IC RF Test Report

(2.4G Wi-Fi)

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-HHRK4-915, NEBHNT-HHRK4-915-2, NEBHNT-HHRK4-915-3
Canada IC:	27187-HHRK4
Applicable standards:	RSS-Gen Issue 5, RSS-247 Issue 2
Date of sample receipt:	05 Jan., 2022
Date of Test:	06 Jan., to 08 May., 2022
Date of report issued:	18 May, 2022
Test Result:	PASS

Tested by:	Mike.ou ***Test Engineer***	***Date:***	*18 May, 2022*
Reviewed by:	Aimer Zhang ***Project Engineer***	***Date:***	*18 May, 2022*
Approved by:	***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	*09 May, 2022*	*Original*
01	*13 May, 2022*	*Updated page 1, 4, 11*

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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.:	NEBHNT-HHRK4-915, NEBHNT-HHRK4-915-2, NEBHNT-HHRK4-915-3
Operation Frequency:	2412 MHz - 2462 MHz (802.11b, g, n-HT20)
Channel numbers:	11 (802.11b, g, n-HT20)
Channel separation:	5MHz
Modulation technology: (IEEE 802.11b)	DSSS-DBPSK, DQPSK, CCK
Modulation technology: (IEEE 802.11g/802.11n)	OFDM-BPSK, QPSK, 16QAM, 64QAM
Antenna Type:	External Antenna
Antenna gain:	1 dBi (declare by applicant)
Antenna transmit mode:	SISO (1TX, 1RX)
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 model, sample#	NEBHNT-HHRK4-915, WSZR122200092
Test Sample Condition:	The test samples were provided in good working order with no visible defects.

4.3 Test Mode and Environment

Test mode:	
Transmitting mode:	Keep the EUT in continuous transmitting with modulation

Per-scan all kind of data rate, the follow list were the worst case:

Mode	Data rate
802.11b	1Mbps
802.11g	6Mbps
802.11n-VHT20	6.5Mbps

Remark: *For AC power line conducted emission and radiated spurious emission (below 1GHz), pre-scan 802.11b, g, n modulation mode, found 802.11b modulation mode was worse case mode. The report only reflects the test data of worst mode.*

Operating Environment:	
Temperature:	15℃ ~ 35℃
Humidity:	20 % ~ 75 % RH
Atmospheric Pressure:	1010 mbar

4.4 Description of Support Units

The EUT has been tested as an independent unit.

4.5 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.*

4.6 Additions to, Deviations, or Exclusions from the Method

No

4.7 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

4.8 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

4.9 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	03-07-2021	03-06-2022
				02-17-2022	02-16-2023
Biconical Antenna	Schwarzbeck	VUBA9117	WXJ002-1	06-20-2021	06-19-2022
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-2	03-07-2021	03-06-2022
				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	03-07-2021	03-06-2022
				02-17-2022	02-16-2023
Pre-amplifier (1GHz ~ 18GHz)	SKET	LNPA_0118G-50	WXG001-3	03-07-2021	03-06-2022
				02-17-2022	02-16-2023
Pre-amplifier (18GHz ~ 40GHz)	RF System	TRLA-180400G45B	WXG001-9	03-07-2021	03-06-2022
				02-17-2022	02-16-2023
EMI Test Receiver	Rohde & Schwarz	ESRP7	WXJ003-1	03-03-2021	03-02-2022
				02-17-2022	02-16-2023
Spectrum Analyzer	KEYSIGHT	N9010B	WXJ004-2	11-27-2021	11-26-2022
Band Reject Filter Group	Tonscend	JS0806-F	WXJ089	N/A	
Coaxial Cable (30MHz ~ 1GHz)	JYTSZ	JYT3M-1G-NN-8M	WXG001-4	03-07-2021	03-06-2022
				02-17-2022	02-16-2023
Coaxial Cable (1GHz ~ 18GHz)	JYTSZ	JYT3M-18G-NN-8M	WXG001-5	03-07-2021	03-06-2022
				02-17-2022	02-16-2023
Coaxial Cable (18GHz ~ 40GHz)	JYTSZ	JYT3M-40G-SS-8M	WXG001-7	03-07-2021	03-06-2022
				02-17-2022	02-16-2023
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	03-03-2021	03-02-2022
				02-17-2022	02-16-2023
RF Switch	TOP PRECISION	RSU0301	WXG003	03-03-2021	03-02-2022
				02-17-2022	02-16-2023
LISN	Schwarzbeck	NSLK 8127	QCJ001-13	03-18-2021	03-17-2022
				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	03-03-2021	03-02-2022
				02-17-2022	02-16-2023
Test Software	AUDIX	E3	Version: 6.110919b		

5 Measurement setup and procedure

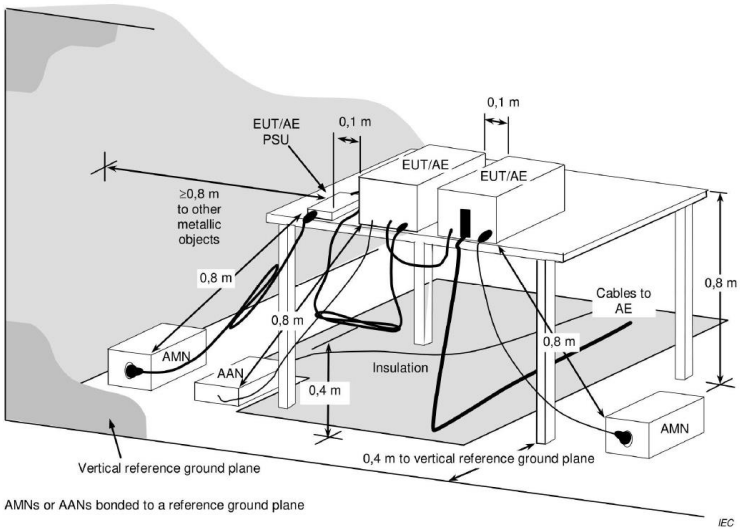
5.1 Test channel

According to ANSI C63.10-2013 chapter 5.6.1 Table 4 requirement, select lowest channel, middle channel, and highest channel in the frequency range in which device operates for testing. The detailed frequency points are as follows:

802.11b, 802.11g, 802.11n-HT20					
Lowest channel		Middle channel		Highest channel	
Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2412	6	2437	11	2462

5.2 Test setup

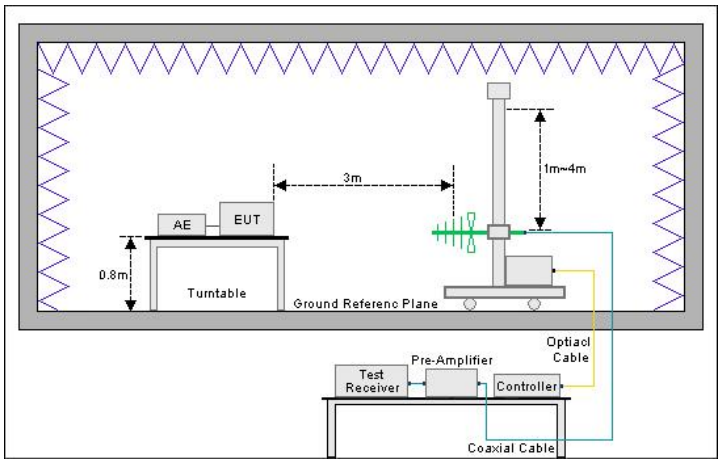
1) Conducted emission measurement:



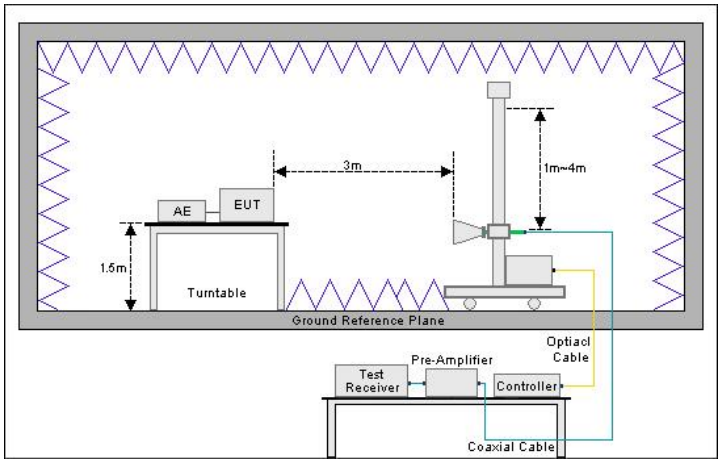
Note: The 0.8 m distance specified between EUT/AE/PSU and AMN/AAN, is applicable only to the EUT being measured. If the device is AE then it shall be >0.8 m.

2) Radiated emission measurement:

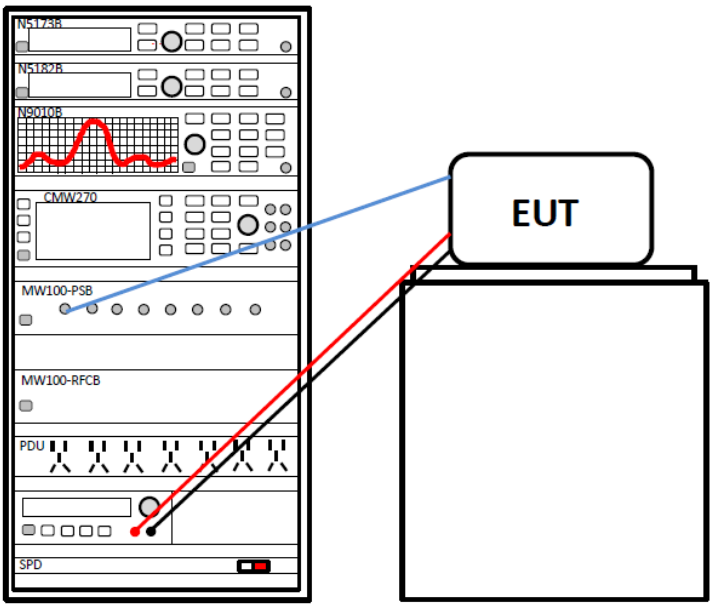
Below 1GHz (3m SAC)



Above 1GHz (3m SAC)



3) Conducted test method



5.3 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 C63.10 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 1.5 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.
Conducted test method	1. The Wi-Fi antenna port of EUT was connected to the test port of the test system through an RF cable. 2. The EUT is keeping in continuous transmission mode and tested in all modulation modes. 3. Open the test software, prepare a test plan, and control the system through the software. After the test is completed, the test report is exported through the test software.

6 Test Results

6.1 Summary

6.1.1 Clause and data summary

Test Items	Standard Clause	Test Data	Result
Antenna Requirement	RSS-Gen Section 6.8 RSS-247 Section 5.4(f)	See Section 6.2	Pass
AC Power Line Conducted Emission	RSS-Gen Section 8.8	See Section 6.3	Pass
Duty Cycle	ANSI C63.10-2013	Appendix A – 2.4G Wi-Fi	Pass
Conducted Peak Output Power	RSS-247 Section 5.4(d)	Appendix A – 2.4G Wi-Fi	Pass
6dB Emission Bandwidth 99% Occupied Bandwidth	RSS-247 Section 5.2(a)	Appendix A – 2.4G Wi-Fi	Pass
Power Spectral Density	RSS-247 Section 5.2(b)	Appendix A – 2.4G Wi-Fi	Pass
Band-edge Emission Conduction Spurious Emission	RSS-247 Section 5.5	Appendix A – 2.4G Wi-Fi	Pass
Emissions in Restricted Frequency Bands	RSS-Gen Section 8.10 RSS-247 Section 5.5	See Section 6.4	Pass
Emissions in Non-restricted Frequency Bands	RSS-Gen Section 6.13 RSS-247 Section 5.5	See Section 6.5	Pass

Remark:

1. *Pass: The EUT complies with the essential requirements in the standard.*
2. *N/A: Not Applicable.*
3. *The cable insertion loss used by "RF Output Power" and other conduction measurement items is 0.5dB (provided by the customer).*

Test Method:	*ANSI C63.10-2013* *KDB 558074 D01 15.247 Meas Guidance v05r02*

6.1.2 Test Limit

<table>
<tr><th>Items</th><th>Limit</th></tr>
<tr><td>AC Power Line Conducted Emission</td><td>
<table>
<tr><th rowspan="2">Frequency (MHz)</th><th colspan="2">Limit (dBµV)</th></tr>
<tr><th>Quasi-Peak</th><th>Average</th></tr>
<tr><td>0.15 – 0.5</td><td>66 to 56 Note</td><td>56 to 46 Note</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>
<tr><td colspan="3">Note: The level decreases linearly with the logarithm of the frequency.</td></tr>
</table>
</td></tr>
<tr><td>Conducted Peak Output Power</td><td>For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).</td></tr>
<tr><td>6dB Emission Bandwidth</td><td>The minimum 6 dB bandwidth shall be at least 500 kHz.</td></tr>
<tr><td>99% Occupied Bandwidth</td><td>N/A</td></tr>
<tr><td>Power Spectral Density</td><td>The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).</td></tr>
<tr><td>Band-edge Emission

Conduction Spurious Emission</td><td>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.</td></tr>
<tr><td>Emissions in Restricted Frequency Bands

Emissions in Non-restricted Frequency Bands</td><td>
<table>
<tr><th rowspan="2">Frequency (MHz)</th><th colspan="2">Limit (dBµV/m)</th><th rowspan="2">Detector</th></tr>
<tr><th>@ 3m</th><th>@ 10m</th></tr>
<tr><td>30 – 88</td><td>40.0</td><td>30.0</td><td>Quasi-peak</td></tr>
<tr><td>88 – 216</td><td>43.5</td><td>33.5</td><td>Quasi-peak</td></tr>
<tr><td>216 – 960</td><td>46.0</td><td>36.0</td><td>Quasi-peak</td></tr>
<tr><td>960 – 1000</td><td>54.0</td><td>44.0</td><td>Quasi-peak</td></tr>
<tr><td colspan="4">Note: The more stringent limit applies at transition frequencies.</td></tr>
<tr><th rowspan="2">Frequency</th><th colspan="3">Limit (dBµV/m) @ 3m</th></tr>
<tr><th colspan="2">Average</th><th>Peake</th></tr>
<tr><td>Above 1 GHz</td><td colspan="2">54.0</td><td>74.0</td></tr>
<tr><td colspan="4">Note: The measurement bandwidth shall be 1 MHz or greater.</td></tr>
</table>
</td></tr>
</table>

6.2 Antenna requirement

Standard requirement:	RSS-Gen Section 6.8 and RSS-247 Section 5.4(f)

RSS-Gen Section 6.8 requirement:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

RSS-247 Section 5.4(f) requirement:

Transmitters operating in the band 2400-2483.5 MHz, may employ antenna systems that emit multiple directional beams simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers, provided that the emissions comply with the following:

i. Different information must be transmitted to each receiver.

ii. If the transmitter employs an antenna system that emits multiple directional beams, but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device (i.e. the sum of the power supplied to all antennas, antenna elements, staves, etc., and summed across all carriers or frequency channels) shall not exceed the applicable output power limit specified in sections 5.4(b) and 5.4(d). However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

iii. If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the applicable power limit specified in sections 5.4(b) and 5.4(d). If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the applicable limit specified in sections 5.4(b) and 5.4(d). In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the applicable limit specified in sections 5.4(b) and 5.4(d) by more than 8 dB.

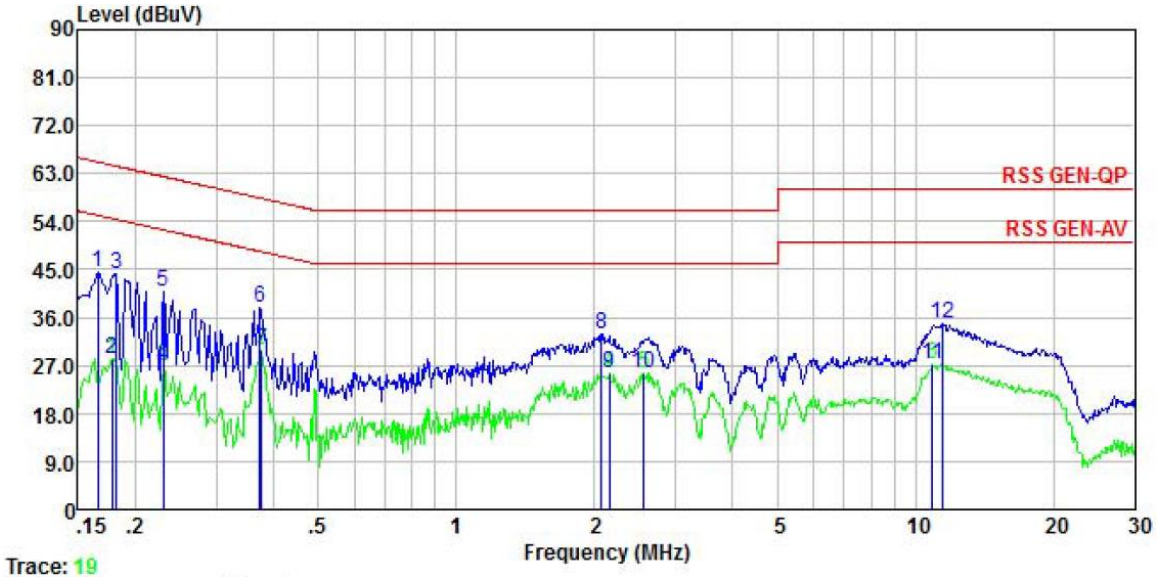
iv. Transmitters that transmit a single directional beam shall operate under the provisions of sections 5.4(b), 5.4(d) and 5.4(e).

E.U.T Antenna:	

The Wi-Fi antenna is an External antenna which cannot replace by end-user, the best case gain of the antenna is 1 dBi. See product internal photos for details.

6.3 AC Power Line 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:	2.4G Wi-Fi mode
Test frequency:	150 kHz ~ 30 MHz	Phase:	Line
Test voltage:	AC 120 V/60 Hz		

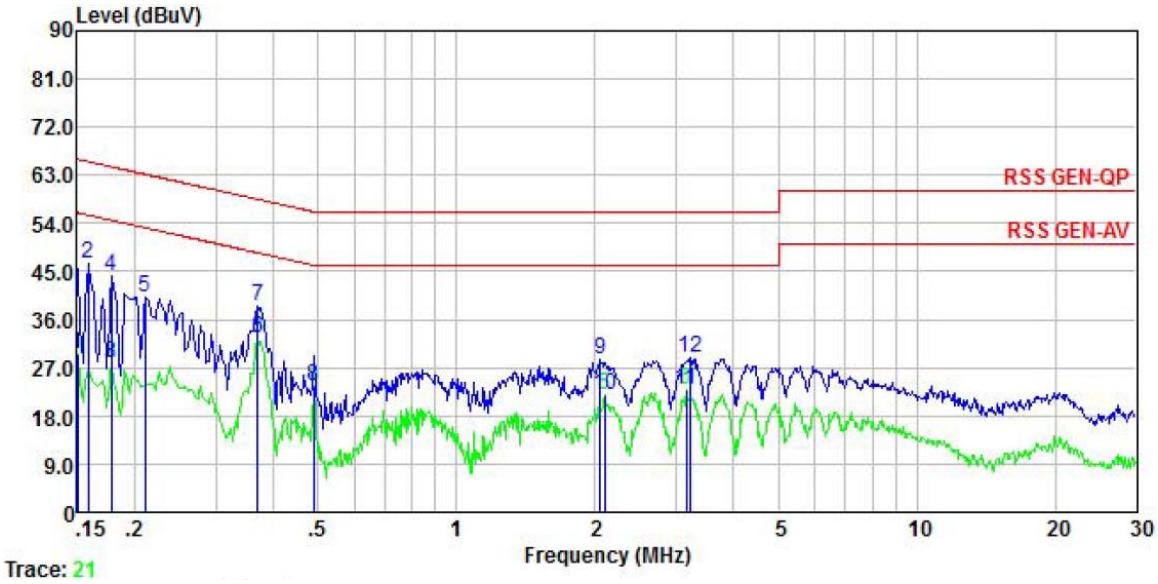


	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.166	44.47	0.00	0.01	44.48	65.16	-20.68	QP
2	0.178	28.38	0.00	0.01	28.39	54.59	-26.20	Average
3	0.182	44.06	0.00	0.01	44.07	64.42	-20.35	QP
4	0.230	27.03	0.00	0.02	27.05	52.44	-25.39	Average
5	0.230	40.99	0.00	0.02	41.01	62.44	-21.43	QP
6	0.373	37.97	0.00	0.03	38.00	58.43	-20.43	QP
7	0.377	29.80	0.00	0.03	29.83	48.34	-18.51	Average
8	2.066	32.62	0.00	0.20	32.82	56.00	-23.18	QP
9	2.155	25.50	0.00	0.18	25.68	46.00	-20.32	Average
10	2.567	25.52	0.00	0.12	25.64	46.00	-20.36	Average
11	10.905	27.08	0.00	0.12	27.20	50.00	-22.80	Average
12	11.438	34.68	0.00	0.11	34.79	60.00	-25.21	QP

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:	2.4G Wi-Fi mode
Test frequency:	150 kHz ~ 30 MHz	Phase:	Neutral
Test voltage:	AC 120 V/60 Hz		



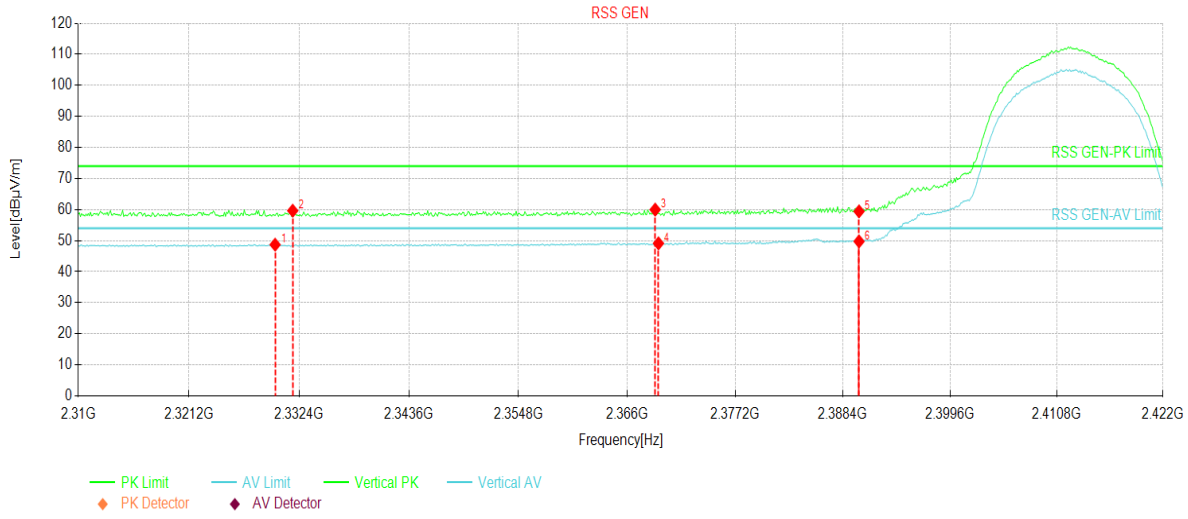
	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.150	29.68	0.00	0.01	29.69	56.00	-26.31	Average
2	0.158	46.49	0.00	0.01	46.50	65.56	-19.06	QP
3	0.178	28.04	0.00	0.01	28.05	54.59	-26.54	Average
4	0.178	44.10	0.00	0.01	44.11	64.59	-20.48	QP
5	0.211	40.28	0.00	0.03	40.31	63.18	-22.87	QP
6	0.369	32.37	0.00	0.03	32.40	48.52	-16.12	Average
7	0.369	38.33	0.00	0.03	38.36	58.52	-20.16	QP
8	0.489	23.64	0.00	0.03	23.67	46.19	-22.52	Average
9	2.055	28.45	0.00	0.20	28.65	56.00	-27.35	QP
10	2.099	21.77	0.00	0.19	21.96	46.00	-24.04	Average
11	3.156	22.78	0.00	0.07	22.85	46.00	-23.15	Average
12	3.207	28.79	0.00	0.07	28.86	56.00	-27.14	QP

Remark:

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

6.4 Emissions in Restricted Frequency Bands

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:	802.11b Tx mode
Test Channel:	Lowest channel	Polarization:	Vertical
Test Voltage:	AC 120/60Hz		



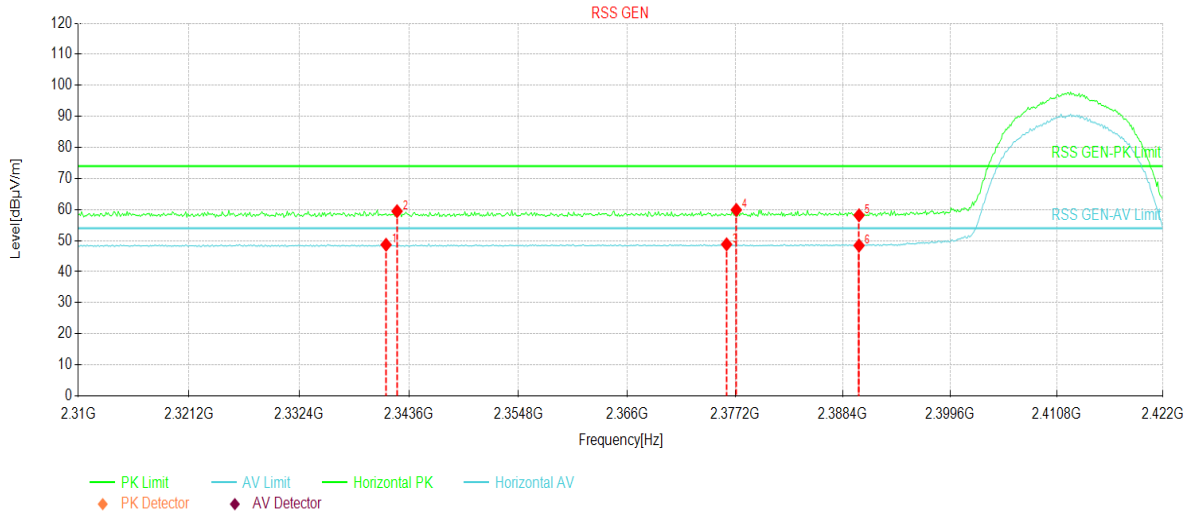
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2329.9360	13.28	48.69	35.41	54.00	5.31	AV	Vertical
2	2331.7280	24.20	59.63	35.43	74.00	14.37	PK	Vertical
3	2368.9120	24.29	59.98	35.69	74.00	14.02	PK	Vertical
4	2369.2480	13.42	49.11	35.69	54.00	4.89	AV	Vertical
5	2390.0800	23.58	59.42	35.84	74.00	14.58	PK	Vertical
6	2390.0800	13.91	49.75	35.84	54.00	4.25	AV	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:	802.11b Tx mode
Test Channel:	Lowest channel	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz		



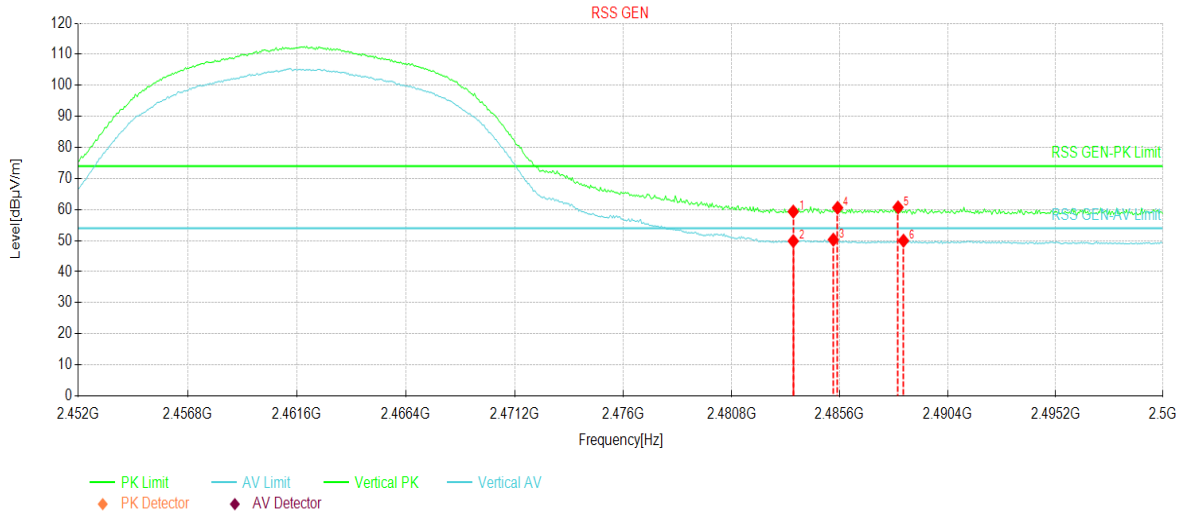
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2341.2480	13.18	48.67	35.49	54.00	5.33	AV	Horizontal
2	2342.3680	23.97	59.47	35.50	74.00	14.53	PK	Horizontal
3	2376.3040	13.06	48.80	35.74	54.00	5.20	AV	Horizontal
4	2377.3120	24.14	59.89	35.75	74.00	14.11	PK	Horizontal
5	2390.0800	22.32	58.16	35.84	74.00	15.84	PK	Horizontal
6	2390.0800	12.57	48.41	35.84	54.00	5.59	AV	Horizontal

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:	802.11b Tx mode
Test Channel:	Highest channel	Polarization:	Vertical
Test Voltage:	AC 120/60Hz		



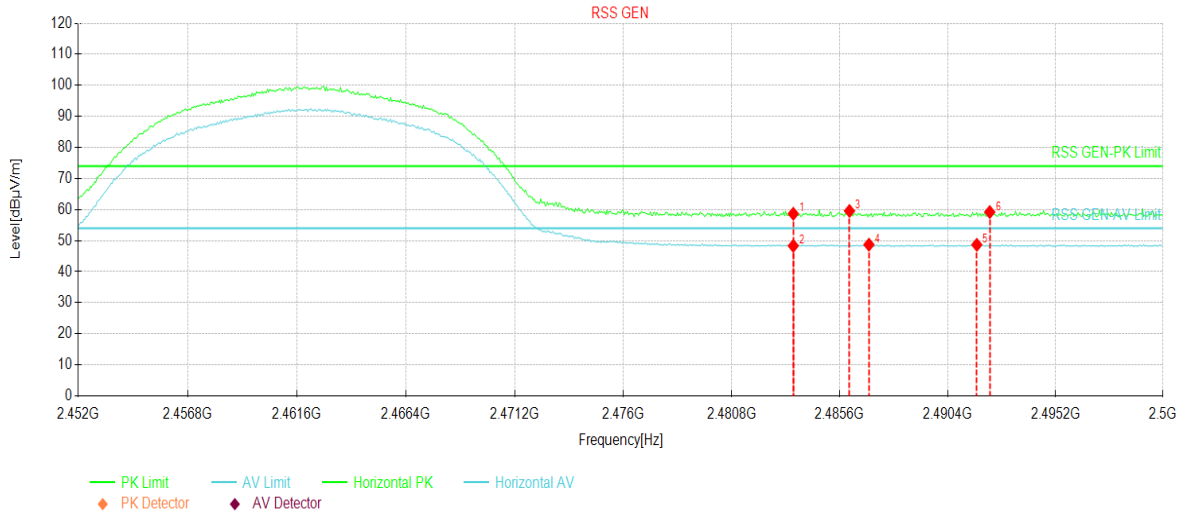
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2483.5360	23.63	59.35	35.72	74.00	14.65	PK	Vertical
2	2483.5360	14.14	49.86	35.72	54.00	4.14	AV	Vertical
3	2485.3120	14.60	50.31	35.71	54.00	3.69	AV	Vertical
4	2485.5040	24.87	60.58	35.71	74.00	13.42	PK	Vertical
5	2488.1920	25.00	60.71	35.71	74.00	13.29	PK	Vertical
6	2488.4320	14.26	49.97	35.71	54.00	4.03	AV	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:	802.11b Tx mode
Test Channel:	Highest channel	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz		



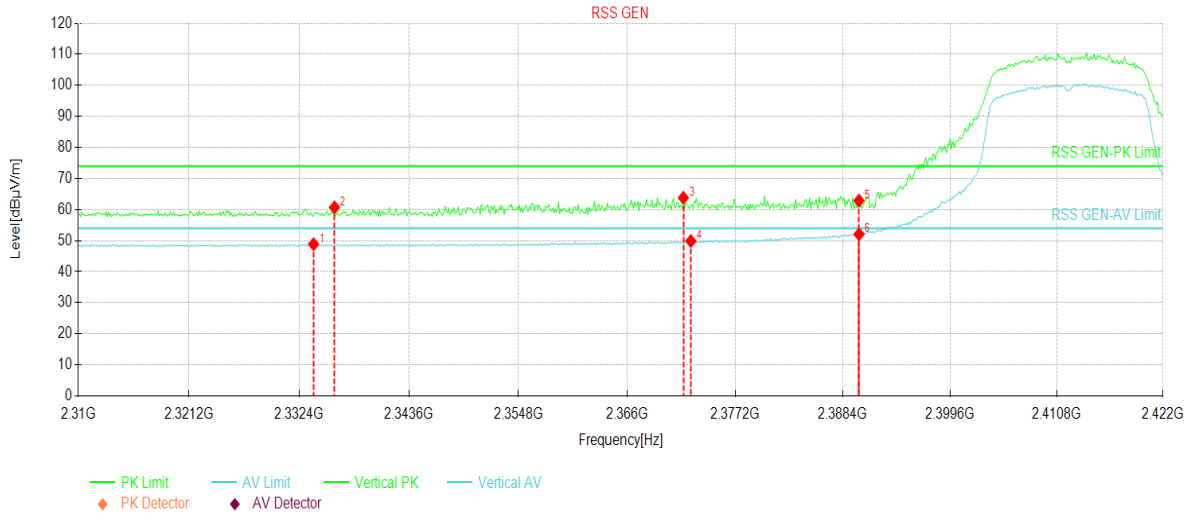
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2483.5360	22.94	58.66	35.72	74.00	15.34	PK	Horizontal
2	2483.5360	12.60	48.32	35.72	54.00	5.68	AV	Horizontal
3	2486.0320	23.84	59.55	35.71	74.00	14.45	PK	Horizontal
4	2486.8960	12.98	48.69	35.71	54.00	5.31	AV	Horizontal
5	2491.6960	12.95	48.65	35.70	54.00	5.35	AV	Horizontal
6	2492.2720	23.50	59.20	35.70	74.00	14.80	PK	Horizontal

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:	802.11g Tx mode
Test Channel:	Lowest channel	Polarization:	Vertical
Test Voltage:	AC 120/60Hz		



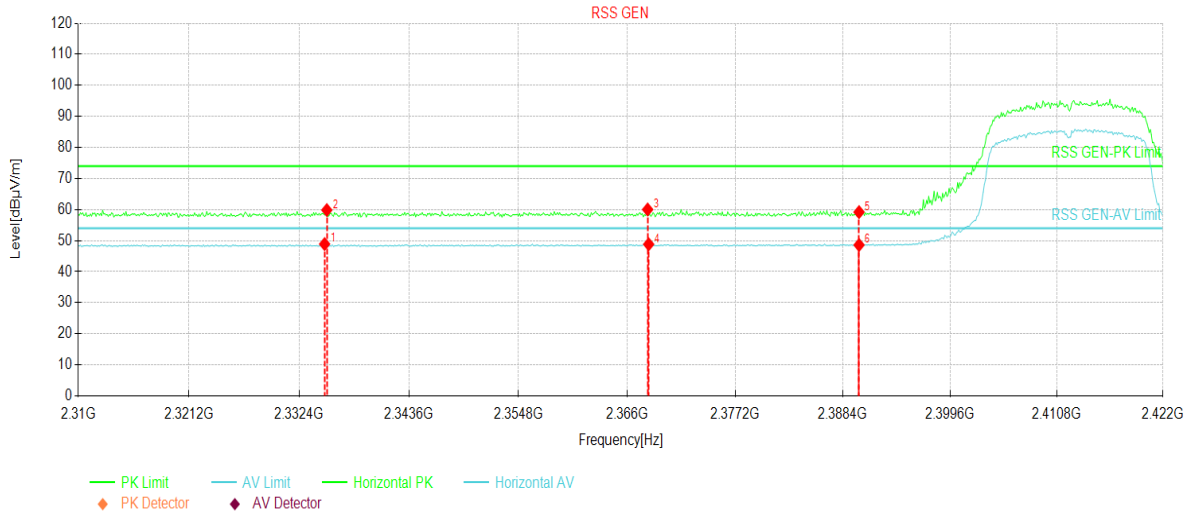
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2333.8560	13.40	48.84	35.44	54.00	5.16	AV	Vertical
2	2335.9840	25.25	60.71	35.46	74.00	13.29	PK	Vertical
3	2371.8240	28.09	63.80	35.71	74.00	10.20	PK	Vertical
4	2372.6080	14.15	49.87	35.72	54.00	4.13	AV	Vertical
5	2390.0800	27.04	62.88	35.84	74.00	11.12	PK	Vertical
6	2390.0800	16.20	52.04	35.84	54.00	1.96	AV	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:	802.11g Tx mode
Test Channel:	Lowest channel	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz		



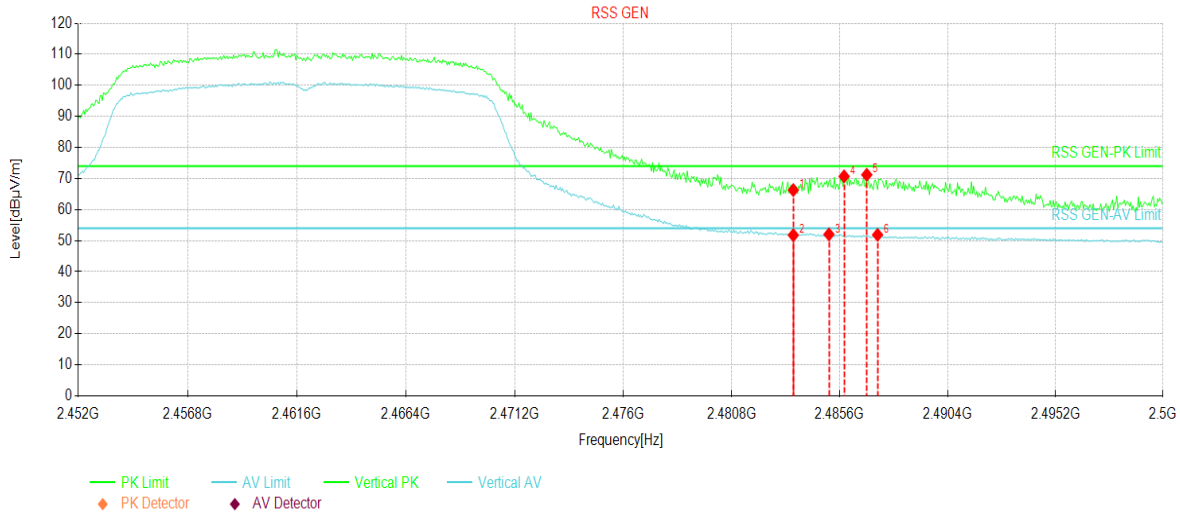
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2334.9760	13.44	48.89	35.45	54.00	5.11	AV	Horizontal
2	2335.2000	24.40	59.85	35.45	74.00	14.15	PK	Horizontal
3	2368.1280	24.34	60.02	35.68	74.00	13.98	PK	Horizontal
4	2368.2400	13.14	48.82	35.68	54.00	5.18	AV	Horizontal
5	2390.0800	23.35	59.19	35.84	74.00	14.81	PK	Horizontal
6	2390.0800	12.75	48.59	35.84	54.00	5.41	AV	Horizontal

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:	802.11g Tx mode
Test Channel:	Highest channel	Polarization:	Vertical
Test Voltage:	AC 120/60Hz		



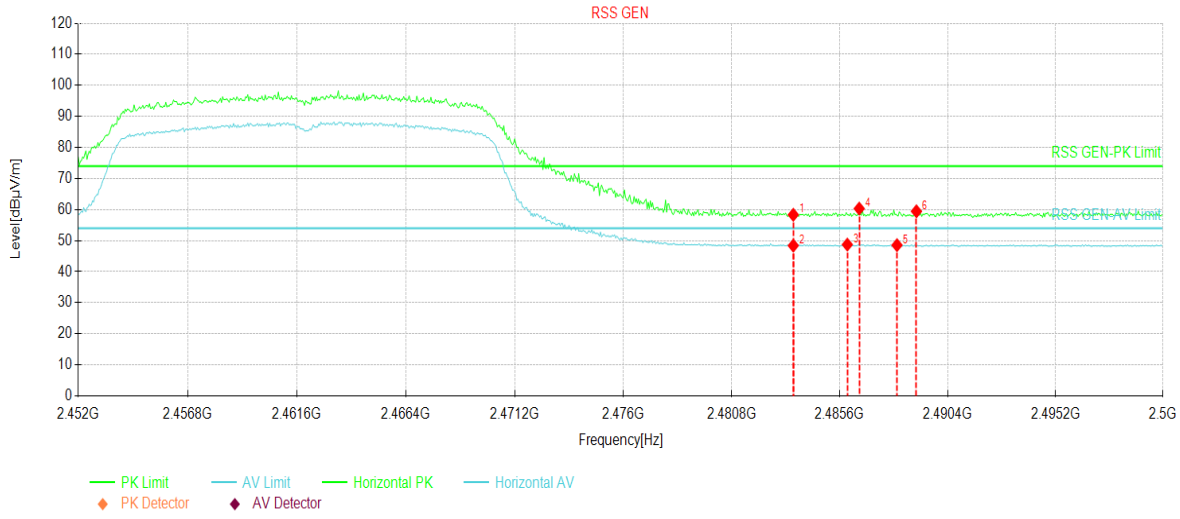
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2483.5360	30.56	66.28	35.72	74.00	7.72	PK	Vertical
2	2483.5360	16.04	51.76	35.72	54.00	2.24	AV	Vertical
3	2485.1200	16.29	52.00	35.71	54.00	2.00	AV	Vertical
4	2485.7920	34.97	70.68	35.71	74.00	3.32	PK	Vertical
5	2486.8000	35.49	71.20	35.71	74.00	2.80	PK	Vertical
6	2487.2800	16.15	51.86	35.71	54.00	2.14	AV	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:	802.11g Tx mode
Test Channel:	Highest channel	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz		



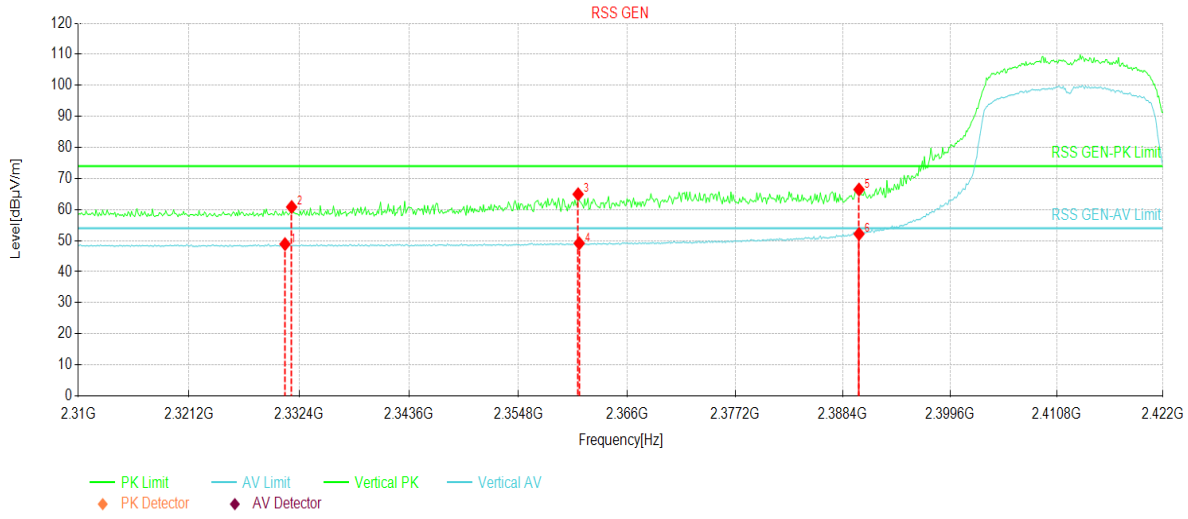
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2483.5360	22.60	58.32	35.72	74.00	15.68	PK	Horizontal
2	2483.5360	12.68	48.40	35.72	54.00	5.60	AV	Horizontal
3	2485.9360	13.01	48.72	35.71	54.00	5.28	AV	Horizontal
4	2486.4640	24.61	60.32	35.71	74.00	13.68	PK	Horizontal
5	2488.1440	12.83	48.54	35.71	54.00	5.46	AV	Horizontal
6	2489.0080	23.73	59.44	35.71	74.00	14.56	PK	Horizontal

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:	802.11n-HT20 Tx mode
Test Channel:	Lowest channel	Polarization:	Vertical
Test Voltage:	AC 120/60Hz		



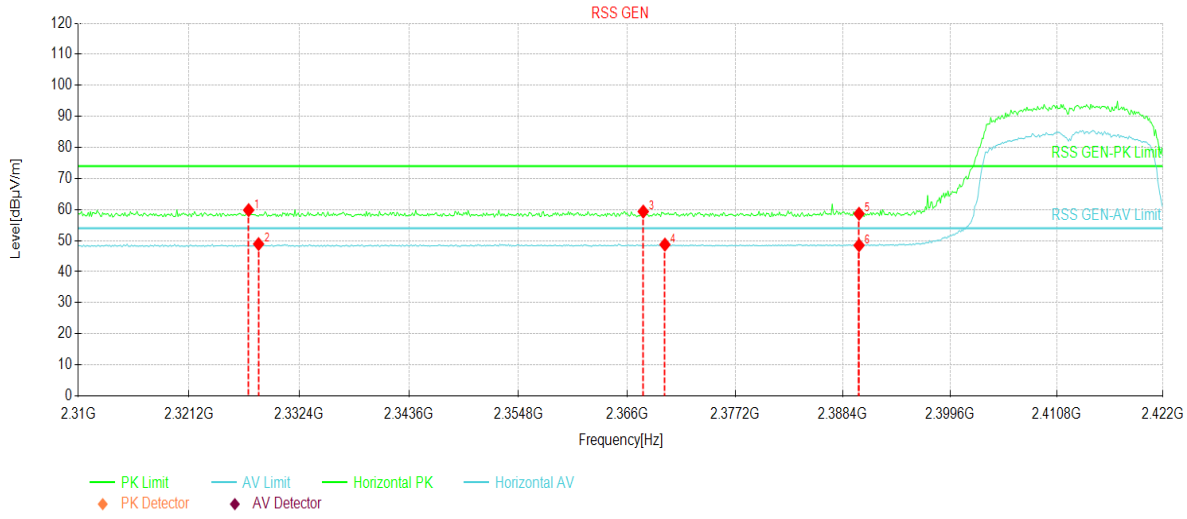
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2330.9440	13.44	48.86	35.42	54.00	5.14	AV	Vertical
2	2331.6160	25.40	60.82	35.42	74.00	13.18	PK	Vertical
3	2360.9600	29.31	64.94	35.63	74.00	9.06	PK	Vertical
4	2361.0720	13.50	49.13	35.63	54.00	4.87	AV	Vertical
5	2390.0800	30.61	66.45	35.84	74.00	7.55	PK	Vertical
6	2390.0800	16.32	52.16	35.84	54.00	1.84	AV	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:	802.11n-HT20 Tx mode
Test Channel:	Lowest channel	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz		

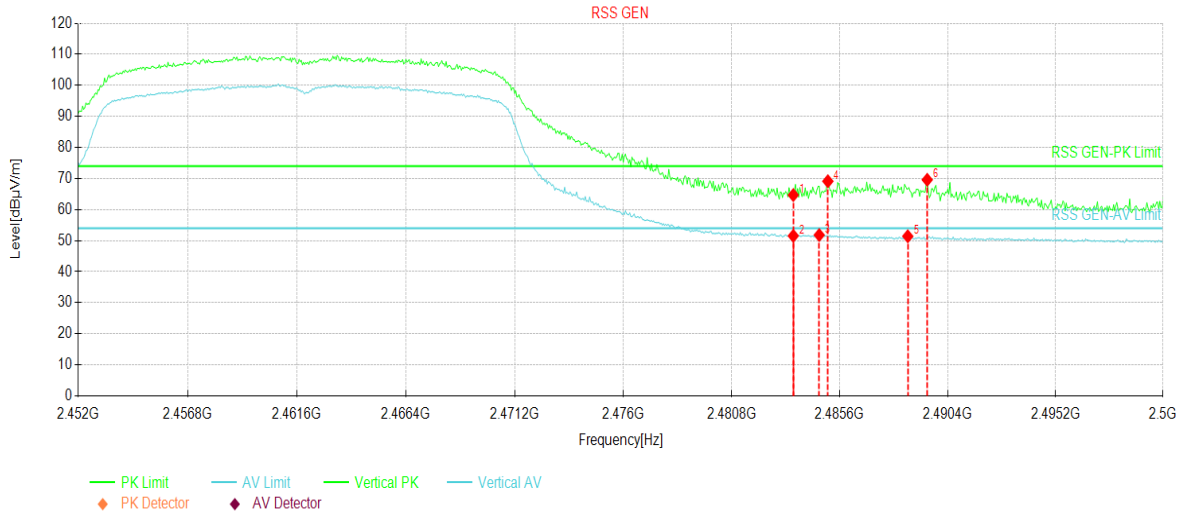


Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2327.2480	24.43	59.82	35.39	74.00	14.18	PK	Horizontal
2	2328.2560	13.49	48.89	35.40	54.00	5.11	AV	Horizontal
3	2367.6800	23.67	59.35	35.68	74.00	14.65	PK	Horizontal
4	2369.9200	13.02	48.72	35.70	54.00	5.28	AV	Horizontal
5	2390.0800	22.82	58.66	35.84	74.00	15.34	PK	Horizontal
6	2390.0800	12.63	48.47	35.84	54.00	5.53	AV	Horizontal

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:	802.11n-HT20 Tx mode
Test Channel:	Highest channel	Polarization:	Vertical
Test Voltage:	AC 120/60Hz		



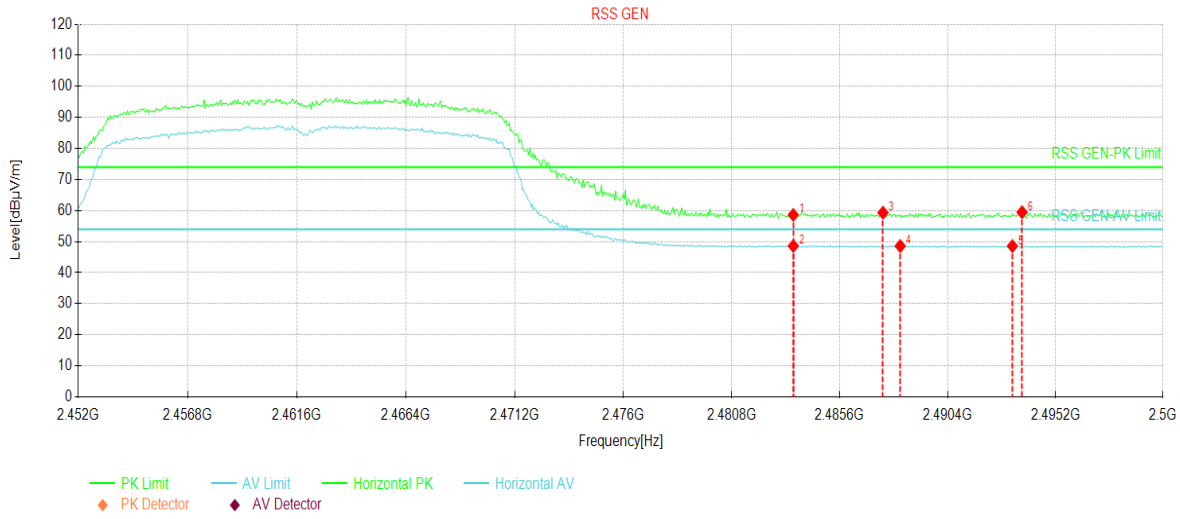
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	2483.5360	28.95	64.67	35.72	74.00	9.33	PK	Vertical
2	2483.5360	15.82	51.54	35.72	54.00	2.46	AV	Vertical
3	2484.6880	16.08	51.80	35.72	54.00	2.20	AV	Vertical
4	2485.0720	33.40	69.11	35.71	74.00	4.89	PK	Vertical
5	2488.6240	15.68	51.39	35.71	54.00	2.61	AV	Vertical
6	2489.4880	33.89	69.59	35.70	74.00	4.41	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:	802.11n-HT20 Tx mode
Test Channel:	Highest channel	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	2483.5360	22.89	58.61	35.72	74.00	15.39	PK	Horizontal
2	2483.5360	12.87	48.59	35.72	54.00	5.41	AV	Horizontal
3	2487.5200	23.60	59.31	35.71	74.00	14.69	PK	Horizontal
4	2488.2880	12.86	48.57	35.71	54.00	5.43	AV	Horizontal
5	2493.2800	12.85	48.55	35.70	54.00	5.45	AV	Horizontal
6	2493.7120	23.78	59.47	35.69	74.00	14.53	PK	Horizontal

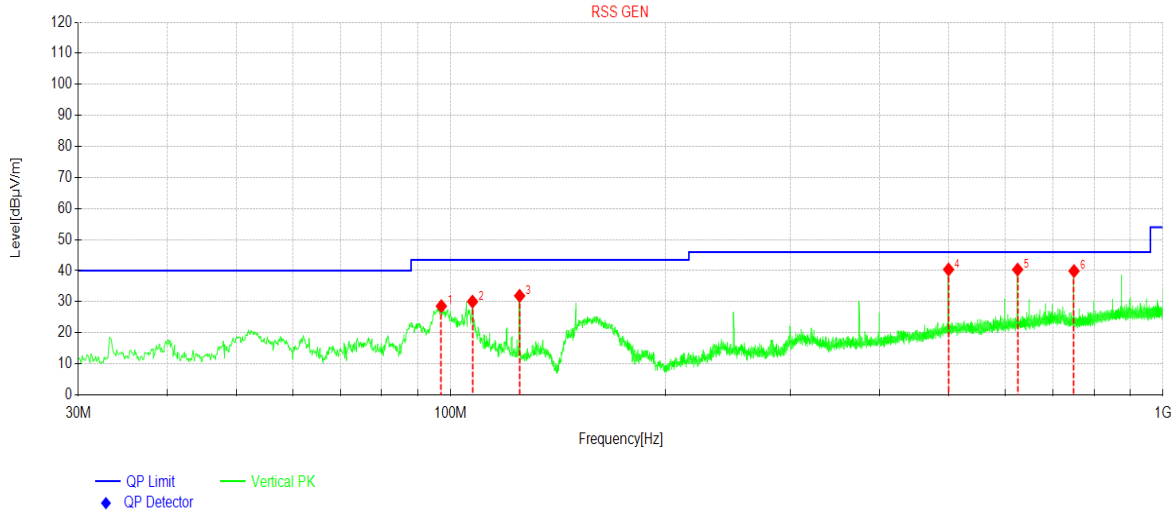
Remark:

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

6.5 Emissions in Non-restricted Frequency Bands

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:**	2.4G Wi-Fi mode
Test Frequency:	30 MHz ~ 1 GHz	**Polarization:**	Vertical
Test Voltage:	AC 120/60Hz		

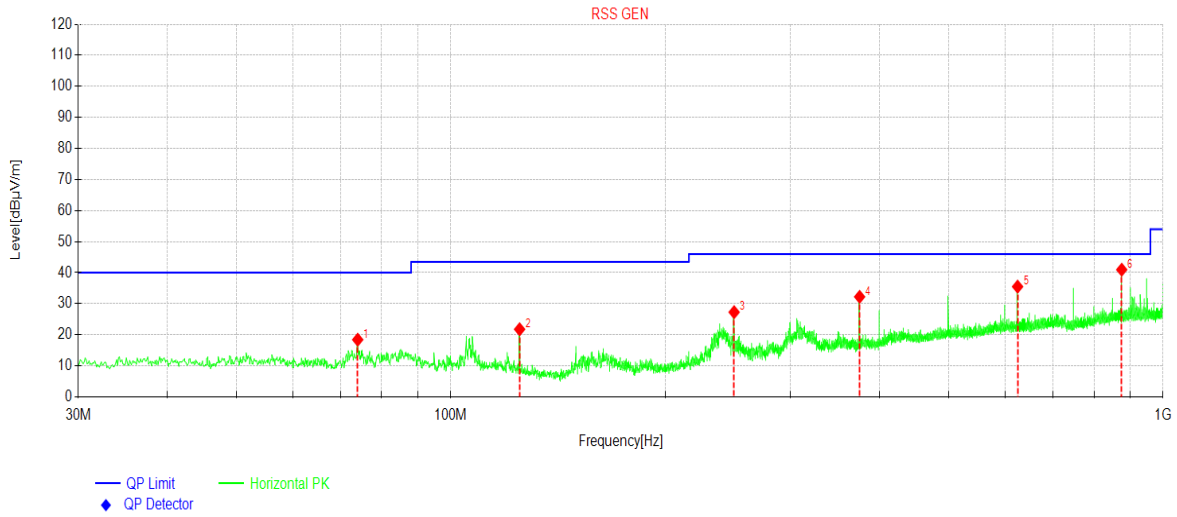


Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	97.034	45.30	28.58	-16.72	43.50	14.92	PK	Vertical
2	107.3167	46.01	30.04	-15.97	43.50	13.46	PK	Vertical
3	124.9725	48.66	31.90	-16.76	43.50	11.60	PK	Vertical
4	500.0120	47.34	40.38	-6.96	46.00	5.62	PK	Vertical
5	625.0575	45.67	40.36	-5.31	46.00	5.64	PK	Vertical
6	750.1030	43.61	39.87	-3.74	46.00	6.13	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:	2.4G Wi-Fi 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	74.042	35.48	18.41	-17.07	40.00	21.59	PK	Horizontal
2	124.972 5	38.53	21.77	-16.76	43.50	21.73	PK	Horizontal
3	250.018 0	41.07	27.28	-13.79	46.00	18.72	PK	Horizontal
4	375.063 5	43.11	32.23	-10.88	46.00	13.77	PK	Horizontal
5	625.057 5	40.81	35.50	-5.31	46.00	10.50	PK	Horizontal
6	875.051 5	42.43	40.96	-1.47	46.00	5.04	PK	Horizontal

Remark:

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

Above 1GHz

802.11b						
Test channel: Lowest channel Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4824.00	42.65	-9.46	33.19	74.00	40.81	Vertical
4824.00	44.80	-9.46	35.34	74.00	38.66	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4824.00	37.29	-9.46	27.83	54.00	26.17	Vertical
4824.00	35.59	-9.46	26.13	54.00	27.87	Horizontal
Test channel: Middle channel Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4874.00	42.92	-9.11	33.81	74.00	40.19	Vertical
4874.00	45.17	-9.11	36.06	74.00	37.94	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4874.00	37.05	-9.11	27.94	54.00	26.06	Vertical
4874.00	35.95	-9.11	26.84	54.00	27.16	Horizontal
Test channel: Highest channel Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4924.00	42.46	-8.74	33.72	74.00	40.28	Vertical
4924.00	45.06	-8.74	36.32	74.00	37.68	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4924.00	37.08	-8.74	28.34	54.00	25.66	Vertical
4924.00	35.63	-8.74	26.89	54.00	27.11	Horizontal
Remark: *1. Level = Read level + Factor.*						

802.11g						
Test channel: Lowest channel Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4824.00	42.38	-9.46	32.92	74.00	41.08	Vertical
4824.00	45.17	-9.46	35.71	74.00	38.29	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4824.00	37.56	-9.46	28.10	54.00	25.90	Vertical
4824.00	36.12	-9.46	26.66	54.00	27.34	Horizontal
Test channel: Middle channel Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4874.00	42.52	-9.11	33.41	74.00	40.59	Vertical
4874.00	44.87	-9.11	35.76	74.00	38.24	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4874.00	37.65	-9.11	28.54	54.00	25.46	Vertical
4874.00	36.01	-9.11	26.90	54.00	27.10	Horizontal
Test channel: Highest channel Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4924.00	42.49	-8.74	33.75	74.00	40.25	Vertical
4924.00	45.21	-8.74	36.47	74.00	37.53	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4924.00	37.89	-8.74	29.15	54.00	24.85	Vertical
4924.00	35.93	-8.74	27.19	54.00	26.81	Horizontal
Remark: *1. Level = Read level + Factor.*						

802.11n-HT20						
Test channel: Lowest channel Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4824.00	42.75	-9.46	33.29	74.00	40.71	Vertical
4824.00	45.56	-9.46	36.10	74.00	37.90	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4824.00	37.91	-9.46	28.45	54.00	25.55	Vertical
4824.00	35.81	-9.46	26.35	54.00	27.65	Horizontal
Test channel: Middle channel Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4874.00	42.40	-9.11	33.29	74.00	40.71	Vertical
4874.00	45.86	-9.11	36.75	74.00	37.25	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4874.00	38.37	-9.11	29.26	54.00	24.74	Vertical
4874.00	35.54	-9.11	26.43	54.00	27.57	Horizontal
Test channel: Highest channel Detector: Peak Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4924.00	42.53	-8.74	33.79	74.00	40.21	Vertical
4924.00	45.46	-8.74	36.72	74.00	37.28	Horizontal
Detector: Average Value						
Frequency (MHz)	Read Level (dBμV)	Factor (dB)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Polarization
4924.00	37.87	-8.74	29.13	54.00	24.87	Vertical
4924.00	35.85	-8.74	27.11	54.00	26.89	Horizontal
Remark: *1. Level = Read level + Factor.*						

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