RADIO TEST REPORT

Test Report No.: 10333230-003A-G

Applicant	:	**CASIO COMPUTER CO., LTD.**
Type of Equipment	:	**Bluetooth Watch**
Model No.	:	**EQB-500**
FCC ID	:	**BBQW005**
Test regulation	:	**FCC Part15 Subpart C: 2014**
Test result	:	**Complied**

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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: July 10 to August 1, 2014

Tested by:

Hikaru Shirasawa
Engineer
Consumer Technology Division

Approved by :

Toyokazu Imamura
Leader
Consumer Technology Division

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

RTL02610

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REVISION HISTORY

Original Test Report No.: 10333230-003A-G

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10333230-003A-G	August 8, 2014	-	-
1	10333230-003A-G	August 22, 2014	5	Correction of Occupied Bandwidth (99%) Test Procedure

Contents

SECTION 1: Customer information

Company Name	:	CASIO COMPUTER CO., LTD.
Brand Name	:	CASIO
Address	:	3-2-1, Sakae-cho, Hamura-shi, Tokyo, 205-8555, JAPAN
Telephone Number	:	+81-42-579-7282
Facsimile Number	:	+81-42-579-7702
Contact Person	:	Hiroaki Suzuki

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

2.1 Identification of E.U.T.

Type of equipment	:	Bluetooth Watch
Model No.	:	EQB-500
Serial No.	:	Refer to 4.2 in this report.
Rating	:	DC2.5V
Country of Mass-production	:	China
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No modification by the test lab.
Receipt Date of Sample	:	June 20, 2014

2.2 Product description

Model: EQB-500 (referred to as the EUT in this report) is a Bluetooth Watch.
The clock frequencies used in the EUT: 26MHz, 32.768kHz

Model EQB-500 has similar model: EQB-510.
The differences between EQB-500 and EQB-510 are design of watch face (display) and design of enclosure only.
Therefore, these differences have no influence to mechanical, electrical and radio condition of Bluetooth Watches.

<Radio part>

Equipment type	:	Transceiver
Frequency of operation	:	2402-2480MHz
Bandwidth & channel spacing	:	2MHz
Type of modulation	:	GFSK
Antenna type	:	Chip antenna
Antenna gain	:	-1.0dBi
Operation temperature range	:	-10 ~ +60 deg.C.

FCC 15.31 (e)
The EUT provides stable voltage (DC2.5V) constantly to the wireless transmitter regardless of input voltage.
Instead of a new battery, DC power supply was used for the test.
That does not affect the test result, therefore the EUT 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 EUT complies with the requirement.

SECTION 3: Test specification, procedures & results

3.1 Test specification

Test specification : FCC Part 15 Subpart C: 2014, final revised on May 1, 2014 and effective June 2, 2014
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 *2)	N/A	N/A
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	2.5dB Freq.: 7206.000MHz Polarization: Horizontal Detection: Average Mode: Tx 2402MHz	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.

3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied Bandwidth (99%)	ANSI C63.10:2009	-	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 (±)
Radiated emission (Measurement distance: 3m)	9kHz-30MHz	3.7 dB	3.7 dB	3.6 dB
	30MHz-300MHz	4.8 dB	5.0 dB	4.8 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	5.6 dB	5.6 dB
	18GHz-40GHz	5.2 dB	4.3 dB	4.3 dB

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

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: (±) 1.5dB
Spurious emission (Conducted) measurement (below 1GHz) uncertainty for this test was: (±) 1.6dB
Spurious emission (Conducted) measurement (1G-3GHz) uncertainty for this test was: (±) 1.4dB
Spurious emission (Conducted) measurement (3G-18GHz) uncertainty for this test was: (±) 2.8dB
Spurious emission (Conducted) measurement (18G-26.5GHz) uncertainty for this test was: (±) 2.5dB
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

	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.1 measurement room	-	2.55 x 4.1 x 2.5	-	-

3.6 Test setup, Data of test & Test instruments

Refer to APPENDIX 1 to 3.

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

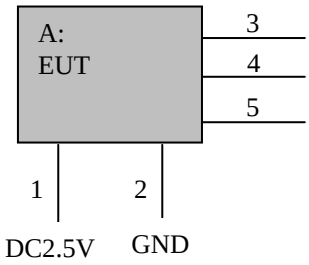
4.1 Operating mode

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

Power settings: -6dBm
Test software: BLE RF Test Tool, Ver1.00

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

4.2 Configuration and peripherals



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

Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	Remark
A	Bluetooth Watch	EQB-500	*1)	CASIO	EUT

*1) Radiated emission: 2, Other test: 1

List of cable used

No.	Item	Length (m)	Shield	Remark
1	DC(+)	2.0	Unshielded	Red
2	DC(-)	2.0	Unshielded	Black
3	Signal	2.0	Unshielded	White
4	Signal	2.0	Unshielded	Dark blue
5	Signal	2.0	Unshielded	Light blue

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: Spurious emissions (Antenna port conducted)

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

Summary of the test results: Pass
Refer to APPENDIX 1.

SECTION 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

SECTION 9: Radiated emission

9.1 Operating environment

Test room : 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 polystyrene platform of nominal size, 0.5m by 0.5m, raised 0.8m above the conducting ground plane. Photographs of the set up are shown in APPENDIX 3.

9.3 Test conditions

Frequency range : 30MHz - 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.

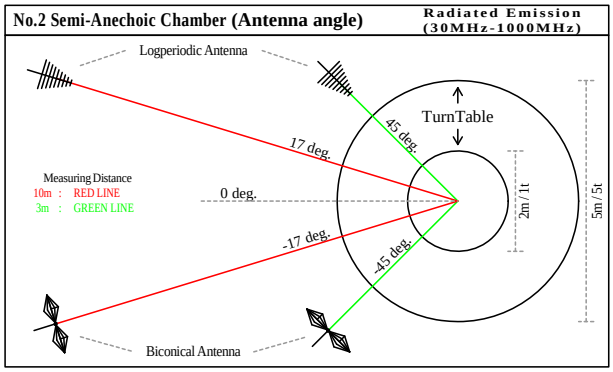
Frequency		30 - 1000MHz	1 - 25GHz		20dBc
Detection Type	:	Quasi-Peak	Peak	Average *1)	Peak
IF Bandwidth	:	120kHz	RBW:1MHz VBW:3MHz	RBW: 1MHz VBW: 3MHz Detector: Linear Voltage Averaging	RBW: 100kHz, VBW: 300kHz

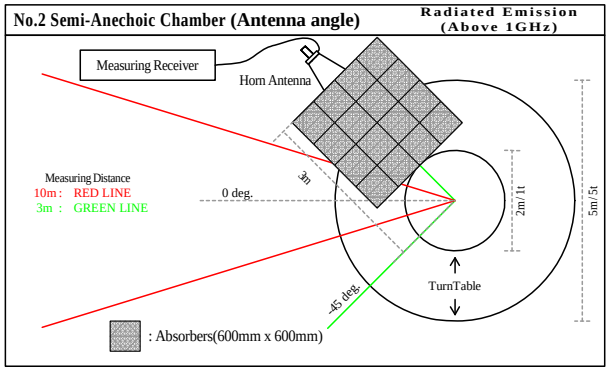
*1) Average Power Measurement was measured based on 12.2.5 of "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247".

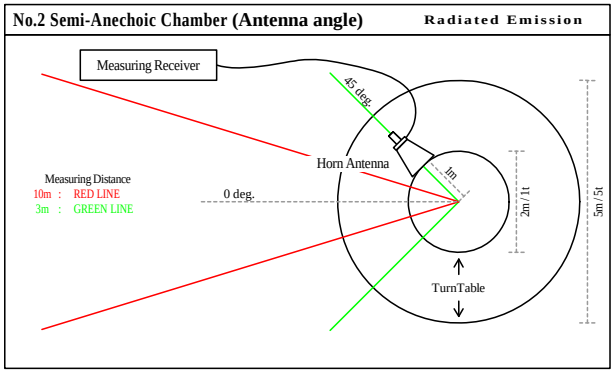
The carrier levels and noise levels were confirmed at each position of X, Y and Z axes to see the position of maximum noise, and the test was made at the position that has the maximum noise.

Antenna polarization	Carrier	Spurious (Below 1GHz)	Spurious (Above 1GHz)
Horizontal	Z	Y	Z
Vertical	Y	Y	Y

Figure 1. Antenna angle







9.5 Band edge

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

9.6 Results

Summary of the test results: Pass
*No noise was detected above the 5th 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

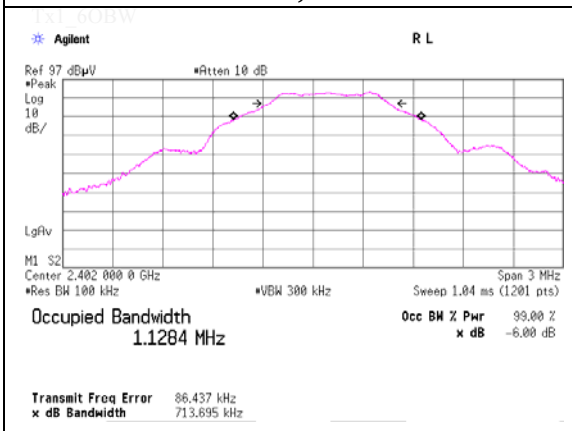
Radiated emission
Pre-check of the worst position

-6dB Bandwidth

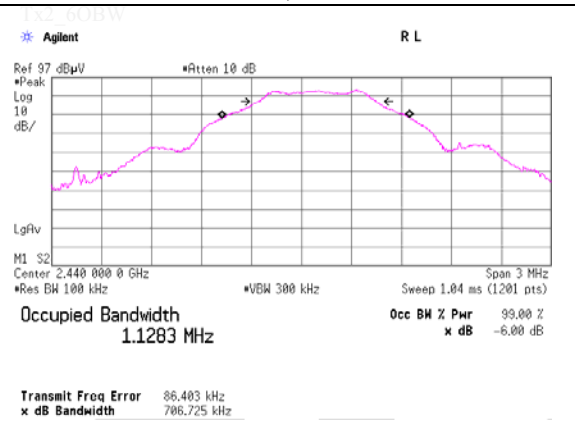
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	July 10, 2014	
Temperature / Humidity	22deg.C , 55%RH	
Engineer	Hiroshi Kukita	
Mode	Tx, Bluetooth LE, PN9	

Freq. [MHz]	-6dB Bandwidth [MHz]	Limit [MHz]
2402.0000	0.714	> 0.500
2440.0000	0.707	> 0.500
2480.0000	0.711	> 0.500

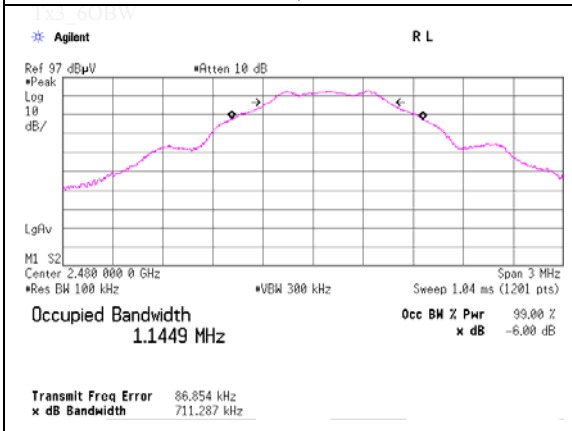
Tx, 2402MHz



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	July 10, 2014
Temperature / Humidity	22deg.C , 55%RH
Engineer	Hiroshi Kukita
Mode	Tx, Bluetooth LE, 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	-14.91	1.38	9.90	-3.63	0.43	30.00	1000	33.63
Mid	2440.0	-15.09	1.39	9.89	-3.81	0.42	30.00	1000	33.81
High	2480.0	-15.35	1.40	9.89	-4.06	0.39	30.00	1000	34.06

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

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Maximum Conducted Output Power (Reference data for SAR test)

(AVGPM)

Test place	UL Japan, Inc. Shonan EMC Lab. No.5 Shielded Room
Date	July 10, 2014
Temperature / Humidity	22deg.C , 55%RH
Engineer	Hiroshi Kukita
Mode	Tx, Bluetooth LE, PN9

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

Ch	Freq.	P/M (AV) Reading	Cable Loss	Atten. Loss	Duty Factor	Result		Limit		Margin
	[MHz]	[dBm]	[dB]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
Low	2402.0	-15.67	1.38	9.90	0.00	-4.39	0.36	30.00	1000	34.39
Mid	2440.0	-15.85	1.39	9.89	0.00	-4.57	0.35	30.00	1000	34.57
High	2480.0	-16.10	1.40	9.89	0.00	-4.81	0.33	30.00	1000	34.81

Sample Calculation:
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Atten. Loss + Duty Factor
E.I.R.P = Result + Antenna Gain

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Radiated Emission

Test place UL Japan, Inc. Shonan EMC Lab. No.2 Semi Anechoic Chamber
Date August 1, 2014
Temperature / Humidity 25 deg.C , 63%RH
Engineer Hikaru Shirasawa
Mode Tx, 2402 MHz
Tx, Bluetooth LE, PN9

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	130.006	QP	30.6	13.7	8.1	31.8	20.6	43.5	22.9	259	42	
Hori.	863.988	QP	25.2	21.8	9.4	31.1	25.3	46.0	20.7	166	277	
Hori.	955.273	QP	22.5	22.7	9.8	30.5	24.5	46.0	21.5	211	94	
Hori.	2390.000	PK	44.1	27.5	14.5	38.2	47.9	73.9	26.0	100	359	
Hori.	2399.721	PK	51.6	27.5	14.5	38.2	55.4	73.9	18.5	100	82	
Hori.	2400.000	PK	50.8	27.5	14.5	38.2	54.6	73.9	19.3	100	82	
Hori.	4804.000	PK	43.2	30.9	7.9	37.1	44.9	73.9	29.0	100	61	
Hori.	7206.000	PK	52.3	36.6	9.0	39.4	58.5	73.9	15.4	120	319	
Hori.	9608.000	PK	44.2	39.1	9.9	37.6	55.6	73.9	18.3	100	0	
Hori.	12010.000	PK	45.5	39.9	11.3	38.5	58.2	73.9	15.7	100	359	
Hori.	2390.000	AV	34.2	27.5	14.5	38.2	38.0	53.9	15.9	100	359	
Hori.	2399.721	AV	35.0	27.5	14.5	38.2	38.8	53.9	15.1	100	82	
Hori.	2400.000	AV	35.0	27.5	14.5	38.2	38.8	53.9	15.1	100	82	
Hori.	4804.000	AV	33.9	30.9	7.9	37.1	35.6	53.9	18.3	100	61	
Hori.	7206.000	AV	45.2	36.6	9.0	39.4	51.4	53.9	**2.5**	120	319	
Hori.	9608.000	AV	34.5	39.1	9.9	37.6	45.9	53.9	8.0	100	0	
Hori.	12010.000	AV	36.4	39.9	11.3	38.5	49.1	53.9	4.8	100	359	
Vert.	44.855	QP	38.1	12.3	7.2	31.9	25.7	40.0	14.3	100	157	
Vert.	408.005	QP	42.7	16.3	7.1	31.7	34.4	46.0	11.6	100	224	
Vert.	891.888	QP	22.9	22.1	9.5	31.0	23.5	46.0	22.5	100	225	
Vert.	905.731	QP	22.2	22.3	9.6	30.9	23.2	46.0	22.8	100	233	
Vert.	2390.000	PK	44.2	27.5	14.5	38.2	48.0	73.9	25.9	100	80	
Vert.	2399.759	PK	51.3	27.5	14.5	38.2	55.1	73.9	18.8	138	48	
Vert.	2400.000	PK	50.4	27.5	14.5	38.2	54.2	73.9	19.7	138	48	
Vert.	4804.000	PK	41.7	30.9	7.9	37.1	43.4	73.9	30.5	100	0	
Vert.	7206.000	PK	48.8	36.6	9.0	39.4	55.0	73.9	18.9	177	212	
Vert.	9608.000	PK	43.6	39.1	9.9	37.6	55.0	73.9	18.9	100	228	
Vert.	12010.000	PK	46.2	39.9	11.3	38.5	58.9	73.9	15.0	100	0	
Vert.	2390.000	AV	34.2	27.5	14.5	38.2	38.0	53.9	15.9	100	80	
Vert.	2399.759	AV	35.5	27.5	14.5	38.2	39.3	53.9	14.6	138	48	
Vert.	2400.000	AV	36.7	27.5	14.5	38.2	40.5	53.9	13.4	138	48	
Vert.	4804.000	AV	33.4	30.9	7.9	37.1	35.1	53.9	18.8	100	0	
Vert.	7206.000	AV	41.1	36.6	9.0	39.4	47.3	53.9	6.6	177	212	
Vert.	9608.000	AV	34.2	39.1	9.9	37.6	45.6	53.9	8.3	100	228	
Vert.	12010.000	AV	36.3	39.9	11.3	38.5	49.0	53.9	4.9	100	0	

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

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

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

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

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Radiated Emission

Test place UL Japan, Inc. Shonan EMC Lab. No.2 Semi Anechoic Chamber
Date August 1, 2014
Temperature / Humidity 25 deg.C , 63%RH
Engineer Hikaru Shirasawa
Mode Tx, 2440 MHz
Tx, Bluetooth LE, PN9

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	130.008	QP	30.7	13.7	8.1	31.8	20.7	43.5	22.8	235	218	
Hori.	303.091	QP	27.2	13.9	6.5	31.7	15.9	46.0	30.1	179	305	
Hori.	953.469	QP	22.7	22.7	9.8	30.5	24.7	46.0	21.3	203	90	
Hori.	4880.000	PK	42.2	31.3	8.0	37.0	44.5	73.9	29.4	100	359	
Hori.	7320.000	PK	48.1	36.7	9.0	39.4	54.4	73.9	19.5	100	92	
Hori.	9760.000	PK	43.0	39.0	9.9	37.5	54.4	73.9	19.5	100	0	
Hori.	12200.000	PK	44.3	39.9	11.3	38.4	57.1	73.9	16.8	100	359	
Hori.	4880.000	AV	34.3	31.3	8.0	37.0	36.6	53.9	17.3	100	359	
Hori.	7320.000	AV	40.1	36.7	9.0	39.4	46.4	53.9	7.5	100	92	
Hori.	9760.000	AV	33.6	39.0	9.9	37.5	45.0	53.9	8.9	100	0	
Hori.	12200.000	AV	35.0	39.9	11.3	38.4	47.8	53.9	6.1	100	359	
Vert.	44.753	QP	38.6	12.4	7.2	31.9	26.3	40.0	13.7	100	194	
Vert.	408.003	QP	42.7	16.3	7.1	31.7	34.4	46.0	11.6	100	224	
Vert.	836.856	QP	22.7	21.4	9.3	31.2	22.2	46.0	23.8	100	209	
Vert.	901.383	QP	22.3	22.3	9.6	30.9	23.3	46.0	22.7	100	233	
Vert.	4880.000	PK	41.8	31.3	8.0	37.0	44.1	73.9	29.8	100	359	
Vert.	7320.000	PK	47.9	36.7	9.0	39.4	54.2	73.9	19.7	152	47	
Vert.	9760.000	PK	43.0	39.0	9.9	37.5	54.4	73.9	19.5	100	359	
Vert.	12200.000	PK	44.3	39.9	11.3	38.4	57.1	73.9	16.8	100	0	
Vert.	4880.000	AV	33.5	31.3	8.0	37.0	35.8	53.9	18.1	100	359	
Vert.	7320.000	AV	39.6	36.7	9.0	39.4	45.9	53.9	8.0	152	47	
Vert.	9760.000	AV	33.6	39.0	9.9	37.5	45.0	53.9	8.9	100	359	
Vert.	12200.000	AV	35.2	39.9	11.3	38.4	48.0	53.9	**5.9**	100	0	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 15GHz)) - Gain(Amprifier)
*Other frequency noises omitted in this report were not seen or have enough margin (more than 20dB).
*The 10th harmonic was not seen so the result was its base noise level.
Distance factor : 15GHz -40GHz : 20log(3.0m/1.0m)= 9.5dB

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Shonan EMC Lab.
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Telephone : +81 463 50 6400
Facsimile : +81 463 50 6401

Radiated Emission

Test place UL Japan, Inc. Shonan EMC Lab. No.2 Semi Anechoic Chamber
Date August 1, 2014
Temperature / Humidity 25 deg.C , 63%RH
Engineer Hikaru Shirasawa
Mode Tx, 2480 MHz
Tx, Bluetooth LE, PN9

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

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg.]	Remark
Hori.	130.011	QP	30.5	13.7	8.1	31.8	20.5	43.5	23.0	244	223	
Hori.	328.336	QP	32.9	14.5	6.7	31.7	22.4	46.0	23.6	214	230	
Hori.	952.727	QP	22.7	22.7	9.8	30.5	24.7	46.0	21.3	215	101	
Hori.	2483.500	PK	45.6	27.8	14.6	38.1	49.9	73.9	24.0	120	79	
Hori.	2484.253	PK	47.3	27.8	14.6	38.1	51.6	73.9	22.3	120	79	
Hori.	4960.000	PK	45.6	31.8	8.0	37.0	48.4	73.9	25.5	102	351	
Hori.	7440.000	PK	46.2	36.8	9.2	39.4	52.8	73.9	21.1	100	187	
Hori.	9920.000	PK	42.1	38.9	9.9	37.5	53.4	73.9	20.5	100	0	
Hori.	12400.000	PK	43.2	40.0	11.4	38.2	56.4	73.9	17.5	100	359	
Hori.	2483.500	AV	34.6	27.8	14.6	38.1	38.9	53.9	15.0	120	79	
Hori.	2484.253	AV	34.5	27.8	14.6	38.1	38.8	53.9	15.1	120	79	
Hori.	4960.000	AV	37.4	31.8	8.0	37.0	40.2	53.9	13.7	102	351	
Hori.	7440.000	AV	37.7	36.8	9.2	39.4	44.3	53.9	9.6	100	187	
Hori.	9920.000	AV	32.7	38.9	9.9	37.5	44.0	53.9	9.9	100	0	
Hori.	12400.000	AV	33.8	40.0	11.4	38.2	47.0	53.9	**6.9**	100	359	
Vert.	44.815	QP	38.2	12.3	7.2	31.9	25.8	40.0	14.2	100	177	
Vert.	408.004	QP	42.9	16.3	7.1	31.7	34.6	46.0	11.4	100	223	
Vert.	657.111	QP	29.6	19.7	8.5	31.7	26.1	46.0	19.9	102	271	
Vert.	949.838	QP	23.6	22.7	9.7	30.5	25.5	46.0	20.5	100	137	
Vert.	2483.500	PK	45.8	27.8	14.6	38.1	50.1	73.9	23.8	100	57	
Vert.	2484.216	PK	47.7	27.8	14.6	38.1	52.0	73.9	21.9	100	57	
Vert.	4960.000	PK	42.5	31.8	8.0	37.0	45.3	73.9	28.6	114	88	
Vert.	7440.000	PK	45.4	36.8	9.2	39.4	52.0	73.9	21.9	141	199	
Vert.	9920.000	PK	41.7	38.9	9.9	37.5	53.0	73.9	20.9	100	359	
Vert.	12400.000	PK	43.2	40.0	11.4	38.2	56.4	73.9	17.5	100	0	
Vert.	2483.500	AV	34.7	27.8	14.6	38.1	39.0	53.9	14.9	100	57	
Vert.	2484.216	AV	34.9	27.8	14.6	38.1	39.2	53.9	14.7	100	57	
Vert.	4960.000	AV	34.9	31.8	8.0	37.0	37.7	53.9	16.2	114	88	
Vert.	7440.000	AV	37.0	36.8	9.2	39.4	43.6	53.9	10.3	141	199	
Vert.	9920.000	AV	32.8	38.9	9.9	37.5	44.1	53.9	9.8	100	359	
Vert.	12400.000	AV	33.6	40.0	11.4	38.2	46.8	53.9	7.1	100	0	

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

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

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

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

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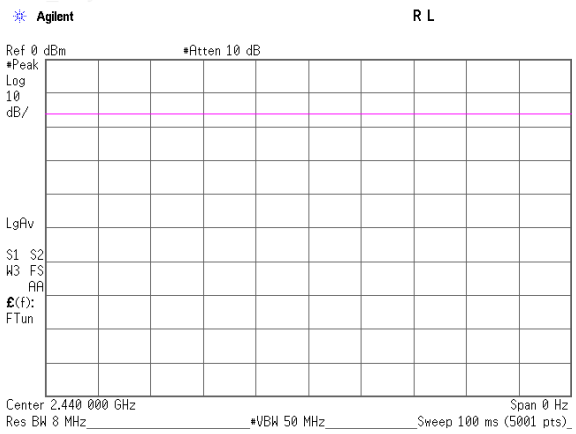
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	July 10, 2014	
Temperature / Humidity	22deg.C , 55%RH	
Engineer	Hiroshi Kukita	

Burst rate confirmation

Tx, Bluetooth LE, PN9

Duty Factor Calculation	
Duty Factor: 20log (1/duty cycle) = 0dB	
duty cycle = 100 / 100 = 1 (100%)	
Tx2_duty1	Tx2_duty2



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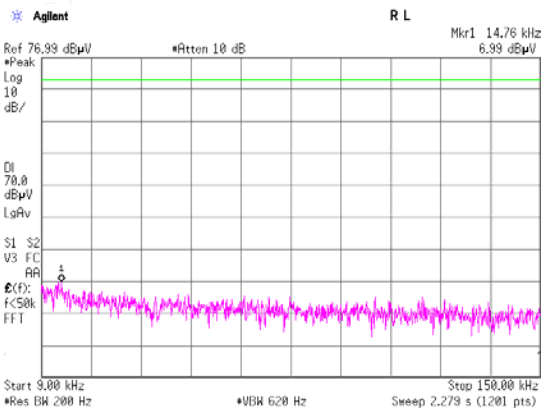
Date	July 10, 2014	
Temperature / Humidity	22deg.C , 55%RH	
Engineer	Hiroshi Kukita	

(Reference chart) Spurious emission (Conducted)

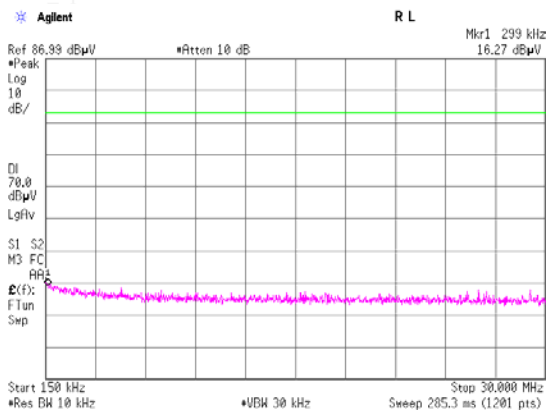
Tx, Bluetooth LE, PN9

Tx, 2402MHz (below 1GHz)

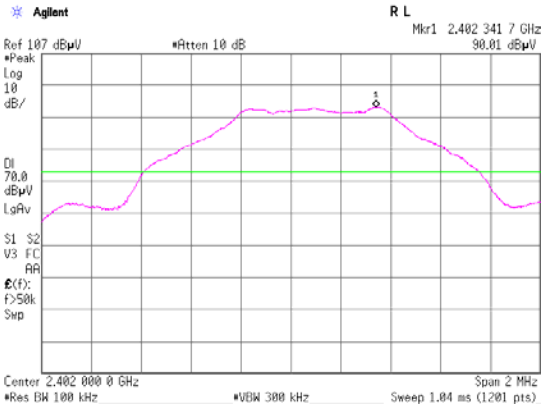
9kHz - 150kHz



150kHz - 30MHz



Carrier, 20dBc limit



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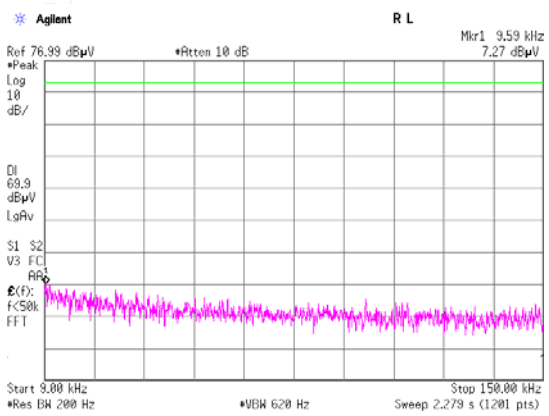
Date	July 10, 2014	
Temperature / Humidity	22deg.C , 55%RH	
Engineer	Hiroshi Kukita	

(Reference chart) Spurious emission (Conducted)

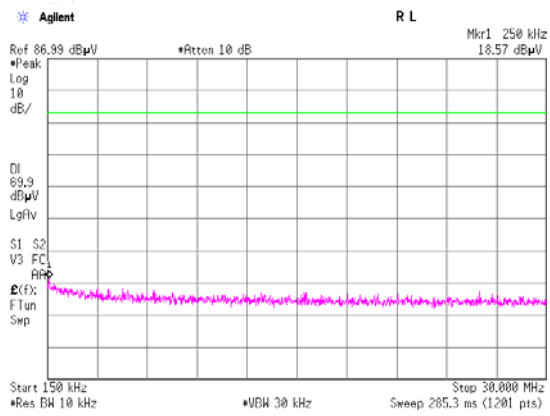
Tx, Bluetooth LE, PN9

Tx, 2440MHz (below 1GHz)

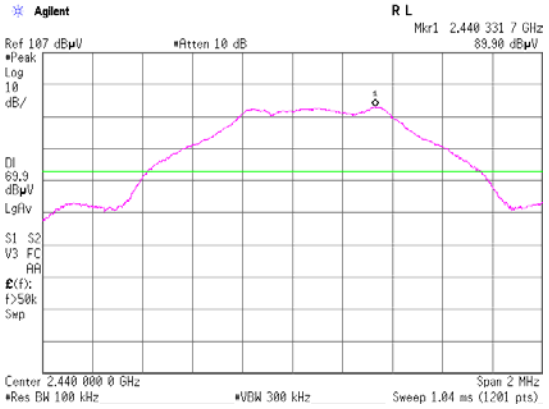
9kHz - 150kHz



150kHz - 30MHz



Carrier, 20dBc limit



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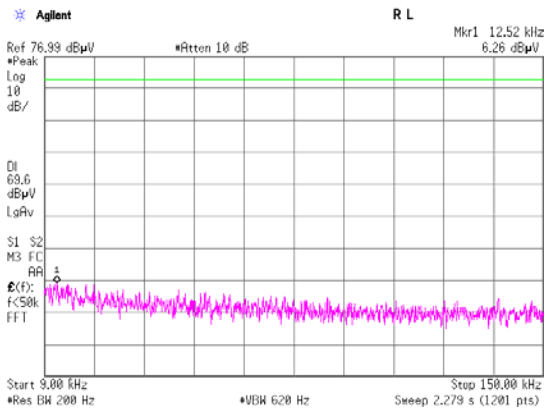
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	July 10, 2014	
Temperature / Humidity	22deg.C , 55%RH	
Engineer	Hiroshi Kukita	

(Reference chart) Spurious emission (Conducted)

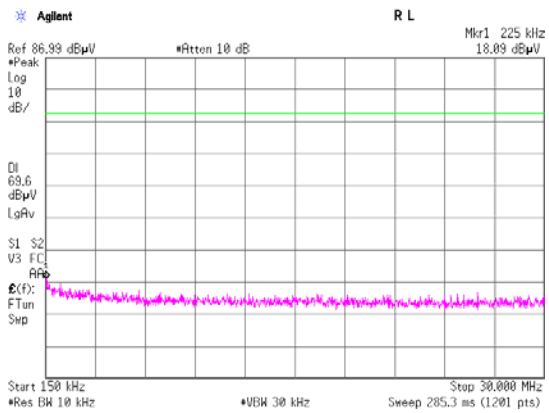
Tx, Bluetooth LE, PN9

Tx, 2480MHz (below 1GHz)

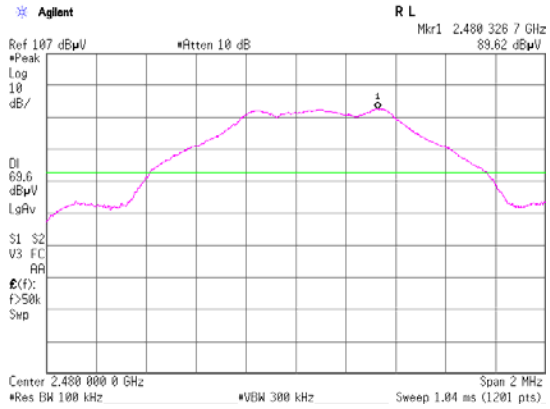
9kHz - 150kHz



150kHz - 30MHz



Carrier, 20dBc limit



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Maximum Power Spectral Density

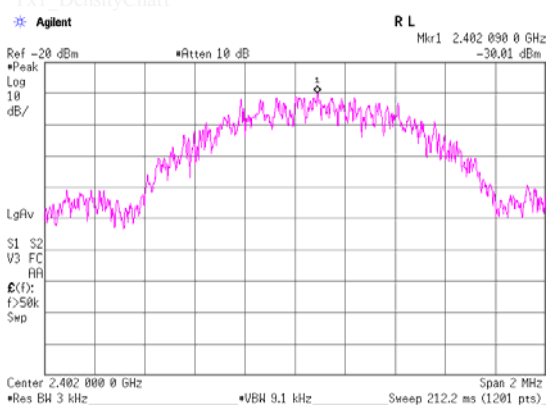
(PKPSD)

Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	July 10, 2014	
Temperature / Humidity	22deg.C , 55%RH	
Engineer	Hiroshi Kukita	
Mode	Tx, Bluetooth LE, PN9	

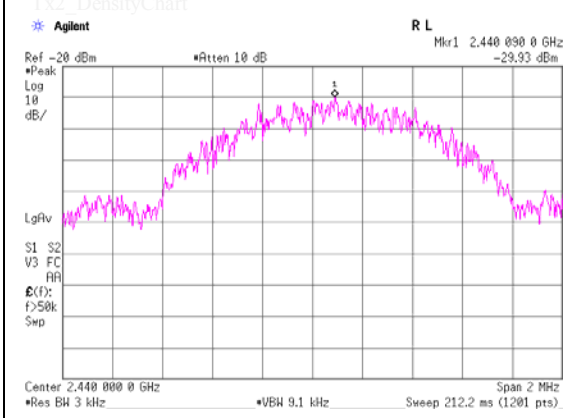
Ch. Freq. [MHz]	Freq. Reading [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2402.0000	2402.09	-30.01	1.38	9.90	-18.74	8.00	26.73
2440.0000	2440.09	-29.93	1.39	9.89	-18.65	8.00	26.65
2480.0000	2480.09	-30.44	1.40	9.89	-19.16	8.00	27.15

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

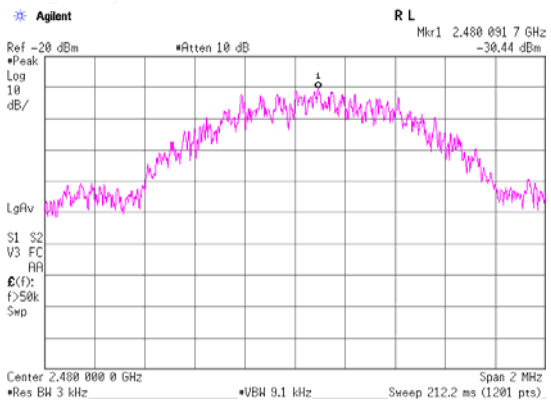
Tx, 2402MHz



Tx, 2440MHz



Tx, 2480MHz



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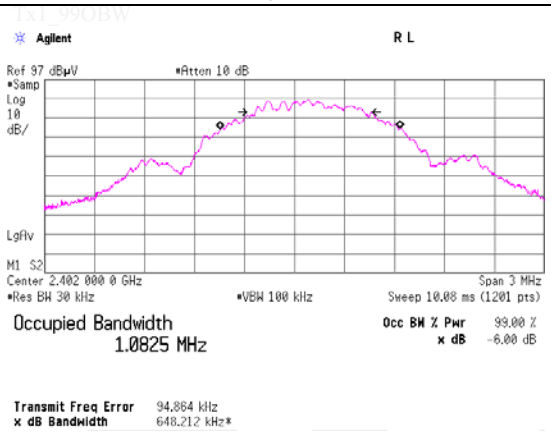
Test place	UL Japan, Inc. Shonan EMC Lab.	No.5 Shielded Room
Date	July 10, 2014	
Temperature / Humidity	22deg.C , 55%RH	
Engineer	Hiroshi Kukita	

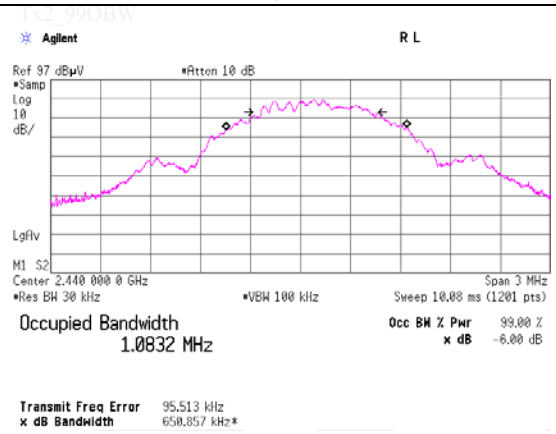
99% Occupied Bandwidth

Tx, Bluetooth LE, PN9

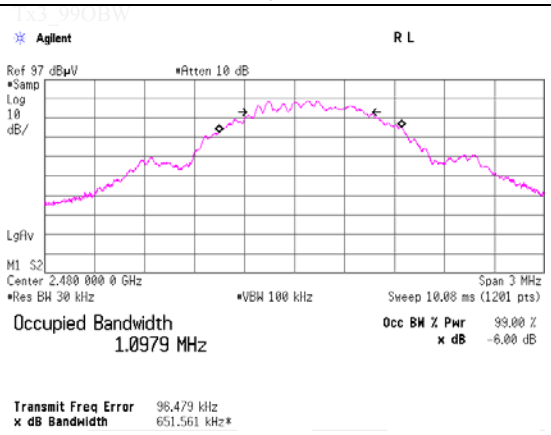
Tx, 2402MHz



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	AT	2014/02/03 * 12
SAT10-11	Attenuator	Weinschel Corp.	54A-10	37588	AT	2014/04/22 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2014/03/14 * 12
SPM-06	Power Meter	Anritsu	ML2495A	0850009	AT	2014/04/08 * 12
SPSS-03	Power sensor	Anritsu	MA2411B	0917063	AT	2014/04/08 * 12
SBM-09	Barometer	Sunoh	SBR121	001074	AT	2012/02/23 * 36
SOS-09	Humidity Indicator	A&D	AD-5681	4061484	AT	2014/03/07 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2014/02/17 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2014/02/17 * 12
KAT3-11	Attenuator	JFW IND. INC.	50HF-003N	-	RE	2013/08/19 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2013/11/24 * 12
SCC-B1/B3/B5/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2014/04/25 * 12
SCC-B2/B4/B6/B7/B8/B13/SRSE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	RE	2014/04/25 * 12
SLA-02	Logperiodic Antenna	Schwarzbeck	UHALP9108A	UHALP 9108-A 0893	RE	2013/11/24 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2014/02/21 * 12
STR-02	Test Receiver	Rohde & Schwarz	ESCI	100575	RE	2013/09/24 * 12
SJM-14	Measure	ASKUL	-	-	RE	-
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	RE	2014/07/08 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,MF)	-	RE	-
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2013/11/22 * 12
SCC-G02	Coaxial Cable	Suhner	SUCOFLEX 104A	46498/4A	RE	2014/04/22 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2014/05/15 * 12
SHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	RE	2013/08/12 * 12
SSA-02	Spectrum Analyzer	Agilent	E4448A	MY48250106	RE	2014/03/17 * 12
SHA-04	Horn Antenna	ETS LINDGREN	3160-09	LM3640	RE	2014/03/15 * 12
SAF-08	Pre Amplifier	TOYO Corporation	HAP18-26W	00000019	RE	2014/03/14 * 12
SCC-G15	Coaxial Cable	Suhner	SUCOFLEX 102	32703/2	RE	2014/03/13 * 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

End of Report