

# Test Report

Report Number:

**F212223E2**

Equipment under Test (EUT):

**CKS2-K-BR-S-F00-USA-167948**

Applicant:

**EUCHNER GmbH + Co. KG**

Manufacturer:

**EUCHNER GmbH + Co. KG**



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.

Tested and written  
by:

[Redacted signature area]

Signature

Reviewed and  
approved by:

[Redacted signature area]

Signature

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# 1 Identification

## 1.1 Applicant

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Applicant represented during the test by the following person:	-

## 1.2 Manufacturer

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Country:	Germany
Name for contact purposes:	Mr. Tobias LEHMANN
Phone:	+49 (0) 711-7597-145
eMail address:	tobias.lehmann@euchner.de
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) 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: *	Key adapter
Model name: *	CKS2-K-BR-S-F00-USA-167948
Model number: *	167948
Order number: *	167948
FCC ID: *	2AJ58-17
IC certification number: *	22052-17
PMN: *	CKS2-K-BR SERIES
HVIN: *	17
FVIN: *	N/A

	EUT number		
	1	2	3
Serial number: *	000004	-	-
PCB identifier: *	168857	-	-
Hardware version: *	V2.1.0.0	-	-
Software version: *	V0.0.0.9	-	-

\* 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: *	DC		
Supply voltage EUT: *	$U_{nom} = 24 \text{ V DC}$	$U_{min} = 9 \text{ V DC}$	$U_{max} = 30 \text{ V DC}$
Temperature range: *	-25 °C to +55 °C		
Lowest / highest internal frequency: *	125 kHz / 72 MHz		

\* Declared by the applicant

RFID part	
Operating frequency: *	125 kHz
Number of channels: *	1
Type of modulation: *	AM
Data rate: *	4 bits / ms, Manchester coded
Duty cycle: *	100 %
Antenna type: *	Ring
Antenna connector: *	None

\* Declared by the applicant

Equipment used for testing	
Monitoring for DIOs: * <sup>1</sup>	"CES-NA PRUEFRACK" with Siemens LOGO! 12/24RC
Extension cable: * <sup>1</sup>	C-M12M08-08X025PV05,0-M12F08-123432
TAG / coin: * <sup>1</sup>	S-K-0B-RD-V02-168962
AC adaptor: * <sup>2</sup>	PHOENIX CONTACT MINI-PS-100-240AC/24DC/1.3

\*<sup>1</sup> Provided by the applicant

\*<sup>2</sup> Provided by the laboratory

Ancillary equipment	
-	-

## 1.6 Dates

Date of receipt of test sample:	15.11.2021
Start of test:	18.11.2021
End of test:	25.11.2021

## 2 Operational States

### Description of function of the EUT:

The EUT is a 125 kHz RFID system used as an authorization system or lockout system running in normal operation mode.

RFID is used for highly coded keys with transponder technology. If there is a key in the key adapter, the data on the key is read and checked for validity. If the key is detected as valid, the safety outputs switch, and the installation can be started.

### The following states were defined as the operating conditions:

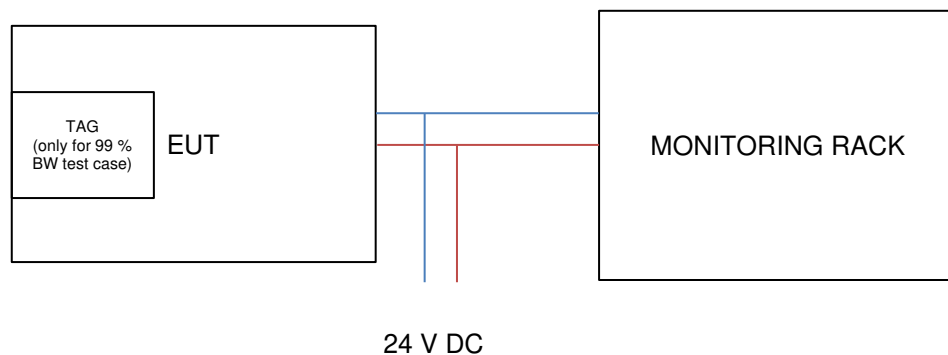
The EUT was supplied by 24 V DC during all tests.

All tests were performed with an unmodified test sample.

The EUT was continuously searching for a TAG, except for the 99 % BW test case. In this test case, a TAG was placed in front of the RFID reader, which was read continuously by the EUT.

The EUT was connected to the monitoring rack.

### The system was setup as follows:



## 3 Additional Information

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

## 4 Overview

Application	Frequency range in 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 – 1000 **	15.205 (a) 15.209 (a)	8.9 and 8.10 [4] 7.1 and 7.3 [3]	1	Passed
99 % bandwidth	0.125	-	6.7 [4]	1	Passed
Antenna requirement	-	15.203 [2]	6.8 [4]	-	Passed *

\*: Integrated antenna only, requirement fulfilled.

\*\* : As declared by the applicant the highest radio clock frequency is 0.125 MHz. Therefore the radiated emission measurement must be carried out up to 10<sup>th</sup> of the highest radio clock frequency, which was in this case exceeded to 1 GHz.



## 5 Results

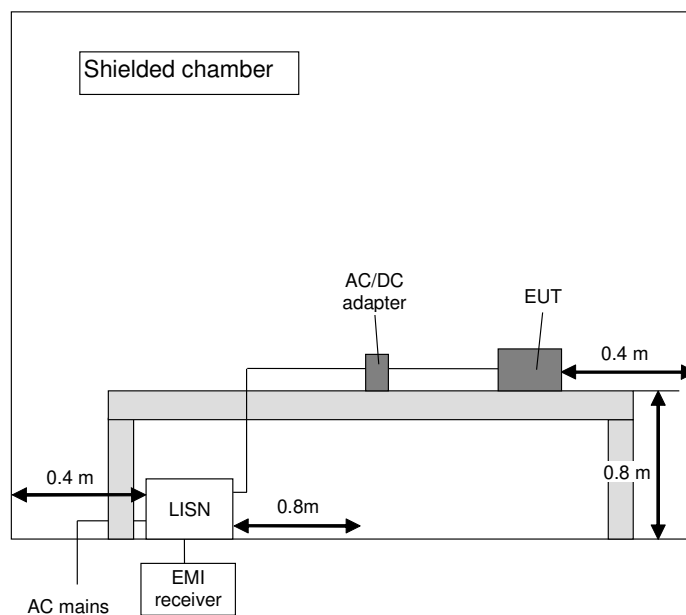
### 5.1 Conducted emissions on AC power supply lines

#### 5.1.1 Test method

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 to [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
150 kHz to 30 MHz	9 kHz

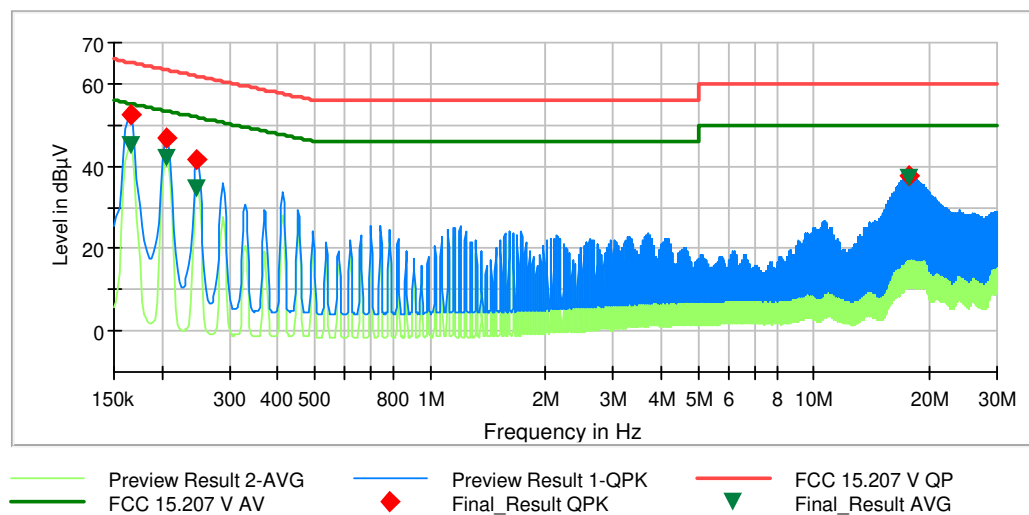


### 5.1.2 Test results

Ambient temperature:	23 °C
Relative humidity:	50 %

Date:	19.11.2021
Tested by:	R. BRAUN

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 in MHz	QuasiPeak in dB(µV)	Average in dB(µV)	Limit in dB(µV)	Margin in dB	Meas. Time in s	Bandwidth in kHz	Line	PE	Corr. in dB
0.16575	52.53	---	65.17	12.65	15.0	9.0	N	GND	9.8
0.16575	---	44.91	55.17	10.26	15.0	9.0	N	GND	9.8
0.20625	47.02	---	63.36	16.34	15.0	9.0	N	GND	9.8
0.20625	---	42.18	53.36	11.18	15.0	9.0	N	GND	9.8
0.24675	---	34.72	51.87	17.14	15.0	9.0	N	GND	9.8
0.24675	41.40	---	61.87	20.47	15.0	9.0	N	GND	9.8
17.61	37.78	---	60.00	22.22	15.0	9.0	N	GND	10.7
17.61	---	37.17	50.00	12.83	15.0	9.0	N	GND	10.7

Test result: Passed

Test equipment (please refer to chapter 6 for details)
1 - 4

## 5.2 Radiated emissions

### 5.2.1 Test method

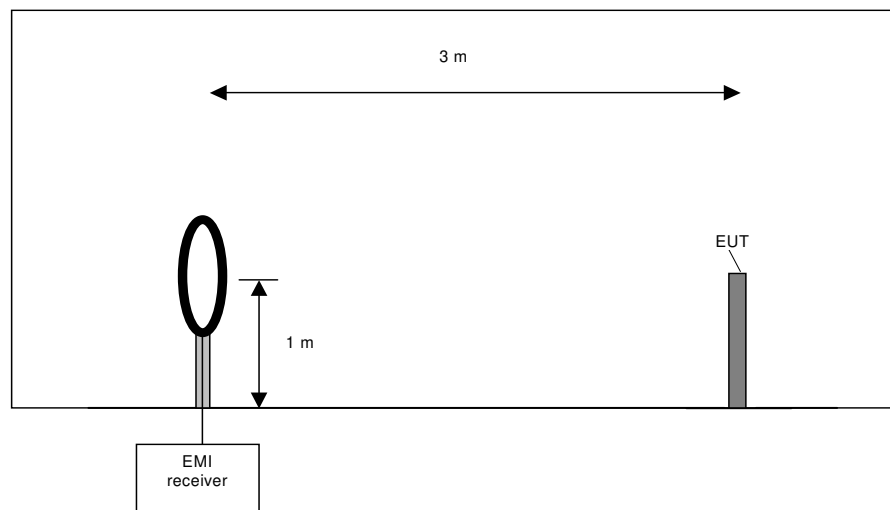
#### Preliminary measurement 9 kHz to 30 MHz

In the first stage a preliminary measurement is performed in an anechoic chamber with 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 to [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.

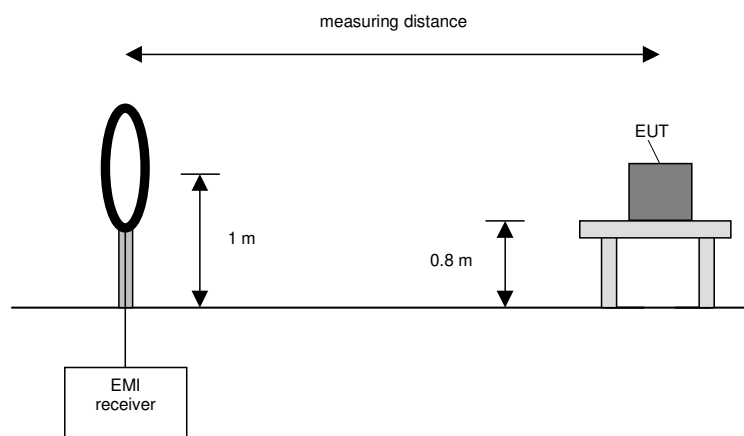
### Final measurement 9 kHz to 30 MHz

In the second stage a final measurement is performed on an open area test site with no conducting ground plane in a measuring distances of 3 m, 10 m or 30 m. In the case where larger measuring distances are required the results are extrapolated based on the values measured on the closer distances 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
9 kHz to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz



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.

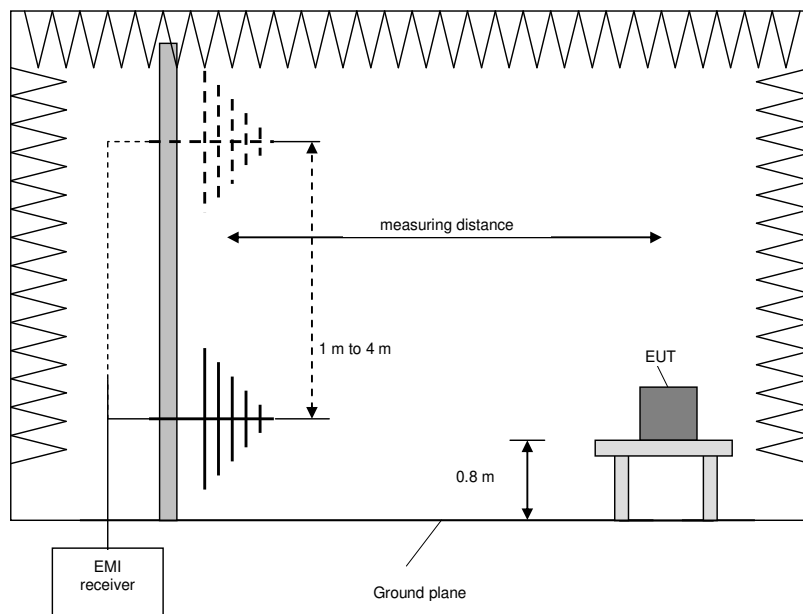
### Preliminary and final measurement 30 MHz to 1 GHz

The preliminary and final measurements are performed in a semi-anechoic chamber with a metal ground plane in a 3 m distance.

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	Resolution bandwidth
Preliminary measurement	30 MHz to 1 GHz	100 kHz
Frequency peak search	± 1 MHz	10 kHz
Final measurement	30 MHz to 1 GHz	120 kHz



Procedure preliminary measurement:

The following procedure is used:

- 1) Set the measuring antenna to 1 m height.
- 2) Monitor the frequency range at horizontal polarisation 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 polarisation 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:

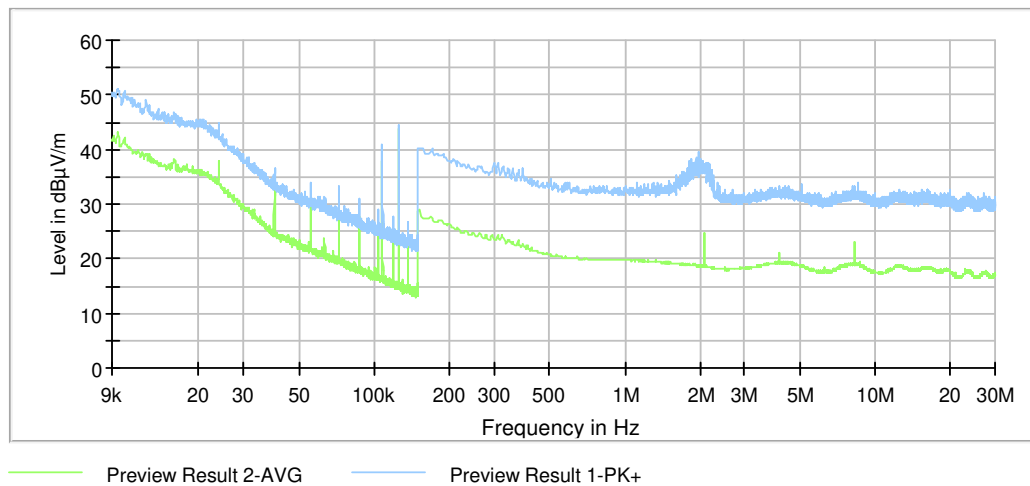
- 1) Select the highest frequency peaks (lowest margin to the limit) for the final measurement.
- 2) The software determines the exact peak frequencies by doing a partial scan with reduced RBW with  $\pm 10$  times the RBW of the pre-scan of the selected peaks.
- 3) If the EUT is portable or ceiling 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  $\pm 0.5$  m from the value obtained in the preliminary measurement while monitoring the emission level.
- 5) The worst-case turntable position is found via varying the turntable azimuth by  $\pm 30^\circ$  from the value obtained in the preliminary measurement while monitoring the emission level.
- 6) The final measurement is performed at the worst-case measuring antenna height and the worst-case turntable azimuth.
- 7) Steps 2 to 6 are repeated for each frequency peak selected in step 1.

### 5.2.2 Test results preliminary measurement 9 kHz to 30 MHz

Ambient temperature:	23 °C
Relative humidity:	55 %

Date:	19.11.2021
Tested by:	R. BRAUN

Full Spectrum



Only the fundamental of the transmitter (125 kHz) was found.

Remark: The emission at 107.7 kHz was caused by the measuring equipment and not by the EUT.

### 5.2.3 Test results final measurement 9 kHz to 30 MHz

Ambient temperature:	5 °C
Relative humidity:	84 %

Date:	24.11.2021
Tested by:	R. BRAUN

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 300 m measuring distance.

Results 9kHz - 30 MHz												
Frequency [MHz]	Reading @ meas. 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
0.125	22.0	-37.7	-89.2	25.7	-25.8	63.4	AV	20.3	3	300	80.0	1

\* Result @ norm dist. = Reading + Antenna factor - Distance correction factor;

Result [dBμA/m] = Result [dBμV/m] - 20\*log(377 Ω)

\*\* Margin = Limit [dBμ{V|A}/m] - Result @ norm dist.

\*\*\* 40dB/decade according Part §15.31 (f) (2)

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 6 for details)
5, 13, 14



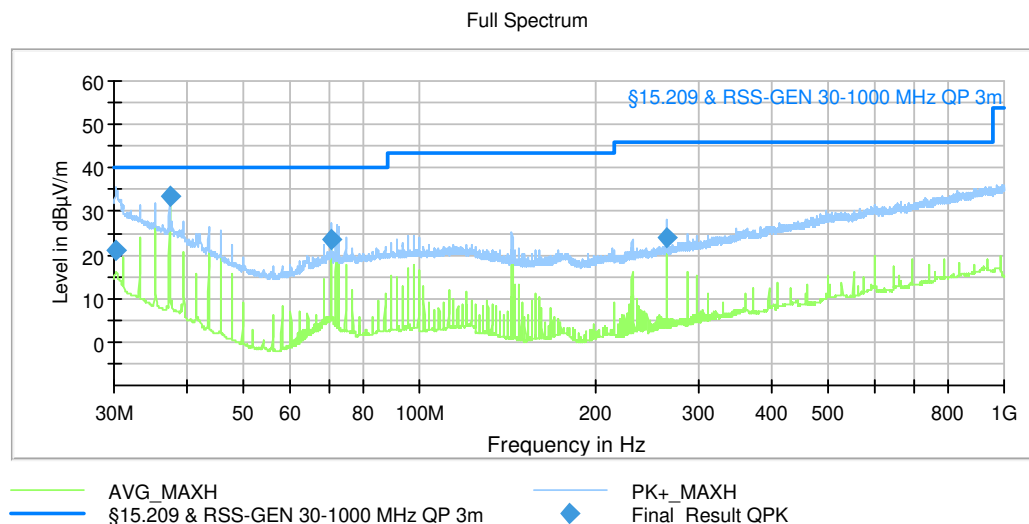
### 5.2.4 Test results final measurement 30 MHz to 1 GHz

Ambient temperature:	23 °C
Relative humidity:	55 %

Date:	18.11.2021
Tested by:	R. BRAUN

Because the EUT is a wall mounted device, as stated by the applicant, the device was measured in 2 different orthogonal axes, vertical and horizontal. Only the worst-case result is shown in the following, which is the vertical orientation.

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



The results of the standard subsequent measurement in a semi anechoic chamber 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 3 m measuring distance.

Frequency in MHz	QuasiPeak in dB(µV/m)	Limit in dB(µV/m)	Margin in dB	Meas. Time in ms	Bandwidth in kHz	Height in cm	Pol	Azimuth in deg	Corr. in dB
30.25	21.2	40.0	18.8	1000.0	120.0	107.0	H	239.0	25.8
37.38	33.3	40.0	6.7	1000.0	120.0	100.0	V	70.0	21.6
70.61	23.7	40.0	16.3	1000.0	120.0	116.0	V	203.0	14.9
264.0	23.8	46.0	22.2	1000.0	120.0	135.0	V	182.0	18.0

Test result: Passed

The correction factor was calculated as follows:

Corr. (dB) = cable attenuation (dB) + 6 dB attenuator (dB) + antenna factor (dB)

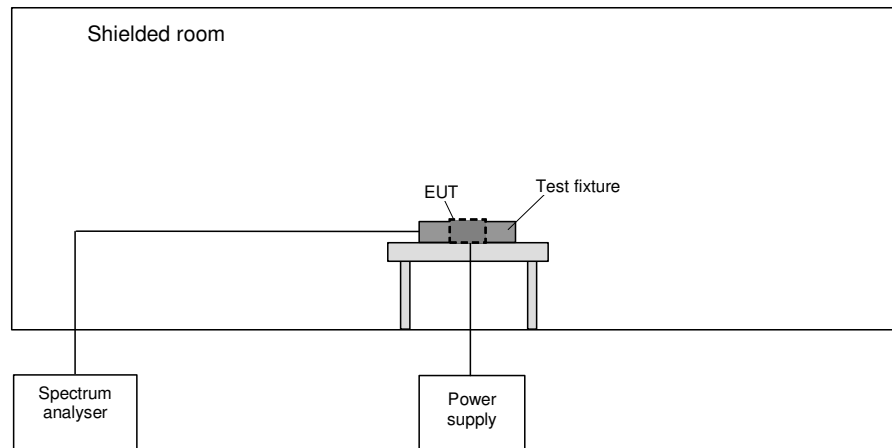
Therefore, the reading can be calculated as follows:

Reading (dBµV/m) = result QuasiPeak (dBµV/m) - Corr. (dB)

Test equipment (please refer to chapter 6 for details)
6 - 12, 15, 16

## 5.3 99 % bandwidth

### 5.3.1 Test method



The following procedure is used for the occupied bandwidth measurement according to [1]:

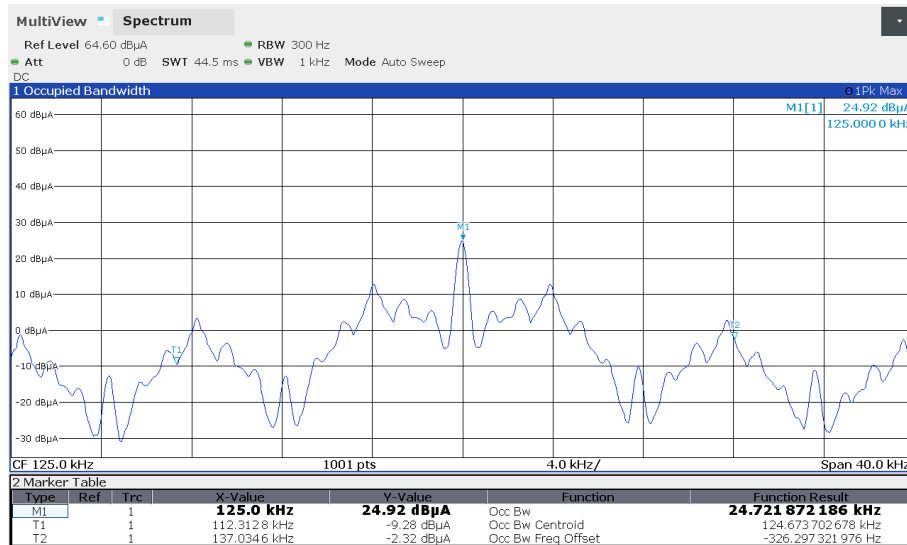
The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure is used for measuring the 99% power bandwidth:

- 1) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- 2) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- 3) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than  $[10 \log (\text{OBW}/\text{RBW})]$  below the reference level.
- 4) Step 1) through step 3) might require iteration to adjust within the specified range.

### 5.3.2 Test results

Ambient temperature:	22 °C
Relative humidity:	28 %

Date:	25.11.2021
Tested by:	R. BRAUN



FL	FU	BW (FU - FL)
112.313 kHz	137.035 kHz	24.722 kHz

Test result: Passed

Test equipment (please refer to chapter 6 for details)
17, 18

## 6 Measurement Uncertainties

Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) $U_{lab}$	$U_{max}$ , acc. to standard
Frequency error	ETSI TR 100 028	$4.5 \times 10^{-8}$	-
Bandwidth measurements	-	$9.0 \times 10^{-8}$	-
Radiated field strength M276 (FCC)			
R&S HL562E @ 3 m 30 MHz – 1 GHz	DIN EN 55016-4-2	4.8 dB	-
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	LISN	NSLK8128RC	Rohde & Schwarz	0412	483186	Calibration not necessary	
2	Shielded chamber M155	SK3	Albatross Projects	-	482786	Calibration not necessary	
3	Software	EMC32	Rohde & Schwarz	100619	483182	Calibration not necessary	
4	EMI receiver	ESR7	Rohde & Schwarz	101939	482558	18.02.2020	02.2022
5	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	14.02.2020	02.2022
6	Software	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
7	RF switch matrix	OSP220	Rohde & Schwarz		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 receiver	ESW44	Rohde & Schwarz	101819	483149	07.09.2020	09.2022
13	Outdoor test site	-	PHOENIX TESTLAB	-	480293	Calibration not necessary	
14	EMI receiver	ESI 40	Rohde & Schwarz	100064/040	480355	25.02.2021	02.2022
15	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
16	Ultra-log. antenna	HL562E	Rohde & Schwarz	101079	482978	18.03.2021	03.2024
17	Loop antenna	22.5 cm	PHOENIX TESTLAB	-	410085	Calibration not necessary	
18	Spectrum analyzer	FSW43	Rohde & Schwarz	100586 & 100926	481720	30.03.2021	03.2023

## 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

## 9 Report History

Report Number	Date	Comment
F212223E2	15.12.2021	Initial Test Report
-	-	-
-	-	-

## 10 List of Annexes

Annex A          Test Setup Photos

10 pages