*AUDIX Technology Corp.*
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*New Taipei City244, Taiwan*
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# *FCC 15.247*
## (Class II Permissive Change)
## 2.4 GHz Report
## *for*

## LG Electronics Inc.

## 1, Gwanak-ro, Gwanak-gu, Seoul, 151-919, Rep. of Korea

| | | |
|---|---|---|
| **Brand** | **:** | **LG** |
| **Product Name** | **:** | **Wireless Multi Sensor** |
| **Model Name** | **:** | **9SDA81VVDA** |
| **FCC ID** | **:** | **BEJ9SD751TVDA** |

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# TEST REPORT CERTIFICATION
# (Class II Permissive Change)

| | | |
|---|---|---|
| Applicant | : | LG Electronics Inc. |
| Manufacture | : | LG Electronics Inc. |
| Factory | : | OHSUNG ELECTRONICS CO., LTD |
| Product Name | : | Wireless Multi Sensor |
| Model No. | : | 9SDA81VVDA |
| Serial No. | : | N/A |
| Brand | : | LG |
| Power Supply | : | DC 3.3V (Via test jig powered by USB) |

Applicable Standards:

FCC Rules and Regulations Part 15 Subpart C, Oct. 2014
ANSI C63.10:2013
KDB 558074 D01 DTS Meas Guidance v03r03

***AUDIX Technology Corp.*** tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report. ***AUDIX Technology Corp.*** does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Test: 2015. 07. 23 ~ 28 Date of Report: 2015. 07. 29

Producer: Tina Huang
(Tina Huang/Administrator)

Signatory: Ben Cheng
(Ben Cheng/Manager)

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# 1. REPORT HISTORY

| Revision | Date | Revision Summary | Report Number |
|---|---|---|---|
| 0 | 2014. 05. 16 | Original Report. | EM-F140293 |
| Rev. A | 2015. 03. 11 | 1. To add new model ”9SDA81TVDA” for different appearance type and construction.<br>2. To update FCC 47 CFR Part 15 Subpart C Standard from version Oct. 2013 to Oct. 2014.<br>3. Supplementary test data are recorded in report number EM-F150110. | EM-F150110 |
| **Rev. B** | **2015. 07. 29** | **1. To add new model 9SDA81VVDA for different case and PCB size and to added daylight sensor and chip items (R.C) on PCB board.**<br>**2. Supplementary test data are recorded in this report.** | **EM-F150436** |

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# 2. SUMMARY OF TEST RESULTS

| Rule | Description | Results |
|---|---|---|
| 15.207 | Conducted Emission | **PASS** |
| 15.247(d)/ 15.205 | Radiated Band Edge and Radiated Spurious Emission | **PASS** |
| 15.247(b) | Maximum Peak Output | **PASS** |
| **Remark:** To add new model 9SDA81VVDA for different case, change PCB size and added daylight sensor and chip items (R.C) on PCB board, above test items were criticized and reconfirmed to comply with FCC requirement. | | |

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# 3. GENERAL INFORMATION

## 3.1. Description of EUT

| | |
|---|---|
| Product | Wireless Multi Sensor |
| Model Number | 9SDA81VVDA |
| Serial Number | N/A |
| Brand Name | LG |
| Applicant | LG Electronics Inc.<br>1, Gwanak-ro, Gwanak-gu, Seoul, 151-919, Rep. of Korea |
| Manufacture | LG Electronics Inc.<br>1, Gwanak-ro, Gwanak-gu, Seoul, 151-919, Rep. of Korea |
| Factory | OHSUNG ELECTRONICS CO., LTD.<br>335-4, Sanho-daero, Gumi-si, Gyeongsangbuk-do, Korea |
| RF Features | ZigBee (IEEE 802.15.4) |
| Transmit Type | 1T1R |
| Device Category | ☐Outdoor Access Point<br>☐Fixed point-to-point Access Point<br>☐Indoor Access Point<br>■Mobile and Portable client device |
| Date of Receipt of Sample | 2015. 07. 17 |

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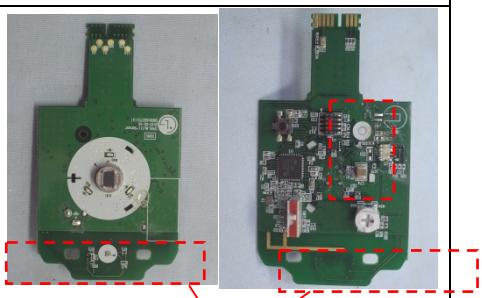
Information for Class II Change Permissive:

1. The EUT is an addition version with original FCC ID: BEJ9SD751TVDA.
2. The difference with original report as following list.

| Item | Original | Class II Change Permissive |
|---|---|---|
| Model | 9SD751TVDA (Wireless Motion Sensor) | 9SDA81VVDA (Wireless Multi Sensor) |
| PCB Board |  |   |
| | (1)Added daylight sensor and chip items(R,C) around it.<br>(2)Changed PCB size due to a daylight sensor | |
| Case |  |  |
| | Made a hole on the top case and inserted lens for daylight sensing. | |

## 3.2. EUT Specifications Assessed in Current Report

| Mode | Fundamental Range (MHz) | Channel Number | Modulation | Data Rate (Mbps) |
|---|---|---|---|---|
| ZigBee (IEEE 802.15.4) | 2405-2480 | 16 | DSSS (O-QPSK) | 0.25 |

| Channel List | | | |
|---|---|---|---|
| ZigBee (IEEE 802.15.4) | | | |
| Channel Number | Frequency (MHz) | Channel Number | Frequency (MHz) |
| 11 | 2405 | 19 | 2445 |
| 12 | 2410 | 20 | 2450 |
| 13 | 2415 | 21 | 2455 |
| 14 | 2420 | 22 | 2460 |
| 15 | 2425 | 23 | 2465 |
| 16 | 2430 | 24 | 2470 |
| 17 | 2435 | 25 | 2475 |
| 18 | 2440 | 26 | 2480 |

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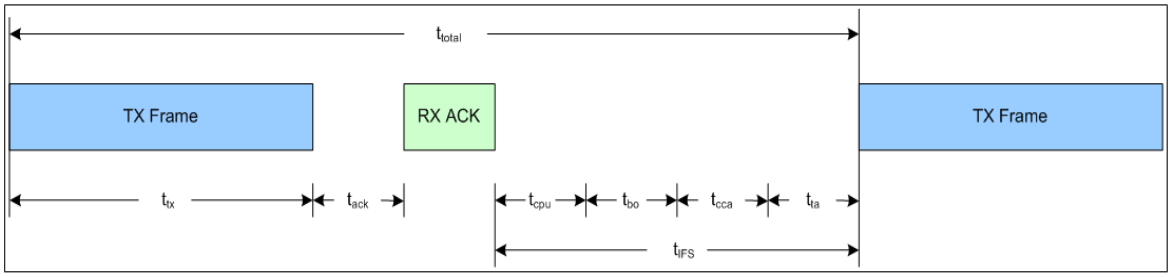
## 3.3. Antenna Information

| Antenna Part Number | Manufacture | Antenna Type | Frequency | Max Gain |
|---|---|---|---|---|
| PNCBC1228A | OHSUNG | PCB | 2405-2480MHz | 0.9073dBi |

## 3.4. Test Configuration

Duty Cycle of EUT

| **IEEE 802.15.4-2003 MAC Constants** | | |
|---|---|---|
| maxBE | 5 | IEEE 802.15.4 specifies 5, ZigBee specifies 8 |
| a Max Frame Response Time | 1220 | symbols |
| a Max Frame Retries | 3 | |
| a Unit Back off Period | 20 | symbols |
| mac Ack Wait Duration | 54 | symbols |
| mac Batt Life Ext Periods | 6 | Backoff periods |
| mac Max CSMA Back offs | 4 | |
| mac Min BE | 3 | IEEE 802.15.4 specifies 3, ZigBee specifies 5 |
| a Min LIFS Period | 40 | symbols |
| a Min SIFS Period | 12 | symbols |
| a Min CAP Length | 440 | symbols |
| NB | 0 | |
| CW | 2 | |
| BE | 3 | |



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**MAC-Level Calculation (SIFS)**

| **Short Frame Scenario:** | |
|---|---|
| 1) TX Frame | Assume Frame is Data Frame |
| 2) Wait for ACK | |
| 3) RX ACK | |
| 4) CPU Processing of ACK | |
| 5) Wait for Back off | |
| 6) Repeat 1) | |

**MAC-Level Calculation (SIFS)**

| **Short Frame Scenario:** | | |
|---|---|---|
| 1) TX Frame | Assume Frame is Data Frame | Assume Frame is Data Frame |
| 2) Wait for ACK | | |
| 3) RX ACK | | |
| 4) CPU Processing of ACK | | |
| 5) Wait for Back off | | |
| 6) Repeat 1) | | |

| **Short Inter Frame Spacing (Slotted w/ ACK)** | | |
|---|---|---|
| Short Frame | 18 | bytes |
| Data Frame Payload | 18 | bytes |
| ACK Frame | 5 | bytes |
| tack | 12 | sym |
| SIFS | 12 | sym |
| Back off Period | 20 | sym |
| Maximum Back off | 7 | |
| Back off Required | 2 | |
| Back off Time | 70 | sym |

| ***Transmit Time*** | | |
|---|---|---|
| TX Time (Packet) | 0.000768 | |
| Total TX Time (sec) | 0.000768 | |

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| ***NOT Transmit time (RX or Idle)*** | | |
|---|---|---|
| Wait for ACK (tack) | 0.000192 | |
| RX Time (ACK) | 0.000352 | |
| Back off Time (tbo) | 0.00112 | (Backoff Time * Backoff Period) |
| CPU Processing (tcpu) | 0.0002 | (0.2ms average on EM2xx running EmberZNet) |
| CCA Assessment (tcca) | 0.000128 | (averaged over 8 symbols in RX Mode) |
| Turn Around Time (RX to TX) | 0.000192 | (After CCA, Radio turns over to TX in 12 symbols) |
| Total Off Time (sec) | 0.002184 | |

| | |
|---|---|
| Total Time (ttotal) | 0.002952 |
| Number of periods in 100ms Window | 33.87533875 |
| | |
| Worse Case (100ms window) | |
| TX Frame 15 times | 0.01152 |
| RX or IDLE 15 Times | 0.03276 |
| Sum | 0.04428 |

Duty Cycle correction= 20*log[0.01152/(0.01152+0.03276)]= -11.34dB

| AC Conduction | |
|---|---|
| Test Case | Normal operation |

| Item | | Mode | Data Rate | Test Channel |
|---|---|---|---|---|
| Radiated Test Case | Radiated Band Edge | ZigBee | 0.25 Mbps | 11/26 |
| | Radiated Spurious Emission (30MHz-1GHz) Note1 | ZigBee | 0.25 Mbps | 11/18/26 |
| | Radiated Spurious Emission (Above 1GHz) Note1 | ZigBee | 0.25 Mbps | 18 |
| Conducted Test Case | Peak Output Power | ZigBee | 0.25 Mbps | 11/18/26 |

Note 1:

■Mobile Device

□Portable Device, and 3 axis were assessed. The worst scenario for Radiated Spurious Emission as follow:

- □ Lie
- □ Side
- □ Stand

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## 3.5. Tested Supporting System List

### 3.5.1. Support Peripheral Unit

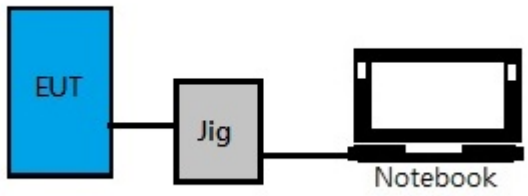
| No. | Product | Brand | Model No. | Serial No. | FCC ID |
|---|---|---|---|---|---|
| 1. | Notebook PC | acer | MS2362 | N/A | PPD-AAR5B225 |
| 2. | Test Jig | N/A | N/A | N/A | N/A |

### 3.5.2. Cable Lists

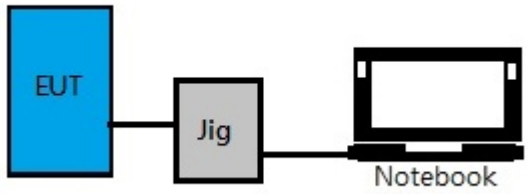
| No. | Cable Description Of The Above Support Units |
|---|---|
| 1. | LAN Cable: Shielded, Detachable, 1.0m<br>USB Cable: Shielded, Detachable, 1.8m<br>Adapter: Chicony, M/N CPA09-A065N1,<br>DC Cord: Shielded, Undetachable, 1.8m, Bonded a ferrite core<br>AC Power Cord: Unshielded, Detachable, 1.8m |
| 2. | BUS Cable: Unshielded, Detachable, 0.1m |

## 3.6. Setup Configuration

### 3.6.1. EUT Configuration for Power Line and Radiated Emission




### 3.6.2. EUT Configuration for Conducted Test Items




## 3.7. Operating Condition of EUT

Test program “ember.desktop” is used for enabling EUT RF function under continues transmitting and choosing data rate/ channel.

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## 3.8. Description of Test Facility

| | | |
|---|---|---|
| Test Firm Name | : | **AUDIX Technology Corporation**<br>**EMC Department**<br>No. 53-11, Dingfu, Linkou Dist.,<br>New Taipei City 244, Taiwan |
| Test Location & Facility | : | **No. 7 Shielded Room**<br>No. 53-11, Dingfu, Linkou Dist.,<br>New Taipei City 244, Taiwan<br><br>**Semi-Anechoic Chamber**<br>No. 53-11, Dingfu, Linkou Dist.,<br>New Taipei City 244, Taiwan<br>May 06, 2015 File on<br>Federal Communication Commission<br>Registration Number: 90993 |
| NVLAP Lab. Code | : | 200077-0 |
| TAF Accreditation No | : | 1724 |

## 3.9. Measurement Uncertainty

| Test Item | Frequency Range | Uncertainty |
|---|---|---|
| Conduction Test | 150kHz~30MHz | ± 3.5dB |
| Radiation Test (Distance: 3m) | 30MHz~300MHz | ± 3.64dB |
| | 300MHz~1000MHz | ± 4.07dB |
| | Above 1GHz | ± 2.94dB |

Remark：Uncertainty = $ku_c(y)$

| Test Item | Uncertainty |
|---|---|
| Maximum peak output power | ± 0.33dB |

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# 4. MEASUREMENT EQUIPMENT LIST

## 4.1. Conducted Emission Measurement

| Item | Type | Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | Test Receiver | R&S | ESCI | 101276 | 2015. 04. 04 | 1 Year |
| 2. | A.M.N. | R&S | ESH2-Z5 | 100366 | 2015. 03. 11 | 1 Year |
| 3. | L.I.S.N. | Kyoritsu | KNW-407 | 8-881-13 | 2015. 01. 14 | 1 Year |
| 4. | Pulse Limiter | R&S | ESH3-Z2 | 101495 | 2015. 01. 17 | 1 Year |

## 4.2. Radiated Emission Measurement

### 4.2.1. Frequency Range 30MHz~1000MHz

| Item | Type | Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | Spectrum Analyzer | Agilent | N9010A-526 | MY53400071 | 2014. 09. 15 | 1 Year |
| 2. | Test Receiver | R & S | ESCS30 | 100338 | 2015. 06. 24 | 1 Year |
| 3. | Amplifier | HP | 8447D | 2944A06305 | 2015. 02. 12 | 1 Year |
| 4. | Bilog Antenna | TESEQ | CBL6112D | 33821 | 2015. 02. 27 | 1 Year |

### 4.2.2. Frequency Range 30MHz~1000MHz

| Item | Type | Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | Spectrum Analyzer | Agilent | N9010A-526 | MY53400071 | 2014. 09. 15 | 1 Year |
| 2. | Test Receiver | R & S | ESCS30 | 100338 | 2015. 06. 24 | 1 Year |
| 3. | Amplifier | Agilent | 8449B | 3008A02676 | 2015. 02. 11 | 1 Year |
| 4. | 2.4GHz Notch Filter | K&L | 7NSL10-2441.5E130.5-00 | 1 | 2015. 07. 22 | 1 Year |
| 5. | 3G High Pass Filter | Microware Circuits | H3G018G1 | 484796 | 2014. 08. 25 | 1 Year |
| 6. | Double-Ridged Waveguide Horn | ETS-Lindgren | 3115 | 00114104 | 2015. 04. 07 | 1 Year |
| 7. | Horn Antenna | EMCO | 3116 | 2653 | 2014. 10. 14 | 1 Year |

## 4.3. RF Conducted Measurement

| Item | Type | Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | Spectrum Analyzer | Agilent | N9030A-544 | US51350140 | 2014. 07. 24 | 1 Year |

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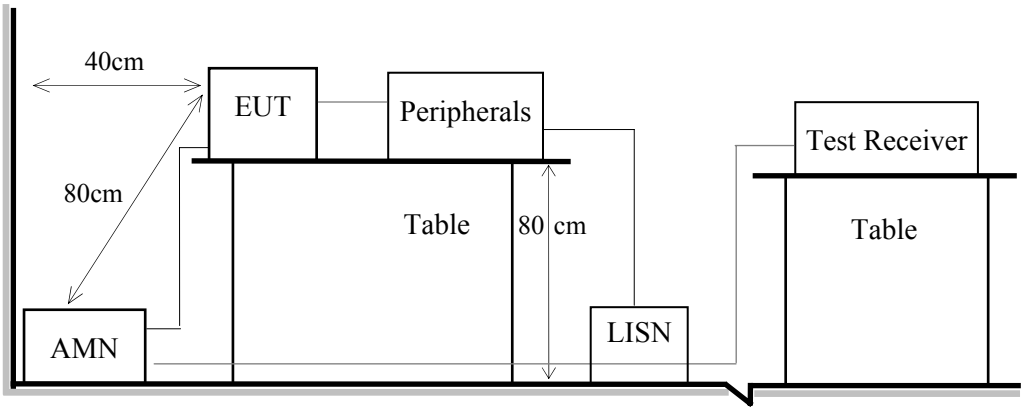
# 5. CONDUCTED EMISSION MEASUREMET

## 5.1. Block Diagram of Test Setup

Shielded Room Setup Diagram




Ground Plane

## 5.2. Power Line Conducted Emission Limit

| Frequency | Conducted Limit | |
|---|---|---|
| | Quasi-Peak Level | Average Level |
| 150kHz ~ 500kHz | 66 ~ 56 dBμV | 56 ~ 46 dBμV |
| 500kHz ~ 5MHz | 56 dBμV | 46 dBμV |
| 5MHz ~ 30MHz | 60 dBμV | 50 dBμV |

Remark 1.: If the average limit is met when using a Quasi-Peak detector, the measurement using the average detector is not required.
2.: The lower limit applies to the band edges.

## 5.3. Test Procedure

5.3.1. To set up the EUT as indicated in ANSI C 63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.

5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).

5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)

5.3.4. Checking frequency range from 150 kHz to 30 MHz and record the emission which does not have 20 dB below limit.

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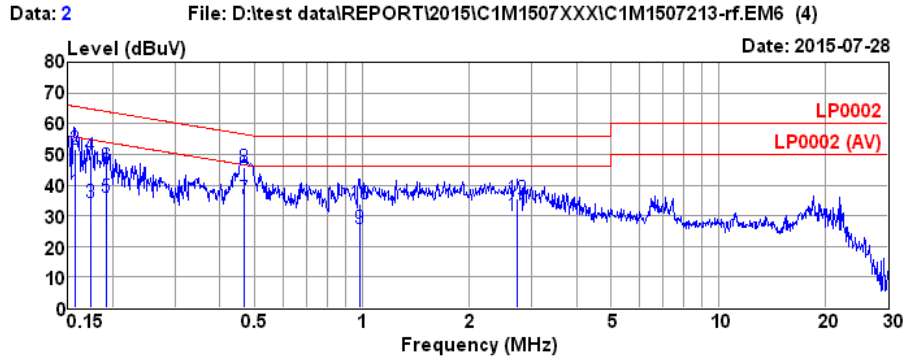
## 5.4. Conducted Emission Measurement Results

**PASSED**.

| Test Date | 2015/07/28 | Temp./Hum. | 27℃/62% |
|---|---|---|---|
| Test Voltage | DC 3.3V (Via test jig powered by USB) | | |




Site no. : No.7 Shielded Room
Data no. : 2
Condition : ESH2-Z5 366
Phase : NEUTRAL
Limit : LP0002
Env. / Ins. : 27*C / 62% ESCI (1276)
Engineer : Ken Yang
EUT : 9SDA81VVDA
Power Rating : DC 3.3V (Via test jig powered by USB)
Test Mode : Operating

| | Freq. (MHz) | AMN Factor (dB) | Cable Loss (dB) | Pulse Att. (dB) | Reading (dBµV) | Emission Level (dBµV) | Limits (dBµV) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.157 | 0.11 | 0.03 | 9.85 | 27.75 | 37.74 | 55.60 | 17.86 | Average |
| 2 | 0.157 | 0.11 | 0.03 | 9.85 | 41.85 | 51.84 | 65.60 | 13.76 | QP |
| 3 | 0.173 | 0.11 | 0.03 | 9.85 | 24.33 | 34.32 | 54.81 | 20.49 | Average |
| 4 | 0.173 | 0.11 | 0.03 | 9.85 | 39.37 | 49.36 | 64.81 | 15.45 | QP |
| 5 | 0.192 | 0.12 | 0.03 | 9.85 | 25.89 | 35.89 | 53.93 | 18.04 | Average |
| 6 | 0.192 | 0.12 | 0.03 | 9.85 | 36.35 | 46.35 | 63.93 | 17.58 | QP |
| 7 | 0.469 | 0.14 | 0.03 | 9.86 | 25.50 | 35.53 | 46.54 | 11.01 | Average |
| 8 | 0.469 | 0.14 | 0.03 | 9.86 | 35.79 | 45.82 | 56.54 | 10.72 | QP |
| 9 | 0.989 | 0.16 | 0.05 | 9.85 | 15.63 | 25.69 | 46.00 | 20.31 | Average |
| 10 | 0.989 | 0.16 | 0.05 | 9.85 | 23.75 | 33.81 | 56.00 | 22.19 | QP |
| 11 | 2.736 | 0.22 | 0.07 | 9.86 | 19.87 | 30.02 | 46.00 | 15.98 | Average |
| 12 | 2.736 | 0.22 | 0.07 | 9.86 | 25.62 | 35.77 | 56.00 | 20.23 | QP |

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when useing a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

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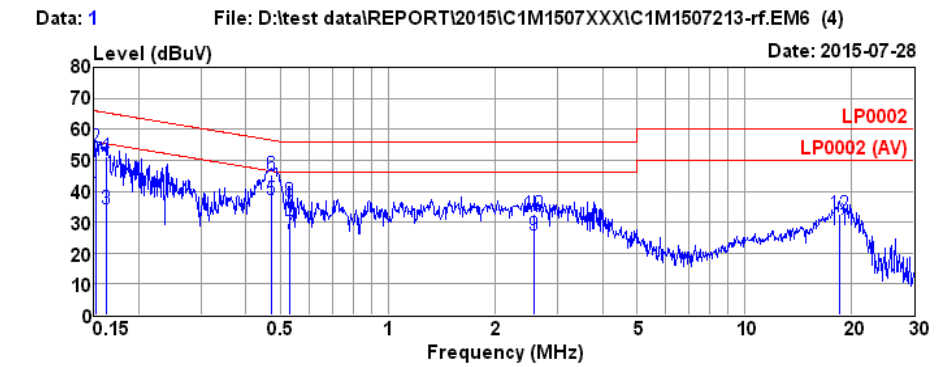


Site no. : No.7 Shielded Room
Data no. : 1
Condition : ESH2-Z5 366
Phase : LINE
Limit : LP0002
Env. / Ins. : 27*C / 62% ESCI (1276)
Engineer : Ken Yang
EUT : 9SDA81VVDA
Power Rating : DC 3.3V (Via test jig powered by USB)
Test Mode : Operating

| | Freq. (MHz) | AMN Factor (dB) | Cable Loss (dB) | Pulse Att. (dB) | Reading (dBµV) | Emission Level (dBµV) | Limits (dBµV) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.152 | 0.11 | 0.03 | 9.85 | 28.78 | 38.77 | 55.91 | 17.14 | Average |
| 2 | 0.152 | 0.11 | 0.03 | 9.85 | 44.36 | 54.35 | 65.91 | 11.56 | QP |
| 3 | 0.162 | 0.11 | 0.03 | 9.85 | 24.39 | 34.38 | 55.38 | 21.00 | Average |
| 4 | 0.162 | 0.11 | 0.03 | 9.85 | 41.43 | 51.42 | 65.38 | 13.96 | QP |
| 5 | 0.471 | 0.13 | 0.03 | 9.86 | 27.44 | 37.46 | 46.49 | 9.03 | Average |
| 6 | 0.471 | 0.13 | 0.03 | 9.86 | 35.11 | 45.13 | 56.49 | 11.36 | QP |
| 7 | 0.532 | 0.13 | 0.03 | 9.86 | 16.11 | 26.13 | 46.00 | 19.87 | Average |
| 8 | 0.532 | 0.13 | 0.03 | 9.86 | 26.99 | 37.01 | 56.00 | 18.99 | QP |
| 9 | 2.581 | 0.20 | 0.07 | 9.86 | 15.89 | 26.02 | 46.00 | 19.98 | Average |
| 10 | 2.581 | 0.20 | 0.07 | 9.86 | 22.33 | 32.46 | 56.00 | 23.54 | QP |
| 11 | 18.524 | 0.64 | 0.20 | 9.94 | 16.87 | 27.65 | 50.00 | 22.35 | Average |
| 12 | 18.524 | 0.64 | 0.20 | 9.94 | 21.75 | 32.53 | 60.00 | 27.47 | QP |

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.
2. If the average limit is met when useing a quasi-peak detector, the EUT shall be deemed to meet both limits and measurement with average detector is unnecessary.

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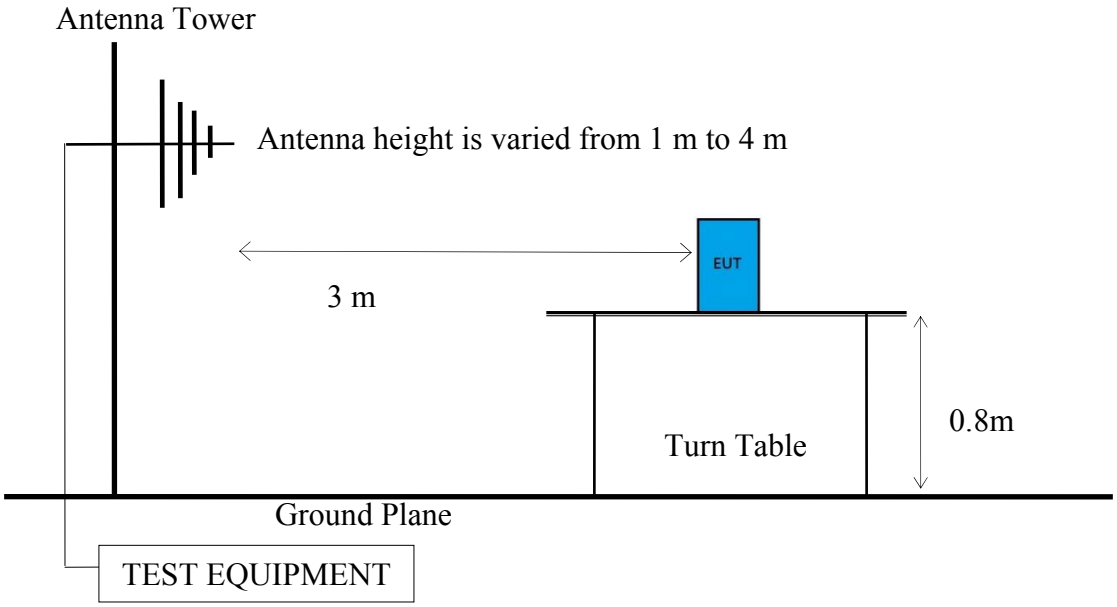
# 6. RADIATED EMISSION MEASUREMENT

## 6.1. Block Diagram of Test Setup

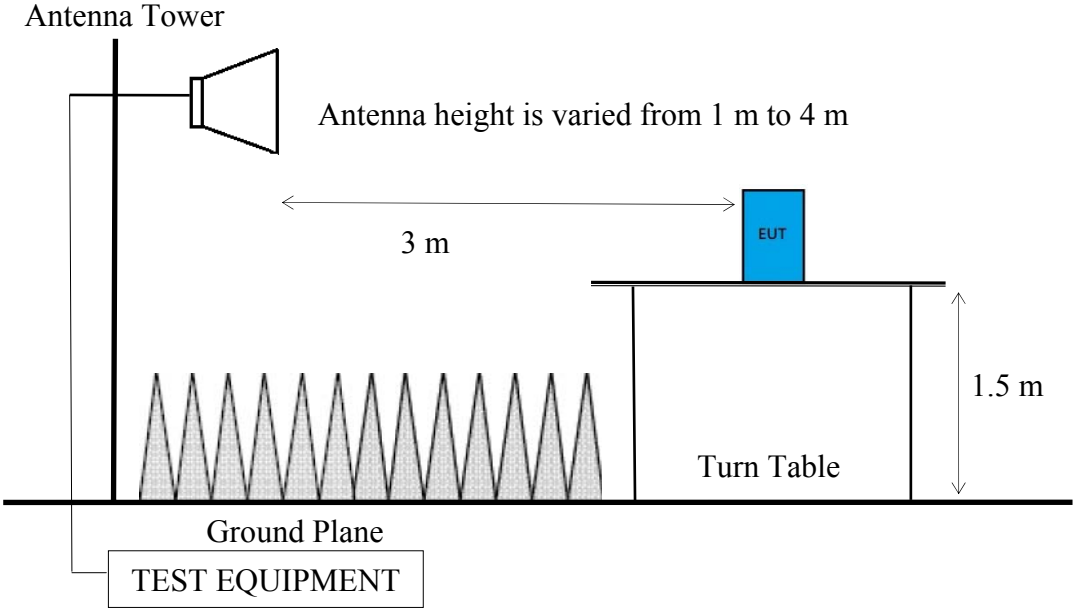
### 6.1.1. Block Diagram of EUT

Indicated as section 3.6

### 6.1.2. Setup Diagram for 30-1000 MHz




### 6.1.3. Semi-Anechoic Chamber (3m) Setup Diagram for above 1GHz



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## 6.2. Radiated Emission Limits

In any 100kHz bandwidth outside the frequency band, the radio frequency power produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205, must also comply with the radiated emission limits specified as below.

| Frequency (MHz) | Distance (m) | Field Strengths Limits | |
|---|---|---|---|
| | | μV/m | dBμV/m |
| 30 ~ 88 | 3 | 100 | 40.0 |
| 88 ~ 216 | 3 | 150 | 43.5 |
| 216 ~ 960 | 3 | 200 | 46.0 |
| Above 960 | 3 | 500 | 54.0 |
| Above 1000 | 3 | 74.0 dBμV/m (Peak)<br>54.0 dBμV/m (Average) | |

Remark：(1) dBμV/m = 20 log (μV/m)
(2) The tighter limit applies to the edge between two frequency bands.
(3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
(4) Fundamental and emission fall within operation band are exempted from this section.
(5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

## 6.3. Test Procedure

The EUT setup on the turn table which has 1.5m height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

Frequency below 1 GHz:
Spectrum Analyzer is used for pre-testing with following setting:

(1) RBW = 120KHz
(2) VBW ≥ 3 x RBW.
(3) Detector = Peak.
(4) Sweep time = auto.
(5) Trace mode = max hold.
(6) Allow sweeps to continue until the trace stabilizes.
(7) When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required. Otherwise using Q.P. for finally measurement.

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Frequency above 1GHz to 10th harmonic:

**Peak Detector:**

(1) RBW = 1MHz
(2) VBW ≥ 3 x RBW.
(3) Detector = Peak.
(4) Sweep time = auto.
(5) Trace mode = max hold.
(6) Allow sweeps to continue until the trace stabilizes.
(7) When peak-detected value is lower than limit that the measurement using the average detector is not required. Otherwise using average for finally measurement.

**Average Measurement:**

☐**Option 1:**

(1) RBW = 1 MHz
(2) VBW =1/T
(3) Detector = Peak.
(4) Sweep time = auto.
(5) Trace mode = max hold.
(6) Allow sweeps to continue until the trace stabilizes.

■**Option 2:**

Average Emission Level= Peak Emission Level+ D.C.C.F.

## 6.4. Measurement Result Explanation

■Peak Emission Level=Antenna Factor + Cable Loss + Meter Reading
☐Average Emission Level l=Antenna Factor + Cable Loss + Meter Reading
■Average Emission Level= Peak Emission Level+ DCCF
Duty Cycle Correction Factor (DCCF)= 20log ($TX_{on}/TX_{on+off}$) presented in section 3.4
☐EPR= Peak Emission Level-95.2dB-2.14dBi

## 6.5. Test Results

**PASSED.**

| Test Date | 2015/07/23 | Temp./Hum. | 23℃/41% |
|---|---|---|---|
| Test Voltage | DC 3.3V (Via test jig powered by USB) | | |

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6.5.1. Emissions within Restricted Frequency Bands

6.5.1.1. Frequency Below 1 GHz

| Mode | ZigBee | Frequency | TX 2405MHz |
|---|---|---|---|

**Antenna at Horizontal Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBμV) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 125.06 | 12.01 | 3.41 | 24.86 | 40.28 | 43.50 | 3.22 | Peak |
| 299.66 | 13.12 | 4.65 | 24.62 | 42.39 | 46.00 | 3.61 | Peak |
| 499.48 | 16.95 | 6.44 | 18.26 | 41.65 | 46.00 | 4.35 | Peak |

**Antenna at Vertical Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBμV) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 125.06 | 12.01 | 3.41 | 21.23 | 36.65 | 43.50 | 6.85 | Peak |
| 250.19 | 12.40 | 4.33 | 23.41 | 40.14 | 46.00 | 5.86 | Peak |
| 500.45 | 16.98 | 6.44 | 18.30 | 41.72 | 46.00 | 4.28 | Peak |

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| Mode | ZigBee | Frequency | TX 2440MHz |
|---|---|---|---|

**Antenna at Horizontal Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBμV) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 125.06 | 12.01 | 3.41 | 24.60 | 40.02 | 43.50 | 3.48 | Peak |
| 299.66 | 13.12 | 4.65 | 24.67 | 42.44 | 46.00 | 3.56 | Peak |
| 499.48 | 16.95 | 6.44 | 18.41 | 41.80 | 46.00 | 4.20 | Peak |

**Antenna at Vertical Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBμV) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 125.06 | 12.01 | 3.41 | 21.25 | 36.67 | 43.50 | 6.83 | Peak |
| 250.19 | 12.40 | 4.33 | 24.17 | 40.90 | 46.00 | 5.10 | Peak |
| 500.45 | 16.98 | 6.44 | 18.62 | 42.04 | 46.00 | 3.96 | Peak |

| Mode | ZigBee | Frequency | TX 2480MHz |
|---|---|---|---|

**Antenna at Horizontal Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBμV) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 150.28 | 10.51 | 3.61 | 25.18 | 39.30 | 43.50 | 4.20 | Peak |
| 250.19 | 12.40 | 4.33 | 24.87 | 41.60 | 46.00 | 4.40 | Peak |
| 499.48 | 16.95 | 6.44 | 16.51 | 39.90 | 46.00 | 6.10 | Peak |

**Antenna at Vertical Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBμV) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 125.06 | 12.01 | 3.41 | 21.59 | 37.01 | 43.50 | 6.49 | Peak |
| 250.19 | 12.40 | 4.33 | 23.71 | 40.44 | 46.00 | 5.56 | Peak |
| 500.45 | 16.98 | 6.44 | 18.49 | 41.91 | 46.00 | 4.09 | Peak |

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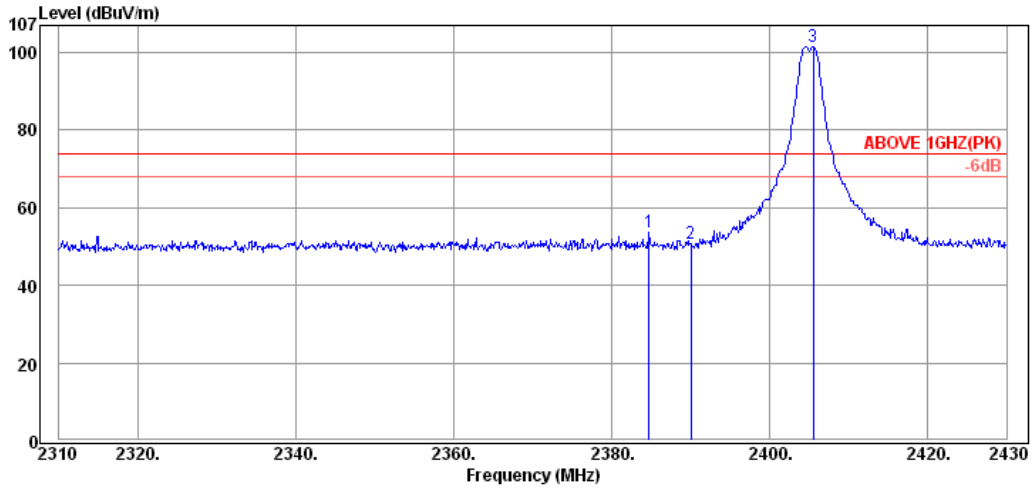
6.5.1.2. Frequency Above 1 GHz to 10th harmonics

**Band Edge:**

| Mode | ZigBee | Frequency | TX 2405MHz |
|---|---|---|---|




**Antenna at Horizontal Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBμV) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 2384.76 | 28.40 | 5.23 | 20.20 | 53.83 | 74.00 | 20.17 | Peak |
| 2390.04 | 28.40 | 5.24 | 17.07 | 50.71 | 74.00 | 23.29 | Peak |
| 2405.52 | 28.42 | 5.26 | 67.72 | 101.40 | --- | --- | Peak |

**Antenna at Horizontal Polarization**

| Emission Frequency (MHz) | Peak Emission Level (dB/m) | DCCF (dB) | Average Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|
| 2384.76 | 53.83 | -11.34 | 42.49 | 54.00 | 11.51 | Average |
| 2390.04 | 50.71 | -11.34 | 39.37 | 54.00 | 14.63 | Average |

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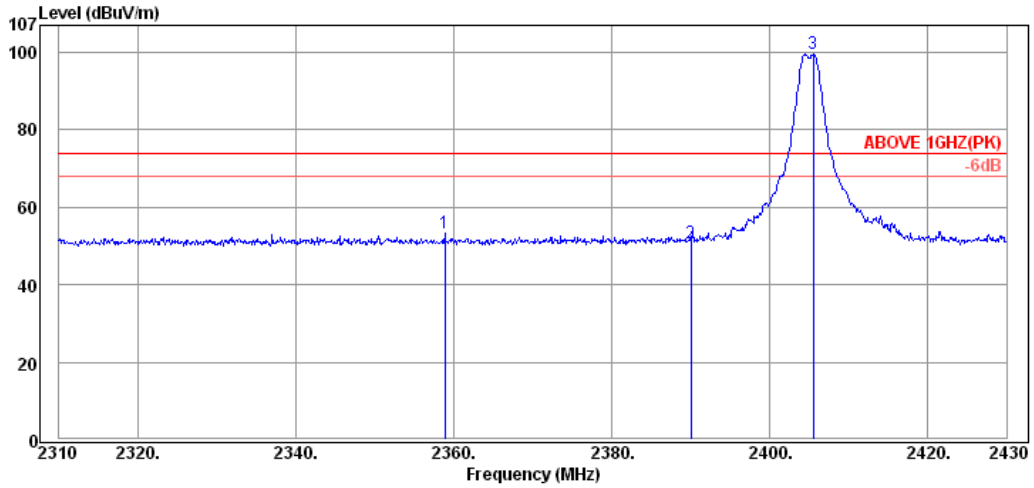
| Mode | ZigBee | Frequency | TX 2405MHz |
|---|---|---|---|




**Antenna at Vertical Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBµV) | Emission Level (dBµV/m) | Limits (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 2358.84 | 28.37 | 5.19 | 19.82 | 53.38 | 74.00 | 20.62 | Peak |
| 2390.04 | 28.40 | 5.24 | 17.20 | 50.84 | 74.00 | 23.16 | Peak |
| 2405.52 | 28.42 | 5.26 | 65.87 | 99.55 | --- | --- | Peak |

**Antenna at Vertical Polarization**

| Emission Frequency (MHz) | Peak Emission Level (dB/m) | DCCF (dB) | Average Emission Level (dBµV/m) | Limits (dBµV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|
| 2358.84 | 53.38 | -11.34 | 42.04 | 54.00 | 11.96 | Average |
| 2390.04 | 50.84 | -11.34 | 39.50 | 54.00 | 14.50 | Average |

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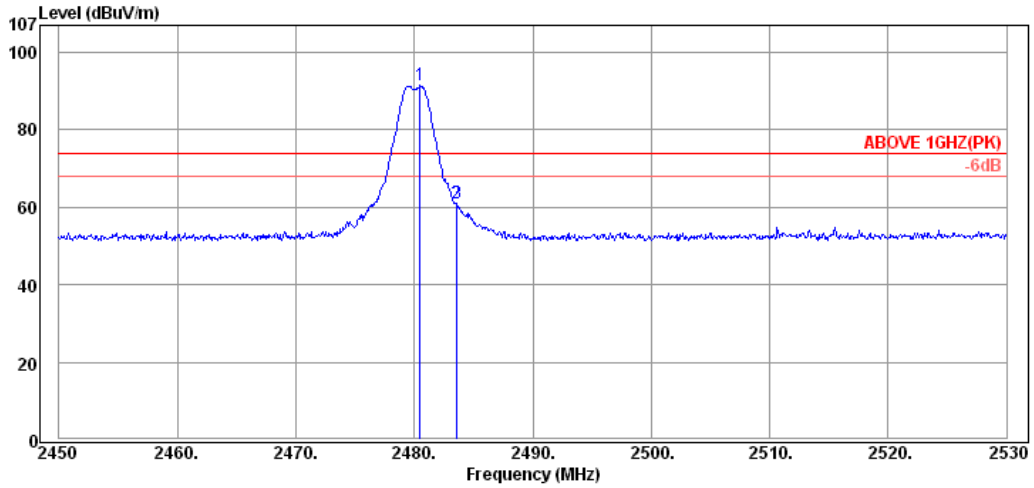
| Mode | ZigBee | Frequency | TX 2480MHz |
|---|---|---|---|




**Antenna at Horizontal Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBμV) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 2480.48 | 28.48 | 5.36 | 57.56 | 91.40 | --- | --- | Peak |
| 2483.52 | 28.49 | 5.37 | 27.07 | 60.93 | 74.00 | 13.07 | Peak |
| 2483.60 | 28.49 | 5.37 | 27.22 | 61.08 | 74.00 | 12.92 | Peak |

**Antenna at Horizontal Polarization**

| Emission Frequency (MHz) | Peak Emission Level (dB/m) | DCCF (dB) | Average Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|
| 2483.52 | 60.93 | -11.34 | 49.59 | 54.00 | 4.41 | Average |
| 2483.60 | 61.08 | -11.34 | 49.74 | 54.00 | 4.26 | Average |

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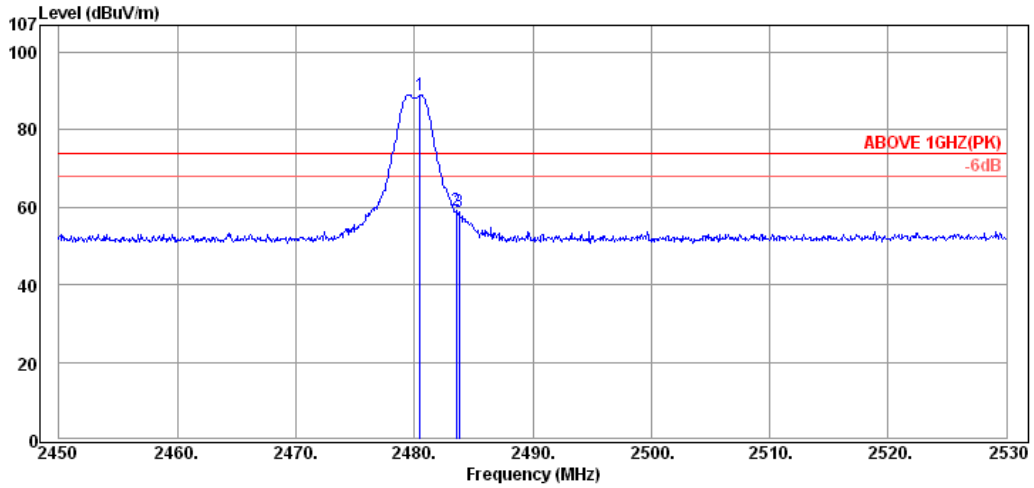
| Mode | ZigBee | Frequency | TX 2480MHz |
|---|---|---|---|




**Antenna at Vertical Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBµV) | Emission Level (dBµV/m) | Limits (dBµV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 2480.48 | 28.48 | 5.36 | 55.18 | 89.02 | --- | --- | Peak |
| 2483.52 | 28.49 | 5.37 | 25.23 | 59.09 | 74.00 | 14.91 | Peak |
| 2483.76 | 28.49 | 5.37 | 24.79 | 58.65 | 74.00 | 15.35 | Peak |

**Antenna at Vertical Polarization**

| Emission Frequency (MHz) | Peak Emission Level (dB/m) | DCCF (dB) | Average Emission Level (dBµV/m) | Limits (dBµV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|
| 2483.52 | 59.09 | -11.34 | 47.75 | 54.00 | 6.25 | Average |
| 2483.76 | 58.65 | -11.34 | 47.31 | 54.00 | 6.69 | Average |

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6.5.2. Emissions outside the frequency band:

The emissions (up to 25GHz) not reported for there is no emission be found.

| Mode | ZigBee | Frequency | TX 2405MHz |
|---|---|---|---|

**Antenna at Vertical Polarization**

| Emission Frequency (MHz) | Antenna Factor (dB/m) | Cable Loss (dB) | Meter Reading (dBμV) | Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 4808.50 | 32.98 | 8.09 | 11.71 | 52.78 | 74.00 | 21.22 | Peak |

| Emission Frequency (MHz) | Peak Emission Level (dB/m) | DCCF (dB) | Average Emission Level (dBμV/m) | Limits (dBμV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|
| 4808.50 | 52.78 | -11.34 | 41.44 | 54.00 | 12.56 | Average |

6.5.3. Emissions in Non-restricted Frequency Bands

Pursuant to KDB 558074 D01 v03r03 that emission levels below the 15.209 general radiated emissions limits is not required.

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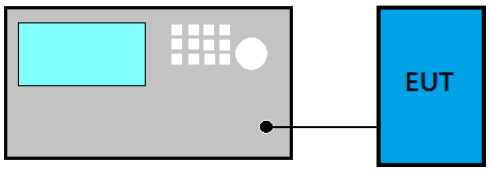
# 7. MAXIMUM PEAK OUTPUT POWER MEASUREMENT

## 7.1. Block Diagram of Test Setup




## 7.2. Specification Limits

The Limits of maximum Peak Output Power for digital modulation in 2400-2483.5MHz is : 1Watt. (30dBm)

## 7.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v03r03:

☐**PKPM1 Peak power meter method:**

EUT is connected to power sensor and record the maximum output power.

☐**Method AVGPM (Measurement using an RF average power meter):**

EUT is connected to power sensor and record the maximum average output power and duty cycle factor is added when duty cycle presented in section 3.5.1 is < 98%.

■**RBW≥DTS bandwidth**

(1) Set span to at least 3 times the OBW
(2) Set RBW ≥ OBW
(3) Set the video bandwidth (VBW) ≥ 3 × RBW.
(4) Detector = Peak
(5) Trace mode = max hold
(6) Sweep = auto couple.
(7) To find the peak amplitude level.

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## 7.4. Test Results

| Test Date | 2015/07/24 | Temp./Hum. | 24℃/40% |
|---|---|---|---|
| Cable Loss | 0.5dB | Test Voltage | DC 3.3V<br>(Via test jig powered by USB) |

7.4.1. Peak Output Power

| Modulation Type | Centre Frequency (MHz) | Peak Output Power | | Limit |
|---|---|---|---|---|
| | | (dBm) | (W) | |
| ZigBee | 2405 | 8.290 | 0.006745 | < 30 dBm (1 W) |
| | 2440 | 8.147 | 0.006527 | |
| | 2480 | -0.929 | 0.000807 | |

Note: The results have been included cable loss.

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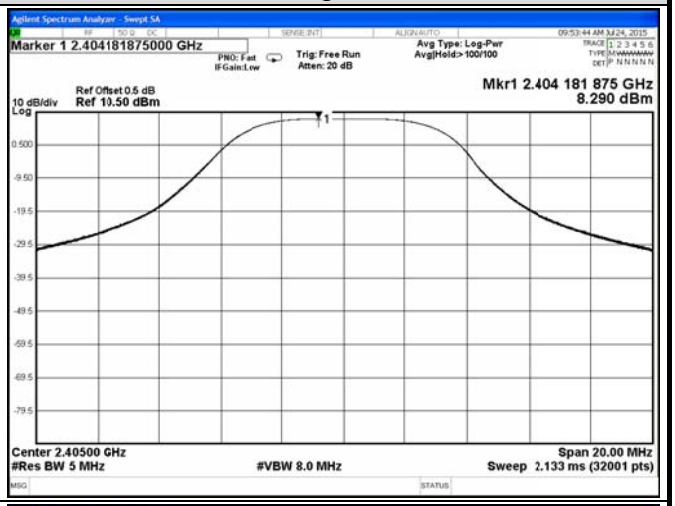
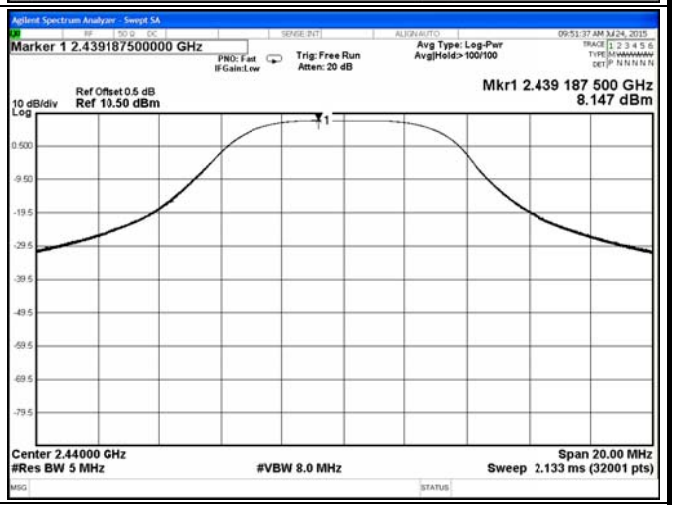
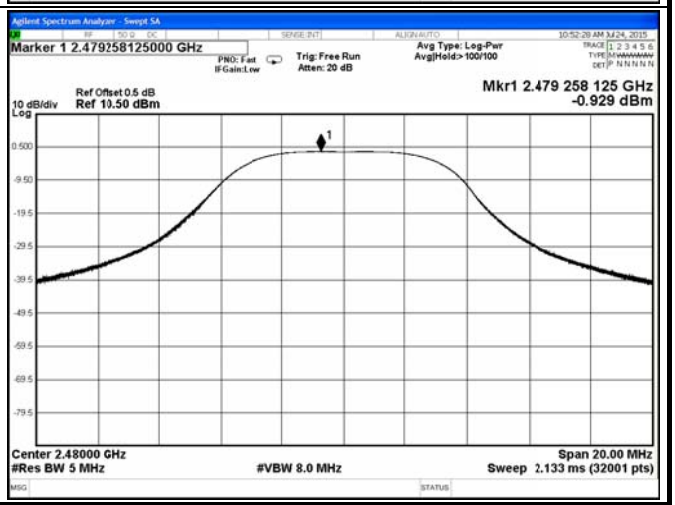
### 7.4.2. Peak Measurement Plots

| ZigBee |
| --- |
| Peak Output Power |



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# 8. DEVIATION TO TEST SPECIFICATIONS

【NONE】