



RADIO TEST REPORT

Test Report No. : 10310962H-A-R1

Applicant : Panasonic Corporation
Type of Equipment : SMART PCU
Model No. : HM1130CA
FCC ID : ACJ932HM1130CA
Test regulation : FCC Part 15 Subpart C: 2014
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.
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 report is a revised version of 10310962H-A. 10310962H-A is replaced with this report.

Date of test: May 2 to 8, 2014

Representative test engineer:

K. Kawamura

Keisuke Kawamura
Engineer
Consumer Technology Division

Approved by:

M. Imura

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://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap>

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13-EM-F0429

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SECTION 1: Customer information

Company Name : Panasonic Corporation
Address : 600 Saedo-cho, Tsuzuki-ku, Yokohama City 224-8539 Japan
Telephone Number : +81-45-939-1665
Facsimile Number : +81-45-939-1917
Contact Person : Masahiro Yoshii

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

2.1 Identification of E.U.T.

Type of Equipment : SMART PCU
Model No. : HM1130CA
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC 6.0 to 16.0 V
Receipt Date of Sample : April 26, 2014
Country of Mass-production : Japan, China
Condition of EUT : Production model
Modification of EUT : No Modification by the test lab

2.2 Product Description

General Specification

Clock frequency(ies) in the system : 16MHz (CPU Main Clock)

Radio Specification

Radio Type : Transceiver

[Transmitter part]

Frequency of Operation : 125kHz
Modulation : ASK
Method of Frequency Generation : Crystal
Output voltage : DC 7.0V
Antenna type : Ferrite Antenna

[Receiver part]

Frequency of Operation : 433.92MHz
Crystal oscillator frequency : 21.948717MHz
Local frequency : 434.194MHz
IF frequency : 274kHz
Antenna type : Monopole Antenna
Antenna gain : -15dBi

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2014, final revised on May 1, 2014 and effective June 2, 2014

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

* The revision on May 1, 2014 does not affect the test specification applied to the EUT.

FCC 15.31 (e)

This test was performed with the New Battery (DC 12V) and the constant voltage was supplied to this EUT during the tests. 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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3.2 Procedures and results

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	Conducted Emission	<FCC> ANSI C63.4:2003 7. AC powerline conducted emission measurements <IC> RSS-Gen 7.2.4	<FCC> Section 15.207 <IC> RSS-Gen 7.2.4	-	N/A *1)	N/A	N/A
2	Electric Field Strength of Fundamental Emission	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> RSS-Gen 4.8, 4.11	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 7.2.5	Radiated	N/A	0.1dB 0.12500MHz, AV, 0deg	Complied
3	Electric Field Strength of Spurious Emission	<FCC> ANSI C63.4:2003 13. Measurement of intentional radiators <IC> RSS-Gen 4.9, 4.11	<FCC> Section 15.209 <IC> RSS-210 2.5.1 RSS-Gen 7.2.5	Radiated	N/A	3.5dB 32.747MHz, Vertical, QP	Complied
4	-26dB Bandwidth	<FCC> ANSI C63.4:2003 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 4.6.1	RSS-Gen 4.6.1	Radiated	N/A	N/A	N/A

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

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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						
	(3m*)(+dB)				(1m*)(+dB)		(0.5m*)(+dB)
	9kHz -30MHz	30MHz -300MHz	300MHz -1GHz	1GHz -10GHz	10GHz -18GHz	18GHz -26.5GHz	26.5GHz -40GHz
No.1	4.0dB	5.1dB	5.0dB	5.1dB	6.0dB	4.9dB	4.3dB
No.2	3.9dB	5.2dB	5.0dB	4.9dB	5.9dB	4.7dB	4.2dB
No.3	4.3dB	5.1dB	5.2dB	5.2dB	6.0dB	4.8dB	4.2dB
No.4	4.6dB	5.2dB	5.0dB	5.2dB	6.0dB	5.7dB	4.2dB

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

Radiated emission test(3m)

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

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 Data of EMI, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Modes

The mode is used: Transmitting mode (Tx) 125kHz

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

The EUT has 2 types: Difference between both types is whether external door handle of vehicle is metal plating or not (non-metal).

EUT has 8 types of LF antennas (F Antenna, R Antenna, M/TI Antenna, FRDR Antenna, RRDR Antenna, FRAS Antenna, RRAS Antenna, TR Antenna).

Since these antennas have differences in the antenna type and their output power, the test was performed with the representative antennas below.

- FRDR Antenna (non-metal)
- FRDR Antenna (metal)
- TR Antenna
- M/TI Antenna
- F Antenna

*The EUT does not transmit simultaneously from multiple antennas.
During testing, transmitting antenna was fixed to one of antennas.

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4.2 Configuration and peripherals

This page has been submitted for a separate exhibit.

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SECTION 5: Radiated emission (Fundamental and Spurious Emission)

Test Procedure

The Radiated Electric Field Strength intensity has been measured on No 3 semi anechoic chamber with a ground plane and at a distance of 3m.

Frequency : From 9kHz to 30MHz at distance 3m

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: 0deg., 45deg., 90deg., 135 deg , and 180deg.)

and horizontal polarization.

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

Frequency : From 30MHz to 1GHz at distance 3m

The measuring antenna height varied between 1 and 4m 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.

Measurements were performed with a QP and PK, and AV detector.

The radiated emission measurements were made with the following detector function of the test receiver.

	From 9kHz to 90kHz and From 110kHz to 150kHz	From 90kHz to 110kHz	From 150kHz to 490kHz	From 490kHz to 30MHz	From 30MHz to 1GHz
Detector Type	PK/AV *2)	QP	PK/AV *2)	QP	QP
IF Bandwidth	200Hz	200Hz	9kHz	9kHz	120kHz
Distance factor *1)	-80dB	-80dB	-80dB	-40dB	-

*1) -80dB = 40 x log (3m/300m)

-40dB = 40 x log (3m /30m)

*2) AV measurements were performed with AV detector since the duty cycle was 100%.

[PCU]

The noise levels were confirmed at each position of X, Y and Z axes of PCU to see the position of maximum noise, and the test was made at representative X-axis since no difference was found among each position.

[Antennas]

Below 30MHz: The carrier level (or, noise levels) was (or were) measured at each position of all three axes X, Y and Z, and the position that has the maximum noise was determined.

With the position, the noise levels of all the frequencies were measured.

Above 30MHz: The noise levels were confirmed at each position of X, Y and Z axes of Antennas to see the position of maximum noise, and the test was made at representative X-axis since no difference was found among each position.

Test data : APPENDIX 1
Test result : Pass

Date: May 2, 2014
May 7 and 8, 2014

Test engineer: Keisuke Kawamura
Shinya Watanabe

UL Japan, Inc.

Ise EMC Lab.

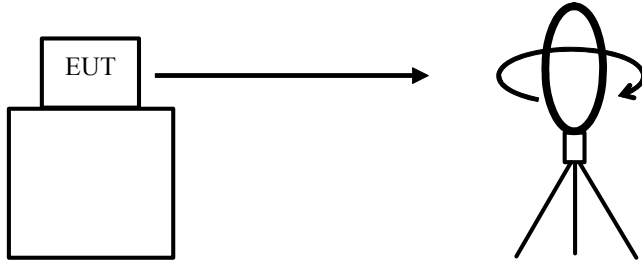
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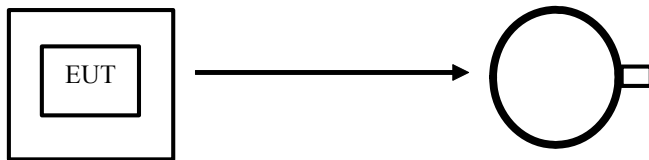
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

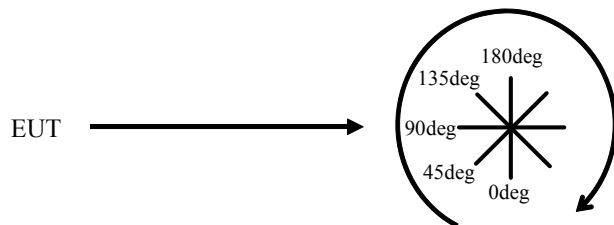


Top View (Horizontal)



Antenna was not rotated.

Top View (Vertical)



Front side: 0 deg.
Forward direction: clockwise

SECTION 6: -26dB Bandwidth

Test Procedure

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
-26dB Bandwidth	100kHz	1kHz	3kHz	Auto	Sample	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1
Test result : Pass

SECTION 7: 99% Occupied Bandwidth

Test Procedure

The measurement was performed in the antenna height to gain the maximum of Electric field strength.

Test	Span	RBW	VBW	Sweep	Detector	Trace	Instrument used
99% Occupied Bandwidth	Enough width to display 20dB Bandwidth	1 % of Span	Three times of RBW	Auto (Single)	Sample	Max Hold	Spectrum Analyzer

Test data : APPENDIX 1
Test result : Pass

APPENDIX 1: Data of EMI test

Radiated Emission below 30MHz (Fundamental and Spurious Emission)
(FRDR Non-metal Antenna)

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2014/05/08

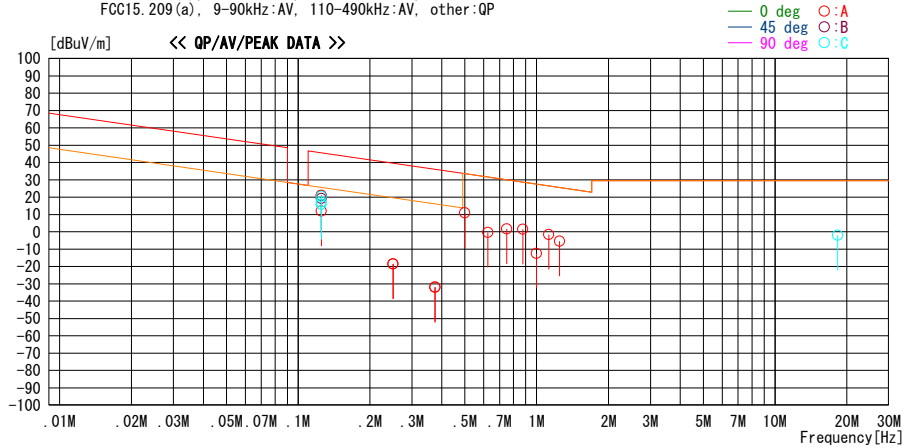
Report No. : 10310962H

Temp. / Humi. : 25deg. C / 13% RH

Engineer : Shinya Watanabe

Mode / Remarks : Tx 125kHz FRDR (Non metal) Antenna Worst Axis

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



Freq.	Reading	DET	Ant. Fac	Loss	Gain	Result	Limit	Margin	Antenna	Table	Comment
[MHz]	[dBuV]		[dB/m]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[deg]	[deg]	
0.12500	75.1	PEAK	20.0	-74.1	0.0	21.0	45.6	24.6	0	A	0
0.12500	75.0	AV	20.0	-74.1	0.0	20.9	25.6	4.7	0	A	0
0.12500	73.3	PEAK	20.0	-74.1	0.0	19.2	45.6	26.4	45	B	326
0.12500	69.8	PEAK	20.0	-74.1	0.0	15.7	45.6	29.9	90	C	89
0.12500	71.2	PEAK	20.0	-74.1	0.0	17.1	45.6	28.5	135	C	210
0.12500	74.6	PEAK	20.0	-74.1	0.0	20.5	45.6	25.1	180	C	0
0.12500	66.0	PEAK	20.0	-74.1	0.0	11.9	45.6	33.7	0	A	0
0.25000	35.6	PEAK	19.9	-74.0	0.0	-18.5	39.6	58.1	0	A	0
0.25000	35.5	AV	19.9	-74.0	0.0	-18.6	19.6	38.2	0	A	0
0.37500	22.4	PEAK	19.8	-74.0	0.0	-31.8	36.1	67.9	0	A	0
0.37500	22.1	AV	19.8	-74.0	0.0	-32.1	16.1	48.2	0	A	0
0.50000	25.1	QP	19.8	-34.0	0.0	10.9	33.6	22.7	0	A	0
0.62500	13.9	QP	19.8	-34.0	0.0	-0.3	31.7	32.0	0	A	0
0.75000	15.9	QP	19.8	-34.0	0.0	1.7	30.1	28.4	0	A	0
0.87500	15.6	QP	19.8	-34.0	0.0	1.4	28.7	27.3	0	A	0
1.00000	1.6	QP	19.8	-34.0	0.0	-12.6	27.6	40.2	0	A	0
1.12500	12.6	QP	19.8	-34.0	0.0	-1.6	26.5	28.1	0	A	0
1.25000	8.7	QP	19.8	-33.9	0.0	-5.4	25.6	31.0	0	A	0
18.33900	11.6	QP	19.8	-33.3	0.0	-1.9	29.5	31.4	90	C	276

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

- * All spurious emissions lower than this result.
- * Gain 0.0dB shows that the pre amplifier was not used to avoid the influence of carrier power.
The pre amplifier used for carrier frequency measurement was not saturated.
- *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 30MHz (Fundamental and Spurious Emission)
(FRDR Metal Antenna)

DATA OF RADIATED EMISSION TEST

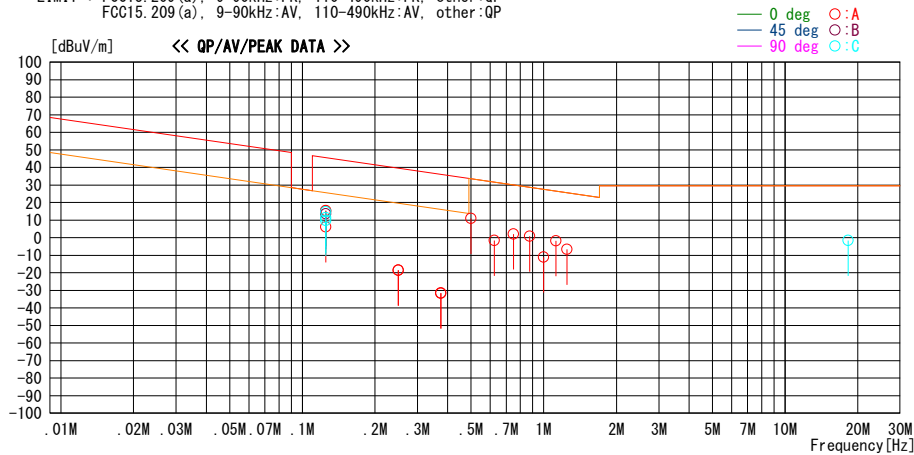
UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
 Date : 2014/05/08

Report No. : 10310962H

Temp./ Humi. : 25deg.C / 13% RH
 Engineer : Shinya Watanabe

Mode / Remarks : Tx 125kHz FRDR(Metal) Antenna Worst Axis

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



Freq. [MHz]	Reading [dBuV]	DET	Ant. Fac [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Antenna [deg]	Table	Comment
										[deg]	
0.12500	69.4	PEAK	20.0	-74.1	0.0	15.3	45.6	-30.3	0	A	0
0.12500	69.3	AV	20.0	-74.1	0.0	15.2	25.6	10.4	0	A	0
0.12500	67.6	PEAK	20.0	-74.1	0.0	13.5	45.6	32.1	45	B	331
0.12500	63.9	PEAK	20.0	-74.1	0.0	9.8	45.6	35.8	90	C	76
0.12500	65.5	PEAK	20.0	-74.1	0.0	11.4	45.6	34.2	135	C	212
0.12500	68.9	PEAK	20.0	-74.1	0.0	14.8	45.6	30.8	180	C	0
0.12500	60.2	PEAK	20.0	-74.1	0.0	6.1	45.6	39.5	0	A	0
0.25000	35.6	PEAK	19.9	-74.0	0.0	-18.5	39.6	58.1	0	A	0
0.25000	35.5	AV	19.9	-74.0	0.0	-18.6	19.6	38.2	0	A	0
0.37500	22.8	PEAK	19.8	-74.0	0.0	-31.4	36.1	67.5	0	A	0
0.37500	22.5	AV	19.8	-74.0	0.0	-31.7	16.1	47.8	0	A	0
0.50000	25.1	QP	19.8	-34.0	0.0	10.9	33.6	22.7	0	A	0
0.62500	12.7	QP	19.8	-34.0	0.0	-1.5	31.7	33.2	0	A	0
0.75000	16.2	QP	19.8	-34.0	0.0	2.0	30.1	28.1	0	A	0
0.87500	15.0	QP	19.8	-34.0	0.0	0.8	28.7	27.9	0	A	0
1.00000	3.2	QP	19.8	-34.0	0.0	-11.0	27.6	38.6	0	A	0
1.12500	12.4	QP	19.8	-34.0	0.0	-1.8	26.5	28.3	0	A	0
1.25000	7.5	QP	19.8	-33.9	0.0	-6.6	25.6	32.2	0	A	0
18.23900	11.9	QP	19.8	-33.3	0.0	-1.6	29.5	31.1	90	C	212

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

- * All spurious emissions lower than this result.
- * Gain 0.0dB shows that the pre amplifier was not used to avoid the influence of carrier power.
The pre amplifier used for carrier frequency measurement was not saturated.
- *The test result is rounded off to one or two decimal places, so some differences might be observed.

Radiated Emission below 30MHz (Fundamental and Spurious Emission) (TR Antenna)

DATA OF RADIATED EMISSION TEST

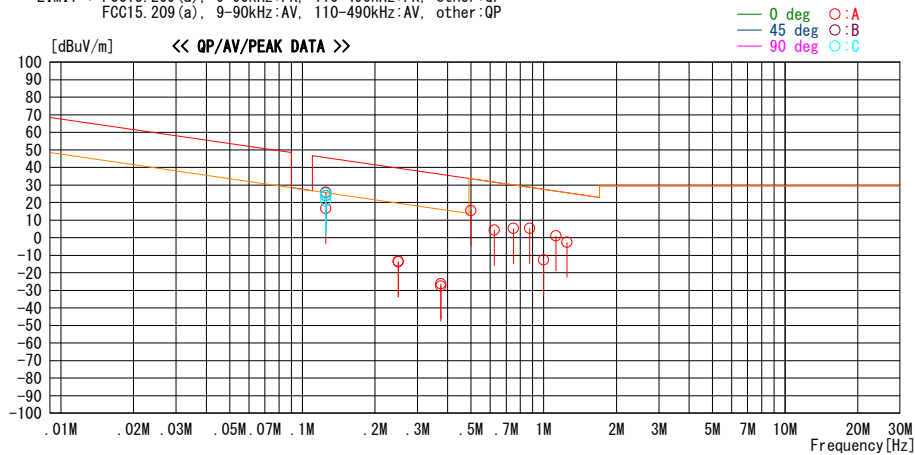
UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2014/05/07

Report No. : 10310962H

Temp./ Humi. : 25deg.C / 13% RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 125kHz TR Antenna Worst Axis

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



Freq. [MHz]	Reading [dBuV]	DET	Ant. Fac [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Antenna [deg]	Table	Comment
										[deg]	
0.12500	79.9	PEAK	20.0	-74.1	0.0	25.8	45.6	19.8	0	A	0
0.12500	79.6	AV	20.0	-74.1	0.0	25.5	25.6	0.1	0	A	0
0.12500	77.9	PEAK	20.0	-74.1	0.0	23.8	45.6	21.8	45	B	326
0.12500	75.0	PEAK	20.0	-74.1	0.0	20.9	45.6	24.7	90	C	79
0.12500	77.8	PEAK	20.0	-74.1	0.0	23.7	45.6	21.9	135	C	211
0.12500	79.3	PEAK	20.0	-74.1	0.0	25.2	45.6	20.4	180	C	176
0.12500	70.6	PEAK	20.0	-74.1	0.0	16.5	45.6	29.1	0	A	Hol.
0.25000	40.6	PEAK	19.9	-74.0	0.0	-13.5	39.6	53.1	0	A	0
0.25000	40.3	AV	19.9	-74.0	0.0	-13.8	19.6	33.4	0	A	0
0.37500	27.9	PEAK	19.8	-74.0	0.0	-26.3	36.1	62.4	0	A	0
0.37500	26.5	AV	19.8	-74.0	0.0	-27.7	16.1	43.8	0	A	0
0.50000	29.6	QP	19.8	-34.0	0.0	15.4	33.6	18.2	0	A	0
0.62500	18.4	QP	19.8	-34.0	0.0	4.2	31.7	27.5	0	A	0
0.75000	19.4	QP	19.8	-34.0	0.0	5.2	30.1	24.9	0	A	0
0.87500	19.4	QP	19.8	-34.0	0.0	5.2	28.7	23.5	0	A	0
1.00000	1.5	QP	19.8	-34.0	0.0	-12.7	27.6	40.3	0	A	NS
1.12500	15.3	QP	19.8	-34.0	0.0	1.1	26.5	25.4	0	A	0
1.25000	11.5	QP	19.8	-33.9	0.0	-2.6	25.6	28.2	0	A	0

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

- * All spurious emissions lower than this result.
- * Gain 0.0dB shows that the pre amplifier was not used to avoid the influence of carrier power.
The pre amplifier used for carrier frequency measurement was not saturated.
- *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 30MHz (Fundamental and Spurious Emission)
(M/TI Antenna)

DATA OF RADIATED EMISSION TEST

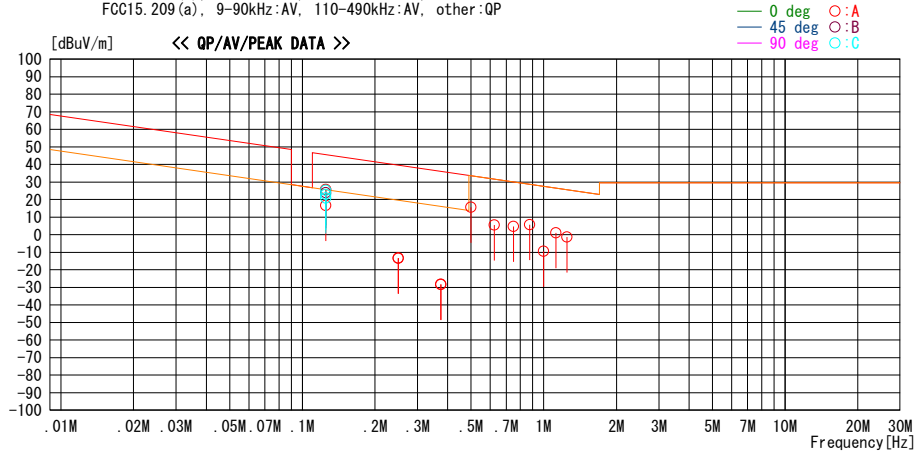
UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
 Date : 2014/05/08

Report No. : 10310962H

Temp./ Humi. : 25deg.C / 13% RH
 Engineer : Shinya Watanabe

Mode / Remarks : Tx 125kHz M/TI Antenna Worst Axis

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



Freq. [MHz]	Reading [dBuV]	DET	Ant. Fac [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Antenna [deg]	Table	Comment
										[deg]	
0.12500	79.7	PEAK	20.0	-74.1	0.0	25.6	45.6	20.0	0	A	0
0.12500	79.5	AV	20.0	-74.1	0.0	25.4	25.6	0.2	0	A	0
0.12500	77.9	PEAK	20.0	-74.1	0.0	23.8	45.6	21.8	45	B	342
0.12500	74.9	PEAK	20.0	-74.1	0.0	20.8	45.6	24.8	90	C	86
0.12500	77.0	PEAK	20.0	-74.1	0.0	22.9	45.6	22.7	135	C	215
0.12500	79.3	PEAK	20.0	-74.1	0.0	25.2	45.6	20.4	180	C	0
0.12500	70.7	PEAK	20.0	-74.1	0.0	16.6	45.6	29.0	0	A	Hol.
0.25000	40.7	PEAK	19.9	-74.0	0.0	-13.4	39.6	53.0	0	A	0
0.25000	40.6	AV	19.9	-74.0	0.0	-13.5	19.6	33.1	0	A	0
0.37500	25.9	PEAK	19.8	-74.0	0.0	-28.3	36.1	64.4	0	A	0
0.37500	25.8	AV	19.8	-74.0	0.0	-28.4	16.1	44.5	0	A	0
0.50000	29.7	QP	19.8	-34.0	0.0	15.5	33.6	18.1	0	A	0
0.62500	19.7	QP	19.8	-34.0	0.0	5.5	31.7	26.2	0	A	0
0.75000	18.8	QP	19.8	-34.0	0.0	4.6	30.1	25.5	0	A	0
0.87500	19.9	QP	19.8	-34.0	0.0	5.7	28.7	23.0	0	A	0
1.00000	4.8	QP	19.8	-34.0	0.0	-9.4	27.6	37.0	0	A	0
1.12500	15.2	QP	19.8	-34.0	0.0	1.0	26.5	25.5	0	A	0
1.25000	12.8	QP	19.8	-33.9	0.0	-1.3	25.6	26.9	0	A	0

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

- * All spurious emissions lower than this result.
- * Gain 0.0dB shows that the pre amplifier was not used to avoid the influence of carrier power.
The pre amplifier used for carrier frequency measurement was not saturated.
- *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 30MHz (Fundamental and Spurious Emission) (F Antenna)

DATA OF RADIATED EMISSION TEST

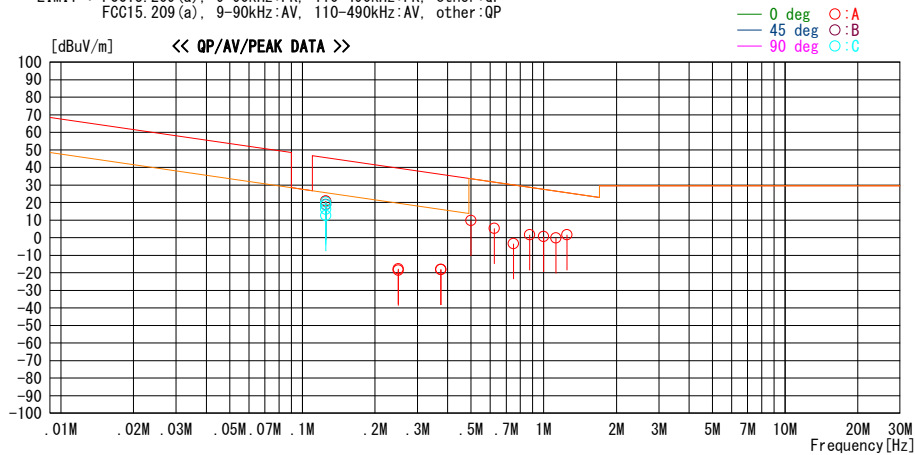
UL Japan, Inc. Ise EMC Lab. No.3 Semi Anechoic Chamber
Date : 2014/05/07

Report No. : 10310962H

Temp./ Humi. : 25deg.C / 13% RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 125kHz F Antenna Worst Axis

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



Freq. [MHz]	Reading [dBuV]	DET	Ant. Fac [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Antenna [deg]	Table	Comment
										[deg]	
0.12500	74.9	PEAK	20.0	-74.1	0.0	20.8	45.6	24.8	0	A	0
0.12500	74.7	AV	20.0	-74.1	0.0	20.6	25.6	5.0	0	A	0
0.12500	72.9	PEAK	20.0	-74.1	0.0	18.8	45.6	26.8	45	B	320
0.12500	70.3	PEAK	20.0	-74.1	0.0	16.2	45.6	29.4	90	C	93
0.12500	72.8	PEAK	20.0	-74.1	0.0	18.7	45.6	26.9	135	C	201
0.12500	74.3	PEAK	20.0	-74.1	0.0	20.2	45.6	25.4	180	C	0
0.12500	66.7	PEAK	20.0	-74.1	0.0	12.6	45.6	33.0	0	C	HoI.
0.25000	36.4	PEAK	19.9	-74.0	0.0	-17.7	39.6	57.3	0	A	0
0.25000	35.5	AV	19.9	-74.0	0.0	-18.6	19.6	38.2	0	A	0
0.37500	36.1	PEAK	19.8	-74.0	0.0	-18.1	36.1	54.2	0	A	180
0.37500	36.0	AV	19.8	-74.0	0.0	-18.2	16.1	34.3	0	A	180
0.50000	24.0	QP	19.8	-34.0	0.0	9.8	33.6	23.8	0	A	0
0.62500	19.5	QP	19.8	-34.0	0.0	5.3	31.7	26.4	0	A	0
0.75000	10.8	QP	19.8	-34.0	0.0	-3.4	30.1	33.5	0	A	0
0.87500	15.8	QP	19.8	-34.0	0.0	1.6	28.7	27.1	0	A	0
1.00000	14.9	QP	19.8	-34.0	0.0	0.7	27.6	26.9	0	A	0
1.12500	14.0	QP	19.8	-34.0	0.0	-0.2	26.5	26.7	0	A	0
1.25000	15.7	QP	19.8	-33.9	0.0	1.6	25.6	24.0	0	A	0

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

- * All spurious emissions lower than this result.
- * Gain 0.0dB shows that the pre amplifier was not used to avoid the influence of carrier power.
The pre amplifier used for carrier frequency measurement was not saturated.
- *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 30MHz (Fundamental and Spurious Emission)

Results of the fundamental emission at 3m without Distance factor

(FRDR Non-metal Antenna)

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	75.1	20.0	6.1	0.0	-	101.2	-	-	Fundamental

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

(FRDR Metal Antenna)

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	69.4	20.0	6.1	0.0	-	95.5	-	-	Fundamental

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

(TR Antenna)

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	79.9	20.0	6.1	0.0	-	106.0	-	-	Fundamental

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

(M/TI Antenna)

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	79.7	20.0	6.1	0.0	-	105.8	-	-	Fundamental

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

(F Antenna)

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	74.9	20.0	6.1	0.0	-	101.0	-	-	Fundamental

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

* All spurious emissions lower than these results.

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Radiated Emission above 30MHz (Spurious Emission)

DATA OF RADIATED EMISSION TEST

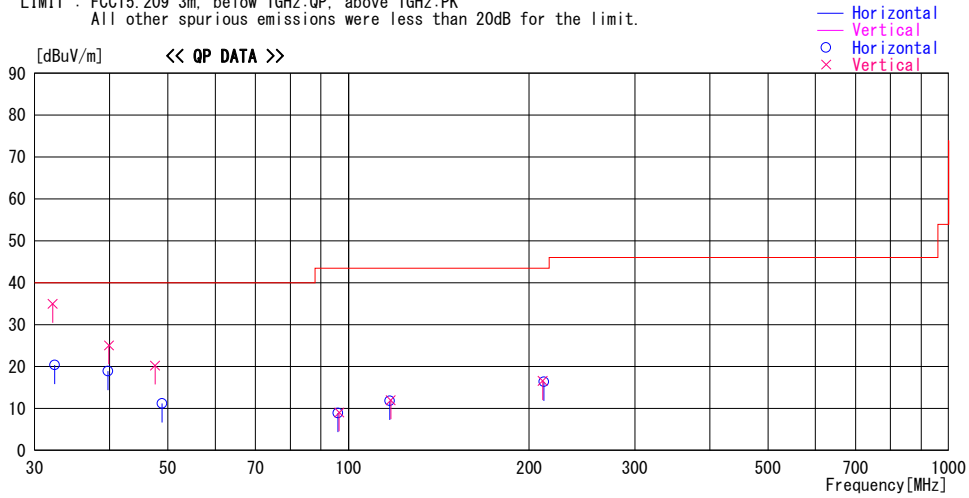
UL Japan, Inc. Ise EMC Lab. No. 4 Semi Anechoic Chamber
Date: 2014/05/02

Report No. : 10310962H

Temp./Humi. : 24deg. C / 36% RH
Engineer : Keisuke Kawamura

Mode / Remarks : Tx 125kHz Modulation On FRDR_Antenna_Metal Worst-axis(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	Angle	Height	Polar.	Limit	Margin	Comment
			Factor	Gain							
[dB/m]	[dB]	[dBuV/m]	[Deg]	[cm]	[dBuV/m]	[dB]					
32.392	28.5	QP	16.9	-25.0	20.4	356	313	Hori.	40.0	19.6	
32.164	43.0	QP	17.0	-25.0	35.0	124	100	Vert.	40.0	5.0	
39.739	29.3	QP	14.6	-24.9	19.0	0	311	Hori.	40.0	21.1	
39.879	35.4	QP	14.6	-24.9	25.1	113	100	Vert.	40.0	14.9	
47.642	33.3	QP	11.7	-24.7	20.3	84	100	Vert.	40.0	19.8	
48.938	24.6	QP	11.3	-24.7	11.2	0	247	Hori.	40.0	28.8	
96.012	23.4	QP	9.5	-24.0	8.9	0	300	Hori.	43.5	34.6	
96.553	23.5	QP	9.6	-24.0	9.1	181	100	Vert.	43.5	34.4	
117.114	23.0	QP	12.6	-23.8	11.8	2	300	Hori.	43.5	31.7	
117.655	23.1	QP	12.7	-23.8	12.0	1	100	Vert.	43.5	31.5	
210.721	22.6	QP	16.7	-22.7	16.6	5	100	Vert.	43.5	26.9	
211.803	22.4	QP	16.7	-22.7	16.4	0	300	Hori.	43.5	27.1	

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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Radiated Emission above 30MHz (Spurious Emission)

DATA OF RADIATED EMISSION TEST

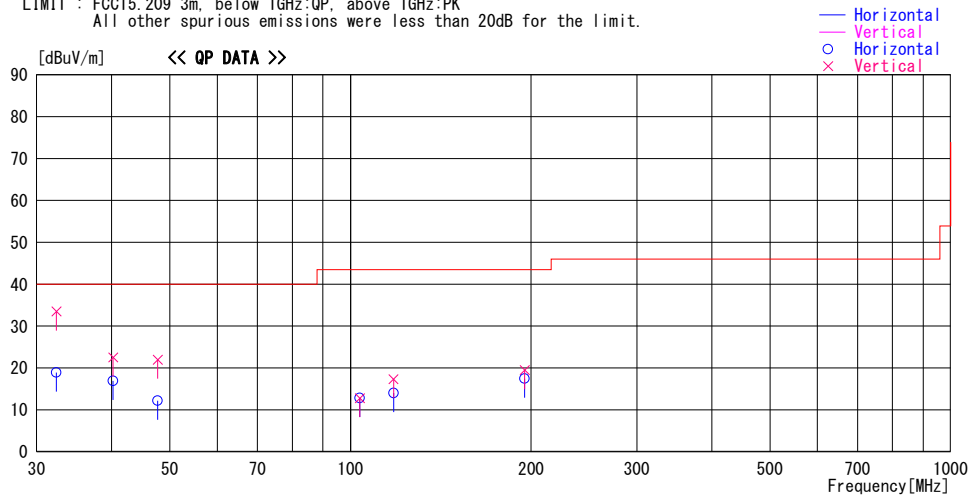
UL Japan, Inc. Ise EMC Lab. No.4 Semi Anechoic Chamber
 Date: 2014/05/02

Report No. : 10310962H

Temp./Humi. : 24deg. C / 36% RH
 Engineer : Keisuke Kawamura

Mode / Remarks : Tx 125kHz Modulation On FRDR_Antenna_Non-Metal Worst-axis(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]							
32.369	27.0	QP	16.9	-25.0	18.9	356	313	Hori.	40.0	21.1	
32.369	41.6	QP	16.9	-25.0	33.5	263	100	Vert.	40.0	6.5	
40.245	27.4	QP	14.4	-24.8	17.0	203	306	Hori.	40.0	23.0	
40.245	32.9	QP	14.4	-24.8	22.5	105	100	Vert.	40.0	17.5	
47.757	35.1	QP	11.6	-24.7	22.0	61	100	Vert.	40.0	18.0	
47.757	25.3	QP	11.6	-24.7	12.2	188	274	Hori.	40.0	27.8	
103.714	26.0	QP	10.8	-24.0	12.8	7	305	Hori.	43.5	30.7	
103.714	26.0	QP	10.8	-24.0	12.8	113	100	Vert.	43.5	30.7	
117.946	25.1	QP	12.7	-23.8	14.0	193	295	Hori.	43.5	29.5	
117.946	28.5	QP	12.7	-23.8	17.4	59	100	Vert.	43.5	26.1	
195.065	26.0	QP	16.5	-23.0	19.5	5	100	Vert.	43.5	24.0	
195.065	24.0	QP	16.5	-23.0	17.5	16	288	Hori.	43.5	26.0	

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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Radiated Emission above 30MHz (Spurious Emission)

DATA OF RADIATED EMISSION TEST

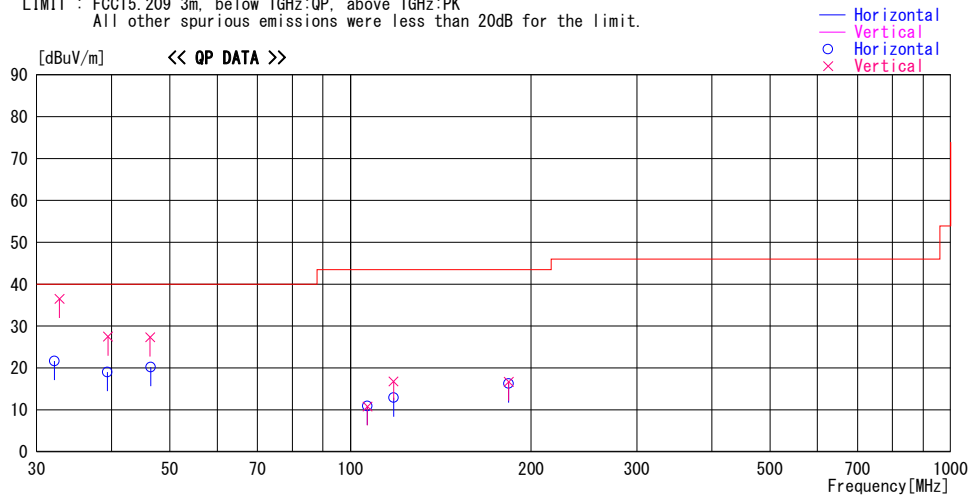
UL Japan, Inc. Ise EMC Lab. No. 4 Semi Anechoic Chamber
 Date: 2014/05/02

Report No. : 10310962H

Temp./Humi. : 24deg. C / 36% RH
 Engineer : Keisuke Kawamura

Mode / Remarks : Tx 125kHz Modulation On F_Antenna Worst-axis(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]							
32.123	29.6	QP	17.0	-25.0	21.6	356	322	Hori.	40.0	18.4	
32.747	44.6	QP	16.9	-25.0	36.5	257	100	Vert.	40.0	3.5	
39.358	29.2	QP	14.8	-24.9	19.1	196	295	Hori.	40.0	21.0	
39.464	37.7	QP	14.7	-24.9	27.5	103	100	Vert.	40.0	12.5	
46.379	39.9	QP	12.1	-24.7	27.3	69	100	Vert.	40.0	12.7	
46.490	32.9	QP	12.0	-24.7	20.2	183	337	Hori.	40.0	19.8	
106.714	23.6	QP	11.2	-23.9	10.9	6	305	Hori.	43.5	32.6	
106.714	23.5	QP	11.2	-23.9	10.8	22	100	Vert.	43.5	32.7	
117.955	24.0	QP	12.7	-23.8	12.9	223	274	Hori.	43.5	30.6	
117.955	27.9	QP	12.7	-23.8	16.8	46	100	Vert.	43.5	26.7	
183.500	23.5	QP	16.3	-23.1	16.7	5	100	Vert.	43.5	26.8	
183.500	23.1	QP	16.3	-23.1	16.3	1	284	Hori.	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 & 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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Radiated Emission above 30MHz (Spurious Emission)

DATA OF RADIATED EMISSION TEST

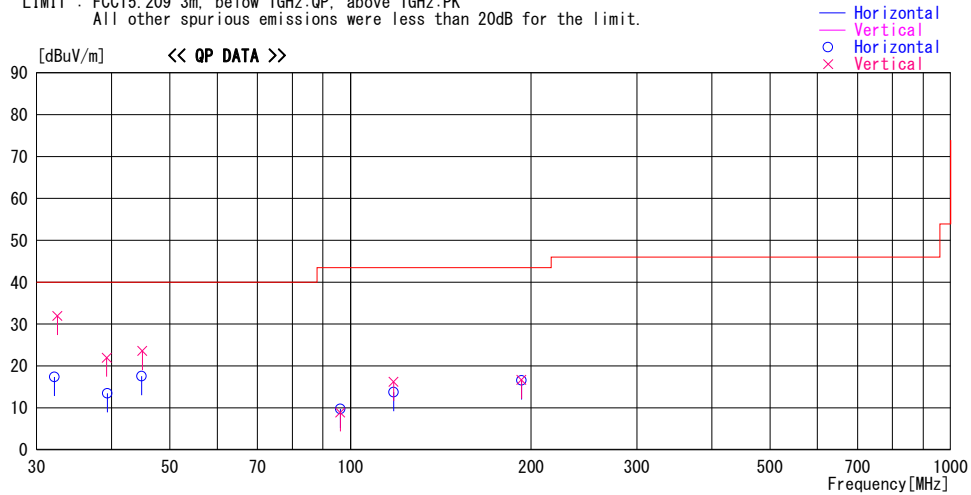
UL Japan, Inc. Ise EMC Lab. No. 4 Semi Anechoic Chamber
 Date: 2014/05/02

Report No. : 10310962H

Temp./Humi. : 24deg. C / 36% RH
 Engineer : Keisuke Kawamura

Mode / Remarks : Tx 125kHz Modulation On M/TI_Antenna Worst-axis(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		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss& Gain [dB]							
32.123	25.4	QP	17.0	-25.0	17.4	357	339	Hori.	40.0	22.6	
32.484	40.0	QP	16.9	-25.0	31.9	252	100	Vert.	40.0	8.1	
39.358	23.6	QP	14.8	-24.9	13.5	77	295	Hori.	40.0	26.5	
39.247	32.1	QP	14.8	-24.9	22.0	131	100	Vert.	40.0	18.0	
44.988	35.8	QP	12.5	-24.7	23.6	174	100	Vert.	40.0	16.4	
44.888	29.8	QP	12.6	-24.8	17.6	183	337	Hori.	40.0	22.4	
96.163	24.3	QP	9.5	-24.0	9.8	7	303	Hori.	43.5	33.7	
96.163	23.4	QP	9.5	-24.0	8.9	35	100	Vert.	43.5	34.6	
117.950	24.8	QP	12.7	-23.8	13.7	213	293	Hori.	43.5	29.8	
117.950	27.3	QP	12.7	-23.8	16.2	67	100	Vert.	43.5	27.3	
192.718	23.3	QP	16.4	-23.0	16.7	10	100	Vert.	43.5	26.8	
192.718	23.2	QP	16.4	-23.0	16.6	9	298	Hori.	43.5	26.9	

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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Radiated Emission above 30MHz (Spurious Emission)

DATA OF RADIATED EMISSION TEST

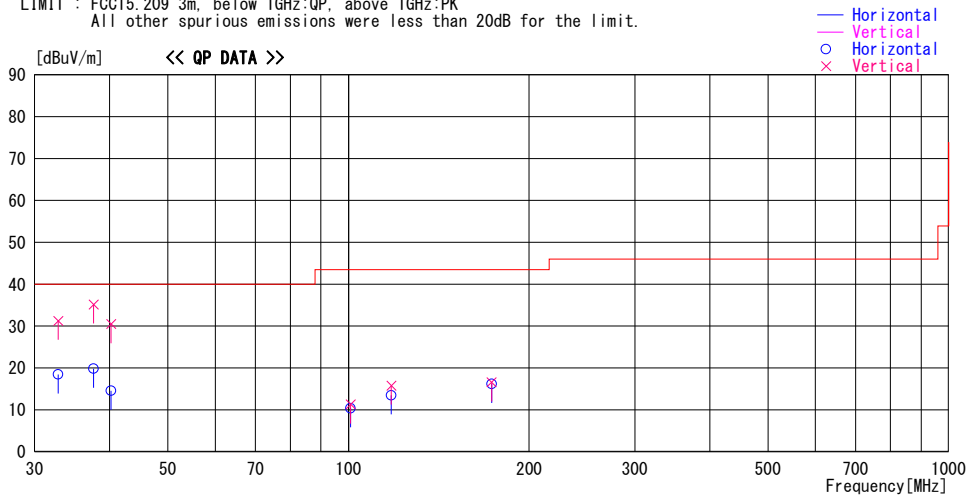
UL Japan, Inc. Ise EMC Lab. No. 4 Semi Anechoic Chamber
 Date: 2014/05/02

Report No. : 10310962H

Temp./Humi. : 24deg. C / 36% RH
 Engineer : Keisuke Kawamura

Mode / Remarks : Tx 125kHz Modulation On TR_Antenna Worst-axis(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		Level [dBuV/m]	Angle [Deg]	Height [cm]	Polar.	Limit [dBuV/m]	Margin [dB]	Comment
			Factor [dB/m]	Loss& Gain [dB]							
32.855	26.7	QP	16.8	-25.0	18.5	352	345	Hori.	40.0	21.5	
32.855	39.5	QP	16.8	-25.0	31.3	126	100	Vert.	40.0	8.7	
37.615	29.3	QP	15.4	-24.9	19.8	186	345	Hori.	40.0	20.2	
37.615	44.7	QP	15.4	-24.9	35.2	139	100	Vert.	40.0	4.8	
40.247	40.9	QP	14.4	-24.8	30.5	222	100	Vert.	40.0	9.5	
40.247	25.0	QP	14.4	-24.8	14.6	156	321	Hori.	40.0	25.4	
100.820	24.1	QP	10.3	-24.0	10.4	186	303	Hori.	43.5	33.1	
100.820	25.0	QP	10.3	-24.0	11.3	22	100	Vert.	43.5	32.2	
117.936	24.6	QP	12.7	-23.8	13.5	201	301	Hori.	43.5	30.0	
117.936	26.9	QP	12.7	-23.8	15.8	20	100	Vert.	43.5	27.7	
173.295	23.7	QP	16.0	-23.1	16.6	10	100	Vert.	43.5	26.9	
173.295	23.3	QP	16.0	-23.1	16.2	11	304	Hori.	43.5	27.3	

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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-26dB Bandwidth and 99% Occupied Bandwidth

Test place Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No. 10310962H
Date 05/08/2014
Temperature/ Humidity 25 deg. C / 43% RH
Engineer Shinya Watanabe
Mode Tx 125kHz

Mode	Frequency [kHz]	-26dB Bandwidth [kHz]	99% Occupied Bandwidth [kHz]
FRDR(Non metal) Antenna	125	2.895	2.164
FRDR(Metal) Antenna	125	2.890	2.165
TR Antenna	125	2.890	2.162
M/TI Antenna	125	2.888	2.164
F Antenna	125	2.889	2.889

UL Japan, Inc.

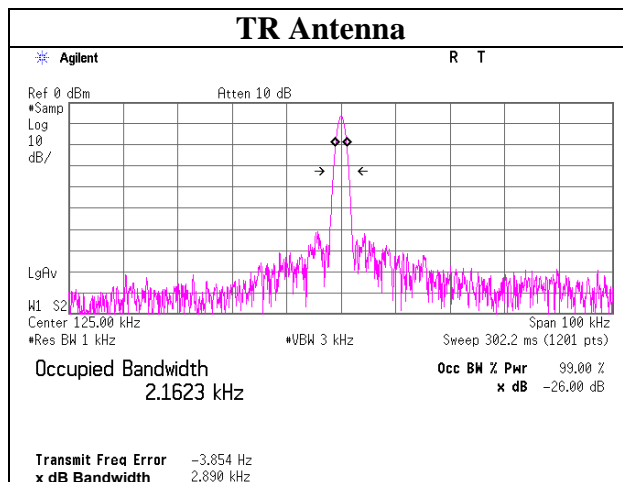
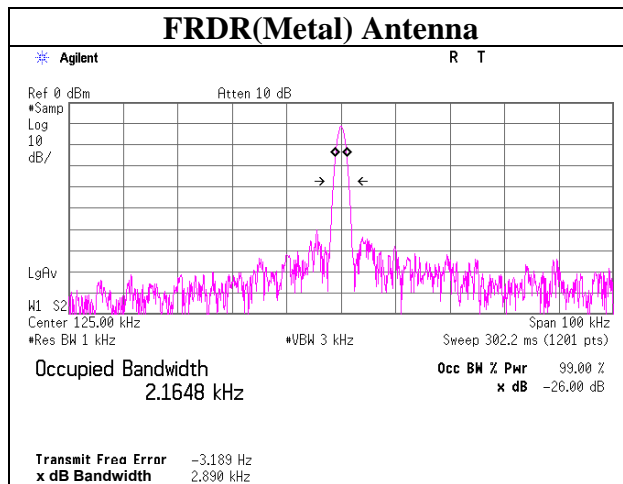
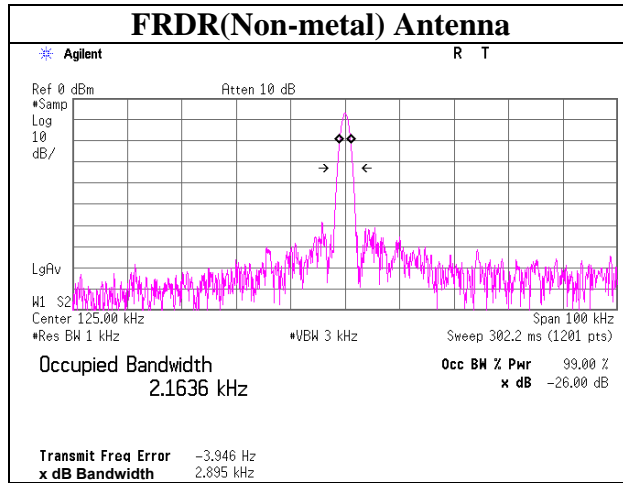
Ise EMC Lab.

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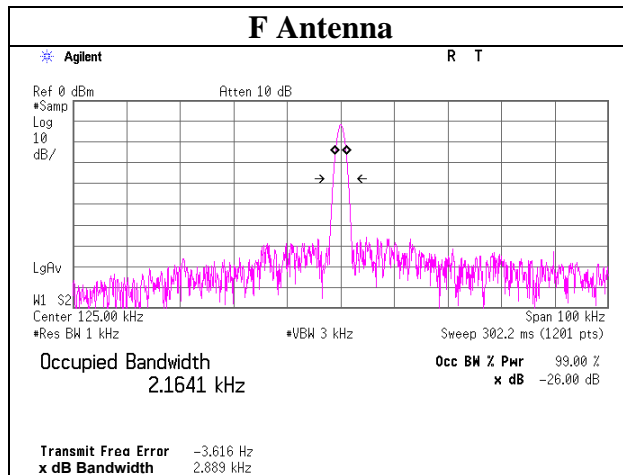
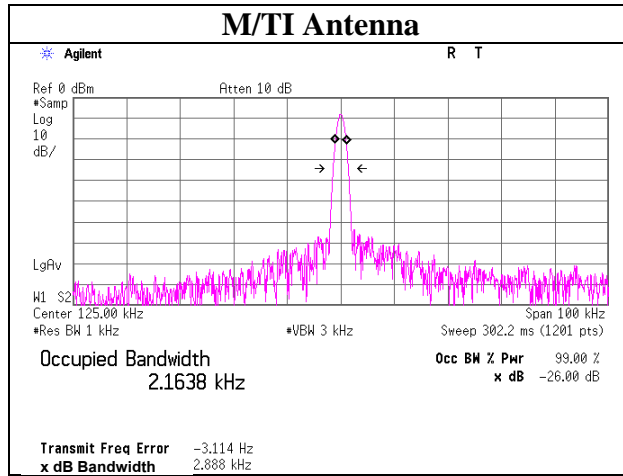
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-26dB Bandwidth and 99% Occupied Bandwidth



-26dB Bandwidth and 99% Occupied Bandwidth



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APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2014/02/28 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE	2014/02/20 * 12
MJM-09	Measure	KDS	E19-55	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MTR-01	Test Receiver	Rohde & Schwarz	ESI40	100084	RE	2013/11/12 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2013/11/24 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2013/11/24 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2013/06/18 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2013/11/26 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2014/03/14 * 12
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2014/02/27 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2014/02/20 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2013/08/20 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2013/10/30 * 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	2013/07/23 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2013/07/22 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2014/03/14 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2014/04/14 * 12
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2014/04/08 * 12

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test Item:

RE: Spurious emission

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