# TEST REPORT

## FCC PART 15 SUBPART C 15.247

**Test report**

**On Behalf of**

**Shenzhen ThreeNH Technology Co.,Ltd.**

**For**

**GRATING SPECTROPHOTOMETER**

**Model No.:TS7700, TS7706, TS7708, TS7709, TS7600, TS7606, TS7608, TS7609, TS7400, TS7410, TS7420, TS7430, TS7010, TS7010A, TS7020, TS7030, TS7036, TS7060, TS7080, TS7090, DS-100, DS-100A, DS-200, DS-300, DS360, DS-600, DS-800, DS-900, TS10, TS10A, TS20**

**FCC ID: 2AMRM-TS7NXX**

| | |
|---|---|
| **Prepared for :** | **Shenzhen ThreeNH Technology Co.,Ltd.**<br>**4/F,Building 8,Nangang Second Industry Zone,Xili,Nanshan District,Shenzhen, Guangdong, China** |
| **Prepared By :** | **Shenzhen HUAK Testing Technology Co., Ltd.**<br>**1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China** |
| **Date of Test:** | **Sep. 03, 2020 -- Sep. 14, 2020** |
| **Date of Report:** | **Sep. 14, 2020** |
| **Report Number:** | **HK2009102514-E** |

# TEST RESULT CERTIFICATION

| | |
|---|---|
| **Applicant's name**.....: | Shenzhen ThreeNH Technology Co.,Ltd. |
| Address.....: | 4/F,Building 8,Nangang Second Industry Zone,Xili,Nanshan District,Shenzhen, Guangdong, China |
| **Manufacture's Name**.....: | Shenzhen ThreeNH Technology Co.,Ltd. |
| Address.....: | 4/F,Building 8,Nangang Second Industry Zone,Xili,Nanshan District,Shenzhen, Guangdong, China |
| **Product description** | |
| Trade Mark.....: | 3nh |
| Product name.....: | GRATING SPECTROPHOTOMETER |
| Model and/or type reference ...: | TS7700, TS7706, TS7708, TS7709, TS7600, TS7606, TS7608, TS7609, TS7400, TS7410, TS7420, TS7430, TS7010, TS7010A, TS7020, TS7030, TS7036, TS7060, TS7080, TS7090, DS-100, DS-100A, DS-200, DS-300, DS360, DS-600, DS-800, DS-900, TS10, TS10A, TS20 |
| **Standards**.....: | **FCC Part 15 Subpart C 15.247** |



| | |
|---|---|
| **Date of Test** .....: | |
| Date (s) of performance of tests.....: | Sep. 03, 2020 -- Sep. 14, 2020 |
| Date of Issue .....: | Sep. 14, 2020 |
| Test Result .....: | **Pass** |

Prepared by: Gary Qian

Project Engineer

Reviewed by: Leo Zhang

Project Supervisor

Approved by: James Zhou

Technical Director

# Table of Contents

# 1 Test Summary

## 1.1 Test Description

| Test Item | Test Requirement | Result |
|---|---|---|
| Antenna Requirement | FCC 15.203/ FCC 15.247 (c) | 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 |

## 1.2 Test Facility

### 1.2.1 Address of the test laboratory

Shenzhen HUAK Testing Technology Co., Ltd.

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

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 32/EN 55032 requirements.

### 1.2.2 Laboratory accreditation

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

IC Registration No.: 21210

The 3m alternate test site of Shenzhen HUAK Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 21210 on May 24, 2016.

## 1.3 Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen HUAK Testing 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 HUAK laboratory is reported:

| No. | Item | MU |
|---|---|---|
| 1 | Conducted Emission | ±2.56dB |
| 2 | RF power, conducted | ±0.12dB |
| 3 | Spurious emissions, conducted | ±0.11dB |
| 4 | All emissions, radiated(<1G) | ±3.92dB |
| 5 | All emissions, radiated(>1G) | ±4.28dB |
| 6 | Temperature | ±0.1°C |
| 7 | Humidity | ±1.0% |

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

# 2 General Information

## 2.1 Environmental conditions

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

| | |
|---|---|
| Normal Temperature: | 25°C |
| Relative Humidity: | 55 % |
| Air Pressure: | 101 kPa |

## 2.2 General Description of EUT

| | |
|---|---|
| Product Name: | GRATING SPECTROPHOTOMETER |
| Model/Type reference: | TS7700 |
| Serial Model: | TS7706, TS7708, TS7709, TS7600, TS7606, TS7608, TS7609, TS7400, TS7410, TS7420, TS7430, TS7010, TS7010A, TS7020, TS7030, TS7036, TS7060, TS7080, TS7090, DS-100, DS-100A, DS-200, DS-300, DS360, DS-600, DS-800, DS-900, TS10, TS10A, TS20 |
| Trade Mark: | 3nh |
| FCC ID | 2AMRM-TS7NXX |
| Hardware Version: | V1.0 |
| Software Version: | V1.3 |
| Operation frequency: | 2402MHz ~ 2480MHz |
| Channel separation: | 2MHz |
| Channel number: | 40 |
| Modulation Technology: | GFSK |
| Antenna Type: | Chip Antenna |
| Antenna Gain: | 1.5dBi |
| Power Supply: | DC3.7V from battery |

Note: 1. For more details, refer to the user's manual of the EUT.

## 2.3 Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing.
There are 40 channels provided to the EUT and Channel 00/19/39 was selected for testing.

| 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 | | |

Test channel：

| Channel | Frequency (MHz) | / |
|---|---|---|
| 0 | 2402 | Low channel |
| 19 | 2440 | Middle channel |
| 39 | 2480 | High channel |

Preliminary tests were performed in each mode and packet length of BT, and found worst case as bellow, finally test were conducted at those mode and recorded in this report.

| Test Items | Worst case |
|---|---|
| Conducted Emissions | N/A |
| Radiated Emissions and Band Edge | Low/Middle/High channel |
| Maximum Conducted Output Power | Low/Middle/High channel |
| Power Spectral Density | Low/Middle/High channel |
| 6dB Bandwidth&99% Bandwidth | Low/Middle/High channel |
| Out-of-band Emissions | Low/Middle/High channel |

## 2.4 Equipments Used during the Test

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | L.I.S.N. Artificial Mains Network | R&S | ENV216 | HKE-002 | Dec. 26, 2019 | 1 Year |
| 2. | Receiver | R&S | ESCI 7 | HKE-010 | Dec. 26, 2019 | 1 Year |
| 3. | RF automatic control unit | Tonscend | JS0806-2 | HKE-060 | Dec. 26, 2019 | 1 Year |
| 4. | Spectrum analyzer | R&S | FSP40 | HKE-025 | Dec. 26, 2019 | 1 Year |
| 5. | Spectrum analyzer | Agilent | N9020A | HKE-048 | Dec. 26, 2019 | 1 Year |
| 6. | Preamplifier | Schwarzbeck | BBV 9743 | HKE-006 | Dec. 26, 2019 | 1 Year |
| 7. | EMI Test Receiver | Rohde & Schwarz | ESCI 7 | HKE-010 | Dec. 26, 2019 | 1 Year |
| 8. | Bilog Broadband Antenna | Schwarzbeck | VULB9163 | HKE-012 | Dec. 26, 2019 | 1 Year |
| 9. | Loop Antenna | Schwarzbeck | FMZB 1519 B | HKE-014 | Dec. 26, 2019 | 1 Year |
| 10. | Horn Antenna | Schewarzbeck | 9120D | HKE-013 | Dec. 26, 2019 | 1 Year |
| 11. | Pre-amplifier | EMCI | EMC051845 SE | HKE-015 | Dec. 26, 2019 | 1 Year |
| 12. | Pre-amplifier | Agilent | 83051A | HKE-016 | Dec. 26, 2019 | 1 Year |
| 13. | EMI Test Software EZ-EMC | Tonscend | JS1120-B Version | HKE-083 | Dec. 27, 2018 | N/A |
| 14. | Power Sensor | Agilent | E9300A | HKE-086 | Dec. 26, 2019 | 1 Year |
| 15. | Spectrum analyzer | Agilent | N9020A | HKE-048 | Dec. 26, 2019 | 1 Year |
| 16. | Signal generator | Agilent | N5182A | HKE-029 | Dec. 26, 2019 | 1 Year |
| 17. | Signal Generator | Agilent | 83630A | HKE-028 | Dec. 26, 2019 | 1 Year |
| 18. | Shielded room | Shiel Hong | 4*3*3 | HKE-039 | Dec. 27, 2017 | 3 Year |
| 19. | Power Meter | R&S | NRVD | SEL0069 | Dec. 26, 2019 | 1 Year |
| 20 | High Gain Antenna | Schewarzbeck | LB-180400K F | HKE-054 | Dec. 26, 2019 | 1 Year |

## 2.5 Description of Test conditions

(1) E.U.T. test conditions:
For intentional radiators, measurements of the variation of the input power or the adiated 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.

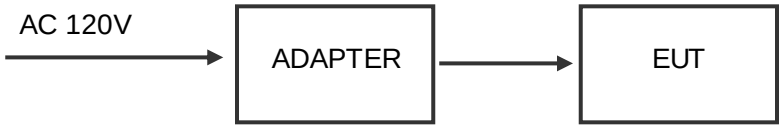
(3) Pre-test the EUT in all transmitting mode at the lowest (2402 MHz), middle (2440 MHz) and

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.

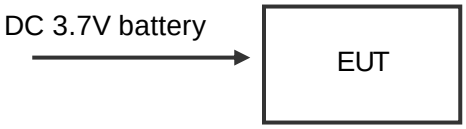
(4) The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

## 2.6 DESCRIPTION OF TEST SETUP

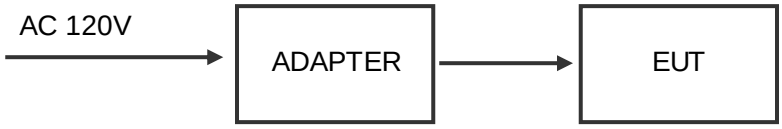
Operation of EUT during conducted testing:




Operation of EUT during above1GHz Radiation testing:




Operation of EUT during Radiation testing:




NOTE: During the test, it has been confirmed that the battery is fully charged

## 2.7 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| Description | Information | Manufacturer | Remark | Certificate |
|---|---|---|---|---|
| AC-DC Adapter | MODEL: PG122-0502000IU<br>INPUT:100-240 50/60Hz 0.4A Max<br>OUTPUT:5V 2A 10W | Shenzhen Perfect Gallant Tec Co.,Ltd. | Provide by applicant | SDOC |
| / | / | / | / | / |

# 3 TEST CONDITIONS AND RESULTS

## 3.1 Antenna Requirement

**Standard requirement**

**Standard Applicable**

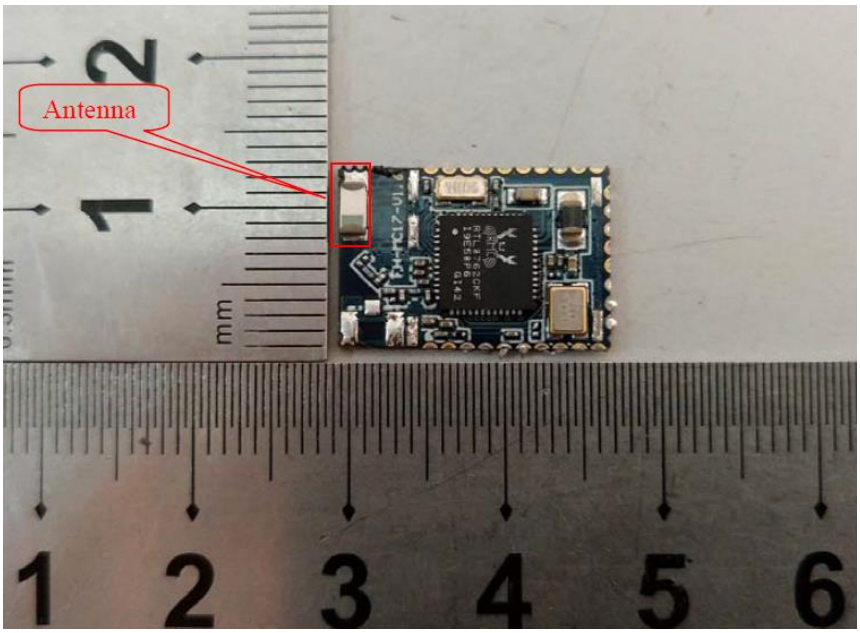
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247, if transmitting antennas of directional gain 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 Chip antenna used in the product is a permanently connected antenna that complies with the provisions of part 15.203 requirement in this section. The antenna used in this product is a Chip antenna, The directional gains of antenna used for transmitting is 1.5 dBi.



## 3.2 Conduction Emissions Measurement

**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:

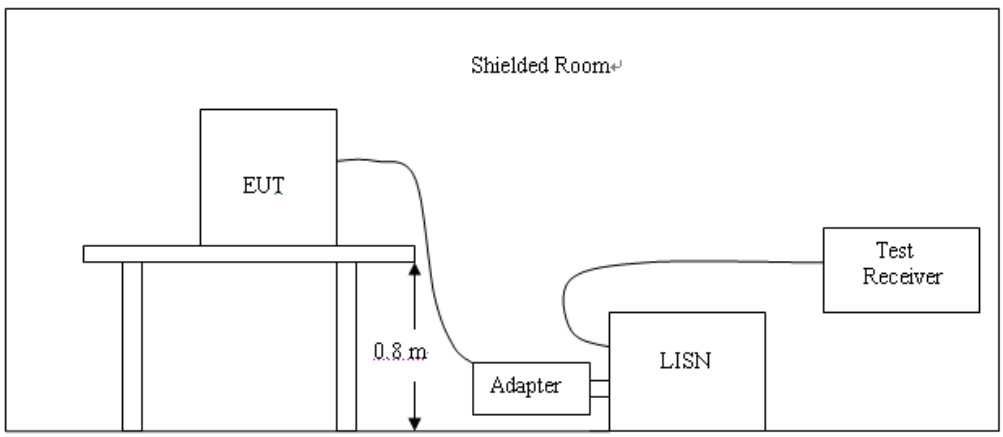
| Frequency range (MHz) | Limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

**Test procedure**

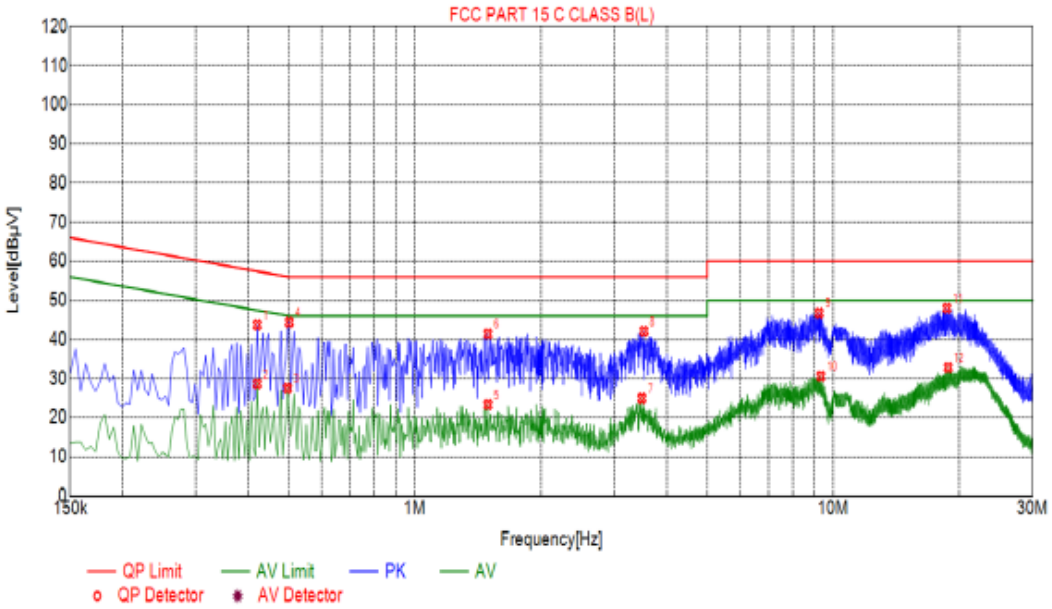
1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as 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.

**Test setup**



## Test results

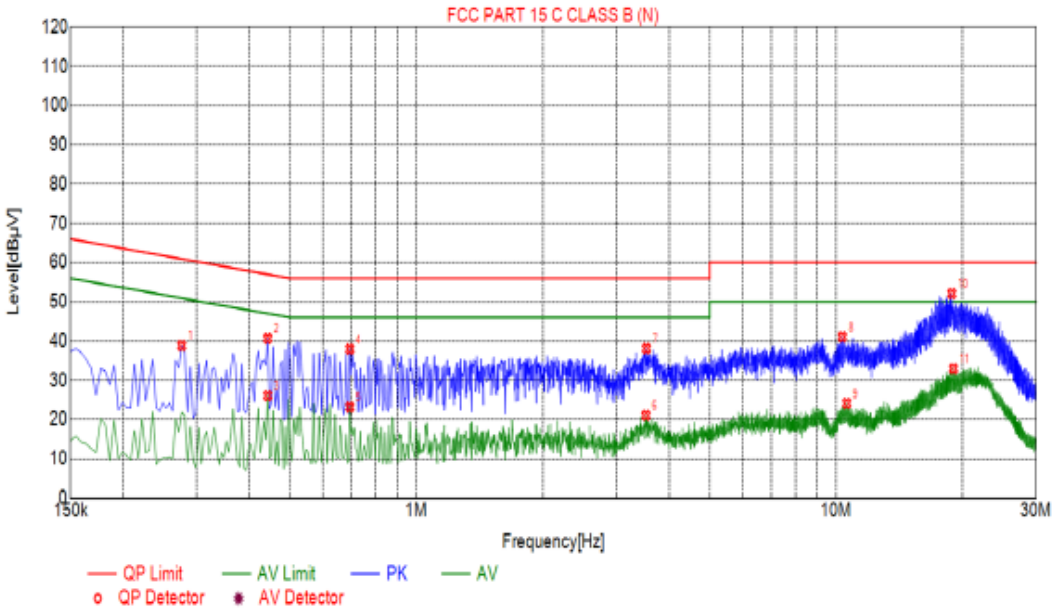
Test Specification: Line




| Suspected List | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | Freq. [MHz] | Level [dBµV] | Factor [dB] | Limit [dBµV] | Margin [dB] | Reading [dBµV] | Detector | Type |
| 1 | 0.4200 | 43.76 | 20.04 | 57.45 | 13.69 | 23.72 | PK | L |
| 2 | 0.4200 | 28.71 | 20.04 | 47.45 | 18.74 | 8.67 | AV | L |
| 3 | 0.4965 | 27.51 | 20.04 | 46.06 | 18.55 | 7.47 | AV | L |
| 4 | 0.5010 | 44.43 | 20.04 | 56.00 | 11.57 | 24.39 | PK | L |
| 5 | 1.4955 | 23.35 | 20.10 | 46.00 | 22.65 | 3.25 | AV | L |
| 6 | 1.4955 | 41.43 | 20.10 | 56.00 | 14.57 | 21.33 | PK | L |
| 7 | 3.4890 | 24.99 | 20.25 | 46.00 | 21.01 | 4.74 | AV | L |
| 8 | 3.5295 | 42.15 | 20.25 | 56.00 | 13.85 | 21.90 | PK | L |
| 9 | 9.2580 | 46.74 | 20.10 | 60.00 | 13.26 | 26.64 | PK | L |
| 10 | 9.3435 | 30.61 | 20.10 | 50.00 | 19.39 | 10.51 | AV | L |
| 11 | 18.7080 | 48.00 | 20.06 | 60.00 | 12.00 | 27.94 | PK | L |
| 12 | 18.8340 | 32.85 | 20.06 | 50.00 | 17.15 | 12.79 | AV | L |

Remark: Margin = Limit – Level
Correction factor = Cable lose + LISN insertion loss
Level=Test receiver reading + correction factor

Test Specification: Neutral




| Suspected List | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NO. | Freq. [MHz] | Level [dBµV] | Factor [dB] | Limit [dBµV] | Margin [dB] | Reading [dBµV] | Detector | Type |
| 1 | 0.2760 | 38.84 | 20.04 | 60.94 | 22.10 | 18.80 | PK | N |
| 2 | 0.4425 | 40.67 | 20.05 | 57.01 | 16.34 | 20.62 | PK | N |
| 3 | 0.4425 | 26.11 | 20.05 | 47.01 | 20.90 | 6.06 | AV | N |
| 4 | 0.6945 | 37.98 | 20.05 | 56.00 | 18.02 | 17.93 | PK | N |
| 5 | 0.6945 | 23.20 | 20.05 | 46.00 | 22.80 | 3.15 | AV | N |
| 6 | 3.5250 | 21.06 | 20.25 | 46.00 | 24.94 | 0.81 | AV | N |
| 7 | 3.5340 | 38.12 | 20.25 | 56.00 | 17.88 | 17.87 | PK | N |
| 8 | 10.3515 | 41.05 | 20.05 | 60.00 | 18.95 | 21.00 | PK | N |
| 9 | 10.6080 | 24.15 | 20.03 | 50.00 | 25.85 | 4.12 | AV | N |
| 10 | 18.8745 | 52.09 | 20.06 | 60.00 | 7.91 | 32.03 | PK | N |
| 11 | 19.0410 | 32.98 | 20.07 | 50.00 | 17.02 | 12.91 | AV | N |

Remark: Margin = Limit – Level

Correction factor = Cable lose + LISN insertion loss

Level=Test receiver reading + correction factor

## 3.3 Radiated Emissions Measurement

**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 licence - 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.

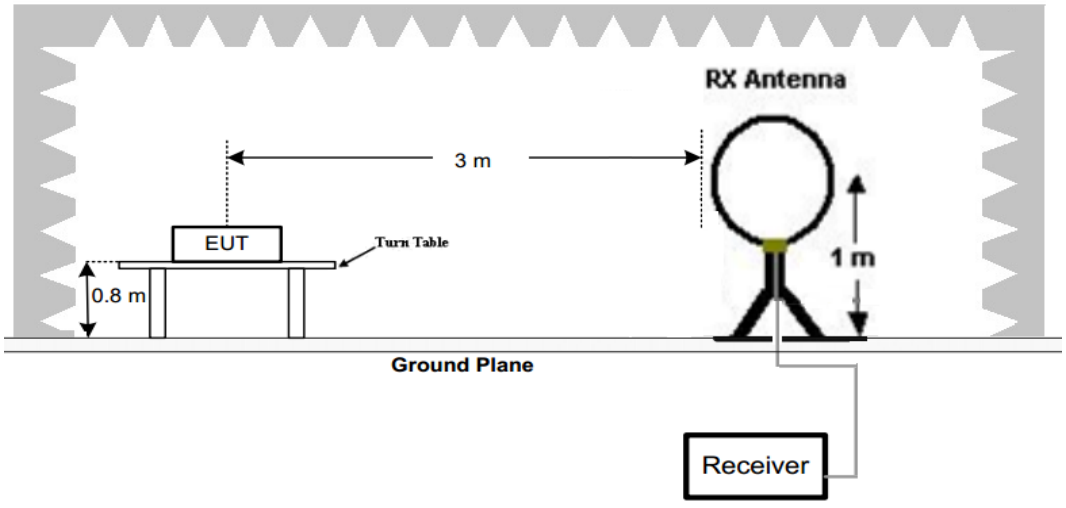
Radiated emission limits

| 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 |

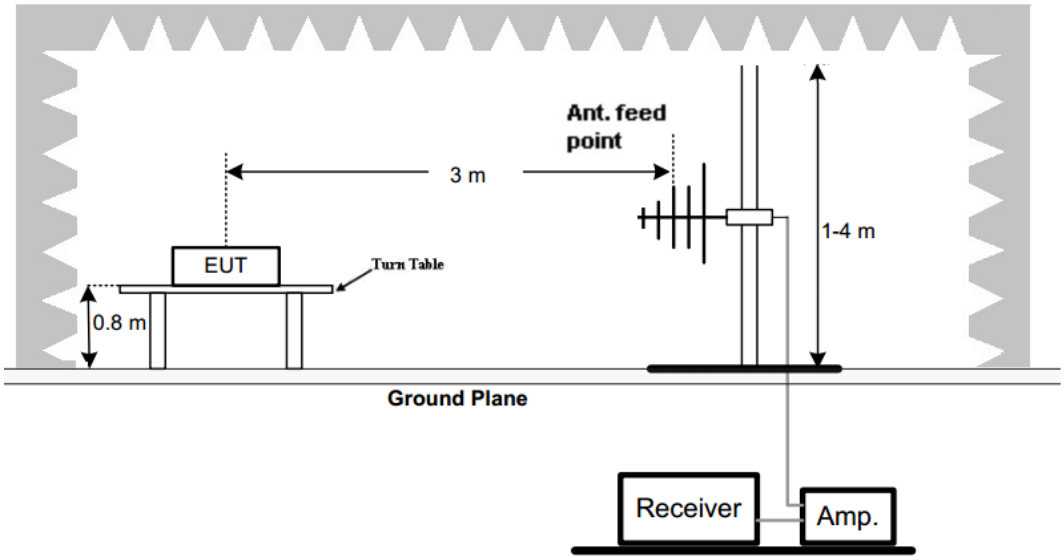
**Test setup**

**Test Configuration:**

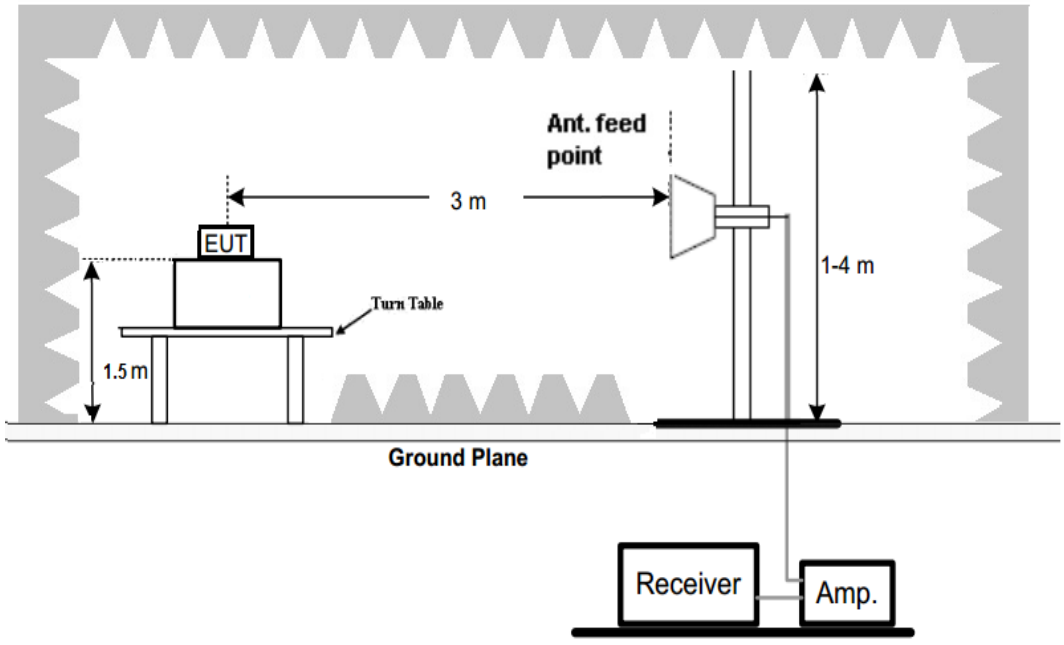
1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:




3) 1 GHz to 25 GHz emissions:




**Test Procedure**

1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.

Note: For the radiated emission test above 1GHz:Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Test the EUT in the lowest channel,the middle channel,the Highest channel
The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.Repeat above procedures until all frequencies measured was complete.

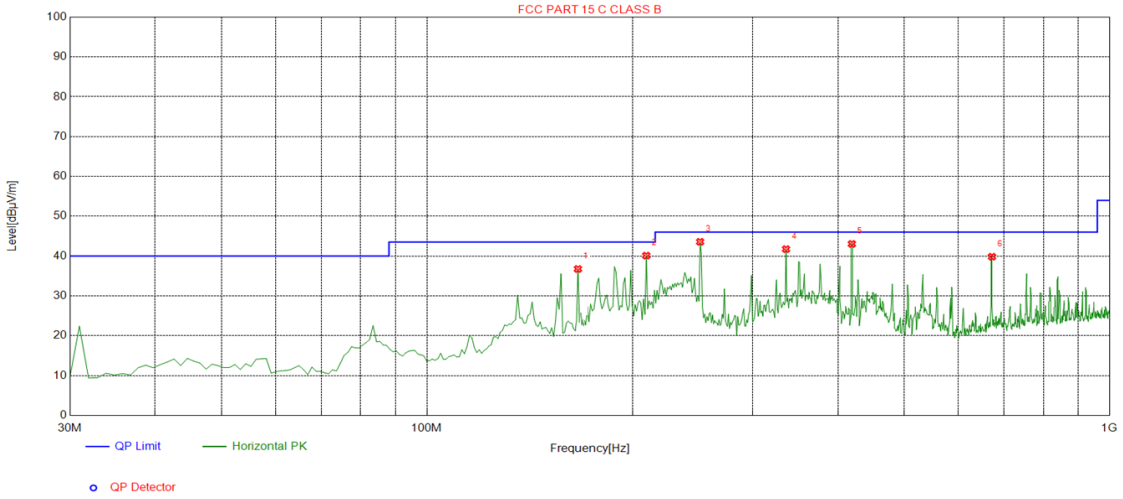
## Test Result

Remark:

1. Radiated Emission measured at GFSK low/mid/high channel from 9 KHz to 10th harmonic of fundamental and recorded worst case at low channel.
2. Radiated emission test from 9KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor (more than 20dB below the limit) in 9KHz to 30MHz and not recorded in this report.
3. For below 1GHz testing recorded worst at Low channel.

Below 1GHz Test Results:

Antenna polarity: H




**Suspected List**

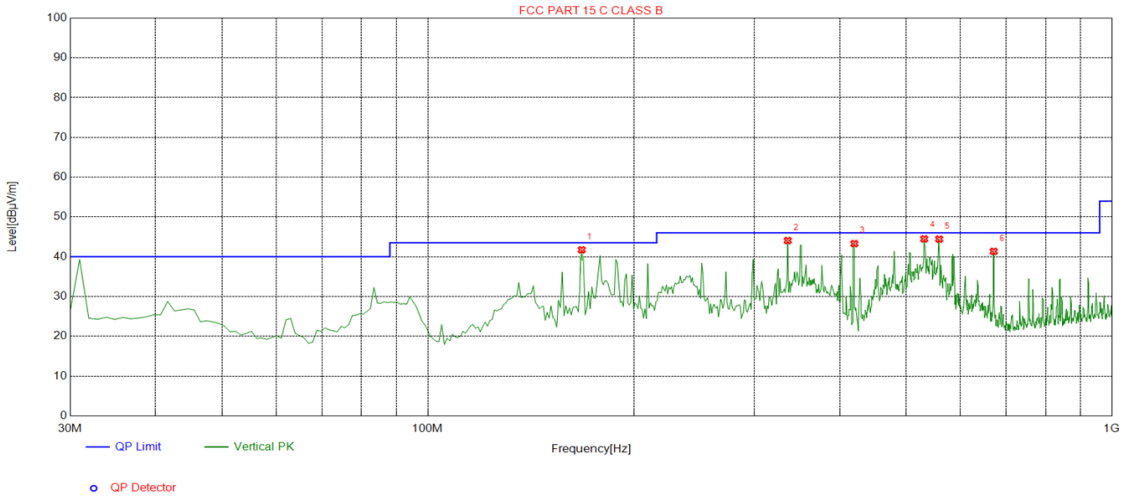
| Suspected List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO. | Freq. [MHz] | Factor [dB] | Reading [dBµV/m] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity |
| 1 | 167.8779 | -17.50 | 54.36 | 36.86 | 43.50 | 6.64 | 100 | 335 | Horizontal |
| 2 | 209.6296 | -14.81 | 54.92 | 40.11 | 43.50 | 3.39 | 100 | 315 | Horizontal |
| 3 | 251.3814 | -13.41 | 56.99 | 43.58 | 46.00 | 2.42 | 100 | 133 | Horizontal |
| 4 | 335.8559 | -11.62 | 53.36 | 41.74 | 46.00 | 4.26 | 100 | 360 | Horizontal |
| 5 | 419.3594 | -10.05 | 53.10 | 43.05 | 46.00 | 2.95 | 100 | 222 | Horizontal |
| 6 | 672.7828 | -4.65 | 44.49 | 39.84 | 46.00 | 6.16 | 100 | 273 | Horizontal |

Remark: Margin = Limit – Level

Correction Factor= Antenna Factor + Cable loss – Pre-amplifier

Level=Test receiver reading + correction factor

Antenna polarity: V




**Suspected List**

| Suspected List | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| NO. | Freq. [MHz] | Factor [dB] | Reading [dBµV/m] | Level [dBµV/m] | Limit [dBµV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity |
| 1 | 167.8779 | -17.50 | 68.14 | 40.64 | 43.50 | 2.86 | 100 | 297 | Vertical |
| 2 | 335.8559 | -11.62 | 55.69 | 44.07 | 46.00 | 1.93 | 100 | 158 | Vertical |
| 3 | 420.3303 | -10.03 | 53.33 | 43.30 | 46.00 | 2.70 | 100 | 329 | Vertical |
| 4 | 532.9630 | -7.38 | 52.10 | 44.72 | 46.00 | 1.28 | 100 | 260 | Vertical |
| 5 | 559.1792 | -6.70 | 51.13 | 44.43 | 46.00 | 1.57 | 100 | 44 | Vertical |
| 6 | 671.8118 | -4.62 | 45.97 | 41.35 | 46.00 | 4.65 | 100 | 15 | Vertical |

Remark: Margin = Limit – Level

Correction Factor= Antenna Factor + Cable loss – Pre-amplifier

Level=Test receiver reading + correction factor

Remark：

(1) Measuring frequencies from 9 KHz to the 1 GHz, Radiated emission test from 9KHz to 30MHz was verified, and no any emission was found except system noise floor(emission in 9kHz to 30MHz is more than 20dB below the limit), so not recorded in the report.

(2) * 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.

(3) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.

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

CH Low (2402MHz)

Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 4804.00 | 56.39 | -3.65 | 52.74 | 74 | -21.26 | Peak |
| 4804.00 | 40.61 | -3.65 | 36.96 | 54 | -17.04 | AVG |
| 7206.00 | 55.53 | -0.95 | 54.58 | 74 | -19.42 | Peak |
| 7206.00 | 37.74 | -0.95 | 36.79 | 54 | -17.21 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 4804.00 | 55.92 | -3.65 | 52.27 | 74 | -21.73 | Peak |
| 4804.00 | 38.66 | -3.65 | 35.01 | 54 | -18.99 | AVG |
| 7206.00 | 55.53 | -0.95 | 54.58 | 74 | -19.42 | Peak |
| 7206.00 | 36.66 | -0.95 | 35.71 | 54 | -18.29 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

CH Middle (2440MHz)

Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 4880.00 | 55.60 | -3.54 | 52.06 | 74 | -21.94 | Peak |
| 4880.00 | 41.13 | -3.54 | 37.59 | 54 | -16.41 | AVG |
| 7320.00 | 54.09 | -0.81 | 53.28 | 74 | -20.72 | Peak |
| 7320.00 | 37.94 | -0.81 | 37.13 | 54 | -16.87 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 4880.00 | 55.74 | -3.54 | 52.20 | 74 | -21.80 | Peak |
| 4880.00 | 40.01 | -3.54 | 36.47 | 54 | -17.53 | AVG |
| 7320.00 | 54.83 | -0.81 | 54.02 | 74 | -19.98 | Peak |
| 7320.00 | 37.23 | -0.81 | 36.42 | 54 | -17.58 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

CH High (2480MHz)

Horizontal:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 4960.00 | 56.86 | -3.43 | 53.43 | 74 | -20.57 | Peak |
| 4960.00 | 40.16 | -3.43 | 36.73 | 54 | -17.27 | AVG |
| 7440.00 | 54.04 | -0.77 | 53.27 | 74 | -20.73 | Peak |
| 7440.00 | 37.44 | -0.77 | 36.67 | 54 | -17.33 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

Vertical:

| Frequency (MHz) | Meter Reading (dBμV) | Factor (dB) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector Type |
|---|---|---|---|---|---|---|
| 4960.00 | 57.84 | -3.43 | 54.41 | 74 | -19.59 | Peak |
| 4960.00 | 41.00 | -3.43 | 37.57 | 54 | -16.43 | AVG |
| 7440.00 | 52.80 | -0.77 | 52.03 | 74 | -21.97 | Peak |
| 7440.00 | 37.41 | -0.77 | 36.64 | 54 | -17.36 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

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 other emissions are 20 dB below the limit value, which are not reported. It is deemed to comply with the requireme.

(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.

Radiated Band Edge Test:

Operation Mode: TX CH Low (2402MHz)

Horizontal (Worst case):

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBµV) | (dB) | (dBµV/m) | (dBµV/m) | (dB) | |
| 2310 | 61.86 | -5.81 | 56.05 | 74 | -17.95 | Peak |
| 2310 | 43.54 | -5.81 | 37.73 | 54 | -16.27 | AVG |
| 2390 | 59.94 | -5.84 | 54.10 | 74 | -19.90 | Peak |
| 2390 | 44.62 | -5.84 | 38.78 | 54 | -15.22 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

Vertical:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBµV) | (dB) | (dBµV/m) | (dBµV/m) | (dB) | |
| 2310 | 60.09 | -5.81 | 54.28 | 74 | -19.72 | Peak |
| 2310 | 45.34 | -5.81 | 39.53 | 54 | -14.47 | AVG |
| 2390 | 59.77 | -5.84 | 53.93 | 74 | -20.07 | Peak |
| 2390 | 44.85 | -5.84 | 39.01 | 54 | -14.99 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

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) | |
| 2483.5 | 59.30 | -6.04 | 53.26 | 74 | -20.74 | Peak |
| 2483.5 | 43.67 | -6.04 | 37.63 | 54 | -16.37 | AVG |
| 2500 | 58.53 | -6.06 | 52.47 | 74 | -21.53 | Peak |
| 2500 | 44.23 | -6.06 | 38.17 | 54 | -15.83 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

Vertical:

| Frequency | Meter Reading | Factor | Emission Level | Limits | Margin | Detector Type |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | |
| 2483.5 | 60.97 | -6.04 | 54.93 | 74 | -19.07 | Peak |
| 2483.5 | 45.07 | -6.04 | 39.03 | 54 | -14.97 | AVG |
| 2500 | 58.96 | -6.06 | 52.90 | 74 | -21.10 | Peak |
| 2500 | 45.32 | -6.06 | 39.26 | 54 | -14.74 | AVG |
| Remark :Factor= Antenna Factor + Cable Loss - Pre-amplifier | | | | | | |

NOTE: The other emissions are 20 dB below the limit value, which are not reported.

## 3.4 Maximum Output Power Measurement

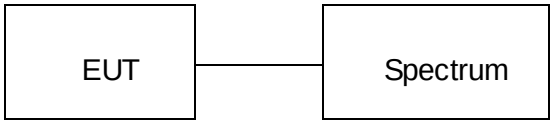
**Limit**

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

**Test procedure**

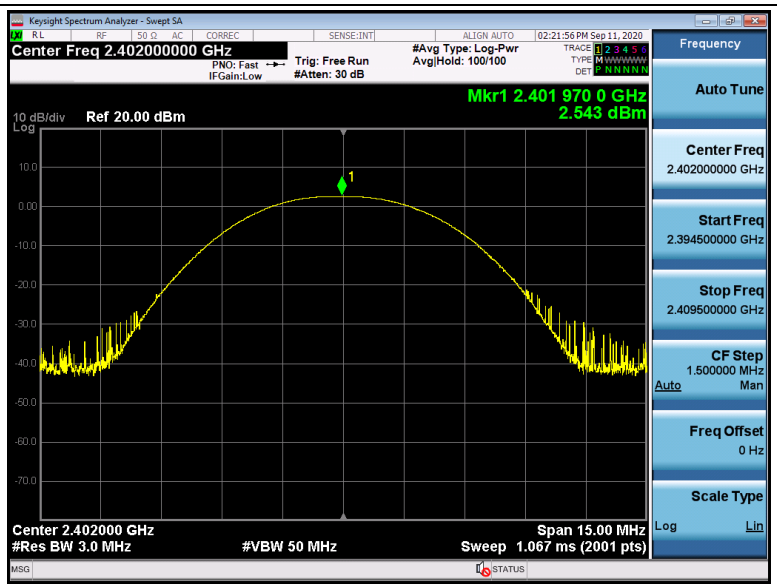
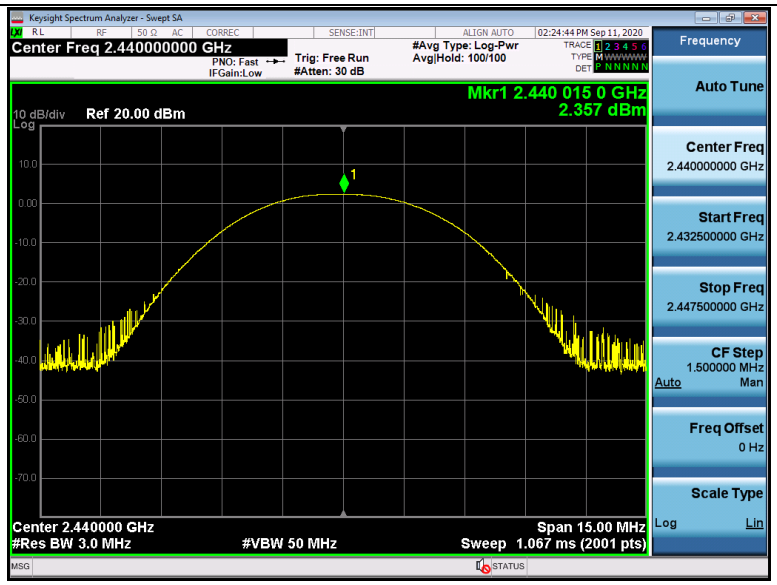
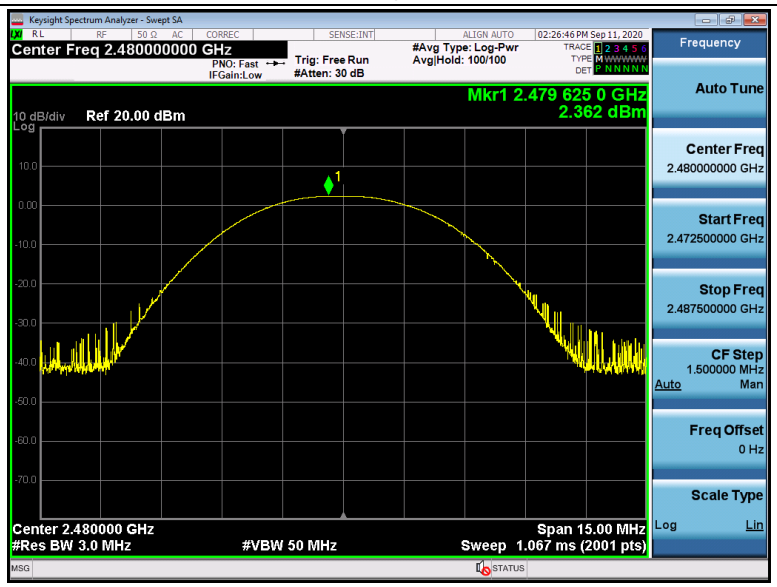
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum.

**Test setup**




**Test results**

| Channel | Channel frequency (MHz) | Output power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| Low | 2402 | 2.543 | 30 | Pass |
| Middle | 2440 | 2.357 | | Pass |
| High | 2480 | 2.362 | | Pass |

| Low |
| --- |
|  |
| Middle |
|  |
| High |
|  |

## 3.5 Power Spectral Density

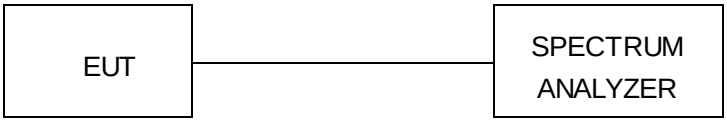
**Limit**

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.

**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.

**Test setup**




**Test results**

| Channel | Channel frequency (MHz) | Power Spectral Density (dBm/3KHz) | Limit (dBm/3KHz) | Result |
|---|---|---|---|---|
| Low | 2402 | -15.017 | 8 | Pass |
| Middle | 2440 | -15.098 | | Pass |
| High | 2480 | -15.147 | | Pass |

**CH 00**


**CH 19**


**CH 39**

## 3.6 6dB Bandwidth

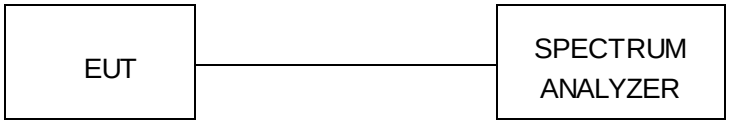
**Limit**

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

**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=300KHz.
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.

**Test setup**




**Test result**

| Channel | Channel frequency (MHz) | 6dB Bandwidth (MHz) | Limit (KHz) | Result |
|---|---|---|---|---|
| Low | 2402 | 0.665 | ≥500 | Pass |
| Middle | 2440 | 0.604 | | Pass |
| High | 2480 | 0.604 | | Pass |

## CH 00


## CH 19

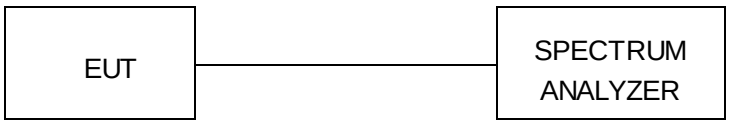

## CH 39

## 3.7 Occupied Bandwidth

**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.

**Test setup**




**Test result**

N/A

## 3.8 Band edge

**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.

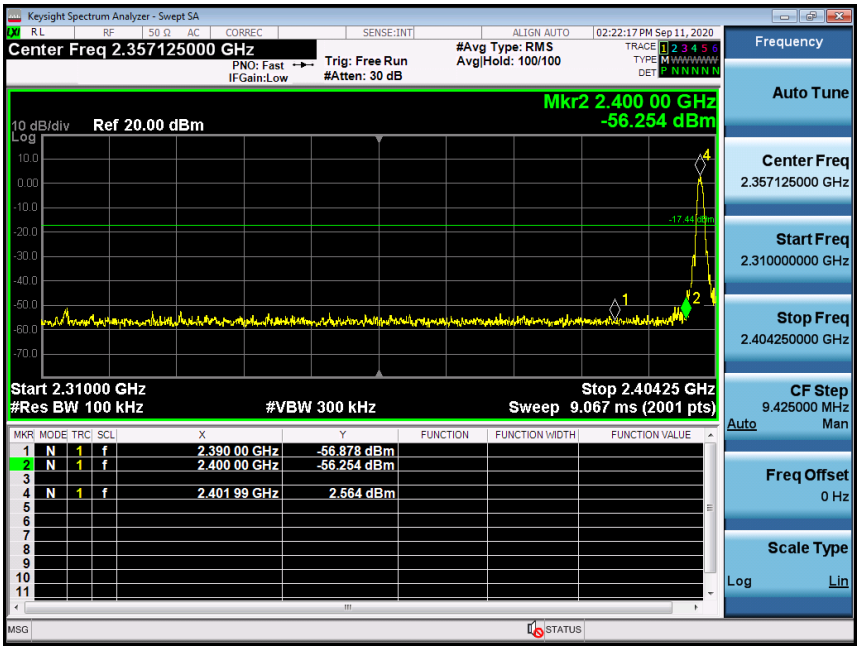
**Test procedure**

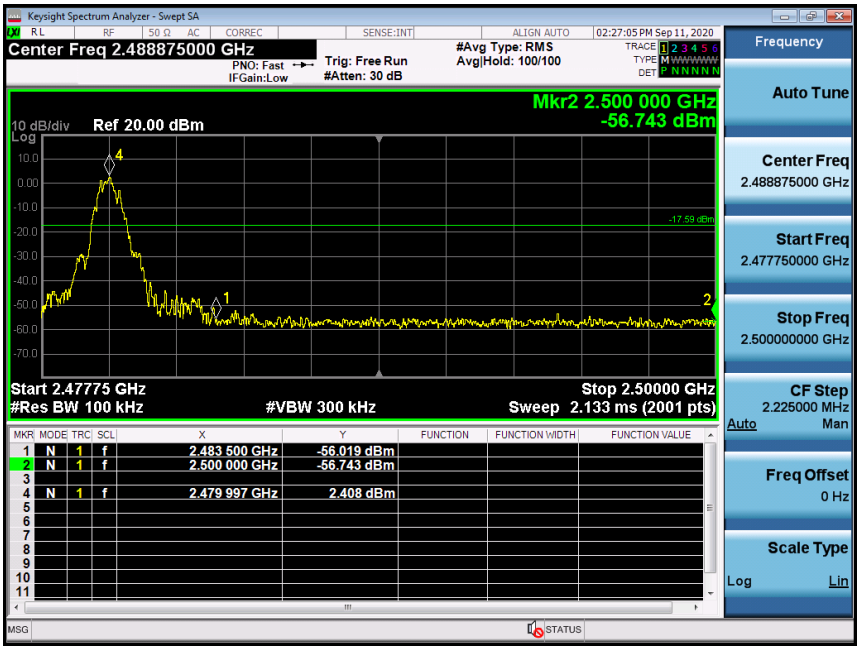
The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, 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

**Test setup**

## Test Results



## 3.9 Conducted Spurious Emissions

**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.

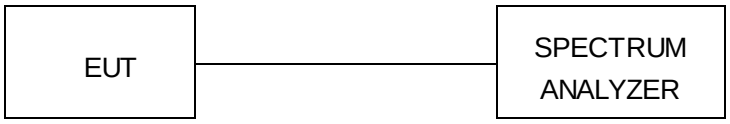
**Test procedure**

a.The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.

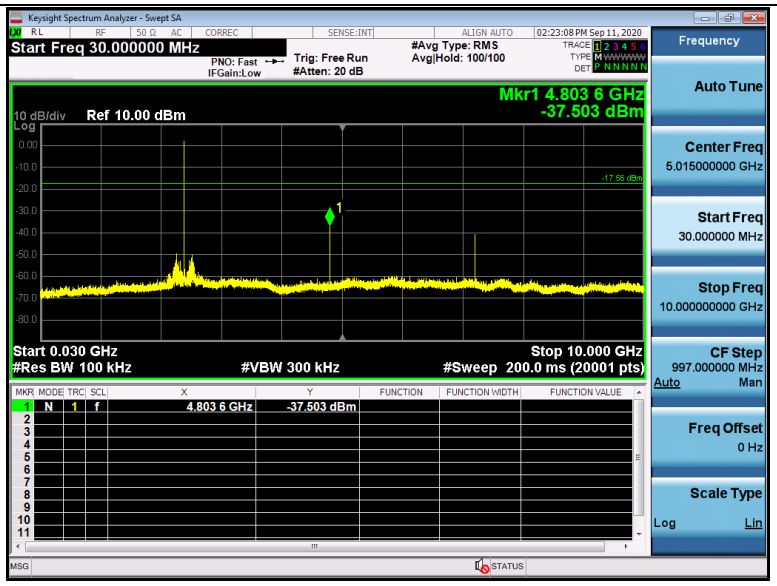
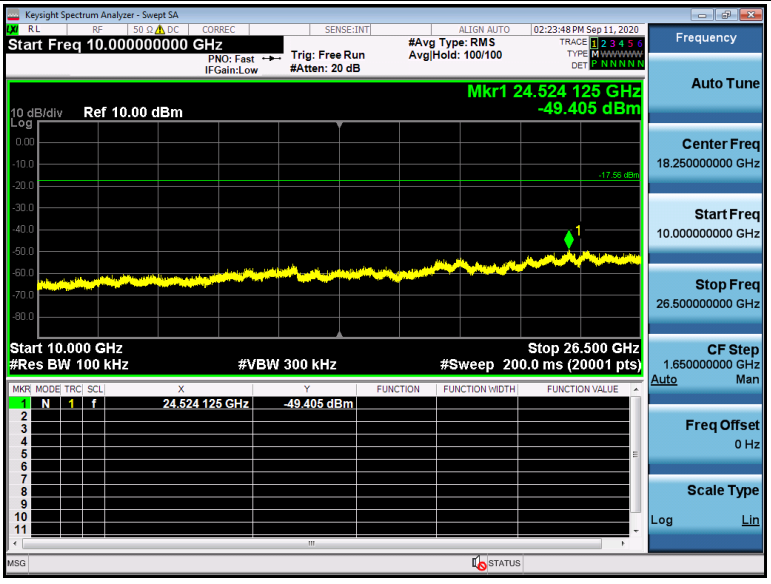
b.Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation, RBW ≥ 1% of the span, VBW ≥ RBW, Sweep = auto,

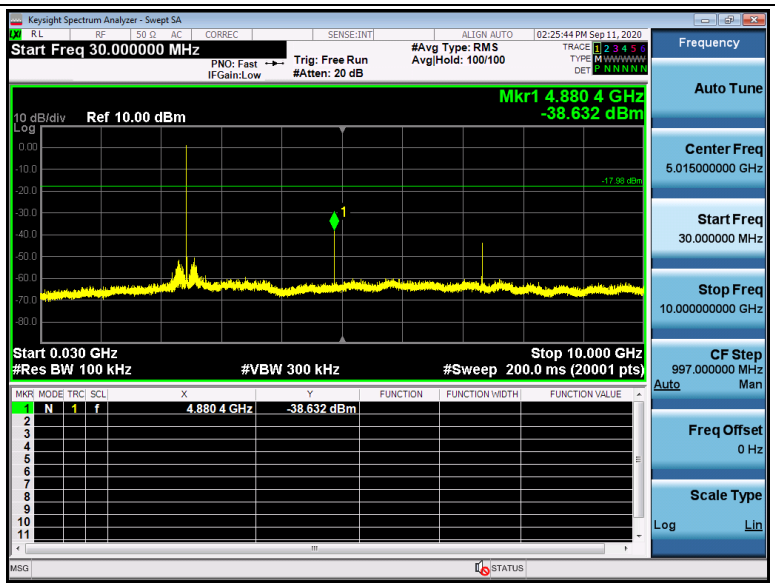
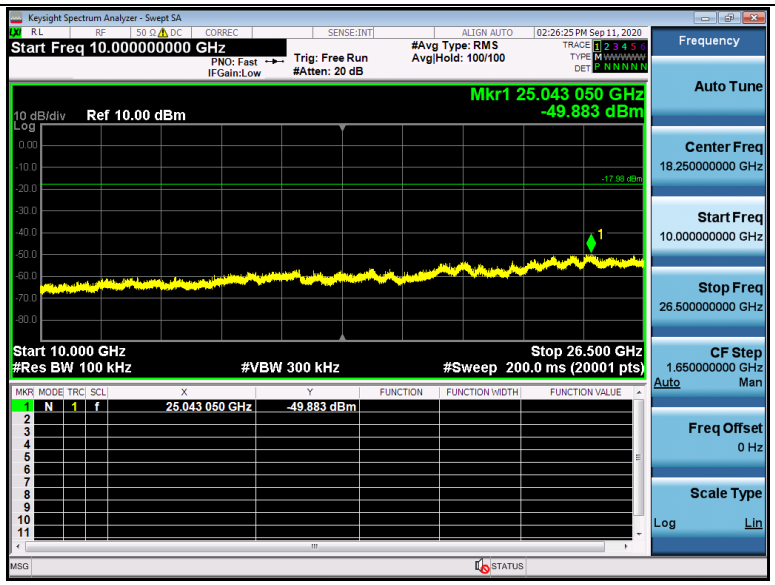
Detector function = peak, Trace = max hold

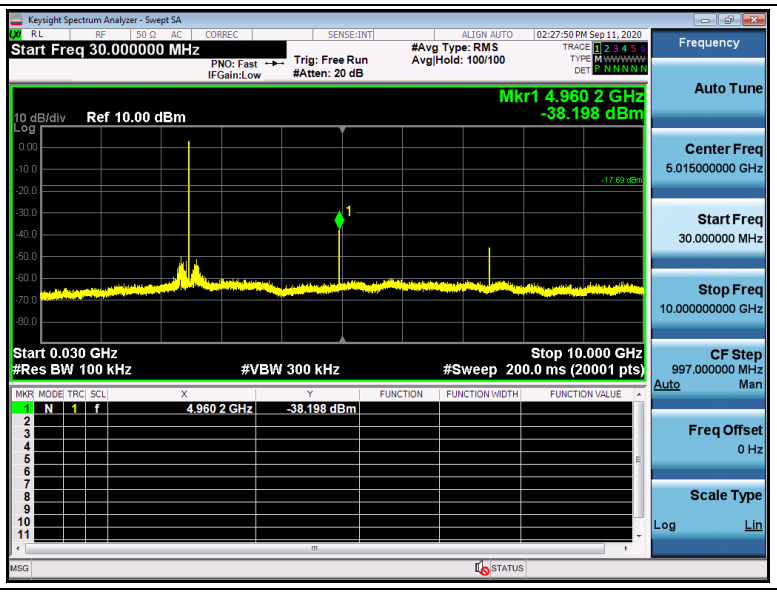
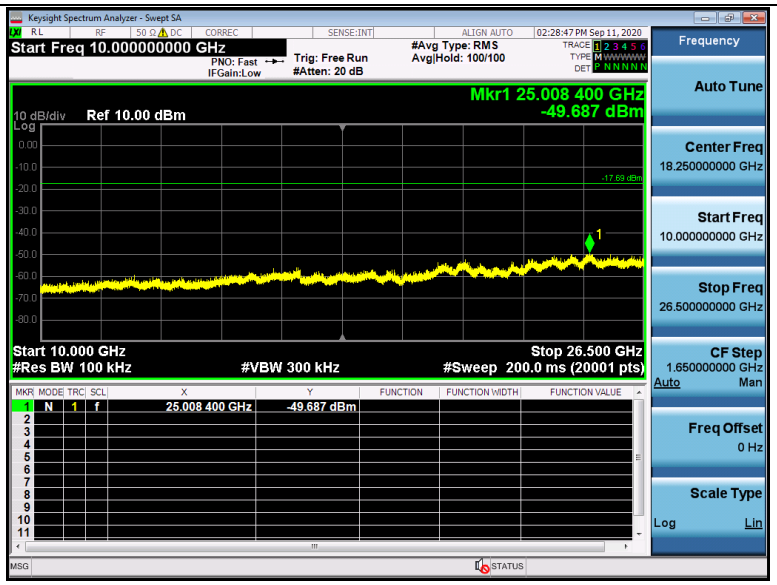
**Test setup**



## Test results

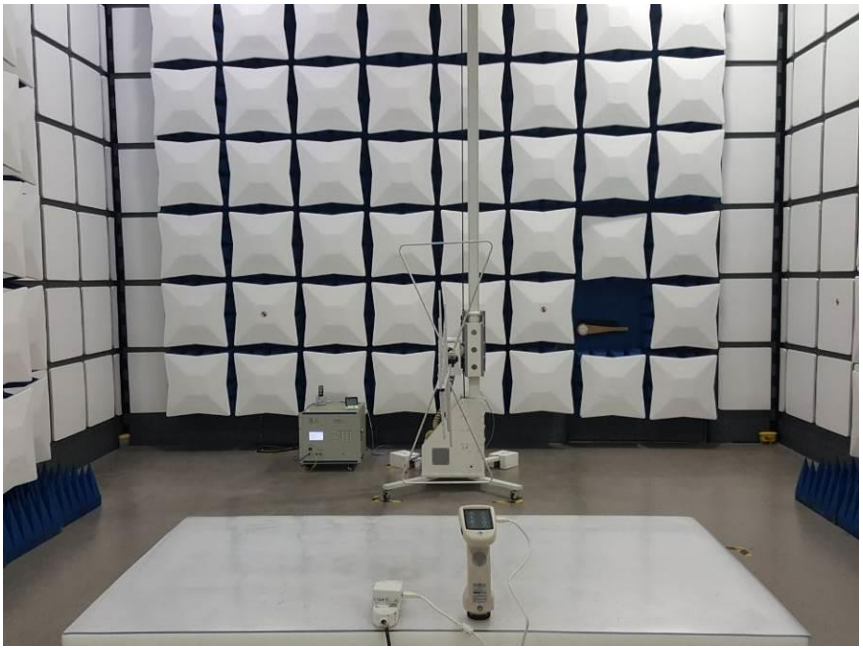
| | |
|---|---|
| | Reference |
| |  |
| | 30MHz-10GHz |
| **CH00** |  |
| | 10GHz-26.5GHz |
| |  |

| | |
|---|---|
| | Reference |
| |  |
| | 30MHz-10GHz |
| **CH19** |  |
| | 10GHz-26.5GHz |
| |  |

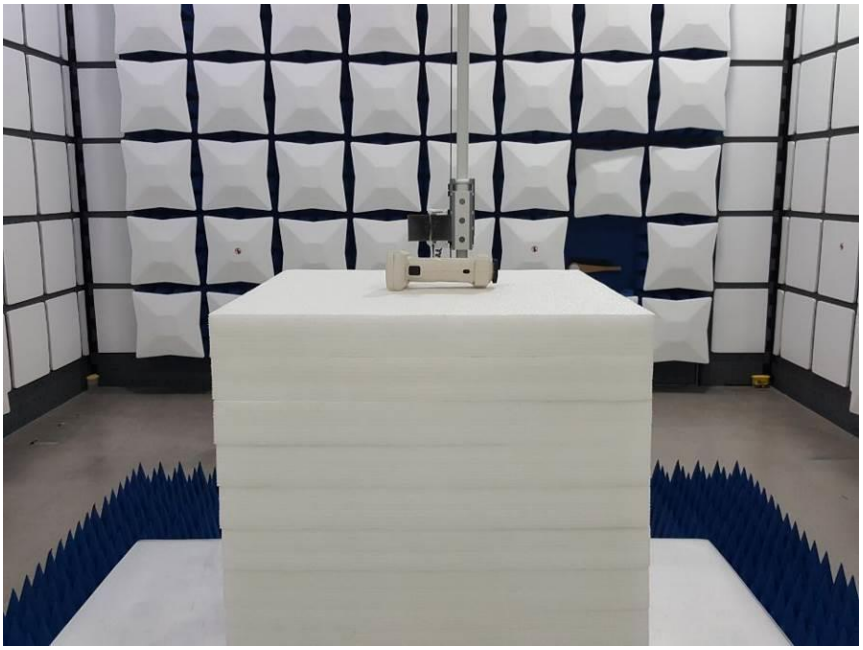
| | |
|---|---|
| | Reference |
| |  |
| | 30MHz-10GHz |
| **CH39** |  |
| | 10GHz-26.5GHz |
| |  |

# 4 Test Setup Photos of the EUT

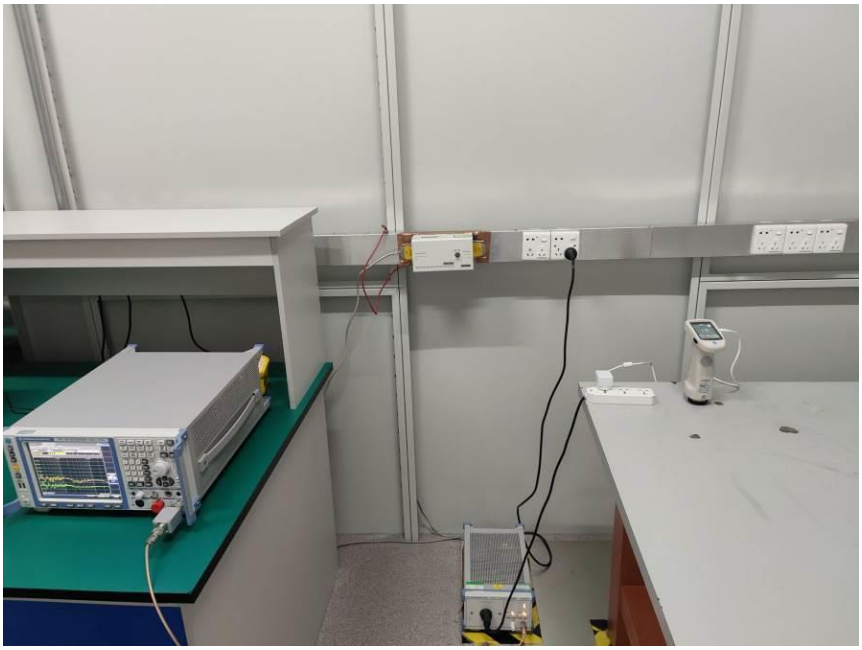
Radiated Emissions: 30MHz-1000MHz



Radiated Emissions: Above 1000MHz



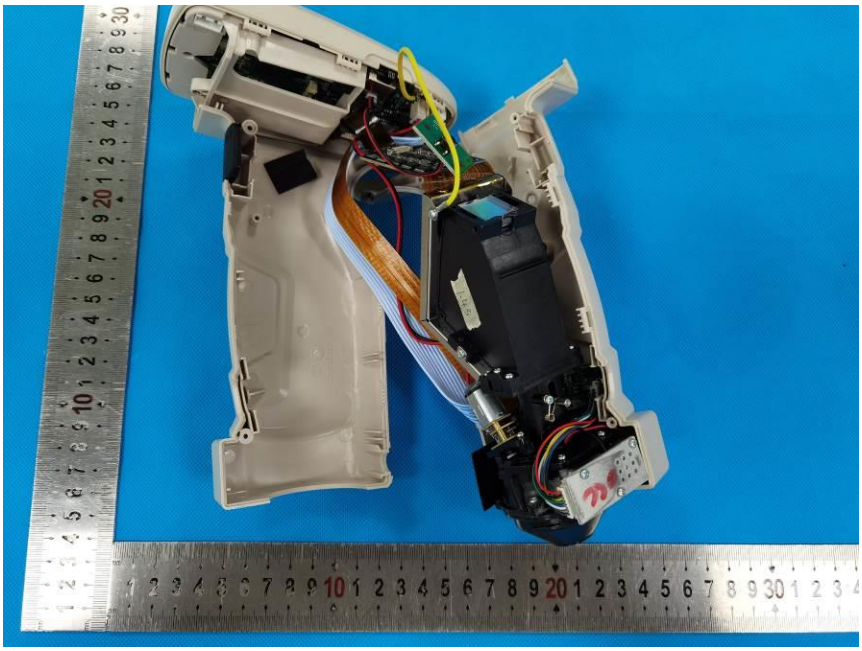
Conducted Emission

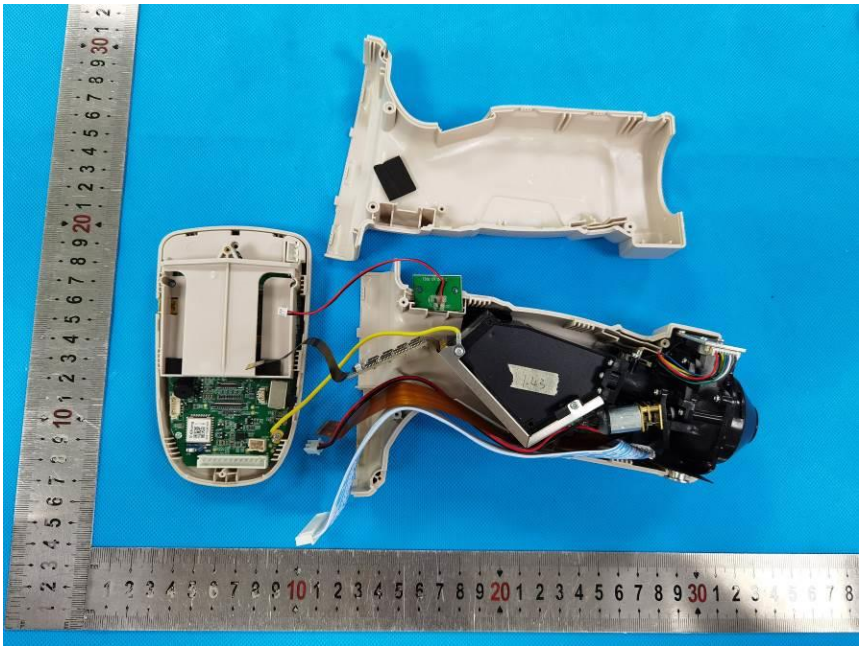


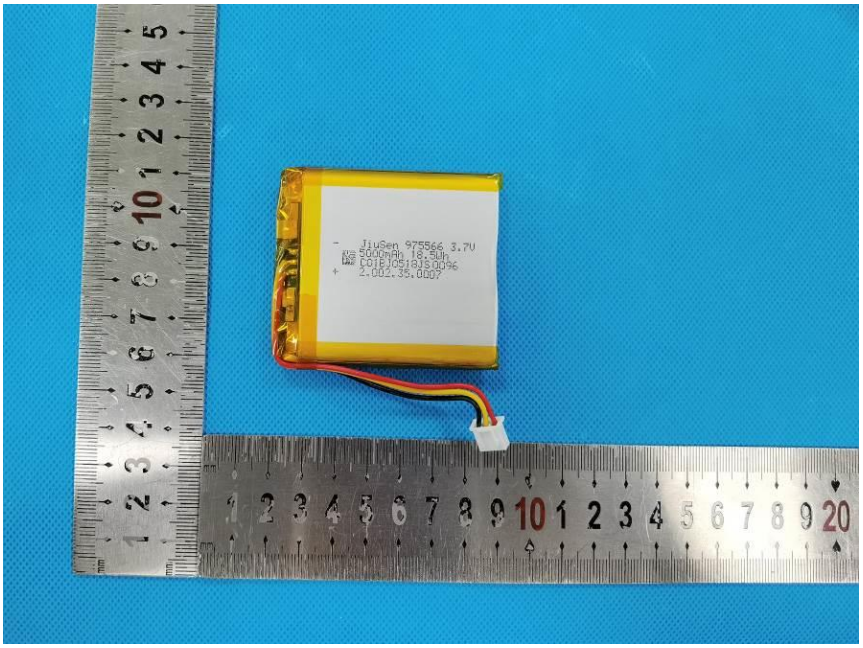
# 5 PHOTOS OF THE EUT

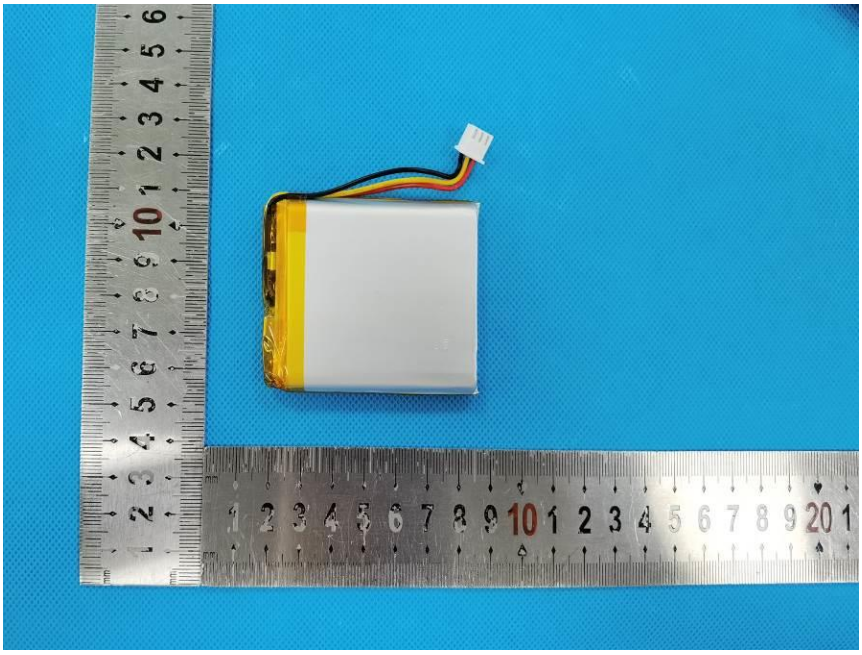
**External Photos**

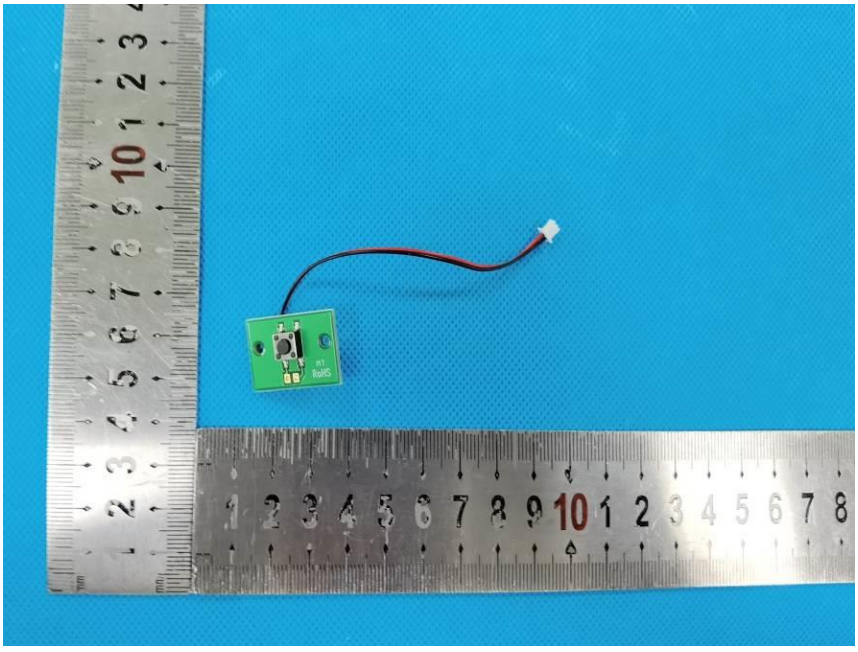
**Internal Photos**

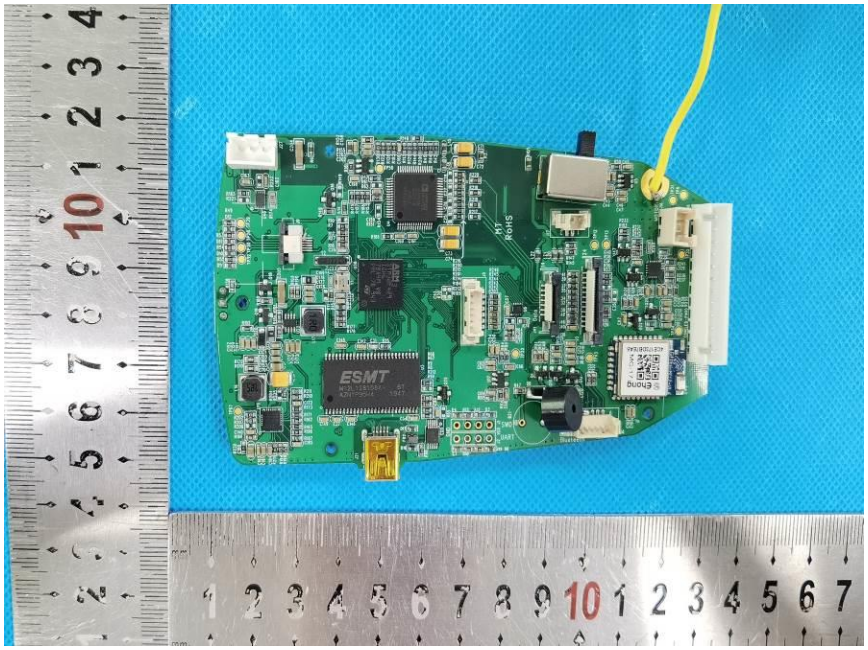





JiuSen 975566 3.7V
5000mAh 18.5Wh
2.002.35.0007



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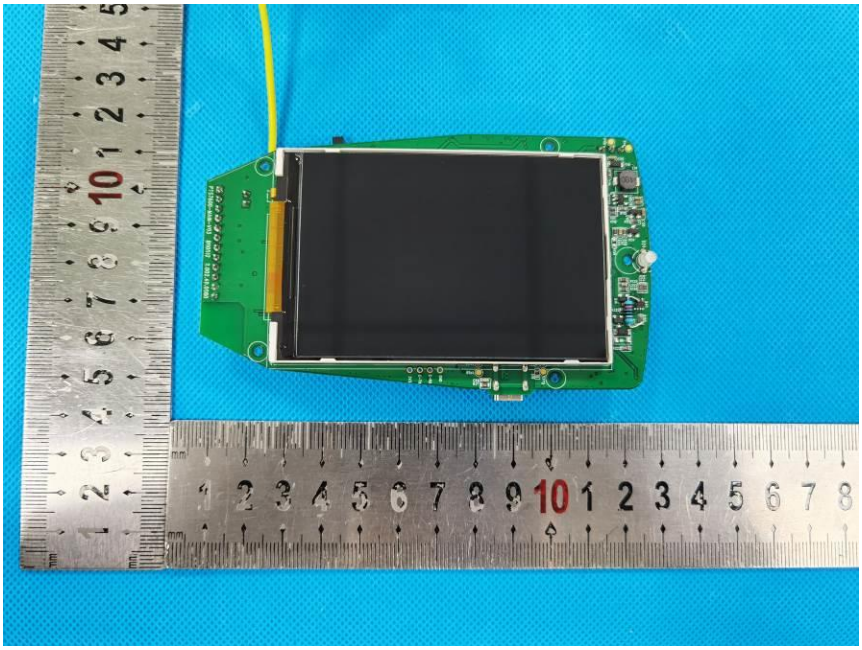

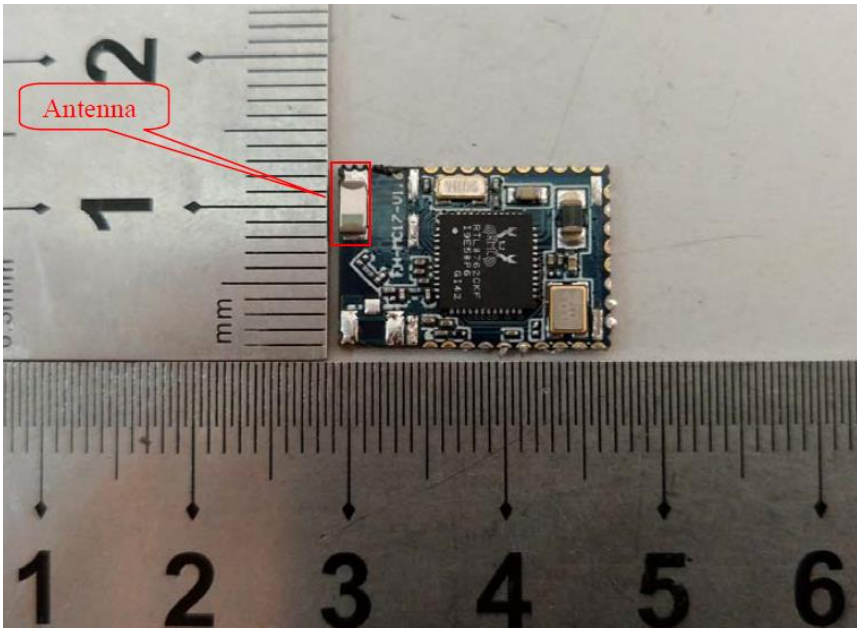
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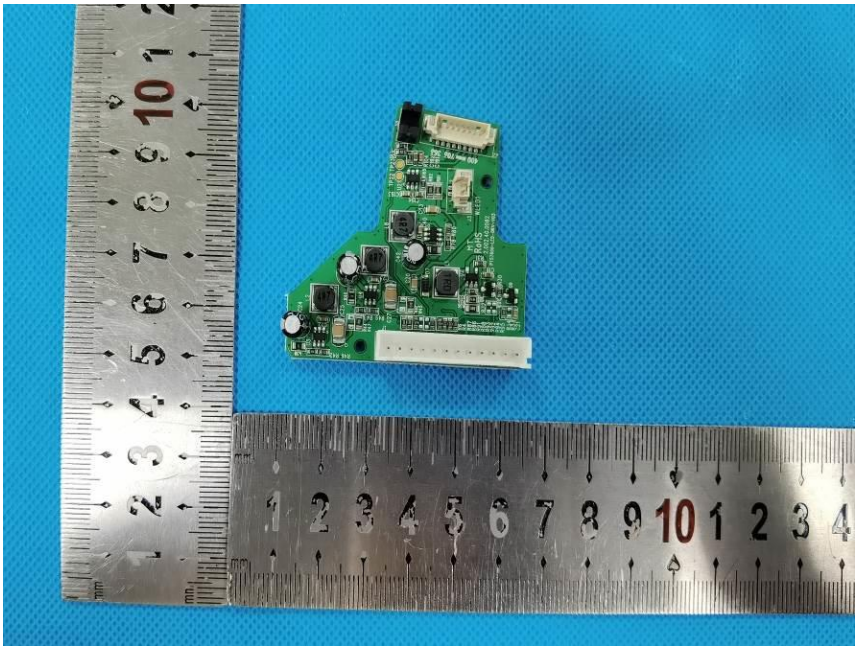

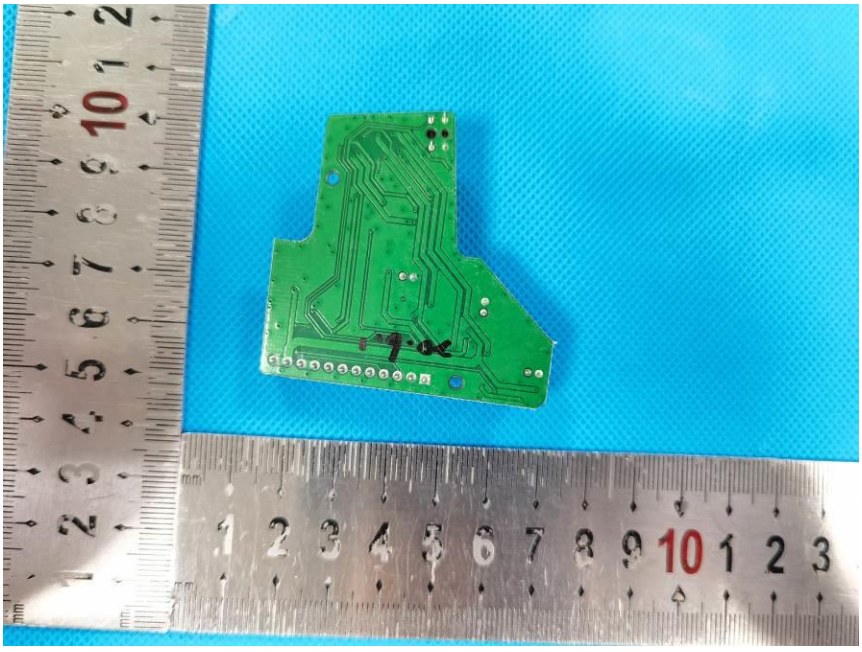

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