



RADIO TEST REPORT

Test Report No. : 11891919H-R1

Applicant : SUBARU CORPORATION
Type of Equipment : Keyless Access System
Model No. : FJ18-1
FCC ID : Y8PFJ18-1
Test regulation : FCC Part 15 Subpart C: 2017
Test Result : Complied

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
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 11891919H. 11891919H is replaced with this report.

Date of test: July 31 and August 1, 2017

Representative test engineer:

Shinya Watanabe

Engineer

Consumer Technology Division

Approved by:

Motoya Imura

Engineer

Consumer Technology Division



NVLAP LAB CODE: 200572-0

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.

*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://japan.ul.com/resources/emc_accredited/

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

13-EM-F0429

REVISION HISTORY

Original Test Report No.: 11891919H

[illegible]

CONTENTS	PAGE
SECTION 1: Customer information	4
SECTION 2: Equipment under test (E.U.T.).....	4
SECTION 3: Test specification, procedures & results	5
SECTION 4: Operation of E.U.T. during testing.....	8
SECTION 5: Radiated emission (Fundamental and Spurious Emission).....	10
SECTION 6: -26dB Bandwidth.....	12
SECTION 7: 99% Occupied Bandwidth.....	12
APPENDIX 1: Test data	13
Radiated Emission below 30 MHz (Fundamental and Spurious Emission)	13
Radiated Emission above 30 MHz (Spurious Emission).....	18
-26 dB Bandwidth and 99 % Occupied Bandwidth	22
APPENDIX 2: Test instruments	25
APPENDIX 3: Photographs of test setup	26
Radiated Emission.....	26
Worst Case Position	27

SECTION 1: Customer information

Company Name	:	SUBARU CORPORATION
Address	:	1-1, Subaru-cho, ota-shi, Gunma-ken, 373-8555, Japan
Telephone Number	:	+81-276-26-3064
Facsimile Number	:	+81-276-26-3878
Contact Person	:	Yuji Kobayashi

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

2.1 Identification of E.U.T.

Type of Equipment	:	Keyless Access System
Model No.	:	FJ18-1
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12.0 V
Receipt Date of Sample	:	July 27, 2017
Country of Mass-production	:	Japan
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

Model No: FJ18-1 (referred to as the EUT in this report) is the Keyless Access System.

General Specification

Clock frequencies in the system	:	4.000 MHz (CPU)
---------------------------------	---	-----------------

Radio Specification

[Transmitter]

Radio Type	:	Transmitter
Frequency of Operation	:	134.2 kHz
Oscillator Frequency	:	4.2944 MHz
Type of Modulation	:	OOK (A1D)
Oscillation circuit	:	Crystal
Power Supply	:	DC 12.0 V
Antenna	:	Antenna (TYPE 1) (*1) (*3) / (TYPE 2) (*2) *1) Maximum number of this antenna is 2. *2) Maximum number of this antenna is 5.
Antenna Specification	:	Ferrite antenna coil

[Receiver]

Radio Type	:	Receiver
Frequency of Operation	:	433.92 MHz
Oscillator frequency	:	52.9025 MHz (Crystal)
Intermediate frequency	:	10.7 MHz
Type of Modulation	:	FSK
Type of receiving system	:	Super-heterodyne
Power Supply	:	DC 5.0 V
Antenna Type	:	Internal antenna (Inverted F antenna)

*3) The Antenna (TYPE 1) of this system has variations of model 1 and model 2.

The difference of these variations is only the outer shell, and the test was performed with the representative model 1.

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

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on November 2, 2017

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.209 Radiated emission limits; general requirements.

* The revision on November 2, 2017, does not affect the test specification applied to the EUT.

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 4.4 RSS-Gen 8.9	Radiated	N/A	9.9 dB 134.2 kHz 0 deg. PK with Duty factor Antenna(Type2)_No.4	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 4.4 RSS-Gen 8.9	Radiated	N/A	10.3 dB 67.098 MHz Horizontal, QP	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 Part 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.

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

3.3 Addition to standard

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99 % Occupied Band Width	RSS-Gen 6.6	-	Radiated	N/A	N/A	N/A

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

3.4 Uncertainty

EMI

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

Test 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	5.0 dB	5.3 dB	5.0 dB	5.0 dB
Vertical	5.2 dB	6.3 dB	5.0 dB	5.0 dB

Radiated emission test(10 m)

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

3.5 Test Location

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
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	N/A	-	-
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 2.0 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.

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

4.1 Operating Modes

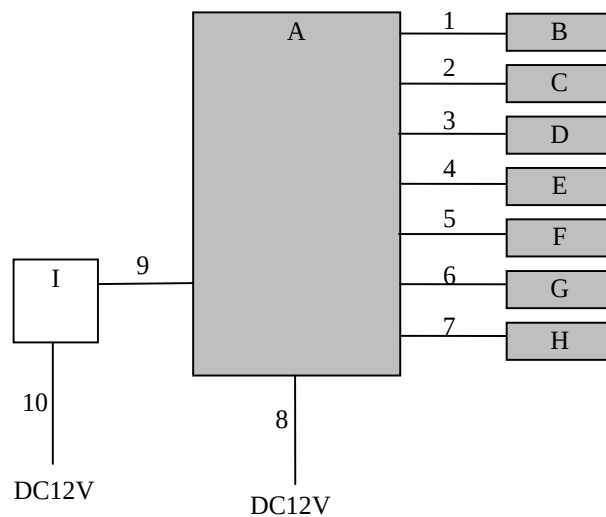
The mode is used : Transmitting mode (Tx) 134.2 kHz
* LF output power is controlled by Smart ECU.

Test mode	Remarks
1) Tx 134.2 kHz Antenna(Type 1) No.1	-
2) Tx 134.2 kHz Antenna(Type 2) No.4	-
3) Tx 134.2 kHz Antenna(Type1)No.1 + (Type1)No.2 + (Type2)No.5	*
4) Tx 134.2 kHz Antenna(Type2)No.1	-

*By specification, Antenna (Type2)No.5 can be only transmitted simultaneously with “Antenna(Type1)No.1 + (Type1)No.2” .

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.

*This system has two kinds (Type1 and Type2) of antenna ports.

- Type 1 has two ports.

There was no difference of the output power of these antenna ports.

- Type 2 has five ports.

The difference of output power of these antenna ports are follows;

Antenna port	Output power	Remarks
No.1	minimum	INSIDE
No.2	minimum	INSIDE
No.3	minimum	INSIDE
No.4	maximum	BUMPER
No.5	middle	LID

* Antenna (Type 1) and Antenna (Type 2) were evaluated with the worst duty respectively.
Worst duty does not change due to the difference in number of connected antenna.

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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Smart ECU	-	001 *1) 002 *2)	-	EUT
B	Antenna (TYPE 1)_No.1	-	G1087 7F05 2	-	EUT
C	Antenna (TYPE 1)_No.2	-	G1087 7F05 3	-	EUT
D	Antenna (TYPE 2) _No.1	-	8RA-62	-	EUT
E	Antenna (TYPE 2) _No.2	-	8RA-63	-	EUT
F	Antenna (TYPE 2) _No.3	-	8RA-64	-	EUT
G	Antenna (TYPE 2) _No.4	-	8RA-65	-	EUT
H	Antenna (TYPE 2) _No.5	-	8RA-66	-	EUT
I	Switch BOX	-	-	-	-

*1) Used except for the simultaneous transmission of three antennas

*2) Used for the simultaneous transmission of three antennas

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Antenna (TYPE 1) Cable	3.0	Unshielded	Unshielded	-
2	Antenna (TYPE 1) Cable	3.0	Unshielded	Unshielded	-
3	Antenna (TYPE 2) Cable	3.0	Unshielded	Unshielded	-
4	Antenna (TYPE 2) Cable	3.0	Unshielded	Unshielded	-
5	Antenna (TYPE 2) Cable	3.0	Unshielded	Unshielded	-
6	Antenna (TYPE 2) Cable	3.0	Unshielded	Unshielded	-
7	Antenna (TYPE 2) Cable	3.0	Unshielded	Unshielded	-
8	DC Cable	3.0	Unshielded	Unshielded	-
9	Signal Cable	3.0	Unshielded	Unshielded	-
10	DC Cable	3.0	Unshielded	Unshielded	-

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

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	10 m *1)	10 m *1)	10 m *1)	10 m *2)	3 m

*1) Distance Factor: $40 \times \log(10 \text{ m} / 300 \text{ m}) = -59 \text{ dB}$

*2) Distance Factor: $40 \times \log(10 \text{ m} / 30 \text{ m}) = -19 \text{ dB}$

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.

- 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: July 31, 2017
August 1, 2017

Test engineer: Koji Yamamoto
Shinya Watanabe

UL Japan, Inc.

Ise EMC Lab.

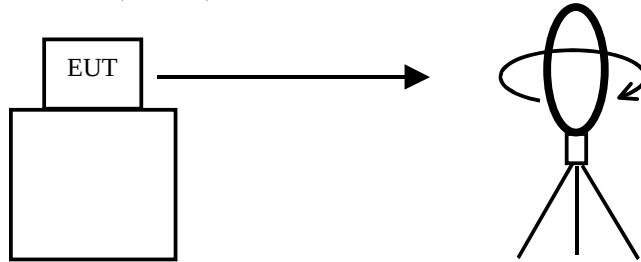
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

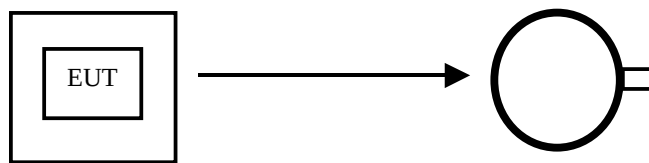
Facsimile : +81 596 24 8124

Figure 1: Direction of the Loop Antenna

Side View (Vertical)



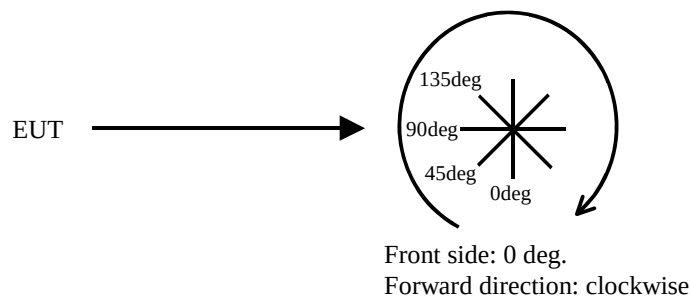
.....
Top View (Horizontal)



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	200 kHz	2 kHz	6.2 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) Antenna (Type1)No.1

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Order No. : 11891919H
Date : 07/31/2017
Temperature/ Humidity : 22 deg. C / 59 % RH
Engineer : Koji Yamamoto
Mode : Tx 134.2 kHz, Antenna (Type1)_No.1

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	69.5	19.7	-53.0	32.2	-	4.0	45.0	41.0	Fundamental
0	0.26840	PK	41.9	19.6	-53.0	32.2	-	-23.7	39.0	62.7	
0	0.40260	PK	47.6	19.6	-52.9	32.1	-	-17.8	35.5	53.3	
0	0.53680	QP	32.6	19.5	-12.9	32.1	-	7.1	33.0	25.9	
0	0.67100	QP	35.0	19.5	-12.9	32.2	-	9.4	31.1	21.7	
0	0.80520	QP	31.5	19.5	-12.9	32.2	-	5.9	29.5	23.6	
0	0.93940	QP	31.7	19.5	-12.8	32.2	-	6.2	28.1	21.9	
0	1.07360	QP	31.1	19.5	-12.8	32.2	-	5.6	26.9	21.3	
0	1.20780	QP	31.0	19.5	-12.8	32.2	-	5.5	25.9	20.4	
0	1.34200	QP	30.8	19.5	-12.8	32.2	-	5.3	25.0	19.7	

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	69.5	19.7	-53.0	32.2	0.0	4.0	25.0	21.0	
0	0.26840	PK	41.9	19.6	-53.0	32.2	0.0	-23.7	19.0	42.7	
0	0.40260	PK	47.6	19.6	-52.9	32.1	0.0	-17.8	15.5	33.3	

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 10 m 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	69.5	19.7	6.0	32.2	-	63.0	-	-	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) Antenna (Type2)No.4

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Order No. : 11891919H
Date : 07/31/2017
Temperature/ Humidity : 22 deg. C / 59 % RH
Engineer : Koji Yamamoto
Mode : Tx 134.2 kHz, Antenna (Type2)_No.4

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	80.6	19.7	-53.0	32.2	-	15.1	45.0	29.9	Fundamental
0	0.26840	PK	42.3	19.6	-53.0	32.2	-	-23.3	39.0	62.3	
0	0.40260	PK	41.8	19.6	-52.9	32.1	-	-23.6	35.5	59.1	
0	0.53680	QP	32.6	19.5	-12.9	32.1	-	7.1	33.0	25.9	
0	0.67100	QP	32.3	19.5	-12.9	32.2	-	6.7	31.1	24.4	
0	0.80520	QP	31.6	19.5	-12.9	32.2	-	6.0	29.5	23.5	
0	0.93940	QP	31.4	19.5	-12.8	32.2	-	5.9	28.1	22.2	
0	1.07360	QP	31.1	19.5	-12.8	32.2	-	5.6	26.9	21.3	
0	1.20780	QP	31.1	19.5	-12.8	32.2	-	5.6	25.9	20.3	
0	1.34200	QP	30.9	19.5	-12.8	32.2	-	5.4	25.0	19.6	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	80.6	19.7	-53.0	32.2	0.0	15.1	25.0	9.9	
0	0.26840	PK	42.3	19.6	-53.0	32.2	0.0	-23.3	19.0	42.3	
0	0.40260	PK	41.8	19.6	-52.9	32.1	0.0	-23.6	15.5	39.1	

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 10 m 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	80.6	19.7	6.0	32.2	-	74.1	-	-	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.

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 30 MHz (Fundamental and Spurious Emission) **Antenna (Type1)No.1 + (Type1)No.2 + (Type2)No.5**

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Order No. : 11891919H
Date : 07/31/2017
Temperature/ Humidity : 22 deg. C / 59 % RH
Engineer : Koji Yamamoto
Mode : Tx 134.2 kHz, Antenna (Type1)_No.1 + No.2 + (Type2)_No.5

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	75.1	19.7	-53.0	32.2	-	9.6	45.0	35.4	Fundamental
0	0.26840	PK	48.2	19.6	-53.0	32.2	-	-17.4	39.0	56.4	
0	0.40260	PK	51.2	19.6	-52.9	32.1	-	-14.2	35.5	49.7	
0	0.53680	QP	32.7	19.5	-12.9	32.1	-	7.2	33.0	25.8	
0	0.67100	QP	34.8	19.5	-12.9	32.2	-	9.2	31.1	21.9	
0	0.80520	QP	31.5	19.5	-12.9	32.2	-	5.9	29.5	23.6	
0	0.93940	QP	31.5	19.5	-12.8	32.2	-	6.0	28.1	22.1	
0	1.07360	QP	31.0	19.5	-12.8	32.2	-	5.5	26.9	21.4	
0	1.20780	QP	31.2	19.5	-12.8	32.2	-	5.7	25.9	20.2	
0	1.34200	QP	30.9	19.5	-12.8	32.2	-	5.4	25.0	19.6	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	75.1	19.7	-53.0	32.2	0.0	9.6	25.0	15.4	
0	0.26840	PK	48.2	19.6	-53.0	32.2	0.0	-17.4	19.0	36.4	
0	0.40260	PK	51.2	19.6	-52.9	32.1	0.0	-14.2	15.5	29.7	

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 10 m 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	75.1	19.7	6.0	32.2	-	68.6	-	-	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.

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 30 MHz (Fundamental and Spurious Emission) Antenna (Type2)No.1

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber
Order No. : 11891919H
Date : 07/31/2017
Temperature/ Humidity : 22 deg. C / 59 % RH
Engineer : Koji Yamamoto
Mode : Tx 134.2 kHz, Antenna (Type2)_No.1

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	56.3	19.7	-53.0	32.2	-	-9.2	45.0	54.2	Fundamental
0	0.26840	PK	41.9	19.6	-53.0	32.2	-	-23.7	39.0	62.7	
0	0.40260	PK	40.1	19.6	-52.9	32.1	-	-25.3	35.5	60.8	
0	0.53680	QP	32.5	19.5	-12.9	32.1	-	7.0	33.0	26.0	
0	0.67100	QP	32.0	19.5	-12.9	32.2	-	6.4	31.1	24.7	
0	0.80520	QP	31.5	19.5	-12.9	32.2	-	5.9	29.5	23.6	
0	0.93940	QP	31.2	19.5	-12.8	32.2	-	5.7	28.1	22.4	
0	1.07360	QP	31.0	19.5	-12.8	32.2	-	5.5	26.9	21.4	
0	1.20780	QP	31.0	19.5	-12.8	32.2	-	5.5	25.9	20.4	
0	1.34200	QP	30.9	19.5	-12.8	32.2	-	5.4	25.0	19.6	

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

PK with Duty factor

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	56.3	19.7	-53.0	32.2	0.0	-9.2	25.0	34.2	
0	0.26840	PK	41.9	19.6	-53.0	32.2	0.0	-23.7	19.0	42.7	
0	0.40260	PK	40.1	19.6	-52.9	32.1	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 10 m 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	56.3	19.7	6.0	32.2	-	49.8	-	-	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.

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

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2017/07/31

Report No. : 11891919H
Temp./Humi. : 22 deg. C / 59 % RH
Engineer : Koji Yamamoto

Mode / Remarks : Tx 125.0kHz Antenna(Type2)_No.4, Worst-Axis (Ant: X / ECU: X)

LIMIT : FCC15.209(a), 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15.209(a), 9-90kHz:AV, 110-490kHz:AV, other:QP

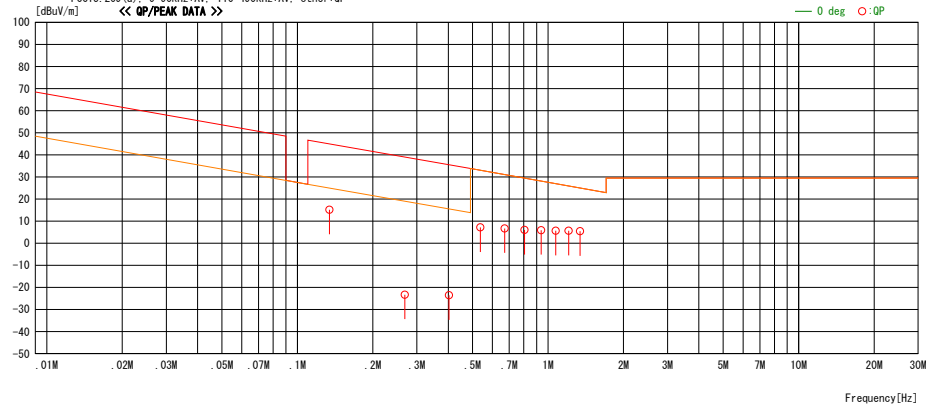


CHART: WITH FACTOR, ANT TYPE: LOOP, Except for the data below, adequate margin data below the limits.
CALCULATION: RESULT = READING + ANT FACTOR + LOSS(CABLE + ATTEN) - GAIN(AMP)

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

Radiated Emission above 30 MHz (Spurious Emission) Antenna (Type1)No.1

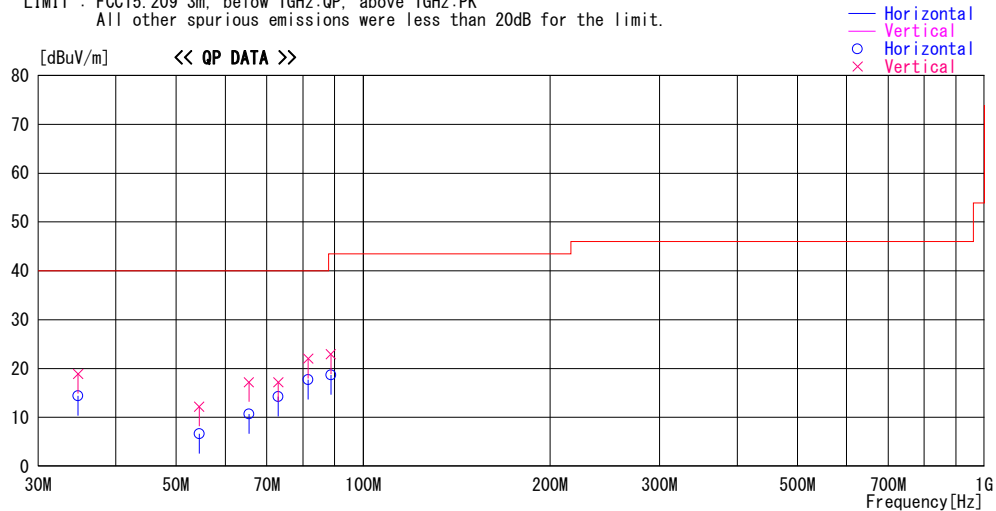
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2017/08/01

Report No. : 11891919H
Power : DC 12.0V
Temp./Humi. : 22 deg. C / 61 % RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz Antenna Type1 No.1 Worst Axis

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
All other spurious emissions were less than 20dB for the limit.



Frequency [MHz]	Reading [dBuV]	DET	Antenna		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss& Gain [dB]							
34.770	29.6	QP	16.1	-31.3	14.4	0	300	Hori.	40.0	25.6	
34.770	34.1	QP	16.1	-31.3	18.9	67	100	Vert.	40.0	21.1	
54.507	28.5	QP	9.1	-31.0	6.6	0	329	Hori.	40.0	33.4	
54.507	34.1	QP	9.1	-31.0	12.2	0	100	Vert.	40.0	27.8	
65.486	34.8	QP	6.7	-30.8	10.7	0	344	Hori.	40.0	29.3	
65.486	41.3	QP	6.7	-30.8	17.2	220	211	Vert.	40.0	22.8	
73.006	38.5	QP	6.3	-30.6	14.2	157	294	Hori.	40.0	25.8	
73.006	41.5	QP	6.3	-30.6	17.2	274	100	Vert.	40.0	22.8	
81.605	41.2	QP	7.0	-30.5	17.7	210	344	Hori.	40.0	22.3	
81.605	45.5	QP	7.0	-30.5	22.0	257	100	Vert.	40.0	18.0	
88.738	41.0	QP	8.2	-30.5	18.7	357	204	Hori.	43.5	24.8	
88.738	45.2	QP	8.2	-30.5	22.9	271	100	Vert.	43.5	20.6	

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

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

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 above 30 MHz (Spurious Emission) Antenna (Type2)No.4

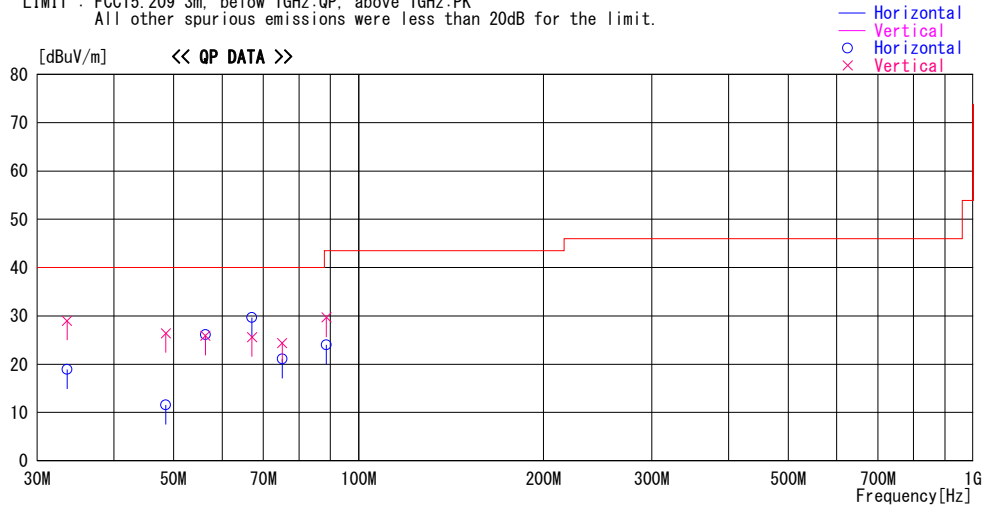
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2017/08/01

Report No. : 11891919H
Power : DC 12.0V
Temp./Humi. : 22 deg. C / 61 % RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz Antenna Type2 No.4 Worst Axis

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
All other spurious emissions were less than 20dB for the limit.



Frequency	Reading	DET	Antenna		Level	Angle	Height	Polar.	Limit	Margin	Comment
			Factor	Gain							
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
33.547	33.7	QP	16.6	-31.4	18.9	0	377	Hori.	40.0	21.1	
33.547	43.8	QP	16.6	-31.4	29.0	277	100	Vert.	40.0	11.0	
48.579	31.6	QP	11.1	-31.1	11.6	0	280	Hori.	40.0	28.5	
48.579	46.4	QP	11.1	-31.1	26.4	281	100	Vert.	40.0	13.6	
56.363	48.5	QP	8.5	-30.9	26.1	23	300	Hori.	40.0	13.9	
56.363	48.3	QP	8.5	-30.9	25.9	256	100	Vert.	40.0	14.1	
67.098	53.9	QP	6.5	-30.7	29.7	0	386	Hori.	40.0	10.3	
67.098	49.8	QP	6.5	-30.7	25.6	275	100	Vert.	40.0	14.4	
75.150	45.3	QP	6.4	-30.6	21.1	326	259	Hori.	40.0	18.9	
75.150	48.6	QP	6.4	-30.6	24.4	0	100	Vert.	40.0	15.6	
88.670	46.3	QP	8.2	-30.5	24.0	0	350	Hori.	43.5	19.5	
88.670	52.0	QP	8.2	-30.5	29.7	273	100	Vert.	43.5	13.8	

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

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

Radiated Emission above 30 MHz (Spurious Emission) Antenna (Type1)No.1 + (Type1)No.2 + (Type2)No.5

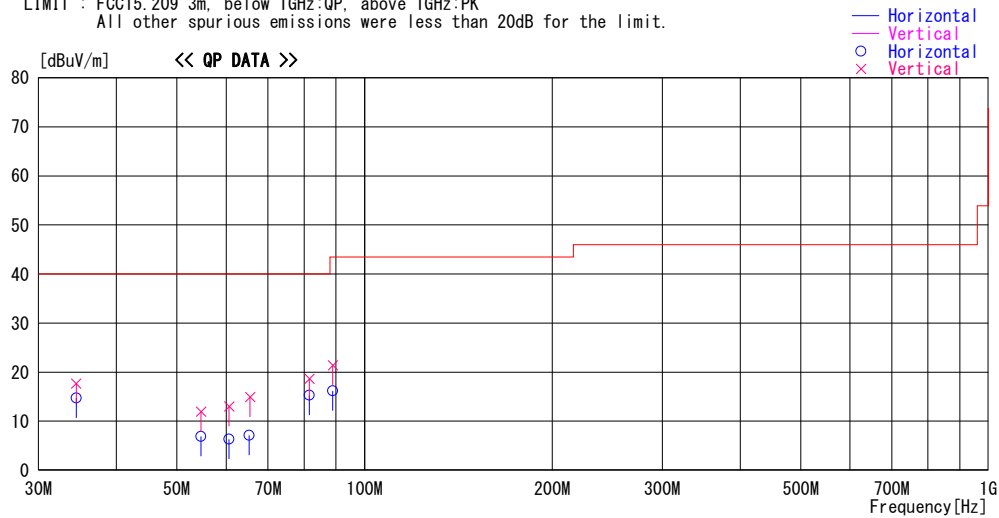
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber
Date : 2017/08/01

Report No. : 11891919H
Power : DC 12.0V
Temp./Humi. : 22 deg. C / 61 % RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz Antenna Type1 No.1 + Type1 No.2 + Type2 No.5 Worst Axis

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
All other spurious emissions were less than 20dB for the limit.



Frequency	Reading	DET	Antenna Factor	Loss & Gain	Level	Angle	Height	Polar.	Limit	Margin	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
34.492	29.8	QP	16.2	-31.3	14.7	210	289	Hori.	40.0	25.3	
34.492	32.8	QP	16.2	-31.3	17.7	113	100	Vert.	40.0	22.3	
54.688	28.9	QP	9.0	-31.0	6.9	0	300	Hori.	40.0	33.1	
54.688	33.9	QP	9.0	-31.0	11.9	0	100	Vert.	40.0	28.1	
60.656	29.8	QP	7.3	-30.8	6.3	230	278	Hori.	40.0	33.7	
60.656	36.5	QP	7.3	-30.8	13.0	255	100	Vert.	40.0	27.0	
65.349	31.2	QP	6.7	-30.8	7.1	0	324	Hori.	40.0	32.9	
65.549	39.1	QP	6.6	-30.8	14.9	0	100	Vert.	40.0	25.1	
81.584	38.8	QP	7.0	-30.5	15.3	0	286	Hori.	40.0	24.7	
81.584	42.1	QP	7.0	-30.5	18.6	252	100	Vert.	40.0	21.4	
88.938	38.5	QP	8.2	-30.5	16.2	326	323	Hori.	43.5	27.3	
88.938	43.7	QP	8.2	-30.5	21.4	225	100	Vert.	43.5	22.1	

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

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

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 above 30 MHz (Spurious Emission) Antenna (Type2)No.1

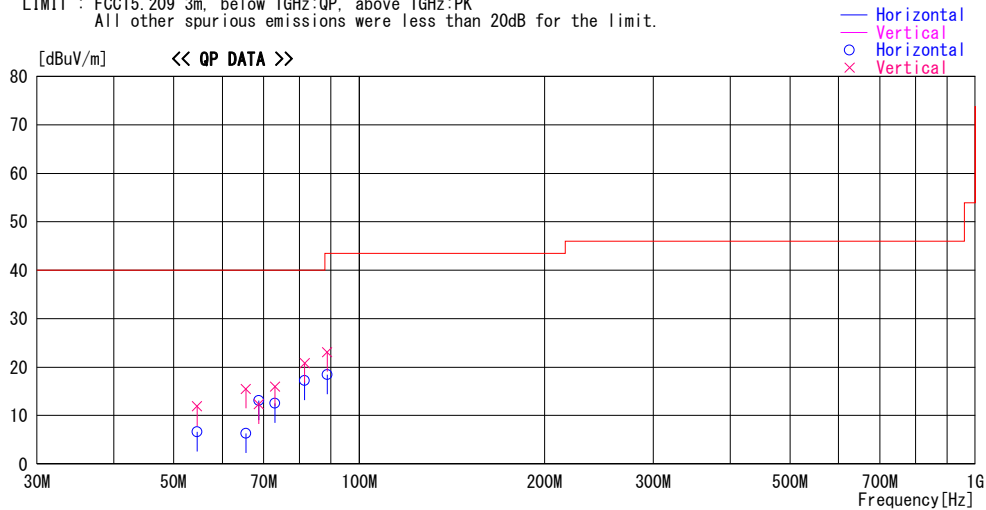
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No. 1 Semi Anechoic Chamber
Date : 2017/08/01

Report No. : 11891919H
Power : DC 12.0V
Temp./Humi. : 22 deg. C / 61 % RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz Antenna Type2 No.1 Worst Axis

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
All other spurious emissions were less than 20dB for the limit.



Frequency	Reading	DET	Antenna		Level	Angle	Height	Polar.	Limit	Margin	Comment
			Factor	Gain							
[MHz]	[dBuV]		[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]		[dBuV/m]	[dB]	
54.550	28.5	QP	9.1	-31.0	6.6	284	300	Hori.	40.0	33.4	
54.550	33.8	QP	9.1	-31.0	11.9	0	100	Vert.	40.0	28.1	
65.509	30.4	QP	6.7	-30.8	6.3	358	300	Hori.	40.0	33.7	
65.509	39.6	QP	6.7	-30.8	15.5	80	100	Vert.	40.0	24.5	
68.710	37.5	QP	6.3	-30.7	13.1	0	286	Hori.	40.0	26.9	
68.710	36.7	QP	6.3	-30.7	12.3	259	100	Vert.	40.0	27.7	
73.006	36.8	QP	6.3	-30.6	12.5	329	285	Hori.	40.0	27.5	
73.006	40.3	QP	6.3	-30.6	16.0	266	100	Vert.	40.0	24.0	
81.594	40.7	QP	7.0	-30.5	17.2	359	276	Hori.	40.0	22.8	
81.594	44.3	QP	7.0	-30.5	20.8	266	100	Vert.	40.0	19.2	
88.750	40.7	QP	8.2	-30.5	18.4	0	188	Hori.	43.5	25.1	
88.750	45.4	QP	8.2	-30.5	23.1	255	100	Vert.	43.5	20.4	

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

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

UL Japan, Inc.

Ise EMC Lab.

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

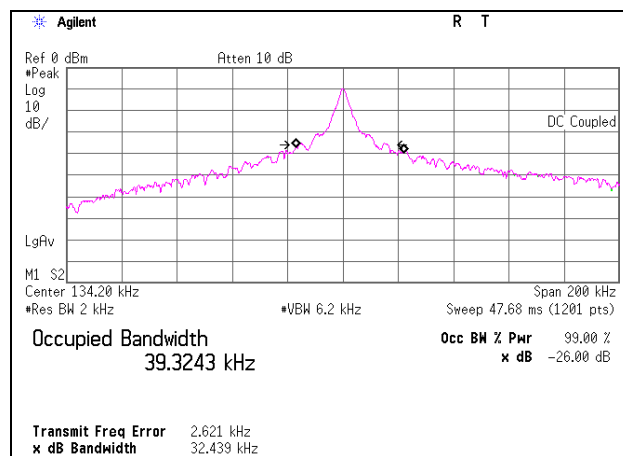
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

-26 dB Bandwidth and 99 % Occupied Bandwidth Antenna (Type1)No.1

Report No.	11891919H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	08/01/2017
Temperature / Humidity	22 deg. C / 61 % RH
Engineer	Shinya Watanabe
Mode	Tx 134.2 kHz Antenna Type 1

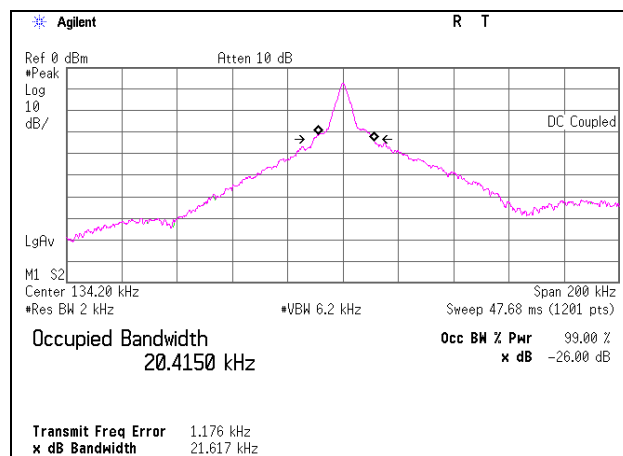
-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
32.439	39.3243



-26 dB Bandwidth and 99 % Occupied Bandwidth Antenna (Type2)No.4

Report No.	11891919H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	08/01/2017
Temperature / Humidity	22 deg. C / 61 % RH
Engineer	Shinya Watanabe
Mode	Tx 134.2 kHz Antenna Type 2

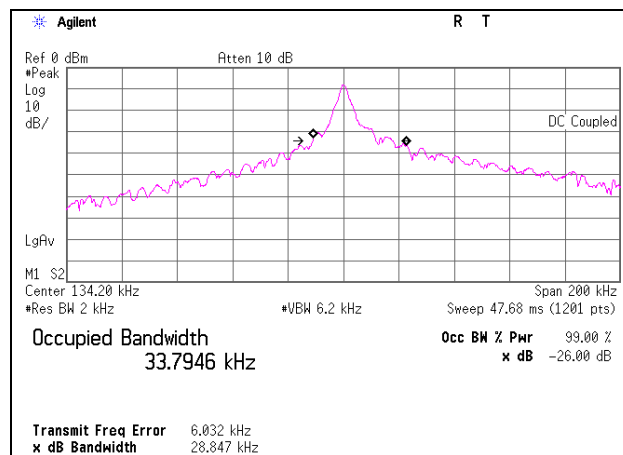
-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
21.617	20.4150



-26 dB Bandwidth and 99 % Occupied Bandwidth
Antenna (Type1)No.1 + (Type1)No.2 + (Type2)No.5

Report No.	11891919H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.1
Date	08/01/2017
Temperature / Humidity	22 deg. C / 61 % RH
Engineer	Shinya Watanabe
Mode	Tx 134.2 kHz Antenna Type 2

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
28.847	33.7946



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	2016/09/30 * 12
MOS-27	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	RE	2017/01/20 * 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	2017/06/27 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2016/10/14 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2017/06/12 * 12
MCC-03	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W(20m)/ 3D-2W(7.5m)/ RG400u(1.5m)/ RFM-E421(Switcher)	-/01068 (Switcher)	RE	2017/06/26 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2017/03/27 * 12
MAT-08	Attenuator(6dB)	Weinschel Corp	2	BK7971	RE	2016/11/28 * 12
MMM-03	Digital Tester	Fluke	FLUKE 26-3	78030621	RE	2016/08/23 * 12
KBA-05	Biconical Antenna	Schwarzbeck	BBA9106	2513	RE	2016/11/23 * 12
MLA-20	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-189	RE	2017/01/05 * 12
MCC-02	Coaxial Cable	Suhner/storm/Agilent/TSJ	-	-	RE	2016/09/09 * 12
MPA-19	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	RE	2017/02/08 * 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

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