

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 engineerJunki Nagatomi
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.
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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.

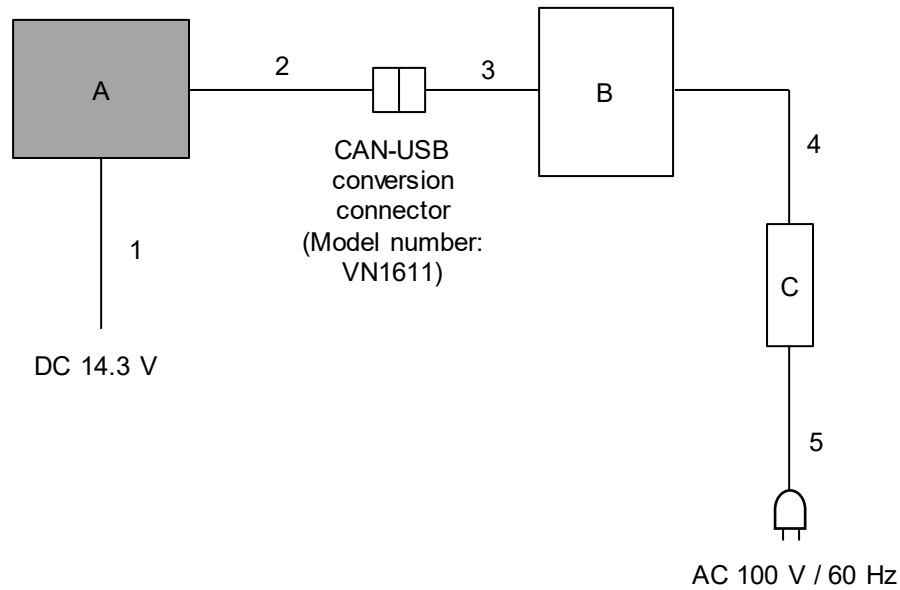
Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Modes

Test Item	Mode	Tested frequency
<ul style="list-style-type: none"> - 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
<ul style="list-style-type: none"> - 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	1123046000000033 *1) 1123046000000072 *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 Cable	Connector	Remarks
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

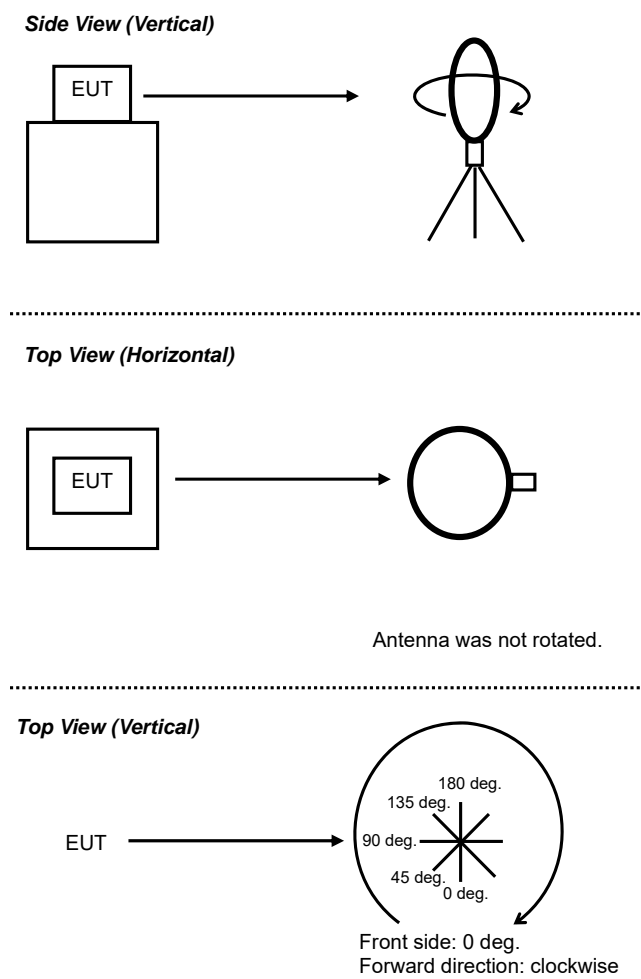
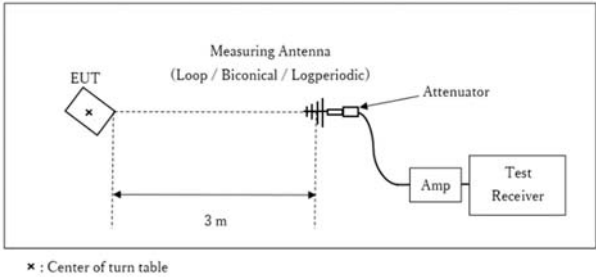


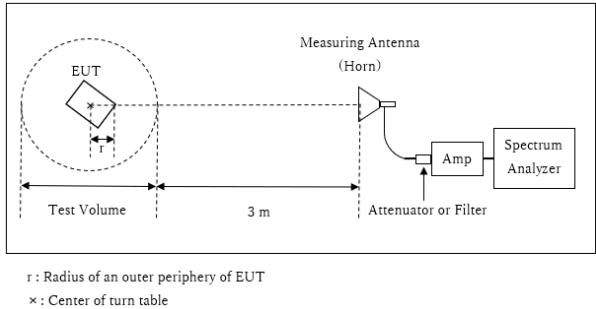
Figure 2: Test Setup

[Test setup]
Below 1 GHz



Test Distance: 3 m

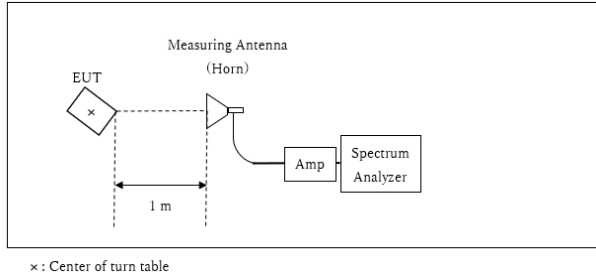
1 GHz to 10 GHz



Distance Factor: $20 \times \log (3.95 \text{ m}^* / 3.0 \text{ m}) = 2.4 \text{ dB}$
* Test Distance: $(3 + \text{SVSWR Volume} / 2) - r = 3.95 \text{ m}$

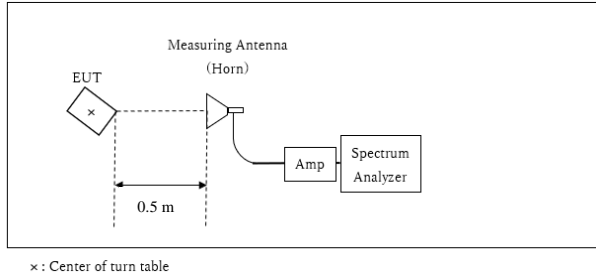
SVSWR Volume: 2 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
 $r = 0.05 \text{ m}$

10 GHz to 26.5 GHz



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



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.)

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

Frequency	Wavelength	EUT	Maximum Dimention Test Antenna Local ID MHA-17	Maximum D	Far Field Boundary r
[GHz]	λ [mm]	[m]	[m]	[m]	[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.

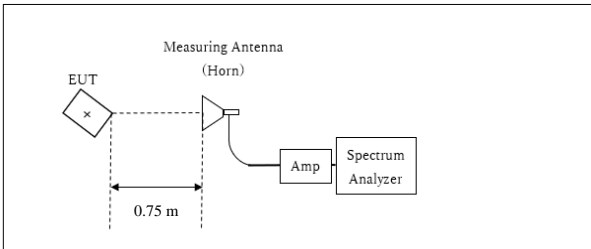
Frequency	40 GHz to 50 GHz	50 GHz to 75 GHz	75 GHz to 100 GHz
Final measurement distance with 1 MHz Peak detector	0.75 m	0.75 m	0.5 m

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

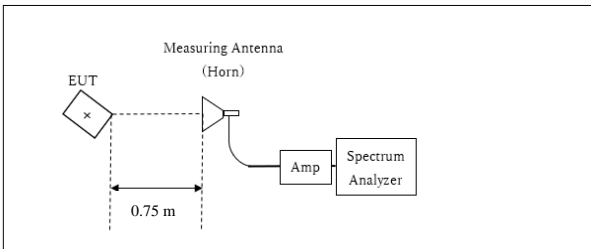
[Test setup]
40 GHz to 50 GHz



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

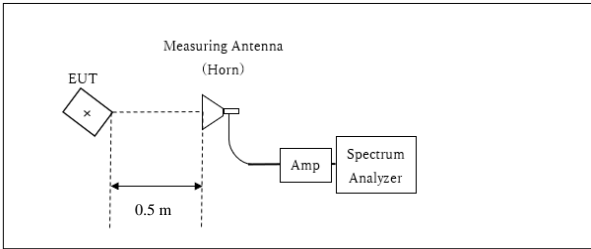
50 GHz to 75 GHz



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)

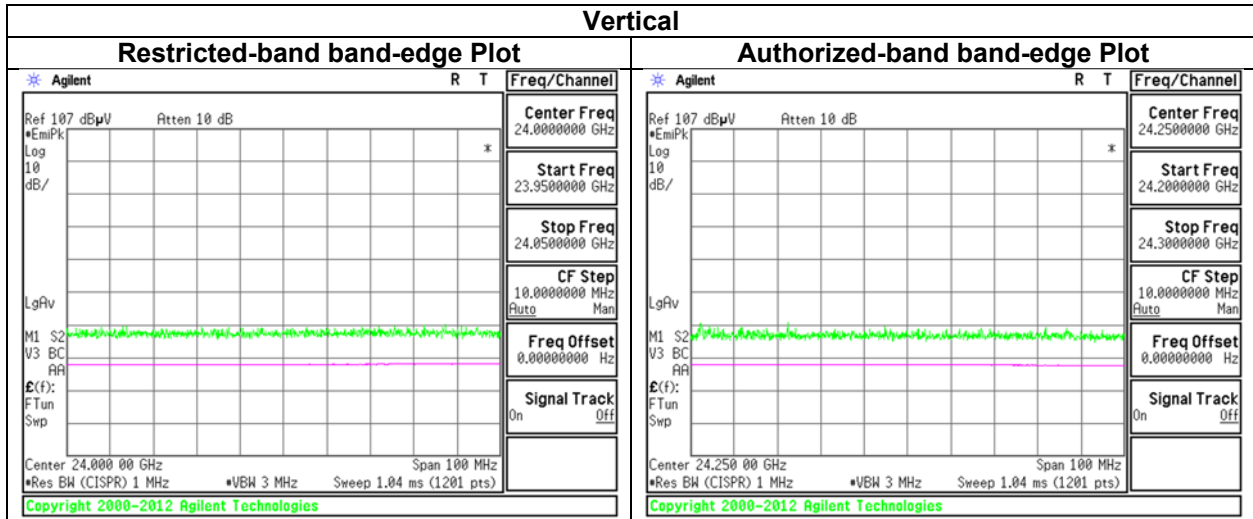
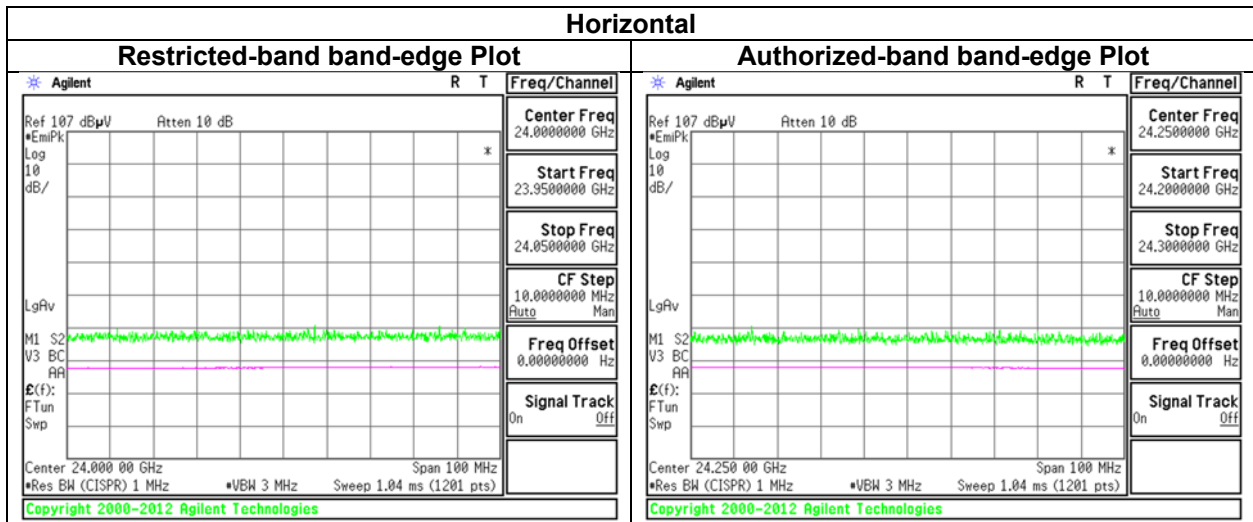
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

*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.

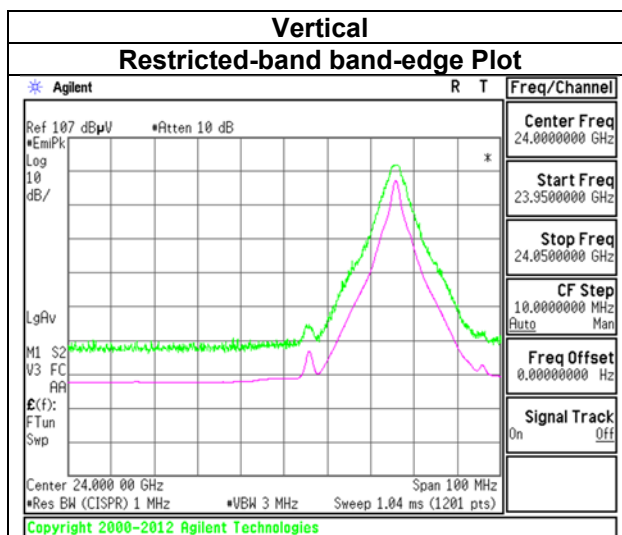
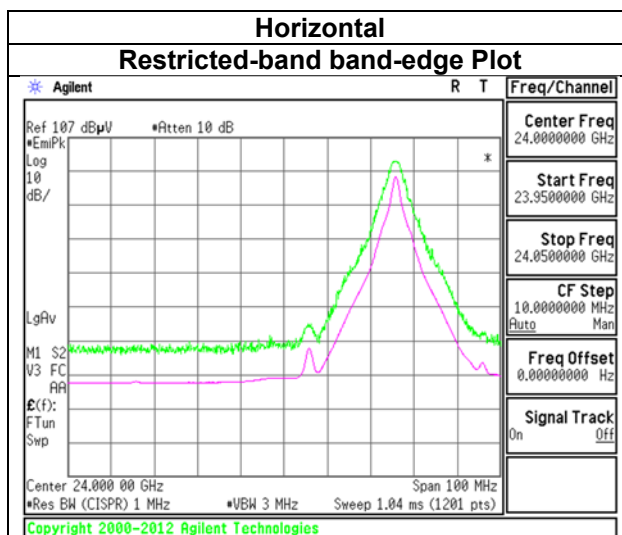
*1) PK with Duty factor : Result (AV)= Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor(Refer to Duty factor sheet)

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 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.	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	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)

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.

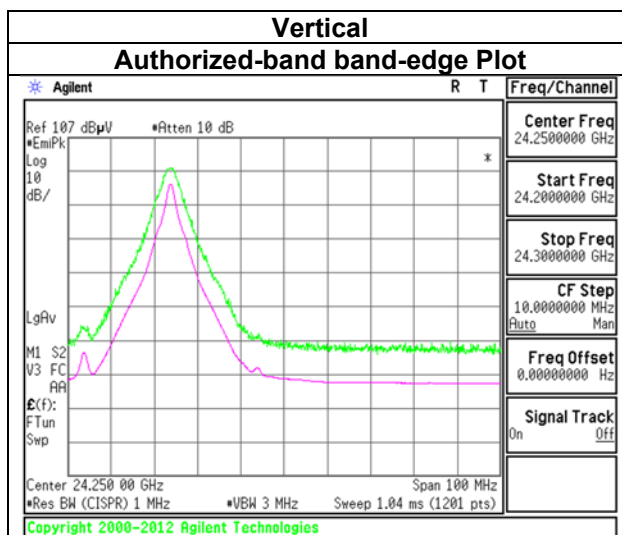
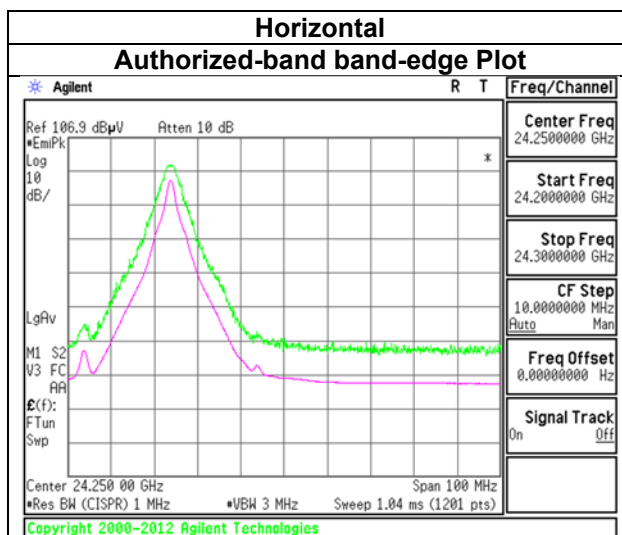
*1) PK with Duty factor : Result (AV)= Reading + Ant Factor + Loss (Cable + Attenuator + Filter + Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor(Refer to Duty factor sheet)

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)

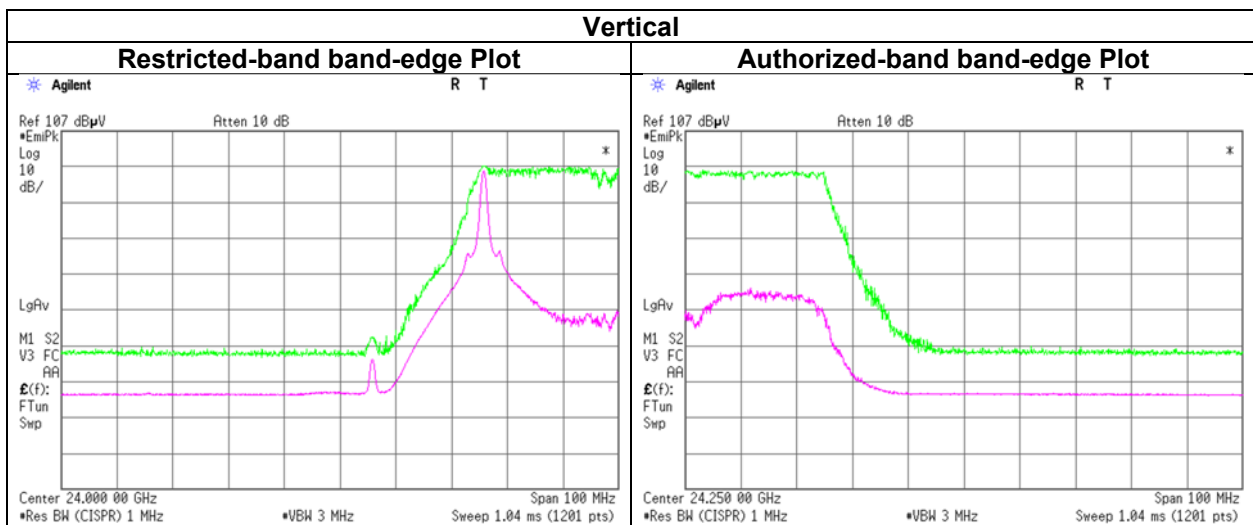
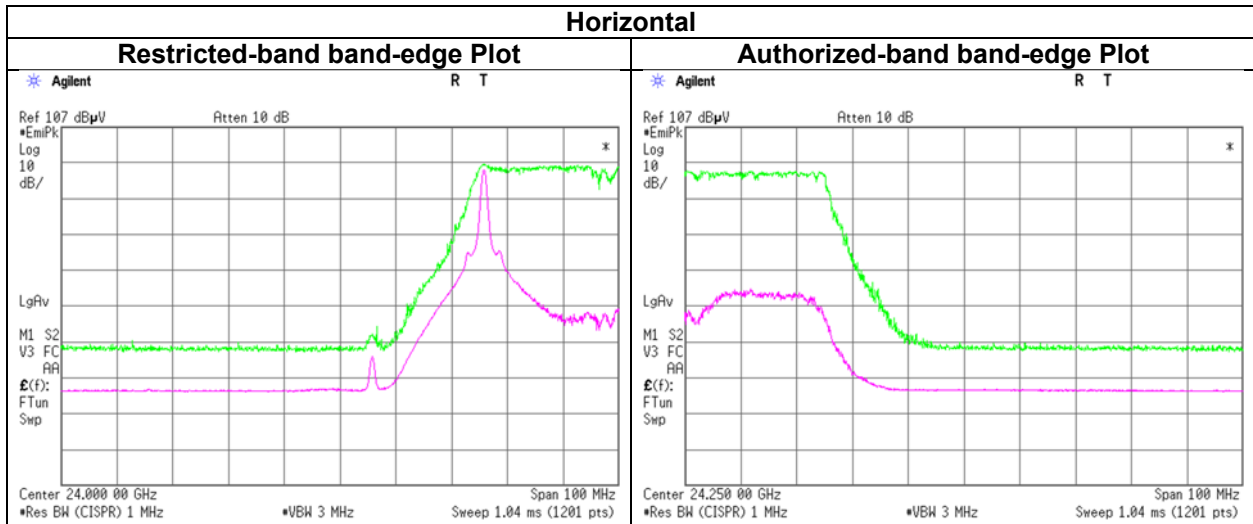
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

*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)

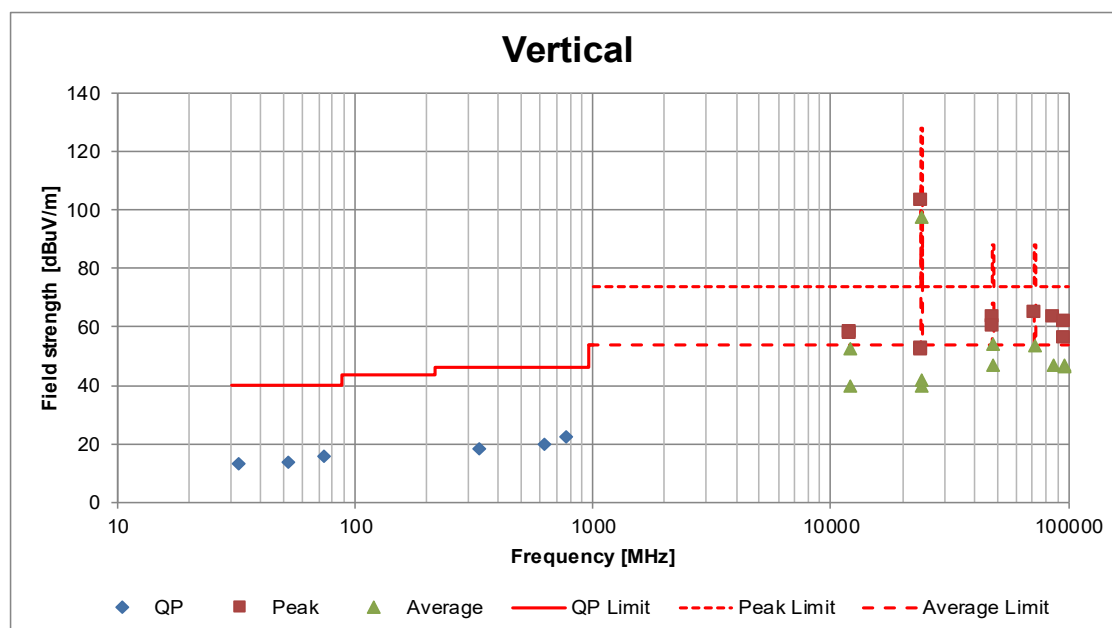
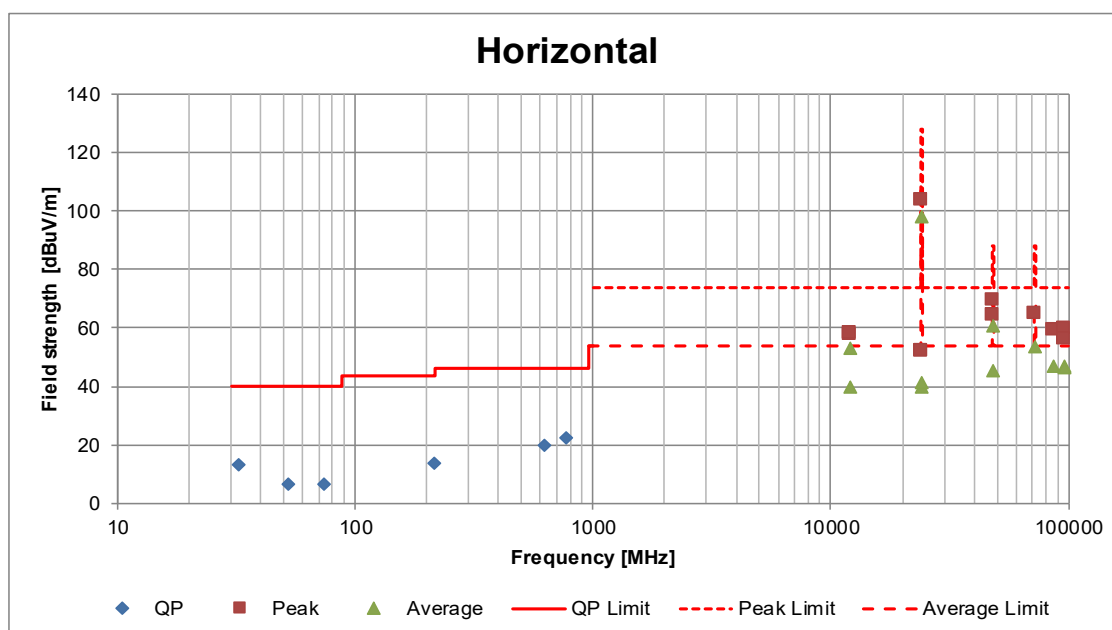
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	September 8, 2023
Temperature / Humidity	23 deg. C / 57 % RH
Engineer	Sayaka Hara
Mode	Mode 2 (FMCW)



* 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)

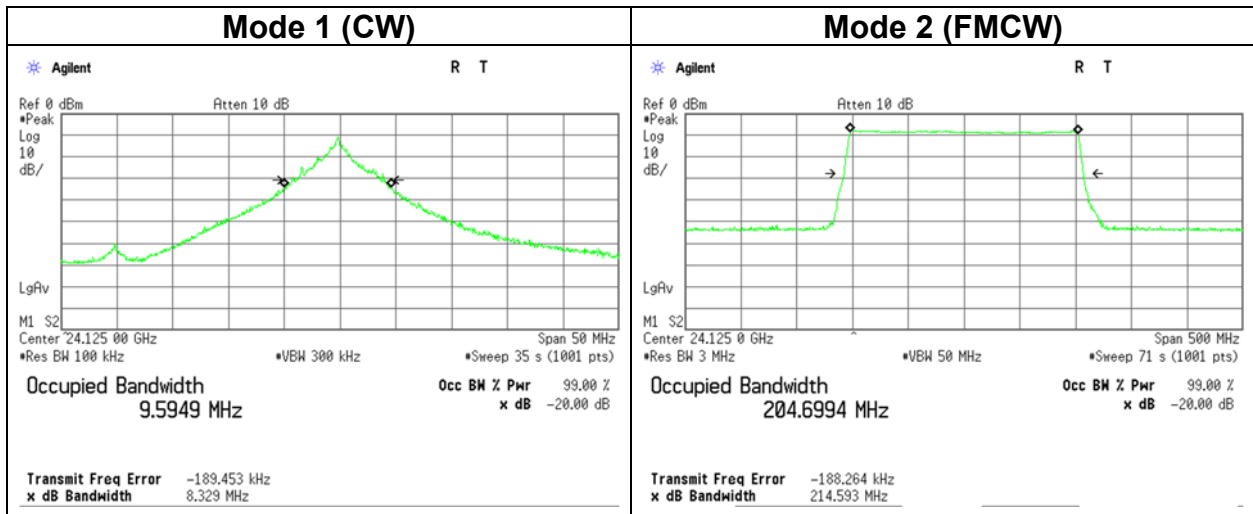
Test place	Ise EMC Lab.				
Semi Anechoic Chamber	No.4	No.4	No.4	No.4	No.1
Date	September 6, 2023	September 6, 2023	September 7, 2023	September 7, 2023	September 10, 2023
Temperature / Humidity	22 deg. C / 57 % RH	22 deg. C / 57 % RH	23 deg. C / 60 % RH	23 deg. C / 60 % RH	23 deg. C / 51 % RH
Engineer	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

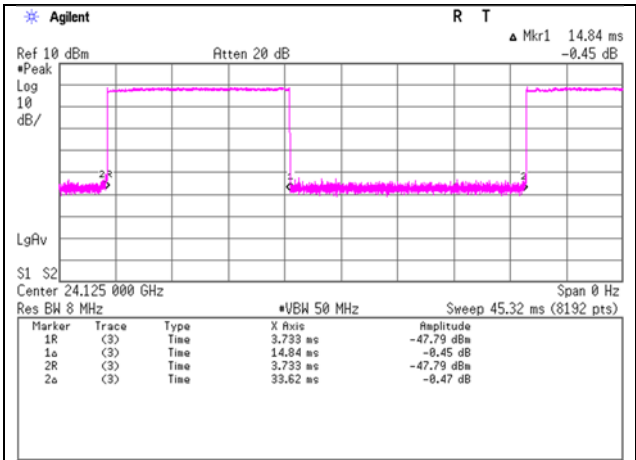


Duty Cycle

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

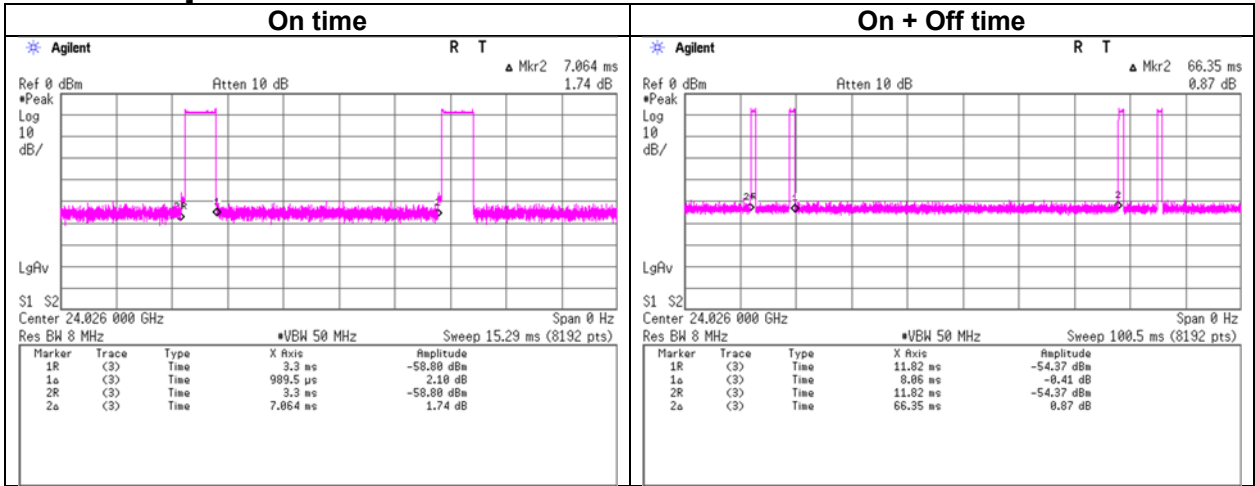
On time	Number of repetitions	Total On time	On + Off time	Duty factor	Remarks
[ms]		[ms]	[ms]	[dB]	
0.99	2	1.98	66.35	-30.51	-

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