



RADIO TEST REPORT

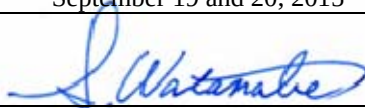
Test Report No. : 10966973H-A-R1

Applicant : TOYOTA MOTOR CORPORATION
Type of Equipment : Smart LF Oscillator
Model No. : TMLF15-3
FCC ID : NI4TMLF15-3
Test regulation : FCC Part 15 Subpart C: 2015
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 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 10966973H-A. 10966973H-A is replaced with this report.

Date of test: September 19 and 20, 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. : TMLF15-3
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC12.0V (Max 0.5A)
Receipt Date of Sample : October 1, 2014
Condition of EUT : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT : No Modification by the test lab

2.2 Product Description

Smart LF Oscillator, model: TMLF15-3 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: TMLF15-3) 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 September 8, 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

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	15.5 dB 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	11.8 dB 75.225 MHz, Horizontal, QP Door 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.

FCC 15.31 (e)

The test was performed with the New Battery (DC 12.0 V) and the EUT constantly provides the stable voltage to RF part through the regulator regardless of input voltage from New Battery. 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.

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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						
	(3 m*)(+dB)				(1 m*)(+dB)		(0.5 m*)(+dB)
	9 kHz - 30 MHz	30 MHz - 300 MHz	300 MHz - 1 GHz	1 GHz - 10 GHz	10 GHz - 18 GHz	18 GHz - 26.5 GHz	26.5 GHz - 40 GHz
No.1	4.3 dB	5.1 dB	6.2 dB	5.5 dB	5.8 dB	5.8 dB	4.3 dB
No.2	4.2 dB	5.1 dB	6.2 dB	5.4 dB	5.7 dB	5.9 dB	5.6 dB
No.3	4.4 dB	5.1 dB	6.3 dB	5.2 dB	5.5 dB	5.8 dB	5.5 dB
No.4	4.7 dB	5.3 dB	6.3 dB	5.3 dB	5.7 dB	5.9 dB	5.5 dB

*3 m / 1 m / 0.5 m = 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 Test data, Test instruments, and Test set up

Refer to APPENDIX.

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

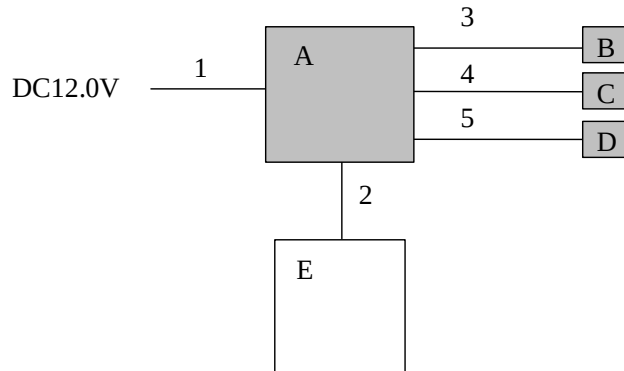
4.1 Operating Modes

The mode is used : Transmitting mode (Tx) 134.2 kHz
[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.

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 [Door Antenna], [Trunk Antenna], [Room Antenna / Luggage Antenna (Maximum Output)].

*2) Used for [Room Antenna / Luggage Antenna (Minimum Output)].

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, 0.5 m by 1.0 m, 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	RBW: 1MHz VBW: 10Hz
Test Distance	3m *1)	3m *1)	3m *1)	3m *2)	3m	3m	3m

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

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

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.

These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane.

However test results were confirmed to pass against standard limit.

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

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

Date: September 19 and 20, 2015

Test engineer:

Shinya Watanabe

UL Japan, Inc.

Ise EMC Lab.

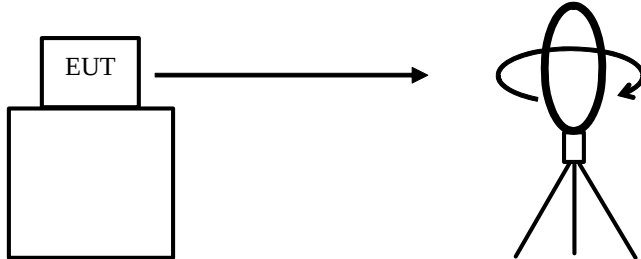
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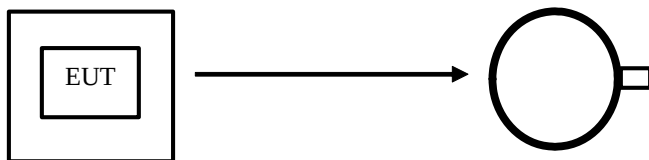
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

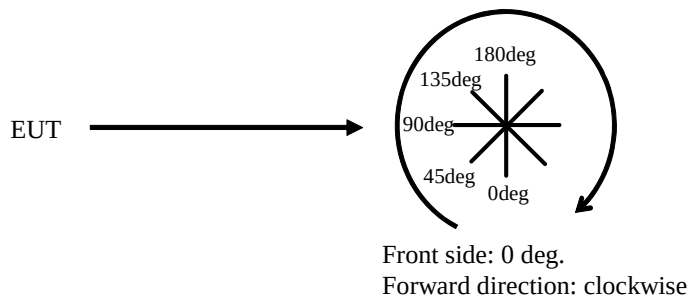


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



SECTION 6: -26dB Bandwidth

Test Procedure

The test was measured with a spectrum analyzer using a test fixture.

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

Test data : APPENDIX 1

SECTION 7: 99% Occupied Bandwidth

Test Procedure

The test was measured with a spectrum analyzer using a test fixture.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
99 % Occupied Bandwidth	Enough width to display emission skirts	1 to 5 % of OBW	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 %.
Peak hold was applied as Worst-case measurement.

Test data : APPENDIX 1

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APPENDIX 1: Test data

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

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. : 10966973H
Date : 09/19/2015
Temperature/ Humidity : 22 deg. C / 57 % 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	96.1	19.6	-74.1	32.4	-	9.2	45.0	35.8	Fundamental
0	0.26840	PK	60.2	19.6	-74.1	32.4	-	-26.7	39.0	65.7	
0	0.40260	PK	75.7	19.6	-74.0	32.3	-	-11.0	35.5	46.5	
0	0.53680	QP	41.9	19.5	-34.0	32.3	-	-4.9	33.0	37.9	
0	0.67100	QP	65.9	19.5	-34.0	32.3	-	19.1	31.1	12.0	
0	0.80520	QP	35.1	19.5	-34.0	32.3	-	-11.7	29.5	41.2	
0	0.93940	QP	55.1	19.5	-34.0	32.3	-	8.3	28.1	19.8	
0	1.07360	QP	32.0	19.5	-34.0	32.3	-	-14.8	26.9	41.7	
0	1.20780	QP	47.6	19.5	-33.9	32.3	-	0.9	25.9	25.0	
0	1.34200	QP	31.9	19.5	-33.9	32.3	-	-14.8	25.0	39.8	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	96.1	19.6	-74.1	32.4	0.0	9.2	25.0	15.8	
0	0.26840	PK	60.2	19.6	-74.1	32.4	0.0	-26.7	19.0	45.7	
0	0.40260	PK	75.7	19.6	-74.0	32.3	0.0	-11.0	15.5	26.5	

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

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

* Since the peak emission result satisfied the average limit, duty factor was omitted.

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	96.1	19.6	5.9	32.4	-	89.2	-	-	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.3 Semi Anechoic Chamber
Report No. : 10966973H
Date : 09/19/2015
Temperature/ Humidity : 22 deg. C / 57 % 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	-74.1	32.4	-	9.5	45.0	35.5	Fundamental
0	0.26840	PK	58.2	19.6	-74.1	32.4	-	-28.7	39.0	67.7	
0	0.40260	PK	62.4	19.6	-74.0	32.3	-	-24.3	35.5	59.8	
0	0.53680	QP	34.1	19.5	-34.0	32.3	-	-12.7	33.0	45.7	
0	0.67100	QP	48.5	19.5	-34.0	32.3	-	1.7	31.1	29.4	
0	0.80520	QP	33.9	19.5	-34.0	32.3	-	-12.9	29.5	42.4	
0	0.93940	QP	47.5	19.5	-34.0	32.3	-	0.7	28.1	27.4	
0	1.07360	QP	31.2	19.5	-34.0	32.3	-	-15.6	26.9	42.5	
0	1.20780	QP	44.3	19.5	-33.9	32.3	-	-2.4	25.9	28.3	
0	1.34200	QP	30.7	19.5	-33.9	32.3	-	-16.0	25.0	41.0	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	96.4	19.6	-74.1	32.4	0.0	9.5	25.0	15.5	
0	0.26840	PK	58.2	19.6	-74.1	32.4	0.0	-28.7	19.0	47.7	
0	0.40260	PK	62.4	19.6	-74.0	32.3	0.0	-24.3	15.5	39.8	

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%.

* Since the peak emission result satisfied the average limit, duty factor was omitted.

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	5.9	32.4	-	89.5	-	-	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.3 Semi Anechoic Chamber
Report No. : 10966973H
Date : 09/19/2015
Temperature/ Humidity : 22 deg. C / 57 % 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	95.9	19.6	-74.1	32.4	-	9.0	45.0	36.0	Fundamental
0	0.26840	PK	58.1	19.6	-74.1	32.4	-	-28.8	39.0	67.8	
0	0.40260	PK	64.6	19.6	-74.0	32.3	-	-22.1	35.5	57.6	
0	0.53680	QP	33.4	19.5	-34.0	32.3	-	-13.4	33.0	46.4	
0	0.67100	QP	47.9	19.5	-34.0	32.3	-	1.1	31.1	30.0	
0	0.80520	QP	31.6	19.5	-34.0	32.3	-	-15.2	29.5	44.7	
0	0.93940	QP	49.6	19.5	-34.0	32.3	-	2.8	28.1	25.3	
0	1.07360	QP	31.3	19.5	-34.0	32.3	-	-15.5	26.9	42.4	
0	1.20780	QP	47.4	19.5	-33.9	32.3	-	0.7	25.9	25.2	
0	1.34200	QP	30.2	19.5	-33.9	32.3	-	-16.5	25.0	41.5	

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	95.9	19.6	-74.1	32.4	0.0	9.0	25.0	16.0	
0	0.26840	PK	58.1	19.6	-74.1	32.4	0.0	-28.8	19.0	47.8	
0	0.40260	PK	64.6	19.6	-74.0	32.3	0.0	-22.1	15.5	37.6	

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%.

* Since the peak emission result satisfied the average limit, duty factor was omitted.

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	95.9	19.6	5.9	32.4	-	89.0	-	-	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.3 Semi Anechoic Chamber
Report No. : 10966973H
Date : 09/19/2015
Temperature/ Humidity : 22 deg. C / 57 % 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	81.6	19.6	-74.1	32.4	-	-5.3	45.0	50.3	Fundamental
0	0.26840	PK	54.1	19.6	-74.1	32.4	-	-32.8	39.0	71.8	
0	0.40260	PK	53.8	19.6	-74.0	32.3	-	-32.9	35.5	68.4	
0	0.53680	QP	46.0	19.5	-34.0	32.3	-	-0.8	33.0	33.8	
0	0.67100	QP	32.3	19.5	-34.0	32.3	-	-14.5	31.1	45.6	
0	0.80520	QP	42.6	19.5	-34.0	32.3	-	-4.2	29.5	33.7	
0	0.93940	QP	37.5	19.5	-34.0	32.3	-	-9.3	28.1	37.4	
0	1.07360	QP	38.5	19.5	-34.0	32.3	-	-8.3	26.9	35.2	
0	1.20780	QP	36.1	19.5	-33.9	32.3	-	-10.6	25.9	36.5	
0	1.34200	QP	34.1	19.5	-33.9	32.3	-	-12.6	25.0	37.6	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	81.6	19.6	-74.1	32.4	0.0	-5.3	25.0	30.3	
0	0.26840	PK	54.1	19.6	-74.1	32.4	0.0	-32.8	19.0	51.8	
0	0.40260	PK	53.8	19.6	-74.0	32.3	0.0	-32.9	15.5	48.4	

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%.

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3m without Distance factor

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	81.6	19.6	5.9	32.4	-	74.7	-	-	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

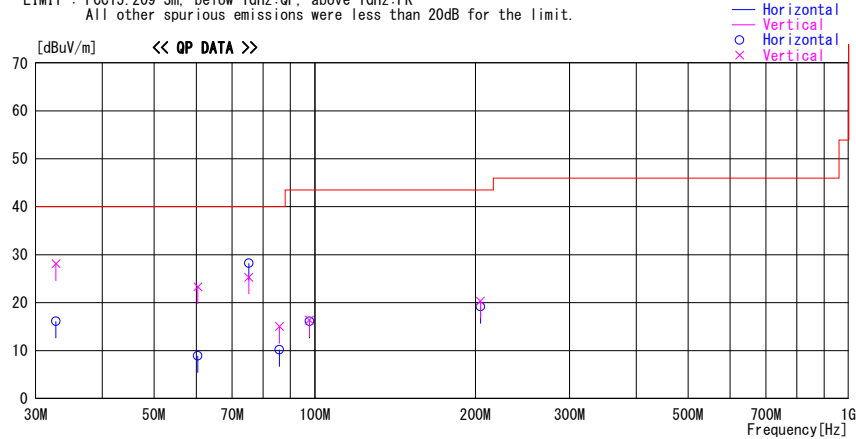
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2015/09/20

Report No. : 10966973H
Temp./Humi. : 22deg. C / 57% RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz Door 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	Reading	DET	Antenna Factor	Loss& Gain	Level	Angle	Height	Polar.	Limit	Margin	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
32.747	24.8	QP	16.5	-25.2	16.1	119	294	Hori.	40.0	23.9	
32.747	36.8	QP	16.5	-25.2	28.1	10	100	Vert.	40.0	11.9	
60.385	26.2	QP	7.3	-24.6	8.9	0	263	Hori.	40.0	31.1	
60.385	40.6	QP	7.3	-24.6	23.3	0	100	Vert.	40.0	16.7	
75.225	46.0	QP	6.5	-24.3	28.2	0	255	Hori.	40.0	11.8	
75.225	43.1	QP	6.5	-24.3	25.3	258	100	Vert.	40.0	14.7	
85.885	26.6	QP	7.8	-24.2	10.2	59	254	Hori.	40.0	29.8	
85.885	31.4	QP	7.8	-24.2	15.0	0	100	Vert.	40.0	25.0	
97.697	30.6	QP	9.7	-24.2	16.1	0	310	Hori.	43.5	27.4	
97.697	30.9	QP	9.7	-24.2	16.4	272	100	Vert.	43.5	27.1	
204.341	25.6	QP	16.6	-23.0	19.2	141	146	Hori.	43.5	24.3	
204.341	26.7	QP	16.6	-23.0	20.3	281	100	Vert.	43.5	23.2	

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

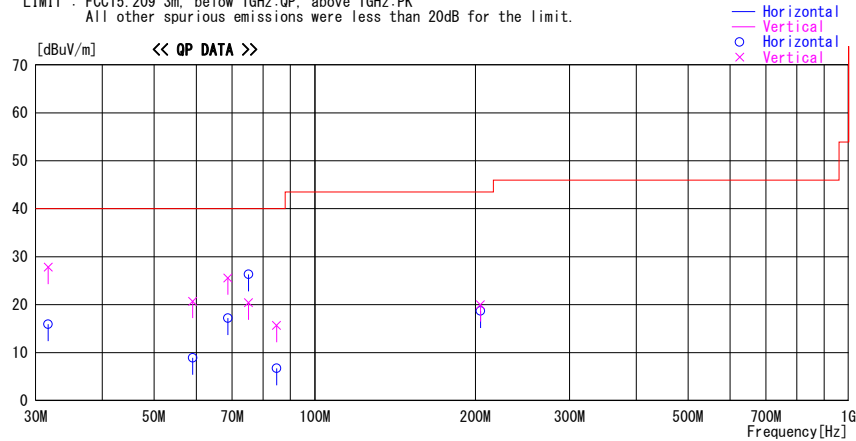
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2015/09/20

Report No. : 10966973H
Temp./Humi. : 22deg. C / 57% RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz Trunk 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	Reading	DET	Antenna Factor	Loss & Gain	Level	Angle	Height	Polar.	Limit	Margin	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
31.670	24.3	QP	16.9	-25.3	15.9	99	240	Hori.	40.0	24.1	
31.670	36.2	QP	16.9	-25.3	27.8	0	100	Vert.	40.0	12.2	
59.046	25.8	QP	7.7	-24.6	8.9	0	251	Hori.	40.0	31.1	
59.046	37.6	QP	7.7	-24.6	20.7	311	100	Vert.	40.0	19.3	
68.707	35.4	QP	6.3	-24.5	17.2	181	296	Hori.	40.0	22.8	
68.707	43.8	QP	6.3	-24.5	25.6	271	100	Vert.	40.0	14.4	
75.151	44.1	QP	6.5	-24.3	26.3	193	229	Hori.	40.0	13.7	
75.151	38.2	QP	6.5	-24.3	20.4	87	100	Vert.	40.0	19.6	
84.812	23.4	QP	7.6	-24.3	6.7	0	100	Hori.	40.0	33.3	
84.812	32.4	QP	7.6	-24.3	15.7	0	100	Vert.	40.0	24.3	
204.341	25.1	QP	16.6	-23.0	18.7	283	144	Hori.	43.5	24.8	
204.341	26.4	QP	16.6	-23.0	20.0	275	100	Vert.	43.5	23.5	

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

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

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

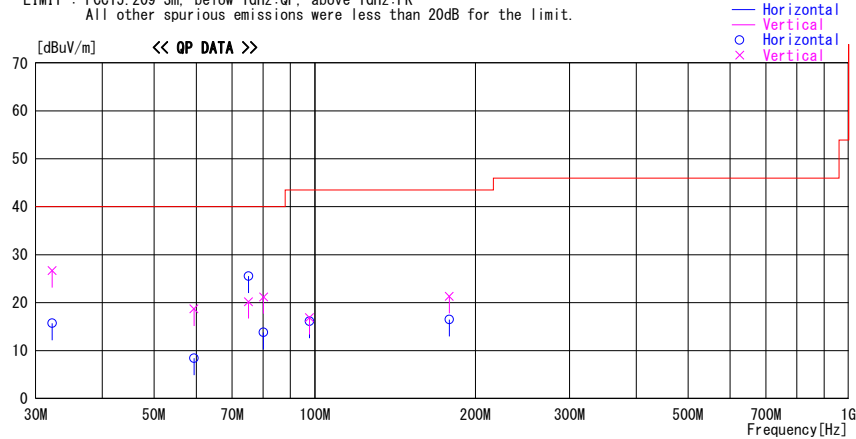
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2015/09/20

Report No. : 10966973H
Temp./Humi. : 22deg. C / 57% RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz 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	Reading	DET	Antenna Factor	Loss& Gain	Level	Angle	Height	Polar.	Limit	Margin	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
32.207	24.3	QP	16.7	-25.3	15.7	109	306	Hori.	40.0	24.3	
32.207	35.3	QP	16.7	-25.3	26.7	0	100	Vert.	40.0	13.3	
59.405	25.4	QP	7.6	-24.6	8.4	0	226	Hori.	40.0	31.6	
59.405	35.7	QP	7.6	-24.6	18.7	0	100	Vert.	40.0	21.3	
75.150	43.3	QP	6.5	-24.3	25.5	168	252	Hori.	40.0	14.5	
75.150	38.0	QP	6.5	-24.3	20.2	99	100	Vert.	40.0	19.8	
80.160	31.2	QP	6.8	-24.2	13.8	181	243	Hori.	40.0	26.2	
80.160	38.6	QP	6.8	-24.2	21.2	101	100	Vert.	40.0	18.8	
97.697	30.6	QP	9.7	-24.2	16.1	0	302	Hori.	43.5	27.4	
97.697	31.4	QP	9.7	-24.2	16.9	273	100	Vert.	43.5	26.6	
178.574	23.7	QP	16.2	-23.4	16.5	292	246	Hori.	43.5	27.0	
178.574	28.5	QP	16.2	-23.4	21.3	245	100	Vert.	43.5	22.2	

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

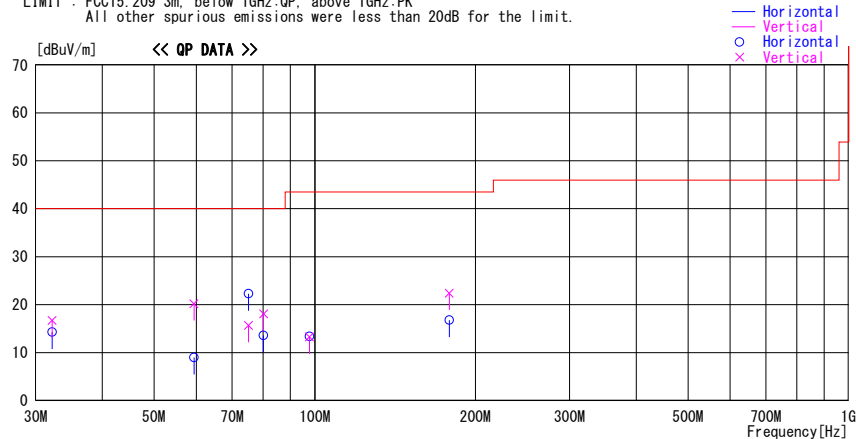
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2015/09/20

Report No. : 10966973H
Temp./Humi. : 22deg. C / 57% RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz 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	Reading	DET	Antenna Factor	Loss& Gain	Level	Angle	Height	Polar.	Limit	Margin	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
32.207	22.9	QP	16.7	-25.3	14.3	0	100	Hori.	40.0	25.7	
32.207	25.3	QP	16.7	-25.3	16.7	0	100	Vert.	40.0	23.3	
59.405	26.0	QP	7.6	-24.6	9.0	0	249	Hori.	40.0	31.0	
59.405	37.2	QP	7.6	-24.6	20.2	0	100	Vert.	40.0	19.8	
75.150	40.1	QP	6.5	-24.3	22.3	179	255	Hori.	40.0	17.7	
75.150	33.5	QP	6.5	-24.3	15.7	86	100	Vert.	40.0	24.3	
80.160	31.0	QP	6.8	-24.2	13.6	202	242	Hori.	40.0	26.4	
80.160	35.5	QP	6.8	-24.2	18.1	119	100	Vert.	40.0	21.9	
97.697	27.9	QP	9.7	-24.2	13.4	0	307	Hori.	43.5	30.1	
97.697	27.8	QP	9.7	-24.2	13.3	275	100	Vert.	43.5	30.2	
178.574	24.0	QP	16.2	-23.4	16.8	304	243	Hori.	43.5	26.7	
178.574	29.6	QP	16.2	-23.4	22.4	251	100	Vert.	43.5	21.1	

CHART:WITH FACTOR ANT TYPE: -30MHz:100P 30-300MHz:R1CONICAL 300MHz-1000MHz:10GPERIODIC 1000MHz-:HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE+ATTEN. - GAIN (AMP))

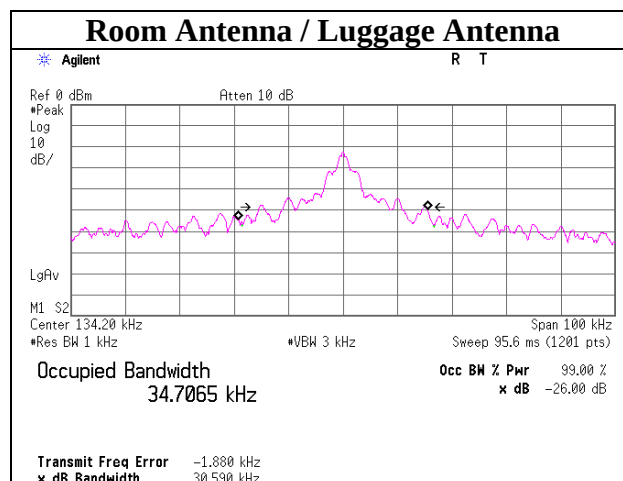
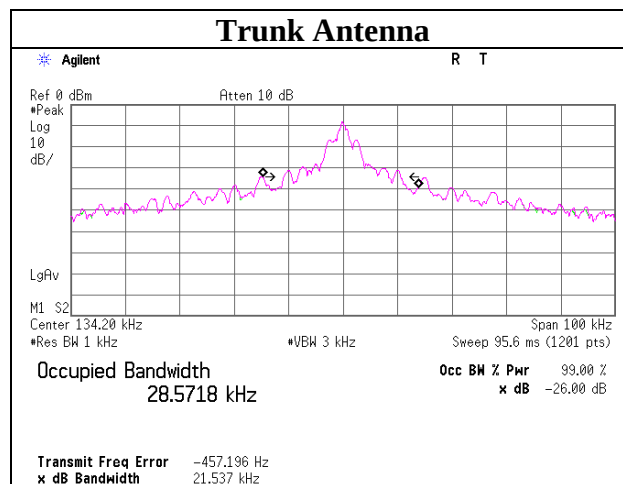
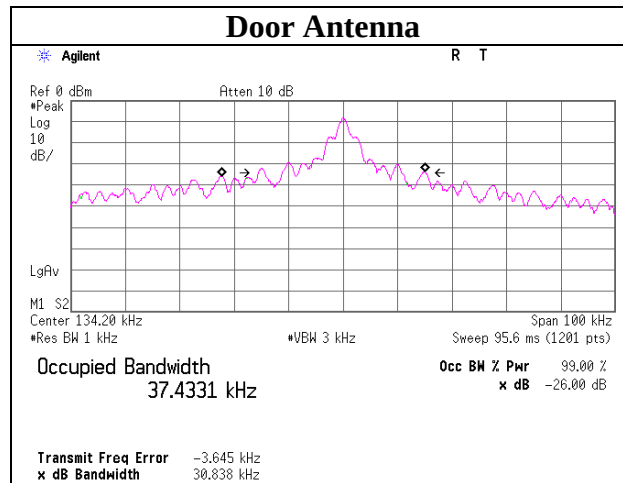
*The test result is rounded off to one or two decimal places, so some differences might be observed.

-26dB Bandwidth and 99% Occupied Bandwidth

Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. 10966973H
Date 09/19/2015
Temperature/ Humidity 22 deg. C / 57 % RH
Engineer Shinya Watanabe
Mode Tx 134.2kHz

Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
Door Antenna	134.2	30.838	37.433
Trunk Antenna	134.2	21.537	28.572
Room Antenna / Luggage Antenna	134.2	30.590	34.707

-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-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2015/02/19 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2015/01/13 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2015/09/02 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2014/10/04 * 12
MCC-112	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(3m)/ suoform141-PE(1m)/ 421-010(1.5m)/ RFM-E321(Switcher)	-/00640	RE	2015/07/02 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2015/06/24 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2015/03/10 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2015/04/08 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2014/10/18 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	174	RE	2014/10/18 * 12
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	RE	2015/02/26 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2015/07/13 * 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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