



**EUROFINS ELECTRICAL TESTING SERVICE (SHENZHEN) CO., LTD.**

# **RADIO TEST - REPORT**

**FCC Compliance Test Report for**

**Product name: Heyday Wireless Headset**

**Model name: TT2235**

**FCC ID: 2AVTM-TT2235**

**Test Report Number: EFGX21070102-IE-02-E01**

The above sample(s) and sample information was/were submitted and identified on behalf of the applicant.  
Eurofins assures objectivity and impartiality of the test, and fulfills the obligation of confidentiality for applicant's commercial information and technical documents.



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## 1 General Information

### 1.1 Notes

The results of this test report relate exclusively to the item tested as specified in chapter "Description of test item" and are not transferable to any other test items.

Eurofins Electrical Testing Service (Shenzhen) Co., Ltd. is not responsible for any generalisations and conclusions drawn from this report. Any modification of the test item can lead to invalidity of test results and this test report may therefore be not applicable to the modified test item.

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#### Operator:

2021-08-10

Bruce Zheng / Project Engineer



Date

Eurofins-Lab.

Name / Title

Signature

#### Technical responsibility for area of testing:

2021-08-10

Tom Tian / Supervisor

Date

Eurofins-Lab.

Name / Title

Signature

## 1.2 Testing laboratory

Eurofins Electrical Testing Service (Shenzhen) Co., Ltd.

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The Laboratory has passed the Accreditation by the American Association for Laboratory Accreditation (A2LA). The Accreditation number is 5376.01

The Laboratory has been listed by industry Canada to perform electromagnetic emission measurements, The CAB identifier is CN0088

## 1.3 Details of applicant

|           |   |                                                                                          |
|-----------|---|------------------------------------------------------------------------------------------|
| Name      | : | TT Innovation Technology (HK) Co., Ltd..                                                 |
| Address   | : | Room 506a 5/F Harbour Crystal centre 100 Granville RD<br>TSIM SHA TSUI KL<br>HK<br>China |
| Telephone | : | 0755-28411004                                                                            |
| Fax       | : | N/A                                                                                      |

## 1.4 Details of manufacturer

|           |   |                                                                                                                   |
|-----------|---|-------------------------------------------------------------------------------------------------------------------|
| Name      | : | Shenzhen Eastport Electronic Co., Ltd.                                                                            |
| Address   | : | Block F, Junfeng Science Park, Lezhujiao, Jiuwei, Xixiang<br>Town, 518126 Baoan District, Shenzhen<br>City, China |
| Telephone | : | N/A                                                                                                               |
| Fax       | : | N/A                                                                                                               |

## 1.5 Application details

Date of receipt of application : 2021-07-12  
 Date of receipt of test item : 2021-07-12  
 Date of test : 2021-07-12 to 2021-08-09  
 Date of issue : 2021-08-10

## 1.6 Test item

Product type : Heyday Wireless Headset  
 Model name : TT2235  
 Brand : heyday  
 Serial number : N/A  
 Ratings : Battery: 3.7V 550mah Li ion battery  
 Charging: type-C 5V < 1A  
 Test voltage : 3.7Vdc  
 FCC ID : 2AVTM-TT2235  
 Additional information : N/A

### RadioTechnical data

Frequency range : 2400-2483.5 MHz,  
 Radio Tech. : Classic Bluetooth  
 Frequency channel : 79 Channels  
 Modulation : GFSK,  $\pi/4$ -DQPSK, 8-DPSK  
 Antenna type : PCB antenna  
 Antenna gain : 2 dBi

## 1.7 Test standards

| Test Standards        |                                                                        |
|-----------------------|------------------------------------------------------------------------|
| FCC Part 15 Subpart C | PART 15 - RADIO FREQUENCY DEVICES<br>Subpart C - Intentional Radiators |

### Test Method

- 1: ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40GHz.
- 2: ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices.
- 3: KDB558074 D01 15.247 Meas Guidance v05r02

## 2 Technical test

### 2.1 Summary of test results

No deviations from the technical specification(s) were ascertained in the course of the tests performed.



or

The deviations as specified were ascertained in the course of the tests performed.



### 2.2 Test environment

Ac line conducted

| Environment Parameter | Temperature | Relative Humidity |
|-----------------------|-------------|-------------------|
| 101.2 kPa             | 25.1 °C     | 61.3%             |

RF Conducted

| Environment Parameter | Temperature | Relative Humidity |
|-----------------------|-------------|-------------------|
| 101.2 kPa             | 25.9 °C     | 61.9%             |

Radiated

| Environment Parameter | Temperature | Relative Humidity |
|-----------------------|-------------|-------------------|
| 101.2 kPa             | 22.3 °C     | 52.7%             |

### 2.3 Measurement uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.

| System Measurement Uncertainty                               |                                                                                       |
|--------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Test Items                                                   | Extended Uncertainty                                                                  |
| Uncertainty in conducted measurements                        | 1.96dB                                                                                |
| Uncertainty for Conducted RF test                            | RF Power Conducted: 1.16dB<br>Frequency test involved:<br>1.05×10 <sup>-7</sup> or 1% |
| Uncertainty for Radiated Spurious Emission 25MHz-3000MHz     | Horizontal: 4.46dB;<br>Vertical: 4.54dB;                                              |
| Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz  | Horizontal: 4.42dB;<br>Vertical: 4.41dB;                                              |
| Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz | Horizontal: 4.63dB;<br>Vertical: 4.62dB;                                              |

## 2.4 Test mode

Center Frequency of Each Channel:

| CHANNEL | FREQ.<br>(MHZ) | CHANNEL | FREQ.<br>(MHZ) | CHANNEL | FREQ.<br>(MHZ) | CHANNEL | FREQ.<br>(MHZ) |
|---------|----------------|---------|----------------|---------|----------------|---------|----------------|
| 0       | 2402           | 20      | 2422           | 40      | 2442           | 60      | 2462           |
| 1       | 2403           | 21      | 2423           | 41      | 2443           | 61      | 2463           |
| 2       | 2404           | 22      | 2424           | 42      | 2444           | 62      | 2464           |
| 3       | 2405           | 23      | 2425           | 43      | 2445           | 63      | 2465           |
| 4       | 2406           | 24      | 2426           | 44      | 2446           | 64      | 2466           |
| 5       | 2407           | 25      | 2427           | 45      | 2447           | 65      | 2467           |
| 6       | 2408           | 26      | 2428           | 46      | 2448           | 66      | 2468           |
| 7       | 2409           | 27      | 2429           | 47      | 2449           | 67      | 2469           |
| 8       | 2410           | 28      | 2430           | 48      | 2450           | 68      | 2470           |
| 9       | 2411           | 29      | 2431           | 49      | 2451           | 69      | 2471           |
| 10      | 2412           | 30      | 2432           | 50      | 2452           | 70      | 2472           |
| 11      | 2413           | 31      | 2433           | 51      | 2453           | 71      | 2473           |
| 12      | 2414           | 32      | 2434           | 52      | 2454           | 72      | 2474           |
| 13      | 2415           | 33      | 2435           | 53      | 2455           | 73      | 2475           |
| 14      | 2416           | 34      | 2436           | 54      | 2456           | 74      | 2476           |
| 15      | 2417           | 35      | 2437           | 55      | 2457           | 75      | 2477           |
| 16      | 2418           | 36      | 2438           | 56      | 2458           | 76      | 2478           |
| 17      | 2419           | 37      | 2439           | 57      | 2459           | 77      | 2479           |
| 18      | 2420           | 38      | 2440           | 58      | 2460           | 78      | 2480           |
| 19      | 2421           | 39      | 2441           | 59      | 2461           |         |                |

The EUT was set at continuously transmitting mode during the test.  
Below modulations was tested and recorded in the report:  
GFSK ,  $\pi/4$  DQPSK, 8-DPSK

## 2.5 Test equipment utilized

| EQUIPMENT ID | EQUIPMENT NAME               | MODEL NO.         | CAL. DUE DATE |
|--------------|------------------------------|-------------------|---------------|
| 23-2-13-05   | EMI Test Receiver            | ESR3              | 2022-03-15    |
| 23-2-13-06   | LISN                         | NNLK 8127 RC      | 2022-03-15    |
| 23-2-10-16   | Attenuator                   | VTSD 9561-F       | 2022-03-16    |
| 23-2-10-63   | Temperature & Humidity Meter | COS-03            | 2022-03-27    |
| 23-2-10-65   | Barometer                    | Baro              | 2022-03-23    |
| 23-2-13-12   | Signal Analyzer              | N9010B-544        | 2022-03-15    |
| 23-2-13-13   | BT/WLAN Tester               | CMW270            | 2022-03-15    |
| 23-2-13-14   | Signal Generator             | N5183B-520        | 2022-03-15    |
| 23-2-13-15   | Vector Signal Generator      | N5182B-506        | 2022-03-15    |
| 23-2-10-43   | Switch and Control Unit      | ERIT-E-JS0806-2   | 2022-06-17    |
| 23-2-10-44   | DC power supply              | E3642A            | 2022-07-03    |
| 23-2-10-45   | Temperature test chamber     | SG-80-CC-2        | 2022-03-15    |
| 23-2-10-50   | Temperature & Humidity Meter | COS-03            | 2022-03-27    |
| 23-2-10-66   | Barometer                    | Baro              | 2022-03-23    |
| 23-2-13-01   | EMI Test Receiver            | ESR7              | 2022-03-15    |
| 23-2-13-02   | Signal Analyzer              | N9020B-544        | 2022-03-15    |
| 23-2-12-01   | Active Loop Antenna          | FMZB 1519B        | 2022-05-13    |
| 23-2-12-02   | TRILOG Broadband Antenna     | VULB9168          | 2022-04-27    |
| 23-2-12-03   | Horn Antenna                 | 3117              | 2022-05-11    |
| 23-2-12-04   | Horn Antenna                 | BBHA 9170         | 2022-05-11    |
| 23-2-10-01   | Preamplifier                 | BBV9745           | 2022-03-16    |
| 23-2-10-02   | Preamplifier                 | TAP01018048       | 2022-03-16    |
| 23-2-10-03   | Preamplifier                 | TAP18040048       | 2022-03-22    |
| 23-2-10-62   | Temperature & Humidity Meter | COS-03            | 2022-03-27    |
| 23-2-10-64   | Barometer                    | Baro              | 2022-03-23    |
| 23-2-10-14   | Switch and Control Unit      | ERIT-E-JS0806-SF1 | N/A           |
| 23-2-13-03   | EMI Test Receiver            | ESR7              | 2022-03-16    |
| 23-2-13-04   | Signal Analyzer              | N9020B-526        | 2022-03-15    |
| 23-2-12-06   | Active Loop Antenna          | FMZB 1519B        | 2022-05-13    |
| 23-2-12-07   | TRILOG Broadband Antenna     | VULB9168          | 2022-04-27    |
| 23-2-12-08   | Horn Antenna                 | 3117              | 2022-05-11    |
| 23-2-10-46   | Preamplifier                 | BBV9745           | 2022-03-16    |
| 23-2-10-47   | Preamplifier                 | TAP01018048       | 2022-03-16    |
| 23-2-10-61   | Temperature & Humidity Meter | COS-03            | 2022-03-27    |
| 23-2-10-52   | Barometer                    | Baro              | 2022-03-23    |
| 23-2-10-15   | Switch and Control Unit      | ERIT-E-JS0806-SF1 | N/A           |

## 2.6 Auxiliary equipment used during test

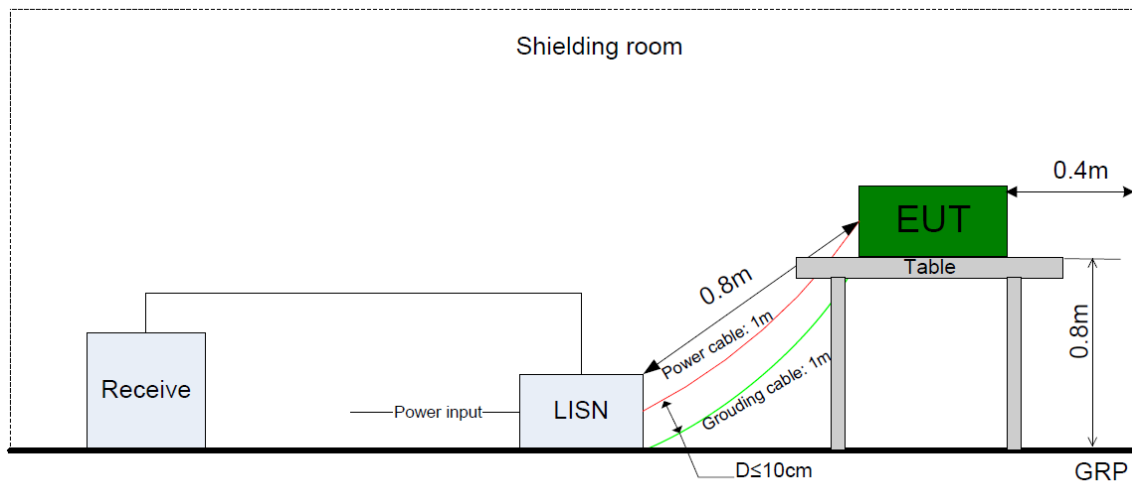
| DESCRIPTION | MANUFACTURER | MODEL NO. | S/N       |
|-------------|--------------|-----------|-----------|
| Laptop      | LENOVO       | TP00096A  | PF-1QH0LV |

## 2.7 Test software information:

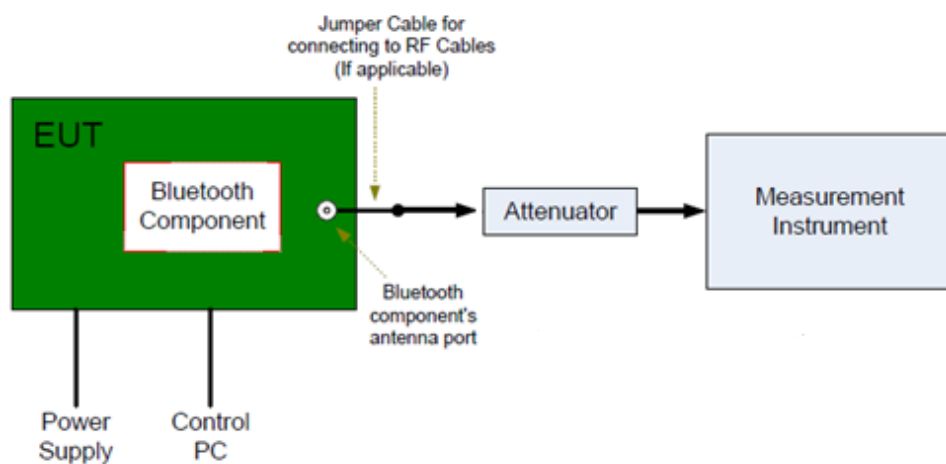
| Test Software&Version | BK32xx RF Test_V1.8.2.exe |            |                 |
|-----------------------|---------------------------|------------|-----------------|
| Mode                  | Power setting             | TX Pattern | Modulation Type |
| DH1/5                 | 1                         | PRBS9      | GFSK            |
| 2-DH1/5               | 1                         | PRBS9      | $\pi/4$ DQPSK   |
| 3-DH1/5               | 1                         | PRBS9      | 8-DPSK          |

## 2.8 Test setup

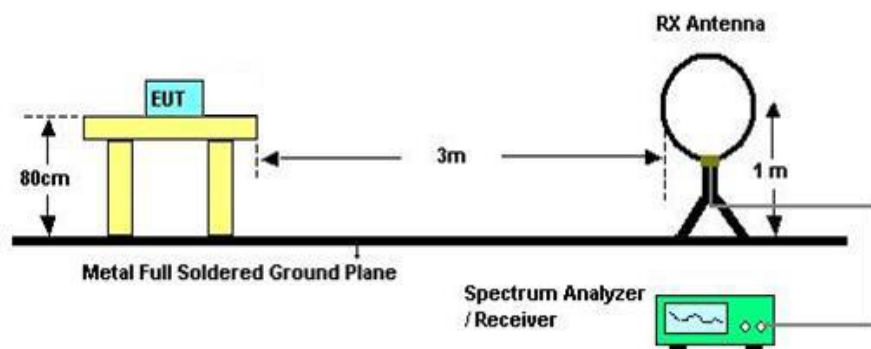
AC line conducted



Conducted tests



Radiated tests below 30MHz





## 2.9 Test results

☒ 1<sup>st</sup> test

☐ test after modification

☐ production test

| Technical Requirements                                |                                    |             |         |           |
|-------------------------------------------------------|------------------------------------|-------------|---------|-----------|
| FCC Part 15 Subpart C/RSS-247 Issue 2/RSS-Gen Issue 5 |                                    |             |         |           |
| Test Condition                                        |                                    | Test Result | Verdict | Test Site |
| §15.207                                               | Conducted emission AC power port   | Appendix J  | Pass    | Site 1    |
| §15.247(b)(1)                                         | Conducted output power for FHSS    | Appendix C  | Pass    | Site 1    |
| §15.247(b)(3)                                         | Conducted output power for DTS     | --          | N/A     | --        |
| §15.247(e)                                            | Power spectral density             | --          | N/A     | --        |
| §15.247(a)(2)                                         | 6dB bandwidth                      | --          | N/A     | --        |
| §15.247(a)(1)                                         | 20dB Occupied bandwidth            | Appendix A  | Pass    | Site 1    |
| --                                                    | 99% Occupied Bandwidth             | Appendix B  | Pass    | Site 1    |
| §15.247(a)(1)                                         | Carrier frequency separation       | Appendix D  | Pass    | Site 1    |
| §15.247(a)(1)(iii)                                    | Number of hopping frequencies      | Appendix F  | Pass    | Site 1    |
| §15.247(a)(1)(iii)                                    | Dwell Time                         | Appendix E  | Pass    | Site 1    |
| §15.247(d)<br>§15.205                                 | Conducted Spurious Emissions       | Appendix H  | Pass    | Site 1    |
| §15.247(d)                                            | Conducted Band edge                | Appendix G  | Pass    | Site 1    |
| §15.247(d) & §15.209 &<br>§15.205                     | Radiated emissions for transmitter | Appendix K  | Pass    | Site 1    |
| --                                                    | Duty cycle                         | Appendix I  | Pass    | Site 1    |
| §15.207 (g) &<br>§15.207 (h)                          | Hopping sequence requirement       | --          | Pass    | --        |
| §15.203                                               | Antenna requirement                | See note 1  | Pass    | --        |

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses an PCB antenna, the gain:2 dBi. According to §15.203, it is considered sufficiently to comply with the provisions of this section.

### 3 Technical Requirement

#### 3.1 Conducted emission AC power port

**Test Method:**

The test method was referred to the subclause 6.2 of ANSI C63.10-2013.

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both Neutral and Live lines.

**Limit:**

FCC §15.207 (a)

| Frequency   | QP Limit   | AV Limit   |
|-------------|------------|------------|
| MHz         | dB $\mu$ V | dB $\mu$ V |
| 0.150-0.500 | 66-56*     | 56-46*     |
| 0.500-5     | 56         | 46         |
| 5-30        | 60         | 50         |

Decreasing linear.

### 3.2 Duty cycle

**Test Method:**

The test method was referred to the subclause 11.6 of ANSI C63.10-2013.

Measurements of duty cycle and transmission duration shall be performed using one of the following techniques:

- a) A diode detector and an oscilloscope that together have a sufficiently short response time to permit accurate measurements of the ON and OFF times of the transmitted signal.
- b) The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the ON and OFF times of the transmitted signal:
  - 1) Set the center frequency of the instrument to the center frequency of the transmission.
  - 2) Set  $RBW \geq OBW$  if possible; otherwise, set RBW to the largest available value.
  - 3) Set  $VBW \geq RBW$ . Set detector = peak or average.
  - 4) The zero-span measurement method shall not be used unless both RBW and VBW are  $> 50/T$  and the number of sweep points across duration  $T$  exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring the duty cycle shall not be used if  $T \leq 16.7 \mu s$ .)

Limit:

None; for reporting purposes only.

### 3.3 20dB Occupied bandwidth

#### Test Method:

The test method was referred to the subclause 6.9.2 of ANSI C63.10-2013.

The occupied bandwidth is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by a specified ratio (or in decibels, a specified number of dB down from the reference value). Typical ratios, expressed in dB, are -6 dB, -20 dB, and -26 dB, corresponding to 6 dB BW, 20 dB BW, and 26 dB BW, respectively. In this subclause, the ratio is designated by “-xx dB.” The reference value is either the level of the unmodulated carrier or the highest level of the spectral envelope of the modulated signal, as stated by the applicable requirement. Some requirements might specify a specific maximum or minimum value for the “-xx dB” bandwidth; other requirements might specify that the “-xx dB” bandwidth be entirely contained within the authorized or designated frequency band.

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than  $[10 \log (OBW/RBW)]$  below the reference level. Specific guidance is given in 4.1.5.2.
- d) Steps a) through c) might require iteration to adjust within the specified tolerances.
- e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- f) Set detection mode to peak and trace mode to max hold.
- g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
- h) Determine the “-xx dB down amplitude” using  $[(\text{reference value}) - xx]$ . Alternatively, this calculation may be made by using the marker-delta function of the instrument.
- i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).
- j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.
- k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

#### Limit:

None; for reporting purposes only.

### 3.4 99% Occupied Bandwidth

**Test Method:**

The test method was referred to the subclause 6.9.3 of ANSI C63.10-2013.

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:

- a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than  $[10 \log (OBW/RBW)]$  below the reference level. Specific guidance is given in 4.1.5.2.
- d) Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

**Limit:**

None; for reporting purposes only.

### 3.5 Carrier frequency separation

**Test Method:**

The test method was referred to the subclause 7.8.2 of ANSI C63.10-2013.

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

- a) Span: Wide enough to capture the peaks of two adjacent channels.
- b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- c) Video (or average) bandwidth (VBW)  $\geq$  RBW.
- d) Sweep: Auto.
- e) Detector function: Peak.
- f) Trace: Max hold.
- g) Allow the trace to stabilize.

**Limit:**

FCC §15.247 (a) (1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### 3.6 Number of hopping frequencies

**Test Method:**

The test method was referred to the subclause 7.8.3 of ANSI C63.10-2013.

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

- a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- c) VBW  $\geq$  RBW.
- d) Sweep: Auto.
- e) Detector function: Peak.
- f) Trace: Max hold.
- g) Allow the trace to stabilize.

**Limit:**

FCC §15.247 (a) (1) (iii)

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

### 3.7 Time of occupancy (dwell time)

**Test Method:**

The test method was referred to the subclause 7.8.4 of ANSI C63.10-2013.

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

- a) Span: Zero span, centered on a hopping channel.
- b) RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1 / T$ , where  $T$  is the expected dwell time per channel.
- c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- d) Detector function: Peak.
- e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

$$\begin{aligned} & \text{(Number of hops in the period specified in the requirements)} = \\ & \text{(number of hops on spectrum analyzer)} \times (\text{period specified in the requirements} / \text{analyzer sweep time}) \end{aligned}$$

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

**Limit:**

FCC §15.247 (a) (1) (iii)

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

### **3.8 Conducted Peak output power**

#### **Test Method**

The test method was referred to the subclause 11.9.1.3 of ANSI C63.10-2013.

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

#### **Limits:**

§15.247 (b) (1)

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. T

### **3.9 Conducted Band-edge & Spurious Emissions**

**Test Method:**

The test method was referred to the subclause 7.8.6 & 7.8.8 of ANSI C63.10-2013.

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835GHz are investigated with the transmitter set to the normal hopping mode.

**Limit:**

FCC §15.247 (d)

Limit = -20 dBc

### 3.10 Radiated emissions for transmitter

#### Test Method:

The test method was referred to the subclause 11.11/11.12 of ANSI C63.10-2013.

- 1: The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
- 3: The height of antenna 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.
- 4: 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 and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5: Use the following spectrum analyzer settings According to C63.10:

For Above 1GHz

Span = wide enough to capture the peak level of the in-band emission and all spurious  
RBW = 1MHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak,  
Trace = max hold.

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious  
RBW = 100 KHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak,  
Trace = max hold.

For Below 30MHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious  
RBW = 200 Hz, VBW ≥ RBW from 9KHz to 0.15MHz, RBW 9KHz VBW ≥ RBW from 0.15MHz to 30MHz for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

#### Note:

- 1: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.
- 3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor ( $20\log(1/\text{duty cycle})$ ).
- 4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
- 5: When duty cycle < 98%, The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is  $\text{VBW} \geq 1 / T$ , the T is transmission duration (T).

**Limit:**

FCC §15.205 and §15.209

| Frequency Range<br>(MHz) | Field Strength Limit<br>(uV/m) at 3 m | Field Strength Limit<br>(dBuV/m) at 3 m |
|--------------------------|---------------------------------------|-----------------------------------------|
| 0.009-0.490              | 2400/F(kHz) @ 300 m                   | -                                       |
| 0.490-1.705              | 24000/F(kHz) @ 30 m                   | -                                       |
| 1.705 - 30               | 30 @ 30m                              | -                                       |
| 30 - 88                  | 100                                   | 40                                      |
| 88 - 216                 | 150                                   | 43.5                                    |
| 216 - 960                | 200                                   | 46                                      |
| Above 960                | 500                                   | 54                                      |

## §15.205 Restricted bands of operation

| MHz               | MHz                 | MHz           | GHz         |
|-------------------|---------------------|---------------|-------------|
| 0.090-0.110       | 16.42-16.423        | 399.9-410     | 4.5-5.15    |
| 0.495-0.505       | 16.69475-16.69525   | 608-614       | 5.35-5.46   |
| 2.1735-2.1905     | 16.80425-16.80475   | 960-1240      | 7.25-7.75   |
| 4.125-4.128       | 25.5-25.67          | 1300-1427     | 8.025-8.5   |
| 4.17725-4.17775   | 37.5-38.25          | 1435-1626.5   | 9.0-9.2     |
| 4.20725-4.20775   | 73-74.6             | 1645.5-1646.5 | 9.3-9.5     |
| 6.215-6.218       | 74.8-75.2           | 1660-1710     | 10.6-12.7   |
| 6.26775-6.26825   | 108-121.94          | 1718.8-1722.2 | 13.25-13.4  |
| 6.31175-6.31225   | 123-138             | 2200-2300     | 14.47-14.5  |
| 8.291-8.294       | 149.9-150.05        | 2310-2390     | 15.35-16.2  |
| 8.362-8.366       | 156.52475-156.52525 | 2483.5-2500   | 17.7-21.4   |
| 8.37625-8.38675   | 156.7-156.9         | 2690-2900     | 22.01-23.12 |
| 8.41425-8.41475   | 162.0125-167.17     | 3260-3267     | 23.6-24.0   |
| 12.29-12.293      | 167.72-173.2        | 3332-3339     | 31.2-31.8   |
| 12.51975-12.52025 | 240-285             | 3345.8-3358   | 36.43-36.5  |
| 12.57675-12.57725 | 322-335.4           | 3600-4400     |             |
| 13.36-13.41       |                     |               |             |

### **3.11 Hopping sequence requirement**

**Limit:**

FCC §15.207 (g)

FCC §15.207 (h)

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

**Result: Meet the requirements of this chapter**

## **4 Test Setup Photos**

Ref "EFGX21070102-IE-02-E01\_Setup\_Photos.pdf"

## **5 External Photos**

Ref "EFGX21070102-IE-02-E01\_External\_Photo.pdf"

## **6 Internal Photos**

Ref "EFGX21070102-IE-02-E01\_Internal\_Photos.pdf"

## **7 Appendix**

Ref "EFGX21070102-IE-02-E01\_appendix.pdf"

**-End of report-**