RADIO TEST REPORT

Test Report No.: 14541001H-A

Customer	**DAIHATSU MOTOR CO., LTD.**
Description of EUT	**Keyfree system**
Model Number of EUT	**DH19C-3**
FCC ID	**2AVSADH19C-3**
Test Regulation	**FCC Part 15 Subpart C**
Test Result	**Complied (Refer to SECTION 3)**
Issue Date	**November 17, 2022**
Remarks	**-**

Representative test engineer	Approved by
	
Kiyoshiro Okazaki Engineer	Tsubasa Takayama Leader

CERTIFICATE 5107.02

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

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

ANNOUNCEMENT

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

REVISION HISTORY

Original Test Report No.: 14541001H-A

Revision	Test Report No.	Date	Page Revised Contents
- (Original)	14541001H-A	November 17, 2022	-

Reference: Abbreviations (Including words undescribed in this report)

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

CONTENTS **PAGE**

SECTION 1: Customer Information **5**
SECTION 2: Equipment Under Test (EUT) **5**
SECTION 3: Test specification, procedures & results **7**
SECTION 4: Operation of EUT during testing **10**
SECTION 5: Radiated emission (Fundamental and Spurious Emission) **12**
SECTION 6: -20 dB Bandwidth **14**
SECTION 7: 99 % emission bandwidth **14**
APPENDIX 1: Test data **15**
Radiated Emission (Fundamental and Spurious Emission) 15
-20 dB Bandwidth / 99 % Occupied Bandwidth 24
APPENDIX 2: Test instruments **28**
APPENDIX 3: Photographs of test setup **29**
Radiated Emission 29
Worst Case Position 30

SECTION 1: Customer Information

Company Name	DAIHATSU MOTOR CO., LTD.*
Address	1-1, Momozono 2-Chome, Ikeda-shi, Osaka, 563-8651, Japan
Telephone Number	+81-72-754-5619
Contact Person	Kouji Ozawa

*Remarks:
DAIHATSU MOTOR CO., LTD. designates DENSO CORPORATION and TOKAI RIKA CO., LTD. as manufacturer of the product (Keyfree system).

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

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

SECTION 2: Equipment Under Test (EUT)

2.1 Identification of EUT

Description	Keyfree system
Model Number	DH19C-3
Serial Number	Refer to SECTION 4.2
Condition	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab
Receipt Date	October 24, 2022
Test Date	October 31 and November 1, 2022

2.2 Product Description

General Specification

Rating	System: DC 12.0 V Internal: DC 12.0 V (Transmitter) / DC 5.0 V (Receiver)

Radio Specification

[Transmitter part]

Radio Type	LF Transmitter
Frequency of Operation	125 kHz
Modulation	ASK (A1D)
Antenna type	LF Antenna (Outside D) LF Antenna (Outside P) LF Antenna (Outside B) LF Antenna (Inside Fr) LF Antenna (Inside Mi) LF Antenna (Inside Rr) Immobilizer Antenna
Antenna Specification	LF antenna: Ferrite antenna coil Immobilizer antenna: Loop antenna coil

[Receiver part]

Frequency of Operation	433.92 MHz (Keyfree) 433.90 MHz (TPMS)
Intermediate frequency	525 kHz (Keyfree) 1.05 MHz (TPMS)
Modulation	FSK (F1D)
Type of receiving system	Super-heterodyne
Antenna Specification	Internal antenna (Inverted F antenna)

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.

*Also the EUT complies with FCC Part 15 Subpart B.

3.2 Procedures and results

Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
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	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 7.2 RSS-Gen 8.9	Radiated	N/A	3.4 dB 125 kHz, 0 deg. Peak with Duty factor <Mode 6>	Complied a)
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 7.3 RSS-Gen 8.9	Radiated	N/A	6.9 dB 54.463 MHz, Vertical, QP <Mode 7>	Complied a)
-20 dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <ISED> -	<FCC> Reference data <ISED> -	Radiated	N/A	N/A	Complied b)

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.

a) Refer to APPENDIX 1 (data of Radiated emission)
b) Refer to APPENDIX 1 (data of -20 dB Bandwidth / 99 % emission bandwidth)

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	Remarks	Deviation	Worst margin	Results
99 % emission bandwidth	RSS-Gen 6.7	-	Radiated	N/A	N/A	-

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.

Test Item		**Frequency range**		**Uncertainty (+/-)**
Radiated emission	3 m	9 kHz to 30 MHz		3.2 dB
	10 m			3.0 dB
	3 m	30 MHz to 200 MHz	Horizontal	4.8 dB
			Vertical	5.0 dB
		200 MHz to 1000 MHz	Horizontal	5.1 dB
			Vertical	6.2 dB
	10 m	30 MHz to 200 MHz	Horizontal	4.8 dB
			Vertical	4.8 dB
		200 MHz to 1000 MHz	Horizontal	5.0 dB
			Vertical	5.0 dB
	3 m	1 GHz to 6 GHz		4.9 dB
		6 GHz to 18 GHz		5.2 dB
	1 m	10 GHz to 26.5 GHz		5.4 dB
		26.5 GHz to 40 GHz		5.4 dB
	10 m	1 GHz to 18 GHz		5.4 dB
-20 dB Bandwidth / 99 % emission bandwidth		-		0.96 %

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
*A2LA Certificate Number: 5107.02 / FCC Test Firm Registration Number: 884919
ISED Lab Company Number: 2973C / CAB identifier: JP0002
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 Japan
Telephone: +81-596-24-8999

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

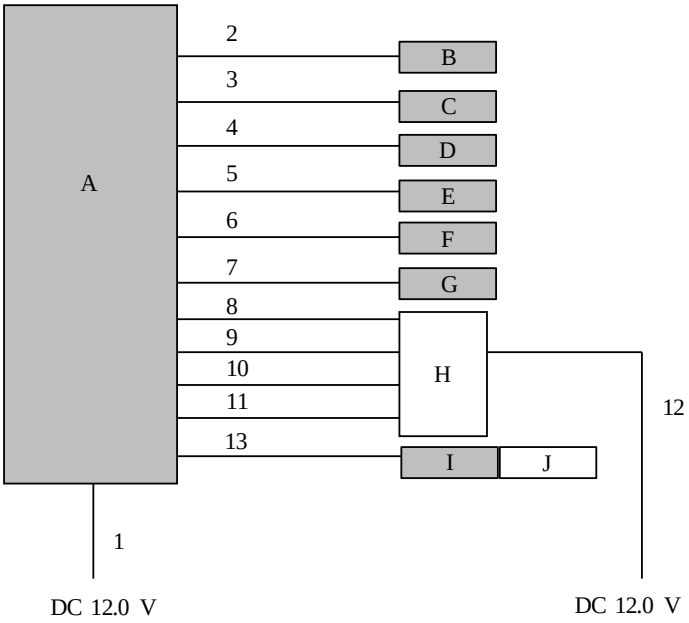
Refer to APPENDIX.

SECTION 4: Operation of EUT during testing

4.1. Operating Mode(s)

Test mode	Remarks
Mode 1: Tx 125 kHz LF Antenna (Outside D)	Section 2 of Timing of transmission
Mode 2: Tx 125 kHz LF Antenna (Outside P)	Section 2 of Timing of transmission
Mode 3: Tx 125 kHz LF Antenna (Outside D + P)	Section 1 of Timing of transmission
Mode 4: Tx 125 kHz LF Antenna (Outside B)	Section 2 of Timing of transmission
Mode 5: Tx 125 kHz LF Antenna (Inside Fr)	Section 2 of Timing of transmission
Mode 6: Tx 125 kHz LF Antenna (Inside Rr)	Section 2 of Timing of transmission
Mode 7: Tx 125 kHz LF Antenna (Inside Mi)	Section 2 of Timing of transmission
Mode 8: Tx 125 kHz Immobilizer Antenna	Section 3 of Timing of transmission
*Power of the EUT was set by the software as follows; Software: 200213_RadioTest_TypeA.s (Date: 2020.02 13, 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.	

4.2. Configuration and peripherals



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

** The input voltage (DC 12 V) passes through Item No. A without affecting it and is supplied to the antennas (Item No. I) without any drop in voltage.
For the antenna (Item No. B to G), a fixed voltage is suppled through the regulator.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Body ECU	DH19C-3	No.778	DENSO CORPORATION	EUT
B	LF Antenna (Outside D)	DH19C-3	No.778-1	TOKAI RIKA CO., LTD.	EUT
C	LF Antenna (Outside P)	DH19C-3	No.778-2	TOKAI RIKA CO., LTD.	EUT
D	LF Antenna (Outside B)	DH19C-3	No.778-3	TOKAI RIKA CO., LTD.	EUT
E	LF Antenna (Inside Fr)	DH19C-3	No.778-4	TOKAI RIKA CO., LTD.	EUT
F	LF Antenna (Inside Rr)	DH19C-3	No.778-5	TOKAI RIKA CO., LTD.	EUT
G	LF Antenna (Inside Mi)	DH19C-3	No.778-6	TOKAI RIKA CO., LTD.	EUT
H	Evaluation Bench	-	No.20	DENSO CORPORATION	-
I	Immobilizer Antenna	DH19C-3	No.778	TOKAI RIKA CO., LTD.	EUT
J	Smart Key	DH19C-3	No.778	DENSO CORPORATION	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	Antenna Cable (AND)	3.0	Unshielded	Unshielded	-
3	Antenna Cable (ANP)	3.0	Unshielded	Unshielded	-
4	Antenna Cable (ANB)	3.0	Unshielded	Unshielded	-
5	Antenna Cable (ANF)	3.0	Unshielded	Unshielded	-
6	Antenna Cable (ANR)	3.0	Unshielded	Unshielded	-
7	Antenna Cable (ANM)	3.0	Unshielded	Unshielded	-
8	Signal Cable (CN-C)	3.0	Unshielded	Unshielded	-
9	Signal Cable (CN-K)	3.0	Unshielded	Unshielded	-
10	Signal Cable (CN-M)	3.0	Unshielded	Unshielded	-
11	Signal Cable (CN-P)	3.0	Unshielded	Unshielded	-
12	DC Cable	3.0	Unshielded	Unshielded	-
13	Antenna Cable	3.0	Unshielded	Unshielded	-

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.) and horizontal polarization.
*Refer to Figure 2 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

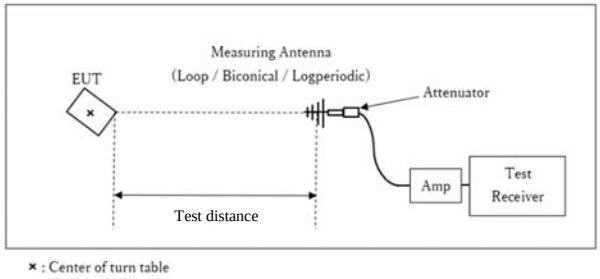
The test was made with the detector (RBW/VBW) in the following table.
When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

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 x log (3 m / 300 m) = -80 dB
*2) Distance Factor: 40 x log (3 m / 30 m) = -40 dB

Figure 1: Test Setup

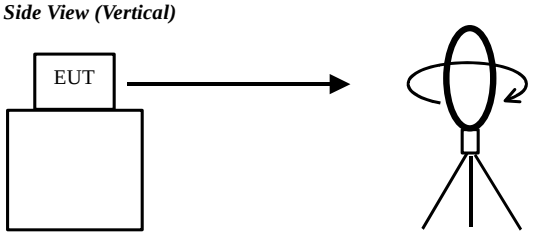
Below 1 GHz



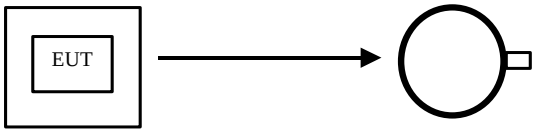
Test Distance: 3 m

Figure 2: Direction of the Loop Antenna

Side View (Vertical)

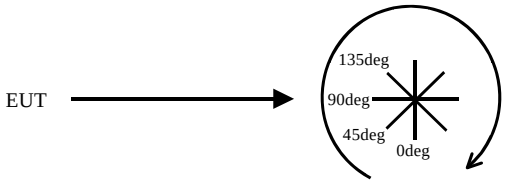


Top View (Horizontal)



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.

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.

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.	
Semi Anechoic Chamber	No.4	No.4
Date	October 31, 2022	November 1, 2022
Temperature / Humidity	22 deg. C / 45 % RH	22 deg. C / 46 % RH
Engineer	Kiyoshiro Okazaki	Kiyoshiro Okazaki
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	108.3	19.1	-73.9	32.2	-	21.3	45.6	24.3	Fundamental (DC 12.0 V)
0deg	0.12500	PK	108.2	19.1	-73.9	32.2	-	21.2	45.6	24.4	Fundamental (DC 10.2 V)
0deg	0.12500	PK	108.1	19.1	-73.9	32.2	-	21.1	45.6	24.5	Fundamental (DC 13.8 V)
0deg	0.25000	PK	56.8	19.1	-64.1	32.2	-	-20.4	39.6	60.0	
0deg	0.37500	PK	42.6	19.0	-64.1	32.2	-	-34.7	36.1	70.8	
0deg	0.50000	QP	29.2	19.0	-24.1	32.1	-	-8.0	33.6	41.6	
0deg	0.62500	QP	25.6	19.0	-24.1	32.1	-	-11.6	31.7	43.3	
0deg	0.75000	QP	24.0	19.1	-24.1	32.2	-	-13.2	30.1	43.3	
0deg	0.87500	QP	23.7	19.1	-24.1	32.2	-	-13.5	28.7	42.2	
0deg	1.00000	QP	23.2	19.0	-24.1	32.2	-	-14.1	27.6	41.7	
0deg	1.12500	QP	23.7	19.0	-24.1	32.2	-	-13.6	26.5	40.1	
0deg	1.25000	QP	22.9	19.1	-24.1	32.2	-	-14.3	25.6	39.9	
Hori.	64.567	QP	36.7	6.9	7.5	32.1	-	19.0	40.0	21.0	
Hori.	89.077	QP	37.9	8.4	7.7	32.1	-	21.9	43.5	21.6	
Hori.	100.135	QP	35.2	10.2	7.9	32.1	-	21.2	43.5	22.3	
Hori.	187.077	QP	32.5	16.3	8.6	32.0	-	25.4	43.5	18.1	
Hori.	216.806	QP	37.3	11.1	8.8	32.0	-	25.2	46.0	20.8	
Hori.	380.796	QP	28.2	15.4	9.9	32.1	-	21.4	46.0	24.6	
Vert.	54.567	QP	33.5	9.4	7.4	32.1	-	18.2	40.0	21.8	
Vert.	89.077	QP	43.6	8.4	7.7	32.1	-	27.6	43.5	15.9	
Vert.	118.655	QP	40.6	12.6	8.0	32.1	-	29.1	43.5	14.4	
Vert.	187.077	QP	38.3	16.3	8.6	32.0	-	31.2	43.5	12.3	
Vert.	216.806	QP	40.7	11.1	8.8	32.0	-	28.6	46.0	17.4	
Vert.	380.796	QP	30.7	15.4	9.9	32.1	-	23.9	46.0	22.1	

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

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	108.3	19.1	-73.9	32.2	0.0	21.3	25.6	4.3	Fundamental (DC 12.0 V)
0deg	0.12500	PK	108.2	19.1	-73.9	32.2	0.0	21.2	25.6	4.4	Fundamental (DC 10.2 V)
0deg	0.12500	PK	108.1	19.1	-73.9	32.2	0.0	21.1	25.6	4.5	Fundamental (DC 13.8 V)
0deg	0.25000	PK	56.8	19.1	-64.1	32.2	0.0	-20.4	19.6	40.0	
0deg	0.37500	PK	42.6	19.0	-64.1	32.2	0.0	-34.7	16.1	50.8	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor + Filter) - Gain(Amprifier) + 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	108.3	19.1	6.1	32.2	-	101.3	-	-	Fundamental

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

*It was confirmed that there was no difference by the input voltage in the spurious emission.
If Gain 0.0dB 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).

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	October 31, 2022	November 1, 2022
Temperature / Humidity	22 deg. C / 45 % RH	22 deg. C / 46 % RH
Engineer	Kiyoshiro Okazaki	Kiyoshiro Okazaki
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	108.3	19.1	-73.9	32.2	-	21.3	45.6	24.3	Fundamental (DC 12.0 V)
0deg	0.12500	PK	108.2	19.1	-73.9	32.2	-	21.2	45.6	24.4	Fundamental (DC 10.2 V)
0deg	0.12500	PK	108.2	19.1	-73.9	32.2	-	21.2	45.6	24.4	Fundamental (DC 13.8 V)
0deg	0.25000	PK	56.3	19.1	-64.1	32.2	-	-20.9	39.6	60.5	
0deg	0.37500	PK	43.4	19.0	-64.1	32.2	-	-33.9	36.1	70.0	
0deg	0.50000	QP	28.4	19.0	-24.1	32.1	-	-8.8	33.6	42.4	
0deg	0.62500	QP	25.6	19.0	-24.1	32.1	-	-11.6	31.7	43.3	
0deg	0.75000	QP	23.8	19.1	-24.1	32.2	-	-13.4	30.1	43.5	
0deg	0.87500	QP	23.4	19.1	-24.1	32.2	-	-13.8	28.7	42.5	
0deg	1.00000	QP	23.0	19.0	-24.1	32.2	-	-14.3	27.6	41.9	
0deg	1.12500	QP	23.7	19.0	-24.1	32.2	-	-13.6	26.5	40.1	
0deg	1.25000	QP	22.7	19.1	-24.1	32.2	-	-14.5	25.6	40.1	
Hori.	64.567	QP	36.5	6.9	7.5	32.1	-	18.8	40.0	21.2	
Hori.	90.105	QP	37.8	8.5	7.8	32.1	-	22.0	43.5	21.5	
Hori.	118.623	QP	35.4	12.6	8.0	32.1	-	23.9	43.5	19.6	
Hori.	186.579	QP	32.1	16.3	8.6	32.0	-	25.0	43.5	18.5	
Hori.	218.005	QP	37.4	11.1	8.8	32.0	-	25.3	46.0	20.7	
Hori.	307.996	QP	35.1	13.9	9.5	32.0	-	26.5	46.0	19.5	
Vert.	54.567	QP	35.4	9.4	7.4	32.1	-	20.1	40.0	19.9	
Vert.	90.105	QP	43.4	8.5	7.8	32.1	-	27.6	43.5	15.9	
Vert.	118.623	QP	40.1	12.6	8.0	32.1	-	28.6	43.5	14.9	
Vert.	186.579	QP	37.8	16.3	8.6	32.0	-	30.7	43.5	12.8	
Vert.	218.005	QP	40.1	11.1	8.8	32.0	-	28.0	46.0	18.0	
Vert.	307.996	QP	30.5	13.9	9.5	32.0	-	21.9	46.0	24.1	

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

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	108.3	19.1	-73.9	32.2	0.0	21.3	25.6	4.3	Fundamental (DC 12.0 V)
0deg	0.12500	PK	108.2	19.1	-73.9	32.2	0.0	21.2	25.6	4.4	Fundamental (DC 10.2 V)
0deg	0.12500	PK	108.2	19.1	-73.9	32.2	0.0	21.2	25.6	4.4	Fundamental (DC 13.8 V)
0deg	0.25000	PK	56.3	19.1	-64.1	32.2	0.0	-20.9	19.6	40.5	
0deg	0.37500	PK	43.4	19.0	-64.1	32.2	0.0	-33.9	16.1	50.0	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor + Filter) - Gain(Amprifier) + 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	108.3	19.1	6.1	32.2	-	101.3	-	-	Fundamental

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

*It was confirmed that there was no difference by the input voltage in the spurious emission.
If Gain 0.0dB 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).

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	October 31, 2022	November 1, 2022
Temperature / Humidity	22 deg. C / 45 % RH	22 deg. C / 46 % RH
Engineer	Kiyoshiro Okazaki	Kiyoshiro Okazaki
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	101.2	19.1	-73.9	32.2	-	14.2	45.6	31.4	Fundamental (DC 12.0 V)
0deg	0.12500	PK	101.1	19.1	-73.9	32.2	-	14.1	45.6	31.5	Fundamental (DC 10.2 V)
0deg	0.12500	PK	101.1	19.1	-73.9	32.2	-	14.1	45.6	31.5	Fundamental (DC 13.8 V)
0deg	0.25000	PK	48.3	19.1	-64.1	32.2	-	-28.9	39.6	68.5	
0deg	0.37500	PK	62.5	19.0	-64.1	32.2	-	-14.8	36.1	50.9	
0deg	0.50000	QP	25.6	19.0	-24.1	32.1	-	-11.6	33.6	45.2	
0deg	0.62500	QP	45.4	19.0	-24.1	32.1	-	8.2	31.7	23.5	
0deg	0.75000	QP	23.2	19.1	-24.1	32.2	-	-14.0	30.1	44.1	
0deg	0.87500	QP	39.4	19.1	-24.1	32.2	-	2.2	28.7	26.5	
0deg	1.00000	QP	22.6	19.0	-24.1	32.2	-	-14.7	27.6	42.3	
0deg	1.12500	QP	35.1	19.0	-24.1	32.2	-	-2.2	26.5	28.7	
0deg	1.25000	QP	22.2	19.1	-24.1	32.2	-	-15.0	25.6	40.6	
Hori.	64.565	QP	36.2	6.9	7.5	32.1	-	18.5	40.0	21.5	
Hori.	90.096	QP	37.1	8.5	7.8	32.1	-	21.3	43.5	22.2	
Hori.	99.105	QP	31.9	10.0	7.8	32.1	-	17.6	43.5	25.9	
Hori.	119.590	QP	34.9	12.7	8.0	32.1	-	23.5	43.5	20.0	
Hori.	252.273	QP	33.2	12.0	9.1	32.0	-	22.3	46.0	23.7	
Hori.	300.010	QP	29.1	13.8	9.4	32.0	-	20.3	46.0	25.7	
Vert.	54.565	QP	40.1	9.4	7.4	32.1	-	24.8	40.0	15.2	
Vert.	90.096	QP	43.1	8.5	7.8	32.1	-	27.3	43.5	16.2	
Vert.	99.105	QP	37.5	10.0	7.8	32.1	-	23.2	43.5	20.3	
Vert.	119.590	QP	40.2	12.7	8.0	32.1	-	28.8	43.5	14.7	
Vert.	252.273	QP	33.5	12.0	9.1	32.0	-	22.6	46.0	23.4	
Vert.	300.010	QP	32.1	13.8	9.4	32.0	-	23.3	46.0	22.7	

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

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	101.2	19.1	-73.9	32.2	0.0	14.2	25.6	11.4	Fundamental (DC 12.0 V)
0deg	0.12500	PK	101.1	19.1	-73.9	32.2	0.0	14.1	25.6	11.5	Fundamental (DC 10.2 V)
0deg	0.12500	PK	101.1	19.1	-73.9	32.2	0.0	14.1	25.6	11.5	Fundamental (DC 13.8 V)
0deg	0.25000	PK	48.3	19.1	-64.1	32.2	0.0	-28.9	19.6	48.5	
0deg	0.37500	PK	62.5	19.0	-64.1	32.2	0.0	-14.8	16.1	30.9	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor + Filter) - Gain(Amprifier) + 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	101.2	19.1	6.1	32.2	-	94.2	-	-	Fundamental

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

*It was confirmed that there was no difference by the input voltage in the spurious emission.
If Gain 0.0dB 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).

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	October 31, 2022	November 1, 2022
Temperature / Humidity	22 deg. C / 45 % RH	20 deg. C / 48 % RH
Engineer	Kiyoshiro Okazaki	Takumi Shimada
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	109.1	19.1	-73.9	32.2	-	22.1	45.6	23.5	Fundamental (DC 12.0 V)
0deg	0.12500	PK	109.0	19.1	-73.9	32.2	-	22.0	45.6	23.6	Fundamental (DC 10.2 V)
0deg	0.12500	PK	109.0	19.1	-73.9	32.2	-	22.0	45.6	23.6	Fundamental (DC 13.8 V)
0deg	0.25000	PK	55.0	19.1	-64.1	32.2	-	-22.2	39.6	61.8	
0deg	0.37500	PK	44.2	19.0	-64.1	32.2	-	-33.1	36.1	69.2	
0deg	0.50000	QP	25.5	19.0	-24.1	32.1	-	-11.7	33.6	45.3	
0deg	0.62500	QP	24.1	19.0	-24.1	32.1	-	-13.1	31.7	44.8	
0deg	0.75000	QP	24.0	19.1	-24.1	32.2	-	-13.2	30.1	43.3	
0deg	0.87500	QP	23.0	19.1	-24.1	32.2	-	-14.2	28.7	42.9	
0deg	1.00000	QP	23.0	19.0	-24.1	32.2	-	-14.3	27.6	41.9	
0deg	1.12500	QP	22.8	19.0	-24.1	32.2	-	-14.5	26.5	41.0	
0deg	1.25000	QP	22.6	19.1	-24.1	32.2	-	-14.6	25.6	40.2	
Hori.	30.183	QP	26.8	18.5	7.0	32.1	-	20.2	40.0	19.8	
Hori.	101.606	QP	39.1	10.4	7.9	32.1	-	25.3	43.5	18.2	
Hori.	191.293	QP	31.7	16.4	8.6	32.0	-	24.7	43.5	18.8	
Hori.	226.093	QP	39.0	11.2	8.9	32.0	-	27.1	46.0	18.9	
Hori.	281.429	QP	36.4	13.5	9.3	32.0	-	27.2	46.0	18.8	
Hori.	372.897	QP	37.6	15.2	9.9	32.1	-	30.6	46.0	15.4	
Vert.	30.183	QP	37.3	18.5	7.0	32.1	-	30.7	40.0	9.3	
Vert.	32.822	QP	39.4	17.4	7.1	32.1	-	31.8	40.0	8.2	
Vert.	54.550	QP	44.4	9.4	7.4	32.1	-	29.1	40.0	10.9	
Vert.	59.460	QP	39.1	7.9	7.4	32.1	-	22.3	40.0	17.7	
Vert.	118.624	QP	42.5	12.6	8.0	32.1	-	31.0	43.5	12.5	
Vert.	215.197	QP	35.2	11.1	8.8	32.0	-	23.1	43.5	20.4	

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

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	109.1	19.1	-73.9	32.2	0.0	22.1	25.6	3.5	Fundamental (DC 12.0 V)
0deg	0.12500	PK	109.0	19.1	-73.9	32.2	0.0	22.0	25.6	3.6	Fundamental (DC 10.2 V)
0deg	0.12500	PK	109.0	19.1	-73.9	32.2	0.0	22.0	25.6	3.6	Fundamental (DC 13.8 V)
0deg	0.25000	PK	55.0	19.1	-64.1	32.2	0.0	-22.2	19.6	41.8	
0deg	0.37500	PK	44.2	19.0	-64.1	32.2	0.0	-33.1	16.1	49.2	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor + Filter) - Gain(Amprifier) + 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	109.1	19.1	6.1	32.2	-	102.1	-	-	Fundamental

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

*It was confirmed that there was no difference by the input voltage in the spurious emission.
If Gain 0.0dB 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).

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	October 31, 2022	November 1, 2022
Temperature / Humidity	22 deg. C / 45 % RH	20 deg. C / 48 % RH
Engineer	Kiyoshiro Okazaki	Takumi Shimada
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	108.5	19.1	-73.9	32.2	-	21.5	45.6	24.1	Fundamental (DC 12.0 V)
0deg	0.12500	PK	108.4	19.1	-73.9	32.2	-	21.4	45.6	24.2	Fundamental (DC 10.2 V)
0deg	0.12500	PK	108.4	19.1	-73.9	32.2	-	21.4	45.6	24.2	Fundamental (DC 13.8 V)
0deg	0.25000	PK	57.5	19.1	-64.1	32.2	-	-19.7	39.6	59.3	
0deg	0.37500	PK	42.9	19.0	-64.1	32.2	-	-34.4	36.1	70.5	
0deg	0.50000	QP	29.6	19.0	-24.1	32.1	-	-7.6	33.6	41.2	
0deg	0.62500	QP	23.9	19.0	-24.1	32.1	-	-13.3	31.7	45.0	
0deg	0.75000	QP	23.5	19.1	-24.1	32.2	-	-13.7	30.1	43.8	
0deg	0.87500	QP	22.9	19.1	-24.1	32.2	-	-14.3	28.7	43.0	
0deg	1.00000	QP	22.5	19.0	-24.1	32.2	-	-14.8	27.6	42.4	
0deg	1.12500	QP	22.7	19.0	-24.1	32.2	-	-14.6	26.5	41.1	
0deg	1.25000	QP	22.4	19.1	-24.1	32.2	-	-14.8	25.6	40.4	
Hori.	195.590	QP	32.8	16.5	8.7	32.0	-	26.0	43.5	17.5	
Hori.	214.623	QP	36.5	11.1	8.8	32.0	-	24.4	43.5	19.1	
Hori.	295.500	QP	40.7	13.8	9.4	32.0	-	31.9	46.0	14.1	
Hori.	314.292	QP	39.5	14.1	9.5	32.1	-	31.0	46.0	15.0	
Hori.	336.581	QP	33.5	14.9	9.7	32.1	-	26.0	46.0	20.0	
Hori.	379.904	QP	36.3	15.4	9.9	32.1	-	29.5	46.0	16.5	
Vert.	31.529	QP	32.9	17.9	7.0	32.1	-	25.7	40.0	14.3	
Vert.	34.540	QP	32.6	16.8	7.1	32.1	-	24.4	40.0	15.6	
Vert.	54.560	QP	43.9	9.4	7.4	32.1	-	28.6	40.0	11.4	
Vert.	87.600	QP	42.3	8.1	7.7	32.1	-	26.0	40.0	14.0	
Vert.	103.609	QP	41.4	10.7	7.9	32.1	-	27.9	43.5	15.6	
Vert.	215.615	QP	43.4	11.1	8.8	32.0	-	31.3	43.5	12.2	

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

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	108.5	19.1	-73.9	32.2	0.0	21.5	25.6	4.1	Fundamental (DC 12.0 V)
0deg	0.12500	PK	108.4	19.1	-73.9	32.2	0.0	21.4	25.6	4.2	Fundamental (DC 10.2 V)
0deg	0.12500	PK	108.4	19.1	-73.9	32.2	0.0	21.4	25.6	4.2	Fundamental (DC 13.8 V)
0deg	0.25000	PK	57.5	19.1	-64.1	32.2	0.0	-19.7	19.6	39.3	
0deg	0.37500	PK	42.9	19.0	-64.1	32.2	0.0	-34.4	16.1	50.5	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor + Filter) - Gain(Amprifier) + 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	108.5	19.1	6.1	32.2	-	101.5	-	-	Fundamental

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

*It was confirmed that there was no difference by the input voltage in the spurious emission.
If Gain 0.0dB 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).

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	October 31, 2022	November 1, 2022
Temperature / Humidity	22 deg. C / 45 % RH	20 deg. C / 48 % RH
Engineer	Kiyoshiro Okazaki	Takumi Shimada
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	109.2	19.1	-73.9	32.2	-	22.2	45.6	23.4	Fundamental (DC 12.0 V)
0deg	0.12500	PK	109.1	19.1	-73.9	32.2	-	22.1	45.6	23.5	Fundamental (DC 10.2 V)
0deg	0.12500	PK	109.1	19.1	-73.9	32.2	-	22.1	45.6	23.5	Fundamental (DC 13.8 V)
0deg	0.25000	PK	55.3	19.1	-64.1	32.2	-	-21.9	39.6	61.5	
0deg	0.37500	PK	44.8	19.0	-64.1	32.2	-	-32.5	36.1	68.6	
0deg	0.50000	QP	25.4	19.0	-24.1	32.1	-	-11.8	33.6	45.4	
0deg	0.62500	QP	24.2	19.0	-24.1	32.1	-	-13.0	31.7	44.7	
0deg	0.75000	QP	23.8	19.1	-24.1	32.2	-	-13.4	30.1	43.5	
0deg	0.87500	QP	22.9	19.1	-24.1	32.2	-	-14.3	28.7	43.0	
0deg	1.00000	QP	22.9	19.0	-24.1	32.2	-	-14.4	27.6	42.0	
0deg	1.12500	QP	22.8	19.0	-24.1	32.2	-	-14.5	26.5	41.0	
0deg	1.25000	QP	22.5	19.1	-24.1	32.2	-	-14.7	25.6	40.3	
Hori.	54.555	QP	37.9	9.4	7.4	32.1	-	22.6	40.0	17.4	
Hori.	194.810	QP	34.0	16.5	8.7	32.0	-	27.2	43.5	16.3	
Hori.	296.463	QP	41.6	13.8	9.4	32.0	-	32.8	46.0	13.2	
Hori.	316.003	QP	40.1	14.1	9.5	32.1	-	31.6	46.0	14.4	
Hori.	378.899	QP	36.6	15.3	9.9	32.1	-	29.7	46.0	16.3	
Hori.	436.976	QP	35.8	16.4	10.3	32.2	-	30.3	46.0	15.7	
Vert.	32.535	QP	32.2	17.5	7.1	32.1	-	24.7	40.0	15.3	
Vert.	54.555	QP	45.3	9.4	7.4	32.1	-	30.0	40.0	10.0	
Vert.	98.107	QP	41.9	9.8	7.8	32.1	-	27.4	43.5	16.1	
Vert.	105.611	QP	43.9	11.0	7.9	32.1	-	30.7	43.5	12.8	
Vert.	120.626	QP	39.2	12.9	8.0	32.1	-	28.0	43.5	15.5	
Vert.	215.340	QP	44.6	11.1	8.8	32.0	-	32.5	43.5	11.0	

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

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	109.2	19.1	-73.9	32.2	0.0	22.2	25.6	3.4	Fundamental (DC 12.0 V)
0deg	0.12500	PK	109.1	19.1	-73.9	32.2	0.0	22.1	25.6	3.5	Fundamental (DC 10.2 V)
0deg	0.12500	PK	109.1	19.1	-73.9	32.2	0.0	22.1	25.6	3.5	Fundamental (DC 13.8 V)
0deg	0.25000	PK	55.3	19.1	-64.1	32.2	0.0	-21.9	19.6	41.5	
0deg	0.37500	PK	44.8	19.0	-64.1	32.2	0.0	-32.5	16.1	48.6	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor + Filter) - Gain(Amprifier) + 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	109.2	19.1	6.1	32.2	-	102.2	-	-	Fundamental

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

*It was confirmed that there was no difference by the input voltage in the spurious emission.
If Gain 0.0dB 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).

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	October 31, 2022	November 1, 2022
Temperature / Humidity	22 deg. C / 45 % RH	20 deg. C / 48 % RH
Engineer	Kiyoshiro Okazaki	Takumi Shimada
Mode	Mode 7	

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	109.1	19.1	-73.9	32.2	-	22.1	45.6	23.5	Fundamental (DC 12.0 V)
0deg	0.12500	PK	109.0	19.1	-73.9	32.2	-	22.0	45.6	23.6	Fundamental (DC 10.2 V)
0deg	0.12500	PK	109.0	19.1	-73.9	32.2	-	22.0	45.6	23.6	Fundamental (DC 13.8 V)
0deg	0.25000	PK	54.5	19.1	-64.1	32.2	-	-22.7	39.6	62.3	
0deg	0.37500	PK	44.4	19.0	-64.1	32.2	-	-32.9	36.1	69.0	
0deg	0.50000	QP	25.3	19.0	-24.1	32.1	-	-11.9	33.6	45.5	
0deg	0.62500	QP	24.0	19.0	-24.1	32.1	-	-13.2	31.7	44.9	
0deg	0.75000	QP	24.0	19.1	-24.1	32.2	-	-13.2	30.1	43.3	
0deg	0.87500	QP	23.0	19.1	-24.1	32.2	-	-14.2	28.7	42.9	
0deg	1.00000	QP	22.9	19.0	-24.1	32.2	-	-14.4	27.6	42.0	
0deg	1.12500	QP	22.8	19.0	-24.1	32.2	-	-14.5	26.5	41.0	
0deg	1.25000	QP	22.6	19.1	-24.1	32.2	-	-14.6	25.6	40.2	
Hori.	54.870	QP	35.8	9.3	7.4	32.1	-	20.4	40.0	19.6	
Hori.	98.908	QP	39.1	10.0	7.8	32.1	-	24.8	43.5	18.7	
Hori.	292.216	QP	37.9	13.7	9.4	32.0	-	29.0	46.0	17.0	
Hori.	311.991	QP	36.4	14.0	9.5	32.0	-	27.9	46.0	18.1	
Hori.	339.291	QP	32.8	15.0	9.7	32.1	-	25.4	46.0	20.6	
Hori.	436.962	QP	35.1	16.4	10.3	32.2	-	29.6	46.0	16.4	
Vert.	30.209	QP	35.8	18.4	7.0	32.1	-	29.1	40.0	10.9	
Vert.	33.804	QP	31.8	17.0	7.1	32.1	-	23.8	40.0	16.2	
Vert.	54.463	QP	48.3	9.5	7.4	32.1	-	33.1	40.0	6.9	
Vert.	192.300	QP	35.9	16.4	8.6	32.0	-	28.9	43.5	14.6	
Vert.	208.327	QP	40.9	11.3	8.8	32.0	-	29.0	43.5	14.5	
Vert.	220.094	QP	41.9	11.1	8.8	32.0	-	29.8	46.0	16.2	

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

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	109.1	19.1	-73.9	32.2	0.0	22.1	25.6	3.5	Fundamental (DC 12.0 V)
0deg	0.12500	PK	109.0	19.1	-73.9	32.2	0.0	22.0	25.6	3.6	Fundamental (DC 10.2 V)
0deg	0.12500	PK	109.0	19.1	-73.9	32.2	0.0	22.0	25.6	3.6	Fundamental (DC 13.8 V)
0deg	0.25000	PK	54.5	19.1	-64.1	32.2	0.0	-22.7	19.6	42.3	
0deg	0.37500	PK	44.4	19.0	-64.1	32.2	0.0	-32.9	16.1	49.0	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor + Filter) - Gain(Amprifier) + 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	109.1	19.1	6.1	32.2	-	102.1	-	-	Fundamental

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

*It was confirmed that there was no difference by the input voltage in the spurious emission.
If Gain 0.0dB 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).

Radiated Emission (Fundamental and Spurious Emission)

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	October 31, 2022	November 1, 2022
Temperature / Humidity	22 deg. C / 45 % RH	22 deg. C / 46 % RH
Engineer	Kiyoshiro Okazaki	Kiyoshiro Okazaki
Mode	Mode 8	

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	98.5	19.1	-73.9	32.2	-	11.5	45.6	34.1	Fundamental (DC 12.0 V)
0deg	0.12500	PK	98.4	19.1	-73.9	32.2	-	11.4	45.6	34.2	Fundamental (DC 10.2 V)
0deg	0.12500	PK	98.4	19.1	-73.9	32.2	-	11.4	45.6	34.2	Fundamental (DC 13.8 V)
0deg	0.25000	PK	36.2	19.1	-64.1	32.2	-	-41.0	39.6	80.6	
0deg	0.37500	PK	45.6	19.0	-64.1	32.2	-	-31.7	36.1	67.8	
0deg	0.50000	QP	23.8	19.0	-24.1	32.1	-	-13.4	33.6	47.0	
0deg	0.62500	QP	34.4	19.0	-24.1	32.1	-	-2.8	31.7	34.5	
0deg	0.75000	QP	22.7	19.1	-24.1	32.2	-	-14.5	30.1	44.6	
0deg	0.87500	QP	29.4	19.1	-24.1	32.2	-	-7.8	28.7	36.5	
0deg	1.00000	QP	22.3	19.0	-24.1	32.2	-	-15.0	27.6	42.6	
0deg	1.12500	QP	26.5	19.0	-24.1	32.2	-	-10.8	26.5	37.3	
0deg	1.25000	QP	22.3	19.1	-24.1	32.2	-	-14.9	25.6	40.5	
Hori.	76.070	QP	22.2	6.6	7.6	32.1	-	4.3	40.0	35.7	
Hori.	89.572	QP	21.1	8.4	7.8	32.1	-	5.2	43.5	38.3	
Hori.	104.122	QP	22.0	10.8	7.9	32.1	-	8.6	43.5	34.9	
Hori.	188.195	QP	21.3	16.3	8.6	32.0	-	14.2	43.5	29.3	
Hori.	300.036	QP	29.1	13.8	9.4	32.0	-	20.3	46.0	25.7	
Hori.	316.156	QP	28.8	14.1	9.5	32.1	-	20.3	46.0	25.7	
Vert.	76.070	QP	29.1	6.6	7.6	32.1	-	11.2	40.0	28.8	
Vert.	89.572	QP	30.9	8.4	7.8	32.1	-	15.0	43.5	28.5	
Vert.	104.122	QP	26.5	10.8	7.9	32.1	-	13.1	43.5	30.4	
Vert.	188.195	QP	24.3	16.3	8.6	32.0	-	17.2	43.5	26.3	
Vert.	300.036	QP	30.2	13.8	9.4	32.0	-	21.4	46.0	24.6	
Vert.	316.156	QP	28.7	14.1	9.5	32.1	-	20.2	46.0	25.8	

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

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	98.5	19.1	-73.9	32.2	0.0	11.5	25.6	14.1	Fundamental (DC 12.0 V)
0deg	0.12500	PK	98.4	19.1	-73.9	32.2	0.0	11.4	25.6	14.2	Fundamental (DC 10.2 V)
0deg	0.12500	PK	98.4	19.1	-73.9	32.2	0.0	11.4	25.6	14.2	Fundamental (DC 13.8 V)
0deg	0.25000	PK	36.2	19.1	-64.1	32.2	0.0	-41.0	19.6	60.6	
0deg	0.37500	PK	45.6	19.0	-64.1	32.2	0.0	-31.7	16.1	47.8	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + D.Factor + Filter) - Gain(Amprifier) + 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	98.5	19.1	6.1	32.2	-	91.5	-	-	Fundamental

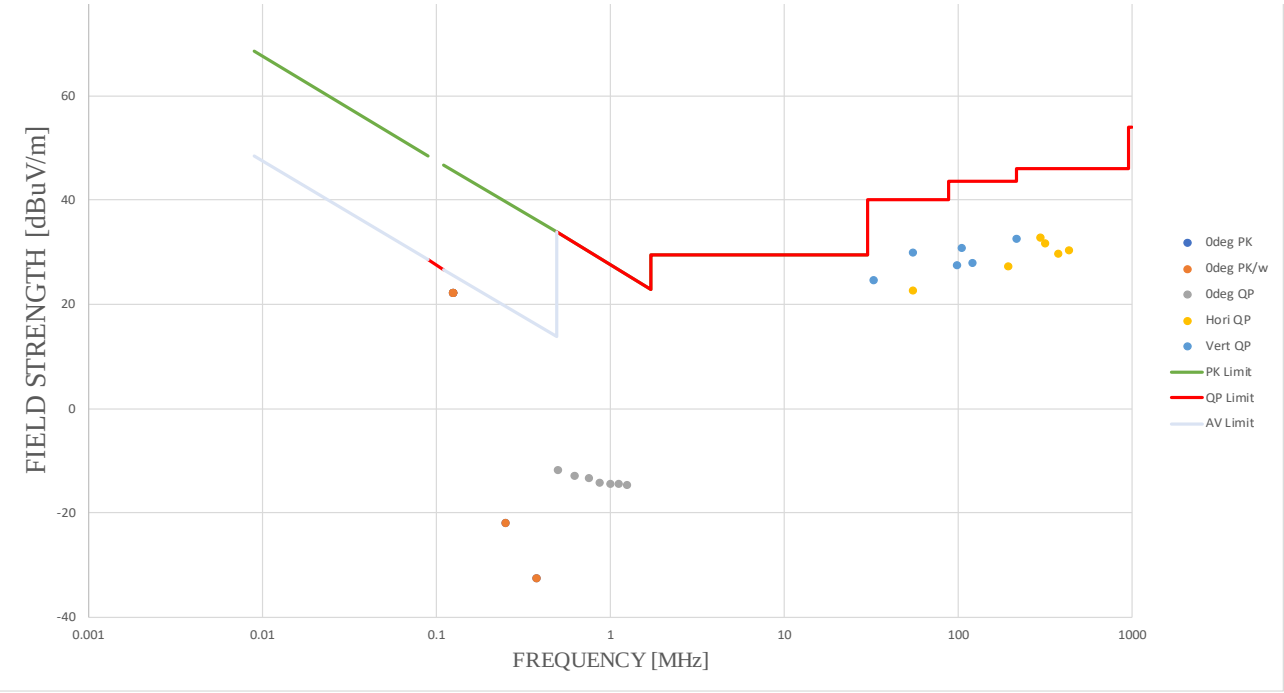
Result = Reading + Ant Factor + Loss (Cable+Attenuator) - Gain(Amprifier)

*It was confirmed that there was no difference by the input voltage in the spurious emission.
If Gain 0.0dB 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).

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

Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	October 31, 2022	November 1, 2022
Temperature / Humidity	22 deg. C / 45 % RH	20 deg. C / 48 % RH
Engineer	Kiyoshiro Okazaki	Takumi Shimada
Mode	Mode 6	



-20 dB Bandwidth / 99 % Occupied Bandwidth

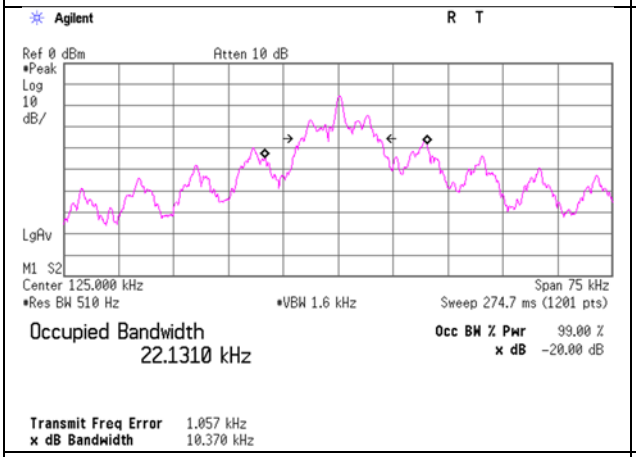
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	November 1, 2022
Temperature / Humidity	22 deg. C / 46 % RH
Engineer	Kiyoshiro Okazaki
Mode	Mode 1 to 8

Mode	-20 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
1) Outside Antenna D	10.370	22.1310
2) Outside Antenna P	10.447	22.8583
3) Outside Antenna D+P	31.753	31.6904
4) Outside Antenna B	9.903	16.9062
5) Inside Antenna Fr	16.637	18.4694
6) Inside Antenna Rr	9.770	17.0409
7) Inside Antenna Mi	9.759	17.0358
8) Immobilizer Antenna (With transponder key attached)	17.730	35.2809
Immobilizer Antenna (Without transponder key attached)	10.431	22.3109

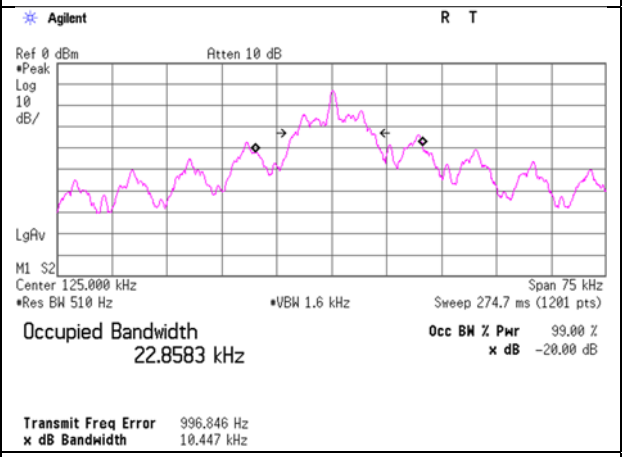
-20 dB Bandwidth / 99 % Occupied Bandwidth

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	November 1, 2022
Temperature / Humidity	22 deg. C / 46 % RH
Engineer	Kiyoshiro Okazaki
Mode	Mode 1, 2, 4, 5, 6, 7

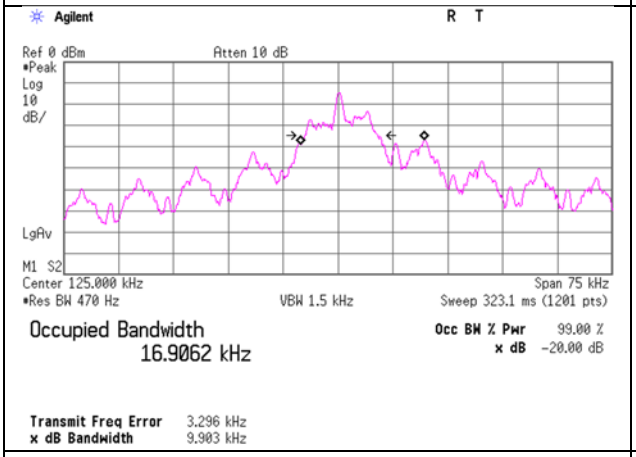
Outside Antenna D



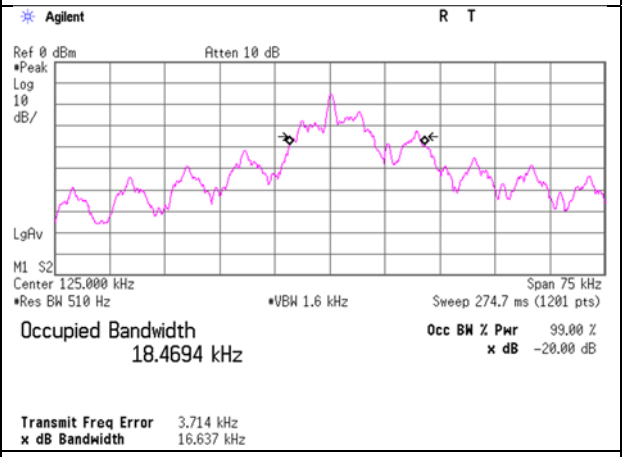
Outside Antenna P



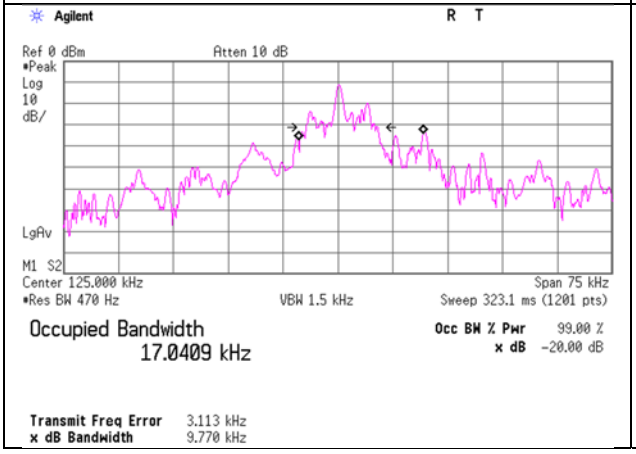
Outside Antenna B



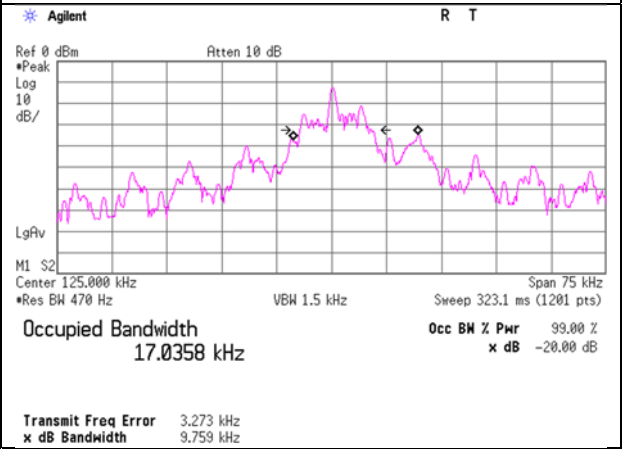
Inside Antenna Fr



Inside Antenna Rr

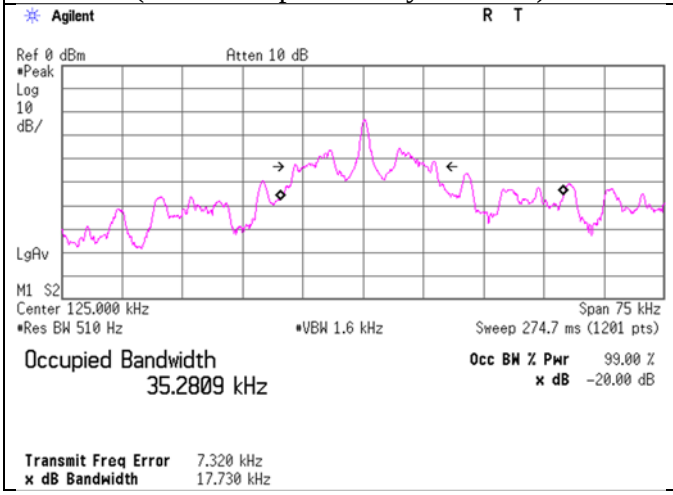
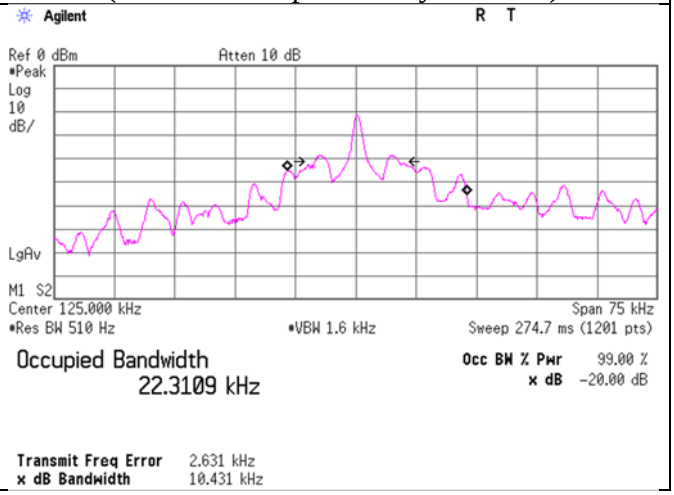


Inside Antenna Mi



-20 dB Bandwidth / 99 % Occupied Bandwidth

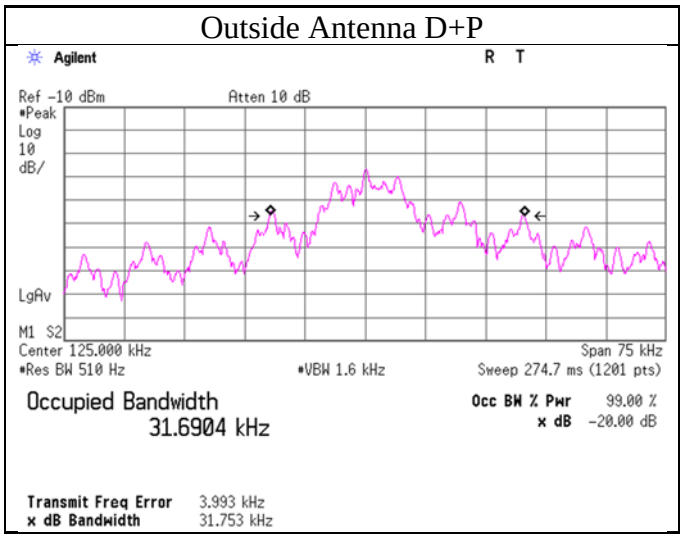
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	November 1, 2022
Temperature / Humidity	22 deg. C / 46 % RH
Engineer	Kiyoshiro Okazaki
Mode	Mode 8

Immobilizer Antenna (With transponder key attached)	Immobilizer Antenna (Without transponder key attached)
	

-20 dB Bandwidth / 99 % Occupied Bandwidth

Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	November 1, 2022
Temperature / Humidity	22 deg. C / 46 % RH
Engineer	Kiyoshiro Okazaki
Mode	Mode 3

Outside Antenna D+P



APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	KBA-05	141198	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+ BBA9106	2513	05/14/2022	12
RE	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2022	24
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/25/2022	12
RE	MCC-113	141217	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM141/ 421-010/ sucoform141-PE/ RFM-E121(SW)	-/04178	06/11/2022	12
RE	MCC-255	207745	Coaxial Cable	UL Japan	-	-	05/17/2022	12
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	11/03/2021	12
RE	MHF-24	141295	High Pass Filter 0.15-30MHz	Rohde & Schwarz	EZ-25/3	100041	02/24/2022	12
RE	MJM-29	142230	Measure	KOMELON	KMC-36	-	-	-
RE	MLA-23	141267	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-192	09/21/2022	12
RE	MLPA-01	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	05/31/2022	12
RE	MMM-10	141545	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201148	01/16/2022	12
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0010	01/10/2022	12
RE	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	04/04/2022	12
RE	MSA-22	141978	Spectrum Analyzer	Keysight Technologies Inc	E4448A	MY46180899	03/24/2022	12
RE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	07/25/2022	12

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

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

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

Test item: RE: Radiated Emission