



RADIO TEST REPORT

Test Report No. : 10410328H-A-R1

Applicant : Braveridge Co., Ltd.
Type of Equipment : Bluetooth Low Energy Module
Model No. : BVMCN5103
FCC ID : 2ABXRBVMCN5103
Test regulation : FCC Part 15 Subpart C: 2014
Test Result : Complied

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3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
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6. This report is a revised version of 10410328H-A. 10410328H-A is replaced with this report.

Date of test: July 11 and 15, 2014

Representative test engineer:

Shinya Watanabe
Engineer
Consumer Technology Division

Approved by:

Takayuki Shimada
Engineer
Consumer Technology Division



NVLAP LAB CODE: 200572-0

This laboratory is accredited by the NVLAP LAB CODE 200572-0, U.S.A. The tests reported herein have been performed in accordance with its terms of accreditation.
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<http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap>

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13-EM-F0429

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SECTION 1: Customer information

Company Name : Braveridge Co., Ltd.
Address : 3-27-2 Shusenji Nishi-ku, Fukuoka-city, Fukuoka, Japan 819-0373
Telephone Number : +81-92-834-5789
Facsimile Number : +81-92-807-7718
Contact Person : Yasunari Kohashi

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

2.1 Identification of E.U.T.

Type of Equipment : Bluetooth Low Energy Module
Model No. : BVMCN5103
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC1.8V - 3.6V
Receipt Date of Sample : July 10, 2014
Country of Mass-production : Japan
Condition of EUT : Production model
Modification of EUT : No Modification by the test lab

2.2 Product Description

General Specification

Clock frequency(ies) in the system : 16MHz

Radio Specification

Radio Type : Transceiver
Frequency of Operation : 2402-2480MHz
Modulation : GFSK
Power Supply (radio part input) : DC 1.6V
Antenna type : Multilayer Monopole Antenna
Antenna Gain : 0.9dBi (peak)

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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 15.247 Operation within the bands 902-928MHz,
2400-2483.5MHz, and 5725-5850MHz

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.4:2003 7. AC powerline Conducted Emission measurements IC: RSS-Gen 7.2.4	FCC: Section 15.207 IC: RSS-Gen 7.2.4	QP 16.3dB, 0.15349MHz, N AV 18.9dB, 0.53008MHz, N	Complied	-
6dB Bandwidth	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on June 5, 2014)" IC: RSS-Gen 4.6.2	FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(a)	See data.	-	Conducted
Maximum Peak Output Power	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on June 5, 2014)" IC: RSS-Gen 4.8	FCC: Section 15.247(b)(3) IC: RSS-210 A8.4(4)		Complied	Conducted
Power Density	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on June 5, 2014)" IC: -	FCC: Section 15.247 (e) IC: RSS-210 A8.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on June 5, 2014)" IC: RSS-Gen 4.9	FCC: Section15.247(d) IC: RSS-210 A8.5 RSS-Gen 7.2.3	9.5dB 7320.000MHz, AV, Hori.	Complied	Conducted/ Radiated

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

* In case any questions arise about test procedure, ANSI C63.4: 2003 is also referred.

FCC 15.31 (e)

This EUT provides stable voltage (DC1.6V) constantly to RF part regardless of input voltage. Therefore, this EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

It is impossible for end users to replace the antenna, because the antenna is mounted inside of the EUT. Therefore, the equipment complies with the antenna requirement of Section 15.203/212.

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3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 4.6.1	IC: RSS-Gen 4.6.1	N/A	-	Conducted

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI

The following uncertainties have been calculated to provide a confidence level of 95% using a coverage factor k=2.

Test room (semi-anechoic chamber)	Conducted emission (+dB)
	150kHz-30MHz
No.1	3.5dB
No.2	3.5dB
No.3	3.6dB
No.4	3.5dB

Test room (semi-anechoic chamber)	Radiated emission						
	(3m*)(+dB)				(1m*)(+dB)		(0.5m*)(+dB)
	9kHz -30MHz	30MHz -300MHz	300MHz -1GHz	1GHz -10GHz	10GHz -18GHz	18GHz -26.5GHz	26.5GHz -40GHz
No.1	4.0dB	5.1dB	5.0dB	5.1dB	6.0dB	4.9dB	4.3dB
No.2	3.9dB	5.2dB	5.0dB	4.9dB	5.9dB	4.7dB	4.2dB
No.3	4.3dB	5.1dB	5.2dB	5.2dB	6.0dB	4.8dB	4.2dB
No.4	4.6dB	5.2dB	5.0dB	5.2dB	6.0dB	5.7dB	4.2dB

*3m/1m/0.5m = Measurement distance

Power meter (+dB)	
Below 1GHz	Above 1GHz
0.7dB	1.5dB

Antenna terminal conducted emission and Power density (+dB)			Antenna terminal conducted emission (+dB)		Channel power (+dB)
Below 1GHz	1GHz-3GHz	3GHz-18GHz	18GHz-26.5GHz	26.5GHz-40GHz	
1.5dB	1.7dB	2.8dB	2.8dB	2.9dB	2.6dB

Conducted Emission test

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

Radiated emission test(3m)

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

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3.5 Test Location

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	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Other rooms
No.1 semi-anechoic chamber	2973C-1	19.2 x 11.2 x 7.7m	7.0 x 6.0m	No.1 Power source room
No.2 semi-anechoic chamber	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	2973C-3	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.3 Preparation room
No.3 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.4 semi-anechoic chamber	2973C-4	12.0 x 8.5 x 5.9m	6.8 x 5.75m	No.4 Preparation room
No.4 shielded room	-	4.0 x 6.0 x 2.7m	N/A	-
No.5 semi-anechoic chamber	-	6.0 x 6.0 x 3.9m	6.0 x 6.0m	-
No.6 shielded room	-	4.0 x 4.5 x 2.7m	4.0 x 4.5 m	-
No.6 measurement room	-	4.75 x 5.4 x 3.0m	4.75 x 4.15 m	-
No.7 shielded room	-	4.7 x 7.5 x 2.7m	4.7 x 7.5m	-
No.8 measurement room	-	3.1 x 5.0 x 2.7m	N/A	-
No.9 measurement room	-	8.0 x 4.6 x 2.8m	2.4 x 2.4m	-
No.11 measurement room	-	6.2 x 4.7 x 3.0m	4.8 x 4.6m	-

* Size of vertical conducting plane (for Conducted Emission test) : 2.0 x 2.0m for No.1, No.2, No.3, and No.4 semi-anechoic chambers and No.3 and No.4 shielded rooms.

3.6 Data of EMI, Test instruments, and Test set up

Refer to APPENDIX.

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

4.1 Operating Mode(s)

Bluetooth Low Energy (BLE): Transmitting (Tx)

Details of Operating Mode(s)

Test Item	Operating Mode	Tested Frequency
Conducted Emission	Tx BLE	2402MHz
Spurious Emission		2440MHz
6dB Bandwidth		2480MHz
Maximum Peak Output Power		
Power Density		
99% Occupied Bandwidth		

*Power of the EUT was set by the software as follows;

Power settings: +4dBm

Software: nRF Studio Ver.1.17.0.3211

*This setting of software is the worst case.

Any conditions under the normal use do not exceed the condition of setting.

In addition, end users cannot change the settings of the output power of the product.

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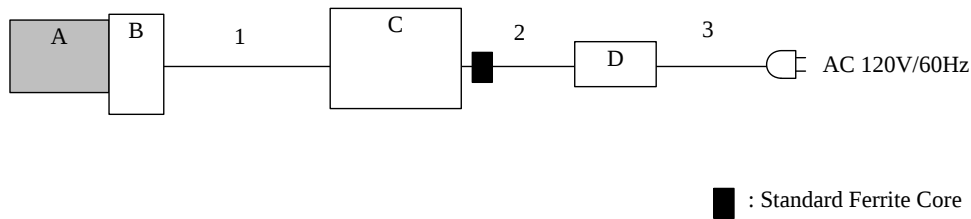
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4.2 Configuration and peripherals



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

Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Bluetooth Low Energy Module	BVMCN5103	001 *1) 002 *2)	Braveridge Co., Ltd.	EUT
B	Jig	-	-	Braveridge Co., Ltd.	-
C	Laptop PC	P5WE0	LXR9702196206172FB1601	Acer	-
D	AC Adapter	ADP-65VHB	AP065010331520621BP102	DELTA ELECTRONICS, INC.	-

*1) Used for Antenna Terminal conducted test

*2) Used for Conducted Emission test and Radiated Emission test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	2.0	Shielded	Shielded	-
2	DC Cable	1.8	Unshielded	Unshielded	-
3	AC Cable	1.8	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 0.5m by 1.0m, raised 0.8m above the conducting ground plane.

The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals aligned and 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 a Line Impedance Stabilization Network (LISN)/ Artificial mains Network (AMN) and excess AC cable was bundled in center.

For the tests on EUT with other peripherals (as a whole system)

I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane. All unused 50ohm connectors of the LISN(AMN) were resistivity terminated in 50ohm when not connected to the measuring equipment.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Detector	: QP and CISPR AV
Measurement range	: 0.15-30MHz
Test data	: APPENDIX
Test result	: Pass

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SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "558074 D01 DTS Meas Guidance v03r02 (Issued on June 5, 2014)".

EUT was placed on a urethane platform of nominal size, 0.5m by 1.0m, raised 0.8m above the conducting ground plane.

The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

The height of the measuring antenna varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	Below 30MHz	30MHz to 300MHz	300MHz to 1GHz	Above 1GHz
Antenna Type	Loop	Biconical	Logperiodic	Horn

In any 100kHz bandwidth outside the restricted 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.

20dBc was applied to the frequency over the limit of FCC 15.209 / Table 5 of RSS-Gen 7.2.5(IC) and outside the restricted band of FCC15.205 / Table 3 of RSS-Gen 7.2.2 (IC).

Frequency	Below 1GHz	Above 1GHz		20dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer *1)
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120kHz	RBW: 1MHz VBW: 3MHz	Average Power Method: Alternative 1 RBW: 1MHz VBW: 3MHz Trace: Free Run Detector: Power Averaging (RMS) Duty factor was added to the results.	RBW: 100kHz VBW: 300kHz
Test Distance	3m	3m (below 10GHz), 1m *2) (above 10GHz)		3m (below 10GHz), 1m *2) (above 10GHz)

*1) Average Power Measurement was performed based on 6.0 & 12.2.5 of "558074 D01 DTS Meas Guidance v03r02 (Issued on June 5, 2014)"

*2) Distance Factor: $20 \times \log(3.0\text{m}/1.0\text{m}) = 9.5\text{dB}$

- 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.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range	: 30M-26.5GHz
Test data	: APPENDIX
Test result	: Pass

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SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	3MHz	100kHz	300kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth	Enough width to display 20dB Bandwidth	1 to 3% of Span	Three times of RBW	Auto	Peak	Max Hold*1)	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/Average *2)	-	Power Meter (Sensor: 50MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3kHz	10kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200Hz	620Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1kHz	27kHz				

*1) The measurement was performed with Max Hold since the duty cycle was not 100%.
*2) Reference data
*3) Section 10.2 Method PKPSD (peak PSD) of "558074 D01 DTS Meas Guidance v03r02 (Issued on June 5, 2014) ".
*4) 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=9.1kHz)

The test results and limit are rounded off to two decimals place, so some differences might be observed.

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Data of EMI test

Conducted Emission

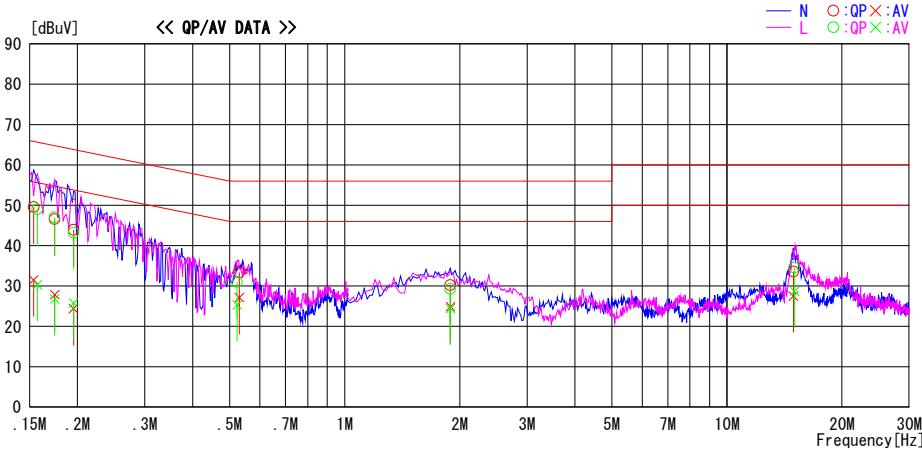
DATA OF CONDUCTED EMISSION TEST

UL Japan, Inc. Ise HQ EMC Lab. No.24 Semi Anechoic Chamber
Date : 2014/07/15

Report No. : 10410328H
Temp./Humi. : 24deg. C / 65% RH
Engineer : Yuta Moriya

Mode / Remarks : Tx BLE 2402MHz

LIMIT : FCC15. 207 QP
FCC15. 207 AV

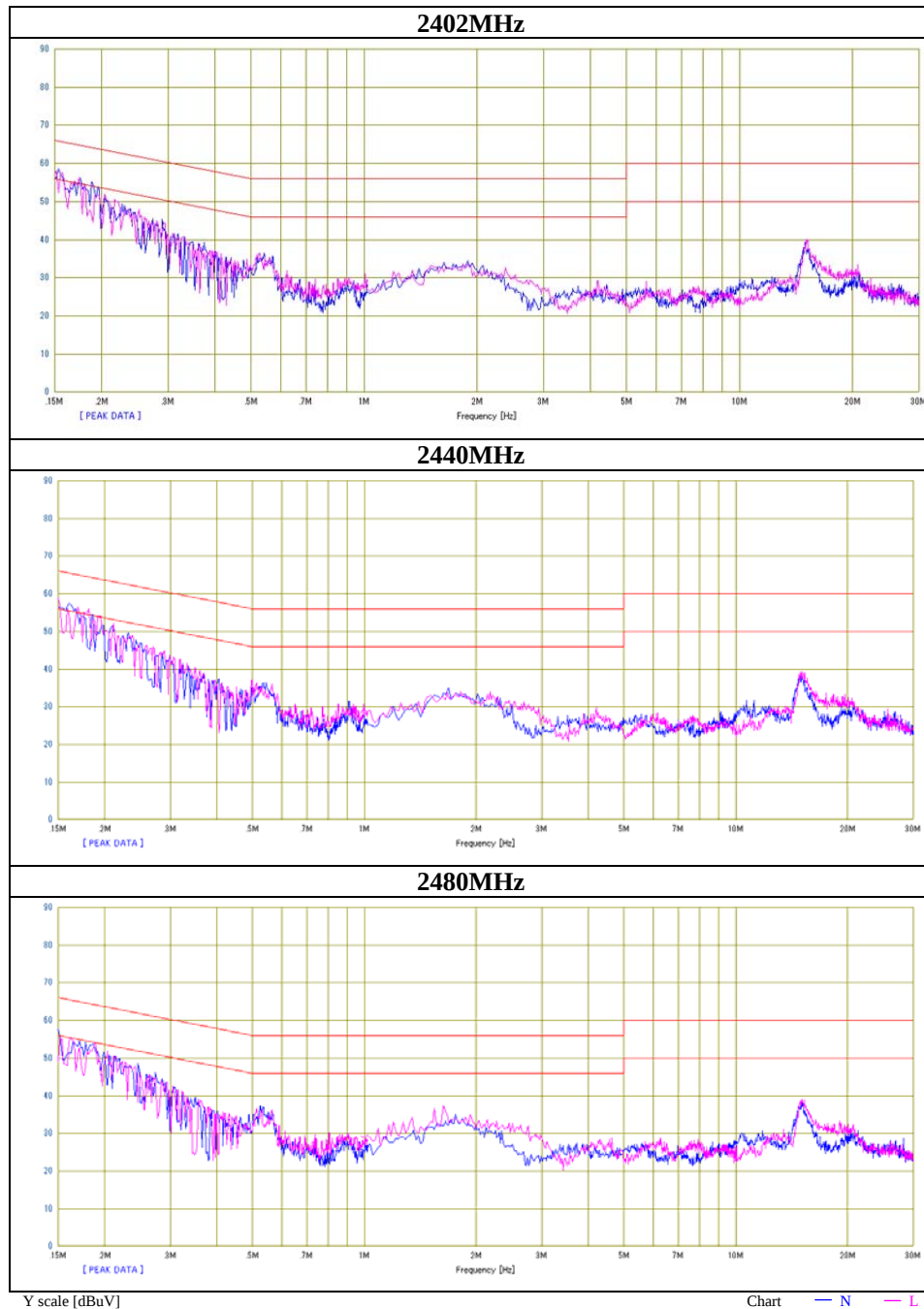


Frequency	Reading_Level		Corr.	Results		Limit		Margin		Phase	Comment
	QP	AV		QP	AV	QP	AV	QP	AV		
[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
0.15349	36.2	18.2	13.3	49.5	31.5	65.8	55.8	16.3	24.3	N	
0.17441	33.2	14.6	13.3	46.5	27.9	64.7	54.7	18.2	26.8	N	
0.19533	30.6	11.1	13.3	43.9	24.4	63.8	53.8	19.9	29.4	N	
0.53008	20.0	13.7	13.4	33.4	27.1	56.0	46.0	22.7	18.9	N	
1.88882	16.7	11.3	13.5	30.2	24.8	56.0	46.0	25.9	21.2	N	
14.93235	19.3	13.2	14.3	33.6	27.5	60.0	50.0	26.5	22.5	N	
0.15697	35.7	17.0	13.3	49.0	30.3	65.6	55.6	16.6	25.3	L	
0.17441	33.7	13.5	13.3	47.0	26.8	64.7	54.7	17.7	27.9	L	
0.19533	29.9	12.5	13.3	43.2	25.8	63.8	53.8	20.7	28.0	L	
0.52300	17.6	11.9	13.4	31.0	25.3	56.0	46.0	25.0	20.7	L	
1.88882	15.8	11.0	13.5	29.3	24.5	56.0	46.0	26.7	21.5	L	
15.01271	20.3	14.4	14.3	34.6	28.7	60.0	50.0	25.4	21.3	L	

CHART:WITH FACTOR,Peak hold data. CALCULATION:RESULT[dBuV]=READING[dBuV]+C.F[dB] (LISN+CABLE+ATTEN.)
Except for the above table : adequate margin data below the limits.

Conducted Emission

Test place	Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No.	10410328H
Date	07/15/2014
Temperature/ Humidity	24 deg. C / 65% RH
Engineer	Yuta Moriya
Mode	Tx BLE



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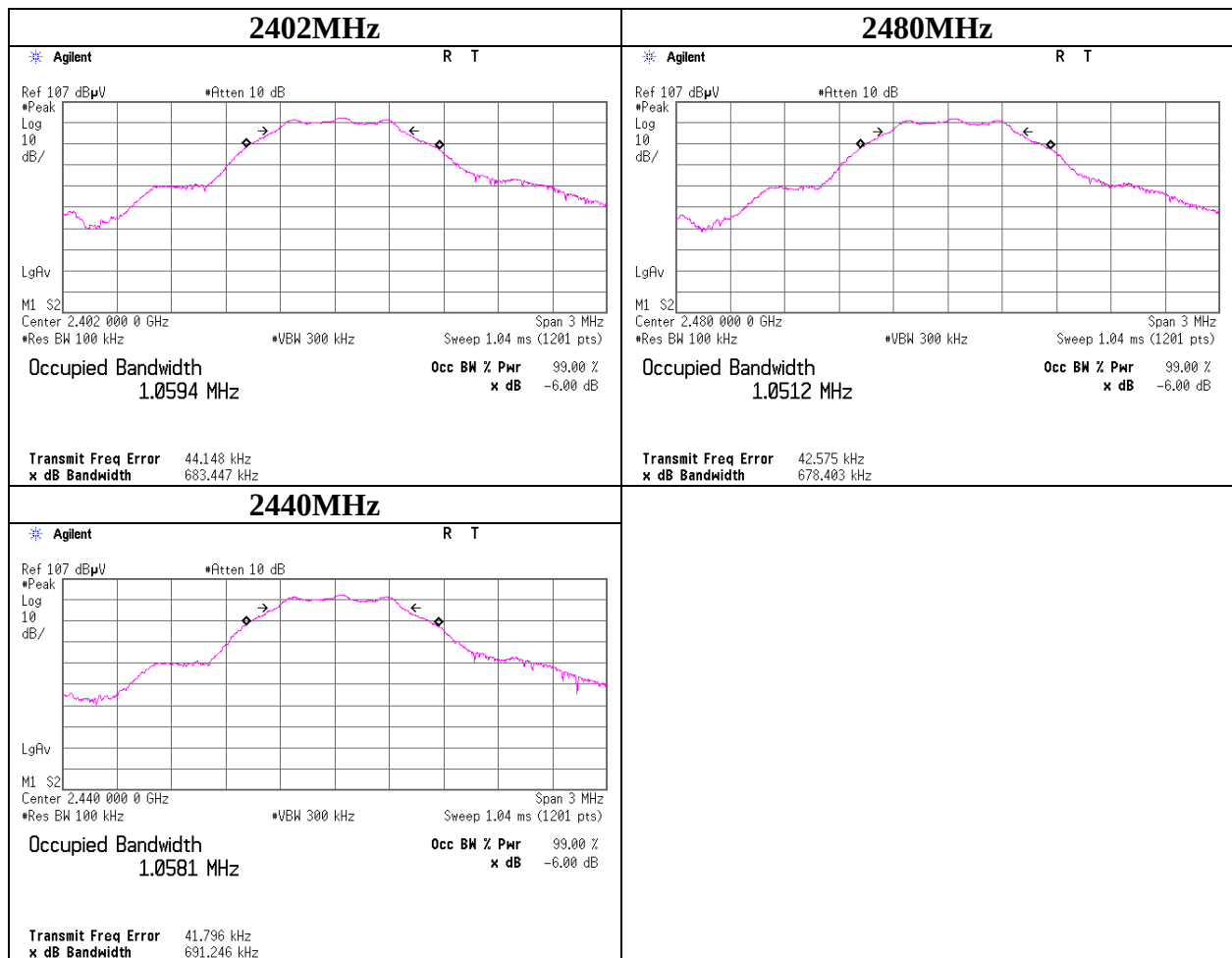
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6dB Bandwidth

Test place Ise EMC Lab. No.3 Measurement Room
Report No. 10410328H
Date 07/11/2014
Temperature/ Humidity 23 deg. C / 58% RH
Engineer Tomohisa Nakagawa
Mode Tx BLE

Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
2402	0.683	>500
2440	0.691	>500
2480	0.678	>500



Maximum Peak Output Power

Test place : Ise EMC Lab. No.3 Measurement Room
Report No. : 10410328H
Date : 07/11/2014
Temperature/ Humidity : 23 deg. C / 58% RH
Engineer : Tomohisa Nakagawa
Mode : Tx BLE

Setting value 4dBm

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-7.72	2.40	10.08	4.76	2.99	30.00	1000	25.24
2440	-7.85	2.40	10.08	4.63	2.90	30.00	1000	25.37
2480	-8.11	2.40	10.08	4.37	2.74	30.00	1000	25.63

Setting value -30dBm

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-32.58	2.40	0.00	-30.18	0.000959	30.00	1000	60.18
2440	-32.35	2.40	0.00	-29.95	0.001012	30.00	1000	59.95
2480	-32.44	2.40	0.00	-30.04	0.000991	30.00	1000	60.04

Average Output Power(Referece value)

Setting value 4dBm

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
				[dBm]	[mW]
2402	-9.61	2.40	10.08	2.87	1.94
2440	-9.72	2.40	10.08	2.76	1.89
2480	-9.95	2.40	10.08	2.53	1.79

Setting value -30dBm

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result	
				[dBm]	[mW]
2402	-35.32	2.40	0.00	-32.92	0.000511
2440	-34.91	2.40	0.00	-32.51	0.000561
2480	-35.19	2.40	0.00	-32.79	0.000526

Sample Calculation:

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

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Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 10410328H
Date : 07/15/2014 07/15/2014
Temperature/ Humidity : 23 deg. C / 68% RH 24 deg. C / 65% RH
Engineer : Shinya Watanabe Yuta Moriya
(30MHz-10GHz) (Above 10GHz)
Mode : Tx BLE 2402MHz

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]	Remark
Hori	333.000	QP	28.9	16.7	10.1	31.9	-	23.8	46.0	22.2	
Hori	2335.677	PK	60.4	28.1	3.1	32.8	-	58.8	73.9	15.1	
Hori	2390.000	PK	50.7	28.3	3.1	32.8	-	49.3	73.9	24.6	
Hori	4804.000	PK	42.3	32.2	4.5	31.9	-	47.1	73.9	26.8	
Hori	7206.000	PK	44.1	36.7	5.7	33.0	-	53.5	73.9	20.4	
Hori	2335.677	AV	43.4	28.1	3.1	32.8	1.2	43.0	53.9	10.9	
Hori	2390.000	AV	34.5	28.3	3.1	32.8	1.2	34.3	53.9	19.6	*1)
Hori	4804.000	AV	31.9	32.2	4.5	31.9	1.2	37.9	53.9	16.0	
Hori	7206.000	AV	33.6	36.7	5.7	33.0	1.2	44.2	53.9	9.7	
Vert	333.000	QP	28.7	16.7	10.1	31.9	-	23.6	46.0	22.4	
Vert	2335.677	PK	56.9	28.1	3.1	32.8	-	55.3	73.9	18.6	
Vert	2390.000	PK	40.8	28.3	3.1	32.8	-	39.4	73.9	34.5	
Vert	4804.000	PK	41.3	32.2	4.5	31.9	-	46.1	73.9	27.8	
Vert	7206.000	PK	44.5	36.7	5.7	33.0	-	53.9	73.9	20.0	
Vert	2335.677	AV	42.3	28.1	3.1	32.8	1.2	41.9	53.9	12.0	
Vert	2390.000	AV	25.1	28.3	3.1	32.8	1.2	24.9	53.9	29.0	*1)
Vert	4804.000	AV	32.7	32.2	4.5	31.9	1.2	38.7	53.9	15.2	
Vert	7206.000	AV	33.5	36.7	5.7	33.0	1.2	44.1	53.9	9.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier) + Duty Factor

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

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB

*1) Not Out of Band emission (Leakage Power)

20dBc Data Sheet

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant Factor [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2402.000	PK	94.2	28.4	3.1	32.8	92.9	-	-	Carrier
Hori	2400.000	PK	41.5	28.4	3.1	32.8	40.2	72.9	32.7	
Vert	2402.000	PK	96.7	28.4	3.1	32.8	95.4	-	-	Carrier
Vert	2400.000	PK	33.9	28.4	3.1	32.8	32.6	75.4	42.8	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

UL Japan, Inc.

Ise EMC Lab.

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Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 10410328H
Date : 07/15/2014 07/15/2014
Temperature/ Humidity : 23 deg. C / 68% RH 24 deg. C / 65% RH
Engineer : Shinya Watanabe Yuta Moriya
(30MHz-10GHz) (Above 10GHz)
Mode : Tx BLE 2440MHz

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]	Remark
Hori	333.000	QP	29.0	16.7	10.1	31.9	-	23.9	46.0	22.1	
Hori	4880.000	PK	43.1	32.5	4.6	31.9	-	48.3	73.9	25.6	
Hori	7320.000	PK	44.9	36.6	5.7	33.0	-	54.2	73.9	19.7	
Hori	4880.000	AV	32.3	32.5	4.6	31.9	1.2	38.7	53.9	15.2	
Hori	7320.000	AV	33.9	36.6	5.7	33.0	1.2	44.4	53.9	9.5	
Vert	333.000	QP	28.1	16.7	10.1	31.9	-	23.0	46.0	23.0	
Vert	4880.000	PK	43.1	32.5	4.6	31.9	-	48.3	73.9	25.6	
Vert	7320.000	PK	44.3	36.6	5.7	33.0	-	53.6	73.9	20.3	
Vert	4880.000	AV	32.2	32.5	4.6	31.9	1.2	38.6	53.9	15.3	
Vert	7320.000	AV	33.1	36.6	5.7	33.0	1.2	43.6	53.9	10.3	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier) + Duty Factor

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

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB

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Radiated Spurious Emission

Test place : Ise EMC Lab. No.4 Semi Anechoic Chamber
Report No. : 10410328H
Date : 07/15/2014 07/15/2014
Temperature/ Humidity : 23 deg. C / 68% RH 24 deg. C / 65% RH
Engineer : Shinya Watanabe Yuta Moriya
Mode : (30MHz-10GHz) (Above 10GHz)
Tx BLE 2480MHz

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]	Remark
Hori	333.000	QP	29.0	16.7	10.1	31.9	-	23.9	46.0	22.1	
Hori	2483.500	PK	52.1	28.7	3.2	32.7	-	51.3	73.9	22.6	
Hori	2484.330	PK	56.1	28.7	3.2	32.7	-	55.3	73.9	18.6	
Hori	4960.000	PK	42.2	32.7	4.6	31.9	-	47.6	73.9	26.3	
Hori	7440.000	PK	43.5	36.5	5.9	33.1	-	52.8	73.9	21.1	
Hori	2483.500	AV	38.1	28.7	3.2	32.7	1.2	38.5	53.9	15.4	*1)
Hori	2484.330	AV	42.4	28.7	3.2	32.7	1.2	42.8	53.9	11.1	*1)
Hori	4960.000	AV	32.1	32.7	4.6	31.9	1.2	38.7	53.9	15.2	
Hori	7440.000	AV	33.8	36.5	5.9	33.1	1.2	44.3	53.9	9.6	
Vert	333.000	QP	28.4	16.7	10.1	31.9	-	23.3	46.0	22.7	
Vert	2483.500	PK	48.2	28.7	3.2	32.7	-	47.4	73.9	26.5	
Vert	2484.330	PK	59.0	28.7	3.2	32.7	-	58.2	73.9	15.7	
Vert	4960.000	PK	43.3	32.7	4.6	31.9	-	48.7	73.9	25.2	
Vert	7440.000	PK	42.7	36.5	5.9	33.1	-	52.0	73.9	21.9	
Vert	2483.500	AV	34.9	28.7	3.2	32.7	1.2	35.3	53.9	18.6	*1)
Vert	2484.330	AV	37.9	28.7	3.2	32.7	1.2	38.3	53.9	15.6	*1)
Vert	4960.000	AV	32.2	32.7	4.6	31.9	1.2	38.8	53.9	15.1	
Vert	7440.000	AV	33.3	36.5	5.9	33.1	1.2	43.8	53.9	10.1	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier) + Duty Factor

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

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB

*1) Not Out of Band emission (Leakage Power)

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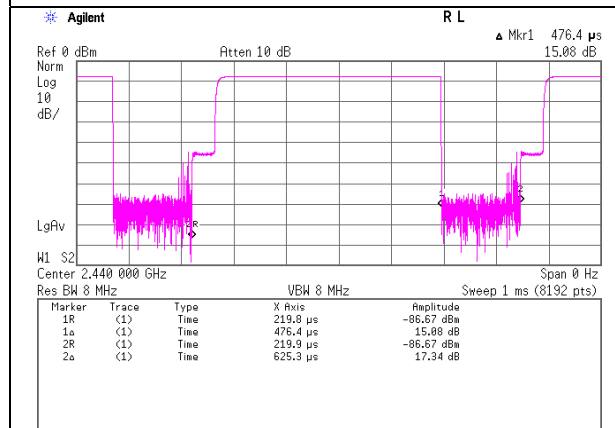
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Burst rate confirmation

Test place : Ise EMC Lab. No.3 Measurement Room
 Report No. : 10410328H
 Date : 07/11/2014
 Temperature/ Humidity : 23 deg. C / 58% RH
 Engineer : Tomohisa Nakagawa
 Mode : Tx BLE

Tx on / (Tx on + Tx off) = 0.762
Tx on / (Tx on + Tx off) * 100 = 76.2 %
Duty factor = 10 * log (0.6253 / 0.4764) 1.18 dB



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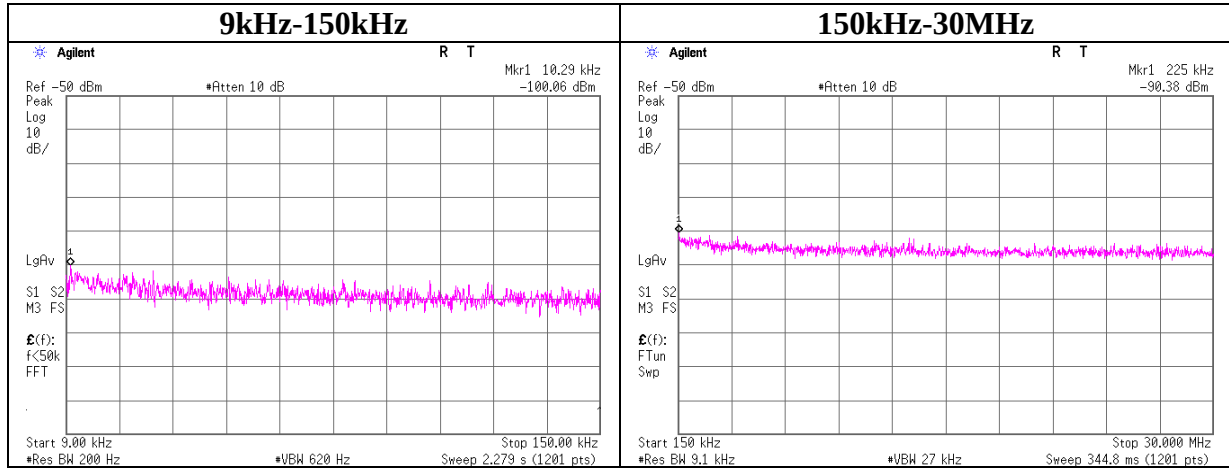
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	10410328H
Date	07/11/2014
Temperature/ Humidity	23 deg. C / 58% RH
Engineer	Tomohisa Nakagawa
Mode	Tx BLE

Tx 2402MHz



Frequency	Reading	Cable Loss	Attenuator	Antenna Gain	EIRP	Distance	Ground bounce	E (field strength)	Limit
[kHz]	[dBm]	[dB]	[dB]	[dBi]	[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]
10.29	-100.1	2.40	10.1	2.0	-85.6	300.0	6.0	-24.3	47.3
225	-90.4	2.40	10.1	2.0	-75.9	300.0	6.0	-14.6	20.5

$E = \text{EIRP} - 20\log(D) + \text{Ground bounce} + 104.8 [\text{dBuV/m}]$

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator} + \text{Antenna Gain}$

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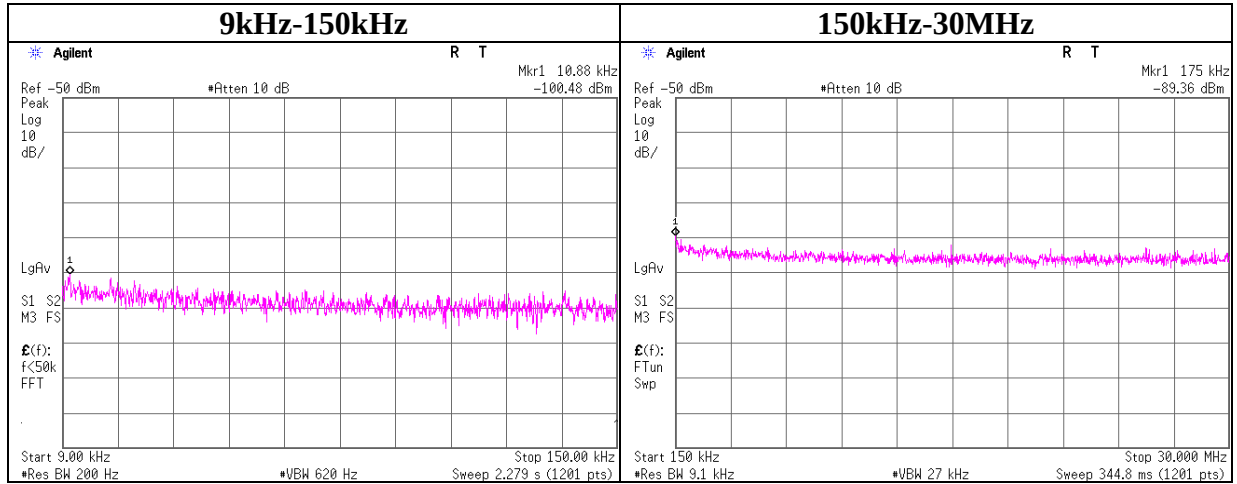
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	10410328H
Date	07/11/2014
Temperature/ Humidity	23 deg. C / 58% RH
Engineer	Tomohisa Nakagawa
Mode	Tx BLE

Tx 2440MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator [dB]	Antenna Gain [dBi]	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]
10.88	-100.5	2.40	10.1	2.0	-86.0	300.0	6.0	-24.7	46.8
175	-89.4	2.40	10.1	2.0	-74.9	300.0	6.0	-13.6	22.7

$E = \text{EIRP} - 20\log(D) + \text{Ground bounce} + 104.8 [\text{dBuV/m}]$

$\text{EIRP} = \text{Reading} + \text{Cable Loss} + \text{Attenuator} + \text{Antenna Gain}$

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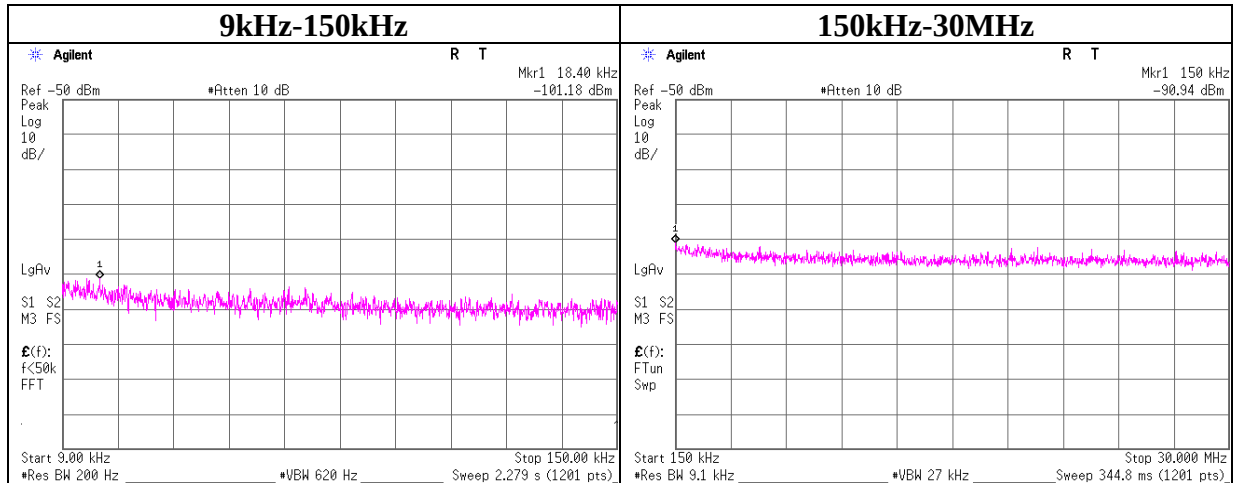
Telephone : +81 596 24 8999

Facsimile : +81 596 24 8124

Conducted Spurious Emission

Test place : Ise EMC Lab. No.3 Measurement Room
Report No. : 10410328H
Date : 07/11/2014
Temperature/ Humidity : 23 deg. C / 58% RH
Engineer : Tomohisa Nakagawa
Mode : Tx BLE

Tx 2480MHz



Frequency	Reading	Cable Loss	Attenuator	Antenna Gain	EIRP	Distance	Ground bounce	E (field strength)	Limit
[kHz]	[dBm]	[dB]	[dB]	[dBi]	[dBm]	[m]	[dB]	[dBuV/m]	[dBuV/m]
18.40	-101.2	2.40	10.1	2.0	-86.7	300.0	6.0	-25.4	42.3
150	-90.9	2.40	10.1	2.0	-76.5	300.0	6.0	-15.2	24.0

$E = EIRP - 20 \log(D) + \text{Ground bounce} + 104.8 [\text{dBuV/m}]$
 $EIRP = \text{Reading} + \text{Cable Loss} + \text{Attenuator} + \text{Antenna Gain}$

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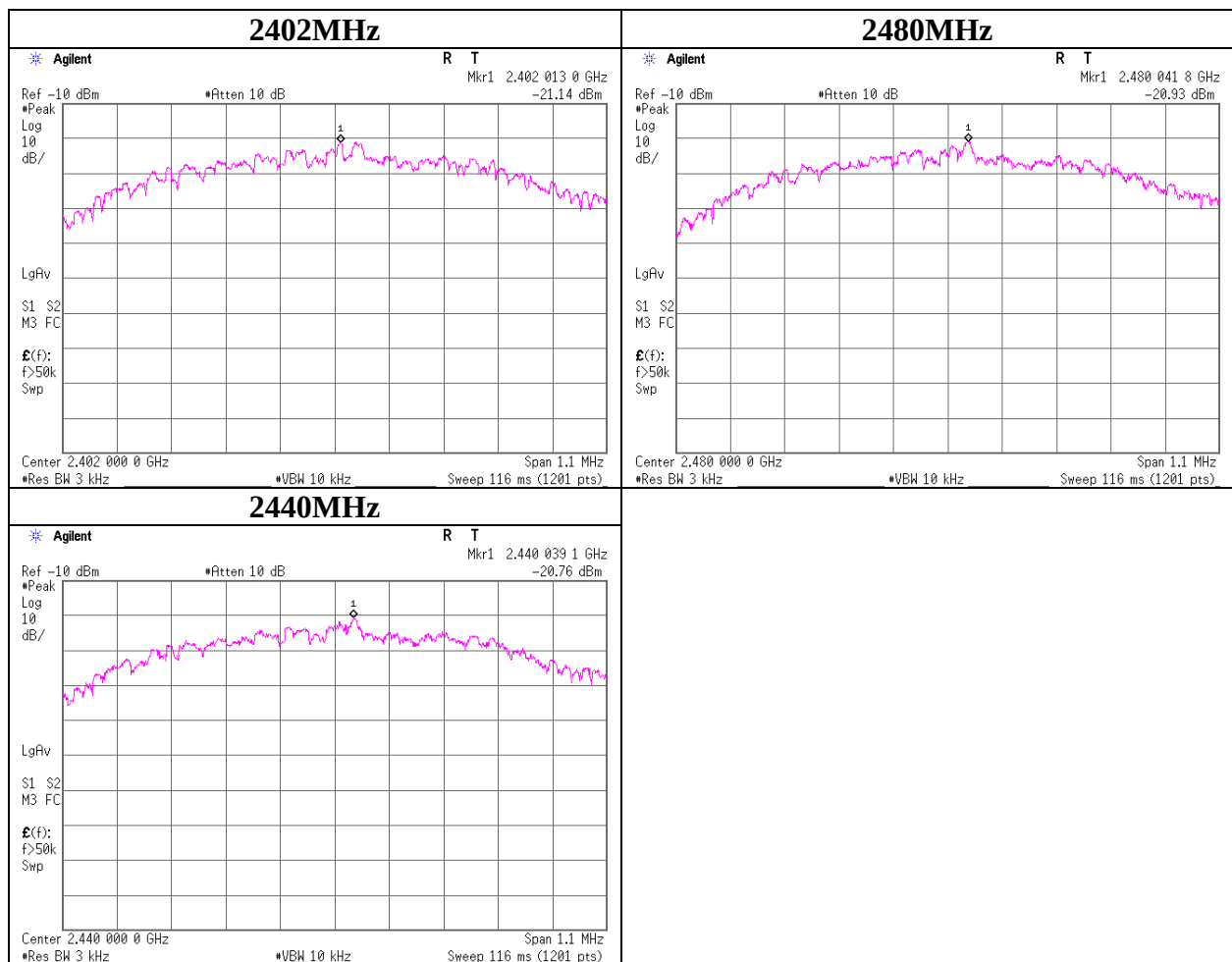
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Power Density

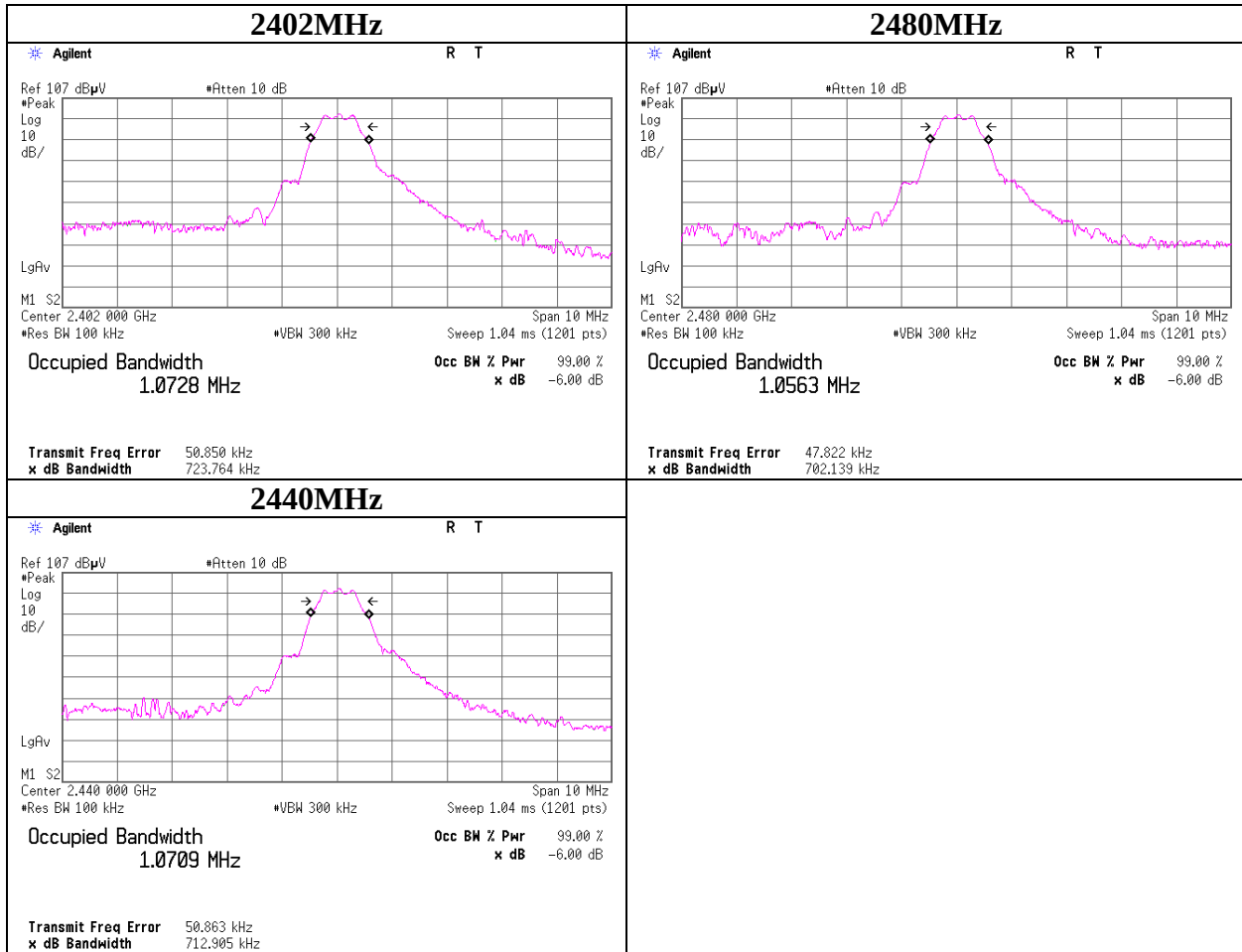
Test place Ise EMC Lab. No.3 Measurement Room
Report No. 10410328H
Date 07/11/2014
Temperature/ Humidity 23 deg. C / 58% RH
Engineer Tomohisa Nakagawa
Mode Tx BLE

Freq.	Reading	Cable Loss	Atten.	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402.00	-21.14	2.40	10.08	-8.66	8.00	16.66
2440.00	-20.76	2.40	10.08	-8.28	8.00	16.28
2480.00	-20.93	2.40	10.08	-8.45	8.00	16.45



99%Occupied Bandwidth

Test place	Ise EMC Lab. No.3 Measurement Room
Report No.	10410328H
Date	07/11/2014
Temperature/ Humidity	23 deg. C / 58% RH
Engineer	Tomohisa Nakagawa
Mode	Tx BLE



APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MOS-12	Thermo-Hygrometer	Custom	CTH-180	1201	AT	2014/01/14 * 12
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	AT	2014/02/20 * 12
MPM-08	Power Meter	Anritsu	ML2495A	6K00003338	AT	2013/10/15 * 12
MPSE-11	Power sensor	Anritsu	MA2411B	011737	AT	2013/10/15 * 12
MAT-23	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	AT	2014/03/13 * 12
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE/CE	2014/02/28 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	1501	RE/CE	2014/02/20 * 12
MJM-22	Measure	ASKUL	-	-	RE/CE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MSA-04	Spectrum Analyzer	Agilent	E4448A	US44300523	RE	2013/11/25 * 12
MTR-01	Test Receiver	Rohde & Schwarz	ES140	100084	RE/CE	2013/11/12 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2013/11/24 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2013/11/24 * 12
MCC-50	Coaxial Cable	UL Japan	-	-	RE	2014/06/02 * 12
MAT-68	Attenuator	Anritsu	MP721B	6200961025	RE	2013/11/26 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2014/03/14 * 12
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2013/08/12 * 12
MCC-141	Microwave Cable	Junkosha	MWX221	1305S002R(1m) / 1405S146(5m)	RE	2014/06/11 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	MY39500780	RE	2014/03/11 * 12
MHF-26	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	002	RE	2013/09/01 * 12
MHA-17	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	RE	2014/06/11 * 12
MLS-23	LISN(AMN)	Schwarzbeck	NSLK8127	8127-729	CE(EUT)	2014/07/10 * 12
MAT-67	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	CE	2014/01/29 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/SFM141(5m)/421-010(1m)/sucoform141-PE(1m)/RFM-E121(Switcher)	-/04178	CE	2014/07/15 * 12

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test Item: CE: Conducted Emission test

RE: Radiated Emission test

AT: Antenna Terminal Conducted tests

UL Japan, Inc.

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