# Shenzhen HTT Technology Co., Ltd.

## FCC PART 15 SUBPART C TEST REPORT

### FCC PART 15.247

| | |
|---|---|
| **Report Reference No. .....:** | **HTT202601677F01** |
| **FCC ID. ..... :** | **2BUPE-SH-08** |
| Compiled by ( position+printed name+signature) .: | File administrators Heber He |
| Supervised by ( position+printed name+signature) .: | Project Engineer Bruce Zhu |
| Approved by ( position+printed name+signature) .: | RF Manager Kevin Yang |
| Date of issue .....: | Jan. 29, 2026 |
| **Testing Laboratory Name.....:** | **Shenzhen HTT Technology Co.,Ltd.** |
| Address .....: | 1F, Building B, Huafeng International Robotics Industrial Park, Hangcheng Road,Nanchang Community, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China |
| **Applicant's name .....:** | **Shenzhen Yuntianyue Technology Co., Ltd.** |
| Address .....: | Floor 3, Tengfa Technology Park, No. 16, Tangming Road, Guangming District, Shenzhen,China |
| **Test specification.....:** | |
| Standard.....: | **FCC Part 15.247** |

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| | |
|---|---|
| **Test item description .....:** | **Multi-functional wake and sleep light** |
| Trade Mark .....: | N/A |
| **Manufacturer .....:** | **Shenzhen Yuntianyue Technology Co., Ltd.** |
| Model/Type reference .....: | SH-08 |
| Listed Models .....: | SH-08A, SH-08B, SH-08C, SH-09, SH-10 |
| Modulation .....: | GFSK, Π/4DQPSK |
| Frequency ..... | From 2402MHz to 2480MHz |
| Ratings .....: | DC 3.0V From Battery |
| Result .....: | **PASS** |

# T E S T  R E P O R T

| | | |
|---|---|---|
| Equipment under Test | : | Multi-functional wake and sleep light |
| Model /Type | : | SH-08 |
| Listed Models | : | SH-08A, SH-08B, SH-08C, SH-09, SH-10 |
| **Applicant** | : | **Shenzhen Yuntianyue Technology Co., Ltd.** |
| Address | : | Floor 3, Tengfa Technology Park, No. 16, Tangming Road, Guangming District, Shenzhen,China |
| **Manufacturer** | : | **Shenzhen Yuntianyue Technology Co., Ltd.** |
| Address | : | Floor 3, Tengfa Technology Park, No. 16, Tangming Road, Guangming District, Shenzhen,China |

| | |
|---|---|
| **Test Result**: | **PASS** |

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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# 1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2020 +Cor. 1-2023+ C63.10a-2024+ Errata to C63.10a-2024: American National Standard for Testing Unlicensed Wireless Devices

# 2 SUMMARY

## 2.1 General Remarks

| | | |
|---|---|---|
| Date of receipt of test sample | : | Jan. 23, 2026 |
| | | |
| Testing commenced on | : | Jan. 23, 2026 |
| | | |
| Testing concluded on | : | Jan. 29, 2026 |

## 2.2 Product Description

| | |
|---|---|
| Product description: | Multi-functional wake and sleep light |
| Model/Type reference: | SH-08 |
| Power supply: | DC 3.0V From Battery |
| Adapter Information (Auxiliary test provided by the lab): | Mode: GS-0500200<br>Input: AC100-240V, 50/60Hz, 0.3A max<br>Output: DC 5V, 2A |
| Testing sample ID： | HTT202601677-1# (Engineer sample)<br>HTT202601677-2# (Normal sample) |
| Hardware version: | / |
| Software version: | / |
| **Bluetooth :** | |
| Supported Type: | Bluetooth BR/EDR |
| Modulation: | GFSK, π/4DQPSK |
| Operation frequency: | 2402MHz~2480MHz |
| Channel number: | 79 |
| Channel separation: | 1MHz |
| Antenna type: | PCB Antenna |
| Antenna gain: | 2.499 dBi |

## 2.3 Equipment Under Test

### Power supply system utilised

Refer to section 2.2

## 2.4 Short description of the Equipment under Test (EUT)

This is a Multi-functional wake and sleep light.
For more details, refer to the user's manual of the EUT.

| Test Software Version | FCC Assist 1.0.2.2 | | |
|---|---|---|---|
| Frequency | 2402 MHz | 2441MHz | 2480 MHz |
| GFSK | 7 | 7 | 7 |
| π /4-DQPSK | 7 | 7 | 7 |

## 2.5 EUT configuration

**The following peripheral devices and interface cables were connected during the measurement:**

○ - supplied by the manufacturer
● - supplied by the lab

| | | | |
|---|---|---|---|
| | | | |

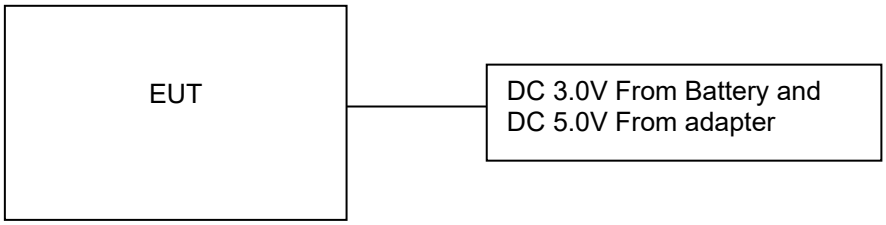
## 2.6 EUT operation mode

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing .There are 79 channels provided to the EUT and Channel 00/39/78 were selected to test.

**Operation Frequency：**

| Channel | Frequency (MHz) |
|---|---|
| 00 | 2402 |
| 01 | 2403 |
| ⋮ | ⋮ |
| 38 | 2440 |
| 39 | 2441 |
| 40 | 2442 |
| ⋮ | ⋮ |
| 77 | 2479 |
| 78 | 2480 |

## 2.7 Block Diagram of Test Setup




## 2.8 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for the device filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

## 2.9 Modifications

No modifications were implemented to meet testing criteria.

# 3 TEST ENVIRONMENT

## 3.1 Address of the test laboratory

**Shenzhen HTT Technology Co.,Ltd.**
1F, Building B, Huafeng International Robotics Industrial Park, Hangcheng Road,Nanchang Community, Xixiang Street, Bao'an District, Shenzhen, Guangdong, China

## 3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

**FCC-Registration No.: 779513 Designation Number: CN1319**
Shenzhen HTT Technology Co.,Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

**A2LA-Lab Cert. No.: 6435.01**
Shenzhen HTT Technology Co.,Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

**ISED#: 27952 CAB identifier: CN0128**
Shenzhen HTT Technology Co.,Ltd. has been listed by Innovation, Science and Economic Development Canada to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

## 3.3 Environmental conditions

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

| | |
|---|---|
| Temperature: | 23 ° C |
| | |
| Humidity: | 48 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

AC Main Conducted testing：

| | |
|---|---|
| Temperature: | 24 ° C |
| | |
| Humidity: | 45 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

Conducted testing：

| | |
|---|---|
| Temperature: | 24 ° C |
| | |
| Humidity: | 45 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

## 3.4 Summary of measurement results

| Test Specification clause | Test case | Test Mode | Test Channel | Recorded In Report | | Test result |
|---|---|---|---|---|---|---|
| §15.247(a)(1) | Carrier Frequency separation | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK | ☒ Middle | Compliant |
| §15.247(a)(1) | Number of Hopping channels | GFSK<br>Π/4DQPSK | ☒ Full | GFSK | ☒ Full | Compliant |
| §15.247(a)(1) | Time of Occupancy (dwell time) | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK | ☒ Middle | Compliant |
| §15.247(a)(1) | Spectrumbandwidth of aFHSS system20dB bandwidth | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | Compliant |
| §15.247(b)(1) | Maximum output peak power | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | Compliant |
| §15.247(d) | Band edgecompliance conducted | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Highest | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Highest | Compliant |
| §15.205 | Band edgecompliance radiated | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Highest | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Highest | Compliant |
| §15.247(d) | TX spuriousemissions conducted | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | Compliant |
| §15.247(d) | TX spuriousemissions radiated | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | Compliant |
| §15.209(a) | TX spurious Emissions radiated Below 1GHz | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | ☒ Middle | Compliant |
| §15.107(a)<br>§15.207 | Conducted Emissions 9KHz-30 MHz | GFSK<br>Π/4DQPSK | ☒ Lowest<br>☒ Middle<br>☒ Highest | GFSK | ☒ Middle | Compliant |

Remark:
1. The measurement uncertainty is not included in the test result.
2. We tested all test mode and recorded worst case in report
3. RF Conducted test Offset= cable loss,For conducted spurious emission test, cable loss is the maximum value in the range of test.

## 3.5 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 TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the Shenzhen HTT Technology Co.,Ltd. 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.
Hereafter the best measurement capability for Shenzhen HTT Technology Co.,Ltd. :

| Test Item | Frequency Range | Measurement Uncertainty | Notes |
|---|---|---|---|
| Radiated Emission | 9KHz~30MHz | 3.12 dB | (1) |
| Radiated Emission | 30~1000MHz | 4.37 dB | (1) |
| Radiated Emission | 1~18GHz | 5.40 dB | (1) |
| Radiated Emission | 18-40GHz | 5.45 dB | (1) |
| Conducted Disturbance | 0.15~30MHz | 2.68 dB | (1) |
| Spectrum bandwidth | / | 1.2% | (1) |
| Output Peak power | 30MHz~18GHz | 0.57dB | (1) |
| Time | / | ±10% | (1) |
| Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%. | | | |

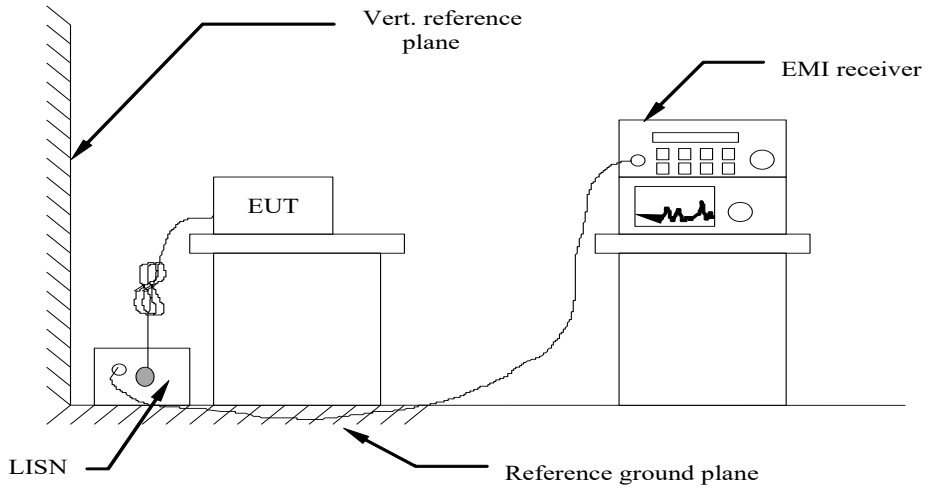
## 3.6 Equipments Used during the Test

| Item | Test Equipment | Manufacturer | Model No. | Inventory No. | Cal.Date (mm-dd-yy) | Cal.Due date (mm-dd-yy) |
|---|---|---|---|---|---|---|
| 1 | 3m Semi- Anechoic Chamber | Shenzhen C.R.T technology co., LTD | 9*6*6 | HTT-E028 | Aug. 10 2024 | Aug. 09 2027 |
| 2 | Control Room | Shenzhen C.R.T technology co., LTD | 4.8*3.5*3.0 | HTT-E030 | Aug. 10 2024 | Aug. 09 2027 |
| 3 | EMI Test Receiver | Rohde&Schwar | ESCI7 | HTT-E022 | Apr. 22 2025 | Apr. 21 2026 |
| 4 | Spectrum Analyzer | ROHDE&SCHWARZ | FSV40-N | HTT-E050 | Jun. 09 2025 | Jun. 08 2026 |
| 5 | Coaxial Cable | ZDecl | ZT26-NJ-NJ-0.6M | HTT-E018 | Apr. 22 2025 | Apr. 21 2026 |
| 6 | Coaxial Cable | ZDecl | ZT26-NJ-SMAJ-2M | HTT-E019 | Apr. 22 2025 | Apr. 21 2026 |
| 7 | Coaxial Cable | ZDecl | ZT26-NJ-SMAJ-0.6M | HTT-E020 | Apr. 22 2025 | Apr. 21 2026 |
| 8 | Coaxial Cable | ZDecl | ZT26-NJ-SMAJ-8.5M | HTT-E021 | Apr. 22 2025 | Apr. 21 2026 |
| 9 | Composite logarithmic antenna | Schwarzbeck | VULB 9168 | HTT-E017 | Apr. 19 2025 | Apr. 18 2026 |
| 10 | Horn Antenna | Schwarzbeck | BBHA9120D | HTT-E016 | Apr. 19 2025 | Apr. 18 2026 |
| 11 | Loop Antenna | Zhinan | ZN30900C | HTT-E039 | Apr. 19 2025 | Apr. 18 2026 |
| 12 | Horn Antenna | A.H. Systems, inc. | SAS-574 | HTT-E040 | Jun. 04 2025 | Jun. 03 2026 |
| 13 | low frequency Amplifier | Sonoma Instrument | 310 | HTT-E015 | Apr. 22 2025 | Apr. 21 2026 |
| 14 | high-frequency Amplifier | HP | 8449B | HTT-E014 | Apr. 22 2025 | Apr. 21 2026 |
| 15 | Variable frequency power supply | Shenzhen Anbiao Instrument Co., Ltd | ANB-10VA | HTT-082 | Apr. 22 2025 | Apr. 21 2026 |
| 16 | EMI Test Receiver | Rohde & Schwarz | ESCI3 | HTT-E043 | Apr. 22 2025 | Apr. 21 2026 |
| 17 | Artificial Mains | Rohde & Schwarz | ESH3-Z5 | HTT-E006 | Apr. 22 2025 | Apr. 21 2026 |
| 18 | Artificial Mains | Rohde & Schwarz | ENV-216 | HTT-E038 | Apr. 22 2025 | Apr. 21 2026 |
| 19 | Cable Line | Robinson | Z302S-NJ-BNCJ-1.5M | HTT-E001 | Apr. 22 2025 | Apr. 21 2026 |
| 20 | Filter | ROHDE&SCHWARZ | ESH3-Z2 | HTT-E045 | May. 19 2025 | May. 18 2026 |
| 21 | Variable frequency power supply | Shenzhen Yanghong Electric Co., Ltd | YF-650（5KVA） | HTT-E032 | Apr. 22 2025 | Apr. 21 2026 |
| 22 | Control Room | Shenzhen C.R.T technology co., LTD | 8*4*3.5 | HTT-E029 | Aug. 10 2024 | Aug. 09 2027 |
| 23 | DC power supply | Agilent | E3632A | HTT-E023 | Apr. 22 2025 | Apr. 21 2026 |
| 24 | EMI Test Receiver | Agilent | N9020A | HTT-E024 | Apr. 22 2025 | Apr. 21 2026 |
| 25 | Analog signal generator | Agilent | N5181A | HTT-E025 | Apr. 22 2025 | Apr. 21 2026 |
| 26 | Vector signal generator | Agilent | N5182A | HTT-E026 | Apr. 22 2025 | Apr. 21 2026 |
| 27 | RF Switch box | Keysight | Switchbox | HTT-E047 | May. 19 2025 | May. 18 2026 |
| 28 | Temperature and humidity meter | Shenzhen Anbiao Instrument Co., Ltd | TH10R | HTT-074 | Apr. 21 2025 | Apr. 20 2026 |
| 29 | Radiated Emission Test Software | Farad | EZ-EMC | N/A | N/A | N/A |
| 30 | Conducted Emission Test Software | Farad | EZ-EMC | N/A | N/A | N/A |
| 31 | RF Test Software | panshanrf | TST | N/A | N/A | N/A |
| 32 | Power Meter | R&S | NRVS | HTT-E057 | Apr. 22 2025 | Apr. 21 2026 |

# 4 TEST CONDITIONS AND RESULTS

## 4.1 AC Power Conducted Emission

**TEST CONFIGURATION**




**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 C63.10-2020.
2 Support equipment, if needed, was placed as per ANSI C63.10-2020
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2020
4 The EUT received power from adapter, the adapter received AC120V/60Hz and AC 240V/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.

**AC Power Conducted Emission Limit**

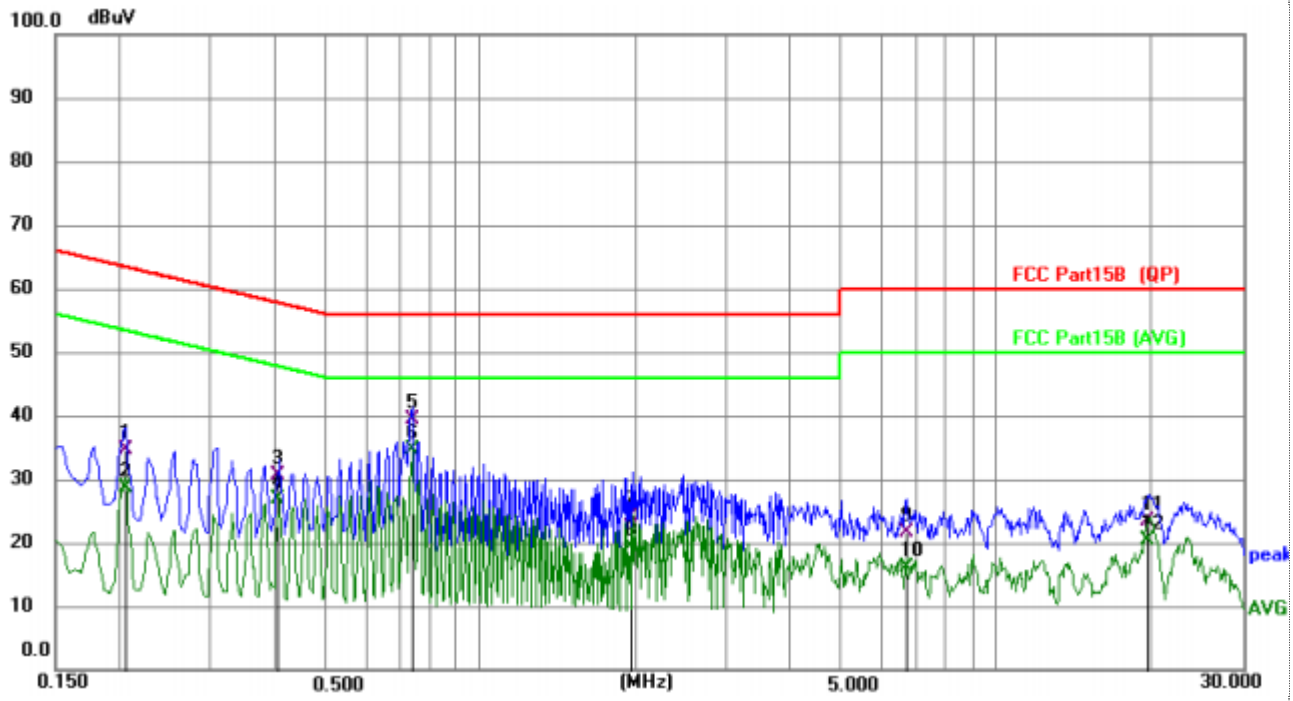
For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

| 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. | | |

**TEST RESULTS**

Remark:
1. All modes of GFSK, Π/4 DQPSK were test at Low, Middle, and High channel; only the worst result of GFSK Middle Channel was reported as below:
2. Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:

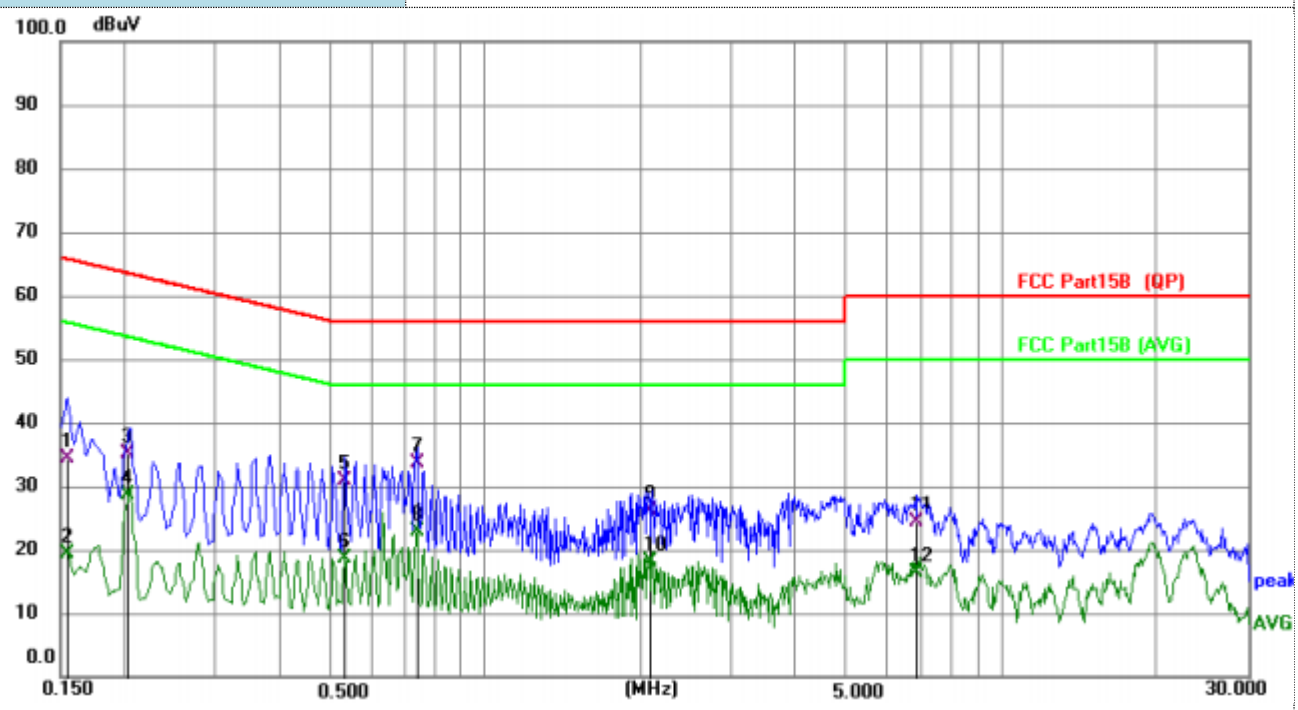
| Polarization: | L |
|---|---|




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.2041 | 24.46 | 10.07 | 34.53 | 63.44 | -28.91 | QP |
| 2 | | 0.2041 | 18.53 | 10.07 | 28.60 | 53.44 | -24.84 | AVG |
| 3 | | 0.4059 | 20.56 | 10.09 | 30.65 | 57.73 | -27.08 | QP |
| 4 | | 0.4059 | 16.70 | 10.09 | 26.79 | 47.73 | -20.94 | AVG |
| 5 | | 0.7351 | 29.20 | 10.08 | 39.28 | 56.00 | -16.72 | QP |
| 6 | * | 0.7351 | 24.43 | 10.08 | 34.51 | 46.00 | -11.49 | AVG |
| 7 | | 1.9758 | 14.00 | 10.14 | 24.14 | 56.00 | -31.86 | QP |
| 8 | | 1.9758 | 9.20 | 10.14 | 19.34 | 46.00 | -26.66 | AVG |
| 9 | | 6.6892 | 11.45 | 10.18 | 21.63 | 60.00 | -38.37 | QP |
| 10 | | 6.6892 | 5.97 | 10.18 | 16.15 | 50.00 | -33.85 | AVG |
| 11 | | 19.6972 | 12.55 | 10.94 | 23.49 | 60.00 | -36.51 | QP |
| 12 | | 19.6972 | 9.40 | 10.94 | 20.34 | 50.00 | -29.66 | AVG |

Note:1).QP Value (dBμV)= QP Reading (dBμV)+ Factor (dB)
2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)
3). QPMargin(dB) = QP Limit (dBμV) - QP Value (dBμV)
4). AVMargin(dB) = AV Limit (dBμV) - AV Value (dBμV)

| Polarization: | N |
|---|---|



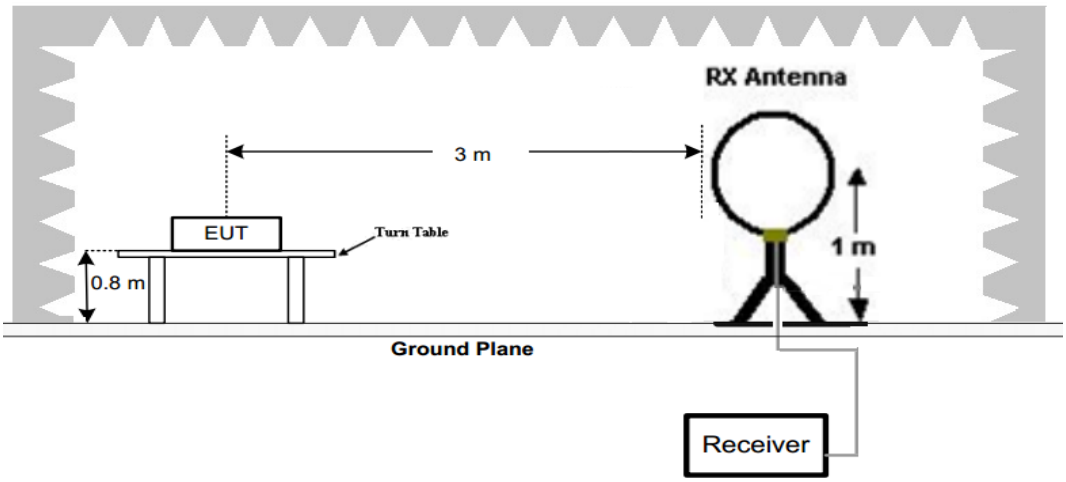

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | | dB | dBuV | dBuV | dB | Detector |
| 1 | | 0.1550 | 24.24 | 10.05 | 34.29 | 65.73 | -31.44 | QP |
| 2 | | 0.1550 | 9.43 | 10.05 | 19.48 | 55.73 | -36.25 | AVG |
| 3 | | 0.2038 | 25.03 | 10.04 | 35.07 | 63.45 | -28.38 | QP |
| 4 | | 0.2038 | 18.60 | 10.04 | 28.64 | 53.45 | -24.81 | AVG |
| 5 | | 0.5324 | 20.78 | 10.05 | 30.83 | 56.00 | -25.17 | QP |
| 6 | | 0.5324 | 8.46 | 10.05 | 18.51 | 46.00 | -27.49 | AVG |
| 7 | * | 0.7357 | 23.63 | 10.04 | 33.67 | 56.00 | -22.33 | QP |
| 8 | | 0.7357 | 12.90 | 10.04 | 22.94 | 46.00 | -23.06 | AVG |
| 9 | | 2.1028 | 16.00 | 10.08 | 26.08 | 56.00 | -29.92 | QP |
| 10 | | 2.1028 | 8.07 | 10.08 | 18.15 | 46.00 | -27.85 | AVG |
| 11 | | 6.8691 | 14.25 | 10.15 | 24.40 | 60.00 | -35.60 | QP |
| 12 | | 6.8691 | 6.30 | 10.15 | 16.45 | 50.00 | -33.55 | AVG |

Note:1).QP Value (dBμV)= QP Reading (dBμV)+ Factor (dB)
2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)
3). QPMargin(dB) = QP Limit (dBμV) - QP Value (dBμV)
4). AVMargin(dB) = AV Limit (dBμV) - AV Value (dBμV)

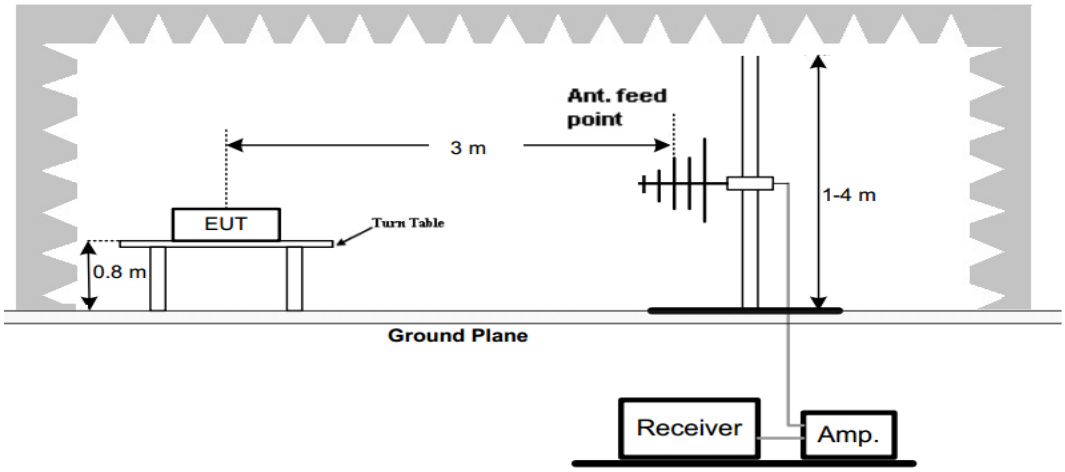
## 4.2 Radiated Emission

**TEST CONFIGURATION**

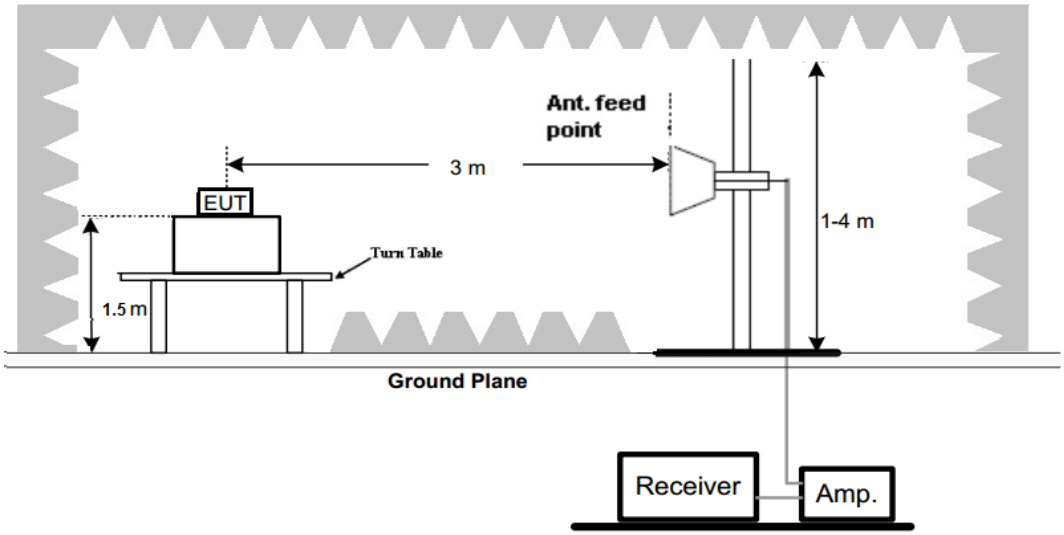
Frequency range 9 KHz – 30MHz

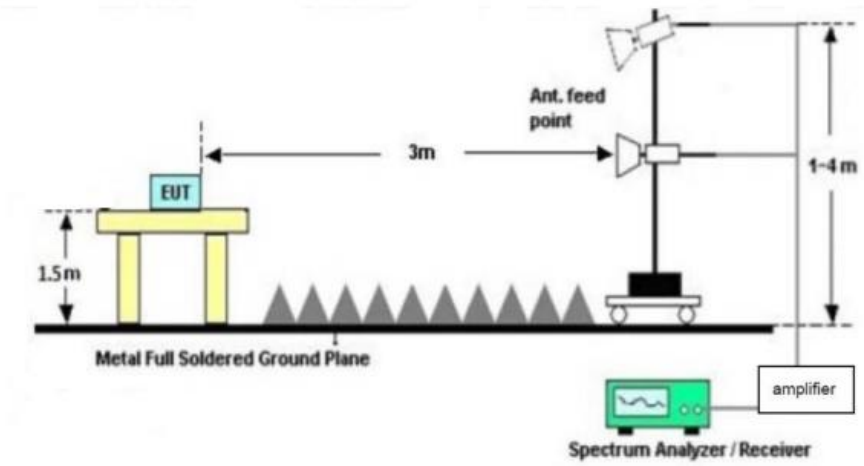



Frequency range 30MHz – 1000MHz




Frequency range above 1GHz-25GHz






## TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
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.
5. Radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

| Test Frequency range | Test Antenna Type | Test Distance |
|---|---|---|
| 9KHz-30MHz | Active Loop Antenna | 3 |
| 30MHz-1GHz | Ultra-Broadband Antenna | 3 |
| 1GHz-18GHz | Double Ridged Horn Antenna | 3 |
| 18GHz-25GHz | Horn Anternna | 1 |

7. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting | Detector |
|---|---|---|
| 9KHz-150KHz | RBW=200Hz/VBW=3KHz,Sweep time=Auto | QP |
| 150KHz-30MHz | RBW=9KHz/VBW=100KHz,Sweep time=Auto | QP |
| 30MHz-1GHz | RBW=120KHz/VBW=1000KHz,Sweep time=Auto | QP |
| 1GHz-40GHz | Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto<br>Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto | Peak |

## Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

**FS = RA + AF + CL - AG**

| | |
|---|---|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude | AG = Amplifier Gain |
| AF = Antenna Factor | |

Transd=AF +CL-AG

## RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

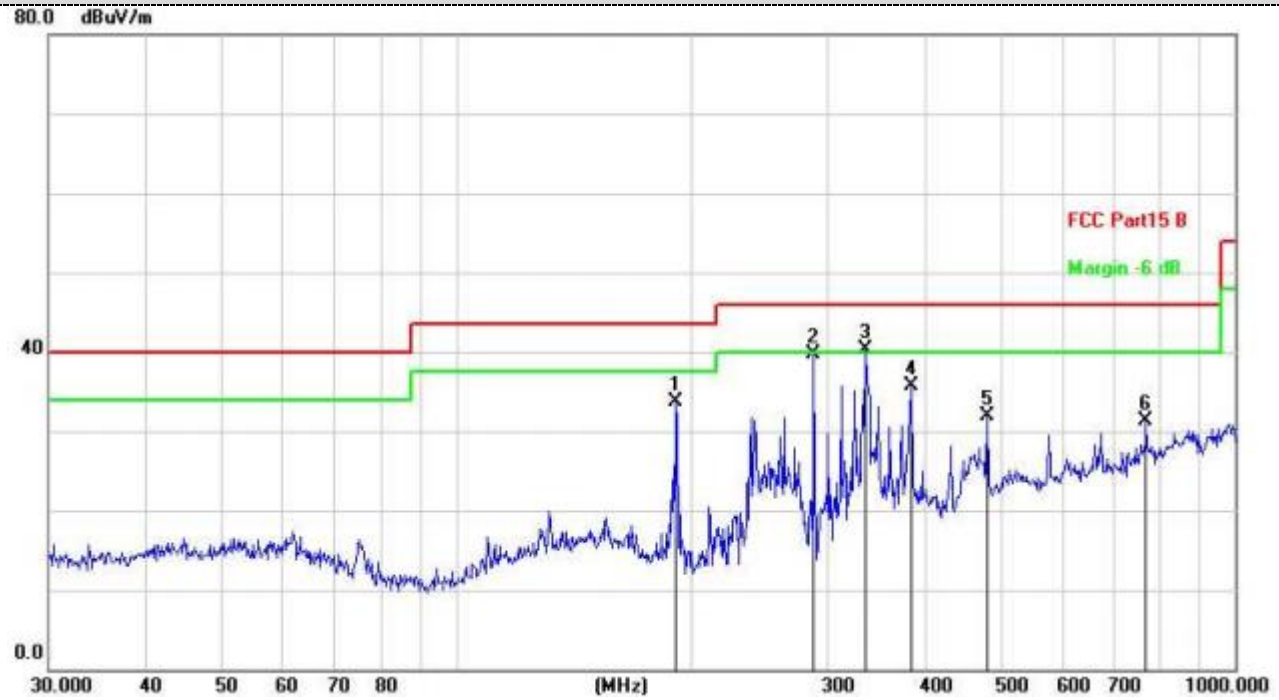
| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m) | Radiated (μV/m) |
|---|---|---|---|
| 0.009-0.49 | 3 | 20log(2400/F(KHz))+40log(300/3) | 2400/F(KHz) |
| 0.49-1.705 | 3 | 20log(24000/F(KHz))+ 40log(30/3) | 24000/F(KHz) |
| 1.705-30 | 3 | 20log(30)+ 40log(30/3) | 30 |
| 30-88 | 3 | 40.0 | 100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

## TEST RESULTS

Remark:
1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
2. We measured Radiated Emission at GFSK,π/4 DQPSK mode from 9 KHz to 25GHz and recorded worst case at GFSK DH5 mode.
3. For below 1GHz testing recorded worst at GFSK DH5 middle channel.
4. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

**For 30MHz-1GHz**

Horizontal




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB/m | dBuV/m | dB/m | dB | Detector |
| 1 | | 191.7450 | 47.09 | -13.41 | 33.68 | 43.50 | -9.82 | peak |
| 2 | | 287.9904 | 49.91 | -10.13 | 39.78 | 46.00 | -6.22 | peak |
| 3 | * | 336.0350 | 49.52 | -9.15 | 40.37 | 46.00 | -5.63 | peak |
| 4 | | 383.9318 | 44.11 | -8.31 | 35.80 | 46.00 | -10.20 | peak |
| 5 | | 480.5276 | 37.43 | -5.57 | 31.86 | 46.00 | -14.14 | peak |
| 6 | | 768.7481 | 32.52 | -1.13 | 31.39 | 46.00 | -14.61 | peak |

Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)

2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin(dB) = Limit (dBμV/m) - Level (dBμV/m)

Vertical

| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | |
|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB/m | dBuV/m | dB/m | dB | Detector |
| 1 | | 46.3402 | 41.57 | -11.45 | 30.12 | 40.00 | -9.88 | peak |
| 2 | | 143.8292 | 40.65 | -10.39 | 30.26 | 43.50 | -13.24 | peak |
| 3 | * | 191.7450 | 53.23 | -13.41 | 39.82 | 43.50 | -3.68 | peak |
| 4 | ! | 287.9904 | 50.94 | -10.13 | 40.81 | 46.00 | -5.19 | peak |
| 5 | ! | 336.0350 | 49.50 | -9.15 | 40.35 | 46.00 | -5.65 | peak |
| 6 | ! | 480.5276 | 47.23 | -5.57 | 41.66 | 46.00 | -4.34 | peak |

Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)

2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)

3). Margin(dB) = Limit (dBμV/m) - Level (dBμV/m)

**For 1GHz to 25GHz**

*Note: GFSK , π/4 DQPSK all have been tested, only worse case GFSK is reported.*

***GFSK (above 1GHz)***

| Frequency(MHz): | | | 2402 | | Polarity: | | HORIZONTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4804.00 | 58.98 | PK | 74 | 15.02 | 53.28 | 31 | 6.5 | 31.8 | 5.7 |
| 4804.00 | 41.94 | AV | 54 | 12.06 | 36.24 | 31 | 6.5 | 31.8 | 5.7 |
| 7206.00 | 54.62 | PK | 74 | 19.38 | 41.97 | 36 | 8.15 | 31.5 | 12.65 |
| 7206.00 | 43.63 | AV | 54 | 10.37 | 30.98 | 36 | 8.15 | 31.5 | 12.65 |

| Frequency(MHz): | | | 2402 | | Polarity: | | VERTICAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4804.00 | 59.40 | PK | 74 | 14.60 | 53.70 | 31 | 6.5 | 31.8 | 5.7 |
| 4804.00 | 42.45 | AV | 54 | 11.55 | 36.75 | 31 | 6.5 | 31.8 | 5.7 |
| 7206.00 | 53.88 | PK | 74 | 20.12 | 41.23 | 36 | 8.15 | 31.5 | 12.65 |
| 7206.00 | 43.16 | AV | 54 | 10.84 | 30.51 | 36 | 8.15 | 31.5 | 12.65 |

| Frequency(MHz): | | | 2441 | | Polarity: | | HORIZONTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4882.00 | 60.18 | PK | 74 | 13.82 | 54.02 | 31.2 | 6.61 | 31.65 | 6.16 |
| 4882.00 | 44.35 | AV | 54 | 9.65 | 38.19 | 31.2 | 6.61 | 31.65 | 6.16 |
| 7323.00 | 53.45 | PK | 74 | 20.55 | 40.50 | 36.2 | 8.23 | 31.48 | 12.95 |
| 7323.00 | 44.62 | AV | 54 | 9.38 | 31.67 | 36.2 | 8.23 | 31.48 | 12.95 |

| Frequency(MHz): | | | 2441 | | Polarity: | | VERTICAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4882.00 | 61.91 | PK | 74 | 12.09 | 55.75 | 31.2 | 6.61 | 31.65 | 6.16 |
| 4882.00 | 43.65 | AV | 54 | 10.35 | 37.49 | 31.2 | 6.61 | 31.65 | 6.16 |
| 7323.00 | 53.62 | PK | 74 | 20.38 | 40.67 | 36.2 | 8.23 | 31.48 | 12.95 |
| 7323.00 | 43.89 | AV | 54 | 10.11 | 30.94 | 36.2 | 8.23 | 31.48 | 12.95 |

| Frequency(MHz): | | | 2480 | | Polarity: | | HORIZONTAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4960.00 | 61.24 | PK | 74 | 12.76 | 54.58 | 31.4 | 6.76 | 31.5 | 6.66 |
| 4960.00 | 42.64 | AV | 54 | 11.36 | 35.98 | 31.4 | 6.76 | 31.5 | 6.66 |
| 7440.00 | 54.43 | PK | 74 | 19.57 | 41.13 | 36.4 | 8.35 | 31.45 | 13.3 |
| 7440.00 | 44.19 | AV | 54 | 9.81 | 30.89 | 36.4 | 8.35 | 31.45 | 13.3 |

| Frequency(MHz): | | | 2480 | | Polarity: | | VERTICAL | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 4960.00 | 64.13 | PK | 74 | 9.87 | 57.47 | 31.4 | 6.76 | 31.5 | 6.66 |
| 4960.00 | 44.05 | AV | 54 | 9.95 | 37.39 | 31.4 | 6.76 | 31.5 | 6.66 |
| 7440.00 | 54.57 | PK | 74 | 19.43 | 41.27 | 36.4 | 8.35 | 31.45 | 13.3 |
| 7440.00 | 44.93 | AV | 54 | 9.07 | 31.63 | 36.4 | 8.35 | 31.45 | 13.3 |

REMARKS:
1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

***Results of Band Edges Test (Radiated)***

*Note: GFSK, π/4 DQPSK all have been tested, only worse case GFSK is reported.*

***GFSK***

| **Frequency(MHz):** | | | **2402** | | **Polarity:** | | **HORIZONTAL** | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2390.00 | 60.71 | PK | 74 | 13.29 | 62.10 | 27.2 | 4.31 | 32.9 | -1.39 |
| 2390.00 | 45.71 | AV | 54 | 8.29 | 47.10 | 27.2 | 4.31 | 32.9 | -1.39 |
| **Frequency(MHz):** | | | **2402** | | **Polarity:** | | **VERTICAL** | | |
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2390.00 | 59.06 | PK | 74 | 14.94 | 60.45 | 27.2 | 4.31 | 32.9 | -1.39 |
| 2390.00 | 45.33 | AV | 54 | 8.67 | 46.72 | 27.2 | 4.31 | 32.9 | -1.39 |
| **Frequency(MHz):** | | | **2480** | | **Polarity:** | | **HORIZONTAL** | | |
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2483.50 | 57.20 | PK | 74 | 16.80 | 58.13 | 27.4 | 4.47 | 32.8 | -0.93 |
| 2483.50 | 45.43 | AV | 54 | 8.57 | 46.36 | 27.4 | 4.47 | 32.8 | -0.93 |
| **Frequency(MHz):** | | | **2480** | | **Polarity:** | | **VERTICAL** | | |
| Frequency (MHz) | Emission Level (dBuV/m) | | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 2483.50 | 54.80 | PK | 74 | 19.20 | 55.73 | 27.4 | 4.47 | 32.8 | -0.93 |
| 2483.50 | 44.27 | AV | 54 | 9.73 | 45.20 | 27.4 | 4.47 | 32.8 | -0.93 |

REMARKS:
1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

## 4.3 Maximum Peak Output Power

**Limit**

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels : 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

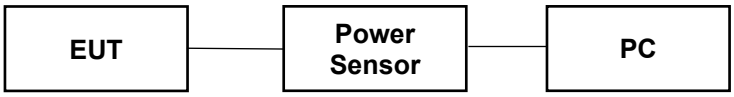
**Test Procedure**

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

Method PM is Measurement using an RF Peak power sensor. The procedure for this method is as follows:

1. The testing follows the ANSI C63.10 Section 7.8.5
2. The maximum peak conducted output power may be measured using a broadband peak RF power sensor.
3. The power sensor shall have a video bandwidth that is greater than or equal to the 20db bandwidth and shall use a fast-responding diode detector.

**Test Configuration**




**Test Results**

Please refer to Appendix RF Test Data for BT.

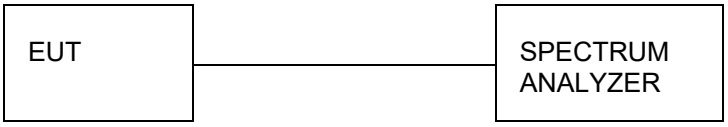
Note: 1.The test results including the cable loss.

## 4.4 On Time and Duty Cycle

**Standard Applicable**

None; for reporting purpose only.

**TEST CONFIGURATION**




**Test Procedures**

1). Set the Centre frequency of the spectrum analyzer to the transmitting frequency;
2). Set the span=0MHz, RBW=8MHz, VBW=8MHz, Sweep time=Auto;
3). Detector = peak;
4). Trace mode = Single hold.

Please refer to Appendix RF Test Data for BT.

## 4.5 20dB Bandwidth

**Limit**

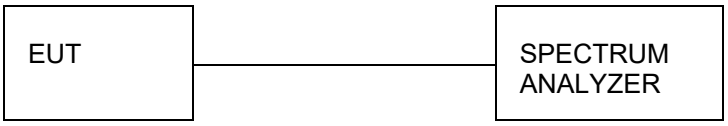
For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwidth.

**Test Procedure**

The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW. 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 was 1% to 5% of the OBW and VBW shall be at least three times RBW.

a) Span: shall be between two times and five times the OBW.
b) RBW: 1% to 5% of the OBW.
c) Video bandwidth (VBW) ⩾ 3RBW
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max-hold.
g) Allow the trace to stabilize

**Test Configuration**




**Test Results**

Please refer to Appendix RF Test Data for BT.

## 4.6 Frequency Separation

**LIMIT**

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

**TEST PROCEDURE**

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

a) Span: Wide enough to capture the peaks of two adjacent channels.

b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.

c) Video (or average) bandwidth (VBW) ≥ RBW

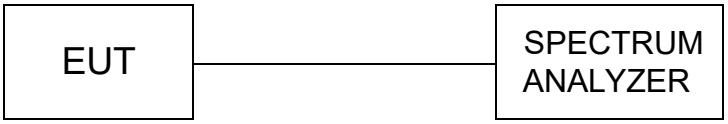
d) Sweep: Auto.

e) Detector function: Peak.

f) Trace: Max-hold.

g) Allow the trace to stabilize

**TEST CONFIGURATION**




**TEST RESULTS**

Please refer to Appendix RF Test Data for BT.

Note:

We have tested all mode at high, middle and low channel, and recorded worst case at middle

## 4.7 Number of hopping frequency

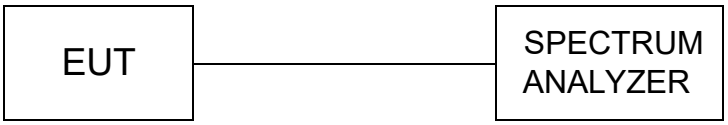
**Limit**

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

**Test Procedure**

The transmitter output was connected to the spectrum analyzer through an attenuator.
The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
a) Span: The frequency band of operation. Depending on the number of channels the device supports, it could be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
c) VBW ⩾ RBW.
d) Sweep: Auto time.
e) Detector function: Peak.
f) Trace: Max-hold.
g) Allow the trace to stabilize

**Test Configuration**




**Test Results**

Please refer to Appendix RF Test Data for BT.

## 4.8 Time of Occupancy (Dwell Time)

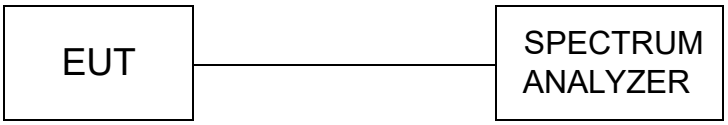
**Limit**

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

**Test Procedure**

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with 1MHz RBW and VBW≥RBW, Span 0Hz.

**Test Configuration**




**Test Results**

Please refer to Appendix RF Test Data for BT.

Note:We have tested all mode at high,middle and low channel,and recoreded worst case at middle channel.

## 4.9 Out-of-band Emissions

**Limit**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

**Test Procedure**

The testing follows the ANSI C63.10 Section 6.10.4 and 7.8.7:

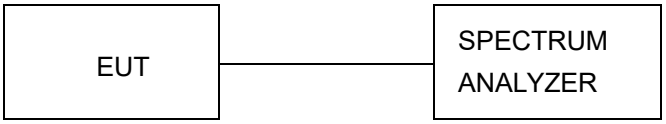
- Reference level measurement

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 = 100kHz
VBW = 300kHz
Detector = Peak
Sweep time = Auto couple
Trace mode = Max hold
Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.

- Emission level measurement

Span = Wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100kHz
VBW = 300kHz
Detector = Peak
Sweep time = Auto couple
Trace mode = Max hold
Trace was allowed to stabilize
Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this section.

**Test Configuration**




**Test Results**

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.
We measured all conditions (DH1, DH3, DH5) and recorded worst case at DH5

Please refer to Appendix RF Test Data for BT.

## 4.10 Pseudorandom Frequency Hopping Sequence

**TEST APPLICABLE**

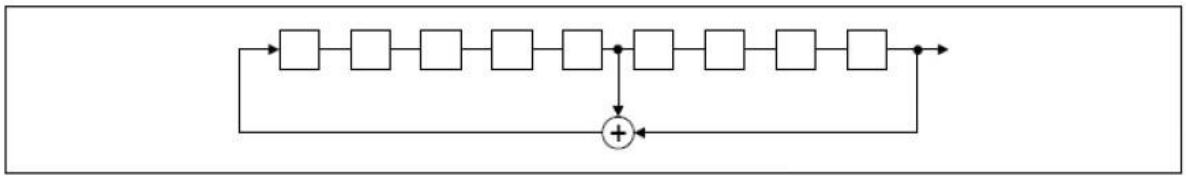
**For 47 CFR Part 15C section 15.247 (a) (1) requirement:**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

**EUT Pseudorandom Frequency Hopping Sequence Requirement**

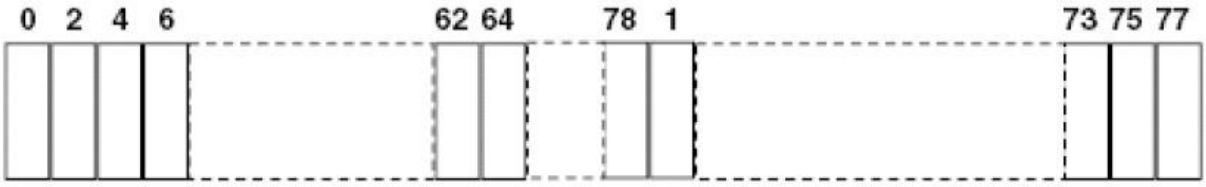
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first one of 9 consecutive ones, for example: the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



*Linear Feedback Shift Register for Generation of the PRBS sequence*

An example of pseudorandom frequency hopping sequence as follows:




Each frequency used equally one the average by each transmitter.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

## 4.11 Antenna 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 (c), 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 PCB Antenna maximum gain of antenna was 2.499 dBi

Remark:The antenna gain is provided by the customer , if the data provided by the customer is not accurate, Shenzhen HTT Technology Co.,Ltd. does not assume any responsibility.

# 5 Test Setup Photos of the EUT

Reference to the appendix I for details.

# 6 External and Internal Photos of the EUT

Reference to the appendix II for details.

**.....End of Report.....**