RADIO TEST REPORT

Test Report No. : 12812711H-A-R2

Applicant	:	**SUBARU CORPORATION**
Type of Equipment	:	**Keyless Access with Push-Button Start System**
Model No.	:	**SU19S-1**
FCC ID	:	**Y8PSU19S-1**
Test regulation	:	**FCC Part 15 Subpart C: 2019**
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 12812711H-A-R1. 12812711H-A-R1 is replaced with this report.

Date of test: April 11 and May 13, 2019

Representative test engineer:
Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:
Motoya Imura
Leader
Consumer Technology Division

NVLAP LAB CODE: 200572-0

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☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

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

REVISION HISTORY

Original Test Report No.: 12812711H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	12812711H-A	May 28, 2019	-	-
1	12812711H-A-R1	June 20, 2019	P.1	Correction of Test regulation in cover page
1	12812711H-A-R1	June 20, 2019	P.6	Update of FCC version
1	12812711H-A-R1	June 20, 2019	P.20 to 23	Correction of calculating formula under the test data
1	12812711H-A-R1	June 20, 2019	P.21 to 23	Deletion of chart part
1	12812711H-A-R1	June 20, 2019	P.15 to 17	Correction of note sentence
1	12812711H-A-R1	June 20, 2019	P.20 to 23	Addition of the following sentence under the test data; * Other frequency noises omitted in this report were not seen or had enough margin (more than 20 dB).
2	12812711H-A-R2	June 25, 2019	P.6	Correction of the worst margin of Electric Field Strength of Fundamental Emission in clause 3.2
2	12812711H-A-R2	June 25, 2019	P.17	Correction of the PK with Duty factor data by duty factor change
2	12812711H-A-R2	June 25, 2019	P.23	Correction of chart of the plot data
2	12812711H-A-R2	June 25, 2019	P.24	Correction of Duty factor by changing to On Time per 100ms.

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

CONTENTS PAGE

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	:	Kenichi Hanamata

The information provided from the customer is as follows;
- Applicant, Type of Equipment, Model No. on the cover and other relevant pages
- SECTION 1: Customer information
- SECTION 2: Equipment under test (E.U.T.)
- SECTION 4: Operation of E.U.T. during testing

* The laboratory is exempted from liability of any test results affected from the above information in SECTION 2 and 4.

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

2.1 Identification of E.U.T.

Type of Equipment	:	Keyless Access with Push-Button Start System
Model No.	:	SU19S-1
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12.0 V
Receipt Date of Sample (Information from test lab.)	:	April 10, 2019
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: SU19S-1, (referred to as the EUT in this report), is the Keyless Access with Push-Button Start System.

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 4.
Antenna Specification	:	Ferrite antenna coil
Clock frequency (maximum)	:	8.000 MHz (CPU)

*3) The Antennas (TYPE 1) of this system have 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.

[Receiver]

Radio Type	:	Receiver
Frequency of Operation	:	433.92 MHz
Oscillator frequency	:	30.265 MHz (Crystal)
Intermediate frequency	:	280 kHz
Type of Modulation	:	FSK
Type of receiving system	:	Super-heterodyne
Power Supply	:	DC 5.0 V
Antenna Type	:	Internal antenna (Inverted F antenna)

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 limits Section 15.209 Radiated emission limits; general requirements.

* The revision on June 4, 2019, does not affect the test specification applied to the EUT.

* Also the EUT complies with FCC Part 15 Subpart B.

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 *1)	N/A
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	4.1 dB 134.2 kHz 0 deg. PK with Duty factor (Antenna Type 2 LUGGAGE 2)	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	7.90 dB 30.591 MHz, Vertical, QP (Antenna Type 1)	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 Part 15.31 (e)
The test was performed with the New Battery 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.

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

*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

Radiated emission (Above 1 GHz)				
(3 m*)(+/-)		(1 m*)(+/-)		(10 m*)(+/-)
1 GHz to 6 GHz	6 GHz to 18 GHz	10 GHz to 26.5 GHz	26.5 GHz to 40 GHz	1 GHz to 18 GHz
5.0 dB	5.3 dB	5.8 dB	5.8 dB	5.2 dB

* Measurement distance

Bandwidth
0.96 %

3.5 Test Location

UL Japan, Inc. Ise EMC Lab.
*NVLAP Lab. code: 200572-0 / FCC Test Firm Registration Number: 199967 / ISED Lab Company Number: 2973C
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone: +81 596 24 8999, Facsimile: +81 596 24 8124

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.

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

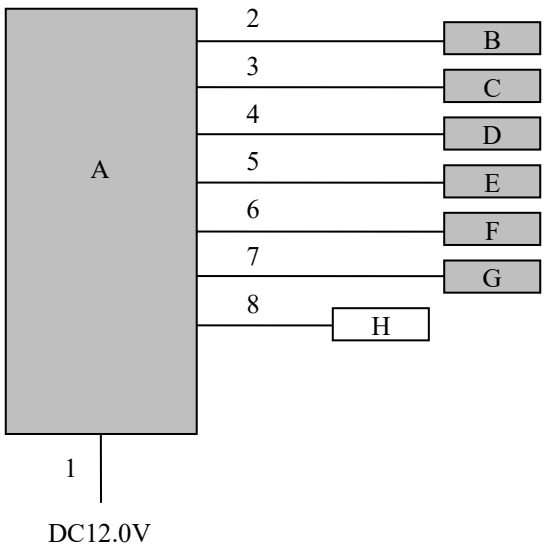
4.1 Operating Modes

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	-
2) Tx 134.2 kHz Antenna Type 2 INSIDE 1	-
3) Tx 134.2 kHz Antenna Type 2 LUGGAGE 2	-
4) Tx 134.2 kHz, Antenna Type 1 (No.1) + Type 1 (No.2)	simultaneous transmission (Antenna Type 1 (No.1) and Antenna Type 1(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 of antenna types.
- Two ports where Antenna (TYPE 1) are connected.
- Four ports where Antenna (2 for TYPE 2 INSIDE and 2 for TYPE 2 LUGGAGE) are connected.
- The difference between INSIDE 1 Antenna and LUGGAGE 2 Antenna is output power only.
The test was performed with each representative one of above three kinds of antenna ports.

* 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.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Keyless Access with Push-Button Start System	SU19S-1	SU19S-1-1 SU19S-1-32 *1)	SUBARU CORPORATION	EUT
B	Antenna	TYPE1 (No.1)	2DD0-25	SUBARU CORPORATION	EUT
C	Antenna	TYPE1 (No.2)	2DD0-26	SUBARU CORPORATION	EUT
D	Antenna	TYPE2 INSIDE 1	8RA-130	SUBARU CORPORATION	EUT
E	Antenna	TYPE2 INSIDE 2	8RA-129	SUBARU CORPORATION	EUT
F	Antenna	TYPE2 LUGGAGE 1	8RA-132	SUBARU CORPORATION	EUT
G	Antenna	TYPE2 LUGGAGE 2	8RA-131	SUBARU CORPORATION	EUT
H	Checker	-	001	SUBARU CORPORATION	-

*1) Simultaneous transmission with Type1 Antenna

List of cables used

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

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

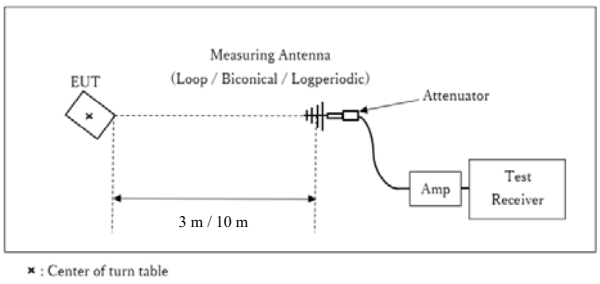
Frequency	From 9 kHz to 90 kHz and From 110 kHz to 150 kHz	From 90 kHz to 110 kHz	From 150 kHz to 490 kHz	From 490 kHz to 30 MHz	From 30 MHz to 1 GHz
Instrument used	Test Receiver				
Detector	PK / AV	QP	PK / AV	QP	QP
IF Bandwidth	200 Hz	200 Hz	9 kHz	9 kHz	120 kHz
Test Distance	3 m *1)	3 m *1)	3 m *1)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

*1) Distance Factor: 40 x log (3 m / 300 m) = -80 dB
*2) Distance Factor: 40 x log (3 m / 30 m) = -40 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



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.

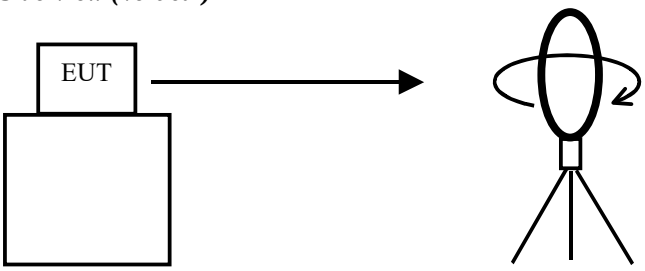
The test results and limit are rounded off to one decimal place, so some differences might be observed.

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

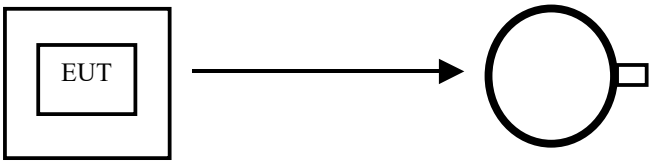
Date: April 11, 2019 Test engineer: Koji Yamamoto

Figure 1: Direction of the Loop Antenna

Side View (Vertical)

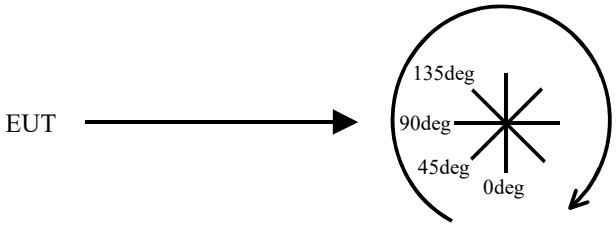


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

SECTION 6: -26dB Bandwidth

Test Procedure

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

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26 dB Bandwidth	200 kHz	1.8 kHz	5.6 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	Max Hold	Spectrum Analyzer
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 Type 1

Report No.	12812711H
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	04/11/2019
Temperature/ Humidity	21 deg. C / 38 % RH
Engineer	Koji Yamamoto
Mode	Tx 134.2 kHz, Antenna Type 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	100.8	19.7	-73.9	32.3	-	14.3	45.0	30.7	Fundamental
0	0.26840	PK	60.0	19.7	-73.9	32.3	-	-26.5	39.0	65.5	
0	0.40260	PK	75.3	19.6	-73.9	32.3	-	-11.2	35.5	46.7	
0	0.53680	QP	38.0	19.6	-33.9	32.2	-	-8.5	33.0	41.5	
0	0.67100	QP	62.7	19.6	-33.8	32.3	-	16.2	31.1	14.9	
0	0.80520	QP	36.6	19.6	-33.8	32.3	-	-9.9	29.5	39.4	
0	0.93940	QP	51.0	19.6	-33.8	32.3	-	4.5	28.1	23.6	
0	1.07360	QP	31.2	19.6	-33.8	32.3	-	-15.3	26.9	42.2	
0	1.20780	QP	43.1	19.6	-33.8	32.3	-	-3.4	25.9	29.3	
0	1.34200	QP	31.1	19.6	-33.8	32.3	-	-15.3	25.0	40.3	

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	100.8	19.7	-73.9	32.3	0.0	14.3	25.0	10.7	
0	0.26840	PK	60.0	19.7	-73.9	32.3	0.0	-26.5	19.0	45.5	
0	0.40260	PK	75.3	19.6	-73.9	32.3	0.0	-11.2	15.5	26.7	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier) + 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	100.8	19.7	6.1	32.3	-	94.3	-	-	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).

*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 Type 2 INSIDE 1

Report No.	12812711H
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	04/11/2019
Temperature/ Humidity	21 deg. C / 38 % RH
Engineer	Koji Yamamoto
Mode	Tx 134.2 kHz, Antenna Type 2 INSIDE 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	102.1	19.7	-73.9	32.3	-	15.6	45.0	29.4	Fundamental
0	0.26840	PK	73.9	19.7	-73.9	32.3	-	-12.6	39.0	51.6	
0	0.40260	PK	65.8	19.6	-73.9	32.3	-	-20.7	35.5	56.2	
0	0.53680	QP	33.4	19.6	-33.9	32.2	-	-13.1	33.0	46.1	
0	0.67100	QP	49.6	19.6	-33.8	32.3	-	3.1	31.1	28.0	
0	0.80520	QP	31.5	19.6	-33.8	32.3	-	-15.0	29.5	44.5	
0	0.93940	QP	45.7	19.6	-33.8	32.3	-	-0.8	28.1	28.9	
0	1.07360	QP	31.1	19.6	-33.8	32.3	-	-15.4	26.9	42.3	
0	1.20780	QP	40.0	19.6	-33.8	32.3	-	-6.5	25.9	32.4	
0	1.34200	QP	30.8	19.6	-33.8	32.3	-	-15.6	25.0	40.6	

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	102.1	19.7	-73.9	32.3	0.0	15.6	25.0	9.4	
0	0.26840	PK	73.9	19.7	-73.9	32.3	0.0	-12.6	19.0	31.6	
0	0.40260	PK	65.8	19.6	-73.9	32.3	0.0	-20.7	15.5	36.2	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier) + 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	102.1	19.7	6.1	32.3	-	95.6	-	-	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).

*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 Type 2 LUGGAGE 2

Report No.	12812711H
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	04/11/2019
Temperature/ Humidity	21 deg. C / 38 % RH
Engineer	Koji Yamamoto
Mode	Tx 134.2 kHz, Antenna Type 2 LUGGAGE 2

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	112.2	19.7	-73.9	32.3	-	25.7	45.0	19.3	Fundamental
0	0.26840	PK	77.7	19.7	-73.9	32.3	-	-8.8	39.0	47.8	
0	0.40260	PK	70.1	19.6	-73.9	32.3	-	-16.4	35.5	51.9	
0	0.53680	QP	45.0	19.6	-33.9	32.2	-	-1.5	33.0	34.5	
0	0.67100	QP	55.4	19.6	-33.8	32.3	-	8.9	31.1	22.2	
0	0.80520	QP	31.9	19.6	-33.8	32.3	-	-14.6	29.5	44.1	
0	0.93940	QP	50.6	19.6	-33.8	32.3	-	4.1	28.1	24.0	
0	1.07360	QP	31.4	19.6	-33.8	32.3	-	-15.1	26.9	42.0	
0	1.20780	QP	44.4	19.6	-33.8	32.3	-	-2.1	25.9	28.0	
0	1.34200	QP	31.0	19.6	-33.8	32.3	-	-15.4	25.0	40.4	

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	112.2	19.7	-73.9	32.3	-4.7	20.9	25.0	4.1	
0	0.26840	PK	77.7	19.7	-73.9	32.3	-4.7	-13.6	19.0	32.6	
0	0.40260	PK	70.1	19.6	-73.9	32.3	-4.7	-21.1	15.5	36.6	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier) + Duty factor (Refer to Duty cycle data sheet)

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	112.2	19.7	6.1	32.3	-	105.7	-	-	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).

*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 Type 1 (No.1) + Type 1 (No.2)

Report No.	12812711H
Test place	Ise EMC Lab. No.2 Semi Anechoic Chamber
Date	05/13/2019
Temperature/ Humidity	23 deg. C / 59 % RH
Engineer	Shinya Watanabe
Mode	Tx 134.2 kHz, Antenna Type 1 (No.1) + Type 1 (No.2)

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	101.4	19.7	-74.0	32.3	-	14.8	45.0	30.2	Fundamental
0	0.26840	PK	67.4	19.7	-73.9	32.3	-	-19.1	39.0	58.1	
0	0.40260	PK	81.6	19.6	-73.9	32.3	-	-4.9	35.5	40.4	
0	0.53680	QP	44.2	19.6	-33.9	32.2	-	-2.3	33.0	35.3	
0	0.67100	QP	65.3	19.6	-33.9	32.3	-	18.8	31.1	12.3	
0	0.80520	QP	40.4	19.6	-33.8	32.3	-	-6.1	29.5	35.6	
0	0.93940	QP	53.7	19.6	-33.8	32.3	-	7.2	28.1	20.9	
0	1.07360	QP	31.2	19.6	-33.8	32.3	-	-15.2	26.9	42.1	
0	1.20780	QP	45.2	19.6	-33.8	32.3	-	-1.3	25.9	27.2	
0	1.34200	QP	31.1	19.6	-33.8	32.3	-	-15.3	25.0	40.3	

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	101.4	19.7	-74.0	32.3	0.0	14.8	25.0	10.2	
0	0.26840	PK	67.4	19.7	-73.9	32.3	0.0	-19.1	19.0	38.1	
0	0.40260	PK	81.6	19.6	-73.9	32.3	0.0	-4.9	15.5	20.4	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + Filter + D.Factor) - Gain(Amprifier) + 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	101.4	19.7	6.0	32.3	-	94.8	-	-	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).

*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 Type 1

Report No.	12812711H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	04/11/2019
Temperature / Humidity	21 deg. C / 33 % RH
Engineer	Koji Yamamoto (Above 30 MHz)
Mode	Tx 134.2 kHz, Antenna Type 1

Pola. [H/V]	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
H	30.591	QP	26.2	18.5	7.2	32.2	19.6	40.0	20.4	
H	32.917	QP	22.5	17.7	7.2	32.2	15.2	40.0	24.8	
H	51.532	QP	24.4	10.6	7.5	32.2	10.3	40.0	29.7	
H	389.612	QP	21.6	15.4	10.7	31.9	15.8	46.0	30.2	
H	523.100	QP	21.3	17.6	11.6	32.0	18.5	46.0	27.5	
H	881.225	QP	21.5	22.1	13.6	31.0	26.1	46.0	19.9	
V	30.591	QP	38.7	18.5	7.2	32.2	32.1	40.0	7.9	
V	32.917	QP	30.6	17.7	7.2	32.2	23.3	40.0	16.7	
V	51.532	QP	28.5	10.6	7.5	32.2	14.4	40.0	25.6	
V	389.612	QP	22.0	15.4	10.7	31.9	16.2	46.0	29.8	
V	523.100	QP	21.8	17.6	11.6	32.0	19.0	46.0	27.0	
V	881.225	QP	21.6	22.1	13.6	31.0	26.2	46.0	19.8	

* 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)

Radiated Emission above 30 MHz (Spurious Emission)

Antenna Type 2 INSIDE 1

Report No.	12812711H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	04/11/2019
Temperature / Humidity	21 deg. C / 33 % RH
Engineer	Koji Yamamoto
	(Above 30 MHz)
Mode	Tx 134.2 kHz, Antenna Type 2 INSIDE 1

Pola. [H/V]	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
H	30.590	QP	26.1	18.5	7.2	32.2	19.5	40.0	20.5	
H	32.916	QP	24.2	17.7	7.2	32.2	16.9	40.0	23.1	
H	51.532	QP	24.8	10.6	7.5	32.2	10.7	40.0	29.3	
H	85.892	QP	26.2	7.3	8.0	32.2	9.4	40.0	30.6	
H	162.950	QP	22.3	15.7	8.9	32.1	14.8	43.5	28.7	
H	912.625	QP	21.1	22.1	13.7	30.9	26.1	46.0	19.9	
V	30.590	QP	37.9	18.5	7.2	32.2	31.3	40.0	8.7	
V	32.916	QP	31.1	17.7	7.2	32.2	23.8	40.0	16.2	
V	51.532	QP	29.2	10.6	7.5	32.2	15.1	40.0	24.9	
V	85.892	QP	30.1	7.3	8.0	32.2	13.3	40.0	26.7	
V	162.950	QP	22.8	15.7	8.9	32.1	15.3	43.5	28.2	
V	912.625	QP	21.5	22.1	13.7	30.9	26.5	46.0	19.5	

* 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)

Radiated Emission above 30 MHz (Spurious Emission)

Antenna Type 2 LUGGAGE 2

Report No.	12812711H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.3
Date	04/11/2019
Temperature / Humidity	21 deg. C / 33 % RH
Engineer	Koji Yamamoto (Above 30 MHz)
Mode	Tx 134.2 kHz, Antenna Type 2 LUGGAGE 2

Pola. [H/V]	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
H	30.596	QP	25.9	18.5	7.2	32.2	19.3	40.0	20.7	
H	32.820	QP	25.5	17.7	7.2	32.2	18.2	40.0	21.8	
H	51.533	QP	25.1	10.6	7.5	32.2	11.0	40.0	29.0	
H	85.892	QP	25.8	7.3	8.0	32.2	9.0	40.0	31.0	
H	120.768	QP	22.8	13.2	8.4	32.1	12.3	43.5	31.2	
H	913.662	QP	21.6	22.2	13.7	30.9	26.6	46.0	19.4	
V	30.596	QP	38.5	18.5	7.2	32.2	31.9	40.0	8.1	
V	32.820	QP	30.7	17.7	7.2	32.2	23.4	40.0	16.6	
V	51.533	QP	29.1	10.6	7.5	32.2	15.0	40.0	25.0	
V	85.892	QP	30.3	7.3	8.0	32.2	13.5	40.0	26.5	
V	120.768	QP	23.5	13.2	8.4	32.1	13.0	43.5	30.5	
V	913.662	QP	21.9	22.2	13.7	30.9	26.9	46.0	19.1	

* 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)

Radiated Emission above 30 MHz (Spurious Emission)

Antenna Type 1 (No.1) + Type 1 (No.2)

Report No.	12812711H
Test place	Ise EMC Lab.
Semi Anechoic Chamber	No.2
Date	05/13/2019
Temperature / Humidity	23 deg. C / 59 % RH
Engineer	Shinya Watanabe (Above 30 MHz)
Mode	Tx 134.2 kHz, Antenna Type 1 (No.1) + Type 1 (No.2)

Pola. [H/V]	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
H	31.338	QP	24.9	17.5	6.7	30.5	18.6	40.0	21.4	
H	32.029	QP	24.8	17.2	6.7	30.5	18.2	40.0	21.8	
H	50.071	QP	24.3	10.8	7.0	30.5	11.5	40.0	28.5	
H	75.912	QP	24.9	6.1	7.2	30.4	7.8	40.0	32.2	
H	90.104	QP	24.4	8.4	7.4	30.3	9.8	43.5	33.7	
H	292.482	QP	23.0	13.4	8.8	29.2	16.0	46.0	30.0	
V	31.338	QP	25.0	17.5	6.7	30.5	18.7	40.0	21.3	
V	32.029	QP	25.8	17.2	6.7	30.5	19.2	40.0	20.8	
V	50.071	QP	24.3	10.8	7.0	30.5	11.5	40.0	28.5	
V	75.912	QP	27.4	6.1	7.2	30.4	10.3	40.0	29.7	
V	90.104	QP	25.4	8.4	7.4	30.3	10.9	43.5	32.6	
V	292.482	QP	23.0	13.4	8.8	29.2	16.0	46.0	30.0	

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

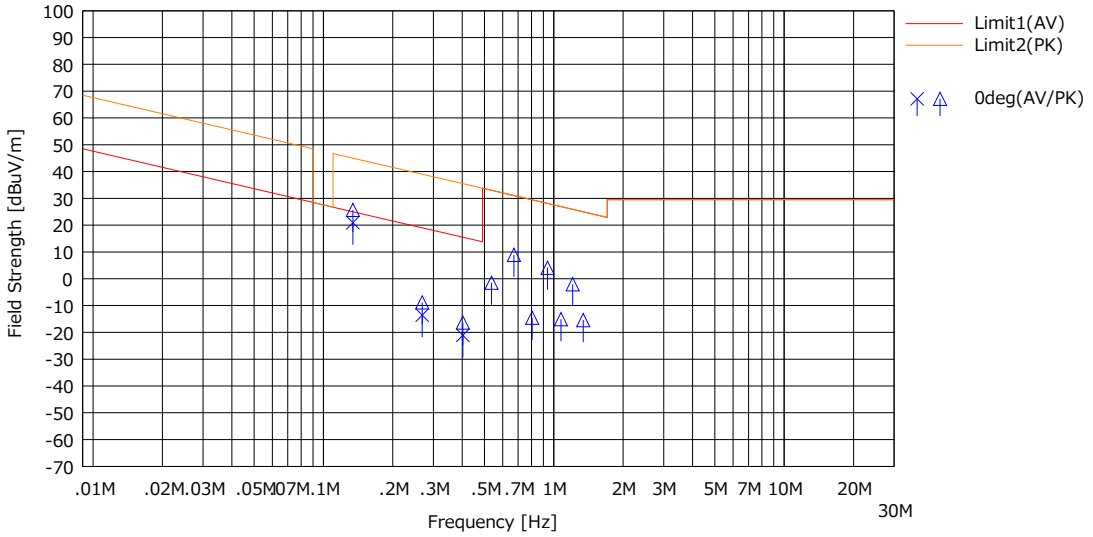
CHART: WITH FACTOR
ANT TYPE: - 30 MHz: LOOP, 30 MHz - 200 MHz: BICONICAL, 200 MHz - 1000 MHz: LOGPERIODIC, 1000 MHz -: HORN
CALCULATION: RESULT = READING + ANT FACTOR + LOSS (CABLE + ATT) - GAIN(AMP)

Radiated Emission Plot data, Worst case

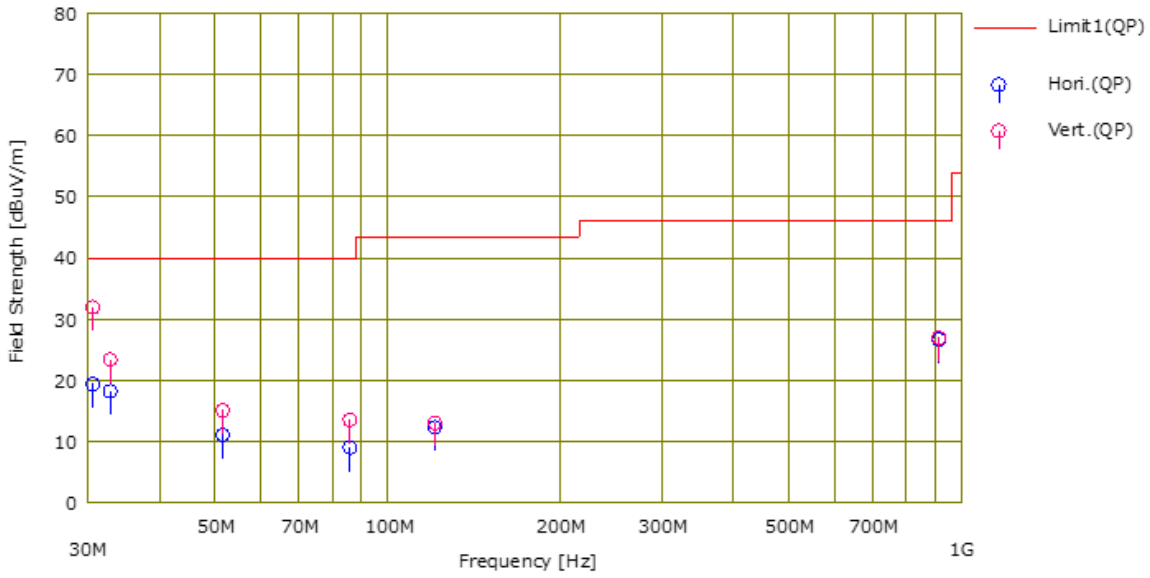
Report No.	12812711H
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Date	04/11/2019
Temperature/ Humidity	21 deg. C / 38 % RH
Engineer	Koji Yamamoto
Mode	Tx 134.2 kHz, Antenna Type 2 LUGGAGE 2

(below 30MHz)

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



(above 30MHz)



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

Duty Cycle

Antenna Type 2 LUGGAGE 2

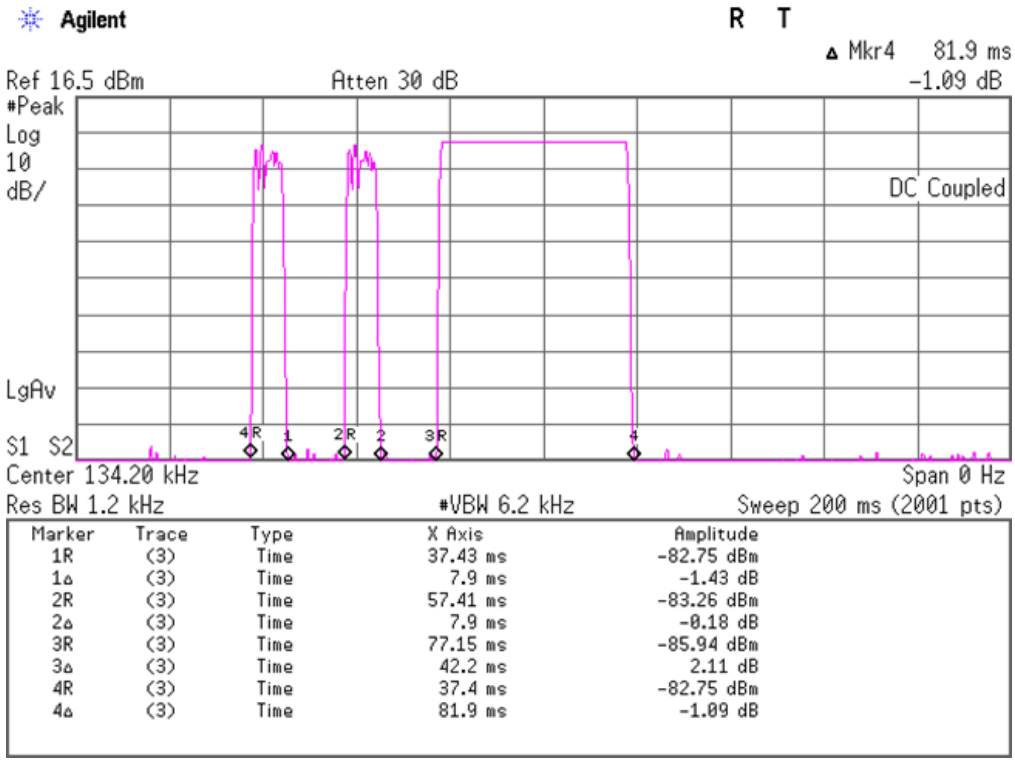
Report No.	12812711H
Test place	Ise EMC Lab. No.7 shielded room
Date	05/08/2019
Temperature/ Humidity	23 deg. C / 31 % RH
Engineer	Shinya Watanabe
Mode	Tx 134.2 kHz, Antenna Type 2 LUGGAGE 2

(Total)

ON time [ms]	Cycle [ms]	Duty (On time/Cycle)	Duty [dB]
58.0	100.0	0.580	-4.73

ON time[ms] = 7.9 + 7.9 + 42.2 = 58.0

Duty = $20\log_{10}$(ON time/Cycle)

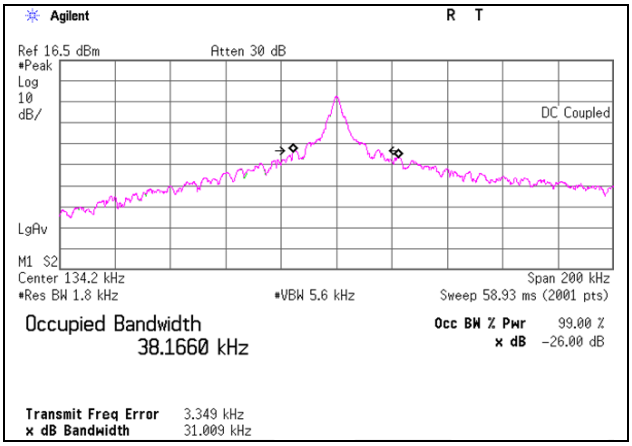


-26 dB Bandwidth / 99 % Occupied Bandwidth

Antenna Type 1

Report No.	12812711H
Test place	Ise EMC Lab. No.7 shielded room
Date	05/08/2019
Temperature/ Humidity	23 deg. C / 31 % RH
Engineer	Shinya Watanabe
Mode	Tx 134.2 kHz, Antenna Type 1

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
31.009	38.1660



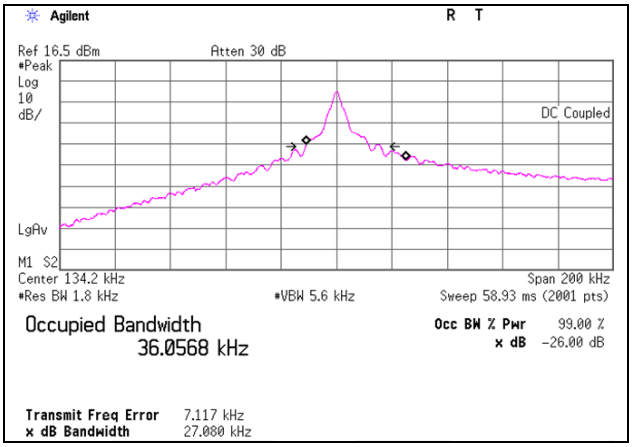
UL Japan, Inc.
Ise EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

-26 dB Bandwidth / 99 % Occupied Bandwidth

Antenna Type 2 INSIDE 1

Report No.	12812711H
Test place	Ise EMC Lab. No.7 shielded room
Date	05/08/2019
Temperature/ Humidity	23 deg. C / 31 % RH
Engineer	Shinya Watanabe
Mode	Tx 134.2 kHz, Antenna Type 2 INSIDE 1

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
27.080	36.0568

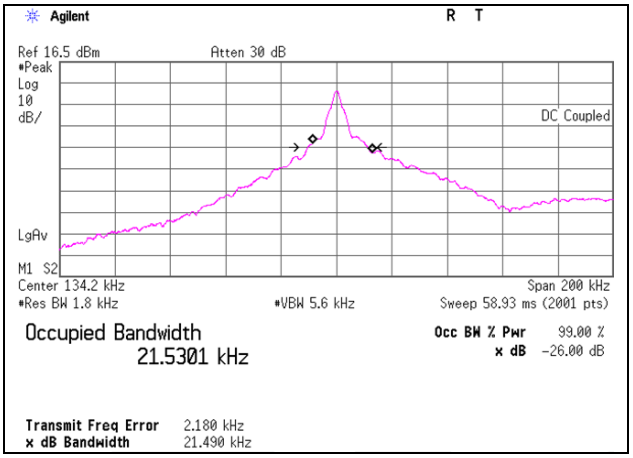


-26 dB Bandwidth / 99 % Occupied Bandwidth

Antenna Type 2 LUGGAGE 2

Report No.	12812711H
Test place	Ise EMC Lab. No.7 shielded room
Date	05/08/2019
Temperature/ Humidity	23 deg. C / 31 % RH
Engineer	Shinya Watanabe
Mode	Tx 134.2 kHz, Antenna Type 2 LUGGAGE 2

-26 dB Bandwidth [kHz]	99 % Occupied Bandwidth [kHz]
21.490	21.5301



APPENDIX 2: Test instruments

Test Instruments

Test Item	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Due Date	Cal Int
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	1/11/2019	1/31/2020	12
RE	148897	Attenuator	KEYSIGHT	8491A	MY52462349	12/20/2018	12/31/2019	12
RE	141216	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W/SFM14/ sucoform141-PE/ 421-010	-/00640	7/3/2018	7/31/2019	12
RE	141152	EMI measurement program	TSJ	TEPTO-DV	-	-	-	-
RE	141323	Coaxial cable	UL Japan	-	-	7/3/2018	7/31/2019	12
RE	141266	Logperiodic Antenna (200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	3/25/2019	3/31/2020	12
RE	141424	Biconical Antenna	Schwarzbeck	BBA9106	1915	6/4/2018	6/30/2019	12
RE	141532	DIGITAL HiTESTER	HIOKI	3805	51201197	1/29/2019	1/31/2020	12
RE	141582	Pre Amplifier	SONOMA INSTRUMENT	310	260834	2/8/2019	2/29/2020	12
RE	141413	Coaxial Cable	UL Japan	-	-	6/12/2018	6/30/2019	12
RE	141949	Test Receiver	Rohde & Schwarz	ESCI	100767	8/6/2018	8/31/2019	12
RE	142180	Measure	KOMELON	KMC-36	-	-	-	-
RE	141254	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	10/11/2018	10/31/2019	12
RE	141572	Thermo-Hygrometer	CUSTOM	CTH-201	3401	1/11/2019	1/31/2020	12
RE	141903	Spectrum Analyzer	AGILENT	E4440A	MY46186390	9/20/2018	9/30/2019	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