RADIO TEST REPORT

Test Report No. : 10180434H-A-R1

Applicant	:	**Murata Manufacturing Company, Ltd.**
Type of Equipment	:	**Communication Module**
Model No.	:	**LBWA1ZZSNE-460**
FCC ID	:	**VPYLBSN460**
Test regulation	:	**FCC Part 15 Subpart C: 2013**
Test Result	:	**Complied**

1. This test report shall not be reproduced in full or partial, without the written approval of UL Japan, Inc.
2. The results in this report apply only to the sample tested.
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.
5. This test report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.
6. This report is a revised version of 10180434H-A. 10180434H-A is replaced with this report.

Date of test: January 11 to 22, 2014

Representative test engineer:
H. Kukita
Hiroshi Kukita
Engineer of WiSE Japan,
UL Verification Service

Approved by:
Masanori Nishiyama
Manager of WiSE Japan,
UL Verification Service

NVLAP®
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.
*As for the range of Accreditation in NVLAP, you may refer to the WEB address,
http://www.ul.com/japan/jpn/pages/services/emc/about/mark1/index.jsp#nvlap

UL Japan, Inc.
Head Office EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

REVISION HISTORY

Original Test Report No.: 10180434H-A

Revision	Test report No.	Date	Page revised	Contents
- (Original)	10180434H-A	February 6, 2014	-	-
1	10180434H-A-R1	February 12, 2014	8	Correction of power setting information

CONTENTS **PAGE**

SECTION 1: Customer information

Company Name	:	Murata Manufacturing Company, Ltd.
Address	:	10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555 Japan
Telephone Number	:	+81-75-955-6375
Facsimile Number	:	+81- 75-955-6634
Contact Person	:	Takaharu Kawakatsu

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

2.1 Identification of E.U.T.

Type of Equipment	:	Communication Module
Model No.	:	LBWA1ZZSNE-460
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC3.3V
Receipt Date of Sample	:	January 8, 2014
Country of Mass-production	:	Japan
Condition of EUT	:	Production prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Radio Specification

Radio Type	:	Transceiver
Frequency of Operation	:	2412-2462MHz
Modulation	:	DSSS
Power Supply (radio part input)	:	DC1.8V/3.3V
Antenna type	:	Chip Antenna
Antenna Gain	:	0.45dBi

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification	:	FCC Part 15 Subpart C: 2013, final revised on September 30, 2013 and effective October 30, 2013
Title	:	FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators Section 15.207 Conducted limits Section 15.247 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	**FCC:** Section 15.207	**QP** 5.1dB, 5.86945MHz, L **AV** 5.5dB, 5.86945MHz, L	Complied	-
	IC: RSS-Gen 7.2.4	**IC:** RSS-Gen 7.2.4			
6dB Bandwidth	**FCC:** "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)"	**FCC:** Section 15.247(a)(2)	See data.	Complied	Conducted
	IC: RSS-Gen 4.6.2	**IC:** RSS-210 A8.2(a)			
Maximum Peak Output Power	**FCC:** "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)"	**FCC:** Section 15.247(b)(3)		Complied	Conducted
	IC: RSS-Gen 4.8	**IC:** RSS-210 A8.4(4)			
Power Density	**FCC:** "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)"	**FCC:** Section 15.247 (e)		Complied	Conducted
	IC: -	**IC:** RSS-210 A8.2(b)			
Spurious Emission Restricted Band Edges	**FCC:** "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247(issued on April 9, 2013)"	**FCC:** Section15.247(d)	9.3dB 48.000MHz, QP, Vert.	Complied	Conducted/ Radiated
	IC: RSS-Gen 4.9	**IC:** RSS-210 A8.5 RSS-Gen 7.2.3			
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)
The EUT has the power supply regulator. However one of the input voltages to RF part doesn't go through the regulator. The stable voltage will be supplied by the end product, which will be required to have a power supply regulator. Therefore, the EUT complies with the requirement.

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

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.

3.5 Test Location

UL Japan, Inc. Head Office EMC Lab. *NVLAP Lab. code: 200572-0
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999 Facsimile : +81 596 24 8124

	FCC Registration Number	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	313583	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	655103	2973C-2	7.5 x 5.8 x 5.2m	4.0 x 4.0m	-
No.3 semi-anechoic chamber	148738	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	134570	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	2.4 x 3.4m	-

* 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.

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

4.1 Operating Mode(s)

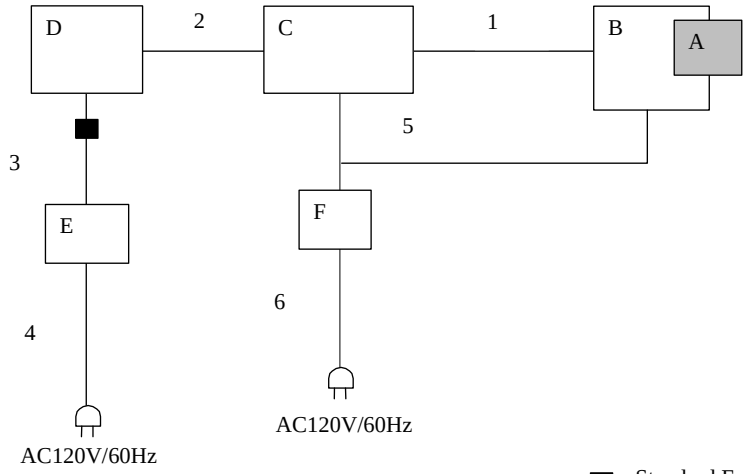
Mode	Remarks*
IEEE 802.11b (11b)	11Mbps, PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*Power of the EUT was set by the software as follows; Power settings: AT+EXTPA=1 AT+WP=10 Software : GainSpan FW : GEPS 2.3.5(WPS) *This setting of software 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.	

*Details of Operating mode(s)

Test Item	Operating Mode	Tested frequency
Conducted Emission 6dB Bandwidth Maximum Peak Output Power Spurious Emission (Radiated) Power Density 99% Occupied Bandwidth	11b	2412MHz 2437MHz 2462MHz
Spurious Emission (Conducted)	11b Tx *1)	2416MHz *1)
*1) The mode was tested as a representative, because it had the highest power at antenna terminal test.		

4.2 Configuration and peripherals

[Conducted Emission]



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

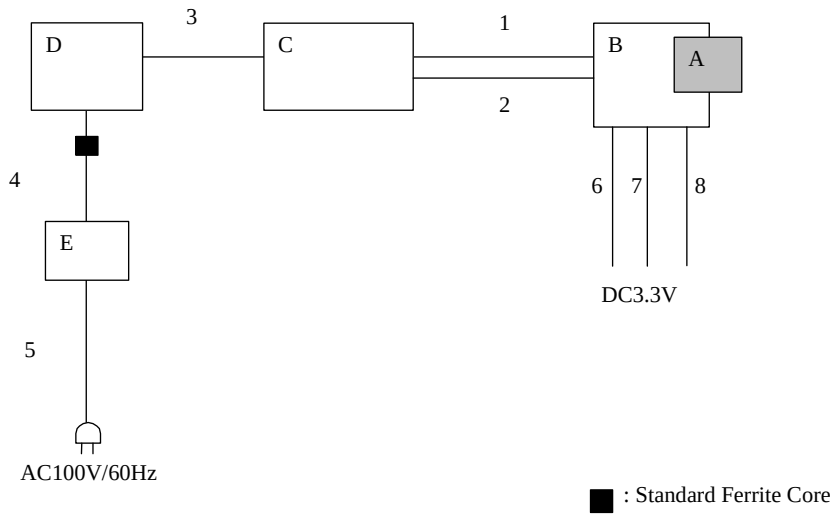
Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Communication Module	LBWA1ZZSNE-460	001	MURATA	EUT
B	Jig board	-	-	MURATA	-
C	Jig board	-	-	MURATA	-
D	Laptop PC	T30	97-1DZ8M	IBM	-
E	AC Adaptor	02K6750	11S02K6750Z1Z2UP 3561HY	IBM	-
F	Power Supply	PMG35-2A	13090501	KIKUSUI	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.3	Unshielded	Unshielded	-
2	UART-USB Cable	1.8	Shielded	Shielded	-
3	DC Cable	1.8	Unshielded	Unshielded	-
4	AC Cable	1.0	Unshielded	Unshielded	-
5	DC Cable	0.6	Unshielded	Unshielded	-
6	AC Cable	0.8	Unshielded	Unshielded	-

[Antenna Terminal Conducted / Radiated Emission]



* Cabling and setup(s) 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	Remarks
A	Communication Module	LBWA1ZZSNE-460	001	MURATA	EUT
B	Jig board	-	-	MURATA	-
C	Jig board	-	-	MURATA	-
D	Laptop PC	7661-CB9	L3-R2055	Lenovo	-
E	AC Adaptor	92P1156	11S92P1156Z1ZDX N85M5PY	Lenovo	-

* RE: Radiated Emission, AT: Antenna Terminal Conducted Test

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	Signal Cable	0.3	Unshielded	Unshielded	-
2	Signal Cable	0.3	Unshielded	Unshielded	-
3	USB Cable	1.8	Shielded	Shielded	-
4	DC Cable	1.8	Unshielded	Unshielded	-
5	AC Cable	1.0	Unshielded	Unshielded	-
6	DC Cable	2.0	Unshielded	Unshielded	-
7	DC Cable	2.0	Unshielded	Unshielded	-
8	DC Cable	2.0	Unshielded	Unshielded	-

SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0m by 1.5m, 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**

SECTION 6: Radiated Spurious Emission

Test Procedure
It was measured based on "11.0 Emissions in non-restricted frequency bands" of "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 (Issued on April 9, 2013)".
EUT was placed on a urethane platform of nominal size, 1.0m by 1.5m, 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
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120kHz(T/R)	RBW: 1MHz VBW: 3MHz	Average Power Method: WLAN: 12.2.5.1 RBW: 1MHz VBW: 3MHz Detector: Power Averaging (RMS) Trace: Free Run	RBW: 100kHz VBW: 300kHz (S/A)
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 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 (Issued on April 9, 2013)"
*2) Distance Factor: 20 x log (3.0m/1.0m) = 9.5dB

- 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

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	20MHz	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	Sample	Clear write	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *1)	-	Power Meter (Sensor: 50MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3kHz	10kHz	Auto	Peak	Max Hold	Spectrum Analyzer *2)
Conducted Spurious Emission *3)	9kHz to 150kHz	200Hz	620Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1kHz	27kHz				

*1) Reference data
*2) Section 10.2 Method PKPSD (peak PSD) of "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 (Issued on April 9, 2013)".
*3) 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

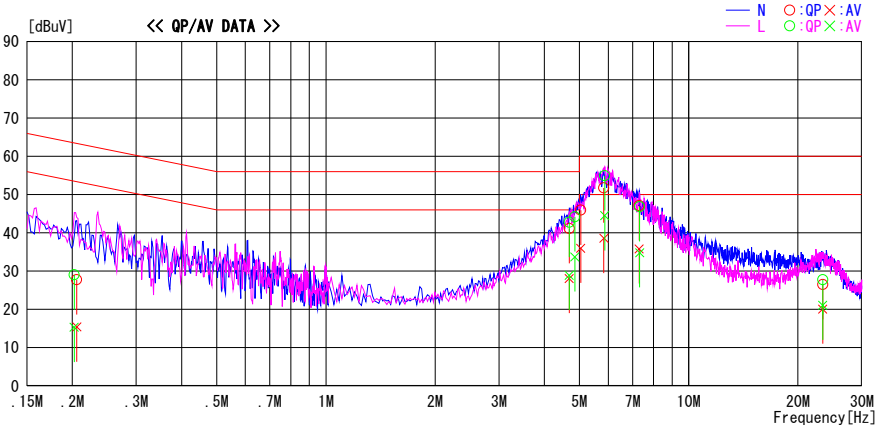
UL Japan, Inc. Head Office EMC Lab. No.4 Semi Anechoic Chamber
Date : 2014/01/22

Report No. : 100180434H

Temp./Humi. : 22deg. C / 30% RH
Engineer : Masatoshi Nishiguchi

Mode / Remarks : WLAN 11b Tx 2462MHz 11Mbps

LIMIT : FCC15.207 QP
FCC15.207 AV



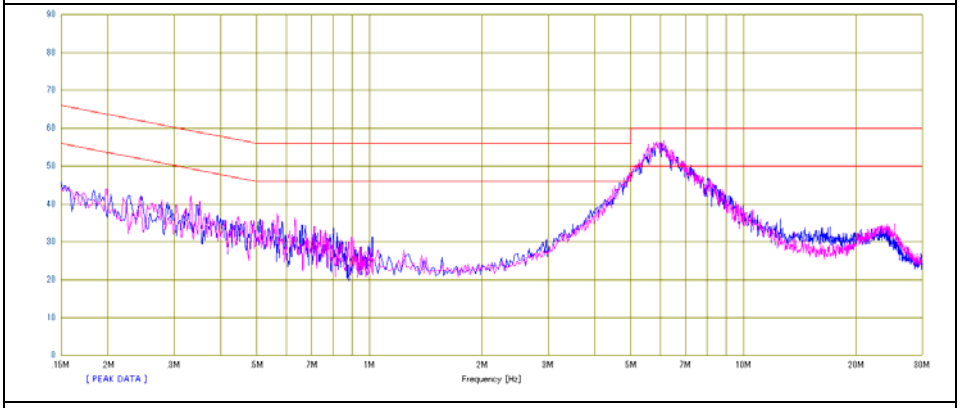
Frequency	Reading Level		Corr.	Results		Limit		Margin		Phase	Comment
	QP	AV	Factor	QP	AV	QP	AV	QP	AV		
[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
0.20579	14.4	2.1	13.3	27.7	15.4	63.4	53.4	35.7	38.0	N	
4.68798	27.2	14.2	13.9	41.1	28.1	56.0	46.0	14.9	17.9	N	
5.04020	32.0	22.1	13.9	45.9	36.0	60.0	50.0	14.1	14.0	N	
5.83310	37.8	24.7	13.9	51.7	38.6	60.0	50.0	8.3	11.4	N	
7.30540	33.0	21.7	14.1	47.1	35.8	60.0	50.0	12.9	14.2	N	
23.41037	11.4	5.0	15.1	26.5	20.1	60.0	50.0	33.5	29.9	N	
0.20230	15.7	2.0	13.3	29.0	15.3	63.5	53.5	34.5	38.2	L	
4.68798	28.8	15.0	13.9	42.7	28.9	56.0	46.0	13.3	17.1	L	
4.85157	30.3	19.8	13.9	44.2	33.7	56.0	46.0	11.8	12.3	L	
5.86945	41.0	30.6	13.9	54.9	44.5	60.0	50.0	5.1	5.5	L	
7.32358	32.7	20.7	14.1	46.8	34.8	60.0	50.0	13.2	15.2	L	
23.41037	12.6	6.0	15.1	27.7	21.1	60.0	50.0	32.3	28.9	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.

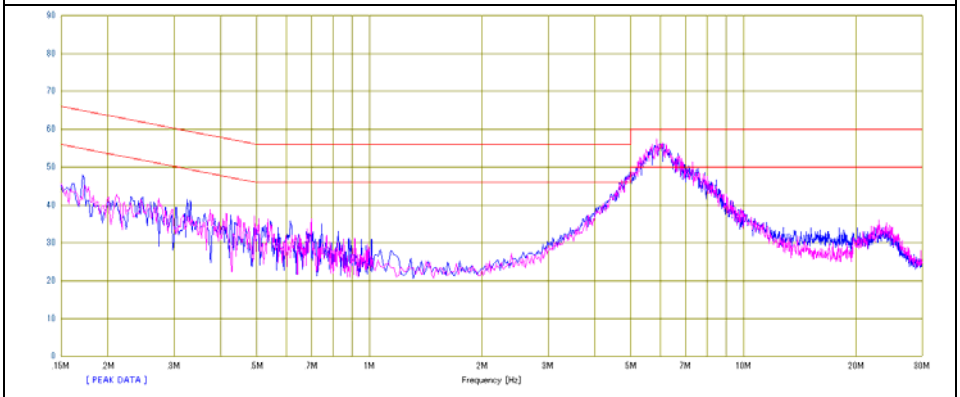
Conducted Emission

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber
Report No.	10180434H
Date	01/22/2014
Temperature/ Humidity	22 deg.C./ 30%
Engineer	Masatoshi Nishiguchi
Mode	11b Tx

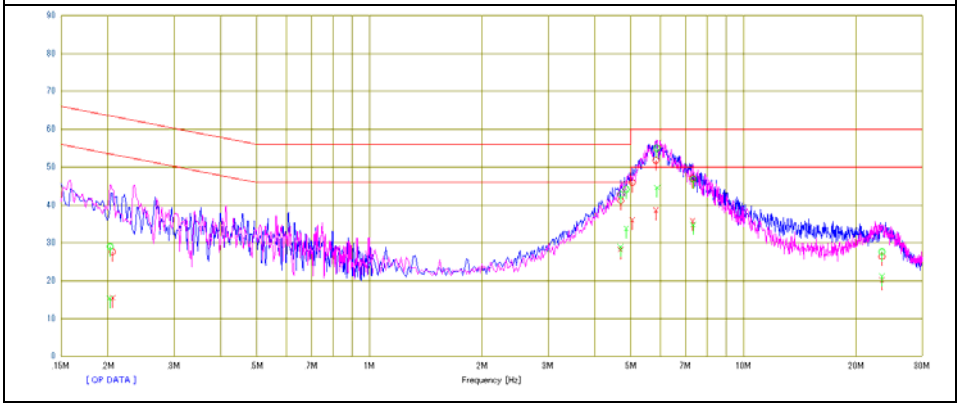
2412MHz



2437MHz



2462MHz



Y scale [dBuV] Chart — N — L

6dB Bandwidth

Test place	Head Office EMC Lab. No.11 Measurement Room
Report No.	10180434H
Date	01/22/2014
Temperature/ Humidity	23 deg.C./ 58%
Engineer	Shinya Watanabe
Mode	Tx 11b

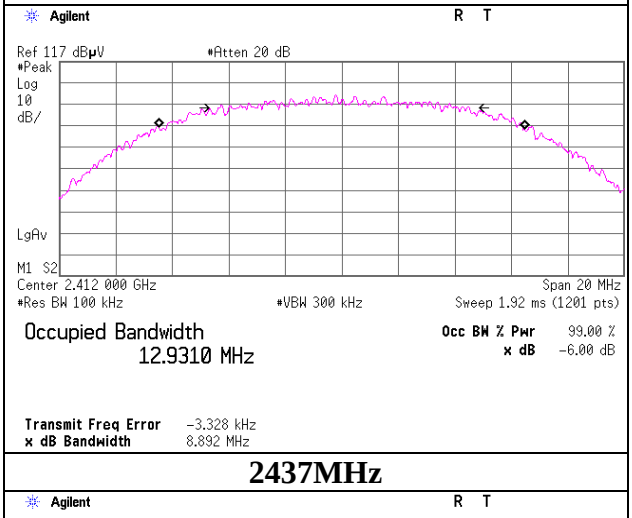
11b

Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
2412	8.892	>500
2437	8.887	>500
2462	8.890	>500

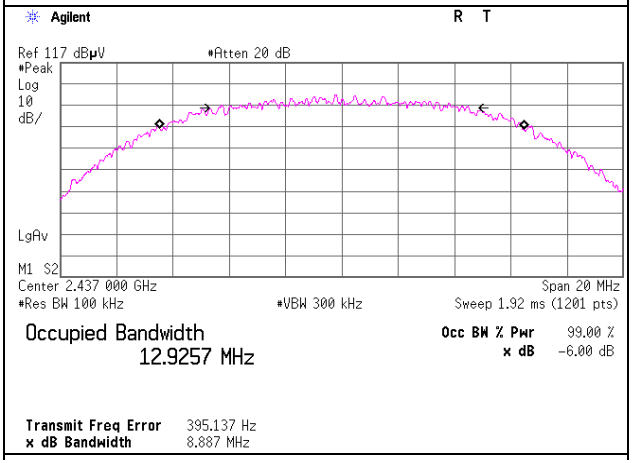
6dB Bandwidth

11b

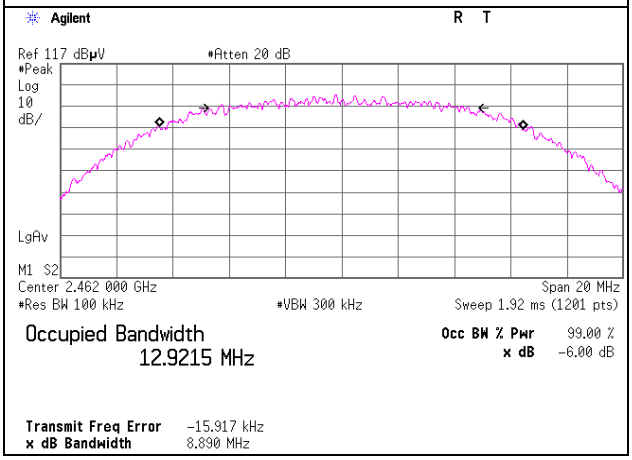
2412MHz



2437MHz



2462MHz



Maximum Peak Output Power

Test place	Head Office EMC Lab. No.11 Semi Anechoic Chamber
Report No.	10180434H
Date	01/11/2014
Temperature/ Humidity	22 deg.C./ 41%
Engineer	Hiroshi Kukita
Mode	11b Tx

11b 11Mbps

Freq.	Reading	Cable Loss	Atten.	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	5.56	0.75	10.07	16.38	43.45	30.00	1000	13.62
2437	6.33	0.75	10.07	17.15	51.88	30.00	1000	12.85
2462	6.72	0.75	10.07	17.54	56.75	30.00	1000	12.46

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

2437MHz

Rate	Reading	Remark
[Mbps]	[dBm]	
1	6.06	
2	6.22	
5.5	5.72	
11	6.33	*

*: Worst Rate
All comparizon were carried out on same frequency and measurement factors.

Average Output Power

Test place	Head Office EMC Lab. No.11 Semi Anechoic Chamber
Report No.	10180434H
Date	01/11/2014
Temperature/ Humidity	22 deg.C./ 41%
Engineer	Hiroshi Kukita
Mode	11b Tx

[AV]
11b 11Mbps

Freq.	Reading	Cable Loss	Atten.	Result		Limit		Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[mW]	[dBm]	[mW]	[dB]
2412	2.73	0.75	10.07	13.55	22.65	30.00	1000	16.45
2437	3.40	0.75	10.07	14.22	26.42	30.00	1000	15.78
2462	3.91	0.75	10.07	14.73	29.72	30.00	1000	15.27

Radiated Spurious Emission

Test place Head Office EMC Lab. No.3 Semi Anechoic Chamber
Report No. 10180434H
Date 01/11/2014
Temperature/ Humidity 22 deg.C./ 41%
Engineer Hiroshi Kukita
Mode 11b Tx 2412MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	2390.000	PK	46.0	28.2	3.1	32.4	44.9	73.9	29.0	
Hori	4824.000	PK	NS	-	-	-	-	73.9	-	
Hori	7236.000	PK	NS	-	-	-	-	73.9	-	
Hori	9648.000	PK	NS	-	-	-	-	73.9	-	
Hori	2390.000	AV	37.4	28.2	3.1	32.4	36.3	53.9	17.6	
Hori	4824.000	AV	NS	-	-	-	-	53.9	-	
Hori	7236.000	AV	NS	-	-	-	-	53.9	-	
Hori	9648.000	AV	NS	-	-	-	-	53.9	-	
Vert	2390.000	PK	46.0	28.2	3.1	32.4	44.9	73.9	29.0	
Vert	4824.000	PK	NS	-	-	-	-	73.9	-	
Vert	7236.000	PK	NS	-	-	-	-	73.9	-	
Vert	9648.000	PK	NS	-	-	-	-	73.9	-	
Vert	2390.000	AV	35.5	28.2	3.1	32.4	34.4	53.9	19.5	
Vert	4824.000	AV	NS	-	-	-	-	53.9	-	
Vert	7236.000	AV	NS	-	-	-	-	53.9	-	
Vert	9648.000	AV	NS	-	-	-	-	53.9	-	

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

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

*NS: Not supurious emission detected

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

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

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	2412.000	PK	103.0	28.2	3.1	32.4	101.9	-	-	Carrier
Hori	2400.000	PK	49.2	28.2	3.1	32.4	48.1	81.9	33.8	
Vert	2412.000	PK	102.4	28.2	3.1	32.4	101.3	-	-	Carrier
Vert	2400.000	PK	47.0	28.2	3.1	32.4	45.9	81.3	35.4	

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

Radiated Spurious Emission

Test place Head Office EMC Lab. No.3 Semi Anechoic Chamber
Report No. 10180434H
Date 01/11/2014
Temperature/ Humidity 22 deg.C./ 41%
Engineer Hiroshi Kukita
Mode 11b Tx 2437MHz

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	4874.000	PK	NS	-	-	-	-	-	73.9	-	
Hori	7311.000	PK	NS	-	-	-	-	-	73.9	-	
Hori	9748.000	PK	NS	-	-	-	-	-	73.9	-	
Hori	4874.000	AV	NS	-	-	-	-	-	53.9	-	
Hori	7311.000	AV	NS	-	-	-	-	-	53.9	-	
Hori	9748.000	AV	NS	-	-	-	-	-	53.9	-	
Vert	4874.000	PK	NS	-	-	-	-	-	73.9	-	
Vert	7311.000	PK	NS	-	-	-	-	-	73.9	-	
Vert	9748.000	PK	NS	-	-	-	-	-	73.9	-	
Vert	4874.000	AV	NS	-	-	-	-	-	53.9	-	
Vert	7311.000	AV	NS	-	-	-	-	-	53.9	-	
Vert	9748.000	AV	NS	-	-	-	-	-	53.9	-	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).
*NS: Not supurious emission detected

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

UL Japan, Inc.
Head Office EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

Radiated Spurious Emission

Test place Head Office EMC Lab. No.3 Semi Anechoic Chamber
Report No. 10180434H
Date 01/11/2014
Temperature/ Humidity 22 deg.C./ 41%
Engineer Hiroshi Kukita
Mode 11b Tx 2462MHz

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	120.120	QP	32.5	13.0	8.3	32.1	21.7	43.5	21.8	
Hori	144.000	QP	30.6	14.7	8.5	32.1	21.7	43.5	21.8	
Hori	168.011	QP	32.1	15.7	8.8	32.1	24.5	43.5	19.0	
Hori	192.014	QP	38.4	16.4	9.0	32.1	31.7	43.5	11.8	
Hori	216.020	QP	42.2	16.8	9.2	32.1	36.1	46.0	9.9	
Hori	333.040	QP	38.5	15.4	10.1	32.0	32.0	46.0	14.0	
Hori	2483.500	PK	44.5	28.4	3.1	32.3	43.7	73.9	30.2	
Hori	4924.000	PK	NS	-	-	-	-	73.9	-	
Hori	7386.000	PK	NS	-	-	-	-	73.9	-	
Hori	9848.000	PK	NS	-	-	-	-	73.9	-	
Hori	2483.500	AV	37.5	28.4	3.1	32.3	36.7	53.9	17.2	
Hori	4924.000	AV	NS	-	-	-	-	53.9	-	
Hori	7386.000	AV	NS	-	-	-	-	53.9	-	
Hori	9848.000	AV	NS	-	-	-	-	53.9	-	
Vert	48.000	QP	43.9	11.6	7.3	32.1	30.7	40.0	9.3	
Vert	51.650	QP	41.9	10.4	7.4	32.1	27.6	40.0	12.4	
Vert	72.000	QP	47.5	6.5	7.7	32.2	29.5	40.0	10.5	
Vert	120.001	QP	43.4	13.0	8.3	32.1	32.6	43.5	10.9	
Vert	168.000	QP	35.8	15.7	8.8	32.1	28.2	43.5	15.3	
Vert	192.000	QP	38.6	16.4	9.0	32.1	31.9	43.5	11.6	
Vert	2483.500	PK	46.0	28.4	3.1	32.3	45.2	73.9	28.7	
Vert	4924.000	PK	NS	-	-	-	-	73.9	-	
Vert	7386.000	PK	NS	-	-	-	-	73.9	-	
Vert	9848.000	PK	NS	-	-	-	-	73.9	-	
Vert	2483.500	AV	37.3	28.4	3.1	32.3	36.5	53.9	17.4	
Vert	4924.000	AV	NS	-	-	-	-	53.9	-	
Vert	7386.000	AV	NS	-	-	-	-	53.9	-	
Vert	9848.000	AV	NS	-	-	-	-	53.9	-	

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

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

*NS: Not supurious emission detected

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

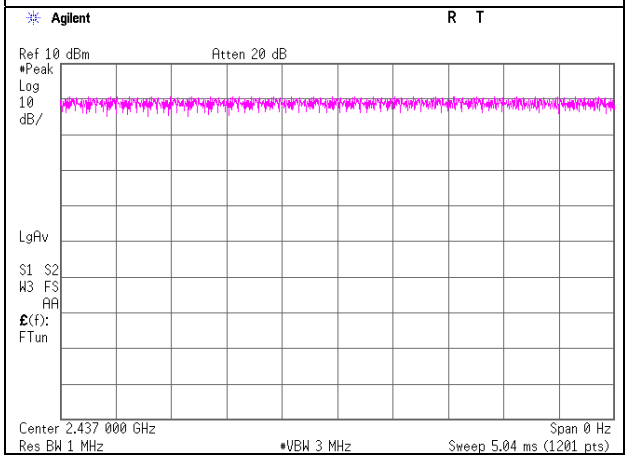
Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB

Burst rate confirmation

Test place	Head Office EMC Lab. No.11 Measurement Room
Report No.	10180434H
Date	01/22/2014
Temperature/ Humidity	23 deg.C./ 58%
Engineer	Shinya Watanabe
Mode	11b Tx

11b 11Mbps

Tx on / (Tx on + Tx off) =	**1.000**
Tx on / (Tx on + Tx off) * 100 =	**100.0 %**
Duty factor = 10 * log (1 / 1) =	**0.00 dB**

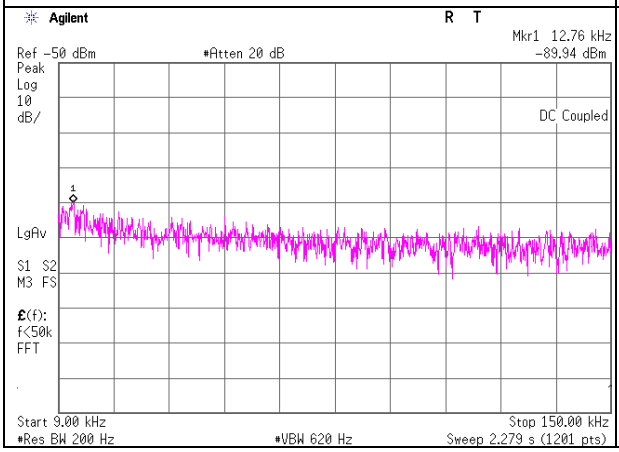


Conducted Spurious Emission

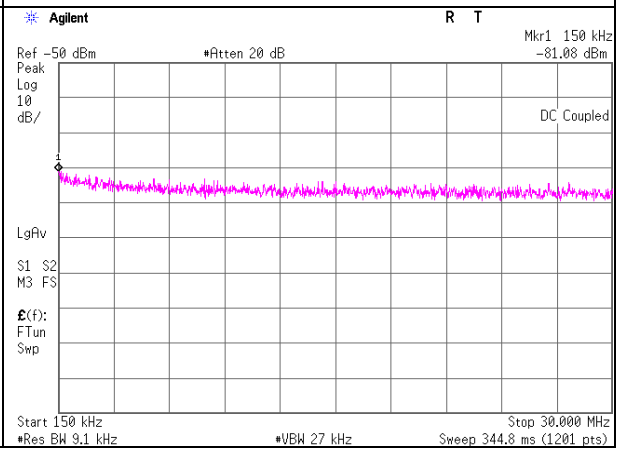
Test place	Head Office EMC Lab. No.11 Measurement Room
Report No.	10180434H
Date	01/22/2014
Temperature/ Humidity	23 deg.C./ 58%
Engineer	Shinya Watanabe
Mode	11b Tx

11b Tx 2462MHz

9kHz-150kHz



150kHz-30MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenator [dB]	Antenna Gain [dBi]	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]
12.76	-89.9	0.75	10.1	2.1	-77.0	300.0	6.0	-15.8	45.5
150	-81.0	0.75	10.1	2.1	-68.1	300.0	6.0	-6.8	24.1

E=EIRP-20log(D)+Ground bounce +104.8[dBuV/m]

EIRP=Reading+Cable Loss+Attenator+Antenna Gain

UL Japan, Inc.
Head Office EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124

Power Density

Test place	Head Office EMC Lab. No.11 Measurement Room
Report No.	10180434H
Date	01/22/2014
Temperature/ Humidity	23 deg.C./ 58%
Engineer	Shinya Watanabe
Mode	11b Tx

11b 11Mbps

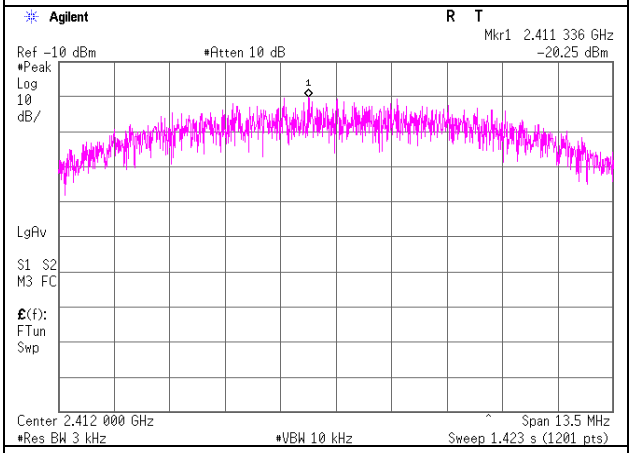
Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2412.00	-20.25	0.75	10.07	-9.43	8.00	17.43
2437.00	-19.63	0.75	10.07	-8.81	8.00	16.81
2462.00	-19.17	0.75	10.07	-8.35	8.00	16.35

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

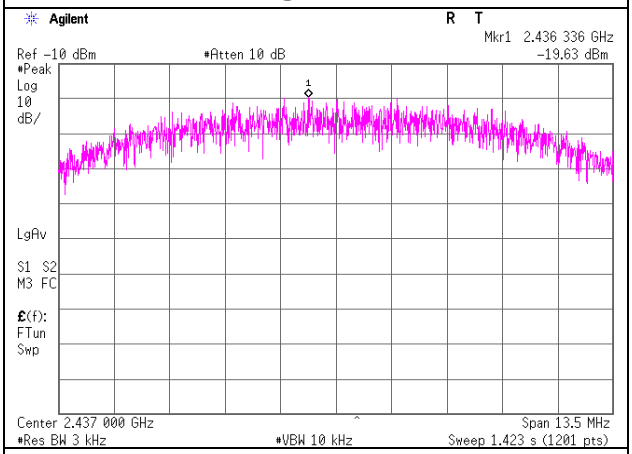
Power Density

11b

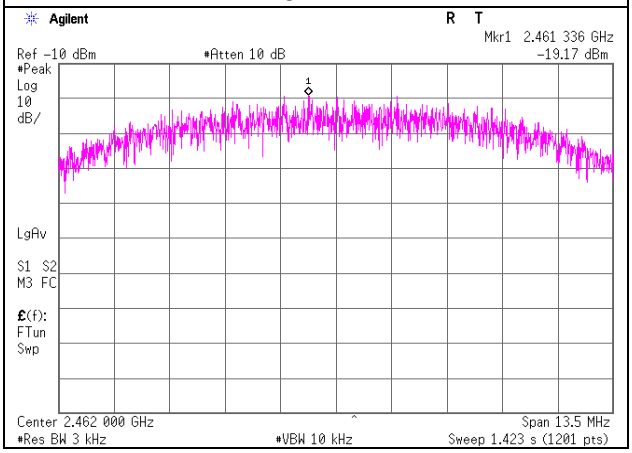
2412MHz



2437MHz



2462MHz

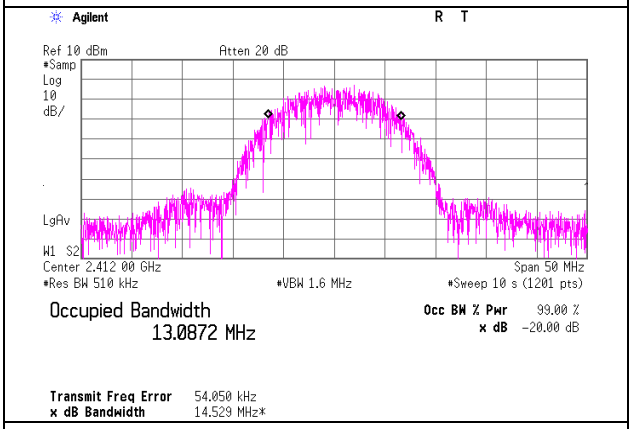


99%Occupied Bandwidth

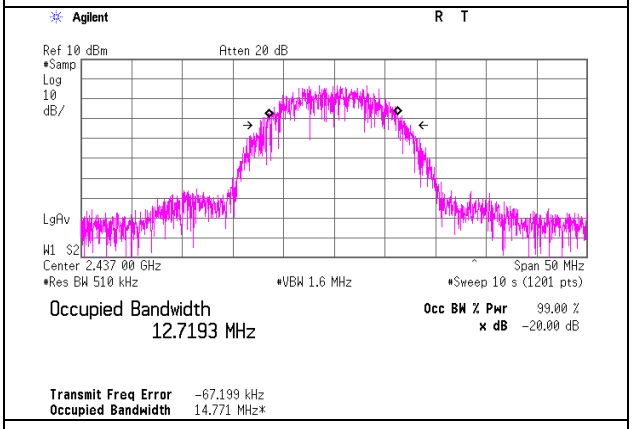
Test place	Head Office EMC Lab. No.11 Measurement Room
Report No.	10180434H
Date	01/22/2014
Temperature/ Humidity	23 deg.C./ 58%
Engineer	Shinya Watanabe
Mode	11b Tx

11b

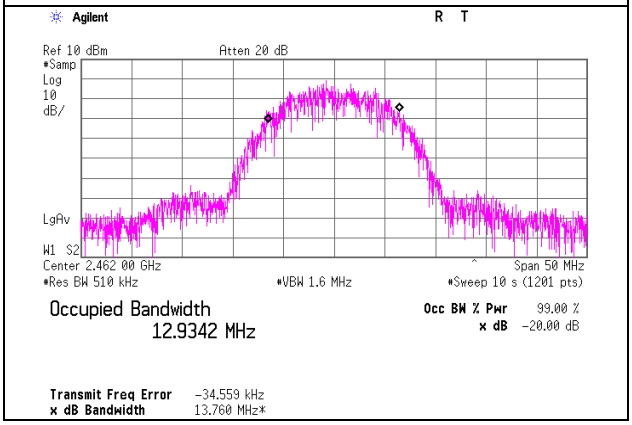
2412MHz



2437MHz



2462MHz



APPENDIX 2: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MAEC-03	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2013/02/28 * 12
MOS-13	Thermo-Hygrometer	Custom	CTH-180	-	RE	2013/02/26 * 12
MJM-16	Measure	KOMELON	KMC-36	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE/CE	-
MSA-05	Spectrum Analyzer	Advantest	R3273	160400285	RE	2013/11/08 * 12
MTR-08	Test Receiver	Rohde & Schwarz	ESCI	100767	RE	2013/08/20 * 12
MBA-03	Biconical Antenna	Schwarzbeck	BBA9106	1915	RE	2013/10/13 * 12
MLA-03	Logperiodic Antenna	Schwarzbeck	USLP9143	174	RE	2013/10/13 * 12
MCC-51	Coaxial cable	UL Japan	-	-	RE	2013/07/23 * 12
MAT-70	Attenuator(6dB)	Agilent	8491A-006	MY52460153	RE	2013/04/05 * 12
MPA-13	Pre Amplifier	SONOMA INSTRUMENT	310	260834	RE	2013/03/12 * 12
MHA-20	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	258	RE	2013/05/17 * 12
MCC-133	Microwave Cable	HUBER+SUHNER	SUCOFLEX104	336164/4(1m) / 340640(5m)	RE	2013/09/27 * 12
MPA-11	MicroWave System Amplifier	Agilent	83017A	MY39500779	RE	2013/03/12 * 12
MHA-16	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170306	RE	2013/05/17 * 12
MHF-25	High Pass Filter 3.5-18.0GHz	UL Japan	HPF SELECTOR	001	RE	2013/09/01 * 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-20	Attenuator(10dB)(above 1GHz)	HIROSE ELECTRIC CO.,LTD.	AT-110	-	AT	2013/01/09 * 12
MBM-12	Barometer	Sunoh	SBR121	873	AT	2012/02/20 * 36
MOS-19	Thermo-Hygrometer	Custom	CTH-201	0001	AT	2013/12/17 * 12
MRENT-95	Spectrum Analyzer	Agilent	E4440A	MY46185823	AT	2013/06/14 * 12
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	CE	2013/02/28 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	-	CE	2013/02/26 * 12
MJM-09	Measure	KDS	E19-55	-	CE	-
MTR-01	Test Receiver	Rohde & Schwarz	ESI40	100084	CE	2013/11/12 * 12
MLS-06	LISN(AMN)	Schwarzbeck	NSLK8127	8127363	CE(EUT)	2013/01/07 * 12
MLS-07	LISN(AMN)	Schwarzbeck	NSLK8127	8127364	CE(AE)	2013/01/07 * 12
MTA-28	Terminator	TME	CT-01	-	CE	2013/11/26 * 12
MAT-67	Attenuator	JFW Industries, Inc.	50FP-013H2 N	-	CE	2013/01/09 * 12
MCC-113	Coaxial cable	Fujikura/Suhner/TSJ	5D-2W(10m)/SFM141(5m)/421-010(1m)/sucoform141-PE(1m)/RFM-E121(Switcher)	-/04178	CE	2013/07/23 * 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
RE: Radiated Emission
AT: Antenna Terminal Conducted test

UL Japan, Inc.
Head Office EMC Lab.
4383-326 Asama-cho, Ise-shi, Mie-ken 516-0021 JAPAN
Telephone : +81 596 24 8999
Facsimile : +81 596 24 8124