

RADIO TEST REPORT

Test Report No. 15470574H-R2

Customer	TOYOTA MOTOR CORPORATION
Description of EUT	Smart LF oscillator
Model Number of EUT	TMLF19D-A
FCC ID	NI4TMLF19D-A
Test Regulation	FCC Part 15 Subpart C
Test Result	Complied
Issue Date	November 26, 2024
Remarks	-

Representative test engineerTetsuro Yoshida
Engineer**Approved by**Shinichi Miyazono
Leader

CERTIFICATE 5107.02

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REVISION HISTORY

Original Test Report No. 15470574H

This report is a revised version of 15470574H-R1. 15470574H-R1 is replaced with this report.

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	15470574H	November 7, 2024	-
1	15470574H-R1	November 25, 2024	Correction of the Test Date in Clause 2.1 due to the additional test. from October 7 to 17, 2024 to October 7 to November 22, 2024
1	15470574H-R1	November 25, 2024	Correction of the product configuration in Clause 2.2.
1	15470574H-R1	November 25, 2024	Correction of the FCC Part 15.31 (e) in Clause 3.2
1	15470574H-R1	November 25, 2024	Change the following in Clause 4.1. - Correction of test mode - Addition of "2)" to the Remarks of Mode 3 - Addition of "3)" to the Remarks of Mode 1 and note "3)" under the table
1	15470574H-R1	November 25, 2024	Correction of the notation of items in Clause 4.2.
1	15470574H-R1	November 25, 2024	Addition of the following to Radiated Emission data (Page 15 to 21). - Test date - Voltage fluctuation data
1	15470574H-R1	November 25, 2024	Deletion of the following sentence from Radiated Emission data (Mode 6); * Since the peak emission result satisfied the average limit, duty factor was omitted
1	15470574H-R1	November 25, 2024	Addition of LIMS ID:146613 in the Test Equipment.
1	15470574H-R1	November 25, 2024	Correction of the antenna identification for the Worst Case Position. (page 28)
2	15470574H-R2	November 26, 2024	- Addition of the "1)" to LIMS ID: 142152 in Test Equipment. - Addition of the following sentence; "The expiration*1) This test equipment was used for the tests before the expiration date of the calibration."

Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer Information

Company Name	TOYOTA MOTOR CORPORATION
Address	1, Toyota-Cho, Toyota, Aichi, 471-8572, Japan
Telephone Number	+81-50-3166-4371
Contact Person	Arinobu Kimura

The information provided by the customer is as follows;

- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- SECTION 1: Customer Information
- SECTION 2: Equipment Under Test (EUT) other than the Receipt Date and Test Date
- SECTION 4: Operation of EUT during testing

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Smart LF oscillator
Model Number	TMLF19D-A
Serial Number	Refer to SECTION 4.2
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	October 1, 2024
Test Date	October 7 to November 22, 2024

2.2 Product Description

General Specification

Rating	DC 12 V
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Radio Specification

Equipment Type	Transmitter
Frequency of Operation	125 kHz
Type of Modulation	ASK
Antenna type	Outside antenna Var.C2 (*1), Inside antenna Var.1 (*2), Inside antenna Var.3 (*3), Rear antenna (*4) *1: Maximum number of this antenna is 4. *2: Maximum number of this antenna is 2. *3: Maximum number of this antenna is 1. *4: Maximum number of this antenna is 6.

Smart LF oscillator (model: TMLF19D-A) consists of the following parts:

- Smart ECU
- Outside Antenna Var.C2*
- Inside Antenna Var.1
- Inside antenna Var.3
- Rear Antenna

*Outside Antenna Var.C2 has a variant model: Var.C4 with a different circuit.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	FCC Part 15 Subpart C The latest version on the first day of the testing period
Title	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.209 Radiated emission limits; general requirements.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 8.8	<FCC> Section 15.207 <ISED> RSS-Gen 8.8	N/A	N/A	*1)
Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 6.5, 6.12	<FCC> Section 15.209 <ISED> RSS-210 8.2 RSS-Gen 8.9	6.9 dB 125 kHz, 0 deg. Peak with Duty factor (Mode 3)	Complied	Radiated
Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> RSS-Gen 6.5, 6.6, 6.13	<FCC> Section 15.209 <ISED> RSS-210 8.3 RSS-Gen 8.9	9.8 dB 0.62500 MHz, 0 deg. QP (Mode 6)	Complied	Radiated
-20 dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> -	<FCC> Reference data <ISED> -	N/A	Complied	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

FCC Part 15.31 (e)

The battery voltage (DC 12 V) is provided to the EUT. Input voltage to RF part does not go through the regulator.

So the test was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage (DC 12 V) and the variation of the input power does not affect 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 vehicle.

Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99 % emission bandwidth	RSS-Gen 6.7	-	N/A	-	Radiated

Note: UL Japan, Inc.'s EMI Work Procedures: Work Instructions-ULID-003591 and Work Instructions-ULID-003593.

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

3.4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement. Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

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

Radiated emission

Measurement distance	Frequency range		Unit	Calculated Uncertainty (+/-)
3 m	9 kHz to 30 MHz		dB	3.3
10 m			dB	3.1
3 m	30 MHz to 200 MHz	Horizontal	dB	5.0
		Vertical	dB	5.0
	200 MHz to 1000 MHz	Horizontal	dB	5.2
		Vertical	dB	6.2
10 m	30 MHz to 200 MHz	Horizontal	dB	5.5
		Vertical	dB	5.4
	200 MHz to 1000 MHz	Horizontal	dB	5.5
		Vertical	dB	5.5

-20 dB Bandwidth and 99% Occupied Bandwidth

Item	Unit	Calculated Uncertainty (+/-)
Bandwidth (OBW)	%	0.96

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan
Telephone: +81-596-24-8999

*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919
ISED Lab Company Number: 2973C / CAB identifier: JP0002

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.10 shielded room	3.8 x 2.8 x 2.8	3.8 x 2.8	-	-
No.11 measurement room	4.0 x 3.4 x 2.5	N/A	-	-
No.12 measurement room	2.6 x 3.4 x 2.5	N/A	-	-
Large Chamber	16.9 x 22.1 x 10.17	16.9 x 22.1	-	10 m
Small Chamber	5.3 x 6.69 x 3.59	5.3 x 6.69	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1 Operating Mode(s)

Test mode	Remarks
1) Tx 125 kHz, Outside Antenna Var.C2	*1), *3)
2) Tx 125 kHz, Inside Antenna Var.3 (Inside Mode)	*1)
3) Tx 125 kHz, Inside Antenna Var.3 (Immobilizer mode)	*1), *2)
4) Tx 125 kHz, Inside Antenna Var.1	*1)
5) Tx 125 kHz, Rear Antenna	*1)
6) Tx 125 kHz, Outside Antenna and Rear Antenna (Outside Antenna 1, 2, 3, 4 and Rear Antenna 5, 6)	*1)

*Power of the EUT was set by the software as follows;

Software: 19CYV3_IDT_denpa_v01_cm0_240411 Version: 01
(Date: 2024.04.11, Storage location: EUT memory)

19CYV3_IDT_denpa_v01_cm4_240411 Version: 01
(Date: 2024.04.11, 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.

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

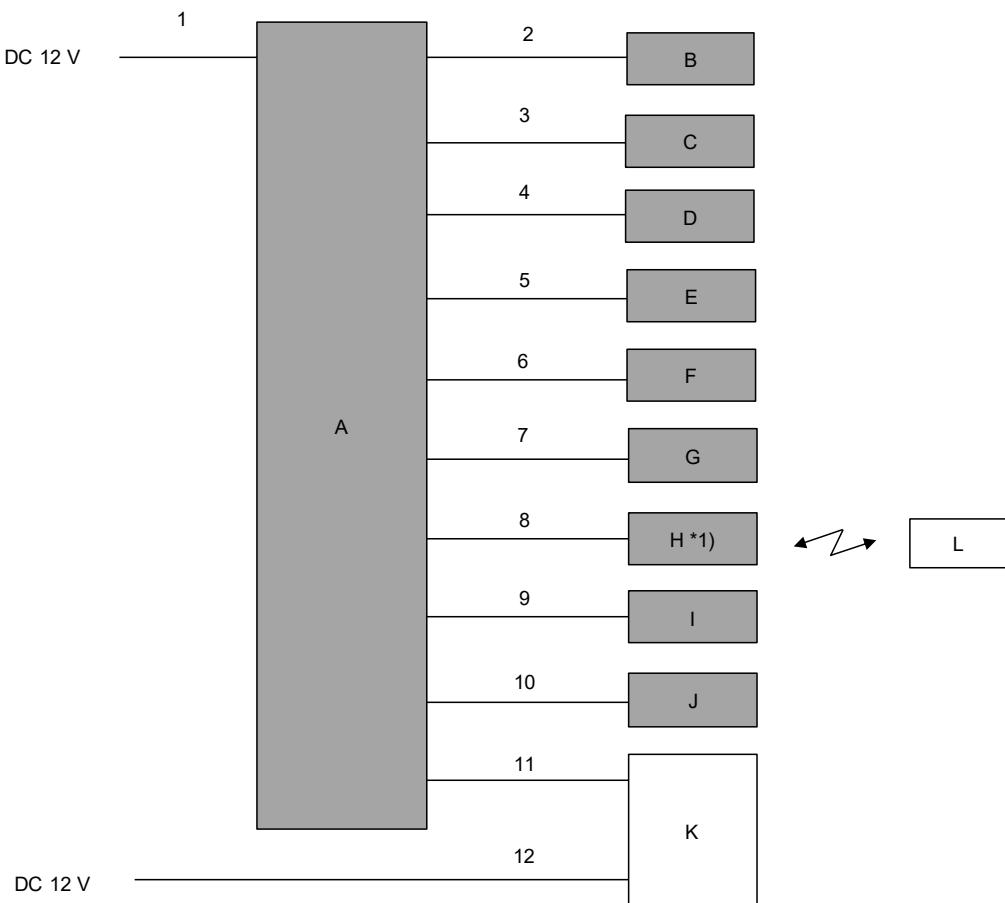
*1) Refer to Timing of transmission in "Operational Descrip-Transmission spec." for details.

*2) This EUT has two modes which transponder key is attached or not. The worst case was confirmed with and without transponder key attached, as a result, the test without transponder key attached was the worst case. Therefore the test without transponder key attached was performed only.

*3) Outside Antenna has the following two types; Var.C2 and Var.C4.

After the worst case was confirmed with Var.C2 and Var.C4 at pre check, the test was performed with Var.C2 as representative as its result was the worst one.

4.2 Configuration and Peripherals



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

*1) *Item H has two modes: LF transmission mode and Immobilizer communication mode.

Description of EUT and Support Equipment

No.	Item	Model number	Serial Number	Manufacturer	Remark
A	Smart ECU	TMLF19D-A	TE174 for Mode 1 to 5 TE175 for Mode 6	-	EUT
B	Outside Antenna Var.C2	D19C2	TD926	-	EUT
C	Outside Antenna Var.C2	D19C2	TD924	-	EUT
D	Outside Antenna Var.C2	D19C2	TD927	-	EUT
E	Outside Antenna Var.C2	D19C2	TD925	-	EUT
F	Rear Antenna	12TA0	TT250	-	EUT
G	Rear Antenna	12TA0	TT255	-	EUT
H	Inside Antenna Var.3	R19A1	TR407	-	EUT
I	Inside Antenna Var.1	18WA0	TR392	-	EUT
J	Inside Antenna Var.1	18WA0	TR390	-	EUT
K	Switch Box	-	No.7	-	*1)
L	Smart key	19CY_V3	TK171	-	*2)

List of Cables Used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	2.2	Unshielded	Unshielded	-
2	Signal Cable	3.0	Unshielded	Unshielded	-
3	Signal Cable	3.0	Unshielded	Unshielded	-
4	Signal Cable	3.0	Unshielded	Unshielded	-
5	Signal Cable	3.0	Unshielded	Unshielded	-
6	Signal Cable	3.0	Unshielded	Unshielded	-
7	Signal Cable	3.0	Unshielded	Unshielded	-
8	Signal Cable	3.0	Unshielded	Unshielded	-
9	Signal Cable	3.0	Unshielded	Unshielded	-
10	Signal Cable	3.0	Unshielded	Unshielded	-
11	Signal Cable	3.0	Unshielded	Unshielded	-
12	DC Cable	3.0	Unshielded	Unshielded	*1)

*1) Used for Mode 1 to 5 only

*2) Used for Mode 3 only

SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

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.

[Limit conversion]

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377 Ohmes. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0$ dBuA/m, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

[Frequency: From 9 kHz to 30 MHz]

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., and 135 deg., 180 deg.) and horizontal polarization.

*Refer to Figure 22 about Direction of the Loop Antenna.

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.

These tests were performed in semi anechoic chamber. Therefore, the measured level of emissions may be higher than if measurements were made without a ground plane. However, test results were confirmed to pass against standard limit.

[Frequency: From 30 MHz to 1 GHz]

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

The measurements were performed for both vertical and horizontal antenna polarization.

[Test instruments and test settings]

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

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.

Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)	3 m *2)	3 m

*1) Distance Factor: $40 \times \log (3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

*2) Distance Factor: $40 \times \log (3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

Figure 1: Test Setup

Below 1 GHz

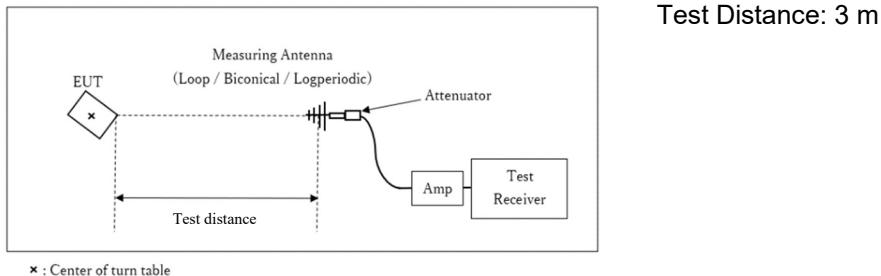
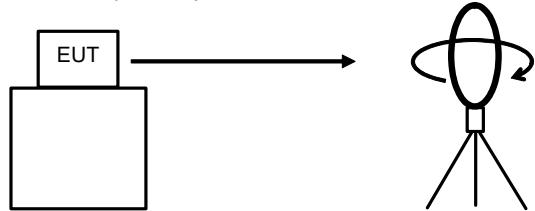
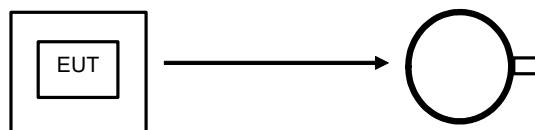


Figure 2: Direction of the Loop Antenna

Side View (Vertical)

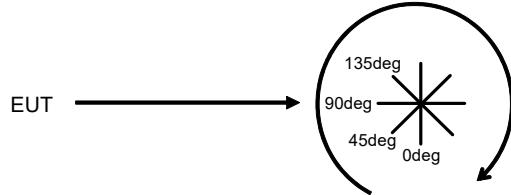


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

Measurement range : 9 kHz to 1 GHz
Test data : APPENDIX
Test result : Pass

SECTION 6: -20 dB Bandwidth

Test Procedure

The test was measured with a spectrum analyzer using a test fixture.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-20 dB Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX
Test result : Pass

SECTION 7: 99 % emission bandwidth

Test Procedure

The test was measured with a spectrum analyzer using a test fixture.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
99 % emission bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer

Peak hold was applied as Worst-case measurement.

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.	No.4	No.4
Semi Anechoic Chamber			
Date	October 7, 2024	October 9, 2024	November 22, 2024
Temperature / Humidity	22 deg. C / 52 % RH	21 deg. C / 71 % RH	20 deg. C / 46 % RH
Engineer	Tetsuro Yoshida (Below 30 MHz)	Tomoya Sone (Above 30 MHz)	Shousei Hamaguchi (Below 30 MHz), (Above 30 MHz)

Mode Mode 1

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	102.2	19.5	-73.8	32.2	-	15.7	45.6	29.9	Fundamental(DC 10.2 V)
0deg	0.12500	PK	102.2	19.5	-73.8	32.2	-	15.7	45.6	29.9	Fundamental(DC 12.0 V)
0deg	0.12500	PK	102.2	19.5	-73.8	32.2	-	15.7	45.6	29.9	Fundamental(DC 13.8 V)
0deg	0.25000	PK	42.7	19.6	-64.0	32.2	-	-33.9	39.6	73.5	
0deg	0.37500	PK	60.2	19.7	-64.1	32.2	-	-16.4	36.1	52.5	
0deg	0.50000	QP	28.9	19.7	-24.1	32.2	-	-7.7	33.6	41.3	
0deg	0.62500	QP	49.5	19.7	-24.1	32.2	-	12.9	31.7	18.8	
0deg	0.75000	QP	23.8	19.7	-24.1	32.2	-	-12.8	30.1	42.9	
0deg	0.87500	QP	43.6	19.7	-24.0	32.2	-	7.1	28.7	21.6	
0deg	1.00000	QP	22.1	19.7	-24.0	32.2	-	-14.4	27.6	42.0	
0deg	1.12500	QP	38.9	19.7	-24.0	32.2	-	2.4	26.5	24.1	
0deg	1.25000	QP	21.7	19.7	-24.0	32.2	-	-14.8	25.6	40.4	
Hori.	51.421	QP	20.5	10.7	7.3	32.1	-	6.4	40.0	33.6	Floor Noise
Hori.	59.009	QP	33.9	8.1	7.4	32.1	-	17.3	40.0	22.7	
Hori.	105.307	QP	20.4	11.1	7.9	32.1	-	7.3	43.5	36.2	Floor Noise
Hori.	176.730	QP	20.7	16.1	8.5	32.0	-	13.3	43.5	30.2	Floor Noise
Hori.	244.808	QP	20.3	11.9	9.1	32.0	-	9.3	46.0	36.7	Floor Noise
Hori.	461.615	QP	20.1	16.9	10.5	32.2	-	15.3	46.0	30.7	Floor Noise
Vert.	51.421	QP	20.6	10.7	7.3	32.1	-	6.5	40.0	33.5	Floor Noise
Vert.	59.009	QP	31.4	8.1	7.4	32.1	-	14.8	40.0	25.2	
Vert.	105.307	QP	20.4	11.1	7.9	32.1	-	7.3	43.5	36.2	Floor Noise
Vert.	176.730	QP	20.7	16.1	8.5	32.0	-	13.3	43.5	30.2	Floor Noise
Vert.	244.808	QP	20.3	11.9	9.1	32.0	-	9.3	46.0	36.7	Floor Noise
Vert.	461.615	QP	20.2	16.9	10.5	32.2	-	15.4	46.0	30.6	Floor Noise

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier)

* Since the peak emission result satisfied the average limit, duty factor was omitted.

PK with Duty factor

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	102.2	19.5	-73.8	32.2	0.0	15.7	25.6	9.9	Fundamental(DC 10.2 V)
0deg	0.12500	PK	102.2	19.5	-73.8	32.2	0.0	15.7	25.6	9.9	Fundamental(DC 12.0 V)
0deg	0.12500	PK	102.2	19.5	-73.8	32.2	0.0	15.7	25.6	9.9	Fundamental(DC 13.8 V)
0deg	0.25000	PK	42.7	19.6	-64.0	32.2	0.0	-33.9	19.6	53.5	
0deg	0.37500	PK	60.2	19.7	-64.1	32.2	0.0	-16.4	16.1	32.5	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor *

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3 m without Distance factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	102.2	19.5	6.2	32.2	-	95.7	-	-	-Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amplifier)

If Gain 0.0 dB shown in the above table, pre-amplifier was not used to avoid the influence of carrier power. The pre-amplifier used for carrier frequency measurement was not saturated.

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

The test result is rounded off, so some differences might be observed.

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	October 7, 2024	October 9, 2024	November 22, 2024
Temperature / Humidity	22 deg. C / 52 % RH	21 deg. C / 71 % RH	20 deg. C / 46 % RH
Engineer	Tetsuro Yoshida (Below 30 MHz)	Tomoya Sone (Above 30 MHz)	Shousei Hamaguchi (Below 30 MHz), (Above 30 MHz)

Mode Mode 2

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	103.4	19.5	-73.8	32.2	-	16.9	45.6	28.7	Fundamental(DC 10.2 V)
0deg	0.12500	PK	103.4	19.5	-73.8	32.2	-	16.9	45.6	28.7	Fundamental(DC 12.0 V)
0deg	0.12500	PK	103.4	19.5	-73.8	32.2	-	16.9	45.6	28.7	Fundamental(DC 13.8 V)
0deg	0.25000	PK	37.8	19.6	-64.0	32.2	-	-38.8	39.6	78.4	
0deg	0.37500	PK	32.9	19.7	-64.1	32.2	-	-43.7	36.1	79.8	
0deg	0.50000	QP	22.8	19.7	-24.1	32.2	-	-13.8	33.6	47.4	
0deg	0.62500	QP	22.7	19.7	-24.1	32.2	-	-13.9	31.7	45.6	
0deg	0.75000	QP	21.8	19.7	-24.1	32.2	-	-14.8	30.1	44.9	
0deg	0.87500	QP	21.7	19.7	-24.0	32.2	-	-14.8	28.7	43.5	
0deg	1.00000	QP	21.4	19.7	-24.0	32.2	-	-15.1	27.6	42.7	
0deg	1.12500	QP	21.5	19.7	-24.0	32.2	-	-15.0	26.5	41.5	
0deg	1.25000	QP	21.4	19.7	-24.0	32.2	-	-15.1	25.6	40.7	
Hori.	50.911	QP	20.5	10.8	7.3	32.1	-	6.5	40.0	33.5	Floor Noise
Hori.	61.682	QP	21.4	7.5	7.5	32.1	-	4.3	40.0	35.7	
Hori.	103.779	QP	20.4	10.9	7.9	32.1	-	7.1	43.5	36.4	Floor Noise
Hori.	176.370	QP	20.9	16.0	8.5	32.0	-	13.4	43.5	30.1	Floor Noise
Hori.	254.400	QP	20.3	12.1	9.2	32.0	-	9.6	46.0	36.4	Floor Noise
Hori.	482.402	QP	20.1	17.6	10.6	32.2	-	16.1	46.0	29.9	Floor Noise
Vert.	50.911	QP	20.4	10.8	7.3	32.1	-	6.4	40.0	33.6	Floor Noise
Vert.	61.682	QP	23.5	7.5	7.5	32.1	-	6.4	40.0	33.6	
Vert.	103.779	QP	20.4	10.9	7.9	32.1	-	7.1	43.5	36.4	Floor Noise
Vert.	176.370	QP	20.5	16.0	8.5	32.0	-	13.0	43.5	30.5	Floor Noise
Vert.	254.400	QP	20.3	12.1	9.2	32.0	-	9.6	46.0	36.4	Floor Noise
Vert.	482.402	QP	20.2	17.6	10.6	32.2	-	16.2	46.0	29.8	Floor Noise

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier)

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3 m without Distance factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	103.4	19.5	-73.8	32.2	0.0	16.9	25.6	8.7	Fundamental(DC 10.2 V)

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor *

* Since the peak emission result satisfied the average limit, duty factor was omitted.

If Gain 0.0 dB shown in the above table, pre-amplifier was not used to avoid the influence of carrier power. The pre-amplifier used for carrier frequency measurement was not saturated.

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

The test result is rounded off, so some differences might be observed.

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	October 7, 2024	October 9, 2024	November 22, 2024
Temperature / Humidity	22 deg. C / 52 % RH	21 deg. C / 71 % RH	20 deg. C / 46 % RH
Engineer	Tetsuro Yoshida (Below 30 MHz)	Tomoya Sone (Above 30 MHz)	Shousei Hamaguchi (Below 30 MHz), (Above 30 MHz)

Mode Mode 3

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	105.2	19.5	-73.8	32.2	-	18.7	45.6	26.9	Fundamental(DC 10.2 V)
0deg	0.12500	PK	105.2	19.5	-73.8	32.2	-	18.7	45.6	26.9	Fundamental(DC 12.0 V)
0deg	0.12500	PK	105.2	19.5	-73.8	32.2	-	18.7	45.6	26.9	Fundamental(DC 13.8 V)
0deg	0.25000	PK	36.0	19.6	-64.0	32.2	-	-40.6	39.6	80.2	
0deg	0.37500	PK	32.8	19.7	-64.1	32.2	-	-43.8	36.1	79.9	
0deg	0.50000	QP	22.8	19.7	-24.1	32.2	-	-13.8	33.6	47.4	
0deg	0.62500	QP	22.6	19.7	-24.1	32.2	-	-14.0	31.7	45.7	
0deg	0.75000	QP	21.9	19.7	-24.1	32.2	-	-14.7	30.1	44.8	
0deg	0.87500	QP	21.8	19.7	-24.0	32.2	-	-14.7	28.7	43.4	
0deg	1.00000	QP	21.5	19.7	-24.0	32.2	-	-15.0	27.6	42.6	
0deg	1.12500	QP	21.5	19.7	-24.0	32.2	-	-15.0	26.5	41.5	
0deg	1.25000	QP	21.4	19.7	-24.0	32.2	-	-15.1	25.6	40.7	
Hori.	51.591	QP	20.3	10.6	7.3	32.1	-	6.1	40.0	33.9	Floor Noise
Hori.	74.880	QP	24.7	6.5	7.6	32.1	-	6.7	40.0	33.3	
Hori.	104.121	QP	20.2	10.9	7.9	32.1	-	6.9	43.5	36.6	Floor Noise
Hori.	180.454	QP	20.6	16.2	8.6	32.0	-	13.4	43.5	30.1	Floor Noise
Hori.	254.424	QP	20.2	12.1	9.2	32.0	-	9.5	46.0	36.5	Floor Noise
Hori.	465.591	QP	20.3	17.0	10.5	32.2	-	15.6	46.0	30.4	Floor Noise
Vert.	51.591	QP	20.3	10.6	7.3	32.1	-	6.1	40.0	33.9	Floor Noise
Vert.	74.880	QP	23.5	6.5	7.6	32.1	-	5.5	40.0	34.5	
Vert.	104.121	QP	20.5	10.9	7.9	32.1	-	7.2	43.5	36.3	Floor Noise
Vert.	180.454	QP	20.4	16.2	8.6	32.0	-	13.2	43.5	30.3	Floor Noise
Vert.	254.424	QP	20.1	12.1	9.2	32.0	-	9.4	46.0	36.6	Floor Noise
Vert.	465.591	QP	20.1	17.0	10.5	32.2	-	15.4	46.0	30.6	Floor Noise

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier)

PK with Duty factor

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	105.2	19.5	-73.8	32.2	0.0	18.7	25.6	6.9	Fundamental(DC 10.2 V)
0deg	0.12500	PK	105.2	19.5	-73.8	32.2	0.0	18.7	25.6	6.9	Fundamental(DC 12.0 V)
0deg	0.12500	PK	105.2	19.5	-73.8	32.2	0.0	18.7	25.6	6.9	Fundamental(DC 13.8 V)
0deg	0.25000	PK	36.0	19.6	-64.0	32.2	0.0	-40.6	19.6	60.2	
0deg	0.37500	PK	32.8	19.7	-64.1	32.2	0.0	-43.8	16.1	59.9	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor *

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3 m without Distance factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	105.2	19.5	6.2	32.2	-	98.7	-	-	-Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amplifier)

If Gain 0.0 dB shown in the above table, pre-amplifier was not used to avoid the influence of carrier power. The pre-amplifier used for carrier frequency measurement was not saturated.

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

The test result is rounded off, so some differences might be observed.

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	October 7, 2024	October 9, 2024	November 22, 2024
Temperature / Humidity	22 deg. C / 52 % RH	21 deg. C / 71 % RH	20 deg. C / 46 % RH
Engineer	Tetsuro Yoshida (Below 30 MHz)	Tomoya Sone (Above 30 MHz)	Shousei Hamaguchi (Below 30 MHz), (Above 30 MHz)

Mode Mode 4

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	100.5	19.5	-73.8	32.2	-	14.0	45.6	31.6	Fundamental(DC 10.2 V)
0deg	0.12500	PK	100.5	19.5	-73.8	32.2	-	14.0	45.6	31.6	Fundamental(DC 12.0 V)
0deg	0.12500	PK	100.5	19.5	-73.8	32.2	-	14.0	45.6	31.6	Fundamental(DC 13.8 V)
0deg	0.25000	PK	36.8	19.6	-64.0	32.2	-	-39.8	39.6	79.4	
0deg	0.37500	PK	34.7	19.7	-64.1	32.2	-	-41.9	36.1	78.0	
0deg	0.50000	QP	22.8	19.7	-24.1	32.2	-	-13.8	33.6	47.4	
0deg	0.62500	QP	22.3	19.7	-24.1	32.2	-	-14.3	31.7	46.0	
0deg	0.75000	QP	22.9	19.7	-24.1	32.2	-	-13.7	30.1	43.8	
0deg	0.87500	QP	23.0	19.7	-24.0	32.2	-	-13.5	28.7	42.2	
0deg	1.00000	QP	21.7	19.7	-24.0	32.2	-	-14.8	27.6	42.4	
0deg	1.12500	QP	21.6	19.7	-24.0	32.2	-	-14.9	26.5	41.4	
0deg	1.25000	QP	21.5	19.7	-24.0	32.2	-	-15.0	25.6	40.6	
Hori.	52.781	QP	20.4	10.2	7.3	32.1	-	5.8	40.0	34.2	Floor Noise
Hori.	63.262	QP	23.9	7.1	7.5	32.1	-	6.4	40.0	33.6	
Hori.	106.842	QP	20.1	11.3	7.9	32.1	-	7.2	43.5	36.3	Floor Noise
Hori.	181.641	QP	20.5	16.2	8.6	32.0	-	13.3	43.5	30.2	Floor Noise
Hori.	254.401	QP	20.3	12.1	9.2	32.0	-	9.6	46.0	36.4	Floor Noise
Hori.	463.999	QP	20.4	16.9	10.5	32.2	-	15.6	46.0	30.4	Floor Noise
Vert.	52.781	QP	20.4	10.2	7.3	32.1	-	5.8	40.0	34.2	Floor Noise
Vert.	63.262	QP	25.1	7.1	7.5	32.1	-	7.6	40.0	32.4	
Vert.	106.842	QP	20.4	11.3	7.9	32.1	-	7.5	43.5	36.0	Floor Noise
Vert.	181.641	QP	20.3	16.2	8.6	32.0	-	13.1	43.5	30.4	Floor Noise
Vert.	254.401	QP	20.2	12.1	9.2	32.0	-	9.5	46.0	36.5	Floor Noise
Vert.	463.999	QP	20.1	16.9	10.5	32.2	-	15.3	46.0	30.7	Floor Noise

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier)

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	100.5	19.5	-73.8	32.2	0.0	14.0	25.6	11.6	Fundamental(DC 10.2 V)
0deg	0.12500	PK	100.5	19.5	-73.8	32.2	0.0	14.0	25.6	11.6	Fundamental(DC 12.0 V)
0deg	0.12500	PK	100.5	19.5	-73.8	32.2	0.0	14.0	25.6	11.6	Fundamental(DC 13.8 V)
0deg	0.25000	PK	36.8	19.6	-64.0	32.2	0.0	-39.8	19.6	59.4	
0deg	0.37500	PK	34.7	19.7	-64.1	32.2	0.0	-41.9	16.1	58.0	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor *

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3 m without Distance factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	100.5	19.5	6.2	32.2	-	94.0	-	-	-Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amplifier)

If Gain 0.0 dB shown in the above table, pre-amplifier was not used to avoid the influence of carrier power. The pre-amplifier used for carrier frequency measurement was not saturated.

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

The test result is rounded off, so some differences might be observed.

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	October 7, 2024	October 9, 2024	November 22, 2024
Temperature / Humidity	22 deg. C / 52 % RH	21 deg. C / 71 % RH	20 deg. C / 46 % RH
Engineer	Tetsuro Yoshida (Below 30 MHz)	Tomoya Sone (Above 30 MHz)	Shousei Hamaguchi (Below 30 MHz), (Above 30 MHz)

Mode Mode 5

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	99.6	19.5	-73.8	32.2	-	13.1	45.6	32.5	Fundamental(DC 10.2 V)
0deg	0.12500	PK	99.6	19.5	-73.8	32.2	-	13.1	45.6	32.5	Fundamental(DC 12.0 V)
0deg	0.12500	PK	99.6	19.5	-73.8	32.2	-	13.1	45.6	32.5	Fundamental(DC 13.8 V)
0deg	0.25000	PK	45.8	19.6	-64.0	32.2	-	-30.8	39.6	70.4	
0deg	0.37500	PK	62.1	19.7	-64.1	32.2	-	-14.5	36.1	50.6	
0deg	0.50000	QP	39.5	19.7	-24.1	32.2	-	2.9	33.6	30.7	
0deg	0.62500	QP	50.8	19.7	-24.1	32.2	-	14.2	31.7	17.5	
0deg	0.75000	QP	24.9	19.7	-24.1	32.2	-	-11.7	30.1	41.8	
0deg	0.87500	QP	43.8	19.7	-24.0	32.2	-	7.3	28.7	21.4	
0deg	1.00000	QP	21.7	19.7	-24.0	32.2	-	-14.8	27.6	42.4	
0deg	1.12500	QP	38.2	19.7	-24.0	32.2	-	1.7	26.5	24.8	
0deg	1.25000	QP	21.5	19.7	-24.0	32.2	-	-15.0	25.6	40.6	
Hori.	45.245	QP	21.4	12.9	7.2	32.1	-	9.4	40.0	30.6	
Hori.	58.248	QP	32.0	8.4	7.4	32.1	-	15.7	40.0	24.3	
Hori.	67.750	QP	35.9	6.5	7.5	32.1	-	17.8	40.0	22.2	
Hori.	76.752	QP	23.2	6.6	7.6	32.1	-	5.3	40.0	34.7	
Hori.	255.200	QP	20.2	12.2	9.2	32.0	-	9.6	46.0	36.4	Floor Noise
Hori.	465.601	QP	20.3	17.0	10.5	32.2	-	15.6	46.0	30.4	Floor Noise
Vert.	45.245	QP	28.0	12.9	7.2	32.1	-	16.0	40.0	24.0	
Vert.	58.248	QP	27.3	8.4	7.4	32.1	-	11.0	40.0	29.0	
Vert.	67.750	QP	32.9	6.5	7.5	32.1	-	14.8	40.0	25.2	
Vert.	76.752	QP	31.9	6.6	7.6	32.1	-	14.0	40.0	26.0	
Vert.	255.200	QP	20.3	12.2	9.2	32.0	-	9.7	46.0	36.3	Floor Noise
Vert.	465.601	QP	20.2	17.0	10.5	32.2	-	15.5	46.0	30.5	Floor Noise

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier)

PK with Duty factor

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	99.6	19.5	-73.8	32.2	0.0	13.1	25.6	12.5	Fundamental(DC 10.2 V)
0deg	0.12500	PK	99.6	19.5	-73.8	32.2	0.0	13.1	25.6	12.5	Fundamental(DC 12.0 V)
0deg	0.12500	PK	99.6	19.5	-73.8	32.2	0.0	13.1	25.6	12.5	Fundamental(DC 13.8 V)
0deg	0.25000	PK	45.8	19.6	-64.0	32.2	0.0	-30.8	19.6	50.4	
0deg	0.37500	PK	62.1	19.7	-64.1	32.2	0.0	-14.5	16.1	30.6	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor *

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3 m without Distance factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	99.6	19.5	6.2	32.2	-	93.1	-	-	-Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amplifier)

If Gain 0.0 dB shown in the above table, pre-amplifier was not used to avoid the influence of carrier power. The pre-amplifier used for carrier frequency measurement was not saturated.

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

The test result is rounded off, so some differences might be observed.

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.		
Semi Anechoic Chamber	No.4	No.4	No.4
Date	October 7, 2024	October 9, 2024	November 22, 2024
Temperature / Humidity	22 deg. C / 52 % RH	21 deg. C / 71 % RH	20 deg. C / 46 % RH
Engineer	Tetsuro Yoshida (Below 30 MHz)	Tomoya Sone (Above 30 MHz)	Shousei Hamaguchi (Below 30 MHz), (Above 30 MHz)

Mode Mode 6

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	105.1	19.5	-73.8	32.2	-	18.6	45.6	27.0	Fundamental(DC 10.2 V)
0deg	0.12500	PK	105.1	19.5	-73.8	32.2	-	18.6	45.6	27.0	Fundamental(DC 12.0 V)
0deg	0.12500	PK	105.1	19.5	-73.8	32.2	-	18.6	45.6	27.0	Fundamental(DC 13.8 V)
0deg	0.25000	PK	52.2	19.6	-64.0	32.2	-	-24.4	39.6	64.0	
0deg	0.37500	PK	73.4	19.7	-64.1	32.2	-	-3.2	36.1	39.3	
0deg	0.50000	QP	43.8	19.7	-24.1	32.2	-	7.2	33.6	26.4	
0deg	0.62500	QP	58.5	19.7	-24.1	32.2	-	21.9	31.7	9.8	
0deg	0.75000	QP	25.5	19.7	-24.1	32.2	-	-11.1	30.1	41.2	
0deg	0.87500	QP	52.7	19.7	-24.0	32.2	-	16.2	28.7	12.5	
0deg	1.00000	QP	23.6	19.7	-24.0	32.2	-	-12.9	27.6	40.5	
0deg	1.12500	QP	47.5	19.7	-24.0	32.2	-	11.0	26.5	15.5	
0deg	1.25000	QP	21.7	19.7	-24.0	32.2	-	-14.8	25.6	40.4	
Hori.	62.004	QP	30.9	7.4	7.5	32.1	-	13.7	40.0	26.3	
Hori.	71.501	QP	33.9	6.4	7.6	32.1	-	15.8	40.0	24.2	
Hori.	85.377	QP	28.9	7.7	7.7	32.1	-	12.2	40.0	27.8	
Hori.	100.666	QP	21.3	10.4	7.9	32.1	-	7.5	43.5	36.0	
Hori.	258.402	QP	20.3	12.3	9.3	32.0	-	9.9	46.0	36.1	Floor Noise
Hori.	471.201	QP	20.4	17.1	10.5	32.2	-	15.8	46.0	30.2	Floor Noise
Vert.	62.004	QP	37.4	7.4	7.5	32.1	-	20.2	40.0	19.8	
Vert.	71.501	QP	32.5	6.4	7.6	32.1	-	14.4	40.0	25.6	
Vert.	85.377	QP	29.5	7.7	7.7	32.1	-	12.8	40.0	27.2	
Vert.	100.666	QP	28.0	10.4	7.9	32.1	-	14.2	43.5	29.3	
Vert.	258.402	QP	20.2	12.3	9.3	32.0	-	9.8	46.0	36.2	Floor Noise
Vert.	471.201	QP	20.3	17.1	10.5	32.2	-	15.7	46.0	30.3	Floor Noise

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier)

PK with Duty factor

Ant Deg [deg] or Polarity [Hori/Vert]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	105.1	19.5	-73.8	32.2	-21.4	-2.8	25.6	28.4	Fundamental(DC 10.2 V)
0deg	0.12500	PK	105.1	19.5	-73.8	32.2	-21.4	-2.8	25.6	28.4	Fundamental(DC 12.0 V)
0deg	0.12500	PK	105.1	19.5	-73.8	32.2	-21.4	-2.8	25.6	28.4	Fundamental(DC 13.8 V)
0deg	0.25000	PK	52.2	19.6	-64.0	32.2	-21.4	-45.8	19.6	65.4	
0deg	0.37500	PK	73.4	19.7	-64.1	32.2	-21.4	-24.6	16.1	40.7	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor *

Result of the fundamental emission at 3 m without Distance factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0deg	0.12500	PK	105.1	19.5	6.2	32.2	-	98.6	-	-	Fundamental

Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amplifier)

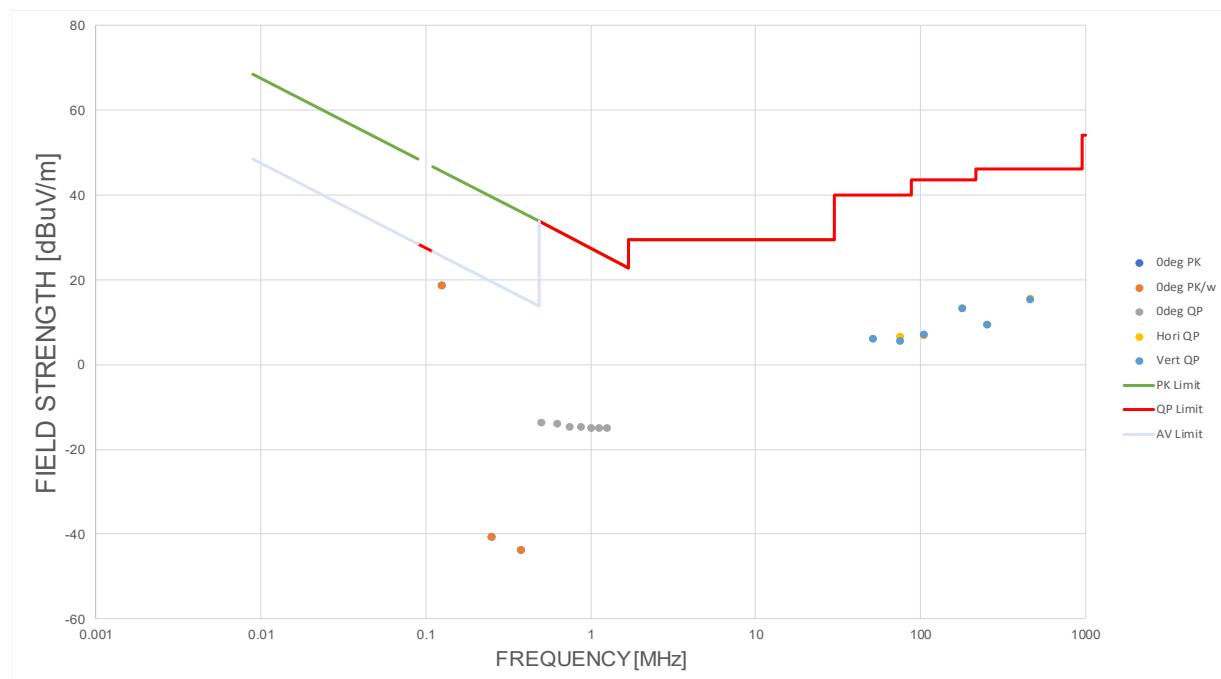
If Gain 0.0 dB shown in the above table, pre-amplifier was not used to avoid the influence of carrier power. The pre-amplifier used for carrier frequency measurement was not saturated.

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

The test result is rounded off, so some differences might be observed.

Radiated Spurious Emission
(Plot data, Worst case for Fundamental Emission)

Test place	Ise EMC Lab.	No.4	No.4
Semi Anechoic Chamber			
Date	October 7, 2024	October 9, 2024	November 22, 2024
Temperature / Humidity	22 deg. C / 52 % RH	21 deg. C / 71 % RH	20 deg. C / 46 % RH
Engineer	Tetsuro Yoshida (Below 30 MHz)	Tomoya Sone (Above 30 MHz)	Shousei Hamaguchi (Below 30 MHz), (Above 30 MHz)
Mode	Mode 3		



Duty Cycle

Test place Ise EMC Lab.
 Semi Anechoic Chamber No.4
 Date October 8, 2024
 Temperature / Humidity 22 deg. C / 70 % RH
 Engineer Tetsuro Yoshida
 Mode Mode 6

ON time [ms]	Cycle [ms]	Duty (On time/Cycle)	Duty factor [dB]
8.44	100	0.0844	-21.4

$$\text{Duty} = 20 * \log_{10}(\text{ON time/Cycle})$$

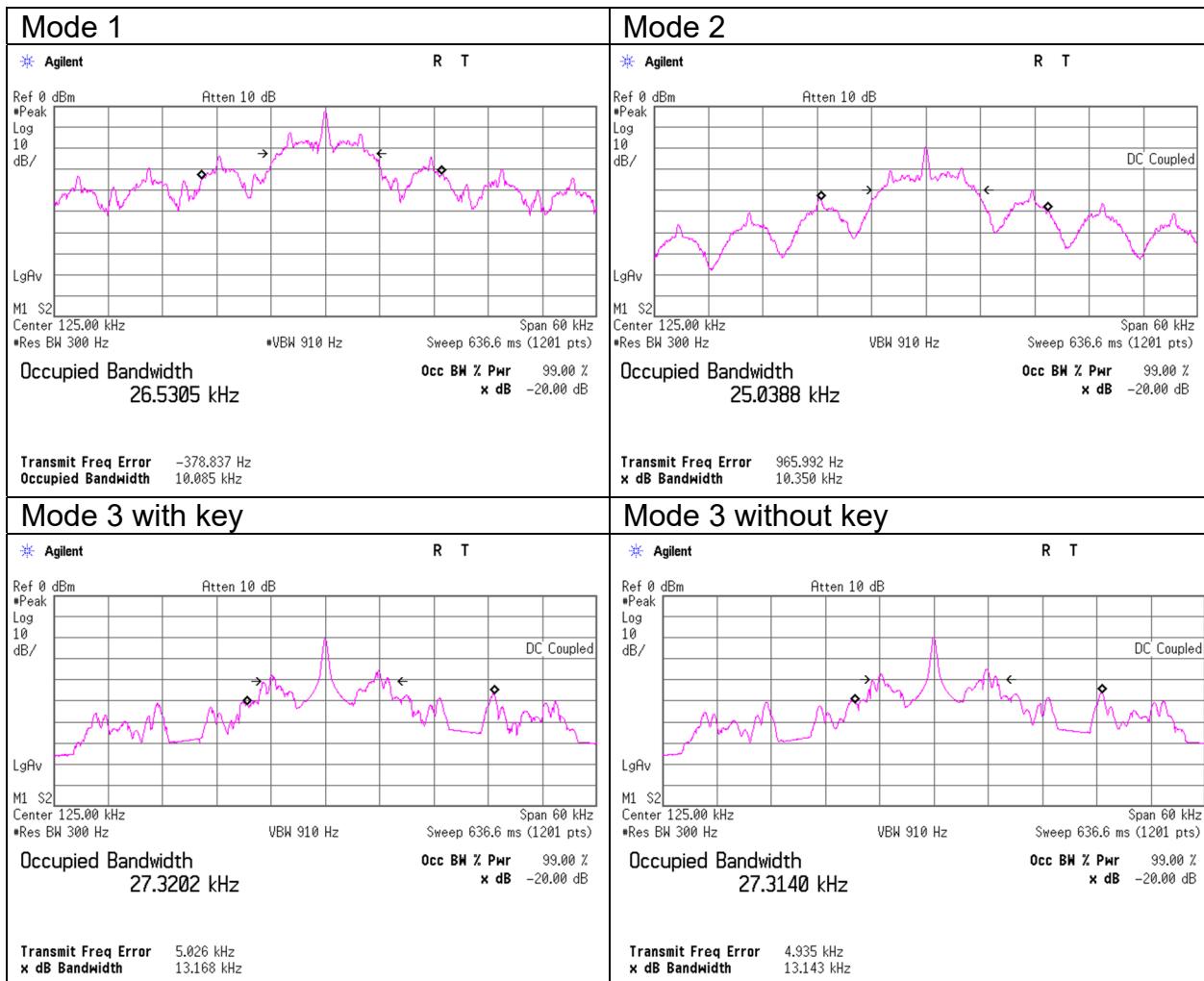


-20 dB Bandwidth / 99 % emission bandwidth

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber	No.4 Semi Anechoic Chamber	No.8 Measurement Room
Date	October 7, 2024	October 8, 2024	October 17, 2024
Temperature / Humidity Engineer	22 deg. C / 52 % RH Tetsuro Yoshida	22 deg. C / 70 % RH Tetsuro Yoshida	21 deg. C / 63 % RH Ken Fujita

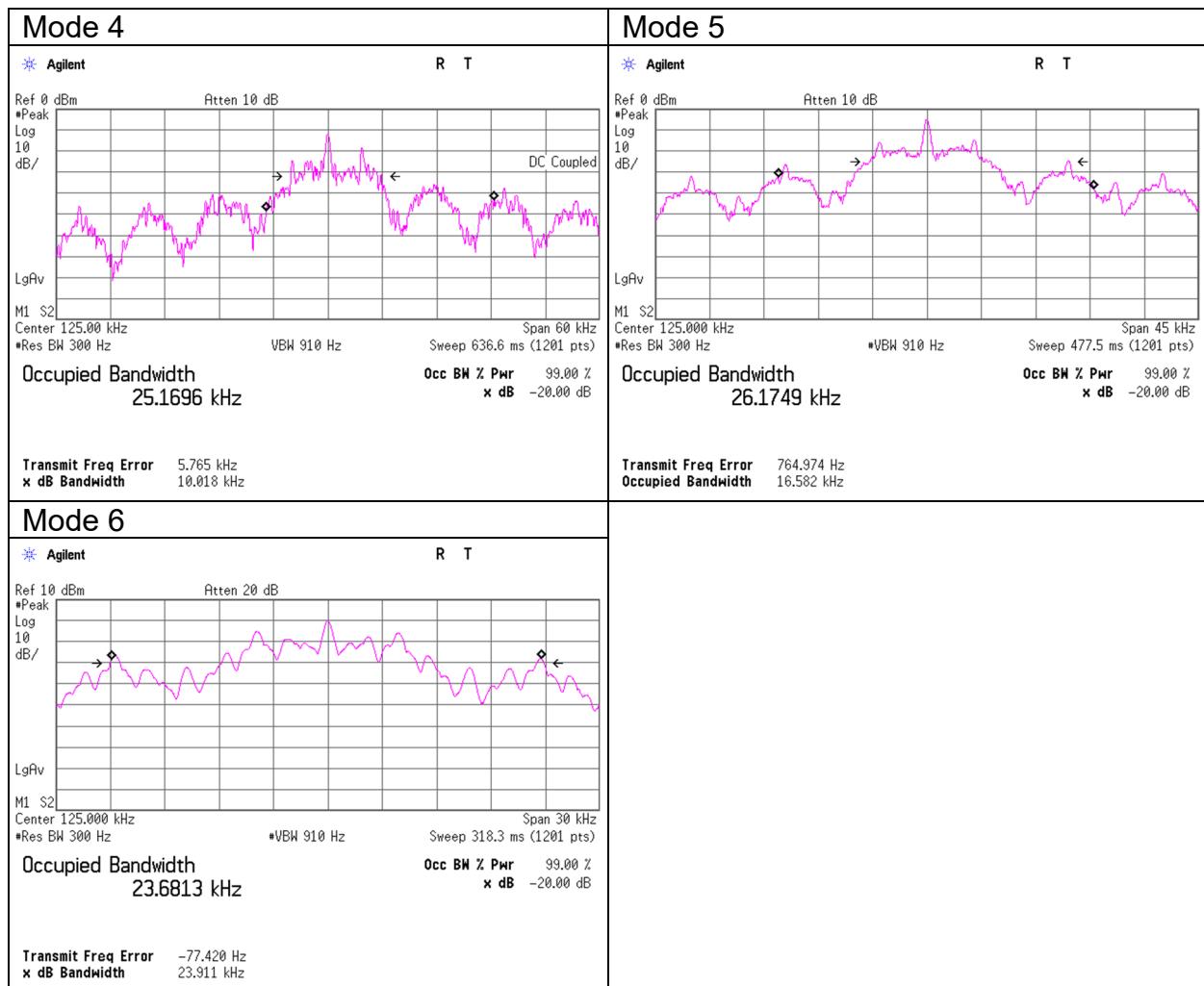
Mode	99 % emission bandwidth [kHz]	-20 dB Bandwidth [kHz]
1	26.5305	10.085
2	25.0388	10.350
3 with key	27.3202	13.168
3 without key	27.3140	13.143
4	25.1696	10.018
5	26.1749	16.582
6	23.6813	23.911

*It was confirmed that there were no differences in the bandwidth due to the input voltage.



-20 dB Bandwidth / 99 % emission bandwidth

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber	No.8 Measurement Room
Date	October 7, 2024	October 17, 2024
Temperature / Humidity	22 deg. C / 52 % RH	21 deg. C / 63 % RH
Engineer	Tetsuro Yoshida	Ken Fujita



APPENDIX 2: Test instruments

Test Equipment

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	141217	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM141/421-010/sucoform141-PE/RFM-E121(SW)	-/04178	06/14/2024	12
RE	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-192	09/18/2024	12
RE	141295	High Pass Filter 0.15-30MHz	Rohde & Schwarz	EZ-25/3	100041	02/14/2024	12
RE	141331	Attenuator (6dB)	TME	UFA-01	-	02/17/2024	12
RE	141397	Coaxial Cable	UL Japan	-	-	11/22/2023	12
RE	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	VHA 91031302	08/23/2024	12
RE	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	02/01/2024	12
RE	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	04/04/2024	12
RE	141885	Spectrum Analyzer	Keysight Technologies Inc	E4448A	US44300523	11/29/2023	12
RE	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	05/17/2024	12
RE	142011	AC4_Semi Anechoic Chamber (NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	12/13/2023	24
RE	142152	Loop Antenna	Rohde & Schwarz	HFH2-Z2	836553/009	10/17/2023 *1)	12
RE	142230	Measure, Tape, Steel	KOMELON	KMC-36	-	-	-
RE	159670	Coaxial Cable	UL Japan	-	-	11/21/2023	12
RE	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	244710	Thermo-Hygrometer	HIOKI E.E. CORPORATION	LR5001	231202104	01/25/2024	12
RE	146613	Loop Antenna	Rohde & Schwarz	HFH2-Z2	842906/011	09/02/2024	12

***Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.**

**The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.**

The expiration*1) This test equipment was used for the tests before the expiration date of the calibration.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

Test item:

RE: Radiated Emission