# RADIO TEST REPORT

## Test Report No. : 13594903H-A

| | | |
|---|---|---|
| **Applicant** | : | **DENSO CORPORATION** |
| **Type of EUT** | : | **Remote Keyless Entry System (Transmitter)** |
| **Model Number of EUT** | : | **12BGF** |
| **FCC ID** | : | **HYQ12BGF** |
| **Test regulation** | : | **FCC Part 15 Subpart C: 2020** |
| **Test Result** | : | **Complied (Refer to SECTION 3.2)** |

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.
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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. Ise 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.

**Date of test:** December 12 and 13, 2020

**Representative test engineer:**
Hiroki Numata
Engineer
Consumer Technology Division

**Approved by:**
Motoya Imura
Leader
Consumer Technology Division

CERTIFICATE 5107.02

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

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# REVISION HISTORY

## Original Test Report No.: 13594903H-A

| Revision | Test report No. | Date | Page revised | Contents |
|---|---|---|---|---|
| -<br>(Original) | 13594903H-A | January 8, 2021 | - | - |

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

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

**CONTENTS** **PAGE**

# SECTION 1: Customer information

| | | |
|---|---|---|
| Company Name | : | DENSO CORPORATION |
| Address | : | 1-1 Showa-cho, Kariya-shi, Aichi-ken, 448-8661 Japan |
| Telephone Number | : | +81-566-20-3953 |
| Facsimile Number | : | +81-566-25-4837 |
| Contact Person | : | MASASHI URABE |

The information provided from the customer is as follows;
- Applicant, Type of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT) other than the Receipt Date
- SECTION 4: Operation of EUT during testing

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

# SECTION 2: Equipment under test (EUT)

## 2.1 Identification of EUT

| | | |
|---|---|---|
| Type | : | Remote Keyless Entry System (Transmitter) |
| Model Number | : | 12BGF |
| Serial Number | : | Refer to SECTION 4.2 |
| Rating | : | DC 3.0 V |
| Receipt Date | : | December 4, 2020 |
| Country of Mass-production | : | Japan, United States of America, China |
| Condition | : | Engineering prototype<br>(Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification | : | No Modification by the test lab |

## 2.2 Product Description

Model: 12BGF (referred to as the EUT in this report) is a Remote Keyless Entry System (Transmitter).

**Radio Specification**

| | | |
|---|---|---|
| Radio Type | : | Transmitter |
| Frequency of Operation | : | 312.10 MHz / 314.35 MHz* |
| Clock frequency | : | 27.6 MHz Crystal |
| Modulation | : | FSK (F1D) |
| Type of Battery | : | One lithium battery |
| Antenna type | : | Built-in type (Fixed) |

*These two different frequencies are not emitted simultaneously.

# SECTION 3: Test specification, procedures & results

## 3.1 Test Specification

| | | |
|---|---|---|
| Test Specification | : | FCC Part 15 Subpart C<br>FCC Part 15 final revised on October 13, 2020 |
| Title | : | FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators<br>Section 15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz. |

## 3.2 Procedures and results

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|---|---|---|---|---|---|
| Conducted emission | **FCC:** ANSI C63.10:2013 6 Standard test methods<br>**ISED:** RSS-Gen 8.8 | **FCC:** Section 15.207<br>**ISED:** RSS-Gen 8.8 | N/A | N/A | *1) |
| Automatically Deactivate | **FCC:** ANSI C63.10:2013 6 Standard test methods<br>**ISED:** - | **FCC:** Section 15.231(a)(1)<br>**ISED:** RSS-210 A1.1 | N/A | Complied a) | Radiated |
| Electric Field Strength of Fundamental Emission | **FCC:** ANSI C63.10:2013 6 Standard test methods<br>**ISED:** RSS-Gen 6.12 | **FCC:** Section 15.231(b)<br>**ISED:** RSS-210 A1.2 | 6.4 dB<br>314.350 MHz<br>Horizontal,<br>PK with Duty factor | Complied b) | Radiated |
| Electric Field Strength of Spurious Emission | **FCC:** ANSI C63.10:2013 6 Standard test methods<br>**ISED:** RSS-Gen 6.13 | **FCC:** Section 15.205<br>Section 15.209<br>Section 15.231(b)<br>**ISED:** RSS-210 A1.2<br>RSS-Gen 8.9 | 7.9 dB<br>2829.150 MHz<br>Horizontal<br>/Vertical,<br>PK with Duty factor<br><314.35 MHz> | Complied b) | Radiated |
| -20dB Bandwidth | **FCC:** ANSI C63.10:2013 6 Standard test methods<br>**ISED:** - | **FCC:** Section 15.231(c)<br>**ISED:** Reference data | N/A | Complied c) | Radiated |

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*1) The test is not applicable since the EUT does not have AC Mains.

a) Refer to APPENDIX 1 (data of Automatically deactivate)
b) Refer to APPENDIX 1 (data of Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission))
c) Refer to APPENDIX 1 (data of -20 dB and 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. |

**FCC Part 15.31 (e)**
This test was performed with the New Battery (DC 3.0 V) and the constant voltage was supplied to the EUT during the tests. Therefore, the EUT complies with the requirement.

**FCC Part 15.203 Antenna requirement**
It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

## 3.3 Addition to standard

| Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|---|---|---|---|---|---|
| 99 % Occupied Bandwidth | **ISED:** RSS-Gen 6.7 | **ISED:** RSS-210 A1.3 | N/A | - | Radiated |
| Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422. | | | | | |

Other than above, no addition, exclusion nor deviation has been made from the standard.

## 3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the following results are derived depending on whether or not laboratory uncertainty is applied.

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

**Radiated emission**

| Measurement distance | Frequency range | | Uncertainty (+/-) |
|---|---|---|---|
| 3 m | 9 kHz to 30 MHz | | 3.3 dB |
| 10 m | | | 3.2 dB |
| 3 m | 30 MHz to 200 MHz | (Horizontal) | 4.8 dB |
| | | (Vertical) | 5.0 dB |
| | 200 MHz to 1000 MHz | (Horizontal) | 5.2 dB |
| | | (Vertical) | 6.3 dB |
| 10 m | 30 MHz to 200 MHz | (Horizontal) | 4.8 dB |
| | | (Vertical) | 4.8 dB |
| | 200 MHz to 1000 MHz | (Horizontal) | 5.0 dB |
| | | (Vertical) | 5.0 dB |
| 3 m | 1 GHz to 6 GHz | | 4.9 dB |
| | 6 GHz to 18 GHz | | 5.2 dB |
| 1 m | 10 GHz to 26.5 GHz | | 5.5 dB |
| | 26.5 GHz to 40 GHz | | 5.5 dB |
| 10 m | 1 GHz to 18 GHz | | 5.2 dB |

**Antenna Terminal test**

| Test Item | Uncertainty (+/-) |
|---|---|
| Automatically Deactivate | 0.10 % |
| -20 dB Emission Bandwidth / 99 % Occupied Bandwidth | 0.96 % |

## 3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 199967
ISED Lab Company Number: 2973C / CAB identifier: JP0002
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

| Test site | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms | Maximum measurement distance |
|---|---|---|---|---|
| No.1 semi-anechoic chamber | 19.2 x 11.2 x 7.7 | 7.0 x 6.0 | No.1 Power source room | 10 m |
| No.2 semi-anechoic chamber | 7.5 x 5.8 x 5.2 | 4.0 x 4.0 | - | 3 m |
| No.3 semi-anechoic chamber | 12.0 x 8.5 x 5.9 | 6.8 x 5.75 | No.3 Preparation room | 3 m |
| No.3 shielded room | 4.0 x 6.0 x 2.7 | N/A | - | - |
| No.4 semi-anechoic chamber | 12.0 x 8.5 x 5.9 | 6.8 x 5.75 | No.4 Preparation room | 3 m |
| No.4 shielded room | 4.0 x 6.0 x 2.7 | N/A | - | - |
| No.5 semi-anechoic chamber | 6.0 x 6.0 x 3.9 | 6.0 x 6.0 | - | - |
| No.5 measurement room | 6.4 x 6.4 x 3.0 | 6.4 x 6.4 | - | - |
| No.6 shielded room | 4.0 x 4.5 x 2.7 | 4.0 x 4.5 | - | - |
| No.6 measurement room | 4.75 x 5.4 x 3.0 | 4.75 x 4.15 | - | - |
| No.7 shielded room | 4.7 x 7.5 x 2.7 | 4.7 x 7.5 | - | - |
| No.8 measurement room | 3.1 x 5.0 x 2.7 | 3.1 x 5.0 | - | - |
| No.9 measurement room | 8.8 x 4.6 x 2.8 | 2.4 x 2.4 | - | - |
| No.11 measurement room | 6.2 x 4.7 x 3.0 | 4.8 x 4.6 | - | - |

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

## 3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

# SECTION 4: Operation of EUT during testing

## 4.1 Operating Mode(s)

| Test Item* | Mode |
|---|---|
| Automatically Deactivate<br>-20 dB & 99 % Occupied Bandwidth | Normal use mode |
| Electric Field Strength of Fundamental Emission<br>Electric Field Strength of Spurious Emission | Transmitting mode (Tx) *1) |

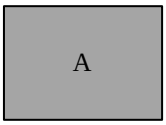
* The system was configured in typical fashion (as a user would normally use it) for testing.
*1) End users cannot change the settings of the output power of the product.

* EUT was set by the software as follows;
Software: 20201130_RKETX_RC_01220F01 Version 2514300010
(Date: 2020.11.30, Storage location: EUT memory)

*This setting of software is the worst case.
Any conditions under the normal use do not exceed the condition of setting.
In addition, end users cannot change the settings of the output power of the product.

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

## 4.2 Configuration and peripherals




*Setup was taken into consideration and test data was taken under worse case conditions.

**Description of EUT**

| No. | Item | Model number | Serial number | Manufacturer | Remarks |
|---|---|---|---|---|---|
| A | Remote Keyless Entry System (Transmitter) | 12BGF | No.1 *1)<br>No.2 *2) | DENSO CORPORATION | EUT |

*1) Used for Normal use mode
*2) Used for Transmitting use mode

## SECTION 5: Radiated emission (Electric Field Strength of Fundamental and Spurious Emission)

**Test Procedure and conditions**

[For below 30 MHz]
The noise level was checked by moving a search-coil (Loop Antenna) close to the EUT.

[For 30 MHz to 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

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 strength.
Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.
The measurements were performed for both vertical and horizontal antenna polarization.
The radiated emission measurements were made with the following detector function of the test receiver / spectrum analyzer.

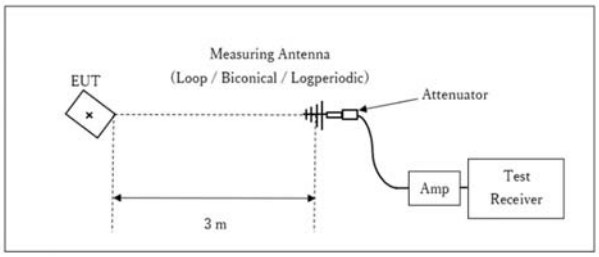
**Test Antennas are used as below;**

| Frequency | Below 30 MHz | 30 MHz to 200 MHz | 200 MHz to 1 GHz | Above 1 GHz |
|---|---|---|---|---|
| Antenna Type | Loop | Biconical | Logperiodic | Horn |

| | From 9 kHz to 90 kHz and From 110 kHz to 150 kHz | From 90 kHz to 110 kHz | From 150 kHz to 490 kHz | From 490 kHz to 30 MHz | From 30 MHz to 1 GHz | Above 1 GHz |
|---|---|---|---|---|---|---|
| Detector Type | Peak | Peak | Peak | Peak | Peak and Peak with Duty factor | Peak and Peak with Duty factor |
| IF Bandwidth | 200 Hz | 200 Hz | 9.1 kHz | 9.1 kHz | 120 kHz | PK: S/A: RBW 1 MHz, VBW: 3 MHz |

**[Test Setup]**

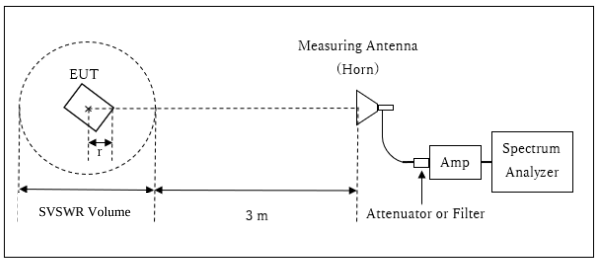
Below 1 GHz




× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz




r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (4.00 m*/3.0 m) = 2.50 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 4.00 m

SVSWR Volume: 2.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.0 m

* The test was performed with r = 0.0 m since EUT is small and it was the rather conservative condition.

- The carrier level (or, noise levels) was (or were) measured at each position of all three axes X, Y and Z, and the position that has the maximum noise was determined.
Noise levels of all the frequencies were measured at the position.

- This EUT has two modes which mechanical key is folded in or out. The worst case was confirmed that mechanical key is folded in or out, as a result, the test which mechanical key was folded in was the worst case. Therefore the test was performed under the worst condition.

*The result is rounded off to the second decimal place, so some differences might be observed.

**Measurement range : 9 kHz - 3.2 GHz**
**Test data : APPENDIX**
**Test result : Pass**

## SECTION 6: Automatically deactivate

**Test Procedure**

The measurement was performed with Electric field strength using a spectrum analyzer.

**Test data : APPENDIX**
**Test result : Pass**

## SECTION 7: -20 dB and 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 | 150 kHz | 1.5 kHz | 5.1 kHz | Auto | Peak | Max Hold | Spectrum Analyzer |
| 99 % Occupied Bandwidth | Enough width to display emission skirts | 1 to 5 % of OBW | Three times of RBW | Auto | Peak | Max Hold | Spectrum Analyzer |
| Peak hold was applied as Worst-case measurement. | | | | | | | |

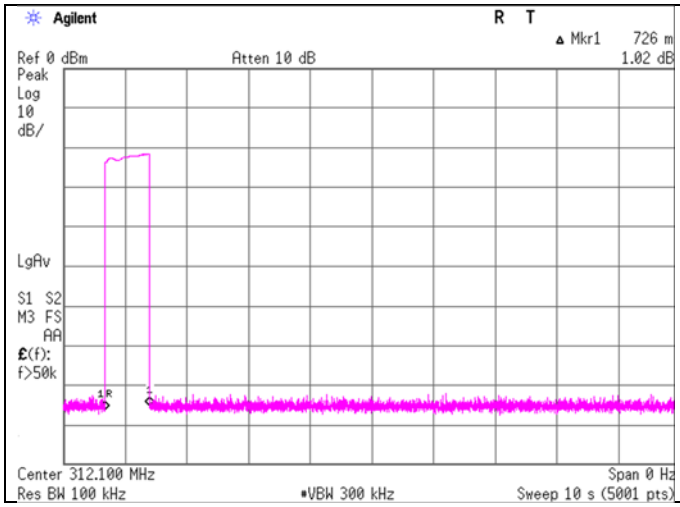
**Test data : APPENDIX**
**Test result : Pass**

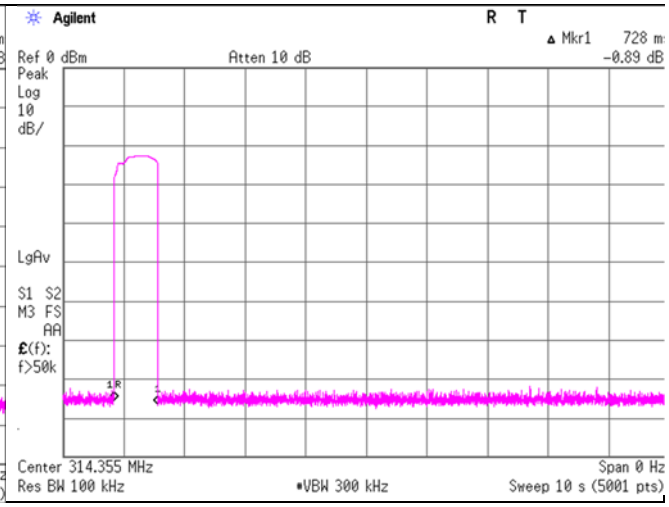
# APPENDIX 1: Test data

## Automatically deactivate

| | |
|---|---|
| Report No. | 13594903H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | December 13, 2020 |
| Temperature / Humidity | 18 deg. C / 42 % RH |
| Engineer | Hiroki Numata |
| Mode | Normal use mode 312.10 MHz / 314.35 MHz |

| Tx Frequency [MHz] | Time of Transmitting [sec] | Limit [sec] | Result |
|---|---|---|---|
| 312.10 | 0.726 | 5.00 | Pass |
| 314.35 | 0.728 | 5.00 | Pass |



# Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)

| | | |
|---|---|---|
| Report No. | 13594903H | |
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.4 | No.4 |
| Date | December 12, 2020 | December 13, 2020 |
| Temperature / Humidity | 19 deg. C / 44 % RH | 18 deg. C / 42 % RH |
| Engineer | Hiroki Numata | Hiroki Numata |
| | (Below 1 GHz) | (Above 1 GHz) |
| Mode | Transmitting mode 312.10 MHz | |

**QP or PK**

| Frequency | Detector | Reading [dBuV] | | Ant Factor | Loss | Gain | Duty Factor | Result [dBuV/m] | | Limit | Margin [dB] | | Remark Inside or Outside |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | | Hor | Ver | [dB/m] | [dB] | [dB] | [dB] | Hor | Ver | [dBuV/m] | Hor | Ver | of Restricted Bands |
| 312.100 | PK | 76.7 | 72.3 | 13.8 | 9.7 | 31.8 | - | 68.4 | 64.0 | 95.4 | 27.0 | 31.4 | Carrier |
| 624.200 | PK | 31.9 | 27.6 | 19.4 | 11.3 | 32.0 | - | 30.7 | 26.4 | 75.4 | 44.8 | 49.1 | Outside |
| 936.300 | PK | 28.1 | 26.8 | 21.9 | 12.5 | 30.9 | - | 31.6 | 30.3 | 75.4 | 43.8 | 45.1 | Outside |
| 1248.400 | PK | 44.2 | 44.3 | 25.2 | 6.1 | 33.8 | - | 41.6 | 41.7 | 75.4 | 33.8 | 33.7 | Outside |
| 1560.500 | PK | 45.3 | 45.0 | 25.0 | 5.5 | 33.1 | - | 42.7 | 42.5 | 73.9 | 31.2 | 31.4 | Inside |
| 1872.600 | PK | 43.3 | 43.3 | 25.4 | 5.5 | 32.3 | - | 41.9 | 41.9 | 75.4 | 33.5 | 33.5 | Outside |
| 2184.700 | PK | 43.3 | 43.3 | 28.2 | 5.5 | 31.9 | - | 45.1 | 45.1 | 75.4 | 30.3 | 30.3 | Outside |
| 2496.800 | PK | 43.0 | 42.6 | 27.6 | 5.7 | 31.8 | - | 44.5 | 44.1 | 73.9 | 29.4 | 29.8 | Inside |
| 2808.900 | PK | 43.0 | 42.5 | 28.5 | 5.8 | 31.7 | - | 45.6 | 45.1 | 73.9 | 28.3 | 28.8 | Inside |
| 3121.000 | PK | 42.3 | 42.5 | 28.9 | 5.9 | 31.6 | - | 45.4 | 45.6 | 75.4 | 30.0 | 29.8 | Outside |

**PK with Duty factor**

| Frequency | Detector | Reading [dBuV] | | Ant Factor | Loss | Gain | Duty Factor | Result [dBuV/m] | | Limit | Margin [dB] | | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | | Hor | Ver | [dB/m] | [dB] | [dB] | [dB] | Hor | Ver | [dBuV/m] | Hor | Ver | |
| 312.100 | PK | 76.7 | 72.3 | 13.8 | 9.7 | 31.8 | 0.0 | 68.4 | 64.0 | 75.4 | 7.0 | 11.4 | Carrier |
| 624.200 | PK | 31.9 | 27.6 | 19.4 | 11.3 | 32.0 | 0.0 | 30.7 | 26.4 | 55.4 | 24.8 | 29.1 | Outside |
| 936.300 | PK | 28.1 | 26.8 | 21.9 | 12.5 | 30.9 | 0.0 | 31.6 | 30.3 | 55.4 | 23.8 | 25.1 | Outside |
| 1248.400 | PK | 44.2 | 44.3 | 25.2 | 6.1 | 33.8 | 0.0 | 41.6 | 41.7 | 55.4 | 13.8 | 13.7 | Outside |
| 1560.500 | PK | 45.3 | 45.0 | 25.0 | 5.5 | 33.1 | 0.0 | 42.7 | 42.5 | 53.9 | 11.2 | 11.4 | Inside |
| 1872.600 | PK | 43.3 | 43.3 | 25.4 | 5.5 | 32.3 | 0.0 | 41.9 | 41.9 | 55.4 | 13.5 | 13.5 | Outside |
| 2184.700 | PK | 43.3 | 43.3 | 28.2 | 5.5 | 31.9 | 0.0 | 45.1 | 45.1 | 55.4 | 10.3 | 10.3 | Outside |
| 2496.800 | PK | 43.0 | 42.6 | 27.6 | 5.7 | 31.8 | 0.0 | 44.5 | 44.1 | 53.9 | 9.4 | 9.8 | Inside |
| 2808.900 | PK | 43.0 | 42.5 | 28.5 | 5.8 | 31.7 | 0.0 | 45.6 | 45.1 | 53.9 | 8.3 | 8.8 | Inside |
| 3121.000 | PK | 42.3 | 42.5 | 28.9 | 5.9 | 31.6 | 0.0 | 45.4 | 45.6 | 55.4 | 10.0 | 9.8 | Outside |

Sample calculation:
Result of PK = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier)
Result of PK with Duty factor = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1 GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier) + Duty factor

For above 1GHz : Distance Factor: 20 x log (4.0 m/3.0 m) = 2.50 dB
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Since the peak emission result satisfied the average limit, duty factor was omitted.
Although Duty of this product was 100% or less, the result of AV (PK with Duty factor) was calculated by applying Duty 100% as worst.

# Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)

| | | |
|---|---|---|
| Report No. | 13594903H | |
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.4 | No.4 |
| Date | December 12, 2020 | December 13, 2020 |
| Temperature / Humidity | 19 deg. C / 44 % RH | 18 deg. C / 42 % RH |
| Engineer | Hiroki Numata | Hiroki Numata |
| | (Below 1 GHz) | (Above 1 GHz) |
| Mode | Transmitting mode 314.35 MHz | |

**QP or PK**

| Frequency | Detector | Reading [dBuV] | | Ant Factor | Loss | Gain | Duty Factor | Result [dBuV/m] | | Limit | Margin [dB] | | Remark Inside or Outside of Restricted Bands |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | | Hor | Ver | [dB/m] | [dB] | [dB] | [dB] | Hor | Ver | [dBuV/m] | Hor | Ver | |
| 314.350 | PK | 77.3 | 73.9 | 13.9 | 9.7 | 31.8 | - | 69.1 | 65.7 | 95.5 | 26.4 | 29.8 | Carrier |
| 628.700 | PK | 32.0 | 32.1 | 19.4 | 11.3 | 32.0 | - | 30.8 | 30.9 | 75.5 | 44.7 | 44.6 | Outside |
| 943.050 | PK | 27.2 | 27.8 | 21.8 | 12.6 | 30.9 | - | 30.7 | 31.3 | 75.5 | 44.8 | 44.2 | Outside |
| 1257.400 | PK | 44.5 | 45.0 | 25.2 | 6.1 | 33.8 | - | 42.0 | 42.5 | 75.5 | 33.5 | 33.0 | Outside |
| 1571.750 | PK | 46.0 | 45.4 | 25.0 | 5.5 | 33.0 | - | 43.4 | 42.9 | 73.9 | 30.5 | 31.1 | Inside |
| 1886.100 | PK | 43.3 | 44.6 | 25.4 | 5.5 | 32.3 | - | 42.0 | 43.2 | 75.5 | 33.5 | 32.3 | Outside |
| 2200.450 | PK | 43.7 | 43.9 | 28.2 | 5.6 | 31.9 | - | 45.6 | 45.8 | 73.9 | 28.3 | 28.1 | Inside |
| 2514.800 | PK | 43.2 | 43.0 | 27.7 | 5.7 | 31.8 | - | 44.7 | 44.6 | 75.5 | 30.8 | 30.9 | Outside |
| 2829.150 | PK | 43.4 | 43.5 | 28.5 | 5.8 | 31.7 | - | 46.0 | 46.0 | 73.9 | 27.9 | 27.9 | Inside |
| 3143.500 | PK | 42.9 | 43.7 | 28.8 | 5.9 | 31.6 | - | 46.1 | 46.8 | 75.5 | 29.4 | 28.7 | Outside |

**PK with Duty factor**

| Frequency | Detector | Reading [dBuV] | | Ant Factor | Loss | Gain | Duty Factor | Result [dBuV/m] | | Limit | Margin [dB] | | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [MHz] | | Hor | Ver | [dB/m] | [dB] | [dB] | [dB] | Hor | Ver | [dBuV/m] | Hor | Ver | |
| 314.350 | PK | 77.3 | 73.9 | 13.9 | 9.7 | 31.8 | 0.0 | 69.1 | 65.7 | 75.5 | 6.4 | 9.8 | Carrier |
| 628.700 | PK | 32.0 | 32.1 | 19.4 | 11.3 | 32.0 | 0.0 | 30.8 | 30.9 | 55.5 | 24.7 | 24.6 | Outside |
| 943.050 | PK | 27.2 | 27.8 | 21.8 | 12.6 | 30.9 | 0.0 | 30.7 | 31.3 | 55.5 | 24.8 | 24.2 | Outside |
| 1257.400 | PK | 44.5 | 45.0 | 25.2 | 6.1 | 33.8 | 0.0 | 42.0 | 42.5 | 55.5 | 13.5 | 13.0 | Outside |
| 1571.750 | PK | 46.0 | 45.4 | 25.0 | 5.5 | 33.0 | 0.0 | 43.4 | 42.9 | 53.9 | 10.5 | 11.1 | Inside |
| 1886.100 | PK | 43.3 | 44.6 | 25.4 | 5.5 | 32.3 | 0.0 | 42.0 | 43.2 | 55.5 | 13.5 | 12.3 | Outside |
| 2200.450 | PK | 43.7 | 43.9 | 28.2 | 5.6 | 31.9 | 0.0 | 45.6 | 45.8 | 53.9 | 8.3 | 8.1 | Inside |
| 2514.800 | PK | 43.2 | 43.0 | 27.7 | 5.7 | 31.8 | 0.0 | 44.7 | 44.6 | 55.5 | 10.8 | 10.9 | Outside |
| 2829.150 | PK | 43.4 | 43.5 | 28.5 | 5.8 | 31.7 | 0.0 | 46.0 | 46.0 | 53.9 | 7.9 | 7.9 | Inside |
| 3143.500 | PK | 42.9 | 43.7 | 28.8 | 5.9 | 31.6 | 0.0 | 46.1 | 46.8 | 55.5 | 9.4 | 8.7 | Outside |

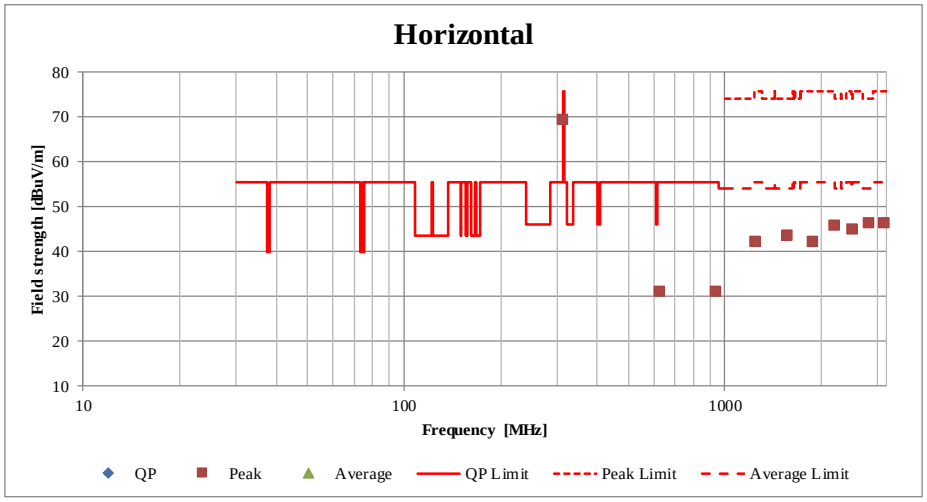
Sample calculation:
Result of PK = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier)
Result of PK with Duty factor = Reading + Ant Factor + Loss {Cable + Attenuator + Filter (above 1 GHz) +Distance factor (above 1 GHz)} - Gain (Amplifier) + Duty factor

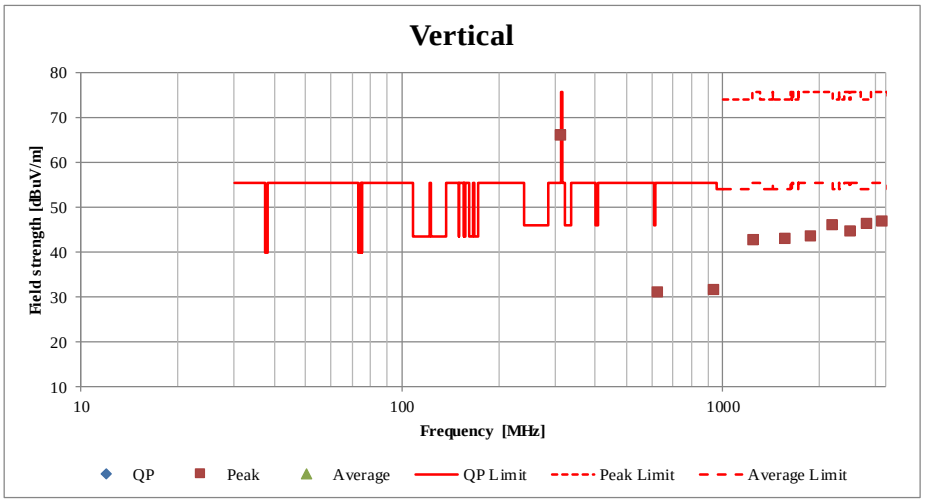
For above 1GHz : Distance Factor: 20 x log (4.0 m/3.0 m) = 2.50 dB
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Since the peak emission result satisfied the average limit, duty factor was omitted.
Although Duty of this product was 100% or less, the result of AV (PK with Duty factor) was calculated by applying Duty 100% as worst.

# Radiated Spurious Emission
## (Plot data, Worst case)

| | | |
|---|---|---|
| Report No. | 13594903H | |
| Test place | Ise EMC Lab. | |
| Semi Anechoic Chamber | No.4 | No.4 |
| Date | December 12, 2020 | December 13, 2020 |
| Temperature / Humidity | 19 deg. C / 44 % RH | 18 deg. C / 42 % RH |
| Engineer | Hiroki Numata | Hiroki Numata |
| | (Below 1 GHz) | (Above 1 GHz) |
| Mode | Transmitting mode 314.35 MHz | |




*These plots data contains sufficient number to show the trend of characteristic features for EUT.

# -20dB and 99% Occupied Bandwidth

**312.10 MHz / 314.35 MHz**

| | |
|---|---|
| Report No. | 13594903H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | December 13, 2020 |
| Temperature / Humidity | 18 deg. C / 42 % RH |
| Engineer | Hiroki Numata |
| Mode | Normal use mode 312.10 MHz / 314.35 MHz |

Bandwidth Limit : Fundamental Frequency **312.10** MHz x 0.25% = 780.25 kHz

* The above limit was calculated from more stringent nominal frequency.

* Method of KDB 926416 for systems employing non sweeping frequencies was referred.

**312.10MHz**

| -20dB Bandwidth [kHz] |
|---|
| 60.113 |

**314.35MHz**

| -20dB Bandwidth [kHz] |
|---|
| 60.064 |

| -20dB Bandwidth [kHz] | Bandwidth Limit [kHz] | Result |
|---|---|---|
| 120.177 | 780.25 | Pass |

Bandwidth Limit : Fundamental Frequency **312.10** MHz x 0.25% = 780.25 kHz

| 99% Occupied Bandwidth [kHz] | Bandwidth Limit [kHz] | Result |
|---|---|---|
| 62.3192 | 780.25 | Pass |

Bandwidth Limit : Fundamental Frequency **314.35** MHz x 0.25% = 785.88 kHz

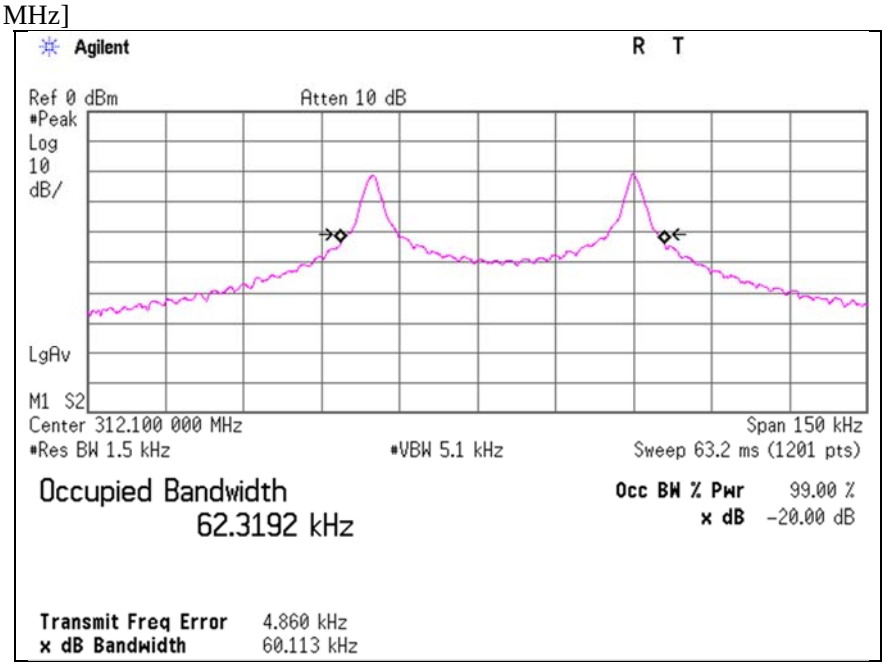
| 99% Occupied Bandwidth [kHz] | Bandwidth Limit [kHz] | Result |
|---|---|---|
| 61.7241 | 785.88 | Pass |

# -20dB and 99% Occupied Bandwidth

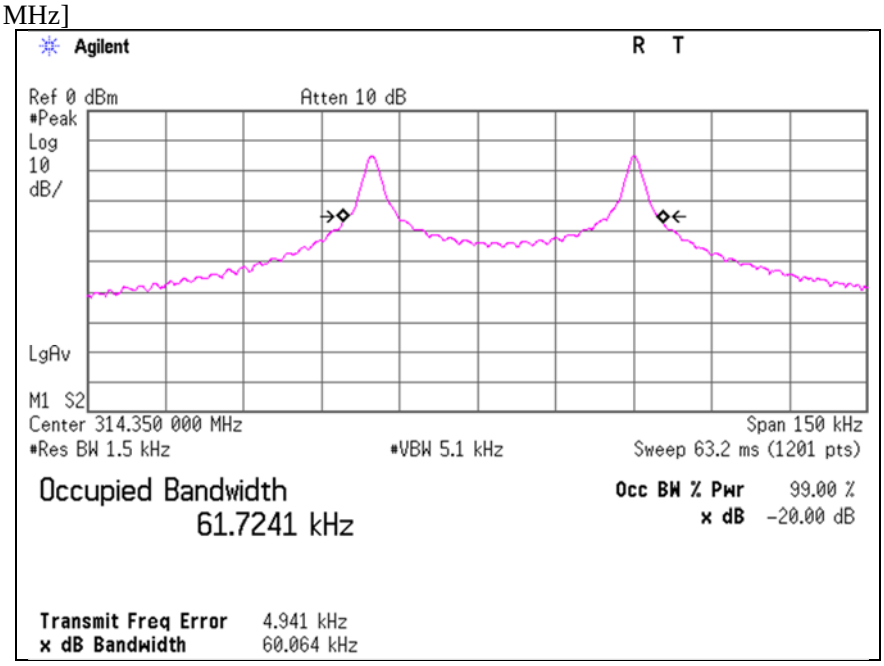
**312.10 MHz / 314.35 MHz**

| | |
|---|---|
| Report No. | 13594903H |
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | December 13, 2020 |
| Temperature / Humidity | 18 deg. C / 42 % RH |
| Engineer | Hiroki Numata |
| Mode | Normal use mode 312.10 MHz / 314.35 MHz |

[312.10 MHz]




[314.35 MHz]



# APPENDIX 2: Test instruments

**Test equipment**

| Test Item | Local ID | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Cal Int |
|---|---|---|---|---|---|---|---|---|
| RE | MAEC-04 | 142011 | AC4_Semi Anechoic Chamber(NSA) | TDK | Semi Anechoic Chamber 3m | DA-10005 | 05/25/2020 | 24 |
| RE | MOS-15 | 141562 | Thermo-Hygrometer | CUSTOM. Inc | CTH-201 | 0010 | 01/07/2020 | 12 |
| RE | MMM-10 | 141545 | DIGITAL HiTESTER | Hioki | 3805 | 51201148 | 01/06/2020 | 12 |
| RE | MJM-29 | 142230 | Measure | KOMELON | KMC-36 | - | - | - |
| RE | COTS-MEMI-02 | 178648 | EMI measurement program | TSJ (Techno Science Japan) | TEPTO-DV | - | - | - |
| RE | MAT-34 | 141331 | Attenuator(6dB) | TME | UFA-01 | - | 02/05/2020 | 12 |
| RE | MBA-05 | 141425 | Biconical Antenna | Schwarzbeck Mess - Elektronik | VHA9103+BBA9106 | VHA 91031302 | 08/31/2020 | 12 |
| RE | MCC-50 | 141397 | Coaxial Cable | UL Japan | - | - | 11/06/2020 | 12 |
| RE | MLA-23 | 141267 | Logperiodic Antenna (200-1000MHz) | Schwarzbeck Mess - Elektronik | VUSLP9111B | 9111B-192 | 09/02/2020 | 12 |
| RE | MPA-14 | 141583 | Pre Amplifier | SONOMA INSTRUMENT | 310 | 260833 | 02/18/2020 | 12 |
| RE | MTR-10 | 141951 | EMI Test Receiver | Rohde & Schwarz | ESR26 | 101408 | 03/10/2020 | 12 |
| RE | MSA-04 | 141885 | Spectrum Analyzer | Keysight Technologies Inc | E4448A | US44300523 | 11/09/2020 | 12 |
| RE | MSA-03 | 141884 | Spectrum Analyzer | Keysight Technologies Inc | E4448A | MY44020357 | 03/04/2020 | 12 |
| RE | MHA-21 | 141508 | Horn Antenna 1-18GHz | Schwarzbeck Mess - Elektronik | BBHA9120D | 557 | 05/22/2020 | 12 |
| RE | MHF-27 | 141297 | High Pass Filter (1.1-10GHz) | TOKYO KEIKI | TF219CD1 | 1001 | 01/09/2020 | 12 |
| RE | MCC-246 | 199563 | Microwave Cable | HUBER+SUNER | SF126E/11PC35/ 11PC35/1000M,5000M | 537061/126E / 537072/126E | 06/11/2020 | 12 |
| RE | MPA-12 | 141581 | MicroWave System Amplifier | Keysight Technologies Inc | 83017A | 00650 | 10/19/2020 | 12 |
| RE | MAEC-04-SVSWR | 142017 | AC4_Semi Anechoic Chamber(SVSWR) | TDK | Semi Anechoic Chamber 3m | DA-10005 | 04/04/2019 | 24 |
| RE | MLPA-07 | 142645 | Loop Antenna | UL Japan | - | - | - | - |

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

**The expiration date of the calibration is the end of the expired month.**
**As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.**

**All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.**

**Test item:**
**RE: Radiated emission, 99 % Occupied Bandwidth, -20 dB bandwidth, and Automatically deactivate tests**