



# RADIO TEST REPORT

**Test Report No. : 10232789H-A**

**Applicant** : Toyota Motor Corporation  
**Type of Equipment** : Smart LF Oscillator  
**Model No.** : TMLF12-6  
**FCC ID** : NI4TMLF12-6  
**Test regulation** : FCC Part 15 Subpart C: 2013  
**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 must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

**Date of test:** August 1 to 29, 2013 and March 12 to 13, 2014

**Representative test engineer:**

Keisuke Kawamura  
Engineer of WiSE Japan,  
UL Verification Service

**Approved by:**

Masanori Nishiyama  
Manager of WiSE Japan,  
UL Verification Service



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. \*As for the range of Accreditation in NVLAP, you may refer to the WEB address, <http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap>

**UL Japan, Inc.**

**Head Office 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.: 10232789H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10232789H-A	March 26, 2014	-	-

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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. : TMLF12-6  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC12.0V (Max 0.5A)  
Receipt Date of Sample : July 25, 2013, February 21, 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: TMLF12-6 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: TMLF12-6) consists of the following parts:

- Computer Assy, Smart Key (ECU)
- Door Antenna
- Trunk Antenna
- Room Antenna / Luggage Antenna

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## **UL Japan, Inc.**

### **Head Office EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## SECTION 3: Test specification, procedures & results

### 3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2013, final revised on September 30, 2013 and effective October 30, 2013

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

#### 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 C63.4:2003 7. AC powerline conducted emission measurements <IC> RSS-Gen 7.2.4	<FCC> Section 15.207 <IC> RSS-Gen 7.2.4	-	N/A *1)	N/A	N/A
2	Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> RSS-Gen 4.8, 4.11	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 7.2.5	Radiated	N/A	15.1dB 0.13420MHz, PK (PK with Duty factor) <Door Antenna>	Complied
3	Electric Field Strength of Spurious Emission	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> RSS-Gen 4.9, 4.11	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 7.2.5	Radiated	N/A	8.2dB 75.148MHz, Horizontal, QP <Door Antenna>	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.4:2003 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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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 4.6.1	RSS-Gen 4.6.1	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)

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. Head Office 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

	FCC Registration Number	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	313583	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	655103	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	148738	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	134570	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	4.75 x 5.4 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	-	-	8.8 x 4.6 x 2.8m	2.4 x 2.4m	-
No.11 measurement room	-	-	3.1 x 3.4 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 Test set up, Data of EMI, and Test instruments

Refer to APPENDIX 1 to 3.

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

### **4.1 Operating Modes**

The mode is used :

- 1) Transmitting mode (Tx) 134.2kHz (Door Antenna, Trunk Antenna, Room Antenna / Luggage Antenna, Maximum Output)
- 2) Transmitting mode (Tx) 134.2kHz (Room Antenna / Luggage Antenna only, Minimum Output)

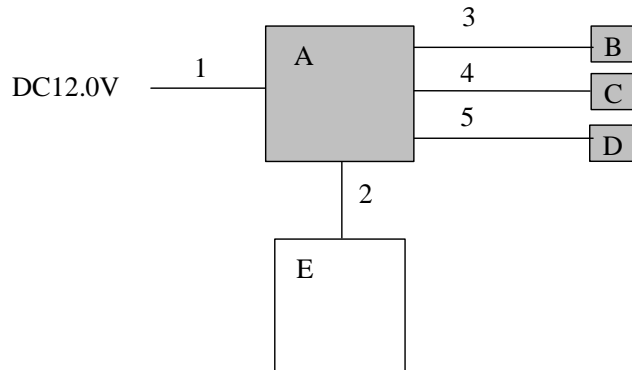
\* LF output power is controlled by Component Assy, Smart Key.

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.

### 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	2.5	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	-

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

Telephone : +81 596 24 8999

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

**Test Procedure**

The Radiated Electric Field Strength intensity has been measured on No 1, No 2 and No.4 semi anechoic chamber with a ground plane and at a distance of 3m.

Frequency : From 9kHz to 30MHz at distance 3m

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., 135 deg., and 180deg.)

and horizontal polarization.

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

Frequency : From 30MHz to 1GHz at distance 3m

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.

Measurements were performed with a QP and PK detector.

The radiated emission measurements were made with the following detector function of the test receiver (below 1GHz).

	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
Detector Type	PK/AV	QP	PK/AV	QP	QP
IF Bandwidth	200Hz	200Hz	9kHz	9kHz	120kHz
Distance factor *1)	-80dB	-80dB	-80dB	-40dB	-

\*1) -80dB = 40 x log (3m/300m)

-40dB = 40 x log (3m /30m)

- The carrier level (or, noise levels) was (or were) measured at each position of all three axes X, Y and Z, and the position that has the maximum noise was determined.

With the position, the noise levels of all the frequencies were measured.

**Test data** : APPENDIX 2

**Test result** : Pass

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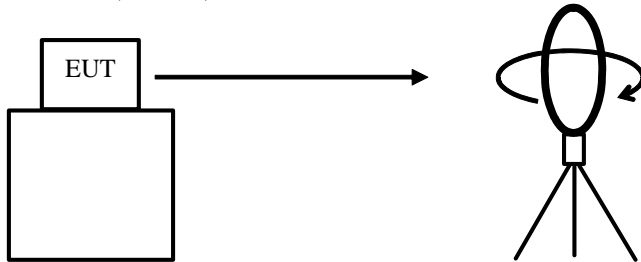
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

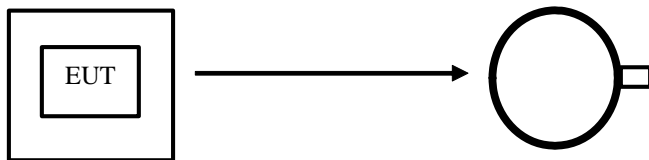
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**Figure 1: Direction of the Loop Antenna**

*Side View (Vertical)*

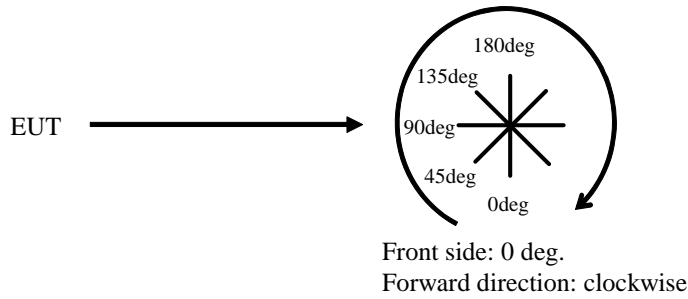


.....  
*Top View (Horizontal)*



Antenna was not rotated.

.....  
*Top View (Vertical)*



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

### **Test Procedure**

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

**Test data** : APPENDIX 2  
**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 data** : APPENDIX 2  
**Test result** : Pass

**APPENDIX 1: Data of EMI test**

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

Test place Head Office EMC Lab. No.1 Semi Anechoic Chamber  
Report No. 10232789H  
Date 03/12/2013  
Temperature/ Humidity 19 deg. C / 33% RH  
Engineer Keisuke Kawamura  
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	-74.0	32.1	-	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	75.2	19.8	-73.9	32.1	-	-11.0	35.5	46.5	
0	0.53680	QP	42.0	19.8	-33.9	32.2	-	-4.3	33.0	37.3	
0	0.67100	QP	64.2	19.8	-33.8	32.1	-	18.1	31.1	13.0	
0	0.80520	QP	33.9	19.8	-33.8	32.1	-	-12.2	29.5	41.7	
0	0.93940	QP	53.1	19.8	-33.8	32.1	-	7.0	28.1	21.1	
0	1.07360	QP	32.2	19.8	-33.8	32.0	-	-13.8	26.9	40.7	
0	1.20780	QP	45.4	19.8	-33.8	32.0	-	-0.6	25.9	26.5	
0	1.34200	QP	32.6	19.8	-33.7	32.1	-	-13.4	25.0	38.4	

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	-74.0	32.1	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	75.2	19.8	-73.9	32.1	0.0	-11.0	15.5	26.5	

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	6.0	32.1	-	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 : Head Office EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 10232789H  
Date : 08/27/2013  
Temperature/ Humidity : 21 deg. C / 52% 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	96.5	19.2	-73.9	32.1	-	9.7	45.0	35.3	Fundamental
0	0.26840	PK	60.3	19.1	-73.9	32.1	-	-26.6	39.0	65.6	
0	0.40260	PK	63.4	19.1	-73.9	32.1	-	-23.5	35.5	59.0	
0	0.53680	QP	33.9	19.1	-33.8	32.2	-	-13.0	33.0	46.0	
0	0.67100	QP	45.0	19.2	-33.8	32.1	-	-1.7	31.1	32.8	
0	0.80520	QP	32.5	19.2	-33.8	32.1	-	-14.2	29.5	43.7	
0	0.93940	QP	46.4	19.2	-33.8	32.1	-	-0.3	28.1	28.4	
0	1.07360	QP	37.5	19.1	-33.8	32.0	-	-9.2	26.9	36.1	
0	1.20780	QP	43.5	19.1	-33.8	32.0	-	-3.2	25.9	29.1	
0	1.34200	QP	30.9	19.1	-33.8	32.1	-	-15.9	25.0	40.9	

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	0.13420	PK	96.5	19.2	-73.9	32.1	0.0	9.7	25.0	15.3	
0	0.26840	PK	60.3	19.1	-73.9	32.1	0.0	-26.6	19.0	45.6	
0	0.40260	PK	63.4	19.1	-73.9	32.1	0.0	-23.5	15.5	39.0	

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	96.5	19.2	6.1	32.2	-	89.6	-	-	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 Maximum Output**

Test place : Head Office EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 10232789H  
Date : 08/27/2013  
Temperature/ Humidity : 21 deg. C / 52% 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	19.2	-73.9	32.1	-	9.2	45.0	35.8	Fundamental
0	0.26840	PK	59.5	19.1	-73.9	32.1	-	-27.4	39.0	66.4	
0	0.40260	PK	65.9	19.1	-73.9	32.1	-	-21.0	35.5	56.5	
0	0.53680	QP	34.0	19.1	-33.8	32.2	-	-12.9	33.0	45.9	
0	0.67100	QP	42.4	19.2	-33.8	32.1	-	-4.3	31.1	35.4	
0	0.80520	QP	31.5	19.2	-33.8	32.1	-	-15.2	29.5	44.7	
0	0.93940	QP	47.9	19.2	-33.8	32.1	-	1.2	28.1	26.9	
0	1.07360	QP	33.8	19.1	-33.8	32.0	-	-12.9	26.9	39.8	
0	1.20780	QP	45.8	19.1	-33.8	32.0	-	-0.9	25.9	26.8	
0	1.34200	QP	30.8	19.1	-33.8	32.1	-	-16.0	25.0	41.0	

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	19.2	-73.9	32.1	0.0	9.2	25.0	15.8	
0	0.26840	PK	59.5	19.1	-73.9	32.1	0.0	-27.4	19.0	46.4	
0	0.40260	PK	65.9	19.1	-73.9	32.1	0.0	-21.0	15.5	36.5	

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	19.2	6.1	32.2	-	89.1	-	-	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 : Head Office EMC Lab. No.4 Semi Anechoic Chamber  
Report No. : 10232789H  
Date : 08/27/2013  
Temperature/ Humidity : 21 deg. C / 52% 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	81.9	19.2	-73.9	32.1	-	-4.9	45.0	49.9	Fundamental
0	0.26840	PK	53.0	19.1	-73.9	32.1	-	-33.9	39.0	72.9	
0	0.40260	PK	54.7	19.1	-73.9	32.1	-	-32.2	35.5	67.7	
0	0.53680	QP	44.6	19.1	-33.8	32.2	-	-2.3	33.0	35.3	
0	0.67100	QP	32.5	19.2	-33.8	32.1	-	-14.2	31.1	45.3	
0	0.80520	QP	41.5	19.2	-33.8	32.1	-	-5.2	29.5	34.7	
0	0.93940	QP	35.3	19.2	-33.8	32.1	-	-11.4	28.1	39.5	
0	1.07360	QP	38.1	19.1	-33.8	32.0	-	-8.6	26.9	35.5	
0	1.20780	QP	35.4	19.1	-33.8	32.0	-	-11.3	25.9	37.2	
0	1.34200	QP	34.2	19.1	-33.8	32.1	-	-12.6	25.0	37.6	

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	81.9	19.2	-73.9	32.1	0.0	-4.9	25.0	29.9	
0	0.26840	PK	53.0	19.1	-73.9	32.1	0.0	-33.9	19.0	52.9	
0	0.40260	PK	54.7	19.1	-73.9	32.1	0.0	-32.2	15.5	47.7	

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	81.9	19.2	6.1	32.2	-	75.0	-	-	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**

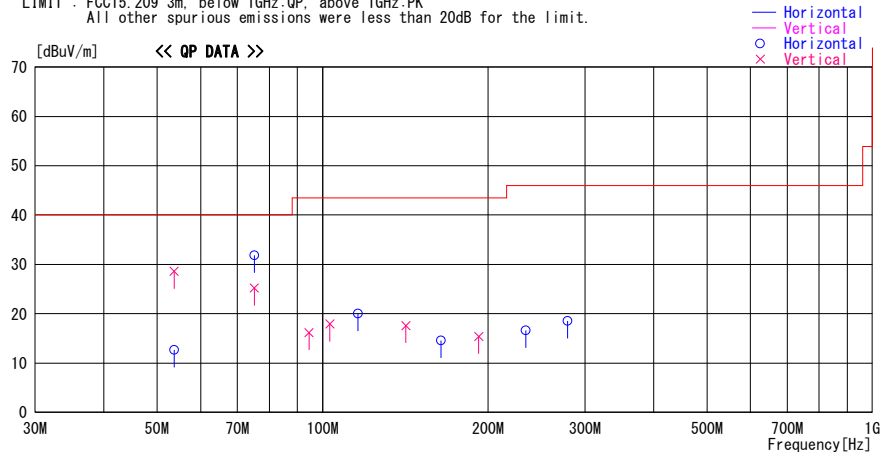
**DATA OF RADIATED EMISSION TEST**

UL Japan, Inc. Head Office EMC Lab. No.1 Semi Anechoic Chamber  
Date : 2014/03/12

Report No. : 10232789H  
Temp./Humi. : 19deg. C / 33% RH  
Engineer : Keisuke Kawamura

Mode / Remarks : Tx 134.2kHz, Normal Modulation, Door Antenna, Worst Axis (Ant Hor:X Ver:X, ECU Hor:X Ver: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	Loss&	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Gain [dB]							
53.681	34.0	QP	9.7	-31.0	12.7	345	213	Hori.	40.0	27.3	
53.681	49.9	QP	9.7	-31.0	28.6	268	100	Vert.	40.0	11.4	
75.148	49.4	QP	6.5	-30.7	25.2	268	100	Vert.	40.0	14.8	
75.148	56.0	QP	6.5	-30.7	31.8	183	250	Hori.	40.0	8.2	
94.472	37.6	QP	9.1	-30.5	16.2	174	100	Vert.	43.5	27.3	
103.067	37.6	QP	10.6	-30.3	17.9	78	100	Vert.	43.5	25.6	
115.946	37.9	QP	12.4	-30.3	20.0	0	280	Hori.	43.5	23.5	
141.715	33.1	QP	14.5	-30.0	17.6	359	100	Vert.	43.5	25.9	
164.098	28.9	QP	15.5	-29.8	14.6	0	300	Hori.	43.5	28.9	
192.324	28.7	QP	16.3	-29.6	15.4	359	100	Vert.	43.5	28.1	
233.987	28.7	QP	16.9	-29.0	16.6	0	300	Hori.	46.0	29.4	
278.896	28.3	QP	18.7	-28.5	18.5	0	300	Hori.	46.0	27.5	

CHART:WITH FACTOR ANT TYPE: ~30MHz:LOOP, 30~300MHz:BICONICAL, 300MHz~1000MHz:LOGPERIODIC, 1000MHz~:HORN  
CALCULATION:RESULT = READING + ANT FACTOR + LOSS(CABLE) - 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**

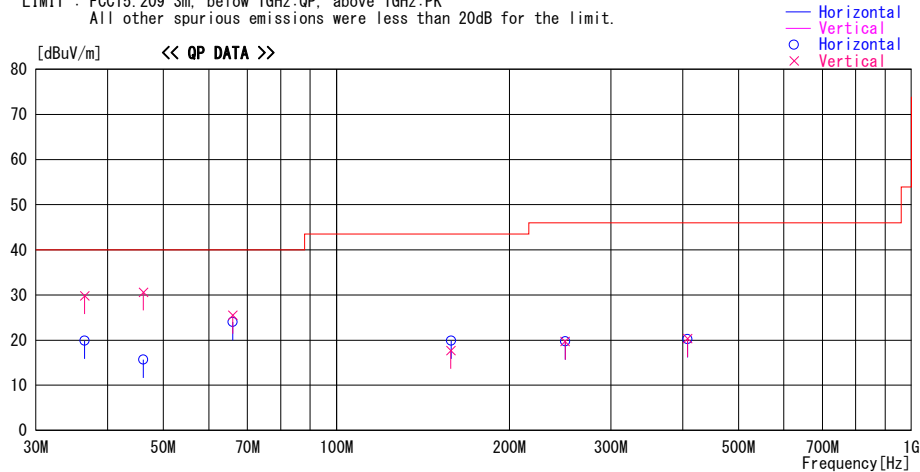
**DATA OF RADIATED EMISSION TEST**

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber  
Date : 2013/08/01

Report No. : 10232789H  
Temp./Humi. : 20deg. C / 62% RH  
Engineer : Hironobu Ohnishi

Mode / Remarks : Tx 134.2kHz, Normal modulation, Trunk Antenna, Worst axis(Antenna: X, ECU: 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]							
36.502	25.9	QP	15.8	-21.8	19.9	179	255	Hori.	40.0	20.1	
36.502	35.8	QP	15.8	-21.8	29.8	92	100	Vert.	40.0	10.2	
46.164	40.3	QP	12.0	-21.7	30.6	301	100	Vert.	40.0	9.4	
46.164	25.4	QP	12.0	-21.7	15.7	359	274	Hori.	40.0	24.3	
66.025	39.8	QP	7.1	-21.4	25.5	237	100	Vert.	40.0	14.5	
66.025	38.3	QP	7.1	-21.4	24.0	13	400	Hori.	40.0	16.0	
158.366	24.9	QP	15.2	-20.2	19.9	96	143	Hori.	43.5	23.6	
158.128	22.7	QP	15.2	-20.2	17.7	263	100	Vert.	43.5	25.8	
249.862	21.5	QP	17.2	-19.0	19.7	296	100	Vert.	46.0	26.3	
249.862	21.5	QP	17.2	-19.0	19.7	277	185	Hori.	46.0	26.3	
407.995	22.0	QP	17.4	-19.1	20.3	327	100	Vert.	46.0	25.7	
407.867	21.9	QP	17.4	-19.1	20.2	47	100	Hori.	46.0	25.8	

CHART: WITH FACTOR    ANT TYPE: -30MHz: LOOP, 30-300MHz: BICONICAL, 300MHz-1000MHz: LOGPERIODIC, 1000MHz-: HORN  
CALCULATION: RESULT = READING + ANT FACTOR + LOSS (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**

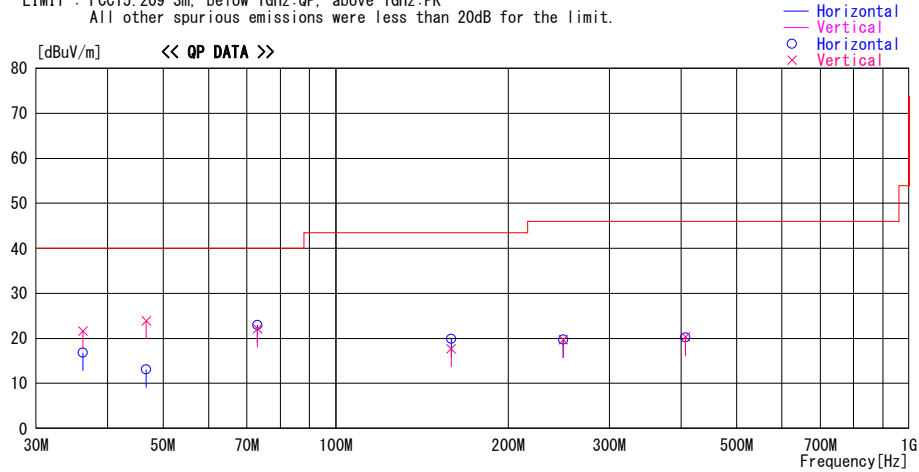
**DATA OF RADIATED EMISSION TEST**

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber  
Date : 2013/08/01

Report No. : 10232789H  
Temp./Humi. : 20deg. C / 62% RH  
Engineer : Hironobu Ohnishi

Mode / Remarks : Tx 134.2kHz Normal modulation, Room/Luggage Antenna(Max. output), Worst axis(Antenna: X, ECU: 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	Loss&	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Gain [dB]							
36.234	27.5	QP	15.9	-21.8	21.6	113	100	Vert.	40.0	18.4	
36.234	22.7	QP	15.9	-21.8	16.8	359	224	Hori.	40.0	23.2	
46.701	33.8	QP	11.8	-21.7	23.9	269	100	Vert.	40.0	16.1	
46.701	23.0	QP	11.8	-21.7	13.1	359	296	Hori.	40.0	26.9	
73.004	37.8	QP	6.5	-21.3	23.0	197	219	Hori.	40.0	17.0	
73.004	36.9	QP	6.5	-21.3	22.1	244	100	Vert.	40.0	17.9	
158.990	24.9	QP	15.2	-20.2	19.9	180	144	Hori.	43.5	23.6	
158.990	22.7	QP	15.2	-20.2	17.7	270	100	Vert.	43.5	25.8	
249.378	21.5	QP	17.2	-19.0	19.7	10	232	Hori.	46.0	26.3	
249.369	21.5	QP	17.2	-19.0	19.7	293	100	Vert.	46.0	26.3	
407.439	21.9	QP	17.4	-19.1	20.2	359	152	Hori.	46.0	25.8	
407.371	22.0	QP	17.4	-19.1	20.3	168	187	Vert.	46.0	25.7	

CHART:WITH FACTOR ANT TYPE: -30MHz:LOOP, 30-300MHz:BICONICAL, 300MHz-1000MHz:LOGPERIODIC, 1000MHz-:HORN  
CALCULATION:RESULT = READING + ANT FACTOR + LOSS(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**

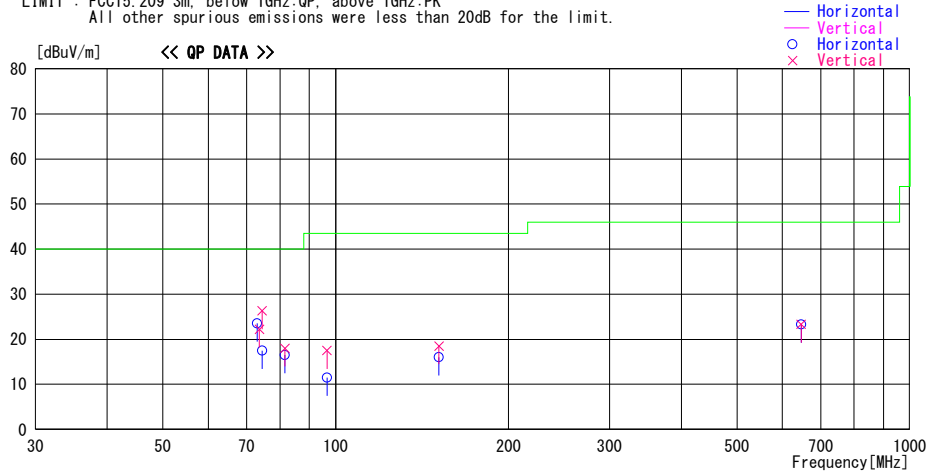
**DATA OF RADIATED EMISSION TEST**

UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber  
Date : 2013/08/29

Report No. : 10232789H  
Temp./Humi. : 22deg. C / 53% RH  
Engineer : Masatoshi Nishiguchi

Mode / Remarks : Tx 134.2kHz, Normal modulation, Room/Luggage Antenna, Minimum Output, WorstAxis(Antenna: X, ECU: 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]							
73.005	41.2	QP	6.6	-24.3	23.5	0	400	Hori.	40.0	16.5	
73.676	39.9	QP	6.6	-24.3	22.2	260	100	Vert.	40.0	17.8	
74.481	35.2	QP	6.6	-24.3	17.5	0	400	Hori.	40.0	22.5	
74.481	44.0	QP	6.6	-24.3	26.3	262	100	Vert.	40.0	13.7	
81.594	33.8	QP	6.9	-24.2	16.5	174	217	Hori.	40.0	23.5	
81.594	35.3	QP	6.9	-24.2	18.0	90	100	Vert.	40.0	22.0	
96.624	25.6	QP	9.8	-23.9	11.5	130	306	Hori.	43.5	32.0	
96.624	31.6	QP	9.8	-23.9	17.5	72	100	Vert.	43.5	26.0	
151.378	24.1	QP	15.1	-23.2	16.0	6	250	Hori.	43.5	27.5	
151.378	26.6	QP	15.1	-23.2	18.5	285	100	Vert.	43.5	25.0	
646.576	22.4	QP	21.1	-20.2	23.3	359	100	Hori.	46.0	22.7	
646.576	22.4	QP	21.1	-20.2	23.3	359	100	Vert.	46.0	22.7	

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

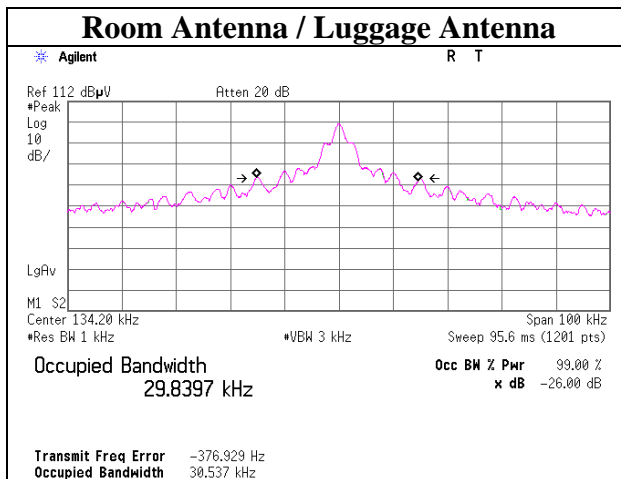
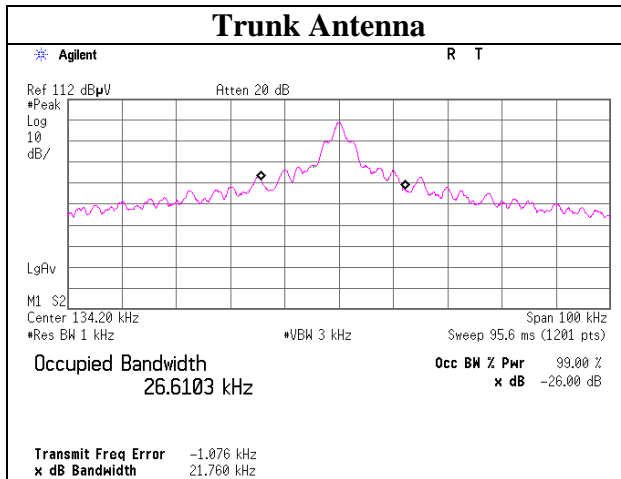
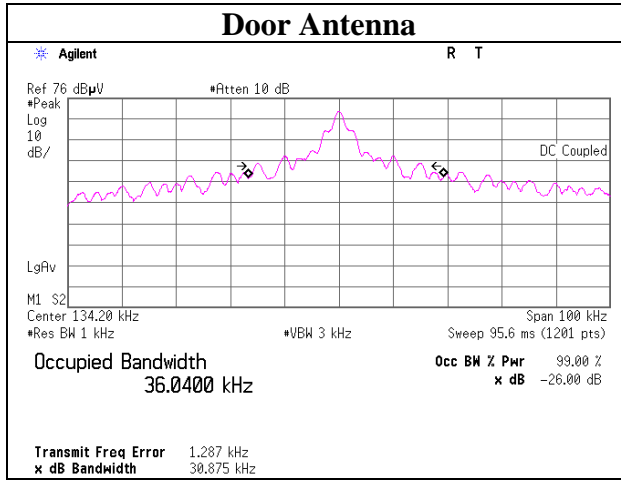
\*The test result is rounded off to one or two decimal places, so some differences might be observed.

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

Test place Head Office EMC Lab. No.1 Semi Anechoic Chamber  
Report No. 10232789H  
Date 08/27/2013 03/13/2014  
Temperature/ Humidity 21 deg. C / 52% RH 20 deg. C / 37% RH  
Engineer Masatoshi Nishiguchi Keisuke Kawamura  
Mode Tx 134.2kHz

Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
Door Antenna	134.2	30.875	36.040
Trunk Antenna	134.2	21.760	26.610
Room Antenna / Ruggage Antenna	134.2	30.537	29.840

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



## APPENDIX 2: Test instruments

### EMI test equipment (Tested on August 1 to 29, 2013)

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	2013/02/28 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	-	RE	2013/02/26 * 12
MJM-09	Measure	KDS	E19-55	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	RE	2013/02/22 * 12
MTR-07	Test Receiver	Rohde & Schwarz	ESCI	100635	RE	2013/04/10 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2012/10/12 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/SFM141(5m)/421-010(1m)/sucoform141-PE(1m)/RFM-E121(Switcher)	-/04178	RE	2013/07/23 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2013/07/22 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2013/03/12 * 12
MAT-07	Attenuator(6dB)	Weinschel Corp	2	BK7970	RE	2012/11/06 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2012/11/18 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2012/11/18 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2013/06/18 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2012/11/21 * 12
MRENT-95	Spectrum Analyzer	Agilent	E4440A	MY46185823	RE	2013/06/14 * 12
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	RE	2013/06/30 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE	2013/02/26 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
MSA-09	Spectrum Analyzer	Advantest	R3273	95090115	RE	2012/10/22 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	RE	2013/06/11 * 12
MBA-02	Biconical Antenna	Schwarzbeck	BBA9106	VHA91032008	RE	2012/10/08 * 12
MLA-02	Logperiodic Antenna	Schwarzbeck	USLP9143	201	RE	2012/10/08 * 12
MCC-12	Coaxial Cable	Fujikura/Agilent	-	-	RE	2013/02/06 * 12
MPA-09	Pre Amplifier	Agilent	8447D	2944A10845	RE	2012/09/11 * 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.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

**EMI test equipment (Tested on March 12 and 13, 2014)**

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	2013/08/01 * 12
MOS-27	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	RE	2014/02/20 * 12
MJM-21	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MTR-09	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	RE	2013/06/07 * 12
KBA-05	Biconical Antenna	Schwarzbeck	BBA9106	2513	RE	2013/11/24 * 12
KLA-04	Logperiodic Antenna	Schwarzbeck	USLP9143	361	RE	2013/11/24 * 12
MAT-08	Attenuator(6dB)	Weinschel Corp	2	BK7971	RE	2013/11/26 * 12
MCC-02	Coaxial Cable	Suhner/storm/Agilent/ TSJ	-	-	RE	2013/09/12 * 12
MPA-19	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	RE	2014/02/17 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2013/10/30 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2013/07/22 * 12
MCC-03	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W(20m)/3D-2W(7.5m)/RG400u(1.5m)/RFM-E421(Switcher)	-/01068(Switcher)	RE	2013/09/12 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2013/03/12 * 12
MSA-13	Spectrum Analyzer	Agilent	E4440A	MY46185823	RE	2013/06/14 * 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.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124