



Test report No. : 10893288H-R1
Page : 1 of 18
Issued date : September 18, 2015
Revised date : November 16, 2015
FCC ID : Y8PFJ16-2

RADIO TEST REPORT

Test Report No. : 10893288H-R1

Applicant : FUJI HEAVY INDUSTRIES LTD.
Type of Equipment : Immobilizer
Model No. : FJ16-2
FCC ID : Y8PFJ16-2
Test regulation : FCC Part 15 Subpart C: 2015
Test Result : Complied

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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.
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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 10893288H. 10893288H is replaced with this report.

Date of test: August 11, 2015

Representative test engineer:

Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:

Motoya Imura
Engineer
Consumer Technology Division



NVLAP LAB CODE: 200572-0

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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

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SECTION 1: Customer information

Company Name	:	FUJI HEAVY INDUSTRIES LTD.
Address	:	1-1 SUBARU-CHO, OTA, GUNMA, 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	:	Immobilizer
Model No.	:	FJ16-2
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12.0V
Receipt Date of Sample	:	August 4, 2015
Country of Mass-production	:	United States of America, 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: FJ16-2 (referred to as the EUT in this report) is the Immobilizer.

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 MHz
Type of Modulation	:	ASK (A1D)
Oscillation circuit	:	Ceramic Resonator
Power Supply	:	DC 12.0 V
Antenna Type	:	Coil antenna

[Receiver]

Radio Type	:	Receiver
Frequency of Operation	:	128.7 kHz
Oscillator frequency	:	4 MHz
Type of Modulation	:	FSK (F1D)
Type of receiving system	:	Direct conversion
Power Supply	:	DC 12.0 V
Antenna Type	:	Coil antenna

* The antenna (Refer to Section 4, Clause 4.2; item No. B) has model 1 and model 2. The test was performed with the representative model 1.

The difference between model 1 and model 2 is presence or absence of LED lighting circuit board.

Model 1 has LED lighting circuit board.

Model 2 does not have LED lighting circuit board.

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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	34.7 dB 0.13420 MHz PK (PK with Duty factor)	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	17.6 dB 320.186 MHz, Horizontal, QP	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.

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3.3 Addition to standard

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99 % Occupied Band Width	RSS-Gen 6.6	-	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 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	5.1 dB	6.2 dB	5.5 dB	5.8 dB	5.8 dB	4.3 dB
No.2	4.2 dB	5.1 dB	6.2 dB	5.4 dB	5.7 dB	5.9 dB	5.6 dB
No.3	4.4 dB	5.1 dB	6.3 dB	5.2 dB	5.5 dB	5.8 dB	5.5 dB
No.4	4.7 dB	5.3 dB	6.3 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.

3.5 Test Location

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	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.

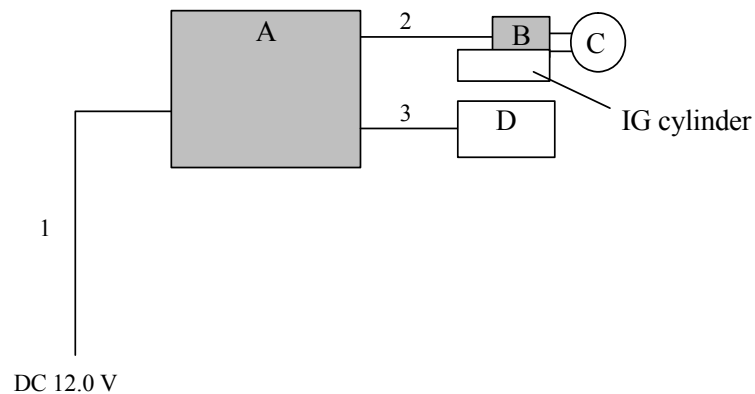
SECTION 4: Operation of E.U.T. during testing

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.

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Joint Box	-	001	-	EUT
B	Antenna	-	001	-	EUT
C	Key	-	001	-	-
D	Evaluation Bench	-	-	-	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	Antenna Cable	3.0	Unshielded	Unshielded	-
3	Signal Cable	3.0	Unshielded	Unshielded	-

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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.

This EUT has two modes which mechanical key is inserted or not. The worst case was confirmed with and without mechanical key, as a result, the test with mechanical key was the worst case. Therefore the test with mechanical key was performed only.

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: August 11, 2015

Test engineer: Shinya Watanabe

UL Japan, Inc.

Ise EMC Lab.

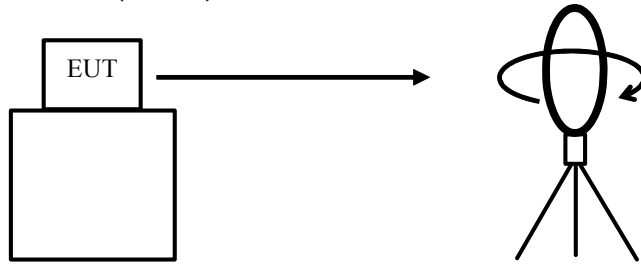
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Telephone : +81 596 24 8999

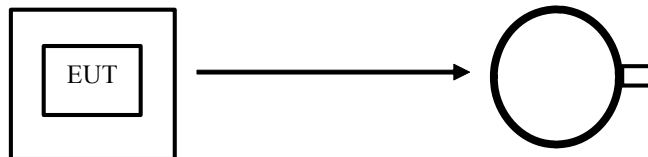
Facsimile : +81 596 24 8124

Figure 1: Direction of the Loop Antenna

Side View (Vertical)



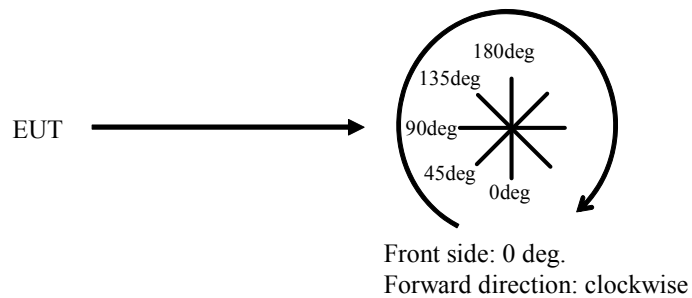
.....
Top View (Horizontal)



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

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

APPENDIX 1: Test data

Radiated Emission below 30MHz (Fundamental and Spurious Emission)

Test place : Ise EMC Lab. No.3 Semi Anechoic Chamber
Order No. : 10893288H
Date : 08/11/2015
Temperature/ Humidity : 23 deg. C / 50% RH
Engineer : Shinya Watanabe
Mode : Tx 134.2kHz

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	77.2	19.6	-74.1	32.4	-	-9.7	45.0	54.7	Fundamental
0	0.26840	PK	43.1	19.6	-74.1	32.4	-	-43.8	39.0	82.8	
90	0.26840	PK	45.4	19.6	-74.1	32.4	-	-41.5	39.0	80.5	
0	0.40260	PK	43.7	19.6	-74.0	32.3	-	-43.0	35.5	78.5	
90	0.40260	PK	42.6	19.6	-74.0	32.3	-	-44.1	35.5	79.6	
0	0.53680	QP	34.3	19.5	-34.0	32.3	-	-12.5	33.0	45.5	
90	0.53680	QP	40.7	19.5	-34.0	32.3	-	-6.1	33.0	39.1	
0	0.67100	QP	31.8	19.5	-34.0	32.3	-	-15.0	31.1	46.1	NS
90	0.67100	QP	32.0	19.5	-34.0	32.3	-	-14.8	31.1	45.9	NS
0	0.80520	QP	32.7	19.5	-34.0	32.3	-	-14.1	29.5	43.6	
90	0.80520	QP	39.2	19.5	-34.0	32.3	-	-7.6	29.5	37.1	
0	0.93940	QP	32.3	19.5	-34.0	32.3	-	-14.5	28.1	42.6	
90	0.93940	QP	31.2	19.5	-34.0	32.3	-	-15.6	28.1	43.7	NS
0	1.074	QP	31.2	19.5	-34.0	32.3	-	-15.6	26.9	42.5	NS
0	1.208	QP	31.0	19.5	-33.9	32.3	-	-15.7	25.9	41.6	NS
0	1.342	QP	31.0	19.5	-33.9	32.3	-	-15.7	25.0	40.7	NS

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

NS: No signal detected

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	77.2	19.6	-74.1	32.4	0.0	-9.7	25.0	34.7	Fundamental
0	0.26840	PK	43.1	19.6	-74.1	32.4	0.0	-43.8	19.0	62.8	
90	0.26840	PK	45.4	19.6	-74.1	32.4	0.0	-41.5	19.0	60.5	
0	0.40260	PK	43.7	19.6	-74.0	32.3	0.0	-43.0	15.5	58.5	
90	0.40260	PK	42.6	19.6	-74.0	32.3	0.0	-44.1	15.5	59.6	

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

* Since the peak emission result satisfied the average limit, duty factor was omitted.

Result of the fundamental emission at 3m without Distance factor

PK or QP

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.13420	PK	77.2	19.6	5.9	32.4	-	95.3	-	-	Fundamental

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

* All spurious emissions lower than this result.

* The test result is rounded off to one or two decimal

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

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Radiated Emission above 30MHz (Spurious Emission)

DATA OF RADIATED EMISSION TEST

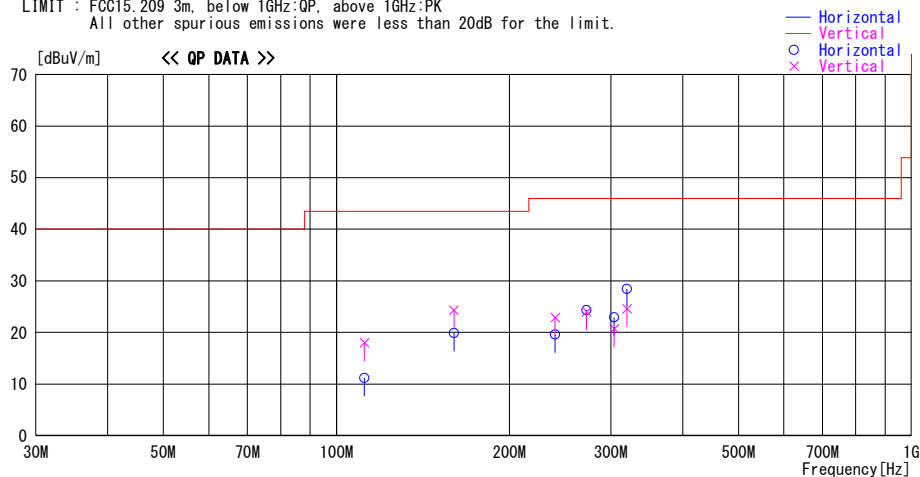
UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2015/08/11

Report No. : 10893288H

Temp./Humi. : 23deg. C / 50% RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 134.2kHz WorstAxis

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	
			Factor [dB/m]	Gain [dB]					[dBuV/m]	[dB]
111.900	23.5	QP	11.7	-24.0	11.2	0	114	Hori.	43.5	32.3
111.900	30.3	QP	11.7	-24.0	18.0	123	100	Vert.	43.5	25.5
160.094	27.9	QP	15.5	-23.5	19.9	106	195	Hori.	43.5	23.6
160.094	32.3	QP	15.5	-23.5	24.3	0	100	Vert.	43.5	19.2
240.141	25.3	QP	17.0	-22.7	19.6	191	153	Hori.	46.0	26.4
240.141	28.6	QP	17.0	-22.7	22.9	28	100	Vert.	46.0	23.1
272.157	28.3	QP	18.4	-22.4	24.3	193	170	Hori.	46.0	21.7
272.157	28.0	QP	18.4	-22.4	24.0	41	103	Vert.	46.0	22.0
304.176	30.1	QP	14.8	-22.0	22.9	204	116	Hori.	46.0	23.1
304.176	27.9	QP	14.8	-22.0	20.7	22	231	Vert.	46.0	25.3
320.186	35.0	QP	15.3	-21.9	28.4	293	100	Hori.	46.0	17.6
320.186	31.2	QP	15.3	-21.9	24.6	58	231	Vert.	46.0	21.4

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

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

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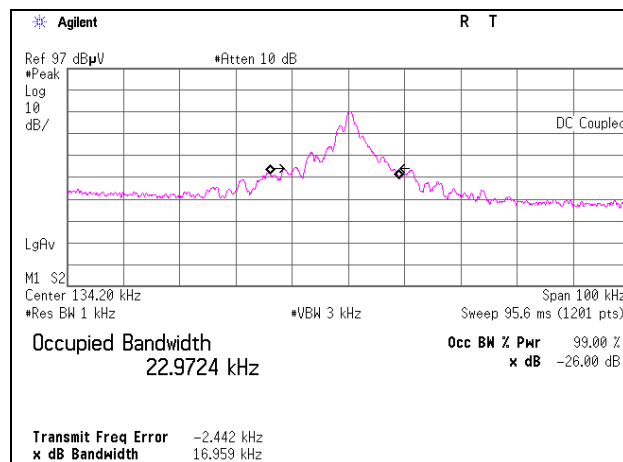
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-26dB Bandwidth and 99% Occupied Bandwidth

Report No. 10893288H
Test place Ise EMC Lab.
Semi Anechoic Chamber No.3
Date 08/11/2015
Temperature / Humidity 23 deg. C / 50 % RH
Engineer Shinya Watanabe
Mode Tx 134.2 kHz

-26 dB Bandwidth
[kHz]
16.959

99% Occupied Bandwidth
[kHz]
22.9724



APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2015/02/19 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2015/01/13 * 12
MJM-16	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-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2014/08/19 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2014/10/04 * 12
MCC-112	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(3m)/ sucoform141-PE(1m)/ 421-010(1.5m)/ RFM-E321(Switcher)	-/00640	RE	2015/07/02 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2015/06/24 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2015/03/10 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2015/04/08 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2014/10/18 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	174	RE	2014/10/18 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2015/07/13 * 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