RADIO TEST REPORT

Test Report No. : 13664352H-A

Applicant	:	**DENSO CORPORATION**
Type of EUT	:	**Blind Spot Monitor Sensor**
Model Number of EUT	:	**DNSRR002**
FCC ID	:	**HYQDNSRR002**
Test regulation	:	**FCC Part 15 Subpart C: 2021** ***For Permissive Change**
Test Result	:	**Complied (Refer to SECTION 3.2)**

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

Date of test: January 8 to 13, 2021

Representative test engineer:
Yuichiro Yamazaki
Engineer
Consumer Technology Division

Approved by:
Tsubasa Takayama
Leader
Consumer Technology Division

CERTIFICATE 5107.02

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

REVISION HISTORY

Original Test Report No.: 13664352H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13664352H-A	March 1, 2021	-	-

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS **PAGE**

SECTION 1: Customer Information **5**
SECTION 2: Equipment under test (EUT) **5**
SECTION 3: Test specification, methods & procedures **6**
SECTION 4: Operation of EUT during testing **9**
SECTION 5: Radiated emission (Electric Field Strength of Fundamental and Spurious Emission) **11**
SECTION 6: 20 dB Bandwidth, 99 % Occupied Bandwidth and Duty Cycle **16**
APPENDIX 1: Test data **17**
Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission) 17
20 dB Bandwidth, 99 % Occupied Bandwidth 27
Duty Cycle 30
APPENDIX 2: Test Instruments **31**
APPENDIX 3: Photograph of test setup **33**
Radiated Emission 33
Worst Case Position (Horizontal: Y-axis / Vertical: X-axis) 36

SECTION 1: Customer Information

Company Name	:	DENSO CORPORATION
Address	:	1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661, Japan
Telephone Number	:	+81-78-682-2674
Facsimile Number	:	+81-78-682-2046
Contact Person	:	Shozo Taniguchi

The information provided from the customer is as follows;
- Applicant, Type of EUT Model Number of EUT, FCC ID on the cover and other relevant pages- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (EUT) other than the Receipt Date
- SECTION 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

Type	:	Blind Spot Monitor Sensor
Model Number	:	DNSRR002
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 12 V (Car battery)
Receipt Date	:	January 7, 2021
Country of Mass-production	:	Japan
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab.

2.2 Product Description

Model: DNSRR002 (referred to as the EUT in this report) is a Blind Spot Monitor Sensor.
This radar sensor (DNSRR002) is the 24.05 GHz - 24.25GHz vehicle-mounted field disturbance sensor that is a microwave frequency modulated continuous wave (FM-CW) and two frequency continuous wave (Two frequency-CW) radar operating at 24.05 GHz to 24.25 GHz (Nominal: 24.15 GHz).
DNSRR002 is using an electric scanning called Digital Beam Forming (DBF) to determine azimuth angle of objects.
This equipment is an obstacle detector of the diagonally backward vehicle.

General Specificaion

Clock frequency(ies) in the system	:	Microcomputer: 240 MHz

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	24.15 GHz
Frequency range	:	24.05 GHz to 24.25 GHz (FM-CW / Two frequency-CW)
Modulation	:	QXN (FM-CW, Two frequency-CW)
Antenna type	:	Microstrip Antenna (Built-in type)
Antenna connector	:	None (Internal Antenna)
Antenna Gain	:	9.3 dBi (Broad beam), 13.0 dBi (Narrow beam)
Steerable Antenna	:	Electronically
Usage location	:	Vehicle-mounted

SECTION 3: Test specification, methods & procedures

3.1 Test specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on January 12, 2021 and effective February 11, 2021
Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.249 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz and 24.0-24.25 GHz

* The revision does not affect the test result conducted before its effective date.

3.2 Procedures and results

No.	Item	Test Procedure	Specification	Deviation	Worst margin	Results
1	Conducted Emission	ANSI C63.10-2013 6. Standard test methods	Section 15.207(a)	N/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)	N/A	7.7 dB (24150.000 MHz, Horizontal, PK with Duty Factor) < Narrow beam (Left) >	Complied a)
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)	N/A	4.8 dB (24250.00 MHz, Vertical, PK with Duty Factor) < Narrow beam (Right) >	Complied# a)
4	20dB Bandwidth	ANSI C63.10-2013 6. Standard test methods	FCC 15.215	N/A	N/A	Complied b)
5	Frequency Tolerance	ANSI C63.10-2013 6. Standard test methods	Section 15.249(b)	N/A	N/A	N/A *2)

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
*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.
*2) The test is not required since this EUT does not point- to- point operation with 24.05 GHz to 24.25 GHz

a) Refer to APPENDIX 1 (data of Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission))
b) Refer to APPENDIX 1 (data of 20dB Bandwidth, 99% Occupied Bandwidth)

Symbols:
Complied The data of this test item has enough margin, more than the measurement uncertainty.
Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

FCC Part 15.31 (e)
The EUT provides stable voltage constantly to the RF part regardless of input voltage. Instead of a new battery, DC power supply was used for the test.
That does not affect to the test result, therefore the 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, deviation, exclusion to standards

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

3.4 Uncertainty

EMI

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

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

Ise EMC Lab.

Test distance	Radiated emission (+/-) 9 kHz - 30 MHz
3 m	3.3 dB
10 m	3.2 dB

Polarity	Radiated emission (Below 1 GHz)			
	(3 m*) (+/-)		(10 m*) (+/-)	
	30 MHz - 200 MHz	200 MHz - 1000 MHz	30 MHz - 200 MHz	200 MHz - 1000 MHz
Horizontal	4.8 dB	5.2 dB	4.8 dB	5.0 dB
Vertical	5.0 dB	6.3 dB	4.8 dB	5.0 dB

Radiated emission (Above 1 GHz)					
(3 m*) (+/-)		(1 m*) (+/-)		(0.5 m*) (+/-)	(10 m*) (+/-)
1 GHz - 6 GHz	6 GHz - 18 GHz	10 GHz - 26.5 GHz	26.5 GHz - 40 GHz	26.5 GHz - 40 GHz	1 GHz - 18 GHz
4.9 dB	5.2 dB	5.5 dB	5.5 dB	5.5 dB	5.2 dB

*Measurement distance

Radiated emission (+/-)		Distance
40 GHz - 50 GHz	4.1 dB	> =0.5 m
50 GHz - 75 GHz	5.1 dB	> =0.5 m
75 GHz - 110 GHz	5.4 dB	> =0.5 m

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, Facsimile: +81 596 24 8124
* A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 199967
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.11 measurement room	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

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

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Test Item	Mode	Tested frequency
Electric Field Strength of Fundamental Emission Electric Field Strength of Spurious Emission 20 dB Bandwidth, 99 % Occupied Bandwidth Duty Cycle	Transmitting mode (Tx) Beam setting *1) - Broad beam - Narrow beam (Left) - Narrow beam (Right)	24.15 GHz FSK setting *2) - 24.06 GHz - 24.15 GHz - 24.24 GHz

*1) This EUT has three transmission beam patterns. The tests were performed in these three patterns.

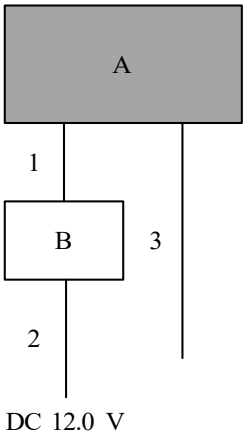
*2) There are FM and FSK modulation part in one transmission burst. The FSK modulation hopped to any frequencies per 80 ms in actual operation.
The FSK frequency was fixed to lowest (24.06 GHz), middle (24.15 GHz) or highest (24.24 GHz) for the purpose of bandwidth measurement. The FSK frequency was fixed to lowest or highest for the purpose of band-edge measurement. As for other tests, it was fixed to middle frequency.

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

*EUT has the power settings by the software as follows;
Power Settings: Same as Production model
Software: mwr_24291_p02
(Date: January 8, 2021, Storage location: EUT memory)

*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	Blind Spot Monitor Sensor	DNSRR002	120001112010	DENSO CORPORATION	EUT
B	Switch Box	110	-	DENSO CORPORATION	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.0	Unshielded	Unshielded	-
2	DC Cable	3.0	Unshielded	Unshielded	-
3	CAN Cable	1.0	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, 0.5 m by 1.0 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 below 1 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[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 - 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

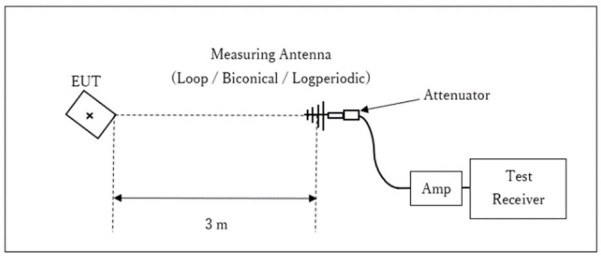
Frequency	9 kHz - 150 kHz	150 kHz - 30 MHz	30 MHz - 1 GHz	1 GHz - 40 GHz	
Instrument used	Test Receiver	Test Receiver	Test Receiver	Spectrum Analyzer	
Detector	QP, Average *1)	QP, Average *1)	QP	Peak	Average *2)
IF Bandwidth	BW 200 Hz	BW 9 kHz	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Pulsed emission - RBW: 1 MHz - Peak with duty Other than above - RBW: 1 MHz - VBW: 10 Hz

*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. Other than pulsed emission, aVBW was set to 10 Hz and linear voltage average mode was used.

[Test setup]

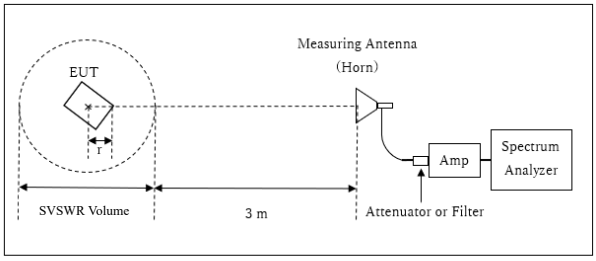
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



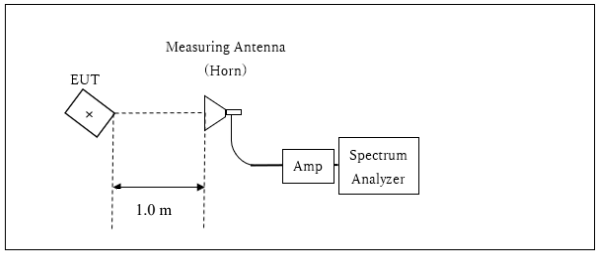
r : Radius of an outer periphery of EUT
× : Center of turn table

Distance Factor: 20 x log (3.75 m*/3.0 m) = 1.9 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.75 m

SVSWR Volume: 1.5 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0 m

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

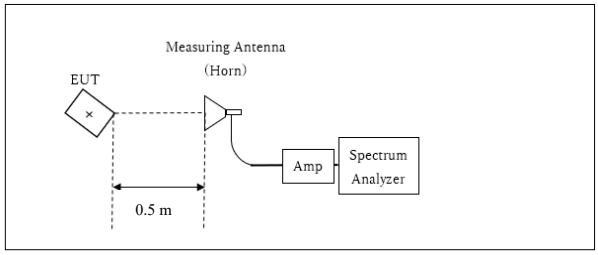
10 GHz - 26.5 GHz



× : Center of turn table

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

26.5 GHz - 40 GHz

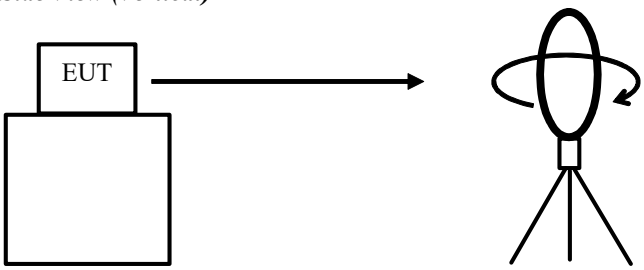


× : Center of turn table

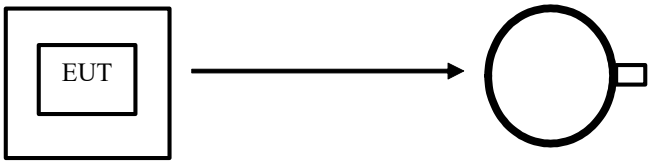
Distance Factor: 20 x log (0.5 m* / 3.0 m) = -15.6 dB
*Test Distance: 0.5 m

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

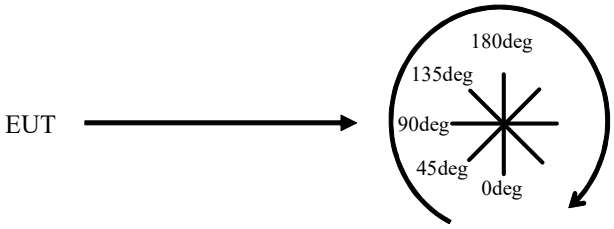


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

[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 caluculation.)
Lambda is the wavelength of the emission under investigation [300 / *f* (MHz) * 10^3], in millimeter

Frequency	Wavelength	Maximum Dimention			Far Field
		EUT	Test Antenna	Maximum	Boundary
	Lambda		(MHA-02)	*D*	*r*
[GHz]	[mm]	[m]	[m]	[m]	[m]
24.250	12.4	0.028	0.039	0.039	0.246

[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.

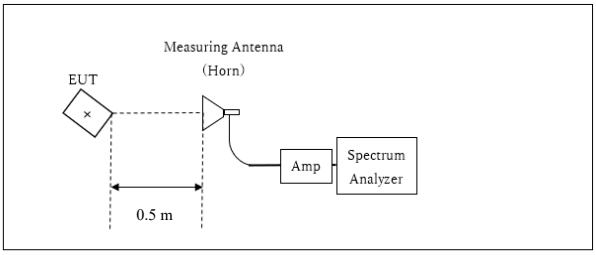
Frequency	40 GHz - 100 GHz
Final measurement distance with 1 MHz Peak detector	0.5 m

Detector	Peak	Average *1)	
IF Bandwidth	RBW: 1 MHz VBW: 3 MHz	Pulsed emission - RBW: 1 MHz - Peak with duty	Other than pulsed - RBW: 1 MHz - VBW: 10 Hz

*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. Other than pulsed emission, a VBW was set to 10 Hz and linear voltage average mode was used.

[Test setup]

40 GHz - 100 GHz



× : Center of turn table

Distance Factor: 20 x log (0.5 m* / 3.0 m) = -15.6 dB
*Test Distance: 0.5 m

- The carrier level and noise levels were confirmed at each position of X and Y 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 - 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	600 MHz	2 MHz 1 % to 5 % of OBW	6 MHz Three times of RBW	60 sec	Peak	Max Hold	Spectrum Analyzer
99 % Occupied Bandwidth	600 MHz, Enough width to display emission skirts	2 MHz, 1 % to 5 % of OBW	6 MHz, Three times of RBW	60 sec	Peak *1)	Max Hold *2)	Spectrum Analyzer
Duty Cycle	-	-	-	200 msec	-	Single	Oscilloscope

*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)

Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	21 deg. C / 34 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz, Broad beam

[Fundamental, band-edge]

Peak

Frequency [MHz]	Detector	Reading [dBuV] Hor	Reading [dBuV] Ver	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (3 m) [dBuV/m] Hor	Result (3 m) [dBuV/m] Ver	Limit (3 m) [dBuV/m]	Margin [dB] Hor	Margin [dB] Ver	Remark Inside or Outside of Restricted Bands
24000.00	Peak	48.3	48.5	40.2	-1.2	32.4	-	54.9	55.0	73.9	19.0	18.9	Inside
24150.00	Peak	98.6	98.8	40.2	-1.2	32.7	-	105.0	105.2	127.9	22.9	22.7	Fundamental
24250.00	Peak	48.6	49.0	40.3	-1.1	32.8	-	54.9	55.3	73.9	19.0	18.6	Outside

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

Peak with Duty factor

Frequency [MHz]	Detector	Reading [dBuV] Hor	Reading [dBuV] Ver	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m] Hor	Result [dBuV/m] Ver	Limit [dBuV/m]	Margin [dB] Hor	Margin [dB] Ver	Remark
24000.00	Peak	48.3	48.5	40.2	-1.2	32.4	-6.9	48.1	48.2	53.9	5.8	5.7	Inside
24150.00	Peak	98.6	98.8	40.2	-1.2	32.7	-6.9	98.1	98.3	107.9	9.8	9.6	Fundamental
24250.00	Peak	48.6	49.0	40.3	-1.1	32.8	-6.9	48.1	48.5	53.9	5.8	5.4	Outside

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance Factor) - Gain(Amprifier) + Duty factor (Refer to Duty factor data sheet)

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

Report No.	13664352H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.3	No.3
Date	January 8, 2021	January 12, 2021	January 13, 2021
Temperature / Humidity	21 deg. C / 34 % RH	23 deg. C / 34 % RH	22 deg. C / 35 % RH
Engineer	Yuichiro Yamazaki		
	1 GHz - 10 GHz	9 kHz - 1 GHz	50 GHz - 100 GHz
	18 GHz - 26.5 GHz	10 GHz - 18 GHz	
		26.5 GHz - 50 GHz	
Mode	Tx 24.15 GHz, Broad beam		

[Spurious emissions other than above]

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	35.022	QP	21.8	16.7	7.2	32.2	-	13.5	40.0	26.6	
Hori.	80.110	QP	22.1	7.0	7.9	32.2	-	4.9	40.0	35.1	
Hori.	180.021	QP	21.1	16.2	9.0	32.0	-	14.3	43.5	29.2	
Hori.	220.011	QP	21.1	11.1	9.4	32.0	-	9.6	46.0	36.4	
Hori.	449.880	QP	21.1	16.5	11.1	32.0	-	16.7	46.0	29.3	
Hori.	899.889	QP	20.8	22.0	13.6	30.9	-	25.4	46.0	20.6	
Hori.	48300.000	PK	53.7	41.7	-6.6	32.5	-	56.3	87.9	31.6	
Hori.	72450.000	PK	38.5	43.1	2.4	20.8	-	63.2	87.9	24.7	NS
Hori.	96600.000	PK	49.1	45.6	-4.5	34.8	-	55.5	73.9	18.4	NS
Hori.	48300.000	AV	41.2	41.7	-6.6	32.5	-	43.8	67.9	24.1	VBW:10Hz Voltage Avg
Hori.	72450.000	AV	25.2	43.1	2.4	20.8	-	49.9	67.9	18.1	NS VBW:10Hz Voltage Avg
Hori.	96600.000	AV	35.6	45.6	-4.5	34.8	-	41.9	53.9	12.0	NS VBW:10Hz Voltage Avg
Vert.	35.022	QP	21.8	16.7	7.2	32.2	-	13.4	40.0	26.6	
Vert.	80.110	QP	22.1	7.0	7.9	32.2	-	4.9	40.0	35.2	
Vert.	180.021	QP	21.1	16.2	9.0	32.0	-	14.3	43.5	29.3	
Vert.	220.011	QP	21.2	11.1	9.4	32.0	-	9.7	46.0	36.4	
Vert.	449.880	QP	21.0	16.5	11.1	32.0	-	16.6	46.0	29.4	
Vert.	899.889	QP	20.8	22.0	13.6	30.9	-	25.4	46.0	20.6	
Vert.	48300.000	PK	53.6	41.7	-6.6	32.5	-	56.2	87.9	31.7	
Vert.	72450.000	PK	38.1	43.1	2.4	20.8	-	62.8	87.9	25.1	NS
Vert.	96600.000	PK	49.1	45.6	-4.5	34.8	-	55.4	73.9	18.5	NS
Vert.	48300.000	AV	40.1	41.7	-6.6	32.5	-	42.7	67.9	25.2	VBW:10Hz Voltage Avg
Vert.	72450.000	AV	25.1	43.1	2.4	20.8	-	49.8	67.9	18.1	NS VBW:10Hz Voltage Avg
Vert.	96600.000	AV	35.7	45.6	-4.5	34.8	-	42.0	53.9	11.9	NS VBW:10Hz Voltage Avg

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).

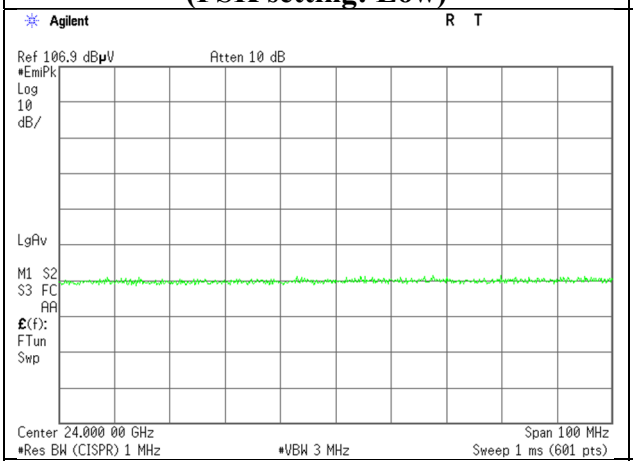
Distance factor:	1 GHz - 10 GHz	20log (3.75 m / 3.0 m) = 1.9 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB
	26.5 GHz - 100 GHz	20log (0.5 m / 3.0 m) = -15.6 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

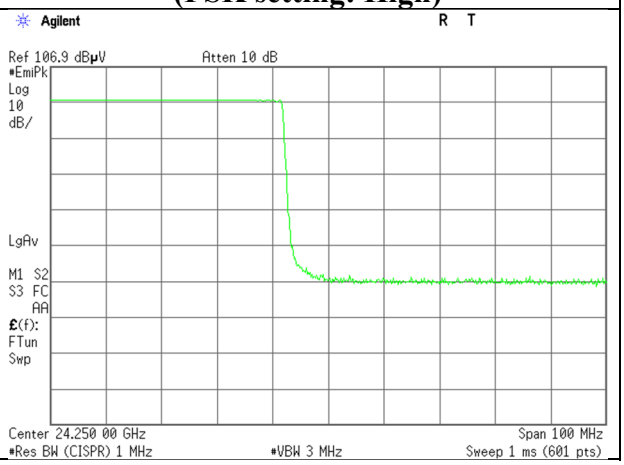
Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	21 deg. C / 34 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz, Broad beam

Horizontal polarization

Restricted band-edge Plot (FSK setting: Low)

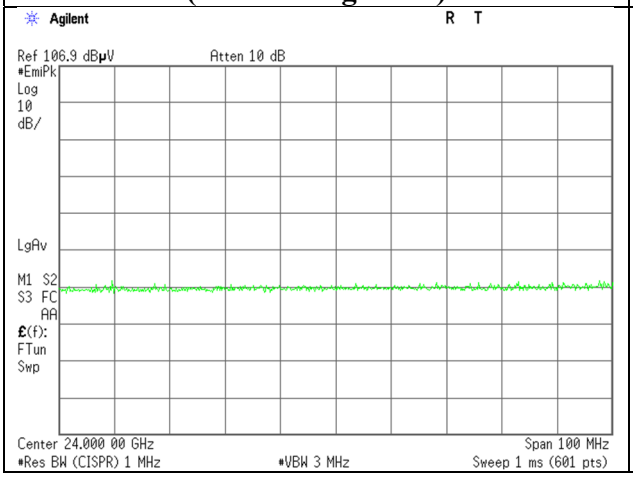


Authorized band-edge Plot (FSK setting: High)

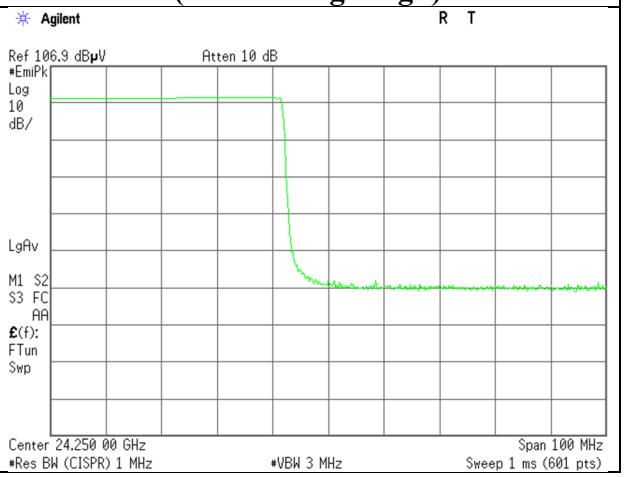


Vertical polarization

Restricted band-edge Plot (FSK setting: Low)



Authorized band-edge Plot (FSK setting: High)



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

The test was performed on two FSK settings in consideration of the worst case measurement.

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

Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	21 deg. C / 34 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz, Narrow beam (Left)

[Fundamental, band-edge]

Peak

Frequency [MHz]	Detector	Reading [dBuV] Hor	Reading [dBuV] Ver	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (3 m) [dBuV/m] Hor	Result (3 m) [dBuV/m] Ver	Limit (3 m) [dBuV/m]	Margin [dB] Hor	Margin [dB] Ver	Remark Inside or Outside of Restricted Bands
24000.00	Peak	48.3	48.3	40.2	-1.2	32.4	-	54.8	54.9	73.9	19.1	19.0	Inside
24150.00	Peak	100.6	100.5	40.2	-1.2	32.7	-	107.0	106.9	127.9	20.9	21.0	Fundamental
24250.00	Peak	49.3	49.4	40.3	-1.1	32.8	-	55.6	55.7	73.9	18.3	18.2	Outside

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

Peak with Duty factor

Frequency [MHz]	Detector	Reading [dBuV] Hor	Reading [dBuV] Ver	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m] Hor	Result [dBuV/m] Ver	Limit [dBuV/m]	Margin [dB] Hor	Margin [dB] Ver	Remark
24000.00	Peak	48.3	48.3	40.2	-1.2	32.4	-6.8	48.0	48.1	53.9	5.9	5.8	Inside
24150.00	Peak	100.6	100.5	40.2	-1.2	32.7	-6.8	100.2	100.1	107.9	7.7	7.8	Fundamental
24250.00	Peak	49.3	49.4	40.3	-1.1	32.8	-6.8	48.8	48.9	53.9	5.1	5.0	Outside

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance Factor) - Gain(Amprifier) + Duty factor (Refer to Duty factor data sheet)

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

Report No.	13664352H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.3	No.3
Date	January 8, 2021	January 12, 2021	January 13, 2021
Temperature / Humidity	21 deg. C / 34 % RH	23 deg. C / 34 % RH	22 deg. C / 35 % RH
Engineer	Yuichiro Yamazaki		
	1 GHz - 10 GHz	9 kHz - 1 GHz	50 GHz - 100 GHz
	18 GHz - 26.5 GHz	10 GHz - 18 GHz	
		26.5 GHz - 50 GHz	
Mode	Tx 24.15 GHz, Narrow beam (Left)		

[Spurious emissions other than above]

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	35.033	QP	21.8	16.7	7.2	32.2	-	13.5	40.0	26.5	
Hori.	79.952	QP	22.0	7.0	7.9	32.2	-	4.8	40.0	35.2	
Hori.	179.982	QP	21.0	16.2	9.0	32.0	-	14.2	43.5	29.3	
Hori.	219.934	QP	21.1	11.1	9.4	32.0	-	9.6	46.0	36.4	
Hori.	449.973	QP	20.8	16.5	11.1	32.0	-	16.4	46.0	29.6	
Hori.	900.062	QP	20.9	22.0	13.6	30.9	-	25.5	46.0	20.5	
Hori.	48300.000	PK	53.8	41.7	-6.6	32.5	-	56.4	87.9	31.5	
Hori.	72450.000	PK	38.5	43.1	2.4	20.8	-	63.1	87.9	24.8	NS
Hori.	96600.000	PK	49.9	45.6	-4.5	34.8	-	56.2	73.9	17.7	NS
Hori.	48300.000	AV	41.3	41.7	-6.6	32.5	-	43.9	67.9	24.0	VBW:10Hz Voltage Avg
Hori.	72450.000	AV	25.2	43.1	2.4	20.8	-	49.9	67.9	18.0	NS VBW:10Hz Voltage Avg
Hori.	96600.000	AV	35.5	45.6	-4.5	34.8	-	41.9	53.9	12.0	NS VBW:10Hz Voltage Avg
Vert.	35.033	QP	21.8	16.7	7.2	32.2	-	13.4	40.0	26.6	
Vert.	79.952	QP	22.1	7.0	7.9	32.2	-	4.8	40.0	35.2	
Vert.	179.982	QP	21.1	16.2	9.0	32.0	-	14.2	43.5	29.3	
Vert.	219.934	QP	21.1	11.1	9.4	32.0	-	9.6	46.0	36.4	
Vert.	449.973	QP	20.9	16.5	11.1	32.0	-	16.5	46.0	29.5	
Vert.	900.062	QP	20.8	22.0	13.6	30.9	-	25.4	46.0	20.6	
Vert.	48300.000	PK	53.9	41.7	-6.6	32.5	-	56.5	87.9	31.5	
Vert.	72450.000	PK	38.4	43.1	2.4	20.8	-	63.1	87.9	24.8	NS
Vert.	96600.000	PK	49.7	45.6	-4.5	34.8	-	56.0	73.9	17.9	NS
Vert.	48300.000	AV	40.4	41.7	-6.6	32.5	-	43.0	67.9	24.9	VBW:10Hz Voltage Avg
Vert.	72450.000	AV	25.2	43.1	2.4	20.8	-	49.9	67.9	18.0	NS VBW:10Hz Voltage Avg
Vert.	96600.000	AV	35.5	45.6	-4.5	34.8	-	41.8	53.9	12.1	NS VBW:10Hz Voltage Avg

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).

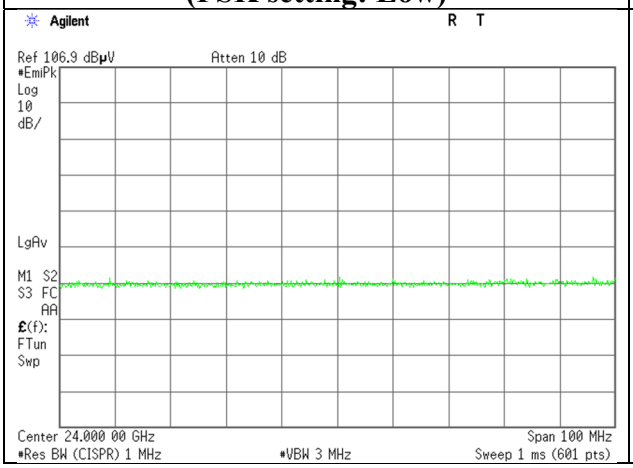
Distance factor:	1 GHz - 10 GHz	20log (3.75 m / 3.0 m) = 1.9 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB
	26.5 GHz - 100 GHz	20log (0.5 m / 3.0 m) = -15.6 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

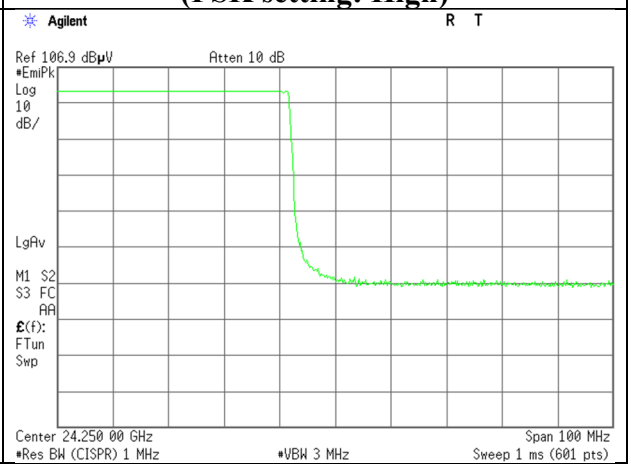
Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	21 deg. C / 34 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz, Narrow beam(Left)

Horizontal polarization

Restricted band-edge Plot (FSK setting: Low)

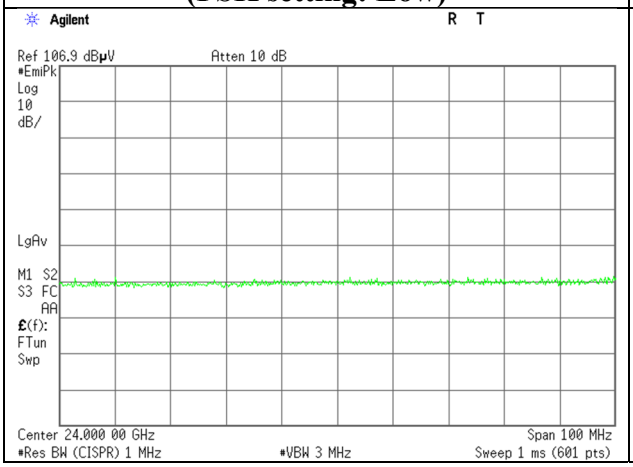


Authorized band-edge Plot (FSK setting: High)

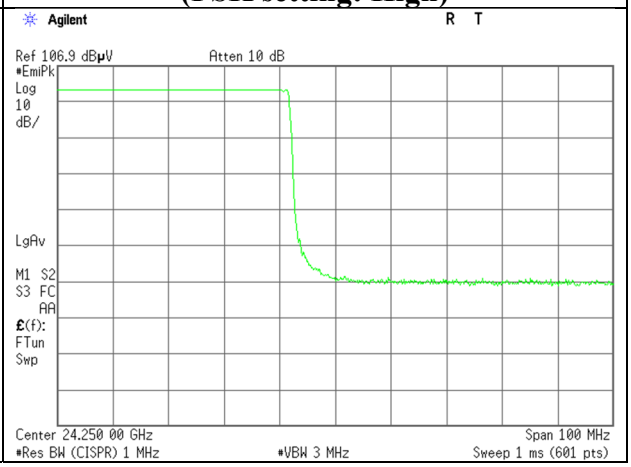


Vertical polarization

Restricted band-edge Plot (FSK setting: Low)



Authorized band-edge Plot (FSK setting: High)



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

The test was performed on two FSK settings in consideration of the worst case measurement.

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

Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	21 deg. C / 34 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz, Narrow beam (Right)

[Fundamental, band-edge]

Peak

Frequency [MHz]	Detector	Reading [dBuV] Hor	Reading [dBuV] Ver	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result (3 m) [dBuV/m] Hor	Result (3 m) [dBuV/m] Ver	Limit (3 m) [dBuV/m]	Margin [dB] Hor	Margin [dB] Ver	Remark Inside or Outside of Restricted Bands
24000.00	Peak	48.2	48.3	40.2	-1.2	32.4	-	54.8	54.9	73.9	19.1	19.0	Inside
24150.00	Peak	99.9	99.8	40.2	-1.2	32.7	-	106.3	106.2	127.9	21.7	21.7	Fundamental
24250.00	Peak	49.3	49.6	40.3	-1.1	32.8	-	55.6	55.9	73.9	18.3	18.0	Outside

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

Peak with Duty factor

Frequency [MHz]	Detector	Reading [dBuV] Hor	Reading [dBuV] Ver	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m] Hor	Result [dBuV/m] Ver	Limit [dBuV/m]	Margin [dB] Hor	Margin [dB] Ver	Remark
24000.00	Peak	48.2	48.3	40.2	-1.2	32.4	-6.8	48.0	48.1	53.9	5.9	5.8	Inside
24150.00	Peak	99.9	99.8	40.2	-1.2	32.7	-6.8	99.5	99.5	107.9	8.4	8.5	Fundamental
24250.00	Peak	49.3	49.6	40.3	-1.1	32.8	-6.8	48.9	49.1	53.9	5.1	4.8	Outside

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter+Distance Factor) - Gain(Amprifier) + Duty factor (Refer to Duty factor data sheet)

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

Report No.	13664352H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.3	No.3
Date	January 8, 2021	January 12, 2021	January 13, 2021
Temperature / Humidity	21 deg. C / 34 % RH	23 deg. C / 34 % RH	22 deg. C / 35 % RH
Engineer	Yuichiro Yamazaki		
	1 GHz - 10 GHz	9 kHz - 1 GHz	50 GHz - 100 GHz
	18 GHz - 26.5 GHz	10 GHz - 18 GHz	
		26.5 GHz - 50 GHz	
Mode	Tx 24.15 GHz, Narrow beam (Right)		

[Spurious emissions other than above]

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	35.230	QP	21.7	16.6	7.2	32.2	-	13.3	40.0	26.7	
Hori.	80.002	QP	22.1	7.0	7.9	32.2	-	4.9	40.0	35.1	
Hori.	179.978	QP	21.0	16.2	9.0	32.0	-	14.2	43.5	29.3	
Hori.	220.012	QP	21.1	11.1	9.4	32.0	-	9.6	46.0	36.4	
Hori.	450.021	QP	21.0	16.5	11.1	32.0	-	16.6	46.0	29.4	
Hori.	899.879	QP	20.8	22.0	13.6	30.9	-	25.4	46.0	20.6	
Hori.	48300.000	PK	53.7	41.7	-6.6	32.5	-	56.3	87.9	31.7	
Hori.	72450.000	PK	38.7	43.1	2.4	20.8	-	63.4	87.9	24.6	NS
Hori.	96600.000	PK	50.2	45.6	-4.5	34.8	-	56.6	73.9	17.4	NS
Hori.	48300.000	AV	41.5	41.7	-6.6	32.5	-	44.1	67.9	23.8	VBW:10Hz Voltage Avg
Hori.	72450.000	AV	25.2	43.1	2.4	20.8	-	49.9	67.9	18.0	NS VBW:10Hz Voltage Avg
Hori.	96600.000	AV	35.5	45.6	-4.5	34.8	-	41.9	53.9	12.0	NS VBW:10Hz Voltage Avg
Vert.	35.230	QP	21.7	16.6	7.2	32.2	-	13.3	40.0	26.7	
Vert.	80.002	QP	22.1	7.0	7.9	32.2	-	4.8	40.0	35.2	
Vert.	179.978	QP	21.1	16.2	9.0	32.0	-	14.3	43.5	29.2	
Vert.	220.012	QP	21.2	11.1	9.4	32.0	-	9.7	46.0	36.3	
Vert.	450.021	QP	21.0	16.5	11.1	32.0	-	16.6	46.0	29.4	
Vert.	899.879	QP	20.8	22.0	13.6	30.9	-	25.4	46.0	20.6	
Vert.	48300.000	PK	53.9	41.7	-6.6	32.5	-	56.4	87.9	31.5	
Vert.	72450.000	PK	38.4	43.1	2.4	20.8	-	63.1	87.9	24.8	NS
Vert.	96600.000	PK	50.0	45.6	-4.5	34.8	-	56.3	73.9	17.6	NS
Vert.	48300.000	AV	40.2	41.7	-6.6	32.5	-	42.7	67.9	25.2	VBW:10Hz Voltage Avg
Vert.	72450.000	AV	25.2	43.1	2.4	20.8	-	49.9	67.9	18.0	NS VBW:10Hz Voltage Avg
Vert.	96600.000	AV	35.5	45.6	-4.5	34.8	-	41.9	53.9	12.1	NS VBW:10Hz Voltage Avg

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).

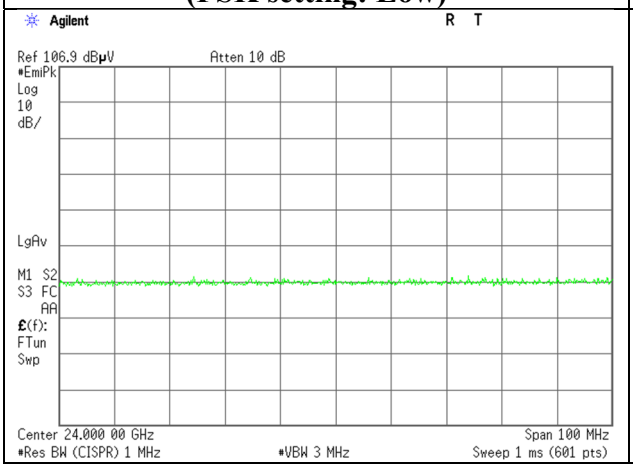
Distance factor:	1 GHz - 10 GHz	20log (3.75 m / 3.0 m) = 1.9 dB
	10 GHz - 26.5 GHz	20log (1.0 m / 3.0 m) = -9.5 dB
	26.5 GHz - 100 GHz	20log (0.5 m / 3.0 m) = -15.6 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

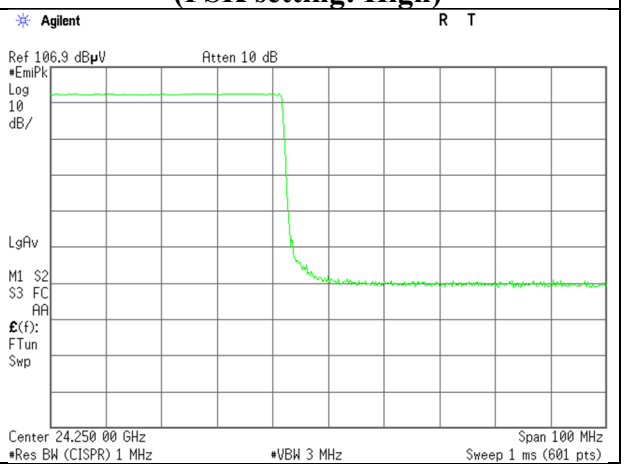
Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	21 deg. C / 34 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz, Narrow beam (Right)

Horizontal polarization

Restricted band-edge Plot (FSK setting: Low)

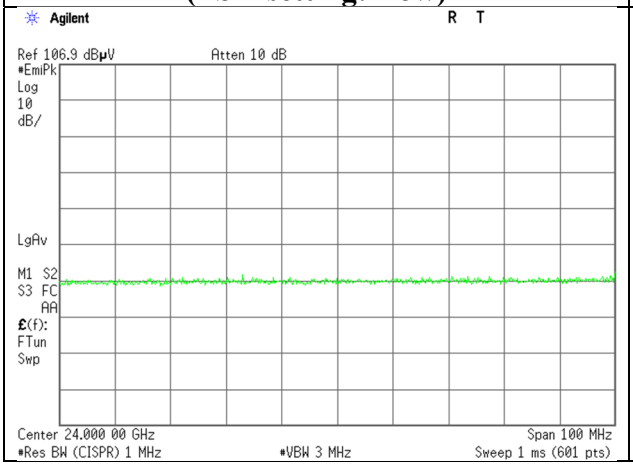


Authorized band-edge Plot (FSK setting: High)

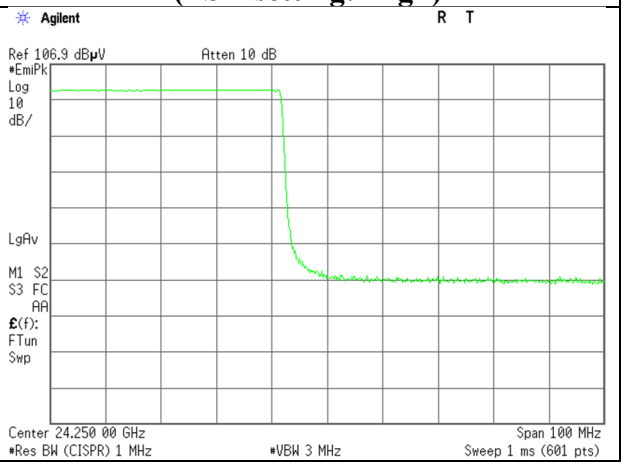


Vertical polarization

Restricted band-edge Plot (FSK setting: Low)



Authorized band-edge Plot (FSK setting: High)

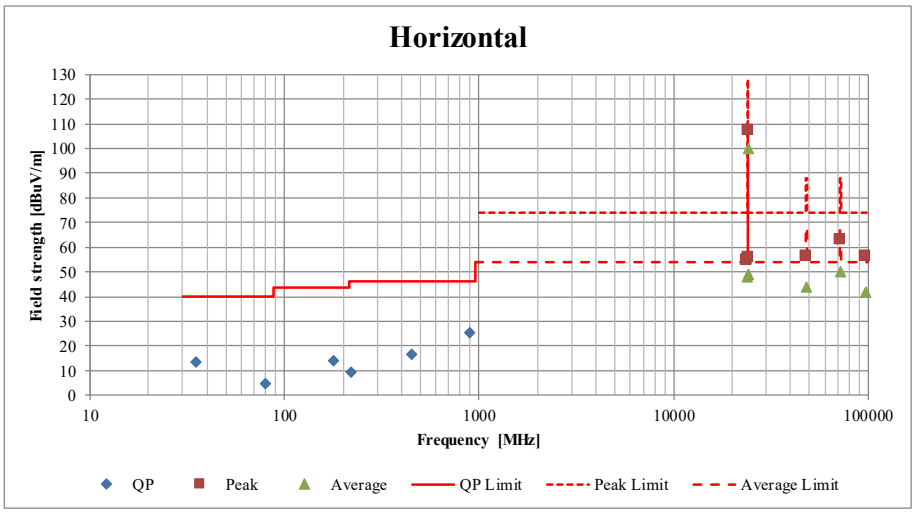


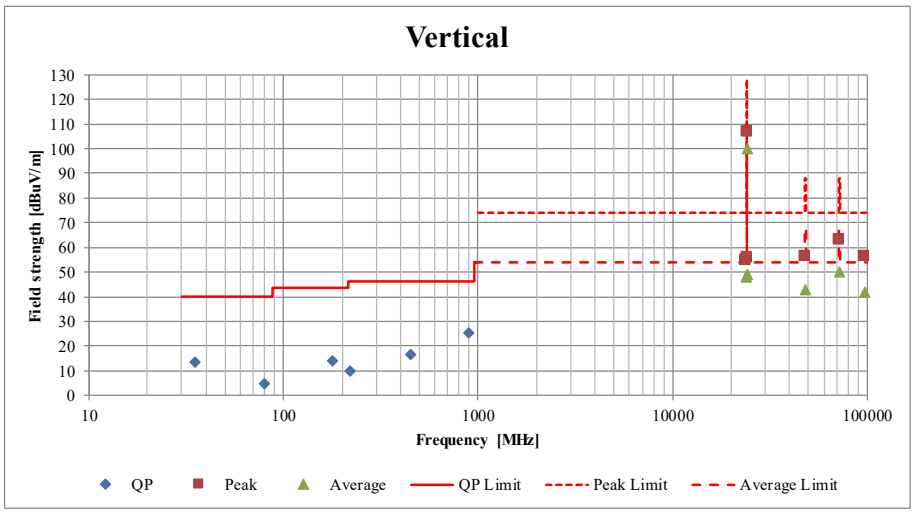
* Final result of restricted band edge was shown in tabular data.

The test was performed on two FSK settings in consideration of the worst case measurement.

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

Report No.	13664352H		
Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.2	No.3	No.3
Date	January 8, 2021	January 12, 2021	January 13, 2021
Temperature / Humidity	21 deg. C / 34 % RH	23 deg. C / 34 % RH	22 deg. C / 35 % RH
Engineer	Yuichiro Yamazaki		
	1 GHz - 10 GHz 18 GHz - 26.5 GHz	9 kHz - 1 GHz 10 GHz - 18 GHz 26.5 GHz - 50 GHz	50 GHz - 100 GHz
Mode	Tx 24.15 GHz, Narrow beam (Left)		



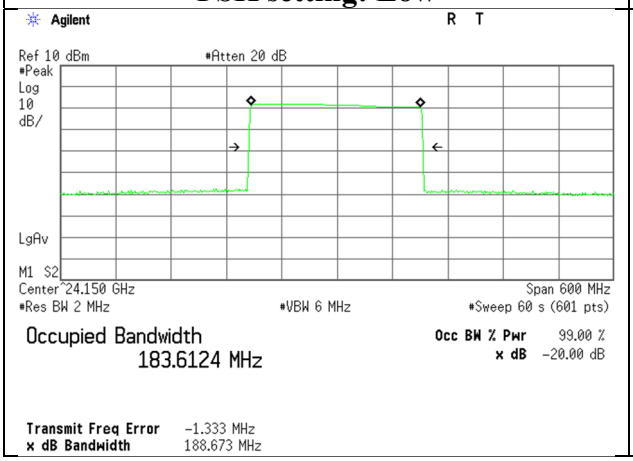


20 dB Bandwidth, 99 % Occupied Bandwidth

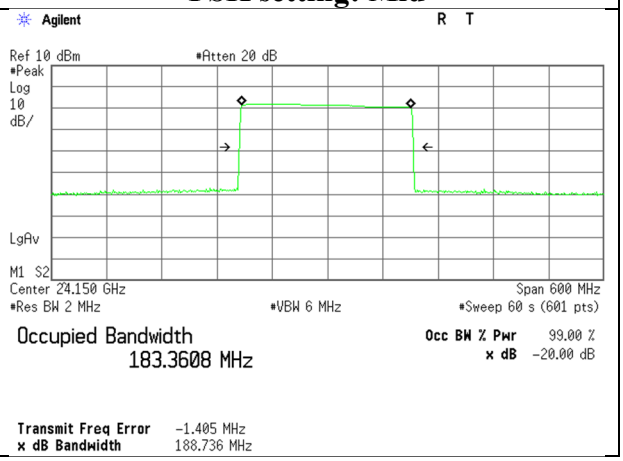
Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	21 deg. C / 34 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz, Broad beam

Frequency [GHz]	FSK setting	20 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
24.15	Low	188.673	183.6124
24.15	Mid	188.736	183.3608
24.15	High	190.541	184.6943

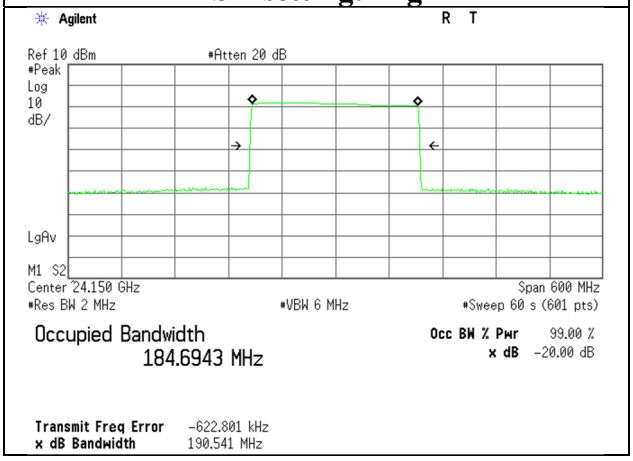
FSK setting: Low



FSK setting: Mid



FSK setting: High

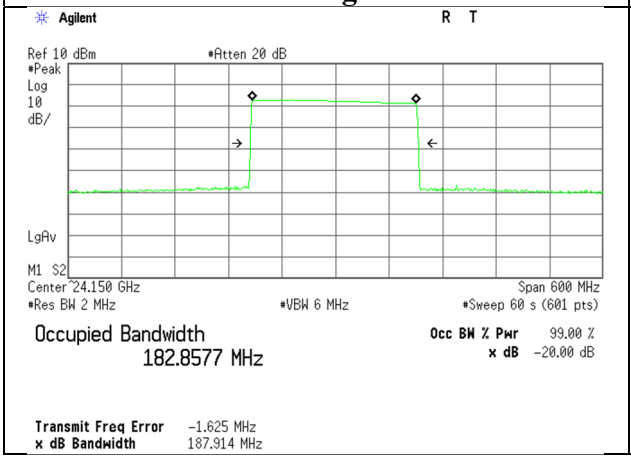


20 dB Bandwidth, 99 % Occupied Bandwidth

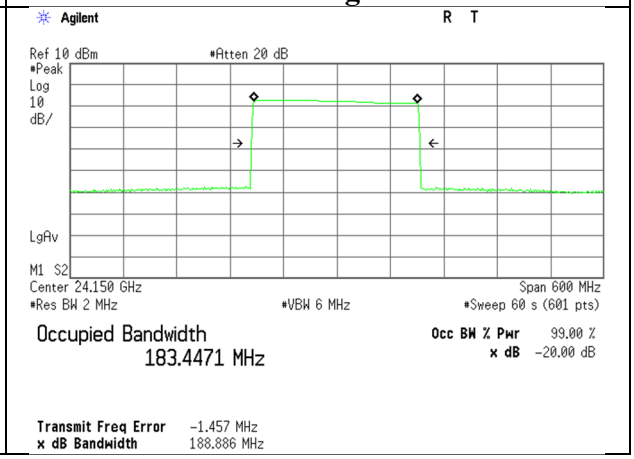
Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	21 deg. C / 34 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz, Narrow beam (Left)

Frequency [GHz]	FSK setting	20 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
24.15	Low	187.914	182.8577
24.15	Mid	188.886	183.4471
24.15	High	190.543	184.6016

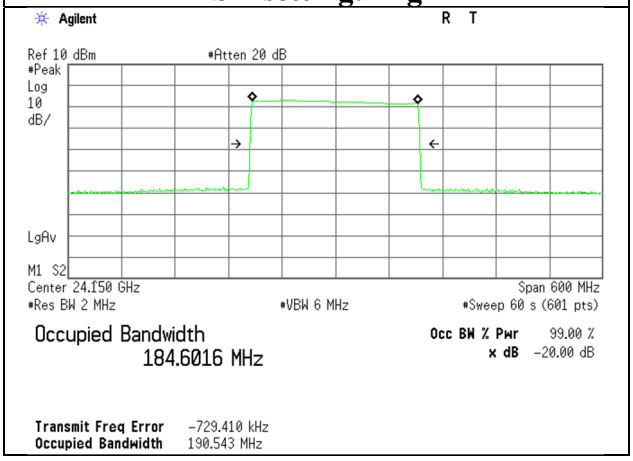
FSK setting: Low



FSK setting: Mid



FSK setting: High

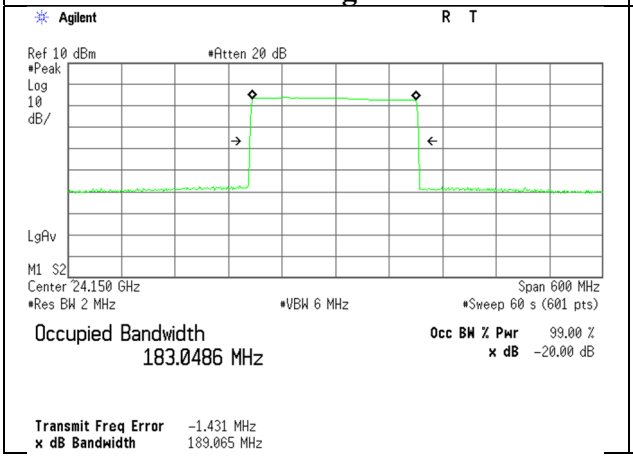


20 dB Bandwidth, 99 % Occupied Bandwidth

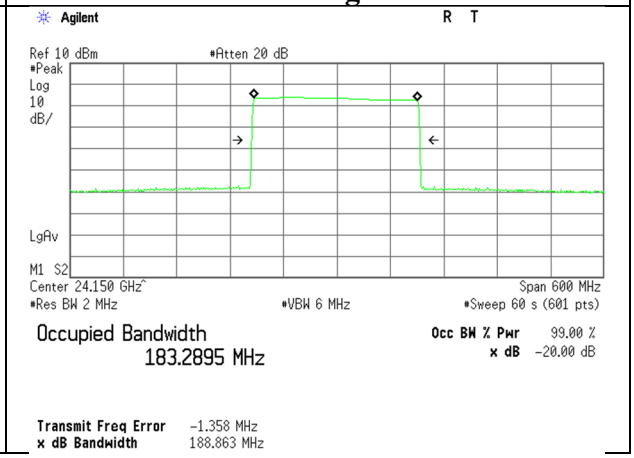
Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	21 deg. C / 34 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz, Narrow beam (Right)

Frequency [GHz]	FSK setting	20 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
24.15	Low	189.065	183.0486
24.15	Mid	188.863	183.2895
24.15	High	190.252	184.4933

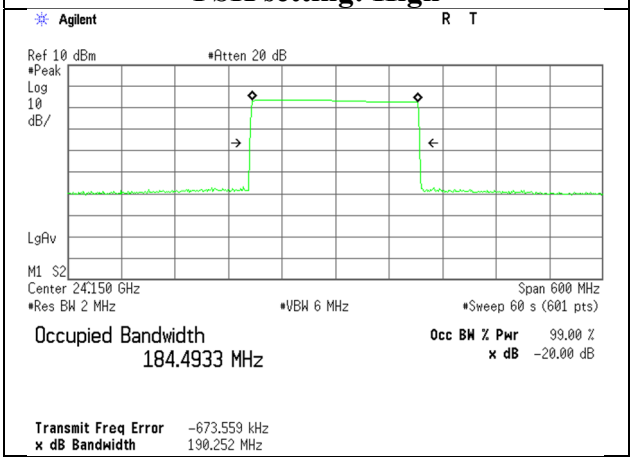
FSK setting: Low



FSK setting: Mid



FSK setting: High



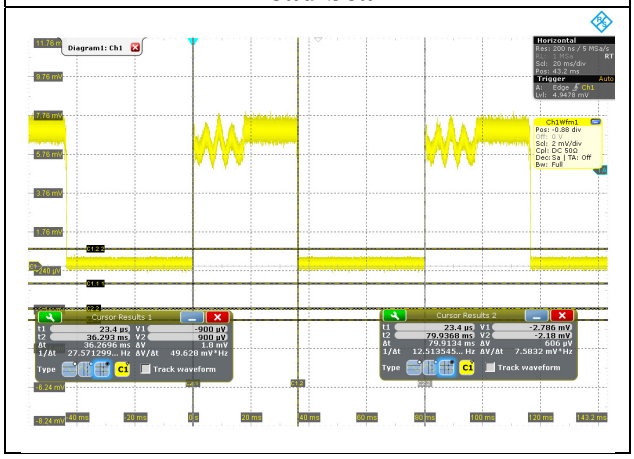
Duty Cycle

Report No.	13664352H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	January 8, 2021
Temperature / Humidity	20 deg. C / 37 % RH
Engineer	Yuichiro Yamazaki
Mode	Tx 24.15 GHz

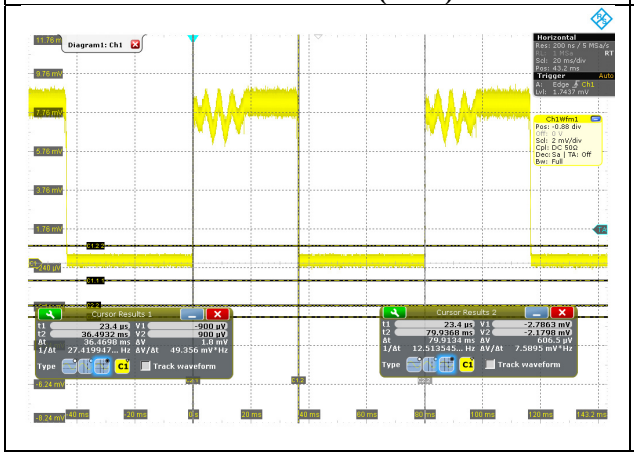
Mode	Tx On time [ms]	Tx On + Off time [ms]	Duty factor [dB]
Broad beam	36.270	79.913	-6.86
Narrow beam (Left)	36.470	79.913	-6.81
Narrow beam (Right)	36.670	79.913	-6.77
Declared	36.400	80.000	-6.84

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

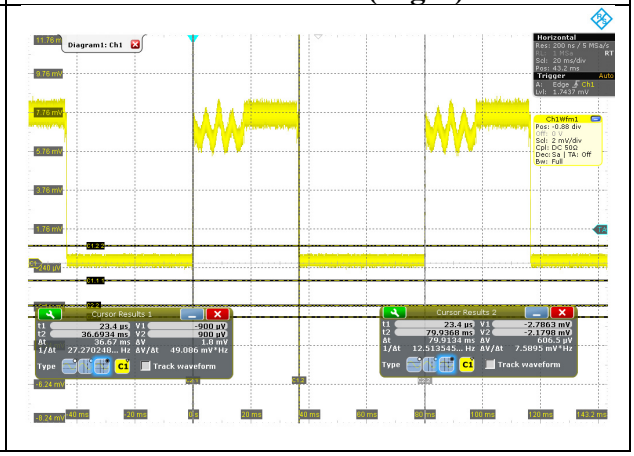
Broad beam



Narrow beam (Left)



Narrow beam (Right)



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	MOS-41	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/06/2020	12
RE	MMM-01	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/18/2020	12
RE	MJM-27	142228	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-02-SVSWR	142006	AC2_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-06902	04/01/2019	24
RE	MCC-216	141392	Microwave Cable	Junkosha	MWX221	1604S253(1 m) / 537073/126E(5 m)	02/18/2020	12
RE	MPA-10	141579	Pre Amplifier	Keysight Technologies Inc	8449B	3008A02142	01/12/2021	12
RE	MHA-02	141503	Horn Antenna 18-26.5GHz	EMCO	3160-09	1265	06/15/2020	12
RE	MSA-10	141899	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180655	08/04/2020	12
RE	MHA-06	141512	Horn Antenna 1-18GHz	Schwarzbeck Mess - Elektronik	BBHA9120D	254	09/14/2020	12
RE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2020	24
RE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/15/2021	12
RE	MMM-08	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	01/07/2021	12
RE	MJM-16	142183	Measure	KOMELON	KMC-36	-	-	-
RE	MAT-95	142314	Attenuator	Pasternack	PE7390-6	D/C 1504	06/17/2020	12
RE	MCC-112	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/ sucoform141-PE/ 421-010/ RFM-E321(SW)	-/00640	07/06/2020	12
RE	MLPA-02	142152	Loop Antenna	Rohde & Schwarz	HFH2-Z2	836553/009	12/04/2020	12
RE	MCC-219	159670	Coaxial Cable	UL Japan Inc.	-	-	11/17/2020	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/10/2020	12
RE	MTR-08	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	08/18/2020	12
RE	MBA-03	141424	Biconical Antenna	Schwarzbeck Mess - Elektronik	VHA9103+BBA9106	1915	08/13/2020	12
RE	MCC-51	141323	Coaxial cable	UL Japan	-	-	07/06/2020	12
RE	MLA-22	141266	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess - Elektronik	VUSLP9111B	9111B-191	08/13/2020	12
RE	MHA-20	141507	Horn Antenna 1-18GHz	Schwarzbeck Mess - Elektronik	BBHA9120D	258	10/01/2020	12
RE	MPA-11	141580	MicroWave System Amplifier	Keysight Technologies Inc	83017A	MY39500779	03/24/2020	12
RE	MCC-231	177964	Microwave Cable	Junkosha INC.	MMX221	1901S329(1m)/ 1902S579(5m)	03/02/2020	12
RE	MAEC-03-SVSWR	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/08/2019	24
RE	MHA-04	141505	Horn Antenna 26.5-40GHz	EMCO	3160-10	1140	08/03/2020	12
RE	MPA-03	141577	Microwave System Power Amplifier	Keysight Technologies Inc	83050A	MY39500610	10/19/2020	12
RE	MCC-220	151897	Microwave Cable	Huber+Suhner	SF101EA/11PC24/ 11PC24/2.5M	SN MY1726/1EA	04/13/2020	12
RE	MHA-31	142041	Horn Antenna	Oshima Prototype Engineering Co.	A16-187	1	09/24/2020	12
RE	MPA-25	159919	Power Amplifier	SAGE Millimeter, Inc.	SBP-4035033018-2F2F-S1	12559-01	06/30/2020	12
RE	MHA-33	180634	Horn Antenna	SAGE Millimeter, Inc.	SAZ-2410-15-S1	17343-01	06/24/2020	12
RE	MMX-01	142047	Preselected Millimeter Mixer	Keysight Technologies Inc	11974V-E01	3001A00412	05/25/2020	12

Test equipment (2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MPA-23	142055	Power Amplifier	SAGE Millimeter, Inc.	SBP-5037532015-1515-N1	11599-01	12/11/2020	12
RE	MCC-177	141226	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S304	03/18/2020	12
RE	MHA-35	180544	Horn Antenna	SAGE Millimeter, Inc.	SAZ-2410-10-S1	17343-01	06/24/2020	12
RE	MPA-31	180607	Power Amplifier	SAGE Millimeter, Inc.	SBP-7531142515-1010-E1	17343-01	10/26/2020	12
RE	MMX-02	142048	Harmonic Mixer	Keysight Technologies Inc	11970W	2521 A01909	10/19/2020	12
RE	MCC-135	142032	Microwave Cable	Huber+Suhner	SUCOFLEX102	37511/2	09/16/2020	12
RE	MCC-136	142033	Microwave Cable	Huber+Suhner	SUCOFLEX102	37512/2	09/16/2020	12
RE	OSC-01	141962	Digital Oscilloscope	Rohde & Schwarz	RTO1004	200355	08/18/2020	12
RE	MDT-05	142529	Detector	HEROTEK, INC.	DT1840P	484823	-	-

***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 and Duty cycle tests