

EMI TEST REPORT

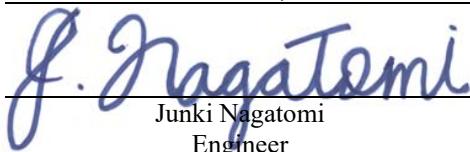
Test Report No. : 14082125H-A-R2

Applicant : DENSO CORPORATION
Type of EUT : Radio Frequency Key (RFK)
Model Number of EUT : YBN00
FCC ID : HYQYBN00
Test regulation : FCC Part 18
Test Result : Complied (Refer to SECTION 3)

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 standard.
4. The test results in this test report are traceable to the national or international standards.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by the A2LA accreditation body.
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, Inc. 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 14082125H-A-R1. 14082125H-A-R1 is replaced with this report.

Date of test: November 24, 2021

Representative test engineer:



Junki Nagatomi
Engineer

Approved by:



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".

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Report Cover Page - 13-EM-F0429 Issue # 19.0

REVISION HISTORY

Original Test Report No.: 14082125H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	14082125H-A	December 27, 2021	-	-
1	14082125H-A-R1	May 20, 2022	P.1	Deletion of "2021" from Test regulation
1	14082125H-A-R1	May 20, 2022	P.7	Update for FCC version
1	14082125H-A-R1	May 20, 2022	P.7	Correction of the Test Procedure & Limits in Clause 3.2; From Section 18.305 FCC/OST MP-5 To Section 18.305 FCC/OET MP-5
2	14082125H-A-R2	June 15, 2022	P.7	Correction of Test Specification in Clause 3.1

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Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	LIMS	Laboratory Information Management System
AC	Alternating Current	MCS	Modulation and Coding Scheme
AFH	Adaptive Frequency Hopping	MRA	Mutual Recognition Arrangement
AM	Amplitude Modulation	N/A	Not Applicable
Amp, AMP	Amplifier	NIST	National Institute of Standards and Technology
ANSI	American National Standards Institute	NS	No signal detect.
Ant, ANT	Antenna	NSA	Normalized Site Attenuation
AP	Access Point	OBW	Occupied BandWidth
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	Quadrature Phase Shift Keying
CW	Continuous Wave	RBW	Resolution BandWidth
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	RNSS	Radio Navigation Satellite Service
DSSS	Direct Sequence Spread Spectrum	RSS	Radio Standards Specifications
DUT	Device Under Test	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, T/R	Test Receiver
EN	European Norm	Tx	Transmitting
ERP, e.r.p.	Effective Radiated Power	VBW	Video BandWidth
ETSI	European Telecommunications Standards Institute	Vert.	Vertical
EU	European Union	WLAN	Wireless LAN
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		

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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.....	9
SECTION 5: Radiated Emission	10
APPENDIX 1: Test data	13
Radiated Emission	13
APPENDIX 2: Test instruments	15
APPENDIX 3: Photographs of test setup.....	16
Radiated Emission	16
Worst Case Position.....	18

SECTION 1: Customer information

Company Name : DENSO CORPORATION
Address : 1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661 Japan
Telephone Number : +81-566-61-5789
Contact Person : Toshiaki Saito

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 : Radio Frequency Key (RFK)
Model Number : YBN00
Serial Number : Refer to SECTION 4.2
Receipt Date : November 3, 2021
Condition : Engineering prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification : No Modification by the test lab

2.2 Product Description

Model: YBN00 (referred to as the EUT in this report) is a Radio Frequency Key (RFK).

General Specification

Rating : DC 3.7 V typical (DC 3.0 V to 4.2 V)
Operating Temperature : -30 deg. C to +60 deg. C

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Radio Specification

[UWB]

Radio Type : Transceiver
Frequency of Operation : (CH5): 6489.6 MHz (6240.0 to 6739.2 MHz),
(CH9): 7987.2 MHz (7737.6 to 8236.8 MHz)
Modulation : BPM-BPSK
Antenna Gain : (CH5): 6.78 dBi (max),
(CH9): 2.83 dBi (max)

[Bluetooth Low Energy]

Radio Type : Transceiver
Frequency of Operation : 2402 MHz to 2480 MHz
Modulation : GFSK
Antenna Gain : -1.69 dBi (max)

[NFC (Passive)]

Radio Type : Transceiver
Frequency of Operation : 13.56 MHz
Modulation : ASK

[WPC1.2 (5W BPP)] *1)

Equipment Type : Receiver
Operating Frequency : 110 kHz to 205 kHz
Rated Receive Output Power : 5 W (BPP)
Charging distance : Contact

*1) This test report applies to WPC1.2 (5W BPP).

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SECTION 3: Test specification, procedures & results

3.1 Test specification

Test Specification : FCC Part 18 2020, final revised on June 26, 2020 and effective July 27, 2020
 Title : FCC 47CFR Part18 Industrial, scientific, and medical equipment

3.2 Procedures and results

Item	Test Procedure & Limits	Deviation	Worst margin	Results	Remarks
Radiated emission	Section 18.305 FCC/OET MP-5	N/A	18.8 dB, 160.044 MHz, Horizontal	Complied a)	-
Conducted emission	Section 18.307 FCC/OET MP-5	N/A	N/A	N/A	*1)
*Note: UL Japan, Inc.'s EMI Work Procedure 13-EM-W0420.					
*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)					
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.					

3.3 Addition to standard

No addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI

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	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

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3.5 Test Location

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

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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SECTION 4: Operation of EUT during testing

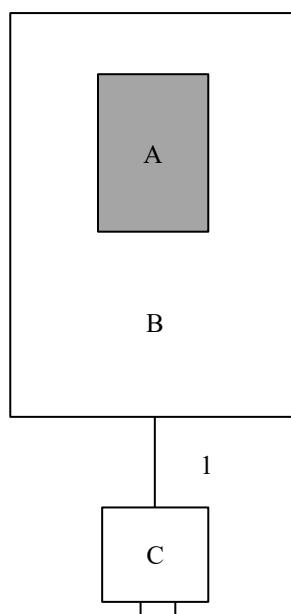
4.1 Operating mode(s)

The mode is used :

Test mode	Remarks
Charging mode	Mode 1

*The test was performed with the points designated by the customer and worst frequencies.

4.2 Configuration and peripherals



AC 100 V / 60 Hz

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

* The test was performed together with a representative transmitter.

* EUT was arranged so that the emission level becomes a maximum.

* EUT was set up to receive maximum power from the WPT source.

To receive maximum power, the test was performed with the batteries fully discharged.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	Radio Frequency Key (RFK)	YBN00	No.13	DENSO CORPORATION	EUT
B	Wireless Power TX	BQ50002AEVM-607	3404146WBG 1514117HH1	Texas Instruments	-
C	AC Adaptor	ACA-IP528K	J04-0256319	SANWA SUPPLY	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	USB Cable	1.0	Shielded	Shielded	-

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SECTION 5: Radiated Emission

5.1 Operating environment

Test place : No.1 semi anechoic chamber
Temperature : See data
Humidity : See data

5.2 Test configuration

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 1.0 m above the conducting ground plane. The EUT was set on the edge of the tabletop.

Test was made with the antenna positioned in 0 deg., 45 deg., 90 deg., 135 deg., 180 deg., and Horizontal.

The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength. Photographs of the set up are shown in Appendix 3.

*Refer to Figure 1 about Direction of the Loop Antenna.

5.3 Test conditions

Frequency range : 9 kHz - 30 MHz (Loop antenna)
30 MHz - 200 MHz (Biconical antenna)
200 MHz - 400 MHz (Logperiodic antenna)
Test distance : 3 m / 10 m
EUT position : Table top
EUT operation mode : See Clause 4.1

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5.4 Test procedure

Below 30 MHz

The height of antenna was fixed in 2 m.

EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed in 0 deg., 45 deg., 90 deg., 135deg., 180 deg., and Horizontal with the Test Receiver.

The test was made with the detector (RBW) in the following table.

The electric field intensity at a distance of 300 m was calculated from the measurement results at distances of 3 m and 10 m.

Above 30 MHz

Maximum electric field intensity was confirmed with the measurements at distances of 3 m and 10 m.

The electric field intensity at a distance of 300 m was calculated from the measurement results at distances of 3 m and 10 m.

The radiated emission measurements were made with the following detector function of the test receiver.

The test was made with the detector (RBW) in the following table.

Frequency	9 kHz - 150 kHz	150 kHz - 30 MHz	30 MHz - 400 MHz
Instrument used	Test Receiver		
IF Bandwidth	AV: 200 Hz	AV: 9 kHz	AV: 120 kHz

The measurement result was calculated by the following formula:

[Frequency at which the signal was confirmed at both 10m and 3m]

Result = Reading + ANT Factor + Cable loss + Atten loss + Extrapolation Factor - AMP gain

Extrapolation Factor = decade * Log (Test distance (3m) / Separate distance (300m))

decade = (10m reading - 3m reading) / (log 3m - log 10m)

*Refer to Part 18 Section 305 Notes 2 and KDB 629601.

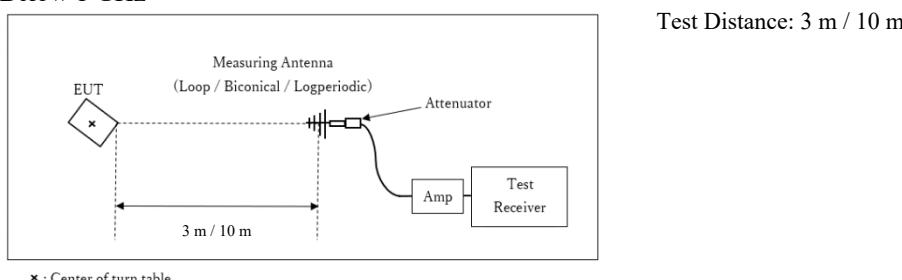
[Other Frequency]

Result = Reading + ANT Factor + Cable loss + Atten loss + Extrapolation Factor - AMP gain

Extrapolation Factor = 20 * Log (Test distance (3m) / Separate distance (300m))

<Test Setup>

Below 1 GHz



5.5 Test result

Summary of the test results: Pass

Date: November 24, 2021

Test engineer: Junki Nagatomi

UL Japan, Inc.

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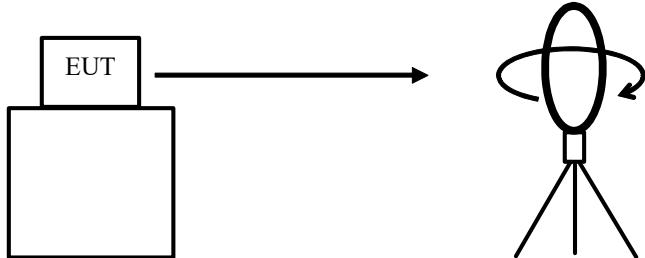
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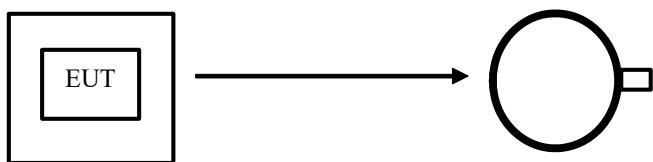
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

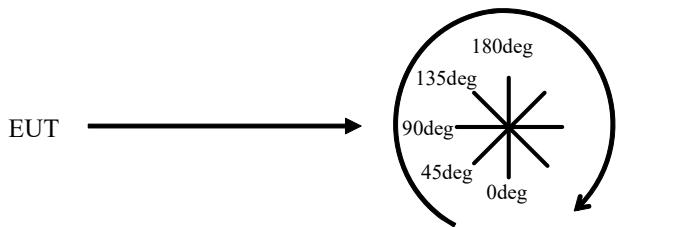


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

APPENDIX 1: Test data

Radiated Emission (Below 30 MHz)

Report No. 14082125H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.1
 Date November 24, 2021
 Temperature / Humidity 22 deg. C / 36 % RH
 Engineer Junki Nagatomi
 Mode Mode 1

FREQ [MHz]	Reading (3m) [dB μ V]	Reading (10m) [dB μ V]	ANT Factor [dB/m]	Atten + Cable loss [dB]	AMP Gain [dB]	Extrapolatio Factor [dB]	Result (300 m) [dB μ V/m]	Limit (300 m) [dB μ V/m]	Margin [dB]	Antenna [deg]	Remarks
0.1430	90.3	62.4	18.9	6.0	32.3	-106.7	-23.8	23.5	47.3	0	
0.1430	88.6	61.8	18.9	6.0	32.3	-102.5	-21.3	23.5	44.8	45	
0.1430	87.5	61.7	18.9	6.0	32.3	-98.7	-18.6	23.5	42.1	90	
0.1430	88.6	61.9	18.9	6.0	32.3	-102.1	-20.9	23.5	44.4	135	
0.1430	90.2	62.3	18.9	6.0	32.3	-106.7	-23.9	23.5	47.4	180	
0.1430	88.4	54.8	18.9	6.0	32.3	-128.5	-47.5	23.5	71.0	Horizontal	
0.2860	41.0	30.2	18.9	6.0	32.3	-40.0	-6.4	23.5	29.9	0	Reading(10m) is Floor Noise *1)
0.4290	65.4	37.9	18.8	6.1	32.3	-98.3	-40.4	23.5	63.9	0	
0.5720	32.0	27.3	18.8	6.1	32.4	-40.0	-15.5	23.5	39.0	0	Reading(10m) is Floor Noise *1)
0.7150	55.7	30.0	18.8	6.1	32.4	-98.3	-50.1	23.5	73.6	0	
0.8580	28.9	26.5	18.8	6.2	32.4	-40.0	-18.6	23.5	42.1	0	Reading(10m) is Floor Noise *1)
1.0010	49.7	27.5	18.8	6.2	32.4	-40.0	2.2	23.5	21.3	0	Reading(10m) is Floor Noise *1)
1.1440	27.7	26.1	18.8	6.2	32.4	-40.0	-19.7	23.5	43.2	0	Reading(10m) is Floor Noise *1)
1.2870	45.3	26.5	18.8	6.2	32.4	-40.0	-2.1	25.5	27.6	0	Reading(10m) is Floor Noise *1)
1.4300	27.0	26.0	18.8	6.2	32.4	-40.0	-20.4	23.5	43.9	0	Reading(10m) is Floor Noise *1)

CALCULATION(Result) : Reading + ANT Factor + Cable loss + Atten loss + Extrapolation Factor - AMP gain
 Extrapolation Factor = decade * Log (Test distance(3m) / Separate distance(300m))
 decade = (10m reading - 3m reading) / (log 3m - log 10m)

*1) Used for the square of an inverse linear distance extrapolation factor (20 dB/decade)
 Except for the above table : adequate margin data below the limits.

Worst direction of EUT was decided by test result performed on test distance at 3m, and test distance at 10 m was performed worst direction.

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Radiated emission
(Above 30 MHz)

Report No. 14082125H
 Test place Ise EMC Lab.
 Semi Anechoic Chamber No.1
 Date November 24, 2021
 Temperature / Humidity 22 deg. C / 36 % RH
 Engineer Junki Nagatomi
 Mode Mode 1

FREQ [MHz]	Reading (3m) [dB μ V]	Reading (10m) [dB μ V]	ANT Factor [dB/m]	AMP gain [dB]	Atten + Cable loss [dB]	Extrapolation Factor [dB]	Result (300 m) [dB μ V/m]	Limit (300 m) [dB μ V/m]	Margin [dB]	Antenna Polarization	Remarks
31.171	21.1	21.0	18.0	38.7	7.3	-40.0	-32.3	23.5	55.8	Horizontal	Reading(10m) is Floor Noise *1)
40.386	20.8	20.7	14.6	38.7	7.5	-40.0	-35.8	23.5	59.3	Horizontal	Reading(10m) is Floor Noise *1)
52.695	21.6	21.1	10.2	38.7	7.8	-40.0	-39.2	23.5	62.7	Horizontal	Reading(10m) is Floor Noise *1)
77.668	33.1	23.6	6.7	38.8	8.2	-36.3	-27.1	23.5	50.6	Horizontal	
92.905	45.4	28.5	8.9	38.8	8.4	-64.6	-40.8	23.5	64.3	Horizontal	
147.121	45.4	32.9	14.8	38.9	9.2	-47.8	-17.4	23.5	40.9	Horizontal	
160.044	36.9	32.2	15.4	38.9	9.3	-18.0	4.7	23.5	18.8	Horizontal	
31.171	28.6	23.8	18.0	38.7	7.3	-18.4	-3.1	23.5	26.6	Vertical	
40.386	27.2	22.2	14.6	38.7	7.5	-19.1	-8.6	23.5	32.1	Vertical	
52.695	31.9	24.2	10.2	38.7	7.8	-29.5	-18.4	23.5	41.9	Vertical	
82.259	36.2	26.5	7.2	38.8	8.3	-37.1	-24.3	23.5	47.8	Vertical	
92.905	40.4	26.8	8.9	38.8	8.4	-52.0	-33.1	23.5	56.6	Vertical	
147.479	41.1	35.2	14.8	38.9	9.2	-22.6	3.6	23.5	19.9	Vertical	
160.044	39.9	32.5	15.4	38.9	9.3	-28.3	-2.6	23.5	26.1	Vertical	

CALCULATION(Result) : Reading + ANT Factor + Cable loss + Atten loss + Extrapolation Factor - AMP gain

Extrapolation Factor = decade * Log (Test distance(3m) / Separate distance(300m))

decade = (10m reading - 3m reading) / (log 3m - log 10m)

*1) Used for the square of an inverse linear distance extrapolation factor (20 dB/decade)

Except for the above table : adequate margin data below the limits.

Worst direction of EUT was decided by test result performed on test distance at 3m, and test distance at 10m was performed worst direction.

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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-01	141998	AC1_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	06/08/2020	24
RE	MOS-27	141566	Thermo-Hygrometer	CUSTOM, Inc	CTH-201	A08Q26	01/15/2021	12
RE	MMM-03	141530	Digital Tester	Fluke Corporation	FLUKE 26-3	78030621	08/10/2021	12
RE	MJM-25	142226	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-MEMI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	03/09/2021	12
RE	MCC-03	141215	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W/3D-2W/RG400u/RFM-E421(SW)	-/01068 (Switcher)	06/02/2021	12
RE	MLPA-01	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	04/17/2021	12
RE	MCC-255	207745	Coaxial Cable	UL Japan Inc.	-	-	05/17/2021	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/18/2021	12
RE	KBA-05	141198	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	2513	04/10/2021	12
RE	MLA-20	141264	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	189	04/10/2021	12
RE	MAT-08	141213	Attenuator(6dB)	Weinschel Corp	2	BK7971	11/13/2020	12
RE	MCC-02	141350	Coaxial Cable	Suhner/storm/Agilent/TSJ	-	-	06/02/2021	12
RE	MPA-19	141585	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	02/18/2021	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.

Ise EMC Lab.

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