RADIO TEST REPORT

Test Report No. : 32AE0195-HO-01-A-R1

Applicant	:	**DENSO CORPORATION**
Type of Equipment	:	**Millimeter Wave Radar Sensor**
Model No.	:	**DNMWR006**
FCC ID	:	**HYQDNMWR006**
Test regulation	:	**FCC Part 15 Subpart C: 2011**
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 32AE0195-HO-01-A. 32AE0195-HO-01-A is replaced with this report.

Date of test: September 15 to October 14, 2011

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

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CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	DENSO CORPORATION
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Telephone Number	:	+81-566-25-5947
Facsimile Number	:	+81-566-25-4548
Contact Person	:	Madoka Shimotsuru

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

2.1 Identification of E.U.T.

Type of Equipment	:	Millimeter Wave Radar Sensor
Model No.	:	DNMWR006
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12V (Car battery), DC9V to 16V(Operating range)
Receipt Date of Sample	:	September 6, 2011
Country of Mass-production	:	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

This radar sensor (DNMWR006) is the 76GHz - 77GHz vehicle-mounted field disturbance sensor that is a millimeter wave frequency modulated continuous wave (FM-CW) radar operating at 76.0GHz to 77.0GHz (Nominal: 76.5GHz).

General Specification

Clock frequency(ies) in the system	:	Microcomputer: 20MHz

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	76-77GHz
Modulation	:	FM-CW
Antenna Type	:	Internal Antenna
Antenna Connector	:	None
Antenna Gain	:	21.5dBi
Antenna beam width (-3dB)	:	+/-10deg. (Horizontal), +/-2.5deg. (Vertical)
Steerable Antenna	:	Electronically (Receiving Part only)
Usage location	:	Forward-looking, vehicle-mounted
Power Supply (inner)	:	DC -4.5V, DC 5V, DC6.5V

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C: 2011, final revised on July 8, 2011 and effective August 8, 2011
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.253 Operation within the bands 46.7-46.9GHz and 76.0-77.0GHz.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	**FCC:** ANSI C63.4:2003 7. AC power line Conducted Emission measurements	**FCC:** Section 15.207	N/A	N/A	*1)
	IC: RSS-Gen 7.2.4	**IC:** RSS-Gen 7.2.4			
26dB Bandwidth	**FCC:** "MILLIMETER WAVE TEST PROCEDURES"	**FCC:** Section 15.253(e)	See data.	Complied	Radiated
	IC: -	**IC:** RSS-210 A13.1.5			
Power Density	**FCC:** "MILLIMETER WAVE TEST PROCEDURES"	**FCC:** Section 15.253(b), (d)		Complied	Radiated *2)
	IC: -	**IC:** RSS-210 A13.1.2(1)			
Spurious Emissions	**FCC:** ANSI C63.4:2003, "MILLIMETER WAVE TEST PROCEDURES"	**FCC:** Section 15.253(c) , (d)	2.0dB 432.067MHz, Hori. QP	Complied	Radiated *2)
	IC: RSS-Gen 4.9	**IC:** RSS-210 A13.1.2(2), A13.1.4, RSS-Gen 7.2.3			
Frequency Stability	**FCC:** "MILLIMETER WAVE TEST PROCEDURES"	**FCC:** Section 15.253(e)	See data.	Complied	Radiated
	IC: RSS-Gen 4.7, 7.2.4	**IC:** RSS-210 A13.1.5			
RF Exposure	**FCC:** -	**FCC:** Section 15.253(f)	See Appendix.	Complied	-
	IC: RSS-Gen 5.5	**IC:** RSS-102 4.2			

*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
*2) Since the EUT is forward-looking sensor, the limit of side-looking and rear-looking is not applied in Power Density and Spurious Emissions tests.

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.
Millimeter wave measurement was performed accordance with FCC KDB 200443 (MILLIMETER WAVE TEST PROCEDURES).

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

FCC 15.31 (e)

This EUT provides stable voltage(DC -4.5V, DC 5V, DC6.5V) constantly to RF part 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 the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	**IC:** RSS-Gen 4.6.1	**IC:** RSS-Gen 4.6.1	N/A	-	Radiated
Receiver Spurious Emission	**IC:** RSS-Gen 4.10	**IC:** RSS-Gen 6	- *1)	Complied	Radiated

*1) Transmitting and receiving is operating simultaneously. The limits are same as transmitter spurious emission limits. Therefore, these results were included within transmitter results.

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 (±dB)	
40GHz-50GHz	3.9dB
50GHz-75GHz	5.1dB
75GHz-110GHz	5.4dB
110GHz-170GHz	5.2dB
170GHz-260GHz	5.2dB

Radiated emission test(3m)
The data listed in this report meets the limits unless the uncertainty is taken into consideration.

3.5 Test Location

UL Japan, Inc. Head Office EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8116 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	4.75 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, RF Exposure, Test instruments, and Test set up

Refer to APPENDIX.

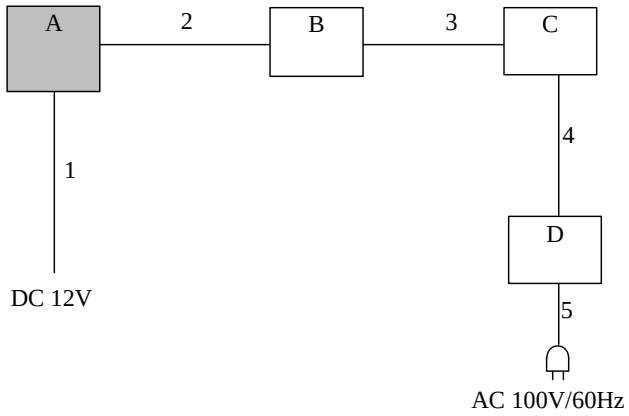
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

Mode	Test Item
Operating mode (In motion) *1)	26dB Bandwidth Power Density Spurious Emission Frequency Stability
Operating mode (Not in motion)	Power Density
Power of the EUT was set by the software as follows; Software: mwr_gen4_0018_t042 This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product. *1) All test items were performed on "In motion" mode, since output power is higher than "Not in motion" mode.	

Detail of Operation: DNMWR006 is using an electric scanning called Digital Beam Forming (DBF) and Monopulse to determine azimuth angle of objects.

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	Millimeter Wave Radar Sensor	DNMWR006	001	DENSO CORPORATION	EUT
B	CAN Cab	251	-	Vector	-
C	PC	CF-B5ER8S	1BKSA01852	Panasonic	-
D	AC Adaptor	CF-AA1639A M3	030600424B	Panasonic	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	9.7	Unshielded	Unshielded	-
2	Signal Cable	10.0	Unshielded	Unshielded	-
3	Signal Cable	0.3	Shielded	Shielded	-
4	DC Cable	1.8	Unshielded	Unshielded	-
5	AC Cable	1.7	Unshielded	Unshielded	-

SECTION 5: Radiated Emission (Spurious Emission, Power Density)

Test Procedure
[Up to 40GHz]
EUT was placed on a urethane platform of nominal size, 0.5m by 1.0m raised 0.8m 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-231GHz	
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 VBW: 3MHz	RBW: 1MHz VBW: 10Hz
Test Distance	3m	3m	3m	3m (below 10GHz), 1m*1) (10GHz - 40GHz)	

*1) Distance Factor: 20 x log (3.0m/1.0m) = 9.5dB

[Above 40GHz]
The test was performed based on "MILLIMETER WAVE TEST PROCEDURES".
The EUT was placed on a urethane platform, raised 1.5m above the conducting ground plane.
The measurements were performed on handheld method.

Set spectrum analyzer RBW, VBW, span, etc., to the proper values. Note these values. Enable two traces—one set to "clear write," and the other set to "max hold."
Begin hand-held measurements with the test antenna (horn) at a distance of 1 m from the EUT in a horizontally polarized position. Slowly adjust its position, entirely covering the plane 1 m from the EUT.
Observation of the two active traces on the spectrum analyzer will allow refined horn positioning at the point(s) of maximum field intensity. Repeat with the horn in a vertically polarized position. If the emission cannot be detected at 1 m, reduce the RBW to increase system sensitivity. Note the value. If the emission still cannot be detected, move the horn closer to the EUT, noting the distance at which a measurement is made.

Note the maximum level indicated on the spectrum analyzer. Adjust this level, if necessary, by the antenna gain, conversion loss of the external mixer and gain of LNA used, at the frequency under investigation. Calculate the field strength of the emission at the measurement distance from the Friis' transmission equation.

[About carrier measurement]
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 fair 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]
77.0	3.9	0.058	1.8

The test was made on EUT at the normal use position except for carrier measurement.
For the carrier measurement, the EUT was placed on the jig because the antenna array was mounted on angularly-tilted.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range : 9kHz-231GHz
Test data : APPENDIX
Test result : Pass

SECTION 6: Frequency Stability

Test Procedure
The external mixer was placed in side of the temperature chamber drain hole.

The power supply set to 100 % nominal setting, raise EUT operating temperature to 50 deg. C.
Record the frequency excursion of the EUT emission mask.
Repeat measurements at each 10 deg. C increment down to –20 deg. C.

Varied EUT power supply between 85 % and 115 % of nominal and record the frequency excursion of the EUT emission mask when temperature is 20 deg. C.

Emission mask was measured 26dB bandwidth.

Test data : APPENDIX
Test result : Pass

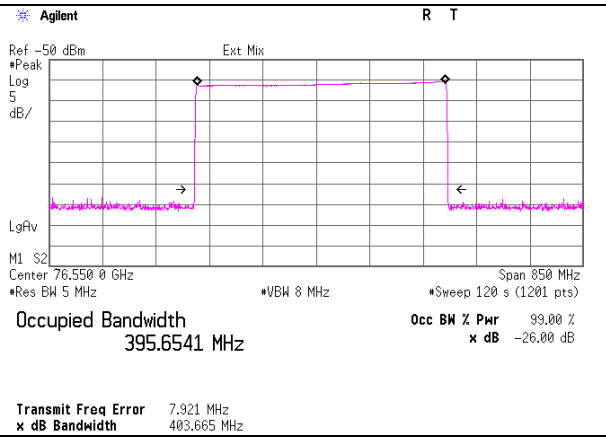
APPENDIX 1: Data of EMI test

26dB and 99% Bandwidth

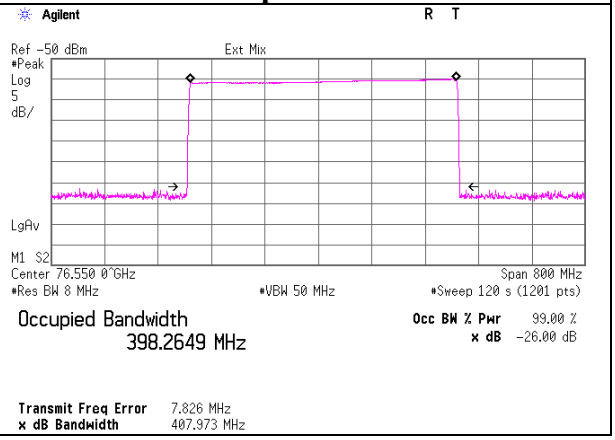
Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	32AE0195-HO-01
Date	10/14/2011
Temperature/ Humidity	24 deg. C / 75% RH
Engineer	Hironobu Ohnishi
Mode	Operating mode (In motion)

Frequency [GHz]	26dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
76.550	403.665	398.265

26dB Bandwidth



99% Occupied Bandwidth



Power Density

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	32AE0195-HO-01
Date	10/14/2011
Temperature/ Humidity	24 deg. C / 75% RH
Engineer	Hironobu Ohnishi
Mode	Operating mode (In motion / Not in motion)

Mode	Frequency [GHz]	Measurement Distance [m]	Measured Power [dBm]	Rx Antenna Gain [dBi]	System Loss [dB]	LNA Gain [dB]	Free field Attenuation [dB]
In motion	76.7476	3.0	-64.07	22.36	42.59	0.00	79.69
Not in motion	76.7434	3.0	-69.78	22.36	42.59	0.00	79.69

Mode	Peak EIRP		Specification Distance [m]	Power Density Pk [uW/cm2]	Limit Pk [uW/cm2]	Margin Pk [dB]
	[dBm]	[mW]				
In motion	35.85	3850.1	3.0	3.404	6000	32.46
Not in motion	30.14	1031.6	3.0	0.912	20	13.41

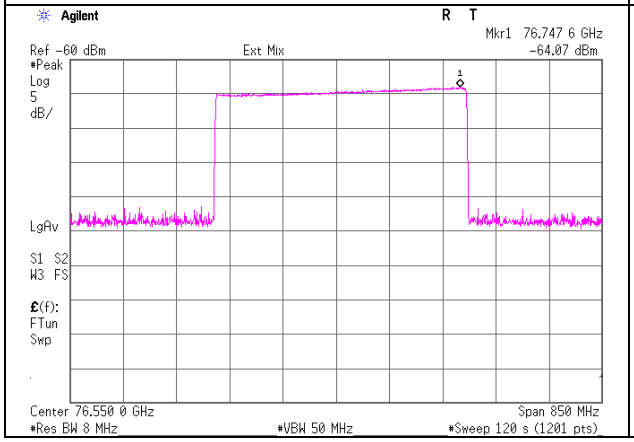
Mode	Duty Factor * [dB]	Average EIRP (Peak with Duty Factor)		Specification Distance [m]	Power Density Av [uW/cm2]	Limit Av [uW/cm2]	Margin Av [dB]
		[dBm]	[mW]				
In motion	-7.69	28.16	655.1	3.0	0.579	60	20.15
Not in motion	-7.69	22.44	175.5	3.0	0.155	0.2	1.10

* Refer to APPENDIX 2

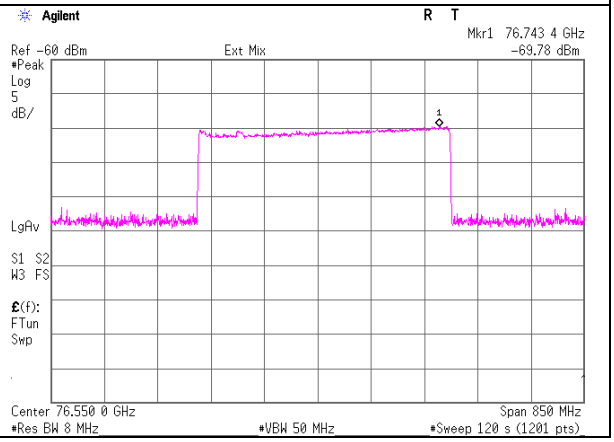
Calculating formula:

Free Field Attenuation = 10 * log((4 * pi * Measurement Distance / lambda) ^ 2)
Peak EIRP = Measured Power - Rx Antenna Gain + System Loss - LNA Gain + Free Field Attenuation
Average EIRP = Peak EIRP + Duty Factor
Power Density = EIRP / (4 * pi * Specification Distance ^ 2)

In Motion



Not In Motion



*The limit of side-looking and rear-looking described in Section 15.253 (b) (3) is not applied since the EUT is forward-looking sensor.

Spurious Emission

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber		
Report No.	32AE0195-HO-01		
Date	09/16/2011	09/19/2011	09/19/2011
Temperature/ Humidity	24 deg. C / 67% RH	23 deg. C / 66% RH	23 deg. C / 66% RH
Engineer	Takeshi Choda	Hironobu Ohnishi	Hironobu Ohnishi
	(30MHz-10GHz)	(10GHz-40GHz)	(9kHz-30MHz)
Mode	Operating mode (In motion)		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	128.003	QP	42.3	13.6	8.3	32.1	32.1	43.5	11.4	
Hori	144.022	QP	44.5	14.5	8.5	32.1	35.4	43.5	8.1	
Hori	164.740	QP	42.3	15.2	8.7	32.1	34.1	43.5	9.4	
Hori	336.051	QP	46.6	16.8	10.0	32.1	41.3	46.0	4.7	
Hori	432.067	QP	47.3	18.2	10.6	32.1	44.0	46.0	2.0	
Hori	911.732	QP	35.1	24.3	13.1	31.2	41.3	46.0	4.7	
Hori	1170.000	PK	48.4	24.4	1.8	34.3	40.3	73.9	33.6	
Hori	1200.000	PK	47.4	24.5	1.8	34.2	39.5	73.9	34.4	
Hori	1230.000	PK	50.4	24.6	1.8	34.1	42.7	73.9	31.2	
Hori	38275.000	PK	42.9	41.5	0.7	24.0	61.1	73.9	12.8	No detect signal.
Hori	1170.000	AV	40.7	24.4	1.8	34.3	32.6	53.9	21.3	
Hori	1200.000	AV	37.5	24.5	1.8	34.2	29.6	53.9	24.3	
Hori	1230.000	AV	38.1	24.6	1.8	34.1	30.4	53.9	23.5	
Hori	38275.000	AV	31.6	41.5	0.7	24.0	49.8	53.9	4.1	No detect signal.
Vert	128.003	QP	38.2	13.6	8.3	32.1	28.0	43.5	15.5	
Vert	144.022	QP	44.8	14.5	8.5	32.1	35.7	43.5	7.8	
Vert	166.165	QP	48.2	15.3	8.7	32.1	40.1	43.5	3.4	
Vert	336.051	QP	43.7	16.8	10.0	32.1	38.4	46.0	7.6	
Vert	432.067	QP	46.2	18.2	10.6	32.1	42.9	46.0	3.1	
Vert	912.010	QP	25.7	24.3	13.1	31.2	31.9	46.0	14.1	
Vert	1170.000	PK	49.5	24.4	1.8	34.3	41.4	73.9	32.5	
Vert	1200.000	PK	52.6	24.5	1.8	34.2	44.7	73.9	29.2	
Vert	1230.000	PK	51.4	24.6	1.8	34.1	43.7	73.9	30.2	
Vert	38275.000	PK	42.8	41.5	0.7	24.0	61.0	73.9	12.9	No detect signal.
Vert	1170.000	AV	42.5	24.4	1.8	34.3	34.4	53.9	19.5	
Vert	1200.000	AV	40.8	24.5	1.8	34.2	32.9	53.9	21.0	
Vert	1230.000	AV	40.1	24.6	1.8	34.1	32.4	53.9	21.5	
Vert	38275.000	AV	31.6	41.5	0.7	24.0	49.8	53.9	4.1	No detect signal.

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB
26.5GHz-40GHz 20log(3.0m/1.0m)= 9.5dB

Spurious Emission (above 40GHz)

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	32AE0195-HO-01
Date	09/15/2011
Temperature/ Humidity	24 deg. C / 58% RH
Engineer	Takeshi Choda (40GHz-231GHz)
Mode	Operating mode (In motion)

There is no spurious emission from 40GHz to 231GHz except for operating band.

*The limit of side-looking and rear-looking described in Section 15.253 (c) (2) (iii) is not applied since the EUT is Forward-looking sensor.

Receiver Spurious Emission

Transmitting and receiving is operating simultaneously. The limits are same as transmitter spurious emission limits. Therefore, these results were included within transmitter results.

Frequency Stability

Test place	Head Office EMC Lab. No.6 Shielded room
Report No.	32AE0195-HO-01
Date	09/21/2011
Temperature/ Humidity	23 deg. C / 68% RH
Engineer	Takeshi Choda
Mode	Operating mode (In motion)

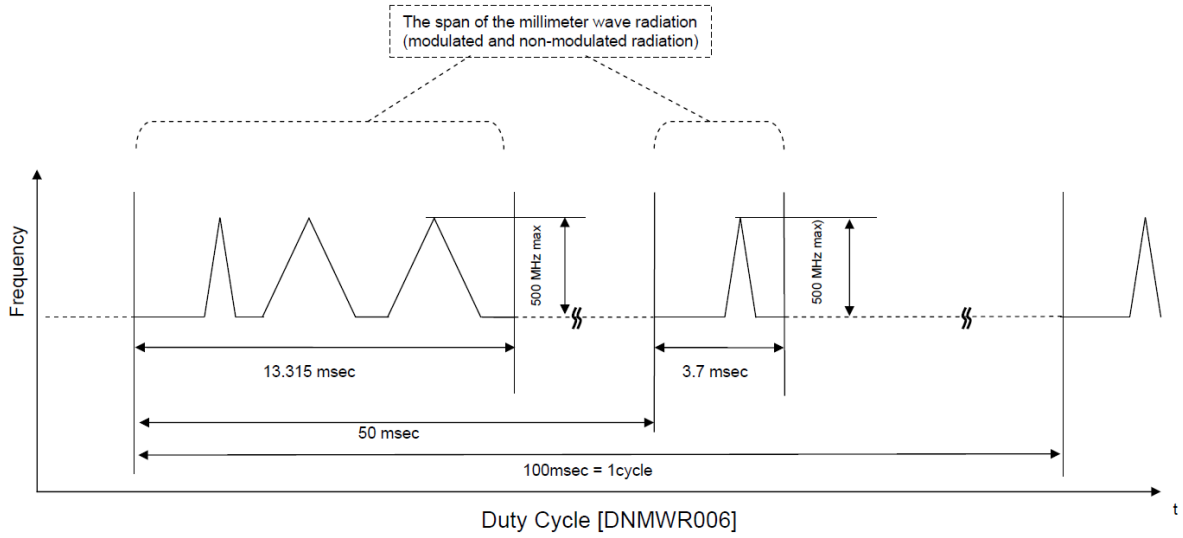
Test Condition		Center	Frequency	26dB	Lower	Upper
Temperature	Power Supply	Frequency	Error	Bandwitdh	Frequency	Frequency
[deg. C]	[V]	[GHz]	[MHz]	[MHz]	[GHz]	[GHz]
50	12.0	76.550	13.838	408.024	76.360	76.768
40	12.0	76.550	11.730	407.233	76.358	76.765
30	12.0	76.550	11.046	404.810	76.359	76.763
20	12.0	76.550	10.887	408.270	76.357	76.765
10	12.0	76.550	12.307	407.828	76.358	76.766
0	12.0	76.550	35.380	414.535	76.378	76.793
-10	12.0	76.550	43.153	412.539	76.387	76.799
-20	12.0	76.550	61.170	412.901	76.405	76.818
20	10.2	76.550	11.205	412.409	76.355	76.767
20	13.8	76.550	11.784	406.958	76.358	76.765
20	9.0	76.550	11.689	406.523	76.358	76.765
20	16.0	76.550	11.343	411.444	76.356	76.767

Calculating formula:

Lower Frequency = Center Frequency + Frequency Error - 26dB Bandwidth / 2
Upper Frequency = Center Frequency + Frequency Error + 26dB Bandwidth / 2

APPENDIX 2: Duty Cycle

[Technical document for the Duty Cycle]



[Duty Factor for average measurements]

Pulse On time			Period	Duty	Duty
A	B	Total			Factor
[ms]	[ms]	[ms]	[ms]	[%]	[dB]
13.315	3.700	17.015	100.0	17.0	-7.69

Calculating formula:

Duty = Total Pulse On time / Period * 100

Duty Factor = 10 * log (Total Pulse On time / Period)

* This Duty is the worst case. Transmitting time does not exceed it.

APPENDIX 3: RF Exposure

[FCC rule]
§1.1310 Radiofrequency radiation exposure limits.
The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
Note 1 to Table 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
Note 2 to Table 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

[IC rule]
RSS-102
§4 Exposure Limits
For the purpose of this standard, Industry Canada has adopted the SAR and RF field strength limits established in Health Canada's RF exposure guideline, Safety Code 6.

§4.2 RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	$280/f$	$2.19/f$	-	6
10-30	28	$2.19/f$	-	6
30-300	28	0.073	2*	6
300-1500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158\ f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
* Power density limit is applicable at frequencies greater than 100 MHz.

[Results]

Mode	Peak EIRP		Duty Factor	Average EIRP (Peak with Duty Factor)	
	[dBm]	[mW]	[dB]	[dBm]	[mW]
In motion	35.85	3850.1	-7.69	28.16	655.1
Not in motion	30.14	1031.6	-7.69	22.44	175.5

Separation Distance [cm]	FCC Power Density [mW/cm2]	FCC Limit [mW/cm2]	IC Power Density [W/m2]	IC Limit [W/m2]
20	0.130	1	1.303	10
20	0.035	1	0.349	10

Calculating formula:

Average EIRP = Peak EIRP + Duty Factor
Power Density = Average EIRP / (4 * Pi * Separation Sistance ^ 2)

APPENDIX 4: 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	-
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	RE	2011/02/15 * 12
MHA-11	Horn Antenna	WiseWave	ARH1023-02	10766-01	RE	2010/10/07 * 12
MPA-18	Pre Amplifier	AmTechs Corporation	LNA-7511025	9601	RE	2011/08/27 * 12
MMX-02	Harmonic Mixer	Agilent	11970W	2521 A01909	RE	2011/06/14 * 12
MCC-66	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28636/2	RE	2011/04/22 * 12
MCC-67	Microwave Cable 1G-40GHz	Suhner	SUCOFLEX102	28635/2	RE	2011/04/22 * 12
MDPLX-01	Diplexer	OML Inc.	DPL26	-	RE	2011/09/19 * 12
MMX-03	Harmonic Mixer	OML Inc.	M06HWD	D100709-1	RE	2010/09/27 * 12
MHA-24	Horn Antenna	Custom Microwave Inc.	HO6R	-	RE	2011/09/19 * 12
MMX-04	Harmonic Mixer	OML Inc.	M04HWD	Y100709-1	RE	2010/09/27 * 12
MHA-27	Horn Antenna	Custom Microwave Inc.	HO4R	-	RE	2011/09/19 * 12
MPA-03	Microwave System Power Amplifier	Agilent	83050A	3950M00205	RE	2011/06/15 * 12
MHA-07	Horn Antenna	Custom	HO22R	10766-01	RE	2010/10/07 * 12
MCC-05	Microwave Cable 1G-40GHz 2m	Storm	421-011 (90-1394-079)	01-12-002	RE	2011/01/20 * 12
MHA-17	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	RE	2011/06/17 * 12
MCC-54	Microwave Cable	Suhner	SUCOFLEX101	2873(1m) / 2876(5m)	RE	2011/03/02 * 12
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2011/08/11 * 12
MCC-56	Microwave Cable	Suhner	SUCOFLEX104	270875/4(1m) / 284655(5m)	RE	2011/03/02 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	MY39500780	RE	2011/03/10 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2011/08/17 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2011/08/17 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2011/03/25 * 12
MAT-51	Attenuator(6dB)	Weinschel	2	AS3557	RE	2011/01/14 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2011/03/04 * 12
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2010/11/30 * 12
MCC-135	Microwave Cable	HUBER+SUHNER	SUCOFLEX102	37511/2	RE	2011/08/31 * 12
MCC-136	Microwave Cable	HUBER+SUHNER	SUCOFLEX102	37512/2	RE	2011/08/31 * 12
MTR-07	Test Receiver	Rohde & Schwarz	ESCI	100635	RE	2010/10/27 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2010/10/15 * 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-30	Coaxial cable	UL Japan	-	-	RE	2011/07/28 * 12
MAT-08	Attenuator(6dB)	Weinschel Corp	2	BK7971	RE	2010/11/05 * 12
MCH-04	Temperature and Humidity Chamber	Tabai Espec	PL-2KP	14015723	RE	2011/08/22 * 12

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

[Below 40GHz]
All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

[Above 40GHz]
Acceptance criteria for untraceable equipment was formulated according to ISO/IEC 17025 5.6.2.2.2, and the regular inspection was performed based on it annually.
For 40-110GHz, power sensor is calibrated by manufacturer, and the measured calibration data is used as in-house reference.
The calibration data by manufacturer is checked for acceptance by a calorie meter except for some frequency bands.
For above 110GHz, output level of millimeter wave source module is used as the reference, and inspection by the calorie meter is performed.
Electric power is checked with the calorie meter by measuring resistance and voltage of reference resistor.

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