



FCC/ISED - TEST REPORT

Report Number : **709502124233-00B** Date of Issue: January 26, 2022

Model : 9290031346

Product Type : LED light

Trademark : PHILIPS

FCC ID: : 2AGBW9290031346X

IC: : 20812-31346X

Applicant : Signify (China) Investment Co., Ltd.

Address : Building no.9, Lane 888, Tianlin Road, Minhang District Shanghai, 200233 China

Production Facility : Ningbo Klite Electric Manufacture Co., Ltd

Address : No.5 Dapu River, Beilun, 315800 Ningbo
PEOPLE'S REPUBLIC OF CHINA

Test Result : **Positive** **Negative**

Total pages including Appendices : 38

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2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
No.16 Lane, 1951 Du Hui Road,
Shanghai 201108,
P.R. China

Telephone: +86 21 6141 0123

Fax: +86 21 6140 8600

FCC Registration No.: 820234

FCC Designation Number: CN1183

ISED#: 25988

CAB identifier CN0101

3 Description of the Equipment under Test

Description of the Equipment Under Test

| | |
|----------------------------|-------------------------|
| Product: | LED light |
| Model no.: | 9290031346 |
| FCC ID: | 2AGBW9290031346X |
| IC: | 20812-31346X |
| Options and accessories: | 6" metal can |
| Rating: | 120 Vac, 60Hz |
| RF Transmission Frequency: | 2405-2480MHz for Zigbee |
| No. of Operated Channel: | 16 |

Zigbee Working Frequency of Each Channel:

| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|---------|-----------|---------|-----------|
| 11 | 2405 MHz | 12 | 2410 MHz | 13 | 2415 MHz | 14 | 2420 MHz |
| 15 | 2425 MHz | 16 | 2430 MHz | 17 | 2435 MHz | 18 | 2440 MHz |
| 19 | 2445 MHz | 20 | 2450 MHz | 21 | 2455 MHz | 22 | 2460 MHz |
| 23 | 2465 MHz | 24 | 2470 MHz | 25 | 2475 MHz | 26 | 2480 MHz |

| | |
|-------------------------|---|
| Modulation: | 16-ary orthogonal modulation, O-QPSK PHY for Zigbee |
| Data transmission rate: | 250kbps Max for Zigbee |
| Antenna Type: | Integral PCB Antenna |
| Antenna Gain: | 0.59dBi |
| Description of the EUT: | The Equipment Under Test (EUT) is a LED light support Bluetooth 5.0 and Zigbee. We tested it and listed the worst data in this report. |
| Test sample no.: | SHA-616767-1 for RF conducted test SHA-616767-2 for RF radiated test and Conducted emission AC power port test |

The sample's mentioned in this report is supplied by client. The laboratory therefore assumes no responsibility for accuracy of information on the brand name, model number, origin of manufacture, consignment, antenna gain or any information supplied.

4 Summary of Test Standards

| Test Standards | |
|--|--|
| FCC Part 15 Subpart C 10-1-2014 Edition | PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators |
| RSS-Gen Issue 5 Amendment 1 March 2019 | General Requirements for Compliance of Radio Apparatus |
| RSS-247 Issue 2 February 2017 | Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices |

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10 (2013).

5 Summary of Test Results

| Technical Requirements | | | | | | |
|---|---|------------|-------------|-------------------------------------|--------------------------|-------------------------------------|
| FCC Part 15 Subpart C | | | | | | |
| Test Condition | Pages | Test Site | Test Result | | | |
| | | | Pass | Fail | N/A | |
| §15.207 & RSS-GEN 8.8 | Conducted emission AC power port | 12-14 | Site 1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| §15.247 (b) (3) & RSS-247 5.4(d) | Conducted peak output power | 15-16 | Site 1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| §15.247(a)(1) & RSS-247 5.1(b) | 20dB bandwidth | --- | --- | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1) & RSS-247 5.1(b) | Carrier frequency separation | --- | --- | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1)(iii) & RSS-247 5.1(d) | Number of hopping frequencies | --- | --- | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1)(iii) & RSS-247 5.1(d) | Dwell Time | --- | --- | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(2) & RSS-247 5.2(a) & RSSGEN 6.7 | 6dB bandwidth and 99% Occupied Bandwidth | 17-20 | Site 1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| §15.247(e) & RSS-247 5.2(b) | Power spectral density | 21-22 | Site 1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| §15.247(d) & RSS-247 5.5 | Spurious RF conducted emissions | 23-27 | Site 1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| §15.247(d) & RSS-247 5.5 | Band edge | 28-29 | Site 1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| §15.247(d) & §15.209 & RSS-247 5.5 & RSS-Gen 6.13 | Spurious radiated emissions for transmitter | 30-34 | Site 1 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| §15.203 & RSS-Gen 6.8 | Antenna requirement | See note 1 | | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses an Integral PCB Antenna, which gain is 0.59dBi. In accordance to §15.203 and RSS-Gen 6.8, It is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AGBW9290031346X, IC: 20812-31346X complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules and RSS-247, RSS-GEN.

This report is only for the 2.4GHz Zigbee test report, for the 2.4GHz Bluetooth 5.0 LE test report please refer to 709502124233-00A.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

□ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

□ - **Does not** fulfill the general approval requirements.

Sample Received Date: November 18, 2021

Testing Start Date: November 19, 2021

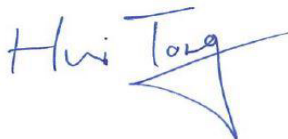
Testing End Date: January 6, 2022

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Reviewed by:

Prepared by:

Tested by:



Hui TONG
EMC Section Manager

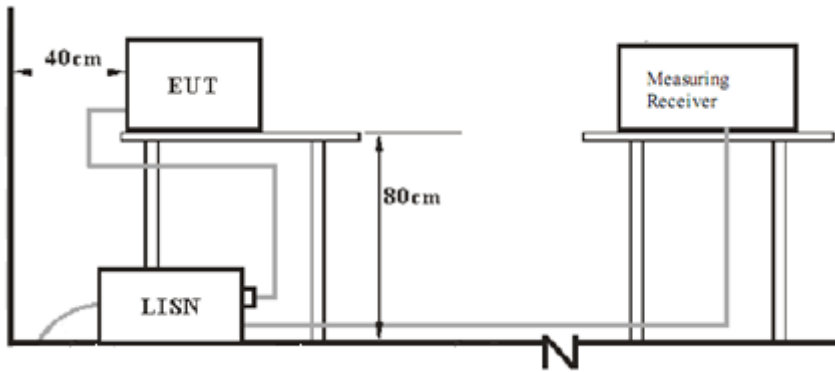


Zhining ZHANG
EMC Project Engineer

Chengjie GUO
EMC Test Engineer

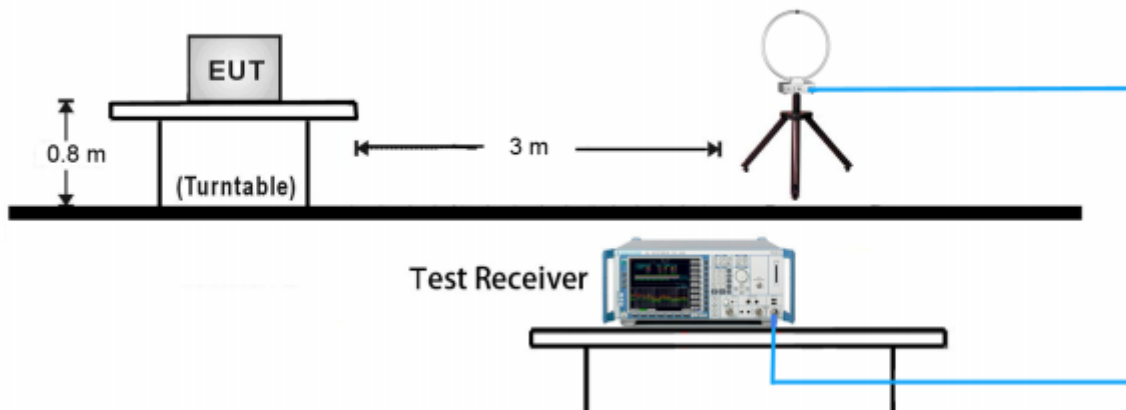
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

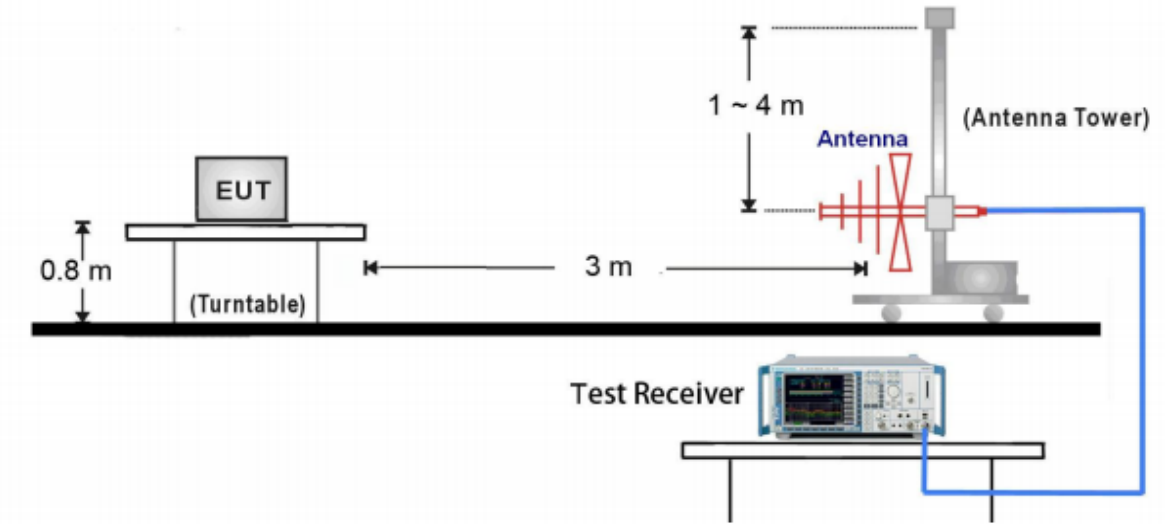


7.2 Radiated test setups

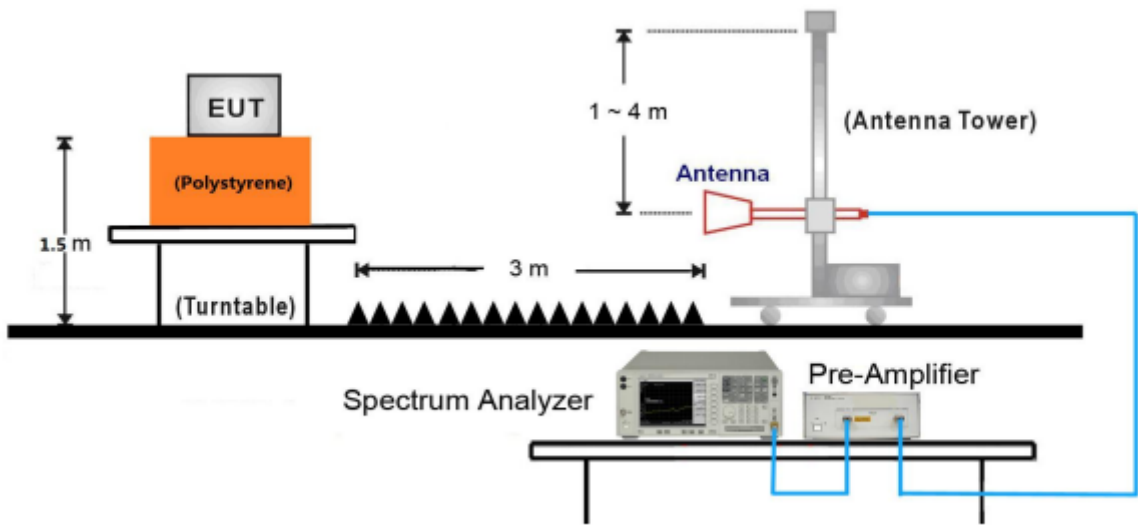
9kHz ~ 30MHz Test Setup:



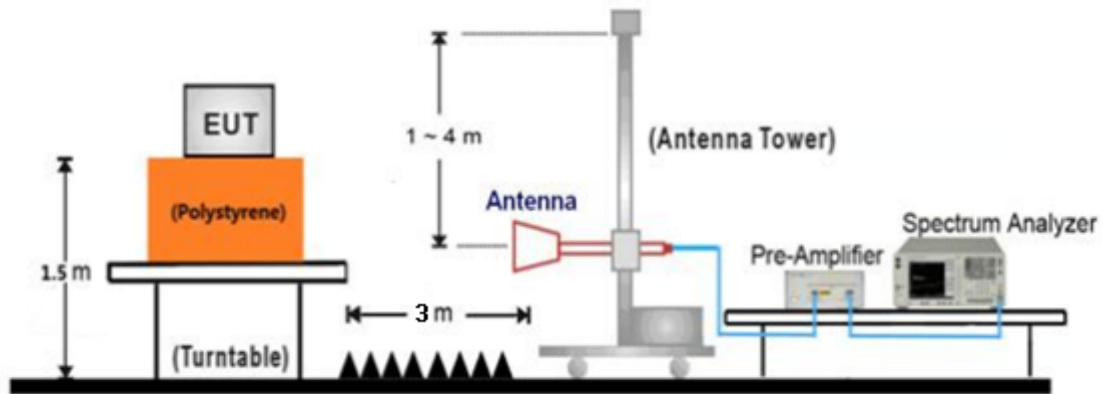
30MHz ~ 1GHz Test Setup:



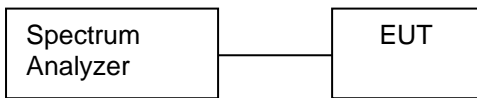
1GHz ~ 18GHz Test Setup:



18GHz ~ 25GHz Test Setup:



7.2 Conducted RF test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

| DESCRIPTION | MANUFACTURER | MODEL NO.(SHIELD) | S/N(LENGTH) |
|-------------|--------------|-------------------|-----------------|
| Notebook | Lenovo | E470 | PF-OU5TS7 17/09 |

Test software: HueApprobatonTool, which used to control the EUT in continues transmitting mode.

Power level setting at 9dBm.

The system was configured to channel 11, 18, and 26 for the test.

9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

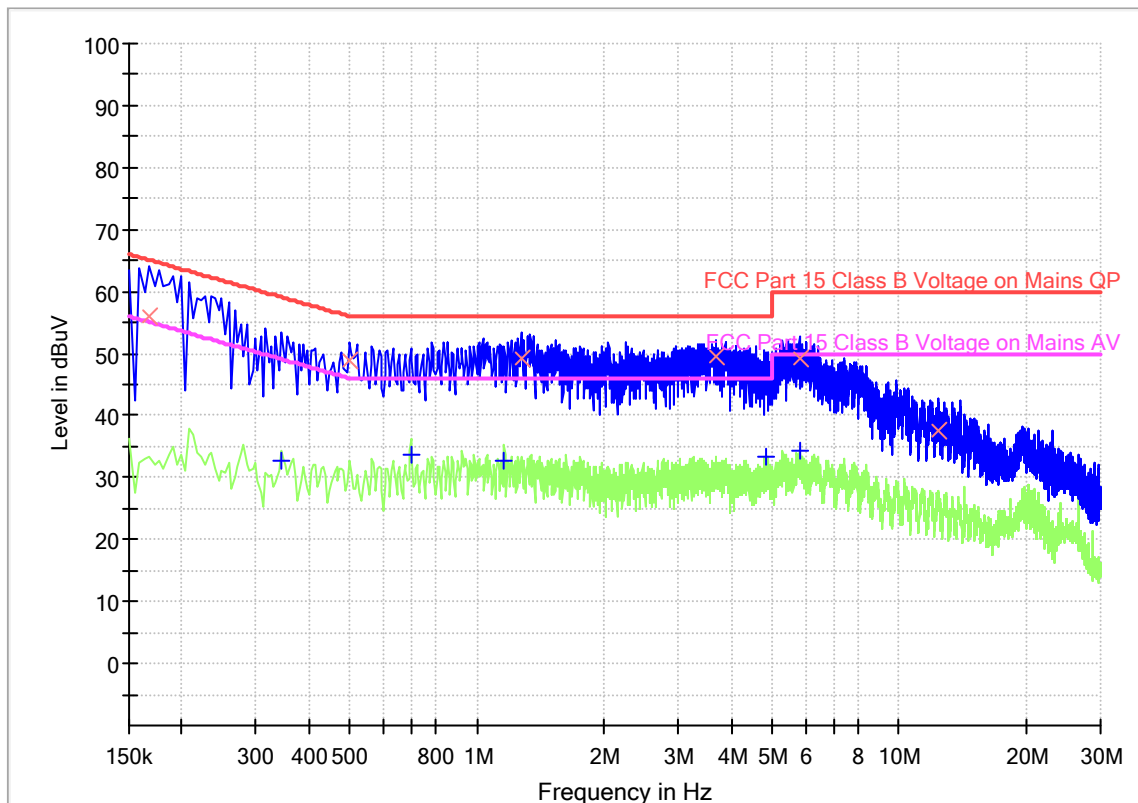
Limit

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

Decreasing linearly with logarithm of the frequency

Conducted Emission

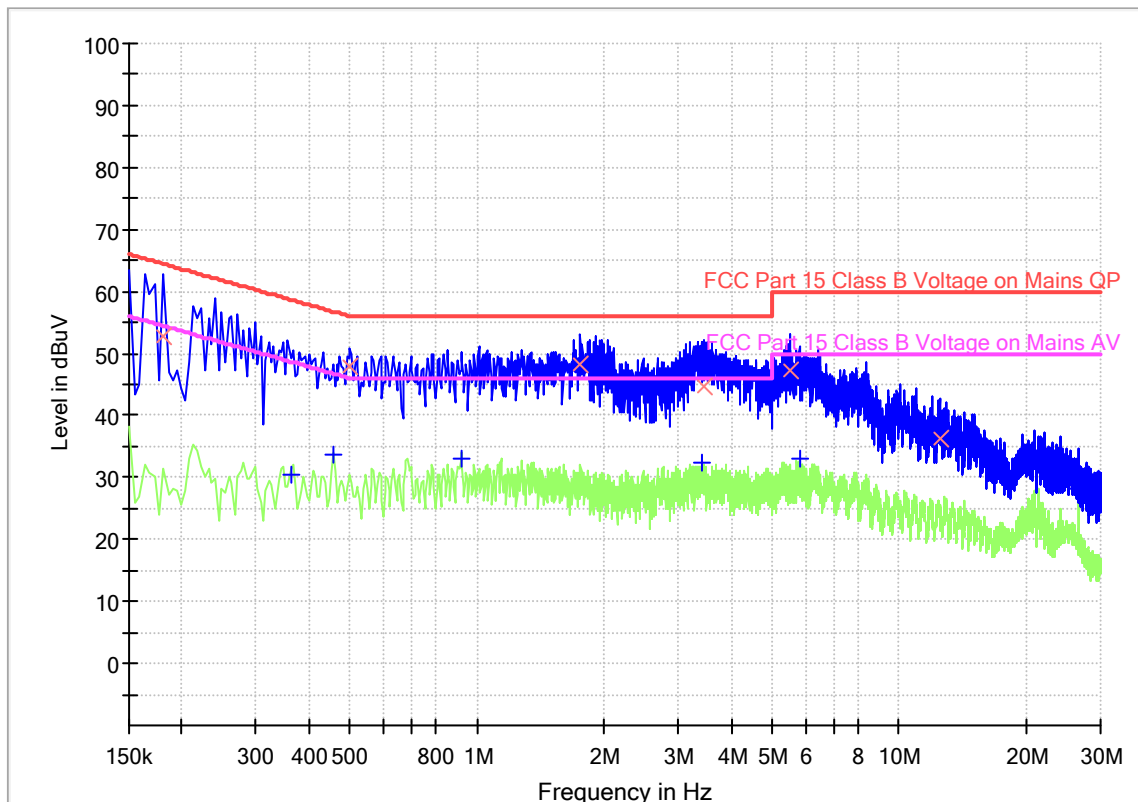
Product Type : LED light
 M/N : 9290031346
 Operating Condition : Mode 1: Tx_2480MHz Zigbee
 Test Specification : L-Line
 Comment : AC 120V 60Hz



Final Result

| Frequency (MHz) | QuasiPeak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|-----------------|-----------------|------|------------|
| 0.168000 | 56.07 | --- | 65.06 | 8.99 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.343500 | --- | 32.62 | 49.12 | 16.50 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.501000 | 48.94 | --- | 56.00 | 7.06 | 1000.0 | 9.000 | L1 | 19.5 |
| 0.699000 | --- | 33.72 | 46.00 | 12.28 | 1000.0 | 9.000 | L1 | 19.5 |
| 1.162500 | --- | 32.76 | 46.00 | 13.24 | 1000.0 | 9.000 | L1 | 19.5 |
| 1.270500 | 49.07 | --- | 56.00 | 6.93 | 1000.0 | 9.000 | L1 | 19.5 |
| 3.669000 | 49.63 | --- | 56.00 | 6.37 | 1000.0 | 9.000 | L1 | 19.6 |
| 4.866000 | --- | 33.38 | 46.00 | 12.62 | 1000.0 | 9.000 | L1 | 19.6 |
| 5.797500 | 49.31 | --- | 60.00 | 10.69 | 1000.0 | 9.000 | L1 | 19.6 |
| 5.797500 | --- | 34.36 | 50.00 | 15.64 | 1000.0 | 9.000 | L1 | 19.6 |
| 12.439500 | 37.43 | --- | 60.00 | 22.57 | 1000.0 | 9.000 | L1 | 19.7 |
| 26.623500 | --- | 29.83 | 50.00 | 20.17 | 1000.0 | 9.000 | L1 | 20.0 |

Product Type : LED light
 M/N : 9290031346
 Operating Condition : Mode 1: Tx_2480MHz Zigbee
 Test Specification : N-Line
 Comment : AC 120V 60Hz



Final Result

| Frequency (MHz) | QuasiPeak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|-----------------|-----------------|------|------------|
| 0.181500 | 52.87 | --- | 64.42 | 11.55 | 1000.0 | 9.000 | N | 19.5 |
| 0.361500 | --- | 30.57 | 48.69 | 18.12 | 1000.0 | 9.000 | N | 19.5 |
| 0.456000 | --- | 33.58 | 46.77 | 13.19 | 1000.0 | 9.000 | N | 19.5 |
| 0.501000 | 48.07 | --- | 56.00 | 7.93 | 1000.0 | 9.000 | N | 19.5 |
| 0.919500 | --- | 33.11 | 46.00 | 12.89 | 1000.0 | 9.000 | N | 19.5 |
| 1.761000 | 48.13 | --- | 56.00 | 7.87 | 1000.0 | 9.000 | N | 19.5 |
| 3.403500 | --- | 32.26 | 46.00 | 13.74 | 1000.0 | 9.000 | N | 19.5 |
| 3.462000 | 44.52 | --- | 56.00 | 11.48 | 1000.0 | 9.000 | N | 19.5 |
| 5.509500 | 47.23 | --- | 60.00 | 12.77 | 1000.0 | 9.000 | N | 19.6 |
| 5.797500 | --- | 33.12 | 50.00 | 16.88 | 1000.0 | 9.000 | N | 19.6 |
| 12.453000 | 36.34 | --- | 60.00 | 23.66 | 1000.0 | 9.000 | N | 19.7 |
| 26.623500 | --- | 28.14 | 50.00 | 21.86 | 1000.0 | 9.000 | N | 20.0 |

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
 Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

9.2 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
RBW > the 6 dB bandwidth of the emission being measured, VBW \geq 3RBW, Span \geq 3RBW
Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

Limits

According to §15.247 (b) (1) & RSS-247 5.4(d), conducted peak output power limit as below:

| Frequency Range MHz | Limit W | Limit dBm |
|------------------------|------------|--------------|
| 2400-2483.5 | ≤ 1 | ≤ 30 |

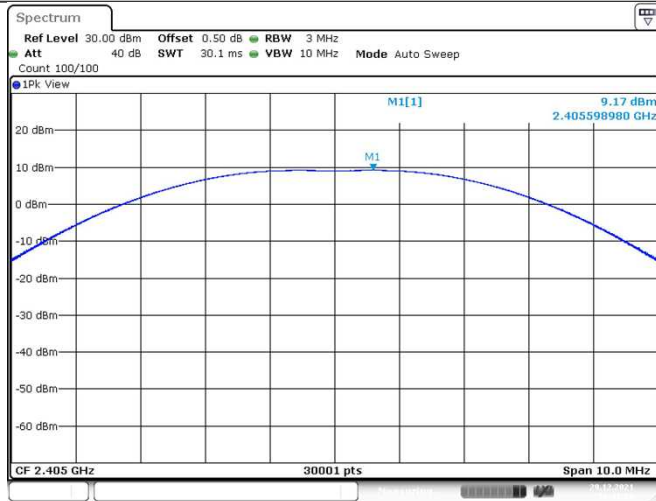
| Frequency Range MHz | Limit (EIRP) W | Limit dBm |
|------------------------|-------------------|--------------|
| 2400-2483.5 | ≤ 4 | ≤ 36 |

Test result

| TestMode | Channel | Conducted Peak Output Power Result[dBm] | Limit[dBm] | Verdict |
|----------|---------|---|------------|---------|
| Zigbee | 2405 | 9.17 | ≤ 30 | PASS |
| | 2440 | 9.38 | ≤ 30 | PASS |
| | 2480 | 9.49 | ≤ 30 | PASS |

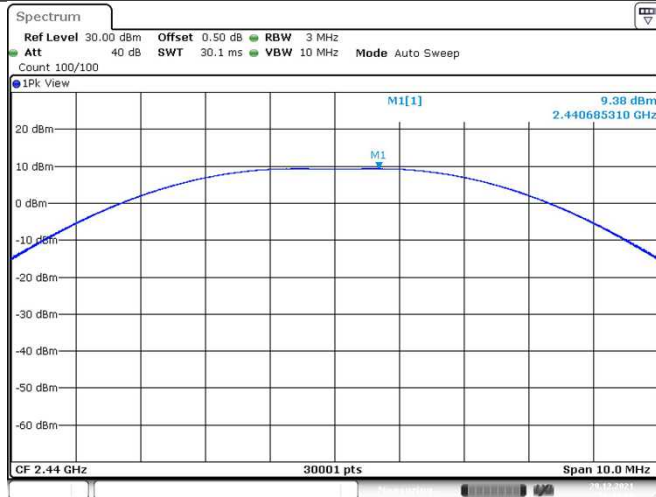
| TestMode | Channel | EIRP Result[dBm] | Limit[dBm] | Verdict |
|----------|---------|------------------|------------|---------|
| Zigbee | 2405 | 9.76 | ≤ 36 | PASS |
| | 2440 | 9.97 | ≤ 36 | PASS |
| | 2480 | 10.08 | ≤ 36 | PASS |

Test Graphs
ZIGB_Ant1_2405



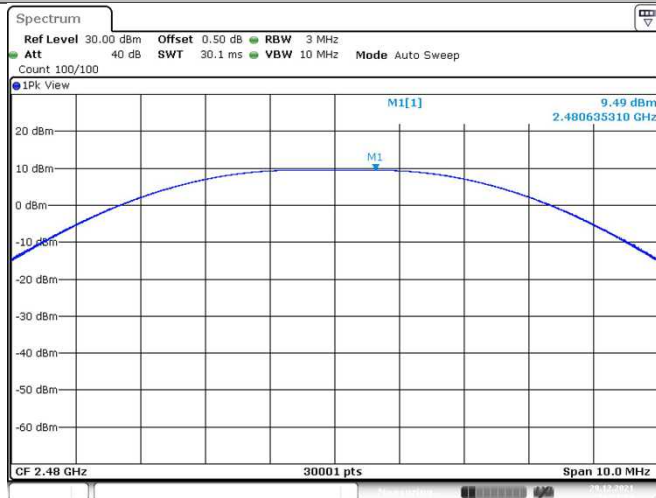
Date: 29 DEC 2021 16:41:56

ZIGB_Ant1_2440



Date: 29 DEC 2021 16:49:39

ZIGB_Ant1_2480



Date: 29 DEC 2021 16:51:54

9.3 6dB bandwidth and 99% Occupied Bandwidth

Test Method

1. Use the following spectrum analyzer settings:
RBW=100K, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Test Method for 99 % Bandwidth

1. Use the following spectrum analyzer settings:
RBW=1% to 5% of the actual occupied, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]

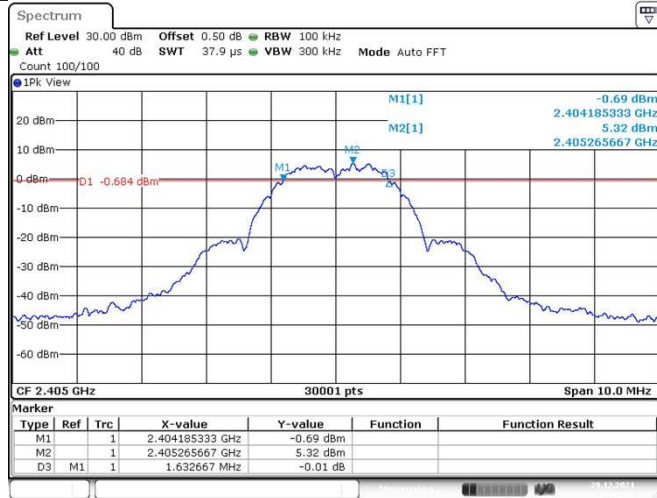
≥500

Test result

6dB Bandwidth

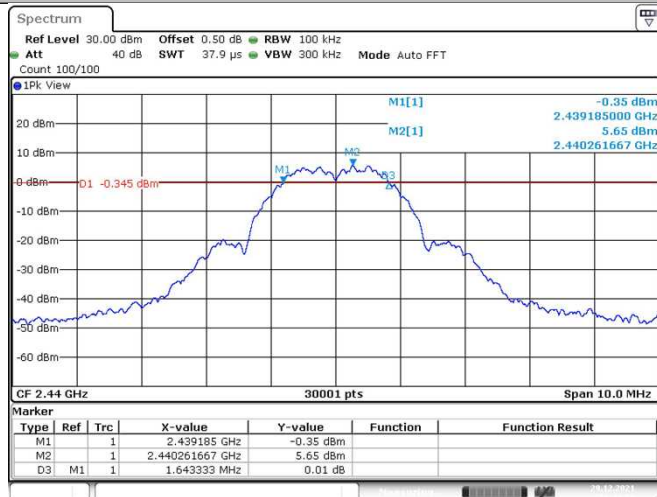
| TestMode | Channel | DTS BW [MHz] | FL[MHz] | FH[MHz] | Limit[MHz] | Verdict |
|----------|---------|--------------|----------|----------|------------|---------|
| Zigbee | 2405 | 1.633 | 2404.185 | 2405.818 | 0.5 | PASS |
| | 2440 | 1.643 | 2439.185 | 2440.828 | 0.5 | PASS |
| | 2480 | 1.639 | 2479.188 | 2480.827 | 0.5 | PASS |

ZIGB_Ant1_2405



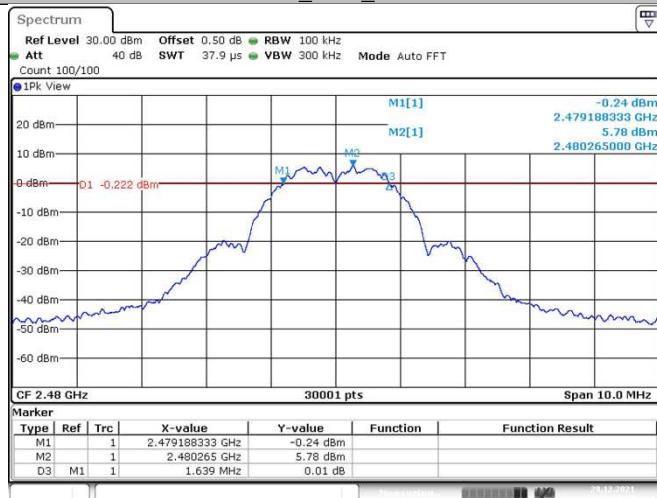
Date: 29.DEC.2021 16:41:37

ZIGB_Ant1_2440



Date: 29.DEC.2021 16:49:20

ZIGB_Ant1_2480



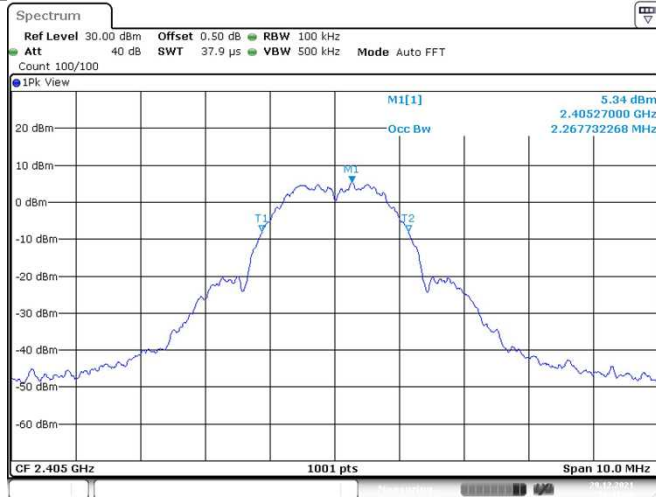
Date: 29.DEC.2021 16:51:35



99% Occupied Bandwidth

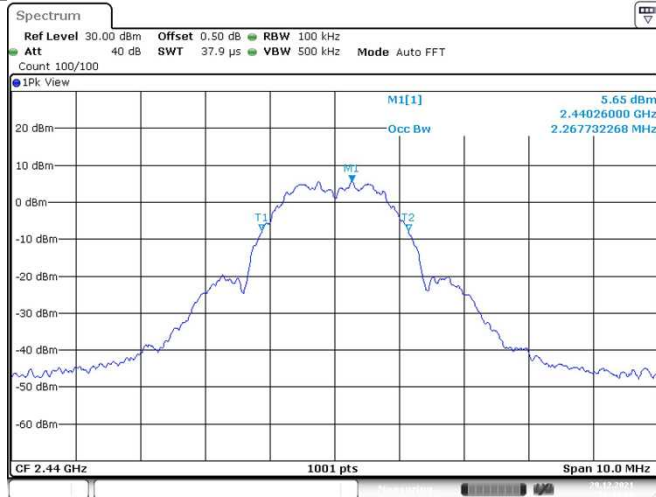
| TestMode | Channel | OCB [MHz] | FL[MHz] | FH[MHz] | Limit[MHz] | Verdict |
|----------|---------|-----------|----------|----------|------------|---------|
| Zigbee | 2405 | 2.268 | 2403.871 | 2406.139 | --- | PASS |
| | 2440 | 2.268 | 2438.871 | 2441.139 | --- | PASS |
| | 2480 | 2.268 | 2478.871 | 2481.139 | --- | PASS |

ZIGB_Ant1_2405



Date: 29. DEC 2021 16:41:47

ZIGB_Ant1_2440



Date: 29. DEC 2021 16:49:30

9.4 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency.
RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm/3kHz]

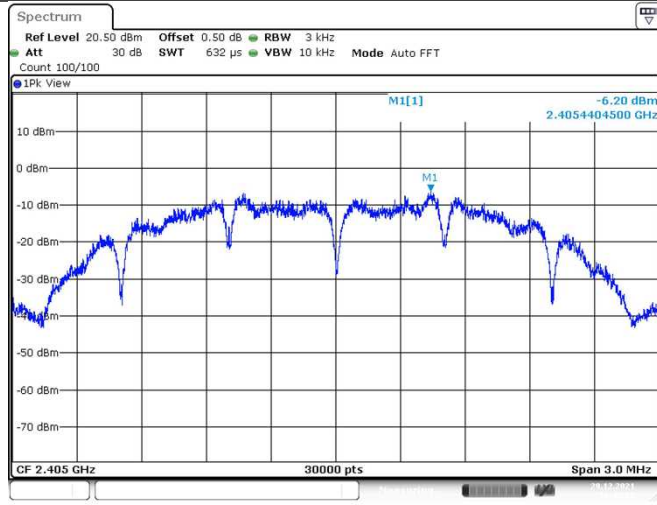
≤8

Test result

| TestMode | Channel | Result[dBm/3kHz] | Limit[dBm/3kHz] | Verdict |
|----------|---------|------------------|-----------------|---------|
| Zigbee | 2405 | -6.2 | ≤8 | PASS |
| | 2440 | -6.01 | ≤8 | PASS |
| | 2480 | -5.88 | ≤8 | PASS |

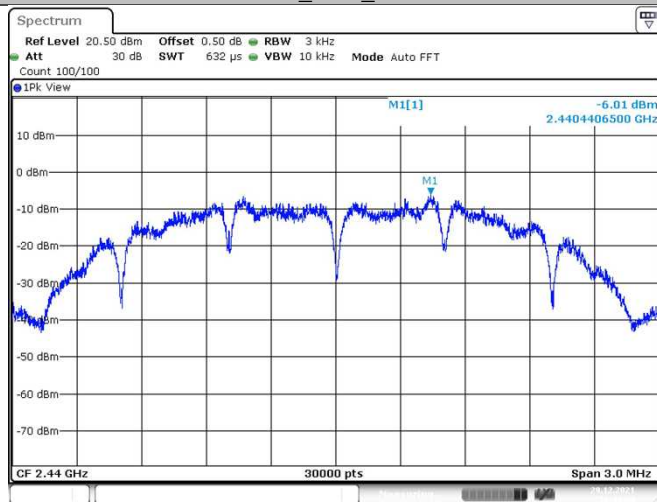
Test Graphs

ZIGB_Ant1_2405



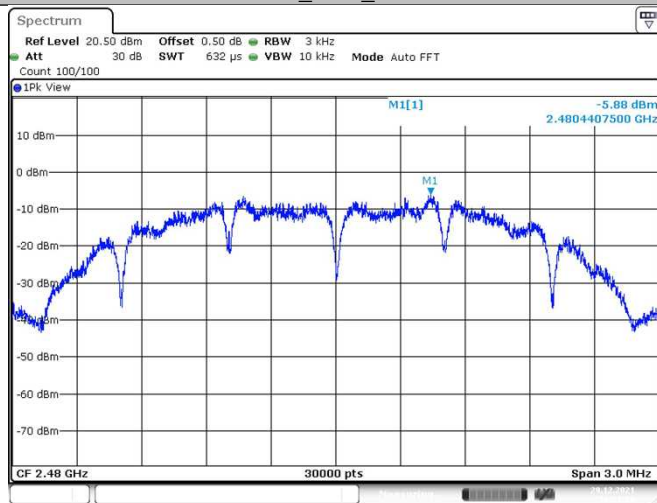
Date: 29 DEC 2021 16:42:02

ZIGB_Ant1_2440



Date: 29 DEC 2021 16:49:44

ZIGB_Ant1_2480



Date: 29 DEC 2021 16:51:59

9.5 Spurious RF conducted emissions

Test Method

1. Establish a reference level by using the following procedure:
 - a. Set RBW=100 kHz. VBW \geq 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
 - b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish the reference level.
 - a. Set the center frequency and span to encompass frequency range to be measured.
 - b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
3. Repeat above procedures until other frequencies measured were completed.

Limit

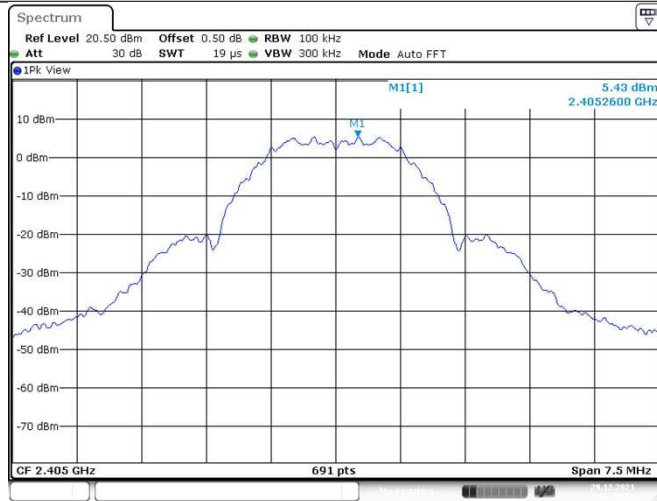
| Frequency Range MHz | Limit (dBc) |
|------------------------|-------------|
| 30-26500 | -20 |

Test Result

| TestMode | Channel | FreqRange [MHz] | RefLevel [dBm] | Result[dBm] | Limit[dBm] | Verdict | |
|----------|---------|--------------------|-------------------|-------------|---------------|---------------|------|
| Zigbee | 2405 | Reference | 5.43 | 5.43 | --- | PASS | |
| | | 30~1000 | 5.43 | -58.29 | ≤ -14.57 | PASS | |
| | | 1000~5000 | 5.43 | -54.93 | ≤ -14.57 | PASS | |
| | | 5000~26500 | 5.43 | -46.8 | ≤ -14.57 | PASS | |
| | 2440 | Reference | 5.64 | 5.64 | 5.64 | --- | PASS |
| | | 30~1000 | 5.64 | -57.71 | -57.71 | ≤ -14.36 | PASS |
| | | 1000~5000 | 5.64 | -54.9 | -54.9 | ≤ -14.36 | PASS |
| | | 5000~26500 | 5.64 | -46.84 | -46.84 | ≤ -14.36 | PASS |
| | 2480 | Reference | 5.76 | 5.76 | 5.76 | --- | PASS |
| | | 30~1000 | 5.76 | -57.49 | -57.49 | ≤ -14.24 | PASS |
| | | 1000~5000 | 5.76 | -55.36 | -55.36 | ≤ -14.24 | PASS |
| | | 5000~26500 | 5.76 | -47.31 | -47.31 | ≤ -14.24 | PASS |

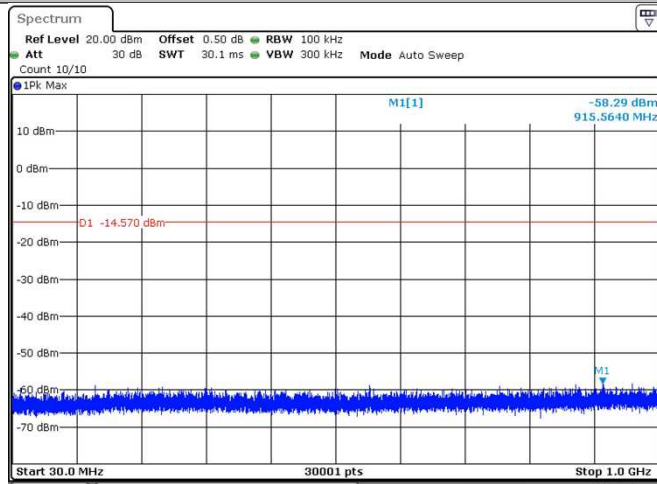
Test Graphs

ZIGB_Ant1_2405_0~Reference



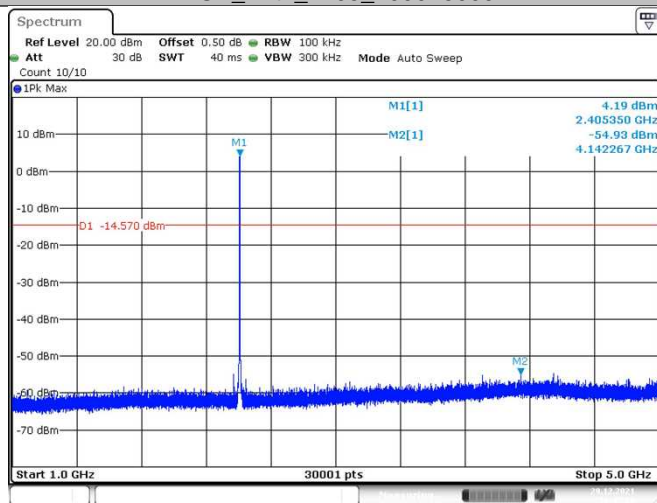
Date: 29. DEC 2021 16:47:33

ZIGB_Ant1_2405_30~1000



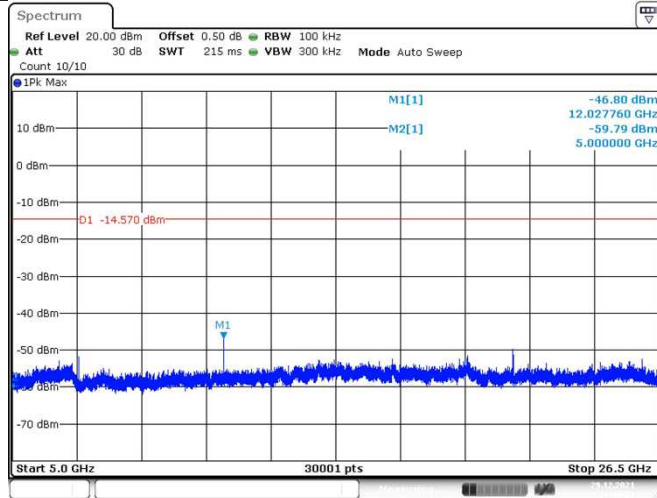
Date: 29. DEC 2021 16:47:38

ZIGB_Ant1_2405_1000~5000



Date: 29. DEC 2021 16:47:50

ZIGB_Ant1_2405_5000~26500



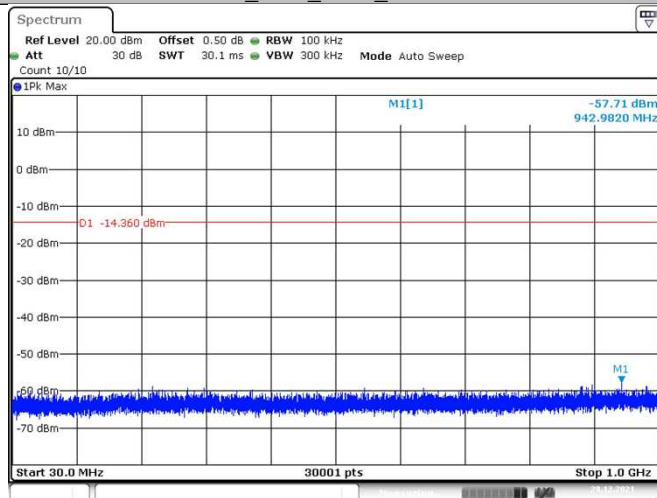
Date: 29.DEC.2021 16:48:21

ZIGB_Ant1_2440_0-Reference



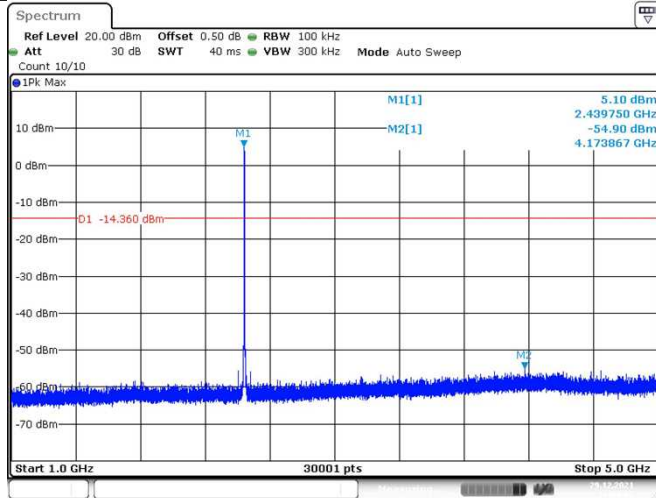
Date: 29.DEC.2021 16:49:49

ZIGB_Ant1_2440_30~1000



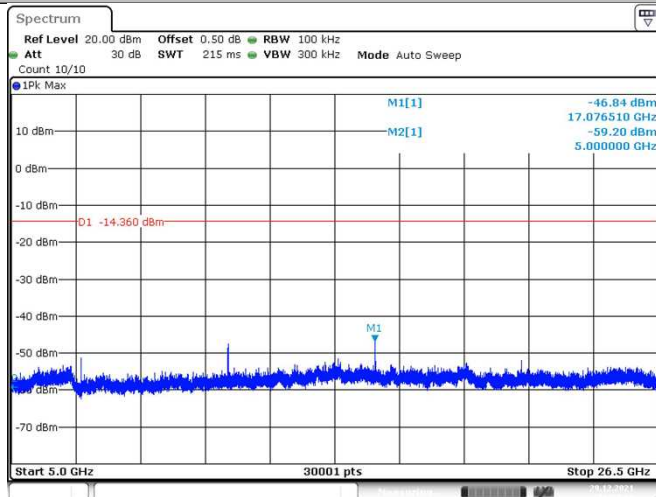
Date: 29.DEC.2021 16:49:53

ZIGB_Ant1_2440_1000~5000



Date: 29. DEC 2021 16:50:05

ZIGB_Ant1_2440_5000~26500



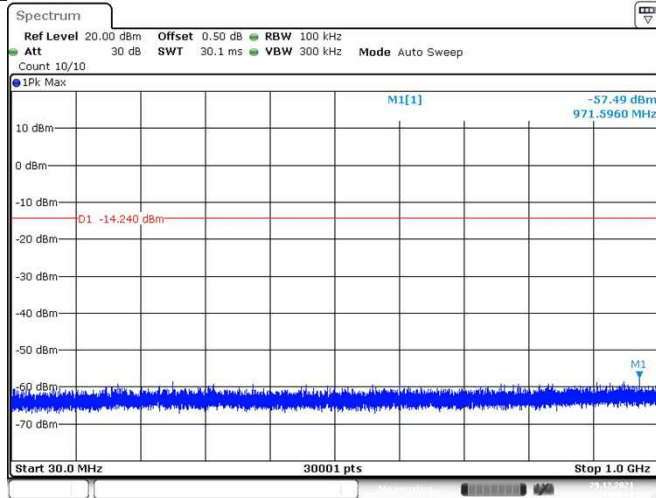
Date: 29. DEC 2021 16:50:37

ZIGB_Ant1_2480_0~Reference



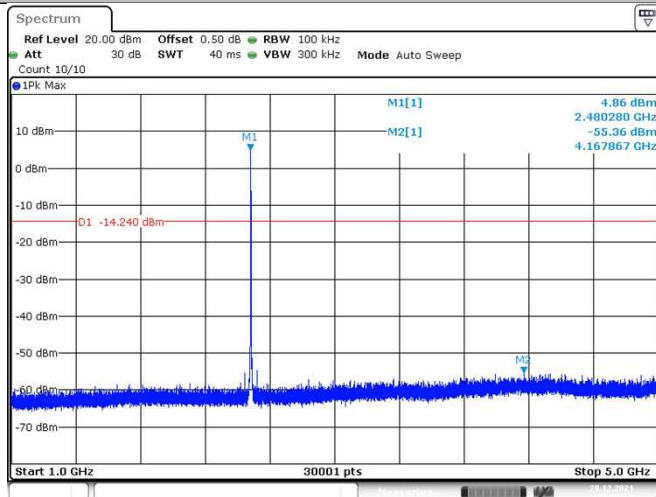
Date: 29. DEC 2021 16:56:27

ZIGB_Ant1_2480_30~1000



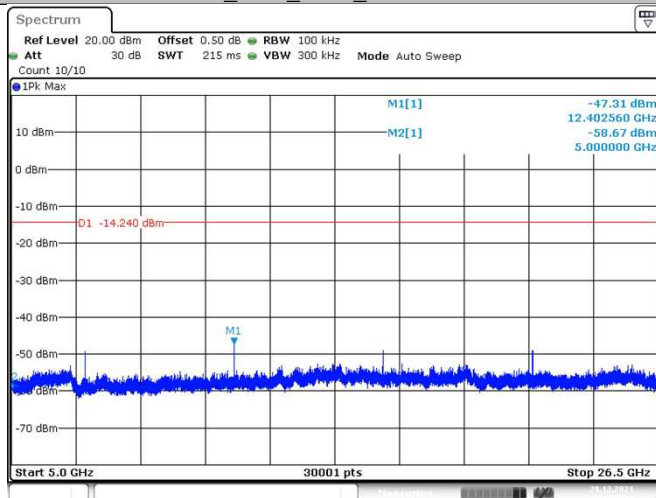
Date: 29. DEC 2021 16:56:31

ZIGB_Ant1_2480_1000~5000



Date: 29. DEC 2021 16:56:43

ZIGB_Ant1_2480_5000~26500



Date: 29. DEC 2021 16:57:14

9.6 Band edge

Test Method

- 1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW \geq RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section.

Limit

According to §15.247(d) and RSS-247 5.5, in any 100 kHz bandwidth outside the frequency bands 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, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) and RSS-Gen 8.10, must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)) and RSS-Gen.

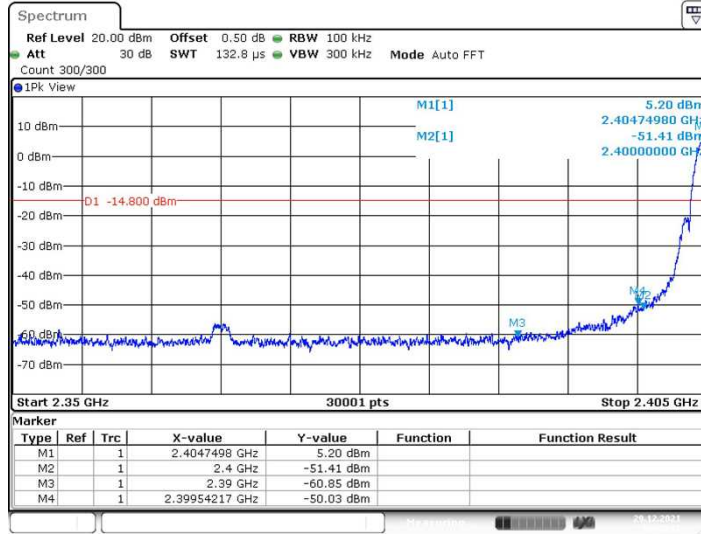
Test result

| TestMode | ChName | Channel | RefLevel[dBm] | Result[dBm] | Limit[dBm] | Verdict |
|----------|--------|---------|---------------|-------------|---------------|---------|
| Zigbee | Low | 2405 | 5.20 | -50.03 | ≤ -14.8 | PASS |
| | High | 2480 | 4.94 | -44.42 | ≤ -15.06 | PASS |



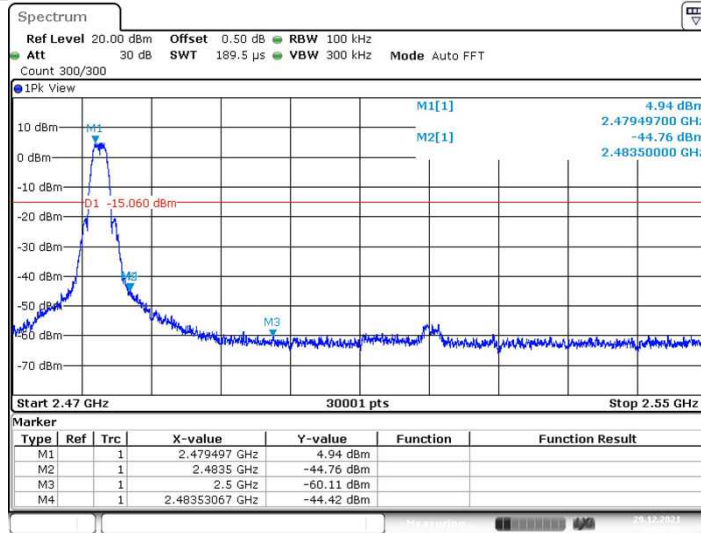
Test Graphs

ZIGB_Ant1_Low_2405



Date: 29.DEC.2021 16:42:11

ZIGB_Ant1_High_2480



Date: 29.DEC.2021 16:52:08

9.7 Spurious radiated emissions for transmitter

Test Method

1. The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. Use the following spectrum analyzer settings According to C63.10:

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
 RBW = 100 kHz to 120 kHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

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

Procedures for average unwanted emissions measurements above 1000 MHz

- a) RBW = 1MHz.
- b) VBW ≥ [3 × RBW].
- c) Detector = RMS (power averaging), if $[\text{span} / (\# \text{ of points in sweep})] \leq \text{RBW} / 2$. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
- d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
- e) Sweep time = auto.
- f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of $1 / D$, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
- g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (rms) mode was used in the preceding step e), then the correction

factor is $[10 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is $[20 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.

3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section 15.205 and RSS-GEN 8.10 must comply with the radiated emission limits specified in section 15.209.

| Frequency MHz | Field Strength uV/m | Measured Distance Meters |
|------------------|------------------------|-----------------------------|
| 0.009~0.490 | 2400/F (kHz) | 300 |
| 0.490~1.705 | 24000/F (kHz) | 30 |
| 1.705~30 | 30 | 30 |

| Frequency MHz | Field Strength uV/m | Field Strength dBµV/m | Detector |
|------------------|------------------------|--------------------------|----------|
| 30-88 | 100 | 40 | QP |
| 88-216 | 150 | 43.5 | QP |
| 216-960 | 200 | 46 | QP |
| 960-1000 | 500 | 54 | QP |
| Above 1000 | 500 | 54 | AV |
| Above 1000 | 5000 | 74 | PK |

Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Transmitting spurious emission test result as below:

Test mode: O-QPSK Zigbee Channel (2405MHz)

| Frequency MHz | Mmission Level dBuV/m | Limit dBuV/m | Margin dB | Detector | Polarization |
|------------------|-----------------------------|-----------------|--------------|----------|--------------|
| 2389.4 | 42.31 | 74.0 | 31.69 | Peak | Horizontal |
| 7216.8 | 52.35 | 74.0 | 21.65 | Peak | Horizontal |
| 7216.8 | 48.46 | 54.0 | 5.54 | AV | Horizontal |
| 2366.4 | 42.61 | 74.0 | 31.39 | Peak | Vertical |
| 7219.4 | 48.06 | 74.0 | 25.94 | Peak | Vertical |

Test mode: O-QPSK Zigbee Channel (2440MHz)

| Frequency MHz | Mmission Level dBuV/m | Limit dBuV/m | Margin dB | Detector | Polarization |
|------------------|-----------------------------|-----------------|--------------|----------|--------------|
| 7318.4 | 49.67 | 74.0 | 24.33 | Peak | Horizontal |
| 7318.4 | 50.17 | 74.0 | 23.83 | Peak | Vertical |
| 7318.4 | 46.43 | 54.0 | 7.57 | AV | Vertical |

Test mode: O-QPSK Zigbee Channel (2480MHz)

| Frequency MHz | Mmission Level dBuV/m | Limit dBuV/m | Margin dB | Detector | Polarization |
|------------------|-----------------------------|-----------------|--------------|----------|--------------|
| 2483.5 | 49.51 | 74.0 | 24.49 | Peak | Horizontal |
| 7438.4 | 52.35 | 74.0 | 21.65 | Peak | Horizontal |
| 7438.4 | 49.01 | 74.0 | 24.99 | AV | Horizontal |
| 2483.5 | 50.53 | 74.0 | 23.47 | Peak | Vertical |
| 2483.5 | 43.45 | 54.0 | 10.55 | AV | Vertical |
| 7438.4 | 53.16 | 74.0 | 20.84 | Peak | Vertical |
| 7438.4 | 50.63 | 54.0 | 3.37 | AV | Vertical |

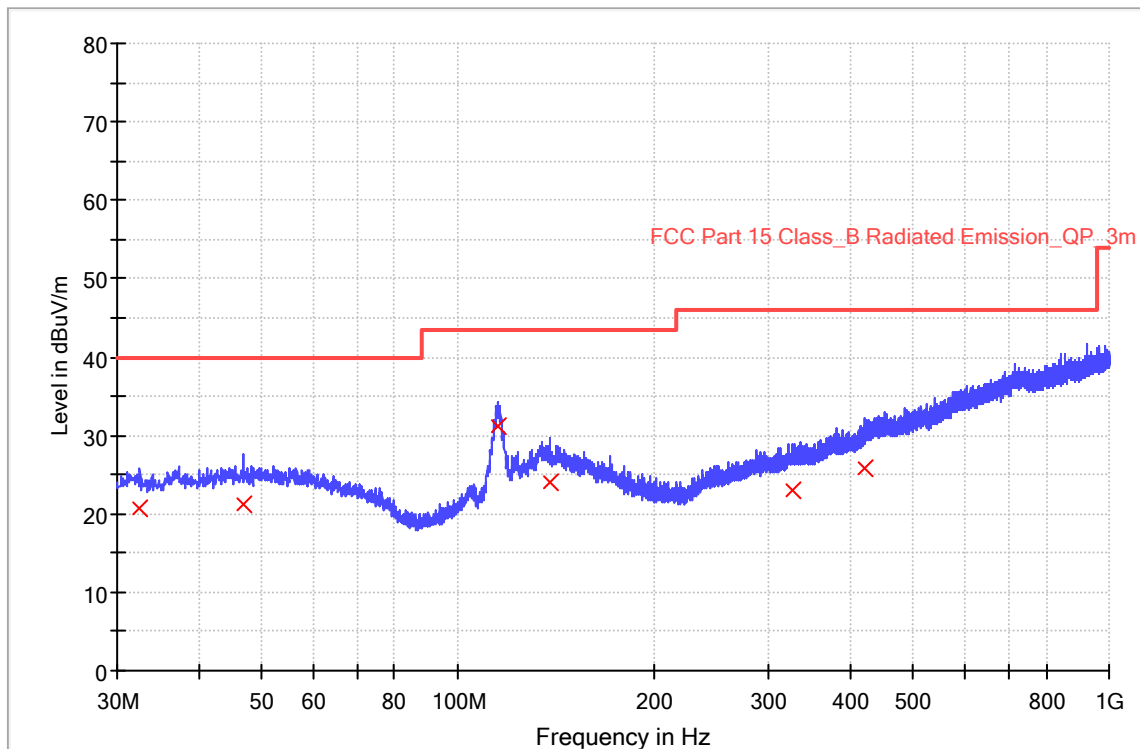
Remark:

- (1) Emission level= Original Receiver Reading + Correct Factor
- (2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
- (3) Margin = limit – Corrected Reading

The worst case of Radiated Emission below 1GHz:

| | |
|---|--------------------------|
| Site: 3 meter chamber | Time: 2022/01/06 - 16:20 |
| Limit: FCC_Part15.209 and RSS-GEN 8.8_RE(3m) | Engineer: Chengjie Guo |
| Probe: VULB9168 | Polarity: Horizontal |
| EUT: LED light, Model no: 9290031346 | Power: AC 120V, 60Hz |
| Note: Transmit by at channel 2480MHz, Zigbee. | |

RE_VULB9168_pre_Cont_30-1000

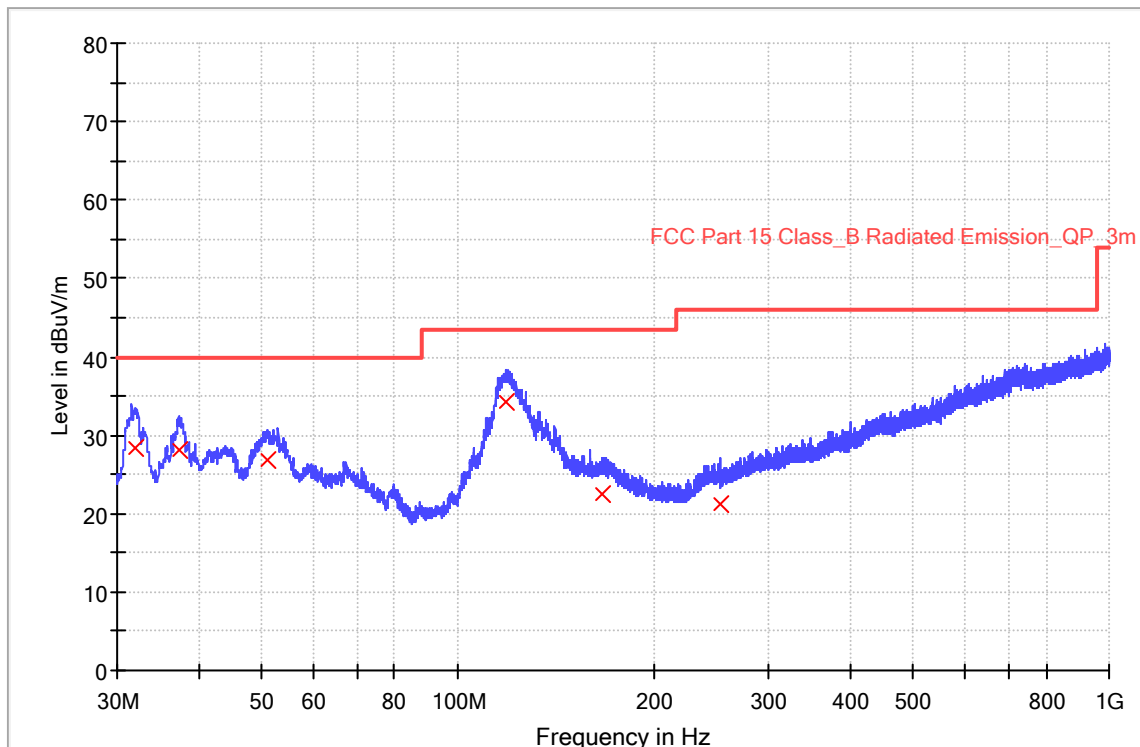


Limit and Margin

| Frequency (MHz) | QuasiPeak (dBuV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBuV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|-----|---------------|------------|-------------------|----------------------|
| 32.520000 | 20.6 | 1000.0 | 120.000 | 150.0 | H | 142.0 | 19.4 | 19.4 | 40.0 |
| 46.840000 | 21.2 | 1000.0 | 120.000 | 100.0 | H | 253.0 | 20.5 | 18.9 | 40.0 |
| 114.960000 | 31.1 | 1000.0 | 120.000 | 150.0 | H | 349.0 | 17.7 | 12.4 | 43.5 |
| 138.800000 | 24.0 | 1000.0 | 120.000 | 200.0 | H | 219.0 | 20.2 | 19.5 | 43.5 |
| 325.640000 | 23.1 | 1000.0 | 120.000 | 150.0 | H | 117.0 | 22.5 | 22.9 | 46.0 |
| 422.760000 | 25.8 | 1000.0 | 120.000 | 150.0 | H | 239.0 | 24.9 | 20.2 | 46.0 |

| | |
|--|--------------------------|
| Site: 3 meter chamber | Time: 2022/01/06 - 16:26 |
| Limit: FCC_Part15.209 and RSS-GEN 8.8_RE(3m) | Engineer: Chengjie Guo |
| Probe: VULB9168 | Polarity: Vertical |
| EUT: LED light, Model no: 9290031346 | Power: AC 120V, 60Hz |
| Note: Transmit by at channel 2480MHz Zigbee. | |

RE_VULB9168_pre_Cont_30-1000



Limit and Margin

| Frequency (MHz) | QuasiPeak (dBuV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBuV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|-----|---------------|------------|-------------------|----------------------|
| 32.080000 | 28.3 | 1000.0 | 120.000 | 100.0 | V | 216.0 | 19.4 | 11.7 | 40.0 |
| 37.320000 | 28.1 | 1000.0 | 120.000 | 200.0 | V | 195.0 | 19.7 | 12.0 | 40.0 |
| 51.160000 | 26.7 | 1000.0 | 120.000 | 100.0 | V | 338.0 | 20.6 | 13.3 | 40.0 |
| 118.640000 | 34.3 | 1000.0 | 120.000 | 100.0 | V | 17.0 | 18.0 | 9.2 | 43.5 |
| 166.760000 | 22.6 | 1000.0 | 120.000 | 100.0 | V | 221.0 | 20.5 | 20.9 | 43.5 |
| 252.320000 | 21.1 | 1000.0 | 120.000 | 100.0 | V | 142.0 | 19.9 | 24.9 | 46.0 |

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 26.5GHz), therefore no data appear in the report.

10 Test Equipment List

List of Test Instruments

Test Site1

| TEST ITEM | DESCRIPTION | MANUFACTURER | MODEL NO. | SERIAL NO. | CAL. DATE | CAL. DUE DATE |
|-----------|---|-----------------|-----------|------------|-----------|---------------|
| C | Signal Analyzer | Rohde & Schwarz | FSV40 | 101091 | 2021-8-2 | 2022-8-1 |
| RE | EMI Test Receiver | Rohde & Schwarz | ESR3 | 101906 | 2021-8-2 | 2022-8-1 |
| | Signal Analyzer | Rohde & Schwarz | FSV40 | 101091 | 2021-8-2 | 2022-8-1 |
| | Trilog Super Broadband Test Antenna | Schwarzbeck | VULB 9168 | 961 | 2019-3-16 | 2022-3-15 |
| | Horn Antenna | Rohde & Schwarz | HF907 | 102393 | 2021-3-15 | 2022-3-14 |
| | Pre-amplifier | Rohde & Schwarz | SCU-18D | 19006451 | 2021-8-2 | 2022-8-1 |
| | Loop antenna | Rohde & Schwarz | HFH2-Z2 | 100443 | 2021-5-21 | 2022-5-20 |
| | DOUBLE-RIDGED WAVEGUIDE HORN WITH PRE-AMPLIFIER (18 GHZ - 40 GHZ) | ETS-Lindgren | 3116C-PA | 002222727 | 2020-9-23 | 2023-9-22 |
| | 3m Semi-anechoic chamber | TDK | 9X6X6 | ---- | 2021-5-8 | 2024-5-7 |
| | EMI Test Receiver | Rohde & Schwarz | ESR3 | 101907 | 2021-8-2 | 2022-8-1 |
| | LISN | Rohde & Schwarz | ENV216 | 101924 | 2021-8-2 | 2022-8-1 |

| Measurement Software Information | | | |
|----------------------------------|--------------------------------|------------------------------|-------------|
| Test Item | Software | Manufacturer | Version |
| C | Bluetooth and WiFi Test System | Shenzhen JS tonscond co.,ltd | 2.6.77.0518 |
| RE | EMC 32 | Rohde & Schwarz | V9.15.00 |
| CE | EMC 32 | Rohde & Schwarz | V9.15.03 |

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density*
- Spurious RF conducted emissions
- Band edge

11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

| Items | Extended Uncertainty |
|--|--|
| Conducted Disturbance at Mains Terminals | 150kHz to 30MHz, LISN, ± 3.16 dB |
| Radiated Disturbance | 30MHz to 1GHz, ± 5.03 dB (Horizontal) ± 5.12 dB (Vertical) 1GHz to 18GHz, ± 5.49 dB 18GHz to 40GHz, ± 5.63 dB |
| Carrier power conducted measurement | 50MHz~18GHz, ± 1.238 dB |
| Spurious Emission Conducted Measurement | 9kHz ~40GHz, ± 1.224 dB |



12 Photographs of Test Set-ups

Refer to the < Test Setup photos >.



13 Photographs of EUT

Refer to the < External Photos > & < Internal Photos >.

THE END