

# TEST REPORT

## Client Information:

Applicant: Hannuowei Toys Factory

Applicant add.: Guanshan Industrial Zone Chenghai Shanotu, China

Manufacturer: Hannuowei Toys Factory

Manufacturer add.: Guanshan Industrial Zone Chenghai Shanotu, China

## Product Information:

Product Name: Remote control four axis

Model No.: Please refer to page 6 for detail.

Brand Name: N/A

FCC ID: 2AD4W-F1

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.249

## Prepared By:

**Dongguan Yaxu (AiT) Technology Limited**

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Date of Receipt: Aug. 14, 2024 Date of Test: Aug. 14, 2024~Aug. 15, 2024

Date of Issue: Aug. 16, 2024 Test Result: Pass

This device has been tested and found to comply with the stated standard(s), which is (are) required by the council directive of 2014/53/EU and indicated in the test report and are applicable only to the tested sample identified in the report.

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Reviewed by: Emiya Lin  
Emiya Lin

Approved by: Simba Huang  
Simba Huang

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**Report Revise Record**

| Report Version | Revise Time | Issued Date   | Valid Version | Notes           |
|----------------|-------------|---------------|---------------|-----------------|
| V1.0           | /           | Aug. 16, 2024 | Valid         | Initial release |

## 2 Test Summary

| Test Item  | Section in CFR 47    | Result |
|--|----------------------|--------|
| Antenna requirement                                  | §15.203              | Pass   |
| AC Power Line Conducted Emission                     | §15.207              | N/A    |
| Fundamental & Radiated Spurious Emission Measurement | §15.249 (a)/ §15.209 | Pass   |
| 20dB Channel Bandwidth                               | 15.215(c)            | Pass   |
| Band Edge  | §15.249 (d)/ §15.205 | Pass   |

**Note**

1. Test according to ANSI C63.10:2013.
2. The measurement uncertainty is not included in the test result.

### 2.1 Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the AiT quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

### 2.2 Measurement Uncertainty

| Test Item                        | Frequency Range | Measurement Uncertainty | Notes |
|----------------------------------|-----------------|-------------------------|-------|
| Radiated Emission                | 0.009MHz-30MHz  | 3.10dB                  | (1)   |
| Radiated Emission                | 30MHz-1GHz      | 3.75dB                  | (1)   |
| Radiated Emission                | 1GHz-18GHz      | 3.88dB                  | (1)   |
| Radiated Emission                | 18GHz-40GHz     | 3.88dB                  | (1)   |
| AC Power Line Conducted Emission | 0.15MHz ~ 30MHz | 1.20dB                  | (1)   |

Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.

### 3 Test Facility

#### **The test facility is recognized, certified or accredited by the following organizations:**

##### **.CNAS- Registration No: L6177**

Dongguan Yaxu (AiT) technology Limited is accredited to ISO/IEC 17025:2017 general Requirements for the competence of testing and calibration laboratories (CNAS-CL01 Accreditation Criteria for the competence of testing and calibration laboratories) on April 18, 2022

##### **FCC-Registration No.: 703111 Designation Number: CN1313**

Dongguan Yaxu (AiT) technology Limited has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

##### **IC —Registration No.: 6819A CAB identifier: CN0122**

The 3m Semi-anechoic chamber of Dongguan Yaxu (AiT) technology Limited has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 6819A

##### **A2LA-Lab Cert. No.: 6317.01**

Dongguan Yaxu (AiT) technology Limited has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

#### **3.1 Deviation from standard**

None

#### **3.2 Abnormalities from standard conditions**

None

#### **3.3 Test Location**

##### **Dongguan Yaxu (AiT) Technology Limited**

Address: No.22, Jinqianling 3rd Street, Jitigang, Huangjiang, Dongguan, Guangdong, China

Tel.: +86-769-8202 0499

Fax.: +86-769-8202 0495

## 4 General Information

|                        |   |
|------------------------|---|
| EUT Name:              | Remote control four axis  |
| Model No:              | F1  |
| Serial Model:          | H827,H828,H830,H831,H832,H835,H836,H837,H838,H839,H840,H841,H842,H843,H845,H846,H847,H848,H849,H850,H851,H852,H853,H855,H856,H857,H858,H859,H860,H861,H862,H863,H865,H866,H867,H868,H869,H870,H871,H872,H873,H875,H876,H877,H878,H879,H880,H881,H882,H883,F2,F3,F4,F5,F6,F7,F8,F9,F10,ZD10,X10min,X20mini |
| Test sample(s) ID:     | AiTDG-240814003-1   |
| Sample(s) Status:      | Engineer sample:  |
| Operation frequency:   | 2420MHz-2460MHz   |
| Channel Number:        | 17 channels   |
| Modulation Technology: | GFSK  |
| Antenna Type:          | Wire antenna  |
| Antenna gain:          | 0.17dBi   |
| H/W No.:               | V1.12   |
| S/W No.:               | V2.1  |
| Power supply:          | DC 6.0V(4*1.5V "AAA" battery)(for remote control)   |
| Model different:       | PCB board, structure and internal of these model(s) are the same, So no additional models were tested.  |
| Note:                  | For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.   |

#### 4.1 Test frequencies

**EUT channels and frequencies list**

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|---------|-----------------|
| 1       | 2420            | 11      | 2446            |         |                 |
| 2       | 2421            | 12      | 2447            |         |                 |
| 3       | 2422            | 13      | 2448            |         |                 |
| 4       | 2423            | 14      | 2449            |         |                 |
| 5       | 2440            | 15      | 2450            |         |                 |
| 6       | 2441            | 16      | 2453            |         |                 |
| 7       | 2442            | 17      | 2460            |         |                 |
| 8       | 2443            |         |                 |         |                 |
| 9       | 2444            |         |                 |         |                 |
| 10      | 2445            |         |                 |         |                 |

## 4.2 EUT Peripheral List

| No. | Equipment | Manufacturer | EMC Compliance | Model No. | Serial No. | Power cord | Signal cord |
|-----|-----------|--------------|----------------|-----------|------------|------------|-------------|
| 1   | N/A       | N/A          | N/A            | N/A       | N/A        | N/A        | N/A         |

## 4.3 Test Peripheral List

| No. | Equipment | Manufacturer | EMC Compliance | Model No. | Serial No. | Power cord | Signal cord |
|-----|-----------|--------------|----------------|-----------|------------|------------|-------------|
| 1   | N/A       | N/A          | N/A            | N/A       | N/A        | N/A        | N/A         |

## 4.4 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Dongguan Yaxu (AiT) Technology Limit.

### EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

### EUT Exercise

The EUT was operated in the normal operating mode and a continuous transmits mode for other tests.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209, 15.247 under the FCC Rules Part 15 Subpart C and RSS-247 Issue 2, RSS-Gen Issue 5.

### General Test Procedures

#### Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

#### Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013.

#### 4.5 Description of Test Modes

The EUT has been tested under operating condition.

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was determined to be TX(1Mbps-Low Channel).

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

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:

|                   |   |          |          |
|-------------------|---|----------|----------|
| Transmitting mode | Keep the EUT in continuously transmitting mode. |          |          |
| Test software:    | fixed in EUT by manufacturer                    |          |          |
| Frequency         | 2420 MHz  | 2440 MHz | 2460 MHz |
| Parameters(1Mbps) | Default   | Default  | Default  |

## 5 Equipment Used during Test

| No | Test Equipment                      | Manufacturer | Model No        | Serial No     | Cal. Date  | Cal. Due Date |
|----|-------------------------------------|--------------|-----------------|---------------|------------|---------------|
| 1  | Spectrum Analyzer                   | R&S          | FSV40           | 101470        | 2023.09.08 | 2024.09.07    |
| 2  | EMI Measuring Receiver              | R&S          | ESR             | 101660        | 2023.09.08 | 2024.09.07    |
| 3  | Low Noise Pre Amplifier             | HP           | HP8447E         | 1937A01855    | 2023.09.08 | 2024.09.07    |
| 4  | Low Noise Pre Amplifier             | Tsj          | MLA-0120-A02-34 | 2648A04738    | 2023.09.08 | 2024.09.07    |
| 5  | Passive Loop                        | ETS          | 6512            | 00165355      | 2022.09.04 | 2024.09.03    |
| 6  | TRILOG Super Broadband test Antenna | SCHWARZBECK  | VULB9160        | 9160-3206     | 2021.08.29 | 2024.08.28    |
| 7  | Broadband Horn Antenna              | SCHWARZBECK  | BBHA9120D       | 452           | 2021.08.29 | 2024.08.28    |
| 8  | SHF-EHF Horn Antenna 15-40GHz       | SCHWARZBECK  | BBHA9170        | BBHA917036 7d | 2023.11.24 | 2026.11.23    |
| 9  | EMI Test Receiver                   | R&S          | ESCI            | 100124        | 2023.09.08 | 2024.09.07    |
| 10 | LISN                                | R&S          | ESH3-Z5         | 892785/016    | 2023.09.08 | 2024.09.07    |
| 11 | Pro.Temp&Humi.chamber               | MENTEK       | MHP-150-1C      | MAA0811250 1  | 2023.09.08 | 2024.09.07    |
| 12 | RF Automatic Test system            | MW           | MW100-RFCB      | 21033016      | 2023.09.08 | 2024.09.07    |
| 13 | Signal Generator                    | Agilent      | N5182A          | MY50143009    | 2023.09.08 | 2024.09.07    |
| 14 | Wideband Radio communication tester | R&S          | CMW500          | 1201.0002K5 0 | 2023.09.08 | 2024.09.07    |
| 15 | RF Automatic Test system            | MW           | MW100-RFCB      | 21033016      | 2023.09.08 | 2024.09.07    |
| 16 | Pulse Limiter                       | R&S          | ESH3-Z2         | 03578810.54   | 2023.09.08 | 2024.09.07    |
| 17 | Switch                              | MFJ Rhinos   | MFJ-2702        | CZ3457        | 2023.09.08 | 2024.09.07    |
| 18 | DC power supply                     | ZHAOXIN      | RXN-305D-2      | 2807000255 9  | N/A        | N/A           |
| 19 | RE Software                         | EZ           | EZ-EMC_RE       | Ver.AIT-03A   | N/A        | N/A           |
| 20 | CE Software                         | EZ           | EZ-EMC_CE       | Ver.AIT-03A   | N/A        | N/A           |
| 21 | RF Software                         | MW           | MTS 8310        | 2.0.0.0       | N/A        | N/A           |
| 22 | temporary antenna connector(Note)   | NTS          | R001            | N/A           | N/A        | N/A           |

Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

## 6 Test Results and Measurement Data

### 6.1 Antenna requirement

#### 6.1.1 Standard requirement:

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.

#### 6.1.2 EUT Antenna:

*Refer to Section 4(General Information)*

## 6.2 20 dB Spectrum Bandwidth Measurement

### 6.4.1 Standard requirement:

FCC Part15 C Section part 15.249/15.215(c):

| FCC Part15 (15.249) , Subpart C |           |                       |        |
|---------------------------------|-----------|-----------------------|--------|
| Section                         | Test Item | Frequency Range (MHz) | Result |
| Part 15.215(c)                  | Bandwidth | 2400-2483.5           | PASS   |

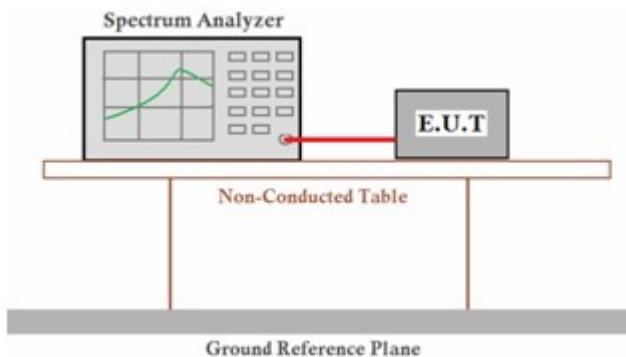
### 6.4.2 Measuring Instruments:

Please refer to equipment's list in this report.

### 6.4.3 Test Procedures

1. Set resolution bandwidth (RBW) = 1-5% or DTS BW, not to exceed 100 kHz.
2. Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

### 6.4.4 Test Setup Layout



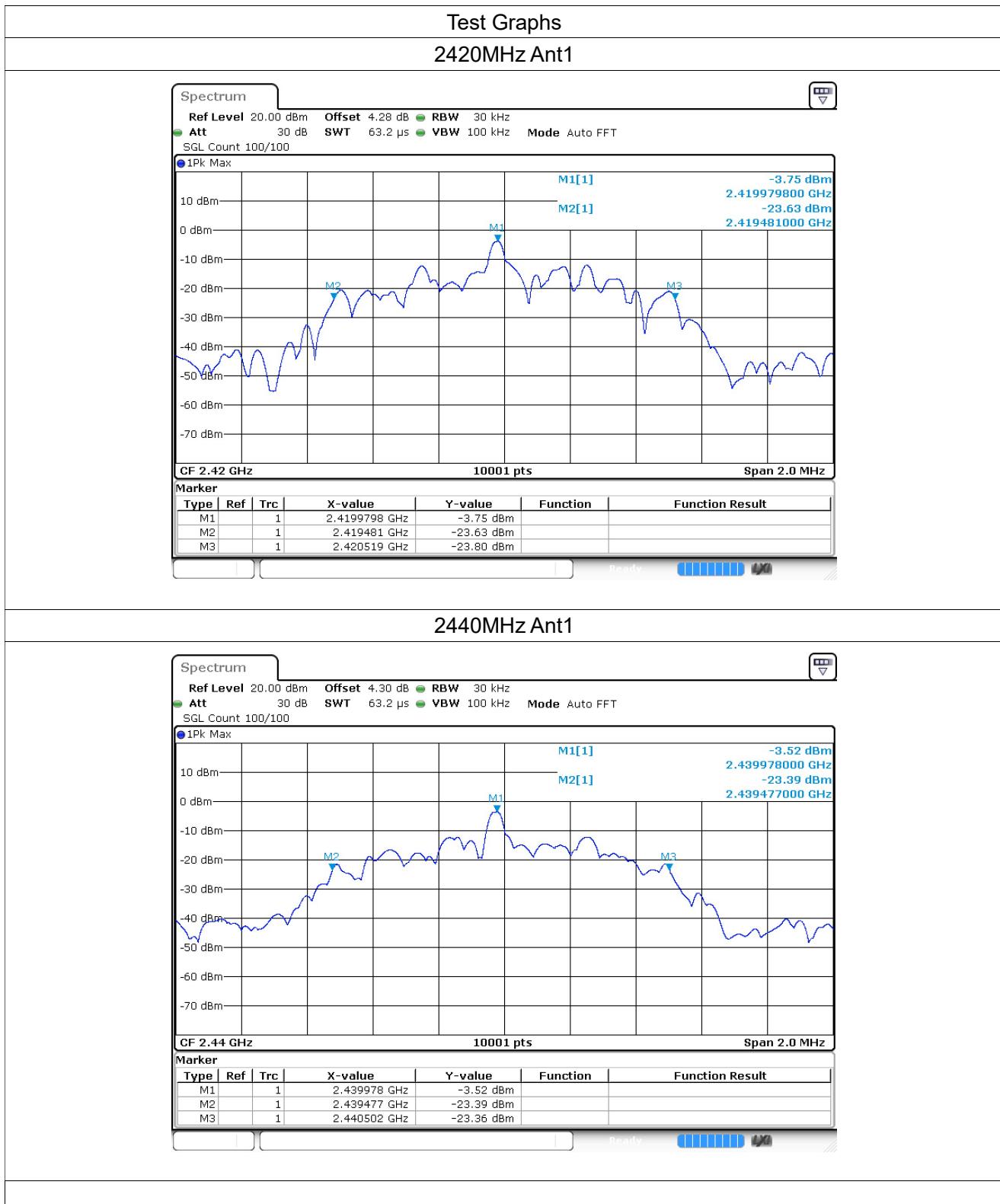
### 6.4.5 EUT Operation during Test

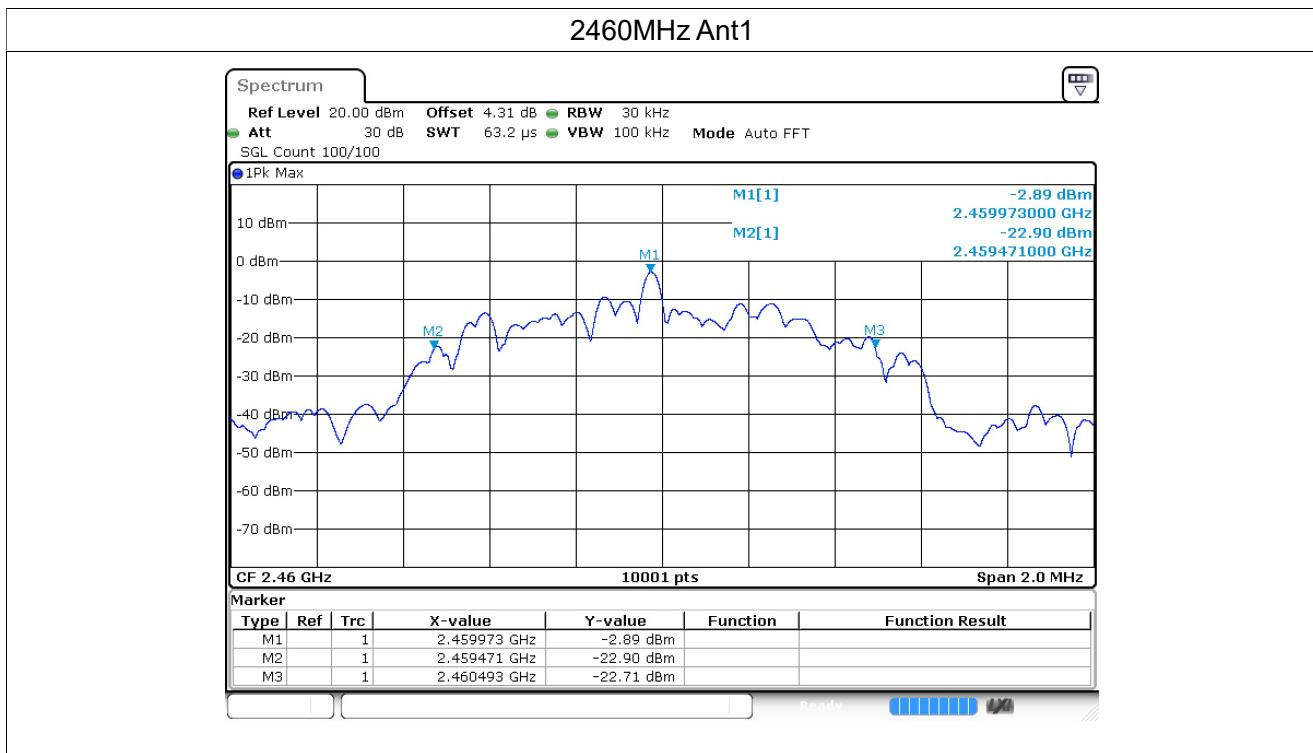
The EUT was programmed to be in continuously transmitting mode.

### 6.4.6 Test result

PASS

| Frequency (MHz) | Ant. | -20 dB Bandwidth (MHz) | Limit -20 dB Bandwidth (MHz) | Verdict |
|-----------------|------|------------------------|------------------------------|---------|
| 2420            | Ant1 | 1.038                  | /                            | Pass    |
| 2440            | Ant1 | 1.026                  | /                            | Pass    |
| 2460            | Ant1 | 1.022                  | /                            | Pass    |



**Remark:**

- 1). Measured 20dB Bandwidth at difference data rate for each mode and recorded worst case for each mode.
- 2). Test results including cable loss;

## 6.3 Radiated Emissions Measurement

### 6.8.1 Standard requirement:

FCC Part15 C Section 15.209 :

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-------------------|-----------------------------------|-------------------------------|
| 0.009~0.490       | 2400/F(KHz)                       | 300                           |
| 0.490~1.705       | 24000/F(KHz)                      | 30                            |
| 1.705~30.0        | 30                                | 30                            |
| 30~88             | 100                               | 3                             |
| 88~216            | 150                               | 3                             |
| 216~960           | 200                               | 3                             |
| Above 960         | 500                               | 3                             |

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental frequency | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|-----------------------|--|--|
| 902-928 MHz           | 50   | 500  |
| 2400-2483.5 MHz       | 50   | 500  |
| 5725-5875 MHz         | 50   | 500  |
| 24.0-24.25 GHz        | 250  | 2500   |

#### Band-edge Measurements

According to §15.249 (d)Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation

### 6.8.2 Measuring Instruments and Setting:

Please refer to equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

| Spectrum Parameter                        | Setting   |
|---|---|
| Attenuation                               | Auto  |
| Start Frequency                           | 1000 MHz  |
| Stop Frequency                            | 10 <sup>th</sup> carrier harmonic                 |
| RB / VB (Emission in restricted band)     | 1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average |
| RB / VB (Emission in non-restricted band) | 1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average |

| Receiver Parameter     | Setting                                    |
|------------------------|--|
| Attenuation            | Auto                                       |
| Start ~ Stop Frequency | 9kHz~150kHz / RB/VB 200Hz/1kHz for QP/AVG  |
| Start ~ Stop Frequency | 150kHz~30MHz / RB/VB 9kHz/30kHz for QP/AVG |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB/VB 120kHz/1MHz for QP   |

### 6.8.3 Test Procedures

#### 1) Sequence of testing 9 kHz to 30 MHz

##### **Setup:**

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

##### **Premeasurement:**

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.0 meter.
- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

##### **Final measurement:**

- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

## 2) Sequence of testing 30 MHz to 1 GHz

### Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

### Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 to 3 meter.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

### Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ( $\pm 45^\circ$ ) and antenna movement between 1 and 4 meter.
- The final measurement will be done with QP detector with an EMI receiver.
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

### 3) Sequence of testing 1 GHz to 18 GHz

#### Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

#### Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 2.5 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

#### Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ( $\pm 45^\circ$ ) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

#### 4) Sequence of testing above 18 GHz

##### Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

##### Premeasurement:

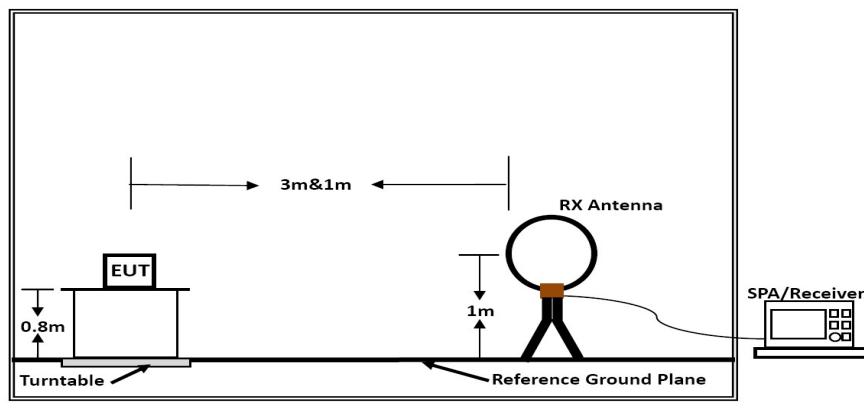
--- The antenna is moved spherical over the EUT in different polarisations of the antenna.

##### Final measurement:

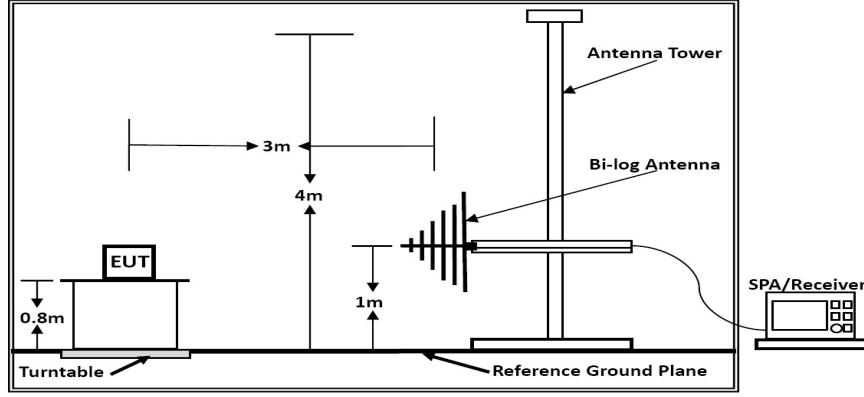
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

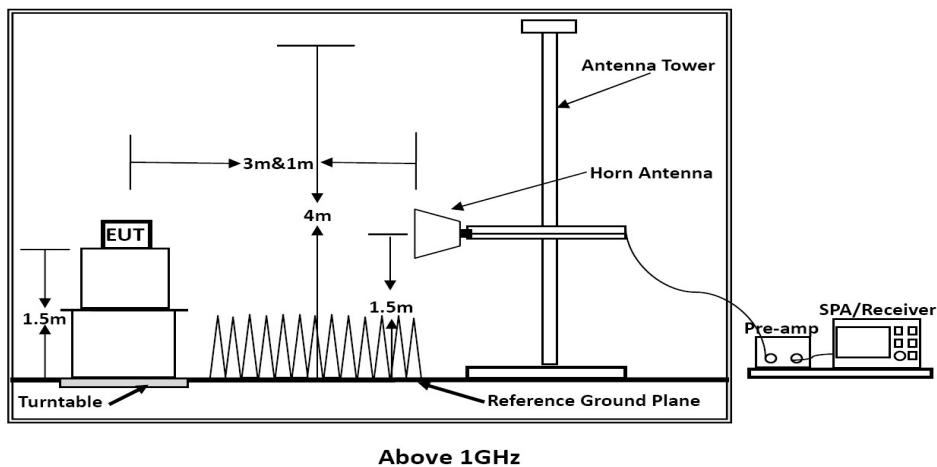
#### 6.8.4 Test Setup Layout



Below 30MHz



Below 1GHz



Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor =  $20 \log (\text{specific distance [3m]} / \text{test distance [1m]})$  (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

### 6.8.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 6.8.6 Test result

|               |           |                |       |
|---------------|-----------|----------------|-------|
| Temperature   | 25.5°C    | Humidity       | 52.6% |
| Test Engineer | Emiya Lin | Configurations | TX    |

Remarks:

1. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which is worse case.

### 6.3.1 Field Strength of the Fundamental Signal

**Peak value:**

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 2420            | 97.11             | -5.53         | 91.58          | 114.00              | -22.42          | Vertical     |
| 2420            | 99.42             | -5.53         | 93.89          | 114.00              | -20.11          | Horizontal   |
| 2440            | 97.09             | -5.36         | 91.73          | 114.00              | -22.27          | Vertical     |
| 2440            | 98.80             | -5.36         | 93.44          | 114.00              | -20.56          | Horizontal   |
| 2460            | 96.81             | -5.18         | 91.63          | 114.00              | -22.37          | Vertical     |
| 2460            | 99.08             | -5.18         | 93.90          | 114.00              | -20.10          | Horizontal   |

**Average value:**

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 2420            | 82.77             | -5.53         | 77.24          | 94.00               | -16.76          | Vertical     |
| 2420            | 88.99             | -5.53         | 83.46          | 94.00               | -10.54          | Horizontal   |
| 2440            | 83.25             | -5.36         | 77.89          | 94.00               | -16.11          | Vertical     |
| 2440            | 87.03             | -5.36         | 81.67          | 94.00               | -12.33          | Horizontal   |
| 2460            | 82.55             | -5.18         | 77.37          | 94.00               | -16.63          | Vertical     |
| 2460            | 86.39             | -5.18         | 81.21          | 94.00               | -12.79          | Horizontal   |

Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

### 6.3.2 Spurious emissions

#### ■ Results of Radiated Emissions (9 KHz~30MHz)

| Freq.<br>(MHz) | Level<br>(dBuV) | Over Limit<br>(dB) | Over Limit<br>(dBuV) | Remark   |
|----------------|-----------------|--------------------|----------------------|----------|
| -              | -               | -                  | -                    | See Note |

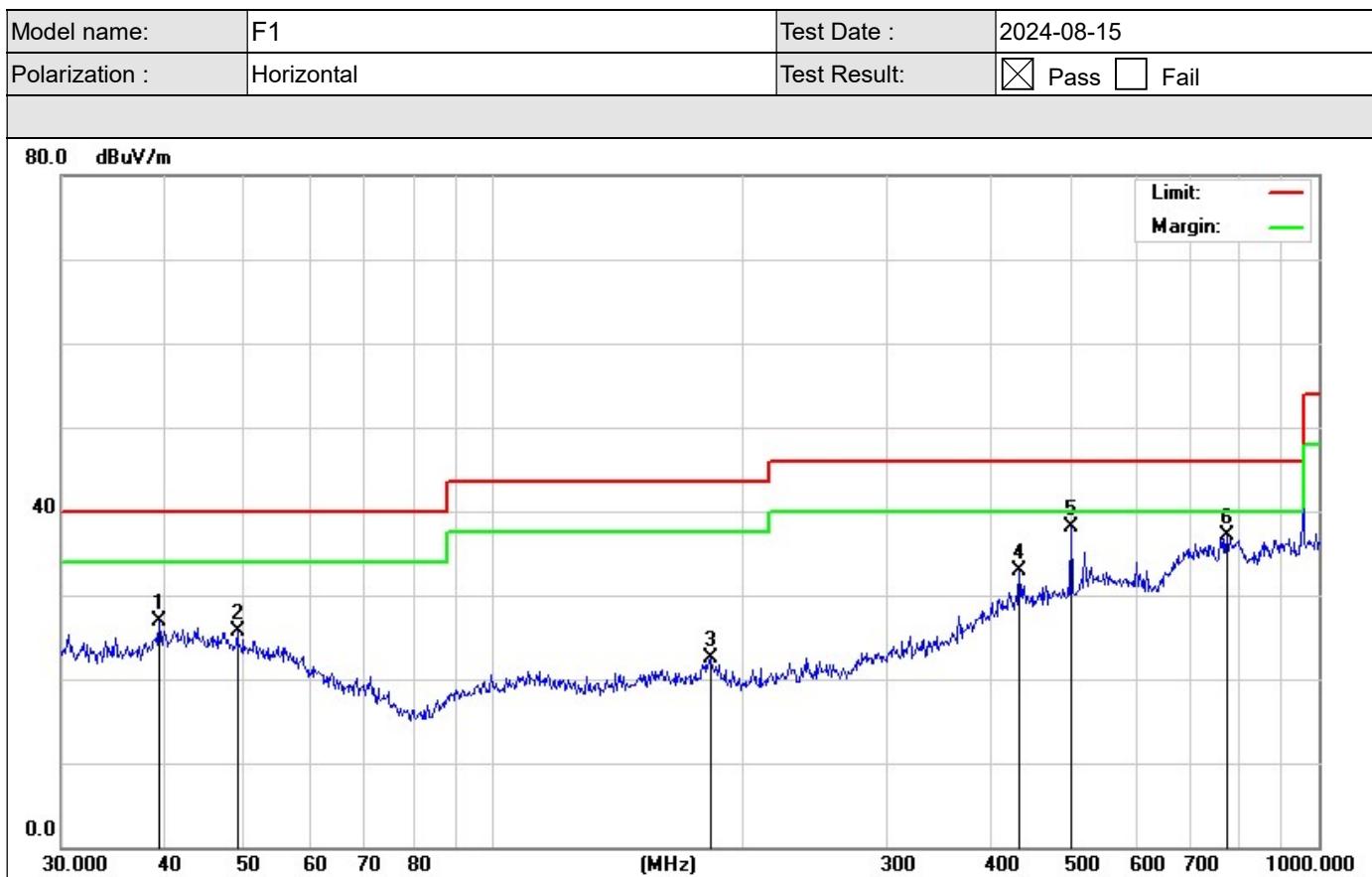
Note:

The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and the permissible value has no need to be reported.

Distance extrapolation factor =  $40 \log (\text{specific distance} / \text{test distance})$  (dB);  
Limit line = specific limits (dBuV) + distance extrapolation factor.

## ■ Results of Radiated Emissions (30MHz~1GHz)

Pre-scan all test modes, found worst case at GFSK (LCH), and so only show the test result of GFSK (LCH).



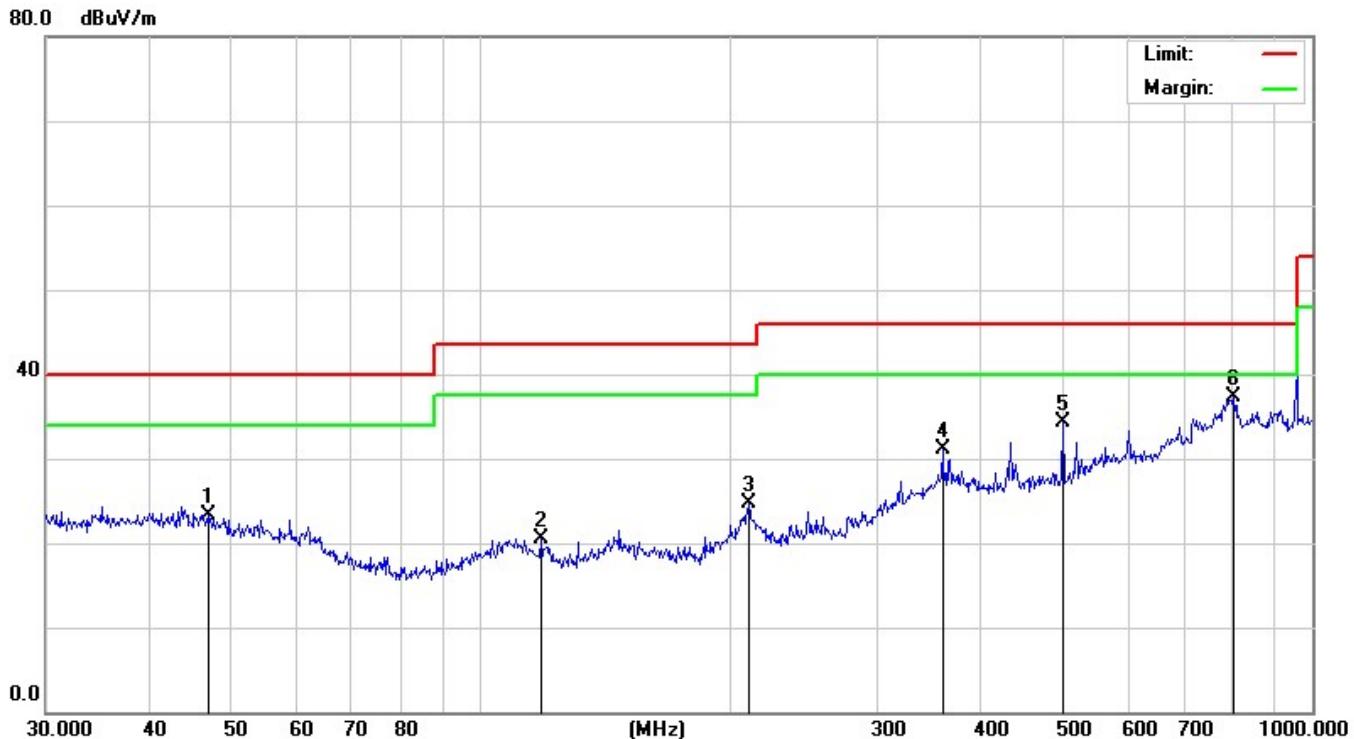
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Measurement Result=Reading Level +Correct Factor;

Over Limit= Measurement Result- Limit;

| No. | Mk. | Freq.    | Reading Level    | Correct Factor | Measure-ment        | Limit | Over   | Detector |
|-----|-----|----------|------------------|----------------|---------------------|-------|--------|----------|
|     |     | MHz      | dB <sub>UV</sub> | dB             | dB <sub>UV</sub> /m | dB    |        |          |
| 1   |     | 39.4371  | 23.22            | 3.71           | 26.93               | 40.00 | -13.07 | QP       |
| 2   |     | 49.0145  | 22.99            | 2.71           | 25.70               | 40.00 | -14.30 | QP       |
| 3   |     | 183.2005 | 21.78            | 0.70           | 22.48               | 43.50 | -21.02 | QP       |
| 4   |     | 434.0651 | 25.44            | 7.41           | 32.85               | 46.00 | -13.15 | QP       |
| 5   | *   | 501.1790 | 29.60            | 8.44           | 38.04               | 46.00 | -7.96  | QP       |
| 6   |     | 774.1584 | 24.61            | 12.57          | 37.18               | 46.00 | -8.82  | QP       |

|                |          |              |  |
|----------------|----------|--------------|--|
| Model name:    | F1       | Test Date :  | 2024-08-15   |
| Polarization : | Vertical | Test Result: | <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail |



Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Measurement Result=Reading Level +Correct Factor;

Over Limit= Measurement Result- Limit;

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dB | Over<br>Detector |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-------------|------------------|
| 1   |     | 46.9948      | 22.59                    | 0.71                    | 23.30                      | 40.00       | -16.70 QP        |
| 2   |     | 118.1862     | 23.34                    | -2.89                   | 20.45                      | 43.50       | -23.05 QP        |
| 3   |     | 210.0482     | 22.58                    | 2.18                    | 24.76                      | 43.50       | -18.74 QP        |
| 4   |     | 359.1860     | 25.61                    | 5.49                    | 31.10                      | 46.00       | -14.90 QP        |
| 5   |     | 501.1790     | 29.49                    | 4.89                    | 34.38                      | 46.00       | -11.62 QP        |
| 6   | *   | 804.6028     | 24.56                    | 12.81                   | 37.37                      | 46.00       | -8.63 QP         |

**Results for Radiated Emissions (1- 26 GHz)**

|               |        |  |  |  |  |  |
|---------------|--------|--|--|--|--|--|
| Test channel: | Lowest |  |  |  |  |  |
|---------------|--------|--|--|--|--|--|

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 4840.000        | 48.71             | 5.10          | 53.81          | 74.00               | -20.19          | Vertical     |
| 7260.000        | 39.27             | 7.26          | 46.53          | 74.00               | -27.47          | Vertical     |
| 4840.000        | 47.64             | 5.10          | 52.74          | 74.00               | -21.26          | Horizontal   |
| 7260.000        | 40.53             | 7.26          | 47.79          | 74.00               | -26.21          | Horizontal   |

**Average value:**

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 4840.000        | 33.26             | 5.10          | 38.36          | 54.00               | -15.64          | Vertical     |
| 7260.000        | 31.15             | 7.26          | 38.41          | 54.00               | -15.59          | Vertical     |
| 4840.000        | 37.92             | 5.10          | 43.02          | 54.00               | -10.98          | Horizontal   |
| 7260.000        | 31.93             | 7.26          | 39.19          | 54.00               | -14.81          | Horizontal   |

|               |        |  |  |  |  |  |
|---------------|--------|--|--|--|--|--|
| Test channel: | Middle |  |  |  |  |  |
|---------------|--------|--|--|--|--|--|

**Peak value:**

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 4880.000        | 48.02             | 5.14          | 53.16          | 74.00               | -20.84          | Vertical     |
| 7320.000        | 43.10             | 7.52          | 50.62          | 74.00               | -23.38          | Vertical     |
| 4916.000        | 49.07             | 5.14          | 54.21          | 74.00               | -19.79          | Horizontal   |
| 7374.000        | 42.72             | 7.52          | 50.24          | 74.00               | -23.76          | Horizontal   |

**Average value:**

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 4880.000        | 35.74             | 5.14          | 40.88          | 54.00               | -13.12          | Vertical     |
| 7320.000        | 33.48             | 7.52          | 41.00          | 54.00               | -13.00          | Vertical     |
| 4880.000        | 37.04             | 5.14          | 42.18          | 54.00               | -11.82          | Horizontal   |
| 7320.000        | 32.69             | 7.52          | 40.21          | 54.00               | -13.79          | Horizontal   |

|               |         |
|---------------|---------|
| Test channel: | Highest |
|---------------|---------|

**Peak value:**

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 4920.000        | 48.49             | 5.18          | 53.67          | 74.00               | -20.33          | Vertical     |
| 7380.000        | 44.67             | 7.80          | 52.47          | 74.00               | -21.53          | Vertical     |
| 4920.000        | 49.42             | 5.18          | 54.60          | 74.00               | -19.40          | Horizontal   |
| 7380.000        | 43.18             | 7.80          | 50.98          | 74.00               | -23.02          | Horizontal   |

**Average value:**

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 4920.000        | 33.51             | 5.18          | 38.69          | 54.00               | -15.31          | Vertical     |
| 7380.000        | 32.47             | 7.80          | 40.27          | 54.00               | -13.73          | Vertical     |
| 4920.000        | 35.38             | 5.18          | 40.56          | 54.00               | -13.44          | Horizontal   |
| 7380.000        | 31.83             | 7.80          | 39.63          | 54.00               | -14.37          | Horizontal   |

**Remarks:**

- 1). Measuring frequencies from 9 KHz - 10<sup>th</sup> harmonic or 26.5GHz (which is less), No emission found between lowest internal used/generated frequency to 30MHz.
- 2). Radiated emissions measured in frequency range from 9 KHz~10th harmonic or 26.5GHz (which is less) were made with an instrument using Peak detector mode.
- 3). Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 4). Margin= Final Level – Limit
- 5).Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
- 6). All the modes have been tested and the only shows the worst case GFSK mode

### 6.3.3 Band-edge Measurements

All of the restriction bands were tested, and only the data of worst case was exhibited.

|               |                |
|---------------|----------------|
| Test channel: | Lowest channel |
|---------------|----------------|

#### Peak value:

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 2310.000        | 44.24             | -5.92         | 38.32          | 74.00               | -35.68          | Vertical     |
| 2390.000        | 44.48             | -5.79         | 38.69          | 74.00               | -35.31          | Vertical     |
| 2310.000        | 44.48             | -5.92         | 38.56          | 74.00               | -35.44          | Horizontal   |
| 2390.000        | 44.81             | -5.79         | 39.02          | 74.00               | -34.98          | Horizontal   |

#### Average value:

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 2310.000        | 31.05             | -5.92         | 25.13          | 54.00               | -28.87          | Vertical     |
| 2390.000        | 30.10             | -5.79         | 24.31          | 54.00               | -29.69          | Vertical     |
| 2310.000        | 29.36             | -5.92         | 23.44          | 54.00               | -30.56          | Horizontal   |
| 2390.000        | 30.15             | -5.79         | 24.36          | 54.00               | -29.64          | Horizontal   |

|               |                 |
|---------------|-----------------|
| Test channel: | Highest channel |
|---------------|-----------------|

#### Peak value:

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 2483.500        | 46.35             | -4.98         | 41.37          | 74.00               | -32.63          | Vertical     |
| 2500.00         | 46.12             | -4.83         | 41.29          | 74.00               | -32.71          | Vertical     |
| 2483.500        | 44.46             | -4.98         | 39.48          | 74.00               | -34.52          | Horizontal   |
| 2500.000        | 45.23             | -4.83         | 40.40          | 74.00               | -33.60          | Horizontal   |

#### Average value:

| Frequency (MHz) | Read Level (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit Line (dBuV/m) | Over Limit (dB) | polarization |
|-----------------|-------------------|---------------|----------------|---------------------|-----------------|--------------|
| 2483.500        | 32.78             | -4.98         | 27.80          | 54.00               | -26.20          | Vertical     |
| 2500.00         | 35.27             | -4.83         | 30.44          | 54.00               | -23.56          | Vertical     |
| 2483.500        | 30.87             | -4.98         | 25.89          | 54.00               | -28.11          | Horizontal   |
| 2500.000        | 29.36             | -4.83         | 24.53          | 54.00               | -29.47          | Horizontal   |

Remark:

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

## 6.4 Conducted Emissions

### 6.9.1 Standard requirement:

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

| Frequency Range<br>(MHz) | Limits (dB $\mu$ V) |          |
|--------------------------|---------------------|----------|
|                          | Quasi-peak          | Average  |
| 0.15 to 0.50             | 66 to 56            | 56 to 46 |
| 0.50 to 5                | 56                  | 46       |
| 5 to 30                  | 60                  | 50       |

\* Decreasing linearly with the logarithm of the frequency

### 6.9.2 Measuring Instruments and Setting:

Please refer to equipment list in this report. The following table is the setting of the spectrum analyzer.

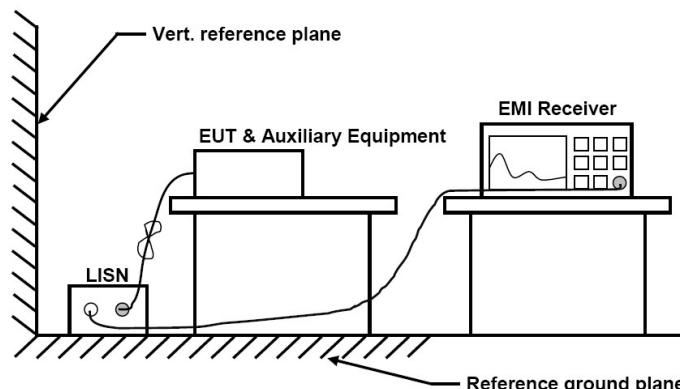
| Spectrum Parameter                        | Setting       |
|---|---------------|
| Detector                                  | Peak          |
| Attenuation                               | Auto          |
| RB / VB (Emission in restricted band)     | 100KHz/300KHz |
| RB / VB (Emission in non-restricted band) | 100KHz/300KHz |

### 6.9.3 Test Procedures

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz

The spectrum from 9 kHz to 26.5GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

### 6.9.4 Test Setup Layout



#### 6.9.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

#### 6.9.6 Test result

N/A

The EUT is powered by DC power.

## 7 Test Setup Photo

Reference to the **appendix Setup photo** for details.

## 8 EUT Constructional Details

Reference to the appendix **External EUT photo & Internal EUT photo** for details.

-----End-----