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Test Report

Report Number:

F220394E1

Equipment under Test (EUT):

RevoLix HTL

Applicant:

LISA Laser Products GmbH

Manufacturer:

LISA Laser Products GmbH



Deutsche
Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

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 (March 2019) Amendment 1**
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 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

Name:	LISA Laser Products GmbH
Address:	Albert-Einstein-Str. 4, 37191 Katlenburg-Lindau
Country:	Germany
Name for contact purposes:	Mr. Thomas BRANDT
Phone:	+49 5556-9938-0
eMail address:	info@lisalaser.de
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	LISA Laser Products GmbH
Address:	Albert-Einstein-Str. 4, 37191 Katlenburg-Lindau
Country:	Germany
Name for contact purposes:	Mr. Thomas BRANDT
Phone:	+49 5556-9938-0
eMail address:	info@lisalaser.de
Manufacturer represented during the test by the following person:	None

1.3 Test Laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-06 and D-PL-17186-01-05, 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: *	Integrated RFID reader
Model name: *	LIR-1
Model number: *	LIR-1
Order number: *	Not provided by the applicant
FCC ID: *	2A6YV-SDLLIR1
IC certification number: *	Not provided by the applicant
PMN: *	Not provided by the applicant
HVIN: *	Not provided by the applicant
FVIN: *	Not provided by the applicant

* Declared by the applicant

	EUT number		
	1	2	3
Serial number: *	0133873	-	-
PCB identifier: *	LISA HF-Reader Board	-	-
Hardware version: *	v1	-	-
Software version: *	STD_HF_RFnoLED.script	-	-

* 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: *	1/N/PE AC 110 V...115 V, 50Hz / 60 Hz* ¹ 1/N/PE AC 200 V...240 V, 50Hz / 60 Hz* ¹			
Supply voltage EUT: *	$U_{\text{nom}} = 110 \text{ V}$ 230 V	$U_{\text{min}} = 100 \text{ V}$ 180 V	$U_{\text{max}} = 132 \text{ V}$	264 V
Temperature range: *	+10 °C to +28 °C			
Lowest / highest internal frequency: *	DC (20 kHz) 1.1 GHz			

* Declared by the applicant

*¹ The EUT has an automatic voltage detection, the tests were carried out with 120 V AC 60 Hz.

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Power supply cord	Schuko Connector	AC plug	5m	No
Footswitch	Neutrik XLR Stecker NC7MX-B	fixed	2.9m	Yes

RFID part				
Equipment category: *	1 internal coil antenna < 24mm diameter			
Channel spacing: *	Not applicable (one channel operation)			
Operating frequency *	13.56 MHz			
Antenna characteristics: *	Printed coil antenna, round, 20mm diameter, 9 turns			
Antenna gain: *	Quality factor of the printed coil: about 100			
ITU classification: *	DXX			
Alignment range: *	Not applicable (one channel operation)			
Switching range: *	Not applicable (one channel operation)			
Modulation: *	AM			
Bit rate of transmitter: *	26.48 kbaud			
Supply Voltage: *	$U_{\text{nom}} = 5.0 \text{ V}_{\text{DC}}$	$U_{\text{min}} = 4.8 \text{ V}_{\text{DC}}$	$U_{\text{max}} = 5.2 \text{ V}_{\text{DC}}$	
Type of power supply: *	External DC			
Temperature range: *	+5 °C to +40 °C			

* Declared by the applicant

Equipment used for testing	
RFID TAG * ¹	TAG-MODULE R18-11 1.3k (ISO15693 kompatibel)

*¹ Provided by the applicant

1.6 Dates

Date of receipt of test sample:	14.03.2022
Start of test:	22.04.2022
End of test:	17.05.2022

2 Operational States

Description of function of the EUT:

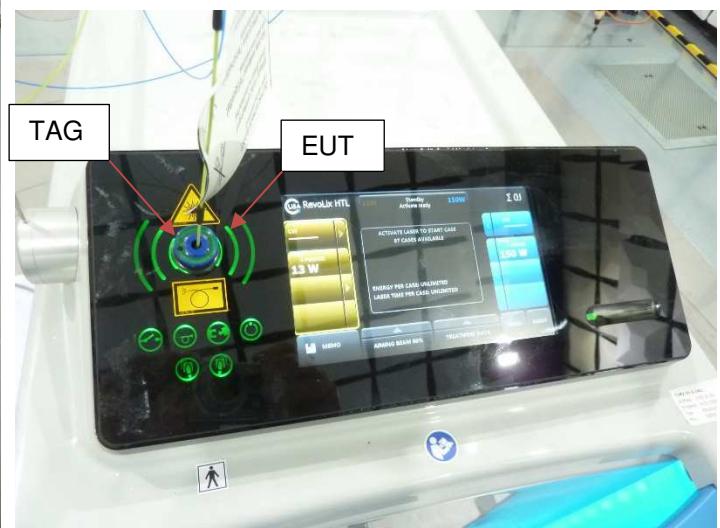
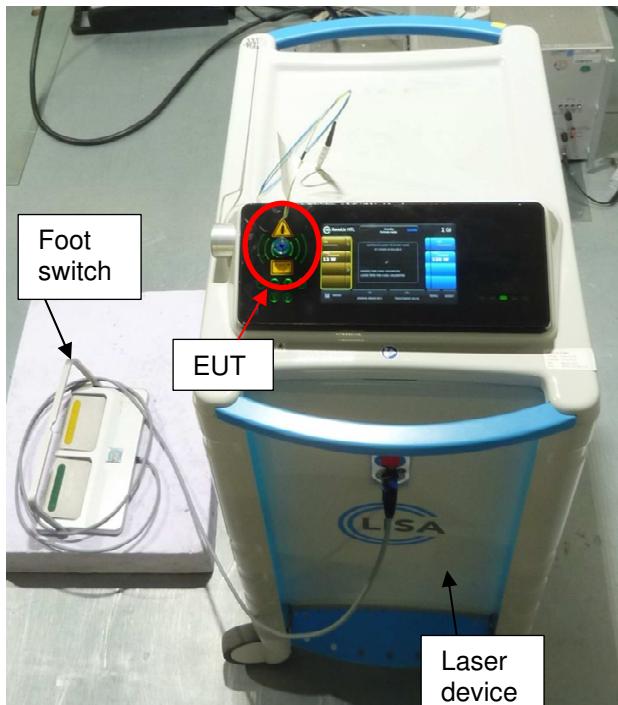
The EUT is a RFID part in a Laser device for medical application running in normal operation mode. RFID is used for identifying the laser fiber optic unit.

The following states were defined as the operating conditions:

The EUT was supplied by 120 V 60 Hz AC during all tests.

During all tests the EUT, RFID part of the laser device is in continuously reading a TAG of the fiber optics unit.

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]	1	Passed
Radiated emissions	0.009 – 12000 **	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.

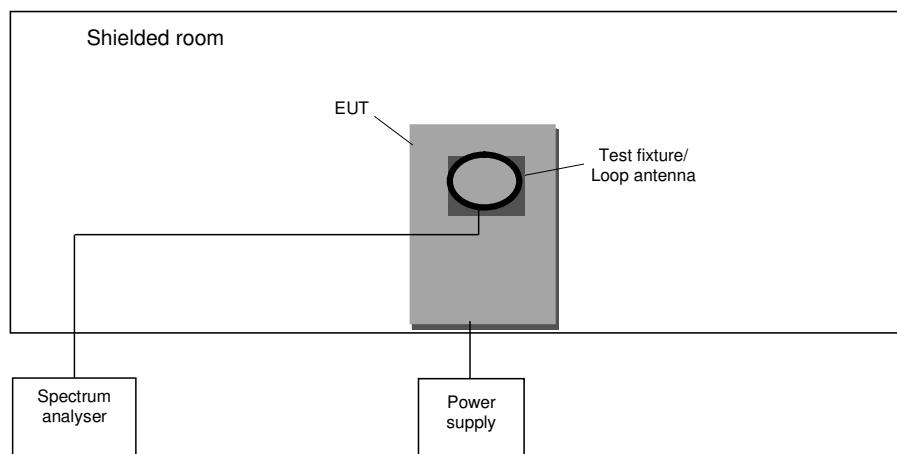
**: As declared by the applicant the highest radio clock frequency is 13.56 MHz and the highest internal clock frequency is below 1.1 GHz.
Therefore the radiated emission measurement must be carried out up to 10th of the highest radio clock frequency or up to 5th of the highest clock frequency in this case up to 12 GHz.

5 Results

5.1 Test setups

5.1.1 Radiated: Test fixture

The test is carried out in a shielded chamber. Floor standing devices are set up on a floor and the spectrum analyser is connected to a test fixture / loop antenna, which is placed at the antenna of the EUT.



5.1.2 Radiated: 9 kHz to 30 MHz

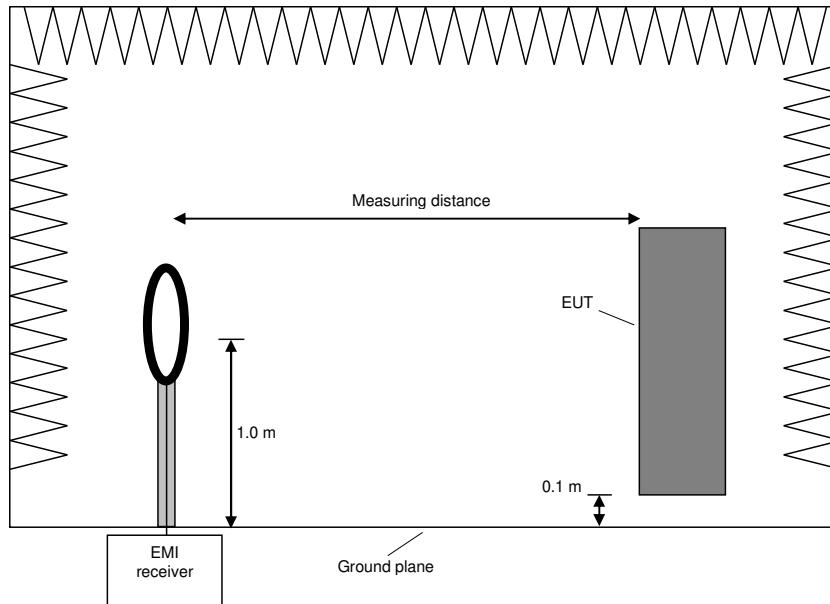
5.1.2.1 Preliminary measurement 9 kHz to 30 MHz

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



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.

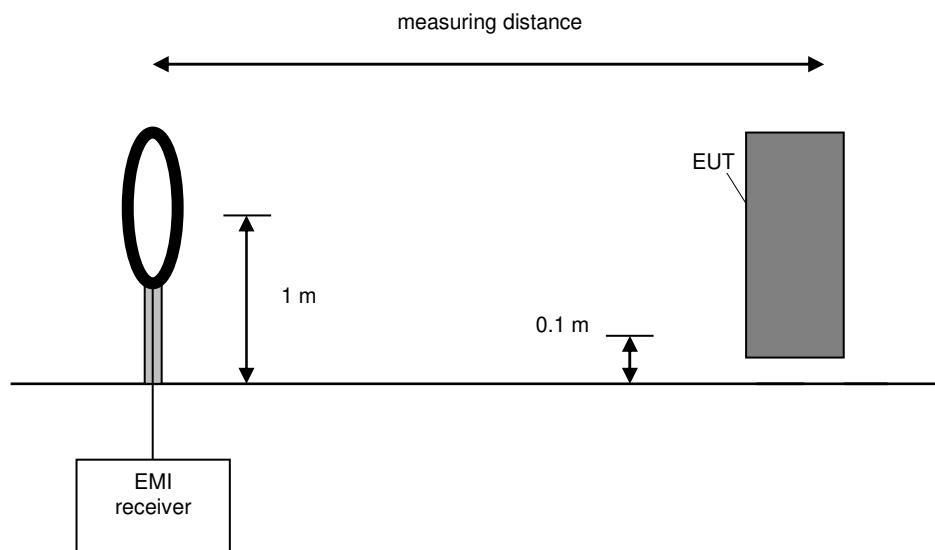
5.1.2.2 Final measurement 9 kHz to 30 MHz

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

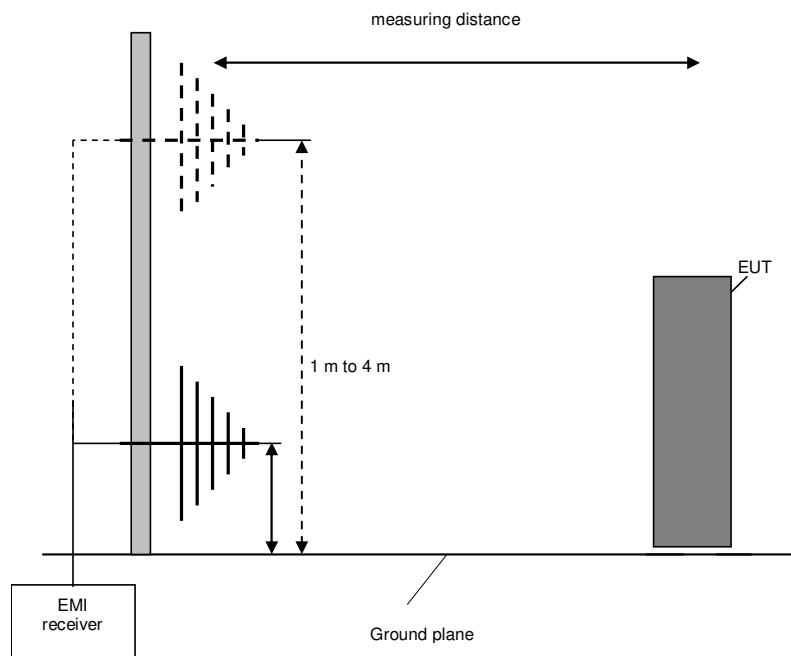
5.1.3.1 Preliminary and final measurement 30 MHz to 1 GHz

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.

5.1.4 Radiated: 1 GHz to 40 GHz

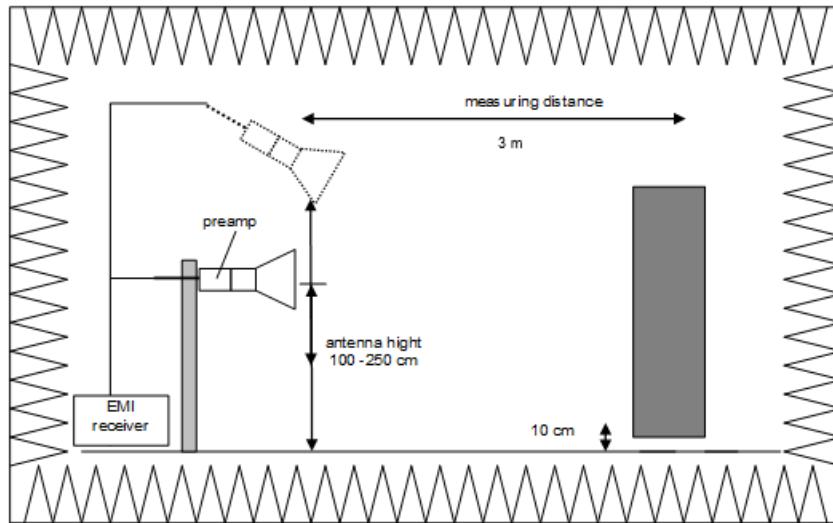
5.1.4.1 Preliminary and final measurement 1 GHz to 40 GHz

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. 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 ° and the measuring antenna is set to horizontal and vertical polarization to find the maximum level of emissions. If the EUT is portable 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) If the EUT is portable 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:

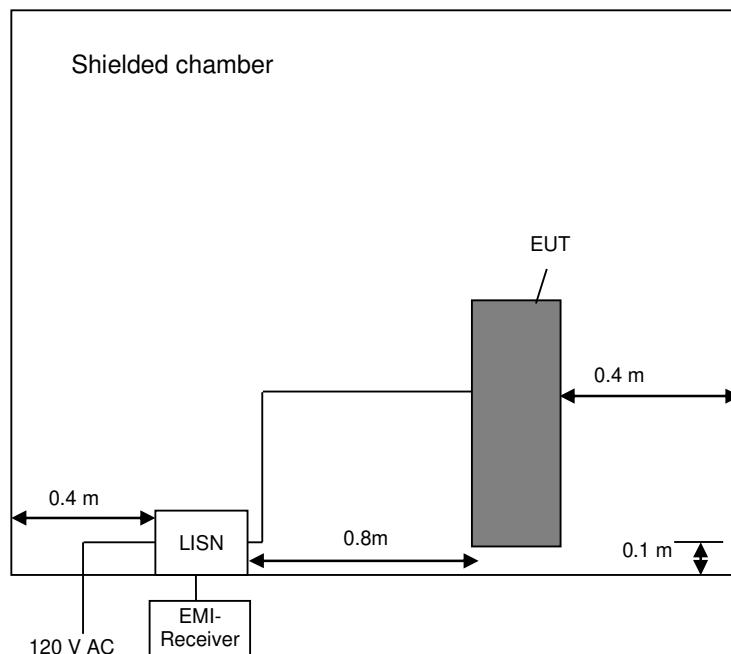
- 1) Set the turntable and the turn device to the position which leads to the highest emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna to the polarisation which leads to the highest emission for the first frequency identified in the preliminary 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.

5.1.5 Conducted: AC power line

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

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

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



5.2 99 % bandwidth

5.2.1 Test setup (99 % bandwidth)

Test setup (99 % bandwidth)			
Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Radiated: Test fixture	5.1.1	-
<input type="checkbox"/>	Test setup (antenna port conducted)	-	-

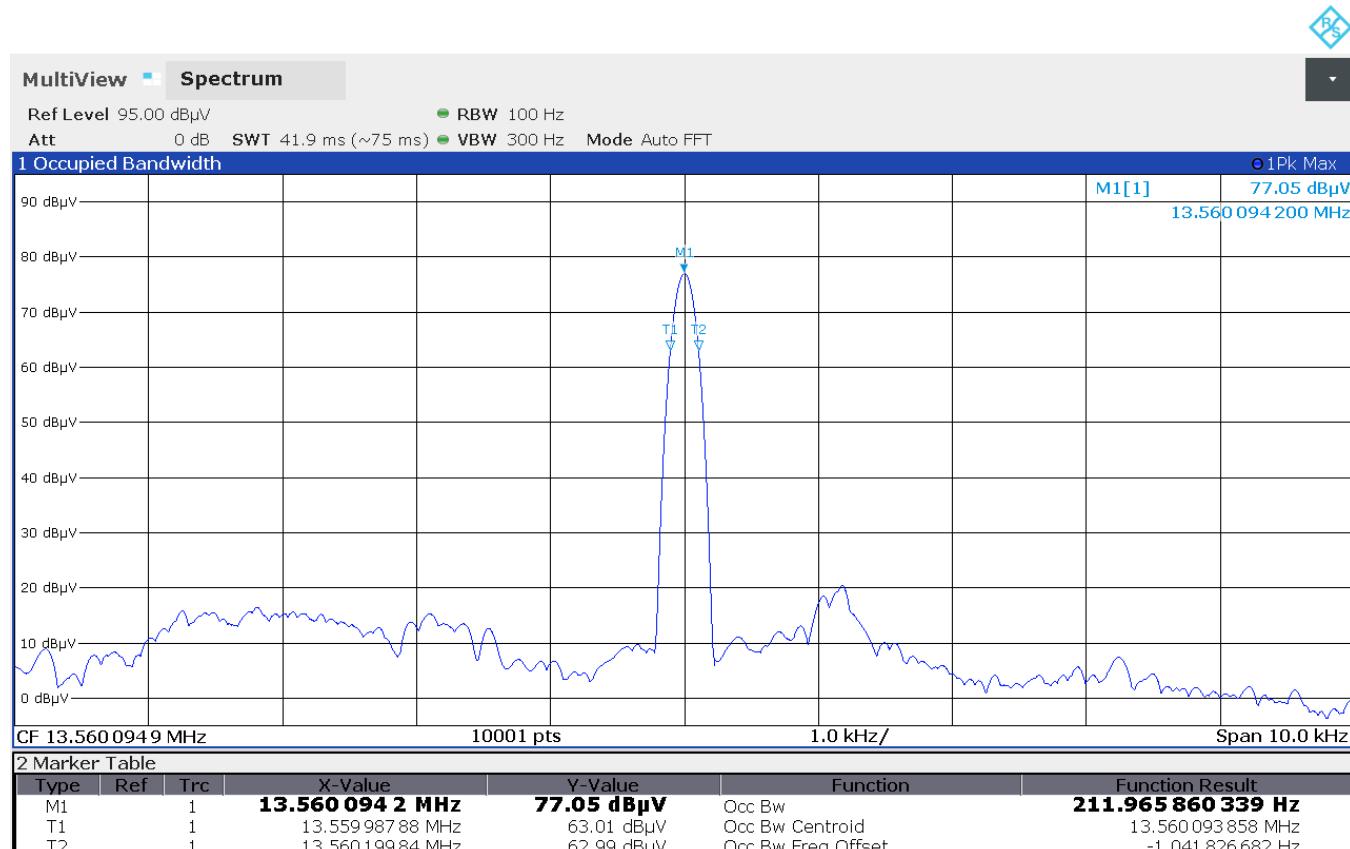
5.2.2 Test method (99 % bandwidth)

Test method (99 % bandwidth)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	6.9.3	Occupied bandwidth – power bandwidth (99%) measurement procedure	applicable	-

5.2.3 Test results (99 % bandwidth)

Ambient temperature:	22 °C
Relative humidity:	53 %

Date:	17.05.2022
Tested by:	M.DINTER



F_L	F_U	$BW (F_U - F_L)$
13.55998788 MHz	13.56019984 MHz	211.966 Hz

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1 - 2 , 22 -24

5.3 Radiated emissions

5.3.1 Test setup (Maximum unwanted emissions)

Test setup (Maximum unwanted emissions)			
Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Radiated: 9 kHz to 30 MHz / 30 MHz to 1 GHz / 1 GHz to 40 GHz	5.1.2 / 5.1.3 / 5.1.4	-

5.3.2 Test method (Maximum unwanted emissions)

Test method (radiated) see sub-clause 5.1.2 / 5.1.3 / 5.1.4 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	Date:	02.05.2022
Relative humidity:	33 %	Tested by:	Michael DINTER

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

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

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

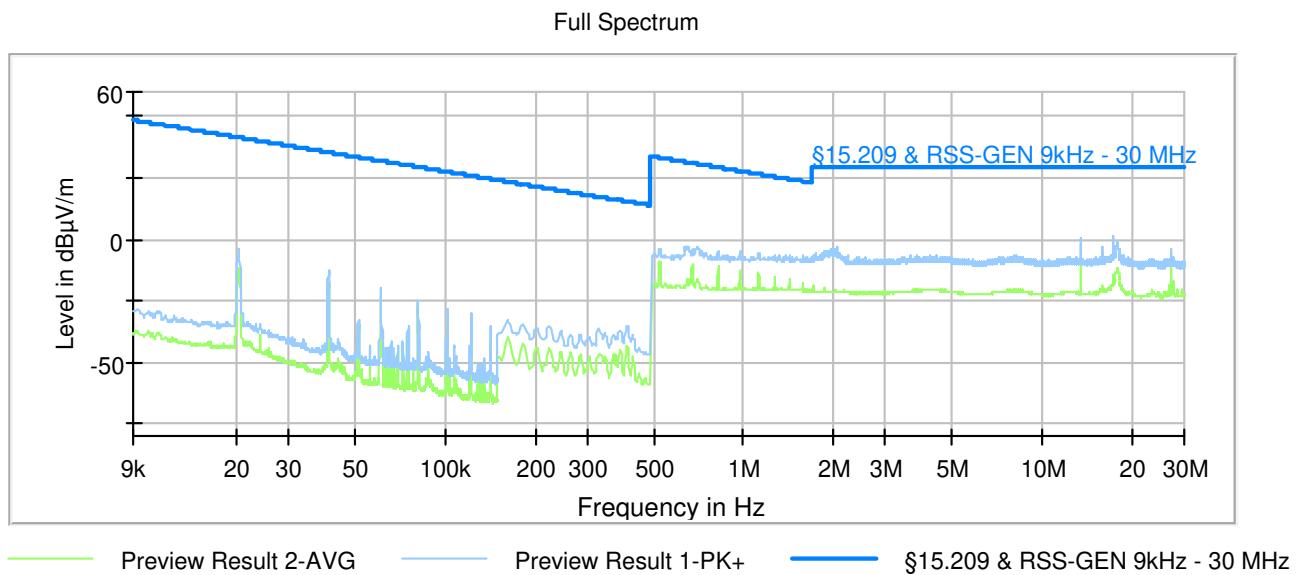
Calculations:

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

Result @ norm. dist. [dB μ A/m] = Result @ norm. dist. [dB] – 20 x log₁₀ (377 Ω)

Margin [dB] = Limit [dB(μ V| μ A)/m] - Result [dB(μ V| μ A)/m]

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



The following frequencies were found in the frequency range 9 kHz to 30 MHz:
-13.560 MHz* ; 17.383 MHz and 27.121 MHz

These frequencies have to be measured within a final measurement.

Remark: No further emissions close than 20 dB to the limit.

*: Fundamental

5.3.3.2 Test results final measurement 9 kHz to 30 MHz

Ambient temperature:	20 °C
Relative humidity:	45 %

Date:	17.05.2022
Tested by:	Michael DINTER

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 | 300 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 #
13.560*	18.3	-1.5	-53.0	29.5	-22.0	31.0	QP	20.2	3	30	-40	1
17.383	14.0	-5.8	-57.3	29.5	-22.0	35.3	QP	20.2	3	30	-40	1
27.120	12.4	-7.0	-58.5	29.5	-22.0	36.5	QP	20.6	3	30	-40	1

*: Fundamental

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)
3 – 9, 22 - 24 Preliminary Measurement
10 – 12, 22 - 24 final measurement

5.3.3.3 Test results (30 MHz – 1 GHz)

Ambient temperature:	22 °C
Relative humidity:	33 %

Date:	25.04.2022
Tested by:	Michael DINTER

Position of EUT: For tests for f between 9 kHz to 30 MHz, the EUT was set-up on the floor. 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.

Calculations:

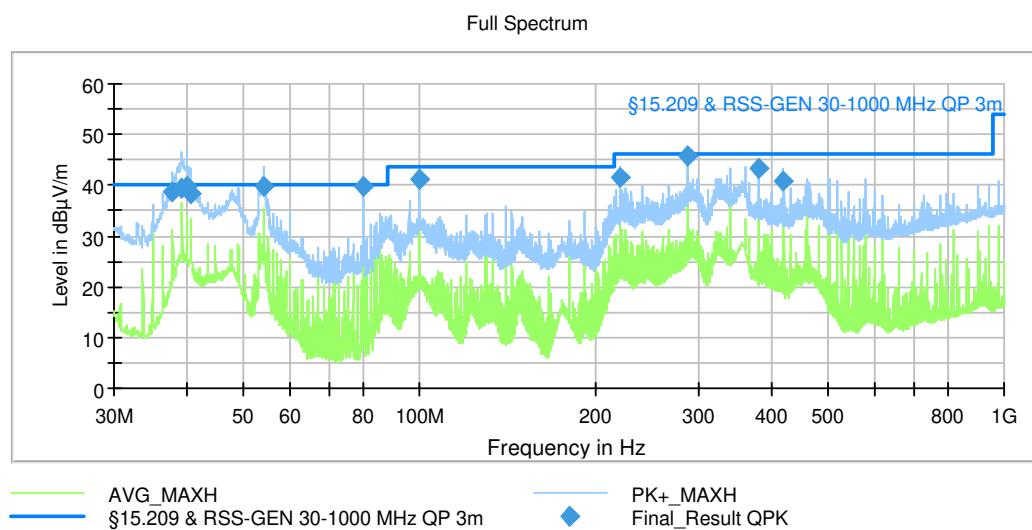
Result [$\text{dB}\mu\text{V}/\text{m}$] = Reading [$\text{dB}\mu\text{V}$] + Correction [$\text{dB}\mu\text{V}/\text{m}$]

Correction [$\text{dB}\mu\text{V}/\text{m}$] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]

Margin [dB] = Limit [$\text{dB}\mu\text{V}/\text{m}$] - Result [$\text{dB}\mu\text{V}/\text{m}$]

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.

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



Result tables:

Frequency [MHz]	Result (QP) [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Readings [dB μ V]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol. (H/V)
37.810	38.8	40.0	1.2	17.4	21.4	100.0	-23	V
39.210	39.4	40.0	0.6	18.9	20.5	110.0	293	V
40.000	39.7	40.0	0.3	19.6	20.1	118.0	163	V
40.590	38.3	40.0	1.7	18.6	19.7	101.0	113	V
54.150	39.7	40.0	0.3	27.4	12.3	104.0	166	V
80.000	39.6	40.0	0.4	23.2	16.4	150.0	338	V
100.000	41.2	43.5	2.3	23.9	17.3	200.0	99	H
220.000	41.6	46.0	4.4	25.6	16.0	116.0	-1	H
288.000	45.6	46.0	0.4	26.9	18.7	157.0	-18	V
380.000	43.3	46.0	2.7	22	21.3	101.0	24	V
420.000	40.8	46.0	5.2	18.5	22.3	118.0	8	V

Test result: Passed

Test equipment (please refer to chapter 7 for details)
4 - 9, 13 – 15, 22 - 24

5.3.3.4 Test results (radiated 1 GHz to 40 GHz)

Ambient temperature:	22 °C
Relative humidity:	33 %

Date:	25.04.2022
Tested by:	Michael DINTER

Position of EUT: For tests for f between 9 kHz to 30 MHz, the EUT was set-up on the floor. 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.

Calculation:

Max Peak [dB μ V/m] = Reading [dB μ V] + Correction [dB μ V/m]

Average [dB μ V/m] = Reading [dB μ V] + Correction [dB μ V/m]

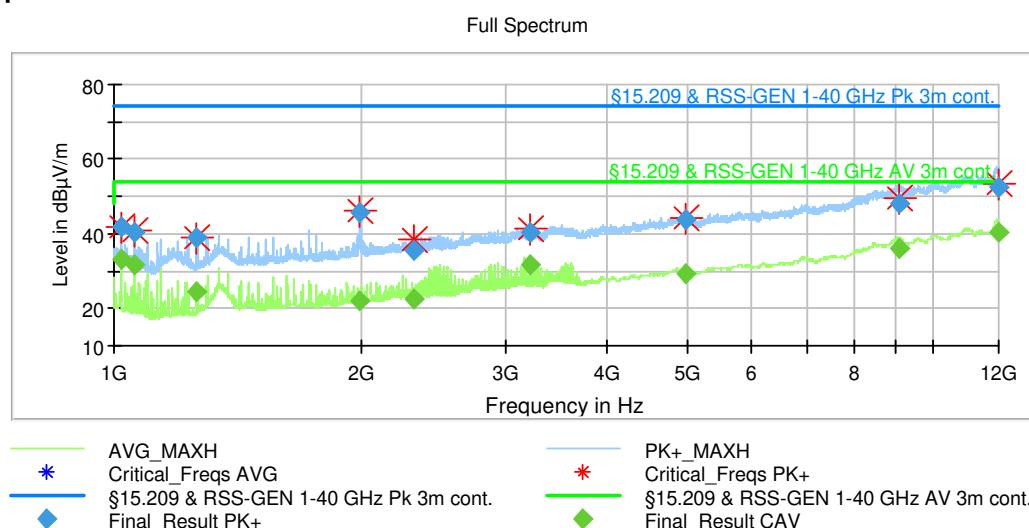
Correction [dB μ V/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB] + DCCF* [dB]
* (if applicable – only for Average values, that are fundamental related)

Margin [dB] = Limit [dB μ V/m] – Max Peak | Average [dB μ V/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 12 GHz (operation mode reading TAG):

Result tables:

Frequency [MHz]	MaxPeak [dB(µV/m)]	Average [dB(µV/m)]	Limit [dB(µV/m)]	Margin [dB]	Pol [H/V]	Hight [cm]	Azimuth [deg]	Corr. [dB]
1020.050	41.7	---	74.0	32.3	V	172.0	172.0	22.3
1020.050	---	33.3	54.0	20.7	V	172.0	172.0	22.3
1059.950	40.6	---	74.0	33.4	V	158.0	158.0	22.6
1059.950	---	31.9	54.0	22.1	V	158.0	158.0	22.6
1263.650	---	24.3	54.0	29.7	V	109.0	109.0	23.9
1263.650	39.1	---	74.0	34.9	V	109.0	109.0	23.9
1994.700	---	21.8	54.0	32.2	V	230.0	230.0	28.0
1994.700	45.5	---	74.0	28.5	V	230.0	230.0	28.0
2324.400	---	22.6	54.0	31.4	V	242.0	242.0	29.7
2324.400	35.6	---	74.0	38.4	V	242.0	242.0	29.7
3213.650	---	31.6	54.0	22.4	V	208.0	208.0	32.6
3213.650	40.5	---	74.0	33.5	V	208.0	208.0	32.6
4982.450	---	29.5	54.0	24.5	V	166.0	166.0	36.1
4982.450	43.6	---	74.0	30.4	V	166.0	166.0	36.1
9077.800	48.2	---	74.0	25.8	V	196.0	196.0	42.2
9077.800	---	36.2	54.0	17.8	V	196.0	196.0	42.2
11982.200	52.4	---	74.0	21.6	H	152.0	152.0	43.7
11982.200	---	40.5	54.0	13.5	H	152.0	152.0	43.7

Test result: Passed

Test equipment (please refer to chapter 7 for details)
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4 - 9, 15 - 17, 22 - 24

5.4 AC power-line conducted emissions

5.4.1 Test setup (Conducted emissions on power supply lines)

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

5.4.2 Test method (Conducted emissions on power supply lines)

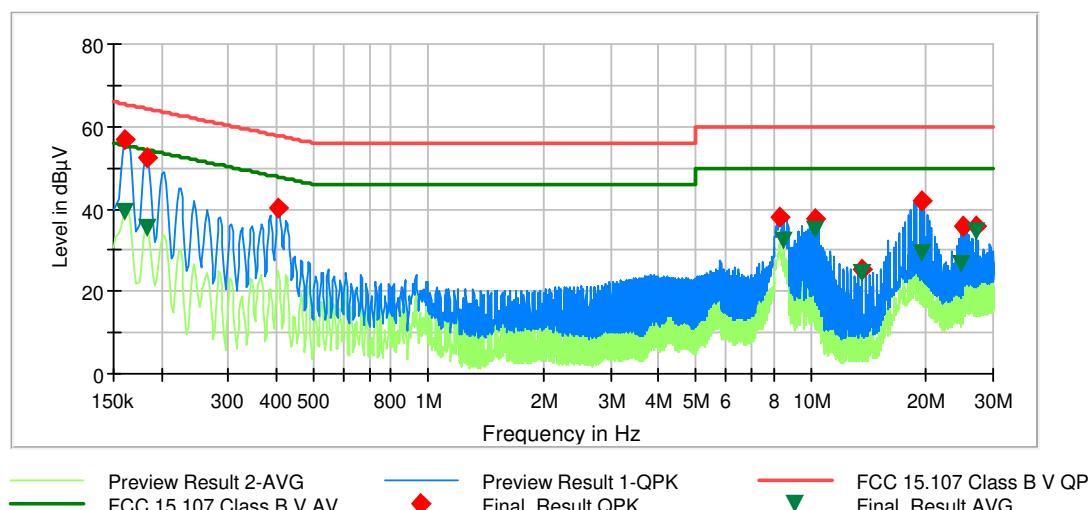
Test setup (Conducted emissions on power supply lines)				
Used	Clause [1]	Name of method	Sub-clause	Comment
<input type="checkbox"/>	6.2	Tabletop equipment testing	-	-
<input checked="" type="checkbox"/>	6.2	Floor-standing equipment testing	-	-

The EUT was supplied by 120V_{AC} 60Hz.

5.4.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	22 °C	Date:	22.04.2022
Relative humidity:	32 %	Tested by:	Michael DINTER

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



Frequency [MHz]	QuasiPeak [dB(µV)]	Average [dB(µV)]	Limit [dB(µV)]	Margin [dB]	Line	PE	Corr. [dB]
0.161250	---	39.54	55.40	15.86	N	GND	9.8
0.161250	56.74	---	65.40	8.66	N	GND	9.8
0.183750	---	35.62	54.31	18.70	N	GND	9.8
0.183750	52.46	---	64.31	11.86	N	GND	9.8
0.404250	40.36	---	57.77	17.40	N	GND	9.8
8.286000	38.11	---	60.00	21.89	N	GND	10.5
8.493000	---	32.40	50.00	17.60	N	GND	10.5
10.239000	---	35.08	50.00	14.92	N	GND	10.6
10.239000	37.50	---	60.00	22.50	N	GND	10.6
13.560000	25.21	---	60.00	34.79	L1	GND	10.6
13.560000	---	24.38	50.00	25.62	L1	GND	10.6
19.506750	---	29.14	50.00	20.86	N	GND	10.8
19.538250	41.88	---	60.00	18.12	N	GND	10.8
24.884250	---	26.59	50.00	23.41	N	GND	10.8
25.077750	35.82	---	60.00	24.18	N	GND	10.8
27.120750	---	34.62	50.00	15.38	N	GND	10.8
27.120750	35.80	---	60.00	24.20	N	GND	10.8

Remark: The measurement was carried out in FFT mode with a measuring time of 15 seconds.

Test result: Passed

Test equipment (please refer to chapter 7 for details)
18 - 24

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	Signal & Spectrum Analyzer	FSW43	Rohde & Schwarz	100586 & 100926	481720	19.11.2021	11.2022
2	Loop antenna	Loop antenna 11cm	PHOENIX TESTLAB GmbH	-	410084	Calibration not necessary	
3	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	22.02.2022	02.2024
4	Software	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
5	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
6	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
7	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
8	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
9	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	08.12.2021	12.2023
10	Loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	22.02.2022	02.2024
11	Outdoor test site	-	PHOENIX TESTLAB GmbH	-	480293	Calibration not necessary	
12	EMI Receiver / Spectrum Analyser	ESI 40	Rohde & Schwarz	100064/040	480355	18.02.2022	02.2023
13	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
14	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	482978	18.03.2021	03.2024
15	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
16	Low Noise Amplifier 100 MHz - 18 GHz	LNA-30-00101800-25-10P	Narda-Mited	2110917	482967	18.02.2022	02.2024
17	Log.-Per. antenna	HL050	Rohde & Schwarz	100908	482977	13.08.2019	08.2022
18	V-LISN	NSLK8128RC	Schwarzbeck	0412	483186	15.02.2022	02.2024
19	Shielded chamber M155	SK3	Albatross Projects	-	482786	Calibration not necessary	
20	Software	EMC32	Rohde & Schwarz	100619	483182	Calibration not necessary	
21	EMI Testreceiver	ESR7	Rohde & Schwarz	101939	482558	15.02.2022	02.2024
22	Software	Software	Spitzenberger & Spies	Siehe Textzusatz	480114	Calibration not necessary	
23	EMC test system	EMC D 30000 / PAS	Spitzenberger & Spies	A4507 00/1 1110	481301	Calibration not necessary	
24	Control unit	SyCore 1k4	Spitzenberger & Spies	A4507 12/0 1110	481302	21.09.2020	09.2022

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	25.09.2020	24.09.2022
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	03.03.2021	02.03.2023
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	25.02.2021	24.02.2023

9 Report History

Report Number	Date	Comment
F220394E1	21.06.2022	Initial Test Report
-	-	-

10 List of Annexes

Annex A	Test Setup Photos	5 pages
Annex B	EUT External Photos	10 pages
Annex C	EUT Internal Photos	18 pages