



# RADIO TEST REPORT

Test Report No.: 33CE0139-SH-02-A

**Applicant** : SMK Corporation

**Type of Equipment** : ZigBee RF4CE-compatible RF receiver

**Model No.** : SSR-RFNANO

**FCC ID** : GT3FC017

**Test regulation** : FCC Part15 Subpart C: 2012

**Test result** : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the limits of the above regulation.
4. The test results in this test report are traceable to the national or international standards.
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6. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.

**Date of test:** November 29, 2012 to January 15, 2013

**Tested by:**

Kenichi Adachi  
Engineer of WiSE Japan, UL  
Verification Service

**Approved by :**

Toyokazu Imamura  
Leader of WiSE Japan, UL  
Verification Service



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- There is no testing item of "Non-accreditation".

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**Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

13-EM-F0429



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**Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

## **SECTION 1: Customer information**

Company Name : SMK Corporation  
Address : 5-5, Togoshi 6-chome, Shinagawa-ku, Tokyo 142-8511 JAPAN  
Telephone Number : +81-3-3785-1111  
Facsimile Number : +81-3-3785-1878  
Contact Person : Mitsuhiro Goto

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

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

Type of Equipment : ZigBee RF4CE-compatible RF receiver  
Model Number : SSR-RFNANO  
Serial Number : Refer to Section 4.2  
Rating : DC3.4 to 5.5V (USB)  
Country of Mass-production : China, Japan, Malaysia, USA, Mexico, Hungary  
(Test sample: Japan)  
Condition of EUT : Engineering prototype  
(Not for Sale: This sample is equivalent to mass-produced items.)  
Receipt Date of Sample : November 27, 2012  
Modification of EUT : No modification by the test lab.

### **2.2 Product description**

Model: SSR-RFNANO (referred to as the EUT in this report) is a ZigBee RF4CE-compatible RF receiver.

Clock frequency(ies) in the system : 32MHz, 32kHz

#### **Radio specification**

Equipment type : Transceiver  
Frequency of operation : 2425-2475MHz  
Bandwidth & channel spacing : 2MHz & 5MHz  
Type of modulation : OQPSK  
Antenna type : Chip Antenna  
Antenna connector type : None  
Antenna gain with cable loss : +2.5dBi  
ITU code : G1D  
Operation temperature range : -20 to +70 deg.C.

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

The stable voltage (DC3.3V) is constantly provided with the RF transmitter through the regulator. Therefore, this EUT complies with the requirement.

#### **FCC 15.203**

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement.

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1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN  
Telephone : +81 463 50 6400  
Facsimile : +81 463 50 6401

**SECTION 3: Test specification, procedures & results****3.1 Test specification**

Test specification : FCC Part 15 Subpart C: 2012, final revised on August 13, 2012 and effective September 12, 2012

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators  
Section 15.207 Conducted limits  
Section 15.209 Radiated emission limits, general requirements  
Section 15.247 Operation within the bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz

The EUT has been tested for compliance with FCC Part 15 Subpart B by the customer.

**3.2 Procedures & Results**

Item	Test Procedure	Specification	Remarks	Deviation	Worst Margin	Results
Conducted Emission	ANSI C63.10: 2009 Section 6.2	FCC 15.207	-	N/A	7.1dB (0.40931MHz / 0.40933MHz, AV, N, Tx 2425MHz / Tx 2475MHz)	Complied
6dB Bandwidth	ANSI C63.10: 2009 Section 6.9	FCC 15.247 (a)(2)	Conducted	N/A	* See data	Complied
Maximum Peak Conducted Output Power	ANSI C63.10: 2009 Section 6.10	FCC 15.247 (b)(3)	Conducted	N/A		Complied
Out of Band Emission & Restricted Band Edges	ANSI C63.10: 2009 Section 6.3 to 6.7, 6.9	FCC 15.109, 15.247 (d) & 15.209	Conducted / Radiated	N/A	7.1dB (729.015MHz, QP, Vertical, Tx 2425MHz, )	Complied
Maximum Power Spectral Density	ANSI C63.10: 2009 Section 6.11	FCC 15.247 (e)	Conducted	N/A	* See data	Complied

Note: UL Japan's EMI Work Procedures No.13-EM-W0420 and 13-EM-W0422.

These tests were also referred to "Guidance on Measurement for Digital Transmission Systems Section15.247". (KDB 558074)

**3.3 Addition to standard**

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied Bandwidth (99%)	ANSI C63.10: 2009 Section 6.9, RSS-Gen 4.6.1	RSS-Gen 4.6.1	Conducted	-	-

Note: UL Japan's EMI Work Procedures No.13-EM-W0420 and 13-EM-W0422.

\* Other than above, no addition, exclusion nor deviation has been made from the standard.

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**Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

### 3.4 Uncertainty

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

Item	Frequency range	No.1 SAC <sup>*1</sup> /SR <sup>*2</sup> (±)	No.2 SAC/SR (±)	No.3 SAC/SR (±)
Conducted emission (AC Mains) LISN	150kHz-30MHz	3.6 dB	3.6 dB	3.5 dB
Radiated emission (Measurement distance: 3m)	30MHz-300MHz	4.9 dB	5.1 dB	4.9 dB
	300MHz-1GHz	5.0 dB	5.2 dB	4.9 dB
	1GHz-15GHz	4.8 dB	4.8 dB	4.9 dB
Radiated emission (Measurement distance: 1m)	15GHz-18GHz	5.6 dB	5.6 dB	5.6 dB
	18GHz-40GHz	4.6 dB	4.3 dB	4.4 dB

\*1: SAC=Semi-Anechoic Chamber  
\*2: SR= Shielded Room is applied besides radiated emission

#### Conducted emission test

The data listed in this test report has enough margin, more than the site margin.

#### Radiated emission test

The data listed in this test report has enough margin, more than the site margin.

Power Measurement uncertainty above 1GHz for this test was: (±) 1.5dB

Conducted emissions Measurement (below 1GHz) uncertainty for this test was: (±) 1.7dB

Conducted emissions, Power Density Measurement (1G-3GHz) uncertainty for this test was: (±) 2.3dB

Conducted emissions Measurement (3G-18GHz) uncertainty for this test was: (±) 3.0dB

Conducted emissions Measurement (18G-26.5GHz) uncertainty for this test was: (±) 2.9dB

Frequency Measurement uncertainty for this test was: (±)  $5.3 \times 10^{-6}$ .

Bandwidth Measurement uncertainty for this test was: (±) 5.4%

### 3.5 Test location

UL Japan, Inc. Shonan EMC Lab.

1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN

Telephone number : +81 463 50 6400

Facsimile number : +81 463 50 6401

JAB Accreditation No. : RTL02610

	FCC Registration No.	IC Registration No.	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
<input type="checkbox"/> No.1 Semi-anechoic chamber	697847	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
<input checked="" type="checkbox"/> No.2 Semi-anechoic chamber	697847	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
<input checked="" type="checkbox"/> No.3 Semi-anechoic chamber	697847	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5m
<input type="checkbox"/> No.4 Semi-anechoic chamber	-	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
<input type="checkbox"/> No.1 shielded room	-	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
<input checked="" type="checkbox"/> No.2 shielded room	-	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
<input checked="" type="checkbox"/> No.3 shielded room	-	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
<input type="checkbox"/> No.4 shielded room	-	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
<input type="checkbox"/> No.5 shielded room	-	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
<input type="checkbox"/> No.6 shielded room	-	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-

### 3.6 Test setup, Data of EMI & Test instruments

Refer to APPENDIX 1 to 3.

## UL Japan, Inc.

### Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

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

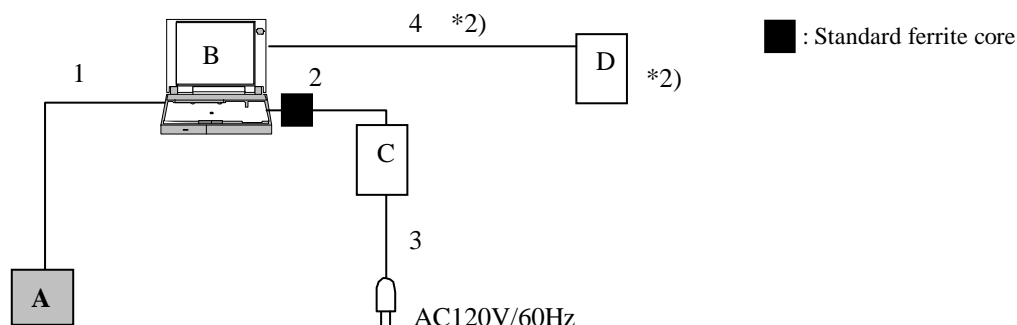
### 4.1 Operating mode

The EUT exercise program used during testing was designed to exercise the various system components in a manner similar to typical use.

Test item	Mode	Tested frequency
All items	Transmitting	2425MHz, 2450MHz, 2475MHz
*1) Software: "CC2531app[201008181656].exe" ver.0		
*2) Power setting: F5		

**Justification:** The system was configured in typical fashion (as customer would normally use it) for testing.

### 4.2 Configuration and peripherals



\* Test data was taken under worst case conditions.

#### Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	ZigBee RF4CE-compatible RF receiver	SSR-RFNANO	3, *1) 1	SMK	EUT
B	Personal Computer	2373L32	L3NHT3Y	IBM	-
C	AC Adapter	08K8208	11S08K8208Z1Z9MA5 686XM	IBM	-
D	Mouse	MS111-L	CN-09RRC7-44751-17 N-0406	Dell	*2)

\*1) 3: Antenna terminal conducted emission and Radiated emission, 1: Other test

#### List of cables used

No.	Cable Name	Length (m)	Shield-Cable	Shield-Connector	Remarks
1	USB	3.0	Shielded	Shielded	-
2	DC	1.8	Unshielded	Unshielded	-
3	AC	1.0	Unshielded	Unshielded	-
4	USB (mouse)	1.8	Shielded	Shielded	*2)

\* All cables used for the measurement are exclusive use or marketed.

\*2) used for only Conducted emission test.

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**Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

## **SECTION 5: Conducted emission**

### **5.1 Operating environment**

Test place : See test data (APPENDIX 1)  
Temperature : See test data (APPENDIX 1)  
Humidity : See test data (APPENDIX 1)

### **5.2 Test configuration**

EUT was placed on a platform of nominal size, 1m by 2m, raised 80cm above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and was 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 LISN and excess AC cable was bundled in center. I/O cables that were connected to the peripherals were bundled in center. They were folded back and for the forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane. Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the input power source. All unused 50ohm connectors of the LISN were resistively terminated in 50ohm when not connected to the measuring equipment. Photographs of the set up are shown in APPENDIX 3.

### **5.3 Test conditions**

Frequency range : 0.15 - 30MHz  
EUT position : Table top  
EUT operation mode : Refer to SECTION 4.1

### **5.4 Test procedure**

The AC Mains Terminal Continuous disturbance Voltage had been measured with the EUT within a Shielded room. The EUT was connected to a Line Impedance Stabilization Network (LISN). An overview sweep with peak detection has been performed. The measurements had been performed with a quasi-peak detector and if required, an average detector. The conducted emission measurements were made with the following detection of the test receiver.

Detection Type : Quasi-Peak/ Average  
IF Bandwidth : 9kHz

### **5.5 Results**

Summary of the test results : Pass  
Refer to APPENDIX 1



## **SECTION 6: Radiated emission**

### **6.1 Operating environment**

Test place : See test data (APPENDIX 1)  
 Temperature : See test data (APPENDIX 1)  
 Humidity : See test data (APPENDIX 1)

### **6.2 Test configuration**

EUT was placed on a platform of nominal size, 0.5m by 0.5m, raised 80cm above the conducting ground plane.

The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity.

The configuration was set in accordance with ANSI C63.10: 2009.

The rear of EUT, including its peripherals was aligned and flushed with rear of tabletop. I/O cables that were connected to the peripherals were bundled in center. They were folded back and for the forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane.

Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength. Photographs of the set up are shown in APPENDIX 3.

### **6.3 Test conditions**

Frequency range : 30MHz to 25GHz  
 Test distance : 3m(below 15GHz) / 1m(above15GHz)  
 EUT position : Table top  
 EUT operation mode : Refer to SECTION 4.1

### **6.4 Test procedure**

The Radiated Electric Field Strength intensity has been measured on a semi-anechoic chamber with a ground plane and at a distance of 3m(below 15GHz) / 1m(above 15GHz) (Refer to Figure 1). Measurements were performed with quasi-peak, peak and average detector. The measuring antenna height was 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.

The radiated emission measurements were made with the following detection.

Frequency	30-1000MHz	1-25GHz		20dBc
Detection type	Quasi-Peak	Peak	Average *1)	Peak
IF Bandwidth	120kHz	RBW: 1MHz VBW: 3MHz Detector: Peak	RBW: 1MHz VBW: 3MHz Detector: RMS	RBW: 100kHz VBW: 300kHz

\*1) Average Power Measurement was measured based on 10.2.3.3 and 8.2.1 of "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

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

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1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

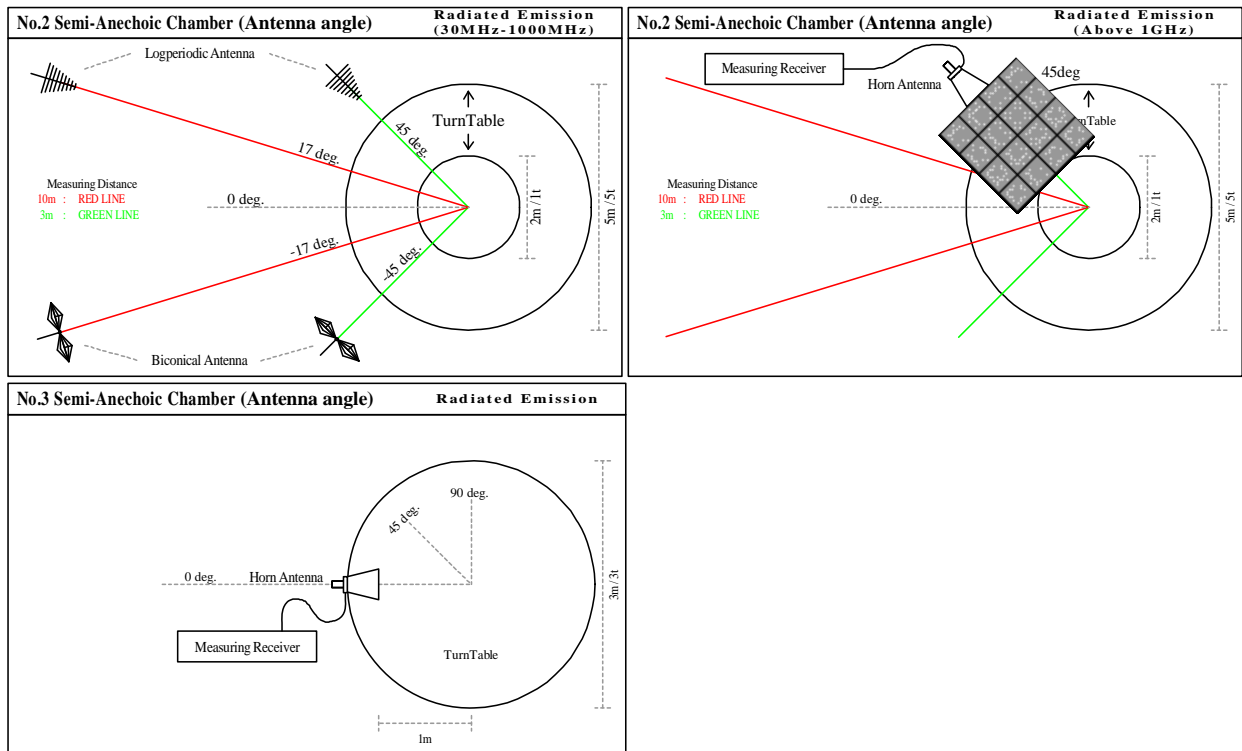
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The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Combinations of the worst case

	Frequency Antenna polarization	Carrier *2)	Spurious			
			Below 1GHz	1-15GHz	15-18GHz	15-25GHz
Module	Horizontal	X	Y	X	X	X
	Vertical	Y	Y	Z	X	X

\*2) with spurious emissions near carrier frequency.



## 6.5 Band edge

Band edge level at 2390MHz, 2400MHz and 2483.5MHz is below the limits of FCC 15.209. Refer to the data.

## 6.6 Results

Summary of the test results : Pass \*No noise was detected above the 3<sup>rd</sup> order harmonics.  
Refer to APPENDIX 1

## **SECTION 7: Out of band emissions (Antenna port conducted)**

### **Test procedure**

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

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.

In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.

Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart. (9kHz-150kHz:RBW=200Hz, 150kHz-30MHz:RBW=10kHz)

Summary of the test results: Pass

Refer to APPENDIX 1

## **SECTION 8: 6dB bandwidth & Occupied bandwidth (99%)**

### **Test procedure**

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

Summary of the test results: Pass

Refer to APPENDIX 1

## **SECTION 9: Maximum peak conducted output power**

### **Test procedure**

The maximum peak conducted output power was measured with a power meter connected to the antenna port.

\*1) Output power Option 3 of KDB 558074.

Summary of the test results: Pass

Refer to APPENDIX 1

## **SECTION 10: Maximum power spectral density**

### **Test procedure**

The maximum power spectral density was measured with a spectrum analyzer connected to the antenna port.

Instrument used : Spectrum Analyzer \*1)

RBW / VBW : 3kHz / 10kHz

\*1) PSD Option 1 of KDB 558074.

Summary of the test results: Pass

Refer to APPENDIX 1

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**Shonan EMC Lab.**

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Facsimile : +81 463 50 6401

## **Contents of APPENDIXES**

### **APPENDIX 1: Data of EMI test**

Conducted emission  
6dB Bandwidth  
Maximum peak conducted output power  
Radiated emission  
Spurious emission (Antenna port conducted)  
Maximum power spectral density  
Occupied Bandwidth

### **APPENDIX 2: Test instruments**

Test instruments

### **APPENDIX 3: Photographs of test setup**

Conducted emission  
Radiated emission  
Pre-check of worst position