



# RADIO TEST REPORT

Test Report No.: 10035783S-B

**Applicant** : SEIKO EPSON CORPORATION  
**Type of Equipment** : GPS Sports Monitor  
**Model No.** : SF-710  
**FCC ID** : BKMAP003  
**Test regulation** : FCC Part15 Subpart C: 2013  
**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:** October 17 to 29, 2013

**Tested by:**

  
Akio Hayashi

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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13-EM-F0429

## REVISION HISTORY

### Original Test Report No.: 10035783S-B

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10035783S-B	December 12, 2013	-	-
1	10035783S-B	March 3, 2014	5	Addition of description (3.1 Test specification)

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## **SECTION 1: Customer information**

Company Name : SEIKO EPSON CORPORATION  
Address : 281 Fujimi, Fujimi-machi, Suwa-gun, Nagano-ken 399-0293 Japan  
Telephone Number : +81-266-61-0617  
Facsimile Number : +81-266-61-2045  
Contact Person : Manabu Komiyama

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

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

Type of Equipment : GPS Sports Monitor  
Model Number : SF-710  
Serial Number : Refer to 4.2 in this report.  
Rating : DC3.7V  
Country of Mass-production : Japan  
Condition of EUT : Production prototype  
(Not for Sale: This sample is equivalent to mass-produced items.)  
Receipt Date of Sample : September 20, 2013  
Modification of EUT : No modification by the test lab.

### **2.2 Product description**

Model: SF-710 (referred to as the EUT in this report) is a GPS Sports Monitor.

Clock frequency(ies) in the system : 26MHz, 32MHz, 32.768kHz, 48MHz

<Radio part>

Equipment type : Transceiver  
Frequency of operation : 2402-2480MHz  
Bandwidth / Channel spacing : 1MHz / 2MHz  
Type of modulation : GFSK  
Antenna type / Antenna connector type : 1/4λ chip antenna / None  
Antenna gain : 1.6dBi  
ITU code : F1D  
Operation temperature range : -5 to +50 deg.C

FCC 15.31 (e)

The RF transmitter is constantly provided voltage (DC3.1V) through the regulator regardless of input voltage. Therefore, the equipment 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.

Similar models: SF-510 and SF-310

All the modules are common. Form and the color of the case are different. These models have same RF module.

SF-710	SF-510	SF-310
Full-option	No vibration alert function	No acceleration meter No vibration alert function

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

### **3.1 Test specification**

Test specification : FCC Part 15 Subpart C: 2013,  
final revised on September 30, 2013 and effective October 30, 2013  
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 September 30, 2013 does not affect the test specification applied to the EUT.

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

### **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	*2)	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	10.9 dB Freq.: 7206.000MHz Polarization: Horizontal Detection: Average Mode: Tx 2402MHz Freq.: 7440.000MHz Polarization: Horizontal Detection: Average Mode: Tx 2480MHz	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 v03r01 (FCC), "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

\*2) The test is not applicable since the EUT has no AC mains. (The EUT does not perform transmission during recharging.)

### **3.3 Addition to standard**

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied bandwidth (99%)	ANSI C63.4:2009 13. Measurement of intentional radiators, RSS-Gen 4.6.1	-	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 <sup>*1</sup> /SR <sup>*2</sup> (±)	No.2 SAC/SR (±)	No.3 SAC/SR (±)
<b>Radiated emission (Measurement distance: 3m)</b>	9kHz-30MHz	3.7 dB	3.7 dB	3.6 dB
	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
<b>Radiated emission (Measurement distance: 1m)</b>	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

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

### Antenna port conducted test

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

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

Spurious emission (Conducted) measurement (1G-3GHz) uncertainty for this test was: (±) 2.3dB

Spurious emission (Conducted) measurement (3G-18GHz) uncertainty for this test was: (±) 3.0dB

Spurious emission (Conducted) measurement (18G-26.5GHz) uncertainty for this test was: (±) 2.9dB

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

### 3.5 Test location

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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 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 type="checkbox"/> No.2 shielded room	-	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
<input 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 checked="" 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 3 to 3.

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

### **4.1 Operating mode**

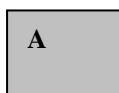
<b>Test item</b>	<b>Mode</b>	<b>Tested frequency</b>
All items	Transmitting Hopping OFF (Low Energy), Payload: PRBS9	2402MHz, 2440MHz, 2480MHz

Power settings: Fixed

Test software: RF test program ver.2.00

**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**

<b>No.</b>	<b>Item</b>	<b>Model number</b>	<b>Serial number</b>	<b>Manufacturer</b>	<b>Remarks</b>
A	GPS Sports Monitor	SF-710	*1)	SEIKO EPSON	EUT

\*1) Radiated emission: S71S1 ES100, Other test: 105

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## **SECTION 5: 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 8.1 Option 1 and 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 6: Maximum peak output power**

### **Test procedure**

The Maximum Peak Output Power was measured with a power meter connected to the antenna port.

The test was measured based on Method 9.1.3 PKPM1 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: 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: 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 / 9kHz

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 9: Radiated emission**

### **9.1 Operating environment**

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

### **9.2 Test configuration**

EUT was placed on a urethane 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.

### **9.3 Test conditions**

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

### **9.4 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: RMS	RBW: 100kHz VBW: 300kHz

\*1) Average Power Measurement was measured based on 12.2.5 of "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	1-18GHz	18-25GHz
Horizontal	Y	Z	Y	Y
Vertical	Z	Z	X	X

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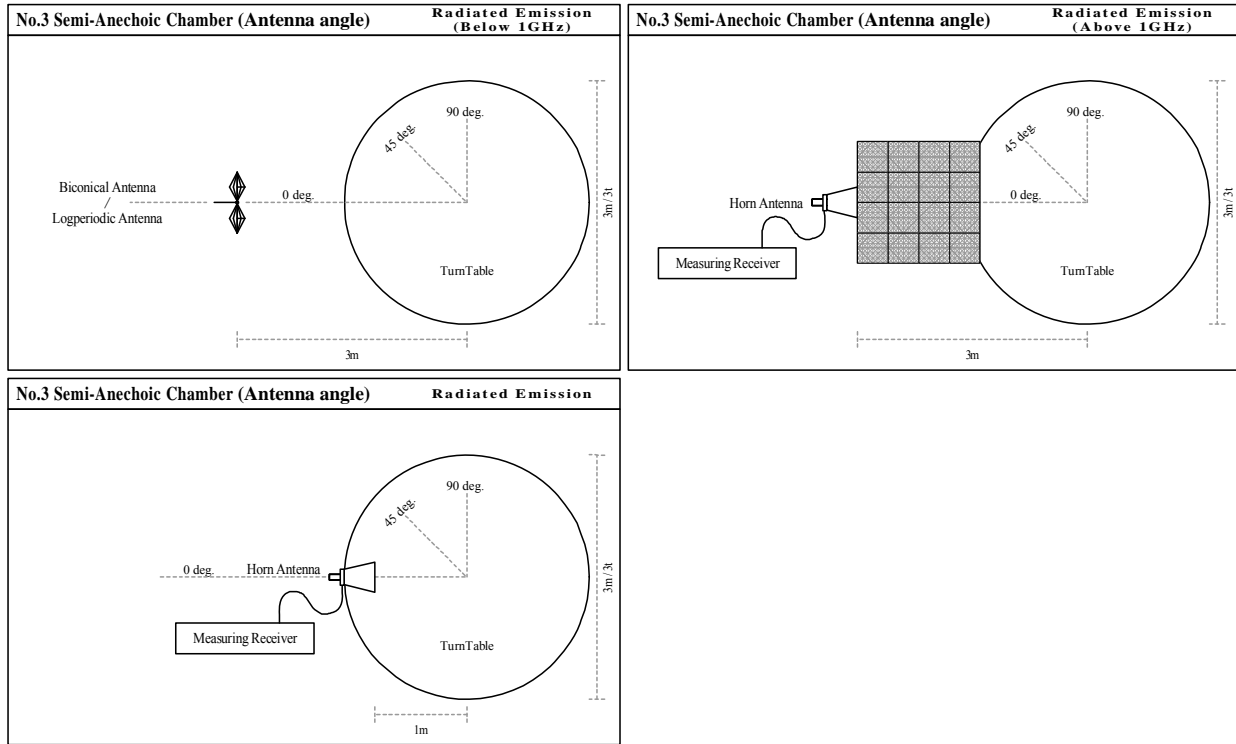
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**Figure 1. Antenna angle**



**9.5 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.

**9.6 Results**

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

Refer to APPENDIX 1

## **Contents of APPENDIXES**

### **APPENDIX 1: Data of Radio tests**

6dB bandwidth  
Maximum peak output power  
Radiated emission  
Spurious emission (Antenna port conducted)  
Peak power density  
Occupied bandwidth

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

Test instruments

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

Radiated emission  
Pre-check of worst position

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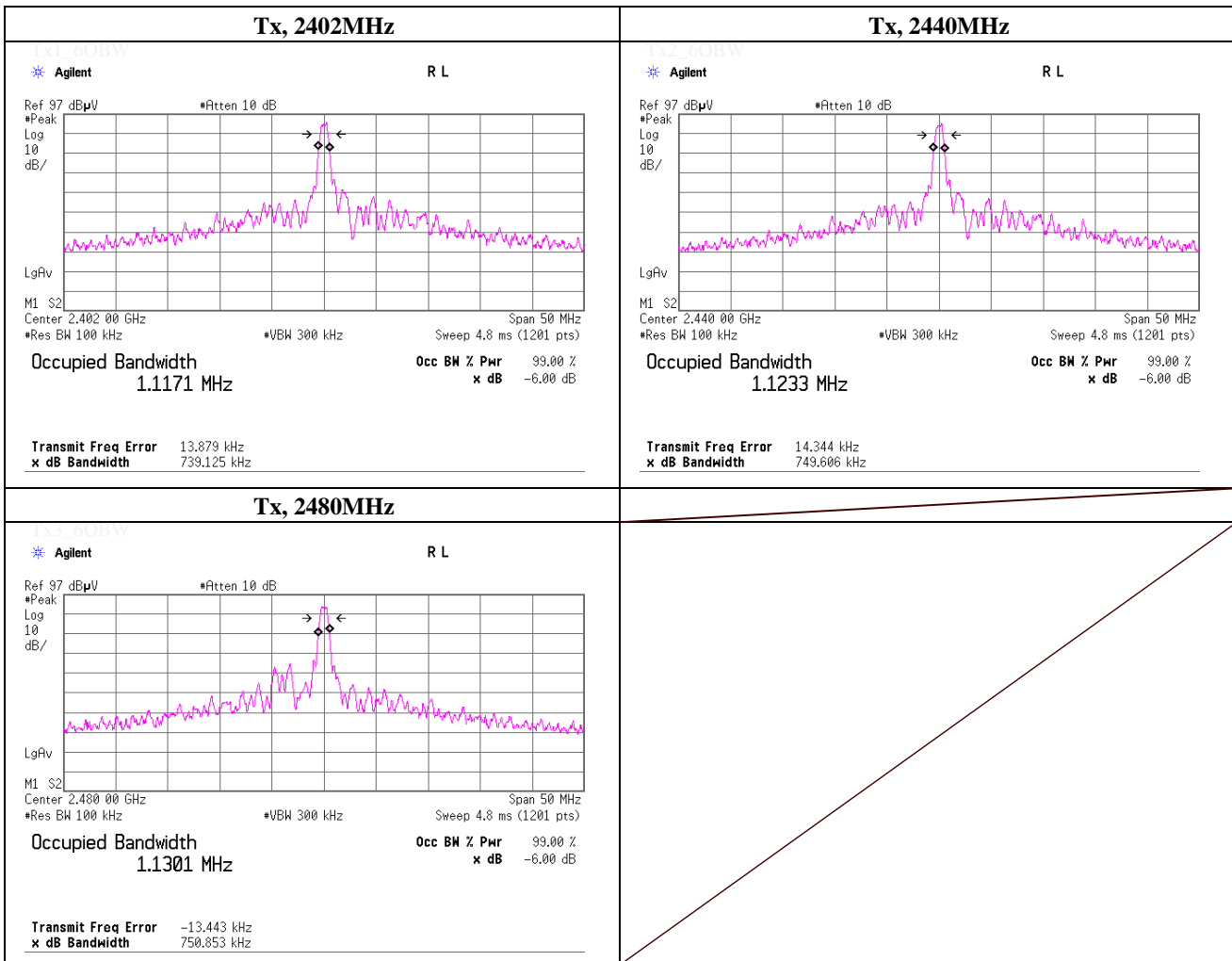
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**APPENDIX 1: Data of Radio tests**

**-6dB Bandwidth**

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	October 17, 2013	
Temperature / Humidity	23deg.C , 45%RH	
Engineer	Hikaru Shirasawa	
Mode	Tx, Bluetooth LE	

Freq. [MHz]	-6dB Bandwidth [MHz]	Limit [MHz]
2402.0000	0.739	> 0.500
2440.0000	0.750	> 0.500
2480.0000	0.751	> 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                         October 17, 2013  
 Temperature / Humidity    23deg.C      , 45%RH  
 Engineer                  Hikaru Shirasawa  
 Mode                        Tx, Bluetooth LE

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

Ch	Freq. [MHz]	P/M (Peak) Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
					[dBm]	[mW]	[dBm]	[mW]	
Low	2402.0	-13.40	0.87	9.62	-2.91	0.51	30.00	1000	32.91
Mid	2440.0	-13.95	0.88	9.63	-3.44	0.45	30.00	1000	33.44
High	2480.0	-14.03	0.88	9.63	-3.52	0.44	30.00	1000	33.52

Sample Calculation:

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

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## Radiated Emission

Test place                   UL Japan, Inc. Shonan EMC Lab.                   No.3 Semi Anechoic Chamber  
 Date                         October 28, 2013   October 29, 2013  
 Temperature / Humidity   25 deg.C , 41%RH                                     23 deg.C , 45%RH  
 Engineer                   Akio Hayashi   Akio Hayashi  
 Mode                        Tx,   2402 MHz  
                                   Tx, Bluetooth LE

(\* 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.	32.000	QP	22.5	17.2	6.5	32.2	14.0	40.0	26.0	250	0	
Hori.	48.000	QP	22.0	11.5	6.7	32.2	8.0	40.0	32.0	250	0	
Hori.	2388.678	PK	47.7	26.8	14.7	41.1	48.1	73.9	25.8	100	183	
Hori.	2390.000	PK	48.0	26.8	14.7	41.1	48.4	73.9	25.5	100	183	
Hori.	4804.000	PK	49.5	30.9	7.5	41.2	46.7	73.9	27.2	100	3	
Hori.	7206.000	PK	48.0	37.1	9.1	41.0	53.2	73.9	20.7	100	0	
Hori.	2388.678	AV	39.3	26.8	14.7	41.1	39.7	53.9	14.2	100	183	
Hori.	2390.000	AV	39.4	26.8	14.7	41.1	39.8	53.9	14.1	100	183	
Hori.	4804.000	AV	40.9	30.9	7.5	41.2	38.1	53.9	15.8	100	3	
Hori.	7206.000	AV	37.8	37.1	9.1	41.0	43.0	53.9	10.9	100	0	
Vert.	32.000	QP	22.5	17.2	6.5	32.2	14.0	40.0	26.0	100	0	
Vert.	48.000	QP	22.0	11.5	6.7	32.2	8.0	40.0	32.0	100	0	
Vert.	78.000	QP	22.7	6.4	7.3	32.1	4.3	40.0	35.7	100	0	
Vert.	96.000	QP	24.0	9.4	7.4	32.1	8.7	43.5	34.8	100	0	
Vert.	144.000	QP	22.3	14.6	7.7	32.1	12.5	43.5	31.0	100	0	
Vert.	240.000	QP	22.3	16.9	8.2	32.0	15.4	46.0	30.6	100	0	
Vert.	2388.678	PK	48.0	26.8	14.7	41.1	48.4	73.9	25.5	100	157	
Vert.	2390.000	PK	47.8	26.8	14.7	41.1	48.2	73.9	25.7	100	157	
Vert.	4804.000	PK	49.4	30.9	7.5	41.2	46.6	73.9	27.3	100	324	
Vert.	7206.000	PK	47.4	37.1	9.1	41.0	52.6	73.9	21.3	100	0	
Vert.	2388.678	AV	39.0	26.8	14.7	41.1	39.4	53.9	14.5	100	157	
Vert.	2390.000	AV	38.9	26.8	14.7	41.1	39.3	53.9	14.6	100	157	
Vert.	4804.000	AV	41.2	30.9	7.5	41.2	38.4	53.9	15.5	100	324	
Vert.	7206.000	AV	37.7	37.1	9.1	41.0	42.9	53.9	11.0	100	0	

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

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

\*The 4th harmonic was not seen so the result was its base noise level.

Distance factor :           15GHz -25GHz :                                 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.	2402.000	PK	89.3	26.8	14.7	41.1	89.7	-	-	Carrier
Hori.	2396.215	PK	49.6	26.8	14.7	41.1	50.0	69.7	19.7	
Hori.	2397.511	PK	46.7	26.8	14.7	41.1	47.1	69.7	22.6	
Hori.	2399.245	PK	50.7	26.8	14.7	41.1	51.1	69.7	18.6	
Hori.	2400.000	PK	44.4	26.8	14.7	41.1	44.8	69.7	24.9	
Vert.	2402.000	PK	90.8	26.8	14.7	41.1	91.2	-	-	Carrier
Vert.	2396.215	PK	50.1	26.8	14.7	41.1	50.5	71.2	20.7	
Vert.	2397.511	PK	46.3	26.8	14.7	41.1	46.7	71.2	24.5	
Vert.	2399.245	PK	51.7	26.8	14.7	41.1	52.1	71.2	19.1	
Vert.	2400.000	PK	45.3	26.8	14.7	41.1	45.7	71.2	25.5	

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

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## Radiated Emission

Test place                   UL Japan, Inc. Shonan EMC Lab.                   No.3 Semi Anechoic Chamber  
Date                           October 28, 2013   October 29, 2013  
Temperature / Humidity    25 deg.C , 41%RH                                   23 deg.C , 45%RH  
Engineer                    Akio Hayashi   Akio Hayashi  
Mode                         Tx,    2440 MHz  
                                  Tx, Bluetooth LE

(\* 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.	32.000	QP	23.0	17.2	6.5	32.2	14.5	40.0	25.5	250	0	
Hori.	48.000	QP	22.3	11.5	6.7	32.2	8.3	40.0	31.7	250	0	
Hori.	4880.000	PK	49.6	31.4	7.5	41.1	47.4	73.9	26.5	100	359	
Hori.	7320.000	PK	47.6	37.2	9.0	41.1	52.7	73.9	21.2	100	0	
Hori.	4880.000	AV	39.6	31.4	7.5	41.1	37.4	53.9	16.5	100	359	
Hori.	7320.000	AV	37.0	37.2	9.0	41.1	42.1	53.9	11.8	100	0	
Vert.	32.000	QP	22.5	17.2	6.5	32.2	14.0	40.0	26.0	100	0	
Vert.	48.000	QP	21.7	11.5	6.7	32.2	7.7	40.0	32.3	100	0	
Vert.	78.000	QP	23.0	6.4	7.3	32.1	4.6	40.0	35.4	100	0	
Vert.	96.000	QP	23.0	9.4	7.4	32.1	7.7	43.5	35.8	100	0	
Vert.	144.000	QP	21.7	14.6	7.7	32.1	11.9	43.5	31.6	100	0	
Vert.	240.000	QP	22.3	16.9	8.2	32.0	15.4	46.0	30.6	100	0	
Vert.	4880.000	PK	48.2	31.4	7.5	41.1	46.0	73.9	27.9	100	231	
Vert.	7320.000	PK	46.6	37.2	9.0	41.1	51.7	73.9	22.2	100	0	
Vert.	4880.000	AV	41.1	31.4	7.5	41.1	38.9	53.9	15.0	100	231	
Vert.	7320.000	AV	37.7	37.2	9.0	41.1	42.8	53.9	11.1	100	0	

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

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

\*The 4th harmonic was not seen so the result was its base noise level.

Distance factor :           15GHz -25GHz :                                20log(3.0m/1.0m)= 9.5dB

## Radiated Emission

Test place                   UL Japan, Inc. Shonan EMC Lab.                   No.3 Semi Anechoic Chamber  
 Date                         October 28, 2013   October 29, 2013  
 Temperature / Humidity   25 deg.C , 41%RH                                     23 deg.C , 45%RH  
 Engineer                   Akio Hayashi   Akio Hayashi  
 Mode                         Tx,   2480 MHz  
                                   Tx, Bluetooth LE

(\* 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.	32.000	QP	22.5	17.2	6.5	32.2	14.0	40.0	26.0	250	0	
Hori.	48.000	QP	21.7	11.5	6.7	32.2	7.7	40.0	32.3	250	0	
Hori.	2483.500	PK	48.6	26.9	14.8	41.0	49.3	73.9	24.6	100	201	
Hori.	2484.250	PK	48.6	26.9	14.8	41.0	49.3	73.9	24.6	100	201	
Hori.	2485.742	PK	50.1	26.9	14.8	41.0	50.8	73.9	23.1	100	201	
Hori.	4960.000	PK	48.4	31.8	7.5	41.1	46.6	73.9	27.3	100	221	
Hori.	7440.000	PK	46.3	37.4	9.0	41.1	51.6	73.9	22.3	100	0	
Hori.	2483.500	AV	40.0	26.9	14.8	41.0	40.7	53.9	13.2	100	201	
Hori.	2484.250	AV	39.8	26.9	14.8	41.0	40.5	53.9	13.4	100	201	
Hori.	2485.742	AV	41.4	26.9	14.8	41.0	42.1	53.9	11.8	100	201	
Hori.	4960.000	AV	40.4	31.8	7.5	41.1	38.6	53.9	15.3	100	221	
Hori.	7440.000	AV	37.7	37.4	9.0	41.1	43.0	53.9	10.9	100	0	
Vert.	32.000	QP	22.5	17.2	6.5	32.2	14.0	40.0	26.0	100	0	
Vert.	48.000	QP	21.8	11.5	6.7	32.2	7.8	40.0	32.2	100	0	
Vert.	78.000	QP	22.5	6.4	7.3	32.1	4.1	40.0	35.9	100	0	
Vert.	96.000	QP	24.3	9.4	7.4	32.1	9.0	43.5	34.5	100	0	
Vert.	144.000	QP	21.8	14.6	7.7	32.1	12.0	43.5	31.5	100	0	
Vert.	240.000	QP	21.7	16.9	8.2	32.0	14.8	46.0	31.2	100	0	
Vert.	2483.500	PK	48.3	26.9	14.8	41.0	49.0	73.9	24.9	100	161	
Vert.	2484.250	PK	48.3	26.9	14.8	41.0	49.0	73.9	24.9	100	161	
Vert.	2485.742	PK	50.8	26.9	14.8	41.0	51.5	73.9	22.4	100	161	
Vert.	4960.000	PK	48.2	31.8	7.5	41.1	46.4	73.9	27.5	100	233	
Vert.	7440.000	PK	47.1	37.4	9.0	41.1	52.4	73.9	21.5	100	0	
Vert.	2483.500	AV	39.8	26.9	14.8	41.0	40.5	53.9	13.4	100	161	
Vert.	2484.250	AV	39.8	26.9	14.8	41.0	40.5	53.9	13.4	100	161	
Vert.	2485.742	AV	42.1	26.9	14.8	41.0	42.8	53.9	11.1	100	161	
Vert.	4960.000	AV	40.8	31.8	7.5	41.1	39.0	53.9	14.9	100	233	
Vert.	7440.000	AV	37.6	37.4	9.0	41.1	42.9	53.9	11.0	100	0	

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

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

\*The 4th harmonic was not seen so the result was its base noise level.

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

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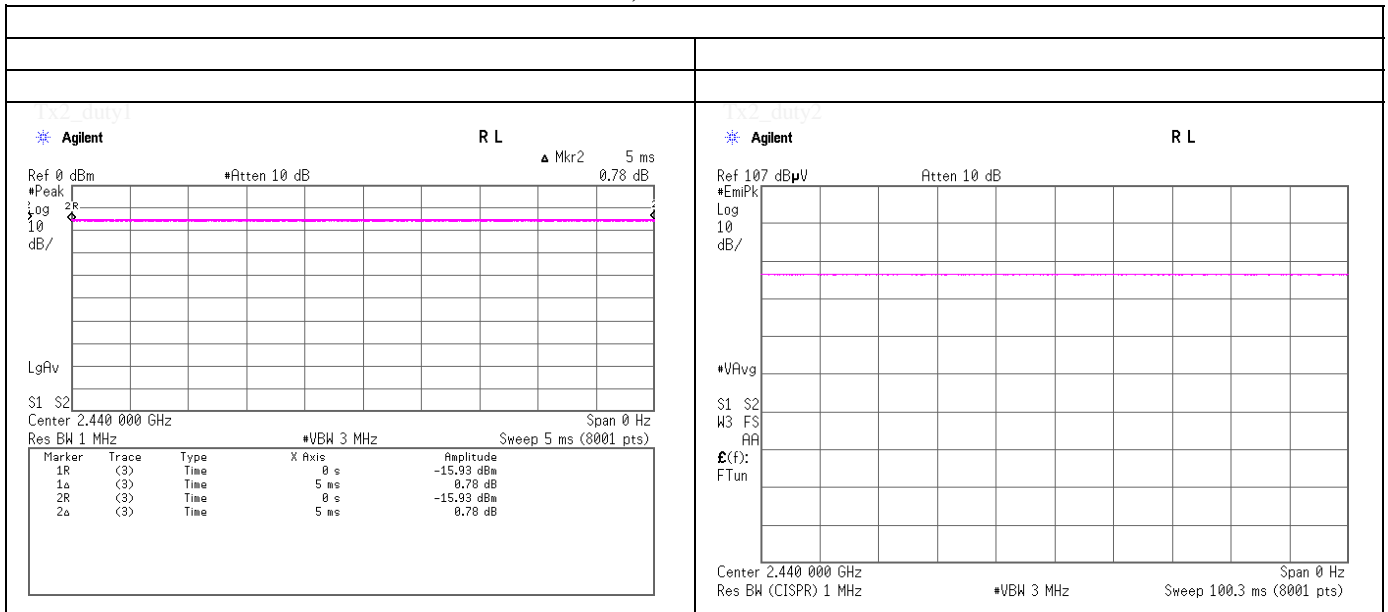
Facsimile : +81 463 50 6401



Test place: UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room  
 Date: October 17, 2013, Temperature / Humidity: 23deg.C , 45%RH  
 Engineer: Hikaru Shirasawa

## Burst rate confirmation

### Tx, Bluetooth LE



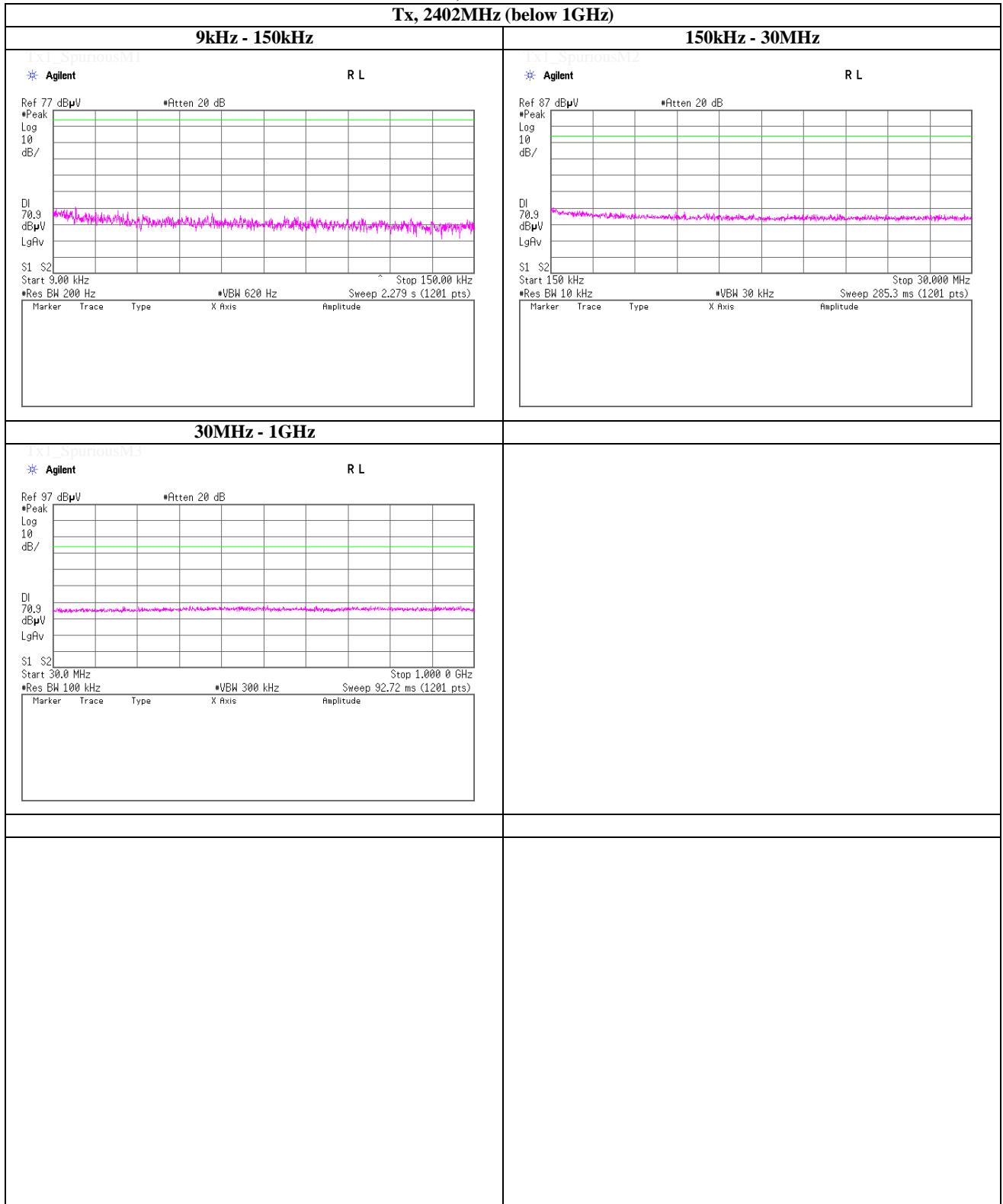
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**Shonan EMC Lab.**  
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Test place: UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room  
 Date: October 17, 2013, Temperature / Humidity: 23deg.C , 45%RH  
 Engineer: Hikaru Shirasawa

**(Reference chart) Spurious emission (Conducted)**

**Tx, Bluetooth LE**

**Tx, 2402MHz (below 1GHz)**



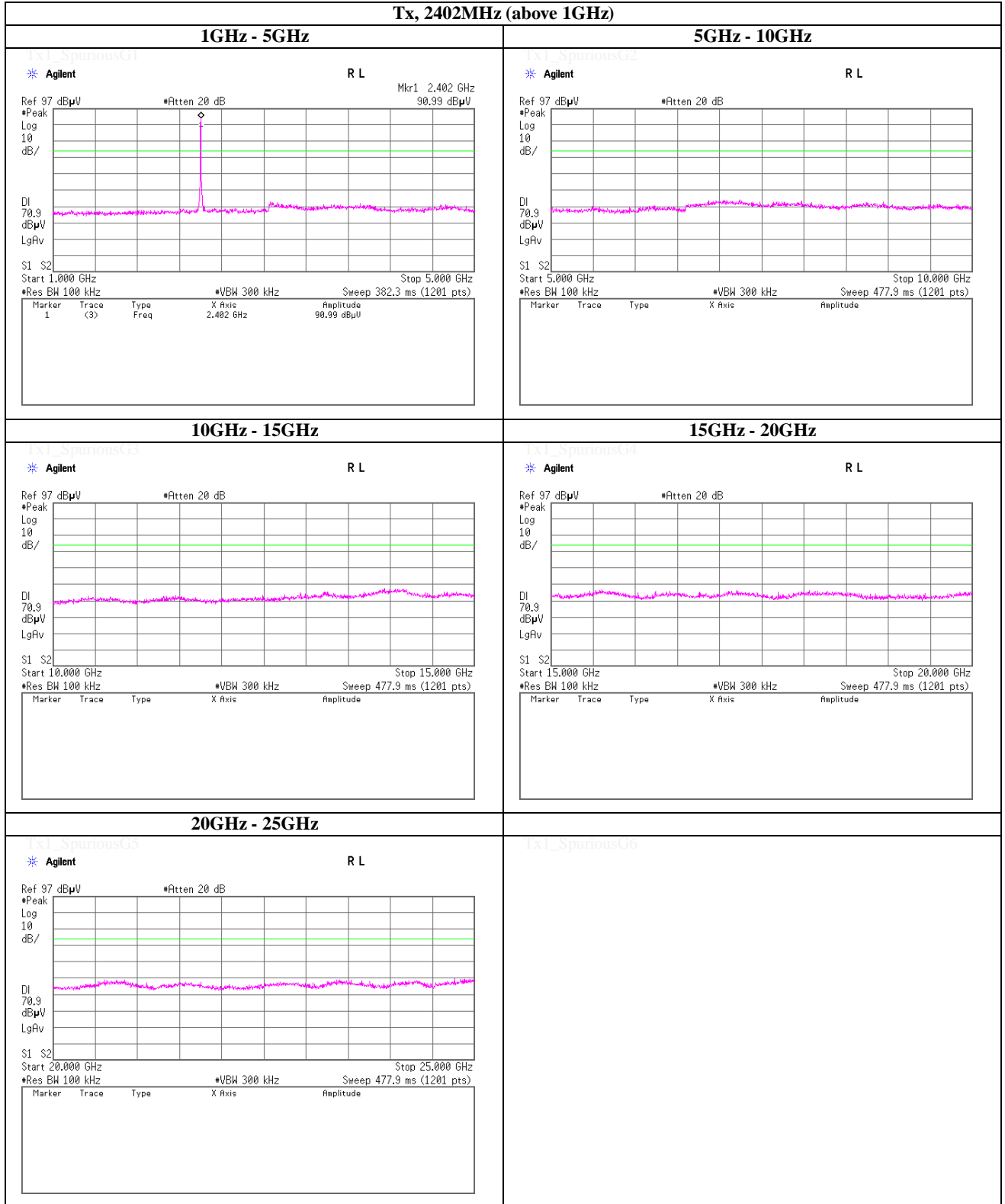
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Test place: UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room  
 Date: October 17, 2013, Temperature / Humidity: 23deg.C , 45%RH  
 Engineer: Hikaru Shirasawa

**(Reference chart) Spurious emission (Conducted)**

**Tx, Bluetooth LE**

**Tx, 2402MHz (above 1GHz)**



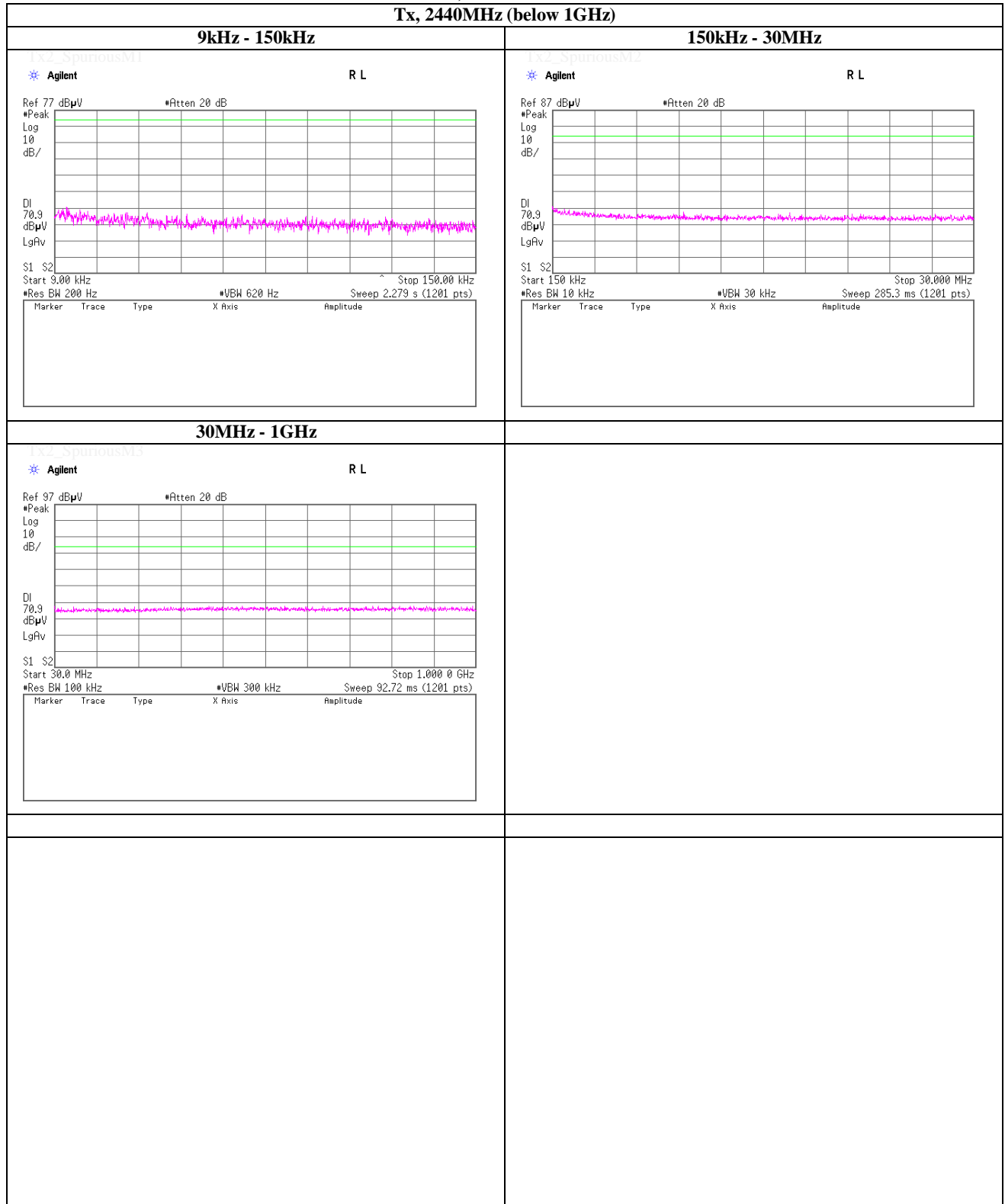
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Test place: UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room  
 Date: October 17, 2013, Temperature / Humidity: 23deg.C , 45%RH  
 Engineer: Hikaru Shirasawa

**(Reference chart) Spurious emission (Conducted)**

**Tx, Bluetooth LE**

**Tx, 2440MHz (below 1GHz)**



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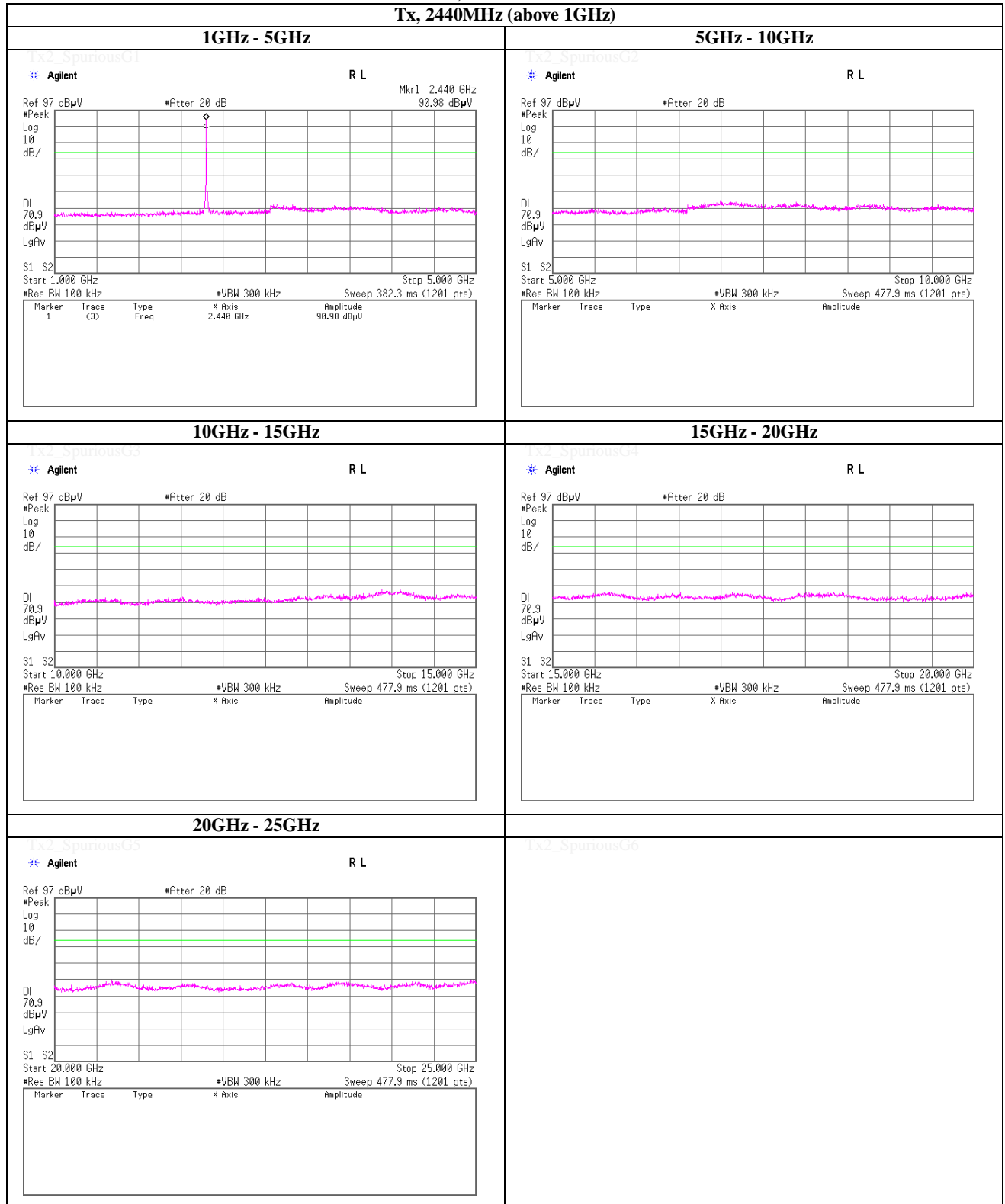
Facsimile : +81 463 50 6401

Test place: UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room  
 Date: October 17, 2013, Temperature / Humidity: 23deg.C , 45%RH  
 Engineer: Hikaru Shirasawa

**(Reference chart) Spurious emission (Conducted)**

**Tx, Bluetooth LE**

**Tx, 2440MHz (above 1GHz)**



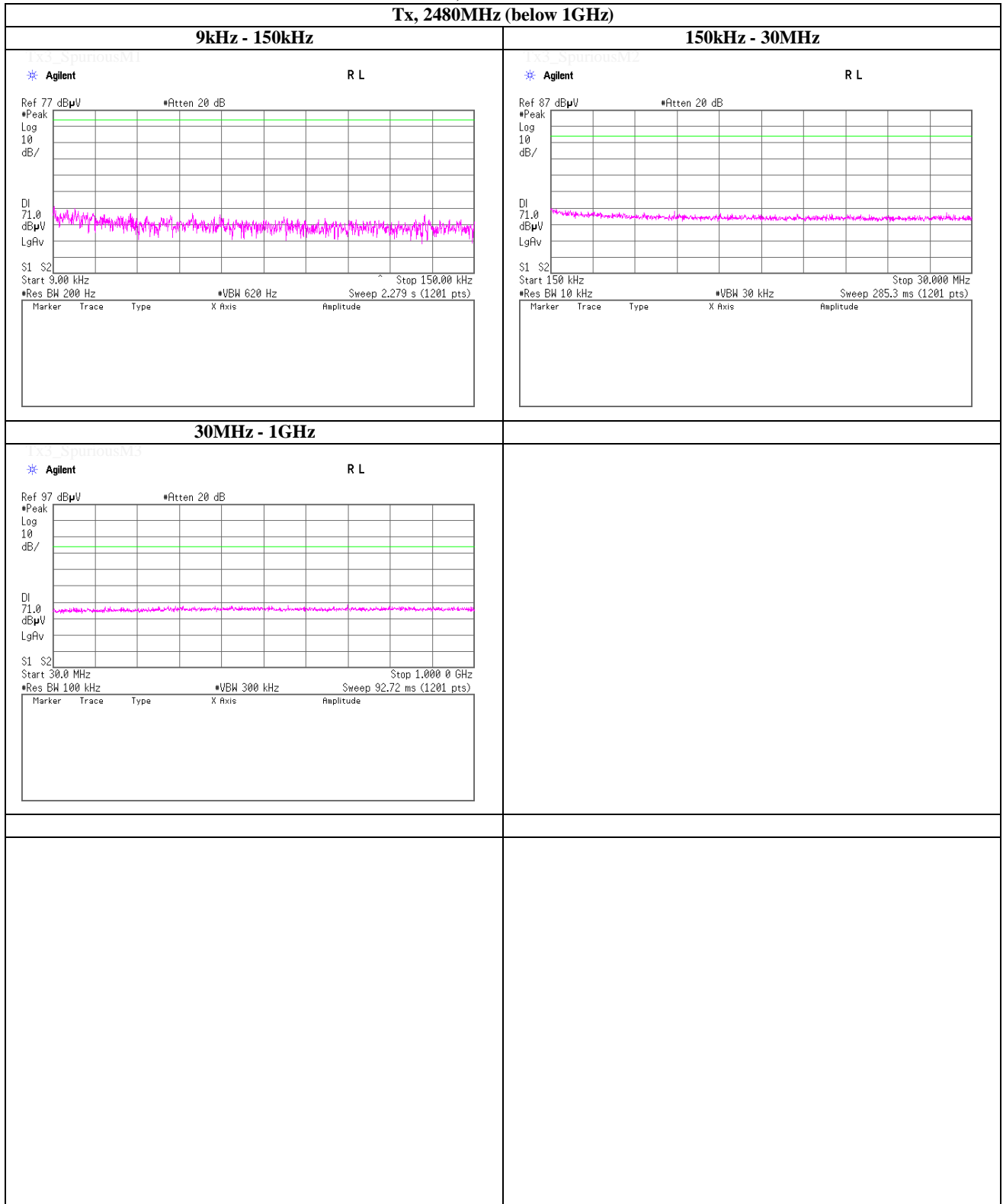
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Test place: UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room  
 Date: October 17, 2013, Temperature / Humidity: 23deg.C , 45%RH  
 Engineer: Hikaru Shirasawa

**(Reference chart) Spurious emission (Conducted)**

**Tx, Bluetooth LE**

**Tx, 2480MHz (below 1GHz)**



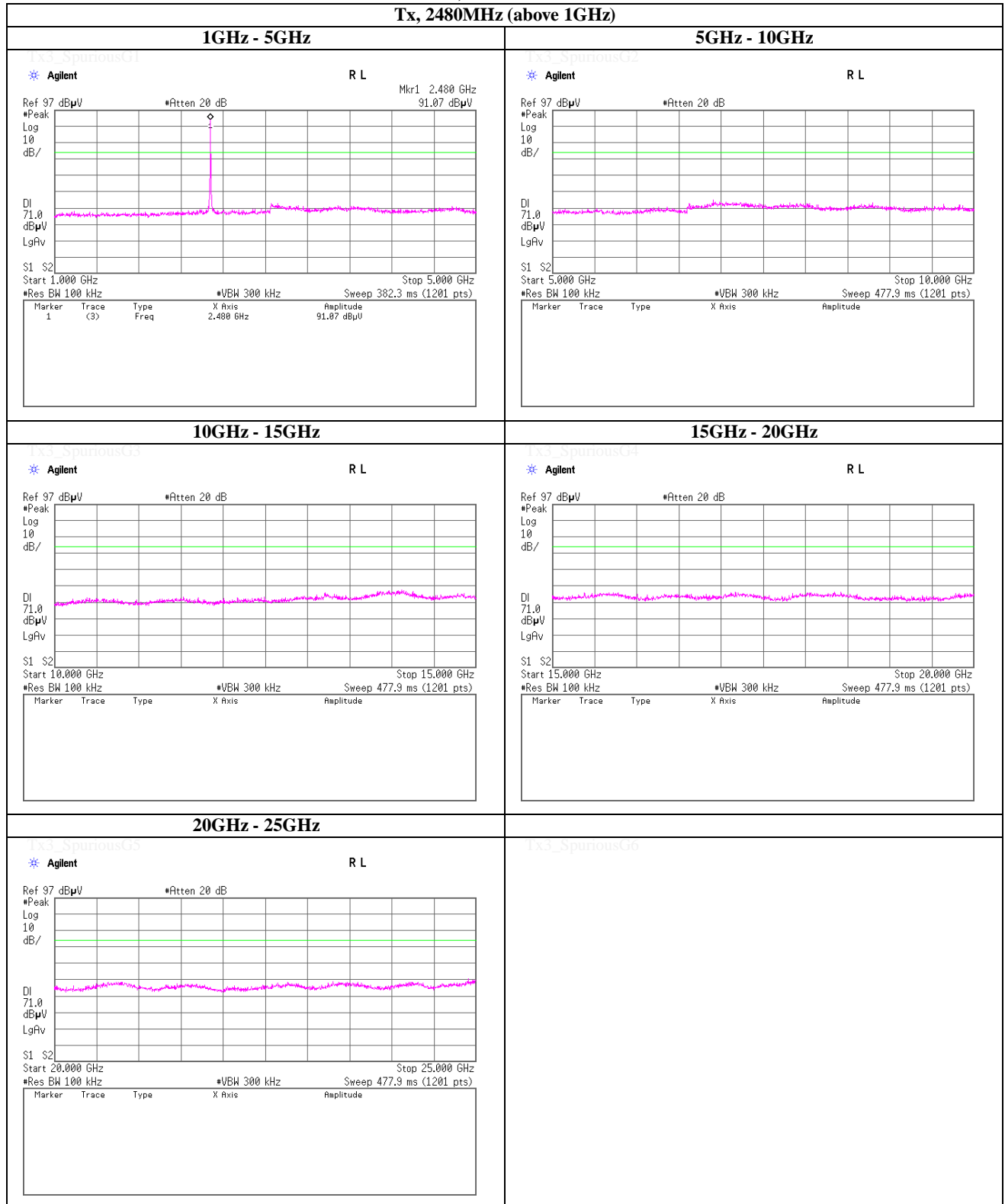
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Test place: UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room  
 Date: October 17, 2013, Temperature / Humidity: 23deg.C , 45%RH  
 Engineer: Hikaru Shirasawa

**(Reference chart) Spurious emission (Conducted)**

**Tx, Bluetooth LE**

**Tx, 2480MHz (above 1GHz)**

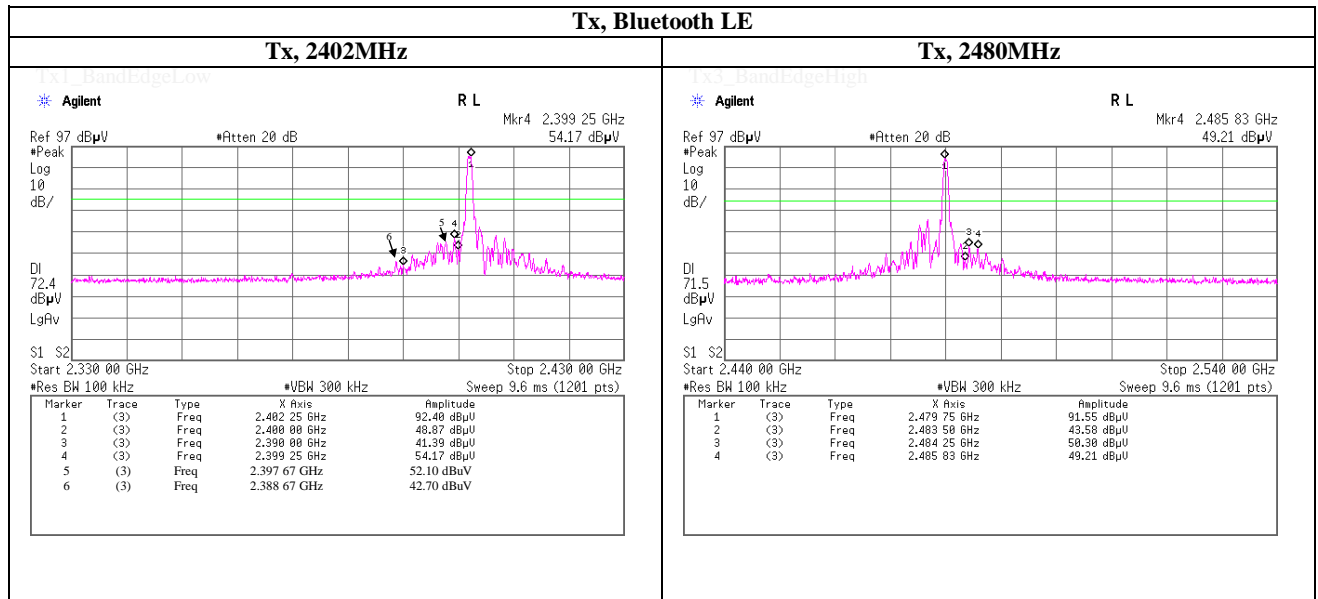


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Test place: UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room  
 Date: October 17, 2013, Temperature / Humidity: 23deg.C , 45%RH  
 Engineer: Hikaru Shirasawa

**(Reference chart) Spurious emission (Conducted)**

**Band Edge compliance**



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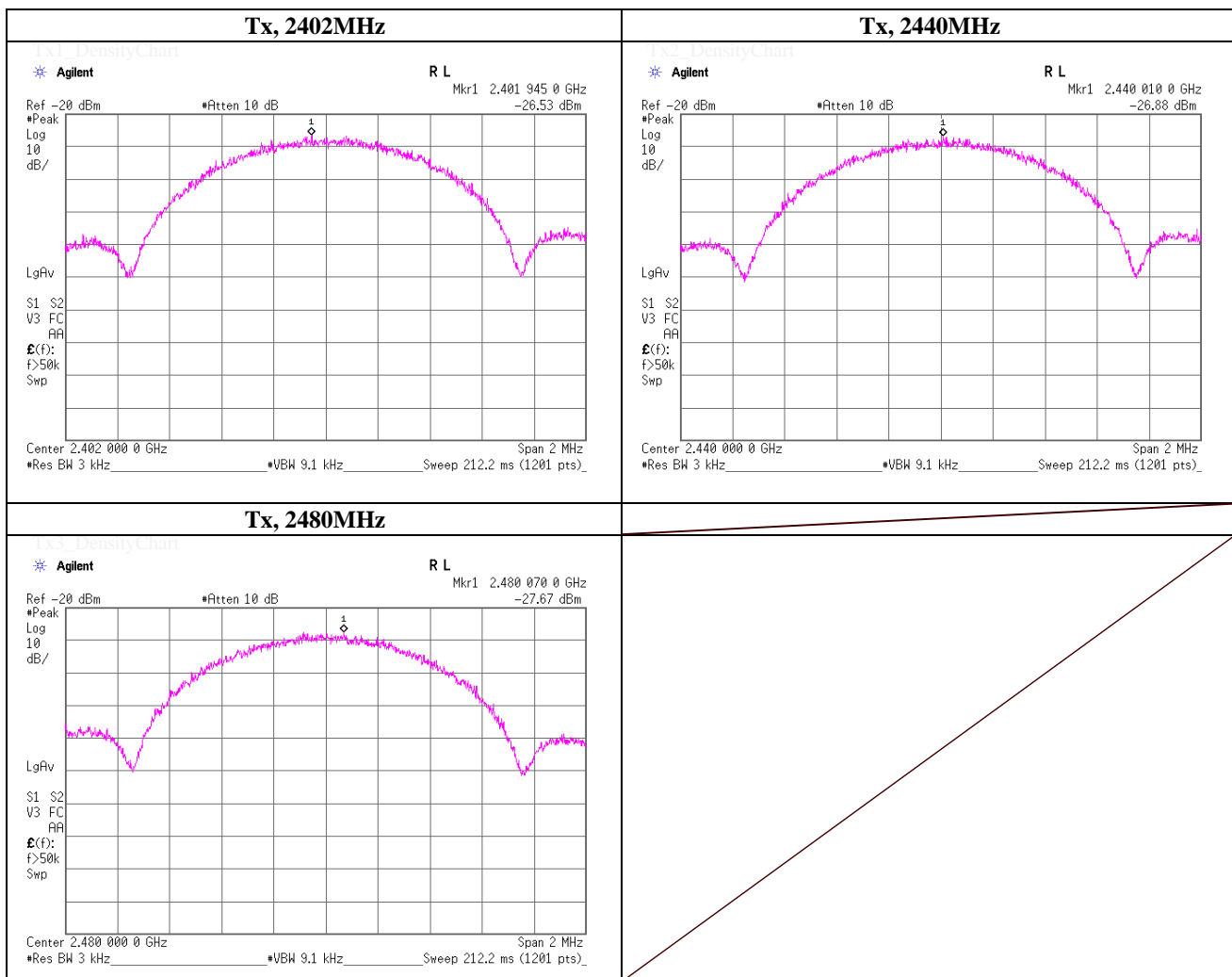


## Maximum Power Spectral Density (PKPSD)

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	October 17, 2013	
Temperature / Humidity	23deg.C , 45%RH	
Engineer	Hikaru Shirasawa	
Mode	Tx, Bluetooth LE	

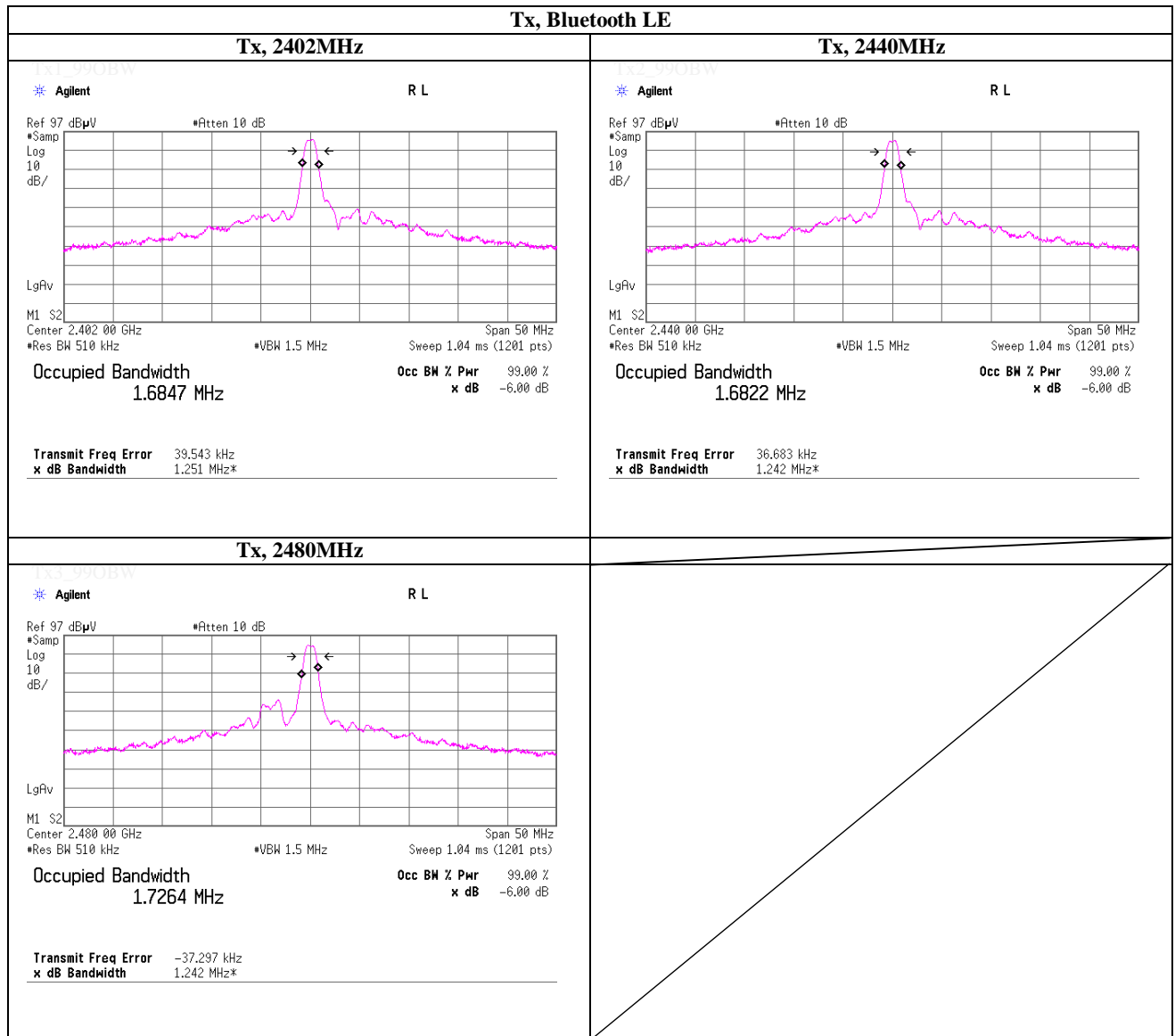
Ch. Freq. [MHz]	Freq. Reading [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.0000	2401.95	-26.53	0.87	9.62	-16.04	8.00	24.04
2440.0000	2440.01	-26.88	0.88	9.63	-16.37	8.00	24.37
2480.0000	2480.07	-27.67	0.88	9.63	-17.16	8.00	25.16

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



Test place: UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room  
 Date: October 17, 2013, Temperature / Humidity: 23deg.C , 45%RH  
 Engineer: Hikaru Shirasawa

### 99% Occupied Bandwidth



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## APPENDIX 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	2013/01/08 * 12
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2013/04/09 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2013/04/09 * 12
SCC-G11	Coaxial Cable	Suhner	SUCOFLEX 102	31595/2	AT	2013/03/16 * 12
SAT10-09	Attenuator	Weinschel Corp.	54A-10	W5692	AT	2012/11/15 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2013/03/07 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2013/07/09 * 12
SAF-06	Pre Amplifier	TOYO Corporation	TPA0118-36	1440491	RE	2013/07/22 * 12
SCC-G03	Coaxial Cable	Suhner	SUCOFLEX 104A	46499/4A	RE	2013/04/11 * 12
SCC-G23	Coaxial Cable	Suhner	SUCOFLEX 104	297342/4	RE	2013/05/22 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2013/08/19 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2013/02/27 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2013/03/28 * 12
SJM-11	Measure	PROMART	SEN1935	-	RE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE, RFLMF)	-	RE	-
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2012/12/18 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2012/12/18 * 12
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2013/03/14 * 12
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	00000018	RE	2013/03/19 * 12
SCC-G18	Coaxial Cable	Suhner	SUCOFLEX 104A	46292/4A	RE	2013/03/16 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2013/02/12 * 12
SAT6-06	Attenuator	JFW	50HF-006N	-	RE	2013/02/12 * 12
SBA-03	Biconical Antenna	Schwarzbeck	BBA9106	91032666	RE	2013/10/26 * 12
SCC-C1/C2/C3/C4/C5/C10/SRSE-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	RE	2013/04/03 * 12
SLA-03	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0901	RE	2013/10/26 * 12
STR-06	Test Receiver	Rohde & Schwarz	ESCI	101259	RE	2013/02/27 * 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 :

RE: Radiated emission,

AT: Antenna terminal disturbance voltage