

RADIO TEST REPORT

Test Report No. : 30KE0072-HO-02-B-R1

Applicant : Murata Manufacturing Co., Ltd.
Type of Equipment : Wireless LAN Module
Model No. : LBWA1ZZSJ1
FCC ID : VPY-LBSJ
Test regulation : FCC Part 15 Subpart E: 2010
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with 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 30KE0072-HO-02-B. 30KE0072-HO-02-B is replaced with this report.

Date of test: September 13 to 24, 2010

**Representative test
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CONTENTS	PAGE
SECTION 1: Customer information.....	3
SECTION 2: Equipment under test (E.U.T.).....	3
SECTION 3: Test specification, procedures & results.....	5
SECTION 4: Operation of E.U.T. during testing.....	9
SECTION 5: Conducted Emission.....	12
SECTION 6: Radiated Spurious Emission and Band Edge Compliance	13
SECTION 7: Antenna Terminal Conducted Tests.....	14
APPENDIX 1: Photographs of test setup	15
Conducted Emission	15
Radiated Spurious Emission	16
Worst Case Position	17
APPENDIX 2: Data of EMI test.....	18
Conducted Emission	18
26dB Emission Bandwidth and 99% Occupied Bandwidth.....	22
20dB Bandwidth	31
Maximum Peak Output Power	33
Radiated Spurious Emission	58
The tested burst timing.....	96
Conducted Spurious Emission	98
Peak Excursion Ratio	155
APPENDIX 3: Test instruments	162

SECTION 1: Customer information

Company Name : Murata Manufacturing Co., Ltd.
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SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment : Wireless LAN Module
Model No. : LBWA1ZZSJ1
Serial No. : Refer to Section 4, Clause 4.2
Rating : DC5.0V
Receipt Date of Sample : August 30, 2010
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

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2.2 Product Description

General Specification

Clock frequency in the system : CRYSTAL: 20MHz

Specification of WLAN (IEEE802.11a/b/g)

Type of radio	Wireless LAN (IEEE802.11a)	Wireless LAN (IEEE802.11b/g)
Equipment Type	Transceiver	
Frequency of Operation	5180MHz - 5320MHz 5500MHz - 5700MHz 5745MHz - 5825MHz	2412MHz - 2462MHz
Bandwidth & Channel spacing	Bandwidth : 18MHz Ch spacing : 20MHz	Bandwidth : 20MHz Ch spacing : 5MHz
Type of Modulation	OFDM	11b: DSSS 11g: OFDM
Antenna Type	Chip antenna (ANT0) PWB Pattern antenna (ANT1)	
Antenna Gain	5180-5240MHz : Chip antenna : -1.0dBi PWB Pattern antenna 1.3dBi 5260-5320MHz : Chip antenna : -0.8dBi PWB Pattern antenna 2.3dBi 5500-5700MHz : Chip antenna : -0.6dBi PWB Pattern antenna 1.6dBi 5745-5825MHz : Chip antenna : -1.4dBi PWB Pattern antenna: 2.4dBi	Chip antenna : 1.2dBi PWB Pattern antenna: 0.7dBi
Power Supply	DC 5.0V	
Operating temperature range	0 to +55 deg. C.	

Specification of WLAN (IEEE802.11n)

Type of radio	Wireless LAN (IEEE802.11n)			
	2.4G Band MISO (20M Band)	2.4G Band MISO (40M Band)	5G Band MISO (20M Band)	5G Band MISO (40M Band)
Equipment Type	Transceiver			
Frequency of Operation	2412MHz - 2462MHz	2422MHz - 2452MHz	5180MHz - 5320MHz 5500MHz - 5700MHz 5745MHz - 5825MHz	5190MHz - 5310MHz 5510MHz - 5670MHz 5755MHz - 5795MHz
Bandwidth & Channel spacing	Bandwidth : 20MHz Ch spacing : 5MHz	Bandwidth : 40MHz Ch spacing : 5MHz	Bandwidth : 18MHz Ch spacing : 20MHz	Bandwidth : 40MHz Ch spacing : 40MHz
Type of Modulation	OFDM			
Antenna Type	Chip antenna (ANT0) PWB Pattern antenna (ANT1)			
Antenna Gain	Chip antenna : 1.2dBi PWB Pattern antenna : 0.7dBi		5180-5240MHz : Chip antenna : -1.0dBi PWB Pattern antenna 1.3dBi 5260-5320MHz : Chip antenna : -0.8dBi PWB Pattern antenna 2.3dBi 5500-5700MHz : Chip antenna : -0.6dBi PWB Pattern antenna 1.6dBi 5745-5825MHz : Chip antenna : -1.4dBi PWB Pattern antenna : 2.4dBi	
Power Supply	DC 5.0V			
Operating temperature range	0 to +55 deg. C.			
Notes: 5600-5650MHz is not used in Canada				

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SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part15 Subpart E: 2010, final revised on October 13, 2010

Title : FCC 47CFR Part15 Radio Frequency Device Subpart E
Unlicensed National Information Infrastructure Devices
Section 15.407 General technical requirements

*The revision on October 13, 2010 does not affect the test specification applied to the EUT.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC :ANSI C63.4:2003 IC: RSS-Gen 7.2.2	FCC: 15.407(b)(6) / 15.207 IC: RSS-Gen 7.2.2	[Tx] QP 6.8dB, 0.53802MHz, L AV 7.0dB, 0.53802MHz, N [Rx] QP 6.8dB, 0.53280MHz, L 0.53802MHz, N AV 6.9dB, 0.53802MHz, N 0.53889MHz, L	Complied	-
26dB Emission Bandwidth	FCC :ANSI C63.4:2003 FCC Public Notice DA 02-2138A1 IC: -	FCC : 15.407(a)(1)(2)(3) IC: -	See data	N/A	Conducted
Maximum Peak Output Power	FCC :ANSI C63.4:2003, FCC Public Notice DA 02-2138A1 IC: -	FCC : 15.407(a)(1)(2)(3) IC: RSS-210 A9.2(1)(2)(3)		Complied	Conducted
Peak Power Spectral Density	FCC :ANSI C63.4:2003, FCC Public Notice DA 02-2138A1 IC: -	FCC : 15.407(a)(1)(2)(3) IC: RSS-210 A9.2(1)(2)(3)		Complied	Conducted
Peak Excursion Ratio	FCC :ANSI C63.4:2003, FCC Public Notice DA 02-2138A1 IC: -	FCC : 15.407(a)(6) IC: -		Complied	Conducted
Spurious Emission Restricted Band Edge	FCC: ANSI C63.4:2003 IC: -	FCC : 15.407(b), 15.205 and 15.209 IC: RSS-210 A.9.3(1)(2)(3)(4)		[Tx] 0.8dB 5725.000MHz, PK, Vert. [Rx] 1.3dB 214.761MHz, QP, Hori.	Complied
20dB Emission Bandwidth	FCC :ANSI C63.4:2003	FCC : 15.215(c)	See data	Complied	Conducted

Note: UL Japan, Inc.'s EMI Work Procedures No.QPM05 and QPM15.
For DFS tests, please see the test report number 30KE0072-HO-02-C issued by UL Japan, Inc.

*These tests were also referred to FCC Public Notice DA 02-2138A1 "Measurement Procedure Updated for Peak Transmit Power in the Unlicensed National Information Infrastructure (U-NII) Bands".

FCC 15.31 (e)

The RF Module has its own regulator.
The RF Module is constantly provided voltage (DC3.3V/1.2V) through own regulator 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 it is soldered on the circuit board. Therefore the equipment complies with the requirement of 15.203/212.

3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Band Width	RSS-Gen 4.6.1	RSS-210 A9.2 (1)(2)(3)	N/A	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	2.6dB
No.2	2.9dB
No.3	3.3dB
No.4	2.8dB

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	2.9dB	4.8dB	5.0dB	3.9dB	4.3dB	4.5dB	4.3dB
No.2	3.5dB	4.8dB	5.1dB	4.0dB	4.2dB	4.4dB	4.2dB
No.3	3.8dB	4.6dB	4.7dB	4.0dB	4.2dB	4.5dB	4.2dB
No.4	3.5dB	4.4dB	4.9dB	4.0dB	4.2dB	4.6dB	4.2dB

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

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	
1.0dB	1.1dB	2.7dB	3.2dB	3.3dB	1.5dB

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 report meets the limits unless the uncertainty is taken into consideration.

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3.5 Test Location

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	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	4.75 x 5.4 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 4.5 x 2.8m	2.0 x 2.0m	-
No.10 measurement room	-	-	2.6 x 2.8 x 2.5m	2.4 x 2.4m	-
No.11 measurement room	-	-	3.1 x 3.4 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 Test set up, Data of EMI, and Test instruments

Refer to APPENDIX.

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

4.1 Operating Modes

Test operating mode was determined as follows according to “Section 1 of 6 802.11 a/b/g/n testing - Managing Complex Regulatory Approvals - ” of TCB Council Workshop October 2009.

Mode	Remarks*
IEEE 802.11a (11a)	6Mbps, PN9
IEEE 802.11n MISO 20MHz BW (11n-20)	MCS 0, PN9
IEEE 802.11n MISO 40MHz BW (11n-40)	MCS 0, PN9
*The worst condition was determined based on the test result of Maximum Peak Output Power (Mid Channel)	
*This EUT has two antennas, but it transmits with single antenna and does not transmit with multi antennas.	

Power of the EUT was set by the software as follows:

Software name & version: USB Driver Version 5.100

[Power Setting]

2.4GHz

Channel ID	1	2	3	4	5	6	7	8	9	10	11
11b	12	12	12	12	12	12	12	12	12	12	12
11g	13.5	14	14	14	14	14	14	14	14	14	14
11n 20 MISO	11.5	14	14	14	14	14	14	14	14	14	13.5
11n 40 MISO	-	-	8.5	14	14	14	14	14	13.5	-	-

5GHz	W52			W53			W56			W58
Channel	36	38	40-48	52-60	62	64	100	102	104-140	149-165
11a	12	-	12	11.5	-	12	12	-	8.5	15
11n 20 MISO	12	-	12	12	-	12	10.5	-	9	15
11n 40 MISO	-	9	12.5	12.5	8.5	-	-	8	13.5	15

*The above setting of the 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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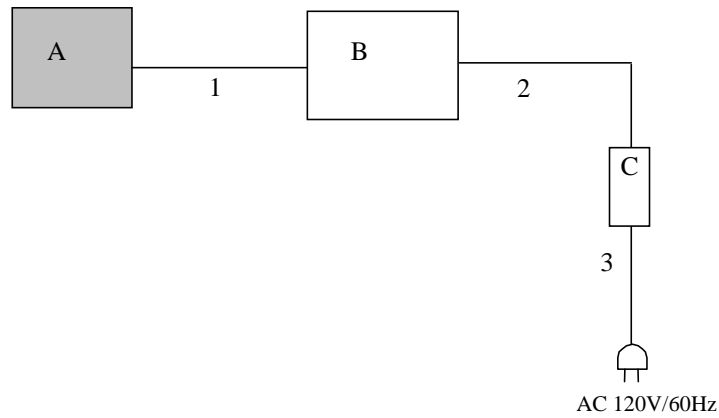
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*Details of Operating mode(s)

Test Item	Operating Mode	Tested Antenna	Tested Frequency		
			Low Band	Middle Band	Additional Band
Conducted emission	11n-40 Tx *1)	ANT1 *2)	5270MHz		5550MHz
	11n-20/-40 Rx		5260MHz		5580MHz
Spurious Emission (Radiated)	11a Tx	ANT0 *3) and ANT1	5180MHz	5260MHz	5500MHz
	11n-20 Tx		5260MHz	5300MHz	5580MHz
			5320MHz	5320MHz	5700MHz
			5180MHz	5260MHz	5500MHz
	11n-40 Tx		5260MHz	5300MHz	5580MHz
			5320MHz	5320MHz	5700MHz
			5190MHz	5270MHz	5510MHz
	5230MHz		5310MHz	5550MHz	
5270MHz	5310MHz	5670MHz			
5310MHz	5310MHz	5670MHz			
11a Rx	5260MHz	5580MHz			
11n-20/-40 Rx	5260MHz	5580MHz			
26dB Emission Bandwidth, 99% Occupied Bandwidth, Maximum Peak Output Power, Peak Power Spectral Density, Spurious Emission (Conducted) Peak Excursion Ratio	11a Tx	ANT0 and ANT1 *4)	5180MHz	5260MHz	5500MHz
	11n-20 Tx		5220MHz	5300MHz	5580MHz
			5240MHz	5320MHz	5700MHz
			5180MHz	5260MHz	5500MHz
	11n-40 Tx		5220MHz	5300MHz	5580MHz
			5240MHz	5320MHz	5700MHz
			5190MHz	5270MHz	5510MHz
	5230MHz		5310MHz	5550MHz	
	5270MHz		5310MHz	5670MHz	
5310MHz	5310MHz	5670MHz			
Spurious Emission (Conducted)	11a Rx	ANT1 *2)	5260MHz		5580MHz
	11n-20/-40 Rx		5260MHz		5580MHz
20dB Bandwidth	11a Tx	ANT1 *2)	-		5580MHz
	11n-20 Tx		-		5660MHz
			-		5580MHz
	11n-40 Tx		-		5660MHz
			-		5550MHz
			-		5670MHz

*1) The mode was tested as a representative, because it had the highest power at antenna terminal test and the noise levels at the mode/tested frequencies were equivalent to those of other modes/tested frequencies.
*2) ANT1 was used for the test as a representative, because it had the highest power at antenna terminal test.
*3) ANT0 was used for all the frequency of the representative mode, 11n-40 Tx (the mode that had the highest power at antenna terminal test) and band edges of each mode.
*4) ANT0 and ANT1 were used for Maximum Peak Output Power test. For other tests except Maximum Peak Output Power, ANT1 was only used because it had the highest power at antenna terminal test.

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	Wireless LAN Module	LBWA1ZZSJ1	1 *1) 3 *2)	MURATA	EUT
B	Laptop PC	2366-LJ7	97-99D4L	IBM	-
C	AC Adaptor	02K6750	11S02K6750Z1Z2UP29 AOTJ	IBM	-

*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	0.2	Shielded	Shielded	-
2	DC Cable	1.8	Shielded	Shielded	-
3	AC Cable	1.0	Unshielded	Unshielded	-

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SECTION 5: Conducted Emission

Test Procedure

EUT was placed on a urethane platform of nominal size, 1.0m by 0.5m, 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.

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

I/O cable and AC 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 or a Measurement Room.

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

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

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SECTION 6: Radiated Spurious Emission and Band Edge Compliance

Test Procedure

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

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

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.

Below 1GHz

The result also satisfied with the general limits specified in section 15.209(a).

Above 1GHz

Inside of restricted bands(Section 15.205): Apply to limit in the Section 15.209(a).

Outside of the restricted bands: Apply to limit 68.2dBuV/m(-27dBm e.i.r.p. *) in the Section 15.407(b)(1)(2)(3).

Restricted bandedge: Average detector apply to limit in the Section 15.209(a).
Peak detector apply to limit 68.2dBuV/m(-27dBm) e.i.r.p. in the Section 15.407(b)(1)(2)(3). since this limit is severer than the limit of the inside of restricted bands.

*Electric Field Strength to e.i.r.p. Conversion

$$E = \frac{1000000\sqrt{30P}}{3} \text{ (uV/m)} \quad :P \text{ is the e.i.r.p. (Watts)}$$

Test Antennas are used as below;

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

Frequency	Below 1GHz	Above 1GHz	
Instrument used	Test Receiver	Spectrum Analyzer *1)	
Detector	QP	PK	AV
IF Bandwidth	BW 120kHz(T/R)	RBW: 1MHz VBW: 3MHz	RBW: 1MHz VBW: 10Hz*2)
Test Distance	3m	3m (below 10GHz), 1m*3) (above 10GHz), 0.5m*4) (above 26.5GHz)	

*1) The Spectrum Analyzer was used in 3dB resolution bandwidth.

*2) The test was performed with VBW 10Hz since the EUT had no intervals during which the transmitter was off (see Appendix).

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

*4) Distance Factor: $20 \times \log(3.0\text{m}/0.5\text{m}) = 15.6\text{dB}$

- 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-40GHz
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 with Spectrum Analyzer.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Remarks
26dB Bandwidth	30MHz, 60MHz	Close to 1% of EBW	Greater than RBW	Auto	Peak	Max Hold	*1)
99% Occupied Bandwidth	Enough width to display 20dB Bandwidth	Close to 1% of Span	Three times of RBW	Auto	Peak	Max Hold	*1)
20dB Bandwidth	50MHz	Close to 1% of Span	Three times of RBW	Auto	Peak	Max Hold	*1)
Maximum Peak Output Power	50MHz / 100MHz	1MHz	3MHz	Auto	Sample Power Averaging (100 times)	Clear Write	method 1
Peak Power Spectral Density	50MHz /100MHz	1MHz	3MHz	Auto	Sample Power Averaging (100 times)	Clear Write	method 2
Peak Excursion Ratio	Enough width to display Emission Bandwidth	1MHz	3MHz	Auto	Peak Sample Power Averaging (100 times)	Max Hold Clear Write	method 1
Conducted Spurious Emission	Less or equal to 5GHz (Range: 30MHz-40GHz)	1MHz	3MHz	Auto	Peak	Max Hold	-

*1) The measurement was performed with Max Hold since the duty cycle was not 100%.

*EBW: Enough width to display Bandwidth

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

Test data : APPENDIX
Test result : Pass