EMI TEST REPORT

Test Report No. : 30LE0017-HO-01-R1

Applicant	:	**DENSO CORPORATION**
Type of Equipment	:	**Tire Pressure Monitoring System (Receiver)**
Model No.	:	**23AAD**
FCC ID	:	**HYQ23AAD**
Test standard	:	**FCC Part 15 Subpart B 2010**
Test Result	:	**Complied**

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4. The test results in this report are traceable to the national or international standards.
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6. This report is a revised version of 30LE0017-HO-01. 30LE0017-HO-01 is replaced with this report.

Date of test:

August 8 to 31, 2010

Representative test engineer:

Takayuki Shimada
Engineer of EMC Service

Approved by:

Shinya Watanabe
Leader of EMC Service

NVLAP LAB CODE: 200572-0

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http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap

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SECTION 1: Customer information

Company Name	:	DENSO CORPORATION
Address	:	1-1, Showa-cho, Kariya-shi, Aichi-ken, 448-8661, Japan
Telephone Number	:	+81-566-61-7086
Facsimile Number	:	+81-566-25-4837
Contact Person	:	Nobuya Watanabe

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

2.1 Identification of E.U.T.

Type of Equipment	:	Tire Pressure Monitoring System (Receiver)
Model No.	:	23AAD
Serial No.	:	Refer to Section 4, Clause 4.2
Receipt Date of Sample	:	August 6, 2010
Country of Mass-production	:	Japan and United States of America
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

Model No: 23AAD (referred to as the EUT in this report) is the Tire Pressure Monitoring System (Receiver). 23AAD has 24 variations. For details of variations, see "Theory of Operation".

Feature of EUT	:	Tire Pressure Monitoring System is used for monitoring and indicating information of air pressure in vehicle's tires. Transmitter sends receiver the data that are information of air pressure in vehicle's tire through ANT1 or ANT2. The data also include temperature, battery voltage and identity code of transmitter. The receiver judges the data. If the data of air pressure and others are not normal condition, the receiver sends signal to a warning lamp. Then, the warning lamp warns drivers. AUTOMATIC LOCATION System is used for showing air pressure in vehicle's each tire. The multiple antennas fitted to the vehicle transmit a low-frequency wave signal. The system automatically detects the wheel position involved in a pressure reading, even after tire rotation.
Type of receiving system	:	Super-heterodyne
Frequency of Operation	:	314.98MHz
Oscillator Frequency	:	38.035MHz (Crystal)
Type of Modulation	:	FSK (F1D)
Power Supply	:	DC12.0V
Antenna Type	:	ANT1: Internal antenna (Inverse F antenna / Inverse L antenna) ANT2: External antenna

SECTION 3: Test specification, procedures & results

3.1 Test specification

Test Specification : FCC Part 15 Subpart B 2010, final revised on January 22, 2010 and effective March 1, 2010

Title : FCC 47CFR Part15 Radio Frequency Device
Subpart B Unintentional Radiators

3.2 Procedures and results

Item	Test Procedure	Limits	Deviation	Worst margin	Result
Conducted emission	**FCC:** ANSI C63.4: 2003 7. AC powerline conducted emission measurements **IC:** RSS-Gen 7.2.2	Receiver	N/A *1)	N/A	N/A
Radiated emission	**FCC:** ANSI C63.4: 2003 8. Radiated emission measurements **IC:** RSS-Gen 4.10	Receiver	N/A	18.1dB 912.840MHz Horizontal / Vertical	Complied
Antenna Terminal	**FCC:** ANSI C63.4: 2003 12. Measurement of unintentional radiators other than ITE **IC:** RSS-Gen 4.10	Receiver	N/A	30.4dB 1217.120MHz PK	Complied
*Note: UL Japan, Inc's EMI Work Procedure QPM05. *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.					

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 (10m*)(±dB)**		
	9kHz -30MHz	30MHz -300MHz	300MHz -1GHz
No.1	2.7dB	4.8dB	5.0dB
No.2	-	-	-
No.3	-	-	-
No.4	-	-	-

*10m = Measurement distance

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	2.9dB	4.8dB	5.0dB	3.9dB	4.3dB	4.5dB	4.3dB
No.2	3.5dB	4.8dB	5.1dB	4.0dB	4.2dB	4.4dB	4.2dB
No.3	3.8dB	4.6dB	4.7dB	4.0dB	4.2dB	4.5dB	4.2dB
No.4	3.5dB	4.4dB	4.9dB	4.0dB	4.2dB	4.6dB	4.2dB

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

Antenna terminal conducted emission and Power density (±dB)			**Antenna terminal conducted emission (±dB)**	
Below 1GHz	1GHz-3GHz	3GHz-18GHz	18GHz-26.5GHz	26.5GHz-40GHz
1.0dB	1.1dB	2.7dB	3.2dB	3.3dB

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

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 Test set up, Data of EMI, and Test instruments

Refer to APPENDIX.

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

4.1 Operating modes

The mode used : TPMS Receiving mode (314.98MHz)

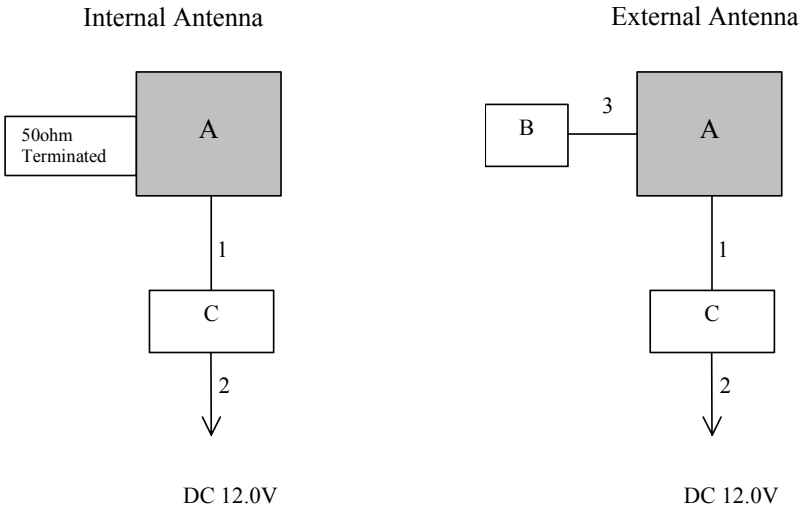
Variation No. 11 was tested as the EUT in this test report, because it has the highest emission level compared to the other representative variants (Variation No. 3, 7, 15, and 23) of the table in "Theory of Operation".

Among Variation No.1 to 24,

- the difference due to feeding point of the internal antenna was confirmed with Variation No. 3, 7, 11, and 15.
- the difference due to internal antenna type was confirmed with Variation No. 11 and 23.
- regarding external antenna and Automatic Location System, variants with the external antenna port and the system mounted were tested, which were the worst condition for EMI.
- for external antenna, antenna conducted test was performed with Variation No. 3, 7, 11, 15, and 23 and Radiated emission test was performed with Variation No. 3 and 11 with the external antenna attached, as a representative.

As a result, enough margin for the limit was observed.

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 numbe	Serial number	Manufacturer	Remarks
A	Tire Pressure Monitoring System (Receiver)	23AAD	3 (Variation No. 11)	DENSO CORPORATION	Only serial No.3 was EUT. Serial No. 1, 2, 4 and 5 were tested just for reference. For details, see "Theory of Operation."
			1 (Variation No. 3) Reference data		
			2 (Variation No. 7) *1) Reference data		
			4 (Variation No. 15) *1) Reference data		
			5 (Variation No. 23) Reference data		
B	External Antenna	-	001	DENSO CORPORATION	-
C	Checker	-	1004816-02-02	DENSO CORPORATION	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	1.2	Unshielded	Unshielded	-
2	DC Cable	3.2	Unshielded	Unshielded	-
3	Antenna Cable	0.3	Shielded	Shielded	-

***1) Variations owing to antenna matching (Inverse F Antenna Type)** *See "Theory of Operation" for details.
*TYPE 2 which was used for the tests has 308 "Capacitor 4pF" and 309 "Nothing". TYPE 4 which was used for the tests has 306 "Capacitor 5pF" and 307 "Nothing".
The result of Radiated emission test was mainly from characteristics of Local Oscillator.
If the range of 306, 307, 308 and 309 becomes "Capacitor 0.5 - 100pF", or "Inductor 1 - 100nH", there is no influence on the result of Radiated emission test.

SECTION 5: Radiated Emission

5.1 Operating environment

Test place : No.4 semi anechoic chamber
Temperature : See data
Humidity : See data

5.2 Test configuration

EUT was placed on a urethane platform of nominal size, 1.0m by 0.5m, raised 0.8m above the conducting ground plane. The EUT was set on the edge of the tabletop.
Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength.
Photographs of the set up are shown in Appendix 1.

5.3 Test conditions

Frequency range : 30MHz-300MHz (Biconical antenna) / 300MHz-1000MHz (Logperiodic antenna)
1000MHz -2000MHz (Horn antenna)
Test distance : 3m
EUT position : Table top
EUT operation mode : See Clause 4.1

5.4 Test procedure

The height of the measuring antenna 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 with the Test Receiver, or the Spectrum Analyzer.
The radiated emission measurements were made with the following detector function of the test receiver and the Spectrum analyzer.

Frequency	Below 1GHz	Above 1GHz
Instrument used	Test Receiver	Spectrum Analyzer
IF Bandwidth	QP: BW 120kHz	PK: RBW:1MHz/VBW: 3MHz AV *1): RBW:1MHz/VBW:10Hz

*1) When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

- The noise levels were confirmed at each position of X, Y and Z axes of EUT and External antenna to see the position of maximum noise, and the test was made at the position that has the maximum noise.

5.5 Test result

Summary of the test results: Pass

Date: August 10, 2010
August 11, 2010

Test engineer: Takumi Shimada
Takayuki Shimada

SECTION 6: Antenna Terminal

6.1 Operating environment

Test place : No.4 semi anechoic chamber
Temperature : See data
Humidity : See data

6.2 Test configuration

EUT was placed on a urethane platform of nominal size, 1.0m by 0.5m, raised 0.8m from the ground.

6.3 Test conditions

Frequency range : 30MHz-1000MHz / 1000MHz-2000MHz
Test distance : N/A
EUT position : Table top
EUT operation mode : See Clause 4.1

6.4 Test procedure

The Antenna Terminal was measured with a spectrum analyzer connected to the antenna port.

Frequency	Below 1GHz	Above 1GHz
Instrument used	Spectrum Analyzer	Spectrum Analyzer
IF Bandwidth	PK: RBW:100kHz/VBW: 300kHz	PK: RBW:1MHz/VBW: 3MHz

6.5 Test result

Summary of the test results: Pass

Date: August 8, 2010 Test engineer: Takayuki Shimada