



# **RADIO TEST REPORT**

**Test Report No.: 32BE0326-SH-01-D**

**Applicant** : Tokyo Cosmos Electric Co., Ltd.  
**Type of Equipment** : TOCOS wireless engine  
**Model No.** : TWE-001  
**FCC ID** : Z7W-TWE-001  
**Test regulation** : FCC Part15 Subpart C: 2011 (Class II change)  
**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.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by any agency of the Federal Government.
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:** December 14 to 15, 2011

**Representative test engineer:**

Takahiro Suzuki  
Engineer of WiSE Japan,  
UL Verification Service

**Approved by :**

Go Ishiwata  
Manager of WiSE Japan,  
UL Verification Service

- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.  
☒ There is no testing item of "Non-accreditation".



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13-EM-F0429

## **Contents**

### **Page**

<b>SECTION 1: Customer information .....</b>	<b>3</b>
<b>SECTION 2: Equipment under test (E.U.T.) .....</b>	<b>3</b>
<b>SECTION 3: Test specification, procedures &amp; results .....</b>	<b>4</b>
<b>SECTION 4: Operation of E.U.T. during testing.....</b>	<b>6</b>
<b>SECTION 5: Conducted emission.....</b>	<b>7</b>
<b>SECTION 6: Radiated emission.....</b>	<b>8</b>
<b>Contents of appendixes .....</b>	<b>10</b>
<b>APPENDIX 1: Test data .....</b>	<b>11</b>
<b>APPENDIX 2: Test instruments.....</b>	<b>17</b>
<b>APPENDIX 3: Photographs of test setup.....</b>	<b>18</b>

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**SECTION 1: Customer information**

Company Name : Tokyo Cosmos Electric Co., Ltd.  
Brand Name : TOCOS  
Address : 2-268 Sobudai Zama Kanagawa 252-8550 Japan  
Telephone Number : 81-46-253-2117  
Facsimile Number : 81-46-253-6816  
Contact Person : Takahiro Oguchi

**SECTION 2: Equipment under test (E.U.T.)****2.1 Identification of E.U.T.**

Type of Equipment : TOCOS wireless engine  
Model Number : TWE-001  
Serial Number : 080042D  
Rating : DC2.0V-3.6V  
Country of Mass-production : Japan  
Condition of EUT : Production model  
Receipt Date of Sample : November 21, 2011  
Modification of EUT : No modification by the test lab.

**2.2 Product description**

Model: TWE-001 (referred to as the EUT in this report) is a TOCOS wireless engine.

Clock frequency in the system : 32MHz

## &lt;Radio part&gt;

Equipment type : Transceiver  
Frequency of operation : 2405-2475MHz  
Bandwidth / Channel spacing : 2MHz & 5MHz  
Type of modulation : O-QPSK, DSSS  
Antenna type : Dipole Antenna  
Antenna connector type : U.FL  
Antenna gain : +2.00dBi (max)  
ITU code : G1D  
Operation temperature range : -40 to +85 deg. C.

FCC 15.31 (e) / 212

The RF Module has its own regulator.

The RF Module is constantly provided voltage (DC1.8V) through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement of 15.203/212.

FCC 15.203 / 212

The EUT has a unique coupling/antenna connector. Therefore, the equipment complies with the antenna requirement of Section 15.203/212.

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

Test specification : FCC Part 15 Subpart C: 2011,  
final revised on November 21, 2011 and effective December 21, 2011

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 revision on November 21, 2011 does not affect the test specification applied to the EUT.

**3.2 Procedures & Results**

Item	Test Procedure	Specification	Remarks	Deviation	Worst Margin	Results
Conducted emission	ANSI C63.4:2003 7. AC powerline conducted emission measurements	FCC 15.207	-	N/A	20.9dB Freq.: 0.52854MHz Phase: L1 Detection: Quasi-Peak Mode: Tx 2440MHz	Complied
6dB bandwidth	"Guidance on Measurement for Digital Transmission Systems Section 15.247" & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC 15.247 (a)(2)	Conducted	*1)	-	N/A
Maximum peak output power	"Guidance on Measurement for Digital Transmission Systems Section 15.247" & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC 15.247 (b)(3)	Conducted	*1)		N/A
Spurious emission & Restricted band edges	"Guidance on Measurement for Digital Transmission Systems Section 15.247" & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC 15.109, 15.247 (d) & 15.209	Conducted / Radiated	N/A	0.4dB Freq.: 7215.000MHz Polarization: Horizontal Detection: Average Mode: Tx 2405MHz	Complied
Power density	"Guidance on Measurement for Digital Transmission Systems Section 15.247" & ANSI C63.4:2003 13. Measurement of intentional radiators	FCC 15.247 (e)	Conducted	*1)	-	N/A

\*1) Refer to the original test report: 32BE0326-SH-01-A.

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

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### 3.3 Addition to standard

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

### 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) AMN/LISN	150kHz-30MHz	3.6 dB	3.6 dB	3.6 dB
Radiated emission (Measurement distance: 3m)	9kHz-30MHz	3.7 dB	3.7 dB	3.6 dB
	30MHz-300MHz	4.9 dB	5.1 dB	5.0 dB
	300MHz-1GHz	5.0 dB	5.2 dB	5.0 dB
	1GHz-13GHz	4.8 dB	4.8 dB	4.9 dB
Radiated emission (Measurement distance: 1m)	13GHz-18GHz	5.6 dB	5.6 dB	5.6 dB
	18GHz-40GHz	4.8 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 site margin.

### Radiated emission test

The data listed in this report meets the limits unless the uncertainty is taken into consideration.

### 3.5 Test location

UL Japan, Inc. Shonan EMC Lab.

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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 Full-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 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 test & Test instruments

Refer to Appendix 1 to 3.

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

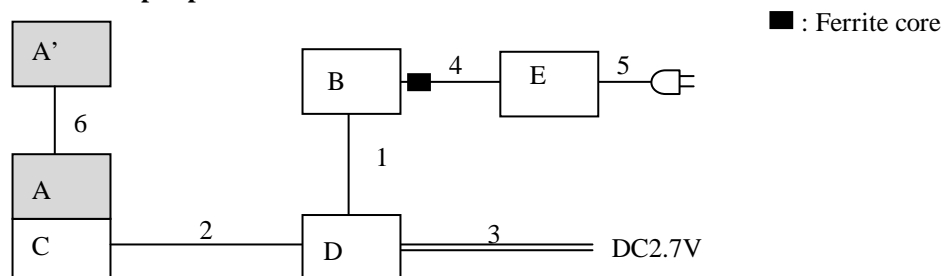
### 4.1 Operating mode

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	Data rate
All items	Transmitting IEEE 802.15.4	2405MHz, 2440MHz, 2475MHz	250kbps
*1) Software: Customer Module Evaluation Tool (Ver 1.02) *2) Power setting: 3 *3) The worst rate was determined based on the test result of Maximum Peak Output Power (Middle Channel). Refer to the original test report: 32BE0326-SH-01-A.			

**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 worse case conditions.

#### Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	TOCOS wireless engine	TWE-001	080042D	TOCOS	EUT
A'	Antenna	GY111B099-006	-	Wieson	EUT
B	Laptop PC	LATITUDE D400	07898349890122	DELL	-
C	Jig 1	-	-	TOCOS	-
D	Jig 2	-	-	TOCOS	-
E	AC Adaptor	ADP-65JB B	CN-0F8834-48661-57E-6EES	DELL	-

#### List of cables used

No.	Name	Length (m)	Shield (Cable)	Shield (Connector)	Remarks
1	USB	1.7	Shielded	Shielded	-
2	Signal	2.4	Unshielded	Unshielded	-
3	DC	1.0	Unshielded	Unshielded	-
4	DC	1.8	Unshielded	Unshielded	-
5	AC	0.9	Unshielded	Unshielded	-
6	Antenna	0.1	Shielded	Shielded	-

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## **SECTION 5: Conducted emission**

### **5.1 Operating environment**

The test was carried out in No.3 shielded room.

Temperature : Refer to test data (APPENDIX 2)  
Humidity : Refer to test data (APPENDIX 2)

### **5.2 Test configuration**

EUT was placed on a platform of nominal size, 1m by 1.5m, raised 80cm above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT was aligned and was flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. DC Power Supply was located 80cm from LISN and excess AC cable was bundled in center. Photographs of the set up are shown in Appendix 1.

### **5.3 Test conditions**

Frequency range : 0.15 - 30MHz  
EUT position : Table top

### **5.4 Test procedure**

The AC Mains Terminal Continuous disturbance Voltage had been measured with the EUT within a screened room. The EUT was connected to a Line Impedance Stabilization Network (LISN) via DC Power Supply. 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 detector of the test receiver.

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

### **5.5 Results**

Summary of the test results : Pass  
Refer to APPENDIX 2

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## **SECTION 6: Radiated emission**

### **6.1 Operating environment**

The test was carried out in No.2 / No.3 Semi-Anechoic Chamber.

Temperature : Refer to test data (APPENDIX 2)  
Humidity : Refer to test data (APPENDIX 2)

### **6.2 Test configuration**

EUT was placed on a platform of nominal size, 1m by 1.5m, raised 80cm above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. The rear of EUT, including its peripherals was aligned and flushed with rear of tabletop. 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 1.

### **6.3 Test conditions**

Frequency range : 30MHz to 26.5GHz  
EUT position : Table top

### **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 13GHz) / 1m (above 13GHz). 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 of the test receiver and Spectrum Analyzer.

Frequency	:	30-1000MHz	1000-26500MHz	
Detection Type	:	Quasi-Peak	Peak	* Average
IF Bandwidth	:	120kHz	RBW: 1MHz/VBW: 3MHz	RBW: 1MHz/VBW: 10Hz

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

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.

Worst position:

		Carrier	Spurious			
			30M-1GHz	1-13GHz	13-18GHz	18-26.5GHz
Horizontal	Antenna	X	X	X	X	X
	Module	X	Y	X	X	Z
Vertical	Antenna	Y	X	Y	X	Y
	Module	X	Y	Y	X	Z

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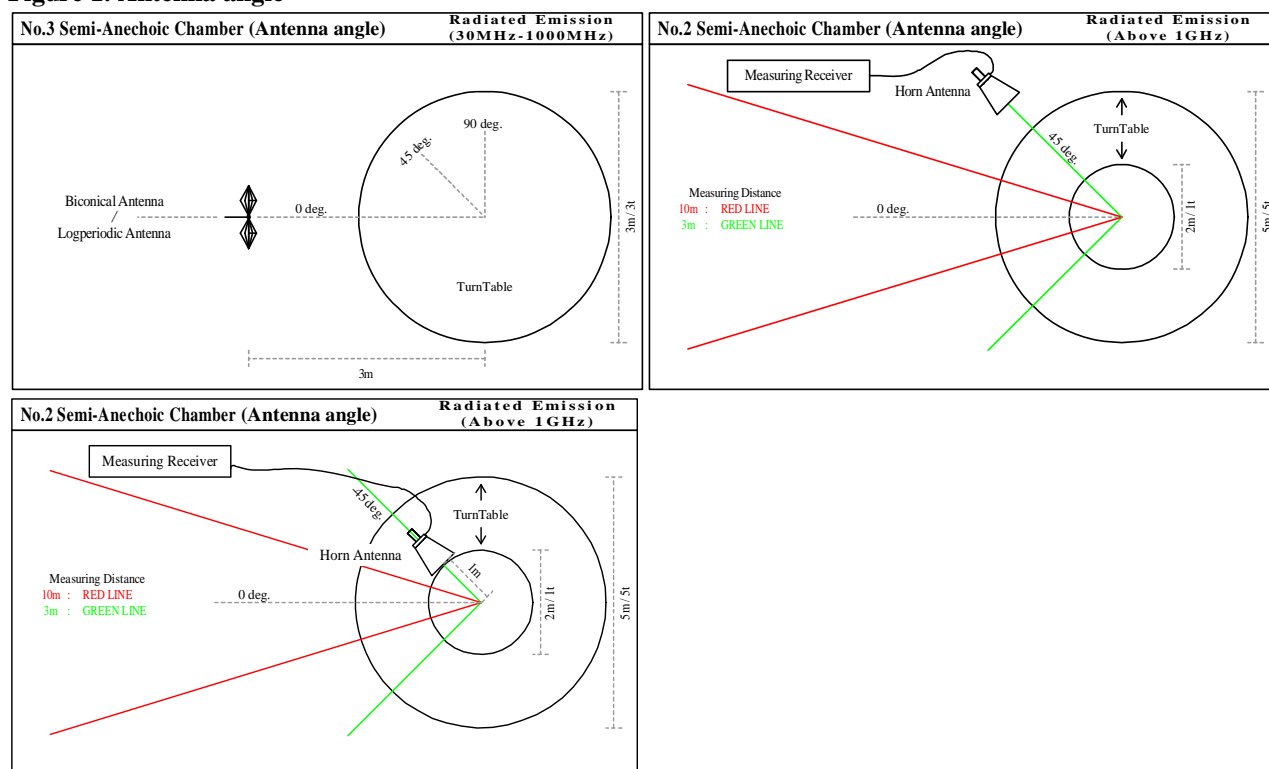
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**Figure 1. Antenna angle**

## 6.5 Band edge

Band edge level at 2400MHz is less than 20dB of peak point of the carrier. Band edge level at 2390MHz and 2483.5MHz are 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 5th order harmonics.  
Refer to APPENDIX 2

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## **Contents of appendixes**

### **APPENDIX 1: Test data**

Conducted emission

Radiated emission

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

Test instruments

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

Conducted emission

Radiated emission

Pre-check of the worst position

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# DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room  
Date : 2011/12/15

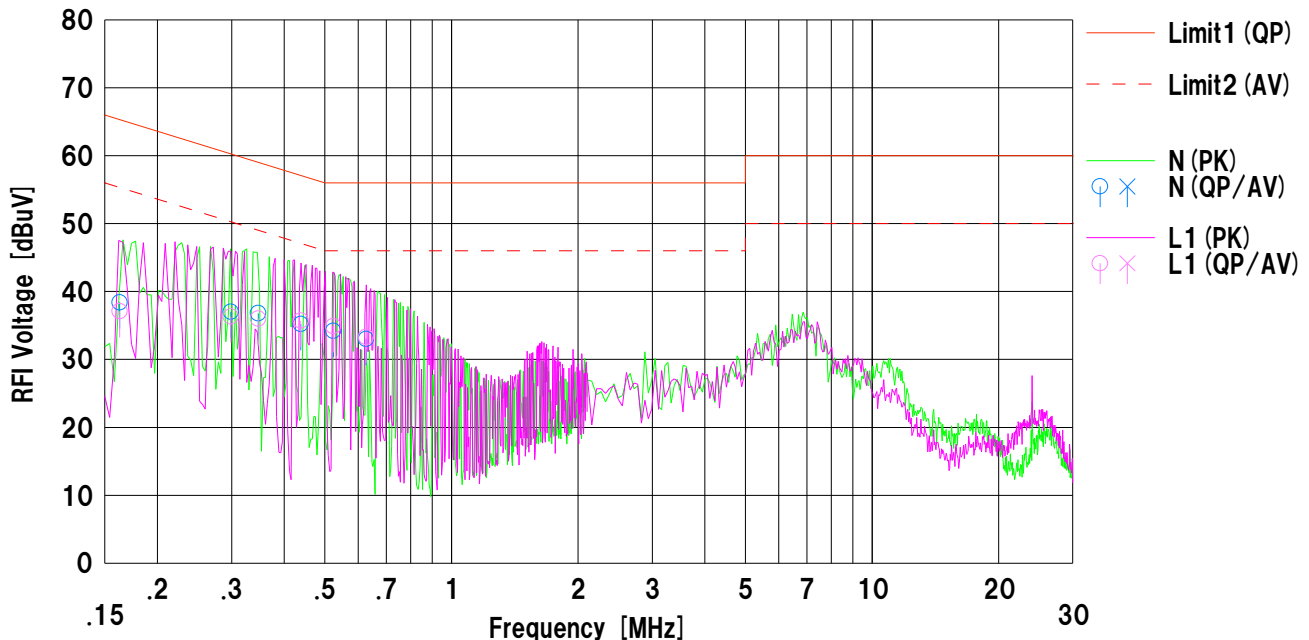
Company : TOKYO COSMOS ELECTRIC CO.,LTD.  
Kind of EUT : TOCOS wireless engine  
Model No. : TWE-001  
Serial No. : 080042D

Mode : Tx 2405MHz  
Report No. : 32BE0326-SH-01-D  
Power : AC120V/60Hz (EUT:DC2.7V)  
Temp./Humi. : 23deg.C / 40%RH

Remarks : Antenna:GY111B

Limit1 : FCC 15C (15.207) QP  
Limit2 : FCC 15C (15.207) AV

Engineer : Takahiro Suzuki



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.16263	25.7	---	12.7	38.4	---	65.3	55.3	26.9	---	N	
2	0.29866	24.3	---	12.7	37.0	---	60.2	50.2	23.2	---	N	
3	0.34703	24.1	---	12.7	36.8	---	59.0	49.0	22.2	---	N	
4	0.43818	22.5	---	12.7	35.2	---	57.0	47.0	21.8	---	N	
5	0.52373	21.5	---	12.7	34.2	---	56.0	46.0	21.8	---	N	
6	0.62609	20.3	---	12.7	33.0	---	56.0	46.0	23.0	---	N	
7	0.16263	24.4	---	12.7	37.1	---	65.3	55.3	28.2	---	L1	
8	0.29866	23.6	---	12.7	36.3	---	60.2	50.2	23.9	---	L1	
9	0.34703	23.3	---	12.7	36.0	---	59.0	49.0	23.0	---	L1	
10	0.43818	23.0	---	12.7	35.7	---	57.0	47.0	21.3	---	L1	
11	0.52373	22.2	---	12.7	34.9	---	56.0	46.0	21.1	---	L1	
12	0.62609	20.6	---	12.7	33.3	---	56.0	46.0	22.7	---	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]  
LISN:SLS-02

# DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room  
Date : 2011/12/15

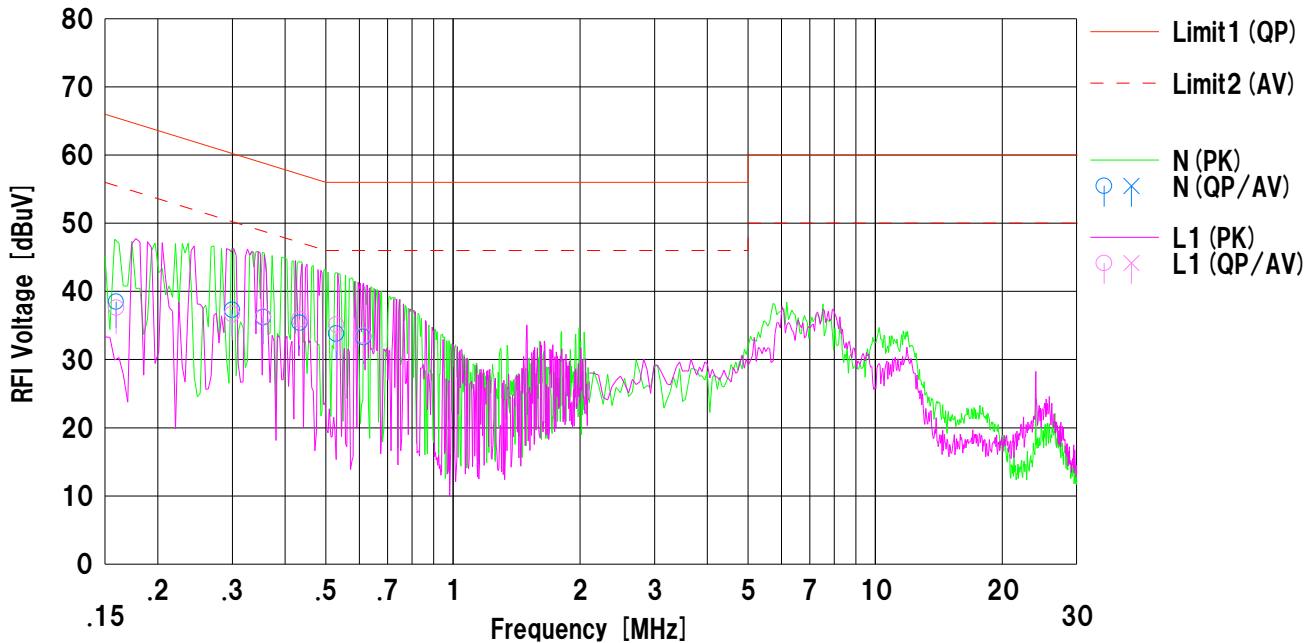
Company : TOKYO COSMOS ELECTRIC CO.,LTD.  
Kind of EUT : TOCOS wireless engine  
Model No. : TWE-001  
Serial No. : 080042D

Mode : Tx 2440MHz  
Report No. : 32BE0326-SH-01-D  
Power : AC120V/60Hz (EUT:DC2.7V)  
Temp./Humi. : 23deg.C /40%RH

Remarks : Antenna:GY111B

Limit1 : FCC 15C (15.207) QP  
Limit2 : FCC 15C (15.207) AV

Engineer : Takahiro Suzuki



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
		[dBuV]	[dBuV]		[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15908	25.8	---	12.7	38.5	---	65.5	55.5	27.0	---	N	
2	0.29995	24.6	---	12.7	37.3	---	60.2	50.2	22.9	---	N	
3	0.35516	23.5	---	12.7	36.2	---	58.8	48.8	22.6	---	N	
4	0.43308	22.7	---	12.7	35.4	---	57.1	47.1	21.7	---	N	
5	0.52854	21.1	---	12.7	33.8	---	56.0	46.0	22.2	---	N	
6	0.61420	20.6	---	12.7	33.3	---	56.0	46.0	22.7	---	N	
7	0.15930	24.9	---	12.7	37.6	---	65.5	55.5	27.9	---	L1	
8	0.29995	24.0	---	12.7	36.7	---	60.2	50.2	23.5	---	L1	
9	0.35516	23.6	---	12.7	36.3	---	58.8	48.8	22.5	---	L1	
10	0.43308	23.2	---	12.7	35.9	---	57.1	47.1	21.2	---	L1	
11	0.52854	22.4	---	12.7	35.1	---	56.0	46.0	20.9	---	L1	
12	0.61420	20.8	---	12.7	33.5	---	56.0	46.0	22.5	---	L1	

Calculation:Result [dBuV] =Reading [dBuV] +C.Fac (LISN+Cable+ATT) [dB]  
LISN:SLS-02

# DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room  
Date : 2011/12/15

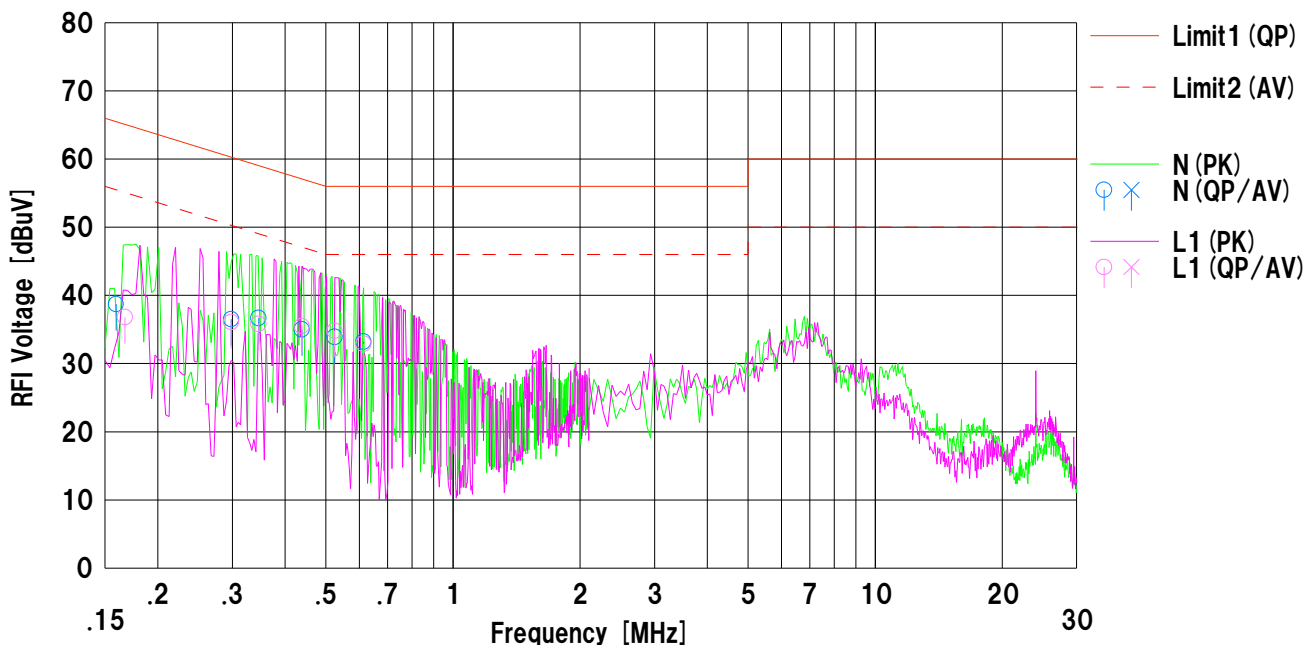
Company : TOKYO COSMOS ELECTRIC CO.,LTD.  
Kind of EUT : TOCOS wireless engine  
Model No. : TWE-001  
Serial No. : 080042D

Mode : Tx 2475MHz  
Report No. : 32BE0326-SH-01-D  
Power : AC120V/60Hz (EUT:DC2.7V)  
Temp./Humi. : 23deg.C / 40%RH

Remarks : Antenna:GY111B

Limit1 : FCC 15C (15.207) QP  
Limit2 : FCC 15C (15.207) AV

Engineer : Takahiro Suzuki



No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
		[dBuV]	[dBuV]		[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15905	26.0	---	12.7	38.7	---	65.5	55.5	26.8	---	N	
2	0.29820	23.8	---	12.7	36.5	---	60.2	50.2	23.7	---	N	
3	0.34641	24.0	---	12.7	36.7	---	59.0	49.0	22.3	---	N	
4	0.43859	22.3	---	12.7	35.0	---	57.0	47.0	22.0	---	N	
5	0.52438	21.2	---	12.7	33.9	---	56.0	46.0	22.1	---	N	
6	0.61372	20.5	---	12.7	33.2	---	56.0	46.0	22.8	---	N	
7	0.16703	24.1	---	12.7	36.8	---	65.1	55.1	28.3	---	L1	
8	0.29820	23.4	---	12.7	36.1	---	60.2	50.2	24.1	---	L1	
9	0.34641	23.1	---	12.7	35.8	---	59.0	49.0	23.2	---	L1	
10	0.43859	22.8	---	12.7	35.5	---	57.0	47.0	21.5	---	L1	
11	0.52438	22.1	---	12.7	34.8	---	56.0	46.0	21.2	---	L1	
12	0.61372	20.2	---	12.7	32.9	---	56.0	46.0	23.1	---	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]  
LISN:SLS-02

## Radiated Emission

Test place                      UL Japan, Inc. Shonan EMC Lab.      No.2 and No.3 Semi Anechoic Chamber  
 Date                              December 14, 2011                      December 15, 2011  
 Temperature / Humidity      24deg.C , 32%RH                      23deg.C , 40%RH  
 Engineer                        Tatsuya Arai                              Takahiro Suzuki  
 Mode                              Tx,                              2405 MHz  
    Tx, IEEE802.15.4, Transmitting, worst data mode 250kbps

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	216.043	QP	36	16.4	8.1	32	28.5	46	17.5	290	151	
Hori.	240.089	QP	36.4	16.9	8.2	32	29.5	46	16.5	150	153	
Hori.	504.099	QP	36.6	17.8	9.5	31.9	32	46	14.0	174	38	
Hori.	2373.000	PK	48	27.2	13.7	37.8	51.1	73.9	22.8	100	325	
Hori.	2390.000	PK	45	27.2	13.7	37.8	48.1	73.9	25.8	100	325	
Hori.	4810.000	PK	46.2	31.2	5.9	36.6	46.7	73.9	27.2	100	317	
Hori.	7215.000	PK	55.7	36.5	7.3	38.4	61.1	73.9	12.8	102	86	
Hori.	9620.000	PK	42	38.4	8.6	37.1	51.9	73.9	22.0	100	0	
Hori.	12025.000	PK	42.7	39.3	9.9	37.9	54	73.9	19.9	100	0	
Hori.	2373.000	AV	41.2	27.2	13.7	37.8	44.3	53.9	9.6	100	325	
Hori.	2390.000	AV	33.2	27.2	13.7	37.8	36.3	53.9	17.6	100	325	
Hori.	4810.000	AV	38.8	31.2	5.9	36.6	39.3	53.9	14.6	100	317	
Hori.	7215.000	AV	48.1	36.5	7.3	38.4	53.5	53.9	0.4	102	86	
Hori.	9620.000	AV	32.9	38.4	8.6	37.1	42.8	53.9	11.1	100	0	
Hori.	12025.000	AV	31.2	39.3	9.9	37.9	42.5	53.9	11.4	100	0	
Vert.	96.009	QP	49.3	8.9	7.2	32.1	33.3	43.5	10.2	100	15	
Vert.	360.051	QP	37.9	15.4	9	31.9	30.4	46	15.6	100	16	
Vert.	563.310	QP	34.5	18.5	9.7	31.9	30.8	46	15.2	100	28	
Vert.	2373.000	PK	46.9	27.2	13.7	37.8	50	73.9	23.9	100	233	
Vert.	2390.000	PK	43.8	27.2	13.7	37.8	46.9	73.9	27.0	100	233	
Vert.	4810.000	PK	48.3	31.2	5.9	36.6	48.8	73.9	25.1	100	261	
Vert.	7215.000	PK	53.5	36.5	7.3	38.4	58.9	73.9	15.0	102	211	
Vert.	9620.000	PK	42.5	38.4	8.6	37.1	52.4	73.9	21.5	100	0	
Vert.	12025.000	PK	43.1	39.3	9.9	37.9	54.4	73.9	19.5	100	0	
Vert.	2373.000	AV	38.9	27.2	13.7	37.8	42	53.9	11.9	100	233	
Vert.	2390.000	AV	33.4	27.2	13.7	37.8	36.5	53.9	17.4	100	233	
Vert.	4810.000	AV	41.2	31.2	5.9	36.6	41.7	53.9	12.2	100	261	
Vert.	7215.000	AV	45.2	36.5	7.3	38.4	50.6	53.9	3.3	102	211	
Vert.	9620.000	AV	32.9	38.4	8.6	37.1	42.8	53.9	11.1	100	0	
Vert.	12025.000	AV	31.1	39.3	9.9	37.9	42.4	53.9	11.5	100	0	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 13GHz)) - Gain(Amplifier)

\*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

\*The 10th harmonic was not seen so the result was its base noise level.

Distance factor:                      13GHz-40GHz                      20log(3.0m/1.0m)= 9.5dB

### 20dBc Data Sheet (RBW 100kHz, VBW 300kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2405.000	PK	95.6	27.3	13.7	37.8	98.8	-	-	Carrier
Hori.	2400.000	PK	52.6	27.3	13.7	37.8	55.8	78.8	23.0	-
Vert.	2405.000	PK	95.2	27.3	13.7	37.8	98.4	-	-	Carrier
Vert.	2400.000	PK	50.9	27.3	13.7	37.8	54.1	78.4	24.3	-

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 13GHz)) - Gain(Amplifier)

**UL Japan, Inc.**  
**Shonan EMC Lab.**  
 1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa 259-1220 JAPAN  
 Telephone : +81 463 50 6400  
 Facsimile : +81 463 50 6401

## Radiated Emission

Test place UL Japan, Inc. Shonan EMC Lab. No.2 and No.3 Semi Anechoic Chamber  
 Date December 14, 2011 December 15, 2011  
 Temperature / Humidity 24deg.C , 32%RH 23deg.C , 40%RH  
 Engineer Tatsuya Arai Takahiro Suzuki  
 Mode Tx, 2440 MHz  
 Tx, IEEE802.15.4, Transmitting, worst data mode 250kbps

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	126.203	QP	30.9	13.3	7.4	32.1	19.5	43.5	24.0	282	233	
Hori.	216.046	QP	35.8	16.4	8.1	32	28.3	46	17.7	286	156	
Hori.	240.012	QP	36.1	16.9	8.2	32	29.2	46	16.8	151	156	
Hori.	4880.000	PK	44.2	31.4	5.9	36.6	44.9	73.9	29.0	100	318	
Hori.	7320.000	PK	53.7	36.7	7.4	38.4	59.4	73.9	14.5	107	29	
Hori.	9760.000	PK	41.9	38.7	8.6	37.1	52.1	73.9	21.8	100	0	
Hori.	12200.000	PK	44.4	39.4	9.9	38	55.7	73.9	18.2	100	0	
Hori.	4880.000	AV	34.9	31.4	5.9	36.6	35.6	53.9	18.3	100	318	
Hori.	7320.000	AV	45.4	36.7	7.4	38.4	51.1	53.9	2.8	107	29	
Hori.	9760.000	AV	32.6	38.7	8.6	37.1	42.8	53.9	11.1	100	0	
Hori.	12200.000	AV	32.4	39.4	9.9	38	43.7	53.9	10.2	100	0	
Vert.	95.996	QP	48.9	8.9	7.2	32.1	32.9	43.5	10.6	100	11	
Vert.	360.057	QP	38.3	15.4	9	31.9	30.8	46	15.2	100	8	
Vert.	563.315	QP	34.2	18.5	9.7	31.9	30.5	46	15.5	100	33	
Vert.	4880.000	PK	43.3	31.4	5.9	36.6	44	73.9	29.9	100	264	
Vert.	7320.000	PK	51.4	36.7	7.4	38.4	57.1	73.9	16.8	100	220	
Vert.	9760.000	PK	42.4	38.7	8.6	37.1	52.6	73.9	21.3	100	0	
Vert.	12200.000	PK	44.2	39.4	9.9	38	55.5	73.9	18.4	100	0	
Vert.	4880.000	AV	34.7	31.4	5.9	36.6	35.4	53.9	18.5	100	264	
Vert.	7320.000	AV	44.4	36.7	7.4	38.4	50.1	53.9	3.8	100	220	
Vert.	9760.000	AV	32.5	38.7	8.6	37.1	42.7	53.9	11.2	100	0	
Vert.	12200.000	AV	32.4	39.4	9.9	38	43.7	53.9	10.2	100	0	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 13GHz)) - Gain(Amplifier)

\*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

\*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 13GHz-40GHz 20log(3.0m/1.0m)= 9.5dB

## Radiated Emission

Test place UL Japan, Inc. Shonan EMC Lab. No.2 and No.3 Semi Anechoic Chamber  
 Date December 14, 2011 December 15, 2011  
 Temperature / Humidity 24deg.C , 32%RH 23deg.C , 40%RH  
 Engineer Tatsuya Arai Takahiro Suzuki  
 Mode Tx, 2475 MHz  
 Tx, IEEE802.15.4, Transmitting, worst data mode 250kbps

(\* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	216.032	QP	36.3	16.4	8.1	32	28.8	46	17.2	300	138	
Hori.	240.079	QP	35.9	16.9	8.2	32	29	46	17.0	150	142	
Hori.	504.082	QP	36.4	17.8	9.5	31.9	31.8	46	14.2	168	30	
Hori.	2483.500	PK	48	27.5	13.6	37.6	51.5	73.9	22.4	119	327	
Hori.	2507.000	PK	47	27.6	13.7	37.6	50.7	73.9	23.2	119	327	
Hori.	4950.000	PK	44.1	31.5	5.9	36.5	45	73.9	28.9	100	57	
Hori.	7425.000	PK	52.3	36.9	7.3	38.4	58.1	73.9	15.8	106	28	
Hori.	9900.000	PK	42.6	39	8.6	37.2	53	73.9	20.9	100	0	
Hori.	12375.000	PK	43.7	39.5	9.9	38	55.1	73.9	18.8	100	0	
Hori.	2483.500	AV	36.5	27.5	13.6	37.6	40	53.9	13.9	119	327	
Hori.	2507.000	AV	37.7	27.6	13.7	37.6	41.4	53.9	12.5	119	327	
Hori.	4950.000	AV	34.3	31.5	5.9	36.5	35.2	53.9	18.7	100	57	
Hori.	7425.000	AV	45.6	36.9	7.3	38.4	51.4	53.9	2.5	106	28	
Hori.	9900.000	AV	32.3	39	8.6	37.2	42.7	53.9	11.2	100	0	
Hori.	12375.000	AV	32.2	39.5	9.9	38	43.6	53.9	10.3	100	0	
Vert.	96.010	QP	49.1	8.9	7.2	32.1	33.1	43.5	10.4	100	17	
Vert.	360.041	QP	37.2	15.4	9	31.9	29.7	46	16.3	100	20	
Vert.	563.298	QP	34	18.5	9.7	31.9	30.3	46	15.7	100	19	
Vert.	2483.500	PK	48.2	27.5	13.6	37.6	51.7	73.9	22.2	100	59	
Vert.	2507.000	PK	48	27.6	13.7	37.6	51.7	73.9	22.2	100	59	
Vert.	4950.000	PK	43.8	31.5	5.9	36.5	44.7	73.9	29.2	100	352	
Vert.	7425.000	PK	50.1	36.9	7.3	38.4	55.9	73.9	18.0	100	200	
Vert.	9900.000	PK	42.2	39	8.6	37.2	52.6	73.9	21.3	100	0	
Vert.	12375.000	PK	44.6	39.5	9.9	38	56	73.9	17.9	100	0	
Vert.	2483.500	AV	36.9	27.5	13.6	37.6	40.4	53.9	13.5	100	59	
Vert.	2507.000	AV	38	27.6	13.7	37.6	41.7	53.9	12.2	100	59	
Vert.	4950.000	AV	33.4	31.5	5.9	36.5	34.3	53.9	19.6	100	352	
Vert.	7425.000	AV	41.6	36.9	7.3	38.4	47.4	53.9	6.5	100	200	
Vert.	9900.000	AV	32.4	39	8.6	37.2	42.8	53.9	11.1	100	0	
Vert.	12375.000	AV	32.2	39.5	9.9	38	43.6	53.9	10.3	100	0	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 13GHz)) - Gain(Amplifier)

\*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).

\*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 13GHz-40GHz 20log(3.0m/1.0m)= 9.5dB



## APPENDIX 2

### Test Instruments

#### EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2011/03/23 * 12
SCC-G02	Coaxial Cable	Suhner	SUCOFLEX 104A	46498/4A	RE	2011/04/28 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2011/05/27 * 12
SHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	RE	2011/08/28 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2011/02/23 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2011/03/07 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RF, MF)	-	RE/CE	-
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2010/12/15 * 12
SAT10-04	Attenuator(above1GHz)	Agilent	8493C-010	74863	RE	2010/12/15 * 12
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2011/03/15 * 12
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	00000018	RE	2011/03/16 * 12
SCC-G18	Coaxial Cable	Suhner	SUCOFLEX 104A	46292/4A	RE	2011/03/16 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2011/02/17 * 12
SAT6-03	Attenuator	JFW	50HF-006N	-	RE	2011/02/17 * 12
SBA-03	Biconical Antenna	Schwarzbeck	BBA9106	91032666	RE	2011/10/23 * 12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271 (RF Selector)	RE	2011/04/28 * 12
SLA-03	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0901	RE	2011/10/23 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2011/02/23 * 12
STR-03	Test Receiver	Rohde & Schwarz	ES140	100054/040	RE/CE	2011/07/28 * 12
SJM-10	Measure	PROMART	SEN1935	-	RE/CE	-
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2011/09/23 * 12
SCC-C9/C10/SRSE-03	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/N S4906	-/0901-271 (RF Selector)	CE	2011/04/28 * 12
SLS-02	LISN	Rohde & Schwarz	ENV216	100512	CE	2011/02/22 * 12
SAT3-06	Attenuator	JFW	50HF-003N	-	CE	2011/02/17 * 12
SOS-06	Humidity Indicator	A&D	AD-5681	4062118	CE	2011/03/02 * 12
STM-05	Terminator	TME	CT-01 BP	-	CE	2011/01/07 * 12
SLS-05	LISN	Rohde & Schwarz	ENV216	100516	CE	2011/02/23 * 12

The expiration date of the calibration is the end of the expired month .  
As for some calibrations performed after the tested dates , those test equipment have been controlled by means of an unbroken chains of calibrations .

All equipment is calibrated with valid calibrations . Each measurement data is traceable to the national or international standards .

Test Item :

CE: Conducted emission ,  
RE: Radiated emission