



RADIO TEST REPORT

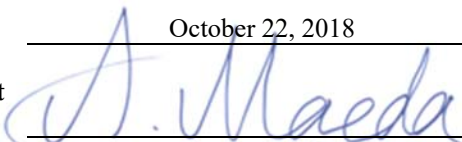
Test Report No. : 12496785H-A-R1

Applicant : TOYOTA MOTOR CORPORATION
Type of Equipment : Smart LF Oscillator
Model No. : TMLF12-8
FCC ID : NI4TMLF12-8
Test regulation : FCC Part 15 Subpart C: 2018
Test Result : Complied

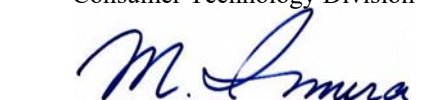
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3. This sample tested is in compliance with above regulation.
4. The test results in this report are traceable to the national or international standards.
5. This test report covers Radio technical requirements. It does not cover administrative issues 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. This report is a revised version of 12496785H-A. 12496785H-A is replaced with this report.

Date of test: October 22, 2018

Representative test engineer:


Akihiko Maeda
Engineer
Consumer Technology Division

Approved by:


Motoya Imura
Leader
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 12496785H-A

[illegible]

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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	:	Shinji Suganuma

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

2.1 Identification of E.U.T.

Type of Equipment	:	Smart LF Oscillator
Model No.	:	TMLF12-8
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12.0 V (Max 0.5A)
Receipt Date of Sample	:	October 15, 2018
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Smart LF Oscillator, model: TMLF12-8 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
Clock Frequency	:	4.000 MHz, 4.2944 MHz

Smart LF Oscillator (model: TMLF12-8) consists of the following parts:

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

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on March 12, 2018 and effective April 11, 2018

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
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 6.5, 6.12	<FCC> Section 15.209 <IC> RSS-210 4.4 RSS-Gen 8.9	Radiated	N/A	17.7 dB 134.2 kHz, 0 deg. PK(PK with Duty Factor) (Room Antenna / Luggage Antenna Maximum Output)	Complied
3	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	9.4 dB 77.290 MHz, Vertical, QP (Door Antenna) / 77.290 MHz, Vertical, QP (Trunk 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.

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)

The EUT provides stable voltage constantly to the wireless transmitter regardless of input voltage.

Instead of a new battery, DC power supply was used for the test.

That does not affect the test result, therefore the 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 6.7	-	Radiated	N/A	N/A	Complied

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.

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 distance	Radiated emission (+/-)
	9 kHz to 30 MHz
3 m	3.8 dB
10 m	3.6 dB

*Measurement distance

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

Bandwidth
0.96 %

3.5 Test Location

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NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967

Test site	IC Registration Number	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	2973C-1	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	2973C-2	7.5 x 5.8 x 5.2	4.0 x 4.0	-	3 m
No.3 semi-anechoic chamber	2973C-3	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	2973C-4	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.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 m 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.

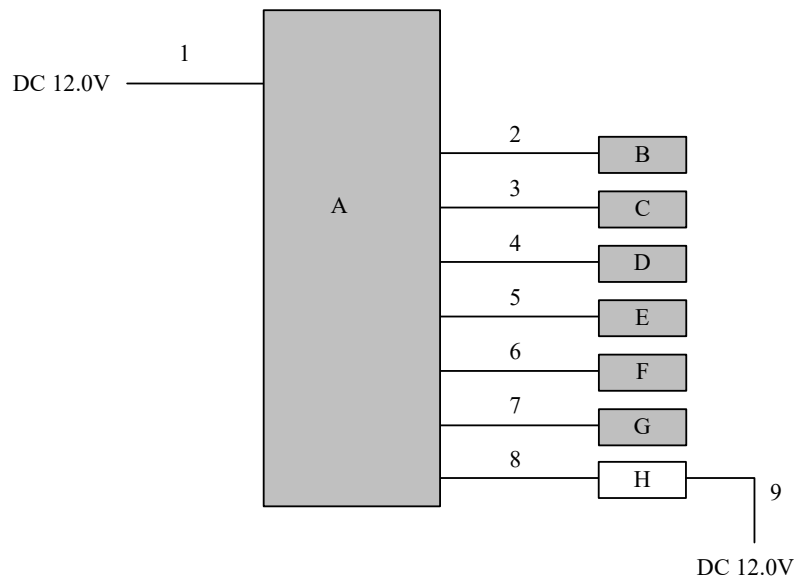
SECTION 4: Operation of E.U.T. during testing

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.

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 six antennas (B to G), and the test was conducted with the worst duty.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Computer Assy, Smart Key (ECU)	-	Max: LF12-148 Min: LF12-149	-	EUT
B	Door Antenna	-	001	-	EUT
C	Door Antenna	-	002	-	EUT
D	Room Antenna	-	001	-	EUT
E	Room Antenna	-	002	-	EUT
F	Room Antenna	-	003	-	EUT
G	Trunk Antenna	-	001	-	EUT
H	Switch BOX	-	001	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	Signal Cable	3.0	Unshielded	Unshielded	-
3	Signal Cable	3.0	Unshielded	Unshielded	-
4	Signal Cable	3.0	Unshielded	Unshielded	-
5	Signal Cable	3.0	Unshielded	Unshielded	-
6	Signal Cable	3.0	Unshielded	Unshielded	-
7	Signal Cable	3.0	Unshielded	Unshielded	-
8	Signal Cable	3.0	Unshielded	Unshielded	-
9	DC Cable	2.0	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., 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
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: $40 \times \log(3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

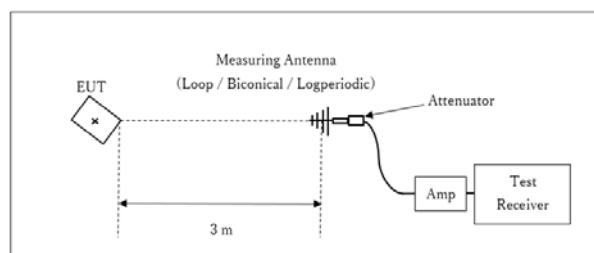
Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open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

[Test Setup]

Below 1 GHz



* : Center of turn table

Test Distance: 3 m

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- 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.

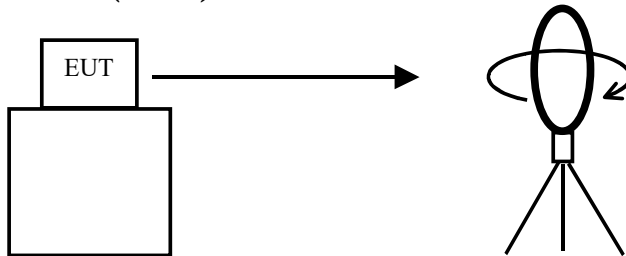
Measurement range : 9 kHz - 1 GHz
Test data : APPENDIX 1
Test result : Pass

Date: October 22, 2018

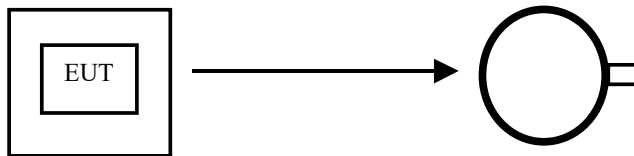
Test engineer: Akihiko Maeda

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

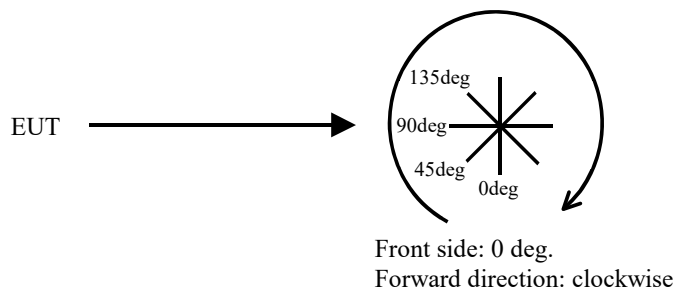


Top View (Horizontal)



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

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 30 MHz (Fundamental and Spurious Emission)

Door Antenna

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

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	94.2	19.1	-74.0	32.3	-	7.0	45.0	38.0	Fundamental
0	0.26840	PK	49.7	19.1	-74.0	32.3	-	-37.5	39.0	76.5	
0	0.40260	PK	56.9	19.1	-73.9	32.2	-	-30.1	35.5	65.6	
0	0.53680	QP	34.2	19.1	-33.9	32.2	-	-12.8	33.0	45.8	
0	0.67100	QP	51.9	19.1	-33.9	32.2	-	4.9	31.1	26.2	
0	0.80520	QP	32.0	19.1	-33.9	32.2	-	-15.0	29.5	44.5	
0	0.93940	QP	44.2	19.1	-33.9	32.2	-	-2.8	28.1	30.9	
0	1.07360	QP	30.4	19.1	-33.9	32.2	-	-16.6	26.9	43.5	
0	1.20780	QP	36.4	19.1	-33.9	32.2	-	-10.6	25.9	36.5	
0	1.34200	QP	29.9	19.1	-33.9	32.2	-	-17.1	25.0	42.1	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	94.2	19.1	-74.0	32.3	0.0	7.0	25.0	18.0	
0	0.26840	PK	49.7	19.1	-74.0	32.3	0.0	-37.5	19.0	56.5	
0	0.40260	PK	56.9	19.1	-73.9	32.2	0.0	-30.1	15.5	45.6	

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

* 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	94.2	19.1	6.0	32.3	-	87.0	-	-	Fundamental

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

* 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.

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Trunk Antenna

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

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	93.8	19.1	-74.0	32.3	-	6.6	45.0	38.4	Fundamental
0	0.26840	PK	56.5	19.1	-74.0	32.3	-	-30.7	39.0	69.7	
0	0.40260	PK	61.7	19.1	-73.9	32.2	-	-25.3	35.5	60.8	
0	0.53680	QP	32.5	19.1	-33.9	32.2	-	-14.5	33.0	47.5	
0	0.67100	QP	36.1	19.1	-33.9	32.2	-	-10.9	31.1	42.0	
0	0.80520	QP	31.0	19.1	-33.9	32.2	-	-16.0	29.5	45.5	
0	0.93940	QP	43.2	19.1	-33.9	32.2	-	-3.8	28.1	31.9	
0	1.07360	QP	34.4	19.1	-33.9	32.2	-	-12.6	26.9	39.5	
0	1.20780	QP	41.3	19.1	-33.9	32.2	-	-5.7	25.9	31.6	
0	1.34200	QP	29.7	19.1	-33.9	32.2	-	-17.3	25.0	42.3	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	93.8	19.1	-74.0	32.3	0.0	6.6	25.0	18.4	
0	0.26840	PK	56.5	19.1	-74.0	32.3	0.0	-30.7	19.0	49.7	
0	0.40260	PK	61.7	19.1	-73.9	32.2	0.0	-25.3	15.5	40.8	

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

* 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	93.8	19.1	6.0	32.3	-	86.6	-	-	Fundamental

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

* 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.

Radiated Emission below 30 MHz (Fundamental and Spurious Emission)

Room Antenna / Luggage Antenna Maximum Output

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

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	94.5	19.1	-74.0	32.3	-	7.3	45.0	37.7	Fundamental
0	0.26840	PK	57.5	19.1	-74.0	32.3	-	-29.7	39.0	68.7	
0	0.40260	PK	64.8	19.1	-73.9	32.2	-	-22.2	35.5	57.7	
0	0.53680	QP	31.6	19.1	-33.9	32.2	-	-15.4	33.0	48.4	
0	0.67100	QP	39.6	19.1	-33.9	32.2	-	-7.4	31.1	38.5	
0	0.80520	QP	30.6	19.1	-33.9	32.2	-	-16.4	29.5	45.9	
0	0.93940	QP	44.2	19.1	-33.9	32.2	-	-2.8	28.1	30.9	
0	1.07360	QP	31.4	19.1	-33.9	32.2	-	-15.6	26.9	42.5	
0	1.20780	QP	42.2	19.1	-33.9	32.2	-	-4.8	25.9	30.7	
0	1.34200	QP	29.7	19.1	-33.9	32.2	-	-17.3	25.0	42.3	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	94.5	19.1	-74.0	32.3	0.0	7.3	25.0	17.7	
0	0.26840	PK	57.5	19.1	-74.0	32.3	0.0	-29.7	19.0	48.7	
0	0.40260	PK	64.8	19.1	-73.9	32.2	0.0	-22.2	15.5	37.7	

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

Result of the fundamental emission at 3m without Distance factor

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	94.5	19.1	6.0	32.3	-	87.3	-	-	Fundamental

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

* 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.

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

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

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	79.2	19.1	-74.0	32.3	-	-8.0	45.0	53.0	Fundamental
0	0.26840	PK	51.3	19.1	-74.0	32.3	-	-35.9	39.0	74.9	
0	0.40260	PK	52.5	19.1	-73.9	32.2	-	-34.5	35.5	70.0	
0	0.53680	QP	43.7	19.1	-33.9	32.2	-	-3.3	33.0	36.3	
0	0.67100	QP	31.2	19.1	-33.9	32.2	-	-15.8	31.1	46.9	
0	0.80520	QP	40.6	19.1	-33.9	32.2	-	-6.4	29.5	35.9	
0	0.93940	QP	34.8	19.1	-33.9	32.2	-	-12.2	28.1	40.3	
0	1.07360	QP	37.4	19.1	-33.9	32.2	-	-9.6	26.9	36.5	
0	1.20780	QP	34.5	19.1	-33.9	32.2	-	-12.5	25.9	38.4	
0	1.34200	QP	33.6	19.1	-33.9	32.2	-	-13.4	25.0	38.4	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	79.2	19.1	-74.0	32.3	0.0	-8.0	25.0	33.0	
0	0.26840	PK	51.3	19.1	-74.0	32.3	0.0	-35.9	19.0	54.9	
0	0.40260	PK	52.5	19.1	-73.9	32.2	0.0	-34.5	15.5	50.0	

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

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	79.2	19.1	6.0	32.3	-	72.0	-	-	Fundamental

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

* 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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Ise EMC Lab.

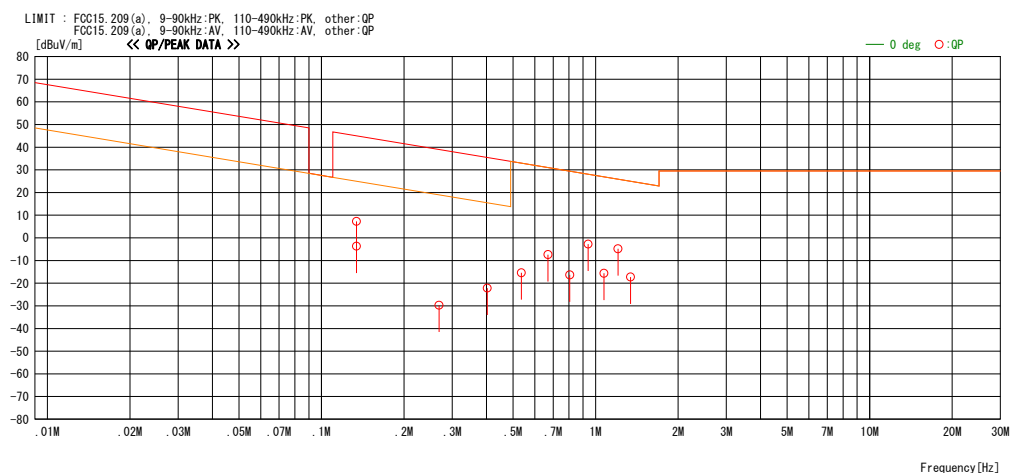
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Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

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

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz, Room Antenna / Luggage Antenna Maximum Output



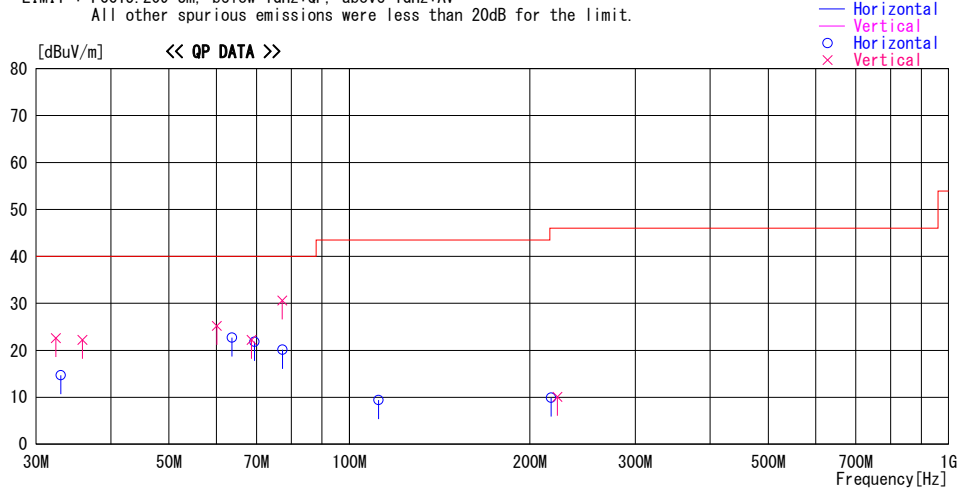
*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Radiated Emission above 30 MHz (Spurious Emission)

Door Antenna

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:AV
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]	
32.370	30.0	QP	17.7	-25.1	22.6	58	100	Vert.	40.0	17.4	
33.000	22.3	QP	17.5	-25.1	14.7	124	400	Hori.	40.0	25.3	
35.870	30.8	QP	16.5	-25.1	22.2	156	100	Vert.	40.0	17.8	
60.110	41.9	QP	7.9	-24.6	25.2	178	100	Vert.	40.0	14.8	
63.700	40.2	QP	7.0	-24.5	22.7	203	369	Hori.	40.0	17.3	
68.670	40.1	QP	6.5	-24.4	22.2	256	100	Vert.	40.0	17.8	
69.440	39.8	QP	6.4	-24.4	21.8	359	400	Hori.	40.0	18.2	
77.305	37.7	QP	6.7	-24.3	20.1	231	400	Hori.	40.0	19.9	
77.290	48.2	QP	6.7	-24.3	30.6	223	100	Vert.	40.0	9.4	
111.800	21.4	QP	11.9	-23.9	9.4	123	300	Hori.	43.5	34.1	
217.000	21.4	QP	11.2	-22.7	9.9	0	200	Hori.	46.0	36.1	
222.500	21.5	QP	11.3	-22.7	10.1	0	100	Vert.	46.0	35.9	

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 & GAIN (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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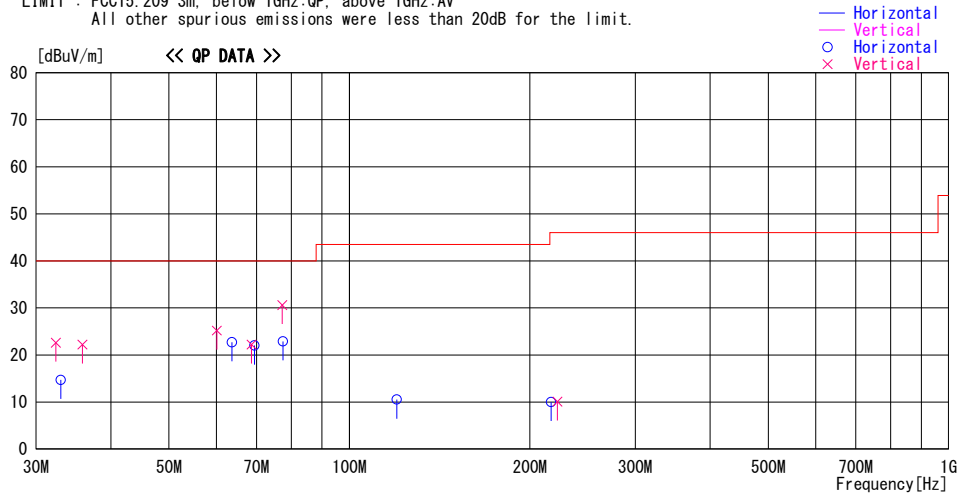
Facsimile : +81 596 24 8124

Radiated Emission above 30 MHz (Spurious Emission)

Trunk Antenna

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:AV
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	Margin	Comment
			Factor [dB/m]	Gain [dB]					[dBuV/m]	[dB]	
32.370	30.0	QP	17.7	-25.1	22.6	58	100	Vert.	40.0	17.4	
33.000	22.3	QP	17.5	-25.1	14.7	124	400	Hori.	40.0	25.3	
35.870	30.8	QP	16.5	-25.1	22.2	156	100	Vert.	40.0	17.8	
60.110	41.9	QP	7.9	-24.6	25.2	178	100	Vert.	40.0	14.8	
63.700	40.2	QP	7.0	-24.5	22.7	203	369	Hori.	40.0	17.3	
68.670	40.1	QP	6.5	-24.4	22.2	256	100	Vert.	40.0	17.8	
69.445	40.0	QP	6.4	-24.4	22.0	321	400	Hori.	40.0	18.0	
77.500	40.5	QP	6.7	-24.3	22.9	145	400	Hori.	40.0	17.1	
77.290	48.2	QP	6.7	-24.3	30.6	223	100	Vert.	40.0	9.4	
120.000	21.5	QP	12.8	-23.8	10.5	123	300	Hori.	43.5	33.0	
217.000	21.5	QP	11.2	-22.7	10.0	0	200	Hori.	46.0	36.0	
222.500	21.5	QP	11.3	-22.7	10.1	0	100	Vert.	46.0	35.9	

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 & GAIN (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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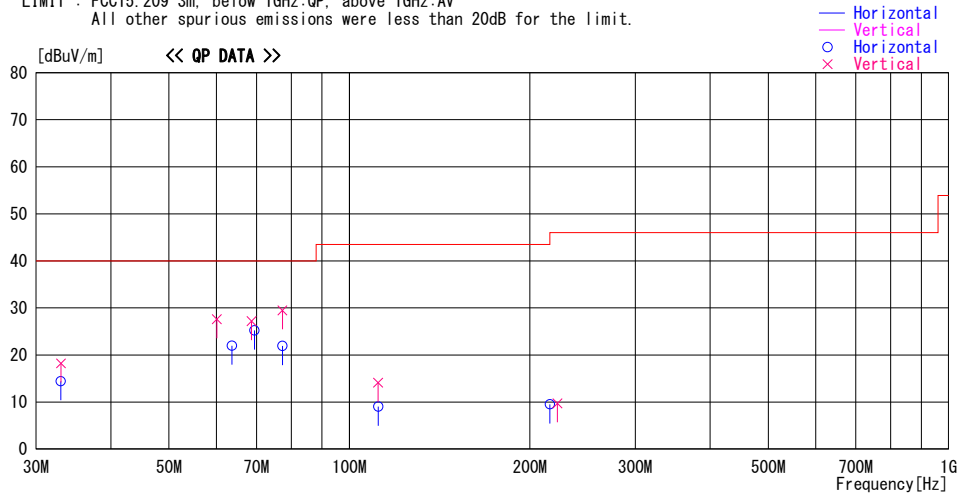
Facsimile : +81 596 24 8124

Radiated Emission above 30 MHz (Spurious Emission)

Room Antenna / Luggage Antenna Maximum Output

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:AV
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]	
33.000	22.0	QP	17.5	-25.1	14.4	123	400	Hori.	40.0	25.6	
33.020	25.8	QP	17.5	-25.1	18.2	58	100	Vert.	40.0	21.8	
63.700	39.5	QP	7.0	-24.5	22.0	234	325	Hori.	40.0	18.1	
60.110	44.3	QP	7.9	-24.6	27.6	145	100	Vert.	40.0	12.4	
69.430	43.2	QP	6.4	-24.4	25.2	224	300	Hori.	40.0	14.8	
68.680	45.1	QP	6.5	-24.4	27.2	234	100	Vert.	40.0	12.8	
77.355	39.5	QP	6.7	-24.3	21.9	211	235	Hori.	40.0	18.1	
77.310	47.1	QP	6.7	-24.3	29.5	231	100	Vert.	40.0	10.5	
111.764	21.0	QP	11.9	-23.9	9.0	121	300	Hori.	43.5	34.5	
111.640	26.1	QP	11.9	-23.9	14.1	123	100	Vert.	43.5	29.4	
216.032	21.0	QP	11.2	-22.7	9.5	0	200	Hori.	46.0	36.5	
222.445	21.1	QP	11.3	-22.7	9.7	0	100	Vert.	46.0	36.3	

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 & GAIN (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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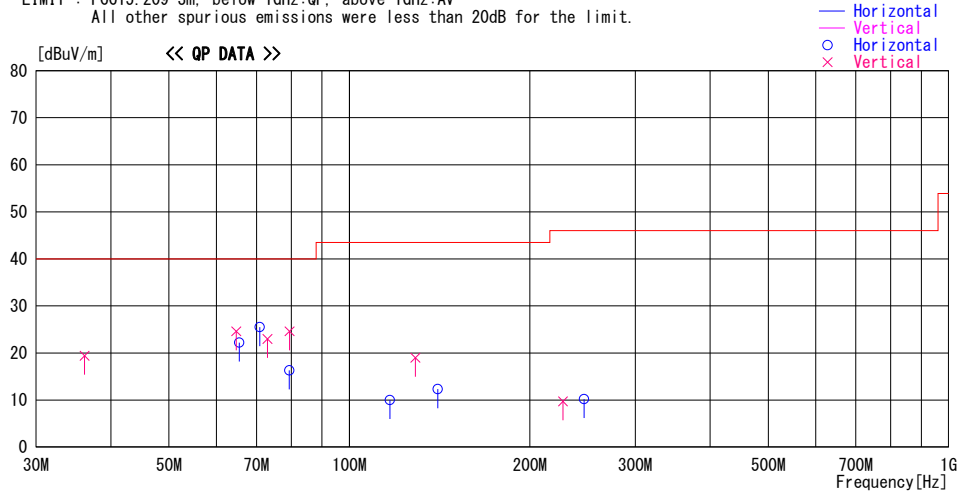
Facsimile : +81 596 24 8124

Radiated Emission above 30 MHz (Spurious Emission)

Room Antenna / Luggage Antenna Minimum Output

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:AV
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	Margin	Comment
			Factor [dB/m]	Gain [dB]					[dBuV/m]	[dB]	
36.151	28.1	QP	16.4	-25.1	19.4	231	100	Vert.	40.0	20.6	
64.770	42.3	QP	6.8	-24.5	24.6	278	100	Vert.	40.0	15.4	
65.500	40.0	QP	6.7	-24.5	22.2	342	300	Hori.	40.0	17.8	
70.860	43.6	QP	6.3	-24.4	25.5	178	400	Hori.	40.0	14.5	
73.000	41.1	QP	6.3	-24.4	23.0	123	100	Vert.	40.0	17.0	
79.399	33.7	QP	6.9	-24.3	16.3	213	219	Hori.	40.0	23.7	
79.456	42.0	QP	6.9	-24.3	24.6	279	100	Vert.	40.0	15.4	
116.874	21.3	QP	12.5	-23.8	10.0	0	100	Hori.	43.5	33.5	
128.840	28.9	QP	13.8	-23.7	19.0	123	100	Vert.	43.5	24.5	
140.381	21.3	QP	14.6	-23.6	12.3	0	100	Hori.	43.5	31.2	
227.255	20.9	QP	11.4	-22.6	9.7	0	100	Vert.	46.0	36.3	
246.493	20.9	QP	11.8	-22.5	10.2	0	100	Hori.	46.0	35.8	

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 & GAIN (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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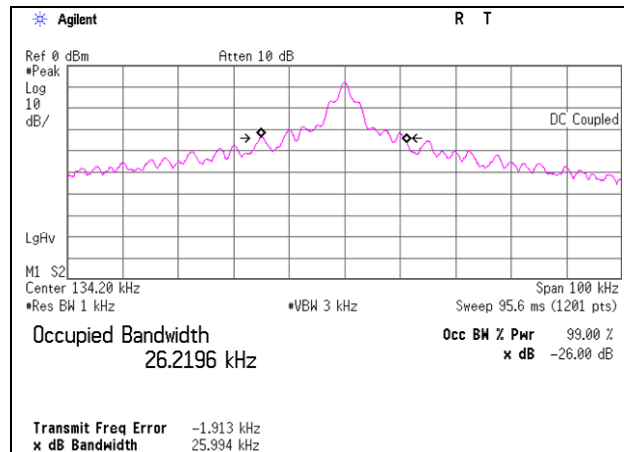
Facsimile : +81 596 24 8124

-26dB Bandwidth and 99% Occupied Bandwidth
Door Antenna

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

-26 dB Bandwidth
[kHz]
25.994

99% Occupied Bandwidth
[kHz]
26.2196

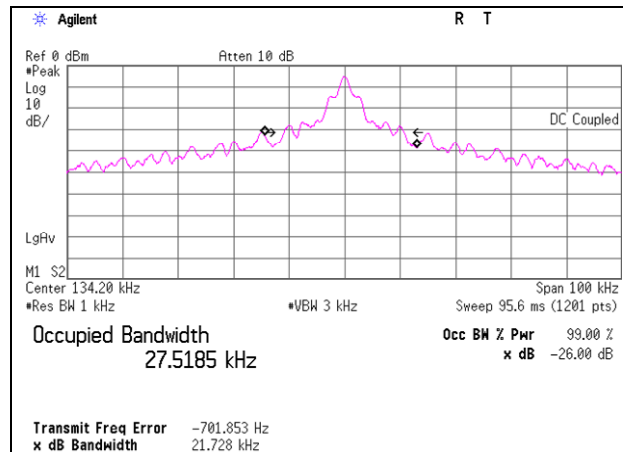


-26dB Bandwidth and 99% Occupied Bandwidth
Trunk Antenna

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 12496785H
Date : 10/22/2018
Temperature/ Humidity : 21 deg. C / 53 % RH
Engineer : Akihiko Maeda
Mode : Tx 134.2 kHz

-26 dB Bandwidth
[kHz]
21.728

99% Occupied Bandwidth
[kHz]
27.5185

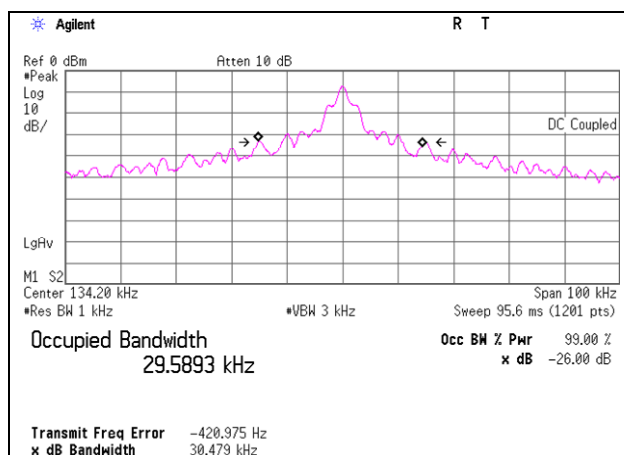


-26dB Bandwidth and 99% Occupied Bandwidth
Room Antenna / Luggage Antenna Maximum Output

Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. 12496785H
Date 10/22/2018
Temperature/ Humidity 21 deg. C / 53 % RH
Engineer Akihiko Maeda
Mode Tx 134.2 kHz

-26 dB Bandwidth
[kHz]
30.479

99% Occupied Bandwidth
[kHz]
29.5893

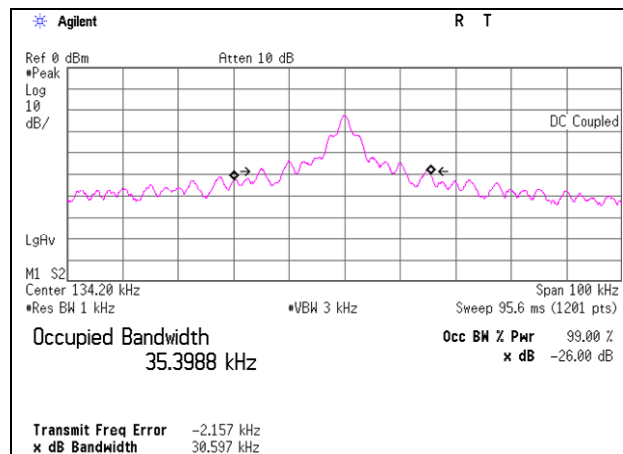


-26dB Bandwidth and 99% Occupied Bandwidth
Room Antenna / Luggage Antenna Minimum Output

Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. 12496785H
Date 10/22/2018
Temperature/ Humidity 21 deg. C / 53 % RH
Engineer Akihiko Maeda
Mode Tx 134.2 kHz

-26 dB Bandwidth
[kHz]
30.597

99% Occupied Bandwidth
[kHz]
35.3988



APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	8/6/2018	8/31/2019	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	142152	Loop Antenna	Rohde & Schwarz	HFH2-Z2	836553/009	11/22/2017	11/30/2018	12
RE	142183	Measure	KOMELON	KMC-36	-	-	-	-
RE	142008	AC3_Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	6/26/2018	6/30/2020	24
RE	141554	Thermo-Hygrometer	CUSTOM	CTH-180	1301	1/24/2018	1/31/2019	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	1/9/2018	1/31/2019	12
RE	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/sucoform141-PE/421-010	-/00640	7/3/2018	7/31/2019	12
RE	148897	Attenuator	KEYSIGHT	8491A	MY52462349	12/18/2017	12/31/2018	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	2/27/2018	2/28/2019	12
RE	141900	Spectrum Analyzer	AGILENT	E4440A	MY46185823	11/16/2017	11/30/2018	12
RE	159670	Coaxial Cable	UL Japan Inc.	-	-	11/9/2017	11/30/2018	12
RE	141266	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	6/4/2018	6/30/2019	12
RE	141323	Coaxial cable	UL Japan	-	-	7/3/2018	7/31/2019	12
RE	141424	Biconical Antenna	Schwarzbeck	BBA9106	1915	6/4/2018	6/30/2019	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.

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