RADIO TEST REPORT

Test Report No.: 15537776H-A-R2

Customer	**Murata Manufacturing Co., Ltd.**
Description of EUT	**Millimeter Wave Radar**
Model Number of EUT	**2LP**
FCC ID	**VPYLBVA0ZZ2LP**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied**
Issue Date	**January 21, 2025**
Remarks	**-**

Representative test engineer	Approved by
Junki Nagatomi Engineer	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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REVISION HISTORY

Original Test Report No.: 15537776H-A

This report is a revised version of 15537776H-A-R1. 15537776H-A-R1 is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15537776H-A	December 10, 2024	-
1	15537776H-A-R1	January 17, 2025	**Section 2.1** -Updated test date. October 28 to November 12, 2024 → October 28, 2024 to January 14, 2025 **Section 2.2** **Radio Specification** -Deletion of Antenna Gain and Steerable Antenna. -Modified usage location. Fixed Field disturbance sensor → Field disturbance sensor **Section 3.1** -Deletion of below note. *The customer has declared that the EUT has complies with FCC Part 15 Subpart B as SDoC. **Section 6** **[For above 1 GHz, up to 40 GHz]** -Modified test distance of frequency: from 1 GHz to 40 GHz in the table. 4 m (below 10 GHz), 1 m (above 10 GHz) → 1 GHz to 6 GHz: 3.0 m, 6 GHz to 10 GHz: 3.25 m, 10 GHz to 40 GHz: 1.0 m **[Above 40 GHz]** **[About fundamental measurement]** -Modified tested distance in the table. 0.75 m → 1.50 -Added below explanatory note. The frequencies and test distances in the table are calculated at the center frequency of the 61 GHz to 61.5 GHz band. **APPENDIX 1 Test data** **[EIRP]** -Replacement of chart data for Average. **[Frequency Stability]** -Modified power supply value to two decimal places in the table. **APPENDIX 2 Test instruments** -Added below test equipment. LIMS ID: 244710, 141545, 142230, 142017, 141899
2	15537776H-A-R2	January 21, 2025	**Section 3.2** **--**Modified below text for FCC Part 15.31 (e). This EUT provides the stable voltage constantly to RF Module regardless of input voltage.→ This EUT provides the stable voltage constantly to RF part regardless of input voltage.

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

CONTENTS PAGE

SECTION 1: Customer Information

Company Name	Murata Manufacturing Co., Ltd.
Address	1-10-1 Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Telephone Number	+81-50-1737-2801
Contact Person	Kenji Hayashikoshi

The information provided by 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

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Millimeter Wave Radar
Model Number	2LP
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	October 27, 2024
Test Date	October 28, 2024 to January 14, 2025

2.2 Product Description

General Specification

Rating	DC 5 V
Operating temperature	-40 deg. C to 60 deg. C

Radio Specification

Equipment Type	Transceiver
Frequency of Operation range	61.01 GHz to 61.43 GHz 61.07 GHz to 61.49 GHz
Bandwidth	420 MHz
Type of Modulation	Frequency modulation (FMCW)
Usage location	Field disturbance sensor

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 15.255 Operation within the band 57-71 GHz.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	ANSI C63.10-2020, 6. Standard test methods	Section 15.207	14.13 dB, 26.24081 MHz, L, AV	Complied	-
6 dB Bandwidth	Section 15.255(e) (2) ANSI C63.10 2020, 9. Procedures for testing millimeter-wave systems	Section 15.255(e) (1)	See data.	N/A	*1)
10 dB Bandwidth	ANSI C63.10 2020, 9. Procedures for testing millimeter-wave systems	KDB364244 D01 Meas 15.255 Radars v01 Section 6		N/A	*2)
99% Occupied Bandwidth	ANSI C63.10 2020, 9. Procedures for testing millimeter-wave systems	KDB364244 D01 Meas 15.255 Radars v01 Section 6		Complied	Radiated
EIRP (Peak, Average) Duty cycle	ANSI C63.10 2020, 9. Procedures for testing millimeter-wave systems	Section 15.255(c)		Complied	Radiated
Peak Output Power	Section 15.255(e) ANSI C63.10 2020, 9. Procedures for testing millimeter-wave systems	Section 15.255(e)		N/A	*1)
Spurious Emissions	ANSI C63.10 2020, 6. Standard test methods 9. Procedures for testing millimeter-wave systems	Section 15.255(d) Section 15.209	0.3 dB 81.8 MHz, QP, Vertical	Complied	Radiated
Frequency Stability	ANSI C63.10 2020, 9. Procedures for testing millimeter-wave systems	Section 15.255(f)	See data.	Complied	Radiated
Group Installation	-	Section 15.255(h)	See data.	N/A	*3)

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.
In case any questions arise about test procedure, ANSI C63.10-2020 and KDB364244 are also referred.
*1) The test is not applicable since the application of Section 15.255(e) (2) is unnecessary due to the application of Section 15.255(c) (2)(v).
*2) This test is not applicable since not pulse radar.
*3) The test is not applicable since there are no external phase-locking inputs in this EUT.

FCC Part 15.31 (e)

This EUT provides the stable voltage constantly to RF part regardless of input voltage.
Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT.
Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

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.

Conducted emission

Item	Frequency range	Unit	Calculated Uncertainty (+/-)
AMN (LISN)	0.15 MHz to 30 MHz	dB	3.3

Radiated emission

Measurement distance	Frequency range		Unit	Calculated Uncertainty (+/-)
3 m	9 kHz to 30 MHz		dB	3.3
10 m			dB	3.1
3 m	30 MHz to 200 MHz	Horizontal	dB	4.7
		Vertical	dB	4.7
	200 MHz to 1000 MHz	Horizontal	dB	4.8
		Vertical	dB	6.0
10 m	30 MHz to 200 MHz	Horizontal	dB	5.2
		Vertical	dB	5.1
	200 MHz to 1000 MHz	Horizontal	dB	5.2
		Vertical	dB	5.2
3 m	1 GHz to 6 GHz		dB	5.0
	6 GHz to 18 GHz		dB	5.2
1 m	10 GHz to 18 GHz		dB	5.3
	18 GHz to 26.5 GHz		dB	5.2
	26.5 GHz to 40 GHz		dB	4.7
0.5 m	26.5 GHz to 40 GHz		dB	4.8
>= 0.5 m	40 GHz to 50 GHz		dB	4.3
>= 0.5 m	50 GHz to 75 GHz		dB	5.9
>= 0.5 m	75 GHz to 110 GHz		dB	5.7
>= 3.8 cm	110 GHz to 170 GHz		dB	5.8
>= 2.5 cm	170 GHz to 260 GHz		dB	5.0

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	-	-

* Size of vertical conducting plane (for Conducted Emission test): 2.0 m × 3.0 m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Test data, RF Exposure, Test instruments, and Test set up

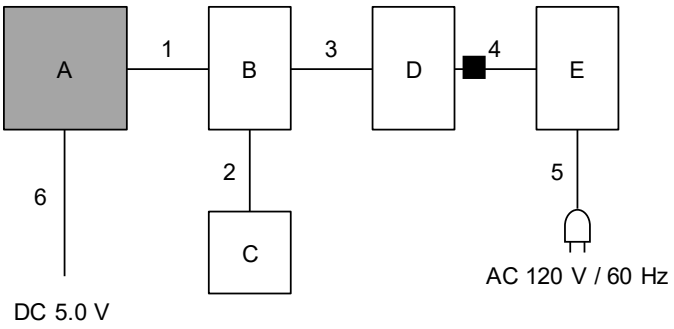
Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Mode	Frequency Range	Test Item
Mode 1	61.01 GHz to 61.43 GHz	Conducted emission, EIRP (Peak / Average), Duty cycle, 99 % Occupied bandwidth, Frequency stability, Spurious Emissions
Mode 2	61.07 GHz to 61.49 GHz	
*Power of the EUT was set by the software as follows; Power Setting: 29 dBm (peak / eirp) Software: SWR1MFIPI10102_00_01_04_01.bin (Date: March 19, 2024, Storage location: Driven by connected PC)		
*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.		

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	Millimeter Wave Radar	2LP	603002	Murata Manufacturing Co., Ltd.	EUT
B	Jig board	IFBB01	IFBB0-A-25	Murata Manufacturing Co., Ltd.	-
C	DC battery	700-BTL033BK	-	SANWA SUPPLY INC.	-
D	Laptop PC	CF-NX4EDHCS	6FKSA41360	Panasonic	-
E	AC adapter	CF-AA6412C	6412CM416205493C	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	14pin cable	0.2 for RE* 3.0 for RE* (30 MHz to 1000 MHz), Frequency Stability))	Unshielded	Unshielded	-
2	USB Cable	2.0	Shielded	Shielded	-
3	USB Cable	2.0	Shielded	Shielded	-
4	DC Cable	0.9	Unshielded	Unshielded	-
5	AC Cable	1.0 for CE* 0.8 for other	Unshielded	Unshielded	-
6	DC Cable	1.5	Unshielded	Unshielded	Only Frequency Stability

*CE: Conducted Emission, RE: Radiated Emission

SECTION 5: Conducted Emission

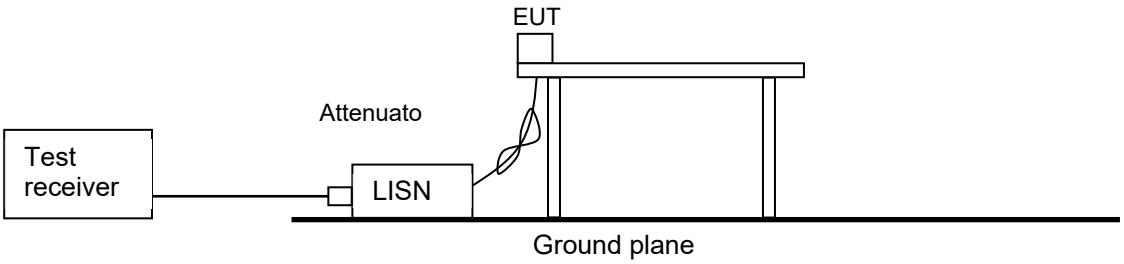
Test Procedure and Conditions

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 rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.
The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.
The EUT was connected to a LISN (AMN).
An overview sweep with peak detection has been performed.

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

Detector : QP and CISPR AV
Measurement Range : 0.15 MHz to 30 MHz
Test Data : APPENDIX
Test Result : Pass

Figure 1: Test Setup



SECTION 6: Radiated Emissions

Test Procedure

[For below 30 MHz]

The 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 absorbent materials lined on a ground plane.
The loop antenna was fixed height at 1.0 m.
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 above 30 MHz, up to 1 GHz]

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

[For above 1 GHz, up to 40 GHz]

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

Test Antennas are used as below;

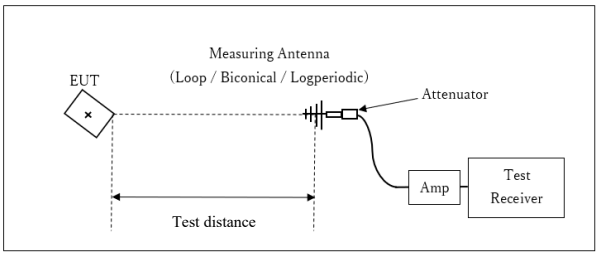
Frequency	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz	From 1 GHz to 40 GHz
Instrument used	Test Receiver					Spectrum Analyzer
Detector	PK / AV	QP	PK / AV	QP	QP	PK *a) / AV
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz	RBW: 1 MHz VBW: 3 MHz
Test Distance	3 m	3 m	3 m	3 m	3 m	1 GHz to 6 GHz: 3.0 m 6 GHz to 10 GHz: 3.25 m 10 GHz to 40 GHz: 1.0 m

*a) The Spectrum Analyzer was used in 3 dB resolution bandwidth.

[Test setup]

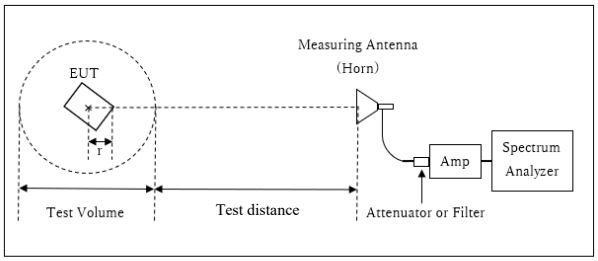
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz to 10 GHz



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

[1 GHz to 6 GHz]
Distance Factor: 20 x log (3.75 m* / 3.0 m) = 1.94 dB
* (Test Distance + SVSWR Volume /2) - r = 3.75 m

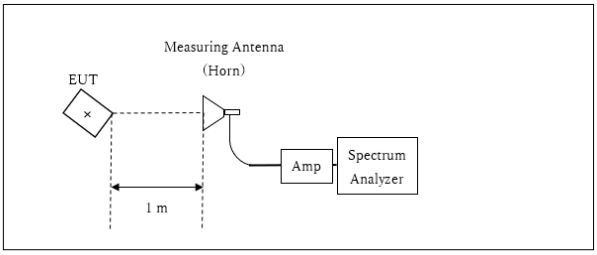
Test Distance: 3.0 m
SVSWR Volume : 1.5 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.0 m

[6 GHz to 10 GHz]
Distance Factor: 20 x log (3.75 m* / 3.0 m) = 1.94 dB
* (Test Distance + SVSWR Volume /2) - r = 3.75 m

Test Distance: 3.25 m
SVSWR Volume : 1.0 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.0 m

*The test was performed with r = 0.0 m since EUT is small and it was the rather conservative condition.

10 GHz to 40 GHz

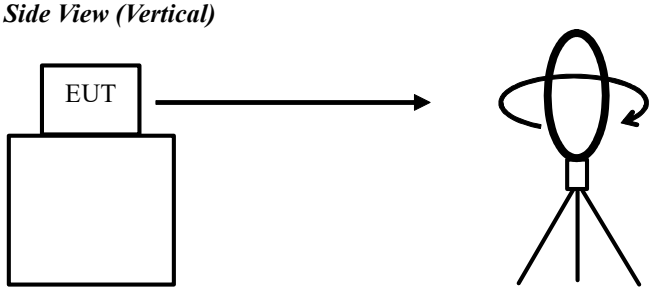


× : Center of turn table

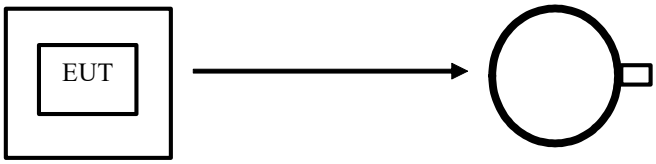
Distance Factor: 20 x log (1.0 m* / 3.0 m) = -9.5 dB
*Test Distance: 1 m

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

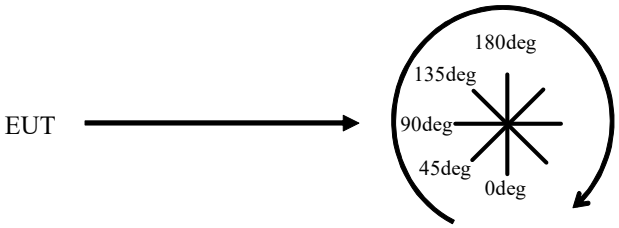


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

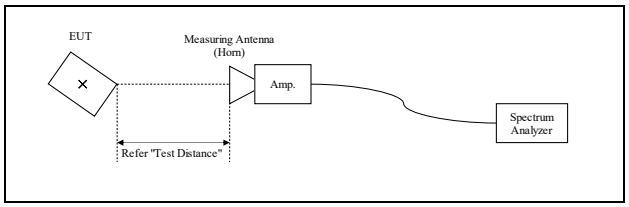
[Above 40 GHz]
The test was performed based on “Procedures for testing millimeter-wave systems” of ANSI C63.10-2020.
The EUT was placed on a urethane platform, raised 1.5 m above the conducting ground plane.
The measurements were performed on handheld method.

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, filter loss, 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.

The final test was performed with a 1 MHz RMS detctor and Peak detector at the following distances;

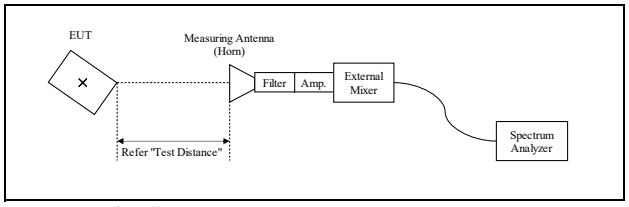
[Test setup]
40 GHz to 50 GHz



×: Center of turn table

*Test Distance: 1.0 m

Above 50 GHz



×: Center of turn table

*Test Distance:

50 GHz to 75 GHz	1.5 m
75 GHz to 110 GHz	1.0 m
110 GHz to 170 GHz	0.01 m
170 GHz to 200GHz	0.005 m

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

The 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.

[About fundamental measurement]

Test Procedure
The test was performed based on “Procedures for testing millimeter-wave systems” of ANSI C63.10-2020 and KDB364244 D01 Meas 15.255 Radars v01.

The EUT was placed on a urethane platform, raised 1.5 m above the conducting ground plane.
The measurements were performed on handheld method.

The carrier levels were confirmed at maximum direction of transmission.
The maximum direction was searched under carefully since beam-widths are extremely 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
Lambda is the wavelength of the emission under investigation [300/f (MHz)], in m

Frequency	Wavelength	Maximum Dimension			Far Field Boundary	Tested Distance
		EUT	Test Antenna	Maximum		
	Lambda			*D*	*r*	
[GHz]	[mm]	[m]	[m]	[m]	[m]	[m]
61.25	4.9	0.01736	0.03759	0.03759	0.577	1.50

* The frequencies and test distances in the table are calculated at the center frequency of the 61 GHz to 61.5 GHz band.

In order to maximize the carrier level, the EUT, which has a horizontally polarized antenna, and the polarization plane of the measurement antenna were aligned for the test.

The Peak Power results was applied to the desensitization correction factor by KDB653005 4 (c) and 5.4 (d).
The derivation of the FMCW Desensitization Factor is given in Keysight Application Note 5952 1039 Appendix B.

Desensitization factor was calculated from follow equation;

$$\alpha = \frac{1}{\sqrt[4]{1 + \left(\frac{2In(2)}{\pi}\right)^2 \left(\frac{Fs}{Ts\,B^2}\right)^2}}$$

and

FMCW Desensitization factor = 20 Log (α)

Where
*F*s is FMCW Sweep Width or Chirp Width, is used the actual measurement value.
*T*s is FMCW Sweep Time, is referred to the values in the specifications.
B is -3dB Bandwidth of Gaussian RBW Filter, is used the actual measurement value.

Mode	F_s	T_s	*B*	α	FMCW Desensitization factor
	[MHz]	[us]	[MHz]		[dB]
Mode 1	413.4662	59.0	8.0	0.999	-0.01
Mode 2	413.2029	59.0	8.0	0.999	-0.01

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

Measurement range : 9 kHz to 200 GHz
Test data : APPENDIX
Test result : Pass

SECTION 7: Frequency Stability

Test Procedure
The test was performed based on “Procedures for testing millimeter-wave systems” of ANSI C63.10-2020.
The external mixer was placed in side of the temperature chamber’s drain hole.

The power supply was set to nominal operating voltage (110 %), and the spectrum mask was measured at 20 deg. C. After that, EUT power supply was varied between 85 % and 115 % of nominal voltage and the frequency excursion of the EUT emission mask was recorded.

The EUT operating temperature was raised to 50 deg. C, and the frequency excursion of the EUT emission mask was recorded. Measurements were repeated at each 10 deg. C decrement down to -20 deg. C.

Both lower and upper frequencies of the 99 % Occupied bandwidth were recorded.

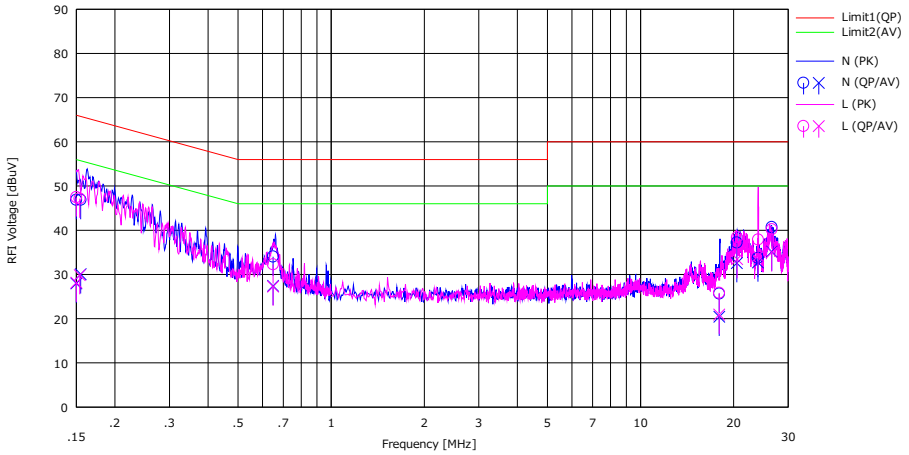
Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No. 2
Date	October 30, 2024
Temperature / Humidity	24 deg. C / 48 % RH
Engineer	Yuichiro Yamazaki
Mode	Mode 1

Limit : FCC_Part 15 Subpart C(15.207)



No.	Freq.	Reading		LISN	LOSS	Results		Limit		Margin		Phase	Comment
		〈QP〉	〈AV〉			〈QP〉	〈AV〉	〈QP〉	〈AV〉	〈QP〉	〈AV〉		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	33.70	14.80	0.05	13.10	46.85	27.95	66.00	56.00	19.15	28.05	N	
2	0.15509	33.70	16.90	0.05	13.10	46.85	30.05	65.72	55.72	18.87	25.67	N	
3	0.64872	20.80	14.20	0.05	13.19	34.04	27.44	56.00	46.00	21.96	18.56	N	
4	17.96823	11.10	5.90	0.35	14.19	25.64	20.44	60.00	50.00	34.36	29.56	N	
5	20.48023	22.50	17.90	0.40	14.28	37.18	32.58	60.00	50.00	22.82	17.42	N	
6	23.95753	18.80	17.80	0.53	14.39	33.72	32.72	60.00	50.00	26.28	17.28	N	
7	26.55620	25.70	20.20	0.52	14.47	40.69	35.19	60.00	50.00	19.31	14.81	N	
8	0.15000	34.30	15.00	0.06	13.10	47.46	28.16	66.00	56.00	18.54	27.84	L	
9	0.15385	34.00	16.70	0.06	13.10	47.16	29.86	65.79	55.79	18.63	25.93	L	
10	0.64924	19.00	14.00	0.07	13.19	32.26	27.26	56.00	46.00	23.74	18.74	L	
11	17.95500	11.20	6.30	0.44	14.19	25.83	20.93	60.00	50.00	34.17	29.07	L	
12	20.52220	23.60	18.70	0.49	14.29	38.38	33.48	60.00	50.00	21.62	16.52	L	
13	24.00081	22.90	19.20	0.59	14.39	37.88	34.18	60.00	50.00	22.12	15.82	L	
14	26.55881	25.10	19.90	0.62	14.47	40.19	34.99	60.00	50.00	19.81	15.01	L	

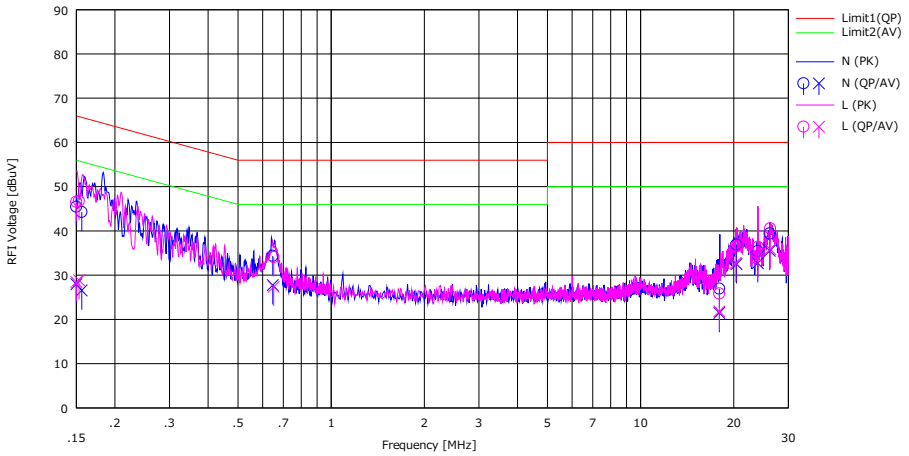
CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + C.F (LISN + CABLE + ATT)
Except for the above table: adequate margin data below the limits.

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

Conducted Emission

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No. 2
Date	October 30, 2024
Temperature / Humidity	24 deg. C / 48 % RH
Engineer	Yuichiro Yamazaki
Mode	Mode 2

Limit : FCC_Part 15 Subpart C(15.207)



No.	Freq.	Reading ⟨QP⟩	Reading ⟨AV⟩	LISN	LOSS	Results ⟨QP⟩	Results ⟨AV⟩	Limit ⟨QP⟩	Limit ⟨AV⟩	Margin ⟨QP⟩	Margin ⟨AV⟩	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	32.30	14.80	0.05	13.10	45.45	27.95	66.00	56.00	20.55	28.05	N	
2	0.15619	31.10	13.40	0.05	13.10	44.25	26.55	65.66	55.66	21.41	29.11	N	
3	0.64718	21.10	14.50	0.05	13.19	34.34	27.74	56.00	46.00	21.66	18.26	N	
4	17.96032	12.40	6.90	0.35	14.19	26.94	21.44	60.00	50.00	33.06	28.56	N	
5	20.40430	22.20	17.80	0.40	14.28	36.88	32.48	60.00	50.00	23.12	17.52	N	
6	23.92252	20.50	17.80	0.53	14.39	35.42	32.72	60.00	50.00	24.58	17.28	N	
7	26.16081	24.40	20.50	0.53	14.46	39.39	35.49	60.00	50.00	20.61	14.51	N	
8	0.15000	33.40	15.30	0.06	13.10	46.56	28.46	66.00	56.00	19.44	27.54	L	
9	0.15323	33.60	15.70	0.06	13.10	46.76	28.86	65.82	55.82	19.06	26.96	L	
10	0.65180	20.80	14.10	0.07	13.19	34.06	27.36	56.00	46.00	21.94	18.64	L	
11	17.96942	11.20	7.20	0.44	14.19	25.83	21.83	60.00	50.00	34.17	28.17	L	
12	20.32123	21.70	18.00	0.48	14.28	36.46	32.76	60.00	50.00	23.54	17.24	L	
13	23.96181	21.40	18.90	0.59	14.39	36.38	33.88	60.00	50.00	23.62	16.12	L	
14	26.24081	25.50	20.80	0.61	14.46	40.57	35.87	60.00	50.00	19.43	14.13	L	

CHART: WITH FACTOR Peak hold data. CALCULATION : RESULT = READING + C.F (LISN + CABLE + ATT)
Except for the above table: adequate margin data below the limits.

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

99 % Occupied bandwidth

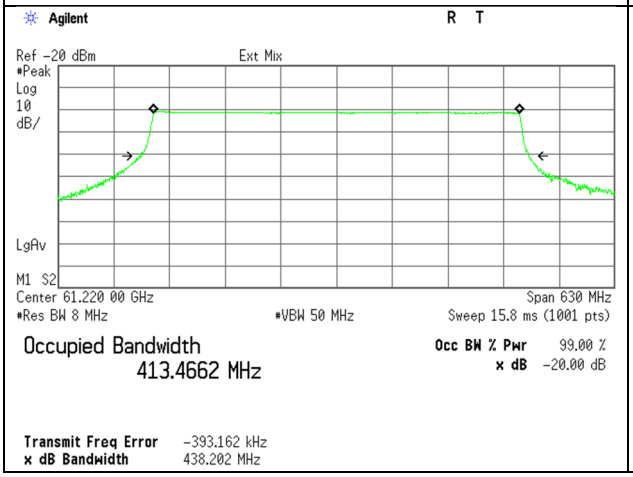
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No. 2	No. 2
Date	October 28, 2024	October 29, 2024
Temperature / Humidity	22 deg. C / 54 % RH	22 deg. C / 54 % RH
Engineer	Junki Nagatomi	Junki Nagatomi
Mode	Mode 1, Mode 2	

Mode	Center Frequency [GHz]	Frequency error [MHz]	99% OBW [MHz]	99 % OBW		Lower Limit [GHz]	Upper Limit [GHz]	Result
				The Lower frequency [GHz]	The Upper frequency [GHz]			
1	61.220	-0.393	413.466	61.013	61.426	61.0	61.5	Pass
2	61.280	-0.352	413.203	61.073	61.486			Pass

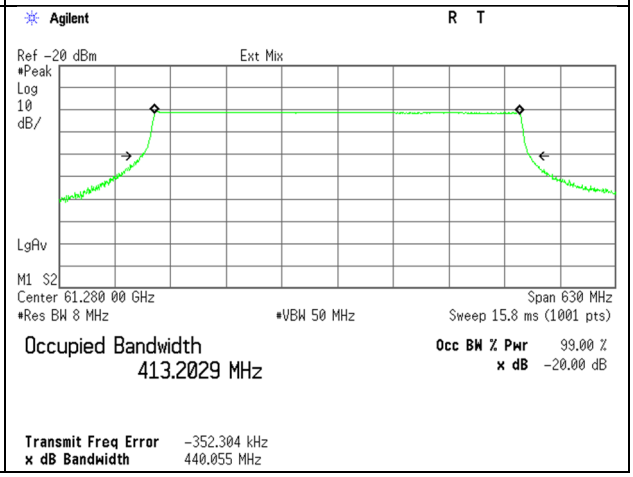
Calculation:
The Lower frequency = Center frequency + Frequency error – 99 % OBW / 2
The Upper frequency = Center frequency + Frequency error + 99 % OBW / 2

[Data]

Mode 1



Mode 2



The measurement was performed with Peak detector and Max Hold since the duty cycle was not 100 %.

EIRP

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No. 2	No. 2	No. 4
Date	October 28, 2024	October 31, 2024	January 14, 2025
Temperature / Humidity	22 deg. C / 54 % RH	22 deg. C / 50 % RH	22 deg. C / 40% RH
Engineer	Junki Nagatomi	Junki Nagatomi	Junki Nagatomi
Mode	Mode 1, Mode 2		

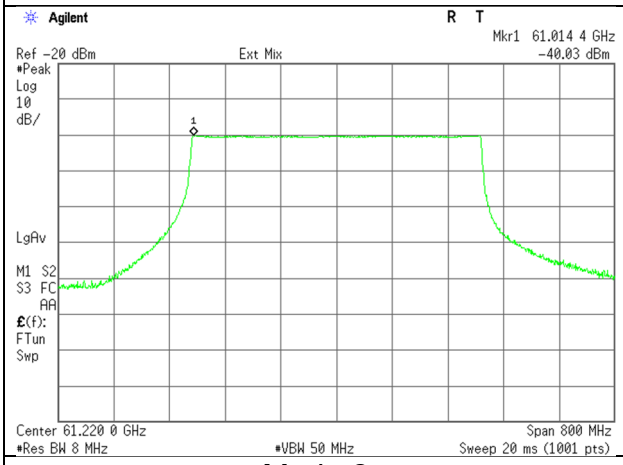
Mode	Power	Freq. [GHz]	Measured Power [dBm]	Rx Ant. Gain [dBi]	LNA Gain [dB]	Mixer Conv. Loss [dB]	Tested Distance [m]	FSL [dB]	Duty Factor [dB]	FMCW desensitization Factor [dB]	EIRP [dBm]	EIRP [mW]	Limit [dBm]	Margin [dB]
1	Average	61.220	-54.81	23.80	24.63	45.95	1.5	71.70	8.21	-	22.62	182.81	40	17.38
	Peak	61.014	-40.03	23.80	24.75	46.03	1.5	71.67	-	-0.01	29.13	818.46	43	13.87
2	Average	61.280	-54.54	23.80	24.60	45.94	1.5	71.71	8.20	-	22.91	195.43	40	17.09
	Peak	61.074	-39.94	23.80	24.73	46.02	1.5	71.68	-	-0.01	29.24	839.46	43	13.76

Calculating formula:
FSL (Free Space path Loss) = 10 * log10((4 * Pi * Tested Distance / Lambda) ^2)
Average EIRP = Measured Power - Rx Ant. Gain -LNA Gain + Mixer Conv. Loss + FSL + Duty factor
Peak EIRP = Measured Power - Rx Ant. Gain -LNA Gain + Mixer Conv. Loss + FSL - FMCW desensitization factor

[Data]

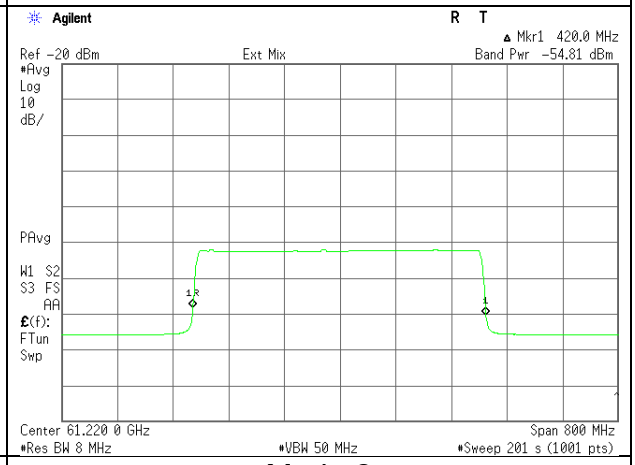
Peak

Mode 1

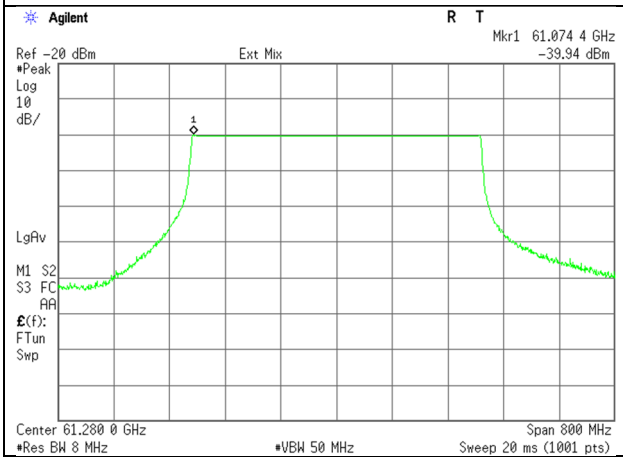


Average

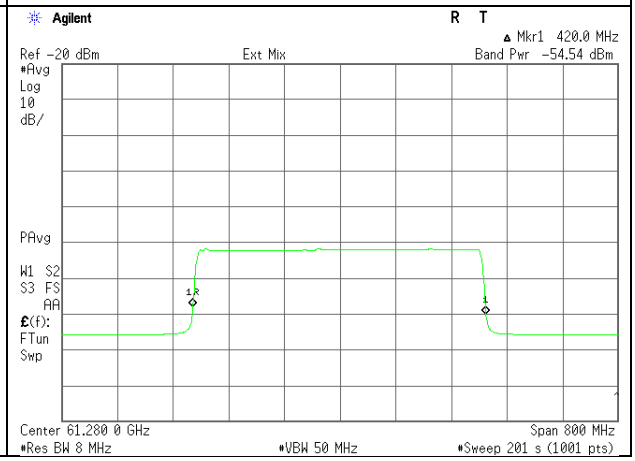
Mode 1



Mode 2



Mode 2



Duty Cycle

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No. 2
Date	October 29, 2024
Temperature / Humidity	22 deg. C / 54 % RH
Engineer	Junki Nagatomi
Mode	Mode 1, Mode 2

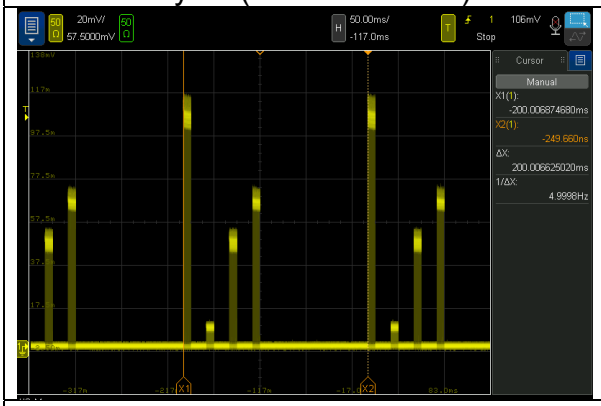
Mode	Tx On + Tx Off time [ms]	1 Chirp On time [us]	Number of Chirp	Tx On (1 Burst) time [ms]	Number of Burst	Total Tx On time [ms]	Duty [%]	Duty Factor [dB]
1	200.007	59.009	128	7.553	4	30.213	15.1	8.21
2	200.007	59.125	128	7.568	4	30.272	15.1	8.20

Calculating formula:

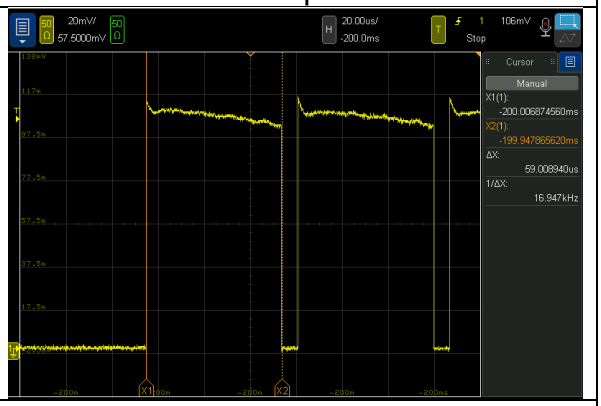
Tx On (1 Burst) time = 1 Chirp On time * Number of Chirp
Total Tx On time = Tx On (1 Burst) time * Number of Burst
Duty = (Total Tx on time / Tx On + Tx Off time) * 100
Duty factor = 10 * log (Tx On + Tx Off time / Total Tx On time)

Mode 1

1cycle (Tx On + Tx Off)

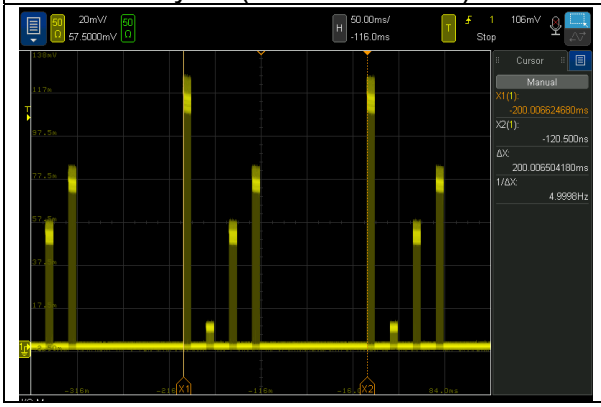


1 Chirp On

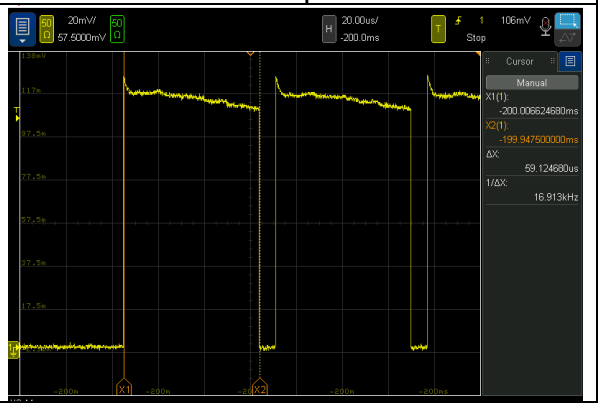


Mode 2

1cycle (Tx On + Tx Off)



1 Chirp On



Spurious Emissions
(Below 40 GHz)

Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No. 2	No. 2	No. 2	No. 2
Date	October 29, 2024	October 30, 2024	October 30, 2024	November 5, 2024
Temperature / Humidity	22 deg. C / 54 % RH	22 deg. C / 52 % RH	24 deg. C / 48 % RH	22 deg. C / 46 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Yuichiro Yamazaki	Junki Nagatomi
	(1 GHz to 10 GHz)	(10 GHz to 40 GHz)	(Below 30 MHz)	(30 MHz to 1 GHz)
Mode	Mode 1			

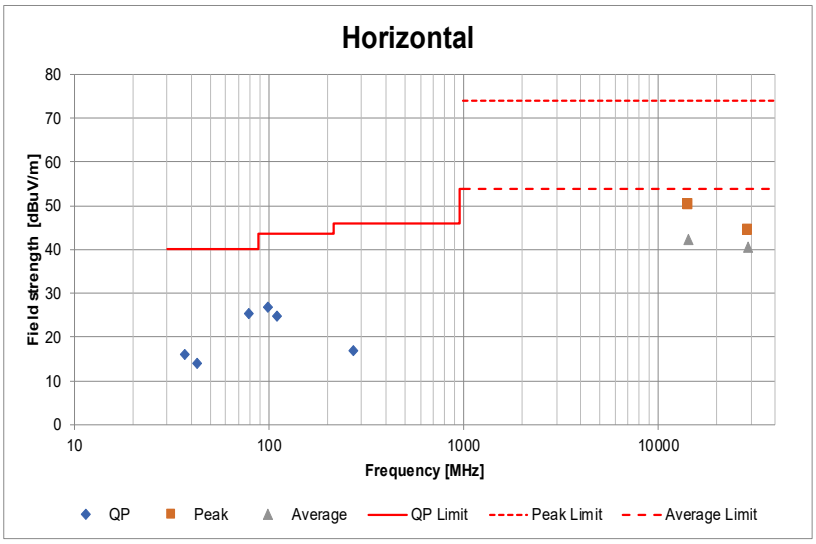
Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	36.8	21.6	-	16.2	6.7	28.5	-	16.0	-	40.0	-	24.1	-	
Hori.	42.6	21.6	-	14.1	6.8	28.5	-	13.9	-	40.0	-	26.1	-	
Hori.	79.2	39.9	-	6.8	7.2	28.5	-	25.4	-	40.0	-	14.6	-	
Hori.	98.6	37.8	-	9.9	7.4	28.4	-	26.7	-	43.5	-	16.8	-	
Hori.	110.3	34.2	-	11.6	7.5	28.4	-	24.9	-	43.5	-	18.6	-	
Hori.	270.9	23.1	-	13.0	8.5	27.7	-	16.9	-	46.0	-	29.1	-	
Hori.	14399.5	45.0	37.1	39.5	-3.3	30.9	-	50.3	42.3	73.9	53.9	23.6	11.6	
Hori.	28799.1	72.4	68.4	43.3	2.9	74.2	-	44.4	40.5	73.9	53.9	29.5	13.4	
Vert.	41.5	31.4	-	14.4	6.8	28.5	-	24.1	-	40.0	-	15.9	-	
Vert.	79.0	53.4	-	6.8	7.2	28.5	-	38.9	-	40.0	-	1.1	-	
Vert.	98.7	50.8	-	9.9	7.4	28.4	-	39.7	-	43.5	-	3.8	-	
Vert.	108.5	49.5	-	11.3	7.4	28.4	-	39.9	-	43.5	-	3.6	-	
Vert.	188.9	36.0	-	16.5	8.0	28.0	-	32.5	-	43.5	-	11.1	-	
Vert.	267.4	40.9	-	12.8	8.5	27.7	-	34.5	-	46.0	-	11.5	-	
Vert.	352.9	37.9	-	15.1	9.0	28.1	-	34.0	-	46.0	-	12.1	-	
Vert.	14399.5	44.2	36.4	39.5	-3.3	30.9	-	49.5	41.7	73.9	53.9	24.4	12.2	
Vert.	28799.1	72.7	68.6	43.3	2.9	74.2	-	44.7	40.6	73.9	53.9	29.2	13.3	

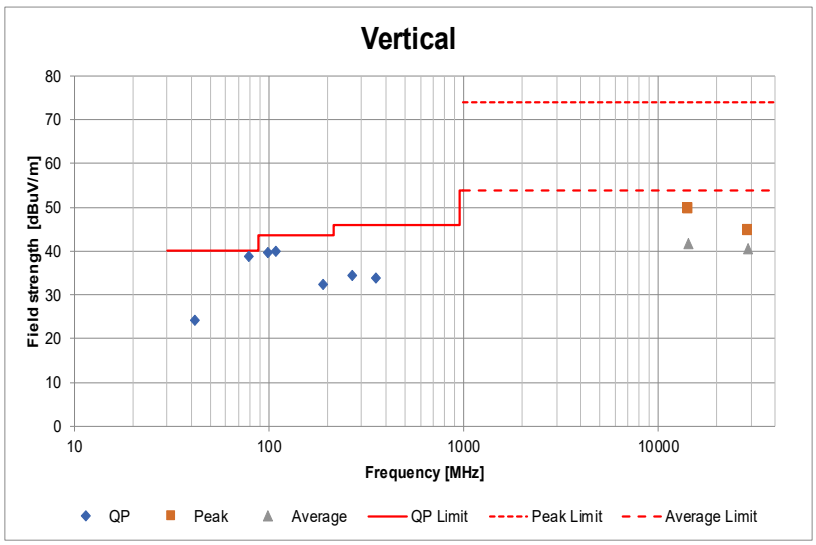
Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.

Distance factor:	1 GHz - 6 GHz	20log (3.75 m / 3.0 m) = 1.94 dB
	6 GHz - 10 GHz	20log (3.75 m / 3.0 m) = 1.94 dB
	10 GHz - 40 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Spurious Emissions
(Below 40 GHz)
(Plot data, Worst case)

Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No. 2	No. 2	No. 2	No. 2
Date	October 29, 2024	October 30, 2024	October 30, 2024	November 5, 2024
Temperature / Humidity	22 deg. C / 54 % RH	22 deg. C / 52 % RH	24 deg. C / 48 % RH	22 deg. C / 46 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Yuichiro Yamazaki	Junki Nagatomi
	(1 GHz to 10 GHz)	(10 GHz to 40 GHz)	(Below 30 MHz)	(30 MHz to 1 GHz)
Mode	Mode 1			





Spurious Emissions
(Below 40 GHz)

Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No. 2	No. 2	No. 2	No. 2
Date	October 29, 2024	October 30, 2024	October 30, 2024	November 5, 2024
Temperature / Humidity	22 deg. C / 54 % RH	22 deg. C / 52 % RH	24 deg. C / 48 % RH	22 deg. C / 46 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Yuichiro Yamazaki	Junki Nagatomi
	(1 GHz to 10 GHz)	(10 GHz to 40 GHz)	(Below 30 MHz)	(30 MHz to 1 GHz)
Mode	Mode 2			

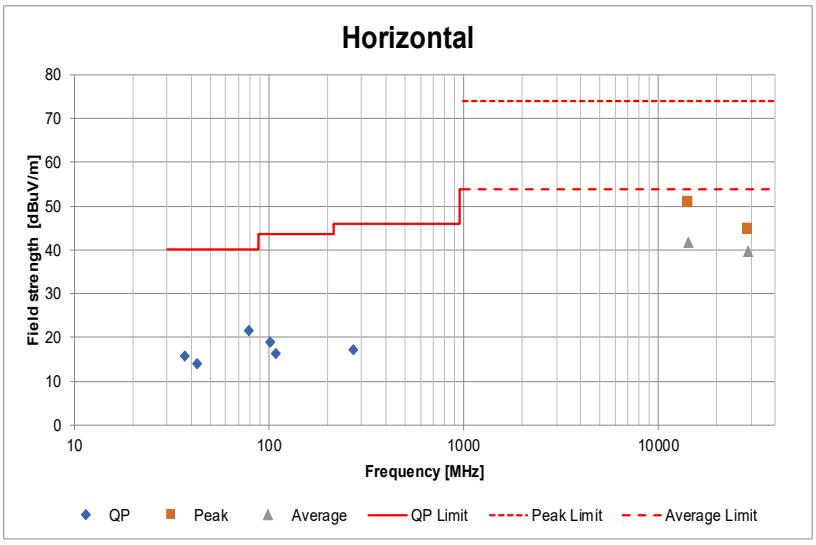
Polarity [Hori/Vert]	Frequency [MHz]	Reading (QP / PK) [dBuV]	Reading (AV) [dBuV]	Ant. Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (QP / PK) [dBuV/m]	Result (AV) [dBuV/m]	Limit (QP / PK) [dBuV/m]	Limit (AV) [dBuV/m]	Margin (QP / PK) [dB]	Margin (AV) [dB]	Remark
Hori.	36.9	21.5	-	16.2	6.7	28.5	-	15.9	-	40.0	-	24.2	-	
Hori.	42.5	21.6	-	14.1	6.8	28.5	-	13.9	-	40.0	-	26.1	-	
Hori.	79.2	35.9	-	6.8	7.2	28.5	-	21.4	-	40.0	-	18.6	-	
Hori.	101.4	29.7	-	10.4	7.4	28.4	-	19.0	-	43.5	-	24.5	-	
Hori.	108.5	25.9	-	11.3	7.4	28.4	-	16.3	-	43.5	-	27.2	-	
Hori.	270.9	23.3	-	13.0	8.5	27.7	-	17.1	-	46.0	-	28.9	-	
Hori.	14399.5	45.5	36.5	39.5	-3.3	30.9	-	50.8	41.8	73.9	53.9	23.1	12.1	
Hori.	28799.1	72.5	67.7	43.3	2.9	74.2	-	44.6	39.8	73.9	53.9	29.3	14.1	
Vert.	35.2	30.7	-	16.8	6.7	28.5	-	25.7	-	40.0	-	14.3	-	
Vert.	69.3	47.4	-	6.3	7.1	28.5	-	32.3	-	40.0	-	7.7	-	
Vert.	81.8	53.8	-	7.2	7.2	28.5	-	39.8	-	40.0	-	0.3	-	
Vert.	101.3	51.1	-	10.4	7.4	28.4	-	40.4	-	43.5	-	3.1	-	
Vert.	110.3	46.5	-	11.6	7.5	28.4	-	37.2	-	43.5	-	6.3	-	
Vert.	353.1	33.5	-	15.1	9.0	28.1	-	29.6	-	46.0	-	16.5	-	
Vert.	14399.5	44.2	36.1	39.5	-3.3	30.9	-	49.5	41.4	73.9	53.9	24.4	12.5	
Vert.	28799.1	71.5	66.7	43.3	2.9	74.2	-	43.6	38.8	73.9	53.9	30.3	15.2	

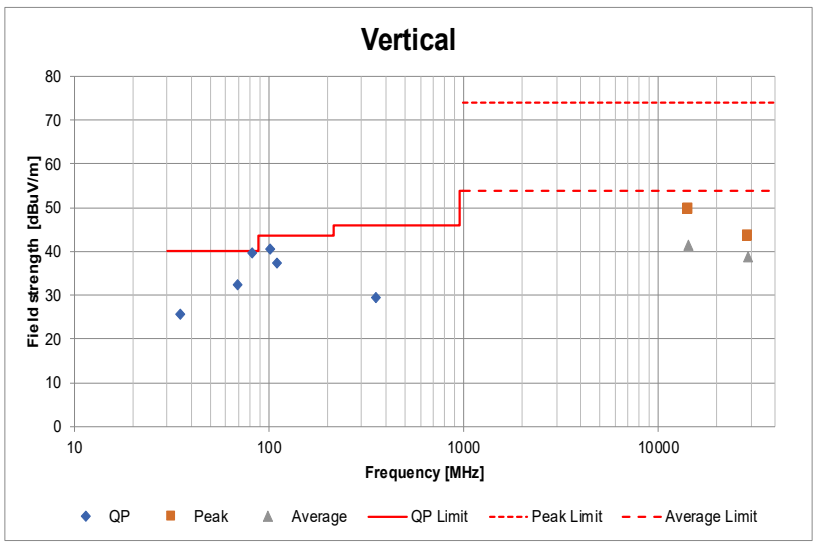
Result (QP / PK) = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier)
Result (AV)= Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance factor(above 1 GHz)) - Gain(Amplifier) + Duty factor
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
*QP detector was used up to 1GHz.

Distance factor:		
	1 GHz - 6 GHz	20log (3.75 m / 3.0 m) = 1.94 dB
	6 GHz - 10 GHz	20log (3.75 m / 3.0 m) = 1.94 dB
	10 GHz - 40 GHz	20log (1.0 m / 3.0 m) = -9.5 dB

Spurious Emissions
(Below 40 GHz)
(Plot data, Worst case)

Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No. 2	No. 2	No. 2	No. 2
Date	October 29, 2024	October 30, 2024	October 30, 2024	November 5, 2024
Temperature / Humidity	22 deg. C / 54 % RH	22 deg. C / 52 % RH	24 deg. C / 48 % RH	22 deg. C / 46 % RH
Engineer	Junki Nagatomi	Junki Nagatomi	Yuichiro Yamazaki	Junki Nagatomi
	(1 GHz to 10 GHz)	(10 GHz to 40 GHz)	(Below 30 MHz)	(30 MHz to 1 GHz)
Mode	Mode 2			





Spurious Emissions
(Above 40 GHz)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No. 2	No. 2
Date	October 29, 2024	October 31, 2024
Temperature / Humidity	24 deg. C / 61 % RH	22 deg. C / 50 % RH
Engineer	Yuichiro Yamazaki	Junki Nagatomi
	(40 GHz to 50 GHz, Above 75 GHz)	(50 GHz to 75 GHz)
Mode	Mode 1	

[57 GHz to 71 GHz (Excluding 61 GHz to 61.5 GHz)]

Average Result

Freq. [GHz]	Reading (Average) [dBm]	Rx Ant. Gain [dBi]	Filter Loss [dB]	LNA Gain [dB]	Mixer Conv. Loss [dB]	IF Amp. Gain [dB]	IF Cable Loss [dB]	Test Distance *D* [m]	FSL [dB]	EIRP Result [dBm]	EIRP Result [mW]	Limit (Average) [dBm]	Margin (Average) [dB]	Remarks
58.724	-101.97	23.69	0.00	25.55	46.05	0.00	0.00	1.50	71.34	-33.82	0.000415	10	43.82	NS
60.999	-102.67	23.80	0.00	24.76	46.03	0.00	0.00	1.50	71.68	-33.52	0.000445	10	43.52	
61.502	-103.49	23.79	0.00	24.56	45.93	0.00	0.00	1.50	71.75	-34.16	0.000384	10	44.16	
64.250	-102.24	23.97	0.00	23.98	47.72	0.00	0.00	1.50	72.13	-30.34	0.000925	10	40.34	NS
70.166	-102.34	24.30	0.00	20.71	48.87	0.00	0.00	1.50	72.89	-25.59	0.002761	10	35.59	NS

Calculation:
FSL (Free Space path Loss) = 10 * log ((4 * Pi * D / λ)^2)
EIRP = Reading - Rx Ant. gain + Filter loss - LNA gain + Mixer conversion loss - IF Amp. gain + IF Cable loss + FSL

Peak Result

Freq. [GHz]	Reading (Peak) [dBm]	Rx Ant. Gain [dBi]	Filter Loss [dB]	LNA Gain [dB]	Mixer Conv. Loss [dB]	IF Amp. Gain [dB]	IF Cable Loss [dB]	Test Distance *D* [m]	FSL [dB]	EIRP Result [dBm]	EIRP Result [mW]	Limit (Peak) [dBm]	Margin (Peak) [dB]	Remarks
58.724	-92.52	23.69	0.00	25.55	46.05	0.00	0.00	1.50	71.34	-24.37	0.003655	13	37.37	NS
60.999	-79.32	23.80	0.00	24.76	46.03	0.00	0.00	1.50	71.68	-10.17	0.096095	13	23.17	
61.502	-91.57	23.79	0.00	24.56	45.93	0.00	0.00	1.50	71.75	-22.24	0.005970	13	35.24	
64.250	-92.90	23.97	0.00	23.98	47.72	0.00	0.00	1.50	72.13	-21.00	0.007952	13	34.00	NS
70.166	-92.70	24.30	0.00	20.71	48.87	0.00	0.00	1.50	72.89	-15.95	0.025404	13	28.95	NS

Calculation:
FSL (Free Space path Loss) = 10 * log ((4 * Pi * D / λ)^2)
EIRP = Reading - Rx Ant. gain + Filter loss - LNA gain + Mixer conversion loss - IF Amp. gain + IF Cable loss + FSL

These calculation results are same as results which were calculated with formulas described in the Section 9 of ANSI C63.10-2020.

NS: No signal detected.
The equipment were not used for factor 0 dB of the data sheets.

Spurious Emissions
(Above 40 GHz)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No. 2	No. 2
Date	October 29, 2024	October 31, 2024
Temperature / Humidity	24 deg. C / 61 % RH	22 deg. C / 50 % RH
Engineer	Yuichiro Yamazaki	Junki Nagatomi
	(40 GHz to 50 GHz, Above 75 GHz)	(50 GHz to 75 GHz)
Mode	Mode 1	

[40 GHz to 200 GHz (Excluding 57 GHz to 71 GHz)]

Average Result

Freq. [GHz]	Reading (Average) [dBm]	Rx Ant. Gain [dBi]	Filter Loss [dB]	LNA Gain [dB]	Mixer Conv. Loss [dB]	IF Amp. Gain [dB]	IF Cable Loss [dB]	Test Distance *D* [m]	FSL [dB]	EIRP [dBm]	EIRP [mW]	Power density Result at 3 m (Average) [pW/cm^2]	Limit Average [pW/cm^2]	Margin Average [dB]	Remarks
44.933	-56.96	21.73	0.00	31.79	0.00	0.00	8.41	1.00	65.49	-36.58	0.000220	0.19	90	26.65	NS
49.982	-53.06	22.64	0.00	31.38	0.00	0.00	8.92	1.00	66.42	-31.74	0.000670	0.59	90	21.82	NS
54.417	-100.85	23.26	0.00	26.52	46.08	0.00	0.00	1.50	70.68	-33.87	0.000410	0.36	90	23.95	NS
71.585	-102.30	24.36	0.00	20.74	49.09	0.00	0.00	1.50	73.06	-25.24	0.002989	2.64	90	15.32	NS
81.329	-62.17	23.42	0.12	34.44	40.07	32.00	0.10	1.00	70.65	-41.09	0.000078	0.07	90	31.17	NS
88.933	-61.90	23.86	0.23	32.91	41.25	32.00	0.10	1.00	71.42	-37.67	0.000171	0.15	90	27.75	NS
94.977	-60.81	24.26	0.26	33.05	41.97	32.00	0.10	1.00	71.99	-35.79	0.000263	0.23	90	25.87	NS
98.147	-60.32	24.40	0.36	34.28	42.55	32.00	0.10	1.00	72.28	-35.71	0.000268	0.24	90	25.79	NS
108.432	-60.99	24.78	0.70	21.71	42.95	32.00	0.10	1.00	73.14	-22.59	0.005514	4.88	90	12.66	NS
117.148	-87.78	22.54	0.00	18.30	53.71	0.00	0.00	0.01	33.82	-41.09	0.000078	0.07	90	31.17	NS
120.109	-87.47	22.65	0.00	18.94	50.39	0.00	0.00	0.01	34.03	-44.63	0.000034	0.03	90	34.71	NS
122.170	-88.54	22.71	0.00	19.69	48.19	0.00	0.00	0.01	34.18	-48.57	0.000014	0.01	90	38.65	NS
127.233	-88.11	22.87	0.00	20.61	52.74	0.00	0.00	0.01	34.53	-44.32	0.000037	0.03	90	34.40	NS
131.417	-88.73	22.99	0.00	19.76	51.82	0.00	0.00	0.01	34.81	-44.85	0.000033	0.03	90	34.92	NS
139.146	-89.79	23.17	0.00	19.20	51.62	0.00	0.00	0.01	35.31	-45.23	0.000030	0.03	90	35.31	NS
148.418	-90.97	23.31	0.00	17.98	55.04	0.00	0.00	0.01	35.87	-41.34	0.000073	0.06	90	31.42	NS
160.207	-92.52	23.39	0.00	16.70	58.66	0.00	0.00	0.01	36.54	-37.41	0.000181	0.16	90	27.49	NS
163.901	-92.80	23.40	0.00	14.10	59.99	0.00	0.00	0.01	36.73	-33.57	0.000439	0.39	90	23.65	NS
172.150	-87.52	22.45	0.00	0.00	61.34	0.00	0.00	0.005	31.14	-17.49	0.017805	15.74	90	7.57	NS
178.283	-88.41	22.59	0.00	0.00	61.08	0.00	0.00	0.005	31.44	-18.48	0.014198	12.55	90	8.55	NS
186.266	-88.41	22.77	0.00	0.00	58.64	0.00	0.00	0.005	31.82	-20.71	0.008488	7.50	90	10.79	NS
194.428	-90.13	22.92	0.00	0.00	59.43	0.00	0.00	0.005	32.20	-21.43	0.007202	6.37	90	11.50	NS

Calculation:
FSL (Free Space path Loss) = 10 * log ((4 * Pi * D / λ)^2)
EIRP = Reading - Rx Ant. gain + Filter loss - LNA gain + Mixer conversion loss - IF Amp. gain + IF Cable loss + FSL
Power density Result at 3 m = EIRP / (4 * Pi * 300^2)

Peak Result

Freq. [GHz]	Reading (Peak) [dBm]	Rx Ant. Gain [dBi]	Filter Loss [dB]	LNA Gain [dB]	Mixer Conv. Loss [dB]	IF Amp. Gain [dB]	IF Cable Loss [dB]	Test Distance *D* [m]	FSL [dB]	EIRP [dBm]	EIRP [mW]	Power density Result at 3 m (Peak) [pW/cm^2]	Limit Peak [pW/cm^2]	Margin Peak [dB]	Remarks
44.921	-51.88	21.73	0.00	31.78	0.00	0.00	8.41	1.00	65.49	-31.49	0.000709	0.63	9000	41.57	NS
49.936	-48.04	22.62	0.00	31.40	0.00	0.00	8.91	1.00	66.41	-26.74	0.002120	1.87	9000	36.81	NS
53.437	-92.85	23.13	0.00	26.69	46.01	0.00	0.00	1.50	70.52	-26.14	0.002431	2.15	9000	36.22	NS
72.262	-92.41	24.36	0.00	20.93	49.20	0.00	0.00	1.50	73.14	-15.35	0.029153	25.78	9000	25.43	NS
80.369	-57.75	23.31	0.12	35.14	39.71	32.00	0.10	1.00	70.54	-37.73	0.000169	0.15	9000	47.81	NS
86.623	-57.23	23.75	0.21	30.54	40.79	32.00	0.10	1.00	71.19	-31.22	0.000754	0.67	9000	41.30	NS
94.921	-55.95	24.26	0.26	33.05	41.95	32.00	0.10	1.00	71.99	-30.96	0.000802	0.71	9000	41.04	NS
99.789	-56.05	24.48	0.21	32.64	43.01	32.00	0.10	1.00	72.42	-29.43	0.001141	1.01	9000	39.50	NS
108.346	-56.26	24.77	0.67	21.86	42.87	32.00	0.10	1.00	73.14	-18.11	0.015453	13.66	9000	28.19	NS
117.556	-82.25	22.55	0.00	18.67	54.00	0.00	0.00	0.01	33.85	-35.62	0.000274	0.24	9000	45.70	NS
120.865	-83.01	22.67	0.00	19.40	50.13	0.00	0.00	0.01	34.09	-40.86	0.000082	0.07	9000	50.94	NS
122.027	-83.92	22.71	0.00	19.55	47.94	0.00	0.00	0.01	34.17	-44.07	0.000039	0.03	9000	54.15	NS
128.095	-83.53	22.89	0.00	20.61	49.92	0.00	0.00	0.01	34.59	-42.51	0.000056	0.05	9000	52.59	NS
131.293	-84.38	22.98	0.00	19.88	52.06	0.00	0.00	0.01	34.81	-40.37	0.000092	0.08	9000	50.45	NS
141.753	-85.05	23.22	0.00	19.04	53.06	0.00	0.00	0.01	35.47	-38.78	0.000133	0.12	9000	48.85	NS
149.948	-86.53	23.33	0.00	17.25	56.56	0.00	0.00	0.01	35.96	-34.59	0.000348	0.31	9000	44.66	NS
160.738	-87.44	23.40	0.00	16.35	58.21	0.00	0.00	0.01	36.56	-32.41	0.000574	0.51	9000	42.49	NS
163.947	-88.24	23.40	0.00	14.03	60.03	0.00	0.00	0.01	36.74	-28.90	0.001288	1.14	9000	38.98	NS
176.383	-82.50	22.55	0.00	0.00	60.20	0.00	0.00	0.005	31.35	-13.50	0.044682	39.51	9000	23.58	NS
178.555	-83.65	22.60	0.00	0.00	61.16	0.00	0.00	0.005	31.46	-13.63	0.043317	38.30	9000	23.71	NS
187.035	-83.05	22.78	0.00	0.00	58.94	0.00	0.00	0.005	31.86	-15.03	0.031410	27.77	9000	25.11	NS
197.659	-85.98	22.98	0.00	0.00	60.86	0.00	0.00	0.005	32.34	-15.76	0.026561	23.49	9000	25.83	NS

Calculation:
FSL (Free Space path Loss) = 10 * log ((4 * Pi * D / λ)^2)
EIRP = Reading - Rx Ant. gain + Filter loss - LNA gain + Mixer conversion loss - IF Amp. gain + IF Cable loss + FSL
Power density Result at 3 m = EIRP / (4 * Pi * 300^2)

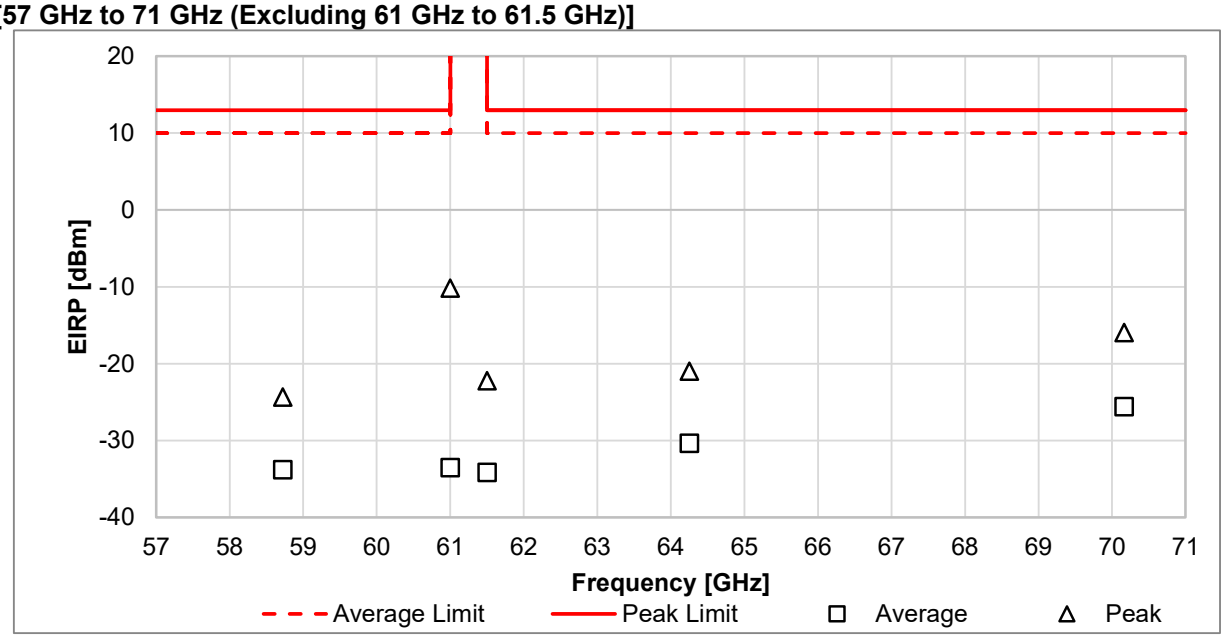
These calculation results are same as results which were calculated with formulas described in the Section 9 of ANSI C63.10-2020.

NS: No signal detected.
The equipment were not used for factor 0 dB of the data sheets.

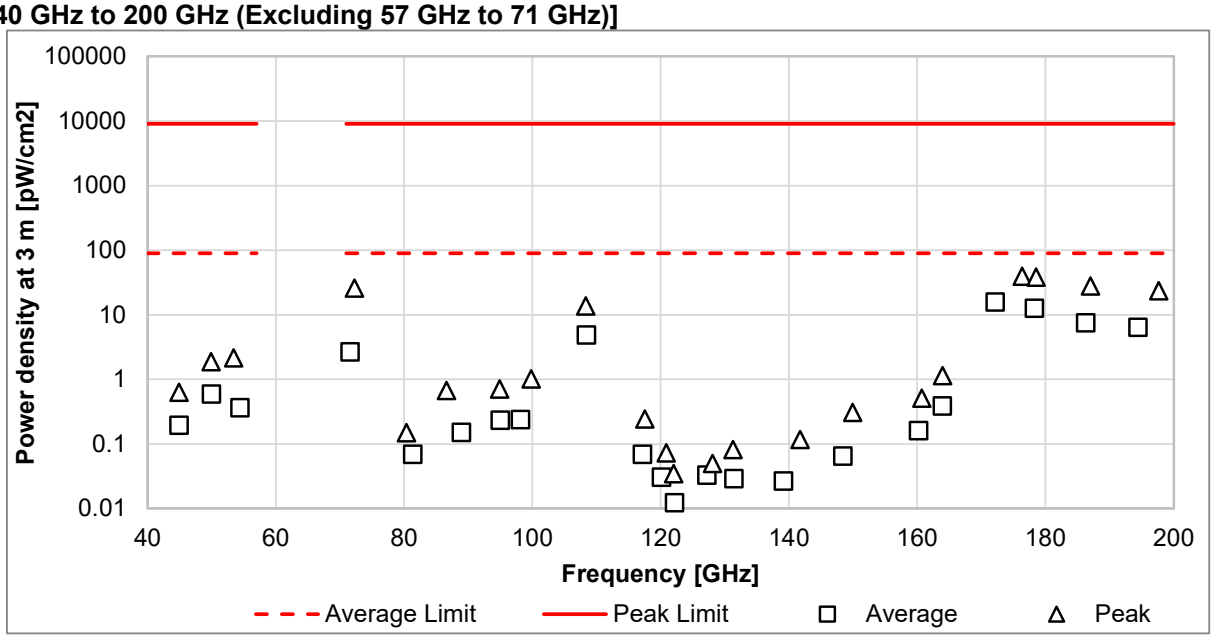
Spurious Emissions
(Above 40 GHz)
(Plot data, Worst case)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No. 2	No. 2
Date	October 29, 2024	October 31, 2024
Temperature / Humidity	24 deg. C / 61 % RH	22 deg. C / 50 % RH
Engineer	Yuichiro Yamazaki	Junki Nagatomi
	(40 GHz to 50 GHz, Above 75 GHz)	(50 GHz to 75 GHz)
Mode	Mode 1	

[57 GHz to 71 GHz (Excluding 61 GHz to 61.5 GHz)]



[40 GHz to 200 GHz (Excluding 57 GHz to 71 GHz)]



Spurious Emissions
(Above 40 GHz)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No. 2	No. 2
Date	October 29, 2024	October 31, 2024
Temperature / Humidity	24 deg. C / 61 % RH	22 deg. C / 50 % RH
Engineer	Yuichiro Yamazaki	Junki Nagatomi
	(40 GHz to 50 GHz, Above 75 GHz)	(50 GHz to 75 GHz)
Mode	Mode 2	

[57 GHz to 71 GHz (Excluding 61 GHz to 61.5 GHz)]

Average Result

Freq. [GHz]	Reading (Average) [dBm]	Rx Ant. Gain [dBi]	Filter Loss [dB]	LNA Gain [dB]	Mixer Conv. Loss [dB]	IF Amp. Gain [dB]	IF Cable Loss [dB]	Test Distance *D* [m]	FSL [dB]	EIRP Result [dBm]	EIRP Result [mW]	Limit (Average) [dBm]	Margin (Average) [dB]	Remarks
59.316	-103.11	23.71	0.00	25.36	46.02	0.00	0.00	1.50	71.43	-34.73	0.000337	10	44.73	NS
60.996	-103.50	23.80	0.00	24.76	46.03	0.00	0.00	1.50	71.67	-34.36	0.000366	10	44.36	
61.501	-103.03	23.79	0.00	24.56	45.93	0.00	0.00	1.50	71.75	-33.70	0.000427	10	43.70	
62.646	-101.85	23.91	0.00	24.31	46.26	0.00	0.00	1.50	71.91	-31.90	0.000646	10	41.90	NS
68.939	-102.11	24.33	0.00	21.85	48.45	0.00	0.00	1.50	72.74	-27.10	0.001950	10	37.10	NS

Calculation:
FSL (Free Space path Loss) = 10 * log ((4 * Pi * D / λ)^2)
EIRP = Reading - Rx Ant. gain + Filter loss - LNA gain + Mixer conversion loss - IF Amp. gain + IF Cable loss + FSL

Peak Result

Freq. [GHz]	Reading (Peak) [dBm]	Rx Ant. Gain [dBi]	Filter Loss [dB]	LNA Gain [dB]	Mixer Conv. Loss [dB]	IF Amp. Gain [dB]	IF Cable Loss [dB]	Test Distance *D* [m]	FSL [dB]	EIRP Result [dBm]	EIRP Result [mW]	Limit (Peak) [dBm]	Margin (Peak) [dB]	Remarks
59.316	-92.72	23.71	0.00	25.36	46.02	0.00	0.00	1.50	71.43	-24.34	0.003686	13	37.34	NS
60.996	-91.10	23.80	0.00	24.76	46.03	0.00	0.00	1.50	71.67	-21.96	0.006366	13	34.96	
61.501	-79.96	23.79	0.00	24.56	45.93	0.00	0.00	1.50	71.75	-10.63	0.086537	13	23.63	
62.646	-92.31	23.91	0.00	24.31	46.26	0.00	0.00	1.50	71.91	-22.36	0.005813	13	35.36	NS
68.939	-93.11	24.33	0.00	21.85	48.45	0.00	0.00	1.50	72.74	-18.10	0.015488	13	31.10	NS

Calculation:
FSL (Free Space path Loss) = 10 * log ((4 * Pi * D / λ)^2)
EIRP = Reading - Rx Ant. gain + Filter loss - LNA gain + Mixer conversion loss - IF Amp. gain + IF Cable loss + FSL

These calculation results are same as results which were calculated with formulas described in the Section 9 of ANSI C63.10-2020.

NS: No signal detected.
The equipment were not used for factor 0 dB of the data sheets.

Spurious Emissions
(Above 40 GHz)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No. 2	No. 2
Date	October 29, 2024	October 31, 2024
Temperature / Humidity	24 deg. C / 61 % RH	22 deg. C / 50 % RH
Engineer	Yuichiro Yamazaki	Junki Nagatomi
	(40 GHz to 50 GHz, Above 75 GHz)	(50 GHz to 75 GHz)
Mode	Mode 2	

[40 GHz to 200 GHz (Excluding 57 GHz to 71 GHz)]

Average Result

Freq. [GHz]	Reading (Average) [dBm]	Rx Ant. Gain [dBi]	Filter Loss [dB]	LNA Gain [dB]	Mixer Conv. Loss [dB]	IF Amp. Gain [dB]	IF Cable Loss [dB]	Test Distance *D* [m]	FSL [dB]	EIRP [dBm]	EIRP [mW]	Power density Result at 3 m (Average) [pW/cm^2]	Limit Average [pW/cm^2]	Margin Average [dB]	Remarks
44.906	-56.08	21.72	0.00	31.77	0.00	0.00	8.41	1.00	65.49	-35.67	0.000271	0.24	90	25.74	NS
49.967	-52.40	22.63	0.00	31.38	0.00	0.00	8.91	1.00	66.42	-31.08	0.000780	0.69	90	21.16	NS
53.990	-100.96	23.25	0.00	26.67	46.00	0.00	0.00	1.50	70.61	-34.27	0.000374	0.33	90	24.35	NS
71.904	-102.08	24.34	0.00	20.74	49.01	0.00	0.00	1.50	73.10	-25.05	0.003123	2.76	90	15.13	NS
81.194	-62.53	23.40	0.14	34.51	40.02	32.00	0.10	1.00	70.63	-41.54	0.000070	0.06	90	31.62	NS
88.844	-62.23	23.87	0.23	32.82	41.19	32.00	0.10	1.00	71.41	-37.98	0.000159	0.14	90	28.06	NS
95.887	-61.35	24.22	0.37	33.94	41.94	32.00	0.10	1.00	72.08	-37.02	0.000198	0.18	90	27.10	NS
100.778	-60.66	24.53	0.43	32.58	42.82	32.00	0.10	1.00	72.51	-33.91	0.000406	0.36	90	23.99	NS
108.260	-61.42	24.76	0.63	22.00	42.79	32.00	0.10	1.00	73.13	-23.53	0.004435	3.92	90	13.61	NS
117.193	-87.31	22.54	0.00	18.34	53.74	0.00	0.00	0.01	33.82	-40.63	0.000087	0.08	90	30.71	NS
120.091	-87.31	22.65	0.00	18.93	50.40	0.00	0.00	0.01	34.03	-44.46	0.000036	0.03	90	34.53	NS
122.171	-88.50	22.71	0.00	19.70	48.19	0.00	0.00	0.01	34.18	-48.53	0.000014	0.01	90	38.61	NS
128.862	-88.21	22.91	0.00	20.02	51.96	0.00	0.00	0.01	34.64	-44.53	0.000035	0.03	90	34.61	NS
131.350	-88.81	22.98	0.00	19.82	51.95	0.00	0.00	0.01	34.81	-44.85	0.000033	0.03	90	34.93	NS
139.059	-90.02	23.17	0.00	19.24	51.44	0.00	0.00	0.01	35.31	-45.69	0.000027	0.02	90	35.76	NS
150.581	-91.47	23.33	0.00	17.24	56.78	0.00	0.00	0.01	36.00	-39.26	0.000119	0.10	90	29.34	NS
160.735	-92.38	23.40	0.00	16.35	58.21	0.00	0.00	0.01	36.56	-37.36	0.000184	0.16	90	27.43	NS
163.171	-92.52	23.40	0.00	15.12	59.22	0.00	0.00	0.01	36.69	-35.13	0.000307	0.27	90	25.21	NS
171.202	-87.19	22.42	0.00	0.00	60.47	0.00	0.00	0.005	31.09	-18.05	0.015669	13.85	90	8.13	NS
178.733	-88.76	22.60	0.00	0.00	61.21	0.00	0.00	0.005	31.47	-18.68	0.013540	11.97	90	8.76	NS
187.029	-88.10	22.78	0.00	0.00	58.92	0.00	0.00	0.005	31.86	-20.10	0.009775	8.64	90	10.18	NS
197.507	-90.50	22.98	0.00	0.00	60.36	0.00	0.00	0.005	32.33	-20.78	0.008350	7.38	90	10.86	NS

Calculation:
FSL (Free Space path Loss) = 10 * log ((4 * Pi * D / λ)^2)
EIRP = Reading - Rx Ant. gain + Filter loss - LNA gain + Mixer conversion loss - IF Amp. gain + IF Cable loss + FSL
Power density Result at 3 m = EIRP / (4 * Pi * 300^2)

Peak Result

Freq. [GHz]	Reading (Peak) [dBm]	Rx Ant. Gain [dBi]	Filter Loss [dB]	LNA Gain [dB]	Mixer Conv. Loss [dB]	IF Amp. Gain [dB]	IF Cable Loss [dB]	Test Distance *D* [m]	FSL [dB]	EIRP [dBm]	EIRP [mW]	Power density Result at 3 m (Peak) [pW/cm^2]	Limit Peak [pW/cm^2]	Margin Peak [dB]	Remarks
44.923	-51.96	21.73	0.00	31.78	0.00	0.00	8.41	1.00	65.49	-31.57	0.000696	0.62	9000	41.65	NS
49.920	-48.13	22.61	0.00	31.40	0.00	0.00	8.90	1.00	66.41	-26.83	0.002075	1.83	9000	36.91	NS
52.979	-92.62	23.04	0.00	26.70	46.02	0.00	0.00	1.50	70.45	-25.90	0.002573	2.28	9000	35.97	NS
72.233	-92.68	24.36	0.00	20.91	49.18	0.00	0.00	1.50	73.14	-15.63	0.027323	24.16	9000	25.71	NS
81.130	-58.01	23.40	0.15	34.54	40.00	32.00	0.10	1.00	70.63	-37.07	0.000196	0.17	9000	47.15	NS
88.932	-57.09	23.86	0.23	32.90	41.24	32.00	0.10	1.00	71.42	-32.86	0.000517	0.46	9000	42.94	NS
95.957	-56.28	24.21	0.37	34.01	41.94	32.00	0.10	1.00	72.08	-32.01	0.000630	0.56	9000	42.08	NS
96.938	-55.43	24.34	0.23	34.63	42.10	32.00	0.10	1.00	72.17	-31.80	0.000661	0.58	9000	41.88	NS
109.000	-56.00	24.87	0.93	20.74	43.48	32.00	0.10	1.00	73.19	-15.91	0.025647	22.68	9000	25.99	NS
117.093	-82.75	22.54	0.00	18.25	53.67	0.00	0.00	0.01	33.81	-36.06	0.000248	0.22	9000	46.13	NS
121.039	-83.07	22.68	0.00	19.48	49.99	0.00	0.00	0.01	34.10	-41.14	0.000077	0.07	9000	51.21	NS
122.141	-83.69	22.71	0.00	19.66	48.14	0.00	0.00	0.01	34.18	-43.74	0.000042	0.04	9000	53.82	NS
128.882	-83.42	22.91	0.00	20.00	52.02	0.00	0.00	0.01	34.65	-39.66	0.000108	0.10	9000	49.74	NS
131.878	-83.74	23.00	0.00	19.33	50.94	0.00	0.00	0.01	34.85	-40.29	0.000094	0.08	9000	50.36	NS
141.324	-85.07	23.21	0.00	19.04	53.71	0.00	0.00	0.01	35.45	-38.17	0.000153	0.13	9000	48.24	NS
149.398	-86.35	23.32	0.00	17.69	55.46	0.00	0.00	0.01	35.93	-35.98	0.000253	0.22	9000	46.05	NS
160.251	-88.04	23.39	0.00	16.67	58.62	0.00	0.00	0.01	36.54	-32.94	0.000508	0.45	9000	43.02	NS
164.564	-87.36	23.40	0.00	14.08	59.78	0.00	0.00	0.01	36.77	-28.29	0.001482	1.31	9000	38.37	NS
172.688	-82.65	22.46	0.00	0.00	62.85	0.00	0.00	0.005	31.17	-11.10	0.077668	68.67	9000	21.17	NS
178.646	-84.20	22.60	0.00	0.00	61.18	0.00	0.00	0.005	31.46	-14.16	0.038380	33.94	9000	24.24	NS
187.614	-83.79	22.79	0.00	0.00	60.03	0.00	0.00	0.005	31.89	-14.66	0.034202	30.24	9000	24.74	NS
198.048	-85.79	22.99	0.00	0.00	61.84	0.00	0.00	0.005	32.36	-14.58	0.034806	30.78	9000	24.66	NS

Calculation:
FSL (Free Space path Loss) = 10 * log ((4 * Pi * D / λ)^2)
EIRP = Reading - Rx Ant. gain + Filter loss - LNA gain + Mixer conversion loss - IF Amp. gain + IF Cable loss + FSL
Power density Result at 3 m = EIRP / (4 * Pi * 300^2)

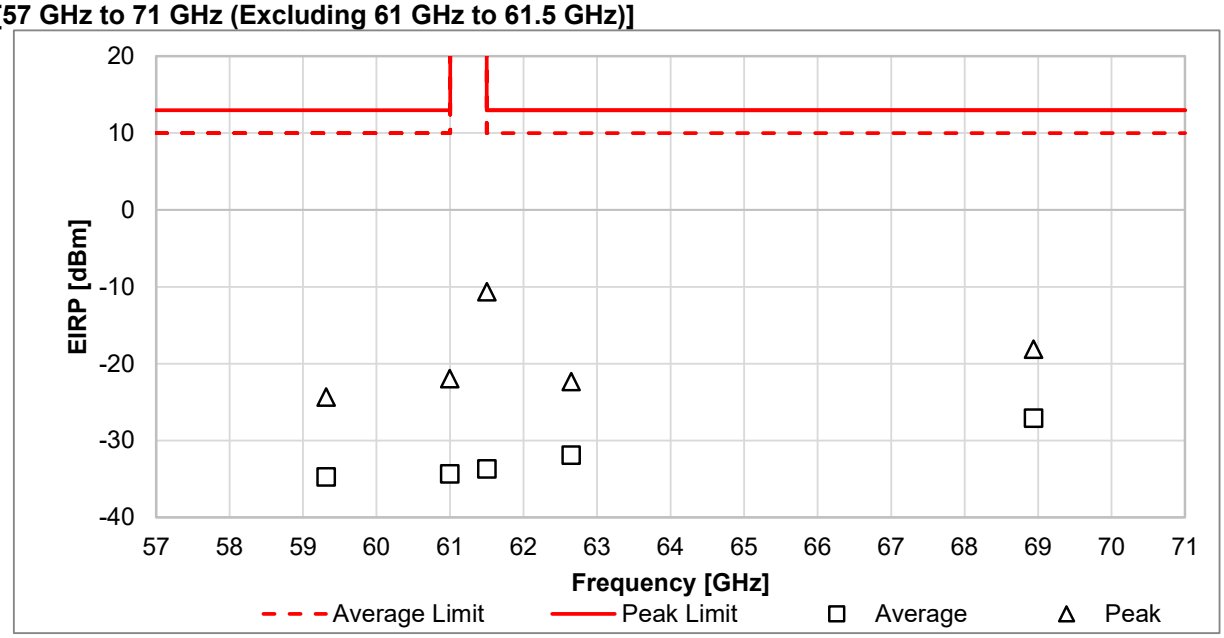
These calculation results are same as results which were calculated with formulas described in the Section 9 of ANSI C63.10-2020.

NS: No signal detected.
The equipment were not used for factor 0 dB of the data sheets.

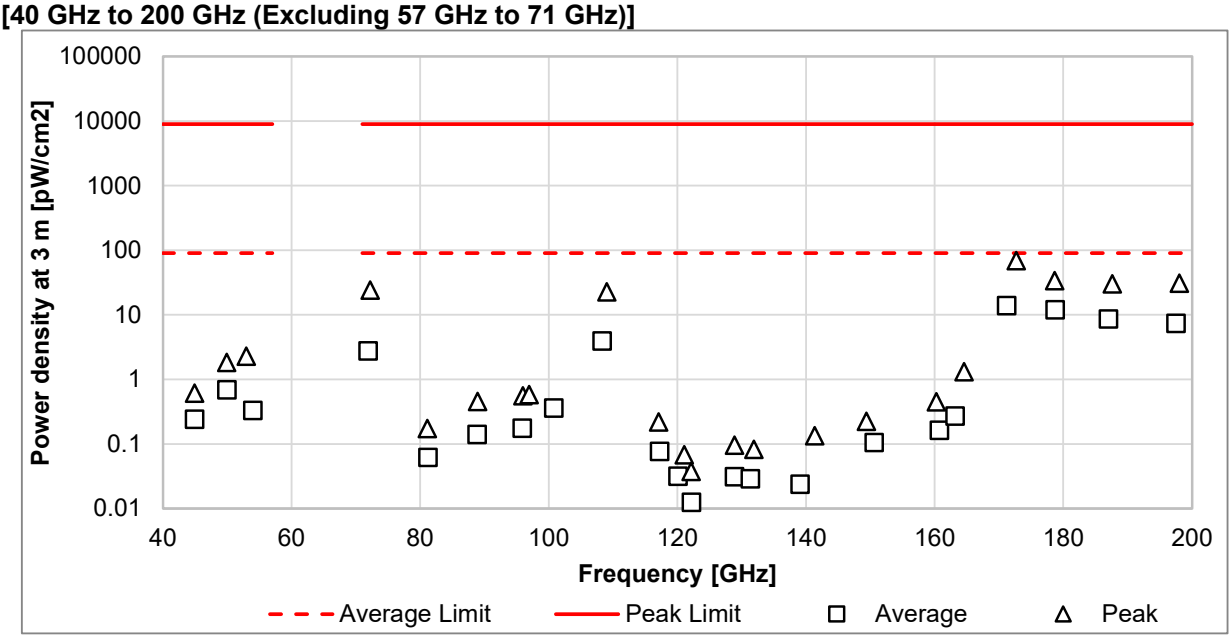
Spurious Emissions
(Above 40 GHz)
(Plot data, Worst case)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No. 2	No. 2
Date	October 29, 2024	October 31, 2024
Temperature / Humidity	24 deg. C / 61 % RH	22 deg. C / 50 % RH
Engineer	Yuichiro Yamazaki	Junki Nagatomi
	(40 GHz to 50 GHz, Above 75 GHz)	(50 GHz to 75 GHz)
Mode	Mode 2	

[57 GHz to 71 GHz (Excluding 61 GHz to 61.5 GHz)]



[40 GHz to 200 GHz (Excluding 57 GHz to 71 GHz)]



Frequency Stability

Test place	Ise EMC Lab. No. 6 Measurement Room
Date	November 6, 2024
Temperature / Humidity	23 deg. C / 48 % RH
Engineer	Nachi Konegawa
Mode	Mode 1

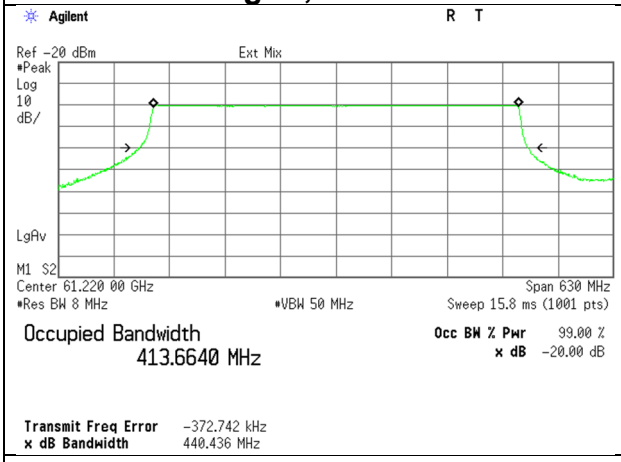
Test Condition		Center frequency	Frequency error	99 % OBW	99 % OBW		Remarks
Temperature [deg. C]	Power Supply [V]	[GHz]	[MHz]	[MHz]	The lower frequency [GHz]	The Upper frequency [GHz]	
50	5.00	61.22	-0.373	413.6640	61.013	61.426	
40	5.00	61.22	-0.218	413.6952	61.013	61.427	
30	5.00	61.22	0.060	413.4811	61.013	61.427	
20	5.00	61.22	0.389	413.5760	61.014	61.427	
20	4.25	61.22	0.422	413.6920	61.014	61.427	85 % of the minimum operating voltage, DC 5 V * 0.85
20	5.75	61.22	0.431	413.6082	61.014	61.427	115 % of the maximum operating voltage, DC 5 V * 1.15
10	5.00	61.22	1.003	413.5904	61.014	61.428	
0	5.00	61.22	1.377	413.5189	61.015	61.428	
-10	5.00	61.22	1.804	413.6495	61.015	61.429	
-20	5.00	61.22	2.051	413.6073	61.015	61.429	

Calculation:
The Lower frequency = Center frequency + Frequency error – 99 % OBW / 2
The Upper frequency = Center frequency + Frequency error + 99 % OBW / 2

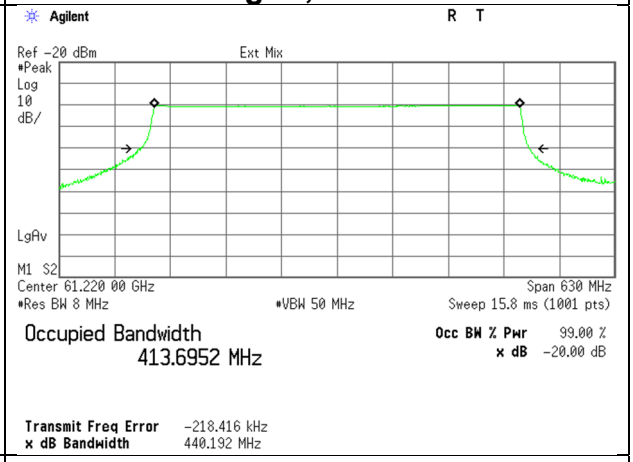
Fundamental emissions were contained within the frequency band 61 GHz to 61.5 GHz during all conditions of operation.

[Data]

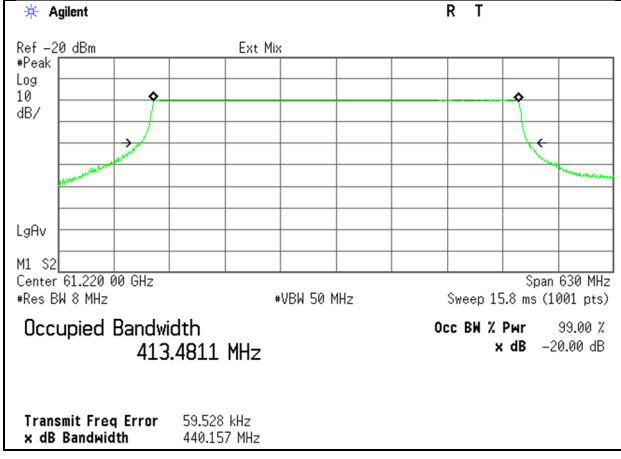
50 deg. C, DC 5.00 V



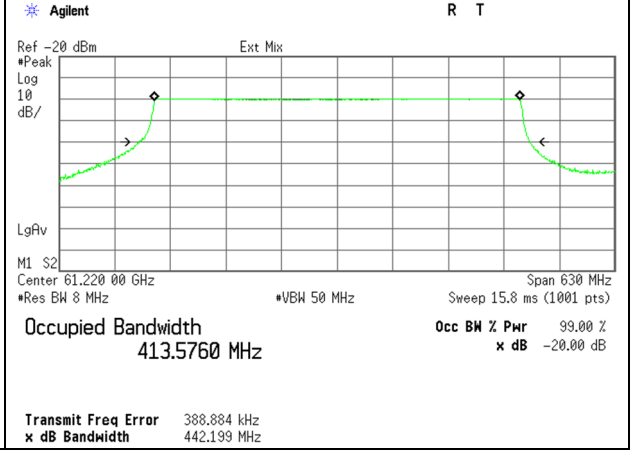
40 deg. C, DC 5.00 V



30 deg. C, DC 5.00 V

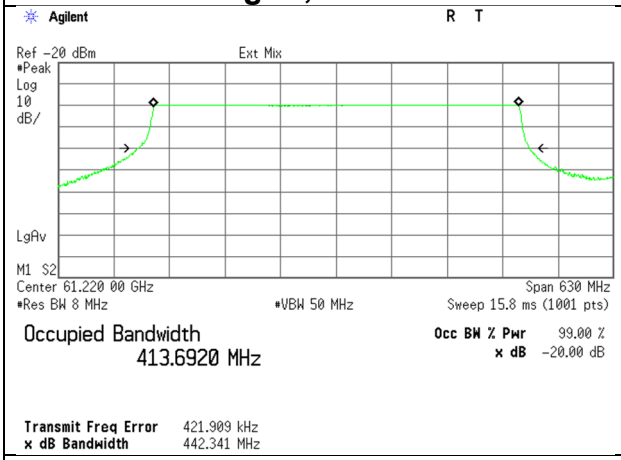


20 deg. C, DC 5.00 V

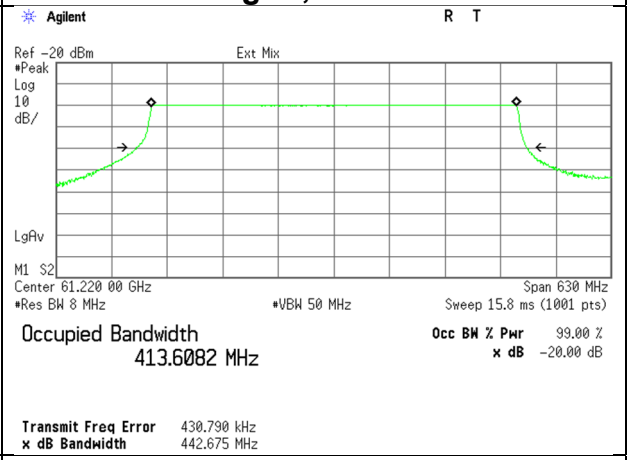


Frequency Stability

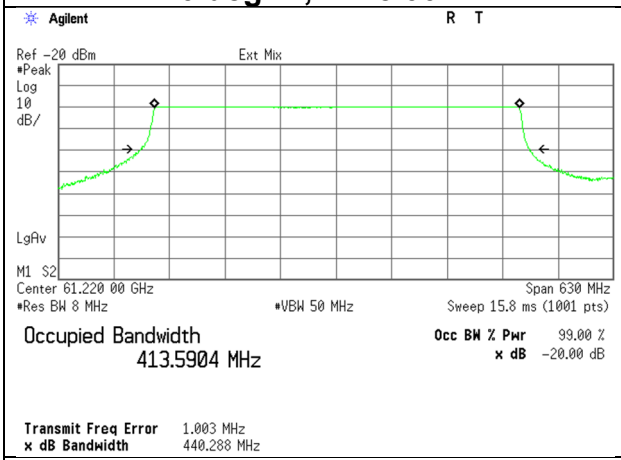
20 deg. C, DC 4.25 V



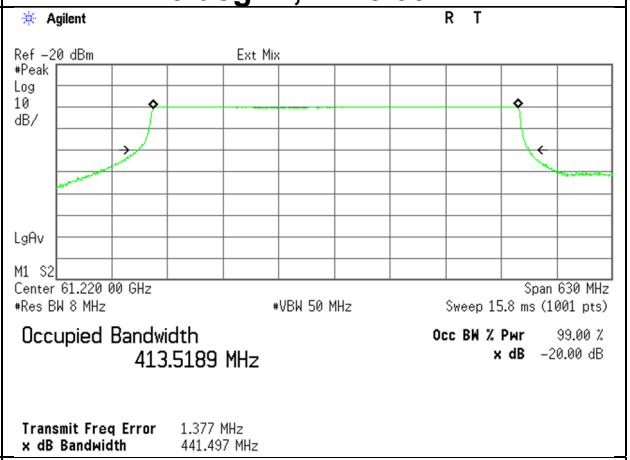
20 deg. C, DC 5.75 V



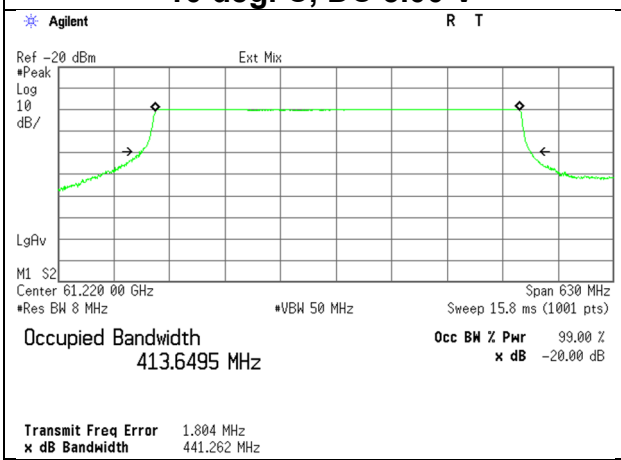
10 deg. C, DC 5.00 V



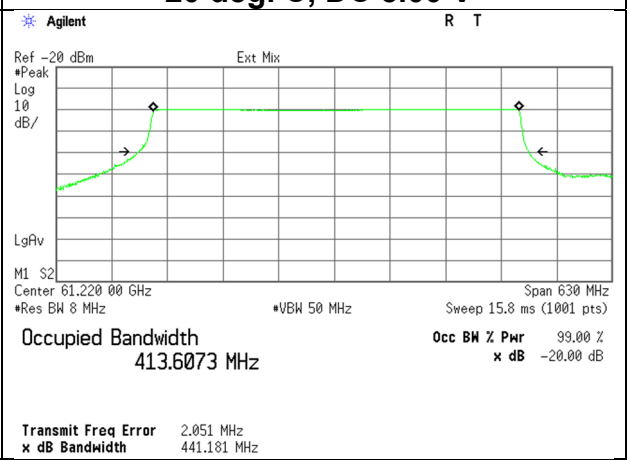
0 deg. C, DC 5.00 V



-10 deg. C, DC 5.00 V



-20 deg. C, DC 5.00 V



Frequency Stability

Test place	Ise EMC Lab. No. 6 Measurement Room
Date	November 12, 2024
Temperature / Humidity	26 deg. C / 43 % RH
Engineer	Nachi Konegawa
Mode	Mode 2

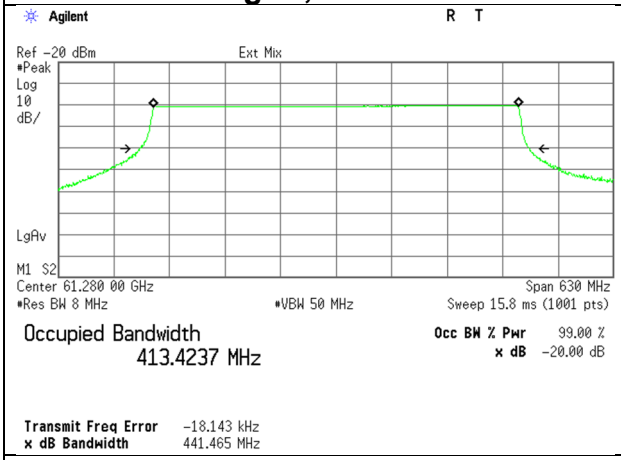
Test Condition		Center frequency	Frequency error	99 % OBW	99 % OBW		Remarks
Temperature [deg. C]	Power Supply [V]	[GHz]	[MHz]	[MHz]	The lower frequency [GHz]	The Upper frequency [GHz]	
50	5.00	61.28	-0.018	413.4237	61.073	61.487	
40	5.00	61.28	-0.013	413.5580	61.073	61.487	
30	5.00	61.28	0.177	413.4850	61.073	61.487	
20	5.00	61.28	0.579	413.4358	61.074	61.487	
20	4.25	61.28	0.534	413.3460	61.074	61.487	85 % of the minimum operating voltage, DC 5 V * 0.85
20	5.75	61.28	0.637	413.4387	61.074	61.487	115 % of the maximum operating voltage, DC 5 V * 1.15
10	5.00	61.28	0.998	413.3372	61.074	61.488	
0	5.00	61.28	1.444	413.4041	61.075	61.488	
-10	5.00	61.28	1.784	413.3705	61.075	61.488	
-20	5.00	61.28	2.039	413.3890	61.075	61.489	

Calculation:
The Lower frequency = Center frequency + Frequency error – 99 % OBW / 2
The Upper frequency = Center frequency + Frequency error + 99 % OBW / 2

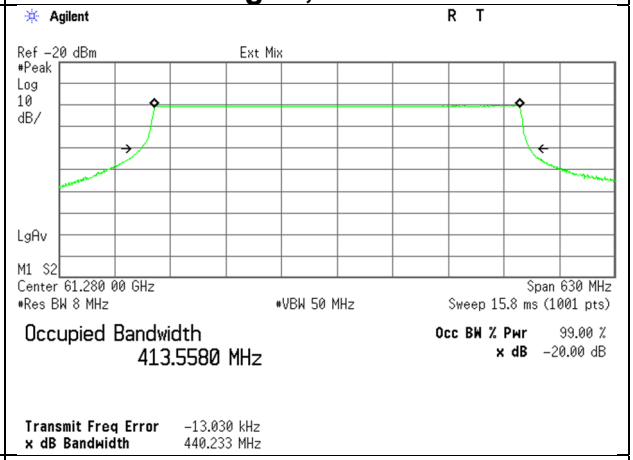
Fundamental emissions were contained within the frequency band 61 GHz to 61.5 GHz during all conditions of operation.

[Data]

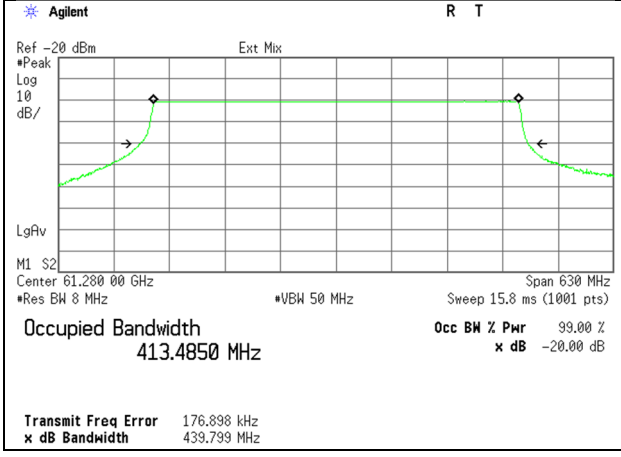
50 deg. C, DC 5.00 V



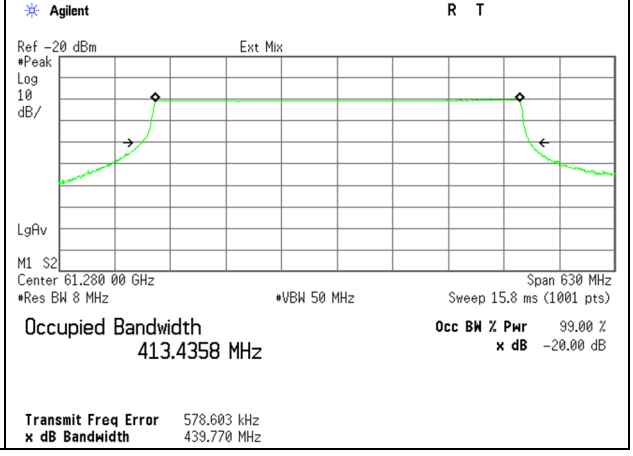
40 deg. C, DC 5.00 V



30 deg. C, DC 5.00 V

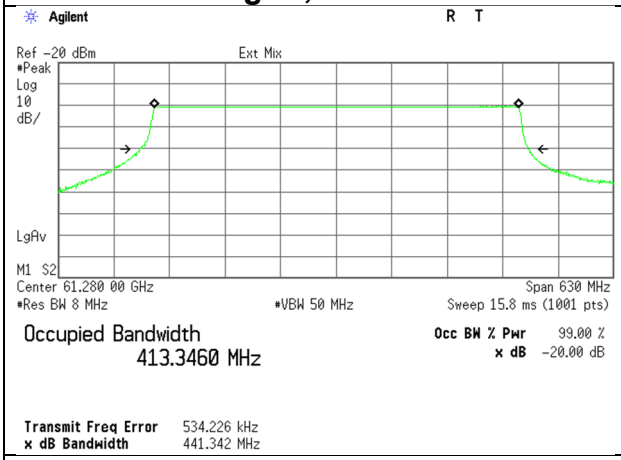


20 deg. C, DC 5.00 V

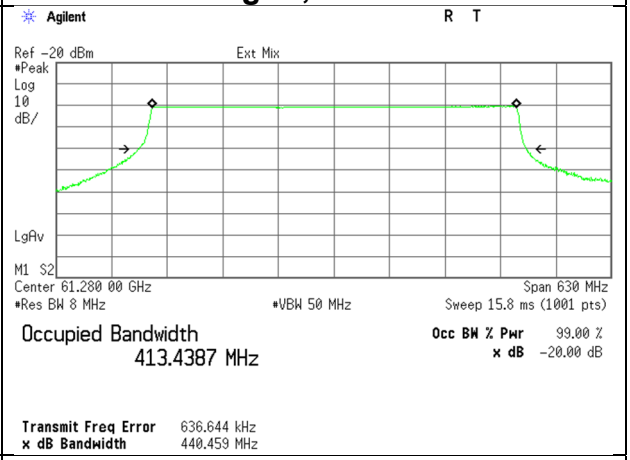


Frequency Stability

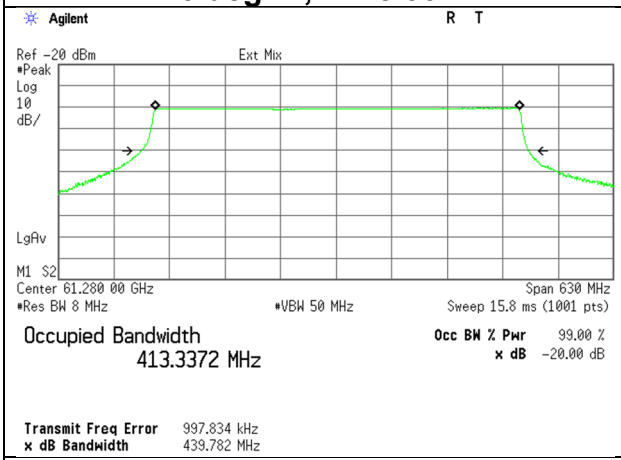
20 deg. C, DC 4.25 V



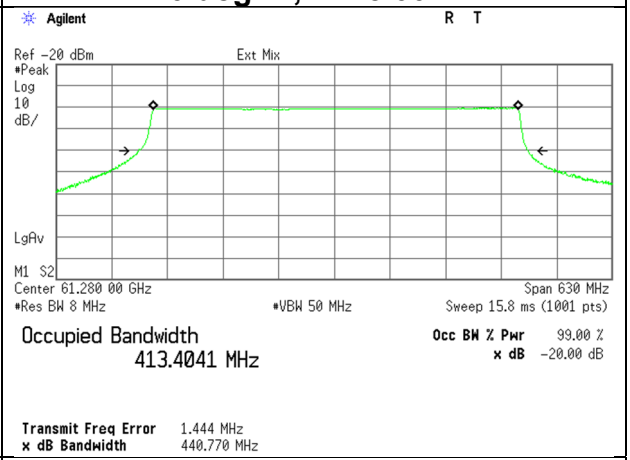
20 deg. C, DC 5.75 V



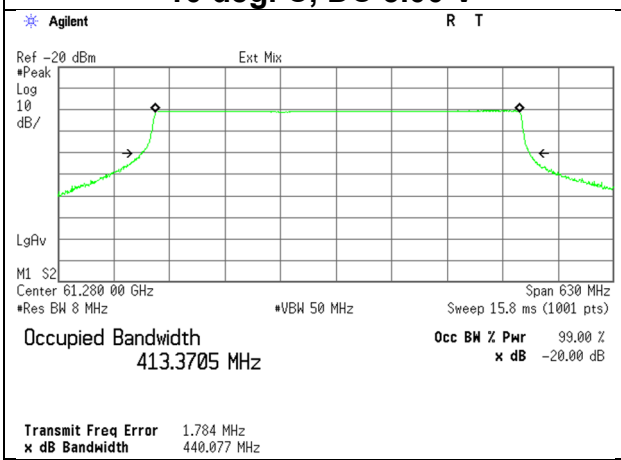
10 deg. C, DC 5.00 V



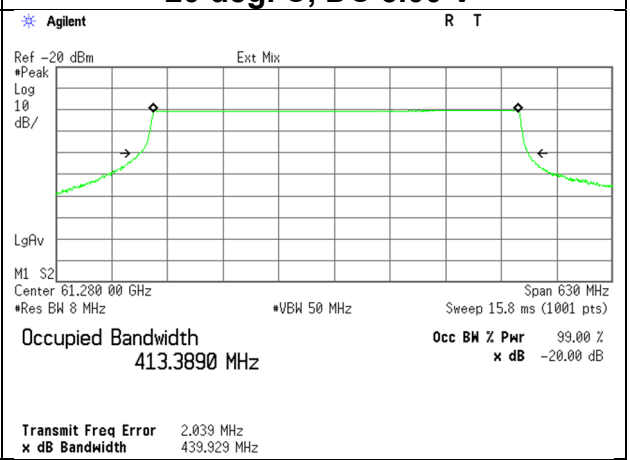
0 deg. C, DC 5.00 V



-10 deg. C, DC 5.00 V



-20 deg. C, DC 5.00 V



Group InstIlation

There are no external phase-locking inputs in this EUT.
Therefore, the EUT comply this requirement.

APPENDIX 2: Test instruments

Test equipment (1/2)

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
CE	141222	Coaxial Cable	Fujikura,HP,Mini-Circits,Fujikura	3D-2W(12m)/ 5D-2W(5m)/ 5D-2W(0.8m)/ 5D-2W(1m)	-	02/17/2024	12
CE	141290	Attenuator(13dB)	JFW Industries, Inc.	50FP-013H2 N	-	12/07/2023	12
CE	141357	LISN(AMN)	Schwarzbeck Mess-Elektronik OHG	NSLK8127	8127-729	07/09/2024	12
CE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/06/2024	12
CE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	06/05/2024	12
CE	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	12/12/2023	24
CE	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
CE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
CE	244707	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202102	01/25/2024	12
RE	141222	Coaxial Cable	Fujikura,HP, Mini-Circits,Fujikura	3D-2W(12m)/ 5D-2W(5m)/ 5D-2W(0.8m)/ 5D-2W(1m)	-	02/17/2024	12
RE	141265	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-190	07/10/2024	12
RE	141279	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S303	03/04/2024	12
RE	141317	Coaxial Cable	UL Japan	-	-	09/11/2024	12
RE	141328	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28636/2	04/01/2024	12
RE	141427	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103B+ BBA9106	08031	07/30/2024	12
RE	141429	Temperature and Humidity Chamber	Espec	PL-2KP	14015723	08/23/2024	12
RE	141503	Horn Antenna 18-26.5GHz	EMCO	3160-09	1265	06/25/2024	12
RE	141504	Horn Antenna 26.5-40GHz	EMCO	3160-10	1150	09/09/2024	12
RE	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	557	05/17/2024	12
RE	141517	Horn Antenna 26.5-40GHz	ETS-Lindgren	3160-10	152399	11/20/2023	12
RE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/06/2024	12
RE	141558	Digital Tester(TRUE RMS MULTIMETER)	Fluke Corporation	115	17930030	05/17/2024	12
RE	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	00650	10/30/2024	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/17/2024	12
RE	141588	Pre Amplifier	L3 Narda-MITEQ	AMF-6F-2600400-33-8P / AMF-4F-2600400-33-8P	1871355 /1871328	01/22/2024	12
RE	141594	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10150	02/17/2024	12
RE	141885	Spectrum Analyzer	Keysight Technologies Inc	E4448A	US44300523	11/29/2023	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	06/05/2024	12
RE	141978	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180899	05/09/2024	12
RE	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	12/12/2023	24
RE	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	04/17/2023	24
RE	142026	Diplexer	OML INC.	DPL26	-	-	-
RE	142032	Microwave Cable	Huber+Suhner	SUCOFLEX102	37511/2	-	-
RE	142036	Horn Antenna	Custom Microwave Inc.	HO6R	-	09/03/2024	12
RE	142039	Horn Antenna	Custom Microwave Inc.	HO4R	-	09/03/2024	12
RE	142041	Horn Antenna	Oshima Prototype Engineering Co.	A16-187	1	09/03/2024	12

Test equipment (2/2)

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	142047	Preselected Millimeter Mixer	Keysight Technologies Inc	11974V-E01	3001A00412	04/04/2024	12
RE	142048	Harmonic Mixer	Keysight Technologies Inc	11970W	2521 A01909	04/04/2024	12
RE	142049	Harmonic Mixer	OML INC.	M06HWD	D100709-1	12/04/2023	12
RE	142053	Harmonic Mixer	OML INC.	M04HWD	Y100709-1	05/16/2024	12
RE	142055	Power Amplifier	SAGE Millimeter, Inc.	SBP-5037532015-1515-N1	11599-01	03/15/2024	12
RE	142152	Loop Antenna	Rohde & Schwarz	HFH2-Z2	836553/009	10/17/2023	12
RE	142228	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	142528	Detector	Millitech	DET-15-RPFW0	34	-	-
RE	142592	Waveguide Isolator	Millitech	FBI-15-RSES0	1858	-	-
RE	151897	Microwave Cable	Huber+Suhner	SF101EA/11PC24/ 11PC24/2.5M	SN MY1726/1EA	04/14/2024	12
RE	159670	Coaxial Cable	UL Japan	-	-	11/21/2023	12
RE	159919	Power Amplifier	SAGE Millimeter, Inc.	SBP-4035033018-2F2F-S1	12559-01	06/05/2024	12
RE	160324	Coaxial Cable	Huber+Suhner	SUCOFLEX 102A	MY009/2A	10/25/2024	12
RE	176027	D-Band Low Noise Amplifier	SAGE Millimeter, Inc.	SBL-1141741860-0606-EI	15235-01	07/10/2024	12
RE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	180607	Power Amplifier	SAGE Millimeter, Inc.	SBP-7531142515-1010-E1	17343-01	09/06/2024	12
RE	180634	Horn Antenna	SAGE Millimeter, Inc.	SAZ-2410-15-S1	17343-01	06/03/2024	12
RE	199856	WR-10 HighPass Filter	Oshima Prototype Engineering Co.	A20-110-A01	001	04/16/2024	12
RE	211944	Digital Storage Oscilloscope	Keysight Technologies Inc	DSOX6002A	MY59380318	12/16/2023	12
RE	220646	Attenuator	Huber+Suhner	6806_N-50-1	-	03/12/2024	12
RE	238713	Double Ridge Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA 9120 C	688	09/02/2024	12
RE	244707	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202102	01/25/2024	12
RE	244712	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202106	01/25/2024	12
RE	246778	Microwave Cable	Huber+Suhner	SF126E/11PC35/ 11PC35/2000MM	SN 537000/126E	-	-
RE	252663	Microwave Cable	Huber+Suhner	SF126E/11PC35/ 11PC35/1000MM, 5000MM	616276/126E / 616275/126E	09/10/2024	12
RE	253739	Pre Amplifier	Keysight Technologies Inc	8449B	3008A01919	10/23/2024	12
RE	244710	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202104	01/25/2024	12
RE	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	02/01/2024	12
RE	142230	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	142017	AC4_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/14/2023	24
RE	141899	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180655	05/09/2024	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:

CE: Conducted Emission
RE: Radiated Emission