



# RADIO TEST REPORT

**Test Report No. : 11872090H**

**Applicant** : **Panasonic Corporation**  
**Type of Equipment** : **Immobilizer ECU**  
**Model No.** : **EMU360901**  
**FCC ID** : **ACJ932EMU360901**  
**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)

**Date of test:** July 19, 2017

**Representative test engineer:**

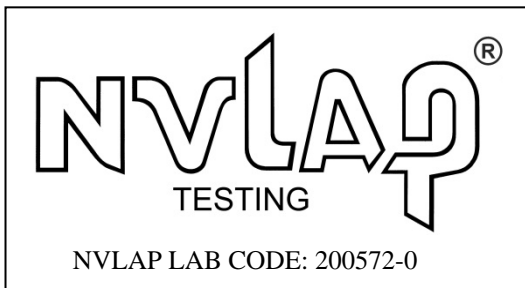


Shuichi Ohyama  
Engineer  
Consumer Technology Division

**Approved by:**



Motoya Imura  
Engineer  
Consumer Technology Division



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.**

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13-EM-F0429



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## **SECTION 1: Customer information**

Company Name : Panasonic Corporation  
Address : 1006 Kadoma, Kadoma City, Osaka 571-8506, Japan  
Telephone Number : +81-6-6906-4726  
Contact Person : Hirohumi Oosawa

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

### **2.1 Identification of E.U.T.**

Type of Equipment : Immobilizer ECU  
Model No. : EMU360901  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC 12.0 V  
Receipt Date of Sample : July 18, 2017  
Country of Mass-production : Thailand  
Condition of EUT : Production model  
Modification of EUT : No Modification by the test lab

### **2.2 Product Description**

Model No: EMU360901 (referred to as the EUT in this report) is the Immobilizer ECU.

#### **General Specification**

Clock frequencies in the system : 4 MHz, 125 kHz

#### **Radio Specification**

Radio Type : Transmitter  
Frequency of Operation : 125 kHz  
Type of Modulation : ASK  
Antenna Type : Coil Antenna  
Method of Frequency Generation : Ceramic Oscillator  
Operating voltage (inner) : DC 5.0 V

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### SECTION 3: Test specification, procedures & results

#### 3.1 Test Specification

Test Specification : FCC Part 15 Subpart C  
FCC Part 15 final revised on June 14, 2017 and effective July 14, 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.

#### 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	26.4 dB 125 kHz 0 deg. AV PK with Duty Factor	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	0.7 dB 164.192 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 15.31 (e)

The test was performed with the New Battery (DC 12 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.

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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 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(3 m)

[Electric Field Strength of Fundamental Emission]

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

[Electric Field Strength of Spurious Emission]

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

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### 3.5 Test Location

UL Japan, Inc. Ise EMC Lab. \*NVLAP Lab. code: 200572-0  
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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.

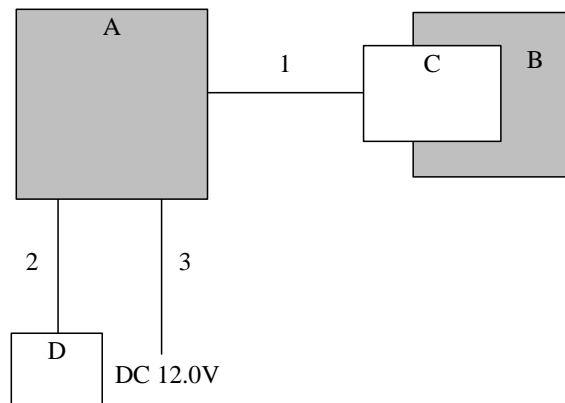
## **SECTION 4: Operation of E.U.T. during testing**

### **4.1 Operating Modes**

The mode(s) : Transmitting (Tx) mode

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	Remark
A	Immobilizer ECU	EMU360901	001	Panasonic Corporation	EUT
B	Immobilizer Antenna	-	001	Panasonic Corporation	EUT
C	Key Cylinder	-	-	-	-
D	Switch BOX	-	-	Panasonic Corporation	-

#### **List of cables used**

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Signal Cable	0.5	Unshielded	Unshielded	-
2	Signal Cable	2.0	Unshielded	Unshielded	-
3	DC Cable	1.0	Unshielded	Unshielded	-

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## **SECTION 5: Radiated emission (Fundamental and Spurious Emission)**

### **Test Procedure**

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane.

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

Frequency : From 9 kHz to 30 MHz

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

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

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

Frequency: From 30 MHz to 1 GHz

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

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

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

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

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

Frequency	Below 30 MHz	30 MHz to 200 MHz	200 MHz to 1 GHz
Antenna Type	Loop	Biconical	Logperiodic

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

\*1) Distance Factor:  $40 \times \log(3 \text{ m} / 300 \text{ m}) = -80 \text{ dB}$

\*2) Distance Factor:  $40 \times \log(3 \text{ m} / 30 \text{ m}) = -40 \text{ dB}$

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

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

However test results were confirmed to pass against standard limit.

- 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 19, 2017

Test engineer: Shuichi Ohyama

**UL Japan, Inc.**

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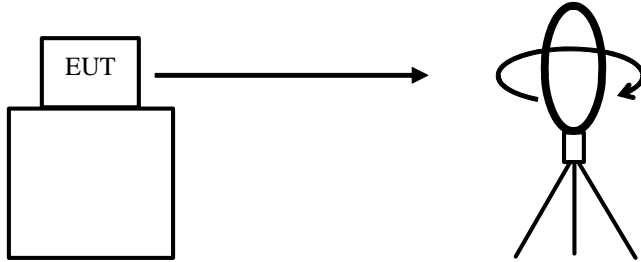
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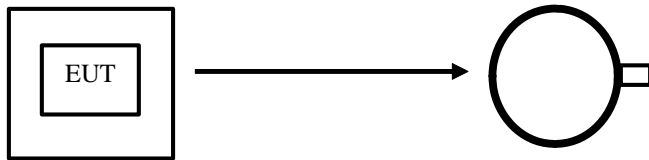
Facsimile : +81 596 24 8124

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

*Side View (Vertical)*



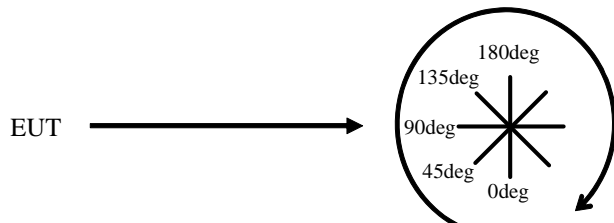
.....  
*Top View (Horizontal)*



Antenna was not rotated.

.....

*Top View (Vertical)*



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	125 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	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)**

Test place Ise EMC Lab. No.3 Semi Anechoic Chamber  
Order No. 11872090H  
Date 07/19/2017  
Temperature/ Humidity 25 deg. C / 52 % RH  
Engineer Shuichi Ohyama  
Mode Tx 125kHz

**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	0.12500	PK	85.8	19.7	-74.0	32.3	-	-0.8	45.6	46.4	Fundamental
0	0.25000	PK	48.1	19.6	-74.0	32.3	-	-38.6	39.6	78.2	
0	0.37500	PK	58.5	19.6	-74.0	32.3	-	-28.2	36.1	64.3	
0	0.50000	QP	33.1	19.5	-33.9	32.3	-	-13.6	33.6	47.2	
0	0.62500	QP	49.0	19.5	-33.9	32.3	-	2.3	31.7	29.4	
0	0.75000	QP	31.6	19.5	-33.9	32.2	-	-15.0	30.1	45.1	
0	0.87500	QP	44.0	19.5	-33.9	32.2	-	-2.6	28.7	31.3	
0	1.00000	QP	31.2	19.5	-33.9	32.2	-	-15.4	27.6	43.0	
0	1.12500	QP	40.7	19.5	-33.9	32.2	-	-5.9	26.5	32.4	
0	1.25000	QP	30.9	19.5	-33.9	32.2	-	-15.7	25.6	41.3	

Result = Reading + Ant Factor + Loss (Cable + Attenuator + 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	0.125	PK	85.8	19.7	-74.0	32.3	0.0	-0.8	25.6	26.4	
0	0.250	PK	48.1	19.6	-74.0	32.3	0.0	-38.6	19.6	58.2	
0	0.375	PK	58.5	19.6	-74.0	32.3	0.0	-28.2	16.1	44.3	

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

**Result of the fundamental emission at 3m without Distance factor**

**PK or QP**

Ant Deg [deg]	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
0	0.12500	PK	85.8	19.7	6.0	32.3	-	79.2	-	-	Fundamental

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

\* All spurious emissions lower than this result.

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

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

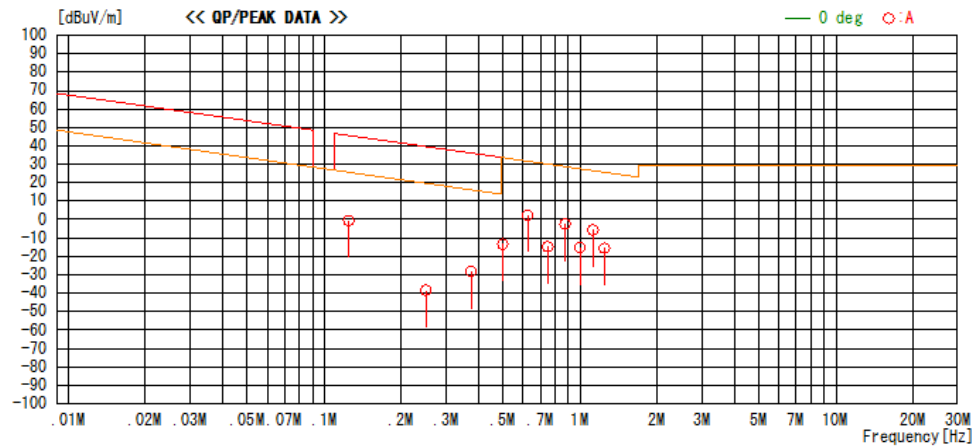
**DATA OF RADIATED EMISSION TEST**

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber  
 Date : 2017/07/19

Report No. : 11872090H  
 Temp./ Humi. : 25deg. C / 52% RH  
 Engineer : Shuichi Ohyama

Mode / Remarks : Tx 125kHz worst-axis (Ant:X , ECU:X) w/o key

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



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

## Radiated Emission above 30 MHz (Spurious Emission)

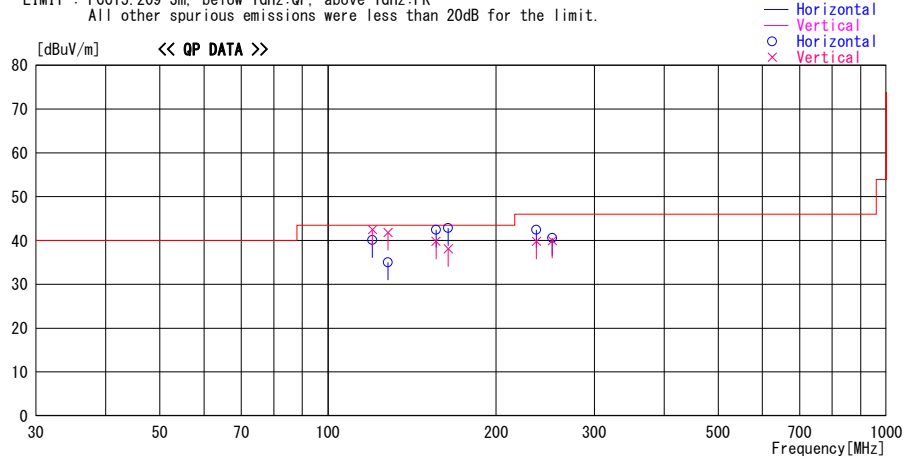
### DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No. 3 Semi Anechoic Chamber  
Date : 2017/07/19

Report No. : 11872090H  
Temp./Humi. : 25 deg. C / 52 % RH  
Engineer : Shuichi Ohyama

Mode / Remarks : Tx 125kHz worst-axis (Ant and ECU, Hori:X Vert: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	Loss&	Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Gain [dB]							
120.141	51.1	QP	12.8	-23.8	40.1	337	267	Hori.	43.5	3.4	
120.141	53.5	QP	12.8	-23.8	42.5	214	100	Vert.	43.5	1.0	
128.149	45.2	QP	13.5	-23.7	35.0	333	300	Hori.	43.5	8.5	
128.149	52.0	QP	13.5	-23.7	41.8	205	100	Vert.	43.5	1.7	
156.182	50.3	QP	15.4	-23.3	42.4	318	220	Hori.	43.5	1.1	
156.182	47.7	QP	15.4	-23.3	39.8	201	100	Vert.	43.5	3.7	
164.192	50.3	QP	15.7	-23.2	42.8	348	272	Hori.	43.5	0.7	
164.192	45.6	QP	15.7	-23.2	38.1	232	100	Vert.	43.5	5.4	
236.274	53.2	QP	11.7	-22.5	42.4	36	132	Hori.	46.0	3.6	
236.274	50.6	QP	11.7	-22.5	39.8	248	100	Vert.	46.0	6.2	
252.295	50.5	QP	11.9	-22.4	40.0	177	100	Vert.	46.0	6.0	
252.295	51.1	QP	11.9	-22.4	40.6	359	131	Hori.	46.0	5.4	

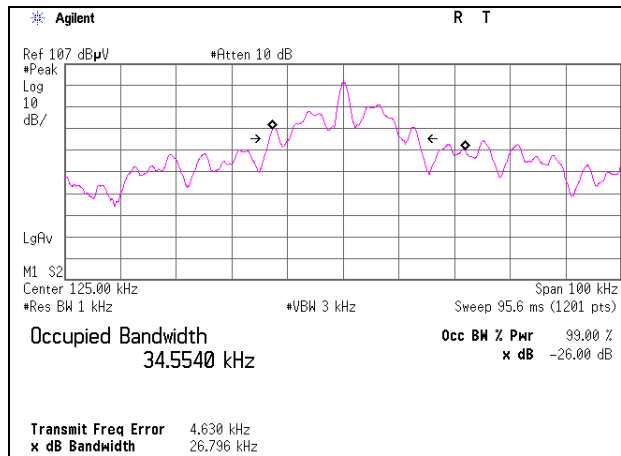
CHART : WITH FACTOR ANT TYPE: -30MHz:LOOP, 30-200MHz:BICONICAL, 200MHz-1000MHz:LOGPERIODIC, 1000MHz--:HORN  
CALCULATION : RESULT = READING + ANT FACTOR + LOSS(CABLE + ATTEN) - GAIN(AMP)

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

### -26 dB Bandwidth

Test place Ise EMC Lab. No.3 Semi Anechoic Chamber  
Order No. 11872090H  
Date 07/19/2017  
Temperature/ Humidity 25 deg. C / 52 % RH  
Engineer Shuichi Ohyama  
Mode Tx 125 kHz

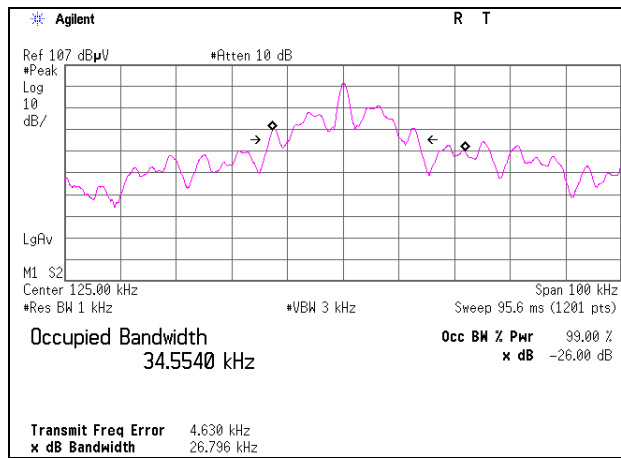
-26 dB Bandwidth
[kHz]
26.796



### 99 % Occupied Bandwidth

Test place Ise EMC Lab. No.3 Semi Anechoic Chamber  
Order No. 11872090H  
Date 07/19/2017  
Temperature/ Humidity 25 deg. C / 52 % RH  
Engineer Shuichi Ohyama  
Mode Tx 125kHz

99 % Occupied Bandwidth [kHz]
34.5540





## **APPENDIX 2: Test instruments**

### **EMI test equipment**

<b>Control No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Model No</b>	<b>Serial No</b>	<b>Test Item</b>	<b>Calibration Date * Interval(month)</b>
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2016/10/20 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2017/01/20 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2017/05/29 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2016/09/15 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2016/10/14 * 12
MCC-112	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(3m)/ suoform141-PE(1m)/ 421-010(1.5m)/ RFM-E321(Switcher)	-/00640	RE	2017/07/12 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2017/06/12 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2017/03/27 * 12
MAT-98	Attenuator	KEYSIGHT	8491A	MY52462349	RE	2016/12/05 * 12
MMM-08	DIGITAL HiTESTER	Hioki	3805	051201197	RE	2017/01/19 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2016/10/15 * 12
MLA-22	Logperiodic Antenna(200-1000MHz)	Schwarzbeck	VUSLP9111B	911B-191	RE	2017/01/26 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2017/07/12 * 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**

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