



# **RADIO TEST REPORT**

**Test Report No. : 12525886H-A-R1**

**Applicant** : DENSO CORPORATION  
**Type of Equipment** : Smart Card Key  
**Model No.** : 14CBK  
**Test regulation** : FCC Part 15 Subpart C: 2018  
**FCC ID** : HYQ14CBK  
**Test Result** : Complied

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2. The results in this report apply only to the sample tested.
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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. This report is a revised version of 12525886H-A. 12525886H-A is replaced with this report.

**Date of test:** October 3, 2018

**Representative test engineer:**

Shuichi Ohyama  
Engineer

Consumer Technology Division

**Approved by:**

Motoya Imura  
Leader

Consumer Technology Division



NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.

\*As for the range of Accreditation in NVLAP, you may refer to the WEB address,  
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- ☐ 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.**

**Ise EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

13-EM-F0429

## REVISION HISTORY

**Original Test Report No.: 12525886H-A**

[illegible]

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## **SECTION 1: Customer information**

|                  |   |                                                      |
|------------------|---|------------------------------------------------------|
| Company Name     | : | DENSO CORPORATION                                    |
| Address          | : | 1-1 Showa-cho, Kariya-shi, Aichi-ken, 448-8661 Japan |
| Telephone Number | : | +81-566-20-3955                                      |
| Facsimile Number | : | +81-566-25-4837                                      |
| Contact Person   | : | TAKAYUKI HATTORI                                     |

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

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

|                            |   |                                                                                            |
|----------------------------|---|--------------------------------------------------------------------------------------------|
| Type of Equipment          | : | Smart Card Key                                                                             |
| Model No.                  | : | 14CBK                                                                                      |
| Serial No.                 | : | Refer to Clause 4.2                                                                        |
| Rating                     | : | DC 3.0 V                                                                                   |
| Receipt Date of Sample     | : | September 27, 2018                                                                         |
| Country of Mass-production | : | Japan, United states of America and China                                                  |
| Condition of EUT           | : | Engineering prototype<br>(Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification of EUT        | : | No Modification by the test lab                                                            |

### **2.2 Product Description**

Model No: 14CBK (referred to as the EUT in this report) is the Smart Card Key.

|                                    |   |                                                                  |
|------------------------------------|---|------------------------------------------------------------------|
| Radio Type                         | : | Transceiver                                                      |
| Frequency of Operation             | : | 314.35 MHz / 312.10 MHz*                                         |
|                                    |   | *These two different frequencies are not emitted simultaneously. |
| Clock frequency(ies) in the system | : | 18.370 MHz Crystal (RF) / 8 MHz (IC)                             |
| Modulation                         | : | FSK (F1D)                                                        |
| Type of Battery                    | : | One lithium battery                                              |
| Antenna type                       | : | Built-in type (Fixed)                                            |
| Receiving frequency of Operation   | : | 134.2 kHz *1)                                                    |

\*1) The test of receiver part was performed separately from this test report, and the conformability is confirmed.

\* Model: 14CBK has two types; Type A and Type B.  
The worst case was confirmed with Type A and Type B at pre check.  
The test was performed with Type B, which had the worst result.

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

#### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C  
FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators  
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<br>6 Standard test methods                                                            | FCC: Section 15.207                                        | N/A                                                                         | N/A *1)   | -        |
|                                                                             | IC: RSS-Gen 8.8                                                                                             | IC: RSS-Gen 8.8                                            |                                                                             |           |          |
| Automatically Deactivate                                                    | FCC: ANSI C63.10:2013<br>6 Standard test methods                                                            | FCC: Section 15.231(a)(1)                                  | N/A                                                                         | Complied  | Radiated |
|                                                                             | IC: -                                                                                                       | IC: RSS-210 A1.1                                           |                                                                             |           |          |
| Electric Field Strength<br>of Fundamental Emission                          | FCC: ANSI C63.10:2013<br>6 Standard test methods                                                            | FCC: Section 15.231(b)                                     | 1.3 dB<br>314.350 MHz<br>Horizontal<br>PK with Duty factor                  | Complied# | Radiated |
|                                                                             | IC: RSS-Gen 6.12                                                                                            | IC: RSS-210 A1.2                                           |                                                                             |           |          |
| Electric Field Strength<br>of Spurious Emission                             | FCC: ANSI C63.10:2013<br>6 Standard test methods                                                            | FCC: Section 15.205<br>Section 15.209<br>Section 15.231(b) | 8.8 dB<br>2829.150 MHz<br>Horizontal<br>PK with Duty factor<br><314.35 MHz> | Complied  | Radiated |
|                                                                             | IC: RSS-Gen 6.13                                                                                            | IC: RSS-210 A1.2, 4.4<br>RSS-Gen 8.9                       |                                                                             |           |          |
| -20dB Bandwidth                                                             | FCC: ANSI C63.10:2013<br>6 Standard test methods                                                            | FCC: Section 15.231(c)                                     | N/A                                                                         | Complied  | Radiated |
|                                                                             | IC: -                                                                                                       | IC: Reference data                                         |                                                                             |           |          |
| 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.        |                                                                                                             |                                                            |                                                                             |           |          |
| 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 15.31 (e)**

This test was performed with the New Battery (DC 3.0 V) 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.

**UL Japan, Inc.**

**Ise EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

### 3.3 Addition to standard

| Item                    | Test Procedure  | Specification    | Worst margin | Results  | Remarks  |
|-------------------------|-----------------|------------------|--------------|----------|----------|
| 99 % Occupied Bandwidth | IC: RSS-Gen 6.7 | IC: RSS-210 A1.3 | N/A          | Complied | Radiated |

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

### 3.4 Uncertainty

#### EMI

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

| Polarity   | Radiated emission (Below 1 GHz) |                     |                   |                     |
|------------|---------------------------------|---------------------|-------------------|---------------------|
|            | (3 m*)(+/-)                     |                     | (10 m*)(+/-)      |                     |
|            | 30 MHz to 200 MHz               | 200 MHz to 1000 MHz | 30 MHz to 200 MHz | 200 MHz to 1000 MHz |
| Horizontal | 4.8 dB                          | 5.2 dB              | 4.8 dB            | 5.0 dB              |
| Vertical   | 5.0 dB                          | 6.3 dB              | 4.9 dB            | 5.0 dB              |

| Radiated emission (Above 1 GHz) |                 |                    |                    |                 |
|---------------------------------|-----------------|--------------------|--------------------|-----------------|
| (3 m*)(+/-)                     |                 | (1 m*)(+/-)        |                    | (10 m*)(+/-)    |
| 1 GHz to 6 GHz                  | 6 GHz to 18 GHz | 10 GHz to 26.5 GHz | 26.5 GHz to 40 GHz | 1 GHz to 18 GHz |
| 5.2 dB                          | 5.5 dB          | 5.9 dB             | 5.9 dB             | 5.5 dB          |

\* Measurement distance

| Automatically Deactivate |
|--------------------------|
| 0.10 %                   |

| Bandwidth |
|-----------|
| 0.96 %    |

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab.  
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN  
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124  
NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

| Test site                  | IC Registration Number | 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 | 2973C-1                | 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 | 2973C-2                | 7.5 x 5.8 x 5.2            | 4.0 x 4.0                                                        | -                      | 3 m                          |
| No.3 semi-anechoic chamber | 2973C-3                | 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 | 2973C-4                | 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.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 m 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

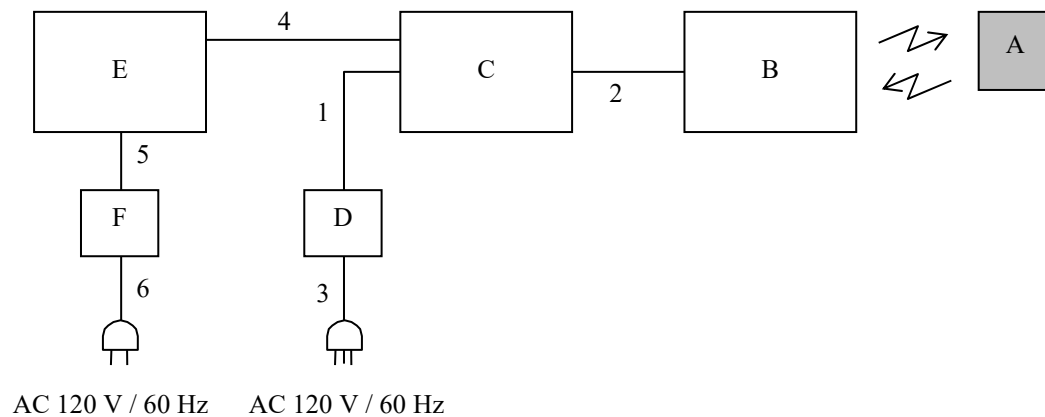
Refer to APPENDIX.

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

### **4.1 Operating Modes**

| <b>Test Item</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Mode</b>                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Automatically Deactivate                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Normal use mode, 314.35 MHz *1)<br>Normal use mode, 312.10 MHz *1)               |
| Electric Field Strength of Fundamental Emission<br>Electric Field Strength of Spurious Emission<br>-20dB & 99% Occupied Bandwidth                                                                                                                                                                                                                                                                                                                                                                      | Transmitting mode (Tx), 314.35 MHz *2)<br>Transmitting mode (Tx), 312.10 MHz *2) |
| <p>* The system was configured in typical fashion (as a customer would normally use it) for testing.</p> <p>*1) The EUT transmits only when it receives 134.2 kHz radio signal. End users cannot change the settings of the output power of the product.</p> <p>*2) The software of this mode is the same as one of normal product, except that EUT continues to transmit when transmitter button is being pressed. This button was attached just for testing.(for making continuous transmission)</p> |                                                                                  |

## 4.2 Configuration and peripherals



\* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

### Description of EUT and Support equipment

| No. | Item             | Model number | Serial number              | Manufacturer      | Remarks |
|-----|------------------|--------------|----------------------------|-------------------|---------|
| A   | Smart Card Key   | 14CBK        | 002 *1)<br>001 *2)         | DENSO CORPORATION | EUT     |
| B   | Door handle unit | -            | -                          | DENSO CORPORATION | *1)     |
| C   | Test bench       | -            | -                          | DENSO CORPORATION | *1)     |
| D   | AC Adapter       | -            | -                          | DENSO CORPORATION | *1)     |
| E   | Laptop PC        | L540         | R90B035F                   | Lenovo            | *1)     |
| F   | AC Adapter       | ADLX65NCC2A  | 11S45N0263Z1ZS9948C7<br>3U | Lenovo            | *1)     |

\*1) Used for Normal use mode only.

\*2) Used for Transmitting mode only.

### List of cables used

| No. | Name                | Length (m) | Shield     |            | Remark |
|-----|---------------------|------------|------------|------------|--------|
|     |                     |            | Cable      | Connector  |        |
| 1   | DC Cable            | 3.0        | Unshielded | Unshielded | *1)    |
| 2   | DC and Signal Cable | 1.5        | Unshielded | Unshielded | *1)    |
| 3   | AC Cable            | 2.0        | Unshielded | Unshielded | *1)    |
| 4   | USB Cable           | 1.8        | Shielded   | Shielded   | *1)    |
| 5   | DC Cable            | 1.7        | Unshielded | Unshielded | *1)    |
| 6   | AC Cable            | 0.9        | Unshielded | Unshielded | *1)    |

\*1) Used for Normal use mode only.

## **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.

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 |

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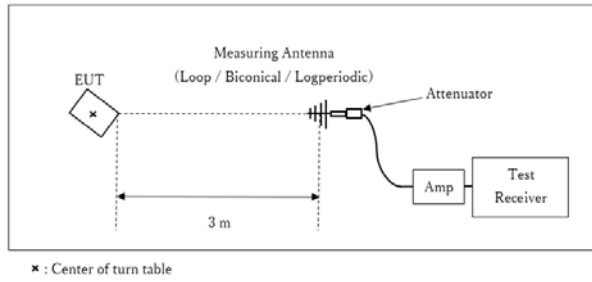
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

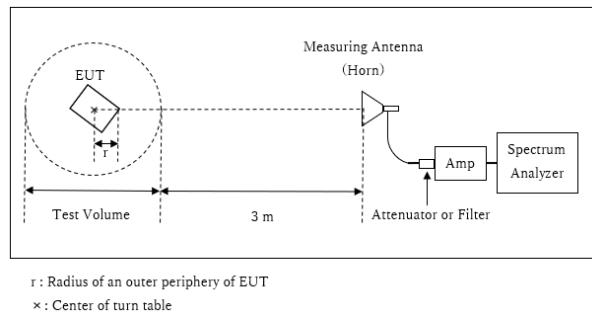
## [Test Setup]

Below 1 GHz



Test Distance: 3 m

1 GHz - 10 GHz



Distance Factor:  $20 \times \log (3.75 \text{ m} / 3.0 \text{ m}) = 1.94 \text{ dB}$

\* Test Distance:  $(3 + \text{Test Volume} / 2) - r = 3.75 \text{ m}$

Test Volume : 1.5 m

(Test Volume has been calibrated based on CISPR 16-1-4.)

$r = 0.0 \text{ m}$

\* The test was performed with  $r = 0.0 \text{ m}$  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 inserted or not. The worst case was confirmed with and without mechanical key, as a result, the test without mechanical key was the worst case. Therefore the test without mechanical key was performed only.

\*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            |

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**Ise EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## **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

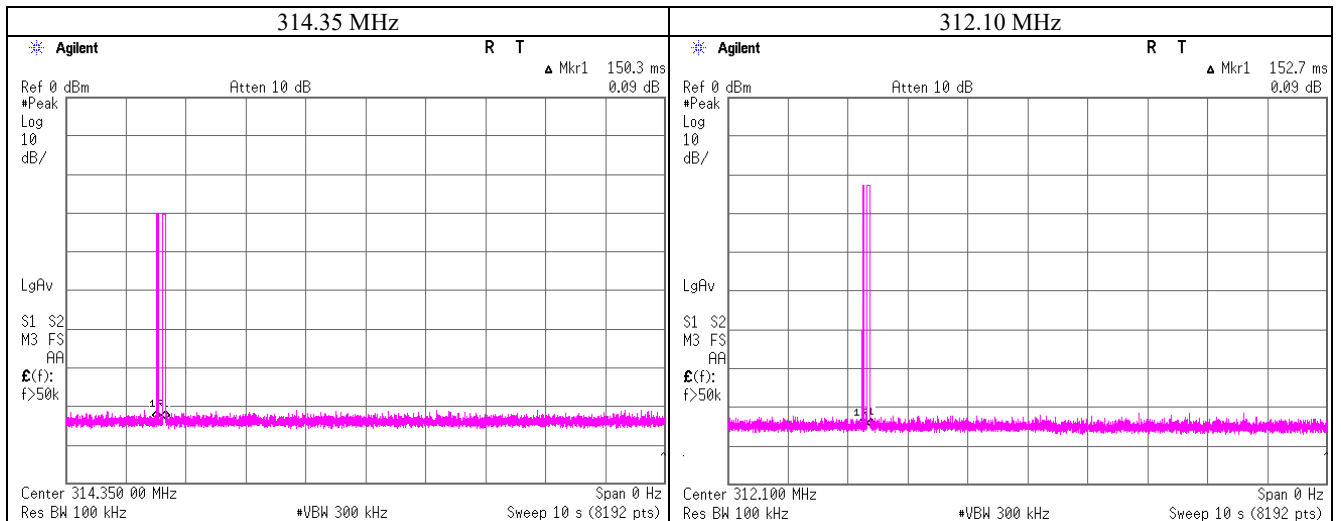
Test result : Pass

## APPENDIX 1: Test data

### Automatically deactivate

|                       |                                    |
|-----------------------|------------------------------------|
| Report No.            | 12525886H                          |
| Test place            | Ise EMC Lab. No.2 Measurement Room |
| Date                  | 10/03/2018 (Night)                 |
| Temperature/ Humidity | 23 deg. C / 51 % RH                |
| Engineer              | Shuichi Ohyama                     |
| Mode                  | Normal use mode                    |

| Tx Freq    | Time of Transmitting [sec] | Limit [sec] | Result |
|------------|----------------------------|-------------|--------|
| 314.35 MHz | 0.1503                     | 5.00        | Pass   |
| 312.10 MHz | 0.1527                     | 5.00        | Pass   |



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Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

Report No. 12525886H  
Test place Ise EMC Lab. No.2 Semi Anechoic Chamber  
Date 10/03/2018 (Day) 10/03/2018 (Night)  
Temperature/ Humidity 23 deg. C / 51 % RH 23 deg. C / 51 % RH  
Engineer Koji Yamamoto Shuichi Ohyama  
(Below 1GHz) (Above 1GHz)  
Mode Transmitting mode 314.35 MHz

### QP or PK

| Frequency<br>[MHz] | Detector | Reading<br>[dBuV] |      | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] |      | Limit<br>[dBuV/m] | Margin<br>[dB] |      | Remark<br>Inside or Outside<br>of Restricted Bands |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------|------|-------------------|----------------|------|----------------------------------------------------|
|                    |          | Hor               | Ver  |                         |              |              |                        | Hor                | Ver  |                   | Hor            | Ver  |                                                    |
| 314.350            | PK       | 80.6              | 71.0 | 13.9                    | 9.0          | 29.3         | -                      | 74.2               | 64.6 | 95.5              | 21.3           | 30.9 | Carrier                                            |
| 628.700            | PK       | 34.7              | 34.1 | 19.3                    | 10.3         | 29.6         | -                      | 34.7               | 34.1 | 75.5              | 40.8           | 41.4 | Outside                                            |
| 943.050            | PK       | 29.0              | 28.8 | 21.8                    | 11.5         | 27.8         | -                      | 34.5               | 34.3 | 75.5              | 41.0           | 41.2 | Outside                                            |
| 1257.400           | PK       | 46.8              | 47.1 | 25.3                    | 3.8          | 35.3         | -                      | 40.6               | 40.9 | 75.5              | 34.9           | 34.6 | Outside                                            |
| 1571.750           | PK       | 46.2              | 46.2 | 25.5                    | 4.0          | 35.0         | -                      | 40.7               | 40.7 | 73.9              | 33.2           | 33.2 | Inside                                             |
| 1886.100           | PK       | 48.3              | 48.2 | 25.7                    | 4.2          | 34.7         | -                      | 43.5               | 43.4 | 75.5              | 32.0           | 32.1 | Outside                                            |
| 2200.450           | PK       | 46.9              | 46.9 | 27.9                    | 4.4          | 34.5         | -                      | 44.7               | 44.7 | 73.9              | 29.2           | 29.2 | Inside                                             |
| 2514.800           | PK       | 46.2              | 46.3 | 27.8                    | 4.5          | 34.4         | -                      | 44.1               | 44.2 | 75.5              | 31.4           | 31.3 | Outside                                            |
| 2829.150           | PK       | 46.4              | 46.3 | 28.4                    | 4.7          | 34.4         | -                      | 45.1               | 45.0 | 73.9              | 28.8           | 28.9 | Inside                                             |
| 3143.500           | PK       | 46.2              | 46.5 | 28.6                    | 4.9          | 34.2         | -                      | 45.5               | 45.8 | 75.5              | 30.0           | 29.7 | Outside                                            |

### PK with Duty factor

| Frequency<br>[MHz] | Detector | Reading<br>[dBuV] |      | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] |      | Limit<br>[dBuV/m] | Margin<br>[dB] |      | Remark  |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------|------|-------------------|----------------|------|---------|
|                    |          | Hor               | Ver  |                         |              |              |                        | Hor                | Ver  |                   | Hor            | Ver  |         |
| 314.350            | PK       | 80.6              | 71.0 | 13.9                    | 9.0          | 29.3         | 0.0                    | 74.2               | 64.6 | 75.5              | 1.3            | 10.9 | Carrier |
| 628.700            | PK       | 34.7              | 34.1 | 19.3                    | 10.3         | 29.6         | 0.0                    | 34.7               | 34.1 | 55.5              | 20.8           | 21.4 | Outside |
| 943.050            | PK       | 29.0              | 28.8 | 21.8                    | 11.5         | 27.8         | 0.0                    | 34.5               | 34.3 | 55.5              | 21.0           | 21.2 | Outside |
| 1257.400           | PK       | 46.8              | 47.1 | 25.3                    | 3.8          | 35.3         | 0.0                    | 40.6               | 40.9 | 55.5              | 14.9           | 14.6 | Outside |
| 1571.750           | PK       | 46.2              | 46.2 | 25.5                    | 4.0          | 35.0         | 0.0                    | 40.7               | 40.7 | 53.9              | 13.2           | 13.2 | Inside  |
| 1886.100           | PK       | 48.3              | 48.2 | 25.7                    | 4.2          | 34.7         | 0.0                    | 43.5               | 43.4 | 55.5              | 12.0           | 12.1 | Outside |
| 2200.450           | PK       | 46.9              | 46.9 | 27.9                    | 4.4          | 34.5         | 0.0                    | 44.7               | 44.7 | 53.9              | 9.2            | 9.2  | Inside  |
| 2514.800           | PK       | 46.2              | 46.3 | 27.8                    | 4.5          | 34.4         | 0.0                    | 44.1               | 44.2 | 55.5              | 11.4           | 11.3 | Outside |
| 2829.150           | PK       | 46.4              | 46.3 | 28.4                    | 4.7          | 34.4         | 0.0                    | 45.1               | 45.0 | 53.9              | 8.8            | 8.9  | Inside  |
| 3143.500           | PK       | 46.2              | 46.5 | 28.6                    | 4.9          | 34.2         | 0.0                    | 45.5               | 45.8 | 55.5              | 10.0           | 9.7  | Outside |

Sample calculation:

Result of PK = Reading + Ant Factor + Loss (Cable + Attenuator) - Gain (Amplifier)

Result of PK with Duty factor = Reading + Ant Factor + Loss (Cable + Attenuator) - Gain (Amplifier) + Duty factor

For above 1GHz : Distance Factor:  $20 \times \log(3.75 \text{ m}/3.0 \text{ m}) = 1.94 \text{ dB}$

\*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

Since the peak emission result satisfied the average limit, duty factor was omitted.

The result of AV (PK with Duty factor) was calculated by applying Duty 100%.

**UL Japan, Inc.**

**Ise EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

Report No. 12525886H  
Test place Ise EMC Lab. No.2 Semi Anechoic Chamber  
Date 10/03/2018 (Day) 10/03/2018 (Night)  
Temperature/ Humidity 23 deg. C / 51 % RH 23 deg. C / 51 % RH  
Engineer Koji Yamamoto Shuichi Ohyama  
(Below 1GHz) (Above 1GHz)  
Mode Transmitting mode 312.10 MHz

### QP or PK

| Frequency<br>[MHz] | Detector | Reading<br>[dBuV] |      | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] |      | Limit<br>[dBuV/m] | Margin<br>[dB] |      | Remark<br>Inside or Outside<br>of Restricted Bands |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------|------|-------------------|----------------|------|----------------------------------------------------|
|                    |          | Hor               | Ver  |                         |              |              |                        | Hor                | Ver  |                   | Hor            | Ver  |                                                    |
| 312.100            | PK       | 79.1              | 70.8 | 13.8                    | 9.0          | 29.3         | -                      | 72.6               | 64.3 | 95.4              | 22.8           | 31.1 | Carrier                                            |
| 624.200            | PK       | 33.8              | 33.3 | 19.3                    | 10.3         | 29.6         | -                      | 33.8               | 33.3 | 75.4              | 41.6           | 42.1 | Outside                                            |
| 936.300            | PK       | 28.6              | 28.8 | 21.8                    | 11.4         | 27.8         | -                      | 34.0               | 34.2 | 75.4              | 41.4           | 41.2 | Outside                                            |
| 1248.400           | PK       | 46.7              | 46.4 | 25.2                    | 3.8          | 35.3         | -                      | 40.4               | 40.1 | 75.4              | 35.0           | 35.3 | Outside                                            |
| 1560.500           | PK       | 46.1              | 46.6 | 25.6                    | 4.0          | 35.0         | -                      | 40.7               | 41.2 | 73.9              | 33.2           | 32.7 | Inside                                             |
| 1872.600           | PK       | 47.0              | 46.5 | 25.6                    | 4.2          | 34.7         | -                      | 42.1               | 41.6 | 75.4              | 33.3           | 33.8 | Outside                                            |
| 2184.700           | PK       | 47.7              | 47.3 | 27.9                    | 4.4          | 34.5         | -                      | 45.5               | 45.1 | 75.4              | 29.9           | 30.3 | Outside                                            |
| 2496.800           | PK       | 46.5              | 46.5 | 27.6                    | 4.5          | 34.4         | -                      | 44.2               | 44.2 | 73.9              | 29.7           | 29.7 | Inside                                             |
| 2808.900           | PK       | 46.3              | 46.3 | 28.4                    | 4.7          | 34.4         | -                      | 45.0               | 45.0 | 73.9              | 28.9           | 28.9 | Inside                                             |
| 3121.000           | PK       | 46.8              | 46.6 | 28.6                    | 4.9          | 34.3         | -                      | 46.0               | 45.8 | 75.4              | 29.4           | 29.6 | Outside                                            |

### PK with Duty factor

| Frequency<br>[MHz] | Detector | Reading<br>[dBuV] |      | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] |      | Limit<br>[dBuV/m] | Margin<br>[dB] |      | Remark  |
|--------------------|----------|-------------------|------|-------------------------|--------------|--------------|------------------------|--------------------|------|-------------------|----------------|------|---------|
|                    |          | Hor               | Ver  |                         |              |              |                        | Hor                | Ver  |                   | Hor            | Ver  |         |
| 312.100            | PK       | 79.1              | 70.8 | 13.8                    | 9.0          | 29.3         | 0.0                    | 72.6               | 64.3 | 75.4              | 2.8            | 11.1 | Carrier |
| 624.200            | PK       | 33.8              | 33.3 | 19.3                    | 10.3         | 29.6         | 0.0                    | 33.8               | 33.3 | 55.4              | 21.6           | 22.1 | Outside |
| 936.300            | PK       | 28.6              | 28.8 | 21.8                    | 11.4         | 27.8         | 0.0                    | 34.0               | 34.2 | 55.4              | 21.4           | 21.2 | Outside |
| 1248.400           | PK       | 46.7              | 46.4 | 25.2                    | 3.8          | 35.3         | 0.0                    | 40.4               | 40.1 | 55.4              | 15.0           | 15.3 | Outside |
| 1560.500           | PK       | 46.1              | 46.6 | 25.6                    | 4.0          | 35.0         | 0.0                    | 40.7               | 41.2 | 53.9              | 13.2           | 12.7 | Inside  |
| 1872.600           | PK       | 47.0              | 46.5 | 25.6                    | 4.2          | 34.7         | 0.0                    | 42.1               | 41.6 | 55.4              | 13.3           | 13.8 | Outside |
| 2184.700           | PK       | 47.7              | 47.3 | 27.9                    | 4.4          | 34.5         | 0.0                    | 45.5               | 45.1 | 55.4              | 9.9            | 10.3 | Outside |
| 2496.800           | PK       | 46.5              | 46.5 | 27.6                    | 4.5          | 34.4         | 0.0                    | 44.2               | 44.2 | 53.9              | 9.7            | 9.7  | Inside  |
| 2808.900           | PK       | 46.3              | 46.3 | 28.4                    | 4.7          | 34.4         | 0.0                    | 45.0               | 45.0 | 53.9              | 8.9            | 8.9  | Inside  |
| 3121.000           | PK       | 46.8              | 46.6 | 28.6                    | 4.9          | 34.3         | 0.0                    | 46.0               | 45.8 | 55.4              | 9.4            | 9.6  | Outside |

Sample calculation:

Result of PK = Reading + Ant Factor + Loss (Cable + Attenuator) - Gain (Amplifier)

Result of PK with Duty factor = Reading + Ant Factor + Loss (Cable + Attenuator) - Gain (Amplifier) + Duty factor

For above 1GHz : Distance Factor:  $20 \times \log(3.75 \text{ m}/3.0 \text{ m}) = 1.94 \text{ dB}$

\*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

Since the peak emission result satisfied the average limit, duty factor was omitted.

The result of AV (PK with Duty factor) was calculated by applying Duty 100%.

**UL Japan, Inc.**

**Ise EMC Lab.**

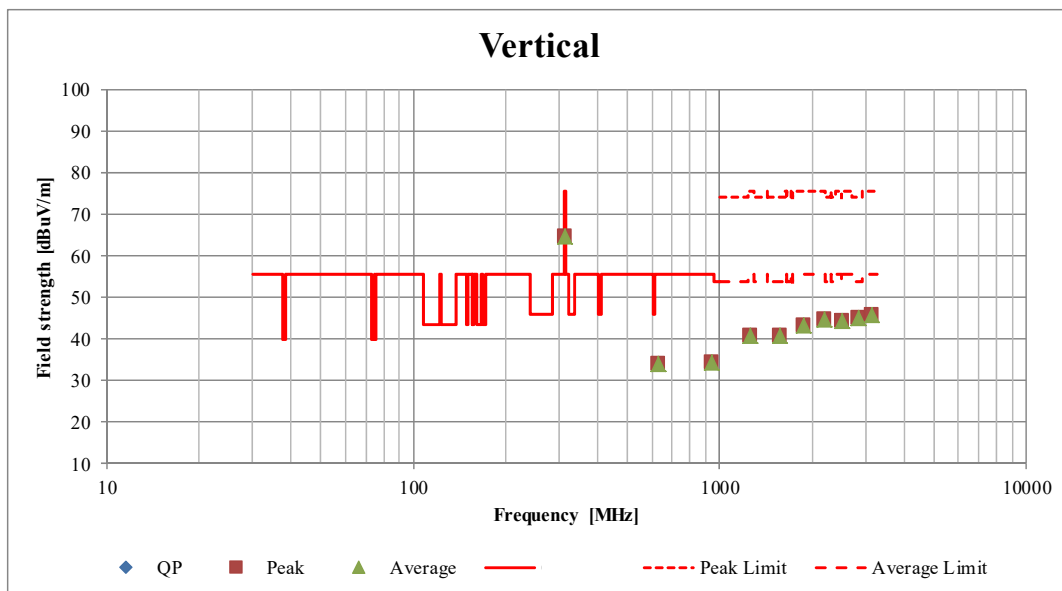
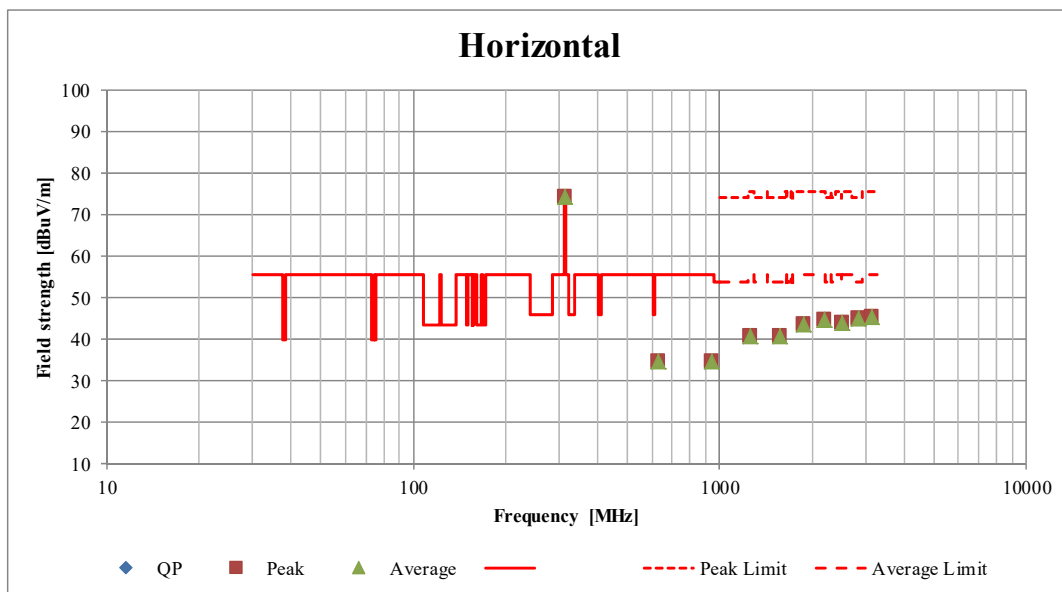
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

|                       |                                         |                     |
|-----------------------|-----------------------------------------|---------------------|
| Report No.            | 12525886H                               |                     |
| Test place            | Ise EMC Lab. No.2 Semi Anechoic Chamber |                     |
| Date                  | 10/03/2018 (Day)                        | 10/03/2018 (Night)  |
| Temperature/ Humidity | 23 deg. C / 51 % RH                     | 23 deg. C / 51 % RH |
| Engineer              | Koji Yamamoto                           | Shuichi Ohyama      |
|                       | (Below 1GHz)                            | (Above 1GHz)        |
| 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

Report No. 12525886H  
Test place Ise EMC Lab. No.2 Semi Anechoic Chamber  
Date 10/03/2018 (Night)  
Temperature/ Humidity 23 deg. C / 51 % RH  
Engineer Shuichi Ohyama  
Mode Transmitting mode 314.35 MHz / 312.10 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.

### 314.35 MHz

|                          |
|--------------------------|
| -20dB Bandwidth<br>[kHz] |
| 37.08                    |

### 312.10MHz

|                          |
|--------------------------|
| -20dB Bandwidth<br>[kHz] |
| 36.96                    |

| -20dB Bandwidth<br>[kHz] | Bandwidth Limit<br>[kHz] | Result |
|--------------------------|--------------------------|--------|
| 37.08 + 36.96 = 74.04    | 780.25                   | Pass   |

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

| 99% Occupied Bandwidth<br>[kHz] | Bandwidth Limit<br>[kHz] | Result |
|---------------------------------|--------------------------|--------|
| 36.5443                         | 785.88                   | Pass   |

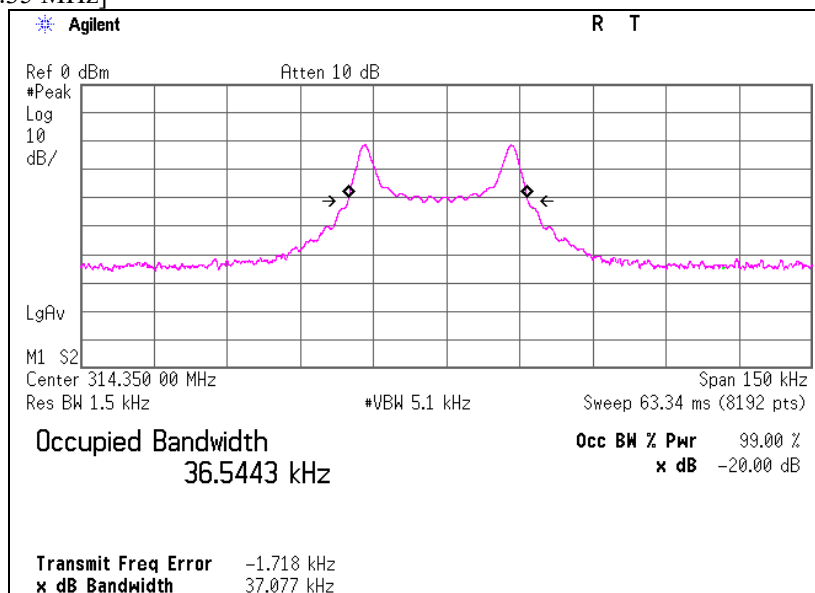
Bandwidth Limit : Fundamental Frequency **312.10** MHz x 0.25% = 780.25 kHz

| 99% Occupied Bandwidth<br>[kHz] | Bandwidth Limit<br>[kHz] | Result |
|---------------------------------|--------------------------|--------|
| 36.4053                         | 780.25                   | Pass   |

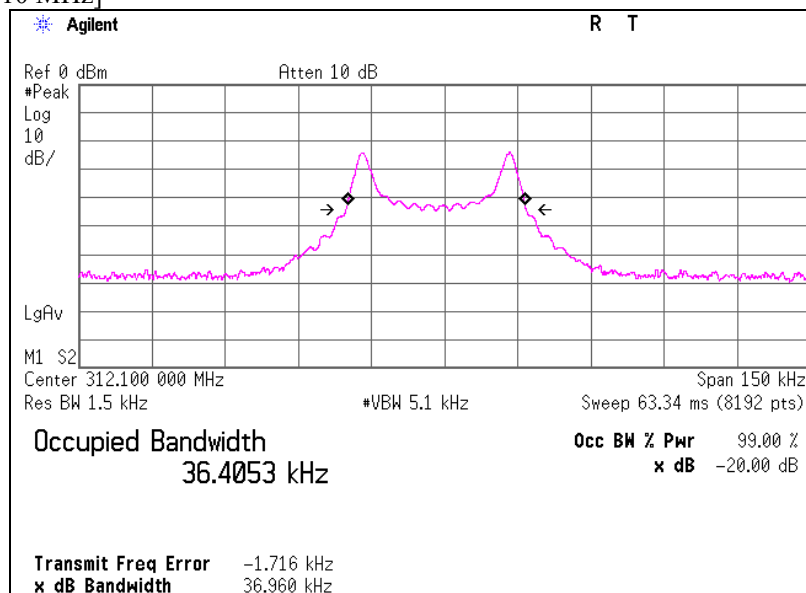
## -20dB and 99% Occupied Bandwidth

Report No. 12525886H  
Test place Ise EMC Lab. No.2 Measurement Room  
Date 10/03/2018 (Night)  
Temperature/ Humidity 23 deg. C / 51 % RH  
Engineer Shuichi Ohyama  
Mode Transmitting mode 314.35 MHz / 312.10 MHz

[314.35 MHz]



[312.10 MHz]



## APPENDIX 2: Test Instruments

### Test equipment

| Test item | LIMS ID | Description                      | Manufacturer      | Model                    | Serial                        | Last Calibration Date | Calibration Due Date | Cal Int |
|-----------|---------|----------------------------------|-------------------|--------------------------|-------------------------------|-----------------------|----------------------|---------|
| RE        | 141203  | Attenuator(6dB)                  | Weinschel Corp    | 2                        | BK7970                        | 11/14/2017            | 11/30/2018           | 12      |
| RE        | 142006  | AC2_Semi Anechoic Chamber(SVSWR) | TDK               | Semi Anechoic Chamber 3m | DA-06902                      | 4/2/2018              | 4/29/2019            | 12      |
| RE        | 141317  | Coaxial Cable                    | Fujikura/Agilent  | -                        | -                             | 2/23/2018             | 2/28/2019            | 12      |
| RE        | 141542  | Digital Tester                   | Fluke Corporation | FLUKE 26-3               | 78030611                      | 8/21/2018             | 8/31/2019            | 12      |
| RE        | 141152  | EMI measurement program          | TSJ               | TEPTO-DV                 | -                             | -                     | -                    | -       |
| RE        | 141265  | Logperiodic Antenna(200-1000MHz) | Schwarzbeck       | VUSLP9111B               | 911B-190                      | 5/31/2018             | 5/31/2019            | 12      |
| RE        | 142228  | Measure                          | KOMELON           | KMC-36                   | -                             | -                     | -                    | -       |
| RE        | 141578  | Pre Amplifier                    | AGILENT           | 8447D                    | 2944A10845                    | 9/19/2018             | 9/30/2019            | 12      |
| RE        | 141556  | Thermo-Hygrometer                | CUSTOM            | CTH-201                  | 0003                          | 12/21/2017            | 12/31/2018           | 12      |
| RE        | 141512  | Horn Antenna 1-18GHz             | Schwarzbeck       | BBHA9120D                | 254                           | 6/6/2018              | 6/30/2019            | 12      |
| RE        | 141392  | Microwave Cable                  | Junkosha          | MWX221                   | 1604S253(1 m) / 1608S087(5 m) | 8/8/2018              | 8/31/2019            | 12      |
| RE        | 141579  | Pre Amplifier                    | AGILENT           | 8449B                    | 3008A02142                    | 1/23/2018             | 1/31/2019            | 12      |
| RE        | 141885  | Spectrum Analyzer                | AGILENT           | E4448A                   | US44300523                    | 11/14/2017            | 11/30/2018           | 12      |
| RE        | 142004  | AC2_Semi Anechoic Chamber(NSA)   | TDK               | Semi Anechoic Chamber 3m | DA-06902                      | 6/29/2018             | 6/30/2020            | 24      |
| RE        | 141942  | Test Receiver                    | Rohde & Schwarz   | ESCI                     | 100300                        | 8/8/2018              | 8/31/2019            | 12      |
| RE        | 141427  | Biconical Antenna                | Schwarzbeck       | VHA9103B                 | 8031                          | 5/31/2018             | 5/31/2019            | 12      |
| RE        | 142645  | Loop Antenna                     | UL Japan          | -                        | -                             | -                     | -                    | -       |

\*Hyphens for Last Calibration Date, Calibration Due 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.

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

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test item:

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

UL Japan, Inc.

Ise EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124