MEASUREMENT REPORT

FCC PART 15.407 / RSS-247 WLAN 802.11a/n/ac

FCC ID:	T2C-WF50
IC:	10741A-WF50
APPLICANT:	YEALINK(XIAMEN) NETWORK TECHNOLOGY CO.,LTD
Application Type:	Certification
Product:	Wi-Fi USB Dongle
Model No.:	WF50
Brand Name:	YEALINK
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15.407
IC Rule(s):	RSS-247 Issue 2, RSS-GEN Issue 4
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02v02r01
Test Date:	December 26, 2017 ~ March 11, 2018

Reviewed By : Sunny Sun
(Sunny Sun)

Approved By : Marlinchen
(Marlin Chen)

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

The test results relate only to the samples tested.
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 789033 D02v02r01. Test results reported herein relate only to the item(s) tested.
The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
1802RSU004-U2	Rev. 01	Initial Report	04-04-2018	Valid

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§2.1033 General Information

Applicant:	YEALINK(XIAMEN) NETWORK TECHNOLOGY CO.,LTD
Applicant Address:	309, 3th Floor, No.16, Yun Ding North Road, Huli District, Xiamen City, Fujian, P.R. China
Manufacturer:	YEALINK(XIAMEN) NETWORK TECHNOLOGY CO.,LTD
Manufacturer Address:	309, 3th Floor, No.16, Yun Ding North Road, Huli District, Xiamen City, Fujian, P.R. China
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
FCC Registration No.:	893164
IC Registration No.:	11384A
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering

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-20025, G-20034, C-20020, T-20020) 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.**

Accredited Laboratory

A2LA has accredited

MRT TECHNOLOGY (SUZHOU) CO., LTD.

Suzhou, Jiangsu, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 6th day of September 2016.

Senior Director of Quality and Communications
For the Accreditation Council
Certificate Number 3628.01
Valid to August 31, 2018

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

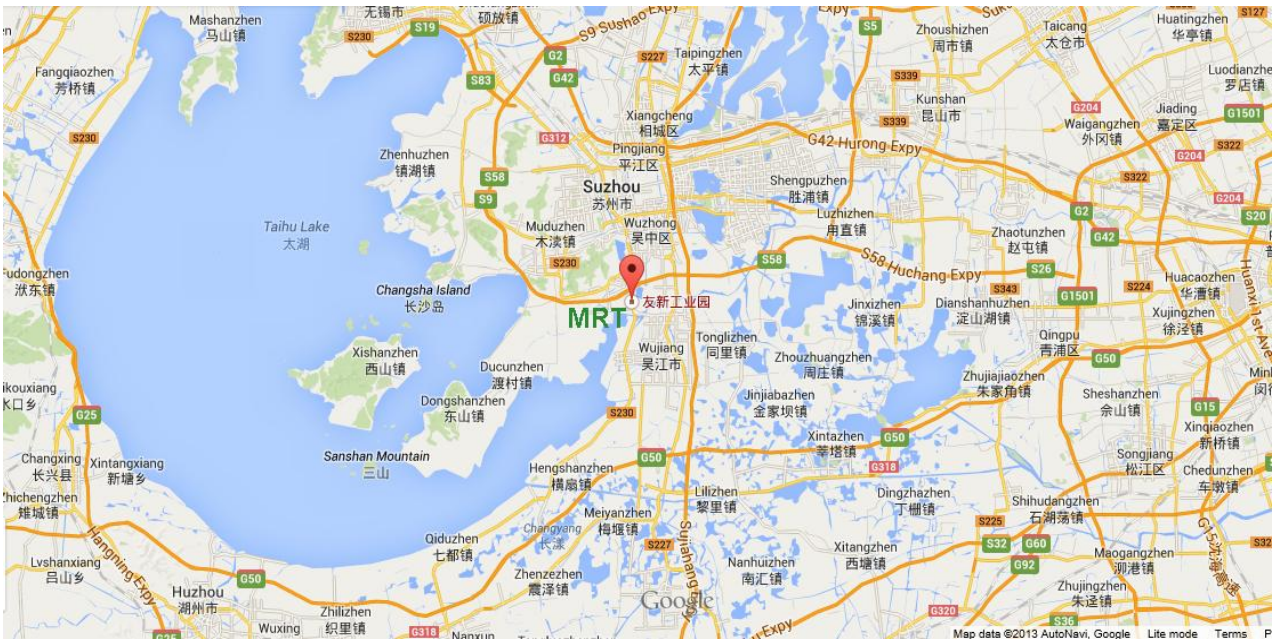
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	Wi-Fi USB Dongle
Model No.	WF50
Wi-Fi Specification	802.11a/b/g/n/ac

2.2. Product Specification Subjective to this Report

Frequency Range	For 802.11a/n-HT20/ac-VHT20: 5180~5240MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40: 5190~5230MHz, 5755~5795MHz For 802.11ac-VHT80: 5210MHz, 5775MHz
Type of Modulation	802.11a/n/ac: OFDM
Data Rate:	802.11a: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 150Mbps 802.11ac: up to 433.3Mbps

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

2.3. Operation Frequency / Channel list

802.11a/n-HT20/ac-VHT20

Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	149	5745 MHz	153	5765 MHz
157	5785 MHz	161	5805 MHz	165	5825 MHz

802.11n-HT40/ac-VHT40

Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz	54	5270 MHz
151	5755 MHz	159	5795 MHz	--	--

802.11ac-VHT80

Channel	Frequency	Channel	Frequency	Channel	Frequency
42	5210 MHz	155	5775 MHz	--	--

2.4. Description of Available Antennas

Antenna Type	Frequency Band (MHz)	TX Paths	Max Peak Gain (dBi)
Built-in	2400 ~ 2483.5	1	3
	5150 ~ 5850	1	3

2.5. Description of Antenna RF Port

Antenna RF Port

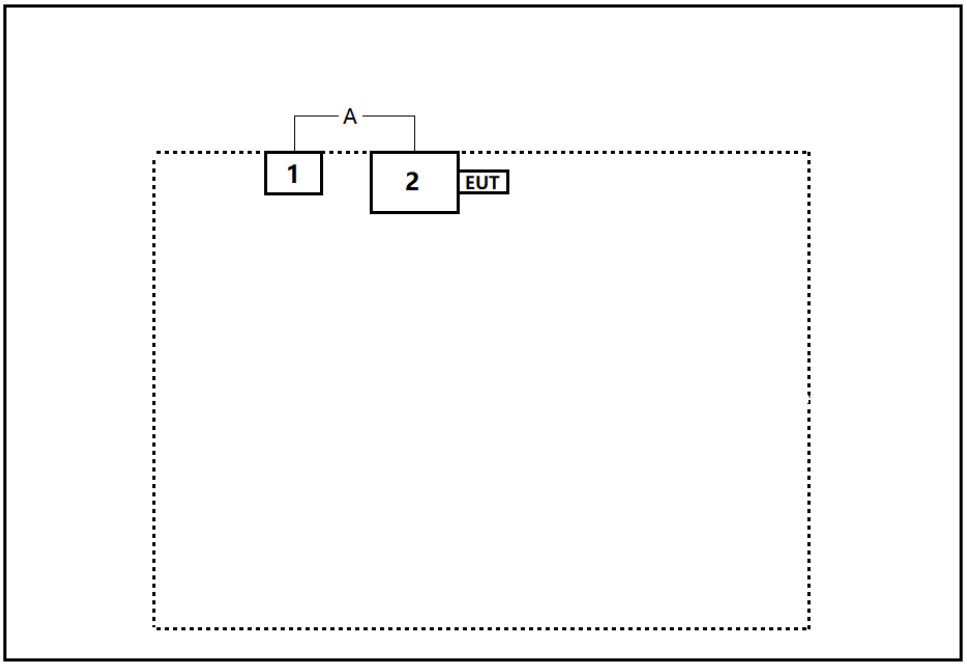
2.6. Test Mode

Test Mode	Mode 1: Transmit by 802.11a (6Mbps)
	Mode 2: Transmit by 802.11n-HT20 (MCS0)
	Mode 3: Transmit by 802.11n-HT40 (MCS0)
	Mode 4: Transmit by 802.11ac-VHT20 (MCS0)
	Mode 5: Transmit by 802.11ac-VHT40 (MCS0)
	Mode 6: Transmit by 802.11ac-VHT80 (MCS0)

2.7. Test Configuration

The EUT was tested per the guidance ANSI C63.10: 2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

Connection Diagram (Mode 1)



Signal Cable Type		Signal Cable Description
A	Power Cable	Non-Shielded, 2m

2.8. 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	Adapter	YEALINK	OH-1015A0502000U2-BZ	N/A	Non-Shielded, 2m
2	IP Phone	YEALINK	SIP-T41S	N/A	Non-Shielded, 2m

2.9. Description of Test Software

The test utility software used during testing was “QCARCT”, and the version was “3.0.250.0”.

Test Mode	Channel No.	Frequency (MHz)	Power Parameter Value	Test Mode	Channel No.	Frequency (MHz)	Power Parameter Value
802.11a	36	5180	19.5	802.11 n-HT20	36	5180	19.5
	44	5220	20.0		44	5220	20.0
	48	5240	20.0		48	5240	20.0
	149	5745	20.0		149	5745	20.0
	157	5785	20.0		157	5785	20.0
	165	5825	20.0		165	5825	20.0
802.11 n-HT40	38	5190	16.5	802.11 ac-VHT20	36	5180	19.5
	46	5230	20.0		44	5220	20.0
	151	5755	20.0		48	5240	20.0
	159	5795	20.0		149	5745	20.0
	--	--	--		157	5785	20.0
	--	--	--		165	5825	20.0
802.11 ac-VHT40	38	5190	16.0	802.11 ac-VHT80	42	5210	15.5
	46	5230	20.0		155	5775	19.5
	151	5755	20.0		--	--	--
	159	5795	20.0		--	--	--

2.10. Device Capabilities

This device contains the following capabilities:

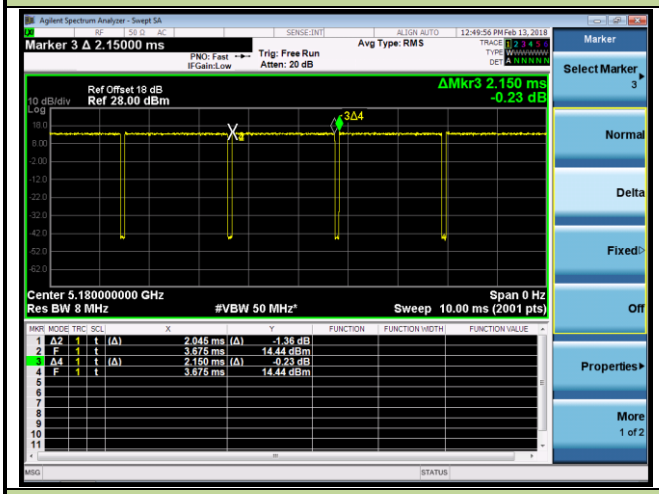
802.11a/b/g/n/ac Wi-Fi Device.

Note: 5GHz (UNII) operation is possible in 20MHz and 40MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz.

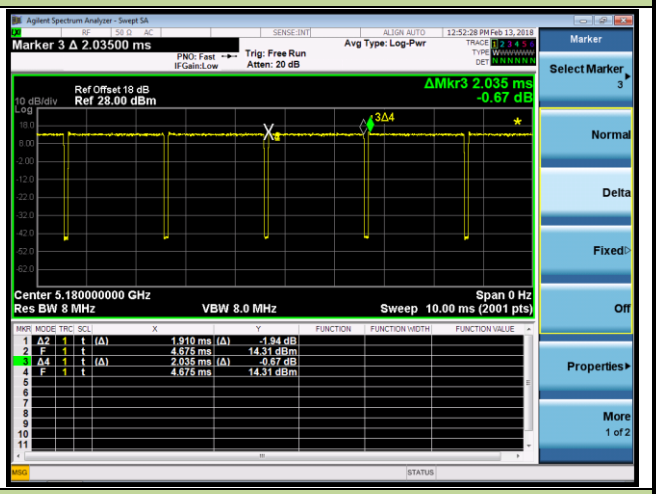
The duty cycles are as follows:

Test Mode	Duty Cycle
802.11a	95.12 %
802.11n-HT20	93.86 %
802.11n-HT40	89.01 %
802.11ac-VHT20	95.08 %
802.11ac-VHT40	89.67 %
802.11ac-VHT80	84.26 %

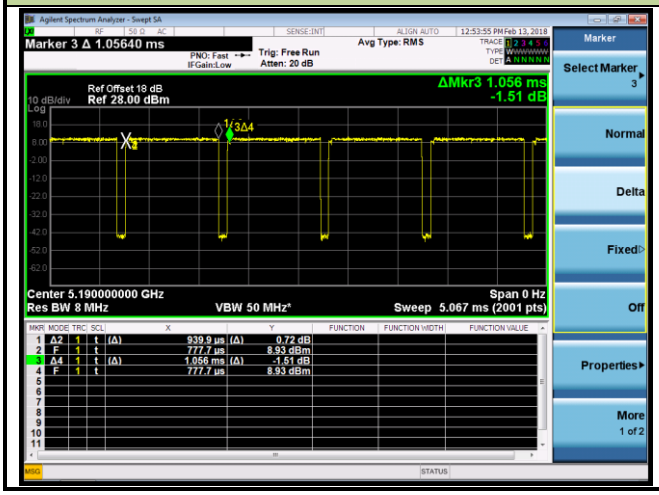
802.11a - T = 2.045 ms



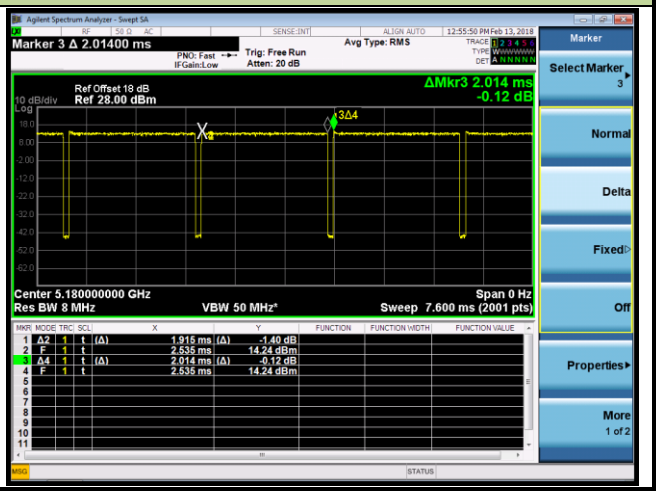
802.11n-HT20 - T = 1.910 ms

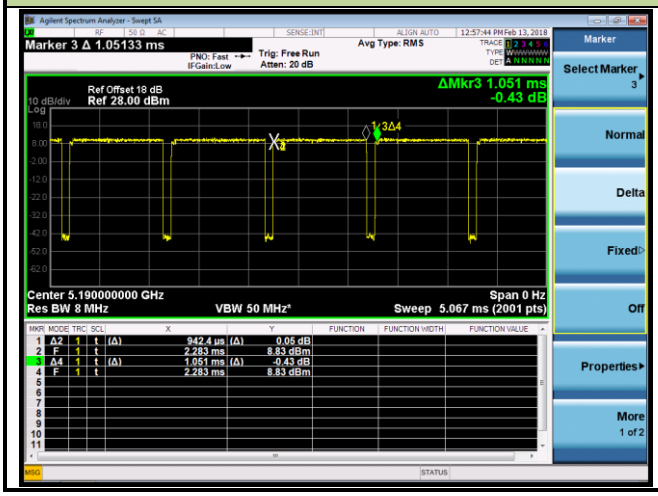
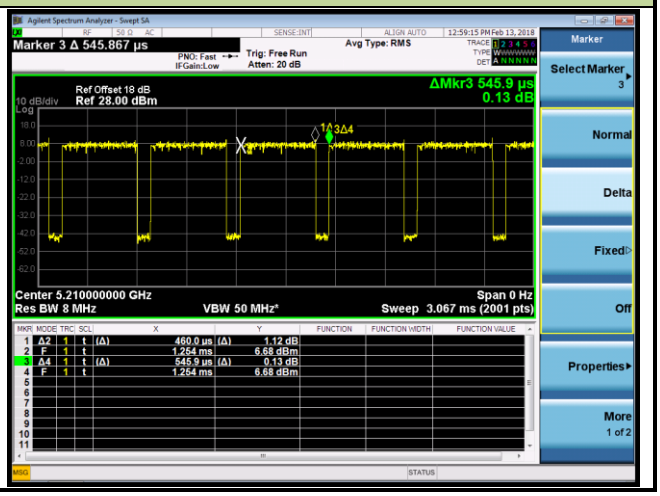


802.11n-HT40 - T = 939.9 us



802.11ac-VHT20 - T = 1.915 ms



802.11ac-VHT40 - T = 942.4 us	802.11ac-VHT80 - T = 460.0 us
	

2.11. Test Configuration

The device was tested per the guidance of KDB 789033 D02v02r01. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.12. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.13. Labeling Requirements

<u>Per 2.1074 & 15.19; Docket 95-19</u>

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 789033 D02v02r01 were used in the measurement.

Deviation from measurement procedure…….....None

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna of the **Wi-Fi USB Dongle** is **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2018/08/18
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2018/06/21
Two-Line V-Network	R&S	ENV216	MRTSUE06003	1 year	2018/06/21
Thermohygrometer	Testo	608-H1	MRTSUE06404	1 year	2018/08/14
Shielding Anechoic Chamber	Mikebang	Chamber-SR2	MRTSUE06215	1 year	2018/05/10

Radiated Disturbance - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
PXA Signal Analyzer	Keysight	9030B	MRTSUE06395	1 year	2018/09/13
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2018/08/18
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2018/11/20
EXA Signal Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2018/04/25
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2018/11/17
Bilog Period Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2018/11/18
Broad Band Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2018/10/21
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06024	1 year	2018/12/14
Amplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2018/06/14
Thermohygrometer	Testo	608-H1	MRTSUE06403	1 year	2018/08/14
Anechoic Chamber	TDK	Chamber-AC1	MRTSUE06212	1 year	2018/05/10

Conducted Test Equipment - TR3

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2018/04/25
Power Meter	Agilent	U2021XA	MRTSUE06030	1 year	2018/12/06
Thermohygrometer	Testo	608-H1	MRTSUE06401	1 year	2018/08/14

Software	Version	Function
e3	V8.3.5	EMI Test Software

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

AC Conducted Emission Measurement - SR2
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement - AC1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 25GHz: 4.76dB

7. TEST RESULT

7.1. Summary

Company Name: **YEALINK(XIAMEN) NETWORK TECHNOLOGY CO.,LTD**

FCC ID: **T2C-WF50**

IC: **10741A-WF50**

FCC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407(a)	26dB Bandwidth	N/A	Conducted	Pass	Section 7.2
15.407(e)	6dB Bandwidth	≥ 500kHz		Pass	Section 7.3
15.407(a)(1)(iv), (3), (4)	Maximum Conducted Output Power	≤ 23.98 dBm U-NII-1 ≤ 30 dBm U-NII-3		Pass	Section 7.4
15.407(a)(1)(iv), (3), (5)	Peak Power Spectral Density	Refer to Section 7.5		Pass	Section 7.5
15.407(g)	Frequency Stability	N/A		Pass	Section 7.6
15.407(b)(1), (4)(i)	Undesirable Emissions	Refer to section 7.8	Radiated	Pass	Section 7.7 & 7.8
15.205, 15.209 15.407(b)(5), (6), (7)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		Pass	
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 7.9

RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
RSS-247 §6.2	99% Bandwidth	N/A	Conducted	Pass	Section 7.2
RSS-247 §6.2.4	6dB Bandwidth	>500kHz		Pass	Section 7.3
RSS-247 §6.2.1, §6.2.4	Max Conducted Output Power	Refer to section 7.4		Pass	Section 7.4
RSS-247 §6.2.1, §6.2.4	Peak Power Spectral Density	Refer to section 7.5		Pass	Section 7.5
RSS-Gen [8.11]	Frequency Stability	N/A		Pass	Section 7.6
RSS-247 §6.2.1, §6.2.4	Out-of-Band Emissions	Refer to section 7.8	Radiated	Pass	Section 7.7 & 7.8
RSS-247 §6.2.1, §6.2.4	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in RSS-Gen [8.9]		Pass	
RSS-Gen [8.8]	AC Conducted Emissions 150kHz - 30MHz	≤ RSS-Gen [8.8] Limit	Line Conducted	Pass	Section 7.9

Notes:

1) All channels, modes, and modulations/data rates were investigated among all UNII bands. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.

7.2. 26dB Bandwidth Measurement

7.2.1.Test Limit

N/A

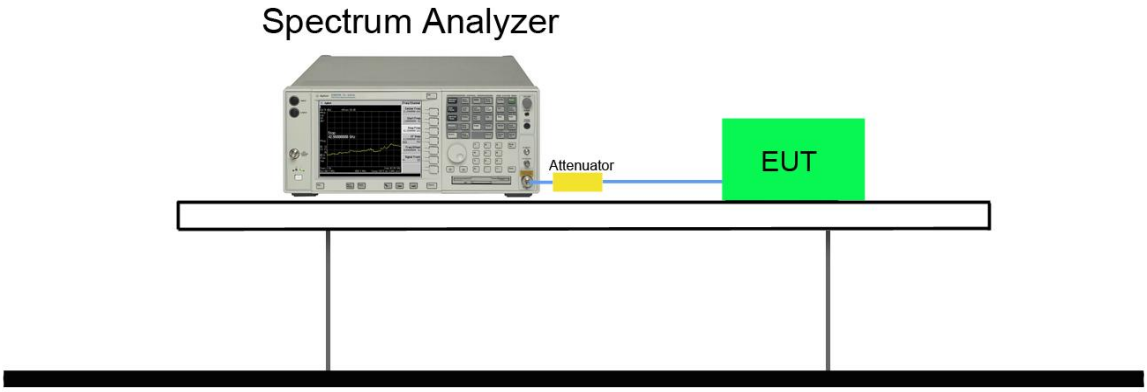
7.2.2.Test Procedure used

KDB 789033 D02v02r01 – Section C.1

7.2.3.Test Setting

1. The analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 26. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediated power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth.
3. VBW ≥ 3 × RBW.
4. Detector = Peak.
5. Trace mode = max hold.

7.2.4.Test Setup



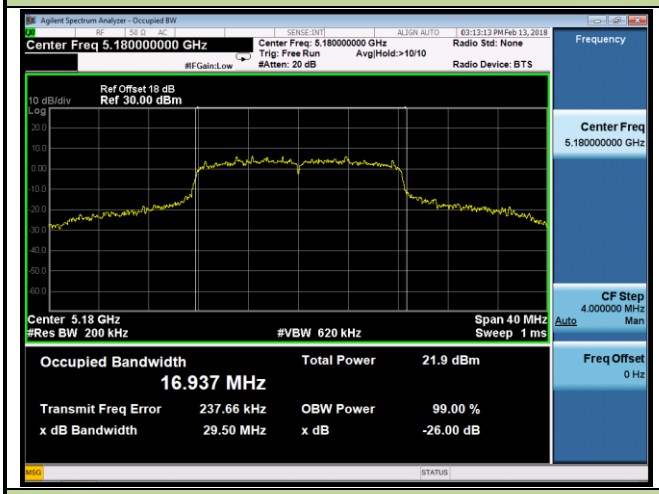
7.2.5.Test Result

Product	Wi-Fi USB Dongle	Temperature	22°C
Test Engineer	Hunk Li	Relative Humidity	54%
Test Site	TR3	Test Date	2018/02/13 ~ 2018/03/11

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
802.11a	6	36	5180	29.50	16.94	Pass
802.11a	6	44	5220	35.67	21.88	Pass
802.11a	6	48	5240	36.60	23.93	Pass
802.11a	6	149	5745	34.11	19.58	Pass
802.11a	6	157	5785	30.73	17.90	Pass
802.11a	6	165	5825	33.10	17.79	Pass
802.11n-HT20	MCS0	36	5180	30.46	17.89	Pass
802.11n-HT20	MCS0	44	5220	33.52	18.36	Pass
802.11n-HT20	MCS0	48	5240	35.78	20.45	Pass
802.11n-HT20	MCS0	149	5745	31.10	18.23	Pass
802.11n-HT20	MCS0	157	5785	36.85	21.72	Pass
802.11n-HT20	MCS0	165	5825	30.33	18.22	Pass
802.11n-HT40	MCS0	38	5190	41.94	35.91	Pass
802.11n-HT40	MCS0	46	5230	76.43	37.38	Pass
802.11n-HT40	MCS0	151	5755	74.81	39.50	Pass
802.11n-HT40	MCS0	159	5795	75.92	42.06	Pass
802.11ac-VHT20	MCS0	36	5180	33.35	17.85	Pass
802.11ac-VHT20	MCS0	44	5220	35.08	19.22	Pass
802.11ac-VHT20	MCS0	48	5240	36.58	20.22	Pass
802.11ac-VHT20	MCS0	149	5745	31.28	18.14	Pass
802.11ac-VHT20	MCS0	157	5785	32.99	18.25	Pass
802.11ac-VHT20	MCS0	165	5825	27.49	17.72	Pass
802.11ac-VHT40	MCS0	38	5190	40.18	35.84	Pass
802.11ac-VHT40	MCS0	46	5230	80.00	39.34	Pass
802.11ac-VHT40	MCS0	151	5755	74.98	37.86	Pass
802.11ac-VHT40	MCS0	159	5795	71.99	37.16	Pass
802.11ac-VHT80	MCS0	42	5210	81.94	75.07	Pass
802.11ac-VHT80	MCS0	155	5775	141.7	78.23	Pass

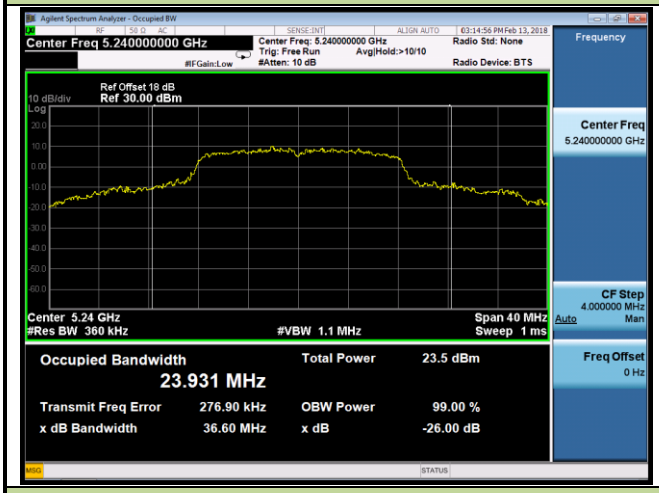
802.11a 26dB Bandwidth & 99% Bandwidth

Channel 36 (5180MHz)

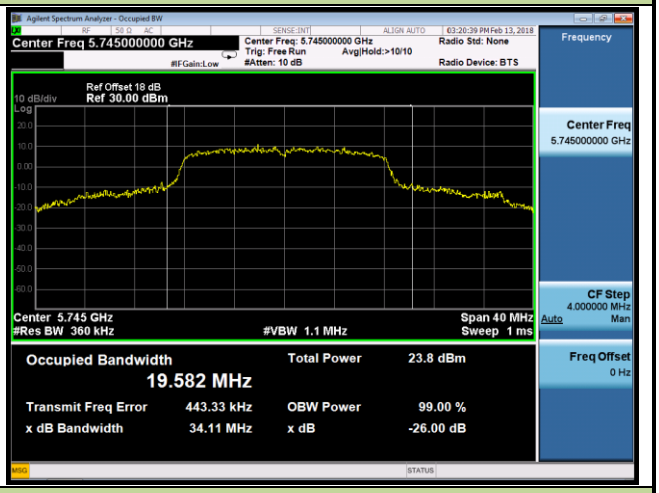


Channel 44 (5220MHz)

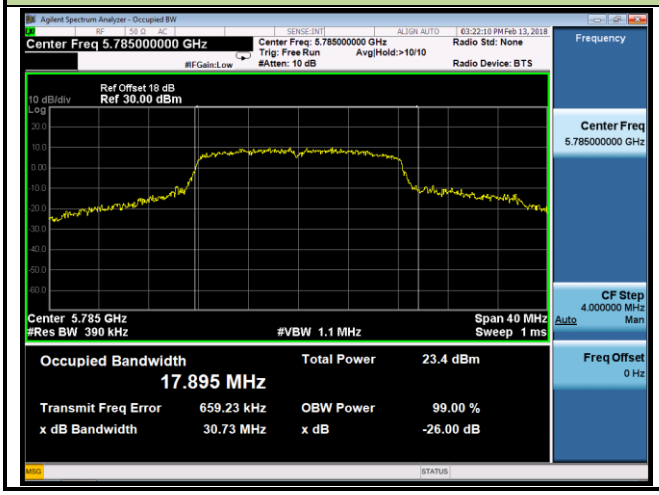
Channel 48 (5240MHz)



Channel 149 (5745MHz)



Channel 157 (5785MHz)



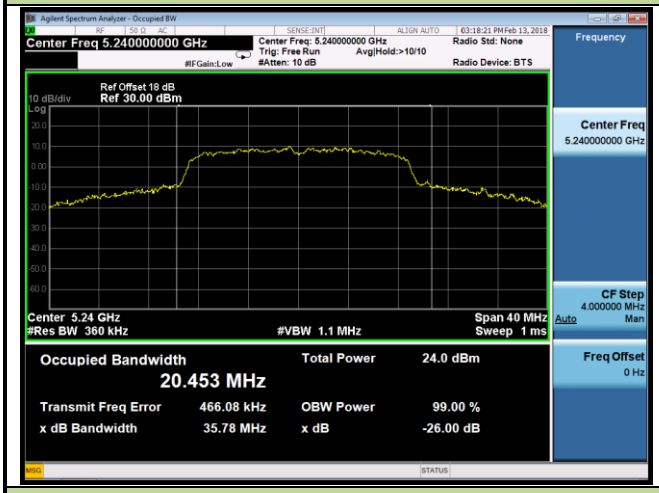
Channel 165 (5825MHz)

802.11n-HT20 26dB Bandwidth & 99% Bandwidth

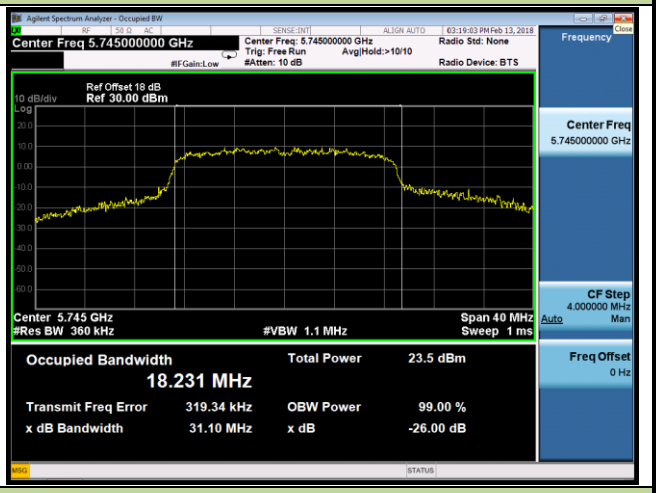
Channel 36 (5180MHz)

Channel 44 (5220MHz)

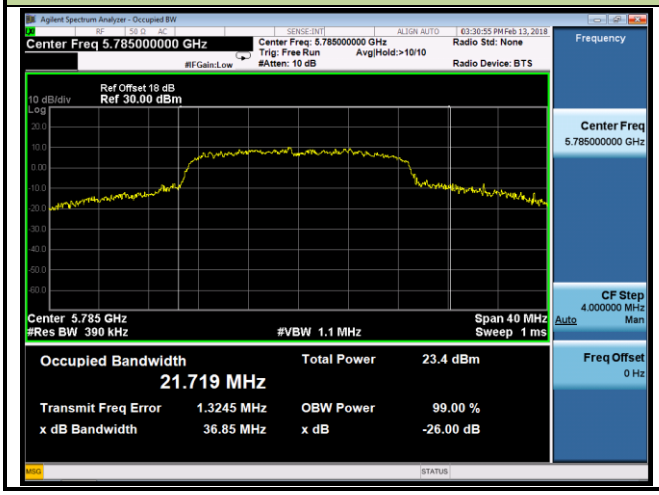
Channel 48 (5240MHz)



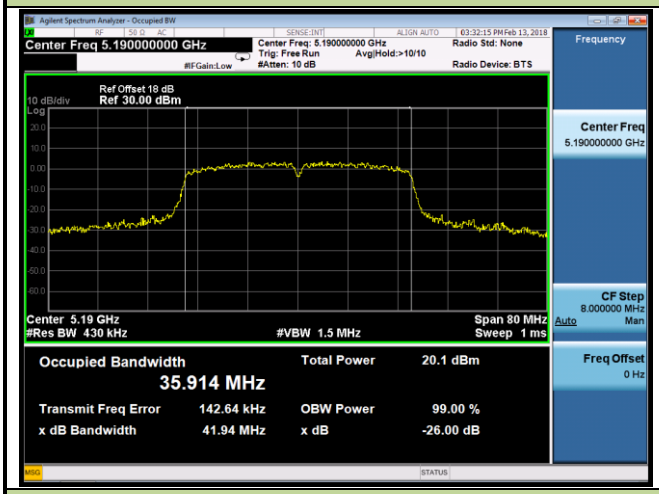
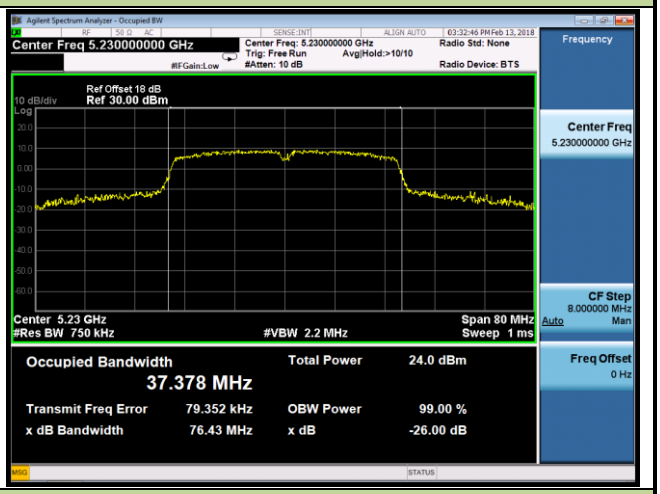
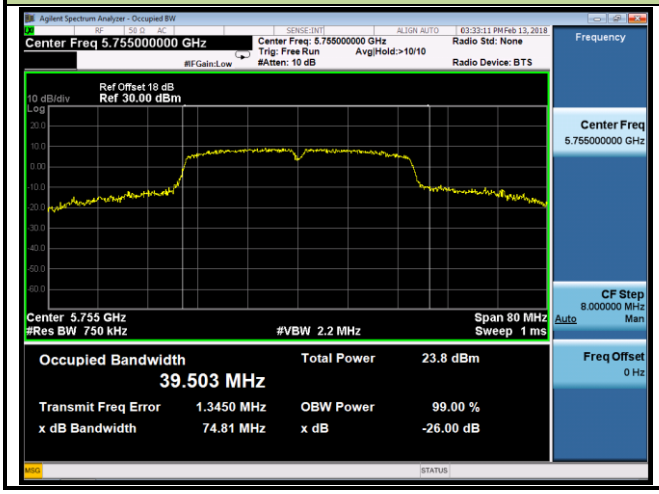
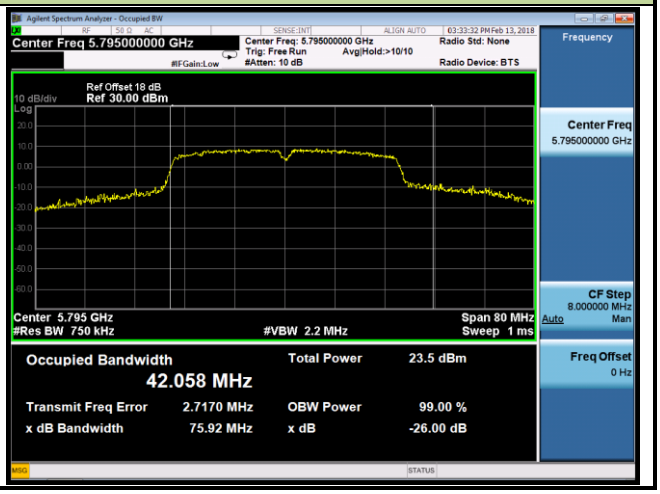
Channel 149 (5745MHz)



Channel 157 (5785MHz)

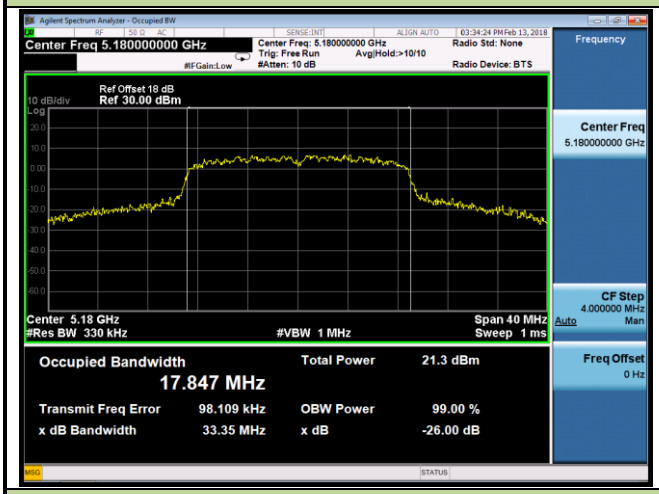


Channel 165 (5825MHz)

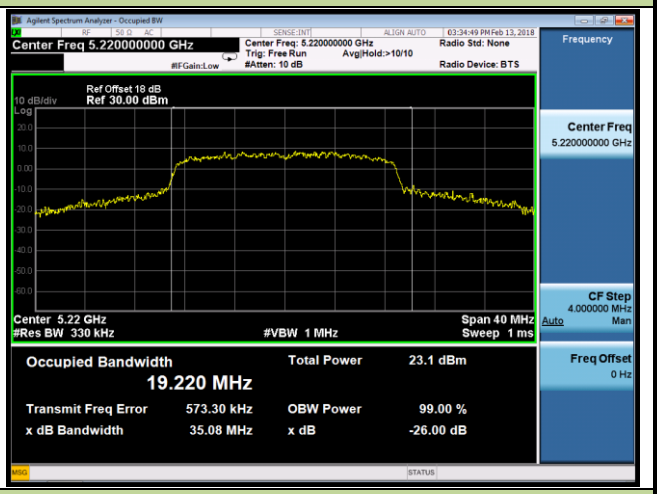
802.11n-HT40 26dB Bandwidth & 99% Bandwidth	
Channel 38 (5190MHz)	Channel 46 (5230MHz)
	
Channel 151 (5755MHz)	Channel 159 (5795MHz)
	

802.11ac-VHT20 26dB Bandwidth & 99% Bandwidth

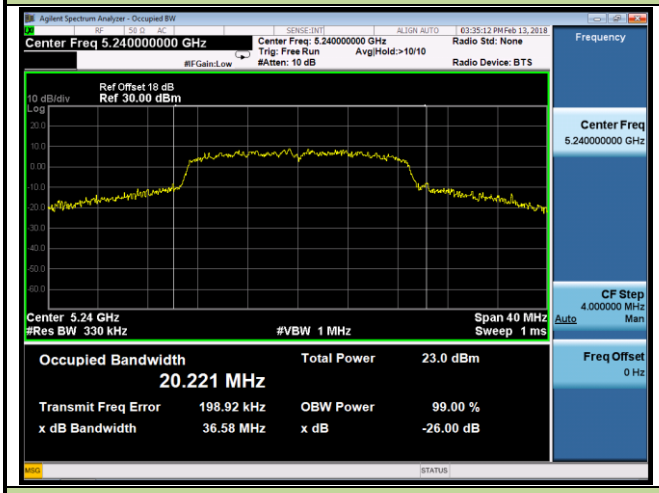
Channel 36 (5180MHz)



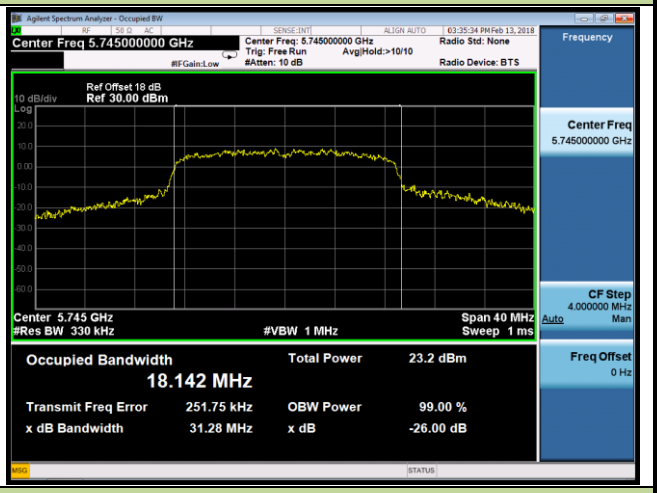
Channel 44 (5220MHz)



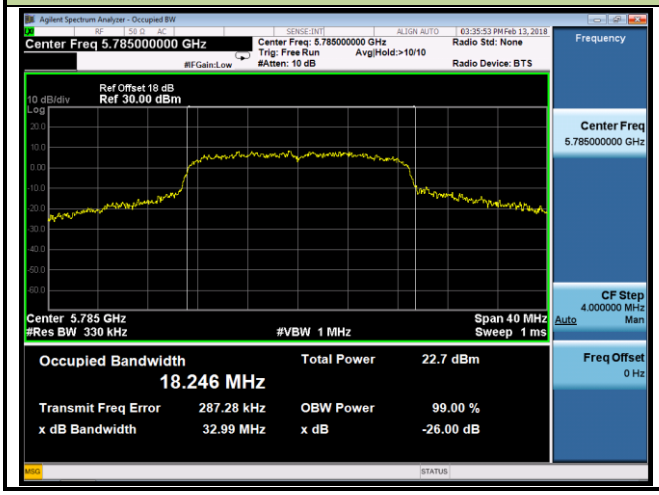
Channel 48 (5240MHz)



Channel 149 (5745MHz)



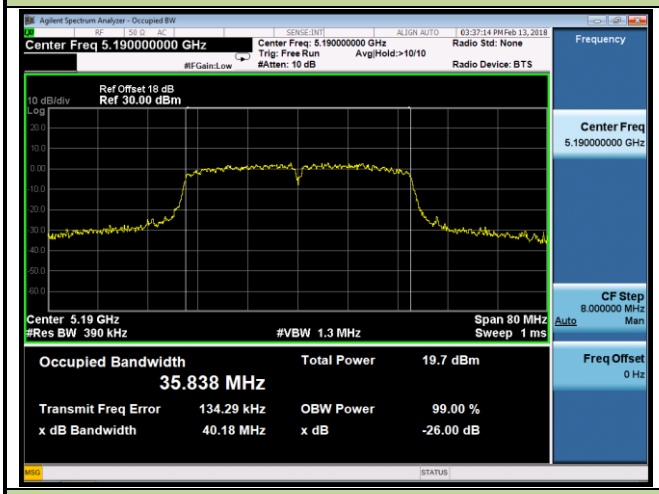
Channel 157 (5785MHz)



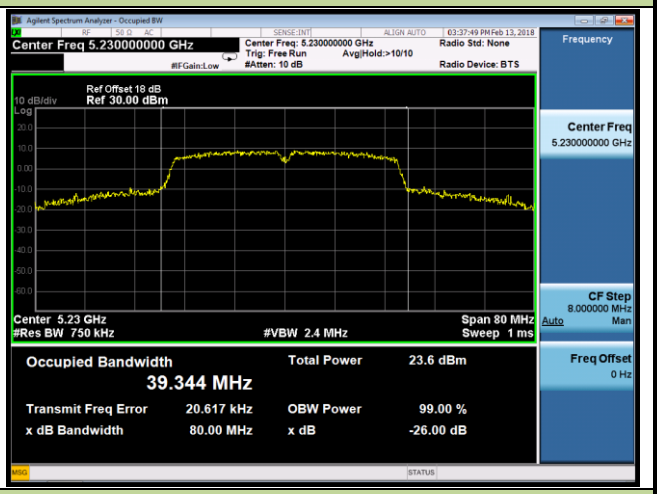
Channel 165 (5825MHz)

802.11ac-VHT40 26dB Bandwidth & 99% Bandwidth

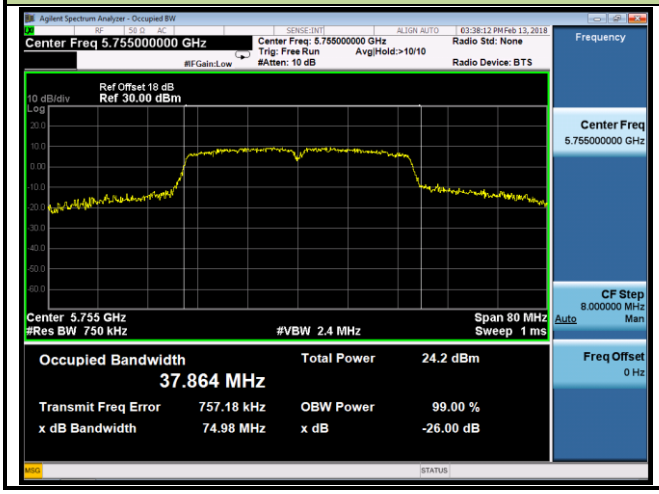
Channel 38 (5190MHz)



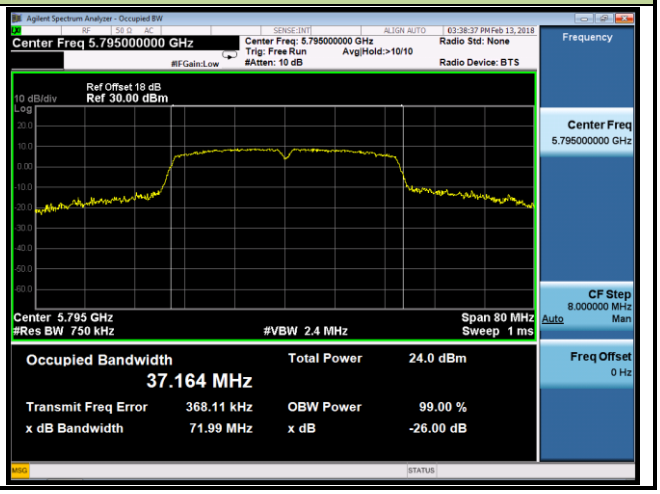
Channel 46 (5230MHz)

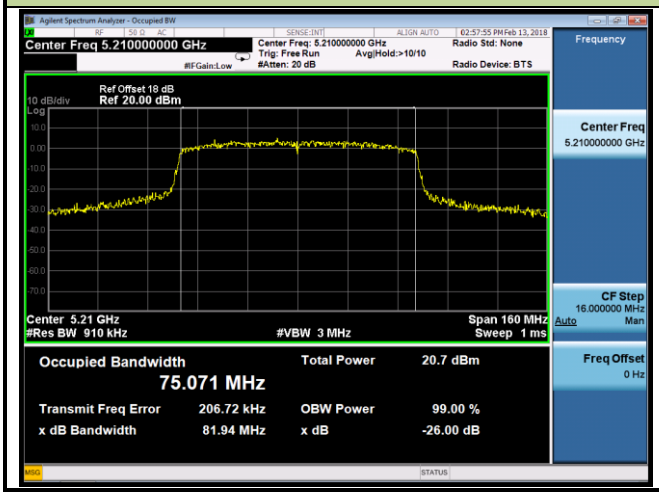


Channel 151 (5755MHz)



Channel 159 (5795MHz)



802.11ac-VHT80 26dB Bandwidth & 99% Bandwidth	
Channel 42 (5210MHz)	Channel 155 (5775MHz)
	

7.3. 6dB Bandwidth Measurement

7.3.1.Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

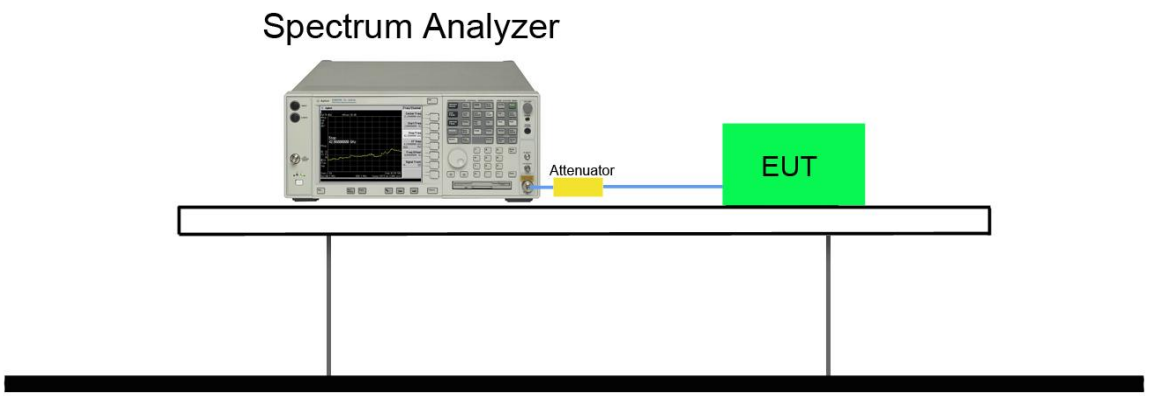
7.3.2.Test Procedure used

KDB 789033 D02v02r01 – Section C.2

7.3.3.Test Setting

1. Set center frequency to the nominal EUT channel center frequency.
2. RBW = 100 kHz.
3. VBW ≧ 3 × RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

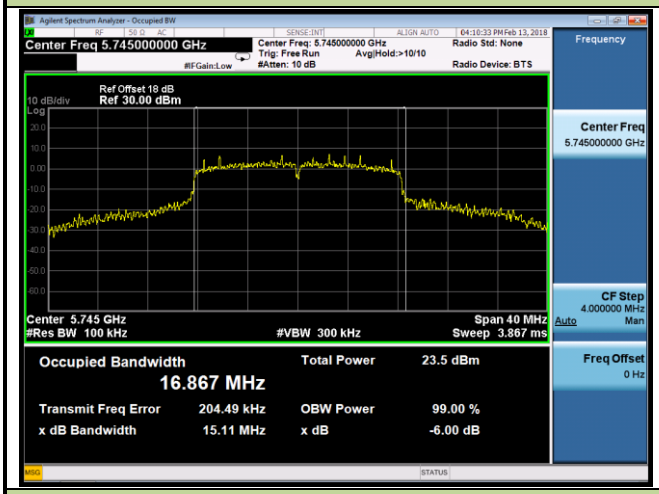
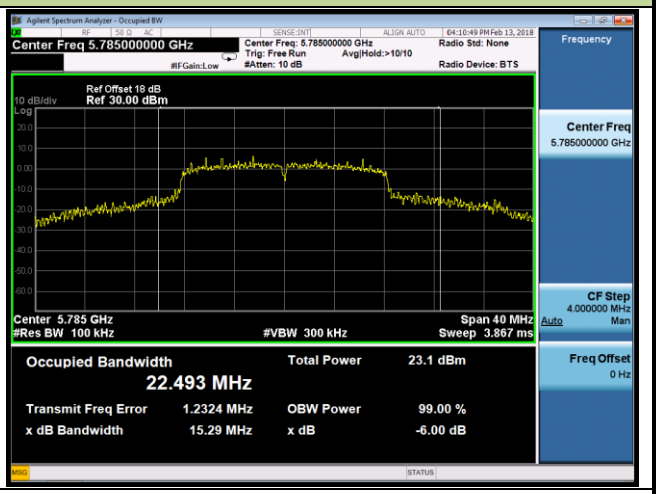
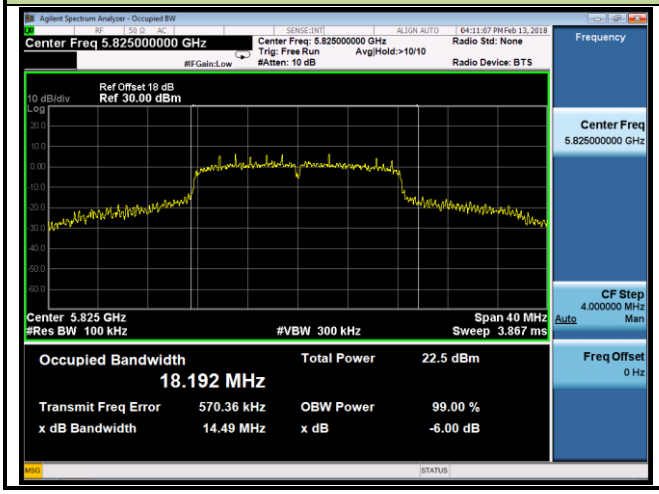
7.3.4.Test Setup



7.3.5.Test Result

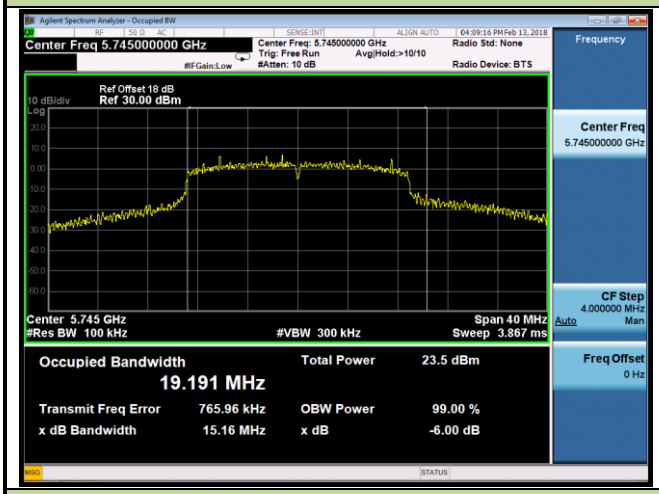
Product	Wi-Fi USB Dongle	Temperature	23°C
Test Engineer	Hunk Li	Relative Humidity	52%
Test Site	TR3	Test Date	2018/02/13

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	6	149	5745	15.11	≥ 0.5	Pass
802.11a	6	157	5785	15.29	≥ 0.5	Pass
802.11a	6	165	5825	14.49	≥ 0.5	Pass
802.11n-HT20	MCS0	149	5745	15.16	≥ 0.5	Pass
802.11n-HT20	MCS0	157	5785	15.06	≥ 0.5	Pass
802.11n-HT20	MCS0	165	5825	14.26	≥ 0.5	Pass
802.11n-HT40	MCS0	151	5755	35.02	≥ 0.5	Pass
802.11n-HT40	MCS0	159	5795	32.72	≥ 0.5	Pass
802.11ac-VHT20	MCS0	149	5745	14.17	≥ 0.5	Pass
802.11ac-VHT20	MCS0	157	5785	15.16	≥ 0.5	Pass
802.11ac-VHT20	MCS0	165	5825	15.12	≥ 0.5	Pass
802.11ac-VHT40	MCS0	151	5755	35.16	≥ 0.5	Pass
802.11ac-VHT40	MCS0	159	5795	33.85	≥ 0.5	Pass
802.11ac-VHT80	MCS0	155	5775	72.65	≥ 0.5	Pass

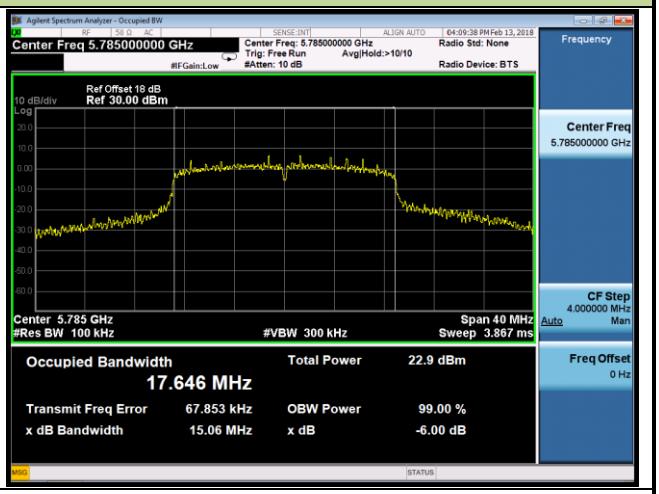
802.11a 6dB Bandwidth	
Channel 149 (5745MHz)	Channel 157 (5785MHz)
	
Channel 165 (5825MHz)	
	

802.11n-HT20 6dB Bandwidth

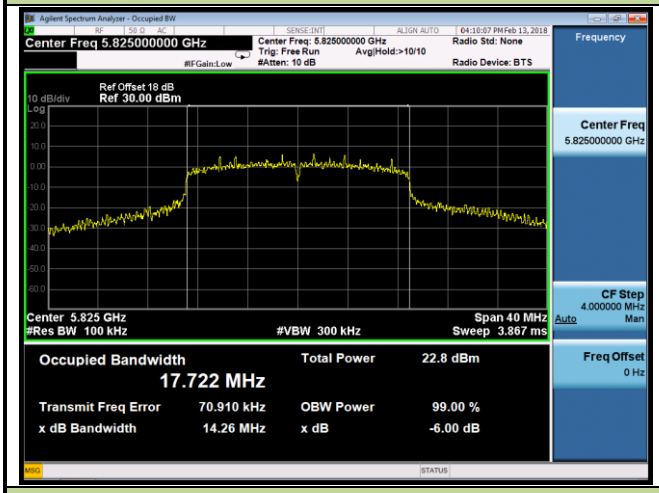
Channel 149 (5745MHz)



Channel 157 (5785MHz)

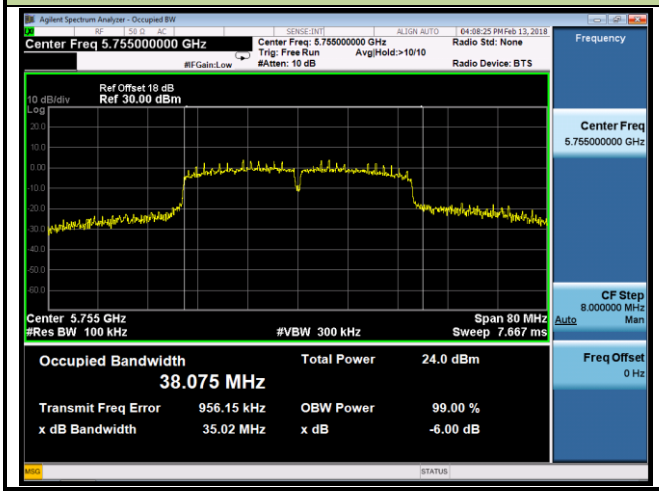


Channel 165 (5825MHz)

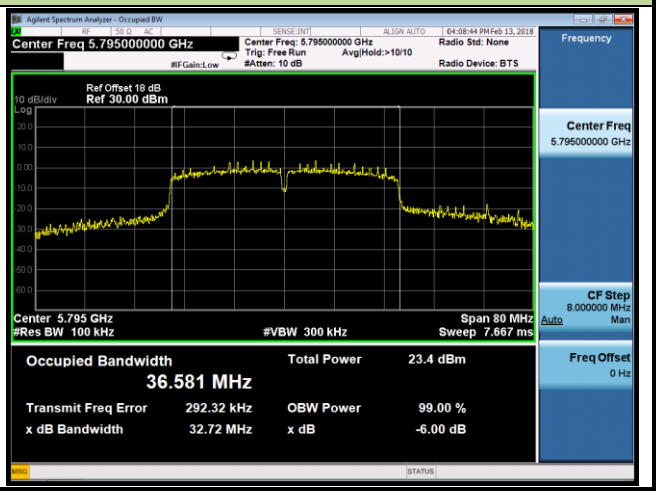


802.11n-HT40 6dB Bandwidth

Channel 151 (5755MHz)

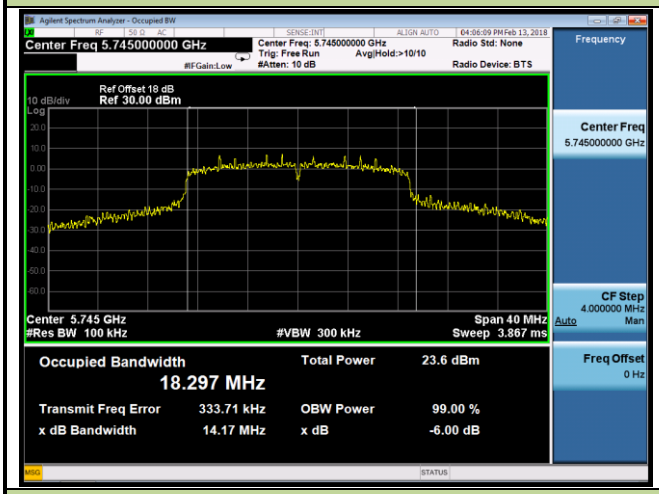


Channel 159 (5795MHz)

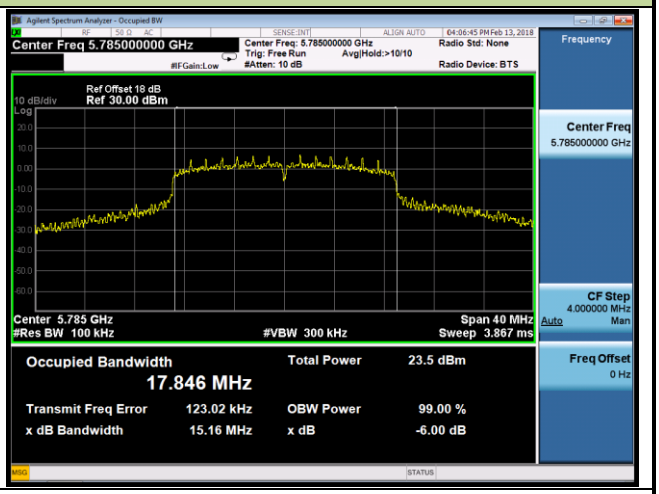


802.11ac-VHT20 6dB Bandwidth

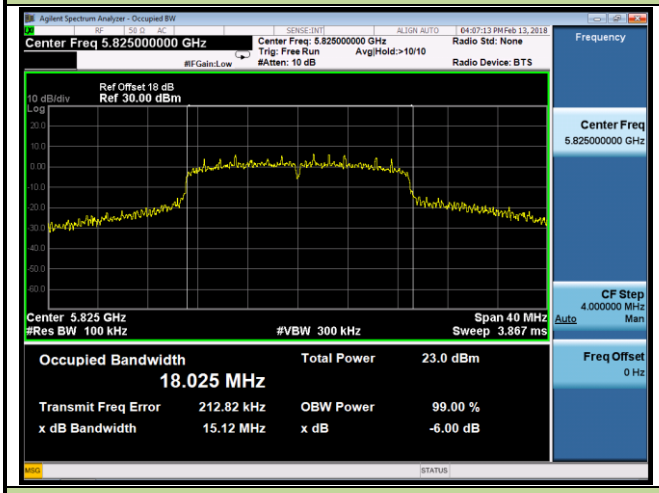
Channel 149 (5745MHz)



Channel 157 (5785MHz)

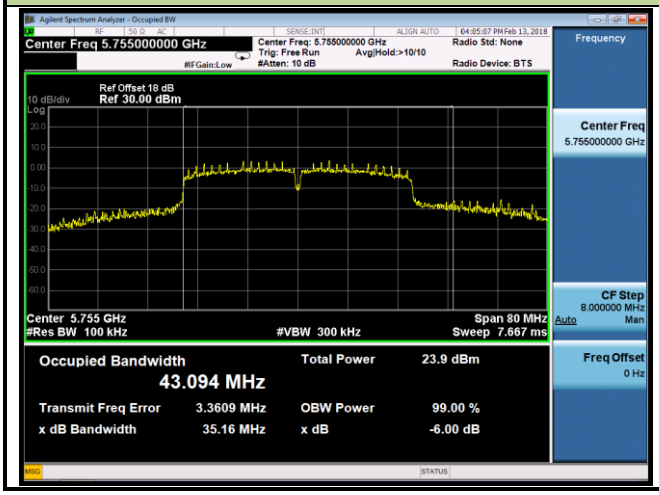


Channel 165 (5825MHz)

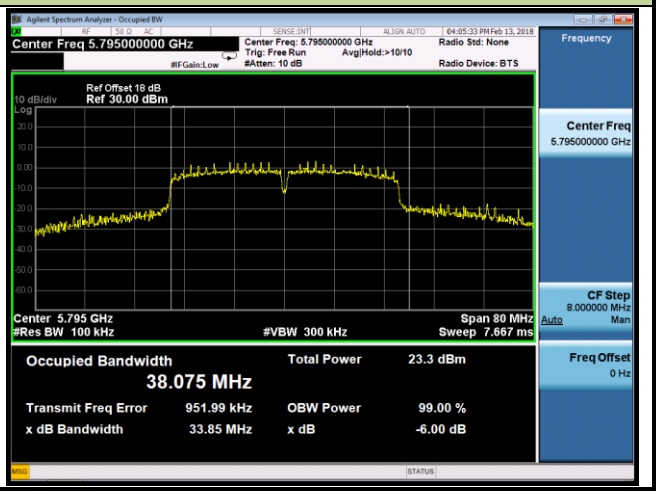


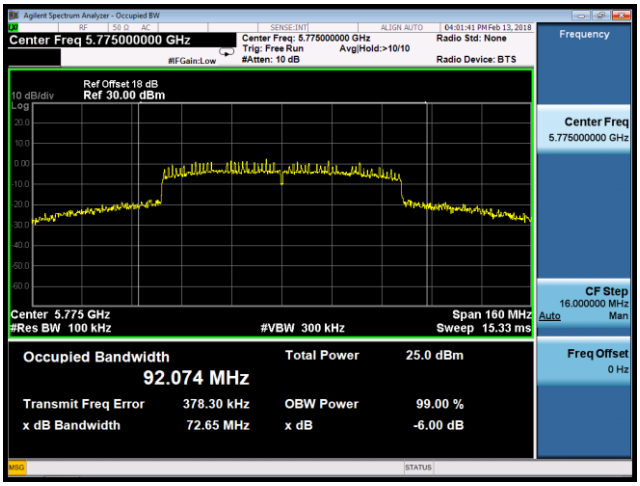
802.11ac-VHT40 6dB Bandwidth

Channel 151 (5755MHz)



Channel 159 (5795MHz)



802.11ac-VHT80 6dB Bandwidth	
Channel 155 (5775MHz)	
	

7.4. Output Power Measurement

7.4.1.Test Limit

For FCC

For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For IC

For the band 5.15-5.25 GHz, the maximum e.i.r.p. shall not exceed 200 mW (23.01dBm) or 10 + 10 $\log_{10}$ B, dBm, whichever is less. B is the 99% emission bandwidth in MHz.

For the 5.725-5.85 GHz band, the maximum conducted output power shall not exceed 1 W.

If transmitting antennas of directional gain greater than 6dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

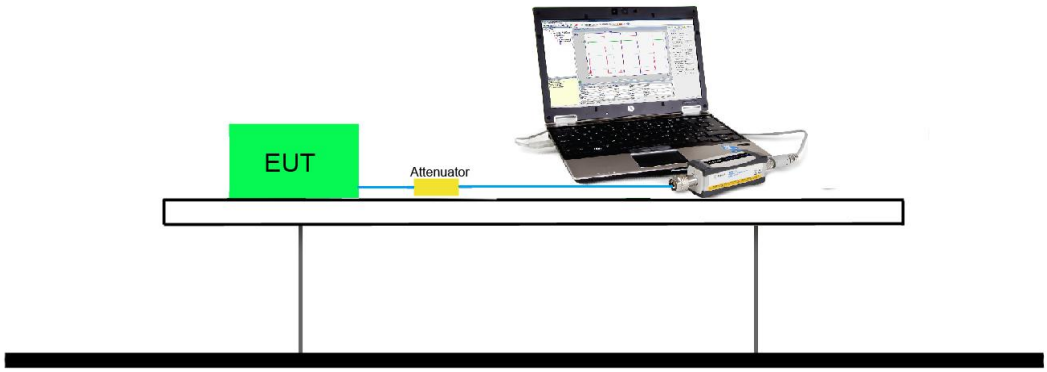
7.4.2.Test Procedure Used

KDB 789033 D02v02r01 - Section E) 3) b) Method PM-G

7.4.3.Test Setting

Average power measurements were perform only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

7.4.4.Test Setup



7.4.5.Test Result

Power output test was verified over all data rates of each mode shown as below, and then choose the maximum power output (Gray Marker) for final test of each channel.

Output power at various data rates:

Test Mode	Bandwidth	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)
802.11a	20	36	5180	6	16.38
				24	16.01
				54	15.72
802.11n	20	36	5180	MCS0	16.35
				MCS3	16.03
				MCS7	15.68
802.11n	40	38	5190	MCS0	14.12
				MCS3	13.79
				MCS7	13.44
802.11ac	20	36	5180	MCS0	16.14
				MCS4	15.77
				MCS8	15.37
802.11ac	40	38	5190	MCS0	13.72
				MCS4	13.34
				MCS9	13.03
802.11ac	80	42	5210	MCS0	13.24
				MCS4	12.86
				MCS9	12.47

Product	Wi-Fi USB Dongle	Temperature	22°C
Test Engineer	Hunk Li	Relative Humidity	54%
Test Site	TR3	Test Date	2018/02/08

Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Average Power (dBm)	Average Power Limit (dBm)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Result
11a	6	36	5180	16.38	≤ 23.98	19.38	22.29	Pass
11a	6	44	5220	17.10	≤ 23.98	20.10	22.29	Pass
11a	6	48	5240	16.78	≤ 23.98	19.78	22.29	Pass
11a	6	149	5745	17.30	≤ 30.00	--	--	Pass
11a	6	157	5785	16.71	≤ 30.00	--	--	Pass
11a	6	165	5825	16.28	≤ 30.00	--	--	Pass
11n-HT20	MCS0	36	5180	16.35	≤ 23.98	19.35	22.53	Pass
11n-HT20	MCS0	44	5220	16.81	≤ 23.98	19.81	22.53	Pass
11n-HT20	MCS0	48	5240	16.47	≤ 23.98	19.47	22.53	Pass
11n-HT20	MCS0	149	5745	17.17	≤ 30.00	--	--	Pass
11n-HT20	MCS0	157	5785	16.72	≤ 30.00	--	--	Pass
11n-HT20	MCS0	165	5825	16.38	≤ 30.00	--	--	Pass
11n-HT40	MCS0	38	5190	14.12	≤ 23.98	17.12	23.01	Pass
11n-HT40	MCS0	46	5230	16.70	≤ 23.98	19.70	23.01	Pass
11n-HT40	MCS0	151	5755	17.13	≤ 30.00	--	--	Pass
11n-HT40	MCS0	159	5795	16.57	≤ 30.00	--	--	Pass
11ac-VHT20	MCS0	36	5180	16.14	≤ 23.98	19.14	22.52	Pass
11ac-VHT20	MCS0	44	5220	16.65	≤ 23.98	19.65	22.52	Pass
11ac-VHT20	MCS0	48	5240	16.42	≤ 23.98	19.42	22.52	Pass
11ac-VHT20	MCS0	149	5745	17.37	≤ 30.00	--	--	Pass
11ac-VHT20	MCS0	157	5785	16.61	≤ 30.00	--	--	Pass
11ac-VHT20	MCS0	165	5825	16.31	≤ 30.00	--	--	Pass
11ac-VHT40	MCS0	38	5190	13.72	≤ 23.98	16.72	23.01	Pass
11ac-VHT40	MCS0	46	5230	16.82	≤ 23.98	19.82	23.01	Pass
11ac-VHT40	MCS0	151	5755	17.35	≤ 30.00	--	--	Pass
11ac-VHT40	MCS0	159	5795	16.65	≤ 30.00	--	--	Pass
11ac-VHT80	MCS0	42	5210	13.24	≤ 23.98	16.24	23.01	Pass
11ac-VHT80	MCS0	155	5775	16.86	≤ 30.00	--	--	Pass

Note 1: Max Conducted Output Power Limit Calculation as below:

Note 2: EIRP Power Limit Calculation as below:

For 5150-5250MHz

802.11a: 10 + 10 $\log_{10}$ (16.94MHz) = 22.29dBm < 23.01dBm;

802.11n-HT20: 10 + 10 $\log_{10}$ (17.89MHz) = 22.53dBm < 23.01dBm;

802.11n-HT40: 10 + 10 $\log_{10}$ B > 23.01dBm;

802.11ac-VHT20: 10 + 10 $\log_{10}$ (17.85MHz) = 22.52dBm < 23.01dBm;

802.11ac-VHT40: 10 + 10 $\log_{10}$ B > 23.01dBm;

802.11ac-VHT80: 10 + 10 $\log_{10}$ B > 23.01dBm.

7.5. Power Spectral Density Measurement

7.5.1.Test Limit

For FCC

For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

If transmitting antennas of directional gain greater than 6dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

For IC

For the band 5.15-5.25 GHz, the e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

For the 5.725-5.85 GHz band, the power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.5.2.Test Procedure Used

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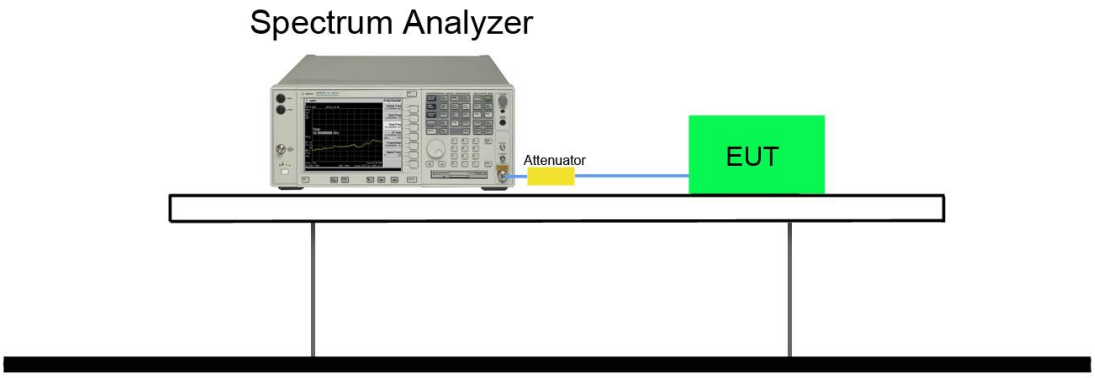
7.5.3.Test Setting

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire 26dB OBW of the signal.
3. RBW = 1MHz, if measurement bandwidth of Maximum PSD is specified in 500 kHz,
4. RBW = 100 kHz
5. VBW = 3MHz
6. Number of sweep points ≥ 2 × (span / RBW)
7. Detector = power averaging (RMS)
8. Sweep time = auto
9. Trigger = free run
10. Use the peak search function on the instrument to find the peak of the spectrum and record its value.

11. Add 10*log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add 10*log(1/0.25) = 6 dB if the duty cycle is 25 percent.
12. When the measurement bandwidth of Maximum PSD is specified in 500 kHz, add a constant factor 10*log(500kHz/100kHz) = 6.99 dB to the measured result

7.5.4.Test Setup



7.5.5.Test Result

Product	Wi-Fi USB Dongle	Temperature	22°C
Test Engineer	Hunk Li	Relative Humidity	54%
Test Site	TR3	Test Date	2018/02/13 ~ 2018/03/01

Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	PSD (dBm / MHz)	Duty Cycle (%)	Final PSD (dBm / MHz)	Limit (dBm / MHz)	EIRP PSD (dBm / MHz)	EIRP Limit (dBm / MHz)	Result
11a	6	36	5180	5.12	95.12	5.34	≤ 11.00	8.34	10.00	Pass
11a	6	44	5220	6.41	95.12	6.63	≤ 11.00	9.63	10.00	Pass
11a	6	48	5240	6.13	95.12	6.35	≤ 11.00	9.35	10.00	Pass
11n-HT20	MCS0	36	5180	4.81	93.86	5.09	≤ 11.00	8.09	10.00	Pass
11n-HT20	MCS0	44	5220	6.29	93.86	6.57	≤ 11.00	9.57	10.00	Pass
11n-HT20	MCS0	48	5240	6.36	93.86	6.64	≤ 11.00	9.64	10.00	Pass
11n-HT40	MCS0	38	5190	-0.17	89.01	0.34	≤ 11.00	3.34	10.00	Pass
11n-HT40	MCS0	46	5230	3.03	89.01	3.54	≤ 11.00	6.54	10.00	Pass
11ac-VHT20	MCS0	36	5180	4.64	95.08	4.86	≤ 11.00	7.86	10.00	Pass
11ac-VHT20	MCS0	44	5220	6.05	95.08	6.27	≤ 11.00	9.27	10.00	Pass
11ac-VHT20	MCS0	48	5240	5.59	95.08	5.81	≤ 11.00	8.81	10.00	Pass
11ac-VHT40	MCS0	38	5190	-0.96	89.67	-0.49	≤ 11.00	2.51	10.00	Pass
11ac-VHT40	MCS0	46	5230	2.98	89.67	3.45	≤ 11.00	6.45	10.00	Pass
11ac-VHT80	MCS0	42	5210	-4.24	84.26	-3.50	≤ 11.00	-0.50	10.00	Pass

Note 1: When EUT duty cycle < 98%, Final PSD (dBm/MHz) = PSD (dBm/MHz) + 10*log (1/Duty Cycle).

Note 2: EIRP PSD (dBm/MHz) = Final PSD (dBm/MHz) + Antenna Gain (dBi).

Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	PSD (dBm/ 100KHz)	Duty Cycle (%)	Constant Factor	Final PSD (dBm/ 500kHz)	Limit (dBm/ MHz)	Result
11a	6	149	5745	-2.11	95.12	6.99	5.10	30.00	Pass
11a	6	157	5785	-2.90	95.12	6.99	4.31	30.00	Pass
11a	6	165	5825	-3.19	95.12	6.99	4.02	30.00	Pass
11n-HT20	MCS0	149	5745	-2.71	93.86	6.99	4.56	30.00	Pass
11n-HT20	MCS0	157	5785	-3.27	93.86	6.99	4.00	30.00	Pass
11n-HT20	MCS0	165	5825	-3.58	93.86	6.99	3.69	30.00	Pass
11n-HT40	MCS0	151	5755	-5.87	89.01	6.99	1.63	30.00	Pass
11n-HT40	MCS0	159	5795	-6.27	89.01	6.99	1.23	30.00	Pass
11ac-VHT20	MCS0	149	5745	-2.43	95.08	6.99	4.78	30.00	Pass
11ac-VHT20	MCS0	157	5785	-3.38	95.08	6.99	3.83	30.00	Pass
11ac-VHT20	MCS0	165	5825	-3.35	95.08	6.99	3.86	30.00	Pass
11ac-VHT40	MCS0	151	5755	-5.66	89.67	6.99	1.80	30.00	Pass
11ac-VHT40	MCS0	159	5795	-6.41	89.67	6.99	1.05	30.00	Pass
11ac-VHT80	MCS0	155	5775	-9.71	84.26	6.99	-1.98	30.00	Pass

Note: When EUT duty cycle < 98%, Final PSD (dBm/500kHz) = PSD (dBm/100kHz) + Constant Factor + 10*log (1/Duty Cycle).