



RADIO TEST REPORT

Test Report No. : 13487461H-A-R1

Applicant : NIDEC MOBILITY CORPORATION
Type of EUT : ECU of Keyless Operation System
Model Number of EUT : R515E
FCC ID : OUCR515E
Test regulation : FCC Part 15 Subpart C: 2020
Test Result : Complied (Refer to SECTION 3.2)

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
8. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
9. The information provided from the customer for this report is identified in Section 1.
10. This report is a revised version of 13487461H-A. 13487461H-A is replaced with this report.

Date of test:

September 4, 2020

Representative test engineer:

Ken Fujita

Ken Fujita

Engineer

Consumer Technology Division

Approved by:

S. Miyazono

Shinichi Miyazono

Engineer

Consumer Technology Division



CERTIFICATE 5107.02

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

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REVISION HISTORY

Original Test Report No.: 13487461H-A

Revision	Test report No.	Date	Page revised	Contents																																																																
- (Original)	13487461H-A	October 13, 2020	-	-																																																																
1	13487461H-A-R1	November 26, 2020	P.6	Addition of “Type of Modulation: ASK” in Smart System: LF Transmitting function of Clause 2.2																																																																
1	13487461H-A-R1	November 26, 2020	P.11	Correction of the following table in Clause 4.2; From <table><tr><th colspan="4">Description of EUT and Support equipment</th></tr><tr><th>No.</th><th>Item</th><th>Model number</th><th>Serial number</th></tr><tr><td>A</td><td>ECU</td><td>R515E</td><td>14</td></tr><tr><td>B</td><td>LF Antenna DR</td><td>CGF-M004-T04</td><td>8637C166</td></tr><tr><td>C</td><td>LF Antenna AS</td><td>CGF-M004-T04</td><td>8637C166</td></tr><tr><td>D</td><td>LF Antenna INF</td><td>CGF-M004-T04</td><td>8637C166</td></tr><tr><td>E</td><td>LF Antenna INR</td><td>CGF-M004-T04</td><td>8637C166</td></tr><tr><td>F</td><td>LF Antenna T/G</td><td>CGF-M004-T04</td><td>8637C166</td></tr></table> To <table><tr><th colspan="4">Description of EUT and Support equipment</th></tr><tr><th>No.</th><th>Item</th><th>Model number</th><th>Serial number</th></tr><tr><td>A</td><td>KOS</td><td>R515E</td><td>#14</td></tr><tr><td>B</td><td>LF Antenna DR</td><td>CGF-M004-T03</td><td>200826-7</td></tr><tr><td>C</td><td>LF Antenna AS</td><td>CGF-M004-T03</td><td>200826-8</td></tr><tr><td>D</td><td>LF Antenna INF</td><td>CGF-M004-T03</td><td>200826-9</td></tr><tr><td>E</td><td>LF Antenna INR</td><td>CGF-M004-T03</td><td>200826-10</td></tr><tr><td>F</td><td>LF Antenna T/G</td><td>CGF-M004-T04</td><td>200826-11</td></tr></table>	Description of EUT and Support equipment				No.	Item	Model number	Serial number	A	ECU	R515E	14	B	LF Antenna DR	CGF-M004-T04	8637C166	C	LF Antenna AS	CGF-M004-T04	8637C166	D	LF Antenna INF	CGF-M004-T04	8637C166	E	LF Antenna INR	CGF-M004-T04	8637C166	F	LF Antenna T/G	CGF-M004-T04	8637C166	Description of EUT and Support equipment				No.	Item	Model number	Serial number	A	KOS	R515E	#14	B	LF Antenna DR	CGF-M004-T03	200826-7	C	LF Antenna AS	CGF-M004-T03	200826-8	D	LF Antenna INF	CGF-M004-T03	200826-9	E	LF Antenna INR	CGF-M004-T03	200826-10	F	LF Antenna T/G	CGF-M004-T04	200826-11
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1	13487461H-A-R1	November 26, 2020	P.11	Correction of No.7 cable name in the cable list of Clause 4.2; From Antenna Cable to Signal Cable																																																																

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Reference: Abbreviations (Including words undescribed in this report)

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

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SECTION 1: Customer information

Company Name	:	NIDEC MOBILITY CORPORATION
Address	:	6368, Nenjo-zaka, Okusa, Komaki-city, Aichi 485-802 Japan
Telephone Number	:	+81-568-78-6159
Facsimile Number	:	+81-568-78-7659
Contact Person	:	Kazushi Yamasaki

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	:	ECU of Keyless Operation System
Model Number	:	R515E
Serial Number	:	Refer to SECTION 4.2
Rating	:	DC 12.0 V
Receipt Date	:	August 28, 2020
Country of Mass-production	:	China
Condition	:	Production model
Modification	:	No Modification by the test lab

2.2 Product Description

Model No: R515E, (referred to as the EUT in this report), is the ECU of Keyless Operation System. Keyless Operation System has the following radio functions: Immobilizer system and Smart System (LF Transmitting / UHF Receiving).

General Specification

Clock frequency (maximum)	:	UHF: 21.948717 MHz
Operating Temperature	:	-40 deg. C to +85 deg. C

Radio Specification

Immobilizer system function

Equipment Type : Transceiver
Frequency of Operation : 125 kHz
Type of Modulation : ASK
Antenna Type : Coil Antenna

Smart System: LF Transmitting function

Equipment Type : Transmitter
Frequency of Operation : 125 kHz
Type of Modulation : ASK
Antenna Type : Coil Antenna

Smart System: UHF Receiving function *

Type of Receiver : Super Heterodyne
Receiving Frequency : 433.92 MHz
Oscillator Frequency : 21.948717 MHz
Local Oscillator Frequency : 434.194 MHz
Intermediate Frequency : 274 kHz
Antenna Type : $\lambda/4$ Monopole Antenna

*The test of this function was performed separately from this test report, and the conformability is confirmed.

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on June 26, 2020 and effective July 27, 2020

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	5.9 dB 125 kHz, 0 deg. Peak with Duty factor <LF Antenna DR>	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	15.4 dB 30.960 MHz, Vertical, QP <LF Antenna DR>	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) 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 test was performed with the New Battery and the EUT constantly provides the stable voltage to RF part through the regulator regardless of input voltage from New Battery. Therefore, this 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.

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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
		5.0 dB
	200 MHz to 1000 MHz (Horizontal)	5.2 dB
		6.3 dB
10 m	30 MHz to 200 MHz (Horizontal)	4.8 dB
		4.8 dB
	200 MHz to 1000 MHz (Horizontal)	5.0 dB
		5.0 dB

Antenna Terminal test

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

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3.5 Test Location

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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.

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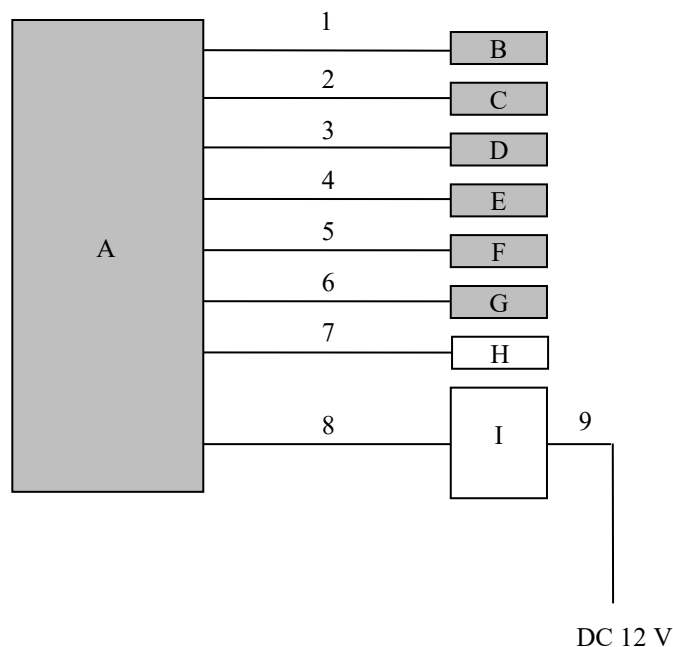
SECTION 4: Operation of EUT during testing

4.1 Operating Modes

Test mode	Remarks
1) Transmitting mode (Tx) 125 kHz	-
* EUT was set by the software as follows; Software: Radio_Law_Certification_EU Version 35 FC E1 (Date: 2013/10/10, 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 EUT does not transmit simultaneously from multiple antennas.
- * Antenna was evaluated with the worst duty respectively.
- * The EUT was set to transmit the data continuously from one antenna as a worst case, not to transmit it randomly from each antenna.
- * The each carrier level of the five antennas (DR, AS, INF, INR, T/G) was compared at the pre-check.
As a result, all the tests were performed with the LF Antenna DR as representative, which had the worst result.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	KOS	R515E	#14	NIDEC MOBILITY CORPORATION	EUT
B	LF Antenna DR	CGF-M004-T03	200826-7	NIDEC MOBILITY CORPORATION	EUT
C	LF Antenna AS	CGF-M004-T03	200826-8	NIDEC MOBILITY CORPORATION	EUT
D	LF Antenna INF	CGF-M004-T03	200826-9	NIDEC MOBILITY CORPORATION	EUT
E	LF Antenna INR	CGF-M004-T03	200826-10	NIDEC MOBILITY CORPORATION	EUT
F	LF Antenna T/G	CGF-M004-T04	200826-11	NIDEC MOBILITY CORPORATION	EUT
G	FOB BOX	C8Z-F116M-K-T	3718747	NIDEC MOBILITY CORPORATION	EUT
H	Push Start Switch	C8N-B100M-Z	CA541389	NIDEC MOBILITY CORPORATION	-
I	Jig	-	-	NIDEC MOBILITY CORPORATION	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Antenna Cable	2.3	Unshielded	Unshielded	-
2	Antenna Cable	2.3	Unshielded	Unshielded	-
3	Antenna Cable	2.3	Unshielded	Unshielded	-
4	Antenna Cable	2.3	Unshielded	Unshielded	-
5	Antenna Cable	2.3	Unshielded	Unshielded	-
6	Antenna Cable	2.3	Unshielded	Unshielded	-
7	Signal Cable	2.3	Unshielded	Unshielded	-
8	DC & Signal Cable	3.0	Unshielded	Unshielded	-
9	DC Cable	3.0	Unshielded	Unshielded	-

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SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

EUT was placed on a urethane platform of nominal size, 0.5 m by 1.0 m, raised 0.8 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

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

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

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.

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 Ohms. For example, the measurement at frequency 9 kHz resulted in a level of 45.5 dBuV/m, which is equivalent to $45.5 - 51.5 = -6.0 \text{ dBuA/m}$, which has the same margin, 3 dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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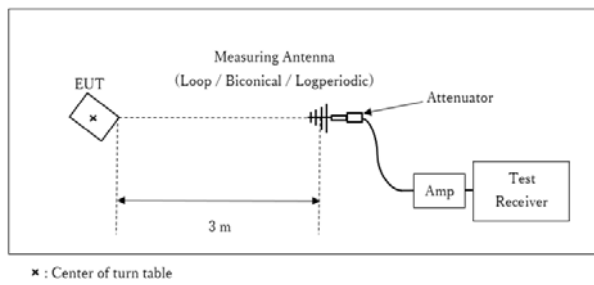
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[Test Setup]
Below 1 GHz



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.

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

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

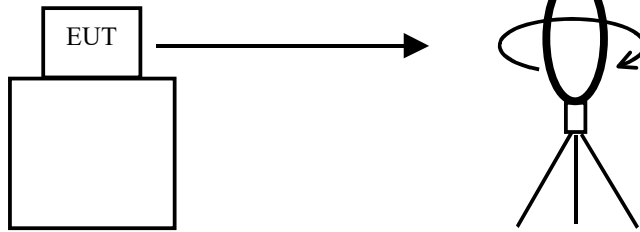
Measurement range : 9 kHz - 1 GHz
Test data : APPENDIX 1
Test result : Pass

Date: September 4, 2020

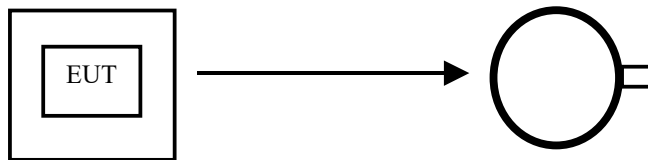
Test engineer: Ken Fujita

Figure 1: Direction of the Loop Antenna

Side View (Vertical)



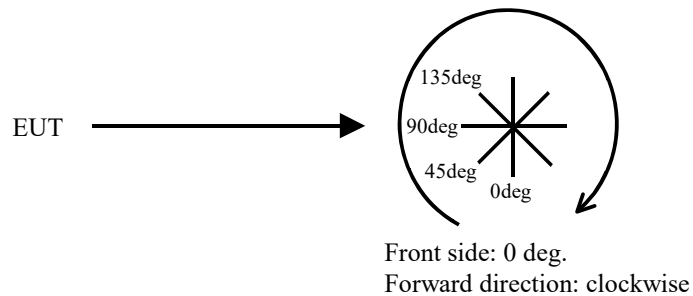
.....
Top View (Horizontal)



Antenna was not rotated.

.....

Top View (Vertical)



SECTION 6: -26 dB Bandwidth

Test Procedure

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

<LF Antenna DR>

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26 dB Bandwidth	1 kHz	1 Hz	3 Hz	Auto	Peak	Max Hold	Spectrum Analyzer

<FOB BOX>

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26 dB Bandwidth	1 kHz	9.1Hz	27 Hz	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) <LF Antenna DR>

Report No. 13487461H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date September 4, 2020
Temperature / Humidity 22 deg. C / 47 % RH
Engineer Ken Fujita
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	106.5	19.4	-74.0	32.3	-	19.7	45.6	25.9	Fundamental
0deg	0.25000	PK	66.0	19.5	-73.9	32.3	-	-20.8	39.6	60.4	
0deg	0.37500	PK	56.1	19.5	-73.9	32.3	-	-30.6	36.1	66.7	
0deg	0.50000	QP	38.9	19.4	-33.9	32.2	-	-7.8	33.6	41.4	
0deg	0.62500	QP	44.1	19.4	-33.9	32.2	-	-2.6	31.7	34.3	
0deg	0.75000	QP	31.4	19.4	-33.8	32.2	-	-15.3	30.1	45.4	
0deg	0.87500	QP	38.9	19.4	-33.8	32.2	-	-7.7	28.7	36.4	
0deg	1.00000	QP	31.0	19.5	-33.8	32.2	-	-15.6	27.6	43.2	
0deg	1.12500	QP	36.2	19.5	-33.8	32.2	-	-10.4	26.5	36.9	
0deg	1.25000	QP	30.7	19.5	-33.8	32.2	-	-15.8	25.6	41.4	

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

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	106.5	19.4	-74.0	32.3	0.0	19.7	25.6	5.9	
0deg	0.25000	PK	66.0	19.5	-73.9	32.3	0.0	-20.8	19.6	40.4	
0deg	0.37500	PK	56.1	19.5	-73.9	32.3	0.0	-30.6	16.1	46.7	

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 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	106.5	19.4	6.0	32.3	-	99.7	-	-	Fundamental

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

UL Japan, Inc.

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Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

<FOB BOX>

Report No. 13487461H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date September 4, 2020
Temperature / Humidity 22 deg. C / 47 % RH
Engineer Ken Fujita
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	91.6	19.4	-74.0	32.3	-	4.8	45.6	40.8	Fundamental
0deg	0.25000	PK	71.7	19.5	-73.9	32.3	-	-15.1	39.6	54.7	
0deg	0.37500	PK	57.5	19.5	-73.9	32.3	-	-29.2	36.1	65.3	
0deg	0.50000	QP	32.2	19.4	-33.9	32.2	-	-14.5	33.6	48.1	
0deg	0.62500	QP	45.7	19.4	-33.9	32.2	-	-1.0	31.7	32.7	
0deg	0.75000	QP	39.8	19.4	-33.8	32.2	-	-6.9	30.1	37.0	
0deg	0.87500	QP	41.0	19.4	-33.8	32.2	-	-5.6	28.7	34.3	
0deg	1.00000	QP	30.8	19.5	-33.8	32.2	-	-15.8	27.6	43.4	
0deg	1.12500	QP	37.4	19.5	-33.8	32.2	-	-9.2	26.5	35.7	
0deg	1.25000	QP	33.5	19.5	-33.8	32.2	-	-13.0	25.6	38.6	

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

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	91.6	19.4	-74.0	32.3	0.0	4.8	25.6	20.8	
0deg	0.25000	PK	71.7	19.5	-73.9	32.3	0.0	-15.1	19.6	34.7	
0deg	0.37500	PK	57.5	19.5	-73.9	32.3	0.0	-29.2	16.1	45.3	

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 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	91.6	19.4	6.0	32.3	-	84.8	-	-	Fundamental

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

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Radiated Emission above 30 MHz (Spurious Emission)
<LF Antenna DR>

Report No. 13487461H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date September 4, 2020
Temperature / Humidity 22 deg. C / 47 % RH
Engineer Ken Fujita
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.	30.960	QP	22.3	18.2	7.0	28.6	18.9	40.0	21.1	
Hori.	34.056	QP	23.7	17.0	7.1	28.6	19.1	40.0	20.9	
Hori.	121.599	QP	21.6	12.9	8.2	28.4	14.3	43.5	29.2	
Hori.	211.268	QP	21.2	11.1	9.1	28.0	13.4	43.5	30.1	
Hori.	309.427	QP	22.3	13.9	9.9	27.9	18.2	46.0	27.8	
Hori.	608.452	QP	22.5	19.4	11.6	29.4	24.1	46.0	21.9	
Vert.	30.960	QP	28.0	18.2	7.0	28.6	24.6	40.0	15.4	
Vert.	34.056	QP	26.6	17.0	7.1	28.6	22.0	40.0	18.0	
Vert.	121.599	QP	21.5	12.9	8.2	28.4	14.2	43.5	29.3	
Vert.	211.268	QP	22.3	11.1	9.1	28.0	14.5	43.5	29.0	
Vert.	309.427	QP	23.0	13.9	9.9	27.9	18.9	46.0	27.1	
Vert.	608.452	QP	22.7	19.4	11.6	29.4	24.3	46.0	21.7	

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.

Radiated Emission above 30 MHz (Spurious Emission)
<FOB BOX>

Report No. 13487461H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date September 4, 2020
Temperature / Humidity 22 deg. C / 47 % RH
Engineer Ken Fujita
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.	30.651	QP	24.1	18.3	7.0	28.6	20.8	40.0	19.2	
Hori.	33.957	QP	23.6	17.0	7.1	28.6	19.1	40.0	20.9	
Hori.	67.273	QP	23.2	6.4	7.6	28.6	8.6	40.0	31.4	
Hori.	130.449	QP	23.8	13.6	8.3	28.4	17.3	43.5	26.2	
Hori.	293.910	QP	25.6	13.6	9.7	27.8	21.1	46.0	24.9	
Hori.	719.778	QP	21.8	20.1	12.1	29.3	24.8	46.0	21.3	
Vert.	30.651	QP	24.3	18.3	7.0	28.6	21.0	40.0	19.0	
Vert.	33.957	QP	23.5	17.0	7.1	28.6	19.0	40.0	21.0	
Vert.	67.273	QP	23.4	6.4	7.6	28.6	8.8	40.0	31.2	
Vert.	130.449	QP	23.0	13.6	8.3	28.4	16.5	43.5	27.0	
Vert.	293.910	QP	24.8	13.6	9.7	27.8	20.3	46.0	25.7	
Vert.	719.778	QP	21.7	20.1	12.1	29.3	24.7	46.0	21.4	

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).

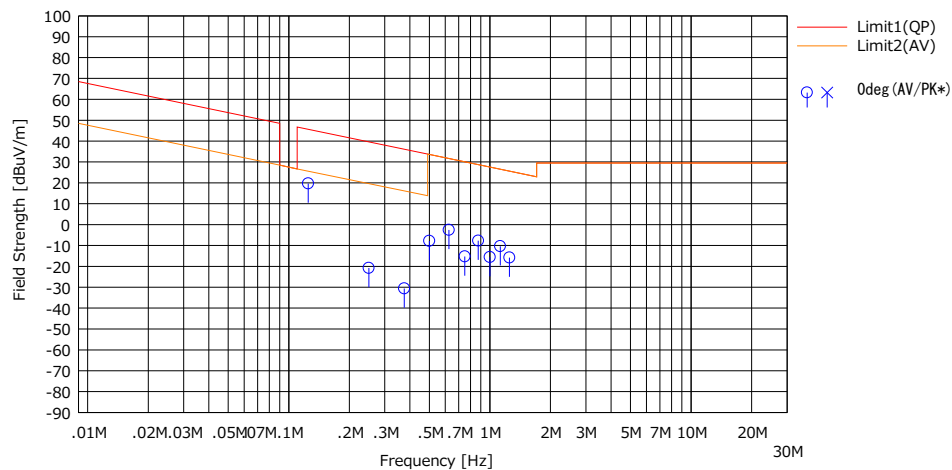
*The test result is rounded off to one or two decimal places, so some differences might be observed.

Radiated Emission Plot data, Worst case
<LF Antenna DR>

Report No. 13487461H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date September 4, 2020
Temperature / Humidity 22 deg. C / 47 % RH
Engineer Ken Fujita
Mode Mode 1

(below 30MHz)

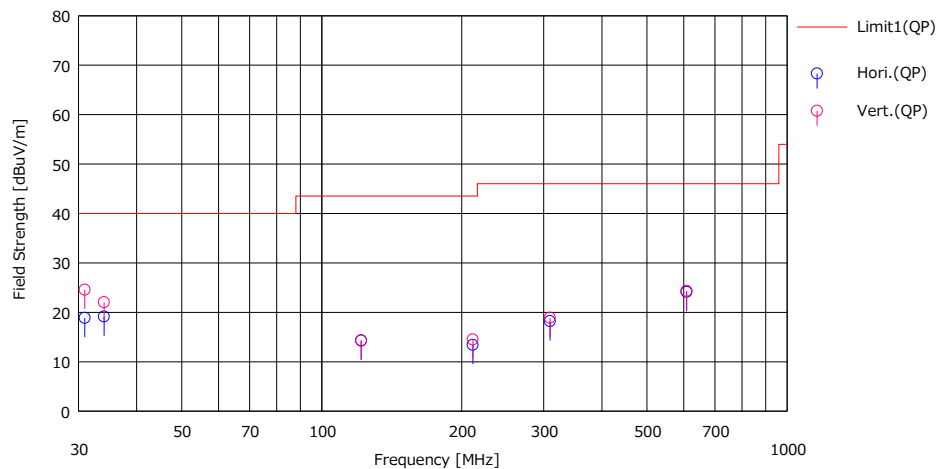
Limit : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP



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

(above 30MHz)

Limit : FCC15.209 3 m, below 1 GHz:QP, above 1 GHz:AV/PK



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

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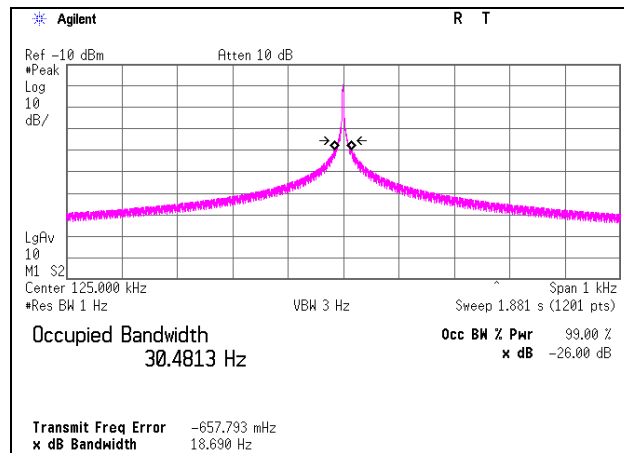
Facsimile : +81 596 24 8124

-26 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 13487461H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.2
Date September 4, 2020
Temperature / Humidity 22 deg. C / 47 % RH
Engineer Ken Fujita
Mode Mode 1

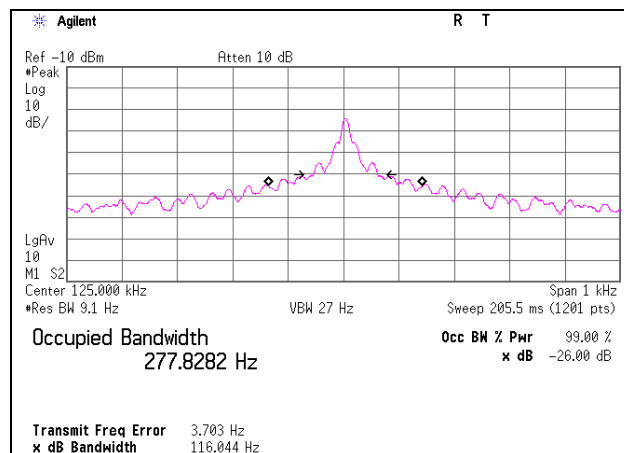
<LF Antenna DR>

-26 dB Bandwidth [Hz]	99 % Occupied Bandwidth [Hz]
18.690	30.4813



<FOB BOX>

-26 dB Bandwidth [Hz]	99 % Occupied Bandwidth [Hz]
116.044	277.8282



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APPENDIX 2: Test instruments

Test equipment

Test Item	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Cal Int
RE	MAEC-02	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	05/26/2020	24
RE	MOS-41	192300	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	0013	12/19/2019	12
RE	MMM-01	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	08/18/2020	12
RE	MJM-27	142228	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MAT-07	141203	Attenuator(6dB)	Weinschel Corp	2	BK7970	11/07/2019	12
RE	MBA-08	141427	Biconical Antenna	Schwarzbeck Mess - Elektronik	VHA9103B+BBA9106	8031	07/29/2020	12
RE	MCC-12	141317	Coaxial Cable	UL Japan Inc.	-	-	09/03/2019	12
RE	MLA-21	141265	Logperiodic Antenna(200-1000MHz)	Schwarzbeck Mess - Elektronik	VUSLP9111B	9111B-190	07/29/2020	12
RE	MPA-09	141578	Pre Amplifier	Keysight Technologies Inc	8447D	2944A10845	-	-
RE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/18/2020	12
RE	MLPA-01	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/04/2019	12
RE	MCC-143	141413	Coaxial Cable	UL Japan	-	-	06/18/2020	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

UL Japan, Inc.

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