

# FCC REPORT

## (UNII)

**Applicant:** Nebra Ltd

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

### Equipment Under Test (EUT)

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

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

**FCC ID:** 2AZDM-HHRK4

**Applicable standards:** FCC CFR Title 47 Part 15 Subpart E Section 15.407

**Date of sample receipt:** 05 Jan., 2022

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

**Date of report issued:** 28 Jan., 2022

**Test Result:** PASS\*

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

Authorized Signature:

Bruce Zhang  
Laboratory Manager

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

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## 2 Version

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

**Tested by:** \_\_\_\_\_  
**Test Engineer**

**Date:** \_\_\_\_\_ 28 Jan., 2022

**Reviewed by:** \_\_\_\_\_  
**Project Engineer**

**Date:** \_\_\_\_\_ 28 Jan., 2022

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## 4 Test Summary

Test Item	Section in CFR 47	Test Data	Test Result
Antenna requirement	15.203 & 15.407 (a)	See Section 6.1	Pass
AC Power Line Conducted Emission	15.207	See Section 6.2	Pass
Duty Cycle	ANSI C63.10-2013	Please refer to FCC ID: 2A3PA-ROCKPI4 Report No.: BCTC2110851942-4E	Pass
Conducted Peak Output Power	15.407 (a) (1) (iv)	Please refer to FCC ID: 2A3PA-ROCKPI4 Report No.: BCTC2110851942-4E	Pass
26dB Occupied Bandwidth	15.407 (a) (12)	Please refer to FCC ID: 2A3PA-ROCKPI4 Report No.: BCTC2110851942-4E	Pass
6dB Emission Bandwidth	15.407(e)	Please refer to FCC ID: 2A3PA-ROCKPI4 Report No.: BCTC2110851942-4E	Pass
Power Spectral Density	15.407 (a) (1) (iv)	Please refer to FCC ID: 2A3PA-ROCKPI4 Report No.: BCTC2110851942-4E	Pass
Band Edge	15.407(b)	See Section 6.6	Pass
Spurious Emission	15.407 (b) & 15.205 & 15.209	See Section 6.7	Pass
Frequency Stability	15.407(g)	Please refer to FCC ID: 2A3PA-ROCKPI4 Report No.: BCTC2110851942-4E	Pass
<b>Remark:</b> 1. Pass: The EUT complies with the essential requirements in the standard. 2. Pass*: Please refer to FCC ID: 2A3PA-ROCKPI4, and the report No.: BCTC2110851942-4E issue by Shenzhen BCTC Testing Co., Ltd.			
<b>Test Method:</b>	ANSI C63.10-2013 KDB 789033 D02 General UNII Test Procedures New Rules v02r01		

## 5 General Information

### 5.1 Client Information

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

### 5.2 General Description of E.U.T.

Product Name:	Nebra Indoor LoRa Gateway <del>ROCK Pi 4 Version</del> / Nebra Indoor Helium Hotspot <del>ROCK Pi 4 Version</del>		
Model No.:	NEBHNT-HHRK4-433, NEBHNT-HHRK4-470, <del>NEBHNT-HHRK4-868</del> , NEBHNT-HHRK4-915, <del>NEBHNT-HHRK4-433-2</del> , <del>NEBHNT-HHRK4-470-2</del> , NEBHNT-HHRK4-868-2, <del>NEBHNT-HHRK4-915-2</del> , <del>NEBHNT-HHRK4-433-3</del> , NEBHNT-HHRK4-470-3, <del>NEBHNT-HHRK4-868-3</del> , NEBHNT-HHRK4-915-3, <del>NEBHNT-HHRK4-433-3</del> , <del>NEBHNT-HHRK4-470-3</del> , <del>NEBHNT-HHRK4-868-3</del> , <del>NEBHNT-HHRK4-915-3</del>		
Operation Frequency:	Band 1: 5150MHz-5250MHz		
Channel numbers:	Band 1:	802.11a/802.11n20: 4	<del>802.11n40: 2</del> 802.11ac: 1
Channel separation:	20MHz:	<del>802.11a/802.11n-HT20/802.11ac-HT20</del>	
	40MHz:	802.11n-HT40/802.11ac-HT40	
	80MHz:	802.11ac-HT80	
Modulation technology (IEEE 802.11a):	BPSK, QPSK, 16-QAM, 64-QAM		
Modulation technology (IEEE 802.11n):	BPSK, QPSK, 16-QAM, 64-QAM		
Modulation technology (IEEE 802.11ac):	BPSK, QPSK, 16-QAM, 64-QAM, <del>256-QAM</del>		
Data speed (IEEE 802.11a):	6Mbps, 9Mbps, <del>12Mbps</del> , 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps		
Data speed (IEEE 802.11n20):	<del>MCS0: 6.5Mbps</del> , <del>MCS1:13Mbps</del> , <del>MCS2:19.5Mbps</del> , <del>MCS3:26Mbps</del> , <del>MCS4:39Mbps</del> , <del>MCS5:52Mbps</del> , <del>MCS6:58.5Mbps</del> , <del>MCS7:65Mbps</del>		
Data speed (IEEE 802.11n40):	<del>MCS0:15Mbps</del> , <del>MCS1:30Mbps</del> , <del>MCS2:45Mbps</del> , <del>MCS3:60Mbps</del> , <del>MCS4:90Mbps</del> , <del>MCS5:120Mbps</del> , <del>MCS6:135Mbps</del> , <del>MCS7:150Mbps</del>		
Data speed (IEEE 802.11ac):	Up to 433.3Mbps		
Antenna Type:	External Antenna		
Antenna gain:	1 dBi		
AC adapter:	Model No.:R241-1202500I Input: AC100-240V, 50/60Hz 1.5 A Output: DC 12.0V, 2.5A		
Remark:	Model No.: NEBHNT-HHRK4-433, NEBHNT-HHRK4-470, NEBHNT-HHRK4-868, NEBHNT-HHRK4-915, NEBHNT-HHRK4-433-2, NEBHNT-HHRK4-470-2, NEBHNT-HHRK4-868-2, NEBHNT-HHRK4-915-2, NEBHNT-HHRK4-433-3, NEBHNT-HHRK4-470-3, NEBHNT-HHRK4-868-3, NEBHNT-HHRK4-915-3, NEBHNT-HHRK4-433-3, NEBHNT-HHRK4-470-3, NEBHNT-HHRK4-868-3, NEBHNT-HHRK4-915-3, The difference between the models is that the LoRa Radio module used inside is different for each variant. Along with a respective antenna for each region / frequency. The -2 and -3 flags at the end of the model number relates to the specific chip part number for the main LoRa chip.		

Test Sample Condition:	The test samples were provided in good working order with no visible defects.
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Operation Frequency each of channel					
Band 1					
802.11a/802.11n/ac-HT20		802.11n/ac-HT40		802.11ac-HT80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180MHz	38	5190MHz	42	5210MHz
40	5200MHz	46	5230MHz		
44	5220MHz				
48	5240MHz				

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Band 1					
802.11a/802.11n/ac-HT20		802.11n/ac-HT40		802.11ac-HT80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
Lowest	5180MHz	Lowest	5190MHz	Middle	5210MHz
Middle	5200MHz	Highest	5230MHz		
Highest	5240MHz				

### 5.3 Test environment and mode, and test samples plans

Operating Environment:	
Temperature:	24.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010 mbar
Test mode:	
Continuously transmitting mode	Keep the EUT in 100% duty cycle transmitting with modulation.
We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:	
Per-scan all kind of data rate, and found the follow list were the worst case.	
Mode	Data rate
802.11a	6 Mbps
802.11n/ac20	6.5 Mbps
802.11n/ac40	13.5 Mbps
802.11ac80	29.3 Mbps
<b>Remark:</b> JianYan Testing Group Shenzhen Co., Ltd. is only responsible for the test project data of the above samples, and will keep the above samples for a month.	

## 5.4 Description of Support Units

Manufacturer	Description	Model	Serial Number	FCC ID/DoC
The EUT has been tested as an independent unit.				

## 5.5 Measurement Uncertainty

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

## 5.6 Additions to, deviations, or exclusions from the method

No
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## 5.7 Related Submittal(s) / Grant (s)

This is an original grant, no related submittals and grants.
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## 5.8 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>

## 5.9 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>



## 5.10 Test Instruments list

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

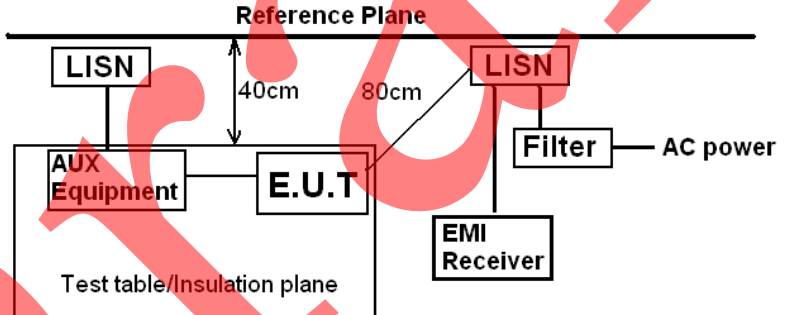
Conducted Emission:					
Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
EMI Test Receiver	Rohde & Schwarz	ESCI 3	101189	03-03-2021	03-02-2022
LISN	Schwarzbeck	NSLK 8127	QCJ001-13	03-18-2021	03-17-2022
LISN	Rohde & Schwarz	ESH3-Z5	843862/010	06-18-2020	06-17-2022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

## 6 Test results and Measurement Data

### 6.1 Antenna requirement

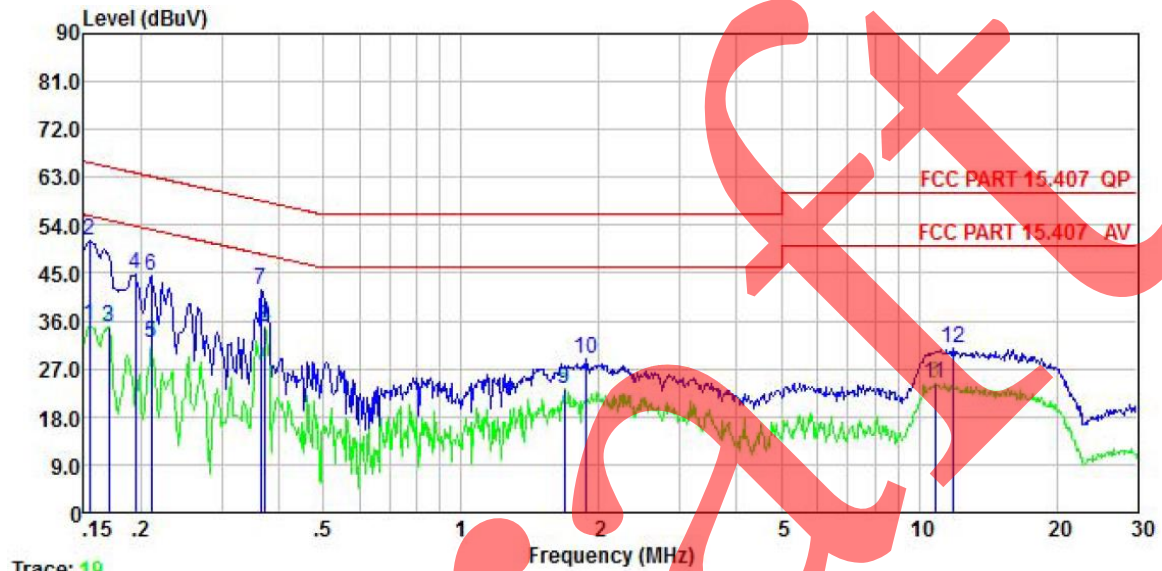
<b>Standard requirement:</b>	FCC Part15 E Section 15.203 /407(a)
<p>15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that 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.</p> <p>This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.</p>	
<b>E.U.T Antenna:</b>	
<p>The External antenna is an Internal antenna which cannot replace by end-user, the best case gain of the antenna is 1 dBi.</p>	

## 6.2 Conducted Emission

Test Requirement:	FCC Part15 C Section 15.207		
Test Frequency Range:	150kHz to 30MHz		
Class / Severity:	Class B		
Receiver setup:	RBW=9kHz, VBW=30kHz		
Limit:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	
	0.15-0.5	66 to 56*	0.15-0.5
	0.5-5	56	0.5-5
	5-30	60	5-30
* Decreases with the logarithm of the frequency.			
Test procedure	<ol style="list-style-type: none"> <li>The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). It provides a 50ohm/50uH coupling impedance for the measuring equipment.</li> <li>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).</li> <li>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(latest version) on conducted measurement.</li> </ol>		
Test setup:	 <p>Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p>		
Test Instruments:	Refer to section 5.10 for details		
Test mode:	Refer to section 5.3 for details.		
Test results:	Passed		

## Measurement Data:

Product name:	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	Product model:	NEBHNT-HHRK4-915
Test by:	Mike	Test mode:	5G Wi-Fi Tx mode
Test frequency:	150 kHz ~ 30 MHz	Phase:	Line
Test voltage:	AC 120 V/60 Hz	Environment:	Temp: 22.5℃ Humi: 55%



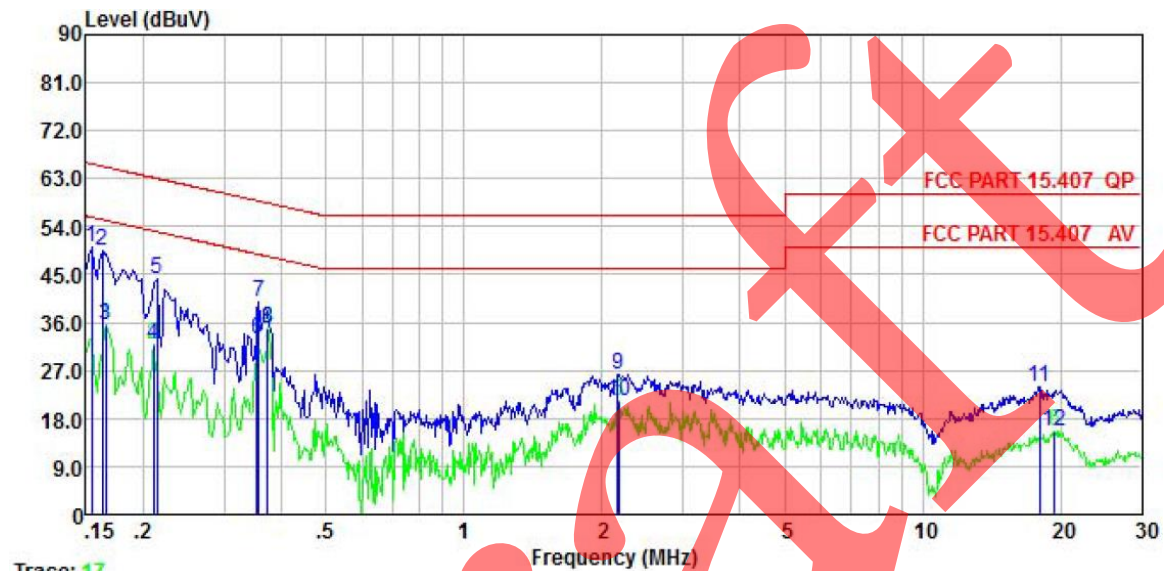
Trace: 19

	Read Freq	LISN Level	Cable Factor	Cable Loss	Limit Level	Over Line	Remark
	MHz	dBuV	dB	dB	dBuV	dB	
1	0.154	35.28	0.04	0.01	35.33	55.78	Average
2	0.154	50.96	0.04	0.01	51.01	65.78	QP
3	0.170	34.85	0.04	0.01	34.90	54.94	Average
4	0.194	44.61	0.04	0.03	44.68	63.84	QP
5	0.211	31.71	0.04	0.03	31.78	53.18	Average
6	0.211	44.53	0.04	0.03	44.60	63.18	QP
7	0.365	41.75	0.04	0.03	41.82	58.61	QP
8	0.373	34.87	0.04	0.03	34.94	48.43	Average
9	1.680	22.98	0.07	0.17	23.22	46.00	Average
10	1.868	28.66	0.07	0.19	28.92	56.00	QP
11	10.847	24.02	0.22	0.12	24.36	50.00	Average
12	11.870	30.48	0.24	0.10	30.82	60.00	QP

## Notes:

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

<b>Product name:</b>	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	<b>Product model:</b>	NEBHNT-HHRK4-915
<b>Test by:</b>	Mike	<b>Test mode:</b>	5G Wi-Fi Tx mode
<b>Test frequency:</b>	150 kHz ~ 30 MHz	<b>Phase:</b>	Neutral
<b>Test voltage:</b>	AC 120 V/60 Hz	<b>Environment:</b>	Temp: 22.5°C Humi: 55%



Trace: 17

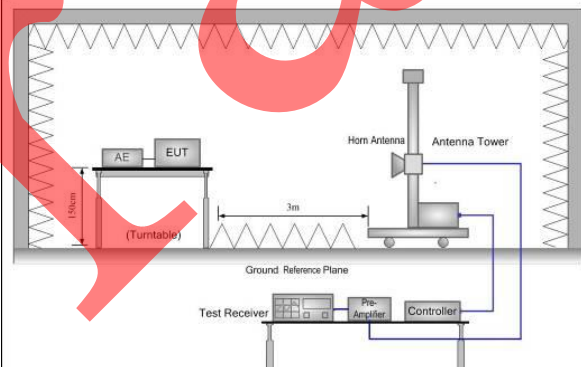
	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit	Over	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.154	49.99	0.05	0.01	50.05	65.78	-15.73	QP
2	0.162	49.52	0.05	0.01	49.58	65.34	-15.76	QP
3	0.166	35.48	0.05	0.01	35.54	55.16	-19.62	Average
4	0.211	31.94	0.04	0.03	32.01	53.18	-21.17	Average
5	0.214	44.22	0.04	0.03	44.29	63.05	-18.76	QP
6	0.354	32.68	0.04	0.02	32.74	48.87	-16.13	Average
7	0.358	39.70	0.04	0.02	39.76	58.78	-19.02	QP
8	0.373	34.72	0.04	0.03	34.79	48.43	-13.64	Average
9	2.167	25.97	0.06	0.18	26.21	56.00	-29.79	QP
10	2.178	20.89	0.06	0.18	21.13	46.00	-24.87	Average
11	17.944	23.44	0.28	0.15	23.87	60.00	-36.13	QP
12	19.428	15.23	0.29	0.15	15.67	50.00	-34.33	Average

#### Notes:

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



### 6.3 Band Edge

Test Requirement:	FCC Part 15 E Section 15.407 (b)			
Receiver setup:	Detector	RBW	VBW	Remark
	Quasi-peak	120kHz	300kHz	Quasi-peak Value
	RMS	1MHz	3MHz	Average Value
Limit:	Band	Limit (dBuV/m @3m)		Remark
	Band 1	68.20		Peak Value
		54.00		Average Value
	Remark:			
1. Band 1 limit: $E[\text{dBuV/m}] = \text{EIRP}[\text{dBm}] + 95.2 = 68.2 \text{ dBuV/m}$ , for $\text{EIPR}[\text{dBm}] = -27\text{dBm}$ .				
Test Procedure:	<div>1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.</div> <div>2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.</div> <div>3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.</div> <div>4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable was turned from 0 degrees to 360 degrees to find the maximum reading.</div> <div>5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</div> <div>6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.</div>			
Test setup:				
Test Instruments:	Refer to section 5.10 for details			
Test mode:	Refer to section 5.3 for details			
Test results:	Passed			

**Measurement Data (worst case):**
**Band 1:**

Band 1 – 802.11a							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5150.00	40.92	15.49	56.41	68.20	11.79	Horizontal	Peak
5150.00	39.60	15.49	55.09	68.20	13.11	Vertical	Peak
5150.00	33.01	15.49	48.50	54.00	5.5	Horizontal	Average
5150.00	32.21	15.49	47.70	54.00	6.3	Vertical	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5350.00	41.39	16.44	57.83	68.20	10.37	Horizontal	Peak
5350.00	39.98	16.44	56.42	68.20	11.78	Vertical	Peak
5350.00	32.98	16.44	49.42	54.00	4.58	Horizontal	Average
5350.00	32.31	16.44	48.75	54.00	5.25	Vertical	Average
Band 1 – 802.11n(HT20)							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5150.00	40.77	15.49	56.26	68.20	11.94	Horizontal	Peak
5150.00	39.37	15.49	54.86	68.20	13.34	Vertical	Peak
5150.00	32.84	15.49	48.33	54.00	5.67	Horizontal	Average
5150.00	32.08	15.49	47.57	54.00	6.43	Vertical	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5350.00	40.76	16.44	57.20	68.20	11	Horizontal	Peak
5350.00	39.17	16.44	55.61	68.20	12.59	Vertical	Peak
5350.00	33.01	16.44	49.45	54.00	4.55	Horizontal	Average
5350.00	32.53	16.44	48.97	54.00	5.03	Vertical	Average
<b>Remark:</b> 1. Final Level = Receiver Read level + Factor. 2. The emission levels of other frequencies are lower than the limit 20dB and not show in test report.							

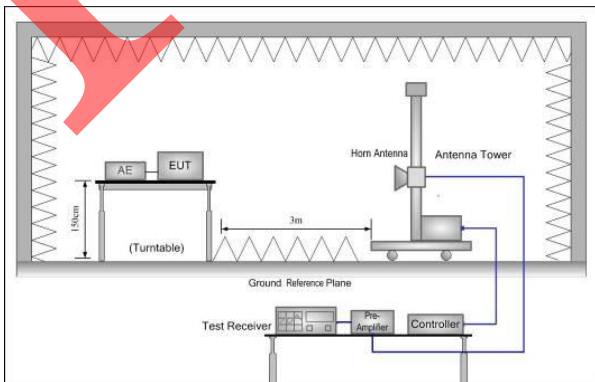
Band 1 – 802.11n(HT40)							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5150.00	40.41	15.49	55.90	68.20	12.3	Horizontal	Peak
5150.00	39.02	15.49	54.51	68.20	13.69	Vertical	Peak
5150.00	32.55	15.49	48.04	54.00	5.96	Horizontal	Average
5150.00	32.25	15.49	47.74	54.00	6.26	Vertical	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5350.00	40.18	16.44	56.62	68.20	11.58	Horizontal	Peak
5350.00	39.33	16.44	55.77	68.20	12.43	Vertical	Peak
5350.00	32.52	16.44	48.96	54.00	5.04	Horizontal	Average
5350.00	31.81	16.44	48.25	54.00	5.75	Vertical	Average
Band 1 – 802.11ac(HT20)							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5150.00	41.59	15.49	57.08	68.20	11.12	Horizontal	Peak
5150.00	39.53	15.49	55.02	68.20	13.18	Vertical	Peak
5150.00	33.07	15.49	48.56	54.00	5.44	Horizontal	Average
5150.00	32.61	15.49	48.10	54.00	5.9	Vertical	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5350.00	41.76	16.44	58.20	68.20	10	Horizontal	Peak
5350.00	39.61	16.44	56.05	68.20	12.15	Vertical	Peak
5350.00	33.22	16.44	49.66	54.00	4.34	Horizontal	Average
5350.00	32.14	16.44	48.58	54.00	5.42	Vertical	Average
Remark: 1. Final Level = Receiver Read level + Factor. 2. The emission levels of other frequencies are lower than the limit 20dB and not show in test report.							



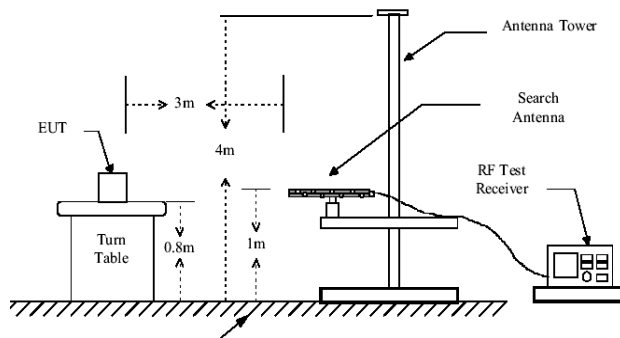
Band 1 – 802.11ac(HT40)							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5150.00	40.73	15.49	56.22	68.20	11.98	Horizontal	Peak
5150.00	39.25	15.49	54.74	68.20	13.46	Vertical	Peak
5150.00	33.04	15.49	48.53	54.00	5.47	Horizontal	Average
5150.00	31.68	15.49	47.17	54.00	6.83	Vertical	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5350.00	40.39	16.44	56.83	68.20	11.37	Horizontal	Peak
5350.00	38.99	16.44	55.43	68.20	12.77	Vertical	Peak
5350.00	32.68	16.44	49.12	54.00	4.88	Horizontal	Average
5350.00	31.51	16.44	47.95	54.00	6.05	Vertical	Average
Band 1 – 802.11ac(HT80)							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5150.00	40.55	15.49	56.04	68.20	12.16	Horizontal	Peak
5150.00	39.05	15.49	54.54	68.20	13.66	Vertical	Peak
5150.00	32.03	15.49	47.52	54.00	6.48	Horizontal	Average
5150.00	31.36	15.49	46.85	54.00	7.15	Vertical	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Polarity
5350.00	40.36	16.44	56.80	68.20	11.4	Horizontal	Peak
5350.00	38.76	16.44	55.20	68.20	13	Vertical	Peak
5350.00	31.89	16.44	48.33	54.00	5.67	Horizontal	Average
5350.00	30.99	16.44	47.43	54.00	6.57	Vertical	Average
Remark: 1. Final Level = Receiver Read level + Factor. 2. The emission levels of other frequencies are lower than the limit 20dB and not show in test report.							

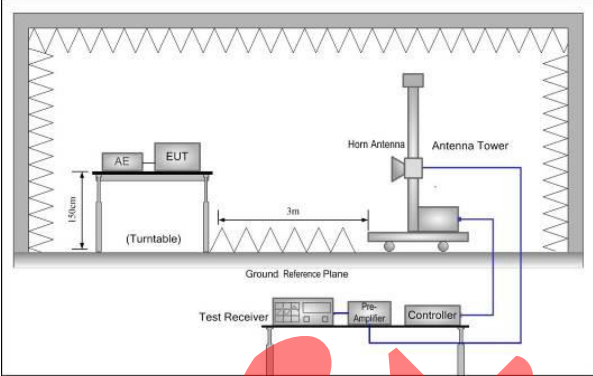
## 6.4 Spurious Emission

### 6.4.1 Restricted Band

Test Requirement:	FCC Part15 E Section 15.407(b)				
Test Frequency Range:	4.5 GHz to 5.15 GHz and 5.35GHz to 5.46GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Remark
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		RMS	1MHz	3MHz	Average Value
Limit:	Frequency	Limit (dBuV/m @3m)		Remark	
	Above 1GHz	74.00		Peak Value	
		54.00		Average Value	
Test Procedure:	<div><div><div>1.</div><div>The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.</div></div><div><div>2.</div><div>The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.</div></div><div><div>3.</div><div>The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.</div></div><div><div>4.</div><div>For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.</div></div><div><div>5.</div><div>The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</div></div><div><div>6.</div><div>If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.</div></div></div>				
Test setup:	<div></div>				
Test Instruments:	Refer to section 5.10 for details				
Test mode:	Refer to section 5.3 for details				
Test results:	Passed(Refer to section 6.6)				

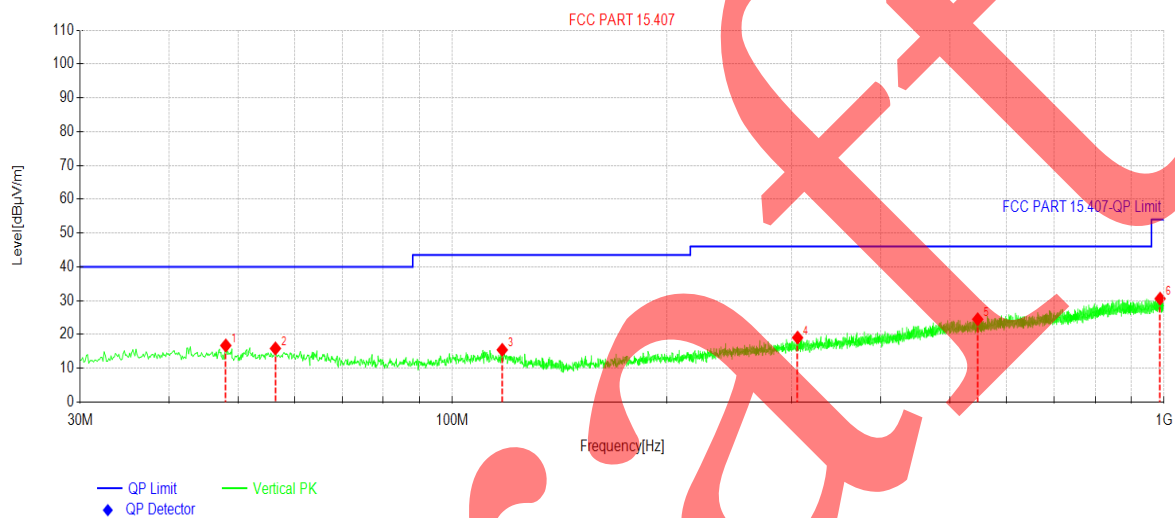
## 6.4.2 Unwanted Emissions out of the Restricted Bands

Test Requirement:	FCC Part15 C Section 15.209 and 15.205				
Test Frequency Range:	30MHz to 40GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Remark
	30MHz-1GHz	Quasi-peak	100kHz	300kHz	Quasi-peak Value
	Above 1GHz	Peak RMS	1MHz 1MHz	3MHz 3MHz	Peak Value Average Value
Limit:	Frequency	Limit (dBuV/m @3m)			Remark
	30MHz-88MHz	40.0			Quasi-peak Value
	88MHz-216MHz	43.5			Quasi-peak Value
	216MHz-960MHz	46.0			Quasi-peak Value
	960MHz-1GHz	54.0			Quasi-peak Value
	Above 1GHz	68.20			Peak Value
		54.00			Average Value
Remark: Above 1GHz limit: $E[dB\mu V/m] = EIRP[dBm] + 95.2 = 68.2 \text{ dB}\mu V/m$ , for $EIPR[dBm] = -27dBm$ .					
Test Procedure:	<ol style="list-style-type: none"><li>The EUT was placed on the top of a rotating table 0.8m(below 1GHz)/1.5m(above 1GHz) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.</li><li>The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.</li><li>The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.</li><li>For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.</li><li>The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</li><li>If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.</li></ol>				
Test setup:	<div>Below 1GHz</div> <div></div> <div>Above 1GHz</div>				

	
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

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

<b>Product name:</b>	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	<b>Product model:</b>	NEBHNT-HHRK4-915
<b>Test By:</b>	Mike	<b>Test mode:</b>	5G Wi-Fi Tx mode
<b>Test Frequency:</b>	30 MHz ~ 1 GHz	<b>Polarization:</b>	Vertical
<b>Test Voltage:</b>	AC 120/60Hz	<b>Environment:</b>	Temp: 24℃ Humi: 57%

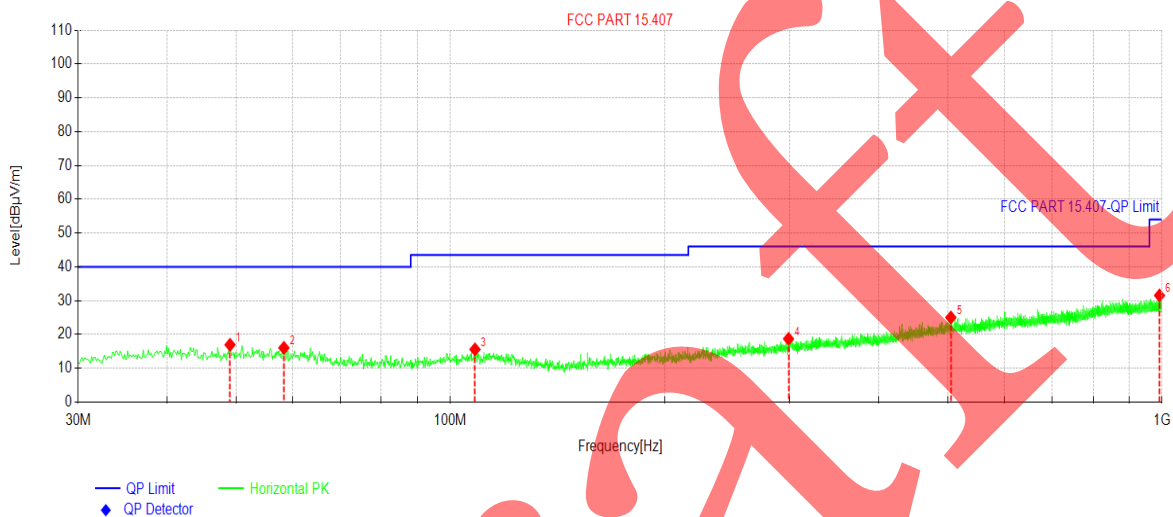


NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Trace	Polarity
1	48.0663	31.58	16.74	-14.84	40.00	23.26	PK	Vertical
2	56.4325	30.60	15.87	-14.73	40.00	24.13	PK	Vertical
3	117.542	31.20	16.45	-15.75	43.50	28.05	PK	Vertical
4	305.601	31.62	19.07	-12.55	46.00	26.93	PK	Vertical
5	547.252	31.37	24.50	-6.87	46.00	21.50	PK	Vertical
6	987.390	31.33	30.59	-0.74	54.00	23.41	PK	Vertical

**Remark:**

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

<b>Product name:</b>	Nebra Indoor LoRa Gateway ROCK Pi 4 Version / Nebra Indoor Helium Hotspot ROCK Pi 4 Version	<b>Product model:</b>	NEBHNT-HHRK4-915
<b>Test By:</b>	Mike	<b>Test mode:</b>	5G Wi-Fi Tx mode
<b>Test Frequency:</b>	30 MHz ~ 1 GHz	<b>Polarization:</b>	Horizontal
<b>Test Voltage:</b>	AC 120/60Hz	<b>Environment:</b>	Temp: 24℃ Humi: 57%



NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Trace	Polarity
1	49.0363	31.72	16.95	-14.77	40.00	23.05	PK	Horizontal
2	58.3725	30.92	16.03	-14.89	40.00	23.97	PK	Horizontal
3	108.327	31.51	15.59	-15.92	43.50	27.91	PK	Horizontal
4	298.690	31.45	18.72	-12.73	46.00	27.28	PK	Horizontal
5	504.936	31.95	25.04	-6.91	46.00	20.96	PK	Horizontal
6	991.876	32.19	31.54	-0.65	54.00	22.46	PK	Horizontal

**Remark:**

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

**Above 1GHz:**  
**Band 1:**

Band 1 – 802.11a							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10360.00	52.66	5.48	58.14	68.20	10.06	Vertical	Peak
10360.00	53.21	5.48	58.69	68.20	9.51	Horizontal	Peak
10360.00	44.89	5.48	50.37	54.00	3.63	Vertical	Average
10360.00	45.69	5.48	51.17	54.00	2.83	Horizontal	Average
Test channel: Middle channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10400.00	52.33	5.31	57.64	68.20	10.56	Vertical	Peak
10400.00	52.71	5.31	58.02	68.20	10.18	Horizontal	Peak
10400.00	44.93	5.31	50.24	54.00	3.76	Vertical	Average
10400.00	45.71	5.31	51.02	54.00	2.98	Horizontal	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10480.00	51.87	5.98	57.85	68.20	10.35	Vertical	Peak
10480.00	52.53	5.98	58.51	68.20	9.69	Horizontal	Peak
10480.00	45.40	5.98	51.38	54.00	2.62	Vertical	Average
10480.00	45.25	5.98	51.23	54.00	2.77	Horizontal	Average
Band 1 – 802.11n(HT20)							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10360.00	52.20	5.48	57.68	68.20	10.52	Vertical	Peak
10360.00	53.10	5.48	58.58	68.20	9.62	Horizontal	Peak
10360.00	45.02	5.48	50.50	54.00	3.50	Vertical	Average
10360.00	45.60	5.48	51.08	54.00	2.92	Horizontal	Average
Test channel: Middle channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10400.00	51.98	5.31	57.29	68.20	10.91	Vertical	Peak
10400.00	53.03	5.31	58.34	68.20	9.86	Horizontal	Peak
10400.00	44.52	5.31	49.83	54.00	4.17	Vertical	Average
10400.00	45.31	5.31	50.62	54.00	3.38	Horizontal	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10480.00	51.77	5.98	57.75	68.20	10.45	Vertical	Peak
10480.00	53.24	5.98	59.22	68.20	8.98	Horizontal	Peak
10480.00	44.21	5.98	50.19	54.00	3.81	Vertical	Average
10480.00	45.12	5.98	51.10	54.00	2.90	Horizontal	Average
<b>Remark:</b> 1. Final Level = Receiver Read level + Factor. 2. The emission levels of other frequencies are lower than the limit 20dB and not show in test report.							

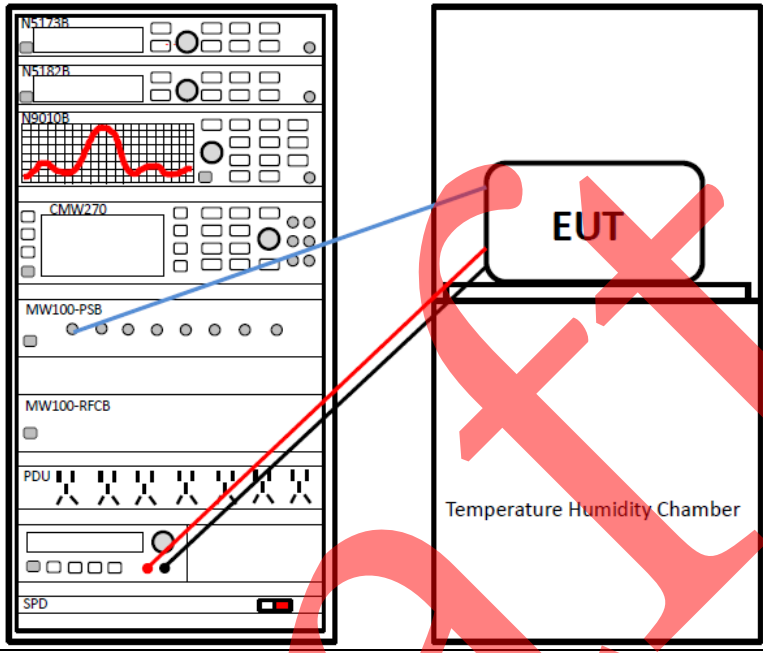


Band 1 – 802.11n(HT40)							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10380.00	54.54	5.39	59.93	68.20	8.27	Vertical	Peak
10380.00	53.71	5.39	59.10	68.20	9.10	Horizontal	Peak
10380.00	44.63	5.39	50.02	54.00	3.98	Vertical	Average
10380.00	44.16	5.39	49.55	54.00	4.45	Horizontal	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10460.00	54.24	5.81	60.05	68.20	8.15	Vertical	Peak
10460.00	53.33	5.81	59.14	68.20	9.06	Horizontal	Peak
10460.00	44.50	5.81	50.31	54.00	3.69	Vertical	Average
10460.00	44.43	5.81	50.24	54.00	3.76	Horizontal	Average
Band 1 – 802.11ac(HT20)							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10360.00	52.34	5.48	57.82	68.20	10.38	Vertical	Peak
10360.00	53.45	5.48	58.93	68.20	9.27	Horizontal	Peak
10360.00	44.92	5.48	50.40	54.00	3.60	Vertical	Average
10360.00	45.78	5.48	51.26	54.00	2.74	Horizontal	Average
Test channel: Middle channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10400.00	52.82	5.31	58.13	68.20	10.07	Vertical	Peak
10400.00	53.69	5.31	59.00	68.20	9.20	Horizontal	Peak
10400.00	44.82	5.31	50.13	54.00	3.87	Vertical	Average
10400.00	45.88	5.31	51.19	54.00	2.81	Horizontal	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10480.00	52.53	5.98	58.51	68.20	9.69	Vertical	Peak
10480.00	53.97	5.98	59.95	68.20	8.25	Horizontal	Peak
10480.00	45.06	5.98	51.04	54.00	2.96	Vertical	Average
10480.00	45.69	5.98	51.67	54.00	2.33	Horizontal	Average
Remark:							
1. Final Level = Receiver Read level + Factor.							
2. The emission levels of other frequencies are lower than the limit 20dB and not show in test report.							



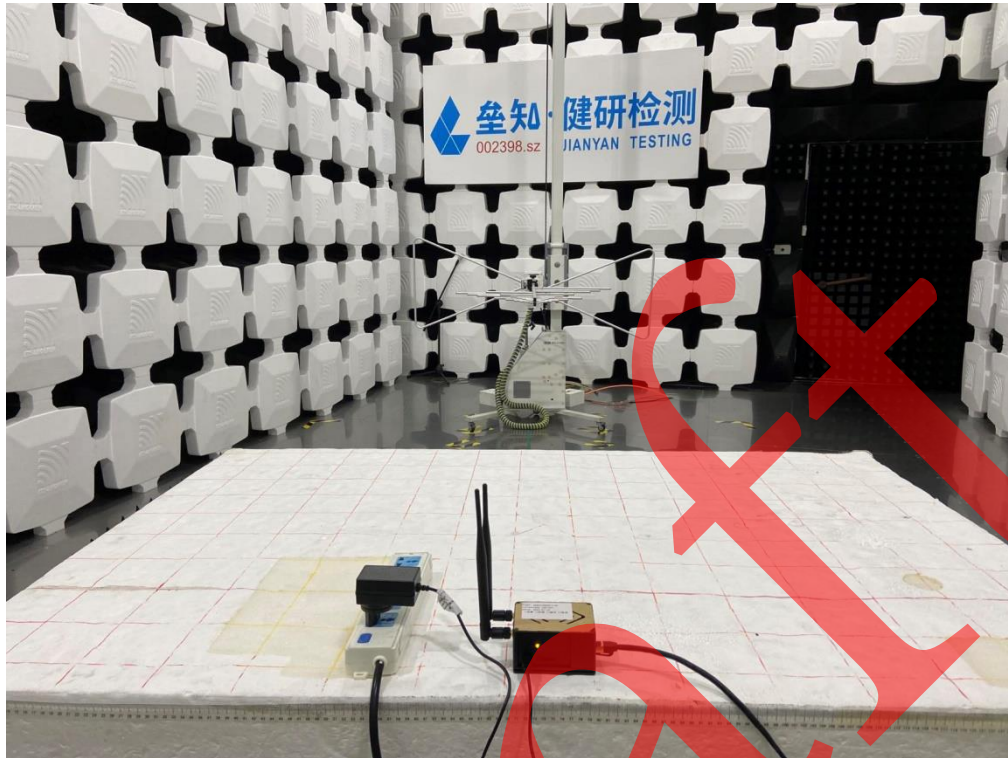
Band 1 – 802.11ac(HT40)							
Test channel: Lowest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10380.00	55.27	5.39	60.66	68.20	7.54	Vertical	Peak
10380.00	54.07	5.39	59.46	68.20	8.74	Horizontal	Peak
10380.00	44.08	5.39	49.47	54.00	4.53	Vertical	Average
10380.00	45.25	5.39	50.64	54.00	3.36	Horizontal	Average
Test channel: Highest channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10460.00	54.66	5.81	60.47	68.20	7.73	Vertical	Peak
10460.00	53.94	5.81	59.75	68.20	8.45	Horizontal	Peak
10460.00	44.20	5.81	50.01	54.00	3.99	Vertical	Average
10460.00	45.53	5.81	51.34	54.00	2.66	Horizontal	Average
Band 1 – 802.11ac(HT80)							
Test channel: Middle channel							
Frequency (MHz)	Read Level (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Margin [dB]	Polarization	Trace
10420.00	52.84	5.48	58.32	68.20	9.88	Vertical	Peak
10420.00	54.38	5.48	59.86	68.20	8.34	Horizontal	Peak
10420.00	44.57	5.48	50.05	54.00	3.95	Vertical	Average
10420.00	45.25	5.48	50.73	54.00	3.27	Horizontal	Average
Remark: 1. Final Level = Receiver Read level + Factor. 2. The emission levels of other frequencies are lower than the limit 20dB and not show in test report.							

## 6.5 Frequency stability

Test Requirement:	FCC Part15 E Section 15.407 (g)
Limit:	Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.
Test setup:	
Test procedure:	<ol style="list-style-type: none"> <li>1. The EUT is installed in an environment test chamber with external power source.</li> <li>2. Set the chamber to operate at 50 centigrade and external power source to output at nominal voltage of EUT.</li> <li>3. A sufficient stabilization period at each temperature is used prior to each frequency measurement.</li> <li>4. When temperature is stabled, measure the frequency stability.</li> <li>5. The test shall be performed under -30 to 50 centigrade and 85 to 115 percent of the nominal voltage. Change setting of chamber and external power source to complete all conditions.</li> </ol>
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	<b>Refer to Appendix A - 5G WIFI</b>

## 7 Test Setup Photo

Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



**Conducted Emission**



## 8 EUT Constructional Details

Reference to the test report No.: JYTSZ-R12-2200086.

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