



RF Test Report

For

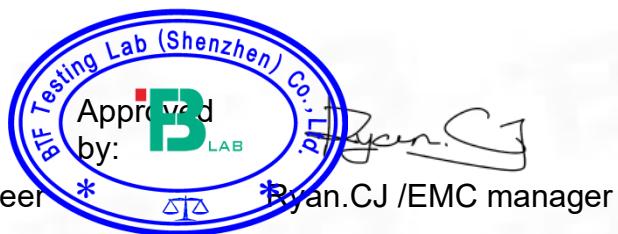
Applicant Name: **Shanghai AllyNav Technology Co.,Ltd.**
Address: Room 201, Buliding 1, No 215, Gaoguang RD, Qingpu District, Shanghai, China
EUT Name: GNSS Receiver
Brand Name: N/A
Model Number: R26pro
Series Model Number: N/A
FCC ID: 2AT4HR26PRO

Issued By

Company name: **BTF Testing Lab (Shenzhen) Co., Ltd.**
Address: 101/201/301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Subdistrict, Bao'an District, Shenzhen, China

Report number: BTF250620R00101
Test standards: FCC CFR Title 47 Part 15 Subpart C (§15.247)
Test conclusion: Pass
Date of sample receipt: 2025-01-21
Test date: 2025-01-21 to 2025-06-19
Date of issue: 2025-06-19
Test by: *Sean He*
Sean He / Tester

Prepared by: *Chris Liu*
Chris Liu / Project engineer



Note: All the test results in this report only related to the testing samples. Which can be duplicated completely for the legal use with approval of applicant; it shall not be reproduced except in full without the written approval of BTF Testing Lab (Shenzhen) Co., Ltd. All the objections should be raised within thirty days from the date of issue. To validate the report, you can contact us.



| Revision History | | |
|------------------|------------|-------------------|
| Version | Issue Date | Revisions Content |
| R_V0 | 2025-06-19 | Original |
| | | |

Note: Once the revision has been made, then previous versions reports are invalid.

Table of Contents

| | |
|---|-----------|
| 1 INTRODUCTION | 5 |
| 1.1 Laboratory Location | 5 |
| 1.2 Laboratory Facility | 5 |
| 1.3 Announcement | 5 |
| 2 PRODUCT INFORMATION | 6 |
| 2.1 Application Information | 6 |
| 2.2 Manufacturer Information | 6 |
| 2.3 Factory Information | 6 |
| 2.4 General Description of Equipment under Test (EUT) | 6 |
| 2.5 Technical Information | 6 |
| 2.6 Channel list: | 6 |
| 3 SUMMARY OF TEST RESULTS..... | 7 |
| 3.1 Test Standards | 7 |
| 3.2 Uncertainty of Test | 7 |
| 3.3 Summary of Test Result | 8 |
| 4 TEST CONFIGURATION | 9 |
| 4.1 Test Equipment List | 9 |
| 4.2 Test Auxiliary Equipment | 10 |
| 4.3 Test Modes | 10 |
| 4.4 Test software | 10 |
| 4.5 Test Setup Block | 10 |
| 5 EVALUATION RESULTS (EVALUATION)..... | 12 |
| 5.1 Antenna requirement | 12 |
| 5.1.1 Conclusion: | 12 |
| 6 RADIO SPECTRUM MATTER TEST RESULTS (RF)..... | 13 |
| 6.1 Conducted Emission at AC power line | 13 |
| 6.1.1 E.U.T. Operation: | 13 |
| 6.1.2 Test Setup | 13 |
| 6.1.3 Test Data: | 13 |
| 6.2 Occupied Bandwidth..... | 14 |
| 6.2.1 E.U.T. Operation: | 15 |
| 6.2.2 Test Setup | 15 |
| 6.2.3 Test Data: | 15 |
| 6.3 Maximum Conducted Output Power | 16 |
| 6.3.1 E.U.T. Operation: | 16 |
| 6.3.2 Test Setup | 16 |
| 6.3.3 Test Data: | 16 |
| 6.4 Channel Separation..... | 17 |
| 6.4.1 E.U.T. Operation: | 17 |
| 6.4.2 Test Setup | 17 |
| 6.4.3 Test Data: | 17 |
| 6.5 Number of Hopping Frequencies..... | 18 |
| 6.5.1 E.U.T. Operation: | 18 |
| 6.5.2 Test Setup | 18 |
| 6.5.3 Test Data: | 18 |
| 6.6 Dwell Time | 19 |
| 6.6.1 E.U.T. Operation: | 19 |

| | |
|---|-----------|
| 6.6.2 Test Setup | 20 |
| 6.6.3 Test Data: | 20 |
| 6.7 Emissions in non-restricted frequency bands | 21 |
| 6.7.1 E.U.T. Operation:..... | 21 |
| 6.7.2 Test Setup | 21 |
| 6.7.3 Test Data: | 21 |
| 6.8 Band edge emissions (Radiated)..... | 22 |
| 6.8.1 E.U.T. Operation:..... | 22 |
| 6.8.2 Test Setup | 23 |
| 6.8.3 Test Data: | 23 |
| 6.9 Emissions in restricted frequency bands (below 1GHz)..... | 24 |
| 6.9.1 E.U.T. Operation:..... | 24 |
| 6.9.2 Test Setup | 25 |
| 6.9.3 Test Data: | 25 |
| 6.10 Emissions in restricted frequency bands (above 1GHz)..... | 27 |
| 6.10.1 E.U.T. Operation:..... | 27 |
| 6.10.2 Test Setup | 28 |
| 6.10.3 Test Data: | 28 |
| 7 TEST SETUP PHOTOS | 29 |
| 8 EUT CONSTRUCTIONAL DETAILS (EUT PHOTOS)..... | 29 |

1 Introduction

1.1 Laboratory Location

| | |
|----------------|--|
| Test location: | BTF Testing Lab (Shenzhen) Co., Ltd. |
| Address: | 101/201/301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Subdistrict, Bao'an District, Shenzhen, China |
| Phone number: | +86-0755-23146130 |
| Fax number: | +86-0755-23146130 |

1.2 Laboratory Facility

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

- **FCC - Designation No.: CN1409**

BTF Testing Lab (Shenzhen) Co., Ltd. has been accredited as a testing laboratory by FCC (Federal Communications Commission). The test firm Registration No. is 695374.

- **CNAS - Registration No.: CNAS L17568**

BTF Testing Lab (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 L17568.

- **A2LA - Registration No.: 6660.01**

BTF Testing Lab (Shenzhen) Co., Ltd. is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories.

1.3 Announcement

- (1) The test report reference to the report template version v0.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing, reviewing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) This document may not be altered or revised in any way unless done so by BTF and all revisions are duly noted in the revisions section.
- (5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.
- (6) The laboratory is only responsible for the data released by the laboratory, except for the part provided by the applicant.

2 Product Information

2.1 Application Information

| | |
|---------------|---|
| Company Name: | Shanghai AllyNav Technology Co.,Ltd. |
| Address: | Room 201, Buliding 1, No 215, Gaoguang RD, Qingpu District, Shanghai, China |

2.2 Manufacturer Information

| | |
|---------------|---|
| Company Name: | Shanghai AllyNav Technology Co.,Ltd. |
| Address: | Room 201, Buliding 1, No 215, Gaoguang RD, Qingpu District, Shanghai, China |

2.3 Factory Information

| | |
|---------------|---|
| Company Name: | Shanghai AllyNav Technology Co.,Ltd. |
| Address: | Room 201, Buliding 1, No 215, Gaoguang RD, Qingpu District, Shanghai, China |

2.4 General Description of Equipment under Test (EUT)

| | |
|---|------------------------|
| EUT name | GNSS Receiver |
| Under test model name | R26pro |
| Series model name | N/A |
| Description of model name differentiation | N/A |
| Hardware Version | V2.010 |
| Software Version | V200.2.10 |
| Rating: | Input Voltage 12VDC 2A |

2.5 Technical Information

| | |
|------------------------|---------------------------------|
| Operation frequency: | 2402MHz ~ 2480MHz |
| Channel numbers: | 79 |
| Channel separation: | 1MHz |
| Modulation technology: | GFSK, $\pi/4$ DQPSK, 8DPSK |
| Data rate: | 1/2/3 Mbits/s |
| Max. Conducted Power: | 6.87 dBm ($\pi/4$ DQPSK) |
| Antenna type: | Internal Antenna |
| Antenna gain: | 2.07 dBi (declare by Applicant) |
| Antenna transmit mode: | SISO (1TX, 1RX) |

2.6 Channel list:

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|---------|-----------|---------|-----------|
| 0 | 2402MHz | 20 | 2422MHz | 40 | 2442MHz | 60 | 2462MHz |
| 1 | 2403MHz | 21 | 2423MHz | 41 | 2443MHz | 61 | 2463MHz |
| ... | ... | ... | ... | ... | ... | ... | ... |
| 10 | 2412MHz | 30 | 2432MHz | 50 | 2452MHz | 70 | 2472MHz |
| 11 | 2413MHz | 31 | 2433MHz | 51 | 2453MHz | 71 | 2473MHz |
| ... | ... | ... | ... | ... | ... | ... | ... |
| 18 | 2420MHz | 38 | 2440MHz | 58 | 2460MHz | 78 | 2480MHz |
| 19 | 2421MHz | 39 | 2441MHz | 59 | 2461MHz | - | - |

Remark: Channel 0, 39 & 78 have been tested for GFSK, $\pi/4$ -DQPSK, 8DPSK modulation mode.

3 Summary of Test Results

3.1 Test Standards

| Identity | Document Title |
|--|--|
| FCC CFR Title 47 Part 15 Subpart C (§15.247) | Intentional Radiators - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz. |
| ANSI C63.10-2020 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| KDB 558074 D01 15.247 Meas Guidance v05r02 | Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of The FCC Rules |

3.2 Uncertainty of Test

| Measurement | Value |
|--|----------|
| Occupied Channel Bandwidth | ±5 % |
| RF output power, conducted | ±1.5 dB |
| Power Spectral Density, conducted | ±3.0 dB |
| Unwanted Emissions, conducted | ±3.0 dB |
| Supply voltages | ±3 % |
| Time | ±5 % |
| Conducted Emission for LISN (9kHz ~ 150kHz) | ±2.97 dB |
| Conducted Emission for LISN (150kHz ~ 30MHz) | ±2.45 dB |
| Radiated Emission (30MHz ~ 1000MHz) | ±4.80 dB |
| Radiated Emission (1GHz ~ 18GHz) | ±4.82 dB |

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.3 Summary of Test Result

| Item | Standard | Requirement | Result |
|--|--------------------|--------------------------|--------|
| Antenna requirement | 47 CFR Part 15.247 | Part 15.203 | Pass |
| Conducted Emission at AC power line | 47 CFR Part 15.247 | 47 CFR 15.207(a) | N/A |
| Occupied Bandwidth | 47 CFR Part 15.247 | 47 CFR 15.215(c) | Pass |
| Maximum Conducted Output Power | 47 CFR Part 15.247 | 47 CFR 15.247(b)(1) | Pass |
| Channel Separation | 47 CFR Part 15.247 | 47 CFR 15.247(a)(1) | Pass |
| Number of Hopping Frequencies | 47 CFR Part 15.247 | 47 CFR 15.247(a)(1)(iii) | Pass |
| Dwell Time | 47 CFR Part 15.247 | 47 CFR 15.247(a)(1)(iii) | Pass |
| Emissions in non-restricted frequency bands | 47 CFR Part 15.247 | 47 CFR 15.247(d) | Pass |
| Band edge emissions (Radiated) | 47 CFR Part 15.247 | 47 CFR 15.247(d) | Pass |
| Emissions in restricted frequency bands (below 1GHz) | 47 CFR Part 15.247 | 47 CFR 15.247(d) | Pass |
| Emissions in restricted frequency bands (above 1GHz) | 47 CFR Part 15.247 | 47 CFR 15.247(d) | Pass |

4 Test Configuration

4.1 Test Equipment List

| Radiated test method | | | | | |
|------------------------------|-----------------|-------------|----------------------|------------|------------|
| Test Equipment | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due |
| EMI Receiver | Rohde & Schwarz | ESCI7 | 101032 | 2024/10/25 | 2025/10/24 |
| Signal Analyzer | Rohde & Schwarz | FSQ40 | 100010 | 2024/10/25 | 2025/10/24 |
| Log periodic antenna | Schwarzbeck | VULB 9168 | 01328 | 2024/10/28 | 2025/10/27 |
| Preamplifier (30MHz ~ 1GHz) | Schwarzbeck | BBV9744 | 00246 | 2024/09/24 | 2025/09/23 |
| Horn Antenna (1GHz ~ 18GHz) | Schwarzbeck | BBHA9120D | 2597 | 2024/10/30 | 2025/10/29 |
| Horn Antenna (15GHz ~ 40GHz) | SCHWARZBECK | BBHA9170 | 1157 | 2024/10/24 | 2025/10/23 |
| Preamplifier (1GHz ~ 40GHz) | TST Pass | LNA10180G45 | 246 | 2024/09/24 | 2025/09/23 |
| Test Software | Frad | EZ_EMCA | Version: FA-03A2 RE+ | | |

| Conducted test method | | | | | |
|-------------------------------------|---------------|-----------|--------------|------------|------------|
| Description | Manufacturer | Model | Serial No. | Cal. Date | Cal. Due |
| Spectrum Analyzer | Keysight | N9020A | MY50410020 | 2024/10/25 | 2025/10/24 |
| ESG Vector Signal Generator | Agilent | E4438C | MY45094854 | 2024/10/25 | 2025/10/24 |
| MXG Vector Signal Generator | Agilent | N5182A | MY46240163 | 2024/10/25 | 2025/10/24 |
| Wideband Radio Communication Tester | Rohde&Schwarz | CMW500 | 161997 | 2024/10/25 | 2025/10/24 |
| Temperature Humidity Chamber | ZZCKONG | ZZ-K02A | 20210928007 | 2024/10/25 | 2025/10/24 |
| DC Power Supply | Tongmen | etm-6050c | 20211026123 | 2024/10/25 | 2025/10/24 |
| RF Control Unit | Techy | TR1029-1 | / | 2024/10/25 | 2025/10/24 |
| RF Sensor Unit | Techy | TR1029-2 | / | 2024/10/25 | 2025/10/24 |
| Test Software | TST Pass | / | Version: 2.0 | | |

4.2 Test Auxiliary Equipment

| No. | Description | Manufacturer | Model | Serial Number | Certification |
|-----|-------------|--------------|-------|---------------|---------------|
| 1 | Adapter | Apple | A2244 | N/A | N/A |
| 2 | Load | Yuebuzhe | YBZ | N/A | N/A |

4.3 Test Modes

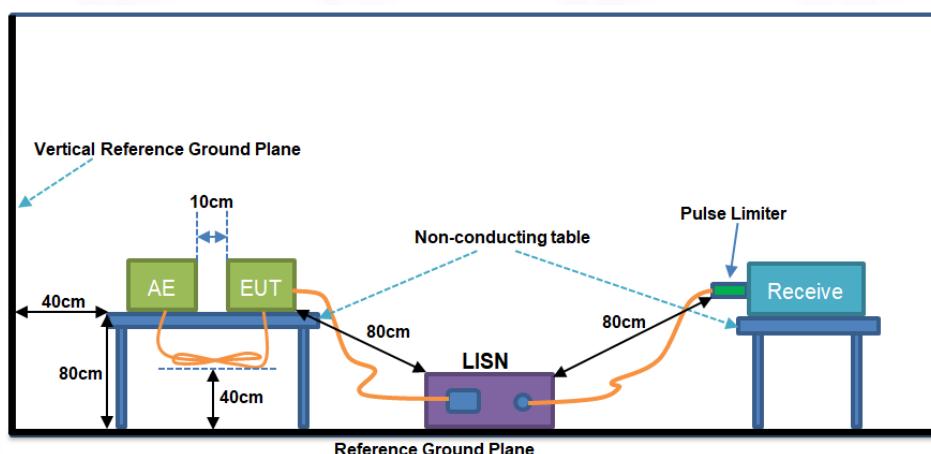
| No. | Test Modes | Description |
|-----|----------------------------|---|
| TM1 | TX-GFSK (Non-Hopping) | Keep the EUT in continuously transmitting mode (non-hopping) with GFSK modulation. |
| TM2 | TX-Pi/4DQPSK (Non-Hopping) | Keep the EUT in continuously transmitting mode (non-hopping) with Pi/4DQPSK modulation. |
| TM3 | TX-8DPSK (Non-Hopping) | Keep the EUT in continuously transmitting mode (non-hopping) with 8DPSK modulation. |
| TM4 | TX-GFSK (Hopping) | Keep the EUT in continuously transmitting mode (hopping) with GFSK modulation.,. |
| TM5 | TX-Pi/4DQPSK (Hopping) | Keep the EUT in continuously transmitting mode (hopping) with Pi/4DQPSK modulation. |
| TM6 | TX-8DPSK (Hopping) | Keep the EUT in continuously transmitting mode (hopping) with 8DPSK modulation. |

4.4 Test software

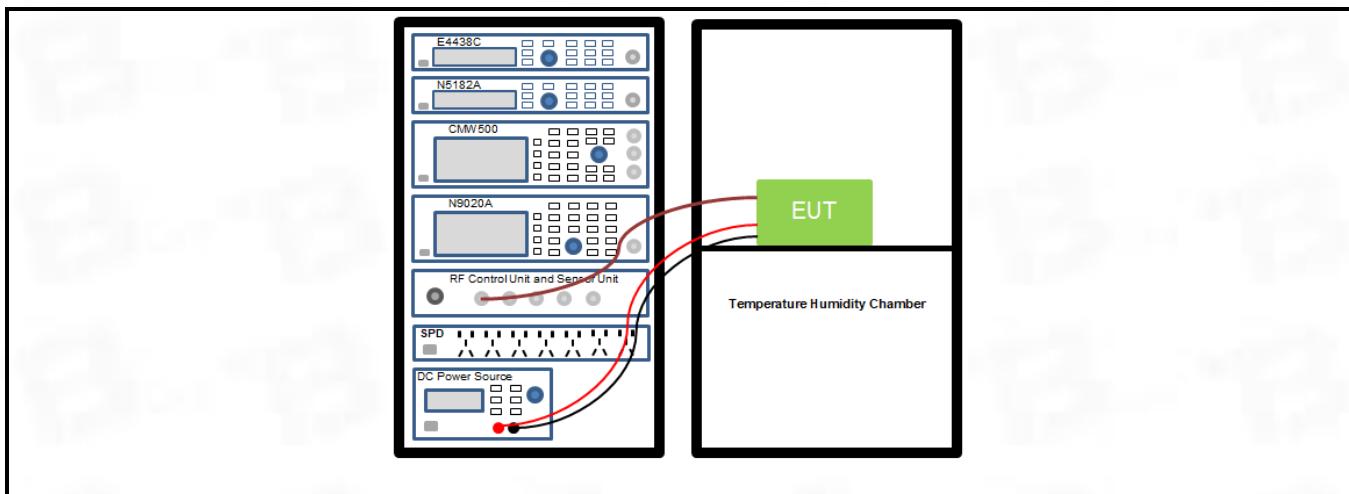
| | | | |
|----------------|--------------|----------|------------|
| Test software: | QRCT4 | Version: | N/A |
| Power Class: | 9 | | |

4.5 Test Setup Block

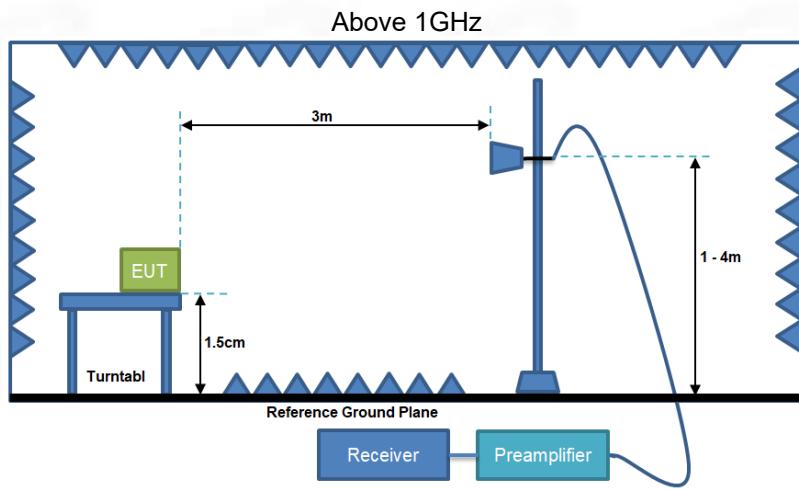
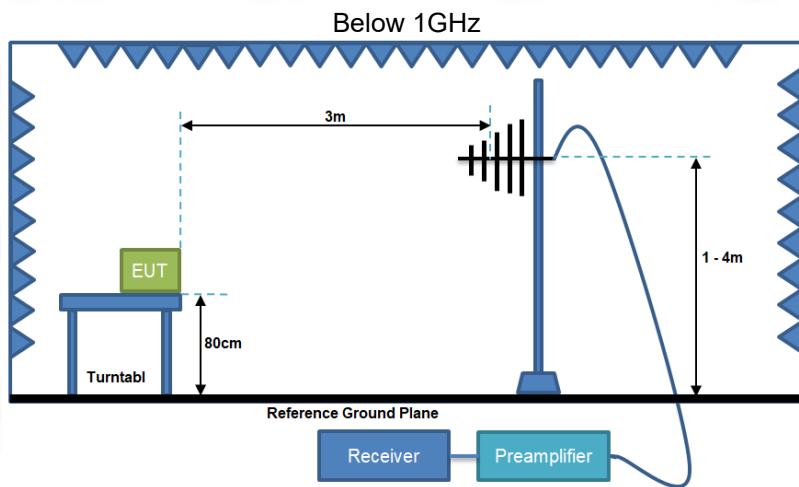
1) Conducted emission measurement:



2) Conducted test method:



3) Radiated test method:

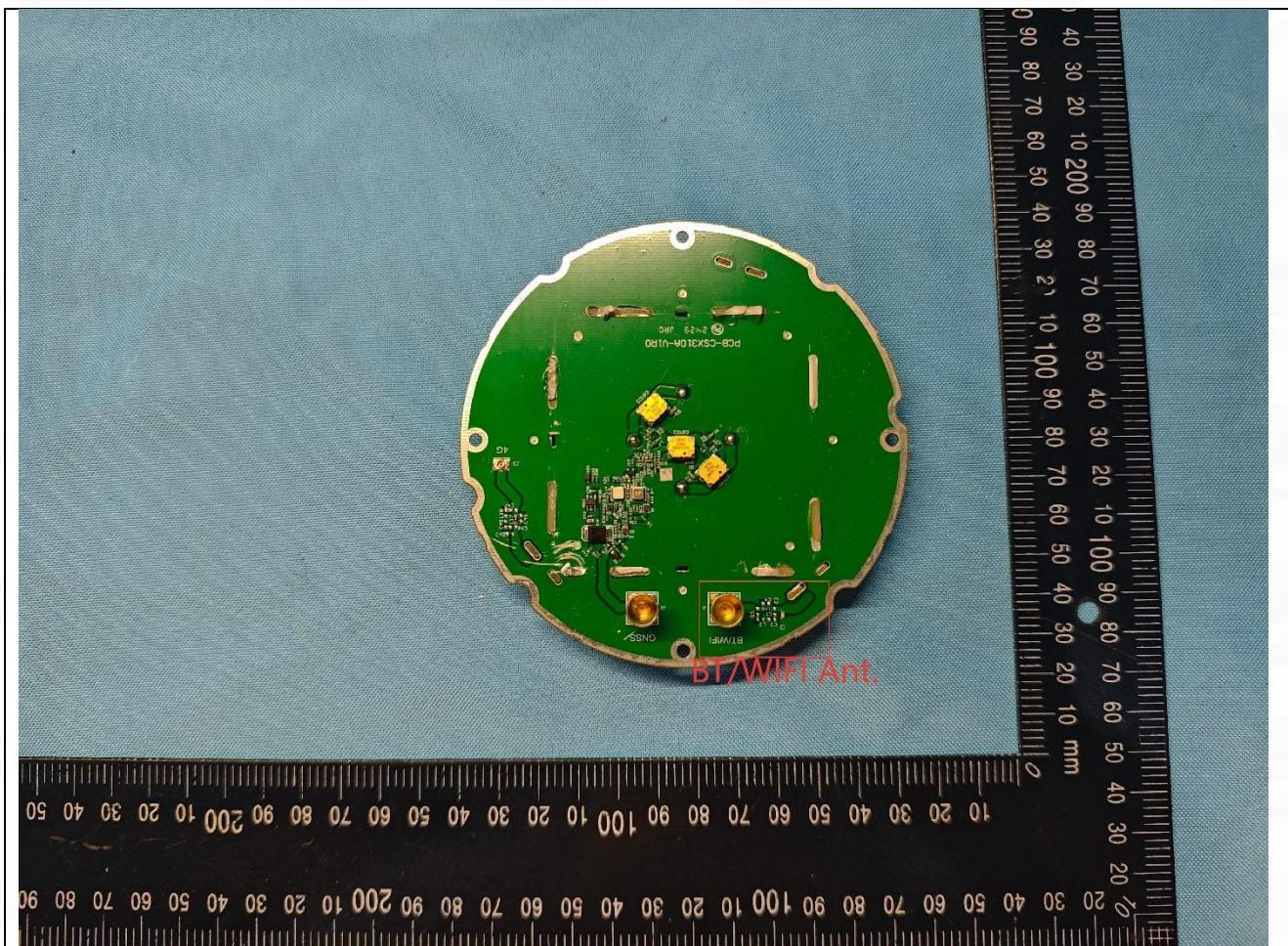


5 Evaluation Results (Evaluation)

5.1 Antenna requirement

| | |
|-------------------|--|
| Test 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 shall be considered sufficient to comply with the provisions of this section. |
|-------------------|--|

5.1.1 Conclusion:



6 Radio Spectrum Matter Test Results (RF)

6.1 Conducted Emission at AC power line

| | | | |
|-------------------|--|------------------------------|-----------|
| Test Requirement: | Except as shown in paragraphs (b)and (c)of this section, for an intentional radiator that 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 the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). | | |
| Test Method: | Refer to ANSI C63.10-2020 section 6.2, standard test method for ac power-line conducted emissions from unlicensed wireless devices | | |
| Test Limit: | Frequency of emission (MHz) | Conducted limit (dB μ V) | |
| | Quasi-peak | Average | |
| | 0.15-0.5 | 66 to 56* | 56 to 46* |
| | 0.5-5 | 56 | 46 |
| | 5-30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

6.1.1 E.U.T. Operation:

| | |
|------------------------|----------|
| Operating Environment: | |
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |
| Test Voltage | AC 120V |

6.1.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test Setup Photos

6.1.3 Test Data:

Remark: This test item is not applicable.

6.2 Occupied Bandwidth

| | |
|-------------------|---|
| Test Requirement: | Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. |
| Test Method: | Occupied bandwidth—relative measurement procedure |
| Test Limit: | Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. |
| Procedure: | <p>a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.</p> <p>b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.</p> <p>c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (\text{OBW}/\text{RBW})]$ below the reference level. Specific guidance is given in 4.1.5.2.</p> <p>d) Steps a) through c) might require iteration to adjust within the specified tolerances.</p> <p>e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.</p> <p>f) Set detection mode to peak and trace mode to max hold.</p> <p>g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).</p> <p>h) Determine the “-xx dB down amplitude” using $[(\text{reference value}) - \text{xx}]$. Alternatively, this calculation may be made by using the marker-delta function of the instrument.</p> <p>i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).</p> <p>j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.</p> |

| | |
|--|---|
| | k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s). |
|--|---|

6.2.1 E.U.T. Operation:

| Operating Environment: | |
|------------------------|----------|
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |

6.2.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test

Setup Photos

6.2.3 Test Data:

Please Refer to Appendix-BT for Details.

6.3 Maximum Conducted Output Power

| | |
|-------------------|---|
| Test Requirement: | For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. |
| Test Method: | Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices |
| Test Limit: | For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. |
| Procedure: | <p>This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:</p> <p>a) Use the following spectrum analyzer settings:</p> <ol style="list-style-type: none"> 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel. 2) RBW > 20 dB bandwidth of the emission being measured. 3) VBW \geq RBW. 4) Sweep: Auto. 5) Detector function: Peak. 6) Trace: Max hold. <p>b) Allow trace to stabilize.</p> <p>c) Use the marker-to-peak function to set the marker to the peak of the emission.</p> <p>d) The indicated level is the peak output power, after any corrections for external attenuators and cables.</p> <p>e) A plot of the test results and setup description shall be included in the test report.</p> <p>NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.</p> |

6.3.1 E.U.T. Operation:

| | |
|------------------------|----------|
| Operating Environment: | |
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |

6.3.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test Setup Photos

6.3.3 Test Data:

Please Refer to Appendix-BT for Details.

6.4 Channel Separation

| | |
|-------------------|---|
| Test Requirement: | Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. |
| Test Method: | Carrier frequency separation |
| Test Limit: | Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. |
| Procedure: | <p>The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:</p> <ul style="list-style-type: none"> a) Span: Wide enough to capture the peaks of two adjacent channels. b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel. c) Video (or average) bandwidth (VBW) \geq RBW. d) Sweep: Auto. e) Detector function: Peak. f) Trace: Max hold. g) Allow the trace to stabilize. <p>Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.</p> |

6.4.1 E.U.T. Operation:

| | |
|------------------------|----------|
| Operating Environment: | |
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |

6.4.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test Setup Photos

6.4.3 Test Data:

Please Refer to Appendix-BT for Details.

6.5 Number of Hopping Frequencies

| | |
|-------------------|---|
| Test Requirement: | Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. |
| Test Method: | Number of hopping frequencies |
| Test Limit: | Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. |
| Procedure: | <p>The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:</p> <ul style="list-style-type: none"> a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen. b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller. c) VBW \geq RBW. d) Sweep: Auto. e) Detector function: Peak. f) Trace: Max hold. g) Allow the trace to stabilize. <p>It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.</p> |

6.5.1 E.U.T. Operation:

| | |
|------------------------|----------|
| Operating Environment: | |
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |

6.5.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test Setup Photos

6.5.3 Test Data:

Please Refer to Appendix-BT for Details.

6.6 Dwell Time

| | |
|-------------------|--|
| Test Requirement: | Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. |
| Test Method: | Time of occupancy (dwell time) |
| Test Limit: | Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. |
| Procedure: | <p>The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:</p> <ul style="list-style-type: none"> a) Span: Zero span, centered on a hopping channel. b) RBW shall be \leq channel spacing and where possible RBW should be set $\gg 1 / T$, where T is the expected dwell time per channel. c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel. d) Detector function: Peak. e) Trace: Max hold. <p>Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.</p> <p>Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:</p> $(\text{Number of hops in the period specified in the requirements}) = (\text{number of hops on spectrum analyzer}) \times (\text{period specified in the requirements} / \text{analyzer sweep time})$ <p>The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.</p> <p>The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.</p> |

6.6.1 E.U.T. Operation:

| | |
|------------------------|----------|
| Operating Environment: | |
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |



6.6.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test Setup Photos

6.6.3 Test Data:

Please Refer to Appendix-BT for Details.

6.7 Emissions in non-restricted frequency bands

| | |
|-------------------|--|
| Test Requirement: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. |
| Test Method: | Conducted spurious emissions test methodology |
| Test Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. |
| Procedure: | Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers. Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered. |

6.7.1 E.U.T. Operation:

| | |
|------------------------|----------|
| Operating Environment: | |
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |
| Test Voltage | DC 5V |

6.7.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test Setup Photos

6.7.3 Test Data:

Please Refer to Appendix-BT for Details.

6.8 Band edge emissions (Radiated)

| Test Requirement: | In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)). | | |
|---|--|-----------------------------------|-------------------------------|
| Test Method: | Radiated emissions tests | | |
| Test Limit: | Frequency (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 |
| ** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241. | | | |
| Procedure: | ANSI C63.10-2020 section 6.10.5.2 | | |

6.8.1 E.U.T. Operation:

| | |
|------------------------|----------|
| Operating Environment: | |
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |
| Test Voltage | AC 120V |

6.8.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test Setup Photos

6.8.3 Test Data:

Remark: During the test, pre-scan GFSK, $\pi/4$ DQPSK, 8DPSK mode, found GFSK was worse case mode. The report only reflects the test data of worst mode.

| Test Mode: GFSK | | | | | | | |
|---|----------------------|----------------------|----------------|---------------|-------------|----------|--------|
| Test Channel: Lowest channel, Test Polarization: Vertical | | | | | | | |
| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margining (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Detector | Result |
| 10139.950 | 45.5 | 74.0 | 28.5 | 38.4 | 55.4 | Peak | P |
| 10139.950 | 37.1 | 54.0 | 16.9 | 38.4 | 55.4 | AV | P |
| 13455.900 | 47.7 | 74.0 | 26.3 | 39.7 | 56.7 | Peak | P |
| 13455.900 | 38.8 | 54.0 | 15.2 | 39.7 | 56.7 | AV | P |
| Test Channel: Lowest channel, Test Polarization: Horizontal | | | | | | | |
| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margining (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Detector | Result |
| 3852.769 | 38.0 | 74.0 | 36.0 | 30.5 | 56.7 | Peak | P |
| 3852.769 | 32.5 | 54.0 | 21.5 | 30.5 | 56.7 | AV | P |
| 15027.292 | 39.8 | 74.0 | 34.2 | 39.1 | 57.7 | Peak | P |
| 15027.292 | 30.4 | 54.0 | 23.6 | 39.1 | 57.7 | AV | P |
| Test Channel: Highest channel, Test Polarization: Horizontal | | | | | | | |
| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margining (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Detector | Result |
| 14915.600 | 44.9 | 74.0 | 29.1 | 39.2 | 57.7 | Peak | P |
| 14915.600 | 36.2 | 54.0 | 17.8 | 39.2 | 57.7 | AV | P |
| 15147.150 | 44.9 | 74.0 | 29.1 | 39.2 | 57.7 | Peak | P |
| 15147.150 | 36.2 | 54.0 | 17.8 | 39.2 | 57.7 | AV | P |
| Test Channel: Highest channel, Test Polarization: Horizontal | | | | | | | |
| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margining (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Detector | Result |
| 9452.450 | 45.5 | 74.0 | 28.5 | 38.1 | 55.0 | Peak | P |
| 9452.450 | 36.7 | 54.0 | 17.3 | 38.1 | 55.0 | AV | P |
| 15147.150 | 45.2 | 74.0 | 28.8 | 39.0 | 57.6 | Peak | P |
| 15147.150 | 36.3 | 54.0 | 17.7 | 39.0 | 57.6 | AV | P |

Note:

1. Margin = Result (Result = Reading + Factor) - Limit
2. Factor = Cable Loss + Antenna Factor - Amplifier Gain

6.9 Emissions in restricted frequency bands (below 1GHz)

| Test Requirement: | In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)). | | |
|---|--|-----------------------------------|-------------------------------|
| Test Method: | Radiated emissions tests | | |
| Test Limit: | Frequency (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 |
| ** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241. | | | |
| Procedure: | ANSI C63.10-2020 section 6.6.4 | | |

6.9.1 E.U.T. Operation:

| | |
|------------------------|----------|
| Operating Environment: | |
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |
| Test Voltage | AC 120V |

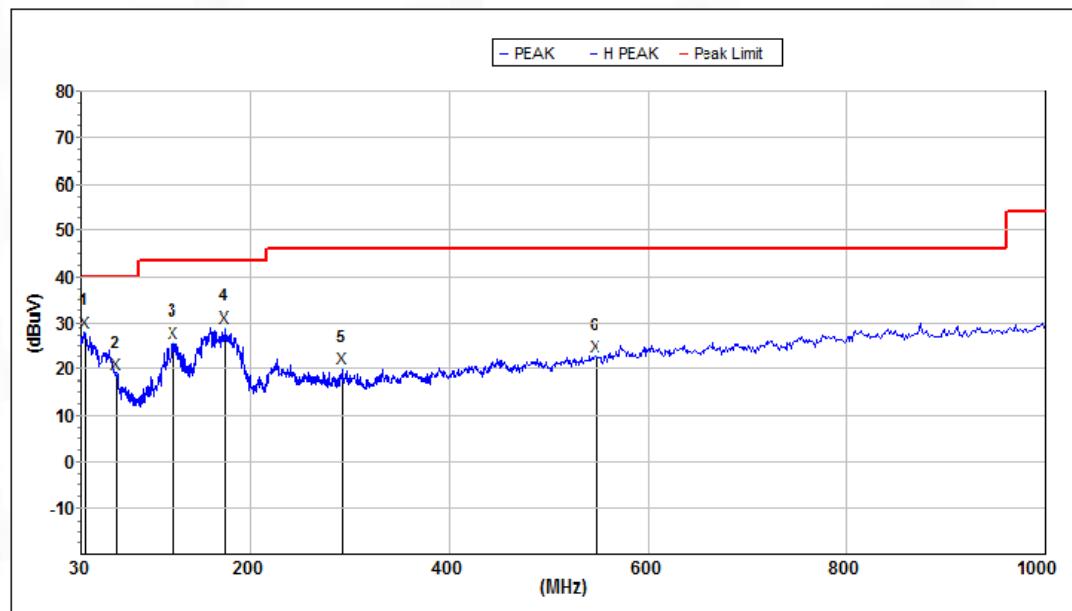
6.9.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test Setup Photos

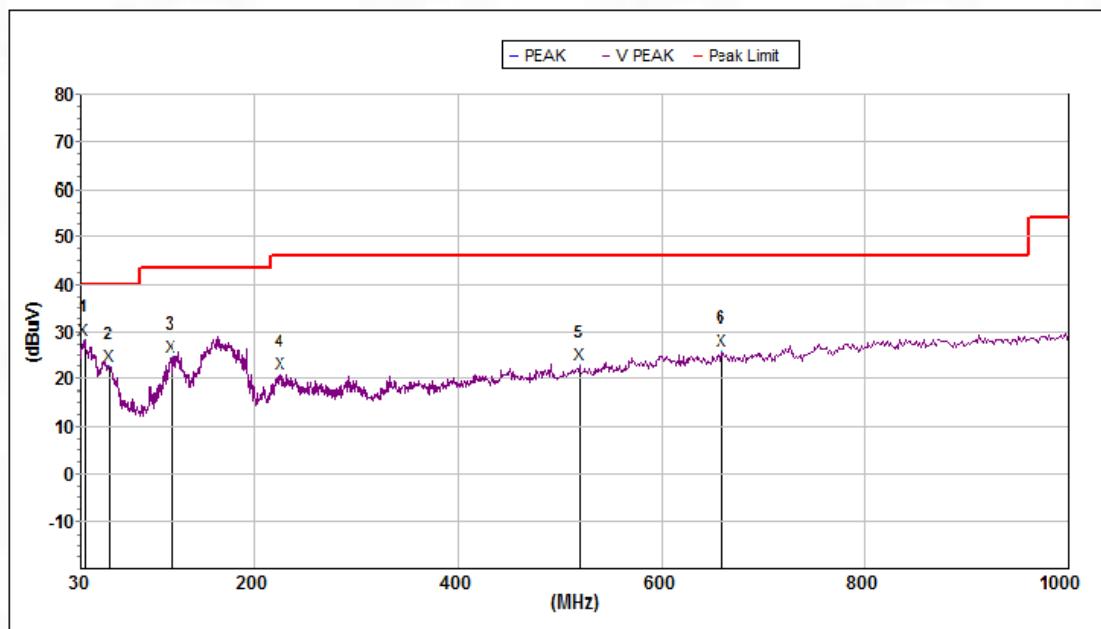
6.9.3 Test Data:

Remark: During the test, pre-scan GFSK, $\pi/4$ DQPSK, 8DPSK mode, found GFSK was worse case mode. The report only reflects the test data of worst mode.

TM1 / Polarization: Horizontal



| Mk. | Freq. (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Det. |
|-----|-------------|----------------------|----------------------|-------------|---------------|-------------|------|
| 1 | 34.336 | 27.9 | 40.0 | 12.1 | 18.7 | 31.8 | peak |
| 2 | 65.803 | 18.9 | 40.0 | 21.1 | 17.1 | 32.2 | peak |
| 3 | 123.482 | 25.6 | 43.5 | 17.9 | 16.9 | 31.0 | peak |
| 4 | 173.814 | 29.0 | 43.5 | 14.5 | 17.5 | 31.5 | peak |
| 5 | 292.058 | 20.1 | 46.0 | 25.9 | 18.9 | 32.3 | peak |
| 6 | 547.098 | 22.9 | 46.0 | 23.1 | 24.6 | 31.6 | peak |

TM1 / Polarization: Vertical


| Mk. | Freq. (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margin (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Det. |
|-----|-------------|----------------------|----------------------|-------------|---------------|-------------|------|
| 1 | 33.621 | 28.2 | 40.0 | 11.8 | 18.6 | 31.8 | peak |
| 2 | 57.594 | 22.8 | 40.0 | 17.2 | 18.4 | 31.1 | peak |
| 3 | 118.601 | 24.9 | 43.5 | 18.6 | 16.4 | 31.0 | peak |
| 4 | 226.099 | 21.0 | 46.0 | 25.0 | 16.7 | 31.9 | peak |
| 5 | 519.065 | 23.1 | 46.0 | 22.9 | 23.9 | 31.5 | peak |
| 6 | 658.836 | 26.2 | 46.0 | 19.8 | 26.4 | 31.8 | peak |

Note:

1. Margin = Result (Result = Reading + Factor) - Limit
2. Factor = Cable Loss + Antenna Factor - Amplifier Gain

6.10 Emissions in restricted frequency bands (above 1GHz)

| Test Requirement: | In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)(see § 15.205(c)). | | |
|---|--|-----------------------------------|-------------------------------|
| Test Method: | Radiated emissions tests | | |
| Test Limit: | Frequency (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 |
| ** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241. | | | |
| Procedure: | ANSI C63.10-2020 section 6.6.4 | | |

6.10.1 E.U.T. Operation:

| | |
|------------------------|----------|
| Operating Environment: | |
| Temperature: | 23 °C |
| Humidity: | 52 % |
| Atmospheric Pressure: | 1010 hpa |
| Test Voltage | AC 120V |

6.10.2 Test Setup

See section 4.5 for test setup description. The photo of test setup please refer to Appendix I Test Setup Photos

6.10.3 Test Data:

Remark: During the test, pre-scan GFSK, $\pi/4$ DQPSK, 8DPSK mode, found GFSK was worse case mode. The report only reflects the test data of worst mode.

| Test Mode: GFSK | | | | | | | |
|---|----------------------|----------------------|----------------|---------------|-------------|----------|--------|
| Test Channel: Lowest channel, Test Polarization: Vertical | | | | | | | |
| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margining (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Detector | Result |
| 2317.682 | 60.0 | 74.0 | 14.0 | 27.2 | 55.6 | peak | P |
| 2324.102 | 36.8 | 54.0 | 17.2 | 27.2 | 55.6 | AV | P |
| 2363.189 | 71.8 | 74.0 | 2.2 | 27.3 | 55.6 | peak | P |
| 2361.695 | 46.6 | 54.0 | 7.4 | 27.3 | 55.6 | AV | P |
| Test Channel: Lowest channel, Test Polarization: Horizontal | | | | | | | |
| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margining (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Detector | Result |
| 2326.308 | 52.2 | 74.0 | 21.8 | 27.2 | 55.6 | peak | P |
| 2324.286 | 25.7 | 54.0 | 28.3 | 27.2 | 55.6 | AV | P |
| 2362.815 | 59.8 | 74.0 | 14.2 | 27.3 | 55.6 | peak | P |
| 2361.695 | 35.6 | 54.0 | 18.4 | 27.3 | 55.6 | AV | P |
| Test Channel: Highest channel, Test Polarization: Vertical | | | | | | | |
| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margining (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Detector | Result |
| 2324.470 | 56.4 | 74.0 | 17.6 | 27.2 | 55.6 | peak | P |
| 2318.781 | 31.1 | 54.0 | 22.9 | 27.2 | 55.6 | AV | P |
| 2368.612 | 68.3 | 74.0 | 5.7 | 27.3 | 55.6 | peak | P |
| 2362.815 | 31.3 | 54.0 | 22.7 | 27.3 | 55.6 | AV | P |
| Test Channel: Highest channel, Test Polarization: Horizontal | | | | | | | |
| Frequency (MHz) | Level (dB μ V/m) | Limit (dB μ V/m) | Margining (dB) | Ant.F/G. (dB) | Amp.G. (dB) | Detector | Result |
| 2317.498 | 53.9 | 74.0 | 20.1 | 27.2 | 55.6 | peak | P |
| 2322.633 | 29.6 | 54.0 | 24.4 | 27.2 | 55.6 | AV | P |
| 2358.710 | 59.8 | 74.0 | 14.2 | 27.3 | 55.6 | peak | P |
| 2366.928 | 33.8 | 54.0 | 20.2 | 27.3 | 55.6 | AV | P |

Note:

1. Margin = Result (Result = Reading + Factor) - Limit
2. Factor = Cable Loss + Antenna Factor - Amplifier Gain
3. Other 18G-25G Emission detected are more than 20dB below the limit.

7 Test Setup Photos

Please refer to the Appendix I Test Setup Photos

8 EUT Constructional Details (EUT Photos)

Please refer to the Appendix II External Photos & Appendix III Internal Photos



Test Report Number: BTF250620R00101



BTF Testing Lab (Shenzhen) Co., Ltd.

F101, 201 and 301, Building 1, Block 2, Tantou Industrial Park, Tantou Community, Songgang Street,
Bao'an District, Shenzhen, China

www.btf-lab.com

-- END OF REPORT --