



# RADIO TEST REPORT


**Test Report No. : 10516910H-A-R1**

**Applicant** : Toyota Motor Corporation  
**Type of Equipment** : Smart LF Oscillator  
**Model No.** : TMLF15-2  
**FCC ID** : NI4TMLF15-2  
**Test regulation** : FCC Part 15 Subpart C: 2014  
**Test Result** : Complied

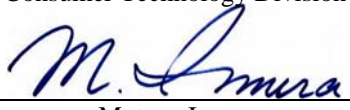
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3. This sample tested is in compliance with above regulation.
4. The test results in this report are traceable to the national or international standards.
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6. This test report covers Radio technical 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 10516910H-A. 10516910H-A is replaced with this report.

**Date of test:** October 10 and 11, 2014

**Representative test engineer:**

  
Masatoshi Nishiguchi  
Engineer  
Consumer Technology Division

**Approved by:**

  
Motoya Imura  
Engineer  
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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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



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## **SECTION 1: Customer information**

Company Name : Toyota Motor Corporation  
Address : 1, Toyota-Cho, Toyota, Aichi, 471-8572 Japan  
Telephone Number : +81-565-94-1006  
Facsimile Number : +81-565-94-1162  
Contact Person : Hiroki Okada

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

### **2.1 Identification of E.U.T.**

Type of Equipment : Smart LF Oscillator  
Model No. : TMLF15-2  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC12.0V (Max 0.5A)  
Receipt Date of Sample : October 1, 2014  
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**

Smart LF Oscillator, model: TMLF15-2 is a transmitter that is installed in a motor vehicle and is used as part of Smart System.

#### **Radio Specification**

Radio Type : Transmitter  
Frequency of Operation : 134.2kHz  
Modulation : ASK  
Method of Frequency Generation : Crystal  
Antenna type : Coil Antenna

Smart LF Oscillator (model: TMLF15-2) consists of the following parts:

- Computer Assy, Smart Key (ECU)
- Door Antenna \*1)
- Trunk Antenna \*1)
- Room Antenna / Luggage Antenna \*2)

\*1) The output value of Door Antenna and Trunk Antenna is not variable. Maximum setting only.

\*2) The output value of Room Antenna / Luggage Antenna is variable and is fixed in product shipment.  
The test was performed with maximum and minimum powers within its variation.

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

#### **3.1 Test Specification**

Test Specification : FCC Part 15 Subpart C: 2014, final revised on August 15, 2014 and effective October 14, 2014

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 August 15, 2014 does not affect the test specification applied to the EUT.

#### **FCC 15.31 (e)**

This test was performed with the New Battery (DC 12V) 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.

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

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	Conducted Emission	<FCC> ANSI C63.4:2009 7. AC powerline conducted emission measurements <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 C63.4:2009 13. Measurement of intentional radiators <IC> RSS-Gen 6.4, 6.12	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 8.9	Radiated	N/A	14.9dB 0.13420MHz, PK (PK with Duty factor) <Trunk Antenna>	Complied
3	Electric Field Strength of Spurious Emission	<FCC> ANSI C63.4:2009 13. Measurement of intentional radiators <IC> RSS-Gen 6.4, 6.13	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 8.9	Radiated	N/A	1.4dB 32.746MHz, QP Vertical <Room/Luggage Antenna [Maximum Output]>	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.4:2009 13. Measurement of intentional radiators <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.

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Facsimile : +81 596 24 8124

### 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.

Test room (semi-anechoic chamber)	Radiated emission						
	(3m*)(+dB)				(1m*)(+dB)		(0.5m*)(+dB)
	9kHz -30MHz	30MHz -300MHz	300MHz -1GHz	1GHz -10GHz	10GHz -18GHz	18GHz -26.5GHz	26.5GHz -40GHz
No.1	4.0dB	5.1dB	5.0dB	5.1dB	6.0dB	4.9dB	4.3dB
No.2	3.9dB	5.2dB	5.0dB	4.9dB	5.9dB	4.7dB	4.2dB
No.3	4.3dB	5.1dB	5.2dB	5.2dB	6.0dB	4.8dB	4.2dB
No.4	4.6dB	5.2dB	5.0dB	5.2dB	6.0dB	5.7dB	4.2dB

\*3m/1m/0.5m = Measurement distance

#### Radiated emission test(3m)

[Electric Field Strength of Fundamental Emission]

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

[Electric Field Strength of Spurious Emission]

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

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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

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab. \*NVLAP Lab. code: 200572-0  
 4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN  
 Telephone : +81 596 24 8999 Facsimile : +81 596 24 8124

	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7m	7.0 x 6.0m	No.1 Power source room
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.3 Preparation room
No.3 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.4 Preparation room
No.4 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9m	6.0 x 6.0m	-
No.6 shielded room	-	4.0 x 4.5 x 2.7m	4.0 x 4.5 m	-
No.6 measurement room	-	4.75 x 5.4 x 3.0m	4.75 x 4.15 m	-
No.7 shielded room	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	3.1 x 5.0 x 2.7m	N/A	-
No.9 measurement room	-	8.0 x 4.6 x 2.8m	2.4 x 2.4m	-
No.11 measurement room	-	6.2 x 4.7 x 3.0m	4.8 x 4.6m	-

\* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

### 3.6 Data of EMI, Test instruments, and Test set up

Refer to APPENDIX.

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

### **4.1 Operating Modes**

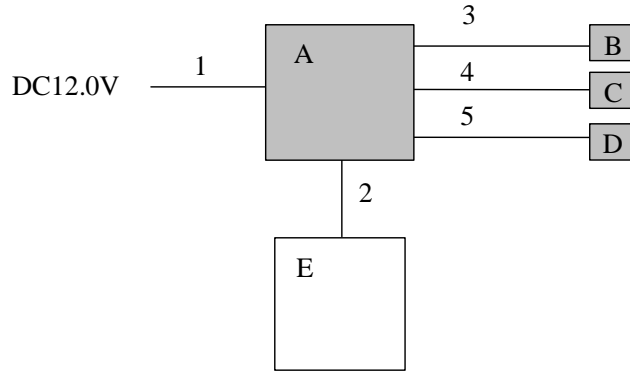
The mode is used : Transmitting mode (Tx) 134.2kHz  
[Door Antenna], [Trunk Antenna], [Room Antenna / Luggage Antenna (Maximum Output)],  
[Room Antenna / Luggage Antenna (Minimum Output)]  
\* LF output power is controlled by Component Assy, Smart Key.

Justification : The system was configured in typical fashion (as a customer would normally use it) for testing.

\*The EUT does not transmit simultaneously from multiple antennas.  
During testing, transmitting antenna was fixed to one of three antennas.



## 4.2 Configuration and peripherals



- \* Cabling and setup were taken into consideration and test data was taken under worse case conditions.
  - \* The test was performed with the representative component which constitute a system.
  - \* During testing, transmitting antenna was fixed to one of three antennas (B, C, D), and the test was conducted with the worst duty.
- Also, the number of connected antennas was no difference within this confirmation, although it was confirmed that some antennas would be added.

### Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Computer Assy, Smart Key (ECU)	-	001 *1) 002 *2)	-	EUT
B	Door Antenna	-	001	-	EUT
C	Room Antenna / Luggage Antenna	-	001	-	EUT
D	Trunk Antenna	-	001	-	EUT
E	Jig Box	-	-	-	-

\*1) Used for Operation mode "1)".

\*2) Used for Operation mode "2)".

### List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	ECU Cable	3.0	Unshielded	Unshielded	-
3	Door Ant Cable	3.0	Unshielded	Unshielded	-
4	Room Ant / Luggage Ant Cable	3.0	Unshielded	Unshielded	-
5	Trunk Ant Cable	3.0	Unshielded	Unshielded	-

**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

## **SECTION 5: Radiated emission (Fundamental and Spurious Emission)**

### **Test Procedure**

EUT was placed on a urethane platform of nominal size, 0.5m by 1.0m, raised 0.8m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

Frequency : From 9kHz to 30MHz

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: 0deg., 45deg., 90deg., and 135 deg.) and horizontal polarization.

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

Frequency : From 30MHz to 1GHz

The measuring antenna height varied between 1 and 4m 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 30MHz	30MHz to 300MHz	300MHz to 1GHz	Above 1GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

Frequency	From 9kHz to 90kHz and From 110kHz to 150kHz	From 90kHz to 110kHz	From 150kHz to 490kHz	From 490kHz to 30MHz	From 30MHz to 1GHz	Above 1GHz	
Instrument used	Test Receiver					Spectrum Analyzer	
Detector	PK/AV	QP	PK/AV	QP	QP	PK	AV
IF Bandwidth	200Hz	200Hz	9kHz	9kHz	120kHz	RBW: 1MHz VBW: 3MHz	RBW: 1MHz VBW: 10Hz
Test Distance	3m *1)	3m *1)	3m *1)	3m *2)	3m	3m	3m

\*1) Distance Factor:  $40 \times \log(3m/300m) = -80dB$

\*2) Distance Factor:  $40 \times \log(3m/30m) = -40dB$

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 937606.

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 test results and limit are rounded off to one decimal place, so some differences might be observed.

**Measurement range** : 9kHz-1GHz  
**Test data** : APPENDIX 1  
**Test result** : Pass

Date: October 10, 2014  
October 11, 2014

Test engineer: Masatoshi Nishiguchi  
Keisuke Kawamura

**UL Japan, Inc.**

**Ise EMC Lab.**

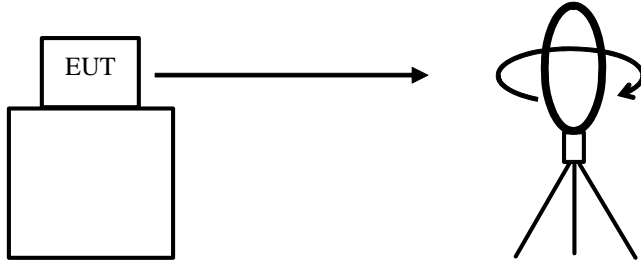
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Telephone : +81 596 24 8999

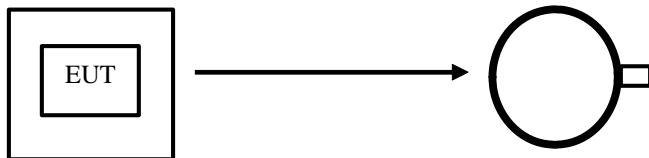
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

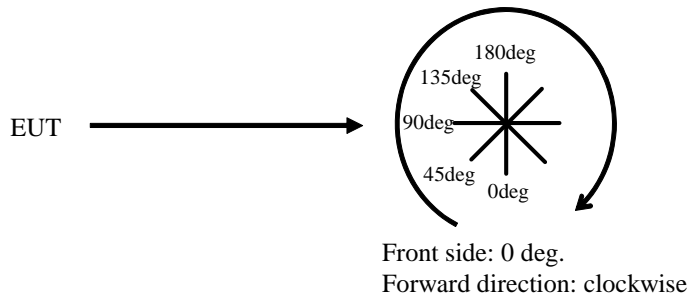


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



## **SECTION 6: -26dB Bandwidth**

### **Test Procedure**

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26dB Bandwidth	100kHz	1kHz	3kHz	Auto	Peak	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1  
Test result : Pass

## **SECTION 7: 99% Occupied Bandwidth**

### **Test Procedure**

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
99% Occupied Bandwidth	Enough width to display 20dB Bandwidth	1 % of Span	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%.

Test data : APPENDIX 1  
Test result : Pass

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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

**APPENDIX 1: Data of EMI test**

**Radiated Emission below 30MHz (Fundamental and Spurious Emission)**  
**Door Antenna**

Test place Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. 10516910H  
Date 10/10/2014  
Temperature/ Humidity 21 deg. C / 63% RH  
Engineer Masatoshi Nishiguchi  
Mode Tx 134.2kHz

**PK or QP**

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	0.13420	PK	96.0	20.0	-73.9	32.2	-	9.9	45.0	35.1	Fundamental
0	0.26840	PK	61.3	19.9	-73.9	32.1	-	-24.8	39.0	63.8	
0	0.40260	PK	76.0	19.8	-73.9	32.1	-	-10.2	35.5	45.7	
0	0.53680	QP	43.2	19.8	-33.8	32.1	-	-2.9	33.0	35.9	
0	0.67100	QP	65.8	19.8	-33.8	32.1	-	19.7	31.1	11.4	
0	0.80520	QP	35.1	19.8	-33.8	32.1	-	-11.0	29.5	40.5	
0	0.93940	QP	55.3	19.8	-33.8	32.1	-	9.2	28.1	18.9	
0	1.07360	QP	33.0	19.8	-33.8	32.1	-	-13.1	26.9	40.0	
0	1.20780	QP	47.4	19.8	-33.8	32.1	-	1.3	25.9	24.6	
0	1.34200	QP	31.9	19.8	-33.8	32.1	-	-14.2	25.0	39.2	

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	0.13420	PK	96.0	20.0	-73.9	32.2	0.0	9.9	25.0	15.1	
0	0.26840	PK	61.3	19.9	-73.9	32.1	0.0	-24.8	19.0	43.8	
0	0.40260	PK	76.0	19.8	-73.9	32.1	0.0	-10.2	15.5	25.7	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor \*

\* Since the peak emission result satisfied the average limit, the peak emission result with Duty Factor was calculated as Duty 100%.

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

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	0.13420	PK	96.0	20.0	6.1	32.2	-	89.9	-	-	Fundamental

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

\* All spurious emissions lower than this result.

**Radiated Emission below 30MHz (Fundamental and Spurious Emission)**  
**Trunk Antenna**

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 10516910H  
Date : 10/10/2014  
Temperature/ Humidity : 21 deg. C / 63% RH  
Engineer : Masatoshi Nishiguchi  
Mode : Tx 134.2kHz

**PK or QP**

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	0.13420	PK	96.2	20.0	-73.9	32.2	-	10.1	45.0	34.9	Fundamental
0	0.26840	PK	58.8	19.9	-73.9	32.1	-	-27.3	39.0	66.3	
0	0.40260	PK	62.6	19.8	-73.9	32.1	-	-23.6	35.5	59.1	
0	0.53680	QP	35.2	19.8	-33.8	32.1	-	-10.9	33.0	43.9	
0	0.67100	QP	48.8	19.8	-33.8	32.1	-	2.7	31.1	28.4	
0	0.80520	QP	34.2	19.8	-33.8	32.1	-	-11.9	29.5	41.4	
0	0.93940	QP	40.6	19.8	-33.8	32.1	-	-5.5	28.1	33.6	
0	1.07360	QP	31.6	19.8	-33.8	32.1	-	-14.5	26.9	41.4	
0	1.20780	QP	44.5	19.8	-33.8	32.1	-	-1.6	25.9	27.5	
0	1.34200	QP	31.4	19.8	-33.8	32.1	-	-14.7	25.0	39.7	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier)

**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	0.13420	PK	96.2	20.0	-73.9	32.2	0.0	10.1	25.0	14.9	
0	0.26840	PK	58.8	19.9	-73.9	32.1	0.0	-27.3	19.0	46.3	
0	0.40260	PK	62.6	19.8	-73.9	32.1	0.0	-23.6	15.5	39.1	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier) + Duty factor \*

\* Since the peak emission result satisfied the average limit, the peak emission result with Duty Factor was calculated as Duty 100%.

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

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	0.13420	PK	96.2	20.0	6.1	32.2	-	90.1	-	-	Fundamental

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

\* All spurious emissions lower than this result.

**Radiated Emission below 30MHz (Fundamental and Spurious Emission)**  
**Room Antenna / Luggage Antenna Maximum Output**

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 10516910H  
Date : 10/10/2014  
Temperature/ Humidity : 21 deg. C / 63% RH  
Engineer : Masatoshi Nishiguchi  
Mode : Tx 134.2kHz

**PK or QP**

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	0.13420	PK	95.8	20.0	-73.9	32.2	-	9.7	45.0	35.3	Fundamental
0	0.26840	PK	59.7	19.9	-73.9	32.1	-	-26.4	39.0	65.4	
0	0.40260	PK	64.4	19.8	-73.9	32.1	-	-21.8	35.5	57.3	
0	0.53680	QP	34.1	19.8	-33.8	32.1	-	-12.0	33.0	45.0	
0	0.67100	QP	48.0	19.8	-33.8	32.1	-	1.9	31.1	29.2	
0	0.80520	QP	32.4	19.8	-33.8	32.1	-	-13.7	29.5	43.2	
0	0.93940	QP	50.4	19.8	-33.8	32.1	-	4.3	28.1	23.8	
0	1.07360	QP	31.5	19.8	-33.8	32.1	-	-14.6	26.9	41.5	
0	1.20780	QP	47.6	19.8	-33.8	32.1	-	1.5	25.9	24.4	
0	1.34200	QP	31.3	19.8	-33.8	32.1	-	-14.8	25.0	39.8	

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	0.13420	PK	95.8	20.0	-73.9	32.2	0.0	9.7	25.0	15.3	
0	0.26840	PK	59.7	19.9	-73.9	32.1	0.0	-26.4	19.0	45.4	
0	0.40260	PK	64.4	19.8	-73.9	32.1	0.0	-21.8	15.5	37.3	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor \*

\* Since the peak emission result satisfied the average limit, the peak emission result with Duty Factor was calculated as Duty 100%.

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

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	0.13420	PK	95.8	20.0	6.1	32.2	-	89.7	-	-	Fundamental

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

\* All spurious emissions lower than this result.

**Radiated Emission below 30MHz (Fundamental and Spurious Emission)**  
**Room Antenna / Luggage Antenna Minimum Output**

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 10516910H  
Date : 10/10/2014  
Temperature/ Humidity : 21 deg. C / 63% RH  
Engineer : Masatoshi Nishiguchi  
Mode : Tx 134.2kHz

**PK or QP**

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	0.13420	PK	81.6	20.0	-73.9	32.2	-	-4.5	45.0	49.5	Fundamental
0	0.26840	PK	54.3	19.9	-73.9	32.1	-	-31.8	39.0	70.8	
0	0.40260	PK	53.7	19.8	-73.9	32.1	-	-32.5	35.5	68.0	
0	0.53680	QP	46.9	19.8	-33.8	32.1	-	0.8	33.0	32.2	
0	0.67100	QP	35.2	19.8	-33.8	32.1	-	-10.9	31.1	42.0	
0	0.80520	QP	43.2	19.8	-33.8	32.1	-	-2.9	29.5	32.4	
0	0.93940	QP	38.5	19.8	-33.8	32.1	-	-7.6	28.1	35.7	
0	1.07360	QP	38.9	19.8	-33.8	32.1	-	-7.2	26.9	34.1	
0	1.20780	QP	37.2	19.8	-33.8	32.1	-	-8.9	25.9	34.8	
0	1.34200	QP	34.0	19.8	-33.8	32.1	-	-12.1	25.0	37.1	

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	0.13420	PK	81.6	20.0	-73.9	32.2	0.0	-4.5	25.0	29.5	
0	0.26840	PK	54.3	19.9	-73.9	32.1	0.0	-31.8	19.0	50.8	
0	0.40260	PK	53.7	19.8	-73.9	32.1	0.0	-32.5	15.5	48.0	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amplifier) + Duty factor \*

\* Since the peak emission result satisfied the average limit, the peak emission result with Duty Factor was calculated as Duty 100%.

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

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	0.13420	PK	81.6	20.0	6.1	32.2	-	75.5	-	-	Fundamental

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

**\* All spurious emissions lower than this result.**



**Radiated Emission above 30MHz (Spurious Emission)**  
**Door Antenna**

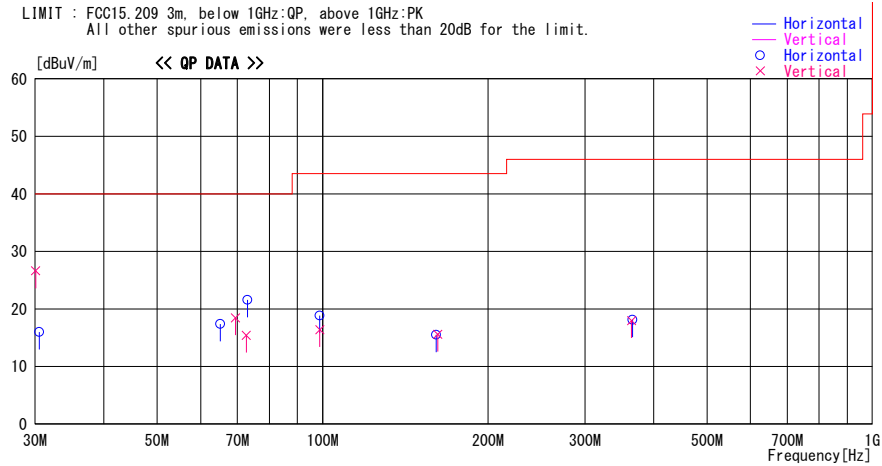
**DATA OF RADIATED EMISSION TEST**

UL Japan, Inc. Ise EMC Lab. No.4 Semi Anechoic Chamber  
Date : 2014/10/11

Report No. : 10516910H  
Temp./Humi. : 22deg. C / 60% RH  
Engineer : Keisuke Kawamura

Mode / Remarks : Tx 134.2kHz Normal Modulation Door Antenna Worst-Axis (Antenna Hori: X / Vert: X, ECU Hori: X / Vert: X)

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		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss& Gain [dB]							
30.064	34.2	QP	17.4	-25.0	26.6	260	100	Vert.	40.0	13.4	
30.541	23.7	QP	17.3	-25.0	16.0	0	300	Hori.	40.0	24.0	
65.134	34.6	QP	7.2	-24.4	17.4	0	294	Hori.	40.0	22.6	
69.427	36.3	QP	6.6	-24.4	18.5	284	100	Vert.	40.0	21.5	
72.648	33.3	QP	6.5	-24.3	15.5	281	100	Vert.	40.0	24.6	
73.008	39.4	QP	6.5	-24.3	21.6	195	400	Hori.	40.0	18.4	
98.771	32.9	QP	10.0	-24.0	18.9	352	308	Hori.	43.5	24.6	
98.772	30.4	QP	10.0	-24.0	16.4	104	100	Vert.	43.5	27.1	
160.942	23.3	QP	15.4	-23.2	15.5	0	300	Hori.	43.5	28.0	
162.024	23.3	QP	15.5	-23.2	15.6	0	100	Vert.	43.5	27.9	
364.529	22.5	QP	17.1	-21.6	18.0	0	100	Vert.	46.0	28.0	
365.932	22.5	QP	17.1	-21.5	18.1	0	100	Hori.	46.0	27.9	

CHART: WITH FACTOR ANT TYPE: -30MHz: LOOP 30-300MHz: BICONICAL 300MHz-1000MHz: LOGPERIODIC 1000MHz-: HORN  
CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN(CABLE+ATTEN. - GAIN (AMP))

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

**Radiated Emission above 30MHz (Spurious Emission)**  
**Trunk Antenna**

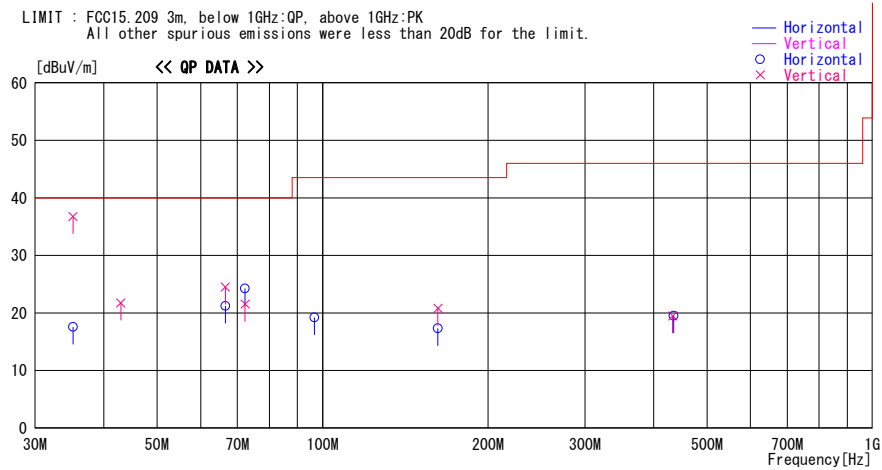
**DATA OF RADIATED EMISSION TEST**

UL Japan, Inc. Ise EMC Lab. No.4 Semi Anechoic Chamber  
Date : 2014/10/11

Report No. : 10516910H  
Temp./Humi. : 22deg. C / 60% RH  
Engineer : Keisuke Kawamura

Mode / Remarks : Tx 134.2kHz Normal Modulation Trunk Antenna Worst-Axis (Antenna Hori:X / Vert:X , ECU Hori:X / Vert:X)

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		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss& Gain [dB]							
35.160	45.3	QP	16.4	-24.9	36.8	274	100	Vert.	40.0	3.2	
35.157	26.1	QP	16.4	-24.9	17.6	0	331	Hori.	40.0	22.4	
42.945	33.3	QP	13.3	-24.8	21.8	274	100	Vert.	40.0	18.3	
66.564	38.6	QP	7.0	-24.4	21.2	188	305	Hori.	40.0	18.8	
66.565	41.9	QP	7.0	-24.4	24.5	254	100	Vert.	40.0	15.5	
72.287	42.1	QP	6.5	-24.3	24.3	191	400	Hori.	40.0	15.7	
72.290	39.3	QP	6.5	-24.3	21.5	278	100	Vert.	40.0	18.5	
96.623	33.6	QP	9.6	-24.0	19.2	174	305	Hori.	43.5	24.3	
162.114	28.5	QP	15.5	-23.2	20.8	114	100	Vert.	43.5	22.7	
162.114	25.0	QP	15.5	-23.2	17.3	0	300	Hori.	43.5	26.2	
433.266	22.6	QP	18.1	-21.2	19.5	0	100	Vert.	46.0	26.5	
434.669	22.5	QP	18.2	-21.2	19.5	0	100	Hori.	46.0	26.5	

CHART: WITH FACTOR ANT TYPE: -30MHz: LOOP, 30-300MHz: BICONICAL, 300MHz-1000MHz: LOGPERIODIC, 1000MHz-: HORN  
CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN(CABLE+ATTEN. - GAIN (AMP))

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

**Radiated Emission above 30MHz (Spurious Emission)**  
**Room Antenna / Luggage Antenna Maximum Output**

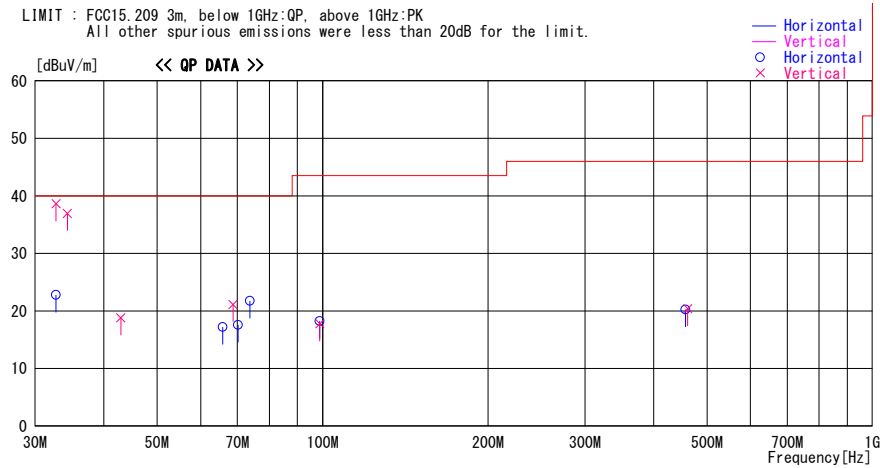
**DATA OF RADIATED EMISSION TEST**

UL Japan, Inc. Ise EMC Lab. No.4 Semi Anechoic Chamber  
 Date : 2014/10/11

Report No. : 10516910H  
 Temp./Humi. : 22deg. C / 60% RH  
 Engineer : Keisuke Kawamura

Mode / Remarks : Tx 134.2kHz Normal Modulation Room Antenna/Luggage Antenna Worst-Axis (Antenna Hori: X / Vert: X, ECU Hori: X / Vert: X)

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		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss&Gain [dB]							
32.744	30.9	QP	16.9	-25.0	22.8	178	311	Hori.	40.0	17.2	
32.746	46.7	QP	16.9	-25.0	38.6	54	100	Vert.	40.0	1.4	
34.356	45.3	QP	16.6	-24.9	37.0	68	100	Vert.	40.0	3.0	
42.943	30.3	QP	13.3	-24.8	18.8	224	100	Vert.	40.0	21.2	
65.845	34.5	QP	7.1	-24.4	17.2	194	293	Hori.	40.0	22.8	
68.712	38.9	QP	6.7	-24.4	21.2	249	100	Vert.	40.0	18.9	
70.143	35.4	QP	6.5	-24.3	17.6	183	400	Hori.	40.0	22.4	
73.719	39.6	QP	6.5	-24.3	21.8	190	400	Hori.	40.0	18.3	
98.717	32.2	QP	10.0	-24.0	18.2	162	301	Hori.	43.5	25.3	
98.771	31.8	QP	10.0	-24.0	17.8	90	100	Vert.	43.5	25.7	
457.114	22.8	QP	18.5	-21.1	20.2	0	100	Hori.	46.0	25.8	
461.322	22.8	QP	18.6	-21.0	20.4	0	100	Vert.	46.0	25.6	

CHART: WITH FACTOR ANT TYPE: -30MHz: LOOP, 30-300MHz: BICONICAL, 300MHz-1000MHz: LOGPERIODIC, 1000MHz-: HORN  
 CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN(CABLE+ATTEN. - GAIN(AMP))

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

**Radiated Emission above 30MHz (Spurious Emission)**  
**Room Antenna / Luggage Antenna Minimum Output**

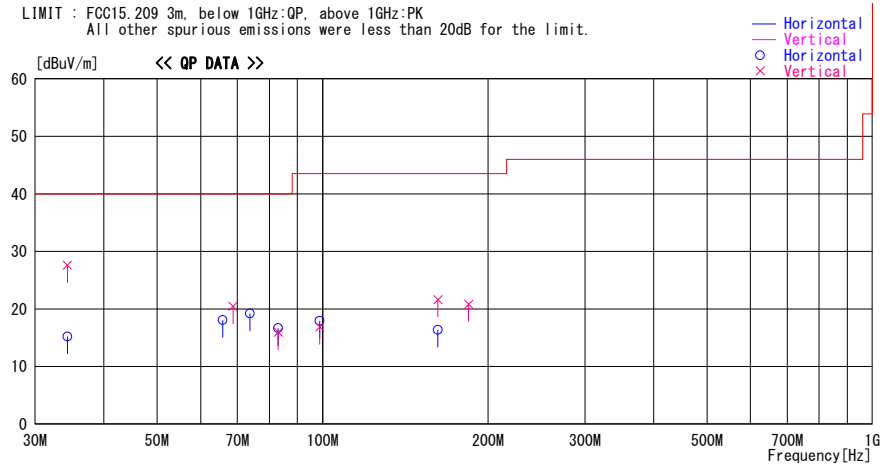
**DATA OF RADIATED EMISSION TEST**

UL Japan, Inc. Ise EMC Lab. No.4 Semi Anechoic Chamber  
 Date : 2014/10/11

Report No. : 10516910H  
 Temp./Humi. : 22deg. C / 60% RH  
 Engineer : Keisuke Kawamura

Mode / Remarks : Tx 134.2kHz Normal Modulation Room Antenna/Luggage Antenna Worst-Axis (Antenna Hori: X / Vert: X, ECU Hori: X / Vert: X)

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		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss& Gain [dB]							
34.356	23.5	QP	16.6	-24.9	15.2	0	300	Hori.	40.0	24.8	
34.356	35.9	QP	16.6	-24.9	27.6	133	100	Vert.	40.0	12.4	
65.847	35.3	QP	7.1	-24.4	18.0	196	300	Hori.	40.0	22.0	
68.711	38.2	QP	6.7	-24.4	20.5	242	100	Vert.	40.0	19.6	
73.721	37.0	QP	6.5	-24.3	19.2	192	400	Hori.	40.0	20.8	
83.024	33.9	QP	7.0	-24.2	16.7	188	210	Hori.	40.0	23.3	
83.024	33.2	QP	7.0	-24.2	16.0	267	100	Vert.	40.0	24.0	
98.767	32.0	QP	10.0	-24.0	18.0	167	315	Hori.	43.5	25.5	
98.767	30.9	QP	10.0	-24.0	16.9	80	100	Vert.	43.5	26.6	
162.110	29.3	QP	15.5	-23.2	21.6	99	100	Vert.	43.5	21.9	
162.110	24.1	QP	15.5	-23.2	16.4	0	300	Hori.	43.5	27.1	
184.304	27.5	QP	16.3	-23.0	20.8	97	100	Vert.	43.5	22.7	

CHART: WITH FACTOR ANT TYPE: -30MHz: LOOP, 30-300MHz: BICONICAL, 300MHz-1000MHz: LOGPERIODIC, 1000MHz-: HORN  
 CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN(CABLE+ATTEN. - GAIN (AMP))

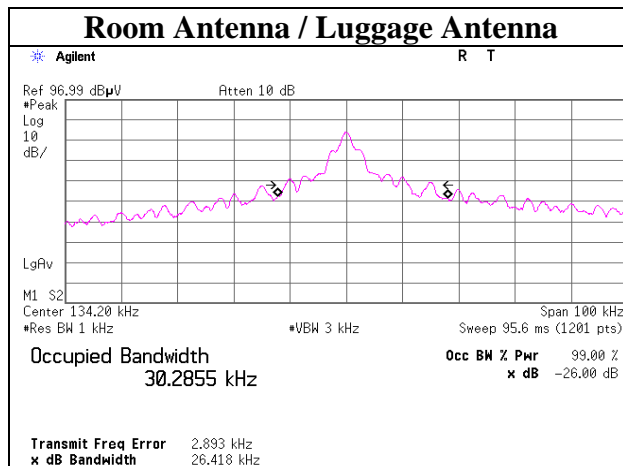
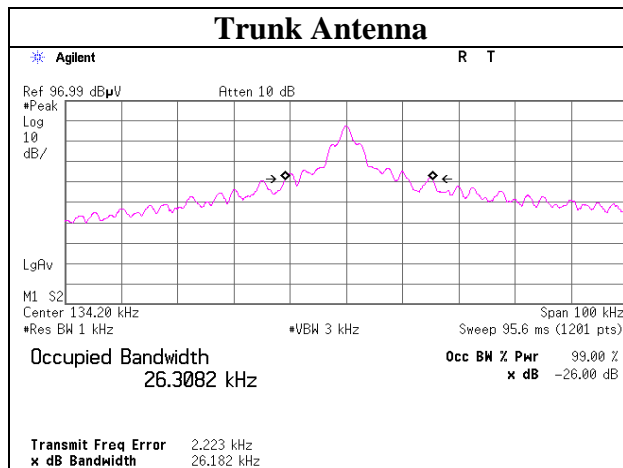
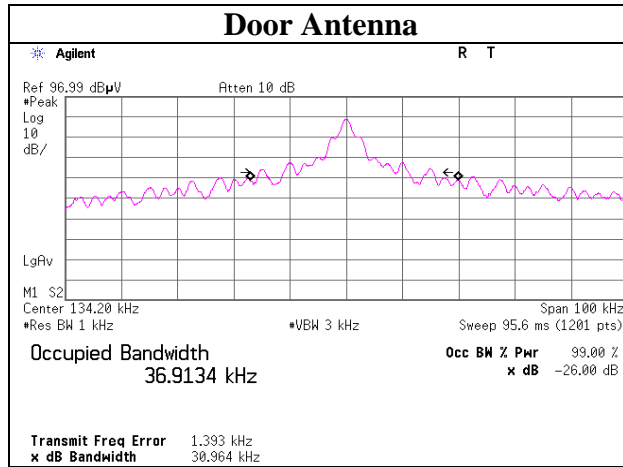
\*The test result is rounded off to one or two decimal places, so some differences might be observed.

**-26dB Bandwidth and 99% Occupied Bandwidth**

Test place Ise EMC Lab. No.4 Semi Anechoic Chamber  
Report No. 10516910H  
Date 10/11/2014  
Temperature/ Humidity 22 deg. C / 60% RH  
Engineer Keisuke Kawamura  
Mode Tx 134.2kHz

Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
Door Antenna	134.2	30.964	36.913
Trunk Antenna	134.2	26.182	26.308
Room Antenna / Ruggage Antenna	134.2	26.418	30.286

**-26dB Bandwidth and 99% Occupied Bandwidth**



## **APPENDIX 2: Test instruments**

### **EMI test equipment**

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2014/02/28 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE	2014/02/20 * 12
MJM-22	Measure	ASKUL	-	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MTR-01	Test Receiver	Rohde & Schwarz	ESI40	100084	RE	2013/11/12 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2013/10/30 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(5m)/ 421-010(1m)/ suciform141-PE(1m)/ RFM-E121(Switcher)	-/04178	RE	2014/07/15 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2014/07/28 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2014/03/14 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2013/11/26 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2013/11/24 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2013/11/24 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2014/06/02 * 12

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