





RADIO TEST REPORT

Test Report No. 14858091H-C-R3

| | |
|---------------------|----------------------------------|
| Customer | ALPS ALPINE CO., LTD. |
| Description of EUT | Automatic access gesture control |
| Model Number of EUT | B2211 |
| FCC ID | CWTB2211 |
| Test Regulation | FCC Part 15 Subpart C |
| Test Result | Complied |
| Issue Date | December 27, 2023 |
| Remarks | - |

| | |
|--|--|
| Representative test engineer | Approved by |
|  |  |
| Junki Nagatomi Engineer | Ryota Yamanaka Engineer |
|   | |
| CERTIFICATE 5107.02 | |
| <input type="checkbox"/> The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc. | |
| <input checked="" type="checkbox"/> There is no testing item of "Non-accreditation". | |

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 22.0

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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. 14858091H-C

This report is a revised version of 14858091H-C-R2. 14858091H-C-R2 is replaced with this report.

| Revision | Test Report No. | Date | Page Revised Contents |
|-----------------|-----------------|-------------------|--|
| - (Original) | 14858091H-C | October 3, 2023 | - |
| 1 | 14858091H-C-R1 | December 18, 2023 | Correction of the measurement distance at "40 GHz to 50 GHz" in SECTION 5 (Page 15). from 0.5 m to 0.75 m |
| 1 | 14858091H-C-R1 | December 18, 2023 | Correction of the carrier frequency for Mode 1 (CW). (Page 18) from 24124.7 MHz to 24125.0 MHz |
| 1 | 14858091H-C-R1 | December 18, 2023 | The following corrections to the data on P.19; - Correction of the harmonic frequencies (3rd and 4th) to the multiplied for 24.125 GHz. - Removed spurious frequency at 24178.6 MHz and 24200.2 MHz. |
| 1 | 14858091H-C-R1 | December 18, 2023 | Correction of the Plot data for Mode 1 (CW) (Page 28). |
| 2 | 14858091H-C-R2 | December 26, 2023 | Correction of the Limit for 48353.4 MHz in Radiated Emission test (page 19); from "87.9 (QP/PK)", "67.9 (AV)" to "73.9 (QP/PK)", "53.9 (AV)" |
| 3 | 14858091H-C-R3 | December 27, 2023 | Correction of Plot data (page 28) |

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 | ALPS ALPINE CO., LTD. |
| Address | 6-3-36, Furukawanakazato, Osaki-city Miyagi-pref, 989-6181, Japan |
| Telephone Number | +81-229-23-5111 |
| Contact Person | Yuji Ouchi |

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 | Automatic access gesture control |
| Model Number | B2211 |
| Serial Number | Refer to SECTION 4.2 |
| Condition | Production prototype (Not for Sale: This sample is equivalent to mass-produced items.) |
| Modification | No Modification by the test lab |
| Receipt Date | September 5, 2023 |
| Test Date | September 5 to 12, 2023 |

2.2 Product Description

General Specification

| | |
|-----------------------|-------------------------|
| Rating | DC 13 V |
| Operating temperature | -40 deg. C to 85 deg. C |

Radio Specification

| | |
|------------------------|--|
| Equipment Type | Transceiver |
| Frequency of Operation | 24.026 GHz to 24.224 GHz (FMCW) 24.125 GHz (CW) |
| Type of Modulation | FMCW, CW |
| Antenna type | Tx: 2 patch antennas Rx: 4 patch antennas |
| Antenna Gain | 9.8 dBi |
| Usage location | Vehicle-mounted |

SECTION 3: Test specification, procedures & results

3.1 Test Specification

| | |
|--------------------|---|
| Test Specification | FCC Part 15 Subpart C The latest version on the first day of the testing period |
| Title | FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.249 Operation within the bands 902-928MHz, 2400-2483.5MHz, 5725-5875MHz and 24.0-24.25GHz |

3.2 Procedures and results

| No. | Item | Test Procedure | Specification | Worst margin | Results | Remarks |
|-----|---|---|--|---|----------|----------|
| 1 | Conducted Emission | ANSI C63.10-2013 6. Standard test methods | Section 15.207(a) | N/A | N/A | *1) |
| 2 | Electric Field Strength of Fundamental Emission | ANSI C63.10-2013 6. Standard test methods | Section 15.249(a)(c)(e) | 10.0 dB 24124.7 MHz, Horizontal, AV (Mode 1: CW) | Complied | Radiated |
| 3 | Electric Field Strength of Spurious Emission | ANSI C63.10-2013 6. Standard test methods 9. Procedures for testing millimeter-wave systems | Section 15.205(a)(b)(d) Section 15.209(a) Section 15.249(a)(c)(d)(e) | 1.0 dB 12062.4 MHz, Horizontal, AV (Mode 1: CW) | Complied | Radiated |
| 4 | 20dB Bandwidth | ANSI C63.10-2013 6. Standard test methods | FCC 15.215 | N/A | 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 stable voltage constantly to RF Module regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

The antenna is not removable from 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 % emission bandwidth | ISED: RSS-Gen 6.7 | ISED: - | 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 |

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.

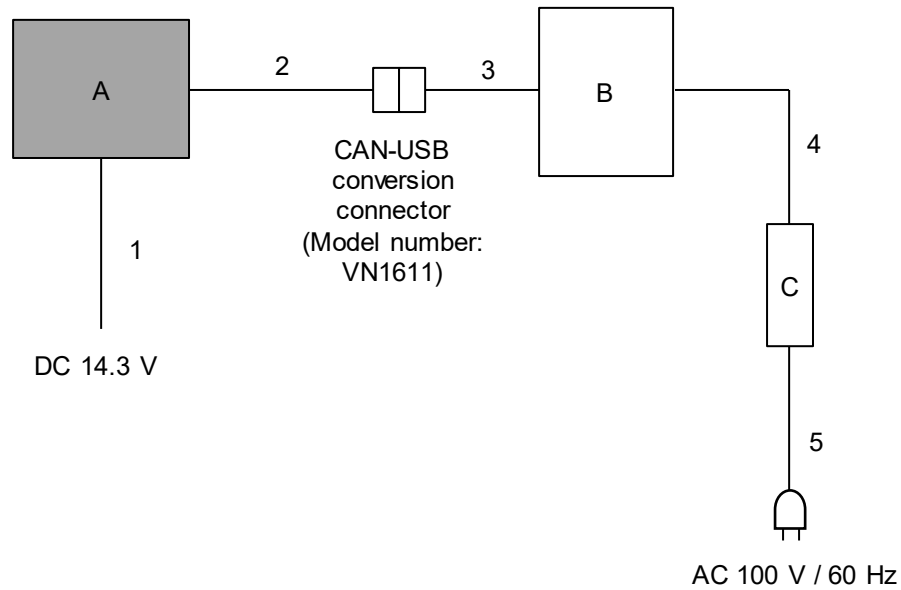
Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Modes

| Test Item | Mode | Tested frequency |
|---|---|--|
| - Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission) - 20 dB Bandwidth, 99 % Occupied Bandwidth - Duty Cycle | 1) Test mode - CW | 24.125 GHz |
| - Radiated Emission (Electric Field Strength of Fundamental Emission and Spurious Emission) | 2) Test mode - Frequency sweep stopped - FMCW | 24.026 GHz 24.125 GHz 24.224 GHz |
| The system was configured in typical fashion (as a customer would normally use it) for testing. | | |
| <p>*Power of the EUT was set by the software as follows;</p> <p>Power Setting: 00</p> <p>Software: [Frequency sweep (FMCW)] 5AB-01531Z14_wzPBL.srec (Date: 2023.09.04, Storage location: EUT memory)</p> <p>[Frequency sweep stopped (FMCW)] 5AB-01531Z13_wzPBL.srec (Date: 2023.09.04, Storage location: EUT memory)</p> <p>*This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.</p> | | |

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

| No. | Item | Model number | Serial number | Manufacturer | Remarks |
|-----|----------------------------------|--------------|--|-----------------------|---------|
| A | Automatic access gesture control | B2211 | 112304600000033 *1) 112304600000072 *2) | ALPS ALPINE CO., LTD. | EUT |
| B | Laptop PC | PC-VKT13HZG4 | 94037281A | NEC | - |
| C | AC Adapter | ADLX45YCC2C | 8SSA10E75852C1SG9 2FG2KL | NEC | - |

*1) Used for Mode 1

*2) Used for Mode 2

List of cables used

| No. | Name | Length (m) | Shield | | Remarks |
|-----|-----------|------------|------------|------------|---------|
| | | | Cable | Connector | |
| 1 | DC Cable | 4.0 | Unshielded | Unshielded | - |
| 2 | CAN Cable | 2.0 | Unshielded | Unshielded | - |
| 3 | USB Cable | 1.1 | Shielded | Shielded | - |
| 4 | DC Cable | 1.8 | Unshielded | Unshielded | - |
| 5 | AC Cable | 0.9 | 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 urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.

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 30 MHz to 1 GHz]

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The 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 urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.

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

The height of the measuring antenna varied between 1 m and 4 m (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 |

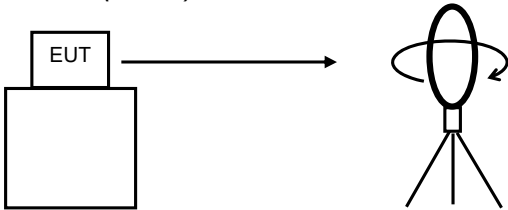
| | | | | | |
|-----------------|------------------|-------------------|-----------------|--------------------------|---|
| Frequency | 9 kHz to 150 kHz | 150 kHz to 30 MHz | 30 MHz to 1 GHz | 1 GHz to 40 GHz | |
| Instrument used | Test Receiver | Test Receiver | Test Receiver | Spectrum Analyzer | |
| Detector | QP, Average *1) | QP, Average *1) | QP | Peak | Average *2) |
| IF Bandwidth | BW 200 Hz | BW 9 kHz | BW 120 kHz | RBW: 1 MHz VBW: 3 MHz | Pulsed emission RBW: 1 MHz VBW: 3 MHz Peak with duty or RBW: 1 MHz VBW: 1/T Power 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.

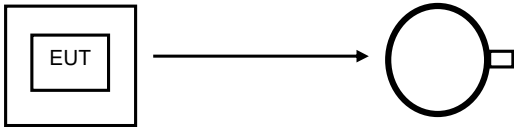
*2) For Pulsed emission (Fundamental and band-edge): The Average value was calculated by reducing Duty factor from Peak (Peak value – Duty factor). For Duty factor, please refer to page Duty factor measurement.

Figure 1: Direction of the Loop Antenna

Side View (Vertical)



Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)

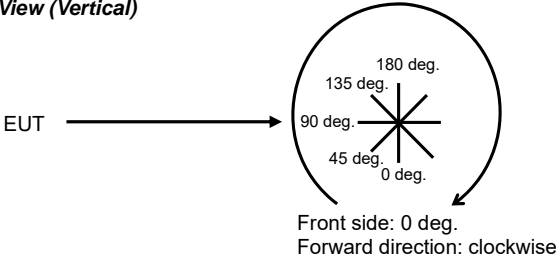
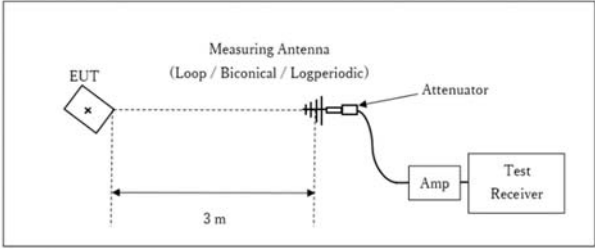


Figure 2: Test Setup

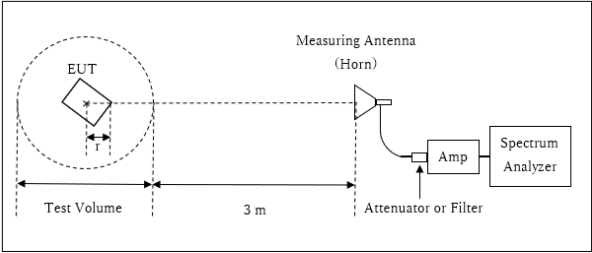
[Test setup]
 Below 1 GHz



x : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz

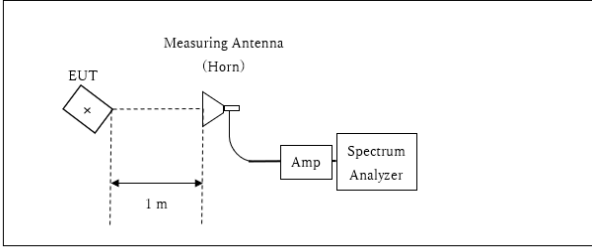


r : Radius of an outer periphery of EUT
 x : Center of turn table

Distance Factor: $20 \times \log(3.95 \text{ m}^* / 3.0 \text{ m}) = 2.4 \text{ dB}$
 * 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.)
 $r = 0.05 \text{ m}$

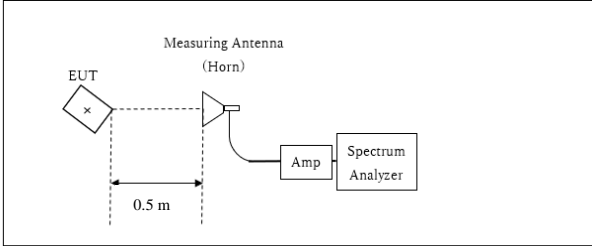
10 GHz to 26.5 GHz



x : Center of turn table

Distance Factor: $20 \times \log(1.0 \text{ m}^* / 3.0 \text{ m}) = -9.5 \text{ dB}$
 *Test Distance: 1 m

26.5 GHz to 40 GHz



x : Center of turn table

Distance Factor: $20 \times \log(0.5 \text{ m}^* / 3.0 \text{ m}) = -15.6 \text{ dB}$
 *Test Distance: 0.5 m

[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 [$300 / f$ (MHz) * 10^3], in millimeter

| Frequency [GHz] | Wavelength <i>Lambda</i> [mm] | Maximum Dimention | | | Far Field Boundary <i>r</i> [m] |
|--------------------|-------------------------------------|-------------------|---|----------------------------|--|
| | | EUT [m] | Test Antenna Local ID MHA-17 [m] | Maximum <i>D</i> [m] | |
| 24.224 | 12.4 | 0.004 | 0.058 | 0.058 | 0.544 |

[Above 40 GHz]

The test was performed based on “Procedures for testing millimeter-wave systems” of ANSI C63.10-2013. The EUT was placed on an urethane platform, raised 1.5 m above the conducting ground plane. The measurements were performed on handheld method.

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.

Note the maximum level indicated on the spectrum analyzer. Adjust this level, if necessary, by the antenna gain, conversion loss of the external mixer and gain of LNA used, at the frequency under investigation. Calculate the field strength of the emission at the measurement distance from the Friis’ transmission equation.

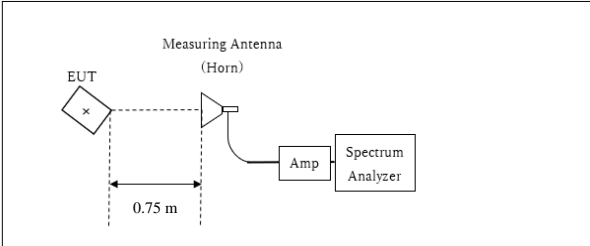
| Frequency | 40 GHz to 50 GHz | 50 GHz to 75 GHz | 75 GHz to 100 GHz |
|---|------------------|------------------|-------------------|
| Final measurement distance with 1 MHz Peak detector | 0.75 m | 0.75 m | 0.5 m |

| Detector | Peak | Average *1) |
|--------------|--------------------------|--|
| IF Bandwidth | RBW: 1 MHz VBW: 3 MHz | Pulsed emission RBW: 1 MHz VBW: 3 MHz Peak with duty or RBW: 1 MHz VBW: 1/T Power avg. |

*1) For Pulsed emission: The Average value was calculated by reducing Duty factor from Peak (Peak value - Duty factor). For Duty factor, please refer to page Duty factor measurement.

Figure 3: Test Setup

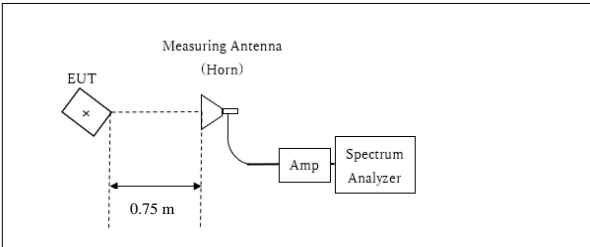
[Test setup]
40 GHz to 50 GHz



x : Center of turn table

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

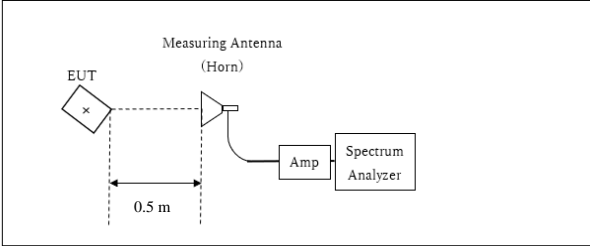
50 GHz to 75 GHz



x : Center of turn table

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

75 GHz to 100 GHz



x : Center of turn table

Distance Factor: $20 \times \log (0.5 \text{ m}^* / 3.0 \text{ m}) = -15.6 \text{ dB}$
*Test Distance: 0.5 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.

*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
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 | CW: 50 MHz FMCW: 500 MHz | CW: 100 kHz FMCW: 3 MHz 1 % to 5 % of OBW | CW: 300 kHz FMCW: 50 MHz Three times of RBW | CW: 35 sec MCW: 71 sec | Peak | Max Hold | Spectrum Analyzer |
| 99 % Occupied Bandwidth | CW: 50 MHz FMCW: 500 MHz Enough width to display emission skirts | Tx CW: 100 kHz Tx FMCW: 3 MHz 1 % to 5 % of OBW | CW: 300 kHz FMCW: 50 MHz Three times of RBW | CW: 35 sec Tx FMCW: 71 sec | Peak *1) | Max Hold *2) | Spectrum Analyzer |
| Duty Cycle | Zero | 8 MHz | 50 MHz | CW 45.32 msec FMCW 15.29 msec 100.5 msec | Peak | Single | Spectrum Analyzer |
| *1) Peak detector was applied as Worst-case measurement. *2) The measurement was performed with Max Hold since the duty cycle was not 100 %. | | | | | | | |

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.4 | No.4 | No.4 | No.4 | No.1 |
| Date | September 6, 2023 | September 6, 2023 | September 7, 2023 | September 7, 2023 | September 10, 2023 |
| Temperature / Humidity | 22 deg. C / 57 % RH | 22 deg. C / 57 % RH | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH | 23 deg. C / 51 % RH |
| Engineer | Sayaka Hara (26.5 GHz to 40 GHz) | Junki Nagatomi (10 GHz to 26.5 GHz) | Sayaka Hara (30 MHz to 10 GHz) | Junki Nagatomi (40 GHz to 100 GHz) | Yuichiro Yamazaki (9 kHz to 30 MHz) |
| Mode | Mode 1 (CW) | | | | |

[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 | 47.9 | 35.2 | 38.9 | -1.5 | 33.1 | 52.2 | 39.5 | 73.9 | 53.9 | 21.7 | 14.4 | Floor noise |
| Hori. | 24125.0 | 99.1 | 93.5 | 38.9 | -1.5 | 33.1 | 103.5 | 97.9 | 127.9 | 107.9 | 24.4 | 10.0 | AV:VBW 1/T Power Avg(RMS) |
| Hori. | 24250.0 | 47.4 | 37.0 | 38.9 | -1.5 | 33.0 | 51.8 | 41.5 | 73.9 | 53.9 | 22.1 | 12.5 | Floor noise |
| Vert. | 24000.0 | 48.0 | 35.3 | 38.9 | -1.5 | 33.1 | 52.3 | 39.6 | 73.9 | 53.9 | 21.6 | 14.3 | Floor noise |
| Vert. | 24125.0 | 98.7 | 93.2 | 38.9 | -1.5 | 33.1 | 103.0 | 97.5 | 127.9 | 107.9 | 24.9 | 10.4 | AV:VBW 1/T Power Avg(RMS) |
| Vert. | 24250.0 | 47.4 | 37.1 | 38.9 | -1.5 | 33.0 | 51.9 | 41.6 | 73.9 | 53.9 | 22.1 | 12.4 | 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 $20\log(1.00\text{ m} / 3.00\text{ m}) = -9.5\text{ dB}$

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

| | | | | | |
|------------------------|----------------------------------|-------------------------------------|--------------------------------|------------------------------------|-------------------------------------|
| Test place | Ise EMC Lab. | | | | |
| Semi Anechoic Chamber | No.4 | No.4 | No.4 | No.4 | No.1 |
| Date | September 6, 2023 | September 6, 2023 | September 7, 2023 | September 7, 2023 | September 10, 2023 |
| Temperature / Humidity | 22 deg. C / 57 % RH | 22 deg. C / 57 % RH | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH | 23 deg. C / 51 % RH |
| Engineer | Sayaka Hara (26.5 GHz to 40 GHz) | Junki Nagatomi (10 GHz to 26.5 GHz) | Sayaka Hara (30 MHz to 10 GHz) | Junki Nagatomi (40 GHz to 100 GHz) | Yuichiro Yamazaki (9 kHz to 30 MHz) |
| Mode | Mode 1 (CW) | | | | |

[Spurious emissions other than above]

| 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. | 32.2 | 20.6 | - | 17.7 | 7.1 | 32.2 | 13.2 | - | 40.0 | - | 26.8 | - | Floor noise |
| Hori. | 52.3 | 21.2 | - | 10.3 | 7.4 | 32.2 | 6.7 | - | 40.0 | - | 33.3 | - | |
| Hori. | 73.7 | 24.6 | - | 6.4 | 7.6 | 32.1 | 6.5 | - | 40.0 | - | 33.5 | - | |
| Hori. | 213.2 | 25.5 | - | 11.1 | 8.9 | 32.0 | 13.5 | - | 43.5 | - | 30.0 | - | |
| Hori. | 620.4 | 20.9 | - | 19.6 | 11.4 | 31.9 | 19.9 | - | 46.0 | - | 26.1 | - | Floor noise |
| Hori. | 771.9 | 21.5 | - | 20.5 | 11.9 | 31.5 | 22.3 | - | 46.0 | - | 23.7 | - | Floor noise |
| Hori. | 12062.4 | 55.5 | 50.6 | 39.1 | -4.0 | 32.7 | 57.8 | 52.9 | 73.9 | 53.9 | 16.1 | 1.0 | AV:VBW 1/T Power Avg(RMS) |
| Hori. | 12092.1 | 55.9 | 37.5 | 39.1 | -4.0 | 32.7 | 58.3 | 39.9 | 73.9 | 53.9 | 15.6 | 14.0 | AV:VBW 1/T Power Avg(RMS) |
| Hori. | 48250.0 | 64.4 | 55.5 | 41.7 | -3.9 | 32.6 | 69.6 | 60.7 | 87.9 | 67.9 | 18.3 | 7.3 | AV:VBW 1/T Power Avg(RMS) |
| Hori. | 48353.4 | 58.8 | 40.3 | 41.7 | -3.9 | 32.6 | 64.1 | 45.6 | 73.9 | 53.9 | 9.8 | 8.3 | AV:VBW 1/T Power Avg(RMS) |
| Hori. | 72375.0 | 36.6 | 25.3 | 43.1 | 6.3 | 21.2 | 64.7 | 53.4 | 87.9 | 67.9 | 23.2 | 14.5 | Floor noise |
| Hori. | 86409.6 | 50.0 | 37.9 | 45.2 | -5.3 | 30.7 | 59.2 | 47.1 | 73.9 | 53.9 | 14.7 | 6.8 | AV:VBW 1/T Power Avg(RMS) |
| Hori. | 96070.7 | 52.3 | 39.4 | 45.7 | -3.8 | 34.6 | 59.6 | 46.7 | 73.9 | 53.9 | 14.3 | 7.2 | AV:VBW 1/T Power Avg(RMS) |
| Hori. | 96500.0 | 49.5 | 40.2 | 45.6 | -4.3 | 35.0 | 55.9 | 46.6 | 73.9 | 53.9 | 18.0 | 7.3 | Floor noise |
| Vert. | 32.2 | 20.6 | - | 17.7 | 7.1 | 32.2 | 13.2 | - | 40.0 | - | 26.8 | - | Floor noise |
| Vert. | 52.3 | 28.2 | - | 10.3 | 7.4 | 32.2 | 13.7 | - | 40.0 | - | 26.3 | - | |
| Vert. | 73.7 | 33.8 | - | 6.4 | 7.6 | 32.1 | 15.7 | - | 40.0 | - | 24.3 | - | |
| Vert. | 329.7 | 25.7 | - | 14.6 | 9.8 | 32.0 | 18.2 | - | 46.0 | - | 27.8 | - | |
| Vert. | 620.4 | 20.9 | - | 19.6 | 11.4 | 31.9 | 19.9 | - | 46.0 | - | 26.1 | - | Floor noise |
| Vert. | 771.9 | 21.5 | - | 20.5 | 11.9 | 31.5 | 22.3 | - | 46.0 | - | 23.7 | - | Floor noise |
| Vert. | 12062.4 | 55.7 | 50.4 | 39.1 | -4.0 | 32.7 | 58.1 | 52.8 | 73.9 | 53.9 | 15.8 | 1.1 | AV:VBW 1/T Power Avg(RMS) |
| Vert. | 12092.1 | 55.1 | 37.2 | 39.1 | -4.0 | 32.7 | 57.5 | 39.6 | 73.9 | 53.9 | 16.4 | 14.3 | AV:VBW 1/T Power Avg(RMS) |
| Vert. | 48250.0 | 58.1 | 48.9 | 41.7 | -3.9 | 32.6 | 63.3 | 54.1 | 87.9 | 67.9 | 24.6 | 13.8 | AV:VBW 1/T Power Avg(RMS) |
| Vert. | 48353.4 | 54.9 | 41.6 | 41.7 | -3.9 | 32.6 | 60.2 | 46.9 | 73.9 | 53.9 | 13.7 | 7.0 | AV:VBW 1/T Power Avg(RMS) |
| Vert. | 72375.0 | 36.6 | 25.3 | 43.1 | 6.3 | 21.2 | 64.7 | 53.4 | 87.9 | 67.9 | 23.3 | 14.5 | Floor noise |
| Vert. | 86409.6 | 54.0 | 38.0 | 45.2 | -5.3 | 30.7 | 63.1 | 47.1 | 73.9 | 53.9 | 10.8 | 6.8 | AV:VBW 1/T Power Avg(RMS) |
| Vert. | 96070.7 | 54.5 | 39.5 | 45.7 | -3.8 | 34.6 | 61.8 | 46.8 | 73.9 | 53.9 | 12.1 | 7.1 | AV:VBW 1/T Power Avg(RMS) |
| Vert. | 96500.0 | 49.6 | 40.2 | 45.6 | -4.3 | 35.0 | 56.0 | 46.6 | 73.9 | 53.9 | 18.0 | 7.3 | Floor noise |

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

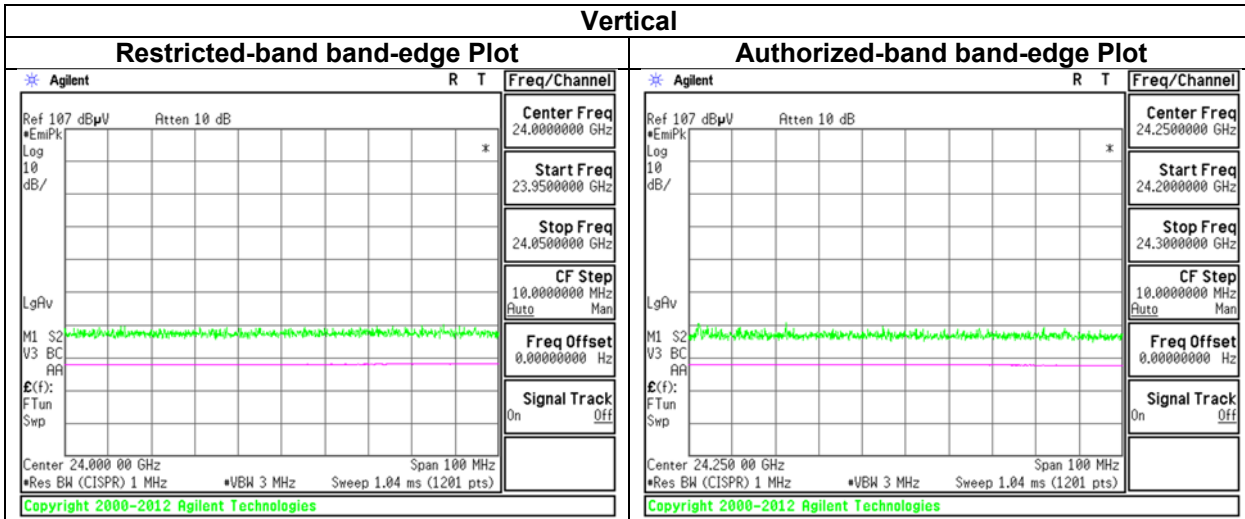
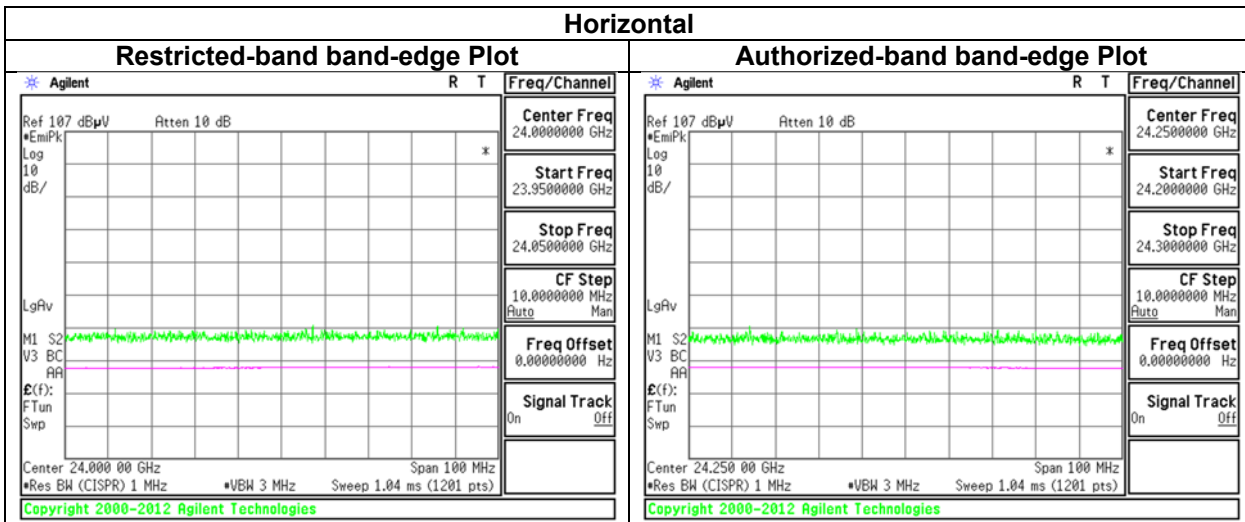
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

*QP detector was used up to 1GHz.

| | | |
|------------------|--------------------|------------------------------------|
| Distance factor: | 1 GHz to 10 GHz | 20log (3.95 m / 3.00 m) = 2.4 dB |
| | 10 GHz to 18 GHz | 20log (1.00 m / 3.00 m) = -9.5 dB |
| | 18 GHz to 26.5 GHz | 20log (1.00 m / 3.00 m) = -9.5 dB |
| | 26.5 GHz to 40 GHz | 20log (0.50 m / 3.00 m) = -15.6 dB |
| | 40 GHz to 50 GHz | 20log (0.75 m / 3.00 m) = -12.0 dB |
| | 50 GHz to 75 GHz | 20log (0.75 m / 3.00 m) = -12.0 dB |
| | 75 GHz to 100 GHz | 20log (0.50 m / 3.00 m) = -15.6 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.4 |
| Date | September 6, 2023 |
| Temperature / Humidity | 22 deg. C / 57 % RH |
| Engineer | Junki Nagatomi |
| Mode | Mode 1 (CW) |



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

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

| | | | | | |
|------------------------|----------------------------------|--------------------------------|------------------------------------|----------------------------------|-------------------------------------|
| Test place | Ise EMC Lab. | | | | |
| Semi Anechoic Chamber | No.4 | No.4 | No.4 | No.4 | No.1 |
| Date | September 6, 2023 | September 7, 2023 | September 7, 2023 | September 8, 2023 | September 10, 2023 |
| Temperature / Humidity | 22 deg. C / 57 % RH | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH | 23 deg. C / 57 % RH | 23 deg. C / 51 % RH |
| Engineer | Sayaka Hara (26.5 GHz to 40 GHz) | Sayaka Hara (30 MHz to 10 GHz) | Junki Nagatomi (40 GHz to 100 GHz) | Sayaka Hara (10 GHz to 26.5 GHz) | Yuichiro Yamazaki (9 kHz to 30 MHz) |
| Mode | Mode 2 Tx 24.026 GHz | | | | |

[Fundamental and Band-edge]

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [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 | 49.0 | 35.5 | 38.9 | -1.5 | 33.1 | - | 53.3 | 39.8 | 73.9 | 53.9 | 20.6 | 14.1 | Floor noise |
| Hori. | 24026.0 | 99.0 | - | 38.9 | -1.5 | 33.1 | -30.5 | 103.3 | 72.8 | 127.9 | 107.9 | 24.6 | 35.1 | AV : PK with duty factor *1) |
| Vert. | 24000.0 | 49.0 | 35.3 | 38.9 | -1.5 | 33.1 | - | 53.3 | 39.6 | 73.9 | 53.9 | 20.6 | 14.3 | Floor noise |
| Vert. | 24026.0 | 98.0 | - | 38.9 | -1.5 | 33.1 | -30.5 | 102.3 | 72.8 | 127.9 | 107.9 | 25.6 | 35.1 | AV : PK with duty factor *1) |

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.

*1) PK with Duty factor : Result (AV)= Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor(Refer to Duty factor sheet)

Distance factor: 18 GHz to 26.5 GHz 20log (1.00 m / 3.00 m) = -9.5 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] | Duty Factor [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. | 12013.0 | 54.1 | - | 39.1 | -4.0 | 32.8 | -30.5 | 56.4 | 25.9 | 73.9 | 53.9 | 17.5 | 28.0 | AV : PK with duty factor *1) |
| Hori. | 48052.0 | 63.7 | - | 41.6 | -3.9 | 32.7 | -30.5 | 68.7 | 38.2 | 87.9 | 67.9 | 19.2 | 29.7 | AV : PK with duty factor *1) |
| Hori. | 72078.0 | 38.1 | 29.3 | 43.1 | 5.8 | 21.0 | - | 66.0 | 57.2 | 87.9 | 67.9 | 22.0 | 10.7 | Floor noise |
| Hori. | 96104.0 | 50.4 | - | 45.7 | -3.8 | 34.6 | -30.5 | 57.7 | 27.2 | 73.9 | 53.9 | 16.2 | 26.7 | AV : PK with duty factor *1) |
| Vert. | 12013.0 | 54.7 | - | 39.1 | -4.0 | 32.8 | -30.5 | 57.0 | 26.5 | 73.9 | 53.9 | 16.9 | 27.5 | AV : PK with duty factor *1) |
| Vert. | 48052.0 | 59.2 | - | 41.6 | -3.9 | 32.7 | -30.5 | 64.2 | 33.7 | 87.9 | 67.9 | 23.7 | 34.2 | AV : PK with duty factor *1) |
| Vert. | 72078.0 | 38.1 | 29.3 | 43.1 | 5.8 | 21.0 | - | 66.0 | 57.2 | 87.9 | 67.9 | 21.9 | 10.7 | Floor noise |
| Vert. | 96104.0 | 51.7 | - | 45.7 | -3.8 | 34.6 | -30.5 | 59.0 | 28.5 | 73.9 | 53.9 | 14.9 | 25.4 | AV : PK with duty factor *1) |

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).

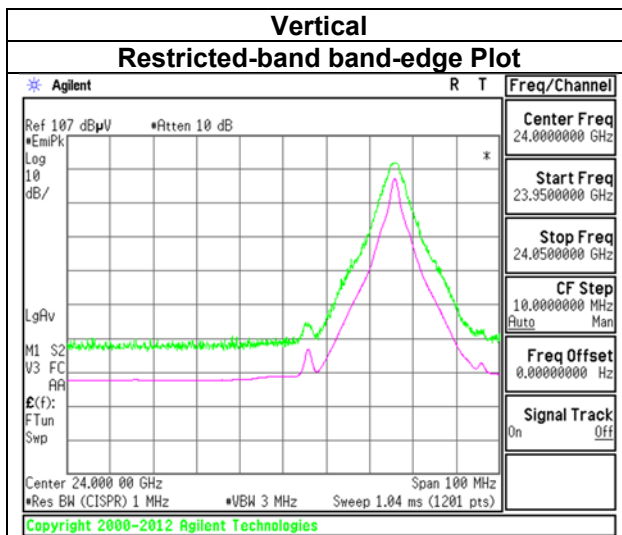
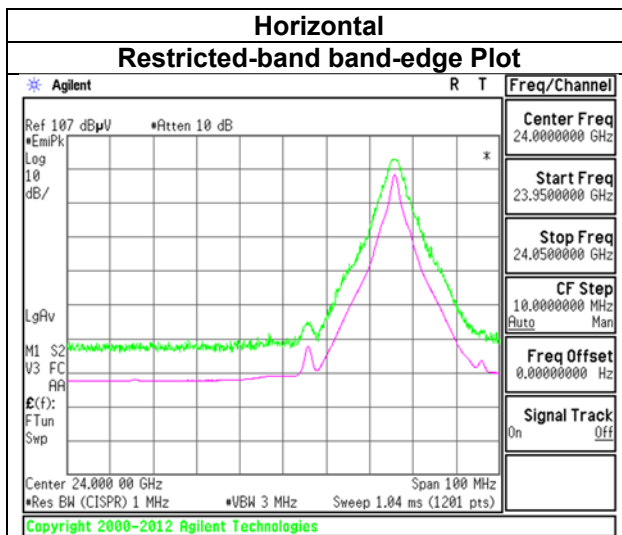
*QP detector was used up to 1GHz.

*1) PK with Duty factor : Result (AV)= Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor(Refer to Duty factor sheet)

Distance factor: 1 GHz to 10 GHz 20log (3.95 m / 3.00 m) = 2.4 dB
 10 GHz to 18 GHz 20log (1.00 m / 3.00 m) = -9.5 dB
 18 GHz to 26.5 GHz 20log (1.00 m / 3.00 m) = -9.5 dB
 26.5 GHz to 40 GHz 20log (0.50 m / 3.00 m) = -15.6 dB
 40 GHz to 50 GHz 20log (0.75 m / 3.00 m) = -12.0 dB
 50 GHz to 75 GHz 20log (0.75 m / 3.00 m) = -12.0 dB
 75 GHz to 100 GHz 20log (0.50 m / 3.00 m) = -15.6 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.4 |
| Date | September 8, 2023 |
| Temperature / Humidity | 23 deg. C / 57 % RH |
| Engineer | Sayaka Hara |
| Mode | Mode 2 Tx 24.026 GHz |



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

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

| | | | | | |
|------------------------|----------------------------------|--------------------------------|------------------------------------|----------------------------------|-------------------------------------|
| Test place | Ise EMC Lab. | | | | |
| Semi Anechoic Chamber | No.4 | No.4 | No.4 | No.4 | No.1 |
| Date | September 6, 2023 | September 7, 2023 | September 7, 2023 | September 8, 2023 | September 10, 2023 |
| Temperature / Humidity | 22 deg. C / 57 % RH | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH | 23 deg. C / 57 % RH | 23 deg. C / 51 % RH |
| Engineer | Sayaka Hara (26.5 GHz to 40 GHz) | Sayaka Hara (30 MHz to 10 GHz) | Junki Nagatomi (40 GHz to 100 GHz) | Sayaka Hara (10 GHz to 26.5 GHz) | Yuichiro Yamazaki (9 kHz to 30 MHz) |
| Mode | Mode 2 Tx 24.125 GHz | | | | |

[Fundamental and Band-edge]

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [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. | 24125.0 | 98.4 | - | 38.9 | -1.5 | 33.1 | -30.5 | 102.8 | 72.3 | 127.9 | 107.9 | 25.1 | 35.7 | AV: PK with duty factor *1) |
| Vert. | 24125.0 | 97.5 | - | 38.9 | -1.5 | 33.1 | -30.5 | 101.8 | 71.3 | 127.9 | 107.9 | 26.1 | 36.6 | AV: PK with duty factor *1) |

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.

*1) PK with Duty factor : Result (AV)= Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor(Refer to Duty factor sheet)

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] | Duty Factor [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. | 12062.5 | 54.3 | - | 39.1 | -4.0 | 32.7 | -30.5 | 56.7 | 26.2 | 73.9 | 53.9 | 17.2 | 27.7 | AV: PK with duty factor *1) |
| Hori. | 48250.0 | 62.0 | - | 41.7 | -3.9 | 32.6 | -30.5 | 67.2 | 36.7 | 87.9 | 67.9 | 20.7 | 31.2 | AV: PK with duty factor *1) |
| Hori. | 72375.0 | 38.0 | 29.6 | 43.1 | 6.2 | 21.2 | - | 66.0 | 57.6 | 87.9 | 67.9 | 21.9 | 10.3 | Floor noise |
| Hori. | 96500.0 | 51.8 | - | 45.7 | -3.8 | 34.9 | -30.5 | 58.7 | 28.2 | 73.9 | 53.9 | 15.2 | 25.7 | AV: PK with duty factor *1) |
| Vert. | 12062.5 | 55.0 | - | 39.1 | -4.0 | 32.7 | -30.5 | 57.4 | 26.8 | 73.9 | 53.9 | 16.6 | 27.1 | AV: PK with duty factor *1) |
| Vert. | 48250.0 | 59.0 | - | 41.7 | -3.9 | 32.6 | -30.5 | 64.2 | 33.7 | 87.9 | 67.9 | 23.7 | 34.2 | AV: PK with duty factor *1) |
| Vert. | 72375.0 | 38.0 | 29.6 | 43.1 | 6.2 | 21.2 | - | 66.0 | 57.6 | 87.9 | 67.9 | 21.9 | 10.3 | Floor noise |
| Vert. | 96500.0 | 51.3 | - | 45.7 | -3.8 | 34.9 | -30.5 | 58.2 | 27.7 | 73.9 | 53.9 | 15.7 | 26.2 | AV: PK with duty factor *1) |

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.

*1) PK with Duty factor : Result (AV)= Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor(Refer to Duty factor sheet)

Distance factor: 1 GHz to 10 GHz $20\log(3.95\text{ m} / 3.00\text{ m}) = 2.4\text{ dB}$
 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 $20\log(0.50\text{ m} / 3.00\text{ m}) = -15.6\text{ dB}$
 40 GHz to 50 GHz $20\log(0.75\text{ m} / 3.00\text{ m}) = -12.0\text{ dB}$
 50 GHz to 75 GHz $20\log(0.75\text{ m} / 3.00\text{ m}) = -12.0\text{ dB}$
 75 GHz to 100 GHz $20\log(0.50\text{ m} / 3.00\text{ m}) = -15.6\text{ dB}$

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

| | | | | | |
|------------------------|----------------------------------|--------------------------------|------------------------------------|----------------------------------|-------------------------------------|
| Test place | Ise EMC Lab. | | | | |
| Semi Anechoic Chamber | No.4 | No.4 | No.4 | No.4 | No.1 |
| Date | September 6, 2023 | September 7, 2023 | September 7, 2023 | September 8, 2023 | September 10, 2023 |
| Temperature / Humidity | 22 deg. C / 57 % RH | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH | 23 deg. C / 57 % RH | 23 deg. C / 51 % RH |
| Engineer | Sayaka Hara (26.5 GHz to 40 GHz) | Sayaka Hara (30 MHz to 10 GHz) | Junki Nagatomi (40 GHz to 100 GHz) | Sayaka Hara (10 GHz to 26.5 GHz) | Yuichiro Yamazaki (9 kHz to 30 MHz) |
| Mode | Mode 2 Tx 24.224 GHz | | | | |

[Fundamental and Band-edge]

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [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. | 24224.0 | 98.3 | - | 38.9 | -1.5 | 33.0 | -30.5 | 102.7 | 72.2 | 127.9 | 107.9 | 25.2 | 35.7 | AV: PK with duty factor *1) |
| Hori. | 24250.0 | 48.1 | 36.1 | 38.9 | -1.5 | 33.0 | - | 52.5 | 40.5 | 73.9 | 53.9 | 21.4 | 13.4 | Floor noise |
| Vert. | 24224.0 | 97.5 | - | 38.9 | -1.5 | 33.0 | -30.5 | 101.9 | 71.4 | 127.9 | 107.9 | 26.0 | 36.5 | AV: PK with duty factor *1) |
| Vert. | 24250.0 | 48.2 | 35.3 | 38.9 | -1.5 | 33.0 | - | 52.6 | 39.8 | 73.9 | 53.9 | 21.3 | 14.1 | 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: 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] | Duty Factor [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. | 12112.0 | 53.8 | - | 39.1 | -4.0 | 32.7 | -30.5 | 56.2 | 25.7 | 73.9 | 53.9 | 17.7 | 28.3 | AV: PK with duty factor *1) |
| Hori. | 48448.0 | 62.5 | - | 41.7 | -3.9 | 32.5 | -30.5 | 67.8 | 37.3 | 87.9 | 67.9 | 20.1 | 30.6 | AV: PK with duty factor *1) |
| Hori. | 72672.0 | 37.7 | 29.3 | 43.1 | 6.5 | 21.4 | - | 65.9 | 57.5 | 87.9 | 67.9 | 22.0 | 10.4 | Floor noise |
| Hori. | 96896.0 | 49.8 | - | 45.6 | -4.3 | 35.2 | -30.5 | 56.0 | 25.5 | 73.9 | 53.9 | 17.9 | 28.4 | AV: PK with duty factor *1) |
| Vert. | 12112.0 | 54.6 | - | 39.1 | -4.0 | 32.7 | -30.5 | 57.0 | 26.5 | 73.9 | 53.9 | 16.9 | 27.4 | AV: PK with duty factor *1) |
| Vert. | 48448.0 | 58.6 | - | 41.7 | -3.9 | 32.5 | -30.5 | 64.0 | 33.5 | 87.9 | 67.9 | 23.9 | 34.4 | AV: PK with duty factor *1) |
| Vert. | 72672.0 | 37.7 | 29.3 | 43.1 | 6.5 | 21.4 | - | 65.9 | 57.5 | 87.9 | 67.9 | 22.0 | 10.4 | Floor noise |
| Vert. | 96896.0 | 51.0 | - | 45.6 | -4.3 | 35.2 | -30.5 | 57.2 | 26.7 | 73.9 | 53.9 | 16.7 | 27.3 | AV: PK with duty factor *1) |

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.

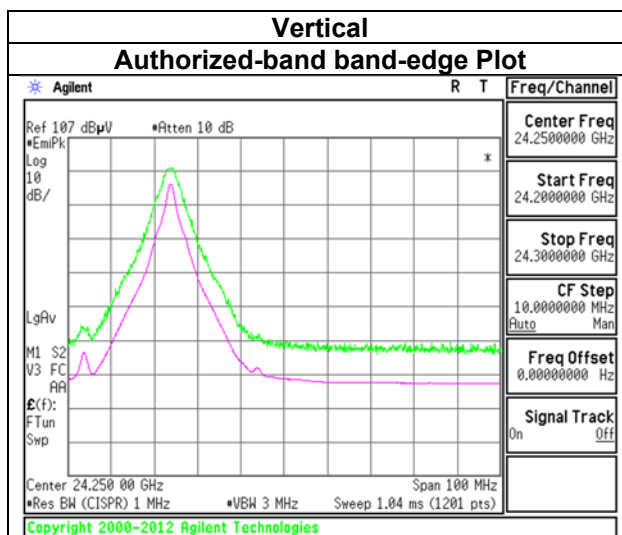
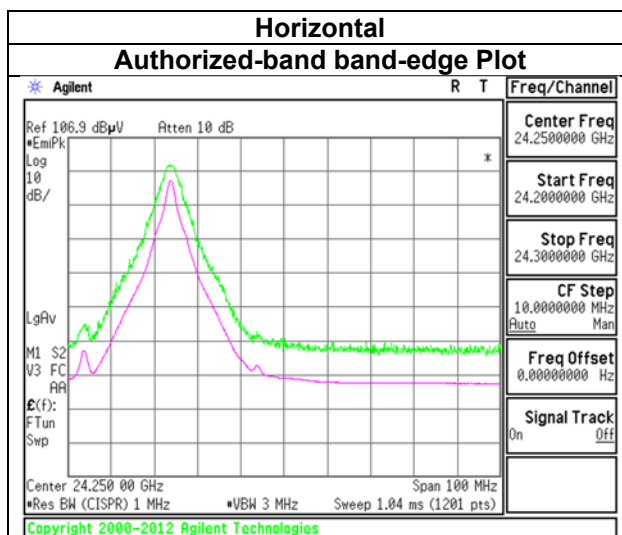
*1) PK with Duty factor : Result (AV)= Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor(Refer to Duty factor sheet)

Distance factor:

| | |
|--------------------|---|
| 1 GHz to 10 GHz | $20\log(3.95\text{ m} / 3.00\text{ m}) = 2.4\text{ dB}$ |
| 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 | $20\log(0.50\text{ m} / 3.00\text{ m}) = -15.6\text{ dB}$ |
| 40 GHz to 50 GHz | $20\log(0.75\text{ m} / 3.00\text{ m}) = -12.0\text{ dB}$ |
| 50 GHz to 75 GHz | $20\log(0.75\text{ m} / 3.00\text{ m}) = -12.0\text{ dB}$ |
| 75 GHz to 100 GHz | $20\log(0.50\text{ m} / 3.00\text{ m}) = -15.6\text{ dB}$ |

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

| | |
|------------------------|----------------------|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | September 8, 2023 |
| Temperature / Humidity | 23 deg. C / 57 % RH |
| Engineer | Sayaka Hara |
| Mode | Mode 2 Tx 24.224 GHz |



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

Radiated Emission (Electric Field Strength of Spurious Emission)

| | | | | | |
|------------------------|----------------------------------|--------------------------------|------------------------------------|----------------------------------|-------------------------------------|
| Test place | Ise EMC Lab. | | | | |
| Semi Anechoic Chamber | No.4 | No.4 | No.4 | No.4 | No.1 |
| Date | September 6, 2023 | September 7, 2023 | September 7, 2023 | September 8, 2023 | September 10, 2023 |
| Temperature / Humidity | 22 deg. C / 57 % RH | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH | 23 deg. C / 57 % RH | 23 deg. C / 51 % RH |
| Engineer | Sayaka Hara (26.5 GHz to 40 GHz) | Sayaka Hara (30 MHz to 10 GHz) | Junki Nagatomi (40 GHz to 100 GHz) | Sayaka Hara (10 GHz to 26.5 GHz) | Yuichiro Yamazaki (9 kHz to 30 MHz) |
| Mode | Mode 2 (FMCW) | | | | |

[Band-edge]

| Polarity [Hori/Vert] | Frequency [MHz] | Reading (QP / PK) [dBuV] | Reading (AV) [dBuV] | Ant. Factor [dB/m] | Loss [dB] | Gain [dB] | Duty Factor [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 | 49.0 | 35.5 | 38.9 | -1.5 | 33.1 | - | 53.3 | 39.8 | 73.9 | 53.9 | 20.6 | 14.1 | Floor noise |
| Hori. | 24250.0 | 48.1 | 36.1 | 38.9 | -1.5 | 33.0 | - | 52.5 | 40.5 | 73.9 | 53.9 | 21.4 | 13.4 | Floor noise |

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+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.

*1) PK with Duty factor: Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor(Refer to Duty factor sheet)

[Spurious emissions other than above]

| 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. | 32.0 | 20.5 | - | 17.8 | 7.1 | 32.2 | 13.2 | - | 40.0 | - | 26.8 | - | Floor noise |
| Hori. | 52.5 | 20.6 | - | 10.2 | 7.4 | 32.2 | 6.0 | - | 40.0 | - | 34.0 | - | |
| Hori. | 73.9 | 24.2 | - | 6.4 | 7.6 | 32.1 | 6.1 | - | 40.0 | - | 33.9 | - | |
| Hori. | 212.7 | 25.3 | - | 11.1 | 8.9 | 32.0 | 13.3 | - | 43.5 | - | 30.2 | - | |
| Hori. | 635.2 | 20.7 | - | 19.5 | 11.4 | 31.9 | 19.7 | - | 46.0 | - | 26.3 | - | Floor noise |
| Hori. | 783.5 | 21.3 | - | 20.6 | 11.9 | 31.5 | 22.4 | - | 46.0 | - | 23.6 | - | Floor noise |
| Vert. | 32.0 | 20.5 | - | 17.8 | 7.1 | 32.2 | 13.2 | - | 40.0 | - | 26.8 | - | Floor noise |
| Vert. | 52.5 | 28.3 | - | 10.2 | 7.4 | 32.2 | 13.7 | - | 40.0 | - | 26.3 | - | |
| Vert. | 73.9 | 35.0 | - | 6.4 | 7.6 | 32.1 | 16.9 | - | 40.0 | - | 23.1 | - | |
| Vert. | 329.2 | 24.8 | - | 14.6 | 9.8 | 32.0 | 17.3 | - | 46.0 | - | 28.8 | - | |
| Vert. | 635.2 | 20.7 | - | 19.5 | 11.4 | 31.9 | 19.7 | - | 46.0 | - | 26.3 | - | Floor noise |
| Vert. | 782.8 | 21.3 | - | 20.6 | 11.9 | 31.5 | 22.4 | - | 46.0 | - | 23.7 | - | Floor noise |

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

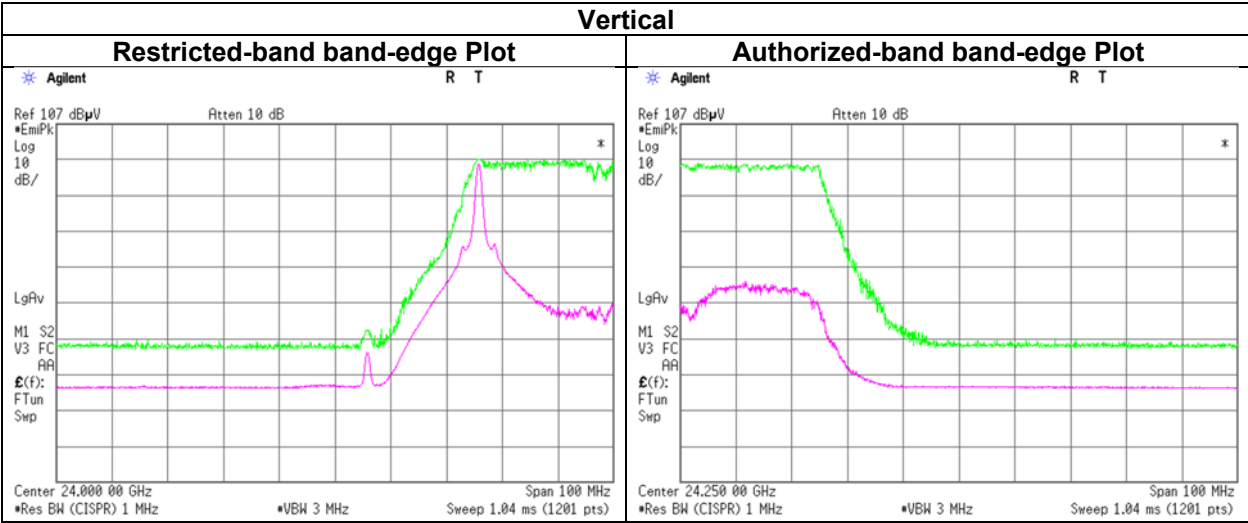
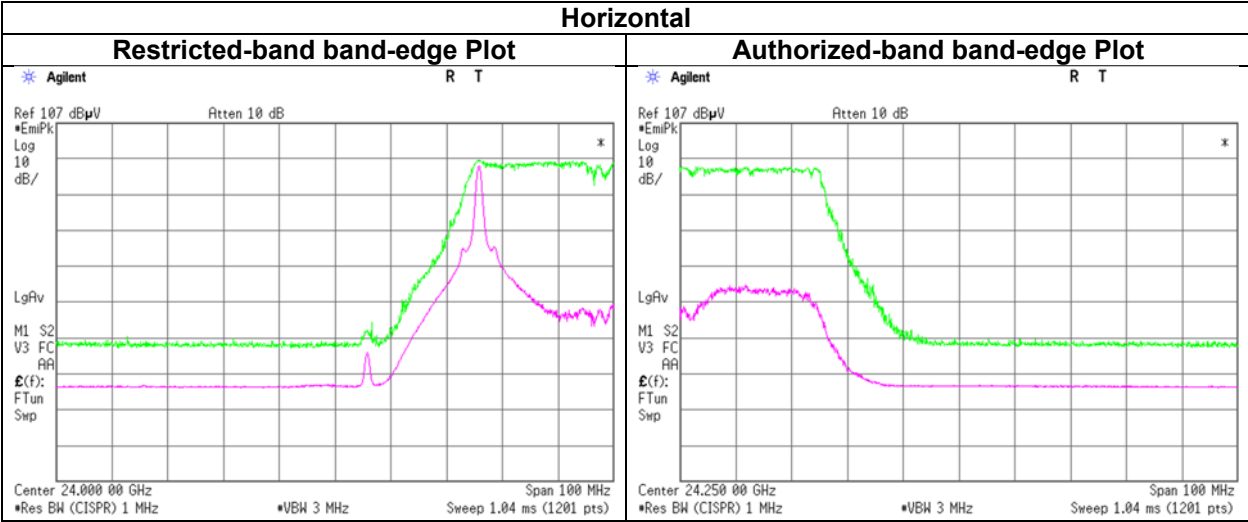
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

*QP detector was used up to 1GHz.

| | | |
|------------------|--------------------|------------------------------------|
| Distance factor: | 1 GHz to 10 GHz | 20log (3.95 m / 3.00 m) = 2.4 dB |
| | 10 GHz to 18 GHz | 20log (1.00 m / 3.00 m) = -9.5 dB |
| | 18 GHz to 26.5 GHz | 20log (1.00 m / 3.00 m) = -9.5 dB |
| | 26.5 GHz to 40 GHz | 20log (0.50 m / 3.00 m) = -15.6 dB |
| | 40 GHz to 50 GHz | 20log (0.75 m / 3.00 m) = -12.0 dB |
| | 50 GHz to 75 GHz | 20log (0.75 m / 3.00 m) = -12.0 dB |
| | 75 GHz to 100 GHz | 20log (0.50 m / 3.00 m) = -15.6 dB |

Radiated Emission (Electric Field Strength of Spurious Emission)

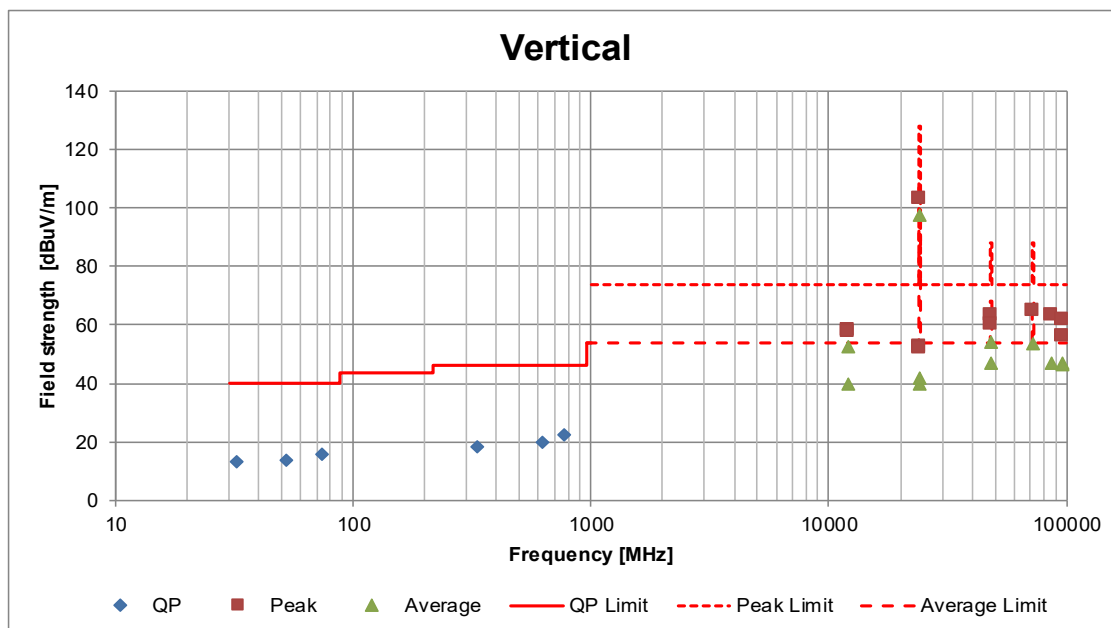
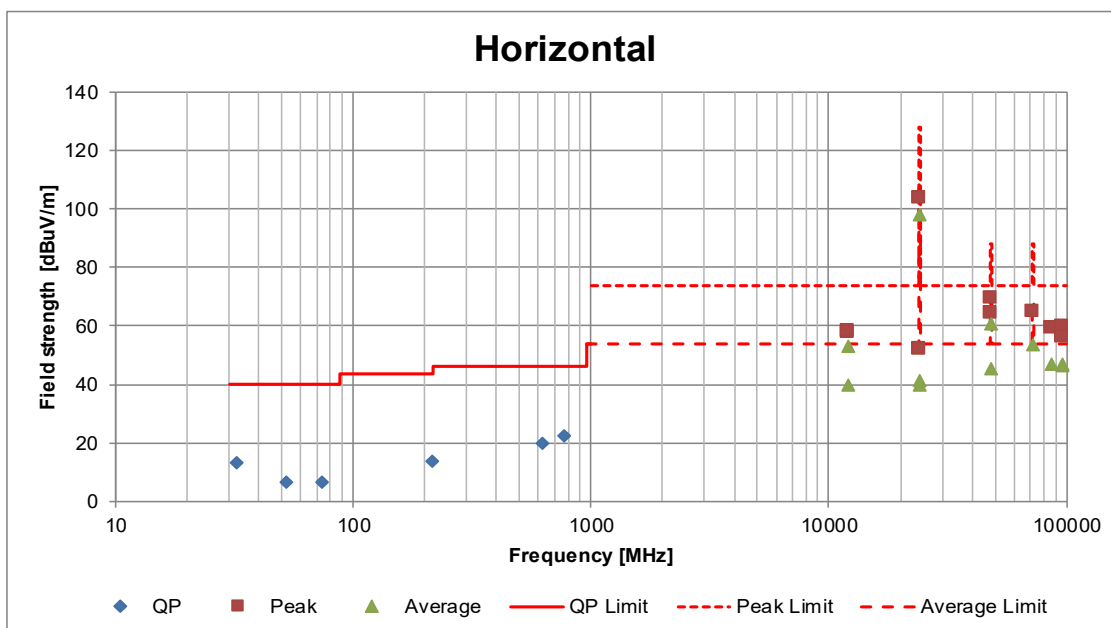
| | |
|------------------------|---------------------|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | September 8, 2023 |
| Temperature / Humidity | 23 deg. C / 57 % RH |
| Engineer | Sayaka Hara |
| Mode | Mode 2 (FMCW) |



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

Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission) (Plot data, Worst case)

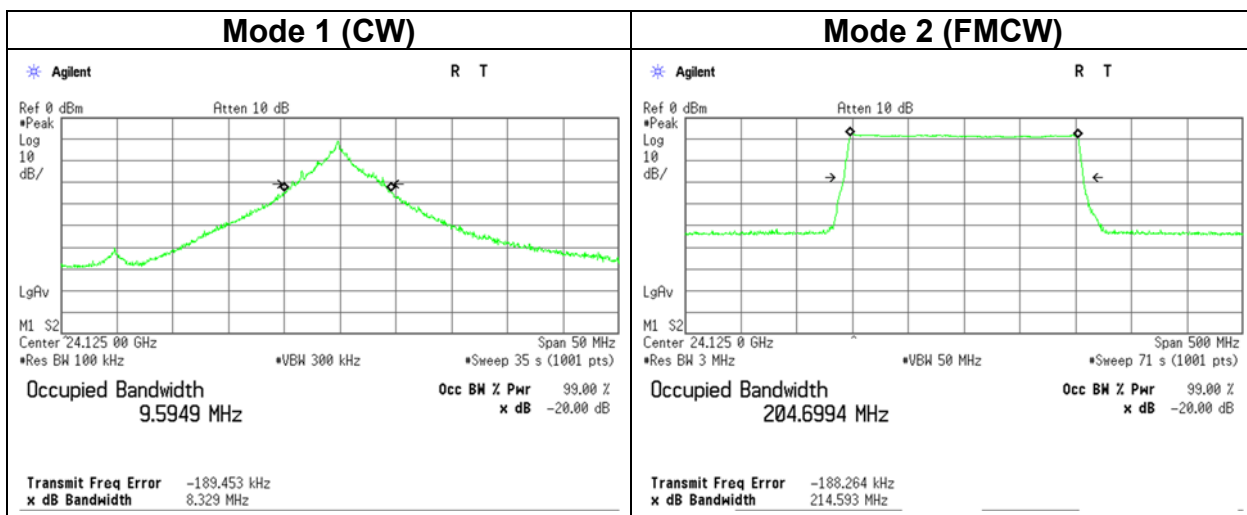
| | | | | | |
|------------------------|----------------------------------|-------------------------------------|--------------------------------|------------------------------------|-------------------------------------|
| Test place | Ise EMC Lab. | | | | |
| Semi Anechoic Chamber | No.4 | No.4 | No.4 | No.4 | No.1 |
| Date | September 6, 2023 | September 6, 2023 | September 7, 2023 | September 7, 2023 | September 10, 2023 |
| Temperature / Humidity | 22 deg. C / 57 % RH | 22 deg. C / 57 % RH | 23 deg. C / 60 % RH | 23 deg. C / 60 % RH | 23 deg. C / 51 % RH |
| Engineer | Sayaka Hara (26.5 GHz to 40 GHz) | Junki Nagatomi (10 GHz to 26.5 GHz) | Sayaka Hara (30 MHz to 10 GHz) | Junki Nagatomi (40 GHz to 100 GHz) | Yuichiro Yamazaki (9 kHz to 30 MHz) |
| Mode | Mode 1 (CW) | | | | |



20 dB Bandwidth, 99 % Occupied Bandwidth

| | |
|------------------------|---------------------|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | September 5, 2023 |
| Temperature / Humidity | 22 deg. C / 55 % RH |
| Engineer | Sayaka Hara |

| Mode | Frequency [GHz] | 99% Occupied Bandwidth [MHz] | 20 dB Bandwidth [MHz] |
|----------|--------------------|------------------------------------|-----------------------------|
| 1 (CW) | 24.125 | 9.5949 | 8.329 |
| 2 (FMCW) | 24.125 | 204.6994 | 214.593 |

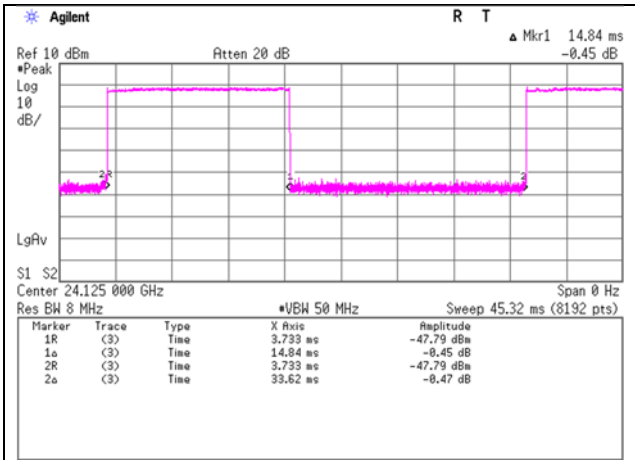


Duty Cycle

| | |
|------------------------|---------------------|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | September 12, 2023 |
| Temperature / Humidity | 23 deg. C / 52 % RH |
| Engineer | Junki Nagatomi |
| Mode | Mode 1 (CW) |

| Tx On time [ms] | Tx On + Off time [ms] | Duty factor [dB] |
|-----------------|-----------------------|------------------|
| 14.840 | 33.620 | -7.10 |

Duty factor = 20 * log (Tx On time / Tx On + Off time)



Duty Cycle

| | |
|------------------------|---------------------|
| Test place | Ise EMC Lab. |
| Semi Anechoic Chamber | No.4 |
| Date | September 7, 2023 |
| Temperature / Humidity | 23 deg. C / 60 % RH |
| Engineer | Sayaka Hara |
| Mode | Mode 2 (FMCW) |

[Measured data]

Transmission time of each pattern

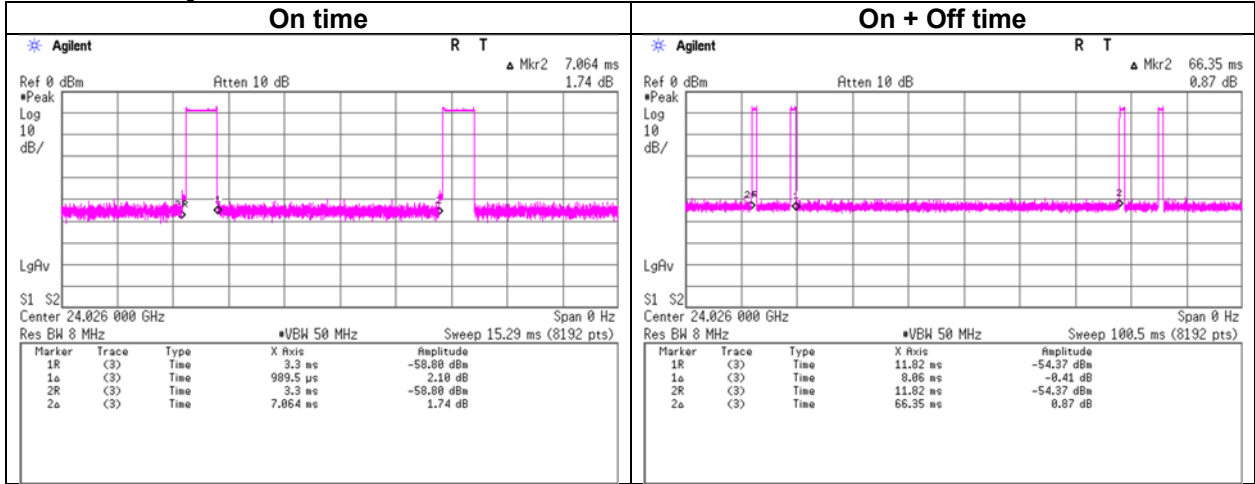
| On time [ms] | Number of repetitions | Total On time [ms] | On + Off time [ms] | Duty factor [dB] | Remarks |
|-----------------|-----------------------|-----------------------|-----------------------|---------------------|---------|
| 0.99 | 2 | 1.98 | 66.35 | -30.51 | - |

Calculation:

Total On time = On time * Number of repetitions

Duty factor = 20 * log(Total On time / On + Off time)

[Measured data]



There are two doppler frequencies and chirp part in one transmission period. These doppler parts and chirp part were compared to calculate the duty factor. The duty factor was calculated within doppler part, because doppler's dwell time is longer than the chirp part.

The declared duty factor and measured one were compared. The maximum duty factor of these results was applied to the average field strength measurement. (Worst case)

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-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-08 | 141213 | Attenuator(6dB) | Weinschel Corp | 2 | BK7971 | 11/19/2022 | 12 |
| RE | MAT-34 | 141331 | Attenuator(6dB) | TME | UFA-01 | - | 02/01/2023 | 12 |
| RE | MBA-08 | 141427 | Biconical Antenna | Schwarzbeck Mess-Elektronik OHG | VHA9103B+ BBA9106 | 08031 | 07/11/2023 | 12 |
| RE | MCC-03 | 141215 | Coaxial Cable | Fujikura/Suhner/TSJ | 5D-2W/3D-2W/ RG400u/ RFM-E421(SW) | -/01068 (Switcher) | 06/23/2023 | 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-178 | 141227 | Microwave Cable | Junkosha | MMX221-00500DMSDMS | 1502S305 | 03/03/2023 | 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 | 12 |
| RE | MCC-50 | 141397 | Coaxial Cable | UL Japan | - | - | 11/18/2022 | 12 |
| RE | MCC-54 | 141325 | Microwave Cable | Suhner | SUCOFLEX101 | 2873(1m) / 2876(5m) | 03/07/2023 | 12 |
| RE | MCH-07 | 141441 | Temperature Chamber | Espec | SU-241 | 92013843 | 07/27/2023 | 12 |
| RE | MHA-17 | 141506 | Horn Antenna 15-40GHz | Schwarzbeck Mess-Elektronik OHG | BBHA9170 | BBHA9170307 | 08/09/2023 | 12 |
| RE | MHA-21 | 141508 | Horn Antenna 1-18GHz | Schwarzbeck Mess-Elektronik OHG | BBHA9120D | 557 | 05/17/2023 | 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 | 06/20/2023 | 12 |
| RE | MHA-35 | 180544 | Horn Antenna | SAGE Millimeter, Inc. | SAZ-2410-10-S1 | 17343-01 | 06/21/2023 | 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-03 | 141530 | Digital Tester | Fluke Corporation | FLUKE 26-3 | 78030621 | 01/18/2023 | 12 |
| 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-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-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 |

Test equipment (2/2)

| Test Item | Local ID | LIMS ID | Description | Manufacturer | Model | Serial | Last Calibration Date | Cal Int |
|-----------|----------|---------|-------------------|---------------------------|---|-------------------|-----------------------|---------|
| 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 | 06/19/2023 | 12 |
| RE | MPA-31 | 180607 | Power Amplifier | SAGE Millimeter, Inc. | SBP-7531142515-1010-E1 | 17343-01 | 10/07/2022 | 12 |
| RE | MSA-10 | 141899 | Spectrum Analyzer | Keysight Technologies Inc | E4448A | MY46180655 | 02/20/2023 | 12 |
| RE | MSA-19 | 182484 | Signal Analyzer | Keysight Technologies Inc | N9030B | MY57143159 | 04/14/2023 | 12 |
| RE | MTR-09 | 141950 | EMI Test Receiver | Rohde & Schwarz | ESU26 | 100412 | 10/11/2022 | 12 |
| RE | MTR-10 | 141951 | EMI Test Receiver | Rohde & Schwarz | ESR26 | 101408 | 04/10/2023 | 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, 20 dB Bandwidth, 99 % Occupied Bandwidth, and Duty cycle tests