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# Hansong (Nanjing) Technology Ltd.

# RF TEST REPORT

**Report Type:**
FCC Part 15.247 & ISED RSS-247 RF report

**Model:**
Tivoli Go Andiamo

**REPORT NUMBER:**
180402312SHA-001

**ISSUE DATE:**
June 27, 2018

**DOCUMENT CONTROL NUMBER:**
TTRF15.247-01_V1 © 2018 Intertek

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# TEST REPORT

Report no.: 180402312SHA-001

| | |
|---|---|
| **Applicant:** | Hansong (Nanjing) Technology Ltd.<br>8th Kangping Road, Jiangning Economy and Technology Development Zone, Nanjing, 211106, China. |
| **Manufacturer:** | Hansong (Nanjing) Technology Ltd.<br>8th Kangping Road, Jiangning Economy and Technology Development Zone, Nanjing, 211106, China. |
| **Manufacturing Site:** | Hansong (Nanjing) Technology Ltd.<br>8th Kangping Road, Jiangning Economy and Technology Development Zone, Nanjing, 211106, China. |
| **Product Name:** | Bluetooth speaker |
| **Type/Model:** | Tivoli Go Andiamo |
| **FCC ID:** | XCO-ANDIAMO |
| **IC:** | 7756A-ANDIAMO |

**SUMMARY:**

The equipment complies with the requirements according to the following standard(s) or Specification:

**47CFR Part 15 (2017):** Radio Frequency Devices (Subpart C)

**ANSI C63.10 (2013):** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

**RSS-247 Issue 2 (February 2017):** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

**RSS-Gen Issue 5 (April 2018):** General Requirements for Compliance of Radio Apparatus

| **PREPARED BY:** | **REVIEWED BY:** |
|---|---|
| Wade zhang | |
| Project Engineer<br>Wade Zhang | Reviewer<br>Daniel Zhao |

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**TEST REPORT**

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# Revision History

| Report No. | Version | Description | Issued Date |
|---|---|---|---|
| 180402312SHA-001 | Rev. 01 | Initial issue of report | June 27, 2018 |
| | | | |
| | | | |

# Measurement result summary

| TEST ITEM | FCC REFERANCE | IC REFERANCE | RESULT |
|---|---|---|---|
| 20 dB Bandwidth | 15.247(a)(1) | RSS-247 Issue 2 Clause 5.1 | Pass |
| Carrier Frequency Separation | 15.247(a)(1) | RSS-247 Issue 2 Clause 5.1 | Pass |
| Output power | 15.247(b)(1) | RSS-247 Issue 2 Clause 5.4 | Pass |
| Radiated Emissions | 15.205 & 15.209 | RSS-Gen Issue 5 Clause 8.9&8.10 | Pass |
| Conducted Spurious Emissions & Band Edge | 15.247(d) | RSS-247 Issue 2 Clause 5.5 | Pass |
| Power line conducted emission | 15.207 | RSS-Gen Issue 5 Clause 8.8 | Pass |
| Number of Hopping Frequencies | 15.247(a)(1)(iii) | RSS-247 Issue 2 Clause 5.1 | Pass |
| Dwell time | 15.247(a)(1)(iii) | RSS-247 Issue 2 Clause 5.1 | Pass |
| Occupied bandwidth | - | RSS-Gen Issue 5 Clause 6.6 | Tested |
| Antenna requirement | 15.203 | - | Pass |

*Notes: 1: NA =Not Applicable*

# 1 GENERAL INFORMATION

## 1.1 Description of Equipment Under Test (EUT)

| | |
|---|---|
| Product name: | Bluetooth speaker |
| Type/Model: | Tivoli Go Andiamo |
| Description of EUT: | The EUT is a Bluetooth speaker which contains a Bluetooth 4.0 technology module, the Bluetooth module support BR+EDR only and there have only one mode. |
| Rating: | DC in: 12V, 1A, Out: Max 15W/4Ω<br>Adaptor 1: FJ-SW1261201000DN<br>Input: 100~240VAC, 50/60Hz, 0.4A Max; Output: 12VDC, 1000mA<br>Adaptor 2: DYS612-120100-17620<br>Input: 100~240VAC, 50/60Hz, 0.4A Max; Output: 12VDC, 1000mA |
| Category of EUT: | Class B |
| EUT type: | ☒ Table top ☐ Floor standing |
| Software Version: | / |
| Hardware Version: | / |
| Sample received date: | April 16, 2018 |
| Date of test: | April 16, 2018 ~ May 31, 2018 |

## 1.2 Technical Specification

| | |
|---|---|
| Frequency Range: | 2400MHz ~ 2483.5MHz |
| Support Standards: | Bluetooth 4.0 (BR+EDR) |
| Modulation Technique: | Frequency Hopping Spread Spectrum(FHSS) |
| Type of Modulation: | GFSK, π/4 DQPSK, 8DPSK |
| Channel Number: | 79 (0 - 78) |
| Data Rate: | 1Mbps |
| Channel Separation: | 1MHz |
| Antenna: | Internal PCB antenna, 2.0dBi Peak gain |

## 1.3 Frequency Hopping System Requirement

**Test Requirement: Section 15.247 (a)(1), (g), (h) requirement:**

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

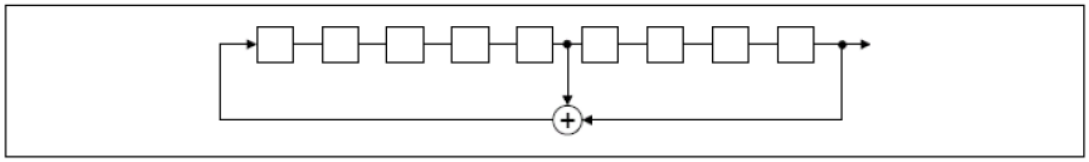
Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented 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 hop sets 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.

**Compliance for section 15.247(a)(1)**

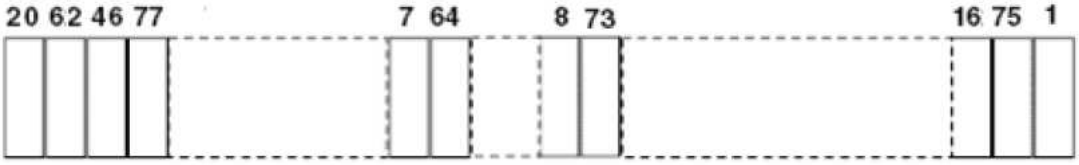
According to Bluetooth Core Specification, the pseudorandom sequence may be generated in a nine stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs;
i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: $2^9$ -1 = 511 bits
- Longest sequence of zeros: 8 (non-inverted signal)



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

An example of Pseudorandom Frequency Hopping Sequence as follow:




Each frequency used equally on the average by each transmitter.
According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted signals.

**Compliance for section 15.247(g)**

According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

**Compliance for section 15.247(h)**

According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.
According to the Bluetooth Core specification, the Bluetooth system is designed not have the ability to coordinate with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

## 1.4 Description of Test Facility

| | |
|---|---|
| Name: | Intertek Testing Services Shanghai |
| Address: | Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China |
| Telephone: | 86 21 61278200 |
| Telefax: | 86 21 54262353 |

| | |
|---|---|
| The test facility is recognized, certified, or accredited by these organizations: | CNAS Accreditation Lab<br>Registration No. CNAS L0139 |
| | FCC Accredited Lab<br>Designation Number: CN1175 |
| | IC Registration Lab<br>Registration code No.: 2042B-1 |
| | VCCI Registration Lab<br>Registration No.: R-4243, G-845, C-4723, T-2252 |
| | NVLAP Accreditation Lab<br>NVLAP LAB CODE: 200849-0 |
| | A2LA Accreditation Lab<br>Certificate Number: 3309.02 |

# 2 TEST SPECIFICATIONS

## 2.1 Standards or specification

47CFR Part 15 (2017)
ANSI C63.10 (2013)
RSS-247 Issue 2 (February 2017)
RSS-Gen Issue 5 (April 2018)
DA 00-705

## 2.2 Mode of operation during the test

While testing the transmitter mode of the EUT, the internal modulation is applied.
All the functions of the host device except the BT module were set on stand-by mode.

The test setting software is offered by the manufactory. The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases.

The worst-case modulation configuration:

| Worst Modulation Used for Conformance Testing | | | |
|---|---|---|---|
| **Bluetooth Mode** | **Data Rate** | **Packet Type** | **Worst Mode** |
| GFSK | BR-1Mbps | DH1,DH3,DH5 | **BR-1Mbps DH5**<br>EDR-2Mbps 2DH5<br>EDR-3Mbps 3DH5 |
| π/4 DQPSK | EDR-2Mbps | 2DH1,2DH3,2DH5 | |
| 8DPSK | EDR-3Mbps | 3DH1,3DH3,3DH5 | |
| Note: The BR-1Mbps DH5 mode was chosen for radiation emission bellow 1GHz and Conducted emission testing as representative in this report. | | | |

The power setting parameter:

| The worst-case power setting parameter | | | |
|---|---|---|---|
| Test software Version | Blue Test 3 | | |
| Modulation Mode | 2402MHz | 2441MHz | 2480MHz |
| BR-1Mbps | 7 | 7 | 7 |
| EDR-2Mbps | 7 | 7 | 7 |
| EDR-3Mbps | 7 | 7 | 7 |

Radiated test mode: EUT transmitted signal with BT antenna;
Conducted test mode: EUT transmitted signal from BT RF port connected to SPA directly;

## 2.3 Test software list

| Test Items | Software | Manufacturer | Version |
|---|---|---|---|
| Conducted emission | ESxS-K1 | R&S | V2.1.0 |
| Radiated emission | ES-K1 | R&S | V1.71 |

## 2.4 Test peripherals list

| Item No. | Name | Band and Model | Description |
|---|---|---|---|
| 1 | Laptop computer | HP ProBook 6470b | 100-240V AC, 50/60Hz<br>FCC DOC |
| 2 | CSR Tool | / | / |

## 2.5 Test environment condition:

| Test items | Temperature | Humidity |
|---|---|---|
| 20 dB Bandwidth | 23°C | 52% RH |
| Output power | | |
| Carrier Frequency Separation | | |
| Number of Hopping Frequencies | | |
| Dwell time | | |
| Occupied bandwidth | | |
| Conducted Spurious Emissions & Band Edge | | |
| Power line conducted emission | 22°C | 53% RH |
| Radiated Emissions | 22°C | 55% RH |

## 2.6 Instrument list

| Conducted Emission | | | | | |
|---|---|---|---|---|---|
| Used | Equipment | Manufacturer | Type | Internal no. | Due date |
| ☑ | Test Receiver | R&S | ESCS 30 | EC 2107 | 2018-09-12 |
| ☑ | A.M.N. | R&S | ESH2-Z5 | EC 3119 | 2018-12-07 |
| ☑ | Shielded room | Zhongyu | - | EC 2838 | 2019-01-07 |
| Radiated Emission | | | | | |
| Used | Equipment | Manufacturer | Type | Internal no. | Due date |
| ☑ | Test Receiver | R&S | ESIB 26 | EC 3045 | 2018-09-12 |
| ☑ | Bilog Antenna | TESEQ | CBL 6112D | EC 4206 | 2019-05-30 |
| ☑ | Horn antenna | R&S | HF 906 | EC 3049 | 2018-11-17 |
| ☑ | Horn antenna | ETS | 3117 | EC 4792-1 | 2019-01-09 |
| ☑ | Horn antenna | TOYO | HAP18-26W | EC 4792-3 | 2020-07-09 |
| ☑ | Pre-amplifier | R&S | Pre-amp 18 | EC5881 | 2019-06-20 |
| ☑ | Semi-anechoic chamber | Albatross project | - | EC 3048 | 2018-09-15 |
| RF test | | | | | |
| Used | Equipment | Manufacturer | Type | Internal no. | Due date |
| ☑ | PXA Signal Analyzer | Keysight | N9030A | EC 5338 | 2019-03-05 |
| ☑ | Power sensor | Agilent | U2021XA | EC 5338-1 | 2019-03-05 |
| ☑ | Vector Signal Generator | Agilent | N5182B | EC 5175 | 2019-03-05 |
| ☑ | MXG Analog Signal Generator | Agilent | N5181A | EC 5338-2 | 2019-03-05 |
| ☑ | Test Receiver | R&S | ESCI 7 | EC 4501 | 2018-09-12 |
| Additional instrument | | | | | |
| Used | Equipment | Manufacturer | Type | Internal no. | Due date |
| ☑ | Therom-Hygrograph | ZJ1-2A | S.M.I.F. | EC 3323 | 2018-06-14 |
| ☑ | Pressure meter | YM3 | Shanghai Mengde | EC 3320 | 2018-06-28 |

## 2.7 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

| Test item | Measurement uncertainty |
|---|---|
| Maximum peak output power | ± 0.74dB |
| Radiated Emissions in restricted frequency bands below 1GHz | ± 4.90dB |
| Radiated Emissions in restricted frequency bands above 1GHz | ± 5.02dB |
| Emission outside the frequency band | ± 2.89dB |
| Power line conducted emission | ± 3.19dB |

# 3 20dB bandwidth

**Test result: Pass**

## 3.1 Limit

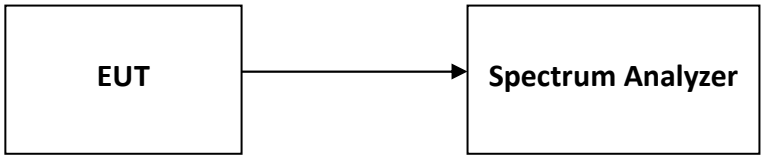
☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ 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 125mW.

## 3.2 Measurement Procedure

The 20 bandwidth is measured using the Spectrum Analyzer with:
Span = 2 to 3 times the 20dB bandwidth,
RBW≥1% of the 20 dB bandwidth,
VBW≥RBW,
Sweep = auto,
Detector = peak,
Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

## 3.3 Test Configuration




## 3.4 Test Results of 20dB bandwidth

Please refer to Appendix A.

TEST REPORT

# 4 Carrier Frequency Separation

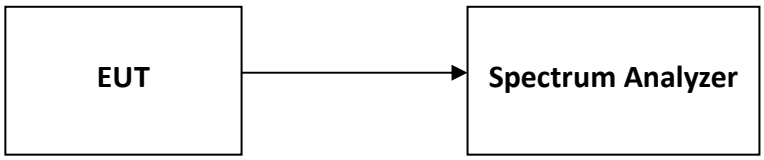
**Test result: Pass**

## 4.1 Limit

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

☒ 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 125mW.

## 4.2 Test Configuration




## 4.3 Test Procedure and test setup

The Carrier Frequency Separation is measured using the Spectrum Analyzer with:
Span can capture two adjacent channels,
RBW≥1% of the span, VBW≥RBW,
Sweep = auto,
Detector = peak,
Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

## 4.4 Test Results of Carrier Frequency Separation

Please refer to Appendix A.

# 5 Output power

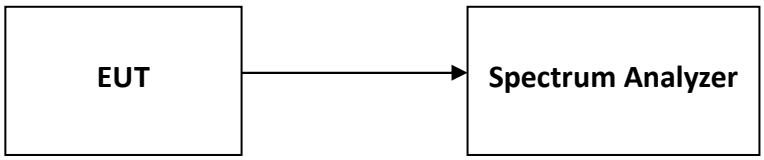
**Test result: Pass**

## 5.1 Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. (The e.i.r.p. shall not exceed 4 W)

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

## 5.2 Test Configuration




## 5.3 Measurement Procedure

The power output per FCC §15.247(b) is measured using the Spectrum Analyzer with:
Span = 5 times the 20dB bandwidth,
RBW≥ the 20dB bandwidth, VBW≥RBW,
Sweep = auto,
Detector = peak,
Trace = max hold.
The test was performed at 3 channels (lowest, middle and highest channel).
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

## 5.4 Test Results of Output Power

Please refer to Appendix A.

# 6 Radiated Emissions

**Test result:** **Pass**

## 6.1 Limit

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified showed as below:

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009 ~ 0.490 | 2400/F(kHz) | 300 |
| 0.490 ~ 1.705 | 24000/F(kHz) | 30 |
| 1.705 ~ 30.0 | 30 | 30 |
| 30 ~ 88 | 100 | 3 |
| 88 ~ 216 | 150 | 3 |
| 216 ~ 960 | 200 | 3 |
| Above 960 | 500 | 3 |

## 6.2 Measurement Procedure

**For Radiated emission below 30MHz:**

a) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c) Both X and Y axes of the antenna are set to make the measurement.
d) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

**NOTE:**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

**TEST REPORT**

**For Radiated emission above 30MHz:**

a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c) 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.

d) 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.

e) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

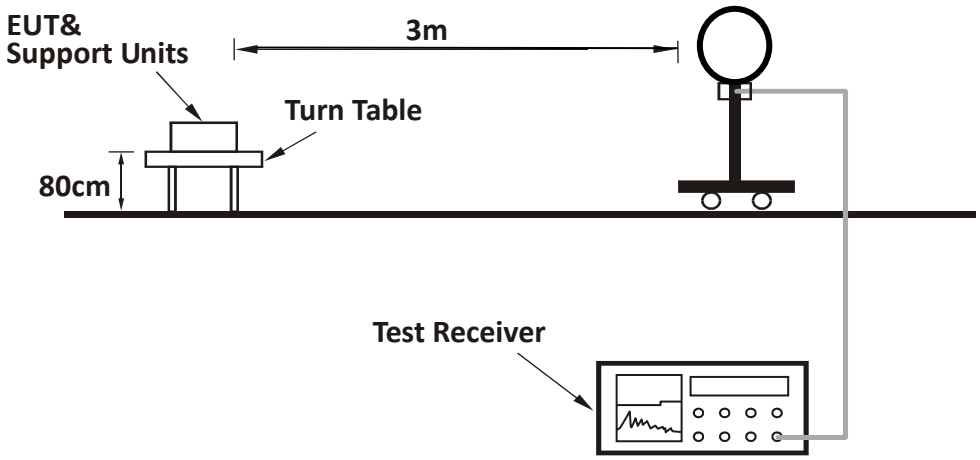
f) The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

**Note:**

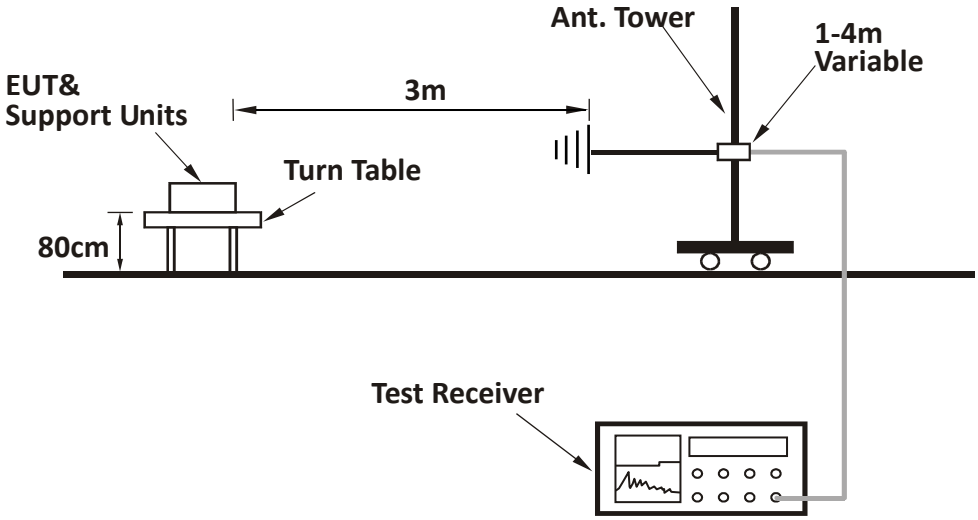
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 3 x RBW (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported

## 6.3 Test Configuration

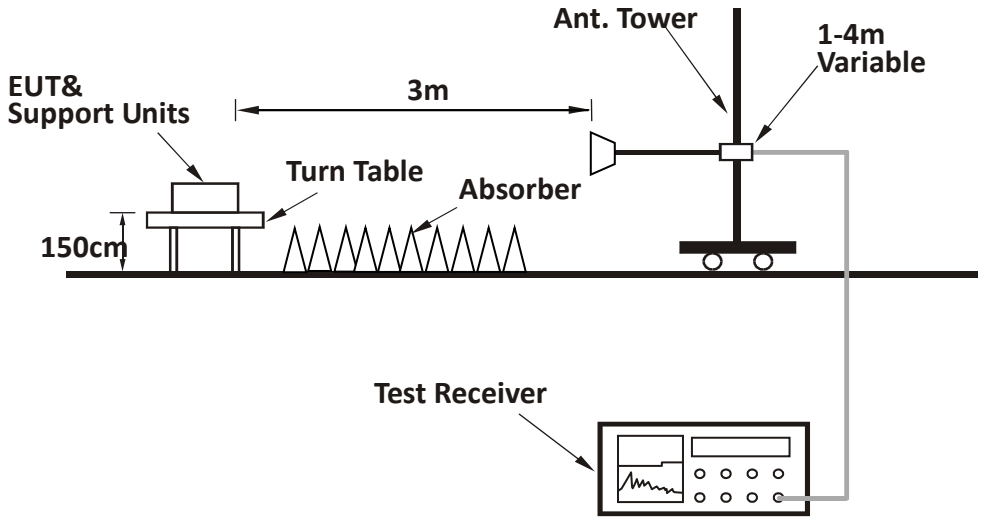
**For Radiated emission below 30MHz:**




**For Radiated emission 30MHz to 1GHz:**



**For Radiated emission above 1GHz:**

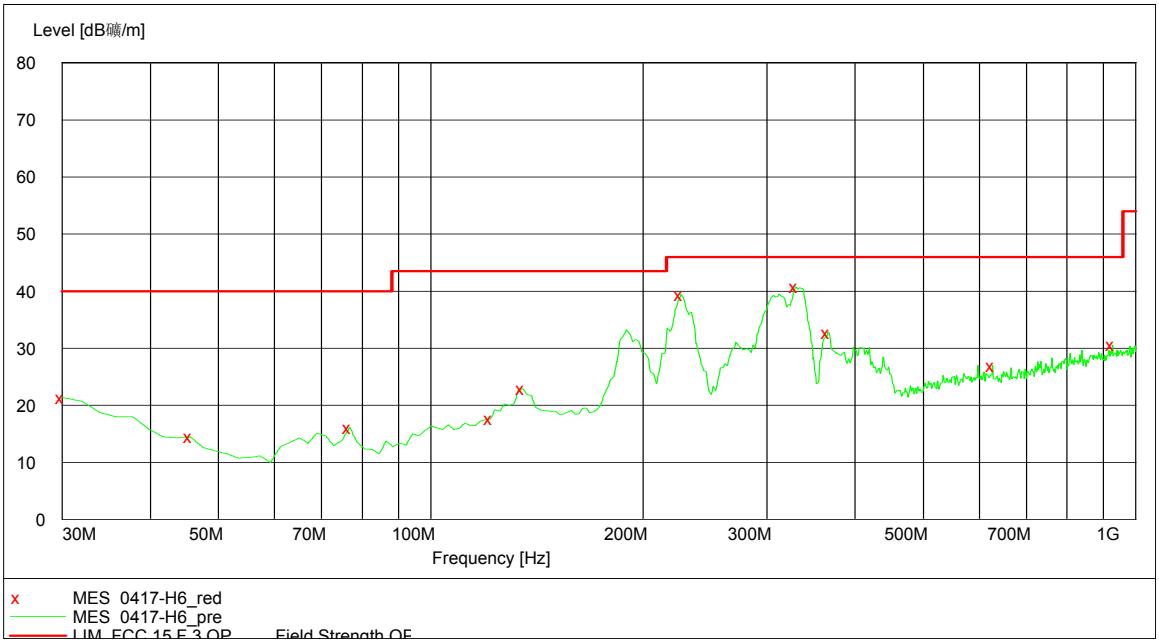


## 6.4 Test Results of Radiated Emissions

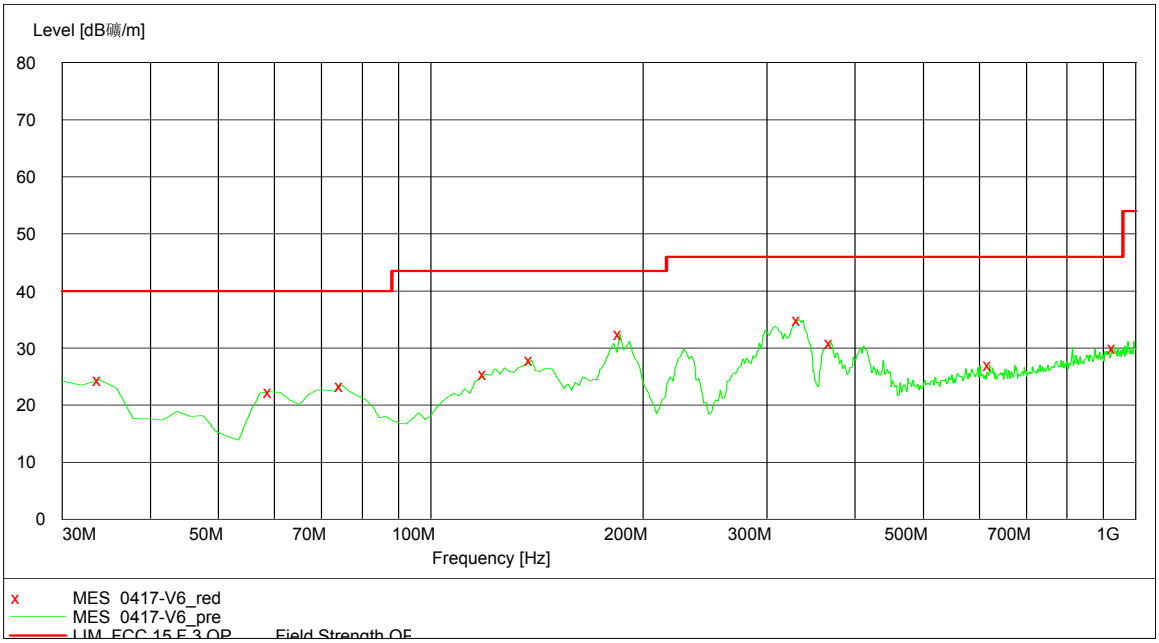
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

The worst waveform from 30MHz to 1000MHz is listed as below:

Horizontal




Vertical



**TEST REPORT**

**Test data 30MHz~1GHz:**

| Polarization | Frequency (MHz) | Measured level (dBμV/m) | Correct Factor (dB/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|
| H | 30.00 | 21.40 | 19.20 | 40.00 | 18.60 | PK |
| | 45.55 | 14.50 | 10.70 | 40.00 | 25.50 | PK |
| | 76.65 | 16.10 | 7.60 | 40.00 | 23.90 | PK |
| | 121.36 | 17.60 | 13.30 | 43.50 | 25.90 | PK |
| | 134.97 | 22.90 | 12.60 | 43.50 | 20.60 | PK |
| | 226.33 | 39.40 | 11.40 | 46.00 | 6.60 | PK |
| | 329.36 | 40.80 | 15.50 | 46.00 | 5.20 | PK |
| | 366.29 | 32.80 | 16.40 | 46.00 | 13.20 | PK |
| | 626.77 | 26.90 | 20.70 | 46.00 | 19.10 | PK |
| | 928.08 | 30.60 | 23.30 | 46.00 | 15.40 | PK |
| V | 33.89 | 24.40 | 16.80 | 40.00 | 15.60 | PK |
| | 59.16 | 22.40 | 7.10 | 40.00 | 17.60 | PK |
| | 74.71 | 23.50 | 7.50 | 40.00 | 16.50 | PK |
| | 119.42 | 25.50 | 13.30 | 43.50 | 18.00 | PK |
| | 138.86 | 27.90 | 12.40 | 43.50 | 15.60 | PK |
| | 185.51 | 32.50 | 10.50 | 43.50 | 11.00 | PK |
| | 333.25 | 35.00 | 15.60 | 46.00 | 11.00 | PK |
| | 370.18 | 31.00 | 16.50 | 46.00 | 15.00 | PK |
| | 620.94 | 27.00 | 20.60 | 46.00 | 19.00 | PK |
| | 931.96 | 30.10 | 23.30 | 46.00 | 15.90 | PK |

**Test result of 1GHz to 25GHz:**

GFSK (DH5) Modulation:

| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| L | H | 2402.00 | 30.70 | 98.10 | Fundamental | / | PK |
| | H | 2390.00 | 30.20 | 48.30 | 74.00 | 25.70 | PK |
| | H | 2390.00 | 30.20 | 39.70 | 54.00 | 14.30 | AV |
| | H | 4804.00 | -1.50 | 45.40 | 74.00 | 28.60 | PK |
| M | V | 2441.00 | 30.70 | 101.60 | Fundamental | / | PK |
| | V | 4882.00 | -1.10 | 46.60 | 74.00 | 27.40 | PK |
| H | H | 2480.00 | 30.70 | 101.40 | Fundamental | / | PK |
| | V | 2483.50 | 31.52 | 49.70 | 74.00 | 24.30 | PK |
| | V | 2483.50 | 31.52 | 42.60 | 54.00 | 11.40 | AV |
| | V | 4960.00 | -0.80 | 45.40 | 74.00 | 28.60 | PK |

π/4DQPSK (2DH5) Modulation:

| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| L | H | 2402.00 | 30.70 | 96.30 | Fundamental | / | PK |
| | H | 2390.00 | 30.20 | 48.30 | 74.00 | 25.70 | PK |
| | H | 2390.00 | 30.20 | 38.90 | 54.00 | 15.10 | AV |
| | H | 4804.00 | -1.50 | 44.30 | 74.00 | 29.70 | PK |
| M | V | 2441.00 | 30.70 | 98.20 | Fundamental | / | PK |
| | V | 4882.00 | -1.10 | 44.60 | 74.00 | 29.40 | PK |
| H | H | 2480.00 | 30.70 | 97.80 | Fundamental | / | PK |
| | V | 2483.50 | 31.52 | 47.30 | 74.00 | 26.70 | PK |
| | V | 2483.50 | 31.52 | 41.70 | 54.00 | 12.30 | AV |
| | V | 4960.00 | -0.80 | 44.40 | 74.00 | 29.60 | PK |

8DPSK (3DH5) Modulation:

| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| L | H | 2402.00 | 30.70 | 94.70 | Fundamental | / | PK |
| | H | 2390.00 | 30.20 | 46.50 | 74.00 | 27.50 | PK |
| | H | 2390.00 | 30.20 | 38.50 | 54.00 | 15.50 | AV |
| | H | 4804.00 | -1.50 | 45.20 | 74.00 | 28.80 | PK |
| M | V | 2441.00 | 30.70 | 97.80 | Fundamental | / | PK |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | V | 4882.00 | -1.10 | 44.30 | 74.00 | 29.70 | PK |
| H | H | 2480.00 | 30.70 | 96.70 | Fundamental | / | PK |
| | V | 2483.50 | 31.52 | 46.30 | 74.00 | 27.70 | PK |
| | V | 2483.50 | 31.52 | 41.20 | 54.00 | 12.80 | AV |
| | V | 4960.00 | -0.80 | 44.50 | 74.00 | 29.50 | PK |

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Limit - Corrected Reading
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
Limit = 40.00dBuV/m.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

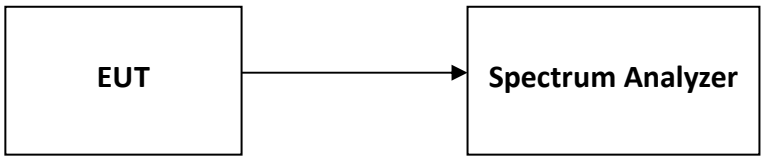
# 7 Conducted Spurious Emissions & Band Edge

**Test result:** **Pass**

## 7.1 Limit

In any 100kHz bandwidth outside the frequency band in which the spread spectrum 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 100kHz bandwidth within the band that contains the highest level of the desired power.

## 7.2 Test Configuration




## 7.3 Measurement Procedure

The Conducted Spurious Emissions is measured using the Spectrum Analyzer with Span wide enough capturing all spurious from the lowest emission frequency of the EUT up to 10th harmonics,

RBW = 100kHz, VBW≥RBW,

Sweep = auto,

Detector = peak,

Trace = max hold.

The test was performed at 3 channels (lowest, middle and highest channel).

The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

## 7.4 Test Results of Conducted Spurious Emissions & Band Edge

Please refer to Appendix A

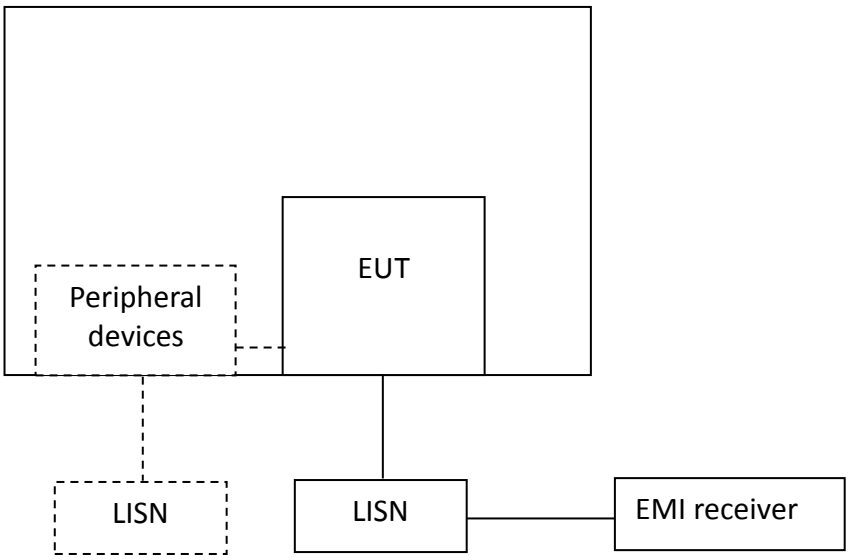
# 8 Power line conducted emission

**Test result:** **Pass**

## 8.1 Limit

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | QP | AV |
| 0.15-0.5 | 66 to 56* | 56 to 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |
| * Decreases with the logarithm of the frequency. | | |

## 8.2 Test Configuration



## 8.3 Measurement Procedure

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

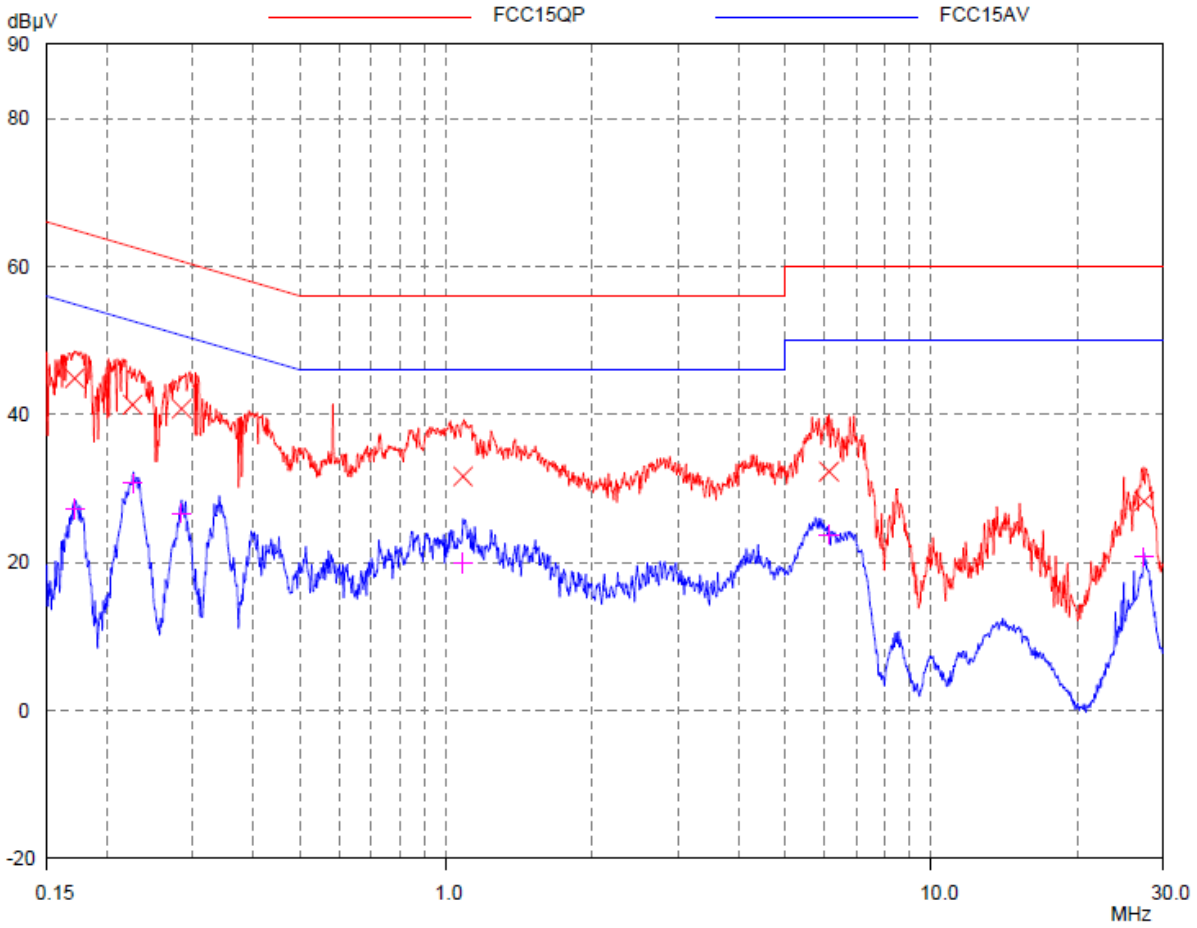
The bandwidth of the test receiver is set at 9 kHz.

## 8.4 Test Results of Power line conducted emission

The worst result is listed as below:

**Test Curve:**

L line

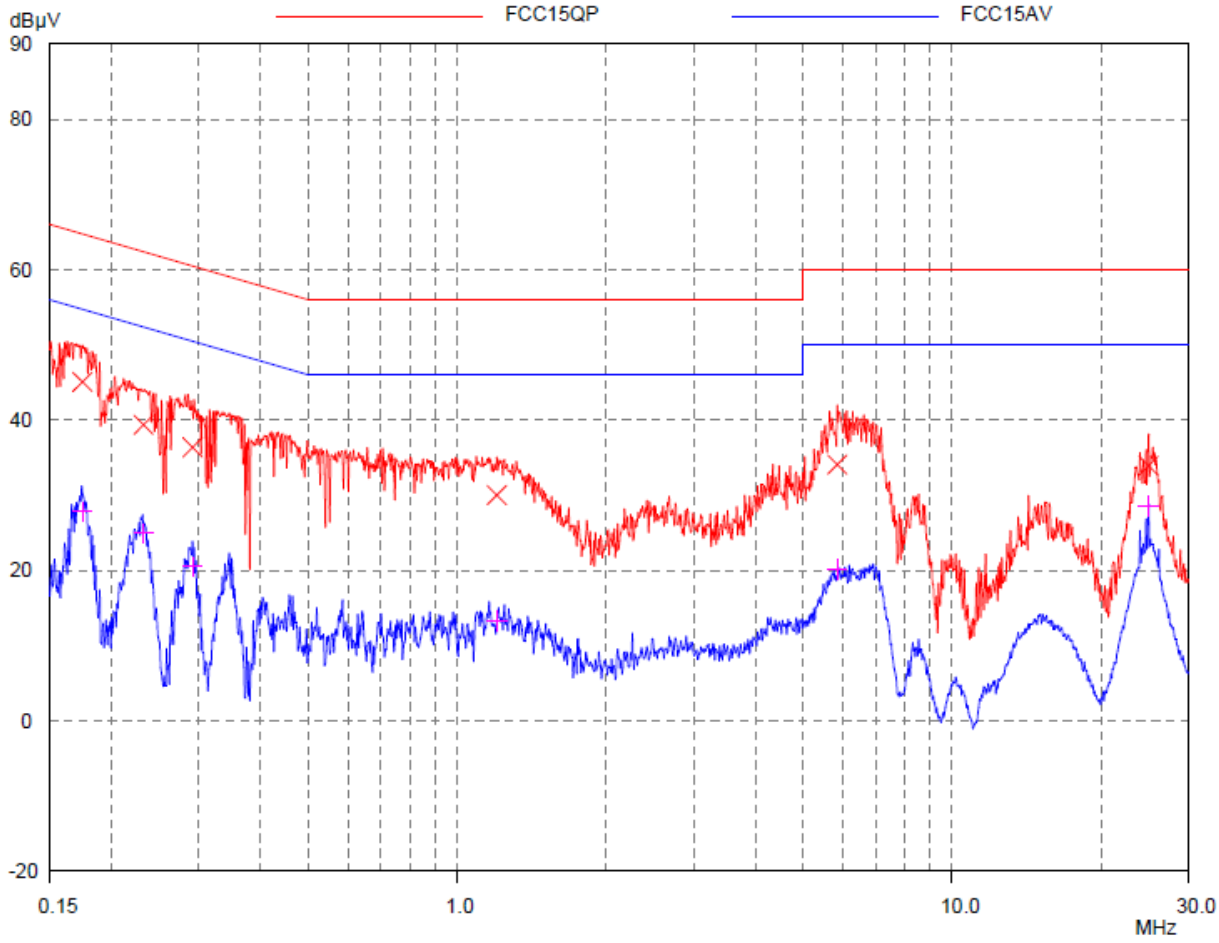



**Test Data:**

| Frequency (MHz) | Quasi-peak | | | Average | | |
|---|---|---|---|---|---|---|
| | level dB(µV) | Limit dB(µV) | Margin (dB) | level dB(µV) | limit dB(µV) | Margin (dB) |
| 0.171 | 44.89 | 64.91 | 20.02 | 27.22 | 54.91 | 27.69 |
| 0.225 | 41.33 | 62.62 | 21.29 | 30.68 | 52.62 | 21.94 |
| 0.284 | 40.78 | 60.70 | 19.92 | 26.61 | 50.70 | 24.09 |
| 1.082 | 31.63 | 56.00 | 24.37 | 19.92 | 46.00 | 26.08 |
| 6.144 | 32.28 | 60.00 | 27.72 | 23.79 | 50.00 | 26.21 |
| 27.453 | 28.28 | 60.00 | 31.72 | 20.76 | 50.00 | 29.24 |

**TEST REPORT**

N line




**Test Data:**

| Frequency (MHz) | Quasi-peak | | | Average | | |
|---|---|---|---|---|---|---|
| | level dB(µV) | Limit dB(µV) | Margin (dB) | level dB(µV) | limit dB(µV) | Margin (dB) |
| 0.175 | 45.09 | 64.74 | 19.65 | 27.81 | 54.74 | 26.93 |
| 0.232 | 39.37 | 62.39 | 23.02 | 24.96 | 52.39 | 27.43 |
| 0.291 | 36.39 | 60.50 | 24.11 | 20.47 | 50.50 | 30.03 |
| 1.200 | 30.03 | 56.00 | 25.97 | 13.30 | 46.00 | 32.70 |
| 5.857 | 34.09 | 60.00 | 25.91 | 20.13 | 50.00 | 29.87 |
| 24.945 | 33.93 | 60.00 | 26.07 | 28.62 | 50.00 | 21.38 |

*Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.*

*2. Corrected Reading = Original Receiver Reading + Correct Factor*

*3. Margin = Limit - Corrected Reading*

*4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.*

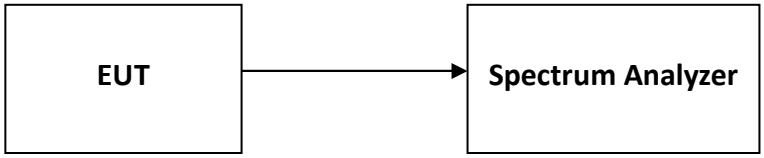
# 9 Number of Hopping Frequencies

**Test result:Pass**

## 9.1 Limit

Number of Hopping Frequencies in the 2400-2483.5 MHz band shall use at least 15 channels.

## 9.2 Test Configuration




## 9.3 Test procedure and test setup

The channel number is measured using the Spectrum Analyzer with RBW=100kHz, VBW≥RBW,
Sweep = auto,
Detector = peak,
Trace = max hold.
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

## 9.4 Test Results of Number of Hopping Frequencies

Please refer to Appendix A

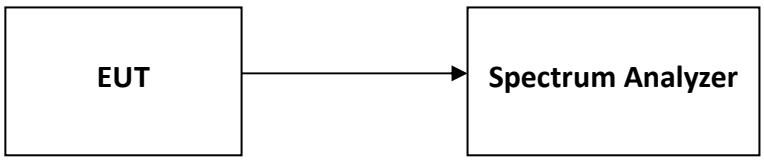
# 10 Dwell Time

**Test result:Pass**

## 10.1 Limit

The dwell time 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

## 10.2 Test Configuration




## 10.3 Test procedure and test setup

Dwell time per FCC §15.247(a)(1)(iii) is measured using the Spectrum Analyzer with Span = 0, RBW=1MHz, VBW≥RBW, Sweep can capture the entire dwell time, Detector = peak, Trace = max hold. The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

## 10.4 Test Results of Dwell Time

Please refer to Appendix A

# 11 Occupied Bandwidth

**Test result:** **Tested**

## 11.1 Limit

None

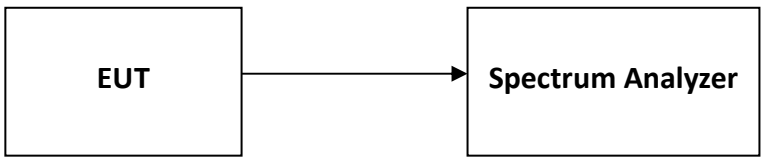
## 11.2 Measurement Procedure

The occupied bandwidth per RSS-Gen Issue 5 Clause 6.6 was measured using the Spectrum Analyzer.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

## 11.3 Test Configuration




## 11.4 The results of Occupied Bandwidth

Please refer to Appendix A

# 12 Antenna requirement

**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 shall be considered sufficient to comply with the provisions of this section.

**Result:**
EUT uses permanently attached antenna to the intentional radiator, so it can comply with the provisions of this section.

********** END **********