RADIO TEST REPORT

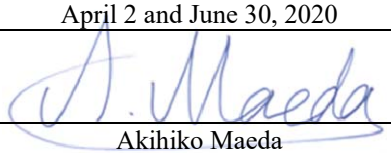
Test Report No. : 13261923H-R1

Applicant	:	**DAIHATSU MOTOR CO., LTD.**
Type of EUT	:	**Immobilizer system (Immobilizer, RKE and TPMS)**
Model Number of EUT	:	**DH19R-1**
FCC ID	:	**2AVSADH19R-1**
Test regulation	:	**FCC Part 15 Subpart C: 2019**
Test Result	:	**Complied (Refer to SECTION 3.2)**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
5. This test report covers Radio technical requirements.
   It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 13261923H. 13261923H is replaced with this report.

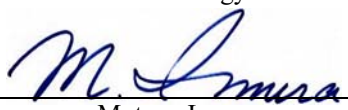
Date of test: April 2 and June 30, 2020

Representative test engineer:



Akihiko Maeda
Engineer
Consumer Technology Division

Approved by:



Motoya Imura
Leader
Consumer Technology Division

NVLAP TESTING
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ilac-MRA

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://japan.ul.com/resources/emc_accredited/

☐ This report contains data that are not covered by the NVLAP accreditation.

☒ There is no testing item of "Non-accreditation".

REVISION HISTORY

Original Test Report No.: 13261923H

Revision	Test report No.	Date	Page revised	Contents
- (Original)	13261923H	April 22, 2020	-	-

Revision 1 (1/2): Test report No. 13261923H-R1 (Date: June 30, 2020)

P. 8 Correction of the FCC Part 15.31 (e) in Clause 3.2;
Before
The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage. Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement.
After
The battery voltage (DC 12V) is provided to the EUT. Input voltage to RF part doesn't 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.

P. 11 Addition of the following sentence in Clause 4.2;
* The input voltage (DC 12 V) passes through Item No. A without affecting it and is supplied to the Coil antenna (Item No. B) without any drop in voltage.

Revision 1 (2/2): Test report No. 13261923H-R1 (Date: June 30, 2020)

P. 15 Correction of data description (Radiated Emission below 30 MHz (Fundamental and Spurious Emission) test)

Before

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	0.1250	PK	94	20	-74	32	-	8.6	45.6	37.1	Fundamental
0deg	0.2500	PK	51	20	-74	32	-	-34.8	39.6	74.4	
0deg	0.3750	PK	57	20	-74	32	-	-29.2	36.1	65.3	
0deg	0.5000	QP	32	20	-34	32	-	-13.4	33.6	47.0	
0deg	0.6250	QP	41	20	-34	32	-	-4.9	31.7	36.6	
0deg	0.7500	QP	31	20	-34	32	-	-14.7	30.1	44.8	
0deg	0.8750	QP	36	20	-34	32	-	-9.5	28.7	38.2	
0deg	1.0000	QP	29	20	-34	32	-	-16.5	27.6	44.1	
0deg	1.1250	QP	34	20	-34	32	-	-12.0	26.5	38.5	
0deg	1.2500	QP	31	20	-34	32	-	-15.3	25.6	40.9	

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

PK with Duty 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	94.3	19.9	-73.6	32.1	0.0	8.6	25.6	17.1	
0deg	0.25000	PK	51.0	19.9	-73.6	32.1	0.0	-34.8	19.6	54.4	
0deg	0.37500	PK	56.6	19.9	-73.6	32.1	0.0	-29.2	16.1	45.3	

After

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	0.1250	PK	94.3	19.9	-73.6	32.1	-	8.6	45.6	37.1	Fundamental (DC 10.2 V)
0deg	0.1250	PK	94.3	19.9	-73.6	32.1	-	8.6	45.6	37.1	Fundamental (DC 12.0 V)
0deg	0.1250	PK	94.3	19.9	-73.6	32.1	-	8.6	45.6	37.1	Fundamental (DC 13.8 V)
0deg	0.2500	PK	51.0	19.9	-73.6	32.1	-	-34.8	39.6	74.4	
0deg	0.3750	PK	56.6	19.9	-73.6	32.1	-	-29.2	36.1	65.3	
0deg	0.5000	QP	32.4	19.8	-33.6	32.1	-	-13.4	33.6	47.0	
0deg	0.6250	QP	40.9	19.8	-33.6	32.0	-	-4.9	31.7	36.6	
0deg	0.7500	QP	31.1	19.8	-33.5	32.0	-	-14.7	30.1	44.8	
0deg	0.8750	QP	36.3	19.8	-33.5	32.0	-	-9.5	28.7	38.2	
0deg	1.0000	QP	29.3	19.8	-33.5	32.0	-	-16.5	27.6	44.1	
0deg	1.1250	QP	33.8	19.8	-33.5	32.0	-	-12.0	26.5	38.5	
0deg	1.2500	QP	30.5	19.8	-33.5	32.0	-	-15.3	25.6	40.9	

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

PK with Duty 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	94.3	19.9	-73.6	32.1	0.0	8.6	25.6	17.1	DC 10.2 V
0deg	0.12500	PK	94.3	19.9	-73.6	32.1	0.0	8.6	25.6	17.1	DC 12.0 V
0deg	0.12500	PK	94.3	19.9	-73.6	32.1	0.0	8.6	25.6	17.1	DC 13.8 V
0deg	0.25000	PK	51.0	19.9	-73.6	32.1	0.0	-34.8	19.6	54.4	
0deg	0.37500	PK	56.6	19.9	-73.6	32.1	0.0	-29.2	16.1	45.3	

P. 16 Addition of the following sentence under the data (Radiated Emission above 30 MHz (Spurious Emission) test)

*It was confirmed that there was no difference by the input voltage in the spurious emission.

P. 18 Addition of the following sentence under the data (-26 dB Bandwidth and 99 % Occupied Bandwidth test)

*It was confirmed that there was no difference by the input voltage.

Reference: Abbreviations (Including words undescribed in this report)

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

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CONTENTS PAGE

SECTION 1: Customer information

Company Name	:	DAIHATSU MOTOR CO., LTD.*
Address	:	2-1-1, Momozono, Ikeda-shi, Osaka, 563-8651, Japan
Telephone Number	:	+81-72-754-4526
Facsimile Number	:	+81-72-754-3857
Contact Person	:	Hideshige Nakano

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

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

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

SECTION 2: Equipment under test (EUT)

2.1 Identification of EUT

Type	:	Immobilizer system (Immobilizer, RKE and TPMS)
Model Number	:	DH19R-1
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 12.0 V
Receipt Date	:	March 25, 2020
Country of Mass-production	:	Republic of Indonesia
Condition	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	:	No Modification by the test lab

2.2 Product Description

Model No: DH19R-1, (referred to as the EUT in this report), is the Immobilizer system (Immobilizer, RKE and TPMS).

Radio Specification

[Transmitter part]

Radio Type	:	LF Transmitter
Frequency of Operation	:	125 kHz
Oscillator Frequency	:	4 MHz
Type of Modulation	:	ASK
Antenna	:	Immobilizer Antenna
Clock frequency (maximum)	:	MPU: 8 MHz

[Receiver part]

Frequency of Operation	:	433.90 MHz (TPMS), 433.92 MHz (Key)	
Oscillator Frequency	:	33.600 MHz (Crystal)	
Operating Channel Width (OCW)	:	TPMS:	433.90 MHz ±120 kHz
		Key:	433.92 MHz ±60 kHz
Local Oscillator Frequency	:	TPMS:	432.85 MHz (433.90 MHz - 1.05 MHz)
		Key:	433.395 MHz (433.92 MHz - 525 kHz)
Intermediate Frequency	:	TPMS:	1.05 MHz
		Key:	525 kHz
Type of Modulation	:	FSK (F1D)	
Type of receiving system	:	Super-heterodyne	
Antenna Type	:	Internal antenna (Inverted F antenna)	
Receiver Bandwidth	:	TPMS:	240 kHz
		Key:	120 kHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C FCC Part 15 final revised on July 19, 2019 and effective August 19, 2019 except 15.258
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	Remarks	Deviation	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	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 4.4 RSS-Gen 8.9	Radiated	N/A	17.1 dB 125 kHz 0 deg. Peak with Duty factor	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 4.4 RSS-Gen 8.9	Radiated	N/A	20.9 dB 32.299 MHz, Vertical, QP	Complied a)	-
-26 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 No. 13-EM-W0420 and 13-EM-W0422.
*1) The test is not applicable since the EUT is not the device that is designed to be connected to the public utility (AC) power line.

a) Refer to APPENDIX 1 (data of Radiated emission)
b) Refer to APPENDIX 1 (data of -26 dB Bandwidth and 99 % Occupied Bandwidth)

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

FCC Part 15.31 (e)
The battery voltage (DC 12V) is provided to the EUT. Input voltage to RF part doesn't 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 % Occupied Band Width	RSS-Gen 6.7	-	Radiated	N/A	N/A	-
Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.						

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

3.4 Uncertainty

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

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

Radiated emission

Measurement distance	Frequency range		Uncertainty (+/-)
3 m	9 kHz to 30 MHz		3.3 dB
10 m			3.2 dB
3 m	30 MHz to 200 MHz	(Horizontal)	4.8 dB
		(Vertical)	5.0 dB
	200 MHz to 1000 MHz	(Horizontal)	5.2 dB
		(Vertical)	6.3 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

Antenna Terminal test

Test Item	Uncertainty (+/-)
-26 dB Bandwidth / 99 % Occupied Bandwidth	0.96 %

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

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

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

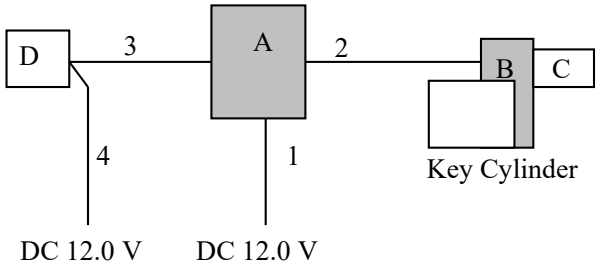
SECTION 4: Operation of EUT during testing

4.1 Operating Modes

Test mode	Remarks
1) Tx 125 kHz Immobilizer Antenna	-
* EUT was set by the software as follows; Software: DN-2390005170-01.S (Date: April 16, 2020, Storage location: IC0001) *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 Coil antenna (Item No. B) without any drop in voltage.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Body ECU	DH19R-1	No.252	DENSO CORPORATION	EUT
B	Coil Antenna	DH19R-1	P9000017	TOKAI RIKA CO.,LTD.	EUT
C	Transponder	-	50025	TOKAI RIKA CO.,LTD.	-
D	Evaluation Bench	-	No.6	DENSO CORPORATION	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	DC and Antenna Cable	3.0	Shielded	Shielded	-
3	Signal Cable	3.0	Unshielded	Unshielded	-
4	DC 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.

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 1 about Direction of the Loop Antenna.

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.

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

Test Antennas are used as below;

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

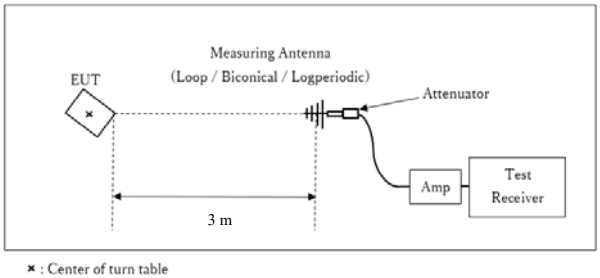
Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)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

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.

[Test Setup]
Below 1 GHz



Test Distance: 3 m

- 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.

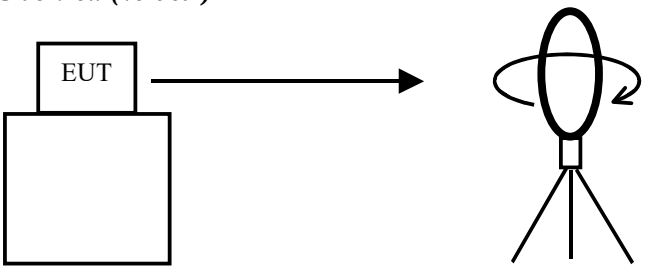
The test results and limit are rounded off to one decimal place, so some differences might be observed.

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

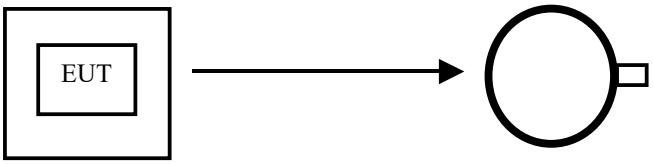
Date: April 2, 2020 Test engineer: Akihiko Maeda

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

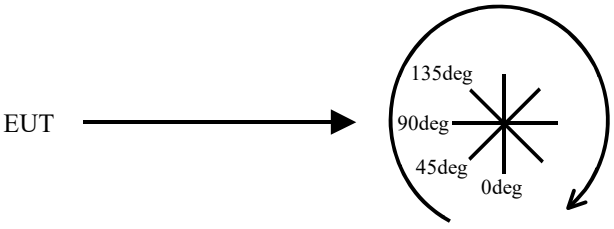


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

SECTION 6: -26 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
-26 dB Bandwidth	100 kHz	1 kHz	3 kHz	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1
Test result : Pass

SECTION 7: 99 % Occupied 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 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Peak *1)	Max Hold *1)	Spectrum Analyzer
*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100 %. Peak hold was applied as Worst-case measurement.							

Test data : APPENDIX 1
Test result : Pass

APPENDIX 1: Test data

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Report No.	13261923H	
Test place	Ise EMC Lab.	
Semi Anechoic Chamber	No.4	No.4
Date	April 2, 2020	June 30, 2020
Temperature / Humidity	20 deg. C / 51 % RH	23 deg. C / 62 % RH
Engineer	Akihiko Maeda	Akihiko Maeda
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	0.1250	PK	94.3	19.9	-73.6	32.1	-	8.6	45.6	37.1	Fundamental (DC 10.2 V)
0deg	0.1250	PK	94.3	19.9	-73.6	32.1	-	8.6	45.6	37.1	Fundamental (DC 12.0 V)
0deg	0.1250	PK	94.3	19.9	-73.6	32.1	-	8.6	45.6	37.1	Fundamental (DC 13.8 V)
0deg	0.2500	PK	51.0	19.9	-73.6	32.1	-	-34.8	39.6	74.4	
0deg	0.3750	PK	56.6	19.9	-73.6	32.1	-	-29.2	36.1	65.3	
0deg	0.5000	QP	32.4	19.8	-33.6	32.1	-	-13.4	33.6	47.0	
0deg	0.6250	QP	40.9	19.8	-33.6	32.0	-	-4.9	31.7	36.6	
0deg	0.7500	QP	31.1	19.8	-33.5	32.0	-	-14.7	30.1	44.8	
0deg	0.8750	QP	36.3	19.8	-33.5	32.0	-	-9.5	28.7	38.2	
0deg	1.0000	QP	29.3	19.8	-33.5	32.0	-	-16.5	27.6	44.1	
0deg	1.1250	QP	33.8	19.8	-33.5	32.0	-	-12.0	26.5	38.5	
0deg	1.2500	QP	30.5	19.8	-33.5	32.0	-	-15.3	25.6	40.9	

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

PK with Duty 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	94.3	19.9	-73.6	32.1	0.0	8.6	25.6	17.1	DC 10.2 V
0deg	0.12500	PK	94.3	19.9	-73.6	32.1	0.0	8.6	25.6	17.1	DC 12.0 V
0deg	0.12500	PK	94.3	19.9	-73.6	32.1	0.0	8.6	25.6	17.1	DC 13.8 V
0deg	0.25000	PK	51.0	19.9	-73.6	32.1	0.0	-34.8	19.6	54.4	
0deg	0.37500	PK	56.6	19.9	-73.6	32.1	0.0	-29.2	16.1	45.3	

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

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

Result of the fundamental emission at 3m without Distance factor

PK or QP

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	94.3	19.9	6.4	32.1	-	88.6	-	-	Fundamental

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

*It was confirmed that there was no difference by the input voltage in the spurious emission.
* Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

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

Radiated Emission above 30 MHz (Spurious Emission)

Report No.	13261923H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	April 2, 2020
Temperature / Humidity	20 deg. C / 51 % RH
Engineer	Akihiko Maeda
Mode	Mode 1

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	32.299	QP	21.7	17.6	7.2	32.0	14.5	40.0	25.5	
Hori.	44.744	QP	21.8	13.1	7.4	32.0	10.3	40.0	29.7	
Hori.	189.120	QP	21.1	16.5	8.9	31.8	14.7	43.5	28.8	
Hori.	343.990	QP	20.8	15.0	10.0	31.8	14.0	46.0	32.0	
Hori.	558.334	QP	21.0	18.1	11.3	31.9	18.4	46.0	27.6	
Hori.	801.335	QP	21.1	20.8	12.4	31.6	22.8	46.0	23.3	
Vert.	32.299	QP	26.3	17.6	7.2	32.0	19.1	40.0	20.9	
Vert.	44.744	QP	22.4	13.1	7.4	32.0	10.9	40.0	29.1	
Vert.	189.120	QP	21.1	16.5	8.9	31.8	14.7	43.5	28.8	
Vert.	343.990	QP	20.8	15.0	10.0	31.8	14.0	46.0	32.0	
Vert.	558.334	QP	21.0	18.1	11.3	31.9	18.4	46.0	27.6	
Vert.	801.335	QP	21.1	20.8	12.4	31.6	22.8	46.0	23.3	

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

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

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

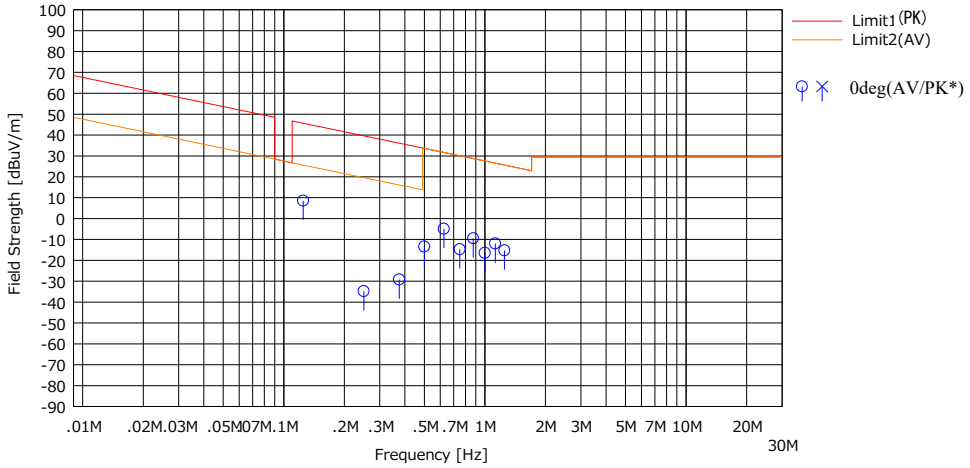
*It was confirmed that there was no difference by the input voltage in the spurious emission.

Radiated Emission Plot data, Worst case

Report No.	13261923H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	April 2, 2020
Temperature / Humidity	20 deg. C / 51 % RH
Engineer	Akihiko Maeda
Mode	Mode 1

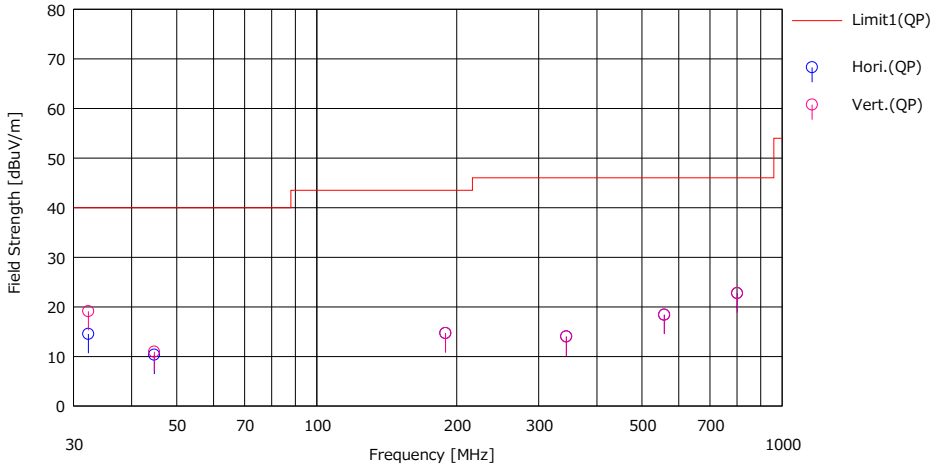
(below 30MHz)

Limit : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



* Data above 490 kHz were measured using a QP detector.

(above 30MHz)



*These plots data contains sufficient number to show the trend of characteristic features for EUT.

-26 dB Bandwidth and 99 % Occupied Bandwidth

Report No.	13261923H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.4
Date	April 2, 2020
Temperature / Humidity	20 deg. C / 51 % RH
Engineer	Akihiko Maeda
Mode	Mode 1

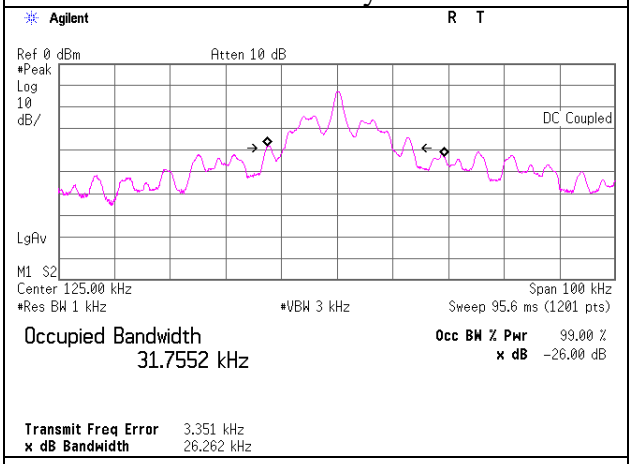
With Key

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
26.262	31.7552

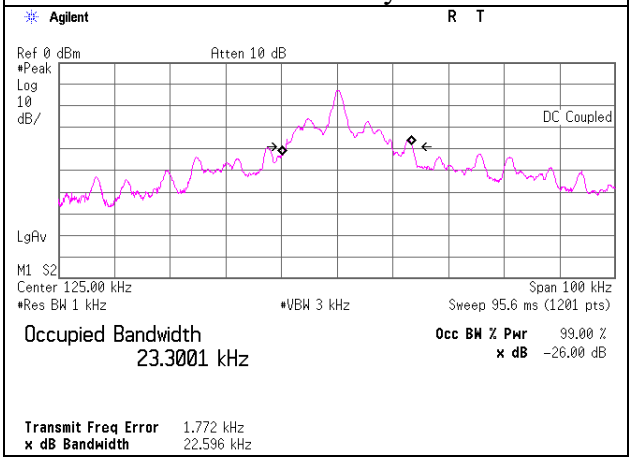
Without Key

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
22.596	23.3001

With Key



Without Key



*It was confirmed that there was no difference by the input voltage.

APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MAEC-04	142011	AC4_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	06/28/2018	24
RE	MOS-15	141562	Thermo-Hygrometer	CUSTOM	CTH-201	0010	01/07/2020	12
RE	MMM-10	141545	DIGITAL HiTESTER	Hioki	3805	51201148	01/06/2020	12
RE	MJM-26	142227	Measure	KOMELON	KMC-36	-	-	-
RE	MSA-16	141903	Spectrum Analyzer	Keysight Technologies Inc	E4440A	MY46186390	02/06/2020	12
RE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	03/10/2020	12
RE	MAT-34	141331	Attenuator(6dB)	TME	UFA-01	-	02/05/2020	12
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess - Elektronik	VHA9103+BBA9106	1302	08/24/2019	12
RE	MCC-50	141397	Coaxial Cable	UL Japan	-	-	03/24/2020	12
RE	MLA-23	141267	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess - Elektronik	VUSLP9111B	9111B-192	08/24/2019	12
RE	MPA-14	141583	Pre Amplifier	SONOMA INSTRUMENT	310	260833	02/18/2020	12
RE	MCC-113	141217	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM141/ 421-010/sucoform141-PE/ RFM-E121(SW)	-/04178	06/18/2019	12
RE	MLPA-01	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/04/2019	12
RE	MCC-143	141413	Coaxial Cable	UL Japan	-	-	06/07/2019	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: Spurious emission