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Test Report

Report Number:

F231198E2 2nd version

Equipment under Test (EUT):

Cerabar PMP43

Applicant:

Endress+Hauser SE+Co. KG

Manufacturer:

Endress+Hauser SE+Co. KG

ilac-MRA

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

References

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

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

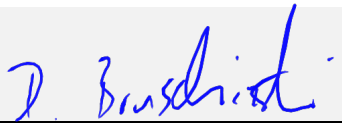
[3] **558074 D01 15.247 Meas Guidance v05r02 (April 2019),** GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

[4] **RSS-247, Issue 2 (2023-08)** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

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

Test Result

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.
“Passed” indicates that the equipment under test conforms with the relevant limits of the testing standard without taking any measurement uncertainty into account as stated in clause 1.3 of ANSI C63.10 (2020). However, the measurement uncertainty is calculated and shown in this test report.

Tested by:		Daniel BRUSCHINSKI 10.12.2024
	Signature	
Tested and written by:		Martin Eppinger 10.12.2024
	Signature	
Reviewed and approved by:		Bernward ROHDE 10.12.2024
	Signature	

This test report is only valid in its original form.

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

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1 Identification

1.1 Applicant

Name:	Endress+Hauser SE+Co. KG
Address:	Hauptstr. 1 79689 Maulburg
Country:	Germany
Name for contact purposes:	Mr. Florian SEIDLER
Phone:	+49 7622-28-0
eMail address:	florian.seidler@endress.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	Endress+Hauser SE+Co. KG
Address:	Hauptstr. 1 79689 Maulburg
Country:	Germany
Name for contact purposes:	Mr. Florian SEIDLER
Phone:	+49 7622-28-0
eMail address:	florian.seidler@endress.com
Manufacturer represented during the test by the following person:	-

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: *	Pressure measuring device
Model name: *	Cerabar PMP43
Model number: *	PMP43
Order number: *	NA
FCC ID: *	LCGPMX43
IC certification number: *	2519A-PMX43
PMN: *	PMP43
HVIN: *	PMP43-2
FVIN: *	NA

	EUT number
	1
Serial number: *	W1000C01225
PCB identifier: *	Display Board: 71548029 Mainboard: 71439136 Terminal Board: 71508546
Hardware version: *	01.00.00
Software version: *	S140 V7.2.0 (Soft device)

* 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 V_{DC}	U_{Min}= 12 V_{DC}	U_{Max}= 30 V_{DC}
Temperature range: *	-40°C to +85°C		

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
4-Wire I/O Link communication & DC	M12	USB-A	2.0 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		
Fulfils radio specification: *1	Bluetooth® low energy (BLE) 5.2	
Radio chip: *1	Nordic nRF52840 (SoC)	
Antenna type: *1	PCB IFA Antenna	
Antenna name: *1	n/a	
Antenna gain: *2	-13.9 dBi	
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 based on the antenna test report F231198E4 by PHOENIX TESTLAB GmbH

1.5.1 Ancillary Equipment / Equipment used for testing

Equipment used for testing	
AC adapter *2	PHOENIX CONTACT MINI-PS.100-240AC/24DC/1.3 Used for AC power line conducted
Laptop*2	Fujitsu LIFEBOOK U748
FTDI Adapter: *1	Used for test mode configuration

*1 Provided by the applicant
*2 Provided by the laboratory

1.6 Dates

Date of receipt of test sample:	24.01.2024
Start of test:	25.04.2024
End of test:	13.06.2024

2 Operational States

2.1 Description of function of the EUT

The EUT is a pressure measuring device for hygiene applications with a touch display.

During all radiated tests, the EUT was supplied by 24 V 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	2 Mbit/s	“pos8dBm”
2	Bluetooth© LE	2440	19	GFSK	2 Mbit/s	“pos8dBm”
3	Bluetooth© LE	2480	39	GFSK	2 Mbit/s	“pos8dBm”
4	Bluetooth© LE	2402	0	GFSK	1 Mbit/s	“pos8dBm”
5	Bluetooth© LE	2440	19	GFSK	1 Mbit/s	“pos8dBm”
6	Bluetooth© LE	2480	39	GFSK	1 Mbit/s	“pos8dBm”
7	Bluetooth© LE	2402	0	GFSK	500 kbit/s	“pos8dBm”
8	Bluetooth© LE	2440	19	GFSK	500 kbit/s	“pos8dBm”
9	Bluetooth© LE	2480	39	GFSK	500 kbit/s	“pos8dBm”
10	Bluetooth© LE	2402	0	GFSK	125 kbit/s	“pos8dBm”
11	Bluetooth© LE	2440	19	GFSK	125 kbit/s	“pos8dBm”
12	Bluetooth© LE	2480	39	GFSK	125 kbit/s	“pos8dBm”

The maximum output power of the Radio chip is +8 dBm (typical)

3 Additional Information

All tests were carried out using 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)	5.4 (d) [4]	1	Passed*2
Maximum conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [4]	1	Passed*2
DTS Bandwidth / 99% Bandwidth	2400.0 - 2483.5	15.247 (a) (2)	5.2 (a) [4]	1	Passed*2
Peak Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [4]	1	Passed*2
Average Power Spectral Density	2400.0 - 2483.5	15.247 (e)	5.2 (b) [4]	1	Passed*2
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [4]	1	Passed
Maximum unwanted emissions	0.009 – 26,500*	15.247 (d) 15.205 (a) 15.209 (a)	8.9 [5]	1	Passed*1
Antenna Requirement	-	15.203 15.247 (b)	6.8 [5] 5.4 (f) (ii) [4]	-	Passed
Conducted emissions on supply line	0.15 – 30	15.207 (a)	8.8 [5]	1	Passed

*1 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.

*2 These results were reported in the report ”F230973E6” from PHOENIX TESTLAB GmbH, because the PCB with its Bluetooth chip and its layout is the exact same as in the EUT, with the FCC ID LCGFMR43L and IC certification number 2519A-43L, tested in this report. This was declared by applicant.

5 Results

5.1 Test setups

5.1.1 Radiated: 9 kHz to 30 MHz

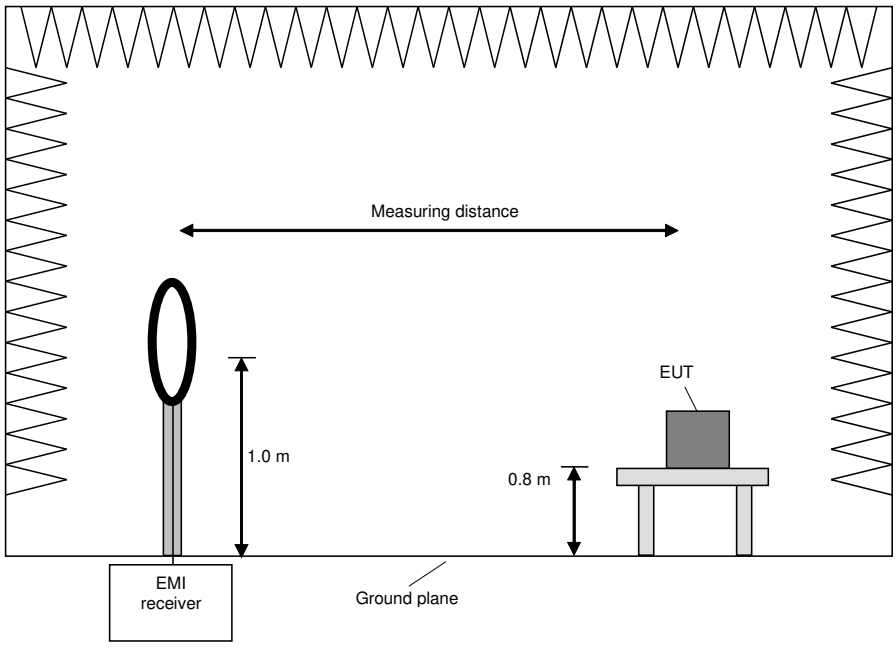
5.1.1.1 Preliminary measurement 9 kHz to 30 MHz

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.

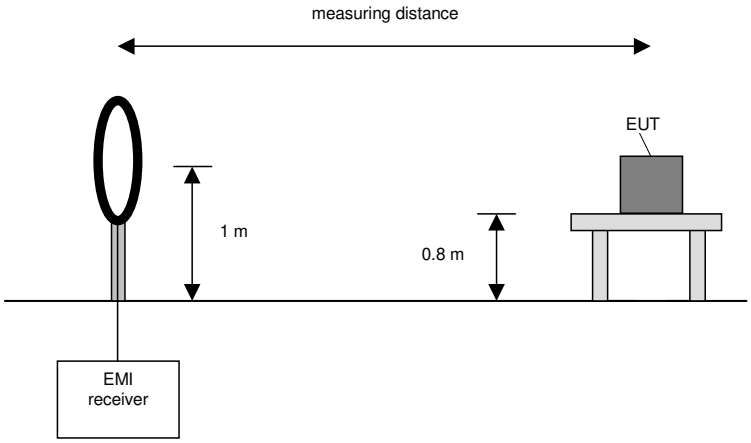
5.1.1.2 Final measurement 9 kHz to 30 MHz

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

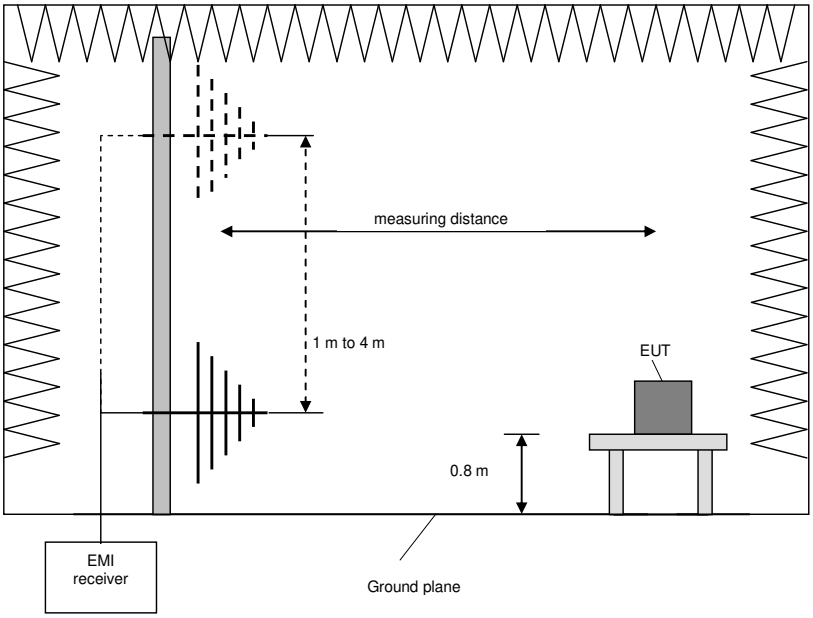
5.1.2.1 Preliminary and final measurement 30 MHz to 1 GHz

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

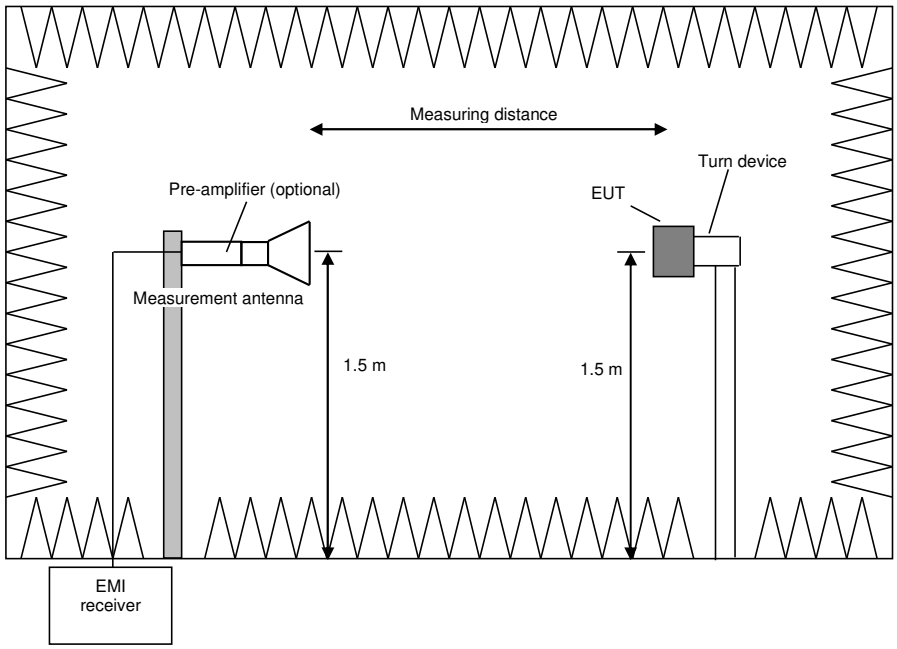
5.1.3.1 Preliminary and final measurement 1 to 40 GHz

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 - 40 GHz	250 kHz	1 MHz	-	Peak Average
Final measurement	1 - 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.

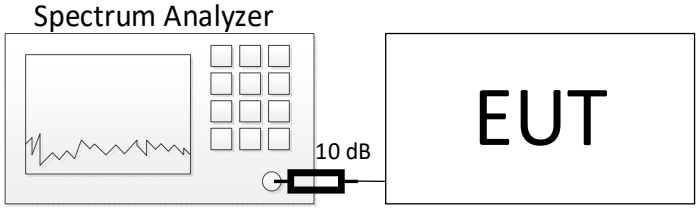
Procedure final measurement:

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
☒	Temporary antenna connector	As provided by the applicant
☐	Normal antenna connector	-



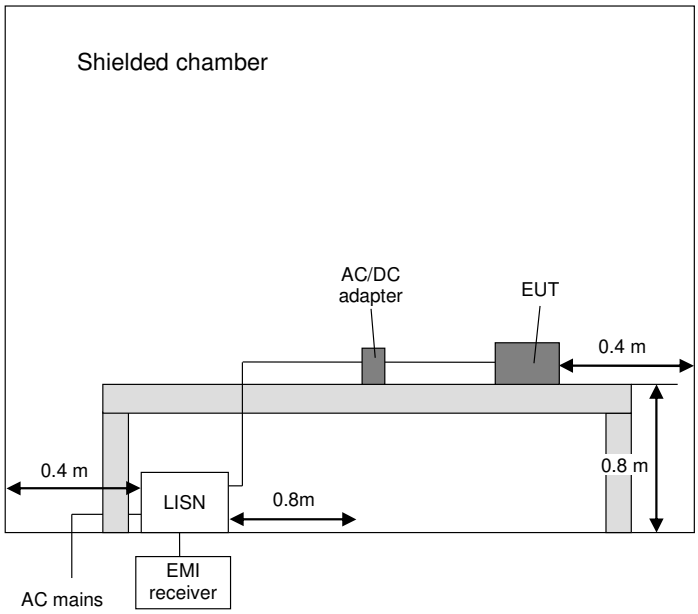
The 10 dB external attenuation are considered in all relevant plots

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 appropriable limit are detected, these emissions are measured with an Average and Quasi-Peak detector on all lines.

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



5.2 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	5.1.3	-
☐	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
☐	11.6. a)	Diode detector	No limitation	-
☒	11.6. b)	Zero span	No limitation	-

5.2.3 Test results (Duty cycle)

Ambient temperature:	24.9 °C
Relative humidity:	53.6 %

Date:	30.04.2024
Tested by:	Martin EPPINGER

No DCCF is applied, duty cycle ≥ 98%.

Test equipment (please refer to chapter 7 for details)
15

5.3 Transmit antenna performance considerations

Test setup (Transmit antenna performance considerations)		
Integral antenna	Antenna gain ≤ 6dBi	Comment
☒	☒	No output power reduction necessary

Antenna gain calculation				
		f_{low}	**f_{mid}**	**f_{high}**
Conducted output power* [dBm]		6.5	6.6	6.8
Radiated EIRP [dBm EIRP]		-9.4	-8.7	-7.1
Antenna Gain [dBi]		-15.9	-15.3	-13.9
Position		Position 3	Position 3	Position 3
Position of maximum gain	**Azimuth**	5	45	21
	Polarisation	V	V	V

* During the antenna chart measurements, the PCB antenna was supplied with a CW rf-signal generated by the EUT.

For details see document: F231198E4

5.4 DTS bandwidth

5.4.1 Test setup (DTS bandwidth)

Test setup (DTS bandwidth)			
Used	Setup	See sub-clause	Comment
☐	Radiated: 1 GHz to 40 GHz	5.1.3	-
☒	Conducted: Antenna port	5.1.4	-

5.4.2 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

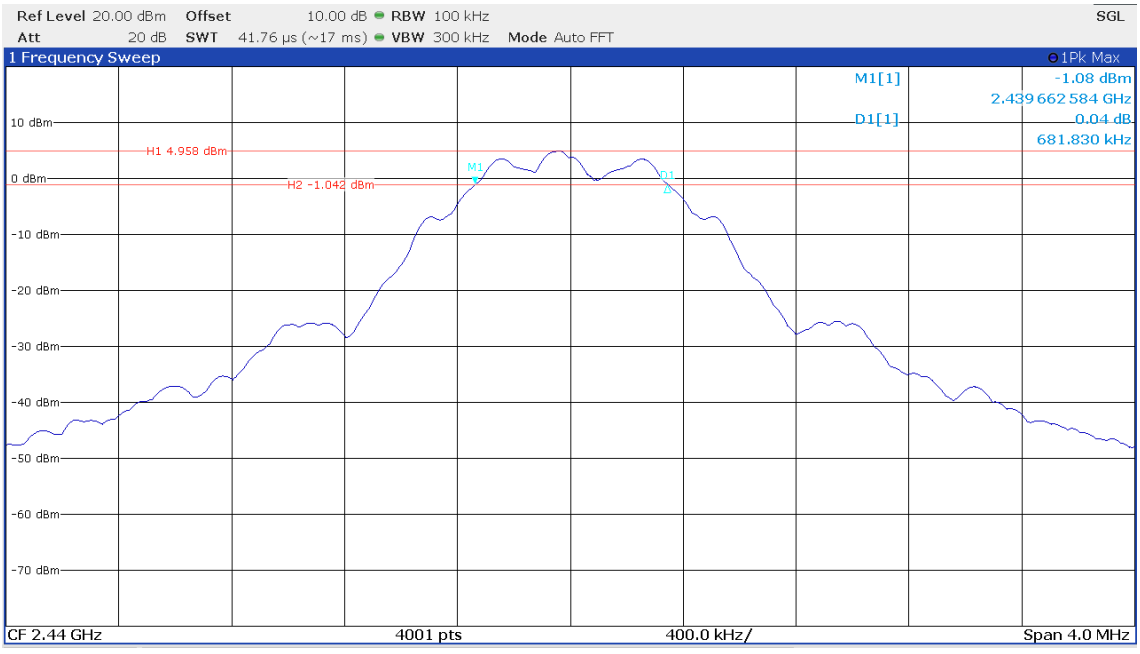
5.4.3 Test results (DTS bandwidth)

Ambient temperature:	22 °C
Relative humidity:	42 %

Date:	25.01.2024
Tested by:	B. ROHDE

The DTS bandwidth was measured in the test report “F230973E6” by PHOENIX TESTLAB GmbH According to the applicant the hardware from that product is the same as in the present EUT, with the FCC ID LCGFMR43L and IC certification number 2519A-43L and therefore the conducted measurements were taken from the above-mentioned report.

Worst case plot (operation mode 11):



Operation mode #	DTS bandwidth [MHz]	Minimum DTS bandwidth Limit [MHz]
1	1.365970	0.5
2	1.411647	0.5
3	1.448638	0.5
4	0.808298	0.5
5	0.780305	0.5
6	0.818795	0.5
7	0.790802	0.5
8	0.778805	0.5
9	0.76081	0.5
10	0.710822	0.5
11	**0.681830**	**0.5**
12	0.713822	0.5

Test result: Passed

Test equipment (please refer to chapter 7 for details)
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5.5 Occupied bandwidth – power bandwidth (99%)

5.5.1 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	5.1.3	-
☒	Conducted: Antenna port	5.1.4	-

5.5.2 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.

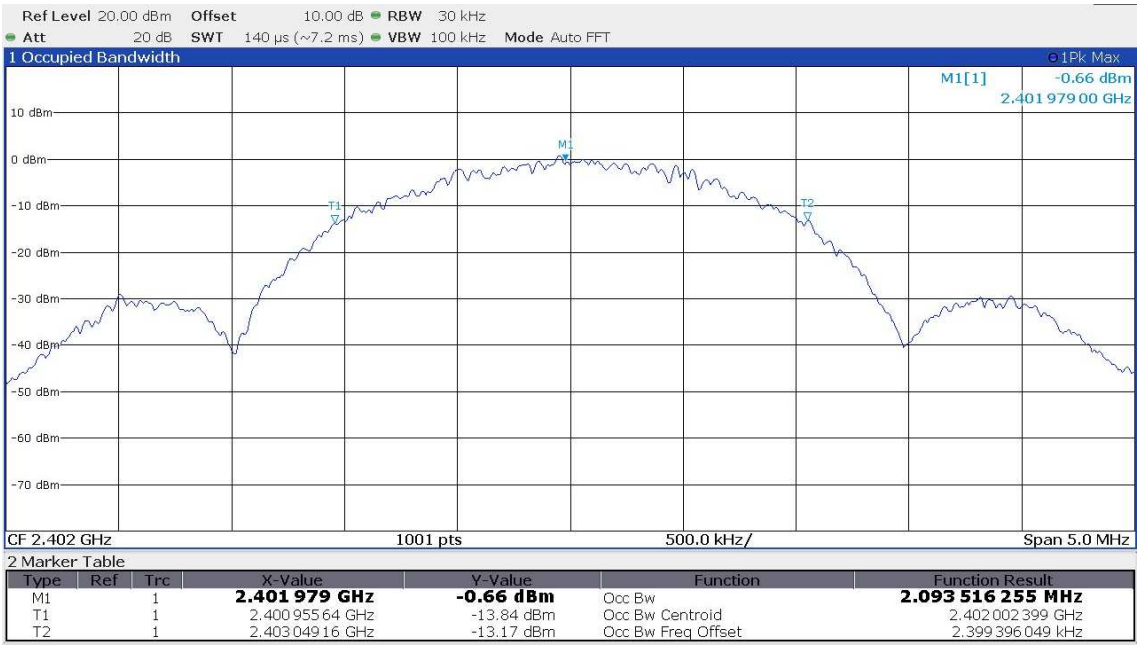
5.5.3 Test results (Occupied bandwidth – power bandwidth (99%))

Ambient temperature:	22 °C
Relative humidity:	42 %

Date:	25.01.2024
Tested by:	B. ROHDE

The occupied bandwidth – power bandwidth (99%) was measured in the test report “F230973E6” by PHOENIX TESTLAB GmbH According to the applicant the hardware from that product is the same as in the present EUT, with the FCC ID LCGFMR43L and IC certification number 2519A-43L and therefore the conducted measurements were taken from the above-mentioned report.

Worst case plot (operation mode 1):



Operation mode #	99% bandwidth [MHz]
1	**2.09352**
2	2.09029
3	2.076989
4	1.069535
5	1.066059
6	1.085461
7	1.057399
8	1.064909
9	1.070405
10	1.089581
11	1.096792
12	1.108519

Test result: Passed

Test equipment (please refer to chapter 7 for details)
15

5.6 DTS fundamental emission output power

5.6.1 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	5.1.3	-
☒	Conducted: Antenna port	5.1.4	-

5.6.2 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 ≥ DTS bandwidth	-	Zero span mode
☐	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
☒	11.9.2.2.2	Method AVGSA-1	D ≥ 98%	-
☐	11.9.2.2.3	Method AVGSA-1A (alternative)	D ≥ 98%	-
☐	11.9.2.2.4	Method AVGSA-2	Constant D (±2%)	-
☐	11.9.2.2.5	Method AVGSA-2A (alternative)	Constant D (±2%)	-
☐	11.9.2.2.6	Method AVGSA-3A	-	-
☐	11.9.2.2.7	Method AVGSA-3A (alternative)	-	-
☐	11.9.2.3.1	Method AVGPM	Constant D (±2%)	-
☐	11.9.2.3.2	Method AVGPM-G	-	-

5.6.3 Test results (DTS fundamental emission output power)

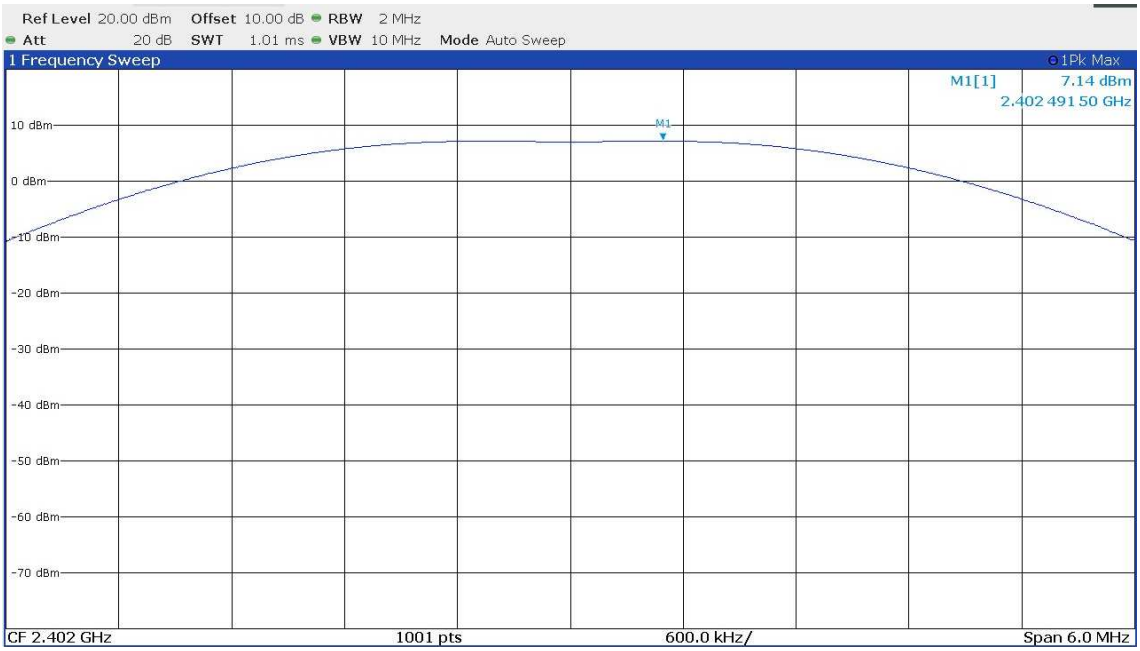
Ambient temperature:	22 °C
Relative humidity:	42 %

Date:	25.01.2024
Tested by:	B. ROHDE

5.6.3.1 Maximum peak conducted output power:

The maximum peak conducted output power was measured in the test report “F230973E6” by PHOENIX TESTLAB GmbH According to the applicant the hardware from that product is the same as in the present EUT, with the FCC ID LCGFMR43L and IC certification number 2519A-43L and therefore the conducted measurements were taken from the above-mentioned report.

Worst case plot (operation mode 1):



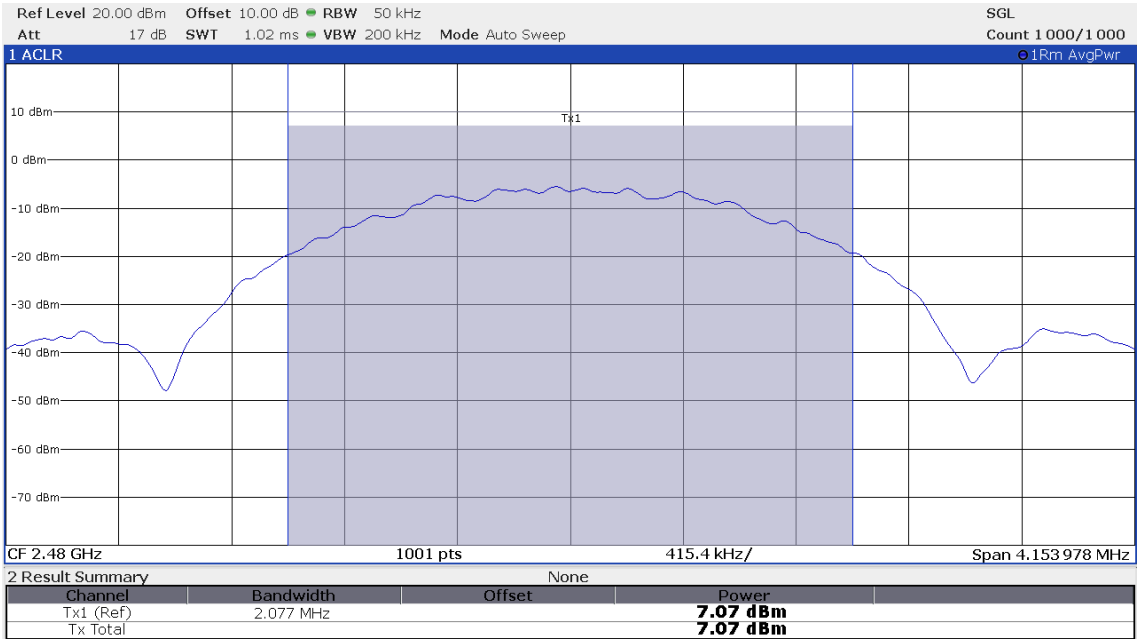
Operation mode	Reading [dBm]	Corr. Fact. [dB]	Result [dBm]	Limit [dBm]	Antenna Gain [dBi]	e.i.r.p. [dBm]	Limit e.i.r.p. [dBm]
1	7.1	0.0	7.1	30	-15.9	-8.8	36
2	7.1	0.0	7.1	30	-15.3	-8.2	36
3	7.1	0.0	7.1	30	-13.9	-6.8	36
4	7.0	0.0	7.0	30	-15.9	-8.9	36
5	7.1	0.0	7.1	30	-15.3	-8.2	36
6	7.1	0.0	7.1	30	-13.9	-6.8	36
7	7.1	0.0	7.1	30	-15.9	-8.8	36
8	7.1	0.0	7.1	30	-15.3	-8.2	36
9	7.1	0.0	7.1	30	-13.9	-6.8	36
10	7.0	0.0	7.0	30	-15.9	-8.9	36
11	7.0	0.0	7.0	30	-15.3	-8.3	36
12	7.1	0.0	7.1	30	-13.9	-6.8	36

Test result: Passed

5.6.3.2 Maximum conducted (average) output power

The maximum conducted average output power was measured in the test report “F230973E6” by PHOENIX TESTLAB GmbH According to the applicant the hardware from that product is the same as in the present EUT, with the FCC ID LCGFMR43L and IC certification number 2519A-43L and therefore the conducted measurements were taken from the above-mentioned report.

Worst case plot (operation mode 3):



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	6.9	0.0	0.0	6.9	30	-15.9	-9.0	36
2	7.0	0.0	0.0	7.0	30	-15.3	-8.3	36
3	7.1	0.0	0.0	7.1	30	-13.9	-6.8	36
4	6.9	0.0	0.0	6.9	30	-15.9	-9.0	36
5	7.0	0.0	0.0	7.0	30	-15.3	-8.3	36
6	7.1	0.0	0.0	7.1	30	-13.9	-6.8	36
7	7.0	0.0	0.0	7.0	30	-15.9	-8.9	36
8	7.0	0.0	0.0	7.0	30	-15.3	-8.3	36
9	7.1	0.0	0.0	7.1	30	-13.9	-6.8	36
10	6.9	0.0	0.0	6.9	30	-15.9	-9.0	36
11	7.0	0.0	0.0	7.0	30	-15.3	-8.3	36
12	7.1	0.0	0.0	7.1	30	-13.9	-6.8	36

Test result: Passed

Test equipment (please refer to chapter 7 for details)
15

5.7 DTS maximum power spectral density

5.7.1 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	5.1.3	-
☒	Conducted: Antenna port	5.1.4	-

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

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

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

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

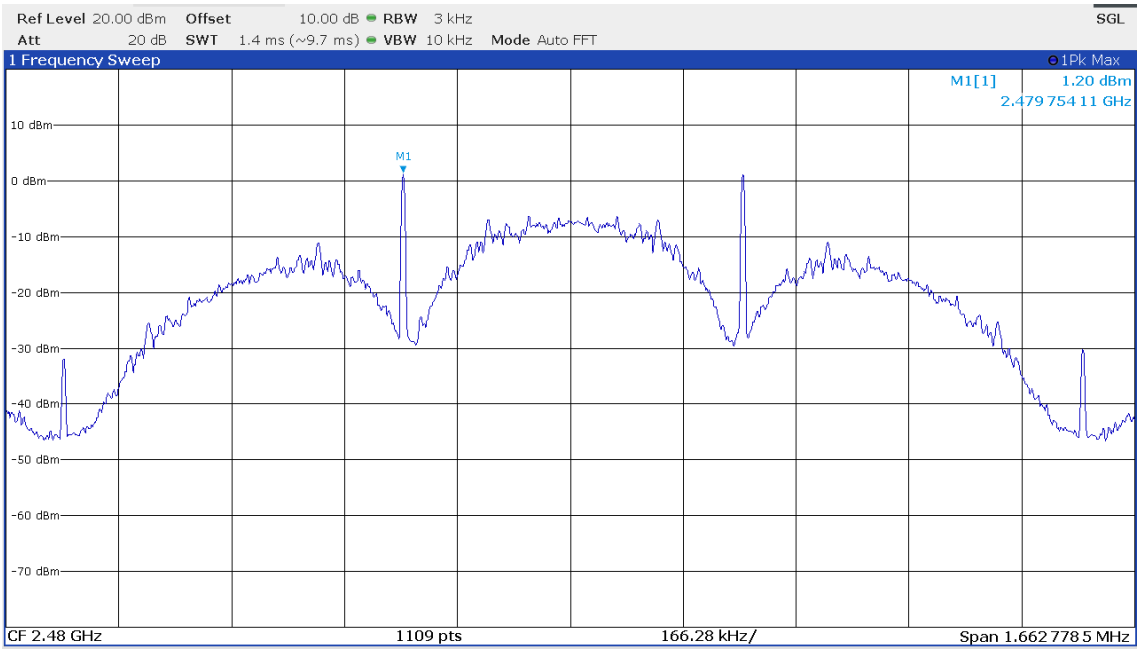
Ambient temperature:	22 °C
Relative humidity:	42 %

Date:	25.01.2024
Tested by:	B. ROHDE

5.7.3.1 Maximum peak PSD:

The maximum peak PSD was measured in the test report “F230973E6” by PHOENIX TESTLAB GmbH According to the applicant the hardware from that product is the same as in the present EUT, with the FCC ID LCGFMR43L and IC certification number 2519A-43L and therefore the conducted measurements were taken from the above-mentioned report.

Worst case plot (operation mode 12):



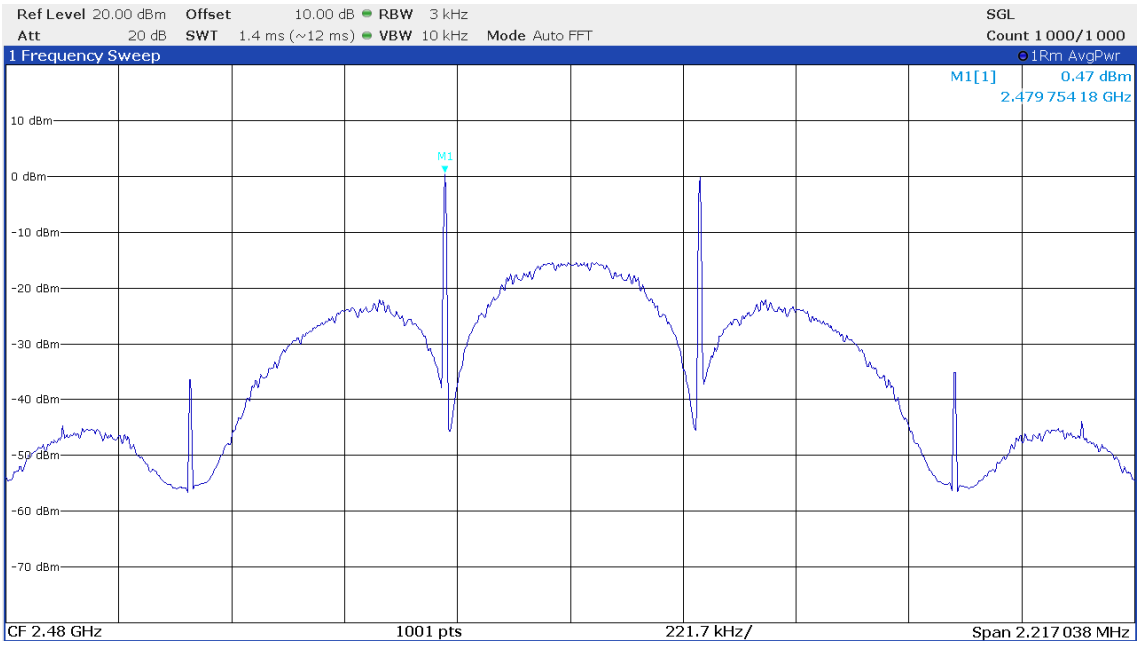
Operation mode	Reading [dBm/3 kHz]	Corr. Fact. [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]
1	-4.1	0.0	-4.1	8.0
2	-9.5	0.0	-9.5	8.0
3	-8.6	0.0	-8.6	8.0
4	-6.8	0.0	-6.8	8.0
5	-5.1	0.0	-5.1	8.0
6	-5.4	0.0	-5.4	8.0
7	-3.2	0.0	-3.2	8.0
8	-4.3	0.0	-4.3	8.0
9	-4.6	0.0	-4.6	8.0
10	0.9	0.0	0.9	8.0
11	1.1	0.0	1.1	8.0
12	1.2	0.0	1.2	8.0

Test result: Passed

5.7.3.2 Maximum average PSD

The maximum average PSD was measured in the test report “F230973E6” by PHOENIX TESTLAB GmbH According to the applicant the hardware from that product is the same as in the present EUT, with the FCC ID LCGFMR43L and IC certification number 2519A-43L and therefore the conducted measurements were taken from the above-mentioned report.

Worst case plot (operation mode 12):



Operation mode	Reading [dBm/3 kHz]	Corr. Fact. [dB]	DCCF [dB]	Result [dBm/3 kHz]	Limit [dBm/3 kHz]
1	-14.7	0.0	0.0	-14.7	8.0
2	-16.4	0.0	0.0	-16.4	8.0
3	-15.5	0.0	0.0	-15.5	8.0
4	-13.1	0.0	0.0	-13.1	8.0
5	-12.2	0.0	0.0	-12.2	8.0
6	-12.3	0.0	0.0	-12.3	8.0
7	-12.7	0.0	0.0	-20.7	8.0
8	-13.8	0.0	0.0	-13.8	8.0
9	-13.6	0.0	0.0	-13.6	8.0
10	0.4	0.0	0.0	0.4	8.0
11	0.4	0.0	0.0	0.4	8.0
12	**0.5**	0.0	0.0	0.5	8.0

Test result: Passed

Test equipment (please refer to chapter 7 for details)
15

5.8 DTS band-edge emission measurements

5.8.1 Test setup (Band edge – unrestricted bands)

Test setup (Band edge – unrestricted bands)			
Used	Setup	See sub-clause	Comment
☐	Radiated: 1 GHz to 40 GHz	5.1.3	-
☒	Conducted: Antenna port	5.1.4	-

5.8.2 Test method (Band edge – unrestricted bands)

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

*1 As declared in “47 CFR 15.247(d)” In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits

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

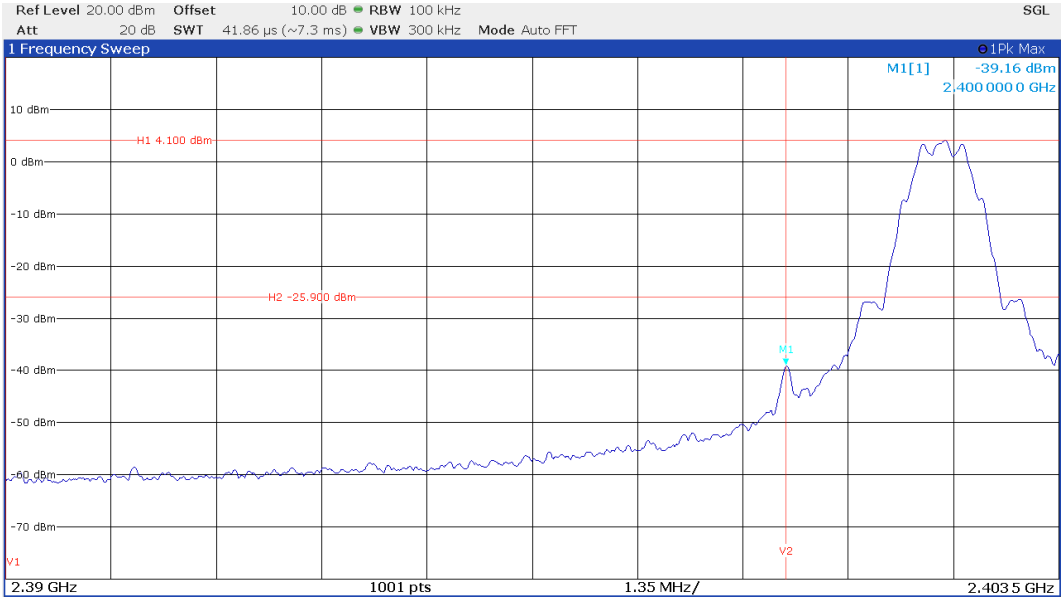
5.8.3 Test results (Band edge – unrestricted bands)

Ambient temperature:	22 °C
Relative humidity:	42 %

Date:	25.01.2024
Tested by:	B. ROHDE

The Band edge – unrestricted bands was measured in the test report “F230973E6” by PHOENIX TESTLAB GmbH According to the applicant the hardware from that product is the same as in the present EUT, with the FCC ID LCGFMR43L and IC certification number 2519A-43L and therefore the conducted measurements were taken from the above-mentioned report.

Worst case plot Lower band edge (operation mode 10):



Lower band edge (operation mode 1):

Frequency [MHz]	Reference [dB(µV/m)]	Limit [dB(µV/m)]	Unrestricted band emission [dB(µV/m)]	Margin [dB]
2400	5.8	-24.2	-38.8	14.6

Lower band edge (operation mode 4):

Frequency [MHz]	Reference [dB(µV/m)]	Limit [dB(µV/m)]	Unrestricted band emission [dB(µV/m)]	Margin [dB]
2400.005	5.8	-24.2	-38.5	14.3

Lower band edge (operation mode 7):

Frequency [MHz]	Reference [dB(µV/m)]	Limit [dB(µV/m)]	Unrestricted band emission [dB(µV/m)]	Margin [dB]
2400	-1.6	-31.6	-49.6	18

Lower band edge (operation mode 10):

Frequency [MHz]	Reference [dB(µV/m)]	Limit [dB(µV/m)]	Unrestricted band emission [dB(µV/m)]	Margin [dB]
2400	4.1	-25.9	-39.2	13.3

Test result: Passed

Test equipment (please refer to chapter 7 for details)
15

5.8.4 Test setup (Band edge – restricted bands)

Test setup (Band edge – restricted bands)			
Used	Setup	See sub-clause	Comment
☒	Radiated: 1 GHz to 40 GHz	5.1.3	
☐	Conducted: Antenna port	5.1.4	

5.8.5 Test method (Band edge – restricted bands)

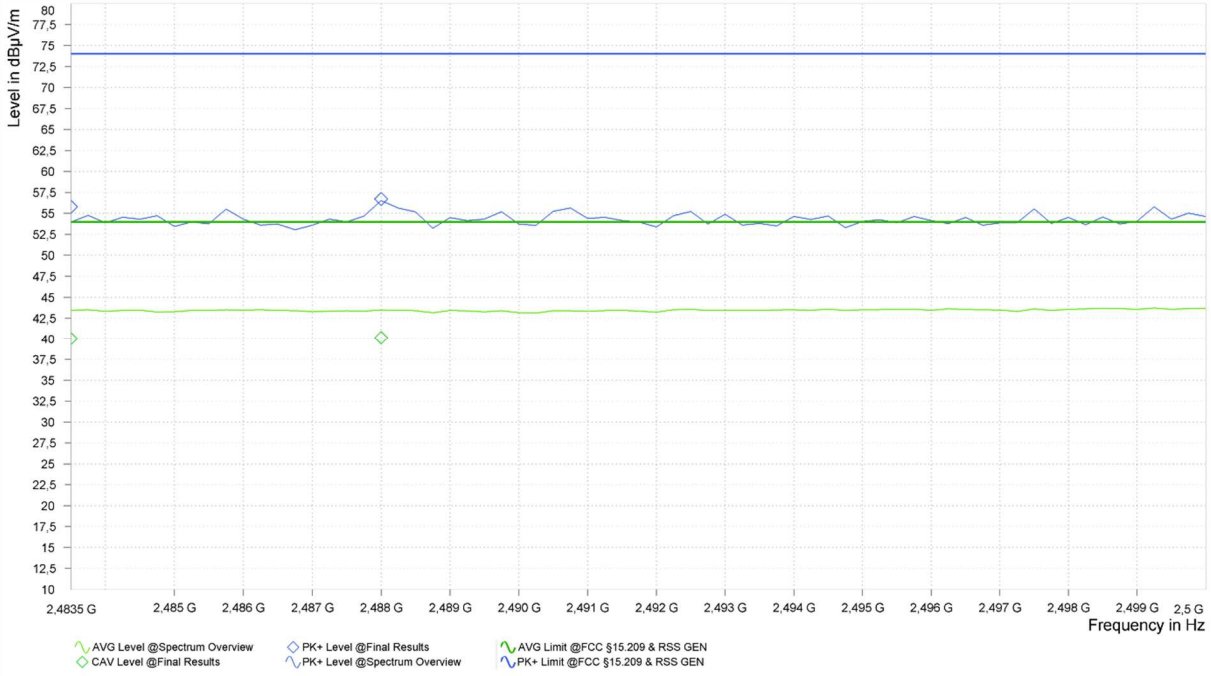
Test method (Band edge – restricted bands)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	11.12.1	Standard method	No limitations	
☐	11.12.3.1	Marker-delta method		See 6.10.6 [3] 2 MHz from band
☐	11.12.3.2	Integration method		2 MHz from band

5.8.6 Test results (Band edge – restricted bands)

Ambient temperature:	22.8 °C
Relative humidity:	33 %

Date:	30.04.2024
Tested by:	Martin EPPINGER

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



Upper band edge (operation mode 6):

Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AV Level [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Correction [dB]	Polarization	Elevation [deg]	Azimuth [deg]
2,483.500	55.80	74.00	18.20	40.02	54.00	13.98	35.38	V	5	11
2,488.000	56.72	74.00	17.28	40.12	54.00	13.88	35.39	V	35	313

Test result: Passed

Test equipment (please refer to chapter 7 for details)
4, 6 – 12

5.9 Radiated emissions

5.9.1 Test setup (Maximum unwanted emissions)

Test setup (Maximum unwanted emissions)			
Used	Setup	See sub-clause	Comment
☒	Radiated: 9 kHz to 30 MHz / 30 MHz to 1 GHz / 1 GHz to 40 GHz	5.1	-
☐	Conducted: Antenna port	-	-

5.9.2 Test method (Maximum unwanted emissions)

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

5.9.3 Test results (Maximum unwanted emissions)

5.9.3.1 Test results preliminary measurement 9 kHz to 30 MHz

Ambient temperature:	23 °C
Relative humidity:	45 %

Date:	05.06.2024
Tested by:	Daniel BRUSCHINSKI

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

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

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

Remark: All 3 orthogonal planes were tested separately

Calculations:

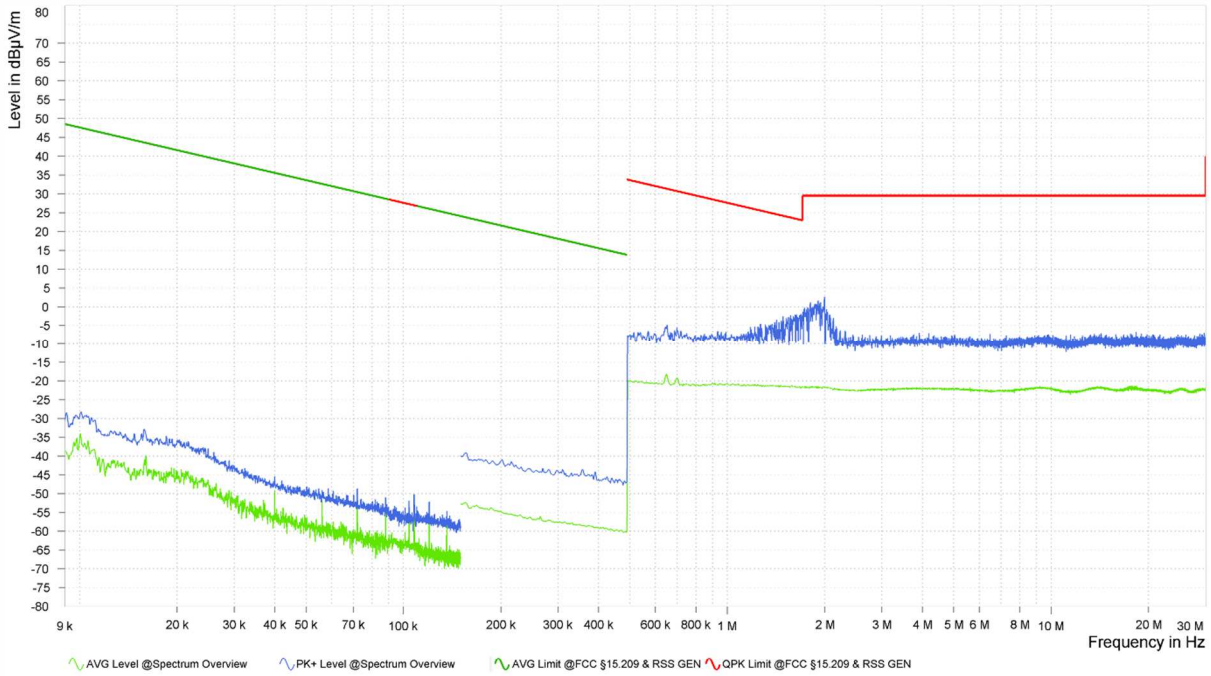
Result @ norm. dist. [dBµV/m] = Reading [dBµV] + AF [dB/m] + Distance corr. fact. [dB]

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

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

Worst case plot:

Spurious emissions from 9 kHz to 30 MHz (operation mode 4, position 1):



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

Test result: passed

Test equipment (please refer to chapter 7 for details)
6 – 12, 16

5.9.3.2 Test results (30 MHz – 1 GHz)

Ambient temperature:	22 °C
Relative humidity:	51 %

Date:	04/05.06.2024
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 detail information of test set-up and the cable guide refer to the pictures in the annex A in the test report.

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

Remark: All 3 orthogonal planes were tested separately

Calculations:

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

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

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

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

Worst case plot:

Spurious emissions from 30 MHz to 1 GHz (operation mode 6, position 3):

Result tables:

Worst case mode (Operation mode 6):

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Correction [dB/m]	Pol. (H/V)	Azimuth [deg]	Height [m]
31.650	19.43	40.00	20.57	25.62	V	337	3.54
33.390	17.88	40.00	22.12	24.56	V	347	3.65
37.260	14.72	40.00	25.28	22.12	V	329	3.55
47.970	30.70	40.00	9.30	14.92	V	332	1.04
50.820	6.40	40.00	33.60	13.33	V	352	1.13
529.470	21.42	46.00	24.58	24.62	V	334	1.01

Test result: Passed

Test equipment (please refer to chapter 7 for details)
6 – 14

5.9.3.3 Test results (radiated 1 to 40 GHz)

Ambient temperature:	22.0 – 23.4 °C
Relative humidity:	26 – 49 %

Date:	30.04/07.05/08.05.2024
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.

Remark: -

Calculation:

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

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

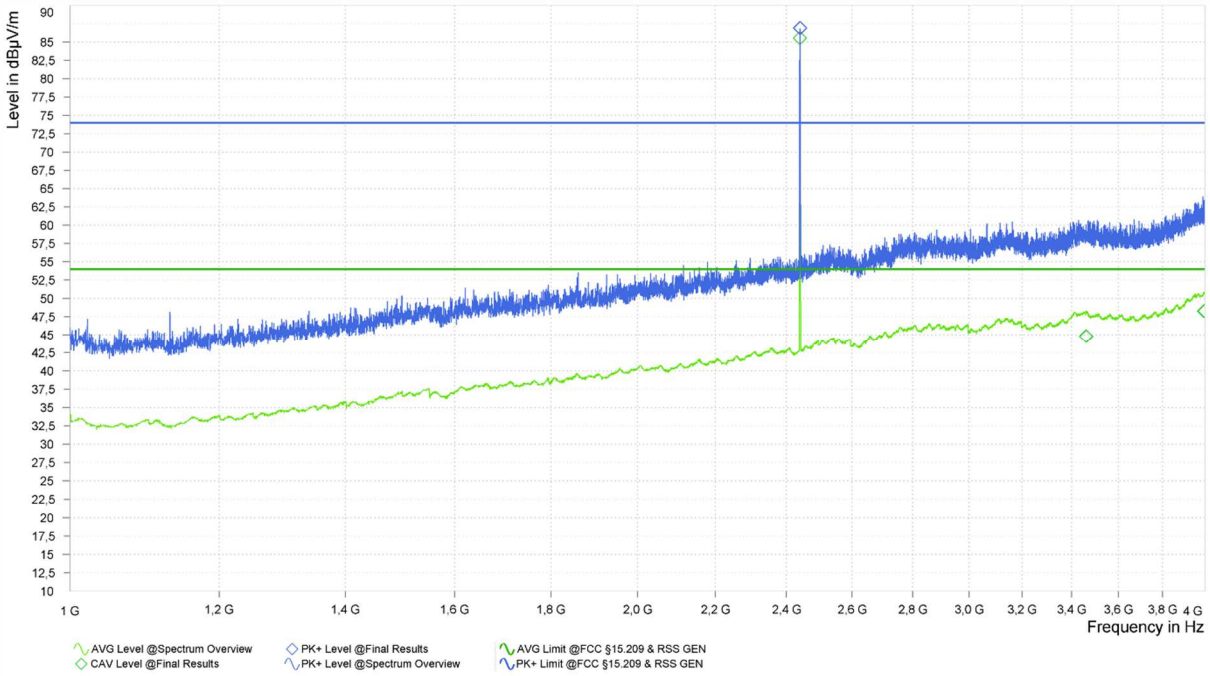
Correction [dBµV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]+DCCF* [dB]
* (if applicable – only for Average values, that are fundamental related)

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

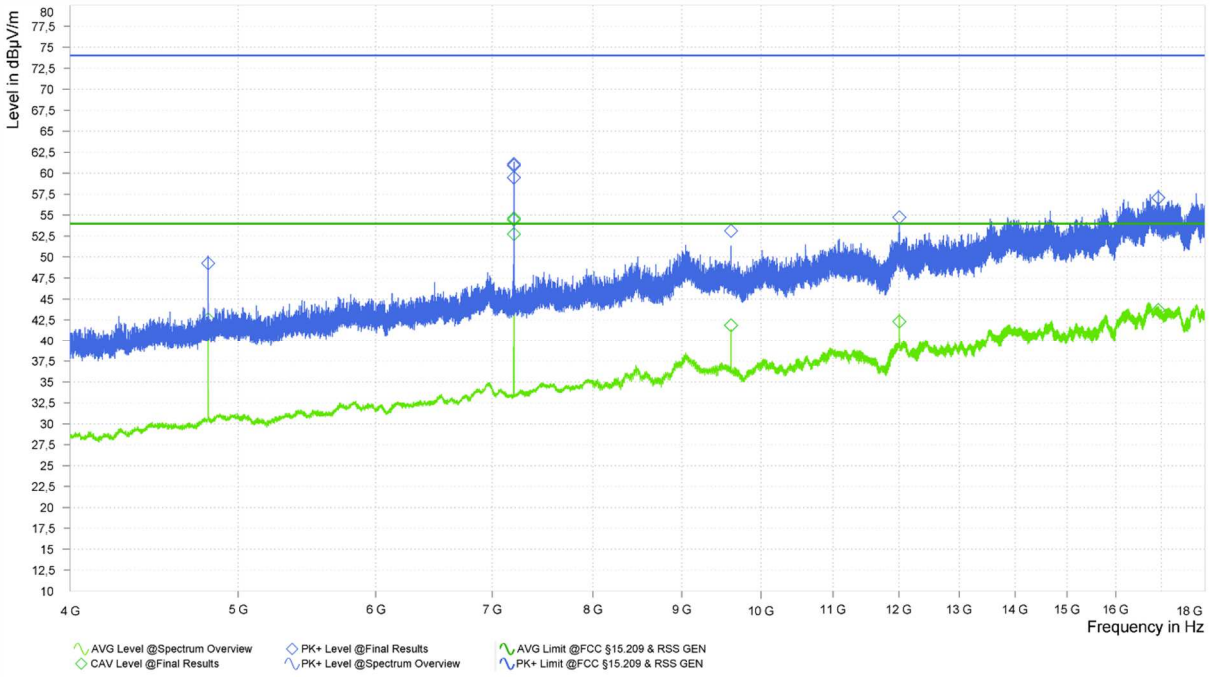
The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna positions.
The top measured curve represents the peak measurement. The measured points marked with "◇" are frequency points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

Worst case plots:

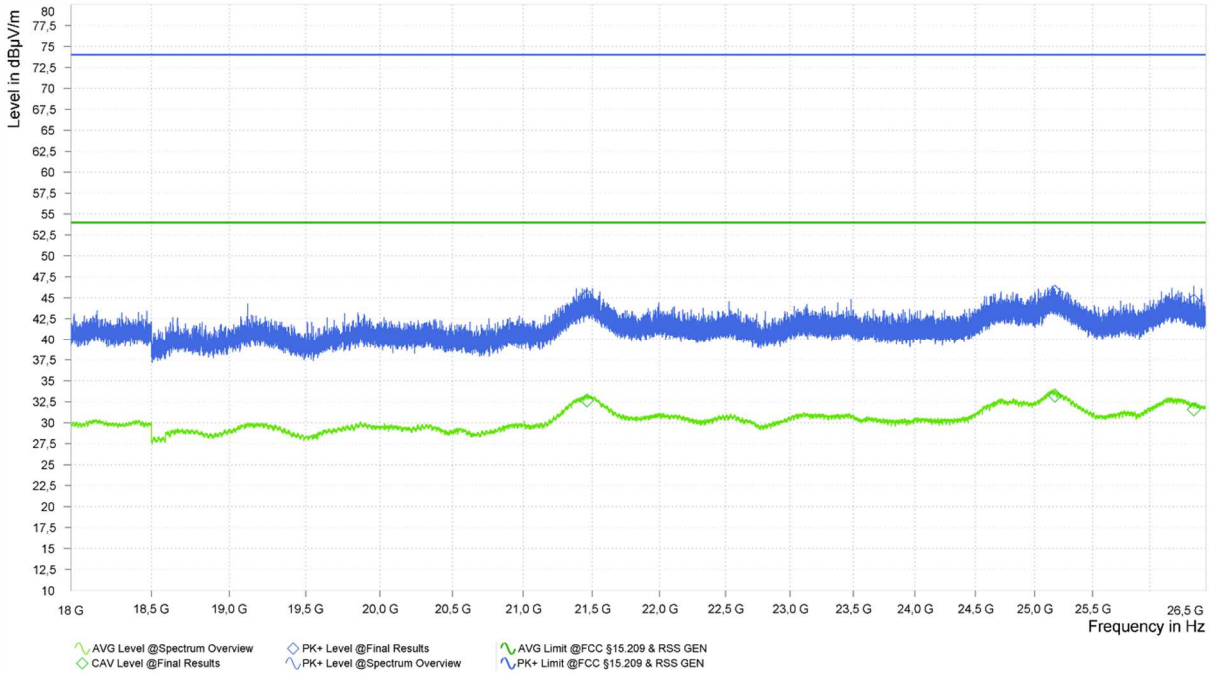
Spurious emissions from 1 GHz to 4 GHz (operation mode 2):



Spurious emissions from 4 GHz to 18 GHz (operation mode 2):



Spurious emissions from 18 GHz to 26.5 GHz (operation mode 1):

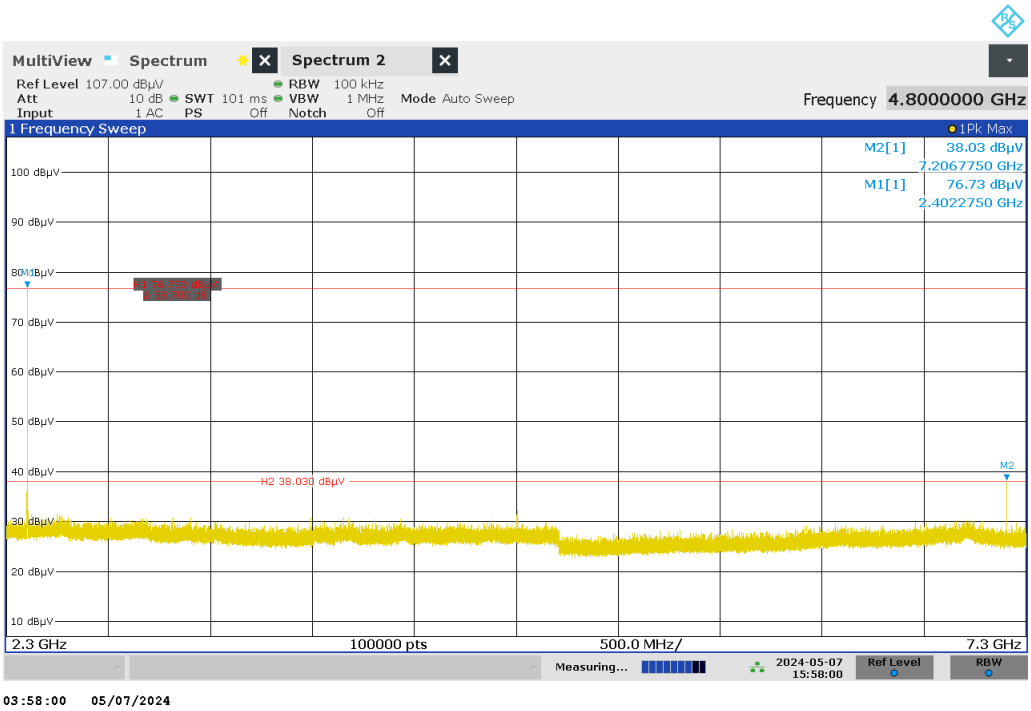


Result tables:

Operation mode 4:

Frequency [MHz]	MaxPeak [dB(µV/m)]	Pk Limit [dB(µV/m)]	Pk Margin [dB(µV/m)]	Average [dB(µV/m)]	Avg Limit [dB(µV/m)]	Avg Margin [dB(µV/m)]	Pol [H/V]	Elevation [deg]	Azimuth [deg]	Corr. [dB]
2,402.000	86.35	---	Fund.	85.40	---	Fund.	V	90	65	35.25
3,969.750	55.75	74.00	18.25	41.05	54.00	12.95	V	0	217	40.97
4,804.000	49.26	74.00	24.74	42.60	54.00	11.40	H	150	76	9.69
7,205.500	38.03*	46.73*	8.70	---	---	---	H	90	64	13.54
7,206.000	59.46	74.00	14.54	52.73	54.00	1.27	H	90	64	13.55
9,607.000	53.12	74.00	20.88	41.87	54.00	12.13	V	90	96	18.84
12,008.500	54.74	74.00	19.26	42.32	54.00	11.68	V	0	345	23.43
16,929.000	57.07	74.00	16.93	43.71	54.00	10.29	H	30	61	29.50
21,435.500	45.16	74.00	28.84	32.42	54.00	21.58	V	150	279	11.36
25,251.750	46.81	74.00	27.19	32.59	54.00	21.41	V	90	13	11.54

*Relative measurement, see image below. For further details see 47 CFR 15.247(d).



Operation mode 5:

Frequency [MHz]	MaxPeak [dB(µV/m)]	Pk Limit [dB(µV/m)]	Pk Margin [dB(µV/m)]	Average [dB(µV/m)]	Avg Limit [dB(µV/m)]	Avg Margin [dB(µV/m)]	Pol [H/V]	Elevation [deg]	Azimuth [deg]	Corr. [dB]
2,439.750	86.91	---	Fund.	---	---	Fund.	V	88	70	35.38
2,440.000	---	---	---	85.56	---	Fund.	V	88	73	35.39
2,440.250	86.94	74.00	Fund.	---	---	---	V	90	73	35.39
3,460.500	---	---	---	44.82	54.00	9.18	V	2	2	40.36
3,461.750	---	---	---	44.79	54.00	9.21	V	0	6	40.35
3,996.750	---	---	---	48.28	54.00	5.72	V	5	248	41.06
3,999.500	---	---	---	48.27	54.00	5.73	V	5	9	41.07
4,880.000	50.64	74.00	23.36	44.52	54.00	9.48	V	90	91	9.92
7,319.500	58.73	74.00	15.27	51.55	54.00	2.45	V	120	60	14.47
7,320.000	57.31	74.00	16.69	49.88	54.00	4.12	V	120	60	14.47
7,320.500	58.47	74.00	15.53	51.58	54.00	2.42	V	120	70	14.47
9,759.250	51.11	74.00	22.89	40.53	54.00	13.47	V	90	103	18.46
12,198.750	53.63	74.00	20.37	41.67	54.00	12.33	V	30	27	23.07
16,692.250	56.76	74.00	17.24	44.15	54.00	9.85	H	60	96	29.37
17,810.250	56.22	74.00	17.78	44.05	54.00	9.95	H	0	300	30.66
21,435.500	45.01	74.00	28.99	32.43	54.00	21.57	H	150	26	11.36
25,113.000	45.69	74.00	28.31	33.17	54.00	20.83	H	60	176	11.57

Operation mode 6:

Frequency	MaxPeak	Pk Limit	Pk Margin	Average	Avg Limit	Avg Margin	Pol	Elevation	Azimuth	Corr.
[MHz]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	[dB(µV/m)]	[H/V]	[deg]	[deg]	[dB]
2,480.000	87.11	Fund.		86.01	Fund.		V	94	79	35.37
2,480.250	87.38			84.81			V	92	78	35.37
3,465.500	60.02	74.00	13.98	44.75	54.00	9.25	V	25	77	40.34
3,994.000	62.57	74.00	11.43	48.27	54.00	5.73	V	33	98	41.04
4,960.000	52.03	74.00	21.97	46.39	54.00	7.61	H	90	98	10.06
7,439.500	55.26	74.00	18.74	47.00	54.00	7.00	V	90	81	15.13
7,440.000	54.15	74.00	19.85	45.36	54.00	8.64	V	90	75	15.14
7,440.500	54.98	74.00	19.02	47.05	54.00	6.95	V	90	83	15.14
16,266.750	56.42	74.00	17.58	43.42	54.00	10.58	H	90	304	29.34
16,729.500	57.11	74.00	16.89	44.19	54.00	9.81	V	120	359	29.53
17,818.000	57.28	74.00	16.72	44.19	54.00	9.81	H	0	183	30.73
21,462.500	45.15	74.00	28.85	32.66	54.00	21.34	V	120	361	11.42
25,171.750	45.73	74.00	28.27	33.24	54.00	20.76	H	150	351	11.51
26,394.000	44.65	74.00	29.35	31.58	54.00	22.42	H	150	113	12.07

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1, 3 – 12

5.10 AC power-line conducted emissions

5.10.1 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	5.1.5	-
☐	Not applicable, because …	-	-

5.10.2 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	5.1.5	-
☐	6.2.3.3	Floor-standing equipment testing	-	-

The AC power adaptor provided by PHOENIX TESTLAB GmbH was used for the tests:
PHOENIX CONTACT MINI-PS.100-240AC/24DC/1.3
The power adaptor itself was supplied by $120V_{AC}$ 60Hz.

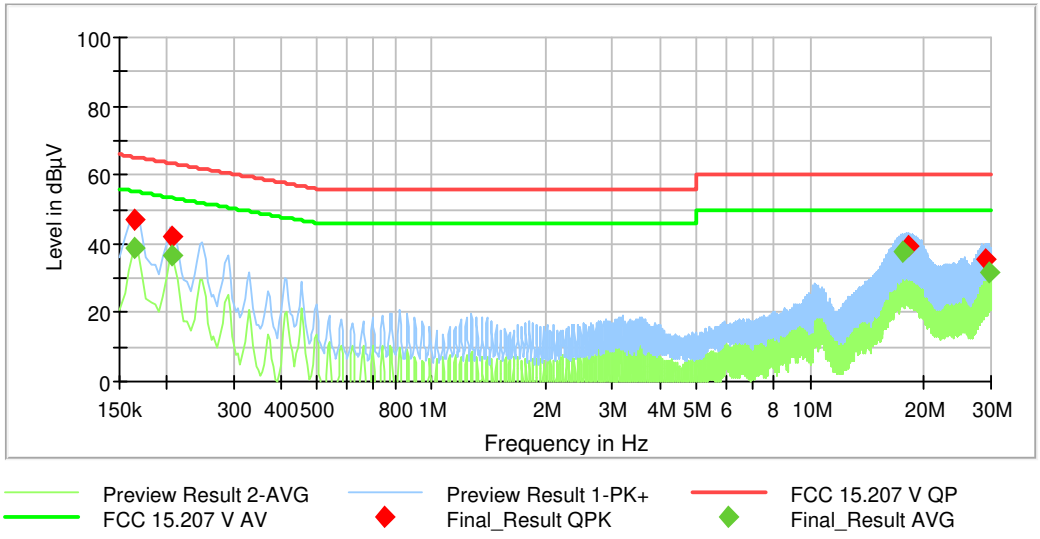
5.10.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	22 °C
Relative humidity:	36 %

Date:	13.06.2024
Tested by:	M. EPPINGER

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 ◆.

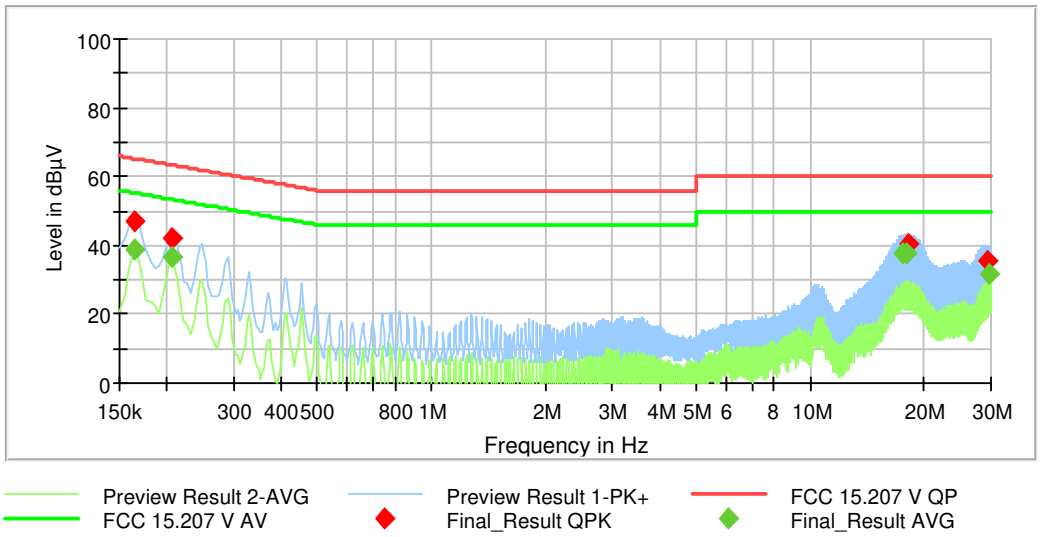
Operation mode 4:



Frequency [MHz]	QuasiPeak [dB(µV)]	Average [dB(µV)]	Limit [dB(µV)]	Margin [dB]	Line	PE	Corr. [dB]
0.164400	---	38.86	55.24	16.37	L1	GND	9.8
0.164400	46.73	---	65.24	18.51	L1	GND	9.8
0.205800	---	36.68	53.37	16.70	L1	GND	9.8
0.205800	42.01	---	63.37	21.37	L1	GND	9.8
17.583900	---	37.77	50.00	12.23	L1	GND	10.9
18.120300	39.57	---	60.00	20.43	L1	GND	10.9
29.007600	35.44	---	60.00	24.56	L1	GND	11.2
29.787900	---	31.60	50.00	18.40	N	GND	11.2

Test results: Passed

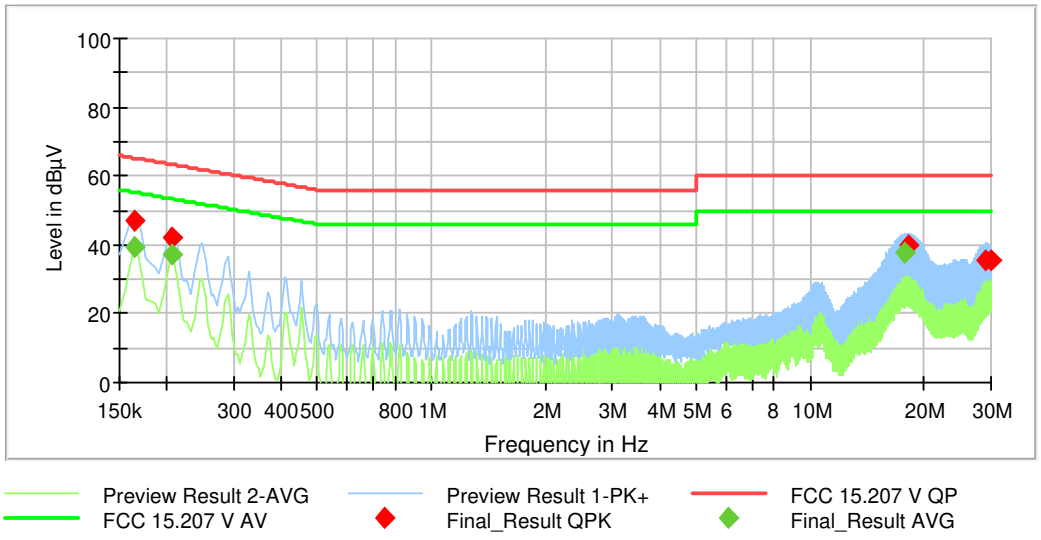
Operation mode 5:



Frequency [MHz]	QuasiPeak [dB(µV)]	Average [dB(µV)]	Limit [dB(µV)]	Margin [dB]	Line	PE	Corr. [dB]
0.164400	---	39.07	55.24	16.17	L1	GND	9.8
0.164400	46.76	---	65.24	18.48	L1	GND	9.8
0.205800	42.04	---	63.37	21.33	L1	GND	9.8
0.205800	---	36.80	53.37	16.57	L1	GND	9.8
17.582100	---	37.72	50.00	12.28	L1	GND	10.9
17.911500	---	37.80	50.00	12.20	L1	GND	10.9
18.076200	40.34	---	60.00	19.66	L1	GND	10.9
29.208300	35.43	---	60.00	24.57	L1	GND	11.2
29.621400	---	31.87	50.00	18.13	L1	GND	11.2

Test results: Passed

Operation mode 6:



Frequency [MHz]	QuasiPeak [dB(µV)]	Average [dB(µV)]	Limit [dB(µV)]	Margin [dB]	Line	PE	Corr. [dB]
0.164400	---	39.21	55.24	16.03	L1	GND	9.8
0.164400	46.82	---	65.24	18.41	L1	GND	9.8
0.205800	---	36.92	53.37	16.46	L1	GND	9.8
0.205800	42.15	---	63.37	21.22	L1	GND	9.8
17.749500	---	37.71	50.00	12.29	L1	GND	10.9
18.080700	40.01	---	60.00	19.99	L1	GND	10.9
29.132700	35.56	---	60.00	24.44	N	GND	11.2
29.829300	35.45	---	60.00	24.55	N	GND	11.2

Test results: Passed

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

6 Measurement Uncertainties

Conducted measurements		
Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) U_{lab}
Frequency error	ETSI TR 100 028	4.5×10^{-8}
Bandwidth measurements	-	9.0×10^{-8}
Conducted emissions using a spectrum analyzer		
< 3.6 GHz	ETSI TR 100 028	2.3 dB
3.6 – 8 GHz	ETSI TR 100 028	2.8 dB
8 – 22 GHz	ETSI TR 100 028	3.2 dB
22 – 40 GHz	ETSI TR 100 028	3.6 dB
Power measurements		
Power meter	ETSI TR 100 028	0.9 dB
Conducted emissions from 150 kHz to 30 MHz with LISN	CISPR 16-4-2	2.8 dB

Radiated measurements		
Frequency error		
(Semi-) Anechoic chamber	ETSI TR 100 028	4.5×10^{-8}
OATS	ETSI TR 100 028	4.5×10^{-8}
Test fixture	ETSI TR 100 028	4.5×10^{-8}
Bandwidth measurements		
(Semi-) Anechoic chamber	-	9.0×10^{-8}
OATS	-	9.0×10^{-8}
Test fixture	-	9.1×10^{-8}
Radiated field strength M20		
CBL6112B @ 3 m 30 MHz – 1 GHz	CISPR 16-4-2	5.3 dB
R&S HL050 @ 3 m		
1 – 6 GHz	CISPR 16-4-2	5.1 dB
6 – 18 GHz	CISPR 16-4-2	5.4 dB
Flann Standard Gain Horns 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	Low Noise Amplifier 100 MHz - 18 GHz	LNA-30-00101800-25-10P	Narda-Miteq	2110917	482967	20.02.2024	02.2026
2	Low Noise Amplifier 12 GHz - 18 GHz	LNA-30-12001800-13-10P	Narda-Miteq	2173737	483430	19.02.2024	02.2026
3	Low Noise Amplifier 18 GHz - 26.5 GHz	LNA-30-18002650-20-10P	Narda-Miteq	2110911	482969	19.02.2024	02.2026
4	Log.-Per. antenna	HL050	Rohde & Schwarz	100908	482977	22.09.2022	09.2025
5	Standard gain horn 18 GHz - 26 GHz	20240-20	Flann	266399	483026	Calibration not necessary	
6	EMC test software	Elektra V5.05	Rohde & Schwarz	--	483755	Calibration not necessary	
7	RF Switch Matrix	OSP220	Rohde & Schwarz	101391	482976	Calibration not necessary	
8	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
9	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
10	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
11	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
12	EMI Test receiver	ESW44	Rohde & Schwarz	101828	482979	21.02.2024	02.2026
13	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
14	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	482978	24.04.2024	04.2027
15	Signal & Spectrum Analyzer	FSW43	Rohde & Schwarz	100586 & 100926	481720	17.03.2023	03.2025
16	Loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	21.02.2024	02.2026
17	LISN	NSLK8128	Schwarzbeck	8128155	480058	28.02.2024	02.2026
18	Power supply AC	AC6803A AC Quelle 2000VA	Keysight	JPVJ002509	482350	Calibration not necessary	
19	Software	EMC32 10.60.20	Rohde & Schwarz	---	483961	Calibration not necessary	
20	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
21	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	22.02.2024	02.2026
22	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	28.03.2024	03.2026

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
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
F231198E2	21.11.2024	Initial Test Report
F231198E2 2nd Version	05.12.2024	Changed two images for the power line conducted setup in Annex A; Removed two incorrect images showing mechanical parts in Annex C; Changed the references to the correct report for all the conducted measurements on page 10, 21, 23, 26, 27, 30, 32 and 34
-	-	-

10 List of Annexes

Annex A	Test Setup Photos	11 pages
Annex B	EUT External Photos	6 pages
Annex C	EUT Internal Photos	11 pages

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