



RADIO TEST REPORT

Test Report No. : 32JE0268-HO-02-A-R2

Applicant : DENSO CORPORATION
Type of Equipment : Passive Entry Passive Start System (LF Transmitter)
Model No. : UPE01
FCC ID : HYQUPE01
Test regulation : FCC Part 15 Subpart C: 2012
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 32JE0268-HO-02-A-R1. 32JE0268-HO-02-A-R1 is replaced with this report.

Date of test: June 9 to September 11, 2012

Representative test engineer:

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Tomohisa Nakagawa
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Approved by:

T. Hatakechi
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UL Verification Service



NVLAP LAB CODE: 200572-0

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13-EM-F0429

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SECTION 1: Customer information

Company Name : DENSO CORPORATION
Address : 1-1 Showa-cho, Kariya-shi, Aichi-ken, 448-8661 Japan
Telephone Number : +81-566-61-2507
Facsimile Number : +81-566-25-4837
Contact Person : TOSHIO SHIMOMURA

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

2.1 Identification of E.U.T.

Type of Equipment : Passive Entry Passive Start System (LF Transmitter)
Model No. : UPE01
Serial No. : Refer to Section 4, Clause 4.2
Receipt Date of Sample : June 7, 2012
Country of Mass-production : United states of America and China
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

General Specification

Clock frequency(ies) in the system : MPU: 4MHz

Radio Specification

Radio Type : LF Transmitter
Frequency of Operation : 125kHz
Oscillation circuit : Ceramic resonator
Oscillator frequency : 8MHz Resonator
Modulation : OOK
Power Supply (inner) : DC 12.0V
Antenna port type : Port type1: Ant 1, 2, 6
(Not inserted resistance between LF Drive Circuit and Output Port in series)
Port type2: Ant 3, 4, 5
(Inserted resistance between LF Drive Circuit and Output Port in series)
Antenna specification : Ferrite antenna coil (impedance $2\ \Omega$ - $54\ \Omega$)[End user cannot control impedance since it is fixed depending on each system]
Transmitting out put current : 50mA - 1000mA [End user cannot control output current since it is fixed depending on each system]

This system has ports three Port type1 and three Port type2.

These 6 ports do not transmit simultaneously.

The application document indicats a relationship between transmitting output current and output field strength by the difference in an antenna impedance.

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2012, final revised on August 13, 2012 and effective September 12, 2012

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 August 13, 2012 does not affect the test specification applied to the EUT.

FCC 15.31 (e)

The EUT is a battery-operated device and test was performed with the full-charged 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 C63.4:2003 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	1.0dB 0.12500MHz 0 deg. PK with Duty factor (Ant1-Max Power)	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	4.5dB 143.850MHz, 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.

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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 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.

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	4.2dB	5.0dB	5.1dB	4.7dB	5.7dB	4.4dB	4.3dB
No.2	4.1dB	5.2dB	5.1dB	4.8dB	5.6dB	4.3dB	4.2dB
No.3	4.5dB	5.0dB	5.2dB	4.8dB	5.6dB	4.5dB	4.2dB
No.4	4.7dB	5.2dB	5.2dB	4.8dB	5.6dB	5.1dB	4.2dB

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

Radiated emission test(3m)

[Electric Field Strength of Fundamental Emission]

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

[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. Head Office EMC Lab. *NVLAP Lab. code: 200572-0
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	FCC Registration Number	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	313583	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	655103	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	148738	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	134570	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	4.75 x 5.4 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 4.5 x 2.8m	2.0 x 2.0m	-
No.10 measurement room	-	-	2.6 x 2.8 x 2.5m	2.4 x 2.4m	-
No.11 measurement room	-	-	3.1 x 3.4 x 3.0m	2.4 x 3.4m	-

* 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.

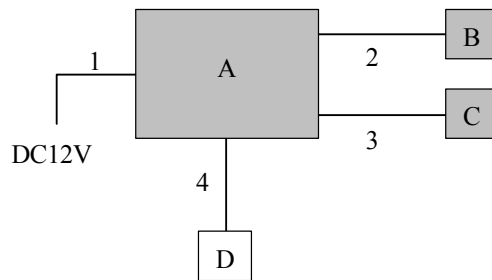
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Modes

Mode	Remarks
(1)Transmitting mode (Tx) Output current 1000mA	Antenna impedance 2Ω Max power *1)
(2)Transmitting mode (Tx) Output current 50mA	Antenna impedance 54Ω Min power *1)
(3)Transmitting mode (Tx) Output current 1000mA	Antenna impedance 54Ω *1)
(4) Normal Transmitting mode (Normal Tx) Output current 1000mA	Antenna impedance 2Ω Max power

*1) The test was performed with one representative antenna on continuous transmitting mode.
This transmission timing was worse than the one using six antennas of normal use.

4.2 Configuration and peripherals



* For two Antenna ports (Port type1 and Port type2), one representative port of each was evaluated.
* Cabling and setup were taken into consideration and test data was taken under worse case conditions.
* Mode (3) was checked if a noise was not radiated in space at the time of high impedance (54Ω) and Max output current (1000mA)

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Passive Entry Passive Start System (LF Transmitter)	UPE01	00022*1) *2) *3) 00021*4)	DENSO CORPORATION	EUT
B	Ant1	TN233800-001	002 *1) *4) 004 *2) *3)	DENSO CORPORATION	EUT for port type1
C	Ant4	TN233800-001	001 *1) *4) 003 *2)	DENSO CORPORATION	EUT for port type2
D	Evaluation Bench	-	-	DENSO CORPORATION	-

*1) Used for Mode (1).
*2) Used for Mode (2).
*3) Used for Mode (3).
*4) Used for Mode (4).

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	3.0	Unshielded	Unshielded	-
2	Antenna Cable	3.2	Unshielded	Unshielded	-
3	Antenna Cable	3.2	Unshielded	Unshielded	-
4	Signal Cable	3.0	Unshielded	Unshielded	-

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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 2 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., and 135 deg.) 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, PK, and PK with Duty factor.

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 and PK with Duty factor	QP	PK and PK with Duty factor	QP	QP
IF Bandwidth	200Hz	200Hz	9kHz	9kHz	120kHz

*This EUT is to be installed in vehicles. In the set-up configuration for the tests, the antenna and the body of EUT were set on three positions of X, Y, and Z axis respectively.

- 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.

* Part 15 Section 15.31 (f)(2) (9kHz-30MHz)

[Limit at 3m]=[Limit at 300m]-40 x log (3[m]/300[m])

[Limit at 3m]=[Limit at 30m]-40 x log (3[m]/30[m])

Test data : APPENDIX 1

Test result : Pass

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

Date: June 9, 10 and 21, 2012

Test engineer: Tomohisa Nakagawa

UL Japan, Inc.

Head Office EMC Lab.

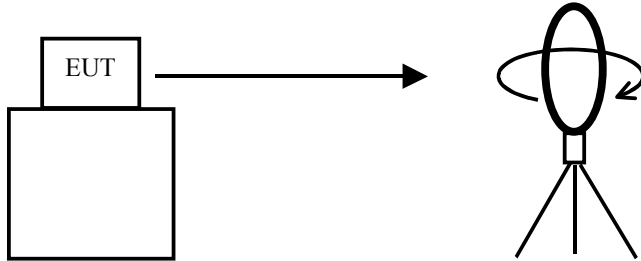
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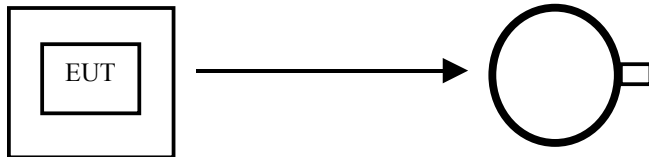
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)

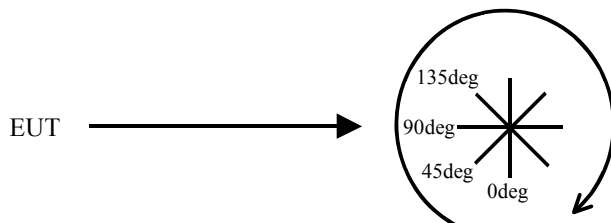


Top View (Horizontal)



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	200kHz	2kHz	6.2kHz	Auto	Peak	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	Peak *1)	Max Hold *1)	Spectrum Analyzer

*1) The measurement was performed with Peak detector, Max Hold since the duty cycle was not 100%.

Test data : APPENDIX 1
Test result : Pass

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APPENDIX 1: Data of EMI test

Radiated Emission below 30MHz (Fundamental and Spurious Emission)

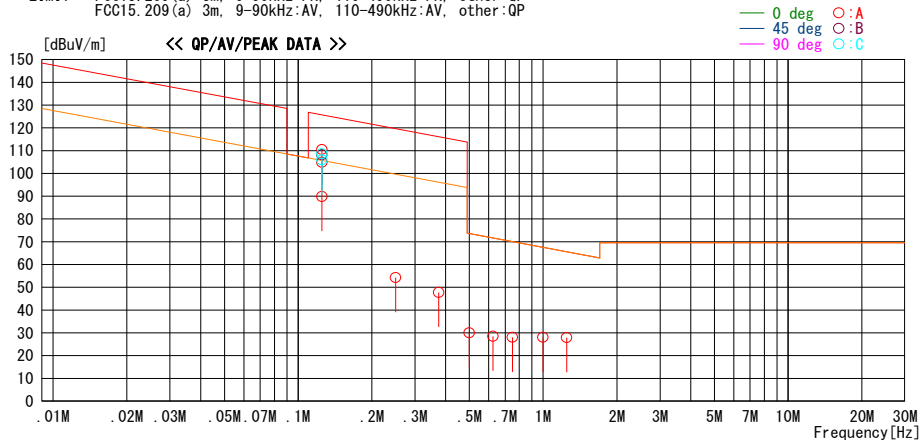
Ant1 Max power (Output current 1000mA, Antenna impedance 2Ω)

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
Date : 2012/06/10

Report No. : 32JE0268-H0-02
 Temp./ Humi. : 23deg. C / 47% RH
 Engineer : Tomohisa Nakagawa

Mode / Remarks : Tx 125kHz, Ant1 Max Power 1000mA
 LIMIT : FCC15.209(a) 3m, 9-90kHz:PK, 110-490kHz:PK, other:QP
 FCC15.209(a) 3m, 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	84.5	PEAK	19.9	6.0	0.0	110.4	125.7	15.3	0	A	0
0.12500	84.5	PEAK*2)	19.9	0.3	0.0	104.7	105.7	1.0	0	A	0
0.12500	82.3	PEAK	19.9	6.0	0.0	108.2	125.7	17.5	45	B	161
0.12500	80.1	PEAK	19.9	6.0	0.0	106.0	125.7	19.7	90	C	70
0.12500	82.8	PEAK	19.9	6.0	0.0	108.7	125.7	17.0	135	C	189
0.12500	64.0	PEAK	19.9	6.0	0.0	89.9	125.7	35.8	0	A	0
0.25000	28.4	PEAK	19.7	6.1	0.0	54.2	119.7	65.5	0	A	0
0.37500	21.9	PEAK	19.7	6.1	0.0	47.7	116.1	68.4	0	A	0
0.50000	4.3	QP	19.6	6.1	0.0	30.0	73.6	43.6	0	A	0
0.62500	2.7	QP	19.6	6.2	0.0	28.5	71.7	43.2	0	A	0
0.75000	2.3	QP	19.6	6.2	0.0	28.1	70.1	42.0	0	A	0
1.00000	2.4	QP	19.5	6.2	0.0	28.1	67.6	39.5	0	A	0
1.25000	2.2	QP	19.5	6.2	0.0	27.9	65.6	37.7	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. + DutyFac.) - Gain(AMP)

- *The test result is rounded off to one or two decimal places, so some differences might be observed.
- *1) Testing with an average detector was excluded, because emission level with a peak detector met the limit of an average detector.
- *2)The Result is included Duty Factor.

Radiated Emission below 30MHz (Fundamental and Spurious Emission)
Ant1 Min power (Output current 50mA, Antenna impedance 54Ω)

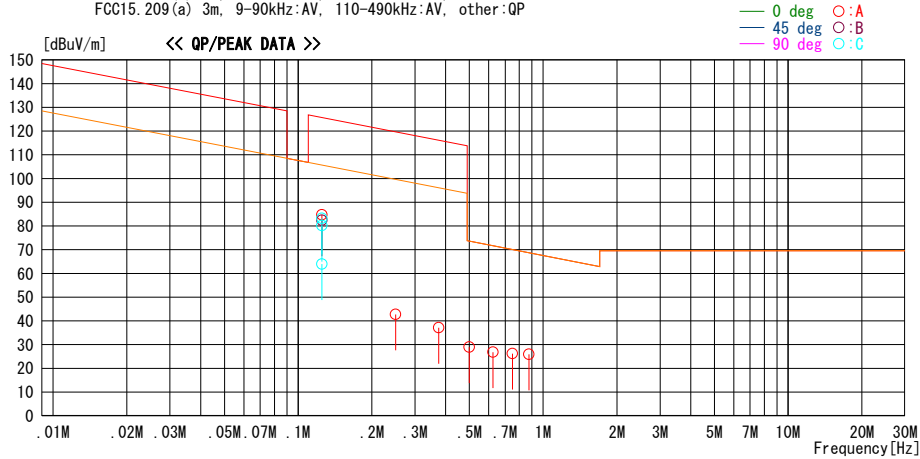
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
Date : 2012/06/21

Report No. : 32JE0268-H0-02
Temp./ Humi. : 23deg. C / 47% RH
Engineer : Tomohisa Nakagawa

Mode / Remarks : Tx 125kHz, Ant1 Min Power 50mA

LIMIT : FCC15.209(a) 3m, 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15.209(a) 3m, 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	58.8	PEAK	19.9	6.0	0.0	84.7	125.7	41.0	0	A	0 *1)
0.12500	56.6	PEAK	19.9	6.0	0.0	82.5	125.7	43.2	45	B	293
0.12500	54.2	PEAK	19.9	6.0	0.0	80.1	125.7	45.6	90	C	253
0.12500	57.3	PEAK	19.9	6.0	0.0	83.2	125.7	42.5	135	C	198
0.12500	38.0	PEAK	19.9	6.0	0.0	63.9	125.7	61.8	0	C	0 Hor i
0.25000	16.9	PEAK	19.7	6.1	0.0	42.7	119.7	77.0	0	A	0 *1)
0.37500	11.4	PEAK	19.7	6.1	0.0	37.2	116.1	78.9	0	A	0 *1)
0.50000	3.2	QP	19.6	6.1	0.0	28.9	73.6	44.7	0	A	0
0.62500	1.1	QP	19.6	6.2	0.0	26.9	71.7	44.8	0	A	0
0.75000	0.5	QP	19.6	6.2	0.0	26.3	70.1	43.8	0	A	0
0.87500	0.3	QP	19.5	6.2	0.0	26.0	68.7	42.7	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.)

- *The test result is rounded off to one or two decimal places, so some differences might be observed.
- *1) Testing with an average detector was excluded, because emission level with a peak detector met the limit of an average detector.

Radiated Emission below 30MHz (Fundamental and Spurious Emission)
Ant4 Max power (Output current 1000mA, Antenna impedance 2Ω)

DATA OF RADIATED EMISSION TEST

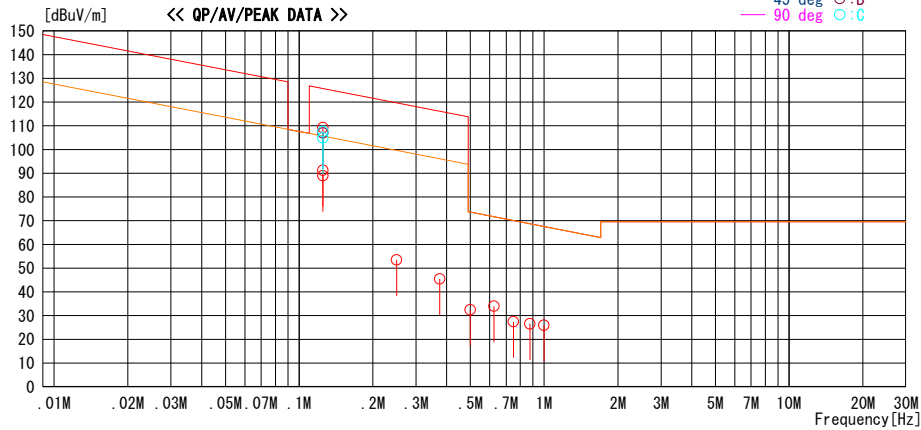
UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
Date : 2012/06/09

Report No. : 32JE0268-H0-02
Temp. / Humi. : 23deg. C / 56% RH
Engineer : Tomohisa Nakagawa

Mode / Remarks : Tx 125kHz, Ant4 Max Power 1000mA

LIMIT : FCC15.209(a) 3m, 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15.209(a) 3m, 9-90kHz:AV, 110-490kHz:AV, other:QP

— 0 deg ○ :A
— 45 deg ○ :B
— 90 deg ○ :C



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	83.3	PEAK	19.9	6.0	0.0	109.2	125.7	16.5	0	A	0
0.12500	83.3	PEAK	19.9	0.3	0.0	103.5	105.7	2.2	0	A	DutyFac=-5.76dB
0.12500	81.1	PEAK	19.9	6.0	0.0	107.0	125.7	18.7	45	B	0
0.12500	78.9	PEAK	19.9	6.0	0.0	104.8	125.7	20.9	90	C	95
0.12500	81.7	PEAK	19.9	6.0	0.0	107.6	125.7	18.1	135	C	197
0.12500	63.0	PEAK	19.9	6.0	0.0	88.9	125.7	36.8	135	A	0
0.25000	27.7	PEAK	19.7	6.1	0.0	53.5	119.7	66.2	0	A	0
0.37500	19.6	PEAK	19.7	6.1	0.0	45.4	116.1	70.7	0	A	0
0.50000	6.8	QP	19.6	6.1	0.0	32.5	73.6	41.1	0	A	0
0.62500	8.2	QP	19.6	6.2	0.0	34.0	71.7	37.7	0	A	0
0.75000	1.6	QP	19.6	6.2	0.0	27.4	70.1	42.7	0	A	0
0.87500	0.8	QP	19.5	6.2	0.0	26.5	68.7	42.2	0	A	0
1.00000	0.3	QP	19.5	6.2	0.0	26.0	67.6	41.6	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. + DutyFac.) - Gain (AMP)

- *The test result is rounded off to one or two decimal places, so some differences might be observed.
- *1) Testing with an average detector was excluded, because emission level with a peak detector met the limit of an average detector.
- *2) The Result is included Duty Factor.

Radiated Emission below 30MHz (Fundamental and Spurious Emission)
Ant4 Min power (Output current 50mA, Antenna impedance 54Ω)

DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
Date : 2012/06/21

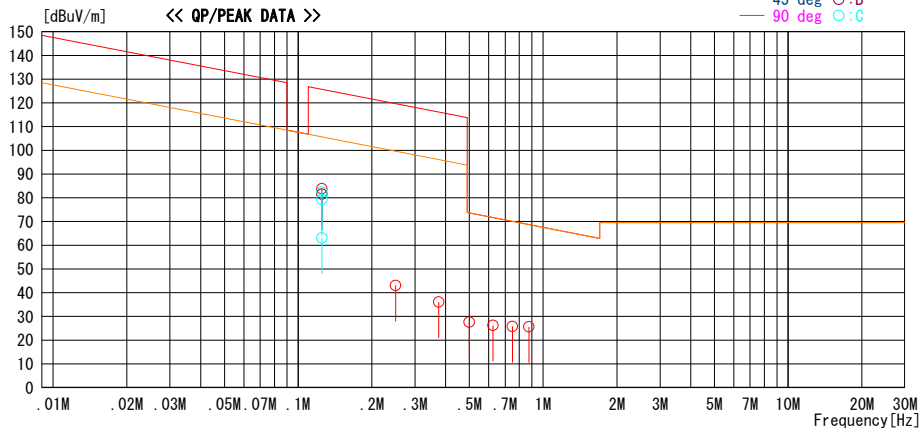
Report No. : 32JE0268-HO-02

Temp./Humi. : 23deg. C / 47% RH
Engineer : Tomohisa Nakagawa

Mode / Remarks : Tx 125kHz, Ant4 Min Power 50mA

LIMIT : FCC15.209(a) 3m, 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15.209(a) 3m, 9-90kHz:AV, 110-490kHz:AV, other:QP

— 0 deg ○:A
— 45 deg ○:B
— 90 deg ○:C



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	57.9	PEAK	19.9	6.0	0.0	83.8	125.7	-41.9	0	A	0*1)
0.12500	55.7	PEAK	19.9	6.0	0.0	81.6	125.7	-44.1	45	B	173
0.12500	53.4	PEAK	19.9	6.0	0.0	79.3	125.7	-46.4	90	C	342
0.12500	56.6	PEAK	19.9	6.0	0.0	82.5	125.7	-43.2	135	C	11
0.12500	37.2	PEAK	19.9	6.0	0.0	63.1	125.7	-62.6	0	C	0 Hori
0.25000	17.2	PEAK	19.7	6.1	0.0	43.0	119.7	-76.7	0	A	0*1)
0.37500	10.3	PEAK	19.7	6.1	0.0	36.1	116.1	-80.0	0	A	0*1)
0.50000	1.9	QP	19.6	6.1	0.0	27.6	73.6	-46.0	0	A	0
0.62500	0.5	QP	19.6	6.2	0.0	26.3	71.7	-45.4	0	A	0
0.75000	0.0	QP	19.6	6.2	0.0	25.8	70.1	-44.3	0	A	0
0.87500	-0.1	QP	19.5	6.2	0.0	25.6	68.7	-43.1	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.)

- *The test result is rounded off to one or two decimal places, so some differences might be observed.
- *1) Testing with an average detector was excluded, because emission level with a peak detector met the limit of an average detector.

Radiated Emission below 30MHz (Fundamental and Spurious Emission)
Ant1 (Output current 1000mA, Antenna impedance 54Ω)

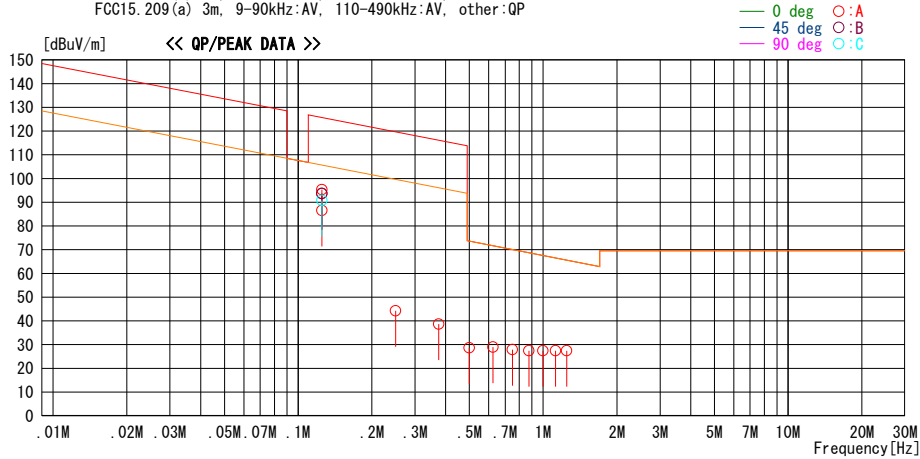
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
Date : 2012/07/16

Report No. : 32JE0268-HO-02
Temp./ Humi. : 21deg. C / 58% RH
Engineer : Kazuya Yoshioka

Mode / Remarks : Tx 125kHz, Ant1 Max Current Max impedance

LIMIT : FCC15.209(a) 3m, 9-90kHz:PK, 110-490kHz:PK, other:QP
FCC15.209(a) 3m, 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	69.4	PEAK	19.9	6.0	0.0	95.3	125.7	30.4	0	A	0*1)
0.12500	67.7	PEAK	19.9	6.0	0.0	93.6	125.7	32.1	45	B	159
0.12500	64.9	PEAK	19.9	6.0	0.0	90.8	125.7	34.9	90	C	96
0.12500	67.7	PEAK	19.9	6.0	0.0	93.6	125.7	32.1	135	A	211
0.12500	60.6	PEAK	19.9	6.0	0.0	86.5	125.7	39.2	0	A	0
0.25000	18.5	PEAK	19.7	6.1	0.0	44.3	119.7	75.4	0	A	0*1)
0.37500	12.9	PEAK	19.7	6.1	0.0	38.7	116.1	77.4	0	A	0*1)
0.50000	2.9	QP	19.6	6.1	0.0	28.6	73.6	45.0	0	A	0
0.62500	3.1	QP	19.6	6.2	0.0	28.9	71.7	42.8	0	A	0
0.75000	2.1	QP	19.6	6.2	0.0	27.9	70.1	42.2	0	A	0
0.87500	1.7	QP	19.5	6.2	0.0	27.4	68.7	41.3	0	A	0
1.00000	1.8	QP	19.5	6.2	0.0	27.5	67.6	40.1	0	A	0
1.12500	1.8	QP	19.5	6.2	0.0	27.5	66.5	39.0	0	A	0
1.25000	1.8	QP	19.5	6.2	0.0	27.5	65.6	38.1	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.)

- *The test result is rounded off to one or two decimal places, so some differences might be observed.
- *1) Testing with an average detector was excluded, because emission level with a peak detector met the limit of an average detector.

Radiated Emission above 30MHz (Spurious Emission)
Ant1 Max power (Output current 1000mA, Antenna impedance 2Ω)

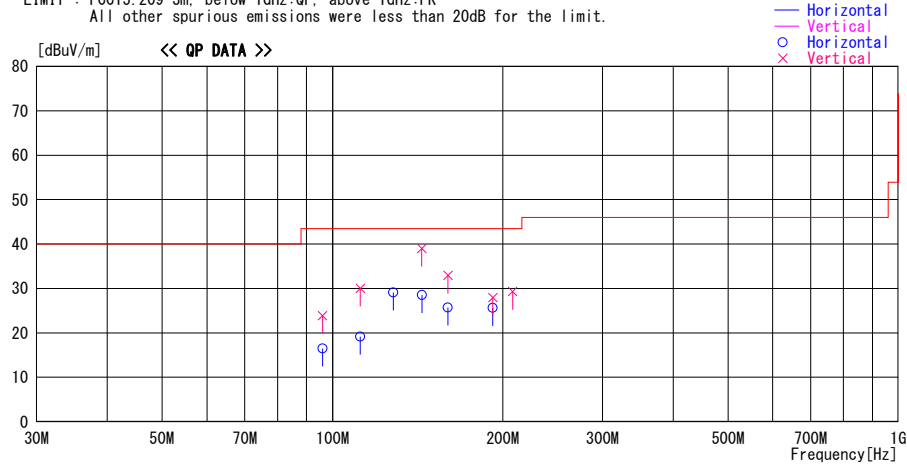
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
Date : 2012/06/09

Report No. : 32JE0268-HO-02
Temp./Humi. : 23deg. C / 56% RH
Engineer : Tomohisa Nakagawa

Mode / Remarks : Tx 125kHz, Ant1 Max Power 1000mA

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]							
96.013	36.1	QP	8.8	-21.0	23.9	244	100	Vert.	43.5	19.6	
96.014	28.7	QP	8.8	-21.0	16.5	359	311	Hori.	43.5	27.0	
112.014	28.4	QP	11.5	-20.7	19.2	193	306	Hori.	43.5	24.3	
112.017	39.2	QP	11.5	-20.7	30.0	248	100	Vert.	43.5	13.5	
128.016	36.3	QP	13.3	-20.5	29.1	168	348	Hori.	43.5	14.4	
143.850	44.8	QP	14.5	-20.3	39.0	272	100	Vert.	43.5	4.5	
144.018	34.3	QP	14.5	-20.3	28.5	209	362	Hori.	43.5	15.0	
160.020	30.5	QP	15.4	-20.2	25.7	358	294	Hori.	43.5	17.8	
160.023	37.7	QP	15.4	-20.2	32.9	64	100	Vert.	43.5	10.6	
192.026	29.3	QP	16.2	-19.9	25.6	320	199	Hori.	43.5	17.9	
192.028	31.6	QP	16.2	-19.9	27.9	359	100	Vert.	43.5	15.6	
208.199	32.5	QP	16.5	-19.7	29.3	4	100	Vert.	43.5	14.2	

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)

Radiated Emission above 30MHz (Spurious Emission)
 Ant1 Min power (Output current 50mA, Antenna impedance 54Ω)

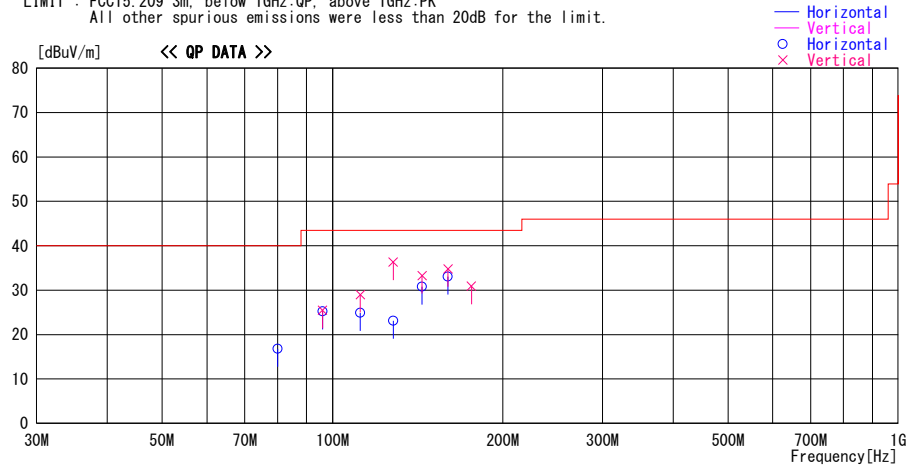
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
 Date : 2012/06/21

Report No. : 32JE0268-HO-02
 Temp./Humi. : 23deg. C / 56% RH
 Engineer : Tomohisa Nakagawa

Mode / Remarks : Tx 125kHz, Ant1 Min Power 50mA

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]							
80.008	31.8	QP	6.2	-21.2	16.8	204	233	Hori.	40.0	23.2	
96.009	37.4	QP	8.8	-21.0	25.2	181	269	Hori.	43.5	18.3	
96.011	37.7	QP	8.8	-21.0	25.5	267	100	Vert.	43.5	18.0	
112.010	34.1	QP	11.5	-20.7	24.9	191	303	Hori.	43.5	18.6	
112.013	38.2	QP	11.5	-20.7	29.0	276	100	Vert.	43.5	14.5	
128.011	30.3	QP	13.3	-20.5	23.1	309	159	Hori.	43.5	20.4	
128.012	43.5	QP	13.3	-20.5	36.3	270	100	Vert.	43.5	7.2	
144.013	36.6	QP	14.5	-20.3	30.8	348	383	Hori.	43.5	12.7	
144.017	39.1	QP	14.5	-20.3	33.3	247	100	Vert.	43.5	10.2	
160.012	39.6	QP	15.4	-20.2	34.8	64	100	Vert.	43.5	8.7	
160.014	37.9	QP	15.4	-20.2	33.1	359	256	Hori.	43.5	10.4	
176.020	35.1	QP	15.9	-20.1	30.9	67	100	Vert.	43.5	12.6	

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)

Radiated Emission above 30MHz (Spurious Emission)
Ant4 Max power (Output current 1000mA, Antenna impedance 2Ω)

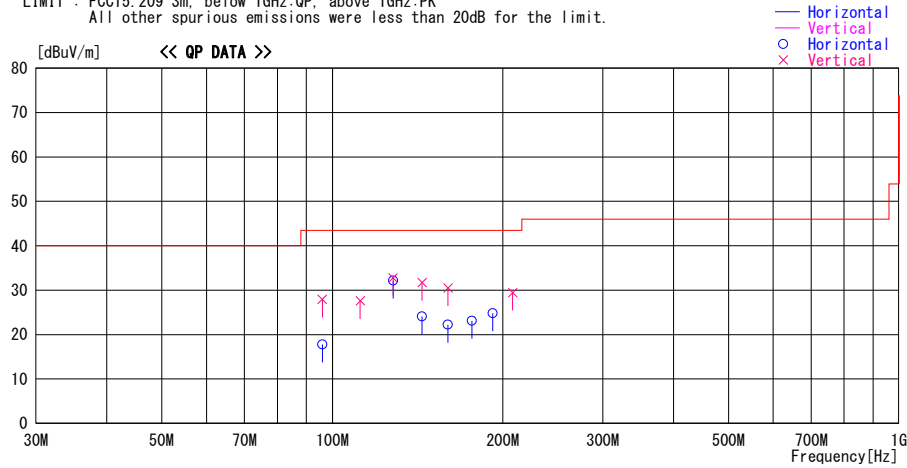
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
Date : 2012/06/09

Report No. : 32JE0268-HO-02
Temp./Humi. : 23deg. C / 56% RH
Engineer : Tomohisa Nakagawa

Mode / Remarks : Tx 125kHz, Ant4 Max Power 1000mA

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]							
96.014	40.1	QP	8.8	-21.0	27.9	0	100	Vert.	43.5	15.6	
96.016	30.0	QP	8.8	-21.0	17.8	190	289	Hori.	43.5	25.7	
112.015	36.8	QP	11.5	-20.7	27.6	263	100	Vert.	43.5	15.9	
128.018	40.0	QP	13.3	-20.5	32.8	271	100	Vert.	43.5	10.7	
128.020	39.4	QP	13.3	-20.5	32.2	4	334	Hori.	43.5	11.3	
144.021	37.5	QP	14.5	-20.3	31.7	67	100	Vert.	43.5	11.8	
144.023	29.9	QP	14.5	-20.3	24.1	7	379	Hori.	43.5	19.4	
160.022	35.3	QP	15.4	-20.2	30.5	112	100	Vert.	43.5	13.0	
160.026	27.0	QP	15.4	-20.2	22.2	359	373	Hori.	43.5	21.3	
176.249	27.3	QP	15.9	-20.1	23.1	1	318	Hori.	43.5	20.4	
192.031	28.5	QP	16.2	-19.9	24.8	341	300	Hori.	43.5	18.7	
208.030	32.7	QP	16.5	-19.7	29.5	0	100	Vert.	43.5	14.0	

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)

Radiated Emission above 30MHz (Spurious Emission)
Ant4 Min power (Output current 50mA, Antenna impedance 54Ω)

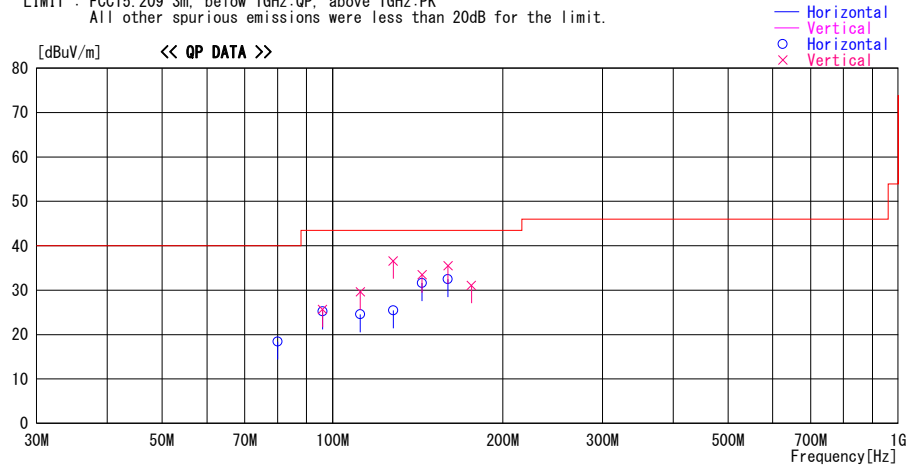
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.2 Semi Anechoic Chamber
 Date : 2012/06/21

Report No. : 32JE0268-HO-02
 Temp./Humi. : 23deg. C / 56% RH
 Engineer : Tomohisa Nakagawa

Mode / Remarks : Tx 125kHz, Ant4 Min Power 50mA

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]							
80.008	33.4	QP	6.2	-21.2	18.4	187	247	Hori.	40.0	21.6	
96.008	37.9	QP	8.8	-21.0	25.7	273	100	Vert.	43.5	17.8	
96.009	37.4	QP	8.8	-21.0	25.2	173	297	Hori.	43.5	18.3	
112.010	33.8	QP	11.5	-20.7	24.6	181	300	Hori.	43.5	18.9	
112.012	38.8	QP	11.5	-20.7	29.6	229	100	Vert.	43.5	13.9	
128.011	32.7	QP	13.3	-20.5	25.5	328	154	Hori.	43.5	18.0	
128.012	43.8	QP	13.3	-20.5	36.6	260	100	Vert.	43.5	6.9	
144.013	37.4	QP	14.5	-20.3	31.6	7	366	Hori.	43.5	11.9	
144.014	39.3	QP	14.5	-20.3	33.5	256	100	Vert.	43.5	10.0	
160.012	40.3	QP	15.4	-20.2	35.5	69	100	Vert.	43.5	8.0	
160.014	37.3	QP	15.4	-20.2	32.5	352	271	Hori.	43.5	11.0	
176.016	35.3	QP	15.9	-20.1	31.1	50	100	Vert.	43.5	12.4	

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)

Radiated Emission above 30MHz (Spurious Emission)
Ant1 (Output current 1000mA, Antenna impedance 54Ω)

DATA OF RADIATED EMISSION TEST

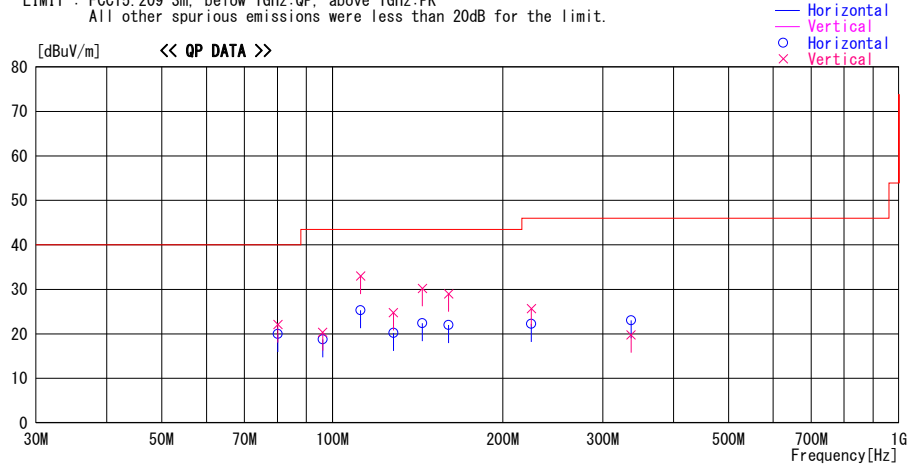
UL Japan, Inc. Head Office EMC Lab. No. 4 Semi Anechoic Chamber
Date : 2012/05/31

Report No. : 32JE0268-HO-02

Temp./Humi. : 23deg. C / 56% RH
Engineer : Shinya Watanabe

Mode / Remarks : Tx 125kHz, Ant1 Max Current Max impedance

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]
			Factor [dB/m]	Loss & Gain [dB]						
80.151	37.8	QP	6.5	-24.3	20.0	197	228	Hori.	40.0	20.0
80.151	39.9	QP	6.5	-24.3	22.1	263	100	Vert.	40.0	17.9
96.182	33.3	QP	9.5	-24.1	18.7	184	312	Hori.	43.5	24.8
96.182	34.9	QP	9.5	-24.1	20.3	65	100	Vert.	43.5	23.2
112.211	37.2	QP	11.9	-23.8	25.3	213	309	Hori.	43.5	18.2
112.211	44.9	QP	11.9	-23.8	33.0	288	100	Vert.	43.5	10.5
128.251	30.1	QP	13.7	-23.6	20.2	0	242	Hori.	43.5	23.3
128.251	34.7	QP	13.7	-23.6	24.8	313	100	Vert.	43.5	18.7
144.277	31.1	QP	14.8	-23.5	22.4	325	156	Hori.	43.5	21.1
144.277	38.9	QP	14.8	-23.5	30.2	0	100	Vert.	43.5	13.3
160.401	29.9	QP	15.4	-23.3	22.0	147	199	Hori.	43.5	21.5
160.401	36.9	QP	15.4	-23.3	29.0	0	100	Vert.	43.5	14.5
224.429	28.0	QP	17.0	-22.8	22.2	293	140	Hori.	46.0	23.8
224.429	31.5	QP	17.0	-22.8	25.7	0	100	Vert.	46.0	20.3
336.656	28.4	QP	16.7	-22.0	23.1	319	106	Hori.	46.0	22.9
336.656	25.1	QP	16.7	-22.0	19.8	220	100	Vert.	46.0	26.2

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)

Duty Cycle(Total calculation)

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	32JE0268-HO-02
Date	09/11/2012
Temperature/ Humidity	24 deg. C / 71% RH
Engineer	Shinya Watanabe
Mode	Normal Transmitting mode

(Total)

ON time [ms]	Cycle [ms]	Duty (On time/Cycle)	Duty [dB]
51.544	100.00	0.5154	-5.76

$$\text{ON time[ms]} = B+C+D+A+A'+A''+E+E'+E''$$

$$= 0.407+4.221+10.886+6.05+6.05+6.05+5.96+5.96+5.96$$

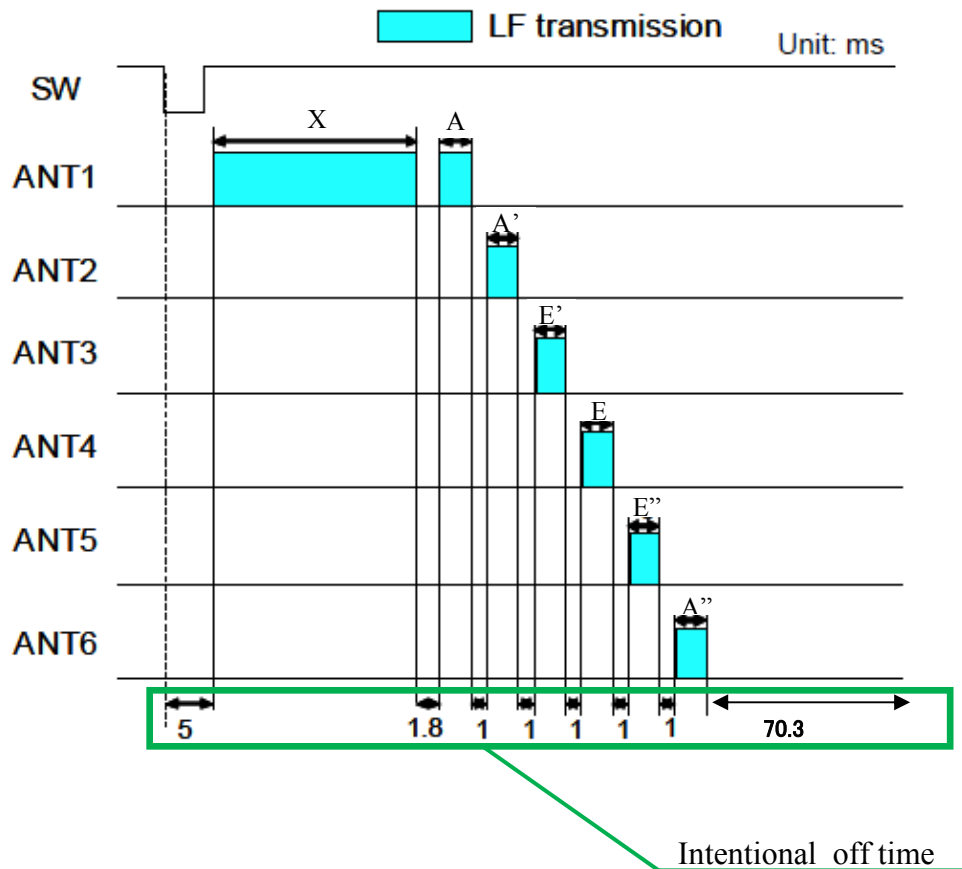
$$\text{Duty} = 20\log_{10}(\text{ON time/Cycle})$$

* The details of ON time A, B, and C, D, and E are explained on next pages (B, C, D are ON time included in time: X).

* "Timing of transmission" of the application documents was referred, since Intentional off time was unrealizable in measurement circumstance.

* "A" ON time of ANT1 was applied to that of ANT2 and ANT6

* "E" ON time of ANT4 was applied to that of ANT3 and ANT5.



Duty Cycle(Ant1 ON time)

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	32JE0268-HO-02
Date	09/11/2012
Temperature/ Humidity	24 deg. C / 71% RH
Engineer	Shinya Watanabe
Mode	Normal Transmitting mode

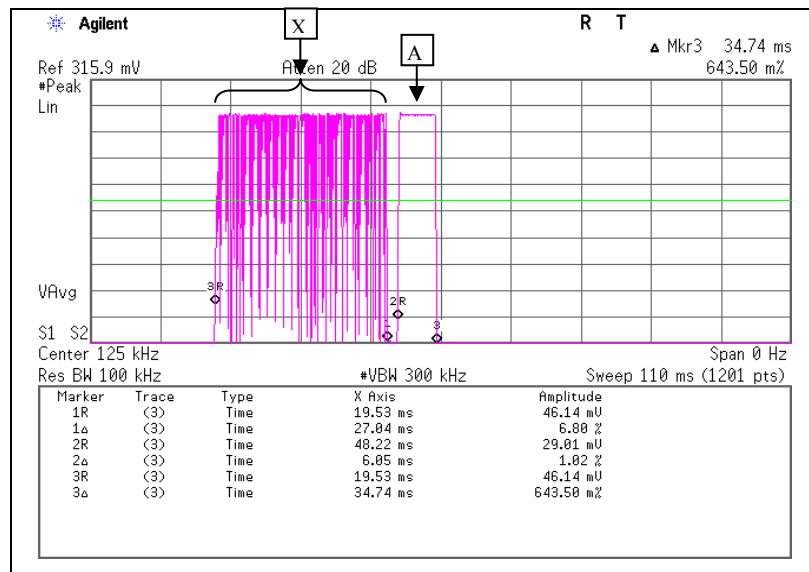
(pulse length)

Type	[ms]
A	6.05

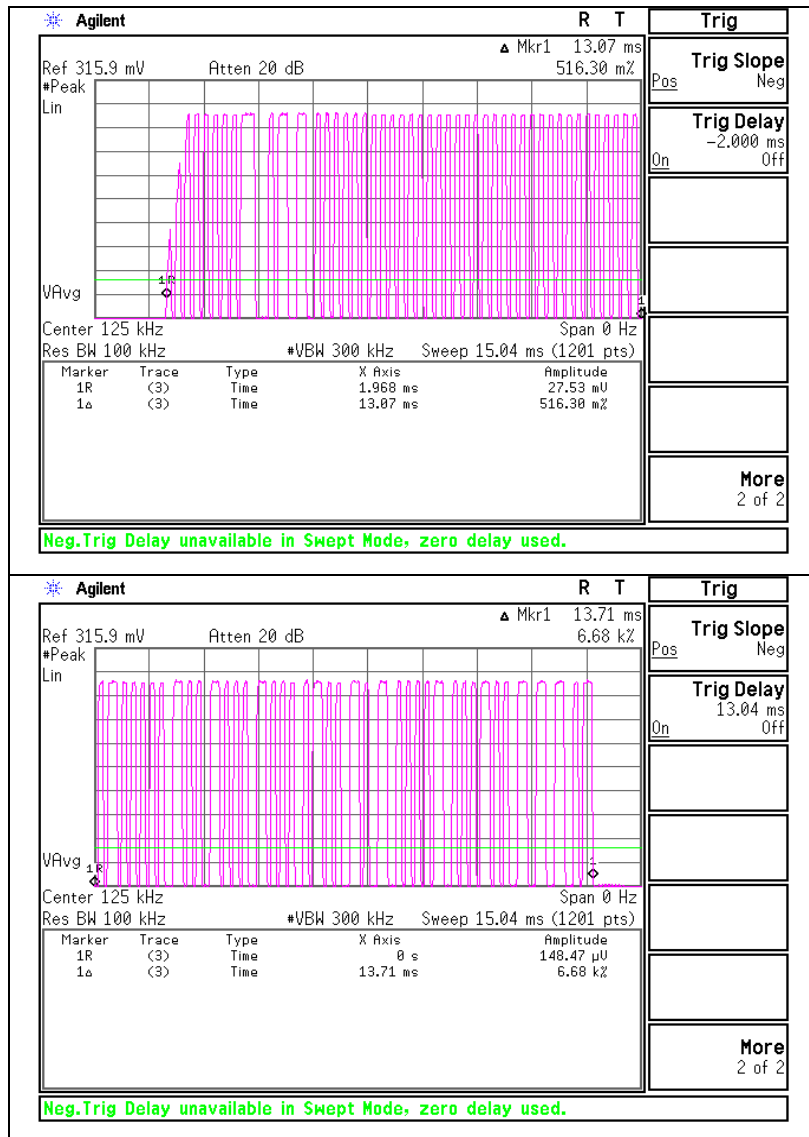
(pulse length(in X))

Type	Times	ON time(One pulse) [ms]	ON time(in X) [ms]
B	1	0.407	0.407
C	15	0.281	4.221
D	72	0.151	10.886

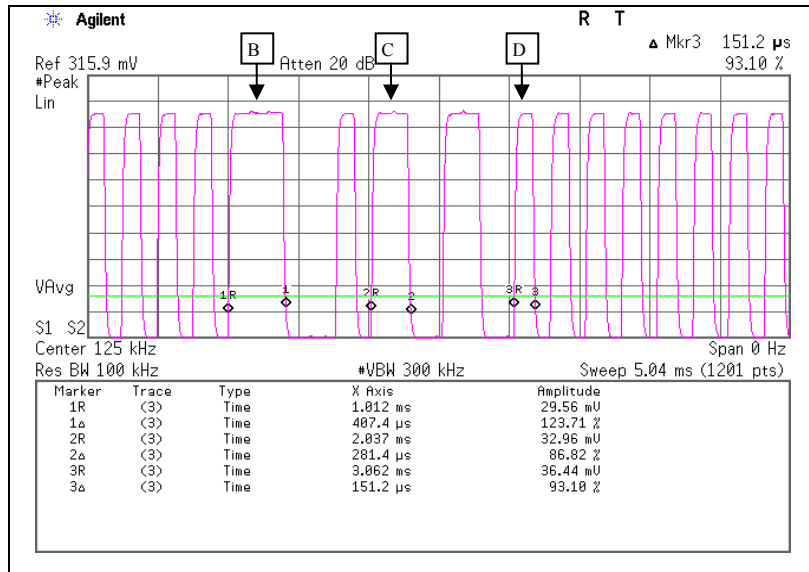
ON time(in X) = Times * ON time(One pulse)



Duty Cycle(Ant1 ON time)
Detail of X



Duty Cycle(Ant1 ON time)
Detail of X(each pulse time)

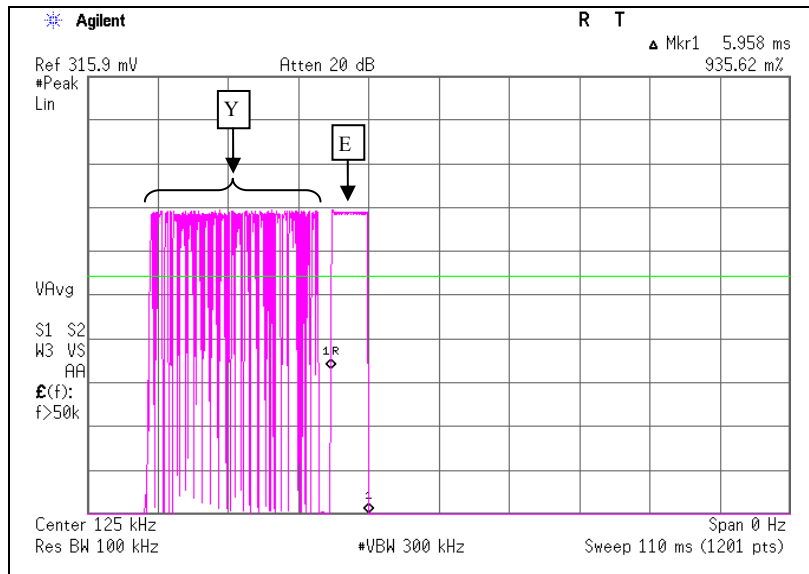


Duty Cycle(Ant4 ON time)

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	32JE0268-HO-02
Date	09/11/2012
Temperature/ Humidity	24 deg. C / 71% RH
Engineer	Shinya Watanabe
Mode	Normal Transmitting mode

(pulse length)

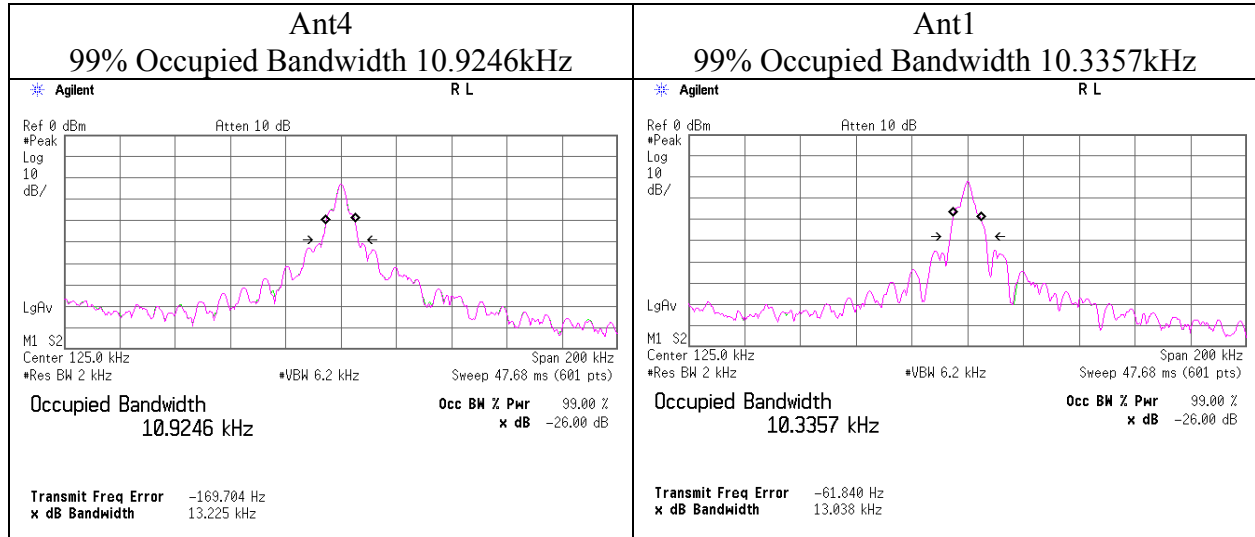
Type	[ms]
E	5.96



*In actual use, pulse sequence Y is not transmitted from Port type 2.
 In measurement circumstance, it is not possible to have only pulse E transmitting.
 Pulse with the same period as pulse E is transmitted from Port type 2 in actual use.

99% Occupied Bandwidth

Report No.	32JE0268-HO-02
Test place	Head Office EMC Lab.
Semi Anechoic Chamber	No.2
Date	06/10/2012
Temperature / Humidity	23 deg. C / 47 % RH
Engineer	Tomohisa Nakagawa
Mode	Tx 125 kHz



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	2012/06/29 * 12
MOS-22	Thermo-Hygrometer	Custom	CTH-201	0003	RE	2012/02/06 * 12
MJM-14	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE	2012/04/06 * 12
MTR-03	Test Receiver	Rohde & Schwarz	ESCI	100300	RE	2012/04/03 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2011/10/19 * 12
MCC-13	Coaxial Cable	Fujikura	3D-2W(12m)/5D-2W(5m)/5D-2W(0.8m)/5D-2W(1m)	-	RE	2012/02/16 * 12
MCC-31	Coaxial cable	UL Japan	-	-	RE	2011/07/28 * 12 *1)
MAT-07	Attenuator(6dB)	Weinschel Corp	2	BK7970	RE	2011/11/02 * 12
MBA-02	Biconical Antenna	Schwarzbeck	BBA9106	VHA91032008	RE	2011/10/23 * 12
MLA-02	Logperiodic Antenna	Schwarzbeck	USLP9143	201	RE	2011/10/23 * 12
MCC-12	Coaxial Cable	Fujikura/Agilent	-	-	RE	2012/02/16 * 12
MPA-09	Pre Amplifier	Agilent	8447D	2944A10845	RE	2011/09/26 * 12
MRENT-95	Spectrum Analyzer	Agilent	E4440A	MY46185823	RE	2012/06/19 * 12
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2012/02/29 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	-	RE	2012/02/06 * 12
MJM-07	Measure	PROMART	SEN1955	-	RE	-
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2011/11/16 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2011/11/16 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2012/06/01 * 12
MAT-07	Attenuator(6dB)	Weinschel Corp	2	BK7970	RE	2011/11/02 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2012/03/05 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/ SFM141(5m)/ 421-010(1m)/ suoform141-PE(1m)/ RFM-E121(Switcher)	-/04178	RE	2011/07/04 * 12 *1)

*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.

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