



# RADIO TEST REPORT


**Test Report No. : 10232780H-A-R1**

**Applicant** : Toyota Motor Corporation  
**Type of Equipment** : Smart LF Oscillator  
**Model No.** : TMLF10-55  
**FCC ID** : NI4TMLF10-55  
**Test regulation** : FCC Part 15 Subpart C: 2014  
**Test Result** : Complied

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
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.
6. This report is a revised version of 10232780H-A. 10232780H-A is replaced with this report.

**Date of test:** February 28, 2014

**Representative test engineer:**

  
Masatoshi Nishiguchi  
Engineer  
Consumer Technology Division

**Approved by:**

  
Masanori Nishiyama  
Manager  
Consumer Technology Division



NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.  
\*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.**

**Ise HQ EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124



---

**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: -26dB Bandwidth..... 12**  
**SECTION 7: 99% Occupied Bandwidth..... 12**  
**APPENDIX 1: Data of EMI test..... 13**  
    **Radiated Emission below 30MHz (Fundamental and Spurious Emission) ..... 13**  
    **Radiated Emission above 30MHz (Spurious Emission)..... 17**  
    **-26dB Bandwidth and 99% Occupied Bandwidth ..... 21**  
**APPENDIX 2: Test instruments ..... 23**  
**APPENDIX 3: Photographs of test setup ..... 24**  
    **Radiated Emission..... 24**  
    **Worst Case Position ..... 27**

## **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. : TMLF10-55  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC12.0V (Max 0.5A)  
Receipt Date of Sample : 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: TMLF10-55 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: TMLF10-55) consists of the following parts:

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

---

**UL Japan, Inc.**

**Ise HQ 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: 2014, final revised on March 6, 2014 and effective April 7, 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 March 6, 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 C63.4:2003 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	12.2dB 0.13420MHz, PK (PK with Duty factor) <Trunk 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	16.3dB 49.122MHz, Vertical, QP <Room/Luggage 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.

**UL Japan, Inc.**

**Ise HQ EMC Lab.**

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

Telephone : +81 596 24 8999

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 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.

**UL Japan, Inc.**

**Ise HQ 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 HQ 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**

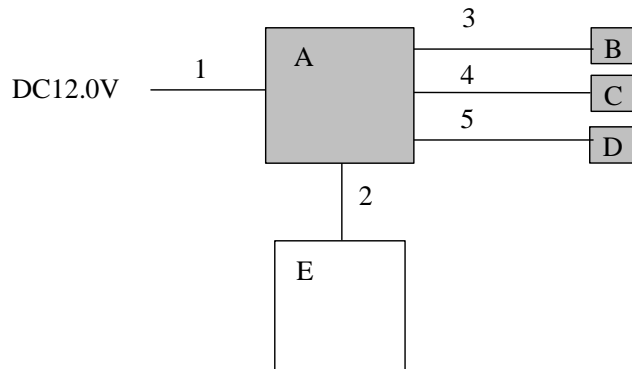
The mode is used :           1) Transmitting mode (Tx) 134.2kHz (Door Antenna, Trunk Antenna,  
  Room Antenna / Luggage Antenna, Maximum Output)  
  2) Transmitting mode (Tx) 134.2kHz (Room Antenna / Luggage Antenna only, Minimum Output)  
  \* LF output power is controlled by Component Assy, Smart 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	2.0	Unshielded	Unshielded	-
2	ECU Cable	2.0	Unshielded	Unshielded	-
3	Door Ant Cable	2.0	Unshielded	Unshielded	-
4	Room Ant / Luggage Ant Cable	2.0	Unshielded	Unshielded	-
5	Trunk Ant Cable	2.0	Unshielded	Unshielded	-

**UL Japan, Inc.**

**Ise HQ 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**

The Radiated Electric Field Strength intensity has been measured on No 2 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**

**UL Japan, Inc.**

**Ise HQ EMC Lab.**

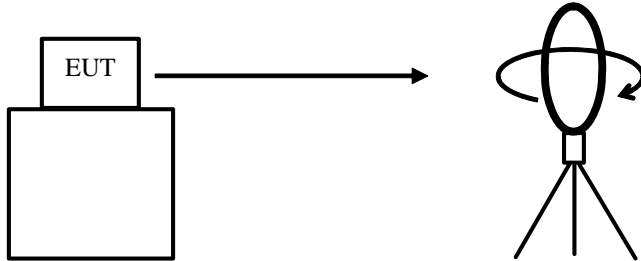
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

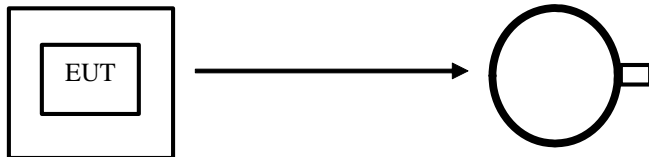
Facsimile : +81 596 24 8124

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

*Side View (Vertical)*

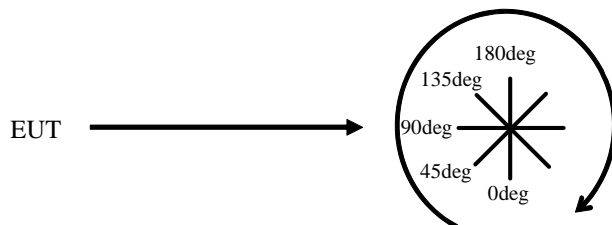


.....  
*Top View (Horizontal)*



Antenna was not rotated.

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



Front side: 0 deg.  
Forward direction: clockwise

## **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 Ise HQ EMC Lab. No.2 Semi Anechoic Chamber  
Report No. 10232780H  
Date 02/28/2014  
Temperature/ Humidity 21 deg. C / 41% 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	98.4	20.0	-74.0	32.1	-	12.3	45.0	32.7	Fundamental
0	0.26840	PK	60.6	19.9	-73.9	32.1	-	-25.5	39.0	64.5	
0	0.40260	PK	75.6	19.8	-73.9	32.1	-	-10.6	35.5	46.1	
0	0.53680	QP	42.0	19.8	-33.9	32.2	-	-4.3	33.0	37.3	
0	0.67100	QP	64.4	19.8	-33.8	32.1	-	18.3	31.1	12.8	
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	31.7	19.8	-33.8	32.0	-	-14.3	26.9	41.2	
0	1.20780	QP	44.8	19.8	-33.8	32.0	-	-1.2	25.9	27.1	
0	1.34200	QP	31.0	19.8	-33.7	32.1	-	-15.0	25.0	40.0	

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	98.4	20.0	-74.0	32.1	0.0	12.3	25.0	12.7	
0	0.26840	PK	60.6	19.9	-73.9	32.1	0.0	-25.5	19.0	44.5	
0	0.40260	PK	75.6	19.8	-73.9	32.1	0.0	-10.6	15.5	26.1	

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	98.4	20.0	6.0	32.1	-	92.3	-	-	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 HQ EMC Lab. No.2 Semi Anechoic Chamber  
Report No. : 10232780H  
Date : 02/28/2014  
Temperature/ Humidity : 21 deg. C / 41% 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	98.9	20.0	-74.0	32.1	-	12.8	45.0	32.2	Fundamental
0	0.26840	PK	60.4	19.9	-73.9	32.1	-	-25.7	39.0	64.7	
0	0.40260	PK	73.5	19.8	-73.9	32.1	-	-12.7	35.5	48.2	
0	0.53680	QP	41.3	19.8	-33.9	32.2	-	-5.0	33.0	38.0	
0	0.67100	QP	55.7	19.8	-33.8	32.1	-	9.6	31.1	21.5	
0	0.80520	QP	34.0	19.8	-33.8	32.1	-	-12.1	29.5	41.6	
0	0.93940	QP	54.8	19.8	-33.8	32.1	-	8.7	28.1	19.4	
0	1.07360	QP	31.7	19.8	-33.8	32.0	-	-14.3	26.9	41.2	
0	1.20780	QP	51.3	19.8	-33.8	32.0	-	5.3	25.9	20.6	
0	1.34200	QP	31.1	19.8	-33.7	32.1	-	-14.9	25.0	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	0.13420	PK	98.9	20.0	-74.0	32.1	0.0	12.8	25.0	12.2	
0	0.26840	PK	60.4	19.9	-73.9	32.1	0.0	-25.7	19.0	44.7	
0	0.40260	PK	73.5	19.8	-73.9	32.1	0.0	-12.7	15.5	28.2	

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	98.9	20.0	6.0	32.1	-	92.8	-	-	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 : Ise HQ EMC Lab. No.2 Semi Anechoic Chamber  
Report No. : 10232780H  
Date : 02/28/2014  
Temperature/ Humidity : 21 deg. C / 41% 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	98.8	20.0	-74.0	32.1	-	12.7	45.0	32.3	Fundamental
0	0.26840	PK	59.7	19.9	-73.9	32.1	-	-26.4	39.0	65.4	
0	0.40260	PK	66.3	19.8	-73.9	32.1	-	-19.9	35.5	55.4	
0	0.53680	QP	34.5	19.8	-33.9	32.2	-	-11.8	33.0	44.8	
0	0.67100	QP	41.9	19.8	-33.8	32.1	-	-4.2	31.1	35.3	
0	0.80520	QP	31.5	19.8	-33.8	32.1	-	-14.6	29.5	44.1	
0	0.93940	QP	48.5	19.8	-33.8	32.1	-	2.4	28.1	25.7	
0	1.07360	QP	31.1	19.8	-33.8	32.0	-	-14.9	26.9	41.8	
0	1.20780	QP	46.8	19.8	-33.8	32.0	-	0.8	25.9	25.1	
0	1.34200	QP	30.9	19.8	-33.7	32.1	-	-15.1	25.0	40.1	

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	98.8	20.0	-74.0	32.1	0.0	12.7	25.0	12.3	
0	0.26840	PK	59.7	19.9	-73.9	32.1	0.0	-26.4	19.0	45.4	
0	0.40260	PK	66.3	19.8	-73.9	32.1	0.0	-19.9	15.5	35.4	

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	98.8	20.0	6.0	32.1	-	92.7	-	-	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 HQ EMC Lab. No.2 Semi Anechoic Chamber  
Report No. : 10232780H  
Date : 02/28/2014  
Temperature/ Humidity : 21 deg. C / 41% 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	84.5	20.0	-74.0	32.1	-	-1.6	45.0	46.6	Fundamental
0	0.26840	PK	49.1	19.9	-73.9	32.1	-	-37.0	39.0	76.0	
0	0.40260	PK	55.1	19.8	-73.9	32.1	-	-31.1	35.5	66.6	
0	0.53680	QP	45.3	19.8	-33.9	32.2	-	-1.0	33.0	34.0	
0	0.67100	QP	35.7	19.8	-33.8	32.1	-	-10.4	31.1	41.5	
0	0.80520	QP	42.3	19.8	-33.8	32.1	-	-3.8	29.5	33.3	
0	0.93940	QP	36.6	19.8	-33.8	32.1	-	-9.5	28.1	37.6	
0	1.07360	QP	38.6	19.8	-33.8	32.0	-	-7.4	26.9	34.3	
0	1.20780	QP	36.2	19.8	-33.8	32.0	-	-9.8	25.9	35.7	
0	1.34200	QP	34.8	19.8	-33.7	32.1	-	-11.2	25.0	36.2	

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	84.5	20.0	-74.0	32.1	0.0	-1.6	25.0	26.6	
0	0.26840	PK	49.1	19.9	-73.9	32.1	0.0	-37.0	19.0	56.0	
0	0.40260	PK	55.1	19.8	-73.9	32.1	0.0	-31.1	15.5	46.6	

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	84.5	20.0	6.0	32.1	-	78.4	-	-	Fundamental

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

\* All spurious emissions lower than this result.



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

**DATA OF RADIATED EMISSION TEST**

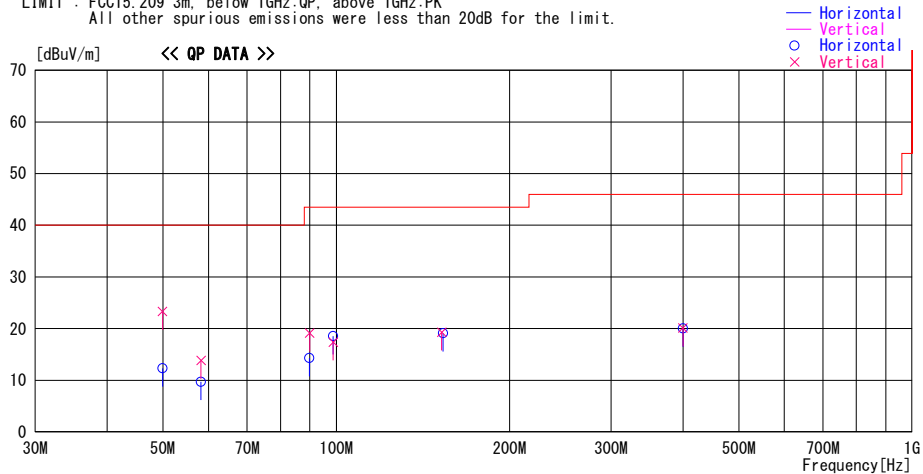
UL Japan, Inc. Ise HQ EMC Lab. No.2 Semi Anechoic Chamber  
 Date : 2014/02/28

Report No. : 10232780H

Temp./Humi. : 21deg. C / 41% RH  
 Engineer : Masatoshi Nishiguchi

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

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		Comment
			Factor [dB/m]	Loss & Gain [dB]					[dBuV/m]	[dB]	
49.914	22.9	QP	10.9	-21.5	12.3	0	400	Hori.	40.0	27.7	
49.914	33.9	QP	10.9	-21.5	23.3	0	100	Vert.	40.0	16.7	
58.238	22.8	QP	8.3	-21.4	9.7	0	400	Hori.	40.0	30.3	
58.238	26.9	QP	8.3	-21.4	13.8	0	100	Vert.	40.0	26.2	
89.850	27.4	QP	8.0	-21.1	14.3	195	239	Hori.	43.5	29.2	
89.902	32.1	QP	8.1	-21.1	19.1	250	100	Vert.	43.5	24.4	
98.784	29.8	QP	9.8	-21.1	18.5	0	298	Hori.	43.5	25.0	
98.778	28.7	QP	9.8	-21.1	17.4	261	100	Vert.	43.5	26.1	
152.462	24.7	QP	15.0	-20.4	19.3	0	100	Vert.	43.5	24.2	
153.340	24.5	QP	15.0	-20.4	19.1	0	201	Hori.	43.5	24.4	
400.000	22.0	QP	17.3	-19.2	20.1	359	100	Vert.	46.0	25.9	
400.000	21.9	QP	17.3	-19.2	20.0	400	100	Hori.	46.0	26.0	

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)**  
**Trunk Antenna**

**DATA OF RADIATED EMISSION TEST**

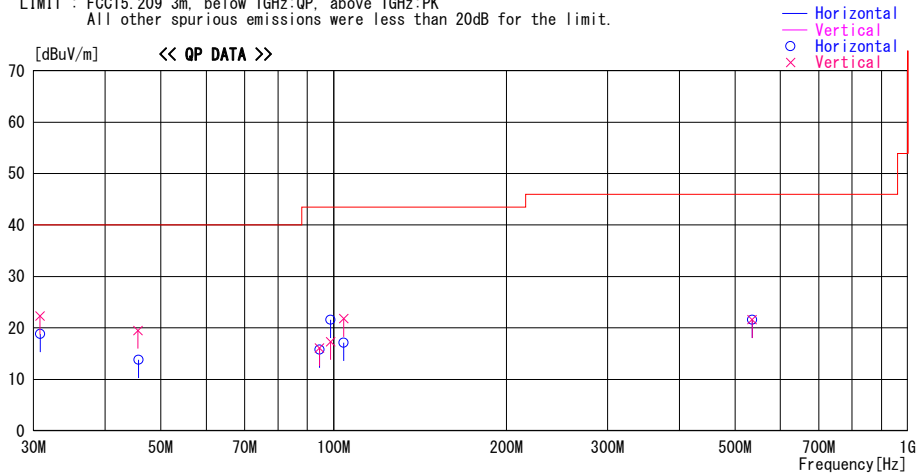
UL Japan, Inc. Ise HQ EMC Lab. No.2 Semi Anechoic Chamber  
 Date : 2014/02/28

Report No. : 10232780H

Temp./Humi. : 21deg. C / 41% RH  
 Engineer : Masatoshi Nishiguchi

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

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	Angle	Height	Polar.	Limit	Margin	Comment
			Factor [dB/m]	Gain [dB]					[dBuV/m]	[dB]	
30.806	26.2	QP	18.1	-22.0	22.3	277	100	Vert.	40.0	17.7	
30.832	22.7	QP	18.1	-22.0	18.8	0	300	Hori.	40.0	21.2	
45.634	28.6	QP	12.5	-21.6	19.5	0	100	Vert.	40.0	20.5	
45.750	22.9	QP	12.5	-21.6	13.8	0	300	Hori.	40.0	26.2	
94.488	27.9	QP	9.0	-21.1	15.8	174	300	Hori.	43.5	27.7	
94.474	28.2	QP	9.0	-21.1	16.1	90	100	Vert.	43.5	27.4	
98.768	32.9	QP	9.8	-21.1	21.6	0	298	Hori.	43.5	21.9	
98.786	28.6	QP	9.8	-21.1	17.3	264	100	Vert.	43.5	26.2	
104.138	27.3	QP	10.7	-20.9	17.1	0	285	Hori.	43.5	26.4	
104.138	32.0	QP	10.7	-20.9	21.8	259	100	Vert.	43.5	21.7	
535.665	22.2	QP	18.6	-19.2	21.6	0	100	Hori.	46.0	24.4	
535.665	22.2	QP	18.6	-19.2	21.6	0	100	Vert.	46.0	24.4	

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**

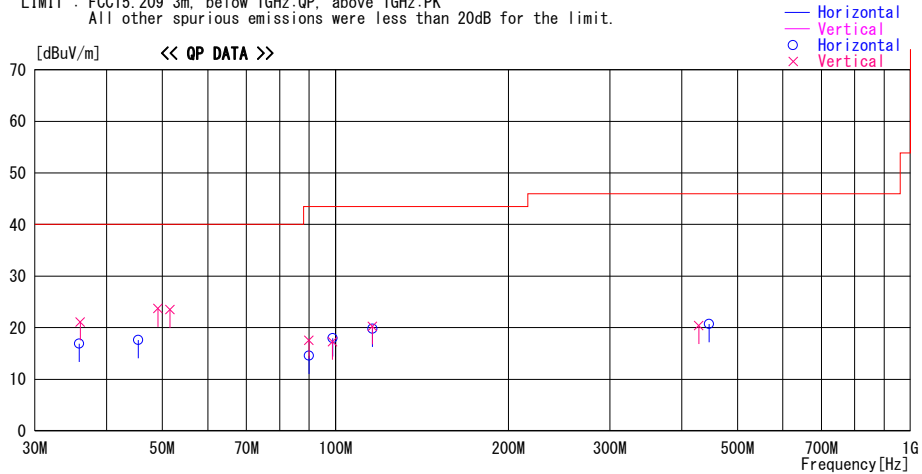
UL Japan, Inc. Ise HQ EMC Lab. No.2 Semi Anechoic Chamber  
 Date : 2014/02/28

Report No. : 10232780H

Temp./Humi. : 21deg. C / 41% RH  
 Engineer : Masatoshi Nishiguchi

Mode / Remarks : Tx 134.2kHz, Normal Modulation, Room Antenna(Max), Worst axis (Ant:Hori-X/Vert-X, ECU:Hori-X/Vert-Y)

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]	
35.850	22.7	QP	16.0	-21.8	16.9	0	300	Hori.	40.0	23.1	
35.980	27.0	QP	15.9	-21.8	21.1	244	100	Vert.	40.0	18.9	
45.380	26.5	QP	12.7	-21.6	17.6	0	301	Hori.	40.0	22.4	
49.122	34.0	QP	11.2	-21.5	23.7	94	100	Vert.	40.0	16.3	
51.544	34.7	QP	10.3	-21.5	23.5	91	100	Vert.	40.0	16.5	
89.904	27.6	QP	8.1	-21.1	14.6	184	219	Hori.	43.5	28.9	
89.890	30.6	QP	8.1	-21.1	17.6	259	100	Vert.	43.5	25.9	
98.850	29.3	QP	9.8	-21.1	18.0	0	303	Hori.	43.5	25.5	
98.780	28.6	QP	9.8	-21.1	17.3	255	100	Vert.	43.5	26.2	
115.950	28.3	QP	12.3	-20.8	19.8	0	302	Hori.	43.5	23.7	
115.950	28.8	QP	12.3	-20.8	20.3	275	100	Vert.	43.5	23.2	
428.332	22.2	QP	17.5	-19.3	20.4	0	100	Vert.	46.0	25.6	
446.682	22.2	QP	17.7	-19.2	20.7	0	100	Hori.	46.0	25.3	

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**

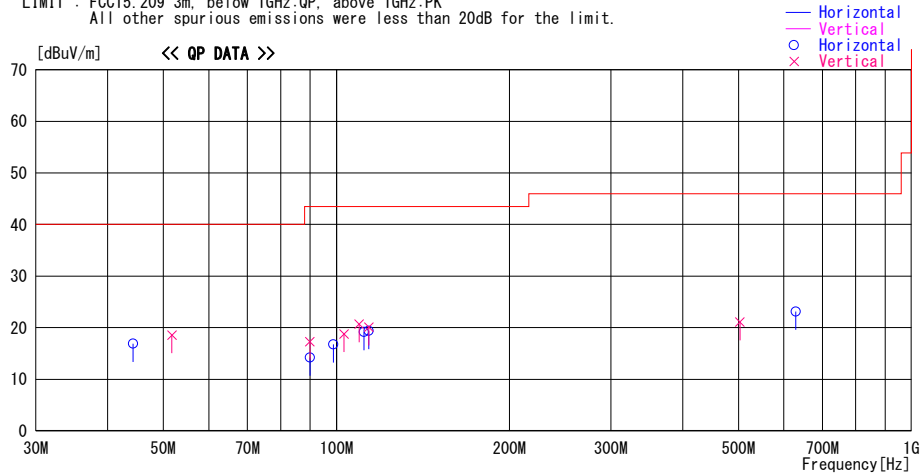
UL Japan, Inc. Ise HQ EMC Lab. No.2 Semi Anechoic Chamber  
 Date : 2014/02/28

Report No. : 10232780H

Temp./Humi. : 21deg. C / 41% RH  
 Engineer : Masatoshi Nishiguchi

Mode / Remarks : Tx 134.2kHz, Normal Modulation, Room Antenna (Min), Worst axis (Ant: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]							
44.331	25.6	QP	13.0	-21.7	16.9	0	317	Hori.	40.0	23.1	
51.740	29.8	QP	10.3	-21.5	18.6	0	100	Vert.	40.0	21.4	
89.905	27.2	QP	8.1	-21.1	14.2	196	232	Hori.	43.5	29.3	
89.924	30.3	QP	8.1	-21.1	17.3	227	100	Vert.	43.5	26.2	
98.778	28.1	QP	9.8	-21.1	16.8	0	300	Hori.	43.5	26.7	
103.070	29.2	QP	10.5	-20.9	18.8	81	100	Vert.	43.5	24.7	
109.508	30.2	QP	11.4	-20.9	20.7	266	100	Vert.	43.5	22.8	
111.662	28.4	QP	11.7	-20.9	19.2	0	280	Hori.	43.5	24.3	
113.806	28.2	QP	12.0	-20.8	19.4	0	281	Hori.	43.5	24.1	
113.806	28.9	QP	12.0	-20.8	20.1	272	100	Vert.	43.5	23.4	
502.998	22.3	QP	18.1	-19.3	21.1	0	100	Vert.	46.0	24.9	
629.000	22.1	QP	19.7	-18.7	23.1	0	100	Hori.	46.0	22.9	

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)

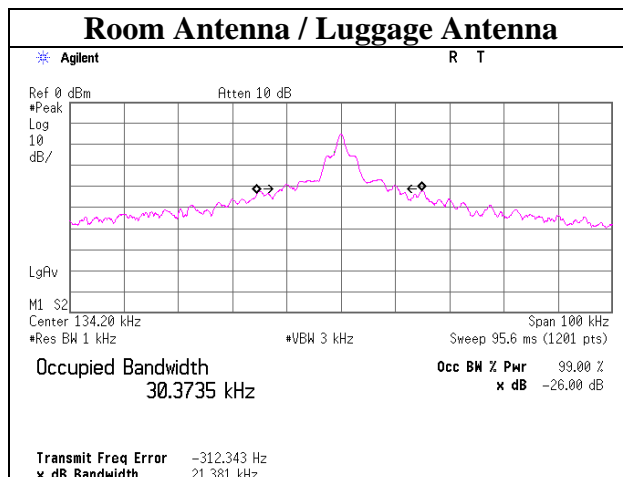
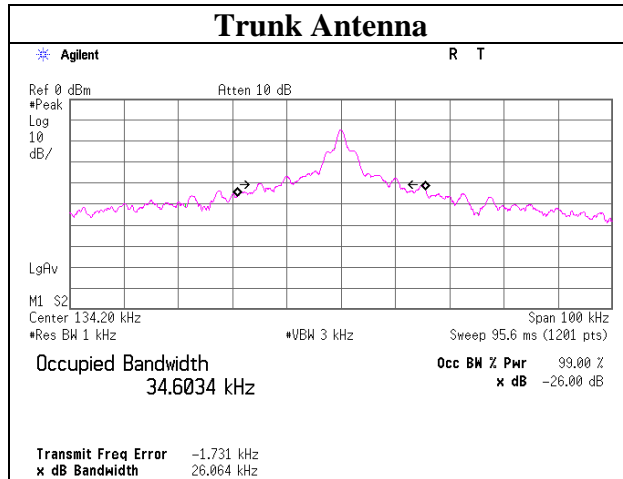
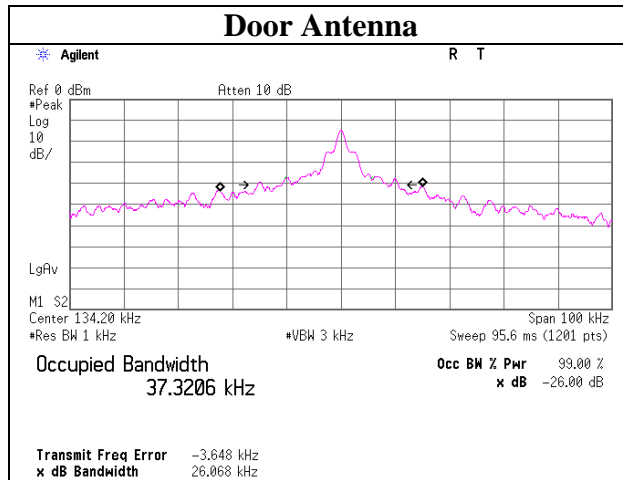
\*The test result is rounded off to one or two decimal places, so some differences might be observed.

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

Test place Ise HQ EMC Lab. No.2 Semi Anechoic Chamber  
Report No. 10232780H  
Date 02/28/2014  
Temperature/ Humidity 21 deg. C / 41% RH  
Engineer Masatoshi Nishiguchi  
Mode Tx 134.2kHz

Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
Door Antenna	134.2	26.068	37.321
Trunk Antenna	134.2	26.064	34.603
Room Antenna / Ruggage Antenna	134.2	21.381	30.374

## -26dB Bandwidth and 99% Occupied Bandwidth



## **APPENDIX 2: Test instruments**

### **EMI test equipment**

<b>Control No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Serial No</b>	<b>Test Item</b>	<b>Calibration Date * Interval(month)</b>
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	2014/02/20 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	RE	2014/02/20 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	RE	2013/06/11 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2013/10/30 * 12
MCC-13	Coaxial Cable	Fujikura	3D-2W(12m)/5D-2W(5m)/5D-2W(0.8m)/5D-2W(1m)	-	RE	2014/02/20 * 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	2013/11/26 * 12
MBA-02	Biconical Antenna	Schwarzbeck	BBA9106	VHA91032008	RE	2013/10/13 * 12
MLA-02	Logperiodic Antenna	Schwarzbeck	USLP9143	201	RE	2013/10/13 * 12
MCC-12	Coaxial Cable	Fujikura/Agilent	-	-	RE	2014/02/20 * 12
MPA-09	Pre Amplifier	Agilent	8447D	2944A10845	RE	2013/09/12 * 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 HQ EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124