CE RF Test Report

Applicant: Nebra Ltd

Address of Applicant: Unit 4 Bells Yew Green Business Court, Bells Yew Green, Tunbridge Wells, East Sussex, TN3 9BJ

Equipment Under Test (EUT)

Product Name: Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version

Model No.: NEBHNT-HHRK4-433, NEBHNT-HHRK4-470, NEBHNT-HHRK4-868, NEBHNT-HHRK4-915, NEBHNT-HHRK4-433-2, NEBHNT-HHRK4-470-2, NEBHNT-HHRK4-868-2, NEBHNT-HHRK4-915-2, NEBHNT-HHRK4-433-3, NEBHNT-HHRK4-470-3, NEBHNT-HHRK4-868-3, NEBHNT-HHRK4-915-3, NEBHNT-HHRK4-433-3, NEBHNT-HHRK4-470-3, NEBHNT-HHRK4-868-3, NEBHNT-HHRK4-915-3

Applicable standards: ETSI EN 300 220-1 V3.1.1 (2017-02)
ETSI EN 300 220-2 V3.2.1 (2018-06)

Date of sample receipt: 05 Jan., 2022

Date of Test: 06 Jan., to 14 Feb., 2022

Date of report issue: 15 Feb., 2022

Test Result: PASS

Tested by:	***Test Engineer***	***Date:***	*15 Feb., 2022*
Reviewed by:	***Project Engineer***	***Date:***	*15 Feb., 2022*
Approved by:	***Manager***	***Date:***	*15 Feb., 2022*

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in above the application standard version. Test results reported herein relate only to the item(s) tested.

2 Version

Version No.	Date	Description
00	*15 Feb., 2022*	*Original*

3 Contents

Page

4 Test Summary

Test Items	Test Requirement	Test method	Result
Transmitter Part			
Operating frequency	EN 300 220-2 Clause 4.2.1	EN 300 220-1 Clause 5.1.2	PASS*
Effective Radiated Power	EN 300 220-2 Clause 4.3.1	EN 300 220-1 Clause 5.2.2	PASS*
Maximum e.r.p. spectral density	EN 300 220-2 Clause 4.3.2	EN 300 220-1 Clause 5.3.2	N/A
Duty Cycle	EN 300 220-2 Clause 4.3.3	EN 300 220-1 Clause 5.4.2	PASS*
Occupied Bandwidth	EN 300 220-2 Clause 4.3.4	EN 300 220-1 Clause 5.6.3	PASS*
Tx Out of Band Emissions	EN 300 220-2 Clause 4.3.5	EN 300 220-1 Clause 5.8.3	PASS*
Transient power	EN 300 220-2 Clause 4.3.6	EN 300 220-1 Clause 5.10.3	PASS*
Adjacent Channel Power	EN 300 220-2 Clause 4.3.7	EN 300 220-1 Clause 5.11.3	N/A
TX behaviour under Low Voltage Conditions	EN 300 220-2 Clause 4.3.8	EN 300 220-1 Clause 5.12.3	PASS*
Adaptive Power Control	EN 300 220-2 Clause 4.3.9	EN 300 220-1 Clause 5.13.3	N/A
FHSS equipment	EN 300 220-2 Clause 4.3.10	EN 300 220-2 Clause 4.3.10.3	N/A
Short term behaviour	EN 300 220-2 Clause 4.3.11	EN 300 220-1 Clause 5.5.2	N/A
Unwanted emissions in the spurious domain	EN 300 220-2 Clause 4.2.2	EN 300 220-1 Clause 5.9.3	PASS
Receiver Part			
RX sensitivity	EN 300 220-2 Clause 4.4.1	EN 300 220-1 Clause 5.14.3	N/A
RX Blocking	EN 300 220-2 Clause 4.4.2	EN 300 220-1 Clause 5.18.6	PASS*
Polite spectrum access conformance requirement			
Clear Channel Assessment threshold	EN 300 220-2 Clause 4.5.2	EN 300 220-1 Clause 5.21.2.3	N/A
Polite spectrum access timing parameters	EN 300 220-2 Clause 4.5.3	EN 300 220-1 Clause 5.21.2.3	N/A
Adaptive Frequency Agility	EN 300 220-2 Clause 4.5.4	EN 300 220-1 Clause 5.21.4.2	N/A

Remark:

1. *Pass: Meet the requirement.*
2. *N/A: Not Applicable for Non-adaptive equipment.*
3. *Pass*: Please refer to the report No.: SZAWW180830005-04W issue by Shenzhen Anbotek Compliance Laboratory Limited , The module used by EUT in this report is that of Report SZAWW180830005-04W.*

5 General Information

5.1 Client Information

Applicant:	Nebra Ltd
Address:	Unit 4 Bells Yew Green Business Court, Bells Yew Green, Tunbridge Wells, East Sussex, TN3 9BJ
Manufacturer/Factory:	Nebra Ltd
Address:	Unit 4 Bells Yew Green Business Court, Bells Yew Green, Tunbridge Wells, East Sussex, TN3 9BJ

5.2 General Description of E.U.T.

Product Name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version
Model No.:	NEBHNT-HHRK4-433, NEBHNT-HHRK4-470, NEBHNT-HHRK4-868, NEBHNT-HHRK4-915, NEBHNT-HHRK4-433-2, NEBHNT-HHRK4-470-2, NEBHNT-HHRK4-868-2, NEBHNT-HHRK4-915-2, NEBHNT-HHRK4-433-3, NEBHNT-HHRK4-470-3, NEBHNT-HHRK4-868-3, NEBHNT-HHRK4-915-3, NEBHNT-HHRK4-433-3, NEBHNT-HHRK4-470-3, NEBHNT-HHRK4-868-3, NEBHNT-HHRK4-915-3
Operation Frequency:	868.1~868.5MHz
Hardware version:	v1
Software version:	781099d
Modulation:	ook
Antenna type:	External Antenna
Antenna Gain:	3dBi
Power supply:	DC 12.0V
Remark:	Model no.: NEBHNT-HHRK4-433, NEBHNT-HHRK4-470, NEBHNT-HHRK4-868, NEBHNT-HHRK4-915, NEBHNT-HHRK4-433-2, NEBHNT-HHRK4-470-2, NEBHNT-HHRK4-868-2, NEBHNT-HHRK4-915-2, NEBHNT-HHRK4-433-3, NEBHNT-HHRK4-470-3, NEBHNT-HHRK4-868-3, NEBHNT-HHRK4-915-3, NEBHNT-HHRK4-433-3, NEBHNT-HHRK4-470-3, NEBHNT-HHRK4-868-3, NEBHNT-HHRK4-915-3, The difference between the models is that the LoRa Radio module used inside is different for each variant. Along with a respective antenna for each region / frequency. The -2 and -3 flags at the end of the model number relates to the specific chip part number for the main LoRa chip.

5.3 Test mode and test environment

Test mode:	
Transmitting mode:	Keep the TX unit in transmitting mode with modulation.
Receiving mode:	Keep the RX unit in receiving mode.
Operating Environment:	
Temperature:	Normal: 15℃ ~ 35℃, Extreme: -20℃ ~ +40℃
Humidity:	20 % ~ 75 % RH
Atmospheric Pressure:	1008 mbar
Voltage:	Normal: 230Vac, Extreme: Low 207Vac, High 253

Remark:

1. *Pre-scan the EUT stand-up position (H mode) and lie down position (E1, E2 mode) for three modes, and found the H mode worst case. The report only reflects the test data of worst mode.*
2. *"NVNT" means Normal Voltage Normal Temperature, "LVLT" means Low Voltage Low Temperature, "LVHT" means Low Voltage High Temperature, "HVLT" means High Voltage Low Temperature, "HVHT" means High Voltage High Temperature.*

5.4 Description of Support Units

The EUT has been tested as an independent unit.

5.5 Measurement Uncertainty

Parameter	Expanded Uncertainty (Confidence of 95%(U = 2Uc(y)))
Radiated Emission (30MHz ~ 1000MHz) (3m SAC)	±4.45 dB
Radiated Emission (1GHz ~ 18GHz) (3m SAC)	±5.34 dB

Note: *All the measurement uncertainty value were shown with a coverage k=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.*

5.6 Additions to, deviations, or exclusions from the method

No

5.7 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **FCC - Designation No.: CN1211**

JianYan Testing Group Shenzhen Co., Ltd. has been accredited as a testing laboratory by FCC(Federal Communications Commission). The test firm Registration No. is 727551.

- **ISED – CAB identifier.: CN0021**

The 3m Semi-anechoic chamber and 10m Semi-anechoic chamber of JianYan Testing Group Shenzhen Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

- **CNAS - Registration No.: CNAS L15527**

JianYan Testing Group Shenzhen Co., Ltd. is accredited to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L15527.

- **A2LA - Registration No.: 4346.01**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. The test scope can be found as below link: https://portal.a2la.org/scopepdf/4346-01.pdf

5.8 Laboratory Location

JianYan Testing Group Shenzhen Co., Ltd.
Address: No.101, Building 8, Innovation Wisdom Port, No.155 Hongtian Road, Huangpu Community, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, People's Republic of China.
Tel: +86-755-23118282, Fax:+86-755-23116366
Email: info-JYTee@lets.com, Website: http://jyt.lets.com

5.9 Test Instruments list

Radiated Emission(3M SAC):

Test Equipment	Manufacturer	Model No.	Manage No.	Cal.Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
3m SAC	ETS	9m*6m*6m	WXJ001-1	01-19-2021	01-18-2024
BiConiLog Antenna	Schwarzbeck	VULB9163	WXJ002	03-03-2021	03-02-2022
Biconical Antenna	Schwarzbeck	VUBA9117	WXJ002-1	06-20-2021	06-19-2022
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-2	03-03-2021	03-02-2022
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-3	06-18-2021	06-17-2022
Loop Antenna	Schwarzbeck	FMZB 1519 B	WXJ002-4	03-07-2021	03-06-2022
Pre-amplifier (30MHz ~ 1GHz)	Schwarzbeck	BBV9743B	WXG001-7	03-07-2021	03-06-2022
Pre-amplifier (1GHz ~ 18GHz)	SKET	LNPA_0118G-50	WXG001-3	03-07-2021	03-06-2022
EMI Test Receiver	Rohde & Schwarz	ESRP7	WXJ003-1	03-03-2021	03-02-2022
Spectrum Analyzer	KEYSIGHT	N9010B	WXJ004-2	10-27-2021	10-26-2022
Signal Generator	Agilent	N5173B	WXJ006-7	03-25-2021	03-24-2022
Simulated Station	Rohde & Schwarz	CMW500	WXJ008-3	06-17-2021	06-16-2022
Coaxial Cable (30MHz ~ 1GHz)	JYT	JYT3M-1G-NN-8M	WXG001-4	03-07-2021	03-06-2022
Coaxial Cable (1GHz ~ 18GHz)	JYT	JYT3M-18G-NN-8M	WXG001-5	03-07-2021	03-06-2022
Coaxial Cable (9kHz ~ 30MHz)	JYT	JYT3M-1G-BB-5M	WXG001-6	03-07-2021	03-06-2022
Band Reject Filter Group	Tonscend	JS0806-F	WXJ089	N/A	
Test Software	Tonscend	TS+	Version: 3.0.0.1		

6 Technical requirements specifications

6.1 Unwanted emissions in the spurious domain

Test requirement:	EN 300 220-2 Clause 4.2.2
Test method:	EN 300 220-1 Clause 5.9.3
Receiver setup:	**Table 20: Parameters for TX Spurious Radiations Measurement**

Operating Mode	Frequency Range	RBW_{REF} (see note 2)
Transmit mode	9 kHz ≤ f < 150 kHz	1 kHz
	150 kHz ≤ f < 30 MHz	10 kHz
	30 MHz ≤ f < f_c - m	100 kHz
	f_c - m ≤ f < f_c - n	10 kHz
	f_c - n ≤ f < f_c - p	1 kHz
	f_c + p < f ≤ f_c + n	1 kHz
	f_c + n < f ≤ f_c + m	10 kHz
	f_c + m < f ≤ 1 GHz	100 kHz
	1 GHz < f ≤ 6 GHz	1 MHz

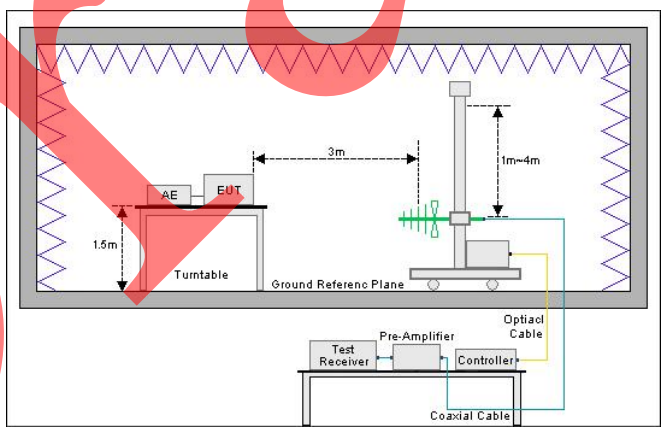
NOTE 1: f is the measurement frequency.
f_c is the Operating Frequency.
m is 10 x OCW or 500 kHz, whichever is the greater.
n is 4 x OCW or 100 kHz, whichever is the greater.
p is 2,5 x OCW.
NOTE 2: If the value of RBW used for measurement is different from RBW_{REF}, use bandwidth correction from clause 4.3.10.1.

Limit:

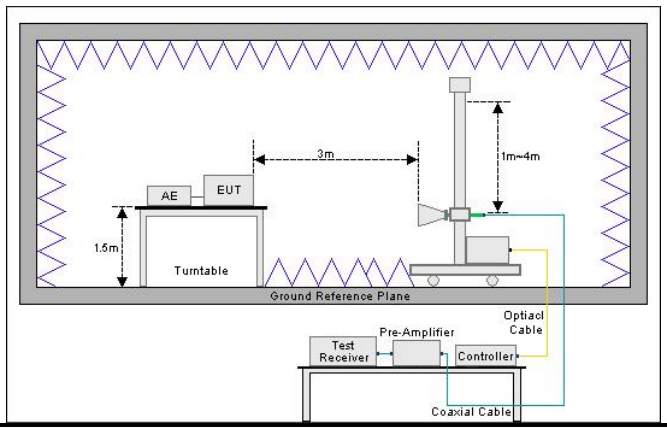
Table 19: Spurious domain emission limits

Frequency / State	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 790 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
TX mode	-54 dBm	-36 dBm	-30 dBm
RX and all other modes	-57 dBm	-57 dBm	-47 dBm

Test frequency range:	25MHz to 4GHz
Test setup:	Below 1GHz



Above 1GHz



Test procedure:	Substitution method was performed to determine the actual ERP emission levels of the EUT. The following test procedure as below: **Below 1GHz test procedure:** 1. On the test site as test setup graph above,the EUT shall be placed at the 1.5m support on the turntable and in the position closest to normal use as declared by the provider. 2. The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.The output of the test antenna shall be connected to the measuring receiver. 3. The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be tuned to the frequency of the transmitter under test. 4. The test antenna shall be raised and lowered from 1m to 4m until a maximum signal level is detected by the measuring receiver. Then the turntable should be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver. 5. Repeat step 4 for test frequency with the test antenna polarized horizontally. 6. Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground. 7. Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends vertically polarized, and with the signal generator tuned to a particular test frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output. 8. Repeat step 7 with both antennas horizontally polarized for each test frequency. 9. Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps 7 and 8 by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula: ERP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBd) where: Pg is the generator output power into the substitution antenna. **Above 1GHz test procedure:** Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber, and the test antenna do not need to raise from 1 to 4m, just test in 1.5m height.
Test instruments:	Refer to section 5.9 for details
Test mode:	Refer to section 5.3 for details
Test results:	Pass

Measurement Data:

TX mode-Low				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
201.81	V	-81.40	-54.00	Pass
381.38	V	-80.78		
944.71	V	-72.31	-36.00	
1736.20	V	-61.54		
2604.30	V	-55.12	-30.00	
3472.40	V	-51.49		
4340.50	V	-53.50		
50.13	Horizontal	-82.08		
221.21	H	-82.42	-54.00	
345.74	H	-83.02		
807.46	H	-73.04	-36.00	
1736.20	H	-62.09		
2604.30	H	-54.47	-30	
3472.40	H	-51.50		
4340.50	H	-53.48		
201.81	V	-81.40		

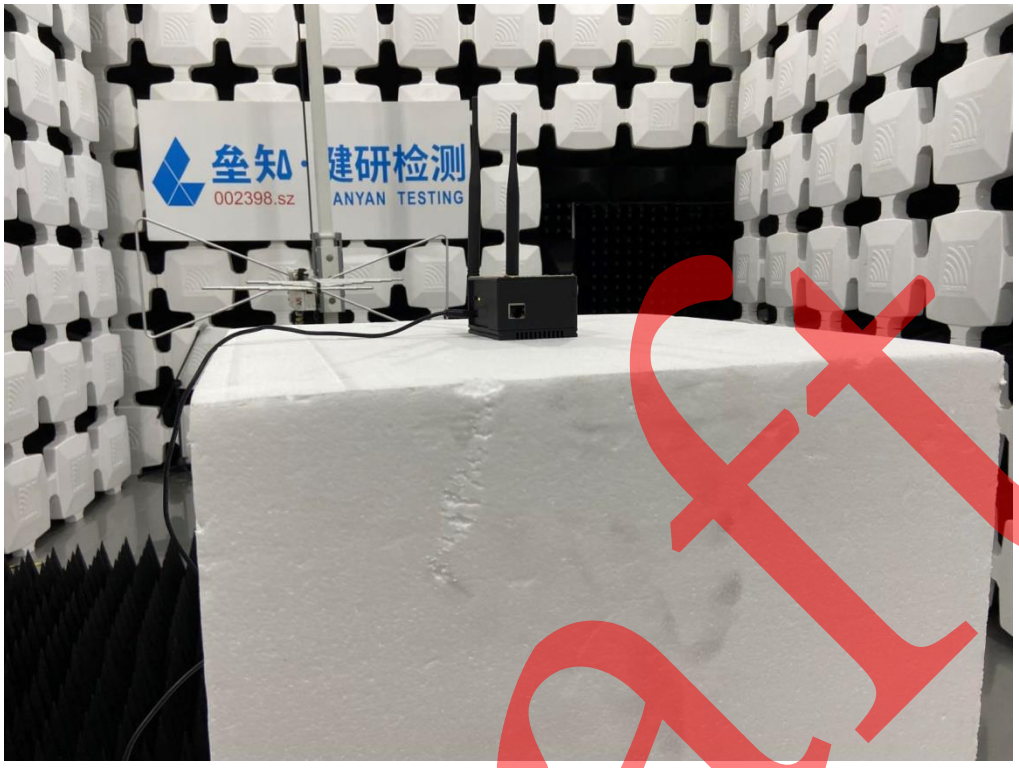
TX mode-Hight				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
105.42	Vertical	-86.09	-54.00	Pass
201.81	V	-81.56		
381.38	V	-81.10	-36.00	
944.71	V	-72.66		
1737.00	V	-62.01	-30.00	
2605.50	V	-54.97		
3474.00	V	-51.21		
4342.50	V	-53.65		
50.13	Horizontal	-81.69	-54.00	
221.21	H	-82.53		
345.74	H	-83.09	-36.00	
807.46	H	-73.38		
1737.00	H	-62.29	-30	
2605.50	H	-54.46		
3474.00	H	-51.91		
4342.50	H	-53.35		

RX mode-LOW				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
105.42	V	-80.41	-57.00	Pass
201.81	V	-72.02		
1736.20	V	-60.47	-47.00	
2604.30	V	-60.45	-57.00	
201.81	Horizontal	-82.06		
381.38	H	-72.93	-47.00	

RX mode-Hight				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	polarization	Level(dBm)		
105.42	V	-80.76	-57.00	Pass
201.81	V	-72.36		
1737.00	V	-60.06	-47.00	
2605.50	V	-60.31	-57.00	
381.38	V	-82.19		
944.71	V	-72.82	-47.00	

7 Test Setup Photo

Radiated Emission Below 1GHz



Radiated Emission Above 1GHz

8 EUT Constructional Details

Reference to the test report No. JYTSZ-R01-2200022.

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