



# SAR TEST REPORT

**Test Report No. : 27IE0024-HO-E-R1**

**Applicant** : Nagano Japan Radio Co., Ltd.  
**Type of Equipment** : Wireless LAN Module  
**Model No.** : NJT-511  
**FCC ID** : D7LNJT511  
**Test standard** : FCC47CFR 2.1093  
FCC OET Bulletin 65, Supplement C  
**Test Result** : Complied

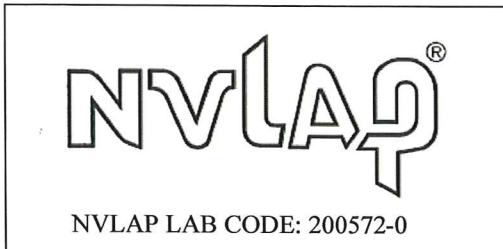
**Max. SAR Value (IEEE 802.11b/g)**  
: 0.636W/kg (2412MHz)

1. This test report shall not be reproduced except full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above standard(s). We hereby certify that the data contain a true representation of the SAR profile.
4. The test results in this test report are traceable to the national or international standards.
5. Original test report number of this report is 27IE0024-HO-E.

**Date of test:** September 10, 11, 2007

**Tested by:** H. Sato  
Hisayoshi Sato  
EMC Services

**Approved by :** T. Maeno  
Tetsuo Maeno  
Site Manager of EMC Services



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://uljapan.co.jp/emc/nvlap.htm>

<b>CONTENTS</b>	<b>PAGE</b>
<b>SECTION 1: Client information</b> .....	<b>3</b>
<b>SECTION 2: Equipment under test (E.U.T.)</b> .....	<b>3</b>
2.1 Identification of E.U.T.....	3
2.2 Product Description .....	3
<b>SECTION 3 : Test standard information</b> .....	<b>4</b>
3.1 Requirements for compliance testing defined by the FCC.....	4
3.2 Exposure limit .....	5
<b>SECTION 4 : Test result</b> .....	<b>6</b>
4.1 Result of Max. SAR value.....	6
4.2 Test Location .....	6
<b>SECTION 5 : Operation of E.U.T. during testing</b> .....	<b>7</b>
5.1 Confirmation before SAR testing.....	7
5.2 Confirmation after SAR testing .....	7
5.3 Operating modes for SAR testing .....	8
<b>SECTION 6 : Test surrounding</b> .....	<b>11</b>
<b>SECTION 7 : Confirmation before testing</b> .....	<b>12</b>
7.1 Correlation of EMC power and SAR power.....	12
7.2 Reference data of SAR test (Data rate determination) .....	14
<b>SECTION 8 : Measurement results</b> .....	<b>15</b>
8.1 SAR Measurement results .....	15
<b>APPENDIX 1 : Photographs of test setup</b> .....	<b>16</b>
<b>APPENDIX 2 : SAR Measurement data</b> .....	<b>29</b>
1. Evaluation procedure .....	30
2. SAR Measurement data .....	31
<b>APPENDIX 2 : Test instruments</b> .....	<b>52</b>
1. Equipment used .....	53
2. Dosimetry assessment setup .....	54
3. Configuration and peripherals .....	55
4. System components .....	56
5. Test system specifications .....	58
6. Simulated Tissues Composition.....	60
7. Simulated Tissue Liquid Parameter confirmation .....	60
8. System validation data.....	61
9. Validation uncertainty .....	63
10. Validation measurement data.....	64
11. System Validation Dipole (D2450V2,S/N: 713) .....	66
12. Dosimetric E-Field Probe Calibration (EX3DV3,S/N: 3507).....	75
13. References .....	84

**SECTION 1: Client information**

Company Name : Nagano Japan Radio Co., Ltd.  
Address : 1163 Inasato-machi, Nagano City 381-2288 Japan  
Telephone Number : +81-26-285-1093  
Facsimile Number : +81-26-285-1037  
Contact Person : Takaaki Fukaya

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

**2.1 Identification of E.U.T.**

Type of Equipment : Wireless LAN Module  
Model No. : NJT-511  
Serial No. : 0013E0999BA0  
Country of Manufacture : JAPAN  
Rating : DC3.3V  
Receipt Date of Sample : July 2, 2007  
Condition of EUT : Production Prototype  
(Not for Sale: This sample is equivalent to mass-produced items.)  
Modification of EUT : No modification by this test lab

**2.2 Product Description**

Model No: NJT-511, referred as the EUT in this report, is the Wireless LAN Module.  
It is integrated into a Barcode Handy Terminal.  
Clock Frequency : 38.4MHz

Equipment Type	Transceiver	
Frequency band	Lower limit	2400MHz
	Upper limit	2483.5MHz
Frequency of Operation	2412-2462MHz	
Bandwidth & Channel spacing	20MHz & 5MHz	
Type of Modulation	DSSS (DBPSK, DQPSK, CCK) OFDM (BPSK, QPSK, 16QAM, 64QAM)	
Antenna Type	Chip Antenna	
Antenna Connector Type	U. FL-R-SMT	
Antenna Gain	2.14dBi max	
ITU code	G1D / D1D	
Power Supply	DC 3.3V	
Maximum Output Power (Peak:FCC15.247)	23.91dBm (246.04mW)	

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

### **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.

---

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

### 3.2 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**

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

## **SECTION 4 : Test result**

### **4.1 Result of Max. SAR value**

**Max. SAR Value (IEEE 802.11b/g) : 0.636W/kg (2412MHz)**

### **4.2 Test Location**

UL Japan, Inc. Head Office EMC Lab.  
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN  
Telephone : +81 596 24 8116  
Facsimile : +81 596 24 8124

## **SECTION 5 : Operation of E.U.T. during testing**

### **5.1 Confirmation before SAR testing**

#### **Correlation of EMC power and SAR power (WLAN IEEE802.11b/g)**

##### **Peak Power test**

As for the peak power, the data of EMC test(September 15, 2007) is shown as a reference data.  
The result is shown in section 7.1.

##### **Average Power test**

It was checked that the antenna port power is correlated within 0~+5% (FCC requirements) at EMC test result (September 15, 2007).

### **5.2 Confirmation after SAR testing**

It was checked that the powerdrift is within  $\pm 5\%$  in the evaluation procedure of SAR testing.  
The result is shown in APPENDIX 2.

---

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

### **5.3 Operating modes for SAR testing**

#### **5.3.1 Setting of EUT**

1. IEEE 802.11b mode (2412-2462 band)

Tx frequency band : 2412-2462MHz  
Channel : 1ch(2412MHz), 6ch(2437MHz), 11ch(2462MHz)  
Modulation : DSSS (DBPSK, DQPSK, CCK)  
Crest factor\* : 1.0

2. IEEE 802.11g mode (2412-2462 band)

Tx frequency band : 2412-2462MHz  
Channel : 1ch(2412MHz), 6ch(2437MHz), 11ch(2462MHz)  
Modulation : OFDM (BPSK, QPSK, 16QAM, 64QAM)  
Crest factor\* : 1.0

---

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124



### 5.3.2 Measurement procedure

#### 1. IEEE 802.11b

The CCK (11Mbps) of the highest data rate and the highest average power\*.

Step1. The searching for the worst position

Step2. The test for the Low and High channels

This test was performed at the worst conditions of Step2 .

#### 2. IEEE 802.11g

Step3. The searching for the worst modulation

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

Step4. The searching for the worst position

This test was performed at the worst modulation of Step3.

Step5. The test for the Low and High channels

This test was performed at the worst conditions of Step4 .

#### 3. Change distance between EUT and SAM Twin Phantom

Step6. 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.

\* Refer to Section 7.2

---

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

### 5.3.3 Test setup of EUT

When users operate the EUT, 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 to the flat phantom.

(2) Front:

The test was performed in touch with front surface to the flat phantom.

(3) Rear:

The test was performed in touch with rear surface to the flat phantom.

(4) Left side:

The test was performed in touch with left side surface to the flat phantom.

(5) Right side:

The test was performed in touch with right side surface to the flat phantom.

(6) Top (separation 5mm) :

The measurement opened 5mm distance between the EUT and the flat phantom.

(7) Top (separation 10mm) :

The measurement opened 10mm distance between the EUT and the flat phantom.

(8) Top (separation 15mm) :

The measurement opened 15mm distance between the EUT and the flat phantom.

---

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

## **SECTION 6 : Test surrounding**

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
<b>Measurement System</b>						
Probe calibration	±6.8	Normal	1	1	±6.8	∞
Axial isotropy of the probe	±4.7	Rectangular	√3	(1-cp) <sup>1/2</sup>	±1.9	∞
Spherical isotropy of the probe	±9.6	Rectangular	√3	(cp) <sup>1/2</sup>	±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	∞
<b>Test Sample Related</b>						
Device positioning	±2.9	Normal	1	1	±2.9	19
Device holder uncertainty	±3.6	Normal	1	1	±3.6	7
Power drift	±5.0	Rectangular	√3	1	±5.8	∞
<b>Phantom and Setup</b>						
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	∞
<b>Combined Standard Uncertainty</b>					<b>±13.48</b>	
<b>Expanded Uncertainty (k=2)</b>					<b>±26.96</b>	

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**SECTION 7 : Confirmation before testing**

**7.1 Correlation of EMC power and SAR power**

**7.1.1 EMC power**

This data is reference data of EMC test. (Report No. 27IE0024-HO-A-R1)

**FCC15.247 Maximum Output Peak Power**

Date: September 15, 2007

**[IEEE802.11b 11Mbps] Peak Power**

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
					[dBm]	[mW]
Low	2412.0	8.17	0.88	10.02	19.07	80.72
Mid	2437.0	8.46	0.89	10.02	19.37	86.50
High	2462.0	7.49	0.89	10.02	18.40	69.18

**[IEEE802.11g 9Mbps] Peak Power**

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
					[dBm]	[mW]
Low	2412.0	12.92	0.88	10.02	23.82	240.99
Mid	2437.0	13.00	0.89	10.02	23.91	246.04
High	2462.0	12.65	0.89	10.02	23.56	226.99

Sample Calculation:

Result = Reading + Cable Loss + Attenuator

**Reference data for SAR testing**

Date: September 15, 2007

**[IEEE802.11b 11Mbps] Average Power**

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
					[dBm]	[mW]
Low	2412.0	5.60	0.88	10.02	16.50	44.67
Mid	2437.0	5.79	0.89	10.02	16.70	46.77
High	2462.0	4.79	0.89	10.02	15.70	37.15

**[IEEE802.11g 9Mbps] Average Power**

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
					[dBm]	[mW]
Low	2412.0	5.34	0.88	10.02	16.24	42.07
Mid	2437.0	4.79	0.89	10.02	15.70	37.15
High	2462.0	5.74	0.89	10.02	16.65	46.24

Sample Calculation:

Result = Reading + Cable Loss + Attenuator

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

### 7.1.2 SAR power

Date: September 10, 2007

#### [IEEE802.11b 11Mbps] Average Power

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
					[dBm]	[mW]
Low	2412.0	5.78	0.88	10.02	16.68	46.56
Mid	2437.0	5.91	0.89	10.02	16.82	48.08
High	2462.0	4.92	0.89	10.02	15.83	38.28

#### [IEEE802.11g 9Mbps] Average Power

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
					[dBm]	[mW]
Low	2412.0	5.42	0.88	10.02	16.32	42.85
Mid	2437.0	4.92	0.89	10.02	15.83	38.28
High	2462.0	5.89	0.89	10.02	16.80	47.86

#### [IEEE802.11g 36Mbps] Average Power

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
					[dBm]	[mW]
Low	2412.0	5.36	0.88	10.02	16.26	42.27
Mid	2437.0	4.82	0.89	10.02	15.73	37.41
High	2462.0	5.76	0.89	10.02	16.67	46.45

Sample Calculation:

Result = Reading + Cable Loss + Attenuator

---

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

## 7.2 Reference data of SAR test (Data rate determination)

Date: September 10, 2007

IEEE 80.2 11b Average power						
Modulation	Data rate [Mbps]	Freq. [MHz]	P/M(AV) Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]
DBPSK	1	2437	5.36	0.89	10.02	16.27
DQPSK	2	2437	5.73	0.89	10.02	16.64
CCK	5.5	2437	5.79	0.89	10.02	16.70
CCK	11	2437	5.82	0.89	10.02	16.73

IEEE 80.2 11g Average power						
Modulation	Data rate [Mbps]	Freq. [MHz]	P/M(AV) Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result [dBm]
BPSK	6	2437	4.84	0.89	10.02	15.75
BPSK	9	2437	5.16	0.89	10.02	16.07
QPSK	12	2437	4.97	0.89	10.02	15.88
QPSK	18	2437	5.08	0.89	10.02	15.99
16QAM	24	2437	4.43	0.89	10.02	15.34
16QAM	36	2437	4.82	0.89	10.02	15.73
64QAM	48	2437	4.83	0.89	10.02	15.74
64QAM	54	2437	4.77	0.89	10.02	15.68

Sample Calculation: Result = Reading + Cable Loss + Attenuator Loss

**UL Japan, Inc.**

**Head Office EMC Lab.**

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

Telephone : +81 596 24 8116

Facsimile : +81 596 24 8124

**SECTION 8 : Measurement results**

**8.1 SAR Measurement results**

**8.1.1 IEEE 802.11 b/g SAR**

Date : **September 10, 2007** Measured By : **Hisayoshi Sato**  
Liquid Depth (cm) : **15.0** Model : **NJT-511**  
Parameters :  $\epsilon_r = 51.4, \sigma = 2.01$  Serial No. : **0013E0999BA0**  
Ambient temperature (deg.c.) : **25.0** Modulation : **DSSS**  
Relative Humidity (%) : **45** Crest factor : **See to Section 7.2**

Date : **September 11, 2007** Measured By : **Hisayoshi Sato**  
Liquid Depth (cm) : **15.0** Model : **NJT-511**  
Parameters :  $\epsilon_r = 50.2, \sigma = 1.95$  Serial No. : **0013E0999BA0**  
Ambient temperature (deg.c.) : **25.0** Modulation : **OFDM**  
Relative Humidity (%) : **48** Crest factor : **See to Section 7.2**

BODY SAR MEASUREMENT RESULTS									
Frequency		Modulation	Phantom Section	EUT Set-up Conditions		Liquid Temp.[deg.c]		SAR(1g)	
Mode	Channel [MHz]			Position	Separation [mm]	Before	After	Maximum value of multi-peak	
<b>Step 1. The searching for the worst position</b>									
11b mode	6	2437	CCK(11Mbps)	Flat	Top	0	23.9	23.9	<b>0.483</b>
	6	2437	CCK(11Mbps)	Flat	Front	0	23.9	23.9	<b>0.077</b>
	6	2437	CCK(11Mbps)	Flat	Rear	0	24.0	24.0	<b>0.017</b>
	6	2437	CCK(11Mbps)	Flat	Left side	0	23.9	23.9	<b>0.00712</b>
	6	2437	CCK(11Mbps)	Flat	Right side	0	23.9	23.9	<b>0.052</b>
<b>Step 2. The test for the Low and High channels</b>									
	1	2412	CCK(11Mbps)	Flat	Top	0	24.0	24.0	<b>0.636</b>
	11	2462	CCK(11Mbps)	Flat	Top	0	24.0	24.0	<b>0.592</b>
<b>Step 3. The searching for the worst modulation</b>									
11g mode	6	2437	BPSK(9Mbps)	Flat	Top	0	24.1	24.1	<b>0.461</b>
	6	2437	QPSK(18Mbps)	Flat	Top	0	24.1	24.1	<b>0.503</b>
	6	2437	16QAM(36Mbps)	Flat	Top	0	24.1	24.1	<b>0.522</b>
	6	2437	64QAM(48Mbps)	Flat	Top	0	24.0	24.0	<b>0.495</b>
	<b>Step 4. The searching for the worst position</b>								
	6	2437	16QAM(36Mbps)	Flat	Front	0	24.0	24.0	<b>0.088</b>
	6	2437	16QAM(36Mbps)	Flat	Rear	0	24.0	24.0	<b>0.017</b>
	6	2437	16QAM(36Mbps)	Flat	Left side	0	24.0	24.0	<b>0.00894</b>
	6	2437	16QAM(36Mbps)	Flat	Right side	0	24.1	24.1	<b>0.095</b>
<b>Step 5. The test for the Low and High channels</b>									
	1	2412	16QAM(36Mbps)	Flat	Top	0	24.1	24.1	<b>0.510</b>
	11	2462	16QAM(36Mbps)	Flat	Top	0	24.1	24.1	<b>0.544</b>
<b>Step 6. Separation change</b>									
11b mode	11	2462	CCK(11Mbps)	Flat	Top	5	24.2	24.2	<b>0.122</b>
	11	2462	CCK(11Mbps)	Flat	Top	10	24.2	24.2	<b>0.058</b>
	11	2462	CCK(11Mbps)	Flat	Top	15	24.2	24.2	<b>0.042</b>