# FCC RF Test Report

| | | |
|---|---|---|
| APPLICANT | : | Nokia Shanghai Bell Co., Ltd. |
| EQUIPMENT | : | NOKIA WiFi Beacon 3.1 |
| BRAND NAME | : | NOKIA |
| MODEL NAME | : | Beacon 3.1 |
| FCC ID | : | 2ADZRBEACON311 |
| STANDARD | : | FCC Part 15 Subpart C §15.247 |
| CLASSIFICATION | : | (DTS) Digital Transmission System |
| TEST DATE(S) | : | Nov. 23, 2024 ~ Jan. 15, 2025 |

**We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.**

Jason Jia

**Approved by: Jason Jia**

ACCREDITED Cert #5145.02

***Sporton International Inc. (Kunshan)***
***No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300***
***People's Republic of China***

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# REVISION HISTORY

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FR4N0526A | Rev. 01 | Initial issue of report | Jan. 16, 2025 |
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# SUMMARY OF TEST RESULT

| Report Section | FCC Rule | Description | Limit | Result | Remark |
|---|---|---|---|---|---|
| 3.1 | 15.247(a)(2) | 6dB Bandwidth | ≥ 0.5MHz | Pass | - |
| 3.1 | - | 99% Bandwidth | - | Report Only | - |
| 3.2 | 15.247(b) | Power Output Measurement | ≤ 30dBm | Pass | - |
| 3.3 | 15.247(e) | Power Spectral Density | ≤ 8dBm/3kHz | Pass | - |
| 3.4 | 15.247(d) | Conducted Band Edges | ≤ 30dBc | Pass | - |
| | | Conducted Spurious Emission | | Pass | - |
| 3.5 | 15.247(d) | Radiated Band Edges and Radiated Spurious Emission | 15.209(a) & 15.247(d) | Pass | Under limit 0.11 dB at 2389.95 MHz |
| 3.6 | 15.207 | AC Conducted Emission | 15.207(a) | Pass | Under limit 11.26 dB at 0.413 MHz |
| 3.7 | 15.203 & 15.247(b) | Antenna Requirement | 15.203 & 15.247(b) | Pass | - |

**Conformity Assessment Condition:**

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”

**Disclaimer:**

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

# 1 General Description

## 1.1 Applicant

**Nokia Shanghai Bell Co., Ltd.**
No.388, Ningqiao Rd, Pilot Free Trade Zone, Shanghai, 201206 P.R. China

## 1.2 Manufacturer

**Nokia of America Corporation**
2301 Sugar Bush Rd. Raleigh, NC 27612

## 1.3 Product Feature of Equipment Under Test

| Product Feature | |
|---|---|
| **Equipment** | NOKIA WiFi Beacon 3.1 |
| **Brand Name** | NOKIA |
| **Model Name** | Beacon 3.1 |
| **FCC ID** | 2ADZRBEACON311 |
| **SN Code** | Conducted: ALCLB45B67E2<br>Conduction: ALCLB45B57D4<br>Radiation: ALCLB45B67BD |
| **HW Version** | PEM1 |
| **SW Version** | 3TN00626 |
| **EUT Stage** | Production Unit |

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

| Power Adapter | | | | |
|---|---|---|---|---|
| **AC Adapter 1** | **Brand Name** | Ruide | **Model Name** | RD1201500-C55-198MG |
| **AC Adapter 2** | **Brand Name** | Fuhua | **Model Name** | UES18LU-120150SPA |

## 1.4 Product Specification of Equipment Under Test

<table>
<tr><th colspan="2">Standards-related Product Specification</th></tr>
<tr><td>Tx/Rx Channel Frequency Range</td><td>2412 MHz - 2462 MHz</td></tr>
<tr><td>Maximum Output Power to antenna</td><td><CDD 1S2T><br>802.11b : 29.63 dBm (0.9183 W)<br>802.11g : 29.01 dBm (0.7962 W)<br>802.11n HT20 : 28.55 dBm (0.7161 W)<br>802.11n HT40 : 24.95 dBm (0.3126 W)<br>802.11ax HE20 : 28.78 dBm (0.7551 W)<br>802.11ax HE40 : 25.21 dBm (0.3319 W)</td></tr>
<tr><td>99% Occupied Bandwidth</td><td><CDD 1S2T><br>802.11b : 14.000MHz<br>802.11g : 16.590MHz<br>802.11n HT20 : 17.543MHz<br>802.11n HT40 : 35.810MHz<br>802.11ax HE20 : 18.857MHz<br>802.11ax HE40 : 37.410MHz</td></tr>
<tr><td>Antenna Type</td><td>Dipole Antenna</td></tr>
<tr><td>Antenna Function Description</td><td>
<table>
<tr><td></td><td>Ant. 3/4</td><td>Ant. 5</td></tr>
<tr><td>802.11 b/g/n/ax<br>SISO</td><td>V</td><td>V</td></tr>
<tr><td>802.11 b/g/n/ax<br>CDD 1S2T</td><td>V</td><td>V</td></tr>
<tr><td>802.11ax<br>Tx Beamforming 1S2T</td><td>V</td><td>V</td></tr>
</table>
</td></tr>
<tr><td>Type of Modulation</td><td>802.11b : DSSS (DBPSK / DQPSK / CCK)<br>802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)<br>802.11ax : OFDMA (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM)</td></tr>
</table>

**Note:**

1. For WLAN SISO & MIMO mode, the whole testing has assessed only MIMO mode by referring to the higher output power.
2. WLAN MIMO support CDD mode for 802.11b/g/n/ax and Tx Beamforming mode for 802.11ax.
3. For 802.11ax mode, the power setting of Tx Beamforming mode is lower than CDD mode. Therefore, the all test has assessed CDD mode only.
4. The device supports multiple spatial streams, the worst cases directional gain will occur when NSS = 1, therefore, the 1S2T(CDD&TXBF) mode is the worst; 1S2T: NSS=1, MIMO 2Tx.
5. The device supports full RU mode only for 802.11ax.
6. Please refer to the antenna report for the maximum single antenna gain and CDD (Cyclic Delay Diversity) directional gain and TXBF (Tx Beamforming) directional gain.

**AOT Antenna:**

| Frequency Band | Max Single Antenna gain (dBi) | | | CDD DG (dBi) | | TXBF DG (dBi) | |
|---|---|---|---|---|---|---|---|
| | Ant.3 | Ant.4 | Ant.5 | For Power | For PSD | For Power | For PSD |
| 2.4GHz | 2.72 | 2.82 | 2.97 | 2.97 | 4.18 | 4.18 | 4.18 |

**Remark:** WLAN 2.4G has three antennas (Ant.3/4/5). In the MIMO(ant.3+ant.5, or ant.4+ant.5) mode, the ant.3 and ant.4 share the same conducted path, and the ant.3/ant.4 will automatically switch when working and will not be used at the same time, always maintain 2*2 MIMO TX/RX with ant5.

**Description of antenna naming for each test item:**

| RSE | Conducted | Antenna Report |
|---|---|---|
| Ant.0(1-B) | Ant.1 | Ant.3 |
| Ant.0(1-A) | / | Ant.4 |
| Ant.1 | Ant.2 | Ant.5 |

**Remark:** The Ant.0(1-B)(RSE) and Ant.1(conducted) in this report is the corresponding antenna report is Ant. 3, Ant.0(1-A)(RSE) corresponding antenna report is Ant. 4, Ant.1(RSE) and Ant.2(conducted) corresponding antenna report is Ant. 5.

## 1.5 Modification of EUT

No modifications are made to the EUT during all test items.

## 1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

| | | | |
|---|---|---|---|
| **Test Firm** | Sporton International Inc. (Kunshan) | | |
| **Test Site Location** | No. 1098, Pengxi North Road, Kunshan Economic Development Zone<br>Jiangsu Province 215300 People's Republic of China<br>TEL : +86-512-57900158 | | |
| **Test Site No.** | **Sporton Site No.** | **FCC Designation No.** | **FCC Test Firm Registration No.** |
| | CO01-KS<br>03CH05-KS<br>TH01-KS | CN1257 | 314309 |

## 1.7 Test Software

| Item | Site | Manufacturer | Name | Version |
|---|---|---|---|---|
| 1. | TH01-KS | Tonscend | JS1120-3 test system China_210602 | 3.3.10 |
| 2. | 03CH05-KS | AUDIX | E3 | 210616 |
| 3. | CO01-KS | AUDIX | E3 | 6.2009-8-24 |

## 1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

# 2 Test Configuration of Equipment Under Test

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report.

b. AC power line Conducted Emission was tested under maximum output power.

## 2.1 Carrier Frequency and Channel

| Frequency Band | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|---|---|---|---|---|
| 2400-2483.5 MHz | 1 | 2412 | 7 | 2442 |
| | 2 | 2417 | 8 | 2447 |
| | 3 | 2422 | 9 | 2452 |
| | 4 | 2427 | 10 | 2457 |
| | 5 | 2432 | 11 | 2462 |
| | 6 | 2437 | - | - |

## 2.2 Test Mode

**Final test modes are considering the modulation and worse data rates as below table.**

**CDD Antenna**

| Modulation | Data Rate |
|---|---|
| 802.11b | 1 Mbps |
| 802.11g | 6 Mbps |
| 802.11n HT20 | MCS0 |
| 802.11n HT40 | MCS0 |
| 802.11ax HE20 | MCS0 |
| 802.11ax HE40 | MCS0 |

**TXBF Mode**

| Modulation | Data Rate |
|---|---|
| 802.11ax HE20 | MCS0 |
| 802.11ax HE40 | MCS0 |

| Test Cases | |
|---|---|
| AC Conducted Emission | Mode 1 :WLAN Tx(2.4G)+ Power From Adapter |
| Remark: For Radiated Test Cases, The tests were performance with Adapter. | |

## 2.3 Connection Diagram of Test System


This example is connection diagram of EUT test configurations.

For detail, please refer to test mode configuration and setup photographs for each test item.

## 2.4 Support Unit used in test configuration and system

| Item | Equipment | Trade Name | Model Name | FCC ID | Data Cable | Power Cord |
|---|---|---|---|---|---|---|
| 1. | Notebook | Lenovo | G480 | QDS-BRCM1050I | N/A | shielded cable DC O/P 1.8m , Unshielded AC I/P cable 1.8m |
| 2. | PC | Adwantech | IPC-610MB-L | KA21R655B1 | N/A | Unshielded,1.8m |
| 3. | Mouse | Dell | MS111-P | Fcc DoC | Shielded, 1.8m | N/A |
| 4. | Hard disk | KINGSHARE | KSP6120G | N/A | N/A | N/A |
| 5. | Monitor | Dell | N/A | N/A | N/A | Unshielded,1.8m |
| 6. | RJ45 Cable | N/A | N/A | N/A | N/A | N/A |

## 2.5 EUT Operation Test Setup

For WLAN RF test items, enter the command in the “PuTTY” program and enabled to make EUT continuous transmit.

## 2.6 Measurement Results Explanation Example

**For all conducted test items:**

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

*Offset = RF cable loss + attenuator factor.*

Following shows an offset computation example with cable loss 1.91 dB and 20dB attenuator.

*Offset(dB) = RF cable loss(dB) + attenuator factor(dB).*

= 1.91 + 20 = 21.91 (dB)

# 3 Test Result

## 3.1 6dB and 99% Bandwidth Measurement

### 3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

### 3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.8
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) = 1%~5% of OBW and set the Video bandwidth (VBW) approximately three times the RBW.
6. Measure and record the results in the test report.

### 3.1.4 Test Setup


### 3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Please refer to Appendix A.

## 3.2 Output Power Measurement

### 3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the output power from the intentional radiator shall be reduced below the above stated value 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 3dB that the directional gain of the antenna exceeds 6dBi.

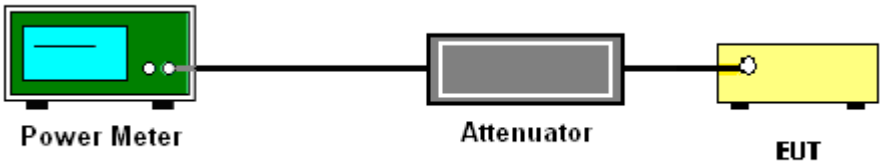
### 3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.2.3.1 Method AVGPM method.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

### 3.2.4 Test Setup




### 3.2.5 Test Result of Average Output Power

Please refer to Appendix A.

# 3.3 Power Spectral Density Measurement

## 3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

## 3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

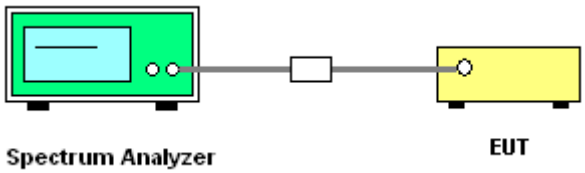
## 3.3.3 Test Procedures

1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.5 Method AVPSD.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 10 kHz. Video bandwidth VBW = 30 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = RMS, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.
7. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01:

   Method (a): Measure and sum the spectra across the outputs.

   The total final Power Spectral Density is from a device with 2 transmitter outputs. The spectrum measurements of the individual outputs are all performed with the same span and number of points, the spectrum value in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 to obtain the value for the first frequency bin of the summed spectrum.

### 3.3.4 Test Setup




### 3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

# 3.4 Conducted Band Edges and Spurious Emission Measurement

## 3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

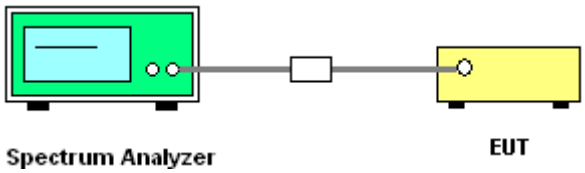
## 3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

## 3.4.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.11
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If 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 per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

## 3.4.4 Test Setup




## 3.4.5 Test Result of Conducted Band Edges and Spurious Emission

Please refer to Appendix A.

# 3.5 Radiated Band Edges and Spurious Emission Measurement

## 3.5.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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

## 3.5.2 Measuring Instruments

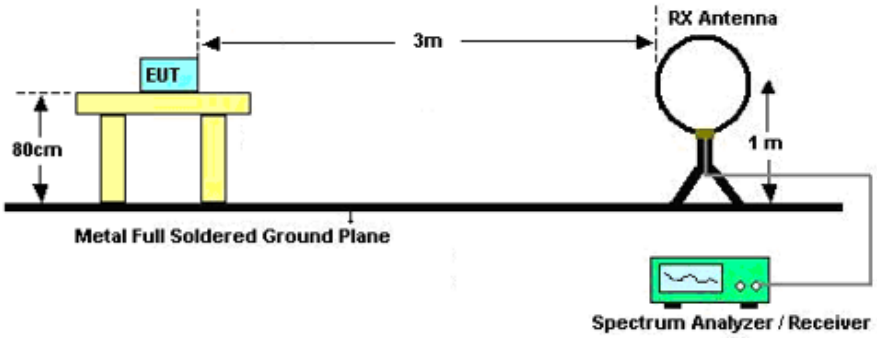
The measuring equipment is listed in the section 4 of this test report.

### 3.5.3 Test Procedures

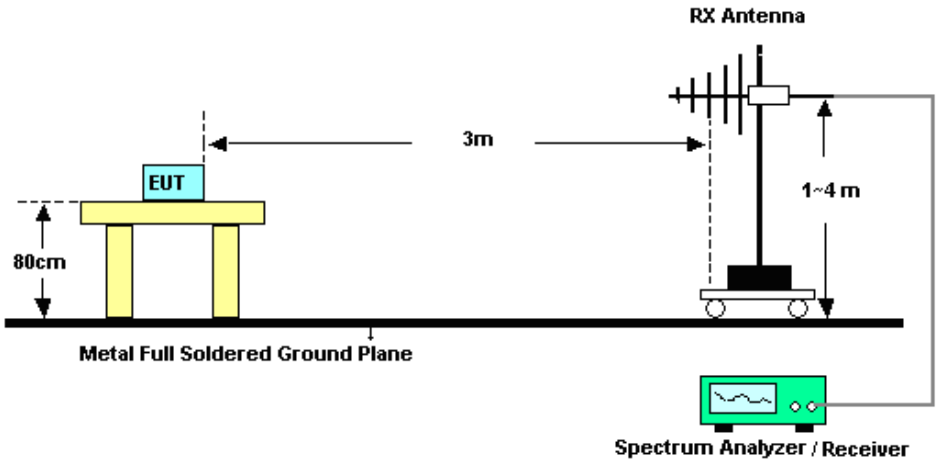
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

## 3.5.4 Test Setup

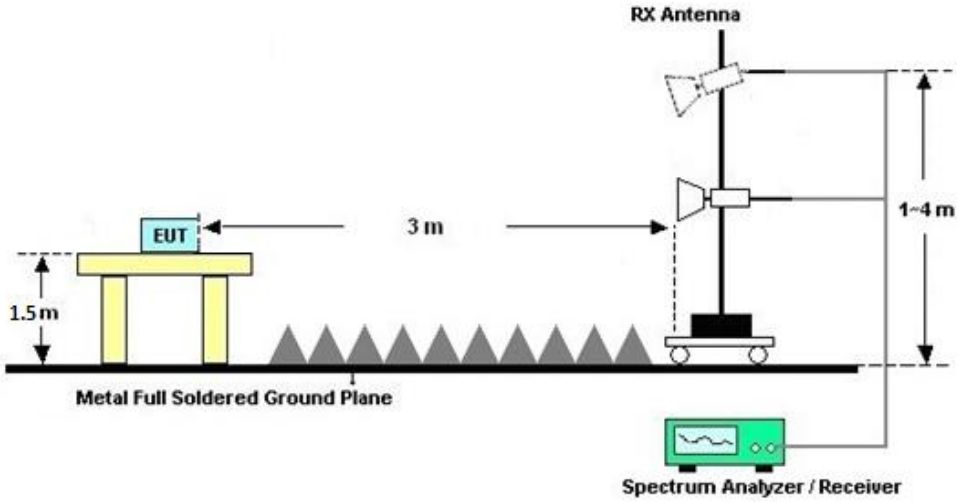
**For radiated emissions below 30MHz**




**For radiated emissions from 30MHz to 1GHz**




**For radiated emissions above 1GHz**



### 3.5.5 Test Results of Radiated Spurious Emissions (9kHz ~ 30MHz)

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

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

### 3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

### 3.5.7 Duty Cycle

Please refer to Appendix D.

### 3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix C.

# 3.6 AC Conducted Emission Measurement

## 3.6.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

| Frequency of Emission (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

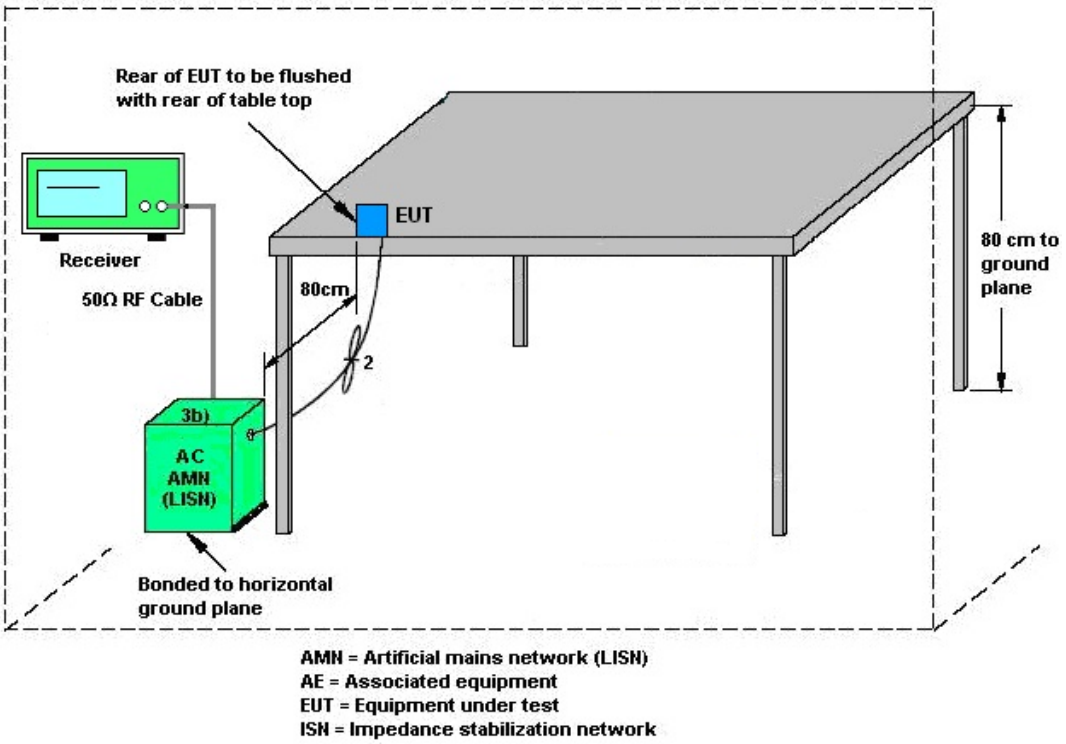
## 3.6.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

## 3.6.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9kHz) with Maximum Hold Mode.

### 3.6.4 Test Setup




### 3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

# 3.7 Antenna Requirements

## 3.7.1 Standard Applicable

If directional gain of transmitting Antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached Antenna or of an Antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

## 3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

## 3.7.3 Antenna Gain

<CDD Modes >

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

Directional gain = $G_{ANT}$ + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = 10 log($N_{ANT}/N_{SS}$=1) dB.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

Directional gain may be calculated by using the formulas applicable to equal gain antennas with $G_{ANT}$ set equal to the gain of the antenna having the highest gain;

For power, the directional gain $G_{ANT}$ is set equal to the antenna having the highest gain, i.e., F)2)f)i).

For PSD, the directional gain calculation is following F)2)f)ii) of KDB 662911 D01 v02r01.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

**<TXBF Mode>**

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For TXBF transmissions, directional gain is calculated as

$$Directional Gain = 10 \cdot \log \left[ \frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

*where*

Each antenna is driven by no more than one spatial stream;
$N_{SS}$ = the number of independent spatial streams of data;
$N_{ANT}$ = the total number of antennas
$g_{j,k} = 10^{G_k/20}$ if the $k$th antenna is being fed by spatial stream $j$, or zero if it is not;
$G_k$ is the gain in dBi of the kth antenna.

The EUT supports beamforming for 802.11n/ac/ax modes.

The directional gain calculation is following F)2)e)ii).

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain “DG” is as following table.

| Frequency Band | Max Single Antenna gain (dBi) | | | CDD DG (dBi) | | TXBF DG (dBi) | |
|---|---|---|---|---|---|---|---|
| | Ant.3 | Ant.4 | Ant.5 | For Power | For PSD | For Power | For PSD |
| 2.4GHz | 2.72 | 2.82 | 2.97 | 2.97 | 4.18 | 4.18 | 4.18 |

**Note:**

1. WLAN 2.4G has three antennas (Ant.3/4/5). In the MIMO(ant.3+ant.5, or ant.4+ant.5) mode, the ant.3 and ant.4 share the same conducted path, and the ant.3/ant.4 will automatically switch when working and will not be used at the same time, always maintain 2*2 MIMO TX/RX with ant5.
2. Please refer to the antenna report for the maximum Single antenna gain and CDD (Cyclic Delay Diversity) directional gain and TXBF (Tx Beamforming) directional gain.
3. The device supports 1S2T(CDD&TXBF) mode; 1S2T: NSS=1, MIMO 2Tx.

# 4 List of Measuring Equipment

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|---|---|---|---|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSV40 | 101040 | 10Hz~40GHz | Oct. 10, 2024 | Nov. 23, 2024~ Jan. 15, 2025 | Oct. 09, 2025 | Conducted (TH01-KS) |
| Pulse Power Senor | Anritsu | MA2411B | 0917070 | 300MHz~40GHz | Jan. 02, 2024 | Nov. 23, 2024~ Jan. 15, 2025 | Jan. 01, 2025 | Conducted (TH01-KS) |
| Pulse Power Senor | Anritsu | MA2411B | 0917070 | 300MHz~40GHz | Jan. 01, 2025 | | Dec. 31, 2026 | Conducted (TH01-KS) |
| Power Meter | Anritsu | ML2495A | 1005002 | 50MHz Bandwidth | Jan. 02, 2024 | Nov. 23, 2024~ Jan. 15, 2025 | Jan. 01, 2025 | Conducted (TH01-KS) |
| Power Meter | Anritsu | ML2495A | 1005002 | 50MHz Bandwidth | Jan. 01, 2025 | | Dec. 31, 2026 | Conducted (TH01-KS) |
| EMI Test Receiver | Keysight | N9038A | MY57290151 | 3Hz~8.5GHz;Max 30dBm | Jul. 04, 2024 | Jan. 07, 2025 | Jul. 03, 2025 | Radiation (03CH05-KS) |
| EXA Spectrum Analyzer | Keysight | N9010B | MY60242126 | 10Hz-44G,MAX 30dB | Oct. 10, 2024 | Jan. 07, 2025 | Oct. 09, 2025 | Radiation (03CH05-KS) |
| Loop Antenna | R&S | HFH2-Z2E | 101125 | 9kHz~30MHz | Sep. 08, 2024 | Jan. 07, 2025 | Sep. 07, 2025 | Radiation (03CH05-KS) |
| Bilog Antenna | TeseQ | CBL6111D | 49921 | 30MHz-1GHz | Apr. 18, 2024 | Jan. 07, 2025 | Apr. 17, 2025 | Radiation (03CH05-KS) |
| Double Ridge Horn Antenna | ETS-Lindgren | 3117 | 00218642 | 1GHz~18GHz | Apr. 11, 2024 | Jan. 07, 2025 | Apr. 10, 2025 | Radiation (03CH05-KS) |
| SHF-EHF Horn | Com-power | AH-840 | 101093 | 18GHz~40GHz | Jan. 05, 2025 | Jan. 07, 2025 | Jan. 04, 2026 | Radiation (03CH05-KS) |
| Amplifier | SONOMA | 310N | 381512 | 9KHz-1GHz | Jan. 01, 2025 | Jan. 07, 2025 | Dec. 31, 2025 | Radiation (03CH05-KS) |
| Amplifier | EM | EM18G40GA | 060852 | 18~40GHz | Jan. 01, 2025 | Jan. 07, 2025 | Dec. 31, 2025 | Radiation (03CH05-KS) |
| high gain Amplifier | EM | EM01G18GA | 060843 | 1Ghz-18Ghz | Jan. 02, 2025 | Jan. 07, 2025 | Jan. 01, 2026 | Radiation (03CH05-KS) |
| Amplifier | EM | EM01G18GA | 060833 | 1Ghz-18Ghz | Jan. 02, 2025 | Jan. 07, 2025 | Jan. 01, 2026 | Radiation (03CH05-KS) |
| AC Power Source | Chroma | 61601 | F104090004 | N/A | NCR | Jan. 07, 2025 | NCR | Radiation (03CH05-KS) |
| Turn Table | ChamPro | EM 1000-T | 060762-T | 0~360 degree | NCR | Jan. 07, 2025 | NCR | Radiation (03CH05-KS) |
| Antenna Mast | ChamPro | EM 1000-A | 060762-A | 1 m~4 m | NCR | Jan. 07, 2025 | NCR | Radiation (03CH05-KS) |
| EMI Receiver | R&S | ESCI7 | 100768 | 9kHz~7GHz; | Apr. 18, 2024 | Dec. 02, 2024 | Apr. 17, 2025 | Conduction (CO01-KS) |
| AC LISN (for auxiliary equipment) | MessTec | AN3016 | 060103 | 9kHz~30MHz | Aug. 20, 2024 | Dec. 02, 2024 | Aug. 19, 2025 | Conduction (CO01-KS) |
| AC LISN | MessTec | AN3016 | 060105 | 9kHz~30MHz | Apr. 18, 2024 | Dec. 02, 2024 | Apr. 17, 2025 | Conduction (CO01-KS) |
| AC Power Source | Chroma | 61602 | ABP000000811 | AC 0V~300V, 45Hz~1000Hz | Oct. 09, 2024 | Dec. 02, 2024 | Oct. 08, 2025 | Conduction (CO01-KS) |

NCR: No Calibration Required

# 5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

**Uncertainty of Conducted Measurement**

| | |
|---|---|
| **Conducted Spurious Emission & Bandedge** | **±2.26 dB** |
| **Occupied Channel Bandwidth** | **±0.1%** |
| **Conducted Power** | **±0.50 dB** |
| **Conducted Power Spectral Density** | **±0.90 dB** |
| **Frequency** | **±0.4 Hz** |

**Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **2.84 dB** |

**Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **3.30 dB** |

**Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **6.02 dB** |

**Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)**

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.22 dB** |

**Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)**

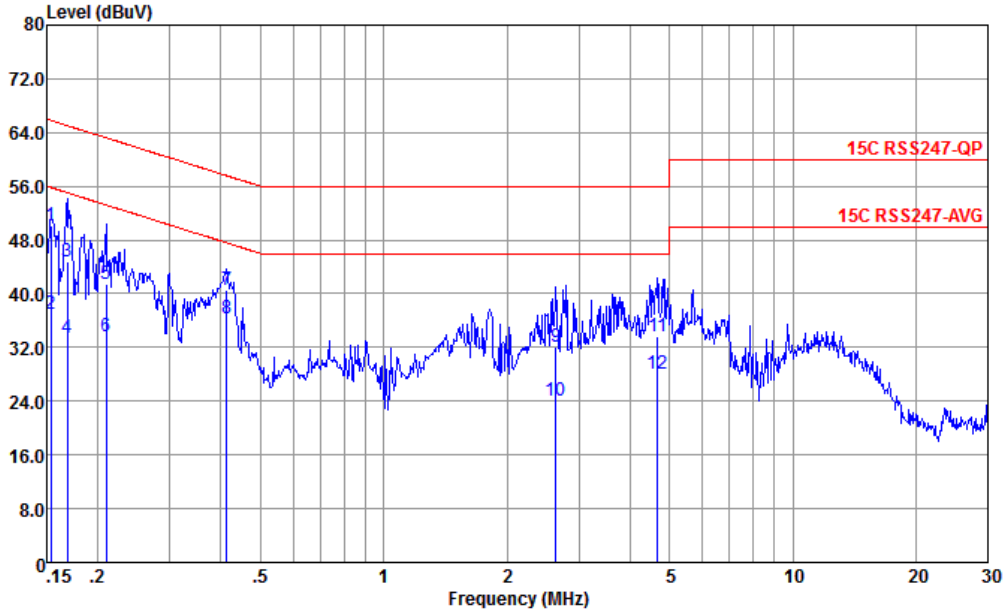
| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.34 dB** |

**---------- THE END ----------**

# Appendix A. Conducted Test Results

# Appendix B. AC Conducted Emission Test Results

| | | | |
|---|---|---|---|
| **Test Engineer :** | Amos Zhang | **Temperature :** | 25.3~26.2℃ |
| | | **Relative Humidity :** | 38~40% |
| **Test Voltage :** | 120Vac / 60Hz | **Phase :** | Line |
| **Remark :** | All emissions not reported here are more than 10 dB below the prescribed limit. | | |

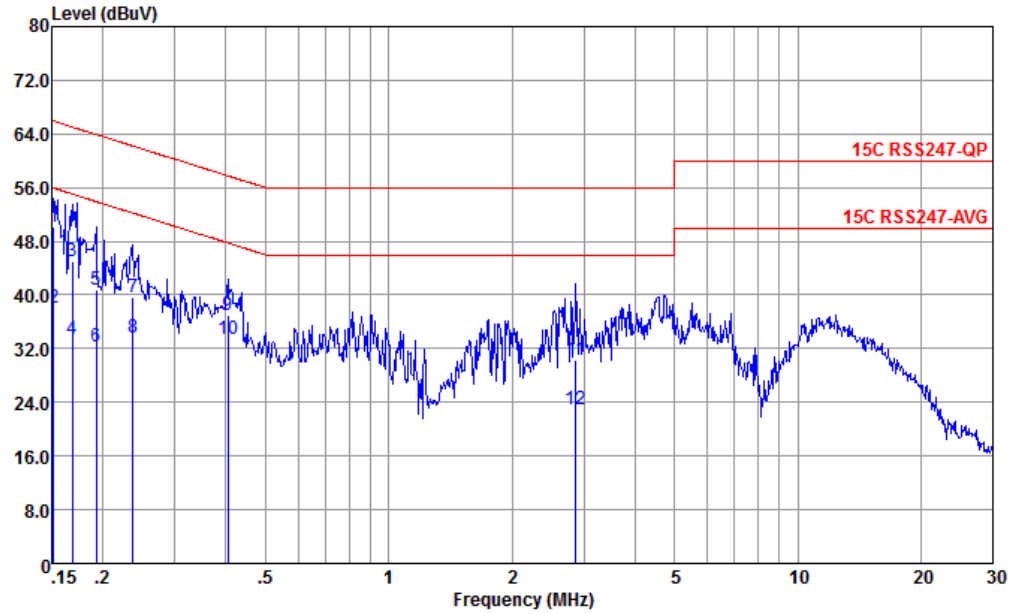



Site : CO01-KS
Condition : 15C RSS247-QP LISN-060105-L 2024 LINE

mode : Mode 1

| | | Freq | Level | Over Limit | Limit Line | Read Level | LISN Factor | Cable Loss | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | dB | |
| 1 | | 0.153 | 50.04 | -15.78 | 65.82 | 39.50 | 0.12 | 10.42 | QP |
| 2 | | 0.153 | 37.04 | -18.78 | 55.82 | 26.50 | 0.12 | 10.42 | Average |
| 3 | | 0.169 | 44.82 | -20.21 | 65.03 | 34.30 | 0.10 | 10.42 | QP |
| 4 | | 0.169 | 33.32 | -21.71 | 55.03 | 22.80 | 0.10 | 10.42 | Average |
| 5 | | 0.209 | 41.38 | -21.85 | 63.23 | 30.90 | 0.08 | 10.40 | QP |
| 6 | | 0.209 | 33.58 | -19.65 | 53.23 | 23.10 | 0.08 | 10.40 | Average |
| 7 | | 0.413 | 40.53 | -17.06 | 57.59 | 30.30 | -0.04 | 10.27 | QP |
| 8 | * | 0.413 | 36.33 | -11.26 | 47.59 | 26.10 | -0.04 | 10.27 | Average |
| 9 | | 2.636 | 32.19 | -23.81 | 56.00 | 22.30 | -0.18 | 10.07 | QP |
| 10 | | 2.636 | 24.09 | -21.91 | 46.00 | 14.20 | -0.18 | 10.07 | Average |
| 11 | | 4.672 | 33.75 | -22.25 | 56.00 | 23.90 | -0.21 | 10.06 | QP |
| 12 | | 4.672 | 28.15 | -17.85 | 46.00 | 18.30 | -0.21 | 10.06 | Average |

| | | | |
|---|---|---|---|
| **Test Engineer :** | Amos Zhang | **Temperature :** | 25.3~26.2℃ |
| | | **Relative Humidity :** | 38~40% |
| **Test Voltage :** | 120Vac / 60Hz | **Phase :** | Neutral |
| **Remark :** | All emissions not reported here are more than 10 dB below the prescribed limit. | | |




Site : CO01-KS
Condition : 15C RSS247-QP LISN-060105-N 2024 NEUTRAL

mode : Mode 1

| | | Freq | Level | Over Limit | Limit Line | Read Level | LISN Factor | Cable Loss | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | dB | |
| 1 | | 0.152 | 50.04 | -15.87 | 65.91 | 39.50 | 0.12 | 10.42 | QP |
| 2 | | 0.152 | 38.14 | -17.77 | 55.91 | 27.60 | 0.12 | 10.42 | Average |
| 3 | | 0.169 | 44.94 | -20.09 | 65.03 | 34.40 | 0.12 | 10.42 | QP |
| 4 | | 0.169 | 33.34 | -21.69 | 55.03 | 22.80 | 0.12 | 10.42 | Average |
| 5 | | 0.192 | 40.74 | -23.19 | 63.93 | 30.20 | 0.13 | 10.41 | QP |
| 6 | | 0.192 | 32.24 | -21.69 | 53.93 | 21.70 | 0.13 | 10.41 | Average |
| 7 | | 0.237 | 39.60 | -22.62 | 62.22 | 29.20 | 0.02 | 10.38 | QP |
| 8 | | 0.237 | 33.70 | -18.52 | 52.22 | 23.30 | 0.02 | 10.38 | Average |
| 9 | | 0.404 | 37.04 | -20.73 | 57.77 | 26.90 | -0.14 | 10.28 | QP |
| 10 | * | 0.404 | 33.34 | -14.43 | 47.77 | 23.20 | -0.14 | 10.28 | Average |
| 11 | | 2.869 | 30.36 | -25.64 | 56.00 | 20.50 | -0.21 | 10.07 | QP |
| 12 | | 2.869 | 23.06 | -22.94 | 46.00 | 13.20 | -0.21 | 10.07 | Average |

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)