



**中认信通**

CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)



# TEST REPORT

**Applicant:** Hangzhou Hylin IoT Technology Co.,Ltd.

**Address:** No.80 Pingshui West Road, xihu District, Hangzhou, China

**FCC ID:** 2A4G5-HLM9S82

**Product Name:** LoRa SPI Module

**Standard(s):** 47 CFR Part 15, Subpart C(15.247)

ANSI C63.10-2013

KDB 558074 D01 15.247 Meas Guidance v05r02

The above equipment has been tested and found compliant with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

**Report Number:** CR230205016-00

**Date Of Issue:** 2023/06/28

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## Test Facility

The Test site used by China Certification ICT Co., Ltd (Dongguan) to collect test data is located on the No. 113, Pingkang Road, Dalang Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 442868, the FCC Designation No. : CN1314.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0123.

## Declarations

China Certification ICT Co., Ltd (Dongguan) 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 a triangle symbol “▲”. Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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## CONTENTS

|                                                              |    |
|--------------------------------------------------------------|----|
| TEST FACILITY .....                                          | 2  |
| DECLARATIONS.....                                            | 2  |
| DOCUMENT REVISION HISTORY .....                              | 5  |
| 1. GENERAL INFORMATION .....                                 | 6  |
| 1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) ..... | 6  |
| 1.2 DESCRIPTION OF TEST CONFIGURATION.....                   | 8  |
| 1.2.1 EUT Operation Condition:.....                          | 8  |
| 1.2.2 Support Equipment List and Details .....               | 8  |
| 1.2.3 Support Cable List and Details .....                   | 8  |
| 1.2.4 Block Diagram of Test Setup.....                       | 9  |
| 1.3 MEASUREMENT UNCERTAINTY .....                            | 10 |
| 2. SUMMARY OF TEST RESULTS .....                             | 11 |
| 3. REQUIREMENTS AND TEST PROCEDURES .....                    | 12 |
| 3.1 AC LINE CONDUCTED EMISSIONS.....                         | 12 |
| 3.1.1 Applicable Standard.....                               | 12 |
| 3.1.2 EUT Setup.....                                         | 13 |
| 3.1.3 EMI Test Receiver Setup .....                          | 13 |
| 3.1.4 Test Procedure .....                                   | 14 |
| 3.1.5 Corrected Amplitude & Margin Calculation.....          | 14 |
| 3.2 RADIATION SPURIOUS EMISSIONS .....                       | 15 |
| 3.2.1 Applicable Standard.....                               | 15 |
| 3.2.2 EUT Setup.....                                         | 15 |
| 3.2.3 EMI Test Receiver & Spectrum Analyzer Setup .....      | 16 |
| 3.2.4 Test Procedure .....                                   | 16 |
| 3.2.5 Corrected Amplitude & Margin Calculation.....          | 16 |
| 3.3 20 DB BANDWIDTH.....                                     | 17 |
| 3.3.1 Applicable Standard.....                               | 17 |
| 3.3.2 EUT Setup.....                                         | 17 |
| 3.3.3 Test Procedure .....                                   | 17 |
| 3.4 CHANNEL SEPARATION .....                                 | 19 |
| 3.4.1 Applicable Standard.....                               | 19 |
| 3.4.2 EUT Setup.....                                         | 19 |
| 3.4.3 Test Procedure .....                                   | 19 |
| 3.5 NUMBER OF HOPPING FREQUENCY .....                        | 20 |
| 3.5.1 Applicable Standard.....                               | 20 |
| 3.5.2 EUT Setup.....                                         | 20 |
| 3.5.3 Test Procedure .....                                   | 20 |
| 3.6 TIME OF OCCUPANCY (DWELL TIME) .....                     | 21 |
| 3.6.1 Applicable Standard.....                               | 21 |
| 3.6.2 EUT Setup.....                                         | 21 |
| 3.6.3 Test Procedure .....                                   | 21 |

|                                                            |           |
|------------------------------------------------------------|-----------|
| <b>3.7 MAXIMUM CONDUCTED OUTPUT POWER.....</b>             | <b>23</b> |
| 3.7.1 Applicable Standard.....                             | 23        |
| 3.7.2 EUT Setup.....                                       | 23        |
| 3.7.3 Test Procedure .....                                 | 23        |
| <b>3.8 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE.....</b>   | <b>24</b> |
| 3.8.1 Applicable Standard.....                             | 24        |
| 3.8.2 EUT Setup.....                                       | 24        |
| 3.8.3 Test Procedure .....                                 | 24        |
| <b>3.9 ANTENNA REQUIREMENT.....</b>                        | <b>25</b> |
| 3.9.1 Applicable Standard.....                             | 25        |
| 3.9.2 Judgment.....                                        | 25        |
| <b>4. TEST DATA AND RESULTS .....</b>                      | <b>26</b> |
| <b>4.1 AC LINE CONDUCTED EMISSIONS.....</b>                | <b>26</b> |
| <b>4.2 RADIATION SPURIOUS EMISSIONS.....</b>               | <b>29</b> |
| <b>4.3 20 dB EMISSION BANDWIDTH: .....</b>                 | <b>35</b> |
| <b>4.4 CHANNEL SEPARATION: .....</b>                       | <b>37</b> |
| <b>4.5 NUMBER OF HOPPING FREQUENCY: .....</b>              | <b>39</b> |
| <b>4.6 TIME OF OCCUPANCY (DWELL TIME):.....</b>            | <b>41</b> |
| <b>4.7 MAXIMUM CONDUCTED OUTPUT POWER: .....</b>           | <b>43</b> |
| <b>4.8 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE: .....</b> | <b>44</b> |
| <b>5. RF EXPOSURE EVALUATION .....</b>                     | <b>47</b> |
| <b>5.1 APPLICABLE STANDARD.....</b>                        | <b>47</b> |
| <b>5. 2 PROCEDURE.....</b>                                 | <b>47</b> |
| <b>5.3 MEASUREMENT RESULT .....</b>                        | <b>47</b> |

**DOCUMENT REVISION HISTORY**

| Revision Number | Report Number  | Description of Revision | Date of Revision |
|-----------------|----------------|-------------------------|------------------|
| 1.0             | CR230205016-00 | Original Report         | 2023/06/19       |
| 2.0             | CR230205016-00 | Update Section 4.3      | 2023/06/28       |

## 1. GENERAL INFORMATION

### 1.1 Product Description for Equipment under Test (EUT)

|                                               |                 |
|-----------------------------------------------|-----------------|
| <b>EUT Name:</b>                              | LoRa SPI Module |
| <b>EUT Model:</b>                             | HLM9S82         |
| <b>Operation Frequency:</b>                   | 902.3-927.7 MHz |
| <b>Maximum Peak Output Power (Conducted):</b> | 22.10 dBm       |
| <b>Modulation Type:</b>                       | CSS             |
| <b>Rated Input Voltage:</b>                   | 3.3Vdc          |
| <b>Serial Number:</b>                         | 20A7_7          |
| <b>EUT Received Date:</b>                     | 2023/3/7        |
| <b>EUT Received Status:</b>                   | Good            |

#### Operation Frequency Detail:

| Channel                                                                       | Frequency (MHz) | Channel         | Frequency (MHz) |
|-------------------------------------------------------------------------------|-----------------|-----------------|-----------------|
| 1                                                                             | 902.3           | 65              | 915.1           |
| 2                                                                             | 902.5           | 66              | 915.3           |
| ...                                                                           | ...             | ...             | ...             |
| ...                                                                           | ...             | ...             | ...             |
| ...                                                                           | ...             | 126             | 927.3           |
| 63                                                                            | 914.7           | 127             | 927.5           |
| 64                                                                            | 914.9           | 128             | 927.7           |
| Per section 15.31(m), the below frequencies were performed the test as below: |                 |                 |                 |
| Test Channel                                                                  |                 | Frequency (MHz) |                 |
| Lowest                                                                        |                 | 902.3           |                 |
| Middle                                                                        |                 | 914.9           |                 |
| Highest                                                                       |                 | 927.7           |                 |

**Antenna Information Detail▲:**

| Antenna Type                                                                                                                                                                                                                                                                                                                                                                                     | input impedance<br>(Ohm) | Frequency Range | Antenna Gain |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------|--------------|
| Dipole                                                                                                                                                                                                                                                                                                                                                                                           | 50                       | 902-928MHz      | 1.03dBi      |
| The Method of §15.203 Compliance:<br><input type="checkbox"/> Antenna must be permanently attached to the unit.<br><input checked="" type="checkbox"/> Antenna must use a unique type of connector to attach to the EUT.<br><input type="checkbox"/> Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit. |                          |                 |              |

**Accessory Information:**

NO.

## 1.2 Description of Test Configuration

### 1.2.1 EUT Operation Condition:

|                                                                                                                                |                                                                                                    |        |         |
|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------|---------|
| <b>EUT Operation Mode:</b>                                                                                                     | The system was configured for testing in Engineering Mode, which was provided by the manufacturer. |        |         |
| <b>Equipment Modifications:</b>                                                                                                | No                                                                                                 |        |         |
| <b>EUT Exercise Software:</b>                                                                                                  | secureCRTPortable.exe                                                                              |        |         |
| The software was provided by manufacturer. The maximum power was configured as below, that was provided by the manufacturer▲ : |                                                                                                    |        |         |
| Test Modes                                                                                                                     | Power Level Setting                                                                                |        |         |
|                                                                                                                                | Lowest                                                                                             | Middle | Highest |
| CSS                                                                                                                            | 22                                                                                                 | 22     | 22      |

### 1.2.2 Support Equipment List and Details

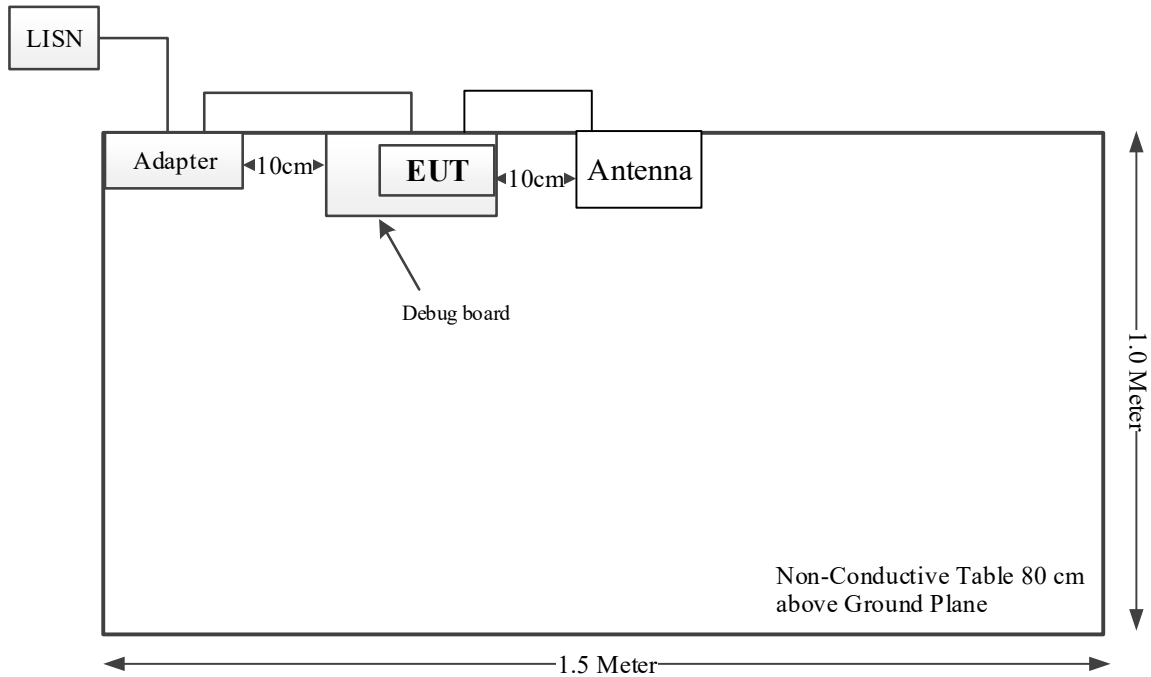
| Manufacturer                                        | Description | Model                     | Serial Number |
|-----------------------------------------------------|-------------|---------------------------|---------------|
| DONG GUAN<br>ORIENTAL.HERO<br>ELECTRICAL<br>FACTORY | AC ADAPTER  | OH-<br>1015A0502000U4U-UL | E230965       |
| unknown                                             | Debug Board | unknown                   | unknown       |

### 1.2.3 Support Cable List and Details

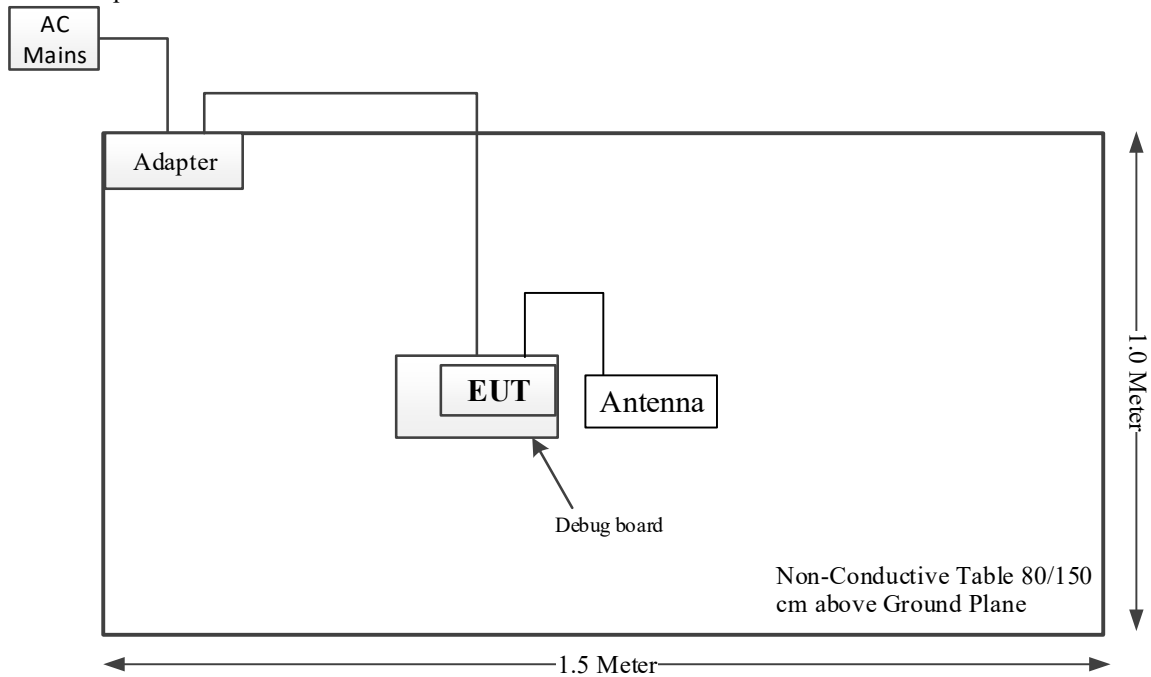
| Cable Description | Shielding Type | Ferrite Core | Length (m) | From Port   | To      |
|-------------------|----------------|--------------|------------|-------------|---------|
| USB Cable         | No             | No           | 0.8        | Debug Board | Adapter |

### 1.2.4 Block Diagram of Test Setup

AC line conducted emissions



Radiated spurious emissions



### 1.3 Measurement Uncertainty

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

| Parameter                         | Measurement Uncertainty                                                                                           |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Occupied Channel Bandwidth        | ±5 %                                                                                                              |
| RF output power, conducted        | ±0.61dB                                                                                                           |
| Power Spectral Density, conducted | ±0.61 dB                                                                                                          |
| Unwanted Emissions, radiated      | 30M~200MHz: 4.15 dB,200M~1GHz: 5.61 dB,1G~6GHz: 5.14 dB,<br>6G~18GHz: 5.93 dB,18G~26.5G:5.47 dB,26.5G~40G:5.63 dB |
| Unwanted Emissions, conducted     | ±1.26 dB                                                                                                          |
| Temperature                       | ±1℃                                                                                                               |
| Humidity                          | ±5%                                                                                                               |
| DC and low frequency voltages     | ±0.4%                                                                                                             |
| Duty Cycle                        | 1%                                                                                                                |
| AC Power Lines Conducted Emission | 2.8 dB (150 kHz to 30 MHz)                                                                                        |

## 2. SUMMARY OF TEST RESULTS

| FCC Rules                             | Description of Test            | Result    |
|---------------------------------------|--------------------------------|-----------|
| FCC §15.207(a)                        | AC line conducted emissions    | Compliant |
| FCC §15.205, §15.209,<br>§15.247(d)   | Radiated Spurious emissions    | Compliant |
| FCC §15.247(a)(1)                     | 20 dB bandwidth                | Compliant |
| FCC §15.247(a)(1)                     | Channel separation             | Compliant |
| FCC §15.247(a)(1)(i)                  | Number of hopping Frequency    | Compliant |
| FCC §15.247(a)(1)(i)                  | Time of occupancy (dwell time) | Compliant |
| FCC §15.247(b)(2)                     | Maximum Conducted Output Power | Compliant |
| FCC §15.247(d)                        | Band edges                     | Compliant |
| FCC §15.203                           | Antenna requirement            | Compliant |
| FCC§15.247 (i) & §1.1307 &<br>§2.1091 | RF Exposure Evaluation         | Compliant |

### 3. REQUIREMENTS AND TEST PROCEDURES

#### 3.1 AC Line Conducted Emissions

##### 3.1.1 Applicable Standard

FCC§15.207(a).

(a) 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  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of emission (MHz) | Conducted limit (dB $\mu$ 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.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

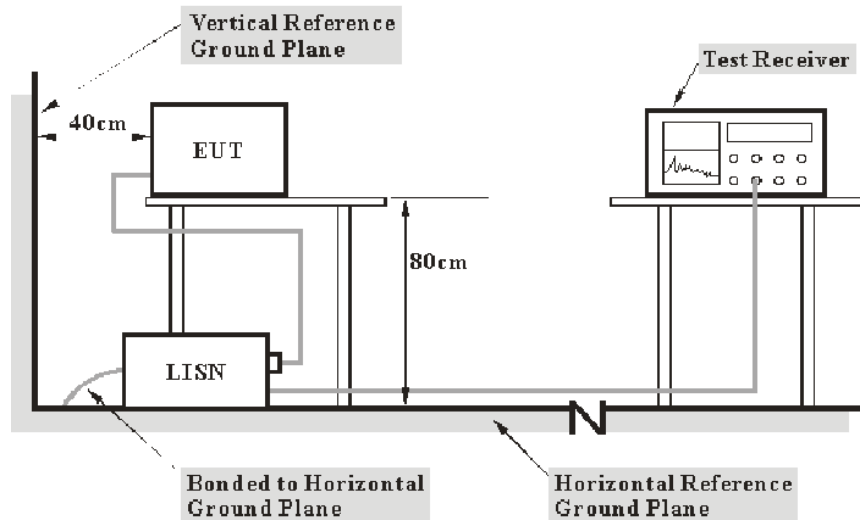
(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000  $\mu$ V within the frequency band 535-1705 kHz, as measured using a 50  $\mu$ H/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

### 3.1.2 EUT Setup



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

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

The adapter or EUT was connected to the main LISN with a 120 V/60 Hz AC power source.

### 3.1.3 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  |

### 3.1.4 Test Procedure

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase (“hot”) line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

### 3.1.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

Result = Reading + Factor

Factor = attenuation caused by cable loss + voltage division factor of AMN

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. The equation for margin calculation is as follows:

Margin = Limit – Result

## 3.2 Radiation Spurious Emissions

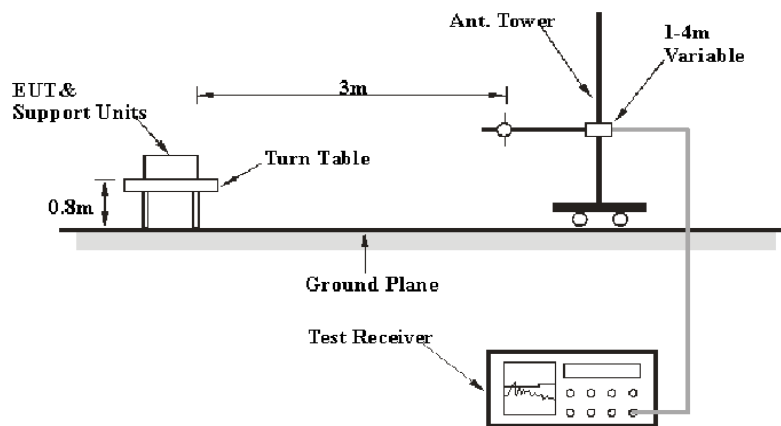
### 3.2.1 Applicable Standard

FCC §15.247 (d);

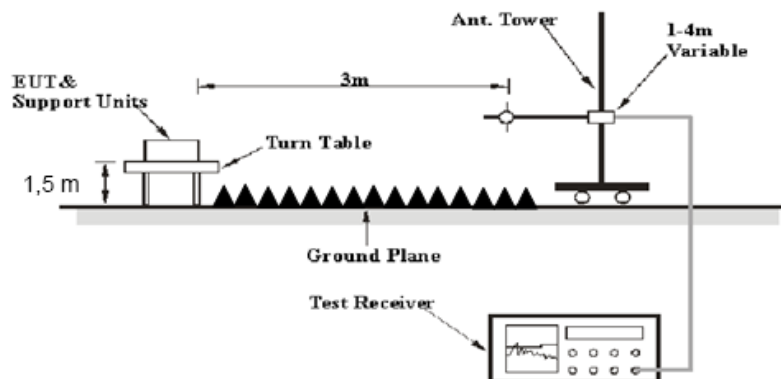
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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)).

### 3.2.2 EUT Setup

**Below 1GHz:**



**Above 1GHz:**



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

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

### 3.2.3 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 | 120 kHz | 300 kHz   | 120 kHz | QP          |
| Above 1 GHz       | 1MHz    | 3 MHz     | /       | PK          |
|                   | 1MHz    | 10 Hz     | /       | AV          |

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

### 3.2.4 Test Procedure

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

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

### 3.2.5 Corrected Amplitude & Margin Calculation

The basic equation is as follows:

Result = Reading + Factor

Factor = Antenna Factor + Cable Loss- Amplifier Gain

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. The equation for margin calculation is as follows:

Margin = Limit – Result

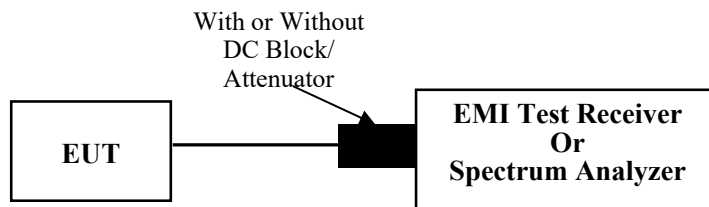
### 3.3 20 dB Bandwidth

#### 3.3.1 Applicable Standard

FCC §15.247 (a)(1)

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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

#### 3.3.2 EUT Setup



#### 3.3.3 Test Procedure

According to ANSI C63.10-2013 Section 6.9.2

- 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.
- 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.
- 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
- d) Steps a) through c) might require iteration to adjust within the specified tolerances.
- 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.
- f) Set detection mode to peak and trace mode to max hold.
- 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).
- 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.
- 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).

- 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.
- 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).

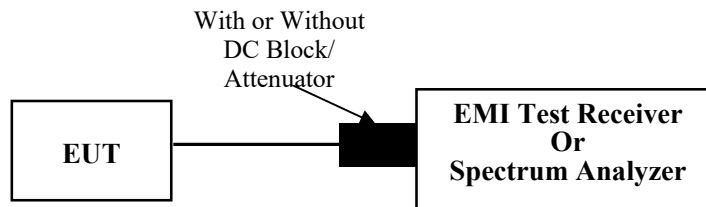
### 3.4 Channel Separation

#### 3.4.1 Applicable Standard

FCC §15.247 (a)(1)

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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

#### 3.4.2 EUT Setup



#### 3.4.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.2

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

- 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.

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.

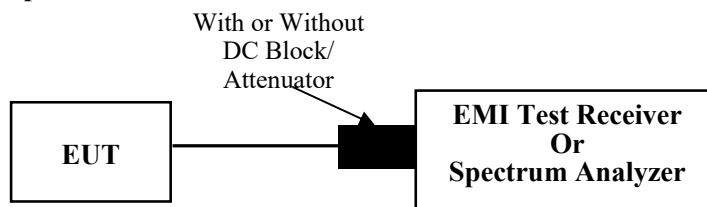
### 3.5 Number Of Hopping Frequency

#### 3.5.1 Applicable Standard

FCC §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.

#### 3.5.2 EUT Setup



#### 3.5.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.3

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

- 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

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.

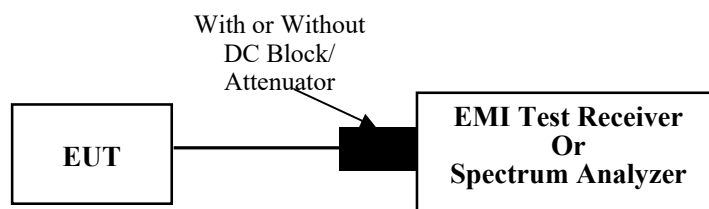
### 3.6 Time Of Occupancy (Dwell Time)

#### 3.6.1 Applicable Standard

FCC §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.

#### 3.6.2 EUT Setup



#### 3.6.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.4

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

- Span: Zero span, centered on a hopping channel.
- 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.
- 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.
- Detector function: Peak.
- 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:

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

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.

The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

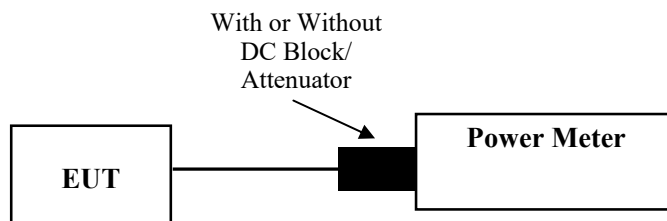
### 3.7 Maximum Conducted Output Power

#### 3.7.1 Applicable Standard

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.

#### 3.7.2 EUT Setup



#### 3.7.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.5

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:

- a) Use the following spectrum analyzer settings:
  - 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.
- b) Allow trace to stabilize.
- c) Use the marker-to-peak function to set the marker to the peak of the emission.
- d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
- e) A plot of the test results and setup description shall be included in the test report.

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.

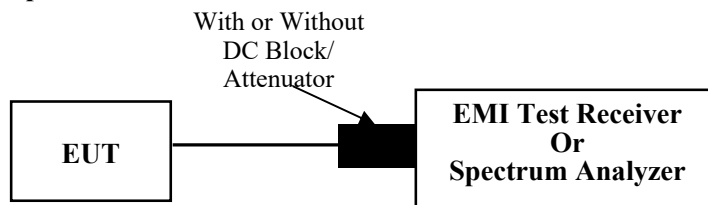
### 3.8 100 kHz Bandwidth of Frequency Band Edge

#### 3.8.1 Applicable Standard

FCC §15.247 (d);

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)).

#### 3.8.2 EUT Setup



#### 3.8.3 Test Procedure

According to ANSI C63.10-2013 Section 7.8.6

For band-edge measurements, use the band-edge procedure in 6.10. Band-edge measurements shall be tested both on single channels, and with the EUT hopping.

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100 kHz.
- c) Set the VBW  $\geq [3 \times \text{RBW}]$ .
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements. Report the three highest emissions relative to the limit.

### **3.9 Antenna Requirement**

#### **3.9.1 Applicable Standard**

FCC §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 use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

#### **3.9.2 Judgment**

**Compliant.** Please refer to the Antenna Information detail in Section 1.

## 4. TEST DATA AND RESULTS

### 4.1 AC Line Conducted Emissions

|                |        |              |                                      |
|----------------|--------|--------------|--------------------------------------|
| Serial Number: | 20A7_7 | Test Date:   | 2023/3/23                            |
| Test Site:     | CE     | Test Mode:   | Transmitting (Low channel was worst) |
| Tester:        | Vic Du | Test Result: | Pass                                 |

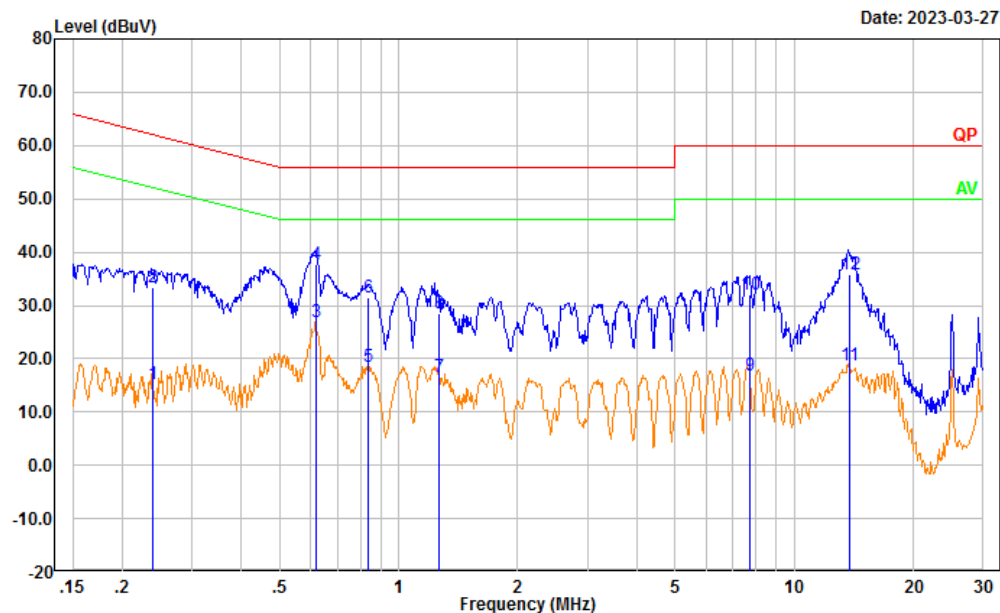
|                                  |      |                              |    |                        |       |
|----------------------------------|------|------------------------------|----|------------------------|-------|
| <b>Environmental Conditions:</b> |      |                              |    |                        |       |
| Temperature:<br>(°C)             | 24.6 | Relative<br>Humidity:<br>(%) | 62 | ATM Pressure:<br>(kPa) | 100.4 |

### Test Equipment List and Details:

| Manufacturer | Description       | Model   | Serial Number | Calibration Date | Calibration Due Date |
|--------------|-------------------|---------|---------------|------------------|----------------------|
| R&S          | LISN              | ENV216  | 101134        | 2022/04/01       | 2023/03/31           |
| R&S          | EMI Test Receiver | ESR3    | 102726        | 2022/07/15       | 2023/07/14           |
| MICRO-COAX   | Coaxial Cable     | UTIFLEX | C-0200-01     | 2022/08/07       | 2023/08/06           |
| Audix        | Test Software     | E3      | 190306 (V9)   | N/A              | N/A                  |

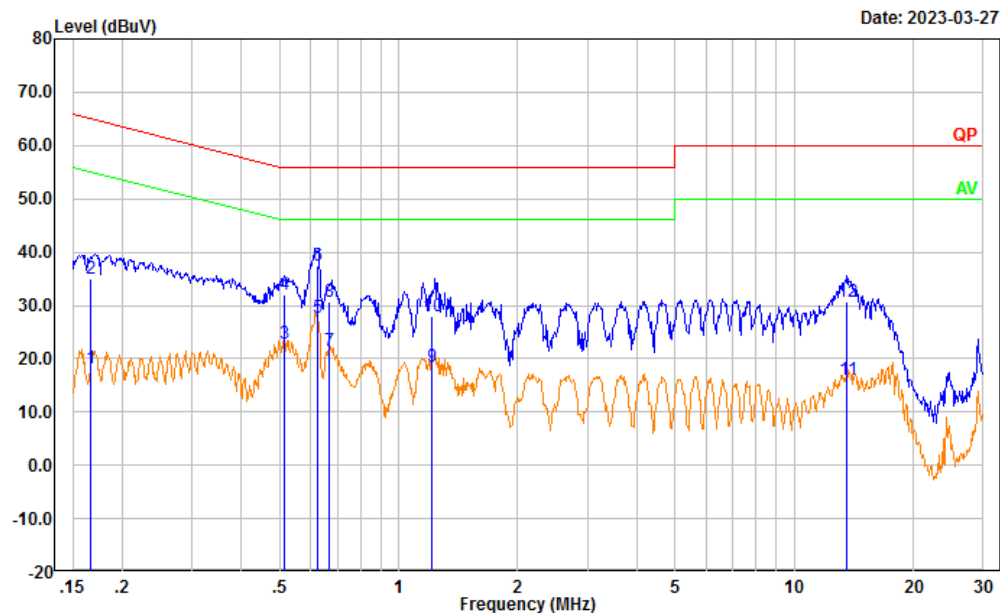
\* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Mode: Trastmittig  
Port: Line  
Note:



| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Factor<br>(dB) | Result<br>(dBuV) | Limit<br>(dBuV) | Margin<br>(dB) | Detector |
|-----|--------------------|-------------------|----------------|------------------|-----------------|----------------|----------|
| 1   | 0.239              | 5.56              | 9.61           | 15.17            | 52.14           | 36.97          | Average  |
| 2   | 0.239              | 23.75             | 9.61           | 33.36            | 62.14           | 28.78          | QP       |
| 3   | 0.617              | 17.34             | 9.62           | 26.96            | 46.00           | 19.04          | Average  |
| 4   | 0.617              | 28.23             | 9.62           | 37.85            | 56.00           | 18.15          | QP       |
| 5   | 0.841              | 8.91              | 9.62           | 18.53            | 46.00           | 27.47          | Average  |
| 6   | 0.841              | 21.74             | 9.62           | 31.36            | 56.00           | 24.64          | QP       |
| 7   | 1.260              | 6.91              | 9.62           | 16.53            | 46.00           | 29.47          | Average  |
| 8   | 1.260              | 18.87             | 9.62           | 28.49            | 56.00           | 27.51          | QP       |
| 9   | 7.739              | 7.06              | 9.67           | 16.73            | 50.00           | 33.27          | Average  |
| 10  | 7.739              | 22.43             | 9.67           | 32.10            | 60.00           | 27.90          | QP       |
| 11  | 13.747             | 9.18              | 9.68           | 18.86            | 50.00           | 31.14          | Average  |
| 12  | 13.747             | 26.23             | 9.68           | 35.91            | 60.00           | 24.09          | QP       |

Test Mode: Trastmittig  
Port: neutral  
Note:



| No. | Frequency<br>(MHz) | Reading<br>(dBμV) | Factor<br>(dB) | Result<br>(dBμV) | Limit<br>(dBμV) | Margin<br>(dB) | Detector |
|-----|--------------------|-------------------|----------------|------------------|-----------------|----------------|----------|
| 1   | 0.167              | 8.47              | 9.61           | 18.08            | 55.12           | 37.04          | Average  |
| 2   | 0.167              | 25.31             | 9.61           | 34.92            | 65.12           | 30.20          | QP       |
| 3   | 0.515              | 13.18             | 9.61           | 22.79            | 46.00           | 23.21          | Average  |
| 4   | 0.515              | 22.35             | 9.61           | 31.96            | 56.00           | 24.04          | QP       |
| 5   | 0.622              | 18.16             | 9.62           | 27.78            | 46.00           | 18.22          | Average  |
| 6   | 0.622              | 27.76             | 9.62           | 37.38            | 56.00           | 18.62          | QP       |
| 7   | 0.667              | 11.93             | 9.62           | 21.55            | 46.00           | 24.45          | Average  |
| 8   | 0.667              | 21.02             | 9.62           | 30.64            | 56.00           | 25.36          | QP       |
| 9   | 1.211              | 8.97              | 9.62           | 18.59            | 46.00           | 27.41          | Average  |
| 10  | 1.211              | 18.33             | 9.62           | 27.95            | 56.00           | 28.05          | QP       |
| 11  | 13.589             | 6.34              | 9.68           | 16.02            | 50.00           | 33.98          | Average  |
| 12  | 13.589             | 21.04             | 9.68           | 30.72            | 60.00           | 29.28          | QP       |

## 4.2 Radiation Spurious Emissions

|                |                    |              |                    |
|----------------|--------------------|--------------|--------------------|
| Serial Number: | 20A7_7             | Test Date:   | 2023/4/12~203/4/24 |
| Test Site:     | 966-1, 966-2       | Test Mode:   | Transmitting       |
| Tester:        | Vic Du, Mack Huang | Test Result: | Pass               |

### Environmental Conditions:

|                      |         |                           |       |                           |             |
|----------------------|---------|---------------------------|-------|---------------------------|-------------|
| Temperature:<br>(°C) | 24~26.1 | Relative Humidity:<br>(%) | 53~60 | ATM<br>Pressure:<br>(kPa) | 100.6~100.8 |
|----------------------|---------|---------------------------|-------|---------------------------|-------------|

### Test Equipment List and Details:

| Manufacturer    | Description       | Model                 | Serial Number | Calibration Date | Calibration Due Date |
|-----------------|-------------------|-----------------------|---------------|------------------|----------------------|
| Sunol Sciences  | Antenna           | JB6                   | A082520-5     | 2020/10/19       | 2023/10/18           |
| R&S             | EMI Test Receiver | ESR3                  | 102724        | 2022/07/15       | 2023/07/14           |
| TIMES MICROWAVE | Coaxial Cable     | LMR-600-UltraFlex     | C-0470-02     | 2022/07/17       | 2023/07/16           |
| TIMES MICROWAVE | Coaxial Cable     | LMR-600-UltraFlex     | C-0780-01     | 2022/07/17       | 2023/07/16           |
| Audix           | Test Software     | E3                    | 201021 (V9)   | N/A              | N/A                  |
| ETS-Lindgren    | Horn Antenna      | 3115                  | 9912-5985     | 2020/10/13       | 2023/10/12           |
| R&S             | Spectrum Analyzer | FSV40                 | 101591        | 2022/07/15       | 2023/07/14           |
| MICRO-COAX      | Coaxial Cable     | UFA210A-1-1200-70U300 | 217423-008    | 2022/08/07       | 2023/08/06           |
| MICRO-COAX      | Coaxial Cable     | UFA210A-1-2362-300300 | 235780-001    | 2022/08/07       | 2023/08/06           |
| Mini            | Pre-amplifier     | ZVA-183-S+            | 5969001149    | 2022/11/09       | 2023/11/08           |

**\* Statement of Traceability:** China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

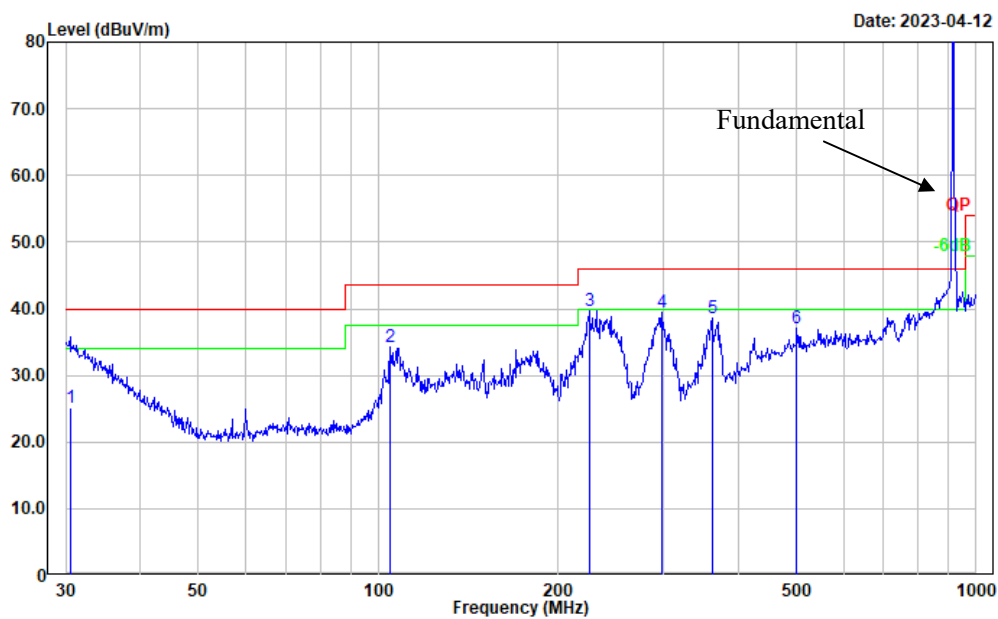
### Test Data:

Please refer to the below table and plots.

Note: The device can be mounted in multiple orientations, test was performed with X,Y, Z Axis according to C63.10 figure 8, the worst orientation was photographed and it's data was recorded.

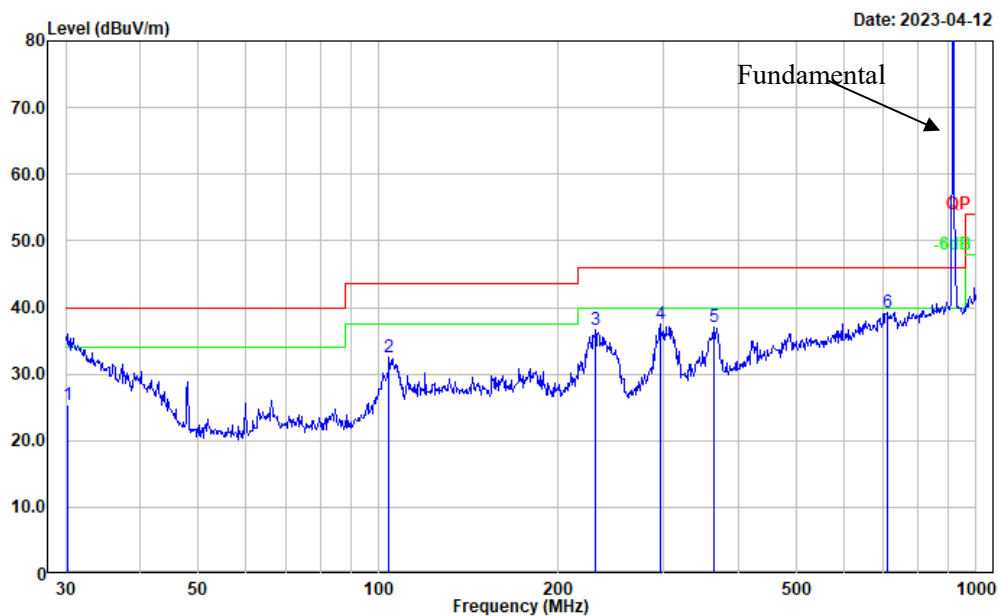
**1) 30MHz-1GHz(Low channel was the worst)**

Test Mode: Transmitting  
Polarization: horizontal  
Note:



| No. | Frequency (MHz) | Reading (dBμV) | Factor (dB/m) | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Detector |
|-----|-----------------|----------------|---------------|-----------------|----------------|-------------|----------|
| 1   | 30.531          | -2.31          | 27.47         | 25.16           | 40.00          | 14.84       | QP       |
| 2   | 104.903         | 16.14          | 18.11         | 34.25           | 43.50          | 9.25        | Peak     |
| 3   | 225.308         | 21.04          | 18.61         | 39.65           | 46.00          | 6.35        | Peak     |
| 4   | 298.268         | 18.83          | 20.61         | 39.44           | 46.00          | 6.56        | Peak     |
| 5   | 361.714         | 16.96          | 21.60         | 38.56           | 46.00          | 7.44        | Peak     |
| 6   | 501.179         | 11.82          | 25.29         | 37.11           | 46.00          | 8.89        | Peak     |

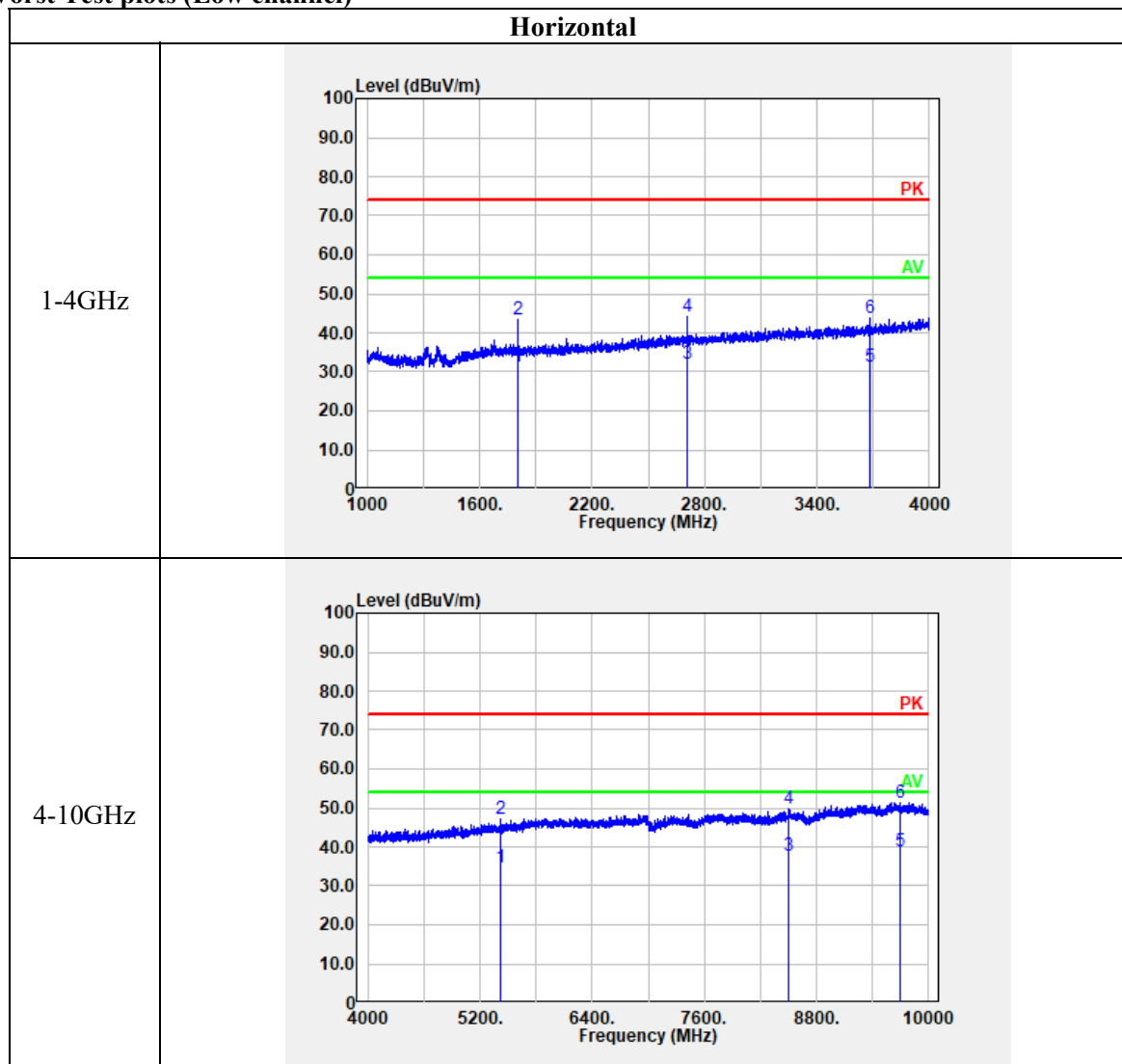
Test Mode: Transmitting  
Polarization: vertical  
Note:

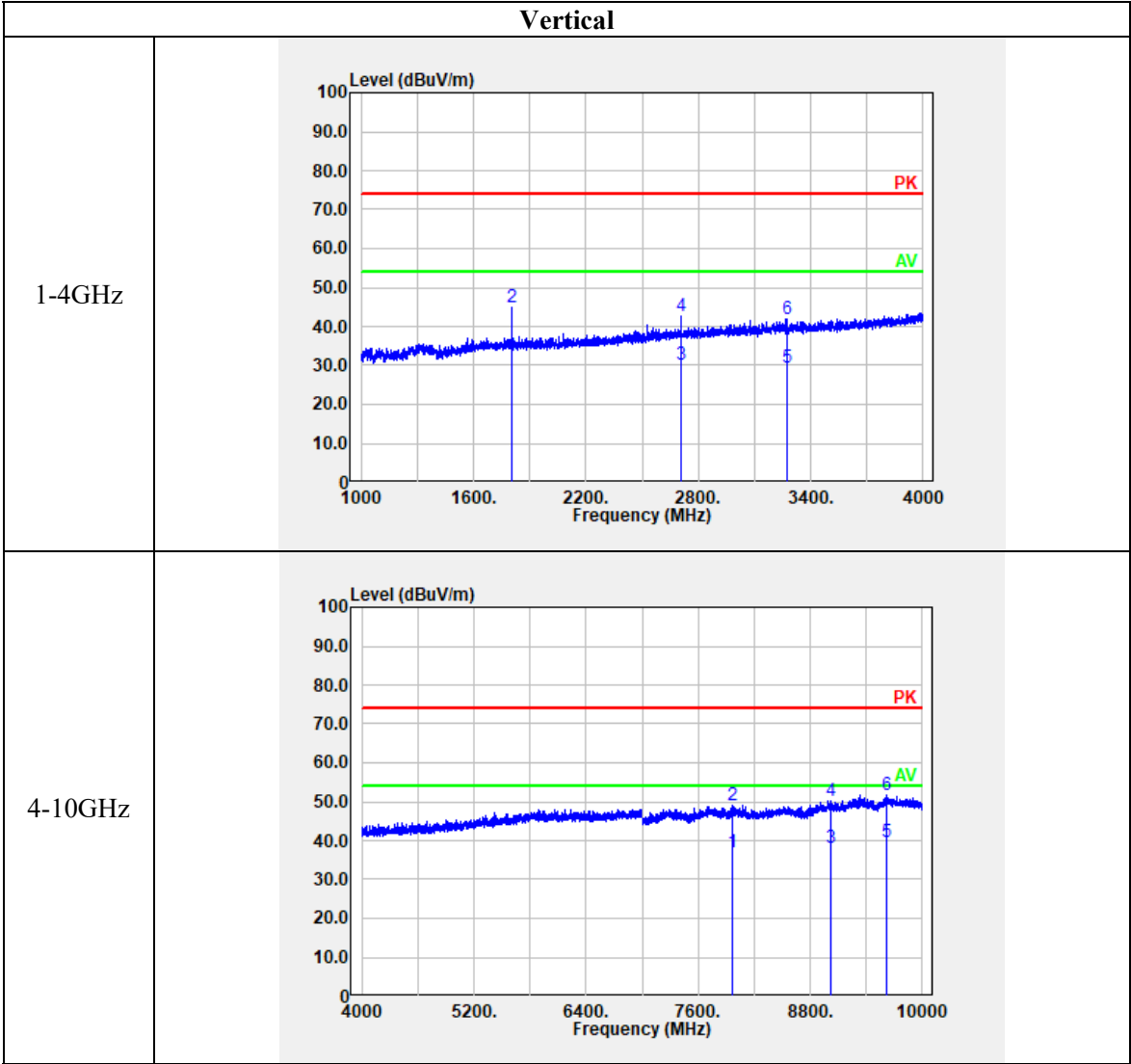


| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|-----|-----------------|----------------|---------------|-----------------|----------------|-------------|----------|
| 1   | 30.317          | -2.35          | 27.63         | 25.28           | 40.00          | 14.72       | QP       |
| 2   | 104.170         | 14.45          | 17.99         | 32.44           | 43.50          | 11.06       | Peak     |
| 3   | 230.907         | 18.16          | 18.47         | 36.63           | 46.00          | 9.37        | Peak     |
| 4   | 296.184         | 16.97          | 20.55         | 37.52           | 46.00          | 8.48        | Peak     |
| 5   | 364.260         | 15.38          | 21.69         | 37.07           | 46.00          | 8.93        | Peak     |
| 6   | 709.182         | 11.38          | 27.91         | 39.29           | 46.00          | 6.71        | Peak     |

**2) Band edge and 1-10GHz:**

| Frequency<br>(MHz)        | Receiver          |          | Polar<br>(H/V) | Factor<br>(dB/m) | Result<br>(dBμV/m) | Limit<br>(dBμV/m) | Margin<br>(dB) |
|---------------------------|-------------------|----------|----------------|------------------|--------------------|-------------------|----------------|
|                           | Reading<br>(dBμV) | Detector |                |                  |                    |                   |                |
| Low Channel: 902.3MHz     |                   |          |                |                  |                    |                   |                |
| 902.30                    | 88.19             | QP       | H              | 29.46            | 117.65             | N/A               | N/A            |
| 902.30                    | 82.21             | QP       | V              | 29.46            | 111.67             | N/A               | N/A            |
| 902.00                    | 41.56             | QP       | H              | 29.46            | 71.02              | 97.65             | 26.63          |
| 1806.000                  | 43.08             | PK       | H              | 1.32             | 44.40              | 74.00             | 29.60          |
| 1806.000                  | 31.04             | AV       | H              | 1.32             | 32.36              | 54.00             | 21.64          |
| 1806.000                  | 43.81             | PK       | V              | 1.32             | 45.13              | 74.00             | 28.87          |
| 1806.000                  | 31.41             | AV       | V              | 1.32             | 32.73              | 54.00             | 21.27          |
| 2709.000                  | 40.07             | PK       | H              | 4.76             | 44.83              | 74.00             | 29.17          |
| 2709.000                  | 28.04             | AV       | H              | 4.76             | 32.80              | 54.00             | 21.20          |
| 2709.000                  | 37.63             | PK       | V              | 4.76             | 42.39              | 74.00             | 31.61          |
| 2709.000                  | 25.32             | AV       | V              | 4.76             | 30.08              | 54.00             | 23.92          |
| 9030.000                  | 36.03             | PK       | H              | 17.70            | 53.73              | 74.00             | 20.27          |
| 9030.000                  | 24.02             | AV       | H              | 17.70            | 41.72              | 54.00             | 12.28          |
| 9030.000                  | 35.33             | PK       | V              | 17.70            | 53.03              | 74.00             | 20.97          |
| 9030.000                  | 23.17             | AV       | V              | 17.70            | 40.87              | 54.00             | 13.13          |
| Middle Channel: 914.9 MHz |                   |          |                |                  |                    |                   |                |
| 914.90                    | 86.14             | QP       | H              | 29.62            | 115.76             | N/A               | N/A            |
| 914.90                    | 777.05            | QP       | V              | 29.62            | 806.67             | N/A               | N/A            |
| 1828.400                  | 39.94             | PK       | H              | 1.43             | 41.37              | 74.00             | 32.63          |
| 1828.400                  | 27.47             | AV       | H              | 1.43             | 28.90              | 54.00             | 25.10          |
| 1828.400                  | 40.57             | PK       | V              | 1.43             | 42.00              | 74.00             | 32.00          |
| 1828.400                  | 28.39             | AV       | V              | 1.43             | 29.82              | 54.00             | 24.18          |
| 2742.600                  | 40.37             | PK       | H              | 4.90             | 45.27              | 74.00             | 28.73          |
| 2742.600                  | 28.19             | AV       | H              | 4.90             | 33.09              | 54.00             | 20.91          |
| 2742.600                  | 39.44             | PK       | V              | 4.90             | 44.34              | 74.00             | 29.66          |
| 2742.600                  | 27.22             | AV       | V              | 4.90             | 32.12              | 54.00             | 21.88          |
| 9142.000                  | 34.74             | PK       | H              | 18.08            | 52.82              | 74.00             | 21.18          |
| 9142.000                  | 22.37             | AV       | H              | 18.08            | 40.45              | 54.00             | 13.55          |
| 9142.000                  | 35.06             | PK       | V              | 18.08            | 53.14              | 74.00             | 20.86          |
| 9142.000                  | 23.03             | AV       | V              | 18.08            | 41.11              | 54.00             | 12.89          |
| High Channel: 927.7MHz    |                   |          |                |                  |                    |                   |                |
| 927.70                    | 89.61             | QP       | H              | 29.70            | 119.31             | N/A               | N/A            |
| 927.70                    | 83.25             | QP       | V              | 29.70            | 112.95             | N/A               | N/A            |
| 928.00                    | 53.34             | QP       | H              | 29.70            | 83.04              | 99.31             | 16.27          |
| 1854.000                  | 47.13             | PK       | H              | 1.56             | 48.69              | 74.00             | 25.31          |
| 1854.000                  | 35.07             | AV       | H              | 1.56             | 36.63              | 54.00             | 17.37          |
| 1854.000                  | 42.16             | PK       | V              | 1.56             | 43.72              | 74.00             | 30.28          |
| 1854.000                  | 30.08             | AV       | V              | 1.56             | 31.64              | 54.00             | 22.36          |
| 2781.000                  | 42.21             | PK       | H              | 5.04             | 47.25              | 74.00             | 26.75          |
| 2781.000                  | 30.11             | AV       | H              | 5.04             | 35.15              | 54.00             | 18.85          |
| 2781.000                  | 41.29             | PK       | V              | 5.04             | 46.33              | 74.00             | 27.67          |
| 2781.000                  | 27.14             | AV       | V              | 5.04             | 32.18              | 54.00             | 21.82          |
| 9270.000                  | 35.46             | PK       | H              | 18.26            | 53.72              | 74.00             | 20.28          |
| 9270.000                  | 23.23             | AV       | H              | 18.26            | 41.49              | 54.00             | 12.51          |
| 9270.000                  | 34.28             | PK       | V              | 18.26            | 52.54              | 74.00             | 21.46          |
| 9270.000                  | 22.14             | AV       | V              | 18.26            | 40.40              | 54.00             | 13.60          |

**Worst Test plots (Low channel)**



**4.3 20 dB Emission Bandwidth:**

|                |             |              |              |
|----------------|-------------|--------------|--------------|
| Serial Number: | 20A7_7      | Test Date:   | 2023/6/28    |
| Test Site:     | RF          | Test Mode:   | Transmitting |
| Tester:        | LingLing Li | Test Result: | Pass         |

**Environmental Conditions:**

|                      |      |                              |    |                        |       |
|----------------------|------|------------------------------|----|------------------------|-------|
| Temperature:<br>(°C) | 27.9 | Relative<br>Humidity:<br>(%) | 64 | ATM Pressure:<br>(kPa) | 100.3 |
|----------------------|------|------------------------------|----|------------------------|-------|

**Test Equipment List and Details:**

| Manufacturer | Description        | Model         | Serial Number | Calibration Date | Calibration Due Date |
|--------------|--------------------|---------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer  | FSU26         | 100147        | 2023/3/31        | 2024/3/30            |
| zhuoxiang    | Coaxial Cable      | SMA-178       | 211003        | Each time        | N/A                  |
| eastsheep    | Coaxial Attenuator | 2W-SMA-JK-18G | 21060301      | Each time        | N/A                  |

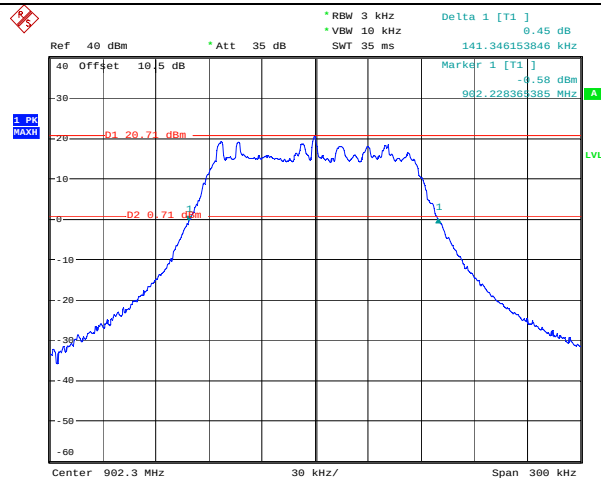
\* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

**Test Data:**

| Test Channel | Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Limit (MHz) |
|--------------|----------------------|-----------------------|-------------|
| Lowest       | 902.3                | 0.141                 | <0.25       |
| Middle       | 914.9                | 0.141                 | <0.25       |
| Highest      | 927.7                | 0.142                 | <0.25       |

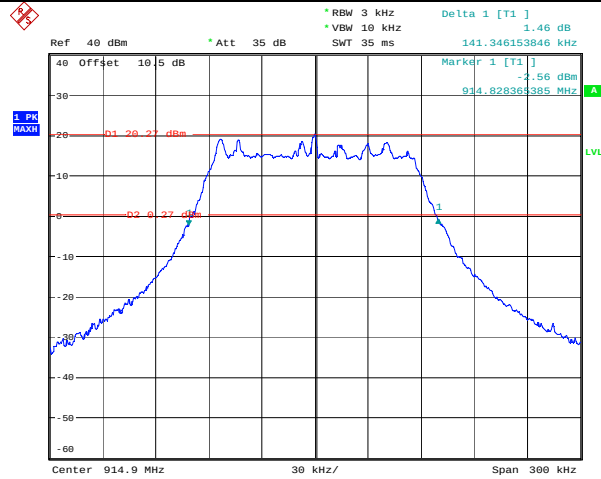
## 20 dB Bandwidth

Lowest Channel



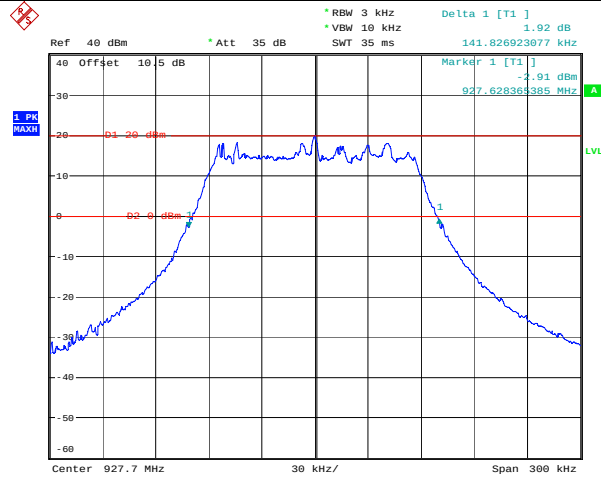
Date: 28 JUN 2023 12:23:23

Middle Channel



Date: 28 JUN 2023 12:39:13

Highest Channel



Date: 28 JUN 2023 12:36:07

**4.4 Channel Separation:**

|                |             |              |              |
|----------------|-------------|--------------|--------------|
| Serial Number: | 20A7_7      | Test Date:   | 2023/5/12    |
| Test Site:     | RF          | Test Mode:   | Transmitting |
| Tester:        | LingLing Li | Test Result: | Pass         |

**Environmental Conditions:**

|                      |      |                              |    |                        |       |
|----------------------|------|------------------------------|----|------------------------|-------|
| Temperature:<br>(°C) | 28.2 | Relative<br>Humidity:<br>(%) | 65 | ATM Pressure:<br>(kPa) | 100.2 |
|----------------------|------|------------------------------|----|------------------------|-------|

**Test Equipment List and Details:**

| Manufacturer | Description        | Model         | Serial Number | Calibration Date | Calibration Due Date |
|--------------|--------------------|---------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer  | FSU26         | 100147        | 2023/03/31       | 2024/03/30           |
| zhuoxiang    | Coaxial Cable      | SMA-178       | 211003        | Each time        | N/A                  |
| eastsheep    | Coaxial Attenuator | 2W-SMA-JK-18G | 21060301      | Each time        | N/A                  |

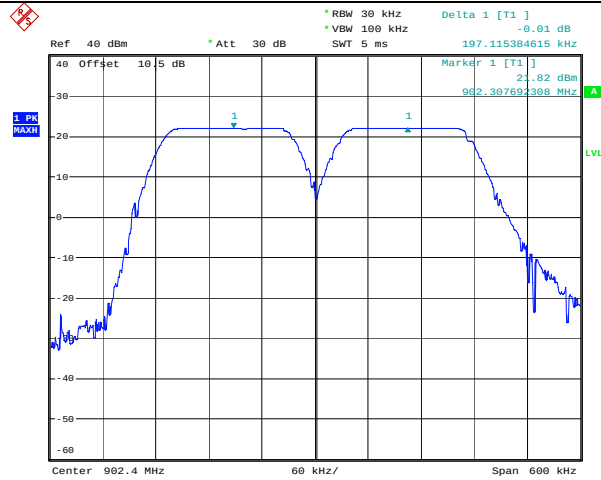
*\* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

**Test Data:**

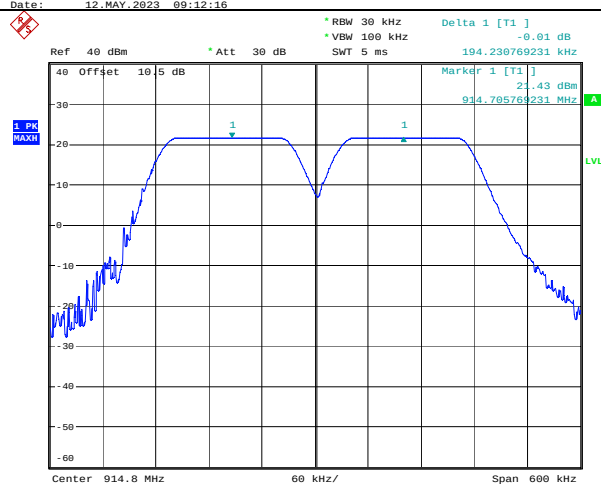
| Test Channel | Test Frequency (MHz) | Channel Separation (MHz) | Limits (MHz) |
|--------------|----------------------|--------------------------|--------------|
| Lowest       | 902.3                | 0.197                    | 0.141        |
| Middle       | 914.9                | 0.194                    | 0.141        |
| Highest      | 927.7                | 0.2                      | 0.142        |

## Channel Separation

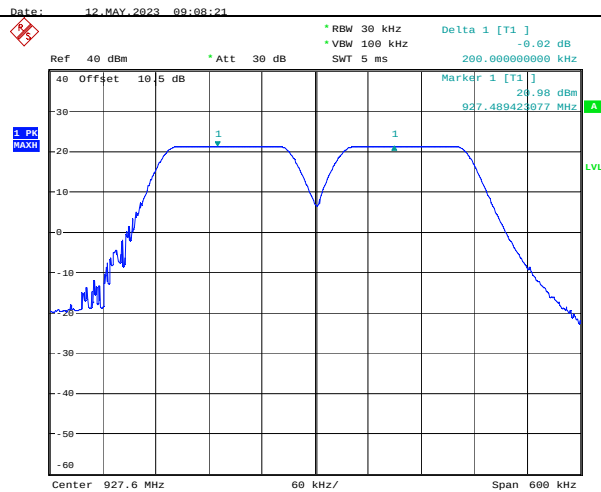
Lowest Channel



Middle Channel



Highest Channel



**4.5 Number Of Hopping Frequency:**

|                |             |              |              |
|----------------|-------------|--------------|--------------|
| Serial Number: | 2023.03.07  | Test Date:   | 2023/5/12    |
| Test Site:     | RF          | Test Mode:   | Transmitting |
| Tester:        | LingLing Li | Test Result: | Pass         |

**Environmental Conditions:**

|                      |      |                              |    |                        |       |
|----------------------|------|------------------------------|----|------------------------|-------|
| Temperature:<br>(°C) | 28.2 | Relative<br>Humidity:<br>(%) | 65 | ATM Pressure:<br>(kPa) | 100.2 |
|----------------------|------|------------------------------|----|------------------------|-------|

**Test Equipment List and Details:**

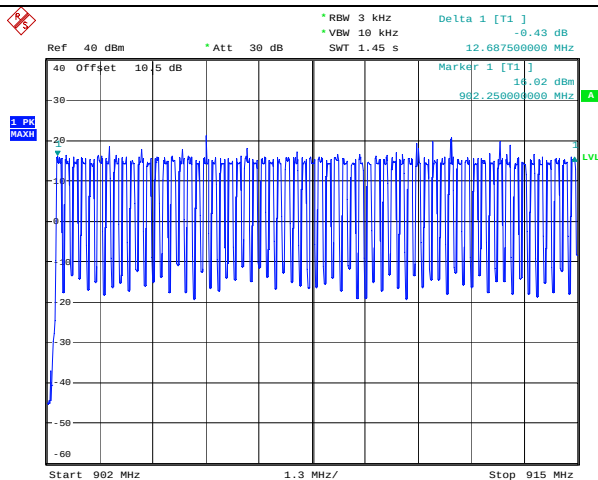
| Manufacturer | Description        | Model         | Serial Number | Calibration Date | Calibration Due Date |
|--------------|--------------------|---------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer  | FSU26         | 100147        | 2023/3/31        | 2024/3/30            |
| zhuoxiang    | Coaxial Cable      | SMA-178       | 211003        | Each time        | N/A                  |
| eastsheep    | Coaxial Attenuator | 2W-SMA-JK-18G | 21060301      | Each time        | N/A                  |

*\* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

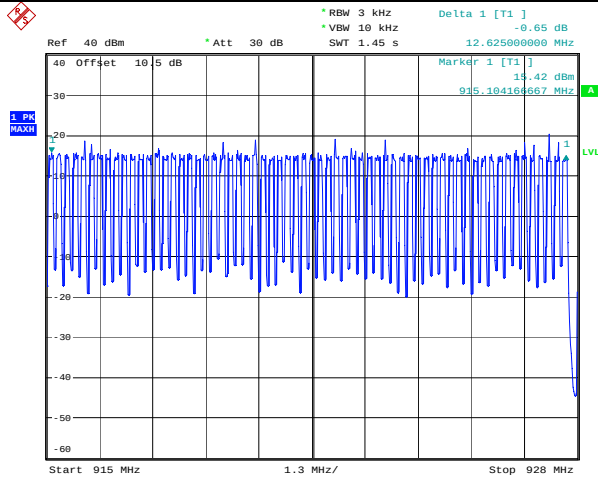
**Test Data:**

| Frequency Range (MHz) | Number of Hopping Channel | Limits    |
|-----------------------|---------------------------|-----------|
| 902-928               | 128                       | $\geq 50$ |

## Number Of Hopping Frequency

902-915  
MHz

Date: 12 MAY 2023 09:30:44

915-928  
MHz

Date: 12 MAY 2023 09:53:04

**4.6 Time Of Occupancy (Dwell Time):**

|                |             |              |              |
|----------------|-------------|--------------|--------------|
| Serial Number: | 20A7_7      | Test Date:   | 2023/5/12    |
| Test Site:     | RF          | Test Mode:   | Transmitting |
| Tester:        | LingLing Li | Test Result: | Pass         |

**Environmental Conditions:**

|                      |      |                              |    |                        |       |
|----------------------|------|------------------------------|----|------------------------|-------|
| Temperature:<br>(°C) | 28.2 | Relative<br>Humidity:<br>(%) | 65 | ATM Pressure:<br>(kPa) | 100.2 |
|----------------------|------|------------------------------|----|------------------------|-------|

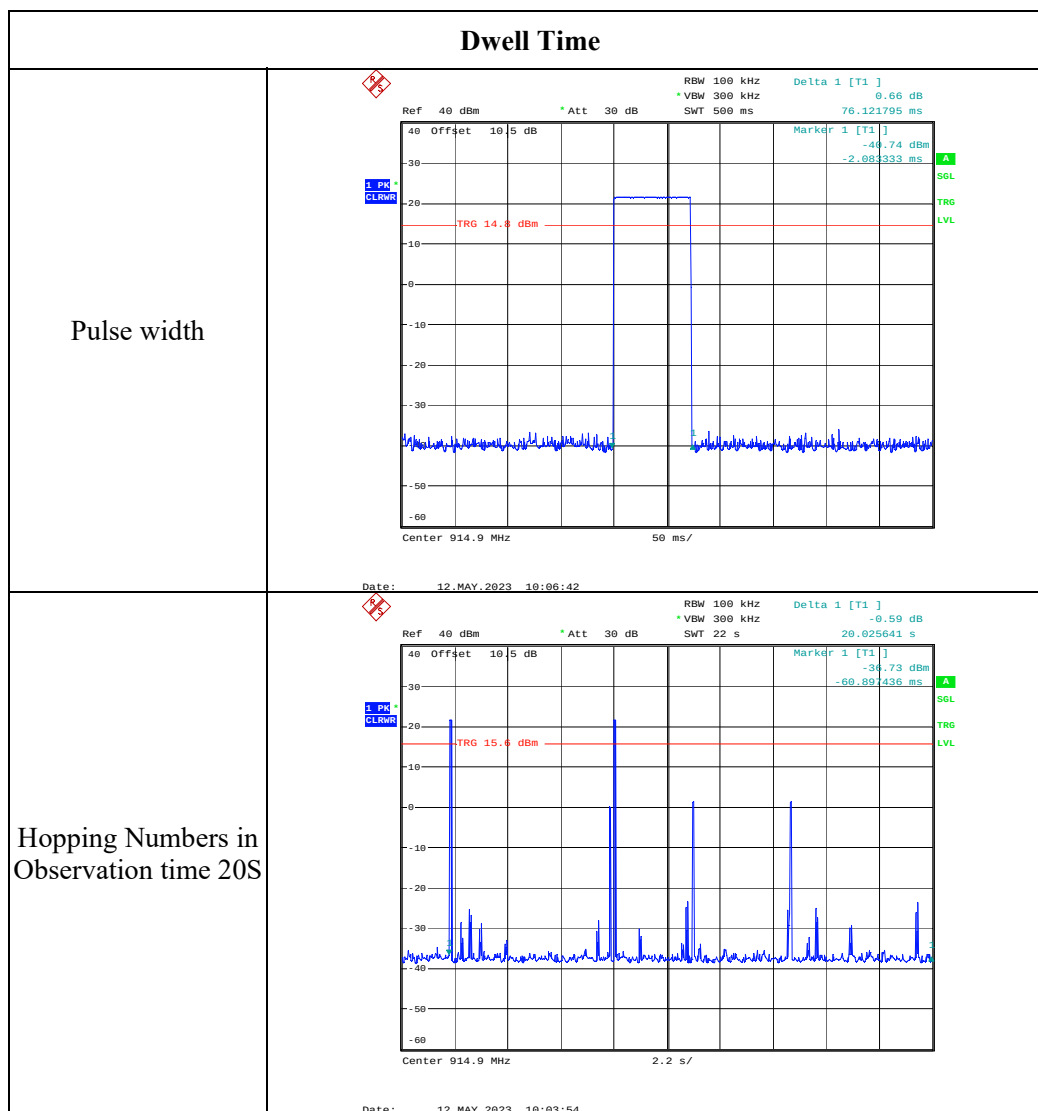
**Test Equipment List and Details:**

| Manufacturer | Description        | Model         | Serial Number | Calibration Date | Calibration Due Date |
|--------------|--------------------|---------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer  | FSU26         | 100147        | 2023/03/31       | 2024/03/30           |
| zhuoxiang    | Coaxial Cable      | SMA-178       | 211003        | Each time        | N/A                  |
| eastsheep    | Coaxial Attenuator | 2W-SMA-JK-18G | 21060301      | Each time        | N/A                  |

*\* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

**Test Data:**

| Test Frequency<br>(MHz)     | Pulse width<br>(ms) | Observation time<br>(s) | Hopping<br>Numbers in<br>Observation<br>time | Dwell Time<br>(s) | Limit<br>(s) |
|-----------------------------|---------------------|-------------------------|----------------------------------------------|-------------------|--------------|
| 914.9                       | 76.122              | 20                      | 2                                            | 0.152             | 0.400        |
| Note: Observation time= 20s |                     |                         |                                              |                   |              |



**4.7 Maximum Conducted Output Power:**

|                |             |              |              |
|----------------|-------------|--------------|--------------|
| Serial Number: | 20A7_7      | Test Date:   | 2023/5/12    |
| Test Site:     | RF          | Test Mode:   | Transmitting |
| Tester:        | LingLing Li | Test Result: | Pass         |

**Environmental Conditions:**

|                      |      |                              |    |                        |       |
|----------------------|------|------------------------------|----|------------------------|-------|
| Temperature:<br>(°C) | 28.2 | Relative<br>Humidity:<br>(%) | 65 | ATM Pressure:<br>(kPa) | 100.2 |
|----------------------|------|------------------------------|----|------------------------|-------|

**Test Equipment List and Details:**

| Manufacturer | Description               | Model         | Serial Number | Calibration Date | Calibration Due Date |
|--------------|---------------------------|---------------|---------------|------------------|----------------------|
| Agilent      | USB Wideband Power Sensor | U2021XA       | MY54080015    | 2022/7/15        | 2023/7/14            |
| zhuoxiang    | Coaxial Cable             | SMA-178       | 211003        | Each time        | N/A                  |
| eastsheep    | Coaxial Attenuator        | 2W-SMA-JK-18G | 21060301      | Each time        | N/A                  |

*\* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

**Test Data:**

| Test Channel | Test Frequency (MHz) | Peak Conducted Output Power (dBm) | Limits (dBm) |
|--------------|----------------------|-----------------------------------|--------------|
| Lowest       | 902.3                | 22.10                             | 30           |
| Middle       | 914.9                | 21.63                             | 30           |
| Highest      | 927.7                | 21.10                             | 30           |

**4.8 100 kHz Bandwidth of Frequency Band Edge:**

|                |             |              |              |
|----------------|-------------|--------------|--------------|
| Serial Number: | 20A7_7      | Test Date:   | 2023/5/12    |
| Test Site:     | RF          | Test Mode:   | Transmitting |
| Tester:        | LingLing Li | Test Result: | Pass         |

**Environmental Conditions:**

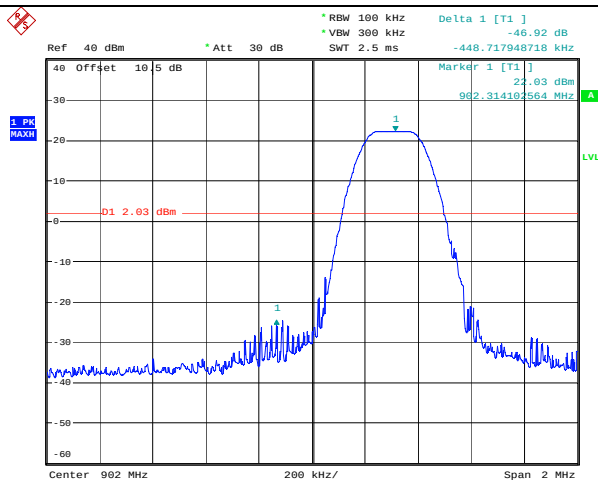
|                      |      |                              |    |                        |       |
|----------------------|------|------------------------------|----|------------------------|-------|
| Temperature:<br>(°C) | 28.2 | Relative<br>Humidity:<br>(%) | 65 | ATM Pressure:<br>(kPa) | 100.2 |
|----------------------|------|------------------------------|----|------------------------|-------|

**Test Equipment List and Details:**

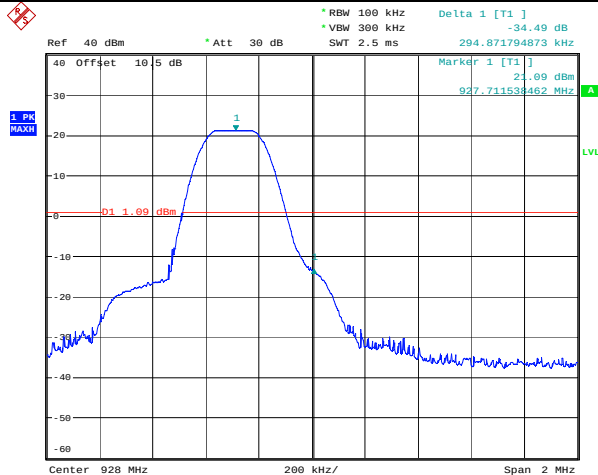
| Manufacturer | Description        | Model         | Serial Number | Calibration Date | Calibration Due Date |
|--------------|--------------------|---------------|---------------|------------------|----------------------|
| R&S          | Spectrum Analyzer  | FSU26         | 100147        | 2023/03/31       | 2024/03/30           |
| zhuoxiang    | Coaxial Cable      | SMA-178       | 211003        | Each time        | N/A                  |
| eastsheep    | Coaxial Attenuator | 2W-SMA-JK-18G | 21060301      | Each time        | N/A                  |

*\* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

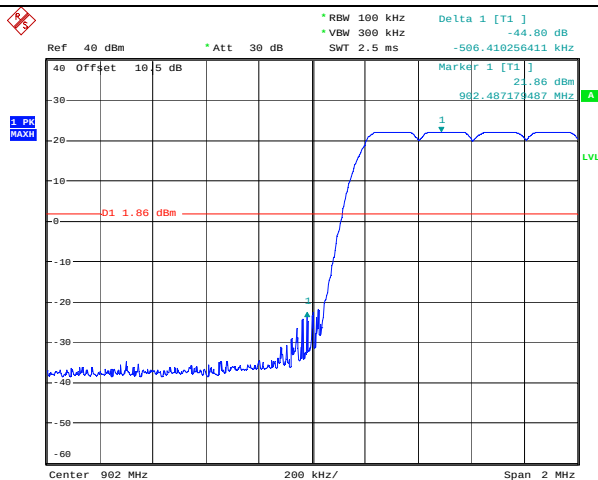
**Test Data:**

**100 kHz Bandwidth of Frequency Band Edge-Single Mode****Band Edge,  
Left Side**

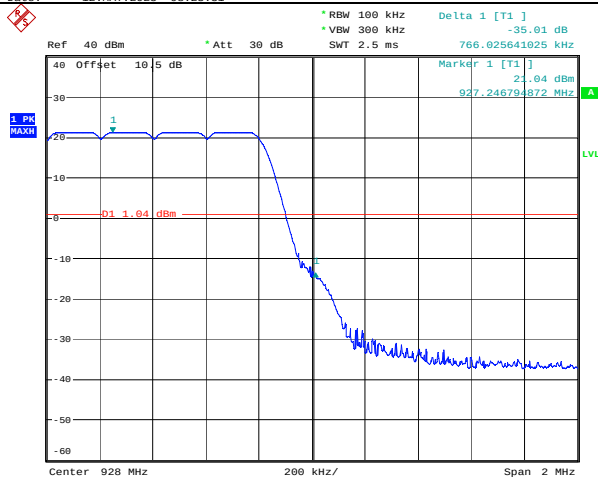
Date: 12.MAY.2023 08:09:15

**Band Edge,  
Right Side**

Date: 12.MAY.2023 08:11:30

**100 kHz Bandwidth of Frequency Band Edge-Hopping Mode****Band Edge,  
Left Side**

Date: 12.MAY.2023 08:23:31

**Band Edge,  
Right Side**

Date: 12.MAY.2023 08:17:43

## 5. RF EXPOSURE EVALUATION

### 5.1 Applicable Standard

FCC §15.247 (i) and subpart §1.1307

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

### 5.2 Procedure

According to §1.1307(b)(3)(i)

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least  $\lambda/2\pi$ , where  $\lambda$  is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of  $\lambda/4$  or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

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                 | $0.0128 R^2 f$ .      |
| 1,500-100,000             | $19.2 R^2$ .          |

### 5.3 Measurement Result

| Operation Modes | Frequency (MHz) | $\lambda/2\pi$ (mm) | Distance (mm) | Exemption ERP (mW) | Maximum Conducted Power including Tune-up Tolerance (dBm) | Antenna Gain (dBi) | ERP   |        | MPE-Based Exemption |
|-----------------|-----------------|---------------------|---------------|--------------------|-----------------------------------------------------------|--------------------|-------|--------|---------------------|
|                 |                 |                     |               |                    |                                                           |                    | (dBm) | (mW)   |                     |
| Lora-FHSS       | 902.3-927.7     | 52.94               | 200           | 462                | 23                                                        | 1.03               | 21.88 | 154.17 | Compliant           |

Note: The Maximum Conducted Power including Tune-up Tolerance was declared by manufacturer.

**Result: The device compliant the MPE-Based Exemption at 20cm distances.**

**===== END OF REPORT =====**