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Test Report

Report Number:

F240849E3

Equipment under Test (EUT):

Torque transducer stator T100

Applicant:

Hottinger Brüel & Kjaer GmbH

Manufacturer:

Hottinger Brüel & Kjaer GmbH



References

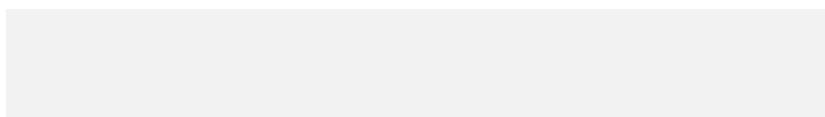
- [1] **ANSI C63.10: 2020 + Cor. 1-2023+C63.10a-2024 + Errata to C63.10a-2024*** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- [2] **FCC CFR 47 Part 15** Radio Frequency Devices
- [3] **RSS-216 Issue 3 (June 2024)**
Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- [4] **RSS-Gen, Issue 5 Amendment 2 (February 2021)**
General Requirements for Compliance of Radio Apparatus
- [5] **ANSI C63.30: 2021*** American National Standard for Methods of Measurements of Radio-Frequency Emissions from Wireless Power Transfer Equipment

*Remark: This standard is not yet in the annex of the laboratory

Test Result

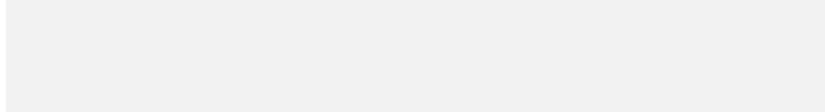
The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.

Tested and
written by:



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:	Hottinger Brüel & Kjaer GmbH
Address:	Im Tiefen See 45, 64293 Darmstadt
Country:	Germany
Name for contact purposes:	Mr. Sebastian MUTINELLI
Phone:	+49 (0)6151-803-0
eMail address:	info.de@hbkworld.com
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	Hottinger Brüel & Kjaer GmbH
Address:	Im Tiefen See 45, 64293 Darmstadt
Country:	Germany
Name for contact purposes:	Mr. Sebastian MUTINELLI
Phone:	+49 (0)6151-803-0
eMail address:	info.de@hbkworld.com
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) 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: *	Torque transducer stator
Model name: *	T100
Model number: *	N/A
Order number: *	K-T100-STL-FAN-0-U
FCC ID: *	2ADAT-DRQZ02B
IC: *	12438A-DRQZ02B
PMN: *	T100 Series
HVIN: *	T100-A01
HMN: *	N/A
FVIN: *	1.0

	EUT number T100		
	1	2	3
Serial number: *	281230132	-	-
PCB identifier: *	Mainboard: Rev. 02 Receiver: Rev. 02 Processor: Rev. 01 Power modul: Rev. 02	-	-

* Declared by the applicant

One EUT T100 was used for all tests together with rotor unit T110.

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: *	$U_{\text{nom}} = 24 \text{ V}_{\text{DC}}$	$U_{\text{min}} = 12 \text{ V}_{\text{DC}}$	$U_{\text{max}} = 30 \text{ V}_{\text{DC}}$
Temperature range: *	-20°C to $+85^{\circ}\text{C}$		
Lowest / highest internal frequency: *	120 kHz, 200 MHz		

* Declared by the applicant

Communication part T100 RX and T110 TX	
Operating frequency: *	15.36 MHz
Number of channels: *	1
Type of modulation: *	AM
Data rate: *	15.36 MBit
Duty cycle: *	50%
Antenna type: *	Coil
Antenna connector: *	Solder pad

* Declared by the applicant

WPT part T100 TX and T110 RX	
Operating frequency: *	120 kHz
Type of modulation: *	FSK
WPT Type	3
Antenna type: *	Coil
Antenna connector: *	Solder pad

Equipment used for testing	
Data cable termination box: * ¹	HBK test device
Laptop PC: * ¹	Dell Precision M4800
Torque transducer rotor	<p>Model name: * T110 Model number: * N/A Order number: * K-T110-500Q-S-0-0 FCC ID: * 2ADAT-DRQX02B IC: * 12438A-DRQX02B PMN: * T110 Series HVIN: * T110-01 HMN: * N/A FVIN: * 1.0 Serial number: * 264530007 PCB identifier: * Rev. 02</p>

*¹ Provided by the applicant

* Declared by the applicant

1.6 Dates

Date of receipt of test sample:	18.09.2024
Start of test:	23.09.2024
End of test:	27.11.2024

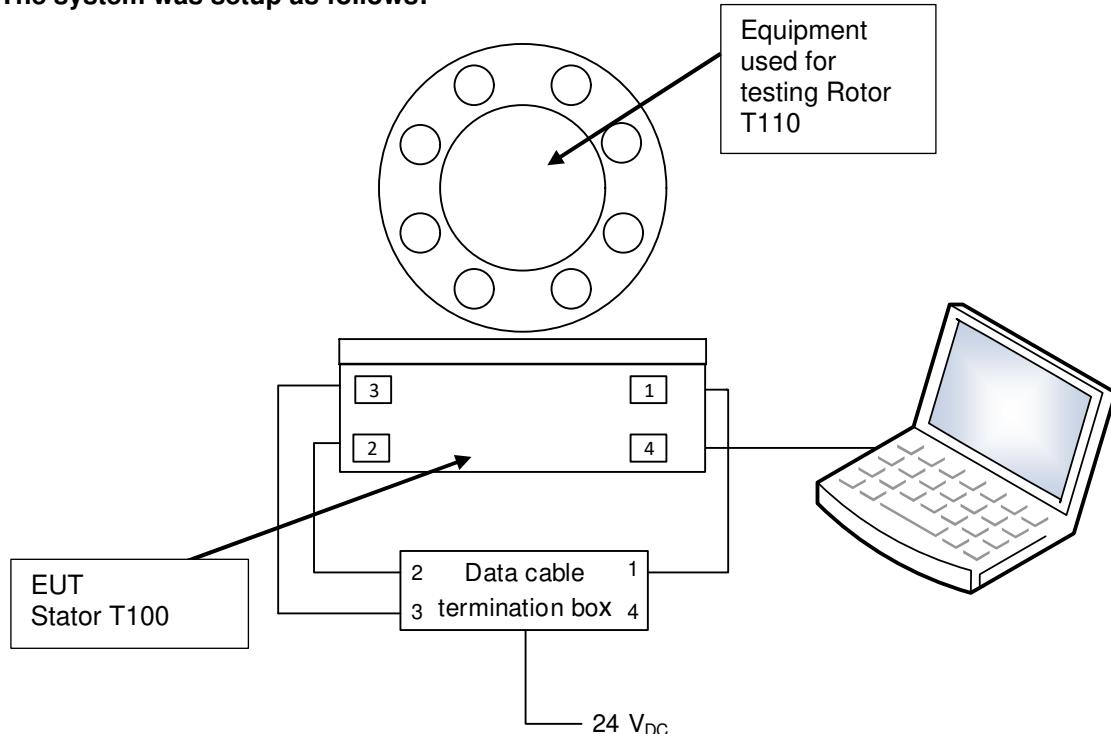
2 Operational States

Description of function of the EUT:

The EUT is the stator of a digital torque measurement system working with 15.36 MHz radio communication and 120 kHz wireless power transfer.

During all tests the EUT was powered with 24 V DC external power supply and internal via 120 kHz WPT.
 The stator transmits WPT at 120 kHz and receives at 15.36 MHz.
 The rotor receives WPT at 120 kHz and transmits at 15.36 MHz.

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]]	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]	1	Passed
99 % bandwidth	0.12	-	6.7 [4]	1	Passed
Antenna requirement	-	15.203 [2]	6.8 [4]	1	Passed *

*: Integrated antenna only, requirement fulfilled.

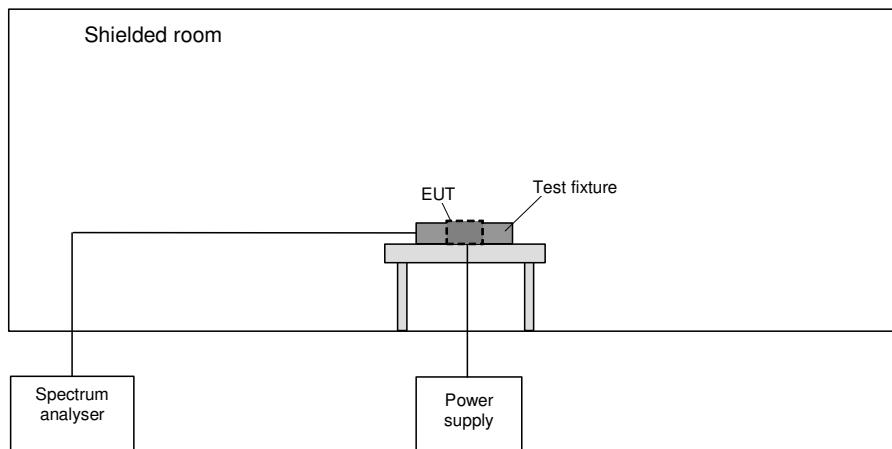
**: As declared by the applicant the highest operating frequency is 15.36 MHz.
Therefore the radiated emission measurement must be carried out up to 10th harmonic of the highest operating frequency, in this case 1 GHz.

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

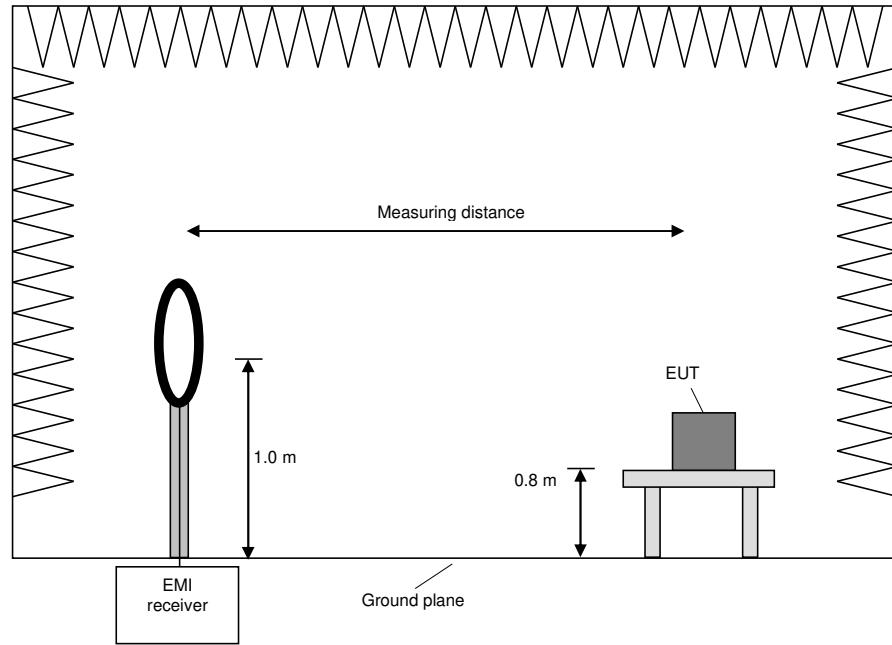
5.1.2.1 Preliminary measurement 9 kHz to 30 MHz

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.

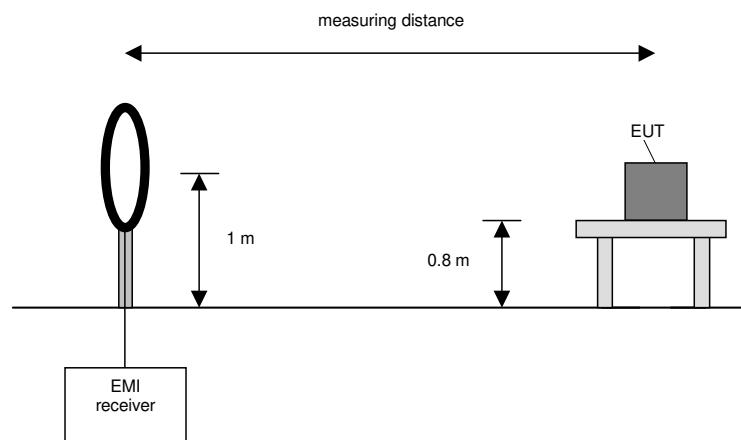
5.1.2.2 Final measurement 9 kHz to 30 MHz

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 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

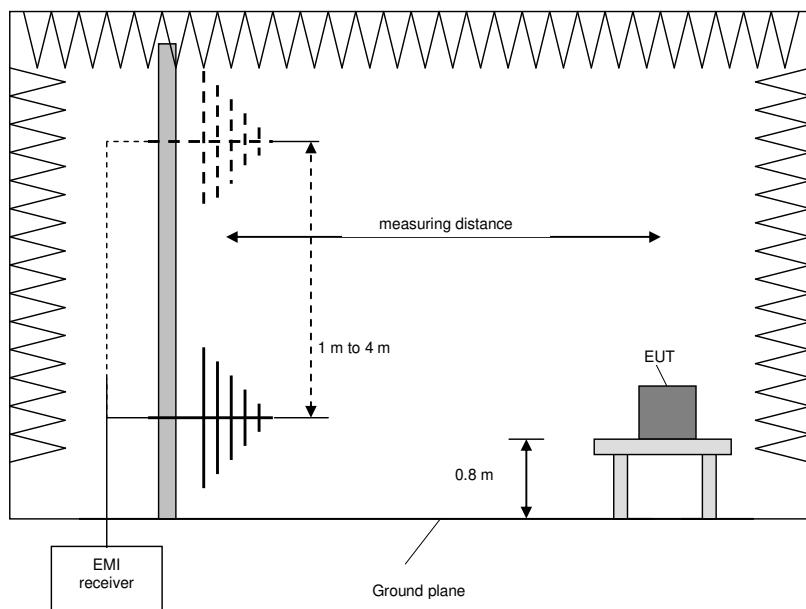
5.1.3.1 Preliminary and final measurement 30 MHz to 1 GHz

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

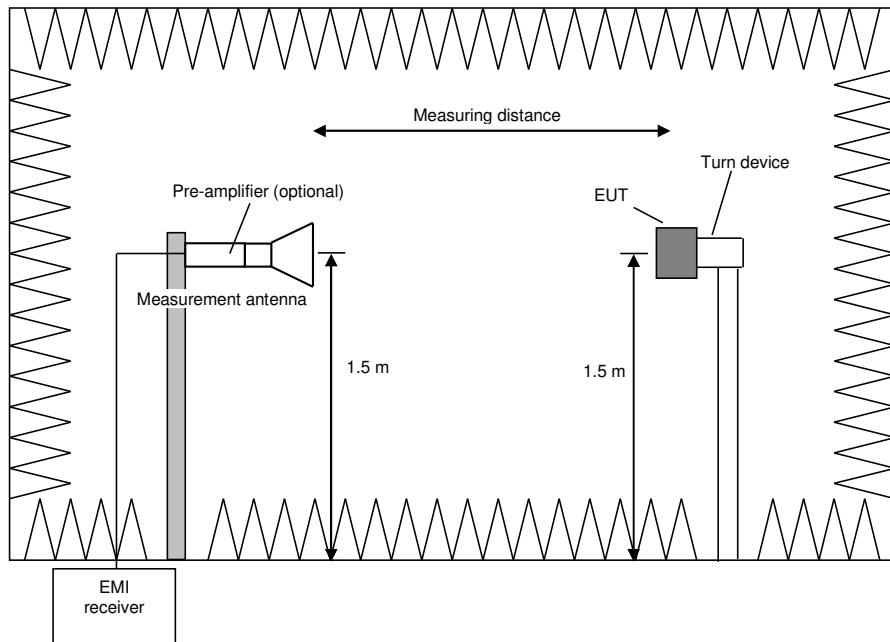
5.1.4.1 Preliminary and final measurement 1 to 40 GHz

The preliminary and final measurements are performed in a fully anechoic chamber at a measuring distance of 3 meters. Table-top devices are set up on a non-conducting turn device at the height of 1.5 m. The setup of the equipment under test is in accordance with [1].

During the tests the EUT is rotated in the range of 0 ° to 360 ° and the measuring antenna is set to horizontal and vertical polarization to find the maximum level of emissions. After these steps, the measurement is repeated after reorientating the EUT in 30 ° steps.

The resolution bandwidth of the EMI receiver is set to the following values:

Test	Frequency range	Step-size	Resolution bandwidth	Measuring time	Detector
Preliminary measurement	1 - 40 GHz	250 kHz	1 MHz	-	Peak Average
Final measurement	1 - 40 GHz	-	1 MHz	100 ms	Peak Average



Procedure preliminary measurement:

The following procedure is used:

- 1) Monitor the frequency range at horizontal polarisation of the measuring antenna and an EUT / turntable azimuth of 0°.
- 2) Rotate the EUT by 360° to maximize the detected signals.
- 3) Repeat steps 1 to 2 with the vertical polarisation of the measuring antenna.
- 4) Repeat steps 1 to 3 with the EUT reorientated by an angle of 30° (60°, 90°, 120° and 150°), according to 6.6.5.4 in [1].
- 5) The highest values for each frequency are saved by the software, including the measuring antenna polarization, the turntable azimuth and the turn device elevation for that value.

Procedure final measurement:

The following procedure is used:

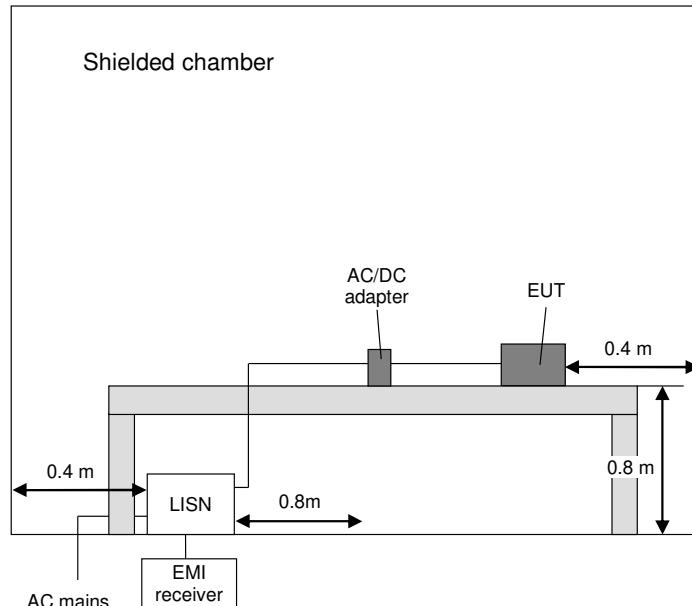
- 1) Set the turntable and the turn device to the position which leads to the highest emission for the first frequency identified in the preliminary measurements.
- 2) Set the measurement antenna to the polarisation which leads to the highest emission for the first frequency identified in the preliminary measurements.
- 3) Set the spectrum analyser to EMI mode with Peak and Average detector activated.
- 4) The worst-case turntable position is found via varying the turntable azimuth by +/- 30° from the value obtained in the preliminary measurement while monitoring the emission level.
- 5) The final measurement is performed at the worst-case turntable azimuth.
- 6) Repeat steps 1 to 5 for each frequency detected during the preliminary measurements.

5.1.5 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].

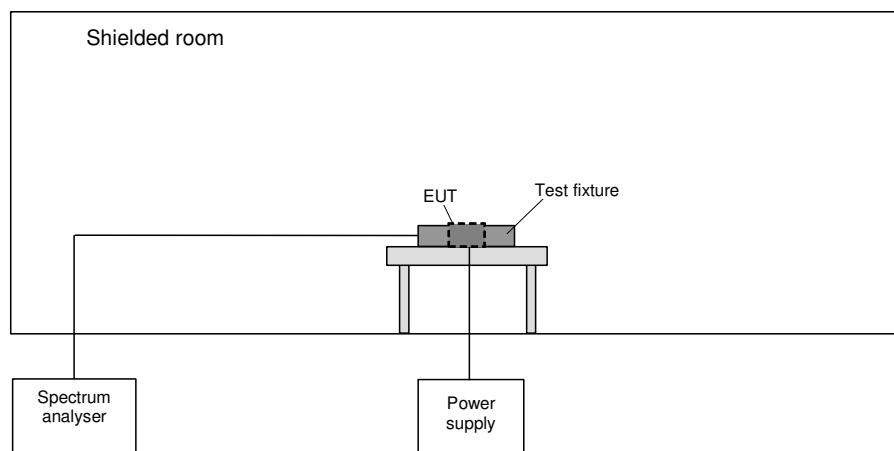
The frequency range 150 kHz to 30 MHz is measured with an EMI receiver set to MAX hold mode with Peak and Average detectors and a resolution bandwidth of 9 kHz. A scan is carried out on the phase and neutral line of the AC mains network. If emissions less than 10 dB below the appropriate limit are detected,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



5.1.6 Method 99% bandwidth

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.



The following procedure will be 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 shall be used for measuring 99% power bandwidth:

- a) 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.
- b) 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.
- c) 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. Specific guidance is given in 4.1.5.2.
- d) Step a) through step c) might require iteration to adjust within the specified range.

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)	-	-

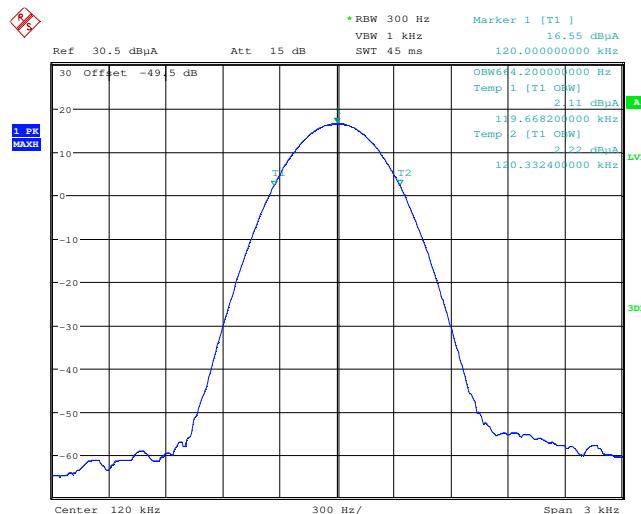
5.2.2 Test method (99 % bandwidth)

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	-	-

5.2.3 Test results (99 % bandwidth)

Ambient temperature:	22 °C	Date:	27.11.2024
Relative humidity:	37 %	Tested by:	M. DINTER

WPT part TX 120 kHz



F_L	F_U	$BW (F_U - F_L)$
119.6682 kHz	120.3324 kHz	664.200 Hz

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1 - 4

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	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:	23 °C
Relative humidity:	47 %

Date:	24.09.2024
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.

Remark: All 3 orthogonal planes were tested separately for all three EUT positions, the plot below shows the maximum values of all measurements.

Calculations:

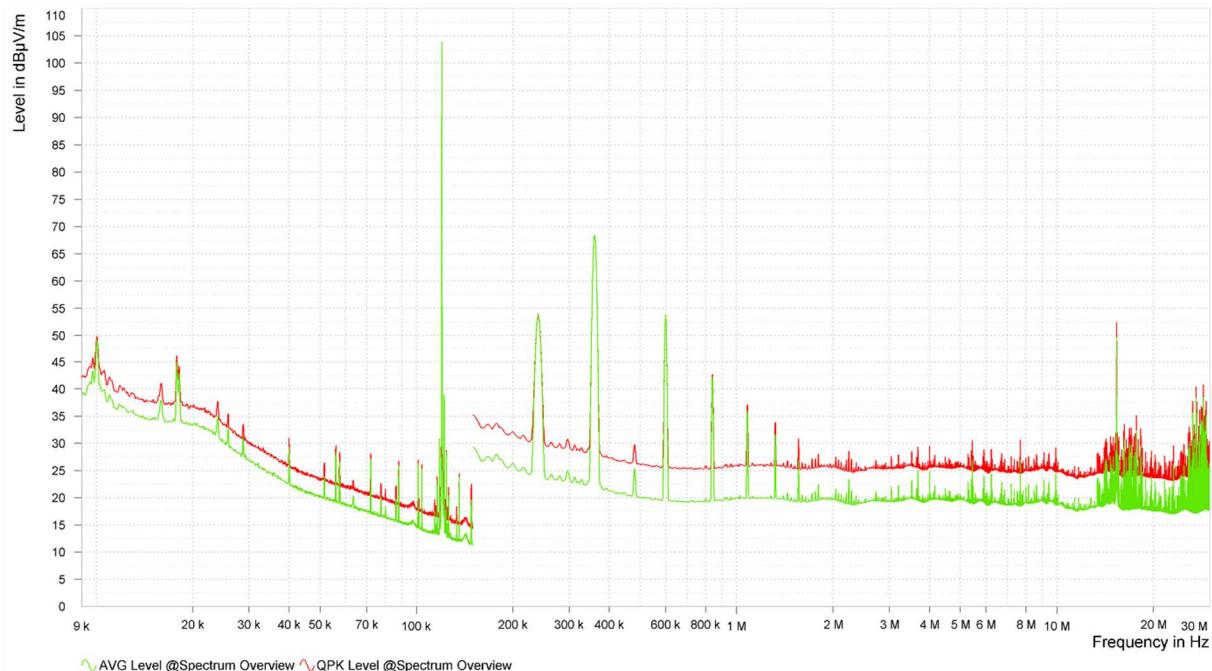
Result @ norm. dist. [dB μ V/m] = Reading [dB μ V] + AF [dB/m] + Distance corr. fact. [dB μ V/m]

Result @ norm. dist. [dB μ A/m] = Result @ norm. dist. [dB μ V/m] – 20 x \log_{10} (377 Ω)

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

Worst case plot:

Spurious emissions from 9 kHz to 30 MHz:



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

0.120 MHz, 0.240 MHz, 0.359 MHz, 0.600 MHz, 0.841 MHz, 15.353 MHz, 27.159 MHz and 28.563 MHz.

These frequencies have to be measured within a final measurement.

5.3.3.2 Test results final measurement 9 kHz to 30 MHz

Ambient temperature:	23 °C	Date:	24.09.2024
Relative humidity:	47 %	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 | 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	Limit acc. RSS-Gen Table 6 [dB(µA/m)]	Margin	Detector	Antenna factor [dB/m]	Measuring distance [m]	Normative distance [m]	Distance correction factor [dB]	Position #
0.120	83.3	23.6	-28.0	26.0	-25.5	2.5	AV	20.3	3	300	80.0	1
0.240	34.1	-25.4	-76.9	20.0	-31.5	45.4	AV	20.5	3	300	80.0	1
0.359	47.7	-11.9	-63.4	16.5	-35.0	28.4	AV	20.4	3	300	80.0	1
0.600	33.1	13.4	-38.1	32.0	-19.5	18.6	QP	20.3	3	30	40.0	1
0.841	21.6	1.9	-49.7	29.1	-22.4	27.2	QP	20.3	3	30	40.0	1
15.353	27.3	7.6	-43.9	29.5	-22.0	21.9	QP	20.3	3	30	40.0	1
27.159	12.6	-7.1	-8.6	29.5	-22.0	36.7	QP	20.3	3	30	40.0	1
28.563	14.5	-5.3	-56.9	29.5	-22.0	34.9	QP	20.2	3	30	40.0	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 377Ω .

For example, the measurement frequency X kHz resulted in the level of Y [dB μ V/m], which is equivalent to Y - 51.5 = Z [dB μ A/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)
5 - 11

5.3.3.3 Test results (30 MHz – 1 GHz)

Ambient temperature:	23 °C
Relative humidity:	47 %

Date:	24.09.2024
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. Only worst-case results are presented below.

Calculations:

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

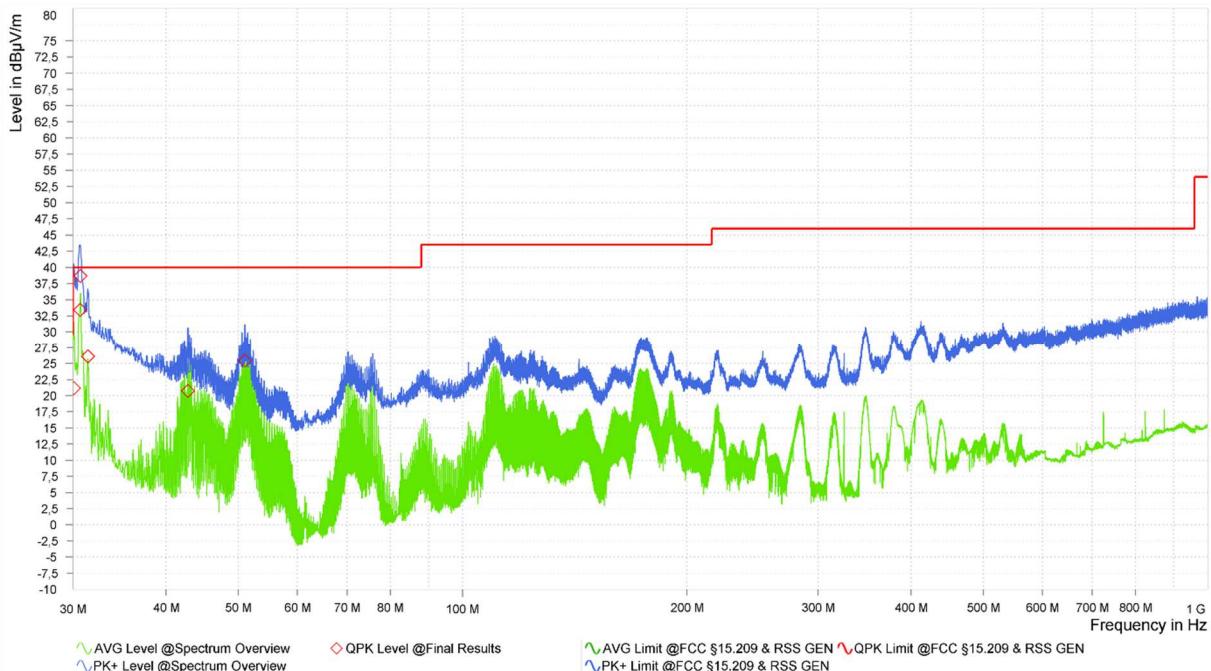
Correction [dB μ V/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]

Margin [dB] = Limit [dB μ V/m] - Result [dB μ V/m]

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

Worst case plot:

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



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)	Position #
30.100	21.2	40.0	18.8	-5.4	26.6	302	143	V	1
30.570	36.3	40.0	3.7	10.0	26.3	350	336	V	2
30.680	33.4	40.0	6.6	7.1	26.3	375	5	V	1
30.700	38.7	40.0	1.3	12.5	26.2	375	37	V	1
31.420	26.1	40.0	13.9	0.3	25.8	389	337	V	1
42.790	20.7	40.0	19.3	2.3	18.4	299	306	V	1
49.260	30.6	40.0	9.4	16.4	14.2	100	336	V	2
51.040	25.4	40.0	14.6	12.2	13.2	116	91	V	1

Test result: Passed

Test equipment (please refer to chapter 7 for details)

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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)

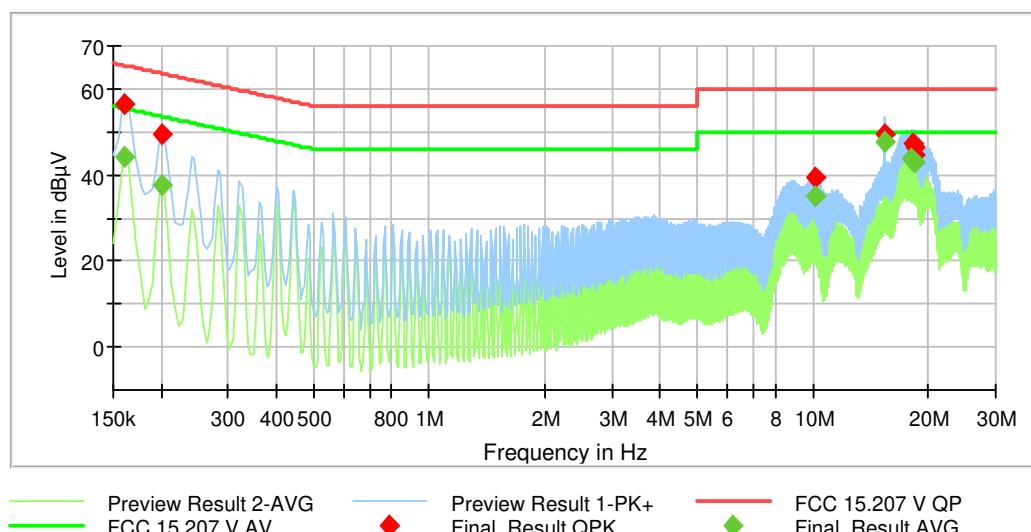
Test setup (Conducted emissions on power supply lines)				
Used	Clause [1]	Name of method	Sub-clause	Comment
<input checked="" type="checkbox"/>	6.2	Tabletop equipment testing	5.1.5	The EUT is DC supplied, therefore, an AC / DC adapter has to be used
<input type="checkbox"/>	6.2	Floor-standing equipment testing	-	-

During the measurement the EUT was supplied with 24.0 V DC by an AC / power adapter MINI-PS-100-240AC/24DC/1.3. The adapter itself was supplied by an AC mains network with 120V_{AC} 60Hz.

5.4.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	22 °C	Date:	25.11.2024
Relative humidity:	36 %	Tested by:	M. 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]
0.160800	---	44.20	55.42	11.23	N	GND	9.8
0.160800	56.38	---	65.42	9.04	N	GND	9.8
0.201300	---	37.75	53.56	15.81	N	GND	9.8
0.201300	49.59	---	63.56	13.97	N	GND	9.8
10.112100	---	34.96	50.00	15.04	L1	GND	10.6
10.153500	39.46	---	60.00	20.54	L1	GND	10.6
15.352800	49.63	---	60.00	10.37	N	GND	10.8
15.360000	---	47.80	50.00	2.20	N	GND	10.8
17.965500	---	43.60	50.00	6.40	N	GND	10.9
18.211200	47.24	---	60.00	12.76	N	GND	10.9
18.327300	---	43.38	50.00	6.62	N	GND	10.9
18.372300	46.43	---	60.00	13.57	N	GND	10.9
18.568500	---	42.85	50.00	7.15	N	GND	10.9
18.568500	44.86	---	60.00	15.14	N	GND	10.9

Test result: Passed

Test equipment (please refer to chapter 7 for details)
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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	Power Supply	TOE8852 (DC)	Toellner Electronic Inst.	51712	480233	Calibration not necessary	
3	Multimeter	971A	Hewlett Packard	JP40010640	480724	02.04.2024	04.2026
4	Spectrum Analyser	FSU46	Rohde & Schwarz	200125	480956	20.02.2024	02.2025
5	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	21.02.2024	02.2026
6	EMC test software	Elektra V5.05.00	Rohde&Schwarz		483755	Calibration not necessary	
7	RF Switch Matrix	OSP220	Rohde & Schwarz	101391	482976	Calibration not necessary	
8	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
9	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
10	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
11	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	21.02.2024	02.2026
12	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
13	Ultralog Antenna	HL562E	Rohde & Schwarz	101079	482978	24.04.2024	04.2027
14	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
15	Log.-Per. antenna	HL050	Rohde & Schwarz	100908	482977	22.09.2022	09.2025
16	Low Noise Amplifier 100 MHz - 18 GHz	LNA-30-00101800-25-10P	Narda-Miteq	2110917	482967	20.02.2024	02.2026
17	AC power supply	AC6803A AC Quelle 2000VA	Keysight	JPVJ002509	482350	Calibration not necessary	
18	Software	EMC32	Rohde & Schwarz	100061	481022	Calibration not necessary	
19	Shielded chamber M4	B83117-S1-X158	Siemens	190075	480088	Calibration not necessary	
20	EMI Receiver / Spectrum Analyser	ESIB 26	Rohde & Schwarz	100292	481182	22.02.2024	02.2026
21	Transient Filter Limiter	CFL 9206A	Teseq GmbH	38268	481982	28.03.2024	03.2026
22	LISN	NSLK8128	Schwarzbeck	8128155	480058	28.02.2024	02.2026

8 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Shielded chamber M4	480088	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	08.11.2022	07.11.2025
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
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	28.02.2023	27.02.2026

9 Report History

Report Number	Date	Comment
F240849E3	22.09.2025	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A

Test Setup Photos

3 pages

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