

FCC REPORT (RFID)

Applicant: Nebra Ltd

Address of Applicant: Unit 4 Bells Yew Green Business Court Bells Yew Green

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

FCC ID: 2AZDM-HHRK4

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247

Date of sample receipt: 05 Jan., 2022

Date of Test: 06 Jan., to 27 Jan., 2022

Date of report issued: 28 Jan., 2022

Test Result: **PASS ***

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Bruce Zhang
Laboratory Manager

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product and does not permit the use of the JYT product certification mark. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards.

This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

2 Version

Version No.	Date	Description
00	28 Jan., 2022	Original

Original

Tested by: _____ **Date:** _____

Test Engineer

Reviewed by: _____ **Date:** _____

Project Engineer

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4 Test Summary

Test Items	Section in CFR 47	Test Data	Result
Antenna requirement	15.203 & 15.247 (b)	See Section 6.1	Pass
AC Power Line Conducted Emission	15.207	See Section 6.2	Pass
Conducted Peak Output Power	15.247 (b)(3)	Please refer to FCC ID: 2ARPP-GL5712UX Report No.: SZAWW180830006-01	Pass*
6dB Emission Bandwidth 99% Occupied Bandwidth	15.247 (a)(2)	Please refer to FCC ID: 2ARPP-GL5712UX Report No.: SZAWW180830006-01	Pass*
Power Spectral Density	15.247 (e)	Please refer to FCC ID: 2ARPP-GL5712UX Report No.: SZAWW180830006-01	Pass*
Conducted Band Edge	15.247 (d)	Please refer to FCC ID: 2ARPP-GL5712UX Report No.: SZAWW180830006-01	Pass*
Radiated Band Edge		See Section 6.3.1	Pass
Conducted Spurious Emission	15.205 & 15.209	Please refer to FCC ID: 2ARPP-GL5712UX Report No.: SZAWW180830006-01	Pass*
Radiated Spurious Emission		See Section 6.4.1	Pass
Remark:			
1. Pass: The EUT complies with the essential requirements in the standard.			
2. Pass*: Please refer to FCC ID: 2A3PA-ROCKPI4, and the report No.: SZAWW180830006-01 by Shenzhen Anbotek Compliance Laboratory Limited			
Test Method:	ANSI C63.10-2013 KDB 558074 D01 15.247 Meas Guidance v05r02		

5 General Information

5.1 Client Information

Applicant:	Nebra Ltd
Address:	Unit 4 Bells Yew Green Business Court Bells Yew Green
Manufacturer/Factory:	Nebra Ltd
Address:	Unit 4 Bells Yew Green Business Court Bells Yew Green

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:	923.3-927.5 MHz
Channel numbers:	25
Channel separation:	1 MHz
Modulation technology:	Lora
Antenna Type:	External Antenna
Antenna gain:	3 dBi
Power supply:	DC 5V
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.
Test Sample Condition:	The test samples were provided in good working order with no visible defects.

Operation Frequency each of channel					
Channel	Frequency	Channel	Frequency	Channel	Frequency
1	923.3MHz	4	925.1MHz	7	926.9MHz
2	923.9MHz	5	925.7MHz	8	927.5MHz
3	924.5MHz	6	926.3MHz		

Note:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test. Channel No. 1, 5 & 8 were selected as Lowest, Middle and Highest channel.

5.3 Test environment and mode

Operating Environment:	
Temperature:	24.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010 mbar
Test mode:	
Transmitting mode	Keep the EUT in continuous transmitting with modulation
The sample was placed 0.8m (below 1GHz)/1.5m (above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages. Duty cycle setting during the transmission is 100% with maximum power setting for all modulations.	

5.4 Description of Support Units

Manufacturer	Description	Model	S/N	FCC ID/DoC
LENOVO	Laptop	SL510	2847A65	DoC

5.5 Measurement Uncertainty

Parameter	Expanded Uncertainty (Confidence of 95%)
Radiated Emission (9kHz ~ 30MHz electric field) for 3m SAC	3.13 dB
Radiated Emission (9kHz ~ 30MHz magnetic field) for 3m SAC	3.13 dB
Radiated Emission (30MHz ~ 1GHz) for 3m SAC	4.45 dB
Radiated Emission (1GHz ~ 18GHz) for 3m SAC	5.34 dB
Radiated Emission (18GHz ~ 40GHz) for 3m SAC	5.34 dB

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

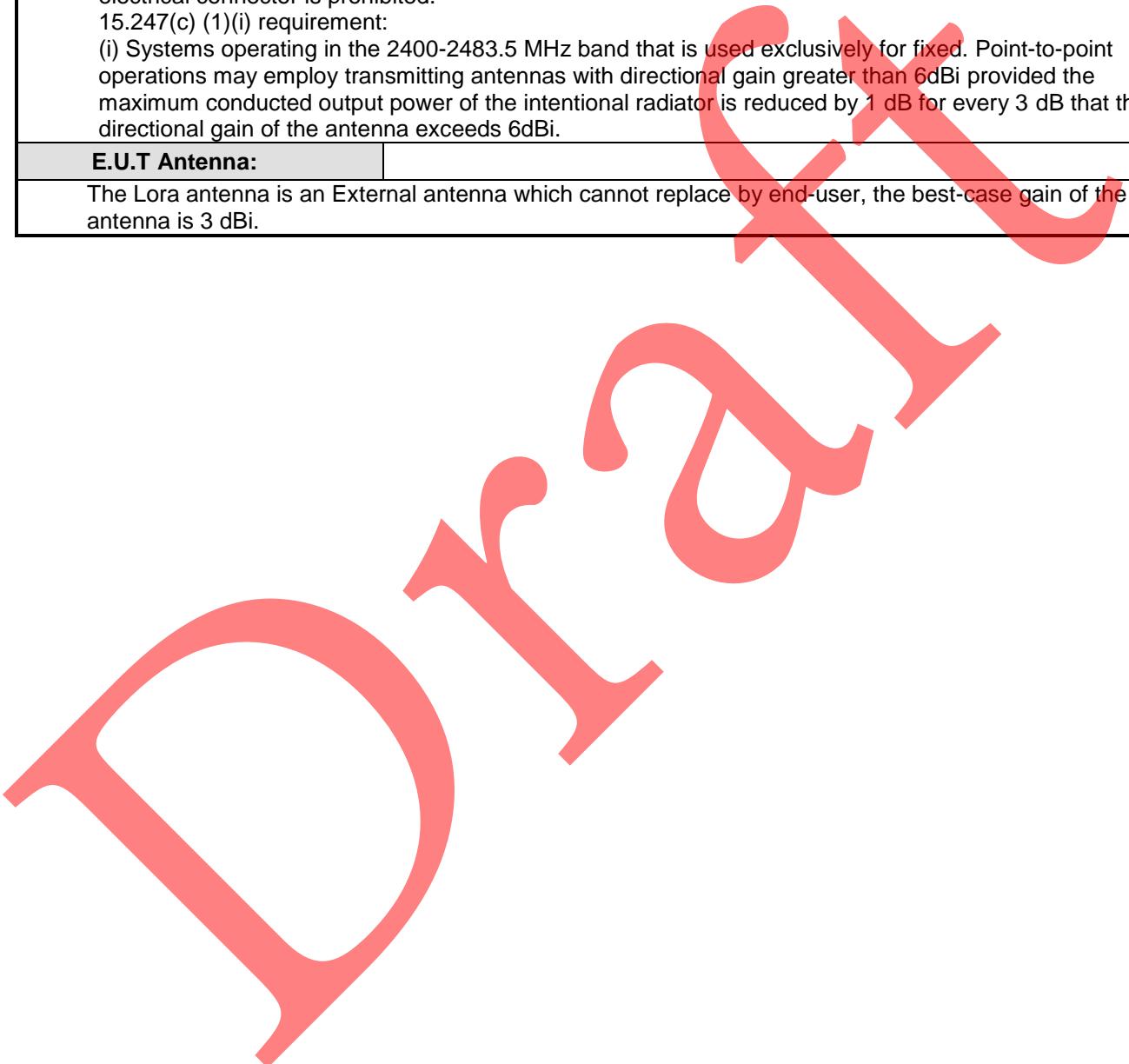
Radiated Emission:					
Test Equipment	Manufacturer	Model No.	Serial No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
3m SAC	ETS	RFD-100	Q1984	04-14-2021	04-13-2024
BiConiLog Antenna	SCHWARZBECK	VULB9163	9163-1246	03-07-2021	03-06-2022
Biconical Antenna	SCHWARZBECK	VUBA 9117	9117#359	06-17-2021	06-17-2022
Horn Antenna	SCHWARZBECK	BBHA9120D	912D-916	03-07-2021	03-06-2022
Broad-Band Horn Antenna	SCHWARZBECK	BBHA9170	1067	04-02-2021	04-01-2022
Broad-Band Horn Antenna	SCHWARZBECK	BBHA9170	1068	04-02-2021	04-01-2022
EMI Test Receiver	Rohde & Schwarz	ESRP7	101070	03-03-2021	03-02-2022
Spectrum analyzer	Rohde & Schwarz	FSP30	101454	03-03-2021	03-02-2022
Spectrum analyzer	Keysight	N9010B	MY60240202	10-27-2021	10-26-2022
Low Pre-amplifier	SCHWARZBECK	BBV9743B	00305	03-07-2021	03-06-2022
High Pre-amplifier	SKET	LNPA_0118G-50	MF280208233	03-07-2021	03-06-2022
Cable	Qualwave	JYT3M-1G-NN-8M	JYT3M-1	03-07-2021	03-06-2022
Cable	Qualwave	JYT3M-18G-NN-8M	JYT3M-2	03-07-2021	03-06-2022
Cable	Qualwave	JYT3M-1G-BB-5M	JYT3M-3	03-07-2021	03-06-2022
Cable	Bost	JYT3M-40G-SS-8M	JYT3M-4	04-02-2021	04-01-2022
EMI Test Software	Tonscend	TS+		Version:3.0.0.1	

Conducted Emission:					
Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
EMI Test Receiver	Rohde & Schwarz	ESCI 3	101189	03-03-2021	03-02-2022
LISN	Schwarzbeck	NSLK 8127	QCJ001-13	03-18-2021	03-17-2022
LISN	Rohde & Schwarz	ESH3-Z5	843862/010	06-18-2020	06-17-2022
ISN	Schwarzbeck	CAT3 8158	#96	03-03-2021	03-02-2022
ISN	Schwarzbeck	CAT5 8158	#166	03-03-2021	03-02-2022
ISN	Schwarzbeck	NTFM 8158	#126	03-03-2021	03-02-2022
RF Switch	TOP PRECISION	RSU0301	N/A	03-03-2021	03-02-2022
Cable	Bost	JYTCE-1G-NN-2M	JYTCE-1	03-03-2021	03-02-2022
Cable	Bost	JYTCE-1G-BN-3M	JYTCE-2	03-03-2021	03-02-2022
EMI Test Software	AUDIX	E3		Version: 6.110919b	

6 Test results and Measurement Data

6.1 Antenna requirement:

Standard requirement:	FCC Part 15 C Section 15.203 /247(c)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.	
E.U.T Antenna:	The Lora antenna is an External antenna which cannot replace by end-user, the best-case gain of the antenna is 3 dBi.

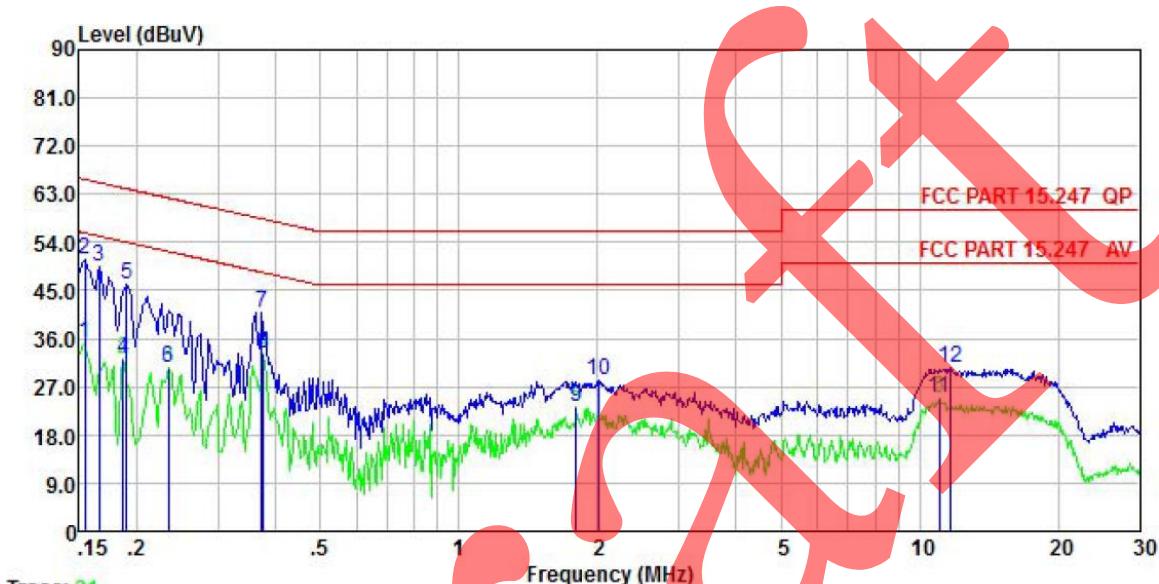


6.2 Conducted Emission

Test Requirement:	FCC Part 15 C Section 15.207														
Test Frequency Range:	150 kHz to 30 MHz														
Class / Severity:	Class B														
Receiver setup:	RBW=9kHz, VBW=30kHz														
Limit:	<table border="1"> <thead> <tr> <th rowspan="2">Frequency range (MHz)</th> <th colspan="2">Limit (dBuV)</th> </tr> <tr> <th>Quasi-peak</th> <th>Average</th> </tr> </thead> <tbody> <tr> <td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr> <tr> <td>0.5-5</td><td>56</td><td>46</td></tr> <tr> <td>5-30</td><td>60</td><td>50</td></tr> </tbody> </table> <p>* Decreases with the logarithm of the frequency.</p>	Frequency range (MHz)	Limit (dBuV)		Quasi-peak	Average	0.15-0.5	66 to 56*	56 to 46*	0.5-5	56	46	5-30	60	50
Frequency range (MHz)	Limit (dBuV)														
	Quasi-peak	Average													
0.15-0.5	66 to 56*	56 to 46*													
0.5-5	56	46													
5-30	60	50													
Test procedure	<ol style="list-style-type: none"> The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.), which provides a 50ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4(latest version) on conducted measurement. 														
Test setup:	<p>Reference Plane</p> <p>LISN</p> <p>40cm</p> <p>80cm</p> <p>AUX Equipment</p> <p>E.U.T</p> <p>Test table/Insulation plane</p> <p>AC power</p> <p>EMI Receiver</p> <p>Filter</p> <p>Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p>														
Test Instruments:	Refer to section 5.9 for details														
Test mode:	Refer to section 5.3 for details														
Test results:	Passed														

Measurement Data:

Product name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	Product model:	NEBHNT-HHRK4-915
Test by:	Mike	Test mode:	Tx mode
Test frequency:	150 KHz ~ 30 MHz	Phase:	Line
Test voltage:	AC 120 V/60 Hz	Environment:	Temp: 22.5°C Huni: 55%



Level (dBuV)

Frequency (MHz)

Trace: 21

FCC PART 15.247 - QP

FCC PART 15.247 - AV

0.15 0.2 0.5 1 2 5 10 20 30

90 81.0 72.0 63.0 54.0 45.0 36.0 27.0 18.0 9.0 0

1 2 3 4 5 6 7 8 9 10 11 12

	Read Freq	LISN Level	Cable Factor	Loss	Limit Level	Over Line Limit	Over Cable Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.154	35.10	0.04	0.01	35.15	55.78	-20.63	Average
2	0.154	50.77	0.04	0.01	50.82	65.78	-14.96	QP
3	0.166	49.43	0.04	0.01	49.48	65.16	-15.68	QP
4	0.186	32.21	0.04	0.02	32.27	54.20	-21.93	Average
5	0.190	46.12	0.04	0.03	46.19	64.02	-17.83	QP
6	0.234	30.54	0.04	0.02	30.60	52.30	-21.70	Average
7	0.373	40.78	0.04	0.03	40.85	58.43	-17.58	QP
8	0.377	33.18	0.04	0.03	33.25	48.34	-15.09	Average
9	1.800	23.07	0.07	0.19	23.33	46.00	-22.67	Average
10	2.012	27.87	0.07	0.21	28.15	56.00	-27.85	QP
11	11.021	24.62	0.22	0.11	24.95	50.00	-25.05	Average
12	11.621	30.14	0.23	0.11	30.48	60.00	-29.52	QP

Notes:

- An initial pre-scan was performed on the line and neutral lines with peak detector.
- Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
- Final Level =Receiver Read level + LISN Factor + Cable Loss.

Product name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	Product model:	NEBHNT-HHRK4-915			
Test by:	Mike	Test mode:	Tx mode			
Test frequency:	150 kHz ~ 30 MHz	Phase:	Neutral			
Test voltage:	AC 120 V/60 Hz	Environment:	Temp: 22.5°C Huni: 55%			
Freq	Read Level	LISN Factor	Cable Loss	Limit Level	Over Line Limit	Remark
MHz	dBuV	dB	dB	dBuV	dBuV	dB
1	0.154	49.11	0.05	0.01	49.17	65.78 -16.61 QP
2	0.166	34.52	0.05	0.01	34.58	55.16 -20.58 Average
3	0.182	45.62	0.04	0.01	45.67	64.42 -18.75 QP
4	0.186	30.90	0.04	0.02	30.96	54.20 -23.24 Average
5	0.222	41.88	0.04	0.03	41.95	62.74 -20.79 QP
6	0.365	39.80	0.04	0.03	39.87	58.61 -18.74 QP
7	0.377	34.48	0.04	0.03	34.55	48.34 -13.79 Average
8	2.167	26.24	0.06	0.18	26.48	56.00 -29.52 QP
9	2.237	20.02	0.07	0.17	20.26	46.00 -25.74 Average
10	2.779	19.96	0.08	0.10	20.14	46.00 -25.86 Average
11	19.740	15.61	0.30	0.15	16.06	50.00 -33.94 Average
12	19.845	23.64	0.30	0.15	24.09	60.00 -35.91 QP

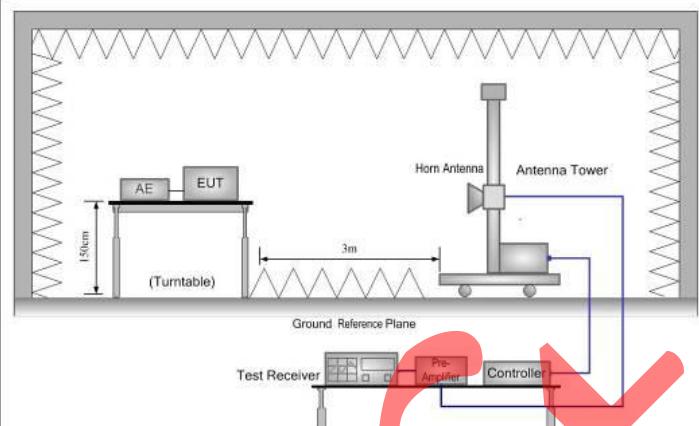
Notes:

- An initial pre-scan was performed on the line and neutral lines with peak detector.
- Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
- Final Level = Receiver Read level + LISN Factor + Cable Loss.

6.3 Band Edge

6.3.1 Radiated Emission Method

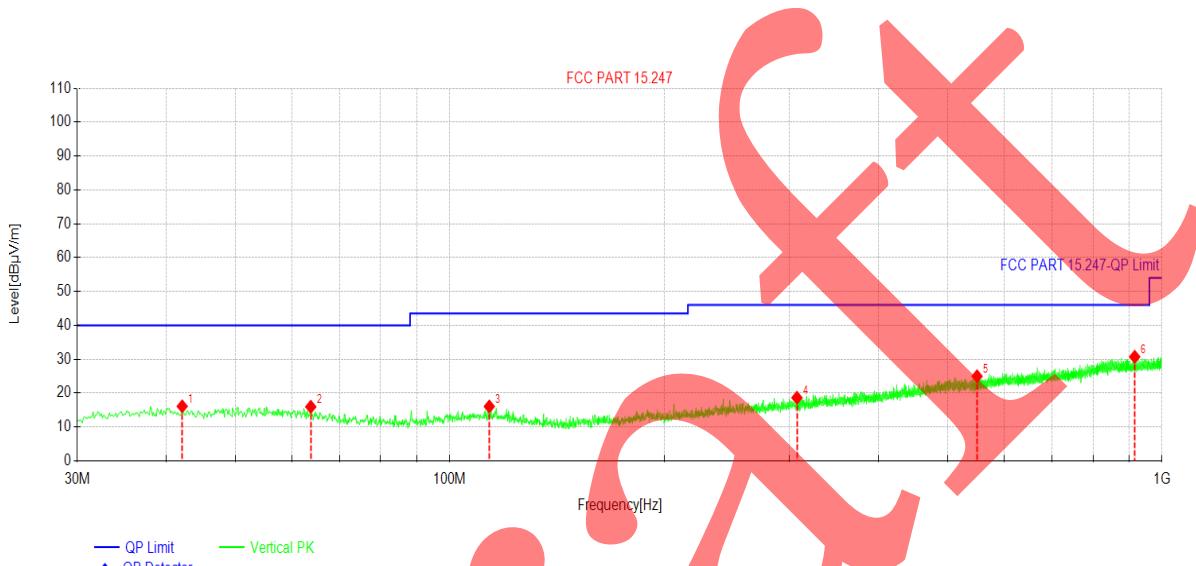
Test Requirement:	FCC Part15 C Section 15.209 and 15.205						
Test Frequency Range:	960MHz to 1.240GHz						
Test site:	Measurement Distance: 3m						
Receiver setup:	Frequency	Detector	RBW	VBW	Remark		
	960MHz-1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak Value		
	Above 1GHz	Peak	1MHz	3MHz	Peak Value		
Limit:	RMS	1MHz	3MHz		Average Value		
	Frequency	Limit (dBuV/m @3m)		Remark			
	960MHz-1GHz	54.00		Quasi-peak Value			
	Above 1GHz	54.00		Average Value			
Test Procedure:		<ol style="list-style-type: none"> The EUT was placed on the top of a rotating table 0.8m(below 1GHz) /1.5m(above 1GHz) above the ground at a 3 meter chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. 					
Test setup:	<p>Below 1GHz</p> <p>Above 1GHz</p>						

	
Test Instruments:	Refer to section 5.9 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

Dr. & I

Below 1GHz:

Product name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	Product model:	NEBHNT-HHRK4-915
Test By:	Mike	Test mode:	Tx mode
Test Channel:	Highest channel	Polarization:	Vertical
Test Voltage:	AC 120/60Hz	Environment:	Temp: 24°C Huni: 57%

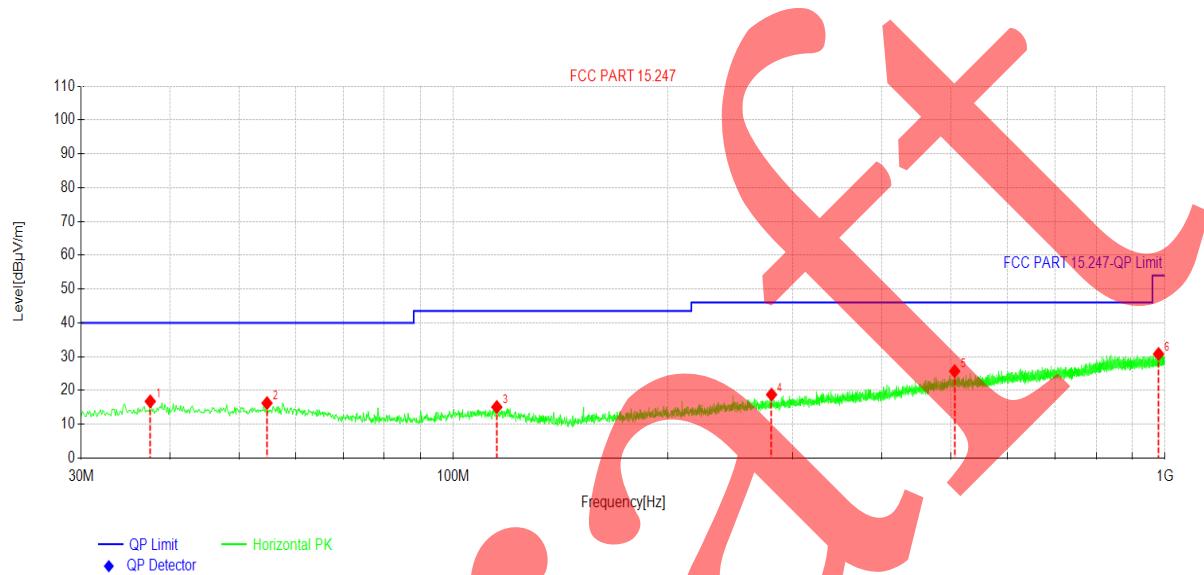


NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Trace	Polarity
1	42.1250	30.80	16.10	-14.70	40.00	23.90	PK	Vertical
2	63.8288	31.46	15.97	-15.49	40.00	24.03	PK	Vertical
3	113.662	31.62	16.05	-15.57	43.50	27.45	PK	Vertical
4	307.298	31.14	18.63	-12.51	46.00	27.37	PK	Vertical
5	550.041	31.87	24.98	-6.89	46.00	21.02	PK	Vertical
6	915.610	31.93	30.72	-1.21	46.00	15.28	PK	Vertical

Remark:

- Final Level = Receiver Read level + Factor(Antenna Factor + Cable Loss – Preamplifier Factor).
- The emission levels of other frequencies are lower than the limit 20dB and not show in test report.

Product name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	Product model:	NEBHNT-HHRK4-915
Test By:	Mike	Test mode:	Tx mode
Test Channel:	Highest channel	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz	Environment:	Temp: 24°C Huni: 57%



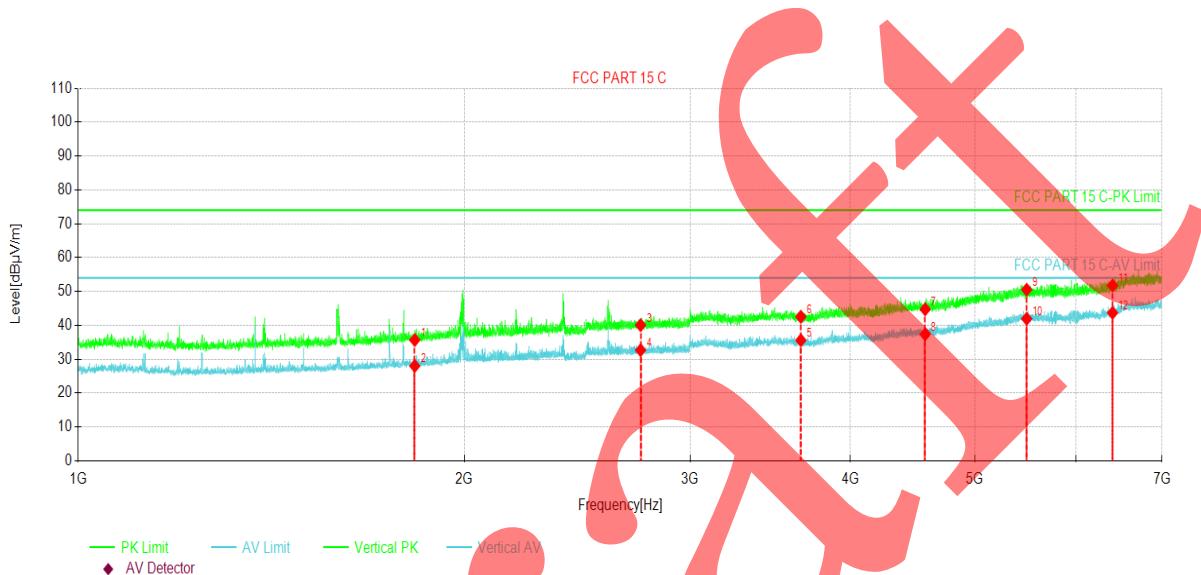
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Trace	Polarity
1	37.5175	31.51	16.78	-14.73	40.00	23.22	PK	Horizontal
2	54.7350	30.89	16.27	-14.62	40.00	23.73	PK	Horizontal
3	115.117	30.59	15.10	-15.49	43.50	28.40	PK	Horizontal
4	280.017	32.04	18.78	-13.26	46.00	27.22	PK	Horizontal
5	506.270	32.61	25.71	-6.90	46.00	20.29	PK	Horizontal
6	979.145	31.72	30.80	-0.92	54.00	23.20	PK	Horizontal

Remark:

- Final Level = Receiver Read level + Factor(Antenna Factor + Cable Loss – Preamplifier Factor).
- The emission levels of other frequencies are lower than the limit 20dB and not show in test report.

Above 1GHz:

Product name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	Product model:	NEBHNT-HHRK4-915
Test By:	Mike	Test mode:	Tx mode
Test Channel:	Highest channel	Polarization:	Vertical
Test Voltage:	AC 120/60Hz	Environment:	Temp: 24°C Huni: 57%



NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Trace	Polarity
1	1830.00	56.54	35.68	-20.86	74.00	38.32	PK	Vertical
2	1830.00	48.87	28.01	-20.86	54.00	25.99	AV	Vertical
3	2745.00	57.14	40.06	-17.08	74.00	33.94	PK	Vertical
4	2745.00	49.78	32.70	-17.08	54.00	21.30	AV	Vertical
5	3660.00	50.04	35.59	-14.45	54.00	18.41	AV	Vertical
6	3660.00	56.98	42.53	-14.45	74.00	31.47	PK	Vertical
7	4575.00	55.28	44.75	-10.53	74.00	29.25	PK	Vertical
8	4575.00	47.89	37.36	-10.53	54.00	16.64	AV	Vertical
9	5490.00	56.70	50.54	-6.16	74.00	23.46	PK	Vertical
10	5490.00	48.12	41.96	-6.16	54.00	12.04	AV	Vertical
11	6405.00	54.99	51.77	-3.22	74.00	22.23	PK	Vertical
12	6405.00	46.93	43.71	-3.22	54.00	10.29	AV	Vertical

Remark:

- Final Level = Receiver Read level + Factor(Antenna Factor + Cable Loss – Preamplifier Factor).
- The emission levels of other frequencies are lower than the limit 20dB and not show in test report.

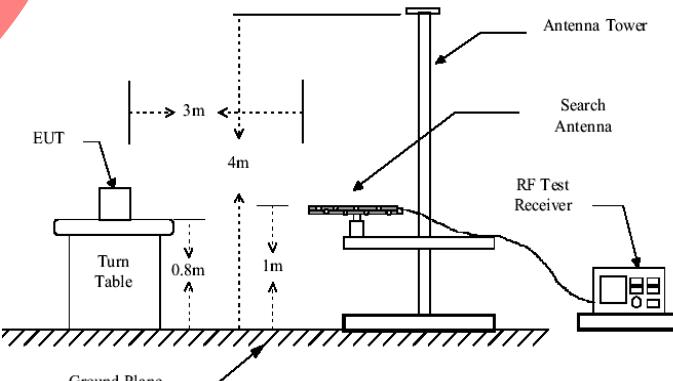
Product name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	Product model:	NEBHNT-HHRK4-915					
Test By:	Mike	Test mode:	Tx mode					
Test Channel:	Highest channel	Polarization:	Horizontal					
Test Voltage:	AC 120/60Hz	Environment:	Temp: 24°C Huni: 57%					
<p>FCC PART 15 C</p> <p>Level [dBµV/m]</p> <p>Frequency [Hz]</p> <p>PK Limit</p> <p>AV Limit</p> <p>Horizontal PK</p> <p>Horizontal AV</p> <p>AV Detector</p> <p>FCC PART 15 C-PK Limit</p> <p>FCC PART 15 C-AV Limit</p>								
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	1830.00	57.33	36.47	-20.86	74.00	37.53	PK	Horizontal
2	1830.00	49.10	28.24	-20.86	54.00	25.76	AV	Horizontal
3	2745.00	49.08	32.00	-17.08	54.00	22.00	AV	Horizontal
4	2745.00	57.54	40.46	-17.08	74.00	33.54	PK	Horizontal
5	3660.00	49.19	34.74	-14.45	54.00	19.26	AV	Horizontal
6	3660.00	56.59	42.14	-14.45	74.00	31.86	PK	Horizontal
7	4575.00	47.62	37.09	-10.53	54.00	16.91	AV	Horizontal
8	4575.00	55.44	44.91	-10.53	74.00	29.09	PK	Horizontal
9	5490.00	55.94	49.78	-6.16	74.00	24.22	PK	Horizontal
10	5490.00	48.48	42.32	-6.16	54.00	11.68	AV	Horizontal
11	6405.00	46.76	43.54	-3.22	54.00	10.46	AV	Horizontal
12	6405.00	55.47	52.25	-3.22	74.00	21.75	PK	Horizontal

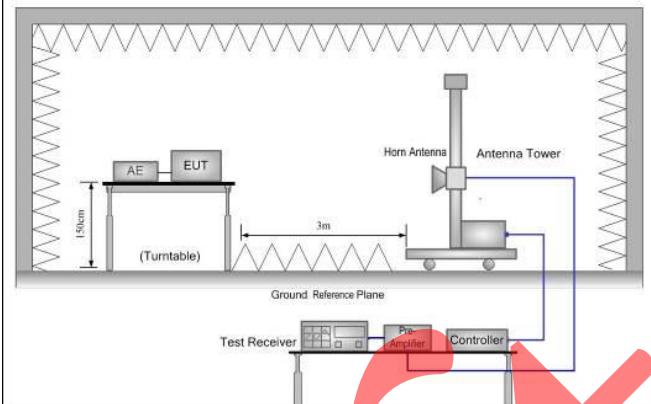
Remark:

- Final Level = Receiver Read level + Factor(Antenna Factor + Cable Loss – Preamplifier Factor).
- The emission levels of other frequencies are lower than the limit 20dB and not show in test report.

6.4 Spurious Emission

6.4.1 Radiated Emission Method

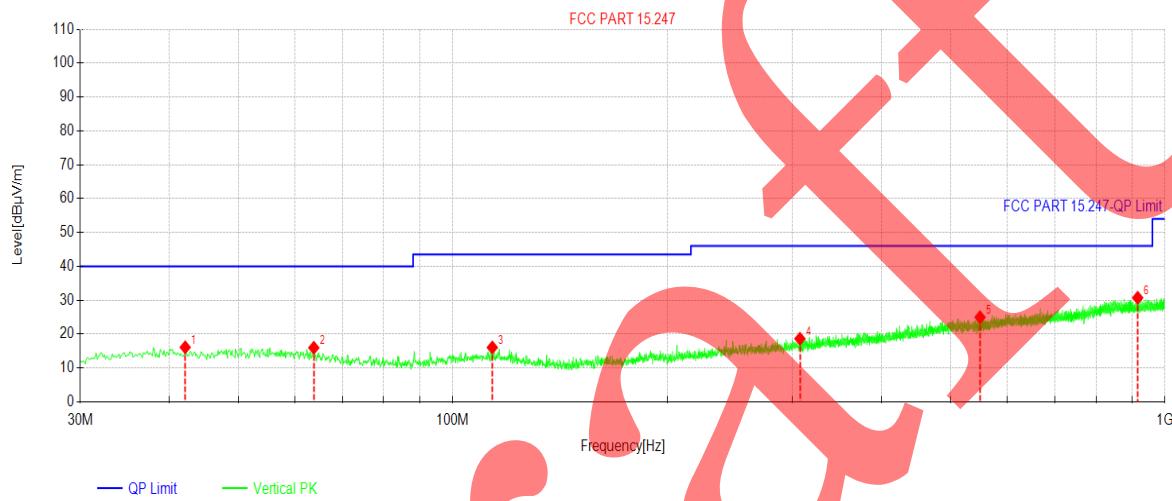
Test Requirement:	FCC Part 15 C Section 15.209 and 15.205								
Test Frequency Range:	9kHz to 25GHz								
Test Distance:	3m								
Receiver setup:	Frequency	Detector	RBW	VBW	Remark				
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak Value				
	Above 1GHz	Peak	1MHz	3MHz	Peak Value				
Limit:	Frequency	Limit (dBuV/m @3m)		Remark					
	30MHz-88MHz	40.0		Quasi-peak Value					
	88MHz-216MHz	43.5		Quasi-peak Value					
	216MHz-960MHz	46.0		Quasi-peak Value					
	960MHz-1GHz	54.0		Quasi-peak Value					
	Above 1GHz	54.0		Average Value					
		74.0		Peak Value					
Test Procedure:	<ol style="list-style-type: none"> The EUT was placed on the top of a rotating table 0.8m(below 1GHz)/1.5m(above 1GHz) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. 								
Test setup:	<p>Below 1GHz</p>  <p>Above 1GHz</p>								

	
Test Instruments:	Refer to section 5.9 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed
Remark:	<ul style="list-style-type: none">1. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis is the worst case.2. 9 kHz to 30MHz is too low, so only shows the data of above 30MHz in this report.

Dr. α

Measurement Data (worst case):**Below 1GHz:**

Product name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	Product model:	NEBHNT-HHRK4-915
Test By:	Mike	Test mode:	Tx mode
Test Frequency:	30 MHz ~ 1 GHz	Polarization:	Vertical
Test Voltage:	AC 120/60Hz	Environment:	Temp: 24°C Huni: 57%



NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Trace	Polarity
1	42.1250	30.80	16.10	-14.70	40.00	23.90	PK	Vertical
2	63.8288	31.46	15.97	-15.49	40.00	24.03	PK	Vertical
3	113.662	31.62	16.05	-15.57	43.50	27.45	PK	Vertical
4	307.298	31.14	18.63	-12.51	46.00	27.37	PK	Vertical
5	550.041	31.87	24.98	-6.89	46.00	21.02	PK	Vertical
6	915.610	31.93	30.72	-1.21	46.00	15.28	PK	Vertical

Remark:

1. Final Level = Receiver Read level + Factor(Antenna Factor + Cable Loss – Preamplifier Factor).
2. The emission levels of other frequencies are lower than the limit 20dB and not show in test report.

Product name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	Product model:	NEBHNT-HHRK4-915
Test By:	Mike	Test mode:	Tx mode
Test Frequency:	30 MHz ~ 1 GHz	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz	Environment:	Temp: 24°C Huni: 57%



NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Trace	Polarity
1	37.5175	31.51	16.78	-14.73	40.00	23.22	PK	Horizontal
2	54.7350	30.89	16.27	-14.62	40.00	23.73	PK	Horizontal
3	115.1117	30.59	15.10	-15.49	43.50	28.40	PK	Horizontal
4	280.017	32.04	18.78	-13.26	46.00	27.22	PK	Horizontal
5	506.270	32.61	25.71	-6.90	46.00	20.29	PK	Horizontal
6	979.145	31.72	30.80	-0.92	54.00	23.20	PK	Horizontal

Remark:

1. Final Level = Receiver Read level + Factor(Antenna Factor + Cable Loss – Preamplifier Factor).
2. The emission levels of other frequencies are lower than the limit 20dB and not show in test report.

Above 1GHz:

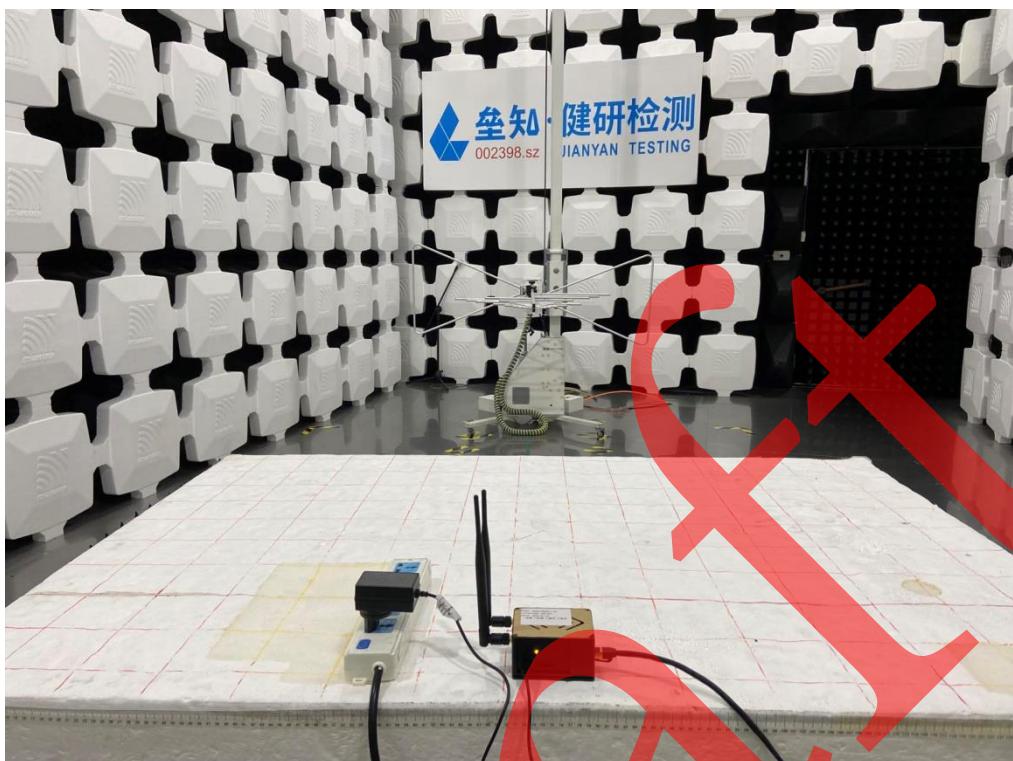
Test channel: Lowest channel								
Detector: Peak Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1806.00	59.40	23.10	4.12	41.21	45.41	74.00	-28.59	Vertical
1806.00	58.37	23.10	4.12	41.21	44.38	74.00	-29.62	Horizontal
Detector: Average Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1806.00	54.84	23.10	4.12	41.21	40.85	54	-13.15	Vertical
1806.00	55.62	23.10	4.12	41.21	41.63	54	-12.37	Horizontal
Test channel: Middle channel								
Detector: Peak Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1830.00	55.80	23.17	4.15	41.27	41.85	74.00	-32.15	Vertical
1830.00	56.49	23.17	4.15	41.27	42.54	74.00	-31.46	Horizontal
Detector: Average Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1830.00	52.05	23.17	4.15	41.27	38.10	54.00	-15.90	Vertical
1830.00	53.42	23.17	4.15	41.27	39.47	54.00	-14.53	Horizontal
Test channel: Highest channel								
Detector: Peak Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1854.00	57.91	23.22	4.17	41.32	43.98	74.00	-30.02	Vertical
1854.00	60.51	23.22	4.17	41.32	46.58	74.00	-27.42	Horizontal
Detector: Average Value								
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
1854.00	55.85	23.22	4.17	41.32	41.92	54.00	-12.08	Vertical
1854.00	57.83	23.22	4.17	41.32	43.90	54.00	-10.10	Horizontal

Remark:

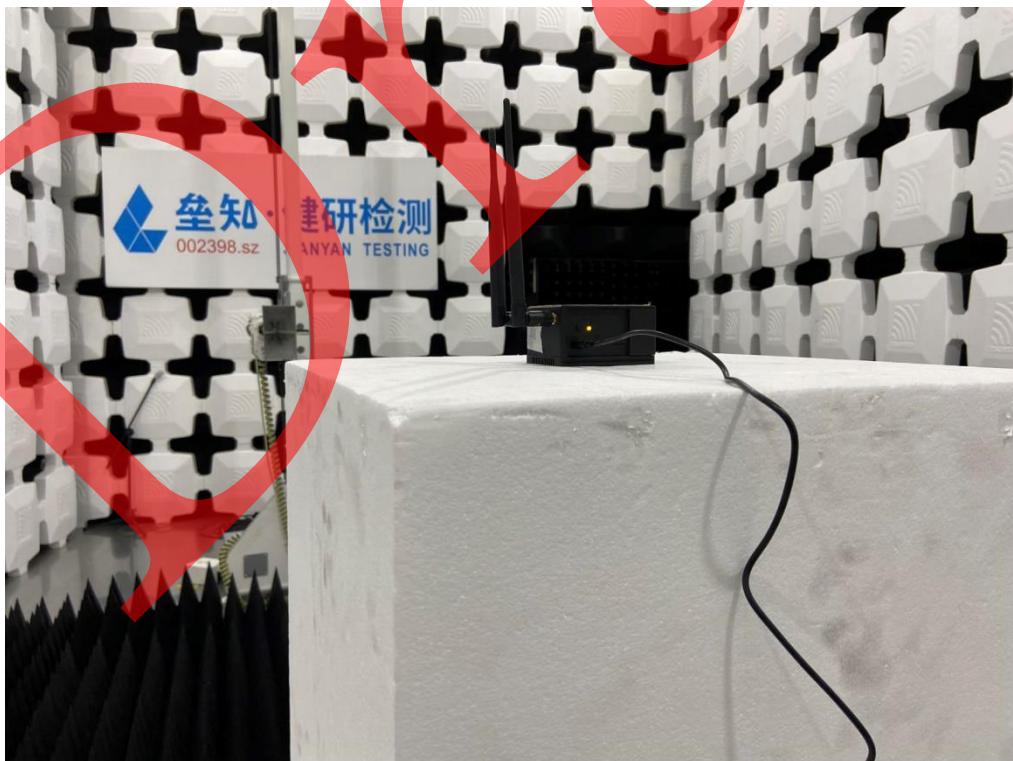
- Final Level = Receiver Read level + Factor(Antenna Factor + Cable Loss – Preamplifier Factor).
- The emission levels of other frequencies are lower than the limit 20dB and not show in test report.

7 Test Setup Photo

Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



Conducted Emission

DR

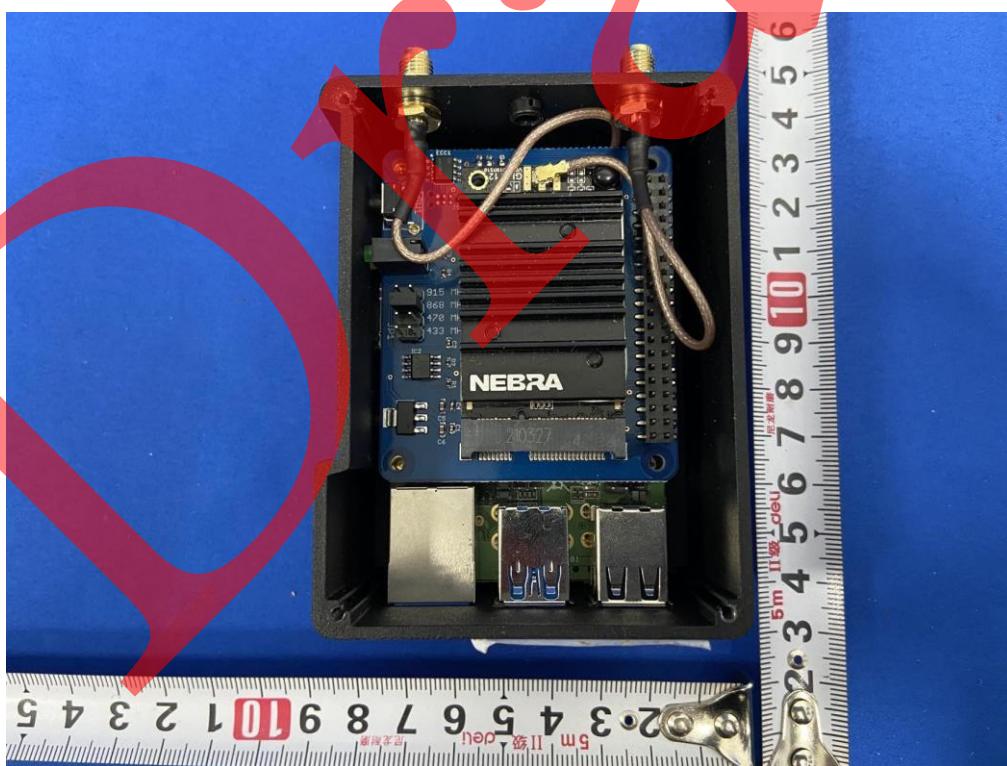
8 EUT Constructional Details

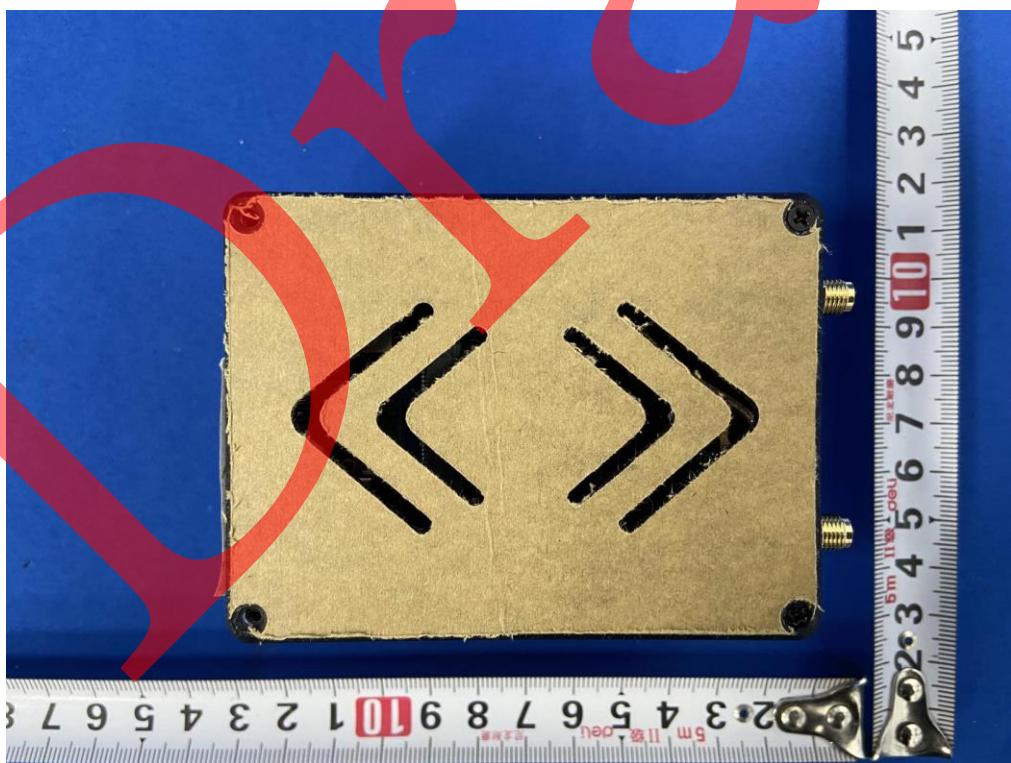
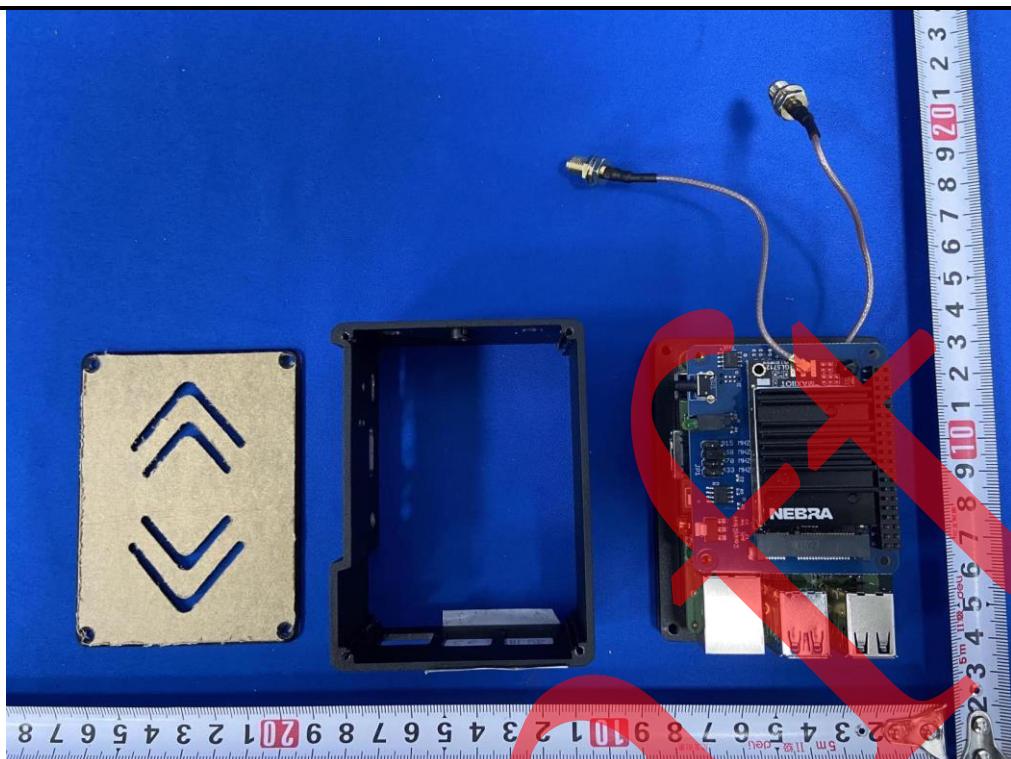




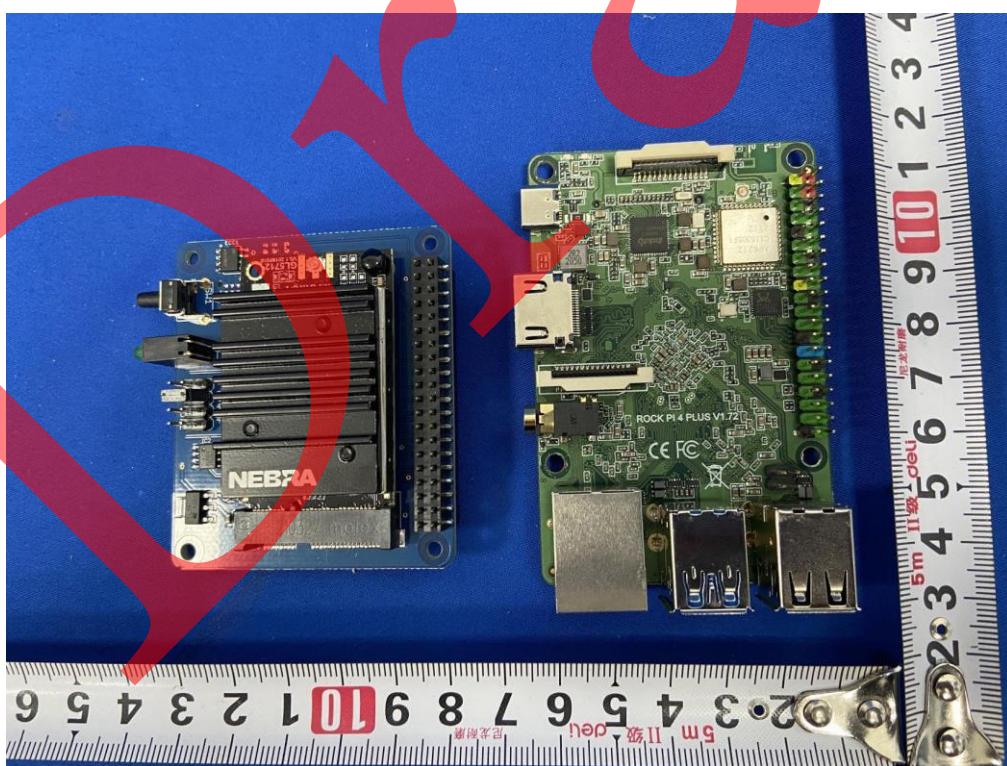
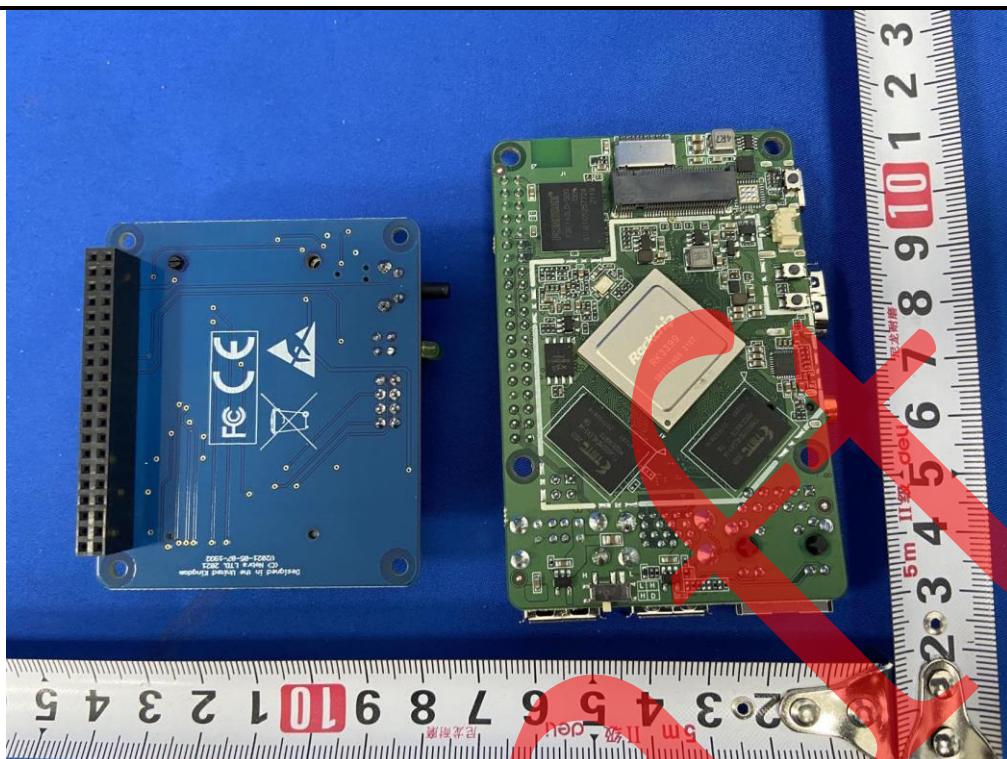


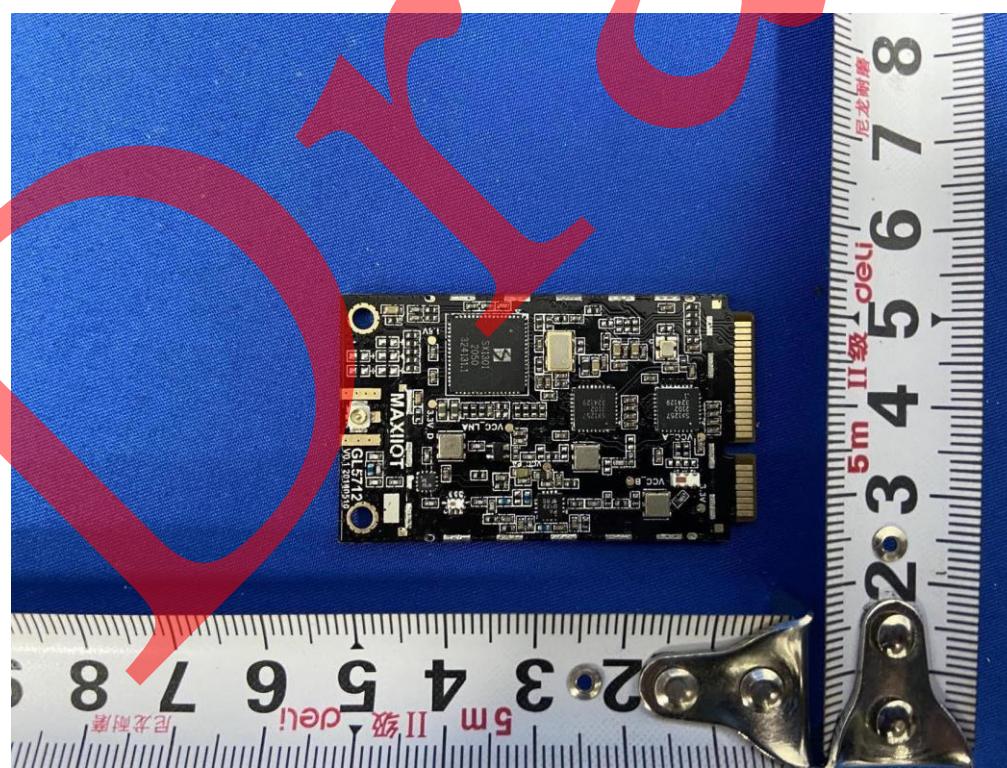
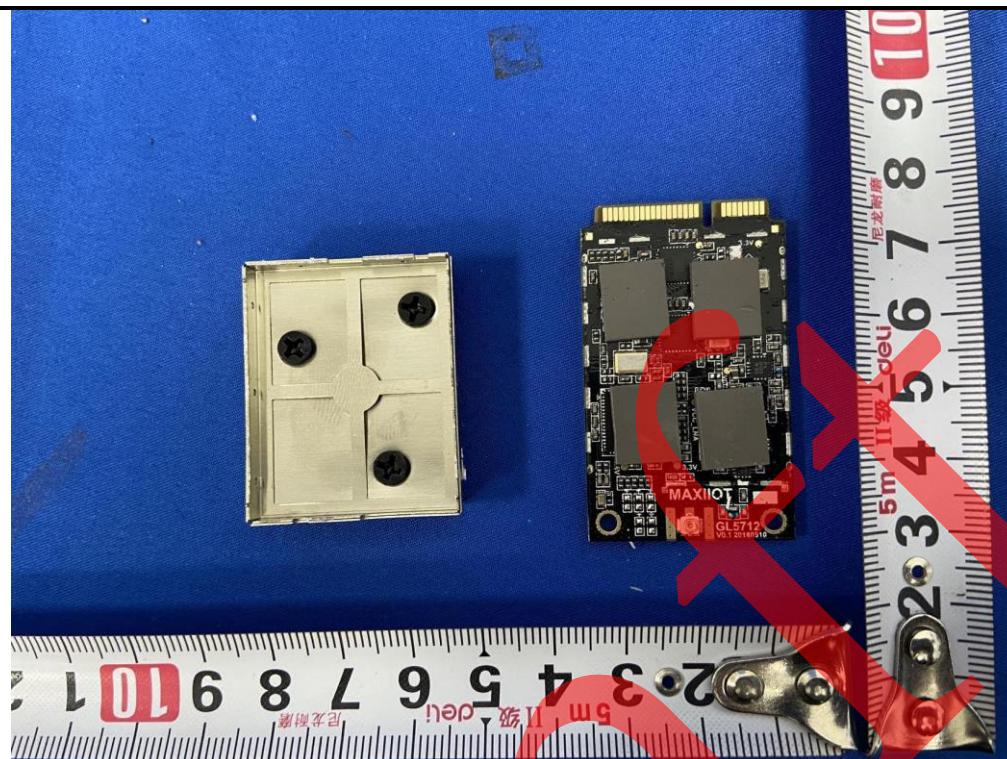


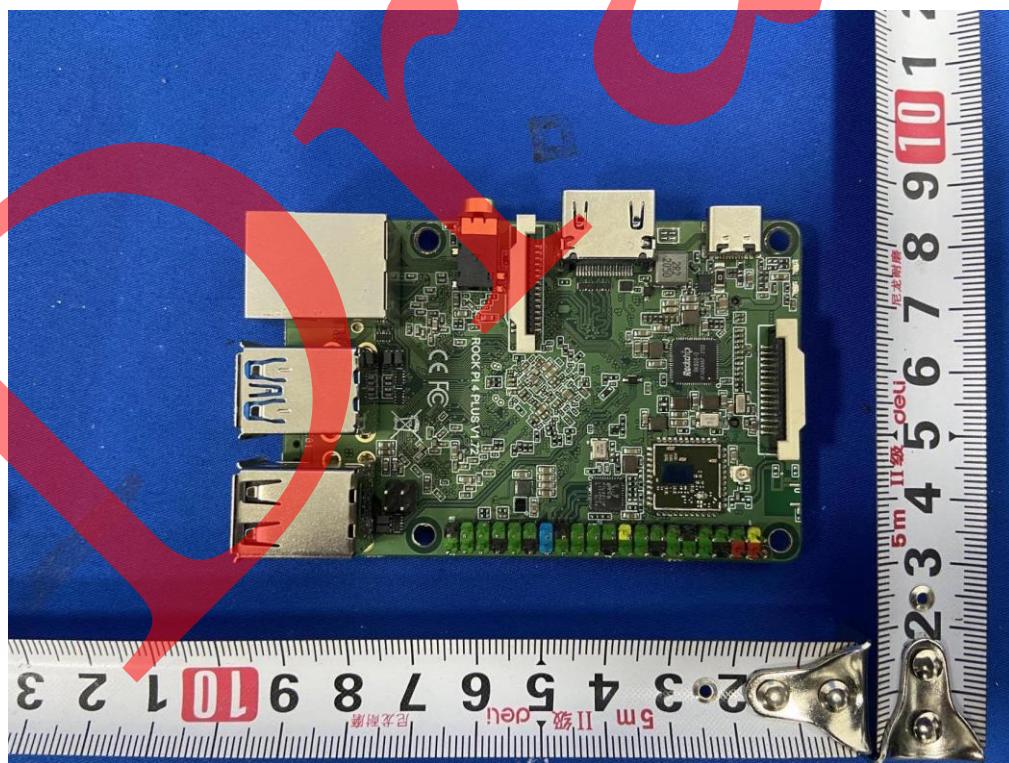
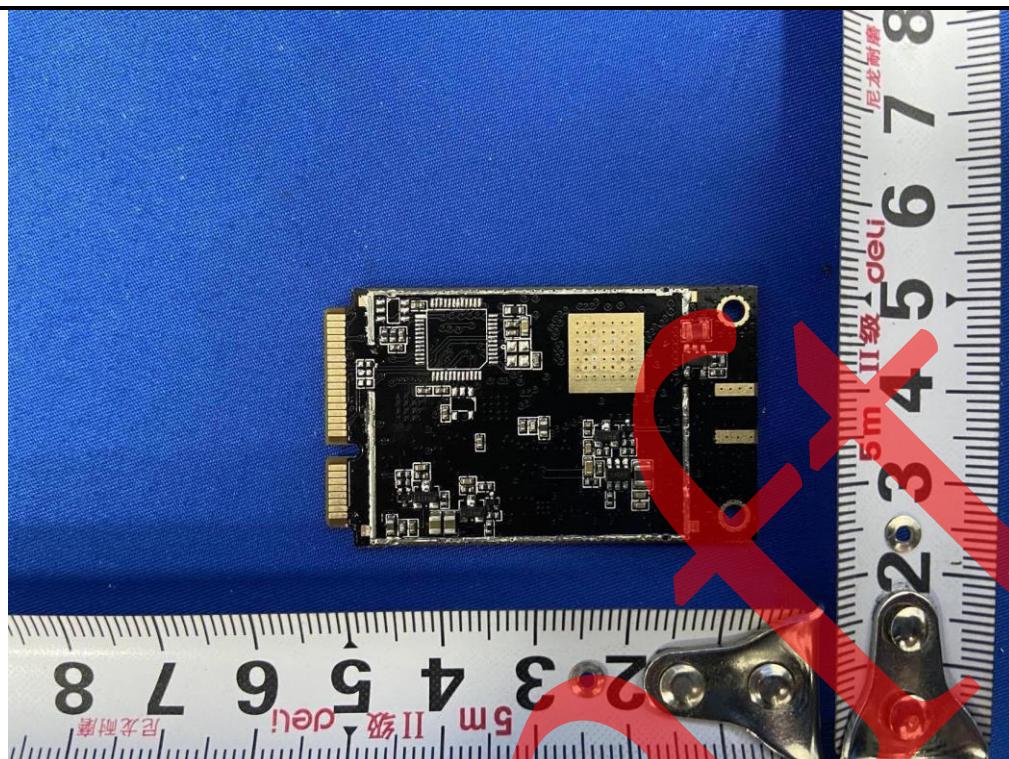


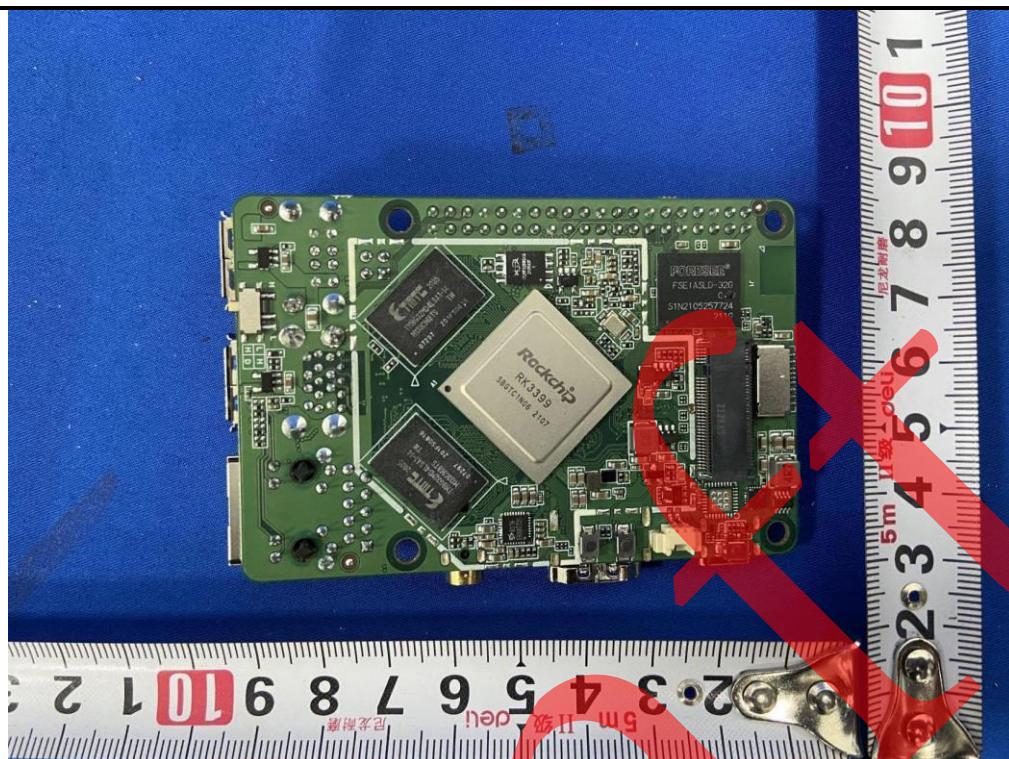


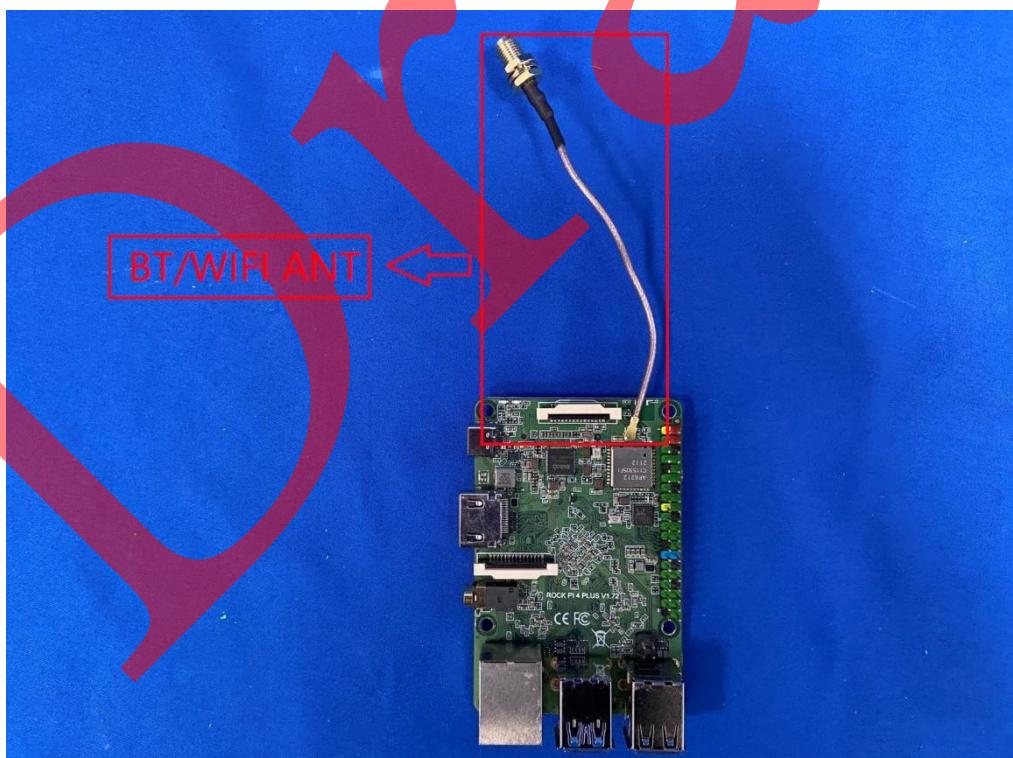
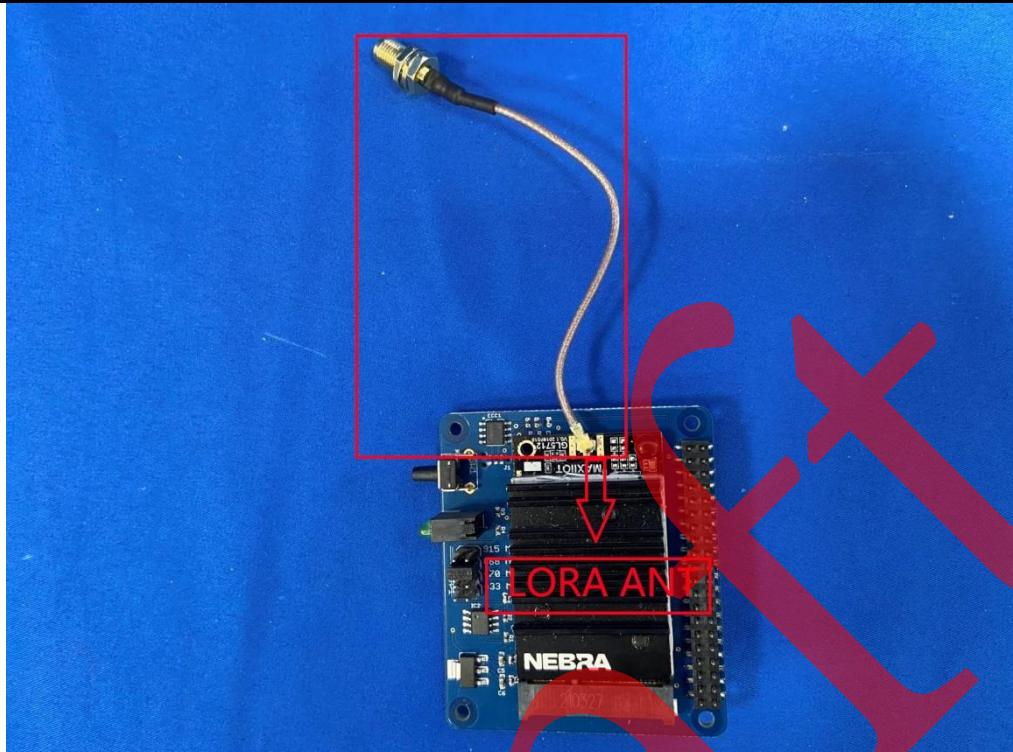












-----End of report-----