

Test Report

Report Number:

F231976E1

Equipment under Test (EUT):

NEARFI 200 R

Applicant:

PHOENIX CONTACT Electronics GmbH

Manufacturer:

PHOENIX CONTACT GmbH & Co.KG



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] **RSS-210 Issue 11, June 2024**,
Licence-Exempt Radio Apparatus: 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 1.4 of ANSI C63.10 (2020). However, the measurement uncertainty is calculated and shown in this test report.

Tested and written
by:

Signature

Reviewed and
approved by:

Signature

This test report is only valid in its original form.

Any reproduction of its contents in extracts without written permission of the accredited test laboratory PHOENIX TESTLAB GmbH is prohibited.

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	5
1.1 Applicant.....	5
1.2 Manufacturer	5
1.3 Test Laboratory	5
1.4 EUT (Equipment under Test)	6
1.5 Technical Data of Equipment	7
1.6 Dates	7
2 Operational States	8
3 Additional Information	8
4 Overview.....	9
5 Results.....	10
5.1 Test setups	10
5.1.1 Radiated: Test fixture	10
5.1.2 Radiated: 9 kHz to 30 MHz.....	10
5.1.3 Radiated: 30 MHz to 1 GHz.....	13
5.2 99 % bandwidth	15
5.2.1 Test setup (99 % bandwidth).....	15
5.2.2 Test method (99 % bandwidth).....	15
5.2.3 Test results (99 % bandwidth)	15
5.3 Radiated emissions	16
5.3.1 Test setup (Maximum unwanted emissions)	16
5.3.2 Test method (Maximum unwanted emissions).....	16
5.3.3 Test results (Maximum unwanted emissions)	16
6 Measurement Uncertainties	21
7 Test Equipment used for Tests	22
8 Test site Verification.....	23
9 Report History.....	23
10 List of Annexes	23

1 Identification

1.1 Applicant

Name:	PHOENIX CONTACT Electronics GmbH
Address:	Dringenauer Straße 30, 31812 Bad Pyrmont
Country:	Germany
Name for contact purposes:	Mr. Maik STEMME
Phone:	+49 5281 946 3381
eMail address:	mstemme@phoenixcontact.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	PHOENIX CONTACT GmbH & Co.KG
Address:	Flachsmarktstr. 8, 32825 Blomberg
Country:	Germany
Name for contact purposes:	Mr. Maik STEMME
Phone:	+49 5281 946 3381
eMail address:	mstemme@phoenixcontact.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: *	Energy coupler (Remote)
Model name: *	NEARFI 200 R
Article number: *	1433046
FCC ID: *	YG3200R
IC: *	4720B-200R
PMN: *	NEARFI 200 R
HVIN: *	1433046
HMN: *	N/A
FVIN: *	N/A

	EUT number
	1
Serial number: *	2024000156
PCB identifier: *	30007851 (Interface PCB) 30007903 (LED/Balancer PCB: 30007725 (Power-PCB)
Hardware version: *	10
Software version: *	100

* Declared by the applicant

1 EUT (remote part) was used for the tests. The overview (chapter 4) shows which EUT was used for each test case.

Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical Data of Equipment

General:			
Power supply EUT 1: *	Revers feed DC (normally Inductive from base by WPT)		
Supply voltage EUT 1: *	$U_{nom} = 24 \text{ V}_{DC}$	$U_{min} = 19 \text{ V}_{DC}$	$U_{max} = 30 \text{ V}_{DC}$
Temperature range: *	-20 °C to +55 °C		
Distance between source and client: *	0 mm to 10 mm		
Max. output of the client: *	24 V _{DC} with 2 A _{DC} (with all distances between source and client)		
Lowest / highest internal frequency: *	110 kHz / 10 MHz		

* Declared by the applicant

Energy transfer part EUT (client) (part not active)	
Receiver frequency range: *	110 kHz – 148 kHz
Number of channels: *	-
Type of modulation: *	None, EUT is a receiver
Data rate: *	-
Duty cycle: *	100 %
Antenna type: *	Internal coil
Antenna connector: *	None

* Declared by the applicant

Energy communication part	
Carrier frequency: *	10 MHz
Receiver bandwidth: *	2.1 MHz
Frequency range: *	8.95 MHz to 11.05 MHz
Type of modulation: *	OOK

* Declared by the applicant

Ports/Connectors			
Identification	Connector		Length
	EUT	Ancillary	
Power	4 pole M12 connector	4 mm laboratory plug	3.0 m
Power through	4 pole M12 connector	Left open	Not used

*: Length during the test

1.6 Dates

Date of receipt of test sample:	11.11.2024
Start of test:	11.11.2024
End of test:	12.11.2024

2 Operational States

Description of function of the EUT:

The NearFi couplers transmit power. For contactless transmission at least two devices are needed: a base coupler and a remote coupler. The base coupler transfers the energy inductively to the remote coupler and its communication is at 10 MHz where the Remote coupler is the TX part.

The following states were defined as the operating conditions:

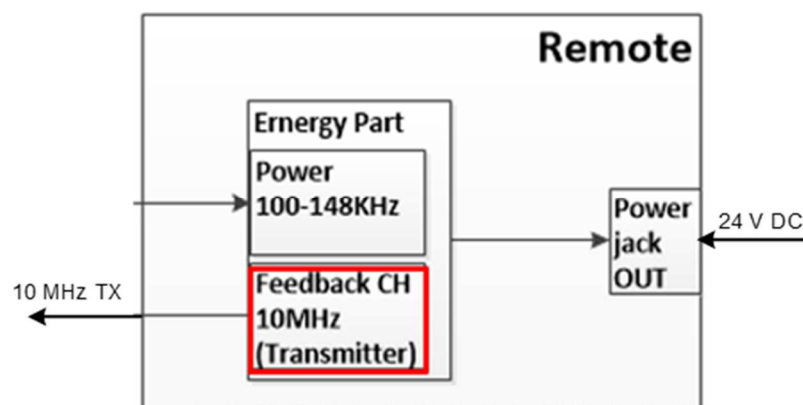
The EUT is the remote coupler on a stand-alone basis.

Since no energy is transferred inductively, the EUT was modified and supplied backwards at the internal point of the WPT part from a laboratory power supply.

The operating voltage of 24 V is applied to the power output of the EUT.

The EUT is transmitting at 10 MHz.

The system was setup as follows:



3 Additional Information

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

This test was performed for the 10 MHz transmitter part only.

WPT part is subject of separate test reports.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-Gen [4] and RSS-210 [3]	Status
Conducted emissions on supply line	0.15 – 30	15.207 (a)	8.8 [4]	N/A ***
Radiated emissions	0.009 – 1000 **	15.205 (a) 15.209 (a)	8.9 and 8.10 [4] 8.2 and 8.3 [3]	Passed
99 % bandwidth	10	-	6.7 [4]	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 0.01 GHz.
Therefore the radiated emission measurement must be carried out up to 10th of the highest radio clock frequency in this case 0.1 GHz.

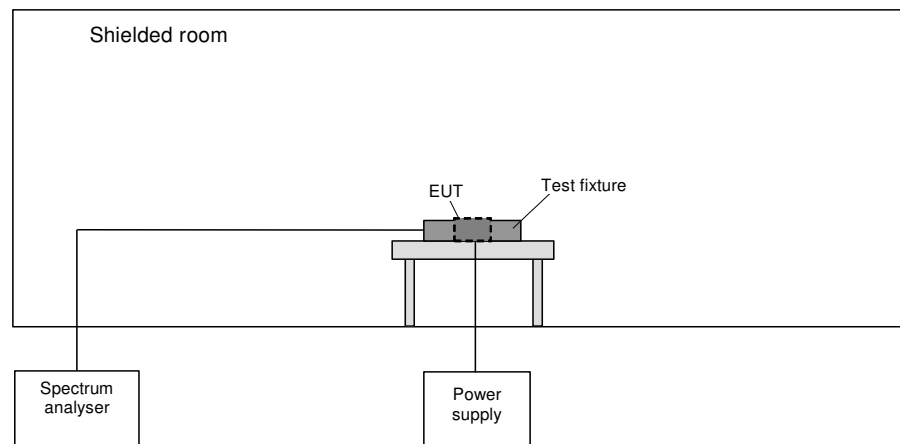
***: Not applicable, because the EUT will be supplied via WPT.

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

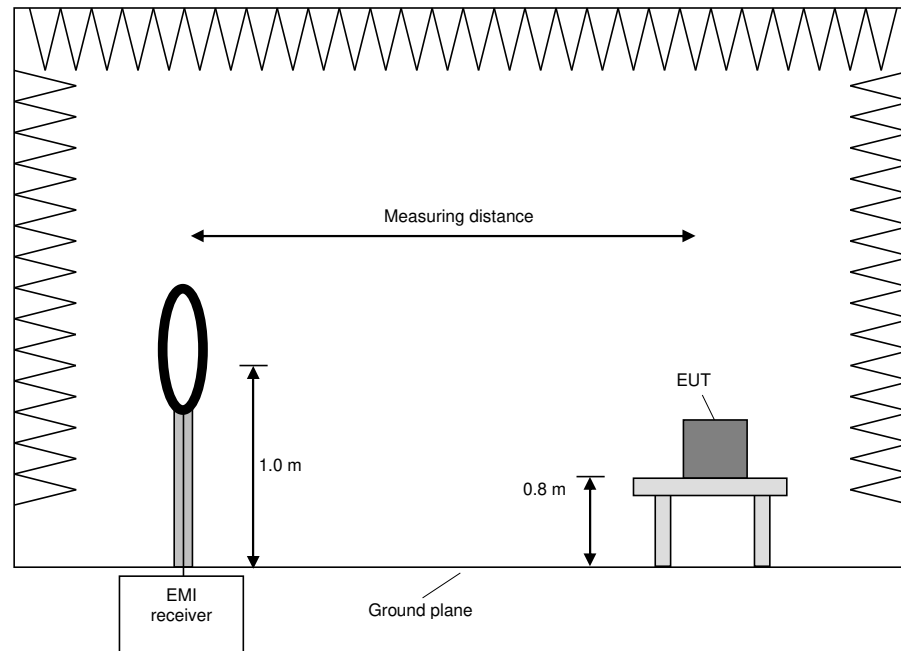
5.1.2.1 Preliminary measurement 9 kHz to 30 MHz

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



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.

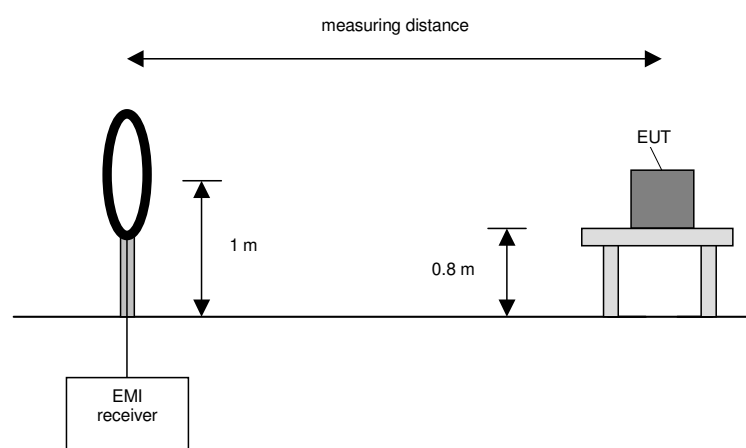
5.1.2.2 Final measurement 9 kHz to 30 MHz

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 to 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

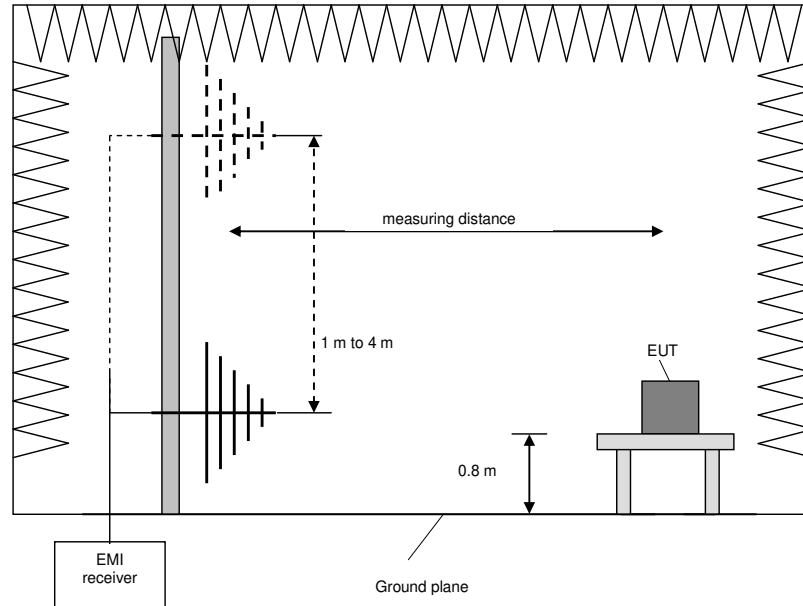
5.1.3.1 Preliminary and final measurement 30 MHz to 1 GHz

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)	-	-

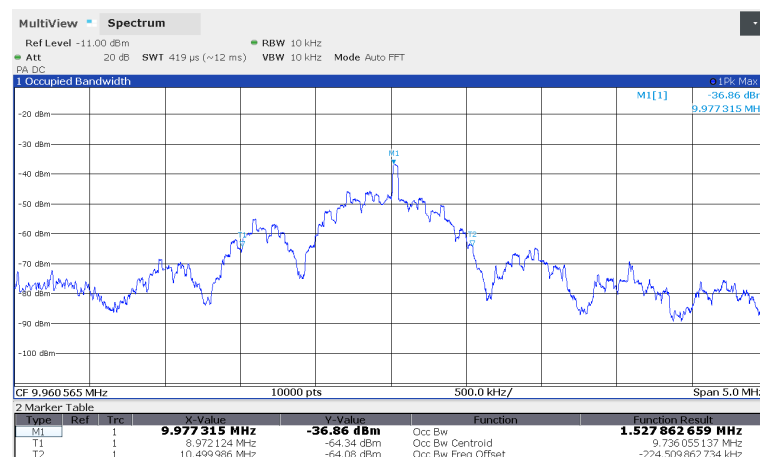
5.2.2 Test method (99 % bandwidth)

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:	43 %

Date:	11.11.2024
Tested by:	M. DINTER



F_L	F_U	$BW (F_U - F_L)$
8.972 MHz	10.500 MHz	1.528 MHz

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1 - 3

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	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	Date:	12.11.2024
Relative humidity:	29 %	Tested by:	M. DINTER

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:

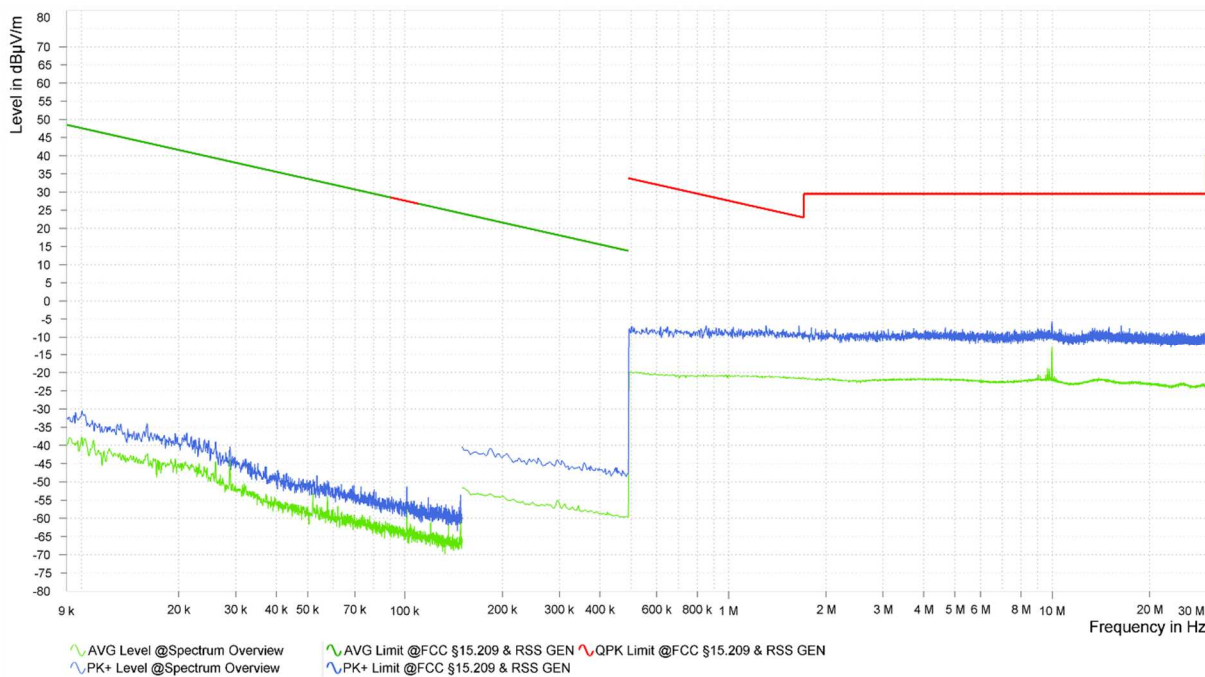
Result @ norm. dist. [dBμV/m] = Reading [dBμV] + AF [dB/m] + Distance corr. fact. [dBμV/m]

Result @ norm. dist. [dBμA/m] = Result @ norm. dist. [dBμV/m] – 20 x log₁₀ (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 (EUT standing):



During the preliminary measurement, the following emissions were found:
-9.980 MHz

On these frequencies a final measurement on an outdoor test site has to be carried out, the results of the final measurement are presented in the following.

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

Test equipment (please refer to chapter 7 for details)

2, 4 - 10

5.3.3.2 Test results final measurement 9 kHz to 30 MHz

Ambient temperature:	7 °C
Relative humidity:	76%

Date:	12.11.2024
Tested by:	M.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 m measuring distance.

Results 9 kHz - 30 MHz												
Frequency	Reading @ measuring distance	Result @ norm. distance	Result @ norm. distance	Limit acc. 15.209	Limit acc. RSS-Gen Table 6	Margin	Detector	Antenna factor	Measuring distance	Normative distance	Distance correction factor	Position
[MHz]	[dB(μV)]	[dB(μV/m)]	[dB(μA/m)]	[dB(μV/m)]	[dB(μA/m)]	[dB]		[dB/m]	[m]	[m]	[dB]	#
9.980	10.3	-9.9	-61.3	29.5	-21.9	39.4	QP	20.2	3	30	-40	1

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)
2, 11 - 13

5.3.3.3 Test results (30 MHz – 1 GHz)

Ambient temperature:	22 °C
Relative humidity:	29 %

Date:	12.11.2024
Tested by:	M. DINTER

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:

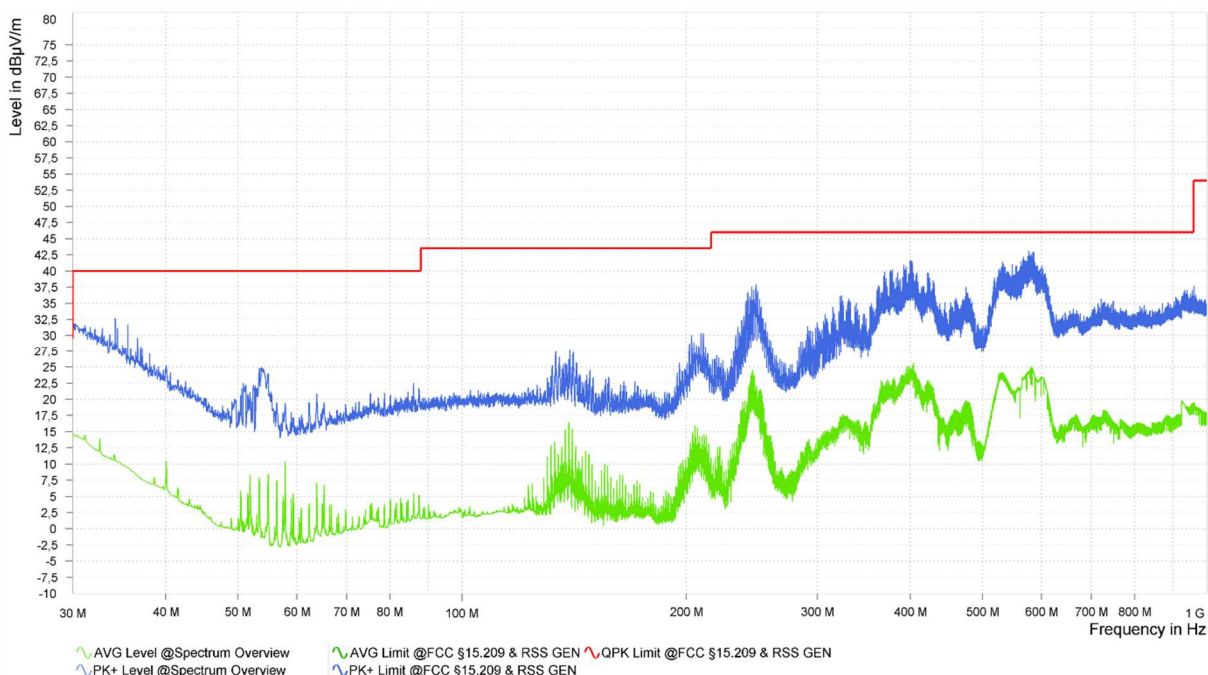
Result [dBμV/m] = Reading [dBμV] + Correction [dBμV/m]

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

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

Worst case plot:

Spurious emissions from 30 MHz to 1 GHz (EUT standing):



Result tables:

Frequency [MHz]	Result (QP) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Readings [dBμV]	Correction [dB/m]	Height [m]	Azimuth [deg]	Pol. (H/V)	Position #
34.140	17.50	40.00	22.50	-1.58	24.08	1.30	313	H	1
53.580	9.99	40.00	30.01	17.71	12.30	1.34	67	V	1
139.530	21.50	43.50	22.00	6.02	15.98	1.65	291	H	1
248.040	29.87	46.00	16.13	-0.9	17.03	1.03	251	H	1
399.270	33.64	46.00	12.36	-9.37	21.73	1.03	233	H	1
531.840	30.24	46.00	15.76	-8.87	24.63	1.08	-1	V	1
576.630	31.87	46.00	14.13	-11.25	25.38	1.33	207	H	1

Test result: Passed

Test equipment (please refer to chapter 7 for details)
5 - 10, 14 - 16

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	11 cm	PHOENIX TESTLAB GmbH	-	410084	Calibration not necessary	
2	Power Supply	TOE8852 (DC)	Toellner Electronic Inst.	51712	480233	Calibration not necessary	
3	Signal & spectrum analyzer	FSW43	Rohde & Schwarz	100586 & 100926	481720	07.05.2024	05.2026
4	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	21.02.2024	02.2026
5	EMC test software	Elektra V5.05.00	Rohde&Schwarz		483755	Calibration not necessary	
6	RF Switch Matrix	OSP220	Rohde & Schwarz	101391	482976	Calibration not necessary	
7	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
8	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
9	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
10	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	21.02.2024	02.2026
11	Loop antenna	HFH2-Z2	Rohde & Schwarz	100417	481912	21.02.2024	02.2026
12	Outdoor test site	-	PHOENIX TESTLAB GmbH	-	480293	Calibration not necessary	
13	EMI Receiver / Spectrum Analyser	ESI 40	Rohde & Schwarz	100064/040	480355	20.02.2024	02.2025
14	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
15	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	482978	24.04.2024	04.2027
16	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	

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	ANSI C63.4-2014 ANSI C63.4a-2017	01.03.2023	28.02.2026

9 Report History

Report Number	Date	Comment
F231976E1	20.11.2024	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A Test Setup Photos

7 pages

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