



# **RADIO TEST REPORT**

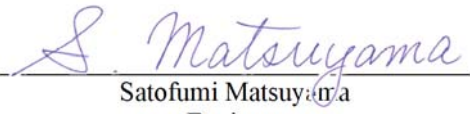
**Test Report No. : 13274648H-A-R1**

**Applicant** : DENSO CORPORATION  
**Type of EUT** : Cockpit Control Unit  
**Model Number of EUT** : DNNS114  
**FCC ID** : HYQDNN114  
**Test regulation** : FCC Part 15 Subpart C: 2019  
\*WLAN part  
(Radiated Spurious Emission test only)  
**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.
5. This test report covers Radio technical requirements.  
It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 13274648H-A. 13274648H-A is replaced with this report.

**Date of test:** March 8 to 10, 2020

**Representative test engineer:**   
Junya Okuno  
Engineer  
Consumer Technology Division

**Approved by:**   
Satofumi Matsuyama  
Engineer  
Consumer Technology Division



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,  
[http://japan.ul.com/resources/emc\\_accredited/](http://japan.ul.com/resources/emc_accredited/)

- ☐ This report contains data that are not covered by the NVLAP accreditation.  
☒ There is no testing item of "Non-accreditation".

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## **REVISION HISTORY**

### **Original Test Report No.: 13274648H-A**

| Revision     | Test report No. | Date           | Page revised | Contents                                                                    |
|--------------|-----------------|----------------|--------------|-----------------------------------------------------------------------------|
| - (Original) | 13274648H-A     | March 26, 2020 | -            | -                                                                           |
| 1            | 13274648H-A-R1  | May 20, 2020   | P.6          | Addition of Clock frequency for Radio part.                                 |
| 1            | 13274648H-A-R1  | May 20, 2020   | P.7          | Correction of reference test report No. from 13204004M-A to 13204004M-A-R1. |
| 1            | 13274648H-A-R1  | May 20, 2020   | P.7          | Correction of Worst Margin: from 1.6 dB to 1.5 dB                           |
| 1            | 13274648H-A-R1  | May 20, 2020   | P.10         | Correction of Power setting value from 11 dBm to 9 dBm                      |
| 1            | 13274648H-A-R1  | May 20, 2020   | P.11, 12     | Addition of Item A' and A''                                                 |
| 1            | 13274648H-A-R1  | May 20, 2020   | P.12         | Correction of name of Item B: from CID to Center Information Display (CID)  |
| 1            | 13274648H-A-R1  | May 20, 2020   | P.15, 17, 18 | Correction of Duty factor: from 0.4 to 0.5                                  |
| 1            | 13274648H-A-R1  | May 20, 2020   | P.20, 22, 23 | Correction of Duty factor: from 1.7 to 1.8                                  |

## 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                        |         |                                                     |

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| <b>CONTENTS</b>                                                     | <b>PAGE</b> |
|---------------------------------------------------------------------|-------------|
| <b>SECTION 1: Customer information.....</b>                         | <b>5</b>    |
| <b>SECTION 2: Equipment under test (EUT).....</b>                   | <b>5</b>    |
| <b>SECTION 3: Test specification, procedures &amp; results.....</b> | <b>7</b>    |
| <b>SECTION 4: Operation of EUT during testing.....</b>              | <b>10</b>   |
| <b>SECTION 5: Radiated Spurious Emission .....</b>                  | <b>13</b>   |
| <b>APPENDIX 1: Test data .....</b>                                  | <b>15</b>   |
| Radiated Spurious Emission .....                                    | 15          |
| <b>APPENDIX 2: Test instruments .....</b>                           | <b>26</b>   |
| <b>APPENDIX 3: Photographs of test setup .....</b>                  | <b>27</b>   |
| Radiated Spurious Emission .....                                    | 27          |

## **SECTION 1: Customer information**

|                  |   |                                                      |
|------------------|---|------------------------------------------------------|
| Company Name     | : | DENSO CORPORATION                                    |
| Address          | : | 1-1 Showa-cho, Kariya-shi, Aichi ken, 448-8661 Japan |
| Telephone Number | : | +81-566-20-3304                                      |
| Facsimile Number | : | +81-566-25-4920                                      |
| Contact Person   | : | Naoto Makino                                         |

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 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                       | : | Cockpit Control Unit                                                                      |
| Model Number               | : | DNNS114                                                                                   |
| Serial Number              | : | Refer to SECTION 4.2                                                                      |
| Rating                     | : | DC 13.2 V                                                                                 |
| Receipt Date               | : | March 6, 2020                                                                             |
| Country of Mass-production | : | Japan                                                                                     |
| Condition                  | : | Production 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: DNN114 (referred to as the EUT in this report) is a Cockpit Control Unit.

### General Specification

The maximum clock frequencies used in the EUT (Radio part): 40 MHz

### Radio Specification

#### [WLAN (IEEE802.11b/g/n-20)] \*1)

|                        | IEEE802.11b                    | IEEE802.11g/n (20 M band)             |
|------------------------|--------------------------------|---------------------------------------|
| Radio Type             | Transceiver                    |                                       |
| Frequency of operation | 2412 MHz - 2462 MHz            |                                       |
| Type of modulation     | DSSS<br>(CCK, DQPSK,<br>DBPSK) | OFDM<br>(64QAM, 16QAM,<br>QPSK, BPSK) |
| Channel spacing        | 5 MHz                          |                                       |
| Antenna type           | ASSEMBLY WiFi Antenna          |                                       |
| Antenna Connector type | MHF PLUG                       |                                       |
| Antenna Gain           | -6.40 dBi (max.)               |                                       |

#### [Bluetooth (BDR / EDR function)]

|                        | Bluetooth Ver.4.2<br>with EDR function |
|------------------------|----------------------------------------|
| Radio Type             | Transceiver                            |
| Frequency of operation | 2402 MHz - 2480 MHz                    |
| Type of modulation     | FHSS (GFSK, $\pi/4$ -DQPSK, 8-DPSK)    |
| Channel spacing        | 1 MHz                                  |
| Antenna type           | ASSEMBLY BT Antenna                    |
| Antenna Connector type | MHF PLUG                               |
| Antenna Gain           | -4.52 dBi (max)                        |

#### [Broadcast]

|                        | AM                 | FM                   | RBDS                 | XM                          |
|------------------------|--------------------|----------------------|----------------------|-----------------------------|
| Radio Type             | Receiver           |                      |                      |                             |
| Frequency of operation | 522 kHz - 1629 kHz | 87.5 MHz - 108.0 MHz | 87.5 MHz - 108.0 MHz | 2333.465 MHz - 2344.045 MHz |
| Antenna Connector type | GT13               | GT13                 | GT13                 | GT13                        |

\*Wireless LAN and Bluetooth do not transmit simultaneously.

\*1) This test report applies to Wireless LAN (2.4 GHz band).

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

### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C  
FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258

Title : FCC 47 CFR Part 15 Radio Frequency Device Subpart C Intentional Radiators  
Section 15.207 Conducted limits  
Section 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz,  
and 5725-5850 MHz

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

### **3.2 Procedures and results**

| Item                                                                                                                                               | Test Procedure                                        | Specification                                                                                               | Worst margin                      | Results         | Remarks                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------|-----------------------------------|
| Spurious Emission<br>Restricted Band<br>Edges                                                                                                      | FCC: KDB 558074 D01<br>15.247<br>Meas Guidance v05r02 | FCC: Section15.247(d)                                                                                       | 1.5 dB<br>9748.000 MHz, AV, Vert. | Complied#<br>a) | Radiated<br>(above 30 MHz)<br>*1) |
|                                                                                                                                                    | ISED: RSS-Gen 6.13                                    | ISED: RSS-247 5.5<br>RSS-Gen 8.9<br>RSS-Gen 8.10                                                            |                                   |                 |                                   |
| Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.                                                                        |                                                       |                                                                                                             |                                   |                 |                                   |
| *1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02 8.5 and 8.6.                  |                                                       |                                                                                                             |                                   |                 |                                   |
| * The other tests other than Spurious Emission Restricted Band Edges were performed in the test report No. 13204004M-A-R1 issued by UL Japan, Inc. |                                                       |                                                                                                             |                                   |                 |                                   |
| a)Refer to APPENDIX 1 (data of Radiated Spurious Emission)                                                                                         |                                                       |                                                                                                             |                                   |                 |                                   |
| 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. |                                   |                 |                                   |

\* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

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

The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage.  
Instead of a new battery, DC power supply was used for the test.  
That does not affect the test result, 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 vehicle.  
Therefore, the equipment complies with the antenna requirement of Section 15.203.

### **3.3 Addition to standard**

No addition, exclusion nor deviation has been made from the standard.

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### 3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the 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  $k=2$ .

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#### 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)<br>(Vertical)   | 4.8 dB            |
|                      |                                                | 5.0 dB            |
|                      | 200 MHz to 1000 MHz (Horizontal)<br>(Vertical) | 5.2 dB            |
|                      |                                                | 6.3 dB            |
| 10 m                 | 30 MHz to 200 MHz (Horizontal)<br>(Vertical)   | 4.8 dB            |
|                      |                                                | 4.8 dB            |
|                      | 200 MHz to 1000 MHz (Horizontal)<br>(Vertical) | 5.0 dB            |
|                      |                                                | 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            |

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### 3.5 Test Location

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\*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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| 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.

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## **SECTION 4: Operation of EUT during testing**

### **4.1 Operating Mode(s)**

Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009.

| Mode                                                                                                                                                                                                                 | Remarks*      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| IEEE 802.11b (11b)                                                                                                                                                                                                   | 5.5 Mbps, PN9 |
| IEEE 802.11n MHz BW (11n-20)                                                                                                                                                                                         | MCS 4, PN9    |
| *The worst condition was determined based on the test result of Maximum Peak Output Power (Test report No.: 13204004M-A issued by UL Japan, Inc.                                                                     |               |
| *Power of the EUT was set by the software as follows;<br>Power settings: 9 dBm<br>Software: MSoC Ver: F41CMM006-007<br>(Date: January 10, 2020, Storage location: EUT Memory)                                        |               |
| *This setting of software is the worst case.<br>Any conditions under the normal use do not exceed the condition of setting.<br>In addition, end users cannot change the settings of the output power of the product. |               |

\*The details of Operating mode(s)

| Test Item                       | Operating Mode | Tested frequency |
|---------------------------------|----------------|------------------|
| Spurious Emission<br>(Radiated) | 11b Tx         | 2412 MHz         |
|                                 |                | 2437 MHz         |
|                                 |                | 2462 MHz         |
|                                 | 11n-20 Tx      | 2412 MHz         |
|                                 |                | 2437 MHz         |
|                                 |                | 2462 MHz         |

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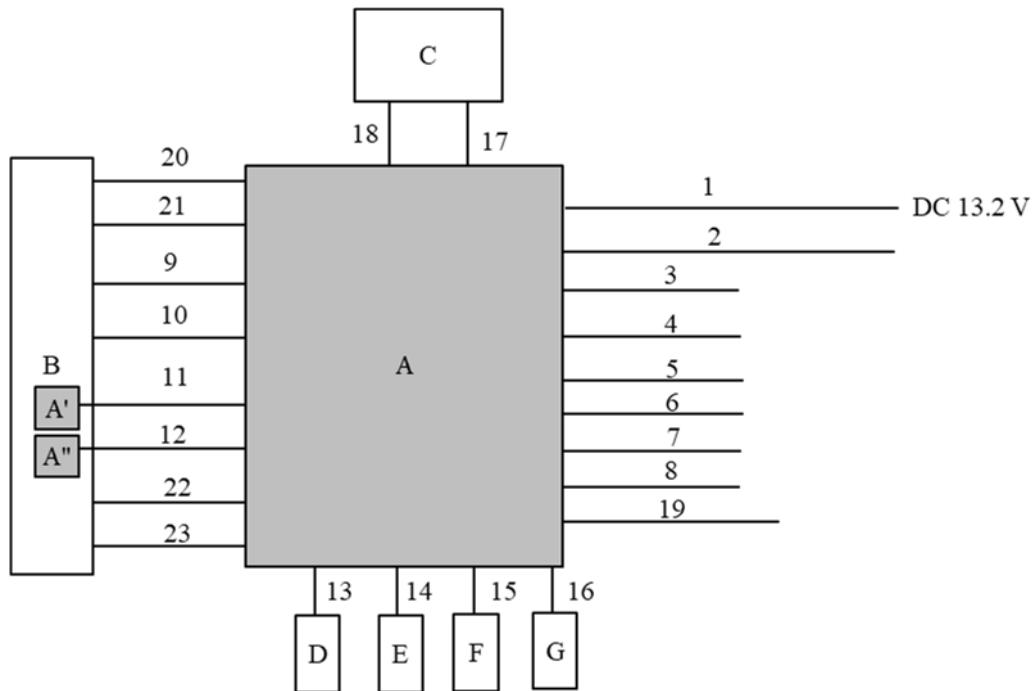
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## 4.2 Configuration and peripherals



\* 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   | Cockpit Control Unit (CCU)       | DNNS114      | K3-US-K3-Mid-S-008 | DENSO                | EUT     |
| A'  | WiFi Antenna                     | 2314128-2    | *1)                | TE Connectivity Ltd. | EUT     |
| A'' | ASSEMBLY Bluetooth Antenna       | 2462810-0140 | *1)                | TE Connectivity Ltd. | EUT     |
| B   | Center Information Display (CID) | DNNS105      | K3-MS2_Mid-LHD027  | DENSO                | -       |
| C   | Meter                            | 457300-7520  | 85002CC110         | DENSO                | -       |
| D   | Speaker(8 ohm)                   | K50          | -                  | VISATON              | -       |
| E   | Speaker(8 ohm)                   | K50          | -                  | VISATON              | -       |
| F   | Speaker(8 ohm)                   | K50          | -                  | VISATON              | -       |
| G   | Speaker(8 ohm)                   | K50          | -                  | VISATON              | -       |

#### List of cables used

| No. | Name               | Length (m) | Shield     |            | Remarks |
|-----|--------------------|------------|------------|------------|---------|
|     |                    |            | Cable      | Connector  |         |
| 1   | DC Cable           | 2.5        | Unshielded | Unshielded | -       |
| 2   | Frame Ground Cable | 1.6        | Unshielded | Unshielded | -       |
| 3   | AM/FM Cable        | 2.0        | Shielded   | Shielded   | -       |
| 4   | XM Cable           | 1.1        | Shielded   | Shielded   | -       |
| 5   | CAN Cable          | 1.8        | Unshielded | Unshielded | -       |
| 6   | MIC Cable          | 1.8        | Unshielded | Unshielded | -       |
| 7   | Signal Cable       | 1.5        | Shielded   | Shielded   | -       |
| 8   | Signal Cable       | 1.5        | Shielded   | Shielded   | -       |
| 9   | DC Cable           | 0.2        | Unshielded | Unshielded | -       |
| 10  | LVDS Cable         | 0.2        | Shielded   | Shielded   | -       |
| 11  | WiFi Cable         | 0.2        | Shielded   | Shielded   | -       |
| 12  | BT Cable           | 0.2        | Shielded   | Shielded   | -       |
| 13  | Speaker Cable      | 2.0        | Unshielded | Unshielded | -       |
| 14  | Speaker Cable      | 2.0        | Unshielded | Unshielded | -       |
| 15  | Speaker Cable      | 2.0        | Unshielded | Unshielded | -       |
| 16  | Speaker Cable      | 2.0        | Unshielded | Unshielded | -       |
| 17  | Meter Cable        | 3.0        | Shielded   | Shielded   | -       |
| 18  | DC Cable           | 1.7        | Unshielded | Unshielded | -       |
| 19  | USB Cable          | 1.5        | Shielded   | Shielded   | -       |
| 20  | FG Cable           | 0.2        | Unshielded | Unshielded | -       |
| 21  | FG Cable           | 0.2        | Unshielded | Unshielded | -       |
| 22  | FG Cable           | 0.2        | Unshielded | Unshielded | -       |
| 23  | FG Cable           | 0.2        | Unshielded | Unshielded | -       |

\*1) This item is controlled with B: Center Information Display

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## **SECTION 5: Radiated Spurious Emission**

### **Test Procedure**

It was measured based on "8.5 and 8.6 of KDB 558074 D01 15.247 Meas Guidance v05r02".

[For below 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 height of the measuring antenna varied between 1 m 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 with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

#### **Test Antennas are used as below;**

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

In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

**20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(ISED) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (ISED).**

|                 |               |                          |                                                                                                                                                                                                                               |                              |
|-----------------|---------------|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Frequency       | Below 1 GHz   | Above 1 GHz              |                                                                                                                                                                                                                               | 20 dBc                       |
| Instrument used | Test Receiver | Spectrum Analyzer        |                                                                                                                                                                                                                               | Spectrum Analyzer            |
| Detector        | QP            | PK                       | AV *1)                                                                                                                                                                                                                        | PK                           |
| IF Bandwidth    | BW 120 kHz    | RBW: 1 MHz<br>VBW: 3 MHz | 11.12.2.5.1<br>RBW: 1 MHz<br>VBW: 3 MHz<br>Detector:<br>Power Averaging (RMS)<br>Trace: 100 traces<br>11.12.2.5.2<br>The duty cycle was less than 98% for detected noise, a duty factor was added to the 11.12.2.5.1 results. | RBW: 100 kHz<br>VBW: 300 kHz |

\*1) Average Power Measurement was performed based on ANSI C63.10-2013.

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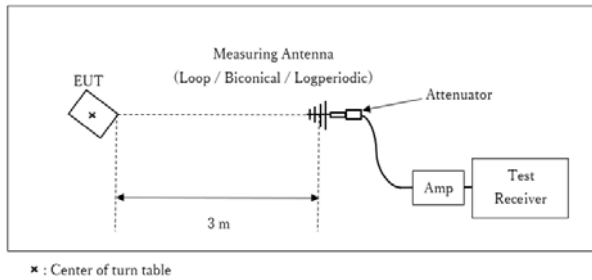
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

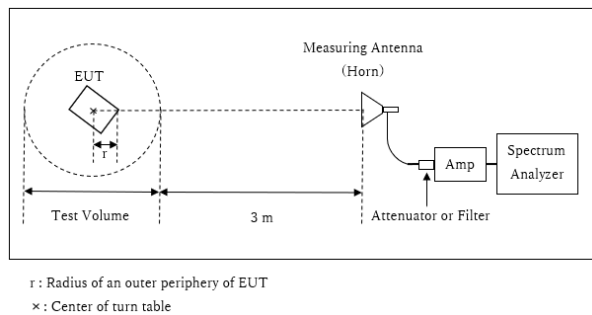
**Figure 2: Test Setup**

Below 1 GHz



Test Distance: 3 m

1 GHz - 10 GHz



Distance Factor:  $20 \times \log (3.8 \text{ m} / 3.0 \text{ m}) = 2.06 \text{ dB}$

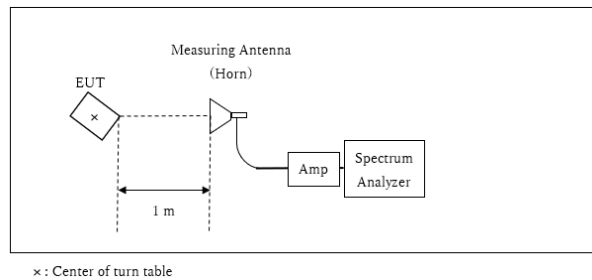
\* Test Distance:  $(3 + \text{Test Volume} / 2) - r = 3.8 \text{ m}$

Test Volume : 2.0 m

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

r = 0.2 m

10 GHz - 26.5 GHz



Distance Factor:  $20 \times \log (1.0 \text{ m} / 3.0 \text{ m}) = -9.5 \text{ dB}$

\*Test Distance: 1 m

The test was made on EUT at the normal use position.

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

**Measurement range** : 30 MHz - 26.5 GHz

**Test data** : APPENDIX

**Test result** : Pass

## APPENDIX 1: Test data

### Radiated Spurious Emission

Report No. 13274648H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.4  
Date March 8, 2020 Night March 9, 2020  
Temperature / Humidity 22 deg. C / 41 % RH 21 deg. C / 39 % RH  
Engineer Akihiko Maeda Takeshi Hiyaji  
(1 GHz - 18 GHz) (18 GHz - 26.5 GHz)  
Mode Tx 11b 2412 MHz

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant.Fac. [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark      |
|----------|-----------------|----------|----------------|-----------------|-----------|-----------|------------------|-----------------|----------------|-------------|-------------|
| Hori.    | 2390.000        | PK       | 39.6           | 27.9            | 5.5       | 31.9      | -                | 41.1            | 73.9           | 32.8        |             |
| Hori.    | 3650.017        | PK       | 46.5           | 29.2            | 6.3       | 31.5      | -                | 50.5            | 73.9           | 23.4        |             |
| Hori.    | 4824.000        | PK       | 42.7           | 31.7            | 7.6       | 31.3      | -                | 50.7            | 73.9           | 23.2        |             |
| Hori.    | 7236.000        | PK       | 40.1           | 36.3            | 9.1       | 32.4      | -                | 53.1            | 73.9           | 20.9        | Floor noise |
| Hori.    | 9648.000        | PK       | 40.0           | 38.0            | 10.0      | 32.8      | -                | 55.2            | 73.9           | 18.7        | Floor noise |
| Hori.    | 2390.000        | AV       | 33.8           | 27.9            | 5.5       | 31.9      | 0.5              | 35.7            | 53.9           | 18.2        | *1)         |
| Hori.    | 3650.017        | AV       | 42.9           | 29.2            | 6.3       | 31.5      | -                | 46.8            | 53.9           | 7.1         |             |
| Hori.    | 4824.000        | AV       | 33.6           | 31.7            | 7.6       | 31.3      | 0.5              | 42.1            | 53.9           | 11.8        |             |
| Hori.    | 7236.000        | AV       | 32.4           | 36.3            | 9.1       | 32.4      | -                | 45.4            | 53.9           | 8.6         | Floor noise |
| Hori.    | 9648.000        | AV       | 31.2           | 38.0            | 10.0      | 32.8      | -                | 46.4            | 53.9           | 7.5         | Floor noise |
| Vert.    | 2390.000        | PK       | 40.3           | 27.9            | 5.5       | 31.9      | -                | 41.7            | 73.9           | 32.2        |             |
| Vert.    | 3650.017        | PK       | 46.5           | 29.2            | 6.3       | 31.5      | -                | 50.5            | 73.9           | 23.4        |             |
| Vert.    | 4824.000        | PK       | 43.5           | 31.7            | 7.6       | 31.3      | -                | 51.5            | 73.9           | 22.4        |             |
| Vert.    | 7236.000        | PK       | 40.2           | 36.3            | 9.1       | 32.4      | -                | 53.2            | 73.9           | 20.7        | Floor noise |
| Vert.    | 9648.000        | PK       | 39.2           | 38.0            | 10.0      | 32.8      | -                | 54.4            | 73.9           | 19.5        | Floor noise |
| Vert.    | 2390.000        | AV       | 34.1           | 27.9            | 5.5       | 31.9      | 0.5              | 36.0            | 53.9           | 17.9        | *1)         |
| Vert.    | 3650.017        | AV       | 42.6           | 29.2            | 6.3       | 31.5      | -                | 46.5            | 53.9           | 7.4         |             |
| Vert.    | 4824.000        | AV       | 34.9           | 31.7            | 7.6       | 31.3      | 0.5              | 43.4            | 53.9           | 10.5        |             |
| Vert.    | 7236.000        | AV       | 32.4           | 36.3            | 9.1       | 32.4      | -                | 45.4            | 53.9           | 8.5         | Floor noise |
| Vert.    | 9648.000        | AV       | 31.5           | 38.0            | 10.0      | 32.8      | -                | 46.7            | 53.9           | 7.2         | Floor noise |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor

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

Distance factor: 1 GHz - 10 GHz  $20\log(3.8\text{ m} / 3.0\text{ m}) = 2.06\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

\*1) Not Out of Band emission(Leakage Power)

#### 20dBc Data Sheet

| Polarity | Frequency [MHz] | Detector | Reading [dBuV] | Ant Factor [dB/m] | Loss [dB] | Gain [dB] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark  |
|----------|-----------------|----------|----------------|-------------------|-----------|-----------|-----------------|----------------|-------------|---------|
| Hori     | 2412.000        | PK       | 89.4           | 27.9              | 5.5       | 31.9      | 90.9            | -              | -           | Carrier |
| Hori     | 2400.000        | PK       | 39.8           | 27.9              | 5.5       | 31.9      | 41.3            | 70.9           | 29.5        |         |
| Vert     | 2412.000        | PK       | 91.5           | 27.9              | 5.5       | 31.9      | 93.0            | -              | -           | Carrier |
| Vert     | 2400.000        | PK       | 41.6           | 27.9              | 5.5       | 31.9      | 43.0            | 73.0           | 30.0        |         |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

Distance factor: 1 GHz - 10 GHz  $20\log(3.8\text{ m} / 3.0\text{ m}) = 2.06\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

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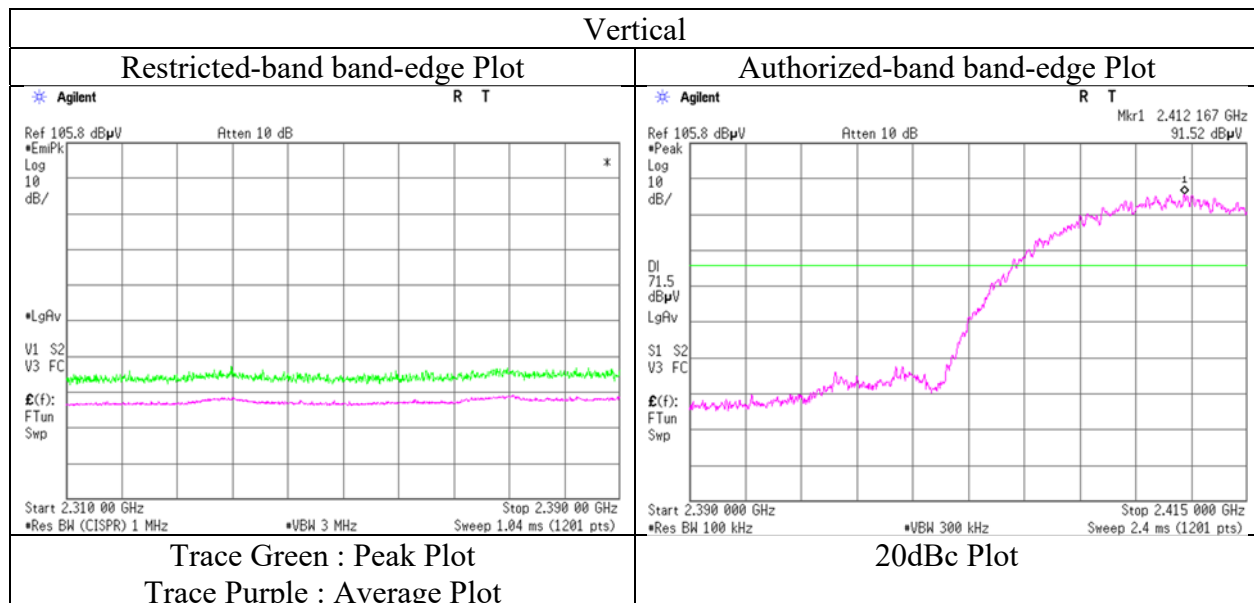
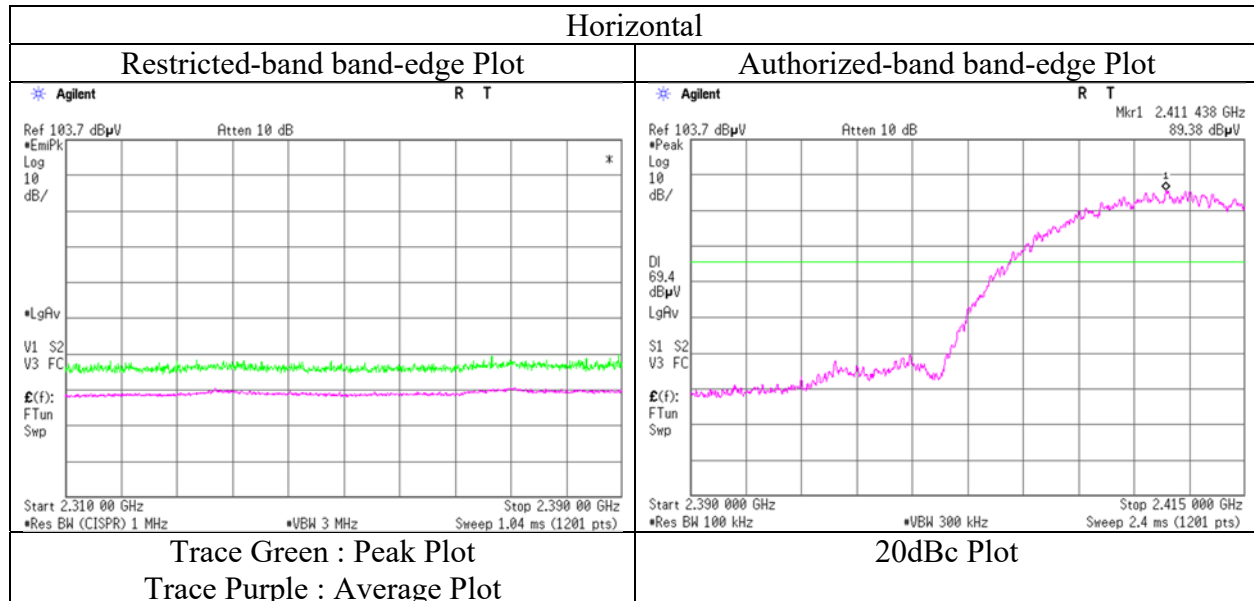
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Radiated Spurious Emission (Reference Plot for band-edge)

|                        |                     |
|------------------------|---------------------|
| Report No.             | 13274648H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.4                |
| Date                   | March 8, 2020 Night |
| Temperature / Humidity | 22 deg. C / 41 % RH |
| Engineer               | Akihiko Maeda       |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11b 2412 MHz     |



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.  
Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

|                        |                     |                     |
|------------------------|---------------------|---------------------|
| Report No.             | 13274648H           |                     |
| Test place             | Ise EMC Lab.        |                     |
| Semi Anechoic Chamber  | No.4                | No.4                |
| Date                   | March 8, 2020 Night | March 9, 2020       |
| Temperature / Humidity | 22 deg. C / 41 % RH | 21 deg. C / 39 % RH |
| Engineer               | Akihiko Maeda       | Takeshi Hiyaji      |
|                        | (1 GHz - 18 GHz)    | (18 GHz - 26.5 GHz) |
| Mode                   | Tx 11b 2437 MHz     |                     |

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori.    | 3650.017           | PK       | 46.5              | 29.2               | 6.3          | 31.5         | -                   | 50.4               | 73.9              | 23.5           |             |
| Hori.    | 4874.000           | PK       | 41.1              | 31.6               | 7.6          | 31.2         | -                   | 49.1               | 73.9              | 24.8           |             |
| Hori.    | 7311.000           | PK       | 42.1              | 36.4               | 9.1          | 32.5         | -                   | 55.2               | 73.9              | 18.7           | Floor noise |
| Hori.    | 9748.000           | PK       | 40.1              | 38.3               | 10.0         | 32.9         | -                   | 55.5               | 73.9              | 18.4           | Floor noise |
| Hori.    | 3650.017           | AV       | 42.4              | 29.2               | 6.3          | 31.5         | -                   | 46.3               | 53.9              | 7.6            |             |
| Hori.    | 4874.000           | AV       | 32.6              | 31.6               | 7.6          | 31.2         | 0.5                 | 41.1               | 53.9              | 12.8           |             |
| Hori.    | 7311.000           | AV       | 32.6              | 36.4               | 9.1          | 32.5         | -                   | 45.6               | 53.9              | 8.3            | Floor noise |
| Hori.    | 9748.000           | AV       | 31.1              | 38.3               | 10.0         | 32.9         | -                   | 46.5               | 53.9              | 7.4            | Floor noise |
| Vert.    | 3650.017           | PK       | 48.0              | 29.2               | 6.3          | 31.5         | -                   | 52.0               | 73.9              | 21.9           |             |
| Vert.    | 4874.000           | PK       | 42.2              | 31.6               | 7.6          | 31.2         | -                   | 50.2               | 73.9              | 23.7           |             |
| Vert.    | 7311.000           | PK       | 41.8              | 36.4               | 9.1          | 32.5         | -                   | 54.8               | 73.9              | 19.1           | Floor noise |
| Vert.    | 9748.000           | PK       | 40.6              | 38.3               | 10.0         | 32.9         | -                   | 56.0               | 73.9              | 17.9           | Floor noise |
| Vert.    | 3650.017           | AV       | 44.4              | 29.2               | 6.3          | 31.5         | -                   | 48.4               | 53.9              | 5.5            |             |
| Vert.    | 4874.000           | AV       | 34.0              | 31.6               | 7.6          | 31.2         | 0.5                 | 42.5               | 53.9              | 11.4           |             |
| Vert.    | 7311.000           | AV       | 32.7              | 36.4               | 9.1          | 32.5         | -                   | 45.7               | 53.9              | 8.2            | Floor noise |
| Vert.    | 9748.000           | AV       | 31.3              | 38.3               | 10.0         | 32.9         | -                   | 46.7               | 53.9              | 7.2            | Floor noise |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor

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

Distance factor: 1 GHz - 10 GHz  $20\log(3.8\text{ m} / 3.0\text{ m}) = 2.06\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

## Radiated Spurious Emission

Report No. 13274648H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.4  
Date March 8, 2020 Night March 9, 2020  
Temperature / Humidity 22 deg. C / 41 % RH 21 deg. C / 39 % RH  
Engineer Akihiko Maeda Takeshi Hiyaji  
(1 GHz - 18 GHz) (18 GHz - 26.5 GHz)  
Mode Tx 11b 2462 MHz

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|--------|
| Hori.    | 2483.500           | PK       | 40.8              | 27.7               | 5.5          | 31.8         | -                   | 42.2               | 73.9              | 31.7           |        |
| Hori.    | 3650.017           | PK       | 47.3              | 29.2               | 6.3          | 31.5         | -                   | 51.3               | 73.9              | 22.6           |        |
| Hori.    | 4924.000           | PK       | 42.0              | 31.6               | 7.7          | 31.2         | -                   | 50.0               | 73.9              | 23.9           |        |
| Hori.    | 7386.000           | PK       | 41.5              | 36.5               | 9.1          | 32.5         | -                   | 54.6               | 73.9              | 19.3           |        |
| Hori.    | 9848.000           | PK       | 40.5              | 38.5               | 10.1         | 32.9         | -                   | 56.2               | 73.9              | 17.7           |        |
| Hori.    | 2483.500           | AV       | 34.7              | 27.7               | 5.5          | 31.8         | 0.5                 | 36.6               | 53.9              | 17.3           | *1)    |
| Hori.    | 3650.017           | AV       | 43.8              | 29.2               | 6.3          | 31.5         | -                   | 47.8               | 53.9              | 6.1            |        |
| Hori.    | 4924.000           | AV       | 33.2              | 31.6               | 7.7          | 31.2         | 0.5                 | 41.7               | 53.9              | 12.2           |        |
| Hori.    | 7386.000           | AV       | 32.2              | 36.5               | 9.1          | 32.5         | 0.5                 | 45.8               | 53.9              | 8.1            |        |
| Hori.    | 9848.000           | AV       | 31.3              | 38.5               | 10.1         | 32.9         | 0.5                 | 47.4               | 53.9              | 6.5            |        |
| Vert.    | 2483.500           | PK       | 39.4              | 27.7               | 5.5          | 31.8         | -                   | 40.9               | 73.9              | 33.0           |        |
| Vert.    | 3650.017           | PK       | 47.9              | 29.2               | 6.3          | 31.5         | -                   | 51.8               | 73.9              | 22.1           |        |
| Vert.    | 4924.000           | PK       | 41.6              | 31.6               | 7.7          | 31.2         | -                   | 49.6               | 73.9              | 24.3           |        |
| Vert.    | 7386.000           | PK       | 41.5              | 36.5               | 9.1          | 32.5         | -                   | 54.7               | 73.9              | 19.2           |        |
| Vert.    | 9848.000           | PK       | 40.4              | 38.5               | 10.1         | 32.9         | -                   | 56.1               | 73.9              | 17.8           |        |
| Vert.    | 2483.500           | AV       | 33.6              | 27.7               | 5.5          | 31.8         | 0.5                 | 35.5               | 53.9              | 18.4           | *1)    |
| Vert.    | 3650.017           | AV       | 44.5              | 29.2               | 6.3          | 31.5         | -                   | 48.5               | 53.9              | 5.5            |        |
| Vert.    | 4924.000           | AV       | 33.2              | 31.6               | 7.7          | 31.2         | 0.5                 | 41.7               | 53.9              | 12.2           |        |
| Vert.    | 7386.000           | AV       | 32.4              | 36.5               | 9.1          | 32.5         | 0.5                 | 46.0               | 53.9              | 7.9            |        |
| Vert.    | 9848.000           | AV       | 31.3              | 38.5               | 10.1         | 32.9         | 0.5                 | 47.4               | 53.9              | 6.5            |        |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor

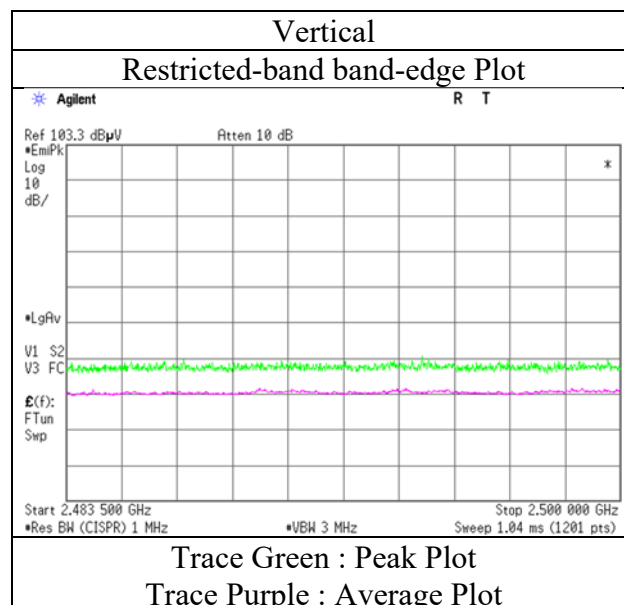
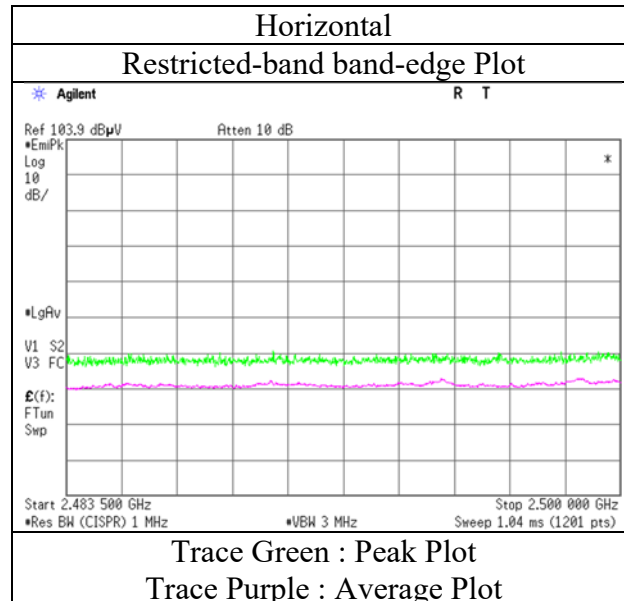
\*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

Distance factor: 1 GHz - 10 GHz  $20\log(3.8\text{ m} / 3.0\text{ m}) = 2.06\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

\*1) Not Out of Band emission(Leakage Power)

## Radiated Spurious Emission (Reference Plot for band-edge)

|                        |                     |
|------------------------|---------------------|
| Report No.             | 13274648H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.4                |
| Date                   | March 8, 2020 Night |
| Temperature / Humidity | 22 deg. C / 41 % RH |
| Engineer               | Akihiko Maeda       |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11b 2462 MHz     |



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

Final result of restricted band edge was shown in tabular data.

**UL Japan, Inc.**

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## Radiated Spurious Emission

|                        |                     |                     |                     |
|------------------------|---------------------|---------------------|---------------------|
| Report No.             | 13274648H           |                     |                     |
| Test place             | Ise EMC Lab.        |                     |                     |
| Semi Anechoic Chamber  | No.4                | No.4                | No.4                |
| Date                   | March 8, 2020       | March 8, 2020 Night | March 9, 2020       |
| Temperature / Humidity | 23 deg. C / 35 % RH | 22 deg. C / 41 % RH | 21 deg. C / 39 % RH |
| Engineer               | Hiroyuki Furutaka   | Akihiko Maeda       | Takeshi Hiyaji      |
|                        | (1 GHz - 10 GHz)    | (10 GHz - 18 GHz)   | (18 GHz - 26.5 GHz) |
| Mode                   | Tx 11n-20 2412 MHz  |                     |                     |

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori.    | 2390.000           | PK       | 52.0              | 27.9               | 5.5          | 31.9         | -                   | 53.5               | 73.9              | 20.4           |             |
| Hori.    | 3650.017           | PK       | 47.7              | 29.2               | 6.3          | 31.5         | -                   | 51.7               | 73.9              | 22.2           |             |
| Hori.    | 4824.000           | PK       | 39.5              | 31.7               | 7.6          | 31.3         | -                   | 47.5               | 73.9              | 26.4           | Floor noise |
| Hori.    | 7236.000           | PK       | 40.7              | 36.3               | 9.1          | 32.4         | -                   | 53.6               | 73.9              | 20.3           | Floor noise |
| Hori.    | 9648.000           | PK       | 40.6              | 38.0               | 10.0         | 32.8         | -                   | 55.8               | 73.9              | 18.1           | Floor noise |
| Hori.    | 2390.000           | AV       | 38.4              | 27.9               | 5.5          | 31.9         | 1.8                 | 41.7               | 53.9              | 12.2           | *1)         |
| Hori.    | 3650.017           | AV       | 45.5              | 29.2               | 6.3          | 31.5         | -                   | 49.5               | 53.9              | 4.4            |             |
| Hori.    | 4824.000           | AV       | 31.8              | 31.7               | 7.6          | 31.3         | -                   | 39.8               | 53.9              | 14.1           | Floor noise |
| Hori.    | 7236.000           | AV       | 32.5              | 36.3               | 9.1          | 32.4         | -                   | 45.4               | 53.9              | 8.5            | Floor noise |
| Hori.    | 9648.000           | AV       | 32.5              | 38.0               | 10.0         | 32.8         | -                   | 47.7               | 53.9              | 6.2            | Floor noise |
| Vert.    | 2390.000           | PK       | 51.1              | 27.9               | 5.5          | 31.9         | -                   | 52.6               | 73.9              | 21.3           |             |
| Vert.    | 3650.017           | PK       | 44.3              | 29.2               | 6.3          | 31.5         | -                   | 48.3               | 73.9              | 25.6           |             |
| Vert.    | 4824.000           | PK       | 41.3              | 31.7               | 7.6          | 31.3         | -                   | 49.3               | 73.9              | 24.6           | Floor noise |
| Vert.    | 7236.000           | PK       | 41.0              | 36.3               | 9.1          | 32.4         | -                   | 53.9               | 73.9              | 20.0           | Floor noise |
| Vert.    | 9648.000           | PK       | 41.1              | 38.0               | 10.0         | 32.8         | -                   | 56.3               | 73.9              | 17.6           | Floor noise |
| Vert.    | 2390.000           | AV       | 38.3              | 27.9               | 5.5          | 31.9         | 1.8                 | 41.6               | 53.9              | 12.3           | *1)         |
| Vert.    | 3650.017           | AV       | 41.1              | 29.2               | 6.3          | 31.5         | -                   | 45.1               | 53.9              | 8.8            |             |
| Vert.    | 4824.000           | AV       | 32.1              | 31.7               | 7.6          | 31.3         | -                   | 40.1               | 53.9              | 13.8           | Floor noise |
| Vert.    | 7236.000           | AV       | 32.5              | 36.3               | 9.1          | 32.4         | -                   | 45.4               | 53.9              | 8.5            | Floor noise |
| Vert.    | 9648.000           | AV       | 32.6              | 38.0               | 10.0         | 32.8         | -                   | 47.8               | 53.9              | 6.1            | Floor noise |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor

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

Distance factor: 1 GHz - 10 GHz  $20\log(3.8\text{ m} / 3.0\text{ m}) = 2.06\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

\*1) Not Out of Band emission(Leakage Power)

### 20dBc Data Sheet

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark  |
|----------|--------------------|----------|-------------------|-------------------------|--------------|--------------|--------------------|-------------------|----------------|---------|
| Hori.    | 2412.000           | PK       | 86.4              | 27.9                    | 5.5          | 31.9         | 87.9               | -                 | -              | Carrier |
| Hori.    | 2400.000           | PK       | 57.7              | 27.9                    | 5.5          | 31.9         | 59.2               | 67.9              | 8.7            |         |
| Vert.    | 2412.000           | PK       | 87.2              | 27.9                    | 5.5          | 31.9         | 88.7               | -                 | -              | Carrier |
| Vert.    | 2400.000           | PK       | 58.1              | 27.9                    | 5.5          | 31.9         | 59.5               | 68.7              | 9.1            |         |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)

Distance factor: 1 GHz - 10 GHz  $20\log(3.8\text{ m} / 3.0\text{ m}) = 2.06\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

**UL Japan, Inc.**

**Ise EMC Lab.**

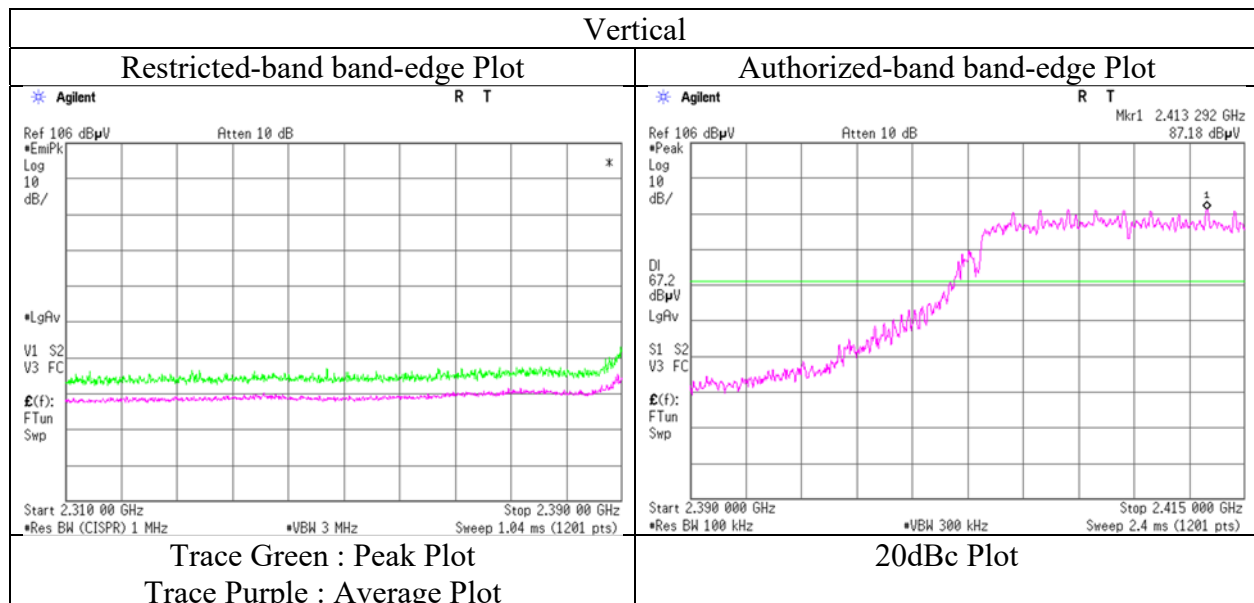
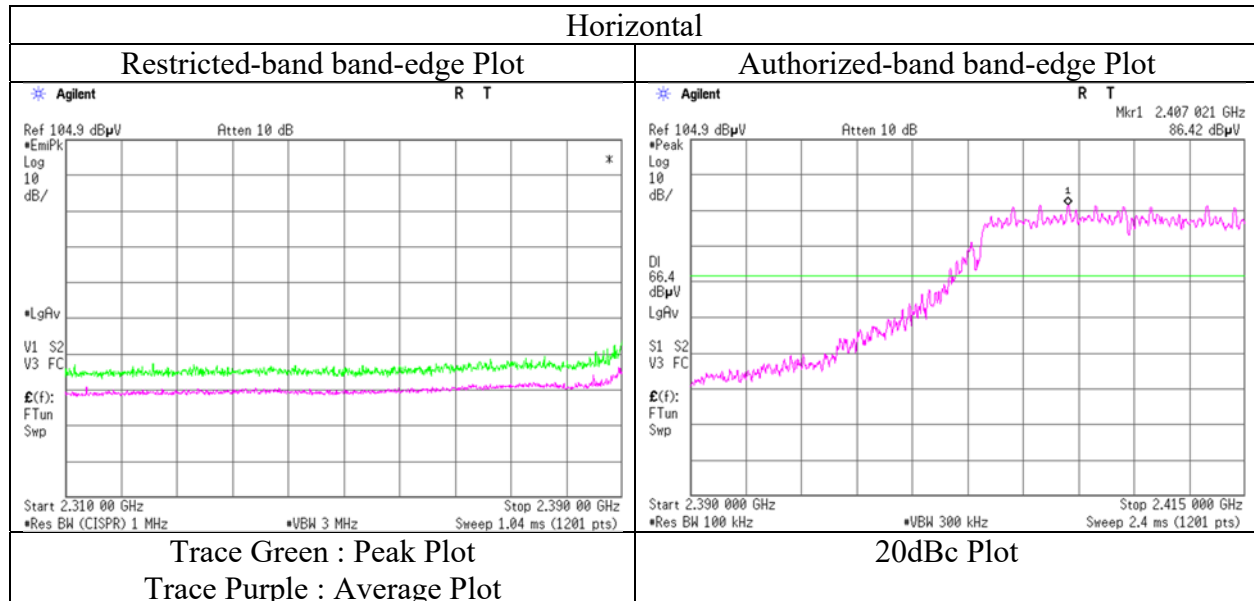
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Radiated Spurious Emission (Reference Plot for band-edge)

|                        |                     |
|------------------------|---------------------|
| Report No.             | 13274648H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.4                |
| Date                   | March 8, 2020       |
| Temperature / Humidity | 23 deg. C / 35 % RH |
| Engineer               | Hiroyuki Furutaka   |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11n-20 2412 MHz  |



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.  
Final result of restricted band edge was shown in tabular data.

## Radiated Spurious Emission

Report No. 13274648H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.4  
Date March 8, 2020 Night March 9, 2020  
Temperature / Humidity 22 deg. C / 41 % RH 21 deg. C / 39 % RH  
Engineer Akihiko Maeda Takeshi Hiyaji  
(1 GHz - 18 GHz) (18 GHz - 26.5 GHz)  
Mode Tx 11n-20 2437 MHz

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori.    | 3650.017           | PK       | 47.0              | 29.2               | 6.3          | 31.5         | -                   | 50.9               | 73.9              | 23.0           |             |
| Hori.    | 4874.000           | PK       | 39.5              | 31.6               | 7.6          | 31.2         | -                   | 47.5               | 73.9              | 26.4           | Floor noise |
| Hori.    | 7311.000           | PK       | 40.0              | 36.4               | 9.1          | 32.5         | -                   | 53.1               | 73.9              | 20.8           | Floor noise |
| Hori.    | 9748.000           | PK       | 41.7              | 38.3               | 10.0         | 32.9         | -                   | 57.1               | 73.9              | 16.8           |             |
| Hori.    | 3650.017           | AV       | 42.9              | 29.2               | 6.3          | 31.5         | -                   | 46.9               | 53.9              | 7.0            |             |
| Hori.    | 4874.000           | AV       | 31.0              | 31.6               | 7.6          | 31.2         | -                   | 39.0               | 53.9              | 14.9           | Floor noise |
| Hori.    | 7311.000           | AV       | 33.1              | 36.4               | 9.1          | 32.5         | -                   | 46.1               | 53.9              | 7.8            | Floor noise |
| Hori.    | 9748.000           | AV       | 34.1              | 38.3               | 10.0         | 32.9         | 1.8                 | 51.3               | 53.9              | 2.6            |             |
| Vert.    | 3650.017           | PK       | 47.4              | 29.2               | 6.3          | 31.5         | -                   | 51.3               | 73.9              | 22.6           |             |
| Vert.    | 4874.000           | PK       | 41.0              | 31.6               | 7.6          | 31.2         | -                   | 49.1               | 73.9              | 24.8           | Floor noise |
| Vert.    | 7311.000           | PK       | 41.2              | 36.4               | 9.1          | 32.5         | -                   | 54.3               | 73.9              | 19.6           | Floor noise |
| Vert.    | 9748.000           | PK       | 42.3              | 38.3               | 10.0         | 32.9         | -                   | 57.6               | 73.9              | 16.3           |             |
| Vert.    | 3650.017           | AV       | 44.4              | 29.2               | 6.3          | 31.5         | -                   | 48.4               | 53.9              | 5.5            |             |
| Vert.    | 4874.000           | AV       | 31.5              | 31.6               | 7.6          | 31.2         | -                   | 39.6               | 53.9              | 14.3           | Floor noise |
| Vert.    | 7311.000           | AV       | 32.8              | 36.4               | 9.1          | 32.5         | -                   | 45.9               | 53.9              | 8.1            | Floor noise |
| Vert.    | 9748.000           | AV       | 35.2              | 38.3               | 10.0         | 32.9         | 1.8                 | 52.4               | 53.9              | 1.5            |             |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor

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

Distance factor: 1 GHz - 10 GHz  $20\log(3.8\text{ m} / 3.0\text{ m}) = 2.06\text{ dB}$   
10 GHz - 26.5 GHz  $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.5\text{ dB}$

## Radiated Spurious Emission

|                        |                     |                     |                     |                     |
|------------------------|---------------------|---------------------|---------------------|---------------------|
| Report No.             | 13274648H           |                     |                     |                     |
| Test place             | Ise EMC Lab.        |                     |                     |                     |
| Semi Anechoic Chamber  | No.4                | No.4                | No.4                | No.3                |
| Date                   | March 8, 2020       | March 8, 2020 Night | March 9, 2020       | March 10, 2020      |
| Temperature / Humidity | 23 deg. C / 35 % RH | 22 deg. C / 41 % RH | 21 deg. C / 39 % RH | 21 deg. C / 50 % RH |
| Engineer               | Hiroyuki Furutaka   | Akihiko Maeda       | Takeshi Hiyaji      | Junya Okuno         |
|                        | (1 GHz - 10 GHz)    | (10 GHz - 18 GHz)   | (18 GHz - 26.5 GHz) | (Below 1 GHz)       |
| Mode                   | Tx 11n-20 2462 MHz  |                     |                     |                     |

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|---------------------|--------------------|-------------------|----------------|-------------|
| Hori.    | 192.000            | QP       | 42.2              | 16.5               | 9.0          | 32.0         | -                   | 35.7               | 43.5              | 7.8            |             |
| Hori.    | 200.000            | QP       | 44.2              | 11.4               | 9.1          | 32.0         | -                   | 32.7               | 43.5              | 10.8           |             |
| Hori.    | 280.000            | QP       | 49.5              | 13.3               | 9.8          | 32.0         | -                   | 40.6               | 46.0              | 5.4            |             |
| Hori.    | 288.000            | QP       | 45.6              | 13.4               | 9.9          | 32.0         | -                   | 36.9               | 46.0              | 9.1            |             |
| Hori.    | 328.000            | QP       | 42.6              | 14.4               | 10.2         | 32.0         | -                   | 35.2               | 46.0              | 10.8           |             |
| Hori.    | 336.000            | QP       | 48.6              | 14.7               | 10.2         | 32.0         | -                   | 41.6               | 46.0              | 4.4            |             |
| Hori.    | 448.000            | QP       | 43.5              | 16.5               | 11.0         | 32.0         | -                   | 39.0               | 46.0              | 7.0            |             |
| Hori.    | 2483.500           | PK       | 48.3              | 27.7               | 5.5          | 31.8         | -                   | 49.7               | 73.9              | 24.2           |             |
| Hori.    | 3650.017           | PK       | 45.5              | 29.2               | 6.3          | 31.5         | -                   | 49.5               | 73.9              | 24.4           |             |
| Hori.    | 4924.000           | PK       | 39.5              | 31.6               | 7.7          | 31.2         | -                   | 47.5               | 73.9              | 26.4           | Floor noise |
| Hori.    | 7386.000           | PK       | 41.3              | 36.5               | 9.1          | 32.5         | -                   | 54.4               | 73.9              | 19.5           | Floor noise |
| Hori.    | 9848.000           | PK       | 41.2              | 38.5               | 10.1         | 32.9         | -                   | 56.8               | 73.9              | 17.1           | Floor noise |
| Hori.    | 2483.500           | AV       | 36.9              | 27.7               | 5.5          | 31.8         | 1.8                 | 40.1               | 53.9              | 13.8           | *1)         |
| Hori.    | 3650.017           | AV       | 42.0              | 29.2               | 6.3          | 31.5         | -                   | 46.0               | 53.9              | 7.9            |             |
| Hori.    | 4924.000           | AV       | 31.6              | 31.6               | 7.7          | 31.2         | -                   | 39.6               | 53.9              | 14.3           | Floor noise |
| Hori.    | 7386.000           | AV       | 32.5              | 36.5               | 9.1          | 32.5         | -                   | 45.6               | 53.9              | 8.3            | Floor noise |
| Hori.    | 9848.000           | AV       | 31.6              | 38.5               | 10.1         | 32.9         | -                   | 47.2               | 53.9              | 6.7            | Floor noise |
| Vert.    | 192.000            | QP       | 44.9              | 16.5               | 9.0          | 32.0         | -                   | 38.4               | 43.5              | 5.1            |             |
| Vert.    | 200.000            | QP       | 51.9              | 11.4               | 9.1          | 32.0         | -                   | 40.4               | 43.5              | 3.1            |             |
| Vert.    | 208.000            | QP       | 52.0              | 11.2               | 9.2          | 32.0         | -                   | 40.4               | 43.5              | 3.1            |             |
| Vert.    | 216.000            | QP       | 52.1              | 11.1               | 9.3          | 32.0         | -                   | 40.4               | 43.5              | 3.1            |             |
| Vert.    | 280.000            | QP       | 49.0              | 13.3               | 9.8          | 32.0         | -                   | 40.1               | 46.0              | 5.9            |             |
| Vert.    | 288.000            | QP       | 47.7              | 13.4               | 9.9          | 32.0         | -                   | 39.0               | 46.0              | 7.0            |             |
| Vert.    | 328.000            | QP       | 47.0              | 14.4               | 10.2         | 32.0         | -                   | 39.6               | 46.0              | 6.4            |             |
| Vert.    | 336.000            | QP       | 46.5              | 14.7               | 10.2         | 32.0         | -                   | 39.5               | 46.0              | 6.5            |             |
| Vert.    | 2483.500           | PK       | 45.3              | 27.7               | 5.5          | 31.8         | -                   | 46.7               | 73.9              | 27.2           |             |
| Vert.    | 3650.017           | PK       | 46.5              | 29.2               | 6.3          | 31.5         | -                   | 50.5               | 73.9              | 23.4           |             |
| Vert.    | 4924.000           | PK       | 42.5              | 31.6               | 7.7          | 31.2         | -                   | 50.5               | 73.9              | 23.4           | Floor noise |
| Vert.    | 7386.000           | PK       | 41.0              | 36.5               | 9.1          | 32.5         | -                   | 54.1               | 73.9              | 19.8           | Floor noise |
| Vert.    | 9848.000           | PK       | 41.7              | 38.5               | 10.1         | 32.9         | -                   | 57.3               | 73.9              | 16.6           | Floor noise |
| Vert.    | 2483.500           | AV       | 35.0              | 27.7               | 5.5          | 31.8         | 1.8                 | 38.2               | 53.9              | 15.7           | *1)         |
| Vert.    | 3650.017           | AV       | 43.2              | 29.2               | 6.3          | 31.5         | -                   | 47.2               | 53.9              | 6.7            |             |
| Vert.    | 4924.000           | AV       | 31.7              | 31.6               | 7.7          | 31.2         | -                   | 39.7               | 53.9              | 14.2           | Floor noise |
| Vert.    | 7386.000           | AV       | 33.0              | 36.5               | 9.1          | 32.5         | -                   | 46.1               | 53.9              | 7.8            | Floor noise |
| Vert.    | 9848.000           | AV       | 31.8              | 38.5               | 10.1         | 32.9         | -                   | 47.4               | 53.9              | 6.5            | Floor noise |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor

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

Distance factor: 1 GHz - 10 GHz 20log (3.8 m / 3.0 m) = 2.06 dB  
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB

\*1) Not Out of Band emission(Leakage Power)

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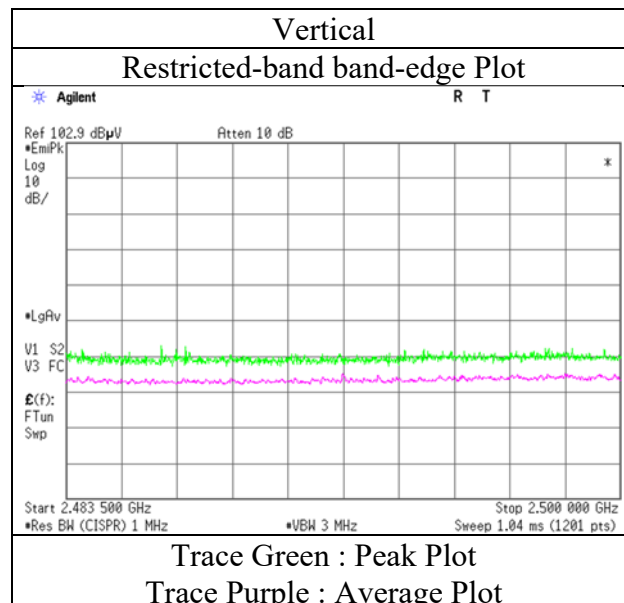
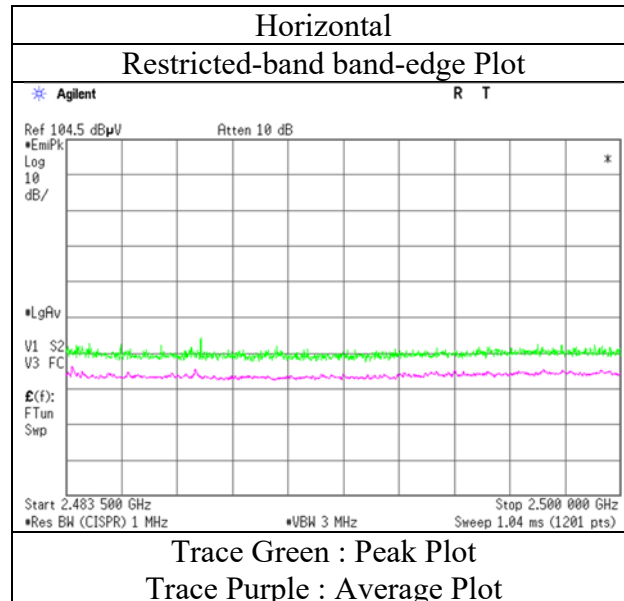
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Radiated Spurious Emission (Reference Plot for band-edge)

|                        |                     |
|------------------------|---------------------|
| Report No.             | 13274648H           |
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.4                |
| Date                   | March 8, 2020       |
| Temperature / Humidity | 23 deg. C / 35 % RH |
| Engineer               | Hiroyuki Furutaka   |
|                        | (1 GHz - 10 GHz)    |
| Mode                   | Tx 11n-20 2462 MHz  |



\* The measurement was conducted for a sufficiently long enough time to detect any possible spurious emissions.

Final result of restricted band edge was shown in tabular data.

**UL Japan, Inc.**

**Ise EMC Lab.**

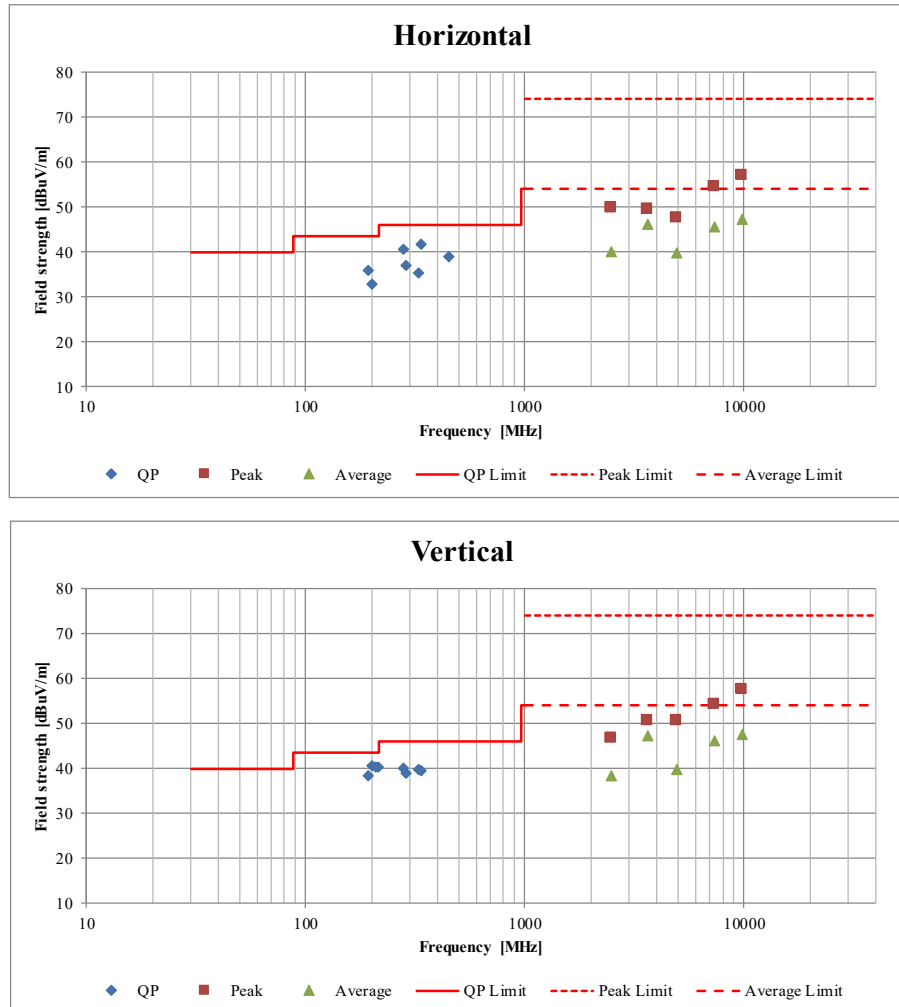
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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

|                        |                                       |                                    |                                       |                              |
|------------------------|---------------------------------------|------------------------------------|---------------------------------------|------------------------------|
| Report No.             | 13274648H                             |                                    |                                       |                              |
| Test place             | Ise EMC Lab.                          |                                    |                                       |                              |
| Semi Anechoic Chamber  | No.4                                  | No.4                               | No.4                                  | No.3                         |
| Date                   | March 8, 2020                         | March 8, 2020 Night                | March 9, 2020                         | March 10, 2020               |
| Temperature / Humidity | 23 deg. C / 35 % RH                   | 22 deg. C / 41 % RH                | 21 deg. C / 39 % RH                   | 21 deg. C / 50 % RH          |
| Engineer               | Hiroyuki Furutaka<br>(1 GHz - 10 GHz) | Akihiko Maeda<br>(10 GHz - 18 GHz) | Takeshi Hiyaji<br>(18 GHz - 26.5 GHz) | Junya Okuno<br>(Below 1 GHz) |
| Mode                   | Tx 11n-20 2462 MHz                    |                                    |                                       |                              |



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

## 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                     | 06/28/2018            | 24      |
| RE        | MOS-15        | 141562  | Thermo-Hygrometer                 | CUSTOM                    | CTH-201                  | 0010                         | 01/07/2020            | 12      |
| RE        | MMM-10        | 141545  | DIGITAL HiTESTER                  | HIOKI                     | 3805                     | 51201148                     | 01/06/2020            | 12      |
| RE        | MJM-26        | 142227  | Measure                           | KOMELON                   | KMC-36                   | -                            | -                     | -       |
| RE        | COTS-MEMI-02  | 178648  | EMI measurement program           | TSJ                       | TEPTO-DV                 | -                            | -                     | -       |
| RE        | MAEC-04-SVSWR | 142017  | AC4_Semi Anechoic Chamber(SVSWR)  | TDK                       | Semi Anechoic Chamber 3m | DA-10005                     | 04/04/2019            | 24      |
| RE        | MHA-21        | 141508  | Horn Antenna 1-18GHz              | Schwarzbeck               | BBHA9120D                | 9120D-557                    | 09/26/2019            | 12      |
| RE        | MPA-12        | 141581  | MicroWave System Amplifier        | Keysight Technologies Inc | 83017A                   | 650                          | 10/16/2019            | 12      |
| RE        | MCC-141       | 141412  | Microwave Cable                   | Junkosha                  | MWX221                   | 1305S002R(1m) / 1405S146(5m) | 06/17/2019            | 12      |
| RE        | MHA-17        | 141506  | Horn Antenna 15-40GHz             | Schwarzbeck               | BBHA9170                 | BBHA9170307                  | 10/08/2019            | 12      |
| RE        | MHF-26        | 141296  | High Pass Filter 3.5-18.0GHz      | UL Japan                  | HPF SELECTOR             | 002                          | 09/11/2019            | 12      |
| RE        | MSA-15        | 141902  | Spectrum Analyzer                 | Keysight Technologies Inc | E4440A                   | MY46187105                   | 10/09/2019            | 12      |
| RE        | MCC-50        | 141397  | Coaxial Cable                     | UL Japan                  | -                        | -                            | 06/18/2019            | 12      |
| RE        | MPA-14        | 141583  | Pre Amplifier                     | SONOMA INSTRUMENT         | 310                      | 260833                       | 02/18/2020            | 12      |
| RE        | MTR-08        | 141949  | Test Receiver                     | Rohde & Schwarz           | ESCI                     | 100767                       | 08/02/2019            | 12      |
| RE        | MAT-34        | 141331  | Attenuator(6dB)                   | TME                       | UFA-01                   | -                            | 02/05/2020            | 12      |
| RE        | MBA-05        | 141425  | Biconical Antenna                 | Schwarzbeck               | VHA9103+ BBA9106         | 1302                         | 08/24/2019            | 12      |
| RE        | MLA-23        | 141267  | Logperiodic Antenna (200-1000MHz) | Schwarzbeck               | VUSLP9111B               | 9111B-192                    | 08/24/2019            | 12      |
| RE        | MAEC-03       | 142008  | AC3_Semi Anechoic Chamber(NSA)    | TDK                       | Semi Anechoic Chamber 3m | DA-10005                     | 06/26/2018            | 24      |
| RE        | MOS-13        | 141554  | Thermo-Hygrometer                 | CUSTOM                    | CTH-201                  | 1301                         | 01/07/2020            | 12      |
| RE        | MMM-08        | 141532  | DIGITAL HiTESTER                  | HIOKI                     | 3805                     | 51201197                     | 01/06/2020            | 12      |
| RE        | MJM-16        | 142183  | Measure                           | KOMELON                   | KMC-36                   | -                            | -                     | -       |
| RE        | MAT-95        | 142314  | Attenuator                        | Pasternack                | PE7390-6                 | D/C 1504                     | 06/11/2019            | 12      |
| RE        | MBA-03        | 141424  | Biconical Antenna                 | Schwarzbeck               | VHA9103+ BBA9106         | 1915                         | 08/24/2019            | 12      |
| RE        | MCC-51        | 141323  | Coaxial cable                     | UL Japan                  | -                        | -                            | 07/02/2019            | 12      |
| RE        | MLA-22        | 141266  | Logperiodic Antenna (200-1000MHz) | Schwarzbeck               | VUSLP9111B               | 9111B-191                    | 08/24/2019            | 12      |
| RE        | MPA-13        | 141582  | Pre Amplifier                     | SONOMA INSTRUMENT         | 310                      | 260834                       | 02/10/2020            | 12      |
| RE        | TR-08         | 146754  | Test Receiver                     | Rohde & Schwarz           | ESCI                     | 100299                       | 10/08/2019            | 12      |
| RE        | MSA-03        | 141884  | Spectrum Analyzer                 | Keysight Technologies Inc | E4448A                   | MY44020357                   | 03/13/2019            | 12      |

\*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 test

**UL Japan, Inc.**

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