



RADIO TEST REPORT

Test Report No. : 10102266H-A-R1

Applicant : OPTEX CO., LTD.
Type of Equipment : Vehicle detection sensor
Model No. : VDS-005
FCC ID : DC9-VDS005
Test regulation : FCC Part 15 Subpart C: 2013
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 the 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 10102266H-A. 10102266H-A is replaced with this report.

Date of test: November 28 to December 4, 2013

Representative test engineer:

Hironobu Ohnishi
Engineer of WiSE Japan,
UL Verification Service

Approved by:

Takahiro Hatakeda
Leader of WiSE Japan,
UL Verification Service



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>

UL Japan, Inc.

Head Office EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

13-EM-F0429

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SECTION 1: Customer information

Company Name : OPTEX CO., LTD.
Address : 5-8-12 Ogoto, Otsu, Shiga 520-0101 Japan
Telephone Number : +81-77-579-8000
Facsimile Number : +81-77-579-7100
Contact Person : Yasuhiro Takada

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

2.1 Identification of E.U.T.

Type of Equipment : Vehicle detection sensor
Model No. : VDS-005
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC3.8V
Receipt Date of Sample : November 8, 2013
Country of Mass-production : Japan
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 : CPU: 32MHz

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 24.125GHz
Modulation : FM-CW
Power Supply (radio part input) : DC5.0V
Antenna type : Internal Antenna
Antenna Gain : 11dBi

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

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Facsimile : +81 596 24 8124

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C: 2013, final revised on September 30, 2013 and effective October 30, 2013

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.249 Operation within the bands 902-928MHz,
2400-2483.5MHz, 5725-5875MHz and 24.0-24.25GHz

*The EUT complies with FCC Part 15 Subpart B: 2013, final revised on September 30, 2013 and effective October 30, 2013.

3.2 Procedures and results

No.	Item	Test Procedure	Specification	Deviation	Worst margin	Results
1	Conducted Emission	ANSI C63.4:2003 7. AC powerline conducted emission measurements	Section 15.207(a)	N/A	N/A	N/A *1)
2	Electric Field Strength of Fundamental Emission	ANSI C63.4:2003 13. Measurement of intentional radiators	Section 15.249(a)(e)	N/A	10.7dB 24125.830MHz Vertical PK with Duty Factor	Complied
3	Electric Field Strength of Spurious Emission	ANSI C63.4:2003 13. Measurement of intentional radiators	Section 15.205(a)(b) Section 15.209(a) Section 15.249(a)(d)(e)	N/A	3.2dB 96516.730MHz Horizontal PK with Duty Factor	Complied
4	20dB Bandwidth	ANSI C63.4:2003	Reference	N/A	N/A	N/A
5	Frequency Tolerance	ANSI C63.4:2003	Section 15.249(b)	N/A	N/A	N/A *2)

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

*1) The test is not applicable since this EUT is operated on DC.

*2) The test is not required since this EUT does not operate in accordance with FCC15.249(b).

*In case any questions arise about test procedure, ANSI C63.4: 2003 is also referred.

FCC 15.31 (e)

The RF Module has its own regulator.

The RF Module is constantly provided voltage (DC5.0V) through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203 Antenna requirement

It is impossible for end users to replace the antenna, because it is printed on the circuit board. Therefore the equipment complies with the requirement of 15.203/212.

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Facsimile : +81 596 24 8124

3.3 Addition to standard

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	4.3dB	5.0dB	5.1dB	4.9dB	5.8dB	4.4dB	4.3dB
No.2	4.3dB	5.2dB	5.1dB	5.0dB	5.7dB	4.3dB	4.2dB
No.3	4.6dB	5.0dB	5.1dB	5.0dB	5.7dB	4.5dB	4.2dB
No.4	4.8dB	5.2dB	5.0dB	5.0dB	5.7dB	5.2dB	4.2dB

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

Radiated emission (+dB)	
40GHz-50GHz	3.9dB
50GHz-75GHz	4.6dB
75GHz-110GHz	5.0dB

Radiated emission test

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

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Head Office EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

3.5 Test Location

UL Japan, Inc. Head Office EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999 Facsimile : +81 596 24 8124

	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	4.0 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	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.

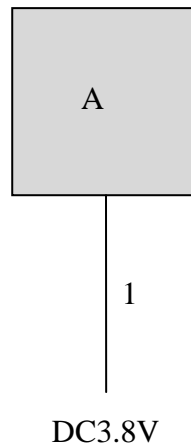
Refer to APPENDIX.

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

4.1 Operating Modes

Test Item	Mode	Tested frequency
Electric Field Strength of Fundamental Emission Electric Field Strength of Spurious Emission 20dB Bandwidth	Running mode (Tx/Rx)	24.125GHz
The system was configured in typical fashion (as a customer would normally use it) for testing. *EUT has the power settings by the software as follows; - Power settings: Same as production model - Software: Sensor Program/Version 4.00 This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting.		

4.2 Configuration and peripherals



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

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Vehicle detection sensor	VDS-005	1 *1) 2 *2)	OPTEX CO., LTD.	EUT

*1) Used for band edge, bandwidth, and duty measurements (FM-CW modulation)

*2) Used for other tests except for band edge and duty measurements (24.175GHz CW)

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-

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Head Office EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

SECTION 5: Radiated emission (Electric Field Strength of Fundamental and Spurious Emission)

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 0.5m by 1.0m(9kHz – 10GHz), 0.5m by 0.5m(10GHz – 100GHz) , raised 0.8m(9kHz – 10GHz), 1.0m(10GHz – 100GHz) above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane. The height of the measuring antenna varied between 1 and 4m (frequency 9kHz – 30MHz: loop antenna was fixed height at 1.0m) and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength. The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer. The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table. When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	Below 30MHz	30MHz to 300MHz	300MHz to 1GHz	Above 1GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

Frequency	9kHz-150kHz	150kHz-30MHz	30MHz-1GHz	1GHz-100GHz	
Instrument used	Test Receiver	Test Receiver	Test Receiver	Spectrum Analyzer	
Detector	QP, AV	QP, AV	QP	PK	AV
IF Bandwidth	BW 200Hz	BW 9kHz	BW 120kHz	RBW: 1MHz	*2), *3)
				VBW: 3MHz	
Test Distance	3m	3m	3m	3m (below 10GHz), 1m*4) (above 10GHz), 0.5m*5) (above 26.5GHz) 0.3m*6) (above 50GHz)	

*1) The test below1GHz was performed with QP detect.

Because it was generated at the repetition cycle of 20Hz or more the pulse emission.

*2) For Pulse emission: Used for the band edge of the carrier and the harmonics that can be measured. The Average value was calculated by reducing Duty factor from PK (PK value – Duty factor).

For Duty factor, please refer to Page 14.

*3) For Non-Pulse emission: Average Detector (RBW: 1MHz, VBW: 10Hz)

*4) Distance Factor: $20 \times \log (3.0m/1.0m) = 9.5dB$

*5) Distance Factor: $20 \times \log (3.0m/0.5m) = 15.6dB$

*6) Distance Factor: $20 \times \log (3.0m/0.3m) = 20.0dB$

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

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[Far field boundary distance]

The carrier levels were confirmed at maximum direction of transmission. The maximum direction was searched under carefully since beam-widths are extremely narrow.

The carrier levels were measured in the far field. The distance of the far field was calculated from follow equation.

$$r = \frac{2D^2}{\lambda}$$

where

r is the distance from the radiating element of the EUT to the edge of the far field, in m
D is the largest dimension of both the radiating element and the test antenna (horn), in m
Lambda is the wavelength of the emission under investigation [300/f (MHz)], in m

Frequency [GHz]	Lambda [mm]	Maximum Dimention D [m]	Far Field Boundary r [m]
24.175	12.4	0.060	0.581

The test was made on EUT at the normal use position.

*The result is rounded off to the second decimal place, so some differences might be observed.

Measurement range : 9kHz-100GHz
Test data : APPENDIX 1
Test result : Pass

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

Telephone : +81 596 24 8999

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SECTION 6: 20dB Bandwidth and Duty Cycle

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
20dB Bandwidth	500MHz	5MHz	50MHz	1100sec	Peak	Max Hold	Spectrum Analyzer
Duty Cycle	-	-	-	2sec / 10sec	-	-	Oscilloscope with diode detector

Test data : APPENDIX 1
Test result : Pass

APPENDIX 1: Data of EMI test

Radiated Emission (Electric Field Strength of Fundamental and Spurious Emission)

Test place : Head Office EMC Lab. No.4 and 3 Semi Anechoic Chambers
Report No. : 10102266H
Date : 11/28/2013 12/04/2013
Temperature / Humidity : 22 deg. C / 34% 24 deg. C / 34%
Engineer : Hironobu Ohnishi Takumi Shimada
(Above 1GHz) (Below 1GHz)
Mode : Running mode

QP

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	162.875	QP	30.4	15.5	8.7	32.1	22.5	43.5	21.0	
Hori	350.916	QP	29.5	16.0	10.2	32.0	23.7	46.0	22.3	
Hori	418.733	QP	29.3	17.6	10.7	32.0	25.6	46.0	20.4	
Hori	485.358	QP	28.5	18.0	11.1	32.0	25.6	46.0	20.4	
Hori	518.390	QP	28.8	18.4	11.3	32.1	26.4	46.0	19.6	
Hori	574.003	QP	25.3	19.2	11.6	32.1	24.0	46.0	22.0	
Vert	164.217	QP	24.7	15.5	8.7	32.1	16.8	43.5	26.7	
Vert	350.300	QP	27.2	16.0	10.2	32.0	21.4	46.0	24.6	
Vert	414.365	QP	28.0	17.6	10.6	32.0	24.2	46.0	21.8	
Vert	482.215	QP	32.4	18.0	11.1	32.0	29.5	46.0	16.5	
Vert	516.973	QP	31.5	18.4	11.3	32.1	29.1	46.0	16.9	
Vert	570.457	QP	28.0	19.1	11.6	32.1	26.6	46.0	19.4	

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

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

Peak (PK)

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 Inside or Outside of Restricted Bands
		Hor	Ver					Hor	Ver		Hor	Ver	
24000.000	PK	46.3	46.9	39.3	-0.6	32.0	-	53.0	53.6	73.9	20.9	20.3	Inside
24125.830	PK	85.4	107.0	39.3	-0.6	32.1	-	92.0	113.6	127.9	35.9	14.3	Carrier
24250.000	PK	46.0	46.3	39.3	-0.5	32.1	-	52.7	53.0	73.9	21.2	20.9	Outside
48253.300	PK	60.4	57.9	40.4	-7.8	19.3	-	73.7	71.2	87.9	14.2	16.7	Inside
72387.560	PK	14.2	14.1	41.7	28.7	5.5	-	79.1	79.0	87.9	8.8	8.9	Inside
96516.730	PK	25.7	22.3	45.6	24.3	28.5	-	67.1	63.7	73.9	6.8	10.2	Inside

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Mixer-Distance factor(above 10GHz)) - Gain(Amplifier)

PK with Duty factor

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 Inside or Outside of Restricted Bands
		Hor	Ver					Hor	Ver		Hor	Ver	
24000.000	PK	46.3	46.9	39.3	-0.6	32.0	-16.4	36.6	37.2	53.9	17.3	16.7	Inside
24125.830	PK	85.4	107.0	39.3	-0.6	32.1	-16.4	75.6	97.2	107.9	32.3	10.7	Carrier
24250.000	PK	46.0	46.3	39.3	-0.5	32.1	-16.4	36.3	36.6	53.9	17.6	17.3	Outside
48253.300	PK	60.4	57.9	40.4	-7.8	19.3	-16.4	57.3	54.8	67.9	10.6	13.1	Inside
72387.560	PK	14.2	14.1	41.7	28.7	5.5	-16.4	62.7	62.6	67.9	5.2	5.3	Inside
96516.730	PK	25.7	22.3	45.6	24.3	28.5	-16.4	50.7	47.3	53.9	3.2	6.6	Inside

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Mixer-Distance factor(above 10GHz)) - 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 above 1GHz was performed with PK detect. Average emission measurements were calculated with PK detect and Duty cycle factor.

* Duty Factor was calculated with the assumption of the worst condition in 100msec.

* The noise measured with PK detect was pulse emission.

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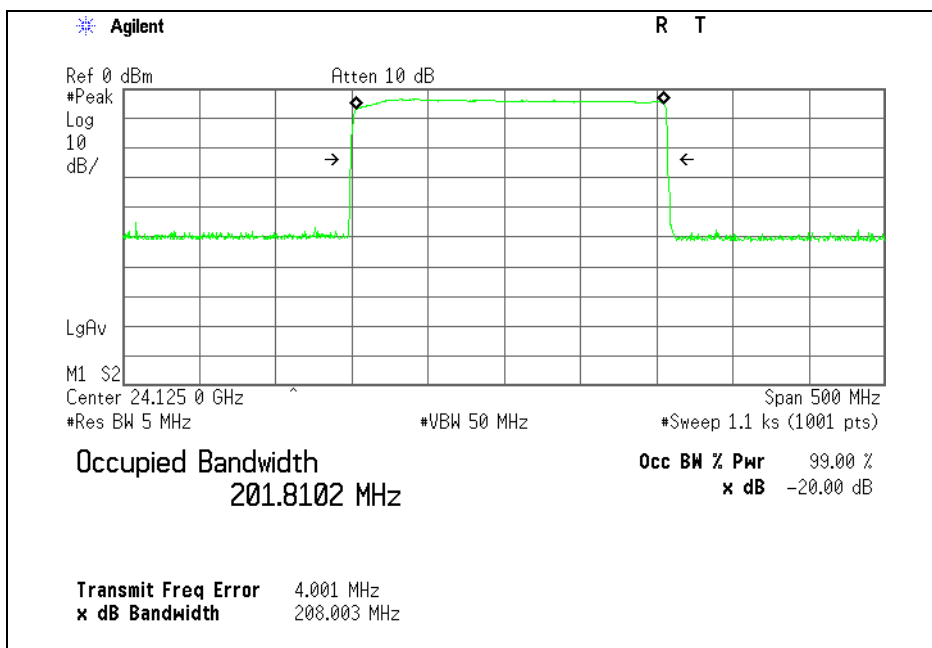
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

20dB Bandwidth

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	10102266H
Date	11/28/2013
Temperature / Humidity	22 deg. C / 34%
Engineer	Hironobu Ohnishi
Mode	Running mode

Frequency [GHz]	20dB Bandwidth [MHz]	99% OBW [MHz]
24.125	208.003	201.8102



Duty Cycle

Test place Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No. 10102266H
Date 11/28/2013
Temperature / Humidity 22 deg. C / 34%
Engineer Hironobu Ohnishi
Mode Running mode

ON time [ms]	Cycle [ms]	Duty (On time/Cycle)	Duty [dB]
15.069	100.00	0.15069	-16.4

*1)The train of pulses was exceeding 100msec, and that sampled 100msec was the worst case against the pulse train.

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

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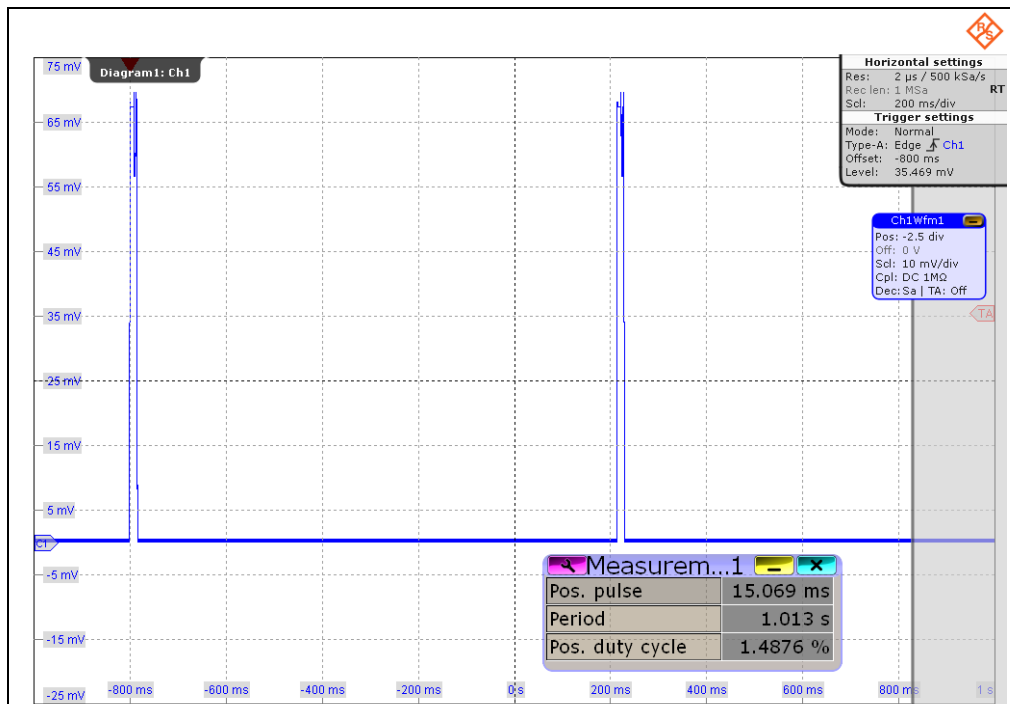
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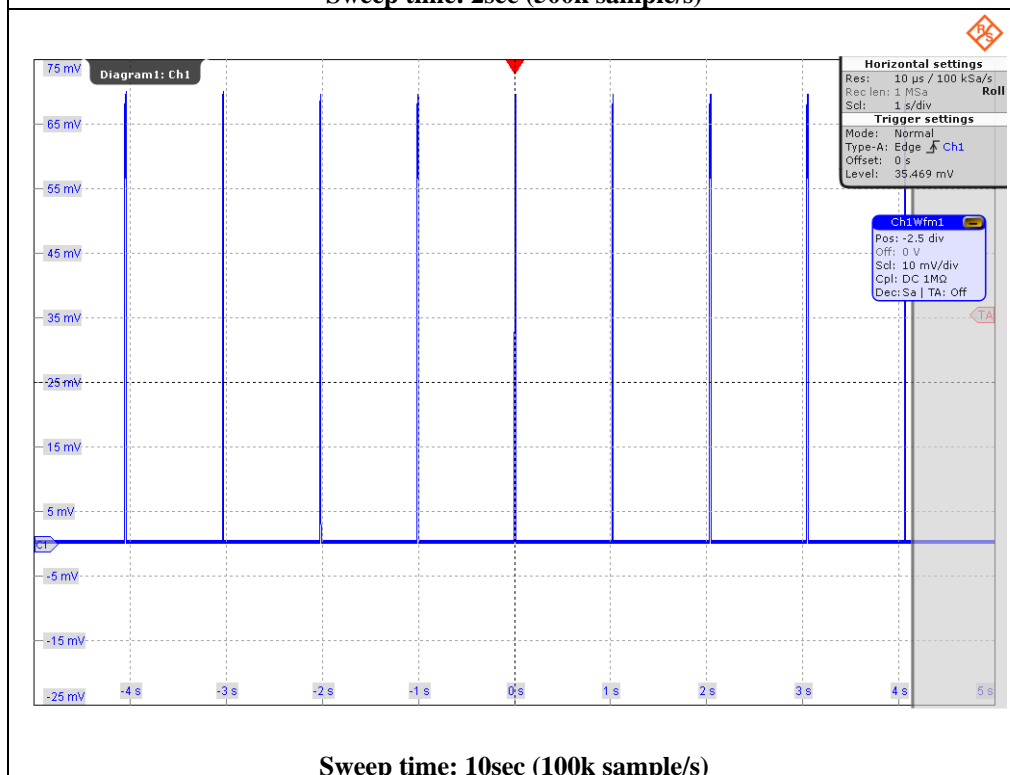
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Duty Cycle



Sweep time: 2sec (500k sample/s)



Sweep time: 10sec (100k sample/s)

APPENDIX 2: Test Instruments

EMI test equipment (1/2)

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	2013/02/28 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	-	RE	2013/02/26 * 12
MJM-09	Measure	KDS	E19-55	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	RE	2013/02/22 * 12
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2013/08/12 * 12
MCC-141	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1204S062(5m)	RE	2013/05/28 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	MY39500780	RE	2013/03/19 * 12
MHA-17	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	RE	2013/06/30 * 12
MHA-04	Horn Antenna 26.5-40GHz	EMCO	3160-10	1140	RE	2013/11/25 * 12
MCC-140	Microwave Cable	Junkosha	J12J101596-00	JAN-31-12-001	RE	2013/02/26 * 12
MPA-03	Microwave System Power Amplifier	Agilent	83050A	3950M00205	RE	2013/06/20 * 12
MHA-07	Horn Antenna	Custom	HO22R	10766-01	RE	2013/10/25 * 12
MHA-10	Horn Antenna	WiseWave	ARH1523-02	10766-02	RE	2013/10/25 * 12
MPA-08	Pre Amplifier	WiseWave	ALN-61226028-51	11576-01-071	RE	2013/08/02 * 12
MMX-01	Preselected Millimeter Mixer	Agilent	11974V-E01	3001A00412	RE	2013/06/06 * 12
MCC-135	Microwave Cable	HUBER+SUHNER	SUCOFLEX102	37511/2	RE	2013/08/22 * 12
MCC-136	Microwave Cable	HUBER+SUHNER	SUCOFLEX102	37512/2	RE	2013/08/22 * 12
MHA-11	Horn Antenna	WiseWave	ARH1023-02	10766-01	RE	2013/10/25 * 12
MPA-18	Pre Amplifier	AmTechs Corporation	LNA-7511025	9601	RE	2013/08/02 * 12
MMX-02	Harmonic Mixer	Agilent	11970W	2521 A01909	RE	2013/06/06 * 12
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2013/02/28 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	-	RE	2013/02/26 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2013/08/20 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2013/10/13 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	174	RE	2013/10/13 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2013/07/23 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2013/04/05 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2013/03/12 * 12
MDT-01	Detector	Agilent	8473C	1822A00789	RE	Pre Check
MDO-07	Digital Oscilloscope	Rohde & Schwarz	RTO1004	200354	RE	2013/07/30 * 12

UL Japan, Inc.

Head Office EMC Lab.

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

Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

EMI test equipment (2/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2013/10/30 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2013/07/22 * 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

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, 20dB bandwidth, and Duty cycle tests

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