# RADIO TEST REPORT

## FCC 47 CFR PART 15 SUBPART C

| | |
|---|---|
| **Test Standard** | **FCC Part 15.247**<br>**IC RSS-247 issue 2 and IC RSS-GEN issue 5** |
| **Product name** | **Photocontroller** |
| **Brand Name** | **CIMCON** |
| **Model** | **iSLC4100-7P-T** |
| **Test Result** | **Pass** |
| **Statements of Conformity** | **Determination of compliance is based on the results of the compliance measurement,**<br>**not taking into account measurement instrumentation uncertainty.** |

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report.
The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc.(Wugu Laboratory)

*Approved by:*

Kevin Tsai
Deputy Manager

*Tested by:*

Dally Hong
Engineer

# Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| 00 | October 17, 2019 | Initial Issue | Allison Chen |

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# 1. GENERAL INFORMATION

## 1.1 EUT INFORMATION

| | |
|---|---|
| Applicant | CIMCON Lighting, Inc.<br>200 Summit Drive, Suite 500, South Tower, Burlington, MA 01803, United States |
| Manufacturer | CIMCON Lighting, Inc.<br>200 Summit Drive, Suite 500, South Tower, Burlington, MA 01803, United States |
| Equipment | Photocontroller |
| Model No. | iSLC4100-7P-T |
| Model Discrepancy | N/A |
| Trade Name | CIMCON |
| Received Date | May 9, 2019 |
| Date of Test | July 26 ~ September 25, 2019 |
| Output Power(W) | Zigbee: 0.6194 (EIRP: 0.8750) |
| Power Operation | 120 to 277VAC, 50/60Hz |

***Remark:***
*1. The above test method for conduction measurements is in accordance with Part 15.247 & RSS-247, so the test data is identical to another test report T190212E01-RP.*

## 1.2 EUT CHANNEL INFORMATION

| | |
|---|---|
| Frequency Range | Zigbee: 2405~2475MHz |
| Modulation Type | Zigbee: OQPSK (Offset Quadrature Phase Shift Keyed) |
| Number of channels | Zigbee: 13 Channels |

**Remark:**
Refer as ANSI C63.10: 2013 clause 5.6.1 Table 4 and RSS-GEN Table A1 for test channels

| Number of frequencies to be tested | | |
|---|---|---|
| **Frequency range in which device operates** | **Number of frequencies** | **Location in frequency range of operation** |
| ☐ 1 MHz or less | 1 | Middle |
| ☐ 1 MHz to 10 MHz | 2 | 1 near top and 1 near bottom |
| ☒ More than 10 MHz | 3 | 1 near top, 1 near middle, and 1 near bottom |

## 1.3 ANTENNA INFORMATION

| | |
|---|---|
| **Antenna Type** | ☐ PIFA<br>☐ PCB<br>☐ Dipole<br>☐ Coils<br>☒ Monopole Antenna |
| **Antenna Gain** | 1.5 dBi |
| **Antenna Connector** | I-PEX |

# 1.4 MEASUREMENT UNCERTAINTY

| PARAMETER | UNCERTAINTY |
|---|---|
| AC Powerline Conducted Emission | +/- 1.2575 |
| Emission bandwidth, 20dB bandwidth | +/- 0.0014 |
| RF output power, conducted | +/- 1.14 |
| Power density, conducted | +/- 1.40 |
| 3M Semi Anechoic Chamber / 30M~200M | +/- 4.12 |
| 3M Semi Anechoic Chamber / 200M~1000M | +/- 4.68 |
| 3M Semi Anechoic Chamber / 1G~8G | +/- 5.18 |
| 3M Semi Anechoic Chamber / 8G~18G | +/- 5.47 |
| 3M Semi Anechoic Chamber / 18G~26G | +/- 3.81 |
| 3M Semi Anechoic Chamber / 26G~40G | +/- 3.87 |

***Remark**:*
*1.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2*
*2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.*

# 1.5 FACILITIES AND TEST LOCATION

All measurement facilities used to collect the measurement data are located at

*No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)*

| Test site | Test Engineer | Remark |
|---|---|---|
| AC Conduction Room | Dally Hong | - |
| Radiation | Jerry Lu | - |
| RF Conducted | Dally Hong | - |

***Remark:*** *The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.*

# 1.6 INSTRUMENT CALIBRATION

| RF Conducted Test Site | | | | | |
|---|---|---|---|---|---|
| **Name of Equipment** | **Manufacturer** | **Model** | **Serial Number** | **Calibration Date** | **Calibration Due** |
| Coaxial Cable | Woken | WC12 | CC001 | 06/28/2019 | 06/27/2020 |
| Coaxial Cable | Woken | WC12 | CC003 | 06/28/2019 | 06/27/2020 |
| Power Meter | Anritsu | ML2495A | 1149001 | 02/12/2019 | 02/11/2020 |
| Power Seneor | Anritsu | MA2491A | 030982 | 02/12/2019 | 02/11/2020 |
| Signal Analyzer | R&S | FSV 40 | 101073 | 09/27/2018 | 09/26/2019 |
| Software | N/A | | | | |

**For Section 3.3: Test date: 2019/05/15**

| Wugu 966 Chamber A | | | | | |
|---|---|---|---|---|---|
| **Name of Equipment** | **Manufacturer** | **Model** | **Serial Number** | **Calibration Date** | **Calibration Due** |
| Band Reject Filters | MICRO TRONICS | BRM 50702 | 120 | 02/26/2019 | 02/25/2020 |
| Bilog Antenna | Sunol Sciences | JB3 | A030105 | 07/13/2018 | 07/12/2019 |
| Cable | HUBER SUHNER | SUCOFLEX 104PEA | 25157 | 02/26/2019 | 02/25/2020 |
| Cable | HUBER SUHNER | SUCOFLEX 104PEA | 20995 | 02/26/2019 | 02/25/2020 |
| Digital Thermo-Hygro Meter | WISEWIND | 1206 | D07 | 01/30/2019 | 01/29/2020 |
| double Ridged Guide Horn Antenna | ETC | MCTD 1209 | DRH13M02003 | 08/20/2018 | 08/19/2019 |
| Loop Ant | COM-POWER | AL-130 | 121051 | 03/21/2018 | 03/20/2019 |
| Pre-Amplifier | EMEC | EM330 | 060609 | 02/26/2019 | 02/25/2020 |
| Pre-Amplifier | HP | 8449B | 3008A00965 | 02/26/2019 | 02/25/2020 |
| PSA Series Spectrum Analyzer | Agilent | E4446A | MY46180323 | 05/31/2018 | 05/30/2019 |
| Antenna Tower | CCS | CC-A-1F | N/A | N.C.R | N.C.R |
| Controller | CCS | CC-C-1F | N/A | N.C.R | N.C.R |
| Turn Table | CCS | CC-T-1F | N/A | N.C.R | N.C.R |
| Software | e3 6.11-20180413 | | | | |

***Remark:*** *Each piece of equipment is scheduled for calibration once a year.*

**For Section 4.6: Test date: 2019/07/26 ~ 2019/08/23**

| Wugu 966 Chamber A | | | | | |
|---|---|---|---|---|---|
| **Name of Equipment** | **Manufacturer** | **Model** | **Serial Number** | **Calibration Date** | **Calibration Due** |
| Bilog Antenna | Sunol Sciences | JB1 | A052609 | 03/06/2019 | 03/05/2020 |
| Cable | HUBER SUHNER | SUCOFLEX 104PEA | 23452 | 06/27/2019 | 06/26/2020 |
| Cable | HUBER SUHNER | SUCOFLEX 104PEA | 33960 | 06/27/2019 | 06/26/2020 |
| Digital Thermo-Hygro Meter | WISEWIND | 1110 | D06 | 01/30/2019 | 01/29/2020 |
| High Pass Filters | MICRO TRONICS | HPM13195 | 003 | 02/26/2019 | 02/25/2020 |
| Horn Antenna | ETS LINDGREN | 3116 | 00026370 | 12/26/2018 | 12/25/2019 |
| Horn Antenna | SCHWARZBECK | BBHA 9120D | 779 | 03/09/2019 | 03/08/2020 |
| Pre-Amplifier | Anritsu | MH648A | M89145 | 06/27/2019 | 06/26/2020 |
| Pre-Amplifier | EMEC | EM01G26G | 060570 | 06/27/2019 | 06/26/2020 |
| Pre-Amplifier | MITEQ | AMF-6F-18004000-37-8P | 985646 | 06/18/2019 | 06/17/2020 |
| Signal Analyzer | Agilent | N9010A | MY52220817 | 03/20/2019 | 03/19/2020 |
| Antenna Tower | CCS | CC-A-1F | N/A | N.C.R | N.C.R |
| Controller | CCS | CC-C-1F | N/A | N.C.R | N.C.R |
| Turn Table | CCS | CC-T-1F | N/A | N.C.R | N.C.R |
| Software | EZ-EMC (CCS-3A1RE) | | | | |

| Conducted Emission Room # B | | | | | |
|---|---|---|---|---|---|
| **Name of Equipment** | **Manufacturer** | **Model** | **Serial Number** | **Calibration Date** | **Calibration Due** |
| CABLE | EMCI | CFD300-NL | CERF | 06/27/2019 | 06/26/2020 |
| EMI Test Receiver | R&S | ESCI | 100064 | 07/26/2019 | 07/25/2020 |
| LISN | SCHWARZBECK | NSLK 8127 | 8127-541 | 01/31/2019 | 01/30/2020 |
| LISN | SCHAFFNER | NNB 41 | 03/10013 | 02/13/2019 | 02/12/2020 |
| Software | EZ-EMC(CCS-3A1-CE-Wugu) | | | | |

***Remark:*** *Each piece of equipment is scheduled for calibration once a year.*

## 1.7 SUPPORT AND EUT ACCESSORIES EQUIPMENT

| EUT Accessories Equipment | | | | | |
|---|---|---|---|---|---|
| **No.** | **Equipment** | **Brand** | **Model** | **Series No.** | **FCC ID** |
| | N/A | | | | |

| Support Equipment | | | | | |
|---|---|---|---|---|---|
| **No.** | **Equipment** | **Brand** | **Model** | **Series No.** | **FCC ID** |
| 1 | NB(B) | Toshiba | PORTEGE R30-A | N/A | PD97260H |

## 1.8 TEST METHODOLOGY AND APPLIED STANDARDS

The test methodology, setups and results comply with all requirements in accordance with ANSI C63.10:2013, FCC Part 2, FCC Part 15.247, KDB 558074 D01, RSS-247 Issue 2 and RSS-GEN Issue 5

# 2. TEST SUMMERY

| FCC Standard Section | ISED Standard Section | Chapter | Test Item | Result |
|---|---|---|---|---|
| 15.203 | - | 1.3 | Antenna Requirement | Pass |
| 15.207 | RSS-GEN 8.8 | 4.1 | AC Conducted Emission | Pass |
| 15.247(a)(2) | RSS-247(5.2)(a) | 4.2 | 6 dB Bandwidth | Pass |
| - | RSS-GEN 6.7 | 4.2 | Occupied Bandwidth (99%) | - |
| 15.247(b) | RSS-247(5.4)(d) | 4.3 | Output Power Measurement | Pass |
| 15.247(e) | RSS-247(5.2)(b) | 4.4 | Power Spectral Density | Pass |
| 15.247(d) | RSS-247(5.5) | 4.5 | Conducted Band Edge | Pass |
| 15.247(d) | RSS-247(5.5) | 4.5 | Conducted Emission | Pass |
| 15.247(d) | RSS-247(5.5) | 4.6 | Radiation Band Edge | Pass |
| 15.247(d) | RSS-247(5.5) | 4.6 | Radiation Spurious Emission | Pass |

# 3. DESCRIPTION OF TEST MODES

## 3.1 THE WORST MODE OF OPERATING CONDITION

| | |
|---|---|
| Operation mode | Zigbee |
| Test Channel Frequencies | **Zigbee:**<br>1. Lowest Channel : 2405MHz<br>2. Middle Channel : 2445MHz<br>3. Highest Channel : 2475MHz |

***Remark:***
*1. EUT pre-scanned data rate of output power for each mode, the worst data rate were recorded in this report.*

## 3.2 THE WORST MODE OF MEASUREMENT

| AC Power Line Conducted Emission | |
|---|---|
| **Test Condition** | **AC Power line conducted emission for line and neutral** |
| **Power supply Mode** | **Mode 1:EUT power by AC.** |
| **Worst Mode** | **☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4** |

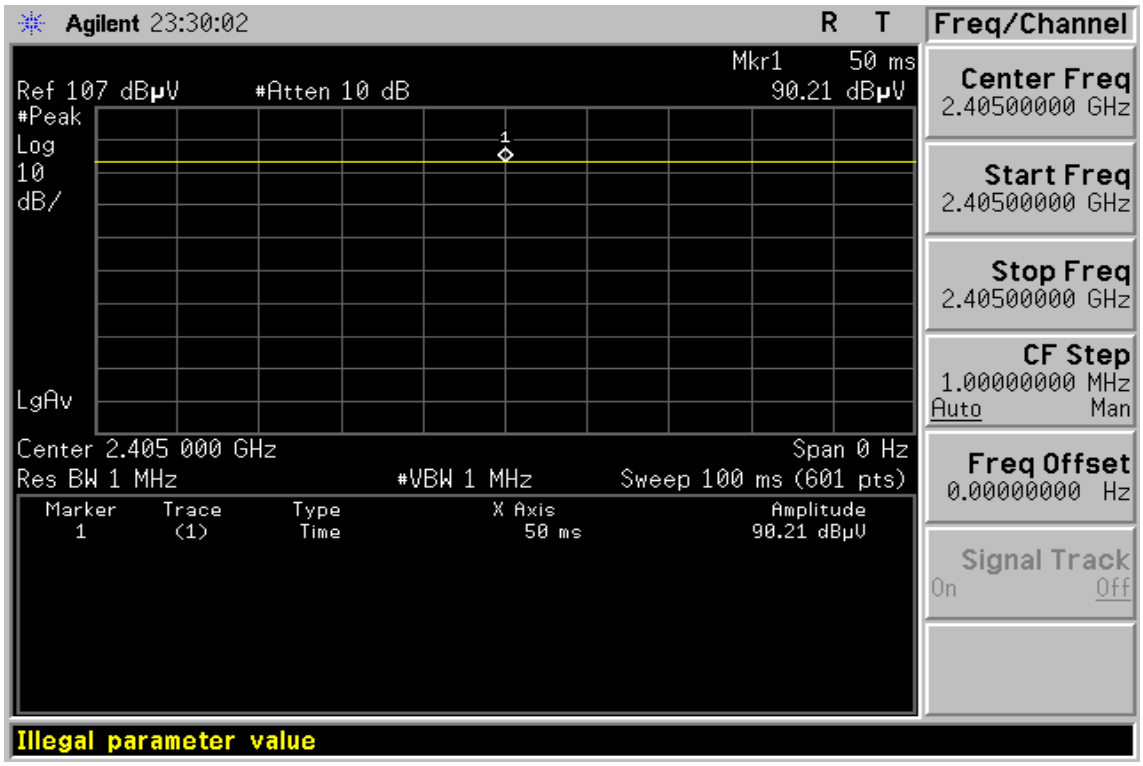
| Radiated Emission Measurement Above 1G | |
|---|---|
| **Test Condition** | **Band edge, Emission for Unwanted and Fundamental** |
| **Power supply Mode** | **Mode 1:EUT power by AC.** |
| **Worst Mode** | **☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4** |
| **Worst Position** | **☐ Placed in fixed position.**<br>**☒ Placed in fixed position at X-Plane (E2-Plane)**<br>**☐ Placed in fixed position at Y-Plane (E1-Plane)**<br>**☐ Placed in fixed position at Z-Plane (H-Plane)** |

| Radiated Emission Measurement Below 1G | |
|---|---|
| **Test Condition** | **Radiated Emission Below 1G** |
| **Power supply Mode** | **Mode 1:EUT power by AC.** |
| **Worst Mode** | **☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4** |

*Remark:*
*1. The worst mode was record in this test report.*
*2. EUT pre-scanned in three axis ,X,Y, Z and two polarity, Horizontal and Vertical for radiated measurement. The worst case(X-Plane) were recorded in this report*
*3. AC power line conducted emission and for below 1G radiation emission were performed the EUT transmit at the highest output power channel as worse case.*

## 3.3 EUT DUTY CYCLE

| Duty Cycle | | | |
|---|---|---|---|
| Configuration | TX ON (ms) | TX ALL (ms) | Duty Cycle (%) |
| Zigbee | 1.0000 | 1.0000 | 100.00% |



# 4. TEST RESULT

## 4.1 AC POWER LINE CONDUCTED EMISSION

### 4.1.1 Test Limit

According to §15.207(a)(2) and RSS-GEN section 8.8,

| Frequency Range (MHz) | Limits(dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56* | 56 to 46* |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

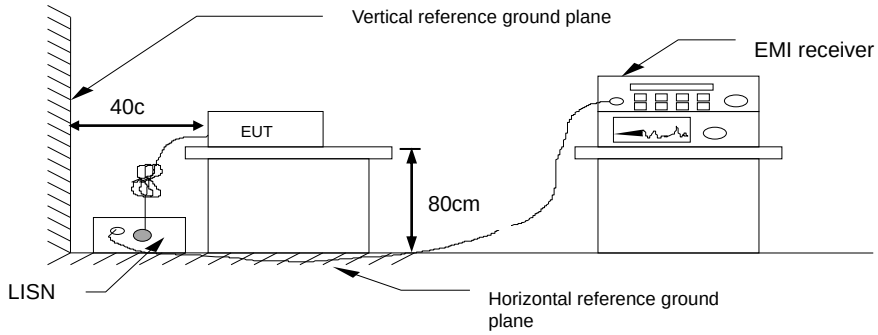
* Decreases with the logarithm of the frequency.

### 4.1.2 Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 6.2,

1. The EUT was placed on a non-conducted table, which is 0.8m above horizontal ground plane and 0.4m above vertical ground plane.
2. EUT connected to the line impedance stabilization network (LISN)
3. Receiver set RBW of 9kHz and Detector Peak, and note as quasi-peak and average.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Recorded Line for Neutral and Line.

### 4.1.3 Test Setup

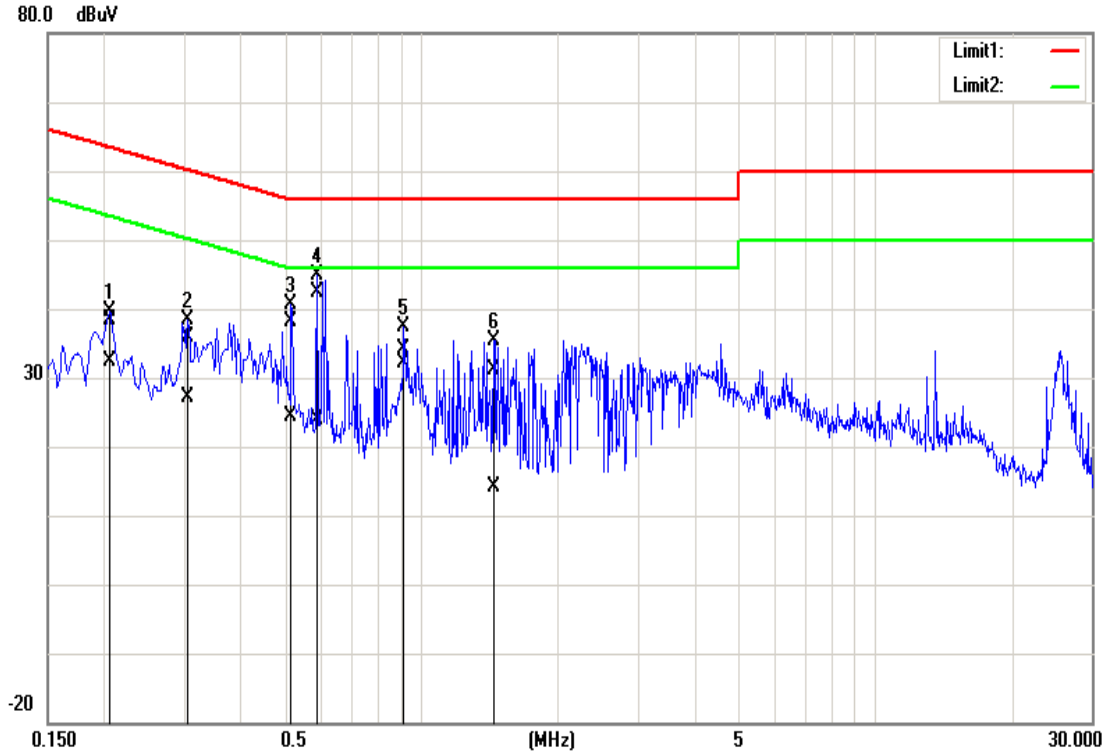



### 4.1.4 Test Result

**Pass.**

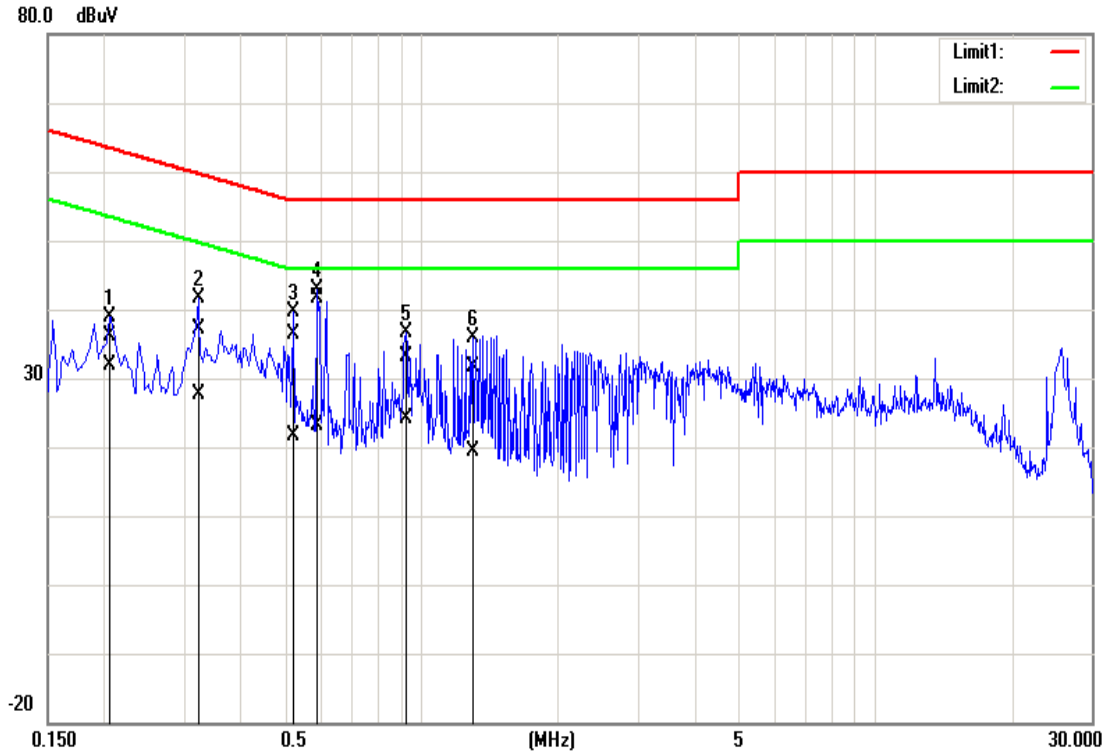
## Test Data

| Test Mode: | Mode 1 | Temp/Hum | 24(℃)/ 50%RH |
|---|---|---|---|
| Test Voltage: | 120Vac / 60Hz | Test Date | 2019/09/25 |
| Phase: | Line | Test Engineer | Dally Hong |




| No. | Frequency | QuasiPeak reading | Average reading | Correction factor | QuasiPeak result | Average result | QuasiPeak limit | Average limit | QuasiPeak margin | Average margin | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | (dBuV) | (dB) | (dBuV) | (dBuV) | (dBuV) | (dBuV) | (dB) | (dB) | |
| 1 | 0.2060 | 28.22 | 22.37 | 10.13 | 38.35 | 32.50 | 63.37 | 53.37 | -25.02 | -20.87 | Pass |
| 2 | 0.3060 | 25.65 | 17.02 | 10.14 | 35.79 | 27.16 | 60.08 | 50.08 | -24.29 | -22.92 | Pass |
| 3 | 0.5180 | 28.02 | 14.29 | 10.14 | 38.16 | 24.43 | 56.00 | 46.00 | -17.84 | -21.57 | Pass |
| 4* | 0.5900 | 32.35 | 13.70 | 10.15 | 42.50 | 23.85 | 56.00 | 46.00 | -13.50 | -22.15 | Pass |
| 5 | 0.9180 | 23.84 | 21.84 | 10.17 | 34.01 | 32.01 | 56.00 | 46.00 | -21.99 | -13.99 | Pass |
| 6 | 1.4420 | 20.98 | 3.90 | 10.17 | 31.15 | 14.07 | 56.00 | 46.00 | -24.85 | -31.93 | Pass |

| Test Mode: | Mode 1 | Temp/Hum | 24(℃)/ 50%RH |
|---|---|---|---|
| Test Voltage: | 120Vac / 60Hz | Test Date | 2019/09/25 |
| Phase: | Neutral | Test Engineer | Dally Hong |




| No. | Frequency | QuasiPeak reading | Average reading | Correction factor | QuasiPeak result | Average result | QuasiPeak limit | Average limit | QuasiPeak margin | Average margin | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | (dBuV) | (dB) | (dBuV) | (dBuV) | (dBuV) | (dBuV) | (dB) | (dB) | |
| 1 | 0.2060 | 26.07 | 21.91 | 10.02 | 36.09 | 31.93 | 63.37 | 53.37 | -27.28 | -21.44 | Pass |
| 2 | 0.3220 | 27.15 | 17.48 | 10.03 | 37.18 | 27.51 | 59.66 | 49.66 | -22.48 | -22.15 | Pass |
| 3 | 0.5220 | 26.32 | 11.71 | 10.03 | 36.35 | 21.74 | 56.00 | 46.00 | -19.65 | -24.26 | Pass |
| 4* | 0.5900 | 31.64 | 13.20 | 10.03 | 41.67 | 23.23 | 56.00 | 46.00 | -14.33 | -22.77 | Pass |
| 5 | 0.9260 | 23.01 | 13.99 | 10.04 | 33.05 | 24.03 | 56.00 | 46.00 | -22.95 | -21.97 | Pass |
| 6 | 1.2980 | 21.52 | 9.37 | 10.04 | 31.56 | 19.41 | 56.00 | 46.00 | -24.44 | -26.59 | Pass |

# 4.2 6dB BANDWIDTH AND OCCUPIED BANDWIDTH (99%)

## 4.2.1 Test Limit

According to §15.247(a)(2) and RSS-247 section 5.2(a), RSS-GEN 6.7,

**6 dB Bandwidth** ：

| | |
|---|---|
| Limit | Shall be at least 500kHz |

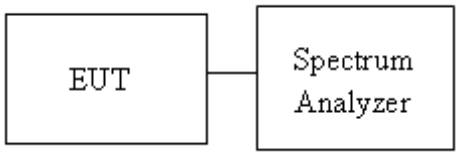
**Occupied Bandwidth(99%)** ： For reporting purposes only.

## 4.2.2 Test Procedure

Test method Refer as KDB 558074 D01 and ANSI C63.10: 2013 clause 6.9.2,

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 100kHz, VBW = 300kHz and Detector = Peak, to measurement 6 dB Bandwidth.
4. SA set RBW = 1% ~ 5% OBW, VBW = three times the RBW and Detector = Peak, to measurement 99% Bandwidth
5. Measure and record the result of 6 dB Bandwidth and 99% Bandwidth in the test report.

## 4.2.3 Test Setup



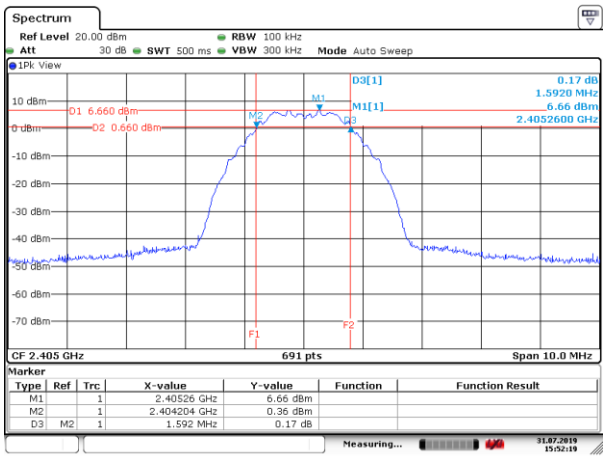

## 4.2.4 Test Result

| Test mode: Zigbee / 2405-2475 MHz | | | | |
|---|---|---|---|---|
| **Channel** | **Frequency (MHz)** | **OBW (99%) (MHz)** | **6dB BW (MHz)** | **6dB limit (kHz)** |
| Low | 2405 | 2.1997 | 1.5920 | ≥500 |
| Mid | 2445 | 2.1997 | 1.5480 | |
| High | 2475 | 2.2286 | 1.5770 | |

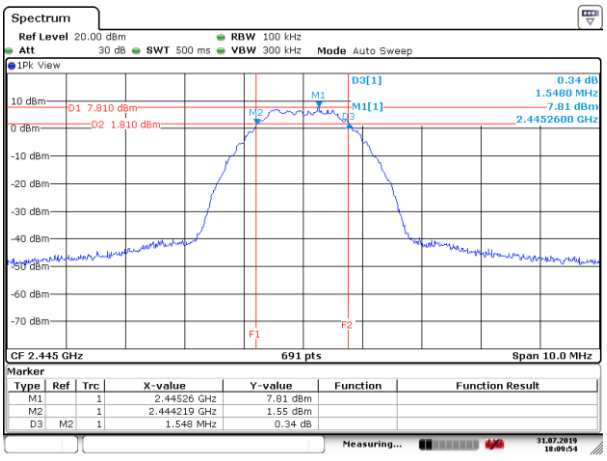
# Test Data 6dB BANDWIDTH

## Zigbee

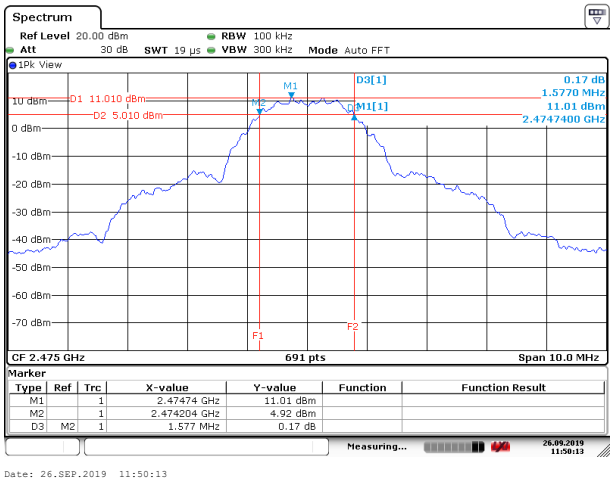
### Low CH



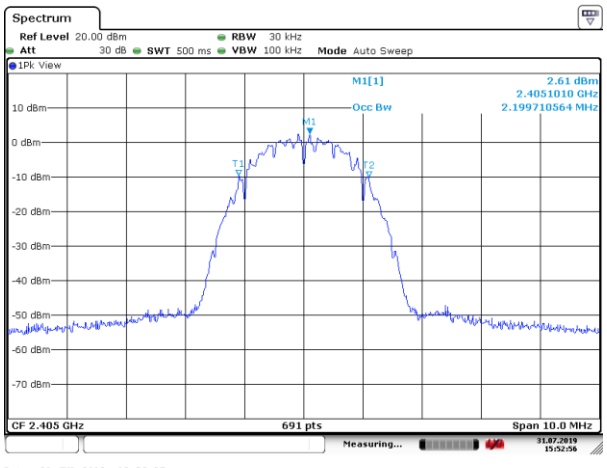
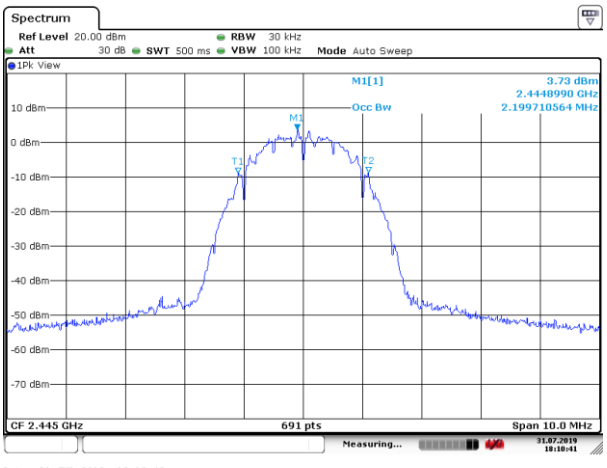
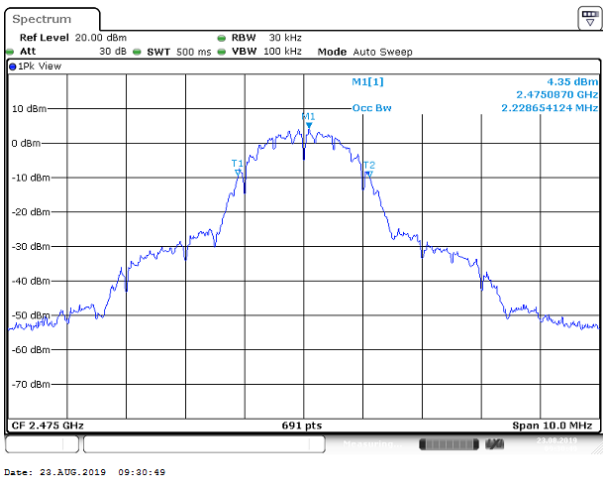

### Mid CH




### High CH



# Test Data BANDWIDTH (99%)

| Zigbee | |
|---|---|
| **Low CH** | **Mid CH** |
|  |  |
| **High CH** | |
|  | |

# 4.3 OUTPUT POWER MEASUREMENT

## 4.3.1 Test Limit

According to §15.247(b) and RSS-247 section 5.4(d),

**Peak output power**：

For systems using digital modulation in the 2400-2483.5 MHz: 1 Watt(30 dBm), base on the use of antennas with directional gain not exceed 6 dBi If transmitting antennas of directional gain greater than 6dBi are used the peak output power the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

| | |
|---|---|
| Limit | ☒ Antenna not exceed 6 dBi：30dBm<br>☐ Antenna with DG greater than 6 dBi：<br>[Limit = 30 – (DG – 6)]<br>☐ Point-to-point operation： |

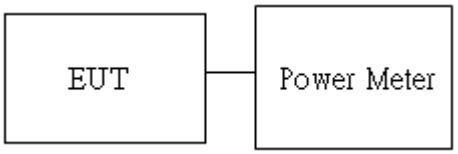
**Average output power**：For reporting purposes only.

## 4.3.2 Test Procedure

Test method Refer as KDB 558074 D01.

1. The EUT RF output connected to the power meter by RF cable.
2. Setting maximum power transmit of EUT.
3. The path loss was compensated to the results for each measurement.
4. Measure and record the result of Peak output power and Average output power in the test report.

## 4.3.3 Test Setup



## 4.3.4 Test Result

**Peak output power**：

| Zigbee | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Config.** | **Freq. (MHz)** | **Power Setting** | **PK Power (dBm)** | **EIRP PK Power (dBm)** | **PK Power (W)** | **EIRP PK Power (W)** | **Limit (dBm)** |
| Zigbee | 2405 | 30 | 27.85 | 29.35 | 0.6095 | 0.8610 | 30 |
| | 2445 | 30 | 27.92 | 29.42 | 0.6194 | 0.8750 | |
| | 2475 | 30 | 27.91 | 29.41 | 0.6180 | 0.8730 | |

**Average output power**：

| Zigbee | | | |
|---|---|---|---|
| **Config.** | **Freq. (MHz)** | **Power Setting** | **AV Power (dBm)** |
| Zigbee | 2405 | 30 | 27.18 |
| | 2445 | 30 | 27.23 |
| | 2475 | 30 | 27.25 |

# 4.4 POWER SPECTRAL DENSITY

## 4.4.1 Test Limit

According to §15.247(e), RSS-247 section 5.2(b),

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

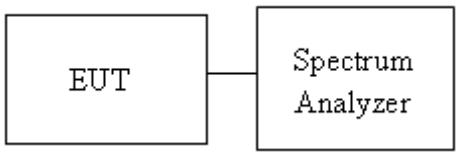
| | |
|---|---|
| Limit | ☒ Antenna not exceed 6 dBi：8dBm<br>☐ Antenna with DG greater than 6 dBi<br>[ Limit = 8 – (DG – 6)]<br>☐ Point-to-point operation： |

## 4.4.2 Test Procedure

Test method Refer as KDB 558074 D01.

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 3kHz, VBW = 30kHz, Span = 1.5 times DTS Bandwidth (6 dB BW), Detector = Peak, Sweep Time = Auto and Trace = Max hold.
4. The path loss and Duty Factor were compensated to the results for each measurement by SA.
5. Mark the maximum level.
6. Measure and record the result of power spectral density. in the test report.

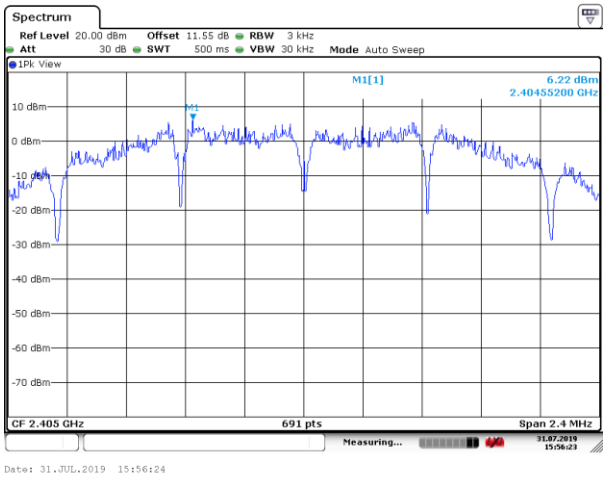
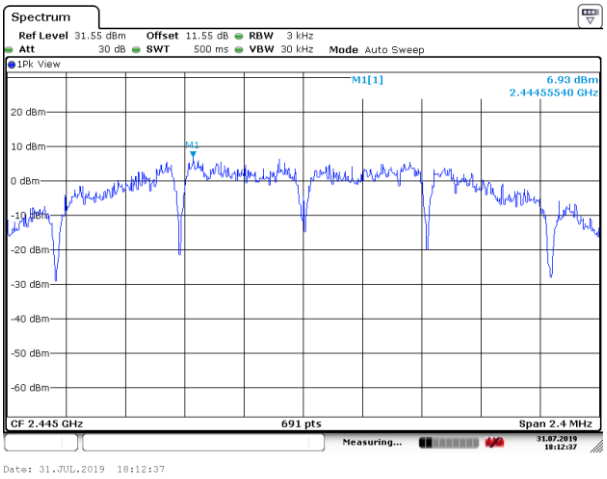
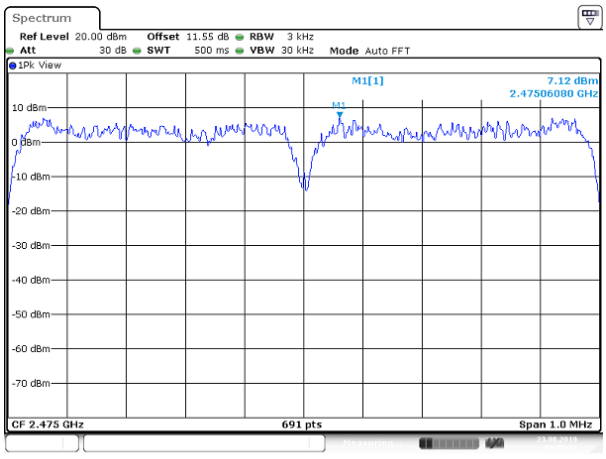
## 4.4.3 Test Setup




### 4.4.4 Test Result

| Test mode: Zigbee | | | |
|---|---|---|---|
| **Channel** | **Frequency (MHz)** | **PPSD (dBm)** | **Limit (dBm)** |
| Low | 2405 | 6.22 | 8 |
| Mid | 2445 | 6.93 | |
| High | 2475 | 7.12 | |

# Test Data

| Zigbee | |
|---|---|
| **Low CH** | **Mid CH** |
|  |  |
| **High CH** | |
|  | |

# 4.5 CONDUCTED BANDEDGE AND SPURIOUS EMISSION

## 4.5.1 Test Limit

According to §15.247(d) and RSS-247 section 5.5,

In any 100 kHz bandwidth outside the authorized frequency band,

Non-restricted bands shall be attenuated at least 20 dB/30 dB relative to the maximum PSD level in 100 kHz by RF conducted or a radiated measurement which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

## 4.5.2 Test Procedure

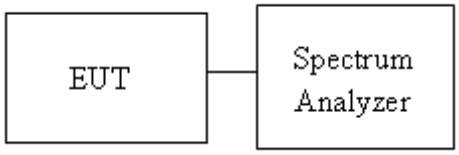
Test method Refer as KDB 558074 D01

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.

2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.

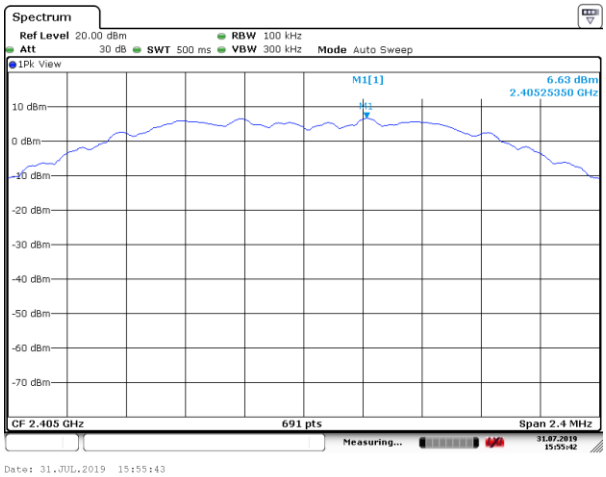
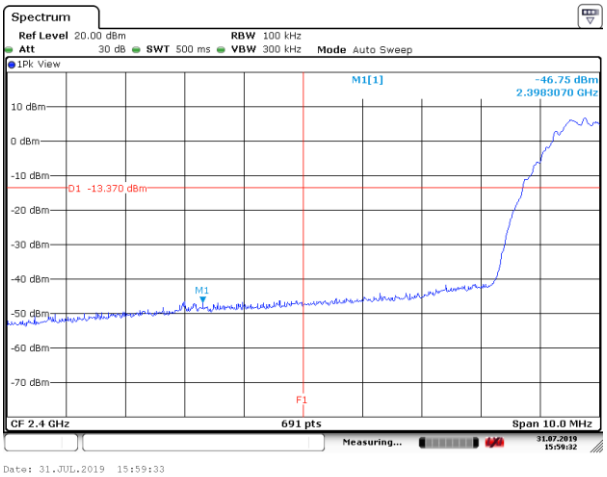
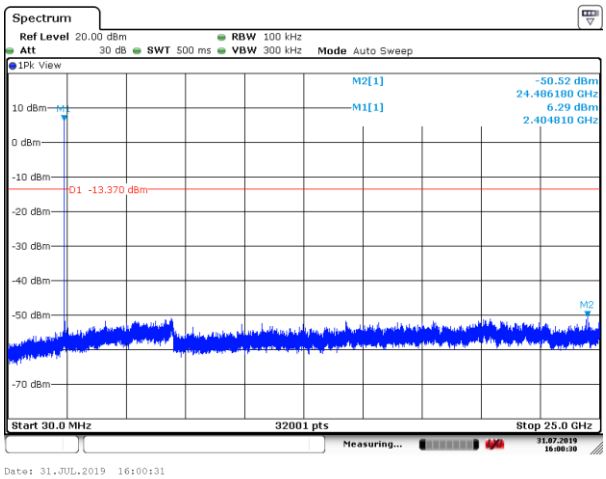
3. In any 100 kHz bandwidth outside the authorized frequency band, shall be attenuated at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when conducted power procedure is used. f the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

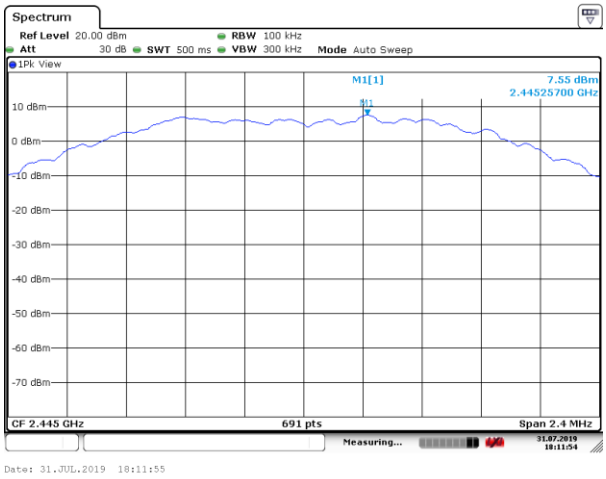
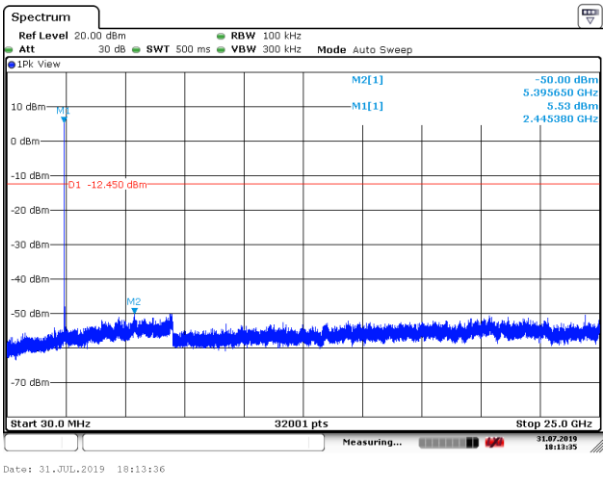
## 4.5.3 Test Setup

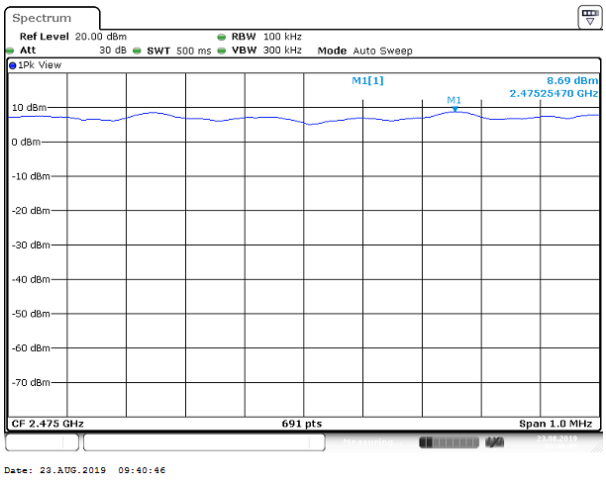
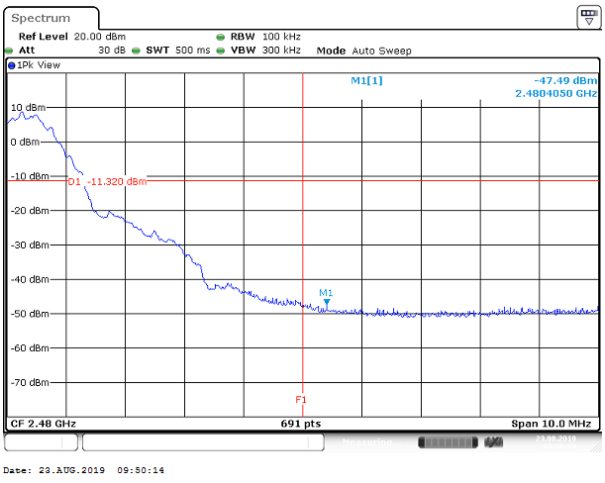
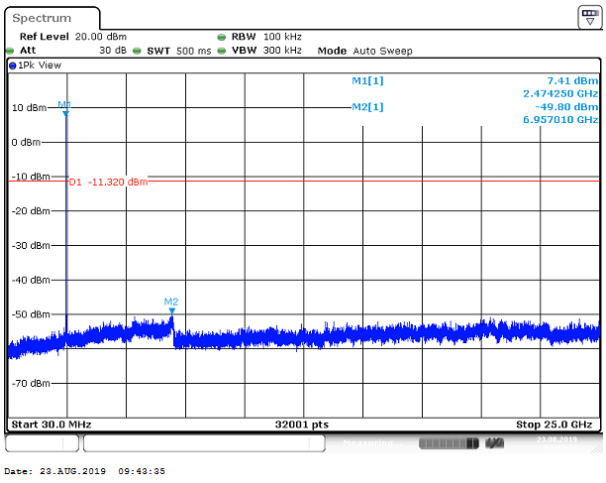


## 4.5.4 Test Result

**Test Data**

| Zigbee Low CH | |
|---|---|
| **Reference Level of PSD in 100kHz** | **Band Edge** |
|  |  |
| **Spurious Emission 30MHz-25GHz** | |
|  | |

| Zigbee Mid CH | |
|---|---|
| **Reference Level of PSD in 100kHz** | **Spurious Emission 30MHz-25GHz** |
|  |  |

| Zigbee High CH | |
|---|---|
| **Reference Level of PSD in 100kHz** | **Band Edge** |
|  |  |
| **Spurious Emission 30MHz-25GHz** | |
|  | |

# 4.6 RADIATION BANDEDGE AND SPURIOUS EMISSION

## 4.6.1 Test Limit

FCC according to §15.247(d), §15.209 and §15.205

IC according to RSS-247 section 5.5, RSS-Gen, Section 8.9 and 8.10,

In any 100 kHz bandwidth outside the authorized frequency band, all harmonic and spurious must be least 20 dB below the highest emission level with the authorized frequency band. Radiation emission which fall in the restricted bands must also follow the FCC section 15.209 as below limit in table.

**Below 30 MHz**

| Frequency | Field Strength (microvolts/m) | Magnetic H-Field (microamperes/m) | Measurement Distance (metres) |
|---|---|---|---|
| 9-490 kHz | 2,400/F (F in kHz) | 2,400/F (F in kHz) | 300 |
| 490-1,705 kHz | 24,000/F (F in kHz) | 24,000/F (F in kHz) | 30 |
| 1.705-30 MHz | 30 | N/A | 30 |

**Above 30 MHz**

| Frequency (MHz) | Field Strength microvolts/m at 3 metres (watts, e.i.r.p.) | |
|---|---|---|
| | Transmitters | Receivers |
| 30-88 | 100 (3 nW) | 100 (3 nW) |
| 88-216 | 150 (6.8 nW) | 150 (6.8 nW) |
| 216-960 | 200 (12 nW) | 200 (12 nW) |
| Above 960 | 500 (75 nW) | 500 (75 nW) |

Remark:
Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field.

**RSS-Gen Table 3 and Table 5 – General Field Strength Limits for Transmitters and Receivers at Frequencies Above 30 MHz (Note)**

| Frequency (MHz) | Field Strength microvolts/m at 3 metres (watts, e.i.r.p.) | |
|---|---|---|
| | Transmitters | Receivers |
| 30-88 | 100 (3 nW) | 100 (3 nW) |
| 88-216 | 150 (6.8 nW) | 150 (6.8 nW) |
| 216-960 | 200 (12 nW) | 200 (12 nW) |
| Above 960 | 500 (75 nW) | 500 (75 nW) |

***Note:*** Measurements for compliance with the limits in table 3 may be performed at distances other than 3 metres, in accordance with Section 6.6.

**RSS-Gen Table 6: General Field Strength Limits for Transmitters at Frequencies Below 30 MHz (Transmit)**

| Frequency | Magnetic field strength (H-Field) (µA/m) | Measurement Distance (m) |
|---|---|---|
| 9-490 kHz Note | 6.37/F (F in kHz) | 300 |
| 490-1,705 kHz | 63.7/F (F in kHz) | 30 |
| 1.705-30 MHz | 0.08 | 30 |

***Note:*** The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector..

### 4.6.2 Test Procedure

Test method Refer as KDB 558074 D01.

1. The EUT is placed on a turntable, Above 1 GHz is 1.5m and below 1 GHz is 0.8m above ground plane. The EUT Configured un accordance with ANSI C63.10: 2013, and the EUT set in a continuous mode.

2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. And EUT is set 3m away from the receiving antenna, which is scanned from 1m to 4m above the ground plane to find out the highest emissions. Measurement are made polarized in both the vertical and the horizontal positions with antenna.

3. Span shall wide enough to full capture the emission measured. The SA from 30MHz to 26.5GHz set to the low, Mid and High channels with the EUT transmit.

4. The SA setting following：

(1) Below 1G：RBW = 100kHz, VBW ≥ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.

(2) Above 1G：

(2.1) For Peak measurement：RBW = 1MHz, VBW ≥ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.

(2.2) For Average measurement：RBW = 1MHz, VBW

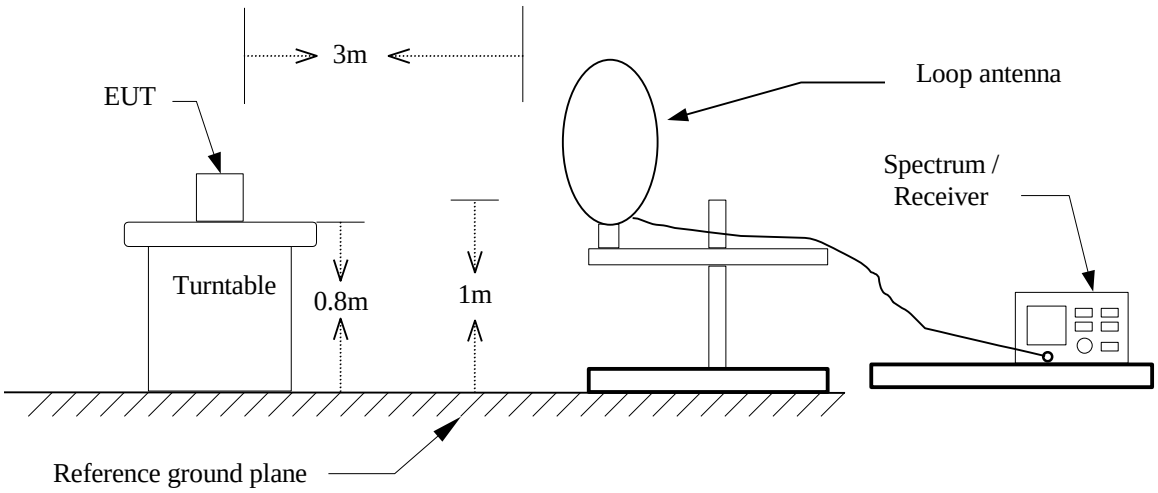
- If Duty Cycle ≥ 98%, VBW=10Hz.
- If Duty Cycle < 98%, VBW≥1/T.

| Configuration | Duty Cycle (%) | T(ms) | 1/T (kHz) | VBW Setting |
|---|---|---|---|---|
| Zigbee | 100% | 1.0000 | - | 10Hz |

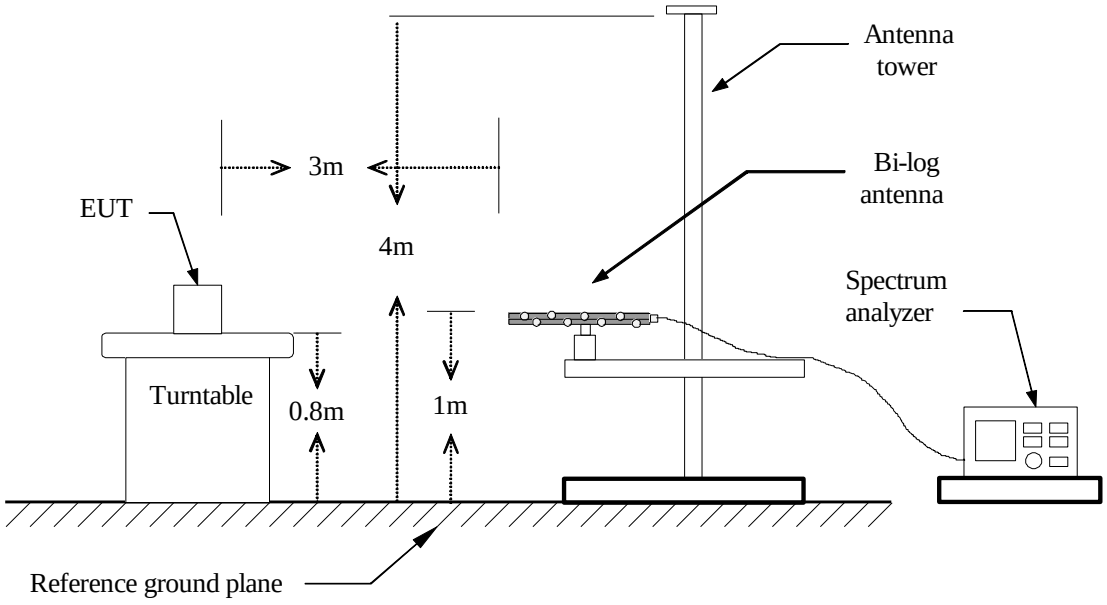
Remark:
1. Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
2. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).

## 4.6.3 Test Setup

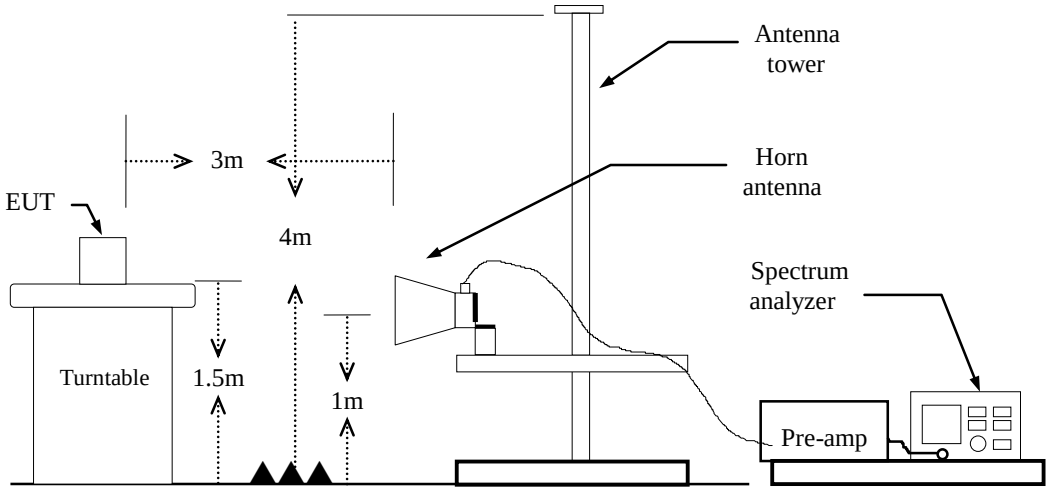
**9kHz ~ 30MHz**




**30MHz ~ 1GHz**



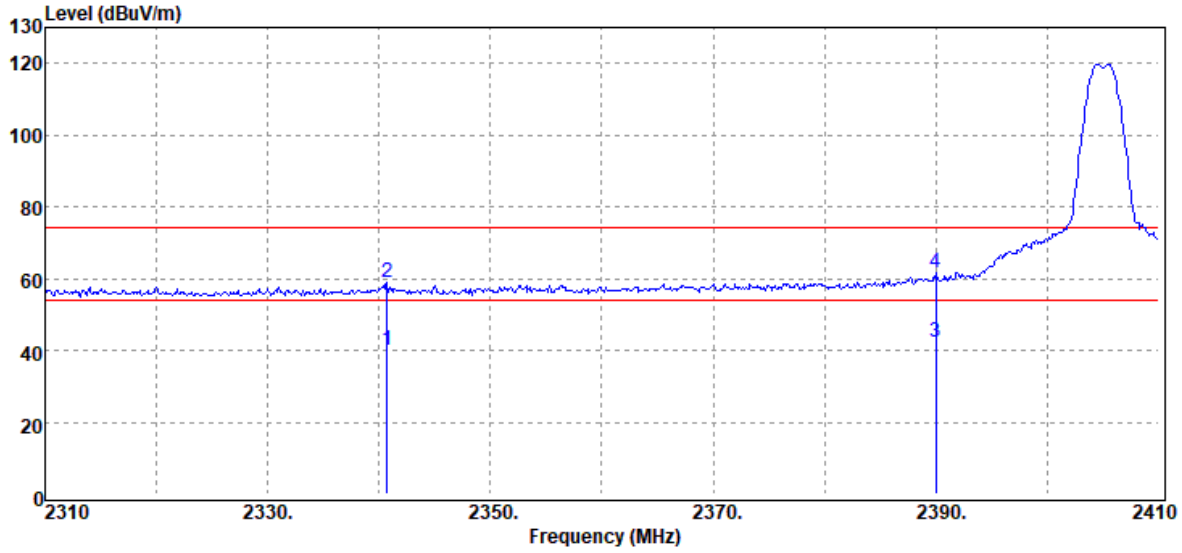
## Above 1 GHz



## 4.6.4 Test Result

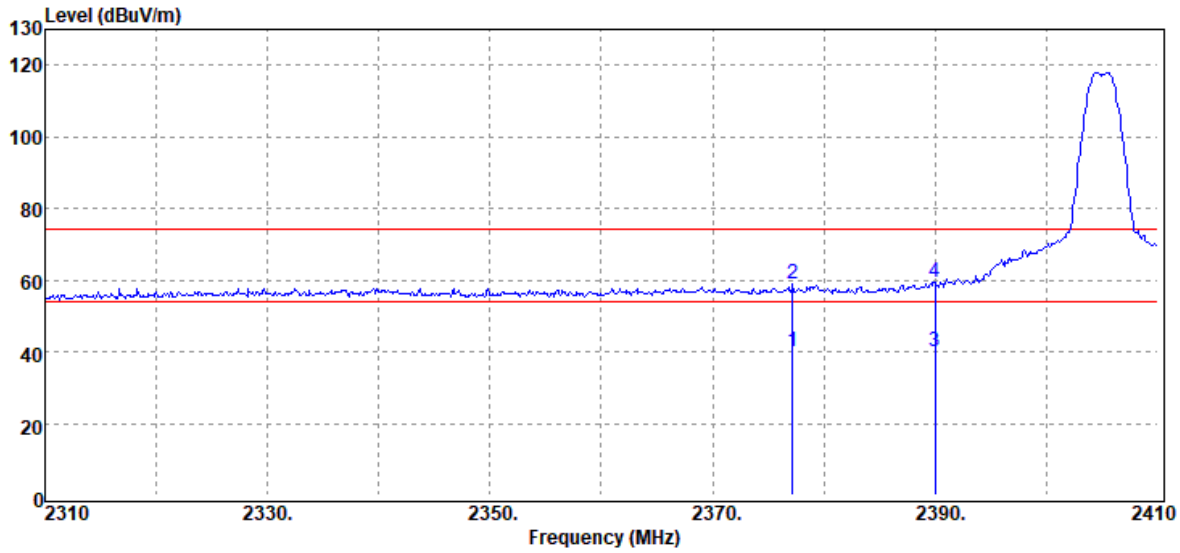
**Band Edge Test Data**

| Test Mode | Zigbee Low CH | Temp/Hum | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | Band Edge | Test Date | July 30, 2019 |
| Polarize | Vertical | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |



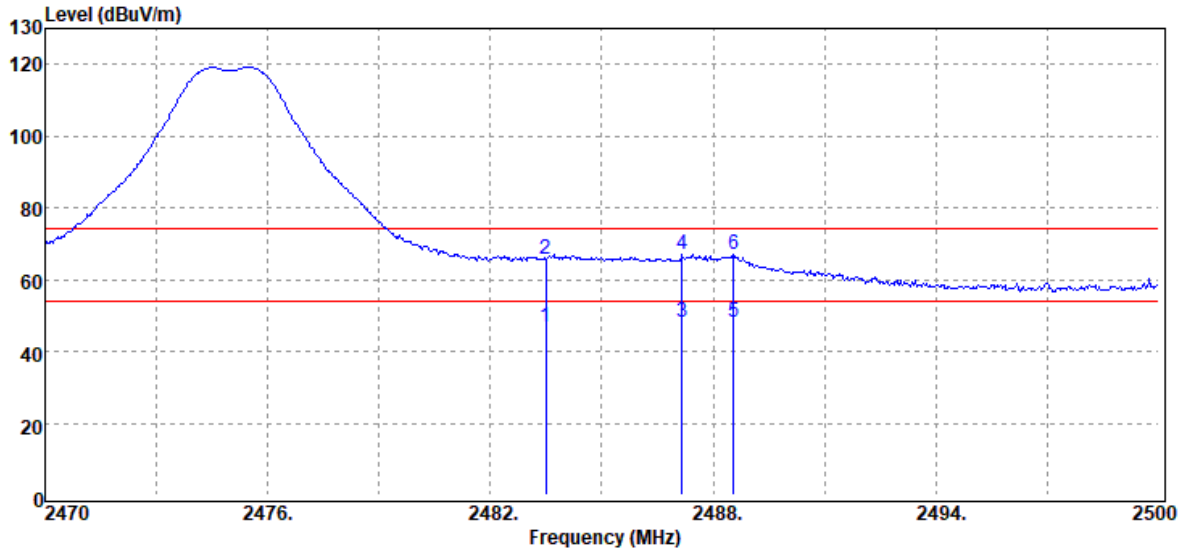

| Frequency (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 2340.70 | Average | - | -19.09 | 39.82 | 54.00 | -14.18 |
| 2340.70 | Peak | 62.20 | -3.29 | 58.91 | 74.00 | -15.09 |
| 2390.00 | Average | - | -19.09 | 42.46 | 54.00 | -11.54 |
| 2390.00 | Peak | 64.93 | -3.38 | 61.55 | 74.00 | -12.45 |

| Test Mode | Zigbee Low CH | Temperature: | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | Band Edge | Test Date | July 30, 2019 |
| Polarize | Horizontal | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |



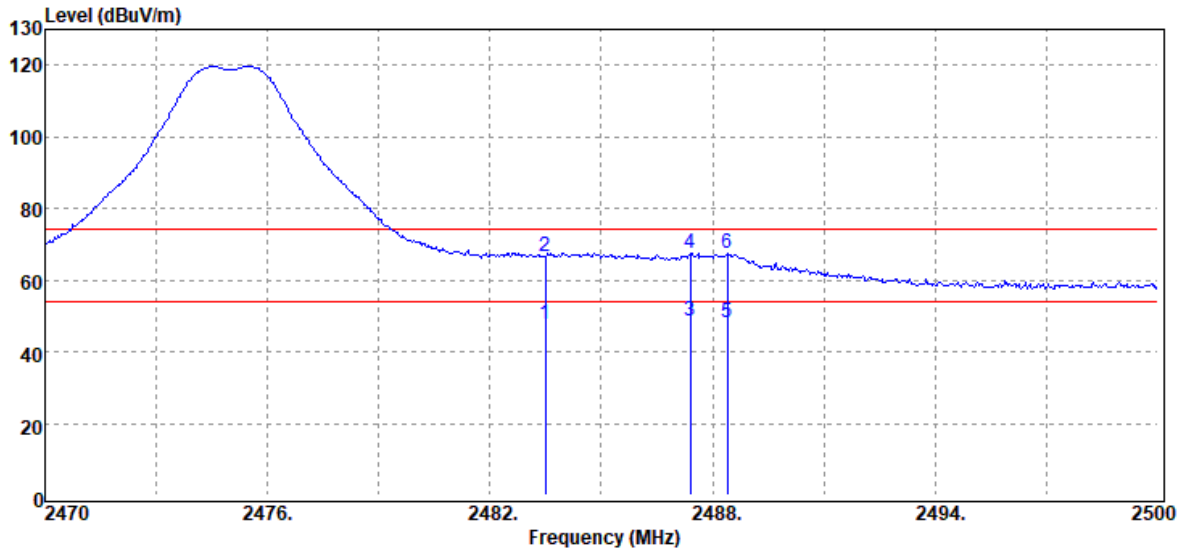

| Frequency (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 2377.20 | Average | - | -19.09 | 39.84 | 54.00 | -14.16 |
| 2377.20 | Peak | 62.29 | -3.36 | 58.93 | 74.00 | -15.07 |
| 2390.00 | Average | - | -19.09 | 40.16 | 54.00 | -13.84 |
| 2390.00 | Peak | 62.63 | -3.38 | 59.25 | 74.00 | -14.75 |

| Test Mode | Zigbee High CH | Temp/Hum | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | Band Edge | Test Date | July 30, 2019 |
| Polarize | Vertical | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |




| Frequency (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 2483.50 | Average | - | -19.09 | 46.73 | 54.00 | -7.27 |
| 2483.50 | Peak | 68.65 | -2.83 | 65.82 | 74.00 | -8.18 |
| 2487.16 | Average | - | -19.09 | 48.00 | 54.00 | -6.00 |
| 2487.16 | Peak | 69.89 | -2.80 | 67.09 | 74.00 | -6.91 |
| 2488.54 | Average | - | -19.09 | 47.93 | 54.00 | -6.07 |
| 2488.54 | Peak | 69.82 | -2.80 | 67.02 | 74.00 | -6.98 |

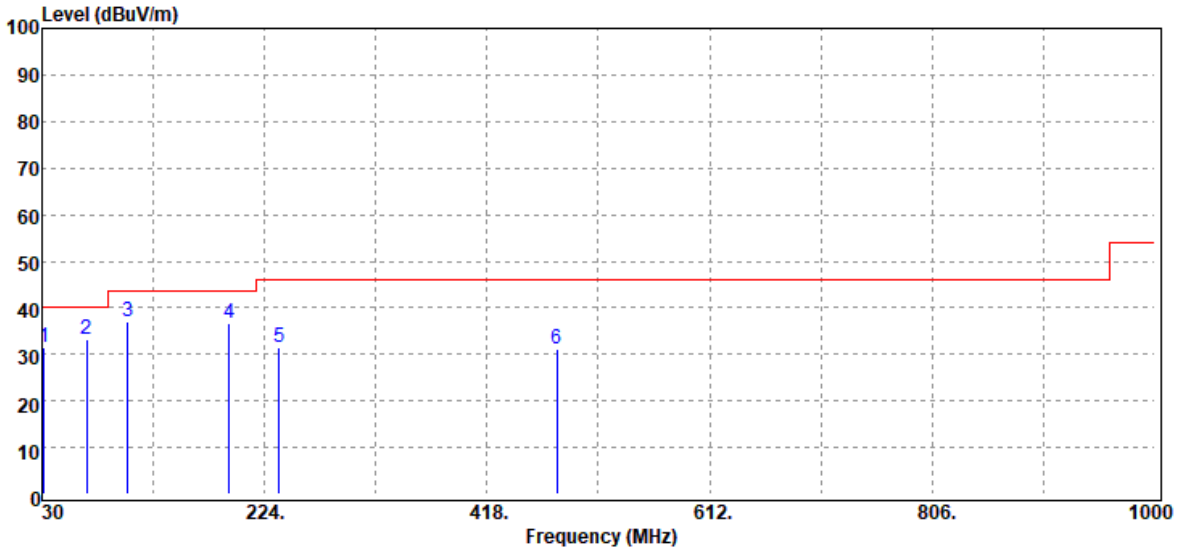
| Test Mode | Zigbee High CH | Temperature: | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | Band Edge | Test Date | July 30, 2019 |
| Polarize | Horizontal | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |




| Frequency (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 2483.50 | Average | - | -19.09 | 47.56 | 54.00 | -6.44 |
| 2483.50 | Peak | 69.48 | -2.83 | 66.65 | 74.00 | -7.35 |
| 2487.40 | Average | - | -19.09 | 48.39 | 54.00 | -5.61 |
| 2487.40 | Peak | 70.28 | -2.80 | 67.48 | 74.00 | -6.52 |
| 2488.39 | Average | - | -19.09 | 48.32 | 54.00 | -5.68 |
| 2488.39 | Peak | 70.21 | -2.80 | 67.41 | 74.00 | -6.59 |

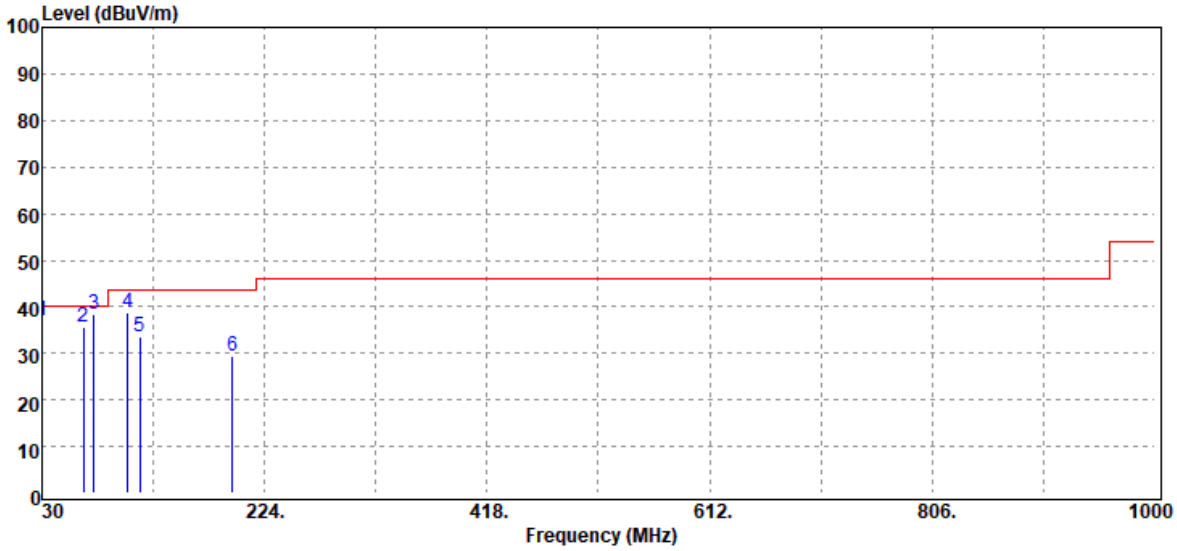
**Below 1GHz**

| Test Mode | Zigbee Mid CH | Temp/Hum | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | 30MHz-1GHz | Test Date | July 26, 2019 |
| Polarize | Vertical | Test Engineer | Jerry Lu |
| Detector | Peak | | |




| Freq. (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 31.94 | Peak | 34.84 | -3.40 | 31.44 | 40.00 | -8.56 |
| 68.80 | Peak | 48.17 | -14.93 | 33.24 | 40.00 | -6.76 |
| 104.69 | Peak | 48.31 | -11.18 | 37.13 | 43.50 | -6.37 |
| 192.96 | Peak | 47.09 | -10.44 | 36.65 | 43.50 | -6.85 |
| 236.61 | Peak | 42.01 | -10.51 | 31.50 | 46.00 | -14.50 |
| 479.11 | Peak | 34.17 | -2.98 | 31.19 | 46.00 | -14.81 |

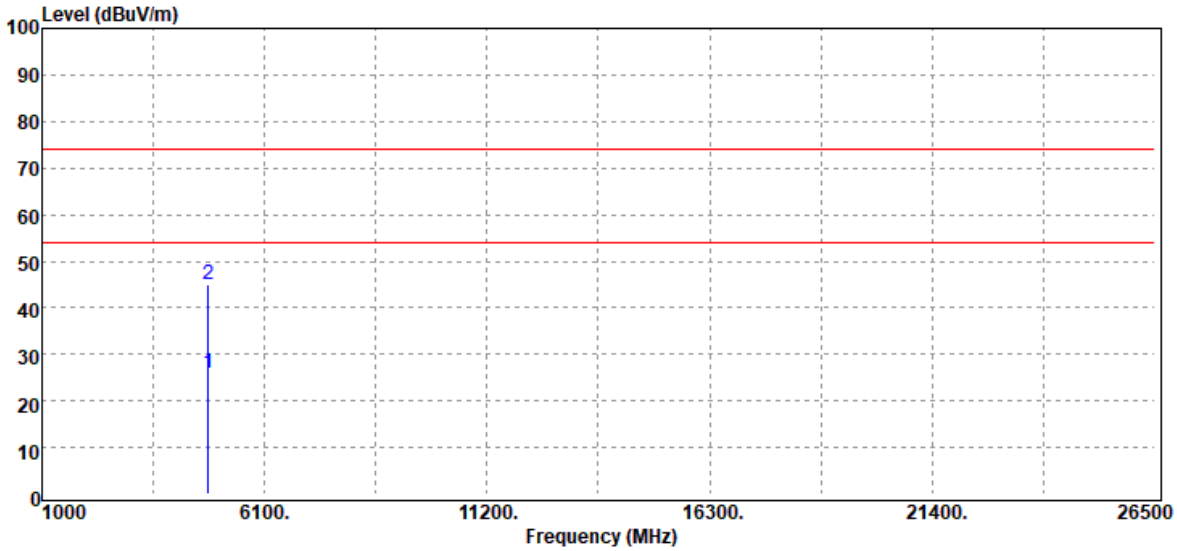
| Test Mode | Zigbee Mid CH | Temp/Hum | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | 30MHz-1GHz | Test Date | July 26, 2019 |
| Polarize | Horizontal | Test Engineer | Jerry Lu |
| Detector | Peak and Quasi-peak | | |




| Freq. (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 30.00 | QP | 38.65 | -1.51 | 37.14 | 40.00 | -2.86 |
| 65.89 | QP | 50.96 | -15.35 | 35.61 | 40.00 | -4.39 |
| 75.59 | QP | 53.06 | -14.79 | 38.27 | 40.00 | -1.73 |
| 104.69 | QP | 50.05 | -11.19 | 38.86 | 43.50 | -4.64 |
| 115.36 | Peak | 42.86 | -9.27 | 33.59 | 43.50 | -9.91 |
| 195.87 | Peak | 39.25 | -9.78 | 29.47 | 43.50 | -14.03 |

**Above 1 GHz**

| Test Mode | Zigbee Low CH | Temp/Hum | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | Harmonic | Test Date | July 30, 2019 |
| Polarize | Vertical | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |

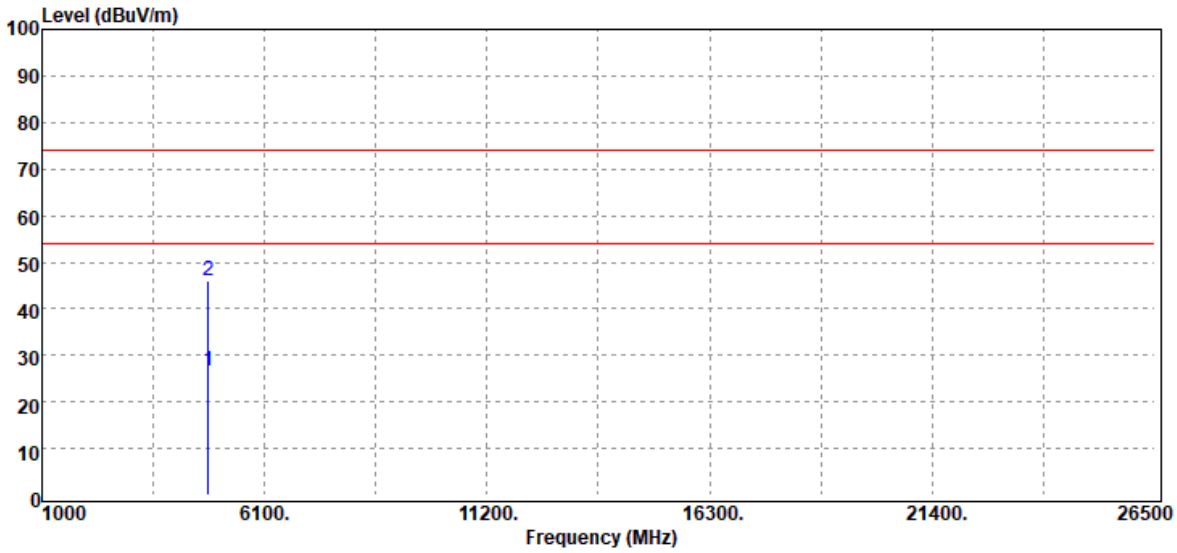



| Freq. (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 4810.00 | Average | - | -19.09 | 25.95 | 54.00 | -28.05 |
| 4810.00 | Peak | 42.00 | 3.04 | 45.04 | 74.00 | -28.96 |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

***Remark:***

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*

| Test Mode | Zigbee Low CH | Temp/Hum | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | Harmonic | Test Date | July 30, 2019 |
| Polarize | Horizontal | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |

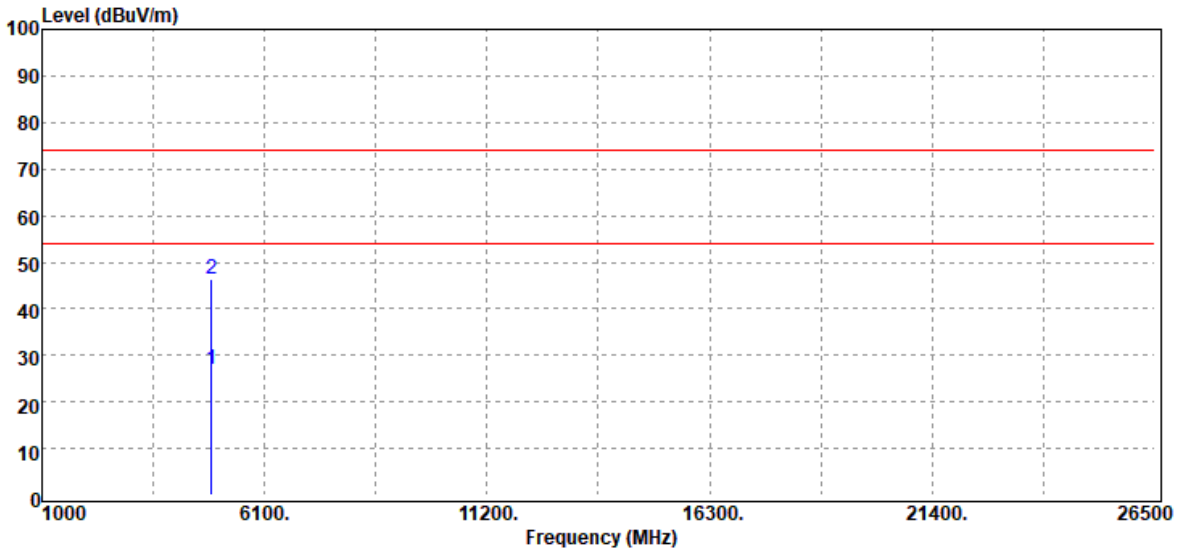



| Freq. (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 4810.00 | Average | - | -19.09 | 26.77 | 54.00 | -27.23 |
| 4810.00 | Peak | 42.82 | 3.04 | 45.86 | 74.00 | -28.14 |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

***Remark:***

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*

| Test Mode | Zigbee Mid CH | Temp/Hum | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | Harmonic | Test Date | July 30, 2019 |
| Polarize | Vertical | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |




| Freq. (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 4890.00 | Average | - | -19.09 | 27.16 | 54.00 | -26.84 |
| 4890.00 | Peak | 42.78 | 3.47 | 46.25 | 74.00 | -27.75 |
| N/A | | | | | | |
| | | | | | | |
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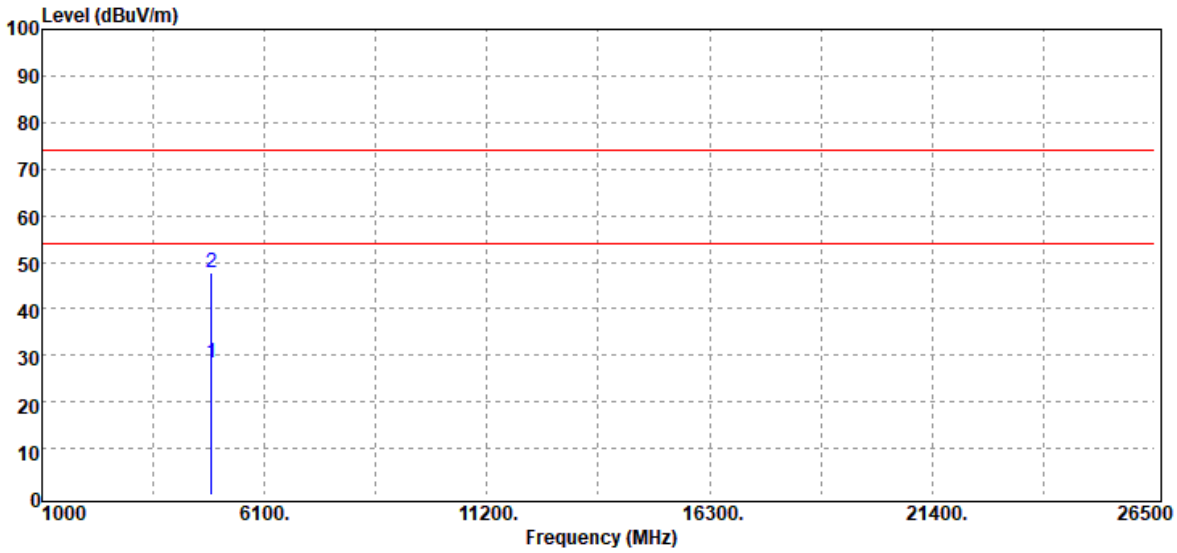
***Remark:***

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*

| Test Mode | Zigbee Mid CH | Temp/Hum | 23.6(℃)/ 48%RH |
|---|---|---|---|
| Test Item | Harmonic | Test Date | July 30, 2019 |
| Polarize | Horizontal | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |




| Freq. (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 4890.00 | Average | - | -19.09 | 28.54 | 54.00 | -25.46 |
| 4890.00 | Peak | 44.16 | 3.47 | 47.63 | 74.00 | -26.37 |
| N/A | | | | | | |
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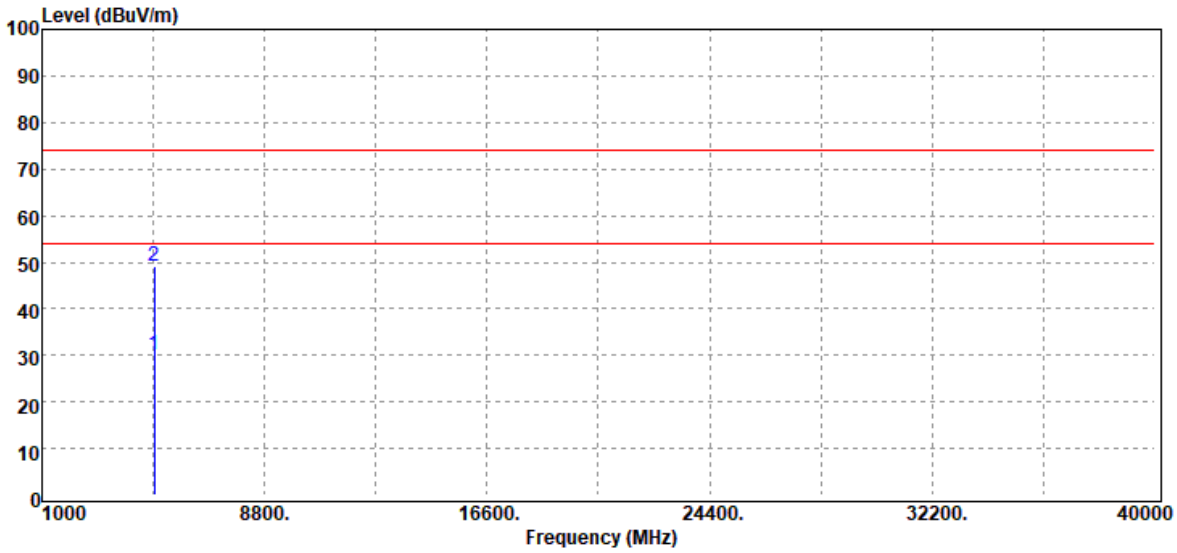
***Remark:***

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*

| Test Mode | Zigbee High CH | Temp/Hum | 28.3(℃)/ 35%RH |
|---|---|---|---|
| Test Item | Harmonic | Test Date | August 23, 2019 |
| Polarize | Vertical | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |




| Freq. (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 4890.00 | Average | - | -19.09 | 28.54 | 54.00 | -25.46 |
| 4890.00 | Peak | 44.16 | 3.47 | 47.63 | 74.00 | -26.37 |
| N/A | | | | | | |
| | | | | | | |
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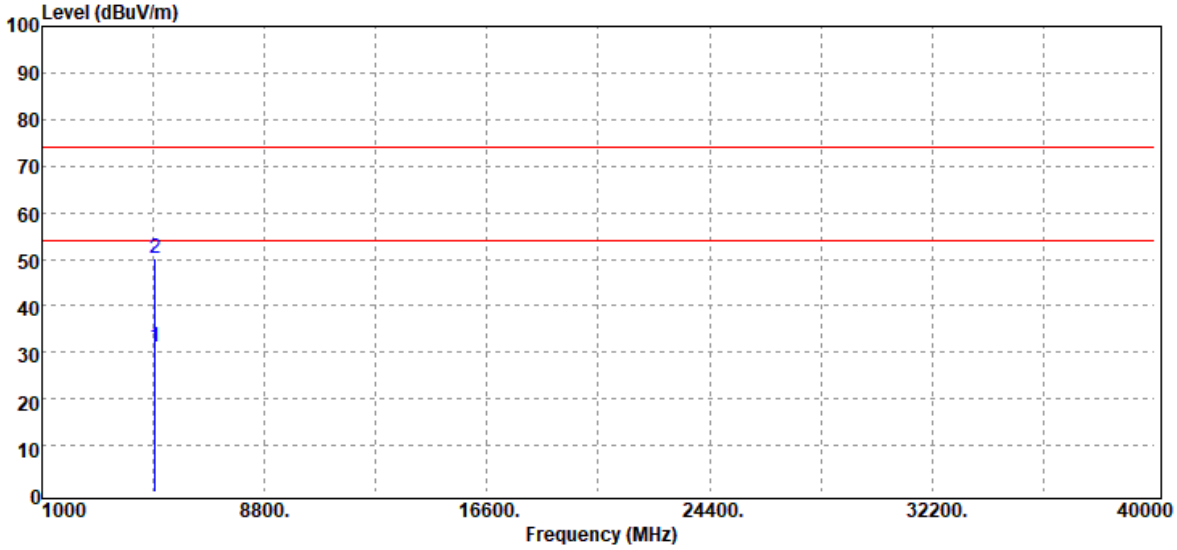
***Remark:***

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*

| Test Mode | Zigbee High CH | Temp/Hum | 28.3(℃)/ 35%RH |
|---|---|---|---|
| Test Item | Harmonic | Test Date | August 23, 2019 |
| Polarize | Horizontal | Test Engineer | Jerry Lu |
| Detector | Peak and Average | | |




| Freq. (MHz) | Detector Mode (PK/QP/AV) | Spectrum Reading Level (dBµV) | Factor (dB) | Actual FS (dBµV/m) | Limit @3m (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|
| 4955.00 | Average | - | -19.09 | 31.17 | 54.00 | -22.83 |
| 4955.00 | Peak | 46.23 | 4.03 | 50.26 | 74.00 | -23.74 |
| N/A | | | | | | |
| | | | | | | |
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***Remark:***

1. *Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.*

***--End of Report--***