



# **RADIO TEST REPORT**

**Test Report No. : 13801638S-A-R1**

**Applicant** : NITTOKU CO.,LTD  
**Type of Equipment** : HF-Band RFID READER/WRITER  
**Model No.** : ITS-HRW110  
**FCC ID** : 2A29TITSHRW110S2109  
**Test regulation** : FCC Part 15 Subpart C: 2021  
**Test Result** : Complied (Refer to SECTION 3)

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements.  
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Shonan EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in SECTION 1.
10. This report is a revised version of 13801638S-A. 13801638S-A is replaced with this report.

**Date of test:** September 20 to 24, 2021

**Representative test engineer:**

Hiromasa Sato  
Engineer

**Approved by:**

Kazuya Noda  
Leader



CERTIFICATE 1266.03

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.  
☒ There is no testing item of "Non-accreditation".

**UL Japan, Inc.**  
**Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

## **REVISION HISTORY**

### **Original Test Report No.: 13801638S-A**

| Revision        | Test report No. | Date             | Page revised | Contents   |
|-----------------|-----------------|------------------|--------------|--|
| -<br>(Original) | 13801638S-A     | October 14, 2021 | -            | -  |
| 1               | 13801638S-A-R1  | October 19, 2021 | 11           | Correction of Volt/Freq. in Figures:<br>From “AC 100 V / 50 Hz” to “AC 120 V / 60 Hz”<br>Correction of Cable length of No. 1 Antenna cable:<br>From “1.0” to “2.0” |

## Reference: Abbreviations (Including words undescribed in this report)

|                |   |         |   |
|----------------|---|---------|---|
| A2LA           | The American Association for Laboratory Accreditation           | MCS     | Modulation and Coding Scheme                        |
| AC             | Alternating Current   | MRA     | Mutual Recognition Arrangement                      |
| AFH            | Adaptive Frequency Hopping                                      | N/A     | Not Applicable                                      |
| AM             | Amplitude Modulation  | NIST    | National Institute of Standards and Technology      |
| Amp, AMP       | Amplifier   | NS      | No signal detect.                                   |
| ANSI           | American National Standards Institute                           | NSA     | Normalized Site Attenuation                         |
| Ant, ANT       | Antenna   | NVLAP   | National Voluntary Laboratory Accreditation Program |
| AP             | Access Point  | OBW     | Occupied Band Width                                 |
| ASK            | Amplitude Shift Keying  | OFDM    | Orthogonal Frequency Division Multiplexing          |
| Atten., ATT    | Attenuator  | P/M     | Power meter   |
| AV             | Average   | PCB     | Printed Circuit Board                               |
| BPSK           | Binary Phase-Shift Keying                                       | PER     | Packet Error Rate                                   |
| BR             | Bluetooth Basic Rate  | PHY     | Physical Layer                                      |
| BT             | Bluetooth   | PK      | Peak  |
| BT LE          | Bluetooth Low Energy  | PN      | Pseudo random Noise                                 |
| BW             | BandWidth   | PRBS    | Pseudo-Random Bit Sequence                          |
| Cal Int        | Calibration Interval  | PSD     | Power Spectral Density                              |
| CCK            | Complementary Code Keying                                       | QAM     | Quadrature Amplitude Modulation                     |
| Ch., CH        | Channel   | QP      | Quasi-Peak  |
| CISPR          | Comite International Special des Perturbations Radioelectriques | QPSK    | Quadri-Phase Shift Keying                           |
| CW             | Continuous Wave   | RBW     | Resolution Band Width                               |
| DBPSK          | Differential BPSK   | RDS     | Radio Data System                                   |
| DC             | Direct Current  | RE      | Radio Equipment                                     |
| D-factor       | Distance factor   | RF      | Radio Frequency                                     |
| DFS            | Dynamic Frequency Selection                                     | RMS     | Root Mean Square                                    |
| DQPSK          | Differential QPSK   | RSS     | Radio Standards Specifications                      |
| DSSS           | Direct Sequence Spread Spectrum                                 | Rx      | Receiving   |
| EDR            | Enhanced Data Rate  | SA, S/A | Spectrum Analyzer                                   |
| EIRP, e.i.r.p. | Equivalent Isotropically Radiated Power                         | SG      | Signal Generator                                    |
| EMC            | ElectroMagnetic Compatibility                                   | SVSWR   | Site-Voltage Standing Wave Ratio                    |
| EMI            | ElectroMagnetic Interference                                    | TR      | Test Receiver                                       |
| EN             | European Norm   | Tx      | Transmitting  |
| ERP, e.r.p.    | Effective Radiated Power  | VBW     | Video BandWidth                                     |
| EU             | European Union  | Vert.   | Vertical  |
| EUT            | Equipment Under Test  | WLAN    | Wireless LAN  |
| Fac.           | Factor  |         |   |
| FCC            | Federal Communications Commission                               |         |   |
| FHSS           | Frequency Hopping Spread Spectrum                               |         |   |
| FM             | Frequency Modulation  |         |   |
| Freq.          | Frequency   |         |   |
| FSK            | Frequency Shift Keying  |         |   |
| GFSK           | Gaussian Frequency-Shift Keying                                 |         |   |
| GNSS           | Global Navigation Satellite System                              |         |   |
| GPS            | Global Positioning System                                       |         |   |
| Hori.          | Horizontal  |         |   |
| ICES           | Interference-Causing Equipment Standard                         |         |   |
| IEC            | International Electrotechnical Commission                       |         |   |
| IEEE           | Institute of Electrical and Electronics Engineers               |         |   |
| IF             | Intermediate Frequency  |         |   |
| ILAC           | International Laboratory Accreditation Conference               |         |   |
| ISED           | Innovation, Science and Economic Development Canada             |         |   |
| ISO            | International Organization for Standardization                  |         |   |
| JAB            | Japan Accreditation Board                                       |         |   |
| LAN            | Local Area Network  |         |   |
| LIMS           | Laboratory Information Management System                        |         |   |

**UL Japan, Inc.**

**Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

## **Contents**

|   | <b><u>Page</u></b> |
|---|--------------------|
| <b>SECTION 1: Customer information .....</b>                          | <b>5</b>           |
| <b>SECTION 2: Equipment under test (E.U.T.) .....</b>                 | <b>5</b>           |
| <b>SECTION 3: Test specification, procedures &amp; results .....</b>  | <b>6</b>           |
| <b>SECTION 4: Operation of E.U.T. during testing.....</b>             | <b>10</b>          |
| <b>SECTION 5: Conducted emission .....</b>                            | <b>12</b>          |
| <b>SECTION 6: Radiated emission .....</b>                             | <b>13</b>          |
| <b>SECTION 7: 20 dB bandwidth &amp; 99 % Occupied bandwidth .....</b> | <b>16</b>          |
| <b>SECTION 8: Frequency Tolerance .....</b>                           | <b>16</b>          |
| <b>APPENDIX 1: Photographs of test setup.....</b>                     | <b>17</b>          |
| <b>APPENDIX 2: Data of Radio tests.....</b>                           | <b>21</b>          |
| <b>APPENDIX 3: Test instruments .....</b>                             | <b>30</b>          |

---

**UL Japan, Inc.**

**Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

## **SECTION 1: Customer information**

Company Name : NITTOKU CO.,LTD  
Address : 2-292-1 Azuma-cho, Omiya-ku, Saitama-city, Saitama-pref, 330-0841, Japan  
Telephone Number : +81-48-615-2117  
Facsimile Number : +81-48-615-2118  
Contact Person : Akitomo Kiriyama

The information provided from the customer is as follows:

- Applicant, Type of Equipment, Model No. on the cover page and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- Section 1: Customer information
- Section 2: Equipment under test (E.U.T.) other than the Receipt Date of Sample
- Section 4: Operation of E.U.T. during testing

\* The laboratory is exempted from liability of any test results affected from the information in Section 2 and 4.

## **SECTION 2: Equipment under test (E.U.T.)**

### **2.1 Identification of E.U.T.**

Type of Equipment : HF-Band RFID READER/WRITER  
Model No. : ITS-HRW110  
Serial No. : Refer to Section 4.2  
Rating : DC 12 V, 0.2 A  
Receipt Date of Sample : September 17, 2021  
Country of Mass-production : Japan  
Condition of EUT : Production model  
Modification of EUT : No Modification by the test lab.

### **2.2 Product description**

Model: ITS-HRW110 (referred to as the EUT in this report) is a HF-Band RFID READER/WRITER.

Clock frequency(ies) in the system : 16 MHz

### **Radio specification**

Equipment type : Transceiver  
Frequency of operation : 13.56 MHz  
Type of modulation : ASK  
Antenna type : Loop

---

## **UL Japan, Inc.**

### **Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

### **SECTION 3: Test specification, procedures & results**

#### **3.1 Test specification**

Test Specification : FCC Part 15 Subpart C  
FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators  
Section 15.207 Conducted limits  
Section 15.209 Radiated emission limits, general requirements  
Section 15.215 Additional provisions to the general radiated emission limitations.  
Section 15.225 Operation within the band 13.110-14.010 MHz.

\* Also the EUT complies with FCC Part 15 Subpart B.

### 3.2 Procedures & Results

| Item   | Test Procedure  | Specification  | Worst margin                                       | Results         | Remarks  |
|--|---|--|--|-----------------|----------|
| Conducted emission   | ANSI C63.10:2013<br>6 Standard test methods<br><ISED>RSS-Gen 8.8        | Section 15.207<br><ISED>RSS-Gen 8.8                        | 0.5 dB,<br>27.12000 MHz,<br>AV, L1                 | Complied#<br>a) | -        |
| Electric Field Strength<br>of Fundamental<br>Emission  | ANSI C63.10:2013<br>6 Standard test methods<br><ISED> RSS-Gen 6.4, 6.12 | Section 15.225(a)<br><ISED>RSS-210 B.6                     | 64.8 dB,<br>13.560 MHz,<br>QP, Vertical<br>90 deg. | Complied<br>b)  | Radiated |
| Spectrum Mask  | ANSI C63.10:2013<br>6 Standard test methods<br><ISED>RSS-Gen 6.4, 6.13  | Section 15.225(b)(c)<br><ISED> RSS-210 B.6                 | 44.1 dB,<br>14.010 MHz,<br>QP, Vertical<br>90 deg. | Complied<br>b)  | Radiated |
| 20 dB Bandwidth  | ANSI C63.10:2013<br>6 Standard test methods<br><ISED> -                 | Section 15.215(c)<br><ISED> -                              | See data   | Complied<br>c)  | Radiated |
| Electric Field Strength<br>of Spurious Emission  | ANSI C63.10:2013<br>6 Standard test methods<br><ISED>RSS-Gen 6.4, 6.13  | Section 15.209,<br>Section 15.225 (d)<br><ISED>RSS-210 B.6 | 4.1 dB<br>488.159 MHz,<br>Horizontal, QP           | Complied#<br>d) | Radiated |
| Frequency Tolerance  | ANSI C63.10:2013<br>6 Standard test methods<br><ISED>RSS-Gen 6.11, 8.11 | Section 15.225(e)<br><ISED> RSS-210 B.6                    | See data   | Complied<br>e)  | Radiated |
| <p>Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422</p> <p>a) Refer to APPENDIX 2 (data of Conducted Emission)<br/> b) Refer to APPENDIX 2 (data of Data of Electric field strength of Fundamental emission and Spurious emission)<br/> c) Refer to APPENDIX 2 (data of 20 dB Bandwidth and 99 % Occupied Bandwidth)<br/> d) Refer to APPENDIX 2 (data of Radiated emission)<br/> e) Refer to APPENDIX 2 (data of Frequency Tolerance)</p> <p>Symbols:<br/> Complied The data of this test item has enough margin, more than the measurement uncertainty.<br/> Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.</p> |   |  |  |                 |          |

#### **FCC Part 15.31 (e)**

The stable voltage was supplied by the end product which was required to have a power supply regulator. Therefore, the EUT complies with the requirement.

However, the supply voltage was varied and tested at 85 % and 115 % of the nominal rated supply voltage during frequency tolerance test according to Section 15.225(e).

#### **FCC Part 15.203 Antenna requirement**

The EUT has an external antenna connector, but it is installed by the professionals. Therefore, the equipment complies with the antenna requirement of Section 15.203.

**UL Japan, Inc.**

**Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

### 3.3 Addition to standard

| Item  | Test Procedure  | Specification | Remarks  | Deviation | Worst margin | Results |
|---|---|---------------|----------|-----------|--------------|---------|
| 99 % Occupied Band Width  | RSS-Gen 6.7   | -             | Radiated | N/A       | N/A          | a)      |
| Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.             |   |               |          |           |              |         |
| a) Refer to APPENDIX 2 (data of 20 dB Bandwidth / 99 % Occupied Bandwidth)              |   |               |          |           |              |         |
| Symbols:  |   |               |          |           |              |         |
| Complied  | The data of this test item has enough margin, more than the measurement uncertainty.                        |               |          |           |              |         |
| Complied#   | The data of this test item meets the limits unless the measurement uncertainty is taken into consideration. |               |          |           |              |         |
| Other than above, no addition, exclusion nor deviation has been made from the standard. |   |               |          |           |              |         |

### 3.4 Uncertainty

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor  $k = 2$ .  
Shonan EMC Lab.

| Item   | Frequency range | Uncertainty (+/-) |                |                |                |              |
|--|-----------------|-------------------|----------------|----------------|----------------|--------------|
|  |                 | No. 1 SAC / SR    | No. 2 SAC / SR | No. 3 SAC / SR | No. 4 SAC / SR | No. 5,6,8 SR |
| Conducted emission (AC Mains) LISN               | 150 kHz-30 MHz  | 2.9 dB            | 2.8 dB         | 2.9 dB         | 2.9 dB         | 2.9 dB       |
| Radiated emission<br>(Measurement distance: 3 m) | 9 kHz-30 MHz    | 3.0 dB            | 3.0 dB         | 3.1 dB         | -              | -            |
|  | 30 MHz-200 MHz  | 4.6 dB            | 4.6 dB         | 4.7 dB         | -              | -            |
|  | 200 MHz-1 GHz   | 6.0 dB            | 6.0 dB         | 6.1 dB         | -              | -            |
|  | 1 GHz-6 GHz     | 4.8 dB            | 4.8 dB         | 4.8 dB         | -              | -            |
|  | 6 GHz-18 GHz    | 5.4 dB            | 5.4 dB         | 5.4 dB         | -              | -            |
|  | 18 GHz-40 GHz   | 5.6 dB            | 5.6 dB         | 5.6 dB         | -              | -            |
|  |                 |                   |                |                |                |              |
| Radiated emission<br>(Measurement distance: 1 m) | 1 GHz-18 GHz    | 5.7 dB            | 5.7 dB         | 5.7 dB         | -              | -            |
|  | 18 GHz-40 GHz   | 5.9 dB            | 5.9 dB         | 5.9 dB         | -              | -            |

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

| Antenna terminal test                                   | Uncertainty (+/-) |
|---|-------------------|
| Power Measurement above 1 GHz (Average Detector)_SPM-06 | 0.81 dB           |
| Power Measurement above 1 GHz (Peak Detector)_SPM-06    | 1.53 dB           |
| Power Measurement above 1 GHz (Average Detector)_SPM-07 | 0.95 dB           |
| Power Measurement above 1 GHz (Peak Detector)_SPM-07    | 1.21 dB           |
| Power Measurement above 1 GHz (Average Detector)_SPM-13 | 0.90 dB           |
| Power Measurement above 1 GHz (Peak Detector)_SPM-13    | 1.04 dB           |
| Spurious emission (Conducted) below 1 GHz               | 1.8 dB            |
| Spurious emission (Conducted) 1 GHz-3 GHz               | 1.7 dB            |
| Spurious emission (Conducted) 3 GHz-18 GHz              | 2.3 dB            |
| Spurious emission (Conducted) 18 GHz-26.5 GHz           | 2.4 dB            |
| Spurious emission (Conducted) 26.5 GHz-40 GHz           | 2.4 dB            |
| Bandwidth Measurement                                   | 0.61 %            |
| Duty cycle and Time Measurement                         | 0.012 %           |
| Temperature_SCH-01                                      | 0.93 deg.C.       |
| Humidity_SCH-01   | 4.1 %             |
| Temperature_SCH-02                                      | 2.0 deg.C.        |
| Humidity_SCH-02   | 6.6 %             |
| Voltage   | 0.97 %            |



### 3.5 Test location

UL Japan, Inc. Shonan EMC Lab.  
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN  
Telephone: +81 463 50 6400, Facsimile: +81 463 50 6401  
A2LA Certificate Number: 1266.03  
(FCC test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

| Test site                  | IC<br>Registration<br>Number | Width x Depth x<br>Height (m) | Size of reference ground plane (m)<br>/ horizontal conducting plane | Maximum<br>measuremen<br>t distance |
|----------------------------|------------------------------|-------------------------------|---|-------------------------------------|
| No.1 Semi-anechoic chamber | 2973D-1                      | 20.6 x 11.3 x 7.65            | 20.6 x 11.3   | 10 m                                |
| No.2 Semi-anechoic chamber | 2973D-2                      | 20.6 x 11.3 x 7.65            | 20.6 x 11.3   | 10 m                                |
| No.3 Semi-anechoic chamber | 2973D-3                      | 12.7 x 7.7 x 5.35             | 12.7 x 7.7  | 5 m                                 |
| No.4 Semi-anechoic chamber | -                            | 8.1 x 5.1 x 3.55              | 8.1 x 5.1   | -                                   |
| No.1 Shielded room         | -                            | 6.8 x 4.1 x 2.7               | 6.8 x 4.1   | -                                   |
| No.2 Shielded room         | -                            | 6.8 x 4.1 x 2.7               | 6.8 x 4.1   | -                                   |
| No.3 Shielded room         | -                            | 6.3 x 4.7 x 2.7               | 6.3 x 4.7   | -                                   |
| No.4 Shielded room         | -                            | 4.4 x 4.7 x 2.7               | 4.4 x 4.7   | -                                   |
| No.5 Shielded room         | -                            | 7.8 x 6.4 x 2.7               | 7.8 x 6.4   | -                                   |
| No.6 Shielded room         | -                            | 7.8 x 6.4 x 2.7               | 7.8 x 6.4   | -                                   |
| No.8 Shielded room         | -                            | 3.45 x 5.5 x 2.4              | 3.45 x 5.5  | -                                   |
| No.1 Measurement room      | -                            | 2.55 x 4.1 x 2.5              | -   | -                                   |

### 3.6 Test setup, Data of EMI & Test instruments

Refer to APPENDIX 1 to 3.

### UL Japan, Inc. Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN  
Telephone : +81 463 50 6400  
Facsimile : +81 463 50 6401

## **SECTION 4: Operation of E.U.T. during testing**

### **4.1 Operating mode**

The EUT exercise program used during testing was designed to exercise the various system components in a manner similar to typical use.

| Test item | Operating mode         | Tested frequency |
|-----------|------------------------|------------------|
| All items | Transmitting 13.56 MHz | 13.56 MHz        |

Power setting : Fixed  
Software (Version) : V1.03  
Date : September 20, 2021

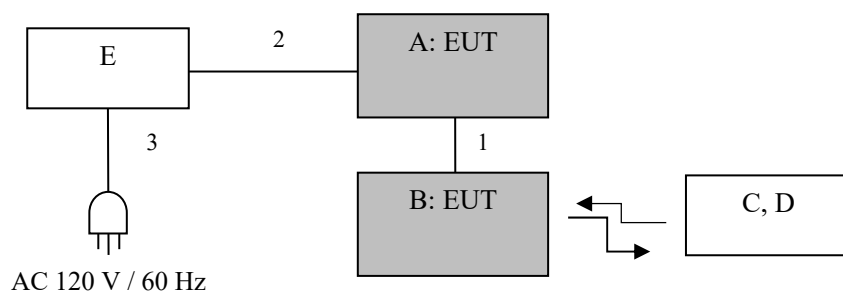
The carrier level and noise levels were confirmed with and without Tag, and the test was made with the condition that has the maximum noise.

Combinations of the worst case:

| Conducted emission        | Radiated emission<br>(Carrier) | Radiated emission<br>(Below 30 MHz) | Radiated emission<br>(Above 30 MHz) |
|---------------------------|--------------------------------|-------------------------------------|-------------------------------------|
| With Tag (ISO15693 Tag 1) | With Tag (ISO15693 Tag 1)      | With Tag (ISO15693 Tag 1)           | With Tag (ISO15693 Tag 1)           |

**Justification:** The system was configured in typical fashion (as customer would normally use it) for testing.

## 4.2 Configuration of tested system



\* Test data was taken under worse case conditions.

### Description of EUT and support equipment

| No. | Item                       | Model number  | Serial number    | Manufacturer | Remarks |
|-----|----------------------------|---------------|------------------|--------------|---------|
| A   | HF-Band RFID READER/WRITER | ITS-HRW110    | 1                | NITTOKU      | EUT     |
| B   | Antenna                    | ITS-HAN10R    | H217-2N001       | NITTOKU      | EUT     |
| C   | ISO15693Tag 1              | ITS-HTG61F52K | E00801424E5394A1 | NITTOKU      | -       |
| D   | ISO15693Tag 2              | ITS-HTG21F52K | E00801424E53A77F | NITTOKU      | -       |
| E   | DC Power Supply            | PAN35-10A     | DE001677         | KIKUSUI      | -       |

### List of cables used

| No. | Cable Name | Length (m) | Shield     |            | Remark |
|-----|------------|------------|------------|------------|--------|
|     |            |            | Cable      | Connector  |        |
| 1   | Antenna    | 2.0        | Shielded   | Shielded   | -      |
| 2   | DC         | 0.3+1.0    | Unshielded | Unshielded | -      |
| 3   | AC         | 1.5        | Unshielded | Unshielded | -      |

## **SECTION 5: Conducted emission**

### **Test Procedure and conditions**

EUT was placed on a platform of nominal size, 1.0 m by 2.0 m, raised 80 cm above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene and the table top is covered with polycarbonate. That has very low permittivity.

The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN / (AMN) to the input power source.

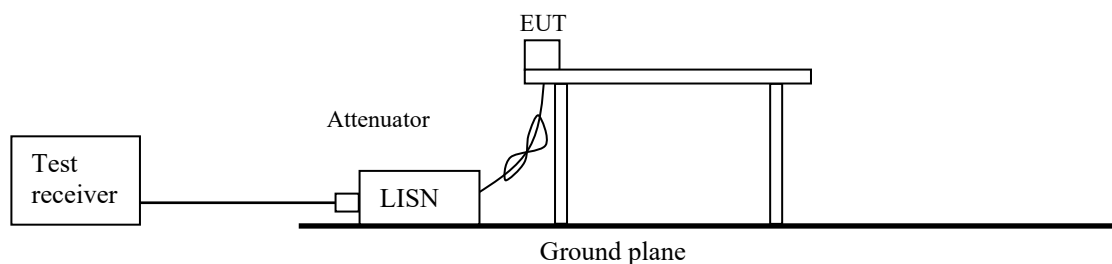
The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Shielded Room. The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

**Detector** : QP and CISPR AV  
**Measurement range** : 0.15 MHz - 30 MHz  
**Test data** : APPENDIX  
**Test result** : Pass

**Figure 1: Test Setup**



## SECTION 6: Radiated emission

### 6.1 Operating environment

Test place : See test data (APPENDIX 2)  
Temperature : See test data (APPENDIX 2)  
Humidity : See test data (APPENDIX 2)

### 6.2 Test configuration

EUT was placed on a platform of nominal size, 1.0 m by 2.0 m, raised 0.8 m above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene and the table top is covered with polycarbonate. That has very low permittivity. Photographs of the set up are shown in APPENDIX 3.

### 6.3 Test procedure

The Radiated Electric Field Strength intensity has been measured on a semi-anechoic chamber with a ground plane at a distance of 3 m.

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open area 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.

These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane.

However test results were confirmed to pass against standard limit.

The Radiated Electric Field Strength intensity has been measured with a ground plane and at a distance of 3 m.

Frequency: From 9 kHz to 30 MHz at distance 3 m (Refer to Figure 2)

The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg. and 135 deg.) and horizontal polarization. Drawing of the antenna direction is shown in Figure 1.

Frequency: From 30 MHz to 1 GHz at distance 3 m (Refer to Figure 2).

The measuring antenna height was varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for both vertical and horizontal antenna polarization.

Measurements were performed with QP, PK, and AV detector.

The radiated emission measurements were made with the following detector function of the test receiver.

|                        | 9 kHz to 90 kHz &<br>110 kHz to 150 kHz | 90 kHz to<br>110 kHz | 150 kHz<br>to 490 kHz | 490 kHz to<br>30 MHz | 30 MHz to 1 GHz   |
|------------------------|---|----------------------|-----------------------|----------------------|---|
| Detector Type          | PK/AV                                   | QP                   | PK/AV                 | QP                   | QP  |
| IF Bandwidth           | 200 Hz                                  | 200 Hz               | 10 kHz                | 9 kHz                | 120 kHz   |
| Distance factor<br>*1) | -80 dB                                  | -80 dB               | -80 dB                | -40 dB               | -   |
| Measuring<br>antenna   | Loop antenna                            |                      |                       |                      | Biconical<br>(30 MHz - 199.999 MHz)<br>Logperiodic<br>(200 MHz - 1 GHz) |

\*1) FCC 15.31 (f)(2) (9 kHz-30 MHz)

Distance Factor:  $40 \times \log (3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

Distance Factor:  $40 \times \log (3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Combinations of the worst case

|         | Frequency<br>Antenna<br>polarization | Below 30 MHz<br>(Carrier) | Below 30 MHz | Above 30 MHz |
|---------|--------------------------------------|---------------------------|--------------|--------------|
| Module  | Horizontal                           | X                         | X            | X            |
|         | Vertical                             | X                         | X            | X            |
| Antenna | Horizontal                           | X                         | X            | X            |
|         | Vertical                             | X                         | X            | X            |

Figure 1: Direction of the Loop Antenna

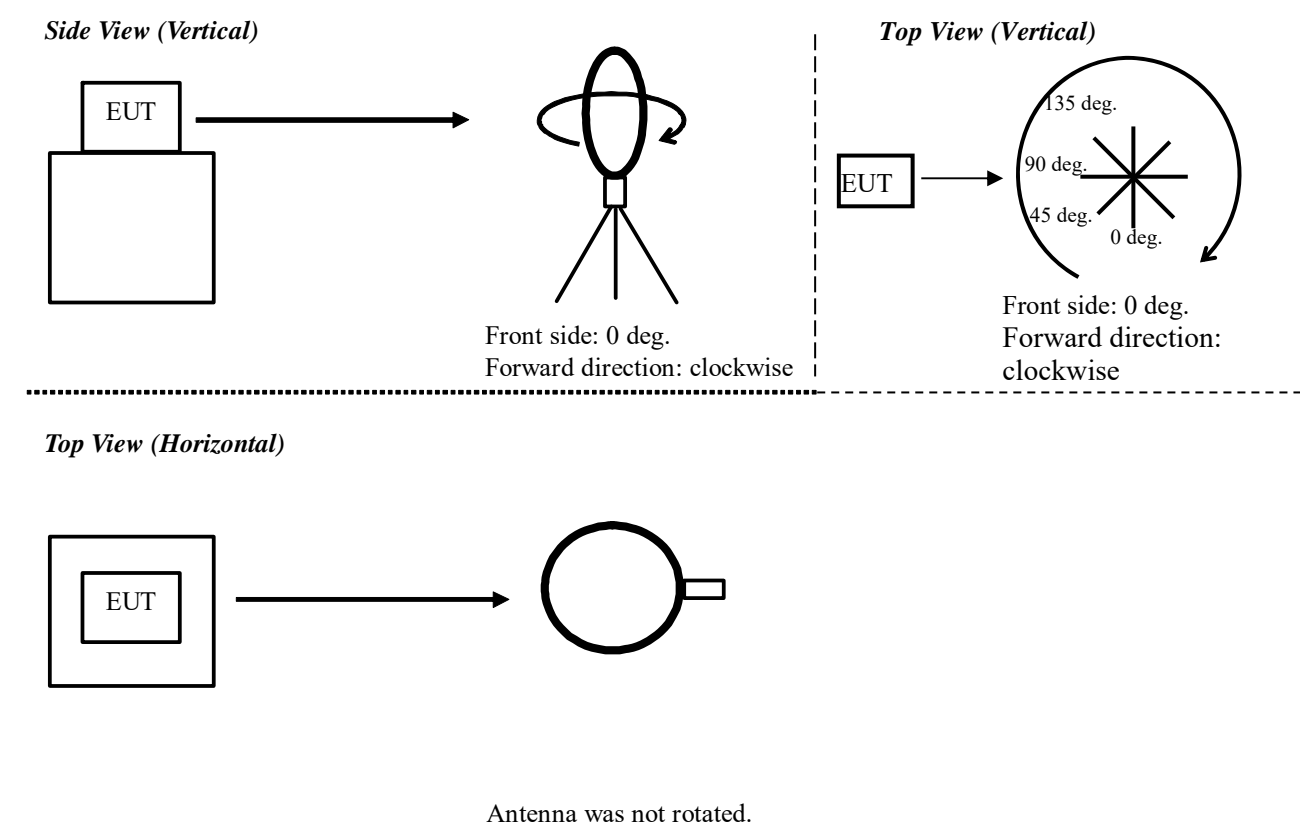
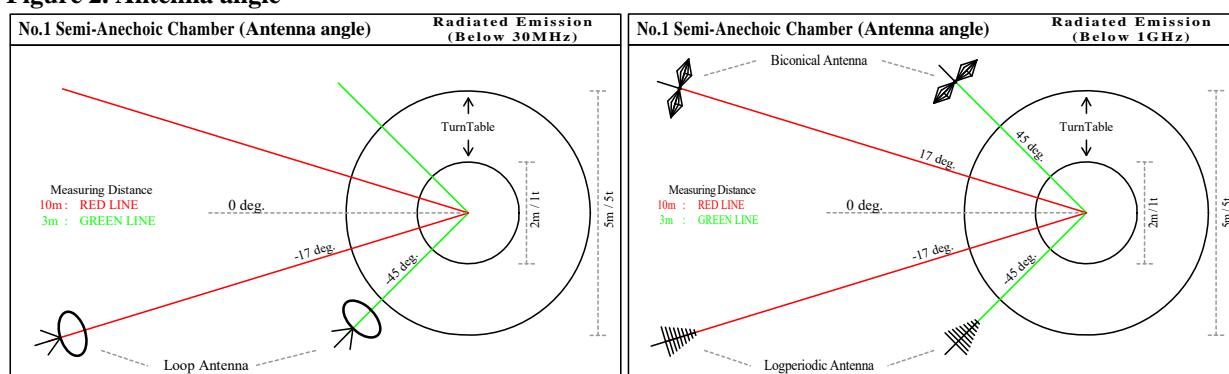
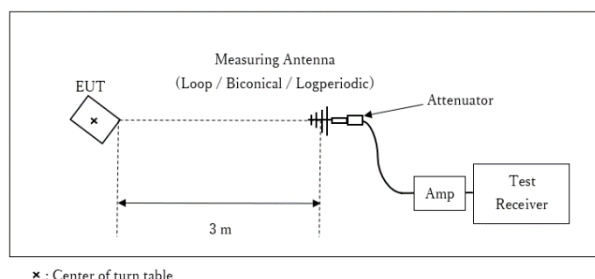


Figure 2. Antenna angle



[Test Setup]  
Below 1 GHz



Test Distance: 3 m

## 6.4 Results

The test results and limit are rounded off to one decimal place, so some differences might be observed.

**Measurement range** : 9 kHz - 1 GHz  
**Test data** : APPENDIX 2  
**Test result** : Pass

## **SECTION 7: 20 dB bandwidth & 99 % Occupied bandwidth**

### **Test procedure**

The test was measured with a spectrum analyzer using a test fixture.

| Test                          | Span                    | RBW             | VBW                | Sweep | Detector | Trace        | Instrument used   |
|-------------------------------|-------------------------|-----------------|--------------------|-------|----------|--------------|-------------------|
| 20 dB Bandwidth               | 1 MHz                   | 5.1 kHz         | 16 kHz             | Auto  | Peak     | Max Hold     | Spectrum Analyzer |
| 99 % Occupied Bandwidth (OBW) | Enough width to display | 1 to 5 % of OBW | Three times of RBW | Auto  | Peak *1) | Max Hold *1) | Spectrum Analyzer |

\*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100%.

Summary of the test results:Pass

Refer to APPENDIX 2

## **SECTION 8: Frequency Tolerance**

### **Test procedure**

The test was measured with a spectrum analyzer (with marker frequency counter function) using a test fixture.

The temperature test was started after the temperature stabilization time of 30 minutes.

The test was begun from 50 deg.C and the temperature was lowered each 10 deg.C.

Summary of the test results:Pass

Refer to APPENDIX 2