

# **RADIO TEST REPORT**

## **Test Report No. 14752026H-A-R1**

|                            |                         |
|----------------------------|-------------------------|
| <b>Customer</b>            | YAMAHA MOTOR CO., LTD.  |
| <b>Description of EUT</b>  | 24GHz Radar Sensor Unit |
| <b>Model Number of EUT</b> | L75N57010               |
| <b>FCC ID</b>              | 2ADBKFAZRSENSOR01       |
| <b>Test Regulation</b>     | FCC Part 15 Subpart C   |
| <b>Test Result</b>         | Complied                |
| <b>Issue Date</b>          | June 28, 2023           |
| <b>Remarks</b>             | -                       |

**Representative test engineer**Sayaka Hara  
Engineer**Approved by**Ryota Yamanaka  
Engineer

CERTIFICATE 5107.02

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

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- The information provided from the customer for this report is identified in Section 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

## **REVISION HISTORY**

### **Original Test Report No. 14752026H-A**

This report is a revised version of 14752026H-A. 14752026H-A is replaced with this report.

| Revision        | Test Report No. | Date          | Page Revised Contents                                                                                                                                                                                                                          |
|-----------------|-----------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| -<br>(Original) | 14752026H-A     | June 21, 2023 | -                                                                                                                                                                                                                                              |
| 1               | 14752026H-A-R1  | June 28, 2023 | Correction of the Receipt Date in Clasue 2.1;<br>From May 11, 2023 to June 1, 2023                                                                                                                                                             |
| 1               | 14752026H-A-R1  | June 28, 2023 | Correction of the Maximum Aperture Dimension of<br>EUT in SECTION 5 (page 15);<br>From 0.040 m to 0.041 m                                                                                                                                      |
| 1               | 14752026H-A-R1  | June 28, 2023 | Correction of the 2nd and 3rd Harmonic Limit<br>(page 18, 20, and 21);<br>From 77.5 to 87.9 for AV<br>From 97.5 to 107.9 for QP/PK                                                                                                             |
| 1               | 14752026H-A-R1  | June 28, 2023 | Correction of the 3rd and 4th Harmonic frequency<br>(page 18);<br>From 72240.0, 96320.0 to 72270.0, 96360.0                                                                                                                                    |
| 1               | 14752026H-A-R1  | June 28, 2023 | Replace the test data due to the Correction of the<br>3rd and 4th Harmonic frequency and test data<br>(page 20 and 21)                                                                                                                         |
| 1               | 14752026H-A-R1  | June 28, 2023 | Addition of the Plot for band-edge (page 19 and<br>22)                                                                                                                                                                                         |
| 1               | 14752026H-A-R1  | June 28, 2023 | Correction of the following notation of Worst Case<br>Position;<br>- Removed "Horizontal and Vertical" notation from<br>Below 30 MHz.<br>- correction of erroneous description for "Above<br>40 GHz".<br>from "Above 40 GHz" to "Above 50 GHz" |

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

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

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## **SECTION 1: Customer Information**

|                  |                                            |
|------------------|--------------------------------------------|
| Company Name     | YAMAHA MOTOR CO., LTD.                     |
| Address          | 2500 Shingai Iwata Shizuoka Japan 438-8501 |
| Telephone Number | +81-538-32-6582                            |
| Contact Person   | Hidenori Akatsuka                          |

The information provided from the customer is as follows;

- Customer, Description 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 and Test 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**

|               |                                 |
|---------------|---------------------------------|
| Description   | 24GHz Radar Sensor Unit         |
| Model Number  | L75N57010                       |
| Serial Number | Refer to SECTION 4.2            |
| Condition     | Production model                |
| Modification  | No Modification by the test lab |
| Receipt Date  | June 1, 2023                    |
| Test Date     | June 1 to 9, 2023               |

### **2.2 Product Description**

#### **General Specification**

|                       |                          |
|-----------------------|--------------------------|
| Rating                | DC 12 V                  |
| Operating temperature | -10 deg. C to +65 deg. C |

#### **Radio Specification**

|                        |                           |
|------------------------|---------------------------|
| Radio Type             | Transceiver               |
| Frequency of Operation | 24.09 GHz to 24.16 GHz    |
| Bandwidth              | 70 MHz                    |
| Modulation             | FMCW                      |
| Antenna Gain           | 15.86 dBi                 |
| Steerable Antenna      | None                      |
| Usage location         | Fixed use with helicopter |

### **2.3 Variant model(s)**

Tested model: L75N57010 has a variant model: L75N57011.

The difference of these models is only the installation position on the helicopter.

## SECTION 3: Test specification, procedures & results

### 3.1 Test Specification

|                    |                                                                                                                                                                                                                                                                                                                       |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Specification | FCC Part 15 Subpart C<br>The latest version on the first day of the testing period                                                                                                                                                                                                                                    |
| Title              | CC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators<br>Section 15.245 Operation within the bands 902 - 928MHz, 2435 - 2465MHz, 5785 - 5815MHz, 10500 - 10550MHz, and 24075 - 24175MHz.<br>Remarks: The full port test filled all available ports was performed at the FCC part 15B. (Verification) |

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

### 3.2 Procedures and results

| No. | Item                                            | Test Procedure                                                                                    | Specification                                         | Worst margin                      | Results  | Remarks  |
|-----|-------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------------------------|-----------------------------------|----------|----------|
| 1   | Conducted Emission                              | ANSI C63.10-2013<br>6. Standard test methods                                                      | Section 15.207(a)                                     | -                                 | N/A      | *1)      |
| 2   | Electric Field Strength of Fundamental Emission | ANSI C63.10-2013<br>6. Standard test methods                                                      | Section 15.245(b)                                     | 3.3 dB<br>24075.0 MHz<br>Vertical | Complied | Radiated |
| 3   | Electric Field Strength of Spurious Emission    | ANSI C63.10-2013<br>6. Standard test methods<br>9. Procedures for testing millimeter-wave systems | Section 15.205<br>Section 15.209<br>Section 15.245(b) | 1.3 dB<br>86.9 MHz<br>Vertical    | Complied | Radiated |
| 4   | -20 dB Bandwidth                                | ANSI C63.4:2009<br>13. Measurement of intentional radiators                                       | Section 15.215(c)                                     | -                                 | Complied | Radiated |

\*Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

\*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.

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

This EUT provides the stable voltage constantly to RF part regardless of input voltage.  
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 EUT.  
Therefore, the equipment complies with the antenna requirement of Section 15.203.

### 3.3 Addition to standard

| Item                     | Test Procedure | Specification | Worst margin | Results | Remarks  |
|--------------------------|----------------|---------------|--------------|---------|----------|
| 99 % Occupied Band Width | RSS-Gen 4.6.1  | RSS-Gen 4.6.1 | N/A          | -       | Radiated |

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

### 3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.  
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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                 |                     |                   | 3.1 dB            |
| 3 m                  | 30 MHz to 200 MHz   | Horizontal        | 4.8 dB            |
|                      |                     | Vertical          | 5.0 dB            |
|                      | 200 MHz to 1000 MHz | Horizontal        | 5.1 dB            |
|                      |                     | Vertical          | 6.2 dB            |
| 10 m                 | 30 MHz to 200 MHz   | Horizontal        | 4.8 dB            |
|                      |                     | Vertical          | 4.8 dB            |
|                      | 200 MHz to 1000 MHz | Horizontal        | 4.9 dB            |
|                      |                     | Vertical          | 5.0 dB            |
| 3 m                  | 1 GHz to 6 GHz      | Test Receiver     | 5.0 dB            |
|                      |                     | Spectrum analyzer | 4.9 dB            |
|                      | 6 GHz to 18 GHz     | Test Receiver     | 5.3 dB            |
|                      |                     | Spectrum analyzer | 5.2 dB            |
| 1 m                  | 10 GHz to 26.5 GHz  | Spectrum analyzer | 5.5 dB            |
|                      | 26.5 GHz to 40 GHz  | Spectrum analyzer | 5.4 dB            |
| 0.5 m                | 26.5 GHz to 40 GHz  | Spectrum analyzer | 5.4 dB            |
| 10 m                 | 1 GHz to 18 GHz     | Test Receiver     | 5.3 dB            |
| >= 0.5 m             | 40 GHz to 50 GHz    |                   | 4.2 dB            |
| >= 0.5 m             | 50 GHz to 75 GHz    |                   | 5.9 dB            |
| >= 0.5 m             | 75 GHz to 110 GHz   |                   | 5.5 dB            |

#### Antenna Terminal test

| Test Item                                           | Uncertainty (+/-) |
|-----------------------------------------------------|-------------------|
| Antenna terminal conducted emission / Power density | 2.7 dB            |

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab.

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

Telephone: +81-596-24-8999

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

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

| Test site                  | Width x Depth x Height (m) | Size of reference ground plane (m) / horizontal conducting plane | Other rooms            | Maximum measurement distance |
|----------------------------|----------------------------|------------------------------------------------------------------|------------------------|------------------------------|
| No.1 semi-anechoic chamber | 19.2 x 11.2 x 7.7          | 7.0 x 6.0                                                        | No.1 Power source room | 10 m                         |
| No.2 semi-anechoic chamber | 7.5 x 5.8 x 5.2            | 4.0 x 4.0                                                        | -                      | 3 m                          |
| No.3 semi-anechoic chamber | 12.0 x 8.5 x 5.9           | 6.8 x 5.75                                                       | No.3 Preparation room  | 3 m                          |
| No.3 shielded room         | 4.0 x 6.0 x 2.7            | N/A                                                              | -                      | -                            |
| No.4 semi-anechoic chamber | 12.0 x 8.5 x 5.9           | 6.8 x 5.75                                                       | No.4 Preparation room  | 3 m                          |
| No.4 shielded room         | 4.0 x 6.0 x 2.7            | N/A                                                              | -                      | -                            |
| No.5 semi-anechoic chamber | 6.0 x 6.0 x 3.9            | 6.0 x 6.0                                                        | -                      | -                            |
| No.5 measurement room      | 6.4 x 6.4 x 3.0            | 6.4 x 6.4                                                        | -                      | -                            |
| No.6 shielded room         | 4.0 x 4.5 x 2.7            | 4.0 x 4.5                                                        | -                      | -                            |
| No.6 measurement room      | 4.75 x 5.4 x 3.0           | 4.75 x 4.15                                                      | -                      | -                            |
| No.7 shielded room         | 4.7 x 7.5 x 2.7            | 4.7 x 7.5                                                        | -                      | -                            |
| No.8 measurement room      | 3.1 x 5.0 x 2.7            | 3.1 x 5.0                                                        | -                      | -                            |
| No.9 measurement room      | 8.8 x 4.6 x 2.8            | 2.4 x 2.4                                                        | -                      | -                            |
| No.10 shielded room        | 3.8 x 2.8 x 2.8            | 3.8 x 2.8                                                        | -                      | -                            |
| No.11 measurement room     | 4.0 x 3.4 x 2.5            | N/A                                                              | -                      | -                            |
| No.12 measurement room     | 2.6 x 3.4 x 2.5            | N/A                                                              | -                      | -                            |
| Large Chamber              | 16.9 x 22.1 x 10.17        | 16.9 x 22.1                                                      | -                      | 10 m                         |
| Small Chamber              | 5.3 x 6.69 x 3.59          | 5.3 x 6.69                                                       | -                      | -                            |

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

Refer to APPENDIX.



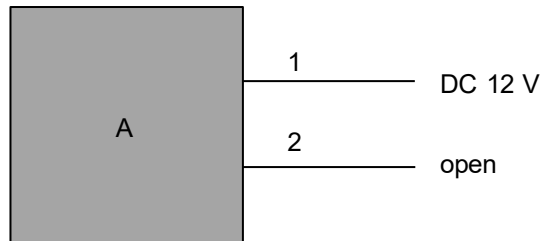
## SECTION 4: Operation of EUT during testing

### 4.1 Operating Modes

| Mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Test Item                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Transmitting mode<br>- 24.09 GHz<br>- 24.125 GHz<br>- 24.16 GHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)                                                                 |
| Normal Operation mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission),<br>-20 dB Bandwidth and 99 % Occupied Bandwidth,<br>Duty Cycle |
| <p>*Power of the EUT was set by the software as follows;<br/>Power Setting: 6<br/>Software: S-Takaya,ST234-001,230531-01<br/>(Date: 2023.05.31, 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.<br/>Justification: The system was configured in typical fashion (as a user would normally use it) for testing.</p> |                                                                                                                                                  |

### 4.2 Configuration and peripherals

#### Radiated Emission (Below 1 GHz) test



\* Test data was taken under worse case conditions.

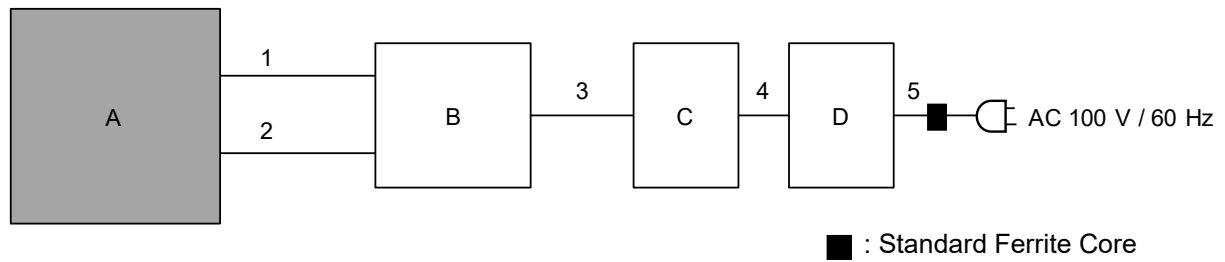
#### Description of EUT

| No. | Item                    | Model number | Serial number | Manufacturer           | Remarks |
|-----|-------------------------|--------------|---------------|------------------------|---------|
| A   | 24GHz Radar Sensor Unit | L75N57010    | L3101U22300   | YAMAHA MOTOR CO., LTD. | EUT     |

#### List of cables used

| No. | Name         | Length (m) | Shield     |            | Remark |
|-----|--------------|------------|------------|------------|--------|
|     |              |            | Cable      | Connector  |        |
| 1   | DC Cable     | 2.0        | Unshielded | Unshielded | -      |
| 2   | Signal Cable | 1.0        | Unshielded | Unshielded | -      |

**Other tests except for Radiated Emission (Below 1 GHz) test**



\* Test data was taken under worse case conditions.

**Description of EUT and Support equipment**

| No. | Item                    | Model number        | Serial number    | Manufacturer           | Remarks |
|-----|-------------------------|---------------------|------------------|------------------------|---------|
| A   | 24GHz Radar Sensor Unit | L75N57010           | L3101U22300      | YAMAHA MOTOR CO., LTD. | EUT     |
| B   | Jig Borad               | JUPITER RELAY BOARD | #01              | S-takaya               | -       |
| C   | Laptop PC               | CF-N8HWCDPS         | 9LKSA04645       | Panasonic              | -       |
| D   | AC Adapter              | CF-AA6372B          | 6372BM610214975E | Panasonic              | -       |

**List of cables used**

| No. | Name         | Length (m) | Shield     |            | Remark |
|-----|--------------|------------|------------|------------|--------|
|     |              |            | Cable      | Connector  |        |
| 1   | DC Cable     | 1.6        | Unshielded | Unshielded | -      |
| 2   | Signal Cable | 1.6        | Unshielded | Unshielded | -      |
| 3   | USB Cable    | 2.0        | Shielded   | Shielded   | -      |
| 4   | DC Cable     | 1.6        | Unshielded | Unshielded | -      |
| 5   | AC Cable     | 0.8        | Unshielded | Unshielded | -      |

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

### **Test Procedure and conditions**

#### **[For below 30 MHz]**

EUT was placed on a carpet for insulation above a reference ground plane. EUT was set up typical spacing for the other equipment.

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., 135 deg and 180 deg.) and horizontal polarization.

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

#### **[For below 1 GHz]**

EUT was placed on a carpet for insulation above a reference ground plane. EUT was set up typical spacing for the other equipment.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

#### **[For above 1 GHz, up to 40 GHz]**

EUT was placed on a carpet for insulation above a reference ground plane. EUT was set up typical spacing for the other equipment.

#### For 1 GHz to 10 GHz

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

#### For 10 GHz to 40 GHz

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

The height of the measuring antenna varied between 1 m and 4 m (frequency range 9 kHz to 30 MHz: loop antenna was fixed height at 1.0 m) and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

Test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

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

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

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

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

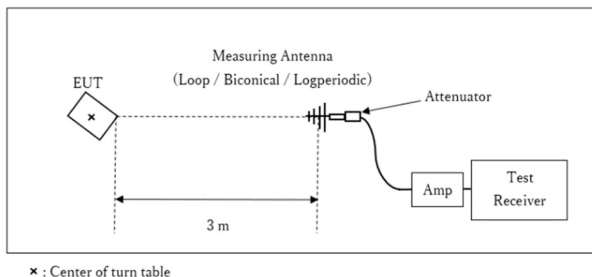
**Test Antennas are used as below;**

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

|                 |                  |                   |                 |                          |                                          |
|-----------------|------------------|-------------------|-----------------|--------------------------|------------------------------------------|
| Frequency       | 9 kHz to 150 kHz | 150 kHz to 30 MHz | 30 MHz to 1 GHz | 1 GHz to 40 GHz          |                                          |
| Instrument used | Test Receiver    | Test Receiver     | Test Receiver   | Spectrum Analyzer        |                                          |
| Detector        | QP, Average *1)  | QP, Average *1)   | QP              | Peak                     | Average                                  |
| IF Bandwidth    | BW 200 Hz        | BW 9 kHz          | BW 120 kHz      | RBW: 1 MHz<br>VBW: 3 MHz | RBW: 1 MHz<br>VBW: 10 Hz<br>Voltage avg. |

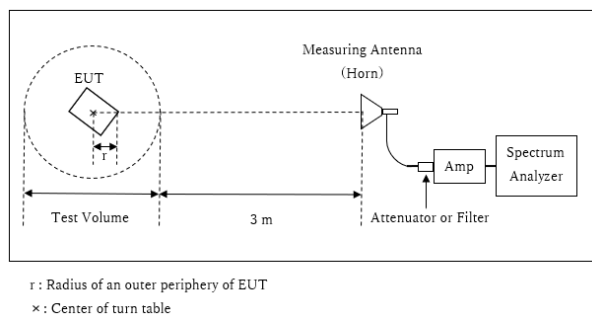
\*1) Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

[Test Setup]  
Below 1 GHz



Test Distance: 3 m

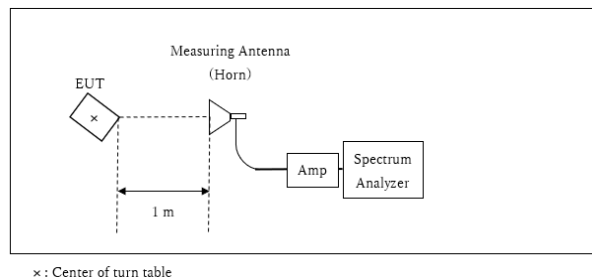
1 GHz to 10 GHz



Distance Factor:  $20 \times \log (3.95 \text{ m}^* / 3.00 \text{ m}) = 2.39 \text{ dB}$   
\* Test Distance:  $(3 + \text{SVSWR Volume} / 2) - r = 3.95 \text{ m}$

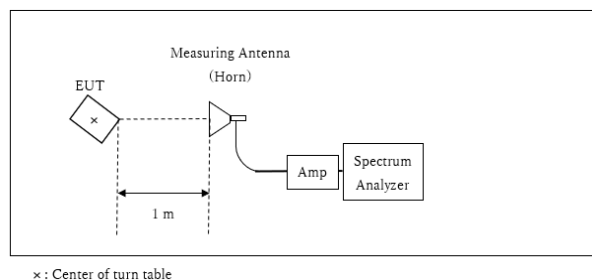
SVSWR Volume: 2 m  
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)  
 $r = 0.05 \text{ m}$

10 GHz to 26.5 GHz



Distance Factor:  $20 \times \log (1.00 \text{ m}^* / 3.00 \text{ m}) = -9.5 \text{ dB}$   
\*Test Distance: 1.0 m

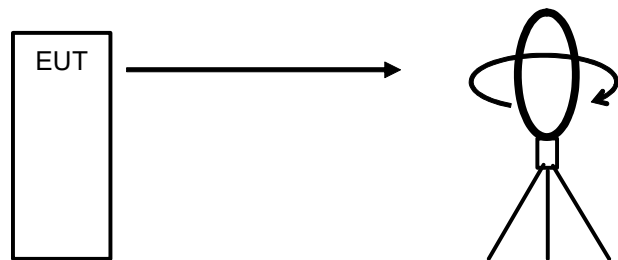
26.5 GHz to 40 GHz



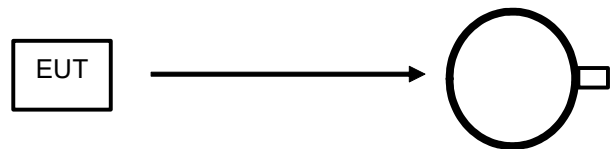
Distance Factor:  $20 \times \log (0.50 \text{ m}^* / 3.00 \text{ m}) = -15.5 \text{ dB}$   
\*Test Distance: 0.5 m

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

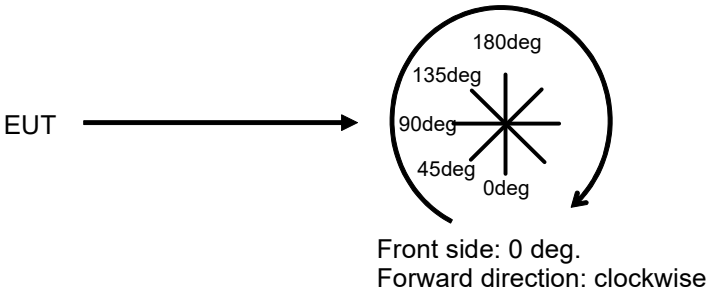


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



#### [About fundamental measurement]

The carrier levels were confirmed at maximum direction of transmission. The maximum direction was searched under carefully since beam-widths are narrow.

The carrier levels were measured in the far field. The distance of the far field was calculated from follow equation.

$$r = \frac{2D^2}{\lambda}$$

where

$r$  is the distance from the radiating element of the EUT to the edge of the far field, in m

$D$  is the largest dimension of both the radiating element and the test antenna (horn), in m

(The antenna aperture size of test antenna was used for this calculation.)

$\lambda$  is the wavelength of the emission under investigation  $[300 / f \text{ (MHz)} * 10^3]$ , in millimeter

| Frequency<br>[GHz] | Wavelength<br>$\lambda$<br>[mm] | Maximum Aperture Dimension |                                 |                       | Far Field<br>Boundary<br>$r$<br>[m] |
|--------------------|---------------------------------|----------------------------|---------------------------------|-----------------------|-------------------------------------|
|                    |                                 | EUT<br>[m]                 | Test Antenna<br>(MHA-16)<br>[m] | Maximum<br>$D$<br>[m] |                                     |
| 24.160             | 12.4                            | 0.041                      | 0.058                           | 0.058                 | 0.542                               |

#### [Above 40 GHz]

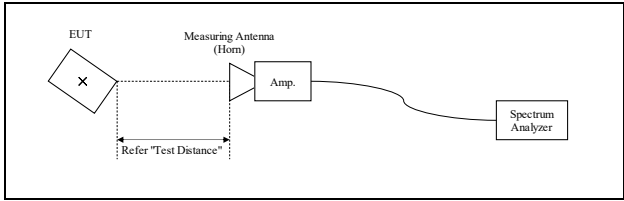
The test was performed based on “Procedures for testing millimeter-wave systems” of ANSI C63.10-2013.

EUT was placed on a carpet for insulation above a reference ground plane. EUT was set up typical spacing for the other equipment.

Set spectrum analyzer RBW, VBW, span, etc., to the proper values. Note these values. Enable two traces—one set to “clear write,” and the other set to “max hold.” Begin hand-held measurements with the test antenna (horn) at a distance of 1 m from the EUT in a horizontally polarized position. Slowly adjust its position, entirely covering the plane 1 m from the EUT. Observation of the two active traces on the spectrum analyzer will allow refined horn positioning at the point(s) of maximum field intensity. Repeat with the horn in a vertically polarized position. If the emission cannot be detected at 1 m, reduce the RBW to increase system sensitivity. Note the value. If the emission still cannot be detected, move the horn closer to the EUT, noting the distance at which a measurement is made.

| Detector     | Peak                     | Average                                  |
|--------------|--------------------------|------------------------------------------|
| IF Bandwidth | RBW: 1 MHz<br>VBW: 3 MHz | RBW: 1 MHz<br>VBW: 10 Hz<br>Voltage avg. |

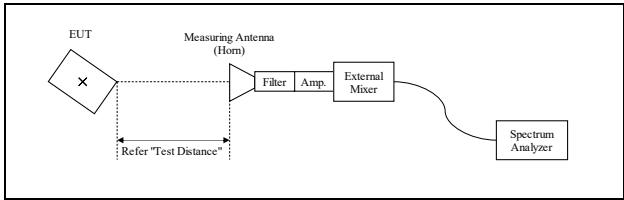
[Test setup]  
40 GHz to 50 GHz



Distance Factor:  $20 \times \log (1.00 \text{ m}^* / 3.0 \text{ m}) = -9.5 \text{ dB}$   
\*Test Distance: 1.00 m

※: Center of turn table

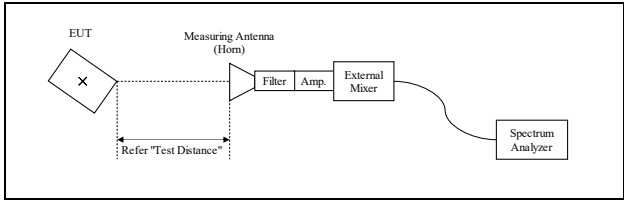
50 GHz to 75 GHz



Distance Factor:  $20 \times \log (0.75 \text{ m}^* / 3.0 \text{ m}) = -12.0 \text{ dB}$   
\*Test Distance: 0.75 m

※: Center of turn table

75 GHz to 100 GHz



Distance Factor:  $20 \times \log (0.50 \text{ m}^* / 3.0 \text{ m}) = -15.5 \text{ dB}$   
\*Test Distance: 0.50 m

※: Center of turn table

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

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

|                   |                    |
|-------------------|--------------------|
| Measurement range | : 9 kHz to 100 GHz |
| Test data         | : APPENDIX 1       |
| Test result       | : Pass             |



## **SECTION 6: 20 dB Bandwidth, 99 % Occupied Bandwidth and Duty Cycle**

### **Test Procedure**

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

| Test                                                     | Span                                                      | RBW                           | VBW                            | Sweep     | Detector    | Trace    | Instrument used   |
|----------------------------------------------------------|-----------------------------------------------------------|-------------------------------|--------------------------------|-----------|-------------|----------|-------------------|
| 20 dB Bandwidth                                          | 100 MHz                                                   | 1 MHz<br>1 % to 5 %<br>of OBW | 3 MHz<br>Three times<br>of RBW | Auto      | Peak        | Max Hold | Spectrum Analyzer |
| 99 % Occupied<br>Bandwidth                               | 100 MHz,<br>Enough width to<br>display emission<br>skirts | 1 MHz<br>1 % to 5 %<br>of OBW | 3 MHz<br>Three times<br>of RBW | Auto      | Peak<br>*1) | Max Hold | Spectrum Analyzer |
| Duty Cycle                                               | Zero                                                      | 8 MHz                         | 50 MHz                         | 20.2 msec | Peak        | Single   | Spectrum Analyzer |
| *1) Peak detector was applied as Worst-case measurement. |                                                           |                               |                                |           |             |          |                   |

Test data : APPENDIX  
Test result : Pass

## APPENDIX 1: Test data

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

|                        |                      |                     |                      |                     |                     |                     |
|------------------------|----------------------|---------------------|----------------------|---------------------|---------------------|---------------------|
| Test place             | Ise EMC Lab.         |                     |                      |                     |                     |                     |
| Semi Anechoic Chamber  | No.1                 | No.3                | No.3                 | No.3                | No.4                | No.4                |
| Date                   | June 1, 2023         | June 4, 2023        | June 5, 2023         | June 6, 2023        | June 7, 2023        | June 9, 2023        |
| Temperature / Humidity | 22 deg. C / 72 % RH  | 22 deg. C / 52 % RH | 20 deg. C / 50 % RH  | 21 deg. C / 47 % RH | 22 deg. C / 58 % RH | 21 deg. C / 59 % RH |
| Engineer               | Sayaka Hara          | Junki Nagatomi      | Sayaka Hara          | Sayaka Hara         | Sayaka Hara         | Sayaka Hara         |
| Frequency              | (18 GHz to 26.5 GHz) | (Above 50 GHz)      | (26.5 GHz to 50 GHz) | (10 GHz to 18 GHz)  | (Below 1 GHz)       | (1 GHz to 10 GHz)   |
| Mode                   | Tx 24.09 MHz         |                     |                      |                     |                     |                     |

#### [Fundamental and Band-edge]

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark      |
|----------------------|-----------------|--------------------------|---------------------|--------------------|-----------|-----------|---------------------------|----------------------|--------------------------|---------------------|-----------------------|------------------|-------------|
| Hori.                | 24000.0         | 46.7                     | 39.2                | 38.8               | -0.2      | 35.1      | 50.3                      | 42.8                 | 73.9                     | 53.9                | 23.6                  | 11.2             | Floor noise |
| Hori.                | 24075.0         | 55.0                     | 46.9                | 38.8               | -0.2      | 35.1      | 58.6                      | 50.5                 | 73.9                     | 53.9                | 15.3                  | 3.4              |             |
| Hori.                | 24089.8         | 109.2                    | 109.2               | 38.8               | -0.2      | 35.1      | 112.7                     | 112.7                | 147.9                    | 127.9               | 35.2                  | 15.2             |             |
| Vert.                | 24000.0         | 46.7                     | 39.3                | 38.8               | -0.2      | 35.1      | 50.3                      | 42.9                 | 73.9                     | 53.9                | 23.6                  | 11.0             | Floor noise |
| Vert.                | 24075.0         | 54.7                     | 47.0                | 38.8               | -0.2      | 35.1      | 58.3                      | 50.6                 | 73.9                     | 53.9                | 15.6                  | 3.3              |             |
| Vert.                | 24089.8         | 109.1                    | 109.1               | 38.8               | -0.2      | 35.1      | 112.7                     | 112.7                | 147.9                    | 127.9               | 35.3                  | 15.3             |             |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Mixer (above 50 GHz) + Distance factor (above 1 GHz)) - Gain(Amplifier)

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

\*QP detector was used up to 1GHz.

Distance factor: 18 GHz to 26.5 GHz  $20\log(1.00\text{ m} / 3.00\text{ m}) = -9.5\text{ dB}$

#### [Spurious emissions other than above]

##### Above 1 GHz

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark      |
|----------------------|-----------------|--------------------------|---------------------|--------------------|-----------|-----------|---------------------------|----------------------|--------------------------|---------------------|-----------------------|------------------|-------------|
| Hori.                | 22584.3         | 49.6                     | 43.6                | 38.3               | -0.6      | 34.7      | 52.6                      | 46.5                 | 73.9                     | 53.9                | 21.3                  | 7.4              |             |
| Hori.                | 48180.0         | 62.2                     | 56.3                | 41.7               | -1.4      | 32.8      | 69.7                      | 63.8                 | 107.9                    | 87.9                | 38.2                  | 24.1             |             |
| Hori.                | 72270.0         | 38.7                     | 25.6                | 43.1               | 6.0       | 21.1      | 66.7                      | 53.5                 | 107.9                    | 87.9                | 41.2                  | 34.4             | Floor noise |
| Hori.                | 96360.0         | 51.3                     | 37.8                | 45.7               | -4.2      | 34.8      | 58.0                      | 44.4                 | 73.9                     | 53.9                | 15.9                  | 9.5              | Floor noise |
| Vert.                | 22584.3         | 49.8                     | 43.2                | 38.3               | -0.6      | 34.7      | 52.7                      | 46.2                 | 73.9                     | 53.9                | 21.2                  | 7.7              |             |
| Vert.                | 48180.0         | 60.7                     | 53.4                | 41.7               | -1.4      | 32.8      | 68.2                      | 60.9                 | 107.9                    | 87.9                | 39.7                  | 27.0             |             |
| Vert.                | 72270.0         | 38.7                     | 25.5                | 43.1               | 6.0       | 21.1      | 66.7                      | 53.5                 | 107.9                    | 87.9                | 41.2                  | 34.4             | Floor noise |
| Vert.                | 96360.0         | 51.3                     | 37.7                | 45.7               | -4.2      | 34.8      | 57.9                      | 44.4                 | 73.9                     | 53.9                | 16.0                  | 9.5              | Floor noise |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Mixer (above 50 GHz) + Distance factor (above 1 GHz)) - Gain(Amplifier)

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

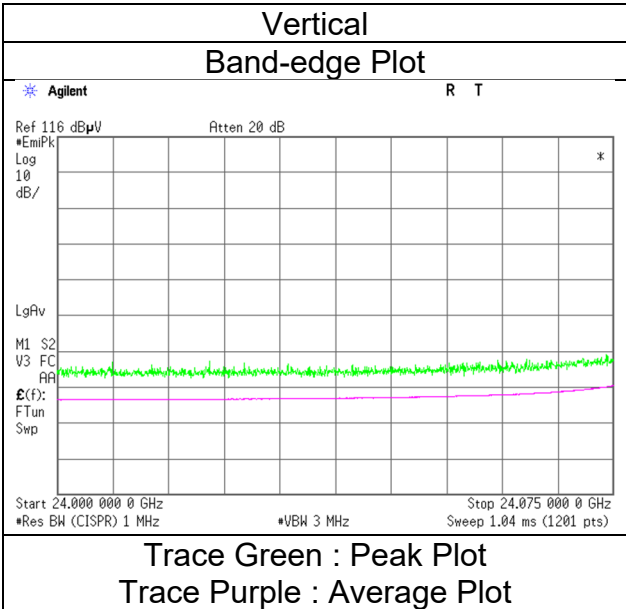
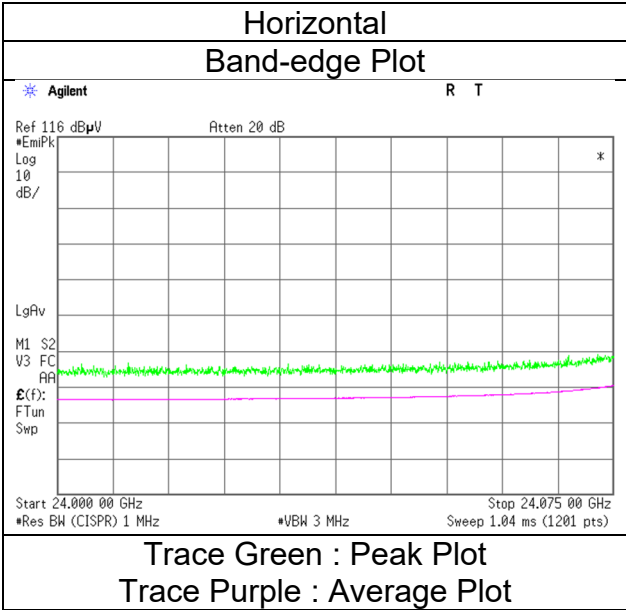
\*QP detector was used up to 1GHz.

Distance factor:

|                    |                                                           |
|--------------------|-----------------------------------------------------------|
| 1 GHz to 10 GHz    | $20\log(3.95\text{ m} / 3.00\text{ m}) = 2.39\text{ dB}$  |
| 10 GHz to 18 GHz   | $20\log(1.00\text{ m} / 3.00\text{ m}) = -9.5\text{ dB}$  |
| 18 GHz to 26.5 GHz | $20\log(1.00\text{ m} / 3.00\text{ m}) = -9.5\text{ dB}$  |
| 26.5 GHz to 40 GHz | $20\log(0.50\text{ m} / 3.00\text{ m}) = -15.5\text{ dB}$ |
| 40 GHz to 50 GHz   | $20\log(1.00\text{ m} / 3.00\text{ m}) = -9.5\text{ dB}$  |
| 50 GHz to 75 GHz   | $20\log(0.75\text{ m} / 3.00\text{ m}) = -12.0\text{ dB}$ |
| 75 GHz to 100 GHz  | $20\log(0.50\text{ m} / 3.00\text{ m}) = -15.5\text{ dB}$ |

**Radiated Emission**  
**(Electric Field Strength of Fundamental and Spurious Emission)**  
**(Reference Plot for band-edge)**

|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.1                |
| Date                   | June 1, 2023        |
| Temperature / Humidity | 22 deg. C / 72 % RH |
| Engineer               | Sayaka Hara         |
| Mode                   | Tx 24.09 MHz        |



\* Final result was shown in tabular data.

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

|                        |                      |                    |                      |                     |                     |                     |
|------------------------|----------------------|--------------------|----------------------|---------------------|---------------------|---------------------|
| Test place             | Ise EMC Lab.         |                    |                      |                     |                     |                     |
| Semi Anechoic Chamber  | No.1                 | No.3               | No.3                 | No.3                | No.4                | No.4                |
| Date                   | June 1, 2023         | June 4, 2023       | June 5, 2023         | June 6, 2023        | June 7, 2023        | June 9, 2023        |
| Temperature / Humidity | 22 deg. C / 72% RH   | 22 deg. C / 52% RH | 20 deg. C / 50 % RH  | 21 deg. C / 47 % RH | 22 deg. C / 58 % RH | 21 deg. C / 59 % RH |
| Engineer               | Sayaka Hara          | Junki Nagatomi     | Sayaka Hara          | Sayaka Hara         | Sayaka Hara         | Sayaka Hara         |
| Frequency              | (18 GHz to 26.5 GHz) | (Above 50 GHz)     | (26.5 GHz to 50 GHz) | (10 GHz to 18 GHz)  | (Below 1 GHz)       | (1 GHz to 10 GHz)   |
| Mode                   | Tx 24.125 MHz        |                    |                      |                     |                     |                     |

### [Fundamental and Band-edge]

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark |
|----------------------|-----------------|--------------------------|---------------------|--------------------|-----------|-----------|---------------------------|----------------------|--------------------------|---------------------|-----------------------|------------------|--------|
| Hori.                | 24124.8         | 109.0                    | 109.0               | 38.8               | -0.2      | 35.1      | 112.6                     | 112.6                | 147.9                    | 127.9               | 35.3                  | 15.3             |        |
| Vert.                | 24124.8         | 109.0                    | 109.0               | 38.8               | -0.2      | 35.1      | 112.6                     | 112.6                | 147.9                    | 127.9               | 35.3                  | 15.3             |        |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Mixer (above 50 GHz) + Distance factor (above 1 GHz)) - Gain(Amplifier)

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

\*QP detector was used up to 1GHz.

Distance factor: 18 GHz to 26.5 GHz  $20\log(1.00 \text{ m} / 3.00 \text{ m}) = -9.5 \text{ dB}$

### [Spurious emissions other than above]

#### Above 1 GHz

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark      |
|----------------------|-----------------|--------------------------|---------------------|--------------------|-----------|-----------|---------------------------|----------------------|--------------------------|---------------------|-----------------------|------------------|-------------|
| Hori.                | 22617.1         | 49.8                     | 43.7                | 38.3               | -0.6      | 34.7      | 52.8                      | 46.7                 | 73.9                     | 53.9                | 21.1                  | 7.2              |             |
| Hori.                | 48250.0         | 62.2                     | 56.0                | 41.7               | -1.4      | 32.8      | 69.8                      | 63.6                 | 107.9                    | 87.9                | 38.1                  | 24.4             |             |
| Hori.                | 72375.0         | 38.1                     | 25.5                | 43.1               | 6.2       | 21.2      | 66.1                      | 53.5                 | 107.9                    | 87.9                | 41.8                  | 34.4             | Floor noise |
| Hori.                | 96500.0         | 50.0                     | 37.4                | 45.7               | -4.2      | 34.9      | 56.5                      | 43.9                 | 73.9                     | 53.9                | 17.4                  | 10.0             | Floor noise |
| Vert.                | 22617.1         | 49.6                     | 43.8                | 38.3               | -0.6      | 34.7      | 52.6                      | 46.8                 | 73.9                     | 53.9                | 21.3                  | 7.1              |             |
| Vert.                | 48250.0         | 61.2                     | 54.1                | 41.7               | -1.4      | 32.8      | 68.7                      | 61.7                 | 107.9                    | 87.9                | 39.2                  | 26.3             |             |
| Vert.                | 72375.0         | 38.0                     | 25.4                | 43.1               | 6.2       | 21.2      | 66.0                      | 53.5                 | 107.9                    | 87.9                | 41.9                  | 34.4             | Floor noise |
| Vert.                | 96500.0         | 50.0                     | 37.4                | 45.7               | -4.2      | 34.9      | 56.5                      | 43.9                 | 73.9                     | 53.9                | 17.4                  | 10.0             | Floor noise |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Mixer (above 50 GHz) + Distance factor (above 1 GHz)) - Gain(Amplifier)

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

\*QP detector was used up to 1GHz.

Distance factor:

|                    |                                                              |
|--------------------|--------------------------------------------------------------|
| 1 GHz to 10 GHz    | $20\log(3.95 \text{ m} / 3.00 \text{ m}) = 2.39 \text{ dB}$  |
| 10 GHz to 18 GHz   | $20\log(1.00 \text{ m} / 3.00 \text{ m}) = -9.5 \text{ dB}$  |
| 18 GHz to 26.5 GHz | $20\log(1.00 \text{ m} / 3.00 \text{ m}) = -9.5 \text{ dB}$  |
| 26.5 GHz to 40 GHz | $20\log(0.50 \text{ m} / 3.00 \text{ m}) = -15.5 \text{ dB}$ |
| 40 GHz to 50 GHz   | $20\log(1.00 \text{ m} / 3.00 \text{ m}) = -9.5 \text{ dB}$  |
| 50 GHz to 75 GHz   | $20\log(0.75 \text{ m} / 3.00 \text{ m}) = -12.0 \text{ dB}$ |
| 75 GHz to 100 GHz  | $20\log(0.50 \text{ m} / 3.00 \text{ m}) = -15.5 \text{ dB}$ |

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

|                        |                      |                    |                      |                     |                     |                     |
|------------------------|----------------------|--------------------|----------------------|---------------------|---------------------|---------------------|
| Test place             | Ise EMC Lab.         |                    |                      |                     |                     |                     |
| Semi Anechoic Chamber  | No.1                 | No.3               | No.3                 | No.3                | No.4                | No.4                |
| Date                   | June 1, 2023         | June 4, 2023       | June 5, 2023         | June 6, 2023        | June 7, 2023        | June 9, 2023        |
| Temperature / Humidity | 22 deg. C / 72% RH   | 22 deg. C / 52% RH | 20 deg. C / 50 % RH  | 21 deg. C / 47 % RH | 22 deg. C / 58 % RH | 21 deg. C / 59 % RH |
| Engineer               | Sayaka Hara          | Junki Nagatomi     | Sayaka Hara          | Sayaka Hara         | Sayaka Hara         | Sayaka Hara         |
| Frequency              | (18 GHz to 26.5 GHz) | (Above 50 GHz)     | (26.5 GHz to 50 GHz) | (10 GHz to 18 GHz)  | (Below 1 GHz)       | (1 GHz to 10 GHz)   |
| Mode                   | Tx 24.16 MHz         |                    |                      |                     |                     |                     |

### [Fundamental and Band-edge]

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark      |
|----------------------|-----------------|--------------------------|---------------------|--------------------|-----------|-----------|---------------------------|----------------------|--------------------------|---------------------|-----------------------|------------------|-------------|
| Hori.                | 24159.8         | 109.1                    | 109.1               | 38.8               | -0.2      | 35.1      | 112.7                     | 112.7                | 147.9                    | 127.9               | 35.2                  | 15.2             |             |
| Hori.                | 24175.0         | 53.8                     | 46.5                | 38.8               | -0.2      | 35.1      | 57.5                      | 50.2                 | 73.9                     | 53.9                | 16.5                  | 3.8              |             |
| Hori.                | 24250.0         | 46.6                     | 38.6                | 38.9               | -0.1      | 35.1      | 50.2                      | 42.3                 | 73.9                     | 53.9                | 23.7                  | 11.6             | Floor noise |
| Vert.                | 24159.8         | 108.9                    | 108.9               | 38.8               | -0.2      | 35.1      | 112.5                     | 112.5                | 147.9                    | 127.9               | 35.4                  | 15.4             |             |
| Vert.                | 24175.0         | 54.0                     | 46.3                | 38.8               | -0.2      | 35.1      | 57.7                      | 49.9                 | 73.9                     | 53.9                | 16.3                  | 4.0              |             |
| Vert.                | 24250.0         | 46.6                     | 38.7                | 38.9               | -0.1      | 35.1      | 50.3                      | 42.3                 | 73.9                     | 53.9                | 23.6                  | 11.6             | Floor noise |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Mixer (above 50 GHz) + Distance factor (above 1 GHz)) - Gain(Amplifier)

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

\*QP detector was used up to 1GHz.

Distance factor: 18 GHz to 26.5 GHz  $20\log(1.00\text{ m} / 3.00\text{ m}) = -9.5\text{ dB}$

### [Spurious emissions other than above]

#### Above 1 GHz

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Result (QP / PK) [dBuV/m] | Result (AV) [dBuV/m] | Limit (QP / PK) [dBuV/m] | Limit (AV) [dBuV/m] | Margin (QP / PK) [dB] | Margin (AV) [dB] | Remark      |
|----------------------|-----------------|--------------------------|---------------------|--------------------|-----------|-----------|---------------------------|----------------------|--------------------------|---------------------|-----------------------|------------------|-------------|
| Hori.                | 22649.9         | 49.8                     | 43.8                | 38.4               | -0.6      | 34.7      | 52.8                      | 46.9                 | 73.9                     | 53.9                | 21.1                  | 7.0              |             |
| Hori.                | 48320.0         | 62.0                     | 55.1                | 41.7               | -1.4      | 32.8      | 69.6                      | 62.7                 | 107.9                    | 87.9                | 38.3                  | 25.2             |             |
| Hori.                | 72480.0         | 38.3                     | 25.5                | 43.1               | 6.3       | 21.3      | 66.4                      | 53.6                 | 107.9                    | 87.9                | 41.5                  | 34.3             | Floor noise |
| Hori.                | 96640.0         | 50.1                     | 37.4                | 45.6               | -4.3      | 35.1      | 56.4                      | 43.8                 | 73.9                     | 53.9                | 17.5                  | 10.1             | Floor noise |
| Vert.                | 22649.9         | 49.7                     | 43.9                | 38.4               | -0.6      | 34.7      | 52.7                      | 46.9                 | 73.9                     | 53.9                | 21.2                  | 7.0              |             |
| Vert.                | 48320.0         | 61.4                     | 54.5                | 41.7               | -1.4      | 32.8      | 69.0                      | 62.1                 | 107.9                    | 87.9                | 38.9                  | 25.8             |             |
| Vert.                | 72480.0         | 38.2                     | 25.5                | 43.1               | 6.3       | 21.3      | 66.3                      | 53.6                 | 107.9                    | 87.9                | 41.6                  | 34.3             | Floor noise |
| Vert.                | 96640.0         | 50.1                     | 37.4                | 45.6               | -4.3      | 35.1      | 56.4                      | 43.8                 | 73.9                     | 53.9                | 17.5                  | 10.1             | Floor noise |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Mixer (above 50 GHz) + Distance factor (above 1 GHz)) - Gain(Amplifier)

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

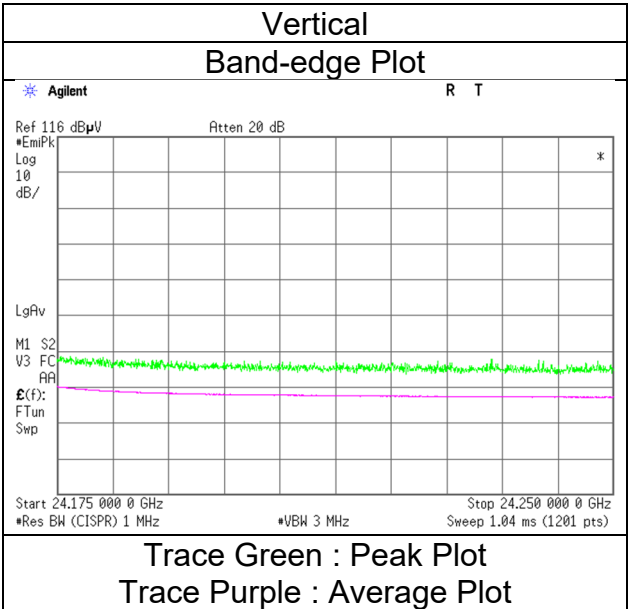
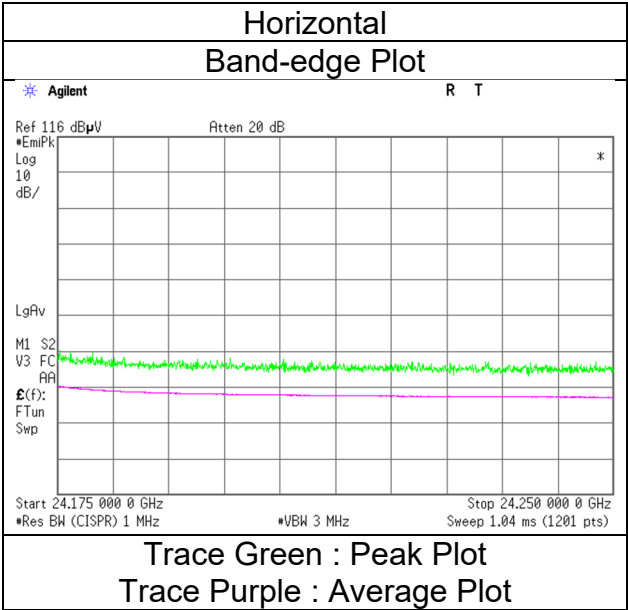
\*QP detector was used up to 1GHz.

Distance factor:

|                    |                                                           |
|--------------------|-----------------------------------------------------------|
| 1 GHz to 10 GHz    | $20\log(3.95\text{ m} / 3.00\text{ m}) = 2.39\text{ dB}$  |
| 10 GHz to 18 GHz   | $20\log(1.00\text{ m} / 3.00\text{ m}) = -9.5\text{ dB}$  |
| 18 GHz to 26.5 GHz | $20\log(1.00\text{ m} / 3.00\text{ m}) = -9.5\text{ dB}$  |
| 26.5 GHz to 40 GHz | $20\log(0.50\text{ m} / 3.00\text{ m}) = -15.5\text{ dB}$ |
| 40 GHz to 50 GHz   | $20\log(1.00\text{ m} / 3.00\text{ m}) = -9.5\text{ dB}$  |
| 50 GHz to 75 GHz   | $20\log(0.75\text{ m} / 3.00\text{ m}) = -12.0\text{ dB}$ |
| 75 GHz to 100 GHz  | $20\log(0.50\text{ m} / 3.00\text{ m}) = -15.5\text{ dB}$ |

**Radiated Emission**  
**(Electric Field Strength of Fundamental and Spurious Emission)**  
**(Reference Plot for band-edge)**

|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.1                |
| Date                   | June 1, 2023        |
| Temperature / Humidity | 22 deg. C / 72 % RH |
| Engineer               | Sayaka Hara         |
| Mode                   | Tx 24.16 MHz        |



\* Final result was shown in tabular data.

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

|                        |                      |                    |                      |                     |                     |                     |
|------------------------|----------------------|--------------------|----------------------|---------------------|---------------------|---------------------|
| Test place             | Ise EMC Lab.         |                    |                      |                     |                     |                     |
| Semi Anechoic Chamber  | No.1                 | No.3               | No.3                 | No.3                | No.4                | No.4                |
| Date                   | June 1, 2023         | June 4, 2023       | June 5, 2023         | June 6, 2023        | June 7, 2023        | June 9, 2023        |
| Temperature / Humidity | 22 deg. C / 72% RH   | 22 deg. C / 52% RH | 20 deg. C / 50 % RH  | 21 deg. C / 47 % RH | 22 deg. C / 58 % RH | 21 deg. C / 59 % RH |
| Engineer               | Sayaka Hara          | Junki Nagatomi     | Sayaka Hara          | Sayaka Hara         | Sayaka Hara         | Sayaka Hara         |
| Frequency              | (18 GHz to 26.5 GHz) | (Above 50 GHz)     | (26.5 GHz to 50 GHz) | (10 GHz to 18 GHz)  | (Below 1 GHz)       | (1 GHz to 10 GHz)   |
| Mode                   | Tx normal operation  |                    |                      |                     |                     |                     |

### Below 1 GHz

| Polarity<br>[Hori/Vert] | Frequency<br>[MHz] | Reading<br>(QP / PK)<br>[dBuV] | Reading<br>(AV)<br>[dBuV] | Ant.<br>Factor<br>[dB/m] | Loss<br>[dB] | Gain<br>[dB] | Result<br>(QP / PK)<br>[dBuV/m] | Result<br>(AV)<br>[dBuV/m] | Limit<br>(QP / PK)<br>[dBuV/m] | Limit<br>(AV)<br>[dBuV/m] | Margin<br>(QP / PK)<br>[dB] | Margin<br>(AV)<br>[dB] | Remark |
|-------------------------|--------------------|--------------------------------|---------------------------|--------------------------|--------------|--------------|---------------------------------|----------------------------|--------------------------------|---------------------------|-----------------------------|------------------------|--------|
| Hori.                   | 85.9               | 30.5                           | -                         | 7.8                      | 7.8          | 32.1         | 14.0                            | -                          | 40.0                           | -                         | 26.0                        | -                      |        |
| Hori.                   | 133.6              | 32.4                           | -                         | 14.1                     | 8.2          | 32.0         | 22.6                            | -                          | 43.5                           | -                         | 20.9                        | -                      |        |
| Hori.                   | 224.0              | 42.9                           | -                         | 11.2                     | 9.0          | 32.0         | 31.0                            | -                          | 46.0                           | -                         | 15.0                        | -                      |        |
| Hori.                   | 244.0              | 37.1                           | -                         | 11.8                     | 9.2          | 32.0         | 26.0                            | -                          | 46.0                           | -                         | 20.0                        | -                      |        |
| Hori.                   | 330.8              | 37.6                           | -                         | 14.7                     | 9.8          | 32.0         | 30.1                            | -                          | 46.0                           | -                         | 16.0                        | -                      |        |
| Hori.                   | 441.2              | 25.3                           | -                         | 16.4                     | 10.4         | 32.1         | 20.0                            | -                          | 46.0                           | -                         | 26.0                        | -                      |        |
| Vert.                   | 48.7               | 42.4                           | -                         | 11.7                     | 7.3          | 32.1         | 29.3                            | -                          | 40.0                           | -                         | 10.7                        | -                      |        |
| Vert.                   | 62.7               | 51.1                           | -                         | 7.3                      | 7.5          | 32.1         | 33.8                            | -                          | 40.0                           | -                         | 6.3                         | -                      |        |
| Vert.                   | 86.9               | 55.0                           | -                         | 8.1                      | 7.8          | 32.1         | 38.7                            | -                          | 40.0                           | -                         | 1.3                         | -                      |        |
| Vert.                   | 133.4              | 43.1                           | -                         | 14.1                     | 8.2          | 32.0         | 33.3                            | -                          | 43.5                           | -                         | 10.2                        | -                      |        |
| Vert.                   | 208.7              | 48.2                           | -                         | 11.3                     | 8.9          | 32.0         | 36.3                            | -                          | 43.5                           | -                         | 7.2                         | -                      |        |
| Vert.                   | 235.4              | 47.2                           | -                         | 11.5                     | 9.1          | 32.0         | 35.8                            | -                          | 46.0                           | -                         | 10.2                        | -                      |        |

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Mixer (above 50 GHz) + Distance factor (above 1 GHz)) - Gain(Amplifier)

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

\*QP detector was used up to 1GHz.

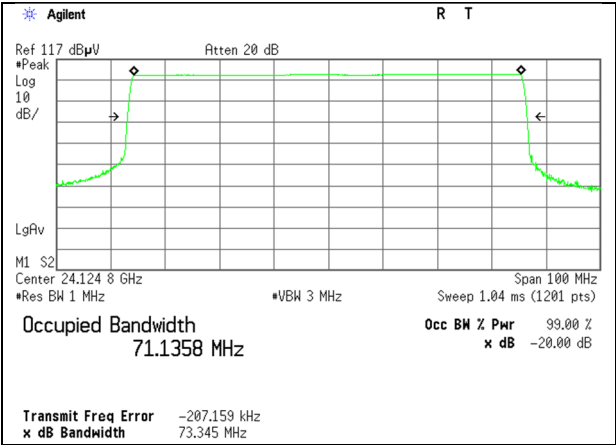
### Above 1 GHz

No signal detected

**-20 dB Bandwidth and 99 % Occupied Bandwidth**

|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.1                |
| Date                   | June 1, 2023        |
| Temperature / Humidity | 22 deg. C / 72% RH  |
| Engineer               | Sayaka Hara         |
| Mode                   | Tx Normal Operation |

| Frequency<br>[MHz] | -20dB<br>Bandwidth<br>[MHz] | 99% Occupied<br>Bandwidth<br>[MHz] |
|--------------------|-----------------------------|------------------------------------|
| 24124.81           | 73.345                      | 71.1358                            |





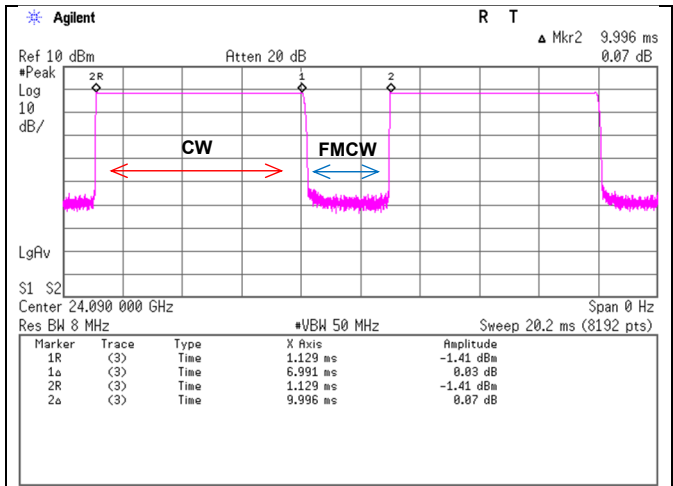
Duty Cycle  
(Reference)

|                        |                     |
|------------------------|---------------------|
| Test place             | Ise EMC Lab.        |
| Semi Anechoic Chamber  | No.3                |
| Date                   | June 5, 2023        |
| Temperature / Humidity | 20 deg. C / 50 % RH |
| Engineer               | Sayaka Hara         |
| Mode                   | Tx Normal Operation |

|            | Tx On time |              | 1cycle<br>time<br>[ms] |
|------------|------------|--------------|------------------------|
|            | CW<br>[ms] | FMCW<br>[ms] |                        |
| Measured   | 6.991      | 3.005        | 9.996                  |
| Declared * | 6.900      | 3.100        | 10.000                 |

\*See the application document.

Tx On time



## APPENDIX 2: Test instruments

### Test equipment (1/2)

| Test Item | Local ID      | LIMS ID | Description                       | Manufacturer                     | Model                                               | Serial                        | Last Calibration Date | Cal Int |
|-----------|---------------|---------|-----------------------------------|----------------------------------|-----------------------------------------------------|-------------------------------|-----------------------|---------|
| RE        | COTS-MEMI-02  | 178648  | EMI measurement program           | TSJ (Techno Science Japan)       | TEPTO-DV                                            | -                             | -                     | -       |
| RE        | MAEC-01       | 141998  | AC1_Semi Anechoic Chamber(NSA)    | TDK                              | Semi Anechoic Chamber 10m                           | DA-06881                      | 06/28/2022            | 24      |
| RE        | MAEC-01-SVSWR | 141994  | AC1_Semi Anechoic Chamber(SVSWR)  | TDK                              | Semi Anechoic Chamber 10m                           | DA-06881                      | 04/20/2023            | 24      |
| RE        | MAEC-03       | 142008  | AC3_Semi Anechoic Chamber(NSA)    | TDK                              | Semi Anechoic Chamber 3m                            | DA-10005                      | 05/23/2022            | 24      |
| RE        | MAEC-03-SVSWR | 142013  | AC3_Semi Anechoic Chamber(SVSWR)  | TDK                              | Semi Anechoic Chamber 3m                            | DA-10005                      | 04/12/2023            | 24      |
| RE        | MAEC-04       | 142011  | AC4_Semi Anechoic Chamber(NSA)    | TDK                              | Semi Anechoic Chamber 3m                            | DA-10005                      | 05/22/2022            | 24      |
| RE        | MAEC-04-SVSWR | 142017  | AC4_Semi Anechoic Chamber(SVSWR)  | TDK                              | Semi Anechoic Chamber 3m                            | DA-10005                      | 04/14/2023            | 24      |
| RE        | MAT-34        | 141331  | Attenuator(6dB)                   | TME                              | UFA-01                                              | -                             | 02/01/2023            | 12      |
| RE        | MBA-05        | 141425  | Biconical Antenna                 | Schwarzbeck Mess-Elektronik OHG  | VHA9103+ BBA9106                                    | VHA 91031302                  | 08/26/2022            | 12      |
| RE        | MCC-113       | 141217  | Coaxial cable                     | Fujikura/Suhner/TSJ              | 5D-2W/SFM141/ 421-010/ sucoform141-PE/ RFM-E121(SW) | -/04178                       | 06/11/2022            | 12      |
| RE        | MCC-135       | 142032  | Microwave Cable                   | Huber+Suhner                     | SUCOFLEX102                                         | 37511/2                       | 09/28/2022            | 12      |
| RE        | MCC-136       | 142033  | Microwave Cable                   | Huber+Suhner                     | SUCOFLEX102                                         | 37512/2                       | 09/28/2022            | 12      |
| RE        | MCC-177       | 141226  | Microwave Cable                   | Junkosha                         | MMX221-00500DMSDMS                                  | 1502S304                      | 03/03/2023            | 12      |
| RE        | MCC-217       | 141393  | Microwave Cable                   | Junkosha                         | MWX221                                              | 1604S254(1 m) / 1608S088(5 m) | 08/02/2022            | 12      |
| RE        | MCC-219       | 159670  | Coaxial Cable                     | UL Japan                         | -                                                   | -                             | 11/18/2022            | 12      |
| RE        | MCC-220       | 151897  | Microwave Cable                   | Huber+Suhner                     | SF101EA/11PC24/ 11PC24/2.5M                         | SN MY1726/1EA                 | 04/11/2023            | 12      |
| RE        | MCC-265       | 234602  | Microwave Cable                   | Huber+Suhner                     | SF126E/11PC35 /11PC35/ 1000M,5000M                  | 537063/126E / 537074/126E     | 03/16/2023            | -       |
| RE        | MCC-50        | 141397  | Coaxial Cable                     | UL Japan                         | -                                                   | -                             | 11/18/2022            | 12      |
| RE        | MCC-55        | 141326  | Microwave Cable                   | Suhner                           | SUCOFLEX101                                         | 2874(1m) / 2877(5m)           | 03/07/2023            | 12      |
| RE        | MDT-03        | 142527  | DETECTOR                          | Keysight Technologies Inc        | 8473C                                               | 1822A 05145                   | -                     | -       |
| RE        | MHA-06        | 141512  | Horn Antenna 1-18GHz              | Schwarzbeck Mess-Elektronik OHG  | BBHA9120D                                           | 254                           | 10/20/2022            | 12      |
| RE        | MHA-16        | 141513  | Horn Antenna 15-40GHz             | Schwarzbeck Mess-Elektronik OHG  | BBHA9170                                            | BBHA9170306                   | 07/05/2022            | 12      |
| RE        | MHA-20        | 141507  | Horn Antenna 1-18GHz              | Schwarzbeck Mess-Elektronik OHG  | BBHA9120D                                           | 258                           | 11/14/2022            | 12      |
| RE        | MHA-31        | 142041  | Horn Antenna                      | Oshima Prototype Engineering Co. | A16-187                                             | 1                             | 09/01/2022            | 12      |
| RE        | MHA-33        | 180634  | Horn Antenna                      | SAGE Millimeter, Inc.            | SAZ-2410-15-S1                                      | 17343-01                      | 06/09/2022            | 12      |
| RE        | MHA-35        | 180544  | Horn Antenna                      | SAGE Millimeter, Inc.            | SAZ-2410-10-S1                                      | 17343-01                      | 06/27/2022            | 12      |
| RE        | MJM-16        | 142183  | Measure                           | KOMELON                          | KMC-36                                              | -                             | 10/03/2022            | 12      |
| RE        | MJM-25        | 142226  | Measure, Tape, Steel              | KOMELON                          | KMC-36                                              | -                             | -                     | -       |
| RE        | MJM-29        | 142230  | Measure, Tape, Steel              | KOMELON                          | KMC-36                                              | -                             | -                     | -       |
| RE        | MLA-23        | 141267  | Logperiodic Antenna (200-1000MHz) | Schwarzbeck Mess-Elektronik OHG  | VUSLP9111B                                          | 9111B-192                     | 09/21/2022            | 12      |
| RE        | MLPA-02       | 142152  | Loop Antenna                      | Rohde & Schwarz                  | HFH2-Z2                                             | 836553/009                    | 10/11/2022            | 12      |
| RE        | MMM-08        | 141532  | DIGITAL HiTESTER                  | HIOKI E.E. CORPORATION           | 3805                                                | 51201197                      | 01/17/2023            | 12      |
| RE        | MMM-09        | 141533  | DIGITAL HiTESTER                  | HIOKI E.E. CORPORATION           | 3805                                                | 51201195                      | 01/18/2023            | 12      |

## Test equipment (2/2)

| Test Item | Local ID | LIMS ID | Description                  | Manufacturer              | Model                                       | Serial            | Last Calibration Date | Cal Int |
|-----------|----------|---------|------------------------------|---------------------------|---------------------------------------------|-------------------|-----------------------|---------|
| RE        | MMM-10   | 141545  | DIGITAL HITESTER             | HIOKI E.E. CORPORATION    | 3805                                        | 51201148          | 01/18/2023            | 12      |
| RE        | MMX-01   | 142047  | Preselected Millimeter Mixer | Keysight Technologies Inc | 11974V-E01                                  | 3001A00412        | 11/25/2022            | 12      |
| RE        | MMX-02   | 142048  | Harmonic Mixer               | Keysight Technologies Inc | 11970W                                      | 2521 A01909       | 10/06/2022            | 12      |
| RE        | MOS-13   | 141554  | Thermo-Hygrometer            | CUSTOM. Inc               | CTH-201                                     | 1301              | 01/13/2023            | 12      |
| RE        | MOS-15   | 141562  | Thermo-Hygrometer            | CUSTOM. Inc               | CTH-201                                     | 0010              | 01/13/2023            | 12      |
| RE        | MOS-27   | 141566  | Thermo-Hygrometer            | CUSTOM. Inc               | CTH-201                                     | A08Q26            | 01/13/2023            | 12      |
| RE        | MPA-01   | 141576  | Pre Amplifier                | Keysight Technologies Inc | 8449B                                       | 3008A01671        | 02/14/2023            | 12      |
| RE        | MPA-11   | 141580  | MicroWave System Amplifier   | Keysight Technologies Inc | 83017A                                      | MY39500779        | 03/08/2023            | 12      |
| RE        | MPA-12   | 141581  | MicroWave System Amplifier   | Keysight Technologies Inc | 83017A                                      | 00650             | 10/05/2022            | 12      |
| RE        | MPA-13   | 141582  | Pre Amplifier                | SONOMA INSTRUMENT         | 310                                         | 260834            | 02/07/2023            | 12      |
| RE        | MPA-14   | 141583  | Pre Amplifier                | SONOMA INSTRUMENT         | 310                                         | 260833            | 04/05/2023            | 12      |
| RE        | MPA-22   | 141588  | Pre Amplifier                | L3 Narda-MITEQ            | AMF-6F-2600400-33-8P / AMF-4F-2600400-33-8P | 1871355 / 1871328 | 01/24/2023            | 12      |
| RE        | MPA-23   | 142055  | Power Amplifier              | SAGE Millimeter, Inc.     | SBP-5037532015-1515-N1                      | 11599-01          | 03/22/2023            | 12      |
| RE        | MPA-25   | 159919  | Power Amplifier              | SAGE Millimeter, Inc.     | SBP-4035033018-2F2F-S1                      | 12559-01          | 06/10/2022            | 12      |
| RE        | MPA-31   | 180607  | Power Amplifier              | SAGE Millimeter, Inc.     | SBP-7531142515-1010-E1                      | 17343-01          | 10/07/2022            | 12      |
| RE        | MSA-14   | 141901  | Spectrum Analyzer            | Keysight Technologies Inc | E4440A                                      | MY48250080        | 01/16/2023            | 12      |
| RE        | MSA-22   | 141978  | Spectrum Analyzer            | Keysight Technologies Inc | E4448A                                      | MY46180899        | 03/06/2023            | 12      |
| RE        | MTR-10   | 141951  | EMI Test Receiver            | Rohde & Schwarz           | ESR26                                       | 101408            | 07/25/2022            | 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