



RADIO TEST REPORT

Test Report No. : 12095693H-B-R1

Applicant : Mitsubishi Electric Corporation Himeji works
Type of Equipment : Keyless System LFU
Model No. : SKE114-01
FCC ID : WAZSKE11401
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.
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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. This report is a revised version of 12095693H-B. 12095693H-B is replaced with this report.

Date of test: January 29 and 30, 2018

Representative test engineer:

K. Yamamoto
Koji Yamamoto

Engineer

Consumer Technology Division

Approved by:

M. Imura
Motoya Imura

Leader

Consumer Technology Division



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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

13-EM-F0429

REVISION HISTORY

Original Test Report No.: 12095693H-B

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CONTENTS	PAGE
SECTION 1: Customer information	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results	5
SECTION 4: Operation of E.U.T. during testing.....	8
SECTION 5: Radiated emission (Fundamental and Spurious Emission).....	10
SECTION 6: -26 dB Bandwidth.....	12
SECTION 7: 99 % Occupied Bandwidth.....	12
APPENDIX 1: Test data	13
Radiated Emission below 30MHz (Fundamental and Spurious Emission)	13
Radiated Emission above 30 MHz (Spurious Emission).....	17
-26 dB Bandwidth and 99 % Occupied Bandwidth	20
APPENDIX 2: Test instruments	23
APPENDIX 3: Photographs of test setup	24
Radiated Emission.....	24
Worst Case Position	25

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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	:	+81-79-298-8994
Facsimile Number	:	+81-79-298-9929
Contact Person	:	Masashi Nojima

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

2.1 Identification of E.U.T.

Type of Equipment	:	Keyless System LFU
Model No.	:	SKE114-01
Serial No.	:	Refer to Clause 4.2
Rating	:	DC 12.0 V
Receipt Date of Sample	:	January 25, 2018
Country of Mass-production	:	Thailand / Mexico
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: SKE114-01 (referred to as the EUT in this report) is the Keyless System LFU.

Radio Specification

Radio Type	:	Transmitter
Frequency of Operation	:	125 kHz
Modulation	:	ASK
Method of Frequency Generation	:	Crystal
Antenna type	:	Inductive
Duty Cycle	:	Very Low
Clock Frequency (maximum)	:	(CPU) 8 MHz, (RF-IC) Inner RC: 8 MHz

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Facsimile : +81 596 24 8124

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on February 2, 2018 and effective March 5, 2018

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted Emission
Section 15.209 Radiated emission limits, general requirements

* The revision on February 2, 2018, does not affect the test specification applied to the EUT.

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	3.0 dB 0.12500 MHz PK with Duty factor (ANT-C)	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	10.2 dB 55.625 MHz, Horizontal, QP (ANT-C)	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> -	<FCC> Reference data <IC> -	Radiated	N/A	N/A	N/A

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 vehicle. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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

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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(3m)

[Electric Field Strength of Fundamental Emission]

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

[Electric Field Strength of Spurious Emission]

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

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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

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

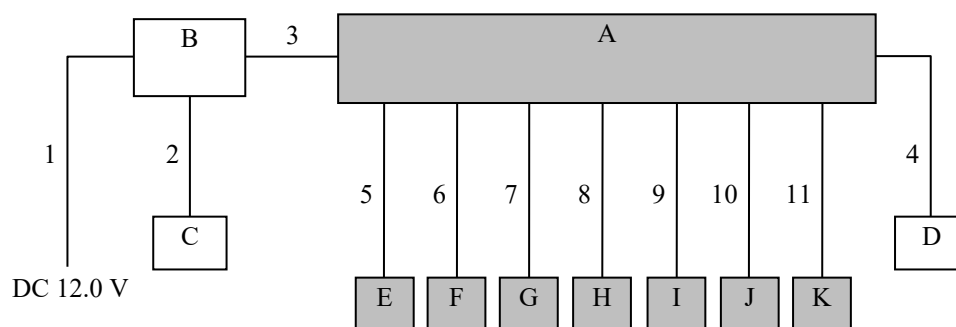
Test mode	Remarks
1) Tx 125 kHz Mod on, ANT-FR	*1)
2) Tx 125 kHz Mod on, ANT-C	*2)
3) Tx 125 kHz Mod on, Antenna-Coil	-

*1) As a result of preliminary test with ANT-FL and ANT-FR, the formal test was performed with ANT-FR, which had the maximum power.

*2) As a result of preliminary test with ANT-BP, ANT-F, ANT-R and ANT-C, the formal test was performed with ANT-C, because ANT-C had the maximum power.

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.

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

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Keyless System LFU	SKE114-01	20180124-L1 (No.1)	Mitsubishi Electric Corporation Himeji Works	EUT
B	Control JIG	-	No.1	Mitsubishi Electric Corporation Himeji Works	-
C	SW BOX	-	No.1	Mitsubishi Electric Corporation Himeji Works	-
D	Keyless System Receiver	SKE115-01	20180124-R4 (No.4)	Mitsubishi Electric Corporation Himeji Works	-
E	LF Antenna (Door)	ANT-FL	No.1	-	EUT
F	LF Antenna (Door)	ANT-FR	No.1	-	EUT
G	LF Antenna (Bumper)	ANT-BP	No.4	Mitsubishi Electric Corporation Himeji Works	EUT
H	LF Antenna (Room)	ANT-F	No.4	Mitsubishi Electric Corporation Himeji Works	EUT
I	LF Antenna (Room)	ANT-R	No.4	Mitsubishi Electric Corporation Himeji Works	EUT
J	LF Antenna (Room)	ANT-C	No.4	Mitsubishi Electric Corporation Himeji Works	EUT
K	Antenna coil (Immobilizer)	-	No.21	-	EUT

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	DC and Signal Cable	1.0	Unshielded	Unshielded	(No.1)
3	DC and Signal Cable	1.0	Unshielded	Unshielded	(No.1)
4	DC and Signal Cable	1.5	Unshielded	Unshielded	(No.1)
5	Antenna Cable	1.2	Unshielded	Unshielded	(No.1)
6	Antenna Cable	1.2	Unshielded	Unshielded	(No.1)
7	Antenna Cable	1.2	Unshielded	Unshielded	(No.1)
8	Antenna Cable	1.2	Unshielded	Unshielded	(No.1)
9	Antenna Cable	1.2	Unshielded	Unshielded	(No.1)
10	Antenna Cable	1.2	Unshielded	Unshielded	(No.1)
11	Antenna Cable	1.2	Unshielded	Unshielded	(No.1)

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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

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.

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

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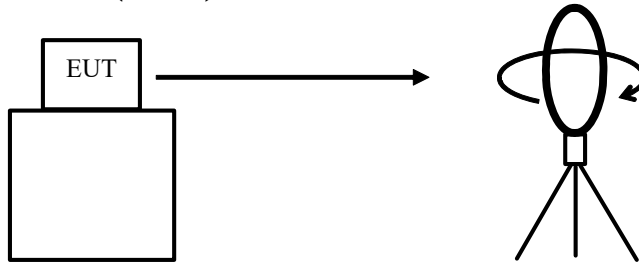
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

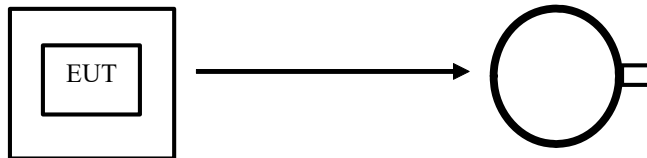
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

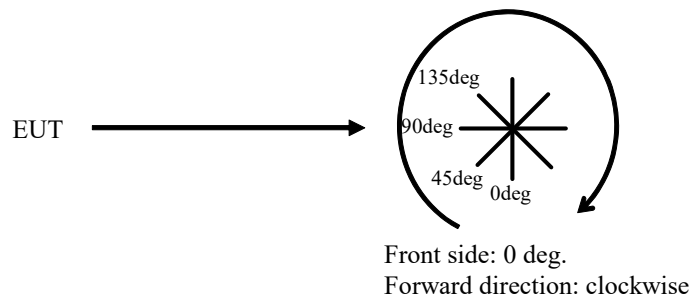


Top View (Horizontal)



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	100 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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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

APPENDIX 1: Test data

Radiated Emission below 30MHz (Fundamental and Spurious Emission) (ANT-FR)

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 12095693H
Date : January 29, 2018
Temperature/ Humidity : 21 deg. C / 35 % RH
Engineer : Koji Yamamoto
Mode : Tx 125 kHz Mod on, ANT-FR

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	107.7	19.8	-74.0	32.2	-	21.3	45.6	24.3	Fundamental
0	0.25000	PK	76.2	19.7	-74.0	32.2	-	-10.3	39.6	49.9	
0	0.37500	PK	56.9	19.7	-73.9	32.2	-	-29.5	36.1	65.6	
0	0.50000	QP	38.9	19.7	-33.9	32.1	-	-7.4	33.6	41.0	
0	0.62500	QP	32.8	19.7	-33.9	32.2	-	-13.6	31.7	45.3	
0	0.75000	QP	32.3	19.7	-33.9	32.2	-	-14.1	30.1	44.2	
0	0.87500	QP	31.4	19.7	-33.9	32.2	-	-15.0	28.7	43.7	
0	1.00000	QP	31.9	19.7	-33.8	32.2	-	-14.4	27.6	42.0	
0	1.12500	QP	30.9	19.7	-33.8	32.2	-	-15.4	26.5	41.9	

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	0.125	AV	107.7	19.8	-74.0	32.2	0.0	21.3	25.6	4.3	
0	0.250	AV	76.2	19.7	-74.0	32.2	0.0	-10.3	19.6	29.9	
0	0.375	AV	56.9	19.7	-73.9	32.2	0.0	-29.5	16.1	45.6	

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	107.7	19.8	6.0	32.2	-	101.3	-	-	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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4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

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Radiated Emission below 30MHz (Fundamental and Spurious Emission) (ANT-C)

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 12095693H
Date : January 29, 2018
Temperature/ Humidity : 21 deg. C / 35 % RH
Engineer : Koji Yamamoto
Mode : Tx 125 kHz Mod on, ANT-C

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	109.0	19.8	-74.0	32.2	-	22.6	45.6	23.0	Fundamental
0	0.25000	PK	79.2	19.7	-74.0	32.2	-	-7.3	39.6	46.9	
0	0.37500	PK	72.1	19.7	-73.9	32.2	-	-14.3	36.1	50.4	
0	0.50000	QP	52.8	19.7	-33.9	32.1	-	6.5	33.6	27.1	
0	0.62500	QP	41.0	19.7	-33.9	32.2	-	-5.4	31.7	37.1	
0	0.75000	QP	43.0	19.7	-33.9	32.2	-	-3.4	30.1	33.5	
0	0.87500	QP	36.7	19.7	-33.9	32.2	-	-9.7	28.7	38.4	
0	1.00000	QP	37.6	19.7	-33.8	32.2	-	-8.7	27.6	36.3	
0	1.12500	QP	32.9	19.7	-33.8	32.2	-	-13.4	26.5	39.9	

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	0.125	AV	109.0	19.8	-74.0	32.2	0.0	22.6	25.6	3.0	
0	0.250	AV	79.2	19.7	-74.0	32.2	0.0	-7.3	19.6	26.9	
0	0.375	AV	72.1	19.7	-73.9	32.2	0.0	-14.3	16.1	30.4	

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	109.0	19.8	6.0	32.2	-	102.6	-	-	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.

UL Japan, Inc.

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Radiated Emission below 30MHz (Fundamental and Spurious Emission) (Antenna-Coil)

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 12095693H
Date : January 29, 2018
Temperature/ Humidity : 21 deg. C / 35 % RH
Engineer : Koji Yamamoto
Mode : Tx 125 kHz Mod on, Antenna-Coil

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	90.1	19.8	-74.0	32.2	-	3.7	45.6	41.9	Fundamental
0	0.25000	PK	45.3	19.7	-74.0	32.2	-	-41.2	39.6	80.8	
0	0.37500	PK	40.4	19.7	-73.9	32.2	-	-46.0	36.1	82.1	
0	0.50000	QP	33.0	19.7	-33.9	32.1	-	-13.3	33.6	46.9	
0	0.62500	QP	32.2	19.7	-33.9	32.2	-	-14.2	31.7	45.9	
0	0.75000	QP	31.8	19.7	-33.9	32.2	-	-14.6	30.1	44.7	
0	0.87500	QP	31.3	19.7	-33.9	32.2	-	-15.1	28.7	43.8	
0	1.00000	QP	31.5	19.7	-33.8	32.2	-	-14.8	27.6	42.4	
0	1.12500	QP	31.6	19.7	-33.8	32.2	-	-14.7	26.5	41.2	

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	0.125	AV	90.1	19.8	-74.0	32.2	0.0	3.7	25.6	21.9	
0	0.250	AV	45.3	19.7	-74.0	32.2	0.0	-41.2	19.6	60.8	
0	0.375	AV	40.4	19.7	-73.9	32.2	0.0	-46.0	16.1	62.1	

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	90.1	19.8	6.0	32.2	-	83.7	-	-	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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Ise EMC Lab.

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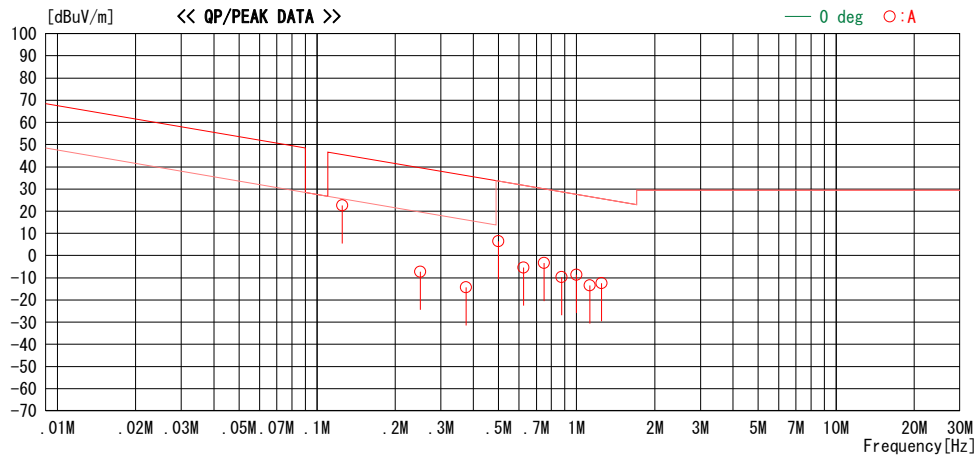
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 12095693H
Date : January 29, 2018
Temperature/ Humidity : 21 deg. C / 35 % RH
Engineer : Koji Yamamoto
Mode : Tx 125 kHz Mod on, ANT-C

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



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

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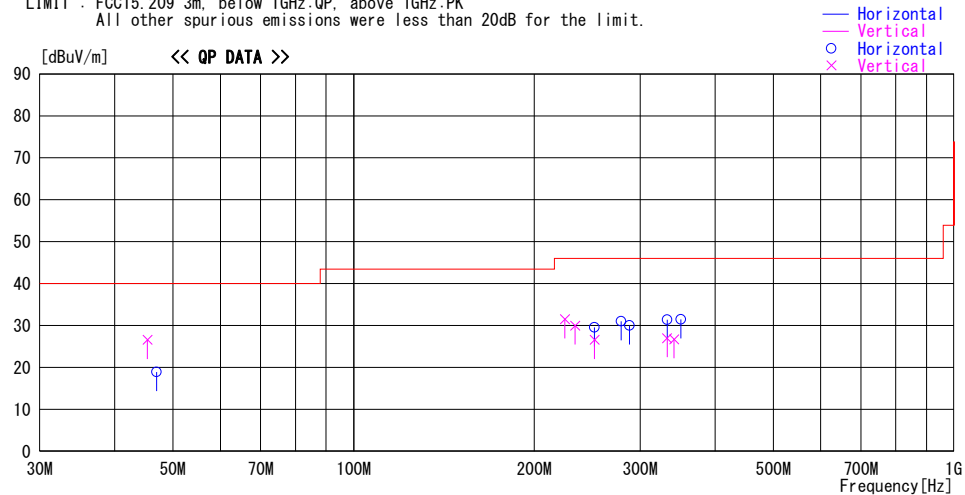
Telephone : +81 596 24 8999

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Radiated Emission above 30 MHz (Spurious Emission) (ANT-FR)

Report No. 12095693H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date January 30, 2018
Temperature / Humidity 21 deg. C / 32 % RH
Engineer Koji Yamamoto
Mode Tx 125 kHz Mod on, ANT-FR

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



Frequency	Reading	DET	Antenna Factor	Loss& Gain	Level	Angle	Height	Polar.	Limit	Margin	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
45.358	45.4	QP	12.3	-31.1	26.6	243	100	Vert.	40.0	13.4	
46.954	38.3	QP	11.7	-31.1	18.9	212	300	Hori.	40.0	21.1	
224.906	48.8	QP	11.6	-28.9	31.5	46	100	Vert.	46.0	14.5	
233.905	47.3	QP	11.6	-28.9	30.0	64	100	Vert.	46.0	16.0	
251.901	43.5	QP	11.8	-28.7	26.6	267	100	Vert.	46.0	19.4	
251.901	46.5	QP	11.8	-28.7	29.6	112	100	Hori.	46.0	16.4	
278.891	46.8	QP	12.7	-28.5	31.0	270	100	Hori.	46.0	15.0	
287.888	45.3	QP	13.1	-28.4	30.0	251	100	Hori.	46.0	16.0	
332.871	40.6	QP	14.2	-27.8	27.0	102	100	Vert.	46.0	19.0	
332.871	45.0	QP	14.2	-27.8	31.4	285	100	Hori.	46.0	14.6	
341.867	40.1	QP	14.4	-27.8	26.7	97	100	Vert.	46.0	19.3	
350.865	44.5	QP	14.6	-27.6	31.5	297	100	Hori.	46.0	14.5	

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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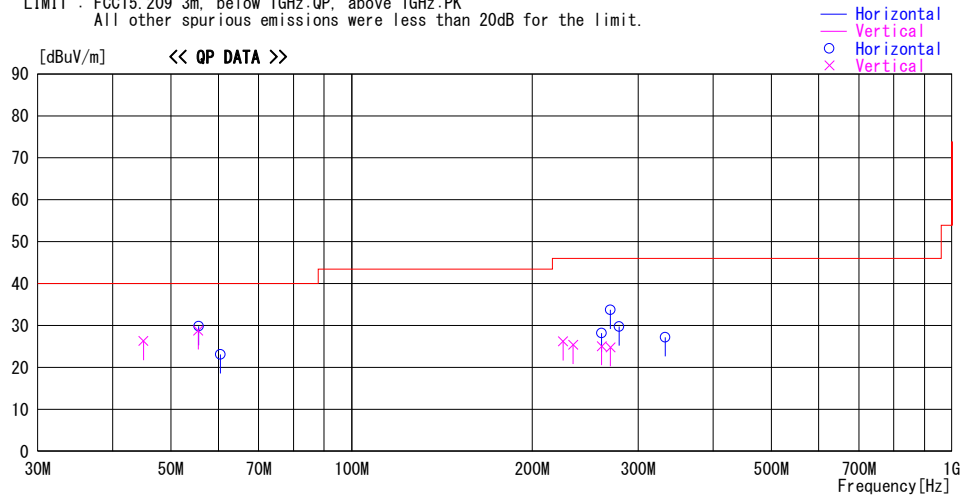
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Emission above 30 MHz (Spurious Emission) (ANT-C)

Report No. 12095693H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date January 30, 2018
Temperature / Humidity 21 deg. C / 32 % RH
Engineer Koji Yamamoto
Mode Tx 125 kHz Mod on, ANT-C

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	Margin	Comment
			Factor [dB/m]	Gain [dB]					[dBuV/m]	[dB]	
44.988	45.0	QP	12.4	-31.1	26.3	258	100	Vert.	40.0	13.7	
55.539	50.9	QP	8.8	-30.9	28.8	246	100	Vert.	40.0	11.2	
55.625	52.0	QP	8.7	-30.9	29.8	177	300	Hori.	40.0	10.2	
60.474	46.6	QP	7.3	-30.8	23.1	179	300	Hori.	40.0	16.9	
224.914	43.5	QP	11.6	-28.9	26.2	39	100	Vert.	46.0	19.8	
233.911	42.7	QP	11.6	-28.9	25.4	45	100	Vert.	46.0	20.6	
260.896	44.7	QP	12.1	-28.6	28.2	248	100	Hori.	46.0	17.8	
260.896	41.6	QP	12.1	-28.6	25.1	0	100	Vert.	46.0	20.9	
269.896	40.9	QP	12.4	-28.5	24.8	0	100	Vert.	46.0	21.2	
269.896	49.8	QP	12.4	-28.5	33.7	234	100	Hori.	46.0	12.3	
278.892	45.5	QP	12.7	-28.5	29.7	233	100	Hori.	46.0	16.3	
332.878	40.8	QP	14.2	-27.8	27.2	289	100	Hori.	46.0	18.8	

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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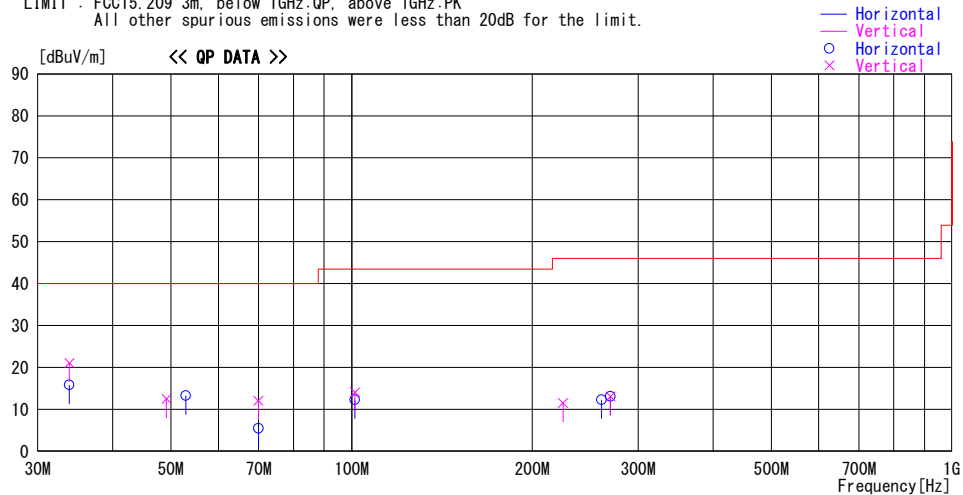
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Radiated Emission above 30 MHz (Spurious Emission) (Antenna-Coil)

Report No. 12095693H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.1
Date January 30, 2018
Temperature / Humidity 21 deg. C / 32 % RH
Engineer Koji Yamamoto
Mode Tx 125 kHz Mod on, Antenna-Coil

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



Frequency	Reading	DET	Antenna Factor	Loss& Gain	Level	Angle	Height	Polar.	Limit	Margin	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
33.877	36.1	QP	16.3	-31.3	21.1	126	100	Vert.	40.0	18.9	
33.877	30.8	QP	16.3	-31.3	15.8	125	300	Hori.	40.0	24.2	
49.161	32.6	QP	10.9	-31.0	12.5	201	100	Vert.	40.0	27.5	
52.916	34.7	QP	9.6	-31.0	13.3	180	300	Hori.	40.0	26.7	
69.923	30.1	QP	6.1	-30.7	5.5	0	300	Hori.	40.0	34.5	
69.923	36.7	QP	6.1	-30.7	12.1	0	100	Vert.	40.0	27.9	
101.303	32.5	QP	10.1	-30.3	12.3	0	300	Hori.	43.5	31.2	
101.303	34.3	QP	10.1	-30.3	14.1	51	100	Vert.	43.5	29.4	
224.914	28.8	QP	11.6	-28.9	11.5	0	100	Vert.	46.0	34.5	
260.896	28.8	QP	12.1	-28.6	12.3	0	100	Hori.	46.0	33.7	
269.875	29.2	QP	12.4	-28.5	13.1	0	100	Hori.	46.0	32.9	
269.896	29.2	QP	12.4	-28.5	13.1	0	100	Vert.	46.0	32.9	

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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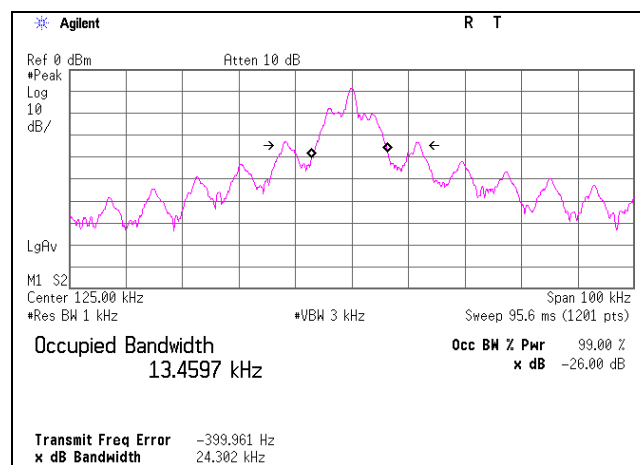
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

-26 dB Bandwidth and 99 % Occupied Bandwidth (ANT-FR)

Report No.	12095693H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	January 30, 2018
Temperature / Humidity	21 deg. C / 32 % RH
Engineer	Koji Yamamoto
Mode	Tx 125 kHz Mod on, ANT-FR

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
24.302	13.4597



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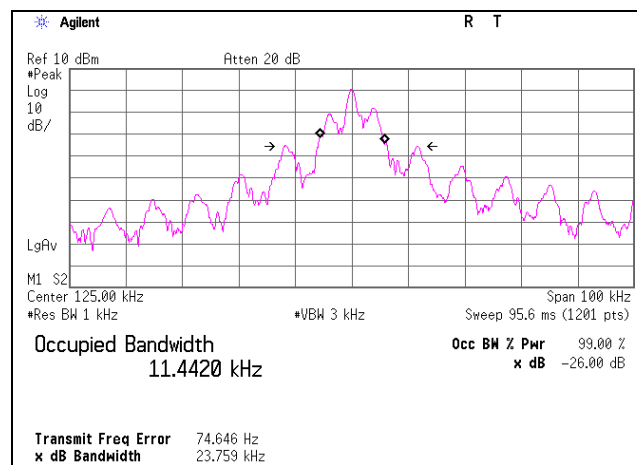
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

-26 dB Bandwidth and 99 % Occupied Bandwidth (ANT-C)

Report No.	12095693H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	January 30, 2018
Temperature / Humidity	21 deg. C / 32 % RH
Engineer	Koji Yamamoto
Mode	Tx 125 kHz Mod on, ANT-C

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
23.759	11.4420



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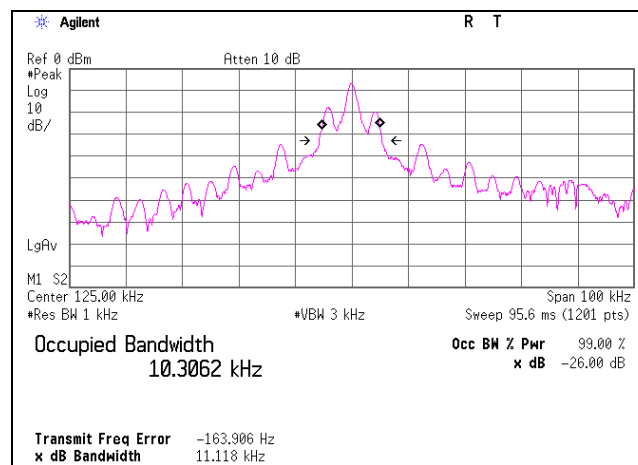
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

-26 dB Bandwidth and 99 % Occupied Bandwidth (Antenna-Coil)

Report No.	12095693H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	January 30, 2018
Temperature / Humidity	21 deg. C / 32 % RH
Engineer	Koji Yamamoto
Mode	Tx 125 kHz Mod on, Antenna-Coil

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
11.118	10.3062



*It was confirmed that there were no differences in the bandwidth of EUT regardless of with or without transponder.

APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval (month)
MAEC-01	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	RE	2017/09/30 * 12
MOS-27	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	RE	2018/01/24 * 12
MJM-25	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MTR-09	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	RE	2017/06/27 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2017/10/11 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2017/06/12 * 12
MCC-03	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W(20m)/3D-2W(7.5m)/RG400u(1.5m)/RFM-E421(Switcher)	-/01068 (Switcher)	RE	2017/06/26 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2017/03/27 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2017/03/27 * 12
MAT-08	Attenuator(6dB)	Weinschel Corp	2	BK7971	RE	2017/11/14 * 12
MMM-03	Digital Tester	Fluke	FLUKE 26-3	78030621	RE	2017/08/07 * 12
KBA-05	Biconical Antenna	Schwarzbeck	BBA9106	2513	RE	2017/11/23 * 12
MLA-21	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	RE	2017/12/10 * 12
MCC-02	Coaxial Cable	Suhner/storm/Agilent/TSJ	-	-	RE	2017/09/26 * 12
MPA-19	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	RE	2017/02/08 * 12
MMM-03	Digital Tester	Fluke	FLUKE 26-3	78030621	RE	2017/08/07 * 12
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2017/11/07 * 12
MLPA-10	Loop Antenna	UL Japan	-	-	RE	Pre Check

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.

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