

RADIO TEST REPORT

Test Report No. : 30KE0072-HO-02-A-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 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.
6. This report is a revised version of 30KE0072-HO-02-A. 30KE0072-HO-02-A is replaced with this report.

Date of test:

September 6 to 24, 2010

**Representative
test engineer:**



Takumi Shimada
Engineer of EMC Service

Approved by:



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NVLAP LAB CODE: 200572-0

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SECTION 1: Customer information

Company Name : Murata Manufacturing Co., Ltd.
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Contact Person : Mitsuhiro Hoshii

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 C: 2010, final revised on October 13, 2010.

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

*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 7. AC powerline Conducted Emission measurements ----- IC: RSS-Gen 7.2.2	FCC: Section 15.207 ----- IC: RSS-Gen 7.2.2	QP 6.8dB, 0.53367MHz, N AV 6.6dB, 0.53367MHz, 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 RSS-Gen 4.10	FCC: Section15.247(d) ----- IC: RSS-210 A8.5 RSS-Gen 7.2.1 and 7.2.3	[Tx] 0.4dB 214.764MHz, QP, Hori. [Rx] 0.5dB 240.039MHz, QP, Hori.	Complied	Conducted/ Radiated

Note: UL Japan, Inc.'s EMI Work Procedures No.QPM05 and QPM15.

* 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	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

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.

Mode	Remarks*
IEEE 802.11a (11a)	6Mbps, PN9
IEEE 802.11b (11b)	1Mbps, PN9
IEEE 802.11g (11g)	36Mbps, PN9
IEEE 802.11n MISO 20MHz BW (11n-20): 2.4G Band	MCS 0, PN9
IEEE 802.11n MISO 20MHz BW (11n-20): 5G Band	MCS 0, PN9
IEEE 802.11n MISO 40MHz BW (11n-40): 2.4G Band	MCS 0, PN9
IEEE 802.11n MISO 40MHz BW (11n-40): 5G Band	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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Details of Operating mode(s) for 2.4GHz band

Test Item	Operating Mode	Tested Antenna	Tested frequency
Conducted Emission	11n-40 Tx *1)	ANT1 *2)	2437MHz
	11n-20/40 Rx		2437MHz
Spurious Emission (Radiated) Maximum Peak Output Power	11b Tx	ANT0 *3) and ANT1	2412MHz 2437MHz 2462MHz
	11g Tx		2412MHz 2417MHz *4) 2437MHz 2462MHz
	11n-20 Tx		2412MHz 2417MHz *4) 2437MHz 2457MHz *4) 2462MHz
	11n-40 Tx		2422MHz 2427MHz *4) 2437MHz 2447MHz *4) 2452MHz
	11b/g Rx *5) 11n-20/-40 Rx *5)		2437MHz *5)
Spurious Emission (Conducted)	11b Tx	ANT1 *2)	2412MHz
	11g Tx		2437MHz
	11n-20 Tx		2462MHz
	11n-40 Tx		2422MHz 2437MHz 2452MHz
	11b/g Rx 11n-20/-40 Rx		2437MHz
6dB Bandwidth Power Density 99% Occupied Bandwidth	11b Tx	ANT1 *2)	2412MHz
	11g Tx		2437MHz
	11n-20 Tx		2462MHz
	11n-40 Tx	ANT1 *2)	2422MHz 2437MHz 2452MHz

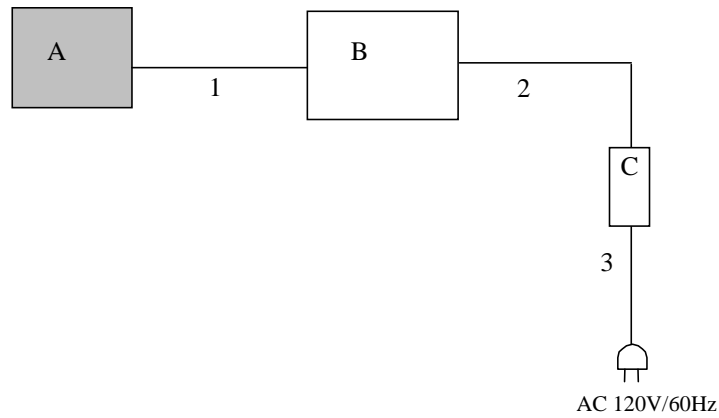
*1) The mode was tested as a representative, because it had the highest power at antenna terminal test and the noise levels at the mode/tested frequencies were equivalent to those of other modes/tested frequencies.
*2) ANT1 was used for the test as a representative, because it had the highest power at 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) Adjacent channel was tested, because the setting of power is lower at Low and High channel.
*5) The mode/tested frequency was not used for Maximum Peak Output Power test.

Details of Operating mode(s) for 5GHz band

Test Item	Operating Mode	Tested Antenna	Tested frequency
Conducted Emission	11a Tx *1)	ANT0 *2)	5785MHz
	11a Rx		5785MHz
Spurious Emission Maximum Peak Output Power	11a Tx	ANT0 and ANT1 *3)	5745MHz
	11n-20 Tx		5785MHz
	11n-40 Tx		5825MHz
	11a Rx *4) 11n-20/-40 Rx *4)		5755MHz 5795MHz 5785MHz *4)
6dB Bandwidth Power Density 99% Occupied Bandwidth	11a Tx	ANT0 *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) ANT0 was used for the test as a representative, because it had the highest power at antenna terminal test.
*3) ANT1 was used for all the frequency of the representative mode, 11a Tx (the mode that had the highest power at antenna terminal test) and band edges of each mode.
*4) The mode/tested frequency was not used for Maximum Peak Output Power 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 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.

Detector	: QP and 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 "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 *1)		Spectrum Analyzer *1)
Detector	QP	PK	AV	PK
IF Bandwidth	BW 120kHz(T/R)	RBW: 1MHz VBW: 3MHz	RBW: 1MHz VBW: 10Hz *2)	RBW: 100kHz VBW: 300kHz (S/A)
Test Distance	3m	3m (below 10GHz), 1m*3) (above 10GHz), 0.5m*4) (above 26.5GHz)		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.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
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	Less or equal to 5GHz (Range: 30MHz-25GHz)	100kHz	300kHz	Auto	Peak	Max Hold	Spectrum Analyzer

*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.

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

Test data : APPENDIX
Test result : Pass