



# RADIO TEST REPORT

Test Report No. : 31HE0183-HO-01-A

**Applicant** : Murata Manufacturing Co., Ltd.  
**Type of Equipment** : Wireless LAN Module  
**Model No.** : LBWA1ZZUN1  
**FCC ID** : VPY-LBUN  
**Test regulation** : FCC Part 15 Subpart C: 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 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.

**Date of test:**

April 26 to May 20, 2011

**Representative  
test engineer:**

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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>

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## **SECTION 1: Customer information**

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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. : LBWA1ZZUN1  
Serial No. : Refer to Section 4, Clause 4.2  
Rating : DC5.0V  
Receipt Date of Sample : April 3, 2011  
Country of Mass-production : China  
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

### 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	Pattern antenna(1/4 lambda monopole antenna) [Antenna 0, Antenna 1]	
Antenna Gain	5150-5350MHz : Antenna 0: 2.3dBi Antenna 1: 2.8dBi	Antenna 0 : -0.6dBi Antenna 1: 0.8dBi
	5470-5725MHz : Antenna 0: 3.5dBi Antenna 1: 2.7dBi	
	5725-5850MHz : Antenna 0: 3.7dBi Antenna 1: 2.9dBi	
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	Pattern antenna(1/4 lambda monopole antenna) [Antenna 0, Antenna 1]			
Antenna Gain	Antenna 0 : -0.6dBi Antenna 1: 0.8dBi		5150-5350MHz : Antenna 0: 2.3dBi Antenna 1: 2.8dBi	
			5470-5725MHz : Antenna 0: 3.5dBi Antenna 1: 2.7dBi	
			5725-5850MHz : Antenna 0: 3.7dBi Antenna 1: 2.9dBi	
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 Part 15 Subpart C: 2010, final revised on December 6, 2010 and effective January 5, 2011

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 14.7dB, 0.20922MHz, L AV 9.8dB, 0.34863MHz, N	Complied	-
6dB Bandwidth	FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" ----- IC: RSS-Gen 4.6.2	FCC: Section 15.247(a)(2) ----- IC: RSS-210 A8.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" ----- IC: RSS-Gen 4.8	FCC: Section 15.247(b)(3) ----- IC: RSS-210 A8.4(4)		Complied	Conducted
Power Density	FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" ----- IC: -	FCC: Section 15.247 (e) ----- IC: RSS-210 A8.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247" ----- IC: RSS-Gen 4.9	FCC: Section15.247(d) ----- IC: RSS-210 A8.5 RSS-Gen 7.2.3	0.7B 2390.000MHz, 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)**

The RF Module has its own regulator.

The stable voltage (DC3.3V/1.2V) is constantly provided to the RF Module through the 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.

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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	3.1dB
No.2	3.3dB
No.3	3.7dB
No.4	3.2dB

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	3.5dB	5.1dB	5.2dB	4.8dB	5.1dB	4.4dB	4.3dB
No.2	4.0dB	5.1dB	5.2dB	4.8dB	5.0dB	4.3dB	4.2dB
No.3	4.2dB	4.7dB	5.2dB	4.8dB	5.0dB	4.5dB	4.2dB
No.4	4.0dB	5.0dB	5.1dB	4.8dB	5.0dB	5.1dB	4.2dB

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

Power meter (+dB)	
Below 1GHz	Above 1GHz
1.0dB	1.0dB

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 Mode(s)**

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.

<b>Mode</b>	<b>Remarks*</b>
IEEE 802.11a (11a)	6Mbps, PN9, Antenna 0
IEEE 802.11b (11b)	1Mbps, PN9, Antenna 1
IEEE 802.11g (11g)	6Mbps, PN9, Antenna 1
IEEE 802.11n MISO 20MHz BW (11n-20): 2.4G Band	MCS 0, PN9, Antenna 1
IEEE 802.11n MISO 20MHz BW (11n-20): 5G Band	MCS 0, PN9, Antenna 0
IEEE 802.11n MISO 40MHz BW (11n-40): 2.4G Band	MCS 0, PN9, Antenna 1
IEEE 802.11n MISO 40MHz BW (11n-40): 5G Band	MCS 0, PN9, Antenna 0
*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]

ch	1	2	3	4	5	6	7	8	9	10	11
11b	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
11g	12	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
11nHT20	11.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	12.5
11nHT40	-	-	8	13.5	13.5	13.5	13.5	13.5	13	-	-

\*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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**Details of Operating mode(s) for 2.4GHz band**

Test Item	Operating Mode	Tested Antenna	Tested frequency
Conducted Emission Spurious Emission (Radiated, below 1GHz)	11g Tx *1)	Antenna 1 *2)	2462MHz
Maximum Peak Output Power	11b Tx	Antenna 0	2412MHz
	11g Tx	Antenna 1	2437MHz
	11n-20 Tx		2462MHz
	11n-40 Tx		2422MHz
Spurious Emission (Radiated, above 1GHz) Spurious Emission (Conducted)	11b Tx	Antenna 1 *2)	2412MHz
	11g Tx		2437MHz
	11n-20 Tx		2462MHz
	11n-40 Tx		2422MHz
6dB Bandwidth Power Density 99% Occupied Bandwidth	11b Tx	Antenna 1 *2)	2412MHz
	11g Tx		2437MHz
	11n-20 Tx		2462MHz
	11n-40 Tx	Antenna 1 *2)	2422MHz
			2437MHz
			2452MHz

\*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) Antenna 1 was used for the test as a representative, because it had the highest power at antenna terminal test.

**Details of Operating mode(s) for 5GHz band**

Test Item	Operating Mode	Tested Antenna	Tested frequency
Conducted Emission Spurious Emission (Radiated, below 1GHz)	11a Tx *1)	Antenna 0 *2)	5785MHz
Maximum Peak Output Power	11a Tx	Antenna 0	5745MHz
	11n-20 Tx	Antenna 1	5785MHz
	11n-40 Tx		5825MHz
Spurious Emission (Radiated, above 1GHz)	11a Tx	Antenna 0 *2)	5745MHz
	11n-20 Tx		5785MHz
	11n-40 Tx		5825MHz
			5755MHz
6dB Bandwidth Power Density 99% Occupied Bandwidth	11a Tx	Antenna 0 *2)	5745MHz
	11n-20 Tx		5785MHz
	11n-40 Tx		5825MHz
			5755MHz
			5795MHz

\*1) The mode was tested as a representative, because it had the highest power at antenna terminal test and the noise level at the mode/channel was equivalent to that of other mode/tested frequency.  
\*2) Antenna 0 was used for the test as a representative, because it had the highest power at antenna terminal test.

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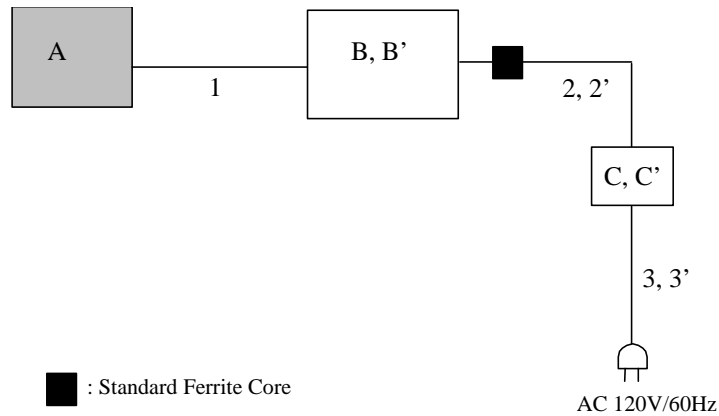
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## 4.2 Configuration and peripherals



- \* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.
- \* It was confirmed there was no difference in emission levels due to a ferrite core attached on cable 2 and 2'

### Description of EUT

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Wireless LAN Module	LBWA1ZZUN1	13 *1) 15 *2)	MURATA	EUT
B	Laptop PC	2373-T49	L3-16W54	IBM	-
B'		7661-CB9	L3-R2056	Lenovo	*3)
C	AC Adaptor	08K8208	11S08K8208Z1Z9MA5686XR	IBM	-
C'		92P1160	11S92P1160Z1ZBGH7B99A8	Lenovo	*3)

- \*1) Used for Antenna Terminal conducted test
- \*2) Used for Conducted Emission and Radiated Emission tests
- \*3) Used for Radiated Emission test (below 1GHz) only

### List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB Cable	0.2	Unshielded	Unshielded	-
2	DC Cable	1.8	Shielded	Shielded	-
2'		1.8	Shielded	Shielded	*1)
3	AC Cable	1.0	Unshielded	Unshielded	-
3'		0.9	Unshielded	Unshielded	*1)

- \*1) Used for Radiated Emission test (below 1GHz) only

## **SECTION 5: Conducted Emission**

### **Test Procedure and conditions**

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.

#### 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.

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

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## **SECTION 6: Radiated Spurious Emission**

### **Test Procedure**

It was measured based on "2. Radiated emission test" of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247".

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 2 of RSS-210 2.7 (IC) and outside the restricted band of FCC15.205 / Table 1 of RSS-210 2.7 (IC).**

Frequency	Below 1GHz	Above 1GHz		20dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV	PK
IF Bandwidth	BW 120kHz(T/R)	RBW: 1MHz VBW: 3MHz	RBW: 1MHz VBW: 10Hz *1)	RBW: 100kHz VBW: 300kHz (S/A)
Test Distance	3m	3m (below 10GHz), 1m*2) (above 10GHz) 0.5m *3) (above 26.5GHz)		3m (below 10GHz), 1m*2) (above 10GHz) 0.5m *3) (above 26.5GHz)

\*1) The test was performed with VBW 10Hz since the EUT had no intervals during which the transmitter was off for the burst rate (see Appendix).

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

\*3) Distance Factor:  $20 \times \log(3.0m/0.5m) = 15.6dB$

- 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.

<b>Test</b>	<b>Span</b>	<b>RBW</b>	<b>VBW</b>	<b>Sweep time</b>	<b>Detector</b>	<b>Trace</b>	<b>Instrument used</b>
6dB Bandwidth	20MHz / 40MHz	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	-	Power Meter (Sensor: 50MHz BW)
Peak Power Density	18MHz 20MHz 40MHz	30kHz	100kHz	600sec 667sec 1334sec	Peak	Max Hold	Spectrum Analyzer *2) *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200Hz	620Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	9.1kHz	27kHz				
	30MHz to 25GHz (Less or equal to 5GHz)	100kHz	300kHz				

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

\*2) PSD Option 1 of "Guidance on Measurement of Digital Transmission Systems Operating under Section15.247 ".

\*3) The test was not performed at RBW:3kHz however the measurement is to be performed with RBW:3kHz in the regulation, because, the measurement value with RBW:3kHz is less than the value of RBW:30kHz and the test data met the limit with RBW:30kHz.

\*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