



UL Apex Co., Ltd.

Test report No. : 26IE0327-HO-E
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Issued date : November 6, 2006
FCC ID : T9F500SEW1

SAR TEST REPORT

Test Report No. : 26IE0327-HO-E

Applicant : RICOH COMPANY, LTD.
Type of Equipment : Digital Camera
Model No. : Caplio 500SE-W
FCC ID : T9F500SEW1
Test standard : FCC47CFR 2.1093
FCC OET Bulletin 65, Supplement C
Test Result : Complied
Max. SAR Measured : Body 0.083W/kg (2412MHz)

1. This test report shall not be reproduced except full or partial, without the written approval of UL Apex Co., Ltd.
2. The results in this report apply only to the sample tested.
3. This equipment is in compliance with the above standard. 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.

Date of test : October 19, 20, 2006

Tested by :
Hisayoshi Sato
EMC Services

Approved by :
Tetsuo Maeno
Site Manager of EMC Services

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UL Apex Co., Ltd.

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

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SECTION 1 : Client information

Company Name	RICOH COMPANY, LTD.
Brand name	RICOH
Address	3-2-3, Shin-yokohama Kohoku-ku, Yokohama-shi, Japan
Telephone Number	+81-45-475-7421
Facsimile Number	+81-45-477-2799
Contact Person	Tomoyuki Kuniyori

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

2.1 Identification of E.U.T.

Type of Equipment	Digital Camera						
Model No.	Caplio 500SE-W						
Serial No.	00010047						
Country of Manufacture	China						
Battery	<table border="1"> <tr> <td>Model Name :</td> <td>DB-43</td> </tr> <tr> <td>Rating :</td> <td>DC3.7V/1800mAh</td> </tr> <tr> <td>Manufacture</td> <td>RICOH</td> </tr> </table>	Model Name :	DB-43	Rating :	DC3.7V/1800mAh	Manufacture	RICOH
Model Name :	DB-43						
Rating :	DC3.7V/1800mAh						
Manufacture	RICOH						
Option Battery	N/A						
Condition of EUT	Production Prototype (Not for Sale: This sample is equivalent to mass-produced items.)						
Operation Clock	40MHz						
Accessories	N/A						
Size	W133mm×D78.95mm×H78.75mm						
Receipt Date of Sample	October 10, 2006						
Modification of EUT	No modification by the test lab.						
Category Identified	Portable device						

2.2 Product Description

Feature of EUT	Model No: Caplio 500SE-W (referred to as the EUT in this report) is the Digital Camera that contains IEEE802.11b/g WLAN and Bluetooth modules. Bluetooth module is granted by FCC (FCC ID: KYYEYXFDC), and thus this test report refers to IEEE802.11b/g WLAN part only. IEEE802.11b/g WLAN and Bluetooth modules do not transmit simultaneously.
Equipment Type	Transceiver
Frequency of Operation	2412-2462MHz
Bandwidth & Channel spacing	20MHz & 5MHz
Max.Peak power tested	17.28[dBm] (53.46mW)
Type of Modulation	DSSS, OFDM
Antenna Type	Integral Chip Antenna
Antenna Gain	2.0 dBi
Power Supply (inner)	DC 3.3V/DC1.8V (inner)
Method of Frequency Generation	Synthesizer

UL Apex Co., Ltd.

Head Office EMC Lab.

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

Telephone: +81 596 24 8116

Faximile: +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.

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**

SECTION 4 : Test result

4.1 Result of Max. SAR value

Max. SAR Measured : Body 0.083 W/kg (2412MHz)

4.2 Test Location

UL Apex Co., Ltd. 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

UL Apex Co., Ltd.

Head Office EMC Lab.

4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
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SECTION 5 : Operation of E.U.T. during testing

5.1 Confirmation before SAR testing

(i)Correlation of output power

- Output power is equal to the power in DATA of EMC test.
 - EMC and SAR tests are performed with the same test sample under the same condition.
- The result is shown in Section 7.1.

(ii)Duty factor verifications

Crest factor determing

Crest factor was calculated by the duty factor measured at each data rate.

The duty factor was calculated according to the following equation:

Duty factor = on time / 1 cycle (on+off time)

5.2 Confirmation of SAR testing

The power drift is within ±5% in the evaluation procedure of SARtesting.
The result is shown in APPENDIX 2.

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(2437MHz)
Modulation : DSSS (DBPSK, DQPSK, CCK)
Crest factor* : 1.1 (DBPSK 1Mbps), 1.2(DQPSK 2Mbps), 2.3 (CCK 5.5Mbps), 3.7(CCK 11Mbps)

Remark* : Crest factor decision in SAR testing

Modulation	DBPSK (1Mbps)	DQPSK (2Mbps)	CCK (5.5Mbps)	CCK (11Mbps)
DutyCycle[%]	96	84	44	26
Crestfactor	1.1	1.2	2.3	3.8

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

Tx frequency band : 2412-2462MHz
Channel : 1ch(2412MHz), 6ch(2437MHz), 11ch(2437MHz)
Modulation : OFDM (BPSK, QPSK, 16QAM, 64QAM)
Crest factor* : 3.6(BPSK 9Mbps), 5.3(QPSK 12Mbps), 13.8(16QAM 36Mbps), 19.6(64QAM 48Mbps)

Remark* : Crest factor decision in SAR testing

Modulation	BPSK (9Mbps)	QPSK (12Mbps)	16QAM (36Mbps)	64QAM (48Mbps)
DutyCycle[%]	27.3	19	7.2	5.1
Crestfactor	3.6	5.3	13.8	19.6

5.3.2 Measurement procedure

Radiated power is always monitored by Spectrum Analyzer.

1. Body Measurement

IEEE 802.11b (2412-2462MHz Band)

Step1. The searching for the worst position

Step2. The searching for the worst modulation

This test was performed at the worst position of Step1.

Step3. The changing to the channel

This test was performed at the worst condition of Step2.

IEEE 802.11g (2412-2462MHz Band)

Step4. The searching for the worst modulation

The data rate in the higher duty cycle each modulation was decided, then the worst modulation was searched in the SAR testing.

Step5. The changing to the channel

This test was performed at the worst conditions of Step4.

Change separations

Step6. The searching for the worst distance

The measurement was performed with the distance, 5mm, 10mm and 15mm to check if the shortest distance (0mm) may not have the worst value at the conditions of the highest SAR value. As a result, the shortest distance (0mm) had the worst value

2. Head Measurement (Reference data)

IEEE 802.11b (2412-2462MHz Band)

Step7. The changing to the channel

This test was performed at the worst condition of Step2.

IEEE 802.11g (2412-2462MHz Band)

Step8. The changing to the channel

This test was performed at the worst conditions of Step4.

Step9. Back position Measurement

This test was performed at the worst conditions of Step7 and Step8.

*It is checked that the power drift value at each measurement is within $\pm 5\%$ as to the power change before and after the SAR test. When the power drift value is over $+/-5\%$, the power changes against time is measured to confirm the changes are within tolerance.

Moreover, the change rate is reflected on the uncertainty.

5.5 Description of test setup

This EUT were tested on the “Back”, “Side”, “Top” and “Bottom” positions at the flat section of SAM Twin phantom.

(1) Back position

The test was performed in touch with back of the EUT to the flat section of SAM Twin phantom.

(2) Right Side position

The test was performed in touch with Side of the EUT to the flat section of SAM Twin phantom.

(3) Top position

The test was performed in touch with Top of the EUT to the flat section of SAM Twin phantom.

(4) Bottom position

The test was performed in touch with bottom of the EUT to the flat section of SAM Twin phantom.

(5), (6), (7) Right Side position / Separated 5mm, 10mm, 15mm

The test was performed in the separation of 5mm, 10mm, 15mm between EUT and flat sections of the SAM Twin Phantom

SECTION 6 : Test surrounding

6.1 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	$\sqrt{3}$	$(1-c_p)^{1/2}$	±1.9	∞
Spherical isotropy of the probe	±9.6	Rectangular	$\sqrt{3}$	$(c_p)^{1/2}$	±3.9	∞
Boundary effects	±2.0	Rectangular	$\sqrt{3}$	1	±1.2	∞
Probe linearity	±4.7	Rectangular	$\sqrt{3}$	1	±2.7	∞
Detection limit	±1.0	Rectangular	$\sqrt{3}$	1	±0.6	∞
Readout electronics	±0.3	Normal	1	1	±0.3	∞
Response time	±0.8	Rectangular	$\sqrt{3}$	1	±0.5	∞
Integration time	±2.6	Rectangular	$\sqrt{3}$	1	±1.5	∞
RF ambient Noise	±3.0	Rectangular	$\sqrt{3}$	1	±1.7	∞
RF ambient Reflections	±3.0	Rectangular	$\sqrt{3}$	1	±1.7	∞
Probe Positioner	±0.8	Rectangular	$\sqrt{3}$	1	±0.5	∞
Probe positioning	±9.9	Rectangular	$\sqrt{3}$	1	±5.7	∞
Max.SAR Eval.	±4.0	Rectangular	$\sqrt{3}$	1	±2.3	∞
Test Sample Related						
Device positioning	±2.9	Normal	1	1	±2.9	24
Device holder uncertainty	±3.6	Normal	1	1	±3.6	6
Power drift	±5.0	Rectangular	$\sqrt{3}$	1	±2.9	∞
Phantom and Setup						
Phantom uncertainty	±4.0	Rectangular	$\sqrt{3}$	1	±2.3	∞
Liquid conductivity (target)	±5.0	Rectangular	$\sqrt{3}$	0.64	±1.8	∞
Liquid conductivity (meas.)	±5.0	Rectangular	1	0.64	±3.2	∞
Liquid permittivity (target)	±5.0	Rectangular	$\sqrt{3}$	0.6	±1.7	∞
Liquid permittivity (meas.)	±5.0	Rectangular	1	0.6	±3.0	∞
Combined Standard Uncertainty					±13.45	
Expanded Uncertainty (k=2)					±26.91	

SECTION 7 : Results of confirmation before SAR testing

7.1 Correlation of EMC power and SAR power

This data is reference data of EMC test. (Report No. 26IE0327-HO-A)

[IEEE802.11b:11Mbps]

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
Low	2412.0	5.58	0.94	10.14	16.66	46.34
Mid	2437.0	5.14	0.94	10.14	16.22	41.88
High	2462.0	4.82	0.94	10.14	15.90	38.90

[IEEE802.11b:1Mbps]

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
Low	2412.0	5.01	0.94	10.14	16.09	40.66
Mid	2437.0	4.86	0.94	10.14	15.94	39.26
High	2462.0	4.75	0.94	10.14	15.83	38.28

[IEEE802.11g:9Mbps]

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
Low	2412.0	6.20	0.94	10.14	17.28	53.46
Mid	2437.0	5.80	0.94	10.14	16.88	48.75
High	2462.0	5.93	0.94	10.14	17.01	50.23

[IEEE802.11b] Rate Check

Rate [Mbps]	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
1.0	2437.0	4.86	0.94	10.14	15.94	39.26
2.0	2437.0	5.03	0.94	10.14	16.11	40.83
5.5	2437.0	5.07	0.94	10.14	16.15	41.21
11.0	2437.0	5.14	0.94	10.14	16.22	41.88

[IEEE802.11g] Rate Check

Rate [Mbps]	Freq. [MHz]	S/A Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
					[dBm]	[mW]
6.0	2437.0	5.15	0.94	10.14	16.23	41.98
9.0	2437.0	5.80	0.94	10.14	16.88	48.75
12.0	2437.0	5.50	0.94	10.14	16.58	45.50
18.0	2437.0	5.19	0.94	10.14	16.27	42.36
24.0	2437.0	4.62	0.94	10.14	15.70	37.15
36.0	2437.0	5.62	0.94	10.14	16.70	46.77
48.0	2437.0	5.69	0.94	10.14	16.77	47.53
54.0	2437.0	4.87	0.94	10.14	15.95	39.36

Sample Calculation:

Result = Reading + Cable Loss (supplied by customer)+ Attenuator

UL Apex Co., Ltd.

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

All of power drifts were within $\pm 5\%$. The measurement data is shown the "APPENDIX 2".

8.1.1 Body SAR 2450MHz

Liquid Depth (cm)	: 15.0	Model	: Caplio 500SE-W
Parameters	: $\epsilon_r = 50.3$, $\sigma = 2.01$	Serial No.	: 00010047
Ambient temperature (deg.c.)	: 24.5	Modulation	: DSSS, OFDM
Relative Humidity (%)	: 50		
Crest factor(11b)	: 1.1(1Mbps), 1.2(2Mbps), 2.3(5.5Mbps), 3.8Mbps(11Mbps)		
Crest factor(11g)	: 3.6(9Mbps), 5.3(12Mbps), 13.8(36Mbps), 19.6Mbps(48Mbps)		
Date	: October 19, 2006	Measured By	: Hisayoshi Sato

BODY SAR MEASUREMENT RESULTS										
Frequency			Modulation	Phantom 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-
11b Step1. Position search										
6	2437.0	DBPSK(1Mbps)	Flat	Fixed	Back	0	24.0	24.0	0.038	
6	2437.0	DBPSK(1Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.078	
6	2437.0	DBPSK(1Mbps)	Flat	Fixed	Top	0	24.0	24.0	0.040	
6	2437.0	DBPSK(1Mbps)	Flat	Fixed	Bottom	0	24.0	24.0	0.011	
Step2. Change Moduration										
6	2437.0	DQPSK(2Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.069	
6	2437.0	CCK(5.5Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.030	
6	2437.0	CCK(11Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.016	
Step3. Change Frequency										
1	2412.0	DBPSK(1Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.083	
11	2462.0	DBPSK(1Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.053	
11g Step4. Change Moduration										
6	2437.0	BPSK(9Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.006	
6	2437.0	QPSK(12Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.004	
6	2437.0	16QAM(36Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.002	
6	2437.0	64QAM(48Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.003	
Step5. Change Frequency										
1	2412.0	BPSK(9Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.008	
11	2462.0	BPSK(9Mbps)	Flat	Fixed	Right side	0	24.0	24.0	0.005	
11b Step6. Change Separation										
1	2412.0	DBPSK(1Mbps)	Flat	Fixed	Right side	5	24.0	24.0	0.060	
1	2412.0	DBPSK(1Mbps)	Flat	Fixed	Right side	10	24.0	24.0	0.041	
1	2412.0	DBPSK(1Mbps)	Flat	Fixed	Right side	15	24.0	24.0	0.027	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population								Body SAR: 1.6 W/kg (averaged over 1 gram)		

* See Appendix 2 for measurement data plots.

UL Apex Co., Ltd.

Head Office EMC Lab.

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

Telephone: +81 596 24 8116

Faxsimile: +81 596 24 8124

8.1.2 Head SAR 2450MHz (Reference data)

Liquid Depth (cm) : **15.1** Model : **Caplio 500SE-W**
 Parameters : $\epsilon_r = 37.3, \sigma = 1.87$ Serial No. : **00010047**
 Ambient temperature (deg.c.) : **24.7** Modulation : **DSSS, OFDM**
 Relative Humidity (%) : **48**
 Crest factor(11b) : **1.1(1Mbps)**
 Crest factor(11g) : **3.6(9Mbps)**
 Date : **October 20, 2006** Measured By : **Hisayoshi Sato**

Head SAR MEASUREMENT RESULTS										
Frequency			Modulation	Phantom 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-
11b Step7. Change Frequency										
1	2412.0	DBPSK(1Mbps)	Flat	Fixed	Right side	0	24.2	24.2	0.100	
6	2437.0	DBPSK(1Mbps)	Flat	Fixed	Right side	0	24.2	24.2	0.080	
11	2462.0	DBPSK(1Mbps)	Flat	Fixed	Right side	0	24.2	24.2	0.062	
11g Step8. Change Frequency										
1	2412.0	BPSK(9Mbps)	Flat	Fixed	Right side	0	24.2	24.2	0.010	
6	2437.0	BPSK(9Mbps)	Flat	Fixed	Right side	0	24.2	24.2	0.008	
11	2462.0	BPSK(9Mbps)	Flat	Fixed	Right side	0	24.2	24.2	0.005	
11b Step9. Measure Back position										
1	2412.0	DBPSK(1Mbps)	Flat	Fixed	Back	0	24.2	24.2	0.054	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population							Head SAR: 1.6 W/kg (averaged over 1 gram)			

* See Appendix 2 for measurement data plots.

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Head Office EMC Lab.

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