IC RF Test Report

(FHSS)

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:	Test Engineer	***Date:***	*18 May, 2022*
Reviewed by:	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	*18 May, 2022*	*Updated page1, 4*

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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:	903.9 MHz – 905.3 MHz
Number of Channel:	8
Modulation Type:	LoRa
Modulation Technology:	Hybrid spread-spectrum
Antenna Type:	External Antenna
Antenna Gain:	1 dBi (declare by applicant)
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, WSZR122200088
Test Sample Condition:	The test samples were provided in good working order with no visible defects.

4.3 Test Mode and Test Environment

Test Modes:	
Non-hopping mode:	Keep the EUT in continuous transmitting mode.
Hopping mode:	Keep the EUT in hopping mode.
Remark: *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

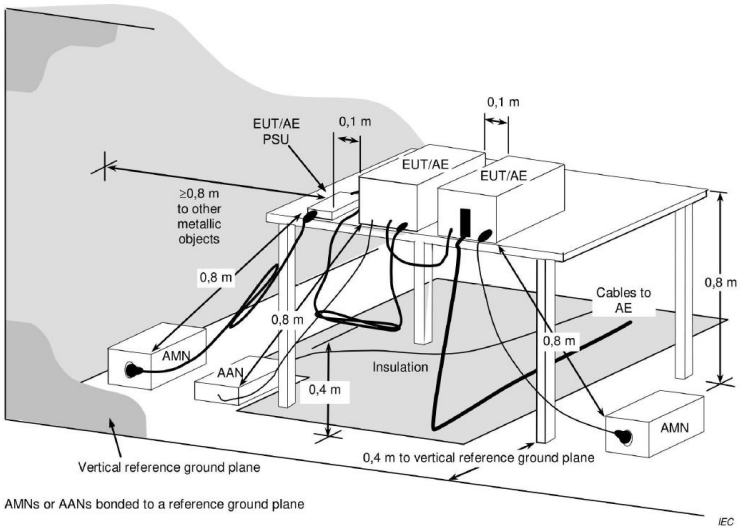
According to ANSI C63.10-2013 chapter 5.6.1 Table 4 requirement, select lowest channel, middle channel, and highest channel in the frequency range in which device operates for testing. The detailed frequency points are as follows:

Channel		Frequency		Channel	
1	903.9MHz	4	904.5MHz	7	905.1MHz
2	904.1MHz	5	904.7MHz	8	905.3MHz
3	904.3MHz	6	904.9MHz		

Note:
Channel No. 1, 5 & 8 were selected as Lowest, Middle and Highest channel.

5.2 Test Setup

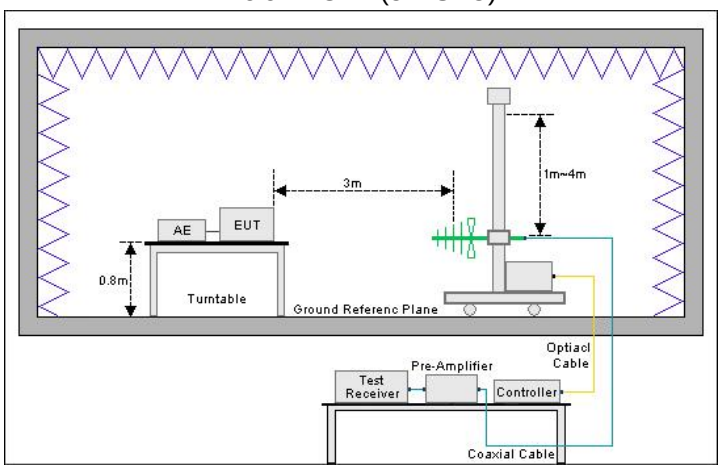
1) Conducted emission measurement:



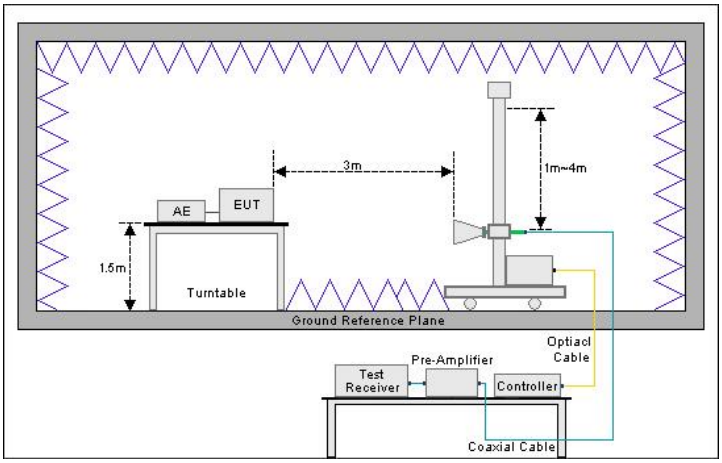
Note: The 0.8 m distance specified between EUT/AE/PSU and AMN/AAN, is applicable only to the EUT being measured. If the device is AE then it shall be >0.8 m.

2) Radiated emission measurement:

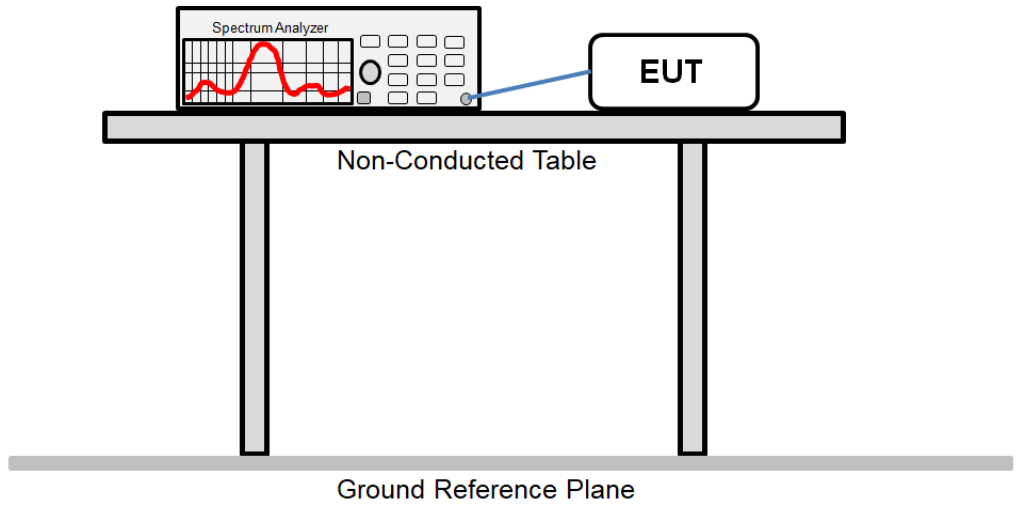
Below 1GHz (3m SAC)



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 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	See Section 6.2	Pass
AC Power Line Conducted Emission	RSS-Gen Section 8.8	See Section 6.3	Pass
Conducted Output Power	RSS-247 Section 5.4(a)	See Section 6.4	Pass
6dB Occupied Bandwidth	RSS-247 Section 5.2(a)	See Section 6.5	Pass
20dB Occupied Bandwidth	RSS-247 Section 5.1(a)	See Section 6.5	Pass
Carrier Frequencies Separation	RSS-247 Section 5.1(b)	See Section 6.6	Pass
Hopping Channel Number	RSS-247 Section 5.1(c)	See Section 6.7	Pass
Dwell Time	RSS-247 Section 5.1(c)	See Section 6.8	Pass
Power Spectral Density	RSS-247 Section 5.2(b)	See Section 6.9	Pass
Spurious Emission	RSS-Gen Section 6.13 RSS-Gen Section 8.10 RSS-247 Section 5.5	See Section 6.10	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>Test 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 Output Power</td><td>For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.</td></tr>
<tr><td>6dB Occupied Bandwidth</td><td>There is no requirement for this type of hybrid system to comply with the 500 kHz minimum bandwidth normally associated with a DTS device.</td></tr>
<tr><td>20dB Occupied Bandwidth</td><td>The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system’s radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.</td></tr>
<tr><td>Carrier Frequencies Separation</td><td>FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.</td></tr>
<tr><td>Hopping Channel Number</td><td>N/A</td></tr>
<tr><td>Dwell Time</td><td>The transmission must comply with a 0.4 second/channel maximum dwell time when the hopping function is turned on.</td></tr>
<tr><td>Max Power 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>Carrier Frequencies Separation</td><td>FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.</td></tr>
</table>

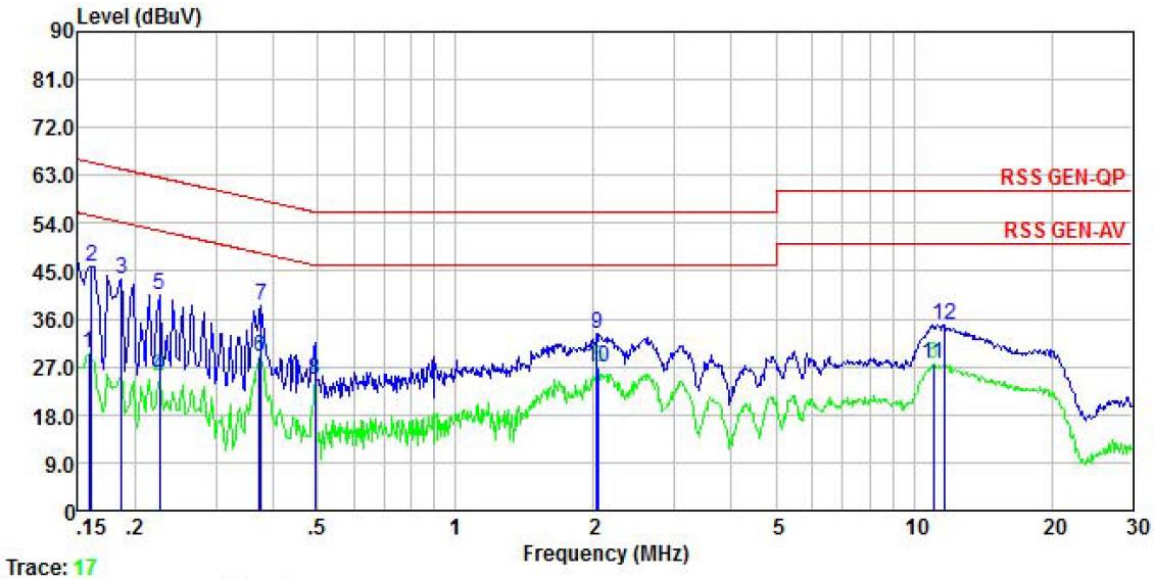
<table>
<tr>
<td>Spurious Emission</td>
<td>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest 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:
<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:	FCC Part 15 C Section 15.203 & 247(b)
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(b) (4) requirement: (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	
E.U.T Antenna:	
The LoRa antenna is an External antenna which permanently attached, and the best case gain of the antenna is 3 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:**	Tx mode
Test frequency:	150 kHz ~ 30 MHz	**Phase:**	Line
Test voltage:	AC 120 V/60 Hz		

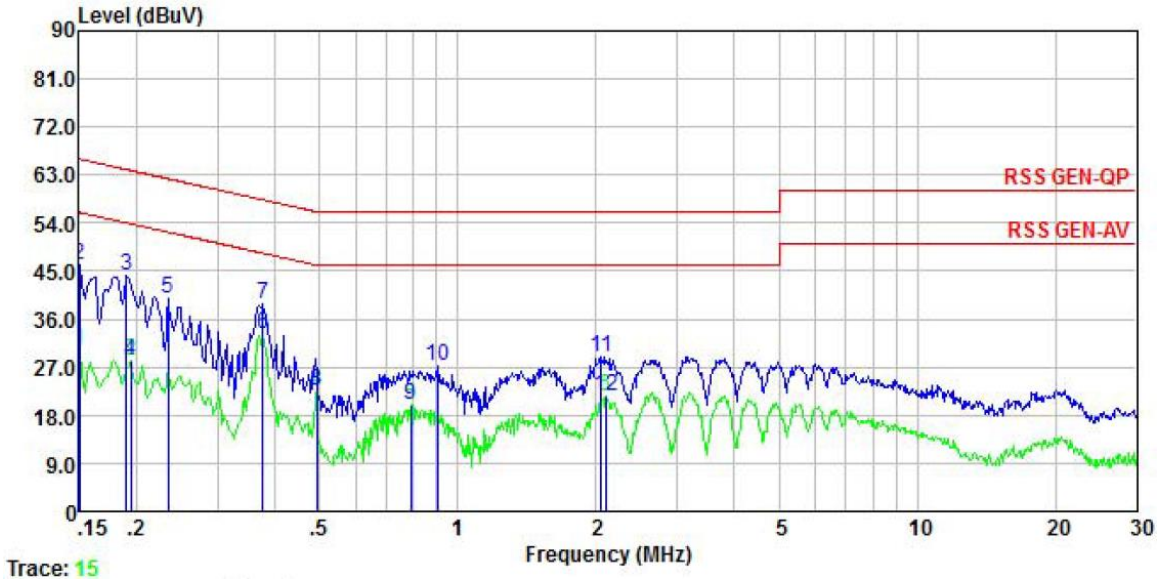


	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.158	29.67	0.00	0.01	29.68	55.56	-25.88	Average
2	0.161	45.81	0.00	0.01	45.82	65.43	-19.61	QP
3	0.186	43.55	0.00	0.02	43.57	64.20	-20.63	QP
4	0.226	25.18	0.00	0.02	25.20	52.61	-27.41	Average
5	0.226	40.49	0.00	0.02	40.51	62.61	-22.10	QP
6	0.373	28.87	0.00	0.03	28.90	48.43	-19.53	Average
7	0.377	38.44	0.00	0.03	38.47	58.34	-19.87	QP
8	0.494	24.64	0.00	0.03	24.67	46.10	-21.43	Average
9	2.033	33.00	0.00	0.20	33.20	56.00	-22.80	QP
10	2.055	26.63	0.00	0.20	26.83	46.00	-19.17	Average
11	11.021	27.36	0.00	0.11	27.47	50.00	-22.53	Average
12	11.621	34.81	0.00	0.11	34.92	60.00	-25.08	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:	Tx 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	30.33	0.00	0.01	30.34	56.00	-25.66	Average
2	0.150	46.17	0.00	0.01	46.18	66.00	-19.82	QP
3	0.190	44.19	0.00	0.03	44.22	64.02	-19.80	QP
4	0.194	28.11	0.00	0.03	28.14	53.84	-25.70	Average
5	0.234	39.81	0.00	0.02	39.83	62.30	-22.47	QP
6	0.377	33.17	0.00	0.03	33.20	48.34	-15.14	Average
7	0.377	38.73	0.00	0.03	38.76	58.34	-19.58	QP
8	0.494	22.39	0.00	0.03	22.42	46.10	-23.68	Average
9	0.792	19.85	0.00	0.03	19.88	46.00	-26.12	Average
10	0.904	27.05	0.00	0.04	27.09	56.00	-28.91	QP
11	2.055	28.65	0.00	0.20	28.85	56.00	-27.15	QP
12	2.099	21.42	0.00	0.19	21.61	46.00	-24.39	Average

Remark:

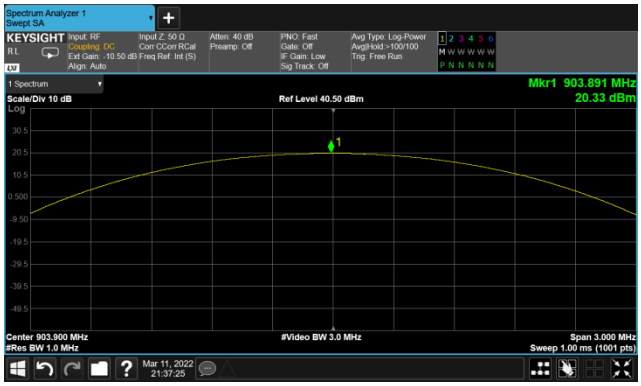
1. Level = Read level + LISN Factor + Cable Loss.

6.4 Conducted Output Power

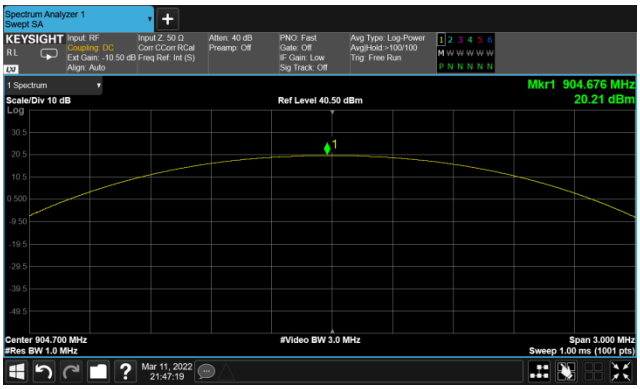
Test channel	Maximum Output Power (dBm)	Limit (dBm)	Result
Lowest channel	20.33	24.00	Pass
Middle channel	20.21	24.00	Pass
Highest channel	20.39	24.00	Pass

Test plot as follows:

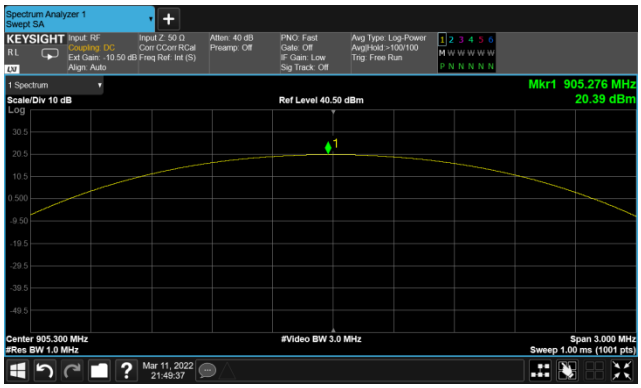
Lowest channel



Middle channel



Highest channel

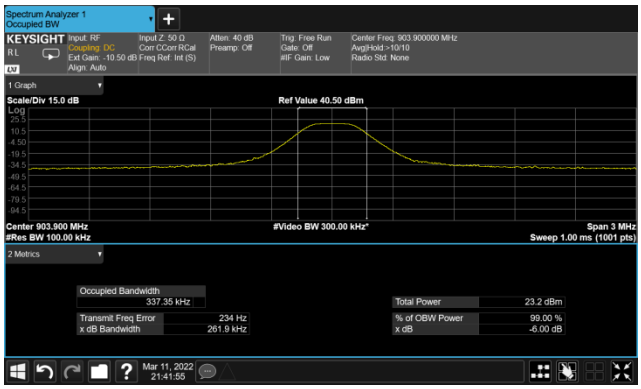


6.5 6dB Occupied Bandwidth

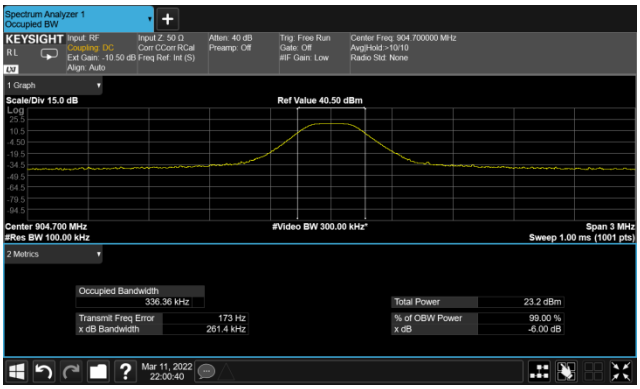
Test channel	6dB Occupy Bandwidth (kHz)	Limit (kHz)	Result
Lowest channel	261.9	N/A	Pass
Middle channel	261.4		Pass
Highest channel	261.1		Pass

Test plot as follows:

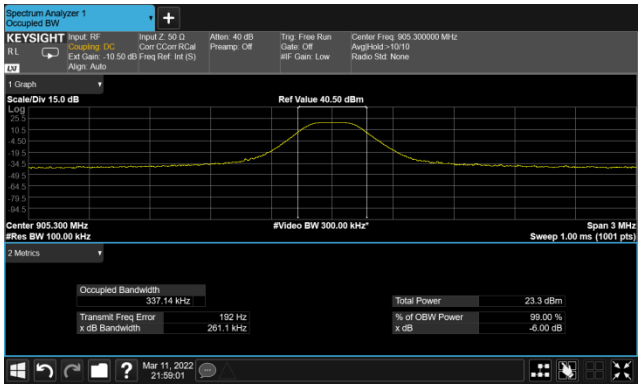
Lowest channel



Middle channel



Highest channel

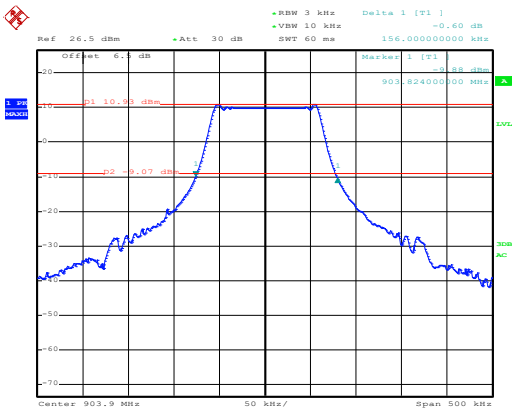


6.6 20dB Occupied Bandwidth

Test channel	20dB Occupy Bandwidth (kHz)	Limit (kHz)	Result
Lowest channel	156.0	N/A	Pass
Middle channel	156.0		Pass
Highest channel	156.0		Pass

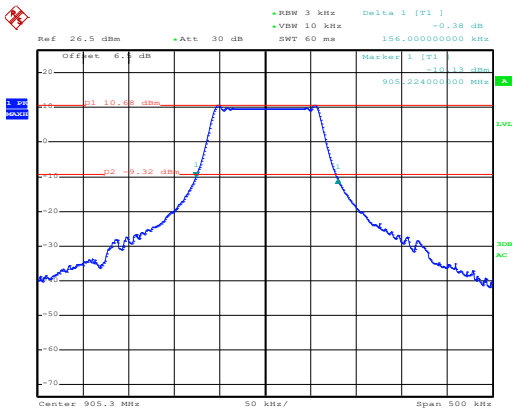
Test plot as follows:

Lowest channel



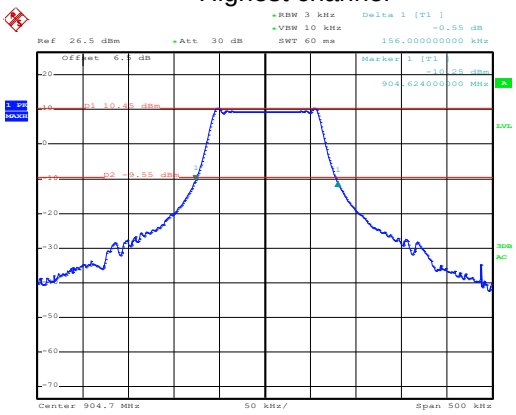
Date: 7.MAY.2022 17:19:20

Middle channel



Date: 7.MAY.2022 17:21:59

Highest channel



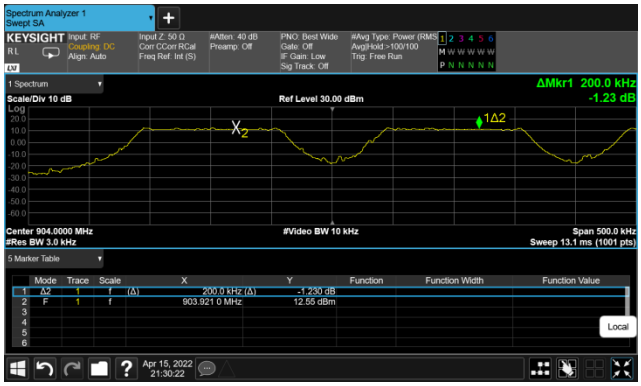
Date: 7.MAY.2022 17:24:18

6.7 Carrier Frequencies Separation

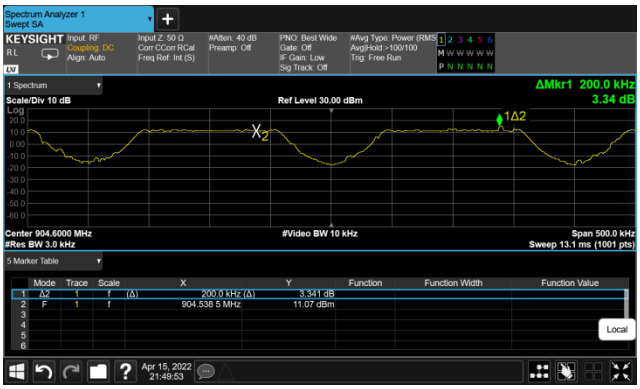
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest channel	200	156	Pass
Middle channel	200		Pass
Highest channel	200		Pass

Test plot as follows:

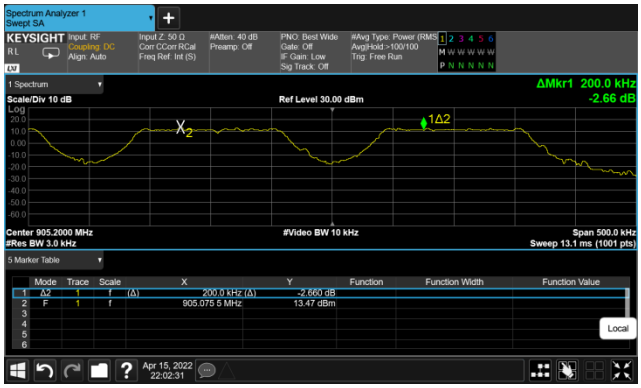
Lowest channel



Middle channel



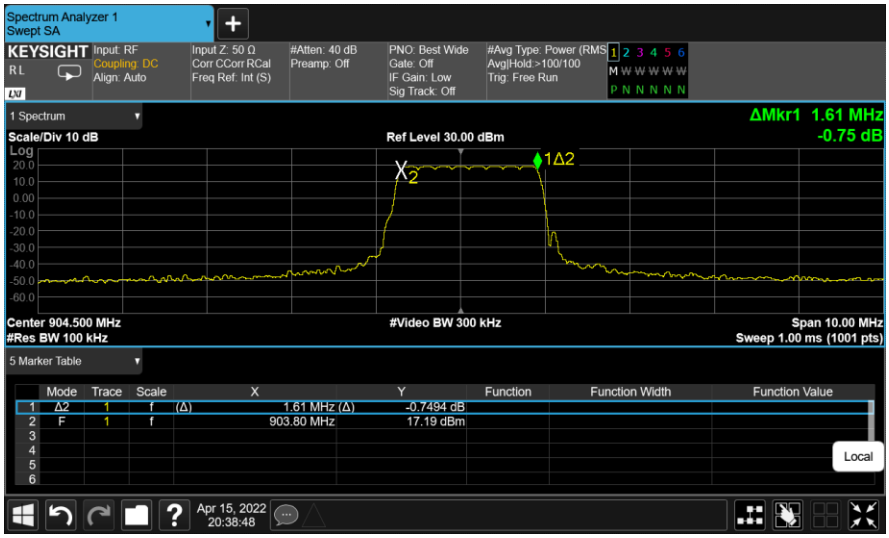
Highest channel



6.8 Hopping Channel Number

Hopping channel numbers	Limit	Result
8	N/A	Pass

Test plot as follows:



6.9 Dwell Time

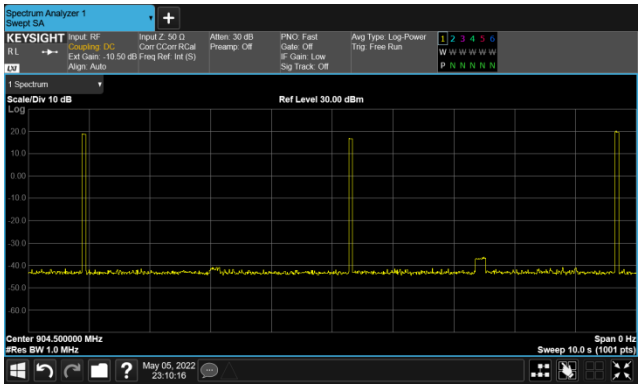
T_{on} (s)	Hopping numbers (10 s or 20 s period)	Dwell time (s)	Limit (s)	Result
0.055	3	0.165	0.4	Pass

Note:

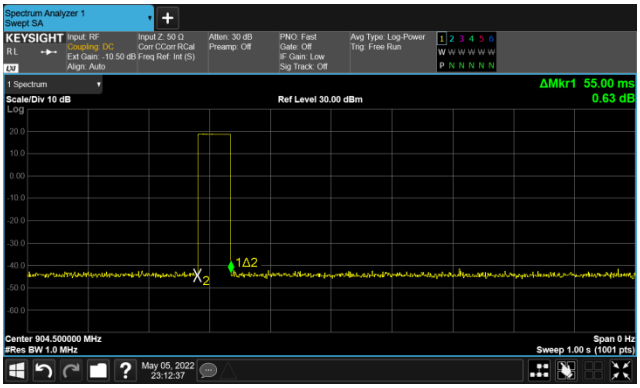
1. T_{on} is time per hop.

*2. Dwell time = T_{on} * Hopping numbers.*

Test plot as follows:



10 s



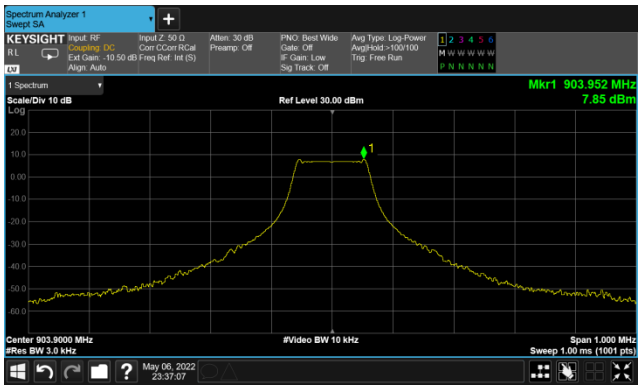
T_{on}

6.10 Power Spectral Density

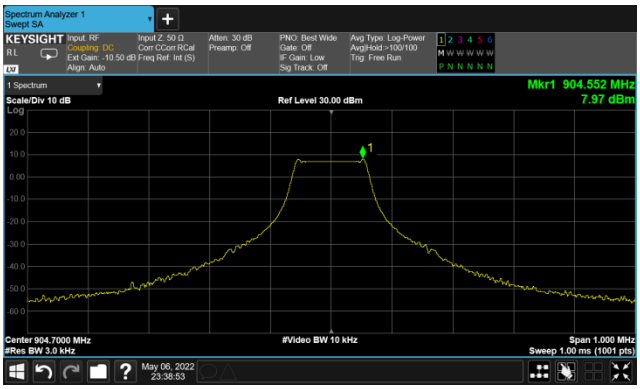
Test Channel	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
Lowest channel	7.85	8.00	Pass
Middle channel	7.97		
Highest channel	6.48		

Test plot as follows:

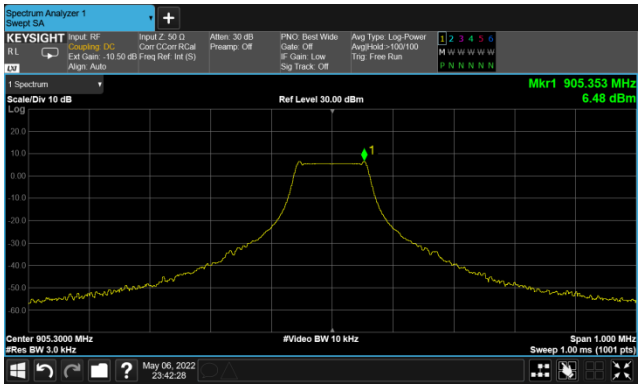
Lowest channel



Middle channel

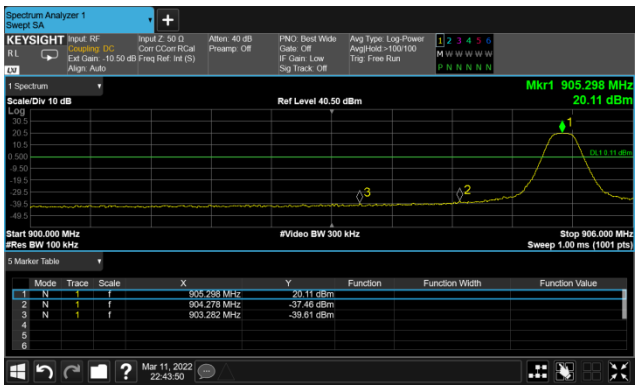
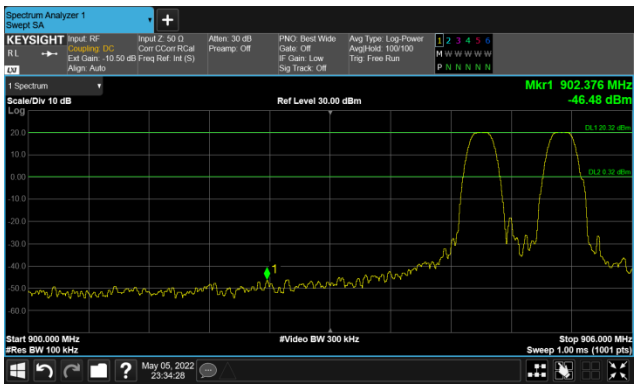
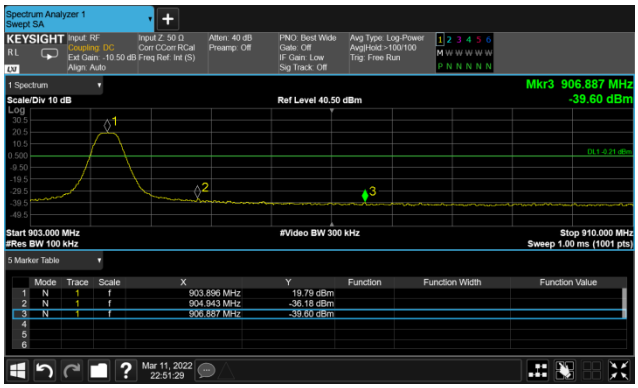
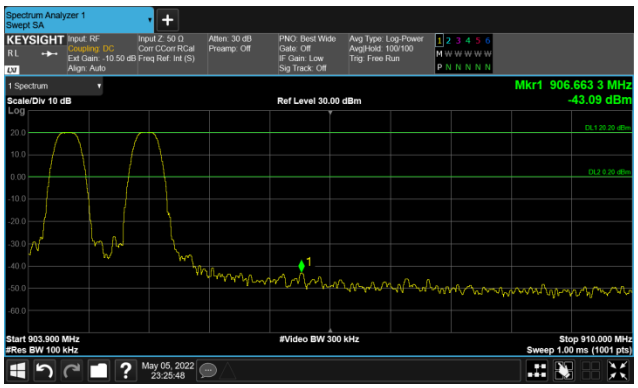


Highest channel

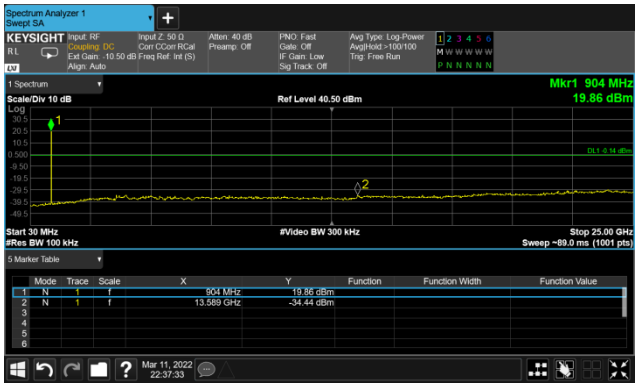
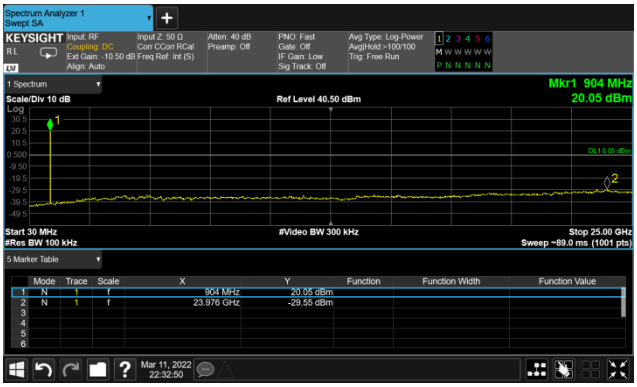
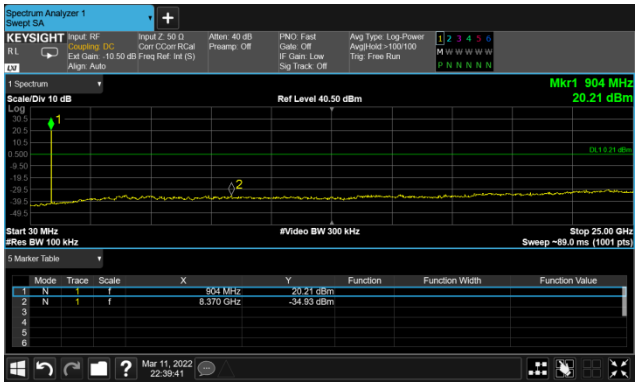


6.11 Spurious Emission

6.11.1 Band-edge Emission

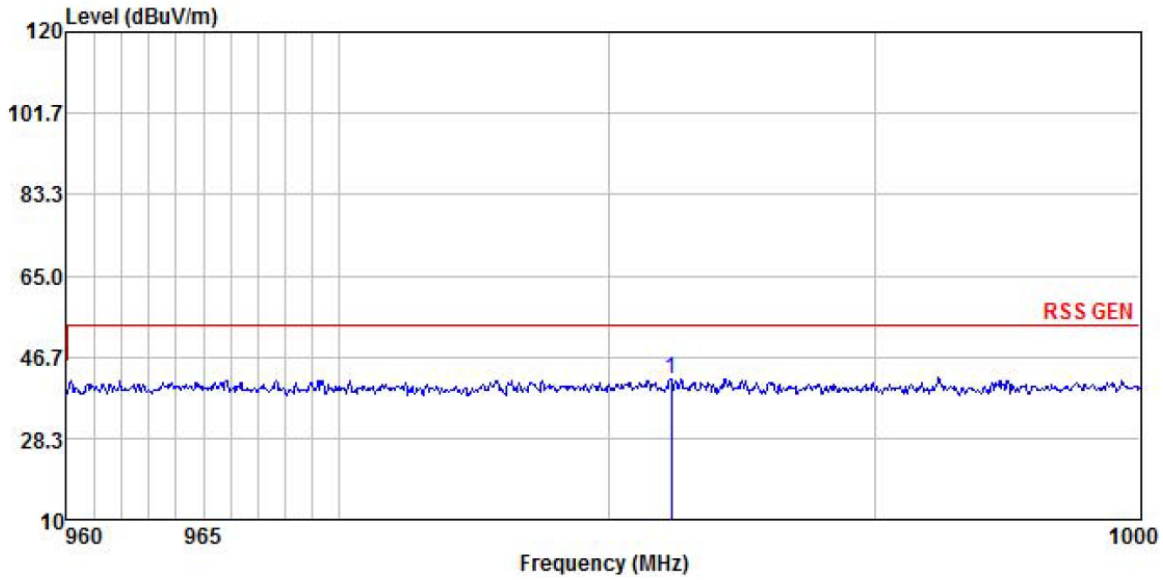
Lowest Channel	
	
No-hopping mode	Hopping mode
Highest Channel	
	
No-hopping mode	Hopping mode

6.11.2 Conducted Spurious Emission

Lowest channel	Middle channel
	
30MHz~10GHz	30MHz~10GHz
Highest channel	
	
30MHz~10GHz	

6.11.3 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:	Tx mode
Test Channel:	960 MHz ~ 1 GHz	Polarization:	Vertical
Test Voltage:	AC 120/60Hz		

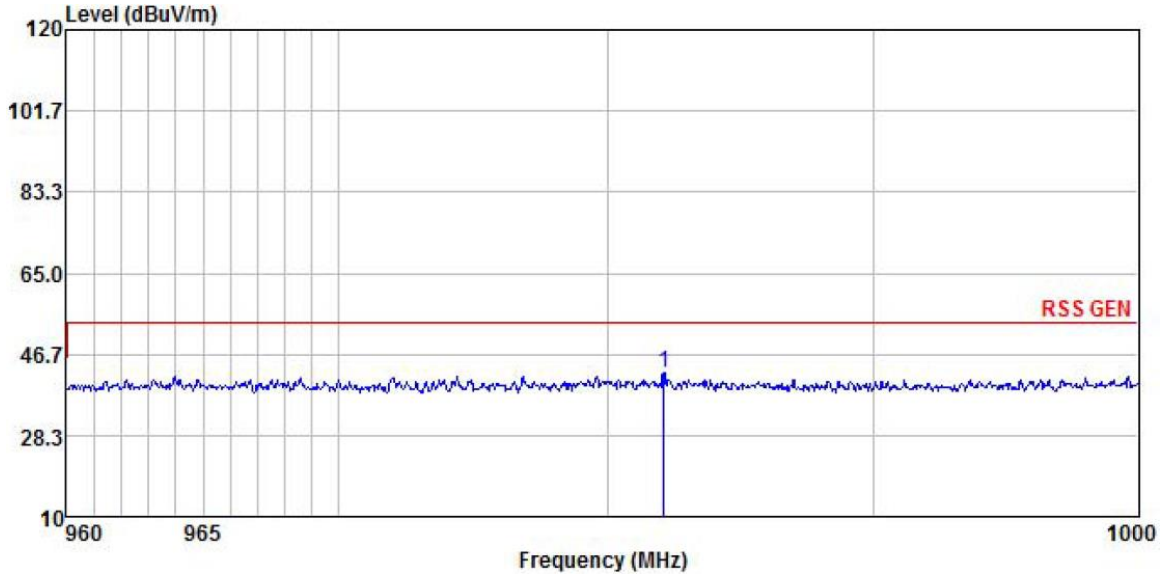


	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	982.319	15.17	23.00	3.61	0.00	41.78	54.00	-12.22	QP

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:	Tx mode
Test Channel:	960 MHz ~ 1 GHz	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz		

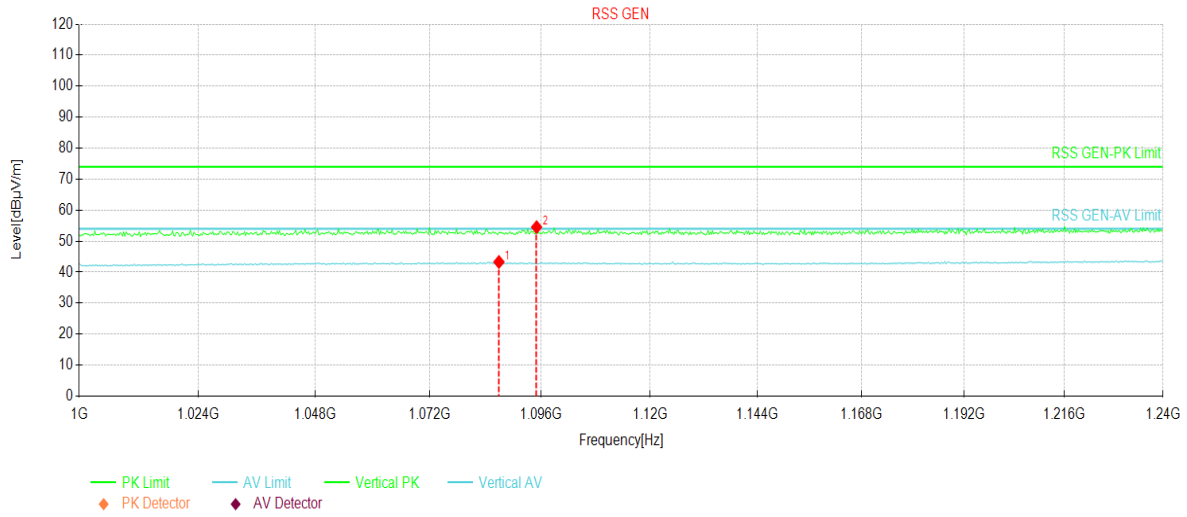


	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	982.078	16.05	23.00	3.61	0.00	42.66	54.00	-11.34	QP

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:	Tx mode
Test Channel:	1000 MHz ~ 1240 MHz	Polarization:	Vertical
Test Voltage:	AC 120/60Hz		



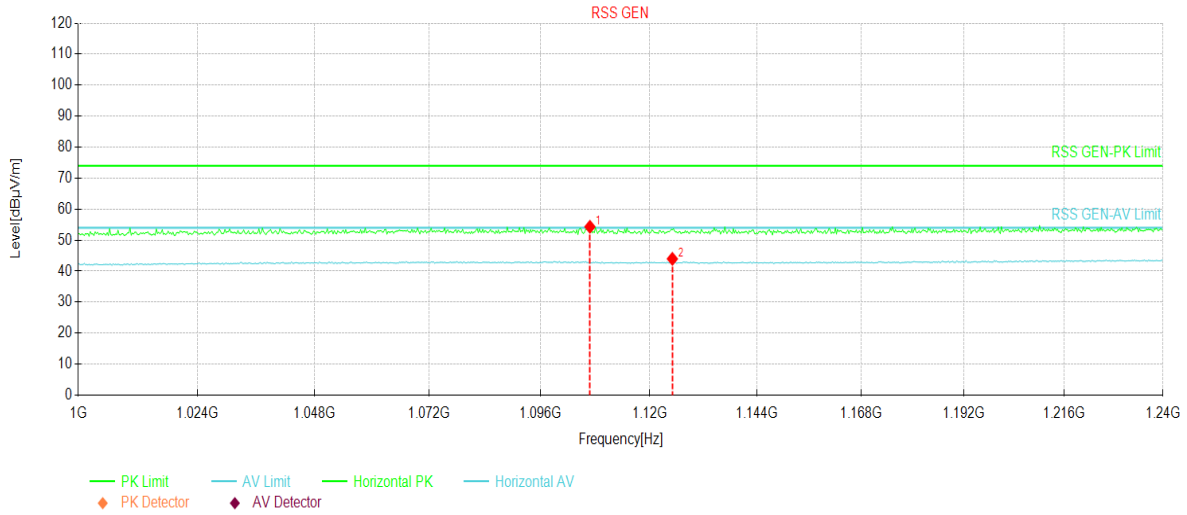
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	1086.8800	13.18	43.28	30.10	54.00	10.72	AV	Vertical
2	1095.0400	24.39	54.53	30.14	74.00	19.47	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:	Tx mode
Test Channel:	1000 MHz ~ 1240 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	1106.8000	24.13	54.31	30.18	74.00	19.69	PK	Horizontal
2	1125.0400	13.77	43.97	30.20	54.00	10.03	AV	Horizontal

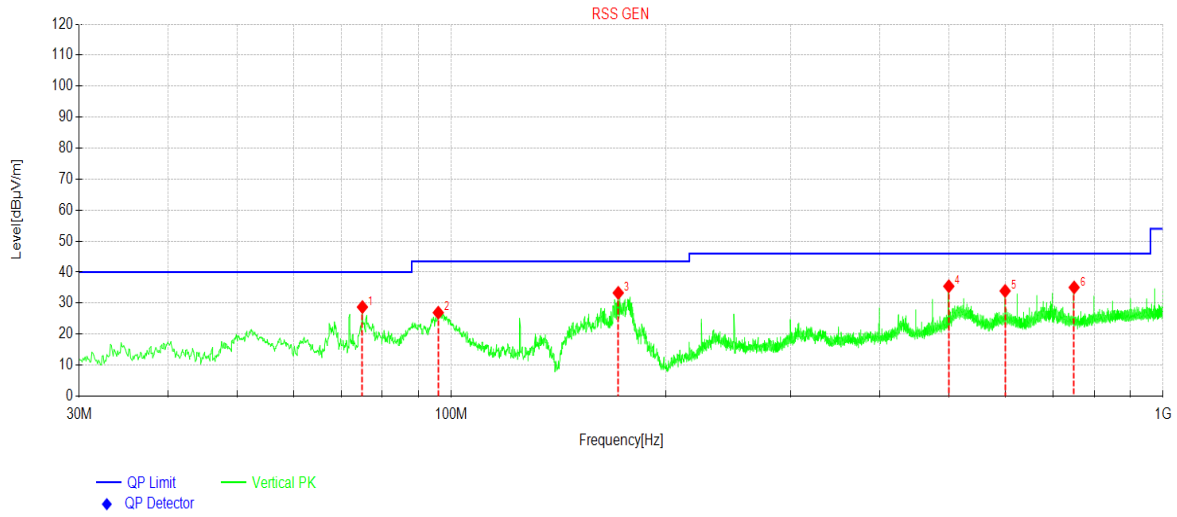
Remark:

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

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



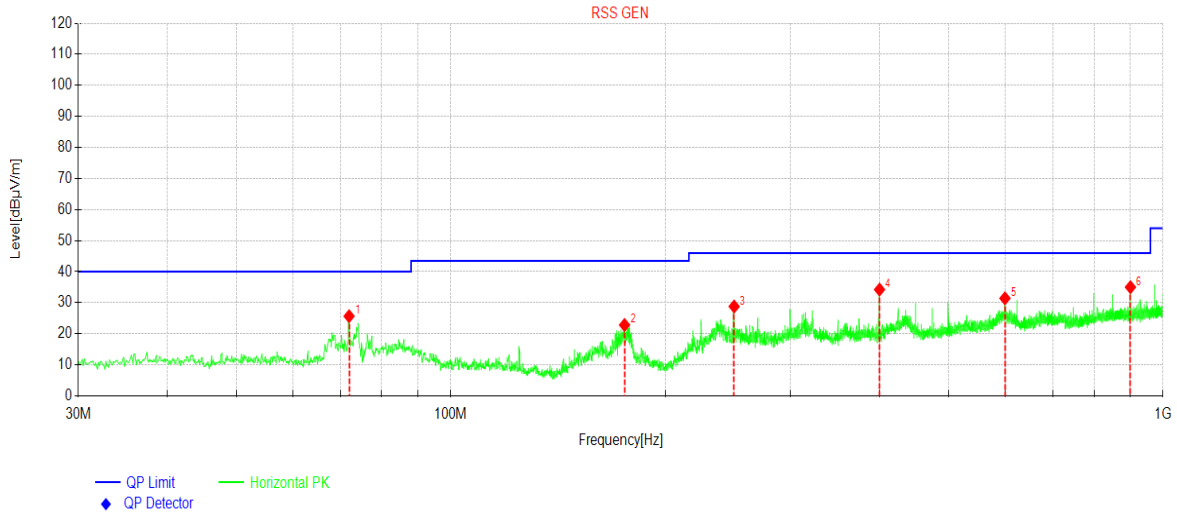
Suspected Data List

NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	75.013	45.83	28.73	-17.10	40.00	11.27	PK	Vertical
2	95.870	43.86	26.93	-16.93	43.50	16.57	PK	Vertical
3	171.6342	50.30	33.31	-16.99	43.50	10.19	PK	Vertical
4	500.0120	42.40	35.44	-6.96	46.00	10.56	PK	Vertical
5	600.0290	39.41	33.93	-5.48	46.00	12.07	PK	Vertical
6	750.1030	38.80	35.06	-3.74	46.00	10.94	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:	Tx mode
Test Frequency:	30 MHz ~ 1 GHz	Polarization:	Horizontal
Test Voltage:	AC 120/60Hz		



Suspected Data List

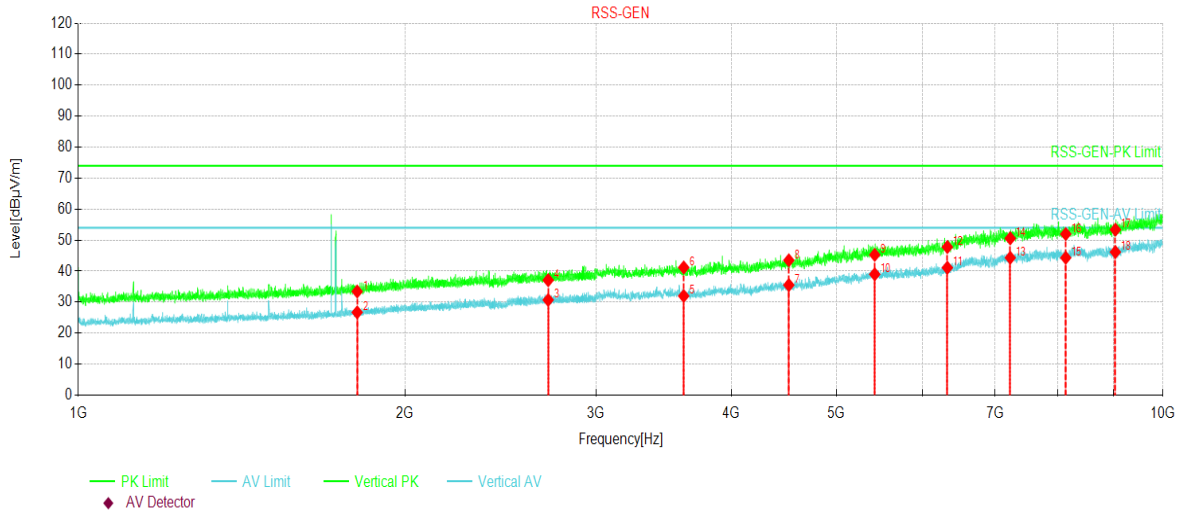
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	72.005	42.66	25.66	-17.00	40.00	14.34	PK	Horizontal
2	175.4175	39.79	22.83	-16.96	43.50	20.67	PK	Horizontal
3	250.0180	42.57	28.78	-13.79	46.00	17.22	PK	Horizontal
4	399.9950	44.70	34.24	-10.46	46.00	11.76	PK	Horizontal
5	600.0290	36.90	31.42	-5.48	46.00	14.58	PK	Horizontal
6	900.0800	36.37	35.00	-1.37	46.00	11.00	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:**	Tx mode
Test Frequency:	1 GHz ~ 10 GHz	**Polarization:**	Vertical
Test Voltage:	AC 120/60Hz		

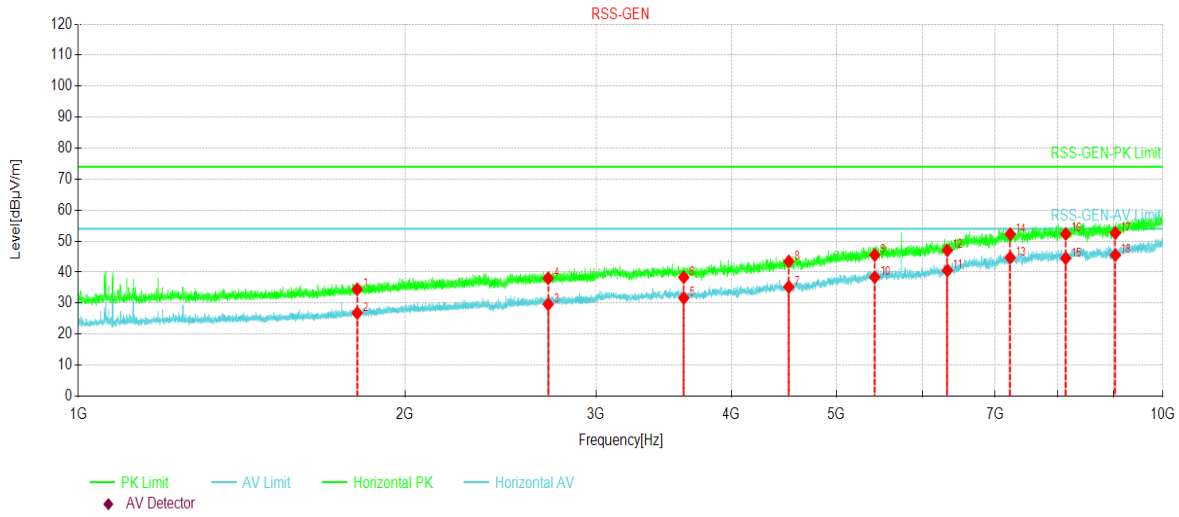


Suspected Data List								
NO.	Freq. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Trace	Polarity
1	1807.80	54.40	33.43	-20.97	74.00	40.57	PK	Vertical
2	1807.80	47.68	26.71	-20.97	54.00	27.29	AV	Vertical
3	2711.70	47.86	30.71	-17.15	54.00	23.29	AV	Vertical
4	2711.70	54.24	37.09	-17.15	74.00	36.91	PK	Vertical
5	3615.60	46.56	31.99	-14.57	54.00	22.01	AV	Vertical
6	3615.60	55.75	41.18	-14.57	74.00	32.82	PK	Vertical
7	4519.50	46.31	35.52	-10.79	54.00	18.48	AV	Vertical
8	4519.50	54.30	43.51	-10.79	74.00	30.49	PK	Vertical
9	5423.40	51.22	45.25	-5.97	74.00	28.75	PK	Vertical
10	5423.40	44.96	38.99	-5.97	54.00	15.01	AV	Vertical
11	6327.30	45.02	41.10	-3.92	54.00	12.90	AV	Vertical
12	6327.30	51.69	47.77	-3.92	74.00	26.23	PK	Vertical
13	7231.20	44.40	44.33	-0.07	54.00	9.67	AV	Vertical
14	7231.20	50.65	50.58	-0.07	74.00	23.42	PK	Vertical
15	8135.10	43.52	44.32	0.80	54.00	9.68	AV	Vertical
16	8135.10	51.17	51.97	0.80	74.00	22.03	PK	Vertical
17	9039.00	51.61	53.37	1.76	74.00	20.63	PK	Vertical
18	9039.00	44.41	46.17	1.76	54.00	7.83	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:	Tx mode
Test Frequency:	1 GHz ~ 10 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	1807.80	55.45	34.48	-20.97	74.00	39.52	PK	Horizontal
2	1807.80	47.77	26.80	-20.97	54.00	27.20	AV	Horizontal
3	2711.70	46.79	29.64	-17.15	54.00	24.36	AV	Horizontal
4	2711.70	55.16	38.01	-17.15	74.00	35.99	PK	Horizontal
5	3615.60	46.22	31.65	-14.57	54.00	22.35	AV	Horizontal
6	3615.60	52.92	38.35	-14.57	74.00	35.65	PK	Horizontal
7	4519.50	46.03	35.24	-10.79	54.00	18.76	AV	Horizontal
8	4519.50	54.23	43.44	-10.79	74.00	30.56	PK	Horizontal
9	5423.40	51.47	45.50	-5.97	74.00	28.50	PK	Horizontal
10	5423.40	44.31	38.34	-5.97	54.00	15.66	AV	Horizontal
11	6327.30	44.48	40.56	-3.92	54.00	13.44	AV	Horizontal
12	6327.30	50.96	47.04	-3.92	74.00	26.96	PK	Horizontal
13	7231.20	44.75	44.68	-0.07	54.00	9.32	AV	Horizontal
14	7231.20	52.36	52.29	-0.07	74.00	21.71	PK	Horizontal
15	8135.10	43.68	44.48	0.80	54.00	9.52	AV	Horizontal
16	8135.10	51.54	52.34	0.80	74.00	21.66	PK	Horizontal
17	9039.00	50.87	52.63	1.76	74.00	21.37	PK	Horizontal
18	9039.00	43.74	45.50	1.76	54.00	8.50	AV	Horizontal

Remark:

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

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