

# TEST REPORT

## FCC ID:2BENR-DH-315

**Product** : DH Series of intelligent switches  
**Model Name** : DH-315  
**Brand** : N/A  
**Report No.** : NCT24001021E-3

Prepared for

**Huizhou Shanjing Technology Co., Ltd**  
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Prepared by

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## 1 TEST RESULT CERTIFICATION

Applicant's name : Huizhou Shanjing Technology Co., Ltd  
Address : 4th Floor, Building F, Xinnanhong Industrial Park, Jiangjun Road,  
Qiuchang Street, Huiyang District, Huizhou City, Guangdong Province  
Manufacture's name : Huizhou Shanjing Technology Co., Ltd  
Address : 4th Floor, Building F, Xinnanhong Industrial Park, Jiangjun Road,  
Qiuchang Street, Huiyang District, Huizhou City, Guangdong Province  
Product name : DH Series of intelligent switches  
Model name : DH-315  
Standards : FCC CFR47 Part 15 Section 15.247  
Test procedure : ANSI C63.10:2013  
Date of test : Jan. 02, 2024-Jan. 19, 2024  
Date of Issue : Jan. 19, 2024

This device described above has been tested by NCT, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Test Engineer:

  
Keven Wu / Engineer

Technical Manager:

  
Henry Wang / Manager



## Contents

|   | Page      |
|---|-----------|
| <b>1 TEST RESULT CERTIFICATION .....</b>                            | <b>2</b>  |
| <b>2 TEST SUMMARY .....</b>   | <b>5</b>  |
| 2.1 TEST SITE .....   | 6         |
| <b>3 GENERAL INFORMATION .....</b>                                  | <b>7</b>  |
| 3.1 GENERAL DESCRIPTION OF E.U.T. ....                              | 7         |
| 3.2 CHANNEL LIST .....  | 8         |
| 3.3 TEST SETUP CONFIGURATION .....                                  | 9         |
| 3.4 TEST MODE .....   | 9         |
| <b>4 EQUIPMENT DURING TEST .....</b>                                | <b>10</b> |
| 4.1 EQUIPMENTS LIST .....   | 10        |
| 4.2 MEASUREMENT UNCERTAINTY .....                                   | 12        |
| 4.3 DESCRIPTION OF SUPPORT UNITS .....                              | 12        |
| <b>5 CONDUCTED EMISSION .....</b>                                   | <b>13</b> |
| 5.1 E.U.T. OPERATION .....  | 13        |
| 5.2 EUT SETUP .....   | 13        |
| 5.3 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) .....              | 14        |
| 5.4 MEASUREMENT PROCEDURE .....                                     | 14        |
| 5.5 CONDUCTED EMISSION LIMIT .....                                  | 14        |
| 5.6 MEASUREMENT DESCRIPTION .....                                   | 14        |
| 5.7 CONDUCTED EMISSION TEST RESULT .....                            | 14        |
| <b>6 RADIATED SPURIOUS EMISSIONS .....</b>                          | <b>17</b> |
| 6.1 EUT OPERATION .....   | 17        |
| 6.2 TEST SETUP .....  | 18        |
| 6.3 SPECTRUM ANALYZER SETUP .....                                   | 19        |
| 6.4 TEST PROCEDURE .....  | 20        |
| 6.5 SUMMARY OF TEST RESULTS .....                                   | 22        |
| <b>7 CONDUCT BAND EDGE AND SPURIOUS EMISSIONS MEASUREMENT .....</b> | <b>29</b> |
| 7.1 TEST PROCEDURE .....  | 29        |
| 7.2 TEST RESULT .....   | 29        |



|   |           |
|---|-----------|
| <b>8 6DB BANDWIDTH MEASUREMENT .....</b>        | <b>30</b> |
| 8.1 TEST PROCEDURE.....                         | 30        |
| 8.2 TEST RESULT .....                           | 30        |
| <b>9 MAXIMUM PEAK OUTPUT POWER.....</b>         | <b>31</b> |
| 9.1 TEST PROCEDURE.....                         | 31        |
| 9.2 TEST RESULT .....                           | 31        |
| <b>10 POWER SPECTRAL DENSITY.....</b>           | <b>32</b> |
| 10.1 TEST PROCEDURE.....                        | 32        |
| 10.2 TEST RESULT .....                          | 32        |
| <b>11 ANTENNA APPLICATION .....</b>             | <b>33</b> |
| 11.1 ANTENNA REQUIREMENT.....                   | 33        |
| 11.2 RESULT .....                               | 33        |
| <b>12 TEST SETUP PHOTOS AND EUT PHOTOS.....</b> | <b>34</b> |

## 2 Test Summary

| Test Items                  | Test Requirement           | Result |
|-----------------------------|----------------------------|--------|
| Conduct Emission            | FCC part 15.207            | PASS   |
| Radiated Spurious Emissions | FCC part 15.205/15.209     | PASS   |
| Conducted Spurious Emission | FCC part 15. 247(d)        | PASS   |
| Band edge                   | FCC part 15.247(d)         | PASS   |
| 6dB&99% Bandwidth           | FCC part 15.247 (a)(2)     | PASS   |
| Maximum Peak Output Power   | FCC part 15.247 (b)(3)     | PASS   |
| Power Spectral Density      | FCC part 15.247 (e)        | PASS   |
| Antenna Requirement         | FCC part 15.203/15.247 (c) | PASS   |

Remark:

1. "N/A" denotes test is not applicable in this Test Report.

## 2.1 Test Site

### Site Description

EMC Lab. : Accredited by CNAS, 2022-09-27

The certificate is valid until 2028.01.07

The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2006 (identical to ISO/IEC 17025:2017)

The Certificate Registration Number is L8251

Designation Number: CN1347

Test Firm Registration Number: 894804

Accredited by A2LA, June 14, 2023

The Certificate Registration Number is 6837.01

Accredited by Industry Canada, November 09, 2018

The Conformity Assessment Body Identifier is CN0150

Company Number: 30806

Name of Firm : Shenzhen NCT Testing Technology Co., Ltd.

Site Location : A101&2F B2, Fuqiao 6th Area, Xintian Community, Fuhai Street, Baoan District, Shenzhen, People's Republic of China

### 3 General Information

#### 3.1 General Description of E.U.T.

|  |   |                                   |
|--|---|-----------------------------------|
| Product Name   | : | DH Series of intelligent switches |
| Model Name   | : | DH-315                            |
| Sample ID  | : | 240102002#                        |
| Sample(s) Status:  | : | Engineer sample                   |
| Series Model   | : | /                                 |
| Model Different.:  | : | /                                 |
| Operating frequency  | : | 2402-2480MHz                      |
| Number of Channels   | : | 40 channels                       |
| Type of Modulation   | : | GFSK                              |
| Antenna installation   | : | PCB Antenna                       |
| Antenna Gain   | : | -0.17 dBi                         |
| Power supply   | : | AC 120V/60Hz                      |
| Hardware Version   | : | /                                 |
| Software Version   | : | /                                 |
| Remark: the Antenna gain is provided by customer from Antenna spec. and the laboratory will not be responsible for the accumulated calculation results which covers the information provided by the applicant. |   |                                   |



### 3.2 Channel List

The EUT has been tested under its typical operating condition. Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting. Only the worst case data were reported.

The EUT has been associated with peripherals pursuant to ANSI C63.10-2013 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation (9 KHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

The details of test channels and bandwidth were for RF conductive measurement.

Channel List:

| Channel | Frequency (MHz) | Channel   | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|-----------|-----------------|---------|-----------------|
| 00      | <b>2402</b>     | 14        | 2430            | 28      | 2458            |
| 01      | 2404            | 15        | 2432            | 29      | 2460            |
| 02      | 2406            | 16        | 2434            | 30      | 2462            |
| 03      | 2408            | 17        | 2436            | 31      | 2464            |
| 04      | 2410            | 18        | 2438            | 32      | 2466            |
| 05      | 2412            | <b>19</b> | <b>2440</b>     | 33      | 2468            |
| 06      | 2414            | 20        | 2442            | 34      | 2470            |
| 07      | 2416            | 21        | 2444            | 35      | 2472            |
| 08      | 2418            | 22        | 2446            | 36      | 2474            |
| 09      | 2420            | 23        | 2448            | 37      | 2476            |
| 10      | 2422            | 24        | 2450            | 38      | 2478            |
| 11      | 2424            | 25        | 2452            | 39      | <b>2480</b>     |
| 12      | 2426            | 26        | 2454            |         |                 |
| 13      | 2428            | 27        | 2456            |         |                 |

Note:

1. Test of channel was included the lowest, middle and highest frequency in highest data rate and to perform the test, then record on this report.



## 3.3 Test Setup Configuration

Conducted Emission



Radiated Emission



Radiated Spurious



Conducted Spurious



## 3.4 Test Mode

|   |   |
|---|---|
| Transmitting mode   | Keep the EUT in continuously transmitting mode. |
| Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data. |   |

|                   |                |
|-------------------|----------------|
| Test Software     | bk_writer1.6.3 |
| Power level setup | < 20 dBm       |

|              | Channel | Frequency(MHz) |
|--------------|---------|----------------|
| Low Channel  | 0       | 2402           |
| Mid Channel  | 19      | 2440           |
| High Channel | 39      | 2480           |

## 4 Equipment During Test

### 4.1 Equipments List

Conducted emission Test Equipment

| Name              | Model No.    | Serial No. | Manufacturer    | Date of Cal. | Due Date  |
|-------------------|--------------|------------|-----------------|--------------|-----------|
| 944 Shielded Room | 944 Room     | /          | EMToni          | 2022/5/31    | 2025/5/30 |
| EMI Test Receiver | ESPI         | 101604     | Rohde & Schwarz | 2023/6/21    | 2024/6/20 |
| LISN              | ENV 216      | 102796     | Rohde & Schwarz | 2023/6/21    | 2024/6/20 |
| LISN              | VN1-13S      | 004023     | CRANAGE         | 2023/6/21    | 2024/6/20 |
| Cable             | RG223-1500MM | NA         | RG              | 2023/6/21    | 2024/6/20 |

Radiated emission & Radio Frequency Test Equipment

| Name  | Model No.   | Serial No. | Manufacturer    | Date of Cal. | Due Date  |
|---|-------------|------------|-----------------|--------------|-----------|
| 966 Shielded Room                                   | 966 Room    | /          | EMToni          | 2022/5/31    | 2025/5/30 |
| EMI Test Receiver                                   | ESCI        | 101178     | Rohde & Schwarz | 2023/6/21    | 2024/6/20 |
| Amplifier<br>(30MHz-1GHz)                           | BBV 9743 B  | 00374      | SCHNWARZBECK    | 2023/6/21    | 2024/6/20 |
| Bilog Antenna<br>(30MHz-1GHz)                       | VULB9162    | 00473      | SCHNWARZBECK    | 2023/3/19    | 2025/3/18 |
| Horn antenna<br>(1GHz-18GHz)                        | BBHA 9120 D | 02622      | SCHNWARZBECK    | 2023/3/19    | 2025/3/18 |
| Preamplifier<br>(1GHz-18GHz)                        | BBV 9718D   | 0024       | SCHNWARZBECK    | 2023/6/21    | 2024/6/20 |
| Spectrum Analyzer<br>(10Hz-40GHz)                   | FSV 40      | 100952     | Rohde & Schwarz | 2023/6/21    | 2024/6/20 |
| Preamplifier<br>(18GHz-40GHz)                       | BBV 9721    | 0056       | SCHNWARZBECK    | 2023/6/21    | 2024/6/20 |
| Double Ridge Guide<br>Horn Antenna<br>(18GHz-40GHz) | SAS-574     | 588        | A.H.System      | 2023/3/19    | 2025/3/18 |
| Loop Antenna<br>(9KHz-30MHz)                        | FMZB1519B   | 014        | SCHNWARZBECK    | 2023/6/21    | 2024/6/20 |

|                                |                   |            |                 |           |           |
|--------------------------------|-------------------|------------|-----------------|-----------|-----------|
| Amplifier<br>(9KHz-30MHz)      | BBV 9745          | 00109      | CHNWARZBECK     | 2023/6/21 | 2024/6/20 |
| Comprehensive<br>tester        | CWM500            | 104995     | Rohde & Schwarz | 2023/6/21 | 2024/6/20 |
| MXG Signal<br>Analyzer         | N9020A            | MY50510202 | Agilent         | 2023/6/21 | 2024/6/20 |
| MXG Vector Signal<br>Generator | N5182A            | MY50140020 | Agilent         | 2023/6/21 | 2024/6/20 |
| MXG Analog Signal<br>Generator | N5181A            | MY47420919 | Agilent         | 2023/6/21 | 2024/6/20 |
| Power Sensor                   | TR1029-2          | 512364     | Techoy          | 2023/6/21 | 2024/6/20 |
| RF Swith                       | TR1029-1          | 512364     | Techoy          | 2023/6/21 | 2024/6/20 |
| Cable                          | DA800-<br>4000MM  | NA         | DA              | 2023/6/21 | 2024/6/20 |
| Cable                          | DA800-<br>11000MM | NA         | DA              | 2023/6/21 | 2024/6/20 |

Other

| Item | Name                         | Manufacturer | Model  | Software version |
|------|------------------------------|--------------|--------|------------------|
| 1    | EMC Conduction Test System   | AUDIX        | e3     | 6.120718         |
| 2    | EMC radiation test system    | AUDIX        | e3     | 6.120718         |
| 3    | RF test system               | TACHOY       | RFTest | V1.0.0           |
| 4    | RF communication test system | TACHOY       | RFTest | V1.0.0           |



## 4.2 Measurement Uncertainty

| Parameter   | Uncertainty              |
|---|--------------------------|
| RF output power, conducted  | ±1.0dB                   |
| Power Spectral Density, conducted   | ±2.2dB                   |
| Radio Frequency   | ± 1 x 10 <sup>-6</sup>   |
| Bandwidth   | ± 1.5 x 10 <sup>-6</sup> |
| Time  | ±2%                      |
| Duty Cycle  | ±2%                      |
| Temperature   | ±1°C                     |
| Humidity  | ±5%                      |
| DC and low frequency voltages   | ±3%                      |
| Conducted Emissions (150kHz~30MHz)  | ±3.64dB                  |
| Radiated Emission(9KHz~30MHz)   | ±4.51dB                  |
| Radiated Emission(30MHz~1GHz)   | ±5.03dB                  |
| Radiated Emission(1GHz~25GHz)   | ±4.74dB                  |
| Radiated Emission(25GHz~40GHz)  | ±3.38dB                  |
| Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95% |                          |

## 4.3 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.

| Item | Equipment | Mfr/Brand | Model/Type No. | Series No. | Note |
|------|-----------|-----------|----------------|------------|------|
|      |           |           |                |            |      |
|      |           |           |                |            |      |
|      |           |           |                |            |      |

Note: (1)The support equipment was authorized by Declaration of Confirmation.

(2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.

## 5 Conducted Emission

|                  |   |  |
|------------------|---|--|
| Test Requirement | : | FCC CFR 47 Part 15 Section 15.207, RSS-Gen§8.8, RSS-247§ 3.1 |
| Test Method      | : | ANSI C63.10: 2013  |
| Test Result      | : | PASS   |
| Frequency Range  | : | 150kHz to 30MHz  |
| Class/Severity   | : | Class B  |

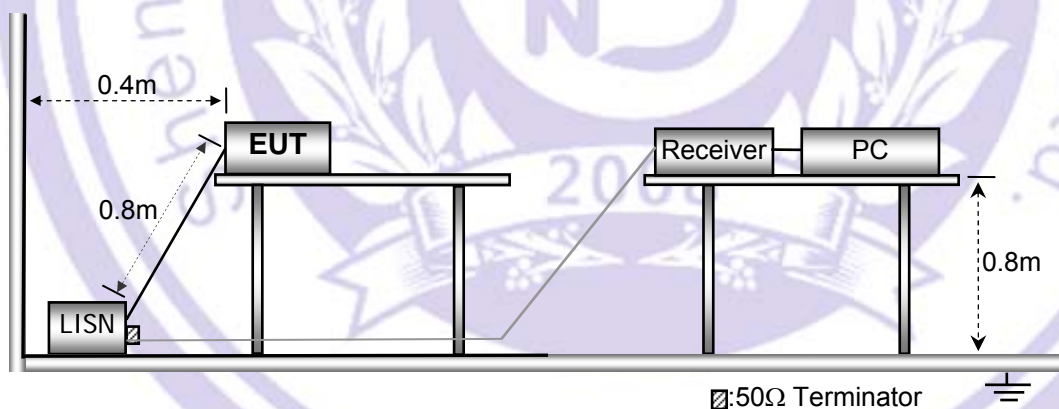
### 5.1 E.U.T. Operation

Operating Environment :

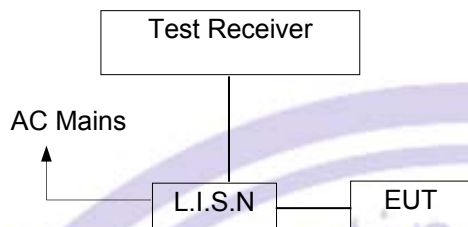
|                      |   |          |
|----------------------|---|----------|
| Temperature          | : | 25.5 °C  |
| Humidity             | : | 51 % RH  |
| Atmospheric Pressure | : | 101.2kPa |

### 5.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



### 5.3 Test SET-UP (Block Diagram of Configuration)



### 5.4 Measurement Procedure

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

### 5.5 Conducted Emission Limit

#### Conducted Emission

| Frequency(MHz) | Quasi-peak | Average |
|----------------|------------|---------|
| 0.15-0.5       | 66-56      | 56-46   |
| 0.5-5.0        | 56         | 46      |
| 5.0-30.0       | 60         | 50      |

#### Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

### 5.6 Measurement Description

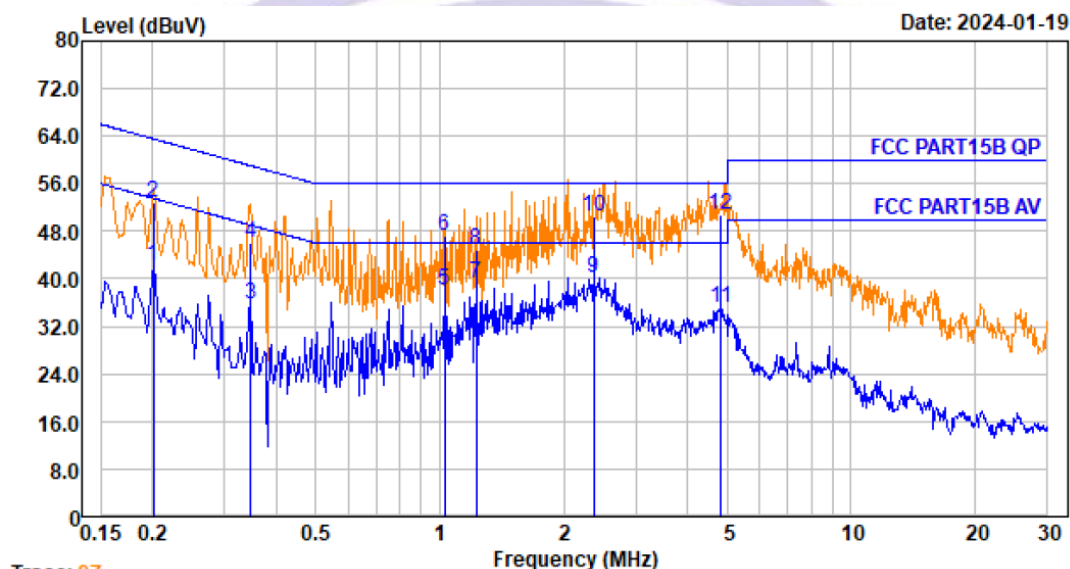
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

### 5.7 Conducted Emission Test Result

Conducted emission at both 120V & 240V is assessed, and emission at 120V represents the worst case. All the modulation modes were tested the data of the worst mode (GFSK, Lowest channel) are recorded in the following pages and the others modulation methods do not exceed the limits.

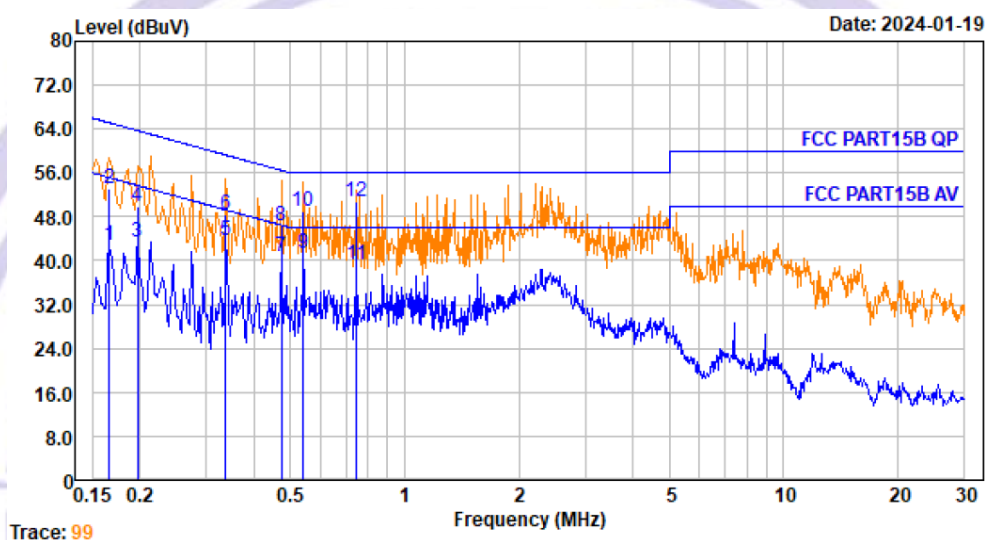


|               |              |                    |     |
|---------------|--------------|--------------------|-----|
| Temperature:  | 26°C         | Relative Humidity: | 54% |
| Pressure:     | 101 kPa      | Phase :            | L   |
| Test Voltage: | AC 120V/60Hz |                    |     |



| No. | Freq<br>MHz | Cable<br>Loss<br>dB | LISN<br>Factor<br>dB/m | Receiver<br>Reading<br>dBuV | Emission<br>Level<br>dBuV/m | Limit<br>dBuV/m | Over<br>Limit<br>dB | Remark  |
|-----|-------------|---------------------|------------------------|-----------------------------|-----------------------------|-----------------|---------------------|---------|
| 1.  | 0.202       | 0.01                | 9.55                   | 32.52                       | 42.08                       | 53.54           | -11.46              | Average |
| 2.  | 0.202       | 0.01                | 9.55                   | 43.19                       | 52.75                       | 63.54           | -10.79              | QP      |
| 3.  | 0.346       | 0.01                | 9.56                   | 26.26                       | 35.83                       | 49.05           | -13.22              | Average |
| 4.  | 0.346       | 0.01                | 9.56                   | 36.39                       | 45.96                       | 59.05           | -13.09              | QP      |
| 5.  | 1.027       | 0.02                | 9.58                   | 28.51                       | 38.11                       | 46.00           | -7.89               | Average |
| 6.  | 1.027       | 0.02                | 9.58                   | 37.68                       | 47.28                       | 56.00           | -8.72               | QP      |
| 7.  | 1.229       | 0.03                | 9.58                   | 29.58                       | 39.19                       | 46.00           | -6.81               | Average |
| 8.  | 1.229       | 0.03                | 9.58                   | 35.40                       | 45.01                       | 56.00           | -10.99              | QP      |
| 9.  | 2.371       | 0.05                | 9.58                   | 30.58                       | 40.21                       | 46.00           | -5.79               | Average |
| 10. | 2.371       | 0.05                | 9.58                   | 40.74                       | 50.37                       | 56.00           | -5.63               | QP      |
| 11. | 4.822       | 0.07                | 9.65                   | 25.42                       | 35.14                       | 46.00           | -10.86              | Average |
| 12. | 4.822       | 0.07                | 9.65                   | 41.02                       | 50.74                       | 56.00           | -5.26               | QP      |

|               |              |                    |     |
|---------------|--------------|--------------------|-----|
| Temperature:  | 26°C         | Relative Humidity: | 54% |
| Pressure:     | 101 kPa      | Phase :            | N   |
| Test Voltage: | AC 120V/60Hz |                    |     |



| No. | Freq<br>MHz | Cable<br>Loss<br>dB | LISN<br>Factor<br>dB/m | Receiver<br>Reading<br>dBuV | Emission<br>Level<br>dBuV/m | Limit<br>dBuV/m | Over<br>Limit<br>dB | Remark  |
|-----|-------------|---------------------|------------------------|-----------------------------|-----------------------------|-----------------|---------------------|---------|
| 1.  | 0.166       | 0.00                | 9.54                   | 33.36                       | 42.90                       | 55.16           | -12.26              | Average |
| 2.  | 0.166       | 0.00                | 9.54                   | 43.54                       | 53.08                       | 65.16           | -12.08              | QP      |
| 3.  | 0.198       | 0.01                | 9.55                   | 33.87                       | 43.43                       | 53.71           | -10.28              | Average |
| 4.  | 0.198       | 0.01                | 9.55                   | 40.47                       | 50.03                       | 63.71           | -13.68              | QP      |
| 5.  | 0.337       | 0.01                | 9.56                   | 34.04                       | 43.61                       | 49.27           | -5.66               | Average |
| 6.  | 0.337       | 0.01                | 9.56                   | 38.99                       | 48.56                       | 59.27           | -10.71              | QP      |
| 7.  | 0.474       | 0.01                | 9.58                   | 31.06                       | 40.65                       | 46.45           | -5.80               | Average |
| 8.  | 0.474       | 0.01                | 9.58                   | 36.74                       | 46.33                       | 56.45           | -10.12              | QP      |
| 9.  | 0.541       | 0.01                | 9.58                   | 31.59                       | 41.18                       | 46.00           | -4.82               | Average |
| 10. | 0.541       | 0.01                | 9.58                   | 39.53                       | 49.12                       | 56.00           | -6.88               | QP      |
| 11. | 0.747       | 0.02                | 9.58                   | 29.74                       | 39.34                       | 46.00           | -6.66               | Average |
| 12. | 0.747       | 0.02                | 9.58                   | 41.22                       | 50.82                       | 56.00           | -5.18               | QP      |

**Notes:**

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Measurement Level = Reading level + Correct Factor

## 6 Radiated Spurious Emissions

Test Requirement : FCC CFR47 Part 15 Section 15.209 & 15.247,  
RSS-Gen §8.9, RSS-Gen §8.10

Test Method : ANSI C63.10:2013

Test Result : PASS

Measurement Distance : 3m

Limit : See the follow table

| Frequency (MHz) | Field Strength        |              | Field Strength Limit at 3m Measurement Dist |                                       |
|-----------------|-----------------------|--------------|---|---------------------------------------|
|                 | uV/m                  | Distance (m) | uV/m  | dBuV/m                                |
| 0.009 ~ 0.490   | $2400/F(\text{kHz})$  | 300          | $10000 * 2400/F(\text{kHz})$                | $20\log^{(2400/F(\text{kHz}))} + 80$  |
| 0.490 ~ 1.705   | $24000/F(\text{kHz})$ | 30           | $100 * 24000/F(\text{kHz})$                 | $20\log^{(24000/F(\text{kHz}))} + 40$ |
| 1.705 ~ 30      | 30                    | 30           | $100 * 30$                                  | $20\log^{(30)} + 40$                  |
| 30 ~ 88         | 100                   | 3            | 100   | $20\log^{(100)}$                      |
| 88 ~ 216        | 150                   | 3            | 150   | $20\log^{(150)}$                      |
| 216 ~ 960       | 200                   | 3            | 200   | $20\log^{(200)}$                      |
| Above 960       | 500                   | 3            | 500   | $20\log^{(500)}$                      |

### 6.1 EUT Operation

Operating Environment :

Temperature : 23.5 °C

Humidity : 51.1 % RH

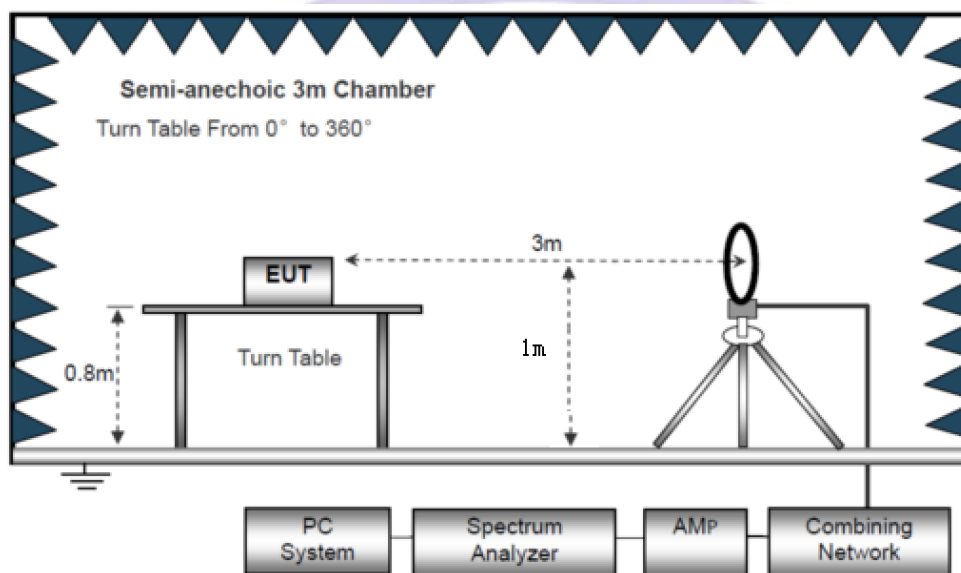
Atmospheric Pressure : 101.2kPa



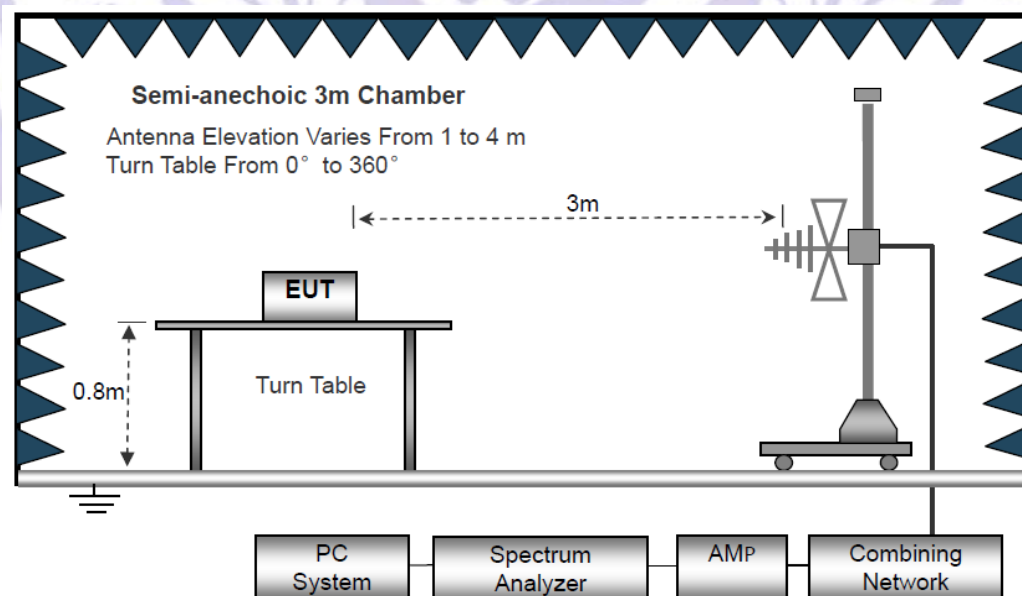
## 6.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

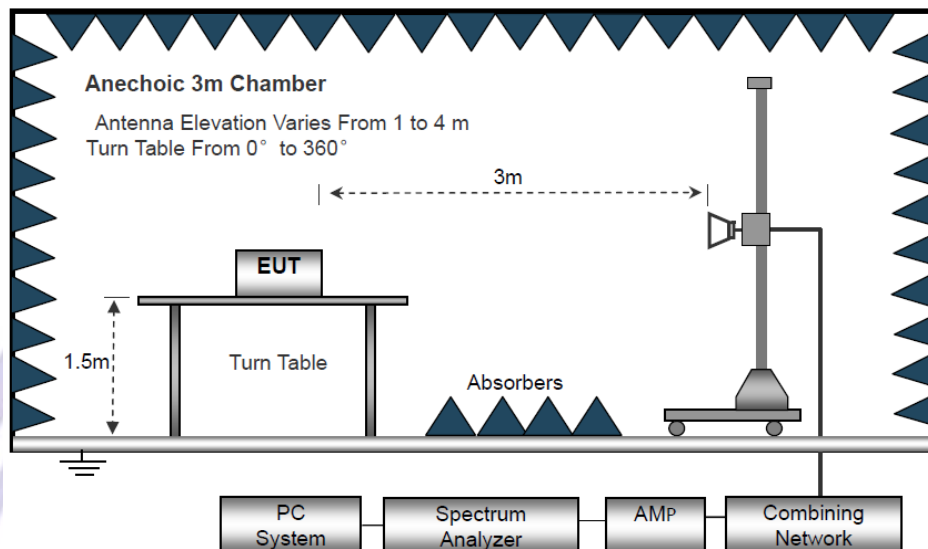
The test setup for emission measurement below 30MHz



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz



## 6.3 Spectrum Analyzer Setup

|                | Frequency    | Detector   | RBW    | VBW    | Remark           |
|----------------|--------------|------------|--------|--------|------------------|
| Receiver Setup | Below 30MHz  | --         | 10kHz  | 10kHz  | --               |
|                | 30MHz ~ 1GHz | Quasi-peak | 120kHz | 300kHz | Quasi-peak Value |
|                | Above 1GHz   | Peak       | 1MHz   | 3MHz   | Peak Value       |
|                |              | RMS        | 1MHz   | 3MHz   | Average Value    |

## 6.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
7. Test Procedure of measurement (For Above 1GHz):
  - 1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
  - 2) Change the antenna polarization and repeat 1) with vertical polarization.
  - 3) Make a hardcopy of the spectrum.
  - 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
  - 5) Change the analyser mode to Clear/ Write and found the cone of emission.
  - 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
  - 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
  - 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.
8. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.



For Average Measurement:

VBW=10Hz, when duty cycle is no less than 98 percent.

VBW $\geq$ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.



## 6.5 Summary of Test Results

### Test Frequency: 9KHz-30MHz

| Freq.<br>(MHz) | Ant.Pol.<br>H/V | Emission Level<br>(dBuV/m) | Limit 3m<br>(dBuV/m) | Over<br>(dB) |
|----------------|-----------------|----------------------------|----------------------|--------------|
| --             | --              | --                         | --                   | >20          |

Note:

The amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

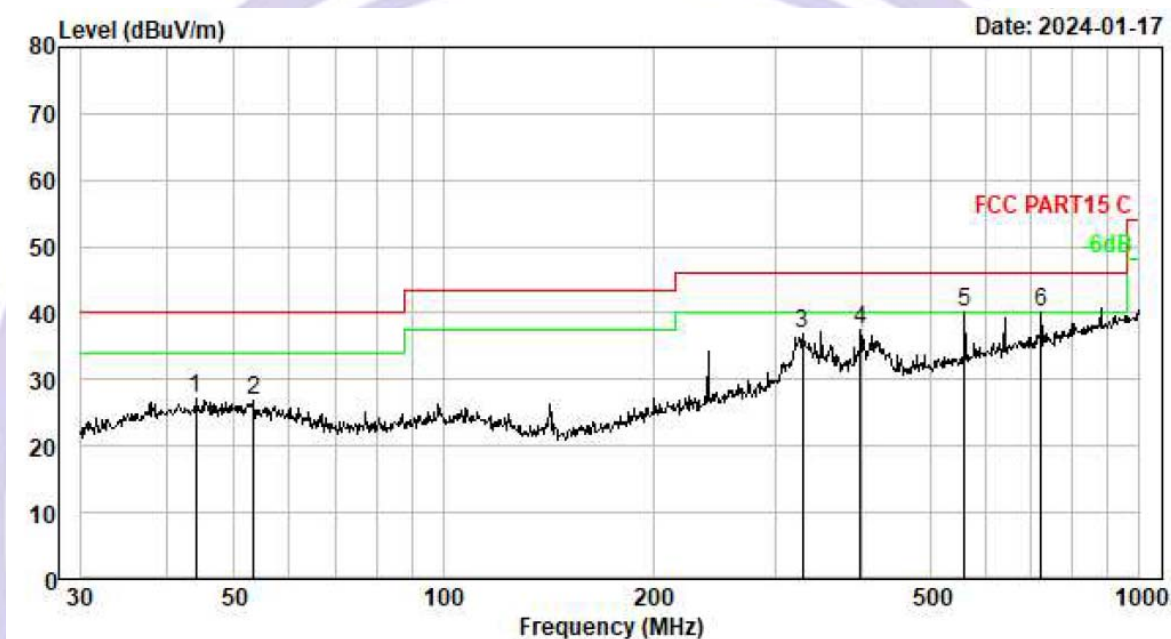
Distance extrapolation factor =  $40\log(\text{Specific distance} / \text{test distance})$  (dB);  
Limit line = Specific limits (dBuV) + distance extrapolation factor.

### Test Frequency: 30MHz ~ 1GHz

Pass.

Please refer to the following test plots for the worst test mode (GFSK, Lowest Channel).

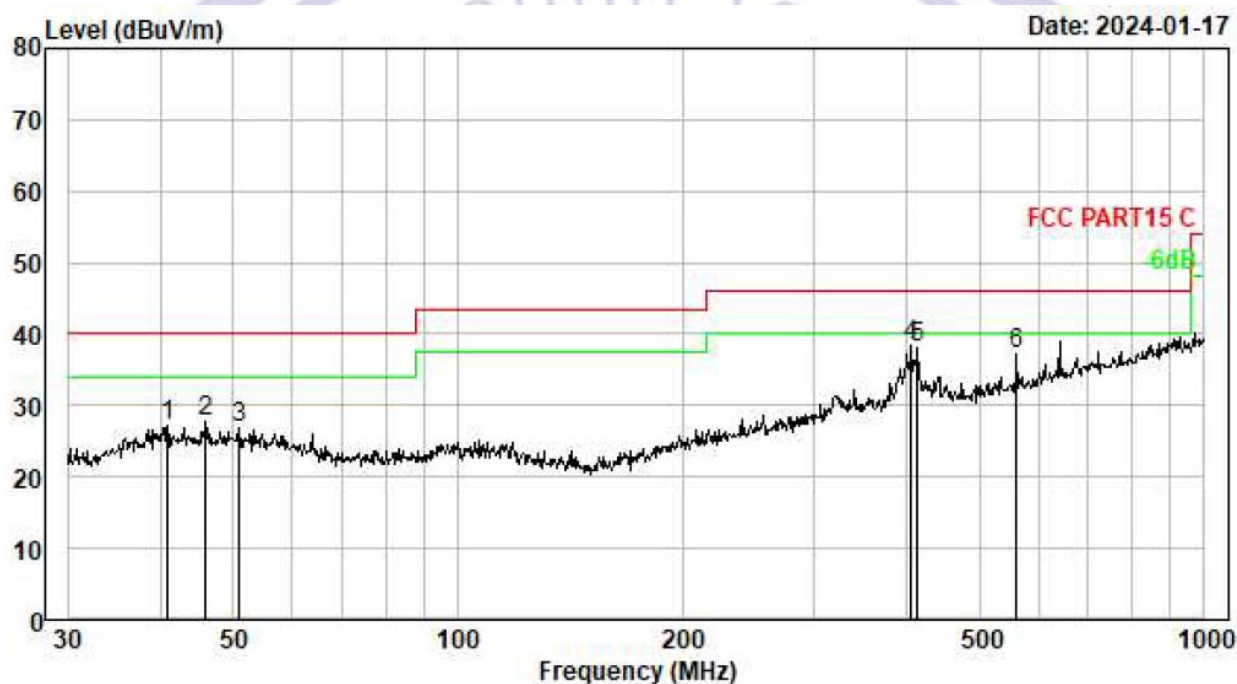
|               |              |                    |            |
|---------------|--------------|--------------------|------------|
| Temperature:  | 26°C         | Relative Humidity: | 54%        |
| Pressure:     | 101 kPa      | Polarization:      | Horizontal |
| Test Voltage: | AC 120V/60Hz |                    |            |



| No. | Freq<br>MHz | Cable<br>Loss<br>dB | ANT<br>Factor<br>dB/m | Preamp<br>Gain<br>dB | Receiver<br>Reading<br>dBuV | Emission<br>Level<br>dBuV/m | Limit<br>dBuV/m | Over<br>Limit<br>dB | Remark |
|-----|-------------|---------------------|-----------------------|----------------------|-----------------------------|-----------------------------|-----------------|---------------------|--------|
| 1   | 43.966      | 0.38                | 12.58                 | 0.00                 | 14.07                       | 27.03                       | 40.00           | -12.97              | QP     |
| 2   | 53.318      | 0.45                | 12.35                 | 0.00                 | 13.97                       | 26.77                       | 40.00           | -13.23              | QP     |
| 3   | 327.887     | 1.32                | 14.76                 | 0.00                 | 20.90                       | 36.98                       | 46.00           | -9.02               | QP     |
| 4   | 397.633     | 1.43                | 15.77                 | 0.00                 | 20.27                       | 37.47                       | 46.00           | -8.53               | QP     |
| 5   | 560.693     | 1.66                | 18.27                 | 0.00                 | 20.30                       | 40.23                       | 46.00           | -5.77               | QP     |
| 6   | 721.726     | 1.89                | 20.71                 | 0.00                 | 17.69                       | 40.29                       | 46.00           | -5.71               | QP     |

Remark: Emission Level = Reading + Cable Loss + ANT Factor - AMP Factor

|               |              |                    |          |
|---------------|--------------|--------------------|----------|
| Temperature:  | 26°C         | Relative Humidity: | 54%      |
| Pressure:     | 101 kPa      | Polarization:      | Vertical |
| Test Voltage: | AC 120V/60Hz |                    |          |



| No. | Freq<br>MHz | Cable<br>Loss<br>dB | ANT<br>Factor<br>dB/m | Preamp<br>Gain<br>dB | Receiver<br>Reading<br>dBμV | Emission<br>Level<br>dBμV/m | Limit<br>dBμV/m | Over<br>Limit<br>dB | Remark |
|-----|-------------|---------------------|-----------------------|----------------------|-----------------------------|-----------------------------|-----------------|---------------------|--------|
| 1   | 40.845      | 0.36                | 12.52                 | 0.00                 | 14.35                       | 27.23                       | 40.00           | -12.77              | QP     |
| 2   | 45.855      | 0.40                | 12.62                 | 0.00                 | 14.73                       | 27.75                       | 40.00           | -12.25              | QP     |
| 3   | 50.942      | 0.44                | 12.60                 | 0.00                 | 13.79                       | 26.83                       | 40.00           | -13.17              | QP     |
| 4   | 404.667     | 1.44                | 15.87                 | 0.00                 | 21.15                       | 38.46                       | 46.00           | -7.54               | QP     |
| 5   | 413.271     | 1.45                | 16.00                 | 0.00                 | 20.75                       | 38.20                       | 46.00           | -7.80               | QP     |
| 6   | 560.693     | 1.66                | 18.27                 | 0.00                 | 17.27                       | 37.20                       | 46.00           | -8.80               | QP     |

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor



**Test Frequency 1GHz-25GHz:**

| Polar<br>(H/V)      | Frequency<br>(MHz) | Meter<br>Reading<br>(dBuV) | Pre-<br>amplifier<br>(dB) | Cable<br>Loss<br>(dB) | Antenna<br>Factor<br>(dB) | Emission<br>Level<br>(dBuV/m) | Limits<br>(dBuV/m) | Margin<br>(dB) | Detector<br>Type |
|---------------------|--------------------|----------------------------|---------------------------|-----------------------|---------------------------|-------------------------------|--------------------|----------------|------------------|
| Low Channel:2402MHz |                    |                            |                           |                       |                           |                               |                    |                |                  |
| V                   | 4804.00            | 51.53                      | 34.12                     | 5.03                  | 32.39                     | 54.83                         | 74.00              | -19.17         | Pk               |
| V                   | 4804.00            | 41.32                      | 34.12                     | 5.03                  | 32.39                     | 44.62                         | 54.00              | -9.38          | AV               |
| V                   | 7206.00            | 46.35                      | 32.54                     | 6.29                  | 35.86                     | 55.96                         | 74.00              | -18.04         | Pk               |
| V                   | 7206.00            | 36.01                      | 32.54                     | 6.29                  | 35.86                     | 45.62                         | 54.00              | -8.38          | AV               |
| V                   | 9608.00            | 47.34                      | 32.98                     | 7.55                  | 38.40                     | 60.31                         | 74.00              | -13.69         | Pk               |
| V                   | 9608.00            | 34.17                      | 32.98                     | 7.55                  | 38.40                     | 47.14                         | 54.00              | -6.86          | AV               |
| V                   | 12010.00           | 43.49                      | 32.09                     | 8.93                  | 39.00                     | 59.33                         | 74.00              | -14.67         | Pk               |
| V                   | 12010.00           | 32.06                      | 32.09                     | 8.93                  | 39.00                     | 47.90                         | 54.00              | -6.10          | AV               |
| H                   | 4804.00            | 50.13                      | 34.12                     | 5.03                  | 32.39                     | 53.43                         | 74.00              | -20.57         | Pk               |
| H                   | 4804.00            | 37.61                      | 34.12                     | 5.03                  | 32.39                     | 40.91                         | 54.00              | -13.09         | AV               |
| H                   | 7206.00            | 46.17                      | 32.54                     | 6.29                  | 35.86                     | 55.78                         | 74.00              | -18.22         | Pk               |
| H                   | 7206.00            | 36.96                      | 32.54                     | 6.29                  | 35.86                     | 46.57                         | 54.00              | -7.43          | AV               |
| H                   | 9608.00            | 47.22                      | 32.98                     | 7.55                  | 38.40                     | 60.19                         | 74.00              | -13.81         | Pk               |
| H                   | 9608.00            | 33.30                      | 32.98                     | 7.55                  | 38.40                     | 46.27                         | 54.00              | -7.73          | AV               |
| H                   | 12010.00           | 40.41                      | 32.09                     | 8.93                  | 39.00                     | 56.25                         | 74.00              | -17.75         | Pk               |
| H                   | 12010.00           | 31.54                      | 32.09                     | 8.93                  | 39.00                     | 47.38                         | 54.00              | -6.62          | AV               |

| Polar<br>(H/V)         | Frequency<br>(MHz) | Meter<br>Reading<br>(dBuV) | Pre-<br>amplifier<br>(dB) | Cable<br>Loss<br>(dB) | Antenna<br>Factor<br>(dB) | Emission<br>Level<br>(dBuV/m) | Limits<br>(dBuV/m) | Margin<br>(dB) | Detector<br>Type |
|------------------------|--------------------|----------------------------|---------------------------|-----------------------|---------------------------|-------------------------------|--------------------|----------------|------------------|
| Middle Channel:2440MHz |                    |                            |                           |                       |                           |                               |                    |                |                  |
| V                      | 4880.00            | 49.86                      | 34.07                     | 5.09                  | 32.59                     | 53.47                         | 74.00              | -20.53         | Pk               |
| V                      | 4880.00            | 39.14                      | 34.07                     | 5.09                  | 32.59                     | 42.75                         | 54.00              | -11.25         | AV               |
| V                      | 7320.00            | 44.56                      | 32.63                     | 6.34                  | 35.96                     | 54.23                         | 74.00              | -19.77         | Pk               |
| V                      | 7320.00            | 34.10                      | 32.63                     | 6.34                  | 35.96                     | 43.77                         | 54.00              | -10.23         | AV               |
| V                      | 9760.00            | 41.72                      | 32.92                     | 7.59                  | 38.40                     | 54.79                         | 74.00              | -19.21         | Pk               |
| V                      | 9760.00            | 29.35                      | 32.92                     | 7.59                  | 38.40                     | 42.42                         | 54.00              | -11.58         | AV               |
| V                      | 12200.00           | 38.38                      | 31.96                     | 8.88                  | 39.04                     | 54.34                         | 74.00              | -19.66         | Pk               |
| V                      | 12200.00           | 28.39                      | 31.96                     | 8.88                  | 39.04                     | 44.35                         | 54.00              | -9.65          | AV               |
| H                      | 4880.00            | 49.78                      | 34.07                     | 5.09                  | 32.59                     | 53.39                         | 74.00              | -20.61         | Pk               |
| H                      | 4880.00            | 38.63                      | 34.07                     | 5.09                  | 32.59                     | 42.24                         | 54.00              | -11.76         | AV               |
| H                      | 7320.00            | 44.85                      | 32.63                     | 6.34                  | 35.96                     | 54.52                         | 74.00              | -19.48         | Pk               |
| H                      | 7320.00            | 32.19                      | 32.63                     | 6.34                  | 35.96                     | 41.86                         | 54.00              | -12.14         | AV               |
| H                      | 9760.00            | 41.40                      | 32.92                     | 7.59                  | 38.40                     | 54.47                         | 74.00              | -19.53         | Pk               |
| H                      | 9760.00            | 28.50                      | 32.92                     | 7.59                  | 38.40                     | 41.57                         | 54.00              | -12.43         | AV               |
| H                      | 12200.00           | 39.88                      | 31.96                     | 8.88                  | 39.04                     | 55.84                         | 74.00              | -18.16         | Pk               |
| H                      | 12200.00           | 29.59                      | 31.96                     | 8.88                  | 39.04                     | 45.55                         | 54.00              | -8.45          | AV               |

| Polar<br>(H/V)       | Frequency<br>(MHz) | Meter<br>Reading<br>(dBuV) | Pre-<br>amplifier<br>(dB) | Cable<br>Loss<br>(dB) | Antenna<br>Factor<br>(dB) | Emission<br>Level<br>(dBuV/m) | Limits<br>(dBuV/m) | Margin<br>(dB) | Detector<br>Type |
|----------------------|--------------------|----------------------------|---------------------------|-----------------------|---------------------------|-------------------------------|--------------------|----------------|------------------|
| High Channel:2480MHz |                    |                            |                           |                       |                           |                               |                    |                |                  |
| V                    | 4960.00            | 46.17                      | 34.02                     | 5.15                  | 32.80                     | 50.10                         | 74.00              | -23.90         | Pk               |
| V                    | 4960.00            | 35.92                      | 34.02                     | 5.15                  | 32.80                     | 39.85                         | 54.00              | -14.15         | AV               |
| V                    | 7440.00            | 45.47                      | 32.71                     | 6.40                  | 36.05                     | 55.21                         | 74.00              | -18.79         | Pk               |
| V                    | 7440.00            | 34.10                      | 32.71                     | 6.40                  | 36.05                     | 43.84                         | 54.00              | -10.16         | AV               |
| V                    | 9920.00            | 40.54                      | 32.86                     | 7.62                  | 38.40                     | 53.70                         | 74.00              | -20.30         | Pk               |
| V                    | 9920.00            | 27.06                      | 32.86                     | 7.62                  | 38.40                     | 40.22                         | 54.00              | -13.78         | AV               |
| V                    | 12400.00           | 37.90                      | 31.82                     | 8.84                  | 39.08                     | 54.00                         | 74.00              | -20.00         | Pk               |
| V                    | 12400.00           | 26.60                      | 31.82                     | 8.84                  | 39.08                     | 42.70                         | 54.00              | -11.30         | AV               |
| H                    | 4960.00            | 48.44                      | 34.02                     | 5.15                  | 32.80                     | 52.37                         | 74.00              | -21.63         | Pk               |
| H                    | 4960.00            | 36.75                      | 34.02                     | 5.15                  | 32.80                     | 40.68                         | 54.00              | -13.32         | AV               |
| H                    | 7440.00            | 45.73                      | 32.71                     | 6.40                  | 36.05                     | 55.47                         | 74.00              | -18.53         | Pk               |
| H                    | 7440.00            | 31.65                      | 32.71                     | 6.40                  | 36.05                     | 41.39                         | 54.00              | -12.61         | AV               |
| H                    | 9920.00            | 38.13                      | 32.86                     | 7.62                  | 38.40                     | 51.29                         | 74.00              | -22.71         | Pk               |
| H                    | 9920.00            | 26.91                      | 32.86                     | 7.62                  | 38.40                     | 40.07                         | 54.00              | -13.93         | AV               |
| H                    | 12400.00           | 39.21                      | 31.82                     | 8.84                  | 39.08                     | 55.31                         | 74.00              | -18.69         | Pk               |
| H                    | 12400.00           | 27.13                      | 31.82                     | 8.84                  | 39.08                     | 43.23                         | 54.00              | -10.77         | AV               |

Note: 1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier,

Margin= Emission Level - Limit

2. If peak below the average limit, the average emission was no test.

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



### Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

|   | Polar<br>(H/V)        | Frequency<br>(MHz) | Meter<br>Reading<br>(dBuV) | Pre-<br>amplifier<br>(dB) | Cable<br>Loss<br>(dB) | Antenna<br>Factor<br>(dB/m) | Emission<br>level<br>(dBuV/m) | Limit<br>(dBuV<br>/m) | Detec<br>tor<br>Type | Result |
|---|-----------------------|--------------------|----------------------------|---------------------------|-----------------------|-----------------------------|-------------------------------|-----------------------|----------------------|--------|
| GFSK  | Low Channel: 2402MHz  |                    |                            |                           |                       |                             |                               |                       |                      |        |
|   | H                     | 2390.00            | 57.95                      | 35.17                     | 3.48                  | 27.49                       | 53.75                         | 74.00                 | PK                   | PASS   |
|   | H                     | 2390.00            | 49.86                      | 35.17                     | 3.48                  | 27.49                       | 45.66                         | 54.00                 | AV                   | PASS   |
|   | H                     | 2400.00            | 59.92                      | 35.16                     | 3.49                  | 27.52                       | 55.77                         | 74.00                 | PK                   | PASS   |
|   | H                     | 2400.00            | 49.71                      | 35.16                     | 3.49                  | 27.52                       | 45.56                         | 54.00                 | AV                   | PASS   |
|   | V                     | 2390.00            | 57.91                      | 35.17                     | 3.48                  | 27.49                       | 53.71                         | 74.00                 | PK                   | PASS   |
|   | V                     | 2390.00            | 49.57                      | 35.17                     | 3.48                  | 27.49                       | 45.37                         | 54.00                 | AV                   | PASS   |
|   | V                     | 2400.00            | 59.56                      | 35.16                     | 3.49                  | 27.52                       | 55.41                         | 74.00                 | PK                   | PASS   |
|   | V                     | 2400.00            | 49.76                      | 35.16                     | 3.49                  | 27.52                       | 45.61                         | 54.00                 | AV                   | PASS   |
|   | High Channel: 2480MHz |                    |                            |                           |                       |                             |                               |                       |                      |        |
|   | H                     | 2483.50            | 57.35                      | 35.11                     | 3.56                  | 27.75                       | 53.55                         | 74.00                 | PK                   | PASS   |
|   | H                     | 2483.50            | 48.81                      | 35.11                     | 3.56                  | 27.75                       | 45.01                         | 54.00                 | AV                   | PASS   |
|   | H                     | 2500.00            | 59.21                      | 35.10                     | 3.57                  | 27.80                       | 55.48                         | 74.00                 | PK                   | PASS   |
|   | H                     | 2500.00            | 49.23                      | 35.10                     | 3.57                  | 27.80                       | 45.50                         | 54.00                 | AV                   | PASS   |
|   | V                     | 2483.50            | 58.55                      | 35.11                     | 3.56                  | 27.75                       | 54.75                         | 74.00                 | PK                   | PASS   |
|   | V                     | 2483.50            | 50.31                      | 35.11                     | 3.56                  | 27.75                       | 46.51                         | 54.00                 | AV                   | PASS   |
|   | V                     | 2500.00            | 59.08                      | 35.10                     | 3.57                  | 27.80                       | 55.35                         | 74.00                 | PK                   | PASS   |
|   | V                     | 2500.00            | 49.92                      | 35.10                     | 3.57                  | 27.80                       | 46.19                         | 54.00                 | AV                   | PASS   |
| Remark:   |                       |                    |                            |                           |                       |                             |                               |                       |                      |        |
| 1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier, Margin= Emission Level - Limit |                       |                    |                            |                           |                       |                             |                               |                       |                      |        |



## **7 Conduct Band Edge And Spurious Emissions Measurement**

- Test Requirement : Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).  
RSS-247 § 5.5
- Test Method : ANSI C63.10:2013
- Test Limit : Regulation 15.247 (d), 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 conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies 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. 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) (see §15.205(c)).  
RSS-247 § 5.5:  
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 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

### **7.1 Test Procedure**

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz, Sweep = auto  
Detector function = peak, Trace = max hold

### **7.2 Test Result**

Please see the attachment for the BLE data

## 8 6dB Bandwidth Measurement

Test Requirement : FCC CFR47 Part 15 Section 15.247, RSS-247

Test Method : ANSI C63.10:2013

Test Limit : Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 8.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

### 8.2 Test Result

Please see the attachment for the BLE data

## 9 Maximum Peak Output Power

|                  |   |
|------------------|---|
| Test Requirement | : FCC CFR47 Part 15 Section 15.247, RSS-247 § 5.4   |
| Test Method      | : ANSI C63.10:2013  |
| Test Limit       | : Regulation 15.247 (b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.<br>RSS-247 § 5.4<br>For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e). |

### 9.1 Test Procedure

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Measure the conducted output power and record the results in the test report.

### 9.2 Test Result

Please see the attachment for the BLE data



## 10 Power Spectral density

|                  |  |
|------------------|--|
| Test Requirement | : FCC CFR47 Part 15 Section 15.247,RSS-247 §5.2 (b)  |
| Test Method      | : ANSI C63.10:2013   |
| Test Limit       | : Regulation 15.247(f) The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.<br>RSS-247 §5.2 (b)<br>The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power). |

### 10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3kHz. VBW = 10kHz , Span = 1.5 times the DTS channel bandwidth(6 dB bandwidth). Sweep = auto; Detector Function = Peak. Trace = Max hold.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

### 10.2 Test Result

Please see the attachment for the BLE data



## 11 Antenna Application

### 11.1 Antenna Requirement

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

According to RSS-GEN section 6.8

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

### 11.2 Result

The antenna is PCB antenna, the best case gain of the antennas is -0.17dBi, reference to the attachment for details.

## 12 Test Setup Photos and EUT Photos

Please see the attachment for details.

\*\*\*\*\*THE END REPORT\*\*\*\*\*

