RADIO TEST REPORT

Test Report No.: 4786002755S-A

Applicant	:	**GAIA Holdings Corporation**
Type of Equipment	:	**JM1**
Model No.	:	**JM1L2**
FCC ID	:	**O8CJM1L2**
Test regulation	:	**FCC Part15 Subpart C: 2012**
Test result	:	**Complied**

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

Date of test: January 21, 2013

Tested by:

Akira Sato
Engineer of WiSE Japan,
UL Verification Service

Approved by :

Go Ishiwata
Manager of WiSE Japan,
UL Verification Service

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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REVISION HISTORY

Original Test Report No.: 4786002755S-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	4786002755S-A	February 1, 2013	-	-

UL Japan, Inc.
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Contents

SECTION 1: Customer information

Company Name	:	GAIA Holdings Corporation
Address	:	Shinjuku Eastside Square 13F 27-30, Shinjuku 6-chome, Shinjuku-ku, Tokyo, 160-0022 Japan
Telephone Number	:	+81-50-3786-1702
Facsimile Number	:	+81-50-3730-5857
Contact Person	:	Isamu Shimosako

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

2.1 Identification of E.U.T.

Type of Equipment	:	JM1
Model Number	:	JM1L2
Serial Number	:	Refer to 4.2 in this report.
Rating	:	DC3.3V
Country of Mass-production	:	Japan, China, Taiwan
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Receipt Date of Sample	:	January 17, 2013
Modification of EUT	:	No modification by the test lab.

2.2 Product description

Model: JM1L2 (referred to as the EUT in this report) is JM1.

Clock frequency(ies) in the system : 16MHz, 32.768kHz

<Radio part>

Equipment type	:	Transceiver
Frequency of operation	:	2402-2480MHz
Bandwidth	:	79MHz
Channel spacing	:	2MHz
Type of modulation	:	DSSS
Antenna type	:	Chip
Antenna gain	:	0.5dBi
Antenna connector type	:	None
ITU code	:	F1D
Operation temperature range	:	-20 to +75 deg.C

FCC 15.31 (e) / 212
The RF transmitter has its own regulator. The RF transmitter is constantly provided voltage (DC1.35V) through the regulator regardless of input voltage. Therefore, the equipment complies with the requirement.

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

SECTION 3: Test specification, procedures & results

3.1 Test specification

Test specification : FCC Part 15 Subpart C: 2012, final revised on December 27, 2012 and effective January 28, 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 December 27, 2012 does not affect the test specification applied to the EUT.

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	20.2dB Freq.: 0.41400MHz Detector: QP Phase: N Mode: Tx 2440MHz	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	10.1dB 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 (FCC), "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".						

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.

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	3.6 dB	3.5 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	4.9 dB
	300MHz-1GHz	5.0 dB	5.2 dB	4.9 dB
	1GHz-15GHz	4.8 dB	4.8 dB	4.9 dB
Radiated emission (Measurement distance: 1m)	15GHz-18GHz	5.6 dB	5.6 dB	5.6 dB
	18GHz-40GHz	4.6 dB	4.3 dB	4.4 dB

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

Conducted emission test

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

Radiated emission test

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

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

UL Japan, Inc. Shonan EMC Lab.
1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
Telephone number : +81 463 50 6400
Facsimile number : +81 463 50 6401
JAB Accreditation No. : RTL02610

	FCC Registration No.	IC Registration No.	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
☐ No.1 semi-anechoic chamber	697847	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
☒ No.2 semi-anechoic chamber	697847	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
☐ No.3 semi-anechoic chamber	697847	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	-

3.6 Test setup, Data of EMI & Test instruments

Refer to APPENDIX 3 to 3.

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

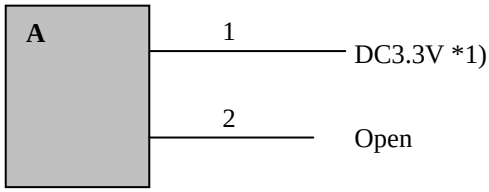
4.1 Operating mode

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

*EUT has the power settings by the software as follows;
Power settings: "0005"(Transmit power level)
Test software: CSR uEnergy Test Application, version 2.0.0.99

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

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	JM1	JM1L2	*2)	GAIA Holdings	-

*1) DC Power Supply (Model No.: PAN55-20A) was used for DC input.
*2) Conducted / Radiated emission: 40095B, Other test: 400913

List of cables used

No.	Cable Name	Length (m)	Shield		Remark
			Cable	Connector	
1	DC	*3)	Unshielded	Unshielded	-
2	SPI	0.3	Unshielded	Unshielded	-

*3) Conducted / Radiated emission: 2.5m, Other test: 0.5m.

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 EUT, including peripherals was aligned and was flushed with rear of tabletop. All other surfaces of tabletop were at least 80cm from any other grounded conducting surface. EUT was located 80cm from LISN.
Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the input power source.
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 host device within a Shielded room. The EUT was connected to a Line Impedance Stabilization Network (LISN) via host device.
An overview sweep with peak detection has been performed.
The measurements had been performed with a quasi-peak detector and if required, an average detector.
The conducted emission measurements were made with the following detection of the test receiver.

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

5.5 Results

Summary of the test results : Pass
Refer to APPENDIX 1

SECTION 6: Radiated emission

6.1 Operating environment

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

6.2 Test configuration

EUT was placed on a 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.

6.3 Test conditions

Frequency range : 30MHz to 25GHz
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 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

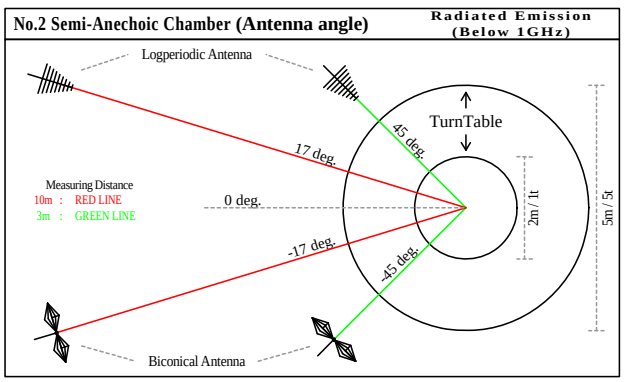
*1) Average Power Measurement was measured based on 10.2.3.3 and 8.2.1 of "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

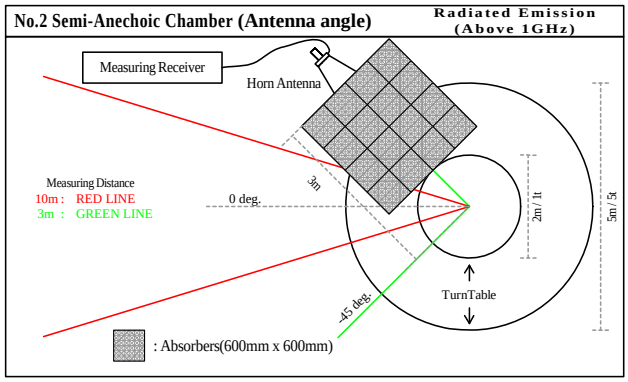
The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

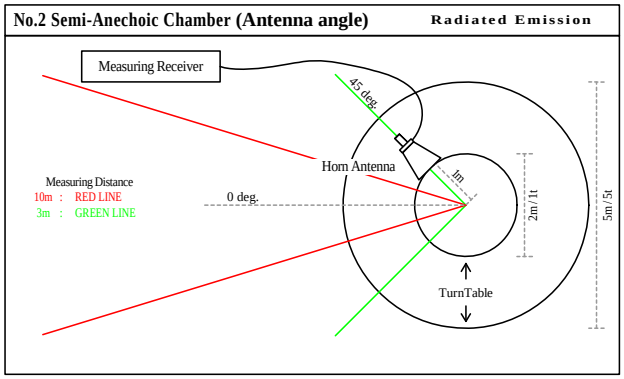
Worst case:

Antenna polarization	Carrier (Band edge)	Spurious	
		Below 1GHz	Above 1GHz
Horizontal	X	X	X
Vertical	X	X	X

Figure 1. Antenna angle







6.5 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.

6.6 Results

Summary of the test results : Pass

* No noise was detected above the 3th order harmonics.

Refer to APPENDIX 1

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

Test procedure
The Out of Band Emissions was measured with a spectrum analyzer connected to the antenna port.
In any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.
In the frequency range below 30MHz, RBW was narrowed to separate the noise contents.
Then, wide-band noise near the limit was checked separately, however the noise was not detected as shown in the chart.
(9kHz-150kHz:RBW=200Hz, 150kHz-30MHz:RBW=10kHz)

Summary of the test results: Pass
Refer to APPENDIX 1

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

Test procedure
The bandwidth was measured with a spectrum analyzer connected to the antenna port.
The test was measured based on Method 7.1 Option 1 and 7.2 Option 2 of "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 9: 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 8.1.3 Option 3 of "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 10: 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 9.1 Option 1 of "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

Summary of the test results: Pass
Refer to APPENDIX 1

Contents of APPENDIXES

APPENDIX 1: Data of Radio tests

Conducted emission
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

Conducted emission
Radiated emission
Pre-check of worst position

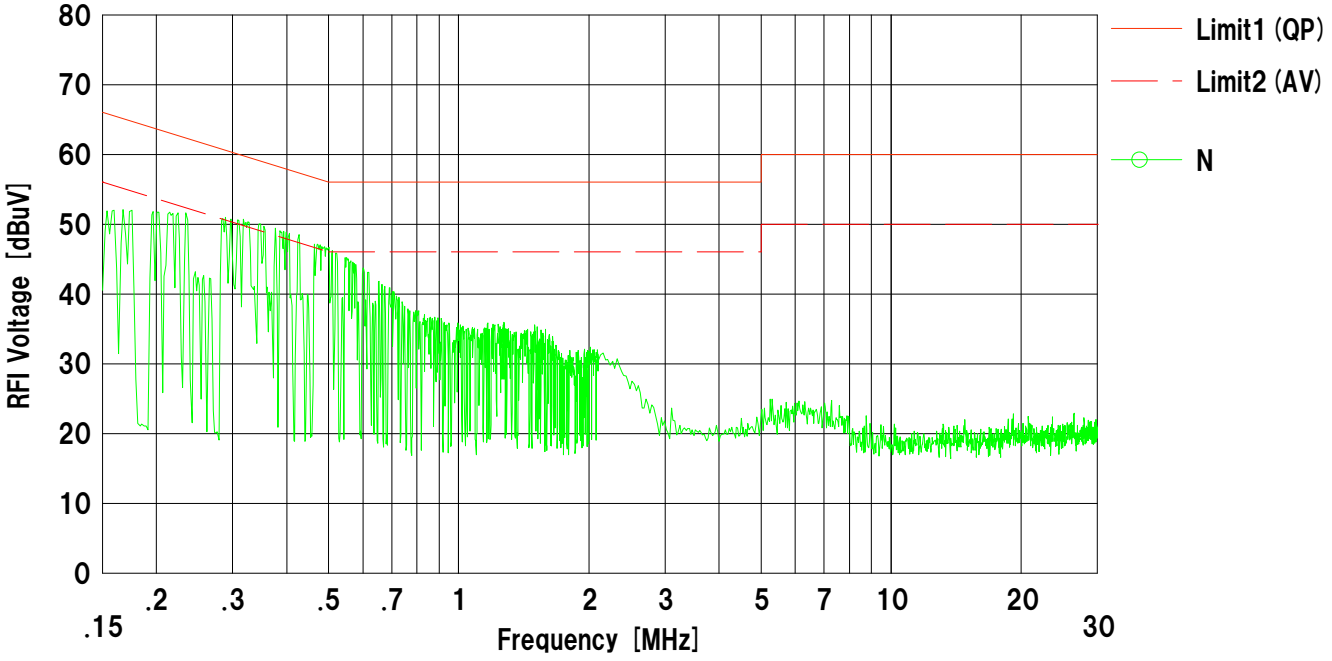
DATA OF CONDUCTED EMISSION TEST

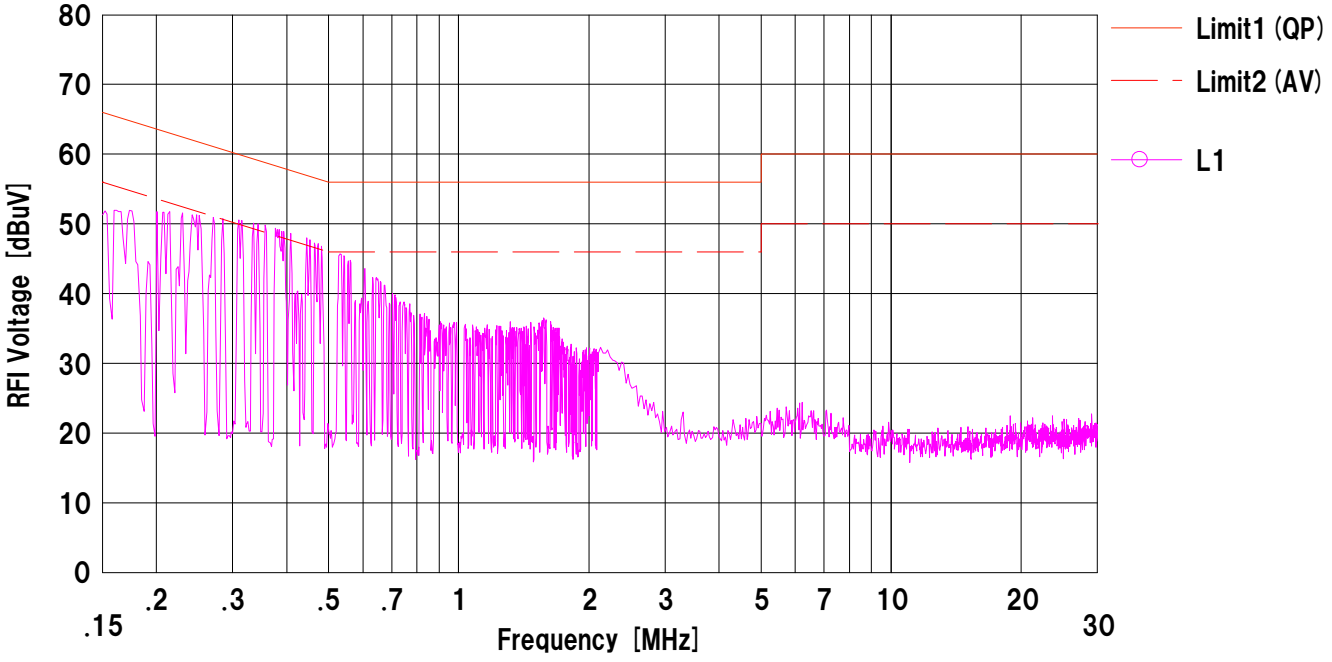
UL Japan,Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2013/01/22

Company	: GAIA Holdings Corporation	Mode	: Tx 2402MHz
Kind of EUT	: JM1	Report No.	: 4786002755S-A
Model No.	: JM1L2	Power	: DC3.3V
Serial No.	: 40095B	Temp./Humi.	: 22deg.C. / 42%RH
Remarks	: DC Power Supply Unit (AC120V/60Hz)		

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

Engineer : Akira Sato





Calculation:Result [dBuV] =Reading [dBuV] +C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-03

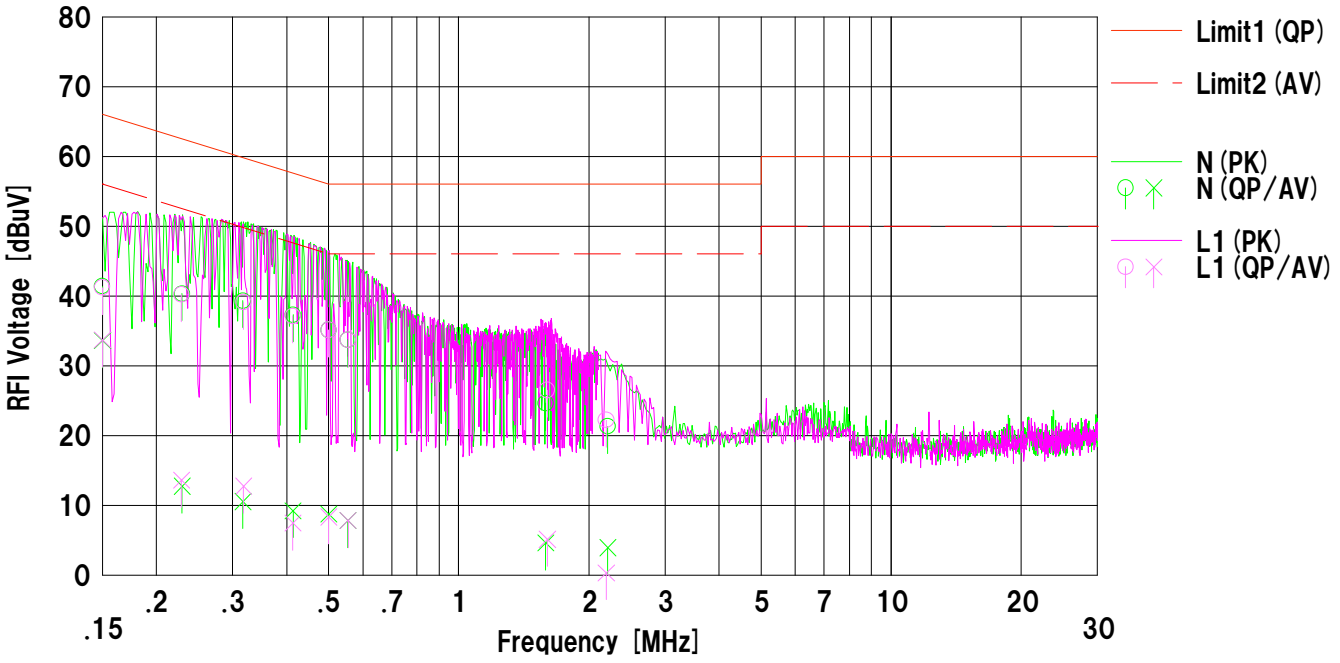
DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2013/01/22

Company	: GAIA Holdings Corporation	Mode	: Tx 2440MHz
Kind of EUT	: JM1	Report No.	: 4786002755S-A
Model No.	: JM1L2	Power	: DC3.3V
Serial No.	: 40095B	Temp./Humi.	: 22deg.C. / 42%RH
Remarks	: DC Power Supply Unit (AC120V/60Hz)		

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

Engineer : Akira Sato



No.	Freq.	Reading <QP>	Reading <AV>	C.Fac	Results <QP>	Results <AV>	Limit <QP>	Limit <AV>	Margin <QP>	Margin <AV>	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	28.8	21.0	12.6	41.4	33.6	66.0	56.0	24.6	22.4	N	
2	0.22940	27.7	0.1	12.6	40.3	12.7	62.4	52.4	22.1	39.7	N	
3	0.31700	26.7	-2.1	12.6	39.3	10.5	59.7	49.7	20.4	39.2	N	
4	0.41400	24.7	-3.4	12.6	37.3	9.2	57.5	47.5	20.2	38.3	N	
5	0.50040	22.5	-3.9	12.6	35.1	8.7	56.0	46.0	20.9	37.3	N	
6	0.55470	21.1	-4.8	12.6	33.7	7.8	56.0	46.0	22.3	38.2	N	
7	1.58940	11.9	-8.1	12.7	24.6	4.6	56.0	46.0	31.4	41.4	N	
8	2.21060	8.6	-8.8	12.7	21.3	3.9	56.0	46.0	34.7	42.1	N	
9	0.15000	28.6	21.1	12.6	41.2	33.7	66.0	56.0	24.8	22.3	L1	
10	0.22860	27.6	1.0	12.6	40.2	13.6	62.5	52.5	22.3	38.9	L1	
11	0.31780	26.5	0.1	12.6	39.1	12.7	59.7	49.7	20.6	37.0	L1	
12	0.41310	24.5	-5.2	12.6	37.1	7.4	57.5	47.5	20.4	40.1	L1	
13	0.50002	22.5	-4.3	12.6	35.1	8.3	56.0	46.0	20.9	37.7	L1	
14	0.55480	21.1	-4.8	12.6	33.7	7.8	56.0	46.0	22.3	38.2	L1	
15	1.60400	13.8	-7.6	12.7	26.5	5.1	56.0	46.0	29.5	40.9	L1	
16	2.19500	9.5	-12.4	12.7	22.2	0.3	56.0	46.0	33.8	45.7	L1	

Calculation:Result [dBuV] =Reading [dBuV] +C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-03

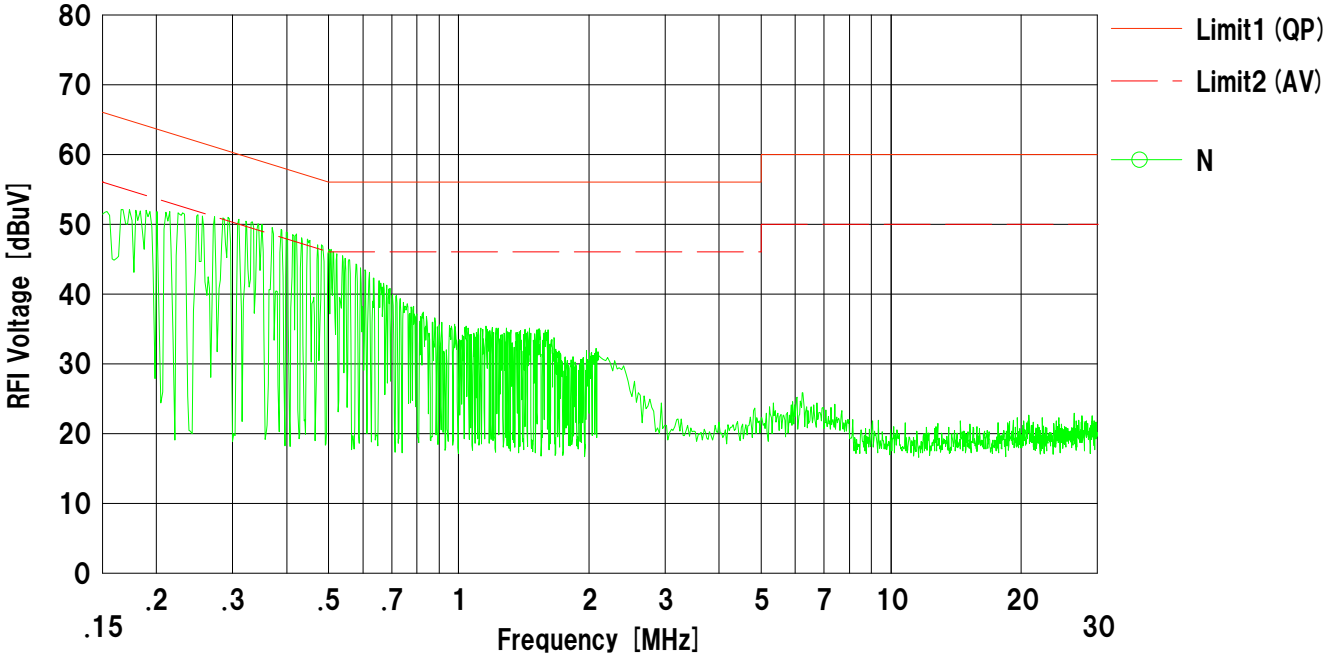
DATA OF CONDUCTED EMISSION TEST

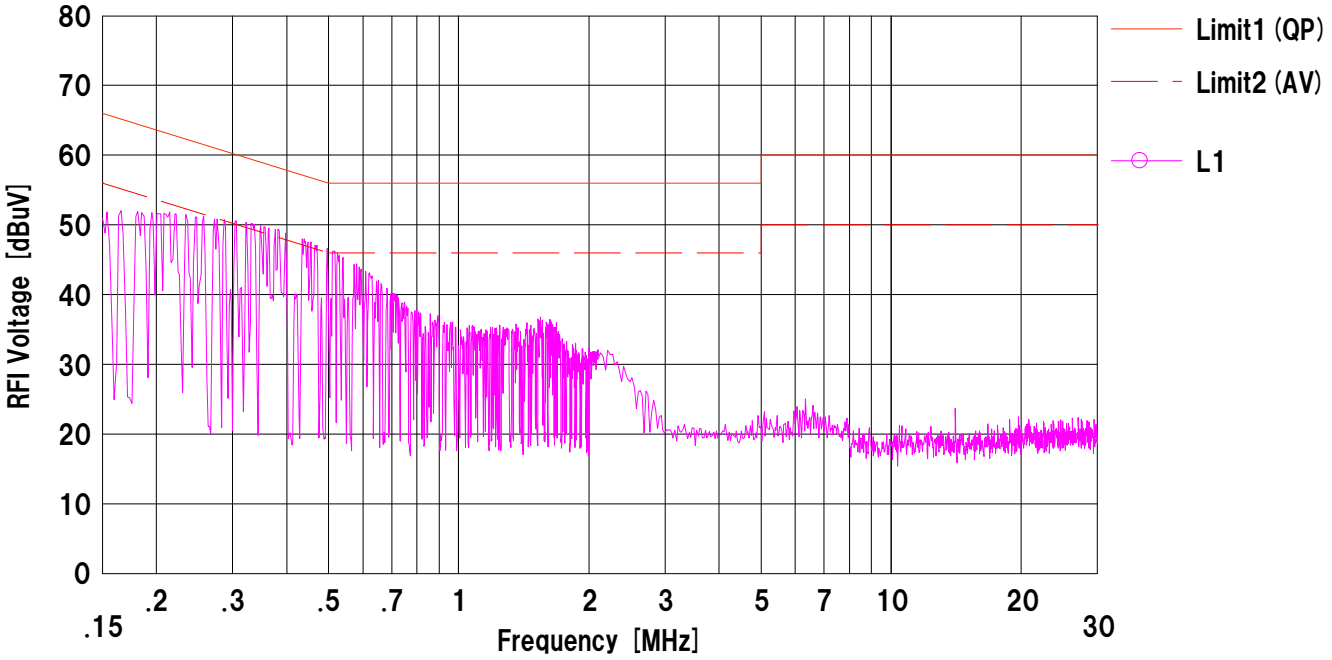
UL Japan,Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2013/01/22

Company	: GAIA Holdings Corporation	Mode	: Tx 2480MHz
Kind of EUT	: JM1	Report No.	: 4786002755S-A
Model No.	: JM1L2	Power	: DC3.3V
Serial No.	: 40095B	Temp./Humi.	: 22deg.C. / 42%RH
Remarks	: DC Power Supply Unit (AC120V/60Hz)		

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

Engineer : Akira Sato





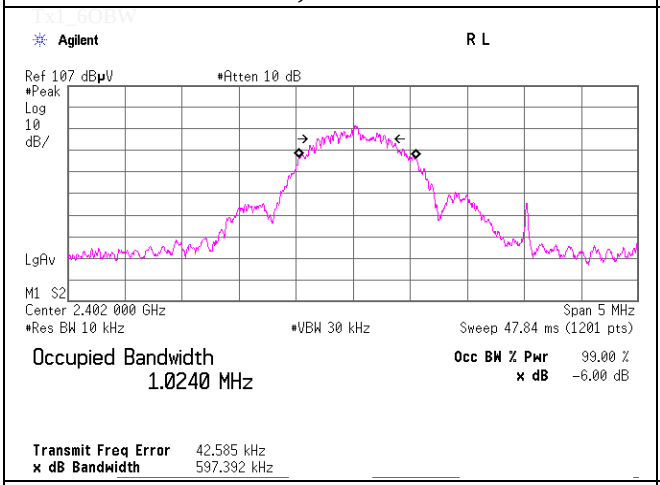
Calculation:Result [dBuV] =Reading [dBuV] +C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-03

-6dB Bandwidth

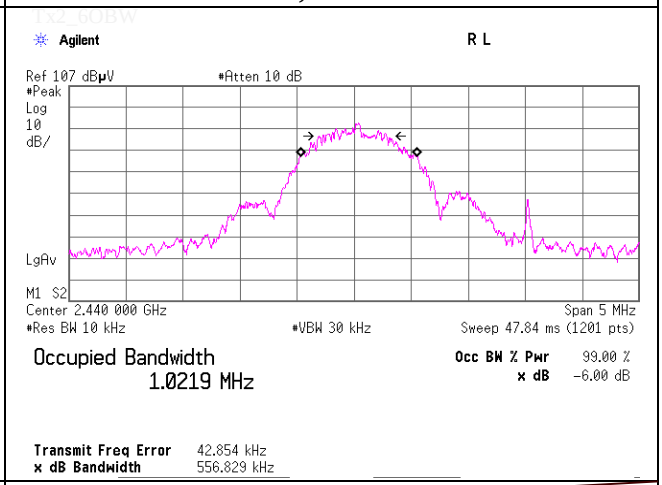
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	January 21, 2013	
Temperature / Humidity	23deg.C , 48%RH	
Engineer	Shinichi Takano	
Mode	Tx, Bluetooth Low Energy, PN9	

Freq. [MHz]	-6dB Bandwidth [MHz]	Limit [MHz]
2402.0000	0.597	> 0.500
2440.0000	0.557	> 0.500
2480.0000	0.593	> 0.500

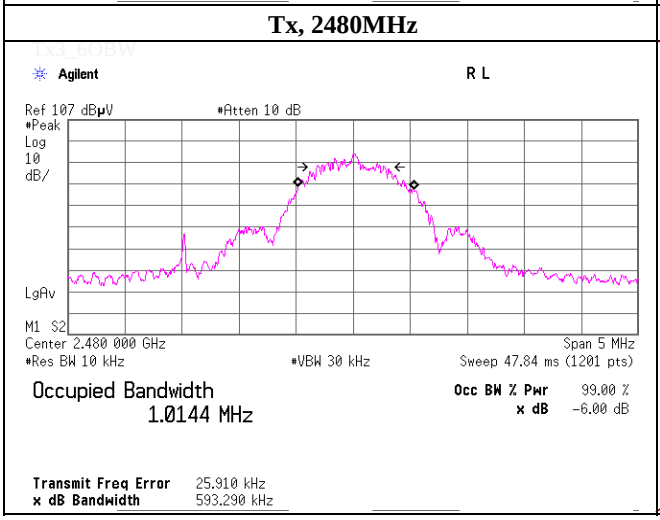
Tx, 2402MHz



Tx, 2440MHz



Tx, 2480MHz



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Maximum Peak Conducted Output Power

(Option 3)

Test place	UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room
Date	January 21, 2013
Temperature / Humidity	23deg.C , 48%RH
Engineer	Shinichi Takano
Mode	Tx, Bluetooth Low Energy, 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	2402.0	-9.96	0.50	9.97	0.51	1.12	30.00	1000	29.49
Mid	2440.0	-9.14	0.50	9.97	1.33	1.36	30.00	1000	28.67
High	2480.0	-8.16	0.50	9.97	2.31	1.70	30.00	1000	27.69

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.2 Semi Anechoic Chamber
Date	January 21, 2013	January 22, 2013	
Temperature / Humidity	24 deg.C , 34 %RH	24 deg.C , 34 %RH	
Engineer	Akira Sato	Akira Sato	
Mode	Tx, 2402 MHz		
	Tx, Bluetooth, Low Energy, PRBS9		

(* 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.	588.010	QP	33.0	18.9	8.7	31.7	28.9	46.0	17.1	208	327	
Hori.	652.104	QP	35.1	19.8	9.0	31.7	32.2	46.0	13.8	138	357	
Hori.	2337.963	PK	43.8	27.2	14.0	38.2	46.8	73.9	27.1	100	181	
Hori.	2390.000	PK	43.1	27.2	14.1	38.2	46.2	73.9	27.7	100	181	
Hori.	2529.617	PK	43.0	27.5	14.1	38.1	46.5	73.9	27.4	100	181	
Hori.	2562.555	PK	43.8	27.5	14.1	38.1	47.3	73.9	26.6	100	50	
Hori.	4804.000	PK	44.5	30.7	6.5	37.0	44.7	73.9	29.2	100	103	
Hori.	7206.000	PK	43.6	36.2	8.0	39.0	48.8	73.9	25.1	100	2	
Vert.	183.999	QP	29.7	16.9	9.0	31.8	23.8	43.5	19.7	102	172	
Vert.	215.999	QP	32.8	17.1	9.6	31.8	27.7	43.5	15.8	100	62	
Vert.	220.009	QP	31.2	17.2	9.7	31.8	26.3	46.0	19.7	100	72	
Vert.	292.006	QP	33.0	18.8	10.9	31.7	31.0	46.0	15.0	100	181	
Vert.	654.354	QP	35.9	19.9	9.0	31.7	33.1	46.0	12.9	100	216	
Vert.	2338.362	PK	44.2	27.2	14.0	38.2	47.2	73.9	26.7	100	103	
Vert.	2390.000	PK	44.1	27.2	14.1	38.2	47.2	73.9	26.7	100	103	
Vert.	2529.875	PK	44.3	27.5	14.1	38.1	47.8	73.9	26.1	100	103	
Vert.	2563.250	PK	45.2	27.5	14.1	38.1	48.7	73.9	25.2	100	103	
Vert.	4804.000	PK	43.9	30.7	6.5	37.0	44.1	73.9	29.8	100	221	
Vert.	7206.000	PK	43.4	36.2	8.0	39.0	48.6	73.9	25.3	100	1	

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	2337.963	AV	34.1	27.2	14.0	38.2	3.7	40.8	53.9	13.1	100	181	
Hori.	2390.000	AV	34.2	27.2	14.1	38.2	3.7	41.0	53.9	12.9	100	181	*1)
Hori.	2529.617	AV	34.1	27.5	14.1	38.1	3.7	41.3	53.9	12.6	100	181	
Hori.	2562.555	AV	33.7	27.5	14.1	38.1	3.7	40.9	53.9	13.0	100	50	
Hori.	4804.000	AV	36.8	30.7	6.5	37.0	3.7	40.7	53.9	13.2	100	103	
Hori.	7206.000	AV	34.5	36.2	8.0	39.0	3.7	43.4	53.9	10.5	100	2	
Vert.	2338.362	AV	34.5	27.2	14.0	38.2	3.7	41.2	53.9	12.7	100	103	
Vert.	2390.000	AV	34.3	27.2	14.1	38.2	3.7	41.1	53.9	12.8	100	103	*1)
Vert.	2529.875	AV	34.3	27.5	14.1	38.1	3.7	41.5	53.9	12.4	100	103	
Vert.	2563.250	AV	34.6	27.5	14.1	38.1	3.7	41.8	53.9	12.1	100	103	
Vert.	4804.000	AV	35.2	30.7	6.5	37.0	3.7	39.1	53.9	14.8	100	221	
Vert.	7206.000	AV	34.5	36.2	8.0	39.0	3.7	43.4	53.9	10.5	100	1	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier) + Duty factor (refer to "Duty Factor Calculation")

*8.2.4 Alternative 1 was applied to AV detection, since the duty cycle is less than 98% and video triggering or signal gating cannot be used.

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

*1): Not out of Band emission (Leakage Power)

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.	2402.000	PK	84.1	27.3	14.1	38.2	87.3	-	-	
Hori.	2400.000	PK	38.9	27.3	14.1	38.2	42.1	67.3	25.2	
Vert.	2402.000	PK	82.0	27.3	14.1	38.2	85.2	-	-	
Vert.	2400.000	PK	38.2	27.3	14.1	38.2	41.4	65.2	23.8	

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

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Radiated Emission

Test place	UL Japan, Inc. Shonan EMC Lab.		No.2 Semi Anechoic Chamber
Date	January 21, 2013	January 22, 2013	
Temperature / Humidity	24 deg.C , 34 %RH	24 deg.C , 34 %RH	
Engineer	Akira Sato	Akira Sato	
Mode	Tx, 2440 MHz		
	Tx, Bluetooth, Low Energy, PRBS9		

(* 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.	592.014	QP	35.8	19.0	8.7	31.7	31.8	46.0	14.2	203	354	
Hori.	654.107	QP	35.4	19.9	9.0	31.7	32.6	46.0	13.4	159	1	
Hori.	2504.080	PK	44.8	27.4	14.1	38.1	48.2	73.9	25.7	100	178	
Hori.	2520.000	PK	43.4	27.5	14.1	38.1	46.9	73.9	27.0	100	178	
Hori.	4880.000	PK	46.7	31.0	6.6	36.9	47.4	73.9	26.5	100	339	
Hori.	7320.000	PK	43.7	36.2	8.0	39.0	48.9	73.9	25.0	100	359	
Vert.	208.003	QP	36.0	17.0	9.5	31.8	30.7	43.5	12.8	100	38	
Vert.	292.007	QP	34.9	18.8	10.9	31.7	32.9	46.0	13.1	100	179	
Vert.	316.029	QP	41.6	14.4	7.1	31.7	31.4	46.0	14.6	100	125	
Vert.	319.999	QP	43.3	14.5	7.1	31.7	33.2	46.0	12.8	100	279	
Vert.	659.367	QP	33.0	19.9	9.0	31.7	30.2	46.0	15.8	154	291	
Vert.	2504.041	PK	43.9	27.4	14.1	38.1	47.3	73.9	26.6	100	123	
Vert.	2519.925	PK	43.2	27.5	14.1	38.1	46.7	73.9	27.2	100	0	
Vert.	4880.000	PK	44.3	31.0	6.6	36.9	45.0	73.9	28.9	117	66	
Vert.	7320.000	PK	43.4	36.2	8.0	39.0	48.6	73.9	25.3	100	3	

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	2504.080	AV	34.5	27.4	14.1	38.1	3.7	41.6	53.9	12.3	100	178	
Hori.	2520.000	AV	34.1	27.5	14.1	38.1	3.7	41.3	53.9	12.6	100	178	
Hori.	4880.000	AV	38.0	31.0	6.6	36.9	3.7	42.4	53.9	11.5	100	339	
Hori.	7320.000	AV	34.5	36.2	8.0	39.0	3.7	43.4	53.9	10.5	100	359	
Vert.	2504.041	AV	34.3	27.4	14.1	38.1	3.7	41.4	53.9	12.5	100	123	
Vert.	2519.925	AV	33.9	27.5	14.1	38.1	3.7	41.1	53.9	12.8	100	0	
Vert.	4880.000	AV	36.3	31.0	6.6	36.9	3.7	40.7	53.9	13.2	117	66	
Vert.	7320.000	AV	34.3	36.2	8.0	39.0	3.7	43.2	53.9	10.7	100	3	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier) + Duty factor (refer to "Duty Factor Calculation")

*8.2.4 Alternative 1 was applied to AV detection, since the duty cycle is less than 98% and video triggering or signal gating cannot be used.

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

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

Radiated Emission

Test place	UL Japan, Inc. Shonan EMC Lab.		No.2 Semi Anechoic Chamber
Date	January 21, 2013	January 22, 2013	
Temperature / Humidity	24 deg.C , 34 %RH	24 deg.C , 34 %RH	
Engineer	Akira Sato	Akira Sato	
Mode	Tx, 2480 MHz		
	Tx, Bluetooth, Low Energy, PRBS9		

(* 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.	592.010	QP	35.3	19.0	8.7	31.7	31.3	46.0	14.7	208	0	
Hori.	656.022	QP	38.0	19.9	9.0	31.7	35.2	46.0	10.8	135	350	
Hori.	2483.500	AV	36.6	27.4	14.1	38.1	40.0	53.9	13.9	132	185	
Hori.	2483.500	PK	56.8	27.4	14.1	38.1	60.2	73.9	13.7	132	185	
Hori.	2512.500	PK	42.9	27.5	14.1	38.1	46.4	73.9	27.5	132	185	
Hori.	2543.993	PK	44.7	27.5	14.1	38.1	48.2	73.9	25.7	132	185	
Hori.	2560.771	PK	44.0	27.5	14.1	38.1	47.5	73.9	26.4	100	0	
Hori.	4960.000	PK	45.8	31.2	6.7	36.8	46.9	73.9	27.0	100	300	
Hori.	7440.000	PK	44.3	36.3	8.1	39.0	49.7	73.9	24.2	100	2	
Vert.	180.000	QP	35.4	16.9	9.0	31.8	29.5	43.5	14.0	100	221	
Vert.	208.006	QP	36.7	17.0	9.5	31.8	31.4	43.5	12.1	100	48	
Vert.	291.998	QP	34.6	18.8	10.9	31.7	32.6	46.0	13.4	100	6	
Vert.	320.005	QP	44.4	14.5	7.1	31.7	34.3	46.0	11.7	100	278	
Vert.	628.013	QP	38.4	19.5	8.9	31.7	35.1	46.0	10.9	100	4	
Vert.	2483.500	AV	36.1	27.4	14.1	38.1	39.5	53.9	14.4	100	172	
Vert.	2483.500	PK	54.5	27.4	14.1	38.1	57.9	73.9	16.0	100	172	
Vert.	2511.735	PK	43.7	27.5	14.1	38.1	47.2	73.9	26.7	100	172	
Vert.	2542.067	PK	43.8	27.5	14.1	38.1	47.3	73.9	26.6	100	172	
Vert.	2560.479	PK	43.5	27.5	14.1	38.1	47.0	73.9	26.9	100	172	
Vert.	4960.000	PK	43.4	31.2	6.7	36.8	44.5	73.9	29.4	128	3	
Vert.	7440.000	PK	44.6	36.3	8.1	39.0	50.0	73.9	23.9	100	358	

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	2512.500	AV	33.9	27.5	14.1	38.1	3.7	37.4	53.9	16.5	132	185	
Hori.	2543.993	AV	34.6	27.5	14.1	38.1	3.7	41.8	53.9	12.1	132	185	
Hori.	2560.771	AV	34.1	27.5	14.1	38.1	3.7	41.3	53.9	12.6	100	0	
Hori.	4960.000	AV	37.9	31.2	6.7	36.8	3.7	42.7	53.9	11.2	100	300	
Hori.	7440.000	AV	34.7	36.3	8.1	39.0	3.7	43.8	53.9	10.1	100	2	
Vert.	2511.735	AV	34.7	27.5	14.1	38.1	3.7	41.9	53.9	12.0	100	172	
Vert.	2542.067	AV	34.2	27.5	14.1	38.1	3.7	41.4	53.9	12.5	100	172	
Vert.	2560.479	AV	34.2	27.5	14.1	38.1	3.7	41.4	53.9	12.5	100	172	
Vert.	4960.000	AV	34.4	31.2	6.7	36.8	3.7	39.2	53.9	14.7	128	3	
Vert.	7440.000	AV	34.4	36.3	8.1	39.0	3.7	43.5	53.9	10.4	100	358	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier) + Duty factor (refer to "Duty Factor Calculation")

*8.2.4 Alternative 1 was applied to AV detection, since the duty cycle is less than 98% and video triggering or signal gating cannot be used.

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

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

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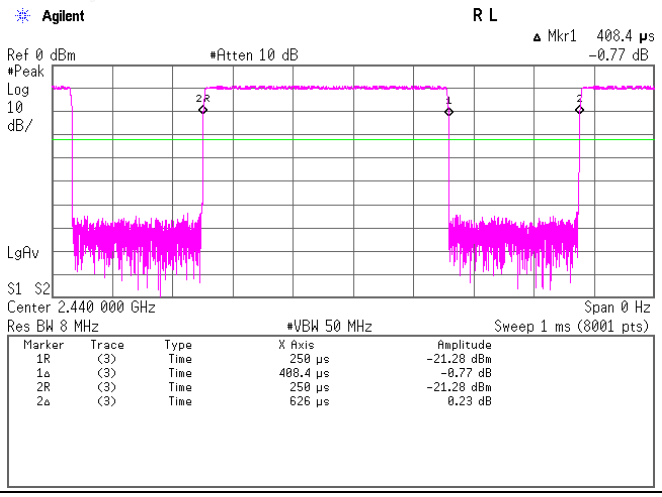
Burst rate confirmation

Tx, Bluetooth Low Energy, PN9

Duty Factor Calculation	
Duty Factor: 20log (1/duty cycle) = 3.7dB	
duty cycle = 0.4084 / 0.6260 = 0.652 (65.2%)	
Tx2_duty1 	Tx2_duty2

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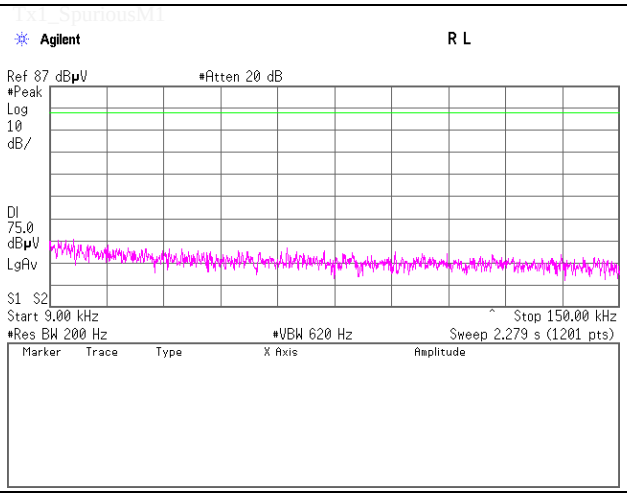
(Reference chart) Spurious emission (Conducted)

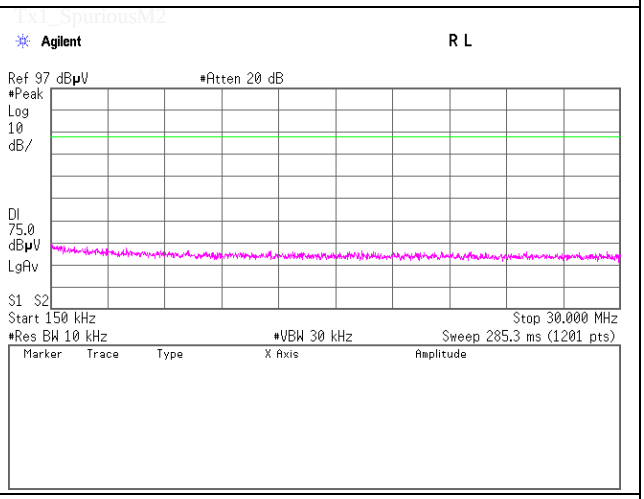
Tx, Bluetooth Low Energy, PN9

Tx, 2402MHz (below 1GHz)

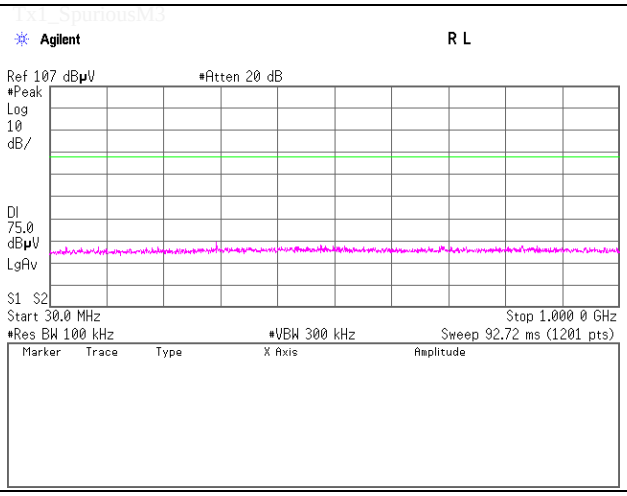
9kHz - 150kHz



150kHz - 30MHz



30MHz - 1GHz



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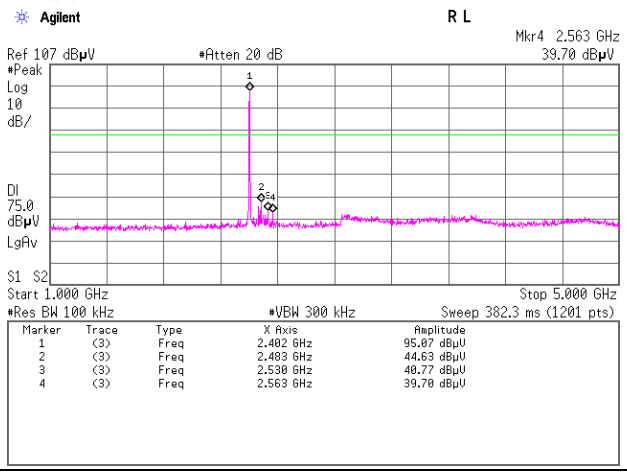
(Reference chart) Spurious emission (Conducted)

Tx, Bluetooth Low Energy, PN9

Tx, 2402MHz (above 1GHz)

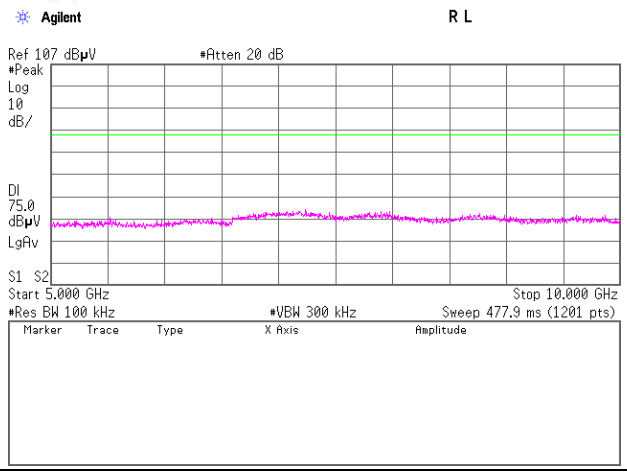
1GHz - 5GHz

Tx1_SpuriousG1



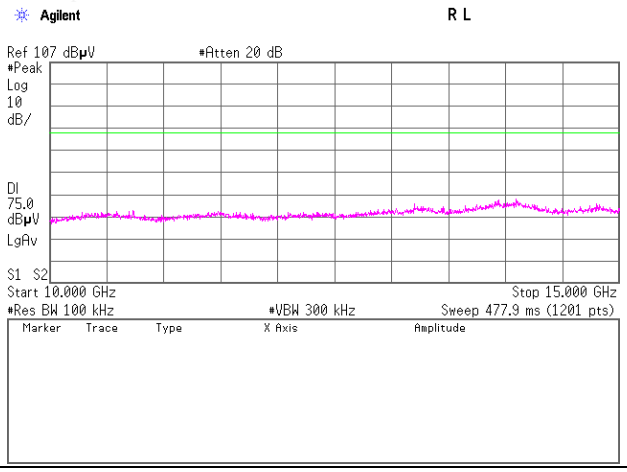
5GHz - 10GHz

Tx1_SpuriousG2



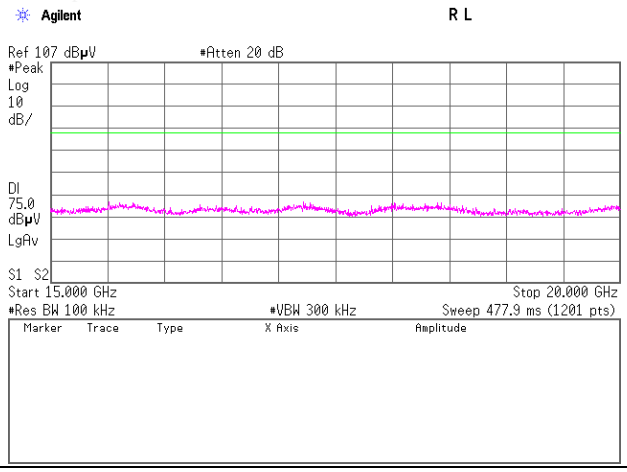
10GHz - 15GHz

Tx1_SpuriousG3



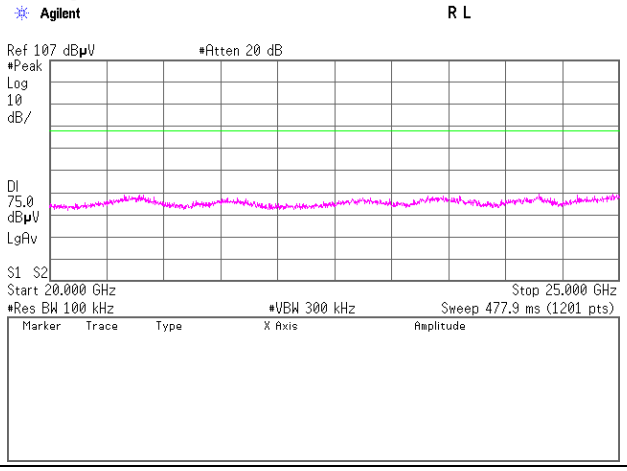
15GHz - 20GHz

Tx1_SpuriousG4



20GHz - 25GHz

Tx1_SpuriousG5



Tx1_SpuriousG6

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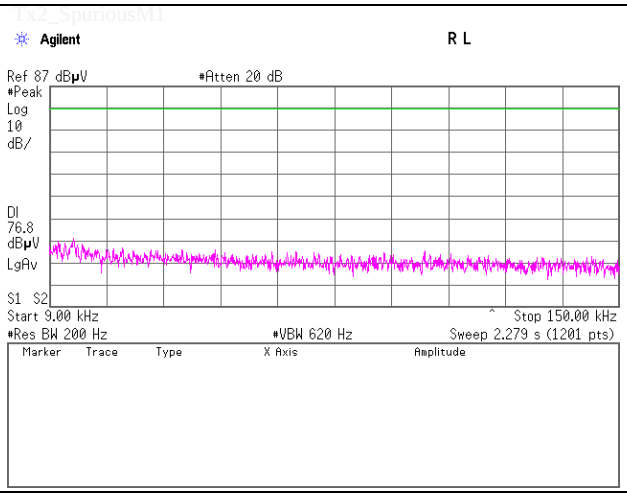
(Reference chart) Spurious emission (Conducted)

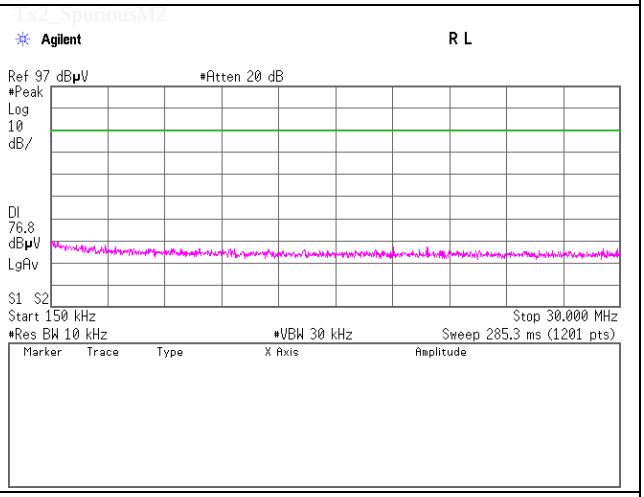
Tx, Bluetooth Low Energy, PN9

Tx, 2440MHz (below 1GHz)

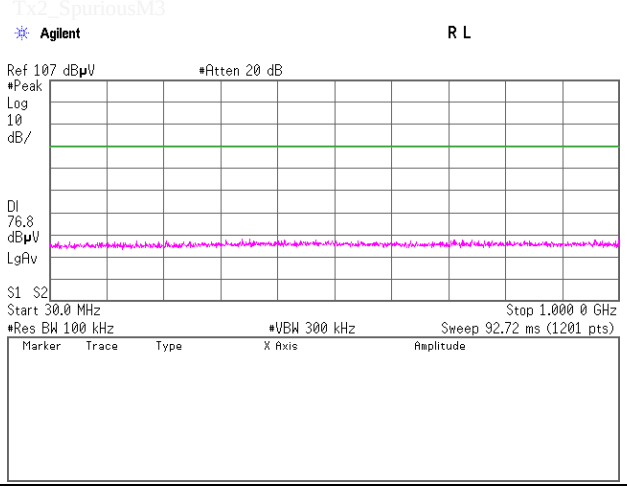
9kHz - 150kHz



150kHz - 30MHz



30MHz - 1GHz



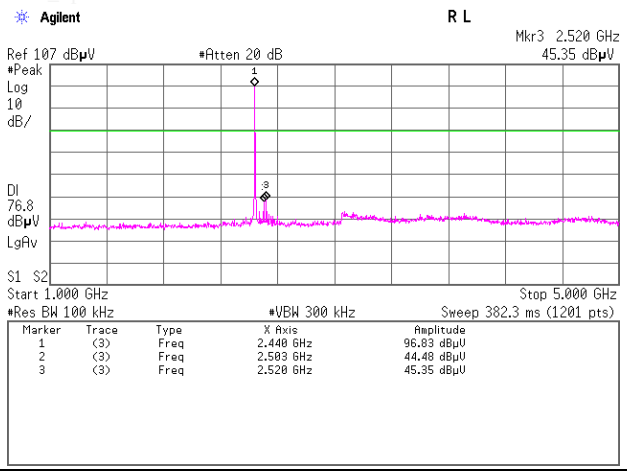
UL Japan, Inc.
Shonan EMC Lab.
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa 259-1220 JAPAN
Telephone : +81 463 50 6400
Facsimile : +81 463 50 6401

(Reference chart) Spurious emission (Conducted)

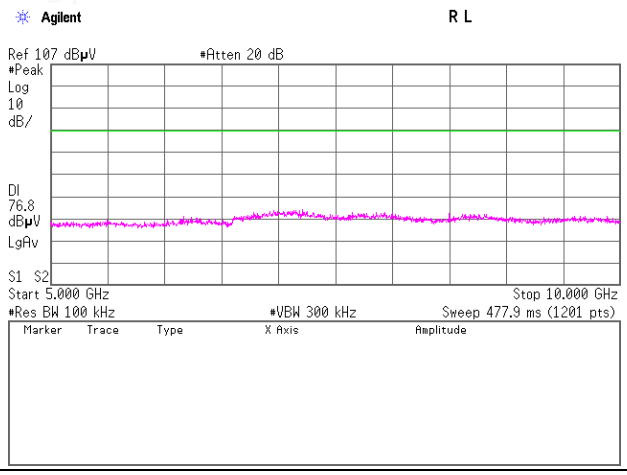
Tx, Bluetooth Low Energy, PN9

Tx, 2440MHz (above 1GHz)

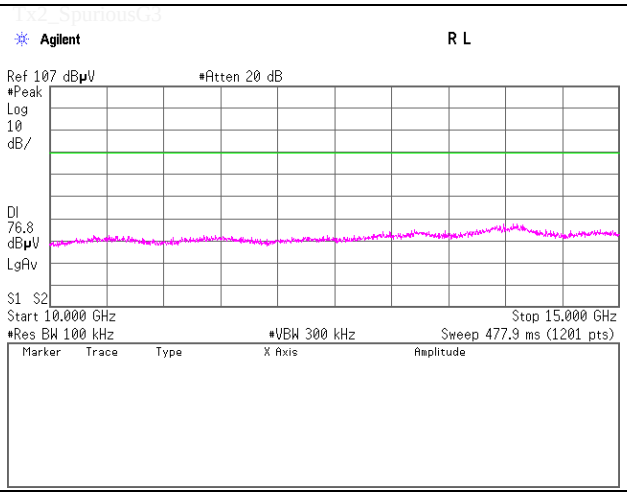
1GHz - 5GHz



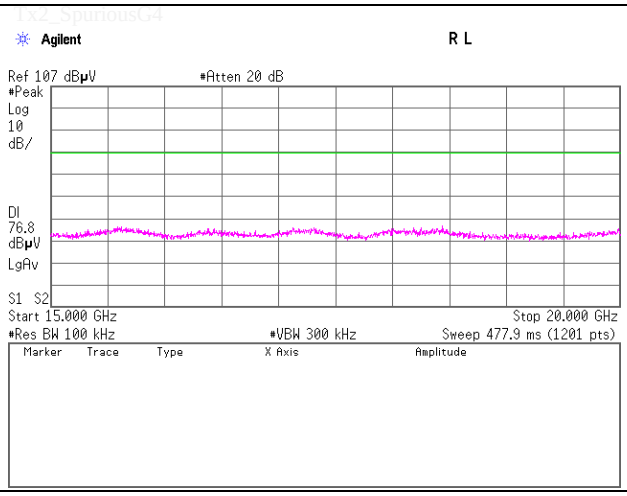
5GHz - 10GHz



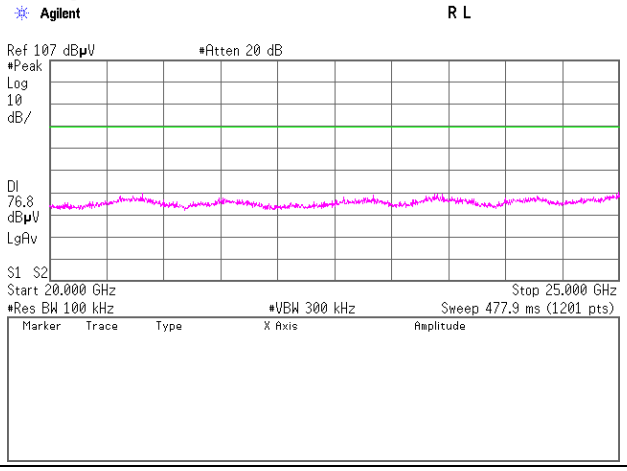
10GHz - 15GHz



15GHz - 20GHz



20GHz - 25GHz



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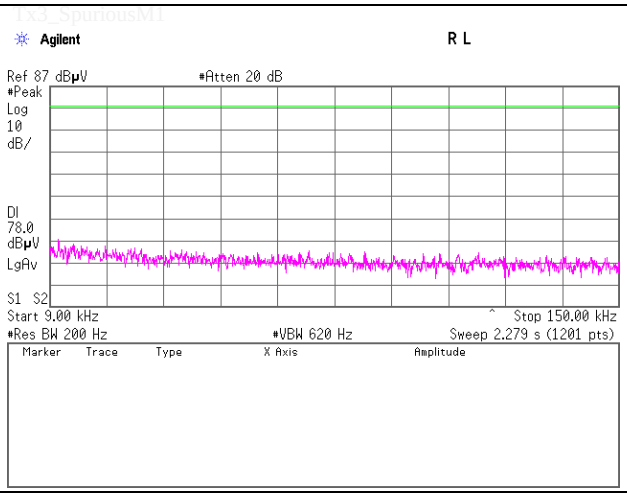
(Reference chart) Spurious emission (Conducted)

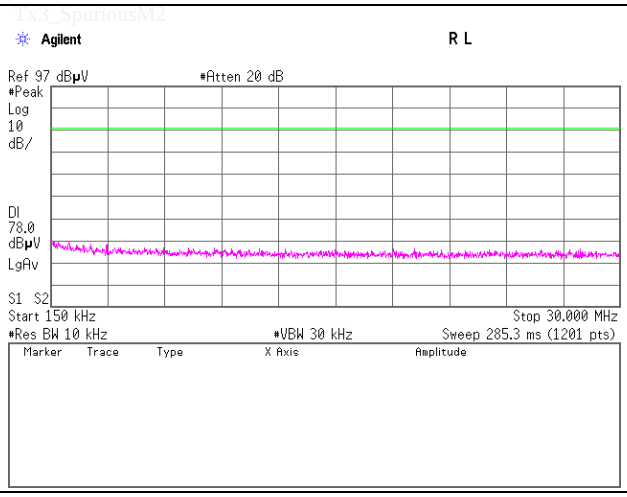
Tx, Bluetooth Low Energy, PN9

Tx, 2480MHz (below 1GHz)

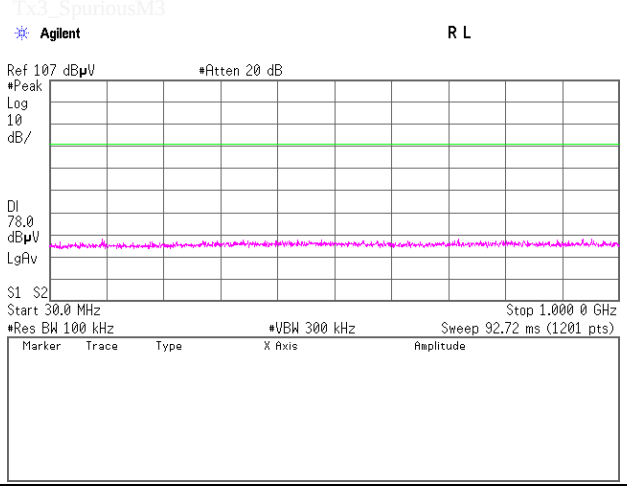
9kHz - 150kHz



150kHz - 30MHz



30MHz - 1GHz



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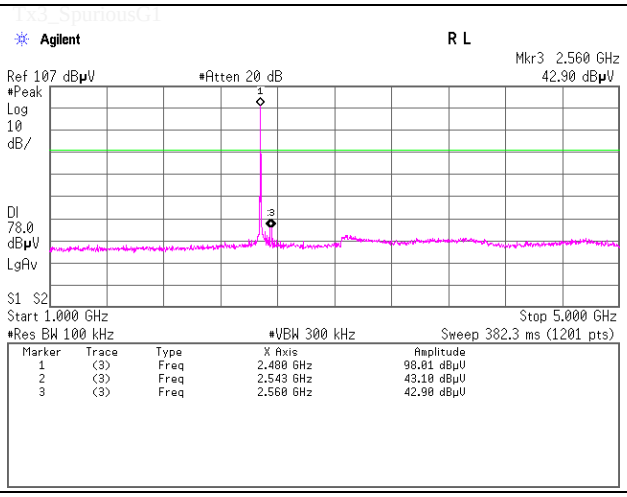
(Reference chart) Spurious emission (Conducted)

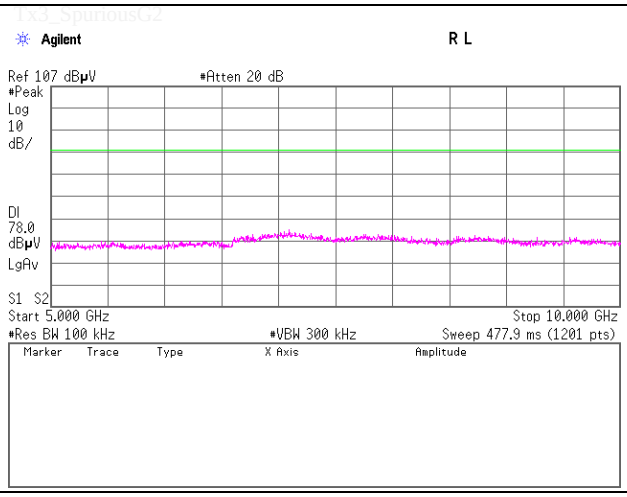
Tx, Bluetooth Low Energy, PN9

Tx, 2480MHz (above 1GHz)

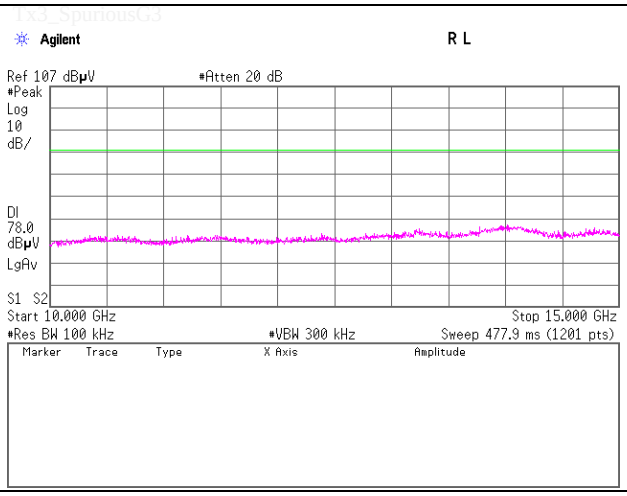
1GHz - 5GHz



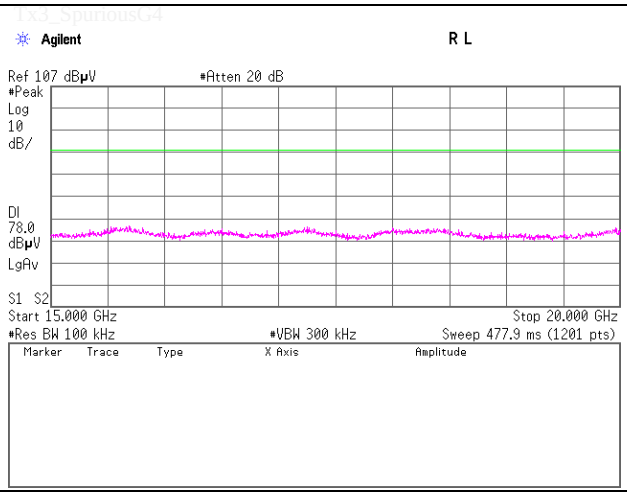
5GHz - 10GHz



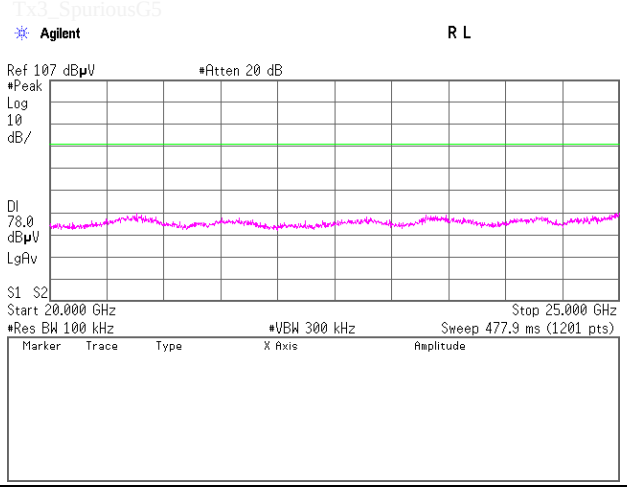
10GHz - 15GHz



15GHz - 20GHz



20GHz - 25GHz



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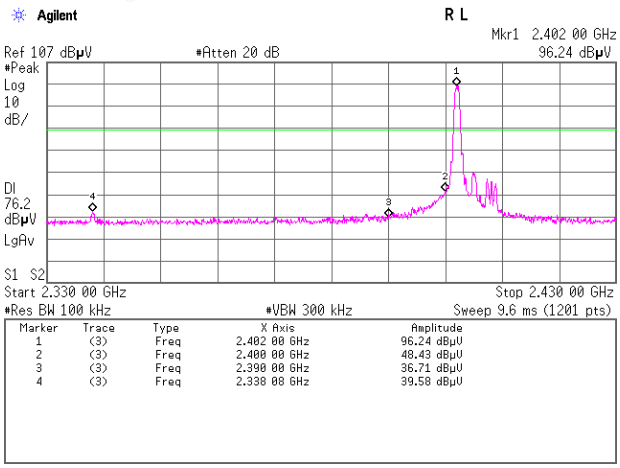
(Reference chart) Spurious emission (Conducted)

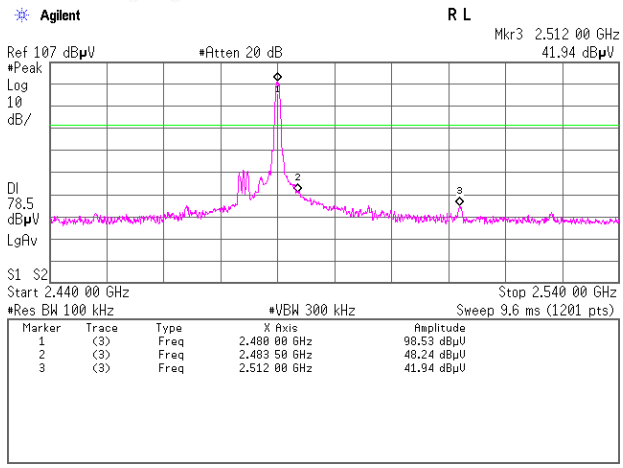
Band Edge compliance

Tx, Bluetooth Low Energy, PN9	
Tx, 2402MHz	**Tx, 2480MHz**

TX1_BandEdgeLow



TX3_BandEdgeHigh



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Maximum Power Spectral Density

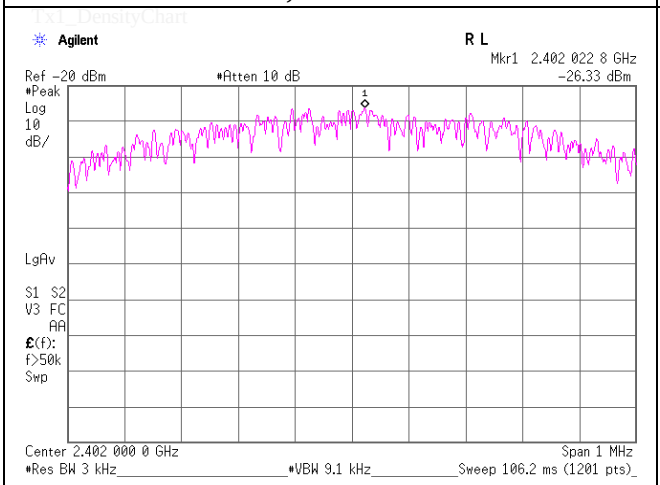
(Option 1)

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	January 21, 2013	
Temperature / Humidity	23deg.C , 48%RH	
Engineer	Shinichi Takano	
Mode	Tx, Bluetooth Low Energy, PN9	

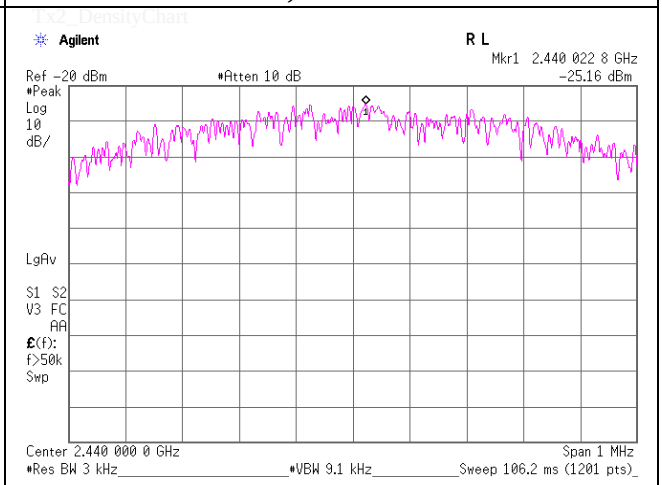
Ch. Freq. [MHz]	Freq. Reading [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.0000	2402.02	-26.33	0.50	9.97	-15.86	8.00	23.86
2440.0000	2440.02	-25.16	0.50	9.97	-14.69	8.00	22.69
2480.0000	2480.00	-21.80	0.50	9.97	-11.33	8.00	19.33

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

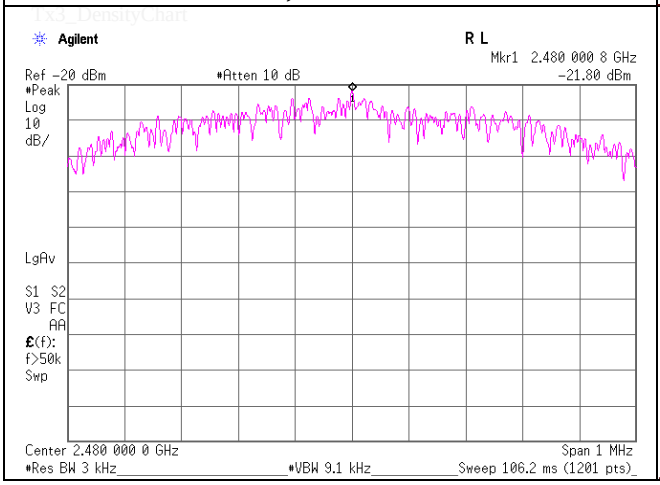
Tx, 2402MHz



Tx, 2440MHz



Tx, 2480MHz



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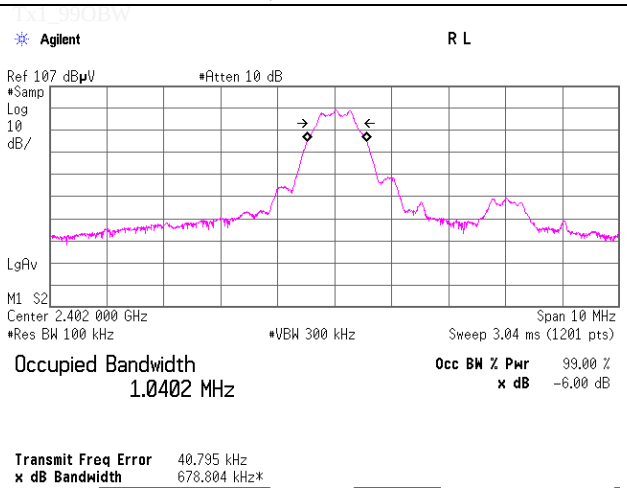
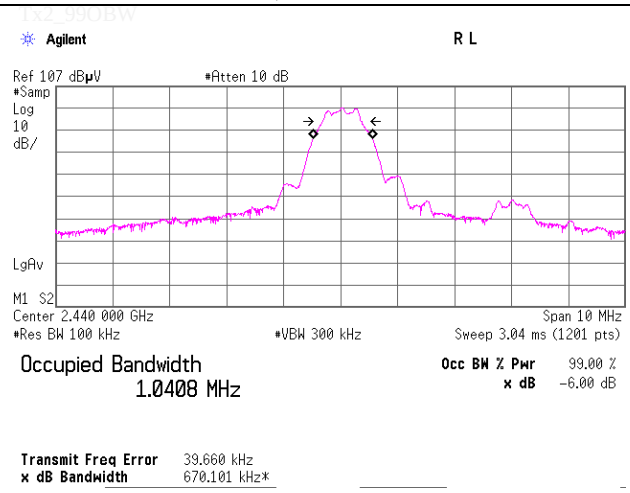
99% Occupied Bandwidth

Tx, Bluetooth Low Energy, PN9

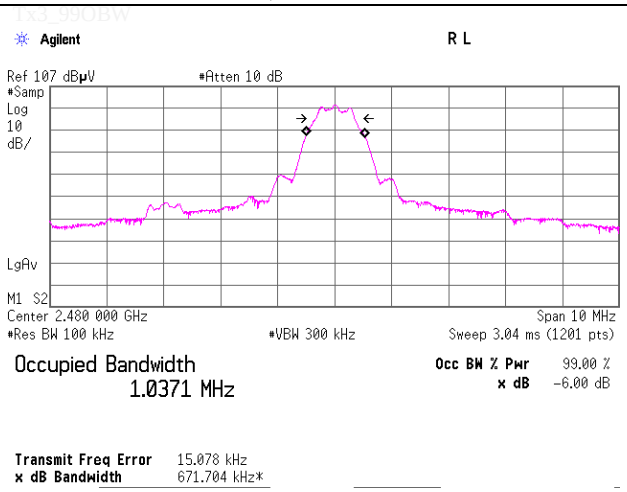
Tx, 2402MHz



Tx, 2440MHz



Tx, 2480MHz



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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	RE/AT	2013/01/08 * 12
SAT10-10	Attenuator	Weinschel Corp.	54A-10	37584	AT	2012/04/06 * 12
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2012/04/19 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2012/04/19 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2012/03/26 * 12
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2012/09/21 * 12
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2012/03/12 * 12
SCC-G02	Coaxial Cable	Suhner	SUCOFLEX 104A	46498/4A	RE	2012/04/10 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2012/05/22 * 12
SHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	RE	2012/08/17 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2012/02/06 * 12
SSA-03	Spectrum Analyzer	Agilent	E4448A	MY48250152	RE	2013/01/08 * 12
SJM-02	Measure	KOMELON	KMC-36	-	CE/RE	-
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2012/12/18 * 12
SAT10-05	Attenuator(above1GHz)	Agilent	8493C-010	74864	AT	2012/12/18 * 12
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM3640	RE	2012/03/30 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2012/03/12 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE, RFI,MF)	-	CE/RE	-
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2012/02/10 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2012/02/10 * 12
KAT3-11	Attenuator	JFW IND. INC.	50HF-003N	-	RE	2012/08/07 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2012/11/18 * 12
SCC-B1/B3/B5 /B7/B8/B13/S RSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/14 1PE/141PE/141PE /141PE/NS4906	-/0901-270(RF Selector)	RE	2012/04/10 * 12
SCC-B2/B4/B6 /B7/B8/B13/S RSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/14 1PE/141PE/141PE /141PE/NS4906	-/0901-270(RF Selector)	RE	2012/04/10 * 12
SLA-02	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0893	RE	2012/11/18 * 12
STR-02	Test Receiver	Rohde & Schwarz	ESCI	100575	CE/RE	2012/09/03 * 12
SCC-B12/B13/ SRSE-02	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/N S4906	-/0901-270(RF Selector)	CE	2012/04/10 * 12
SLS-03	LISN	Rohde & Schwarz	ENV216	100513	CE	2012/02/23 * 12
SAT3-06	Attenuator	JFW	50HF-003N	-	CE	2012/02/17 * 12
SOS-04	Humidity Indicator	A&D	AD-5681	4061512	CE	2012/03/26 * 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