Testing Laboratory
3023

Test Report No:
2430013R-RFUSV26S-A

# TEST REPORT
## FCC Rules & Regulations

| | |
|---|---|
| Product Name | 5G NR Module |
| Brand Name | BEC by BILLION |
| Model No. | MX-220-UT-5G |
| FCC ID | QI3BEC-MX220UT5G |
| Applicant´s Name / Address | Billion Electric Co., Ltd.<br>8F., No. 192, Sec. 2, Zhongxing Rd., Xindian Dist.,New Taipei City 231 Taiwan |
| Manufacturer's Name | Billion Electric Co., Ltd. |
| Test Method Requested, Standard | FCC CFR Title 47 Part 96<br>ANSI/TIA-603-E-2016<br>ANSI C63.26-2015 |
| Verdict Summary | IN COMPLIANCE |
| Documented By Ida Tung | Ida Tung |
| Tested by Joe Wang | Joe Wang |
| Approved By Will Chen | Will Chen |
| Date of Receipt | 2024/03/01 |
| Date of Issue | 2024/06/14 |
| Report Version | V1.0 |

## INDEX

## Competences and Guarantees

DEKRA is a testing laboratory competent to carry out the tests described in this report.
In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated in the report and it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

DEKRA is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.



## General Conditions

1. The test results relate only to the samples tested.
2. The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.
3. This report must not be used to claim product endorsement by TAF or any agency of the government.
4. The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd.
5. Measurement uncertainties evaluated for each testing system and associated connections are given here to provide the system information for reference. Compliance determinations do not take into account measurement uncertainties for each testing system, but are based on the results of the compliance measurement.

## Revision History

| Version | Description | Issued Date |
|---|---|---|
| V1.0 | Initial issue of report | 2024/06/14 |

## Summary of Test Result

| Report Clause | Ref Std. Clause | Test Items | Result (PASS/FAIL) | Remark |
|---|---|---|---|---|
| 3 | Part 2.1046, 96.41(b) | RF Output Power | PASS | - |
| - | Part 2.1046, 96.41(b) | Maximum Power Spectral Density | PASS | Note |
| - | Part 2.1049, 96.41 | Occupied Bandwidth | PASS | Note |
| - | Part 2.1051, 96.41 | Spurious Emission at Antenna Terminals | PASS | Note |
| 4 | Part 2.1051, 96.41 | Spurious Emission | PASS | - |
| - | Part 2.1055 | Frequency Stability | PASS | Note |
| - | Part 96.41 | Peak to Average Ratio | PASS | Note |

Note:
This report is to request the Class II Permissive Change for FCC ID: QI3BEC-MX220UT5G. The major change filed under this application is to:
Change #1: Only 5G NR n48 band is enabled, other WCDMA, LTE and 5G NR bands are diabled by SW.
Change #2: Add 1 antenna and this antenna is used for the platform: Advanced Industrial 5G Router, model: MX-220-UT-5G.
Change #3: Reduce the Output Power through firmware
Except for the above differences, the hardware design is identical with the original grant.
According to the major change, DEKRA tests RF Output Power and Radiated Spurious Emission, and other testing data refer to original module reports.

| Comments and Explanations |
|---|
| The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification. |

# 1. General Information

## 1.1. EUT Description

| | | |
|---|---|---|
| Frequency Range | 3550 ~ 3700 MHz (Uplink)<br>3550 ~ 3700 MHz (Downlink) | |
| Bandwidth | SCS: 30 kHz | 10 / 20 / 40 MHz |
| Type of Modulation | DFT-s-OFDM (pi/2 BPSK / QPSK / 16QAM / 64QAM / 256QAM)<br>CP-OFDM (QPSK / 16QAM / 64QAM / 256QAM) | |
| Maximum Output Power | 13.53 dBm | |
| Maximum E.I.R.P | 22.43 dBm | |

| Accessories Information | | | | | |
|---|---|---|---|---|---|
| No. | Equipment Name | Brand Name | Model No. | Rating | Remark |
| 1 | AC to DC Power adapter | BILLION | BA024-15016AXU | Input: AC 100-240V~0.7A 50/60Hz<br>Output: 15V⎓1.6A | With power cable: Non-Shielded, 1.6m |
| No. | Equipment Name | Description | | | |
| 2 | Terminal Block 3P to DC Jack cable | Brand Name: E-CALL, Model No.: 0116-368-J, Non-Shielded, 0.08m | | | |
| 3 | DB9 Female to Male Cable | Brand Name: Pan-International, Model No.: P96301A-23, Non-Shielded, 1m | | | |

| Host Information | | |
|---|---|---|
| Brand Name | Product Name | Model No. |
| BEC by BILLION | Advanced Industrial 5G Router | MX-220-UT-5G |

| Antenna Information | | | | | | |
|---|---|---|---|---|---|---|
| Item. | Ant. | Brand Name | Model No. | Type | Gain (dBi) | Remark |
| 1 | 0 | BECbyBILLION | ANT-SX-5048 | Directional | 8.8 | RX |
| | 1 | | | | 8.9 | TX/RX |
| | 2 | | | | 8.8 | RX |
| | 3 | | | | 8.9 | TX/RX |

## 1.2. Testing Location Information

| | |
|---|---|
| Site Description | Accredited by TAF |
| | Accredited Number: 3023 |

| | |
|---|---|
| Test Laboratory | DEKRA Testing and Certification Co., Ltd. |
| | Linkou Laboratory |
| Address | No.5-22, Ruishukeng Linkou District, New Taipei City, 24451, Taiwan, R.O.C. |
| Performed Location | No. 26, Huaya 1st Rd., Guishan Dist.,Taoyuan City 333411, Taiwan, R.O.C. |
| Phone Number | +886-3-275-7255 |
| Fax Number | +886-3-327-8031 |

Ambient conditions in the laboratory:

| Performed Item | Items | Required | Actual | Test Date |
|---|---|---|---|---|
| RF Output Power | Temperature (°C) | 15~35 °C | 23.1 °C | 2024/05/02 ~ 2024/05/03 |
| | Humidity (%RH) | 20~75 % | 58.9 % | |
| Radiated Emission | Temperature (°C) | 15~35 °C | 24.8 °C | 2024/05/10 |
| | Humidity (%RH) | 20~75 % | 62.4 % | |

## 1.3. Measurement Uncertainty

Uncertainties have been calculated according to the DEKRA internal document with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2).

| Test Item | Uncertainty |
|---|---|
| RF Output Power | ± 1.58 dB |
| Radiated Spurious Emissions | ± 5.88dB for 30MHz~1GHz<br>± 3.11dB for 1GHz~18GHz<br>± 3.09dB for 18GHz~40GHz |

## 1.4. List of Test Equipment

| Instrument | Manufacturer | Model No. | Serial No. | Cal. Date | Next Cal. Date |
|---|---|---|---|---|---|
| Universal Radio Communication Tester | Anritsu | MT8000A | 6262134961 | 2023.05.30 | 2024.05.29 |
| DC Power Supply | Keysight | E36234A | MY59001234 | 2023.11.09 | 2024.11.08 |
| Bi-Log Antenna | SCHWARZBECK | VULB9168 | 9168-0675 | 2023.08.09 | 2025.08.08 |
| Horn Antenna | Com-Power | AH-840 | 101101 | 2023.12.04 | 2025.12.03 |
| Horn Antenna | RF SPIN | DRH18-E | 210802A18ES | 2024.03.28 | 2025.03.27 |
| Pre-Amplifier | SGH | 0301 | 20211007-7 | 2024.01.10 | 2025.01.09 |
| Pre-Amplifier | EMCI | EMC051845SE | 980632 | 2024.01.10 | 2025.01.09 |
| Pre-Amplifier | EMCI | EMC05820SE | 980362 | 2024.01.10 | 2025.01.09 |
| Pre-Amplifier | EMCI | EMC184045SE | 980369 | 2024.01.10 | 2025.01.09 |
| Coaxial Cable | EMCI | EMC102-KM-KM-600 | 1160314 | 2024.01.10 | 2025.01.09 |
| Coaxial Cable | EMCI | EMC102-KM-KM-7000 | 170242 | 2024.01.10 | 2025.01.09 |
| Spectrum Analyzer | R&S | FSV3044 | 101115 | 2024.01.11 | 2025.01.10 |
| Coaxial Cable | SUHNER | SUCOFLEX 106 | 25450/6 | 2024.01.10 | 2025.01.09 |
| Coaxial Cable | SGH | SGH18 | 2021003-8 | 2024.01.10 | 2025.01.09 |
| Coaxial Cable | SGH | HA800 | GD20110222-8 | 2024.01.10 | 2025.01.09 |
| Coaxial Cable | EMCI | EMC106 | 151113 | 2024.01.10 | 2025.01.09 |

Note: Test Software Version: e3 230303 dekra V9.

# 2. Test Configuration of EUT

## 2.1. Test Condition

| EUT Operational Condition | |
|---|---|
| Testing Voltage | AC 120V/60Hz for host and DC 3.3V for module |

## 2.2. The Measurement Configuration

| Test Mode | Mode 1: 5G NR n48 |
|---|---|

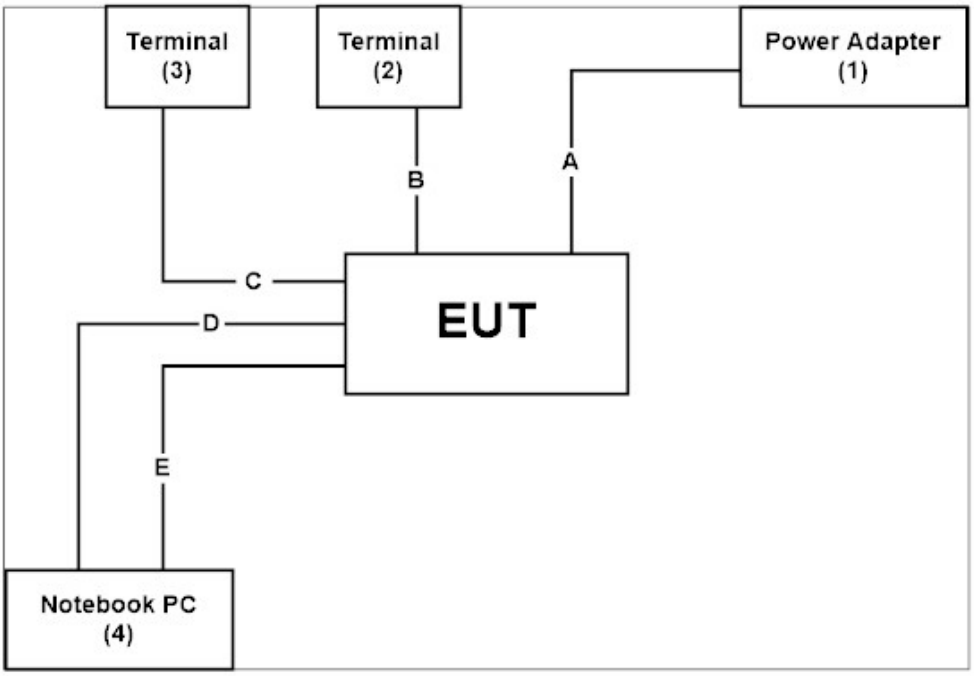
Note:
1. Determining compliance shall be based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
2. Regarding frequency band operation, the lowest, middle and highest frequency of channel were selected to perform the test, and the details were shown on this report.
3. The device was tested under all configurations, combinations, bandwidths, RB configurations and modulations, and the worst case was found in PI/2 BPSK modulation, therefore the “Radiated Spurious Emission” test items perform PI/2 BPSK modulation in this report.
4. The EUT was performed at X axis, Y axis and Z axis positions for radiated spurious emission test. The worst case was found and the measurement will follow this same test configuration.

## 2.3. Tested System Details

| Product | | Manufacturer | Model No. | Description |
|---|---|---|---|---|
| 1 | AC to DC Power adapter | BILLION | BA024-15016AXU | N/A |
| 2 | Terminal | N/A | N/A | N/A |
| 3 | Terminal | N/A | N/A | N/A |
| 4 | Notebook PC | DELL | Latitude 5580 | 2HRD7H2 |

## 2.4. Configuration of Tested System

Connection Diagram



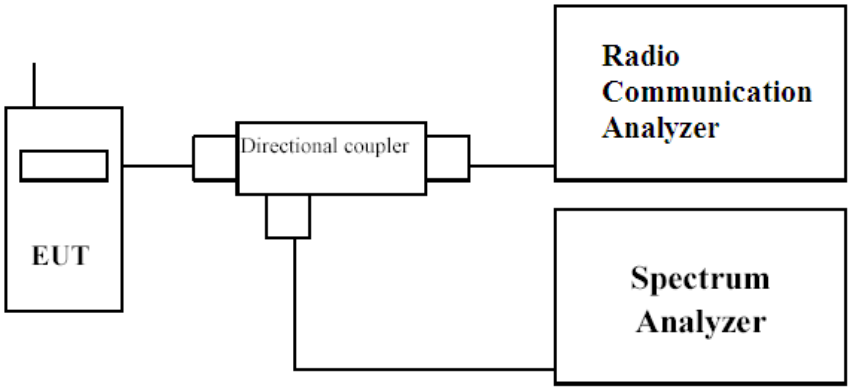

| Signal Cable Type | | Signal cable Description |
|---|---|---|
| A | Terminal Block 3P to DC Jack cable | Non-Shielded, 0.08m |
| B | DB9 Female to Male Cable | Non-Shielded, 1m |
| C | DB9 Female to Male Cable | Non-Shielded, 1m |
| D | LAN Cable | Non-Shielded, 8m |
| E | LAN Cable | Non-Shielded, 8m |

## 2.5. EUT Operating Procedures

| | |
|---|---|
| 1. | Setup the EUT connect to the base station. |
| 2. | Setup the parameter (Band, Channel, Frequency). |
| 3. | The EUT will continue receive the signal from LTE and 5GNR function. |
| 4. | Repeat the above procedure (2) and (3). |

# 3. RF Output Power

## 3.1. Test Setup




## 3.2. Test Limit

| Type | Device | Maximum EIRP (dBm/10 MHz) | Maximum PSD (dBm/MHz) |
|---|---|---|---|
| X | End User Device | 23 | N/A |
| | Category A CBSD | 30 | 20 |
| | Category B CBSD | 47 | 37 |

## 3.3. Test Procedure

1. Channel power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz.
3. VBW ≥ 3 x RBW.
4. Span = 1.5 times the OBW.
5. No. of sweep points > 2 x span / RBW.
6. Detector = RMS.
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto".
8. The integration bandwidth was set to 10MHz.
9. Trace mode = trace averaging (RMS) over 100 sweeps.
10. The trace was allowed to stabilize.

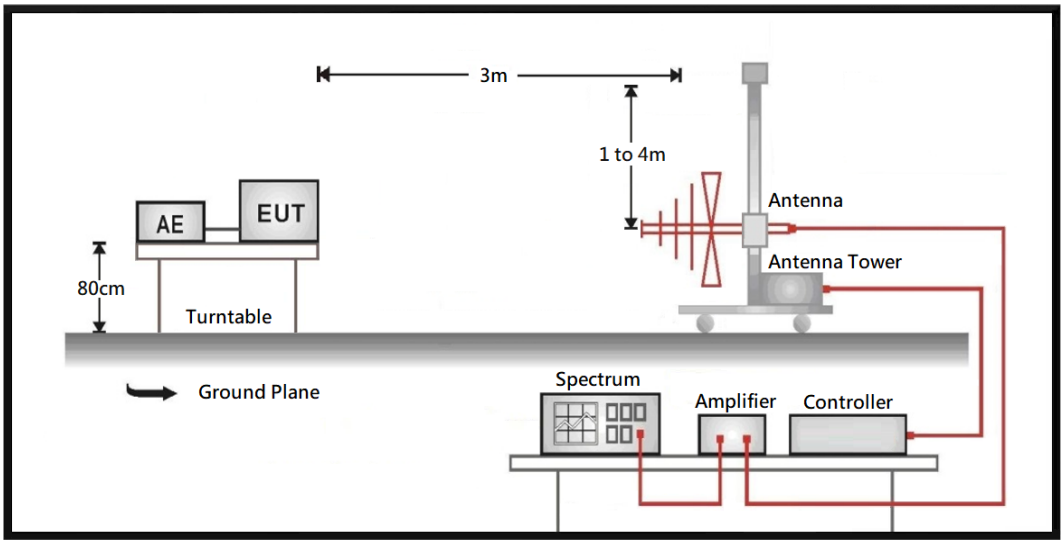
## 3.4. Test Result of RF Output Power

Refer as Appendix A

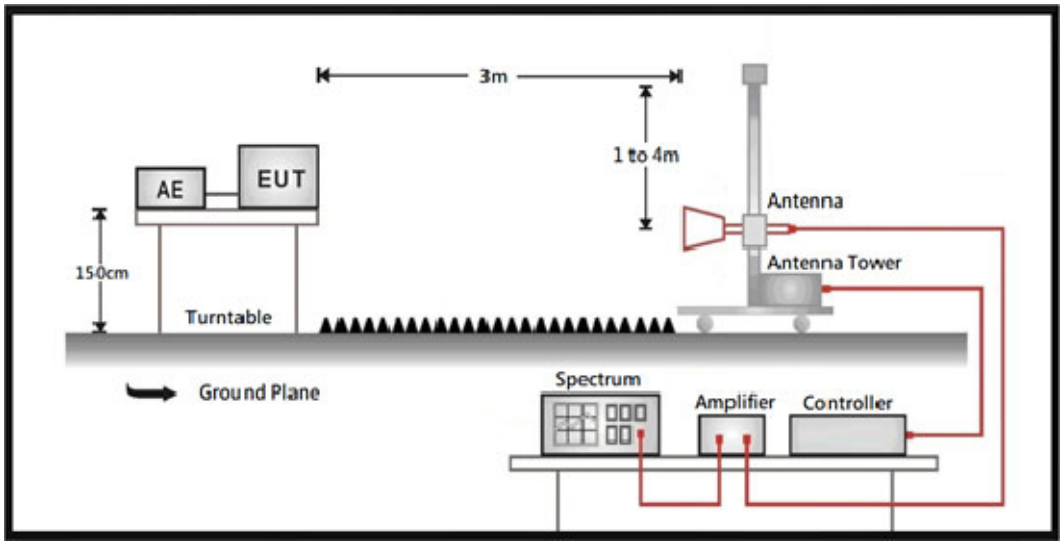
# 4. Spurious Emissions

## 4.1. Test Setup

Radiated Spurious Measurement: below 1GHz




Radiated Spurious Measurement: above 1GHz



## 4.2. Test Procedure

**Radiated Spurious Measurement:**

The EUT and its simulators are placed on a turn table which is 0.8 or 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The height of the receiving antenna is varied between one meter and four meters to search the maximum spurious emission for both horizontal and vertical polarizations. The resolution bandwidth of the spectrum analyzer was set at 1 MHz, sufficient scans were taken to show the out of band Emission if any up to 10th harmonic. Taking the record of maximum spurious emission.

## 4.3. Test Result of Spurious Emission

Refer as Appendix B