



# RADIO TEST REPORT

**Test Report No. : 12449907H-R1**

**Applicant** : TOYOTA MOTOR CORPORATION  
**Type of Equipment** : Smart LF Oscillator  
**Model No.** : TMLF15-1  
**FCC ID** : NI4TMLF15-1  
**Test regulation** : FCC Part 15 Subpart C: 2019  
\*For Permissive Change  
**Test Result** : Complied (Refer to SECTION 3.2)

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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 covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
6. The all test items in this test report are conducted by UL Japan, Inc. Ise EMC Lab.
7. 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.
8. The information provided from the customer for this report is identified in SECTION 1.
9. This report is a revised version of 12449907H. 12449907H- is replaced with this report.

**Date of test:** May 13 and June 12, 2019

**Representative test engineer:**

Shinya Watanabe  
Engineer  
Consumer Technology Division

**Approved by:**

Motoya Imura  
Leader  
Consumer Technology Division



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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

## **REVISION HISTORY**

### **Original Test Report No.: 12449907H**

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12449907H	July 8, 2019	-	-
1	12449907H-R1	November 15, 2019	P.3	Addition of Abbreviations list
1	12449907H-R1	November 15, 2019	P.5	Correction of “changes from the original report” in Clause 2.2
1	12449907H-R1	November 15, 2019	P.9	Correction of note sentence in Clause 4.1
1	12449907H-R1	November 15, 2019	P.10	Correction of note sentence in Clause 4.2

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## Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	MCS	Modulation and Coding Scheme
AC	Alternating Current	MRA	Mutual Recognition Arrangement
AFH	Adaptive Frequency Hopping	N/A	Not Applicable
AM	Amplitude Modulation	NIST	National Institute of Standards and Technology
Amp, AMP	Amplifier	NS	No signal detect.
ANSI	American National Standards Institute	NSA	Normalized Site Attenuation
Ant, ANT	Antenna	NVLAP	National Voluntary Laboratory Accreditation Program
AP	Access Point	OBW	Occupied Band Width
ASK	Amplitude Shift Keying	OFDM	Orthogonal Frequency Division Multiplexing
Atten., ATT	Attenuator	P/M	Power meter
AV	Average	PCB	Printed Circuit Board
BPSK	Binary Phase-Shift Keying	PER	Packet Error Rate
BR	Bluetooth Basic Rate	PHY	Physical Layer
BT	Bluetooth	PK	Peak
BT LE	Bluetooth Low Energy	PN	Pseudo random Noise
BW	BandWidth	PRBS	Pseudo-Random Bit Sequence
Cal Int	Calibration Interval	PSD	Power Spectral Density
CCK	Complementary Code Keying	QAM	Quadrature Amplitude Modulation
Ch., CH	Channel	QP	Quasi-Peak
CISPR	Comite International Special des Perturbations Radioelectriques	QPSK	Quadri-Phase Shift Keying
CW	Continuous Wave	RBW	Resolution Band Width
DBPSK	Differential BPSK	RDS	Radio Data System
DC	Direct Current	RE	Radio Equipment
D-factor	Distance factor	RF	Radio Frequency
DFS	Dynamic Frequency Selection	RMS	Root Mean Square
DQPSK	Differential QPSK	RSS	Radio Standards Specifications
DSSS	Direct Sequence Spread Spectrum	Rx	Receiving
EDR	Enhanced Data Rate	SA, S/A	Spectrum Analyzer
EIRP, e.i.r.p.	Equivalent Isotropically Radiated Power	SG	Signal Generator
EMC	ElectroMagnetic Compatibility	SVSWR	Site-Voltage Standing Wave Ratio
EMI	ElectroMagnetic Interference	TR	Test Receiver
EN	European Norm	Tx	Transmitting
ERP, e.r.p.	Effective Radiated Power	VBW	Video BandWidth
EU	European Union	Vert.	Vertical
EUT	Equipment Under Test	WLAN	Wireless LAN
Fac.	Factor		
FCC	Federal Communications Commission		
FHSS	Frequency Hopping Spread Spectrum		
FM	Frequency Modulation		
Freq.	Frequency		
FSK	Frequency Shift Keying		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
IEC	International Electrotechnical Commission		
IEEE	Institute of Electrical and Electronics Engineers		
IF	Intermediate Frequency		
ILAC	International Laboratory Accreditation Conference		
ISED	Innovation, Science and Economic Development Canada		
ISO	International Organization for Standardization		
JAB	Japan Accreditation Board		
LAN	Local Area Network		
LIMS	Laboratory Information Management System		

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Facsimile : +81 596 24 8124

## **SECTION 1: Customer information**

Company Name : TOYOTA MOTOR CORPORATION  
Address : 1, Toyota-Cho, Toyota, Aichi, 471-8572 Japan  
Telephone Number : +81-565-94-1250  
Facsimile Number : +81-565-94-0415  
Contact Person : Hidemasa Yoshida

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

### **2.1 Identification of E.U.T.**

Type of Equipment : Smart LF Oscillator  
Model No. : TMLF15-1  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC 12.0 V (Max 0.5 A)  
Receipt Date of Sample : May 9, 2019  
Condition of EUT : Production prototype  
(Not for Sale: This sample is equivalent to mass-produced items.)  
Modification of EUT : No Modification by the test lab

### **2.2 Product Description**

Smart LF Oscillator, model: TMLF15-1 is a transmitter that is installed in a motor vehicle and is used as part of Smart System.

#### **Radio Specification**

Radio Type : Transmitter  
Frequency of Operation : 134.2 kHz  
Modulation : ASK  
Antenna type : Coil Antenna

Smart LF Oscillator (model: TMLF15-1) consists of the following parts:

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

<Contents of the change from original model>

Original test report number of this report is 10616579H-A-R1.

The EUT specification was changed from the original model as below.

- Change in the resistance value of the resistors
- Change in the intended connecting antenna for ports (CLG8, CG8B / CLGP, CGPB)

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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 June 4, 2019 and effective July 5, 2019 except 15.258

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 June 4, 2019, does not affect the test specification applied to the EUT.

### **3.2 Procedures and results**

Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
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	N/A	N/A *1)
Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.5, 6.12	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	35.3 dB 0.13420 MHz PK with Duty Factor	Complied a)
Electric Field Strength of Spurious Emission	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> RSS-Gen 6.5, 6.6, 6.13	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	17.15 dB 70.141 MHz, Vertical, QP	Complied a)
-26dB Bandwidth	<FCC> ANSI C63.10:2013 6 Standard test methods <IC> -	<FCC> Reference data <IC> -	Radiated	N/A	N/A	Complied b)

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.

a) Refer to APPENDIX 1 (data of Radiated emission)

b) Refer to APPENDIX 1 (data of -26 dB Bandwidth)

Symbols:

Complied The data of this test item has enough margin, more than the measurement uncertainty.

Complied# The data of this test item meets the limits unless the measurement uncertainty is taken into consideration.

### **FCC 15.31 (e)**

This test was performed with the New Battery (DC 12V) and the constant voltage was supplied to this EUT during the tests. Therefore, this EUT complies with the requirement.

### **FCC Part 15.203 Antenna requirement**

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the vehicle. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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### 3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
99 % Occupied Band Width	RSS-Gen 6.7	-	Radiated	N/A	N/A	-

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

Other than above, no addition, exclusion nor deviation has been made from the standard.

### 3.4 Uncertainty

There is no applicable rule of uncertainty in this applied standard. Therefore, the following results are derived depending on whether or not laboratory uncertainty is applied.

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

Test distance	Radiated emission (+/-)
	9 kHz to 30 MHz
3 m*	3.3 dB
10 m*	3.2 dB

Polarity	Radiated emission (Below 1 GHz)			
	(3 m*)(+/-)		(10 m*)(+/-)	
	30 MHz to 200 MHz	200 MHz to 1000 MHz	30 MHz to 200 MHz	200 MHz to 1000 MHz
Horizontal	4.8 dB	5.2 dB	4.8 dB	5.0 dB
Vertical	5.0 dB	6.3 dB	4.9 dB	5.0 dB

\* Measurement distance

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### 3.5 Test Location

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\*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C

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Test site	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms	Maximum measurement distance
No.1 semi-anechoic chamber	19.2 x 11.2 x 7.7	7.0 x 6.0	No.1 Power source room	10 m
No.2 semi-anechoic chamber	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.3 Preparation room	3 m
No.3 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.4 semi-anechoic chamber	12.0 x 8.5 x 5.9	6.8 x 5.75	No.4 Preparation room	3 m
No.4 shielded room	4.0 x 6.0 x 2.7	N/A	-	-
No.5 semi-anechoic chamber	6.0 x 6.0 x 3.9	6.0 x 6.0	-	-
No.5 measurement room	6.4 x 6.4 x 3.0	6.4 x 6.4	-	-
No.6 shielded room	4.0 x 4.5 x 2.7	4.0 x 4.5	-	-
No.6 measurement room	4.75 x 5.4 x 3.0	4.75 x 4.15	-	-
No.7 shielded room	4.7 x 7.5 x 2.7	4.7 x 7.5	-	-
No.8 measurement room	3.1 x 5.0 x 2.7	3.1 x 5.0	-	-
No.9 measurement room	8.8 x 4.6 x 2.8	2.4 x 2.4	-	-
No.11 measurement room	6.2 x 4.7 x 3.0	4.8 x 4.6	-	-

\* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0 m 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**

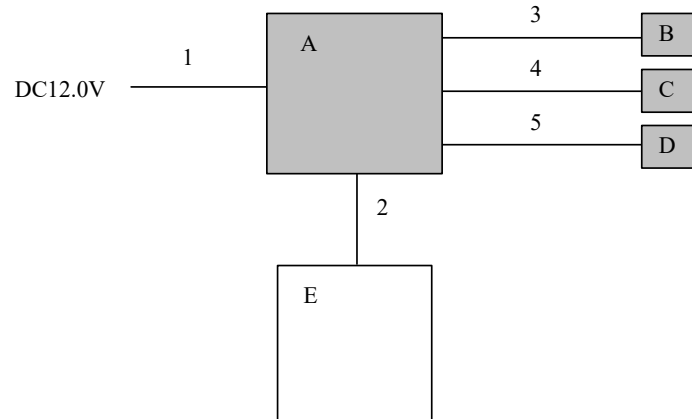
### **4.1 Operating Modes**

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

## 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.
- \* The number of connected antennas was no difference within this confirmation, although it was confirmed that some antennas would be added.

\*\*The Antenna port connected cable No.4 is “ CLG8,CG8B\*1) “.

\*1) Refer to the application document “ Block Diagram “.

The test was made at representative Room Antenna / Luggage Antenna since there was no difference in test result between Room Antenna / Luggage Antenna and Trunk Antenna with connected to this port.

### Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Computer Assy, Smart Key (ECU)	-	LF15-145	-	EUT
B	Door Antenna	-	69210-47050	-	EUT
C	Room Antenna / Luggage Antenna	-	001	-	EUT
D	Trunk Antenna	-	001	-	EUT
E	Jig Box	-	-	-	-

### List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	ECU Cable	3.0	Unshielded	Unshielded	-
3	Door Ant Cable	3.0	Unshielded	Unshielded	-
4	Room Ant / Luggage Ant Cable	3.0	Unshielded	Unshielded	-
5	Trunk Ant Cable	3.0	Unshielded	Unshielded	-

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## **SECTION 5: Radiated emission (Fundamental and Spurious Emission)**

### **Test Procedure**

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 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., 135 deg. and 180 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
Antenna Type	Loop	Biconical	Logperiodic

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
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)	3 m *2)	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 414788.

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.

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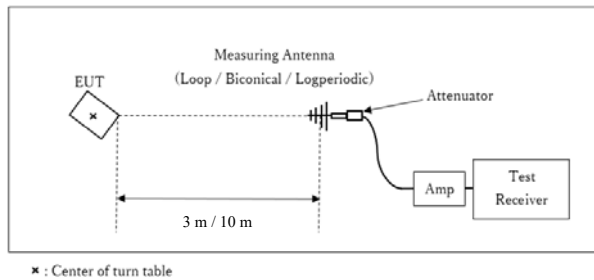
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[Test Setup]  
Below 1 GHz



Test Distance: 3 m / 10 m

- 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: May 13, 2019

Test engineer: Shinya Watanabe

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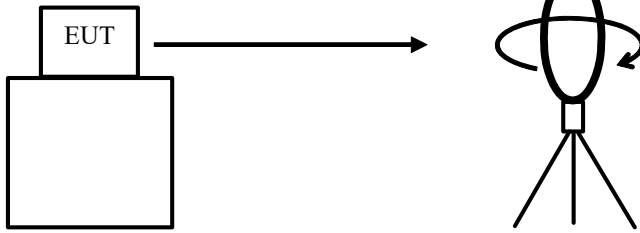
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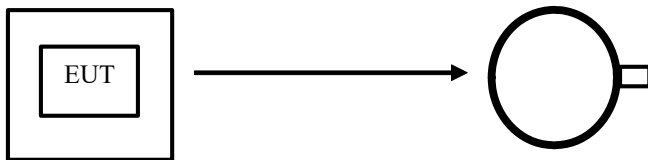
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**Figure 1: Direction of the Loop Antenna**

*Side View (Vertical)*

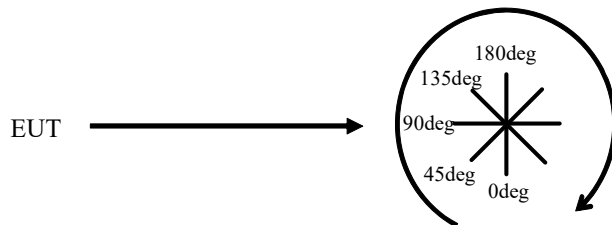


.....  
*Top View (Horizontal)*



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	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26dB 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 measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
99% Occupied Bandwidth	Enough width to display 20dB Bandwidth	1 % of Span	Three times of RBW	Auto	Peak *1)	Max Hold *1)	Spectrum Analyzer

\*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100%.

Test data : APPENDIX 1  
Test result : Pass

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## APPENDIX 1: Test data

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

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber  
Report No. : 12449907H  
Date : 07/26/2019  
Temperature/ Humidity : 21 deg. C / 74 % RH  
Engineer : Shinya Watanabe  
Mode : Tx 134.2 kHz

#### 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	19.7	-74.0	32.2	-	9.9	45.0	35.1	Fundamental
0	0.26840	PK	58.4	19.7	-73.9	32.2	-	-28.1	39.0	67.1	
0	0.40260	PK	64.9	19.6	-73.9	32.2	-	-21.5	35.5	57.0	
0	0.53680	QP	43.7	19.6	-33.9	32.1	-	-2.7	33.0	35.7	
0	0.67100	QP	53.9	19.6	-33.9	32.2	-	7.5	31.1	23.6	
0	0.80520	QP	32.2	19.6	-33.8	32.2	-	-14.2	29.5	43.7	
0	0.93940	QP	46.3	19.6	-33.8	32.2	-	-0.1	28.1	28.2	
0	1.07360	QP	30.9	19.6	-33.8	32.2	-	-15.5	26.9	42.4	
0	1.20780	QP	38.6	19.6	-33.8	32.2	-	-7.8	25.9	33.7	
0	1.34200	QP	29.1	19.6	-33.8	32.2	-	-17.2	25.0	42.2	

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	19.7	-74.0	32.2	0.0	9.9	25.0	15.1	
0	0.26840	PK	58.4	19.7	-73.9	32.2	0.0	-28.1	19.0	47.1	
0	0.40260	PK	64.9	19.6	-73.9	32.2	0.0	-21.5	15.5	37.0	

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

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

#### Result of the fundamental emission at 3m without Distance factor

##### PK or QP

Ant Deg [deg]	Frequency [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	19.7	6.0	32.2	-	89.9	-	-	Fundamental

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

\* Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber  
Report No. : 12449907H  
Date : 07/26/2019  
Temperature/ Humidity : 21 deg. C / 74 % RH  
Engineer : Shinya Watanabe  
Mode : Tx 134.2 kHz

**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	96.2	19.7	-74.0	32.2	-	9.7	45.0	35.3	Fundamental
0	0.26840	PK	59.3	19.7	-73.9	32.2	-	-27.1	39.0	66.1	
0	0.40260	PK	61.9	19.6	-73.9	32.2	-	-24.5	35.5	60.0	
0	0.53680	QP	34.4	19.6	-33.9	32.1	-	-12.0	33.0	45.0	
0	0.67100	QP	47.2	19.6	-33.9	32.2	-	0.8	31.1	30.3	
0	0.80520	QP	32.8	19.6	-33.8	32.2	-	-13.6	29.5	43.1	
0	0.93940	QP	47.4	19.6	-33.8	32.2	-	1.0	28.1	27.1	
0	1.07360	QP	31.2	19.6	-33.8	32.2	-	-15.2	26.9	42.1	
0	1.20780	QP	45.3	19.6	-33.8	32.2	-	-1.1	25.9	27.0	
0	1.34200	QP	30.6	19.6	-33.8	32.2	-	-15.7	25.0	40.7	

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	96.2	19.7	-74.0	32.2	0.0	9.7	25.0	15.3	
0	0.26840	PK	59.3	19.7	-73.9	32.2	0.0	-27.1	19.0	46.1	
0	0.40260	PK	61.9	19.6	-73.9	32.2	0.0	-24.5	15.5	40.0	

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

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

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

Ant Deg [deg]	Frequency [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	96.2	19.7	6.0	32.2	-	89.7	-	-	Fundamental

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

\* Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124



**Radiated Emission below 30MHz (Fundamental and Spurious Emission)**  
**Room Antenna / Luggage Antenna Maximum Output**

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber  
Report No. : 12449907H  
Date : 07/26/2019  
Temperature/ Humidity : 21 deg. C / 74 % RH  
Engineer : Shinya Watanabe  
Mode : Tx 134.2 kHz

**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	95.7	19.7	-74.0	32.2	-	9.2	45.0	35.8	Fundamental
0	0.26840	PK	58.6	19.7	-73.9	32.2	-	-27.8	39.0	66.8	
0	0.40260	PK	64.5	19.6	-73.9	32.2	-	-21.9	35.5	57.4	
0	0.53680	QP	33.0	19.6	-33.9	32.1	-	-13.4	33.0	46.4	
0	0.67100	QP	46.8	19.6	-33.9	32.2	-	0.4	31.1	30.7	
0	0.80520	QP	31.4	19.6	-33.8	32.2	-	-15.0	29.5	44.5	
0	0.93940	QP	48.9	19.6	-33.8	32.2	-	2.5	28.1	25.6	
0	1.07360	QP	31.1	19.6	-33.8	32.2	-	-15.3	26.9	42.2	
0	1.20780	QP	46.3	19.6	-33.8	32.2	-	-0.1	25.9	26.0	
0	1.34200	QP	30.6	19.6	-33.8	32.2	-	-15.8	25.0	40.8	

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	95.7	19.7	-74.0	32.2	0.0	9.2	25.0	15.8	
0	0.26840	PK	58.6	19.7	-73.9	32.2	0.0	-27.8	19.0	46.8	
0	0.40260	PK	64.5	19.6	-73.9	32.2	0.0	-21.9	15.5	37.4	

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

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

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	95.7	19.7	6.0	32.2	-	89.2	-	-	Fundamental

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

\* Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

**Radiated Emission below 30MHz (Fundamental and Spurious Emission)**  
**Room Antenna / Luggage Antenna Minimum Output**

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber  
Report No. : 12449907H  
Date : 05/13/2019  
Temperature/ Humidity : 23 deg. C / 59 % RH  
Engineer : Shinya Watanabe  
Mode : Tx 134.2 kHz

**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	76.3	19.7	-74.0	32.3	-	-10.3	45.0	55.3	Fundamental
0	0.26840	PK	44.5	19.7	-73.9	32.3	-	-42.1	39.0	81.1	
0	0.40260	PK	47.3	19.6	-73.9	32.3	-	-39.2	35.5	74.7	
0	0.53680	QP	45.7	19.6	-33.9	32.2	-	-0.8	33.0	33.8	
0	0.67100	QP	32.4	19.6	-33.9	32.3	-	-14.1	31.1	45.2	
0	0.80520	QP	42.5	19.6	-33.8	32.3	-	-4.0	29.5	33.5	
0	0.93940	QP	36.4	19.6	-33.8	32.3	-	-10.1	28.1	38.2	
0	1.07360	QP	38.4	19.6	-33.8	32.3	-	-8.1	26.9	35.0	
0	1.20780	QP	35.6	19.6	-33.8	32.3	-	-10.9	25.9	36.8	
0	1.34200	QP	34.1	19.6	-33.8	32.3	-	-12.3	25.0	37.3	

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	76.3	19.7	-74.0	32.3	0.0	-10.3	25.0	35.3	
0	0.26840	PK	44.5	19.7	-73.9	32.3	0.0	-42.1	19.0	61.1	
0	0.40260	PK	47.3	19.6	-73.9	32.3	0.0	-39.2	15.5	54.7	

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

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

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	76.3	19.7	6.0	32.3	-	69.7	-	-	Fundamental

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

\* Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

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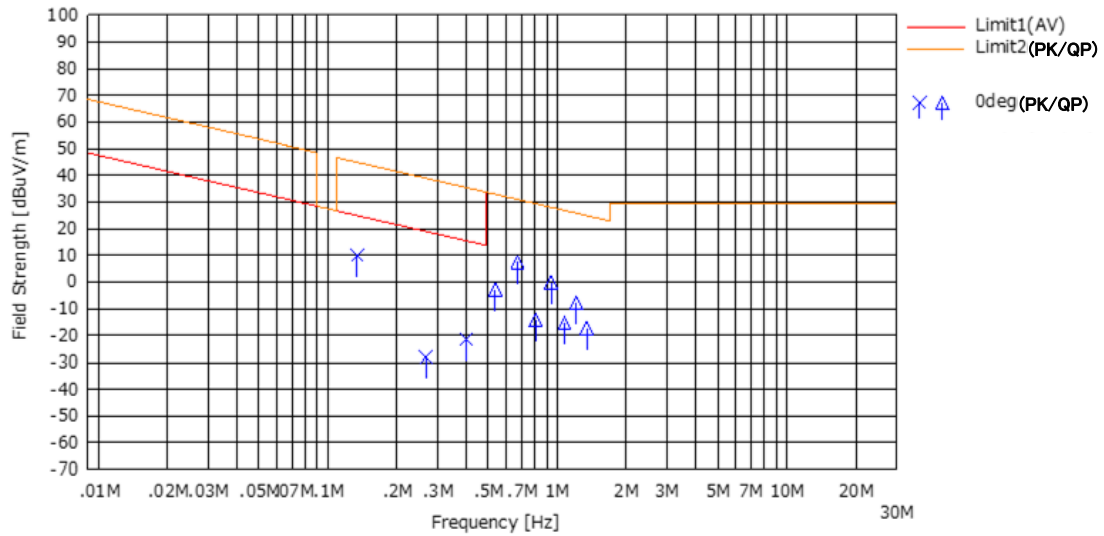
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

**Radiated Emission below 30 MHz (Fundamental and Spurious Emission)**  
**(Plot data, Worst case)**

Test place Ise EMC Lab. No.2 Semi Anechoic Chamber  
Report No. 12449907H  
Date 07/26/2019  
Temperature/ Humidity 21 deg. C / 74 % RH  
Engineer Shinya Watanabe  
Mode Tx 134.2 kHz



\*These plots data contains sufficient number to show the trend of characteristic features for EUT.

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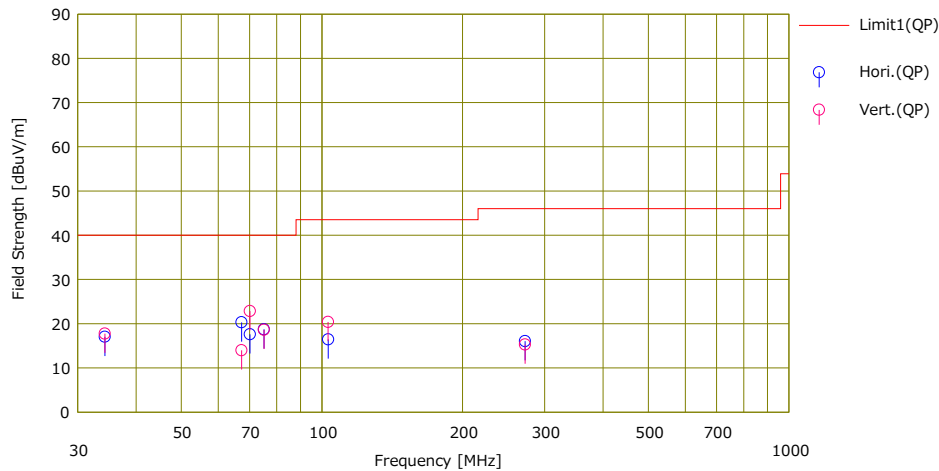
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber  
Report No. : 12449907H  
Date : 05/13/2019  
Temperature/ Humidity : 23 deg. C / 59 % RH  
Engineer : Shinya Watanabe  
Mode : Tx 134.2 kHz

Limit : FCC15.209 3 m, below 1 GHz:QP, above 1 GHz:AV/PK



No.	Freq. [MHz]	Reading			Gain [dB]	Result		Margin [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
		(QP) [dBuV]	Ant.Fac [dB/m]	Loss [dB]		(QP) [dBuV/m]	(QP) [dBuV/m]						
1	34.296	24.30	16.48	6.77	30.51	17.04	40.00	22.96	Hori.	300	0	BA	
2	67.276	37.42	6.12	7.14	30.39	20.29	40.00	19.71	Hori.	168	185	BA	
3	70.141	34.80	6.01	7.17	30.38	17.60	40.00	22.40	Hori.	240	0	BA	
4	75.151	35.83	6.05	7.22	30.36	18.74	40.00	21.26	Hori.	229	181	BA	
5	103.197	28.62	10.60	7.48	30.26	16.44	43.50	27.06	Hori.	281	0	BA	
6	27.2317	23.72	12.95	8.65	29.26	16.06	46.00	29.94	Hori.	100	0	LA21	
7	34.296	25.00	16.48	6.77	30.51	17.74	40.00	22.26	Vert.	100	0	BA	
8	67.276	31.11	6.12	7.14	30.39	13.98	40.00	26.02	Vert.	196	117	BA	
9	70.141	40.05	6.01	7.17	30.38	22.85	40.00	17.15	Vert.	100	94	BA	
10	75.151	35.71	6.05	7.22	30.36	18.62	40.00	21.38	Vert.	100	284	BA	
11	103.064	32.58	10.59	7.48	30.26	20.39	43.50	23.11	Vert.	100	271	BA	
12	27.2317	22.95	12.95	8.65	29.26	15.29	46.00	30.71	Vert.	200	0	LA21	

\* Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).

CHART: WITH FACTOR

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

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

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

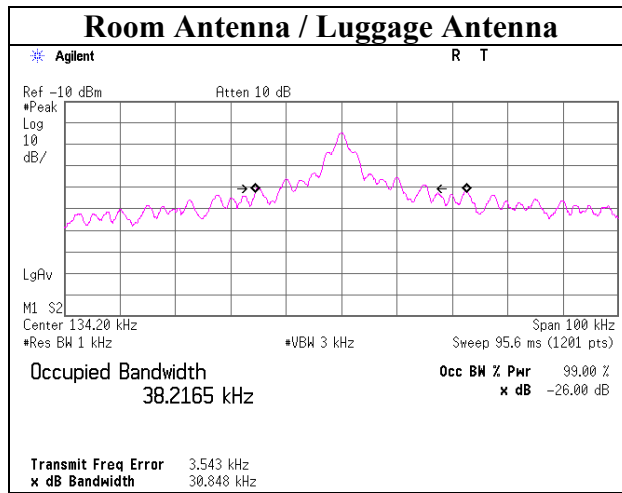
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber  
 Report No. : 12449907H  
 Date : 06/12/2019  
 Temperature/ Humidity : 23 deg. C / 61 % RH  
 Engineer : Shinya Watanabe  
 Mode : Tx 134.2 kHz

Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
Room Antenna / Ruggage Antenna	134.2	30.848	38.2165



## **APPENDIX 2: Test instruments**

### **Test Instruments**

Test item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141222	Coaxial Cable	FUJIKURA	3D-2W(12m)/ 5D-2W(5m)/ 5D-2W(0.8m)/5	-	2/25/2019	2/29/2020	12
RE	141556	Thermo-Hygrometer	CUSTOM	CTH-201	0003	12/5/2018	12/31/2019	12
RE	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/11/2018	10/31/2019	12
RE	141413	Coaxial Cable	UL Japan	-	-	6/7/2019	6/30/2020	12
RE	141203	Attenuator(6dB)	Weinschel Corp	2	BK7970	11/5/2018	11/30/2019	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	2/8/2019	2/29/2020	12
RE	142228	Measure	KOMELON	KMC-36	-	-	-	-
RE	141427	Biconical Antenna	Schwarzbeck	VHA9103B	8031	4/12/2019	4/30/2020	12
RE	141265	Logperiodic Antenna(200- 1000MHz)	Schwarzbeck	VUSLP9111B	911B-190	3/25/2019	3/31/2020	12
RE	141942	Test Receiver	Rohde & Schwarz	ESCI	100300	8/8/2018	8/31/2019	12
RE	141317	Coaxial Cable	Fujikura/Agilent	-	-	2/25/2019	2/29/2020	12
RE	141578	Pre Amplifier	AGILENT	8447D	2944A10845	9/19/2018	9/30/2019	12
RE	141885	Spectrum Analyzer	AGILENT	E4448A	US44300523	11/7/2018	11/30/2019	12

\*Hyphens for Last Calibration Date, Calibration Due Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test item:

RE: Spurious emission

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124