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MEASUREMENT REPORT

EN 300 328 V1.8.1 WLAN 802.11b/g/n

Applicant: Compex Systems Pte Ltd
Address: 135 Joo Seng Road, #08-01 Singapore 368363

Product: 802.11ac Dual Band Module
Model No.: WLE600VX
Brand Name: COMPEX
Standards: ETSI EN 300 328 V1.8.1 (2012-06)
Result: Complies
Test Date: Mar. 16 ~ Jun. 15, 2015

Reviewed By : Robin Wu
(Robin Wu)

Approved By : Marlinchen
(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
1503RSU02905	Rev. 01	Initial report	06-15-2015

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1. General Information

1.1. Applicant

Compex Systems Pte Ltd
135 Joo Seng Road, #08-01 Singapore 368363

1.2. Manufacturer

Compex Systems Pte Ltd
135 Joo Seng Road, #08-01 Singapore 368363

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. 809388) 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 Product

Product Name	802.11ac Dual Band Module
Model No.	WLE600VX
Brand Name	COMPEX
Wi-Fi Specification	802.11a/b/g/n/ac

1.5. Product Specification Subjective to this Report

Frequency Range	802.11b/g/n-HT20: 2412 ~ 2472MHz 802.11n-HT40: 2422 ~ 2462MHz
Channel Number	802.11b/g/n-HT20: 13 802.11n-HT40: 9
Type of Modulation	802.11b: DSSS 802.11g/n: OFDM
Data Rate	802.11b: 1/2/5.5/11Mbps 802.11g: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 300Mbps

Note: For other features of this EUT, test report will be issued separately.

1.6. Operation Frequency / Channel List

802.11b/g/n-HT20


Channel	Frequency	Channel	Frequency	Channel	Frequency
01	2412 MHz	02	2417 MHz	03	2422 MHz
04	2427 MHz	05	2432 MHz	06	2437 MHz
07	2442 MHz	08	2447 MHz	09	2452 MHz
10	2457 MHz	11	2462 MHz	12	2467 MHz
13	2472 MHz	N/A	N/A	N/A	N/A

802.11n-HT40

Channel	Frequency	Channel	Frequency	Channel	Frequency
03	2422 MHz	04	2427 MHz	05	2432 MHz
06	2437 MHz	07	2442 MHz	08	2447 MHz
09	2452 MHz	10	2457 MHz	11	2462 MHz

1.7. Description of Antenna RF Port

--	2.4/5GHz Antenna RF Port	
	2.4/5GHz	2.4/5GHz
Software Control Port	Ant 0	Ant 1

Antenna RF Port Plot


1.8. Description of Available Antennas

Antenna No.	Manufacturer	Tx Paths	Max Directional Gain (dBi)
Antenna 1#	Kunshan Wavelink Electronic Co., Ltd.	2	2.4GHz: 2.0, 5GHz: 2.0
Antenna 2#	TAOGLAS Inc	2	2.4GHz: 4.5, 5GHz: 6.7
Antenna 3#	Compex Systems Pte Ltd	2	2.4GHz: 5.0, 5GHz: 5.0
Antenna 4#	Compex Systems Pte Ltd	2	2.4GHz: 5.0, 5GHz: 5.0
Antenna 5#	Smart Ant Inc	2	5GHz: 7.0
Antenna 6#	Kenbotong Communication LTD	2	5GHz: 10.0

Note 1: We selected the panel antenna 3# for all radiated emission testing.

1.9. Application Form for Testing

Modulation Type	
<input type="checkbox"/>	FHSS
<input checked="" type="checkbox"/>	other forms of modulation
Adaptivity Equipment	
<input type="checkbox"/>	Non-Adaptive Equipment:
	The maximum RF Output Power (e.i.r.p.): ... dBm
	The maximum (corresponding) Duty Cycle: ... %
<input checked="" type="checkbox"/>	Adaptive Equipment without the possibility to switch to a non-adaptive mode:
<input checked="" type="checkbox"/>	The equipment has implemented an LBT based DAA mechanism:
	<input type="checkbox"/> The equipment is Frame Based equipment
	<input checked="" type="checkbox"/> The equipment is Load Based equipment
	The CCA time implemented by the equipment: 25 μ s
	The value q as referred to in clause 4.3.2.5.2.2.2 24
	<input type="checkbox"/> The equipment can switch dynamically between Frame Based and Load Based equipment
<input type="checkbox"/>	The equipment has implemented an non-LBT based DAA mechanism
<input type="checkbox"/>	The equipment can operate in more than one adaptive mode
<input type="checkbox"/>	Adaptive Equipment which can also operate in a non-adaptive mode
The Worst Case Operational Mode for Each of The Following Tests	
<input checked="" type="checkbox"/>	RF Output Power: 19.93dBm
<input checked="" type="checkbox"/>	Power Spectral Density: 9.85dBm/MHz
<input type="checkbox"/>	Duty cycle, Tx-Sequence, Tx-gap
<input type="checkbox"/>	Dwell time, Minimum Frequency Occupation & Hopping Sequence
<input type="checkbox"/>	Medium Utilisation
<input checked="" type="checkbox"/>	Adaptivity & Receiver Blocking:
<input checked="" type="checkbox"/>	Occupied Channel Bandwidth: 36.81MHz
<input checked="" type="checkbox"/>	Transmitter unwanted emissions in the OOB domain: -14.90dBm/MHz
<input checked="" type="checkbox"/>	Transmitter unwanted emissions in the spurious domain: -59.1dBm
<input checked="" type="checkbox"/>	Receiver spurious emissions: -50.0dBm
Antenna Category	
<input checked="" type="checkbox"/>	Integral antenna (antenna permanently attached)
<input checked="" type="checkbox"/>	Temporary RF connector provided
<input type="checkbox"/>	No temporary RF connector provided

Device Type			
<input checked="" type="checkbox"/>	Stand-alone		
<input type="checkbox"/>	Combined (EUT where the radio part is fully integrated within another device) Combined Equipment - Brand Name / Model No.:		
<input type="checkbox"/>	Plug-in radio (EUT intended for a variety of host systems) Host System - Brand Name / Model No.:		
Operating Conditions			
<input checked="" type="checkbox"/>	AC Mains AC Voltage Range: 120 ~ 240 V	<input type="checkbox"/>	DC DC Voltage Range: 12 ~ 24 V
Type of DC Source <input type="checkbox"/> Internal DC supply			
<input type="checkbox"/> External DC adapter			
<input type="checkbox"/> Battery			
<input checked="" type="checkbox"/>	Temperature Range: -20 ~ 70 °C		

1.10. Standards Applicable for Testing

The EUT complies with the requirements of ETSI EN 300328 V1.8.1.

2. Test Configuration of Equipment under Test

2.1. Description of Test Mode

Test Mode	Mode 1: Transmit by 802.11b
	Mode 2: Transmit by 802.11g
	Mode 3: Transmit by 802.11n-HT20
	Mode 4: Transmit by 802.11n-HT40

2.2. Description of Test Software

The test utility software used during testing was “ART”.

Final Power Parameter Value of the test software as below.

Test Mode	Test Frequency	Power Parameter Value		
		Ant 0	Ant 1	Ant 0 + 1
802.11b	2412	10.0	10.0	Not Support
	2442	10.5	10.5	
	2472	11.0	10.5	
802.11g	2412	12.0	12.0	Not Support
	2442	12.5	12.5	
	2472	13.0	12.0	
802.11n-HT20	2412	12.0	12.5	9.0
	2442	12.5	12.5	9.5
	2472	13.0	12.5	9.5
802.11n-HT40	2422	12.0	12.5	9.5
	2442	12.5	12.5	10.0
	2462	13.0	12.5	10.5

3. Test Summary

Clause (EN 300328)	Test Parameter	Result (Pass/Fail)	Remark
Transmitter Parameter			
4.3.2.1	RF Output Power	Pass	--
4.3.2.2	Power Spectral Density	Pass	--
4.3.2.6	Occupied Channel Bandwidth	Pass	--
4.3.2.7	Transmitter Unwanted Emissions in the Out-of-band Domain	Pass	--
4.3.2.8	Transmitter Spurious Emissions	Pass	--
Receiver Parameters			
4.3.2.9	Receiver Spurious Emissions	Pass	--
Adaptive Test Item			
4.3.2.5	Adaptivity	Pass	Only applicable for adaptive equipment RF output power > 10dBm
4.3.2.10	Receiver Blocking	Pass	
Non-Adaptive Test Item			
4.3.2.3	Duty cycle, Tx-Sequence, Tx-gap	N/A	Only applicable for non-adaptive equipment RF output power > 10dBm
4.3.2.4	Medium Utilisation (MU) Factor	N/A	

Note1: The EUT can operate in a adaptive mode with EIRP greater than 10dBm, and can't operate in a non-adaptive mode which was declared by the supplier.

Note2: For radiated spurious emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.

4. RF Output Power

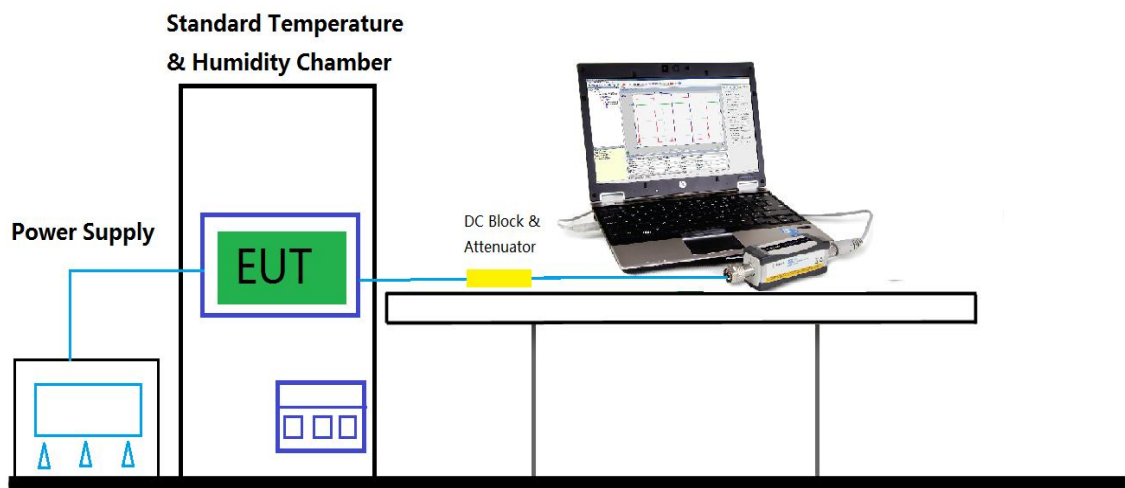
4.1. Limit

The maximum RF output power for adaptive equipment using wide band modulations other than FHSS shall be equal to or less than 20dBm.

Test Conditions	Limit
Normal and Extreme Temperature Conditions	20dBm (E.I.R.P)

4.2. Test Setup

For Conducted Measurement



4.3. Test Procedure

Refer to ETSI EN 300 328 V1.8.1 (2012-06) Clause 5.3.2.2.1.1.

4.4. Test result

Product	802.11ac Dual Band Module	Temperature	-20 ~ 70°C
Test Engineer	Milo Li	Relative Humidity	56%
Test Time	05-12-2015	Test Site	TR3

Normal Conditions (Temperature 25°C)

1T_x

Mode	Ch. No.	Freq. (MHz)	RF Output Power (dBm)		EIRP Power (dBm)	Limit (dBm)	Result
			Ant 0	Ant 1			
11b	1	2412	12.15	12.27	17.27	20	Pass
11b	7	2442	12.27	12.32	17.32	20	Pass
11b	13	2472	12.14	12.43	17.43	20	Pass
11g	1	2412	13.62	13.86	18.86	20	Pass
11g	7	2442	13.96	13.91	18.96	20	Pass
11g	13	2472	13.93	13.82	18.93	20	Pass
11n-HT20	1	2412	13.68	14.07	19.07	20	Pass
11n-HT20	7	2442	13.85	13.89	18.89	20	Pass
11n-HT20	13	2472	13.64	14.03	19.03	20	Pass
11n-HT40	3	2422	13.73	14.08	19.08	20	Pass
11n-HT40	7	2442	13.81	13.98	18.98	20	Pass
11n-HT40	11	2462	13.66	14.14	19.14	20	Pass

Note: EIRP Power (dBm) = RF Output Power (dBm) + Antenna Gain (dBi).

2T_x

Mode	Ch. No.	Freq. (MHz)	RF Output Power (dBm)		Total EIRP Power (dBm)	Limit (dBm)	Result
			Ant 0	Ant 1			
11n-HT20	1	2412	10.93	10.94	18.95	20	Pass
11n-HT20	7	2442	11.01	11.13	19.08	20	Pass
11n-HT20	13	2472	11.15	11.22	19.20	20	Pass
11n-HT40	3	2422	10.59	10.56	18.59	20	Pass
11n-HT40	7	2442	10.51	10.83	18.68	20	Pass
11n-HT40	11	2462	11.08	11.07	19.09	20	Pass

Note: Total EIRP Power (dBm) = $10 \cdot \log\{10^{(\text{Ant 0 RF Output Power}/10)} + 10^{(\text{Ant 1 RF Output Power}/10)}\}$ (dBm) + Antenna Gain (dBi).

Extreme Conditions (Temperature -20°C)

1T_x

Mode	Ch. No.	Freq. (MHz)	RF Output Power (dBm)		EIRP Power (dBm)	Limit (dBm)	Result
			Ant 0	Ant 1			
11b	1	2412	12.16	12.29	17.29	20	Pass
11b	7	2442	12.27	12.32	17.32	20	Pass
11b	13	2472	12.16	12.44	17.44	20	Pass
11g	1	2412	13.69	13.89	18.89	20	Pass
11g	7	2442	13.98	13.93	18.98	20	Pass
11g	13	2472	13.92	13.82	18.92	20	Pass
11n-HT20	1	2412	13.67	14.07	19.07	20	Pass
11n-HT20	7	2442	13.83	13.92	18.92	20	Pass
11n-HT20	13	2472	13.66	14.05	19.05	20	Pass
11n-HT40	3	2422	13.73	14.06	19.06	20	Pass
11n-HT40	7	2442	13.81	13.99	18.99	20	Pass
11n-HT40	11	2462	13.68	14.16	19.16	20	Pass

Note: EIRP Power (dBm) = RF Output Power (dBm) + Antenna Gain (dBi).

2T_x

Mode	Ch. No.	Freq. (MHz)	RF Output Power (dBm)		Total EIRP Power (dBm)	Limit (dBm)	Result
			Ant 0	Ant 1			
11n-HT20	1	2412	10.93	10.94	18.95	20	Pass
11n-HT20	7	2442	11.01	11.15	19.09	20	Pass
11n-HT20	13	2472	11.16	11.23	19.21	20	Pass
11n-HT40	3	2422	10.59	10.57	18.59	20	Pass
11n-HT40	7	2442	10.47	10.83	18.66	20	Pass
11n-HT40	11	2462	11.05	11.11	19.09	20	Pass

Note: Total EIRP Power (dBm) = $10 \cdot \log\{10^{(\text{Ant 0 RF Output Power}/10)} + 10^{(\text{Ant 1 RF Output Power}/10)}\}$ (dBm) + Antenna Gain (dBi).

Extreme Conditions (Temperature 70°C)

1T_x

Mode	Ch. No.	Freq. (MHz)	RF Output Power (dBm)		EIRP Power (dBm)	Limit (dBm)	Result
			Ant 0	Ant 1			
11b	1	2412	13.25	13.35	18.35	20	Pass
11b	7	2442	13.41	13.42	18.42	20	Pass
11b	13	2472	13.27	13.55	18.55	20	Pass
11g	1	2412	14.86	14.89	19.89	20	Pass
11g	7	2442	14.85	14.76	19.85	20	Pass
11g	13	2472	14.91	14.77	19.91	20	Pass
11n-HT20	1	2412	14.68	14.92	19.92	20	Pass
11n-HT20	7	2442	14.89	14.87	19.89	20	Pass
11n-HT20	13	2472	14.79	14.77	19.79	20	Pass
11n-HT40	3	2422	14.68	14.82	19.82	20	Pass
11n-HT40	7	2442	14.93	14.87	19.93	20	Pass
11n-HT40	11	2462	14.78	14.80	19.80	20	Pass

Note: EIRP Power (dBm) = RF Output Power (dBm) + Antenna Gain (dBi).

2T_x

Mode	Ch. No.	Freq. (MHz)	RF Output Power (dBm)		Total EIRP Power (dBm)	Limit (dBm)	Result
			Ant 0	Ant 1			
11n-HT20	1	2412	11.90	11.77	19.85	20	Pass
11n-HT20	7	2442	11.93	11.88	19.92	20	Pass
11n-HT20	13	2472	11.77	11.84	19.82	20	Pass
11n-HT40	3	2422	11.68	11.84	19.77	20	Pass
11n-HT40	7	2442	11.54	11.97	19.77	20	Pass
11n-HT40	11	2462	11.78	11.97	19.89	20	Pass

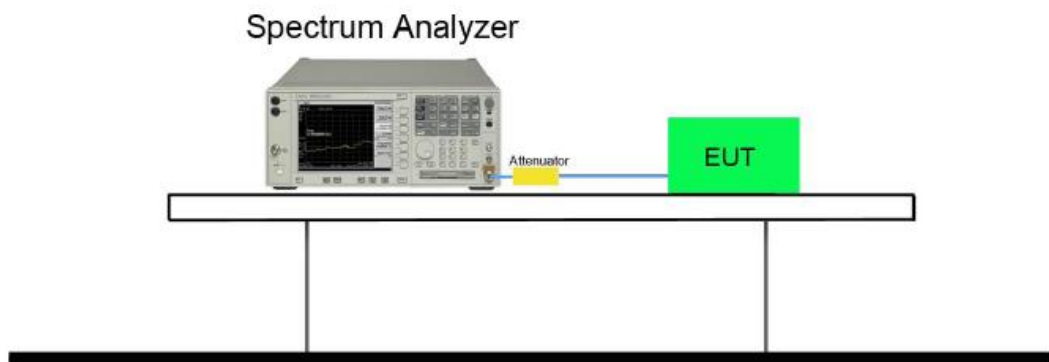
Note: Total EIRP Power (dBm) = $10 \cdot \log\{10^{(\text{Ant 0 RF Output Power}/10)} + 10^{(\text{Ant 1 RF Output Power}/10)}\}$ (dBm) + Antenna Gain (dBi).

5. Power Spectral Density

5.1. Limit

The maximum Power Spectral Density is limited to 10dBm per MHz for equipment using wide band modulations other than FHSS.

5.2. Test Setup



5.3. Test Procedure

Refer to ETSI EN 300 328 V1.8.1 (2012-06) Clause 5.3.3.2.1.

5.4. Test Result

Product	802.11ac Dual Band Module	Temperature	25°C
Test Engineer	Milo Li	Relative Humidity	56%
Test Time	05-15-2015	Test Site	TR3

1Tx

Mode	Channel	Frequency (MHz)	PSD (dBm/MHz) Ant 0	PSD (dBm/MHz) Ant 1	Limit (dBm/MHz)	Result
11b	1	2412	9.66	9.85	10	Pass
11b	7	2442	9.71	9.72	10	Pass
11b	13	2472	9.80	9.61	10	Pass
11g	1	2412	8.00	8.10	10	Pass
11g	7	2442	8.07	8.15	10	Pass
11g	13	2472	7.88	7.77	10	Pass
11n-HT20	1	2412	7.73	7.95	10	Pass
11n-HT20	7	2442	7.62	7.74	10	Pass
11n-HT20	13	2472	7.33	7.75	10	Pass
11n-HT40	3	2422	7.75	4.46	10	Pass
11n-HT40	7	2442	7.74	4.31	10	Pass
11n-HT40	11	2462	7.39	4.56	10	Pass

2Tx

Mode	Channel	Frequency (MHz)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
11n-HT20	1	2412	7.32	10	Pass
11n-HT20	7	2442	6.75	10	Pass
11n-HT20	13	2472	7.31	10	Pass
11n-HT40	3	2422	4.69	10	Pass
11n-HT40	7	2442	4.33	10	Pass
11n-HT40	11	2462	4.72	10	Pass

6. Duty Cycle, Tx-sequence, Tx-gap

6.1. Limit

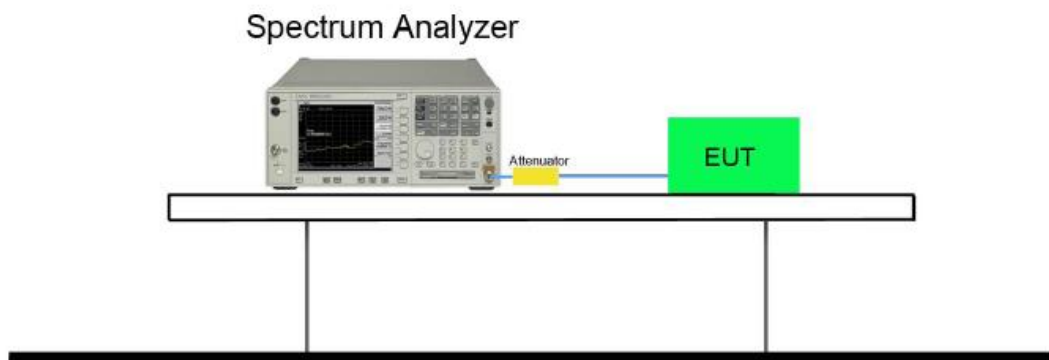
The Duty Cycle shall be equal to or less than the maximum value declared by the supplier.

The maximum Tx-sequence Time and the minimum Tx-gap Time shall be according to the formula below:

Maximum Tx-Sequence Time = Minimum Tx-gap Time = M

where M is in the range of 3,5 ms to 10 ms.

6.2. Test Setup



6.3. Test Procedure

Refer to ETSI EN 300 328 V1.8.1 (2012-06) Clause 5.3.2.2.1.2.

6.4. Test Result

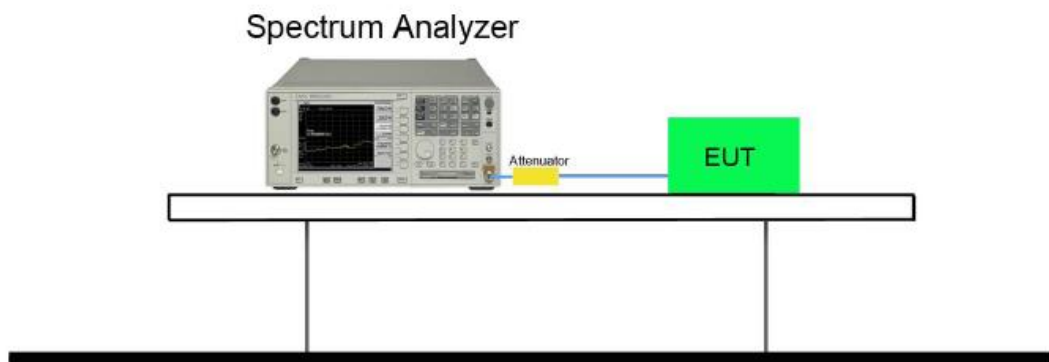
These requirements apply to non-adaptive equipment or to adaptive equipment when operating in a non-adaptive mode. So the item is not applicable.

7. Medium Utilisation (MU) Factor

7.1. Limit

The maximum Medium Utilisation factor shall be 10 % for equipment using wide band modulations other than FHSS.

7.2. Test Setup



7.3. Test Procedure

Refer to ETSI EN 300 328 V1.8.1 (2012-06) Clause 5.3.2.2.1.3.

7.4. Test Result

This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode.
So the item is not applicable.

8. Adaptivity and Receiver Blocking

8.1. Limit

LBT based Detect and Avoid (Load Based Equipment may implement an LBT based spectrum sharing mechanism as described in IEEE Std. 802.11-2007 clauses 9, 15, 18 or 19, in IEEE Std. 802.11n-2009, clauses 9, 11 and 20 or in IEEE Std. 802.15.4-2011, clauses 4 and 5.)

Adaptivity Limit

The CCA observation time shall be not less than 20 us, and the CCA time used by the equipment shall be declared by the supplier.

The Channel Occupancy Time shall be less than $(13 / 32) * q$ ms, $q = [4 \sim 32]$.

The minimum idle period varied between CCA and $q * CCA$.

When adding the interference signal, the EUT shall stop transmissions on the current operating channel.

Short Control Signalling Transmissions Limit

Short Control Signalling Transmissions shall have a maximum duty cycle of 10% within an observation period of 50ms.

Receiver Blocking Limit

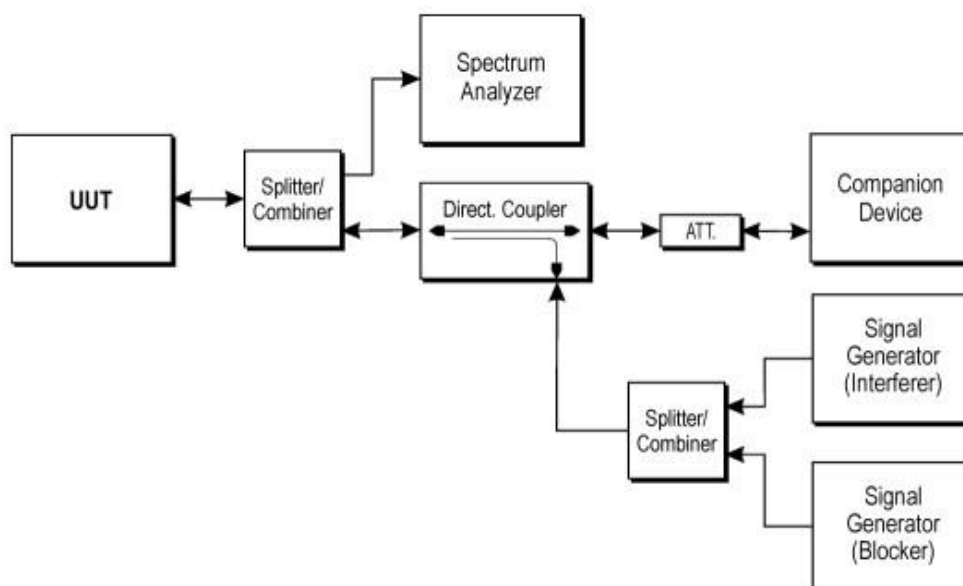
Adaptive Frequency Hopping equipment shall comply with the requirements in the presence of a blocking signal with characteristics as below.

Receiver Blocking parameters				
Equipment Type (LBT / non-LBT)	Wanted signal mean power from companion device	Blocking signal frequency [MHz]	Blocking signal power [dBm]	Type of interfering signal
LBT	Sufficient to maintain the link (see note 2)	2395 or 2488.5 (see note 1)	-30	CW
Non-LBT	-30dBm			
NOTE 1: The highest blocking frequency shall be used for testing the lowest operating channel, while the lowest blocking frequency shall be used for testing the highest operating channel.				
NOTE 2: A typical value which can be used in most cases is -50 dBm/MHz.				

With the interfering signal present, adding the blocking signal, the EUT didn't resume any normal transmissions. When removal the interference and blocking signal, the EUT was allowed to start transmissions again on this channel.

8.2. Test Setup

For Conducted measurement



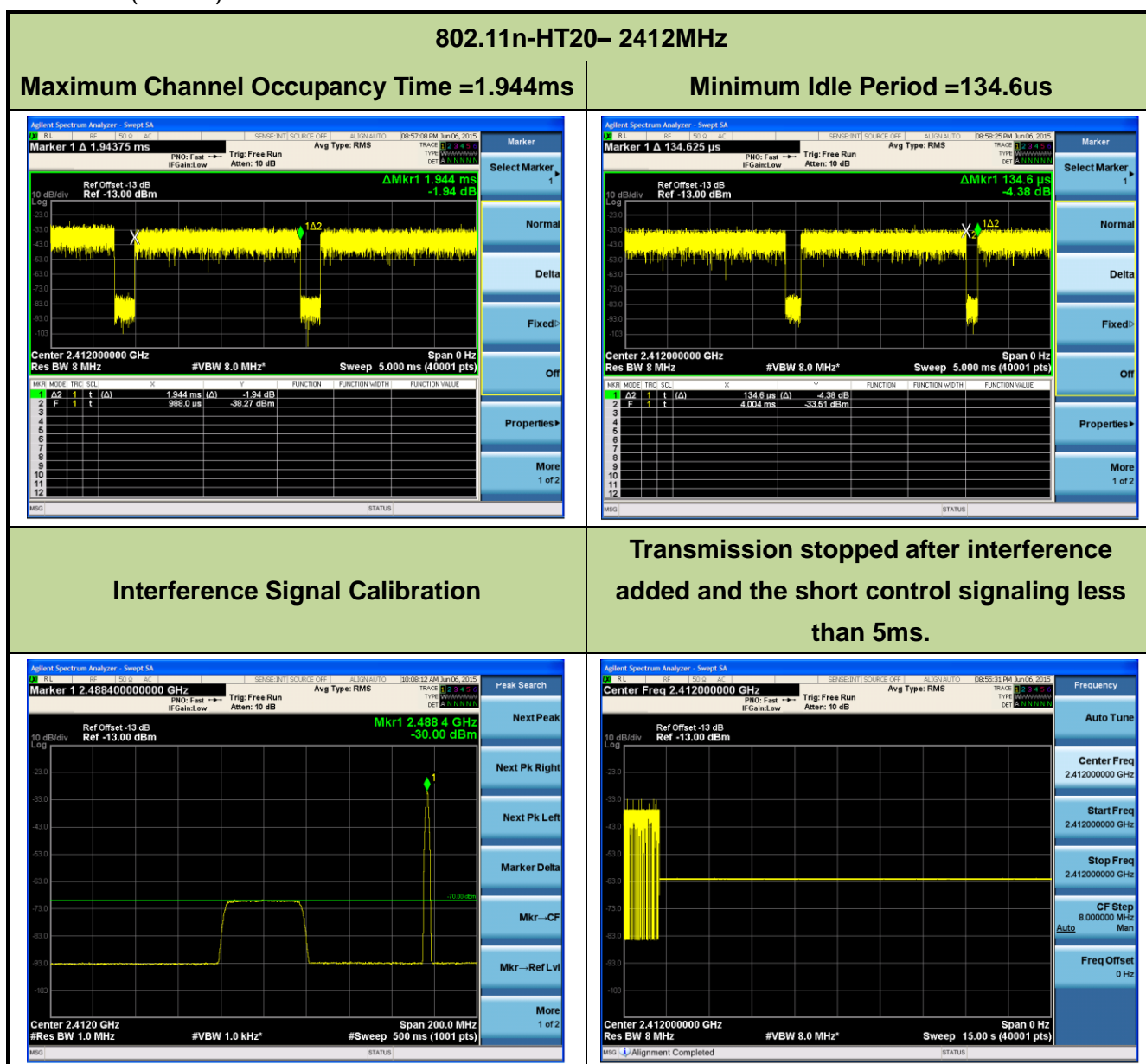
8.3. Test Procedure

Refer to ETSI EN 300 328 V1.8.1 (2012-06) Clause 5.3.7.2.1.

8.4. Test Result

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Andy Zhu	Relative Humidity	54%
Test Time	06-06-2015	Test Site	TR3

The CCA observation time was 25 us, and the maximum factor of $q = 24$ which were declared by the supplier. So the idle period varied between 25 us and 600 us and the channel occupancy time shall less than $(13 / 32) * 24 = 9.75$ ms.

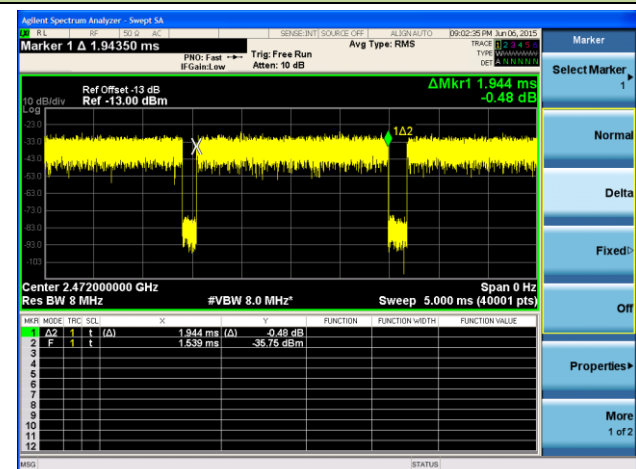


Note: Detection Level = -70 dBm/MHz + 20 – the max conducted power (dBm).

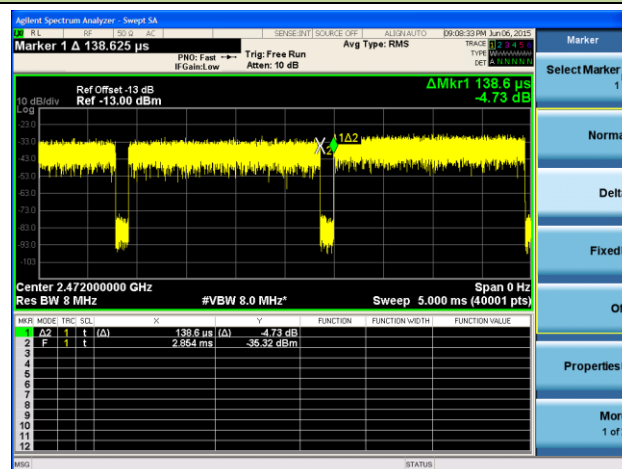
Test Result:	Pass
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802.11n-HT20 – 2472MHz

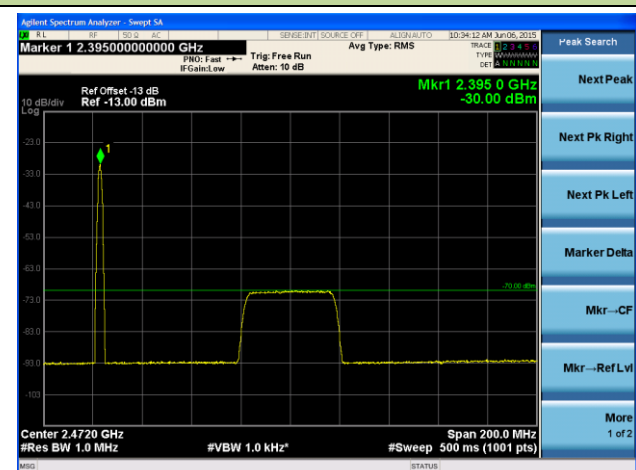
Maximum Channel Occupancy Time = 1.944ms



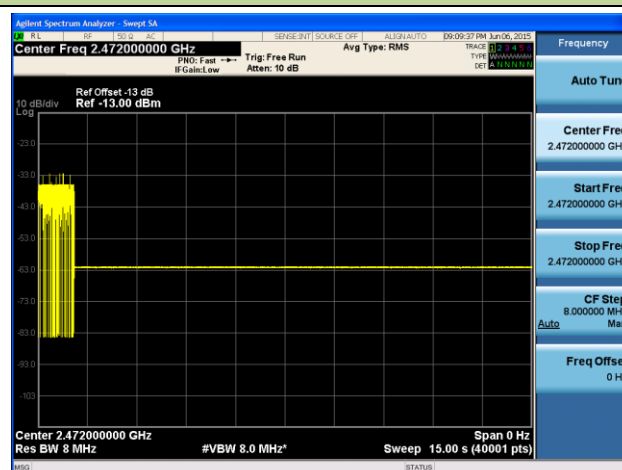
Minimum Idle Period = 138.6us



Interference Signal Calibration



Transmission stopped after interference added and the short control signaling less than 5ms.



Note: Detection Level = -70 dBm/MHz + 20 – the max conducted power (dBm).

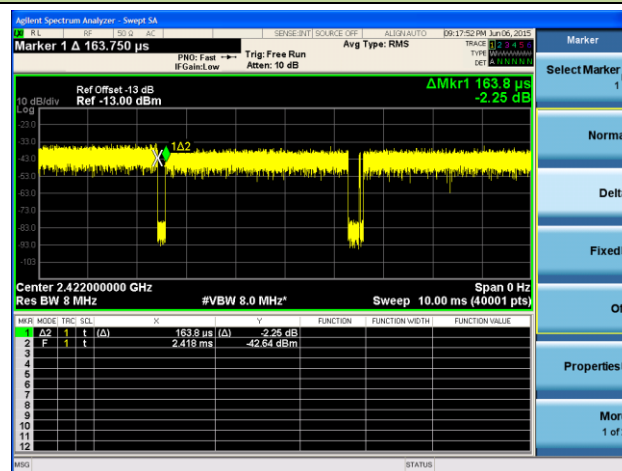
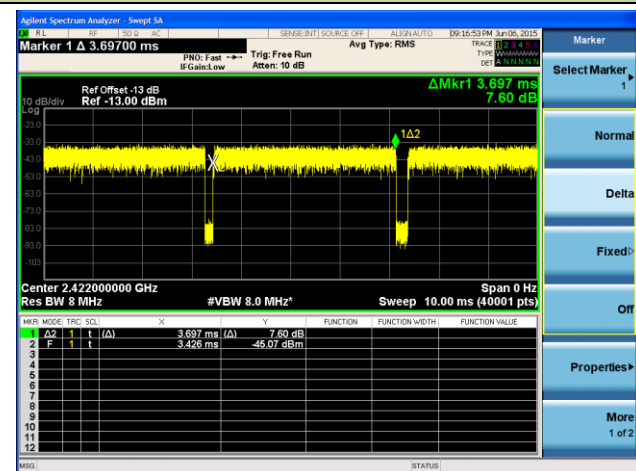
Test Result:

Pass

802.11n-HT40 – 2422MHz

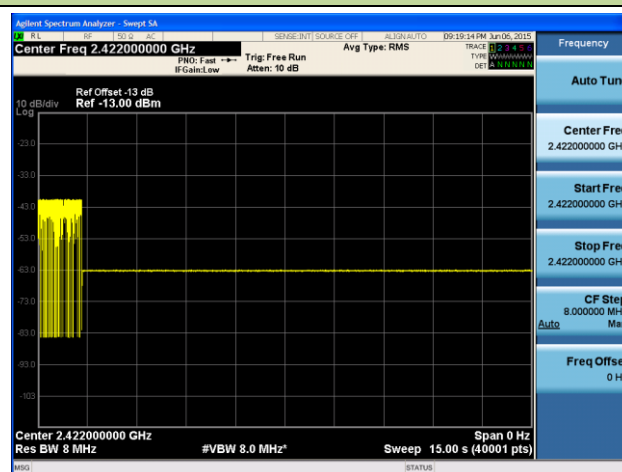
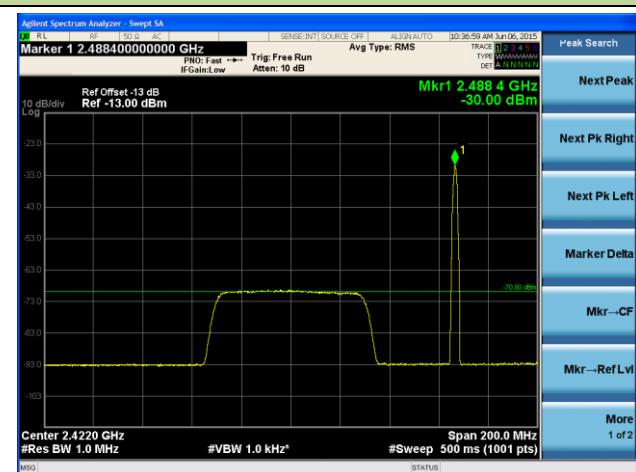
Maximum Channel Occupancy Time = 3.697ms

Minimum Idle Period = 163.8us



Interference Signal Calibration

Transmission stopped after interference added and the short control signaling less than 5ms.



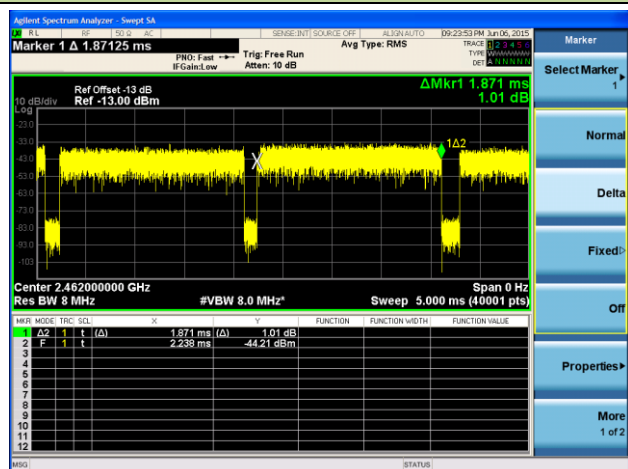
Note: Detection Level = -70 dBm/MHz + 20 – the max conducted power (dBm).

Test Result:

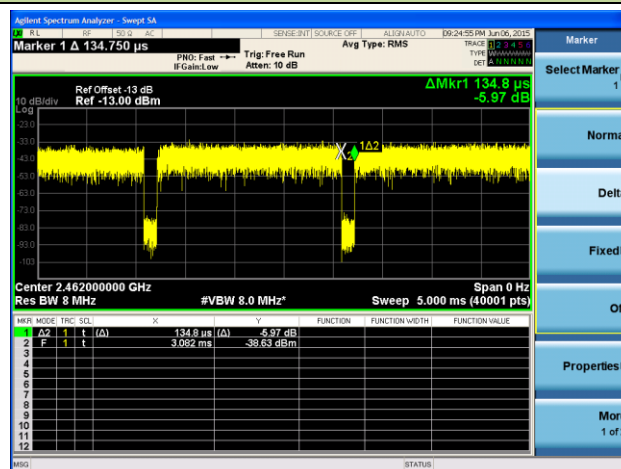
Pass

802.11n-HT40 – 2462MHz

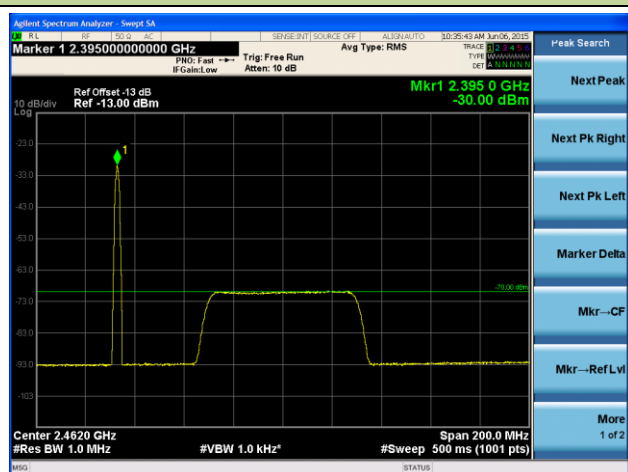
Maximum Channel Occupancy Time = 1.871ms



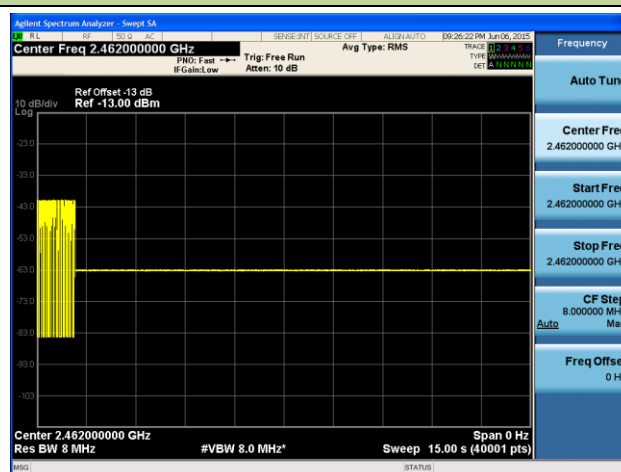
Minimum Idle Period = 134.8us



Interference Signal Calibration



Transmission stopped after interference added and the short control signaling less than 5ms.



Note: Detection Level = -70 dBm/MHz + 20 – the max conducted power (dBm).

Test Result:

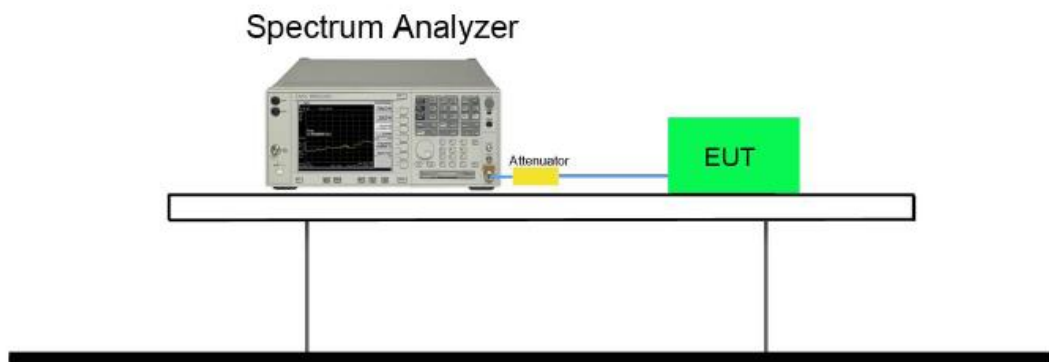
Pass

9. Occupied Channel Bandwidth

9.1. Limit

The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band given in 2.4GHz to 2.4835GHz.

9.2. Test Setup



9.3. Test Procedure

Refer to ETSI EN 300 328 V1.8.1 (2012-06) Clause 5.3.8.2.1.

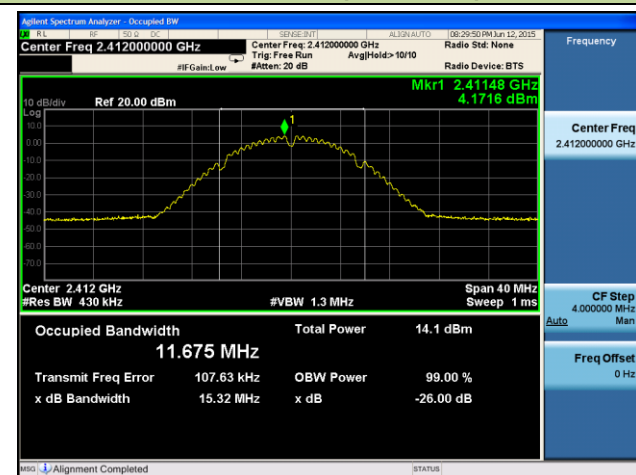
9.4. Test Result

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	06-12-2015	Test Site	TR3

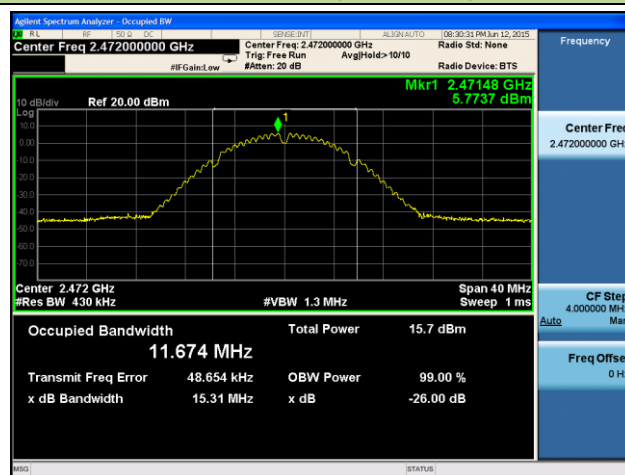
Test Mode	Channel No.	Frequency (MHz)	99% Bandwidth (MHz)	Frequency Range (MHz)	Result
1Tx					
11b	01	2412	11.68	2406.16	Pass
	13	2472	11.67	2477.84	Pass
11g	01	2412	16.90	2403.55	Pass
	13	2472	16.89	2480.45	Pass
11n-HT20	01	2412	17.97	2403.02	Pass
	13	2472	17.97	2480.99	Pass
11n-HT40	03	2422	36.81	2403.60	Pass
	11	2462	36.72	2480.36	Pass
2Tx					
11n-HT20	01	2412	17.99	2403.01	Pass
	13	2472	17.97	2480.99	Pass
11n-HT40	03	2422	36.75	2403.63	Pass
	11	2462	36.71	2480.36	Pass

802.11b Occupied Channel Bandwidth – 1Tx

Channel 01 (2412MHz)

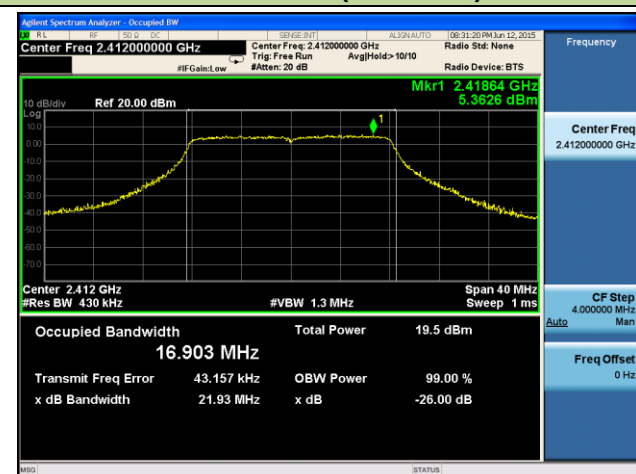


Channel 13 (2472MHz)

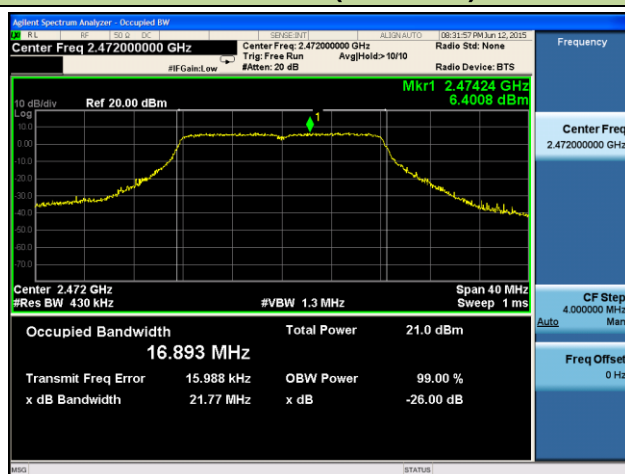


802.11g Occupied Channel Bandwidth –1Tx

Channel 01 (2412MHz)

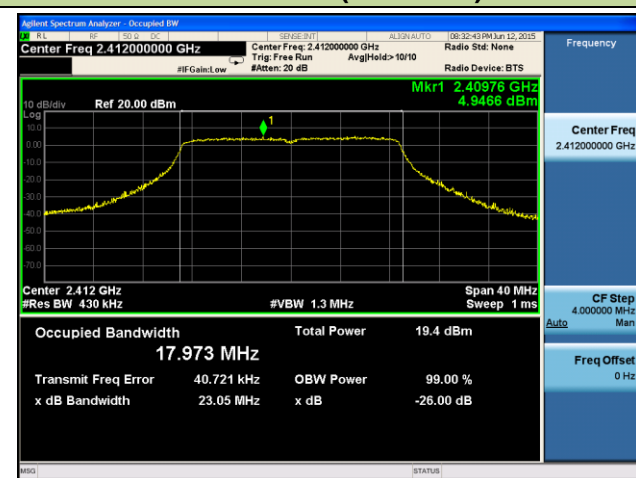


Channel 13 (2472MHz)

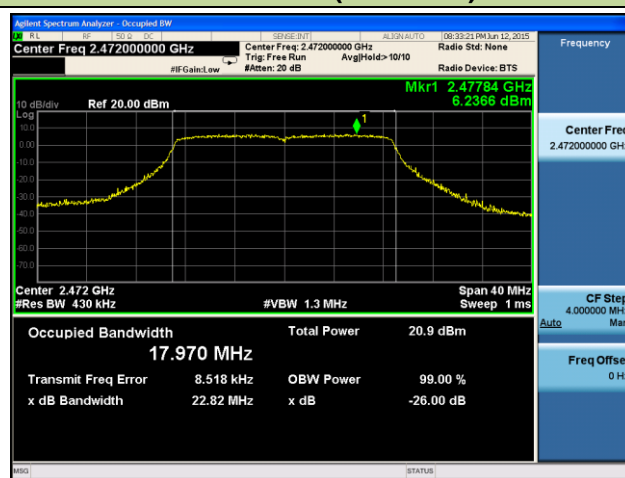


802.11n-HT20 Occupied Channel Bandwidth –1Tx

Channel 01 (2412MHz)

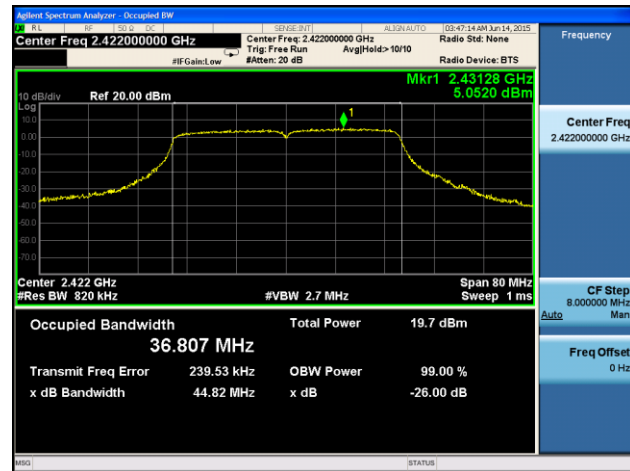


Channel 13 (2472MHz)

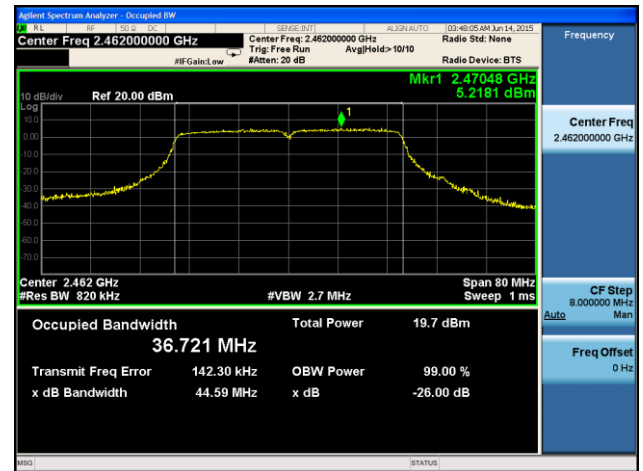


802.11n-HT40 Occupied Channel Bandwidth –1Tx

Channel 03 (2422MHz)

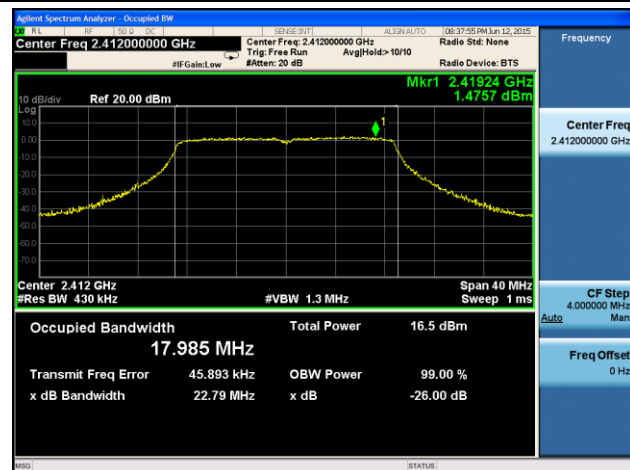


Channel 11 (2462MHz)

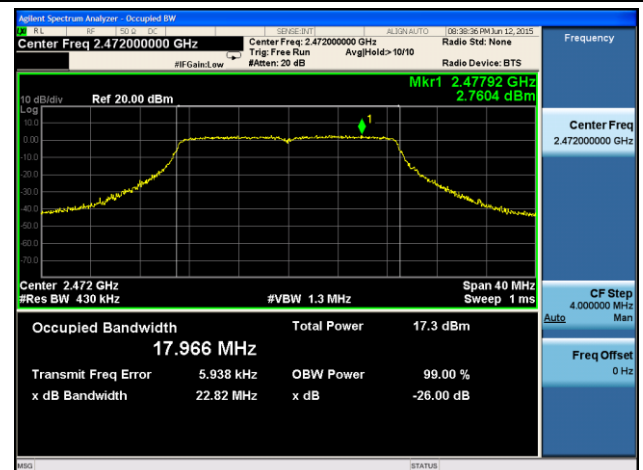


802.11n-HT20 Occupied Channel Bandwidth – 2Tx

Channel 01 (2412MHz)

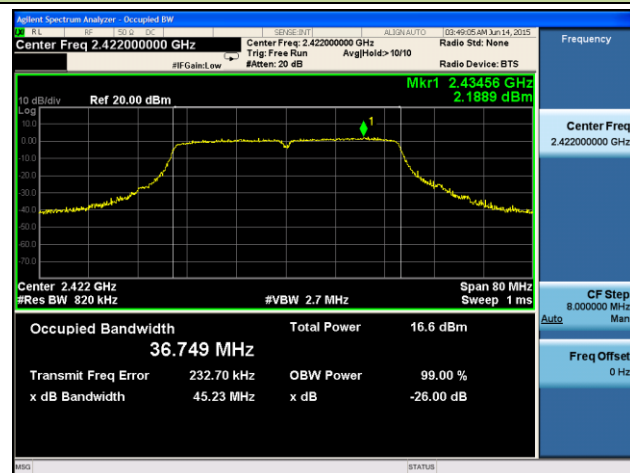


Channel 13 (2472MHz)

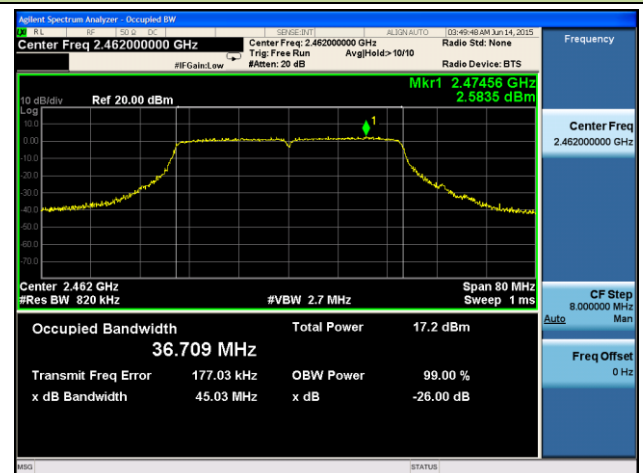


802.11n-HT40 Occupied Channel Bandwidth – 2Tx

Channel 03 (2422MHz)



Channel 11 (2462MHz)



10. Transmitter Unwanted Emissions in the Out-of-band Domain

10.1. Limit

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 3.

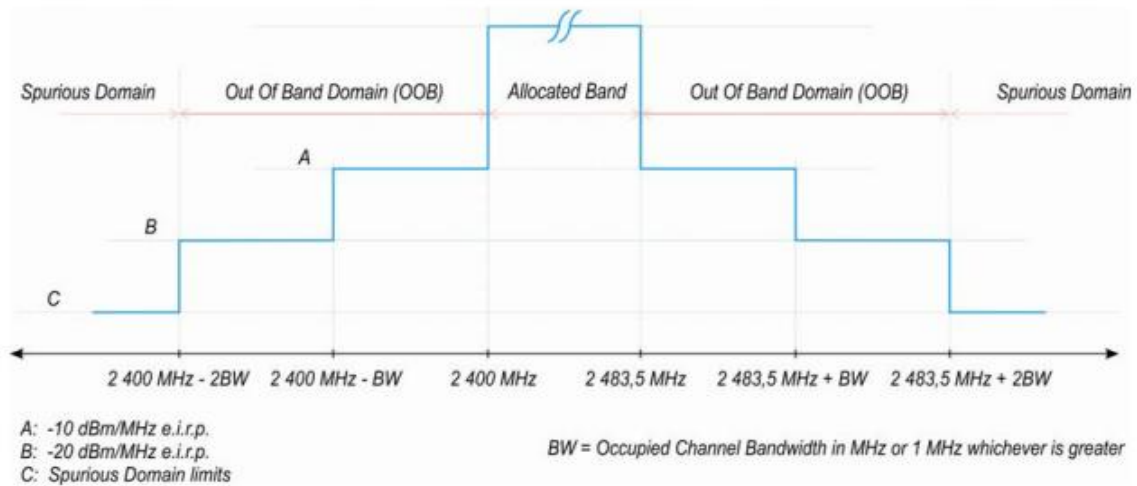
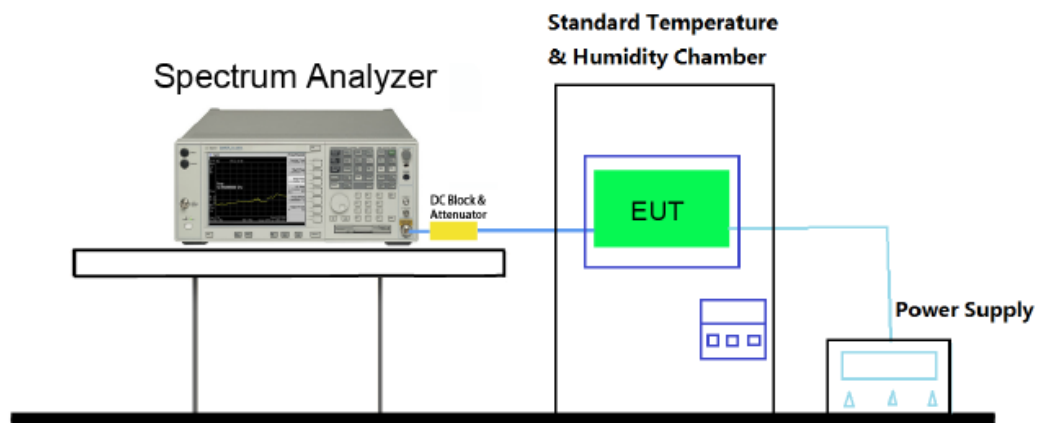


Figure 3: Transmit mask

10.2. Test Setup

For Conducted Measurement



10.3. Test Procedure

Refer to ETSI EN 300 328 V1.8.1 (2012-06) Clause 5.3.9.2.1.

10.4. Test Result

Product	802.11ac Dual Band Module	Temperature	-20 ~ 70°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	05-15-2015	Test Site	TR3

Worst-Case Mode

Test Mode	Ch. No.	Temp. Condition	Freq. Range (MHz)	Max Worst Level (dBm/MHz)	Total Worst Level (dBm/MHz)	Limit (dBm/MHz)	Result
11b	01	T _{nom}	2400-BW~ 2400-2BW	-35.7	-30.7	-20	Pass
		T _{min}		-36.1	-31.1	-20	Pass
		T _{max}		-35.4	-30.4	-20	Pass
		T _{nom}	2400-BW ~ 2400	-28.7	-23.7	-10	Pass
		T _{min}		-28.3	-23.3	-10	Pass
		T _{max}		-29.6	-24.6	-10	Pass
	13	T _{nom}	2483.5+BW ~ 2483.5	-30.0	-25.0	-10	Pass
		T _{min}		-29.5	-24.5	-10	Pass
		T _{max}		-30.4	-25.4	-10	Pass
		T _{nom}	2483.5+2BW ~ 2483.5+BW	-36.8	-31.8	-20	Pass
		T _{min}		-36.7	-31.7	-20	Pass
		T _{max}		-37.4	-32.4	-20	Pass
11g	01	T _{nom}	2400-BW~ 2400-2BW	-30.3	-25.3	-20	Pass
		T _{min}		-29.8	-24.8	-20	Pass
		T _{max}		-31.2	-26.2	-20	Pass
		T _{nom}	2400-BW ~ 2400	-23.1	-18.1	-10	Pass
		T _{min}		-22.8	-17.8	-10	Pass
		T _{max}		-24.1	-19.1	-10	Pass
	13	T _{nom}	2483.5+BW ~ 2483.5	-24.5	-19.5	-10	Pass
		T _{min}		-23.5	-18.5	-10	Pass
		T _{max}		-24.6	-19.6	-10	Pass
		T _{nom}	2483.5+2BW ~ 2483.5+BW	-30.1	-25.1	-20	Pass
		T _{min}		-29.5	-24.5	-20	Pass
		T _{max}		-31.8	-26.8	-20	Pass

11n-HT2 0	01	T_{nom}	2400-BW~ 2400-2BW	-29.4	-24.4	-20	Pass
		T_{min}		-28.7	-23.7	-20	Pass
		T_{max}		-30.0	-25.0	-20	Pass
		T_{nom}	2400-BW ~ 2400	-21.6	-16.6	-10	Pass
		T_{min}		-21.3	-16.3	-10	Pass
		T_{max}		-22.1	-17.1	-10	Pass
	13	T_{nom}	2483.5+BW ~ 2483.5	-21.5	-16.5	-10	Pass
		T_{min}		-20.4	-15.4	-10	Pass
		T_{max}		-22.4	-17.4	-10	Pass
		T_{nom}	2483.5+2BW ~ 2483.5+BW	-29.3	-24.3	-20	Pass
		T_{min}		-29.3	-24.3	-20	Pass
		T_{max}		-30.2	-25.2	-20	Pass
11n-HT4 0	03	T_{nom}	2400-BW~ 2400-2BW	-31.1	-26.1	-20	Pass
		T_{min}		-30.1	-25.1	-20	Pass
		T_{max}		-32.0	-27.0	-20	Pass
		T_{nom}	2400-BW ~ 2400	-20.1	-15.1	-10	Pass
		T_{min}		-19.9	-14.9	-10	Pass
		T_{max}		-21.0	-16.0	-10	Pass
	11	T_{nom}	2483.5+BW ~ 2483.5	-21.4	-16.4	-10	Pass
		T_{min}		-20.5	-15.5	-10	Pass
		T_{max}		-22.3	-17.3	-10	Pass
		T_{nom}	2483.5+2BW ~ 2483.5+BW	-30.3	-25.3	-20	Pass
		T_{min}		-29.4	-24.4	-20	Pass
		T_{max}		-31.4	-26.4	-20	Pass

Note: Total Worst Level(dBm/MHz) = Max Worst Level (dBm/MHz) + Antenna Gain(dBi).

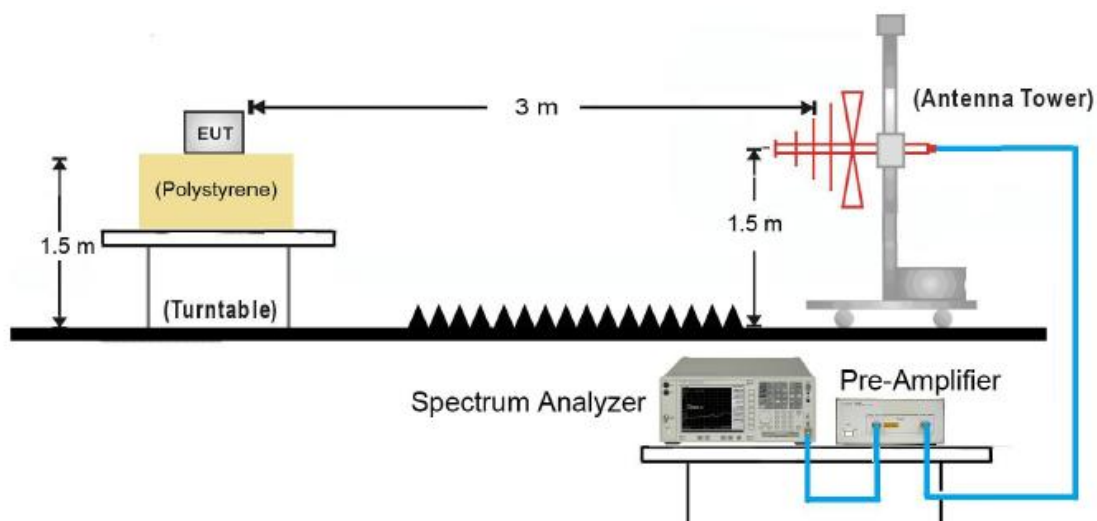
11. Transmitter Unwanted Emissions in the Spurious Domain

11.1. Limit

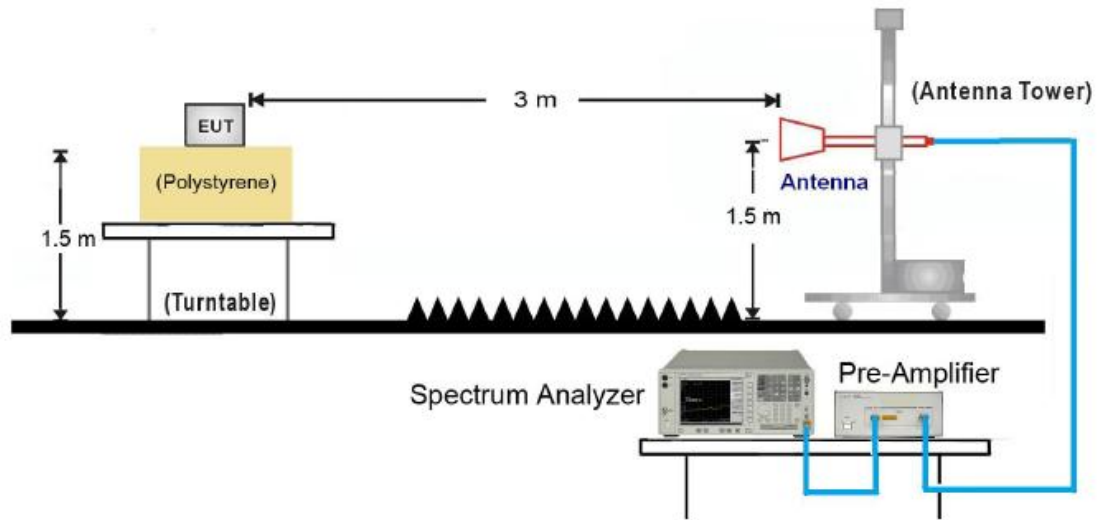
Transmitter Limits for Spurious Emissions		
Frequency Range	Maximum power E.R.P. ($\leq 1\text{GHz}$) E.I.R.P. ($> 1\text{GHz}$)	Bandwidth
30 MHz to 47 MHz	-36dBm	100 kHz
47 MHz to 74 MHz	-54dBm	100 kHz
74 MHz to 87,5 MHz	-36dBm	100 kHz
87,5 MHz to 118 MHz	-54dBm	100 kHz
118 MHz to 174 MHz	-36dBm	100 kHz
174 MHz to 230 MHz	-54dBm	100 kHz
230 MHz to 470 MHz	-36dBm	100 kHz
470 MHz to 862 MHz	-54dBm	100 kHz
862 MHz to 1 GHz	-36dBm	100 kHz
1 GHz to 12,75 GHz	-30dBm	1 MHz

11.2. Test Setup

30MHz ~ 1GHz Test Setup:



1GHz ~ 12.75GHz Test Setup:



11.3. Test Procedure

Refer to ETSI EN 300 328 V1.8.1 (2012-06) Clause 5.3.10.2.2.

11.4. Test Result

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	05-18-2015	Test Site	AC1
Test Mode	11b – 1Tx		

Channel	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
01	63.2	-66.6	-54.0	-12.6	Peak	Horizontal
	48.2	-62.6	-54.0	-8.6	Peak	Vertical
	88.9	-70.6	-54.0	-16.6	Peak	Horizontal
	88.9	-59.2	-54.0	-5.2	RMS	Vertical
	4822.8	-51.5	-30.0	-21.5	Peak	Horizontal
	4822.8	-52.5	-30.0	-22.5	Peak	Vertical
	7234.8	-46.7	-30.0	-16.7	Peak	Horizontal
	7234.8	-47.0	-30.0	-17.0	Peak	Vertical
13	62.3	-67.0	-54.0	-13.0	Peak	Horizontal
	50.1	-63.0	-54.0	-9.0	Peak	Vertical
	498.8	-69.1	-54.0	-15.1	Peak	Horizontal
	88.9	-59.6	-54.0	-5.6	RMS	Vertical
	4942.8	-52.5	-30.0	-22.5	Peak	Horizontal
	4942.8	-52.5	-30.0	-22.5	Peak	Vertical
	7414.8	-46.8	-30.0	-16.8	Peak	Horizontal
	7414.8	-45.5	-30.0	-15.5	Peak	Vertical

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	05-18-2015	Test Site	AC1
Test Mode	11g – 1Tx		

Channel	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
01	62.7	-66.5	-54.0	-12.5	Peak	Horizontal
	50.1	-63.2	-54.0	-9.2	Peak	Vertical
	498.8	-67.2	-54.0	-13.2	Peak	Horizontal
	88.5	-60.7	-54.0	-6.7	Peak	Vertical
	4822.8	-53.4	-30.0	-23.4	Peak	Horizontal
	4822.8	-52.8	-30.0	-22.8	Peak	Vertical
	7234.8	-46.6	-30.0	-16.6	Peak	Horizontal
	7234.8	-46.8	-30.0	-16.8	Peak	Vertical
13	62.3	-66.2	-54.0	-12.2	Peak	Horizontal
	48.7	-63.5	-54.0	-9.5	Peak	Vertical
	498.8	-68.1	-54.0	-14.1	Peak	Horizontal
	88.5	-59.2	-54.0	-5.2	RMS	Vertical
	4942.8	-52.8	-30.0	-22.8	Peak	Horizontal
	4942.8	-52.8	-30.0	-22.8	Peak	Vertical
	7414.8	-46.3	-30.0	-16.3	Peak	Horizontal
	7414.8	-45.7	-30.0	-15.7	Peak	Vertical

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	05-18-2015	Test Site	AC1
Test Mode	11n-HT20 – 2Tx		

Channel	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
01	128.9	-62.0	-36.0	-26.0	Peak	Horizontal
	40.7	-53.0	-36.0	-17.0	Peak	Vertical
	214.3	-66.3	-54.0	-12.3	Peak	Horizontal
	102.3	-62.8	-54.0	-8.8	Peak	Vertical
	4824.0	-51.6	-30.0	-21.6	Peak	Horizontal
	4824.0	-51.5	-30.0	-21.5	Peak	Vertical
	7236.0	-47.1	-30.0	-17.1	Peak	Horizontal
	7236.0	-47.3	-30.0	-17.3	Peak	Vertical
13	128.5	-59.8	-36.0	-23.8	Peak	Horizontal
	40.7	-53.1	-36.0	-17.1	Peak	Vertical
	214.3	-67.0	-54.0	-13.0	Peak	Horizontal
	103.2	-63.6	-54.0	-9.6	Peak	Vertical
	4944.0	-51.6	-30.0	-21.6	Peak	Horizontal
	4944.0	-52.3	-30.0	-22.3	Peak	Vertical
	7416.0	-46.6	-30.0	-16.6	Peak	Horizontal
	7416.0	-46.6	-30.0	-16.6	Peak	Vertical

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	05-18-2015	Test Site	AC1
Test Mode	11n-HT40 – 2Tx		

Channel	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
03	128.9	-62.7	-36.0	-26.7	Peak	Horizontal
	40.2	-52.8	-36.0	-16.8	Peak	Vertical
	214.3	-66.8	-54.0	-12.8	Peak	Horizontal
	103.2	-62.6	-54.0	-8.6	Peak	Vertical
	4844.0	-51.2	-30.0	-21.2	Peak	Horizontal
	4844.0	-52.0	-30.0	-22.0	Peak	Vertical
	7266.0	-46.2	-30.0	-16.2	Peak	Horizontal
	7266.0	-46.7	-30.0	-16.7	Peak	Vertical
11	128.9	-60.0	-36.0	-24.0	Peak	Horizontal
	31.0	-51.7	-36.0	-15.7	Peak	Vertical
	214.3	-66.8	-54.0	-12.8	Peak	Horizontal
	40.7	-52.8	-36.0	-16.8	Peak	Vertical
	4924.0	-51.4	-30.0	-21.4	Peak	Horizontal
	4924.0	-52.2	-30.0	-22.2	Peak	Vertical
	7386.0	-46.2	-30.0	-16.2	Peak	Horizontal
	7386.0	-46.5	-30.0	-16.5	Peak	Vertical

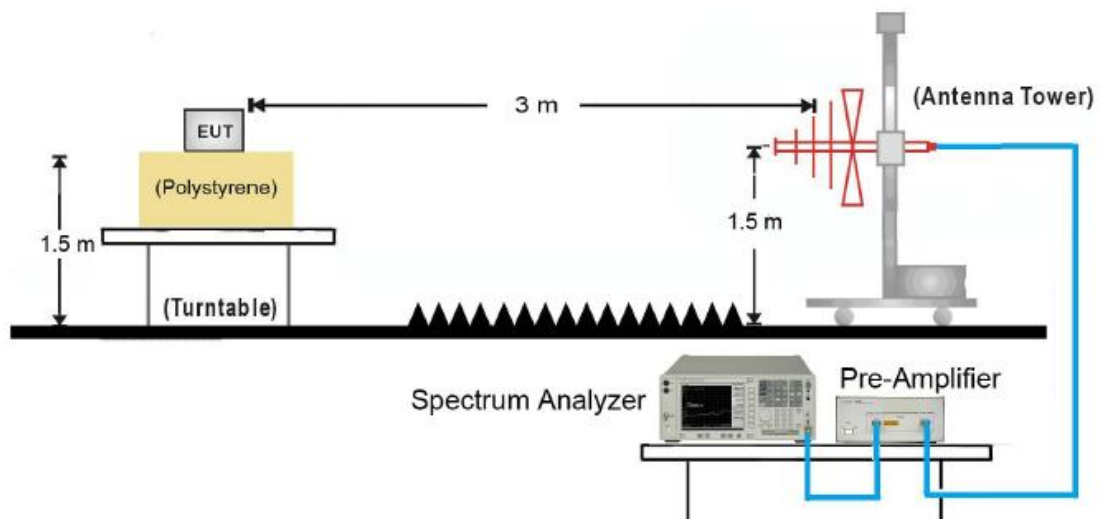
12. Receiver Spurious Emissions

12.1. Limit

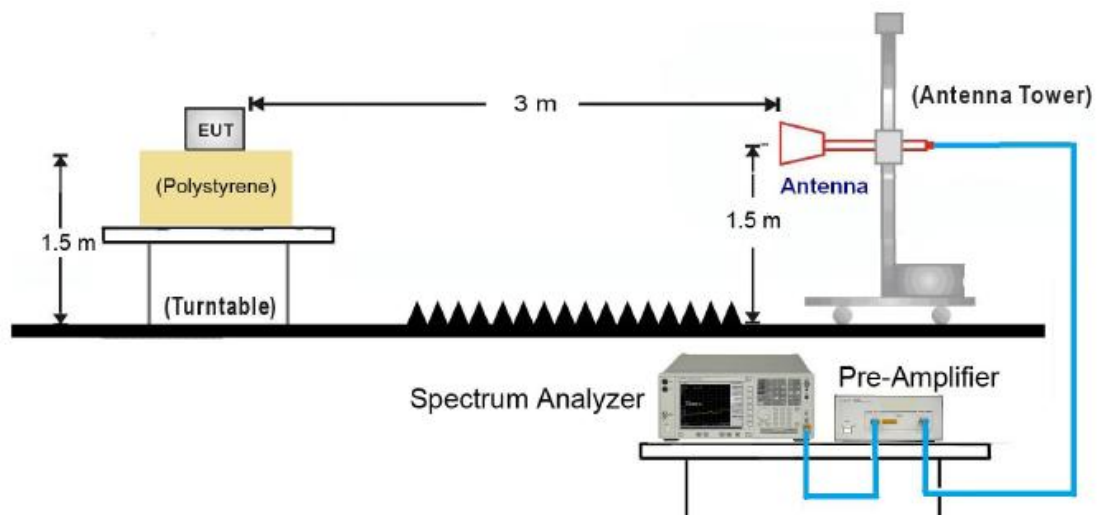
Spurious emissions limits for receivers		
Frequency Range	Maximum power E.R.P	Measurement bandwidth
30 MHz to 1 GHz	-57dBm	100 kHz
1 GHz to 12.75 GHz	-47dBm	1 MHz

12.2. Test Setup

30MHz ~ 1GHz Test Setup:



1GHz ~ 12.5GHz Test Setup:



12.3. Test Procedure

Refer to ETSI EN 300 328 V1.8.1 (2012-06) Clause 5.3.11.2.2.

12.4. Test Result

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	05-18-2015	Test Site	AC1
Test Mode	11b		

Channel	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
01	166.8	-69.4	-57.0	-12.4	Peak	Horizontal
	298.7	-60.0	-57.0	-3.0	RMS	Vertical
	99.8	-65.7	-57.0	-8.7	Peak	Horizontal
	165.8	-66.8	-57.0	-9.8	Peak	Vertical
	1329.0	-49.9	-47.0	-2.9	RMS	Horizontal
	1499.4	-52.5	-47.0	-5.5	RMS	Vertical
	1329.0	-50.1	-47.0	-3.1	RMS	Horizontal
	1499.4	-53.7	-47.0	-6.7	Peak	Vertical
13	366.6	-63.7	-57.0	-6.7	Peak	Horizontal
	582.9	-60.1	-57.0	-3.1	RMS	Vertical
	365.1	-62.9	-57.0	-5.9	RMS	Horizontal
	564.5	-60.3	-57.0	-3.3	RMS	Vertical
	2198.5	-51.2	-47.0	-4.2	RMS	Horizontal
	3761.3	-52.1	-47.0	-5.1	RMS	Vertical
	3731.9	-52.2	-47.0	-5.2	RMS	Horizontal
	5312.3	-54.0	-47.0	-7.0	Peak	Vertical

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	05-18-2015	Test Site	AC1
Test Mode	11g		

Channel	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
01	65.4	-67.7	-57.0	-10.7	Peak	Horizontal
	52.8	-62.6	-57.0	-5.6	RMS	Vertical
	324.4	-68.5	-57.0	-11.5	Peak	Horizontal
	83.8	-60.8	-57.0	-3.8	RMS	Vertical
	2186.8	-53.8	-47.0	-6.8	Peak	Horizontal
	2457.0	-54.0	-47.0	-7.0	Peak	Vertical
	2968.1	-52.4	-47.0	-5.4	RMS	Horizontal
	3109.1	-52.2	-47.0	-5.2	RMS	Vertical
13	39.7	-66.4	-57.0	-9.4	Peak	Horizontal
	85.8	-61.1	-57.0	-4.1	RMS	Vertical
	64.0	-68.2	-57.0	-11.2	Peak	Horizontal
	324.4	-69.8	-57.0	-12.8	Peak	Vertical
	2427.6	-53.1	-47.0	-6.1	Peak	Horizontal
	2245.5	-53.9	-47.0	-6.9	Peak	Vertical
	3120.9	-52.7	-47.0	-5.7	RMS	Horizontal
	3679.0	-51.9	-47.0	-4.9	RMS	Vertical

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	05-18-2015	Test Site	AC1
Test Mode	11n-HT20		

Channel	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
01	128.9	-60.7	-57.0	-3.7	RMS	Horizontal
	103.7	-61.3	-57.0	-4.3	RMS	Vertical
	214.3	-66.9	-57.0	-9.9	Peak	Horizontal
	214.3	-70.1	-57.0	-13.1	Peak	Vertical
	2192.6	-53.6	-47.0	-6.6	Peak	Horizontal
	2192.6	-53.8	-47.0	-6.8	Peak	Vertical
	3156.1	-53.0	-47.0	-6.0	RMS	Horizontal
	3690.8	-52.1	-47.0	-5.1	RMS	Vertical
13	40.2	-66.2	-57.0	-9.2	Peak	Horizontal
	86.3	-64.2	-57.0	-7.2	Peak	Vertical
	129.4	-72.0	-57.0	-15.0	Peak	Horizontal
	109.5	-62.3	-57.0	-5.3	RMS	Vertical
	2180.9	-54.1	-47.0	-7.1	Peak	Horizontal
	2803.6	-53.3	-47.0	-6.3	Peak	Vertical
	3191.4	-53.1	-47.0	-6.1	RMS	Horizontal
	3790.6	-51.8	-47.0	-4.8	RMS	Vertical

Product	802.11ac Dual Band Module	Temperature	24°C
Test Engineer	Milo Li	Relative Humidity	54%
Test Time	05-18-2015	Test Site	AC1
Test Mode	11n-HT40		

Channel	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
03	42.6	-66.4	-57.0	-9.4	Peak	Horizontal
	82.9	-64.6	-57.0	-7.6	Peak	Vertical
	132.8	-72.4	-57.0	-15.4	Peak	Horizontal
	116.3	-63.8	-57.0	-6.8	Peak	Vertical
	2862.4	-51.5	-47.0	-4.5	RMS	Horizontal
	3038.6	-51.5	-47.0	-4.5	RMS	Vertical
	4102.0	-52.0	-47.0	-5.0	RMS	Horizontal
	4525.0	-51.1	-47.0	-4.1	RMS	Vertical
11	39.7	-66.8	-57.0	-9.8	Peak	Horizontal
	83.4	-64.4	-57.0	-7.4	Peak	Vertical
	122.6	-71.6	-57.0	-14.6	Peak	Horizontal
	109.5	-63.7	-57.0	-6.7	Peak	Vertical
	2974.0	-53.3	-47.0	-6.3	Peak	Horizontal
	3602.6	-51.8	-47.0	-4.8	RMS	Vertical
	4184.3	-52.2	-47.0	-5.2	RMS	Horizontal
	4695.4	-51.5	-47.0	-4.5	RMS	Vertical

13. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Occupied Channel Bandwidth	$\pm 5 \%$
RF output power, conducted	$\pm 1,5 \text{ dB}$
Power Spectral Density, conducted	$\pm 3 \text{ dB}$
Unwanted Emissions, conducted	$\pm 3 \text{ dB}$
All emissions, radiated	$\pm 6 \text{ dB}$
Temperature	$\pm 1 \text{ }^{\circ}\text{C}$
Humidity	$\pm 5 \%$
DC and low frequency voltages	$\pm 3 \%$
Time	$\pm 5 \%$
Duty Cycle	$\pm 5 \%$

14. Test Photograph

Description: Radiated Spurious Emissions Test Setup for Below 1GHz



Description: Radiated Spurious Emissions Test Setup for Above 1GHz



15. List of Measuring Instrument

Equivalent Isotropic Radiated Power

Instrument	Manufacturer	Type No.	Cali. Interval	Cali. Due Date
Power Meter	Agilent	U2021XA	1 year	2015/12/09
Programmable Temperature & Humidity Chamber	BAOYT	BYH-1500L	1 year	2015/12/10
Temperature/Humidity Meter	Anymetre	TH101B	1 year	2015/11/14

Power Spectral Density

Instrument	Manufacturer	Type No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	1 year	2016/04/23
Temperature/Humidity Meter	Anymetre	TH101B	1 year	2015/11/14

Duty Cycle, Tx-sequence, Tx-gap

Instrument	Manufacturer	Type No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	1 year	2016/04/23
Temperature/Humidity Meter	Anymetre	TH101B	1 year	2015/11/15

Medium Utilisation (MU) factor

Instrument	Manufacturer	Type No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	1 year	2016/04/23
Power Meter	Agilent	U2021XA	1 year	2015/12/09
Temperature/Humidity Meter	Anymetre	TH101B	1 year	2015/11/14

Adaptivity and Blocking

Instrument	Manufacturer	Type No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	1 year	2016/04/23
Vector Signal Generator	Agilent	E4438C	1 year	2015/12/09
Vector Signal Generator	Agilent	E4438C	1 year	2015/12/09
Directional Coupler	Narda	4216-20	1 year	2016/02/15
Combiner	Mini-Circuits	ZFRSC-123-S+ DC-12000MHz	1 year	2015/11/19
Temperature/Humidity Meter	Anymetre	TH101B	1 year	2015/11/14

Occupied Channel Bandwidth

Instrument	Manufacturer	Type No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	1 year	2016/04/23
Temperature/Humidity Meter	Anymetre	TH101B	1 year	2015/11/14

Transmitter unwanted emissions in the out-of-band domain

Instrument	Manufacturer	Type No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	1 year	2016/04/23
Programmable Temperature & Humidity Chamber	BAOYT	BYH-1500L	1 year	2015/12/10
Temperature/Humidity Meter	Anymetre	TH101B	1 year	2015/11/14

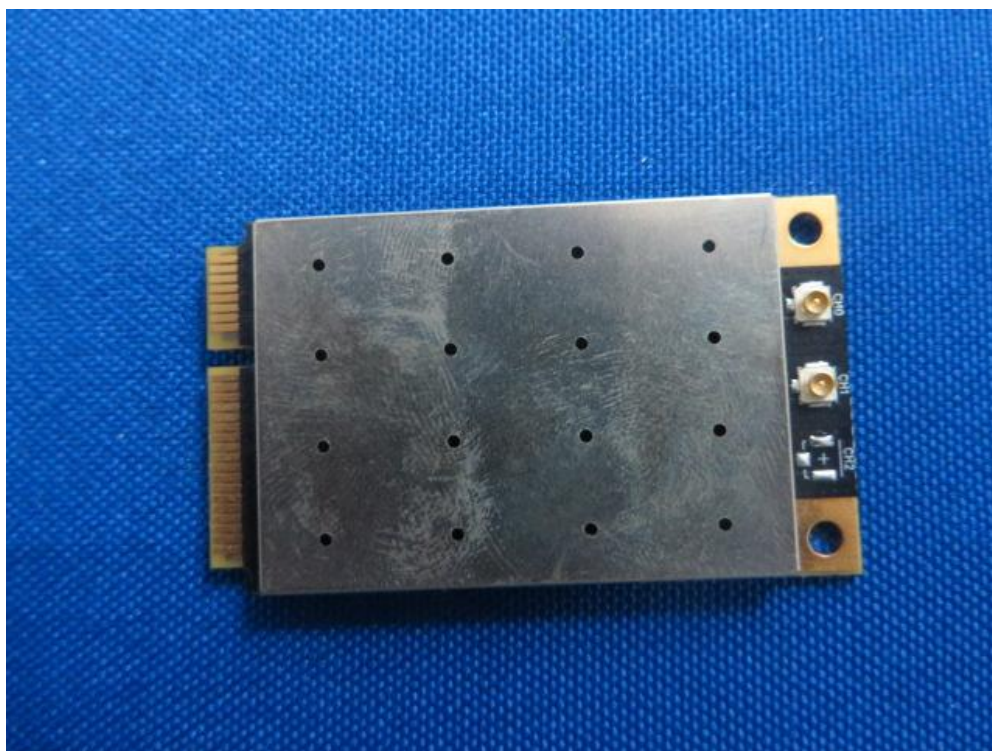
Transmitter Spurious Emissions and Receiver Spurious Emissions

Instrument	Manufacturer	Type No.	Cali. Interval	Cal. Due Date
Spectrum Analyzer	Agilent	N9020A	1 year	2016/04/23
Preamplifier	MRT	AP25M01	1 year	2015/10/06
Preamplifier	Agilent	83017A	1 year	2015/12/13
Bilog Period Antenna	Schwarzbeck	VULB 9162	1 year	2015/11/08
Horn Antenna	Schwarzbeck	BBHA9120D	1 year	2015/11/08
Temperature/Humidity Meter	Anymetre	TH101B	1 year	2015/11/14

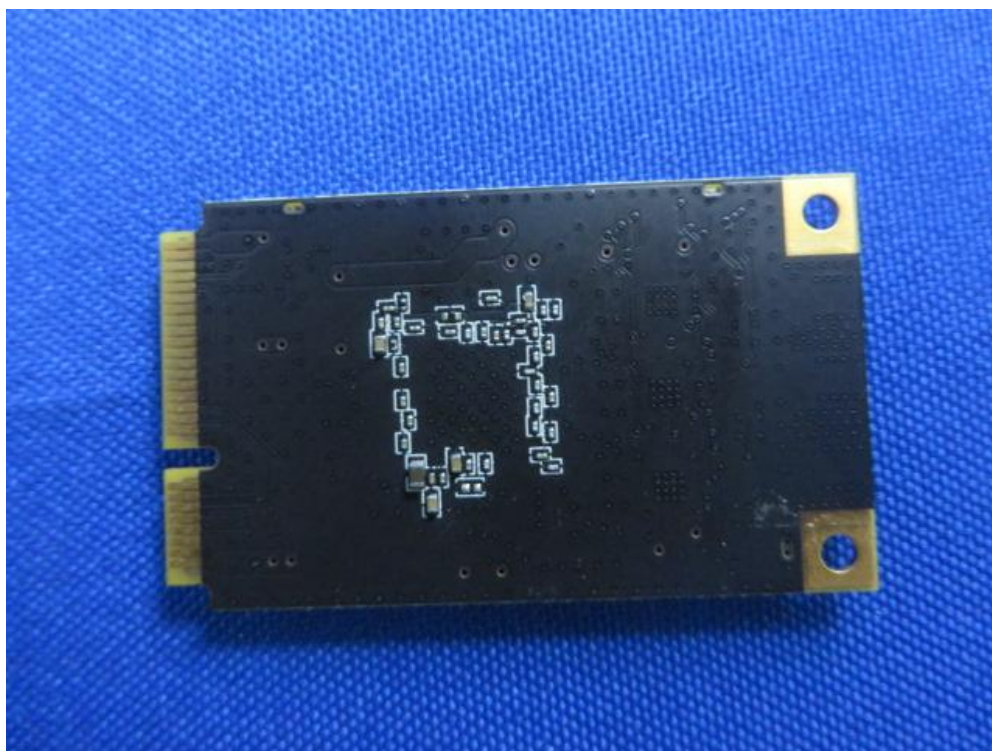
Software	Version	Function
e3	V8.3.5	EMI Test Software

16. Appendix - EUT Photograph

(1) EUT Photo



(2) EUT Photo



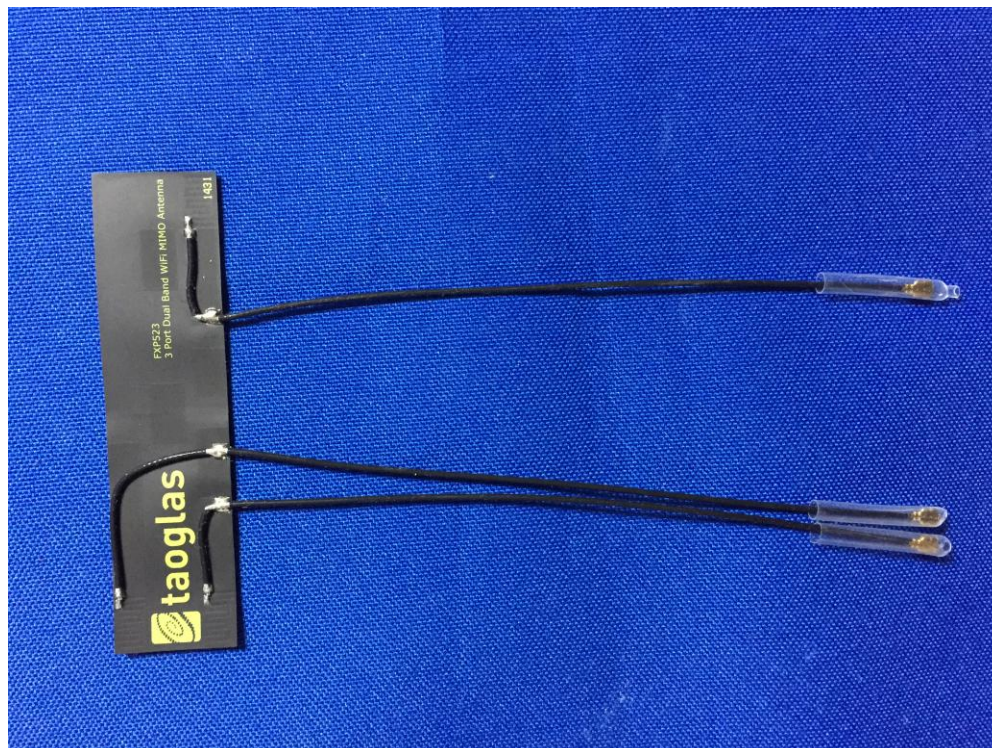
(3) EUT Photo



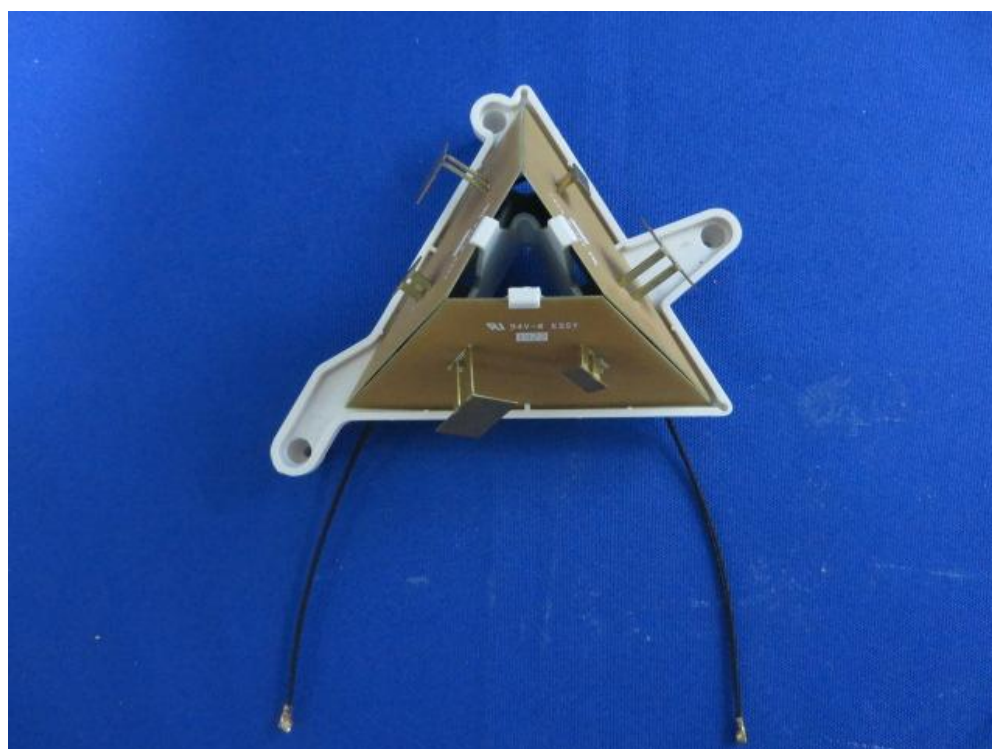
(4) EUT Photo (1#)



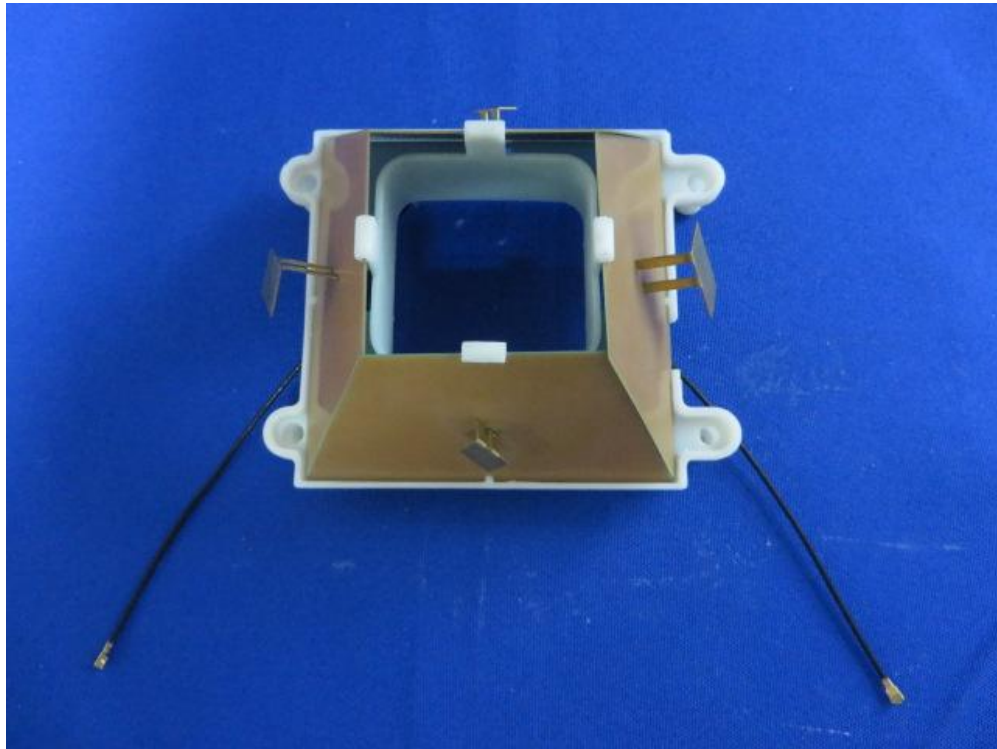
(5) EUT Photo (2#)



(6) EUT Photo (3#)



(7) EUT Photo (4#)



————— The End —————