



RADIO TEST REPORT

Test Report No. : 10056416H-A-R3

Applicant : Toyota Motor Corporation
Type of Equipment : Smart LF Oscillator
Model No. : TMLF12-4
FCC ID : NI4TMLF12-4
Test regulation : FCC Part 15 Subpart C 2013
Section 15.207, Section 15.209
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.
6. This report is a revised version of 10056416H-A-R2. 10056416H-A-R2 is replaced with this report.

Date of test: August 2, 2012 to August 28, 2013

Representative test engineer:

Shinya Watanabe
Engineer of WiSE Japan,
UL Verification Service

Approved by:

Masanori Nishiyama
Manager of WiSE Japan,
UL Verification Service



NVLAP LAB CODE: 200572-0

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CONTENTS	PAGE
SECTION 1: Customer information	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results	5
SECTION 4: Operation of E.U.T. during testing.....	8
SECTION 5: Radiated emission (Fundamental and Spurious Emission)	9
SECTION 6: -26dB Bandwidth.....	11
SECTION 7: 99% Occupied Bandwidth.....	11
APPENDIX 1: Data of EMI test.....	12
Radiated Emission below 30MHz (Fundamental and Spurious Emission)	12
Radiated Emission above 30MHz (Spurious Emission).....	16
-26dB Bandwidth and 99% Occupied Bandwidth	20
APPENDIX 2: Test instruments	23
APPENDIX 3: Photographs of test setup	25
Radiated Emission.....	25
Worst Case Position	26

SECTION 1: Customer information

Company Name : Toyota Motor Corporation
Address : 1, Toyota-Cho, Toyota, Aichi, 471-8572 Japan
Telephone Number : +81-565-94-1007
Facsimile Number : +81-565-94-1192
Contact Person : Tetsuya Matsuo

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

2.1 Identification of E.U.T.

Type of Equipment : Smart LF Oscillator
Model No. : TMLF12-4
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC12.0V(Max 0.5A)
Receipt Date of Sample : March 9, 2012
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: TMLF12-4 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: TMLF12-4) consists of the following parts:

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

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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

* The revision on September 30, 2013 does not affect the test specification applied to the EUT.

FCC 15.31 (e)

The stable voltage (DC2.3 to 6.2V*) is constantly provided to RF Part through the regulator regardless of voltage fluctuation of car battery(DC12V). Therefore, this EUT complies with the requirement.

*The regulated voltage value differs depending on connected LF antennas.

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	15.5dB 0.13420MHz, AV (PK with Duty factor) <Trunk Antenna , Room / Luggage 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	10.2dB 36.300MHz, QP, Vertical <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.

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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	4.3dB	5.0dB	5.1dB	4.9dB	5.8dB	4.4dB	4.3dB
No.2	4.3dB	5.2dB	5.1dB	5.0dB	5.7dB	4.3dB	4.2dB
No.3	4.6dB	5.0dB	5.1dB	5.0dB	5.7dB	4.5dB	4.2dB
No.4	4.8dB	5.2dB	5.0dB	5.0dB	5.7dB	5.2dB	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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	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	2.4 x 3.4m	-

* 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

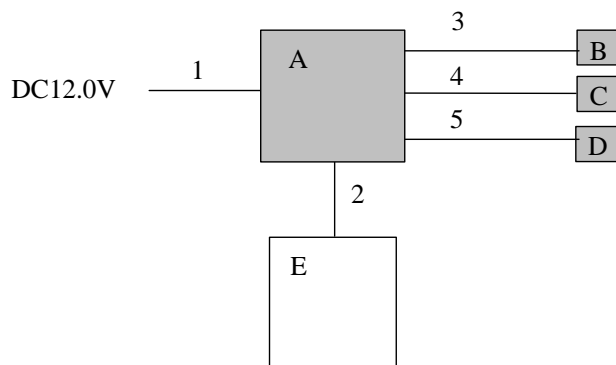
The mode is used :

- 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.

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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SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

The Radiated Electric Field Strength intensity has been measured on No 1, 2 and 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, PK, and PK with Duty factor 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/ PK with Duty factor	QP	PK/ PK with Duty factor	QP	QP
IF Bandwidth	200Hz *1)	200Hz *1)	9kHz *1)	9kHz *2)	120kHz

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

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

- The carrier level was 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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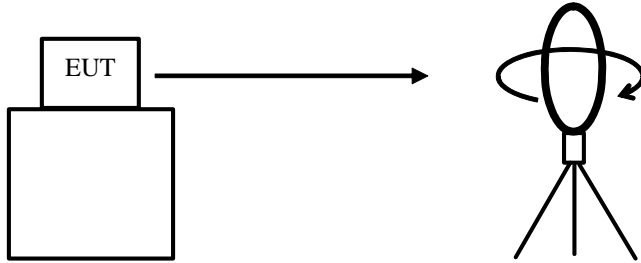
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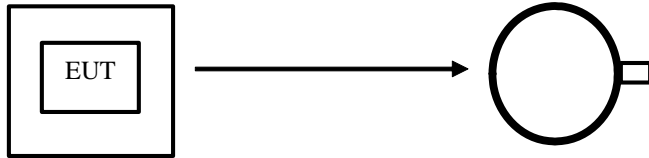
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

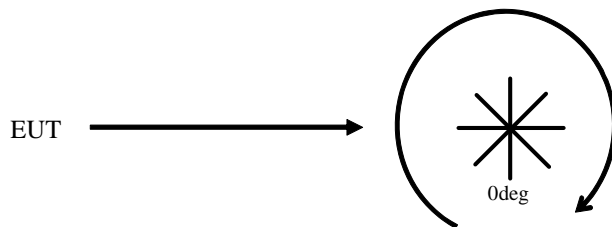


.....
Top View (Horizontal)



Antenna was not rotated.

.....
Top View (Vertical)



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 Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No. 10056416H
Date 08/28/2013
Temperature/ Humidity 22 deg. C / 53% 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	19.2	-73.9	32.1	-	8.5	45.0	36.5	Fundamental
0	0.26840	PK	60.2	19.1	-73.9	32.1	-	-26.7	39.0	65.7	
0	0.40260	PK	75.0	19.1	-73.9	32.1	-	-11.9	35.5	47.4	
0	0.53680	QP	42.0	19.1	-33.8	32.2	-	-4.9	33.0	37.9	
0	0.67100	QP	63.7	19.2	-33.8	32.1	-	17.0	31.1	14.1	
0	0.80520	QP	33.1	19.2	-33.8	32.1	-	-13.6	29.5	43.1	
0	0.93940	QP	52.0	19.2	-33.8	32.1	-	5.3	28.1	22.8	
0	1.07360	QP	31.8	19.1	-33.8	32.0	-	-14.9	26.9	41.8	
0	1.20780	QP	44.7	19.1	-33.8	32.0	-	-2.0	25.9	27.9	
0	1.34200	QP	39.3	19.1	-33.8	32.1	-	-7.5	25.0	32.5	

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

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	19.2	-73.9	32.1	0.0	8.5	25.0	16.5	
0	0.26840	PK	60.2	19.1	-73.9	32.1	0.0	-26.7	19.0	45.7	
0	0.40260	PK	75.0	19.1	-73.9	32.1	0.0	-11.9	15.5	27.4	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor * + D.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	19.2	6.1	32.1	-	88.5	-	-	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. : 10056416H
Date : 08/28/2013
Temperature/ Humidity : 22 deg. C / 53% 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	96.3	19.2	-73.9	32.1	-	9.5	45.0	35.5	Fundamental
0	0.26840	PK	59.8	19.1	-73.9	32.1	-	-27.1	39.0	66.1	
0	0.40260	PK	63.1	19.1	-73.9	32.1	-	-23.8	35.5	59.3	
0	0.53680	QP	34.4	19.1	-33.8	32.2	-	-12.5	33.0	45.5	
0	0.67100	QP	47.6	19.2	-33.8	32.1	-	0.9	31.1	30.2	
0	0.80520	QP	32.4	19.2	-33.8	32.1	-	-14.3	29.5	43.8	
0	0.93940	QP	47.1	19.2	-33.8	32.1	-	0.4	28.1	27.7	
0	1.07360	QP	37.6	19.1	-33.8	32.0	-	-9.1	26.9	36.0	
0	1.20780	QP	43.7	19.1	-33.8	32.0	-	-3.0	25.9	28.9	
0	1.34200	QP	31.0	19.1	-33.8	32.1	-	-15.8	25.0	40.8	

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

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	96.3	19.2	-73.9	32.1	0.0	9.5	25.0	15.5	
0	0.26840	PK	59.8	19.1	-73.9	32.1	0.0	-27.1	19.0	46.1	
0	0.40260	PK	63.1	19.1	-73.9	32.1	0.0	-23.8	15.5	39.3	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor * + D.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	96.3	19.2	6.1	32.1	-	89.5	-	-	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. : 10056416H
Date : 08/28/2013
Temperature/ Humidity : 22 deg. C / 53% 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	96.3	19.2	-73.9	32.1	-	9.5	45.0	35.5	Fundamental
0	0.26840	PK	60.2	19.1	-73.9	32.1	-	-26.7	39.0	65.7	
0	0.40260	PK	65.4	19.1	-73.9	32.1	-	-21.5	35.5	57.0	
0	0.53680	QP	33.6	19.1	-33.8	32.2	-	-13.3	33.0	46.3	
0	0.67100	QP	45.4	19.2	-33.8	32.1	-	-1.3	31.1	32.4	
0	0.80520	QP	31.6	19.2	-33.8	32.1	-	-15.1	29.5	44.6	
0	0.93940	QP	49.4	19.2	-33.8	32.1	-	2.7	28.1	25.4	
0	1.07360	QP	34.9	19.1	-33.8	32.0	-	-11.8	26.9	38.7	
0	1.20780	QP	47.0	19.1	-33.8	32.0	-	0.3	25.9	25.6	
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) - Gain(Amplifier) + D.Factor

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	96.3	19.2	-73.9	32.1	0.0	9.5	25.0	15.5	
0	0.26840	PK	60.2	19.1	-73.9	32.1	0.0	-26.7	19.0	45.7	
0	0.40260	PK	65.4	19.1	-73.9	32.1	0.0	-21.5	15.5	37.0	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor * + D.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	96.3	19.2	6.1	32.1	-	89.5	-	-	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. : 10056416H
Date : 08/28/2013
Temperature/ Humidity : 22 deg. C / 53% 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	82.1	19.2	-73.9	32.1	-	-4.7	45.0	49.7	Fundamental
0	0.26840	PK	52.7	19.1	-73.9	32.1	-	-34.2	39.0	73.2	
0	0.40260	PK	54.4	19.1	-73.9	32.1	-	-32.5	35.5	68.0	
0	0.53680	QP	44.4	19.1	-33.8	32.2	-	-2.5	33.0	35.5	
0	0.67100	QP	33.0	19.2	-33.8	32.1	-	-13.7	31.1	44.8	
0	0.80520	QP	41.9	19.2	-33.8	32.1	-	-4.8	29.5	34.3	
0	0.93940	QP	37.1	19.2	-33.8	32.1	-	-9.6	28.1	37.7	
0	1.07360	QP	38.3	19.1	-33.8	32.0	-	-8.4	26.9	35.3	
0	1.20780	QP	36.7	19.1	-33.8	32.0	-	-10.0	25.9	35.9	
0	1.34200	QP	33.9	19.1	-33.8	32.1	-	-12.9	25.0	37.9	

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

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	82.1	19.2	-73.9	32.1	0.0	-4.7	25.0	29.7	
0	0.26840	PK	52.7	19.1	-73.9	32.1	0.0	-34.2	19.0	53.2	
0	0.40260	PK	54.4	19.1	-73.9	32.1	0.0	-32.5	15.5	48.0	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - Gain(Amplifier) + Duty factor * + D.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	82.1	19.2	6.1	32.1	-	75.3	-	-	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

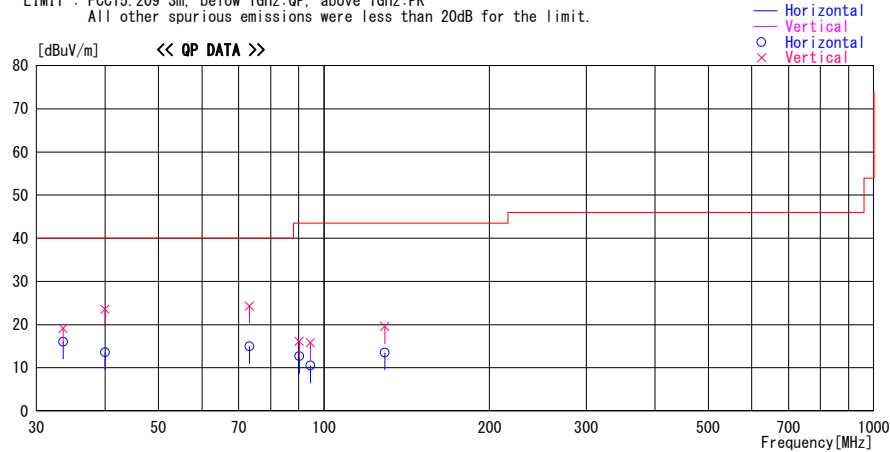
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No. 2 Semi Anechoic Chamber
Date : 2013/08/27

Report No. : 10056416H
Temp./Humi. : 22deg. C / 52% RH
Engineer : Hiroshi Kukita

Mode / Remarks : Tx 134.2kHz, Normal modulation, Door Antenna, ECU Max, 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 Factor [dB/m]	Loss & Gain [dB]	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
33.551	24.5	QP	16.6	-25.1	16.0	232	300	Hori.	40.0	24.0	
33.551	27.6	QP	16.6	-25.1	19.1	306	100	Vert.	40.0	20.9	
39.992	24.0	QP	14.6	-25.0	13.6	148	200	Hori.	40.0	26.4	
39.992	34.0	QP	14.6	-25.0	23.6	131	100	Vert.	40.0	16.4	
73.185	33.0	QP	6.5	-24.5	15.0	208	292	Hori.	40.0	25.0	
73.185	42.3	QP	6.5	-24.5	24.3	281	100	Vert.	40.0	15.7	
90.182	28.8	QP	8.2	-24.3	12.7	11	300	Hori.	43.5	30.8	
90.182	32.2	QP	8.2	-24.3	16.1	312	100	Vert.	43.5	27.4	
94.478	30.9	QP	9.0	-24.1	15.8	299	100	Vert.	43.5	27.7	
94.478	25.6	QP	9.0	-24.1	10.5	343	289	Hori.	43.5	33.0	
129.012	23.5	QP	13.7	-23.7	13.5	25	343	Hori.	43.5	30.0	
129.012	29.6	QP	13.7	-23.7	19.6	38	100	Vert.	43.5	23.9	

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.

Radiated Emission above 30MHz (Spurious Emission)
Trunk Antenna

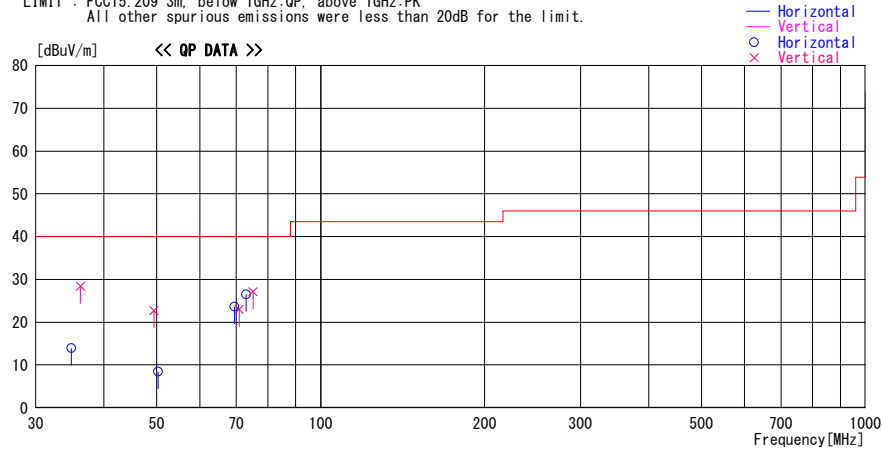
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.1 Semi Anechoic Chamber
 Date : 2012/08/02

Report No. : 10056416H
 Temp./Humi. : 25deg. C / 54% RH
 Engineer : Tomohisa Nakagawa

Mode / Remarks : Tx 134.2kHz, Normal modulation, Trunk Antenna Worst-axis H X V 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	Angle	Height	Polar.	Limit	Margin	Comment
			Factor [dB/m]	Gain [dB]							
34.871	28.9	QP	16.4	-31.4	13.9	0	100	Hori.	40.0	26.1	
36.221	43.9	QP	15.9	-31.4	28.4	168	100	Vert.	40.0	11.6	
50.295	28.8	QP	10.7	-31.1	8.4	0	100	Hori.	40.0	31.6	
49.392	42.9	QP	11.0	-31.2	22.7	256	100	Vert.	40.0	17.3	
69.428	47.7	QP	6.8	-30.9	23.6	354	282	Hori.	40.0	16.4	
70.858	47.2	QP	6.7	-30.9	23.0	259	100	Vert.	40.0	17.0	
73.004	50.8	QP	6.6	-30.9	26.5	182	258	Hori.	40.0	13.5	
75.153	51.3	QP	6.6	-30.8	27.1	134	100	Vert.	40.0	12.9	

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.

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

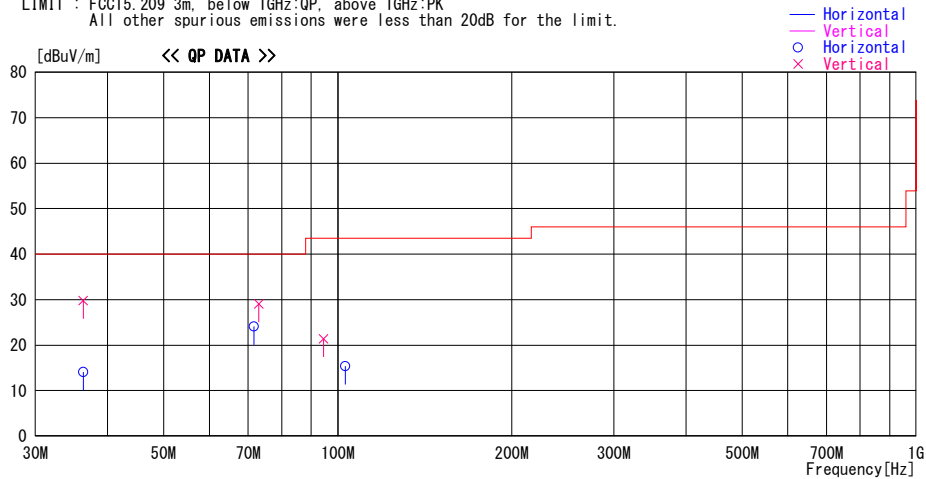
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber
Date : 2012/08/02

Report No. : 10056416H
Temp./Humi. : 23deg. C / 75% RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz, Normal modulation, Room Antenna / Luggage Antenna Worst-axis

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]							
36.300	22.8	QP	16.1	-24.8	14.1	359	300	Hori.	40.0	25.9	
36.300	38.5	QP	16.1	-24.8	29.8	137	100	Vert.	40.0	10.2	
71.585	41.9	QP	6.6	-24.4	24.1	188	400	Hori.	40.0	15.9	
73.004	46.9	QP	6.6	-24.4	29.1	121	100	Vert.	40.0	10.9	
103.072	28.7	QP	10.6	-23.9	15.4	181	321	Hori.	43.5	28.1	
94.478	36.3	QP	9.2	-24.1	21.4	243	100	Vert.	43.5	22.1	

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

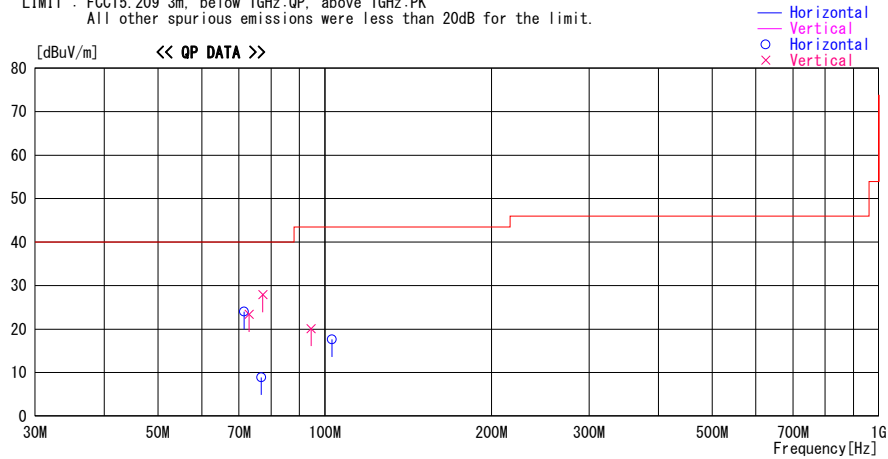
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber
 Date : 2012/08/02

Report No. : 10056416H
 Temp./Humi. : 23deg. C / 75% RH
 Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz, Normal modulation, Room Antenna / Luggage Antenna Worst-axis

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]							
71.572	41.8	QP	6.6	-24.4	24.0	187	300	Hori.	40.0	16.0	
73.017	41.2	QP	6.6	-24.4	23.4	112	100	Vert.	40.0	16.6	
76.800	26.7	QP	6.5	-24.3	8.9	339	300	Hori.	40.0	31.1	
77.307	45.7	QP	6.5	-24.3	27.9	170	100	Vert.	40.0	12.1	
103.052	30.9	QP	10.6	-23.9	17.6	173	306	Hori.	43.5	25.9	
94.479	35.0	QP	9.2	-24.1	20.1	114	100	Vert.	43.5	23.4	

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.

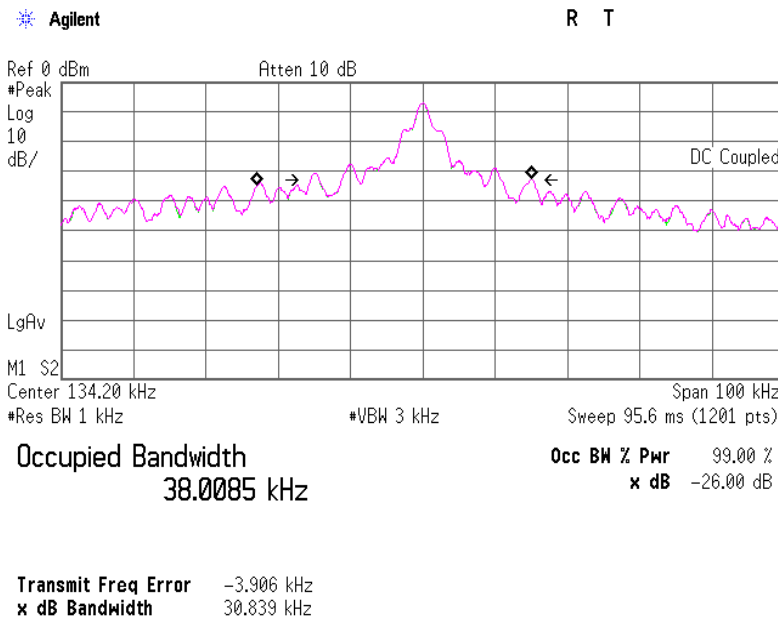
-26dB Bandwidth and 99% Occupied Bandwidth

Door Antenna

Head Office EMC Lab. No.4 Semi Anechoic Chamber

POWER	: DC 12.0V	REPORT NO	: 10056416H
MODE	: Tx	REGULATION	: -/RSS-Gen 4.6.1
	: Door Antenna	TEST DISTANCE	: 3m
		DATE	: 08/28/2013
		TEMPERATURE	: 22deg. C
		HUMIDITY	: 53% RH
		Engineer	: Shinya Watanabe

FREQ	-26dB Bandwidth	99% Occupied Bandwidth
[kHz]	[kHz]	[kHz]
134.2	30.839	38.009



-26dB Bandwidth and 99% Occupied Bandwidth

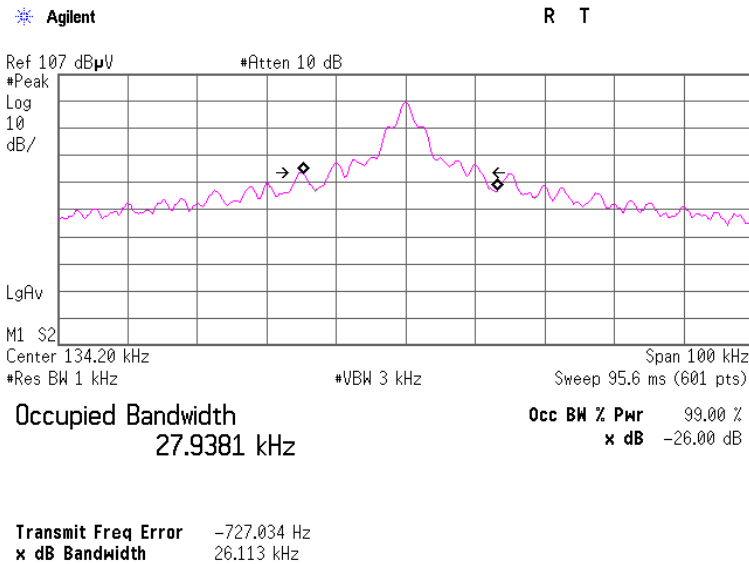
Trunk Antenna

Head Office EMC Lab. No.2 Semi Anechoic Chamber

POWER : DC 12.0V
 MODE : Tx
 : Trunk Antenna

REPORT NO : 10056416H
 REGULATION : -/RSS-Gen 4.6.1
 TEST DISTANCE : 3m
 DATE : 09/06/2012
 TEMPERATURE : 25deg. C
 HUMIDITY : 54% RH
 Engineer : Tomotaka Sasagawa

FREQ	-26dB Bandwidth	99% Occupied Bandwidth
[kHz]	[kHz]	[kHz]
134.2	26.113	27.938

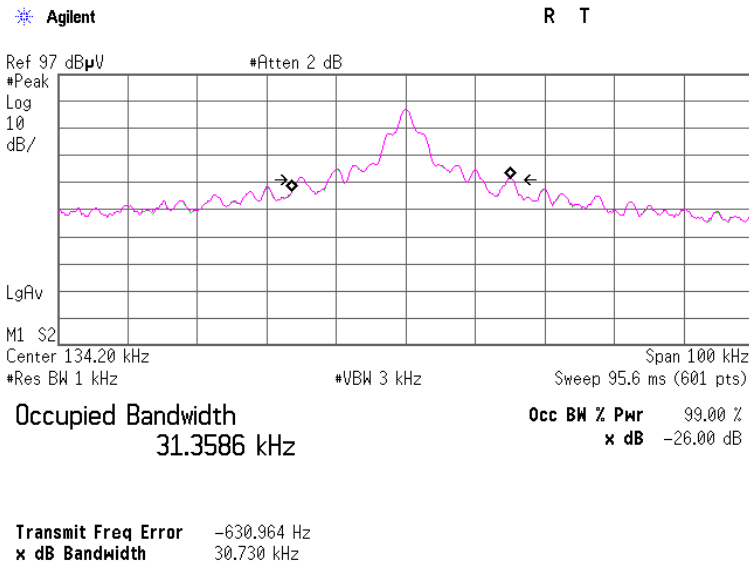


-26dB Bandwidth and 99% Occupied Bandwidth
Room Antenna / Luggage Antenna

Head Office EMC Lab. No.2 Semi Anechoic Chamber

POWER	: DC 12.0V	REPORT NO	: 10056416H
MODE	: Tx	REGULATION	: -/RSS-Gen 4.6.1
		TEST DISTANCE	: 3m
		DATE	: 09/06/2012
		TEMPERATURE	: 25deg. C
		HUMIDITY	: 54% RH
	: Room Antenna	Engineer	: Tomotaka Sasagawa

FREQ	-26dB Bandwidth	99% Occupied Bandwidth
[kHz]	[kHz]	[kHz]
134.2	30.730	31.359



APPENDIX 2: Test instruments

EMI test equipment (Tested on August 2 to September 6, 2012)

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	2012/02/29 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	-	RE	2012/02/06 * 12
MJM-07	Measure	PROMART	SEN1955	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-06	Spectrum Analyzer	Agilent	E4407B	MY45107638	RE	2012/04/04 * 12
MTR-07	Test Receiver	Rohde & Schwarz	ESCI	100635	RE	2012/04/05 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2011/11/16 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2011/11/16 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2012/06/01 * 12
MAT-09	Attenuator(6dB)	Weinschel Corp	2	BK7973	RE	2011/11/02 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2012/03/05 * 12
MAEC-01	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	RE	2012/08/01 * 12
MOS-27	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	RE	2012/02/08 * 12
MJM-01	Measure	KDS	ES19-55	-	RE	-
MTR-09	EMI Test Reseiver	Rohde & Schwarz	ESU26	100412	RE	2012/06/14 * 12
KBA-05	Biconical Antenna	Schwarzbeck	BBA9106	2513	RE	2011/11/23 * 12
KLA-04	Logperiodic Antenna	Schwarzbeck	USLP9143	361	RE	2011/11/23 * 12
MAT-08	Attenuator(6dB)	Weinschel Corp	2	BK7971	RE	2011/11/02 * 12
MCC-02	Coaxial Cable	Suhner/storm/Agilent/TSJ	-	-	RE	2011/09/17 * 12
MPA-19	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	RE	2012/02/20 * 12
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	RE	2012/06/29 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE	2012/02/06 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2011/11/23 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	RE	2012/04/03 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2011/10/19 * 12
MCC-13	Coaxial Cable	Fujikura	3D-2W(12m)/5D-2W(5m)/5D-2W(0.8m)/5D-2W(1m)	-	RE	2012/02/16 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2012/07/27 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2012/03/16 * 12
MAT-07	Attenuator(6dB)	Weinschel Corp	2	BK7970	RE	2011/11/02 * 12

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EMI test equipment (Tested on August 27 and 28, 2013)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2013/02/28 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	-	RE	2013/02/26 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-05	Spectrum Analyzer	Advantest	R3273	160400285	RE	2012/11/21 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2013/08/20 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2012/10/08 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	174	RE	2012/10/08 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2013/07/23 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2013/04/05 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2013/03/12 * 12
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	-
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-68	Attenuator	Anritsu	MP721B	6200961025	RE	2012/11/21 * 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

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