

# **CTC** Laboratories, Inc.

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| Т   | EST REPORT  |                         |  |  |
|---|---|-------------------------|--|--|
| Report No. ······:  | CTC20231245E04  |                         |  |  |
| FCC ID  | 2APN5SNZB01P  |                         |  |  |
| IC:   | 29127-SNZB01P   |                         |  |  |
| Applicant:  | Shenzhen Sonoff Technologies Co.,                     | ,Ltd.                   |  |  |
| Address   | 3F & 6F, Bldg A, No. 663, Bulong Rd,<br>China         | Shenzhen, Guangdong,    |  |  |
| Manufacturer  | Shenzhen Sonoff Technologies Co.,Ltd                  | d.                      |  |  |
| Address   | 3F & 6F, Bldg A, No. 663, Bulong Rd, 8<br>China       | Shenzhen, Guangdong,    |  |  |
| Product Name:   | : Zigbee Wireless Switch                              |                         |  |  |
| Trade Mark······:   | Sonoff  |                         |  |  |
| Model/Type reference······:   | SNZB-01P  |                         |  |  |
| Listed Model(s) ······  | /   |                         |  |  |
| Standard:   | FCC CFR Title 47 Part 15 Subpart C<br>RSS-247 Issue 2 | Section 15.247          |  |  |
| Date of receipt of test sample:   | May 30, 2023  |                         |  |  |
| Date of testing   | May 30, 2023 to Jun. 19, 2023                         |                         |  |  |
| Date of issue   | Jun. 19, 2023   |                         |  |  |
| Result:   | PASS  |                         |  |  |
| Compiled by:  |   | T: Jinny                |  |  |
| (Printed name+signature)  | Jim Jiang   | Jim Jiang<br>Zric zhang |  |  |
| Supervised by:  |   | Tine shang              |  |  |
| (Printed name+signature)  | Eric Zhang  |                         |  |  |
|   |   | 1 0                     |  |  |
| Approved by:  |   | Johnas                  |  |  |
| (Printed name+signature)  | Totti Zhao  |                         |  |  |
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should not use it to claim product endorsement by CTC. The test results in the report only apply to the tested sample. The test report shall be invalid without all the signatures of testing engineers, reviewer and approver. Any objections must be raised to CTC within 15 days since the date when the report is received. It will not be taken into consideration beyond this limit. The test report merely correspond to the test sample.



### **Table of Contents**

### Page

| 1. | TEST | SUMMARY                                      | 3 |
|----|------|--|---|
| -  | 1.1. | Test Standards                               | 3 |
| -  | 1.2. | REPORT VERSION                               | 3 |
| -  | 1.3. | TEST DESCRIPTION                             |   |
| -  | 1.4. | TEST FACILITY                                | 4 |
| -  | 1.5. | Measurement Uncertainty                      | 4 |
| 2  | 1.6. | Environmental Conditions                     | 5 |
| 2. | GENE | RAL INFORMATION                              | 6 |
| 2  | 2.1. | CLIENT INFORMATION                           | 6 |
| 2  | 2.2. | GENERAL DESCRIPTION OF EUT                   | 6 |
| 2  |      | ACCESSORY EQUIPMENT INFORMATION              |   |
| 2  | 2.4. | OPERATION STATE                              |   |
| 2  | 2.5. | Measurement Instruments List                 | 9 |
| 3. | TEST | ITEM AND RESULTS1                            | 1 |
| 3  | 3.1. | CONDUCTED EMISSION1                          | 1 |
| 3  | 3.2. | RADIATED EMISSION                            | 3 |
| 3  | 3.3. | BAND EDGE EMISSIONS (RADIATED)               | 1 |
| 3  | 3.4. | BAND EDGE AND SPURIOUS EMISSIONS (CONDUCTED) | 6 |
| 3  | 3.5. | DTS BANDWIDTH                                | 0 |
| 3  | 3.6. | PEAK OUTPUT POWER                            |   |
| 3  |      | POWER SPECTRAL DENSITY                       |   |
| 3  | 3.8. | DUTY CYCLE                                   |   |
| 3  | 3.9. | ANTENNA REQUIREMENT                          | 8 |



# 1. TEST SUMMARY

# 1.1. Test Standards

The tests were performed according to following standards:

<u>FCC Rules Part 15.247</u>: Operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz. <u>RSS-247 Issue 2</u>: Standard Specifications for Frequency Hopping Systems (FHSs) and Digital Transmission Systems (DTSs) Operating in the Bands 902-928MHz, 2400-2483.5MHz and 5725-5850MHz. <u>ANSI C63.10-2013</u>: American National Standard for Testing Unlicensed Wireless Devices.

# 1.2. Report Version

| Revised No. | Date of issue | Description |  |
|-------------|---------------|-------------|--|
| 01          | Jun. 19, 2023 | Original    |  |
|             |               |             |  |
|             |               |             |  |

# 1.3. Test Description

| FCC Part 15 Subpart C (15.247) / RSS-247 Issue 2 |                  |                             |        |           |  |
|--|------------------|-----------------------------|--------|-----------|--|
| Test Item  | Standard Section |                             | Result | Test      |  |
| lest item  | FCC              | IC                          | Result | Engineer  |  |
| Antenna Requirement                              | 15.203           | /                           | Pass   | Jim Jiang |  |
| Conducted Emission                               | 15.207           | RSS-Gen 8.8                 | N/A    | N/A       |  |
| Band Edge Emissions                              | 15.247(d)        | RSS-247 5.5                 | Pass   | Jim Jiang |  |
| 6dB Bandwidth                                    | 15.247(a)(2)     | RSS-247 5.2 (a)             | Pass   | Jim Jiang |  |
| Conducted Max Output Power                       | 15.247(b)(3)     | RSS-247 5.4 (d)             | Pass   | Jim Jiang |  |
| Power Spectral Density                           | 15.247(e)        | RSS-247 5.2 (b)             | Pass   | Jim Jiang |  |
| Transmitter Radiated Spurious                    | 15.209&15.247(d) | RSS-247 5.5&<br>RSS-Gen 8.9 | Pass   | Jim Jiang |  |

Note:

N/A: Not applicable.

The measurement uncertainty is not included in the test result.



# 1.4. Test Facility

### CTC Laboratories, Inc.

Add: 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China

### Laboratory accreditation

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

### A2LA-Lab Cert. No.: 4340.01

CTC Laboratories, Inc. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for r the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

### Industry Canada (Registration No.: 9783A, CAB Identifier: CN0029)

CTC Laboratories, Inc. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: 9783A on Jan, 2016.

### FCC (Registration No.: 951311, Designation Number CN1208)

CTC Laboratories, Inc. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained inour files. Registration 951311, Aug 26, 2017.

# **1.5. Measurement Uncertainty**

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement characteristics; Part 2" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the CTC Laboratories, Inc. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Below is the best measurement capability for CTC Laboratories, Inc.



| Test Items                              | Measurement Uncertainty | Notes |
|---|-------------------------|-------|
| Transmitter power conducted             | 0.42 dB                 | (1)   |
| Transmitter power Radiated              | 2.14 dB                 | (1)   |
| Conducted spurious emissions 9kHz~40GHz | 1.60 dB                 | (1)   |
| Radiated spurious emissions 9kHz~40GHz  | 2.20 dB                 | (1)   |
| Conducted Emissions 9kHz~30MHz          | 3.20 dB                 | (1)   |
| Radiated Emissions 30~1000MHz           | 4.70 dB                 | (1)   |
| Radiated Emissions 1~18GHz              | 5.00 dB                 | (1)   |
| Radiated Emissions 18~40GHz             | 5.54 dB                 | (1)   |
| Occupied Bandwidth                      |                         | (1)   |

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

# **1.6. Environmental Conditions**

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

| Temperature:       | 21°C~27°C |
|--------------------|-----------|
| Relative Humidity: | 40%~60%   |
| Air Pressure:      | 101kPa    |



# 2. GENERAL INFORMATION

# 2.1. Client Information

| Applicant:   | Shenzhen Sonoff Technologies Co.,Ltd.                                |  |
|--|--|--|
| Address:   | ess: 3F & 6F, Bldg A, No. 663, Bulong Rd, Shenzhen, Guangdong, China |  |
| Manufacturer: Shenzhen Sonoff Technologies Co.,Ltd.                      |  |  |
| Address: 3F & 6F, Bldg A, No. 663, Bulong Rd, Shenzhen, Guangdong, China |  |  |

# 2.2. General Description of EUT

| Product Name:         | Zigbee Wireless Switch |  |  |
|-----------------------|------------------------|--|--|
| Trade Mark:           | Sonoff                 |  |  |
| Model/Type reference: | SNZB-01P               |  |  |
| Listed Model(s):      | /                      |  |  |
| Model Difference:     | /                      |  |  |
| Power supply:         | DC3V from lithium cell |  |  |
| Hardware version:     | V4.1                   |  |  |
| Software version:     | V2.0.0                 |  |  |
| Zigbee 3.0            |                        |  |  |
| Modulation:           | OQPSK                  |  |  |
| Operation frequency:  | 2405MHz~2480MHz        |  |  |
| Channel number:       | 16                     |  |  |
| Channel separation:   | 5MHz                   |  |  |
| Antenna type:         | PCB Antenna            |  |  |
| Antenna gain:         | 2.07dBi                |  |  |



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# 2.3. Accessory Equipment Information

| Equipment Information     |                    |              |              |  |  |  |
|---------------------------|--------------------|--------------|--------------|--|--|--|
| Name                      | Model              | S/N          | Manufacturer |  |  |  |
| Notebook                  | ThinkPad E14 Gen 3 | PF-3384L3    | Lenovo       |  |  |  |
| Cable Information         | Cable Information  |              |              |  |  |  |
| Name                      | Shielded Type      | Ferrite Core | Length       |  |  |  |
| USB Cable                 | Unshielded         | NO           | 120cm        |  |  |  |
| Test Software Information |                    |              |              |  |  |  |
| Name                      | Version            | /            | /            |  |  |  |
| SSCOM                     | V5.13.1            | 1            | /            |  |  |  |



# 2.4. Operation State

The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing. Zigbee, 16 channels are provided to the EUT. Channels 11/18/26 were selected for testing.

**Operation Frequency List:** 

| Channel | Frequency (MHz) |
|---------|-----------------|
| 11      | 2405            |
| 12      | 2410            |
| :       | ÷               |
| 17      | 2435            |
| 18      | 2440            |
| 19      | 2445            |
| :       | :               |
| 25      | 2475            |
| 26      | 2480            |

Note: The display in grey were the channel selected for testing.

### Test Mode:

For RF test items:

The engineering test program was provided and enabled to make EUT continuous transmit.

For AC power line conducted emissions:

The EUT was set to connect with the Bluetooth instrument under large package sizes transmission.

For Radiated spurious emissions test item:

The engineering test program was provided and enabled to make EUT continuous transmit. The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.



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### 2.5. Measurement Instruments List

| Tonscend JS0806-2 Test system |   |              |           |            |                  |
|-------------------------------|---|--------------|-----------|------------|------------------|
| Item                          | Test Equipment                            | Manufacturer | Model No. | Serial No. | Calibrated until |
| 1                             | MXA Signal<br>Analyzer                    | Keysight     | N9020A    | MY46471737 | Dec. 16, 2023    |
| 2                             | Spectrum<br>Analyzer                      | R&S          | FSU26     | 100105     | Dec. 16, 2023    |
| 3                             | Spectrum<br>Analyzer                      | R&S          | FSV40-N   | 101331     | Mar. 14, 2024    |
| 4                             | MXG Vector<br>Signal Generator            | Agilent      | N5182A    | MY47420864 | Dec. 16, 2023    |
| 5                             | PSG Analog<br>Signal Generator            | Agilent      | E8257D    | MY46521908 | Dec. 16, 2023    |
| 6                             | Power Sensor                              | Keysight     | U2021XA   | MY55130004 | Mar. 14, 2024    |
| 7                             | Power Sensor                              | Keysight     | U2021XA   | MY55130006 | Mar. 14, 2024    |
| 8                             | Wideband Radio<br>Communication<br>Tester | R&S          | CMW500    | 102414     | Dec. 16, 2023    |
| 9                             | High and low temperature box              | ESPEC        | MT3035    | /          | Mar. 24, 2024    |
| 10                            | JS1120 RF Test<br>system                  | TONSCEND     | v2.6      | /          | /                |
| Radia                         | ted emission                              |              |           |            |                  |
| Item                          | Test Equipment                            | Manufacturer | Model No. | Serial No. | Calibrated until |

| Taula | Naulated emission                  |              |            |            |                  |  |
|-------|------------------------------------|--------------|------------|------------|------------------|--|
| Item  | Test Equipment                     | Manufacturer | Model No.  | Serial No. | Calibrated until |  |
| 1     | Trilog-Broadband<br>Antenna        | Schwarzbeck  | VULB 9163  | 01026      | Dec. 18, 2024    |  |
| 2     | Horn Antenna                       | Schwarzbeck  | BBHA 9120D | 9120D-647  | Dec. 01, 2024    |  |
| 3     | Test Receiver                      | Keysight     | N9038A     | MY56400071 | Dec. 16, 2023    |  |
| 4     | Broadband<br>Premplifier           | SCHWARZBECK  | BBV9743B   | 259        | Dec. 16, 2023    |  |
| 5     | Mirowave<br>Broadband<br>Amplifier | SCHWARZBECK  | BBV9718C   | 111        | Dec. 16, 2023    |  |
| 6     | 3m chamber 3                       | YIHENG       | EE106      | /          | Sep. 09, 2023    |  |



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| Condu | Conducted Emission   |              |           |                |                  |  |  |  |  |
|-------|----------------------|--------------|-----------|----------------|------------------|--|--|--|--|
| Item  | Test Equipment       | Manufacturer | Model No. | Serial No.     | Calibrated until |  |  |  |  |
| 1     | LISN                 | R&S          | ENV216    | 101112         | Dec. 16, 2023    |  |  |  |  |
| 2     | LISN                 | R&S          | ENV216    | 101113         | Dec. 16, 2023    |  |  |  |  |
| 3     | EMI Test<br>Receiver | R&S          | ESCS30    | 100353         | Dec. 16, 2023    |  |  |  |  |
| 4     | ISN CAT6             | Schwarzbeck  | NTFM 8158 | CAT6-8158-0046 | Dec. 16, 2023    |  |  |  |  |
| 5     | ISN CAT5             | Schwarzbeck  | NTFM 8158 | CAT5-8158-0046 | Dec. 16, 2023    |  |  |  |  |

Note: The Cal. Interval was one year.

# 3. TEST ITEM AND RESULTS

# 3.1. Conducted Emission

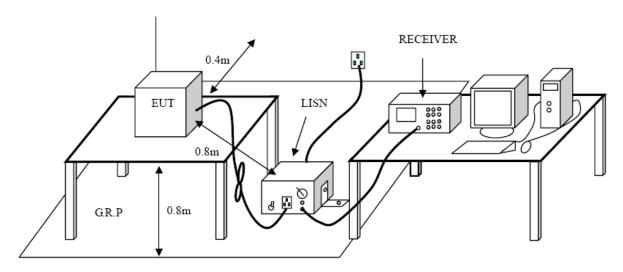
### <u>Limit</u>

### FCC CFR Title 47 Part 15 Subpart C Section 15.207/ RSS - Gen 8.8

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

\* Decreases with the logarithm of the frequency.

### **Test Configuration**



### Test Procedure

1. The EUT was setup according to ANSI C63.10:2013 requirements.

2. The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface.

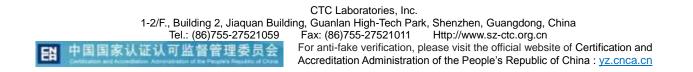
3. The EUT and simulators are connected to the main power through a line impedances stabilization network (LISN). The LISN provides a 50ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs)

4. Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.

5. The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

6. Conducted Emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

7. During the above scans, the emissions were maximized by cable manipulation.





### Test Mode: Please refer to the clause 2.4.

### Test Results

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Not applicable.



# 3.2. Radiated Emission

<u>Limit</u>

### FCC CFR Title 47 Part 15 Subpart C Section 15.209/ RSS - Gen 8.9

| Frequency<br>(MHz) | Field Strength<br>(microvolts/meter) | Measurement Distance<br>(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                                |
| 960~1000           | 500                                  | 3                                |

|                 | dB(uV/m) (a | at 3 meters) |
|-----------------|-------------|--------------|
| Frequency (MHz) | Peak        | Average      |
| Above 1000      | 74          | 54           |

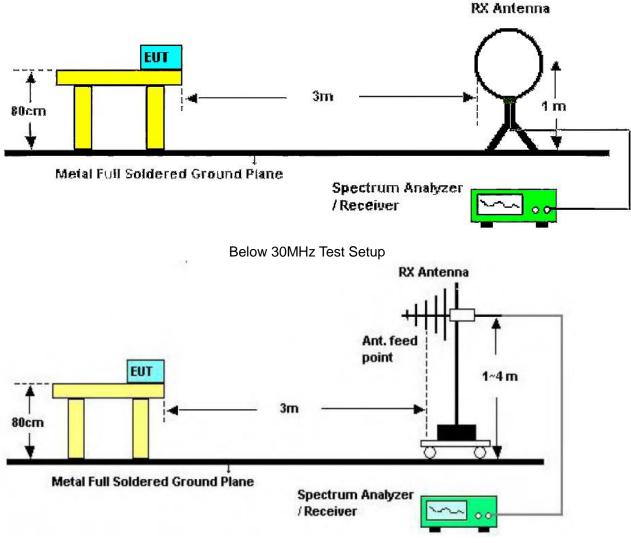
### Note:

(1) The tighter limit applies at the band edges.

(2) Emission Level (dBuV/m)=20log Emission Level (uV/m).

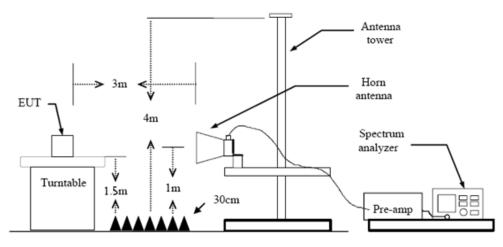
### **Test Configuration**





30-1000MHz Test Setup





Above 1GHz Test Setup

### **Test Procedure**

1. The EUT was setup and tested according to ANSI C63.10:2013

2. The EUT is placed on a turn table which is 0.8 meter above ground for below 1 GHz, and 1.5 m for

above 1 GHz. The turn table is rotated 360 degrees to determine the position of the maximum emission level. 3. The EUT was set 3 meters from the receiving antenna, which was mounted on the top of a variable height antenna tower.

For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower 4. (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) 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.

Set to the maximum power setting and enable the EUT transmit continuously. 5.

6. Use the following spectrum analyzer settings

(1) Span shall wide enough to fully capture the emission being measured;

(2) Below 1 GHz:

RBW=120 kHz, VBW=300 kHz, Sweep=auto, Detector function=peak, Trace=max hold;

If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

(3) From 1 GHz to 10<sup>th</sup> harmonic:

RBW=1MHz, VBW=3MHz Peak detector for Peak value.

RBW=1MHz, VBW see note 1 with Peak Detector for Average Value.

Note 1: For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 3.8 Duty Cycle.

### Test Mode

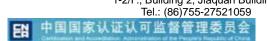
Please refer to the clause 2.4.

### **Test Result**

### 9 KHz~30 MHz

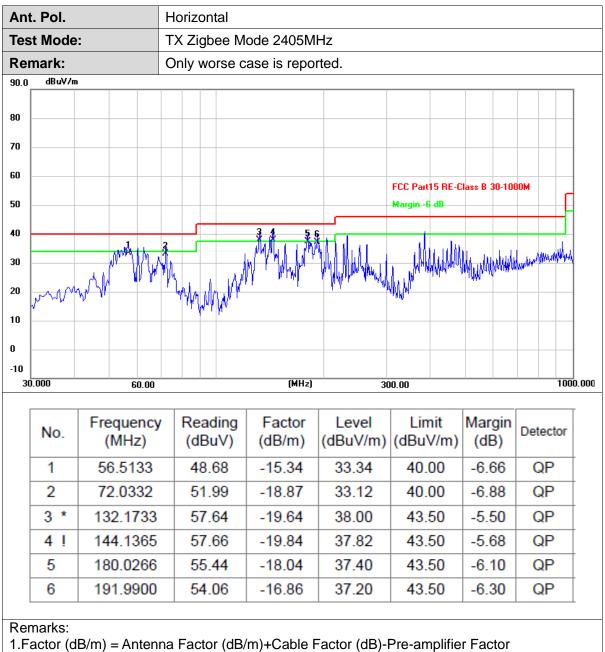
From 9 KHz to 30 MHz: Conclusion: PASS

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

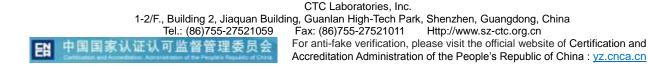




### 30MHz-1GHz

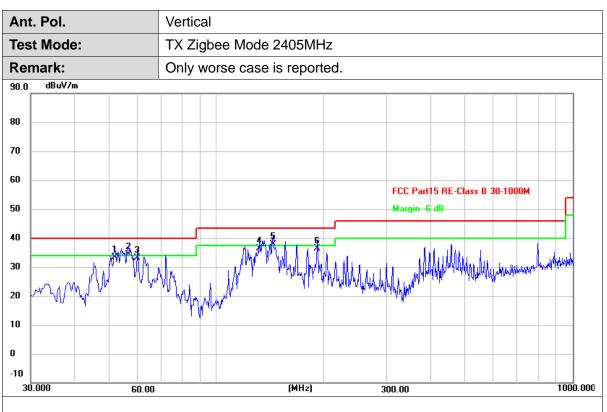


2.Margin value = Level -Limit value









| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Factor<br>(dB/m) | Level<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Detector |
|-----|--------------------|-------------------|------------------|-------------------|-------------------|----------------|----------|
| 1   | 51.6632            | 47.92             | -14.58           | 33.34             | 40.00             | -6.66          | QP       |
| 2 ! | 56.5929            | 49.72             | -15.36           | 34.36             | 40.00             | -5.64          | QP       |
| 3   | 59.8588            | 49.07             | -15.87           | 33.20             | 40.00             | -6.80          | QP       |
| 4   | 131.8500           | 55.91             | -19.62           | 36.29             | 43.50             | -7.21          | QP       |
| 5 * | 144.1365           | 57.74             | -19.84           | 37.90             | 43.50             | -5.60          | QP       |
| 6   | 191.9900           | 53.31             | -16.86           | 36.45             | 43.50             | -7.05          | QP       |

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value



| Ant     | t. Pol. |                    | Horizontal                   |                  |                   |                   |                |          |
|---------|---------|--------------------|------------------------------|------------------|-------------------|-------------------|----------------|----------|
| Tes     | t Mode  | :                  | TX Zigbee Mo                 | ode 2405MI       | Hz                |                   |                |          |
| Remark: |         |                    | No report for prescribed lin |                  | n which mo        | re than 20 d      | B below        | the      |
|         | No.     | Frequency<br>(MHz) | y Reading<br>(dBuV)          | Factor<br>(dB/m) | Level<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Detector |
|         | 1       | 4809.866           | 41.15                        | 2.17             | 43.32             | 74.00             | -30.68         | peak     |
|         | 2       | 4810.021           | 27.43                        | 2.17             | 29.60             | 54.00             | -24.40         | AVG      |
|         | 3 *     | 7216.520           | 35.25                        | 9.53             | 44.78             | 54.00             | -9.22          | AVG      |
|         | 4       | 7216.594           | 45.89                        | 9.53             | 55.42             | 74.00             | -18.58         | peak     |
|         | 5       | 9618.519           | 25.95                        | 12.33            | 38.28             | 54.00             | -15.72         | AVG      |
|         | 6       | 9618.525           | 40.13                        | 12.33            | 52.46             | 74.00             | -21.54         | peak     |

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value

| Ant. Pol. |         |                    | Vertical                     |                  |                   |                   |                |          |
|-----------|---------|--------------------|------------------------------|------------------|-------------------|-------------------|----------------|----------|
| Tes       | st Mode | :                  | TX Zigbee M                  | ode 2405M        | Hz                |                   |                |          |
| Remark:   |         |                    | No report for prescribed lin |                  | on which mo       | re than 20 d      | B below        | the      |
|           | No.     | Frequency<br>(MHz) | / Reading<br>(dBuV)          | Factor<br>(dB/m) | Level<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Detector |
|           | 1       | 4809.738           | 26.93                        | 2.17             | 29.10             | 54.00             | -24.90         | AVG      |
|           | 2       | 4809.802           | 41.57                        | 2.17             | 43.74             | 74.00             | -30.26         | peak     |
|           | 3 *     | 7216.542           | 32.43                        | 9.53             | 41.96             | 54.00             | -12.04         | AVG      |
|           | 4       | 7216.549           | 43.67                        | 9.53             | 53.20             | 74.00             | -20.80         | peak     |
|           | 5       | 9620.498           | 41.17                        | 12.33            | 53.50             | 74.00             | -20.50         | peak     |
|           | 6       | 9620.530           | 25.65                        | 12.33            | 37.98             | 54.00             | -16.02         | AVG      |

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value



| Ant. Pol. |         |                    | Horizontal                   |                  |                   |                   |                |          |
|-----------|---------|--------------------|------------------------------|------------------|-------------------|-------------------|----------------|----------|
| Tes       | st Mode | :                  | TX Zigbee Mo                 | ode 2440M        | Hz                |                   |                |          |
| Remark:   |         |                    | No report for prescribed lin |                  | on which mo       | re than 20 d      | B below        | the      |
|           | No.     | Frequency<br>(MHz) | (dBuV)                       | Factor<br>(dB/m) | Level<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Detector |
|           | 1       | 4879.670           | 26.41                        | 2.31             | 28.72             | 54.00             | -25.28         | AVG      |
|           | 2       | 4879.860           | 41.32                        | 2.31             | 43.63             | 74.00             | -30.37         | peak     |
|           | 3       | 7320.247           | 44.46                        | 9.71             | 54.17             | 74.00             | -19.83         | peak     |
|           | 4 *     | 7321.632           | 33.52                        | 9.71             | 43.23             | 54.00             | -10.77         | AVG      |
|           | 5       | 9761.504           | 25.19                        | 12.57            | 37.76             | 54.00             | -16.24         | AVG      |
|           | 6       | 9761.706           | 39.42                        | 12.57            | 51.99             | 74.00             | -22.01         | peak     |

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value

| An  | Ant. Pol. |                    | Vertical                     |                  |                   |                   |                |          |
|-----|-----------|--------------------|------------------------------|------------------|-------------------|-------------------|----------------|----------|
| Tes | st Mode   |                    | TX Zigbee Me                 | ode 2440M        | Hz                |                   |                |          |
| Re  | Remark:   |                    | No report for prescribed lin |                  | n which mo        | re than 20 d      | B below        | the      |
|     | No.       | Frequency<br>(MHz) | (dBuV)                       | Factor<br>(dB/m) | Level<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Detector |
|     | 1         | 4879.940           | 26.37                        | 2.31             | 28.68             | 54.00             | -25.32         | AVG      |
|     | 2         | 4880.124           | 40.24                        | 2.31             | 42.55             | 74.00             | -31.45         | peak     |
|     | 3         | 7319.959           | 44.17                        | 9.71             | 53.88             | 74.00             | -20.12         | peak     |
|     | 4 *       | 7320.859           | 33.08                        | 9.71             | 42.79             | 54.00             | -11.21         | AVG      |
|     | 5         | 9759.807           | 41.15                        | 12.57            | 53.72             | 74.00             | -20.28         | peak     |
|     | 6         | 9761.001           | 25.26                        | 12.57            | 37.83             | 54.00             | -16.17         | AVG      |

### Remarks:

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value



| Ant. Pol. |          |                    | Horizontal                      |                  |                   |                   |                |          |
|-----------|----------|--------------------|---------------------------------|------------------|-------------------|-------------------|----------------|----------|
| Tes       | st Mode: | :                  | TX Zigbee Me                    | ode 2480M        | Hz                |                   |                |          |
| Remark:   |          |                    | No report for<br>prescribed lin |                  | n which mo        | re than 20 d      | B below        | the      |
|           | No.      | Frequency<br>(MHz) | y Reading<br>(dBuV)             | Factor<br>(dB/m) | Level<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Detector |
|           | 1        | 4959.871           | 26.39                           | 2.48             | 28.87             | 54.00             | -25.13         | AVG      |
|           | 2        | 4960.104           | 40.49                           | 2.48             | 42.97             | 74.00             | -31.03         | peak     |
|           | 3 *      | 7441.524           | 33.77                           | 9.93             | 43.70             | 54.00             | -10.30         | AVG      |
|           | 4        | 7441.549           | 44.45                           | 9.93             | 54.38             | 74.00             | -19.62         | peak     |
|           | 5        | 9920.103           | 39.94                           | 12.84            | 52.78             | 74.00             | -21.22         | peak     |
|           | 6        | 9920.113           | 25.31                           | 12.84            | 38.15             | 54.00             | -15.85         | AVG      |

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value

| An  | Ant. Pol. |                    | Vertical                     |                  |                   |                   |                |          |
|-----|-----------|--------------------|------------------------------|------------------|-------------------|-------------------|----------------|----------|
| Tes | st Mode   |                    | TX Zigbee M                  | ode 2480M        | Hz                |                   |                |          |
| Re  | Remark:   |                    | No report for prescribed lin |                  | n which mo        | re than 20 d      | B below        | the      |
|     | No.       | Frequency<br>(MHz) | (dBuV)                       | Factor<br>(dB/m) | Level<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Detector |
|     | 1         | 4960.380           | 25.87                        | 2.48             | 28.35             | 54.00             | -25.65         | AVG      |
|     | 2         | 4960.405           | 39.61                        | 2.48             | 42.09             | 74.00             | -31.91         | peak     |
|     | 3         | 7439.950           | 43.79                        | 9.93             | 53.72             | 74.00             | -20.28         | peak     |
|     | 4 *       | 7440.151           | 31.98                        | 9.93             | 41.91             | 54.00             | -12.09         | AVG      |
|     | 5         | 9921.539           | 25.96                        | 12.86            | 38.82             | 54.00             | -15.18         | AVG      |
|     | 6         | 9921.541           | 40.70                        | 12.86            | 53.56             | 74.00             | -20.44         | peak     |

### Remarks:

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

2.Margin value = Level -Limit value



# 3.3. Band Edge Emissions (Radiated)

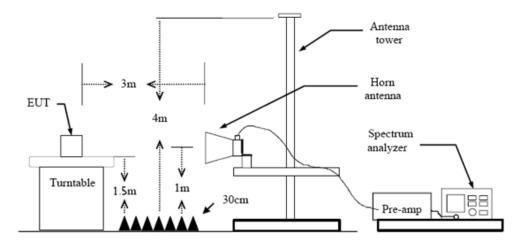
<u>Limit</u>

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d)/ RSS-247 5.5:

| Restricted Frequency Band | (dBuV/m | n)(at 3m) |
|---------------------------|---------|-----------|
| (MHz)                     | Peak    | Average   |
| 2310 ~ 2390               | 74      | 54        |
| 2483.5 ~ 2500             | 74      | 54        |

Conducted band edge limit: The highest point of the operating frequency waveform down 20dB

### **Test Configuration**



### **Test Procedure**

- 1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
- 2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
- 3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
- 4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
- 5. The receiver set as follow:

RBW=1MHz, VBW=3MHz Peak detector for Peak value.

RBW=1MHz, VBW see note 1 with Peak Detector for Average Value.

Note 1: For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 3.8 Duty Cycle.

### Test Mode

Please refer to the clause 2.4.

### Test Results



### (1) Radiation Test

| Ant. Pol.    |                |                    | Ho               | orizontal   |   |                                 |                            |                |           |
|--------------|----------------|--------------------|------------------|---|---|---------------------------------|----------------------------|----------------|-----------|
| est N        | Mode:          |                    | ТХ               | Zigbee Mo   | ode 2405MH  | Ηz                              |                            |                |           |
| 20.0         | dBu¥/m         | 1 1                |                  |   |   | i.                              | 1                          | i              | 1         |
| 10           |                |                    |                  |   |   |                                 |                            |                |           |
| 00           |                |                    |                  |   |   |                                 |                            |                |           |
|              |                |                    |                  |   |   |                                 |                            |                | n         |
|              |                |                    |                  |   |   |                                 |                            |                |           |
|              |                |                    |                  |   |   |                                 | FCC Part15                 | C - Above 10   | а РК      |
|              |                |                    |                  |   |   |                                 |                            |                |           |
|              |                |                    |                  |   |   |                                 | FCC Part15                 | C - Above 10   |           |
|              |                |                    |                  |   |   |                                 |                            | ×              |           |
|              | -Anna Marria A |                    | المدرية والمراجع | hanna han | n de al contra de la | manyyyaan amaa maadadha ahaadha | anterstation and the state | 2 mm           | mer ha    |
| י            |                |                    |                  |   |   |                                 |                            |                |           |
| ר            |                |                    |                  |   |   |                                 |                            |                |           |
| 0            |                |                    |                  |   |   |                                 |                            |                |           |
| 0.0<br>2281. | 500 22         | 94.50 2307.5       | <u>in :</u>      | 2320.50 233   | 3.50 (MHz)  | 2359.50                         | 2372.50 238                | 35.50 23       | 98.50 241 |
| 1            | No.            | Frequence<br>(MHz) | cy               | Reading<br>(dBuV)   | Factor<br>(dB/m)  | Level<br>(dBuV/m)               | Limit<br>(dBuV/m)          | Margin<br>(dB) | Detector  |
|              | 1              | 2390.00            | 0                | 20.21   | 30.84   | 51.05                           | 74.00                      | -22.95         | peak      |
|              | 2 *            | 2390.00            | 0                | 6.18  | 30.84   | 37.02                           | 54.00                      | -16.98         | AVG       |

2.Margin value = Level -Limit value

EN



| Ant. Po         | l              | Ver  | Vertical          |                  |                                |                         |                |            |  |
|-----------------|----------------|------|-------------------|------------------|--------------------------------|-------------------------|----------------|------------|--|
| est Mo          | de:            | TX   | Zigbee Mo         | ode 2405MI       | Ηz                             |                         |                |            |  |
| 20.0 dB         | JV/m           |      |                   |                  | i                              |                         | i              |            |  |
| 10              |                |      |                   |                  |                                |                         |                |            |  |
| 00              |                |      |                   |                  |                                |                         |                |            |  |
| o               |                |      |                   |                  |                                |                         |                |            |  |
| o               |                |      |                   |                  |                                | FCC Part15              | C - Above 10   |            |  |
| 0               |                |      |                   |                  |                                |                         |                |            |  |
| o               |                |      |                   |                  |                                | FCC Part15              | C - Above 10   | AV         |  |
| 0               |                |      |                   |                  |                                |                         | 1<br>X         |            |  |
|                 |                |      |                   |                  | at a state of the state of the | and a second and second | 2              | and have   |  |
| 0               |                |      |                   |                  |                                |                         |                |            |  |
| o               |                |      |                   |                  |                                |                         |                |            |  |
| o               |                |      |                   |                  |                                |                         |                |            |  |
| 0.0<br>2280.850 | ) 2293.85 2306 | 85 2 | 319.85 233        | 2.85 (MHz)       | 2358.85                        | 2371.85 238             | 34.85 23       | 97.85 2410 |  |
|                 | Frequen        |      | Reading<br>(dBuV) | Factor<br>(dB/m) | Level                          | Limit<br>(dBuV/m)       | Margin<br>(dB) | Detector   |  |
| No              | ). (MHz)       |      | (apav)            | (ub/m)           | (ubu v/m)                      | (aba mi)                | · · ·          |            |  |
| No<br>1         |                |      | (dBuV)<br>18.34   | 30.84            | 49.18                          | 74.00                   | -24.82         | peak       |  |

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1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value



| Ant. Pol.   |                  | Hori                 | Horizontal   |                            |                |         |                                 |                             |                      |
|-------------|------------------|----------------------|--|----------------------------|----------------|---------|---------------------------------|-----------------------------|----------------------|
| Fest Mode   | :                | TX Z                 | Zigbee Mo  | ode 2480N                  | lHz            |         |                                 |                             |                      |
| 20.0 dBuV/m |                  |                      |  |                            |                |         |                                 | 1                           |                      |
| 10          |                  |                      |  |                            |                |         |                                 |                             |                      |
| 00          |                  |                      |  |                            |                |         |                                 |                             |                      |
| o <u>A</u>  |                  |                      |  |                            |                |         |                                 |                             |                      |
| o           |                  |                      |  |                            |                |         | FCC Part15                      | C - Above 1G                | PK                   |
|             |                  |                      |  |                            |                |         |                                 |                             |                      |
|             |                  |                      |  |                            |                |         | FCC Part15                      | C - Above 1G                | AV                   |
|             | <                |                      |  |                            |                |         |                                 |                             |                      |
| )           | Construmenter of | an the second of the | angan pantan ang panan ang pang pang pang pang pan | enterdation de salar menul | est in most of | w.M.m.s | e.m.a.g.thereand hader and make | lan manage affection of the | when we also and the |
| )           |                  |                      |  |                            |                |         |                                 |                             |                      |
| 0           |                  |                      |  |                            |                |         |                                 |                             |                      |
| 0.0         |                  |                      |  |                            |                |         |                                 |                             |                      |
|             | 485.20 2498.2    | 20 25                | 11.20 252  | 24.20 (MHz)                | 2550           | .20     | 2563.20 257                     | 76.20 258                   | 89.20 260            |
|             | 485.20 2498.2    | 20 25                | 11.20 252  | 24.20 (MHz)                | 2550           | .20     | 2563.20 257                     | 76.20 258                   | 9.20 26              |
| 2472.200 24 | Frequen<br>(MHz) | -                    | Reading<br>(dBuV)                                  | Factor<br>(dB/m)           | Lev<br>(dBu\   |         | Limit<br>(dBuV/m)               | Margin<br>(dB)              | Detector             |
|             |                  | (                    |  |                            |                | //m)    | Limit<br>(dBuV/m)<br>74.00      |                             | Detector             |

EN

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value



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| nt. Pol.    |                | Ve                     | Vertical                 |                             |                           |  |                  |                  |  |
|-------------|----------------|------------------------|--------------------------|-----------------------------|---------------------------|--|------------------|------------------|--|
| est Mode    | :              | T                      | X Zigbee Mo              | ode 2480M                   | Hz                        |  |                  |                  |  |
| 20.0 dBuV/m |                |                        |                          |                             |                           |  |                  |                  |  |
| 10          |                |                        |                          |                             |                           |  |                  |                  |  |
|             |                |                        |                          |                             |                           |  |                  |                  |  |
|             |                |                        |                          |                             |                           |  |                  |                  |  |
|             |                |                        |                          |                             |                           |  |                  |                  |  |
| $\square$   |                |                        |                          |                             |                           | FCC Part15   | C - Above 10     | G PK             |  |
|             |                |                        |                          |                             |                           |  |                  |                  |  |
|             | 4              |                        |                          |                             |                           | FCC Part15   | C - Above 10     | AV               |  |
|             | X              |                        |                          |                             |                           |  |                  |                  |  |
| D prod      | 2              | hanna <b>an k</b> anna | www.afermanarafafettanga | white and the second of the | anthe-trading work at the | an and the second of the secon | and a supervised | nerdenner        |  |
| D           |                |                        |                          |                             |                           |  |                  |                  |  |
| D           |                |                        |                          |                             |                           |  |                  |                  |  |
| D           |                |                        |                          |                             |                           |  |                  |                  |  |
| D.O         |                | 7 55                   | 2510.55 252              | 23.55 (MHz)                 | 2549.55                   | 2562.55 25   | 75.55 25         | 88.55 26         |  |
|             | 484.55 249     | 1.33                   | 2010.00 202              | .0.00 (IATE)                | 2343.33                   | 2002.00 20   |                  |                  |  |
|             | Freque<br>(MHz | ncy                    | Reading<br>(dBuV)        | Factor<br>(dB/m)            | Level                     | Limit<br>(dBuV/m)  | Margin<br>(dB)   | Detector         |  |
| 2471.550 24 | Freque         | ncy<br>ː)              | Reading                  | Factor                      | Level                     | Limit  |                  | Detector<br>peak |  |

1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor 2.Margin value = Level -Limit value

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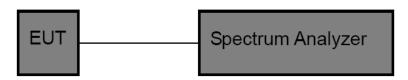


# 3.4. Band edge and Spurious Emissions (Conducted)

### <u>Limit</u>

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d):In any 100 kHz 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 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.

### Test Configuration



### Test Procedure

- 1. The transmitter output was connected to the spectrum analyzer through an 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. Use the following spectrum analyzer settings:
  - RBW = 100 kHz, VBW  $\geq$  RBW, scan up through 10<sup>th</sup> harmonic.
- Sweep = auto, Detector function = peak, Trace = max hold
- 4. Measure and record the results in the test report.

### Test Mode

Please refer to the clause 2.4.

### Test Results

### (1) Band edge Conducted Test

| Test Mode | ChName | Channel | RefLevel[dBm] | Result[dBm] | Limit[dBm] | Verdict |
|-----------|--------|---------|---------------|-------------|------------|---------|
| Zighoo    | Low    | CH11    | 4.21          | -48.50      | ≤-15.79    | PASS    |
| Zigbee    | High   | CH26    | 3.37          | -48.83      | ≤-16.63    | PASS    |





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#### ALIGN OFF Avg Type: Log-Pwr GN OFF Avg Type: Log-Pwr arker 1 2.395420000000 GH: larker 3 2.489600000000 GHz ast 🖵 Trig: Free Run #Atten: 26 dB Fast 🖵 Trig: Free Run ::Low #Atten: 26 dB Ref Offset 0.5 dB Ref 15.00 dBm Ref Offset 0.5 dB Ref 15.00 dBm Stop 2.41000 GH art 2.47000 GH Res BW 100 kH Stop 2.55000 GHz 7.667 ms (1001 pts) #VBW 300 kHz #VBW 300 kHz S٧ 3.372 dBm -51.08 dBm -48.83 dBm -48.50 dBm -55.17 dBm 4.21 dBm 2.480 00 GHz 2.483 50 GHz 2.489 60 GHz 2.395 42 GHz 2.400 00 GHz 2.405 02 GHz **Channel 11 Channel 26**



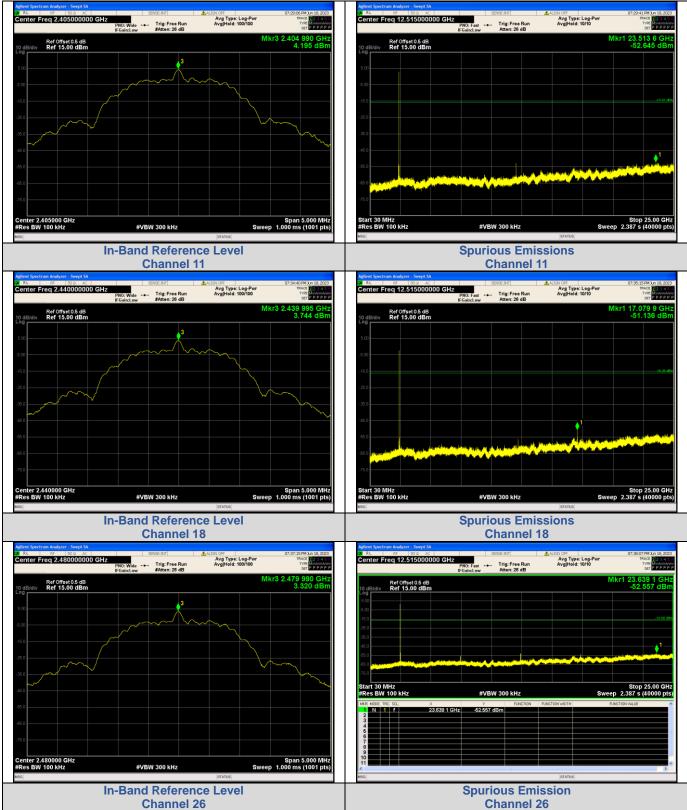
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### (2) Conducted Spurious Emissions Test

| Test Mode | Channel | FreqRange<br>[MHz] | RefLevel<br>[dBm] | Result[dBm] | Limit[dBm] | Verdict |
|-----------|---------|--------------------|-------------------|-------------|------------|---------|
|           | CH11    | Reference          | 4.19              | 4.19        |            | PASS    |
|           | Спп     | 30~25000           | 4.19              | -52.65      | ≤-15.81    | PASS    |
| Zighaa    |         | Reference          | 3.74              | 3.74        |            | PASS    |
| Zigbee    | CH18    | 30~25000           | 3.74              | -51.14      | ≤-16.26    | PASS    |
|           | 01100   | Reference          | 3.32              | 3.32        |            | PASS    |
|           | CH26    | 30~25000           | 3.32              | -52.58      | ≤-16.68    | PASS    |



### Test Graphs:





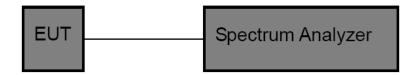
# 3.5. DTS Bandwidth

<u>Limit</u>

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(2)/ RSS-247 5.2 a:

| Test Item     | Limit                       | Frequency Range(MHz) |
|---------------|-----------------------------|----------------------|
| DTS Bandwidth | ≥500 KHz<br>(6dB bandwidth) | 2400~2483.5          |

### Test Configuration



### Test Procedure

- 1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- 2. DTS Spectrum Setting:
  - (1) Set RBW = 100 kHz.
  - (2) Set the video bandwidth (VBW)  $\geq$  3 RBW.
  - (3) Detector = Peak.
  - (4) Trace mode = Max hold.
  - (5) Sweep = Auto couple.
  - OCB Spectrum Setting:
  - (1) Set RBW =  $1\% \sim 5\%$  occupied bandwidth.
  - (2) Set the video bandwidth (VBW)  $\ge$  3 RBW.
  - (3) Detector = Peak.
  - (4) Trace mode = Max hold.
  - (5) Sweep = Auto couple.

NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

### Test Mode

Please refer to the clause 2.4.

### Test Results

| Test Mode | Channel | 99% Bandwidth (MHz) | DTS Bandwidth (MHz) | Limit (kHz) | Result |
|-----------|---------|---------------------|---------------------|-------------|--------|
|           | CH11    | 2.1437              | 0.7930              |             |        |
| Zigbee    | CH18    | 2.1524              | 0.7979              | ≥500        | Pass   |
|           | CH26    | 2.1538              | 0.7993              |             |        |



### 99% Bandwidth:

EN

| RL RF 50 Q AC  | CENCE-INT   |   | 07:28:29 PM Jun 18, 2023   |  |             |   |   | 07:34:03 PM Jun 18, 202         |
|--|---|---|--|--|-------------|---|---|---------------------------------|
| enter Freq 2.405000000 GHz   | Center Freq: 2.405000<br>Trig: Free Run   | ALIGN OFF<br>000 GHz<br>Avg Hold: 100/100   | Radio Std: None  | Center Freq 2.44000000                       |             | Center Freq: 2.440000<br>Trig: Free Run | ALIGN OFF<br>000 GHz<br>Avg Hold: 100/100 | Radio Std: None                 |
|  | Gain:Low #Atten: 26 dB  |   | Radio Device: BTS  |  | #IFGain:Low | #Atten: 26 dB                           | -   | Radio Device: BTS               |
| Ref Offset 0.5 dB<br>dB/div Ref 20.50 dBm  |   | IVIKI   | r2 2.4060225 GHz<br>-22.393 dBm  | Ref Offset 0.5 dB<br>10 dB/div Ref 20.50 dBn |             |   |   | Mkr2 2.441027 GH<br>-21.905 dBr |
| og<br>0.5  |   |   |  | 10.5   |             |   |   |                                 |
| 500  |   |   |  | 0.500  |             | •                                       |   |                                 |
|  | monomon   | mmy 2   |  | -9.50  | 1 mm        | $\sim$                                  | mm 2                                      |                                 |
| 9.5  |   | Mr.   | 10   | -29.5  | ~~ V ·      |   | Mm  |                                 |
|  |   | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~  | mon  | -23.5<br>-33.5<br>-49.5                      |             |   |   | www.www.                        |
| 8.5  |   |   |  | -59.5  |             |   |   |                                 |
| 9.6  |   |   |  | -69.5  |             |   |   |                                 |
| enter 2.405 GHz<br>Res BW 20 kHz   | #VBW 62 kH  | <br> z  | Span 5 MHz<br>Sweep 12 ms  | Center 2.44 GHz<br>#Res BW 20 kHz            |             | #VBW 62 kH                              | lz  | Span 5 MH<br>Sweep 12 m         |
| Occupied Bandwidth   | Total Power   | 9.73 dBm  |  | Occupied Bandwidt                            | 'n          | Total Power                             | 9.23 dBm                                  |                                 |
| 2.1437   | MHz   |   |  | 2.   | 1524 MHz    |   |   |                                 |
| Transmit Freq Error -48.78   | 88 kHz OBW Power  | 99.00 %   |  | Transmit Freq Error                          | -48.992 kHz | OBW Power                               | 99.00 %                                   |                                 |
| x dB Bandwidth 2.50  | 01 MHz x dB   | -26.00 dB   |  | x dB Bandwidth                               | 2.512 MHz   | x dB                                    | -26.00 dB                                 |                                 |
|  |   |   |  |  |             |   |   |                                 |
|  |   |   |  |  |             |   |   |                                 |
|  |   |   |  |  |             |   |   |                                 |
|  |   | STATUS  |  | MSG  |             |   | STATUS                                    |                                 |
| 9  | Channel 11  |   |  | MSG  |             | Channel 18                              |   |                                 |
| glent Spectrum Analyzer - Occupied BW<br>RL RF 50.9. AC  |   |   | 07:36:39 PM Jun 18, 2023   | MSG  |             | Channel 18                              |   |                                 |
| enter Freq 2.480000000 GHz   | SENSE:INT 4<br>Center Freq: 2.480000  | ALISN OFF   | 07:36:39 PM Jun 18, 2023<br>Radio Std: None                                | MSG  |             | Channel 18                              |   |                                 |
| RL RF 58.9 AC<br>enter Freq 2.480000000 GHz  | SENSE:INT 4<br>Center Freq: 2.480000  | LALION OFF<br>100 GHz<br>Avg Hold: 100/100  | Radio Std: None<br>Radio Device: BTS                                       | was)   |             | Channel 18                              |   |                                 |
| enter Freq 2.480000000 GHz   | SENSE:INT 4<br>Center Freq: 2.480000  | LALION OFF<br>100 GHz<br>Avg Hold: 100/100  | Radio Std: None  | was)   |             | Channel 18                              |   |                                 |
| RL RF 58.9 AC<br>enter Freq 2.480000000 GHz  | SENSE:INT 4<br>Center Freq: 2.480000  | LALION OFF<br>100 GHz<br>Avg Hold: 100/100  | Radio Std: None<br>Radio Device: BTS<br>Kr2 2.481027 GHZ                   |  |             | Channel 18                              |   |                                 |
| RL  PF  ISS0  AC    enter Freq  2:4800000000 GHz  rrr    ofBidity  Ref Offset 0.5 dB  offset 0.5 dB    og  og  og  og  | Center Freq: 240000<br>   | Auton off<br>Dog GHz<br>Avg Heid: 100/100   | Radio Std: None<br>Radio Device: BTS<br>Kr2 2.481027 GHZ                   |  |             | Channel 18                              |   |                                 |
| RL  PF  ISS0  AC    enter Freq  2:4800000000 GHz  rrr    ofBidity  Ref Offset 0.5 dB  offset 0.5 dB    og  og  og  og  | SENSE:INT 4<br>Center Freq: 2.480000  | Auton off<br>Dog GHz<br>Avg Heid: 100/100   | Radio Std: None<br>Radio Device: BTS<br>Kr2 2.481027 GHZ                   |  |             | Channel 18                              |   |                                 |
| RL  PF  1950  AC    enter Freq  2.480000000 GHz  arra    arra  arra  arra    addidit  Ref Offset 0.5 dB  arra    addidit  Ref 20.50 dBm  arra    addidit  arra  arra   | Center Freq: 240000<br>   | Ausorom<br>AugiHeid: 100/100<br>MI  | Radio Std: None<br>Radio Device: BTS<br>Kr2 2.481027 GHz<br>-22.352 dBm    |  |             | Channel 18                              |   |                                 |
| RL  PF  350 ac   | Center Freq: 240000<br>   | Ausorom<br>AugiHeid: 100/100<br>MI  | Radio Std: None<br>Radio Device: BTS<br>Kr2 2.481027 GHZ                   |  |             | Channel 18                              |   |                                 |
| RL  PF  1950  AC    enter Freq  2.480000000 GHz  arra    arra  arra  arra    addidit  Ref Offset 0.5 dB  arra    addidit  Ref 20.50 dBm  arra    addidit  arra  arra   | Center Freq: 240000<br>   | Ausorom<br>AugiHeid: 100/100<br>MI  | Radio Std: None<br>Radio Device: BTS<br>kr2 2.481027 GHz<br>-22.352 dBm    | uso)   |             | Channel 18                              |   |                                 |
| RL  PF  350 ac   | Center Freq: 240000<br>   | Ausorom<br>AugiHeid: 100/100<br>MI  | Radio Std: None<br>Radio Device: BTS<br>kr2 2.481027 GHz<br>-22.352 dBm    |  |             | Channel 18                              |   |                                 |
| RL  PF  350 ac   | Center Freq: 240000<br>   | Augure 100 Hz<br>Avgirield: 100/100 Mi  | Radio Std: None<br>Radio Device: BTS<br>kr2 2.481027 GHz<br>-22.352 dBm    |  |             | Channel 18                              |   |                                 |
| RL 07 23.480000000 GHz<br>enter Freq 2.480000000 GHz<br>rer<br>0 dBidly<br>Ref 075et 0.5 dB<br>0 dBidly<br>0 | Geintlew FAtten: 25 dB  | Augure 100 Hz<br>Avgirield: 100/100 Mi  | Radio Sd: None<br>Radio Device: BTS<br>Kr2: 2: 4:810027 GHz<br>-22:352 dBm |  |             | Channel 18                              |   |                                 |
| Rt 0 refer Freq 2:480000000 GHz refer Freq 2:48000000 GHz refer Freq 2:480000000 GHz refer freq 2:480000000 GHz refer 2:480000000 GHz refer freq 2:4800000000 GHz refer freq 2:480000000 GHz refer freq 2:48000000 GHz refer freq 2:480000000 GHz refer freq 2:4800000000 GHz refer freq 2:480000000000000 GHz refer freq 2:48000000000000000000000000000000000000   | Geintlew Fatten: 25 dB  | Augure 1<br>Avgirield: 100/100<br>Mi  | Radio Sd: None<br>Radio Device: BTS<br>Kr2: 2: 4:810027 GHz<br>-22:352 dBm |  |             | Channel 18                              |   |                                 |
| enter Freq 2:480000000 GHz<br>ref<br>GBIdIU<br>Ref Offset 05 dB<br>GBIdIU<br>Ref 20:30 dBm<br>GBIdIU<br>Ref 20:30 dBm<br>GBIDIU<br>R   | Geintlew Fatten: 25 dB  | Augure 1<br>Avgirield: 100/100<br>Mi  | Radio Sd: None<br>Radio Device: BTS<br>Kr2: 2: 4:810027 GHz<br>-22:352 dBm |  |             | Channel 18                              |   |                                 |
| enter Freq 2:48000000 GHz<br>enter Freq 2:48000000 GHz<br>enter Freq 2:48000000 GHz<br>enter 2:48000000 GHz<br>enter 2:48000000 GHz<br>enter 2:480 GHz<br>enter 2:48 GHz   | Geintlew Center Free 2.4000<br>Geintlew Fatten: 25 dB<br>#VBW 62 kH<br>Total Power<br>MHZ                                       | Augure de la constante de la const<br>constante de la constante d | Radio Sd: None<br>Radio Device: BTS<br>Kr2: 2: 4:810027 GHz<br>-22:352 dBm |  |             | Channel 18                              |   |                                 |
| enter Freq 2:48000000 GHz<br>enter Freq 2:48000000 GHz<br>enter Freq 2:48000000 GHz<br>enter 2:48000000 GHz<br>enter 2:48000000 GHz<br>enter 2:480 GHz<br>enter 2:48 GHz   | Geint.ew Center Free: 2.4000<br>Geint.ew Trig:Free Run<br>#Atten: 25 dB<br>#VBW 62 kH<br>Total Power<br>MHz<br>43 kHz OBW Power | Augure 1<br>Augure 1<br>Augure 1<br>2<br>2<br>8.86 dBm<br>99.00 %   | Radio Sd: None<br>Radio Device: BTS<br>Kr2: 2: 4:810027 GHz<br>-22:352 dBm |  |             | Channel 18                              |   |                                 |
| enter Freq 2:48000000 GHz<br>enter Freq 2:48000000 GHz<br>enter Freq 2:48000000 GHz<br>enter 2:48000000 GHz<br>enter 2:48000000 GHz<br>enter 2:480 GHz<br>enter 2:48 GHz   | Geint.ew Center Free: 2.4000<br>Geint.ew Trig:Free Run<br>#Atten: 25 dB<br>#VBW 62 kH<br>Total Power<br>MHz<br>43 kHz OBW Power | Augure 1<br>Augure 1<br>Augure 1<br>2<br>2<br>8.86 dBm<br>99.00 %   | Radio Sd: None<br>Radio Device: BTS<br>Kr2: 2: 4:810027 GHz<br>-22:352 dBm |  |             | Channel 18                              |   |                                 |
| enter Freq 2:48000000 GHz<br>enter Freq 2:48000000 GHz<br>enter Freq 2:48000000 GHz<br>enter 2:48000000 GHz<br>enter 2:48000000 GHz<br>enter 2:480 GHz<br>enter 2:48 GHz   | Geint.ew Center Free: 2.4000<br>Geint.ew Trig:Free Run<br>#Atten: 25 dB<br>#VBW 62 kH<br>Total Power<br>MHz<br>43 kHz OBW Power | Augure 1<br>Augure 1<br>Augure 1<br>2<br>2<br>8.86 dBm<br>99.00 %   | Radio Sd: None<br>Radio Device: BTS<br>Kr2: 2: 4:810027 GHz<br>-22:352 dBm |  |             | Channel 18                              |   |                                 |



### DTS Bandwidth:

EN

| Agilent Spectrum Analyzer - Occupied BW      |  |   | Agilent Spectrum Analyzer - Occupied BW      |                          |  |
|--|--|---|--|--------------------------|--|
| Center Freq 2.405000000 GHz                  | SENSE:INT  ALIGN OFF    Center Freq: 2.405000000 GHz | 07:28:41 PM Jun 18, 2023<br>Radio Std: None | Center Freq 2.440000000 GH                   | Z Center Freq: 2.4400    | ALIGN OFF 07:34:15 PM Jun 18, 2023<br>00000 GHz Radio Std: None<br>AvgjHold: 100/100 |
| #IFGain:Low                                  | Trig: Free Run Avg Hold>100/100<br>#Atten: 26 dB     | Radio Device: BTS                           |  | #FGain:Low #Atten: 26 dB | Radio Device: BTS  |
| Ref Offset 0.5 dB<br>10 dB/div Ref 15.50 dBm |  |   | Ref Offset 0.5 dB<br>10 dB/div Ref 15.50 dBm |                          |  |
|  |  |   | 10 dB/div Ref 15.50 dBm                      |                          |  |
| -4.50  |  |   | 4.50   |                          | ~~~~   |
| -14.5  |  |   | -14.5  |                          |  |
| 24.5   |  | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~     | -24.6  |                          |  |
| -44.5  |  |   | -34.5  |                          |  |
| -54.5  |  |   | -54.5  |                          |  |
| -84.5  |  |   | -84.5  |                          |  |
| Center 2.405 GHz                             |  | Span 5 MHz                                  | Conter 2.44 CHz                              |                          | Span 5 MHz   |
| #Res BW 100 kHz                              | #VBW 300 kHz   | Sweep 1.333 ms                              | Center 2.44 GHz<br>#Res BW 100 kHz           | #VBW 300                 | kHz Sweep 1.333 ms   |
| Occupied Bandwidth                           | Total Power 10.2 dBm                                 |   | Occupied Bandwidth                           | Total Power              | 9.72 dBm   |
| 2.2112 MHz                                   | 1  |   | 2.21   | 45 MHz                   |  |
| Transmit Freq Error -19.235 kHz              | z OBW Power 99.00 %                                  |   | Transmit Freq Error                          | -18.586 kHz OBW Power    | 99.00 %  |
| x dB Bandwidth 793.0 kHz                     | z x dB -6.00 dB                                      |   | x dB Bandwidth                               | 797.9 kHz x dB           | -6.00 dB   |
|  |  |   |  |                          |  |
|  |  |   |  |                          |  |
| MSG  | STATUS   |   | MSG  |                          | STATUS   |
|  | Channel 11   |   |  | Channel 1                | 8  |
| Agilent Spectrum Analyzer - Occupied BW      |  |   |  |                          |  |
| Center Freq 2.480000000 GHz                  | SENSE:INT ALIGN OFF<br>Center Freq: 2.480000000 GHz  | 07:36:50 PM Jun 18, 2023<br>Radio Std: None |  |                          |  |
| #IFGain:Low                                  | Trig: Free Run Avg Hold>100/100<br>#Atten: 26 dB     | Radio Device: BTS                           |  |                          |  |
| Ref Offset 0.5 dB<br>10 dB/div Ref 15.50 dBm |  |   |  |                          |  |
| 10 dB/div Ref 15.50 dBm                      |  |   |  |                          |  |
| 4.50   |  |   |  |                          |  |
| -14.5  |  |   |  |                          |  |
| -24.5  |  | man .                                       |  |                          |  |
| 44.5   |  | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~      |  |                          |  |
| -54.5  |  |   |  |                          |  |
| 74.5   |  |   |  |                          |  |
| Center 2.48 GHz                              |  | Span 5 MHz                                  |  |                          |  |
| #Res BW 100 kHz                              | #VBW 300 kHz   | Sweep 1.333 ms                              |  |                          |  |
| Occupied Bandwidth                           | Total Power 9.32 dBm                                 |   |  |                          |  |
| 2.2172 MHz                                   |  |   |  |                          |  |
| Transmit Freq Error -19.021 kHz              | z OBW Power 99.00 %                                  |   |  |                          |  |
| x dB Bandwidth 799.3 kHz                     | z x dB -6.00 dB                                      |   |  |                          |  |
|  |  |   |  |                          |  |
|  |  |   |  |                          |  |
| MSG  | STATUS   |   |  |                          |  |
|  | Channel 26   |   |  |                          |  |
|  |  |   |  |                          |  |



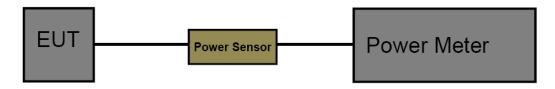
# 3.6. Peak Output Power

Limit

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (b)(3)/ RSS-247 5.4 d:

| Section                 | Test Item                         | Limit           | Frequency Range(MHz) |
|-------------------------|-----------------------------------|-----------------|----------------------|
| CFR 47 FCC 15.247(b)(3) | Maximum conducted<br>output power | 1 Watt or 30dBm | 2400~2483.5          |
| ISED RSS-247 5.4 d      | EIRP                              | 4 Watt or 36dBm | 2400~2483.5          |

### **Test Configuration**



### **Test Procedure**

- 1. The maximum conducted output power may be measured using a broadband Peak RF power meter.
- 2. Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor.
- The power meter implemented triggering and gating capabilities which were set up such that power 3. measurements were recorded only during the ON time of the transmitter.
- Record the measurement data. 4.

### **Test Mode**

Please refer to the clause 2.4.

### **Test Result**

| Test Mode | Channel | Peak Output power (dBm) | Limit (dBm) | Result |
|-----------|---------|-------------------------|-------------|--------|
|           | CH11    | 3.436                   |             |        |
| Zigbee    | CH18    | 2.888                   | ≤30.00      | Pass   |
|           | CH26    | 2.480                   |             |        |

| Test Mode | Channel | EIRP (dBm) | Limit (dBm) | Result |
|-----------|---------|------------|-------------|--------|
|           | CH11    | 5.506      |             |        |
| Zigbee    | CH18    | 4.958      | ≤36.00      | Pass   |
|           | CH26    | 4.550      |             |        |





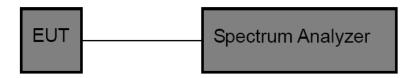
# 3.7. Power Spectral Density

### <u>Limit</u>

### FCC CFR Title 47 Part 15 Subpart C Section 15.247 (e)/ RSS-247 5.2 b:

| Test Item              | Limit              | Frequency Range(MHz) |  |
|------------------------|--------------------|----------------------|--|
| Power Spectral Density | 8dBm(in any 3 kHz) | 2400~2483.5          |  |

### Test Configuration



### Test Procedure

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

2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v05r02.

3. Spectrum Setting:

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: 3 kHz

Set the VBW to: 10 kHz

Detector: peak

Sweep time: auto

Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

### Test Mode

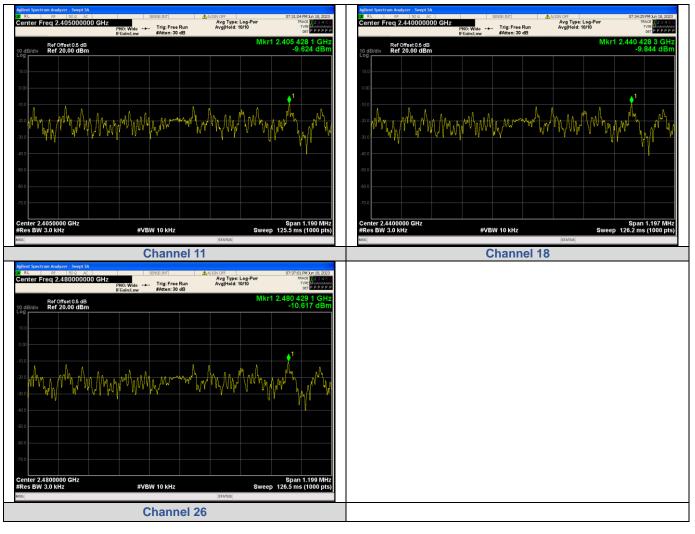
Please refer to the clause 2.4.

### Test Result

| Test Mode | Channel | Power Spectral Density<br>(dBm/3kHz) | Limit (dBm/3kHz) | Result |
|-----------|---------|--------------------------------------|------------------|--------|
|           | CH11    | -9.624                               |                  |        |
| Zigbee    | CH18    | -9.844                               | ≤8.00            | Pass   |
|           | CH26    | -10.617                              |                  |        |



### Test Graphs:



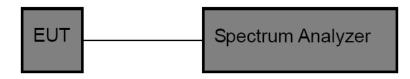


# 3.8. Duty Cycle

<u>Limit</u>

None, for report purposes only.

### Test Configuration



### Test Procedure

- 1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- 2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v05r02.

3. Spectrum Setting:

Set analyzer center frequency to test channel center frequency.

Set the span to 0Hz

Set the RBW to 10MHz Set the VBW to 10MHz

Set the VBVV to 10

Detector: Peak

Sweep time: Auto

Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

### Test Mode

Please refer to the clause 2.4.

### <u>Test Result</u>

| Mode   | Channel | On Time<br>(ms) | Period (ms) | Duty Cycle<br>(%) | 1/T<br>Minimum<br>VBW (kHz) | Final setting<br>For VBW<br>(kHz) |
|--------|---------|-----------------|-------------|-------------------|-----------------------------|-----------------------------------|
|        | CH11    | 0.382           | 0.655       | 58.30             | 2.62                        | 3                                 |
| Zigbee | CH18    | 0.383           | 0.655       | 58.37             | 2.61                        | 3                                 |
|        | CH26    | 0.383           | 0.655       | 58.37             | 2.61                        | 3                                 |

Note: Duty Cycle>98%, VBW=10Hz



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| Aglent Spectrum Analyzer - Swyd SA<br>Dr RL RF   50 g. AC SENSE:INT ▲ HUSV OFF 07:03:43 PM Jun 12, 2023  |
|--|
| Center Freq 2.405000000 GHz<br>PN0: Fast →- Trig: Free RMS<br>IF:Gaint.com<br>Avg Type: RMS<br>Trig: Free RMS<br>Trig: |
| ANAL-9 015 9   |
| Ref Offset0.5 dB  ΔMkr3 655.3 μs    10 dB/div  Ref 16.50 dBm  -1.62 dB   |
|  |
|  |
|  |
| 33.5   |
|  |
|  |
|  |
| Center 2.405000000 GHz Span 0 Hz<br>Res BW 8 MHz #VBW 8.0 MHz* Sweep 3.333 ms (40000 pts)  |
| INKRI MODELTRCI SCUL X Y FUNCTION VIDTH FUNCTION VALUE   |
| 1  N  1  t  1.949 ms  -4.80 dBm    2  Δ1  1  t  (Δ)  3821 us (Δ)  -012 dB    Δ1  1  t  (Δ)  6553 us (Δ)  -052 dB   |
| Δ1  1  t  (Δ)  655.3 из  (Δ)  -1.62 dB  -1.62 dB <t< td=""></t<>   |
|  |
|  |
|  |
| K STATUS   |
| Channel 11   |
| Agflent Spectrum Analyzer - Swept SA<br>ØR R.L. FF   50 g. AC  |
| Center Freq 2.440000000 GHz Avg Type: RMS TRACE 122 435  |
| IF GainLow #Atten: 26 dB cer 14 4 A Az   |
| Ref Offset0.5 dB  ΔMkr3 655.4 μs    10 dB/d/y  Ref 16.50 dBm  -0.71 dB   |
|  |
|  |
|  |
|  |
|  |
|  |
| and a second   |
| Center 2.44000000 GHz Span 0 Hz<br>Res BW 8 MHz #VBW 8.0 MHz* Sweep 3.333 ms (40000 pts)   |
|  |
| 1  N  1  t  1.679 ms  -5.31 dBm    2  Δ1  1  t  (Δ)  3626 µs (Δ)  -0.51 dB    3  Δ1  1  t  (Δ)  -657 dB  -677 dB   |
| a <u>A1 1 t (A) 665.4 us (A) -0.71 dB</u>  |
|  |
|  |
|  |
|  |
| Channel 18   |
| Aglent Spectrum Analyzev - Swydt SA<br>Du RL RF  50 g. AC SENSENT ▲ 4U0V 0FF 07:08:36 PM Jun 12, 2023  |
| Center Freq 2.480000000 GHz Avg Type: RMS TRACE he as to<br>PNO: Fast Trig: Free Run Trig: Free Run  |
| AND CONTRACTOR   |
| Ref Offset0.5 dB  ΔMkr3 655.3 μs    10 dBidity  -0.55 dB    0 dBidity  -0.55 dB  |
|  |
|  |
| 23.5   |
|  |
| 435 ya atangida dharan ya Distantiya da  |
|  |
|  |
|  |
| Center 2.480000000 GHz Span 0 Hz<br>Res BW 8 MHz #VBW 8.0 MHz* Sweep 3.333 ms (40000 pts)  |
| Res BW 8 MHz #VBW 8.0 MHz* Sweep 3.333 ms (40000 pts)  |
|  |
|  |
|  |
|  |
|  |
|  |



### 3.9. Antenna Requirement

### **Requirement**

### FCC CFR Title 47 Part 15 Subpart C Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of 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.

### FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

(i) 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.

### Test Result

The directional gain of the antenna less than 6dBi, please refer to the EUT internal photographs antenna photo.