



## SAR TEST REPORT

### Test Report No.: 26GE0204-HO-C

**Applicant** : FURUNO SYSTEMS CO.,LTD.  
**Type of Equipment** : WLAN module  
**Model No.** : ATC-BICF  
**FCC ID** : T87SS22BXXXM  
**Test standard** : FCC47CFR 2.1093  
FCC OET Bulletin 65, Supplement C  
**Test Result** : Complied  
**Max. SAR Measured** : 0.564W/kg (Body, 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:**

February 28, 2006

**Tested by:**

*H. Sato*

Hisayoshi Sato  
EMC Services

**Approved by :**

*T. Maeno*

Tetsuo Maeno  
Site Manager of EMC Services



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>

**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

MF060a (01.06.05)

**CONTENTS**

**PAGE**

<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
2.3 Host device .....	4
<b>SECTION 3 : Test standard information.....</b>	<b>5</b>
3.1 Requirements for compliance testing defined by the FCC .....	5
3.2 Exposure limit .....	6
<b>SECTION 4 : Test result .....</b>	<b>7</b>
4.1 Result of Max. SAR value.....	7
4.2 Test location .....	7
<b>SECTION 5 : Operation of E.U.T. during testing.....</b>	<b>7</b>
5.1 Operating modes.....	7
5.2 Measurement procedure .....	8
5.4 Test setup of EUT.....	9
<b>SECTION 6 : Test surrounding.....</b>	<b>10</b>
6.1 Measurement uncertainty.....	10
<b>SECTION 7 : Confirmation before testing .....</b>	<b>11</b>
7.1 Conducted power.....	11
<b>SECTION 8 : Measurement results.....</b>	<b>12</b>
8.1 SAR measurement results .....	12
<b>APPENDIX 1 : Photographs of test setup.....</b>	<b>13</b>
<b>APPENDIX 2 : Test instruments.....</b>	<b>27</b>
Equipment & calibration information .....	28
1. Equipment used.....	28
2. Dosimetry assessment setup.....	29
3. Configuration and peripherals.....	30
4. System components .....	31
5. Test system specifications.....	33
6. Simulated tissues composition of 2450MHz.....	35
7. Validation measurement .....	35
8. System validation data .....	36
9. Validation uncertainty.....	37
10. Validation measurement data .....	38
11. System Validation Dipole (D2450V2,S/N: 765).....	39
12. Dosimetric E-Field Probe Calibration (EX3DV3,S/N: 3507).....	48
13. References.....	58
<b>APPENDIX 3 : SAR Measurement data.....</b>	<b>59</b>
1. Evaluation procedure .....	60
2. Measurement data / Body .....	61

**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

MF060a (01.06.05)

---

## **SECTION 1 : Client information**

Company Name	FURUNO SYSTEMS CO., LTD.
Address	9-52,Ashihara-town, Nishinomiya-city, Hyogo, 662-8580 JAPAN
Telephone Number	+81-798-63-1194
Facsimile Number	+81-798-63-1197
Contact Person	Takeaki Okamoto

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

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

Type of Equipment	WLAN module
Model No.	ATC-BICF
Serial No.	44502809
Country of Manufacture	Japan
Rating	DC 3.3V +/-5%
Receipt Date of Sample	February 21, 2006
Condition of EUT	Production model
Category Identified	Portable device & Mobile device
Modification of EUT	No modification by the test lab.

### **2.2 Product description**

#### **2.2.1 General Information**

Feature of EUT	The EUT is IEEE802.11b WLAN module and is installed only in Handy Terminal manufactured by FURUNO SYSTEMS CO., LTD.
Size	About 55 (W)*36 (H)*2.5 (D) mm
Range of operation temperature	-20deg. C. to +60 deg. C.
Operation Clock	44MHz

---

**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

MF060a (01.06.05)

## 2.2.2 Radio specification

Type of radio	Wireless LAN (IEEE802.11b)
Equipment Type	Transceiver
Frequency band	2400-2483.5MHz
Frequency of Operation	2412-2462MHz
Bandwidth & Channel spacing	20MHz & 5MHz
Type of Modulation	DSSS
Antenna Type	Chip Antenna (DA150S-2450G-FS02)
Antenna Connector Type	U.FL connector (AYU1-1P-02676-120)
Antenna Gain	2dBi (Max)
ITU code	G1D
Max. Output Power (Peak)	16.2dBm (41.69mW)
Power Supply	DC +3.3V +/-5%
Method of Frequency Generation	Synthesizer

## 2.3 Host device

### 2.3.1 Information of host device

The EUT will be installed only in PI-13500-W and PI-13503-W (Type of Equipment: Handy Terminal) which is manufactured by FURUNO SYSTEMS CO., LTD.

The details of Handy Terminal used for SAR test are shown in the following table.

Type of Equipment	Handy Terminal
Manufacture	FURUNO SYSTEMS CO., LTD.
Model No.	PI-13500-W
Serial No.	7038-6349
Battery	Type : Li-ion Battery Model name : BP-12000 V/Ah : DC3.7V 1800mAh
Operation Clock	Bus: 29.4912MHz CPU_INT(Max): 117.9648MHz
Size	75 (W)*204 (H)*50 (D) mm
Position of Antenna	See APPENDIX 1.
The shortest distance between surface of host device and antenna	7.9mm

\* PI-13503-W is equivalent model to PI-13500-W. PI-13500-W was tested as a representative.

Model No. PI-13503-W has a series model as Model No. PI-13500-W.

PI-13500-W was tested as a representative model.

PI-13503-W has a function of two-dimensional scanning, and PI-13500-W has a function of one-dimensional scanning.

These two models are same in the exterior and the antenna position.

As a result of the test, the SAR values are equivalent in these two.

The photograph of the EUT and the host device is put on "APPENDIX 1"

**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 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 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

MF060a (01.06.05)

---

### 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.

<p style="text-align: center;"><b>NOTE:GENERAL POPULATION/UNCONTROLLED EXPOSURE SPATIAL PEAK(averaged over any 1g of tissue) LIMIT 1.6 W/kg</b></p>
---

---

## **SECTION 4 : Test result**

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

Max. SAR Measured : 0.564 W/kg (Body, 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

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

### **5.1 Operating modes**

Operation mode	The frequency band and the modulation used in this test are shown as a following.  Frequency band : 2412-2462MHz Channel : Low ch(2412MHz), Mid ch(2437MHz), High ch(2462MHz) Modulation : DSSS Crest factor : 1
----------------	---

## **5.2 Measurement procedure**

### **1. Confirmation before testing**

Conducted power was measured before SAR testing.

Variation between the measured power level and one of EMC Test was within 0~+5%. (FCC requirements)

However, the data of EMC test is used as a substitute for SAR test when there is no possibility in power change obviously as follows:

- EMC and SAR tests are performed with the same test sample under the same condition.
- EMC and SAR tests are performed at the same laboratory.
- The test mode setting is simple, and there is no possibility that the power (value) is changed by the wrong setting.

### **2. SAR Measurement** (Radiated power is always monitored by Spectrum Analyzer.)

#### Step1. Worst position search

The frequency was set to Mid Channel, and the position that has the maximum SAR value was detected.

#### Step2. Change channels

Test was performed using Low/High channels at the position of the maximum value.

#### Step3. Change separations

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

\*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  $\pm 5\%$ , the power changes against time is measured to confirm the changes are within tolerance.

Moreover, the change rate is reflected on the uncertainty.

---

**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

MF060a (01.06.05)



#### **5.4 Test setup of EUT**

---

We tested the Handy Terminal (Model No. : PI-13500-W) with which this EUT was inserted. 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 Handy Terminal to the flat section of SAM Twin Phantom.

(2) Back:

The test was performed in touch with Back surface of the Handy Terminal to the flat section of SAM Twin Phantom.

(3) Left Side:

The test was performed in touch with Left Side surface of the Handy Terminal to the flat section of SAM Twin Phantom.

(4) Right Side:

The test was performed in touch with Right Side surface of the Handy Terminal to the flat section of SAM Twin Phantom.

(5) Top:

The test was performed in touch with Top surface of the Handy Terminal to the flat section of SAM Twin Phantom.

(6) Bottom:

The test was performed in touch with Bottom surface of the Handy Terminal to the flat section of SAM Twin Phantom.

(7) Top (Separation 5mm, 10mm, 15mm):

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

---

**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

MF060a (01.06.05)

## **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 $\pm$ %	Probability distribution	divisor	(ci) 1g	Standard Uncertainty (1g)	vi or veff
<b>Measurement System</b>						
Probe calibration	$\pm 6.8$	Normal	1	1	$\pm 6.8$	$\infty$
Axial isotropy of the probe	$\pm 4.7$	Rectangular	$\sqrt{3}$	0.7	$\pm 1.9$	$\infty$
Spherical isotropy of the probe	$\pm 9.6$	Rectangular	$\sqrt{3}$	0.7	$\pm 3.9$	$\infty$
Boundary effects	$\pm 2.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.2$	$\infty$
Probe linearity	$\pm 4.7$	Rectangular	$\sqrt{3}$	1	$\pm 2.7$	$\infty$
Detection limit	$\pm 1.0$	Rectangular	$\sqrt{3}$	1	$\pm 0.6$	$\infty$
Readout electronics	$\pm 1.0$	Normal	1	1	$\pm 1.0$	$\infty$
Response time	$\pm 0.8$	Rectangular	$\sqrt{3}$	1	$\pm 0.5$	$\infty$
Integration time	$\pm 2.6$	Rectangular	$\sqrt{3}$	1	$\pm 1.5$	$\infty$
RF ambient Noise	$\pm 3.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
RF ambient Reflections	$\pm 3.0$	Rectangular	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
Mech. constraints of robot	$\pm 0.8$	Rectangular	$\sqrt{3}$	1	$\pm 0.5$	$\infty$
Probe positioning	$\pm 9.9$	Rectangular	$\sqrt{3}$	1	$\pm 5.7$	$\infty$
Extrap. and integration	$\pm 4.0$	Rectangular	$\sqrt{3}$	1	$\pm 2.3$	$\infty$
<b>Test Sample Related</b>						
Device positioning	$\pm 2.9$	Normal	1	1	$\pm 2.9$	10
Device holder uncertainty	$\pm 3.6$	Normal	1	1	$\pm 3.6$	8
Power drift	$\pm 5.0$	Rectangular	$\sqrt{3}$	1	$\pm 2.9$	$\infty$
<b>Phantom and Setup</b>						
Phantom uncertainty	$\pm 4.0$	Rectangular	$\sqrt{3}$	1	$\pm 2.3$	$\infty$
Liquid conductivity (target)	$\pm 5.0$	Rectangular	$\sqrt{3}$	0.64	$\pm 1.8$	$\infty$
Liquid conductivity (meas.)	$\pm 5.0$	Normal	1	0.64	$\pm 3.2$	$\infty$
Liquid permittivity (target)	$\pm 5.0$	Rectangular	$\sqrt{3}$	0.6	$\pm 1.7$	$\infty$
Liquid permittivity (meas.)	$\pm 5.0$	Normal	1	0.6	$\pm 3.0$	$\infty$
<b>Combined Standard Uncertainty</b>					<b><math>\pm 13.515</math></b>	
<b>Expanded Uncertainty (k=2)</b>					<b><math>\pm 27.0</math></b>	

**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

MF060a (01.06.05)

## **SECTION 7 : Confirmation before testing**

### **7.1 Conducted power**

Date : February 21, 2006

<b>[IEEE 80.2 11b] Conducted power</b>						
Ch	Modulation (Data rate [Mbps])	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
Mid	DBPSK(1)	-7.80	0.70	19.88	12.78	18.97
Mid	DQPSK(2)	-7.23	0.70	19.88	13.35	21.63
Mid	CCK(5.5)	-5.01	0.70	19.88	15.57	36.06
Mid	CCK(11)	-4.72	0.70	19.88	15.86	38.55

<b>[IEEE 80.2 11b] Conducted power</b>						
Ch	Modulation (Data rate [bps])	P/M Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Result [mW]
Low	CCK(11)	-4.37	0.70	19.87	16.20	41.69
Mid	CCK(11)	-4.72	0.70	19.88	15.86	38.55
High	CCK(11)	-5.31	0.70	19.88	15.27	33.65

Sample Calculation:

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

\* This data is the measured Maximum Peak OutPut Power of EMC Test. (Reference Report No. 26GE0204-HO-A)

**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

MF060a (01.06.05)

## SECTION 8 : Measurement results

### 8.1 SAR measurement results

All of power drifts were within  $\pm 5\%$  in SAR tests .  
The measurement data is put on "APPENDIX 3".

#### 8.1.1 Body 2450MHz SAR

##### Body 2450MHz SAR

Date : **February 28, 2006** Measured By : **Hisayoshi Sato**  
Liquid Depth (cm) : **15.3** Model : **ATC-BICF**  
Parameters :  $\epsilon_r = \mathbf{50.3}$ ,  $\sigma = \mathbf{1.86}$  Serial No. : **44502809**  
Ambient temperature (deg.c.) : **25.0** Modulation : **DSSS**  
Relative Humidity (%) : **32** Crest factor : **1**

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
<b>11b</b>	<b>Worst position search</b>								
	Mid	2437	CCK(11Mbps)	Flat	Front	0	23.7	23.7	<b>0.148</b>
	Mid	2437	CCK(11Mbps)	Flat	Back	0	23.7	23.7	<b>0.030</b>
	Mid	2437	CCK(11Mbps)	Flat	Left side	0	23.5	23.5	<b>0.033</b>
	Mid	2437	CCK(11Mbps)	Flat	Right side	0	23.5	23.5	<b>0.047</b>
	Mid	2437	CCK(11Mbps)	Flat	Top	0	23.4	23.4	<b>0.490</b>
	Mid	2437	CCK(11Mbps)	Flat	Bottom	0	23.4	23.4	<b>0.00464</b>
	<b>Change channels</b>								
	Low	2412	CCK(11Mbps)	Flat	Top	0	23.5	23.5	<b>0.564</b>
	High	2462	CCK(11Mbps)	Flat	Top	0	23.5	23.5	<b>0.352</b>
	<b>Change separations</b>								
	Low	2412	CCK(11Mbps)	Flat	Top	5	23.5	23.5	<b>0.107</b>
	Low	2412	CCK(11Mbps)	Flat	Top	10	23.5	23.5	<b>0.077</b>
	Low	2412	CCK(11Mbps)	Flat	Top	15	23.5	23.5	<b>0.031</b>
<b>ANSI / IEEE C95.1 1992 - SAFETY LIMIT</b>								<b>Body SAR: 1.6 W/kg</b>	
<b>Spatial Peak Uncontrolled Exposure / General Population</b>								<b>(averaged over 1 gram)</b>	

**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

MF060a (01.06.05)