Report No.: ET-23111275E

# TEST REPORT

| | |
|---|---|
| Applicant's name: | Guangzhou FriendlyELEC Technology Co., Ltd. |
| Address: | Room 1106, 11F, East Tower, Top Plaza, No.22, Xingmin Road, Zhujiang New Town, Tianhe District, Guangzhou, China, 510000 |
| Manufacture's Name: | Friendly ELEC |
| Address: | Room 118, Building A, Shilian Technology Park No.33 Science Road, Science City, Luogang District, Guangzhou |
| Product name: | NanoPi R6C |
| Model/Type reference: | NanoPi R6C |
| Trademark: | N/A |
| Standards: | FCC Part 15 Subpart B |
| Test methods | ANSI C63.4-2014 |
| Date of testing: | Nov.03, 2023- Nov.10, 2023 |
| Date of issue: | Nov.29, 2023 |
| Test Result : | PASS * |

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

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full without prior written permission of the company.

The report would be invalid without specific stamp of test institute and the signatures of compiler and approver

## Prepared By

Shenzhen ETR Standard Technology Co., Ltd.

Address: No.103, No.10, Phase I, Zone 3, Xinxing Industrial Park, Xinhe, Fuhai Street, Bao'an District,

Shenzhen, Guangdong, China

| Compiled by: | Reviewed by: | Approved by: |
|---|---|---|
| Project Engineer | Project Manager | Authorized Signature |

| Report Revision History | | |
|---|---|---|
| Report No. | Description | Issue Date |
| ET-23111275E | Original | Nov.29, 2023 |
| | | |
| | | |
| | | |

# Table of Contents

# 1 Summary of Test Result

| Item | Description of Test | Result | Test by |
|---|---|---|---|
| 1 | Conducted emission | Pass | Qiao Li |
| 2 | Radiated emission | Pass | Qiao Li |

# 2 General description

## 2.1 Description of EUT

| | |
|---|---|
| Product name: | NanoPi R6C |
| Test Model name: | NanoPi R6C |
| Series Model： | N/A |
| Different of series model: | N/A |
| Power supply: | DC 5V |
| Power supply of test: | DC 5V or AC 120V 60Hz From Adapter |
| Battery: | N/A |
| EUT Highest Frequency | Above 108MHz |
| Classification of equipment | Class B |

## 2.2 Test mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

| Test mode | Description |
|---|---|
| Mode 1 | System full load(WIFI+TF+HDMI) |
| Note: The test modes were carried out for all operation modes. The final test mode of the EUT was the worst test mode for EMI, and its test data is showed. | |

## 2.3 EUT test setup

See photographs of the test setup in the report for the actual setup and connections between EUT and support equipment.

## 2.4 Ancillary equipment

| Equipment | Model | S/N | Manufacturer |
|---|---|---|---|
| Monitor | SE2416HC | / | DELL |
| Mouse + Keyboard | / | / | / |
| Adapter | HW-090200CH0 | / | HUAWEI |

# 3 Test Facilities and Accreditations

## 3.1 Test laboratory

| | |
|---|---|
| Test laboratory: | Shenzhen ETR Standard Technology Co., Ltd. |
| Laboratory location: | No.103, No.10, Phase I, Zone 3, Xinxing Industrial Park, Xinhe, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China |
| CNAS Registration No.: | L11864 |
| Telephone: | +86 755 85259392 |

## 3.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

| | |
|---|---|
| Temperature: | 15ºC~35ºC |
| Humidity | 20%~75% |
| Atmospheric pressure | 98kPa~101kPa |

## 3.3 Measurement uncertainty

Measurement Uncertainty for a Level of Confidence of 95 %, U=2xUc(y)

| | |
|---|---|
| Conducted emission(150kHz~30MHz) | ± 3.02 dB |
| Radiated emission(30MHz~1GHz) | ±4.30 dB |
| Radiated emission (above 1GHz) | ±4.35 dB |
| Temperature | ±1 degree |
| Humidity | ± 5 % |

## 3.4 Test software

| Software name | Manufacturer | Model | Version |
|---|---|---|---|
| Conducted test software | Farad | EZ-EMC | Ver.EMC-CON 3A1.1 |
| Radiated test software | Farad | EZ-EMC | Ver.FA-03A2 RE |

# 4 List of test equipment

| Item | Equipment name | Manufacturer | Model | Serial No. | Calibration date | Due date |
|---|---|---|---|---|---|---|
| 1 | EMI Test Receiver | Rohde&schwarz | ESCI7 | 100605 | 2023.3.02 | 2024.3.01 |
| 2 | EMI Test Receiver | Rohde&schwarz | ESCI3 | 102696 | 2023.3.02 | 2024.3.01 |
| 3 | Loop Antenna | schwarabeck | FMZB 1519 B | FMZB 1519 B | 2022.3.11 | 2024.3.10 |
| 4 | Broadband antenna | schwarabeck | VULB9168 | 1064 | 2022.3.11 | 2024.3.10 |
| 5 | Horn antenna | schwarabeck | BBHA9120D | 2288 | 2022.3.11 | 2024.3.10 |
| 6 | amplifier | EMtrace | RP01A | 50117 | 2023.3.02 | 2024.3.01 |
| 7 | Artificial power network | schwarabeck | NSLK8127 | 8127483 | 2023.3.02 | 2024.3.01 |
| 8 | Artificial power network | ETS | 3186/2NM | 1132 | 2023.3.02 | 2024.3.01 |
| 9 | 10dB attenuator | HUBER+SUHNER | 10dB | / | 2023.3.02 | 2024.3.01 |
| 10 | amplifier | Space-Dtronics | EWLAN0118G-P40 | 19113001 | 2023.3.02 | 2024.3.01 |
| 11 | Spectrum analyzer | KEYSIGHT | N9020A | MY55370280 | 2023.3.02 | 2024.3.01 |
| 12 | Spectrum analyzer | Rohde&schwarz | FSV40 | 102137 | 2023.3.02 | 2024.3.01 |
| 13 | Amplifier | SKET | LNPA_1840-50 | SK2019040302 | 2023.3.02 | 2024.3.01 |
| 14 | Horn antenna | schwarabeck | BBHA 9170 | 946 | 2022.3.11 | 2024.3.10 |

Note: the calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

# 5 Test Results and test data

## 5.1 Conducted emission

| | |
|---|---|
| Test Requirement: | FCC Part15 B Section 15.107 |
| Test Method: | ANSI C63.4-2014 |
| Test Frequency Range: | 150KHz to 30MHz |
| Receiver setup: | RBW=9KHz, VBW=30KHz, Sweep time=auto |

### 5.1.1 Limits

| Frequency (MHz) | Class A (dBμV) | | Class B (dBμV) | |
|---|---|---|---|---|
| | Quasi-peak | Average | Quasi-peak | Average |
| 0.15 -0.5 | 79 | 66 | 66 - 56 * | 56 - 46 * |
| 0.5 -5 | 73 | 60 | 56 | 46 |
| 5 -30 | 73 | 60 | 60 | 50 |

Note 1: the tighter limit applies at the band edges.
Note 2: the limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

### 5.1.2 Test Procedures

The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

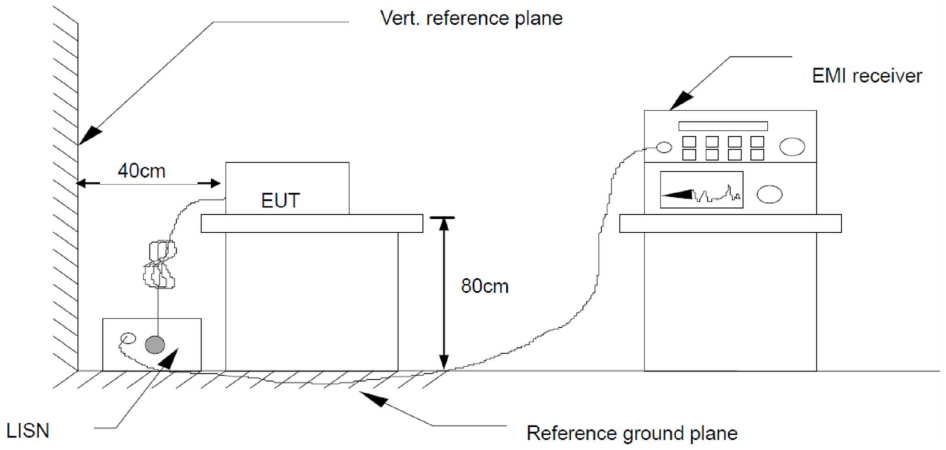
Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

LISN is at least 80 cm from nearest part of EUT chassis.

For the actual test configuration, please refer to the related Item – photographs of the test setup.

### 5.1.3 Test Setup



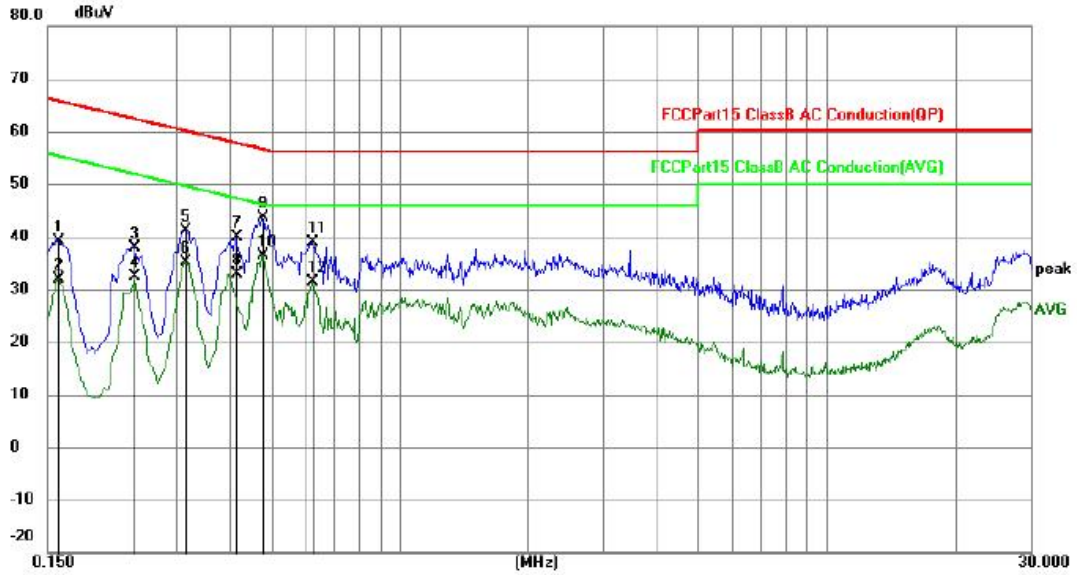

### 5.1.4 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). Test mode Refer to section 2.2 for details and only show the worst case.

### 5.1.5 Test Result

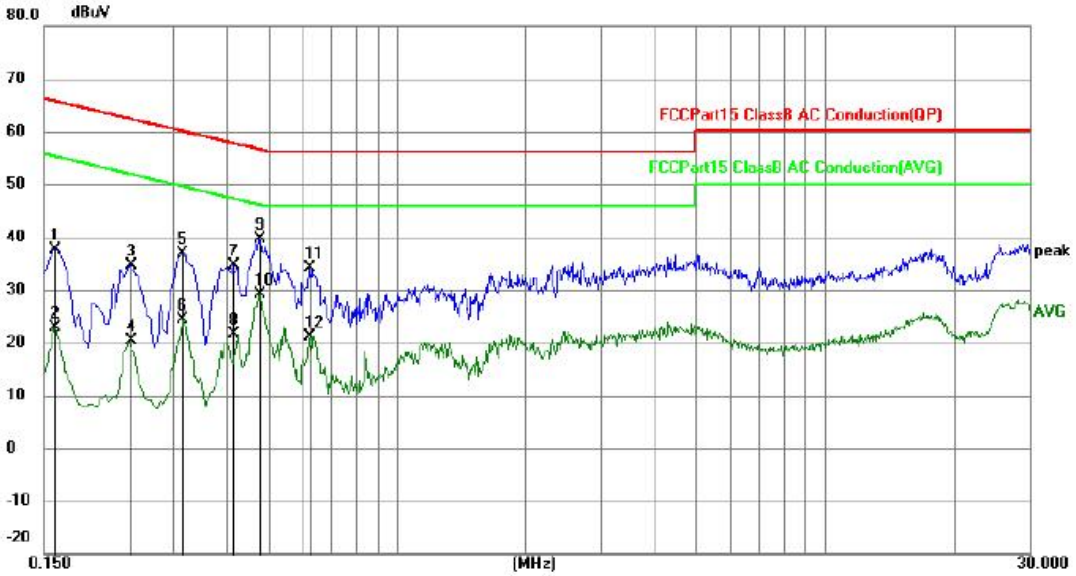
Level = Reading+ Factor
Factor= LISN Factor + Cable Loss+ Attenuator Factor

| Test mode: | Mode 1 | Phase: | L |
|---|---|---|---|
| Temperature: | 25°C | Humidity: | 46%RH |
| Pressure: | 101kPa | Test voltage: | AC 120V 60Hz |




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.1590 | 29.38 | 9.80 | 39.18 | 65.52 | -26.34 | QP |
| 2 | 0.1590 | 22.18 | 9.80 | 31.98 | 55.52 | -23.54 | AVG |
| 3 | 0.2400 | 28.03 | 9.82 | 37.85 | 62.10 | -24.25 | QP |
| 4 | 0.2400 | 22.47 | 9.82 | 32.29 | 52.10 | -19.81 | AVG |
| 5 | 0.3165 | 31.35 | 9.87 | 41.22 | 59.80 | -18.58 | QP |
| 6 | 0.3165 | 25.32 | 9.87 | 35.19 | 49.80 | -14.61 | AVG |
| 7 | 0.4154 | 30.01 | 9.90 | 39.91 | 57.54 | -17.63 | QP |
| 8 | 0.4154 | 23.03 | 9.90 | 32.93 | 47.54 | -14.61 | AVG |
| 9 | 0.4785 | 33.61 | 9.93 | 43.54 | 56.37 | -12.83 | QP |
| 10 | 0.4785 | 26.44 | 9.93 | 36.37 | 46.37 | -10.00 | AVG |
| 11 | 0.6270 | 28.97 | 9.94 | 38.91 | 56.00 | -17.09 | QP |
| 12 | 0.6270 | 21.32 | 9.94 | 31.26 | 46.00 | -14.74 | AVG |

| Test mode: | Mode 1 | Phase: | N |
|---|---|---|---|
| Temperature: | 25°C | Humidity: | 46%RH |
| Pressure: | 101kPa | Test voltage: | AC 120V 60Hz |




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Level (dBuV) | Limit (dBuV) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 0.1590 | 27.88 | 9.80 | 37.68 | 65.52 | -27.84 | QP |
| 2 | 0.1590 | 13.00 | 9.80 | 22.80 | 55.52 | -32.72 | AVG |
| 3 | 0.2400 | 24.92 | 9.82 | 34.74 | 62.10 | -27.36 | QP |
| 4 | 0.2400 | 10.45 | 9.82 | 20.27 | 52.10 | -31.83 | AVG |
| 5 | 0.3165 | 27.05 | 9.87 | 36.92 | 59.80 | -22.88 | QP |
| 6 | 0.3165 | 14.47 | 9.87 | 24.34 | 49.80 | -25.46 | AVG |
| 7 | 0.4154 | 24.65 | 9.90 | 34.55 | 57.54 | -22.99 | QP |
| 8 | 0.4154 | 11.76 | 9.90 | 21.66 | 47.54 | -25.88 | AVG |
| 9 | 0.4784 | 29.76 | 9.93 | 39.69 | 56.37 | -16.68 | QP |
| 10 | 0.4784 | 19.25 | 9.93 | 29.18 | 46.37 | -17.19 | AVG |
| 11 | 0.6269 | 24.19 | 9.94 | 34.13 | 56.00 | -21.87 | QP |
| 12 | 0.6269 | 11.15 | 9.94 | 21.09 | 46.00 | -24.91 | AVG |

## 5.2 Radiated emission

| | |
|---|---|
| Test Requirement: | FCC Part15 B Section 15.109 |
| Test Method: | ANSI C63.4-2014 |
| Test Frequency Range: | 5th harmonic of the highest frequency or 40 GHz, whichever is lower. |
| Test site: | Measurement Distance: 3m |
| Receiver setup: | See below |

| Frequency | Detector | RBW | VBW | Value |
|---|---|---|---|---|
| 30MHz-1GHz | Quasi-peak | 100KHz | 300KHz | Quasi-peak |
| Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | Peak | 1MHz | 10Hz | Average |

### 5.2.1 Limits

Limits of radiated emission measurement

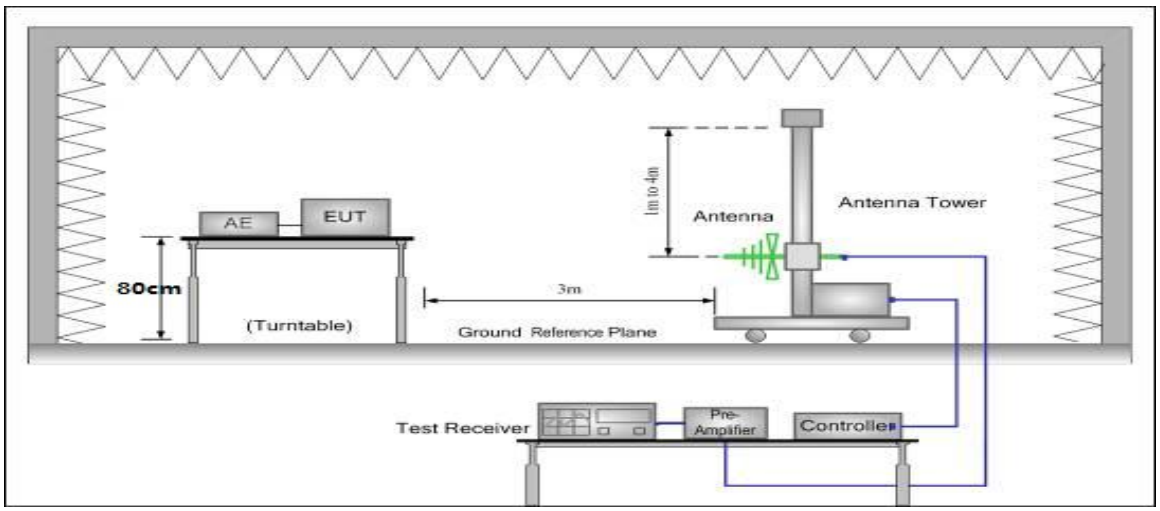
| Frequency (MHz) | Class B device (at 3m) dBμV/m | Class A device (at 3m) dBμV/m | Detector |
|---|---|---|---|
| 30-88 | 40 | 49 | QP |
| 88-216 | 43.5 | 53.5 | QP |
| 216-960 | 46 | 56.4 | QP |
| 960-1000 | 54 | 59.5 | QP |
| Above 1000 | 54 | 59.5 | AV |
| Above 1000 | 74 | 79.5 | PK |

### 5.2.2 Test Procedures

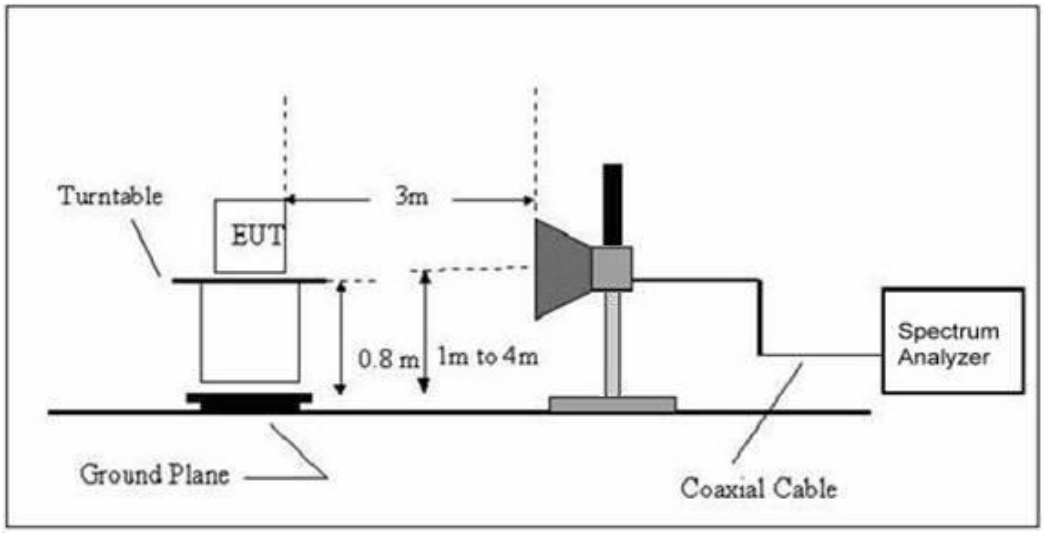
The radiated emission tests were performed in the 3 meters.
The EUT was placed on the top of a rotating table 0.8 meters above the ground. The table was rotated 360 degrees to determine the position of the highest radiation.
The height of the test antenna shall vary between 1m to 4m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
If the peak mode measured value compliance with and lower than quasi peak mode limit, the EUT shall be deemed to meet QP limits and then no additional QP mode measurement performed.
If the peak mode measured value compliance with and lower than average mode limit, the EUT shall be deemed to meet average limits and then no additional average mode measurement performed.
For the actual test configuration, please refer to the related item – EUT test photos.

### 5.2.3 Test Setup

Radiated emission test-up frequency for below 1GHz




Radiated emission test-up frequency for above 1GHz




### 5.2.4 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). Test mode Refer to section 2.2 for details and only show the worst case.

### 5.2.5 Test Result

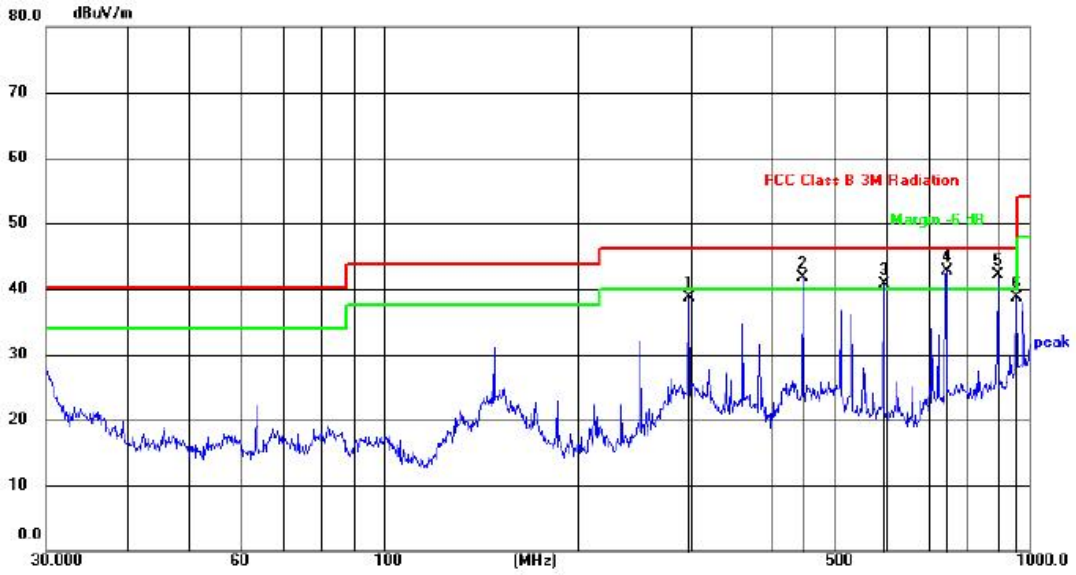
Level = Reading + Factor
Factor= Antenna Factor + Cable Factor – Preamplifier Factor

Below 1GHz

| Test mode: | Mode 1 | Test polarization: | Horizontal |
|---|---|---|---|
| Temperature: | 25.8°C | Humidity: | 51%RH |
| Pressure: | 101kPa | Test voltage: | AC 120V 60Hz |


| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 446.4140 | 56.57 | -15.65 | 40.92 | 46.00 | -5.08 | QP |
| 2 | 510.0435 | 52.85 | -13.93 | 38.92 | 46.00 | -7.08 | QP |
| 3 | 595.1327 | 51.84 | -11.86 | 39.98 | 46.00 | -6.02 | QP |
| 4 | 724.2610 | 48.37 | -8.63 | 39.74 | 46.00 | -6.26 | QP |
| 5 | 744.8660 | 50.28 | -8.21 | 42.07 | 46.00 | -3.93 | QP |
| 6 | 893.8566 | 47.25 | -5.54 | 41.71 | 46.00 | -4.29 | QP |

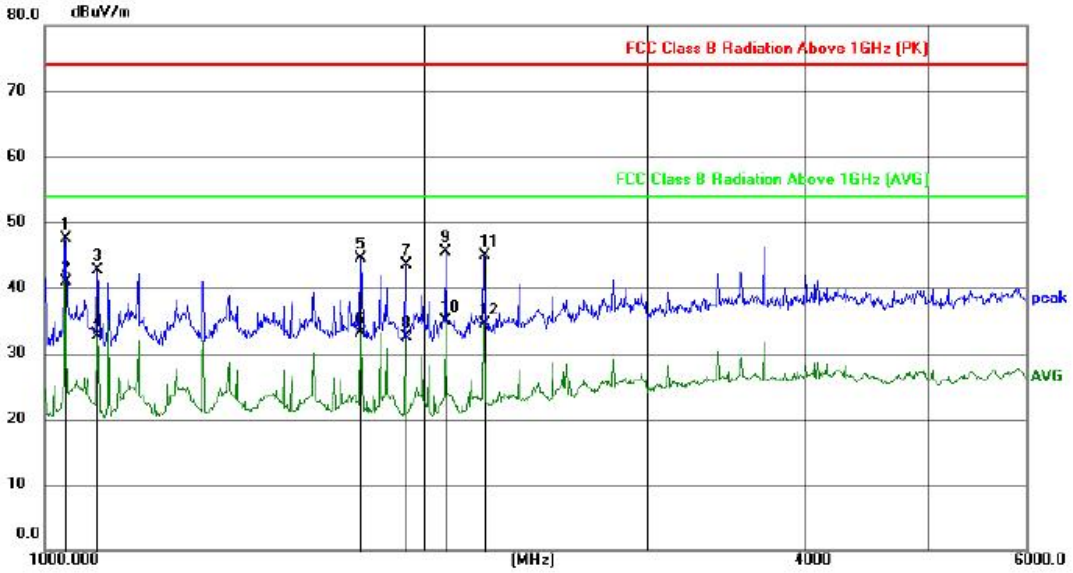
| Test mode: | Mode 1 | Test polarization: | Vertical |
|---|---|---|---|
| Temperature: | 25.8℃ | Humidity: | 51%RH |
| Pressure: | 101kPa | Test voltage: | AC 120V 60Hz |




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 297.2240 | 59.05 | -20.40 | 38.65 | 46.00 | -7.35 | QP |
| 2 | 446.4140 | 57.43 | -15.65 | 41.78 | 46.00 | -4.22 | QP |
| 3 | 595.1327 | 52.56 | -11.86 | 40.70 | 46.00 | -5.30 | QP |
| 4 | 744.8660 | 50.83 | -8.21 | 42.62 | 46.00 | -3.38 | QP |
| 5 | 893.8566 | 47.56 | -5.54 | 42.02 | 46.00 | -3.98 | QP |
| 6 | 955.4381 | 42.37 | -3.76 | 38.61 | 46.00 | -7.39 | QP |

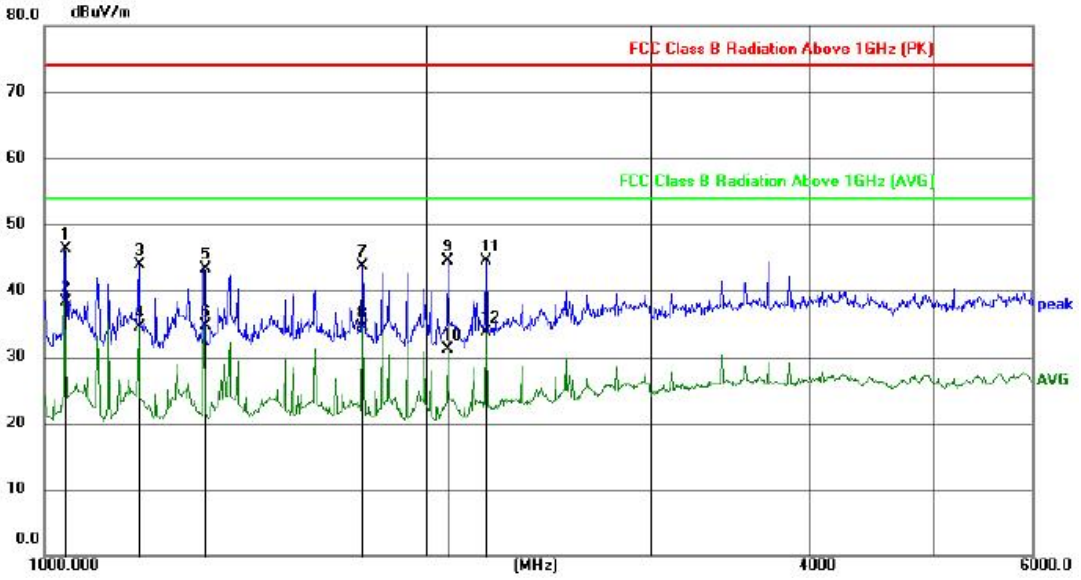
Above 1GHz

| Test mode: | Mode 1 | | |
|---|---|---|---|
| Temperature: | 25.8°C | Humidity: | 51%RH |
| Pressure: | 101kPa | Test voltage: | AC 120V 60Hz |
| Test polarization: | Horizontal | Test Result: | PASS |




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 1038.344 | 62.35 | -14.84 | 47.51 | 74.00 | -26.49 | peak |
| 2 | 1038.344 | 55.75 | -14.84 | 40.91 | 54.00 | -13.09 | AVG |
| 3 | 1101.590 | 57.56 | -14.90 | 42.66 | 74.00 | -31.34 | peak |
| 4 | 1101.590 | 47.59 | -14.90 | 32.69 | 54.00 | -21.31 | AVG |
| 5 | 1780.593 | 59.92 | -15.37 | 44.55 | 74.00 | -29.45 | peak |
| 6 | 1780.593 | 48.41 | -15.37 | 33.04 | 54.00 | -20.96 | AVG |
| 7 | 1930.108 | 58.90 | -15.48 | 43.42 | 74.00 | -30.58 | peak |
| 8 | 1930.108 | 48.03 | -15.48 | 32.55 | 54.00 | -21.45 | AVG |
| 9 | 2077.235 | 60.65 | -15.22 | 45.43 | 74.00 | -28.57 | peak |
| 10 | 2077.235 | 50.11 | -15.22 | 34.89 | 54.00 | -19.11 | AVG |
| 11 | 2227.582 | 59.53 | -14.62 | 44.91 | 74.00 | -29.09 | peak |
| 12 | 2227.582 | 49.13 | -14.62 | 34.51 | 54.00 | -19.49 | AVG |

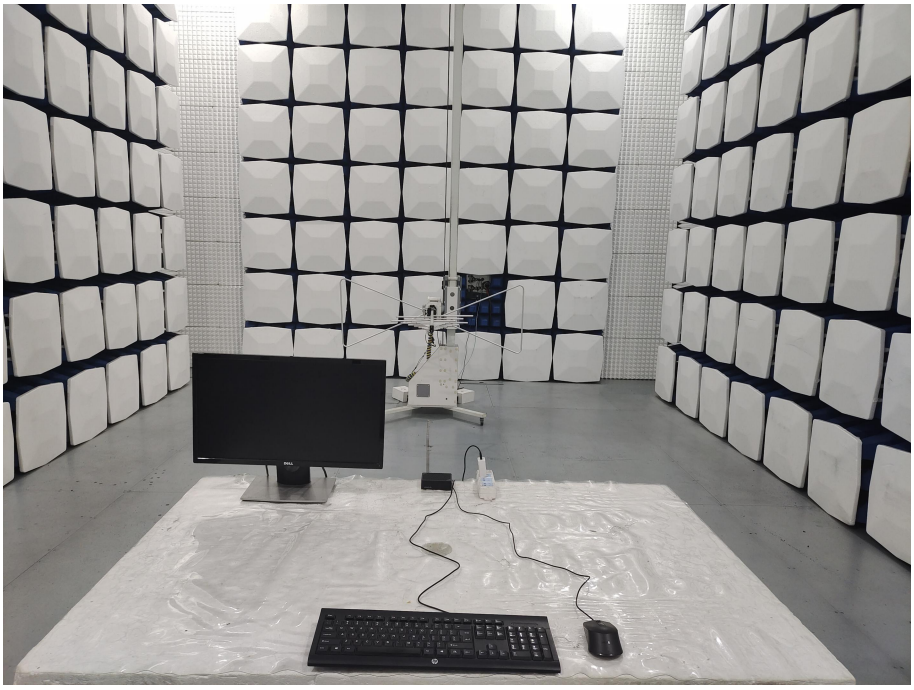
| Test mode: | Mode 1 | | |
|---|---|---|---|
| Temperature: | 25.8°C | Humidity: | 50%RH |
| Pressure: | 101kPa | Test voltage: | AC 120V 60Hz |
| Test polarization: | Vertical | Test Result: | PASS |



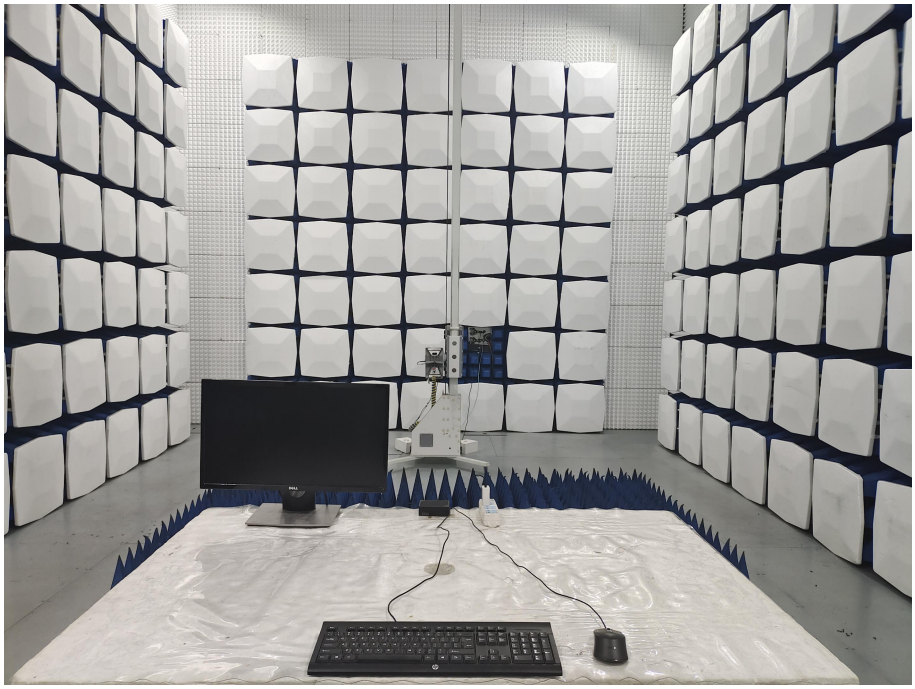

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 1038.344 | 61.05 | -14.84 | 46.21 | 74.00 | -27.79 | peak |
| 2 | 1038.344 | 53.06 | -14.84 | 38.22 | 54.00 | -15.78 | AVG |
| 3 | 1187.688 | 58.90 | -14.95 | 43.95 | 74.00 | -30.05 | peak |
| 4 | 1187.688 | 49.46 | -14.95 | 34.51 | 54.00 | -19.49 | AVG |
| 5 | 1336.782 | 58.41 | -15.06 | 43.35 | 74.00 | -30.65 | peak |
| 6 | 1336.782 | 49.85 | -15.06 | 34.79 | 54.00 | -19.21 | AVG |
| 7 | 1780.593 | 59.04 | -15.37 | 43.67 | 74.00 | -30.33 | peak |
| 8 | 1780.593 | 49.78 | -15.37 | 34.41 | 54.00 | -19.59 | AVG |
| 9 | 2077.235 | 59.78 | -15.22 | 44.56 | 74.00 | -29.44 | peak |
| 10 | 2077.235 | 46.38 | -15.22 | 31.16 | 54.00 | -22.84 | AVG |
| 11 | 2227.581 | 59.13 | -14.62 | 44.51 | 74.00 | -29.49 | peak |
| 12 | 2227.581 | 48.33 | -14.62 | 33.71 | 54.00 | -20.29 | AVG |

Note 1: The test modes were carried out for all operation modes. The worst test mode for test data was showed in the report.
2: Exceeding the emission limit is the main frequency.

## Photographs of the Test setup



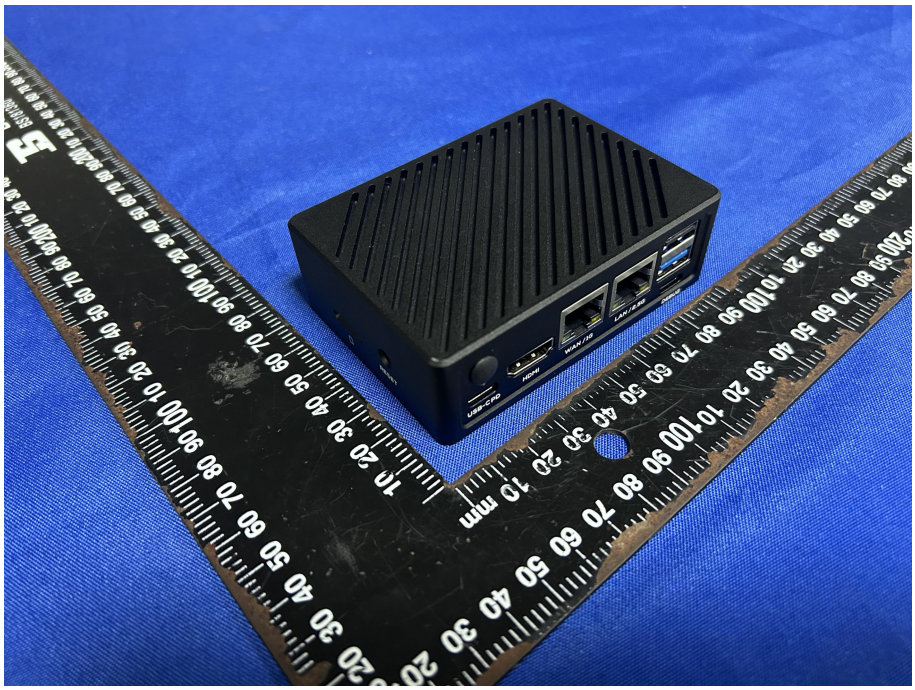
30M-1GHz Radiated test

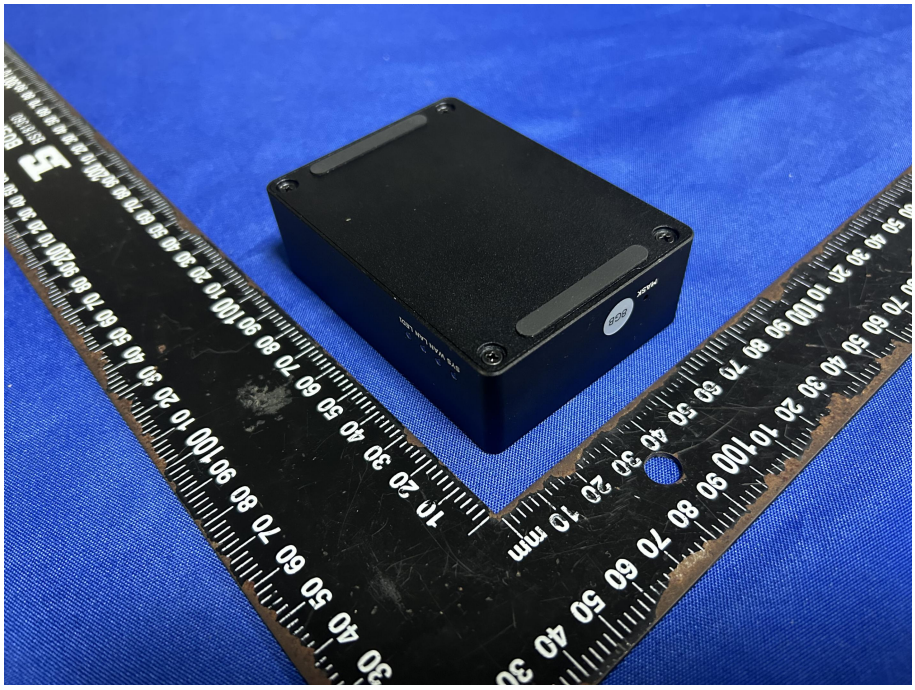


Above 1GHz Radiated test

Conducted test

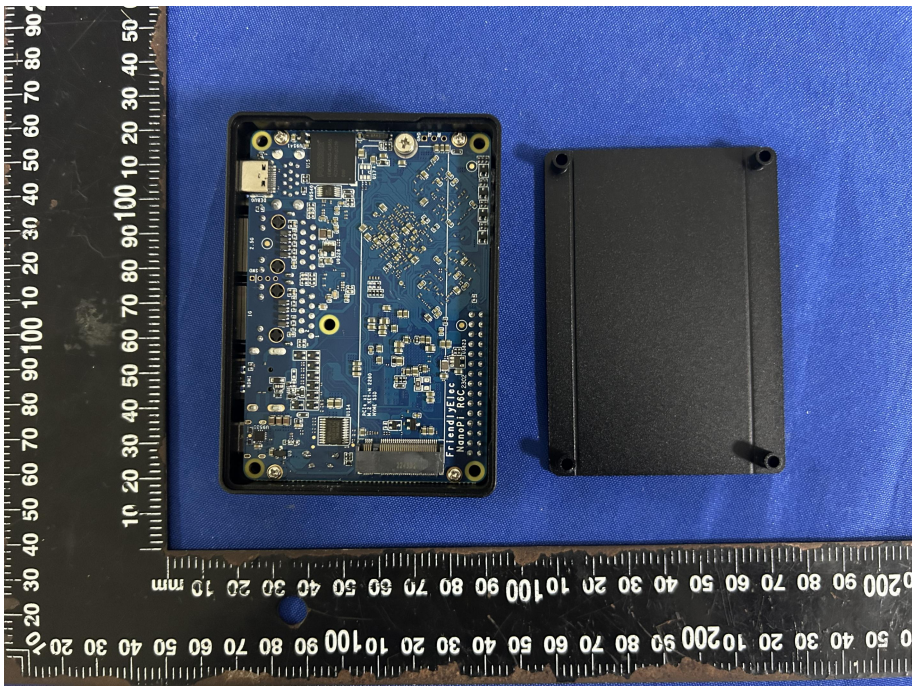
## Photographs of the EUT

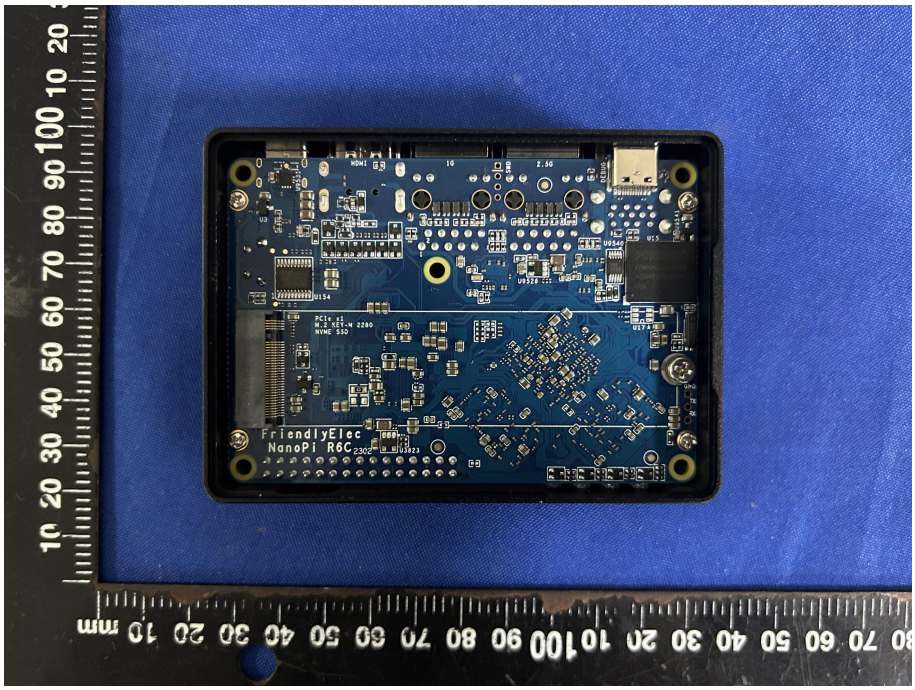


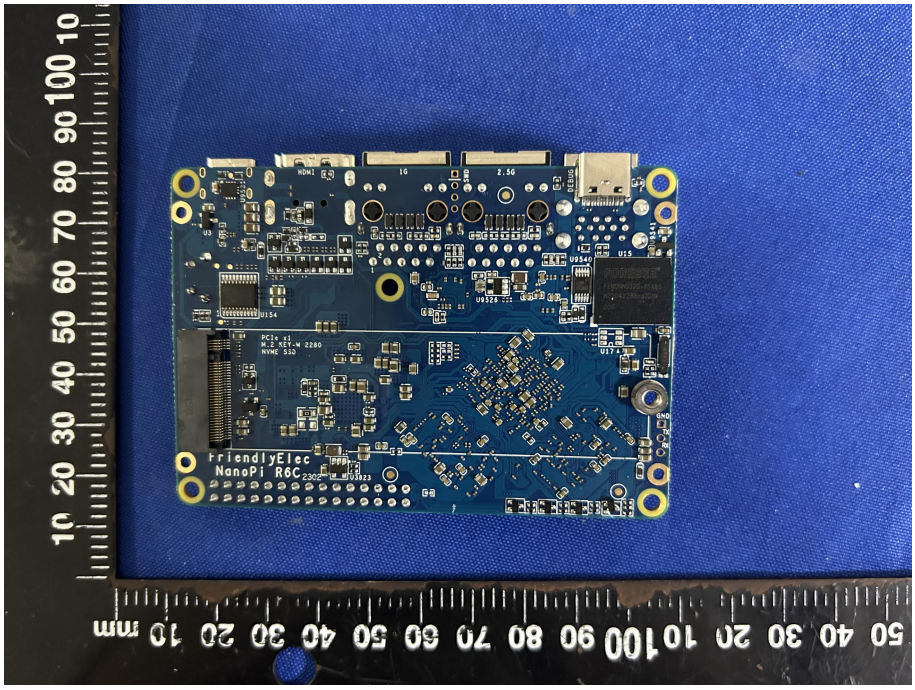


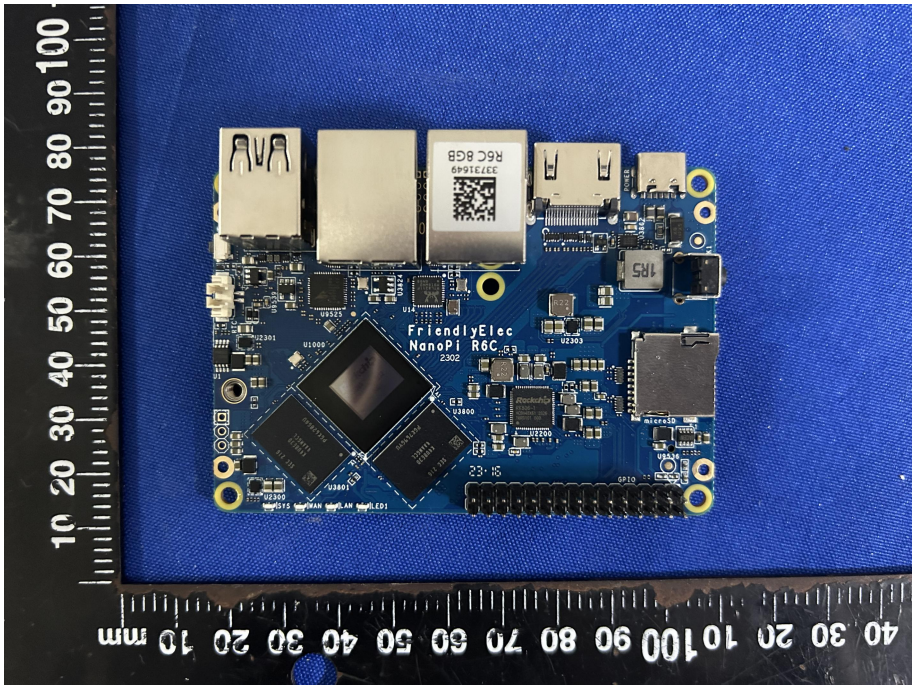

USB-C PD
HDMI
WAN /1G
LAN /2.5G
DEBUG


RESET




FriendlyElec
NanoPi R6C




**----End of Report----**