



RADIO TEST REPORT

Test Report No.: 32FE0117-SH-02-B

Applicant : SMK Corporation
Type of Equipment : WLAN Complete Module
Model No. : VRL4149-0601F
FCC ID : GT3FC016
Test regulation : FCC Part15 Subpart E: 2012
Test result : Complied

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Date of test: June 14 to 26, 2012

Tested by: Kenichi Adachi
Kenichi Adachi
Engineer of WiSE Japan, UL
Verification Service

Approved by : Toyokazu Imamura
Toyokazu Imamura
Leader of WiSE Japan, UL
Verification Service

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13-EM-F0429

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SECTION 1: Customer information

Company Name : SMK Corporation
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Contact Person : Nobuhide Ninomiya

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

2.1 Identification of E.U.T.

Type of Equipment : WLAN Complete Module
Model Number : VRL4149-0601F
Serial Number : Refer to Section 4.2
Rating : DC 1.8V (DC 1.71V to 1.89V)
DC 3.3V (DC 3.0V to 3.6V)
Country of Mass-production : Japan
Condition of EUT : Production prototype
(Not for Sale: This sample is equivalent to mass-produced items.)
Receipt Date of Sample : June 14, 2012
Modification of EUT : The test lab did not make the modification to the EUT supplied from the customer to have it pass the tests.

2.2 Product description

Model: VRL4149-0601F (referred to as the EUT in this report) is a WLAN Complete Module.

Clock frequency(ies) in the system : 38.4MHz

<Radio part>

Equipment type : Transceiver
Frequency of operation : 2412MHz to 2462MHz, 5180MHz to 5320MHz,
5500MHz to 5700MHz, 5745MHz to 5825MHz
Radio part clock frequency : 38.4MHz
Channel spacing : 5MHz (for 2412MHz to 2462MHz), 20MHz (for 5180MHz to 5825MHz)
Type of modulation : DSSS, OFDM
Antenna type : Printed wire
Antenna connector type : None
Antenna gain (maximum) : +1.47dBi (for 2412MHz to 2462MHz), -0.5dBi (for 5180MHz to 5260MHz),
+1.15dBi (for 5260MHz to 5320MHz), -0.2dBi (for above 5500MHz)
ITU code : G1D, D1D
Operating Voltage (Radio part) : DC 1.8V (DC 1.71V to 1.89V)
DC 3.3V (DC 3.0V to 3.6V)
Operation temperature range : -20 deg.C to +70 deg.C

Refer to 32FE0117-SH-02-A is FCC part 15 subpart C report and 32FE0117-SH-02-C is FCC part 15 DFS report.

FCC 15.31 (e) / 212

This EUT provides stable voltage (DC1.8V and DC3.3V) constantly to RF Module regardless of input voltage from host device. Therefore, this EUT complies with the requirement.

FCC Part 15.203 / 212

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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SECTION 3: Test specification, procedures & results**3.1 Test specification**

Test specification : FCC Part 15 Subpart E: 2012, final revised on May 17, 2012 and effective June 18, 2012

Title : FCC 47CFR Part15 Radio Frequency Device Subpart E Unlicensed National Information Infrastructure Devices
Section 15.207 Conducted limits
Section 15.209 Radiated emission limits, general requirements
Section 15.407 General technical requirements

3.2 Procedures & Results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC : ANSI C63.4:2009	FCC: 15.407(b)(6) / 15.207	20.8dB (0.44478MHz, QP, L1, 11a, Tx, 5260MHz, and 0.44466MHz, QP, L1, 11a, Tx, 5580MHz)	Complied	-
	IC: RSS-Gen 7.2.4	IC: RSS-Gen 7.2.4			
26dB Emission Bandwidth	FCC : ANSI C63.4:2009 FCC, KDB789033	FCC : 15.407(a)(1)(2)(3)	See data	N/A	Conducted
	IC: -	IC: -			
Maximum Peak Output Power	FCC : ANSI C63.4:2009, FCC, KDB789033	FCC : 15.407(a)(1)(2)(3)		Complied	Conducted
	IC: -	IC: RSS-210 A9.2(1)(2)(3)			
Peak Power Spectral Density	FCC : ANSI C63.4:2009, FCC, KDB789033	FCC : 15.407(a)(1)(2)(3)		Complied	Conducted
	IC: -	IC: RSS-210 A9.2(1)(2)(3)			
Peak Excursion Ratio	FCC : ANSI C63.4:2009, FCC, KDB789033	FCC : 15.407(a)(6)		Complied	Conducted
	IC: -	IC: -			
Spurious Emission Restricted Band Edge	FCC: ANSI C63.4:2009, FCC, KDB789033	FCC : 15.407(b), 15.205 and 15.209	1.8dB (7600.060MHz, AV, Horizontal, 11a, Tx, 5700MHz)	Complied	Conducted / Radiated
	IC: -	IC: RSS-210 A.9.2(1)(2)(3)			
20dB Emission Bandwidth	FCC : ANSI C63.4:2009	FCC : 15.215(c)	See data	Complied	Conducted

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

For DFS tests, please see the test report number 32FE0117-SH-02-C issued by UL Japan, Inc.

*These tests were also referred to KDB 789033 (FCC), "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E"

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3.3 Addition to standard

Item	Test Procedure	Specification	Remarks	Worst Margin	Results
Occupied Bandwidth (99%)	ANSI C63.4:2003 13. Measurement of intentional radiators, RSS-Gen 4.6.1	RSS-Gen 4.6.1	Conducted	-	N/A

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

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

3.4 Uncertainty

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

Item	Frequency range	No.1 SAC*1/SR*2 (±)	No.2 SAC/SR (±)	No.3 SAC/SR (±)
Conducted emission (AC Mains) LISN	150kHz-30MHz	3.6 dB	3.6 dB	3.5 dB
Radiated emission (Measurement distance: 3m)	30MHz-300MHz	4.9 dB	5.1 dB	4.9 dB
	300MHz-1GHz	5.0 dB	5.2 dB	4.9 dB
	1GHz-18GHz	4.8 dB	4.8 dB	4.9 dB
	18GHz-26.5GHz	4.8 dB	4.5 dB	4.5 dB
Radiated emission (Measurement distance: 10m)	30MHz-300MHz	4.9 Db	5.1 dB	-
	300MHz-1GHz	4.9 dB	5.0 dB	-
Radiated emission (Measurement distance: 1m)	1GHz-18GHz	5.6 dB	5.6 dB	5.6 dB
	18GHz-40GHz	4.6 dB	4.3 dB	4.4 dB

*1: SAC=Semi-Anechoic Chamber

*2: SR= Shielded Room is applied besides radiated emission.

Conducted emission test

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

Radiated emission test

The data listed in this test report meets the limits unless the uncertainty is taken into consideration.

Power Measurement uncertainty above 1GHz for this test was: (±) 1.9dB

Conducted emissions, Power Density Measurement (below 1GHz) uncertainty for this test was: (±) 1.8dB

Conducted emissions, Power Density Measurement (1G-3GHz) uncertainty for this test was: (±) 2.3dB

Conducted emissions, Power Density Measurement (3G-18GHz) uncertainty for this test was: (±) 3.0dB

Conducted emissions Measurement (18G-26.5GHz) uncertainty for this test was: (±) 2.9dB

Conducted emissions Measurement (26.5G-50GHz) uncertainty for this test was: (±) 2.8dB

Bandwidth Measurement uncertainty for this test was: (±) 5.4%

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3.5 Test location

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JAB Accreditation No. : RTL02610

	FCC Registration No.	IC Registration No.	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
<input checked="" type="checkbox"/> No.1 Semi-anechoic chamber	697847	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
<input type="checkbox"/> No.2 Semi-anechoic chamber	697847	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10m
<input type="checkbox"/> No.3 Semi-anechoic chamber	697847	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5m
<input type="checkbox"/> No.4 Semi-anechoic chamber	-	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
<input checked="" type="checkbox"/> No.1 shielded room	-	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
<input type="checkbox"/> No.2 shielded room	-	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
<input type="checkbox"/> No.3 shielded room	-	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
<input type="checkbox"/> No.4 shielded room	-	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
<input checked="" type="checkbox"/> No.5 shielded room	-	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
<input type="checkbox"/> No.6 shielded room	-	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-

3.6 Test setup, Data of EMI & Test instruments

Refer to APPENDIX 3 to 3.

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SECTION 4: Operation of E.U.T. during testing**4.1 Operating mode**

Test item	Operating mode	Tested frequency
Conducted emission, Spurious emission (below 1GHz) *4)	Transmitting (Tx)	11a, 6Mbps, 5260MHz, 11a, 6Mbps, 5580MHz
Spurious emission (above 1GHz), 26dB bandwidth, 20dB bandwidth, Maximum peak output power, Peak Power Spectral density, Peak Excursion Ratio, 99% occupied bandwidth	Transmitting (Tx)	11a, 6Mbps, 5180MHz, 11a, 6Mbps, 5220MHz, 11a, 6Mbps, 5240MHz, 11n (HT20), MCS3(26Mbps), 5180MHz, 11n (HT20), MCS3(26Mbps), 5220MHz, 11n (HT20), MCS3(26Mbps), 5240MHz, 11a, 6Mbps, 5260MHz, 11a, 6Mbps, 5300MHz, 11a, 6Mbps, 5320MHz, 11n (HT20), MCS3(26Mbps), 5260MHz, 11n (HT20), MCS3(26Mbps), 5300MHz, 11n (HT20), MCS3(26Mbps), 5320MHz, 11a, 6Mbps, 5500MHz, 11a, 6Mbps, 5580MHz, 11a, 6Mbps, 5700MHz, 11n (HT20), MCS3(26Mbps), 5500MHz, 11n (HT20), MCS3(26Mbps), 5580MHz, 11n (HT20), MCS3(26Mbps), 5700MHz
Restricted band edge	Transmitting (Tx)	11a, 6Mbps, 5180MHz, 11a, 6Mbps, 5320MHz, 11n (HT20), MCS3(26Mbps), 5180MHz, 11n (HT20), MCS3(26Mbps), 5320MHz, 11a, 6Mbps, 5500MHz, 11a, 6Mbps, 5700MHz, 11n (HT20), MCS3(26Mbps), 5500MHz, 11n (HT20), MCS3(26Mbps), 5700MHz
<p>*1) Transmitting duty was 100% on all tests.</p> <p>*2) Software for testing : WiFi Control Application Ver.3.0 Power settings: Fixed *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.</p> <p>*3) The worst Antenna and condition was determined based on the test result of Maximum peak output power. As a result of preliminary test, the formal test was performed with the above modes, which had the maximum power.</p> <p>*4) 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.</p>		

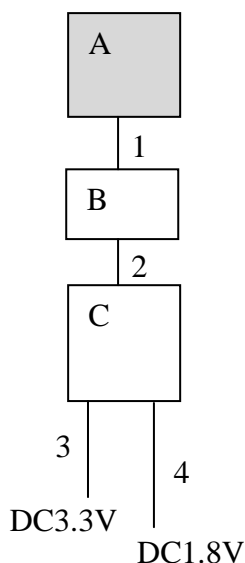
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4.2 Configuration of tested system



* Test data was taken under worst case conditions.

Description of EUT and support equipment

No.	Item	Model number	Serial number	Manufacturer	FCC ID (Remarks)
A	WLAN Complete Module	VRL4149-0601F	1	SMK Corporation	GT3FC016
B	Jig A	-	-	SMK Corporation	-
C	Jig B	-	-	SMK Corporation	-

List of cables used

No.	Cable Name	Length (m)	Shield		Remark
			Cable	Connector	
1	Signal	0.025	Unshielded	Unshielded	-
2	Signal	0.025	Unshielded	Unshielded	-
3	DC	1.3	Unshielded	Unshielded	-
4	DC	1.3	Unshielded	Unshielded	-

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SECTION 5: Conducted emission

5.1 Operating environment

Test place : See test data (APPENDIX 1)
Temperature : See test data (APPENDIX 1)
Humidity : See test data (APPENDIX 1)

5.2 Test configuration

EUT was placed on a platform of nominal size, 1m by 1.5m, raised 80cm above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. The rear of tabletop was located 40cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and was 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 LISN and excess AC cable was bundled in center. I/O cables that were connected to the peripherals were bundled in center. They were folded back and for the forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane. Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the input power source. All unused 50ohm connectors of the LISN were resistively terminated in 50ohm when not connected to the measuring equipment. Photographs of the set up are shown in APPENDIX 3.

5.3 Test conditions

Frequency range : 0.15 - 30MHz
EUT position : Table top
EUT operation mode : Refer to SECTION 4.1

5.4 Test procedure

The AC Mains Terminal Continuous disturbance Voltage had been measured with the EUT via host device within a Shielded room. The host device was connected to a Line Impedance Stabilization Network (LISN). An overview sweep with peak detection has been performed. The measurements had been performed with a quasi-peak detector and if required, an average detector. The conducted emission measurements were made with the following detection of the test receiver.

Detection Type : Quasi-Peak/ Average
IF Bandwidth : 9kHz

5.5 Results

Summary of the test results : Pass
Refer to APPENDIX 1

SECTION 6: Radiated emission

6.1 Operating environment

Test place : See test data (APPENDIX 1)
Temperature : See test data (APPENDIX 1)
Humidity : See test data (APPENDIX 1)

6.2 Test configuration

EUT was placed on a platform of nominal size, 0.5m by 0.5m, raised 80cm above the conducting ground plane.

The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity.

The configuration was set in accordance with ANSI C63.4: 2009.

The rear of EUT, including its peripherals was aligned and flushed with rear of tabletop. I/O cables that were connected to the peripherals were bundled in center. They were folded back and for the forming a bundle 30cm to 40cm long and were hanged at a 40cm height to the ground plane.

Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the maximum signal strength. Photographs of the set up are shown in APPENDIX 3.

6.3 Test conditions

Frequency range : 30MHz to 40GHz
Test distance : 3m(below 15GHz) / 1m(above15GHz)
EUT position : Table top
EUT operation mode : Refer to SECTION 4.1

6.4 Test procedure

The Radiated Electric Field Strength intensity has been measured on a semi-anechoic chamber with a ground plane and at a distance of 3m(below 15GHz) / 1m(above 15GHz) (Refer to Figure 1). Measurements were performed with quasi-peak, peak and average detector. The measuring antenna height was varied between 1 and 4m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity. The measurements were performed for both vertical and horizontal antenna polarization.

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.³)
in the Section 15.407(b)(1)(2)(3).

Restricted bandedge:

Apply to limit in the Section 15.209(a).

Since this limit is severer than the limit of the inside of restricted bands.

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

$$P \text{ [dBm]} = E \text{ [dBuV/m]} - 95.2 \text{ [dB]}$$

$$P \text{ [dBm]} = 10 \times \text{LOG} \left(\left(\left(10^{\left(E \text{ [dBuV/m]} / 20 \right)} \right) \times 10^{-6} \right) \times \left(\text{Distance} = 3\text{[m]} \right)^2 \right) / 30 \times 10^3$$

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

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	
Detector	QP	PK	AV
IF Bandwidth	BW 120kHz(Test Receiver)	RBW: 1MHz VBW: 3MHz	RBW: 1MHz VBW: 10Hz *2)
Test Distance	3m	3m (below 15GHz), 1m*3) (above 15GHz)	

*2) The test was performed with VBW 10Hz since the EUT had no intervals during which the transmitter was off (see APPENDIX 1).

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

*4) 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.

Combinations of the worst case

5180MHz to 5320MHz

	Frequency Antenna polarization	Carrier *5)	Spurious			
			Below 1GHz	1-15GHz	15-18GHz	18-40GHz
Module	Horizontal	Y	Y	Z	Y	Y
	Vertical	Y	Y	Y	Y	Y

5500MHz to 5700MHz

	Frequency Antenna polarization	Carrier *5)	Spurious			
			Below 1GHz	1-15GHz	15-18GHz	18-40GHz
Module	Horizontal	Y	Y	Y	Y	Y
	Vertical	Y	Y	Y	Y	Y

*5) with spurious emissions near carrier frequency.

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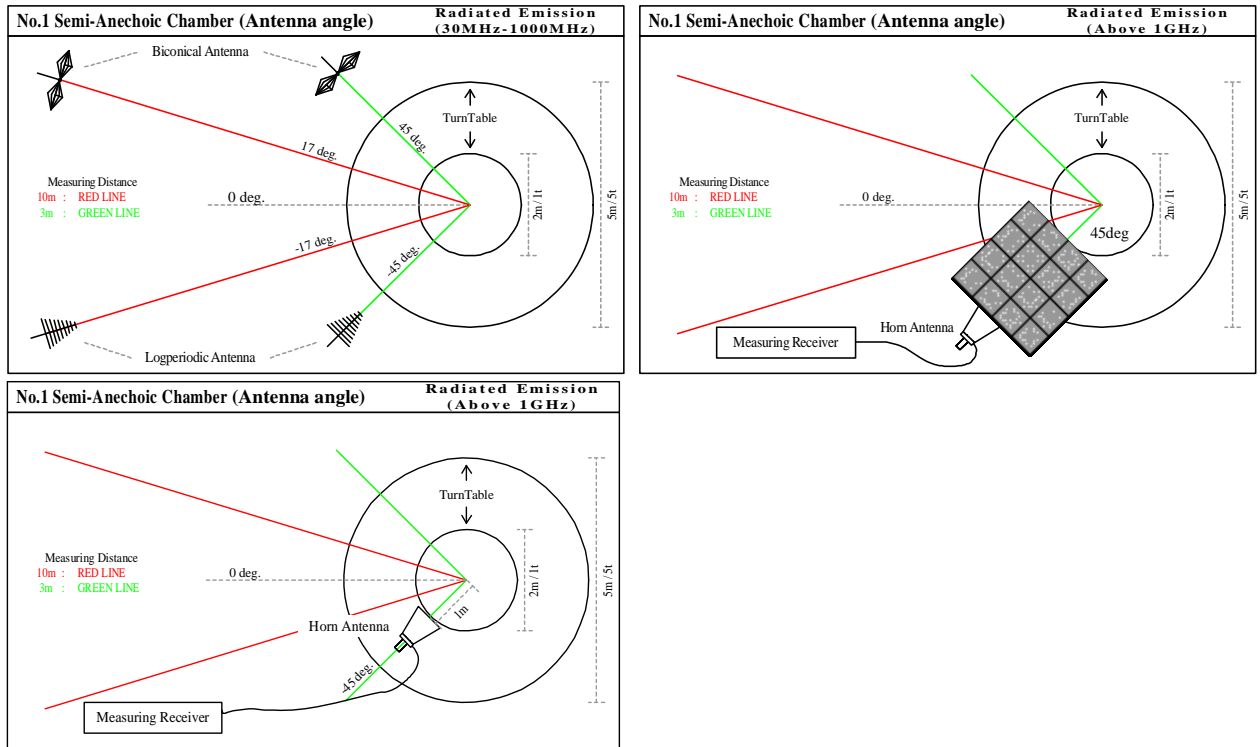


Figure 1. Antenna angle

6.5 Results

Summary of the test results : Pass *No noise was detected above the 2nd order harmonics.
 Refer to APPENDIX 1

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	Instrument used and Test method
26dB Bandwidth	30MHz	Close to 1% of EBW	Greater than RBW	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth	Enough width to display 20dB Bandwidth	Close to 1% of Span	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
20dB Bandwidth	40MHz	Close to 1% of Span	Three times of RBW	Auto	Peak	Max Hold	Spectrum Analyzer
Maximum Peak Output Power *1)	Bandwidth 50MHz	-	-	-	Average	-	Power Meter method PM
Peak Power Spectral Density *2)	52MHz	1MHz	3MHz	Auto	Sample Power Averaging (100 times)	Clear Write	Spectrum Analyzer method SA-1
Peak Excursion Ratio	52MHz	1MHz	3MHz	Auto	Peak	Max Hold	Spectrum Analyzer method SA-1
					Sample Power Averaging (100 times)	Clear Write	
Conducted Spurious Emission *4) (below 1GHz) *3)	9kHz to 150kHz, 150kHz to 30MHz, 30MHz to 1GHz	100kHz	300kHz	Auto	Peak	Max Hold	Spectrum Analyzer
Conducted Spurious Emission *4) (above 1GHz)	Less or equal to 5GHz (Range: 1GHz-40GHz)	1MHz	3MHz	Auto	Peak	Max Hold	Spectrum Analyzer

*EBW: Enough width to display Bandwidth

*1) Maximum Peak Output Power was Method PM.

*2) PSD was Method SA-1 of "Guidance for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E"

*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 low enough as shown in the chart.(9kHz-150kHz:RBW=200Hz, 150kHz-30MHz:RBW=10kHz). Since the margin is more than about 40dB, the EUT complies with the limit of FCC15.209 if the measurement is performed with RBW=100kHz.

*4) The conducted measurement is reference data and the radiated emission measurement is complied data.

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

Test data : **APPENDIX**

Test result : **Pass**

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Contents of APPENDIXES

APPENDIX 1: Data of EMI test

Conducted emission
6dB Bandwidth
Maximum peak output power
Radiated emission
Spurious emission (Antenna port conducted)
Peak power density
Occupied Bandwidth

APPENDIX 2: Test instruments

Test instruments

APPENDIX 3: Photographs of test setup

Conducted emission
Radiated emission
Pre-check of worst position

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