



# EMI TEST REPORT

**Test Report No. : 14098787H-B-R1**

**Applicant** : Mitsubishi Electric Corporation Himeji Works  
**Type of EUT** : Smart Keyless System (Smart Unit)  
**Model Number of EUT** : SKEA7D-04  
**FCC ID** : WAZSKEA7D04  
**Test regulation** : FCC Part 15 Subpart B: 2021  
**Test Result** : Complied (Refer to SECTION 3)

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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 EMC technical requirements. It does not cover administrative issues such as Manual or non-EMC 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 14098787H-B. 14098787H-B is replaced with this report.

**Date of test:** December 26, 2021 and January 5, 2022

**Representative test engineer:** Kiyo  
Kiyoshiro Okazaki  
Engineer

**Approved by:** T. Takayama  
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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**Ise EMC Lab.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN  
Telephone : +81 596 24 8999  
Facsimile : +81 596 24 8124

## **REVISION HISTORY**

### **Original Test Report No.: 14098787H-B**

Revision	Test report No.	Date	Page revised	Contents
- (Original)	14098787H-B	January 25, 2022	-	-
1	14098787H-B-R1	February 16, 2022	P.5	Deletion of “Bandwidth” from LF Part for Radio Specification of Clause 2.2.
1	14098787H-B-R1	February 16, 2022	P.5	Correction of erroneous description (Clock frequency (maximum) and Antenna Type) of LF Part in Radio Specification in Section 2.2.

## Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	IEEE	Institute of Electrical and Electronics Engineers
AAN	Asymmetric Artificial Network	IF	Intermediate Frequency
AC	Alternating Current	ILAC	International Laboratory Accreditation Conference
AM	Amplitude Modulation	ISED	Innovation, Science and Economic Development Canada
AMN	Artificial Mains Network	ISN	Impedance Stabilization Network
Amp, AMP	Amplifier	ISO	International Organization for Standardization
ANSI	American National Standards Institute	JAB	Japan Accreditation Board
Ant, ANT	Antenna	LAN	Local Area Network
AP	Access Point	LCL	Longitudinal Conversion Loss
ASK	Amplitude Shift Keying	LIMS	Laboratory Information Management System
Atten., ATT	Attenuator	LISN	Line Impedance Stabilization Network
AV	Average	MRA	Mutual Recognition Arrangement
BPSK	Binary Phase-Shift Keying	N/A	Not Applicable
BR	Bluetooth Basic Rate	NIST	National Institute of Standards and Technology
BT	Bluetooth	NS	No signal detect.
BT LE	Bluetooth Low Energy	NSA	Normalized Site Attenuation
BW	BandWidth	OBW	Occupied BandWidth
C.F	Correction Factor	OFDM	Orthogonal Frequency Division Multiplexing
Cal Int	Calibration Interval	PER	Packet Error Rate
CAV	CISPR AV	PK	Peak
CCK	Complementary Code Keying	PLT	long-term flicker severity
CDN	Coupling Decoupling Network	POHC(A)	Partial Odd Harmonic Current
Ch., CH	Channel	Pol., Pola.	Polarization
CISPR	Comite International Special des Perturbations Radioelectriques	PR-ASK	Phase Reversal ASK
Corr.	Correction	P <sub>ST</sub>	short-term flicker severity
CPE	Customer premise equipment	QAM	Quadrature Amplitude Modulation
CW	Continuous Wave	QP	Quasi-Peak
DBPSK	Differential BPSK	QPSK	Quadrature Phase Shift Keying
DC	Direct Current	r.m.s., RMS	Root Mean Square
DET	Detector	RBW	Resolution BandWidth
D-factor	Distance factor	RE	Radio Equipment
Dmax	maximum absolute voltage change during an observation period	REV	Reverse
DQPSK	Differential QPSK	RF	Radio Frequency
DSSS	Direct Sequence Spread Spectrum	RFID	Radio Frequency Identifier
DUT	Device Under Test	RNSS	Radio Navigation Satellite Service
EDR	Enhanced Data Rate	RSS	Radio Standards Specifications
e.i.r.p., EIRP	Equivalent Isotropically Radiated Power	Rx	Receiving
EM clamp	Electromagnetic clamp	SINAD	Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)
EMC	ElectroMagnetic Compatibility	S/N	Signal to Noise ratio
EMI	ElectroMagnetic Interference	SA, S/A	Spectrum Analyzer
EMS	ElectroMagnetic Susceptibility	SG	Signal Generator
EN	European Norm	SVSWR	Site-Voltage Standing Wave Ratio
e.r.p., ERP	Effective Radiated Power	THC(A)	Total Harmonic Current
ETSI	European Telecommunications Standards Institute	THD(%)	Total Harmonic Distortion
EU	European Union	TR, T/R	Test Receiver
EUT	Equipment Under Test	Tx	Transmitting
Fac.	Factor	VBW	Video BandWidth
FCC	Federal Communications Commission	Vert.	Vertical
FHSS	Frequency Hopping Spread Spectrum	WLAN	Wireless LAN
FM	Frequency Modulation	xDSL	Generic term for all types of DSL technology (DSL: Digital Subscriber Line)
Freq.	Frequency		
FSK	Frequency Shift Keying		
Fund	Fundamental		
FWD	Forward		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
I/O	Input/Output		
IEC	International Electrotechnical Commission		

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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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## **SECTION 1: Customer information**

Company Name : Mitsubishi Electric Corporation Himeji Works  
Address : 840, Chiyoda-machi, Himeji City, Hyogo-ken 670-8677 Japan  
Telephone Number : +81-79-298-7363  
Contact Person : Yasuhiro Takahashi

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 : Smart Keyless System (Smart Unit)  
Model Number : SKEA7D-04  
Serial Number : Refer to SECTION 4.2  
Receipt Date : December 9, 2021  
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: SKEA7D-04 (referred to as the EUT in this report) is a Smart Keyless System (Smart Unit).

#### **General Specification**

Rating : DC 12.0 V

#### **Radio Specification**

##### **LF Part** \*1)

Equipment Type : Transmitter  
Frequency of operation : 125 kHz  
Type of modulation : ASK  
Clock frequency (maximum) : 8 MHz  
Antenna Type : Inductive

##### **RF Part**

Type of Receiver : Receiver  
Frequency of operation : 315 MHz  
Intermediate frequency : 280 kHz  
Antenna Type : Pattern antenna  
Local Oscillator Frequency : 314.72 MHz  
Clock Frequency (maximum) : 30.32 MHz  
Voltage Controlled Oscillator : 1888.32 MHz

\*1) The test of LF Part was performed separately from this test report, and the conformability is confirmed.

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### **SECTION 3: Test specification, procedures & results**

#### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart B  
FCC Part 15 final revised on May 3, 2021 and effective July 2, 2021  
Title : FCC 47CFR Part15 Radio Frequency Device  
Subpart B Unintentional Radiators

#### **3.2 Procedures and results**

Item	Test Procedure	Limits	Deviation	Worst margin	Result	Remarks
Conducted emission	FCC: ANSI C63.4: 2014 + C63.4a: 2017 7. AC power - line conducted emission measurements	FCC:Part 15 Subpart B 15.107(a)	N/A	N/A	N/A	*1)
	ISED: RSS-Gen 7.1	ISED: RSS-Gen 7.2				
Radiated emission	FCC: ANSI C63.4: 2014 + C63.4a: 2017 8. Radiated emission measurements	FCC: Part 15 Subpart B 15.109(a)	N/A	25.56 dB 629.440 MHz, QP, Vertical	Complied a)	-
	ISED: RSS-Gen 7.1	ISED: RSS-Gen 7.3				
Antenna Terminal	FCC: ANSI C63.4: 2014 + C63.4a: 2017 12. Measurement of unintentional radiators other than ITE	FCC: Part 15 Subpart B 15.111(a)	N/A	N/A	N/A	*2)
	ISED: - RSS-Gen 7.1	ISED: RSS-Gen 7.4				

\*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.

\*2) The receiving antenna (of this EUT) is installed inside the EUT and cannot be removed (permanently attached).  
Therefore, Radiated emission test was performed.

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

There is no applicable rule of uncertainty in this applied standard. Therefore, the 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	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		5.0 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.2 dB
		6.3 dB
10 m	30 MHz to 200 MHz (Horizontal) (Vertical)	4.8 dB
		4.8 dB
	200 MHz to 1000 MHz (Horizontal) (Vertical)	5.0 dB
		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	5.5 dB
	26.5 GHz to 40 GHz	5.5 dB
0.5 m	26.5 GHz to 40 GHz	5.5 dB
10 m	1 GHz to 18 GHz	5.2 dB

### 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

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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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Facsimile : +81 596 24 8124



## **SECTION 4: Operation of EUT during testing**

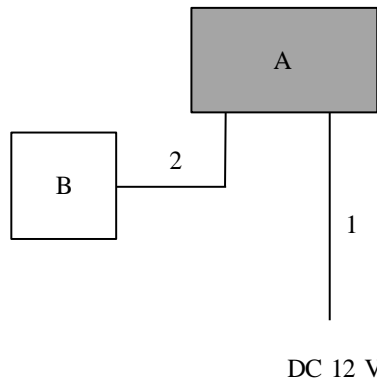
### **4.1 Operating Mode(s)**

Mode	Remarks
1) Receiving mode	-
* EUT was set by the software as follows; Software: DX100481 Version 3964	

\*The test signal level was confirmed to be sufficient to stabilize the local oscillator of the EUT.

\*Tuning was confirmed to be locked on each mode by checking local oscillator frequency to be stable using a search-coil.

### **4.2 Configuration and peripherals**



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

### **Description of EUT and Support equipment**

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Smart Keyless System (Smart Unit)	SKEA7D-04	20211118-E1 No.46	Mitsubishi Electric Corporation Himeji Works	EUT
B	SW and Light	-	-	Mitsubishi Electric Corporation Himeji Works	-

### **List of cables used**

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	1.50	Unshielded	Unshielded	-
2	Signal Cable	0.85	Unshielded	Unshielded	-

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## **SECTION 5: Radiated Emission**

### **5.1 Operating environment**

Test place : No.3 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 0.8 m above the conducting ground plane.

The EUT was set on the edge of the tabletop.

Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. 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.

### **5.3 Test conditions**

Frequency range : 30 MHz - 200 MHz (Biconical antenna) / 200 MHz - 1000 MHz (Logperiodic antenna)  
1000 MHz - 10000 MHz (Horn antenna)  
Test distance : 3 m  
EUT position : Table top  
EUT operation mode : See Clause 4.1

### **5.4 Test procedure**

The height of the measuring antenna 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 with the Test Receiver.

The radiated emission measurements were made with the following detector function of the Test Receiver.

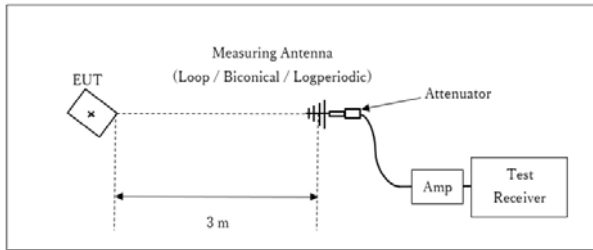
For above 1 GHz, test antenna was aimed at the EUT for receiving the maximum signal and always kept within the illumination area of the 3 dB beamwidth of the antenna.

Frequency	Below 1GHz	Above 1GHz *1)
Instrument used	Test Receiver	Test Receiver
IF Bandwidth	QP: BW 120 kHz	PK: BW 1 MHz, CAV: BW 1 MHz

\*1) The measurement data was adjusted to a 3 m distance using the following Distance Factor.  
Distance Factor: See Figure 1.

**Figure 1: Test Setup**

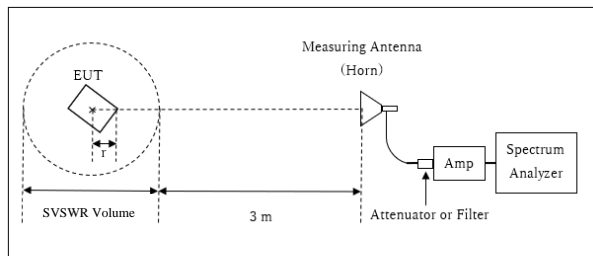
Below 1 GHz



× : Center of turn table

Test Distance: 3 m

1 GHz - 10 GHz



r : Radius of an outer periphery of EUT

× : Center of turn table

Distance Factor:  $20 \times \log(3.95 \text{ m}^*/3.0 \text{ m}) = 2.39 \text{ dB}$   
\* Test Distance:  $(3 + \text{SVSWR Volume} / 2) - r = 3.95 \text{ m}$

SVSWR Volume: 2 m  
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)  
 $r = 0.05 \text{ m}$

\*The test was performed with  $r = 0.0 \text{ m}$  since EUT is small and it was the rather conservative condition.

- The 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.

### 5.5 Test result

Summary of the test results: Pass

The limit is rounded down to one decimal place.

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

Date: December 26, 2021  
January 5, 2022

Test engineer:

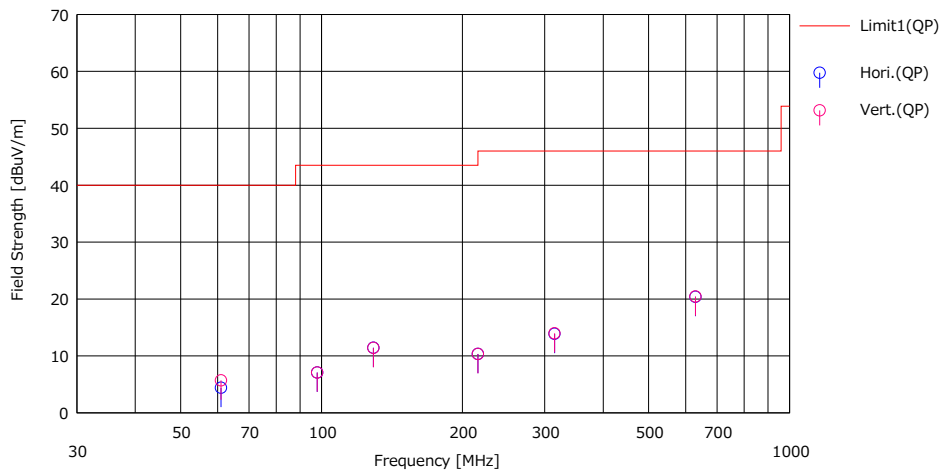
Junya Okuno  
Kiyoshiro Okazaki

**APPENDIX 1: Test data**

**Radiated Emission**

Report No. 14098787H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date December 26, 2021  
Temperature / Humidity 19 deg. C / 28 % RH  
Engineer Junya Okuno  
(Below 1 GHz)  
Mode Mode 1

Limit : FCC\_Part 15 Subpart B(15.109)\_Class B



No.	Freq. [MHz]	Reading	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result	Limit	Margin	Polz. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		[dBUV]				<QP>	<QP>	<QP>					
1	61.000	21.50	7.57	7.60	32.27	4.40	40.00	35.60	Hori.	100	0	BA	
2	97.910	21.27	9.93	8.10	32.24	7.06	43.50	36.44	Hori.	100	0	BA	
3	129.124	21.49	13.71	8.45	32.22	11.43	43.50	32.07	Hori.	100	230	BA	
4	216.000	21.51	11.70	9.31	32.16	10.36	43.50	33.14	Hori.	100	0	LA22	
5	314.720	21.59	14.26	10.12	32.09	13.88	46.00	32.12	Hori.	100	0	LA22	
6	629.440	20.83	19.49	12.15	32.09	20.38	46.00	25.62	Hori.	100	0	LA22	
7	61.000	22.80	7.57	7.60	32.27	5.70	40.00	34.30	Vert.	100	0	BA	
8	97.910	21.29	9.93	8.10	32.24	7.08	43.50	36.42	Vert.	100	0	BA	
9	129.124	21.46	13.71	8.45	32.22	11.40	43.50	32.10	Vert.	100	0	BA	
10	216.000	21.49	11.70	9.31	32.16	10.34	43.50	33.16	Vert.	100	0	LA22	
11	314.720	21.69	14.26	10.12	32.09	13.98	46.00	32.02	Vert.	100	0	LA22	
12	629.440	20.89	19.49	12.15	32.09	20.44	46.00	25.56	Vert.	100	0	LA22	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATT) - GAIN(AMP)

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

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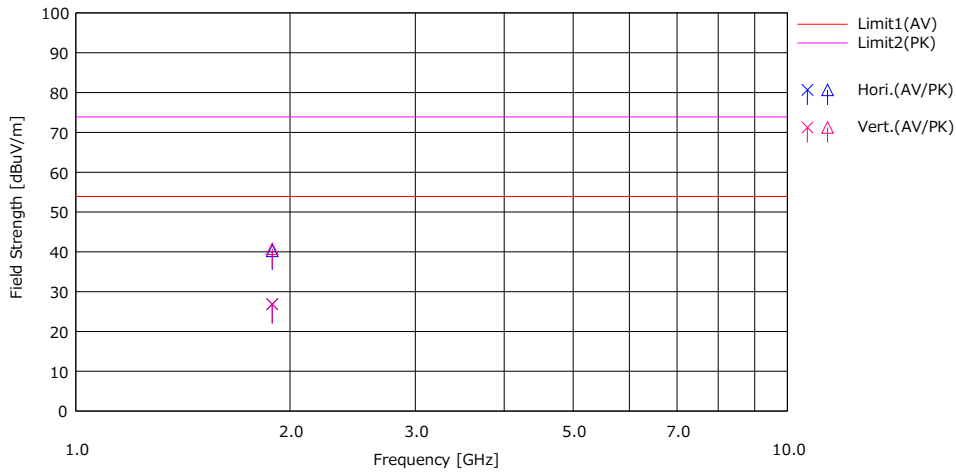
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## Radiated Emission

Report No. 14098787H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.3  
Date January 5, 2022  
Temperature / Humidity 24 deg. C / 28 % RH  
Engineer Kiyoshiro Okazaki  
(Above 1 GHz)  
Mode Mode 1

Limit : FCC\_Part 15 Subpart B(15.109)\_Class B



No.	Freq. [MHz]	Reading		Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	Result		Limit		Margin		Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		<AV> [dBuV]	<PK> [dBuV]				<AV> [dBuV/m]	<PK> [dBuV/m]	<AV> [dBuV/m]	<PK> [dBuV/m]	<AV> [dB]	<PK> [dB]					
1	1888.320	29.80	43.20	25.47	4.60	33.02	26.85	40.25	53.90	73.90	27.05	33.65	Hori.	100	1	H20	
2	1888.320	29.80	43.70	25.47	4.60	33.02	26.85	40.75	53.90	73.90	27.05	33.15	Vert.	100	12	H20	

CHART: WITH FACTOR

ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN

CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + D-factor) - GAIN(AMP)

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

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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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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-03	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	05/22/2020	24
RE	MOS-13	141554	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	1301	01/15/2021	12
RE	MMM-08	141532	DIGITAL HiTESTER	HIOKI E.E. CORPORATION	3805	51201197	01/07/2021	12
RE	MJM-16	142183	Measure	KOMELON	KMC-36	-	-	-
RE	COTS-ME MI-02	178648	EMI measurement program	TSJ (Techno Science Japan)	TEPTO-DV	-	-	-
RE	MBA-05	141425	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	VHA9103+BBA9106	VHA 91031302	08/28/2021	12
RE	MLA-22	141266	Logperiodic Antenna (200-1000MHz)	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	9111B-191	08/21/2021	12
RE	MAT-95	142314	Attenuator	Pasternack Enterprises	PE7390-6	D/C 1504	06/09/2021	12
RE	MCC-51	141323	Coaxial cable	UL Japan	-	-	07/19/2021	12
RE	MPA-13	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	02/18/2021	12
RE	MTR-03	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	08/05/2021	12
RE	MAEC-03-SVSWR	142013	AC3_Semi Anechoic Chamber(SVSWR)	TDK	Semi Anechoic Chamber 3m	DA-10005	04/01/2021	24
RE	MHA-20	141507	Horn Antenna 1-18GHz	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	258	11/09/2021	12
RE	MCC-231	177964	Microwave Cable	Junkosha INC.	MMX221	1901S329(1m)/1902S579(5m)	03/04/2021	12
RE	MPA-11	141580	MicroWave System Amplifier	Keysight Technologies Inc	83017A	MY39500779	03/03/2021	12
RE	MTR-10	141951	EMI Test Receiver	Rohde & Schwarz	ESR26	101408	03/09/2021	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.**

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124