



# **EMI TEST REPORT**

**Test Report No. : 14113269H-B**

**Applicant** : **DAIHATSU MOTOR CO., LTD.**  
**Type of EUT** : **Keyfree system**  
**Model Number of EUT** : **DH19C-1**  
**FCC ID** : **2AVSADH19C-1**  
**Test regulation** : **FCC Part 15 Subpart B: 2021**  
**Test Result** : **Complied (Refer to SECTION 3)**

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

**Date of test:** December 15 and 17, 2021

**Representative test engineer:**

Hiroki Numata  
Engineer

**Approved by:**

Tsubasa Takayama  
Leader



CERTIFICATE 5107.02

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

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## **REVISION HISTORY**

### **Original Test Report No.: 14113269H-B**

| Revision        | Test report No. | Date             | Page revised | Contents |
|-----------------|-----------------|------------------|--------------|----------|
| -<br>(Original) | 14113269H-B     | January 14, 2022 | -            | -        |

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

|                |                                                                 |                 |                                                                                |
|----------------|-----------------------------------------------------------------|-----------------|--------------------------------------------------------------------------------|
| A2LA           | The American Association for Laboratory Accreditation           | IEEE            | Institute of Electrical and Electronics Engineers                              |
| AAN            | Asymmetric Artificial Network                                   | IF              | Intermediate Frequency                                                         |
| AC             | Alternating Current                                             | ILAC            | International Laboratory Accreditation Conference                              |
| AM             | Amplitude Modulation                                            | ISED            | Innovation, Science and Economic Development Canada                            |
| AMN            | Artificial Mains Network                                        | ISN             | Impedance Stabilization Network                                                |
| Amp, AMP       | Amplifier                                                       | ISO             | International Organization for Standardization                                 |
| ANSI           | American National Standards Institute                           | JAB             | Japan Accreditation Board                                                      |
| Ant, ANT       | Antenna                                                         | LAN             | Local Area Network                                                             |
| AP             | Access Point                                                    | LCL             | Longitudinal Conversion Loss                                                   |
| ASK            | Amplitude Shift Keying                                          | LIMS            | Laboratory Information Management System                                       |
| Atten., ATT    | Attenuator                                                      | LISN            | Line Impedance Stabilization Network                                           |
| AV             | Average                                                         | MRA             | Mutual Recognition Arrangement                                                 |
| BPSK           | Binary Phase-Shift Keying                                       | N/A             | Not Applicable                                                                 |
| BR             | Bluetooth Basic Rate                                            | NIST            | National Institute of Standards and Technology                                 |
| BT             | Bluetooth                                                       | NS              | No signal detect.                                                              |
| BT LE          | Bluetooth Low Energy                                            | NSA             | Normalized Site Attenuation                                                    |
| BW             | BandWidth                                                       | OBW             | Occupied BandWidth                                                             |
| C.F            | Correction Factor                                               | OFDM            | Orthogonal Frequency Division Multiplexing                                     |
| Cal Int        | Calibration Interval                                            | PER             | Packet Error Rate                                                              |
| CAV            | CISPR AV                                                        | PK              | Peak                                                                           |
| CCK            | Complementary Code Keying                                       | P <sub>LT</sub> | long-term flicker severity                                                     |
| CDN            | Coupling Decoupling Network                                     | POHC(A)         | Partial Odd Harmonic Current                                                   |
| Ch., CH        | Channel                                                         | Pol., Pola.     | Polarization                                                                   |
| CISPR          | Comite International Special des Perturbations Radioelectriques | PR-ASK          | Phase Reversal ASK                                                             |
| Corr.          | Correction                                                      | P <sub>ST</sub> | short-term flicker severity                                                    |
| CPE            | Customer premise equipment                                      | QAM             | Quadrature Amplitude Modulation                                                |
| CW             | Continuous Wave                                                 | QP              | Quasi-Peak                                                                     |
| DBPSK          | Differential BPSK                                               | QPSK            | Quadrature Phase Shift Keying                                                  |
| DC             | Direct Current                                                  | r.m.s., RMS     | Root Mean Square                                                               |
| DET            | Detector                                                        | RBW             | Resolution BandWidth                                                           |
| D-factor       | Distance factor                                                 | RE              | Radio Equipment                                                                |
| Dmax           | maximum absolute voltage change during an observation period    | REV             | Reverse                                                                        |
| DQPSK          | Differential QPSK                                               | RF              | Radio Frequency                                                                |
| DSSS           | Direct Sequence Spread Spectrum                                 | RFID            | Radio Frequency Identifier                                                     |
| DUT            | Device Under Test                                               | RNSS            | Radio Navigation Satellite Service                                             |
| EDR            | Enhanced Data Rate                                              | RSS             | Radio Standards Specifications                                                 |
| e.i.r.p., EIRP | Equivalent Isotropically Radiated Power                         | Rx              | Receiving                                                                      |
| EM clamp       | Electromagnetic clamp                                           | SINAD           | Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)                 |
| EMC            | ElectroMagnetic Compatibility                                   | S/N             | Signal to Noise ratio                                                          |
| EMI            | ElectroMagnetic Interference                                    | SA, S/A         | Spectrum Analyzer                                                              |
| EMS            | ElectroMagnetic Susceptibility                                  | SG              | Signal Generator                                                               |
| EN             | European Norm                                                   | SVSWR           | Site-Voltage Standing Wave Ratio                                               |
| e.r.p., ERP    | Effective Radiated Power                                        | THC(A)          | Total Harmonic Current                                                         |
| ETSI           | European Telecommunications Standards Institute                 | THD(%)          | Total Harmonic Distortion                                                      |
| EU             | European Union                                                  | TR, T/R         | Test Receiver                                                                  |
| EUT            | Equipment Under Test                                            | Tx              | Transmitting                                                                   |
| Fac.           | Factor                                                          | VBW             | Video BandWidth                                                                |
| FCC            | Federal Communications Commission                               | Vert.           | Vertical                                                                       |
| FHSS           | Frequency Hopping Spread Spectrum                               | WLAN            | Wireless LAN                                                                   |
| FM             | Frequency Modulation                                            | xDSL            | Generic term for all types of DSL technology<br>(DSL: Digital Subscriber Line) |
| Freq.          | Frequency                                                       |                 |                                                                                |
| FSK            | Frequency Shift Keying                                          |                 |                                                                                |
| Fund           | Fundamental                                                     |                 |                                                                                |
| FWD            | Forward                                                         |                 |                                                                                |
| GFSK           | Gaussian Frequency-Shift Keying                                 |                 |                                                                                |
| GNSS           | Global Navigation Satellite System                              |                 |                                                                                |
| GPS            | Global Positioning System                                       |                 |                                                                                |
| Hori.          | Horizontal                                                      |                 |                                                                                |
| ICES           | Interference-Causing Equipment Standard                         |                 |                                                                                |
| I/O            | Input/Output                                                    |                 |                                                                                |
| IEC            | International Electrotechnical Commission                       |                 |                                                                                |

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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 Emission.....</b>                             | <b>13</b>   |
| <b>APPENDIX 1: Test data .....</b>                                   | <b>15</b>   |
| Radiated Emission .....                                              | 15          |
| <b>APPENDIX 2: Test instruments .....</b>                            | <b>19</b>   |
| <b>APPENDIX 3: Photographs of test setup .....</b>                   | <b>20</b>   |
| Radiated Emission .....                                              | 20          |
| Worst Case Position.....                                             | 24          |

## **SECTION 1: Customer information**

|                  |   |                                                    |
|------------------|---|----------------------------------------------------|
| Company Name     | : | DAIHATSU MOTOR CO., LTD.*                          |
| Address          | : | 2-1-1, Momozono, Ikeda-shi, Osaka, 563-8651, Japan |
| Telephone Number | : | +81-72-754-5619                                    |
| Contact Person   | : | Kouji Ozawa                                        |

### **\*Remarks:**

DAIHATSU MOTOR CO., LTD. designates DENSO CORPORATION as manufacturer of the product (Keyfree system).

The information provided from the customer is as follows;

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

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

## **SECTION 2: Equipment under test (EUT)**

### **2.1 Identification of EUT**

|               |   |                                                                                           |
|---------------|---|-------------------------------------------------------------------------------------------|
| Type          | : | Keyfree system                                                                            |
| Model Number  | : | DH19C-1                                                                                   |
| Serial Number | : | Refer to SECTION 4.2                                                                      |
| Receipt Date  | : | November 29, 2021                                                                         |
| 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: DH19C-1 (referred to as the EUT in this report) is a Keyfree system.

### **General Specification**

|                           |   |                                                                                     |
|---------------------------|---|-------------------------------------------------------------------------------------|
| Rating                    | : | System:<br>DC 12.0 V<br>Internal:<br>DC 12.0 V (Transmitter)<br>DC 5.0 V (Receiver) |
| Clock Frequency (maximum) | : | 8 MHz (CPU)                                                                         |

### **Radio Specification**

#### [Transmitter part]

|                        |   |                                                                                                                                                                                               |
|------------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Radio Type             | : | LF Transmitter                                                                                                                                                                                |
| Frequency of Operation | : | 125 kHz                                                                                                                                                                                       |
| Oscillator frequency   | : | 4.0000 MHz (Ceramic)                                                                                                                                                                          |
| Modulation             | : | ASK (A1D)                                                                                                                                                                                     |
| Antenna type           | : | LF Antenna (Outside Antenna D)<br>LF Antenna (Outside Antenna P)<br>LF Antenna (Outside Antenna B)<br>LF Antenna (Inside Antenna Fr)<br>LF Antenna (Inside Antenna Rr)<br>Immobilizer Antenna |
| Antenna Specification  | : | LF antenna: Ferrite antenna coil<br>Immobilizer antenna: Loop antenna coil                                                                                                                    |

#### [Receiver part]

|                          |   |                                           |
|--------------------------|---|-------------------------------------------|
| Frequency of Operation   | : | 433.92 MHz (Keyfree)<br>433.90 MHz (TPMS) |
| Oscillator frequency     | : | 33.6 MHz (Crystal)                        |
| Intermediate frequency   | : | 525 kHz (Keyfree)<br>1.05 MHz (TPMS)      |
| Modulation               | : | FSK (F1D)                                 |
| Type of receiving system | : | Super-heterodyne                          |
| Antenna Specification    | : | Internal antenna (Inverted F antenna)     |

## SECTION 3: Test specification, procedures & results

### 3.1 Test Specification

Test Specification : FCC Part 15 Subpart B  
 FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021  
 Title : FCC 47CFR Part15 Radio Frequency Device  
 Subpart B Unintentional Radiators

### 3.2 Procedures and results

| Item                                                                                                                                                                                                                                                                                                                                                                      | Test Procedure                                                                                           | Limits                                  | Deviation | Worst margin                                           | Result      | Remarks |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------|--------------------------------------------------------|-------------|---------|
| Conducted emission                                                                                                                                                                                                                                                                                                                                                        | <b>FCC:</b> ANSI C63.4: 2014 + C63.4a: 2017<br>7. AC power - line conducted emission measurements        | <b>FCC:</b> Part 15 Subpart B 15.107(a) | N/A       | N/A                                                    | N/A         | *1)     |
|                                                                                                                                                                                                                                                                                                                                                                           | <b>ISED:</b> RSS-Gen 7.1                                                                                 | <b>ISED:</b> RSS-Gen 7.2                |           |                                                        |             |         |
| Radiated emission                                                                                                                                                                                                                                                                                                                                                         | <b>FCC:</b> ANSI C63.4: 2014 + C63.4a: 2017<br>8. Radiated emission measurements                         | <b>FCC:</b> Part 15 Subpart B 15.109(a) | N/A       | 15.94 dB<br>432.850 MHz,<br>Horizontal, QP<br><Mode 2> | Complied a) | -       |
|                                                                                                                                                                                                                                                                                                                                                                           | <b>ISED:</b> RSS-Gen 7.1                                                                                 | <b>ISED:</b> RSS-Gen 7.3                |           |                                                        |             |         |
| Antenna Terminal                                                                                                                                                                                                                                                                                                                                                          | <b>FCC:</b> ANSI C63.4: 2014 + C63.4a: 2017<br>12. Measurement of unintentional radiators other than ITE | <b>FCC:</b> Part 15 Subpart B 15.111(a) | N/A       | N/A                                                    | N/A         | *2)     |
|                                                                                                                                                                                                                                                                                                                                                                           | <b>ISED:</b> - RSS-Gen 7.1                                                                               | <b>ISED:</b> RSS-Gen 7.4                |           |                                                        |             |         |
| *Note: UL Japan, Inc’s EMI Work Procedure 13-EM-W0420.<br>*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.<br>*2) The receiving antenna (of this EUT) is installed inside the EUT and cannot be removed (permanently attached).<br>Therefore, Radiated emission test was performed. |                                                                                                          |                                         |           |                                                        |             |         |
| a) Refer to APPENDIX 1 (data of Radiated Emission)                                                                                                                                                                                                                                                                                                                        |                                                                                                          |                                         |           |                                                        |             |         |
| Symbols:<br>Complied                    The data of this test item has enough margin, more than the measurement uncertainty.<br>Complied#                   The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.                                                                                                   |                                                                                                          |                                         |           |                                                        |             |         |

### 3.3 Addition to standard

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

### 3.4 Uncertainty

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

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

#### Radiated emission

| Measurement distance | Frequency range                  | Uncertainty (+/-) |
|----------------------|----------------------------------|-------------------|
| 3 m                  | 30 MHz to 200 MHz (Horizontal)   | 4.8 dB            |
|                      | (Vertical)                       | 5.0 dB            |
|                      | 200 MHz to 1000 MHz (Horizontal) | 5.2 dB            |
|                      | (Vertical)                       | 6.3 dB            |
| 10 m                 | 30 MHz to 200 MHz (Horizontal)   | 4.8 dB            |
|                      | (Vertical)                       | 4.8 dB            |
|                      | 200 MHz to 1000 MHz (Horizontal) | 5.0 dB            |
|                      | (Vertical)                       | 5.0 dB            |
|                      |                                  |                   |
| 3 m                  | 1 GHz to 6 GHz                   | 4.9 dB            |
|                      | 6 GHz to 18 GHz                  | 5.2 dB            |
| 1 m                  | 10 GHz to 26.5 GHz               | 5.5 dB            |
|                      | 26.5 GHz to 40 GHz               | 5.5 dB            |
| 0.5 m                | 26.5 GHz to 40 GHz               | 5.5 dB            |
| 10 m                 | 1 GHz to 18 GHz                  | 5.2 dB            |

### 3.5 Test Location

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\*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919

ISED Lab Company Number: 2973C / CAB identifier: JP0002

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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.10 shielded room        | 3.8 x 2.8 x 2.8            | 3.8 x 2.8                                                        | -                      | -                            |
| No.11 measurement room     | 4.0 x 3.4 x 2.5            | N/A                                                              | -                      | -                            |
| No.12 measurement room     | 2.6 x 3.4 x 2.5            | N/A                                                              | -                      | -                            |

### 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)**

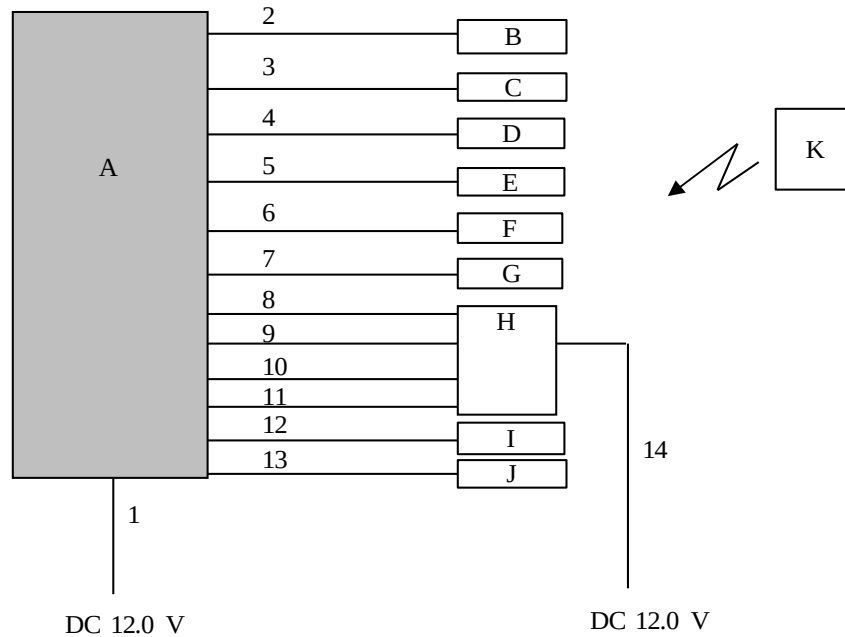
| Mode                                                                                | Remarks |
|-------------------------------------------------------------------------------------|---------|
| 1) RKE Receiving mode                                                               | -       |
| 2) TPMS Receiving mode                                                              |         |
| * EUT was set by the software as follows;<br>Software: DN-2390005080-04.S Version - |         |

\*The test signal level was confirmed to be sufficient to stabilize the local oscillator of the EUT.

\* It was confirmed by using checker that the EUT receives the signal from the transmitter (pair of EUT).

## 4.2 Configuration and peripherals

### Mode 1



\* 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   | Body ECU         | DH19C-1             | No.237        | DENSO CORPORATION    | EUT     |
| B   | Antenna          | Outside Antenna D   | No.237-1      | TOKAI RIKI CO., LTD. | -       |
| C   | Antenna          | Outside Antenna P   | No.237-2      | TOKAI RIKI CO., LTD. | -       |
| D   | Antenna          | Outside Antenna B   | No.237-3      | TOKAI RIKI CO., LTD. | -       |
| E   | Antenna          | Inside Antenna Fr   | No.237-4      | TOKAI RIKI CO., LTD. | -       |
| F   | Antenna          | Inside Antenna Rr   | No.237-5      | TOKAI RIKI CO., LTD. | -       |
| G   | Antenna          | Immobilizer Antenna | No.237        | TOKAI RIKI CO., LTD. | -       |
| H   | Evaluation Bench | -                   | 7             | DENSO CORPORATION    | -       |
| I   | LED              | -                   | -             | DENSO CORPORATION    | -       |
| J   | LED              | -                   | -             | DENSO CORPORATION    | -       |
| K   | Smart Key        | -                   | 237           | DENSO CORPORATION    | -       |

### List of cables used

| No. | Name                | Length (m) | Shield     |            | Remarks |
|-----|---------------------|------------|------------|------------|---------|
|     |                     |            | Cable      | Connector  |         |
| 1   | DC Cable            | 3.0        | Unshielded | Unshielded | -       |
| 2   | Antenna Cable (AND) | 3.0        | Unshielded | Unshielded | -       |
| 3   | Antenna Cable (ANP) | 3.0        | Unshielded | Unshielded | -       |
| 4   | Antenna Cable (ANB) | 3.0        | Unshielded | Unshielded | -       |
| 5   | Antenna Cable (ANF) | 3.0        | Unshielded | Unshielded | -       |
| 6   | Antenna Cable (ANR) | 3.0        | Unshielded | Unshielded | -       |
| 7   | Antenna Cable       | 3.0        | Unshielded | Unshielded | -       |
| 8   | Signal Cable (CN-C) | 3.0        | Unshielded | Unshielded | -       |
| 9   | Signal Cable (CN-K) | 3.0        | Unshielded | Unshielded | -       |
| 10  | Signal Cable (CN-M) | 3.0        | Unshielded | Unshielded | -       |
| 11  | Signal Cable (CN-P) | 3.0        | Unshielded | Unshielded | -       |
| 12  | Signal Cable        | 0.5        | Unshielded | Unshielded | -       |
| 13  | Signal Cable        | 0.5        | Unshielded | Unshielded | -       |
| 14  | DC Cable            | 3.0        | Unshielded | Unshielded | -       |

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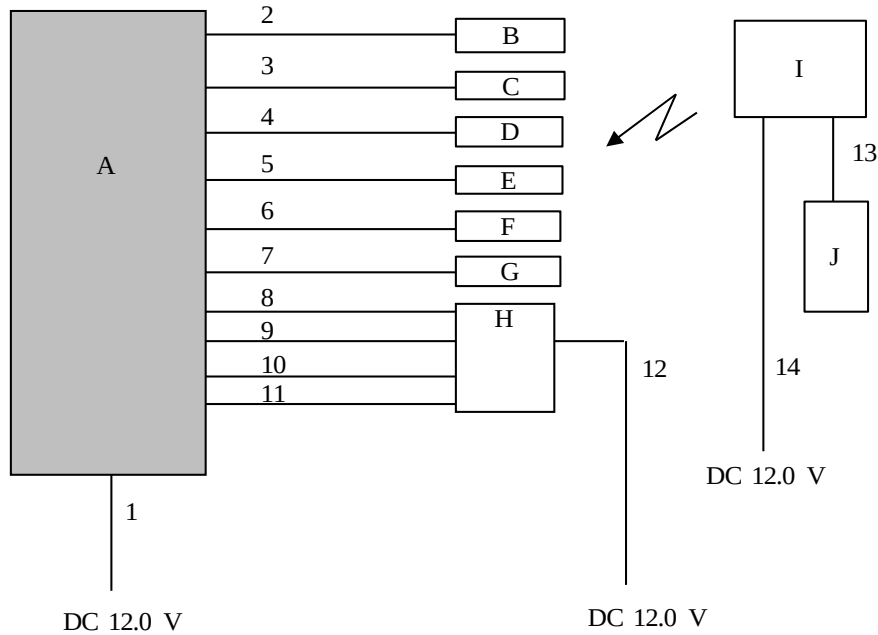
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## Mode 2



\* 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   | Body ECU         | DH19C-1             | No.237        | DENSO CORPORATION     | EUT     |
| B   | Antenna          | Outside Antenna D   | No.237-1      | TOKAI RIKAI CO., LTD. | -       |
| C   | Antenna          | Outside Antenna P   | No.237-2      | TOKAI RIKAI CO., LTD. | -       |
| D   | Antenna          | Outside Antenna B   | No.237 -3     | TOKAI RIKAI CO., LTD. | -       |
| E   | Antenna          | Inside Antenna Fr   | No.237-4      | TOKAI RIKAI CO., LTD. | -       |
| F   | Antenna          | Inside Antenna Rr   | No.237-5      | TOKAI RIKAI CO., LTD. | -       |
| G   | Antenna          | Immobilizer Antenna | No.237        | TOKAI RIKAI CO., LTD. | -       |
| H   | Evaluation Bench | -                   | 7             | DENSO CORPORATION     | -       |
| I   | TPMS bench       | -                   | 7             | -                     | -       |
| J   | TPMS Antenna     | -                   | -             | -                     | -       |

### List of cables used

| No. | Name                | Length (m) | Shield     |            | Remarks |
|-----|---------------------|------------|------------|------------|---------|
|     |                     |            | Cable      | Connector  |         |
| 1   | DC Cable            | 3.0        | Unshielded | Unshielded | -       |
| 2   | Antenna Cable (AND) | 3.0        | Unshielded | Unshielded | -       |
| 3   | Antenna Cable (ANP) | 3.0        | Unshielded | Unshielded | -       |
| 4   | Antenna Cable (ANB) | 3.0        | Unshielded | Unshielded | -       |
| 5   | Antenna Cable (ANF) | 3.0        | Unshielded | Unshielded | -       |
| 6   | Antenna Cable (ANR) | 3.0        | Unshielded | Unshielded | -       |
| 7   | Antenna Cable       | 3.0        | Unshielded | Unshielded | -       |
| 8   | Signal Cable (CN-C) | 3.0        | Unshielded | Unshielded | -       |
| 9   | Signal Cable (CN-K) | 3.0        | Unshielded | Unshielded | -       |
| 10  | Signal Cable (CN-M) | 3.0        | Unshielded | Unshielded | -       |
| 11  | Signal Cable (CN-P) | 3.0        | Unshielded | Unshielded | -       |
| 12  | DC Cable            | 3.0        | Unshielded | Unshielded | -       |
| 13  | Signal Cable        | 1.0        | Shielded   | Shielded   | -       |
| 14  | DC Cable            | 0.7        | Unshielded | Unshielded | -       |

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

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## **SECTION 5: Radiated Emission**

### **5.1. Operating environment**

Test place : No.4 semi anechoic chamber  
Temperature : See data  
Humidity : See data

### **5.2. Test configuration**

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.

The EUT was set on the edge of the tabletop.

Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength.

Photographs of the set up are shown in Appendix 3.

### **5.3. Test conditions**

Frequency range : 30 MHz - 200 MHz (Biconical antenna) / 200 MHz - 1000 MHz (Logperiodic antenna)  
1000 MHz - 2000 MHz (Horn antenna)  
Test distance : 3 m  
EUT position : Table top  
EUT operation mode : See Clause 4.1

### **5.4. Test procedure**

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

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The radiated emission measurements were made with the following detector function of the Test Receiver and the Spectrum Analyzer.

For above 1 GHz, 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.

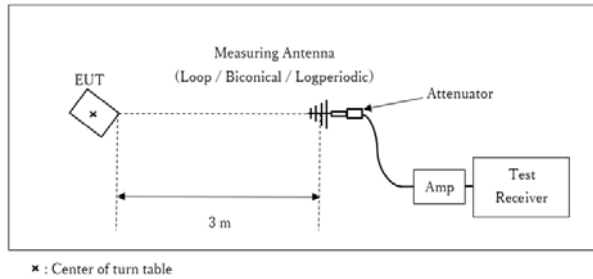
|                 |                |                             |
|-----------------|----------------|-----------------------------|
| Frequency       | Below 1GHz     | Above 1GHz *1)              |
| Instrument used | Test Receiver  | Test Receiver               |
| IF Bandwidth    | QP: BW 120 kHz | PK: BW 1 MHz, CAV: BW 1 MHz |

\*1) The measurement data was adjusted to a 3 m distance using the following Distance Factor.

Distance Factor: See Figure 2.

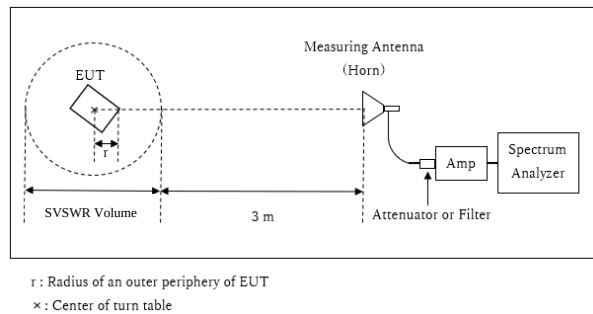
**Figure 1: Test Setup**

Below 1 GHz



Test Distance: 3 m

1 GHz - 2 GHz



Distance Factor:  $20 \times \log(3.40 \text{ m}^*/3.0 \text{ m}) = 1.09 \text{ dB}$   
 \* Test Distance:  $(3 + \text{SVSWR Volume} / 2) - r = 3.40 \text{ m}$

SVSWR Volume: 2 m  
 (SVSWR Volume has been calibrated based on CISPR 16-1-4.)  
 $r = 0.6 \text{ m}$

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

## 5.5. Test result

Summary of the test results: Pass

The limit is rounded down to one decimal place.

The test result is rounded off to one or two decimal places, so some differences might be observed.

Date: December 15, 2021  
 December 17, 2021

Test engineer:

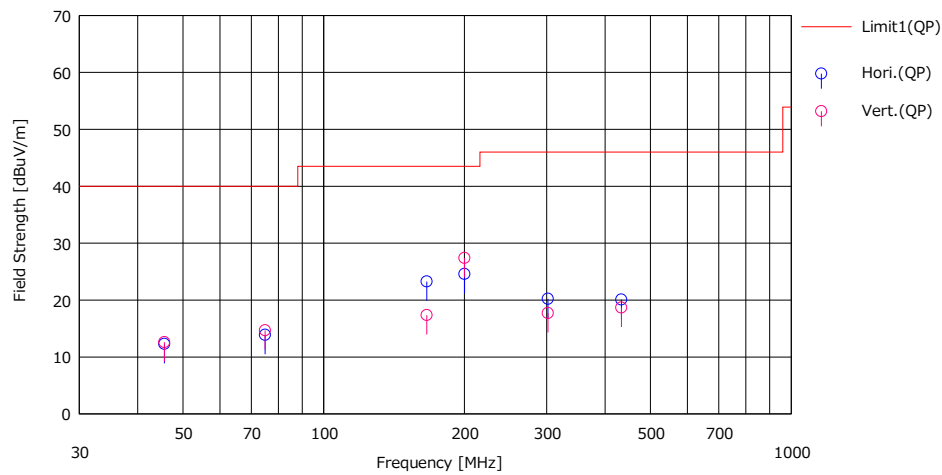
Hiroki Numata  
 Junki Nagatomi

## APPENDIX 1: Test data

### Radiated Emission

Report No. 14113269H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.4  
Date December 15, 2021  
Temperature / Humidity 21 deg. C / 42 % RH  
Engineer Hiroki Numata  
(Below 1 GHz)  
Mode Mode 1

Limit : FCC\_Part 15 Subpart B(15.109)\_Class B



| No. | Freq.<br>[MHz] | Reading<br>(QP)<br>[dBuV] | Ant.Fac<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>(QP)<br>[dBuV/m] | Limit<br>(QP)<br>[dBuV/m] | Margin<br>(QP)<br>[dB] | Pola<br>(H/V) | Height<br>[cm] | Angle<br>(deg) | Ant.<br>Type | Comment |
|-----|----------------|---------------------------|-------------------|--------------|--------------|----------------------------|---------------------------|------------------------|---------------|----------------|----------------|--------------|---------|
| 1   | 45.660         | 31.00                     | 12.77             | 7.24         | 38.72        | 12.29                      | 40.00                     | 27.71                  | Hori.         | 113            | 359            | BA           |         |
| 2   | 74.964         | 38.60                     | 6.46              | 7.60         | 38.79        | 13.87                      | 40.00                     | 26.13                  | Hori.         | 230            | 359            | BA           |         |
| 3   | 166.224        | 38.00                     | 15.70             | 8.43         | 38.88        | 23.25                      | 43.50                     | 20.25                  | Hori.         | 142            | 24             | BA           |         |
| 4   | 200.200        | 43.10                     | 11.68             | 8.69         | 38.89        | 24.58                      | 43.50                     | 18.92                  | Hori.         | 100            | 180            | LA23         |         |
| 5   | 301.870        | 35.70                     | 13.73             | 9.42         | 38.65        | 20.20                      | 46.00                     | 25.80                  | Hori.         | 100            | 124            | LA23         |         |
| 6   | 433.395        | 31.80                     | 16.34             | 10.28        | 38.35        | 20.07                      | 46.00                     | 25.93                  | Hori.         | 100            | 354            | LA23         |         |
| 7   | 45.660         | 31.30                     | 12.77             | 7.24         | 38.72        | 12.59                      | 40.00                     | 27.41                  | Vert.         | 145            | 235            | BA           |         |
| 8   | 74.964         | 39.40                     | 6.46              | 7.60         | 38.79        | 14.67                      | 40.00                     | 25.33                  | Vert.         | 146            | 229            | BA           |         |
| 9   | 166.224        | 32.10                     | 15.70             | 8.43         | 38.88        | 17.35                      | 43.50                     | 26.15                  | Vert.         | 100            | 345            | BA           |         |
| 10  | 200.200        | 45.90                     | 11.68             | 8.69         | 38.89        | 27.38                      | 43.50                     | 16.12                  | Vert.         | 100            | 182            | LA23         |         |
| 11  | 301.870        | 33.20                     | 13.73             | 9.42         | 38.65        | 17.70                      | 46.00                     | 28.30                  | Vert.         | 100            | 258            | LA23         |         |
| 12  | 433.395        | 30.40                     | 16.34             | 10.28        | 38.35        | 18.67                      | 46.00                     | 27.33                  | Vert.         | 100            | 312            | LA23         |         |

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)

Except for the above table: adequate margin data below the limits.

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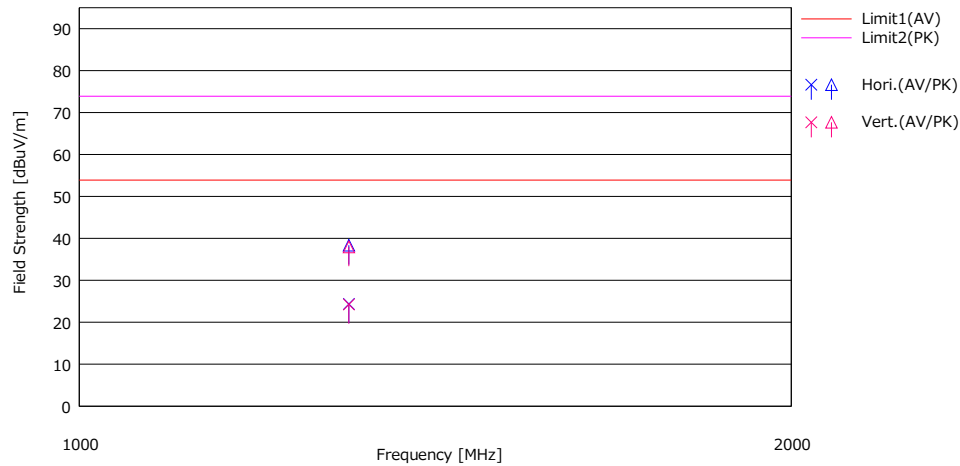
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Radiated Emission

Report No. 14113269H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.4  
Date December 17, 2021  
Temperature / Humidity 21 deg. C / 41 % RH  
Engineer Junki Nagatomi  
(Above 1 GHz)  
Mode Mode 1

Limit : FCC\_Part 15 Subpart B(15.109)\_Class B



| No. | Freq.<br>[MHz] | Reading        |                | Ant Fac<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result           |                  | Limit            |                  | Margin       |              | Pola<br>[H/V] | Height<br>[cm] | Angle<br>[deg] | Ant.<br>Type | Comment |
|-----|----------------|----------------|----------------|-------------------|--------------|--------------|------------------|------------------|------------------|------------------|--------------|--------------|---------------|----------------|----------------|--------------|---------|
|     |                | (AV)<br>[dBuV] | (PK)<br>[dBuV] |                   |              |              | (AV)<br>[dBuV/m] | (PK)<br>[dBuV/m] | (AV)<br>[dBuV/m] | (PK)<br>[dBuV/m] | (AV)<br>[dB] | (PK)<br>[dB] |               |                |                |              |         |
| 1   | 1300.219       | 30.00          | 44.00          | 25.39             | 2.80         | 33.83        | 24.36            | 38.36            | 53.90            | 73.90            | 29.54        | 35.54        | Hori.         | 100            | 0              | H21          |         |
| 2   | 1300.219       | 29.90          | 43.60          | 25.39             | 2.80         | 33.83        | 24.26            | 37.96            | 53.90            | 73.90            | 29.64        | 35.94        | Vert.         | 100            | 0              | H21          |         |

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)

Except for the above table: adequate margin data below the limits.

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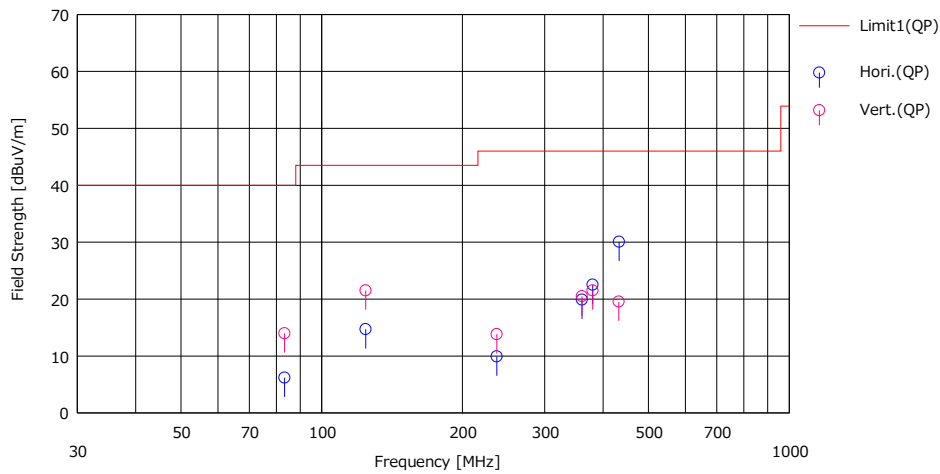
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## Radiated Emission

Report No. 14113269H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.4  
Date December 15, 2021  
Temperature / Humidity 21 deg. C / 42 % RH  
Engineer Hiroki Numata  
(Below 1 GHz)  
Mode Mode 2

Limit : FCC\_Part 15 Subpart B(15.109)\_Class B



| No. | Freq.<br>[MHz] | Reading<br>(QP) | Ant.Fac<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>(QP) | Limit<br>(QP) | Margn.<br>(QP) | Pola<br>[H/V] | Height<br>[cm] | Angle<br>[deg] | Ant.<br>Type | Comment |
|-----|----------------|-----------------|-------------------|--------------|--------------|----------------|---------------|----------------|---------------|----------------|----------------|--------------|---------|
|     |                | [dBuV]          |                   |              |              | [dBuV/m]       | [dBuV/m]      | [dB]           |               |                |                |              |         |
| 1   | 83.304         | 29.90           | 7.40              | 7.69         | 38.81        | 6.18           | 40.00         | 33.82          | Hori.         | 239            | 7              | BA           |         |
| 2   | 124.204        | 32.20           | 13.29             | 8.07         | 38.86        | 14.70          | 43.50         | 28.80          | Hori.         | 156            | 359            | BA           |         |
| 3   | 236.840        | 28.00           | 11.75             | 8.96         | 38.79        | 9.92           | 46.00         | 36.08          | Hori.         | 224            | 0              | LA23         |         |
| 4   | 360.484        | 33.40           | 15.17             | 9.81         | 38.49        | 19.89          | 46.00         | 26.11          | Hori.         | 250            | 193            | LA23         |         |
| 5   | 379.917        | 35.70           | 15.31             | 9.93         | 38.44        | 22.50          | 46.00         | 23.50          | Hori.         | 151            | 172            | LA23         |         |
| 6   | 432.850        | 41.80           | 16.34             | 10.27        | 38.35        | 30.06          | 46.00         | 15.94          | Hori.         | 100            | 193            | LA23         |         |
| 7   | 83.304         | 37.70           | 7.40              | 7.69         | 38.81        | 13.98          | 40.00         | 26.02          | Vert.         | 116            | 2              | BA           |         |
| 8   | 124.204        | 39.00           | 13.29             | 8.07         | 38.86        | 21.50          | 43.50         | 22.00          | Vert.         | 100            | 272            | BA           |         |
| 9   | 236.840        | 31.90           | 11.75             | 8.96         | 38.79        | 13.82          | 46.00         | 32.18          | Vert.         | 100            | 331            | LA23         |         |
| 10  | 360.484        | 34.00           | 15.17             | 9.81         | 38.49        | 20.49          | 46.00         | 25.51          | Vert.         | 100            | 250            | LA23         |         |
| 11  | 379.917        | 34.70           | 15.31             | 9.93         | 38.44        | 21.50          | 46.00         | 24.50          | Vert.         | 117            | 226            | LA23         |         |
| 12  | 432.178        | 31.30           | 16.33             | 10.27        | 38.35        | 19.55          | 46.00         | 26.45          | Vert.         | 133            | 262            | LA23         |         |

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)

Except for the above table: adequate margin data below the limits.

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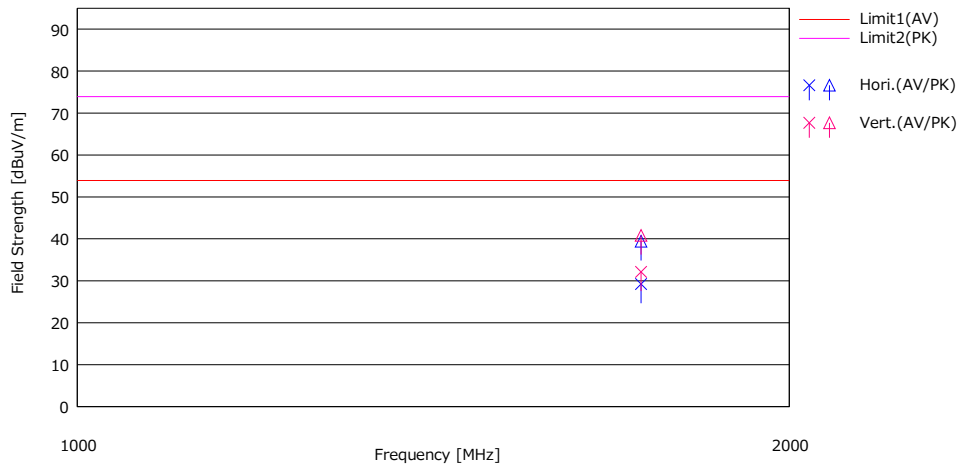
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## Radiated Emission

Report No. 14113269H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.4  
Date December 17, 2021  
Temperature / Humidity 21 deg. C / 41 % RH  
Engineer Junki Nagatomi  
(Above 1 GHz)  
Mode Mode 2

Limit : FCC\_Part 15 Subpart B(15.109)\_Class B



| No. | Freq.<br>[MHz] | Reading        |                | Ant.Fac<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result           |                  | Limit            |                  | Margin       |              | Pola.<br>[H/V] | Height<br>[cm] | Angle<br>[deg] | Ant.<br>Type | Comment |
|-----|----------------|----------------|----------------|-------------------|--------------|--------------|------------------|------------------|------------------|------------------|--------------|--------------|----------------|----------------|----------------|--------------|---------|
|     |                | (AV)<br>[dBuV] | (PK)<br>[dBuV] |                   |              |              | (AV)<br>[dBuV/m] | (PK)<br>[dBuV/m] | (AV)<br>[dBuV/m] | (PK)<br>[dBuV/m] | (AV)<br>[dB] | (PK)<br>[dB] |                |                |                |              |         |
| 1   | 1731.394       | 33.80          | 44.00          | 25.02             | 3.08         | 32.67        | 29.23            | 39.43            | 53.90            | 73.90            | 24.67        | 34.47        | Hori.          | 100            | 232            | H21          |         |
| 2   | 1731.394       | 36.70          | 45.40          | 25.02             | 3.08         | 32.67        | 32.13            | 40.83            | 53.90            | 73.90            | 21.77        | 33.07        | Vert.          | 100            | 158            | H21          |         |

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)

Except for the above table: adequate margin data below the limits.

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## APPENDIX 2: Test instruments

### Test equipment

| Test Item | Local ID      | LIMS ID | Description                       | Manufacturer                    | Model                            | Serial                    | Last Calibration Date | Cal Int |
|-----------|---------------|---------|-----------------------------------|---------------------------------|----------------------------------|---------------------------|-----------------------|---------|
| RE        | MAEC-04       | 142011  | AC4_Semi Anechoic Chamber(NSA)    | TDK                             | Semi Anechoic Chamber 3m         | DA-10005                  | 05/25/2020            | 24      |
| RE        | MOS-15        | 141562  | Thermo-Hygrometer                 | CUSTOM. Inc                     | CTH-201                          | 0010                      | 01/15/2021            | 12      |
| RE        | MMM-10        | 141545  | DIGITAL HiTESTER                  | HIOKI E.E. CORPORATION          | 3805                             | 51201148                  | 01/07/2021            | 12      |
| RE        | MJM-29        | 142230  | Measure                           | KOMELON                         | KMC-36                           | -                         | -                     | -       |
| RE        | COTS-MEMI-02  | 178648  | EMI measurement program           | TSJ (Techno Science Japan)      | TEPTO-DV                         | -                         | -                     | -       |
| RE        | MAEC-04-SVSWR | 142017  | AC4_Semi Anechoic Chamber(SVSWR)  | TDK                             | Semi Anechoic Chamber 3m         | DA-10005                  | 04/12/2021            | 24      |
| RE        | MHA-21        | 141508  | Horn Antenna 1-18GHz              | Schwarzbeck Mess-Elektronik OHG | BBHA9120D                        | 557                       | 05/10/2021            | 12      |
| RE        | MPA-12        | 141581  | MicroWave System Amplifier        | Keysight Technologies Inc       | 83017A                           | 00650                     | 10/07/2021            | 12      |
| RE        | MCC-257       | 208936  | Microwave Cable                   | Huber+Suhner                    | SF126E/11PC35/11PC35/1000M,5000M | 537061/126E / 537076/126E | 07/18/2021            | 12      |
| RE        | MSA-03        | 141884  | Spectrum Analyzer                 | Keysight Technologies Inc       | E4448A                           | MY44020357                | 03/10/2021            | 12      |
| RE        | MTR-03        | 141942  | Test Receiver                     | Rohde & Schwarz                 | ESCI                             | 100300                    | 08/05/2021            | 12      |
| RE        | MAT-34        | 141331  | Attenuator(6dB)                   | TME                             | UFA-01                           | -                         | 02/02/2021            | 12      |
| RE        | MBA-05        | 141425  | Biconical Antenna                 | Schwarzbeck Mess-Elektronik OHG | VHA9103+BBA9106                  | VHA 91031302              | 08/28/2021            | 12      |
| RE        | MCC-50        | 141397  | Coaxial Cable                     | UL Japan                        | -                                | -                         | 11/03/2021            | 12      |
| RE        | MLA-23        | 141267  | Logperiodic Antenna (200-1000MHz) | Schwarzbeck Mess-Elektronik OHG | VUSLP9111B                       | 9111B-192                 | 08/28/2021            | 12      |
| RE        | MPA-19        | 141585  | Pre Amplifier                     | MITEQ                           | MLA-10K01-B01-35                 | 1237616                   | 02/18/2021            | 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

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