



Test report No. : 10835051H-A-R1  
Page : 1 of 29  
Issued date : July 27, 2015  
Revised date : September 17, 2015  
FCC ID : Y8PFJ16-1

# **RADIO TEST REPORT**

**Test Report No. : 10835051H-A-R1**

**Applicant** : FUJI HEAVY INDUSTRIES LTD.  
**Type of Equipment** : Keyless Access with Push-Button Start System  
**Model No.** : FJ16-1  
**FCC ID** : Y8PFJ16-1  
**Test regulation** : FCC Part 15 Subpart C: 2015  
**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 10835051H-A. 10835051H-A is replaced with this report.

**Date of test:** June 18 to July 23, 2015

**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/](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



---

<b>CONTENTS</b>	<b>PAGE</b>
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.....	9
SECTION 5: Radiated emission (Fundamental and Spurious Emission) .....	11
SECTION 6: -26dB Bandwidth.....	13
SECTION 7: 99% Occupied Bandwidth.....	13
APPENDIX 1: Data of EMI test.....	14
Radiated Emission below 30MHz (Fundamental and Spurious Emission) .....	14
Duty Cycle.....	17
Radiated Emission above 30MHz (Spurious Emission).....	18
-26dB Bandwidth and 99% Occupied Bandwidth .....	21
APPENDIX 2: Test instruments .....	24
APPENDIX 3: Photographs of test setup .....	25
Radiated Emission.....	25
Worst Case Position .....	28

## **SECTION 1: Customer information**

Company Name : FUJI HEAVY INDUSTRIES LTD.  
Address : 1-1, Subaru-cho, ota-shi, Gunma-ken, 373-8555, Japan  
Telephone Number : +81-276-26-3064  
Facsimile Number : +81-276-26-3069  
Contact Person : Yuji Kobayashi

## **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. : FJ16-1  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC12.0 V  
Receipt Date of Sample : June 11, 2015  
Country of Mass-production : United States of America and 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: FJ16-1 (referred to as the EUT in this report) is the Smart 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 4.  
Antenna Specification : Ferrite antenna coil

##### **[Receiver] \*4)**

Radio Type : Receiver  
Frequency of Operation : 433.92 MHz  
Oscillator frequency : 52.9025 MHz (Crystal)  
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.

\*4) The test of receiver part was performed separately from this test report, and the conformability is confirmed.

---

## **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: 2015, final revised on September 8, 2015

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

\* The revision on September 8, 2015 does not affect the test specification applied to the EUT.

#### **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.

### 3.2 Procedures and results

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	Conducted Emission	<FCC> ANSI C63.4:2009 7. AC powerline conducted emission measurements <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 C63.4:2009 13. Measurement of intentional radiators <IC> RSS-Gen 6.4, 6.12	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 8.9	Radiated	N/A	6.1 dB 0.13420 kHz PK (PK with Duty factor) (Antenna Type 2 OUTSIDE)	Complied
3	Electric Field Strength of Spurious Emission	<FCC> ANSI C63.4:2009 13. Measurement of intentional radiators <IC> RSS-Gen 6.4, 6.13	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 8.9	Radiated	N/A	11.8 dB 35.952 MHz, Vertical, QP (Antenna Type 2 OUTSIDE)	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.4:2009 13. Measurement of intentional radiators <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.

### 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.

**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

### 3.4 Uncertainty

#### EMI

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

Test room (semi-anechoic chamber)	Radiated emission						
	(3 m*)(+dB)				(1 m*)(+dB)		(0.5 m*)(+dB)
	9 kHz - 30 MHz	30 MHz - 300 MHz	300 MHz - 1 GHz	1 GHz - 10 GHz	10 GHz - 18 GHz	18 GHz - 26.5 GHz	26.5 GHz - 40 GHz
No.1	4.3 dB	5.5 dB	6.3 dB	5.5 dB	5.8 dB	5.8 dB	4.3 dB
No.2	4.2 dB	5.4 dB	6.3 dB	5.4 dB	5.7 dB	5.9 dB	5.6 dB
No.3	4.4 dB	5.4 dB	6.4 dB	5.2 dB	5.5 dB	5.8 dB	5.5 dB
No.4	4.7 dB	5.6 dB	6.4 dB	5.3 dB	5.7 dB	5.9 dB	5.5 dB

\*3 m / 1 m / 0.5 m = Measurement distance

#### Radiated emission test(3 m)

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

**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

### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab. \*NVLAP Lab. code: 200572-0  
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN  
Telephone : +81 596 24 8999 Facsimile : +81 596 24 8124

	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7m	7.0 x 6.0m	No.1 Power source room
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.3 Preparation room
No.3 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.4 Preparation room
No.4 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9m	6.0 x 6.0m	-
No.6 shielded room	-	4.0 x 4.5 x 2.7m	4.0 x 4.5 m	-
No.6 measurement room	-	4.75 x 5.4 x 3.0m	4.75 x 4.15 m	-
No.7 shielded room	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	3.1 x 5.0 x 2.7m	N/A	-
No.9 measurement room	-	8.0 x 4.6 x 2.8m	2.4 x 2.4m	-
No.11 measurement room	-	6.2 x 4.7 x 3.0m	4.8 x 4.6m	-

\* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

### 3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.



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

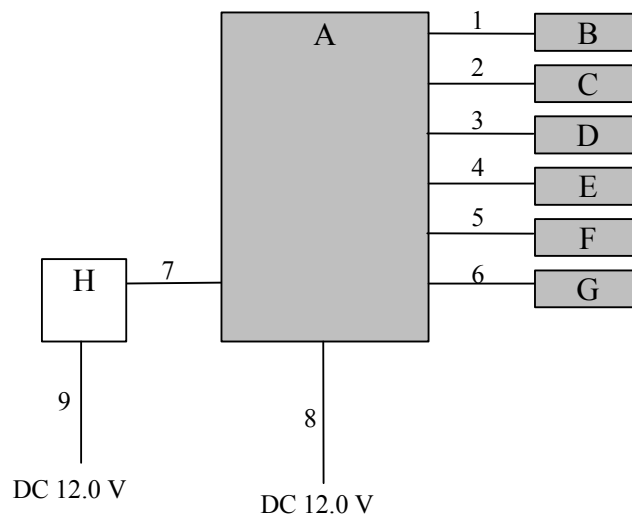
### **4.1 Operating Modes**

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

Justification : The system was configured in typical fashion (as a customer would normally use it) for testing.

\*During testing, transmitting antenna was fixed to one of six antennas.

### **4.2 Configuration and peripherals**



\* Cabling and setup were taken into consideration and test data was taken under worse case conditions.

\*This system has three kinds of antenna ports.

- Two ports where Antenna (TYPE 1) are connected
  - Three ports where Antenna (TYPE 2) are connected (TYPE 2, INSIDE)
  - One port where Antenna (TYPE 2) is connected (TYPE 2, OUTSIDE)
  - The difference between INSIDE Antenna and OUTSIDE 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	Smart ECU	-	001	-	EUT
B	Antenna (TYPE 1)	-	001	-	EUT
C	Antenna (TYPE 1)	-	001	-	EUT
D	Antenna (TYPE 2 INSIDE)	-	001	-	EUT
E	Antenna (TYPE 2 INSIDE)	-	001	-	EUT
F	Antenna (TYPE 2 INSIDE)	-	001	-	EUT
G	Antenna (TYPE 2 OUTSIDE)	-	001	-	EUT
H	Jig	-	-	-	-

#### 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 INSIDE) Cable	3.0	Unshielded	Unshielded	-
4	Antenna (TYPE 2 INSIDE) Cable	3.0	Unshielded	Unshielded	-
5	Antenna (TYPE 2 INSIDE) Cable	3.0	Unshielded	Unshielded	-
6	Antenna (TYPE 2 OUTSIDE) Cable	3.0	Unshielded	Unshielded	-
7	Signal Cable	3.0	Unshielded	Unshielded	-
8	DC Cable	3.0	Unshielded	Unshielded	-
9	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, 0.5 m by 1.0 m, raised 0.8m above the conducting ground plane.

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

Frequency : From 9 kHz to 30 MHz

The EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for vertical polarization (antenna angle: 0 deg., 45 deg., 90 deg., 135 deg., and 180 deg.) and horizontal polarization.

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

Frequency : From 30 MHz to 1 GHz

The measuring antenna height varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for both vertical and horizontal antenna polarization.

The test was made with the detector (RBW / VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

### **Test Antennas are used as below;**

Frequency	Below 30 MHz	30 MHz to 300 MHz	300 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 937606.

These tests were performed in semi anechoic chamber. Therefore the measured level of emissions may be higher than if measurements were made without a ground plane.

However test results were confirmed to pass against standard limit.

- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

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

**Measurement range** : 9 kHz - 1 GHz

**Test data** : APPENDIX 1

**Test result** : Pass

Date: June 18 and 20, 2015  
July 23, 2015

Test engineer: Kenshi Shimomura  
Yuta Moriya

**UL Japan, Inc.**

**Ise EMC Lab.**

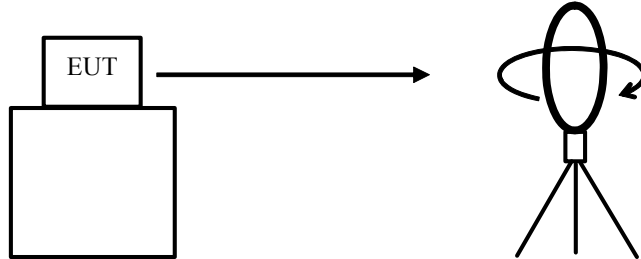
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN

Telephone : +81 596 24 8999

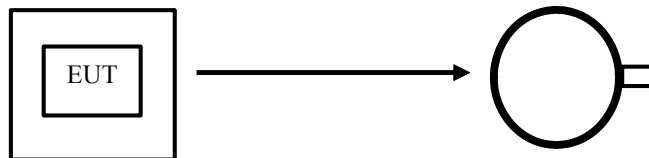
Facsimile : +81 596 24 8124

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

*Side View (Vertical)*

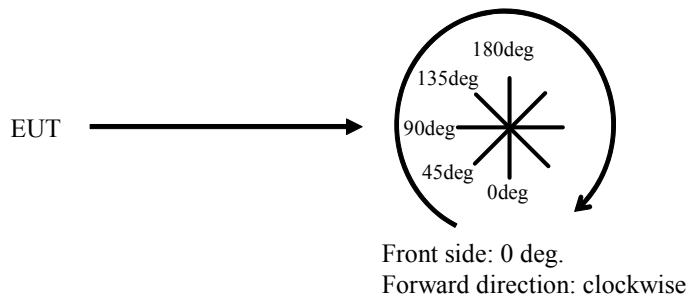


*Top View (Horizontal)*



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	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

---

**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

## APPENDIX 1: Data of EMI test

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

#### Antenna (TYPE 1)

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber  
Order No. : 10835051H  
Date : 06/18/2015  
Temperature/ Humidity : 25 deg. C / 40% RH  
Engineer : Kenshi Shimomura  
Mode : Tx 134.2kHz, 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	69.4	19.6	-74.0	0.0	-	15.0	45.0	30.0	Fundamental
0	0.26840	PK	61.4	19.6	-74.0	32.1	-	-25.1	39.0	64.1	
0	0.40260	PK	76.1	19.6	-73.9	32.1	-	-10.3	35.5	45.8	
0	0.53680	QP	42.0	19.5	-33.9	32.1	-	-4.5	33.0	37.5	
0	0.67100	QP	63.8	19.5	-33.8	32.1	-	17.4	31.1	13.7	
0	0.80520	QP	40.3	19.5	-33.8	32.1	-	-6.1	29.5	35.6	
0	0.93940	QP	53.4	19.5	-33.8	32.1	-	7.0	28.1	21.1	
0	1.07360	QP	39.9	19.5	-33.8	32.1	-	-6.5	26.9	33.4	
0	1.20780	QP	45.9	19.5	-33.8	32.1	-	-0.5	25.9	26.4	
0	1.34200	QP	39.9	19.5	-33.7	32.1	-	-6.4	25.0	31.4	
0	1.47620	QP	43.6	19.6	-33.7	32.1	-	-2.6	24.2	26.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - 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	69.4	19.6	-74.0	0.0	0.0	15.0	25.0	10.0	Fundamental
0	0.26840	PK	61.4	19.6	-74.0	32.1	0.0	-25.1	19.0	44.1	
0	0.40260	PK	76.1	19.6	-73.9	32.1	0.0	-10.3	15.5	25.8	

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

\* Gain 0.0 dB shows that the pre amplifier was not used to avoid the influence of carrier power.

\* 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	69.4	19.6	6.0	0.0	-	95.0	-	-	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

**UL Japan, Inc.**

**Ise EMC Lab.**

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

**Radiated Emission below 30MHz (Fundamental and Spurious Emission)**  
**Antenna (TYPE 2 INSIDE)**

Test place : Ise EMC Lab. No.2 Semi Anechoic Chamber  
Order No. : 10835051H  
Date : 06/18/2015  
Temperature/ Humidity : 25 deg. C / 40% RH  
Engineer : Kenshi Shimomura  
Mode : Tx 134.2kHz, Antenna (TYPE 2 INSIDE)

**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	55.5	19.6	-74.0	0.0	-	1.1	45.0	43.9	Fundamental
0	0.26840	PK	66.3	19.6	-74.0	32.1	-	-20.2	39.0	59.2	
0	0.40260	PK	57.2	19.6	-73.9	32.1	-	-29.2	35.5	64.7	
0	0.53680	QP	43.5	19.5	-33.9	32.1	-	-3.0	33.0	36.0	
0	0.67100	QP	41.3	19.5	-33.8	32.1	-	-5.1	31.1	36.2	
0	0.80520	QP	41.5	19.5	-33.8	32.1	-	-4.9	29.5	34.4	
0	0.93940	QP	40.1	19.5	-33.8	32.1	-	-6.3	28.1	34.4	
0	1.07360	QP	40.4	19.5	-33.8	32.1	-	-6.0	26.9	32.9	
0	1.20780	QP	40.0	19.5	-33.8	32.1	-	-6.4	25.9	32.3	
0	1.34200	QP	40.0	19.5	-33.7	32.1	-	-6.3	25.0	31.3	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - 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	55.5	19.6	-74.0	0.0	0.0	1.1	25.0	23.9	Fundamental
0	0.26840	PK	66.3	19.6	-74.0	32.1	0.0	-20.2	19.0	39.2	
0	0.40260	PK	57.2	19.6	-73.9	32.1	0.0	-29.2	15.5	44.7	

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

- \* Gain 0.0 dB shows that the pre amplifier was not used to avoid the influence of carrier power.
- \* 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	55.5	19.6	6.0	0.0	-	81.1	-	-	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

**Radiated Emission below 30MHz (Fundamental and Spurious Emission)**  
**Antenna (TYPE 2 OUTSIDE)**

Test place : Ise EMC Lab. No.1 Semi Anechoic Chamber  
Order No. : 10835051H  
Date : 07/23/2015  
Temperature/ Humidity : 22 deg. C / 60% RH  
Engineer : Yuta Moriya  
Mode : Tx 134.2kHz, Antenna (TYPE 2 OUTSIDE)

**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	79.6	19.6	-74.0	0.0	-	25.2	45.0	19.8	Fundamental
0	0.26840	PK	76.4	19.6	-73.9	32.4	-	-10.3	39.0	49.3	
0	0.40260	PK	61.4	19.6	-73.9	32.3	-	-25.2	35.5	60.7	
0	0.53680	QP	39.9	19.5	-33.9	32.3	-	-6.8	33.0	39.8	
0	0.67100	QP	53.9	19.5	-33.8	32.3	-	7.3	31.1	23.8	
0	0.80520	QP	31.9	19.5	-33.8	32.3	-	-14.7	29.5	44.2	
0	0.93940	QP	51.1	19.5	-33.8	32.3	-	4.5	28.1	23.6	
0	1.07360	QP	40.6	19.5	-33.8	32.3	-	-6.0	26.9	32.9	
0	1.20780	QP	48.3	19.5	-33.7	32.3	-	1.8	25.9	24.1	
0	1.34200	QP	30.7	19.5	-33.7	32.3	-	-15.8	25.0	40.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter) - 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	79.6	19.6	-74.0	0.0	-6.3	18.9	25.0	6.1	Fundamental
0	0.26840	PK	76.4	19.6	-73.9	32.4	-6.3	-16.6	19.0	35.6	
0	0.40260	PK	61.4	19.6	-73.9	32.3	-6.3	-31.5	15.5	47.0	

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

\* Gain 0.0 dB shows that the pre amplifier was not used to avoid the influence of carrier power.

**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	79.6	19.6	6.0	0.0	-	105.2	-	-	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

**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



## Duty Cycle

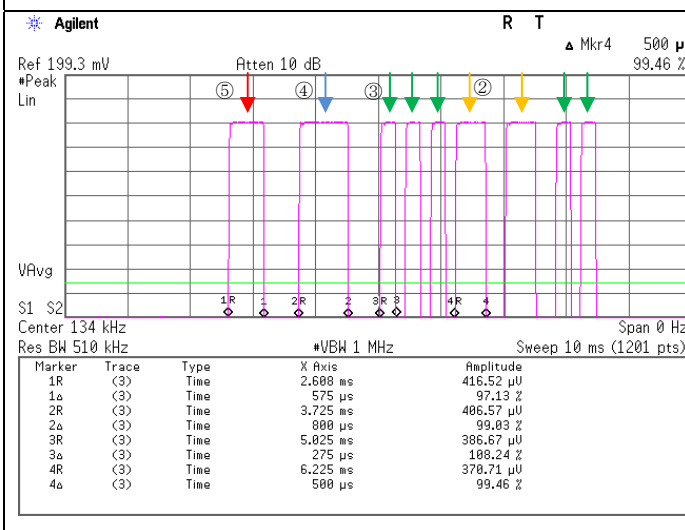
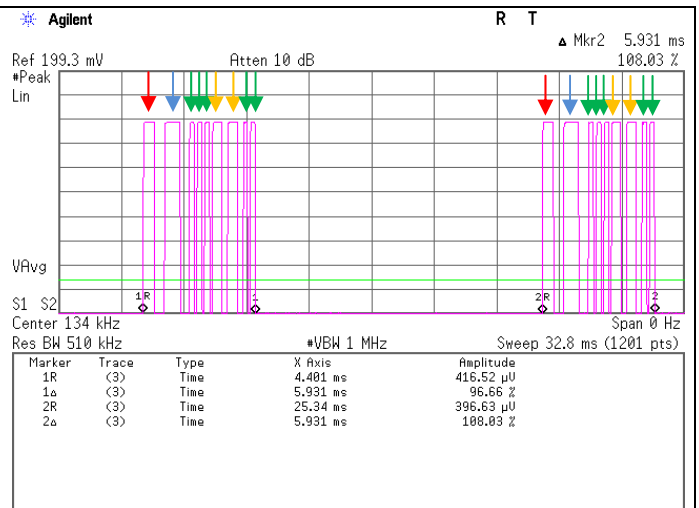
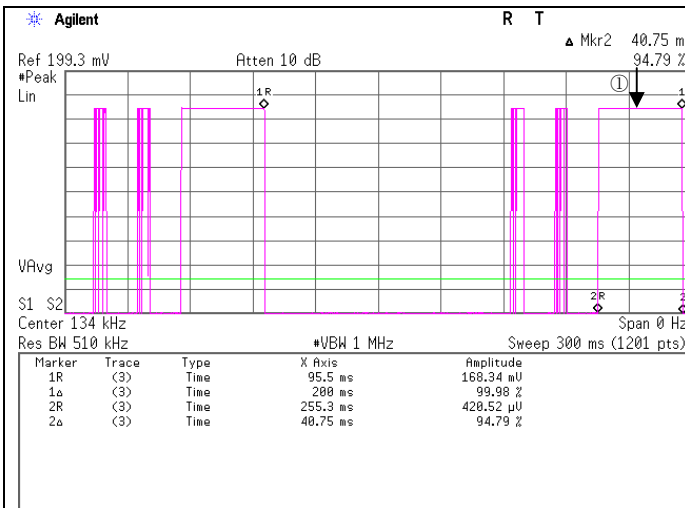
### Antenna (TYPE 2, OUTSIDE)

Test place Ise EMC Lab. No.1 Semi Anechoic Chamber  
Order No. 10835051H  
Date 07/23/2015  
Temperature/ Humidity 22 deg. C / 60% RH  
Engineer Yuta Moriya  
Mode Tx 134.2kHz, Antenna (TYPE 2, OUTSIDE)

ON time [ms]	Cycle [ms]	Duty (On time/Cycle)	Duty [dB]
48.25	100.00	0.48	-6.3

$$\text{ON time[ms]}=40.75+(0.575*2)+(0.8*2)+(0.275*10)+(0.5*4)=48.25$$

$$\text{Duty[dB]}=20\log(\text{On time/Cycle})$$



## Radiated Emission above 30MHz (Spurious Emission)

### Antenna (TYPE 1)

### DATA OF RADIATED EMISSION TEST

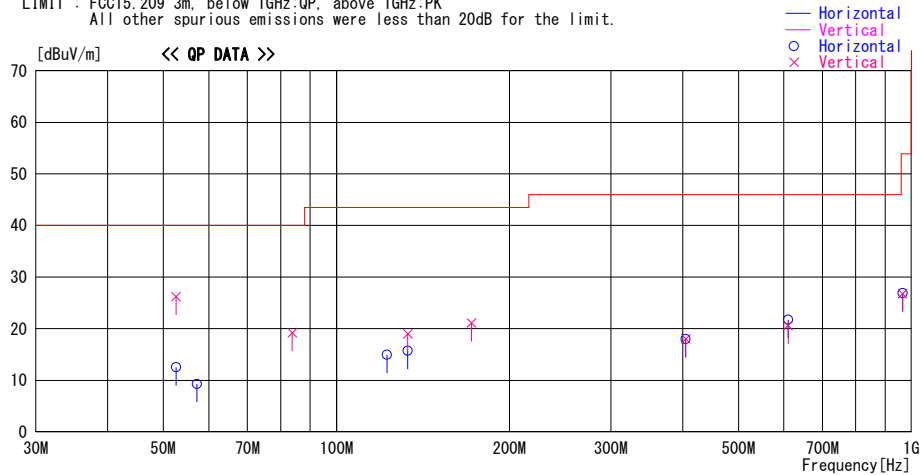
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber  
Date : 2015/06/20

Report No. : 10835051H

Temp./Humi. : 20deg. C / 60% RH  
Engineer : Kenshi Shimomura

Mode / Remarks : Tx 134.2kHz, Antenna (Type 1) (Ant X, ECU X)

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]	
52.612	47.6	QP	9.7	-31.1	26.2	163	100	Vert.	40.0	13.8	
52.605	33.9	QP	9.7	-31.1	12.5	66	290	Hori.	40.0	27.5	
57.161	32.1	QP	8.2	-31.0	9.3	359	338	Hori.	40.0	30.7	
83.744	42.4	QP	7.4	-30.6	19.2	105	100	Vert.	40.0	20.8	
122.395	32.2	QP	12.8	-30.1	14.9	149	246	Hori.	43.5	28.6	
133.122	31.9	QP	13.7	-29.9	15.7	359	249	Hori.	43.5	27.8	
133.126	35.2	QP	13.7	-29.9	19.0	265	100	Vert.	43.5	24.5	
171.778	35.0	QP	15.7	-29.6	21.1	0	100	Vert.	43.5	22.4	
405.000	27.9	QP	17.5	-27.4	18.0	359	100	Vert.	46.0	28.0	
405.000	27.9	QP	17.5	-27.4	18.0	359	100	Hori.	46.0	28.0	
610.000	26.6	QP	19.6	-25.6	20.6	359	100	Vert.	46.0	25.4	
610.000	27.7	QP	19.6	-25.6	21.7	359	100	Hori.	46.0	24.3	
965.000	27.3	QP	22.7	-23.1	26.9	359	100	Hori.	53.9	27.0	
965.000	27.2	QP	22.7	-23.1	26.8	359	100	Vert.	53.9	27.1	

CHART: WITH FACTOR ANT TYPE: -30MHz: LOOP, 30-300MHz: BICONICAL, 300MHz-1000MHz: LOGPERIODIC, 1000MHz-: HORN  
CALCULATION: RESULT = READING + ANT FACTOR + LOSS (CABLE - GAIN (AMP))

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

## Radiated Emission above 30MHz (Spurious Emission)

### Antenna (TYPE 2 INSIDE)

### DATA OF RADIATED EMISSION TEST

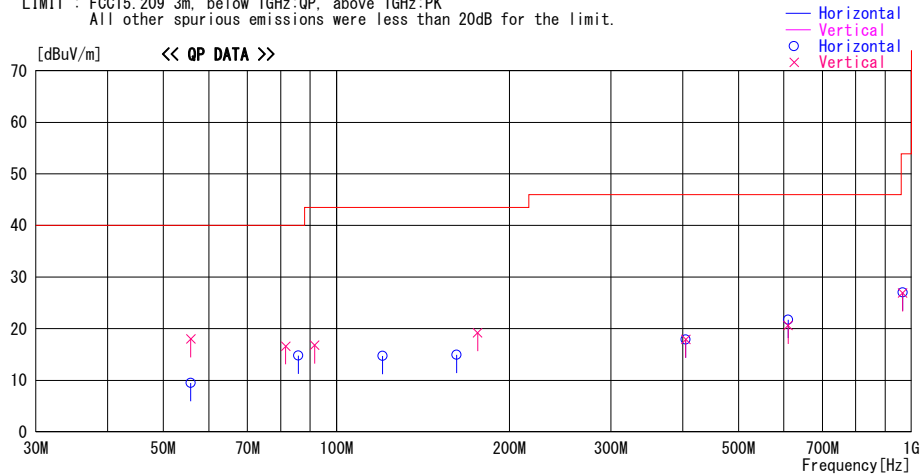
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber  
Date : 2015/06/20

Report No. : 10835051H

Temp./Humi. : 20deg. C / 60% RH  
Engineer : Kenshi Shimomura

Mode / Remarks : Tx 134.2kHz, Antenna (TYPE 2 INSIDE) (ANT Y, ECU: X)

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]	
55.829	40.4	QP	8.6	-31.0	18.0	163	100	Vert.	40.0	22.0	
55.829	31.9	QP	8.6	-31.0	9.5	216	343	Hori.	40.0	30.5	
85.884	37.7	QP	7.7	-30.6	14.8	344	340	Hori.	40.0	25.2	
81.592	40.2	QP	7.0	-30.6	16.6	135	100	Vert.	40.0	23.4	
120.239	32.2	QP	12.6	-30.1	14.7	153	272	Hori.	43.5	28.8	
161.738	29.0	QP	15.5	-29.6	14.9	359	249	Hori.	43.5	28.6	
91.613	38.7	QP	8.6	-30.5	16.8	78	100	Vert.	43.5	26.7	
176.074	32.9	QP	15.9	-29.6	19.2	336	100	Vert.	43.5	24.3	
405.000	27.8	QP	17.5	-27.4	17.9	359	100	Vert.	46.0	28.1	
405.000	27.8	QP	17.5	-27.4	17.9	359	100	Hori.	46.0	28.1	
610.000	26.6	QP	19.6	-25.6	20.6	359	100	Vert.	46.0	25.4	
610.000	27.7	QP	19.6	-25.6	21.7	359	100	Hori.	46.0	24.3	
965.000	27.4	QP	22.7	-23.1	27.0	359	100	Hori.	53.9	26.9	
965.000	27.3	QP	22.7	-23.1	26.9	359	100	Vert.	53.9	27.0	

CHART:WITH FACTOR ANT TYPE: -30MHz:LOOP, 30-300MHz:BICONICAL, 300MHz-1000MHz:LOGPERIODIC, 1000MHz:-HORN  
CALCULATION:RESULT = READING + ANT FACTOR + LOSS(CABLE - GAIN(AMP))

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

## Radiated Emission above 30MHz (Spurious Emission)

### Antenna (TYPE 2 OUTSIDE)

### DATA OF RADIATED EMISSION TEST

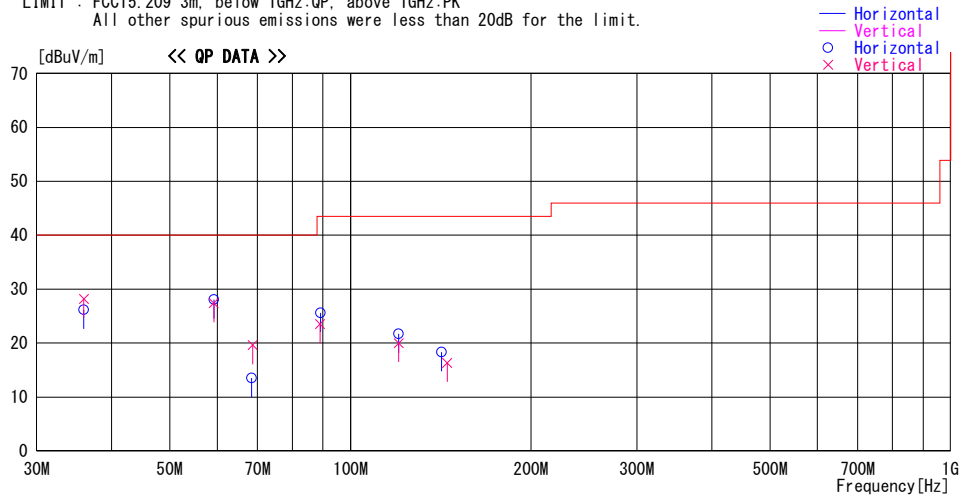
UL Japan, Inc. Ise EMC Lab. No.1 Semi Anechoic Chamber  
Date : 2015/07/23

Report No. : 10835051H

Temp./Humi. : 22deg. C / 66% RH  
Engineer : Yuta Moriya

Mode / Remarks : Tx 134.2kHz, Antenna (Type 2 OUTSIDE), (Ant Y, ECU X)

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



Frequency [MHz]	Reading [dBuV]	DET	Antenna		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Gain [dB]							
35.952	42.1	QP	15.5	-31.4	26.2	182	118	Hori.	40.0	13.8	
35.952	44.1	QP	15.5	-31.4	28.2	0	126	Vert.	40.0	11.8	
59.218	51.6	QP	7.5	-31.0	28.1	359	386	Hori.	40.0	11.9	
59.218	50.9	QP	7.5	-31.0	27.4	73	181	Vert.	40.0	12.6	
68.417	38.0	QP	6.3	-30.8	13.5	8	327	Hori.	40.0	26.5	
68.707	44.1	QP	6.3	-30.8	19.6	134	173	Vert.	40.0	20.4	
89.109	47.9	QP	8.2	-30.5	25.6	351	339	Hori.	43.5	17.9	
88.978	45.8	QP	8.2	-30.5	23.5	276	111	Vert.	43.5	20.0	
120.240	39.2	QP	12.6	-30.1	21.7	169	261	Hori.	43.5	21.8	
120.361	37.5	QP	12.6	-30.1	20.0	290	112	Vert.	43.5	23.5	
141.928	33.7	QP	14.4	-29.8	18.3	0	317	Hori.	43.5	25.2	
144.928	31.5	QP	14.6	-29.8	16.3	276	100	Vert.	43.5	27.2	

CHART:WITH FACTOR ANT TYPE: -30MHz:LOOP, 30-300MHz:BICONICAL, 300MHz-1000MHz:LOGPERIODIC, 1000MHz:-HORN  
CALCULATION:RESULT = READING + ANT FACTOR + LOSS(CABLE + ATTEN - 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.**

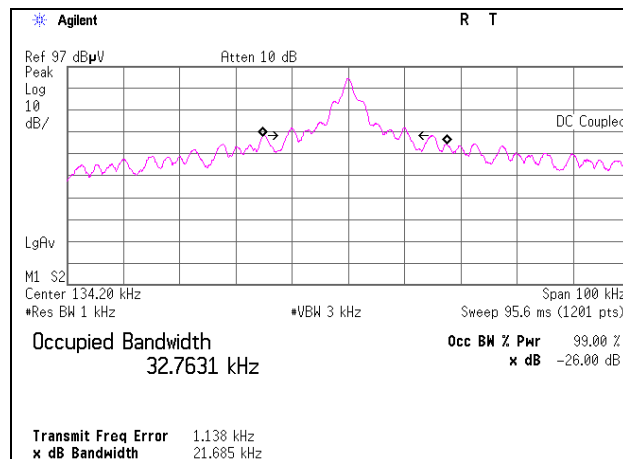
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN  
Telephone : +81 596 24 8999  
Facsimile : +81 596 24 8124

**-26dB Bandwidth and 99% Occupied Bandwidth**  
Antenna (TYPE 1)

Report No. 10835051H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.1  
Date 06/23/2015  
Temperature / Humidity 24 deg. C / 60 % RH  
Engineer Yuta Moriya  
Mode Tx 134.2 kHz (TYPE 1)

-26 dB Bandwidth [kHz]
21.685

99% Occupied Bandwidth [kHz]
32.7631

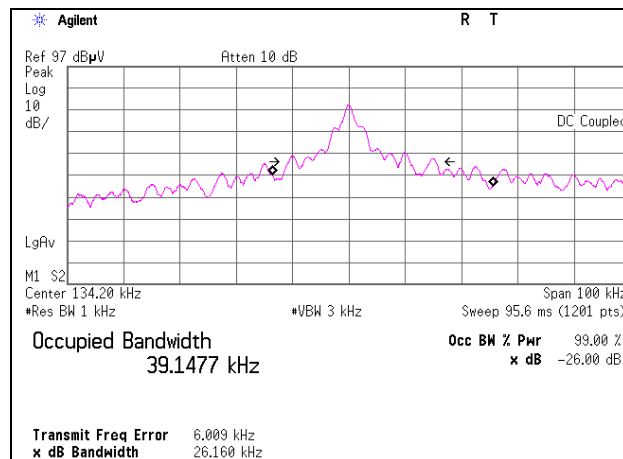


**-26dB Bandwidth and 99% Occupied Bandwidth**  
Antenna (TYPE 2 INSIDE)

Report No. 10835051H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.1  
Date 06/23/2015  
Temperature / Humidity 24 deg. C / 60 % RH  
Engineer Yuta Moriya  
Mode Tx 134.2 kHz (TYPE 2 INSIDE)

-26 dB Bandwidth [kHz]
26.160

99% Occupied Bandwidth [kHz]
39.1477

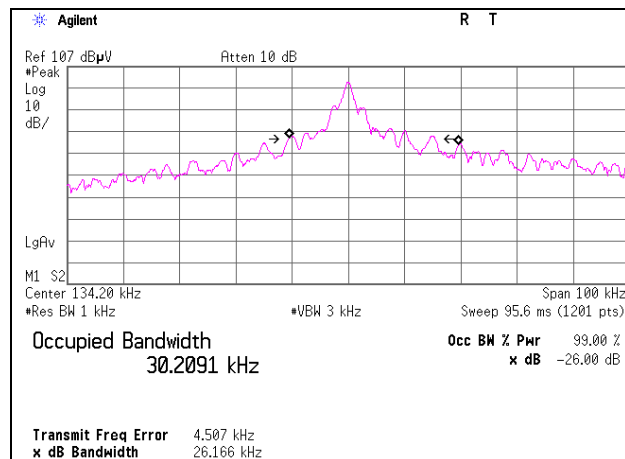


**-26dB Bandwidth and 99% Occupied Bandwidth**  
Antenna (TYPE 2 OUTSIDE)

Report No. 10835051H  
Test place Ise EMC Lab.  
Semi Anechoic Chamber No.1  
Date 07/23/2015  
Temperature / Humidity 20 deg. C / 60 % RH  
Engineer Yuta Moriya  
Mode Tx 134.2 kHz (TYPE 2 OUTSIDE)

-26 dB Bandwidth [kHz]
26.166

99% Occupied Bandwidth [kHz]
30.2091



## APPENDIX 2: Test instruments

### EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-02	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-06902	RE	2014/06/25 * 12 *1)
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE	2015/01/13 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-14	Spectrum Analyzer	Agilent	E4440A	MY48250080	RE	2014/10/17 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	RE	2015/06/08 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2014/10/04 * 12
MCC-13	Coaxial Cable	Fujikura	3D-2W(12m)/ 5D-2W(5m)/ 5D-2W(0.8m)/ 5D-2W(1m)	-	RE	2015/02/06 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2015/06/24 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2015/03/09 * 12
MAT-07	Attenuator(6dB)	Weinschel Corp	2	BK7970	RE	2014/11/11 * 12
MLPA-07	Loop Antenna	UL Japan	-	-	RE	Pre Check
MAEC-01	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 10m	DA-06881	RE	2014/09/01 * 12
MOS-27	Thermo-Hygrometer	CUSTOM	CTH-201	A08Q26	RE	2015/01/13 * 12
MJM-21	Measure	KOMELON	KMC-36	-	RE	-
MTR-09	EMI Test Receiver	Rohde & Schwarz	ESU26	100412	RE	2014/06/06 * 12 *1)
KBA-05	Biconical Antenna	Schwarzbeck	BBA9106	2513	RE	2014/11/22 * 12
KLA-04	Logperiodic Antenna	Schwarzbeck	USLP9143	361	RE	2014/11/22 * 12
MAT-08	Attenuator(6dB)	Weinschel Corp	2	BK7971	RE	2014/11/20 * 12
MCC-02	Coaxial Cable	Suhner/storm/Agilent /TSJ	-	-	RE	2014/09/12 * 12
MPA-19	Pre Amplifier	MITEQ	MLA-10K01-B01-35	1237616	RE	2015/02/03 * 12
MCC-03	Coaxial Cable	Fujikura/Suhner/TSJ	5D-2W(20m)/3D- 2W(7.5m)/RG400u(1 .5m)/RFM- E421(Switcher)	-/01068 (Switcher)	RE	2014/09/12 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2015/03/10 * 12
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	RE	2015/02/26 * 12

\*1) This test equipment was used for the tests before the expiration date of the calibration.

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