# FCC Test Report

## FCC PART 15 SUBPART C 15.247

**Test report**

**On Behalf of**

**DUOMONDI INTERNATIONAL DEVELOPMENT CO., LIMITED**

**For**

**SPERO 10**

**Model No.: DS10**

**FCC ID: 2AZ8Z-DS10**

| | |
|---|---|
| **Prepared For :** | **DUOMONDI INTERNATIONAL DEVELOPMENT CO., LIMITED**<br>**C1, C2&C6 17/F, ROXY INDUSTRIAL CENTRE 58-66 TAI LIN PAI RD, KWAI CHUNG NT, Hong Kong** |
| **Prepared By :** | **Shenzhen HUAK Testing Technology Co., Ltd.**<br>**1-2/F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China** |
| **Date of Test:** | **May. 05, 2023 ~ Jun. 25, 2023** |
| **Date of Report:** | **Jun. 25, 2023** |
| **Report Number:** | **HK2305051734-2E** |

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# Test Result Certification

| | | |
|---|---|---|
| **Applicant's name** | : | DUOMONDI INTERNATIONAL DEVELOPMENT CO., LIMITED |
| Address | : | C1, C2&C6 17/F, ROXY INDUSTRIAL CENTRE 58-66 TAI LIN PAI RD, KWAI CHUNG NT, Hong Kong |
| **Manufacture's Name** | : | DUOMONDI INTERNATIONAL DEVELOPMENT CO., LIMITED |
| Address | : | C1, C2&C6 17/F, ROXY INDUSTRIAL CENTRE 58-66 TAI LIN PAI RD, KWAI CHUNG NT, Hong Kong |

**Product description**

| | | |
|---|---|---|
| Trade Mark: | | DUOMONDI |
| Product name | : | SPERO 10 |
| Model and/or type reference | : | DS10 |
| **Standards** | : | **47 CFR FCC Part 15 Subpart C 15.247** |

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| | | |
|---|---|---|
| **Date of Test** | : | |
| Date (s) of performance of tests | : | May. 05, 2023 ~ Jun. 25, 2023 |
| Date of Issue | : | Jun. 25, 2023 |
| Test Result | : | **Pass** |

Prepared by: Gary Qian

Project Engineer

Reviewed by: Zden Hu

Project Supervisor

Approved by: Jason Zhu

Technical Director

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# ** Modified History **

| Revision | Description | Issued Data | Remark |
|---|---|---|---|
| Revision 1.0 | Initial Test Report Release | Jun. 25, 2023 | Jason Zhou |
| | | | |
| | | | |

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Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

# 1 Test Summary

## 1.1 Test Description

| Test Item | Test Requirement | Result |
|---|---|---|
| Antenna Requirement | §15.203/§15.247(b)(4) | PASS |
| Conducted Emission | FCC Part 15.207 | PASS |
| Radiated Emissions | FCC Part 15.205/15.209 | PASS |
| Maximum Peak Output Power | FCC Part 15.247(b) | PASS |
| Power Spectral Density | FCC Part 15.247(e) | PASS |
| 6dB Bandwidth & 99% Bandwidth | FCC Part 15.247(a)(2) | PASS |
| Spurious RF Conducted Emission | FCC Part 15.247(d) | PASS |
| Band Edge | FCC Part 15.247(d) | PASS |

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## 1.2 Measurement Uncertainty

All measurements involve certain levels of uncertainties. 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. The maximum value of the uncertainty as below:

| No. | Item | Uncertainty |
|---|---|---|
| 1 | Conducted Emission Test | ±2.71dB |
| 2 | All emissions, radiated(<1G) | ±3.90dB |
| 3 | All emissions, radiated(>1G) | ±4.28dB |

## 1.3 Information of the Test Laboratory

Shenzhen HUAK Testing Technology Co., Ltd.
Add.: 1-2/F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping, Fuhai Street, Bao’an District, Shenzhen, Guangdong, China

Testing Laboratory Authorization：

A2LA Accreditation Code is 4781.01.
FCC Designation Number is CN1229.
Canada IC CAB identifier is CN0045.
CNAS Registration Number is L9589.

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# 2 General Information

## 2.1 General Description of EUT

| | |
|---|---|
| EUT Name: | SPERO 10 |
| Model No: | DS10 |
| Series Model: | N/A |
| Model Difference: | N/A |
| Brand Name: | DUOMONDI |
| Operation Frequency: | 2402 MHz to 2480 MHz |
| Channel Separation: | 2MHz |
| Number of Channel: | 40 |
| Modulation Technology: | GFSK |
| Hardware Version: | V2.0 |
| Software Version: | V2.0 |
| Antenna Type: | PCB Antenna |
| Antenna Gain: | 3.3dBi |
| Power Supply: | DC5V From Type-C or DC 3.6V From Battery |
| Note: | |
| 1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual. | |

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| Description of Channel: | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 0 | 2402 | 14 | 2430 | 28 | 2458 |
| 1 | 2404 | 15 | 2432 | 29 | 2460 |
| 2 | 2406 | 16 | 2434 | 30 | 2462 |
| 3 | 2408 | 17 | 2436 | 31 | 2464 |
| 4 | 2410 | 18 | 2438 | 32 | 2466 |
| 5 | 2412 | 19 | 2440 | 33 | 2468 |
| 6 | 2414 | 20 | 2442 | 34 | 2470 |
| 7 | 2416 | 21 | 2444 | 35 | 2472 |
| 8 | 2418 | 22 | 2446 | 36 | 2474 |
| 9 | 2420 | 23 | 2448 | 37 | 2476 |
| 10 | 2422 | 24 | 2450 | 38 | 2478 |
| 11 | 2424 | 25 | 2452 | 39 | 2480 |
| 12 | 2426 | 26 | 2454 | | |
| 13 | 2428 | 27 | 2456 | | |

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## 2.2 Description of Test Conditions

(1) E.U.T. test conditions:
For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

(2) Frequency range of radiated measurements:
The test range will be up to the tenth harmonic of the highest fundamental frequency.

(3) Pre-test the EUT in all transmitting mode at the lowest (2402 MHz), middle (2440 MHz) and highest (2480 MHz) channel with different data packet and conducted to determine the worst-case mode, only the worst-case results are recorded in this report.

(4) The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

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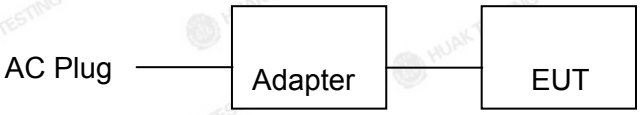
## 2.3 Description of Test Setup

Operation of EUT during conducted and radiation below 1GHz testing:




Operation of EUT during radiation above 1GHz testing:


Adapter information
Model: HW-059200CHQ
Input: 100-240V, 50/60Hz, 0.5A
Output: 5VDC, 2A

The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages. The worst case is X position.

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# 3 Equipments List for All Test Items

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | L.I.S.N. Artificial Mains Network | R&S | ENV216 | HKE-002 | Feb. 17, 2023 | 1 Year |
| 2. | L.I.S.N. | R&S | ENV216 | HKE-059 | Feb. 17, 2023 | 1 Year |
| 3. | Receiver | R&S | ESR-7 | HKE-010 | Feb. 17, 2023 | 1 Year |
| 4. | RF automatic control unit | Tonscend | JS0806-2 | HKE-060 | Feb. 17, 2023 | 1 Year |
| 5. | Spectrum analyzer | R&S | FSP40 | HKE-025 | Feb. 17, 2023 | 1 Year |
| 6. | Spectrum analyzer | Agilent | N9020A | HKE-048 | Feb. 17, 2023 | 1 Year |
| 7. | High gain antenna | Schwarzbeck | LB-180400KF | HKE-054 | Feb. 17, 2023 | 1 Year |
| 8. | Preamplifier | Schwarzbeck | BBV 9743 | HKE-006 | Feb. 17, 2023 | 1 Year |
| 9. | Bilog Broadband Antenna | Schwarzbeck | VULB9163 | HKE-012 | Feb. 17, 2023 | 1 Year |
| 10. | Loop Antenna | Schwarzbeck | FMZB 1519 B | HKE-014 | Feb. 17, 2023 | 1 Year |
| 11. | Horn Antenna | Schewarzbeck | 9120D | HKE-013 | Feb. 17, 2023 | 1 Year |
| 12. | Pre-amplifier | EMCI | EMC051845SE | HKE-015 | Feb. 17, 2023 | 1 Year |
| 13. | Pre-amplifier | Agilent | 83051A | HKE-016 | Feb. 17, 2023 | 1 Year |
| 14. | High pass filter unit | Tonscend | JS0806-F | HKE-055 | Feb. 17, 2023 | 1 Year |
| 15. | Conducted test software | Tonscend | TS+ Rev 2.5.0.0 | HKE-081 | N/A | N/A |
| 16. | Radiated test software | Tonscend | TS+ Rev 2.5.0.0 | HKE-082 | N/A | N/A |
| 17. | RF test software | Tonscend | JS1120-B Version 2.6 | HKE-083 | N/A | N/A |
| 18. | RF automatic control unit | Tonscend | JS0806-2 | HKE-060 | Feb. 17, 2023 | 1 Year |
| 19. | RF test software | Tonscend | JS1120-4 | HKE-113 | N/A | N/A |
| 20. | RF test software | Tonscend | JS1120-3 | HKE-114 | N/A | N/A |
| 21. | RF test software | Tonscend | JS1120-1 | HKE-115 | N/A | N/A |
| 22. | Spectrum analyzer | Agilent | N9020A | HKE-048 | Feb. 17, 2023 | 1 Year |
| 23. | Signal generator | Agilent | N5182A | HKE-029 | Feb. 17, 2023 | 1 Year |
| 24. | Signal Generator | Agilent | 83630A | HKE-028 | Feb. 17, 2023 | 1 Year |
| 25. | Power meter | Agilent | E4419B | HKE-085 | Feb. 17, 2023 | 1 Year |

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| | | | | | | |
|---|---|---|---|---|---|---|
| 26. | Power Sensor | Agilent | E9300A | HKE-086 | Feb. 17, 2023 | 1 Year |
| 27. | RF Cable(below1GHz) | Times | 9kHz-1GHz | HKE-117 | Feb. 17, 2023 | 1 Year |
| 28. | RF Cable(above 1GHz) | Times | 1-40G | HKE-034 | Feb. 17, 2023 | 1 Year |
| 29. | RF Cable (9KHz-40GHz) | Tonscend | 170660 | N/A | Feb. 17, 2023 | 1 Year |
| 30. | Shielded room | Shiel Hong | 4*3*3 | HKE-039 | Dec. 09, 2021 | 3 Year |
| 31. | High gain antenna | Schwarzbeck | LB-180400KF | HKE-054 | Feb. 17, 2023 | 1 Year |

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# 4 Test Result

## 4.1 Antenna Requirement

### 4.1.1 Standard Requirement

**Standard Applicable**

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

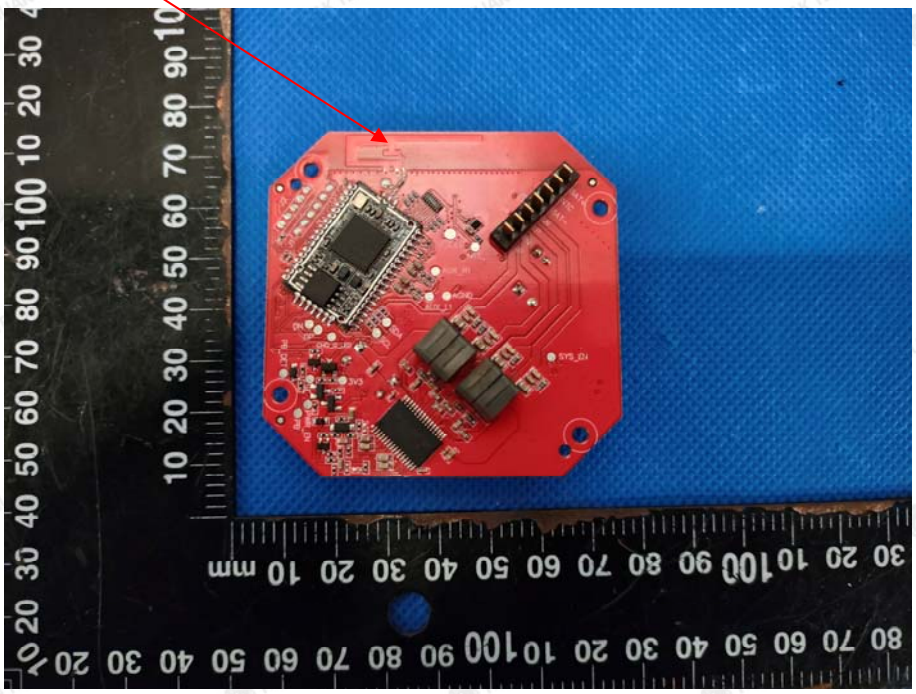
**Refer to statement below for compliance.**

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

**Antenna Connected Construction**

The antenna used in this product is a PCB Antenna, which permanently attached. It conforms to the standard requirements. The directional gains of antenna used for transmitting is 3.3dBi.

### 4.1.2 EUT Antenna



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## 4.2 Conduction Emissions Measurement

### 4.2.1 Applied Procedures / Limit

According to FCC CFR Title 47 Part 15 Subpart C Section 15.207, AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus as below:

| Frequency range (MHz) | Limit (dBuV) | |
|---|---|---|
| | 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.

### 4.2.2 Test Procedure

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. The adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

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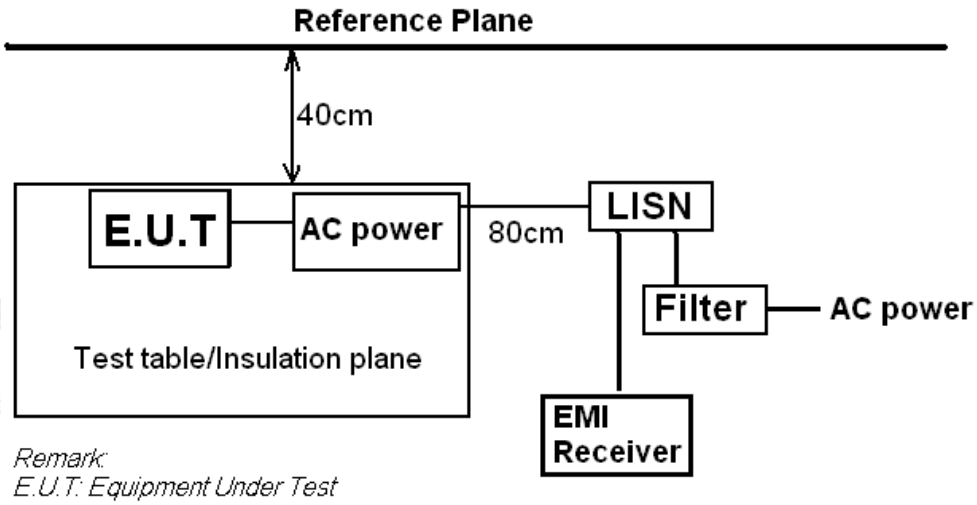
### 4.2.3 Test Setup




*Remark:*
*E.U.T: Equipment Under Test*
*LISN: Line Impedence Stabilization Network*
*Test table height=0.8m*

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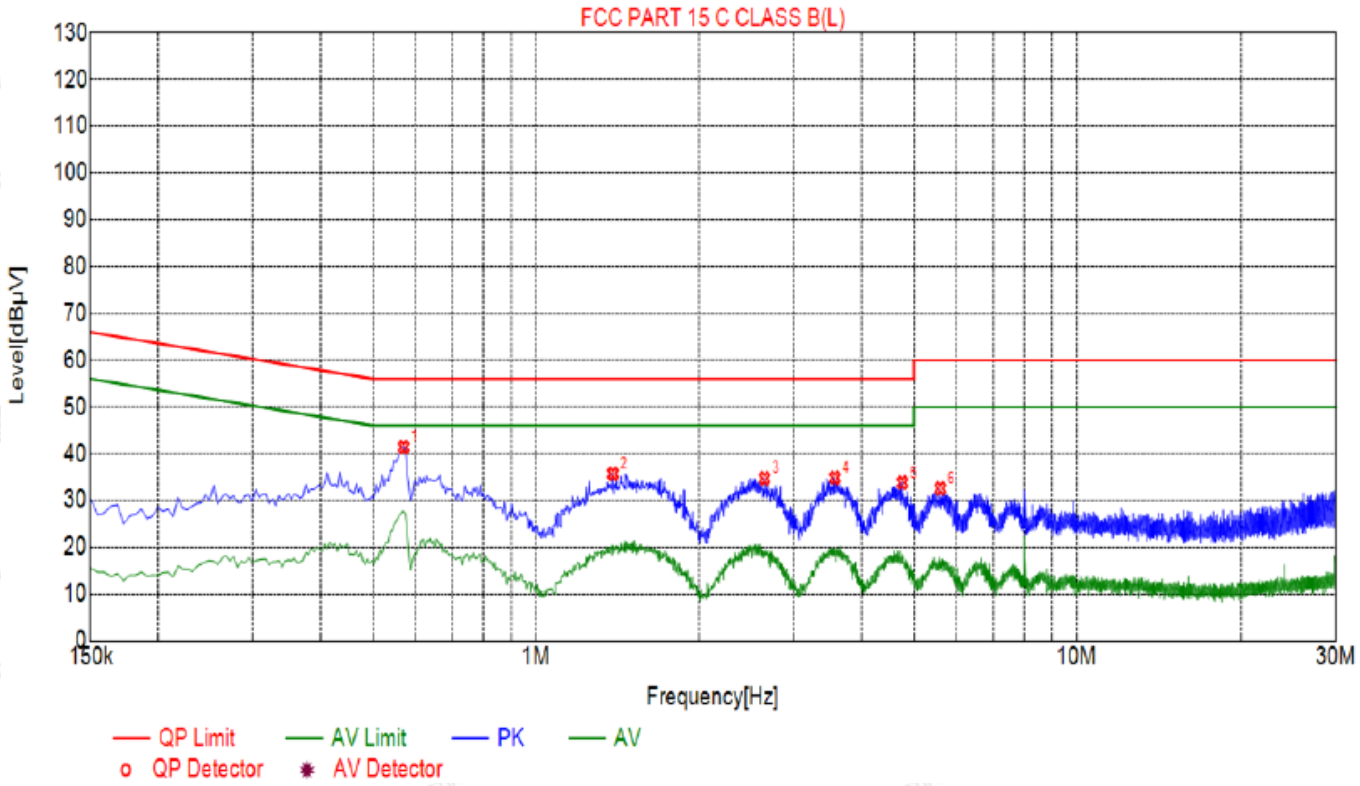
### 4.2.4 Test Results

Test Specification: Line




| Suspected List | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | Freq. [MHz] | Level [dBµV] | Factor [dB] | Limit [dBµV] | Margin [dB] | Reading [dBµV] | Detector | Type |
| 1 | 0.5685 | 41.42 | 20.05 | 56.00 | 14.58 | 21.37 | PK | L |
| 2 | 1.3875 | 35.71 | 20.11 | 56.00 | 20.29 | 15.60 | PK | L |
| 3 | 2.6475 | 34.71 | 20.21 | 56.00 | 21.29 | 14.50 | PK | L |
| 4 | 3.5700 | 34.82 | 20.25 | 56.00 | 21.18 | 14.57 | PK | L |
| 5 | 4.7580 | 33.79 | 20.26 | 56.00 | 22.21 | 13.53 | PK | L |
| 6 | 5.5995 | 32.56 | 20.25 | 60.00 | 27.44 | 12.31 | PK | L |

Remark: Margin = Limit – Level

Correction factor = Cable lose + LISN insertion loss

Level=Test receiver reading + correction factor

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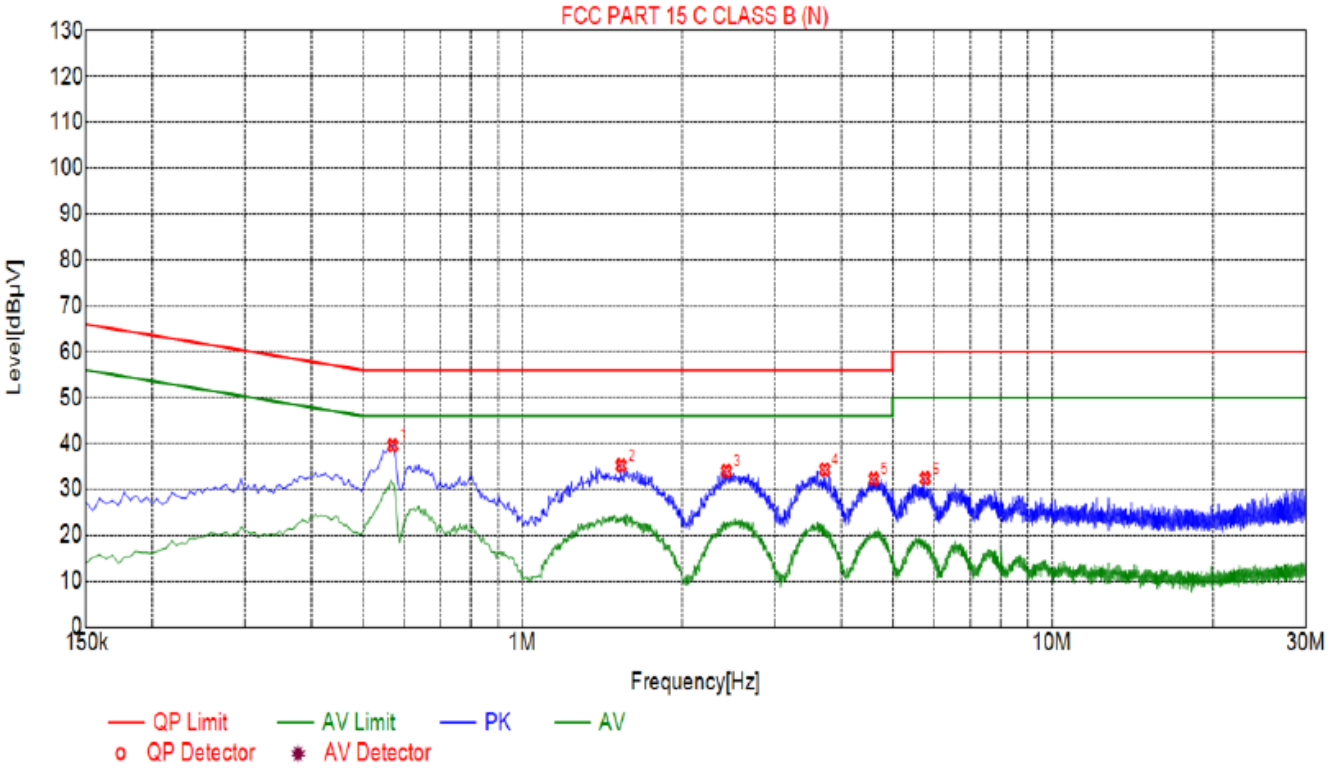
Test Specification: Neutral




## Suspected List

| NO. | Freq. [MHz] | Level [dBµV] | Factor [dB] | Limit [dBµV] | Margin [dB] | Reading [dBµV] | Detector | Type |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.5685 | 39.56 | 20.05 | 56.00 | 16.44 | 19.51 | PK | N |
| 2 | 1.5360 | 35.18 | 20.11 | 56.00 | 20.82 | 15.07 | PK | N |
| 3 | 2.4270 | 33.94 | 20.18 | 56.00 | 22.06 | 13.76 | PK | N |
| 4 | 3.7230 | 34.28 | 20.25 | 56.00 | 21.72 | 14.03 | PK | N |
| 5 | 4.6050 | 32.23 | 20.25 | 56.00 | 23.77 | 11.98 | PK | N |
| 6 | 5.7660 | 32.36 | 20.24 | 60.00 | 27.64 | 12.12 | PK | N |

Remark: Margin = Limit – Level

Correction factor = Cable lose + LISN insertion loss

Level=Test receiver reading + correction factor

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## 4.3 Radiated Emissions Measurement

### 4.3.1 Applied Procedures / Limit

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission out of authorized band shall not exceed the following table at a 3 meters measurement distance.

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).

Except when the requirements applicable to a given device state otherwise, emissions from license-exempt transmitters shall comply with the field strength limits shown in table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

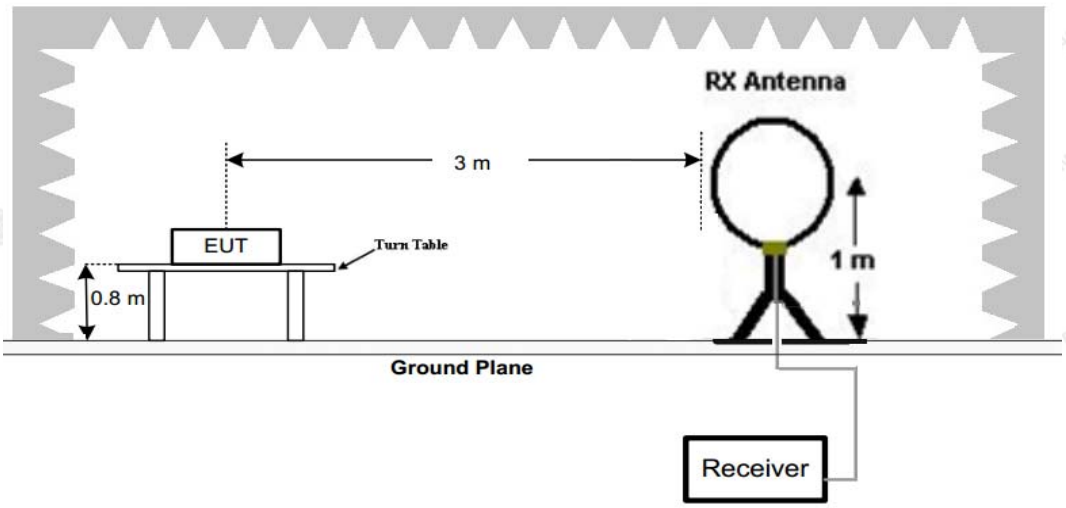
Radiated emission limits

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m) | Radiated (μV/m) |
|---|---|---|---|
| 0.009-0.49 | 3 | 20log(2400/F(KHz))+40log(300/3) | 2400/F(KHz) |
| 0.49-1.705 | 3 | 20log(24000/F(KHz))+ 40log(30/3) | 24000/F(KHz) |
| 1.705-30 | 3 | 20log(30)+ 40log(30/3) | 30 |
| 30-88 | 3 | 40.0 | 100 |
| 88-216 | 3 | 43.5 | 150 |
| 216-960 | 3 | 46.0 | 200 |
| Above 960 | 3 | 54.0 | 500 |

### 4.3.2 Test Setup

**Test Configuration:**

1) 9 kHz to 30 MHz emissions:

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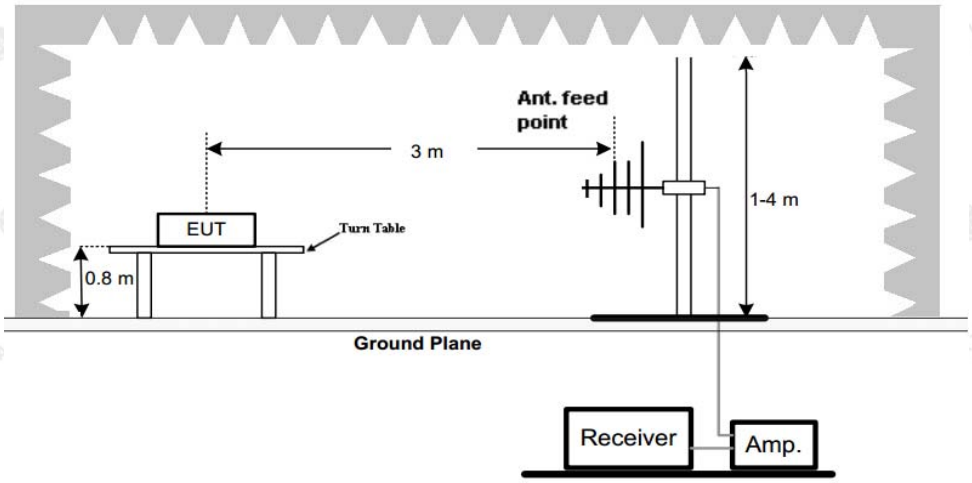
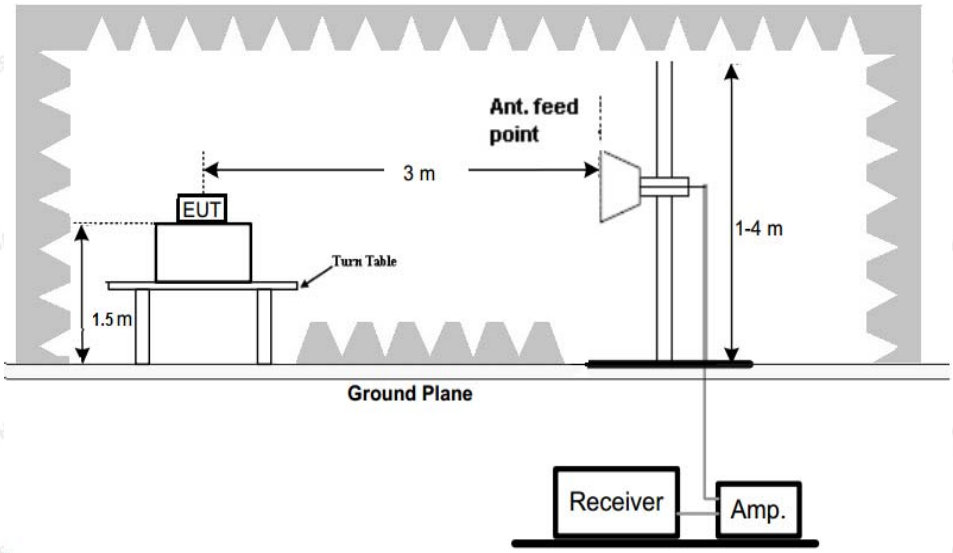
2) 30 MHz to 1 GHz emissions:




3) 1 GHz to 25 GHz emissions:




**Test Procedure**

1. The EUT was placed on turn table which is 0.8m above ground plane for below 1GHz test, and on a low permittivity and low loss tangent turn table which is 1.5m above ground plane for above 1GHz test.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.

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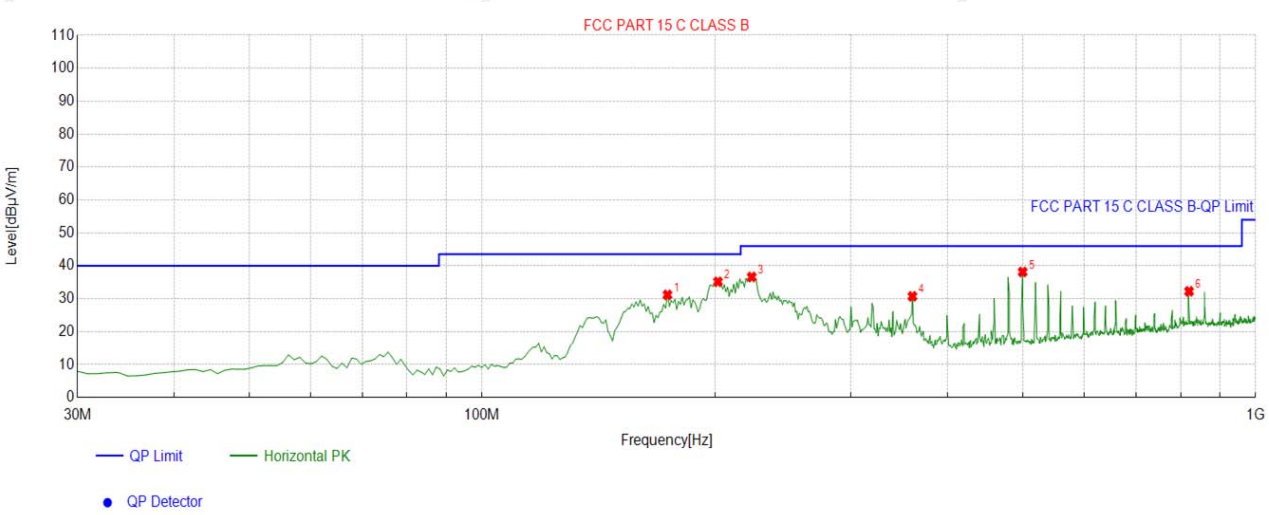
### 4.3.3 Test Result

Below 1GHz Test Results:

All modes have been tested, only the worst mode is reflected.

Antenna polarity: H




| Suspected List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO. | Freq. [MHz] | Factor [dB] | Reading [dBµV/m] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity |
| 1 | 173.7037 | -16.76 | 47.92 | 31.16 | 43.50 | 12.34 | 100 | 252 | Horizontal |
| 2 | 201.8619 | -14.99 | 50.13 | 35.14 | 43.50 | 8.36 | 100 | 64 | Horizontal |
| 3 | 223.2232 | -14.10 | 50.71 | 36.61 | 46.00 | 9.39 | 100 | 59 | Horizontal |
| 4 | 360.1301 | -10.97 | 41.69 | 30.72 | 46.00 | 15.28 | 100 | 48 | Horizontal |
| 5 | 499.9500 | -7.07 | 45.20 | 38.13 | 46.00 | 7.87 | 100 | 150 | Horizontal |
| 6 | 820.3704 | -1.46 | 33.70 | 32.24 | 46.00 | 13.76 | 100 | 185 | Horizontal |

Remark: Factor = Cable loss + Antenna factor – Preamplifier; Level = Reading + Factor; Margin = Limit – Level

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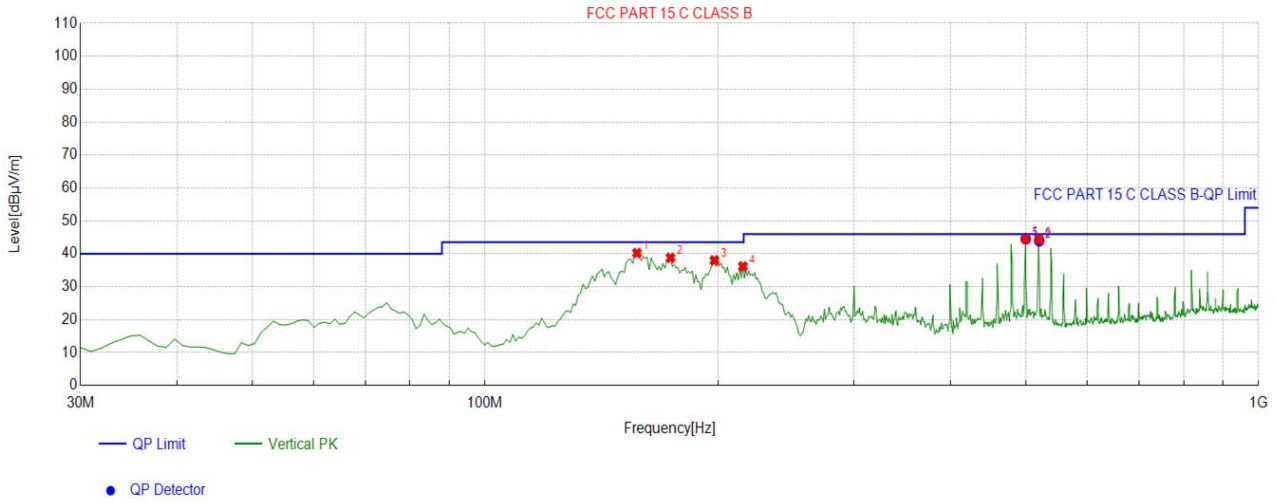
Antenna polarity: V




| Suspected List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO. | Freq. [MHz] | Factor [dB] | Reading [dBµV/m] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity |
| 1 | 157.1972 | -18.07 | 58.29 | 40.22 | 43.50 | 3.28 | 100 | 224 | Vertical |
| 2 | 173.7037 | -16.76 | 55.54 | 38.78 | 43.50 | 4.72 | 100 | 197 | Vertical |
| 3 | 197.9780 | -15.96 | 53.94 | 37.98 | 43.50 | 5.52 | 100 | 146 | Vertical |
| 4 | 215.4555 | -14.43 | 50.57 | 36.14 | 43.50 | 7.36 | 100 | 157 | Vertical |
| 5 | 499.9500 | -7.07 | 51.56 | 44.49 | 46.00 | 1.51 | 100 | 328 | Vertical |
| 6 | 520.3403 | -7.07 | 51.43 | 44.36 | 46.00 | 1.64 | 100 | 358 | Vertical |

| Final Data List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO. | Freq. [MHz] | Factor [dB] | QP Reading [dBµV/m] | QP Value [dBµV/m] | QP Limit [dBµV/m] | QP Margin [dB] | Height [cm] | Angle [°] | Polarity |
| 1 | 499.9500 | -7.07 | 51.67 | 44.60 | 46.00 | 1.40 | 100 | 328 | Vertical |
| 2 | 520.3403 | -7.07 | 50.98 | 43.91 | 46.00 | 2.09 | 100 | 358 | Vertical |

Remark: Factor = Cable loss + Antenna factor – Preamplifier; Level = Reading + Factor; Margin = Limit – Level

**Harmonics and Spurious Emissions**

**Frequency Range (9kHz-30MHz)**

| Frequency (MHz) | Level@3m (dBµV/m) | Limit@3m (dBµV/m) |
|---|---|---|
| -- | -- | -- |
| -- | -- | -- |
| -- | -- | -- |
| -- | -- | -- |

***Note:****1. Emission Level=Reading+ Cable loss+ Antenna factor-Amp factor.*

*2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement.*

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***For 1GHz to 25GHz***

CH Low (2402MHz)

Horizontal:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4804 | 53.86 | -3.65 | 50.21 | 74.00 | -23.79 | peak |
| 4804 | 44.05 | -3.65 | 40.40 | 54.00 | -13.60 | AVG |
| 7206 | 51.12 | -0.95 | 50.17 | 74.00 | -23.83 | peak |
| 7206 | 43.19 | -0.95 | 42.24 | 54.00 | -11.76 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |

Vertical:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4804 | 53.39 | -3.65 | 49.74 | 74.00 | -24.26 | peak |
| 4804 | 42.88 | -3.65 | 39.23 | 54.00 | -14.77 | AVG |
| 7206 | 50.69 | -0.95 | 49.74 | 74.00 | -24.26 | peak |
| 7206 | 40.42 | -0.95 | 39.47 | 54.00 | -14.53 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |

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CH Middle (2440MHz)

Horizontal:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4880.00 | 54.73 | -3.54 | 51.19 | 74.00 | -22.81 | peak |
| 4880.00 | 41.31 | -3.54 | 37.77 | 54.00 | -16.23 | AVG |
| 7320.00 | 53.29 | -0.81 | 52.48 | 74.00 | -21.52 | peak |
| 7320.00 | 38.02 | -0.81 | 37.21 | 54.00 | -16.79 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |

Vertical:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4880.00 | 53.05 | -3.54 | 49.51 | 74.00 | -24.49 | peak |
| 4880.00 | 45.97 | -3.54 | 42.43 | 54.00 | -11.57 | AVG |
| 7320.00 | 50.23 | -0.81 | 49.42 | 74.00 | -24.58 | peak |
| 7320.00 | 42.11 | -0.81 | 41.30 | 54.00 | -12.70 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |

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CH High (2480MHz)

Horizontal:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4960 | 53.04 | -3.43 | 49.61 | 74.00 | -24.39 | peak |
| 4960 | 42.26 | -3.44 | 38.82 | 54.00 | -15.18 | AVG |
| 7440 | 52.46 | -0.77 | 51.69 | 74.00 | -22.31 | peak |
| 7440 | 40.15 | -0.77 | 39.38 | 54.00 | -14.62 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |

Vertical:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 4960 | 56.66 | -3.43 | 53.23 | 74.00 | -20.77 | peak |
| 4960 | 45.14 | -3.44 | 41.70 | 54.00 | -12.30 | AVG |
| 7440 | 53.84 | -0.77 | 53.07 | 74.00 | -20.93 | peak |
| 7440 | 41.55 | -0.77 | 40.78 | 54.00 | -13.22 | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz.
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency; “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) The emissions are attenuated more than 20dB below the permissible limits are not recorded in the report.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
(7) All modes of operation were investigated and the worst-case emissions are reported.

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Radiated Band Edge Test:

Operation Mode: TX CH Low (2402MHz)

Horizontal (Worst case):

| Frequency | Reading Result | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2310.00 | 56.32 | -5.81 | 50.51 | 74 | -23.49 | peak |
| 2310.00 | / | -5.81 | / | 54 | / | AVG |
| 2390.00 | 54.17 | -5.84 | 48.33 | 74 | -25.67 | peak |
| 2390.00 | / | -5.84 | / | 54 | / | AVG |
| 2400.00 | 53.89 | -5.84 | 48.05 | 74 | -25.95 | peak |
| 2400.00 | / | -5.84 | / | 54 | / | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |

Vertical:

| Frequency | Reading Result | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2310.00 | 55.46 | -5.81 | 49.65 | 74 | -24.35 | peak |
| 2310.00 | / | -5.81 | / | 54 | / | AVG |
| 2390.00 | 54.27 | -5.84 | 48.43 | 74 | -25.57 | peak |
| 2390.00 | / | -5.84 | / | 54 | / | AVG |
| 2400.00 | 51.62 | -5.84 | 45.78 | 74 | -28.22 | peak |
| 2400.00 | / | -5.84 | / | 54 | / | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |

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Operation Mode: TX CH High (2480MHz)

Horizontal (Worst case)

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2483.50 | 54.67 | -5.81 | 48.86 | 74 | -25.14 | peak |
| 2483.50 | / | -5.81 | / | 54 | / | AVG |
| 2500.00 | 52.58 | -6.06 | 46.52 | 74 | -27.48 | peak |
| 2500.00 | / | -6.06 | / | 54 | / | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |

Vertical:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2483.50 | 53.66 | -5.81 | 47.85 | 74 | -26.15 | peak |
| 2483.50 | / | -5.81 | / | 54 | / | AVG |
| 2500.00 | 51.49 | -6.06 | 45.43 | 74 | -28.57 | peak |
| 2500.00 | / | -6.06 | / | 54 | / | AVG |
| Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit. | | | | | | |
| Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit. | | | | | | |

Remark:

1. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.
2. In restricted bands of operation, the spurious emissions below the permissible value more than 20dB.
3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

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## 4.4 Maximum Output Power Measurement

### 4.4.1 Limit

The Maximum Peak Output Power Measurement is 30dBm.

### 4.4.2 Test Procedure

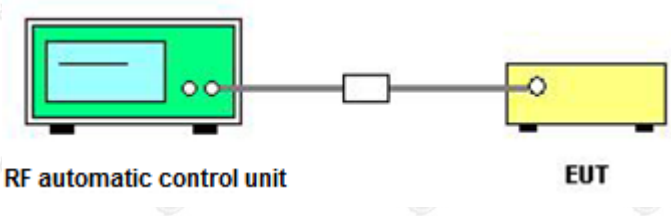
The maximum peak conducted output power may be measured using a broadband peak RF automatic control unit. The RF automatic control unit shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

The maximum Average conducted output power may be measured using a wideband RF automatic control unit with a thermocouple detector or equivalent. The RF automatic control unit shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

### 4.4.3 Deviation From Standard

No deviation.

### 4.4.4 Test Setup




### 4.4.5 Test Results

| Channel | Channel frequency (MHz) | Output power (dBm) | Cable loss | Maximum Output power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|---|
| Low | 2402 | 0.86 | 0.8 | 1.66 | 30.00 | Pass |
| Middle | 2440 | 0.98 | 0.8 | 1.78 | | Pass |
| High | 2480 | 1.44 | 0.8 | 2.24 | | Pass |

Note: Maximum Output power (dBm)= Output Power(dBm)+ Cable loss

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## 4.5 Power Spectral Density

### 4.5.1 Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### 4.5.2 Test Procedure

Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
Set the RBW =3 kHz.
Set the VBW =10 KHz.
Set the span to 1.5 times the DTS channel bandwidth.
Detector = peak.
Sweep time = auto couple.
Trace mode = max hold.
Allow trace to fully stabilize.
Use the peak marker function to determine the maximum power level.
If measured value exceeds limit, reduce RBW(no less than 3 kHz)and repeat.
The resulting peak PSD level must be 8 dBm.

### 4.5.3 Deviation From Standard

No deviation.

### 4.5.4 Test Setup


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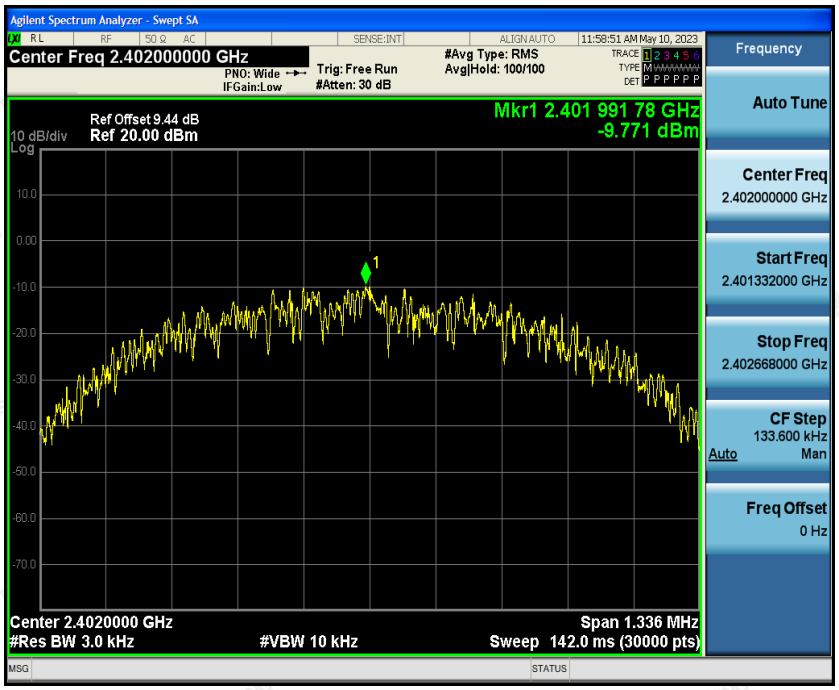
### 4.5.5 Test Results

| Channel | Channel frequency (MHz) | Result (dBm/3kHz) | Offset | Test Result (dBm/3kHz) | Limit (dBm/3KHz) | Result |
|---|---|---|---|---|---|---|
| Low | 2402 | -19.21 | 9.44 | -9.77 | 8.00 | Pass |
| Middle | 2440 | -17.06 | 9.44 | -7.62 | | Pass |
| High | 2480 | -15.17 | 9.44 | -5.73 | | Pass |
| Note: PSD Test Result (dBm/3kHz)= Result +Offset<br>Offset= Instrument attenuation +cable loss=8.64 dB +0.8 dB =9.44dB | | | | | | |

**CH 00**

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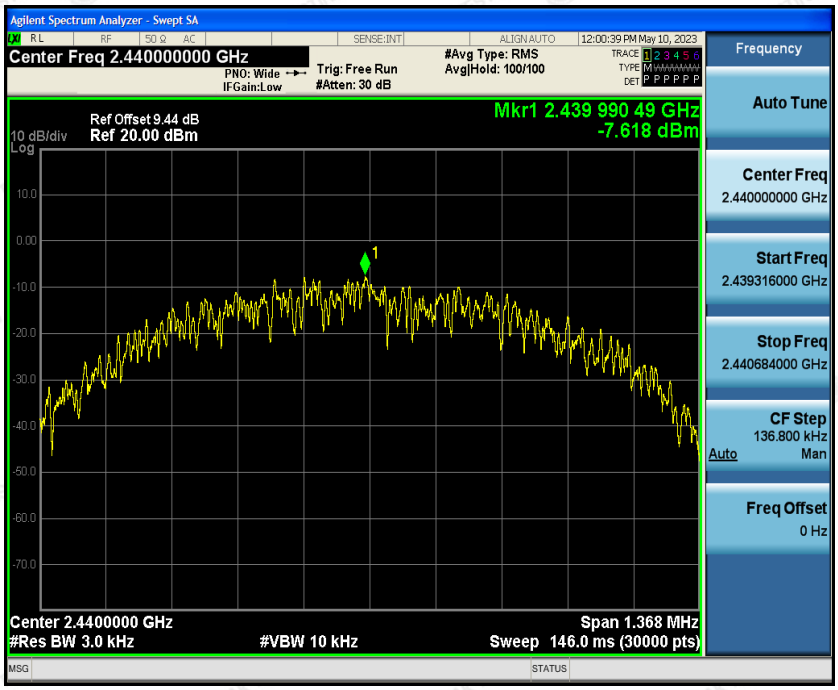
**CH 19**




**CH 39**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## 4.6 6db Bandwidth

### 4.6.1 Limit

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

### 4.6.2 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=100 KHz and VBW=300 KHz.
The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.
1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

### 4.6.3 Deviation From Standard

No deviation.

### 4.6.4 Test Setup


### 4.6.5 Test Result

| Channel | Channel frequency (MHz) | 6dB Bandwidth (MHz) | Limit (KHz) | Result |
|---|---|---|---|---|
| Low | 2402 | 0.668 | ≥500 | Pass |
| Middle | 2440 | 0.684 | | Pass |
| High | 2480 | 0.720 | | Pass |

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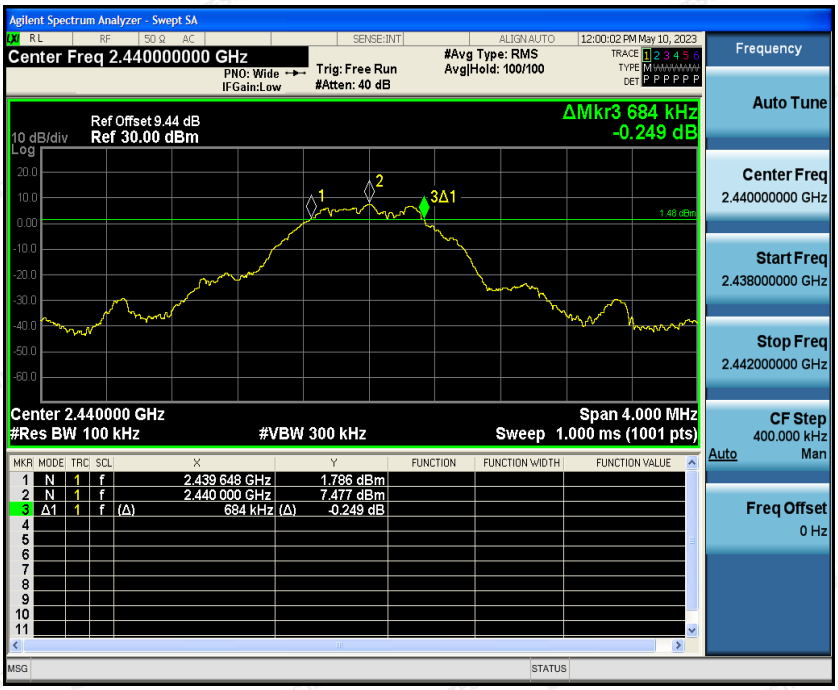
**CH 00**


**CH 19**

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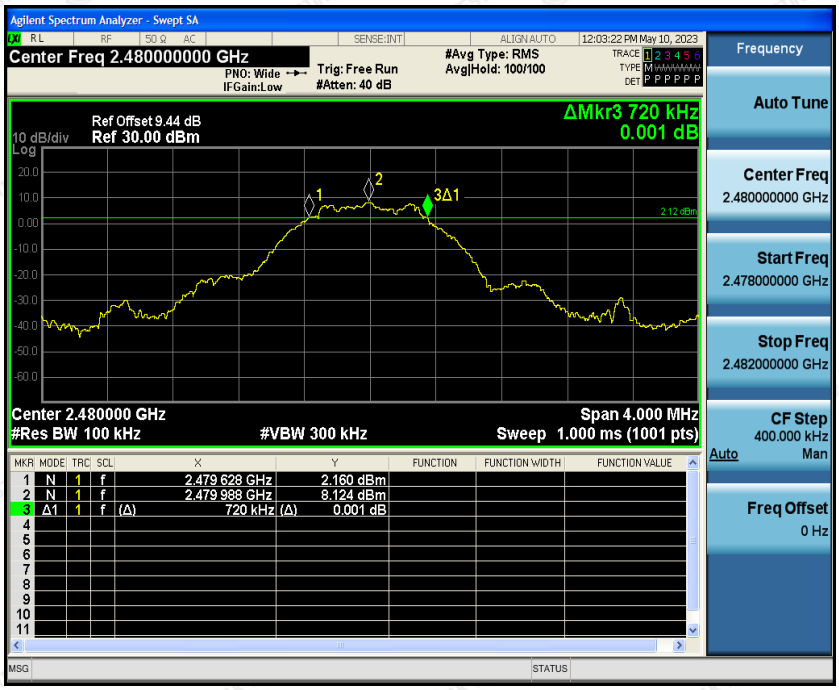
**CH 39**

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## 4.7 Occupied Bandwidth

### 4.7.1 Test Procedure

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:
RBW=1% to 5% of the OBW
VBW=approximately 3 X RBW
Detector=Peak
Trace Mode: Max Hold
Use the 99% power bandwidth function of the instrument to measure the Occupied Bandwidth and recorded.

### 4.7.2 Deviation From Standard

No deviation.

### 4.7.3 Test Setup


### 4.7.4 Test Result

N/A

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## 4.8 Band Edge

### 4.8.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under FCC rules in section 5.8.1, the attenuation required shall be 30 dB instead of 20 dB.

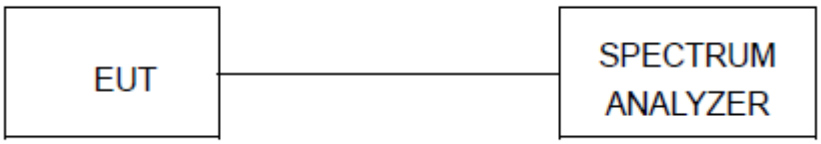
### 4.8.2 Test Procedure

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation, RBW ≥ 1% of the span, VBW ≥ RBW, Sweep = auto,
Detector function = peak, Trace = max hold.

### 4.8.3 Deviation From Standard

No deviation.

### 4.8.4 Test Setup

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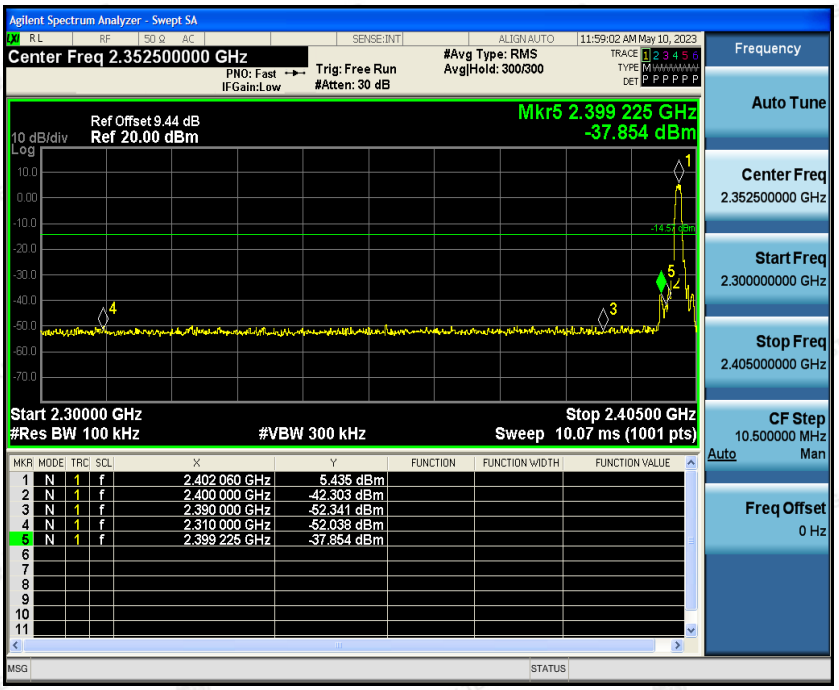
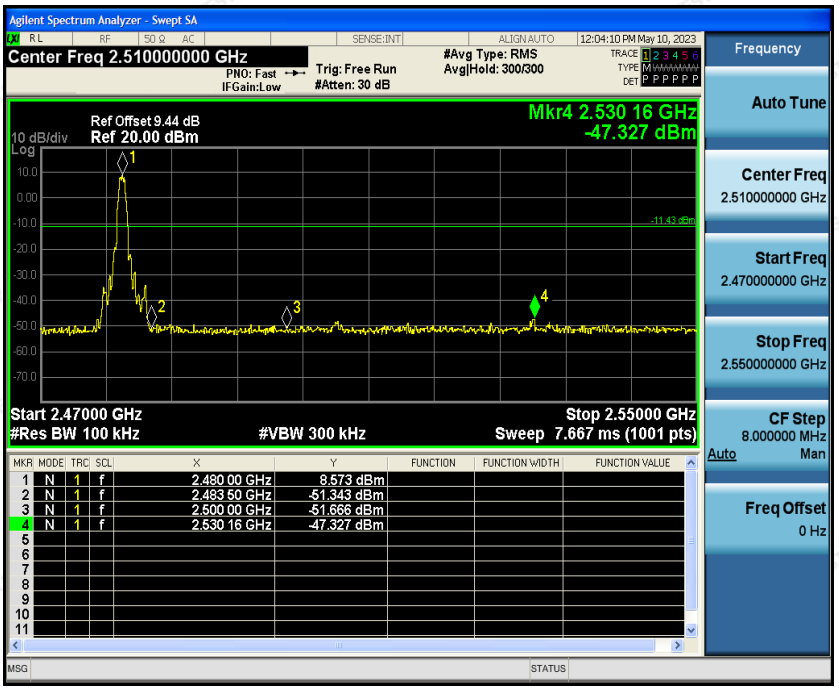
### 4.8.5 Test Results

PASS




2402




2480

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## 4.9 Conducted Spurious Emissions

### 4.9.1 Applied Procedures / Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section (b)(3) of RSS 5.4(4), the attenuation required shall be 30 dB instead of 20 dB.
For below 30MHz,For 9KHz-150kHz,150K-10MHz,We use the RBW 1KHz,10KHz, So the limit need to calculated by “10lg(BW1/BW2)“. for example For9KHz-150kHz,RBW 1KHz, The Limit= the highest emission level-20-10log(100/1)= the highest emission level-40.

### 4.9.2 Test Procedure

a.The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b.Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation, RBW ≥ 1% of the span, VBW ≥ RBW, Sweep = auto,
Detector function = peak, Trace = max hold.

### 4.9.3 Deviation From Standard

No deviation.

### 4.9.4 Test Setup


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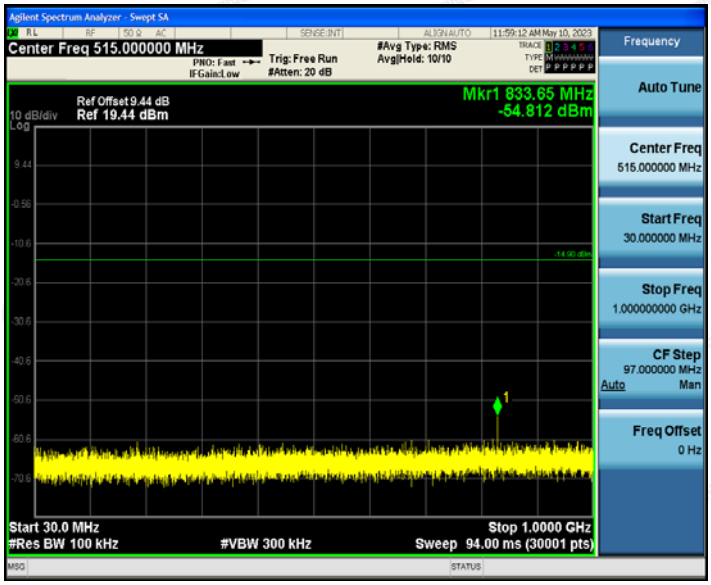
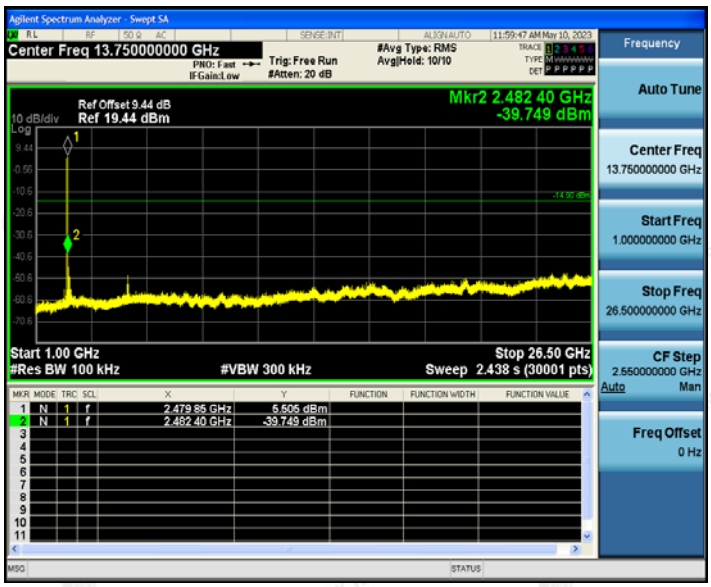
### 4.9.5 Test Results

**CH 00**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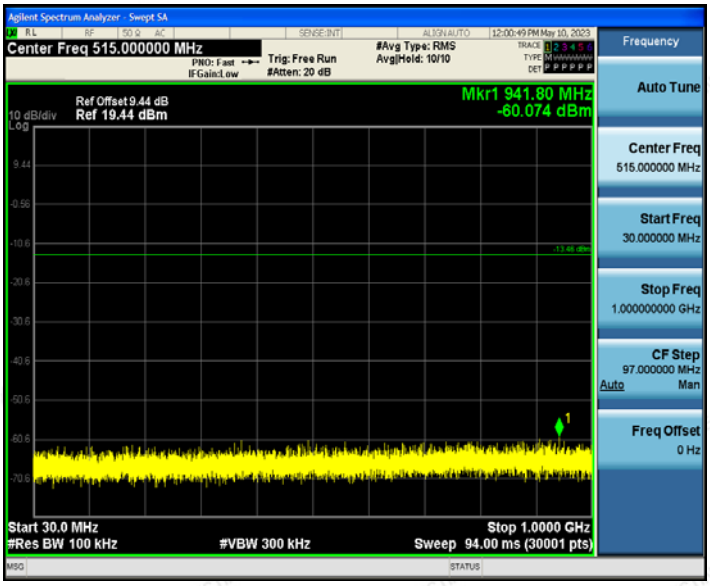
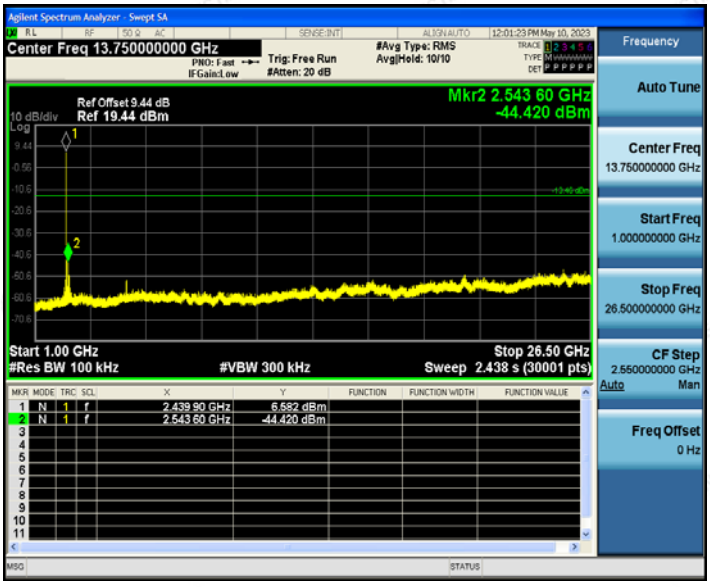
**CH 19**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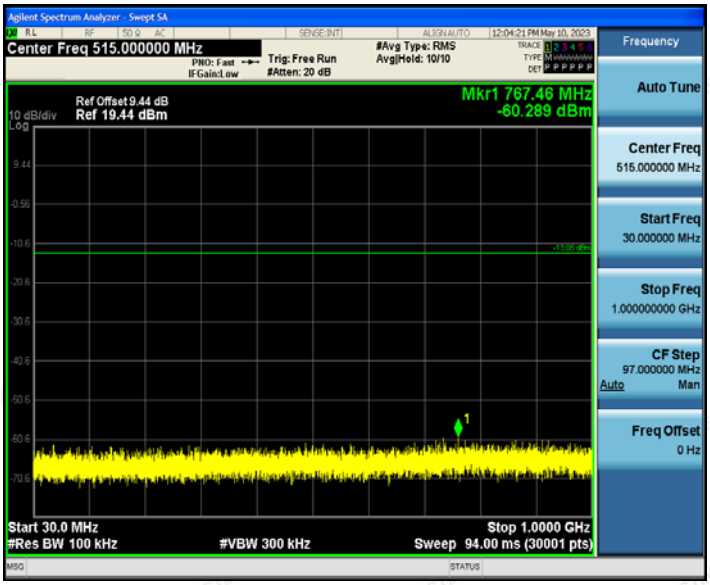
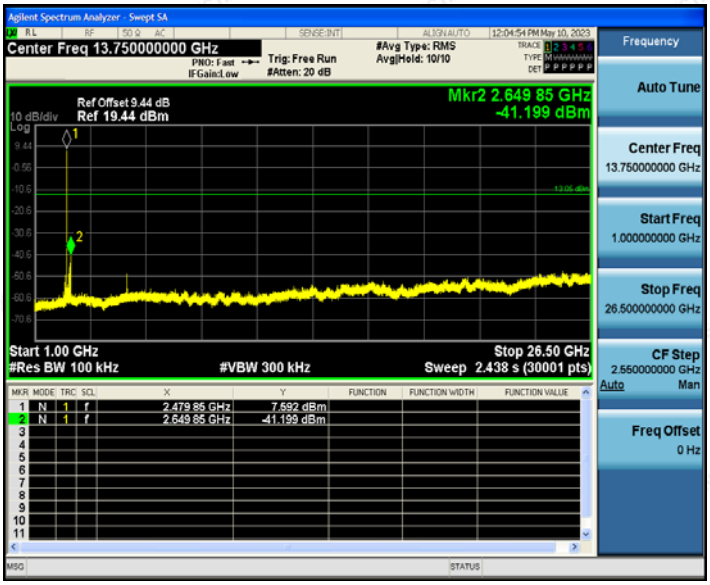
**CH 39**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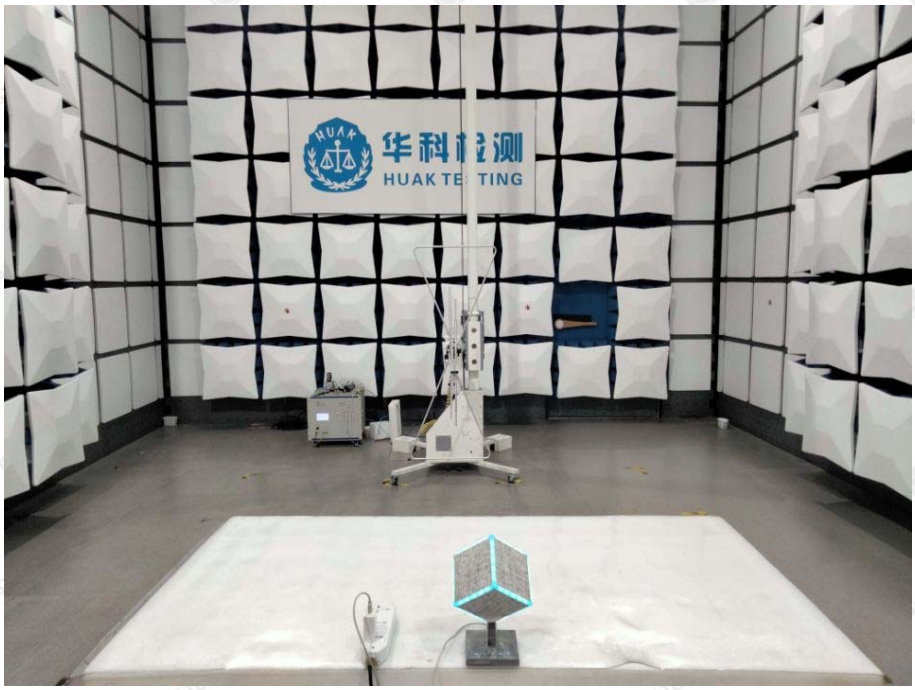
# 5 Test Setup Photo

Radiated Emissions





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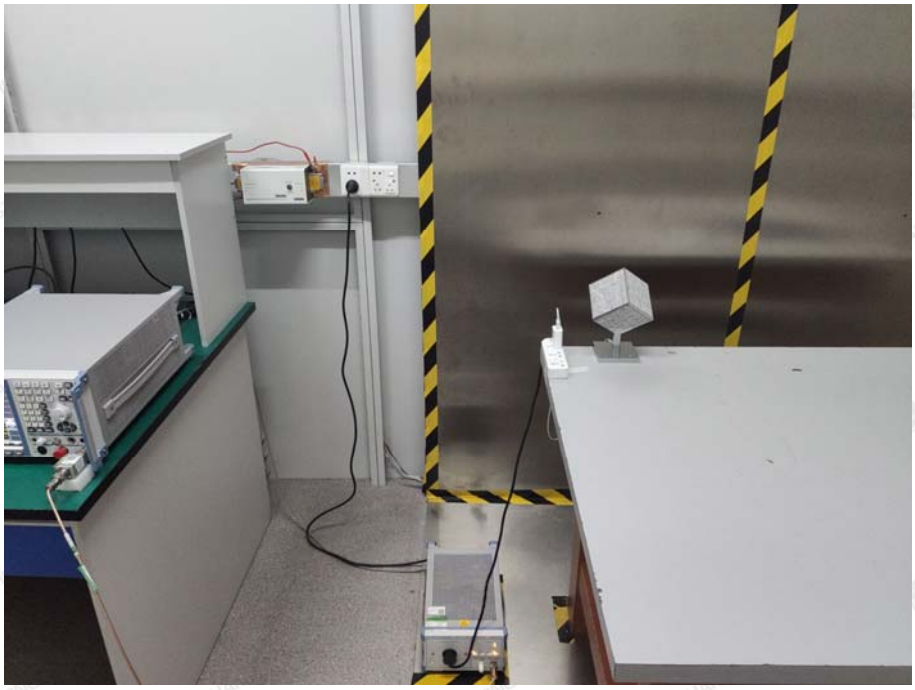
Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Conducted Emission



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# 6 Photos of the EUT

Reference to the report: ANNEX A of external photos and ANNEX B of internal photos.

---------End of test report---------

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