



# RADIO TEST REPORT

Test Report No. : 26GE0203-HO-A

Applicant : FURUNO SYSTEMS CO., LTD.  
Type of Equipment : WLAN module  
Model No. : SS21M  
FCC ID : T87SS21ABGXM  
Test standard : FCC Part 15 Subpart C  
Section 15.207, Section 15.247: 2006  
Test Result : Complied

1. This test report shall not be reproduced in 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 regulation.
4. The test results in this report are traceable to the national or international standards.

Date of test: August 3, 2006 to March 15, 2007

Tested by:

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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	FURUNO SYSTEMS CO., LTD.
Address	9-52,Ashihara-town, Nishinomiya-city, Hyogo, 662-8580 JAPAN
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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.	SS21M
Serial No.	C0695230007DC01
Country of Manufacture	Taiwan
Receipt Date of Sample	July 28, 2006
Condition of EUT	Production model (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	No modification by the test lab.

### **2.2 Product Description**

#### **2.2.1 General Information**

Feature of EUT	The EUT is IEEE802.11a,b,g WLAN module and is installed only in Access Point manufactured by FURUNO SYSTEMS CO., LTD.
Size	About 59.6 (W)*44.6 (H)*1.75 (D) mm
Operation Clock	40MHz

#### **2.2.2 Radio specification**

Type of radio	Wireless LAN (IEEE802.11a,b,g)
Equipment Type	Transceiver
Frequency band	2400-2483.5MHz, 5725-5850 MHz
Frequency of Operation	2412-2462MHz, 5745-5825 MHz
Bandwidth & Channel spacing	[IEEE802.11b/g] 16MHz(DSSS), 18MHz(OFDM) & 5MHz [IEEE802.11a] 18MHz(OFDM) & 20MHz
Type of Modulation	DSSS/OFDM
Antenna Type	Tri-band Dipole Antenna
Antenna Connector Type	Hirose U.FL equivalent
Antenna Gain	[Ant.A (including Attenuator: 3dB)] -1.56dBi(at 2400MHz) , 2.25dBi(at 5850MHz) [Ant.B (Rx only)] 1.44dBi(at 2400MHz) , 5.25dBi(at 5850MHz)
ITU code	G1D/D1D
Power Supply	DC +3.3V +/-5%
Method of Frequency Generation	Synthesizer

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### **SECTION 3: Test specification, procedures & results**

#### **3.1 Test Specification**

Test Specification : FCC Part15 Subpart C : 2006  
Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators  
Section 15.207 Conducted limits : 2006  
Section 15.247 Operation within the bands 902-928MHz,  
2400-2483.5MHz, and 5725-5850MHz : 2006

#### **FCC 15.31 (e)**

The regulated power of 3.3V is supplied from the end product. Therefore, this EUT complies with the requirement.

#### **FCC Part 15.203 Antenna requirement**

The antenna is connected to the EUT with U.FL connector, and the installation is done by the professionals. Therefore, the equipment complies with the requirement.

### 3.2 Procedures and results

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	Conducted emission	FCC: ANSI C63.4:2003 7. AC powerline conducted emission measurements IC: RSS-Gen 7.2.2	FCC: Section 15.207 IC: RSS-Gen 7.2.2	-	N/A	5.4dB 0.52995MHz AV, L	Complied
2	6dB Bandwidth	FCC: ANSI C63.4:2003 13. Measurement of intentional radiators IC: RSS-Gen 4.4.2	FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(1)	Conducted	N/A	See data.	Complied
3	Maximum Peak Output Power	FCC: ANSI C63.4:2003 13. Measurement of intentional radiators IC: RSS-Gen 4.6	FCC: Section 15.247(b)(3) IC: RSS-210 A8.4(4)	Conducted	N/A		Complied
4	Restricted Band Edges	FCC: ANSI C63.4:2003 13. Measurement of intentional radiators IC: -	FCC: Section 15.247 (d) IC: RSS-210 A8.5	Conducted/ Radiated	N/A		Complied
5	Power Density	FCC: ANSI C63.4:2003 13. Measurement of intentional radiators IC: -	FCC: Section 15.247 (e) IC: RSS-210 A8.2(2)	Conducted	N/A		Complied
6	Spurious Emission	FCC: ANSI C63.4:2003 13. Measurement of intentional radiators IC: RSS-Gen 4.7	FCC: Section 15.247(d) IC: RSS-210 A8.5 RSS-Gen 7.2.1	Conducted/ Radiated	N/A		0.7dB 3856.7MHz Vertical, AV

Note: UL Apex's EMI Work Procedures No.QPM05 and QPM15.

\*0) The result is rounded off to the second decimal place. Therefore, there may be 0.1 difference for the result.

\*These tests were also referred to "Guidance on Measurement of Digital Transmission Systems Operating under Section 15.247".

\*These tests were performed without any deviations from test procedure except for additions or exclusions.

### 3.3 Addition to standards

No.	Item	Test Procedure	Specification	Remarks	Deviation	Worst margin	Results
1	99% Occupied Band Width	RSS-Gen 4.4.1	RSS-Gen 4.4.1	Conducted	N/A	N/A	N/A

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### 3.4 Uncertainty

#### Conducted Emission

The measurement uncertainty (with a 95% confidence level) for this test is  $\pm 2.6$ dB.  
The data listed in this test report has enough margin, more than the site margin.

#### Spurious Emission (Radiated)

The measurement uncertainty (with a 95% confidence level) for this test using Biconical antenna is  $\pm 4.59$ dB(3m)/  
 $\pm 4.58$ dB(10m).

The measurement uncertainty (with a 95% confidence level) for this test using Logperiodic antenna is  $\pm 4.62$ dB(3m)/  
 $\pm 4.60$ dB(10m).

The measurement uncertainty (with a 95% confidence level) for this test using Horn antenna is  $\pm 5.27$ dB.  
The data listed in this report meets the limits unless the uncertainty is taken into consideration.

#### Other test except Conducted Emission and Spurious Emission (Radiated)

The measurement uncertainty (with a 95% confidence level) for this test is  $\pm 3.0$ dB.

### 3.5 Test Location

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	FCC Registration Number	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	313583	IC4247A	19.2 x 11.2 x 7.7m	7.0 x 6.0m	Preparation room
No.2 semi-anechoic chamber	655103	IC4247A-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	148738	IC4247A-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	
No.3 shielded room	-	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	134570	IC4247A-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	-
No.4 shielded room	-	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	-	6.0 x 6.0 x 3.9m	N/A	-
No.6 shielded room	-	-	4.0 x 4.5 x 2.7m	2.0 x 2.0 m	-
No.6 measurement room	-	-	4.75 x 5.4 x 3.0m	4.75 x 5.4 m	-
No.7 shielded room	-	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	-	3.1 x 5.0 x 2.7m	N/A	-

\* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No. 3, and No.4 semi-anechoic chambers and No.7 shielded room.

### 3.6 Test set up, Test instruments and Data of EMI

Refer to APPENDIX 1 to 3.

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

### **4.1 Operating Modes**

The mode used for test : Transmitting mode 11b (CCK 11Mbps (Worst), Packet type: Maximum, Payload: PN9)  
- Low Channel : 2412MHz(Ch1)  
- Mid Channel : 2437MHz(Ch6)  
- High Channel : 2462MHz(Ch11)

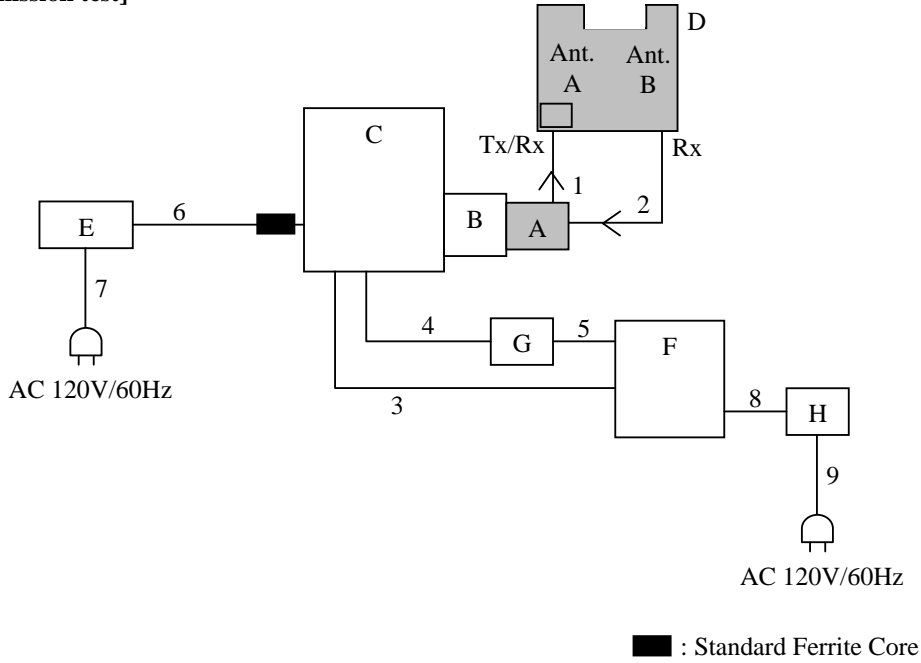
Transmitting mode 11g (OFDM 54Mbps (Worst), Packet type: Maximum, Payload: PN9)  
- Low Channel : 2412MHz(Ch1)  
- Mid Channel : 2437MHz(Ch6)  
- High Channel : 2462MHz(Ch11)

Transmitting mode 11a (OFDM 24Mbps (Worst), Packet type: Maximum, Payload: PN9)  
- Low Channel : 5745MHz(Ch149)  
- Mid Channel : 5785MHz(Ch157)  
- High Channel : 5825MHz(Ch165)

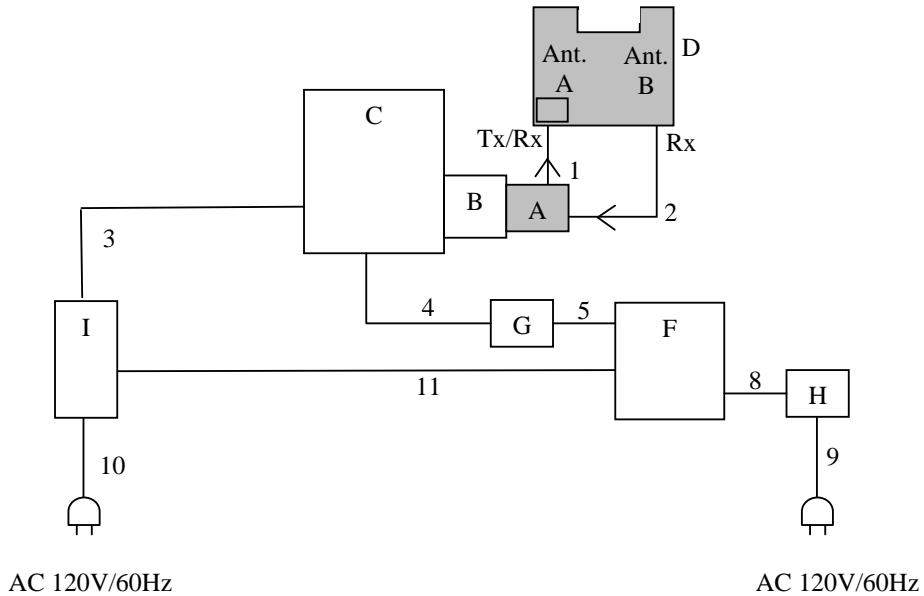
\*As a result of preliminary test, the formal test was performed with the above modes, which had the max power rate.

## 4.2 Configuration and peripherals

### [Conducted Emission test]



### [Radiated Emission /Antenna Terminal Conducted tests]



\* Cabling and setup were taken into consideration and test data was taken under worse case conditions.

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**Description of EUT and Support equipment**

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	WLAN Module	SS21M	C0695230007DC01	FURUNO SYSTEMS CO., LTD.	EUT
B	Printed Circuit Board	MPCIFLEX-01	-	-	-
C	Access Point	WN-701-W	004	FURUNO SYSTEMS CO., LTD.	-
D	Antenna A/B	EX00-0888-00	001	FURUNO SYSTEMS CO., LTD	EUT
E	AC Adapter	02K6750	UP29P0F7	IBM	-
F	Note PC	Compaq nx 9030	-	hp	-
G	USB to Serial converter	US102	003422	-	-
H	AC Adapter	PPP009S	57BC30AU4QVIJS	hp	-
I	Poe Adapter	Power Dsine 3001	B05216050009086301	Power Dsine	*1)

\*1) The Poe Adapter supplies the DC power supply to C. Access Point via LAN Communication line.

**List of cables used**

No.	Name	Length (m)	Shield	
			Cable	Connector
1	Antenna Cable	0.4	Unshielded	Unshielded
2	Antenna Cable	0.17	Unshielded	Unshielded
3	LAN Cable	2.0	Unshielded	Unshielded
4	Serial Cable	2.0	Unshielded	Unshielded
5	USB Cable	1.8	Unshielded	Unshielded
6	DC Cable	1.8	Unshielded	Unshielded
7	AC Cable	1.0	Unshielded	Unshielded
8	DC Cable	1.8	Unshielded	Unshielded
9	AC Cable	1.8	Unshielded	Unshielded
10	AC Cable	1.8	Unshielded	Unshielded
11	LAN Cable	1.0	Unshielded	Unshielded

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## **SECTION 5: Conducted Emission**

### **Test Procedure and conditions**

EUT was placed on a wooden table of nominal size, 1.0m by 1.5m, raised 80cm above the conducting ground plane. The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80cm from a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

#### For the tests on EUT with other peripherals (as a whole system)

I/O cable and AC cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane. All unused 50ohm connectors of the LISN(AMN) were resistivity terminated in 50ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber or a Measurement Room.

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

**Detector** : CISPR quasi-peak and average detector (IF BW 9 kHz)  
**Measurement range** : 0.15-30MHz  
**Test data** : APPENDIX 2  
**Test result** : Pass

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**SECTION 6: Spurious Emission**

**[Conducted]**

**Test Procedure**

The Out of Band Emission was measured with a spectrum analyzer connected to the antenna port.

**Test data : APPENDIX 2**

**Test result : Pass**

**[Radiated]**

**Test Procedure**

EUT was placed on a urethane platform of nominal size, 0.5m by 1.0m, raised 80cm above the conducting ground plane. The Radiated Electric Field Strength intensity has been measured in a Semi Anechoic Chamber with a ground plane and at a distance of 3m(Below 10GHz) and 1m(Upper 10GHz).

The height of the measuring varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

**20dBc was applied to the frequency over the limit of FCC 15.209 and outside the restricted band of FCC15.205.**

Frequency	Below 1GHz	Above 1GHz
Instrument used	Test Receiver / Spectrum Analyzer	Spectrum Analyzer
Detector	QP: BW 120kHz(T/R)	PK: RBW:1MHz/VBW: 1MHz
IF Bandwidth	20dBc : RBW: 100kHz VBW: 300kHz (S/A)	AV: RBW:1MHz/VBW:10Hz 20dBc : RBW:100kHz/VBW:300kHz

The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

**Test data : APPENDIX 2**

**Test result : Pass**

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## **SECTION 7: Bandwidth**

### **Test Procedure**

The bandwidth was measured with a spectrum analyzer connected to the antenna port.

**Test data** : APPENDIX 2  
**Test result** : Pass

## **SECTION 8: Maximum Peak Output Power**

### **Test Procedure**

The Maximum Peak Output Power was measured with a power meter (tested bandwidth: 50MHz) connected to the antenna port.

It was measured based on "Power Output Option 1" of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247".

**Test data** : APPENDIX 2  
**Test result** : Pass

## **SECTION 9: Peak Power Density**

[Conducted]

### **Test Procedure**

The Peak Power Density was measured with a spectrum analyzer connected to the antenna port.

It was measured based on "PSD Option 1" of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247".

**Test data** : APPENDIX 2  
**Test result** : Pass

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