



RADIO TEST REPORT

Test Report No. : 11395574H-R2

Applicant : TOYOTA MOTOR CORPORATION
Type of Equipment : Smart LF Oscillator
Model No. : TS-CTY
FCC ID : NI4TS-CTY
Test regulation : FCC Part 15 Subpart C: 2016
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 11395574H-R1. 11395574H-R1 is replaced with this report.

Date of test: August 7 and 15, 2016

Representative test engineer:

Hiroyuki Furutaka
Engineer
Consumer Technology Division

Approved by:

Motoya Imura
Engineer
Consumer Technology Division



This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
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13-EM-F0429

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SECTION 1: Customer information

Company Name : TOYOTA MOTOR CORPORATION
Address : 1, Toyota-Cho, Toyota, Aichi, 471-8572 Japan
Telephone Number : +81-565-94-0902
Facsimile Number : +81-565-94-1161
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. : TS-CTY
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 12.0 V
Receipt Date of Sample : August 3, 2016
Condition of EUT : Engineering 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: TS-CTY 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: TS-CTY) consists of the following parts:

- Computer Assy, Smart Key (ECU)
- D seat Antenna (Door antenna)
- Extra1 Antenna (Room antenna) *
- Extra2 Antenna (Room antenna) *
- Trunk Antenna (Trunk antenna)

* As for Room Antenna, the test was performed with the Extra1 Antenna as representative.

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC part 15 final revised on April 6, 2016.

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 C63.10:2013 6 Standard test methods <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 C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.4, 6.12	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 8.9	Radiated	N/A	2.6 dB 0.13420 MHz 0 deg. PK with Duty factor <Room Antenna>	Complied
3	Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.4, 6.13	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 8.9	Radiated	N/A	11.1 dB 40.000 MHz, Vertical, QP <Room Antenna>	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <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.

Polarity	Radiated emission (Below 1GHz)			
	(3 m*)(+/-)		(10 m*)(+/-)	
	30 – 200 MHz	200 – 1000MHz	30 – 200 MHz	200 – 1000MHz
Horizontal	5.0 dB	5.3 dB	5.0 dB	5.0 dB
Vertical	4.7 dB	5.9 dB	5.0 dB	5.1 dB

Radiated emission (Above 1GHz)				
(3 m*)(+/-)		(1 m*)(+/-)		(10 m*)(+/-)
1 – 6GHz	6 – 18GHz	10 – 26.5 GHz	26.5 – 40GHz	1 -18 GHz
5.2 dB	5.4 dB	5.5 dB	5.5 dB	5.4 dB

* Measurement distance

Radiated emission test (3m)

[Electric Field Strength of Fundamental Emission]

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

[Electric Field Strength of Spurious Emission]

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

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.

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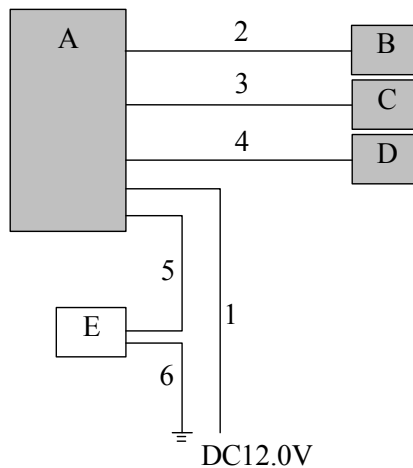
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

The mode is used : Transmitting mode (Tx) 134.2kHz
*The EUT does not transmit simultaneously from multiple antennas.

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.
 - * During testing, transmitting antenna was fixed to one of three antennas (B,C, D), and the test was conducted with the worst duty.
- As for Room antenna (C: Extra1 and Extra2), the test was performed with the representative Extra1 antenna. Because there was no difference in emission level by number of antenna.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Computer Assy, Smart Key (ECU)	TS-CTY	001	-	EUT
B	Door Antenna	-	001	-	EUT
C	Room Antenna	-	001	-	EUT
D	Trunk Antenna	-	001	-	EUT
E	Switch Box	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	Antenna Cable	2.0	Unshielded	Unshielded	-
3	Antenna Cable	2.0	Unshielded	Unshielded	-
4	Antenna Cable	2.0	Unshielded	Unshielded	-
5	Signal Cable	2.0	Unshielded	Unshielded	-
6	Ground Cable	1.0	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 0.8 m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

Frequency : From 9 kHz to 30 MHz

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: 0 deg., 45 deg., 90 deg., and 135 deg.) and horizontal polarization.

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

Frequency: From 30 MHz to 1 GHz

The measuring antenna height varied between 1 and 4 m 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 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz	Above 1 GHz	
Instrument used	Test Receiver					Spectrum Analyzer	
Detector	PK / AV	QP	PK / AV	QP	QP	PK	AV
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 10 Hz
Test Distance	3 m *1)	3 m *1)	3 m *1)	3 m *2)	3 m	3 m	3 m

*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 : 9 kHz - 1 GHz
Test data : APPENDIX 1
Test result : Pass

Date: August 7, 2016
August 15, 2016

Test engineer: Hiroyuki Furutaka
Yuta Moriya

UL Japan, Inc.

Ise EMC Lab.

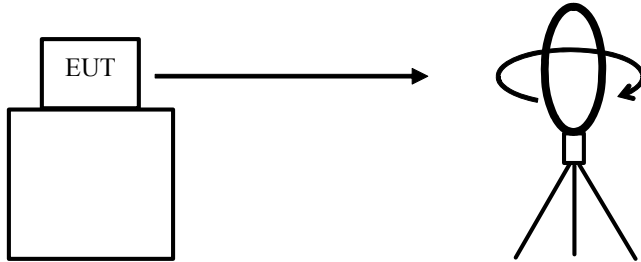
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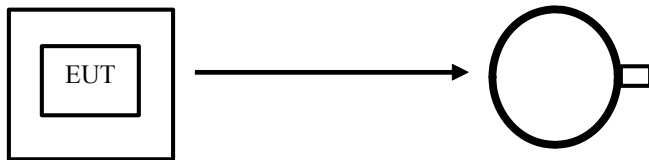
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

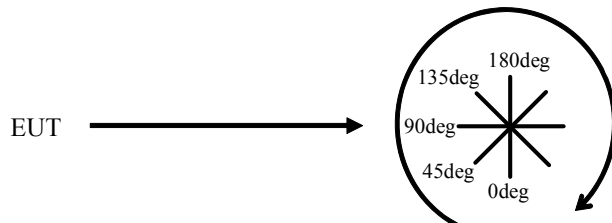


.....
Top View (Horizontal)



Antenna was not rotated.

.....
Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

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
Test result : Pass

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
Test result : Pass

APPENDIX 1: Test data

Radiated Emission below 30MHz (Fundamental and Spurious Emission)

Door Antenna

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Order No. : 11395574H
Date : 08/07/2016
Temperature/ Humidity : 23 deg. C / 48% RH
Engineer : Hiroyuki Furutaka
Mode : Tx 134.2kHz

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	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	99.3	19.6	-74.0	32.2	-	12.7	45.0	32.3	Fundamental
0	0.26840	PK	58.9	19.6	-73.9	32.2	-	-27.6	39.0	66.6	
0	0.40260	PK	47.4	19.6	-73.9	32.2	-	-39.1	35.5	74.6	
0	0.53680	QP	36.4	19.5	-33.9	32.1	-	-10.1	33.0	43.1	
0	0.67100	QP	36.3	19.5	-33.9	32.1	-	-10.2	31.1	41.3	
0	0.80520	QP	32.4	19.5	-33.8	32.1	-	-14.0	29.5	43.5	
0	0.93940	QP	33.4	19.5	-33.8	32.1	-	-13.0	28.1	41.1	
0	1.07360	QP	32.4	19.5	-33.8	32.1	-	-14.0	26.9	40.9	
0	1.20780	QP	31.4	19.5	-33.8	32.1	-	-15.0	25.9	40.9	
0	1.34200	QP	31.7	19.5	-33.8	32.1	-	-14.7	25.0	39.7	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	99.3	19.6	-74.0	32.2	0.0	12.7	25.0	12.3	
0	0.26840	PK	58.9	19.6	-73.9	32.2	0.0	-27.6	19.0	46.6	
0	0.40260	PK	47.4	19.6	-73.9	32.2	0.0	-39.1	15.5	54.6	

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

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

PK or QP (Result of the fundamental emission at 3m without Distance 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
0.000	0.13420	PK	99.3	19.6	6.0	32.2	-	92.7	-	-	Fundamental

* All spurious emissions lower than this result.

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

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

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Order No. : 11395574H
Date : 08/07/2016
Temperature/ Humidity : 23 deg. C / 48% RH
Engineer : Hiroyuki Furutaka
Mode : Tx 134.2kHz

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	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	109.0	19.6	-74.0	32.2	-	22.4	45.0	22.6	Fundamental
0	0.26840	PK	76.3	19.6	-73.9	32.2	-	-10.2	39.0	49.2	
0	0.40260	PK	59.1	19.6	-73.9	32.2	-	-27.4	35.5	62.9	
0	0.53680	QP	38.0	19.5	-33.9	32.1	-	-8.5	33.0	41.5	
0	0.67100	QP	34.1	19.5	-33.9	32.1	-	-12.4	31.1	43.5	
0	0.80520	QP	35.1	19.5	-33.8	32.1	-	-11.3	29.5	40.8	
0	0.93940	QP	31.6	19.5	-33.8	32.1	-	-14.8	28.1	42.9	
0	1.07360	QP	32.8	19.5	-33.8	32.1	-	-13.6	26.9	40.5	
0	1.20780	QP	31.7	19.5	-33.8	32.1	-	-14.7	25.9	40.6	
0	1.34200	QP	31.6	19.5	-33.8	32.1	-	-14.8	25.0	39.8	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + 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	109.0	19.6	-74.0	32.2	0.0	22.4	25.0	2.6	
0	0.26840	PK	76.3	19.6	-73.9	32.2	0.0	-10.2	19.0	29.2	
0	0.40260	PK	59.1	19.6	-73.9	32.2	0.0	-27.4	15.5	42.9	

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

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

PK or QP (Result of the fundamental emission at 3m without Distance 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
0.000	0.13420	PK	109.0	19.6	6.0	32.2	-	102.4	-	-	Fundamental

* All spurious emissions lower than this result.

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

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

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Order No. : 11395574H
Date : 08/07/2016
Temperature/ Humidity : 23 deg. C / 48% RH
Engineer : Hiroyuki Furutaka
Mode : Tx 134.2kHz

PK or QP

Ant Deg [deg] or Polarity [Hori/Vert]	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	100.2	19.6	-74.0	32.2	-	13.6	45.0	31.4	Fundamental
0	0.26840	PK	58.8	19.6	-73.9	32.2	-	-27.7	39.0	66.7	
0	0.40260	PK	49.1	19.6	-73.9	32.2	-	-37.4	35.5	72.9	
0	0.53680	QP	34.8	19.5	-33.9	32.1	-	-11.7	33.0	44.7	
0	0.67100	QP	32.2	19.5	-33.9	32.1	-	-14.3	31.1	45.4	
0	0.80520	QP	33.4	19.5	-33.8	32.1	-	-13.0	29.5	42.5	
0	0.93940	QP	31.7	19.5	-33.8	32.1	-	-14.7	28.1	42.8	
0	1.07360	QP	31.6	19.5	-33.8	32.1	-	-14.8	26.9	41.7	
0	1.20780	QP	31.2	19.5	-33.8	32.1	-	-15.2	25.9	41.1	
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)

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	100.2	19.6	-74.0	32.2	0.0	13.6	25.0	11.4	
0	0.26840	PK	58.8	19.6	-73.9	32.2	0.0	-27.7	19.0	46.7	
0	0.40260	PK	49.1	19.6	-73.9	32.2	0.0	-37.4	15.5	52.9	

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

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

PK or QP (Result of the fundamental emission at 3m without Distance 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
0.000	0.13420	PK	100.2	19.6	6	32.2	-	93.6	-	-	Fundamental

* All spurious emissions lower than this result.

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

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Radiated Emission above 30MHz
Door Antenna

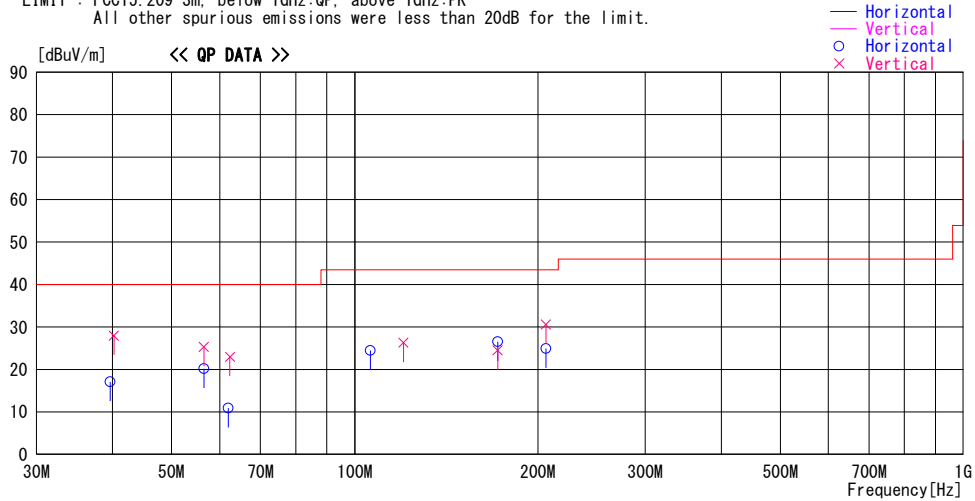
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2016/08/15

Order No. : 11395574H
Temp./Humi. : 24deg. C / 43% RH
Engineer : Yuta Moriya

Mode / Remarks : Tx 134.2kHz 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 [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]							
39.633	28.0	QP	14.1	-25.0	17.1	130	342	Hori.	40.0	22.9	
40.200	39.1	QP	13.9	-25.0	28.0	161	100	Vert.	40.0	12.0	
56.530	36.8	QP	8.1	-24.7	20.2	198	370	Hori.	40.0	19.8	
56.530	41.9	QP	8.1	-24.7	25.3	227	100	Vert.	40.0	14.7	
62.017	28.8	QP	6.7	-24.6	10.9	308	320	Hori.	40.0	29.1	
62.360	40.9	QP	6.7	-24.6	23.0	180	100	Vert.	40.0	17.0	
106.020	38.0	QP	10.6	-24.1	24.5	5	299	Hori.	43.5	19.0	
120.244	37.8	QP	12.4	-23.9	26.3	289	100	Vert.	43.5	17.2	
171.786	32.0	QP	15.8	-23.3	24.5	128	100	Vert.	43.5	19.0	
171.786	34.1	QP	15.8	-23.3	26.6	354	292	Hori.	43.5	16.9	
206.138	36.3	QP	11.5	-22.9	24.9	101	167	Hori.	43.5	18.6	
206.138	42.0	QP	11.5	-22.9	30.6	33	100	Vert.	43.5	12.9	

CHART:WITH FACTOR ANT TYPE: -30MHz:LOOP, 30-200MHz:BICONICAL, 200MHz-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
Room Antenna

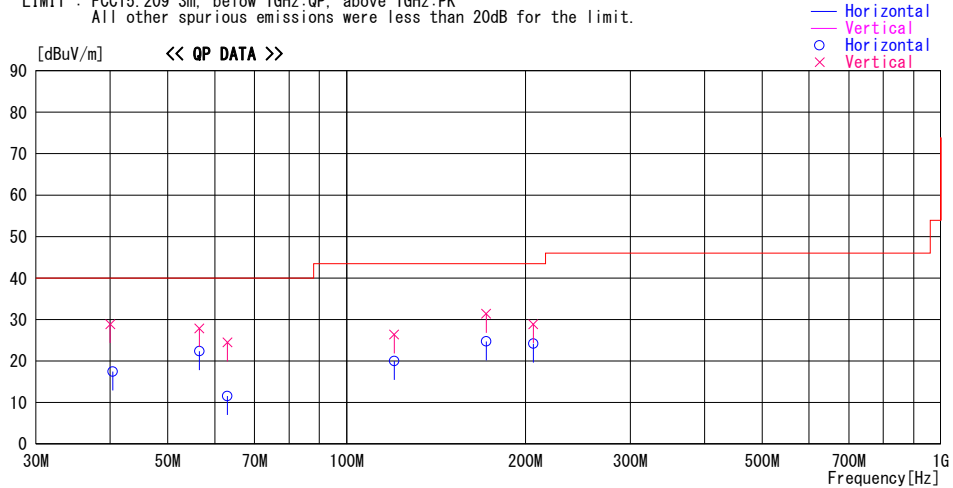
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2016/08/15

Order No. : 11395574H
Temp./Humi. : 24deg. C / 43% RH
Engineer : Yuta Moriya

Mode / Remarks : Tx 134.2kHz Room 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		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss& Gain [dB]							
40.406	28.7	QP	13.8	-25.0	17.5	139	342	Hori.	40.0	22.5	
40.000	39.9	QP	14.0	-25.0	28.9	186	100	Vert.	40.0	11.1	
56.520	39.0	QP	8.1	-24.7	22.4	168	353	Hori.	40.0	17.6	
56.520	44.5	QP	8.1	-24.7	27.9	213	100	Vert.	40.0	12.1	
63.000	29.6	QP	6.6	-24.6	11.6	134	320	Hori.	40.0	28.4	
63.000	42.5	QP	6.6	-24.6	24.5	0	100	Vert.	40.0	15.5	
120.260	31.5	QP	12.4	-23.9	20.0	351	271	Hori.	43.5	23.5	
120.244	37.9	QP	12.4	-23.9	26.4	291	100	Vert.	43.5	17.1	
171.786	38.9	QP	15.8	-23.3	31.4	150	100	Vert.	43.5	12.1	
171.786	32.2	QP	15.8	-23.3	24.7	354	296	Hori.	43.5	18.8	
206.136	35.6	QP	11.5	-22.9	24.2	95	171	Hori.	43.5	19.3	
206.136	40.3	QP	11.5	-22.9	28.9	29	100	Vert.	43.5	14.6	

CHART: WITH FACTOR ANT TYPE: -30MHz: LOOP, 30-200MHz: BICONICAL, 200MHz-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
Trunk Antenna

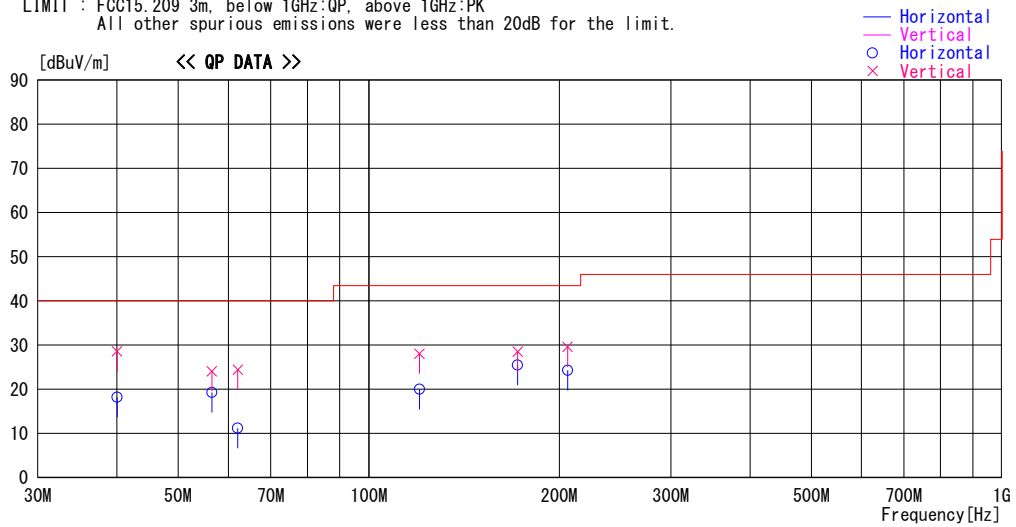
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2016/08/15

Order No. : 11395574H
Temp./Humi. : 24deg. C / 43% RH
Engineer : Yuta Moriya

Mode / Remarks : Tx 134.2kHz 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.



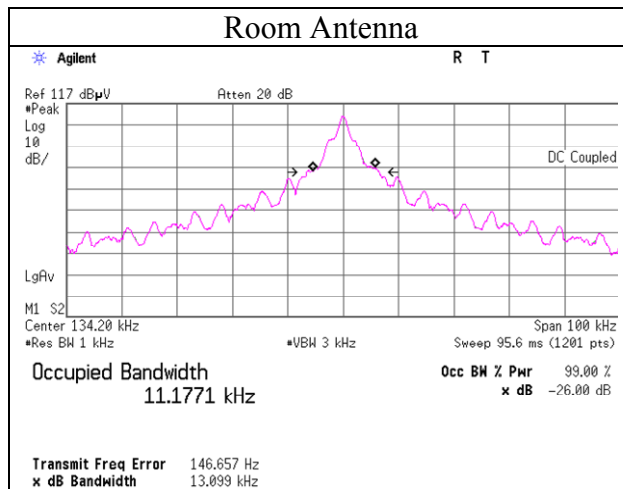
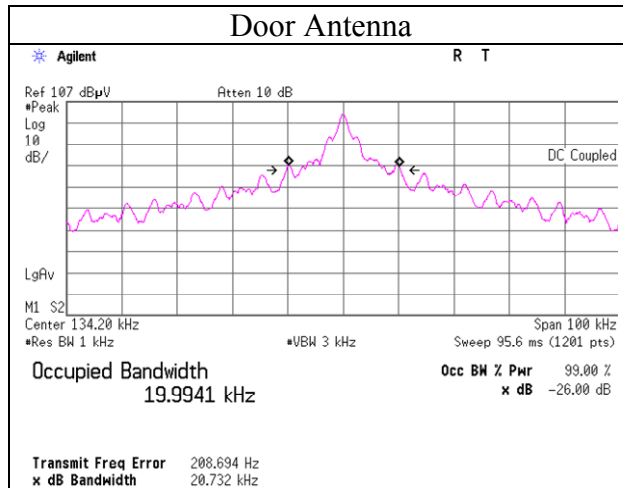
Frequency [MHz]	Reading [dBuV]	DET	Antenna	Loss&	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Gain [dB]							
40.030	29.3	QP	13.9	-25.0	18.2	139	342	Hori.	40.0	21.8	
40.030	39.7	QP	13.9	-25.0	28.6	148	100	Vert.	40.0	11.4	
56.520	35.9	QP	8.1	-24.7	19.3	177	353	Hori.	40.0	20.7	
56.520	40.7	QP	8.1	-24.7	24.1	197	100	Vert.	40.0	15.9	
62.080	29.1	QP	6.7	-24.6	11.2	156	320	Hori.	40.0	28.8	
62.080	42.3	QP	6.7	-24.6	24.4	0	100	Vert.	40.0	15.6	
120.256	31.5	QP	12.4	-23.9	20.0	210	273	Hori.	43.5	23.5	
120.256	39.6	QP	12.4	-23.9	28.1	263	100	Vert.	43.5	15.4	
171.796	36.0	QP	15.8	-23.3	28.5	132	100	Vert.	43.5	15.0	
171.796	33.0	QP	15.8	-23.3	25.5	350	307	Hori.	43.5	18.0	
206.136	35.7	QP	11.5	-22.9	24.3	108	167	Hori.	43.5	19.2	
206.136	41.0	QP	11.5	-22.9	29.6	55	100	Vert.	43.5	13.9	

CHART: WITH FACTOR ANT TYPE: -30MHz: LOOP, 30-200MHz: BICONICAL, 200MHz-1000MHz: LOGPERIODIC, 1000MHz-: HORN
CALCULATION : RESULT = READING + ANT FACTOR + LOSS & GAIN (CABLE + ATTEN - GAIN (AMP))

-26dB Bandwidth and 99% Occupied Bandwidth

Test place Ise EMC Lab. No.1 Semi Anechoic Chamber
Order No. 11395574H
Date 08/07/2016
Temperature/ Humidity 23 deg. C / 48% RH
Engineer Hiroyuki Furutaka
Mode Tx 134.2kHz

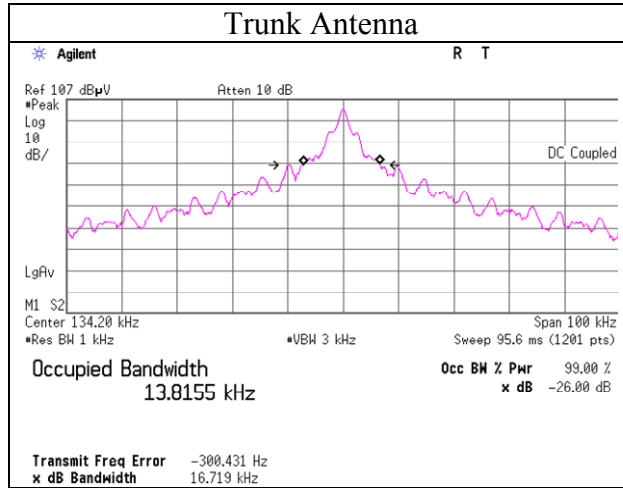
Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
Door Antenna	134.2	20.732	19.994
Room Antenna	134.2	13.099	11.177



-26dB Bandwidth and 99% Occupied Bandwidth

Test place	Ise EMC Lab. No.1 Semi Anechoic Chamber
Order No.	11395574H
Date	08/07/2016
Temperature/ Humidity	23 deg. C / 48% RH
Engineer	Hiroyuki Furutaka
Mode	Tx 134.2kHz

Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
Trunk Antenna	134.2	16.719	13.816



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APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-01	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	RE	2015/09/19 * 12
MOS-27	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	RE	2016/01/21 * 12
MJM-25	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MTR-09	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	RE	2016/06/25 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2015/10/24 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2016/06/20 * 12
MCC-03	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W(20m)/ 3D-2W(7.5m)/ RG400u(1.5m)/ RFM-E421(Switcher)	-/01068 (Switcher)	RE	2016/06/29 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2016/03/18 * 12
MAT-08	Attenuator(6dB)	Weinschel Corp	2	BK7971	RE	2015/11/10 * 12
MMM-03	Digital Tester	Fluke	FLUKE 26-3	78030621	RE	2015/08/19 * 12
MSA-16	Spectrum Analyzer	Agilent	E4440A	MY46186390	RE	2016/02/08 * 12
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2015/10/01 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2016/01/21 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2016/05/19 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2015/09/02 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2015/10/11 * 12
MLA-22	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	RE	2016/01/30 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2016/07/26 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2016/04/05 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2016/03/24 * 12
MMM-08	DIGITAL HiTESTER	Hioki	3805	051201197	RE	2016/01/13 * 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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