



RADIO TEST REPORT

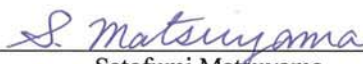
Test Report No. : 32AE0200-HO-03-B-R2

Applicant : Panasonic Corporation Automotive Systems Company
Type of Equipment : SMART PCU
(LF Transmitter Part)
Model No. : HM1120CA
FCC ID : ACJ932HM1120CA
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 32AE0200-HO-03-B-R1. 32AE0200-HO-03-B-R1 is replaced with this report.

Date of test: January 17 and 18, 2012

Representative test engineer:


Satofumi Matsuyama
Engineer of WiSE Japan,
UL Verification Service

Approved by:


Masanori Nishiyama
Leader of WiSE Japan,
UL Verification Service



NVLAP LAB CODE: 200572-0

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SECTION 1: Customer information

Company Name : Panasonic Corporation Automotive Systems Company
Address : 4261 Ikonobe-cho, Tsuzuki-ku, Yokohama city, Kanagawa-ken
224-8520, 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
(LF Transmitter Part)
Model No. : HM1120CA
Serial No. : Refer to Clause 4.2
Rating : DC 6 - 16V
Receipt Date of Sample : November 18, 2011
Country of Mass-production : China and Japan
Condition of EUT : Engineering 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 : 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 : 313.85MHz
Crystal oscillator frequency : 21.948717MHz
Local frequency : 314.124MHz
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: 2012, final revised on February 1, 2012
Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.209 Radiated emission limits, general requirements

*The revision on February 1, 2012 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 the EUT during the tests. Therefore, the 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	6.3dB 0.12500MHz 0 deg. PK with Duty factor (Max Ant (TR Antenna))	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	0.7dB 38.507MHz, 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	5.6dB	5.9dB	4.4dB	4.3dB
No.2	4.1dB	5.2dB	5.1dB	5.7dB	5.8dB	4.3dB	4.2dB
No.3	4.5dB	5.0dB	5.2dB	5.7dB	5.8dB	4.5dB	4.2dB
No.4	4.7dB	5.2dB	5.2dB	5.7dB	5.8dB	5.1dB	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.

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3.5 Test Location

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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

Test mode	Remarks
LF Transmitting (Tx) mode	125kHz

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

The EUT has 2 types: Wagon type and Sedan type.

Wagon type has 5 types of LF Antennas (TR Antenna, M/TI Antenna, R Antenna, F Antenna, FRDR Antenna (Mirror)).

Sedan type has 5 types of LF Antennas (TR Antenna, M/TI Antenna, R Antenna, F Antenna, FRDR Antenna (nonmetal or metal)).

According to the result of precheck, the test was performed with Max and Min Antennas of each type as a representative. (Max Antenna has maximum output power, and Min Antenna has minimum output power.)

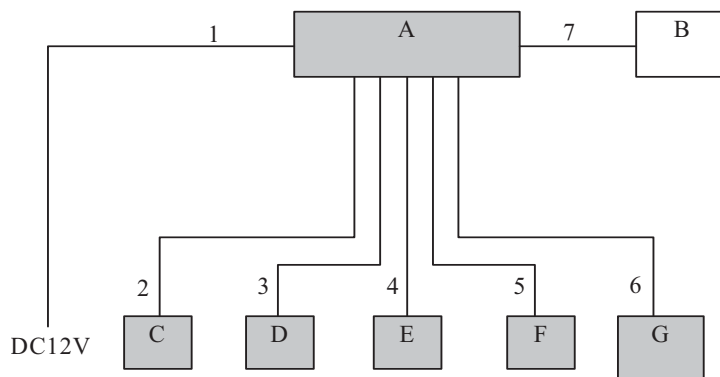
Wagon type: Max Antenna (TR Antenna)

Min Antenna (M/TI Antenna)

Sedan type: Max Antenna (TR Antenna)

Min Antenna (FRDR Antenna (metal))

4.2 Configuration and peripherals



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

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Wagon type

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	SMART PCU (RF Receiver Part)	HM1120CA	No.1	Panasonic Corporation Automotive Systems Company	EUT
B	Switch jig	13MY	-	Panasonic Corporation Automotive Systems Company	-
C	TR Antenna	38387-SLE-003	SLE001	Panasonic Corporation Automotive Systems Company	EUT
D	M/TI Antenna	38387-SZW-003	TF001	Panasonic Corporation Automotive Systems Company	EUT
E	R Antenna	38388-TF0-003	SZW002	Panasonic Corporation Automotive Systems Company	EUT
F	F Antenna	38387-SZW-003	SZW001	Panasonic Corporation Automotive Systems Company	EUT
G	FRDR Antenna (Mirror)	38383-TP6	001	Panasonic Corporation Automotive Systems Company	EUT

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	1.2	Unshielded	Unshielded	-
2	Antenna Cable	2.2	Unshielded	Unshielded	-
3	Antenna Cable	2.0	Unshielded	Unshielded	-
4	Antenna Cable	2.0	Unshielded	Unshielded	-
5	Antenna Cable	2.0	Unshielded	Unshielded	-
6	Antenna Cable	2.0	Unshielded	Unshielded	-
7	Signal Cable	0.15	Unshielded	Unshielded	-

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Sedan type

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	SMART PCU (RF Receiver Part)	HM1120CA	No.2	Panasonic Corporation Automotive Systems Company	EUT
B	Switch jig	13MY	-	Panasonic Corporation Automotive Systems Company	-
C	TR Antenna	38387-SLE-003	SLE001	Panasonic Corporation Automotive Systems Company	EUT
D	M/TI Antenna	38388-TF0-003	TF0001	Panasonic Corporation Automotive Systems Company	EUT
E	R Antenna	38387-SZW-003	SZW002	Panasonic Corporation Automotive Systems Company	EUT
F	F Antenna	38387-SZW-003	SZW001	Panasonic Corporation Automotive Systems Company	EUT
G	FRDR Antenna (metal)	TR0-7B000-000	001	Panasonic Corporation Automotive Systems Company	EUT

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	1.2	Unshielded	Unshielded	-
2	Antenna Cable	2.2	Unshielded	Unshielded	-
3	Antenna Cable	2.0	Unshielded	Unshielded	-
4	Antenna Cable	2.0	Unshielded	Unshielded	-
5	Antenna Cable	2.0	Unshielded	Unshielded	-
6	Antenna Cable	2.0	Unshielded	Unshielded	-
7	Signal Cable	0.15	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 4 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	Peak and Peak with Duty factor	QP	Peak and Peak with Duty factor	QP	QP
IF Bandwidth	200Hz	200Hz	9kHz	9kHz	120kHz

- The carrier level was 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

Date: January 17 and 18, 2012

Test engineer: Satofumi Matsuyama

UL Japan, Inc.

Head Office EMC Lab.

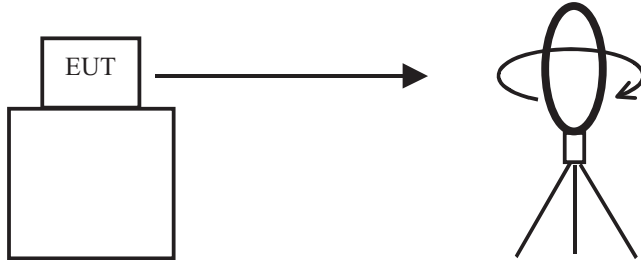
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Figure 1: Direction of the Loop Antenna

Side View (Vertical)



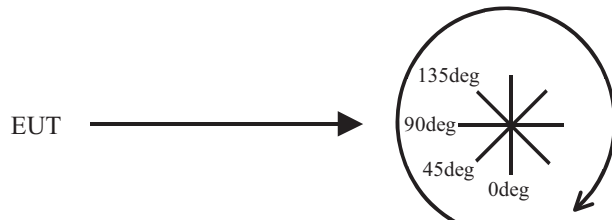
.....
Top View (Horizontal)



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)

Wagon type, TR Antenna

Test place : Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 32AE0200-HO-03
Date : 01/17/2012
Temperature/ Humidity : 25 deg. C / 34% RH
Engineer : Satofumi Matsuyama
Mode : LF Tx 125kHz

QP or PK

Frequency [MHz]	Detector	Antenna [deg]	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit dBuV/m	Margin [dB]	Remark Inside or Outside of Restricted Bands
			Hor				Hor		Hor		
0.125	PK	0	108.9	19.9	6.0	32.2	-	102.6	125.7	23.1	Carrier
0.125	PK	45	107.4	19.9	6.0	32.2	-	101.1	125.7	24.6	Carrier
0.125	PK	90	104.8	19.9	6.0	32.2	-	98.5	125.7	27.2	Carrier
0.125	PK	135	106.6	19.9	6.0	32.2	-	100.3	125.7	25.4	Carrier
0.125	PK	0	97.6	19.9	6.0	32.2	-	91.3	125.7	34.4	Carrier (Loop: Hor)
0.250	PK	0	79.7	19.7	6.1	32.2	-	73.3	119.7	46.4	
0.375	PK	0	63.4	19.7	6.1	32.2	-	57.0	116.1	59.1	
0.500	QP	0	58.6	19.6	6.1	32.3	-	52.0	73.6	21.6	
0.625	QP	0	40.6	19.6	6.1	32.2	-	34.1	71.7	37.6	
0.750	QP	0	51.0	19.6	6.1	32.2	-	44.5	70.1	25.6	
0.875	QP	0	46.6	19.5	6.1	32.2	-	40.0	68.7	28.7	
1.000	QP	0	40.2	19.5	6.2	32.2	-	33.7	67.6	33.9	
1.125	QP	0	45.0	19.5	6.2	32.2	-	38.5	66.5	28.0	

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

PK with Duty factor

Frequency [MHz]	Detector	Antenna [deg]	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result [dBuV/m]	Limit dBuV/m	Margin [dB]	Remark
			Hor				Hor		Hor		
0.125	PK	0	108.9	19.9	6.0	32.2	-3.2	99.4	105.7	6.3	Carrier
0.125	PK	45	107.4	19.9	6.0	32.2	-3.2	97.9	105.7	7.8	Carrier
0.125	PK	90	104.8	19.9	6.0	32.2	-3.2	95.3	105.7	10.4	Carrier
0.125	PK	135	106.6	19.9	6.0	32.2	-3.2	97.1	105.7	8.6	Carrier
0.125	PK	0	97.6	19.9	6.0	32.2	-3.2	88.1	105.7	17.6	Carrier (Loop: Hor)
0.250	PK	0	79.7	19.7	6.1	32.2	-3.2	70.1	99.7	29.6	
0.375	PK	0	63.4	19.7	6.1	32.2	-3.2	53.8	96.1	42.3	

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

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

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

* Average emission measurements were calculated with PK detect and Duty cycle factor.

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Radiated Emission below 30MHz (Fundamental and Spurious Emission)

Wagon type, M/TI Antenna

Test place : Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 32AE0200-HO-03
Date : 01/17/2012
Temperature/ Humidity : 25 deg. C / 34% RH
Engineer : Satofumi Matsuyama
Mode : LF Tx 125kHz

QP or PK

Frequency [MHz]	Detector	Antenna [deg]	Reading	Ant	Loss	Gain	Duty	Result	Limit	Margin	Remark
			[dBuV] Hor	Factor [dB/m]				[dBuV/m] Hor		[dB] Hor	
0.125	PK	0	104.2	19.9	6.0	32.2	-	97.9	125.7	27.8	Carrier
0.125	PK	45	102.6	19.9	6.0	32.2	-	96.3	125.7	29.4	Carrier
0.125	PK	90	99.8	19.9	6.0	32.2	-	93.5	125.7	32.2	Carrier
0.125	PK	135	101.8	19.9	6.0	32.2	-	95.5	125.7	30.2	Carrier
0.125	PK	0	92.6	19.9	6.0	32.2	-	86.3	125.7	39.4	Carrier (Loop: Hor)
0.250	PK	0	70.1	19.7	6.1	32.2	-	63.7	119.7	56.0	
0.375	PK	0	69.0	19.7	6.1	32.2	-	62.6	116.1	53.5	
0.500	QP	0	49.1	19.6	6.1	32.3	-	42.5	73.6	31.1	
0.625	QP	0	43.6	19.6	6.1	32.2	-	37.1	71.7	34.6	
0.750	QP	0	36.2	19.6	6.1	32.2	-	29.7	70.1	40.4	
0.875	QP	0	46.1	19.5	6.1	32.2	-	39.5	68.7	29.2	
1.000	QP	0	42.2	19.5	6.2	32.2	-	35.7	67.6	31.9	
1.125	QP	0	46.4	19.5	6.2	32.2	-	39.9	66.5	26.6	

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

PK with Duty factor

Frequency [MHz]	Detector	Antenna [deg]	Reading	Ant	Loss	Gain	Duty	Result	Limit	Margin	Remark
			[dBuV] Hor	Factor [dB/m]				[dBuV/m] Hor		[dB] Hor	
0.125	PK	0	104.2	19.9	6.0	32.2	-3.2	94.7	105.7	11.0	Carrier
0.125	PK	45	102.6	19.9	6.0	32.2	-3.2	93.1	105.7	12.6	Carrier
0.125	PK	90	99.8	19.9	6.0	32.2	-3.2	90.3	105.7	15.4	Carrier
0.125	PK	135	101.8	19.9	6.0	32.2	-3.2	92.3	105.7	13.4	Carrier
0.125	PK	0	92.6	19.9	6.0	32.2	-3.2	83.1	105.7	22.6	Carrier (Loop: Hor)
0.250	PK	0	70.1	19.7	6.1	32.2	-3.2	60.5	99.7	39.2	
0.375	PK	0	69.0	19.7	6.1	32.2	-3.2	59.4	96.1	36.7	

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

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

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

* Average emission measurements were calculated with PK detect and Duty cycle factor.

UL Japan, Inc.

Head Office EMC Lab.

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

Radiated Emission below 30MHz (Fundamental and Spurious Emission)

Sedan type, TR Antenna

Test place : Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 32AE0200-HO-03
Date : 01/17/2012
Temperature/ Humidity : 25 deg. C / 34% RH
Engineer : Satofumi Matsuyama
Mode : LF Tx 125kHz

QP or PK

Frequency [MHz]	Detector	Antenna [deg]	Reading	Ant	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result	Limit dBuV/m	Margin	Remark Inside or Outside of Restricted Bands
			[dBuV] Hor	Factor [dB/m]				[dBuV/m] Hor		[dB] Hor	
0.125	PK	0	108.9	19.9	6.0	32.2	-	102.6	125.7	23.1	Carrier
0.125	PK	45	107.4	19.9	6.0	32.2	-	101.1	125.7	24.6	Carrier
0.125	PK	90	107.0	19.9	6.0	32.2	-	100.7	125.7	25.0	Carrier
0.125	PK	135	104.9	19.9	6.0	32.2	-	98.6	125.7	27.1	Carrier
0.125	PK	0	97.6	19.9	6.0	32.2	-	91.3	125.7	34.4	Carrier (Loop: Hor)
0.250	PK	0	79.5	19.7	6.1	32.2	-	73.1	119.7	46.6	
0.375	PK	0	63.8	19.7	6.1	32.2	-	57.4	116.1	58.7	
0.500	QP	0	58.9	19.6	6.1	32.3	-	52.3	73.6	21.3	
0.625	QP	0	41.1	19.6	6.1	32.2	-	34.6	71.7	37.1	
0.750	QP	0	51.1	19.6	6.1	32.2	-	44.6	70.1	25.5	
0.875	QP	0	46.8	19.5	6.1	32.2	-	40.2	68.7	28.5	
1.000	QP	0	40.2	19.5	6.2	32.2	-	33.7	67.6	33.9	
1.125	QP	0	45.2	19.5	6.2	32.2	-	38.7	66.5	27.8	

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

PK with Duty factor

Frequency [MHz]	Detector	Antenna [deg]	Reading	Ant	Loss [dB]	Gain [dB]	Duty Factor [dB]	Result	Limit dBuV/m	Margin	Remark
			[dBuV] Hor	Factor [dB/m]				[dBuV/m] Hor		[dB] Hor	
0.125	PK	0	108.9	19.9	6.0	32.2	-3.2	99.4	105.7	6.3	Carrier
0.125	PK	45	107.4	19.9	6.0	32.2	-3.2	97.9	105.7	7.8	Carrier
0.125	PK	90	107.0	19.9	6.0	32.2	-3.2	97.5	105.7	8.2	Carrier
0.125	PK	135	104.9	19.9	6.0	32.2	-3.2	95.4	105.7	10.3	Carrier
0.125	PK	0	97.6	19.9	6.0	32.2	-3.2	88.1	105.7	17.6	Carrier (Loop: Hor)
0.250	PK	0	79.5	19.7	6.1	32.2	-3.2	69.9	99.7	29.8	
0.375	PK	0	63.8	19.7	6.1	32.2	-3.2	54.2	96.1	41.9	

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

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

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

* Average emission measurements were calculated with PK detect and Duty cycle factor.

UL Japan, Inc.

Head Office EMC Lab.

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

Radiated Emission below 30MHz (Fundamental and Spurious Emission)
Sedan type, FRDR Antenna (metal)

Test place : Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 32AE0200-HO-03
Date : 01/17/2012
Temperature/ Humidity : 25 deg. C / 34% RH
Engineer : Satofumi Matsuyama
Mode : LF Tx 125kHz

QP or PK

Frequency [MHz]	Detector	Antenna [deg]	Reading	Ant	Loss	Gain	Duty	Result	Limit	Margin	Remark
			[dBuV] Hor	Factor [dB/m]				[dBuV/m] Hor		[dB] Hor	
0.125	PK	0	97.8	19.9	6.0	32.2	-	91.5	125.7	34.2	Carrier
0.125	PK	45	96.2	19.9	6.0	32.2	-	89.9	125.7	35.8	Carrier
0.125	PK	90	93.3	19.9	6.0	32.2	-	87.0	125.7	38.7	Carrier
0.125	PK	135	95.7	19.9	6.0	32.2	-	89.4	125.7	36.3	Carrier
0.125	PK	0	86.4	19.9	6.0	32.2	-	80.1	125.7	45.6	Carrier (Loop: Hor)
0.250	PK	0	68.5	19.7	6.1	32.2	-	62.1	119.7	57.6	
0.375	PK	0	58.5	19.7	6.1	32.2	-	52.1	116.1	64.0	
0.500	QP	0	54.5	19.6	6.1	32.3	-	47.9	73.6	25.7	
0.625	QP	0	37.6	19.6	6.1	32.2	-	31.1	71.7	40.6	
0.750	QP	0	46.2	19.6	6.1	32.2	-	39.7	70.1	30.4	
0.875	QP	0	42.3	19.5	6.1	32.2	-	35.7	68.7	33.0	
1.000	QP	0	35.8	19.5	6.2	32.2	-	29.3	67.6	38.3	
1.125	QP	0	40.3	19.5	6.2	32.2	-	33.8	66.5	32.7	

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

PK with Duty factor

Frequency [MHz]	Detector	Antenna [deg]	Reading	Ant	Loss	Gain	Duty	Result	Limit	Margin	Remark
			[dBuV] Hor	Factor [dB/m]				[dBuV/m] Hor		[dB] Hor	
0.125	PK	0	97.8	19.9	6.0	32.2	-3.2	88.3	105.7	17.4	Carrier
0.125	PK	45	96.2	19.9	6.0	32.2	-3.2	86.7	105.7	19.0	Carrier
0.125	PK	90	93.3	19.9	6.0	32.2	-3.2	83.8	105.7	21.9	Carrier
0.125	PK	135	95.7	19.9	6.0	32.2	-3.2	86.2	105.7	19.5	Carrier
0.125	PK	0	86.4	19.9	6.0	32.2	-3.2	76.9	105.7	28.8	Carrier (Loop: Hor)
0.250	PK	0	68.5	19.7	6.1	32.2	-3.2	58.9	99.7	40.8	
0.375	PK	0	58.5	19.7	6.1	32.2	-3.2	48.9	96.1	47.2	

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

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

- *The test result is rounded off to one or two decimal places, so some differences might be observed.
- * Average emission measurements were calculated with PK detect and Duty cycle factor.

Radiated Emission above 30MHz (Spurious Emission)
Wagon type, TR Antenna

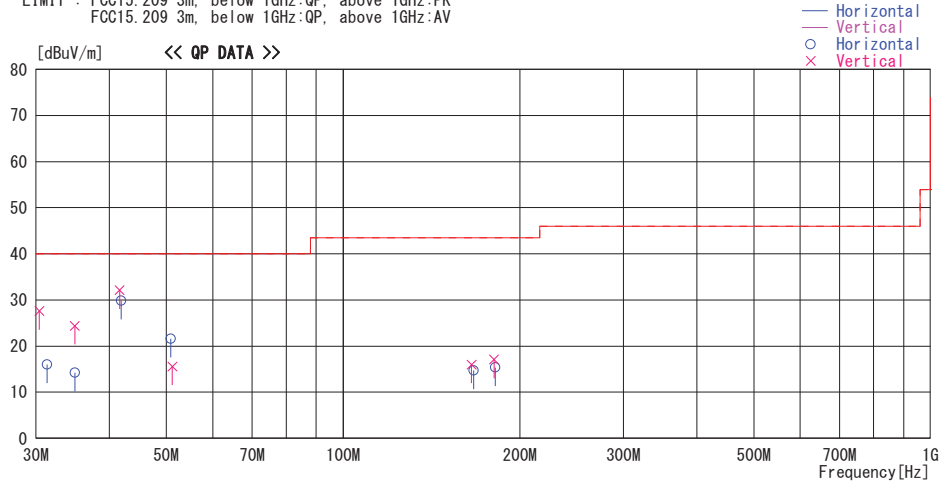
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber
Date : 2012/01/18

Report No. : 32AE0200-HO-03
Power : DC 12.0V
Temp./Humi. : 22 deg. C / 37% RH
Engineer : Satofumi Matsuyama

Mode / Remarks : LF Tx 125kHz, Max Ant(TR Antenna), Worst-axis(PCU H:X V:X, Ant H:X V:X)

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
FCC15.209 3m, below 1GHz:QP, above 1GHz:AV



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]							
30.395	33.9	QP	18.7	-25.0	27.6	315	100	Vert.	40.0	12.4	
31.335	22.9	QP	18.2	-25.1	16.0	0	300	Hori.	40.0	24.0	
34.950	22.6	QP	16.6	-25.0	14.2	0	300	Hori.	40.0	25.8	
34.950	32.8	QP	16.6	-25.0	24.4	88	100	Vert.	40.0	15.6	
41.656	42.9	QP	14.1	-24.9	32.1	116	100	Vert.	40.0	7.9	
41.894	40.7	QP	14.0	-24.9	29.8	355	300	Hori.	40.0	10.2	
50.896	35.7	QP	10.8	-24.9	21.6	178	400	Hori.	40.0	18.4	
51.196	29.8	QP	10.7	-24.9	15.6	63	100	Vert.	40.0	24.4	
165.454	23.7	QP	15.6	-23.3	16.0	298	100	Vert.	43.5	27.5	
166.799	22.4	QP	15.6	-23.3	14.7	0	300	Hori.	43.5	28.8	
180.749	24.1	QP	16.1	-23.1	17.1	288	100	Vert.	43.5	26.4	
181.649	22.3	QP	16.2	-23.1	15.4	0	300	Hori.	43.5	28.1	

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

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

Radiated Emission above 30MHz (Spurious Emission)
Wagon type, M/TI Antenna

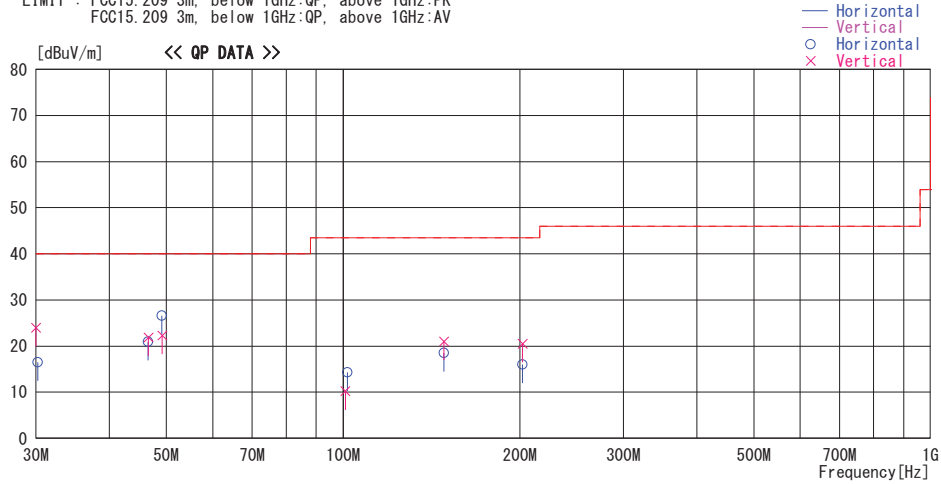
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber
Date : 2012/01/18

Report No. : 32AE0200-HO-03
Power : DC 12.0V
Temp./Humi. : 22 deg. C / 37% RH
Engineer : Satofumi Matsuyama

Mode / Remarks : LF Tx 125kHz, Min Ant(M/TI Antenna), Worst-axis(PCU H:X V:X, Ant H:Y V:X)

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
FCC15.209 3m, below 1GHz:QP, above 1GHz:AV



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]							
30.000	30.1	QP	18.9	-25.0	24.0	338	100	Vert.	40.0	16.0	
30.195	22.7	QP	18.8	-25.0	16.5	0	300	Hori.	40.0	23.5	
46.528	33.6	QP	12.2	-24.9	20.9	147	376	Hori.	40.0	19.1	
46.624	34.6	QP	12.2	-24.9	21.9	252	100	Vert.	40.0	18.1	
49.146	40.1	QP	11.4	-24.9	26.6	154	400	Hori.	40.0	13.4	
49.238	35.9	QP	11.3	-24.9	22.3	289	100	Vert.	40.0	17.7	
100.892	24.0	QP	10.3	-24.1	10.2	87	100	Vert.	43.5	33.3	
101.627	28.0	QP	10.4	-24.1	14.3	170	300	Hori.	43.5	29.2	
148.488	27.0	QP	15.0	-23.5	18.5	46	223	Hori.	43.5	25.0	
148.510	29.5	QP	15.0	-23.5	21.0	288	100	Vert.	43.5	22.5	
202.151	22.2	QP	16.7	-22.9	16.0	354	300	Hori.	43.5	27.5	
202.158	26.7	QP	16.7	-22.9	20.5	289	100	Vert.	43.5	23.0	

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)

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

Radiated Emission above 30MHz (Spurious Emission)
Sedan type, TR Antenna

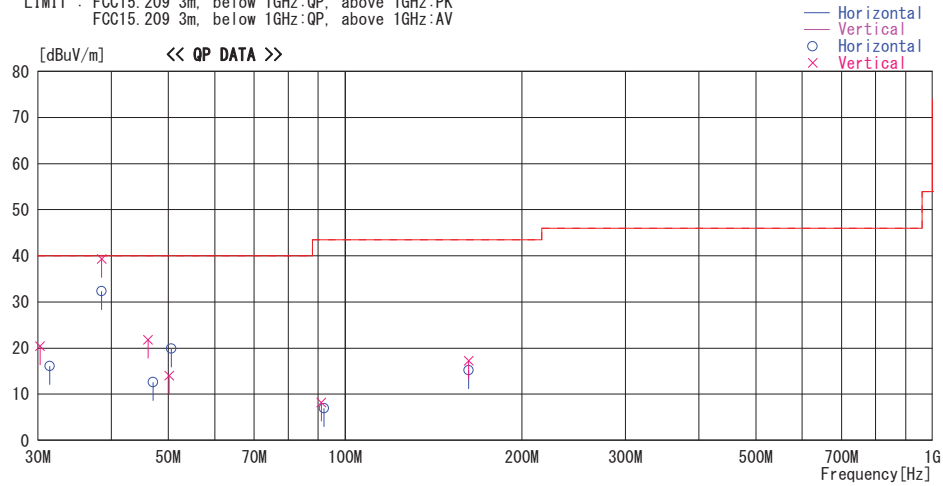
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber
Date : 2012/01/18

Report No. : 32AE0200-HO-03
Power : DC 12.0V
Temp./Humi. : 23 deg. C / 35% RH
Engineer : Satofumi Matsuyama

Mode / Remarks : LF Tx 125kHz, Max Ant(TR Antenna), Worst-axis(PCU H:X V:Z, Ant H:Y V:Y)

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
FCC15.209 3m, below 1GHz:QP, above 1GHz:AV



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]							
30.258	26.7	QP	18.7	-25.0	20.4	150	100	Vert.	40.0	19.6	
31.434	23.0	QP	18.2	-25.1	16.1	0	300	Hori.	40.0	23.9	
38.507	49.0	QP	15.3	-25.0	39.3	129	100	Vert.	40.0	0.7	
38.508	42.0	QP	15.3	-25.0	32.3	210	302	Hori.	40.0	7.7	
46.198	34.3	QP	12.3	-24.8	21.8	109	100	Vert.	40.0	18.2	
47.132	25.5	QP	12.0	-24.9	12.6	311	345	Hori.	40.0	27.4	
50.170	27.9	QP	11.0	-24.9	14.0	75	100	Vert.	40.0	26.0	
50.625	33.9	QP	10.9	-24.9	19.9	182	400	Hori.	40.0	20.1	
91.134	23.9	QP	8.5	-24.2	8.2	92	100	Vert.	43.5	35.3	
92.062	22.5	QP	8.7	-24.2	7.0	0	300	Hori.	43.5	36.5	
162.329	23.1	QP	15.5	-23.4	15.2	179	300	Hori.	43.5	28.3	
162.386	25.2	QP	15.5	-23.4	17.3	80	100	Vert.	43.5	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)

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

Radiated Emission above 30MHz (Spurious Emission)
Sedan type, FRDR Antenna (metal)

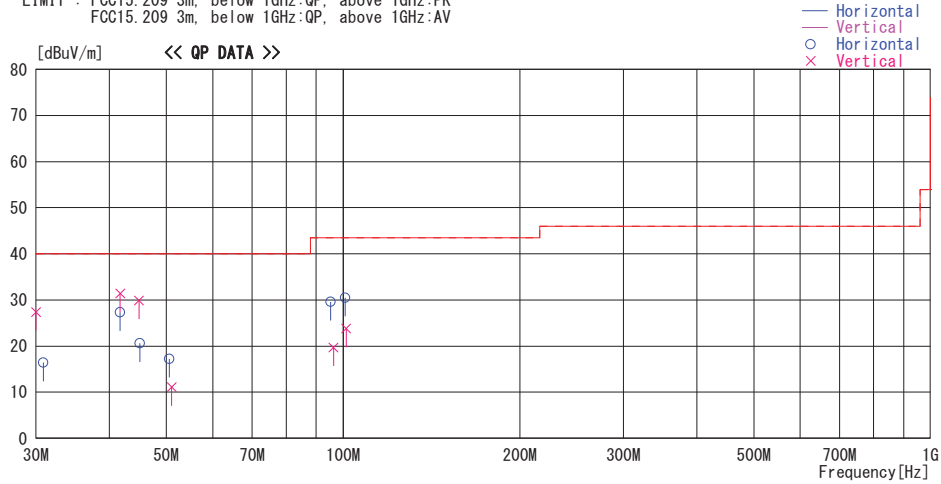
DATA OF RADIATED EMISSION TEST

UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber
Date : 2012/01/18

Report No. : 32AE0200-HO-03
Power : DC 12.0V
Temp./Humi. : 23 deg. C / 35% RH
Engineer : Satofumi Matsuyama

Mode / Remarks : LF Tx 125kHz, Min Ant (FRDR Antenna (metal)), Worst-axis (PCU H:X V:X, Ant H:Z V:Z)

LIMIT : FCC15.209 3m, below 1GHz:QP, above 1GHz:PK
FCC15.209 3m, below 1GHz:QP, above 1GHz:AV



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]							
30.016	33.5	QP	18.9	-25.0	27.4	352	100	Vert.	40.0	12.6	
30.900	23.0	QP	18.4	-25.0	16.4	0	300	Hori.	40.0	23.6	
41.725	38.1	QP	14.1	-24.9	27.3	31	300	Hori.	40.0	12.7	
41.726	42.2	QP	14.1	-24.9	31.4	310	100	Vert.	40.0	8.6	
44.944	42.0	QP	12.8	-24.9	29.9	58	100	Vert.	40.0	10.1	
45.056	32.8	QP	12.7	-24.9	20.6	300	400	Hori.	40.0	19.4	
50.564	31.2	QP	10.9	-24.9	17.2	185	400	Hori.	40.0	22.8	
51.050	25.2	QP	10.8	-24.9	11.1	45	100	Vert.	40.0	28.9	
95.234	44.5	QP	9.3	-24.2	29.6	345	300	Hori.	43.5	13.9	
96.282	34.4	QP	9.5	-24.2	19.7	76	346	Vert.	43.5	23.8	
100.816	44.3	QP	10.3	-24.1	30.5	352	300	Hori.	43.5	13.0	
101.196	37.5	QP	10.4	-24.1	23.8	287	100	Vert.	43.5	19.7	

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

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

-26dB Bandwidth and 99% Occupied Bandwidth
Wagon type, TR Antenna

UL Japan, Inc.
Head Office EMC Lab. No.4 Semi Anechoic Chamber

REPORT NO : 32AE0200-HO-03

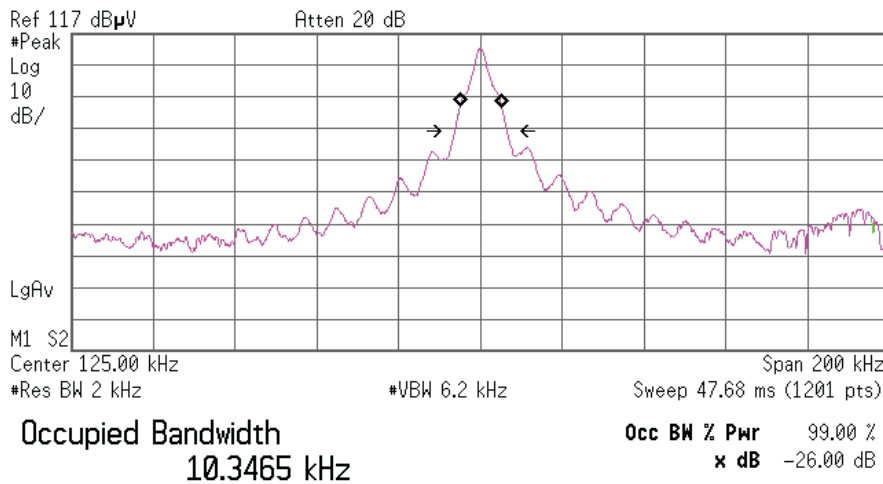
POWER : DC 12.0V
MODE : Tx
: TR Antenna

TEST DISTANCE : -
DATE : 01/18/2012
TEMPERATURE : 22 deg.C
HUMIDITY : 37 %
Engineer : Satofumi Matsuyama

FREQ	-26dB Bandwidth	99% Occupied Bandwidth
[kHz]	[kHz]	[kHz]
125.0	12.892	10.347

Agilent

R T



Transmit Freq Error 158.833 Hz
x dB Bandwidth 12.892 kHz

-26dB Bandwidth and 99% Occupied Bandwidth
Sedan type, TR Antenna

UL Japan, Inc.
Head Office EMC Lab. No.4 Semi Anechoic Chamber

REPORT NO : 32AE0200-HO-03

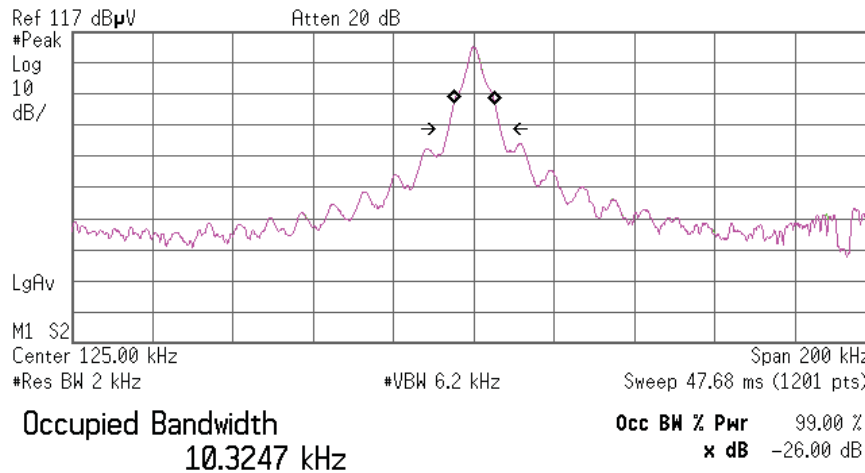
POWER : DC 12.0V
MODE : Tx
: TR Antenna

TEST DISTANCE : -
DATE : 01/18/2012
TEMPERATURE : 22 deg.C
HUMIDITY : 37 %
Engineer : Satofumi Matsuyama

FREQ	-26dB Bandwidth	99% Occupied Bandwidth
[kHz]	[kHz]	[kHz]
125.0	12.948	10.325

Agilent

R T



Transmit Freq Error 165.998 Hz
x dB Bandwidth 12.948 kHz

-26dB Bandwidth and 99% Occupied Bandwidth
Sedan type, FRDR Antenna (metal)

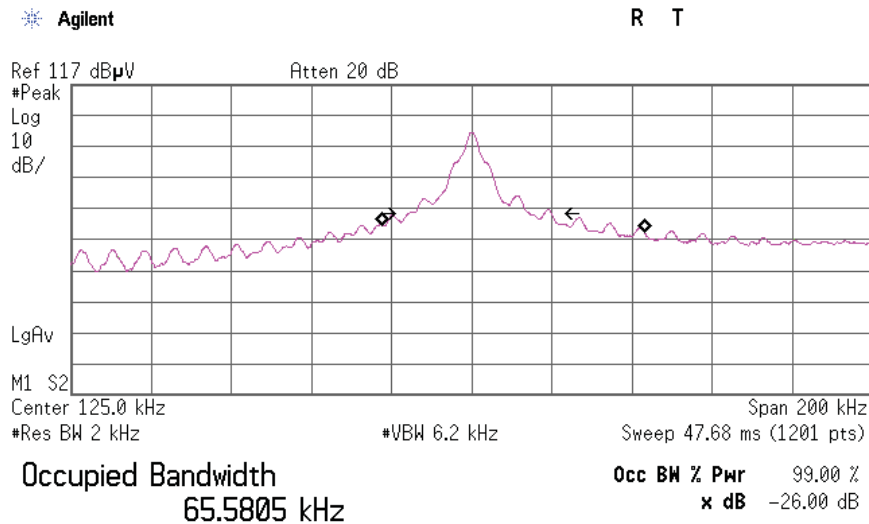
UL Japan, Inc.
Head Office EMC Lab. No.4 Semi Anechoic Chamber

REPORT NO : 32AE0200-HO-03

POWER : DC 12.0V
MODE : Tx
: FRDR Antenna (metal)

TEST DISTANCE : -
DATE : 01/18/2012
TEMPERATURE : 22 deg.C
HUMIDITY : 37 %
Engineer : Satofumi Matsuyama

FREQ	-26dB Bandwidth	99% Occupied Bandwidth
[kHz]	[kHz]	[kHz]
125.0	35.464	65.581



Transmit Freq Error 10.494 kHz
x dB Bandwidth 35.464 kHz

Duty Cycle

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	32AE0200-HO-03
Date	01/17/2012
Temperature/ Humidity	25 deg. C / 34% RH
Engineer	Satofumi Matsuyama
Mode	LF Tx 125kHz

Type	Times	ON time(One pulse) [ms]	ON time(in 1Period) [ms]
A	1	0.480	0.480
B	26	0.305	7.930
C	52	0.207	10.764
D	1	2.899	2.899

*1)ON time(in 1Period) = Times * ON time(One pulse)

*2)The worst Duty cycle was determined to be the actual measurement value based on the comparison between the theoretical value (Duty:50% (-6dB) / Period:27.392msec) and the actual measured one.

Therefore, the final result was Duty cycle -3.2dB.

(Total)

ON time [ms]	Cycle [ms]	Duty (On time/Cycle)	Duty [dB]
22.07	31.73	0.70	-3.2

*2)ON time = Type A's ON time (in 1Period) + Type B's ON time (in 1Period) + Type C' ON time (in 1Period) + Type D' ON time (in 1Period)

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

*4) 1 period is 31.73msec. (See page 25)

UL Japan, Inc.

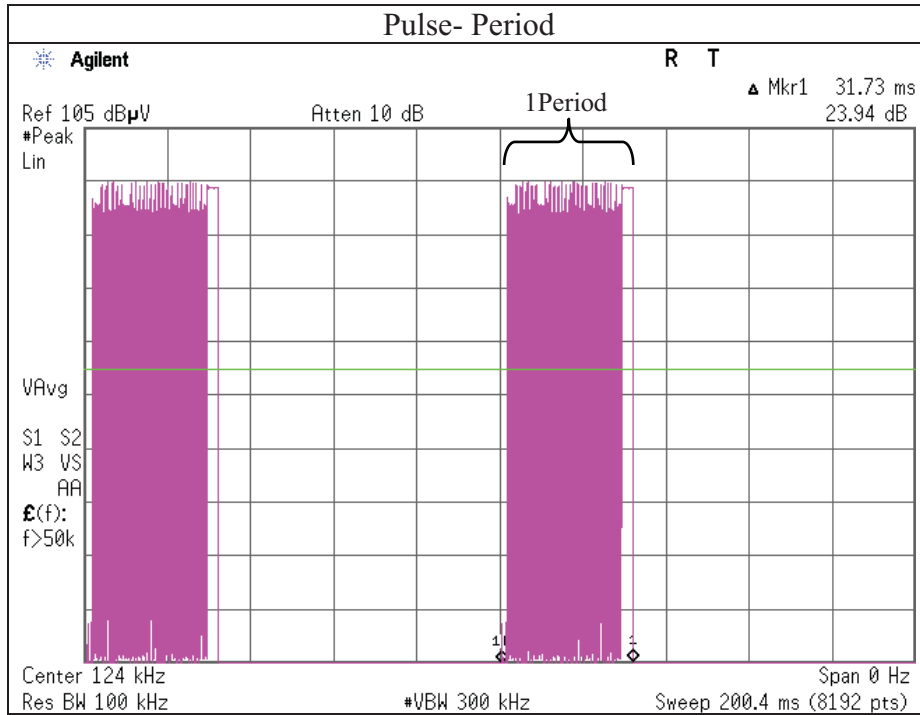
Head Office EMC Lab.

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

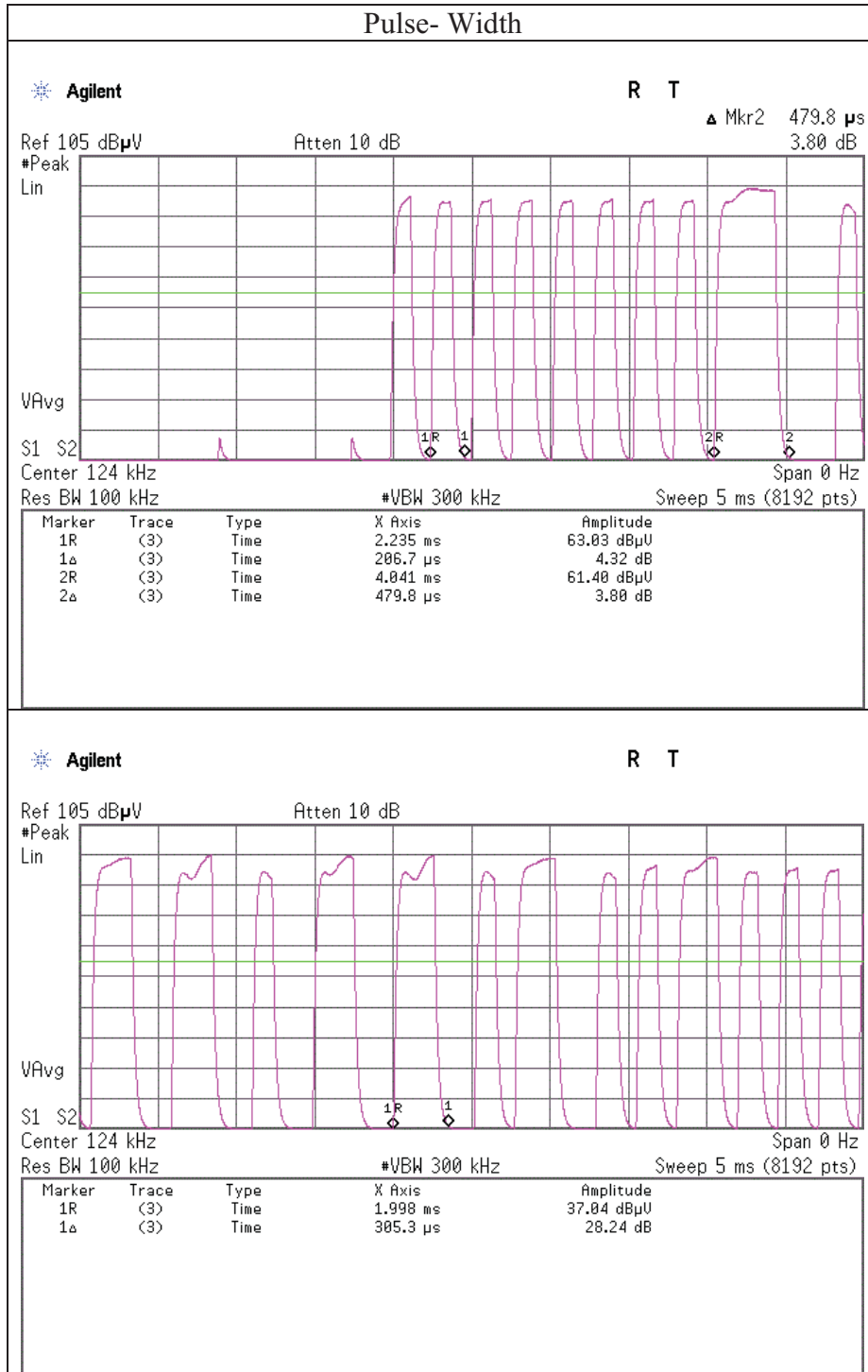
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Duty Cycle



Duty Cycle



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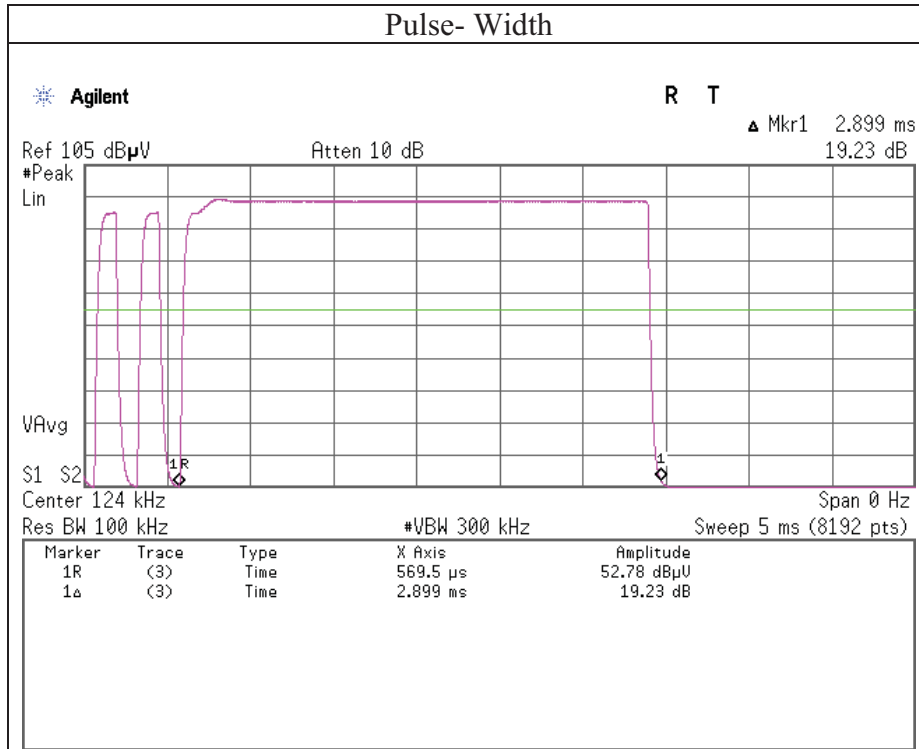
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Duty Cycle



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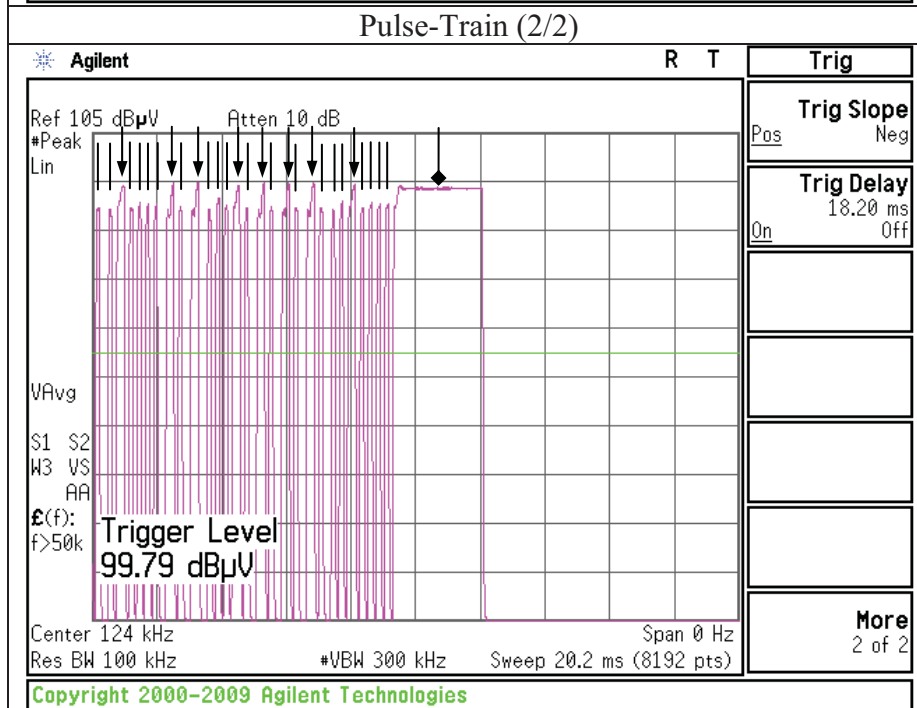
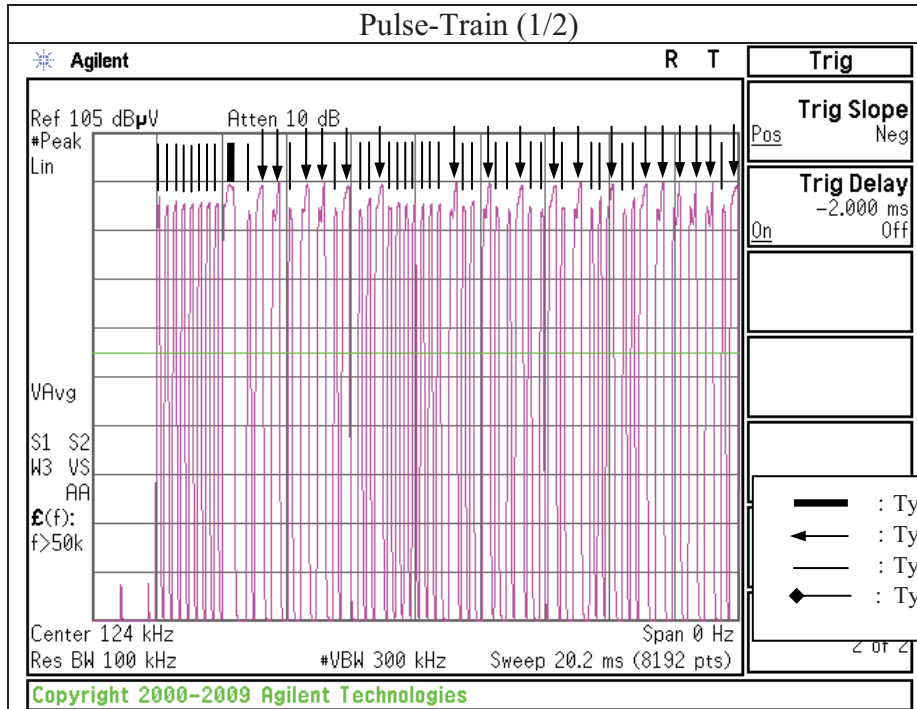
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Duty Cycle



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	2011/03/01 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	-	RE	2011/02/23 * 12
MJM-07	Measure	PROMART	SEN1955	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE	2011/04/08 * 12
MTR-07	Test Receiver	Rohde & Schwarz	ESCI	100635	RE	2011/10/19 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2011/10/19 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/SFM141(5m)/421-010(1m)/sucoform141-PE(1m)/RFM-E121(Switcher)	-/04178	RE	2011/07/04 * 12
MCC-31	Coaxial cable	UL Japan	-	-	RE	2011/07/28 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2011/03/04 * 12
MAT-07	Attenuator(6dB)	Weinschel Corp	2	BK7970	RE	2011/11/02 * 12
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	2011/03/25 * 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: Radiated emission, -26dB Bandwidth, 99% Occupied Bandwidth

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