

# Test Report

Report Number:

**F231182E1**

Equipment under Test (EUT):

**NINA-W151  
in dedicated host  
TAD200**

Applicant:

**u-blox AG**

Manufacturer:

**u-blox AG**



Deutsche  
Akkreditierungsstelle  
D-PL-17186-01-00

## 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] **558074 D01 15.247 Meas Guidance v05r02 (April 2019)**, GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
- [4] **RSS-247, Issue 3 (2023-08)** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- [5] **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 1.3 of ANSI C63.10 (2013). However, the measurement uncertainty is calculated and shown in this test report.

Tested and written  
by:

Signature

Reviewed and  
approved by:

Signature

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<b>Contents:</b>	<b>Page</b>
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 .....	6
1.6 Dates .....	8
2 Operational States .....	9
2.1 Description of function of the EUT .....	9
3 Additional Information .....	9
4 Overview.....	10
5 Results.....	11
5.1 Test setups .....	11
5.2 DTS band-edge emission measurements.....	13
5.3 Test results (radiated 1 GHz to 40 GHz) .....	15
6 Measurement Uncertainties .....	18
7 Test Equipment used for Tests .....	19
8 Test site Verification.....	19
9 Report History.....	19
10 List of Annexes .....	19

# 1 Identification

## 1.1 Applicant

Name:	u-blox AG
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Country:	Switzerland
Name for contact purposes:	Mr. Filip Kruzela
Phone:	+41-44-722-7444
eMail address:	info@u-blox.com
Applicant represented during the test by the following person:	---

## 1.2 Manufacturer

Name:	u-blox AG
Address:	Zürcherstr. 68, 8800 Thalwil
Country:	Switzerland
Name for contact purposes:	Mr. Filip Kruzela
Phone:	+41-44-722-7444
eMail address:	info@u-blox.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) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-05 and D-PL-17186-01-06, 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: *	Wireless Communication System Module
Model name: *	NINA-W151
FCC ID: *	XPYNINAW15
IC certification number: *	8595A-NINAW15

\* Declared by the applicant

	EUT number		
	1	2	3
Serial number: *	P9254F82AB18A900806	-	-

\* 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

### 1.5.1 Dedicated Host

General EUT data - Host	
Power supply EUT: *	DC via battery (type CR123A)
Supply voltage EUT: *	$U_{nom} = 3 V_{DC}$
FCC ID: *	CSQTAD200
IC certification number: *	1499A-TAD200
HVIN: *	TAD-200
PMN: *	BI TAD

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
No ports nor connectors				

## Communication Module inside dedicated host

### 1.5.1.1 WLAN radio part

IEEE 802.11 radio mode (2.4 GHz)	
Fulfil radio specification: *1	IEEE 802.11 b IEEE 802.11 g IEEE 802.11 n (20 MHz) IEEE 802.11 n (40 MHz)
Antenna type: *1	SMD Antenna
Antenna name: *1	WLA.01, taoglas antenna solutions
Antenna gain: *2	2.5 dBi (typical)
Antenna connector: *1	-
Type of modulation: *1	IEEE 802.11 b BPSK, DQPSK, CCK (1/2/5.5/11 Mbit/s)
	IEEE 802.11 g BPSK, QPSK, 16-QAM, 64-QAM (6/9/12/18/24/36/48/54 Mbit/s)
	IEEE 802.11 n20 BPSK, QPSK, 16-QAM, 64-QAM (up to 72.2 Mbit/s 1 spatial stream) (up to 144.4 Mbit/s 2 spatial stream) (up to 72.2 Mbit/s 1 spatial stream) (up to 144.4 Mbit/s 2 spatial stream)
	IEEE 802.11 n40 BPSK, QPSK, 16-QAM, 64-QAM (up to 150 Mbit/s 1 spatial stream) (up to 300 Mbit/s 2 spatial stream)

\*1 declared by the applicant

\*2 based on the antenna data sheet provided by the applicant

IEEE 802.11 frequencies (2.4 GHz)			
20 MHz		40 MHz	
Channel 1	2412 MHz	-	-
Channel 2	2417 MHz	-	-
Channel 3	2422 MHz	Channel 3	2422 MHz
Channel 4	2427 MHz	Channel 4	2427 MHz
Channel 5	2432 MHz	Channel 5	2432 MHz
Channel 6	2437 MHz	Channel 6	2437 MHz
Channel 7	2442 MHz	Channel 7	2442 MHz
Channel 8	2447 MHz	Channel 8	2447 MHz
Channel 9	2452 MHz	Channel 9	2452 MHz
Channel 10	2457 MHz	Channel 10	2457 MHz
Channel 11	2462 MHz	-	-
Channel 12	2467 MHz		

### 1.5.2 Ancillary Equipment / Equipment used for testing

Equipment used for testing	
Power supply* <sup>1</sup>	TOELLNER TOE8852 (PM480233)
USB-2-UART-converter* <sup>2</sup>	UART-pcb with USB-mini
Laptop* <sup>1</sup>	Fujitsu Lifebook E734 (PM201251)

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

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

### 1.6 Dates

Date of receipt of test sample:	30.08.2023
Start of test:	19.09.2023
End of test:	21.09.2023

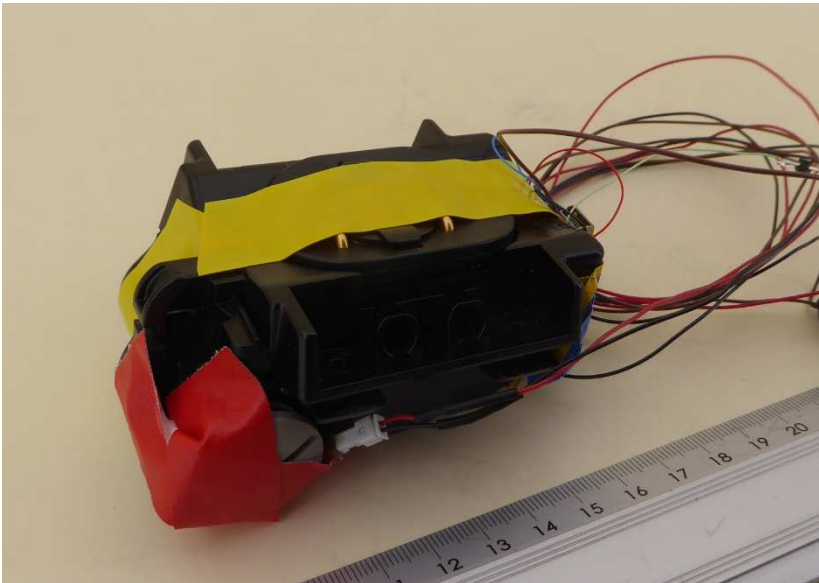


## 2 Operational States

### 2.1 Description of function of the EUT

The EUT is a radio communication module (WLAN) in a specific host.

Host:



#### 2.1.1 Operation modes

Operation mode #	Radio technology	Frequency [MHz]	Channel	Modulation	Data rate / Packet type/ Modulation scheme	Power setting
1	IEEE 802.11 n40	2422	3	64QAM	MCS5	20
2	IEEE 802.11 n40	2457	10	64QAM	MCS5	20
3	IEEE 802.11 b	2437	6	DBPSK	1 Mbit/s	24

Worst cases were taken from original reports (FCC ID: XPYNINAW10 / IC: 8595A-NINAW10) F170297E6 and F170297E8 by PHOENIX TESTLAB GmbH, power settings were used from original test reports.

Power verification was done at worst case.

- IEEE 802.11 g, Channel 6, 24 Mbit/s, power setting: "8"

## 3 Additional Information

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

A different pcb antenna and trace design was used.

The communication module is able to use BT classic and BT LE, as declared by the applicant

## 4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Part 15 section [2]	RSS-247 [4] RSS-Gen [5]	Tested EUT	Status
Maximum peak conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [4]	1	Verified
Maximum conducted output power	2400.0 - 2483.5	15.247 (b) (3), (4)	5.4 (d) [4]	1	
Band edge compliance	2400.0 - 2483.5	15.247 (d) 15.205 (a) 15.209 (a)	5.5 [4]	1	Passed* <sup>2</sup>
Maximum unwanted emissions	1,000 – 26,500*	15.247 (d) 15.205 (a) 15.209 (a)	8.9 [5]	1	Passed* <sup>2</sup>

\*: As declared by the applicant the highest radio clock frequency is 2.480 GHz.  
Therefore, the radiated emission measurement must be carried out up to 10<sup>th</sup> of the highest radio clock frequency in this case 26.5 GHz.

\*<sup>2</sup> Only limited worst cases were tested from original report

## 5 Results

### 5.1 Test setups

#### 5.1.1 Radiated: Above 1 GHz

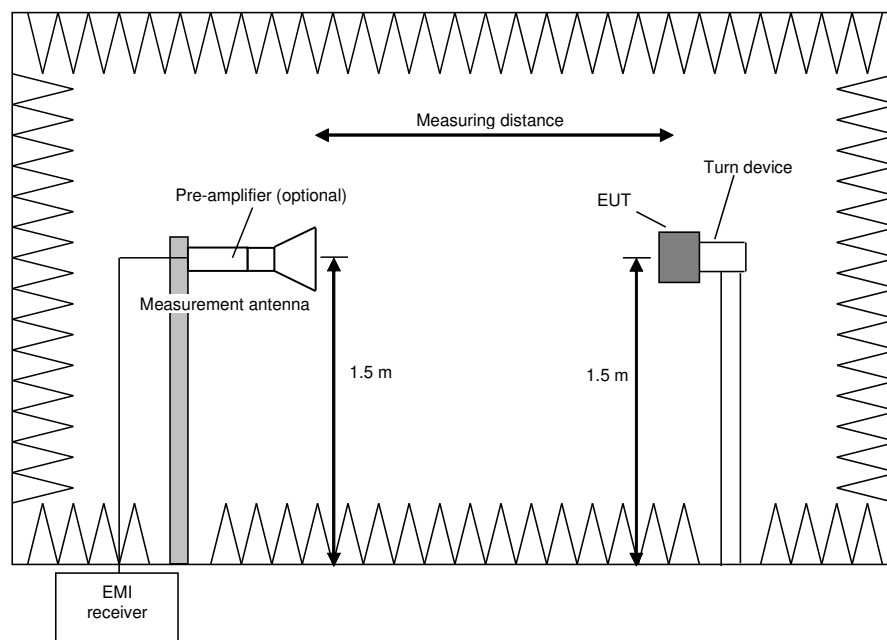
##### 5.1.1.1 Preliminary and final measurement above 1 GHz

The preliminary and final measurements are performed in a fully anechoic chamber at a measuring distance of 3 m. 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  $\pm 30^\circ$  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.

## 5.2 DTS band-edge emission measurements

### 5.2.1 Test setup (Band edge – restricted bands)

Test setup (Band edge – restricted bands)			
Used	Setup	See sub-clause	Comment
<input checked="" type="checkbox"/>	Radiated: Above 1 GHz	5.1.1	-
<input type="checkbox"/>	Conducted: Antenna port	-	-

### 5.2.2 Test method (Band edge – restricted bands)

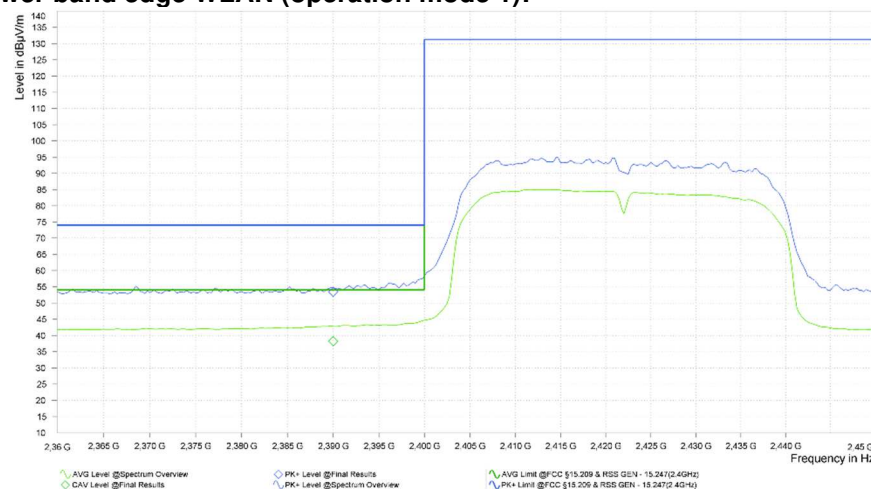
Test method (Band edge – restricted bands)				
Used	Sub-Clause [1]	Name of method	Applicability	Comment
<input checked="" type="checkbox"/>	11.13.1	Standard method	No limitations	-
<input type="checkbox"/>	11.13.2	Marker-delta method		See 6.10.6 [3]
<input type="checkbox"/>	11.13.3.2	Peak detection	Not for DTS testing	2 MHz from band
<input type="checkbox"/>	11.13.3.3	Trace averaging with cont. EUT	D ≥ 98%	2 MHz from band
<input type="checkbox"/>	11.13.3.4	Trace averaging with cont. EUT & D	Constant D (±2%)	2 MHz from band
<input type="checkbox"/>	11.13.3.5	Reduced VBW		2 MHz from band

### 5.2.3 Test results (Band edge – restricted bands)

Ambient temperature:	22 °C
Relative humidity:	54 %

Date:	20.09.2023
Tested by:	B. ROHDE

### Worst case plot lower band edge WLAN (operation mode 1):



### Worst case plot lower band edge WLAN (operation mode 2):



### 5.2.3.1 WLAN modes

#### Lower band edge (operation mode 1):

Frequency [MHz]	Result (Pk) [dB(µV/m)]	Result (Av) [dB(µV/m)]	Limit [dB(µV/m)]	Margin [dB]
2390.0	53.46	---	74.0	20.54
2390.0	---	38.26	54.0	15.74

#### Upper band edge (operation mode 2):

Frequency [MHz]	Result (Pk) [dB(µV/m)]	Result (Av) [dB(µV/m)]	Limit [dB(µV/m)]	Margin [dB]
2483.5	51.91	---	74.0	22.09
2483.5	---	34.97	54.0	19.03

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1 - 8

### 5.3 Test results (radiated 1 GHz to 40 GHz)

Ambient temperature:	22 °C
Relative humidity:	54 - 60 %

Date:	20.- 21.09.2023
Tested by:	B. ROHDE

Position of EUT: For tests for f between 1 GHz and the 10<sup>th</sup> harmonic, the EUT was set-up on a positioner device with a height of 150 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: Only worst cases from original report were tested

Calculation:

Max Peak [dBμV/m] = Reading [dBμV] + Correction [dBμV/m]

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

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

Margin [dB] = Limit [dBμV/m] – Max Peak | Average [dBμV/m]

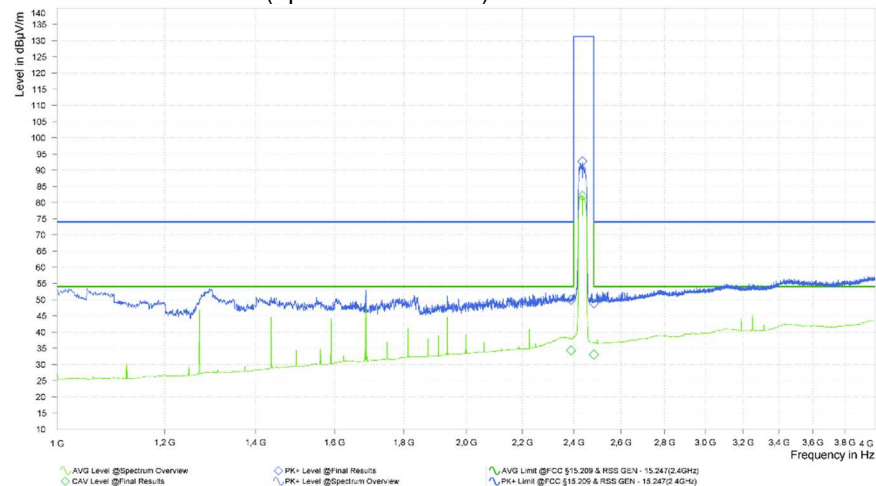
The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with various EUT and antenna positions.

The top measured curve represents the peak measurement. The measured points marked with "◇" are frequency points for the final peak detector measurement. These values are indicated in the following table. The bottom measured curve represents the average measurement. The measured points marked with "◇" are frequency points for the final average detector measurement.

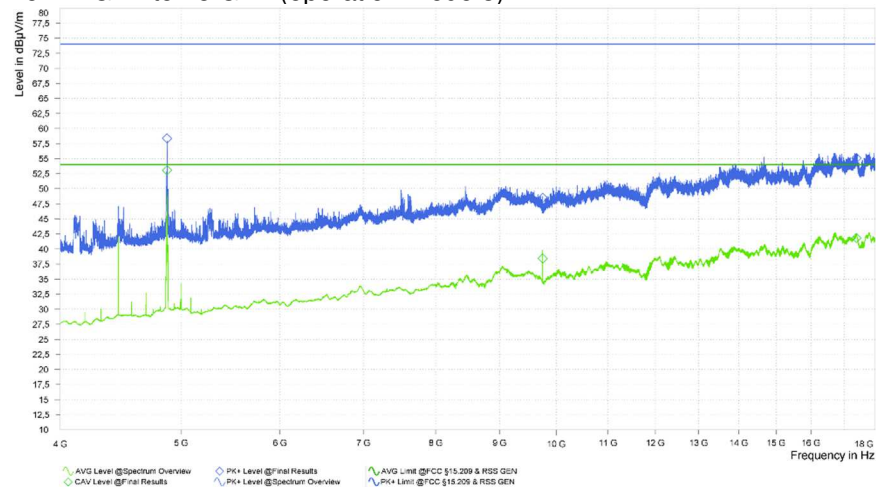
### 5.3.1 Worst case plots

#### 5.3.1.1 WLAN

Spurious emissions from 1 GHz to 4 GHz (operation mode 3):

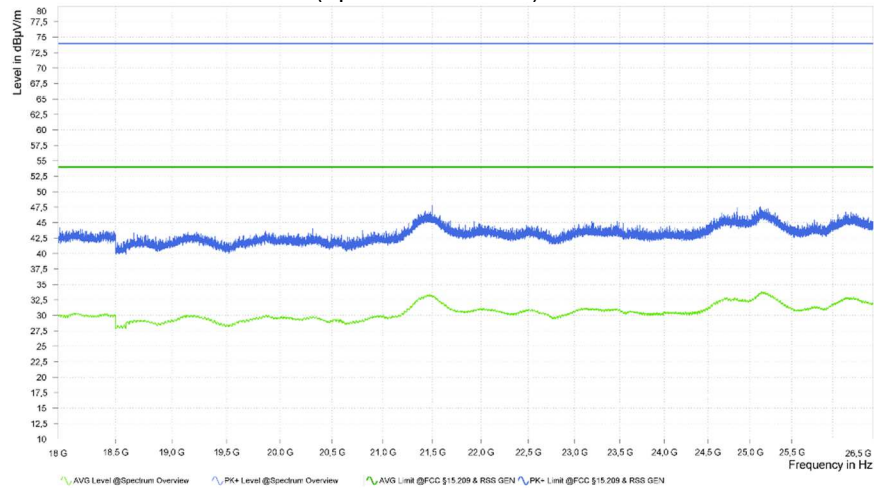


Spurious emissions from 4 GHz to 18 GHz (operation mode 3):





Spurious emissions from 18 GHz to 26.5 GHz (operation mode 3):



## 5.3.2 Result tables

### 5.3.2.1 WLAN

Operation mode 7:

Frequency [MHz]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	AV Level [dBµV/m]	AV Limit [dBµV/m]	AV Margin [dB]	Correction [dB]	Polarization	Elevation [deg]	Azimuth [deg]
2,389.750	49.98	74.00	24.02	34.36	54.00	19.64	35.20	H	30	254
2,435.750	92.72	131.30	38.58	82.10	131.30	49.20	35.36	V	90	141
2,483.500	48.83	131.30	82.47	33.08	131.30	98.22	35.38	V	0	317
4,874.000	58.38	74.00	15.62	53.06	54.00	0.94	9.86	H	120	36
9,747.750	48.50	74.00	25.50	38.43	54.00	15.57	18.47	H	90	139
17,394.750	55.12	74.00	18.88	41.80	54.00	12.20	30.56	V	30	295

Test result: Passed

Test equipment (please refer to chapter 7 for details)
1 - 11

## 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	$4.5 \times 10^{-8}$
Bandwidth measurements	-	$9.0 \times 10^{-8}$
Conducted emissions using a spectrum analyzer		
< 3.6 GHz	ETSI TR 100 028	2.3 dB
3.6 – 8 GHz	ETSI TR 100 028	2.8 dB
8 – 22 GHz	ETSI TR 100 028	3.2 dB
22 – 40 GHz	ETSI TR 100 028	3.6 dB
Power measurements		
Power meter	ETSI TR 100 028	0.9 dB
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	$4.5 \times 10^{-8}$
OATS	ETSI TR 100 028	$4.5 \times 10^{-8}$
Test fixture	ETSI TR 100 028	$4.5 \times 10^{-8}$
Bandwidth measurements		
(Semi-) Anechoic chamber	-	$9.0 \times 10^{-8}$
OATS	-	$9.0 \times 10^{-8}$
Test fixture	-	$9.1 \times 10^{-8}$
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 12 – 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 12 – 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	Log.-Per. antenna	HL050	Rohde & Schwarz	100908	482977	22.09.2022	09.2025
2	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
3	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
4	Antennasupport	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
5	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
6	Semi Anechoic Chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
7	EMI Testreceiver	ESW44	Rohde & Schwarz	101828	482979	08.12.2021	12.2023
8	Test software M276	Elektra	Rohde & Schwarz	101381	483755	Calibration not necessary	
9	Low Noise Amplifier 100 MHz - 18 GHz	LNA-30-00101800-25-10P	Narda-Miteq	2110917	482967	18.02.2022	02.2024
10	Low Noise Amplifier 18 GHz - 26.5 GHz	LNA-30-18002650-20-10P	Narda-Miteq	2110911	482969	18.02.2022	02.2024
11	Standard Gain Horn 20 dB, 18 GHz -26 GHz	20240-20	Flann	266399	483026	Calibration not necessary	

## 8 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Semi anechoic chamber M276	483227	1 GHz -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
F231182E1	06.02.2024	Initial Test Report
-	-	-
-	-	-

## 10 List of Annexes

Annex A              Test Setup Photos

2 pages