SAR TEST REPORT

Test Report No. : 27IE0038-HO-D

Applicant	:	**SATO CORPORATION**
Type of Equipment	:	**BARCODE PRINTER**
Model No.	:	**MB410i-W2**
FCC ID	:	**MMFMB400I-W2**
Test standard	:	**FCC47CFR 2.1093** **FCC OET Bulletin 65, Supplement C**
Test Result	:	**Complied**
Max. SAR Measured	:	**0.054W/kg (Body, 2462MHz)**

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 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 : April 19, 2007

Tested by : H. Sato

Hisayoshi Sato
EMC Services

Approved by : T. Maeno

Tetsuo Maeno
Site Manager of EMC Services

NVLAP®

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://ulapex.jp/emc/nvlap.htm

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SECTION 1: Client information

Company Name	:	SATO CORPORATION
Address	:	1-207, Onari-cho, Omiya-ku, Saitama-shi, Saitama 330-0852 Japan
Telephone Number	:	+81-48-663-8118
Facsimile Number	:	+81-48-651-6662
Contact Person	:	Keisuke Yamada

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

2.1 Identification of E.U.T.

Type of Equipment	:	BARCODE PRINTER
Model No.	:	MB410i-W2
Serial No.	:	2
Country of Manufacture	:	Malaysia, Vietnam
Receipt Date of Sample	:	April 10, 2007
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

MB4xxi-W2 has Model No. MB400i-W2 and Model No. MB410i-W2 as 2 model types.
The difference does not affect on SAR testing results. Therefore, the test was performed with Model No. MB410i-W2 as representative model.
Model No: MB410i-W2 is the BARCODE PRINTER.
The difference of 2 model types is as follows;

MB400i-W2	MB410i-W2
Print head resolution 203 dpi (8 dots/mm)	Print head resolution 305 dpi (12 dots/mm)

Clock frequency		CPU: 14.7456MHz (X'tal) Internal Clock: 14.7456 x 4 = 58.9824MHz Reference Clock: 40MHz
Equipment Type		Transceiver
Frequency of Operation		2412-2462MHz
Bandwidth & Channel spacing		22MHz & 5MHz
Type of Modulation		DSSS/OFDM
Antenna Type		Multilayer Chip Antenna (Inverted-F 1/4 lambda antenna)
Antenna Gain		2.044dBi (MAX)
Antenna connector		Built-in antenna
Method of frequency generation		Synthesizer
Operating voltage		DC14.8V (Battery)/DC19.0V(AC Adaptor)
Battery	Type:	Li-ion Battery
	Rating :	DC14.8V/1700mAh
Option Battery		N/A
Category Identified		Portable device
Accessories		Water Protector case(waist case) *There are small parts of the metal. Refer to appendix 1.
Size		W170*L133.4*H76 mm
Max. Output Power (Peak)		20.88dBm (122.46mW)

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 (IEEE 802.11b) : 0.054 W/kg (Body, 2462MHz)

4.2 Test Location

UL Japan, Inc. Head Office EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8116
Facsimile : +81 596 24 8124

Our company name was changed from "UL Apex Co., Ltd." to "UL Japan, Inc." on April 26, 2007.

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

5.1 Confirmation before / after SAR testing

Correlation of EMC power and SAR power

Peak Power test
It was checked that the antenna port power was correlated within 0~+5% (FCC requirements)
The result is shown in Section 7.1.1

5.2 Confirmation after SAR testing

It is checked that the power drift value at each measurement is within ±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.
Refer to Section 7.2.

5.3 Operating modes for SAR testing

5.3.1 Setting of EUT

1. IEEE 802.11b mode

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

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 : 1

5.3.2 SAR Measurement (Radiated power is 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 peak power and data rate.

Step1. The searching for the worst position

Step2. The changing to the Low and High channels
This test was performed at the worst conditions of Step 1

IEEE 802.11g
Step3. The seaching for the worst modulation
The data rate in the higher peak 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 changing to the Low and High channels
This test was performed at the worst conditions of Step 4.

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.

EUT is put in the water protector case(waist case) for the other reference data
Step7. EUT is put in the case
The users might use this EUT in the the water protector case(waist case) .
Therefore, the test was performed with EUT in this case.

5.4 Test setup of EUT

When users operate or carry 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) Front:
The test was performed in touch with Front surface of the EUT to the flat section of SAM Twin phantom.

(2) Rear :
The test was performed in touch with Rear surface of the EUT to the flat section of SAM Twin phantom.

(3) Left Side :
The test was performed in touch with Left Side surface of the EUT to the flat section of SAM Twin phantom.

(4) Bottom :
The test was performed in touch with Bottom surface of the EUT to the flat section of SAM Twin phantom.

(5) Left Side (5mm) :
The measurement opened 5mm distance between the EUT and flat section of SAM Twin Phantom.

(6) Left Side (10mm) :
The measurement opened 10mm distance between the EUT and flat section of SAM Twin Phantom.

(7) Left Side (15mm) :
The measurement opened 15mm distance between the EUT and flat section of SAM Twin Phantom.

(8) Bottom , EUT is put in the case
The test was performed in touch with Bottom surface of the water protector case(waist case) to the flat section of SAM Twin phantom.

*The test setup photograph is put on appendix 1.

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	√3	$(1-c_p)^{1/2}$	±1.9	∞
Spherical isotropy of the probe	±9.6	Rectangular	√3	$(c_p)^{1/2}$	±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	18
Device holder uncertainty	±3.6	Normal	1	1	±3.6	7
Power drift	±10.0	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**	

The test result shows that the power drift exceeded ±5%. Therefore, the uncertainty of power drift expanded to ±10%. However, the extended uncertainty (k= 2) of a test is less than 30%.

SECTION 7 : Confirmation before/after testing

7.1 Conducted power before

7.1.1 Correlation of EMC power and SAR power

This data is reference data of EMC test. (Report No. 27IE0038-HO-A)
Date of test: April 17, 2007

IEEE802.11b , 11Mbps

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
Low	2412.0	7.14	2.45	10.02	19.61	91.41
Mid	2437.0	7.35	2.45	10.02	19.82	95.94
High	2462.0	7.12	2.20	10.02	19.34	85.90

IEEE802.11g , 54Mbps

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
Low	2412.0	8.40	2.45	10.02	20.87	122.18
Mid	2437.0	8.14	2.45	10.02	20.61	115.08
High	2462.0	7.97	2.20	10.02	20.19	104.47

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

This data is confirmation before SAR test.
Date of test: April 19, 2007

IEEE802.11b , 11Mbps

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
Low	2412.0	7.31	2.45	10.02	19.78	95.06
Mid	2437.0	7.52	2.45	10.02	19.99	99.77
High	2462.0	7.25	2.20	10.02	19.47	88.51

IEEE802.11g , 54Mbps

Ch	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
Low	2412.0	8.51	2.45	10.02	20.98	125.31
Mid	2437.0	8.24	2.45	10.02	20.71	117.76
High	2462.0	8.17	2.20	10.02	20.39	109.40

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

7.1.2 Reference data of SAR test (Data rate determing)

Date of test: April 19, 2007

[IEEE802.1 [IEEE802.11b] Rate check (Average power)

Modulation	Data rate	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
DBPSK	1	2437.0	2.36	2.45	10.02	14.83	30.41
DQPSK	2	2437.0	1.98	2.45	10.02	14.45	27.86
CCK	5.5	2437.0	2.39	2.45	10.02	14.86	30.62
	11	2437.0	2.41	2.45	10.02	14.88	30.76

[IEEE802.11 [IEEE802.11b] Rate check (Peak power)

Modulation	Data rate	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
DBPSK	1	2437.0	6.35	2.45	10.02	18.82	76.21
DQPSK	2	2437.0	6.98	2.45	10.02	19.45	88.10
CCK	5.5	2437.0	7.01	2.45	10.02	19.48	88.72
	11	2437.0	7.37	2.45	10.02	19.84	96.38

[IEEE802.1 [IEEE802.11g] Rate check (Average power)

Modulation	Data rate	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
BPSK	6	2437.0	-1.14	2.45	10.02	11.33	13.58
	9	2437.0	-1.17	2.45	10.02	11.30	13.49
QPSK	12	2437.0	-1.08	2.45	10.02	11.39	13.77
	18	2437.0	-1.03	2.45	10.02	11.44	13.93
16QAM	24	2437.0	-1.43	2.45	10.02	11.04	12.71
	36	2437.0	-1.11	2.45	10.02	11.36	13.68
64QAM	48	2437.0	-0.97	2.45	10.02	11.50	14.13
	54	2437.0	-0.93	2.45	10.02	11.54	14.26

[IEEE802.11 [IEEE802.11g] Rate check (Peak power)

Modulation	Data rate	Freq. [MHz]	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
BPSK	6	2437.0	8.02	2.45	10.02	20.49	111.94
	9	2437.0	7.92	2.45	10.02	20.39	109.40
QPSK	12	2437.0	8.04	2.45	10.02	20.51	112.46
	18	2437.0	8.05	2.45	10.02	20.52	112.72
16QAM	24	2437.0	8.10	2.45	10.02	20.57	114.02
	36	2437.0	8.13	2.45	10.02	20.60	114.82
64QAM	48	2437.0	8.08	2.45	10.02	20.55	113.50
	54	2437.0	8.24	2.45	10.02	20.71	117.76

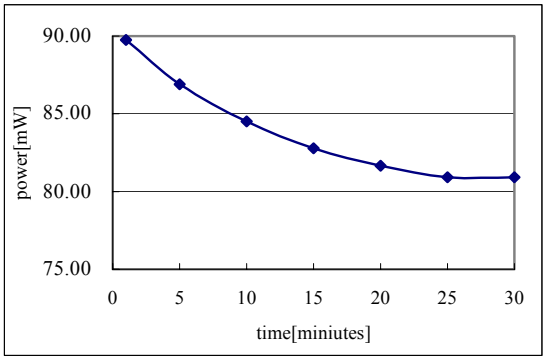
Sample Calc Sample Calculation:
Result = Rea Result = Reading + Cable Loss (supplied by customer) + Attenuator

7.2 Power drift measurement

The power drift was not within ± 5% on SAR re-testing with full-charged battery.
Therefore the conducted power was measured in elapsed time.
The Output power was measured under the condition of Max SAR value.
As a result, power changed by –9.8%. The result is shown in the following.
So the uncertainty of power drift was expanded to ± 10%.

2462 MHz(IEEE 802.11b)

Time [Minutes]	Result [dBm]	Converted [mW]	Diviation [%]
1	19.53	89.74	-
5	19.39	86.90	-3.2
10	19.27	84.53	-5.8
15	19.18	82.79	-7.7
20	19.12	81.66	-9.0
25	19.08	80.91	-9.8
30	19.08	80.91	-9.8



SECTION 8 : Measurement results

8.1 Body SAR 2450MHz

Liquid Depth (cm)	:	**15.1**	Model	:	**MB410i-W2**
Parameters	:	ε_r =**50.8**, σ =**2.01**	Serial No.	:	**2**
Ambient temperature (deg.c.)	:	**25.0**	Modulation	:	**DSSS / OFDM**
Relative Humidity (%)	:	**40**	Crest factor	:	**1**
Date	:	**April 19, 2007**	Measured By	:	**Hisayoshi Sato**

BODY SAR MEASUREMENT RESULTS									
Frequency			Modulation	Phantom Section	EUT Set-up Conditions		Liquid Temp.[deg.c]		SAR(1g) [W/kg]
Band	Channel	[MHz]			Position	Separation [mm]	Before	After	value of multi-peak
11b	**Step 1 Position Search**								
	Mid	2437	CCK(11Mbps)	Flat	Front	0	24.8	24.8	**0.0015**
	Mid	2437	CCK(11Mbps)	Flat	Rear	0	24.7	24.7	**0.017**
	Mid	2437	CCK(11Mbps)	Flat	Left side	0	24.7	24.7	**0.043**
	Mid	2437	CCK(11Mbps)	Flat	Bottom	0	24.8	24.8	**0.013**
	Step 2 Frequency Change								
	Low	2412	CCK(11Mbps)	Flat	Left side	0	24.6	24.6	**0.023**
	High	2462	CCK(11Mbps)	Flat	Left side	0	24.6	24.6	**0.054**
11g	**Step3. Moduration Change**								
	Mid	2437	BPSK(6Mbps)	Flat	Left side	0	24.7	24.7	**0.0083**
	Mid	2437	QPSK(18Mbps)	Flat	Left side	0	24.8	24.8	**0.010**
	Mid	2437	16QAM(36Mbps)	Flat	Left side	0	24.8	24.8	**0.011**
	Mid	2437	64QAM(54Mbps)	Flat	Left side	0	24.7	24.6	**0.0067**
	Step4. Position search								
	Mid	2437	16QAM(36Mbps)	Flat	Front	0	24.6	24.6	**0.0016**
	Mid	2437	16QAM(36Mbps)	Flat	Rear	0	24.7	24.7	**0.0043**
	Mid	2437	16QAM(36Mbps)	Flat	Bottom	0	24.8	24.8	**0.0015**
	Step5. Frequency Change								
	Low	2412	16QAM(36Mbps)	Flat	Left side	0	24.8	24.8	**0.0058**
	High	2462	16QAM(36Mbps)	Flat	Left side	0	24.7	24.6	**0.0062**
11b	**Step6. Change separation**								
	High	2462	CCK(11Mbps)	Flat	Left side	5	24.5	24.5	**0.016**
	High	2462	CCK(11Mbps)	Flat	Left side	10	24.6	24.6	**0.0044**
	High	2462	CCK(11Mbps)	Flat	Left side	15	24.6	24.7	**0.0032**
11b	**Step7. EUT is put in the case (Reference data)**								
	High	2462	CCK(11Mbps)	Flat	Bottom	0	24.8	24.8	**0.0032**
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population									**Body SAR: 1.6 W/kg (averaged over 1 gram)**