



## FCC TEST REPORT

For

Shenzhen Xtooltech Intelligent Co., Ltd

Tire-Pressure Sensor

Test Model: TS101

Prepared for : Shenzhen Xtooltech Intelligent Co., Ltd  
Address : 17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China

Prepared by : Shenzhen LCS Compliance Testing Laboratory Ltd.  
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Date of receipt of test sample : November 08, 2023  
Number of tested samples : 2  
Sample No. : A231106126-1, A231106126-2  
Serial number : Prototype  
Date of Test : November 08, 2023 ~ December 01, 2023  
Date of Report : December 04, 2023



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**FCC TEST REPORT**  
**FCC CFR 47 PART 15C(15.231)****Report Reference No. .... : LCSA11063075EB****Date of Issue..... : December 04, 2023****Testing Laboratory Name..... : Shenzhen LCS Compliance Testing Laboratory Ltd.****Address..... : 101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Shajing Street,  
Baoan District, Shenzhen, China****Testing Location/ Procedure..... : Full application of Harmonised standards ■  
Partial application of Harmonised standards □  
Other standard testing method □****Applicant's Name..... : Shenzhen Xtooltech Intelligent Co., Ltd****Address..... : 17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan  
District, Shenzhen, China****Test Specification****Standard..... : FCC CFR 47 PART 15 C(15.231)****Test Report Form No..... : LCSEMC-1.0****TRF Originator..... : Shenzhen LCS Compliance Testing Laboratory Ltd.****Master TRF..... : Dated 2011-03****Shenzhen LCS Compliance Testing Laboratory Ltd. All rights reserved.**

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**Test Item Description..... : Tire-Pressure Sensor****Trade Mark..... : XTOOL****Test Model..... : TS101****Ratings..... : DC 3V By CR2032A Lithium Cell****Result ..... : Positive****Compiled by:**

Kevin Huang/ Administrator

**Supervised by:**

Cary Luo/ Technique principal

**Approved by:**

Gavin Liang/ Manager



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**FCC -- TEST REPORT**

|                                                |                                           |
|------------------------------------------------|-------------------------------------------|
| <b>Test Report No. :</b> <b>LCSA11063075EB</b> | <u>December 04, 2023</u><br>Date of issue |
|------------------------------------------------|-------------------------------------------|

|                          |                                                                                                   |
|--------------------------|---------------------------------------------------------------------------------------------------|
| Test Mode.....           | : TS101                                                                                           |
| EUT.....                 | : Tire-Pressure Sensor                                                                            |
| <b>Applicant.....</b>    | <b>: Shenzhen Xtooltech Intelligent Co., Ltd</b>                                                  |
| Address.....             | : 17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China          |
| Telephone.....           | : /                                                                                               |
| Fax.....                 | : /                                                                                               |
| <b>Manufacturer.....</b> | <b>: Shenzhen Xtooltech Intelligent Co., Ltd</b>                                                  |
| Address.....             | : 17&18/F, A2 Building, Creative City, Liuxian Avenue, Nanshan District, Shenzhen, China          |
| Telephone.....           | : /                                                                                               |
| Fax.....                 | : /                                                                                               |
| <b>Factory.....</b>      | <b>: Bao'an Branch of Shenzhen Xtooltech Intelligent Co., Ltd</b>                                 |
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| Telephone.....           | : /                                                                                               |
| Fax.....                 | : /                                                                                               |

|                    |                 |
|--------------------|-----------------|
| <b>Test Result</b> | <b>Positive</b> |
|--------------------|-----------------|

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.



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Revision History

| Report Version | Issue Date        | Revision Content | Revised By |
|----------------|-------------------|------------------|------------|
| 000            | December 04, 2023 | Initial Issue    | ---        |
|                |                   |                  |            |
|                |                   |                  |            |





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## 1. GENERAL INFORMATION

### 1.1. Description of Device (EUT)

EUT : Tire-Pressure Sensor  
Test Model : TS101  
Hardware version : TS101\_MB\_V1.1  
Software version : NTM88\_BL33\_AP21\_XT  
Power Supply : DC 3V By CR2032A Lithium Cell

433MHz :  
Operation Frequency : 433.90MHz

Modulation Type : FSK  
Channel Number : 1  
Antenna Type : Internal Antenna  
Antenna Gain : -11.2dBi (Max)

315MHz :  
Operation Frequency : 315MHz  
Modulation Type : FSK  
Channel Number : 1  
Antenna Type : Internal Antenna  
Antenna Gain : -22.9dBi (Max)

### 1.2. Support equipment List

| Manufacturer | Description | Model | Serial Number | Certificate |
|--------------|-------------|-------|---------------|-------------|
| --           | --          | --    | ---           | --          |

### 1.3. External I/O Cable

| I/O Port Description | Quantity | Cable |
|----------------------|----------|-------|
| --                   | --       | --    |

### 1.4. Description of Test Facility

NVLAP Accreditation Code is 600167-0.

FCC Designation Number is CN5024.

CAB identifier is CN0071.

CNAS Registration Number is L4595.

Test Firm Registration Number: 254912

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.



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### 1.5. Statement of the Measurement Uncertainty

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

### 1.6. Measurement Uncertainty

| Test Item              |   | Frequency Range | Uncertainty | Note |
|------------------------|---|-----------------|-------------|------|
| Radiation Uncertainty  | : | 9KHz~30MHz      | ±3.10dB     | (1)  |
|                        |   | 30MHz~200MHz    | ±2.96dB     | (1)  |
|                        |   | 200MHz~1000MHz  | ±3.10dB     | (1)  |
|                        |   | 1GHz~26.5GHz    | ±3.80dB     | (1)  |
|                        |   | 26.5GHz~40GHz   | ±3.90dB     | (1)  |
| Conduction Uncertainty | : | 150kHz~30MHz    | ±1.63dB     | (1)  |
| Power disturbance      | : | 30MHz~300MHz    | ±1.60dB     | (1)  |

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

### 1.7. Description of Test Modes

The EUT has been tested under engineering mode. The field strength of radiation emission was measured in the following position: EUT stand-up position (Y axis), lie-down position (X, Z axis). The worst case of X axis was reported.  
A new battery supplied DC 3V power to the EUT for testing.

The EUT transmits signal as soon as it is powered on, and recorded the result in this report.

\*\*\*Note: Using a temporary antenna connector for the EUT when conducted measurements are performed.



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## 2. TEST METHODOLOGY

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

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd.

### 2.1. EUT Configuration

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

### 2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.231 under the FCC Rules Part 15 Subpart C.

### 2.3. General Test Procedures

#### 2.3.1 Conducted Emissions

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

#### 2.3.2 Radiated Emissions

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

### 2.4. Test Sample

The application provides 2 samples to meet requirement;

| Sample Number          | Description                           |
|------------------------|---------------------------------------|
| Sample 1(A231106126-1) | Engineer sample – continuous transmit |
| Sample 2(A231106126-2) | Normal sample – Intermittent transmit |



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### 3. SYSTEM TEST CONFIGURATION

#### 3.1. Justification

The system was configured for testing in a continuous transmit condition.

Using sample to test, which was automatically launched

#### 3.2. EUT Exercise Software

N/A

#### 3.3. Special Accessories

N/A

#### 3.4. Block Diagram/Schematics

Please refer to the related document

#### 3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

#### 3.6. Test Setup

Please refer to the test setup photo.



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## 4. SUMMARY OF TEST RESULTS

| Applied Standard: FCC Part 15 Subpart C |                        |           |
|-----------------------------------------|------------------------|-----------|
| FCC Rules                               | Description of Test    | Result    |
| §15.203                                 | Antenna Requirement    | Compliant |
| §15.205                                 | Restricted Band        | Compliant |
| §15.209                                 | General Requirement    | Compliant |
| §15.231 (b)                             | Radiated Emissions     | Compliant |
| §15.231 (c)                             | 20dB Bandwidth Testing | Compliant |
| §15.231 (a)(1)                          | Deactivation Testing   | Compliant |
| §15.231                                 | Duty cycle Factor      | Compliant |
| §15.207                                 | Conducted Emissions    | N/A       |

*Note: All test modes were taken into consideration, but we only recorded the worst case in this report.*





## 5. TEST ITEMS AND RESULTS

### 5.1. Duration of each Transmission and the silent period

FCC 15.231 (a)

#### 5.1.1. Limit

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

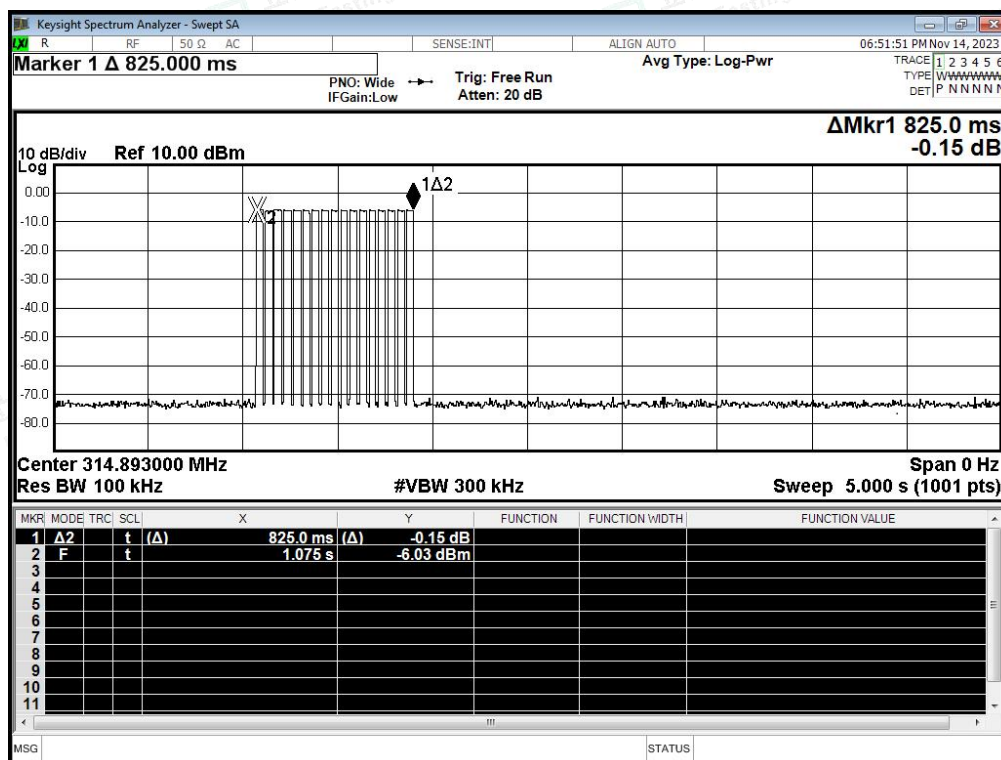
#### 5.1.2. Test Procedure

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

#### 5.1.3. Test Results

|               |           |                |         |
|---------------|-----------|----------------|---------|
| Temperature   | 24.6°C    | Humidity       | 54.1%   |
| Test Engineer | Taylor Hu | Configurations | TX Mode |

| Frequency (MHz) | Activation Time (s) | Limit: not more than 5 seconds of being released (s) | Conclusion |
|-----------------|---------------------|------------------------------------------------------|------------|
| 315             | 0.825               | 5s                                                   | PASS       |



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## 5.2. Transmitter Field Strength of Emissions

### 5.2.1. Limit

#### FCC §15.231 (b)

In addition to the provisions of § 15.205, the field strength of emissions from Intentional radiators operated under this section shall not exceed the following:

| Fundamental frequency (MHz) | Field Strength of Fundamental (microvolt/meter) | Field Strength of spurious emissions (microvolt/meter) |
|-----------------------------|-------------------------------------------------|--------------------------------------------------------|
| 40.66-40.70                 | 2,250                                           | 225                                                    |
| 70-130                      | 1,250                                           | 125                                                    |
| 130-174                     | 1,250 to 3,370                                  | 125 to 375                                             |
| 174-260                     | 3,750                                           | 375                                                    |
| 260-470                     | 3,750 to 12,500                                 | 375 to 1,250                                           |
| Above 470                   | 12,500                                          | 1,250                                                  |

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz,  $\mu\text{V/m}$  at 3 meters =  $56.81818(F) - 6136.3636$ ; for the band 260-470 MHz,  $\mu\text{V/m}$  at 3 meters =  $41.6667(F) - 7083.3333$ . The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

§15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz               | MHz                 | MHz           | GHz              |
|-------------------|---------------------|---------------|------------------|
| 0.090-0.110       | 16.42-16.423        | 608-614       | 4.5-5.15         |
| 0.495-0.505       | 16.69475-16.68525   | 960-1240      | 5.35-5.46        |
| 2.1735-2.1905     | 16.80425-16.80475   | 1300-1427     | 7.25-7.75        |
| 4.125-4.128       | 25.525-67           | 1435-1626.5   | 8.025-8.5        |
| 4.17725-4.17775   | 37.5-38.25          | 1645.5-1646.5 | 9.0-9.2          |
| 4.20725-4.20775   | 73-74.6             | 1660-1710     | 9.3-9.5          |
| 6.215-6.218       | 74.8-75.2           | 1718.8-1722.2 | 10.6-12.7        |
| 6.26775-6.26825   | 108-121.94          | 2200-2300     | 13.25-13.4       |
| 6.31175-6.31225   | 123-138             | 2310-2390     | 14.47-14.5       |
| 8.291-8.294       | 149.9-150.05        | 2483.5-2500   | 15.35-16.2       |
| 8.362-8.366       | 156.52475-156.52525 | 2655-2900     | 17.7-21.4        |
| 8.37625-8.38675   | 156.7-156.9         | 3260-3267     | 22.01-23.12      |
| 8.41425-8.41475   | 162.0125167.17      | 3332-3339     | 23.6-24.0        |
| 12.29-12.293      | 167.72-173.2        | 3345.8-3358   | 31.2-31.8        |
| 12.51975-12.52025 | 240-285             | 3600-4400     | 36.43-36.5       |
| 12.57675-12.57725 | 322-335.4           |               | ( <sup>2</sup> ) |
| 13.36-13.41       | 399.9-410           |               |                  |

1. Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

2. Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions.

The provisions in Section 15.35 apply to these measurements.



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§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 72 MHz, 76 88 MHz, 174 216 MHz or 470 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.





### 5.2.2 Measuring Instruments and Setting

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

| Spectrum Parameter                        | Setting                                        |
|-------------------------------------------|------------------------------------------------|
| Attenuation                               | Auto                                           |
| Start Frequency                           | 1000 MHz                                       |
| Stop Frequency                            | 10th carrier harmonic                          |
| RB / VB (Emission in restricted band)     | 1MHz / 3MHz for Peak, 1 MHz / 10Hz for Average |
| RB / VB (Emission in non-restricted band) | 1MHz / 3MHz for Peak, 1 MHz / 10Hz for Average |

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

### 5.2.3. Test Procedures

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

##### Setup:

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

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

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

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

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

##### Premeasurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna height is 1.5 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

##### Final measurement:

--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

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



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

### Setup:

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

### Premeasurement:

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

### Final measurement:

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



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

#### Setup:

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

#### Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

#### Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum found antenna polarization and turntable position of the premeasurement the software maximizes the peaks by rotating the turntable position (0° to 360°). This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps). This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.



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

##### Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 1 meter.
- The EUT was set into operation.

##### Premeasurement:

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

##### Final measurement:

- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and RMS detector.
- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.



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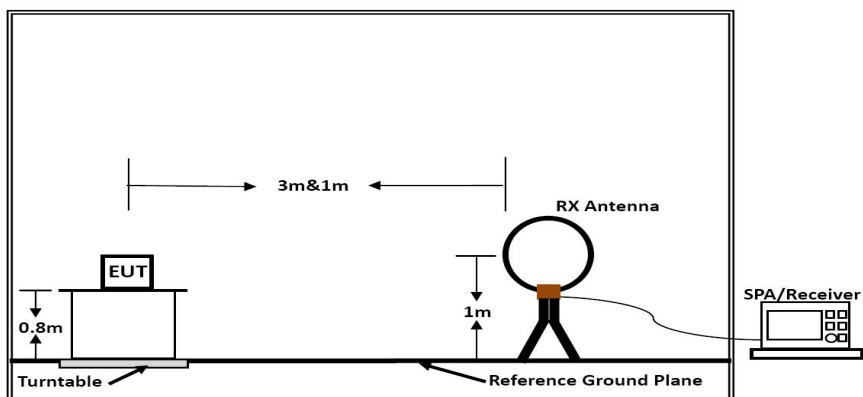
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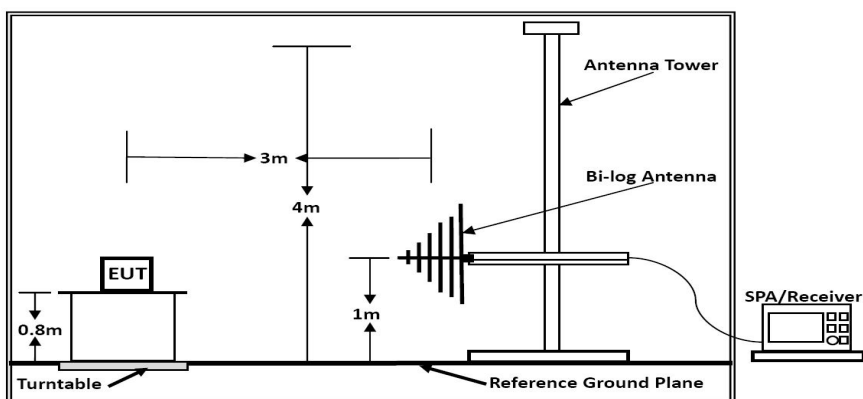
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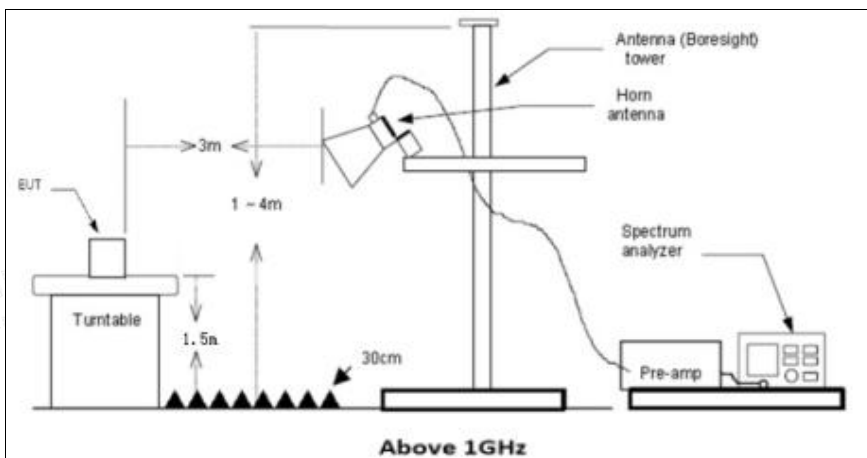
#### 5.2.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

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

#### 5.2.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.



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

|               |           |                |       |
|---------------|-----------|----------------|-------|
| Temperature   | 23.8℃     | Humidity       | 52.1% |
| Test Engineer | Taylor Hu | Configurations | TX    |

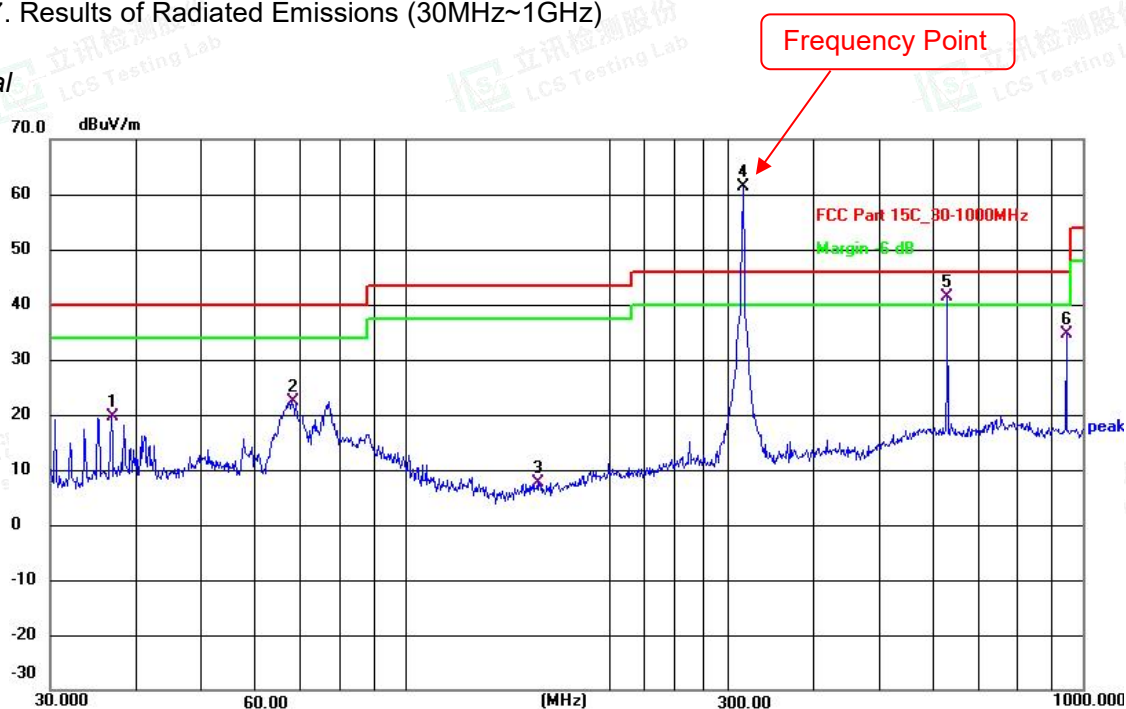
| Freq. (MHz) | Level (dBuV) | Over Limit (dB) | Over Limit (dB) | Remark   |
|-------------|--------------|-----------------|-----------------|----------|
| -           | -            | -               | -               | See Note |

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

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

Horizontal



| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|----------|
| 1   | 36.8953         | 37.37          | -17.70        | 19.67          | 40.00          | -20.33      | QP       |
| 2   | 68.1514         | 41.78          | -19.35        | 22.43          | 40.00          | -17.57      | QP       |
| 3   | 157.0073        | 27.45          | -19.73        | 7.72           | 43.50          | -35.78      | QP       |
| 4   | 315.4806        | 76.20          | -14.74        | 61.46          | 46.00          | 15.46       | peak     |
| 5   | 631.6883        | 52.47          | -11.06        | 41.41          | 46.00          | -4.59       | QP       |
| 6   | 945.4400        | 42.55          | -7.87         | 34.68          | 46.00          | -11.32      | QP       |

## Fundamental and Harmonics Average Result

| Frequency (MHz) | Peak Level (dBμV/m) | AV Factor (dBμV/m) (see Section 5.4) | Average Level (dBμV/m) | Limit (dBμV/m) (average) | Limit (dBμV/m) (Peak) | Conclusion |
|-----------------|---------------------|--------------------------------------|------------------------|--------------------------|-----------------------|------------|
| 315.4806        | 61.46               | -10.89                               | 50.57                  | 75.62                    | 95.62                 | PASS       |
| 631.6883        | 41.41               | -10.89                               | 30.52                  | 55.62                    | 75.62                 | PASS       |



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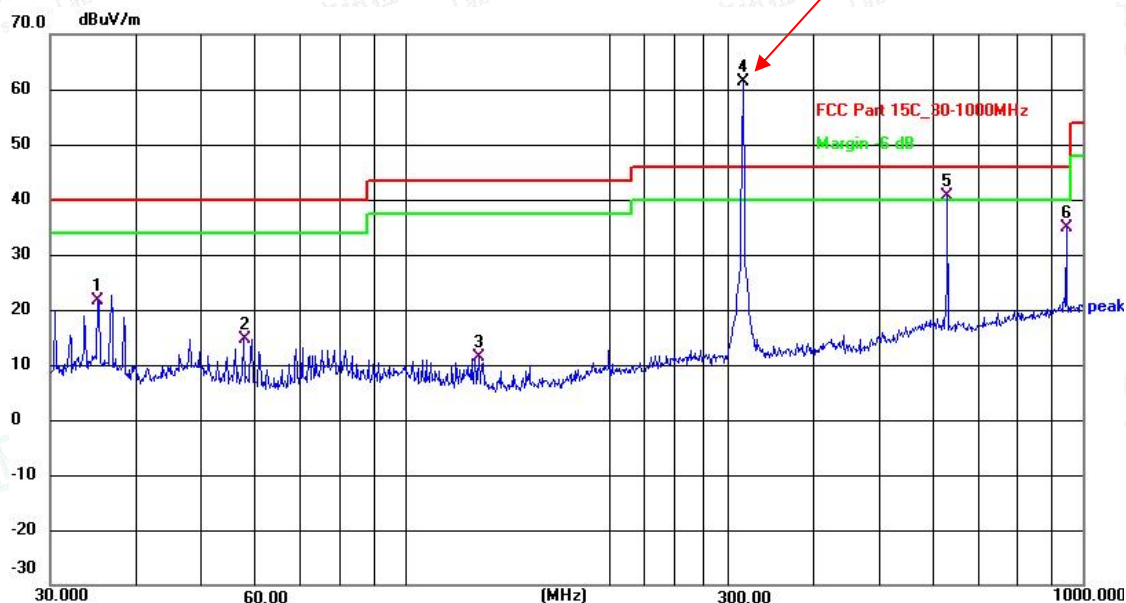
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Vertical



| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|-----|-----------------|----------------|---------------|----------------|----------------|-------------|----------|
| 1   | 35.2511         | 39.53          | -17.79        | 21.74          | 40.00          | -18.26      | QP       |
| 2   | 57.7962         | 33.13          | -18.45        | 14.68          | 40.00          | -25.32      | QP       |
| 3   | 128.5629        | 31.83          | -20.47        | 11.36          | 43.50          | -32.14      | QP       |
| 4   | 315.4806        | 76.11          | -14.74        | 61.37          | 46.00          | 15.37       | peak     |
| 5   | 631.6883        | 51.71          | -11.06        | 40.65          | 46.00          | -5.35       | QP       |
| 6   | 945.4400        | 42.99          | -8.12         | 34.87          | 46.00          | -11.13      | QP       |

Fundamental and Harmonics Average Result

| Frequency (MHz) | Peak Level (dBμV/m) | AV Factor(dBμV/m) (see Section 5.4) | Average Level (dBμV/m) | Limit(dBμV/m) (average) | Limit(dBμV/m) (Peak) | Conclusion |
|-----------------|---------------------|-------------------------------------|------------------------|-------------------------|----------------------|------------|
| 315.4806        | 61.37               | -10.89                              | 50.48                  | 75.62                   | 95.62                | PASS       |
| 631.6883        | 40.65               | -10.89                              | 29.76                  | 55.62                   | 75.62                | PASS       |



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## 5.2.8. Results of Radiated Emissions (Above 1GHz)

|               |           |                |                                           |
|---------------|-----------|----------------|-------------------------------------------|
| Temperature   | 24.6℃     | Humidity       | 54.1%                                     |
| Test Engineer | Taylor Hu | Configurations | Harmonics Emissions/<br>Spurious Emission |

| Peak Value      |                |                     |             |              |
|-----------------|----------------|---------------------|-------------|--------------|
| Frequency (MHz) | Level (dBuV/m) | Limit Line (dBuV/m) | Margin (dB) | Polarization |
| 1299.72         | 45.62          | 74                  | -28.38      | Horizontal   |
| 1735.28         | 37.68          | 74                  | -36.32      | Horizontal   |
| 2167.63         | 41.29          | 74                  | -32.71      | Vertical     |
| 1299.24         | 45.40          | 74                  | -28.60      | Vertical     |

| Average Value:  |                     |                   |                        |                     |             |              |
|-----------------|---------------------|-------------------|------------------------|---------------------|-------------|--------------|
| Frequency (MHz) | Peak Level (dBuV/m) | Duty cycle factor | Average value (dBuV/m) | Limit Line (dBuV/m) | Margin (dB) | Polarization |
| 1299.72         | 45.62               | -10.89            | 34.73                  | 54.00               | -19.27      | Horizontal   |
| 1735.28         | 37.68               | -10.89            | 26.79                  | 54.00               | -27.21      | Horizontal   |
| 2167.63         | 41.29               | -10.89            | 30.40                  | 54.00               | -23.60      | Vertical     |
| 1299.24         | 45.40               | -10.89            | 34.51                  | 54.00               | -19.49      | Vertical     |

## Remark:

1. Measuring frequencies from 9k~10th harmonic (ex. 5GHz), No emission found between lowest internal used/generated frequency to 30MHz.
2. Radiated emissions measured in frequency range from 9k~10th harmonic (ex. 5GHz) were made with an instrument using Peak detector mode.
3. Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
4. Average value=peak reading level + average factor.





### 5.3. 99% and 20dB Bandwidth Emissions

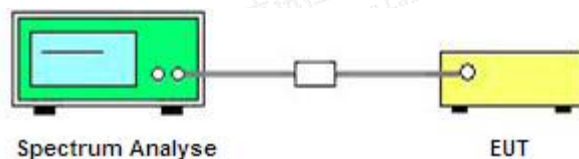
#### 5.3.1. Limit

According to § 15.231 (c), the bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

☒ 0.25% of the center operating frequency

☐ 0.5% of the center operating frequency

#### 5.4.2. Block Diagram of Test Setup



#### 5.3.2. Test Procedure

Use the following spectrum analyzer settings:

Span = 100KHz

RBW = 30KHz

VBW = 100KHz

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

#### 5.3.3. Test Data

| Transmit Frequency (MHz) | Limit (kHz) | 20dB Bandwidth (kHz) | 99% Bandwidth (kHz) | Result |
|--------------------------|-------------|----------------------|---------------------|--------|
| 315.00                   | 787.50      | 27.91                | 50.197              | PASS   |

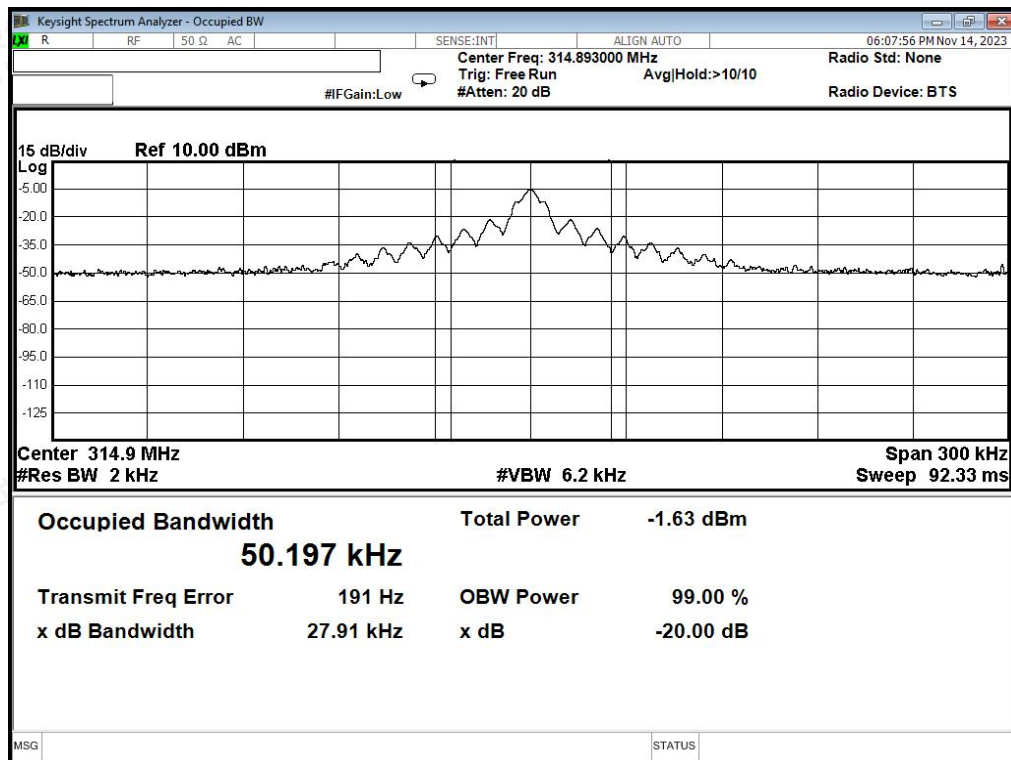


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Remark:

1. Test results including cable loss;
2. Please refer following test plots;



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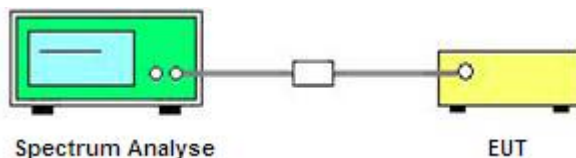


## 5.4. Duty cycle

### 5.4.1. Limit

No dedicated limit specified in the Rules.

### 5.4.2. Block Diagram of Test Setup



### 5.4.3. Test Procedure

- Place the EUT on the table and set it in transmitting mode.
- Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- Set centre frequency of spectrum analyzer=operating frequency.
- Set the spectrum analyzer as RBW=100 KHz, VBW=300 KHz, Span=0Hz, Adjust Sweep=100ms.
- Repeat above procedures until all frequency measured was complete.

### 5.4.3. Test Results

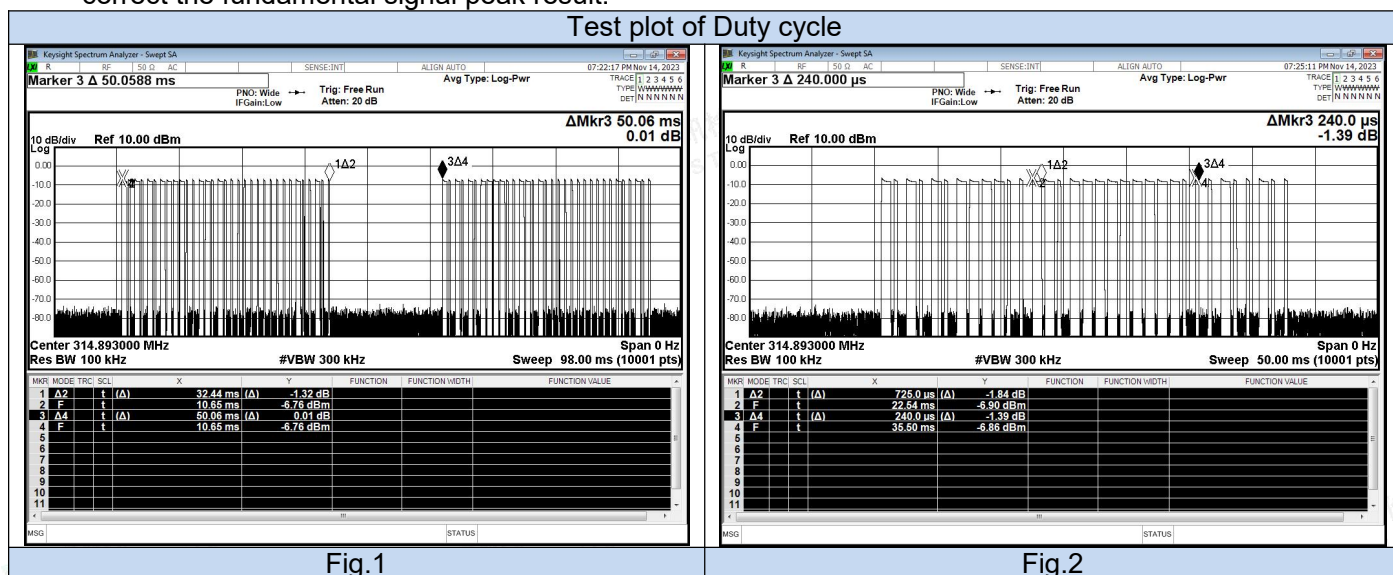
$$T_{on} = 13 \times 0.73 + 20 \times 0.24 = 14.29 \text{ ms}$$

$$T_p = 50.06 \text{ (ms)}$$

$$\text{The duty cycle} = 14.29 / 50.06 = 28.55\%$$

$$\text{Average Correction Factory} = 20 \log (T_{on}/T_p) = 20 \log (0.2855) = -10.89 \text{ dB}$$

Note: The signal bandwidth was measured and less than 100 kHz RBW so PDCF factor is not required to correct the fundamental signal peak result.



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## 5.5. AC Power Line Conducted Emissions (Not Applicable)

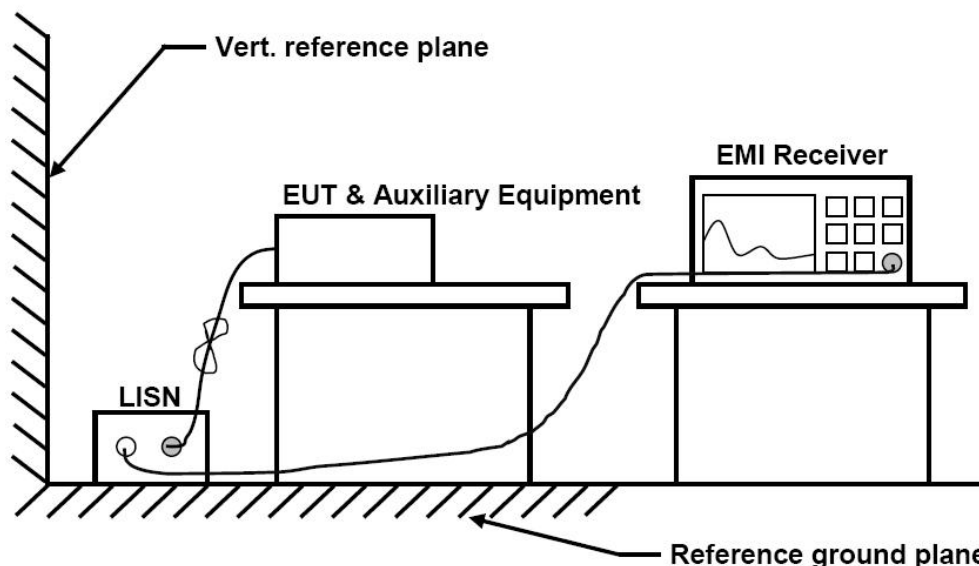
### 5.5.1 Standard Applicable

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

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

\* Decreasing linearly with the logarithm of the frequency

### 5.5.2 Block Diagram of Test Setup



### 5.5.3 Test Results

Not applicable to this device.

NOTE: The device was powered by DC battery, so it unnecessary to test.





## 5.6. Antenna Requirement

### 5.6.1. Standard Applicable

According to § 15.203 and RSS-Gen, 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.

### 5.6.2. Antenna Connected Construction

The directional gains of antenna used for transmitting is -22.9dBi, and the antenna is an Internal Antenna connect to board and no consideration of replacement. Please see EUT photo for details.

### 5.6.3 Result

Compliance.



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## 6. LIST OF MEASURING EQUIPMENTS

| Item | Equipment                      | Manufacturer      | Model No.   | Serial No.      | Cal Date   | Due Date   |
|------|--------------------------------|-------------------|-------------|-----------------|------------|------------|
| 1    | MXA Signal Analyzer            | Agilent           | N9020A      | MY49100060      | 2023-10-18 | 2024-10-17 |
| 2    | DC Power Supply                | Agilent           | E3642A      | N/A             | 2023-10-18 | 2024-10-17 |
| 3    | Temperature & Humidity Chamber | GUANGZHOU GOGNWEN | GDS-100     | 70932           | 2023-10-05 | 2024-10-04 |
| 4    | EMI Test Software              | AUDIX             | E3          | /               | N/A        | N/A        |
| 5    | 3m Semi Anechoic Chamber       | SIDT FRANKONIA    | SAC-3M      | 03CH03-HY       | 2023-06-09 | 2024-06-08 |
| 6    | Positioning Controller         | Max-Full          | MF7802BS    | MF780208586     | N/A        | N/A        |
| 7    | Active Loop Antenna            | SCHWARZBECK       | FMZB 1519B  | 00005           | 2021-08-29 | 2024-08-28 |
| 8    | By-log Antenna                 | SCHWARZBECK       | VULB9163    | 9163-470        | 2021-09-12 | 2024-09-11 |
| 9    | Horn Antenna                   | SCHWARZBECK       | BBHA 9120D  | 9120D-1925      | 2021-09-05 | 2024-09-04 |
| 10   | EMI Test Receiver              | R&S               | ESR 7       | 101181          | 2023-08-15 | 2024-08-14 |
| 11   | RS SPECTRUM ANALYZER           | R&S               | FSP40       | 100503          | 2023-07-17 | 2024-07-16 |
| 12   | Low-frequency amplifier        | SchwarzZBECK      | BBV9745     | 00253           | 2023-10-18 | 2024-10-17 |
| 13   | High-frequency amplifier       | JS Denki Pte      | PA0118-43   | JSPA21009       | 2023-10-18 | 2024-10-17 |
| 14   | EMI Test Receiver              | R&S               | ESPI        | 101940          | 2023-08-15 | 2024-08-14 |
| 15   | Artificial Mains               | R&S               | ENV216      | 101288          | 2023-06-09 | 2024-06-08 |
| 16   | 10dB Attenuator                | SCHWARZBECK       | MTS-IMP-136 | 261115-001-0032 | 2023-06-09 | 2024-06-08 |
| 17   | EMI Test Software              | Farad             | EZ          | /               | N/A        | N/A        |



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## 7. PHOTOGRAPHS OF TEST SETUP

Please refer to separated files for External Photos of the EUT.

## 8. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

## 9. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

-----THE END OF TEST REPORT-----



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