RADIO TEST REPORT

Test Report No.: 10762861S-A

Applicant	:	**Renesas Electronics Corporation**
Type of Equipment	:	**RL78/G1D Module**
Model No.	:	**RTK0EN0002C01001BZ**
FCC ID	:	**2AEMX-G1DEVA**
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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Date of test: April 21 to 23, 2015

Representative test engineer:

Yosuke Ishikawa
Engineer
Consumer Technology Division

Approved by :

Tatsuya Arai
Engineer
Consumer Technology Division

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

RTL02610

UL Japan, Inc.
Shonan EMC Lab.
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REVISION HISTORY

Original Test Report No.: 10762861S-A

Revision	Test report No.	Date	Page revised	Contents
-(Original)	10762861S-A	May 21, 2015	-	-
1	10762861S-A	May 27, 2015	4	Correction of Clock frequency and Antenna gain

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Contents

SECTION 1: Customer information

Company Name	:	Renesas Electronics Corporation
Address	:	2-6-2 Ote-machi, Chiyoda-ku, Tokyo, 100-0004 Japan
Telephone Number	:	+81-3-6865-9506
Facsimile Number	:	+81-3-6865-9801
Contact Person	:	Tomohiko Ohtsu

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

2.1 Identification of E.U.T.

Type of equipment	:	RL78/G1D Module
Model No.	:	RTK0EN0002C01001BZ
Serial No.	:	Refer to 4.2 in this report.
Rating	:	DC 1.6 V to DC 3.6 V
Country of Mass-production	:	Japan
Condition of EUT	:	Production model
Modification of EUT	:	No modification by the test lab.
Receipt Date of Sample	:	April 21, 2015

2.2 Product description

Model: RTK0EN0002C01001BZ (referred to as the EUT in this report) is RL78/G1D Module.

Clock frequency(ies) in the system : 32 MHz

Bluetooth specification:

Equipment type	:	Transceiver
Frequency of operation	:	2402-2480 MHz
Bandwidth / Channel spacing	:	1 MHz / 2 MHz
Type of modulation	:	GFSK
Antenna type	:	λ/4 Chip Antenna
Antenna connector type	:	None
Antenna gain	:	+1.6 dBi
ITU code	:	F1D

FCC 15.31 (e) / 212
The RF Module is constantly provided voltage (DC 1.1 V) through the regulator regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC 15.203 / 212
It is impossible for end users to replace the antenna, because it is soldered on the circuit board.
Therefore the equipment complies with the requirement.

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	10.4 dB Freq.: 0.73503 MHz Detection: Quasi-Peak Phase: L1 Mode: Tx 2480 MHz	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)	4.0 dB Freq.: 14412.000 MHz Polarization: Horizontal Detection: Average Mode: Tx 2402 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.

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%

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

	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.

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

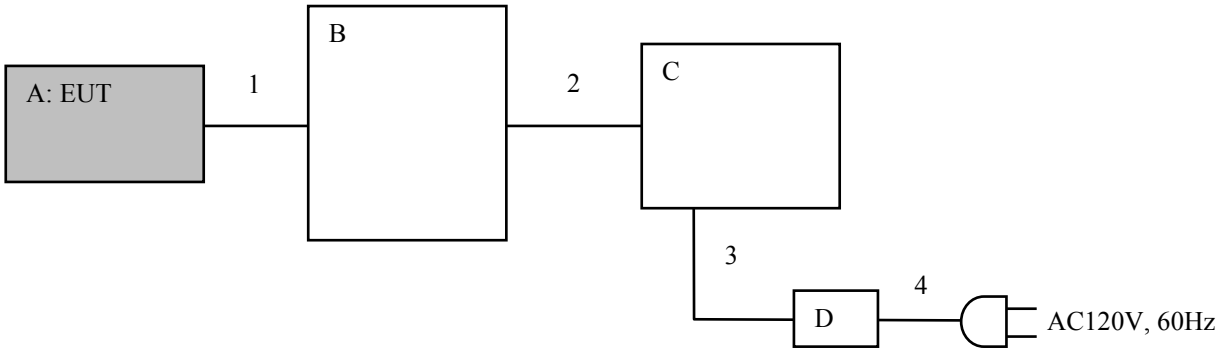
4.1 Operating mode

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

Software : Tera Term ver. 4.69
Power settings : Fixed

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

4.2 Configuration and peripherals



* Test data was taken under worse case conditions.

Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	RL78/G1D Module	RTK0EN0002C01001BZ	*1)	Renesas	EUT
B	Jig	R0K3ZBBBDBN00BR	-	-	-
C	Laptop computer	7666-77J	LV-B8PVT 08/05	Lenovo	-
D	AC adapter	42T4422	11S42T4422Z1ZF3D9BV4XN	Lenovo	-

*1) 74905000897D: Radiated emission (below 1GHz) and Conducted emission, 749050008979: other tests

List of cables used

No.	Cable Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Signal	0.1	Unshielded	Unshielded	-
2	USB	1.5	Unshielded	Unshielded	-
3	DC	1.2	Unshielded	Unshielded	-
4	AC	0.8	Unshielded	Unshielded	-

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, 1.0 m by 1.5 m, raised 0.8 m 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 40 cm to the vertical conducting plane. The rear of EUT and its peripheral was aligned and was flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. EUT was located 80 cm 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 50 ohm 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 MHz to 30 MHz
EUT position : Table top

5.4 Test procedure

The AC Mains Terminal Continuous disturbance Voltage had been measured with the EUT within a Shielded room.
The EUT was connected to a Line Impedance Stabilization Network (LISN). An overview sweep with peak detection has been performed.
The measurements had been performed with a quasi-peak detector and if required, 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 : 9 kHz

5.5 Results

Summary of the test results : Pass
Refer to APPENDIX 1

SECTION 6: 6 dB 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.
In the frequency range below 30 MHz, 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.
(9 kHz-150 kHz:RBW=200 Hz, 150 kHz-30 MHz:RBW=10 kHz)

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	:	3 kHz / 9.1 kHz

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

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, 0.5 m by 0.5 m, raised 0.8 m above the conducting ground plane. Photographs of the set up are shown in APPENDIX 3.

10.3 Test conditions

Frequency range : 30 MHz 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 3 m (below 15 GHz) / 1 m (above 15 GHz) (Refer to Figure 1). Measurements were performed with quasi-peak, peak and average detector. The measuring antenna height was varied between 1 and 4 m 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.

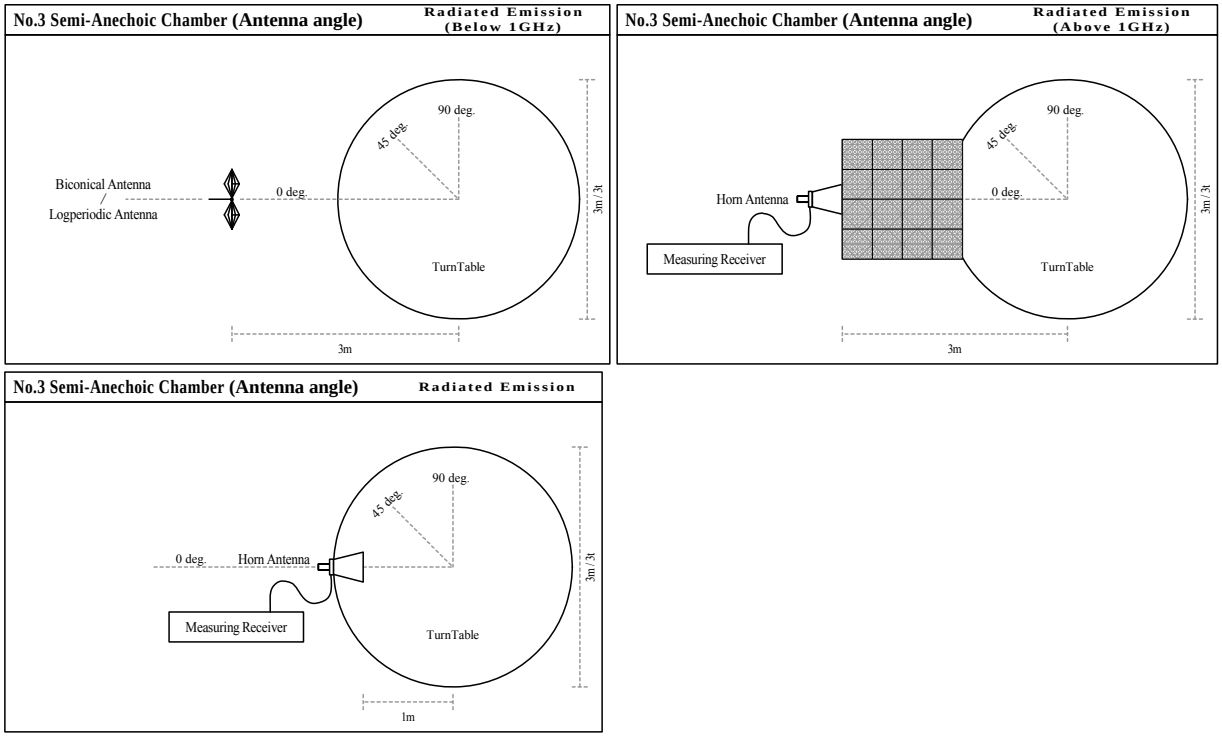
Frequency	30-1000 MHz	1-25 GHz		20 dBc
Detection type	Quasi-Peak	Peak	Average *1)	Peak
IF Bandwidth	120 kHz	RBW: 1 MHz VBW: 3 MHz	RBW: 1 MHz VBW: 3 MHz Detector: Linear Voltage Averaging	RBW: 100 kHz VBW: 300 kHz

*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 Antennas to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Antenna polarization	Carrier	Spurious (30-1000 MHz)	Spurious (1-2.8 GHz)	Spurious (2.8-15 GHz)	Spurious (15-18 GHz)	Spurious (18-25 GHz)
Horizontal	Y	X	Y	Y	X	X
Vertical	Y	X	Y	Z	X	X

Figure 1. Antenna angle



10.5 Band edge

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

10.6 Results

Summary of the test results : Pass
* No noise was detected above the 6th order harmonics.

Refer to APPENDIX 1

Contents of APPENDIXES

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Conducted emission
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Maximum peak output power
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Test instruments

APPENDIX 3: Photographs of test setup

Conducted emission
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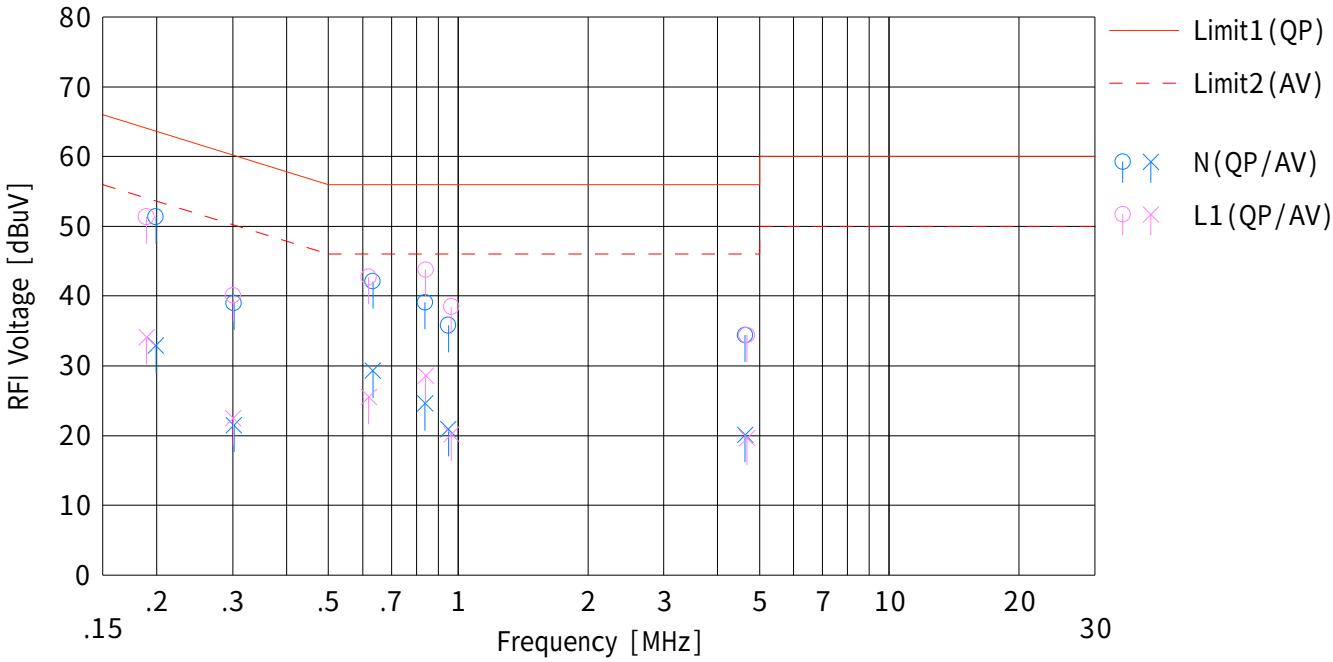
DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2015/04/23

Mode : Tx 2402MHz
Order No. : 10762861S
Power : **AC120V/60Hz(PC)**
Temp./Humi. : 24deg.C / 45%RH

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

Engineer : Yosuke Ishikawa



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	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.19910	39.0	20.5	12.4	51.4	32.9	63.6	53.6	12.2	20.7	N	
2	0.30216	26.6	9.1	12.4	39.0	21.5	60.1	50.1	21.1	28.6	N	
3	0.63452	29.7	16.9	12.4	42.1	29.3	56.0	46.0	13.9	16.7	N	
4	0.83772	26.7	12.2	12.4	39.1	24.6	56.0	46.0	16.9	21.4	N	
5	0.94998	23.4	8.5	12.4	35.8	20.9	56.0	46.0	20.2	25.1	N	
6	4.63143	21.7	7.4	12.7	34.4	20.1	56.0	46.0	21.6	25.9	N	
7	0.18934	39.0	21.7	12.4	51.4	34.1	64.0	54.0	12.6	19.9	L1	
8	0.30099	27.7	10.1	12.4	40.1	22.5	60.2	50.2	20.1	27.7	L1	
9	0.62060	30.3	13.1	12.4	42.7	25.5	56.0	46.0	13.3	20.5	L1	
10	0.84159	31.4	16.2	12.4	43.8	28.6	56.0	46.0	12.2	17.4	L1	
11	0.96334	26.1	7.8	12.4	38.5	20.2	56.0	46.0	17.5	25.8	L1	
12	4.68031	21.7	6.9	12.7	34.4	19.6	56.0	46.0	21.6	26.4	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-05

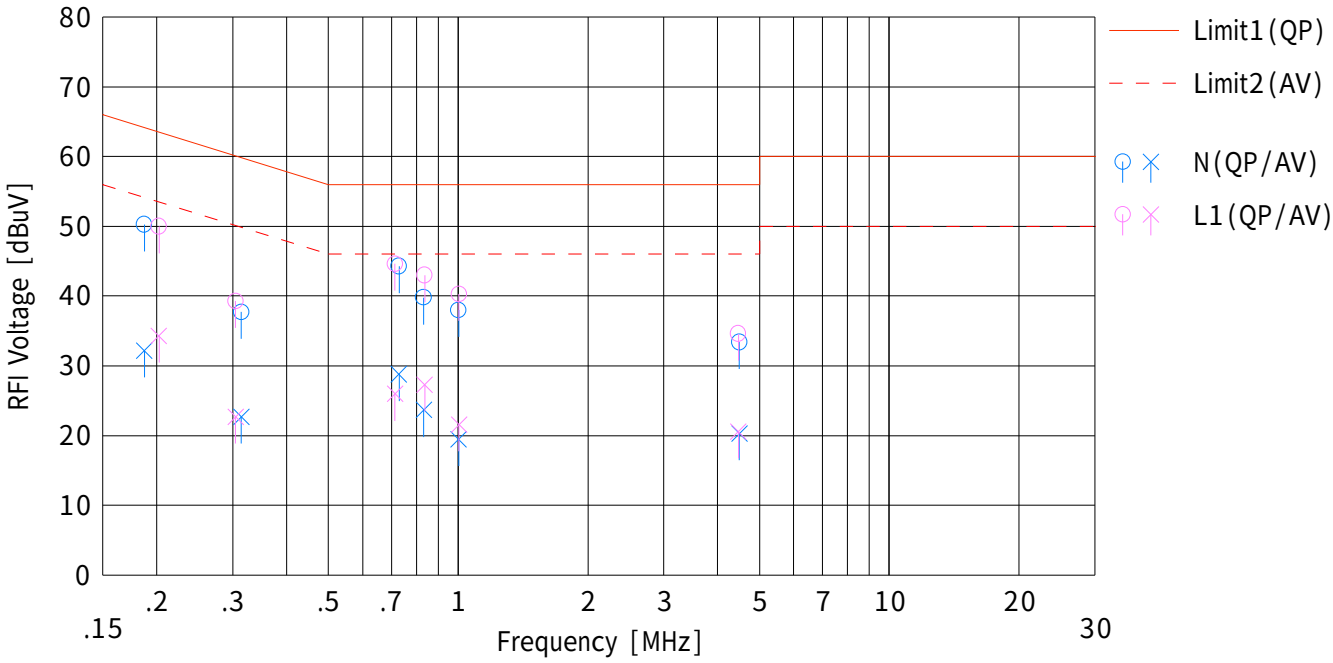
DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2015/04/23

Mode : Tx 2440MHz
Order No. : 10762861S
Power : **AC120V/60Hz(PC)**
Temp./Humi. : 24deg.C / 45%RH

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

Engineer : Yosuke Ishikawa



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		<QP>	<AV>		<QP>	<AV>	<QP>	<AV>	<QP>	<AV>		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.18702	37.9	19.8	12.4	50.3	32.2	64.1	54.1	13.8	21.9	N	
2	0.31422	25.3	10.3	12.4	37.7	22.7	59.8	49.8	22.1	27.1	N	
3	0.72983	31.9	16.4	12.4	44.3	28.8	56.0	46.0	11.7	17.2	N	
4	0.83204	27.4	11.3	12.4	39.8	23.7	56.0	46.0	16.2	22.3	N	
5	1.00265	25.6	7.1	12.4	38.0	19.5	56.0	46.0	18.0	26.5	N	
6	4.49299	20.7	7.6	12.7	33.4	20.3	56.0	46.0	22.6	25.7	N	
7	0.20259	37.6	21.9	12.4	50.0	34.3	63.5	53.5	13.5	19.2	L1	
8	0.30439	26.9	10.3	12.4	39.3	22.7	60.1	50.1	20.8	27.4	L1	
9	0.71432	32.2	13.6	12.4	44.6	26.0	56.0	46.0	11.4	20.0	L1	
10	0.83618	30.6	14.9	12.4	43.0	27.3	56.0	46.0	13.0	18.7	L1	
11	1.00497	27.9	9.2	12.4	40.3	21.6	56.0	46.0	15.7	24.4	L1	
12	4.46738	21.9	7.9	12.7	34.6	20.6	56.0	46.0	21.4	25.4	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-05

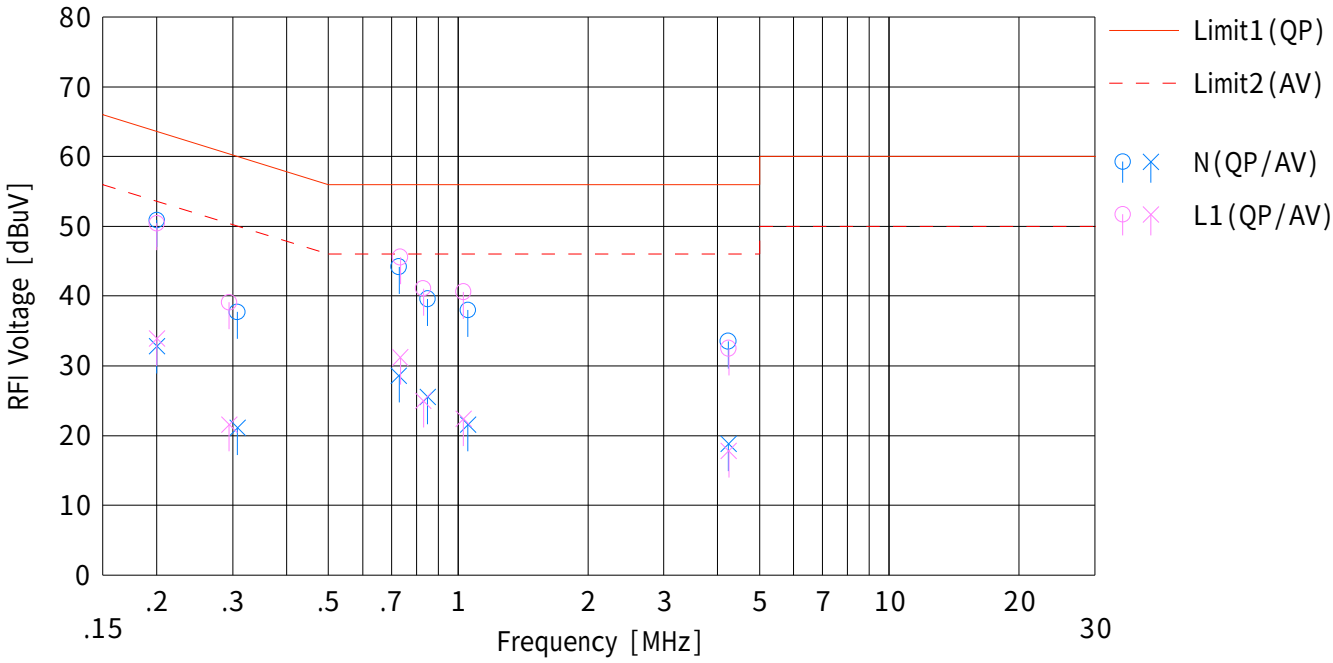
DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2015/04/23

Mode : Tx 2480MHz
Order No. : 10762861S
Power : **AC120V/60Hz(PC)**
Temp./Humi. : 24deg.C / 45%RH

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

Engineer : Yosuke Ishikawa



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	0.20012	38.5	20.4	12.4	50.9	32.8	63.6	53.6	12.7	20.8	N	
2	0.30772	25.3	8.7	12.4	37.7	21.1	60.0	50.0	22.3	28.9	N	
3	0.72926	31.8	16.2	12.4	44.2	28.6	56.0	46.0	11.8	17.4	N	
4	0.84965	27.2	13.1	12.4	39.6	25.5	56.0	46.0	16.4	20.5	N	
5	1.05362	25.6	9.2	12.4	38.0	21.6	56.0	46.0	18.0	24.4	N	
6	4.23901	20.9	6.2	12.6	33.5	18.8	56.0	46.0	22.5	27.2	N	
7	0.19999	38.0	21.5	12.4	50.4	33.9	63.6	53.6	13.2	19.7	L1	
8	0.29428	26.7	9.2	12.4	39.1	21.6	60.4	50.4	21.3	28.8	L1	
9	0.73503	33.2	18.8	12.4	45.6	31.2	56.0	46.0	10.4	14.8	L1	
10	0.83121	28.7	12.6	12.4	41.1	25.0	56.0	46.0	14.9	21.0	L1	
11	1.02830	28.2	10.0	12.4	40.6	22.4	56.0	46.0	15.4	23.6	L1	
12	4.24644	19.9	5.2	12.6	32.5	17.8	56.0	46.0	23.5	28.2	L1	

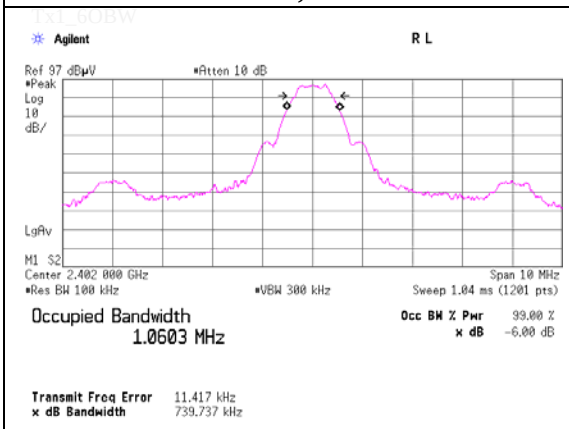
Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN+Cable+ATT)[dB]
LISN:SLS-05

-6dB Bandwidth

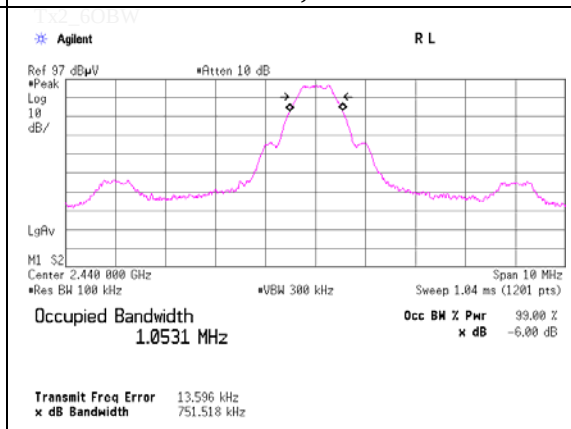
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	April 22, 2015	
Temperature / Humidity	27 deg.C , 35 %RH	
Engineer	Kenichi Adachi	
Mode	Tx, Bluetooth, Low Energy, PN9	

Freq. [MHz]	-6dB Bandwidth [MHz]	Limit [MHz]
2402.0000	0.740	> 0.500
2440.0000	0.752	> 0.500
2480.0000	0.759	> 0.500

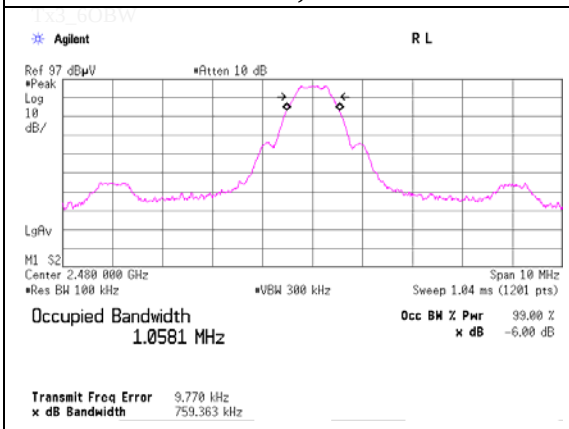
Tx, 2402MHz



Tx, 2440MHz



Tx, 2480MHz



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Maximum Peak Conducted Output Power

(PKPM1)

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	April 22, 2015	
Temperature / Humidity	27 deg.C , 35 %RH	
Engineer	Kenichi Adachi	
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	-11.84	1.56	9.90	-0.38	0.92	30.00	1000	30.38
Mid	2440.0	-12.32	1.57	9.90	-0.85	0.82	30.00	1000	30.85
High	2480.0	-12.40	1.58	9.90	-0.92	0.81	30.00	1000	30.92

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 22, 2015
Temperature / Humidity	27 deg.C , 35 %RH
Engineer	Kenichi Adachi
Mode	Tx, Bluetooth, Low Energy, PN9,

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

Ch	Freq.	P/M (AV) Reading	Cable Loss	Atten. Loss	Duty Factor	Result		Typical Power	Power Range	Deviation
	[MHz]	[dBm]	[dB]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[dB]	[dB]
Low	2402.0	-12.44	1.56	9.90		-0.98	0.80	1.0	-	1.98
Mid	2440.0	-12.90	1.57	9.90		-1.43	0.72	1.0	-	2.43
High	2480.0	-13.06	1.58	9.90		-1.58	0.70	1.0	-	2.58

Sample Calculation:

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

Deviation = Typical Power + Power Range - Result

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Radiated Emission

Test place	No.3 Semi Anechoic Chamber	
Date	April 21, 2015	April 22, 2015
Temperature / Humidity	24 deg.C, 45 %RH	24 deg.C, 45 %RH
Engineer	Kenichi Adachi	Yosuke Ishikawa
Mode	Tx, 2402 MHz	
	Tx, Bluetooth Low Energy	

(* 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.	119.995	QP	43.8	12.8	7.4	32.1	31.9	43.5	11.6	166	248	
Hori.	408.008	QP	34.3	16.6	9.1	31.9	28.1	46.0	17.9	100	231	
Hori.	2390.000	PK	46.5	26.4	13.6	41.1	45.4	73.9	28.5	100	109	
Hori.	4804.000	PK	48.7	30.6	5.6	39.8	45.1	73.9	28.8	100	82	
Hori.	7206.000	PK	46.0	36.6	7.1	40.2	49.5	73.9	24.4	100	114	
Hori.	9608.000	PK	46.6	38.5	8.1	40.1	53.1	73.9	20.8	100	0	
Hori.	12010.000	PK	46.5	39.5	9.2	39.6	55.6	73.9	18.3	100	0	
Hori.	14412.000	PK	47.4	42.0	9.9	40.6	58.7	73.9	15.2	100	0	
Hori.	2390.000	AV	37.0	26.4	13.6	41.1	35.9	53.9	18.0	100	109	
Hori.	4804.000	AV	42.5	30.6	5.6	39.8	38.9	53.9	15.0	100	82	
Hori.	7206.000	AV	37.3	36.6	7.1	40.2	40.8	53.9	13.1	100	114	
Hori.	9608.000	AV	37.1	38.5	8.1	40.1	43.6	53.9	10.3	100	0	
Hori.	12010.000	AV	37.6	39.5	9.2	39.6	46.7	53.9	7.2	100	0	
Hori.	14412.000	AV	38.6	42.0	9.9	40.6	49.9	53.9	**4.0**	100	0	
Vert.	60.015	QP	46.5	7.7	6.7	32.1	28.8	40.0	11.2	100	196	
Vert.	144.073	QP	35.3	14.5	7.8	32.1	25.5	43.5	18.0	100	324	
Vert.	163.067	QP	36.7	15.3	8.0	32.0	28.0	43.5	15.5	100	197	
Vert.	215.999	QP	38.7	16.5	8.2	32.0	31.4	43.5	12.1	100	135	
Vert.	480.036	QP	36.7	17.5	9.4	31.9	31.7	46.0	14.3	100	235	
Vert.	2390.000	PK	46.1	26.4	13.6	41.1	45.0	73.9	28.9	100	242	
Vert.	4804.000	PK	49.8	30.6	5.6	39.8	46.2	73.9	27.7	107	198	
Vert.	7206.000	PK	46.4	36.6	7.1	40.2	49.9	73.9	24.0	100	198	
Vert.	9608.000	PK	45.7	38.5	8.1	40.1	52.2	73.9	21.7	100	0	
Vert.	12010.000	PK	46.4	39.5	9.2	39.6	55.5	73.9	18.4	100	0	
Vert.	14412.000	PK	47.6	42.0	9.9	40.6	58.9	73.9	15.0	100	0	
Vert.	2390.000	AV	36.9	26.4	13.6	41.1	35.8	53.9	18.1	100	242	
Vert.	4804.000	AV	43.9	30.6	5.6	39.8	40.3	53.9	13.6	107	198	
Vert.	7206.000	AV	37.5	36.6	7.1	40.2	41.0	53.9	12.9	100	198	
Vert.	9608.000	AV	37.2	38.5	8.1	40.1	43.7	53.9	10.2	100	0	
Vert.	12010.000	AV	37.7	39.5	9.2	39.6	46.8	53.9	7.1	100	0	
Vert.	14412.000	AV	38.5	42.0	9.9	40.6	49.8	53.9	4.1	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18GHz)-Distance factor(above 15GHz)) - Gain(Amprifier)
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	92.1	26.4	13.6	41.1	91.0	-	-	Carrier
Hori.	2398.049	PK	42.6	26.4	13.6	41.1	41.5	71.0	29.5	
Hori.	2400.000	PK	41.6	26.4	13.6	41.1	40.5	71.0	30.5	
Vert.	2402.000	PK	89.4	26.4	13.6	41.1	88.3	-	-	Carrier
Vert.	2398.233	PK	40.9	26.4	13.6	41.1	39.8	68.3	28.5	
Vert.	2400.000	PK	39.6	26.4	13.6	41.1	38.5	68.3	29.8	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18GHz)-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB

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Radiated Emission

Test place	No.3 Semi Anechoic Chamber	
Date	April 21, 2015	April 22, 2015
Temperature / Humidity	24 deg.C, 45 %RH	24 deg.C, 45 %RH
Engineer	Kenichi Adachi	Yosuke Ishikawa
Mode	Tx, 2440 MHz	
	Tx, Bluetooth Low Energy	

(* 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.	132.143	QP	40.3	13.8	7.6	32.1	29.6	43.5	13.9	234	265	
Hori.	408.002	QP	32.3	16.6	9.1	31.9	26.1	46.0	19.9	100	128	
Hori.	4880.000	PK	48.1	30.9	5.6	39.7	44.9	73.9	29.0	100	97	
Hori.	7320.000	PK	45.9	36.8	7.0	40.3	49.4	73.9	24.5	103	119	
Hori.	9760.000	PK	45.1	38.6	8.1	40.0	51.8	73.9	22.1	100	0	
Hori.	12200.000	PK	45.3	39.4	9.3	39.8	54.2	73.9	19.7	100	0	
Hori.	14640.000	PK	46.8	41.9	10.1	40.7	58.1	73.9	15.8	100	0	
Hori.	4880.000	AV	41.0	30.9	5.6	39.7	37.8	53.9	16.1	100	97	
Hori.	7320.000	AV	36.9	36.8	7.0	40.3	40.4	53.9	13.5	103	119	
Hori.	9760.000	AV	36.5	38.6	8.1	40.0	43.2	53.9	10.7	100	0	
Hori.	12200.000	AV	36.5	39.4	9.3	39.8	45.4	53.9	8.5	100	0	
Hori.	14640.000	AV	37.3	41.9	10.1	40.7	48.6	53.9	**5.3**	100	0	
Vert.	56.879	QP	45.7	8.6	6.8	32.1	29.0	40.0	11.0	100	190	
Vert.	96.000	QP	40.2	9.3	7.6	32.1	25.0	43.5	18.5	100	253	
Vert.	120.009	QP	39.0	12.9	7.4	32.1	27.2	43.5	16.3	100	283	
Vert.	161.285	QP	38.5	15.2	8.0	32.0	29.7	43.5	13.8	100	181	
Vert.	479.913	QP	28.9	17.5	9.4	31.9	23.9	46.0	22.1	100	296	
Vert.	4880.000	PK	47.9	30.9	5.6	39.7	44.7	73.9	29.2	111	205	
Vert.	7320.000	PK	46.0	36.8	7.0	40.3	49.5	73.9	24.4	100	187	
Vert.	9760.000	PK	45.5	38.6	8.1	40.0	52.2	73.9	21.7	100	0	
Vert.	12200.000	PK	45.4	39.4	9.3	39.8	54.3	73.9	19.6	100	0	
Vert.	14640.000	PK	45.8	41.9	10.1	40.7	57.1	73.9	16.8	100	0	
Vert.	4880.000	AV	40.7	30.9	5.6	39.7	37.5	53.9	16.4	111	205	
Vert.	7320.000	AV	37.0	36.8	7.0	40.3	40.5	53.9	13.4	100	187	
Vert.	9760.000	AV	36.3	38.6	8.1	40.0	43.0	53.9	10.9	100	0	
Vert.	12200.000	AV	36.6	39.4	9.3	39.8	45.5	53.9	8.4	100	0	
Vert.	14640.000	AV	37.1	41.9	10.1	40.7	48.4	53.9	5.5	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18GHz)-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB

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Radiated Emission

Test place	No.3 Semi Anechoic Chamber	
Date	April 21, 2015	April 22, 2015
Temperature / Humidity	24 deg.C, 45 %RH	24 deg.C, 45 %RH
Engineer	Kenichi Adachi	Yosuke Ishikawa
Mode	Tx, 2480 MHz	
	Tx, Bluetooth Low Energy	

(* 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.	119.990	QP	43.9	12.8	7.4	32.1	32.0	43.5	11.5	173	254	
Hori.	516.178	QP	30.0	18.0	9.6	31.9	25.7	46.0	20.3	100	131	
Hori.	2483.500	PK	49.7	26.6	13.6	41.1	48.8	73.9	25.1	100	117	
Hori.	2484.019	PK	49.5	26.6	13.6	41.1	48.6	73.9	25.3	100	117	
Hori.	4960.000	PK	47.2	31.2	5.7	39.6	44.5	73.9	29.4	100	96	
Hori.	7440.000	PK	47.3	37.0	7.0	40.4	50.9	73.9	23.0	135	106	
Hori.	9920.000	PK	44.5	38.6	8.0	39.9	51.2	73.9	22.7	100	0	
Hori.	12400.000	PK	44.7	39.3	9.4	40.0	53.4	73.9	20.5	100	0	
Hori.	14880.000	PK	45.5	41.7	10.4	40.9	56.7	73.9	17.2	100	0	
Hori.	2483.500	AV	41.7	26.6	13.6	41.1	40.8	53.9	13.1	100	117	
Hori.	2484.019	AV	41.8	26.6	13.6	41.1	40.9	53.9	13.0	100	117	
Hori.	4960.000	AV	39.5	31.2	5.7	39.6	36.8	53.9	17.1	100	96	
Hori.	7440.000	AV	37.5	37.0	7.0	40.4	41.1	53.9	12.8	135	106	
Hori.	9920.000	AV	35.3	38.6	8.0	39.9	42.0	53.9	11.9	100	0	
Hori.	12400.000	AV	35.4	39.3	9.4	40.0	44.1	53.9	9.8	100	0	
Hori.	14880.000	AV	36.6	41.7	10.4	40.9	47.8	53.9	**6.1**	100	0	
Vert.	60.006	QP	46.7	7.7	6.7	32.1	29.0	40.0	11.0	100	211	
Vert.	95.988	QP	39.9	9.3	7.6	32.1	24.7	43.5	18.8	100	175	
Vert.	120.006	QP	38.8	12.9	7.4	32.1	27.0	43.5	16.5	100	267	
Vert.	167.994	QP	40.3	15.5	8.0	32.0	31.8	43.5	11.7	100	292	
Vert.	215.992	QP	38.6	16.5	8.2	32.0	31.3	43.5	12.2	100	138	
Vert.	666.125	QP	31.0	20.1	10.1	31.9	29.3	46.0	16.7	100	267	
Vert.	2483.500	PK	49.5	26.6	13.6	41.1	48.6	73.9	25.3	100	0	
Vert.	2483.986	PK	48.7	26.6	13.6	41.1	47.8	73.9	26.1	100	0	
Vert.	4960.000	PK	46.8	31.2	5.7	39.6	44.1	73.9	29.8	100	193	
Vert.	7440.000	PK	46.2	37.0	7.0	40.4	49.8	73.9	24.1	100	193	
Vert.	9920.000	PK	44.0	38.6	8.0	39.9	50.7	73.9	23.2	100	0	
Vert.	12400.000	PK	44.5	39.3	9.4	40.0	53.2	73.9	20.7	100	0	
Vert.	14880.000	PK	46.0	41.7	10.4	40.9	57.2	73.9	16.7	100	0	
Vert.	2483.500	AV	41.5	26.6	13.6	41.1	40.6	53.9	13.3	100	0	
Vert.	2483.986	AV	41.4	26.6	13.6	41.1	40.5	53.9	13.4	100	0	
Vert.	4960.000	AV	39.5	31.2	5.7	39.6	36.8	53.9	17.1	100	193	
Vert.	7440.000	AV	37.0	37.0	7.0	40.4	40.6	53.9	13.3	100	193	
Vert.	9920.000	AV	35.6	38.6	8.0	39.9	42.3	53.9	11.6	100	0	
Vert.	12400.000	AV	35.3	39.3	9.4	40.0	44.0	53.9	9.9	100	0	
Vert.	14880.000	AV	36.6	41.7	10.4	40.9	47.8	53.9	**6.1**	100	0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18GHz)-Distance factor(above 15GHz)) - Gain(Amprifier)
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB

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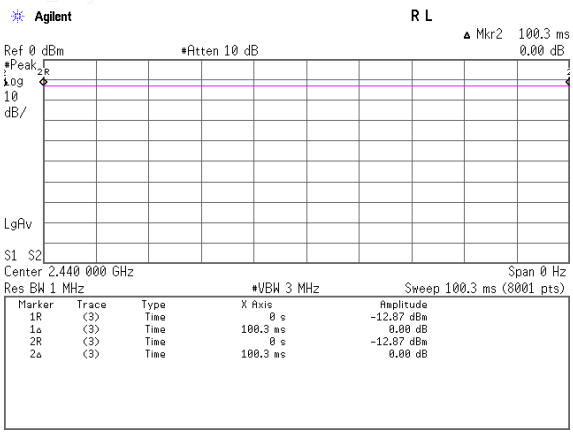
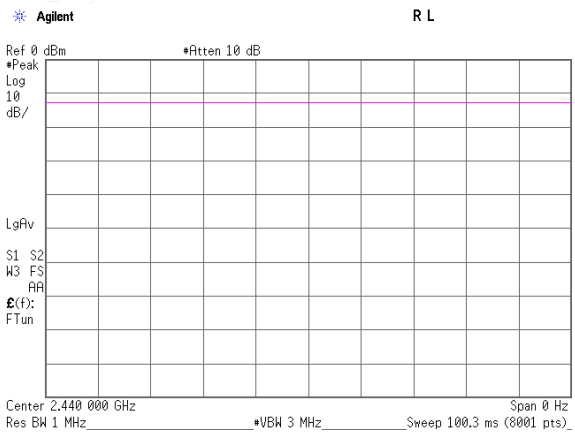
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	April 22, 2015	
Temperature / Humidity	27 deg.C , 35 %RH	
Engineer	Kenichi Adachi	

Burst rate confirmation

Tx, Bluetooth, Low Energy, PN9

duty cycle = 0.1002667 / 0.1002667 = 1 (100%)	
Tx2_duty1	Tx2_duty2





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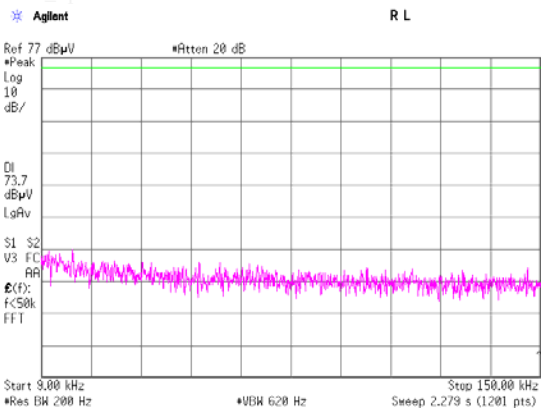
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	April 22, 2015	
Temperature / Humidity	27 deg.C , 35 %RH	
Engineer	Kenichi Adachi	

Spurious emission (Conducted)

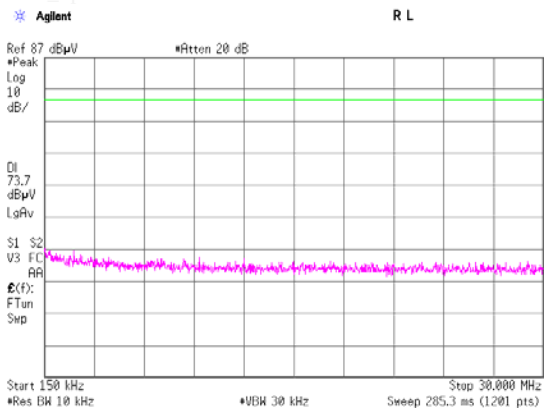
Tx, Bluetooth, Low Energy, PN9

Tx, 2402MHz (below 30MHz)

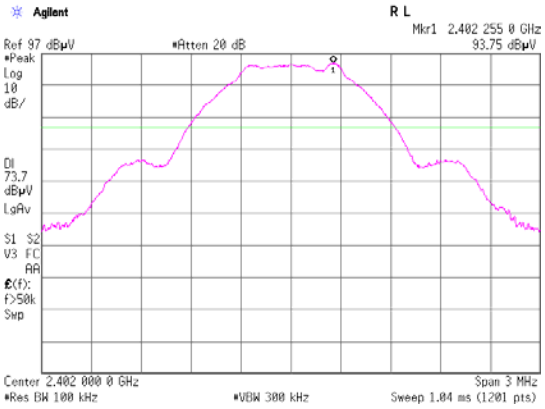
9kHz - 150kHz



150kHz - 30MHz



Carrier, 20dBc Limit



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Telephone : +81 463 50 6400
Facsimile : +81 463 50 6401

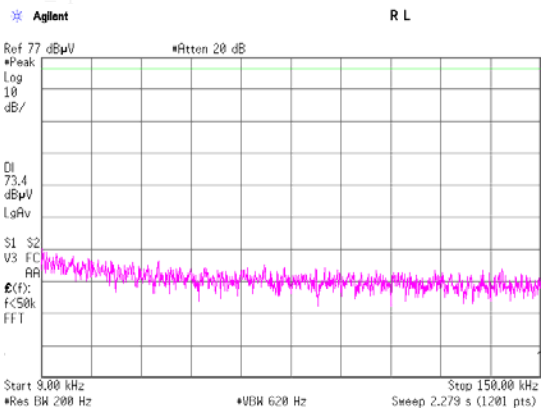
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	April 22, 2015	
Temperature / Humidity	27 deg.C , 35 %RH	
Engineer	Kenichi Adachi	

Spurious emission (Conducted)

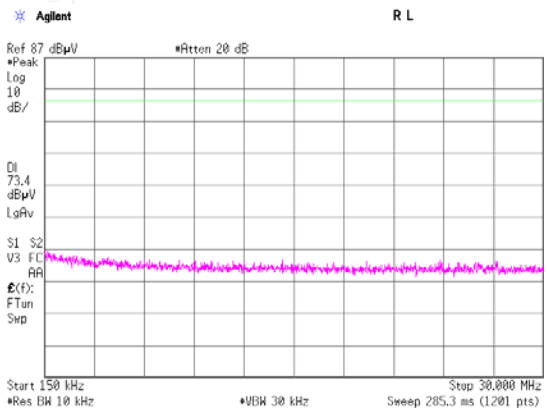
Tx, Bluetooth, Low Energy, PN9

Tx, 2440MHz (below 30MHz)

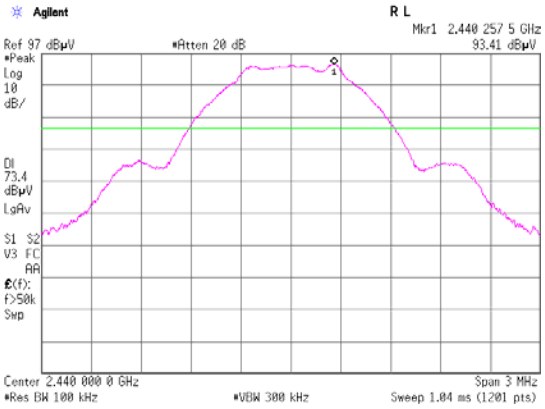
9kHz - 150kHz



150kHz - 30MHz



Carrier, 20dBc Limit



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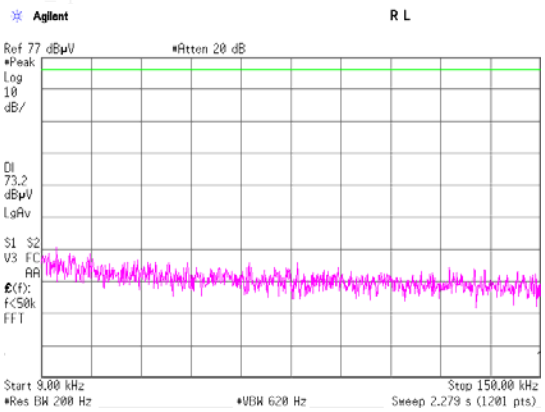
Engineer	Kenichi Adachi	

Spurious emission (Conducted)

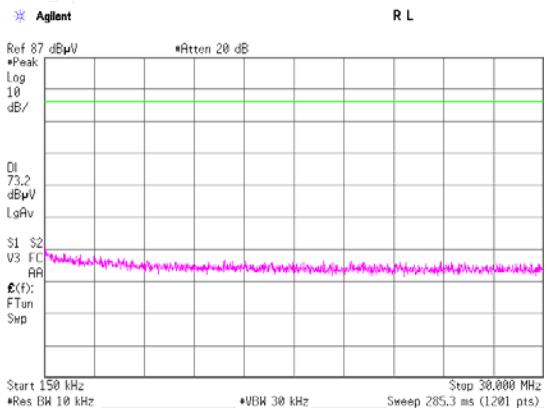
Tx, Bluetooth, Low Energy, PN9

Tx, 2480MHz (below 30MHz)

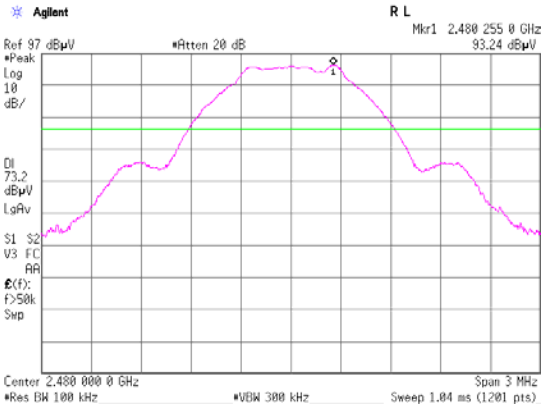
9kHz - 150kHz



150kHz - 30MHz



Carrier, 20dBc Limit



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Maximum Power Spectral Density

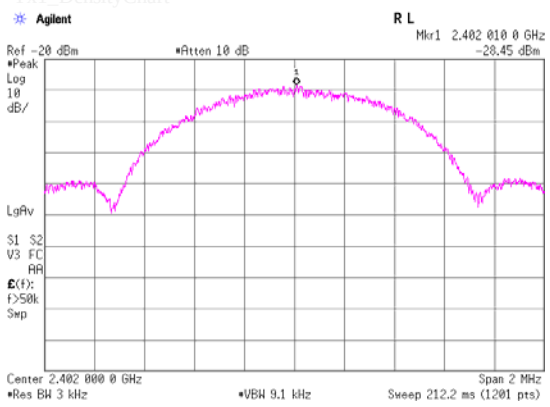
(PKPSD)

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	April 22, 2015	
Temperature / Humidity	27 deg.C , 35 %RH	
Engineer	Kenichi Adachi	
Mode	Tx, Bluetooth, Low Energy, PN9	

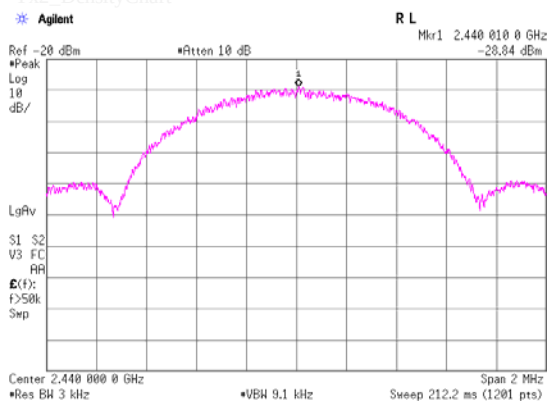
Ch. Freq. [MHz]	Freq. Reading [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.0000	2402.01	-28.45	1.56	9.90	-16.99	8.00	24.99
2440.0000	2440.01	-28.84	1.57	9.90	-17.37	8.00	25.37
2480.0000	2480.01	-29.04	1.58	9.90	-17.56	8.00	25.56

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

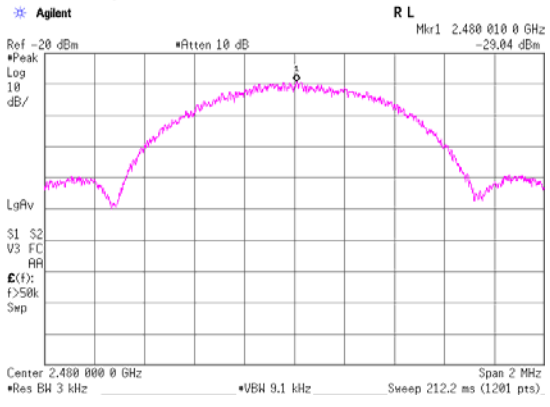
Tx, 2402MHz



Tx, 2440MHz



Tx, 2480MHz



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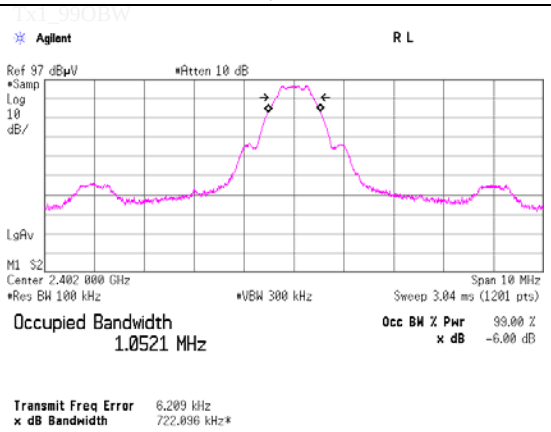
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	April 22, 2015	
Temperature / Humidity	27 deg.C , 35 %RH	
Engineer	Kenichi Adachi	

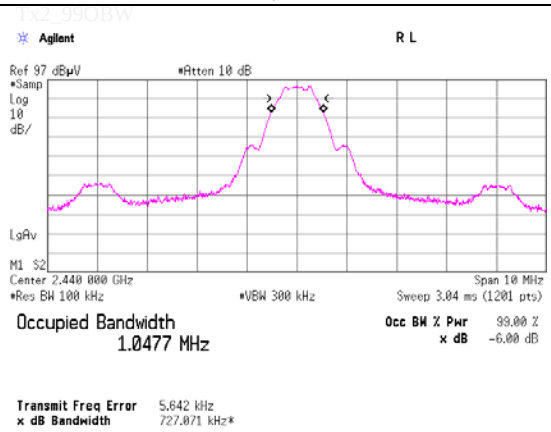
99% Occupied Bandwidth

Tx, Bluetooth, Low Energy, PN9

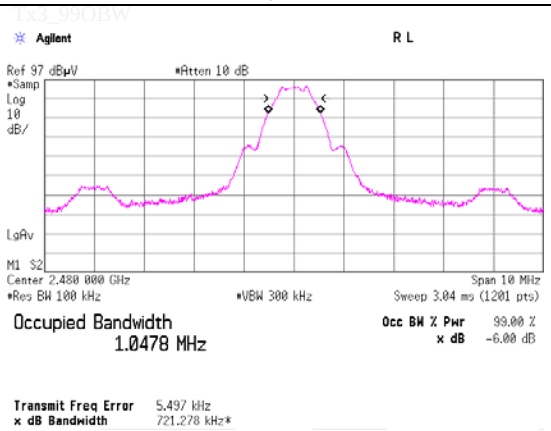
Tx, 2402MHz



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)
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
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2015/03/26 * 12
SJM-15	Measure	ASKUL	-	-	RE,CE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE, RFI,MF)	-	RE.CE	-
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
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2014/11/21 * 12
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2014/11/21 * 12
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/C3/C4/C5/C10/SRSE-03	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-271(RF Selector)	RE	2015/04/17 * 12
SAF-03	Pre Amplifier	SONOMA	310N	290213	RE	2015/02/18 * 12
STR-06	Test Receiver	Rohde & Schwarz	ESCI	101259	RE,CE	2015/03/24 * 12
SSA-03	Spectrum Analyzer	Agilent	E4448A	MY48250152	AT	2015/02/24 * 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-G14	Coaxial Cable	Suhner	SUCOFLEX 102	31600/2	AT	2015/03/11 * 12
SAT10-10	Attenuator	Weinschel Corp.	54A-10	37584	AT	2015/04/09 * 12
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2014/12/24 * 12
SCC-C9/C10/SRSE-03	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141PE/NS4906	-/0901-271(RF Selector)	CE	2015/04/17 * 12
SLS-05	LISN	Rohde & Schwarz	ENV216	100516	CE	2015/02/24 * 12
SAT3-06	Attenuator	JFW	50HF-003N	-	CE	2015/02/18 * 12
SOS-06	Humidity Indicator	A&D	AD-5681	4062118	CE	2014/12/24 * 12
STM-05	Terminator	TME	CT-01 BP	-	CE	2014/12/19 * 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 disturbance voltage