



# **RADIO TEST REPORT**

**Test Report No. : 13487461H-A-R1**

**Applicant** : NIDEC MOBILITY CORPORATION  
**Type of EUT** : ECU of Keyless Operation System  
**Model Number of EUT** : R515E  
**FCC ID** : OUCR515E  
**Test regulation** : FCC Part 15 Subpart C: 2020  
**Test Result** : Complied (Refer to SECTION 3.2)

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in Section 1.
10. This report is a revised version of 13487461H-A. 13487461H-A is replaced with this report.

**Date of test:**

September 4, 2020

**Representative test engineer:**

*Ken Fujita*

Ken Fujita

Engineer

Consumer Technology Division

**Approved by:**

*S. Miyazono*

Shinichi Miyazono

Engineer

Consumer Technology Division



CERTIFICATE 5107.02

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

**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

## REVISION HISTORY

**Original Test Report No.: 13487461H-A**

| Revision                                 | Test report No. | Date              | Page revised  | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
|------------------------------------------|-----------------|-------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|--|--|--|-----|------|--------------|---------------|---|-----|-------|----|---|---------------|--------------|----------|---|---------------|--------------|----------|---|----------------|--------------|----------|---|----------------|--------------|----------|---|----------------|--------------|----------|------------------------------------------|--|--|--|-----|------|--------------|---------------|---|-----|-------|-----|---|---------------|--------------|----------|---|---------------|--------------|----------|---|----------------|--------------|----------|---|----------------|--------------|-----------|---|----------------|--------------|-----------|
| -<br>(Original)                          | 13487461H-A     | October 13, 2020  | -             | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| 1                                        | 13487461H-A-R1  | November 26, 2020 | P.6           | Addition of “Type of Modulation: ASK” in Smart System: LF Transmitting function of Clause 2.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| 1                                        | 13487461H-A-R1  | November 26, 2020 | P.11          | Correction of the following table in Clause 4.2;<br>From<br><table><tr><th colspan="4">Description of EUT and Support equipment</th></tr><tr><th>No.</th><th>Item</th><th>Model number</th><th>Serial number</th></tr><tr><td>A</td><td>ECU</td><td>R515E</td><td>14</td></tr><tr><td>B</td><td>LF Antenna DR</td><td>CGF-M004-T04</td><td>8637C166</td></tr><tr><td>C</td><td>LF Antenna AS</td><td>CGF-M004-T04</td><td>8637C166</td></tr><tr><td>D</td><td>LF Antenna INF</td><td>CGF-M004-T04</td><td>8637C166</td></tr><tr><td>E</td><td>LF Antenna INR</td><td>CGF-M004-T04</td><td>8637C166</td></tr><tr><td>F</td><td>LF Antenna T/G</td><td>CGF-M004-T04</td><td>8637C166</td></tr></table><br>To<br><table><tr><th colspan="4">Description of EUT and Support equipment</th></tr><tr><th>No.</th><th>Item</th><th>Model number</th><th>Serial number</th></tr><tr><td>A</td><td>KOS</td><td>R515E</td><td>#14</td></tr><tr><td>B</td><td>LF Antenna DR</td><td>CGF-M004-T03</td><td>200826-7</td></tr><tr><td>C</td><td>LF Antenna AS</td><td>CGF-M004-T03</td><td>200826-8</td></tr><tr><td>D</td><td>LF Antenna INF</td><td>CGF-M004-T03</td><td>200826-9</td></tr><tr><td>E</td><td>LF Antenna INR</td><td>CGF-M004-T03</td><td>200826-10</td></tr><tr><td>F</td><td>LF Antenna T/G</td><td>CGF-M004-T04</td><td>200826-11</td></tr></table> | Description of EUT and Support equipment |  |  |  | No. | Item | Model number | Serial number | A | ECU | R515E | 14 | B | LF Antenna DR | CGF-M004-T04 | 8637C166 | C | LF Antenna AS | CGF-M004-T04 | 8637C166 | D | LF Antenna INF | CGF-M004-T04 | 8637C166 | E | LF Antenna INR | CGF-M004-T04 | 8637C166 | F | LF Antenna T/G | CGF-M004-T04 | 8637C166 | Description of EUT and Support equipment |  |  |  | No. | Item | Model number | Serial number | A | KOS | R515E | #14 | B | LF Antenna DR | CGF-M004-T03 | 200826-7 | C | LF Antenna AS | CGF-M004-T03 | 200826-8 | D | LF Antenna INF | CGF-M004-T03 | 200826-9 | E | LF Antenna INR | CGF-M004-T03 | 200826-10 | F | LF Antenna T/G | CGF-M004-T04 | 200826-11 |
| Description of EUT and Support equipment |                 |                   |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| No.                                      | Item            | Model number      | Serial number |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| A                                        | ECU             | R515E             | 14            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| B                                        | LF Antenna DR   | CGF-M004-T04      | 8637C166      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| C                                        | LF Antenna AS   | CGF-M004-T04      | 8637C166      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| D                                        | LF Antenna INF  | CGF-M004-T04      | 8637C166      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| E                                        | LF Antenna INR  | CGF-M004-T04      | 8637C166      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| F                                        | LF Antenna T/G  | CGF-M004-T04      | 8637C166      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| Description of EUT and Support equipment |                 |                   |               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| No.                                      | Item            | Model number      | Serial number |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| A                                        | KOS             | R515E             | #14           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| B                                        | LF Antenna DR   | CGF-M004-T03      | 200826-7      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| C                                        | LF Antenna AS   | CGF-M004-T03      | 200826-8      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| D                                        | LF Antenna INF  | CGF-M004-T03      | 200826-9      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| E                                        | LF Antenna INR  | CGF-M004-T03      | 200826-10     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| F                                        | LF Antenna T/G  | CGF-M004-T04      | 200826-11     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |
| 1                                        | 13487461H-A-R1  | November 26, 2020 | P.11          | Correction of No.7 cable name in the cable list of Clause 4.2;<br>From Antenna Cable to Signal Cable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                          |  |  |  |     |      |              |               |   |     |       |    |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |          |   |                |              |          |                                          |  |  |  |     |      |              |               |   |     |       |     |   |               |              |          |   |               |              |          |   |                |              |          |   |                |              |           |   |                |              |           |

**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

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

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

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

| <b>CONTENTS</b>                                                          | <b>PAGE</b> |
|--------------------------------------------------------------------------|-------------|
| SECTION 1: Customer information .....                                    | 5           |
| SECTION 2: Equipment under test (EUT).....                               | 5           |
| SECTION 3: Test specification, procedures & results .....                | 7           |
| SECTION 4: Operation of EUT during testing.....                          | 10          |
| SECTION 5: Radiated emission (Fundamental and Spurious Emission) .....   | 12          |
| SECTION 6: -26 dB Bandwidth.....                                         | 15          |
| SECTION 7: 99 % Occupied Bandwidth.....                                  | 15          |
| APPENDIX 1: Test data .....                                              | 16          |
| Radiated Emission below 30 MHz (Fundamental and Spurious Emission) ..... | 16          |
| Radiated Emission above 30 MHz (Spurious Emission).....                  | 18          |
| -26 dB Bandwidth and 99 % Occupied Bandwidth .....                       | 21          |
| APPENDIX 2: Test instruments .....                                       | 22          |
| APPENDIX 3: Photographs of test setup .....                              | 23          |
| Radiated Emission.....                                                   | 23          |
| Worst Case Position .....                                                | 24          |

## **SECTION 1: Customer information**

|                  |   |                                                           |
|------------------|---|-----------------------------------------------------------|
| Company Name     | : | NIDEC MOBILITY CORPORATION                                |
| Address          | : | 6368, Nenjo-zaka, Okusa, Komaki-city, Aichi 485-802 Japan |
| Telephone Number | : | +81-568-78-6159                                           |
| Facsimile Number | : | +81-568-78-7659                                           |
| Contact Person   | : | Kazushi Yamasaki                                          |

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                       | : | ECU of Keyless Operation System |
| Model Number               | : | R515E                           |
| Serial Number              | : | Refer to SECTION 4.2            |
| Rating                     | : | DC 12.0 V                       |
| Receipt Date               | : | August 28, 2020                 |
| Country of Mass-production | : | China                           |
| Condition                  | : | Production model                |
| Modification               | : | No Modification by the test lab |

### **2.2 Product Description**

Model No: R515E, (referred to as the EUT in this report), is the ECU of Keyless Operation System. Keyless Operation System has the following radio functions: Immobilizer system and Smart System (LF Transmitting / UHF Receiving).

#### **General Specification**

|                           |   |                          |
|---------------------------|---|--------------------------|
| Clock frequency (maximum) | : | UHF: 21.948717 MHz       |
| Operating Temperature     | : | -40 deg. C to +85 deg. C |

## **Radio Specification**

### **Immobilizer system function**

Equipment Type : Transceiver  
Frequency of Operation : 125 kHz  
Type of Modulation : ASK  
Antenna Type : Coil Antenna

### **Smart System: LF Transmitting function**

Equipment Type : Transmitter  
Frequency of Operation : 125 kHz  
Type of Modulation : ASK  
Antenna Type : Coil Antenna

### **Smart System: UHF Receiving function \***

Type of Receiver : Super Heterodyne  
Receiving Frequency : 433.92 MHz  
Oscillator Frequency : 21.948717 MHz  
Local Oscillator Frequency : 434.194 MHz  
Intermediate Frequency : 274 kHz  
Antenna Type :  $\lambda/4$  Monopole Antenna

\*The test of this function was performed separately from this test report, and the conformability is confirmed.

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

#### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C  
FCC Part 15 final revised on June 26, 2020 and effective July 27, 2020

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators  
Section 15.207 Conducted limits  
Section 15.209 Radiated emission limits; general requirements.

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

#### **3.2 Procedures and results**

| Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Test Procedure                                                                           | Specification                                                   | Remarks  | Deviation | Worst margin                                                          | Results        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------------------|----------|-----------|-----------------------------------------------------------------------|----------------|
| Conducted Emission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <FCC><br>ANSI C63.10:2013<br>6 Standard test methods<br><ISED><br>RSS-Gen 8.8            | <FCC><br>Section 15.207<br><ISED><br>RSS-Gen 8.8                | -        | N/A       | N/A                                                                   | N/A<br>*1)     |
| Electric Field Strength of Fundamental Emission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <FCC><br>ANSI C63.10:2013<br>6 Standard test methods<br><ISED><br>RSS-Gen 6.5, 6.12      | <FCC><br>Section 15.209<br><ISED><br>RSS-210 7.2<br>RSS-Gen 8.9 | Radiated | N/A       | 5.9 dB<br>125 kHz, 0 deg.<br>Peak with Duty factor<br><LF Antenna DR> | Complied<br>a) |
| Electric Field Strength of Spurious Emission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <FCC><br>ANSI C63.10:2013<br>6 Standard test methods<br><ISED><br>RSS-Gen 6.5, 6.6, 6.13 | <FCC><br>Section 15.209<br><ISED><br>RSS-210 7.3<br>RSS-Gen 8.9 | Radiated | N/A       | 15.4 dB<br>30.960 MHz,<br>Vertical, QP<br><LF Antenna DR>             | Complied<br>a) |
| -26 dB Bandwidth                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <FCC><br>ANSI C63.10:2013<br>6 Standard test methods<br><ISED><br>-                      | <FCC><br>Reference data<br><ISED><br>-                          | Radiated | N/A       | N/A                                                                   | Complied<br>b) |
| Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.<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>a) Refer to APPENDIX 1 (data of Radiated emission)<br>b) Refer to APPENDIX 1 (data of -26 dB Bandwidth)<br>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. |                                                                                          |                                                                 |          |           |                                                                       |                |

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

The test was performed with the New Battery and the EUT constantly provides the stable voltage to RF part through the regulator regardless of input voltage from New Battery. Therefore, this 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.

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

### 3.3 Addition to standard

| Item                     | Test Procedure | Specification | Remarks  | Deviation | Worst margin | Results |
|--------------------------|----------------|---------------|----------|-----------|--------------|---------|
| 99 % Occupied Band Width | RSS-Gen 6.7    | -             | Radiated | N/A       | N/A          | -       |

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

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

### 3.4 Uncertainty

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

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

#### Radiated emission

| Measurement distance | Frequency range                  | Uncertainty (+/-) |
|----------------------|----------------------------------|-------------------|
| 3 m                  | 9 kHz to 30 MHz                  | 3.3 dB            |
| 10 m                 |                                  | 3.2 dB            |
| 3 m                  | 30 MHz to 200 MHz (Horizontal)   | 4.8 dB            |
|                      |                                  | 5.0 dB            |
|                      | 200 MHz to 1000 MHz (Horizontal) | 5.2 dB            |
|                      |                                  | 6.3 dB            |
| 10 m                 | 30 MHz to 200 MHz (Horizontal)   | 4.8 dB            |
|                      |                                  | 4.8 dB            |
|                      | 200 MHz to 1000 MHz (Horizontal) | 5.0 dB            |
|                      |                                  | 5.0 dB            |

#### Antenna Terminal test

| Test Item                                  | Uncertainty (+/-) |
|--------------------------------------------|-------------------|
| -26 dB Bandwidth / 99 % Occupied Bandwidth | 0.96 %            |

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

\*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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

Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

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

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

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

Refer to APPENDIX.

**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

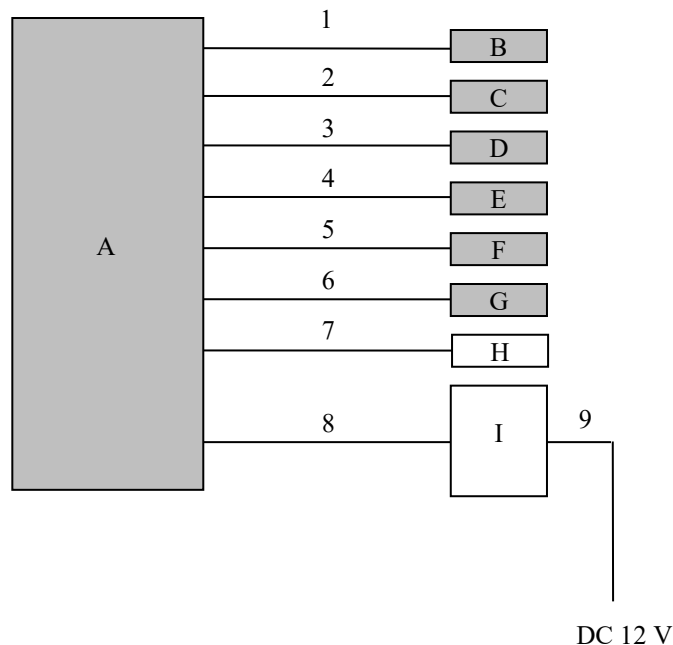
## SECTION 4: Operation of EUT during testing

### 4.1 Operating Modes

| Test mode                                                                                                                                                                                                                                                                                                                                                                                         | Remarks |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 1) Transmitting mode (Tx) 125 kHz                                                                                                                                                                                                                                                                                                                                                                 | -       |
| <p>* EUT was set by the software as follows;<br/> Software: Radio_Law_Certification_EU Version 35 FC E1<br/> (Date: 2013/10/10, Storage location: EUT memory)</p> <p>*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.</p> |         |

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

### 4.2 Configuration and peripherals



- \* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.
- \* The EUT does not transmit simultaneously from multiple antennas.
- \* Antenna was evaluated with the worst duty respectively.
- \* The EUT was set to transmit the data continuously from one antenna as a worst case, not to transmit it randomly from each antenna.
- \* The each carrier level of the five antennas (DR, AS, INF, INR, T/G) was compared at the pre-check.  
As a result, all the tests were performed with the LF Antenna DR as representative, which had the worst result.

#### Description of EUT and Support equipment

| No. | Item              | Model number  | Serial number | Manufacturer               | Remarks |
|-----|-------------------|---------------|---------------|----------------------------|---------|
| A   | KOS               | R515E         | #14           | NIDEC MOBILITY CORPORATION | EUT     |
| B   | LF Antenna DR     | CGF-M004-T03  | 200826-7      | NIDEC MOBILITY CORPORATION | EUT     |
| C   | LF Antenna AS     | CGF-M004-T03  | 200826-8      | NIDEC MOBILITY CORPORATION | EUT     |
| D   | LF Antenna INF    | CGF-M004-T03  | 200826-9      | NIDEC MOBILITY CORPORATION | EUT     |
| E   | LF Antenna INR    | CGF-M004-T03  | 200826-10     | NIDEC MOBILITY CORPORATION | EUT     |
| F   | LF Antenna T/G    | CGF-M004-T04  | 200826-11     | NIDEC MOBILITY CORPORATION | EUT     |
| G   | FOB BOX           | C8Z-F116M-K-T | 3718747       | NIDEC MOBILITY CORPORATION | EUT     |
| H   | Push Start Switch | C8N-B100M-Z   | CA541389      | NIDEC MOBILITY CORPORATION | -       |
| I   | Jig               | -             | -             | NIDEC MOBILITY CORPORATION | -       |

#### List of cables used

| No. | Name              | Length (m) | Shield     |            | Remark |
|-----|-------------------|------------|------------|------------|--------|
|     |                   |            | Cable      | Connector  |        |
| 1   | Antenna Cable     | 2.3        | Unshielded | Unshielded | -      |
| 2   | Antenna Cable     | 2.3        | Unshielded | Unshielded | -      |
| 3   | Antenna Cable     | 2.3        | Unshielded | Unshielded | -      |
| 4   | Antenna Cable     | 2.3        | Unshielded | Unshielded | -      |
| 5   | Antenna Cable     | 2.3        | Unshielded | Unshielded | -      |
| 6   | Antenna Cable     | 2.3        | Unshielded | Unshielded | -      |
| 7   | Signal Cable      | 2.3        | Unshielded | Unshielded | -      |
| 8   | DC & Signal Cable | 3.0        | Unshielded | Unshielded | -      |
| 9   | DC Cable          | 3.0        | Unshielded | Unshielded | -      |

**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

## SECTION 5: Radiated emission (Fundamental and Spurious Emission)

### Test Procedure

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.

Frequency : From 9 kHz to 30 MHz

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

The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg., and 135 deg.) and horizontal polarization.

\*Refer to Figure 1 about Direction of the Loop Antenna.

Frequency: From 30 MHz to 1 GHz

The measuring antenna height 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.

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

| Frequency       | From 9 kHz to 90 kHz and From 110 kHz to 150 kHz | From 90 kHz to 110 kHz | From 150 kHz to 490 kHz | From 490 kHz to 30 MHz | From 30 MHz to 1 GHz |
|-----------------|--------------------------------------------------|------------------------|-------------------------|------------------------|----------------------|
| Instrument used | Test Receiver                                    |                        |                         |                        |                      |
| Detector        | PK / AV                                          | QP                     | PK / AV                 | QP                     | QP                   |
| IF Bandwidth    | 200 Hz                                           | 200 Hz                 | 9 kHz                   | 9 kHz                  | 120 kHz              |
| Test Distance   | 3 m *1)                                          | 3 m *1)                | 3 m *1)                 | 3 m *2)                | 3 m                  |

\*1) Distance Factor:  $40 \times \log(3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

\*2) Distance Factor:  $40 \times \log(3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

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

However test results were confirmed to pass against standard limit.

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to  $45.5 - 51.5 = -6.0 \text{ dBuA/m}$ , which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

**UL Japan, Inc.**

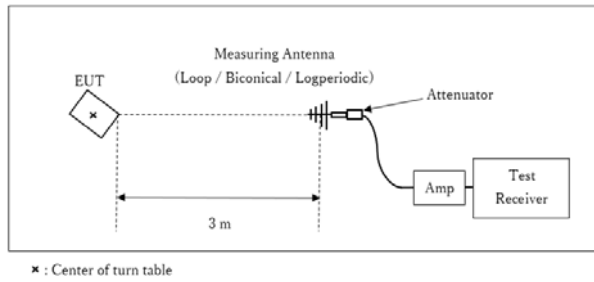
**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

[Test Setup]  
Below 1 GHz



Test Distance: 3 m

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

This EUT has two modes which mechanical key is inserted or not. The worst case was confirmed with and without mechanical key, as a result, the test without mechanical key was the worst case. Therefore, the test without mechanical key was performed only.

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

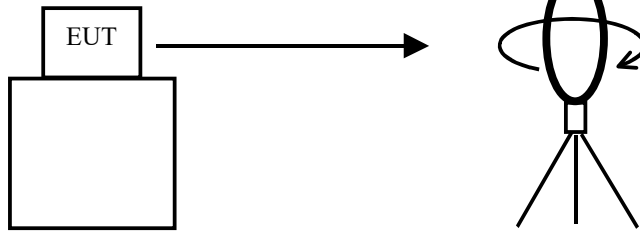
**Measurement range** : 9 kHz - 1 GHz  
**Test data** : APPENDIX 1  
**Test result** : Pass

Date: September 4, 2020

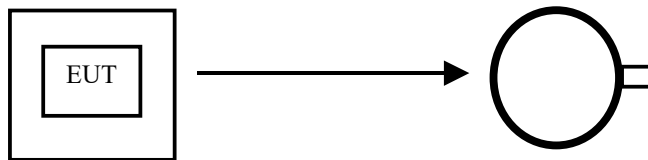
Test engineer: Ken Fujita

**Figure 1: Direction of the Loop Antenna**

*Side View (Vertical)*



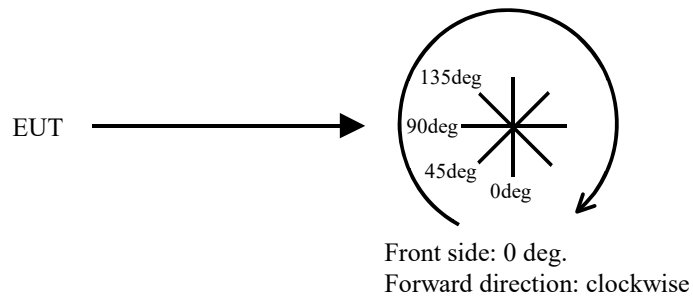
*Top View (Horizontal)*



Antenna was not rotated.

---

*Top View (Vertical)*



## **SECTION 6: -26 dB Bandwidth**

### **Test Procedure**

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

<LF Antenna DR>

| Test             | Span  | RBW  | VBW  | Sweep | Detector | Trace    | Instrument used   |
|------------------|-------|------|------|-------|----------|----------|-------------------|
| -26 dB Bandwidth | 1 kHz | 1 Hz | 3 Hz | Auto  | Peak     | Max Hold | Spectrum Analyzer |

<FOB BOX>

| Test             | Span  | RBW   | VBW   | Sweep | Detector | Trace    | Instrument used   |
|------------------|-------|-------|-------|-------|----------|----------|-------------------|
| -26 dB Bandwidth | 1 kHz | 9.1Hz | 27 Hz | Auto  | Peak     | Max Hold | Spectrum Analyzer |

Test data : APPENDIX 1

Test result : Pass

## **SECTION 7: 99 % Occupied Bandwidth**

### **Test Procedure**

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

| Test                    | Span                                    | RBW             | VBW                | Sweep | Detector | Trace        | Instrument used   |
|-------------------------|-----------------------------------------|-----------------|--------------------|-------|----------|--------------|-------------------|
| 99 % Occupied Bandwidth | Enough width to display emission skirts | 1 to 5 % of OBW | Three times of RBW | Auto  | Peak *1) | Max Hold *1) | Spectrum Analyzer |

\*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %.  
Peak hold was applied as Worst-case measurement.

Test data : APPENDIX 1

Test result : Pass

## APPENDIX 1: Test data

### Radiated Emission below 30 MHz (Fundamental and Spurious Emission) <LF Antenna DR>

Report No. 13487461H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date September 4, 2020  
Temperature / Humidity 22 deg. C / 47 % RH  
Engineer Ken Fujita  
Mode Mode 1

#### PK or QP

| Ant Deg [deg]<br>or<br>Polarity [Hori/Vert] | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|---------------------------------------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0deg                                        | 0.12500            | PK       | 106.5             | 19.4                    | -74.0        | 32.3         | -                      | 19.7               | 45.6              | 25.9           | Fundamental |
| 0deg                                        | 0.25000            | PK       | 66.0              | 19.5                    | -73.9        | 32.3         | -                      | -20.8              | 39.6              | 60.4           |             |
| 0deg                                        | 0.37500            | PK       | 56.1              | 19.5                    | -73.9        | 32.3         | -                      | -30.6              | 36.1              | 66.7           |             |
| 0deg                                        | 0.50000            | QP       | 38.9              | 19.4                    | -33.9        | 32.2         | -                      | -7.8               | 33.6              | 41.4           |             |
| 0deg                                        | 0.62500            | QP       | 44.1              | 19.4                    | -33.9        | 32.2         | -                      | -2.6               | 31.7              | 34.3           |             |
| 0deg                                        | 0.75000            | QP       | 31.4              | 19.4                    | -33.8        | 32.2         | -                      | -15.3              | 30.1              | 45.4           |             |
| 0deg                                        | 0.87500            | QP       | 38.9              | 19.4                    | -33.8        | 32.2         | -                      | -7.7               | 28.7              | 36.4           |             |
| 0deg                                        | 1.00000            | QP       | 31.0              | 19.5                    | -33.8        | 32.2         | -                      | -15.6              | 27.6              | 43.2           |             |
| 0deg                                        | 1.12500            | QP       | 36.2              | 19.5                    | -33.8        | 32.2         | -                      | -10.4              | 26.5              | 36.9           |             |
| 0deg                                        | 1.25000            | QP       | 30.7              | 19.5                    | -33.8        | 32.2         | -                      | -15.8              | 25.6              | 41.4           |             |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier)

#### PK with Duty factor

| Ant Deg [deg] | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|--------|
| 0deg          | 0.12500            | PK       | 106.5             | 19.4                    | -74.0        | 32.3         | 0.0                    | 19.7               | 25.6              | 5.9            |        |
| 0deg          | 0.25000            | PK       | 66.0              | 19.5                    | -73.9        | 32.3         | 0.0                    | -20.8              | 19.6              | 40.4           |        |
| 0deg          | 0.37500            | PK       | 56.1              | 19.5                    | -73.9        | 32.3         | 0.0                    | -30.6              | 16.1              | 46.7           |        |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor \*

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

#### Result of the fundamental emission at 3m without Distance factor

##### PK or QP

| Ant Deg [deg] | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark      |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-------------------|----------------|-------------|
| 0deg          | 0.12500            | PK       | 106.5             | 19.4                    | 6.0          | 32.3         | -                      | 99.7               | -                 | -              | Fundamental |

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

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

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

UL Japan, Inc.

Ise EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

**Radiated Emission below 30 MHz (Fundamental and Spurious Emission)**  
**<FOB BOX>**

Report No. 13487461H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date September 4, 2020  
Temperature / Humidity 22 deg. C / 47 % RH  
Engineer Ken Fujita  
Mode Mode 1

**PK or QP**

| Ant Deg [deg]<br>or<br>Polarity [Hori/Vert] | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>dBuV/m | Margin<br>[dB] | Remark      |
|---------------------------------------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-----------------|----------------|-------------|
| 0deg                                        | 0.12500            | PK       | 91.6              | 19.4                    | -74.0        | 32.3         | -                      | 4.8                | 45.6            | 40.8           | Fundamental |
| 0deg                                        | 0.25000            | PK       | 71.7              | 19.5                    | -73.9        | 32.3         | -                      | -15.1              | 39.6            | 54.7           |             |
| 0deg                                        | 0.37500            | PK       | 57.5              | 19.5                    | -73.9        | 32.3         | -                      | -29.2              | 36.1            | 65.3           |             |
| 0deg                                        | 0.50000            | QP       | 32.2              | 19.4                    | -33.9        | 32.2         | -                      | -14.5              | 33.6            | 48.1           |             |
| 0deg                                        | 0.62500            | QP       | 45.7              | 19.4                    | -33.9        | 32.2         | -                      | -1.0               | 31.7            | 32.7           |             |
| 0deg                                        | 0.75000            | QP       | 39.8              | 19.4                    | -33.8        | 32.2         | -                      | -6.9               | 30.1            | 37.0           |             |
| 0deg                                        | 0.87500            | QP       | 41.0              | 19.4                    | -33.8        | 32.2         | -                      | -5.6               | 28.7            | 34.3           |             |
| 0deg                                        | 1.00000            | QP       | 30.8              | 19.5                    | -33.8        | 32.2         | -                      | -15.8              | 27.6            | 43.4           |             |
| 0deg                                        | 1.12500            | QP       | 37.4              | 19.5                    | -33.8        | 32.2         | -                      | -9.2               | 26.5            | 35.7           |             |
| 0deg                                        | 1.25000            | QP       | 33.5              | 19.5                    | -33.8        | 32.2         | -                      | -13.0              | 25.6            | 38.6           |             |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier)

**PK with Duty factor**

| Ant Deg [deg] | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>dBuV/m | Margin<br>[dB] | Remark |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-----------------|----------------|--------|
| 0deg          | 0.12500            | PK       | 91.6              | 19.4                    | -74.0        | 32.3         | 0.0                    | 4.8                | 25.6            | 20.8           |        |
| 0deg          | 0.25000            | PK       | 71.7              | 19.5                    | -73.9        | 32.3         | 0.0                    | -15.1              | 19.6            | 34.7           |        |
| 0deg          | 0.37500            | PK       | 57.5              | 19.5                    | -73.9        | 32.3         | 0.0                    | -29.2              | 16.1            | 45.3           |        |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor \*

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

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

| Ant Deg [deg] | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Duty<br>Factor<br>[dB] | Result<br>[dBuV/m] | Limit<br>dBuV/m | Margin<br>[dB] | Remark      |
|---------------|--------------------|----------|-------------------|-------------------------|--------------|--------------|------------------------|--------------------|-----------------|----------------|-------------|
| 0deg          | 0.12500            | PK       | 91.6              | 19.4                    | 6.0          | 32.3         | -                      | 84.8               | -               | -              | Fundamental |

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

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

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

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

**Radiated Emission above 30 MHz (Spurious Emission)**  
**<LF Antenna DR>**

Report No. 13487461H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date September 4, 2020  
Temperature / Humidity 22 deg. C / 47 % RH  
Engineer Ken Fujita  
Mode Mode 1

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|--------|
| Hori.    | 30.960             | QP       | 22.3              | 18.2               | 7.0          | 28.6         | 18.9               | 40.0              | 21.1           |        |
| Hori.    | 34.056             | QP       | 23.7              | 17.0               | 7.1          | 28.6         | 19.1               | 40.0              | 20.9           |        |
| Hori.    | 121.599            | QP       | 21.6              | 12.9               | 8.2          | 28.4         | 14.3               | 43.5              | 29.2           |        |
| Hori.    | 211.268            | QP       | 21.2              | 11.1               | 9.1          | 28.0         | 13.4               | 43.5              | 30.1           |        |
| Hori.    | 309.427            | QP       | 22.3              | 13.9               | 9.9          | 27.9         | 18.2               | 46.0              | 27.8           |        |
| Hori.    | 608.452            | QP       | 22.5              | 19.4               | 11.6         | 29.4         | 24.1               | 46.0              | 21.9           |        |
| Vert.    | 30.960             | QP       | 28.0              | 18.2               | 7.0          | 28.6         | 24.6               | 40.0              | 15.4           |        |
| Vert.    | 34.056             | QP       | 26.6              | 17.0               | 7.1          | 28.6         | 22.0               | 40.0              | 18.0           |        |
| Vert.    | 121.599            | QP       | 21.5              | 12.9               | 8.2          | 28.4         | 14.2               | 43.5              | 29.3           |        |
| Vert.    | 211.268            | QP       | 22.3              | 11.1               | 9.1          | 28.0         | 14.5               | 43.5              | 29.0           |        |
| Vert.    | 309.427            | QP       | 23.0              | 13.9               | 9.9          | 27.9         | 18.9               | 46.0              | 27.1           |        |
| Vert.    | 608.452            | QP       | 22.7              | 19.4               | 11.6         | 29.4         | 24.3               | 46.0              | 21.7           |        |

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

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

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

**Radiated Emission above 30 MHz (Spurious Emission)**  
**<FOB BOX>**

Report No. 13487461H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date September 4, 2020  
Temperature / Humidity 22 deg. C / 47 % RH  
Engineer Ken Fujita  
Mode Mode 1

| Polarity | Frequency<br>[MHz] | Detector | Reading<br>[dBuV] | Ant.Fac.<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Remark |
|----------|--------------------|----------|-------------------|--------------------|--------------|--------------|--------------------|-------------------|----------------|--------|
| Hori.    | 30.651             | QP       | 24.1              | 18.3               | 7.0          | 28.6         | 20.8               | 40.0              | 19.2           |        |
| Hori.    | 33.957             | QP       | 23.6              | 17.0               | 7.1          | 28.6         | 19.1               | 40.0              | 20.9           |        |
| Hori.    | 67.273             | QP       | 23.2              | 6.4                | 7.6          | 28.6         | 8.6                | 40.0              | 31.4           |        |
| Hori.    | 130.449            | QP       | 23.8              | 13.6               | 8.3          | 28.4         | 17.3               | 43.5              | 26.2           |        |
| Hori.    | 293.910            | QP       | 25.6              | 13.6               | 9.7          | 27.8         | 21.1               | 46.0              | 24.9           |        |
| Hori.    | 719.778            | QP       | 21.8              | 20.1               | 12.1         | 29.3         | 24.8               | 46.0              | 21.3           |        |
| Vert.    | 30.651             | QP       | 24.3              | 18.3               | 7.0          | 28.6         | 21.0               | 40.0              | 19.0           |        |
| Vert.    | 33.957             | QP       | 23.5              | 17.0               | 7.1          | 28.6         | 19.0               | 40.0              | 21.0           |        |
| Vert.    | 67.273             | QP       | 23.4              | 6.4                | 7.6          | 28.6         | 8.8                | 40.0              | 31.2           |        |
| Vert.    | 130.449            | QP       | 23.0              | 13.6               | 8.3          | 28.4         | 16.5               | 43.5              | 27.0           |        |
| Vert.    | 293.910            | QP       | 24.8              | 13.6               | 9.7          | 27.8         | 20.3               | 46.0              | 25.7           |        |
| Vert.    | 719.778            | QP       | 21.7              | 20.1               | 12.1         | 29.3         | 24.7               | 46.0              | 21.4           |        |

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

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

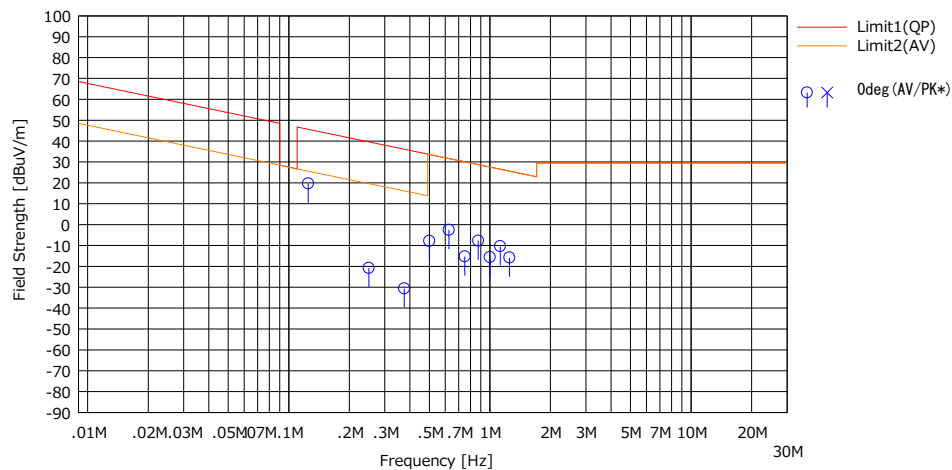
\*The test result is rounded off to one or two decimal places, so some differences might be observed.

**Radiated Emission Plot data, Worst case**  
**<LF Antenna DR>**

Report No. 13487461H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date September 4, 2020  
Temperature / Humidity 22 deg. C / 47 % RH  
Engineer Ken Fujita  
Mode Mode 1

**(below 30MHz)**

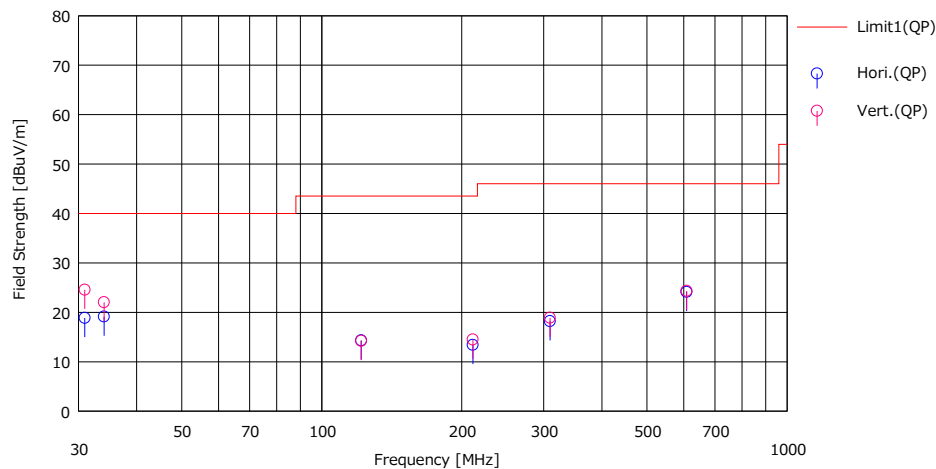
Limit : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



\* Data above 490 kHz were measured using a QP detector.

**(above 30MHz)**

Limit : FCC15.209 3 m, below 1 GHz:QP, above 1 GHz:AV/PK



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

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

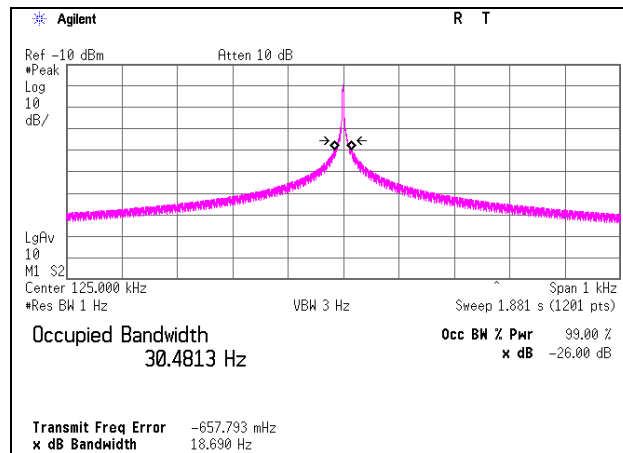
Facsimile : +81 596 24 8124

## -26 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 13487461H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.2  
Date September 4, 2020  
Temperature / Humidity 22 deg. C / 47 % RH  
Engineer Ken Fujita  
Mode Mode 1

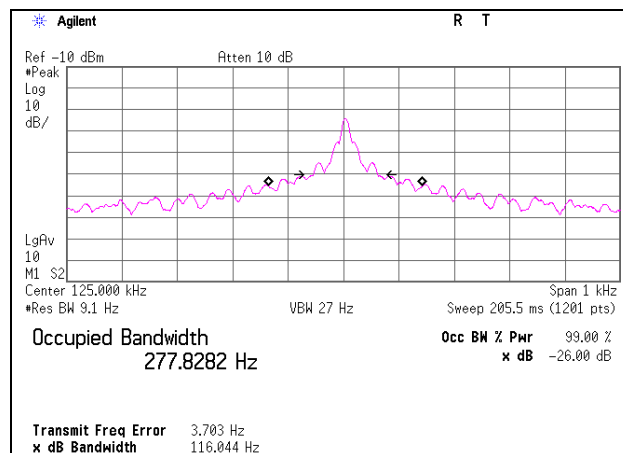
### <LF Antenna DR>

| -26 dB Bandwidth<br>[Hz] | 99 % Occupied Bandwidth<br>[Hz] |
|--------------------------|---------------------------------|
| 18.690                   | 30.4813                         |



### <FOB BOX>

| -26 dB Bandwidth<br>[Hz] | 99 % Occupied Bandwidth<br>[Hz] |
|--------------------------|---------------------------------|
| 116.044                  | 277.8282                        |



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

## **APPENDIX 2: Test instruments**

### **Test equipment**

| Test Item | Local ID     | LIMS ID | Description                      | Manufacturer                  | Model                    | Serial     | Last Calibration Date | Cal Int |
|-----------|--------------|---------|----------------------------------|-------------------------------|--------------------------|------------|-----------------------|---------|
| RE        | MAEC-02      | 142004  | AC2_Semi Anechoic Chamber(NSA)   | TDK                           | Semi Anechoic Chamber 3m | DA-06902   | 05/26/2020            | 24      |
| RE        | MOS-41       | 192300  | Thermo-Hygrometer                | CUSTOM. Inc                   | CTH-201                  | 0013       | 12/19/2019            | 12      |
| RE        | MMM-01       | 141542  | Digital Tester                   | Fluke Corporation             | FLUKE 26-3               | 78030611   | 08/18/2020            | 12      |
| RE        | MJM-27       | 142228  | Measure                          | KOMELON                       | KMC-36                   | -          | -                     | -       |
| RE        | COTS-MEMI-02 | 178648  | EMI measurement program          | TSJ (Techno Science Japan)    | TEPTO-DV                 | -          | -                     | -       |
| RE        | MAT-07       | 141203  | Attenuator(6dB)                  | Weinschel Corp                | 2                        | BK7970     | 11/07/2019            | 12      |
| RE        | MBA-08       | 141427  | Biconical Antenna                | Schwarzbeck Mess - Elektronik | VHA9103B+BBA9106         | 8031       | 07/29/2020            | 12      |
| RE        | MCC-12       | 141317  | Coaxial Cable                    | UL Japan Inc.                 | -                        | -          | 09/03/2019            | 12      |
| RE        | MLA-21       | 141265  | Logperiodic Antenna(200-1000MHz) | Schwarzbeck Mess - Elektronik | VUSLP9111B               | 9111B-190  | 07/29/2020            | 12      |
| RE        | MPA-09       | 141578  | Pre Amplifier                    | Keysight Technologies Inc     | 8447D                    | 2944A10845 | -                     | -       |
| RE        | MTR-03       | 141942  | Test Receiver                    | Rohde & Schwarz               | ESCI                     | 100300     | 08/18/2020            | 12      |
| RE        | MLPA-01      | 141254  | Loop Antenna                     | Rohde & Schwarz               | HFH2-Z2                  | 100017     | 10/04/2019            | 12      |
| RE        | MCC-143      | 141413  | Coaxial Cable                    | UL Japan                      | -                        | -          | 06/18/2020            | 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**

**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