



RADIO TEST REPORT

Test Report No. : 10616579H-A-R1

Applicant : TOYOTA MOTOR CORPORATION

Type of Equipment : Smart LF Oscillator

Model No. : TMLF15-1

FCC ID : NI4TMLF15-1

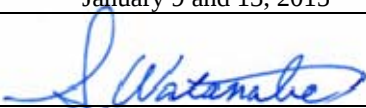
Test regulation : FCC Part 15 Subpart C: 2015

Test Result : Complied

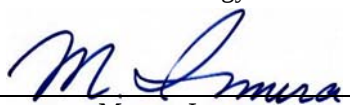
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6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 10616579H-A. 10616579H-A is replaced with this report.

Date of test: January 9 and 13, 2015

Representative test engineer:


Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:


Motoya Imura
Engineer
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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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. : TMLF15-1
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC12.0V (Max 0.5A)
Receipt Date of Sample : December 22, 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: TMLF15-1 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: TMLF15-1) 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: 2015, final revised on January 21, 2015

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 C63.4:2009 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	15.1dB 0.13420MHz 0 deg., 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	7.7dB 41.870MHz, Vertical, QP Trunk Antenna	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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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)

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

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3.5 Test Location

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	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 Computer 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.

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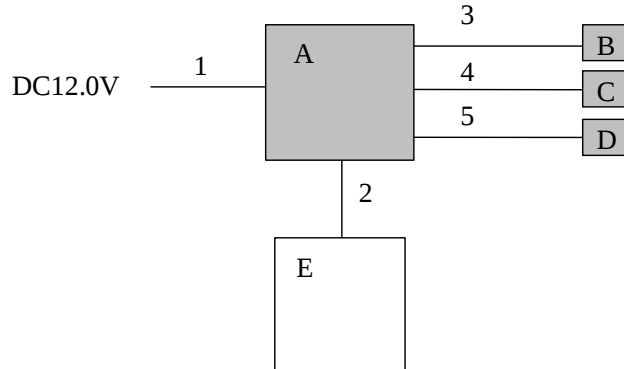
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4.2 Configuration and peripherals



- * 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	-

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SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

EUT was placed on a urethane platform of nominal size, 1.0m by 1.5m, 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., 135 deg., and 180 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
Test Distance	3m *1)	3m *1)	3m *1)	3m *2)	3m	3m

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

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

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 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: January 9, 2015
 January 13, 2015

Test engineer: Shinya Watanabe
 Shinichi Miyazono

UL Japan, Inc.

Ise EMC Lab.

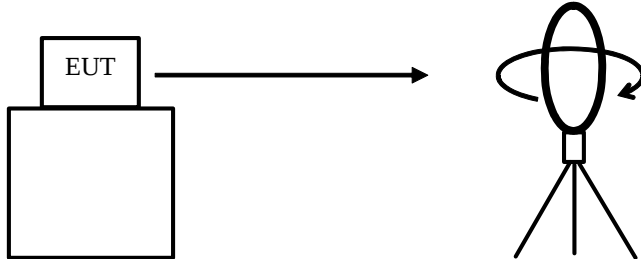
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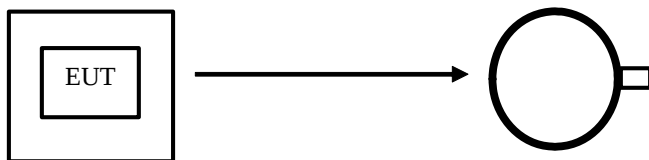
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

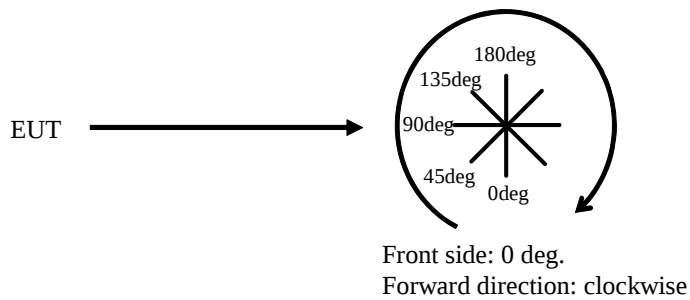


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



SECTION 6: -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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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. : 10616579H
Date : 01/09/2015
Temperature/ Humidity : 20 deg. C / 46% RH
Engineer : Shinya Watanabe
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	95.3	19.6	-73.9	32.2	-	8.8	45.0	36.2	Fundamental
0	0.26840	PK	59.3	19.6	-73.9	32.1	-	-27.1	39.0	66.1	
0	0.40260	PK	64.1	19.6	-73.9	32.1	-	-22.3	35.5	57.8	
0	0.53680	QP	35.9	19.5	-33.8	32.1	-	-10.5	33.0	43.5	
0	0.67100	QP	55.5	19.5	-33.8	32.1	-	9.1	31.1	22.0	
0	0.80520	QP	32.4	19.5	-33.8	32.1	-	-14.0	29.5	43.5	
0	0.93940	QP	45.9	19.5	-33.8	32.1	-	-0.5	28.1	28.6	
0	1.07360	QP	31.4	19.5	-33.8	32.1	-	-15.0	26.9	41.9	
0	1.20780	QP	38.2	19.5	-33.8	32.1	-	-8.2	25.9	34.1	
0	1.34200	QP	36.0	19.5	-33.8	32.1	-	-10.4	25.0	35.4	

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	95.3	19.6	-73.9	32.2	0.0	8.8	25.0	16.2	
0	0.26840	PK	59.3	19.6	-73.9	32.1	0.0	-27.1	19.0	46.1	
0	0.40260	PK	64.1	19.6	-73.9	32.1	0.0	-22.3	15.5	37.8	

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	95.3	19.6	6.1	32.2	-	88.8	-	-	Fundamental

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

* All spurious emissions lower than this result.

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Radiated Emission below 30MHz (Fundamental and Spurious Emission)

Trunk Antenna

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 10616579H
Date : 01/09/2015
Temperature/ Humidity : 20 deg. C / 46% RH
Engineer : Shinya Watanabe
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	96.4	19.6	-73.9	32.2	-	9.9	45.0	35.1	Fundamental
0	0.26840	PK	60.2	19.6	-73.9	32.1	-	-26.2	39.0	65.2	
0	0.40260	PK	62.5	19.6	-73.9	32.1	-	-23.9	35.5	59.4	
0	0.53680	QP	34.8	19.5	-33.8	32.1	-	-11.6	33.0	44.6	
0	0.67100	QP	49.3	19.5	-33.8	32.1	-	2.9	31.1	28.2	
0	0.80520	QP	33.0	19.5	-33.8	32.1	-	-13.4	29.5	42.9	
0	0.93940	QP	47.1	19.5	-33.8	32.1	-	0.7	28.1	27.4	
0	1.07360	QP	31.6	19.5	-33.8	32.1	-	-14.8	26.9	41.7	
0	1.20780	QP	43.4	19.5	-33.8	32.1	-	-3.0	25.9	28.9	
0	1.34200	QP	31.1	19.5	-33.8	32.1	-	-15.3	25.0	40.3	

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	96.4	19.6	-73.9	32.2	0.0	9.9	25.0	15.1	
0	0.26840	PK	60.2	19.6	-73.9	32.1	0.0	-26.2	19.0	45.2	
0	0.40260	PK	62.5	19.6	-73.9	32.1	0.0	-23.9	15.5	39.4	

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	96.4	19.6	6.1	32.2	-	89.9	-	-	Fundamental

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

* All spurious emissions lower than this result.

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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. : 10616579H
Date : 01/09/2015
Temperature/ Humidity : 20 deg. C / 46% RH
Engineer : Shinya Watanabe
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	94.9	19.6	-73.9	32.2	-	8.4	45.0	36.6	Fundamental
0	0.26840	PK	61.5	19.6	-73.9	32.1	-	-24.9	39.0	63.9	
0	0.40260	PK	64.8	19.6	-73.9	32.1	-	-21.6	35.5	57.1	
0	0.53680	QP	33.5	19.5	-33.8	32.1	-	-12.9	33.0	45.9	
0	0.67100	QP	46.9	19.5	-33.8	32.1	-	0.5	31.1	30.6	
0	0.80520	QP	38.0	19.5	-33.8	32.1	-	-8.4	29.5	37.9	
0	0.93940	QP	50.4	19.5	-33.8	32.1	-	4.0	28.1	24.1	
0	1.07360	QP	31.5	19.5	-33.8	32.1	-	-14.9	26.9	41.8	
0	1.20780	QP	46.4	19.5	-33.8	32.1	-	0.0	25.9	25.9	
0	1.34200	QP	31.1	19.5	-33.8	32.1	-	-15.3	25.0	40.3	

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	94.9	19.6	-73.9	32.2	0.0	8.4	25.0	16.6	
0	0.26840	PK	61.5	19.6	-73.9	32.1	0.0	-24.9	19.0	43.9	
0	0.40260	PK	64.8	19.6	-73.9	32.1	0.0	-21.6	15.5	37.1	

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	94.9	19.6	6.1	32.2	-	88.4	-	-	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. : 10616579H
Date : 01/09/2015
Temperature/ Humidity : 20 deg. C / 46% RH
Engineer : Shinya Watanabe
Mode : Tx 134.2kHz

PK or QP

Ant Deg [deg]	Frequency	Detector	Reading	Ant Factor	Loss	Gain	Duty Factor	Result	Limit	Margin	Remark
	[MHz]		[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
0	0.13420	PK	80.8	19.6	-73.9	32.2	-	-5.7	45.0	50.7	Fundamental
0	0.26840	PK	53.5	19.6	-73.9	32.1	-	-32.9	39.0	71.9	
0	0.40260	PK	52.9	19.6	-73.9	32.1	-	-33.5	35.5	69.0	
0	0.53680	QP	45.8	19.5	-33.8	32.1	-	-0.6	33.0	33.6	
0	0.67100	QP	34.9	19.5	-33.8	32.1	-	-11.5	31.1	42.6	
0	0.80520	QP	44.9	19.5	-33.8	32.1	-	-1.5	29.5	31.0	
0	0.93940	QP	41.3	19.5	-33.8	32.1	-	-5.1	28.1	33.2	
0	1.07360	QP	40.2	19.5	-33.8	32.1	-	-6.2	26.9	33.1	
0	1.20780	QP	40.1	19.5	-33.8	32.1	-	-6.3	25.9	32.2	
0	1.34200	QP	39.3	19.5	-33.8	32.1	-	-7.1	25.0	32.1	

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

PK with Duty factor

Ant Deg [deg]	Frequency	Detector	Reading	Ant Factor	Loss	Gain	Duty Factor	Result	Limit	Margin	Remark
	[MHz]		[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
0	0.13420	PK	80.8	19.6	-73.9	32.2	0.0	-5.7	25.0	30.7	
0	0.26840	PK	53.5	19.6	-73.9	32.1	0.0	-32.9	19.0	51.9	
0	0.40260	PK	52.9	19.6	-73.9	32.1	0.0	-33.5	15.5	49.0	

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	Detector	Reading	Ant Factor	Loss	Gain	Duty Factor	Result	Limit	Margin	Remark
	[MHz]		[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
0	0.13420	PK	80.8	19.6	6.1	32.2	-	74.3	-	-	Fundamental

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

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

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Radiated Emission above 30MHz (Spurious Emission) Door Antenna

DATA OF RADIATED EMISSION TEST

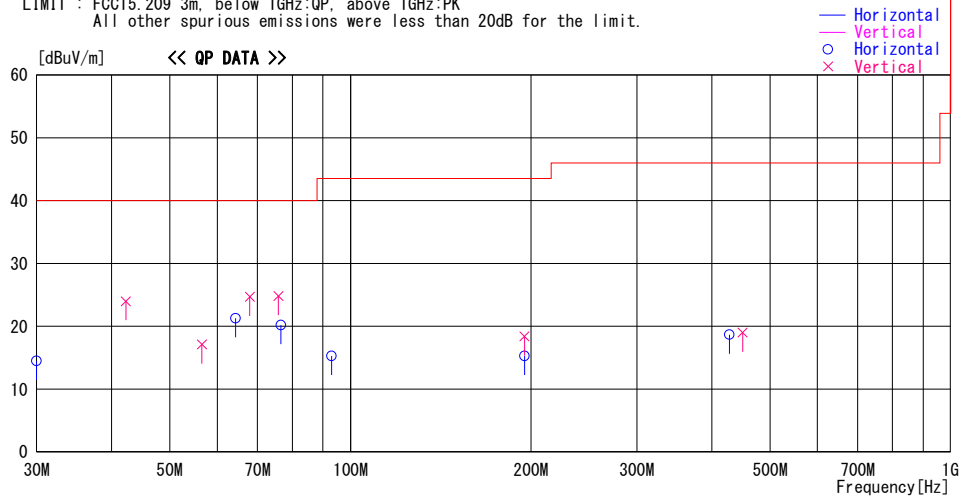
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2015/01/13

Report No. : 10616579H

Temp./Humi. : 21deg. C / 30% RH
Engineer : Shinichi Miyazono

Mode / Remarks : Tx 134.2kHz Normal Modulation Door Antenna 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	Reading	DET	Antenna	Loss&	Level	Angle	Height	Polar.	Limit	Margin	Comment
			Factor	Gain							
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
30.000	28.6	QP	17.4	-31.5	14.5	359	300	Hori.	40.0	25.5	
42.270	41.7	QP	13.5	-31.2	24.0	136	100	Vert.	40.0	16.0	
56.540	39.3	QP	8.7	-30.9	17.1	306	100	Vert.	40.0	22.9	
64.416	45.1	QP	7.1	-30.9	21.3	191	300	Hori.	40.0	18.7	
67.995	48.8	QP	6.7	-30.8	24.7	292	100	Vert.	40.0	15.3	
75.868	49.1	QP	6.4	-30.7	24.8	248	100	Vert.	40.0	15.2	
76.584	44.5	QP	6.4	-30.7	20.2	194	235	Hori.	40.0	19.8	
93.050	37.2	QP	8.6	-30.5	15.3	174	191	Hori.	43.5	28.2	
195.029	31.6	QP	16.4	-29.6	18.4	126	100	Vert.	43.5	25.1	
195.029	28.5	QP	16.4	-29.6	15.3	0	300	Hori.	43.5	28.2	
427.900	28.0	QP	17.6	-26.9	18.7	0	100	Hori.	46.0	27.3	
450.100	28.0	QP	17.8	-26.8	19.0	0	100	Vert.	46.0	27.0	

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

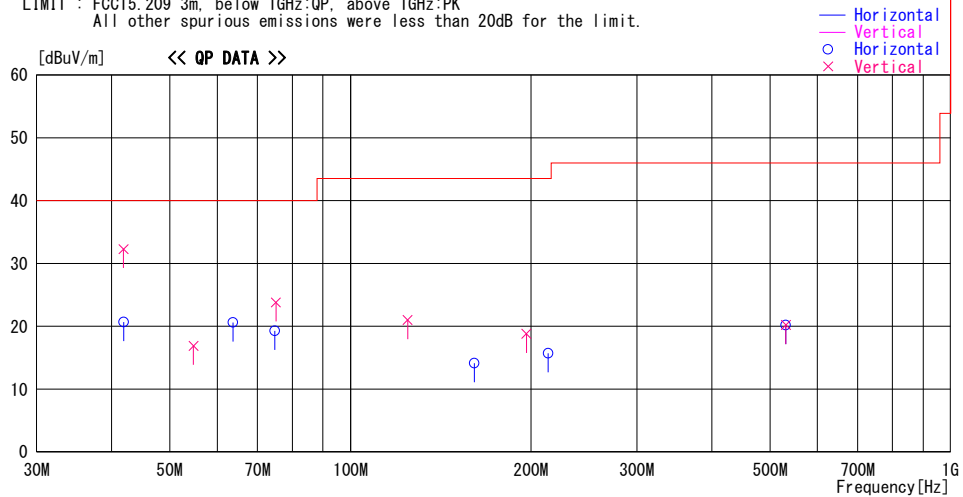
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2015/01/13

Report No. : 10616579H

Temp./Humi. : 21deg. C / 30% RH
Engineer : Shinichi Miyazono

Mode / Remarks : Tx 134.2kHz Normal Modulation Trunk Antenna 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	Reading	DET	Antenna	Loss&	Level	Angle	Height	Polar.	Limit	Margin	Comment
			Factor	Gain							
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
41.870	49.8	QP	13.7	-31.2	32.3	142	100	Vert.	40.0	7.7	
41.880	38.2	QP	13.7	-31.2	20.7	183	230	Hori.	40.0	19.3	
54.753	38.7	QP	9.2	-31.0	16.9	320	100	Vert.	40.0	23.1	
63.700	44.3	QP	7.2	-30.9	20.6	189	300	Hori.	40.0	19.4	
74.783	43.6	QP	6.4	-30.7	19.3	195	241	Hori.	40.0	20.7	
75.152	48.1	QP	6.4	-30.7	23.8	256	100	Vert.	40.0	16.2	
124.538	38.0	QP	13.1	-30.1	21.0	107	100	Vert.	43.5	22.5	
160.942	28.6	QP	15.3	-29.8	14.1	0	300	Hori.	43.5	29.4	
196.460	32.0	QP	16.4	-29.6	18.8	147	100	Vert.	43.5	24.7	
213.426	28.4	QP	16.7	-29.4	15.7	0	300	Hori.	43.5	27.8	
531.463	27.8	QP	18.5	-26.1	20.2	0	100	Vert.	46.0	25.8	
531.463	27.8	QP	18.5	-26.1	20.2	0	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 & 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

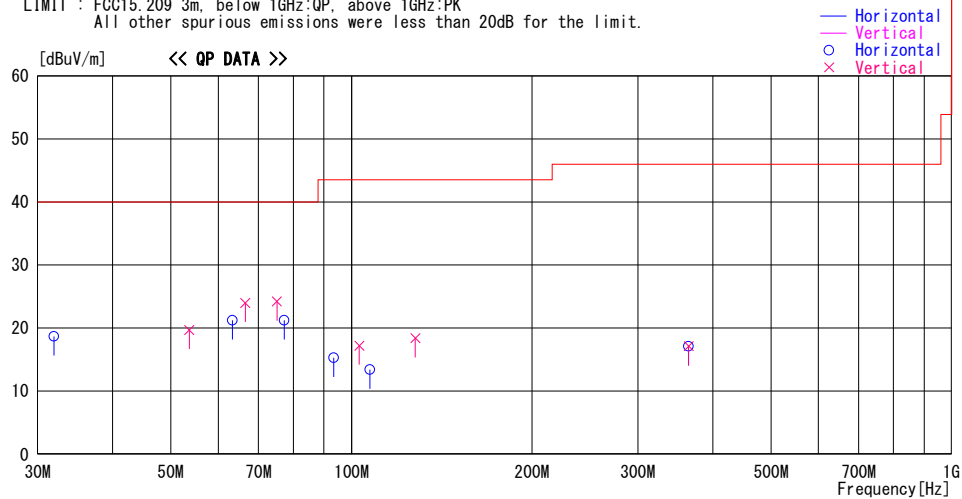
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2015/01/13

Report No. : 10616579H

Temp./Humi. : 21deg. C / 30% RH
Engineer : Shinichi Miyazono

Mode / Remarks : Tx 134.2kHz Normal Modulation Room / Luggage Antenna 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	Loss&	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Gain [dB]							
31.937	33.3	QP	16.8	-31.4	18.7	194	300	Hori.	40.0	21.3	
53.684	41.2	QP	9.5	-31.0	19.7	270	100	Vert.	40.0	20.3	
63.341	44.9	QP	7.2	-30.9	21.2	186	300	Hori.	40.0	18.8	
66.561	48.1	QP	6.8	-30.9	24.0	91	100	Vert.	40.0	16.0	
75.153	48.5	QP	6.4	-30.7	24.2	269	100	Vert.	40.0	15.8	
77.302	45.6	QP	6.3	-30.7	21.2	193	240	Hori.	40.0	18.8	
93.398	37.1	QP	8.7	-30.5	15.3	168	184	Hori.	43.5	28.2	
103.060	37.1	QP	10.4	-30.3	17.2	240	100	Vert.	43.5	26.3	
107.356	32.7	QP	11.0	-30.3	13.4	359	300	Hori.	43.5	30.1	
127.756	35.1	QP	13.4	-30.1	18.4	91	100	Vert.	43.5	25.1	
364.529	28.1	QP	16.5	-27.5	17.1	0	100	Hori.	46.0	28.9	
364.529	28.1	QP	16.5	-27.5	17.1	0	100	Vert.	46.0	28.9	

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)

Room Antenna / Luggage Antenna Minimum Output

DATA OF RADIATED EMISSION TEST

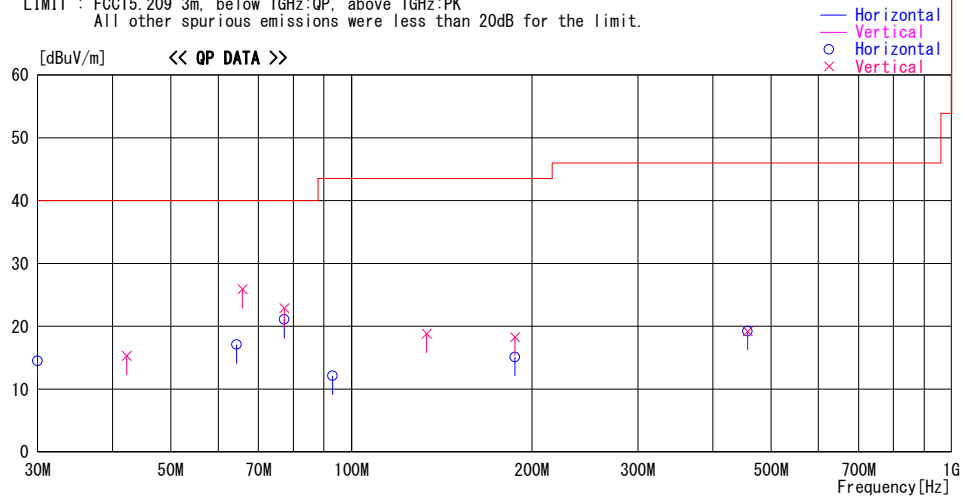
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2015/01/13

Report No. : 10616579H

Temp./Humi. : 21deg. C / 30% RH
Engineer : Shinichi Miyazono

Mode / Remarks : Tx 134.2kHz Normal Modulation Room / Luggage Antenna 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	Reading	DET	Antenna	Loss&	Level	Angle	Height	Polar.	Limit	Margin	Comment
			Factor	Gain							
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
30.000	28.6	QP	17.4	-31.5	14.5	359	300	Hori.	40.0	25.5	
42.229	33.0	QP	13.5	-31.2	15.3	87	100	Vert.	40.0	24.7	
64.420	40.9	QP	7.1	-30.9	17.1	180	300	Hori.	40.0	22.9	
65.846	49.9	QP	6.9	-30.9	25.9	132	100	Vert.	40.0	14.1	
77.300	47.3	QP	6.3	-30.7	22.9	262	100	Vert.	40.0	17.1	
77.300	45.5	QP	6.3	-30.7	21.1	190	254	Hori.	40.0	18.9	
93.050	34.0	QP	8.6	-30.5	12.1	152	188	Hori.	43.5	31.4	
133.482	35.0	QP	13.8	-30.0	18.8	148	100	Vert.	43.5	24.7	
187.305	28.6	QP	16.2	-29.7	15.1	0	300	Hori.	43.5	28.4	
187.305	31.8	QP	16.2	-29.7	18.3	105	100	Vert.	43.5	25.2	
457.114	28.0	QP	17.8	-26.6	19.2	0	100	Vert.	46.0	26.8	
457.114	28.0	QP	17.8	-26.6	19.2	0	100	Hori.	46.0	26.8	

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))

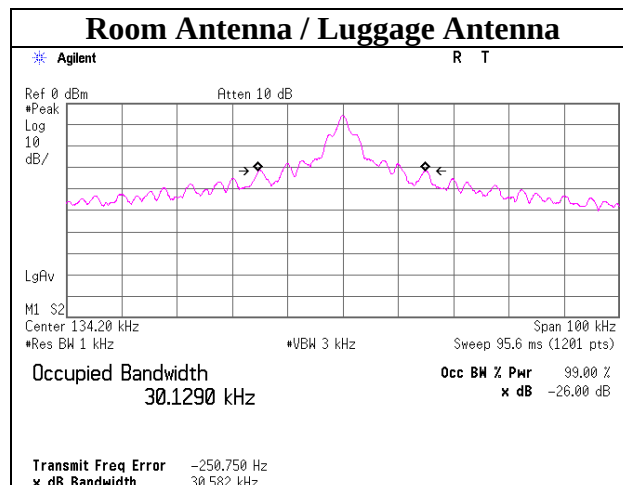
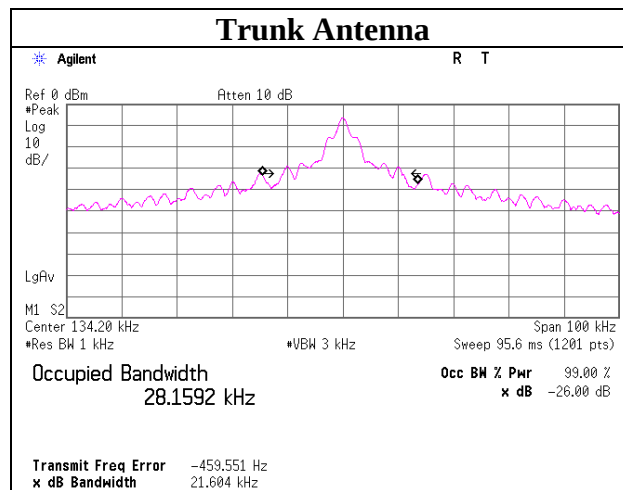
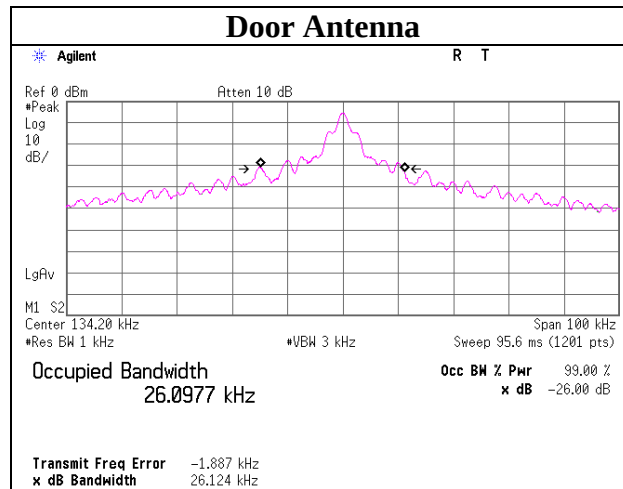
*The test result is rounded off to one or two decimal places, so some differences might be observed.

-26dB Bandwidth and 99% Occupied Bandwidth

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Report No. : 10616579H
Date : 01/13/2015
Temperature/ Humidity : 21 deg. C / 30% RH
Engineer : Shinichi Miyazono
Mode : Tx 134.2kHz

Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
Door Antenna	134.2	26.124	26.098
Trunk Antenna	134.2	21.604	28.159
Room Antenna / Ruggage Antenna	134.2	30.582	30.129

-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-23	Measure	ASKUL	-	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MTR-01	Test Receiver	Rohde & Schwarz	ESI40	100084	RE	2014/11/10 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2014/10/04 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(5m)/ 421-010(1m)/ sucoform141-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	2014/11/11 * 12
MAEC-01	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	RE	2014/09/01 * 12
MOS-27	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	RE	2014/02/20 * 12
MJM-21	Measure	KOMELON	KMC-36	-	RE	-
MTR-09	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	RE	2014/06/06 * 12
KBA-05	Biconical Antenna	Schwarzbeck	BBA9106	2513	RE	2014/11/22 * 12
KLA-04	Logperiodic Antenna	Schwarzbeck	USLP9143	361	RE	2014/11/22 * 12
MAT-08	Attenuator(6dB)	Weinschel Corp	2	BK7971	RE	2014/11/20 * 12
MCC-02	Coaxial Cable	Suhner/storm/Agilent/TSJ	-	-	RE	2014/09/12 * 12
MPA-19	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	RE	2014/02/17 * 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.

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