EMI TEST REPORT

Test Report No. : 12223183H-D-R1

Applicant	:	**Mitsubishi Electric Corporation Himeji works**
Type of Equipment	:	**Smart Keyless System (Smart Unit)**
Model No.	:	**SKE8AD-01**
FCC ID	:	**WAZSKE8AD01**
Test regulation	:	**FCC Part 15 Subpart B: 2018**
Test Result	:	**Complied**

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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 above regulation.
4. The test results in this report are traceable to the national or international standards.
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6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. This test report covers EMC technical requirements. It does not cover administrative issues such as Manual or non-EMC test related Requirements. (if applicable)
8. This report is a revised version of 12223183H-D. 12223183H-D is replaced with this report.

Date of test: April 17, 2018

Representative test engineer:
Toshifumi Yoneshige
Engineer
Consumer Technology Division

Approved by:
Motoya Imura
Leader
Consumer Technology Division

NVLAP LAB CODE: 200572-0

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.
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REVISION HISTORY

Original Test Report No.: 12223183H-D

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12223183H-D	May 23, 2018	-	-
1	12223183H-D-R1	May 30, 2018	P.9	Correction of Test data (Frequency: 314.767 MHz) in APPENDIX 1.
1	12223183H-D-R1	May 30, 2018	P.11	Correction of Test instruments in APPENDIX 2.

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SECTION 1: Customer information

Company Name	:	Mitsubishi Electric Corporation Himeji works
Address	:	840 Chiyoda-machi, Himeji Hyogo 670-8677 Japan
Telephone Number	:	+81-79-298-7363
Facsimile Number	:	+81-79-298-9929
Contact Person	:	Shinichi Furuta

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Smart Keyless System (Smart Unit)
Model No.	:	SKE8AD-01
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12.0 V
Receipt Date of Sample	:	April 11, 2018
Country of Mass-production	:	Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: SKE8AD-01 (referred to as the EUT in this report) is a Smart Keyless System (Smart Unit).

Radio Specification

LF Part *

Equipment Type	:	Transmitter
Type of modulation	:	ASK
Frequency of operation	:	125 kHz
Other clock frequency	:	10 MHz
Antenna Type	:	Inductive
Clock frequency	:	10 MHz (CPU), 29.509394 MHz (RF receiving IC)

RF Part

Type of Receiver	:	Receiver
Frequency of operation	:	315 MHz
Other clock frequency	:	29.509394 MHz
Intermediate frequency	:	220 kHz
Antenna Type	:	Bar Antenna

* The test of transmitter part was performed separately from this test report, and the conformability is confirmed. LF Part test report No. 12223183H-C-R1 (FCC15C).

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart B FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart B Unintentional Radiators

3.2 Procedures and results

Item	Test Procedure	Limits	Deviation	Worst margin	Result
Conducted emission	**FCC:** ANSI C63.4: 2014 7. AC power - line conducted emission measurements	**FCC:**Part 15 Subpart B 15.107(a)	N/A *1)	N/A	N/A
	IC: RSS-Gen 8.8	**IC:** RSS-Gen 8.8			
Radiated emission	**FCC:** ANSI C63.4: 2014 8. Radiated emission measurements	**FCC:** Part 15 Subpart B 15.109(a)	N/A	18.6 dB 921.900 MHz, Horizontal, QP	Complied
	IC: RSS-Gen 7	**IC:** RSS-Gen 7.1.2			
*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.					

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 $k = 2$.

Polarity	Radiated emission (Below 1 GHz)			
	(3 m*)(+/-)		(10 m*)(+/-)	
	30 MHz to 200 MHz	200 MHz to 1000 MHz	30 MHz to 200 MHz	200 MHz to 1000 MHz
Horizontal	4.8 dB	5.2 dB	4.8 dB	5.0 dB
Vertical	5.0 dB	6.3 dB	4.9 dB	5.0 dB

Radiated emission (Above 1 GHz)				
(3 m*)(+/-)		(1 m*)(+/-)		(10 m*)(+/-)
1 GHz to 6 GHz	6 GHz to 18 GHz	10 GHz to 26.5 GHz	26.5 GHz to 40 GHz	1 GHz to 18 GHz
5.0 dB	5.3 dB	5.8 dB	5.8 dB	5.2 dB

* Measurement distance

Radiated emission test (3 m)
The data listed in this test report has enough margin, more than the site margin.

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
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NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	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	2973C-1	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	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	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	2973C-4	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.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	N/A	-	-
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 m 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.

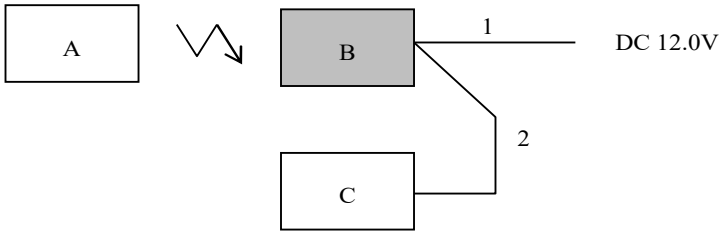
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Mode	Remarks
1) Receiving mode (315 MHz)	-

* It was confirmed by using test bench that the EUT receives the signal from the transmitter (pair of EUT).

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 (Hand Unit)	SKE8AD-02	20180410-T2 (No.2)	Mitsubishi Electric Corporation Himeji works	-
B	Smart Keyless System (Smart Unit)	SKE8AD-01	20180410-E2(No.2)	Mitsubishi Electric Corporation Himeji works	EUT
C	SW BOX	SW BOX2	No.11	Mitsubishi Electric Corporation Himeji works	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	1.4	Unshielded	Unshielded	-
2	DC and Signal Cable	1.3	Unshielded	Unshielded	(No.8)

SECTION 5: Radiated Emission

5.1 Operating environment

Test place : No.2 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 - 4000 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.

Frequency	Below 1 GHz	Above 1 GHz *1)
Instrument used	Test Receiver	Spectrum Analyzer
IF Bandwidth	QP: BW 120 kHz	PK: RBW: 1 MHz / VBW: 3 MHz AV *2): RBW: 1 MHz / VBW: 10 Hz

*1) The measurement data was adjusted to a 3 m distance using the following Distance Factor.
Distance Factor: 20 x log (3.75 m / 3 m) = 1.94 dB
*2) When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

- 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.

5.5 Test result

Summary of the test results: Pass

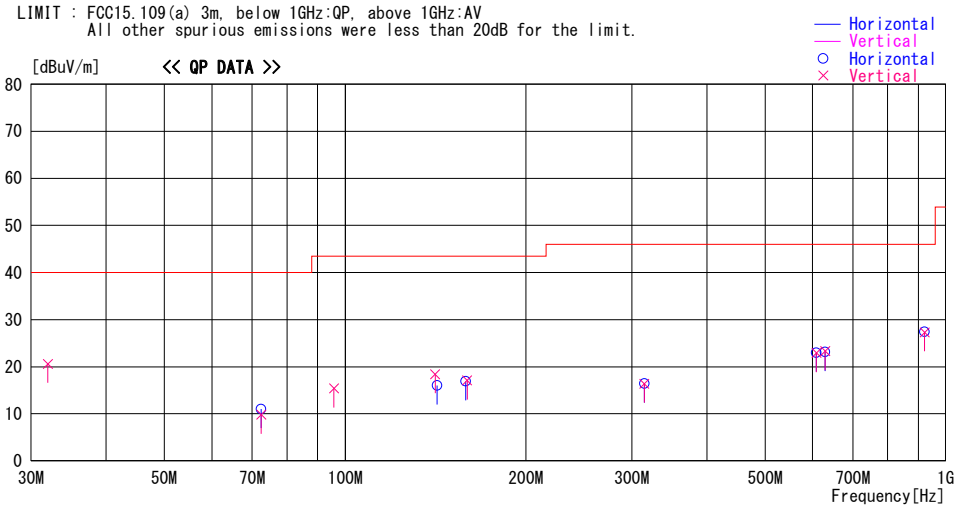
The limit is rounded down to one decimal place.
The test result is rounded off to one or two decimal places, so some differences might be observed.

Date: April 17, 2018 Test engineer: Toshifumi Yoneshige

APPENDIX 1: Test data

Radiated emission

Report No.	12223183H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 17, 2018
Temperature / Humidity	25 deg. C / 36 % RH
Engineer	Toshifumi Yoneshige (Below 1 GHz)
Mode	Mode 1

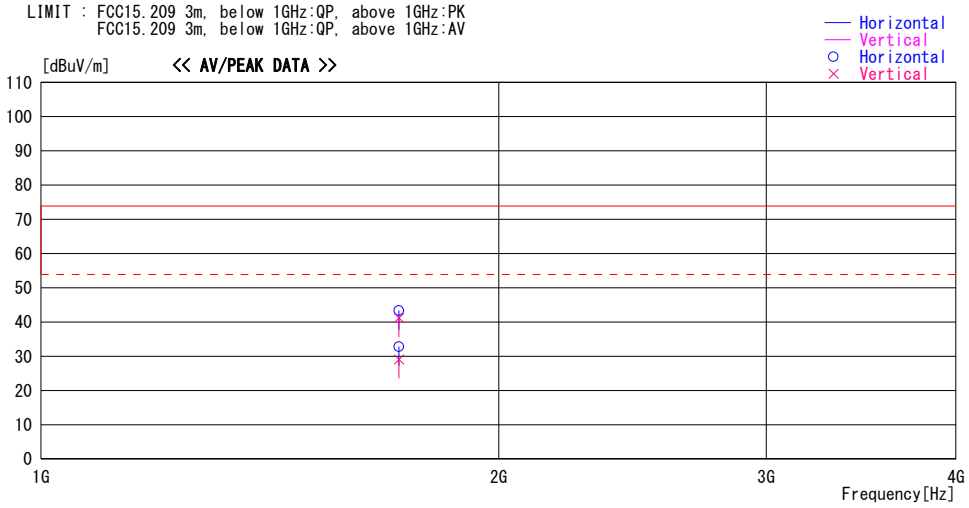


Frequency [MHz]	Reading [dBuV]	DET	Antenna Factor [dB/m]	Loss& Gain [dB]	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
32.003	27.3	QP	17.0	-23.7	20.6	359	100	Vert.	40.0	19.4	
72.499	26.7	QP	6.3	-23.2	9.8	343	100	Vert.	40.0	30.2	
72.503	27.9	QP	6.3	-23.2	11.0	163	300	Hori.	40.0	29.0	
95.832	29.0	QP	9.3	-22.9	15.4	344	100	Vert.	43.5	28.1	
141.208	26.2	QP	14.4	-22.2	18.4	223	100	Vert.	43.5	25.1	
142.244	23.8	QP	14.4	-22.2	16.0	321	283	Hori.	43.5	27.5	
158.863	23.7	QP	15.2	-22.0	16.9	5	275	Hori.	43.5	26.6	
159.630	23.8	QP	15.3	-22.0	17.1	175	100	Vert.	43.5	26.4	
314.767	22.9	QP	13.8	-20.3	16.4	359	211	Hori.	46.0	29.6	
314.767	22.9	QP	13.8	-20.3	16.4	352	100	Vert.	46.0	29.6	
608.600	23.2	QP	19.2	-19.4	23.0	252	100	Hori.	46.0	23.0	
608.600	23.1	QP	19.2	-19.4	22.9	0	100	Vert.	46.0	23.1	
629.534	23.1	QP	19.3	-19.3	23.1	253	100	Hori.	46.0	22.9	
629.534	23.3	QP	19.3	-19.3	23.3	251	100	Vert.	46.0	22.7	
921.900	21.8	QP	22.0	-16.5	27.3	341	100	Vert.	46.0	18.7	
921.900	21.9	QP	22.0	-16.5	27.4	348	100	Hori.	46.0	18.6	

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 & GAIN (CABLE + ATT - GAIN(AMP))

Radiated emission

Report No.	12223183H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	April 17, 2018
Temperature / Humidity	25 deg. C / 36 % RH
Engineer	Toshifumi Yoneshige
	(Above 1 GHz)
Mode	Mode 1



Frequency [MHz]	Reading [dBuV]	DET	Antenna Factor [dB/m]	Loss& Gain [dB]	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
1720.001	37.5	AV	26.0	-30.7	32.8	31	100	Hori.	53.9	21.1	
1720.001	48.1	PK	26.0	-30.7	43.4	31	100	Hori.	73.9	30.5	
1720.003	33.8	AV	26.0	-30.7	29.1	50	204	Vert.	53.9	24.8	
1720.003	45.9	PK	26.0	-30.7	41.2	50	204	Vert.	73.9	32.7	

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 & GAIN (CABLE - GAIN(AMP) + D-factor)

APPENDIX 2: Test instruments

Test Instruments

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141942	Test Receiver	ROHDE & SCHWARZ	ESCI	100300	8/21/2017	8/31/2018	12
RE	142182	Measure	KOMELON	KMC-36	-	-	-	-
RE	141578	Pre Amplifier	AGILENT	8447D	2944A10845	9/27/2017	9/30/2018	12
RE	141317	Coaxial Cable	Fujikura/Agilent	-	-	2/23/2018	2/28/2019	12
RE	141203	Attenuator(6dB)	Weinschel Corp	2	BK7970	11/14/2017	11/30/2018	12
RE	141265	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	12/10/2017	12/31/2018	12
RE	141427	Biconical Antenna	Schwarzbeck	VHA9103B	8031	9/13/2017	9/30/2018	12
RE	141556	Thermo-Hygrometer	CUSTOM	CTH-201	0003	12/21/2017	12/31/2018	12
RE	141901	Spectrum Analyzer	AGILENT	E4440A	MY48250080	10/18/2017	10/31/2018	12
RE	141542	Digital Tester	Fluke Corporation	FLUKE 26-3	78030611	8/7/2017	8/31/2018	12
RE	142004	AC2_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	8/31/2017	8/31/2018	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141579	Pre Amplifier	AGILENT	8449B	3008A02142	1/23/2018	1/31/2019	12
RE	141392	Microwave Cable	Junkosha	MWX221	1604S253(1 m) / 1608S087(5 m)	8/4/2017	8/31/2018	12
RE	141512	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	254	2/25/2018	2/27/2019	12

***Hyphens for Last Calibration Date, Calibration Due 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.
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test item:

RE: Radiated emission