

MEASUREMENT REPORT

EMC Test Report

Applicant: Compex Systems Pte Ltd

Address: No:9 Harrison Road, Harrison Industrial Building, #05-01,
Singapore 369651

Product: 4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module

Model No.: WLE1216V5-20, WLE1216V5-20-I

Brand Name: COMPEX

Standards: EN 301 489 - 1 V2.2.0 (2017-03)
EN 301 489 - 17 V3.2.0 (2017-03)

Result: Complies

Test Date: October 25 ~ November 24, 2017

Reviewed By : Jame Yuan
(Jame Yuan)

Approved By : Marlin Chen
(Marlin Chen)



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standards through the calibration of the equipment and evaluated measurement uncertainty herein.

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Revision History

Report No.	Version	Description	Issue Date	Note
1710RSU02009	Rev. 01	Initial Report	11-25-2017	Valid

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1. General Information

1.1. Applicant

Compex Systems Pte Ltd

No:9 Harrison Road, Harrison Industrial Building, #05-01, Singapore 369651

1.2. Manufacturer

Compex Systems Pte Ltd

No:9 Harrison Road, Harrison Industrial Building, #05-01, Singapore 369651

1.3. Testing Facility

Test Site

MRT Technology (Suzhou) Co., Ltd

Test Site Location

D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- MRT facility is a FCC registered (MRT Reg. No. 893164) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.
- MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.
- MRT facility is a VCCI registered (R-4179, G-814, C-4664, T-2206) test laboratory with the site description on file at VCCI Council.
- MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, EU and TELEC Rules.



1.4. Feature of Equipment under Test

Product Name:	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module
Model No.:	WLE1216V5-20, WLE1216V5-20-I
Brand Name:	COMPEX
Wi-Fi Specification:	802.11a/b/g/n/ac
Operating Temperature:	-20 ~ 70 ° C

Note: The difference between models is for different market sale.

1.5. Standards Applicable for Testing

The EUT complies with the requirements of EN 301 489-1 V2.2.0 & EN 301 489-17 V3.2.0.

EMI Test:

EN 55032: 2015 (Conducted Emission)

EN 55032: 2015 (Radiated Emission)

EN 61000-3-2: 2014 (Harmonic)

EN 61000-3-3: 2013 (Flicker)

EMS Test:

EN 61000-4-2: 2009 (ESD)

EN 61000-4-3: 2006+A1:2008+A2:2010 (RS)

EN 61000-4-4: 2012 (EFT)

EN 61000-4-5: 2014 (Surge)

EN 61000-4-6: 2014 (CS)

EN 61000-4-11: 2004 (Dips)

1.6. Performance Criteria

General Requirements (ETSI EN 301489-1):

The performance criteria are used to take a decision on whether radio equipment passes or fails immunity tests.

For the purpose of the present document four categories of performance criteria apply:

- Performance criteria for continuous phenomena applied to transmitters and receivers;
- Performance criteria for transient phenomena applied to transmitters and receivers;
- Performance criteria for equipment which does not provide a continuous communication link;
- Performance criteria for ancillary equipment tested on a stand alone basis.

Normally, the performance criteria depend on the type of radio equipment. Thus, the present document only contains general performance criteria commonly used for the assessment of radio equipment. More specific and product-related performance criteria for a dedicated type of radio equipment may be found in the part of ETSI EN 301 489 series [i.13] dealing with the particular type of radio equipment.

Performance criteria for continuous phenomena applied to transmitters and receivers

If no further details are given in the relevant part of ETSI EN 301 489 series [i.13] dealing with the particular type of radio equipment, the following general performance criteria for continuous phenomena shall apply.

During and after the test, the equipment shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the equipment is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.

During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.

If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

Performance criteria for transient phenomena applied to transmitters and receivers

If no further details are given in the relevant part of ETSI EN 301 489 series [i.13] dealing with the particular type of radio equipment, the following general performance criteria for transient phenomena shall apply.

For surges applied to symmetrically operated wired network ports intended to be connected directly to outdoor lines the following criteria applies:

- For products with only one symmetrical port intended for connection to outdoor lines, loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. A SW reboot is not allowed. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.
- For products with more than one symmetrical port intended for connection to outdoor lines, loss of function on the port under test is allowed, provided the function is self-recoverable. A SW reboot is not allowed. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

For all other ports the following applies:

- After the test, the equipment shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the equipment is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.
- During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.
- If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.

Performance criteria for equipment which does not provide a continuous communication link

For radio equipment which does not provide a continuous communication link, the performance criteria described in clauses 6.1 and 6.2 are not appropriate, in these cases the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests. The performance specification shall be included in the product description and documentation. The related specifications set out in clause 5.3 have also to be taken into account.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in clauses 6.1 and 6.2.

Performance criteria for ancillary equipment tested on a stand-alone basis

If ancillary equipment is intended to be tested on a standalone basis, the performance criteria described in clauses 6.1 and 6.2 are not appropriate, in these cases the manufacturer shall declare, for inclusion in the test report, his own specification for an acceptable level of performance or degradation of performance during and/or after the immunity tests. The performance specification shall be included in the product description and documentation. The related specifications set out in clause 5.3 have also to be taken into account.

The performance criteria specified by the manufacturer shall give the same degree of immunity protection as called for in clauses 6.1 and 6.2.

Special Performance Requirements (ETSI EN 301489-17):

The performance criteria are:

- performance criteria A for immunity tests with phenomena of a continuous nature;
- performance criteria B for immunity tests with phenomena of a transient nature;
- performance criteria C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as specified in the following clauses.

Criteria	During test	After test
A	Shall operate as intended. May show degradation of performance (see note 1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 3). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
B	May show loss of function (one or more). May show degradation of performance (see note 1). No unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3). Shall be no loss of stored data or user programmable functions.
C	May be loss of function (one or more).	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see note 3).

Note 1: Operate as intended during the test allows a level of degradation not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

Note 2: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.

If the minimum performance level or the permissible performance degradation is not specified by

the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

Note 3: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

Performance criteria for Continuous phenomena applied to Transmitters (CT)

The performance criteria A shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Transient phenomena applied to Transmitters (TT)

The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5000 ms duration, for which performance criteria C shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Continuous phenomena applied to Receivers (CR)

The performance criteria A shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Transient phenomena applied to Receivers (TR)

The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5000 ms duration for which performance criteria C shall apply.

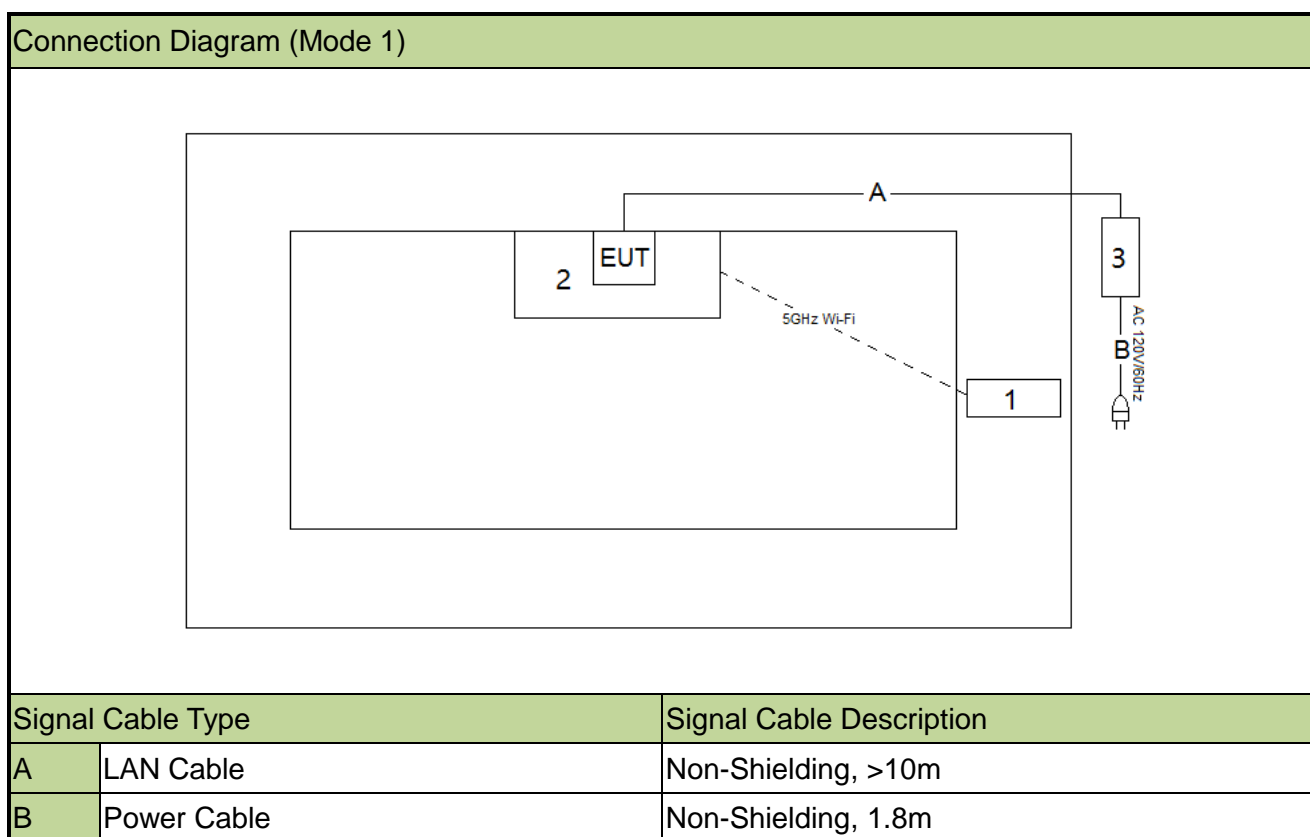
Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

2. Test Configuration of Equipment under Test

2.1. Test Mode

Test Mode	
EMI Mode	Mode 1: Make the EUT communicate with notebook by Wi-Fi.
EMS Mode	Mode 1: Make the EUT communicate with notebook by Wi-Fi.

2.2. Configuration of Tested System



2.3. Test System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product		Manufacturer	Model No.	Serial No.	Power Cord
1	Notebook	Lenovo	X201	N/A	N/A
2	PCB Board	Compex	WPQ864HV	N/A	N/A
3	POE Adapter	MRT	GRT-560110A-AT	N/A	N/A

2.4. Test Procedure

1	Setup the EUT and simulators as shown on above.
2	Make the EUT communicate with notebook by wireless.
3	Turn on the power of all equipment begin to test.

3. Test Summary

Test Reference Standard	Test Item	Result (Pass/Fail)	Remark
Emission Measurements			
EN 55032	Conducted Emission	Pass	--
EN 55032	Radiated Emission	Pass	--
EN 61000-3-2	Harmonic Current Emissions	Pass	--
EN 61000-3-3	Voltage Fluctuations and Flicker	Pass	--
Immunity Measurements			
EN 61000-4-2	Electrostatic Discharge	Pass	--
EN 61000-4-3	Radio-Frequency Electromagnetic Field	Pass	--
EN 61000-4-4	Fast Transients, Common Mode	Pass	--
EN 61000-4-5	Surges	Pass	--
EN 61000-4-6	Radio- Frequency Common Mode	Pass	--
EN 61000-4-11	Voltage Dips and Interruptions	Pass	--

4. Conducted Emission

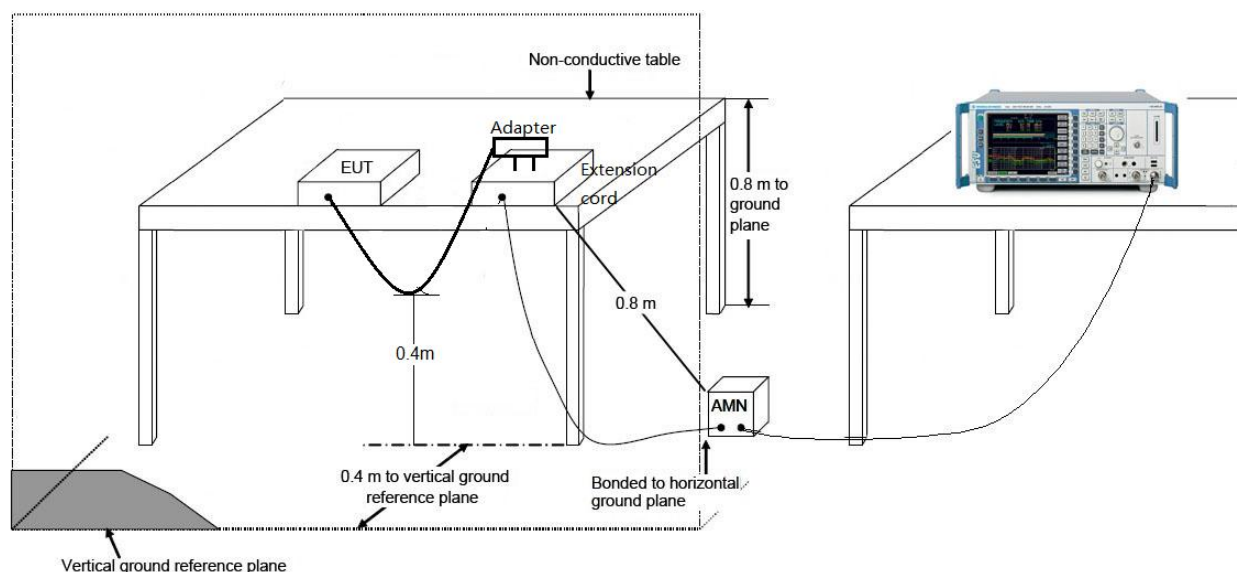
4.1. Limit of Conducted Emission

Limits of conducted emission for AC mains power input/output ports				
Frequency range MHz	Limits dB(μV)			
	Quasi-peak		Average	
0.15 to 0.50	66 to 56		56 to 46	
0.50 to 5	56		46	
5 to 30	60		50	
Limits of conducted emission for telecommunication ports				
Frequency range MHz	Voltage Limits dB(μV)		Current limits dB(μA)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 to 0.50	84 to 74	74 to 64	40 to 30	30 to 20
0.50 to 30	74	64	30	20

Note 1: The lower limit shall apply at the transition frequencies.

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.50MHz.

4.2. Test Setup



4.3. Test Procedure

The receiver or associated equipment under measurement and the artificial mains network are disposed as shown in 3.2. Measurements shall be carried out using a selective voltmeter having a quasi-peak detector for broadband measurements and an average detector for narrow-band measurements in accordance with CISPR 16-1.

The mains lead shall be arranged to follow the shortest possible path between the receiver and artificial mains network on the ground. The mains lead in excess of 0,8 m separating the equipment under test from the artificial mains network shall be folded back and forth parallel to the lead so as to form a bundle with a length of 0,3 m to 0,4 m.

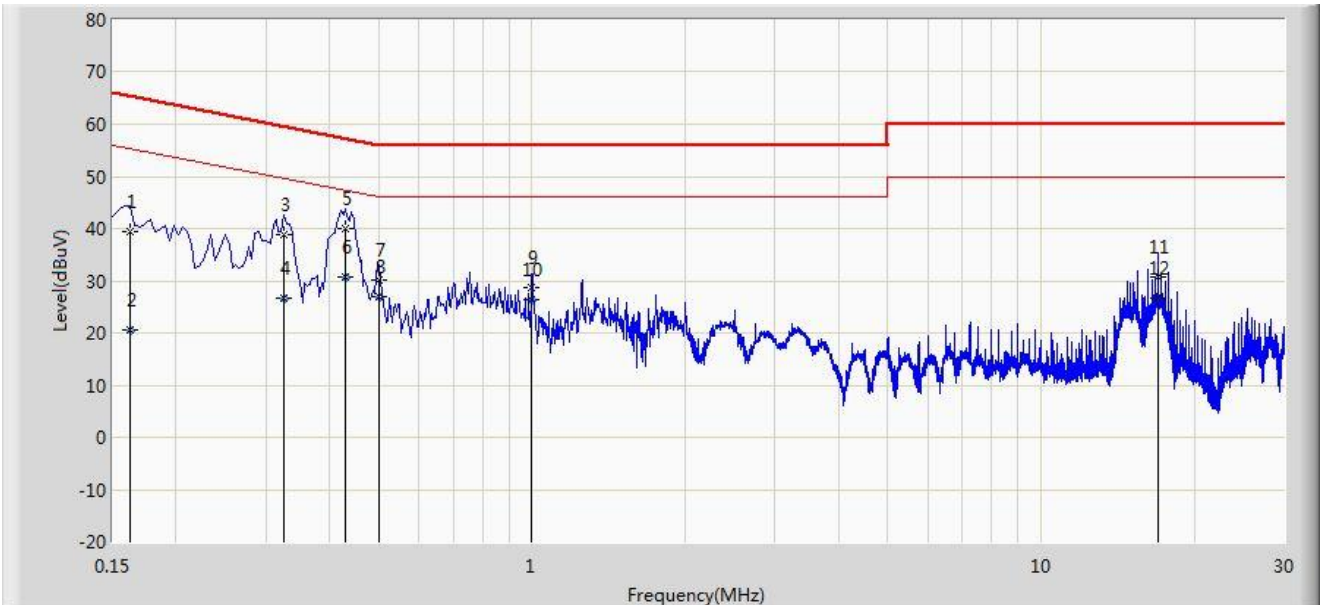
Earthing of the equipment under test if provided with a safety earth connection, shall be made to the earth terminal provided on the artificial mains network with the shortest possible lead.

If the equipment under test has a coaxial RF input connector, tests shall be performed with and without an earth connection made to the outer conductor screen of the coaxial RF input connector. When these tests are being carried out, no other earth connections shall be made to any additional earth terminal whatever.

If the equipment under test has no coaxial RF input connector and if it has an earth terminal, tests shall be performed with this terminal earthed.

4.4. Test Result

Site: SR2	Time: 2017/11/24 - 19:48
Limit: EN55032_CE_Mains_Class B	Engineer: Bacon Dong
Probe: ENV216_101683_Filter On	Polarity: Line
EUT: 4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Power: AC 230V/50Hz
Test Mode: Mode 1	

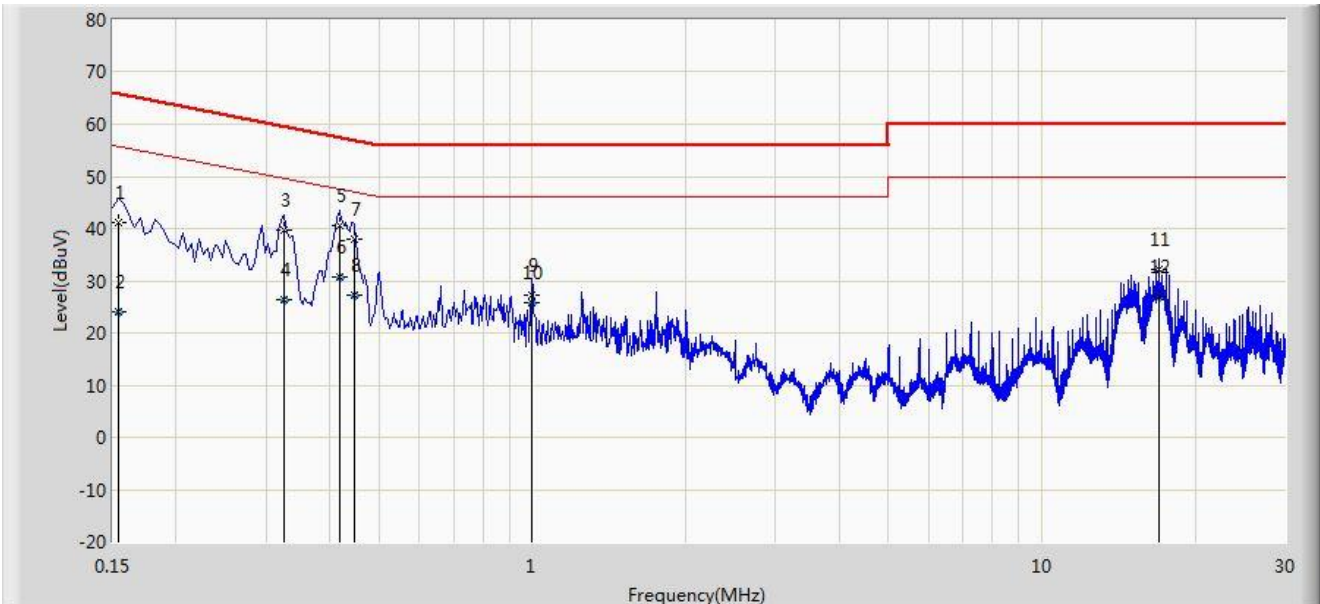


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1			0.162	39.393	29.296	-25.967	65.361	10.097	QP
2			0.162	20.663	10.566	-34.698	55.361	10.097	AV
3			0.326	38.942	28.917	-20.610	59.552	10.025	QP
4			0.326	26.803	16.778	-22.750	49.552	10.025	AV
5			0.430	40.047	29.937	-17.206	57.253	10.110	QP
6		*	0.430	30.700	20.590	-16.552	47.253	10.110	AV
7			0.502	30.019	19.862	-25.981	56.000	10.157	QP
8			0.502	26.853	16.696	-19.147	46.000	10.157	AV
9			0.998	28.785	18.875	-27.215	56.000	9.910	QP
10			0.998	26.454	16.544	-19.546	46.000	9.910	AV
11			16.998	30.774	20.700	-29.226	60.000	10.074	QP
12			16.998	26.614	16.540	-23.386	50.000	10.074	AV

Note: Measure Level (dBμV) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

Site: SR2	Time: 2017/11/24 - 19:54
Limit: EN55032_CE_Mains_Class B	Engineer: Bacon Dong
Probe: ENV216_101683_Filter On	Polarity: Neutral
EUT: 4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Power: AC 230V/50Hz
Test Mode: Mode 1	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV)	Factor (dB)	Type
1			0.154	41.257	30.541	-24.525	65.781	10.716	QP
2			0.154	24.163	13.448	-31.618	55.781	10.716	AV
3			0.326	39.630	29.573	-19.923	59.552	10.057	QP
4			0.326	26.263	16.207	-23.289	49.552	10.057	AV
5			0.418	40.579	30.453	-16.909	57.488	10.126	QP
6		*	0.418	30.860	20.734	-16.627	47.488	10.126	AV
7			0.446	37.887	27.740	-19.062	56.949	10.147	QP
8			0.446	27.239	17.092	-19.711	46.949	10.147	AV
9			0.998	27.383	17.473	-28.617	56.000	9.910	QP
10			0.998	25.905	15.995	-20.095	46.000	9.910	AV
11			17.002	32.129	22.013	-27.871	60.000	10.116	QP
12			17.002	27.080	16.964	-22.920	50.000	10.116	AV

Note: Measure Level (dBμV) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + LISN Factor (dB)

5. Radiated Emission

5.1. Limit of Radiated Emission

Frequency range MHz	Quasi-peak limits dB(μ V/m)
30 to 230	40
230 to 1000	47

Note 1: The lower limit shall apply at the transition frequency.

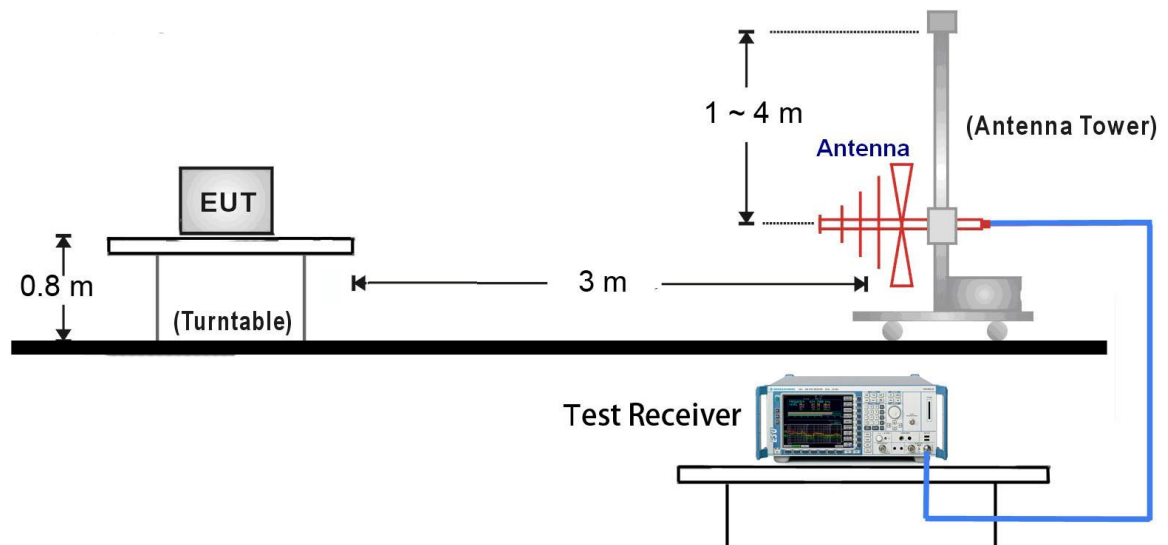
Note 2: Additional provisions may be required for cases where interference occurs.

Frequency range GHz	Average limit dB(μ V/m)	Peak limit dB(μ V/m)
1 to 3	50	70
3 to 6	54	74

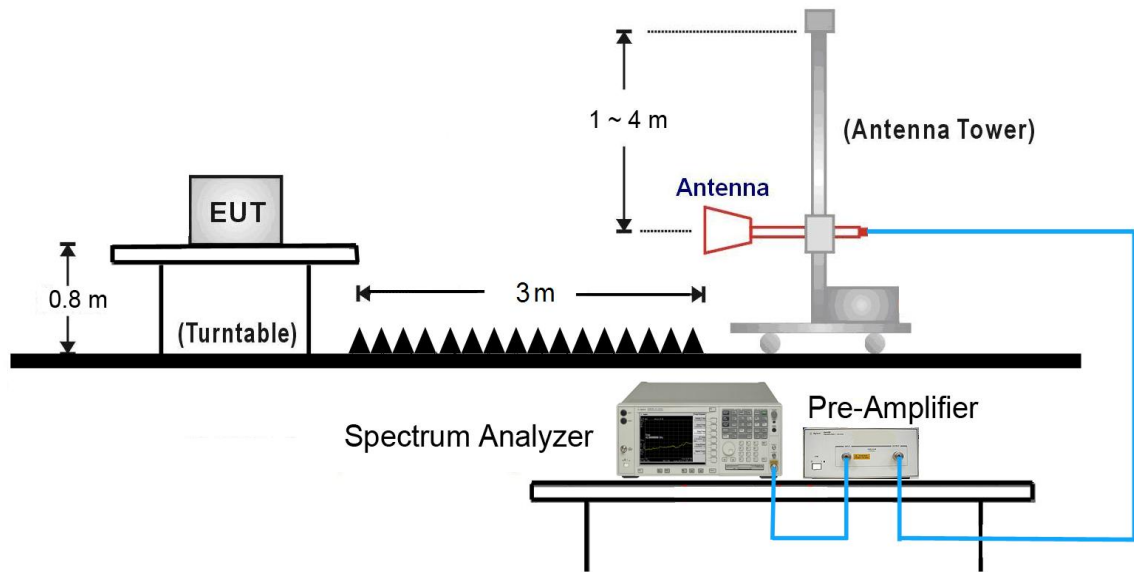
Note: The lower limit applies at the transition frequency.

5.2. Test Setup

30 ~ 1000 MHz



1000 ~ 6000 MHz



Note: About the radiated test setup, the EUT and local AE shall be arranged in the most compact practical arrangement within the test volume, while respecting typical spacing and the requirements defined in EN55032 Annex D. The central point of the arrangement shall be positioned at the centre of the turntable. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and the calibration point of the antenna. See below Figure 1 and Figure 2.

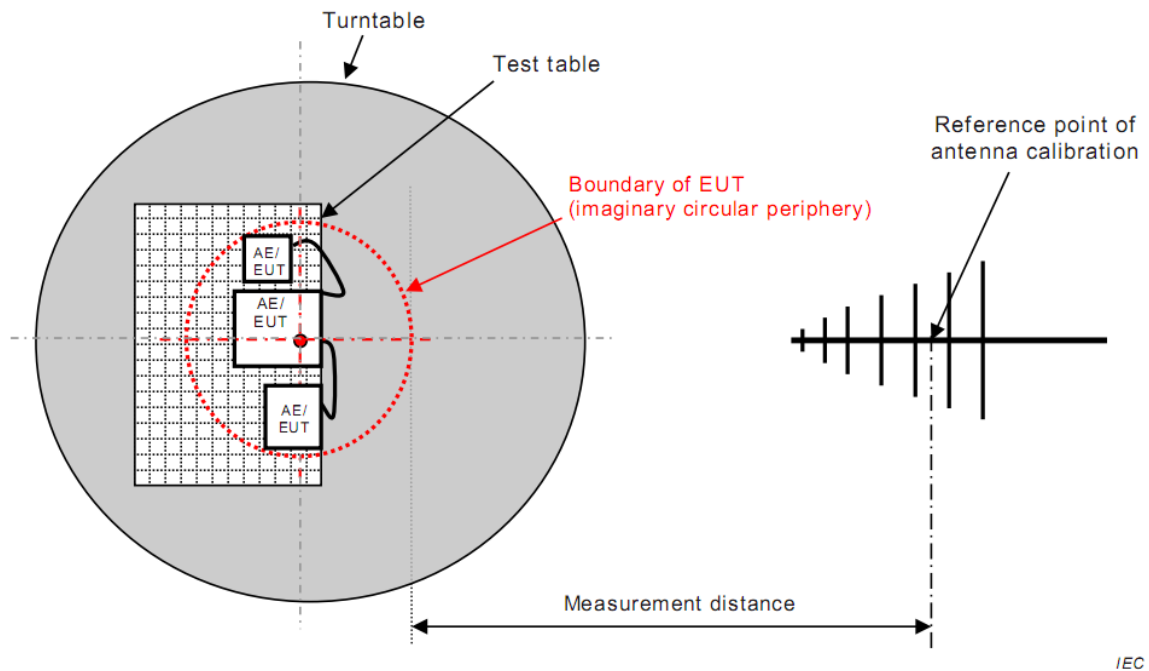


Figure 1

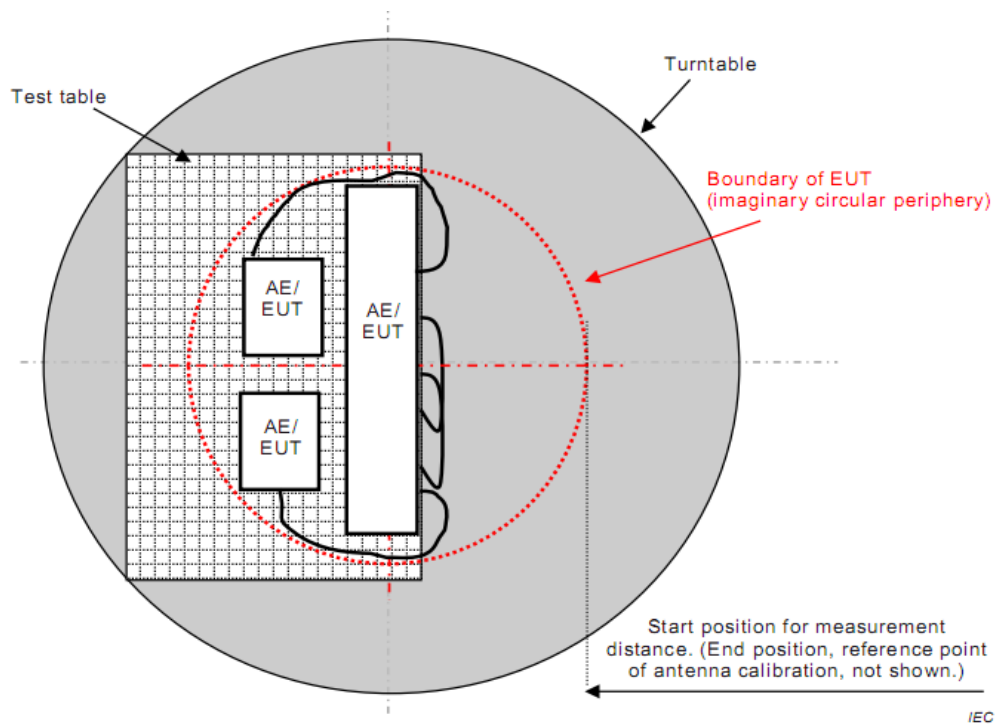


Figure 2

5.3. Test Procedure

Starting with the front of the receiver under test facing the measuring antenna, the measuring antenna is adjusted for horizontal polarization measurement and its height varied between 1 m and 4 m until the maximum reading is obtained.

The receiver under test is then rotated about its centre until the maximum meter reading is obtained, after which the measuring antenna height is again varied between 1 m and 4 m and the maximum reading noted.

The procedure is repeated for vertical polarization of the measuring antenna.

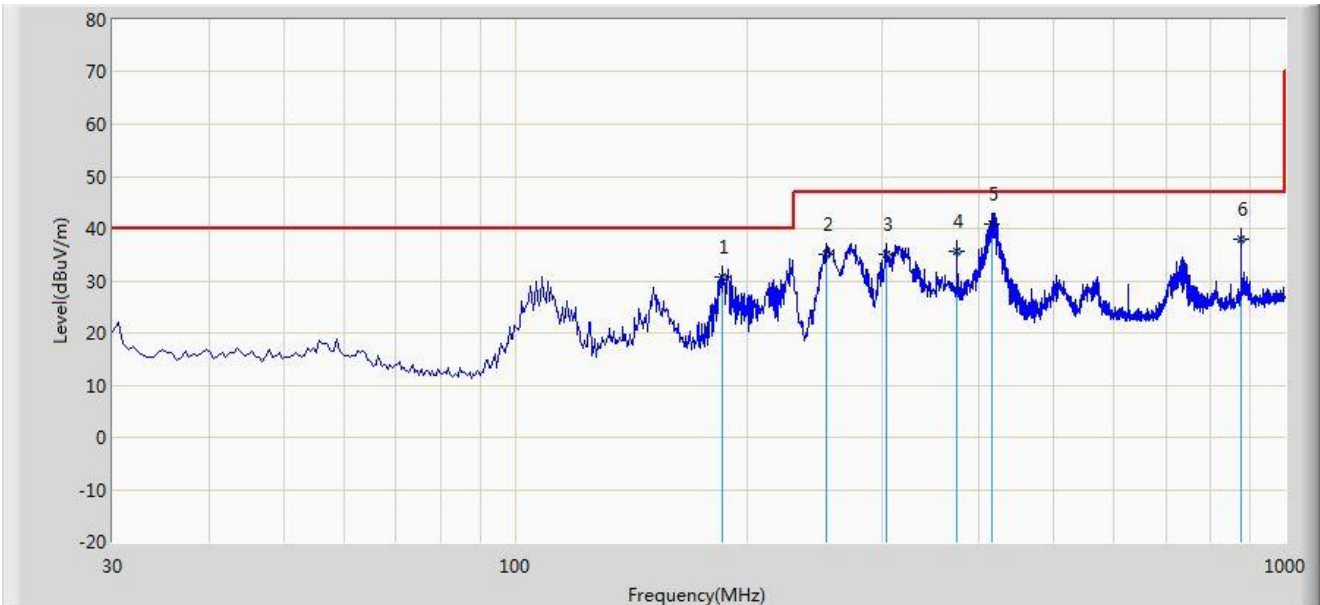
The highest value found, following this procedure, is defined as the radiation figure of the receiver.

If at certain frequencies the ambient signal field strength is high at the position of the receiving antenna, one of the following methods may be used to show compliance of the equipment under test.

a) For small frequency bands with high ambient signals, the disturbance value may be interpolated from the adjacent values. The interpolated value shall lie on the curve describing a continuous function of the disturbance values adjacent to the ambient noise.

5.4. Test Result

Site: AC1	Time: 2017/10/31 - 15:21
Limit: EN55032_RE(3m)_Class B	Engineer: Alex Ma
Probe: VULB 9168 _20-2000MHz	Polarity: Horizontal
EUT: 4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Power: AC 230V/50Hz
Test Mode: Mode 1	

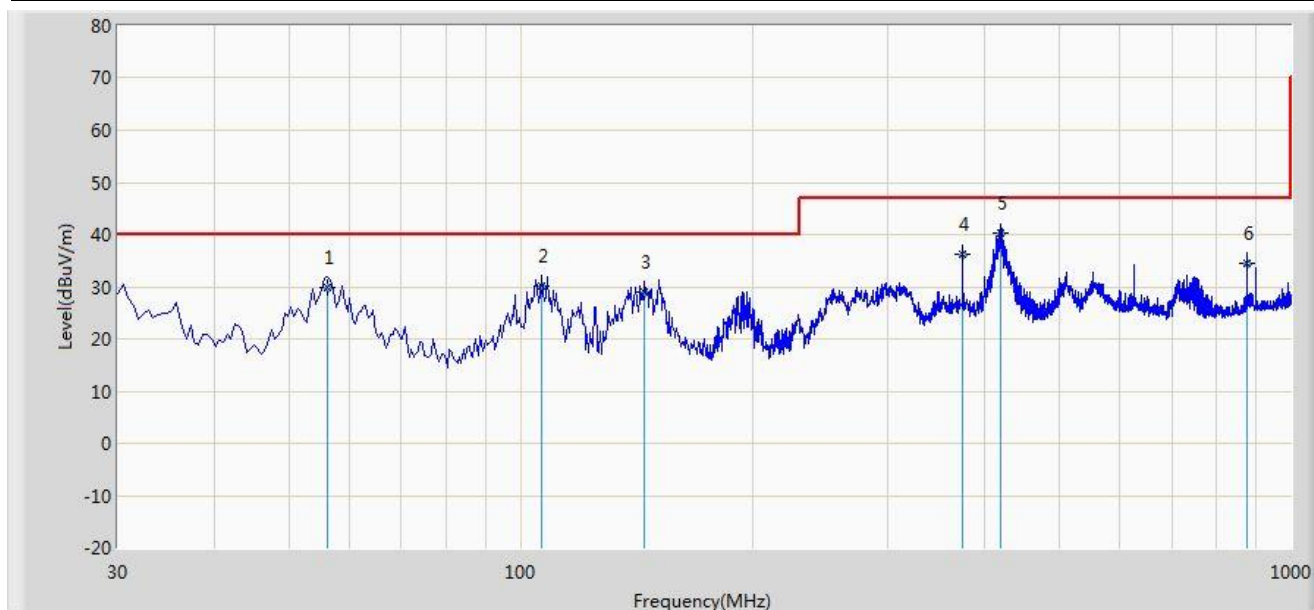


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			185.685	30.812	18.689	-9.188	40.000	12.123	QP
2			254.070	35.176	22.154	-11.824	47.000	13.022	QP
3			303.055	35.134	20.772	-11.866	47.000	14.362	QP
4			374.835	35.615	19.615	-11.385	47.000	16.000	QP
5			415.757	40.797	23.889	-6.203	47.000	16.909	QP
6			875.355	37.965	13.955	-9.035	47.000	24.010	QP

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC1	Time: 2017/10/31 - 15:21
Limit: EN55032_RE(3m)_Class B	Engineer: Alex Ma
Probe: VULB 9168 _20-2000MHz	Polarity: Vertical
EUT: 4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Power: AC 230V/50Hz
Test Mode: Mode 1	

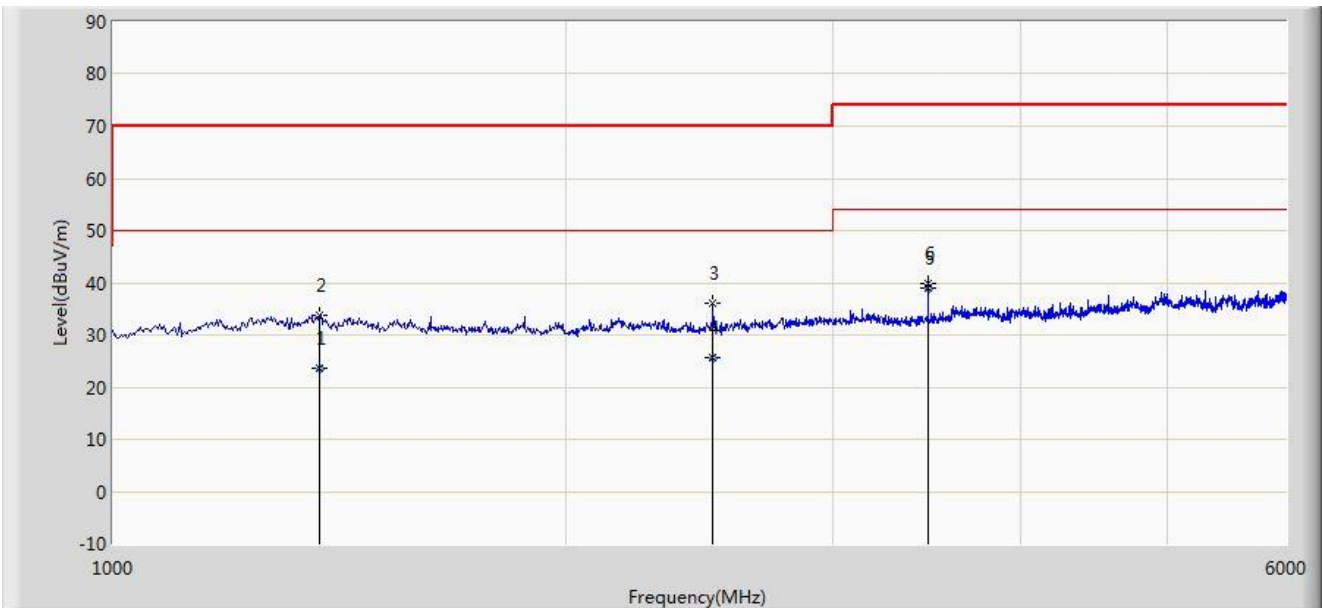


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			56.190	29.981	16.348	-10.019	40.000	13.633	QP
2			106.630	30.107	18.463	-9.893	40.000	11.644	QP
3			144.945	28.880	14.047	-11.120	40.000	14.833	QP
4			374.835	36.109	20.109	-10.891	47.000	16.000	QP
5			419.455	40.155	23.131	-6.845	47.000	17.024	QP
6			875.355	34.633	10.623	-12.367	47.000	24.010	QP

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m).

Site: AC1	Time: 2017/10/31 - 15:45
Limit: EN55032_RE(3m)_Class B	Engineer: Alex Ma
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: 4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Power: AC 230V/50Hz
Test Mode: Mode 1	

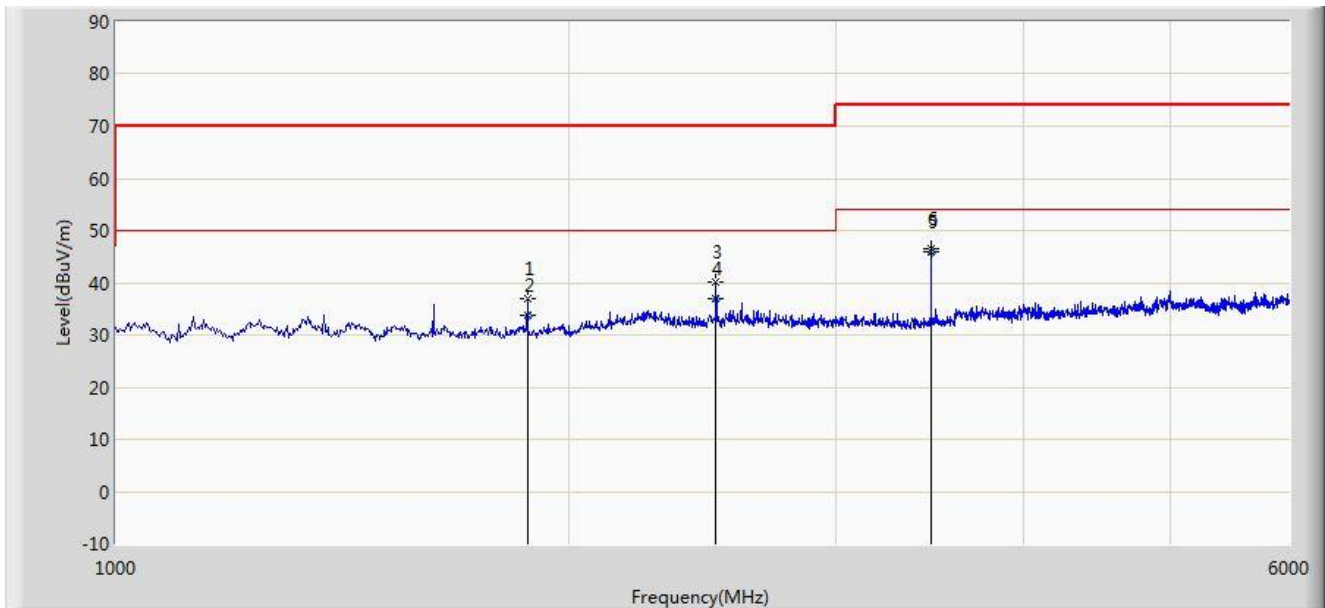


No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			1372.000	23.757	31.654	-26.243	50.000	-7.897	AV
2			1372.500	33.681	41.579	-36.319	70.000	-7.898	PK
3			2500.000	36.076	39.715	-33.924	70.000	-3.639	PK
4			2500.500	25.723	29.360	-24.277	50.000	-3.638	AV
5			3472.300	39.070	40.355	-14.930	54.000	-1.285	AV
6			3472.500	39.929	41.213	-34.071	74.000	-1.284	PK

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB).

Site: AC1	Time: 2017/10/31 - 15:56
Limit: EN55032_RE(3m)_Class B	Engineer: Alex Ma
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: 4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Power: AC 230V/50Hz
Test Mode: Mode 1	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			1875.000	37.026	43.487	-32.974	70.000	-6.461	PK
2			1875.500	33.908	40.365	-16.092	50.000	-6.457	AV
3			2500.000	40.091	43.730	-29.909	70.000	-3.639	PK
4			2500.500	36.961	40.598	-13.039	50.000	-3.638	AV
5			3472.320	46.005	47.290	-7.995	54.000	-1.285	AV
6			3472.500	46.471	47.755	-27.529	74.000	-1.284	PK

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain (dB).

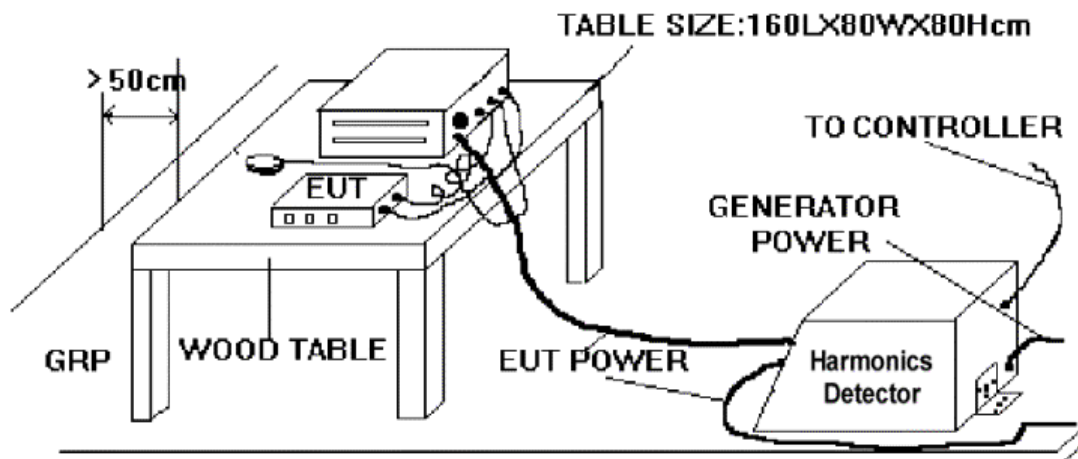
6. Harmonic Current Emissions

6.1. Limit of Harmonic Current Emissions

Limits of Class A Harmonics Currents

Harmonics Order n	Maximum Permissible harmonic current A	Harmonics Order n	Maximum Permissible harmonic current A
Odd harmonics		Even harmonics	
3	2.30	2	1.08
5	1.14	4	0.43
7	0.77	6	0.30
9	0.40	$8 \leq n \leq 40$	$0.23 * 8/n$
11	0.33	--	--
13	0.21	--	--
$15 \leq n \leq 39$	$0.15 * 15/n$	--	--

6.2. Test Setup



6.3. Test Procedure

The EUT is supplied in series with power analyzer from a power source having the same normal voltage and frequency as the rated supply voltage and the equipment under test. And the rated voltage at the supply voltage of EUT of 0.98 times and 1.02 times shall be performed.

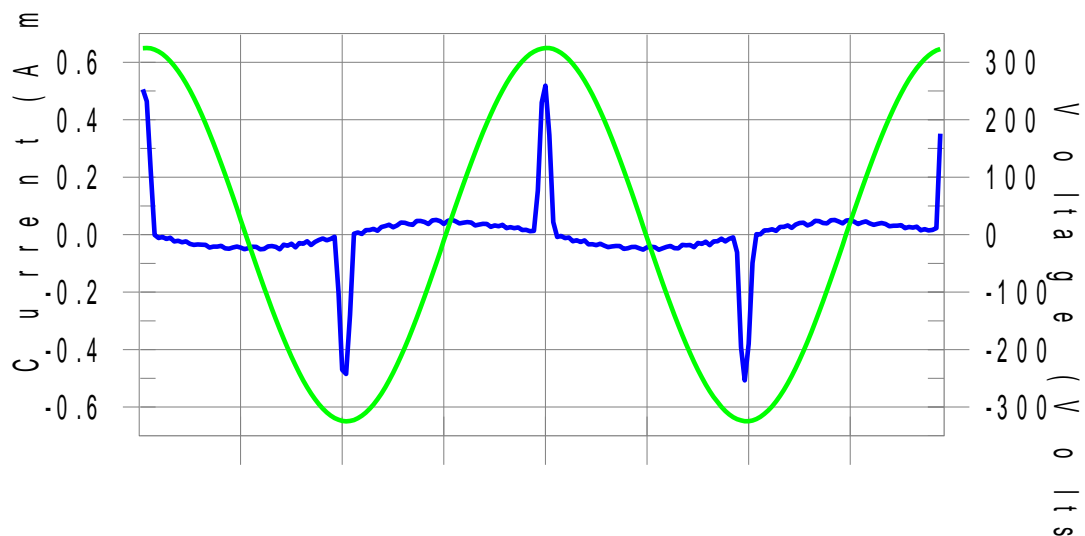
6.4. Test Result

Product	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Temperature	25°C
Test Engineer	Milo Li	Relative Humidity	50%
Test Mode	Mode 1	Date of Test	2017/11/24

Test Result: Pass

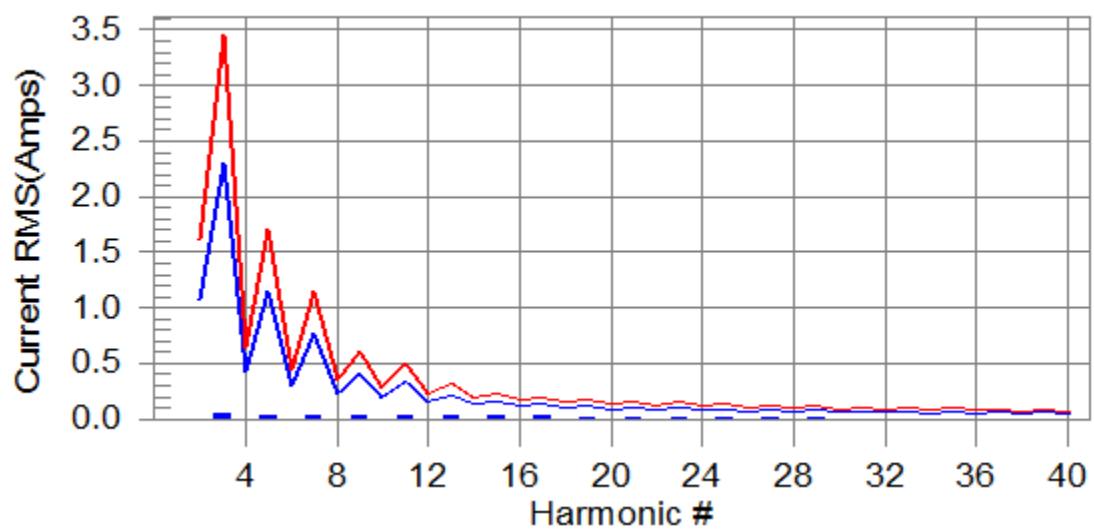
Source qualification: Normal

Current & voltage waveforms



Harmonics and Class A limit line

European Limits



Test result: Pass Worst harmonic was #15 with 17.5% of the limit.

Test Result: Pass **Source qualification: Normal**
THC(A): 0.099 **I-THD(%): 188.1** **POHC(A): 0.025** **POHC Limit(A): 0.251**
Highest parameter values during test:
 V_RMS (Volts): 229.75 **Frequency(Hz): 50.00**
 I_Peak (Amps): 0.545 **I_RMS (Amps): 0.113**
 I_Fund (Amps): 0.053 **Crest Factor: 4.849**
 Power (Watts): 9.4 **Power Factor: 0.364**

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.001	1.080	N/A	0.001	1.620	N/A	Pass
3	0.040	2.300	1.7	0.041	3.450	1.2	Pass
4	0.001	0.430	N/A	0.001	0.645	N/A	Pass
5	0.038	1.140	3.4	0.039	1.710	2.3	Pass
6	0.001	0.300	N/A	0.001	0.450	N/A	Pass
7	0.037	0.770	4.8	0.037	1.155	3.2	Pass
8	0.000	0.230	N/A	0.001	0.345	N/A	Pass
9	0.035	0.400	8.6	0.035	0.600	5.8	Pass
10	0.000	0.184	N/A	0.001	0.276	N/A	Pass
11	0.032	0.330	9.7	0.032	0.495	6.5	Pass
12	0.000	0.153	N/A	0.001	0.230	N/A	Pass
13	0.029	0.210	13.9	0.029	0.315	9.3	Pass
14	0.000	0.131	N/A	0.000	0.197	N/A	Pass
15	0.026	0.150	17.5	0.026	0.225	11.7	Pass
16	0.000	0.115	N/A	0.000	0.173	N/A	Pass
17	0.023	0.132	17.4	0.023	0.198	11.7	Pass
18	0.000	0.102	N/A	0.000	0.153	N/A	Pass
19	0.020	0.118	16.6	0.020	0.178	11.2	Pass
20	0.000	0.092	N/A	0.000	0.138	N/A	Pass
21	0.016	0.107	15.3	0.017	0.161	10.3	Pass
22	0.000	0.084	N/A	0.000	0.125	N/A	Pass
23	0.013	0.098	13.5	0.013	0.147	9.2	Pass
24	0.000	0.077	N/A	0.000	0.115	N/A	Pass
25	0.010	0.090	11.4	0.010	0.135	7.8	Pass
26	0.000	0.071	N/A	0.000	0.107	N/A	Pass
27	0.007	0.083	9.0	0.008	0.125	6.2	Pass
28	0.000	0.066	N/A	0.000	0.099	N/A	Pass
29	0.005	0.078	6.5	0.005	0.116	4.5	Pass
30	0.000	0.061	N/A	0.000	0.092	N/A	Pass
31	0.003	0.073	N/A	0.003	0.109	N/A	Pass
32	0.000	0.058	N/A	0.000	0.086	N/A	Pass
33	0.001	0.068	N/A	0.001	0.102	N/A	Pass
34	0.000	0.054	N/A	0.000	0.081	N/A	Pass
35	0.001	0.064	N/A	0.001	0.096	N/A	Pass
36	0.000	0.051	N/A	0.000	0.077	N/A	Pass
37	0.002	0.061	N/A	0.002	0.091	N/A	Pass
38	0.000	0.048	N/A	0.000	0.073	N/A	Pass
39	0.002	0.058	N/A	0.002	0.087	N/A	Pass
40	0.000	0.046	N/A	0.000	0.069	N/A	Pass

7. Voltage Fluctuations and Flicker

7.1. Limit of Voltage Fluctuations and Flicker

The following limits apply:

- the value of P_{st} shall not be greater than 1.0;
- the value of P_{lt} shall not be greater than 0.65;
- the value of $d(t)$ during a voltage change shall not exceed 3.3% for more than 500ms;
- the relative steady-state voltage change, d_c , shall not exceed 3.3%;
- the maximum relative voltage change, d_{max} , shall not exceed;
 - a) 4% without additional conditions;
 - b) 6% for equipment which is:
 - switched manually, or
 - switched automatically more frequently than twice per day, and also has either a delayed restart (the delay being not less than a few tens of seconds), or manual restart, after a power supply interruption.

Note: The cycling frequency will be further limited by the P_{st} and P_{lt} limit.

For example: a d_{max} of 6% producing a rectangular voltage change characteristic twice per hour will give a P_{lt} of about 0.65.

- c) 7% for equipment which is:
 - attended whilst in use (for example: hair dryers, vacuum cleaners, kitchen equipment such as mixers, garden equipment such as lawn mowers, portable tools such as electric drills), or
 - switched on automatically, or is intended to be switched on manually, no more than twice per day, and also has either a delayed restart (the delay being not less than a few tens of seconds) or manual restart, after a power supply interruption.

P_{st} and P_{lt} requirements shall not be applied to voltage changes caused by manual switching.

Diagram illustrating the experimental setup for the EUT (Electrical Under Test) connected to a generator power source and a harmonics detector.

The setup includes:

- TABLE SIZE:** 160Lx80Wx80Hcm
- GRP** (Grounding Point) is connected to the **WOOD TABLE**.
- The **EUT** (Electrical Under Test) is connected to the **GENERATOR POWER** source via a cable labeled **EUT POWER**.
- The **Harmonics Detector** is connected to the **EUT** and the **GENERATOR POWER** source.
- A cable labeled **TO CONTROLLER** is connected to the **Harmonics Detector**.
- The distance between the **GRP** and the **EUT** is indicated as **> 50cm**.

The EUT is supplied in series with power analyzer from a power source having the same normal voltage and frequency as the rated supply voltage and the equipment under test. And the rated voltage at the supply voltage of EUT of 0.98 times and 1.02 times shall be performed.

7.4. Test Result

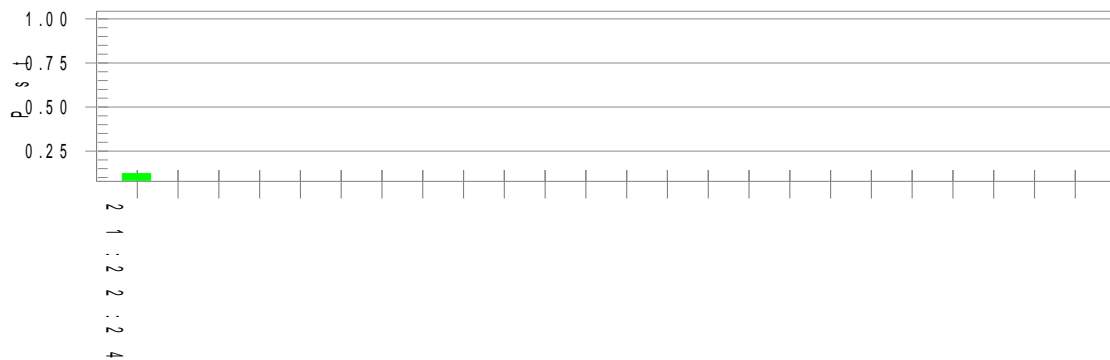
Product	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Temperature	25°C
Test Engineer	Milo Li	Relative Humidity	50%
Test Mode	Mode 1	Date of Test	2017/11/24

Test Result: Pass

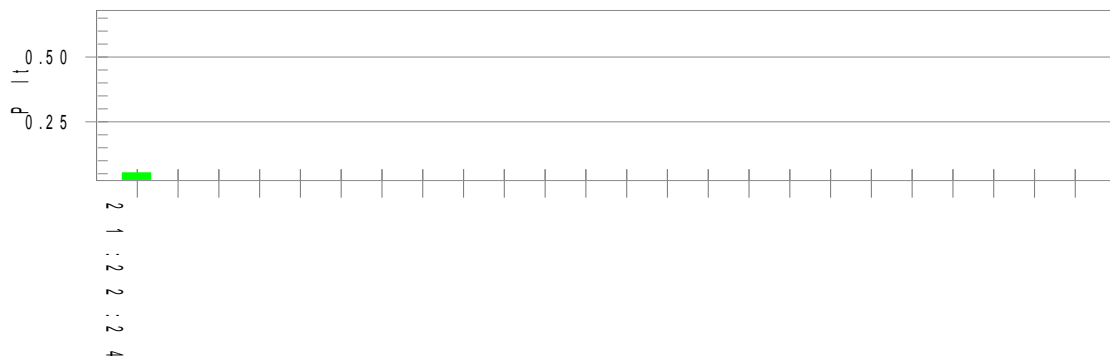
Status: Test Completed

Pst_i and limit line

European Limits



Plt and limit line



Parameter values recorded during the test:

Vrms at the end of test (Volt): 229.68

Highest dt (%): 0.00

T-max (mS): 0

Highest dc (%): 0.00

Highest dmax (%): 0.04

Highest Pst (10 min. period): 0.122

Highest Plt (2 hr. period): 0.053

Test limit (%): N/A N/A

Test limit (mS): 500.0 Pass

Test limit (%): 3.30 Pass

Test limit (%): 4.00 Pass

Test limit: 1.000 Pass

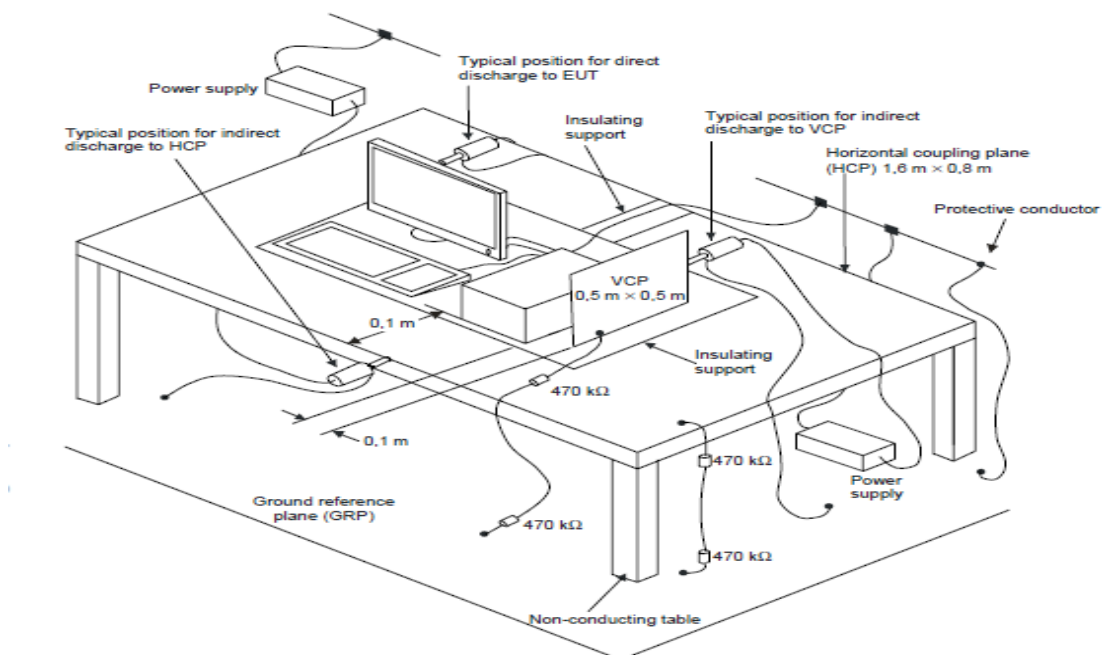
Test limit: 0.650 Pass

8. Electrostatic Discharge

8.1. Limit of Electrostatic Discharge

Environmental phenomenon	Test specification	Units	Performance criterion
Enclosure port			
Electrostatic discharge	±4 (Contact discharge)	kV (Charge voltage)	B (TT & TR)
	±8 (Air discharge)	kV (Charge voltage)	

8.2. Test Setup



8.3. Test Procedure

Direct Application of Discharges to the EUT:

Contact discharge was applied only to conductive surfaces of the EUT.

Air discharges were applied only to non-conductive surfaces of the EUT.

During the test, it was performed with single discharges. For the single discharge time between successive single discharges will be keep longer 1 second. It was at least twenty-five single discharges with positive and negative at the same selected point.

The selected point, which was performed with electrostatic discharge, was marked on the red label of the EUT.

Indirect Application of Discharges to the EUT:

Vertical Coupling Plane (VCP):

The coupling plane, of dimensions 0.5m x 0.5m, is placed parallel to, and positioned at a distance 0.1m from the EUT, with the Discharge Electrode touching the coupling plane.

The four faces of the EUT will be performed with electrostatic discharge. It was at least twenty-five single discharges with positive and negative at the same selected point.

Horizontal Coupling Plane (HCP):

The coupling plane is placed under to the EUT. The generator shall be positioned vertically at a distance of 0.1m from the EUT, with the Discharge Electrode touching the coupling plane.

The four faces of the EUT will be performed with electrostatic discharge. It was at least twenty-five single discharges with positive and negative at the same selected point.

8.4. Test Result

EUT	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Temperature	24°C
Test Engineer	Tom Liu	Relative Humidity	52%
Test Mode	Mode 1	Date of Test	2017/11/16

Indirect Application		Test Result	
Test Location	Test Level	Horizontal Coupling	Vertical Coupling
Front, Rear Left, Right	±4kV	Pass	Pass

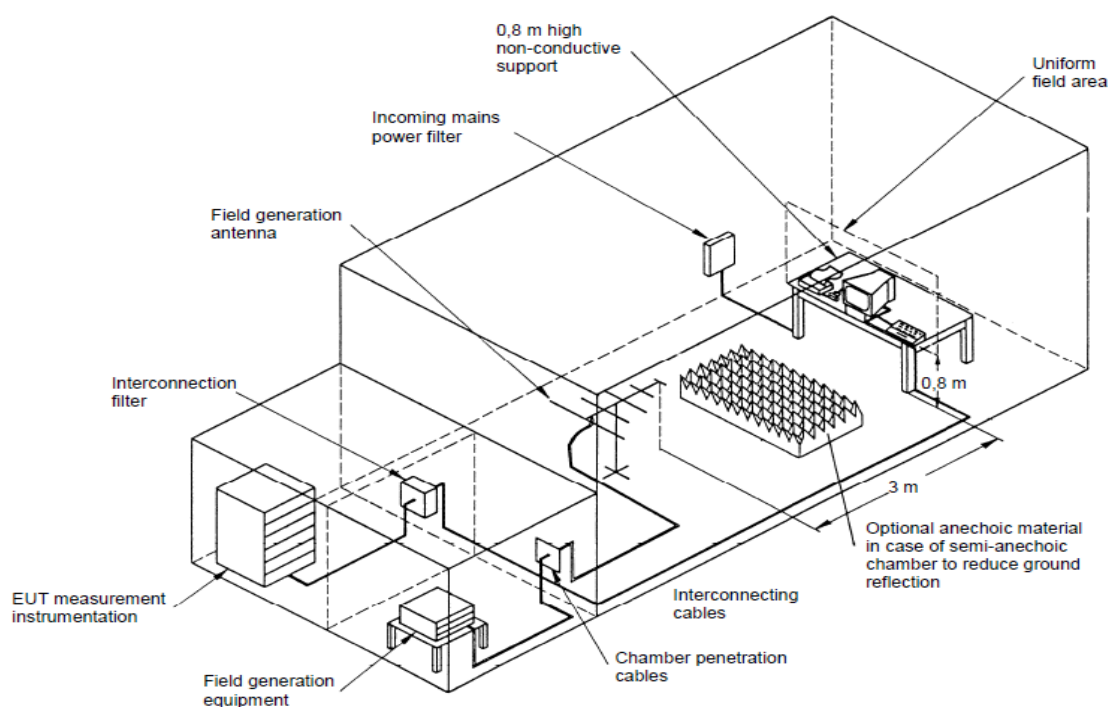
Note: The EUT performance complied with performance criteria for CT & CR to MS Function and there is no any degradation of performance and function, and performance criterion was A.

9. Radio-Frequency Electromagnetic Field

9.1. Limit of Radio-Frequency Electromagnetic Field

Environmental phenomenon	Test specification	Units	Performance criterion
Enclosure port			
Radio frequency electromagnetic field	80 - 6000	MHz	A (CT & CR)
	3	V/m (unmodulated, r.m.s)	
	80	% AM (1kHz)	
Note 1: If the wanted signal is modulated at 1000Hz, then an audio signal of 400Hz shall be used.			
Note 2: The test shall be performed over the frequency range 80MHz to 6000MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers of EN 301 489-1, as appropriate.			

9.2. Test Setup



9.3. Test Procedure

The EUT and load, which are placed on a table that is 0.8 meter above ground, are placed with one coincident with the calibration plane such that the distance from antenna to the EUT was 3 meters. Both horizontal and vertical polarization of the antenna and four sides of the EUT are set on measurement.

In order to judge the EUT performance, a CCD camera is used to monitor EUT screen.

All the scanning conditions are as follows:

	Condition of Test	Remarks
1.	Field Strength	3V/m
2.	Radiated Signal	AM 80% Modulated with 1kHz
3.	Scanning Frequency	80MHz - 6GHz
4.	Dwell Time	3 Seconds
5.	Frequency Step Size Δf	1%

9.4. Test Result

EUT	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Temperature	25°C
Test Engineer	Jone Zhang	Relative Humidity	54%
Test Mode	Mode 1	Date of Test	2017/11/18

Frequency (MHz)	Polarity	Test Position	Field Strength (V/m)	Test Result
80 - 6000	Horizontal/Vertical	Front	3	Pass
		Rear		Pass
		Left		Pass
		Right		Pass
		Top		Pass
		Bottom		Pass

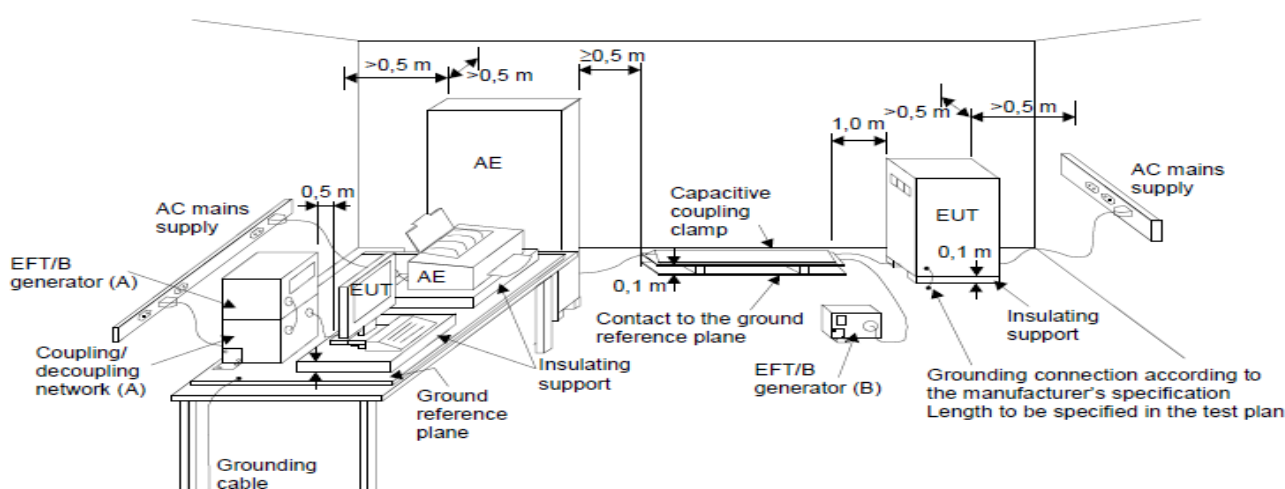
Note: The EUT performance complied with performance criteria for CT & CR to MS Function and there is no any degradation of performance and function, and performance criterion was A.

10. Electrical Fast Transients

10.1. Limit of Electrical Fast Transients

Environmental Phenomenon	Test Specification	Units	Performance Criterion
Input AC power ports			
Electrical fast transients	±1 5/50 5	kV (open circuit test voltage) Tr/Th (ns) Repetition frequency (kHz)	B (TT & TR)
Signal ports, telecommunication ports, and control ports (See Note)			
Fast transients common mode	±0.5 5/50 5	kV (peak) Tr/Th ns Repetition frequency (kHz)	B (TT & TR)
<p>Note 1: This test shall be additionally performed on signal ports, telecommunication ports, control ports, and DC power ports, of radio equipment and associated ancillary equipment, if the cables may be longer than 3m.</p> <p>Note 2: The test level for signal ports, wired network ports (excluding xDSL), and control ports shall be 0.5 kV open circuit voltage at a repetition rate of 5 kHz.</p> <p>Note 3: The test level for xDSL wired network ports shall be 0,5 kV open circuit voltage at a repetition rate of 100 kHz</p>			

10.2. Test Setup



10.3. Test Procedure

The EUT is placed on a table that is 0.8 meter height. A ground reference plane is placed on the table, and uses a 0.1m insulation between the EUT and ground reference plane.

The minimum area of the ground reference plane is 1m*1m, and 0.65mm thick min, and projected beyond the EUT by at least 0.1m on all sides.

For Input AC Power Ports:

The EUT is connected to the power mains through a coupling device that directly couples the EFT/B interference signal.

Each of the line conductors is impressed with burst noise for 1 minute.

The length of the power lines between the coupling device and the EUT is 0.5m.

For Signal Ports, Telecommunication Ports, and Control Ports:

The EFT interference signal is through a coupling clamp device couples to the signal of the EUT with burst noise for 1 minute.

The length of the signal lines between the coupling device and the EUT is 0.5m.

10.4. Test Result

Product	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Temperature	23°C
Test Engineer	Tom Liu	Relative Humidity	54%
Test Mode	Mode 1	Date of Test	2017/11/20

Inject Line	Polarity	Test Level (kV)	Test Duration (second)	Inject Method	Observation	Result
L	+	1	60	Direct	Note	Pass
L	-	1	60	Direct	Note	Pass
N	+	1	60	Direct	Note	Pass
N	-	1	60	Direct	Note	Pass
L + N	+	1	60	Direct	Note	Pass
L + N	-	1	60	Direct	Note	Pass
L + PE	+	1	60	Direct	Note	Pass
L + PE	-	1	60	Direct	Note	Pass
N+PE	+	1	60	Direct	Note	Pass
N+PE	-	1	60	Direct	Note	Pass
L+N+PE	+	1	60	Direct	Note	Pass
L+N+PE	-	1	60	Direct	Note	Pass

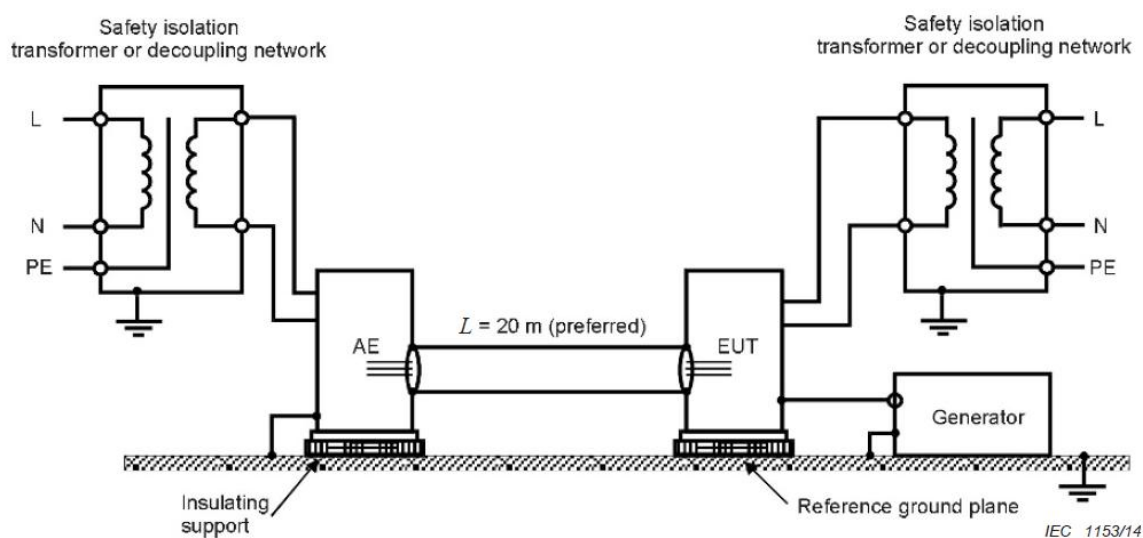
Note 1: The EUT performance complied with performance criteria for TT & TR to MS Function and there is no any degradation of performance and function, and performance criterion was A.

11. Surges

11.1. Limit of Surges

Environmental phenomenon	Test specification	Units	Performance criterion
Input AC power ports (See Note 1)			
Surges	1.2/50 (8/20) ±1 line to line ±2 line to earth	Tr/Th (us) kV (open circuit test voltage) kV (open circuit test voltage)	B (TT & TR)
Telecommunication ports directly connected to indoor cables (See Note 1 and 2)			
Surges	1.2/50 (8/20) 0.5 line to ground	Tr/Th us kV (peak)	B (TT & TR)
<p>Note 1: Where normal functioning cannot be achieved because of the impact of the CDN on the EUT, no test shall be required.</p> <p>Note 2: The test level for wired network ports, intended to be connected to indoor cables (longer than 30 m) shall be 0,5 kV (applied line to ground, or shield to ground)</p>			

11.2. Test Setup



11.3. Test Procedure

The EUT is placed on a table that is 0.8 meter above a metal ground plane measured 1m*1m minimum and 0.65mm thick minimum and projected beyond the EUT by at least 0.1m on all sides. The length of power cord between the coupling device and the EUT shall be 2m or less.

For Input AC Power Ports:

The EUT is connected to the power mains through a coupling device that directly couples the surge interference signal.

The surge noise shall be applied synchronized to the voltage phase at 0° , 90° , 180° , 270° and the peak value of the AC voltage wave. (Positive and negative)

Each of Line to Earth and Line to Line is impressed with a sequence of five surge voltages with interval of 1 minute.

For Telecommunication Ports:

The signal line of EUT is connected to coupling and decoupling network that directly couples the surge interference signal.

Only Line to ground is impressed with a sequence of five surge voltages with interval of 1 minute.

11.4. Test Result

Product	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Temperature	23°C
Test Engineer	Tom Liu	Relative Humidity	54%
Test Mode	Mode 1	Date of Test	2017/11/20

Inject Line	Polarity	Angle (degree)	Test Level (kV)	Test Interval (second)	Observation	Result
L+N	+	0	0.5 & 1	60	Note	Pass
L+N	-	0	0.5 & 1	60	Note	Pass
L+N	+	90	0.5 & 1	60	Note	Pass
L+N	-	90	0.5 & 1	60	Note	Pass
L+N	+	180	0.5 & 1	60	Note	Pass
L+N	-	180	0.5 & 1	60	Note	Pass
L+N	+	270	0.5 & 1	60	Note	Pass
L+N	-	270	0.5 & 1	60	Note	Pass
L+PE	+	0	0.5 & 1 & 2	60	Note 2	Pass
L+PE	-	0	0.5 & 1 & 2	60	Note 2	Pass
L+PE	+	90	0.5 & 1 & 2	60	Note 2	Pass
L+PE	-	90	0.5 & 1 & 2	60	Note 2	Pass
L+PE	+	180	0.5 & 1 & 2	60	Note 2	Pass
L+PE	-	180	0.5 & 1 & 2	60	Note 2	Pass
L+PE	+	270	0.5 & 1 & 2	60	Note 2	Pass
L+PE	-	270	0.5 & 1 & 2	60	Note 2	Pass
N+PE	+	0	0.5 & 1 & 2	60	Note 2	Pass
N+PE	-	0	0.5 & 1 & 2	60	Note 2	Pass
N+PE	+	90	0.5 & 1 & 2	60	Note 2	Pass
N+PE	-	90	0.5 & 1 & 2	60	Note 2	Pass
N+PE	+	180	0.5 & 1 & 2	60	Note 2	Pass
N+PE	-	180	0.5 & 1 & 2	60	Note 2	Pass
N+PE	+	270	0.5 & 1 & 2	60	Note 2	Pass
N+PE	-	270	0.5 & 1 & 2	60	Note 2	Pass

Note: The EUT performance complied with performance criteria for TT & TR to MS Function and there is no any degradation of performance and function, and performance criterion was A.

12. Radio-Frequency Common Mode

12.1. Limit of Radio-Frequency Common Mode

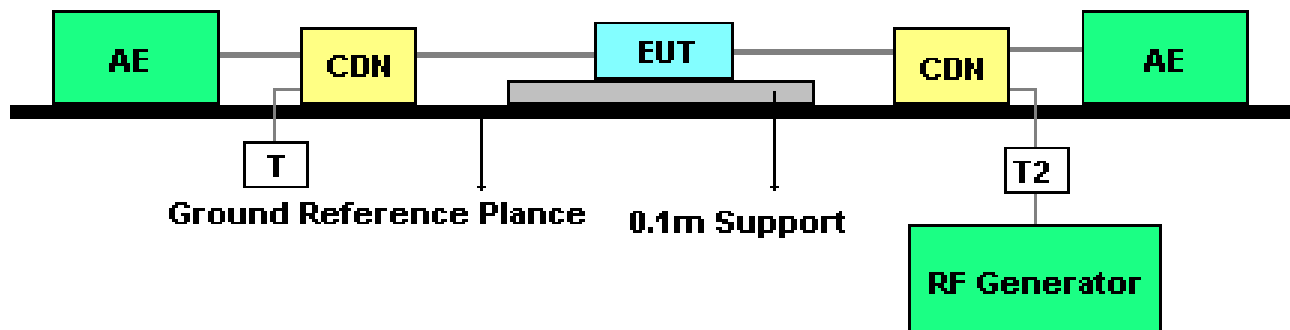
Environmental phenomenon	Test specification	Units	Performance criterion
Input AC power ports (See Note 1 and 2)			
Radio-frequency common mode	0.15 - 80	MHz	A (CT & CR)
	3	V (unmodulated, r.m.s)	
	80	% AM (1kHz)	
Signal ports, telecommunication ports, and control ports (See Note 1, 2 and 3)			
Radio frequency common mode	0.15 - 80	MHz	A (CT & CR)
	3	V (unmodulated, r.m.s)	
	80	% AM (1kHz)	
<p>Note 1: If the wanted signal is modulated at 1000Hz, then an audio signal of 400Hz shall be used.</p> <p>Note 2: The test shall be performed over the frequency range 150kHz to 80MHz with the exception of the exclusion band for transmitters, and for receivers and duplex transceivers [see clause 4 of EN 301 489-1.</p> <p>Note 3: This test shall be additionally performed on signal ports, telecommunication ports, control ports, and DC power ports, of radio equipment and associated ancillary equipment, if the cables may be longer than 3m.</p>			

12.2. Test Setup

CDN Test Setup

T : 50 ohm

T2: Power attenuator(6dB)



12.3. Test Procedure

The EUT is placed on a table that is 0.8 meter height, and a ground reference plane on the table, EUT is placed upon table and use 0.1m insulation between the EUT and ground reference plane.

For Input AC Power Ports:

The EUT is connected to the power mains through a coupling and decoupling networks for power supply lines. And directly couples the disturbances signal into EUT.

For Signal Ports, Telecommunication Ports, and Control Ports:

The disturbance signal is through a coupling and decoupling networks (CDN) or EM-clamp device couples to the signal and telecommunication lines of the EUT.

	Condition of Test	Remarks
1.	Field Strength	3V
2.	Radiated Signal	AM 80% Modulated with 1kHz
3.	Scanning Frequency	0.15MHz - 80MHz
4.	Dwell Time	3 Seconds
5.	Frequency Step Size Δf	1%

12.4. Test Result

Product	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Temperature	23°C
Test Engineer	Tom Liu	Relative Humidity	54%
Test Mode	Mode 1	Date of Test	2017/11/20

Frequency (MHz)	Inject Voltage (V)	Inject Ports	Inject Method	Observation	Result
0.15 - 80	3	AC Mains	CDN	Note	Pass

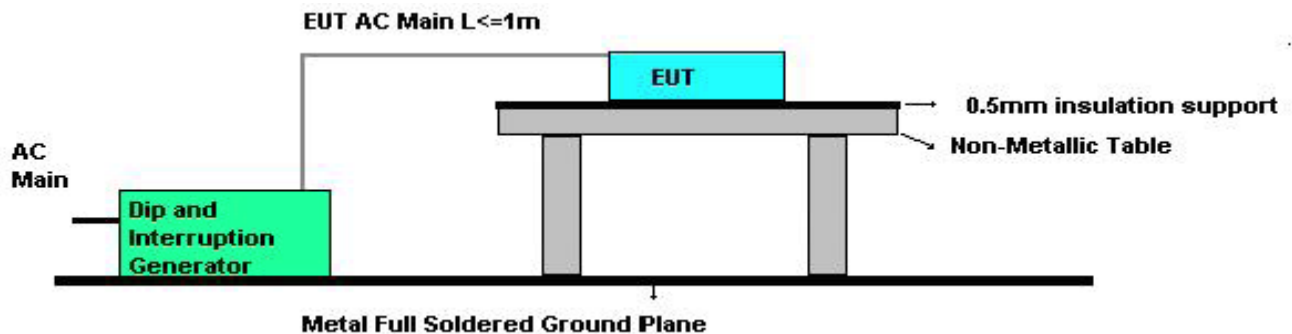
Note: The EUT performance complied with performance criteria for CT & CR to MS Function and there is no any degradation of performance and function, and performance criterion was A.

13. Voltage Dips and Interruptions

13.1. Limit of Voltage Dips and Interruptions

Environmental phenomenon	Test specification	Units	Performance criterion
Input AC power ports			
Voltage dips	0	% residual	B (TT & TR)
	0.5	cycle	
	0	% residual	B (TT & TR)
	1	cycle	
	70	% residual	C (TT & TR)
	25	cycle	
Voltage interruptions	0	% residual	C (TT & TR)
	250	cycle	

13.2. Test Setup



13.3. Test Procedure

The EUT is placed on a table which is 0.8 meter above a metal ground plane measured 1m*1m minimum, and 0.65mm thick minimum, and projected beyond the EUT by at least 0.1m on all sides. The power cord shall be used the shortest power cord as specified by the manufacturer.

For Voltage dips and interruptions test:

The selection of test voltage is based on the rated power range. If the operation range is large than 20% of lower power range, both end of specified voltage shall be tested. Otherwise, the typical voltage specification is selected as test voltage.

The EUT is connected to the power mains through a coupling device that directly couples to the voltage dips and interruption generator.

13.4. Test Result

Product	4x4 Wave-2 802.11ac/a/n Mini PCIe WiFi Module	Temperature	23°C
Test Engineer	Tom Liu	Relative Humidity	54%
Test Mode	Mode 1	Date of Test	2017/11/20
Test Voltage	AC 230V/50Hz		

Voltage % Residual	Test Duration (ms)	Observation	Result
0	10	Note 1	Pass
0	20	Note 1	Pass
70	500	Note 1	Pass
0	5000	Note 1, 2	Pass

Note 1: The EUT performance complied with performance criteria for TT & TR to MS Function and there is no any degradation of performance and function, and performance criterion was A.

Note 2: The system shut down during the test, but the EUT can restart, restore the traffic by the operator. The EUT performance complied with performance criteria for TT & TR to MS Function and the performance criterion was C.

14. Uncertainty Measurement

Conducted Emission - SR2
<p>The maximum measurement uncertainty is evaluated as:</p> <p>9kHz~150kHz: $\pm 3.84\text{dB}$</p> <p>150kHz~30MHz: $\pm 3.46\text{dB}$</p>
Radiated Disturbance - AC1
<p>The maximum measurement uncertainty is evaluated as:</p> <p>Horizontal: 30MHz~300MHz: $\pm 4.07\text{dB}$</p> <p>300MHz~1GHz: $\pm 3.63\text{ dB}$</p> <p>Vertical: 30MHz~300MHz: $\pm 4.18\text{ dB}$</p> <p>300MHz~1GHz: $\pm 3.60\text{ dB}$</p>
Radiated Disturbance - AC1
<p>The maximum measurement uncertainty is evaluated as:</p> <p>Horizontal: 1GHz~6GHz: $\pm 4.16\text{ dB}$</p> <p>Vertical: 1GHz~6GHz: $\pm 4.76\text{ dB}$</p>
Harmonic Current Emissions - SR2
<p>The maximum measurement uncertainty is evaluated as $\pm 0.2\%$.</p>
Voltage Fluctuation and Flicker - SR2
<p>The maximum measurement uncertainty is evaluated as d_c and d_{\max}: $\pm 0.095\%$, P_{st} and P_{lt}: $\pm 4\%$, $d_{(t)}$: $\pm 1.5\%$.</p>

15. List of Measuring Instrument

Conducted Emission - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2018/06/20
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2018/06/20
Two-Line V-Network	R&S	ENV216	MRTSUE06003	1 year	2018/06/20
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06181	1 year	2017/12/20
Shielding Anechoic Chamber	Mikebang	Chamber-SR2	MRTSUE06214	1 year	2018/05/10

Radiated Disturbance - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
MXE EMI Receiver	R&S	ESR7	MRTSUE06001	1 year	2018/08/18
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2018/11/17
Bilog Period Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2018/11/18
Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2018/10/21
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06183	1 year	2017/12/22
Anechoic Chamber	TDK	Chamber-AC1	MRTSUE06212	1 year	2018/05/10

Harmonic Current Emissions - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Power Analyzer	California	PACS-1	MRTSUE06010	1 year	2018/01/21
AC Power Source	California	3001iX	MRTSUE06011	1 year	2018/01/21
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06214	1 year	2017/12/20
Shielding Anechoic Chamber	Mikebang	Chamber-SR2	MRTSUE06214	1 year	2018/05/10

Voltage Fluctuation and Flicker - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Power Analyzer	California	PACS-1	MRTSUE06010	1 year	2018/01/21
AC Power Source	California	3001iX	MRTSUE06011	1 year	2018/01/21
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06214	1 year	2017/12/20
Shielding Anechoic Chamber	Mikebang	Chamber-SR2	MRTSUE06214	1 year	2018/05/10

Electrostatic Discharge - TR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Electrostatic Discharge Simulator	EM TEST	Dito	MRTSUE06225	1 year	2018/06/20
Barometer	BaoPing	DYM3	MRTSUE06044	1 year	2018/11/08
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06179	1 year	2017/12/20

Radio-Frequency Electromagnetic Field - AC2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
MXG Analog Signal Generator	Keysight	E4438C	MRTSUE06370	1 year	2018/06/06
EPM Series Power Meter	Agilent	E4418B	MRTSUE06204	1 year	2018/06/26
Power Sensor	Agilent	E9301H	MRTSUE06205	1 year	2018/06/26
Power Amplifier	rflight	NTWPAS-1025 100	MRTSUE06264	1 year	2018/04/12
Power Amplifier	rflight	NTWPAS-2560 100	MRTSUE06263	1 year	2018/04/12
High-Gain Horn Antenna	AR	ATH800M5GA	MRTSUE06144	N/A	N/A
Log-Periodic Antenna	AR	ATR80M6G	MRTSUE06145	N/A	N/A
Digital Thermometer & Hygrometer	Minggao	ETH529	MRTSUE06170	1 year	2017/11/29
Anechoic Chamber	RIKEN	Chamber-AC2	MRTSUE06213	1 year	2018/05/10

Electrical Fast Transients - TR1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Ultra Compact Simulator	EM TEST GmbH	UCS500N7	MRTSUE06228	1 year	2018/01/09
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06178	1 year	2017/12/20

Surges - TR1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Ultra Compact Simulator	EM TEST GmbH	UCS500N7	MRTSUE06228	1 year	2018/01/09
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06178	1 year	2017/12/20

Radio-Frequency Common Mode - TR1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Compact Immunity Test System	TESEQ	TESEQ NSG4070-35	MRTSUE06237	1 year	2018/11/01
CDN	TESEQ	TESEQ M016S	MRTSUE06238	1 year	2018/01/09
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06178	1 year	2017/12/20

Voltage Dips and Interruptions - TR1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Ultra Compact Simulator	EM TEST GmbH	UCS500N7	MRTSUE06228	1 year	2018/01/09
Motorized Variac	EM TEST GmbH	variac NX1-260-16	MRTSUE06229	1 year	2018/01/09
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06178	1 year	2017/12/20

Software	Version	Function
e3	v 8.3.5	EMI Test Software
Compliance Test System	v 4.6.2	Harmonic & Flicker
JS32-RS	v 1.0.0.1	RS Test Software
NSG 4070 CTRL	v 1.3.0.1	CS Test Software
IEC CTRL	v 6.0.1	EMS Test Software

The End