



TEST REPORT

Applicant Name : Astera LED-Technology GmbH
Address : Stahlgruberring 36, Munich, 81829 Germany
Report Number : SZNS220713-31703E-RF-00
FCC ID: X55AX3-BTB

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type: LightDrop BTB
Model No.: AX3-BTB
Multiple Model(s) No.: AX3-BTB-WT
(model difference see product declaration letter of similarity)
Trade Mark: ASTERA
Date Received: 2022/07/13
Report Date: 2022/09/01

| | |
|--------------|-------|
| Test Result: | Pass* |
|--------------|-------|

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

Prepared and Checked By:

Audy Yu
EMC Engineer

Approved By:

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*" .

Shenzhen Accurate Technology Co., Ltd. is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk "**". Customer model name, addresses, names, trademarks etc. are not considered data.

This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

Shenzhen Accurate Technology Co., Ltd.

1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China
Tel: +86 755-26503290 Fax: +86 755-26503396 Web: www.atc-lab.com

TABLE OF CONTENTS

| | |
|--|-----------|
| GENERAL INFORMATION | 4 |
| PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)..... | 4 |
| OBJECTIVE | 4 |
| TEST METHODOLOGY | 4 |
| MEASUREMENT UNCERTAINTY..... | 5 |
| TEST FACILITY | 5 |
| SYSTEM TEST CONFIGURATION | 6 |
| DESCRIPTION OF TEST CONFIGURATION | 6 |
| EUT EXERCISE SOFTWARE | 6 |
| SPECIAL ACCESSORIES..... | 6 |
| EQUIPMENT MODIFICATIONS | 7 |
| SUPPORT EQUIPMENT LIST AND DETAILS | 7 |
| EXTERNAL I/O CABLE..... | 7 |
| BLOCK DIAGRAM OF TEST SETUP | 8 |
| SUMMARY OF TEST RESULTS | 9 |
| TEST EQUIPMENT LIST | 10 |
| FCC §15.247 (I) & §1.1307 (B) (3) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE) | 11 |
| FCC §15.203 - ANTENNA REQUIREMENT | 13 |
| APPLICABLE STANDARD | 13 |
| ANTENNA CONNECTOR CONSTRUCTION | 13 |
| FCC §15.207 (A) – AC LINE CONDUCTED EMISSIONS | 14 |
| APPLICABLE STANDARD | 14 |
| EUT SETUP | 14 |
| EMI TEST RECEIVER SETUP..... | 14 |
| TEST PROCEDURE | 14 |
| CORRECTED FACTOR & MARGIN CALCULATION | 15 |
| TEST DATA | 15 |
| FCC §15.209, §15.205 & §15.247(D) - SPURIOUS EMISSIONS | 18 |
| APPLICABLE STANDARD | 18 |
| EUT SETUP | 18 |
| EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP | 19 |
| TEST PROCEDURE | 19 |
| CORRECTED AMPLITUDE & MARGIN CALCULATION | 19 |
| TEST DATA | 19 |
| FCC §15.247(A) (1)-CHANNEL SEPARATION TEST | 24 |
| APPLICABLE STANDARD | 24 |
| TEST PROCEDURE | 24 |
| TEST DATA | 24 |
| FCC §15.247(A) (1) (I) – 20 DB EMISSION BANDWIDTH | 27 |
| APPLICABLE STANDARD | 27 |
| TEST PROCEDURE | 27 |
| TEST DATA | 27 |

FCC §15.247(A) (1) (I)-QUANTITY OF HOPPING CHANNEL TEST30
 APPLICABLE STANDARD30
 TEST PROCEDURE30
 TEST DATA30

FCC §15.247(A) (1) (I) - TIME OF OCCUPANCY (DWELL TIME).....32
 APPLICABLE STANDARD32
 TEST PROCEDURE32
 TEST DATA33

FCC §15.247(B) (2) - MAXIMUM CONDUCTED OUTPUT POWER35
 APPLICABLE STANDARD35
 TEST PROCEDURE35
 TEST DATA35

FCC §15.247(D) – 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE38
 APPLICABLE STANDARD38
 TEST PROCEDURE38
 TEST DATA38

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

| | |
|-----------------------|---|
| Frequency Range | 917~922.2MHz |
| Transmit Power | 9.01dBm |
| Modulation Technique | GFSK |
| Antenna Specification | -0.22dBi (It is provided by the applicant) |
| Voltage Range | DC10.8V From Battery DC 5V from Adapter |
| Sample serial number | SZNS220713-31703E-RF-S1 for Radiated and Conducted Emissions SZNS220713-31703E-RF-S2for RF Conducted Test (Assigned by ATC) |
| Sample/EUT Status | Good condition |
| Adapter information | Model: PA1015-050IB250 Input: AC 100-240V, 50/60Hz,0.4A Output: DC 5.0V, 2.5A, 12.5W Max |

Objective

This report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

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.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters. Each test item follows test standards and with no deviation.

Measurement Uncertainty

| Parameter | | uncertainty |
|------------------------------|------------|-------------|
| Occupied Channel Bandwidth | | ±5% |
| RF output power, conducted | | ±0.73dB |
| Unwanted Emission, conducted | | ±1.95dB |
| Radiated Emissions | Below 1GHz | ±4.75dB |
| | Above 1GHz | ±4.88dB |
| Temperature | | ±1 °C |
| Supply voltages | | ±0.4% |

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISED), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 0 | 917.00 | 27 | 919.70 |
| 1 | 917.10 | 28 | 919.80 |
| 2 | 917.20 | 29 | 919.90 |
| 3 | 917.30 | 30 | 920.00 |
| 4 | 917.40 | 31 | 920.10 |
| 5 | 917.50 | 32 | 920.20 |
| 6 | 917.60 | 33 | 920.30 |
| 7 | 917.70 | 34 | 920.40 |
| 8 | 917.80 | 35 | 920.50 |
| 9 | 917.90 | 36 | 920.60 |
| 10 | 918.00 | 37 | 920.70 |
| 11 | 918.10 | 38 | 920.80 |
| 12 | 918.20 | 39 | 920.90 |
| 13 | 918.30 | 40 | 921.00 |
| 14 | 918.40 | 41 | 921.10 |
| 15 | 918.50 | 42 | 921.20 |
| 16 | 918.60 | 43 | 921.30 |
| 17 | 918.70 | 44 | 921.40 |
| 18 | 918.80 | 45 | 921.50 |
| 19 | 918.90 | 46 | 921.60 |
| 20 | 919.00 | 47 | 921.70 |
| 21 | 919.10 | 48 | 921.80 |
| 22 | 919.20 | 49 | 921.90 |
| 23 | 919.30 | 50 | 922.00 |
| 24 | 919.40 | 51 | 922.10 |
| 25 | 919.50 | 52 | 922.20 |
| 26 | 919.60 | / | / |

EUT was test on channel 0, 26, 52.

EUT Exercise Software

“AsterApp_9.96*” software was used for the test and the power level is default*. The software and power level was provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

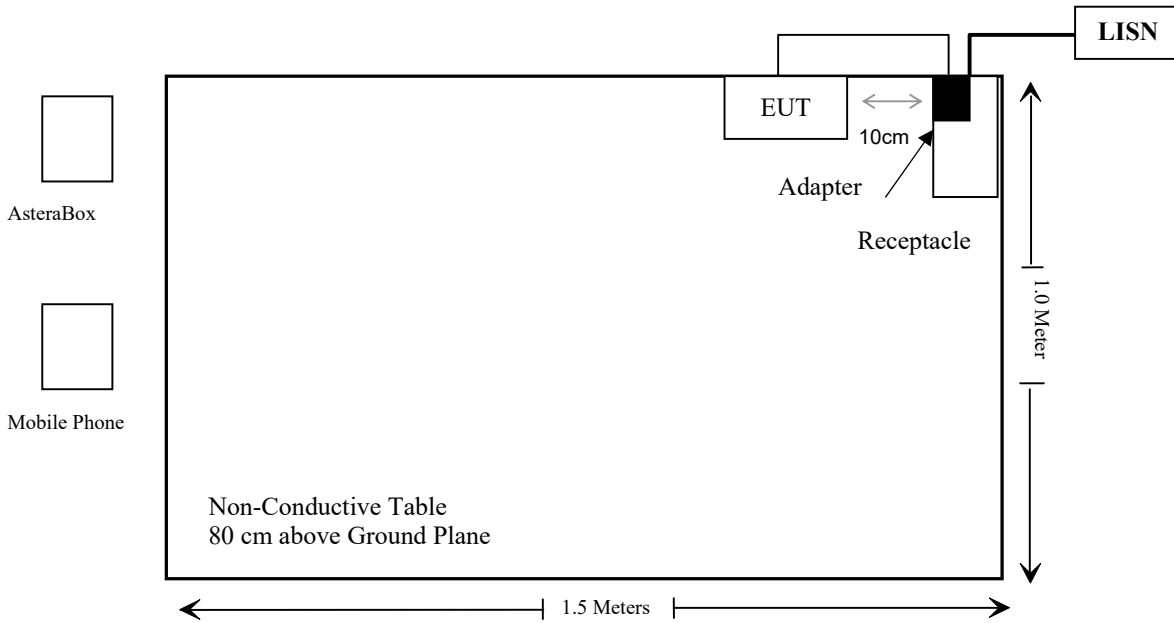
| Manufacturer | Description | Model | Serial Number |
|--------------|--------------|--------|---------------|
| ASTERA | AsteraBox | ART7-U | 025-0918819 |
| Nubia | Mobile Phone | NX549J | F4efaa79 |

External I/O Cable

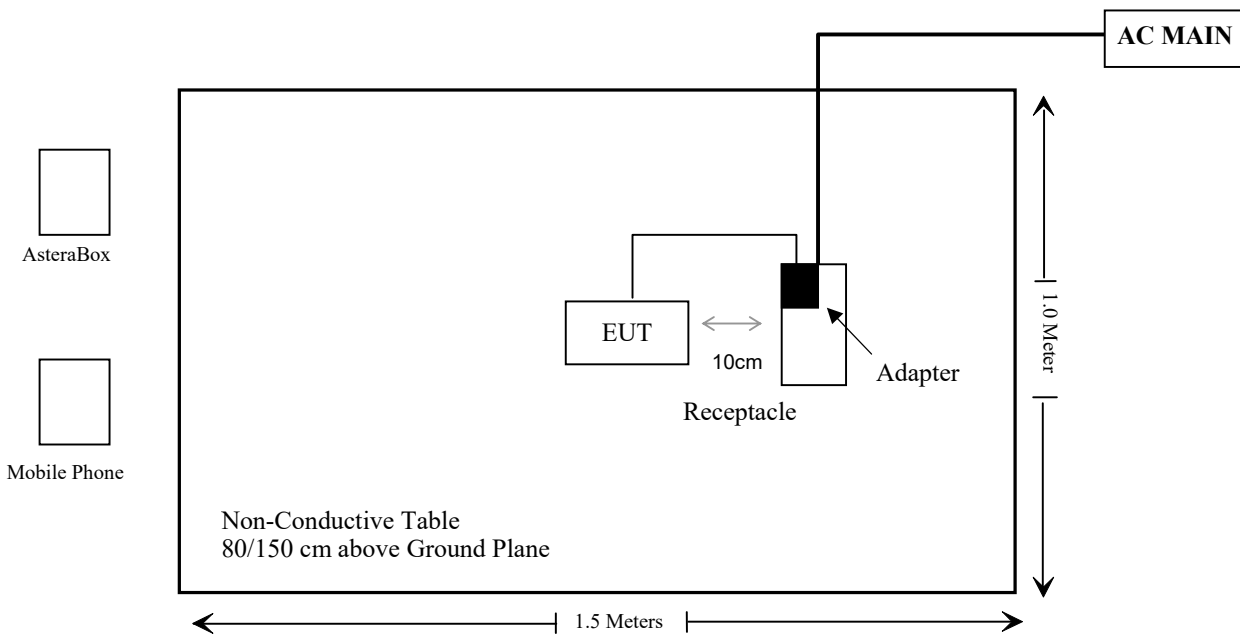
| Cable Description | Length (m) | From Port | To |
|-------------------------------------|------------|-----------|-----|
| Un-shielding Un-Detachable DC Cable | 1.5 | Adapter | EUT |

Block Diagram of Test Setup

For conducted emission;



For Radiated Emissions:



SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|-------------------------------|-----------------------------------|---------------|
| §15.247 (i), §2.1091 | Maximum Permissible Exposure(MPE) | Compliant |
| §15.203 | Antenna Requirement | Compliant |
| §15.207(a) | AC Line Conducted Emissions | Compliant |
| §15.205, §15.209 & §15.247(d) | Radiated Emissions | Compliant |
| §15.247(a)(1) | 20 dB Emission Bandwidth | Compliant |
| §15.247(a)(1)(i) | Channel Separation Test | Compliant |
| §15.247(a)(1)(i) | Time of Occupancy (Dwell Time) | Compliant |
| §15.247(a)(1)(i) | Quantity of hopping channel Test | Compliant |
| §15.247(b)(2) | Peak Output Power Measurement | Compliant |
| §15.247(d) | Band edges | Compliant |

TEST EQUIPMENT LIST

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|--|-------------------|-------------------|---------------|------------------|----------------------|
| Conducted Emissions Test | | | | | |
| Rohde& Schwarz | EMI Test Receiver | ESCI | 100784 | 2021/12/13 | 2022/12/12 |
| Rohde & Schwarz | L.I.S.N. | ENV216 | 101314 | 2021/12/13 | 2022/12/12 |
| Anritsu Corp | 50 Coaxial Switch | MP59B | 6100237248 | 2021/12/13 | 2022/12/12 |
| Unknown | RF Coaxial Cable | No.17 | N0350 | 2021/12/14 | 2022/12/13 |
| Conducted Emission Test Software: e3 19821b (V9) | | | | | |
| Radiated Emission Test | | | | | |
| Rohde& Schwarz | Test Receiver | ESR | 102725 | 2021/12/13 | 2022/12/12 |
| Rohde&Schwarz | Spectrum Analyzer | FSV40 | 101949 | 2021/12/13 | 2022/12/12 |
| SONOMA INSTRUMENT | Amplifier | 310 N | 186131 | 2021/11/09 | 2022/11/08 |
| A.H. Systems, inc. | Preamplifier | PAM-0118P | 135 | 2021/11/09 | 2022/11/08 |
| Quinstar | Amplifier | QLW-18405536-J0 | 15964001002 | 2021/11/11 | 2022/11/10 |
| Schwarzbeck | Bilog Antenna | VULB9163 | 9163-323 | 2021/07/06 | 2024/07/05 |
| Schwarzbeck | Horn Antenna | BBHA9120D | 9120D-1067 | 2020/01/05 | 2023/01/04 |
| Schwarzbeck | HORN ANTENNA | BBHA9170 | 9170-359 | 2020/01/05 | 2023/01/04 |
| Radiated Emission Test Software: e3 19821b (V9) | | | | | |
| Unknown | RF Coaxial Cable | No.10 | N050 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.11 | N1000 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.12 | N040 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.13 | N300 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.14 | N800 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.15 | N600 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Coaxial Cable | No.16 | N650 | 2021/12/14 | 2022/12/13 |
| Wainwright | High Pass Filter | WHKX3.6/18 G-10SS | 5 | 2021/12/14 | 2022/12/13 |
| Mini-Circuits | High Pass Filter | NHP-600+ | 15542 | 2021/12/14 | 2022/12/13 |
| RF Conducted Test | | | | | |
| SPECTRUM ANALYZER | Rohde & Schwarz | FSU26 | 200982 | 2022/07/06 | 2023/07/05 |
| WEINSCHL | 10dB Attenuator | 5324 | AU 3842 | 2021/12/14 | 2022/12/13 |
| Unknown | RF Cable | Unknown | 2 | Each time | / |

* **Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §1.1307 (b) (3) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

| RF Source frequency (MHz) | Threshold ERP (watts) |
|---------------------------|-----------------------|
| 0.3-1.34 | $1,920 R^2$. |
| 1.34-30 | $3,450 R^2/f^2$. |
| 30-300 | $3.83 R^2$. |
| 300-1,500 | $0.0128 R^2f$. |
| 1,500-100,000 | $19.2R^2$. |

R is the minimum separation distance in meters
 f = frequency in MHz

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Result

| Mode | Frequency (MHz) | Tune up conducted power | Antenna Gain | | ERP | | Evaluation Distance (m) | ERP Limit (W) |
|-------|-----------------|-------------------------|--------------|-------|-------|-------|-------------------------|---------------|
| | | (dBm) | (dBi) | (dBd) | (dBm) | (W) | | |
| UHF | 917-922.2 | 9.5 | -0.22 | -2.37 | 7.13 | 0.005 | 0.2 | 0.470 |
| BT | 2402-2480 | 9.0 | 3.4 | 1.25 | 10.25 | 0.011 | 0.2 | 0.768 |
| BLE | 2402-2480 | 7.0 | 3.4 | 1.25 | 8.25 | 0.007 | 0.2 | 0.768 |
| Wi-Fi | 2412-2462 | 27.0 | 3.4 | 1.25 | 28.25 | 0.668 | 0.2 | 0.768 |

- Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
 2. The EUT contains a certified BT/Wi-Fi module (model: ESP32-WROVER-E, FCC ID: 2AC7Z-ESP32WROVERE)
 3. The UHF can transmit at the same time with the BT or Wi-Fi, the BT and Wi-Fi cannot Simultaneous transmitting

Simultaneous transmitting consideration (worst case):

The ratio= $ERP_{UHF}/limit+ERP_{Wi-Fi}/limit=0.005/0.470+0.668/0.768=0.880<1.0$, so simultaneous exposure is compliant.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has an internal antenna arrangement for UHF, which was permanently attached and the antenna gain is -0.22dBi, fulfill the requirement of this section. Please refer to the EUT photos.

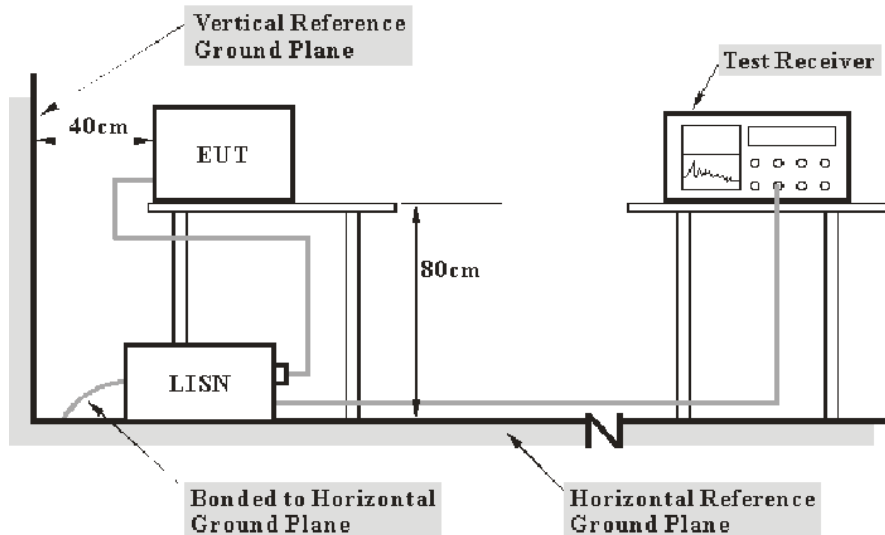
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

EUT Setup



- Note: 1. Support units were connected to second LISN.
 2. Both of LISNs (AMN) 80 cm from EUT and at least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

| Frequency Range | IF B/W |
|------------------|--------|
| 150 kHz – 30 MHz | 9 kHz |

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Transd factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

$$\text{Transd Factor} = \text{LISN VDF} + \text{Cable Loss}$$

The “**Over limit**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

$$\begin{aligned} \text{Over Limit} &= \text{Level} - \text{Limit} \\ \text{Level} &= \text{Read Level} + \text{Factor} \end{aligned}$$

Test Data

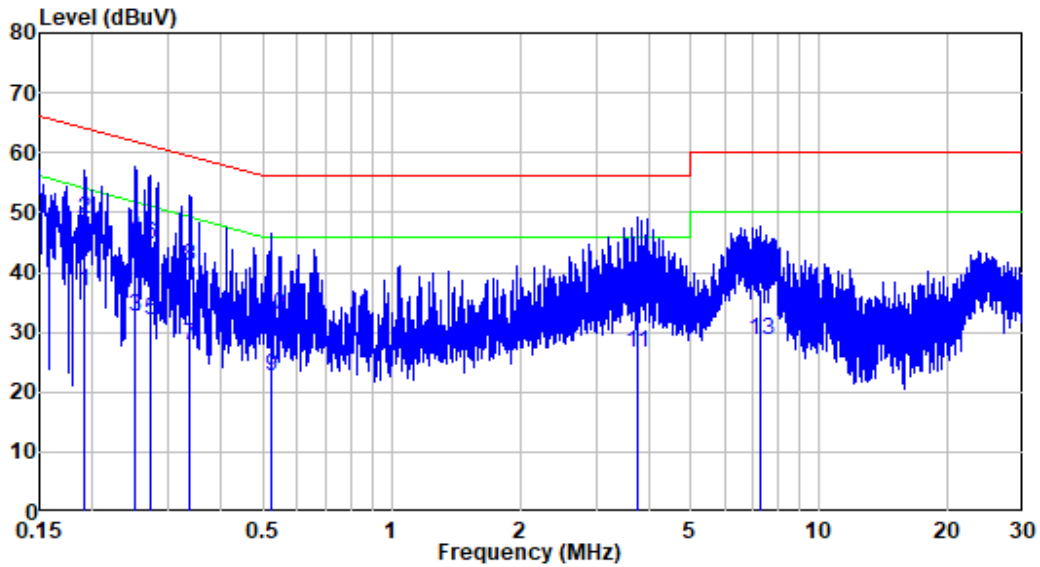
Environmental Conditions

| | |
|---------------------------|-----------|
| Temperature: | 24°C |
| Relative Humidity: | 49 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Jason Liu on 2022-08-10

EUT operation mode: Transmitting (worst case is low channel)

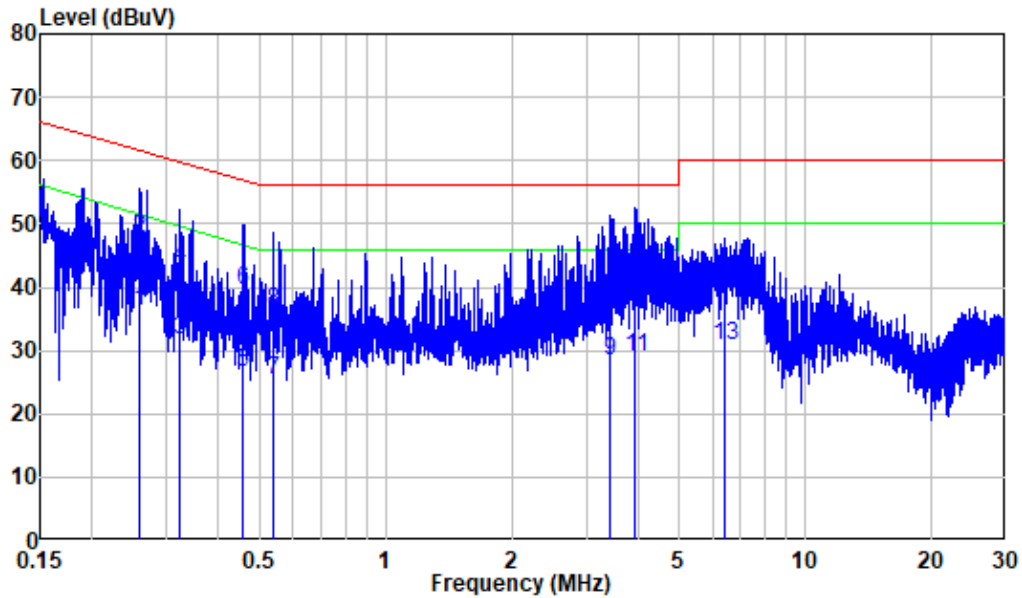
AC 120V/60 Hz, Line



Site : Shielding Room
 Condition: Line
 Mode : UHF
 Model : AX3-BTB
 Power : AC 120V 60Hz

| | Freq | Factor | Read Level | Limit Level | Over Line | Limit | Over Limit | Remark |
|----|-------|--------|------------|-------------|-----------|--------|------------|--------|
| | MHz | dB | dBuV | dBuV | dBuV | dB | dB | |
| 1 | 0.192 | 9.80 | 27.15 | 36.95 | 53.97 | -17.02 | Average | |
| 2 | 0.192 | 9.80 | 39.08 | 48.88 | 63.97 | -15.09 | QP | |
| 3 | 0.252 | 9.80 | 22.80 | 32.60 | 51.69 | -19.09 | Average | |
| 4 | 0.252 | 9.80 | 35.86 | 45.66 | 61.69 | -16.03 | QP | |
| 5 | 0.272 | 9.80 | 22.27 | 32.07 | 51.07 | -19.00 | Average | |
| 6 | 0.272 | 9.80 | 34.94 | 44.74 | 61.07 | -16.33 | QP | |
| 7 | 0.338 | 9.80 | 17.89 | 27.69 | 49.25 | -21.56 | Average | |
| 8 | 0.338 | 9.80 | 31.34 | 41.14 | 59.25 | -18.11 | QP | |
| 9 | 0.524 | 9.81 | 12.87 | 22.68 | 46.00 | -23.32 | Average | |
| 10 | 0.524 | 9.81 | 23.16 | 32.97 | 56.00 | -23.03 | QP | |
| 11 | 3.749 | 9.84 | 16.86 | 26.70 | 46.00 | -19.30 | Average | |
| 12 | 3.749 | 9.84 | 26.89 | 36.73 | 56.00 | -19.27 | QP | |
| 13 | 7.314 | 9.87 | 18.95 | 28.82 | 50.00 | -21.18 | Average | |
| 14 | 7.314 | 9.87 | 27.33 | 37.20 | 60.00 | -22.80 | QP | |

AC 120V/60 Hz, Neutral



Site : Shielding Room
 Condition: Neutral
 Mode : UHF
 Model : AX3-BTB
 Power : AC 120V 60Hz

| | Freq | Factor | Read Level | Level | Limit Line | Over Limit | Remark |
|----|-------|--------|------------|-------|------------|------------|---------|
| | MHz | dB | dBuV | dBuV | dBuV | dB | |
| 1 | 0.260 | 9.80 | 26.54 | 36.34 | 51.43 | -15.09 | Average |
| 2 | 0.260 | 9.80 | 37.83 | 47.63 | 61.43 | -13.80 | QP |
| 3 | 0.324 | 9.80 | 21.82 | 31.62 | 49.61 | -17.99 | Average |
| 4 | 0.324 | 9.80 | 33.35 | 43.15 | 59.61 | -16.46 | QP |
| 5 | 0.458 | 9.80 | 16.91 | 26.71 | 46.72 | -20.01 | Average |
| 6 | 0.458 | 9.80 | 29.73 | 39.53 | 56.72 | -17.19 | QP |
| 7 | 0.539 | 9.81 | 15.53 | 25.34 | 46.00 | -20.66 | Average |
| 8 | 0.539 | 9.81 | 26.37 | 36.18 | 56.00 | -19.82 | QP |
| 9 | 3.433 | 9.83 | 18.58 | 28.41 | 46.00 | -17.59 | Average |
| 10 | 3.433 | 9.83 | 28.52 | 38.35 | 56.00 | -17.65 | QP |
| 11 | 3.930 | 9.84 | 19.09 | 28.93 | 46.00 | -17.07 | Average |
| 12 | 3.930 | 9.84 | 29.91 | 39.75 | 56.00 | -16.25 | QP |
| 13 | 6.437 | 9.95 | 20.94 | 30.89 | 50.00 | -19.11 | Average |
| 14 | 6.437 | 9.95 | 28.94 | 38.89 | 60.00 | -21.11 | QP |

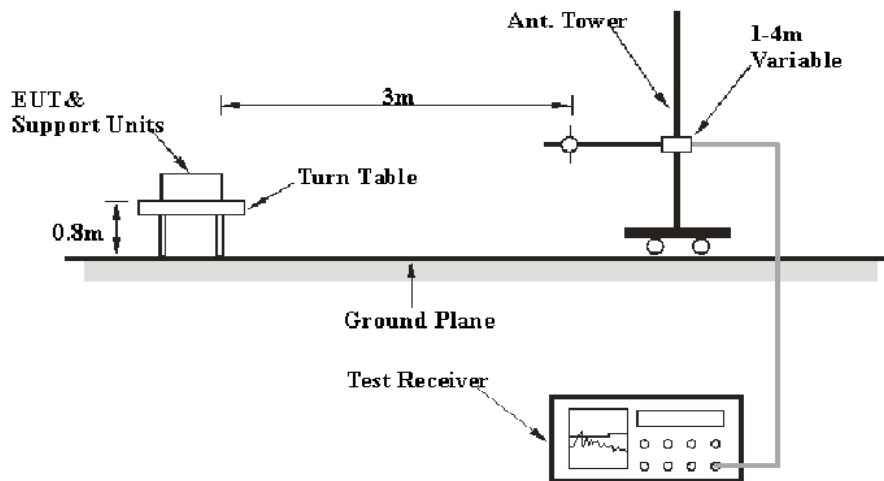
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

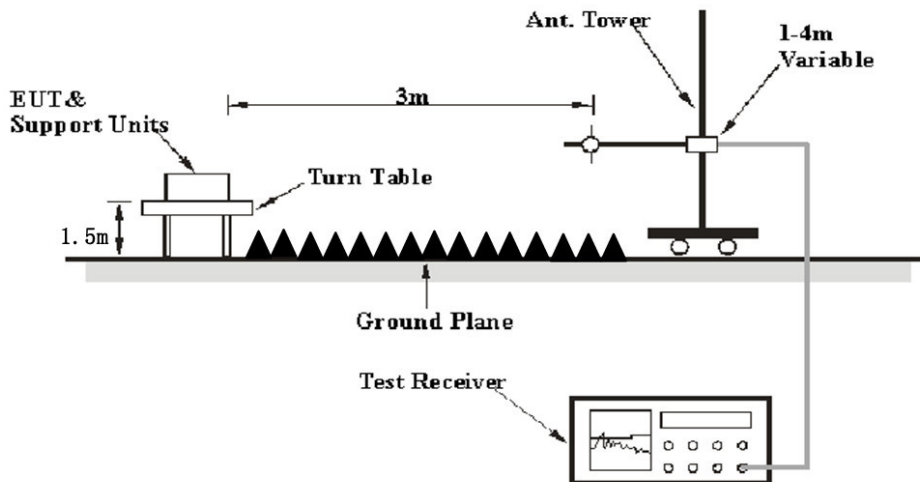
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

| Frequency Range | RBW | Video B/W | IF B/W | Measurement |
|-------------------|---------|-----------|---------|-------------|
| 30 MHz – 1000 MHz | 100 kHz | 300 kHz | 120 kHz | QP |
| Above 1 GHz | 1 MHz | 3 MHz | / | PK |
| | 1 MHz | 10 Hz | / | Average |

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Over Limit/Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

$$\begin{aligned} \text{Over Limit/Margin} &= \text{Level} / \text{Corrected Amplitude} - \text{Limit} \\ \text{Level} / \text{Corrected Amplitude} &= \text{Read Level} + \text{Factor} \end{aligned}$$

Test Data

Environmental Conditions

| | |
|---------------------------|-----------|
| Temperature: | 25~26.7°C |
| Relative Humidity: | 54~62 % |
| ATM Pressure: | 101.0 kPa |

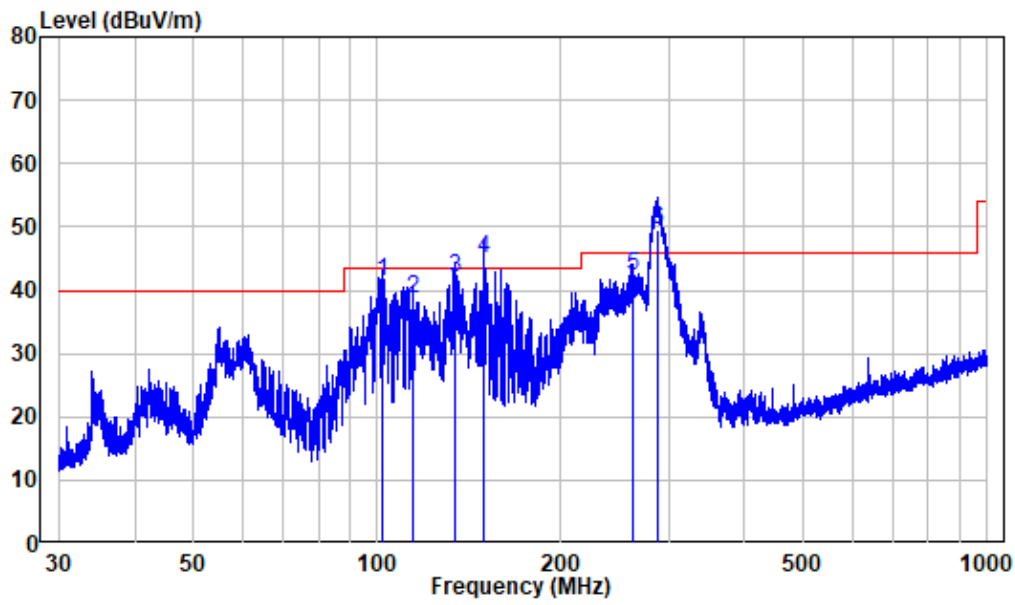
The testing was performed by Level Li on 2022-08-10 for below 1GHz, Zeki Ma 2022-08-05 for above 1GHz

EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case of orientation was recorded)

30 MHz~1 GHz: (worst case is low channel)

Note: when the test result of Peak was below the limit of QP more than 6dB, just the Peak value was recorded.

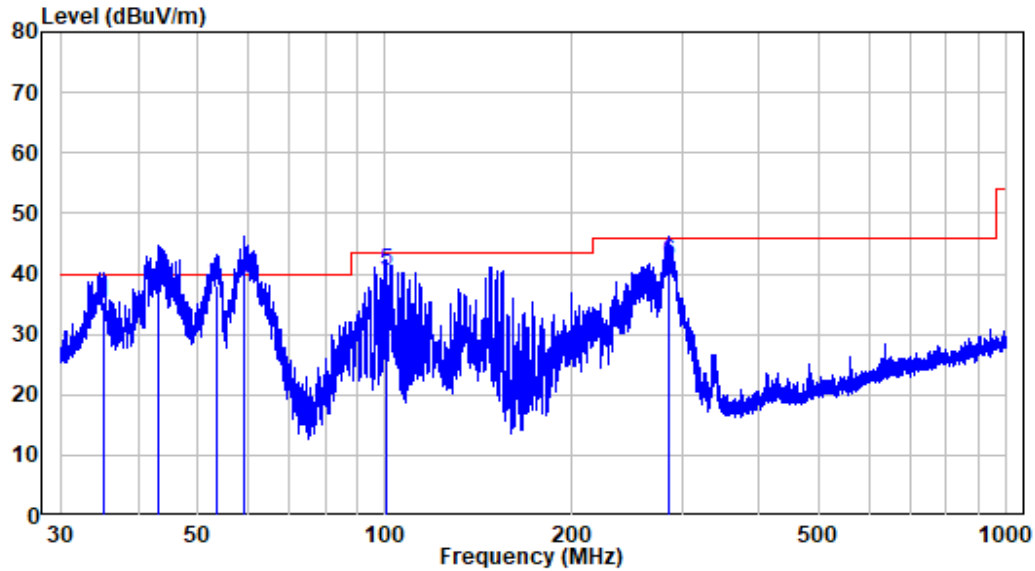
Horizontal:



Site : chamber
 Condition: 3m HORIZONTAL
 Job No. : SZNS220713-31703E-RF
 Test Mode: UHF

| | Freq | Factor | Read Level | Level | Limit | Over | Remark |
|---|---------|--------|------------|--------|--------|-------|--------|
| | MHz | dB/m | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 101.555 | -11.62 | 52.87 | 41.25 | 43.50 | -2.25 | QP |
| 2 | 114.314 | -12.63 | 51.17 | 38.54 | 43.50 | -4.96 | QP |
| 3 | 134.265 | -14.98 | 56.98 | 42.00 | 43.50 | -1.50 | QP |
| 4 | 149.551 | -15.29 | 60.22 | 44.93 | 43.50 | 1.43 | QP* |
| 5 | 262.896 | -10.51 | 52.66 | 42.15 | 46.00 | -3.85 | QP |
| 6 | 287.486 | -9.37 | 59.00 | 49.63 | 46.00 | 3.63 | QP* |

Vertical



Site : chamber
 Condition: 3m VERTICAL
 Job No. : SZNS220713-31703E-RF
 Test Mode: UHF

| | Freq | Factor | Read Level | Limit Level | Over Limit | Remark |
|---|---------|--------|------------|-------------|------------|----------|
| | MHz | dB/m | dBuV | dBuV/m | dBuV/m | dB |
| 1 | 35.128 | -11.50 | 46.90 | 35.40 | 40.00 | -4.60 QP |
| 2 | 43.259 | -9.94 | 47.30 | 37.36 | 40.00 | -2.64 QP |
| 3 | 53.388 | -10.24 | 48.21 | 37.97 | 40.00 | -2.03 QP |
| 4 | 59.258 | -10.35 | 49.60 | 39.25 | 40.00 | -0.75 QP |
| 5 | 100.229 | -11.78 | 52.09 | 40.31 | 43.50 | -3.19 QP |
| 6 | 286.103 | -9.42 | 51.47 | 42.05 | 46.00 | -3.95 QP |

Note *: The data recorded above represents the worst case for all supported operating modes, there were no spurious emission in the range 30MHz -1GHz over the limit in §15.209 caused by radio, the emission list at above table was investigated and was not caused by the radio, the emission was present when the radio was disabled. Those emissions comply with the FCC Part 15, Subpart B-Unintentional radiators §15.109(b) limit set for Class A digital device as the EUT is declared as a Class A equipment according the user manual.

Above 1 GHz:

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB) | Corrected Amplitude (dB μ V/m) | FCC Part 15.247/205/209 | |
|---------------------------------|----------------------|-----------------------|------------------|------------|-------------|-----------------------|------------------------------------|-------------------------|-------------|
| | Reading (dB μ V) | Detector (PK/QP/Ave.) | | Height (m) | Polar (H/V) | | | Limit (dB μ V/m) | Margin (dB) |
| Low Channel (917MHz) | | | | | | | | | |
| 1834 | 61.03 | PK | 128 | 1.1 | H | -8.50 | 52.53 | 74 | -21.47 |
| 1834 | 61.48 | PK | 201 | 1.1 | V | -8.50 | 52.98 | 74 | -21.02 |
| Middle Channel(919.6MHz) | | | | | | | | | |
| 1839.2 | 59.94 | PK | 36 | 1.4 | H | -8.46 | 51.48 | 74 | -22.52 |
| 1839.2 | 60.09 | PK | 171 | 1.4 | V | -8.46 | 51.63 | 74 | -22.37 |
| High Channel (922.2 MHz) | | | | | | | | | |
| 1844.4 | 60.26 | PK | 138 | 2.4 | H | -8.41 | 51.85 | 74 | -22.15 |
| 1844.4 | 60.71 | PK | 220 | 2.4 | V | -8.41 | 52.30 | 74 | -21.70 |

Simultaneous transmitting consideration (worst case):

| Frequency (MHz) | Receiver | | Turn-Table Angle Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dB μ V/m) | FCC Part 15.247 | |
|---|----------------------|---------------------|-------------------------|------------|---------------|-------------------------|------------------------------------|----------------------|-------------|
| | Reading (dB μ V) | Detector (PK/QP/AV) | | Height (m) | Polar (H / V) | | | Limit (dB μ V/m) | Margin (dB) |
| Worst case: 802.11b, high channel + UHF Low channel | | | | | | | | | |
| 1834 | 60.87 | PK | 212 | 1.5 | H | -8.5 | 52.37 | 74 | -21.63 |
| 1834 | 61.25 | PK | 153 | 1.4 | V | -8.5 | 52.75 | 74 | -21.25 |
| 4924 | 57.83 | PK | 21 | 1.5 | H | -3.16 | 54.67 | 74 | -19.33 |
| 4924 | 51.02 | AV | 21 | 1.5 | H | -3.16 | 47.86 | 54 | -6.14 |
| 4924 | 58.21 | PK | 308 | 1.3 | V | -3.16 | 55.05 | 74 | -18.95 |
| 4924 | 52.13 | AV | 308 | 1.3 | V | -3.16 | 48.97 | 54 | -5.03 |

Note:

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

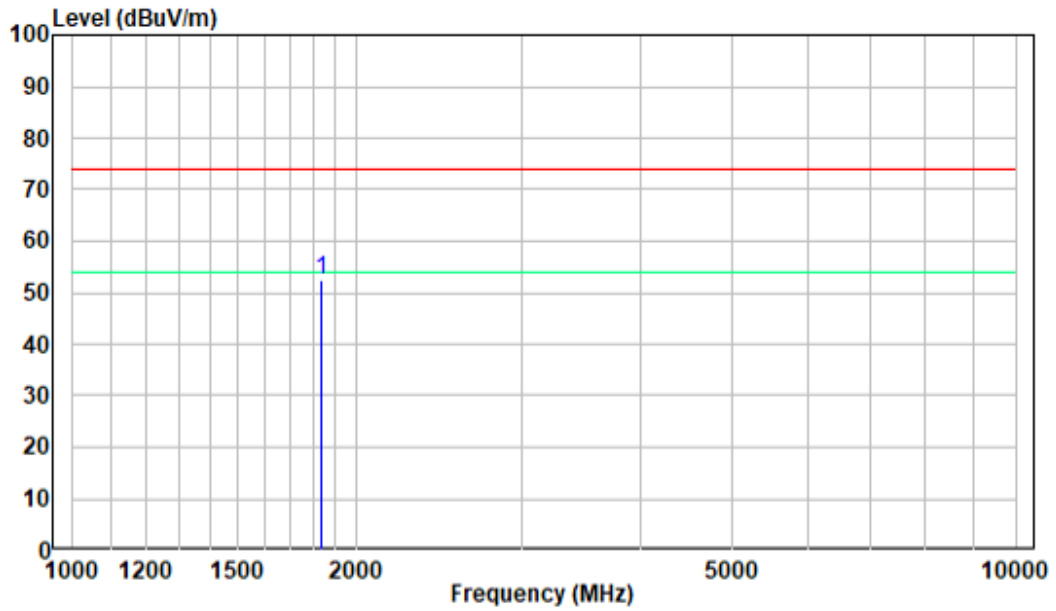
Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

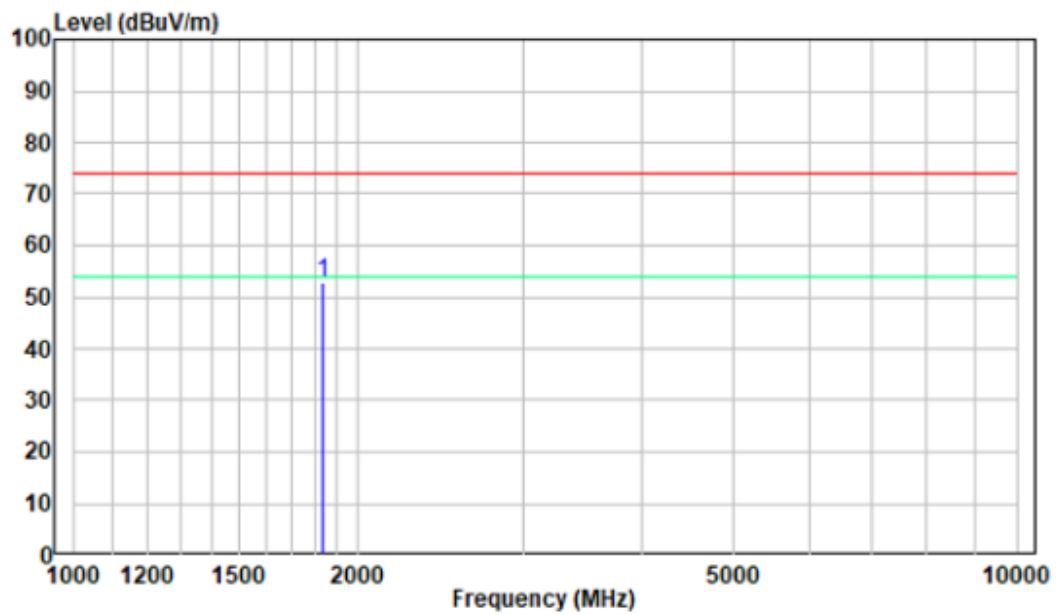
The other spurious emission which is 20dB to the limit or in the noise floor level was not recorded.

When the test result of Peak was below the limit of average, just the Peak value was recorded.

**Pre-scan with Low channel
Horizontal**



Vertical



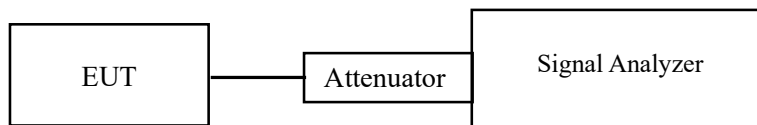
FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

Applicable Standard

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 Procedure

- c. Set the EUT in transmitting mode, maxhold the channel.
- d. Set the adjacent channel of the EUT and maxhold another trace.
- e. Measure the channel separation.



Test Data

Environmental Conditions

| | |
|---------------------------|---------|
| Temperature: | 26°C |
| Relative Humidity: | 54% |
| ATM Pressure: | 101 kPa |

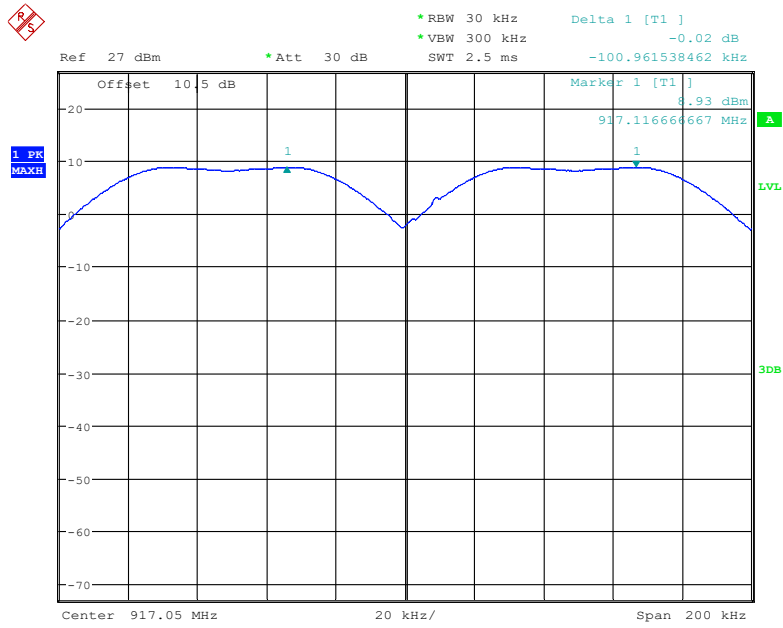
The testing was performed by Audy Yu on 2022-08-09.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots

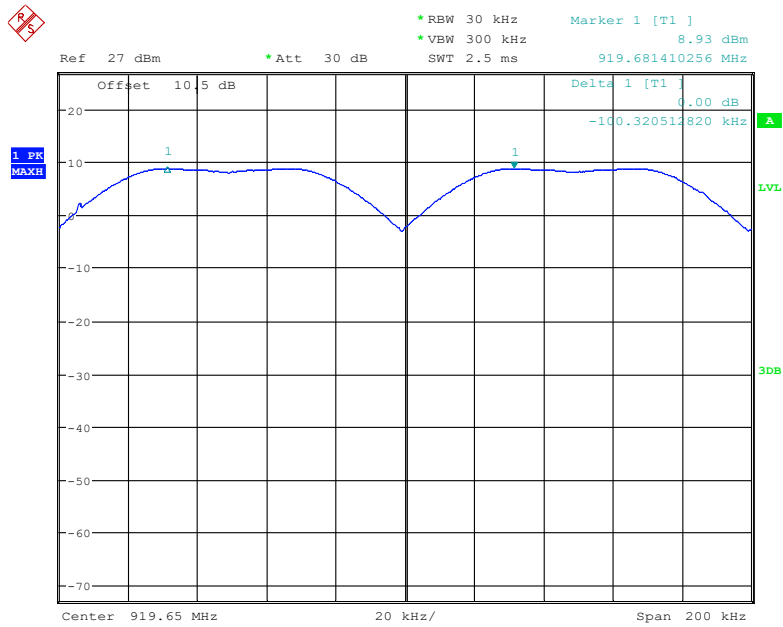
| Channel | Channel Separation (MHz) | 20 dB Emission Bandwidth (MHz) | Limit |
|---------|--------------------------|--------------------------------|-------------------|
| Low | 0.101 | 0.068 | > 20 dB bandwidth |
| Middle | 0.100 | 0.069 | > 20 dB bandwidth |
| High | 0.100 | 0.069 | > 20 dB bandwidth |

Low Channel



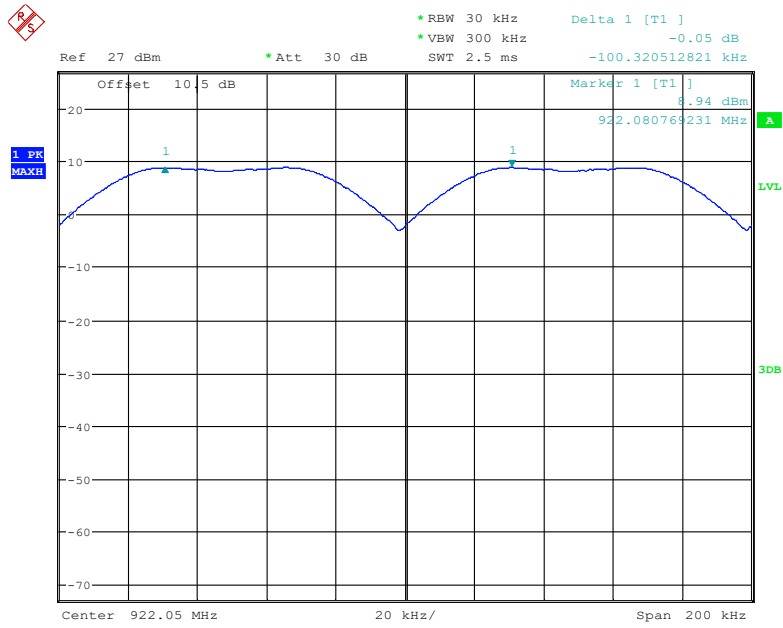
Date: 9.AUG.2022 19:10:11

Middle Channel



Date: 9.AUG.2022 19:12:33

High Channel



Date: 9.AUG.2022 19:14:13

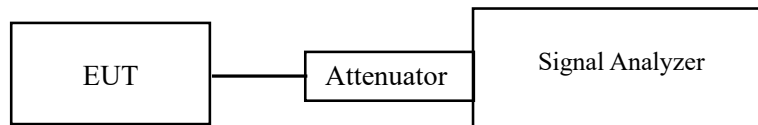
FCC §15.247(a) (1) (i) – 20 dB EMISSION BANDWIDTH

Applicable Standard

According to §15.247(a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy /on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Procedure

- f. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- g. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- h. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
- i. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

| | |
|---------------------------|---------|
| Temperature: | 26°C |
| Relative Humidity: | 54 % |
| ATM Pressure: | 101 kPa |

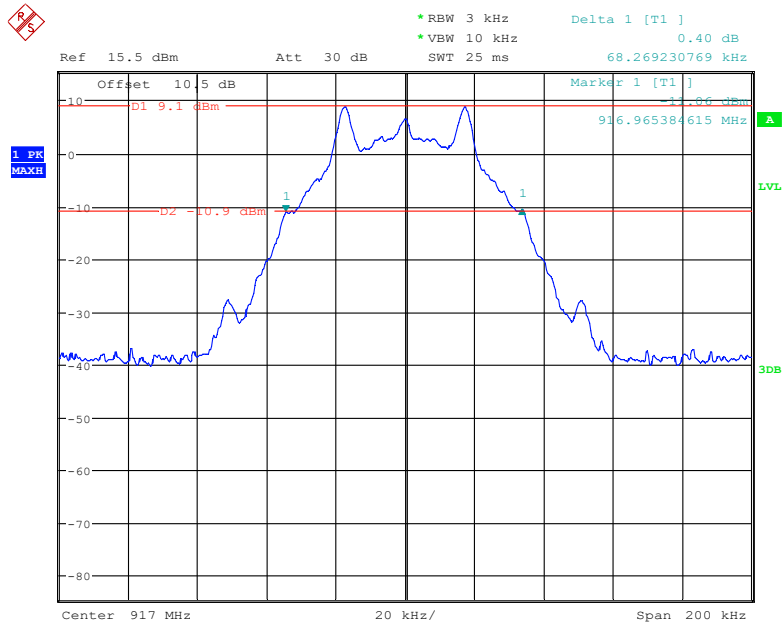
The testing was performed by Audy Yu on 2022-08-09.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

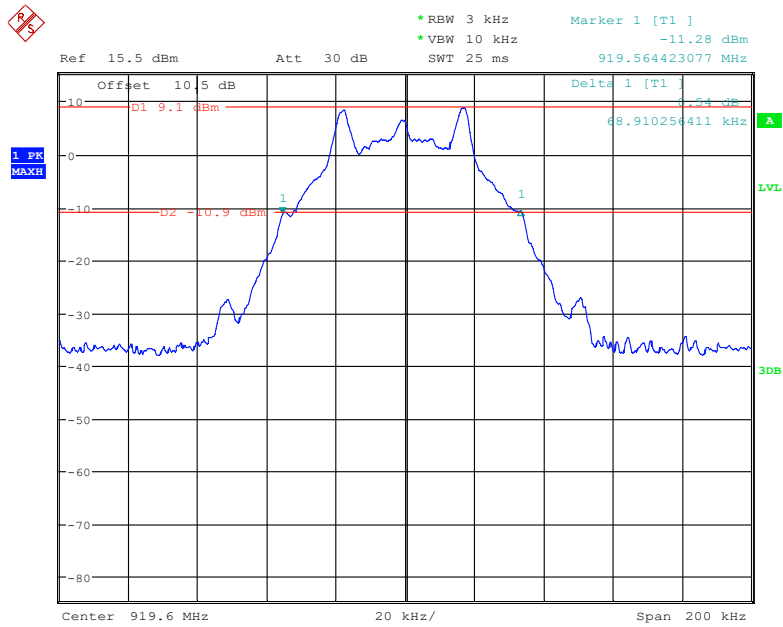
| Mode | Channel | Frequency (MHz) | 20 dB Emission Bandwidth (MHz) |
|------|---------|-----------------|--------------------------------|
| GFSK | Low | 917 | 0.068 |
| | Middle | 919.6 | 0.069 |
| | High | 922.2 | 0.069 |

Low Channel



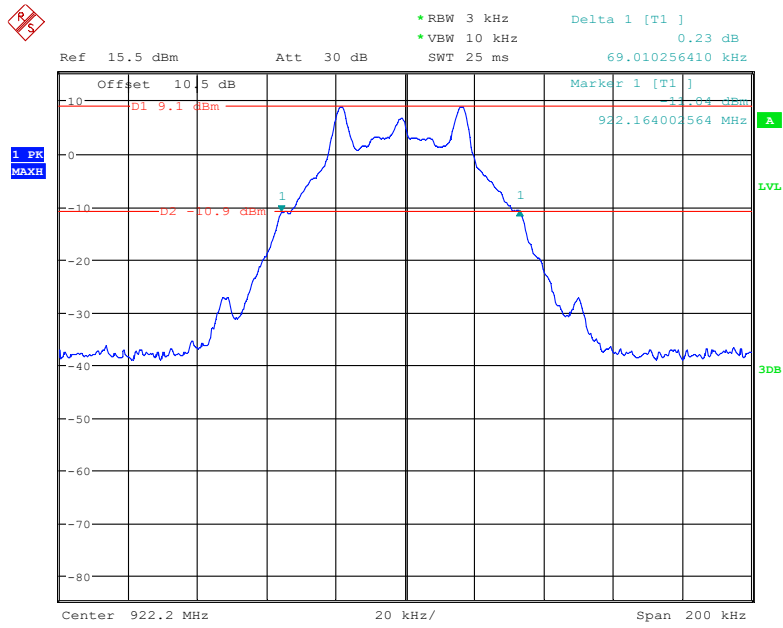
Date: 9.AUG.2022 18:48:34

Middle Channel



Date: 9.AUG.2022 18:47:01

High Channel



Date: 9.AUG.2022 18:42:05

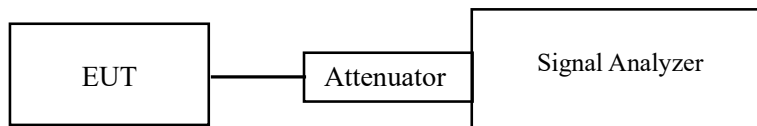
FCC §15.247(a) (1) (i)-QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

According to §15.247(a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Procedure

- j. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- k. Set the EUT in hopping mode from first channel to last.
- l. By using the max-hold function record the quantity of the channel.



Test Data

Environmental Conditions

| | |
|---------------------------|---------|
| Temperature: | 26°C |
| Relative Humidity: | 54 % |
| ATM Pressure: | 101 kPa |

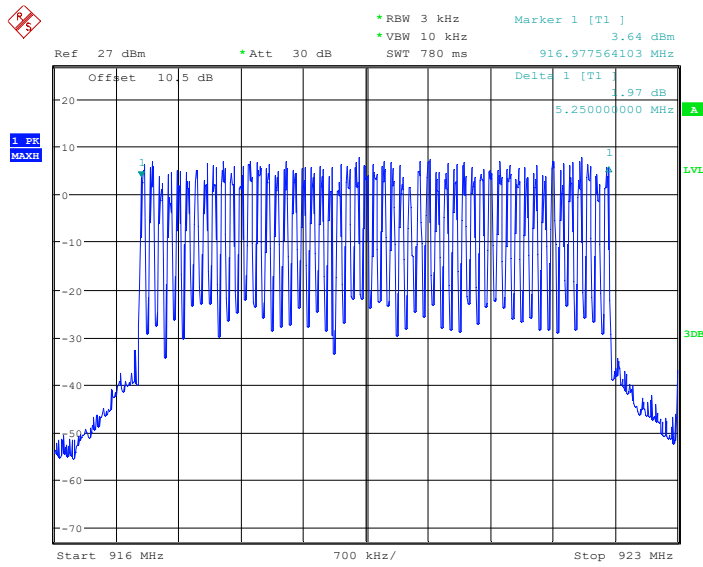
The testing was performed by Audy Yu on 2022-08-09.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

| Mode | Frequency Range (MHz) | Number of Hopping Channel (CH) | Limit (CH) |
|------|-----------------------|--------------------------------|------------|
| GFSK | 902-928 | 53 | ≥50 |

Number of Hopping Channels



Date: 9.AUG.2022 19:30:44

FCC §15.247(a) (1) (i) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

According to §15.247(a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Procedure

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

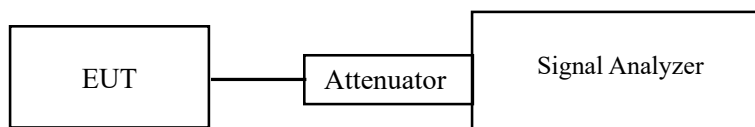
- a) Span: Zero span, centered on a hopping channel.
- b) RBW shall be \leq channel spacing and where possible RBW should be set $\gg 1 / T$, where T is the expected dwell time per channel.
- c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger 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.

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.

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:

$$\begin{aligned} & \text{(Number of hops in the period specified in the requirements)} = \\ & \text{(number of hops on spectrum analyzer)} \times \text{(period specified in the requirements / analyzer sweep time)} \end{aligned}$$

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.



Test Data**Environmental Conditions**

| | |
|---------------------------|---------|
| Temperature: | 26°C |
| Relative Humidity: | 54 % |
| ATM Pressure: | 101 kPa |

The testing was performed by Audy Yu on 2022-08-09.

EUT operation mode: Transmitting

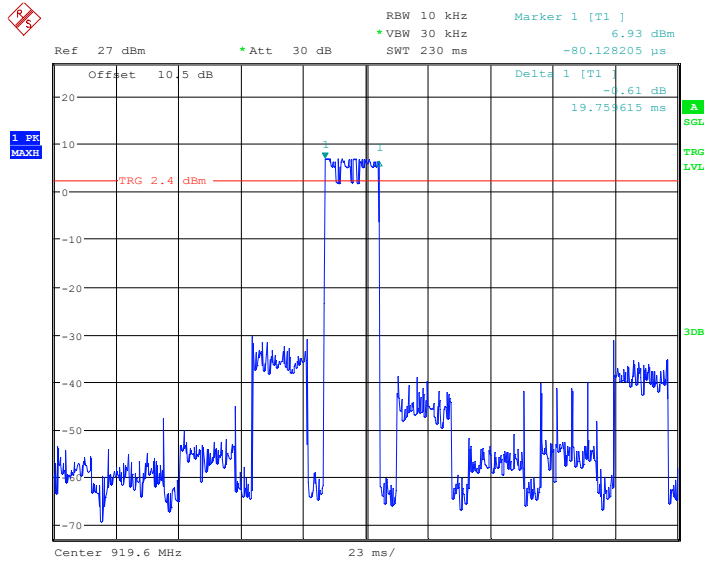
Test Result: Compliance. Please refer to following table and plots.

| Frequency (MHz) | Pulse Time (ms) | Hops | Period Time (s) | Dwell Time (ms) | Limit (ms) | Result |
|------------------------|------------------------|-------------|------------------------|------------------------|-------------------|---------------|
| 919.6 | 19.76 | 15 | 20 | 296.4 | <400 | Pass |

Note 1: A period time=20(S), Dwell time=Pulse time*Hops

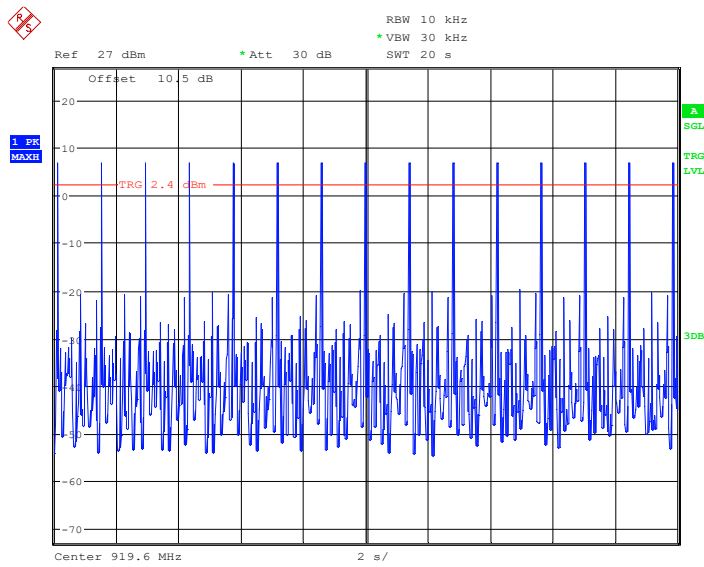
Note 2: Second high signals were other channel

Pulse time



Date: 9.AUG.2022 19:20:14

Hops



Date: 9.AUG.2022 19:22:20

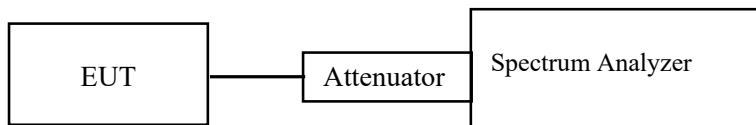
FCC §15.247(b) (2) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (2), For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Test Procedure

- m. Place the EUT on a bench and set it in transmitting mode.
- n. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
- o. Add a correction factor to the display.



Test Data

Environmental Conditions

| | |
|---------------------------|---------|
| Temperature: | 26°C |
| Relative Humidity: | 54 % |
| ATM Pressure: | 101 kPa |

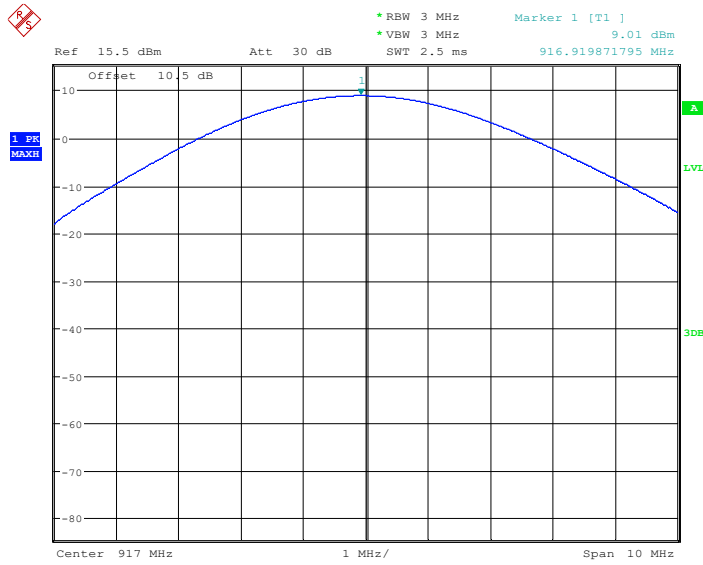
The testing was performed by Audy Yu on 2022-08-09.

Test Result: Compliance. Please refer to following table and plots.

EUT operation mode: Transmitting

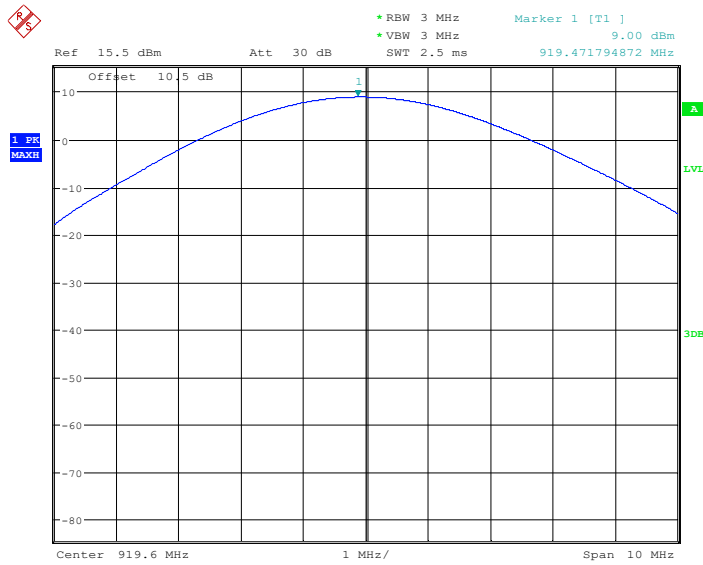
| Channel | Frequency (MHz) | Peak Output Power | Limit (dBm) |
|---------|-----------------|-------------------|-------------|
| | | (dBm) | |
| Low | 917 | 9.01 | 30 |
| Middle | 919.6 | 9.00 | 30 |
| High | 922.2 | 9.01 | 30 |

Low Channel



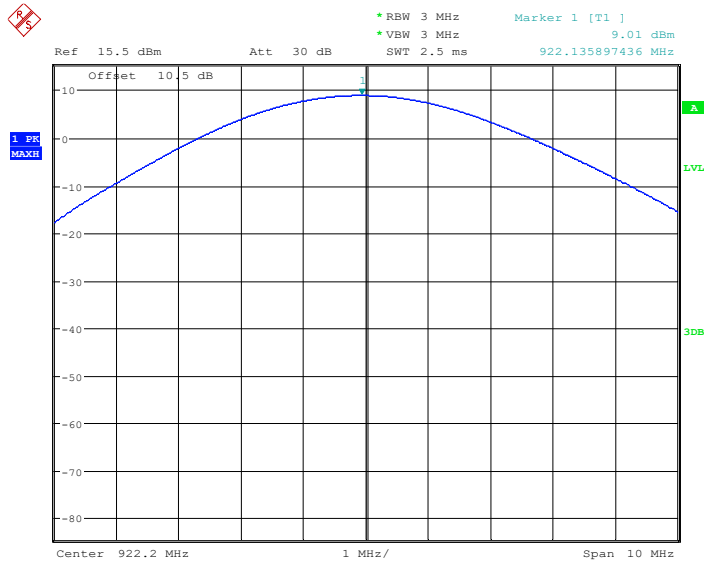
Date: 9.AUG.2022 18:33:55

Middle Channel



Date: 9.AUG.2022 18:32:39

High Channel



Date: 9.AUG.2022 18:35:12

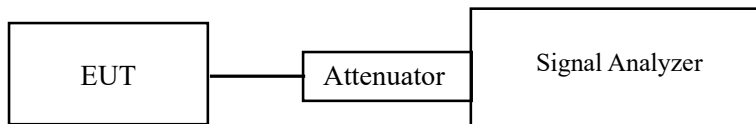
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

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. 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 Procedure

- p. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- q. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- r. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- s. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- t. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

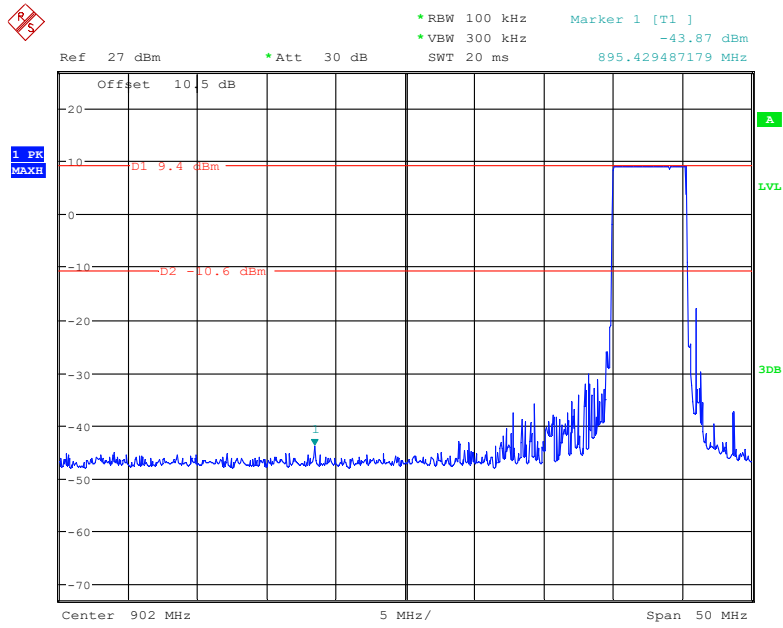
| | |
|---------------------------|---------|
| Temperature: | 26°C |
| Relative Humidity: | 54 % |
| ATM Pressure: | 101 kPa |

The testing was performed by Audy Yu on 2022-08-09.

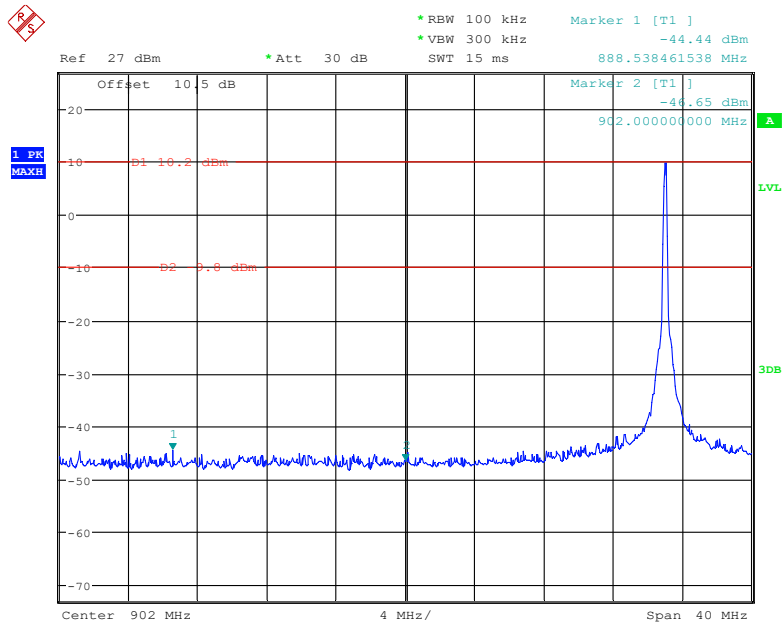
Test Result: Compliance. Please refer to following plots.

EUT operation mode: Transmitting

Band Edge, Left Side

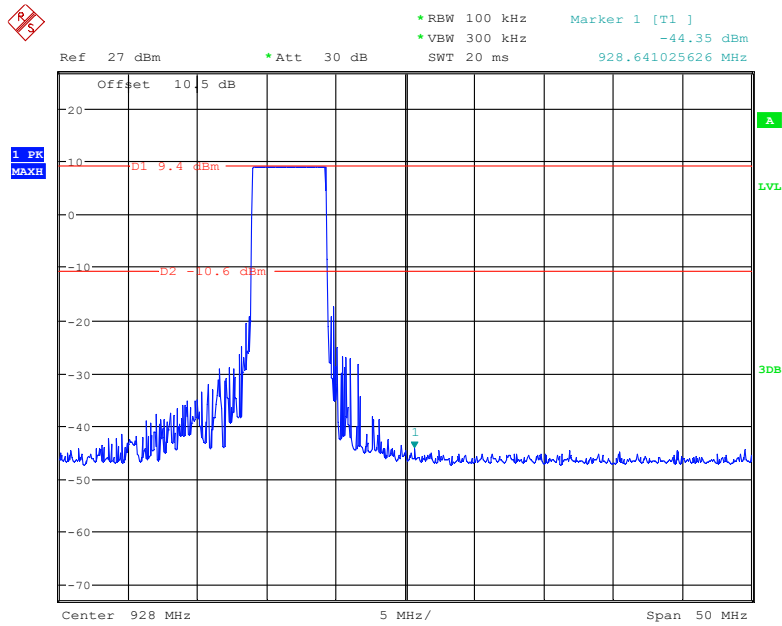


Date: 9.AUG.2022 19:07:15

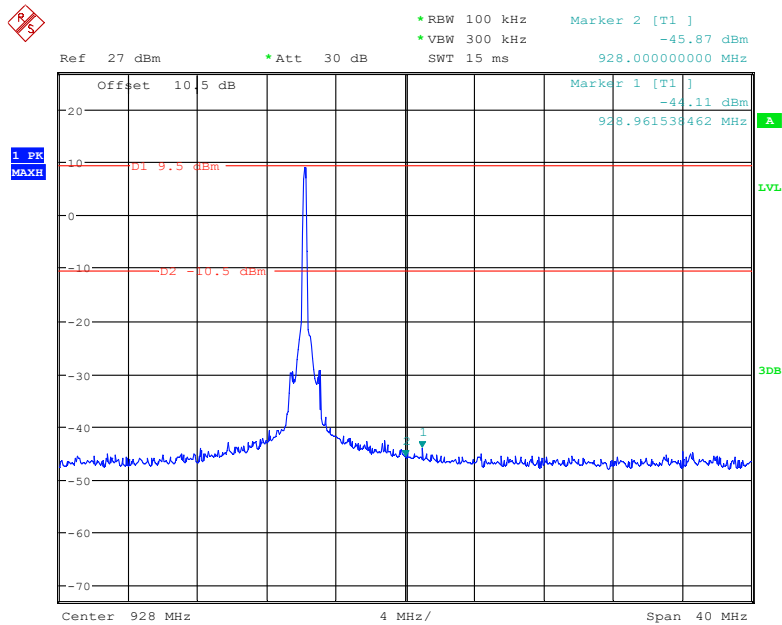


Date: 9.AUG.2022 18:56:27

Band Edge, Right Side



Date: 9.AUG.2022 19:05:43



Date: 9.AUG.2022 18:59:54

**** END OF REPORT ****