



RADIO TEST REPORT

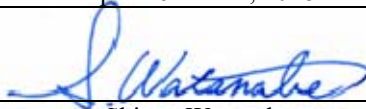
Test Report No. : 12223183H-C-R1

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 C: 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 above regulation.
4. The test results in this 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 Federal Government.
8. This report is a revised version of 12223183H-C. 12223183H-C is replaced with this report.

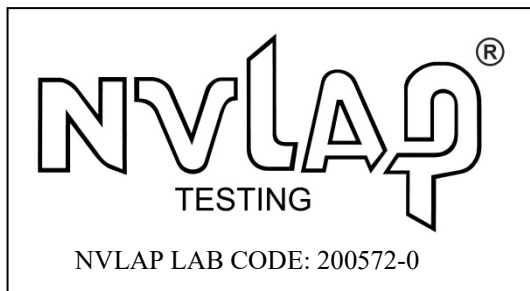
Date of test: April 16 and 24, 2018

Representative test engineer:


Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:


Motoya Imura
Leader
Consumer Technology Division



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- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 12223183H-C

[illegible]**UL Japan, Inc.**

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Telephone : +81 596 24 8999

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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 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 No: SKE8AD-01 (referred to as the EUT in this report) is the 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 receiver part was performed separately from this test report, and the conformability is confirmed.
RF Part test report No. 12223183H-D-R1 (FCC15B).

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018

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

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	Conducted Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 8.8	<FCC> Section 15.207 <IC> RSS-Gen 8.8	-	N/A *1)	N/A	N/A
2	Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.4, 6.12	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	8.2 dB 0.12500 MHz PK with Duty factor	Complied
3	Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.4, 6.13	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	11.0 dB 77.493 MHz, Vertical, QP	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> -	<FCC> Reference data <IC> -	Radiated	N/A	N/A	Complied

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.

FCC 15.31 (e)

This test was performed with the New Battery (DC 12 V) and the constant voltage was supplied to this EUT during the tests. 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 EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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3.3 Addition to standard

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99 % Occupied Band Width	RSS-Gen 6.6	-	Radiated	N/A	N/A	N/A

Other than above, 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
5.2 dB	5.5 dB	5.9 dB	5.9 dB	5.5 dB

* Measurement distance

Radiated emission test(3 m)

The data listed in this test report has enough margin, more than the site margin.

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Facsimile : +81 596 24 8124

3.5 Test Location

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
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.

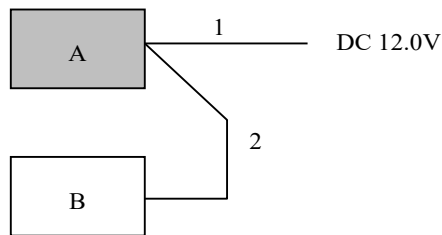
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

Test mode	Remarks
1) Tx 125 kHz Mod on	-

Justification: The system was configured in typical fashion (as a customer 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.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Smart Keyless System (Smart Unit)	SKE8AD-01	20180410-E1(No.1)	Mitsubishi Electric Corporation Himeji works	EUT
B	SW BOX	SW BOX1	No.5	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	1.5	Unshielded	Unshielded	(No.8)

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SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

EUT was placed on a urethane platform of nominal size, 1.5 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 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 result is rounded off to the second decimal place, so some differences might be observed.

Measurement range : 9 kHz - 1 GHz

Test data : APPENDIX

Test result : Pass

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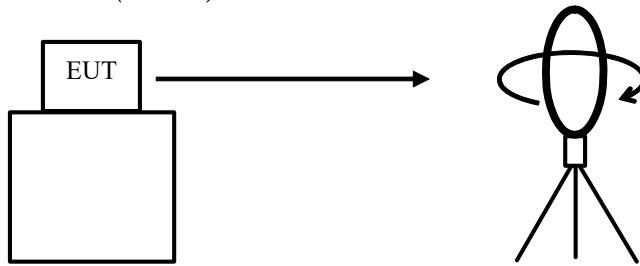
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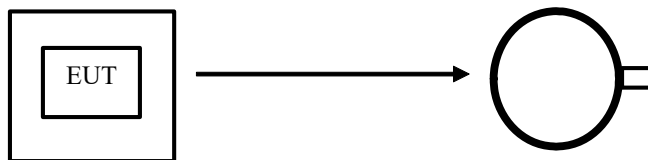
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

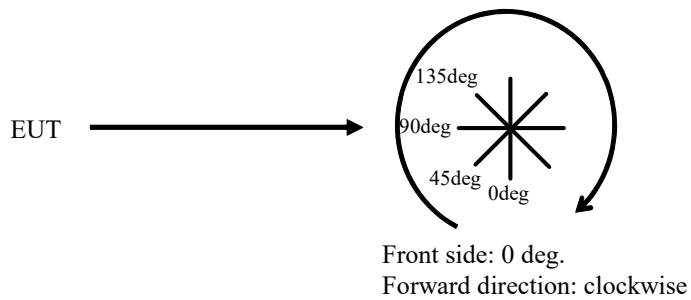


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



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	200 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

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Facsimile : +81 596 24 8124

APPENDIX 1: Test data

Radiated Emission below 30MHz (Fundamental and Spurious Emission)

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No. : 12223183H
Date : April 16, 2018
Temperature/ Humidity : 24 deg. C / 38 % RH
Engineer : Shinya Watanabe
Mode : Tx 125 kHz Mod on

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
0	0.12500	PK	103.7	19.8	-73.9	32.2	-	17.4	45.6	28.2	Fundamental
0	0.25000	PK	66.3	19.7	-73.9	32.2	-	-20.1	39.6	59.7	
0	0.37500	PK	63.9	19.7	-73.9	32.2	-	-22.5	36.1	58.6	
0	0.50000	QP	42.4	19.7	-33.9	32.1	-	-3.9	33.6	37.5	
0	0.62500	QP	54.7	19.7	-33.9	32.2	-	8.3	31.7	23.4	
0	0.75000	QP	42.4	19.7	-33.8	32.2	-	-3.9	30.1	34.0	
0	0.87500	QP	48.6	19.7	-33.8	32.2	-	2.3	28.7	26.4	
0	1.00000	QP	41.2	19.7	-33.8	32.2	-	-5.1	27.6	32.7	
0	1.12500	QP	44.7	19.7	-33.8	32.2	-	-1.6	26.5	28.1	

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
0	0.12500	AV	103.7	19.8	-73.9	32.2	0.0	17.4	25.6	8.2	
0	0.25000	AV	66.3	19.7	-73.9	32.2	0.0	-20.1	19.6	39.7	
0	0.37500	AV	63.9	19.7	-73.9	32.2	0.0	-22.5	16.1	38.6	

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 3 m without Distance factor

PK

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
0	0.12500	PK	103.7	19.8	6.1	32.2	-	97.4	-	-	Fundamental

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

*All spurious emissions lower than this result.

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

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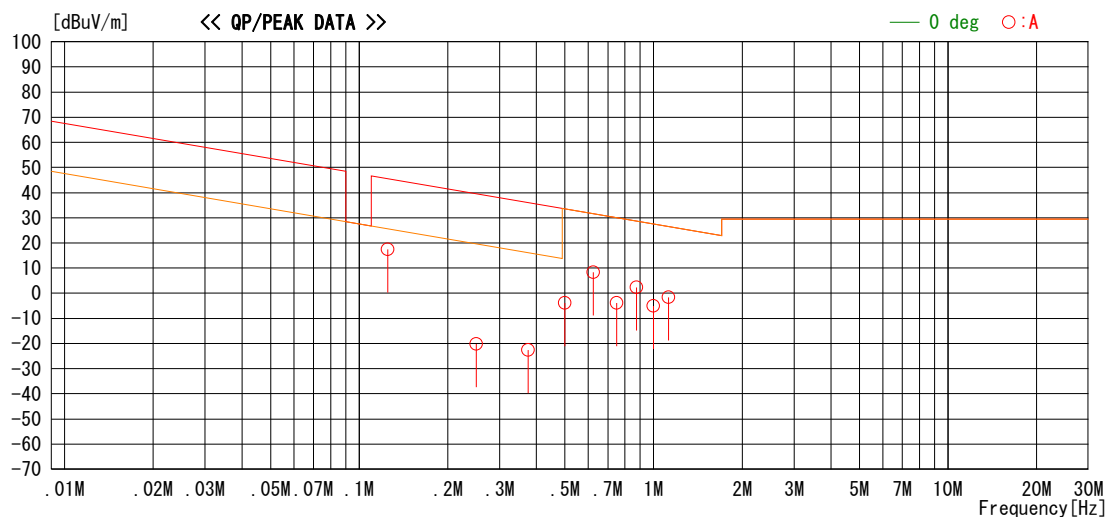
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Radiated Emission below 30MHz (Fundamental and Spurious Emission)
(Plot data, Worst case)

Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No.	12223183H
Date	April 16, 2018
Temperature/ Humidity	24 deg. C / 38 % RH
Engineer	Shinya Watanabe
Mode	Tx 125 kHz Mod on



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

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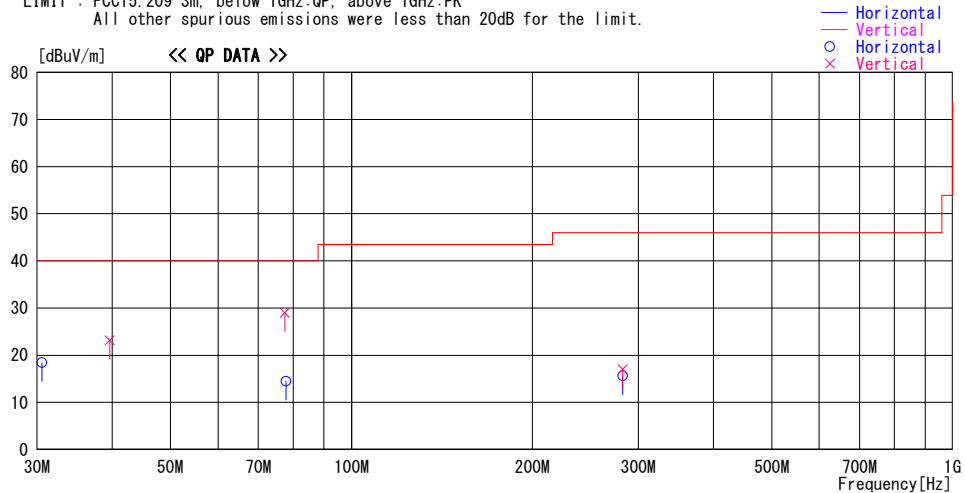
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Radiated Emission above 30 MHz (Spurious Emission)

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber
Report No. : 12223183H
Date : April 16, 2018
Temperature/ Humidity : 24 deg. C / 38 % RH
Engineer : Shinya Watanabe
Mode : Tx 125 kHz Mod on

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
All other spurious emissions were less than 20dB for the limit.



Frequency [MHz]	Reading [dBuV]	DET	Antenna	Loss&	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Gain [dB]							
30.557	24.7	QP	17.5	-23.8	18.4	0	310	Hori.	40.0	21.6	
39.629	32.1	QP	14.7	-23.6	23.2	202	100	Vert.	40.0	16.8	
77.493	45.8	QP	6.3	-23.1	29.0	248	100	Vert.	40.0	11.0	
77.823	31.3	QP	6.3	-23.1	14.5	199	215	Hori.	40.0	25.5	
282.667	24.6	QP	12.9	-20.5	17.0	3	100	Vert.	46.0	29.0	
282.669	23.2	QP	12.9	-20.5	15.6	15	100	Hori.	46.0	30.4	

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))

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

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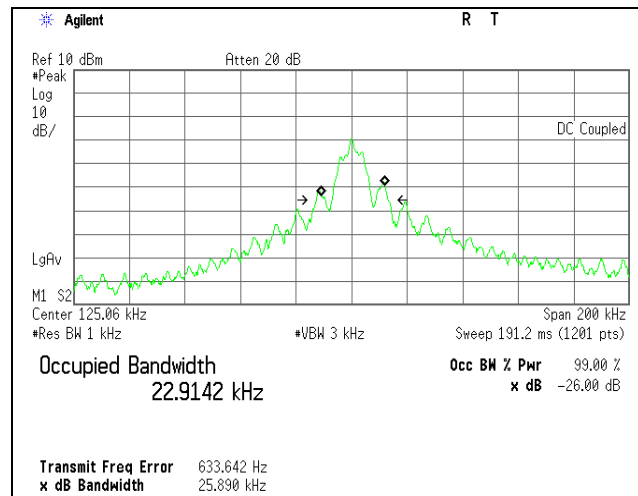
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-26 dB Bandwidth and 99 % Occupied Bandwidth

Report No. 12223183H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.4
Date April 24, 2018
Temperature / Humidity 23 deg. C / 41 % RH
Engineer Shinya Watanabe
Mode Tx 125 kHz Mod on

-26 dB Bandwidth	99 % Occupied Bandwidth
[kHz]	[kHz]
25.890	22.9142



APPENDIX 2: Test instruments

Test equipment

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	141583	Pre Amplifier	SONOMA INSTRUMENT	11/5/1900	260833	2/27/2018	2/28/2019	12
RE	141556	Thermo-Hygrometer	CUSTOM	CTH-201	0003	12/21/2017	12/31/2018	12
RE	141254	Loop Antenna	ROHDE & SCHWARZ	HFH2-Z2	100017	10/11/2017	10/31/2018	12
RE	141222	Coaxial Cable	FUJIKURA	3D-2W(12m)/ 5D-2W(5m)/ 5D-2W(0.8m)/5	-	2/23/2018	2/28/2019	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	141413	Coaxial Cable	UL Japan	-	-	6/12/2017	6/30/2018	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: Spurious 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