

Test Report

Report Number:

F250176E1

Equipment under Test (EUT):

Torque transducer 2ADAT-TCAS13

Applicant:

Hottinger Brüel & Kjaer GmbH

Manufacturer:

Hottinger Brüel & Kjaer GmbH



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 (All Frequency Bands): Category I Equipment
- [4] **RSS-Gen, Issue 5 Amendment 2 (2021-02)** General Requirements for Compliance of Radio Apparatus

Test Result

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

“Passed” indicates that the equipment under test conforms with the relevant limits of the testing standard without taking any measurement uncertainty into account as stated in clause 1.4 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

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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

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Applicant represented during the test by the following person:	Mr. Alexander EHRHARD (some parts of the tests)

1.2 Manufacturer

Name:	Hottinger Brüel & Kjaer GmbH
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Country:	Germany
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Phone:	+49 6151 803 8346
eMail address:	alexander.ehrhard@hbkworld.com
Manufacturer represented during the test by the following person:	Mr. Alexander EHRHARD (some parts of the tests)

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
Model name: *	TCAS13
Model number: *	MPZ2202012B
Order number: *	N/A
FCC ID: *	2ADAT-TCAS13
IC certification number: *	12438A-TCAS13
PMN: *	TCAS13
HVIN: *	TCAS13
FVIN: *	N/A

* Declared by the applicant

	EUT number 2ADAT-TCAS13 Torque transducer rotor
	1
Serial number: *	Torque transducer:281340012 Control unit: 46123 Stator unit: 41273 Rotor amplifier:46455
PCB identifier: *	-
Hardware version: *	-
Software version: *	-

* Declared by the applicant

One EUT 2ADAT-TCAS13 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: *	-10°C - +70°C		
Lowest / highest internal frequency: *	17.5 kHz / 10.7 MHz (< 108 MHz)		

* Declared by the applicant

Communication part	
Operating frequency: *	10.7 MHz
Number of channels: *	1
Type of modulation: *	FM
Data rate: *	Not available
Duty cycle: *	Not available
Antenna type: *	Loop antenna (540 mm diameter)
Antenna connector: *	Fixed

* Declared by the applicant

WPT part	
Operating frequency: *	17.5 kHz
Antenna type: *	Loop antenna (560 mm diameter)
Antenna connector: *	Screw 5 mm

* Declared by the applicant

Equipment used for testing	
Telemetry system: * ¹	Axon Systems Control Unit J1 Ser.No.:46123
AC Adapter: * ¹	Phoenix Contact TRIO-PS/1AC/24DC/5 Order.No: 2866310

*¹ Provided by the applicant

1.6 Dates

Date of receipt of test sample:	05.02.2025
Start of test:	06.02.2025
End of test:	14.02.2025

2 Operational States

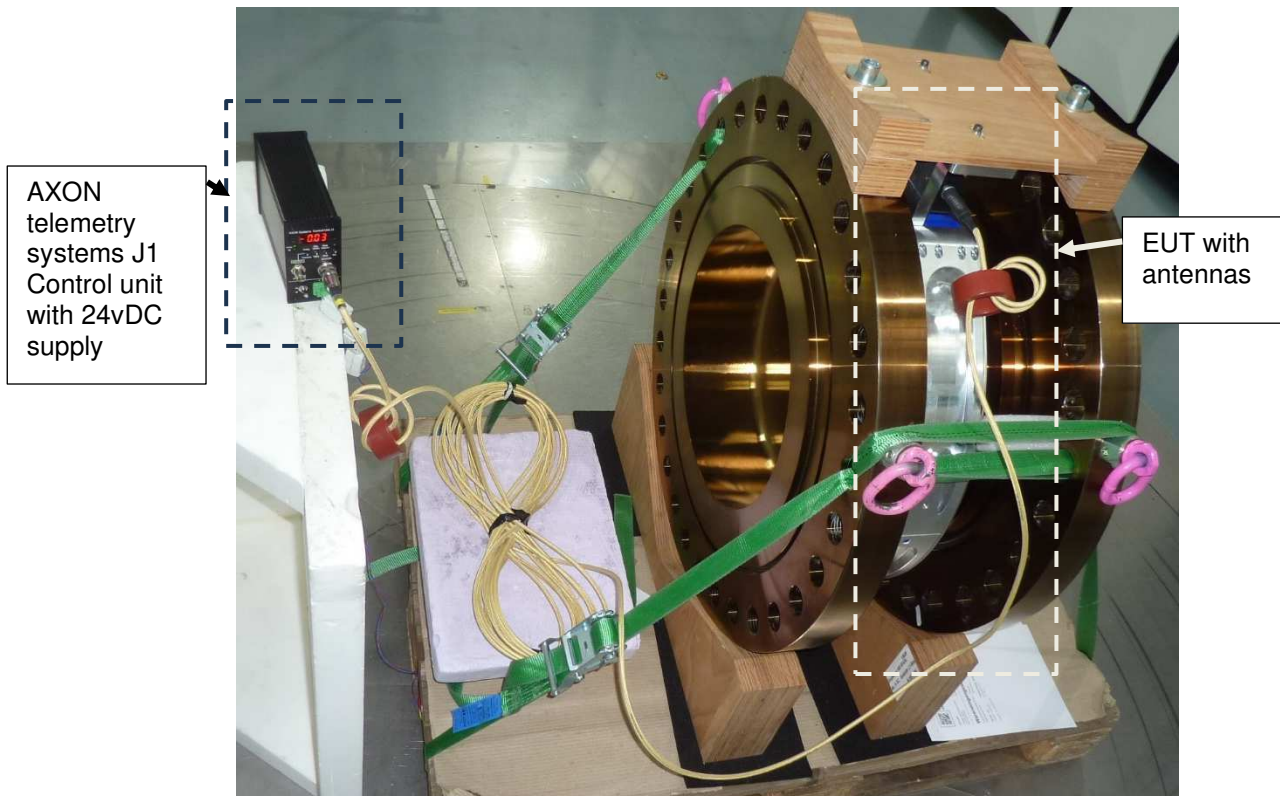
Description of function of the EUT:

The EUT is a digital torque measurement system working with 10.7 MHz radio communication and 17.5 kHz wireless power transfer.

During all tests the EUT was powered with 24 V DC external power supply and internal via 17.5 kHz WPT.

For the conducted emission test the following AC power adaptor provided by the applicant was used:
Phoenix Contact TRIO-PS/1AC/24DC/5 Order.No: 2866310

The system was setup as follows:



3 Additional Information

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

To fulfill the radiated emission test, the following ferrite chokes as shown in the Annex were used.

At the control unit connection cable 2 x Vitroperm 500F Model No.: T60006-L2063-W517 ferrit chokes with 3 turns.

At the supply line of the control unit 2 x Würth snap ferrite 742 716 33 with 1 turn and 1 x Würth snap ferrite 742 711 31 with 2 turns.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-Gen, Issue 5 [4] and RSS-210, Issue 11 [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] 8.1 and 8.3 [3]	1	Passed
99 % bandwidth	17.5 kHz 10.7 MHz	-	6.7 [4]	1	Passed
Antenna requirement	-	15.203 [2]	6.8 [4]	1	Passed *

*: Integrated antenna only, requirement fulfilled.

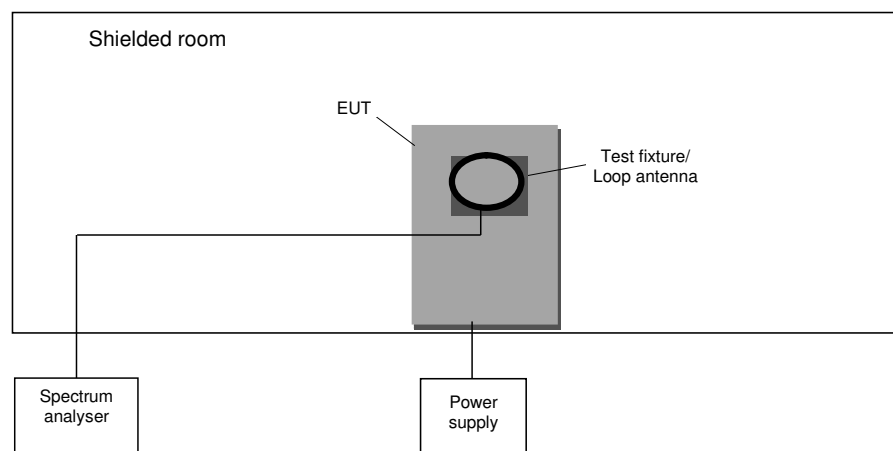
**:
As declared by the applicant the highest radio clock frequency is 10.7 MHz.
Therefore the radiated emission measurement must be carried out up to 10th of the highest radio clock frequency in this case 1 GHz.

5 Results

5.1 Test setups

5.1.1 Radiated: Test fixture

The test is carried out in a shielded chamber. 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

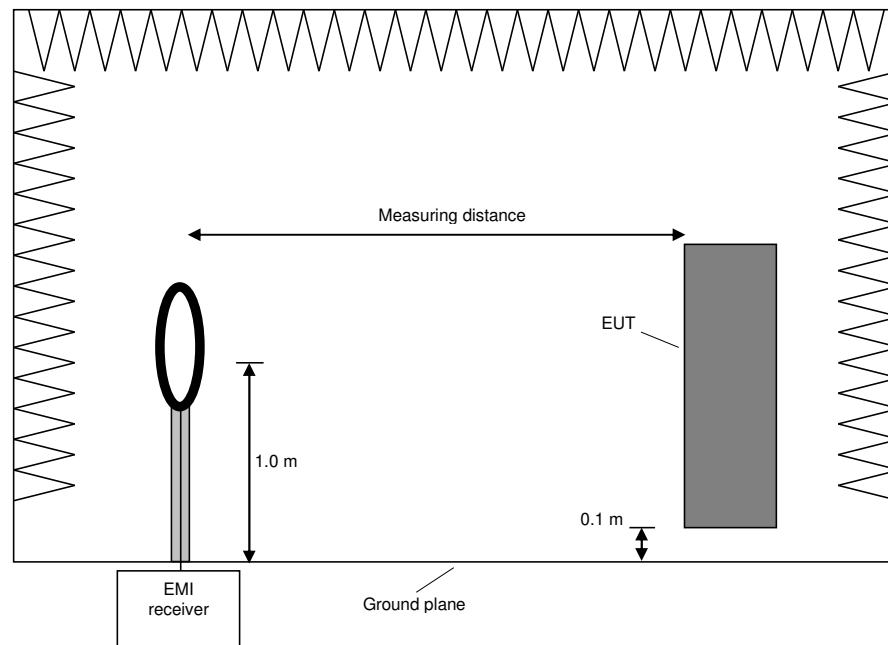
5.1.2.1 Preliminary measurement 9 kHz to 30 MHz

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.

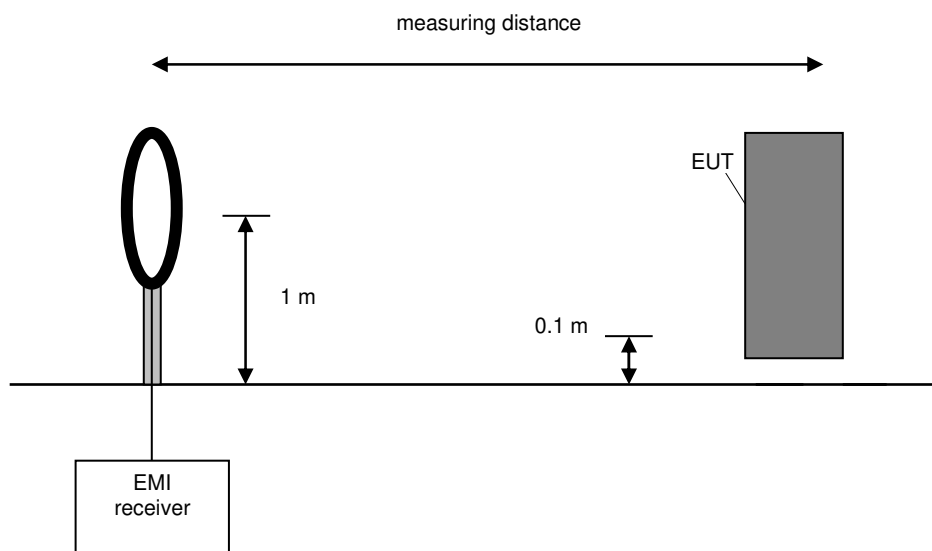
5.1.2.2 Final measurement 9 kHz to 30 MHz

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

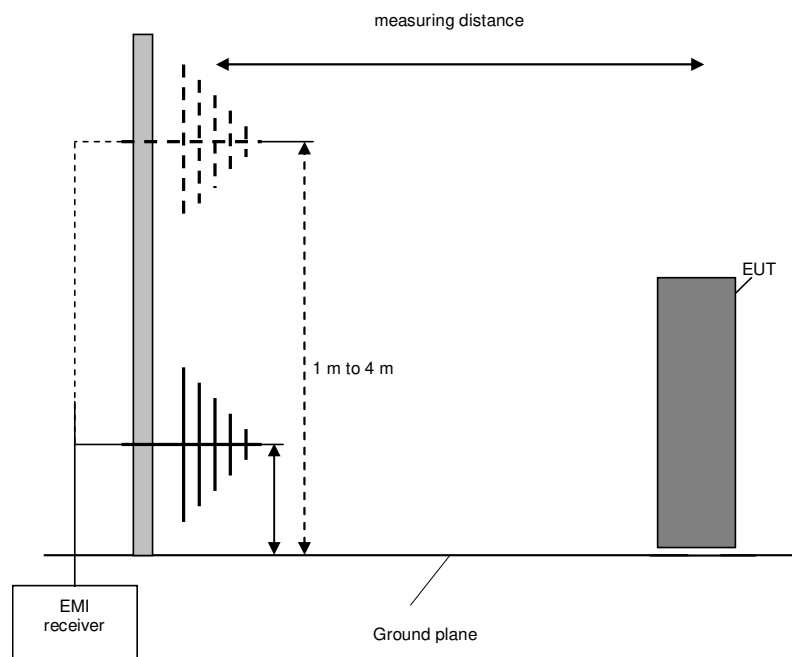
5.1.3.1 Preliminary and final measurement 30 MHz to 1 GHz

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:

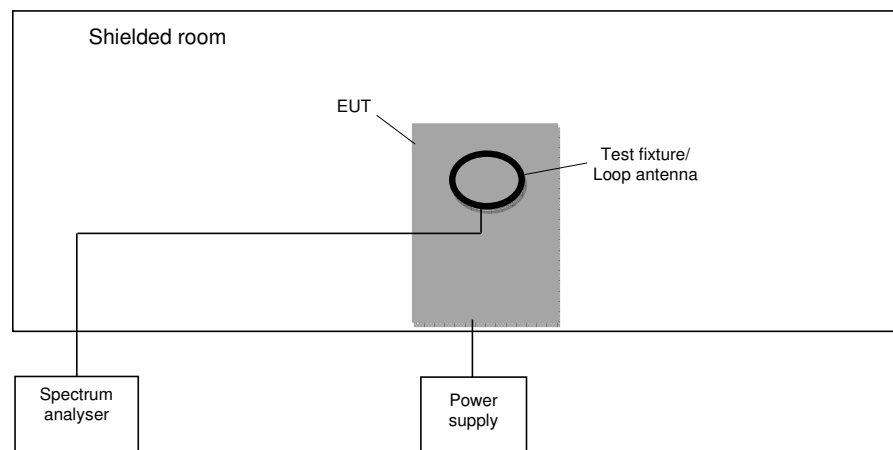
The following procedure is used:

- 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 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 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.



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:

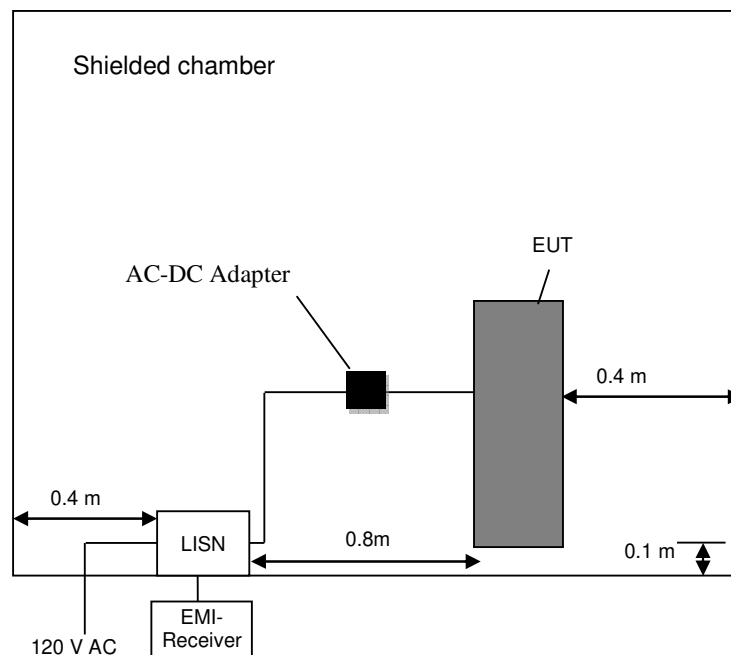
- a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately 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.

5.1.5 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
☒	Radiated: Test fixture	5.1.5	-
☐	Test setup (antenna port conducted)	-	-

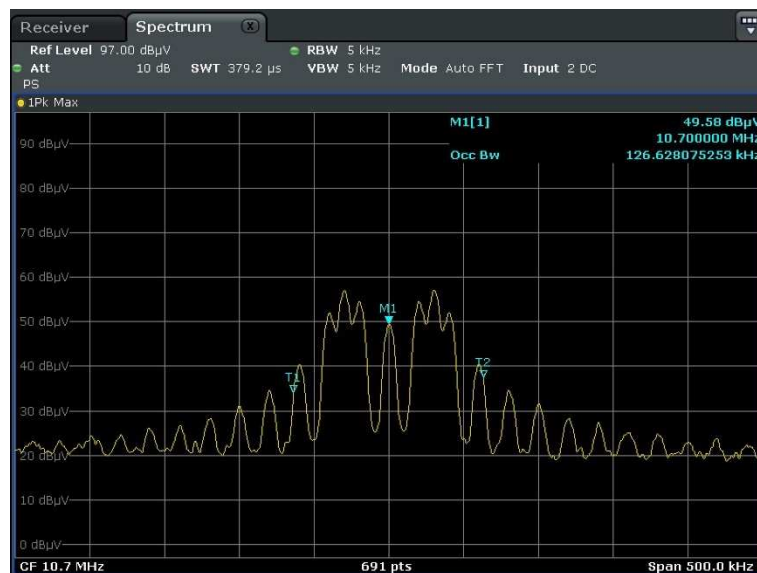
5.2.2 Test method (99 % bandwidth)

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:	23 %

Date:	14.02.2025
Tested by:	M.DINTER



F_L	F_U	BW ($F_U - F_L$)
10.636912 MHz	10.763540 MHz	126.628 kHz



F_L	F_U	BW ($F_U - F_L$)
17.485997 kHz	17.649528 kHz	163.531 Hz

Test result: Passed

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

5.3 Radiated emissions

5.3.1 Test setup (Maximum unwanted emissions)

Test setup (Maximum unwanted emissions)			
Used	Setup	See sub-clause	Comment
☒	Radiated: 9 kHz to 30 MHz / 30 MHz to 1 GHz	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:	06.02.2025
Relative humidity:	23 %	Tested by:	M.DINTER

Position of EUT: The EUT was tested as a floor-standing device. 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: none

Calculations:

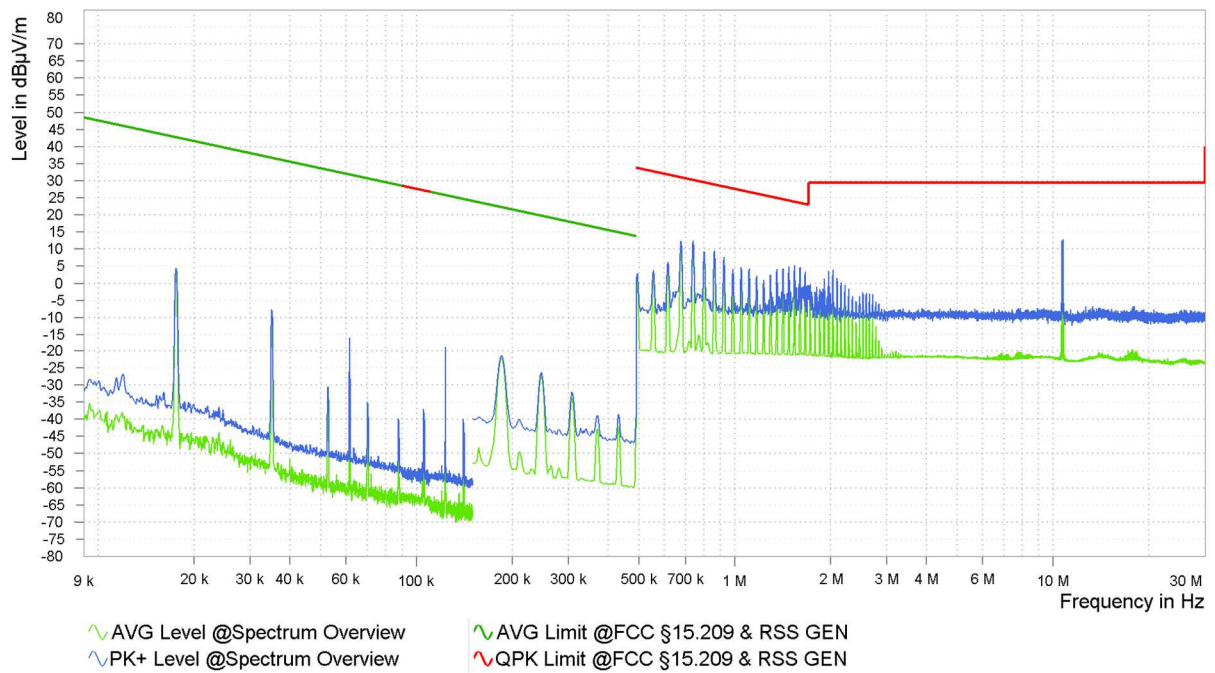
Result @ norm. dist. [dBμV/m] = Reading [dBμV] + AF [dB/m] + Distance corr. fact. [dBμV/m]

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:



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

-0.01755 MHz, 0.03500 MHz, 0.06160 MHz, 0.12320 MHz, 0.18525 MHz, 0.67800 MHz, 0.73900 MHz, 1.60075 MHz, MHz, 10.67025 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:	4 °C
Relative humidity:	35 %

Date:	07.02.2025
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 [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 #
0.017550	63.6	4.2 @ 300m	-47.4 @ 300m	42.7	-8.8	38.6	AV	20.6	3	300	80.0	1
0.035000	51.8	-7.8 @ 300m	-59.3 @ 300m	36.7	-14.8	44.5	AV	20.4	3	300	80.0	1
0.061600**	43.6	-16 @ 300m	-67.6 @ 300m	31.8	-19.7	47.8	AV	20.4	3	300	80.0	1
0.123200**	40.8	-19 @ 300m	-70.5 @ 300m	25.8	-25.7	44.8	AV	20.3	3	300	80.0	1
0.185250**	38.0	-21.7 @ 300m	-73.3 @ 300m	22.2	-29.3	44.0	AV	20.3	3	300	80.0	1
0.678000**	32.0	12.2 @ 30m	-39.3 @ 30m	31.0	-20.5	18.8	QP	20.1	3	30	40.0	1
0.739000**	32.2	12.3 @ 30m	-39.2 @ 30m	30.2	-21.3	17.9	QP	20.1	3	30	40.0	1
1.600750**	23.9	4 @ 30m	-47.5 @ 30m	23.5	-28.0	19.5	QP	20.1	3	30	40.0	1
10.669750	31.6	11.9 @ 30m	-39.6 @ 30m	29.5	-22.0	17.6	QP	20.3	3	30	40.0	1
10.670250	31.6	11.9 @ 30m	-39.6 @ 30m	29.5	-22.0	17.6	QP	20.3	3	30	40.0	1

Remark **: Measurement result was taken from preliminary test because of the noise floor of the outdoor test site.

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.

Test result: Passed

Test equipment (please refer to chapter 7 for details)	
Final measurement:	2 - 3, 10
Preliminary measurement:	3 - 9

5.3.3.3 Test results (30 MHz – 1 GHz)

Ambient temperature:	22 °C
Relative humidity:	20 %

Date:	12.02.2025
Tested by:	M.DINTER

Position of EUT: The EUT was tested as a floor-standing device. 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: None

Calculations:

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

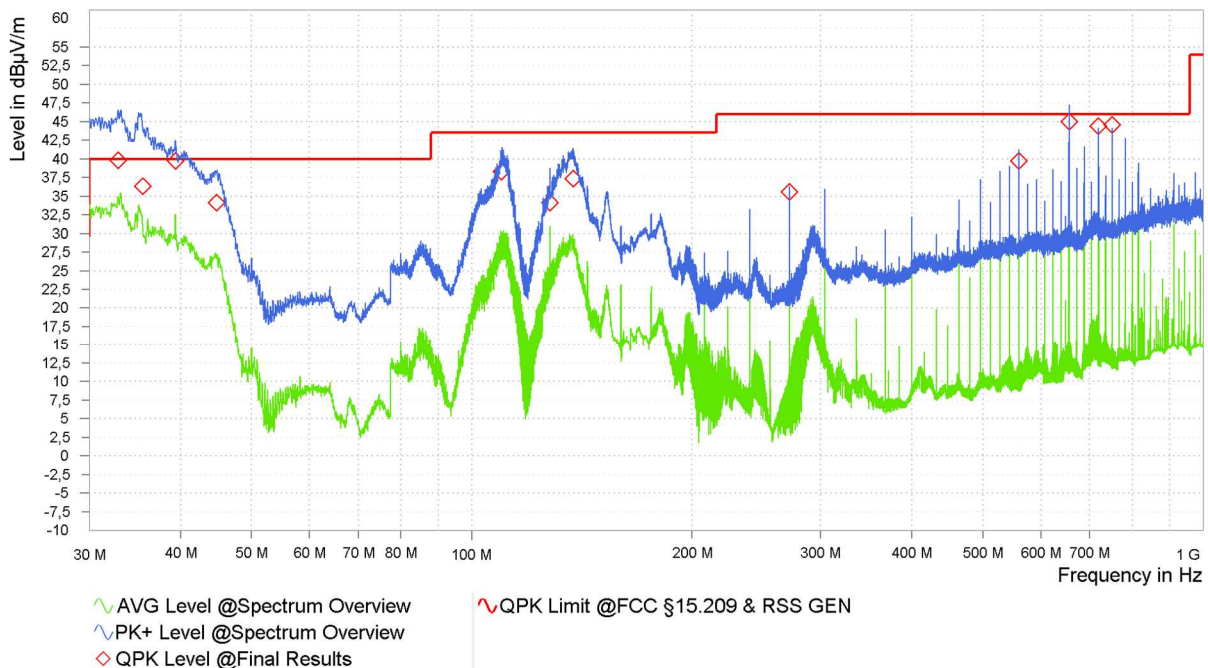
Correction [dBμV/m] = AF [dB/m] + Cable attenuation [dB] + optional preamp gain [dB]

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

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:



Result tables:

(Operation mode 1):

Frequency [MHz]	Result (QP) [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Readings [dBμV]	Correction [dB/m]	Height [cm]	Azimuth [deg]	Pol. (H/V)	Position #
32.850	39.76	40.00	0.24	32.850	39.76	4.08	101	V	1
35.520	36.29	40.00	3.71	35.520	36.29	1.05	101	V	1
39.360	39.75	40.00	0.25	39.360	39.75	1.51	69	V	1
44.760	34.10	40.00	5.90	44.760	34.10	1.39	252	V	1
109.950	38.30	43.50	5.20	109.950	38.30	1.03	79	V	1
128.010	34.13	43.50	9.37	128.010	34.13	1.00	114	V	1
137.790	37.31	43.50	6.19	137.790	37.31	1.05	264	V	1
271.980	35.57	46.00	10.43	271.980	35.57	1.34	117	H	1
559.980	39.73	46.00	6.27	559.980	39.73	1.36	133	H	1
655.980	44.95	46.00	1.05	655.980	44.95	1.02	22	V	1
720.000	44.37	46.00	1.63	720.000	44.37	1.15	32	H	1
751.980	44.53	46.00	1.47	751.980	44.53	1.01	29	H	1

Test result: Passed

Test equipment (please refer to chapter 7 for details)
4 - 9, 11 - 13

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
☒	Conducted: AC power line	5.1.4	-
☐	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
☐	6.2	Tabletop equipment testing	-	-
☒	6.2	Floor-standing equipment testing	5.1.4	Provided AC switching power adaptor

The AC power adaptor provided by the applicant was used for the tests:

Phoenix Contact TRIO-PS/1AC/24DC/5 Order.No: 2866310

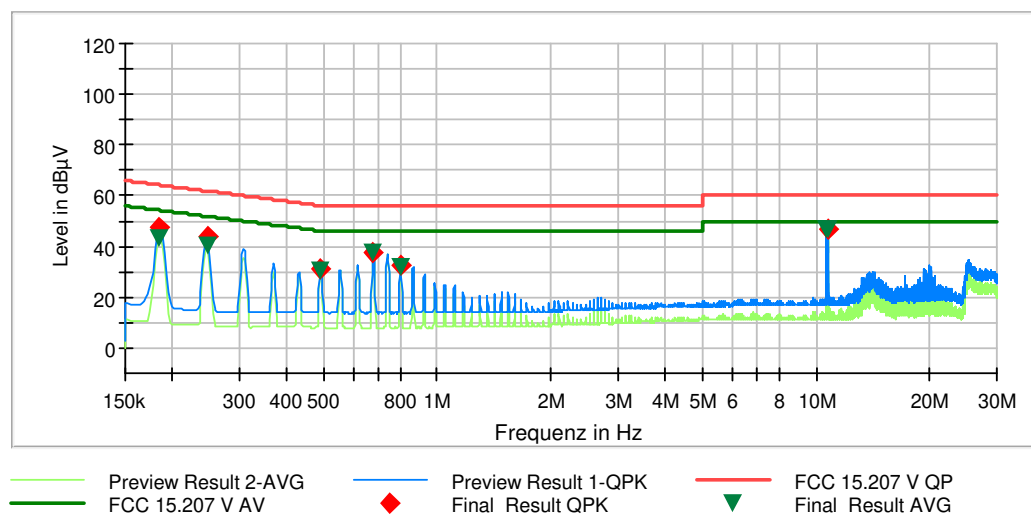
The power adaptor itself was supplied by 120V_{AC} 60Hz.

5.4.3 Test results (Conducted emissions on power supply lines)

Ambient temperature:	22 °C
Relative humidity:	20 %

Date:	07.02.2025
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]
0.1838	47.67	---	64.31	16.64	N	GND	19.8
0.1838	---	43.33	54.31	10.98	N	GND	19.8
0.2468	---	40.09	51.87	11.78	N	GND	19.7
0.2468	43.77	---	61.87	18.10	N	GND	19.7
0.4920	---	30.62	46.13	15.51	N	GND	19.7
0.4920	31.15	---	56.13	24.98	N	GND	19.7
0.6765	37.84	---	56.00	18.16	N	GND	19.7
0.6765	---	37.55	46.00	8.45	N	GND	19.7
0.8003	32.60	---	56.00	23.40	N	GND	19.7
0.8003	---	32.05	46.00	13.95	N	GND	19.7
10.6710	---	46.70	50.00	3.30	N	GND	20.3
10.7295	47.05	---	60.00	12.95	N	GND	20.3
10.7295	---	46.93	50.00	3.07	N	GND	20.3

Test result: Passed

Test equipment (please refer to chapter 7 for details)
14 - 17

6 Measurement Uncertainties

Conducted measurements		
Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) U_{lab}
Frequency error	ETSI TR 100 028	4.5×10^{-8}
Bandwidth measurements	-	9.0×10^{-8}
Conducted emissions from 150 kHz to 30 MHz with LISN	CISPR 16-4-2	2.8 dB

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

7 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Loop antenna	22.5 cm	PHOENIX TESTLAB GmbH	-	410085	Calibration not necessary	
2	EMI Receiver / Spectrum Analyser	ESR7	Rohde & Schwarz	101252	481734	22.02.2024	02.2026
3	Loop antenna	HFH2-Z2	Rohde & Schwarz	832609/014	480059	21.02.2024	02.2026
4	EMC test software	Elektra V5.10.00	Rohde&Schwarz		483755	Calibration not necessary	
5	RF Switch Matrix	OSP220	Rohde & Schwarz	101391	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 receiver / Spectrum analyser	ESW44	Rohde & Schwarz	101828	482979	21.02.2024	02.2026
10	Outdoor test site	-	PHOENIX TESTLAB GmbH	-	480293	Calibration not necessary	
11	Attenuator 6 dB	WA2-6	Weinschel	8254	410119	Calibration not necessary	
12	Ultralog antenna	HL562E	Rohde & Schwarz	101079	482978	24.04.2024	04.2027
13	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
14	V-LISN	NSLK8128RC	Schwarzbeck	0412	483186	28.02.2024	02.2026
15	Shielded chamber M155	SK3	Albatross Projects		482786	Calibration not necessary	
16	Software	EMC32 Ver. 10.60.20	Rohde & Schwarz	100619	483182	Calibration not necessary	
17	EMI Receiver / Spectrum Analyser	ESR7	Rohde & Schwarz	101939	482558	21.02.2024	02.2026

8 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Shielded chamber M155	482784	9 kHz – 30 MHz	GND-Plane	ANSI C63.4-2014	14.11.2022	13.11.2025
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

9 Report History

Report Number	Date	Comment
F250176E1	08.04.2025	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A	Test Setup Photos	6 pages
Annex B	EUT External Photos	13 pages
Annex C	EUT Internal Photos	1 pages

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