SAR TEST REPORT

Test Report No. : 29FE0054-HO-02-E

Applicant	:	**DENSO WAVE INCORPORATED.**
Type of Equipment	:	**BHT-800 MAIN BOARD**
Model No.	:	**DWWL001**
FCC ID	:	**PZWDWWL001**
Test regulation	:	**FCC47CFR 2.1093** **FCC OET BULLETIN 65, SUPPLEMENT C**
Test Result	:	**Complied**
Max. SAR Value	:	**0.735W/kg (Body, 2412MHz)**

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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.
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Date of test: April 15, 2009

Tested by: H. Sato
Hisayoshi Sato
EMC Services

Approved by : H. Shimoji
Hironobu Shimoji
Assistant Site Manager of EMC Services

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CONTENTS PAGE

SECTION 1: Customer information

Company Name	:	DENSO WAVE INCORPORATED
Brand name	:	DENSO
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Telephone Number	:	+81-569-49-5267
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Contact Person	:	Yasushi Iwade

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

2.1 Identification of E.U.T.

Type of Equipment	:	BHT-800 MAIN BOARD
Model No.	:	DWWL001
Serial No.	:	MAC ID（0013E0F39B98）
Receipt Date of Sample	:	March 26, 2009
Rating	:	DC3.7V
Option Battery	:	N/A
Accessories	:	N/A
Size	:	W:84.8mm D:46mm H:8.1mm
Country of Mass-production	:	Japan
Condition of EUT	:	Production 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: DWWL001 (referred to as the EUT in this report) is the BHT-800 MAIN BOARD.
Feature of EUT: This EUT is the Main board of Bar-code Handy Terminal (BHT-800 series) which has function of Wireless LAN(IEEE 802.11b/g technology).
Clock Frequencies are 240MHz (CPU), 120MHz (SDRAM).

Equipment Type	:	Transceiver
Frequency of Operation	:	2412-2462MHz
Modulation	:	DSSS
Bandwidth & Channel Spacing	:	20MHz & 5MHz
Power Supply (inner)	:	DC 3.2V
Antenna Type	:	Inverted-F
Antenna Connector Type	:	SMK CRS5001-0801F
Antenna Gain	:	below 2.14 dBi

SECTION 3 : Test standard information

3.1 Requirements for compliance testing defined by the FCC

The US Federal Communications Commission has released the report and order “Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g for an uncontrolled environment and 8.0 mW/g for an occupational/controlled environment as recommended by the ANSI/IEEE standard C95.1-1992. According to the Supplement C of OET Bulletin 65 “Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under “worst-case” conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

1 Specific Absorption Rate (SAR) is a measure of the rate of energy absorption due to exposure to an RF transmitting source (wireless portable device).
2 IEEE/ANSI Std. C95.1-1992 limits are used to determine compliance with FCC ET Docket 93-62.

3.2 Procedure and result

No.	Item	Test Procedure	Limit	Remarks	Exclusion	Result
1	Human Exposure	FCC OET BULLETIN 65, SUPPLEMENT C	FCC47CFR 2.1093	SAR Measurement	N/A	Complied
Note: UL Japan, Inc. 's SAR Work Procedures QPM47 : SAR Measurement Procedures for 802.11 a/b/g Transmitters (KDB 248227) that TCB directs						

Result of Max. SAR value

Max. SAR Value: 0.735W/kg (Body, 2412MHz)

3.3 Exposure limit

(A) Limits for Occupational/Controlled Exposure (W/kg)

Spatial Average (averaged over the whole body)	Spatial Peak (averaged over any 1g of tissue)	Spatial Peak (hands/wrists/feet/ankles averaged over 10g)
0.4	8.0	20.0

(B) Limits for General population/Uncontrolled Exposure (W/kg)

Spatial Average (averaged over the whole body	Spatial Peak (averaged over any 1g of tissue)	Spatial Peak (hands/wrists/feet/ankles averaged over 10g)
0.08	1.6	4.0

Occupational/Controlled Environments: are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

General Population/Uncontrolled Environments: are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

NOTE:GENERAL POPULATION/UNCONTROLLED EXPOSURE
SPATIAL PEAK(averaged over any 1g of tissue) LIMIT
1.6 W/kg

3.4 Test Location

*Shielded room for SAR testings
UL Japan, Inc. Head Office EMC Lab. *NVLAP Lab. code: 200572-0
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Telephone : +81 596 24 8116 Facsimile : +81 596 24 8124

3.5 Confirmation before SAR testing

Correlation of Output Power between EMC and SAR tests (WLAN IEEE802.11b/g)
It was checked that the antenna port power was correlated within 0~+5% (FCC requirements)
The result is shown in Section 6.1.

- **Peak power at EMC test (April 7, 2009)**
  EMC power was measured for EMC and SAR test sample (S/N: MACID (0013E0F39B98)).

- **Peak power at SAR test (April 15, 2009)**
  SAR power was measured for EMC and SAR test sample (S/N: MACID (0013E0F39B98)).

3.6 Confirmation after SAR testing

It was checked that the power drift[W] is within ±5%. When the power drift [W] is calculated by logarithm(the unit of "dB"), it is –0.223~+0.212dB. Before it begins and after it ends, electric field strength is measured at the same position on the DASY 4 system . The power drift[dB] is calculated from measured electric field strength.

The calculated power drift on the DASY4 system =20log(Ea)/(Eb) ------(A)
Electric field strength before SAR testing (Reference Value) : Eb[V/m]
Electric field strength after SAR testing : Ea[V/m]

Limit of power drift[W] =+/-5%
+5%: X[dB]=10log[P]=10log(1.05/1)=10log(1.05)-10log(1)=0.212[dB] ------(B)
-5%: X[dB]=10log[P]=10log(0.95/1)=10log(0.95)-10log(1)=-0.223[dB] ------(C)
(X[dB]: Power drift[dB] P: Power drift[W])

Relation between electric field strength[V/m] and power[W]
$S=E*H=E^2/\eta=P/4\pi r^2$
$P=E^2*4\pi r^2/\eta$
Therefore, The correlation of power and the E-field
X[dB]=10log(P)=10log(E^2)=20log(E) ------(D)
(S: Power density H: Magnetic field strength
η: Space impedance r: Distance from observation point to the antenna)

From the above mentioned(A~D),
The calculated power drift on the DASY4 system must be from –0.223dB within 0.212dB.

3.7 Measurement procedure

The SAR test was measured according to the following procedures.
Radiated power of EUT was always monitored by Spectrum Analyzer.

IEEE 802.11b
The 11b (DSSS) mode test was performed on the CCK[11Mbps] modulation, because it was the highest average power* and the highest data rate.

Step1. The searching for the worst position

Step2. Change to the Low and High channels
This test was performed at the worst position of Step 1.

IEEE 802.11g
The data rate in the higher average power* of each modulation was decided, then the worst modulation was searched in the SAR testing.

Step3. The searching for the worst modulation
This test was performed at the worst position of Step 1.

Step4. The changing to the Low and High channels
This test was performed at the worst condition of Step 3.

*Refer to Section 6.1.3.

Change distance between EUT and Flat Phantom

Step5. Change separation
The measurement was performed with the distance 5mm,10mm and 15mm to check if the shortest distance may not have the worst value at the conditions of the highest SAR value.

3.8 Test setup of EUT

When users operate or carry the BHT (Bar-code Handy Terminal), it could be considered to touch or get close to their bodies. In order to assume this situation, we performed the test at the following positions. Please refer to "APPENDIX 1" for more details.

(1) Top:
The test was performed in touch with Top surface of the BHT to the flat section of the flat Phantom.

(2) Front:
The test was performed in touch with Front surface of the BHT to the flat section of the flat Phantom.

(3) Rear :
The test was performed in touch with Rear surface of the BHT to the flat section of the flat Phantom.

(4) Left Side :
The test was performed in touch with Left Side surface of the BHT to the flat section of the flat Phantom.

(5) Right Side :
The test was performed in touch with Right Side surface of the BHT to the flat section of the flat Phantom.

(6) Top (5mm) :
The measurement opened 5mm distance between the BHT and flat section of the flat Phantom.

(7) Top (10mm) :
The measurement opened 10mm distance between the BHT and flat section of the flat Phantom.

(8) Top (15mm) :
The measurement opened 15mm distance between the BHT and flat section of the flat Phantom.

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

4.1 Operating modes for SAR testing

4.1.1 Setting of EUT

This EUT has IEEE.802.11b/g continuous transmitting modes.
The frequency band and the modulation used in the testing of IEEE.802.11b/g is shown as a following.

1. IEEE 802.11b mode
Tx frequency band : 2412-2462MHz
Channel : 1ch(2412MHz),6ch(2437MHz),11ch(2462MHz)
Modulation : DSSS (CCK)
Crest factor : Refer to the following

2. IEEE 802.11g mode
Tx frequency band : 2412-2462MHz
Channel : 1ch(2412MHz),6ch(2437MHz),11ch(2462MHz)
Modulation : OFDM (BPSK, QPSK, 16QAM, 64QAM)
Crest factor : Refer to the following

Note: Details of crest factor (PAR)
The data of worst SAR result and maximum PAR was used for the following PAR value.

Modulation (data	Frequency[MHz	PK	AVG	Crest factor (PAR)*
CCK (11Mbps)	2437	46.45	23.93	1.9
CCK (11Mbps)	2412	49.77	25.59	1.9
CCK (11Mbps)	2462	48.87	24.83	2.0
BPSK (9Mbps)	2437	136.77	25.18	5.4
QPSK (12Mbps)	2437	137.09	25.82	5.3
16QAM (24Mbps)	2437	138.36	26.24	5.3
64QAM (54Mbps)	2437	135.52	23.93	5.7
16QAM (24Mbps)	2412	145.88	25.59	5.7
16QAM (24Mbps)	2462	143.88	24.95	5.8

* Crest factor (PAR) = PK power / AVG power

SECTION 5 : Test surrounding

5.1 Measurement uncertainty

The uncertainty budget has been determined for the DASY4 measurement system according to the SPEAG documents[6][7] and is given in the following Table.

Error Description	Uncertainty value ± %	Probability distribution	divisor	(ci) 1g	Standard Uncertainty (1g)	vi or veff
Measurement System						
Probe calibration	±6.8	Normal	1	1	±6.8	∞
Axial isotropy of the probe	±4.7	Rectangular	√3	$(1\text{-cp})^{1/2}$	±1.9	∞
Spherical isotropy of the probe	±9.6	Rectangular	√3	$(\text{cp})^{1/2}$	±3.9	∞
Boundary effects	±2.0	Rectangular	√3	1	±1.2	∞
Probe linearity	±4.7	Rectangular	√3	1	±2.7	∞
Detection limit	±1.0	Rectangular	√3	1	±0.6	∞
Readout electronics	±0.3	Normal	1	1	±0.3	∞
Response time	±0.8	Rectangular	√3	1	±0.5	∞
Integration time	±2.6	Rectangular	√3	1	±1.5	∞
RF ambient Noise	±3.0	Rectangular	√3	1	±1.7	∞
RF ambient Reflections	±3.0	Rectangular	√3	1	±1.7	∞
Probe Positioner	±0.8	Rectangular	√3	1	±0.5	∞
Probe positioning	±9.9	Rectangular	√3	1	±5.7	∞
Max.SAR Eval.	±4.0	Rectangular	√3	1	±2.3	∞
Test Sample Related						
Device positioning	±2.9	Normal	1	1	±2.9	15
Device holder uncertainty	±3.6	Normal	1	1	±3.6	7
Power drift	±5.0	Rectangular	√3	1	±5.8	∞
Phantom and Setup						
Phantom uncertainty	±4.0	Rectangular	√3	1	±2.3	∞
Liquid conductivity (target)	±5.0	Rectangular	√3	0.64	±1.8	∞
Liquid conductivity (meas.)	±5.0	Rectangular	1	0.64	±3.2	∞
Liquid permittivity (target)	±5.0	Rectangular	√3	0.6	±1.7	∞
Liquid permittivity (meas.)	±5.0	Rectangular	1	0.6	±3.0	∞
Combined Standard Uncertainty					**±14.360**	
Expanded Uncertainty (k=2)					**±28.7**	

SECTION 6 : Confirmation before testing

6.1 The correlation of SAR test and EMC test

6.1.1 Peak and Average Power at EMC test

This data is reference data of EMC test(Report No. 29FE0054-HO-02-C).
Date of test: April 7, 2009

IEEE802.11b , 11Mbps

Ch	Frequency	P/M Reading [dBm]		Cable Loss	Atten.	Result [dBm]		Result [mW]	
	[MHz]	PK	AVG	[dB]	[dB]	PK	AVG	PK	AVG
Low	2412.0	5.21	2.32	1.67	10.09	16.97	14.08	49.77	25.59
Mid	2437.0	4.89	2.01	1.69	10.09	16.67	13.79	46.45	23.93
High	2462.0	5.11	2.17	1.69	10.09	16.89	13.95	48.87	24.83

Sample Calculation:
Result = Reading + Cable Loss + Attenuator

IEEE802.11g , 24Mbps

Ch	Frequency	P/M Reading [dBm]		Cable Loss	Atten.	Result [dBm]		Result [mW]	
	[MHz]	PK	AVG	[dB]	[dB]	PK	AVG	PK	AVG
Low	2412.0	9.88	2.32	1.67	10.09	21.64	14.08	145.88	25.59
Mid	2437.0	9.63	2.41	1.69	10.09	21.41	14.19	138.36	26.24
High	2462.0	9.80	2.19	1.69	10.09	21.58	13.97	143.88	24.95

Sample Calculation:
Result = Reading + Cable Loss + Attenuator

6.1.2 Peak and Average Power at SAR test

Date of test: April 15, 2009

IEEE802.11b , 11Mbps

Ch	Frequency	P/M Reading [dBm]		Cable Loss	Atten.	Result [dBm]		Result [mW]		Correlativity of power with EMC test [%]	
	[MHz]	PK	AVG	[dB]	[dB]	PK	AVG	PK	AVG	PK	AVG
Low	2412.0	5.22	2.34	1.67	10.09	16.98	14.10	49.89	25.70	0.23	0.46
Mid	2437.0	4.92	2.03	1.69	10.09	16.70	13.81	46.77	24.04	0.69	0.46
High	2462.0	5.15	2.19	1.69	10.09	16.93	13.97	49.32	24.95	0.93	0.46

Sample Calculation:
Result = Reading + Cable Loss + Attenuator

IEEE802.11g , 24Mbps

Ch	Frequency	P/M Reading [dBm]		Cable Loss	Atten.	Result [dBm]		Result [mW]		Correlativity of power with EMC test [%]	
	[MHz]	PK	AVG	[dB]	[dB]	PK	AVG	PK	AVG	PK	AVG
Low	2412.0	9.91	2.34	1.67	10.09	21.67	14.10	146.89	25.70	0.69	0.46
Mid	2437.0	9.65	2.43	1.69	10.09	21.43	14.21	139.00	26.36	0.46	0.46
High	2462.0	9.81	2.22	1.69	10.09	21.59	14.00	144.21	25.12	0.23	0.69

Sample Calculation:
Result = Reading + Cable Loss + Attenuator

6.1.3 Reference data of SAR test (Data rate determination)

Date of test: April 7, 2009

[IEEE802.11b] Rate check

Modulation	Data rate	Freq.	P/M Reading [dBm]		Cable Loss	Atten.	Result [dBm]		Result [mW]	
	[Mbps]	[MHz]	PK	AVG	[dB]	[dB]	PK	AVG	PK	AVG
DBPSK	1	2437.0	4.68	1.71	1.69	10.09	16.46	13.49	44.26	22.34
DQPSK	2	2437.0	4.58	1.68	1.69	10.09	16.36	13.46	43.25	22.18
CCK	6	2437.0	4.68	1.92	1.69	10.09	16.46	13.70	44.26	23.44
CCK	11	2437.0	4.89	2.01	1.69	10.09	16.67	13.79	46.45	23.93

Sample Calculation:
Result = Reading + Cable Loss + Attenuator

[IEEE802.11g] Rate check

Modulation	Data rate	Freq.	P/M Reading [dBm]		Cable Loss	Atten.	Result [dBm]		Result [mW]	
	[Mbps]	[MHz]	PK	AVG	[dB]	[dB]	PK	AVG	PK	AVG
BPSK	6	2437.0	9.56	2.04	1.69	10.09	21.34	13.82	136.14	24.10
BPSK	9	2437.0	9.58	2.23	1.69	10.09	21.36	14.01	136.77	25.18
QPSK	12	2437.0	9.59	2.34	1.69	10.09	21.37	14.12	137.09	25.82
QPSK	18	2437.0	9.56	2.01	1.69	10.09	21.34	13.79	136.14	23.93
16QAM	24	2437.0	9.63	2.41	1.69	10.09	21.41	14.19	138.36	26.24
16QAM	36	2437.0	9.57	1.89	1.69	10.09	21.35	13.67	136.46	23.28
64QAM	48	2437.0	9.32	1.78	1.69	10.09	21.10	13.56	128.82	22.70
64QAM	54	2437.0	9.54	2.01	1.69	10.09	21.32	13.79	135.52	23.93

Sample Calculation:
Result = Reading + Cable Loss + Attenuator

SECTION 7 : Measurement results

7.1 Body SAR 2450MHz

Liquid Depth (cm)	: **15.0**	Model	: **DWWL001**
Parameters	: **εr =51.5, σ =1.99**	Serial No.	: **MACID (0013E0F39B98)**
Ambient temperature(deg.c.)	: **24.5**	Modulation	: **DSSS**
Relative Humidity (%)	: **44**	Crest factor	: **See to section 4.1**
Date	: **April 15, 2009**	Measured By	: **Hisayoshi Sato**

BODY SAR MEASUREMENT RESULTS

Frequency			Modulation	Phanto Section	EUT Set-up Conditions			Liquid Temp.[deg.c		SAR(1g) [W/kg]
Mode	Channel	[MHz]			Antenna	Position	Separation [mm]	Before	After	Maximum value of multi-peak
	Step 1. The searching for the worst position									
	6	2437	CCK(11Mbps)	Flat	Fixed	Top	0	23.5	23.5	**0.612**
	6	2437	CCK(11Mbps)	Flat	Fixed	Front	0	23.5	23.5	**0.035**
	6	2437	CCK(11Mbps)	Flat	Fixed	Rear	0	23.5	23.5	**0.050**
11b	6	2437	CCK(11Mbps)	Flat	Fixed	Left side	0	23.5	23.5	**0.023**
	6	2437	CCK(11Mbps)	Flat	Fixed	Right side	0	23.5	23.5	**0.028**
	Step 2. Change to the Low and High channels									
	1	2412	CCK(11Mbps)	Flat	Fixed	Top	0	23.5	23.5	**0.735**
	11	2462	CCK(11Mbps)	Flat	Fixed	Top	0	23.7	23.7	**0.673**
	Step 3. The searching for the worst modulation									
	6	2437	BPSK(9Mbps)	Flat	Fixed	Top	0	23.7	23.7	**0.538**
	6	2437	QPSK(12Mbps)	Flat	Fixed	Top	0	23.7	23.7	**0.553**
11g	6	2437	16QAM(24Mbps)	Flat	Fixed	Top	0	23.6	23.6	**0.582**
	6	2437	64QAM(54Mbps)	Flat	Fixed	Top	0	23.6	23.6	**0.536**
	Step 4. Change to the Low and High channels									
	1	2412	16QAM(24Mbps)	Flat	Fixed	Top	0	23.6	23.6	**0.629**
	11	2462	16QAM(24Mbps)	Flat	Fixed	Top	0	23.6	23.6	**0,498**
	Step 5. Change separation									
11b	1	2412	CCK(11Mbps)	Flat	Fixed	Top	5	23.5	23.5	**0.161**
	1	2412	CCK(11Mbps)	Flat	Fixed	Top	10	23.5	23.5	**0.082**
	1	2412	CCK(11Mbps)	Flat	Fixed	Top	15	23.5	23.5	**0.055**