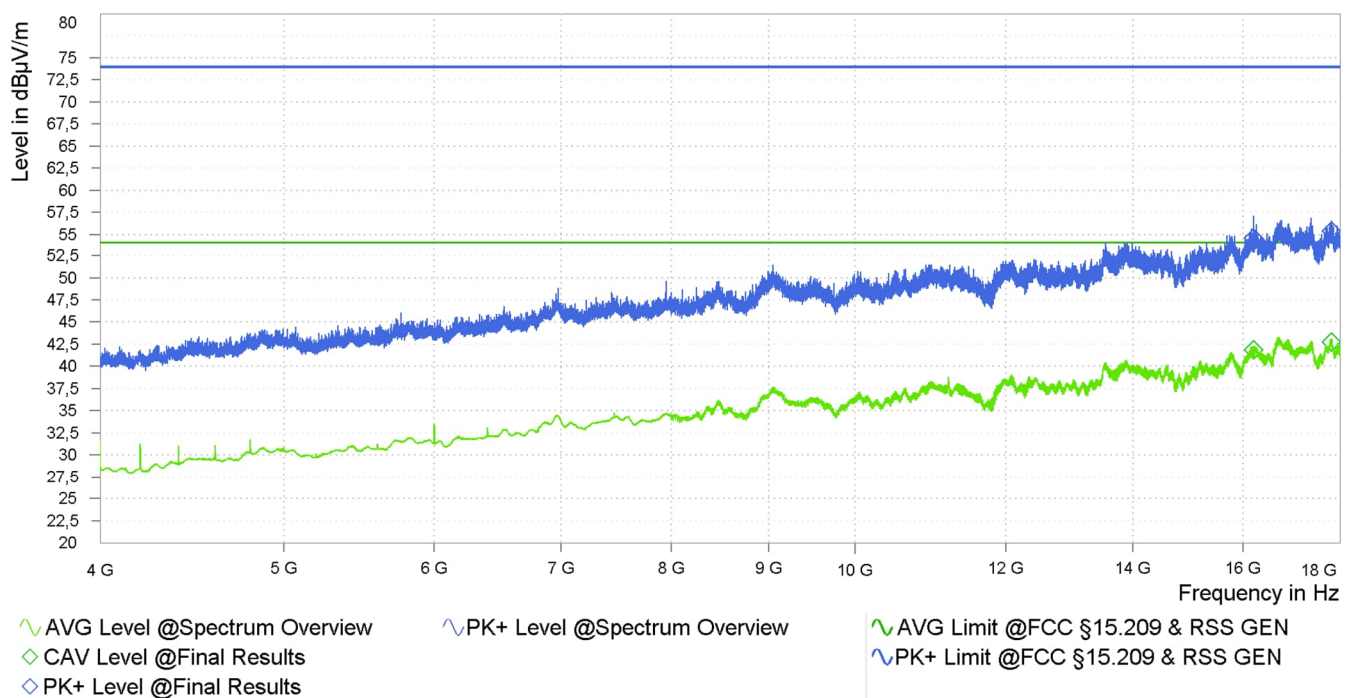
The test results are presented on the following pages.

Measurement plots:

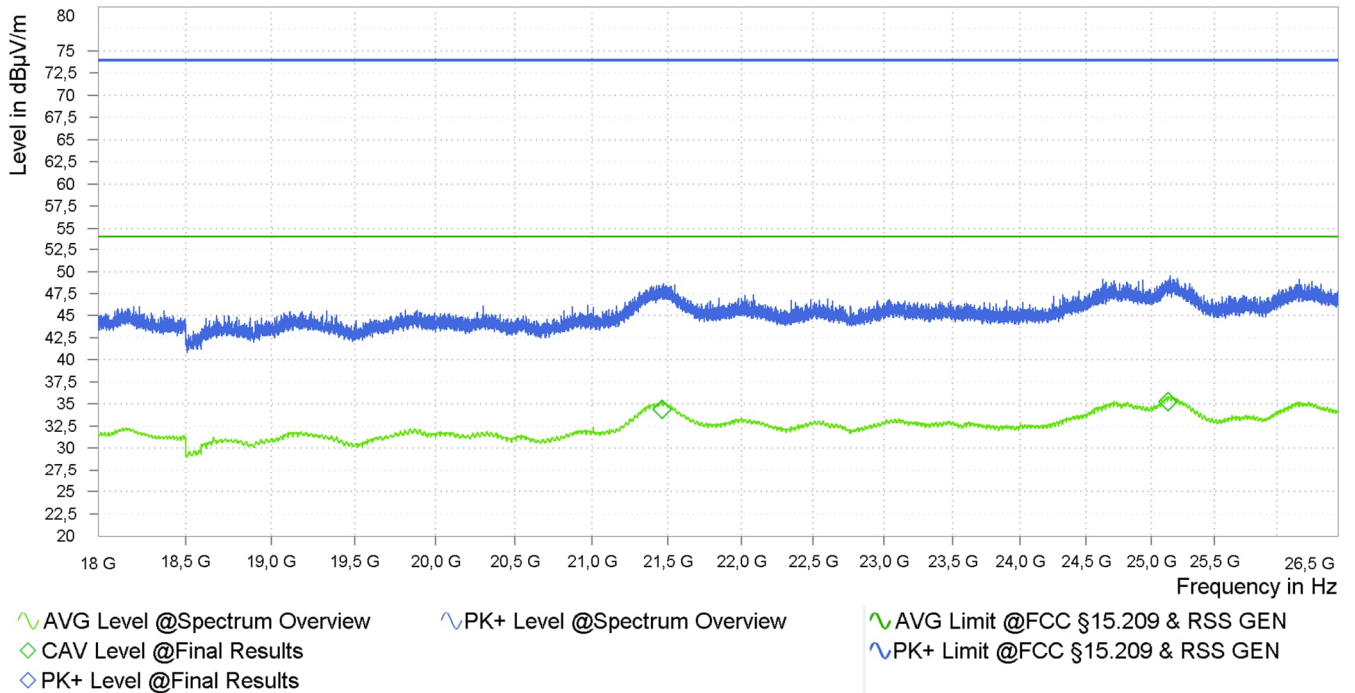
Spurious emissions from 1 GHz to 4 GHz (operation mode 11):



Spurious emissions from 4 GHz to 18 GHz (operation mode 11):



Spurious emissions from 18 GHz to 26.5 GHz (operation mode 11):



Result table (operation mode 11):

Frequency [MHz]	MaxPeak [dB(μ V/m)]	Average [dB(μ V/m)]	Limit [dB(μ V/m)]	Margin [dB]	Pol [H/V]	Azimuth [deg]	Elevation [deg]	Correction [dB/m]
1400.00	42.49	-	74.0	31.51	V	195	117	28.12
1400.00	-	32.28	54.0	21.72	V	187	110	28.12
1800.00	-	32.56	54.0	21.44	V	81	147	30.89
2439.50	99.88	-	Fundamental	-	V	188	0	34.61
2440.00	-	96.93 *	Fundamental	-	V	186	357	41.91
2440.50	99.86	-	Fundamental	-	V	187	0	34.61
3743.00	52.66	-	74.0	21.34	H	315	0	38.50
3957.00	-	39.88	54.0	14.12	V	120	126	39.94
16211.75	54.56	-	74.0	19.44	H	296	90	27.13
16211.75	-	41.85	54.0	12.15	H	296	90	27.13
17810.25	55.34	-	74.0	18.66	H	321	150	28.47
17810.25	-	42.73	54.0	11.27	H	321	150	28.47
21461.75	-	34.35	54.0	19.65	H	317	30	13.49
25130.25	-	35.24	54.0	18.76	H	150	60	13.85

* This result was corrected by the DCCF_{Fieldstrength}.

Test result: Passed

Test equipment (please refer to chapter 7 for details)
2 - 10, 13 - 16

5.8 AC power-line conducted emissions

5.8.1 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	5.1.4	-
☐	Not applicable, because ...	-	-

5.8.2 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
☒	6.2.3.2	Tabletop equipment testing	-	Provided AC switching power adaptor
☐	6.2.3.3	Floor-standing equipment testing	-	-

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

UE36LCP1-240150SPA

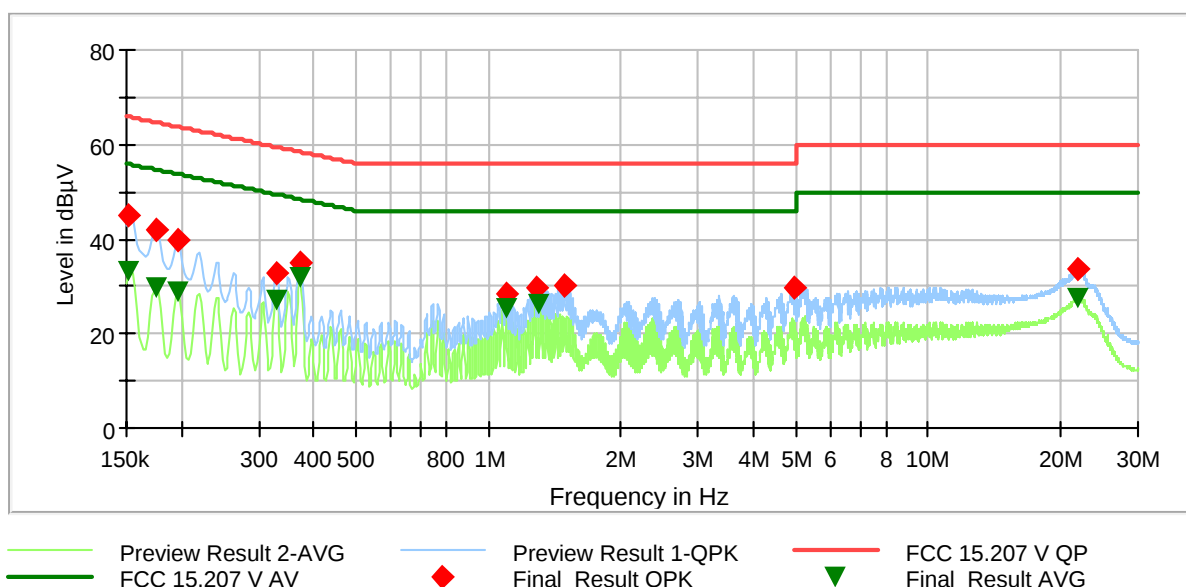
The power adaptor itself was supplied by 120V_{AC} 60Hz.

5.8.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	23 °C
Relative humidity:	64 %

Date:	14.07.2025
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 ▼.



Result table:

Frequency [MHz]	QuasiPeak [dB(μV)]	Average [dB(μV)]	Limit [dB(μV)]	Margin [dB]	Line	PE	Corr. [dB]
0.15225	45.07	-	65.88	20.81	N	GND	19.9
0.15225	-	33.22	55.88	22.65	N	GND	19.9
0.17475	41.98	-	64.73	22.75	L1	GND	19.8
0.17475	-	29.58	54.73	25.15	N	GND	19.8
0.19725	39.80	-	63.73	23.92	L1	GND	19.8
0.19725	-	28.68	53.73	25.04	L1	GND	19.8
0.33000	32.70	-	59.45	26.75	L1	GND	19.7
0.33000	-	27.31	49.45	22.14	L1	GND	19.7
0.37275	34.80	-	58.44	23.64	L1	FLO	19.7
0.37275	-	32.04	48.44	16.40	L1	GND	19.7
1.09725	28.47	-	56.00	27.53	N	FLO	19.7
1.09725	-	25.27	46.00	20.73	N	GND	19.7
1.29075	29.66	-	56.00	26.34	N	GND	19.8
1.29525	-	26.15	46.00	19.85	N	GND	19.8
1.48425	30.33	-	56.00	25.67	N	FLO	19.8
4.94250	29.55	-	56.00	26.45	N	GND	20.1
21.94800	33.65	-	60.00	26.35	L1	GND	20.3
21.90525	-	27.72	50.00	22.28	L1	GND	20.3

Test result: Passed

Test equipment (please refer to chapter 7 for details)

17 - 23

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	Signal & spectrum analyser	FSW43	Rohde & Schwarz	102954	483957	10.07.2024	07.2026
2	Log.-Per. antenna 850 MHz - 26.5 GHz	HL050	Rohde & Schwarz	100908	482977	22.09.2022	09.2025
3	EMC test software	Elektra V5.10.00	Rohde & Schwarz	-	483755	Calibration not necessary	
4	RF switch matrix	OSP220	Rohde & Schwarz	101391	482976	Calibration not necessary	
5	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
6	Antenna support tilt mast	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 receiver / Spectrum analyser	ESW44	Rohde & Schwarz	101828	482979	21.02.2024	02.2026
10	Positioner	TG1.5-10kg	Maturo	110/2648.01	483042	Calibration not necessary	
11	Attenuator 6 dB	WA2-6	Weinschel	-	482793	Calibration not necessary	
12	Ultralog antenna	HL562E	Rohde & Schwarz	101079	482978	24.04.2024	04.2027
13	Low noise amplifier 10 MHz - 18 GHz	LNA-30-00101800-25-10P	Narda-Miteq	2110917	482967	20.02.2024	02.2026
14	Low noise amplifier 18 GHz - 26.5 GHz	LNA-30-18002650-20-10P	Narda-Miteq	2110911	482969	19.02.2024	02.2026
15	Standard gain horn 18 GHz - 26 GHz	20240-20	Flann	266399	483026	Calibration not necessary	
16	High-pass filter	WHKX4.0/18G-8SS	Wainwright	1	480587	Calibration not necessary	
17	V-LISN	NSLK8128RC	Schwarzbeck	0412	483186	28.02.2024	02.2026
18	Shielded chamber M155	SK3	Albatross Projects	-	482786	Calibration not necessary	
19	Software	EMC32 Ver. 10.60.20	Rohde & Schwarz	100619	483182	Calibration not necessary	
20	EMI test receiver	ESR7	Rohde & Schwarz	101939	482558	21.02.2024	02.2026
21	Attenuator	WA8 / 18-20-34	Weinschel	-	481450	Calibration not necessary	
22	EMC test system	EMC D 30000 / PAS	Spitzenberger & Spies	A4507 00/1 1110	481301	Calibration not necessary	
23	Control unit	SyCore 1k4	Spitzenberger & Spies	A4507 12/0 1110	481302	19.02.2025	08.2027

8 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Shielded chamber M155	482784	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	14.11.2022	13.11.2025
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA	ANSI C63.4-2014 ANSI C63.4a-2017	01.03.2023	28.02.2026
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	28.02.2023	27.02.2026

9 Report History

Report Number	Date	Comment
F241002E7	23.01.2026	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A

Test Setup Photos

7 pages

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