FCC EMC Test Report

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.:	NNEBHNT-HHRK4-915, NEBHNT-HHRK4-915-2, NEBHNT-HHRK4-915-3
FCC ID:	2AZDM-HHRK4-1
Applicable Standards:	FCC CFR Title 47 Part 15B
Date of Sample Receipt:	01 Mar., 2022
Date of Test:	02 Mar., to 06 May, 2022
Date of report Issued:	18 May, 2022
Test Result:	PASS

Tested by:	Mike.ou ***Test Engineer***	***Date:***	*18 May, 2022*
Reviewed by:	Winner Zhang ***Project Engineer***	***Date:***	*18 May, 2022*
Approved by:	Manager ***Manager***	***Date:***	*18 May, 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	*07 May, 2022*	*Original*
01	*18 May, 2022*	*Update Model No.*

3 Contents

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4 General Information

4.1 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

4.2 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.:	NNEBHNT-HHRK4-915, NEBHNT-HHRK4-915-2, NEBHNT-HHRK4-915-3
AC Adapter:	Model No.:R241-1202500I Input: AC100-240V, 50/60Hz 1.5 A Output: DC 12.0V, 2.5A
Remark:	Model No.: NEBHNT-HHRK4-915, NEBHNT-HHRK4-915-2, NEBHNT-HHRK4-915-3 were identical inside, the electrical circuit design, layout, components used and internal wiring, with only difference being model name.
Test Sample Condition:	The test samples were provided in good working order with no visible defects.

4.3 Test Mode

Operating Mode	Detail Description
Working mode	Keep the EUT in Working mode
The sample was placed 0.8m 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.	

4.4 Description of Support Units

Manufacturer	Description	Model	S/N	FCC ID/DoC
Lenovo	Laptop	ThinkPad T14 Gen 1	SL10Z47277	DoC

4.5 Description of Cable Used

Cable Type	Description	Length	From	To
N/A				

4.6 Measurement Uncertainty

Parameter	Expanded Uncertainty (Confidence of 95%(U = 2Uc(y)))
Conducted Emission for LISN (9kHz ~ 150kHz)	±3.11 dB
Conducted Emission for LISN (150kHz ~ 30MHz)	±2.62 dB
Radiated Emission (30MHz ~ 1GHz) (3m SAC)	±4.45 dB
Radiated Emission (1GHz ~ 18GHz) (3m SAC)	±5.34 dB
Radiated Emission (18GHz ~ 40GHz) (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.*	

4.7 Additions to, Deviations, or Exclusions from the Method

No

4.8 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

4.9 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

4.10 Test Instruments List

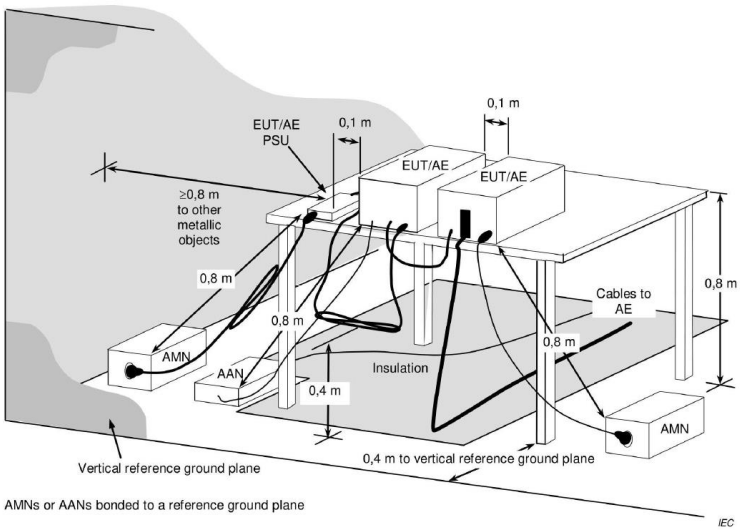
Radiated Emission(3m SAC):					
Test Equipment	**Manufacturer**	**Model No.**	**Manage No.**	**Cal. Date (mm-dd-yy)**	**Cal. Due date (mm-dd-yy)**
3m SAC	ETS	9m*6m*6m	WXJ001-1	01-19-2021	01-18-2024
BiConiLog Antenna	Schwarzbeck	VULB9163	WXJ002	02-17-2022	02-16-2023
Biconical Antenna	Schwarzbeck	VUBA9117	WXJ002-1	06-20-2021	06-19-2022
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-2	02-17-2022	02-16-2023
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-3	06-18-2021	06-17-2022
Pre-amplifier (30MHz ~ 1GHz)	Schwarzbeck	BBV9743B	WXG001-7	02-17-2022	02-16-2023
Pre-amplifier (1GHz ~ 18GHz)	SKET	LNPA_0118G-50	WXG001-3	02-17-2022	02-16-2023
Pre-amplifier (18GHz ~ 40GHz)	RF System	TRLA-180400G45B	WXG001-9	02-17-2022	02-16-2023
EMI Test Receiver	Rohde & Schwarz	ESRP7	WXJ003-1	02-17-2022	02-16-2023
Pre-amplifier (18GHz ~ 40GHz)	RF System	TRLA-180400G45B	WXG001-9	02-17-2022	02-16-2023
Coaxial Cable (30MHz ~ 1GHz)	JYTSZ	JYT3M-1G-NN-8M	WXG001-4	02-17-2022	02-16-2023
Coaxial Cable (1GHz ~ 18GHz)	JYTSZ	JYT3M-18G-NN-8M	WXG001-5	02-17-2022	02-16-2023
Coaxial Cable (9kHz ~ 30MHz)	JYTSZ	JYT3M-1G-BB-5M	WXG001-6	02-17-2022	02-16-2023
Coaxial Cable (18GHz ~ 40GHz)	JYTSZ	JYT3M-40G-SS-8M	WXG001-7	02-17-2022	02-16-2023
Band Reject Filter Group	Tonscend	JS0806-F	WXJ089	N/A	
Test Software	Tonscend	TS+	Version: 3.0.0.1		

Conducted Emission:					
Test Equipment	**Manufacturer**	**Model No.**	**Manage No.**	**Cal. Date (mm-dd-yy)**	**Cal. Due date (mm-dd-yy)**
EMI Test Receiver	Rohde & Schwarz	ESCI 3	WXJ003	02-17-2022	02-16-2023
LISN	Schwarzbeck	NSLK 8127	QCJ001-13	02-17-2022	02-16-2023
LISN	Rohde & Schwarz	ESH3-Z5	WXJ005-1	06-18-2021	06-17-2022
LISN Coaxial Cable (9kHz ~ 30MHz)	JYTSZ	JYTCE-1G-NN-2M	WXG003-1	02-17-2022	02-16-2023
RF Switch	TOP PRECISION	RSU0301	WXG003	N/C	
Test Software	AUDIX	E3	Version: 6.110919b		

5 Measurement Setup and Procedure

5.1 Test Setup

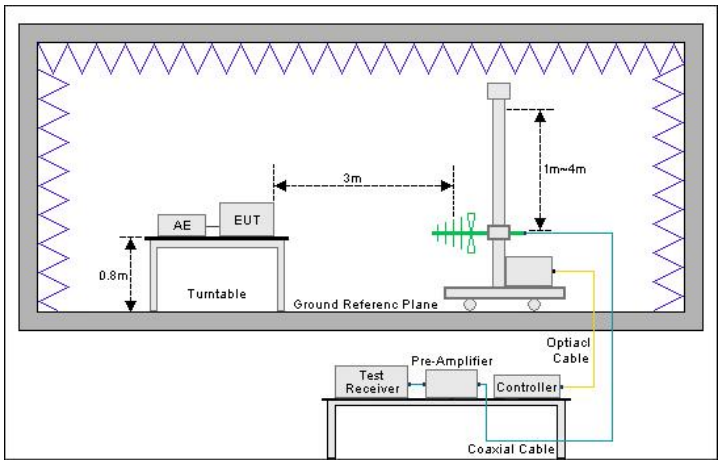
1) Conducted emission measurement:



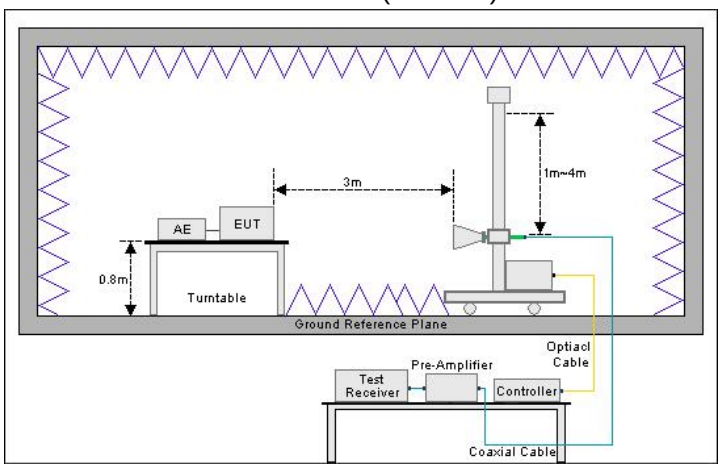
Note: The 0.8 m distance specified between EUT/AE/PSU and AMN/AAN, is applicable only to the EUT being measured. If the device is AE then it shall be >0.8 m.

2) Radiated emission measurement:

Below 1GHz (3m SAC)



Above 1GHz (3m SAC)



5.2 Test Procedure

Test method	Test step
Conducted emission	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. 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). 3. 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 on conducted measurement.
Radiated emission	**For below 1GHz:** 1. The EUT was placed on the tabletop of a rotating table 0.8 m the ground at a 3 m semi anechoic chamber. The measurement distance from the EUT to the receiving antenna is 3 m. 2. EUT works in each mode of operation that needs to be tested，and having the EUT continuously working, respectively on 3 axis (X, Y & Z) and considered typical configuration to obtain worst position. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations. 3. Open the test software to control the test antenna and test turntable. Perform the test, save the test results, and export the test data. **For above 1GHz:** 1. The EUT was placed on the tabletop of a rotating table 0.8 m the ground at a 3 m fully anechoic room. The measurement distance from the EUT to the receiving antenna is 3 m. 2. EUT works in each mode of operation that needs to be tested，and having the EUT continuously working, respectively on 3 axis (X, Y & Z) and considered typical configuration to obtain worst position. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations. 3. Open the test software to control the test antenna and test turntable. Perform the test, save the test results, and export the test data.

6 Test Results

6.1 Summary

6.1.1 Clause and data summary

Test items	Standard clause	Test data	Result
Conducted Emission	Part 15.107	See Section 6.2	Pass
Radiated Emission	Part 15.109	See Section 6.3	Pass

Remark:

1. *The EUT is a **Class B** digital device.*
2. *Pass: The EUT complies with the essential requirements in the standard.*
3. *N/A: Not Applicable.*

Test Method:	*ANSI C63.4:2014*

6.1.2 Test Limit

Test items: Conducted Emission

Limit

Frequency (MHz)	Class A Limit (dBµV)		Class B Limit (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15 – 0.5	79	66	66 to 56 Note 1	56 to 46 Note 1
0.5 – 5	73	60	56	46
5 – 30	73	60	60	50

Note 1: The limit level in dBµV decreases linearly with the logarithm of frequency.
Note 2: The more stringent limit applies at transition frequencies.

Test items: Radiated Emission

Limit

Frequency (MHz)	Class A Limit (dBµV/m)		Class B Limit (dBµV/m)	
	Quasi-Peak @ 3m	Quasi-Peak @ 10m	Quasi-Peak @ 3m	Quasi-Peak @ 10m
30 – 88	49.0	39.0	40.0	30.0
88 – 216	53.5	43.5	43.5	33.5
216 – 960	56.0	46.0	46.0	36.0
960 – 1000	60.0	50.0	54.0	44.0

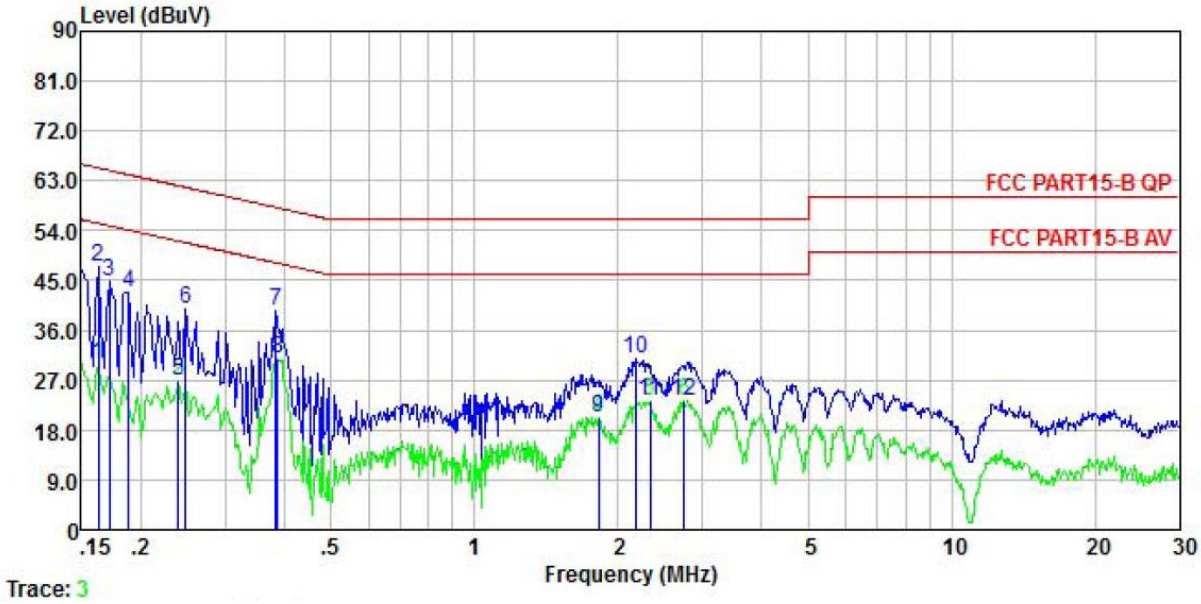
Note: The more stringent limit applies at transition frequencies.

Frequency	Class A Limit (dBµV/m) @ 3m		Class B Limit (dBµV/m) @ 3m	
	Average	Peake	Average	Peake
Above 1 GHz	60.0	80.0	54.0	74.0

Note: The measurement bandwidth shall be 1 MHz or greater.

6.2 Conducted Emission

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:**	Working mode
Test frequency:	150 kHz ~ 30 MHz	**Phase:**	Line
Test voltage:	AC 120 V/60 Hz		

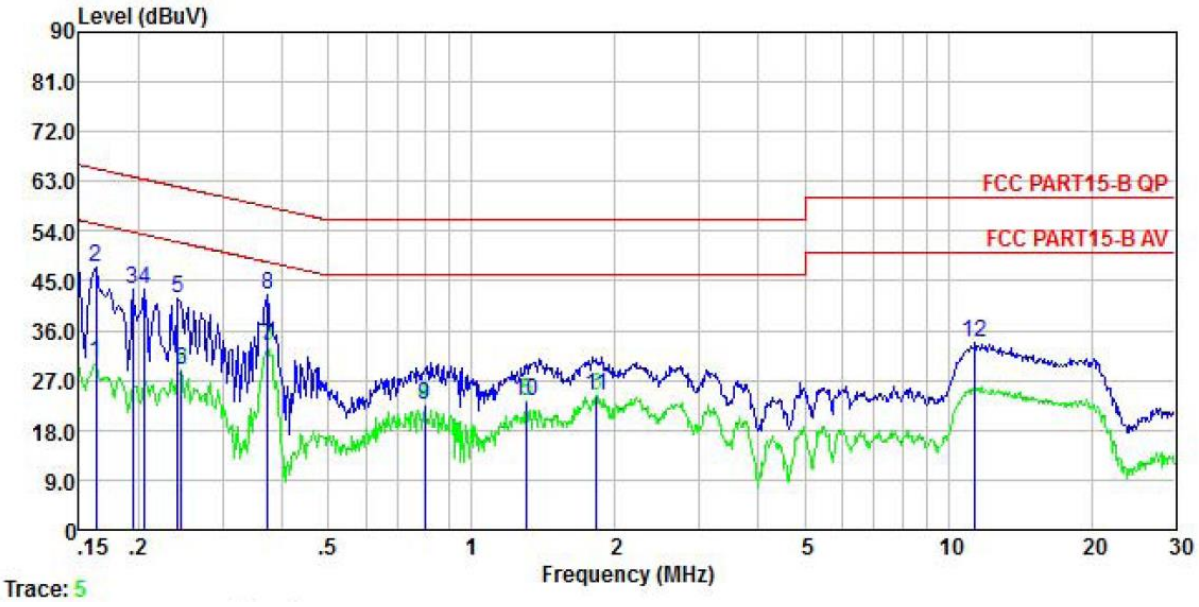


	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.162	29.89	0.00	0.01	29.90	55.34	-25.44	Average
2	0.162	47.43	0.00	0.01	47.44	65.34	-17.90	QP
3	0.171	44.87	0.00	0.01	44.88	64.90	-20.02	QP
4	0.188	42.97	0.00	0.02	42.99	64.11	-21.12	QP
5	0.239	26.86	0.00	0.02	26.88	52.13	-25.25	Average
6	0.248	40.00	0.00	0.01	40.01	61.82	-21.81	QP
7	0.383	39.61	0.00	0.03	39.64	58.21	-18.57	QP
8	0.387	30.82	0.00	0.04	30.86	48.12	-17.26	Average
9	1.819	20.21	0.00	0.19	20.40	46.00	-25.60	Average
10	2.178	30.59	0.00	0.18	30.77	56.00	-25.23	QP
11	2.334	22.93	0.00	0.16	23.09	46.00	-22.91	Average
12	2.750	23.08	0.00	0.10	23.18	46.00	-22.82	Average

Remark:

1. Level = 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:	Working mode
Test frequency:	150 kHz ~ 30 MHz	Phase:	Neutral
Test voltage:	AC 120 V/60 Hz		



	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.162	30.29	0.00	0.01	30.30	55.34	-25.04	Average
2	0.162	47.39	0.00	0.01	47.40	65.34	-17.94	QP
3	0.194	43.50	0.00	0.03	43.53	63.84	-20.31	QP
4	0.206	43.39	0.00	0.04	43.43	63.36	-19.93	QP
5	0.242	41.91	0.00	0.01	41.92	62.04	-20.12	QP
6	0.246	28.83	0.00	0.01	28.84	51.91	-23.07	Average
7	0.373	33.02	0.00	0.03	33.05	48.43	-15.38	Average
8	0.373	42.53	0.00	0.03	42.56	58.43	-15.87	QP
9	0.796	22.47	0.00	0.03	22.50	46.00	-23.50	Average
10	1.303	23.02	0.00	0.11	23.13	46.00	-22.87	Average
11	1.829	23.92	0.00	0.19	24.11	46.00	-21.89	Average
12	11.377	33.80	0.00	0.11	33.91	60.00	-26.09	QP

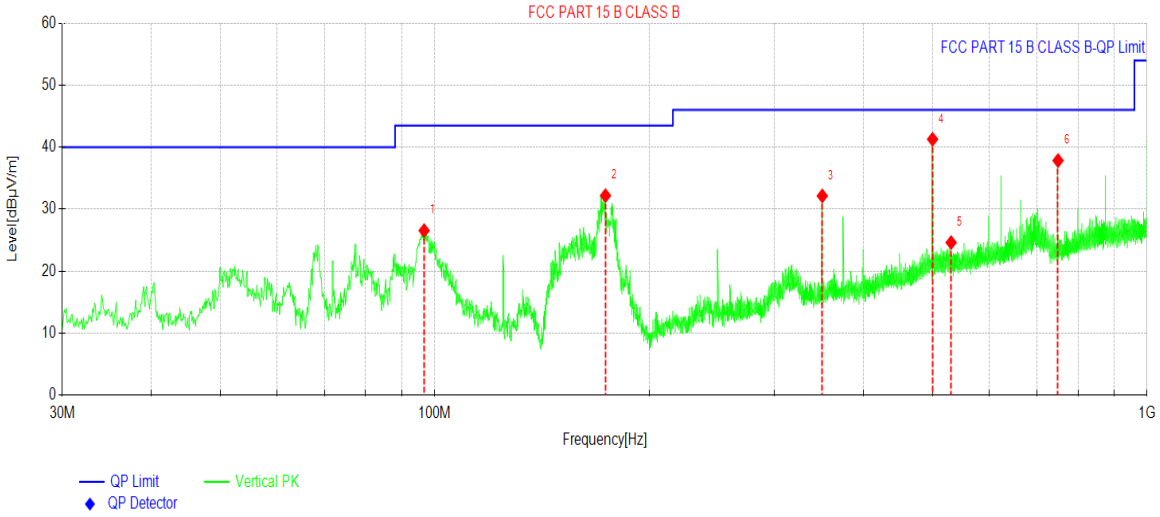
Remark:

1. Level = Read level + LISN Factor + Cable Loss.

6.3 Radiated Emission

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:**	Working mode
Test Frequency:	30 MHz ~ 1 GHz	**Polarization:**	Vertical
Test Voltage:	AC 120/60Hz		

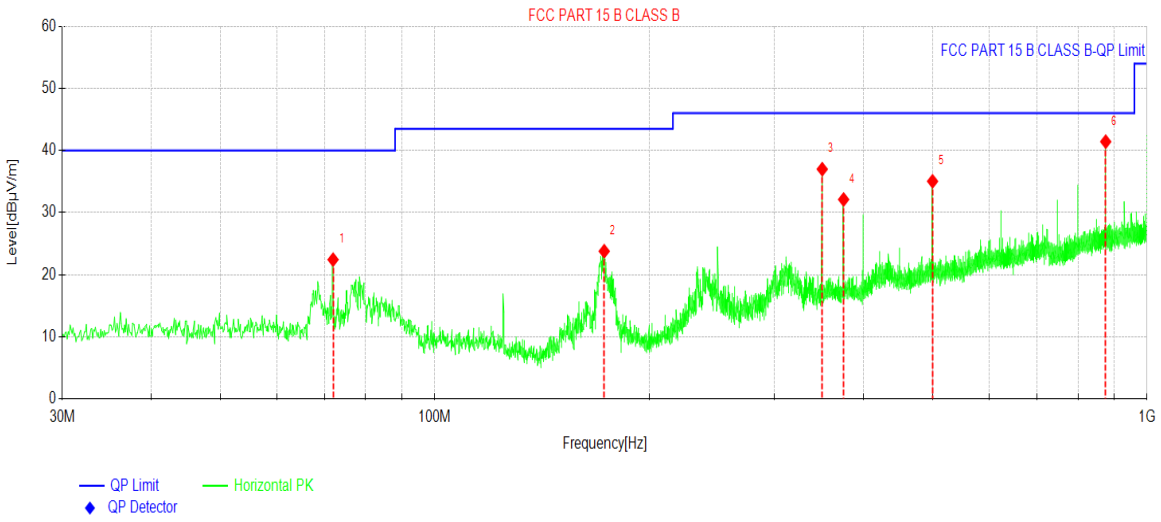


Suspected Data List								
NO.	Freq. [MHz]	Reading[dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	96.6457	43.34	26.55	-16.79	43.50	16.95	PK	Vertical
2	173.671	49.18	32.19	-16.99	43.50	11.31	PK	Vertical
3	350.035	43.62	32.14	-11.48	46.00	13.86	PK	Vertical
4	500.012	48.24	41.28	-6.96	46.00	4.72	PK	Vertical
5	530.861	31.48	24.62	-6.86	46.00	21.38	PK	Vertical
6	750.103	41.59	37.85	-3.74	46.00	8.15	PK	Vertical

Remark:

1. Level = Read level + Antenna Factor + Cable Loss – Preamplifier Factor.

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:	Working mode
Test Frequency:	30 MHz ~ 1 GHz	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz		



Suspected Data List

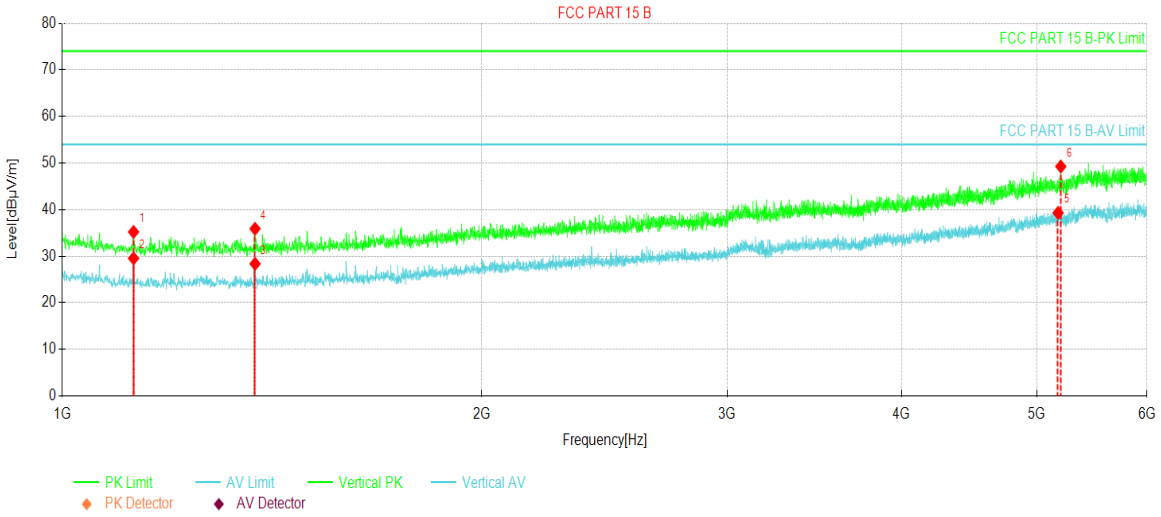
NO.	Freq. [MHz]	Reading[dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Trace	Polarity
1	72.0052	39.42	22.42	-17.00	40.00	17.58	PK	Horizontal
2	172.992	40.77	23.78	-16.99	43.50	19.72	PK	Horizontal
3	350.035	48.47	36.99	-11.48	46.00	9.01	PK	Horizontal
4	375.063	42.99	32.11	-10.88	46.00	13.89	PK	Horizontal
5	500.012	42.00	35.04	-6.96	46.00	10.96	PK	Horizontal
6	875.051	42.89	41.42	-1.47	46.00	4.58	PK	Horizontal

Remark:

1. Level = Read level + Antenna Factor + Cable Loss – Preamplifier Factor.

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:**	Working mode
Test Frequency:	1000 MHz ~ 6000 MHz	**Polarization:**	Vertical
Test Voltage:	AC 120/60Hz		

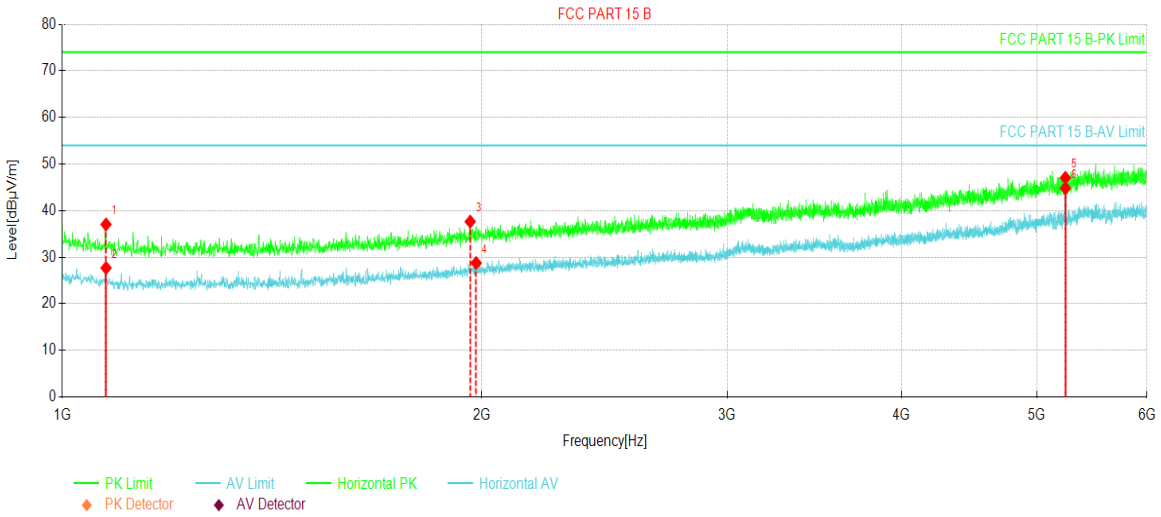


Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	1125.00	58.42	35.20	-23.22	74.00	38.80	PK	Vertical
2	1125.00	52.75	29.53	-23.22	54.00	24.47	AV	Vertical
3	1375.00	51.45	28.36	-23.09	54.00	25.64	AV	Vertical
4	1375.00	58.96	35.87	-23.09	74.00	38.13	PK	Vertical
5	5180.00	46.77	39.29	-7.48	54.00	14.71	AV	Vertical
6	5203.75	56.60	49.25	-7.35	74.00	24.75	PK	Vertical

Remark:

1. Level = Read level + Antenna Factor + Cable Loss – Preamplifier Factor.

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:	Working mode
Test Frequency:	1000 MHz ~ 6000 MHz	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz		



Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	1075.00	59.74	37.02	-22.72	74.00	36.98	PK	Horizontal
2	1075.00	50.40	27.68	-22.72	54.00	26.32	AV	Horizontal
3	1961.87	58.05	37.63	-20.42	74.00	36.37	PK	Horizontal
4	1981.25	49.01	28.74	-20.27	54.00	25.26	AV	Horizontal
5	5243.75	54.10	47.04	-7.06	74.00	26.96	PK	Horizontal
6	5243.75	51.86	44.80	-7.06	54.00	9.20	AV	Horizontal

Remark:

1. Level = Read level + Antenna Factor + Cable Loss – Preamplifier Factor.

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