



RADIO TEST REPORT

Test Report No.: 10744027S-A

Applicant : SMK Corporation
Type of Equipment : ZigBee RF4CE module
Model No. : FD0001
FCC ID : GT3FC020
Test regulation : FCC Part15 Subpart C: 2015
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:

April 7 to 8, 2015

Representative test engineer:

S. Takano

Shinichi Takano

Engineer

Consumer Technology Division

Approved by :

T. Imamura

Toyokazu Imamura

Leader

Consumer Technology Division



JAB
Testing
RTL02610

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

UL Japan, Inc.

Shonan EMC Lab.

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 10744027S-A

[illegible]

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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 module
Model No. : FD0001
Serial No. : Refer to 4.2 in this report.
Rating : DC 1.8V to 3.6V, Typ. 3.0V
Country of Mass-production : Japan, China, Malaysia, Philippines, Hungary, U.S.A., Mexico
Condition of EUT : Engineering prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT : No modification by the test lab.
Receipt Date of Sample : April 7, 2015

2.2 Product description

Model: FD0001 (referred to as the EUT in this report) is ZigBee RF4CE module.

Clock frequency(ies) in the system : 16MHz, 125kHz

Radio Specification

Equipment type : Transceiver
Frequency of operation : 2425-2475MHz
Bandwidth : 2MHz
Channel spacing : 5MHz
Type of modulation : O-QPSK, DSSS
Antenna type : PCB printed antenna
Antenna connector type : None
Antenna gain : -0.6dBi(Max)
ITU code : G1D
Operation temperature range : -20 to +70 deg.C

FCC 15.31 (e) / 212

The RF Module has its own regulator.

The RF Module is constantly provided voltage (DC 1.5V) through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement of 15.212.

FCC 15.203 / 212

The antenna is not removable from the EUT. Therefore the equipment complies with the requirement of 15.203/212.

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SECTION 3: Test specification, procedures & results

3.1 Test specification

Test specification : FCC Part 15 Subpart C: 2015, final revised on January 21, 2015
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

3.2 Procedures & Results

Item	Test Procedure *1)	Specification	Remarks	Deviation	Worst Margin	Results
Conducted emission	ANSI C63.10:2009	FCC 15.207	-	N/A	5.0 dB Freq.: 0.47863 MHz Detector: Quasi-Peak Phase: N Mode: Tx 2475MHz	Complied
6dB bandwidth	ANSI C63.10:2009	FCC 15.247 (a)(2)	Conducted	N/A	* See data	Complied
Maximum peak output power	ANSI C63.10:2009	FCC 15.247 (b)(3)	Conducted	N/A		Complied
Out of band emission & Restricted band edges	ANSI C63.10:2009	FCC 15.109, 15.247 (d) & 15.209	Conducted / Radiated	N/A *2)	3.7 dB Freq.: 65.208 MHz Polarization: Vertical Detection: Quasi-Peak Mode: Tx, 2450 MHz	Complied
Power density	ANSI C63.10:2009	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.

*1) These tests were also referred to KDB 558074 v03 r02 (FCC), "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

*2) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 12.2.7.

3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied Bandwidth (99%)	ANSI C63.10:2009, RSS-Gen 6.6	-	Conducted	-	-

Note: UL Japan's 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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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 ^{*1} /SR ^{*2} (±)	No.2 SAC/SR (±)	No.3 SAC/SR (±)
Conducted emission (AC Mains) LISN	150kHz-30MHz	3.6 dB	3.4 dB	3.4 dB
Radiated emission (Measurement distance: 3m)	9kHz-30MHz	3.7 dB	3.5 dB	3.5 dB
	30MHz-300MHz	4.9 dB	4.9 dB	4.7 dB
	300MHz-1GHz	5.0 dB	5.0 dB	4.8 dB
	1GHz-15GHz	4.9 dB	4.9 dB	4.9 dB
Radiated emission (Measurement distance: 1m)	15GHz-18GHz	5.7 dB	5.7 dB	5.7 dB
	18GHz-40GHz	4.5 dB	4.3 dB	4.3 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 report meets the limits unless the uncertainty is taken into consideration.

Antenna port conducted test

Power measurement uncertainty above 1GHz for this test was: (±) 0.68dB

Spurious emission (Conducted) measurement (below 1GHz) uncertainty for this test was: (±) 1.5dB

Spurious emission (Conducted) measurement (1G-3GHz) uncertainty for this test was: (±) 1.7dB

Spurious emission (Conducted) measurement (3G-18GHz) uncertainty for this test was: (±) 2.4dB

Spurious emission (Conducted) measurement (18G-26.5GHz) uncertainty for this test was: (±) 2.5dB

Bandwidth Measurement uncertainty for this test was: (±) 0.66%

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3.5 Test location

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JAB Accreditation No. : RTL02610

	IC Registration No.	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
☐ No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
☐ No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
☒ No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5m
☐ No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
☒ No.1 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
☐ No.2 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
☐ No.3 Shielded room	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
☐ No.4 Shielded room	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
☒ No.5 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
☐ No.6 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
☐ No.7 Shielded room	-	2.76 x 3.76 x 2.4	2.76 x 3.76	-
☐ No.8 Shielded room	-	3.45 x 5.5 x 2.4	3.45 x 5.5	-
☐ No.1 Measurement room	-	2.55 x 4.1 x 2.5	2.55 x 4.1	-

3.6 Test setup, Test data & Test instruments

Refer to APPENDIX 1 to 3.

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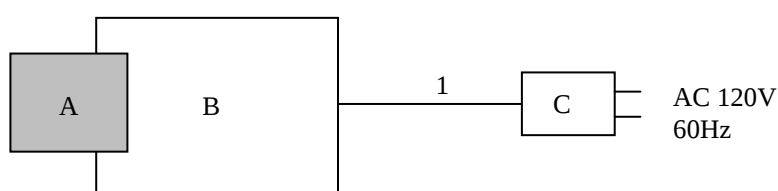
SECTION 4: Operation of E.U.T. during testing

4.1 Operating mode

Test item	Mode	Tested frequency
All items	Transmitting IEEE 802.15.4	2425MHz, 2450MHz, 2475MHz
*1) Software: UartMonitor[v038rc1].exe		
*2) Power setting: Fixed		

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

4.2 Configuration and peripherals



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

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	ZigBee RF4CE module	FD0001	*1)	SMK Corporation	EUT
B	Jig	FD5001-02	-	SMK Corporation	-
C	AC Adaptor	SA106A-0512-6	-	Sino American Electronics Co., Ltd.	-

*1) R1: Used for Radiated emission tests. , C1: Used for Antenna terminal tests.

List of cables used

No.	Cable name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC Cable	2.8	Unshielded	Unshielded	-

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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 1.5m, raised 0.8m 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 peripheral 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.

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

5.4 Test procedure

The AC Mains Terminal Continuous disturbance Voltage had been measured with the EUT via AC adapter within a Shielded room. The EUT via AC adapter 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, a CISPR average detector.

The conducted emission measurements were made with the following detection of the test receiver.

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

5.5 Results

Summary of the test results : Pass
Refer to APPENDIX 1

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SECTION 6: 6dB bandwidth & Occupied bandwidth (99%)

Test procedure

The bandwidth was measured with a spectrum analyzer connected to the antenna port.
The test was measured based on Method 8.2 Option 2 of KDB 558074 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

Summary of the test results: Pass
Refer to APPENDIX 1

SECTION 7: Maximum peak output power

Test procedure

The Maximum Output Power was measured with a power meter connected to the antenna port.
The test was measured based on Method 9.1.2 PKPM1 of KDB 558074 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

Detection type: Peak / Average *1)

Summary of the test results: Pass
Refer to APPENDIX 1

*1) Average detector was used only for Reference data.

SECTION 8: 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.
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 9: Peak power density

Test procedure

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

Instrument used : Spectrum Analyzer
RBW / VBW : 3kHz / 9.1kHz

The test was measured based on Method 10.2 PKPSD of KDB 558074 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

Summary of the test results: Pass
Refer to APPENDIX 1

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SECTION 10: Radiated emission

10.1 Operating environment

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

10.2 Test configuration

EUT was placed on a polystyrene platform of nominal size, 0.5m by 0.5m, raised 0.8m above the conducting ground plane. Photographs of the set up are shown in APPENDIX 3.

10.3 Test conditions

Frequency range : 30MHz to 25GHz
 EUT position : Table top

10.4 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	RBW: 1MHz VBW: 3MHz Detector: Linear Voltage Averaging	RBW: 100kHz VBW: 300kHz

*1) Average Power Measurement was measured based on 13.3.2 of KDB 558074 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

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 case:

Antenna polarization	Carrier (Band edge)	Spurious			
		Below 1GHz	Above 1GHz		
			1-2.8GHz	2.8-15GHz	15-25GHz
Horizontal	Y	X	Y	Y	X
Vertical	Y	X	Y	Z	X

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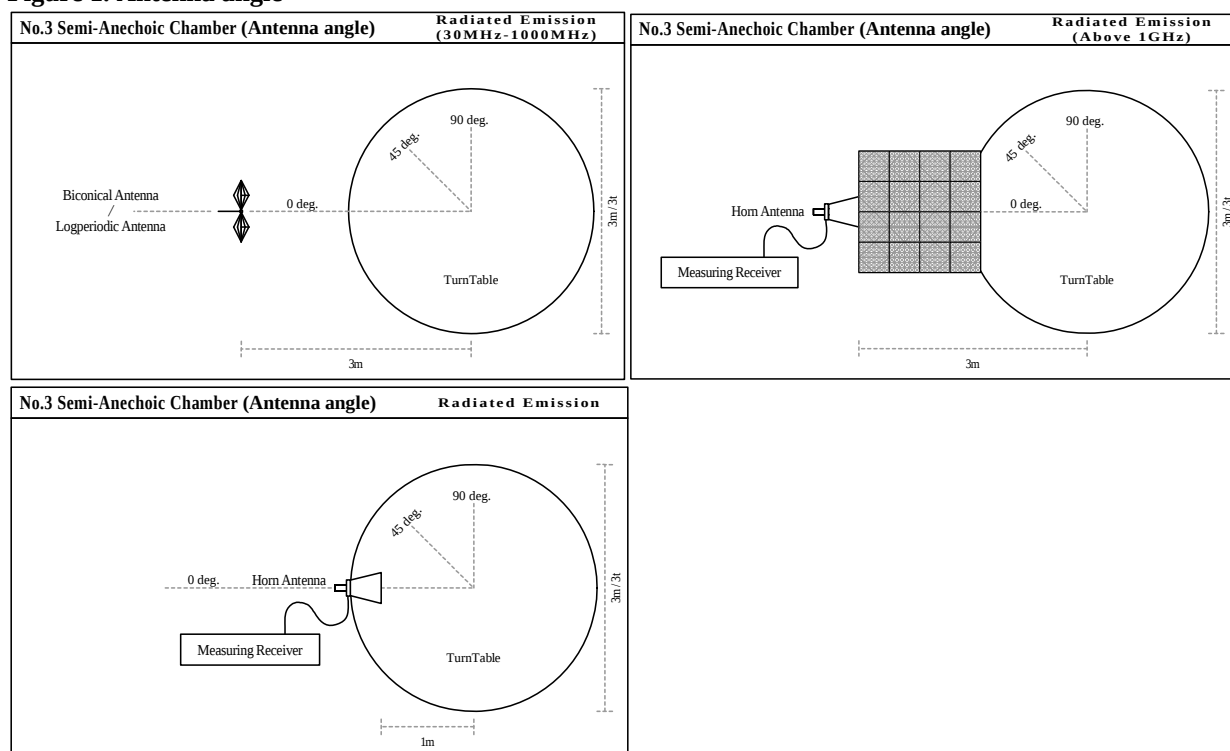
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Figure 1. Antenna angle



10.5 Band edge

Band edge level at 2390MHz and 2483.5MHz is below the limits of FCC 15.209 and band edge level at 2400MHz is below the 20dBc. Refer to the data.

10.6 Results

Summary of the test results : Pass

* No noise was detected above the 5th order harmonics.

Refer to APPENDIX 1

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Contents of APPENDIXES

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Conducted emission
6dB bandwidth
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Spurious emission (Antenna port conducted)
Peak power density
Occupied bandwidth

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

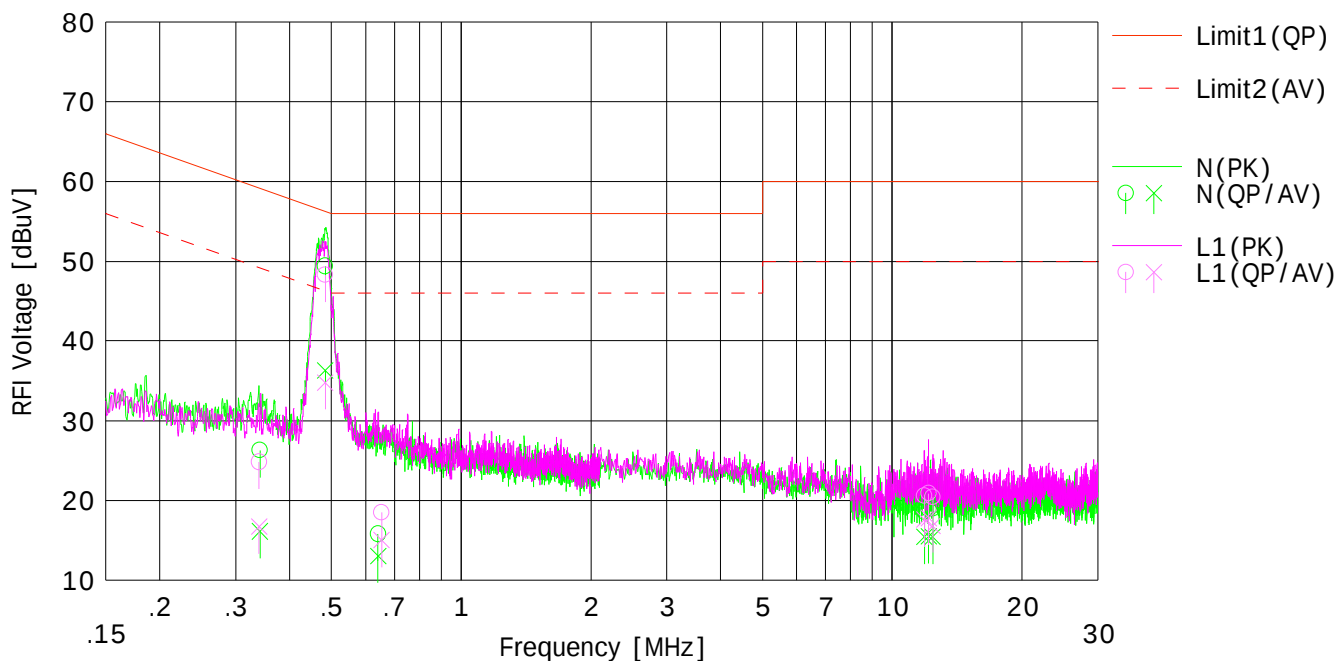
UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2015/04/07

Company : SMK Corporation
Kind of EUT : ZigBee RF4CE module
Model No. : FD0001
Serial No. : R1
Remarks : -

Mode : Tx 2425MHz
Order No. : 10744027S
Power : AC 120V / 60Hz
Temp./Humi. : 22deg.C. / 46%RH

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

Engineer : Tomochika Sato



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.34173	13.4	3.2	12.9	26.3	16.1	59.1	49.1	32.8	33.0	N	
2	0.48407	36.5	23.4	12.9	49.4	36.3	56.2	46.2	6.8	9.9	N	
3	0.64231	2.9	0.1	12.9	15.8	13.0	56.0	46.0	40.2	33.0	N	
4	11.87833	4.2	1.0	14.4	18.6	15.4	60.0	50.0	41.4	34.6	N	
5	12.15466	4.5	1.1	14.4	18.9	15.5	60.0	50.0	41.1	34.5	N	
6	12.43060	4.5	0.9	14.5	19.0	15.4	60.0	50.0	41.0	34.6	N	
7	0.33993	11.9	3.8	12.9	24.8	16.7	59.2	49.2	34.4	32.5	L1	
8	0.48440	35.4	21.9	12.9	48.3	34.8	56.2	46.2	7.9	11.4	L1	
9	0.65435	5.6	2.1	12.9	18.5	15.0	56.0	46.0	37.5	31.0	L1	
10	11.87711	6.2	3.2	14.4	20.6	17.6	60.0	50.0	39.4	32.4	L1	
11	12.15399	6.5	3.4	14.4	20.9	17.8	60.0	50.0	39.1	32.2	L1	
12	12.43236	5.9	2.3	14.5	20.4	16.8	60.0	50.0	39.6	33.2	L1	

DATA OF CONDUCTED EMISSION TEST

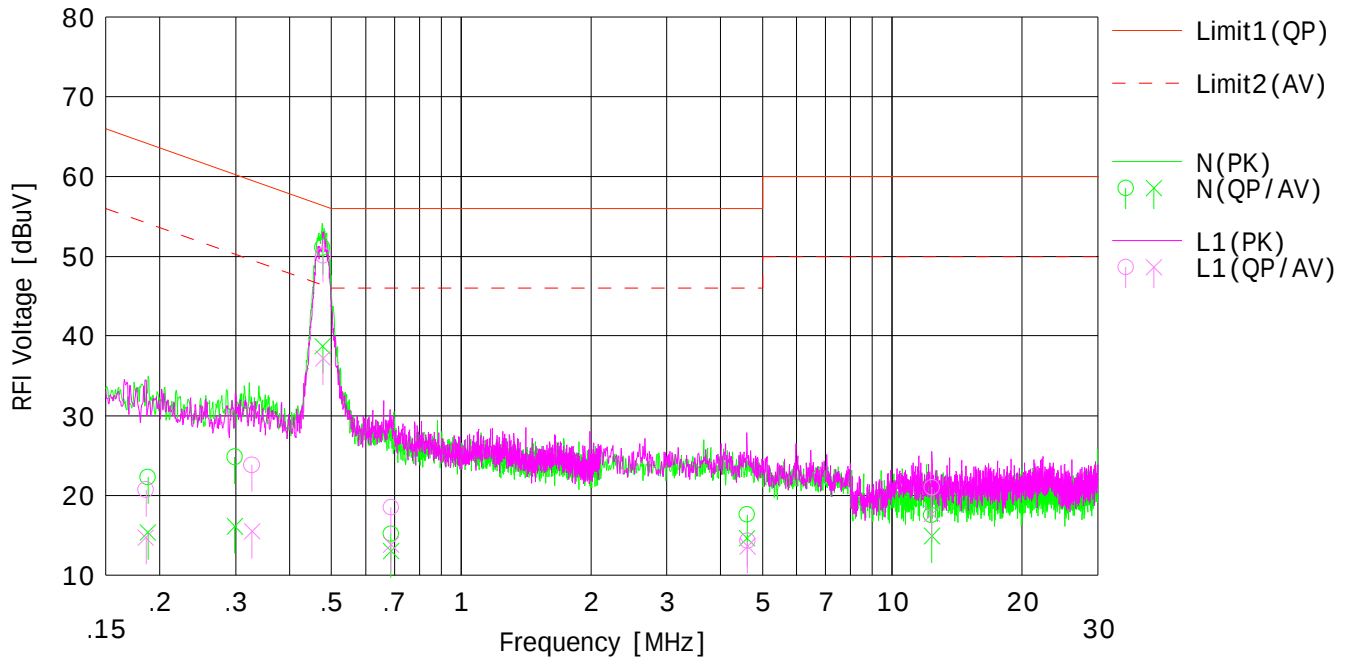
UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2015/04/07

Company : SMK Corporation
Kind of EUT : ZigBee RF4CE module
Model No. : FD0001
Serial No. : R1
Remarks : -

Mode : Tx 2450MHz
Order No. : 10744027S
Power : AC 120V / 60Hz
Temp./Humi. : 22deg.C. / 46%RH

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

Engineer : Tomochika Sato



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.18781	9.4	2.4	12.9	22.3	15.3	64.1	54.1	41.8	38.8	N	
2	0.29859	11.9	3.2	12.9	24.8	16.1	60.2	50.2	35.4	34.1	N	
3	0.47727	38.2	25.8	12.9	51.1	38.7	56.3	46.3	5.2	7.6	N	
4	0.68786	2.3	0.1	12.9	15.2	13.0	56.0	46.0	40.8	33.0	N	
5	4.60547	4.2	1.2	13.4	17.6	14.6	56.0	46.0	38.4	31.4	N	
6	12.35445	3.0	0.4	14.5	17.5	14.9	60.0	50.0	42.5	35.1	N	
7	0.18600	7.8	1.8	12.9	20.7	14.7	64.2	54.2	43.5	39.5	L1	
8	0.32726	10.9	2.6	12.9	23.8	15.5	59.5	49.5	35.7	34.0	L1	
9	0.47803	37.2	24.3	12.9	50.1	37.2	56.3	46.3	6.2	9.1	L1	
10	0.68755	5.6	0.9	12.9	18.5	13.8	56.0	46.0	37.5	32.2	L1	
11	4.61559	0.9	0.2	13.4	14.3	13.6	56.0	46.0	41.7	32.4	L1	
12	12.36193	6.5	3.2	14.5	21.0	17.7	60.0	50.0	39.0	32.3	L1	

DATA OF CONDUCTED EMISSION TEST

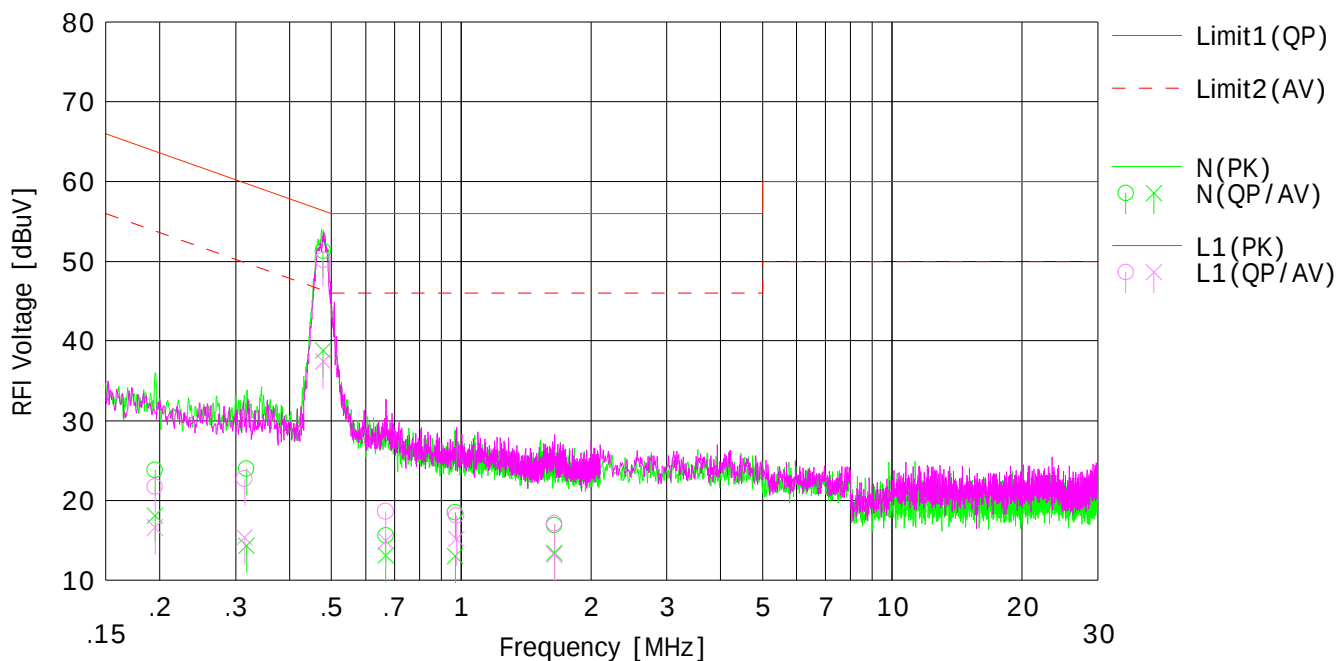
UL Japan, Inc. Shonan EMC Lab. No.1 Shielded Room
Date : 2015/04/07

Company : SMK Corporation
Kind of EUT : ZigBee RF4CE module
Model No. : FD0001
Serial No. : R1
Remarks : -

Mode : Tx 2475MHz
Order No. : 10744027S
Power : AC 120V / 60Hz
Temp./Humi. : 22deg.C. / 46%RH

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

Engineer : Tomochika Sato

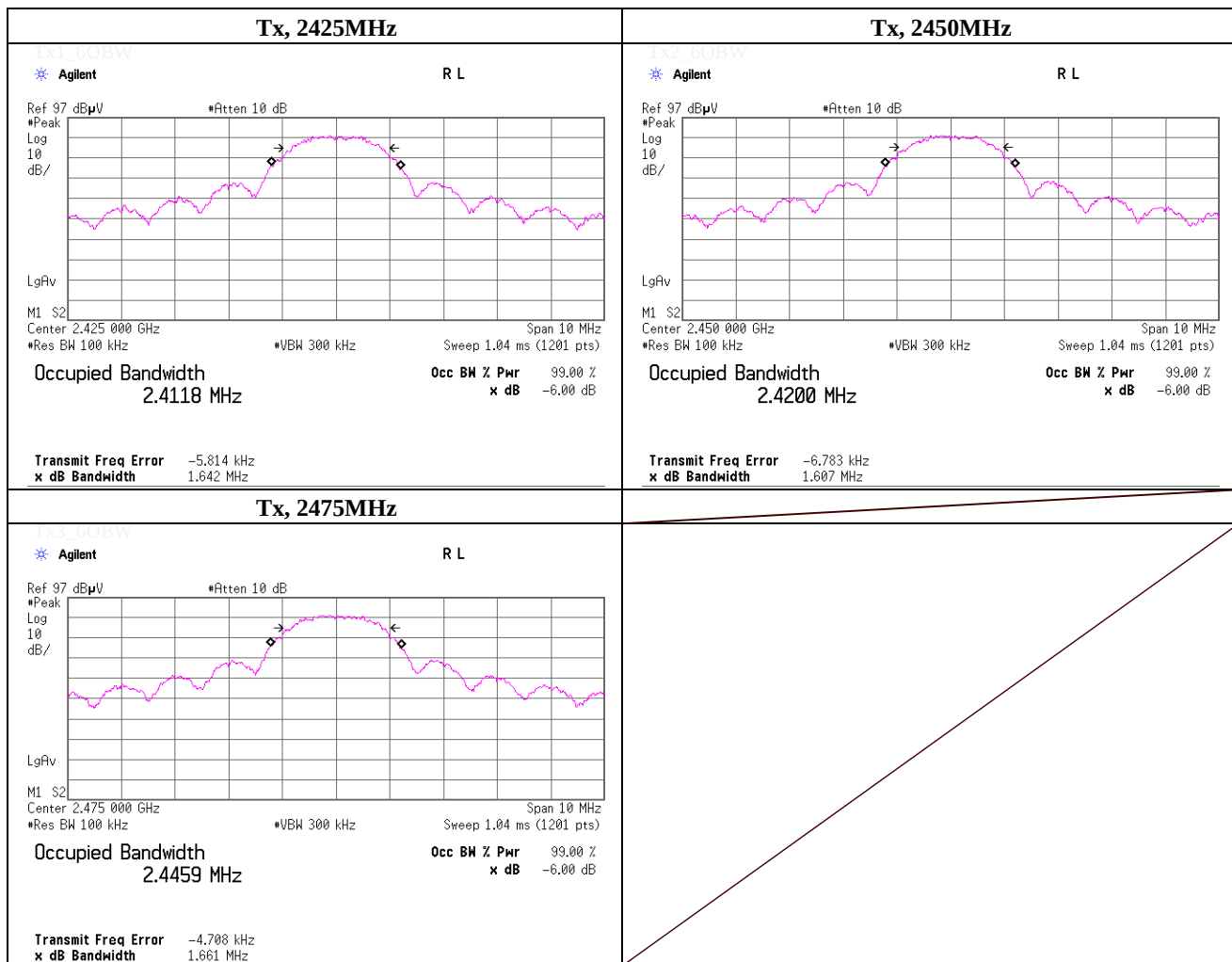


No.	Freq. [MHz]	Reading		C.Fac [dB]	Results		Limit		Margin		Phase	Comment
		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
		[dBuV]	[dBuV]		[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.19490	10.9	5.2	12.9	23.8	18.1	63.8	53.8	40.0	35.7	N	
2	0.31763	11.1	1.4	12.9	24.0	14.3	59.7	49.7	35.7	35.4	N	
3	0.47863	38.4	25.9	12.9	51.3	38.8	56.3	46.3	5.0	7.5	N	
4	0.66888	2.7	0.2	12.9	15.6	13.1	56.0	46.0	40.4	32.9	N	
5	0.97017	5.6	0.1	12.9	18.5	13.0	56.0	46.0	37.5	33.0	N	
6	1.64762	3.9	0.4	13.0	16.9	13.4	56.0	46.0	39.1	32.6	N	
7	0.19490	8.8	3.7	12.9	21.7	16.6	63.8	53.8	42.1	37.2	L1	
8	0.31474	9.8	2.4	12.9	22.7	15.3	59.8	49.8	37.1	34.5	L1	
9	0.47893	37.3	24.5	12.9	50.2	37.4	56.3	46.3	6.1	8.9	L1	
10	0.66859	5.7	2.0	12.9	18.6	14.9	56.0	46.0	37.4	31.1	L1	
11	0.97610	5.2	2.3	12.9	18.1	15.2	56.0	46.0	37.9	30.8	L1	
12	1.64800	4.1	0.2	13.0	17.1	13.2	56.0	46.0	38.9	32.8	L1	

-6dB Bandwidth

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	April 7, 2015	
Temperature / Humidity	24 deg.C , 49 %RH	
Engineer	Shinichi Takano	
Mode	Tx, IEEE802.15.4, PN9	

Freq. [MHz]	-6dB Bandwidth [MHz]	Limit [MHz]
2425.0000	1.642	> 0.500
2450.0000	1.607	> 0.500
2475.0000	1.661	> 0.500

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Maximum Peak Conducted Output Power

(PKPM1)

Test place UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room
Date April 7, 2015
Temperature / Humidity 24 deg.C , 49 %RH
Engineer Shinichi Takano
Mode Tx, IEEE802.15.4, PN9

(* P/M: Power Meter with power sensor)

Ch	Freq.	P/M (Peak Reading	Cable Loss	Atten. Loss	Result		Limit		Margin
	[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
Low	2425.0	-14.43	2.05	9.90	-2.48	0.56	30.00	1000	32.48
Mid	2450.0	-14.27	2.05	9.90	-2.32	0.59	30.00	1000	32.32
High	2475.0	-14.02	2.06	9.90	-2.06	0.62	30.00	1000	32.06

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Atten. Loss

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Maximum Conducted Output Power (Reference data)

(AVGPM)

Test place UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room
Date April 7, 2015
Temperature / Humidity 24 deg.C , 49 %RH
Engineer Shinichi Takano
Mode Tx, IEEE802.15.4, PN9

(* P/M: Power Meter with power sensor, AV: Average)

Ch	Freq.	P/M (AV) Reading	Cable Loss	Atten. Loss	Duty Factor	Result	
	[MHz]	[dBm]	[dB]	[dB]	[dB]	[dBm]	[mW]
Low	2425.0	-15.44	2.05	9.90	0.00	-3.49	0.45
Mid	2450.0	-15.21	2.05	9.90	0.00	-3.26	0.47
High	2475.0	-14.99	2.06	9.90	0.00	-3.03	0.50

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Atten. Loss + Duty Factor

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Radiated Emission

UL Japan, Inc. Shonan EMC Lab.

Test place No.3 Semi Anechoic Chamber
 Date April 8, 2015
 Temperature / Humidity 21 deg.C, 40 %RH
 Engineer Shinichi Takano
 Mode Tx, 2425 MHz
 Tx, IEEE802.15.4, PN9

(* 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.	166.076	QP	32.1	15.4	8.0	32.0	23.5	43.5	20.0	185	263	
Hori.	2390.000	PK	45.9	26.4	13.6	41.1	44.8	73.9	29.1	100	123	
Hori.	4850.000	PK	51.9	30.8	5.6	39.7	48.6	73.9	25.3	107	193	
Hori.	7275.000	PK	46.5	36.7	7.0	40.3	49.9	73.9	24.0	128	173	
Hori.	9700.000	PK	44.2	38.6	8.2	40.0	51.0	73.9	22.9	100	0	
Hori.	12125.000	PK	44.9	39.4	9.3	39.7	53.9	73.9	20.0	100	0	
Hori.	2390.000	AV	36.7	26.4	13.6	41.1	35.6	53.9	18.3	100	123	
Hori.	4850.000	AV	46.3	30.8	5.6	39.7	43.0	53.9	10.9	107	193	
Hori.	7275.000	AV	38.4	36.7	7.0	40.3	41.8	53.9	12.1	128	173	
Hori.	9700.000	AV	35.2	38.6	8.2	40.0	42.0	53.9	11.9	100	0	
Hori.	12125.000	AV	35.9	39.4	9.3	39.7	44.9	53.9	9.0	100	0	
Vert.	34.406	QP	41.7	16.0	6.7	32.1	32.3	40.0	7.7	100	157	
Vert.	43.701	QP	47.8	13.0	6.9	32.1	35.6	40.0	4.4	100	126	
Vert.	65.425	QP	54.4	7.0	6.6	32.1	35.9	40.0	4.1	100	179	
Vert.	138.917	QP	37.9	14.3	7.7	32.1	27.8	43.5	15.7	100	223	
Vert.	480.000	QP	21.9	17.5	9.4	31.9	16.9	46.0	29.1	100	0	
Vert.	2390.000	PK	46.4	26.4	13.6	41.1	45.3	73.9	28.6	120	66	
Vert.	4850.000	PK	52.3	30.8	5.6	39.7	49.0	73.9	24.9	107	196	
Vert.	7275.000	PK	46.3	36.7	7.0	40.3	49.7	73.9	24.2	100	182	
Vert.	9700.000	PK	43.1	38.6	8.2	40.0	49.9	73.9	24.0	100	0	
Vert.	12125.000	PK	44.2	39.4	9.3	39.7	53.2	73.9	20.7	100	0	
Vert.	2390.000	AV	36.7	26.4	13.6	41.1	35.6	53.9	18.3	120	66	
Vert.	4850.000	AV	46.1	30.8	5.6	39.7	42.8	53.9	11.1	107	196	
Vert.	7275.000	AV	36.9	36.7	7.0	40.3	40.3	53.9	13.6	100	182	
Vert.	9700.000	AV	35.2	38.6	8.2	40.0	42.0	53.9	11.9	100	0	
Vert.	12125.000	AV	35.7	39.4	9.3	39.7	44.7	53.9	9.2	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18GHz)-Distance factor(above 15GHz)) - Gain(Amplifier)

Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2425.000	PK	90.6	26.5	13.6	41.1	89.6	-	-	Carrier
Hori.	2400.000	PK	36.7	26.4	13.6	41.1	35.6	69.6	34.0	
Vert.	2425.000	PK	89.5	26.5	13.6	41.1	88.5	-	-	Carrier
Vert.	2400.000	PK	36.8	26.4	13.6	41.1	35.7	68.5	32.8	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18GHz)-Distance factor(above 15GHz)) - Gain(Amplifier)

Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB

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Radiated Emission

UL Japan, Inc. Shonan EMC Lab.

Test place No.3 Semi Anechoic Chamber
 Date April 8, 2015
 Temperature / Humidity 21 deg.C, 40 %RH
 Engineer Shinichi Takano
 Mode Tx, 2450 MHz
 Tx, IEEE802.15.4, PN9

(* 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.	166.056	QP	32.2	15.4	8.0	32.0	23.6	43.5	19.9	184	262	
Hori.	4900.000	PK	52.5	31.0	5.6	39.7	49.4	73.9	24.5	113	190	
Hori.	7350.000	PK	46.7	36.9	7.0	40.3	50.3	73.9	23.6	147	171	
Hori.	9800.000	PK	45.1	38.6	8.0	40.0	51.7	73.9	22.2	100	0	
Hori.	12250.000	PK	44.4	39.4	9.4	39.8	53.4	73.9	20.5	100	0	
Hori.	4900.000	AV	46.4	31.0	5.6	39.7	43.3	53.9	10.6	113	190	
Hori.	7350.000	AV	39.3	36.9	7.0	40.3	42.9	53.9	11.0	147	171	
Hori.	9800.000	AV	35.4	38.6	8.0	40.0	42.0	53.9	11.9	100	0	
Hori.	12250.000	AV	36.2	39.4	9.4	39.8	45.2	53.9	8.7	100	0	
Vert.	34.419	QP	42.5	16.0	6.7	32.1	33.1	40.0	6.9	100	174	
Vert.	43.702	QP	47.6	13.0	6.9	32.1	35.4	40.0	4.6	100	125	
Vert.	65.208	QP	54.8	7.0	6.6	32.1	36.3	40.0	3.7	100	194	
Vert.	138.656	QP	37.8	14.2	7.7	32.1	27.6	43.5	15.9	100	234	
Vert.	480.000	QP	21.9	17.5	9.4	31.9	16.9	46.0	29.1	100	0	
Vert.	4900.000	PK	52.7	31.0	5.6	39.7	49.6	73.9	24.3	110	190	
Vert.	7350.000	PK	47.2	36.9	7.0	40.3	50.8	73.9	23.1	100	197	
Vert.	9800.000	PK	42.8	38.6	8.0	40.0	49.4	73.9	24.5	100	0	
Vert.	12250.000	PK	44.4	39.4	9.4	39.8	53.4	73.9	20.5	100	0	
Vert.	4900.000	AV	46.2	31.0	5.6	39.7	43.1	53.9	10.8	110	190	
Vert.	7350.000	AV	38.2	36.9	7.0	40.3	41.8	53.9	12.1	100	197	
Vert.	9800.000	AV	35.5	38.6	8.0	40.0	42.1	53.9	11.8	100	0	
Vert.	12250.000	AV	36.2	39.4	9.4	39.8	45.2	53.9	8.7	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18GHz)-Distance factor(above 15GHz)) - Gain(Amplifier)

Distance factor : 15GHz -40GHz : $20\log(3.0\text{m}/1.0\text{m})= 9.5\text{dB}$

UL Japan, Inc.

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Radiated Emission

UL Japan, Inc. Shonan EMC Lab.

Test place No.3 Semi Anechoic Chamber
 Date April 8, 2015
 Temperature / Humidity 21 deg.C, 40 %RH
 Engineer Shinichi Takano
 Mode Tx, 2475 MHz
 Tx, IEEE802.15.4, PN9

(* 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.	166.110	QP	32.3	15.4	8.0	32.0	23.7	43.5	19.8	183	261	
Hori.	2483.500	PK	50.9	26.6	13.6	41.1	50.0	73.9	23.9	100	123	
Hori.	4950.000	PK	52.2	31.2	5.7	39.6	49.5	73.9	24.4	105	187	
Hori.	7425.000	PK	48.2	37.0	7.0	40.4	51.8	73.9	22.1	138	163	
Hori.	9900.000	PK	45.2	38.6	8.0	39.9	51.9	73.9	22.0	100	0	
Hori.	12375.000	PK	45.0	39.3	9.4	40.0	53.7	73.9	20.2	100	0	
Hori.	2483.500	AV	42.4	26.6	13.6	41.1	41.5	53.9	12.4	100	123	
Hori.	4950.000	AV	46.1	31.2	5.7	39.6	43.4	53.9	10.5	105	187	
Hori.	7425.000	AV	40.8	37.0	7.0	40.4	44.4	53.9	9.5	138	163	
Hori.	9900.000	AV	35.8	38.6	8.0	39.9	42.5	53.9	11.4	100	0	
Hori.	12375.000	AV	36.1	39.3	9.4	40.0	44.8	53.9	9.1	100	0	
Vert.	34.383	QP	42.5	16.1	6.7	32.1	33.2	40.0	6.8	100	146	
Vert.	43.704	QP	47.5	13.0	6.9	32.1	35.3	40.0	4.7	100	180	
Vert.	65.045	QP	54.6	7.0	6.6	32.1	36.1	40.0	3.9	100	183	
Vert.	138.655	QP	38.1	14.2	7.7	32.1	27.9	43.5	15.6	100	237	
Vert.	480.000	QP	22.0	17.5	9.4	31.9	17.0	46.0	29.0	100	0	
Vert.	2483.500	PK	49.5	26.6	13.6	41.1	48.6	73.9	25.3	106	59	
Vert.	4950.000	PK	52.1	31.2	5.7	39.6	49.4	73.9	24.5	101	172	
Vert.	7425.000	PK	46.5	37.0	7.0	40.4	50.1	73.9	23.8	100	205	
Vert.	9900.000	PK	45.0	38.6	8.0	39.9	51.7	73.9	22.2	100	0	
Vert.	12375.000	PK	44.0	39.3	9.4	40.0	52.7	73.9	21.2	100	0	
Vert.	2483.500	AV	41.3	26.6	13.6	41.1	40.4	53.9	13.5	106	59	
Vert.	4950.000	AV	45.9	31.2	5.7	39.6	43.2	53.9	10.7	101	172	
Vert.	7425.000	AV	39.0	37.0	7.0	40.4	42.6	53.9	11.3	100	205	
Vert.	9900.000	AV	36.0	38.6	8.0	39.9	42.7	53.9	11.2	100	0	
Vert.	12375.000	AV	36.2	39.3	9.4	40.0	44.9	53.9	9.0	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18GHz)-Distance factor(above 15GHz)) - Gain(Amplifier)

Distance factor : 15GHz -40GHz : $20\log(3.0m/1.0m) = 9.5dB$

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Shonan EMC Lab.

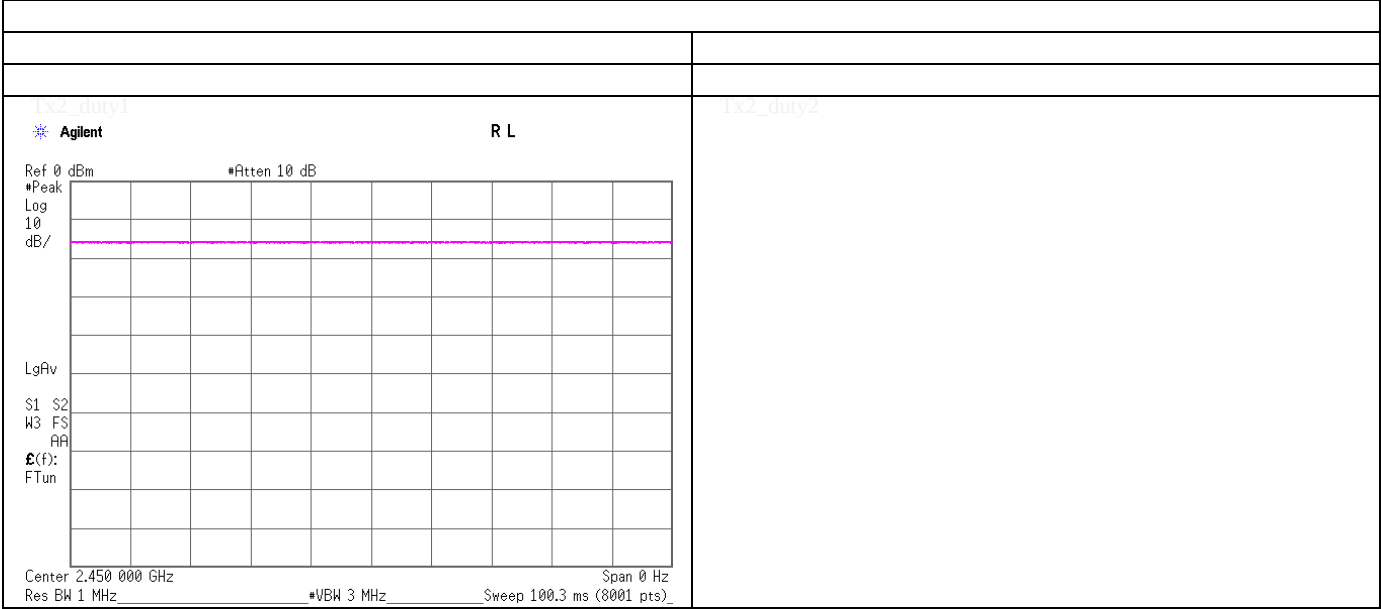
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Burst rate confirmation

Tx, IEEE802.15.4, PN9

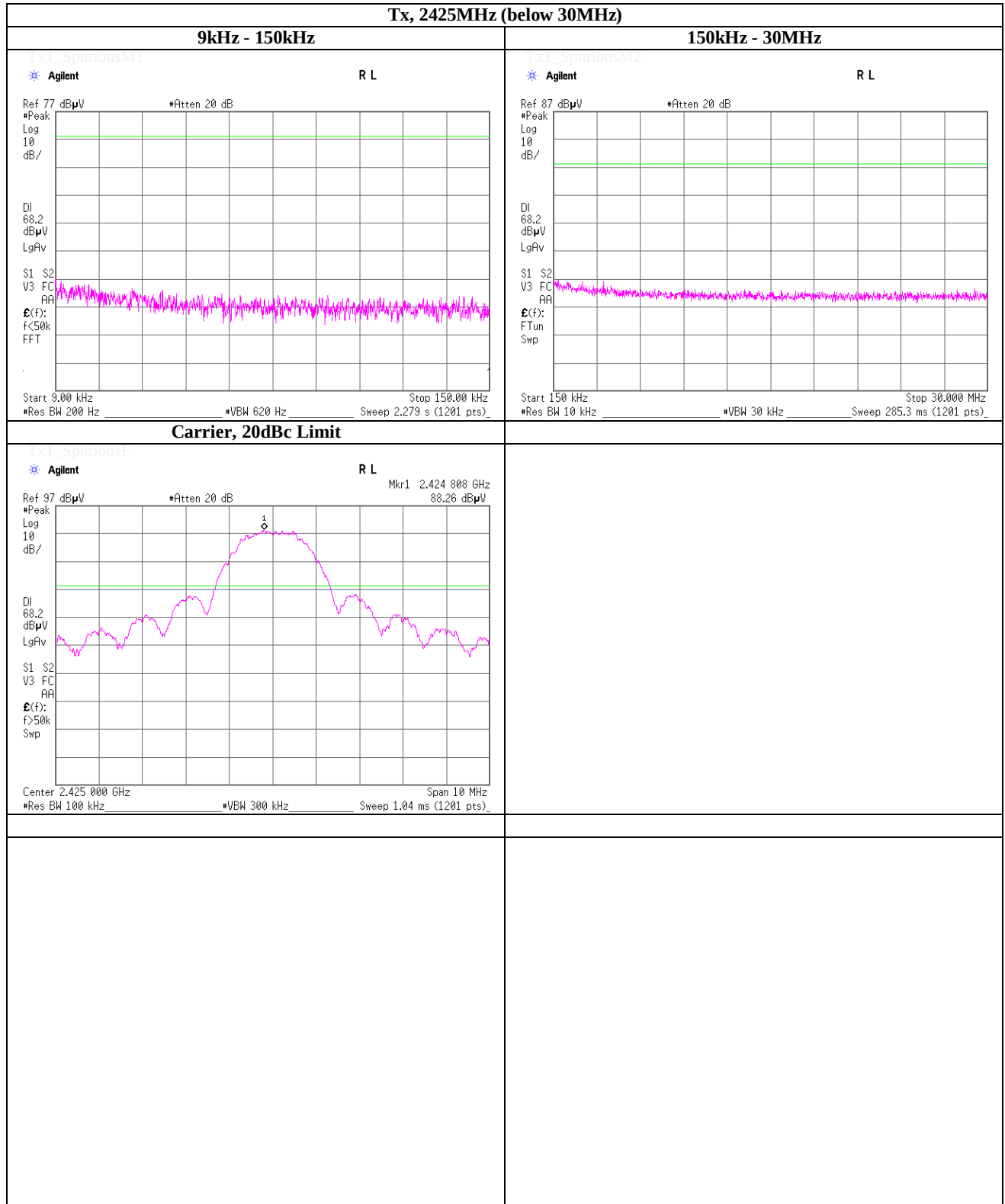


Test place UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room
Date April 7, 2015
Temperature / Humidity 24 deg.C , 49 %RH
Engineer Shinichi Takano

Spurious emission (Conducted)

Tx, IEEE802.15.4, PN9

Tx, 2425MHz (below 30MHz)



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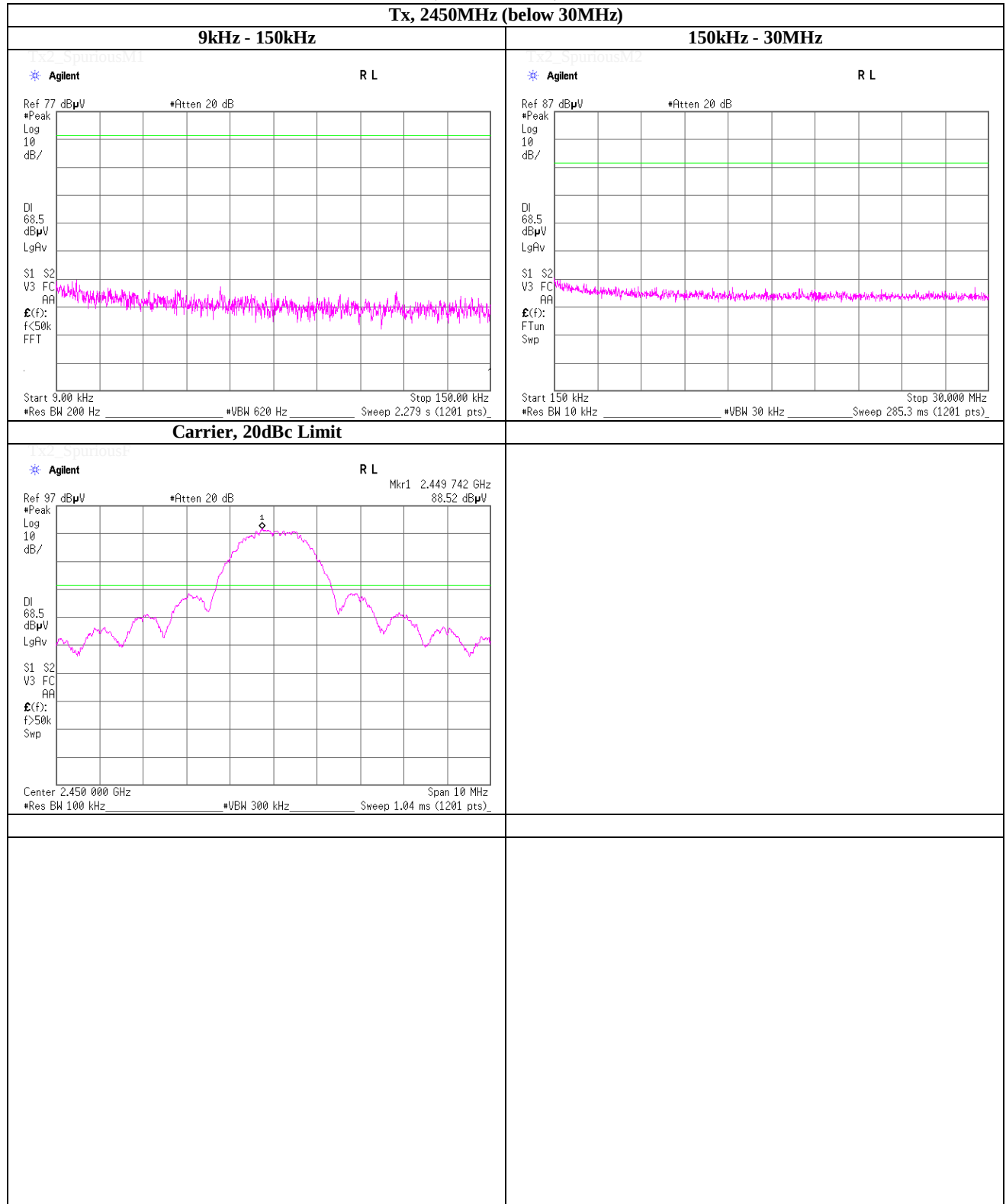
Facsimile : +81 463 50 6401

Test place UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room
Date April 7, 2015
Temperature / Humidity 24 deg.C , 49 %RH
Engineer Shinichi Takano

Spurious emission (Conducted)

Tx, IEEE802.15.4, PN9

Tx, 2450MHz (below 30MHz)



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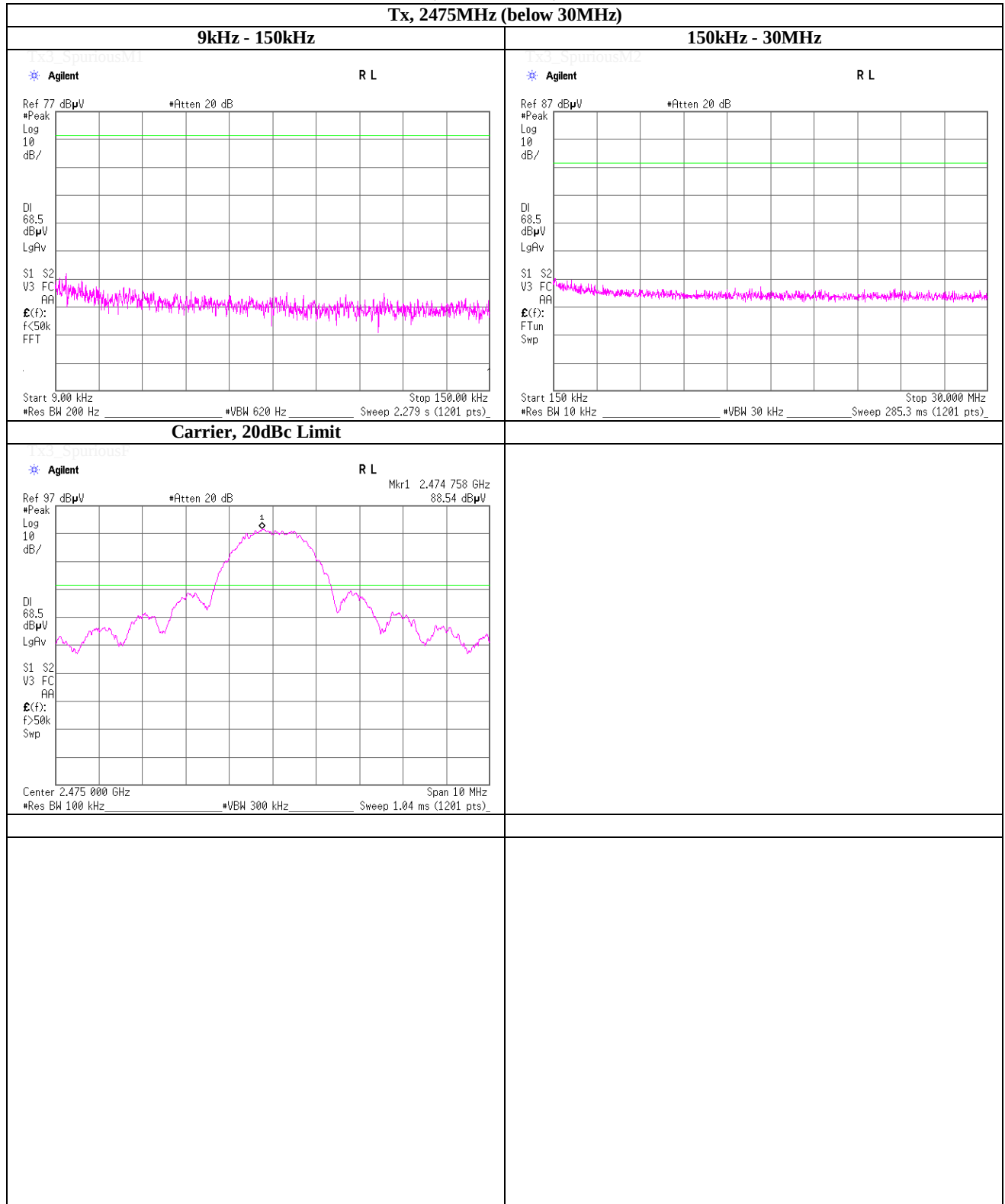
Facsimile : +81 463 50 6401

Test place UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room
Date April 7, 2015
Temperature / Humidity 24 deg.C , 49 %RH
Engineer Shinichi Takano

Spurious emission (Conducted)

Tx, IEEE802.15.4, PN9

Tx, 2475MHz (below 30MHz)



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Maximum Power Spectral Density

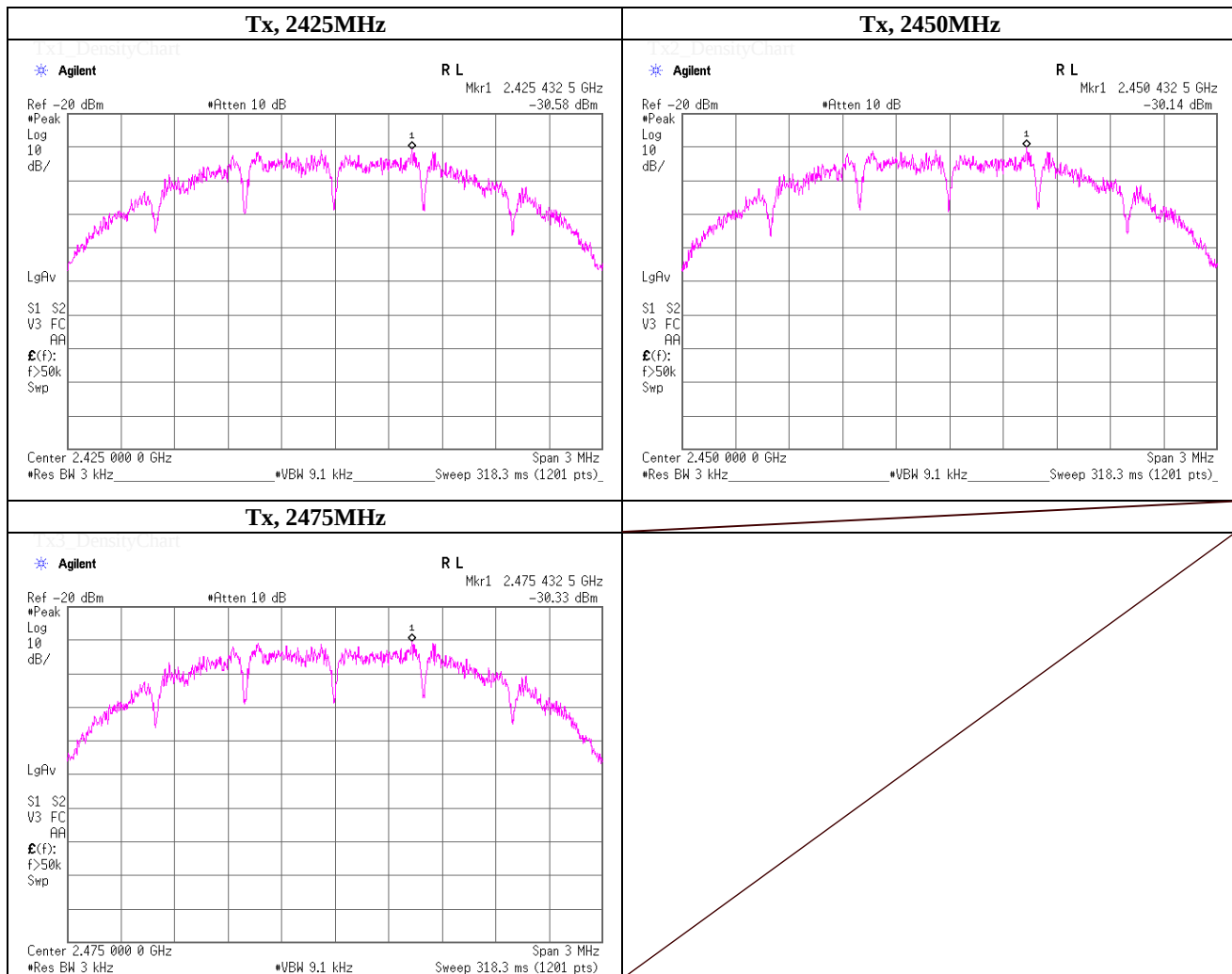
(PKPSD)

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	April 7, 2015	
Temperature / Humidity	24 deg.C , 49 %RH	
Engineer	Shinichi Takano	
Mode	Tx, IEEE802.15.4, PN9	

Ch. Freq. [MHz]	Freq. Reading [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2425.0000	2425.43	-30.58	2.05	9.90	-18.63	8.00	26.63
2450.0000	2450.43	-30.14	2.05	9.90	-18.19	8.00	26.19
2475.0000	2475.43	-30.33	2.06	9.90	-18.37	8.00	26.37

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Atten. Loss

**UL Japan, Inc.****Shonan EMC Lab.**

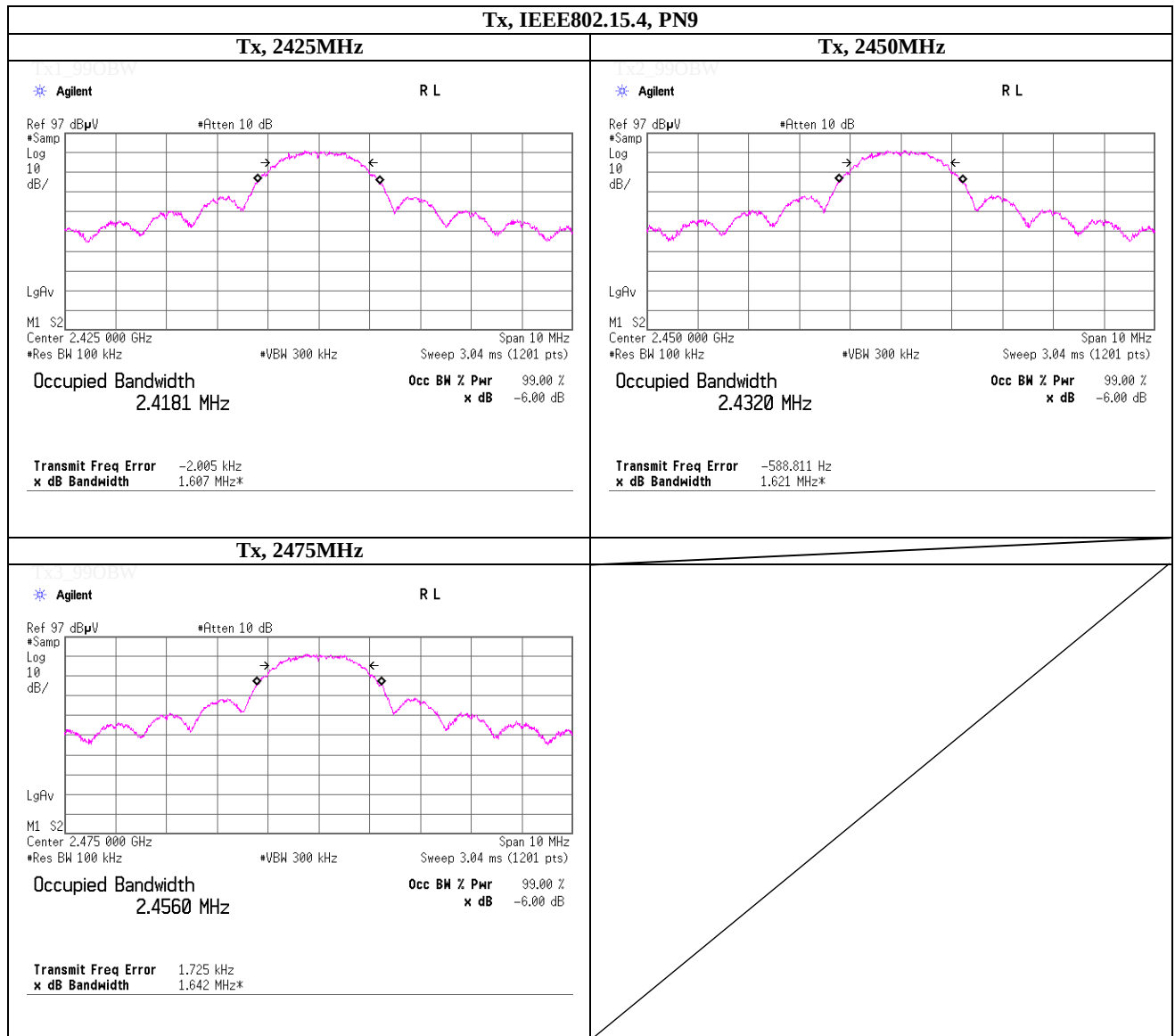
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Test place UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room
 Date April 7, 2015
 Temperature / Humidity 24 deg.C , 49 %RH
 Engineer Shinichi Takano

99% Occupied Bandwidth



UL Japan, Inc.

Shonan EMC Lab.

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

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APPENDIX 2

Test Instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SSA-03	Spectrum Analyzer	Agilent	E4448A	MY48250152	AT	2015/02/24 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2015/03/11 * 12
SAT10-10	Attenuator	Weinschel Corp.	54A-10	37584	AT	2014/04/22 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2014/12/24 * 12
SPM-07	Power Meter	Agilent	8990B	MY5100272	AT	2015/04/02 * 12
SPSS-04	Power sensor	Agilent	N1923A	MY5326009	AT	2015/04/02 * 12
SCC-A12/A13/ SRSE-01	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/N S4906	-/0901-269(RF Selector)	CE	2014/04/25 * 12
SLS-02	LISN	Rohde & Schwarz	ENV216	100512	CE	2015/02/24 * 12
SAT3-05	Attenuator	JFW	50HF-003N	-	CE	2015/02/18 * 12
SOS-02	Humidity Indicator	A&D	AD-5681	4063343	CE	2014/12/24 * 12
STR-01	Test Receiver	Rohde & Schwarz	ESU40	100093	CE	2014/11/11 * 12
SJM-13	Measure	ASKUL	-	-	CE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE, RFLMF)	-	CE	-
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2014/07/14 * 12
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	1440491	RE	2014/05/23 * 12
SCC-G04	Coaxial Cable	Junkosha	J12J102207-00	JUN-12-14-018	RE	2014/06/24 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2014/05/15 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2014/08/12 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2014/10/30 * 12
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY46180525	RE	2015/03/23 * 12
SJM-15	Measure	ASKUL	-	-	RE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE, RFLMF)	-	RE	-
SBA-03	Biconical Antenna	Schwarzbeck	BBA9106	91032666	RE	2014/10/18 * 12
SLA-03	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0901	RE	2014/10/18 * 12
SAT6-08	Attenuator	HIROSE ELECTRIC CO.,LTD.	AT-406(40)	-	RE	2014/08/27 * 12
SCC-C1/C2/C 3/C4/C5/C10/ SRSE-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhne r/Suhner/Suhner/Suhn er/TOYO	8D2W/12DSFA/14 1PE/141PE/141PE /141PE/NS4906	-/0901-271(RF Selector)	RE	2014/04/25 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2015/02/18 * 12
STR-06	Test Receiver	Rohde & Schwarz	ESCI	101259	RE	2015/03/24 * 12
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM3640	RE	2015/03/17 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2015/03/23 * 12
SCC-G15	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	RE	2015/03/11 * 12
SAT10-05	Attenuator(above1GHz)	Agilent	8493C-010	74864	RE	2014/11/21 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2014/11/21 * 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 ,

AT: Antenna terminal conducted test