PHOENIX TESTLAB

Königswinkel 10
32825 Blomberg, Germany
Phone: +49 (0) 52 35 / 95 00-0
Fax: +49 (0) 52 35 / 95 00-10
office@phoenix-testlab.de
www.phoenix-testlab.de

Test Report

Report Number:

F231801E1

Equipment under Test (EUT):

GIRO RFID MIFARE

Applicant:

Martin Lehmann GmbH & Co. KG

Manufacturer:

Martin Lehmann GmbH & Co. KG

ilac-MRA

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

References

[1] **ANSI C63.10: 2013** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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

[3] **RSS-210 Issue 10 (December 2019)**
Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

[4] **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 (2013). However, the measurement uncertainty is calculated and shown in this test report.

Tested by and written by:		Sebastian KREHS 21.05.2024
	Signature	
Reviewed and approved by:		Michael Dinter 21.05.2024
	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.

Contents: Page

1 Identification

1.1 Applicant

Name:	Martin Lehmann GmbH & Co. KG
Address:	Uphauser Weg 82, 32429 Minden
Country:	Germany
Name for contact purposes:	-
Phone:	0571-5046-0
eMail address:	info@lehmann-locks.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	Martin Lehmann GmbH & Co. KG
Address:	Uphauser Weg 82, 32429 Minden
Country:	Germany
Name for contact purposes:	-
Phone:	0571-5046-0
eMail address:	info@lehmann-locks.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: *	Electronic furniture lock
Model name: *	GIRO RFID MIFARE
Model number: *	L5NF13DX
Order number: *	---
FCC ID: *	W2Y-L5NF13DX
IC certification number: *	8141A-L5NF13DX
PMN: *	GIRO RFID MIFARE
HVIN: *	L5NF13DX
FVIN: *	----

	EUT number		
	1	2	3
Serial number: *	Engineering sample	-	-
PCB identifier: *	SA020-1	-	-
Hardware version: *	SA020-11G	-	-
Software version: *	V2.0.0	-	-

* 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			
Power supply EUT: *	Lithium-Battey CR 123A 1600 mAh		
Supply voltage EUT: *	U_{nom} = 3.0	U_{min} = 2.8	U_{max} = 5.0
Temperature range: *	-5 °C to +60 °C		
Lowest / highest internal frequency: *	32.768 kHz / 32 MHz		

* Declared by the applicant

RFID part	
Operating frequency: *	13.56 MHz
Number of channels: *	1
Type of modulation: *	100% ASK
Data rate: *	106 kbit/s
Duty cycle: *	-
Antenna type: *	Integrated PCB antenna
Antenna connector: *	None

Equipment used for testing	

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

Ancillary equipment	
NFC Card*1	MIFARE DESFIRE transponder card

*1 Provided by the applicant

1.6 Dates

Date of receipt of test sample:	18.10.2023
Start of test:	01.02.2024
End of test:	14.02.2024

2 Operational States

Description of function of the EUT:

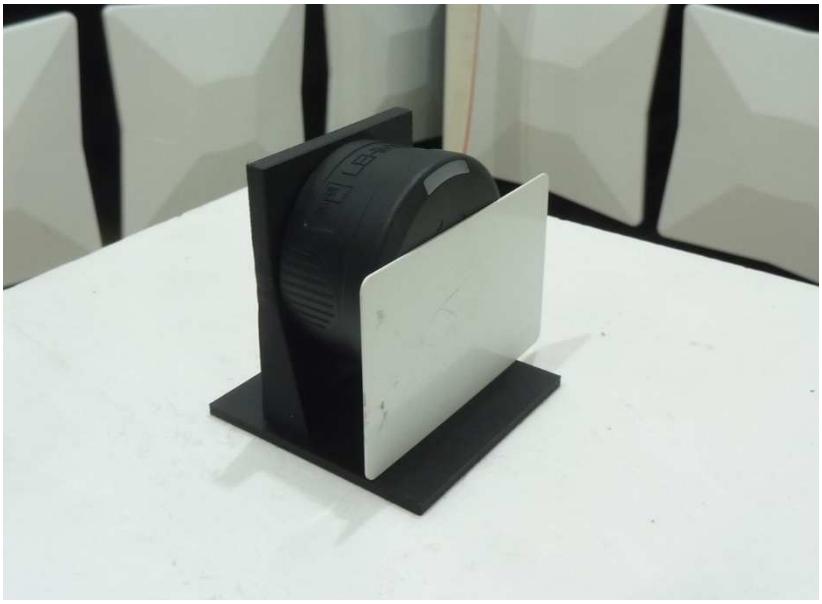
The GIRO MIFARE electronic lock is an access control system for furniture. It provides RFID functionality. The EUT is supplied via battery. This lock opens when a transponder authorized for access is recognized by the reader.
In normal operation mode, the EUT detects when the RF field of the RFID transceiver is changed, e. g. when a TAG is placed in front of the EUT. The EUT then tries to read a TAG. When the reading is not successful, the EUT returns to sleep mode.

The EUT has an integrated antenna.

The following states were defined as the operating conditions:

The EUT was supplied by 3 V DC lithium battery CR 123 A during all tests.
The EUT was set into continuous reading mode. A green flashing LED and a Beep noise shows the correct reading of a TAG.

The system was setup as follows:



3 Additional Information

The EUT was not labeled as required by FCC / IC.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-Gen, Issue 5 [4] and RSS-210, Issue 10 [3]	Tested EUT	Status
Conducted emissions on supply line	0.15 – 30	15.207 (a)	8.8 [4]	-	-
Radiated emissions	0.009 – 1000 **	15.205 (a) 15.209 (a)	8.9 and 8.10 [4] 7.1 and 7.3 [3]	1	Passed
99 % bandwidth	13.56	-	6.7 [4]	1	Passed
Antenna requirement	-	15.203 [2]	6.8 [4]	1	Passed *

*: Integrated antenna only, requirement fulfilled.

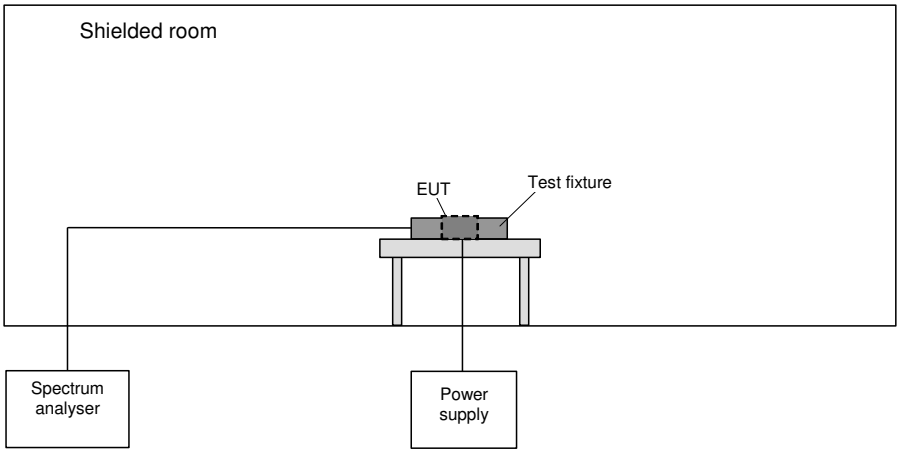
**: As declared by the applicant the highest radio clock frequency is 13.56 MHz.
Therefore the radiated emission measurement must be carried out up to 10th of the highest radio clock frequency, which is 135.6 MHz, but was exceeded to 1 GHz in this test report.

5 Results

5.1 Test Setups

5.1.1 Radiated: Test fixture

The test is carried out in a shielded chamber. Table-top devices are set up on a table and the spectrum analyser is connected to a test fixture / loop antenna, which is placed around / on top of the EUT.



5.1.2 Radiated: 9 kHz to 30 MHz

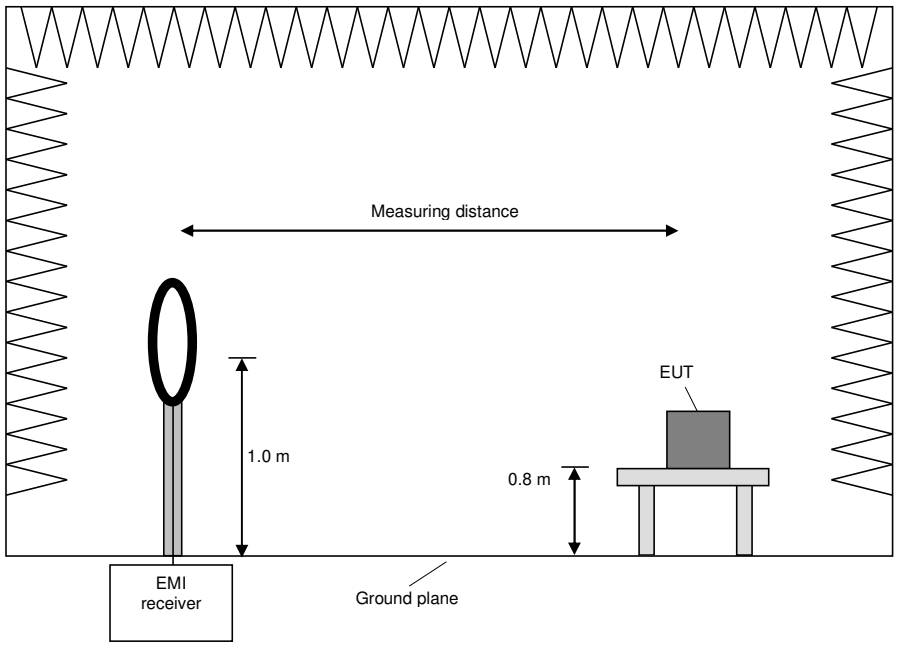
5.1.2.1 Preliminary measurement 9 kHz to 30 MHz

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



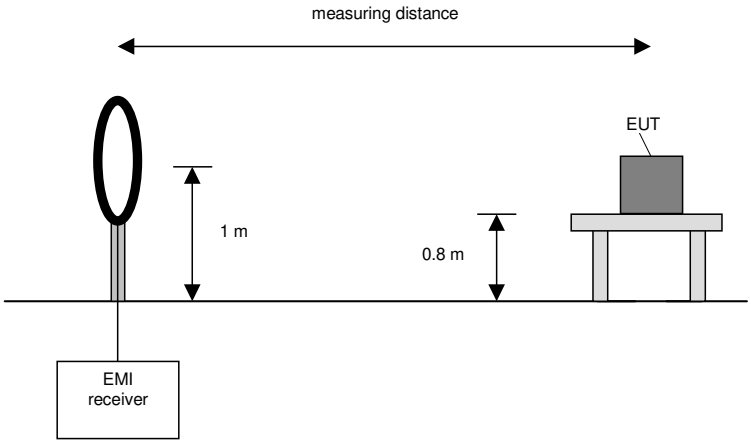
5.1.2.2 Final measurement 9 kHz to 30 MHz

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.

5.1.3 Radiated: 30 MHz to 1 GHz

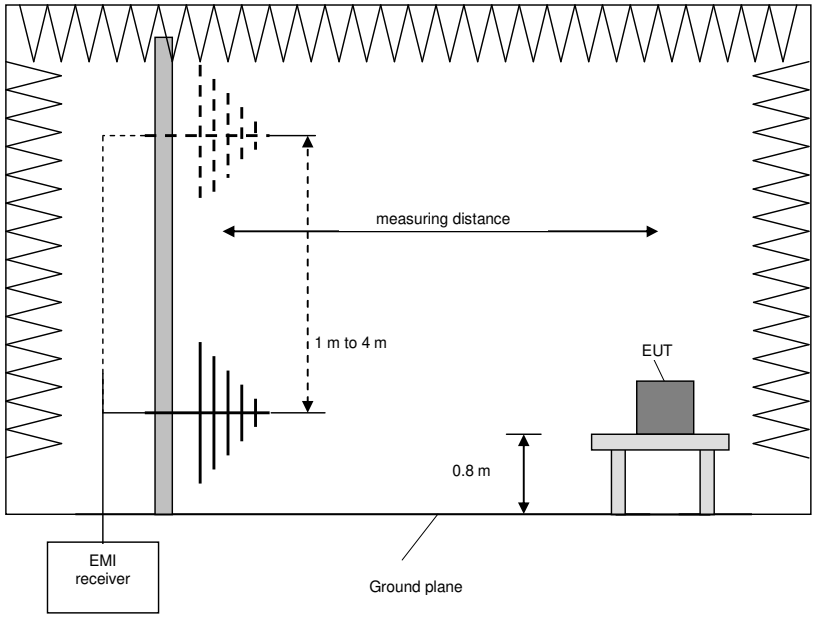
5.1.3.1 Preliminary and final measurement 30 MHz to 1 GHz

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.

5.2 99 % bandwidth

5.2.1 Test setup (99 % bandwidth)

Test setup (99 % bandwidth)			
Used	Setup	See sub-clause	Comment
☒	Radiated: Test fixture	5.1.1	-
☐	Test setup (antenna port conducted)	-	-

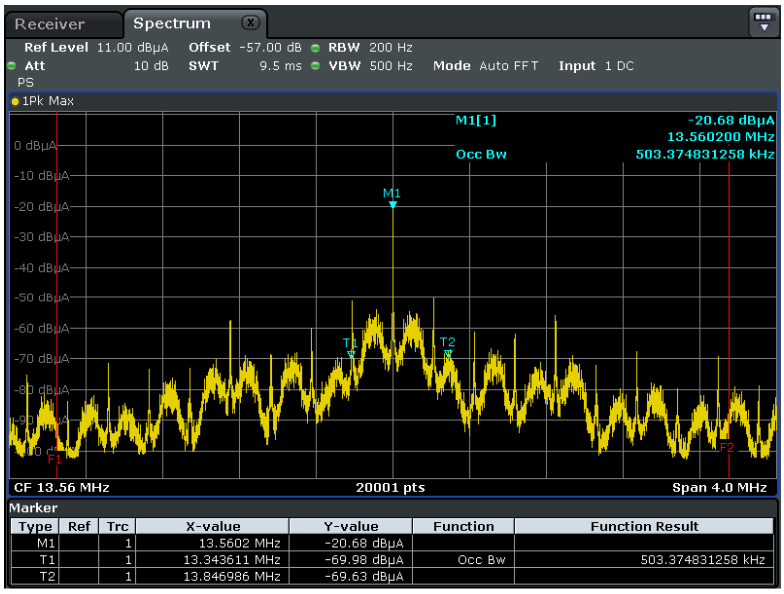
5.2.2 Test method (99 % bandwidth)

Test method (99 % bandwidth)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
☒	6.9.3	Occupied bandwidth – power bandwidth (99%) measurement procedure	-	-

5.2.3 Test results (99 % bandwidth)

Ambient temperature:	22 °C
Relative humidity:	22 %

Date:	14.02.2024
Tested by:	S. KREHS



F_L	F_U	BW (F_U - F_L)
13.343611 MHz	13.846986 MHz	503.375 kHz

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1 – 2

5.3 Radiated emissions

5.3.1 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	5.1.2 / 5.1.3	-

5.3.2 Test method (Maximum unwanted emissions)

☒ Test method (radiated) see sub-clause 5.1.2 / 5.1.3 as described herein

5.3.3 Test results (Maximum unwanted emissions)

5.3.3.1 Test results preliminary measurement 9 kHz to 30 MHz

Ambient temperature:	22 °C
Relative humidity:	28 %

Date:	01.02.2024
Tested by:	S. KREHS

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.

Remark: The test was carried out in normal build in position.

Calculations:

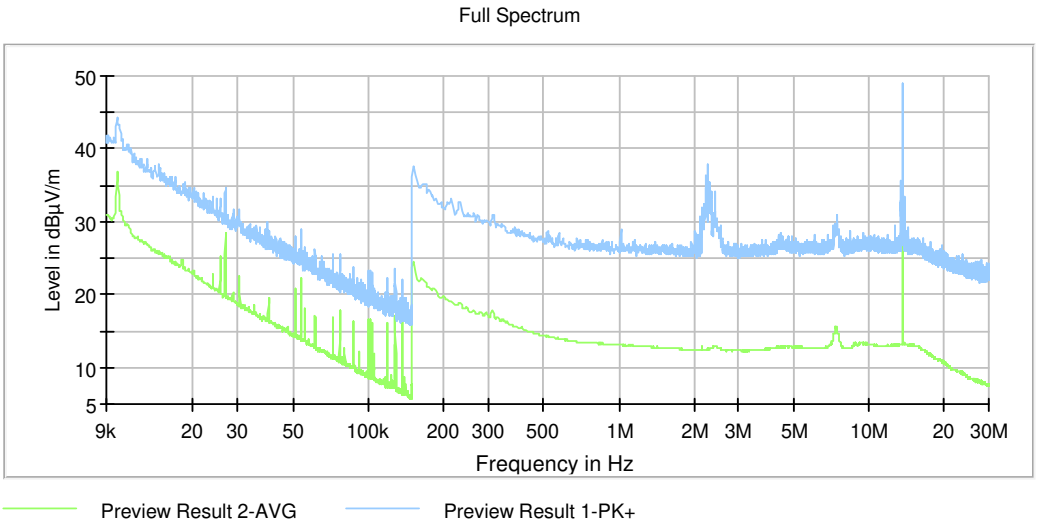
Result @ norm. dist. [dBµV/m] = Reading [dBµV] + AF [dB/m] + Distance corr. fact. [dBµV/m]

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

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

Worst case plot:

Spurious emissions from 9 kHz to 30 MHz (operation mode reading TAG continously):



Remark: Only the 13.56 MHz fundamental was found for the final measurement. All other emissions are below the noise floor of the outdoor test site and have more than 20 dB margin to the limit at 300 m or 30 m.

The following frequencies were found in the frequency range 9 kHz to 30 MHz:

13.56 MHz

This frequency has to be measured within a final measurement.

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

5.3.3.2 Test results final measurement 9 kHz to 30 MHz

Ambient temperature:	6 °C
Relative humidity:	64 %

Date:	13.02.2024
Tested by:	S. KREHS

The results of the standard subsequent measurement on the outdoor test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above-mentioned standard while taking account of the specified requirements for a 30 m measuring distance.

Results 9 kHz - 30 MHz												
Frequency [MHz]	Reading @ measuring distance [dB(µV)]	Result @ norm. distance [dB(µV/m)]	Result @ norm. distance [dB(µA/m)]	Limit acc. 15.209 [dB(µV/m)]	Limit acc. RSS-Gen Table 6 [dB(µA/m)]	Margin [dB]	Detector	Antenna factor [dB/m]	Measuring distance [m]	Normative distance [m]	Distance correction factor [dB]	Position #
13.56	32.5	12.7	-38.8	29.5	-22.0	16.8	QP	20.2	3	30	40	normal

Remark:
The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ω.
For example, the measurement frequency X kHz resulted in the level of Y dBµV/m, which is equivalent to Y - 51.5 = Z dBµA/m, which was the same margin, W dB, to the corresponding RSS-GEN Table 6 as it has to the 15.209(a) limit.

Remark: At 10m measuring distance the signal of the EUT was below the sensitivity of the measuring system.

Test result: Passed

Test equipment (please refer to chapter 7 for details)
11 - 13

5.3.3.3 Test results (30 MHz – 1 GHz)

Ambient temperature:	23 °C
Relative humidity:	23 %

Date:	08.02.2024
Tested by:	S. KREHS

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: The test was carried

Calculations:

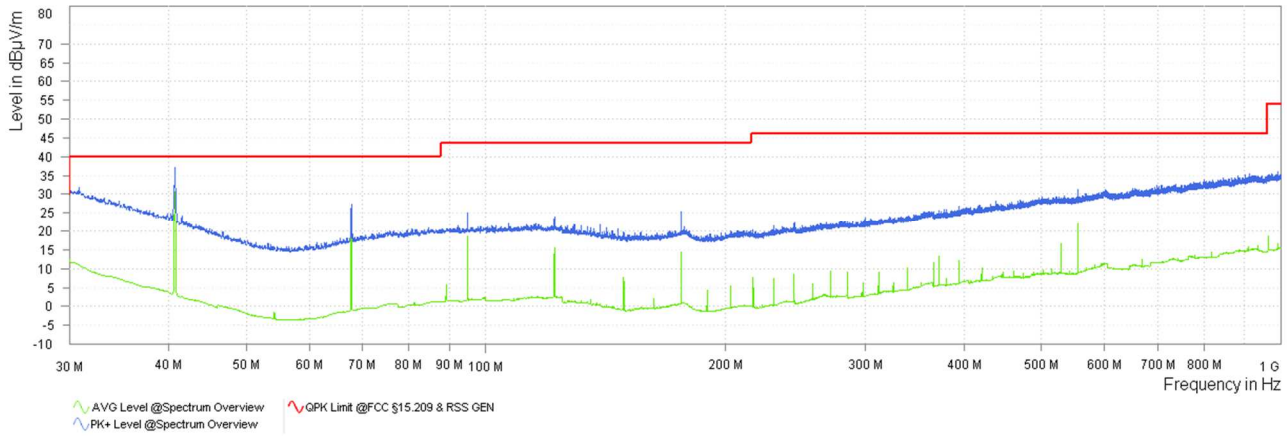
Result [dBµV/m] = Reading [dBµV] + Correction [dBµV/m]

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

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

Worst case plot:

Spurious emissions from 30 MHz to 1 GHz:



Result tables:

Frequency [MHz]	Result (QP) [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Readings [dBµV]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol. (H/V)
40.690	31.34	40.00	8.66	11.81	19.53	175	272	V
67.810	22.59	40.00	17.41	8.41	14.18	175	276	V
94.930	18.62	43.50	24.88	1.74	16.88	100	279	V
122.050	15.66	43.50	27.84	-1.64	17.30	100	285	V
176.290	20.30	43.50	23.20	3.73	16.57	100	302	V
555.970	24.16	46.00	21.84	-0.61	24.77	137	349	H

Test result: Passed

Test equipment (please refer to chapter 7 for details)
14 - 21

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 from 150 kHz to 30 MHz with LISN	CISPR 16-4-2	2.8 dB

Radiated measurements		
Frequency error		
(Semi-) Anechoic chamber	ETSI TR 100 028	4.5×10^{-8}
OATS	ETSI TR 100 028	4.5×10^{-8}
Test fixture	ETSI TR 100 028	4.5×10^{-8}
Bandwidth measurements		
(Semi-) Anechoic chamber	-	9.0×10^{-8}
OATS	-	9.0×10^{-8}
Test fixture	-	9.1×10^{-8}
Radiated field strength M20		
CBL6112B @ 3 m 30 MHz – 1 GHz	CISPR 16-4-2	5.3 dB
R&S HL050 @ 3 m		
1 – 6 GHz	CISPR 16-4-2	5.1 dB
6 – 18 GHz	CISPR 16-4-2	5.4 dB
Flann Standard Gain Horns 18 – 40 GHz	-	5.9 dB
Radiated field strength M276		
R&S HL562E @ 3 m 30 MHz – 1 GHz	CISPR 16-4-2	4.8 dB
R&S HL050 @ 3 m	-	
1 – 6 GHz	CISPR 16-4-2	5.1 dB
6 – 18 GHz	CISPR 16-4-2	5.4 dB
Flann Standard Gain Horns 18 – 40 GHz	-	5.9 dB
OATS		
Field strength measurements below 30 MHz on OATS without ground plane	-	4.4 dB

7 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Loop antenna	22.5 cm	PHOENIX TESTLAB GmbH	-	410085	Calibration not necessary	
2	EMI Receiver / Spectrum Analyser	ESR7	Rohde & Schwarz	101733	482330	02.06.2022	02.06.2024
3	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	22.02.2022	22.02.2024
4	Attenuator 6 dB	WA2-6	Weinschel		482794	Calibration not necessary	
5	OSP220	OSP220	Rohde & Schwarz	101366	483164	Calibration not necessary	
6	OSP220 Master	OSP220	Rohde & Schwarz	101377	483165	Calibration not necessary	
7	OSP Satellite	Satellit	Rohde & Schwarz	101422	483166	Calibration not necessary	
8	Fully anechoic chamber	FAR-3-ANSI	Albatross Projects		482785	Calibration not necessary	
9	EMI Receiver / Spectrum Analyser	ESR7	Rohde & Schwarz	101252	481734	15.02.2022	15.02.2024
10	Measurement Software	EMC32 V10.60.20	Rohde & Schwarz	100638	483173	Calibration not necessary	
11	Loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	22.02.2022	22.02.2024
12	Outdoor test site	-	PHOENIX TESTLAB GmbH	-	480293	Calibration not necessary	
13	EMI Receiver / Spectrum Analyser	ESI 40	Rohde & Schwarz	100064/040	480355	18.02.2022	18.02.2024
14	Attenuator 6 dB	WA2-6	Weinschel		482793	Calibration not necessary	
15	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	482978	18.03.2021	18.03.2024
16	Measurement Software	Elektra V5.00.2	Rohde&Schwarz	101381	483755	Calibration not necessary	
17	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
18	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
19	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
20	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
21	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	08.12.2021	28.02.2024

8 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
OATS Outdoor	480293	9 kHz – 30 MHz	-	ANSI C63.4-2014	-	-
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA/RSM	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	01.03.2023	28.02.2026

9 Report History

Report Number	Date	Comment
F231801E1	21.05.2024	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A	Test Setup Photos	3 pages
Annex B	EUT External Photos	2 pages
Annex C	EUT Internal Photos	2 pages