# FCC TEST REPORT

For

The Wheel Group

sensor

Test Model: GEN 5

Additional Model No.: GEN 2, GEN 6

| | | |
|---|---|---|
| Prepared for | : | The Wheel Group |
| Address | : | 1050 Vineyard Ave, Ontario, California, United States |
| Prepared by | : | Shenzhen LCS Compliance Testing Laboratory Ltd. |
| Address | : | 101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China |
| Tel | : | (+86)755-82591330 |
| Fax | : | (+86)755-82591332 |
| Web | : | www.LCS-cert.com |
| Mail | : | webmaster@LCS-cert.com |
| Date of receipt of test sample | : | October 19, 2023 |
| Number of tested samples | : | 2 |
| Sample No. | : | A10113010-1, A10113010-2 |
| Serial number | : | Prototype |
| Date of Test | : | October 19, 2023 ~ December 27, 2023 |
| Date of Report | : | December 28, 2023 |

| FCC TEST REPORT<br>FCC CFR 47 PART 15 C(15.231) | |
|---|---|
| **Report Reference No. .....** | **: LCSA10113010EB** |
| Date of Issue..... | : December 28, 2023 |
| **Testing Laboratory Name.....** | **: Shenzhen LCS Compliance Testing Laboratory Ltd.** |
| Address..... | : 101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Yabianxueziwei, Shajing Street, Baoan District, Shenzhen, 518000, China |
| Testing Location/ Procedure..... | : Full application of Harmonised standards ■<br>Partial application of Harmonised standards □<br>Other standard testing method □ |
| **Applicant's Name.....** | **: The Wheel Group** |
| Address..... | : 1050 Vineyard Ave, Ontario, California, United States |
| **Test Specification** | |
| Standard..... | : FCC Part 15.231(e), ANSI C63.10-2013 |
| **Test Report Form No.....** | **:** LCSEMC-1.0 |
| TRF Originator..... | : Shenzhen LCS Compliance Testing Laboratory Ltd. |
| Master TRF..... | : Dated 2011-03 |
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| **Test Item Description.....** | **: sensor** |
| Trade Mark..... | : N/A |
| Test Model..... | : GEN 5 |
| Ratings..... | : DC 3.0V By CR2050 Battery |
| Result ..... | : **Positive** |

| Compiled by: | Supervised by: | Approved by: |
|---|---|---|
| Diamond Lu/ Administrator | Cary Luo/ Technique principal | Gavin Liang/ Manager |

# FCC -- TEST REPORT

| | |
|---|---|
| **Test Report No. : LCSA10113010EB** | December 28, 2023<br>Date of issue |

| | |
|---|---|
| EUT..... | : sensor |
| Test Model..... | : GEN 5 |
| **Applicant.....** | **: The Wheel Group** |
| Address..... | : 1050 Vineyard Ave, Ontario, California, United States |
| Telephone..... | : / |
| Fax..... | : / |
| **Manufacturer.....** | **: Shanghai Representative Office of wheel group** |
| Address..... | : Room 1502 Bilding A NO1055 Zhongshan Rd West Shanghai China |
| Telephone..... | : / |
| Fax..... | : / |
| **Factory.....** | **: Shanghai Representative Office of wheel group** |
| Address..... | : Room 1502 Bilding A NO1055 Zhongshan Rd West Shanghai China |
| Telephone..... | : / |
| Fax..... | : / |

| **Test Result** | **Positive** |
|---|---|

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.

## Revision History

| Report Version | Issue Date | Revision Content | Revised By |
|---|---|---|---|
| 000 | December 28, 2023 | Initial Issue | -- |
| | | | |
| | | | |

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# 1. GENERAL INFORMATION

## 1.1. Description of Device (EUT)

| | | |
|---|---|---|
| EUT | : | sensor |
| Test Model | : | GEN 5 |
| Additional Model No. | : | GEN 2, GEN 6 |
| Model Declaration | : | PCB board, structure and internal of these model(s) are the same, So no additional models were tested |
| Hardware version | : | / |
| Software version | : | / |
| Power Supply | : | DC 3.0V By CR2050 Battery |
| 433MHz Operation frequency | : | 433.92MHz |
| Modulation Type | : | ASK,FSK |
| Channel Number | : | 1 |
| Antenna Type | : | Internal antenna |
| Antenna Gain | : | -17.37dBi (Max) |
| 315MHz Operation frequency | : | 315MHz |
| Modulation Type | : | ASK,FSK |
| Channel Number | : | 1 |
| Antenna Type | : | Internal antenna |
| Antenna Gain | : | -4.03dBi (Max) |

## 1.2. Objective

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiator. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured. Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

## 1.3. Environmental Conditions

During the measurement the environmental conditions were within the listed ranges:

- Temperature: 15-35ºC

- Humidity: 30-60 %

- Atmospheric pressure: 86-106 kPa

## 1.4. Host System Configuration List and Details

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

## 1.5. External I/O Port

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

## 1.6. EUT Operation

The EUT was placed in a RF test mode for testing of the transmitter and in normal mode of operation for testing the digital circuitry and receiver.

## 1.7. Antenna System

The directional gains of antenna used for transmitting is 0dBi, and EUT uses an Internal antenna which is permanently attached.

## 1.8. Description of Test Facility

Site Description
EMC Lab. : 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.

## 1.9. Statement of The Measurement Uncertainty

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

| Test Item | | Frequency Range | Uncertainty | Note |
|---|---|---|---|---|
| Radiation Uncertainty | : | 9KHz~30MHz | ±3.10dB | (1) |
| | | 30MHz~200MHz | ±2.96dB | (1) |
| | | 200MHz~1000MHz | ±3.10dB | (1) |
| | | 1GHz~26.5GH | ±4.20dB | (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.

# 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 normal operating mode. The TX frequency that was fixed which 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, 15.209 and 15.231(e) 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 13.1.4.1 of ANSI C63.10 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 and for below 1GHz and 1.5m for above 1GHz. 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 13.1.4.1 of ANSI C63.10

## 2.4. Instrument Calibration

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

## 2.5. Test Mode

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 3.0V power to the EUT for testing.

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

# 3. SYSTEM TEST CONFIGURATION

## 3.1. Justification

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

## 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.

# 4. SUMMARY OF TEST RESULTS

| FCC Rules | Description of test | Result |
|---|---|---|
| §15.203 | Antenna Requirement | Compliant |
| §15.231 (e) & §15.209 | Transmitter Field Strength of Emissions and Spurious Emission | Compliant |
| §15.231 (c) | 20dB Bandwidth Testing | Compliant |
| §15.231 (e) | Deactivation Testing | Compliant |
| §15.231 | Duty cycle Factor | Compliant |

*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. Transmitter Deactivation Time

FCC 15.231 (e)

### 5.1.1. Limit

devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

### 5.1.2. Test Procedure

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

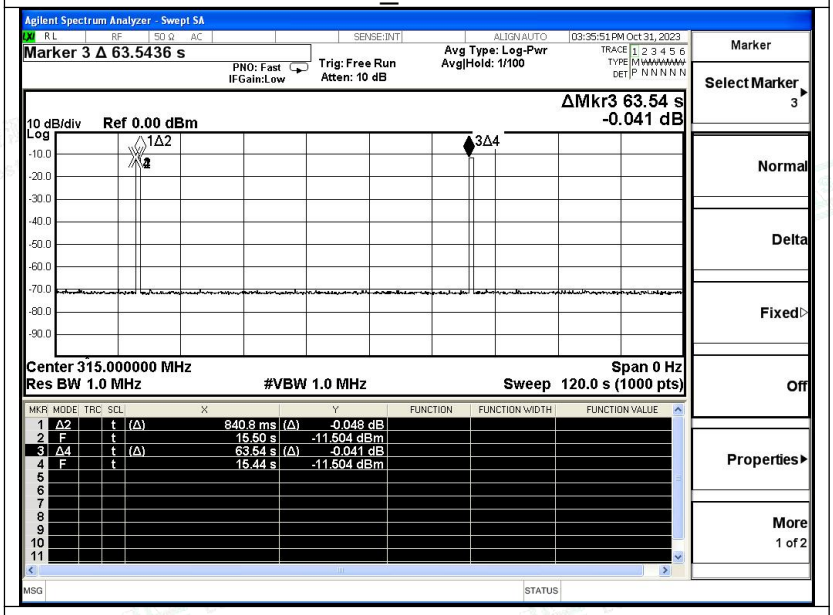
### 5.1.3. Test Results

Test Result: PASS

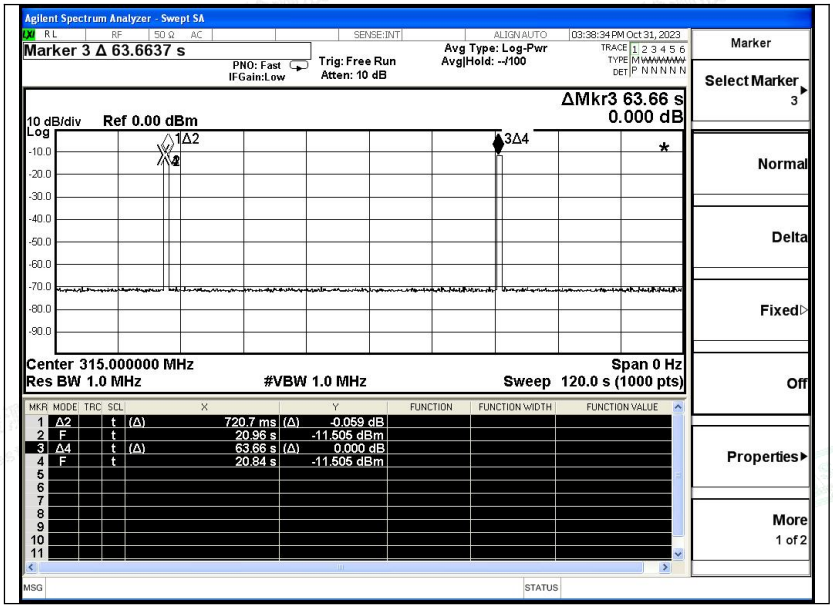
| Temperature | 23.8℃ | Humidity | 52.2% |
|---|---|---|---|
| Test Engineer | Joker Hu | Configurations | TX Mode |

| mode | Frequency (MHz) | the duration of each transmission (s) | Limit: the duration of each transmission shall not be greater than one second(s) | the silent period (s) | Limit: shall be at least 30 times the duration of the transmission but in no case less than 10 seconds. | Conclusion |
|---|---|---|---|---|---|---|
| ASK | 315 | 0.84 | 1 | 63.54 | | PASS |
| FSK | 315 | 0.72 | 1 | 63.66 | | PASS |

ASK_315MHz




FSK_315MHz


Agilent Spectrum Analyzer - Swept SA
Marker 3 Δ 63.6637 s
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
Avg|Hold: --/100
03:38:34 PM Oct 31, 2023
ΔMkr3 63.66 s
0.000 dB
10 dB/div Ref 0.00 dBm
Log
1Δ2
3Δ4
Center 315.000000 MHz
Span 0 Hz
Res BW 1.0 MHz
#VBW 1.0 MHz
Sweep 120.0 s (1000 pts)
1 Δ2 t (Δ) 720.7 ms (Δ) -0.059 dB
2 F t 20.96 s -11.505 dBm
3 Δ4 t (Δ) 63.66 s (Δ) 0.000 dB
4 F t 20.84 s -11.505 dBm
Marker
Select Marker 3
Normal
Delta
Fixed
Off
Properties
More 1 of 2

## 5.2. Transmitter Field Strength of Emissions and Spurious Emission

### 5.2.1. Limit

FCC §15.231 (e) & FCC §15.209

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 | 1000 | 100 |
| 70-130 | 500 | 50 |
| 130-174 | 500 to 1500[1] | 50 to 150[1] |
| 174-260 | 1500 | 150 |
| 260-470 | 1500 to 5000[1] | 150 to 500[1] |
| Above 470 | 5000 | 500 |

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 260-470 MHz, μV/m at 3 meters = 16.6667(F) - 2833.3333. 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 |
| [1]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 | | .([2]) |
| 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.

§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 section 6 of equipments 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 / 1MHz for Peak, 1 MHz / 10Hz for Average |
| RB / VB (Emission in non-restricted band) | 1MHz / 1MHz for Peak, 1 MHz / 10Hz for Average |

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Start ~ Stop Frequency | 9kHz~150kHz / RB 200Hz for QP |
| Start ~ Stop Frequency | 150kHz~30MHz / RB 9kHz for QP |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB 120kHz 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.

**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 (± 45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

**3) Sequence of testing 1 GHz to 5 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:

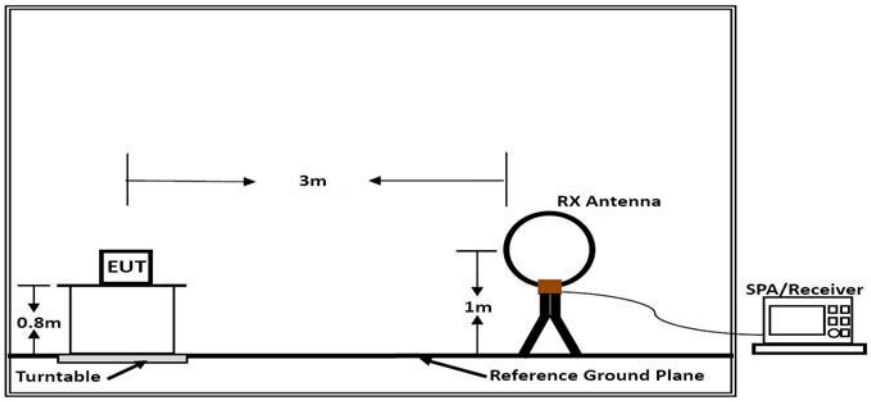
--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum found antenna polarisation 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 polarisations.

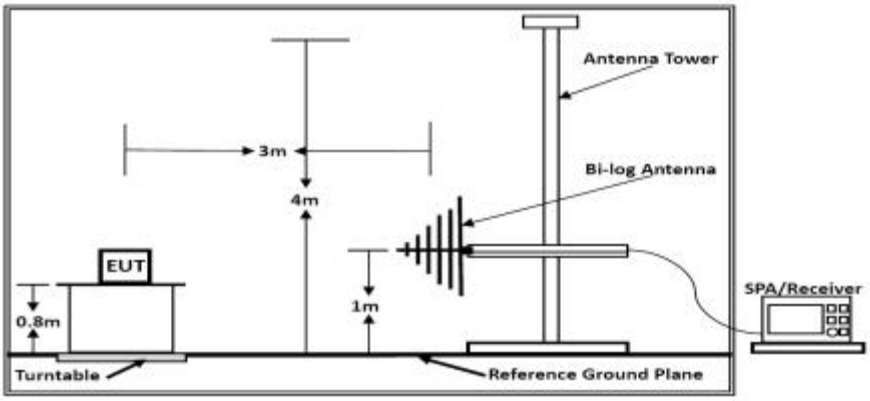
--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector.

--- 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.

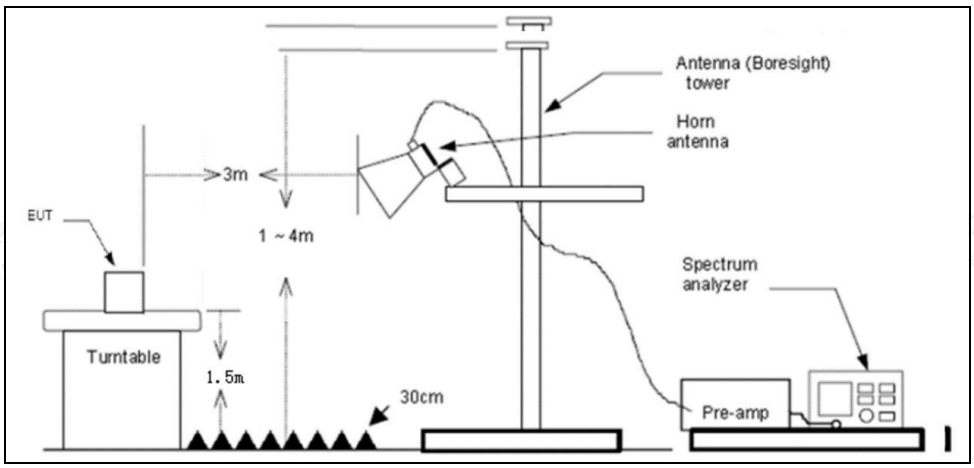
5.2.4 Block Diagram of Test Setup




Below 30MHz




Below 1GHz



5.2.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

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

| | | | |
|---|---|---|---|
| Temperature | 23.8℃ | Humidity | 52.2% |
| Test Engineer | Joker Hu | Configurations | TX Mode |

| Freq. (MHz) | Level (dBuV) | Over Limit (dB) | Over Limit (dBuV) | 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.

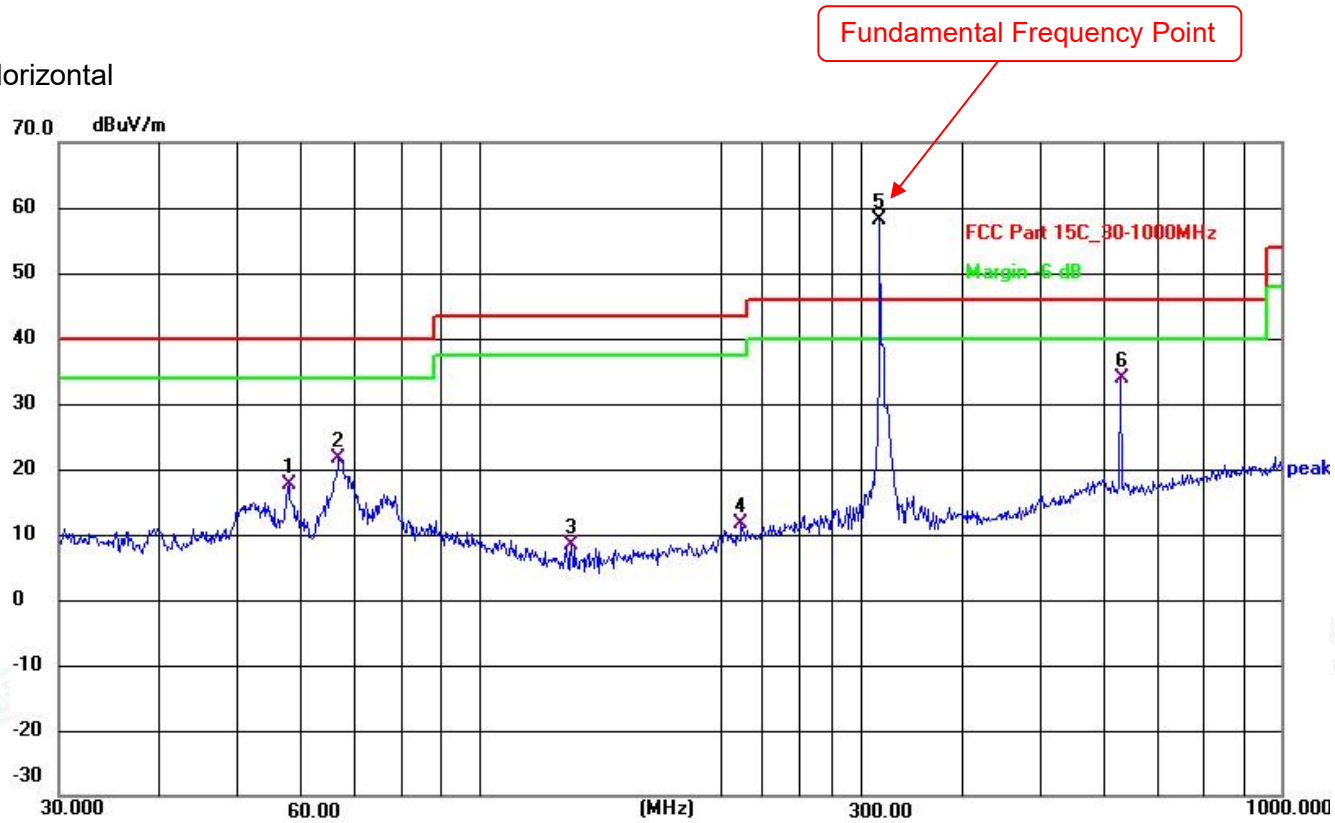
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

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

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

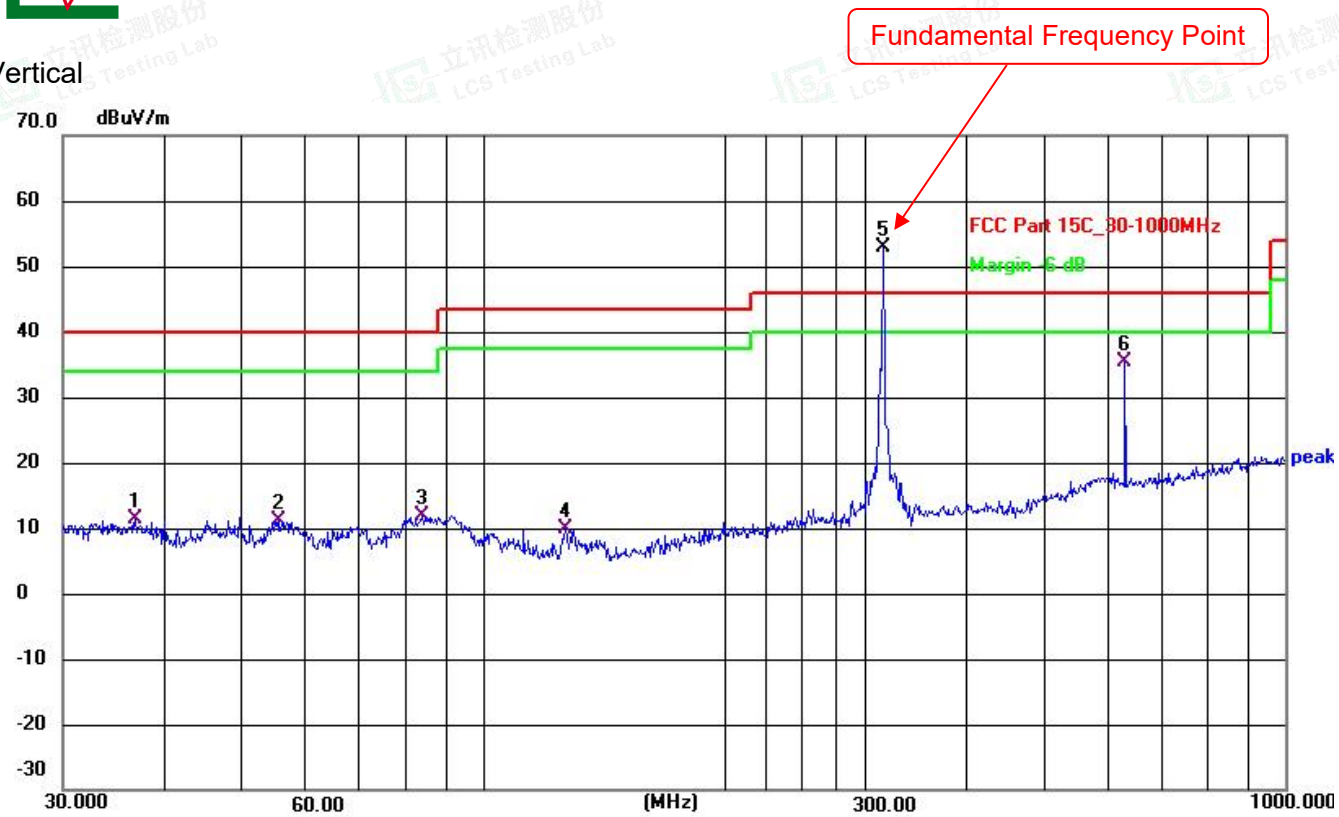
Horizontal




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 57.9992 | 36.01 | -18.49 | 17.52 | 40.00 | -22.48 | QP |
| 2 | 66.9668 | 40.83 | -19.29 | 21.54 | 40.00 | -18.46 | QP |
| 3 | 130.3788 | 29.05 | -20.58 | 8.47 | 43.50 | -35.03 | QP |
| 4 | 212.2692 | 28.71 | -17.08 | 11.63 | 43.50 | -31.87 | QP |
| 5 | 315.4806 | 72.92 | -14.74 | 58.18 | 46.00 | 12.18 | peak |
| 6 | 631.3980 | 44.89 | -11.06 | 33.83 | 46.00 | -12.17 | 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 | 58.18 | -10.90 | 47.28 | 67.66 | 87.66 | PASS |
| 631.3980 | 33.83 | -10.90 | 22.93 | 47.66 | 67.66 | PASS |

Vertical




| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 36.8952 | 29.02 | -17.70 | 11.32 | 40.00 | -28.68 | QP |
| 2 | 55.8046 | 29.26 | -18.09 | 11.17 | 40.00 | -28.83 | QP |
| 3 | 84.1100 | 31.37 | -19.47 | 11.90 | 40.00 | -28.10 | QP |
| 4 | 126.7723 | 30.24 | -20.37 | 9.87 | 43.50 | -33.63 | QP |
| 5 | 315.4806 | 67.65 | -14.74 | 52.91 | 46.00 | 6.91 | peak |
| 6 | 631.6883 | 46.47 | -11.06 | 35.41 | 46.00 | -10.59 | 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 | 52.91 | -10.90 | 42.01 | 67.66 | 87.66 | PASS |
| 631.6883 | 35.41 | -10.90 | 24.51 | 47.66 | 67.66 | PASS |

*Note:*

*1. All reading are Quasi-peak values.*
*2. Measured = Reading + Antenna Factor + Cable Loss*
*3. The emission that are 20dB below the official limit are not reported*
*4. * - means fundamental frequency*
*5. ** - means harmonic frequency*
*6. Pre-scan all modes and recorded the worst case results in this report ASK mode.*
*7. Due to the measure PK emission level less than the AV limit value. No necessary to take down the AV emission level.*

5.2.8. Results of Radiated Emissions (Above 1GHz)

| Temperature | 23.8℃ | Humidity | 52.2% |
|---|---|---|---|
| Test Engineer | Joker Hu | Configurations | TX Mode |

| **Peak Value:** | | | | |
|---|---|---|---|---|
| Frequency（MHz） | Level (dBuV/m) | Limit Line (dBuV/m) | Over limit (dB) | Polarization |
| 1300.28 | 46.49 | 74.00 | -27.51 | Horizontal |
| 1737.82 | 32.42 | 74.00 | -41.58 | Horizontal |
| 2165.22 | 40.33 | 74.00 | -33.67 | Vertical |
| 1299.09 | 47.10 | 74.00 | -26.90 | Vertical |

| **Average Value:** | | | | | | |
|---|---|---|---|---|---|---|
| Frequency (MHz) | Peak Level (dBuV/m) | *average* factor | Average value (dBuV/m) | Limit Line (dBuV/m) | Over limit (dB) | Polarization |
| 1300.28 | 46.49 | -10.90 | 35.59 | 54.00 | -18.41 | Horizontal |
| 1737.82 | 32.42 | -10.90 | 21.52 | 54.00 | -32.48 | Horizontal |
| 2165.22 | 40.33 | -10.90 | 29.43 | 54.00 | -24.57 | Vertical |
| 1299.09 | 47.10 | -10.90 | 36.2 | 54.00 | -17.8 | Vertical |

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. *Pre-scan all modes and recorded the worst case results in this report ASK mode.*

## 5.3. 20dB Bandwidth Emissions

FCC 15.231 (c)

### 5.3.1. Limit

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. Bandwidth is determined at the points 20 dB down from the modulated carrier.

### 5.3.2. Test Procedure

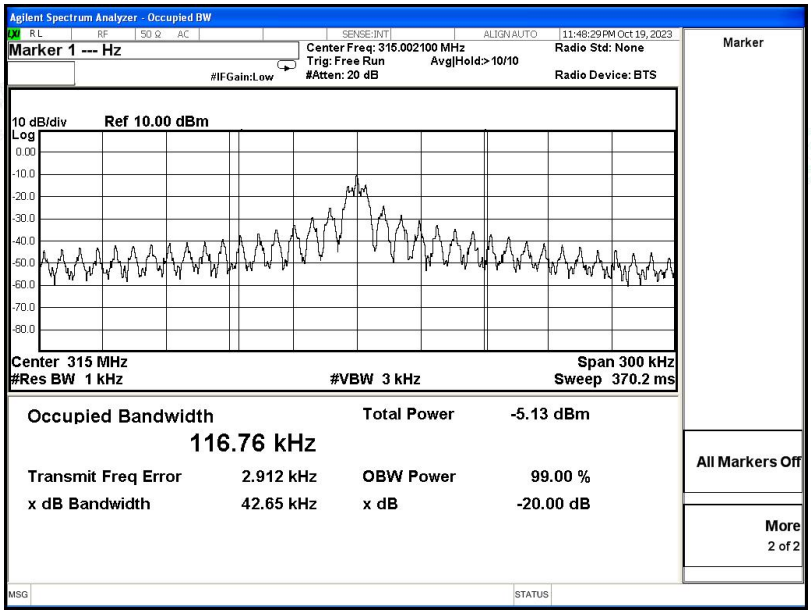
With the EUT's antenna attached, the EUT's 20dB Bandwidth power was received by the test antenna which was connected to the spectrum analyzer with the START and STOP frequencies set to the EUT's operation band.

### 5.3.3. Test Data

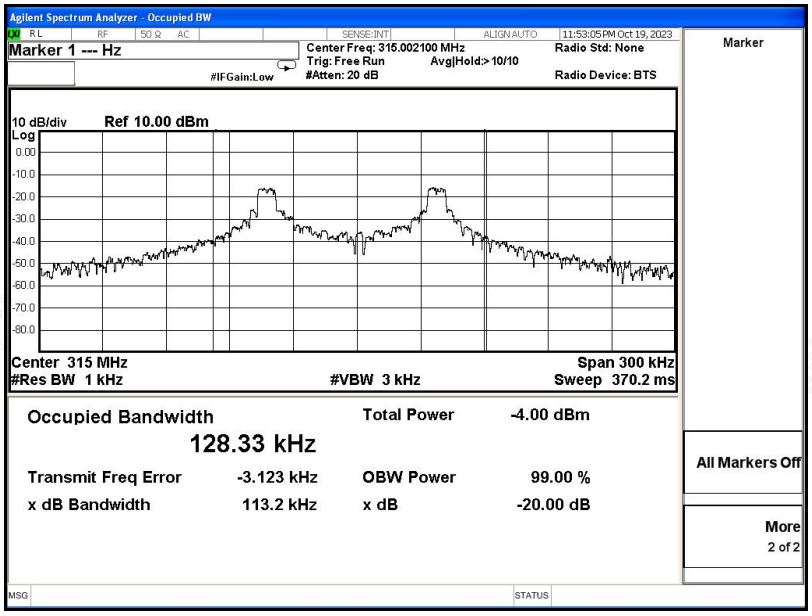
| | | | |
|---|---|---|---|
| Temperature | 23.8℃ | Humidity | 52.2% |
| Test Engineer | Joker Hu | Configurations | TX Mode |

| mode | Center Frequency of operation MHz | Maximum allowed bandwidth kHz | Measured 20dB bandwidth kHz | Result |
|---|---|---|---|---|
| ASK | 315 | 1084.8 | 42.65 | PASS |
| FSK | 315 | 1084.8 | 113.2 | PASS |
| **Maximum allowed bandwidth:** | | ☒ 0.25% of the centre operating frequency<br>☐ 0.5% of the centre operating frequency | | |
| **RBW:**<br>**VBW:** | | ☐ 10kHz ☐ 100kHz ☒ other kHz<br>☐ 30kHz ☐ 300kHz ☒ other kHz | | |

ASK_315MHz



FSK_315MHz


Agilent Spectrum Analyzer - Occupied BW
Marker 1 --- Hz
Center Freq: 315.002100 MHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 20 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
11:53:05 PM Oct 19, 2023
Marker
10 dB/div
Ref 10.00 dBm
Log
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
Center 315 MHz
#Res BW 1 kHz
#VBW 3 kHz
Span 300 kHz
Sweep 370.2 ms
Occupied Bandwidth
128.33 kHz
Total Power -4.00 dBm
Transmit Freq Error -3.123 kHz
OBW Power 99.00 %
x dB Bandwidth 113.2 kHz
x dB -20.00 dB
All Markers Off
More
2 of 2
MSG
STATUS

## 5.4. Duty cycle

### 5.4.1. Limit

No dedicated limit specified in the Rules.

### 5.4.2. Test Procedure

5.4.2.1. Place the EUT on the table and set it in transmitting mode.

5.4.2.2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

5.4.2.3. Set centre frequency of spectrum analyzer=operating frequency.

5.4.2.4. Set the spectrum analyzer as RBW=1MHz, VBW=1MHz, Span=0Hz, Adjust Sweep=Auto.

5.4.2.5. Repeat above procedures until all frequency measured was complete.

### 5.4.3. Test Result

Ton = 0.725*13+0.242*20=14.265 ms

Tp = 50.05 (ms)

The duty cycle = 14.265/50.05 = 28.50%

Average Correction Factor = 20log (Ton/Tp) =20log (0.2850) = -10.90dB

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.

Test plot of Duty cycle

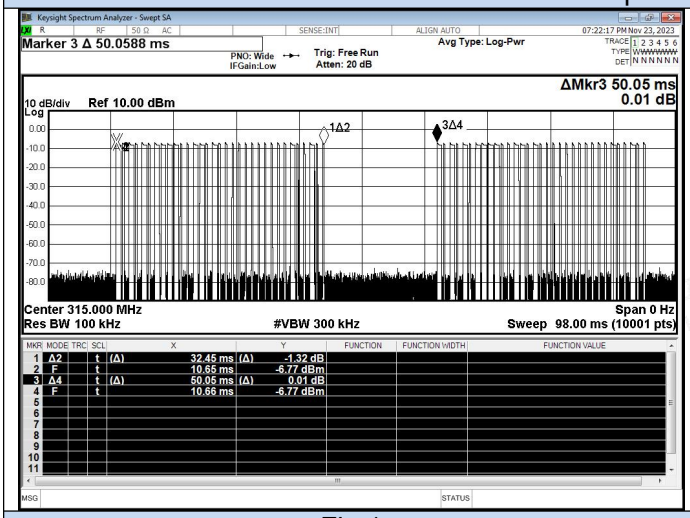



Fig.1

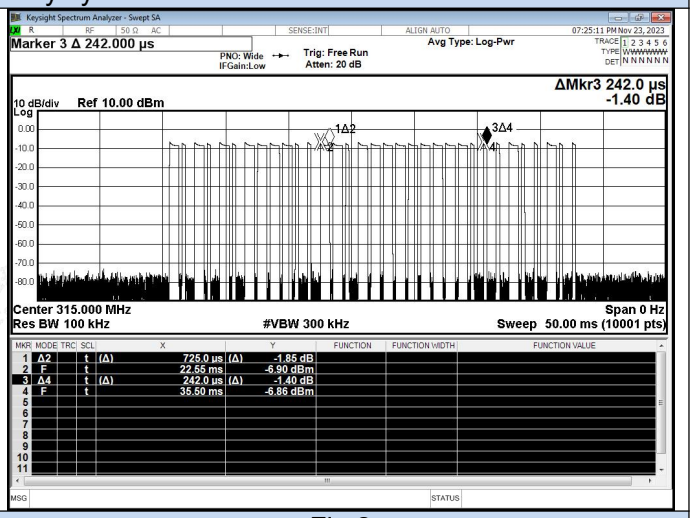



Fig.2

## 5.5. Antenna Requirement

FCC 15.203

### 5.5.1. Standard Applicable

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.

This EUT uses an integral antenna which is permanently attached.

### 5.5.2. Result

Compliant.

The antenna used for transmitting is permanently attached and no consideration of replacement. Please see EUT photo for details.

# 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 |

# 7. TEST SETUP PHOTOGRAPHS

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----------