RADIO TEST REPORT

Test Report No. : 10329820H-A-R2

Applicant	:	**DENSO CORPORATION**
Type of Equipment	:	**Millimeter Wave Radar Sensor**
Model No.	:	**DNMWR008**
FCC ID	:	**HYQDNMWR008**
Test regulation	:	**FCC Part 15 Subpart C: 2014**
Test Result	:	**Complied**

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with 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 10329820H-A-R1. 10329820H-A-R1 is replaced with this report.

Date of test: May 12 to 21, 2014

Representative test engineer:

Hironobu Ohnishi
Engineer
Consumer Technology Division

Approved by:

Takayuki Shimada
Engineer
Consumer Technology Division

NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap

REVISION HISTORY

Original Test Report No.: 10329820H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10329820H-A	June 3, 2014	-	-
1	10329820H-A-R1	June 23, 2014	P. 4	Correction of Frequency of Operation
1	10329820H-A-R1	June 23, 2014	P. 5	Correction of tested voltage requirement
1	10329820H-A-R1	June 23, 2014	P. 10	Correction of measurement setting table
1	10329820H-A-R1	June 23, 2014	P. 11	Addition of measurement distance table
2	10329820H-A-R2	June 26, 2014	P. 11	Correction of Maximum Dimension

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CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	DENSO CORPORATION
Address	:	1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661 Japan
Telephone Number	:	+81-566-61-3590
Facsimile Number	:	+81-566-25-4683
Contact Person	:	Takashi Sakurai

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

2.1 Identification of E.U.T.

Type of Equipment	:	Millimeter Wave Radar Sensor
Model No.	:	DNMWR008
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 12V (Car battery), DC10V to 16V(Operating range)
Receipt Date of Sample	:	May 10, 2014
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 (DNMWR008) 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: 10MHz

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	76.5GHz
Modulation	:	FM-CW
Antenna Type	:	Internal Antenna
Antenna Connector	:	None
Antenna Gain	:	21.1dBi
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, DC6.5V

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C: 2014, final revised on May 1, 2014 and effective June 2, 2014
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.253 Operation within the bands 46.7-46.9GHz and 76.0-77.0GHz.

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

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 **IC:** RSS-Gen 7.2.4	**FCC:** Section 15.207 **IC:** RSS-Gen 7.2.4	N/A	N/A	*1)
26dB Bandwidth	**FCC:** "MILLIMETER WAVE TEST PROCEDURES" **IC:** -	**FCC:** Section 15.253(f) **IC:** RSS-210 A13.1.5	See data.	Complied	Radiated
Power Density	**FCC:** "MILLIMETER WAVE TEST PROCEDURES" **IC:** -	**FCC:** Section 15.253(d) **IC:** RSS-210 A13.1.2(1)		Complied	Radiated
Spurious Emissions	**FCC:** ANSI C63.4:2003, "MILLIMETER WAVE TEST PROCEDURES" **IC:** RSS-Gen 4.9	**FCC:** Section 15.253(d) **IC:** RSS-210 A13.1.2(2), A13.1.4, RSS-Gen 7.2.3	8.9dB 99.468MHz, QP, Vert.	Complied	Radiated
Frequency Stability	**FCC:** "MILLIMETER WAVE TEST PROCEDURES" **IC:** RSS-Gen 4.7, 7.2.4	**FCC:** Section 15.253(f) **IC:** RSS-210 A13.1.5	See data.	Complied	Radiated

*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.

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 Part 15.31 (e)

The EUT provides stable voltage (DC -4.5V, DC6.5V) constantly to RF Part regardless of input voltage.
Instead of a new battery, DC power supply was used for the test. That does not affect the test result, therefore the EUT complies with the requirement. As for the Frequency Stability, the test was performed based on 15.253 (f).

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

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)	**Conducted emission (±dB)**
	150kHz-30MHz
No.1	3.5dB
No.2	3.6dB
No.3	3.6dB
No.4	3.6dB

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

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

Radiated emission (±dB)	
40GHz-50GHz	3.9dB
50GHz-75GHz	4.6dB
75GHz-110GHz	5.0dB
110GHz-170GHz	5.1dB
170GHz-260GHz	5.0dB

Radiated emission test(3m)

The data listed in this test report has enough margin, more than the site margin.

3.5 Test Location

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	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7m	7.0 x 6.0m	No.1 Power source room
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.3 Preparation room
No.3 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.4 Preparation room
No.4 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9m	6.0 x 6.0m	-
No.6 shielded room	-	4.0 x 4.5 x 2.7m	4.0 x 4.5 m	-
No.6 measurement room	-	4.75 x 5.4 x 3.0m	4.75 x 4.15 m	-
No.7 shielded room	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	3.1 x 5.0 x 2.7m	N/A	-
No.9 measurement room	-	8.0 x 4.6 x 2.8m	2.4 x 2.4m	-
No.11 measurement room	-	6.2 x 4.7 x 3.0m	4.8 x 4.6m	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Data of EMI, Test instruments, and Test set up

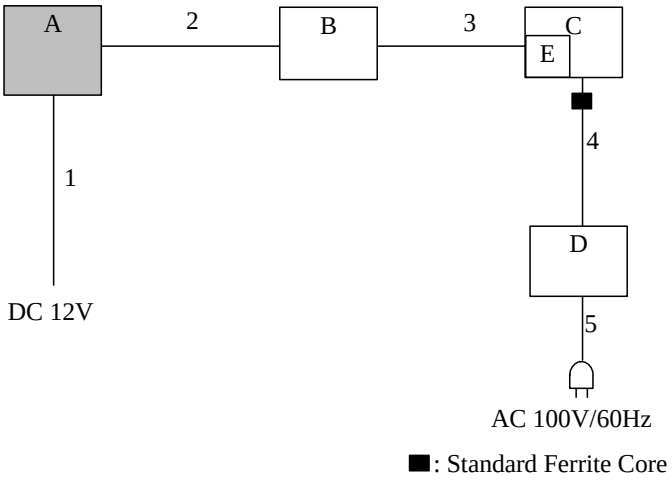
Refer to APPENDIX.

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

4.1 Operating Mode(s)

Mode	Test Item
Operating mode	26dB Bandwidth Power Density Spurious Emission Frequency Stability
Power of the EUT was set by the software as follows; Power settings: Same as production model Software: mwr_4upd_0035_t070 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.	

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 and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	Millimeter Wave Radar Sensor	DNMWR008	PNJ151	DENSO CORPORATION	EUT
B	CAN Cab	251	-	Vector	-
C	PC	CF-B5ER8S	1BKSA01852	Panasonic	-
D	AC Adaptor	CF-AA1639A M3	030600424 B	Panasonic	-
E	CANcardXL	007100	027872	Vector	-

List of cables used

No.	Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	2.0	Unshielded	Unshielded	-
2	Signal Cable	2.3	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 (9kHz – 10GHz), 0.5m by 0.5m (10GHz – 40GHz), raised 0.8m (9kHz – 10GHz), 1.5m (10GHz - 40GHz) 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-40GHz	
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) (10G-26.5GHz), 0.5m*2) (26.5G-40GHz)	

*1) Distance Factor: 20 x log (3.0m/1.0m) = 9.5dB
*2) Distance Factor: 20 x log (3.0m/0.5m) = 15.6dB

[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.

Frequency [GHz]	40-50	50-75	75-110	110-170	170-231
Final measurement distance [m] with 1MHz Peak detector	0.5	1.0	1.0	0.02	0.02

[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 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	Lambda	Maximum Dimension			Far Field
		H	V	Diagonal	Boundary
[GHz]	[mm]	[mm]	[mm]	D [m]	r [m]
77.0	3.9	10	58	0.059	1.8

Antenna aperture sizes were measured.

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 : 9k-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

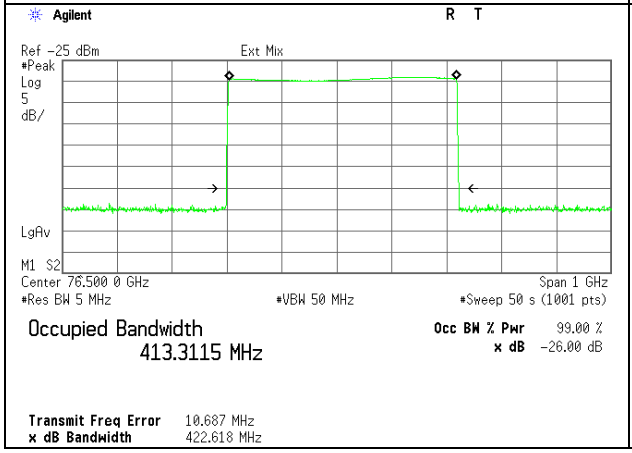
APPENDIX 1: Data of EMI test

26dB and 99% Bandwidth

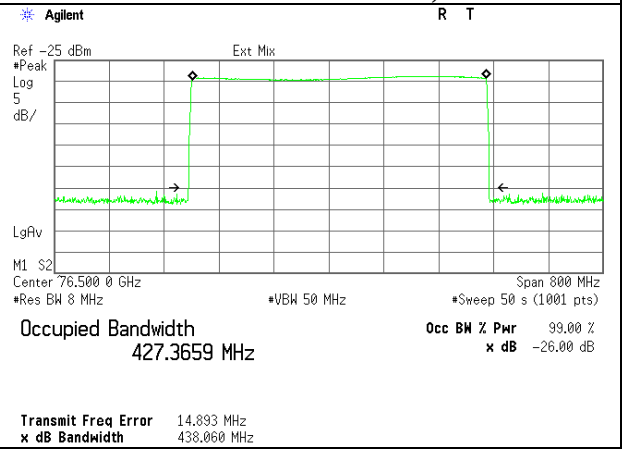
Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	10329820H
Date	05/13/2014
Temperature/ Humidity	24 deg. C / 57% RH
Engineer	Hironobu Ohnishi
Mode	Operating mode

Frequency [GHz]	26dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
76.500	422.618	427.366

26dB bandwidth



99% bandwidth *1)



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

Power Density

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	10329820H
Date	05/12/2014
Temperature/ Humidity	24 deg. C / 48% RH
Engineer	Hironobu Ohnishi
Mode	Operating mode

Mode	Frequency [GHz]	Measurement Distance [m]	Measured Power [dBm]	Rx Antenna Gain [dBi]	System Loss [dB]	LNA Gain [dB]	Free field Attenuation [dB]	Duty Factor [dB]
Operating	76.3096	3	-68.76	22.30	41.72	0.00	79.64	-2.37

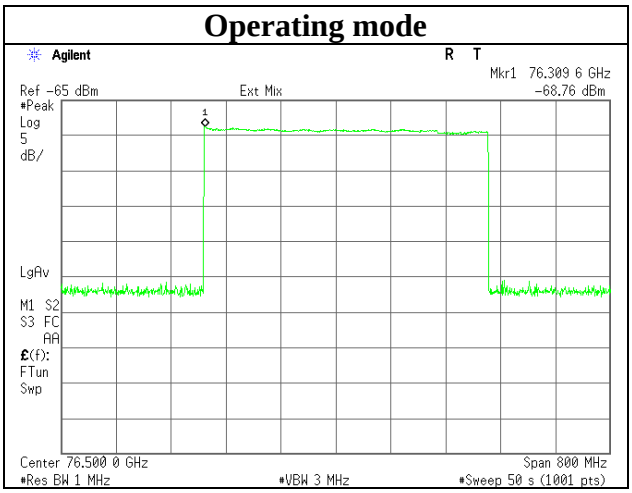
	Result		Limit *	Margin
	[dBm]	[mW]	[dBm]	[dB]
Average Power (EIRP)	27.92	619.6	50	22.08
Peak Power (EIRP)	30.29	1070.1	55	24.71

* Average power density limit: 50dBm EIRP = 88uW/cm^2 at 3m
Peak power density limit: 55dBm EIRP = 279uW/cm^2 at 3m

Calculating formula:

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

Operating mode



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Duty Cycle

Test place	Ise EMC Lab. No.3 Semi Anechoic Chamber
Report No.	10329820H
Date	05/12/2014
Temperature/ Humidity	24 deg. C / 48% RH
Engineer	Hironobu Ohnishi
Mode	Operating mode

[Duty Factor for average measurements]

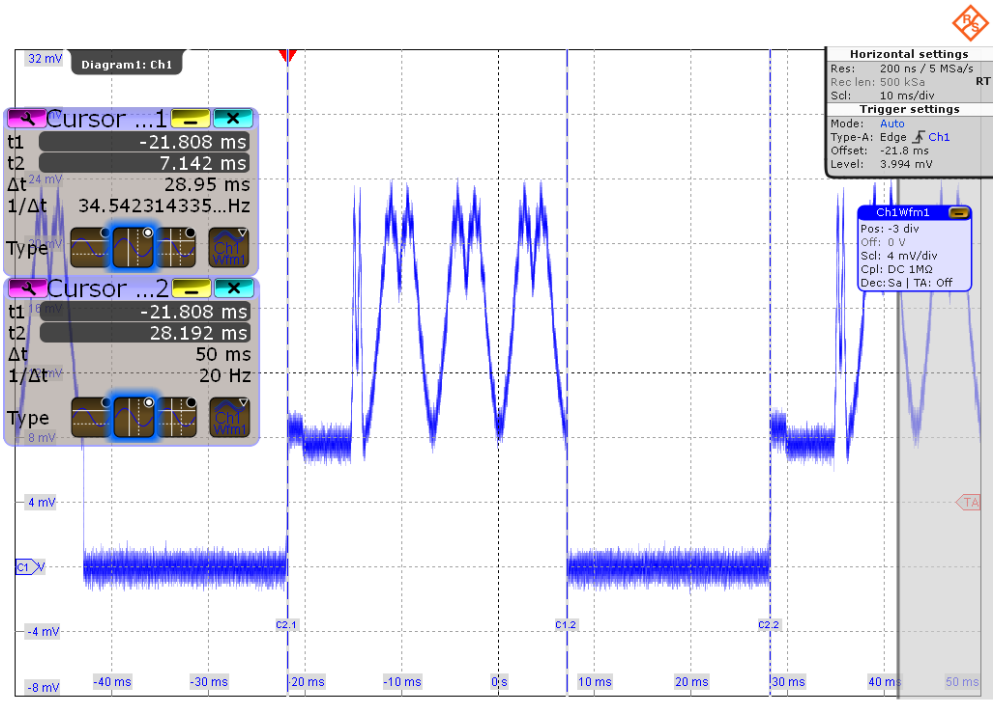
Pulse On time A [ms]	Period [ms]	Duty [%]	Duty Factor [dB]
28.95	50.00	57.9	-2.37

Calculating formula:

Duty = Pulse On time / Period * 100

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

[Data]



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

Spurious Emission

Test place	Ise EMC Lab. No.3 Anechoic Chamber	
Report No.	10329820H	
Date	05/13/2014	05/14/2014
Temperature/ Humidity	24 deg. C / 57% RH	23 deg. C / 50% RH
Engineer	Hironobu Ohnishi (26.5G – 40GHz)	Hironobu Ohnishi (9k – 26.5GHz)
Mode	Operating mode	

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	64.001	QP	34.0	7.3	7.6	32.2	16.7	40.0	23.3	
Hori	80.000	QP	30.9	6.3	7.8	32.1	12.9	40.0	27.1	
Hori	99.468	QP	41.7	10.0	8.0	32.2	27.5	43.5	16.0	
Hori	130.000	QP	22.3	13.8	8.4	32.1	12.4	43.5	31.1	
Hori	240.040	QP	32.0	17.1	9.4	32.0	26.5	46.0	19.5	
Hori	610.000	QP	22.0	19.6	11.9	32.0	21.5	46.0	24.5	
Hori	38250.000	PK	43.7	44.1	-8.4	20.9	58.5	73.9	15.4	NS
Hori	38250.000	AV	31.2	44.1	-8.4	20.9	46.0	53.9	7.9	NS
Vert	36.487	QP	33.8	15.7	7.1	32.2	24.4	40.0	15.6	
Vert	44.415	QP	36.5	12.9	7.3	32.2	24.5	40.0	15.5	
Vert	45.927	QP	36.5	12.3	7.3	32.2	23.9	40.0	16.1	
Vert	48.002	QP	39.1	11.6	7.3	32.2	25.8	40.0	14.2	
Vert	64.001	QP	45.5	7.3	7.6	32.2	28.2	40.0	11.8	
Vert	80.000	QP	39.1	6.3	7.8	32.1	21.1	40.0	18.9	
Vert	99.468	QP	48.8	10.0	8.0	32.2	34.6	43.5	8.9	
Vert	130.000	QP	22.3	13.8	8.4	32.1	12.4	43.5	31.1	
Vert	240.040	QP	33.2	17.1	9.4	32.0	27.7	46.0	18.3	
Vert	610.000	QP	22.0	19.6	11.9	32.0	21.5	46.0	24.5	
Vert	38250.000	PK	43.8	44.1	-8.4	20.9	58.6	73.9	15.3	NS
Vert	38250.000	AV	31.2	44.1	-8.4	20.9	46.0	53.9	7.9	NS

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/0.5m)=15.6dB
NS:	No signal detect.	

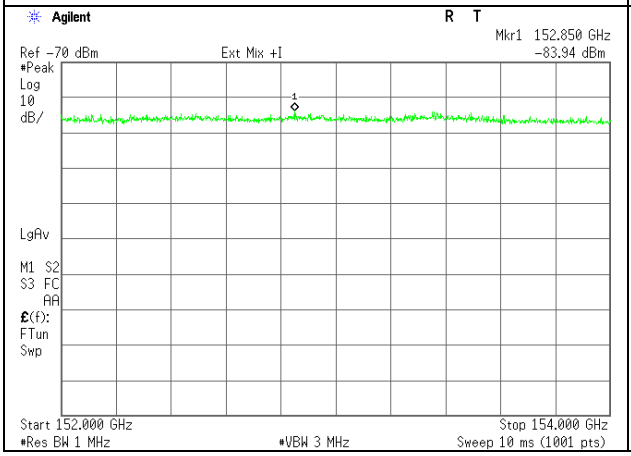
Spurious Emission (above 40GHz)

Test place	Ise EMC Lab. No.3 Anechoic Chamber	
Report No.	10329820H	
Date	05/12/2014	05/13/2014
Temperature/ Humidity	24 deg. C / 48% RH	24 deg. C / 57% RH
Engineer	Hironobu Ohnishi	Hironobu Ohnishi
	(75G – 110GHz)	(40G – 75GHz, 110G – 231GHz)
Mode	Operating mode	

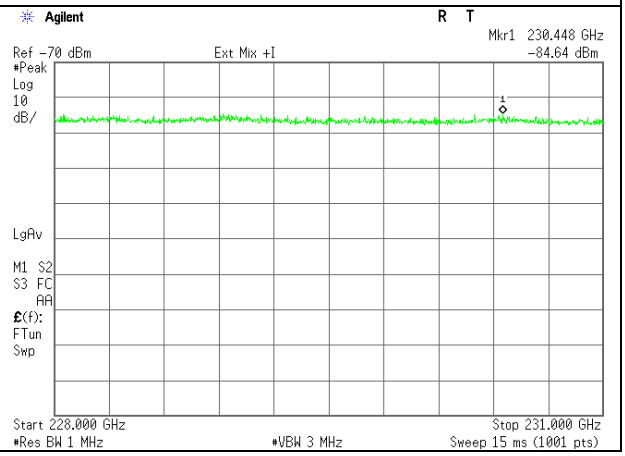
* The peak density is less than the average limit.
There is no spurious emission from 40GHz to 231GHz except for operating band.

The following shows the measurement results of the harmonics.

2nd harmonics



3rd harmonics



Frequency Stability

Test place Ise EMC Lab. No.11 Shielded room
Report No. 10329820H
Date 05/21/2014
Temperature/ Humidity 26 deg. C / 40% RH
Engineer Shinya Watanabe
Mode Operating mode

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	76.500	26.105	430.280	76.311	76.741
40	12.0	76.500	18.702	425.063	76.306	76.731
30	12.0	76.500	13.673	422.500	76.302	76.725
20	12.0	76.500	-8.217	435.916	76.274	76.710
10	12.0	76.500	-13.105	436.985	76.268	76.705
0	12.0	76.500	-15.019	427.618	76.271	76.699
-10	12.0	76.500	-25.797	424.120	76.262	76.686
-20	12.0	76.500	-28.050	437.741	76.253	76.691
20	10.2	76.500	-8.022	431.985	76.276	76.708
20	13.8	76.500	-5.659	425.427	76.282	76.707
20	9.0	76.500	-10.299	432.803	76.273	76.706
20	16.0	76.500	10.500	428.296	76.296	76.725

Calculating formula:

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

APPENDIX 2: Test instruments

EMI test equipment (1/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2014/02/27 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	1301	RE	2014/02/20 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	-
MSA-03	Spectrum Analyzer	Agilent	E4448A	MY44020357	RE	2014/04/08 * 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
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
MHF-15	High Pass Filter 81-110GHz	VCSS	HPF-10-778030	201	RE	2013/08/02 * 12
MDT-02	Detector	Agilent	8473C	00789B	RE	Pre Check
MDO-07	Digital Oscilloscope	Rohde & Schwarz	RTO1004	200354	RE	2013/07/30 * 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	2014/02/21 * 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-09	Horn Antenna	WiseWave	ARH1523-02	10766-01	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
MHA-24	Horn Antenna	Custom Microwave Inc.	HO6R	-	RE	2013/09/26 * 12
MMX-03	Harmonic Mixer	OML Inc.	M06HWD	D100709-1	RE	2013/09/27 * 12
MDPLX-01	Diplexer	OML Inc.	DPL26	-	RE	2013/09/26 * 12
MHA-27	Horn Antenna	Custom Microwave Inc.	HO4R	-	RE	2013/09/26 * 12
MMX-04	Harmonic Mixer	OML Inc.	M04HWD	Y100709-1	RE	2013/09/27 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2013/08/20 * 12
MLPA-01	Loop Antenna	Rohde & Schwarz	HFH2-Z2	100017	RE	2013/10/30 * 12
MCC-112	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/SFM141(3m)/sucoform141-PE(1m)/421-010(1.5m)/RFM-E321(Switcher)	-/00640	RE	2013/07/23 * 12
MCC-143	Coaxial Cable	UL Japan	-	-	RE	2013/07/22 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2014/03/14 * 12
MOS-19	Thermo-Hygrometer	Custom	CTH-201	0001	RE	2013/12/17 * 12
MCH-06	Temperature and Humidity Chamber	Tabai Espec	PL-1KT	14007630	RE	2014/04/23 * 12

EMI test equipment (2/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2014/04/14 * 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
MHA-20	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	RE	2013/05/17 * 12
MCC-133	Microwave Cable	HUBER+SUHNER	SUCOFLEX104	336164/4(1m) / 340640(5m)	RE	
MPA-11	MicroWave System Amplifier	Agilent	83017A	MY39500779	RE	2014/03/24 * 12
MHA-16	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	RE	2013/05/17 * 12
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE	2013/11/25 * 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