RADIO TEST REPORT

Test Report No. : 13639562H-A-R3

Applicant	:	**Furukawa Automotive Systems Inc.**
Type of EUT	:	**24GHz Short Range Multi Mode Radar**
Model Number of EUT	:	**24GMMR20**
FCC ID	:	**2AHE9-24GMMR20**
Test regulation	:	**FCC Part 15 Subpart C: 2021**
Test Result	:	**Complied (Refer to SECTION 3.2)**

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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.
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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.
10. This report is a revised version of 13639562H-A-R2. 13639562H-A-R2 is replaced with this report.

Date of test: December 19 to 22, 2020

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.: 13639562H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13639562H-A	February 1, 2021	-	-
1	13639562H-A-R1	March 1, 2021	P.1	Correction of cover title; From EMI to RADIO
1	13639562H-A-R1	March 1, 2021	P.5	Correction of “Frequency of Operation” in Clause 2.2; from 24.123 GHz to 24.150 GHz
1	13639562H-A-R1	March 1, 2021	P.5	Deletion of Frequency range from Radio Specification in Clause 2.2.
1	13639562H-A-R1	March 1, 2021	P.6	Correction of the note * 2) in Section 3.2 to the following content; *2) The test is not required since this EUT does not point- to- point operation with 24.05 GHz to 24.25 GHz
1	13639562H-A-R1	March 1, 2021	P.19, 22	Correction of the Peak with Duty factor data by Duty factor correction.
1	13639562H-A-R1	March 1, 2021	P.22	Correction of Pulse desensitization factor sign in Result formula under the test data. from “-“ to “+”
1	13639562H-A-R1	March 1, 2021	P.25	Replaced Worst Plot data with Worst Margin mode Tx1.
1	13639562H-A-R1	March 1, 2021	P.26	Correction of test result display
1	13639562H-A-R1	March 1, 2021	P.27	Correction of duty factor value due to calculation formula correction
1	13639562H-A-R1	March 1, 2021	P.19, 22, 27	Correction of the calculation formula of Duty factor from 10log to 20log.
2	13639562H-A-R2	March 8, 2021	P.6	Correction of the Worst margin for Electric Field Strength of Fundamental Emission test in clause 3.2; From 12.6 dB (24150.000 MHz, Horizontal, PK with Duty Factor) <Transmitting mode, Tx 1/Tx 2> To 16.7 dB (24150.000 MHz, Vertical, PK) <Transmitting mode, Tx 1>
2	13639562H-A-R2	March 4, 2021	P.19, 22	- Correction of Pulse desensitization factor sign in Result formula under the test data. from “+“ to “-” - Data correction due to the above change
3	13639562H-A-R3	March 8, 2021	P.6	Correction of the Worst margin for Electric Field Strength of Fundamental Emission test in clause 3.2; From 16.7 dB (24150.000 MHz, Vertical, PK) <Transmitting mode, Tx 1> To 15.8 dB (24150.000 MHz, Vertical, PK) <Transmitting mode, Tx 2>
3	13639562H-A-R3	March 8, 2021	P.19, 22	Correction of the test data by calculation formula correction

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

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SECTION 1: Customer Information

Company Name	:	Furukawa Automotive Systems Inc.
Address	:	5-1-9, Higashi-yawata, Hiratsuka, Kanagawa 254-0016 Japan
Telephone Number	:	+81-463-24-8492
Facsimile Number	:	+81-463-24-8501
Contact Person	:	Eiji Ichii

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	:	24GHz Short Range Multi Mode Radar
Model Number	:	24GMMR20
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 13.5 V
Receipt Date	:	December 18, 2020
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: 24GMMR20 (referred to as the EUT in this report) is a 24GHz Short Range Multi Mode Radar

General Specificaion

Clock frequency(ies) in the system	:	40 MHz

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	24.150 GHz
Modulation	:	P0N
Antenna type	:	Patch Antenna
Antenna connector	:	None (Internal Antenna)
Antenna Gain	:	Tx1: 10.6 dBi, Tx2: 10.7 dBi
Steerable Antenna	:	None

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	15.8 dB (24150.000 MHz, Vertical, PK) <Transmitting mode, Tx 2>	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	8.1 dB (48245.000 MHz, Horizontal, AV) <Transmitting mode, Tx 1>	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 the 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, theequipment complies with the antenna requirement of Section 15.203.

3.3 Addition, deviation, exclusion to standards

Item	Test Procedure	Specification	Deviation	Worst margin	Results
99 % Occupied Band Width	RSS-Gen 6.7	-	N/A	N/A	-
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.					

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	3.9 dB	> =0.5 m
50 GHz - 75 GHz	5.3 dB	> =0.5 m
75 GHz - 110 GHz	5.6 dB	> =0.5 m

3.5 Test Location

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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

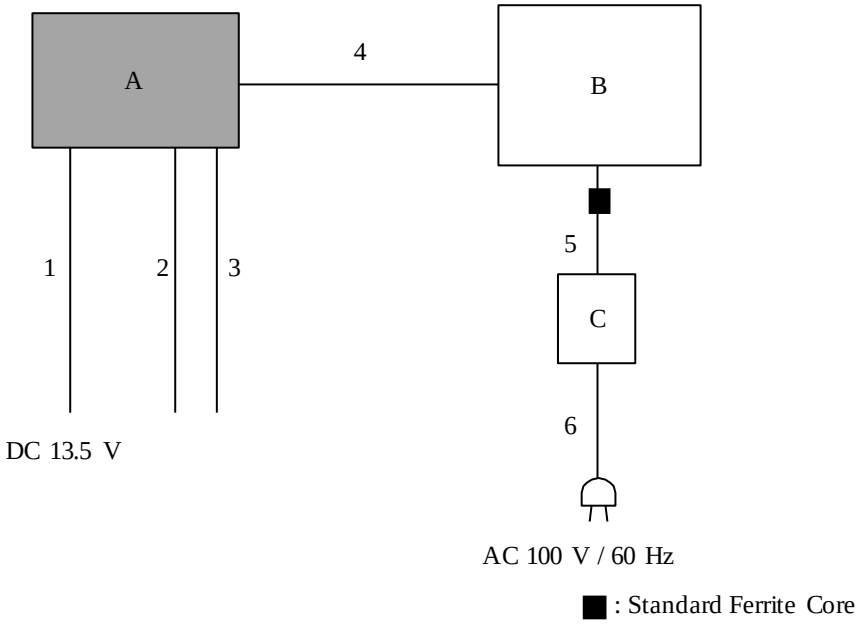
Refer to APPENDIX.

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) - Tx 1 - Tx 2	24150.000 MHz
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: 24GMMR20 SW ver.1.0 (Date: December 19, 2020, 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	24GHz Short Range Multi Mode Radar	24GMMR20	QH003 99026A2051100034	Furukawa Automotive Systems Inc.	EUT
B	Laptop PC	LATITUDE(E5510)	496N6N1	DELL	*1)
C	AC Adapter	DA90PE0-00	CN-0NN236-48661-04O-27PZ-A03	DELL	*1)

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.00	Unshielded	Unshielded	-
2	Signal Cable	2.00	Unshielded	Unshielded	-
3	Signal Cable	2.00	Unshielded	Unshielded	-
4	Signal Cable	3.00	Unshielded	Unshielded	-
5	DC Cable	1.80	Unshielded	Unshielded	*1)
6	AC Cable	0.85	Unshielded	Unshielded	*1)

*1) Used for other tests except for Electric Field Strength of Spurious Emission test.

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

Test Procedure and conditions

[For below 30 MHz]
EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.
The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg., 135 deg., and 180 deg.) and horizontal polarization.
*Refer to Figure 1 about Direction of the Loop Antenna.

[For below 1 GHz]
EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz, up to 40 GHz]
EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane.
The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 m and 4 m (frequency range 9 kHz - 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 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.
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	QP, 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
Test Distance	3 m	3 m	3 m	4.0 m *3) (1 GHz - 10 GHz) 1.0 m *4) (10 GHz -40 GHz)	

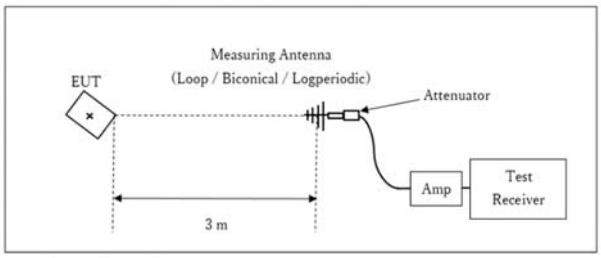
*1) Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative siteproduces results that correlate with the ones of tests made in an open 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 pulsedemission, VBW was set to 10 Hz and linear voltage average mode was used.

*3) Distance Factor: 20 x log (4.0 m / 3.0 m) = 2.5 dB
*4) Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 dB

[Test setup]

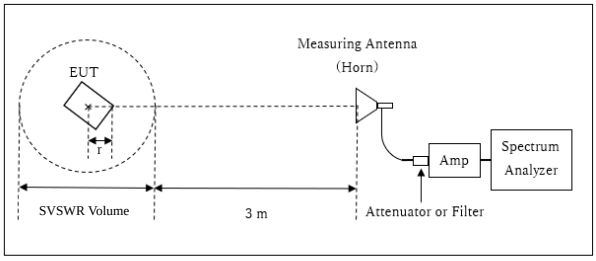
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT

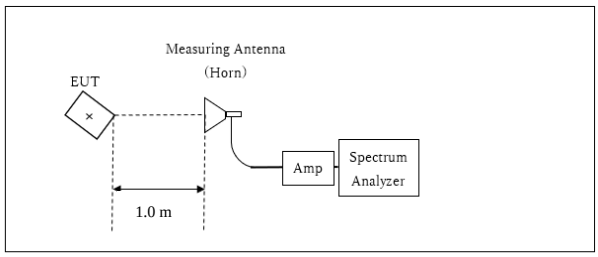
× : Center of turn table

Distance Factor: 20 x log (1.0 m*/3.0 m) = -9.5 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 4.0 m

SVSWR Volume: 2 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 - 40 GHz

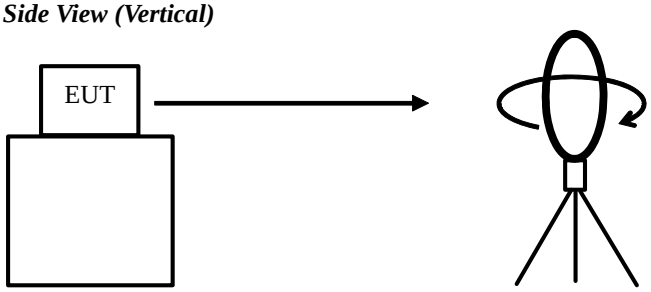


× : Center of turn table

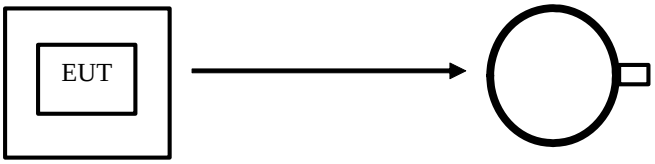
Distance Factor: 20 x log (1.0 m* / 3.0 m) = -9.5 dB
*Test Distance: 1.0 m

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

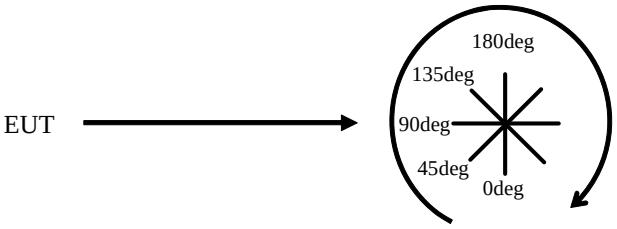


Top View (Horizontal)



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 *D*	Boundary *r*
[GHz]	*Lambda* [mm]	[m]	[m]	[m]	[m]
24.250	12.4	0.028	0.075	0.075	0.910

The Fundamental Emission results was applied to the desensitization correction factor.
The derivation of the Pulse Desensitization Factor is given in Keysight Application Note 5952 1039 section 4.

Desensitization factor was calculated from follow equation.
Pulse Desensitization factor = 20 Log (α_p)
And

$$\alpha_p = \tau_{eff} * K * RBW$$

Where

τ_{eff} is Pulse On Time
K is Constant of IF Amplifier (K = 1.48)
RBW is -3dB bandwidth of Gaussian RBW Filter (RBW = 8 MHz)

For the values of τ_{eff}, refer to page27 to 28.

[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.

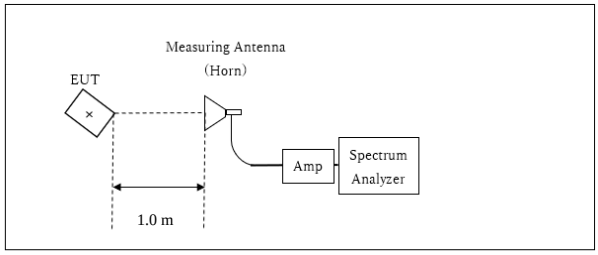
Frequency	40 GHz - 50 GHz	50 GHz - 75 GHz	75 GHz - 100 GHz
Final measurement distance with 1 MHz Peak detector	1.0 m	0.75 m	0.5 m

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
Test Distance	1.0 m *2)	0.75 m *3)	0.5 m *4)

*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 setto 10 Hz and linear voltage average mode was used.
*2) Distance Factor: 20 x log (1.0 m / 3.0 m) = -9.5 dB
*3) Distance Factor: 20 x log (0.75 m / 3.0 m) = -12.0 dB
*4) Distance Factor: 20 x log (0.5 m / 3.0 m) = -15.6 dB

[Test setup]

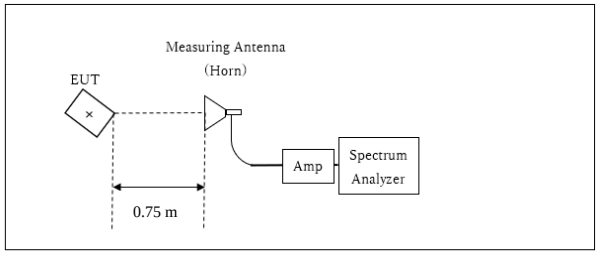
40 GHz - 50 GHz



× : Center of turn table

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

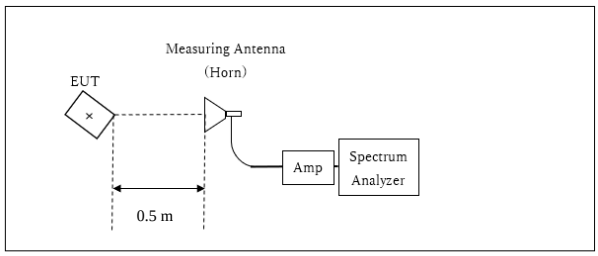
50 GHz - 75 GHz



× : Center of turn table

Distance Factor: 20 x log (0.75 m* / 3.0 m) = -12.0 dB
*Test Distance: 0.75 m

75 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 maxim 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	400 MHz	2 MHz, 1 % to 5 % of OBW	6 MHz, Three times of RBW	60 sec	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth	400 MHz, Enough width to displayemission 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	-	-	-	90 msec/ 90 msec/ 2μsec	-	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.	13639562H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	December 19, 2020
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki
Mode	Transmitting mode, Tx 1

[Fundamental]

Peak

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Fac. [dB/m]	Loss [dB]	Gain [dB]	Pulse desensitization factor	Duty factor	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	24150.00	PK	94.5	38.7	-0.9	31.9	-11.4	-	111.8	127.9	16.1	
Vert	24150.00	PK	94.0	38.7	-0.9	31.9	-11.4	-	111.3	127.9	16.6	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter)+Distance factor(above 1 GHz)) - Gain(Amp lifier) - Pulse desensitization factor

Distance factor: 20log (1.0 m / 3.0 m) = -9.5 dB

Pulse desensitization factor : 20log (τeff * K * RBW)

Peak with Duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Fac. [dB/m]	Loss [dB]	Gain [dB]	Pulse desensitization factor	Duty factor	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	24150.00	PK	94.5	38.7	-0.9	31.9	-11.4	-33.0	78.8	107.9	29.1	
Vert	24150.00	PK	94.0	38.7	-0.9	31.9	-11.4	-33.0	78.3	107.9	29.6	

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

Distance factor: 20log (1.0 m / 3.0 m) = -9.5 dB

Pulse desensitization factor : 20log (τeff * K * RBW)

Duty factor: 20log (Duty cycle))

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

Report No.	13639562H			
Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No.3	No.3	No.4	No.3
Date	December 19, 2020	December 20, 2020	December 21, 2020	December 22, 2020
Temperature / Humidity	24 deg. C / 46 % RH	24 deg. C / 45 % RH	20 deg. C / 45 % RH	22 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki	Yuichiro Yamazaki	Yuichiro Yamazaki	Yuichiro Yamazaki
	(18 GHz - 26.5 GHz)	(10 GHz - 18 GHz)	(30 MHz - 10 GHz)	(Below 30 MHz)
		(26.5 GHz - 40 GHz)	(40 GHz- 100 GHz)	
Mode	Transmitting mode, Tx 1			

[Spurious emissions other than above]

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	54.067	QP	22.1	9.6	7.5	32.0	7.2	40.0	32.8	
Hori.	60.890	QP	21.6	7.6	7.6	32.0	4.8	40.0	35.2	
Hori.	80.012	QP	22.3	6.8	7.8	32.0	5.0	40.0	35.0	
Hori.	103.217	QP	22.2	10.6	8.0	31.9	8.9	43.5	34.6	
Hori.	117.954	QP	22.0	12.6	8.1	31.9	10.9	43.5	32.7	
Hori.	269.788	QP	31.7	12.9	9.4	31.8	22.2	46.0	23.8	
Hori.	24000.000	PK	48.5	38.7	-0.9	32.0	54.2	73.9	19.7	
Hori.	24250.000	PK	49.3	38.7	-0.9	31.8	55.2	73.9	18.7	
Hori.	48245.000	PK	57.3	41.7	-0.6	32.5	65.8	87.9	22.1	
Hori.	72450.000	PK	37.0	43.1	6.0	20.8	65.3	87.9	22.6	NS
Hori.	96600.000	PK	45.9	45.6	-4.1	34.8	52.6	73.9	21.3	NS
Hori.	24000.000	AV	35.1	38.7	-0.9	32.0	40.8	53.9	13.1	
Hori.	24250.000	AV	38.1	38.7	-0.9	31.8	44.1	53.9	9.8	
Hori.	48245.000	AV	51.3	41.7	-0.6	32.5	59.8	67.9	8.1	
Hori.	72450.000	AV	24.0	43.1	6.0	20.8	52.3	67.9	15.6	NS
Hori.	96600.000	AV	32.6	45.6	-4.1	34.8	39.3	53.9	14.6	NS
Vert.	54.067	QP	33.0	9.6	7.5	32.0	18.1	40.0	21.9	
Vert.	60.890	QP	37.6	7.6	7.6	32.0	20.8	40.0	19.2	
Vert.	80.012	QP	35.2	6.8	7.8	32.0	17.9	40.0	22.1	
Vert.	103.217	QP	39.6	10.6	8.0	31.9	26.3	43.5	17.2	
Vert.	117.954	QP	34.3	12.6	8.1	31.9	23.2	43.5	20.4	
Vert.	269.788	QP	32.8	12.9	9.4	31.8	23.3	46.0	22.7	
Vert.	24000.000	PK	48.0	38.7	-0.9	32.0	53.8	73.9	20.1	
Vert.	24250.000	PK	48.7	38.7	-0.9	31.8	54.7	73.9	19.3	
Vert.	48245.000	PK	57.3	41.7	-0.6	32.5	65.8	87.9	22.1	
Vert.	72450.000	PK	36.9	43.1	6.0	20.8	65.3	87.9	22.6	NS
Vert.	96600.000	PK	45.8	45.6	-4.1	34.8	52.5	73.9	21.4	NS
Vert.	24000.000	AV	34.9	38.7	-0.9	32.0	40.6	53.9	13.3	
Vert.	24250.000	AV	38.1	38.7	-0.9	31.8	44.1	53.9	9.8	
Vert.	48245.000	AV	51.2	41.7	-0.6	32.5	59.7	67.9	8.2	
Vert.	72450.000	AV	23.9	43.1	6.0	20.8	52.3	67.9	15.6	NS
Vert.	96600.000	AV	32.6	45.6	-4.1	34.8	39.3	53.9	14.6	NS

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).

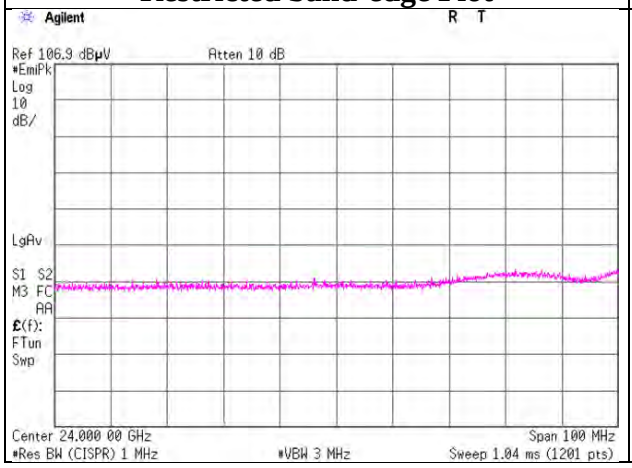
Distance factor:
1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB
26.5 GHz - 50 GHz 20log (0.75 m / 3.0 m) = -12.0 dB
50 GHz - 100 GHz 20log (0.5 m / 3.0 m) = -15.6 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

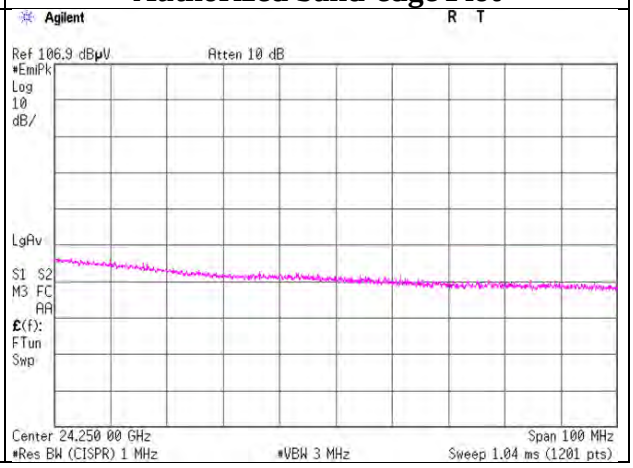
Report No.	13639562H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	December 19, 2020
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki
Mode	Transmitting mode, Tx 1

Horizontal polarization

Restricted band-edge Plot

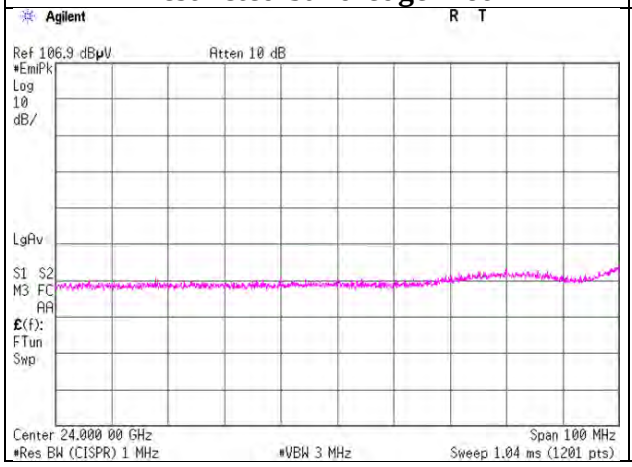


Authorized band-edge Plot

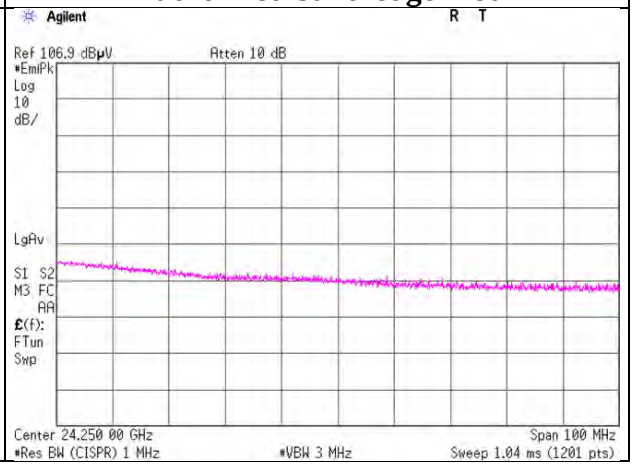


Vertical polarization

Restricted band-edge Plot



Authorized band-edge Plot



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

Report No.	13639562H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	December 19, 2020
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki
Mode	Transmitting mode, Tx 2

[Fundamental]

Peak

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Fac. [dB/m]	Loss [dB]	Gain [dB]	Pulse desensitization factor	Duty factor	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	24150.00	PK	94.2	38.7	-0.9	31.9	-11.4	-	111.5	127.9	16.4	
Vert	24150.00	PK	94.8	38.7	-0.9	31.9	-11.4	-	112.1	127.9	15.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter)+Distance factor(above 1 GHz)) - Gain(Amp lifier) - Pulse desensitization factor

Distance factor: 20log (1.0 m / 3.0 m) = -9.5 dB

Pulse desensitization factor : 20log (τeff * K * RBW)

Peak with Duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Fac. [dB/m]	Loss [dB]	Gain [dB]	Pulse desensitization factor	Duty factor	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	24150.00	PK	94.2	38.7	-0.9	31.9	-11.4	-33.0	78.5	107.9	29.4	
Vert	24150.00	PK	94.8	38.7	-0.9	31.9	-11.4	-33.0	79.1	107.9	28.8	

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

Distance factor: 20log (1.0 m / 3.0 m) = -9.5 dB

Pulse desensitization factor : 20log (τeff * K * RBW)

Duty factor: 20log (Duty cycle))

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

Report No.	13639562H			
Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No.3	No.3	No.4	No.3
Date	December 19, 2020	December 20, 2020	December 21, 2020	December 22, 2020
Temperature / Humidity	24 deg. C / 46 % RH	24 deg. C / 45 % RH	20 deg. C / 45 % RH	22 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki (18 GHz - 26.5 GHz)	Yuichiro Yamazaki (10 GHz - 18 GHz) (26.5 GHz - 40 GHz)	Yuichiro Yamazaki (30 MHz - 10 GHz) (40 GHz- 100 GHz)	Yuichiro Yamazaki (Below 30 MHz)
Mode	Transmitting mode, Tx 2			

[Spurious emissions other than above]

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	53.109	QP	22.0	9.9	7.5	32.0	7.4	40.0	32.6	
Hori.	60.662	QP	21.4	7.6	7.6	32.0	4.6	40.0	35.4	
Hori.	82.428	QP	22.0	7.1	7.8	32.0	5.0	40.0	35.0	
Hori.	105.230	QP	22.3	10.9	8.0	31.9	9.3	43.5	34.2	
Hori.	170.776	QP	21.3	15.7	8.6	31.9	13.7	43.5	29.8	
Hori.	267.668	QP	30.5	12.7	9.4	31.8	20.9	46.0	25.2	
Hori.	24000.000	PK	48.4	38.7	-0.9	32.0	54.2	73.9	19.7	
Hori.	24250.000	PK	48.9	38.7	-0.9	31.8	54.9	73.9	19.0	
Hori.	48245.000	PK	57.2	41.7	-0.6	32.5	65.7	87.9	22.2	
Hori.	72450.000	PK	37.0	43.1	6.0	20.8	65.3	87.9	22.6	NS
Hori.	96600.000	PK	45.9	45.6	-4.1	34.8	52.6	73.9	21.3	NS
Hori.	24000.000	AV	35.2	38.7	-0.9	32.0	41.0	53.9	12.9	
Hori.	24250.000	AV	37.9	38.7	-0.9	31.8	43.9	53.9	10.0	
Hori.	48245.000	AV	51.2	41.7	-0.6	32.5	59.7	67.9	8.2	
Hori.	72450.000	AV	24.0	43.1	6.0	20.8	52.3	67.9	15.6	NS
Hori.	96600.000	AV	32.6	45.6	-4.1	34.8	39.3	53.9	14.6	NS
Vert.	53.109	QP	34.3	9.9	7.5	32.0	19.7	40.0	20.3	
Vert.	60.662	QP	36.2	7.6	7.6	32.0	19.4	40.0	20.6	
Vert.	81.674	QP	35.8	7.0	7.8	32.0	18.7	40.0	21.3	
Vert.	105.230	QP	38.6	10.9	8.0	31.9	25.6	43.5	17.9	
Vert.	170.776	QP	26.3	15.7	8.6	31.9	18.7	43.5	24.8	
Vert.	267.668	QP	31.0	12.7	9.4	31.8	21.3	46.0	24.7	
Vert.	24000.000	PK	48.2	38.7	-0.9	32.0	53.9	73.9	20.0	
Vert.	24250.000	PK	49.4	38.7	-0.9	31.8	55.4	73.9	18.5	
Vert.	48245.000	PK	57.1	41.7	-0.6	32.5	65.6	87.9	22.3	
Vert.	72450.000	PK	37.0	43.1	6.0	20.8	65.3	87.9	22.6	NS
Vert.	96600.000	PK	45.8	45.6	-4.1	34.8	52.5	73.9	21.4	NS
Vert.	24000.000	AV	35.3	38.7	-0.9	32.0	41.0	53.9	12.9	
Vert.	24250.000	AV	38.8	38.7	-0.9	31.8	44.8	53.9	9.1	
Vert.	48245.000	AV	51.0	41.7	-0.6	32.5	59.5	67.9	8.4	
Vert.	72450.000	AV	24.0	43.1	6.0	20.8	52.3	67.9	15.6	NS
Vert.	96600.000	AV	32.6	45.6	-4.1	34.8	39.3	53.9	14.6	NS

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).

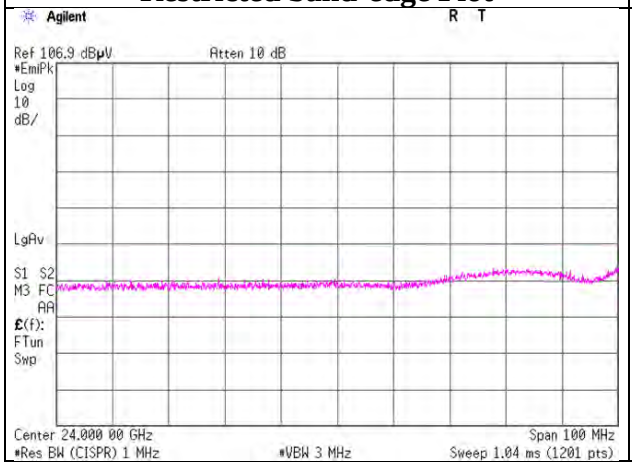
Distance factor:
1 GHz - 10 GHz 20log (4.0 m / 3.0 m) = 2.5 dB
10 GHz - 26.5 GHz 20log (1.0 m / 3.0 m) = -9.5 dB
26.5 GHz - 50 GHz 20log (0.75 m / 3.0 m) = -12.0 dB
50 GHz - 100 GHz 20log (0.5 m / 3.0 m) = -15.6 dB

Radiated Spurious Emission
(Reference Plot for band-edge)

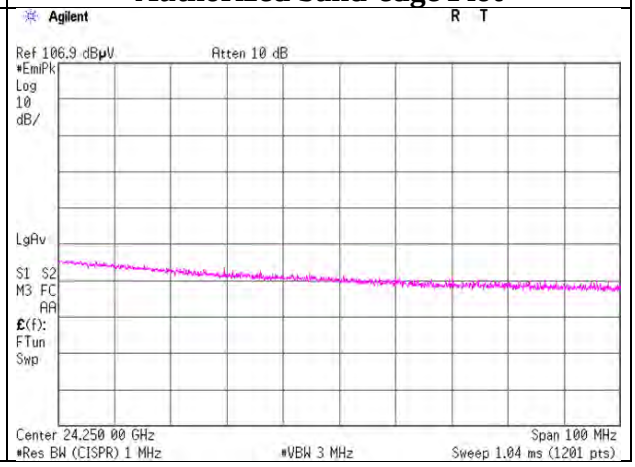
Report No.	13639562H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	December 19, 2020
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki
Mode	Transmitting mode, Tx 2

Horizontal polarization

Restricted band-edge Plot

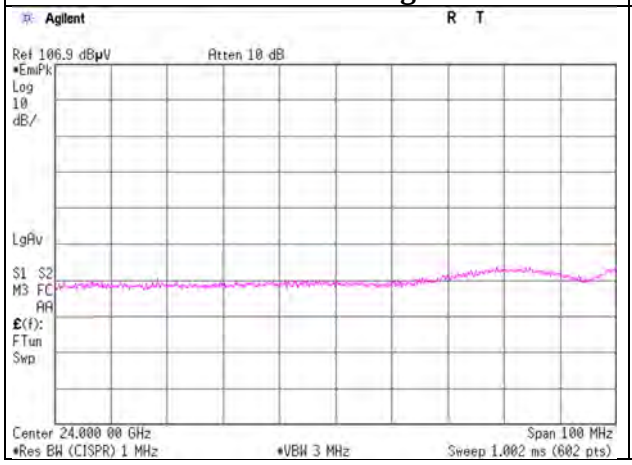


Authorized band-edge Plot

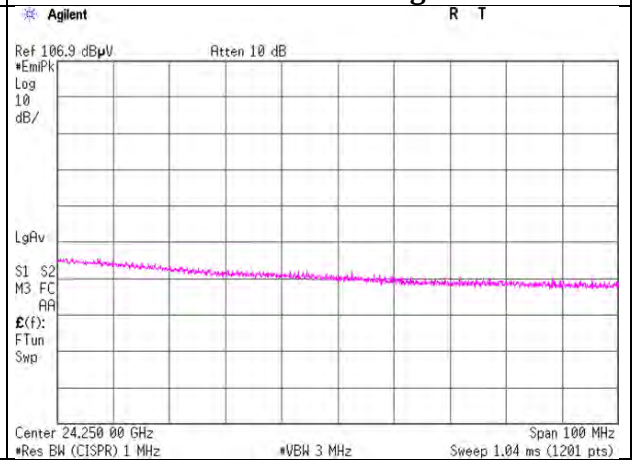


Vertical polarization

Restricted band-edge Plot

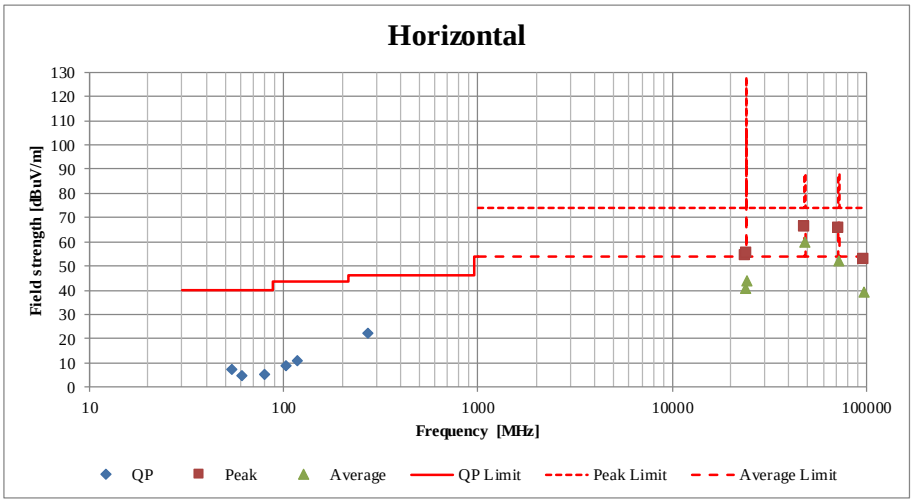


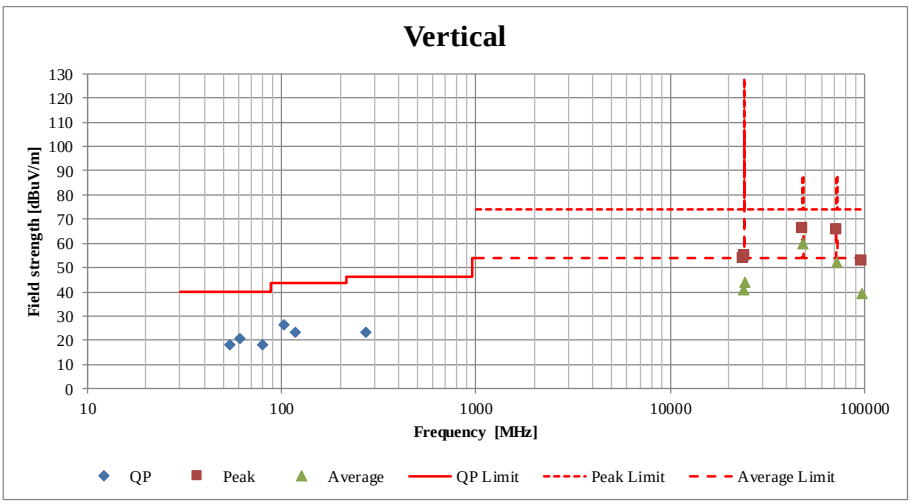
Authorized band-edge Plot



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

Report No.	13639562H			
Test place	Ise EMC Lab.			
Semi Anechoic Chamber	No.3	No.3	No.4	No.3
Date	December 19, 2020	December 20, 2020	December 21, 2020	December 22, 2020
Temperature / Humidity	24 deg. C / 46 % RH	24 deg. C / 45 % RH	20 deg. C / 45 % RH	22 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki (18 GHz - 26.5 GHz)	Yuichiro Yamazaki (10 GHz - 18 GHz) (26.5 GHz - 40 GHz)	Yuichiro Yamazaki (30 MHz - 10 GHz) (40 GHz- 100 GHz)	Yuichiro Yamazaki (Below 30 MHz)
Mode	Transmitting mode, Tx 1			





20 dB Bandwidth, 99 % Occupied Bandwidth

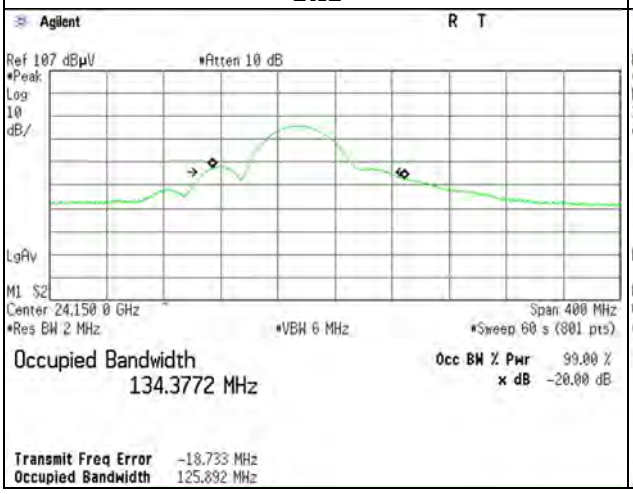
Report No.	13639562H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	December 19, 2020
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki
Mode	Transmitting mode

	Antenna	Freq. [GHz]	Freq. Error [MHz]	OBW [MHz]	Lower Freq. [GHz]	Higher Freq. [GHz]	Allowed Freq. Lower [GHz]	Allowed Freq. Higher [GHz]
20dB Bandwidth	Tx1	24.150	-18.733	125.8920	24.068	24.195	24.000	24.250
	Tx2	24.150	-20.220	130.1890	24.064	24.195	24.000	24.250
99% OBW	Tx1	24.150	-18.733	134.377	24.064	24.199	24.000	24.250
	Tx2	24.150	-20.220	139.447	24.060	24.200	24.000	24.250

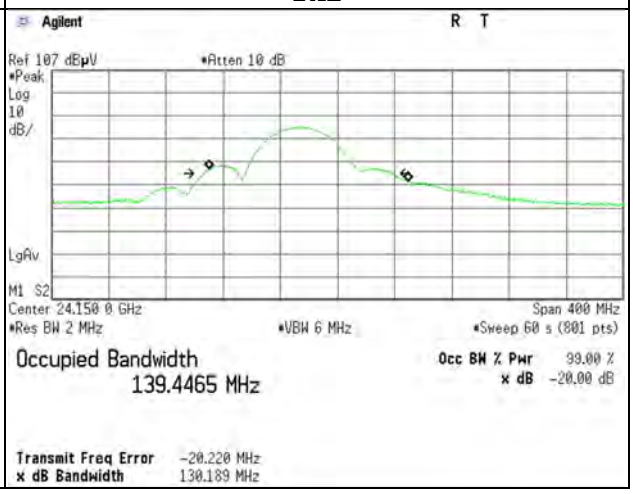
Lower Freq. = (Center Freq.) - (99% OBW or 20dB Bandwitdh) / 2 + (Freq. Error)

Higher Freq. = (Center Freq.) + (99% OBW or 20dB Bandwitdh) / 2 + (Freq. Error)

Tx1



Tx2



Duty Cycle

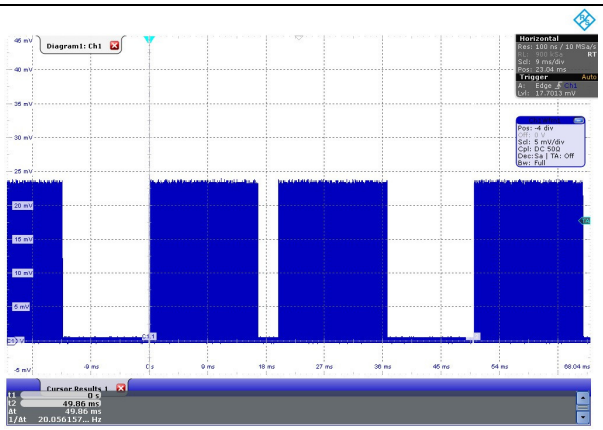
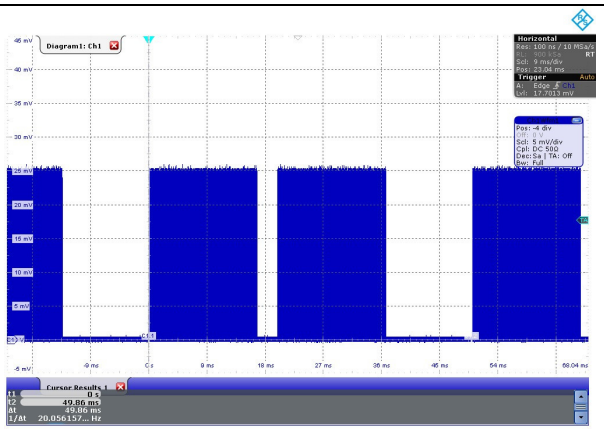
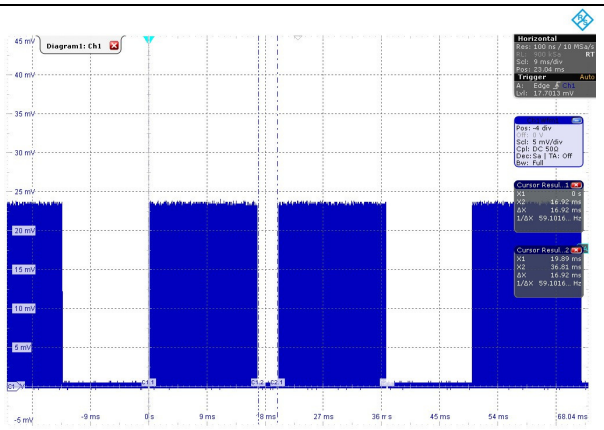
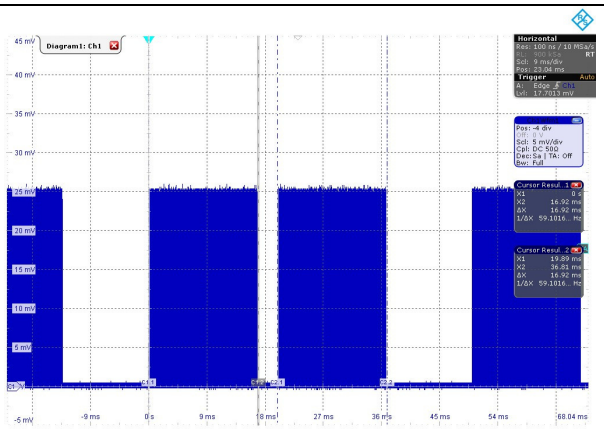
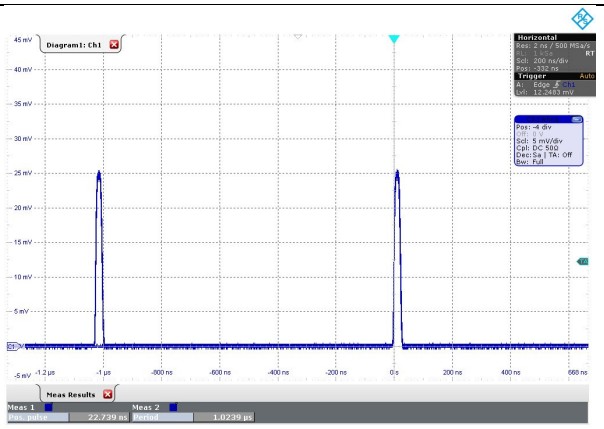
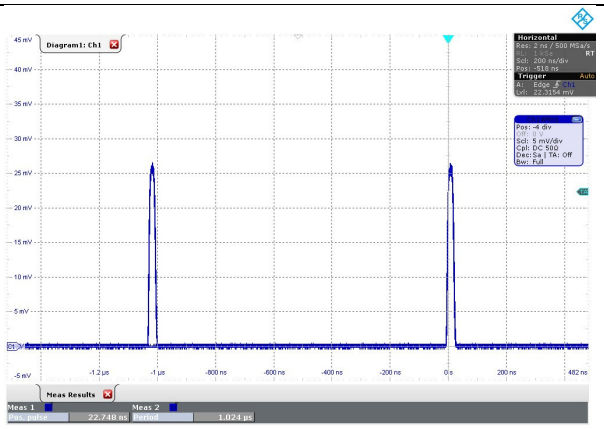
Report No.	13639562H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	December 19, 2020
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki
Mode	Transmitting mode

Antenna	Pulse width (nsec)	PRI (μsec)	Duty cycle (%)	Duty factor (dB)
Tx1	22.739	1.024	2.221	-33.071
Tx2	22.748	1.024	2.221	-33.067

Duty cycle = (Pluse width / PRI) * 100
Duty factor = $20\log_{10}$(Duty cycle)

Duty Cycle

Report No.	13639562H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	December 19, 2020
Temperature / Humidity	24 deg. C / 46 % RH
Engineer	Yuichiro Yamazaki
Mode	Transmitting mode

Tx1	Tx2
On + Off	On + Off
	
1 Burst	1 Burst
	
1 Pulse	1 Pulse
	

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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-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/07/2020	12
RE	MMM-08	141532	DIGITAL HiTESTER	Hioki	3805	51201197	01/06/2020	12
RE	MJM-16	142183	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAEC-03-SVSWR	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/08/2019	24
RE	MSA-10	141899	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180655	08/04/2020	12
RE	MHA-16	141513	Horn Antenna 15-40GHz	Schwarzbeck Mess - Elektronik	BBHA9170	BBHA9170306	05/21/2020	12
RE	MCC-231	177964	Microwave Cable	Junkosha INC.	MMX221	1901S329(1m)/ 1902S579(5m)	03/02/2020	12
RE	MPA-11	141580	MicroWave System Amplifier	Keysight Technologies Inc	83017A	MY39500779	03/24/2020	12
RE	MHA-20	141507	Horn Antenna 1-18GHz	Schwarzbeck Mess - Elektronik	BBHA9120D	258	10/01/2020	12
RE	MCC-220	151897	Microwave Cable	Huber+Suhner	SF101EA/11PC24/ 11PC24/2.5M	SN MY1726/1EA	04/13/2020	12
RE	MPA-03	141577	Microwave System Power Amplifier	Keysight Technologies Inc	83050A	MY39500610	10/19/2020	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-35	180544	Horn Antenna	SAGE Millimeter, Inc.	SAZ-2410-10-S1	17343-01	06/24/2020	12
RE	MPA-23	142055	Power Amplifier	SAGE Millimeter, Inc.	SBP-5037532015-1515-N1	11599-01	12/11/2020	12
RE	MMX-01	142047	Preselected Millimeter Mixer	Keysight Technologies Inc	11974V-E01	3001A00412	05/25/2020	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	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	02/18/2020	12
RE	MCC-178	141227	Microwave Cable	Junkosha	MMX221-00500DMSDMS	1502S305	03/18/2020	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	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/25/2020	24
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/07/2020	12
RE	MMM-10	141545	DIGITAL HiTESTER	Hioki	3805	51201148	01/06/2020	12
RE	MJM-29	142230	Measure	KOMELON	KMC-36	-	-	-
RE	MAEC-04-SVSWR	142017	AC4_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/04/2019	24
RE	MHA-21	141508	Horn Antenna 1-18GHz	Schwarzbeck Mess - Elektronik	BBHA9120D	557	05/22/2020	12
RE	MPA-12	141581	MicroWave System Amplifier	Keysight Technologies Inc	83017A	00650	10/19/2020	12
RE	MCC-246	199563	Microwave Cable	HUBER+SUNER	SF126E/11PC35/ 11PC35/1000M,5000M	537061/126E / 537072/126E	06/11/2020	12
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/05/2020	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess - Elektronik	VHA9103+BBA9106	VHA 91031302	08/31/2020	12
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	11/06/2020	12
RE	MLA-23	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess - Elektronik	VUSLP9111B	9111B-192	09/02/2020	12
RE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	03/10/2020	12

Test equipment (2/2)

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MAEC-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2020	24
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	MAT-95	142314	Attenuator	Pasternack	PE7390-6	D/C 1504	06/17/2020	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/10/2020	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