MEASUREMENT REPORT

FCC PART 15.407 WLAN 802.11a/n

FCC ID:	2ATZUSOIMTZS11HA8SA
APPLICANT:	SAIC MOTOR Overseas Intelligent Mobility Technology Co., Ltd.
Application Type:	Certification
Product:	Color Radio
Model No.:	10682313/01
FCC Classification:	Unlicensed National Information Infrastructure (NII)
FCC Rule Part(s):	Part15 Subpart C (Section 15.407)
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02v02r01
Test Date:	August 16, 2019 ~ October 14, 2019

Reviewed By: (Kevin Guo)

Approved By: (Robin Wu)

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

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 ANSI C63.10-2013. 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
1907WSU008-U3	Rev. 01	Initial report	02-02-2020	Valid

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§2.1033General Information

Applicant:	SAIC MOTOR Overseas Intelligent Mobility Technology Co., Ltd.
Applicant Address:	2nd Floor, Building No.8, No.2119 ZhangYang Rd., PuDong District, Shanghai, China
Manufacturer:	SAIC MOTOR Overseas Intelligent Mobility Technology Co., Ltd.
Manufacturer Address:	2nd Floor, Building No.8, No.2119 ZhangYang Rd., PuDong District, Shanghai, China
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
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 ANSI C63.4-2014.**
- **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, Radio and SAR testing.**

Accredited Laboratory

MRT TECHNOLOGY (SUZHOU) CO., LTD.

Electrical Testing

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, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The measurement facility compliant with the test site requirements specified in ANSI C63.4-2014.

2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name:	Color Radio
Model No.:	10682313/01
Wi-Fi Specification:	802.11a/b/g/n
Bluetooth Version:	v4.1 single mode
GSM Band(s):	850MHz / 1900MHz
WCDMA Band(s):	Band II / IV / V
LTE Band(s):	FDD Band 2 / 4 / 5 / 12 / 13 / 17
Working Voltage:	DC 12V

2.2. Product Specification Subjective to this Report

Frequency Range:	For 802.11a/n-HT20: 5180~5240MHz, 5745~5825MHz For 802.11n-HT40: 5190~5230MHz, 5755~5795MHz
Type of Modulation:	802.11a/n: OFDM
Data Rate:	802.11a: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 150Mbps
Antenna Type	Chip Antenna
Antenna Gain	4.13dBi

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

2.3. Working Frequencies for this report

802.11a/n-HT20

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

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

2.4. 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)

2.5. Description of Test Software

The test utility software used during testing was provided by the customer.

2.6. Device Capabilities

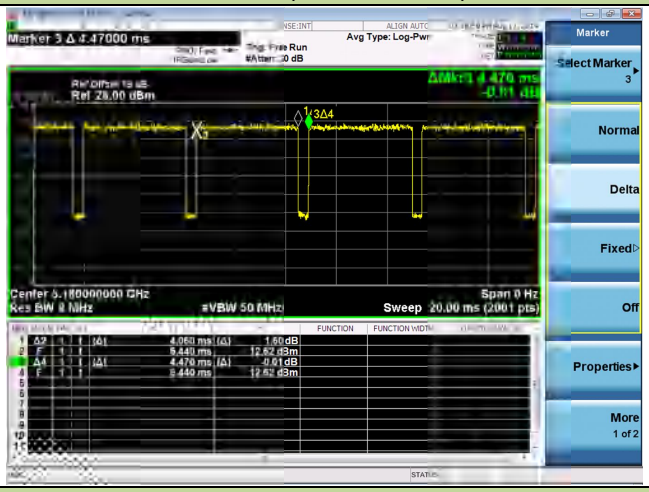
This device contains the following capabilities:

802.11a/b/g/n Wi-Fi, Bluetooth v4.1-single mode, GSM/UMTS/LTE Device.

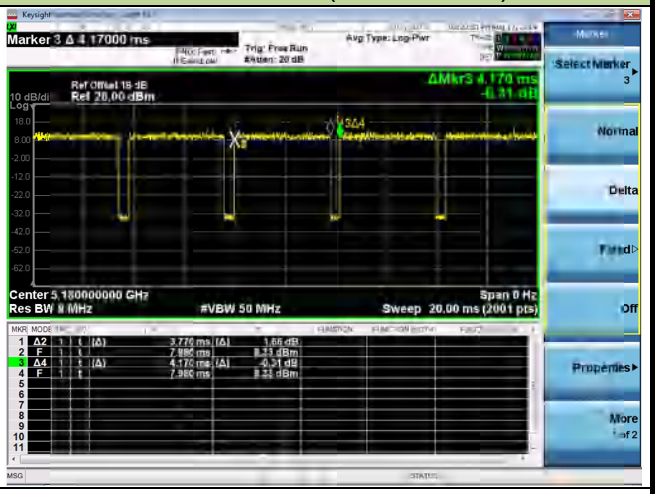
Note: 5GHz (NII) operation is possible in 20MHz, 40MHz. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = average. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
802.11a	90.83 %
802.11n-HT20	90.41 %
802.11n-HT40	82.12%

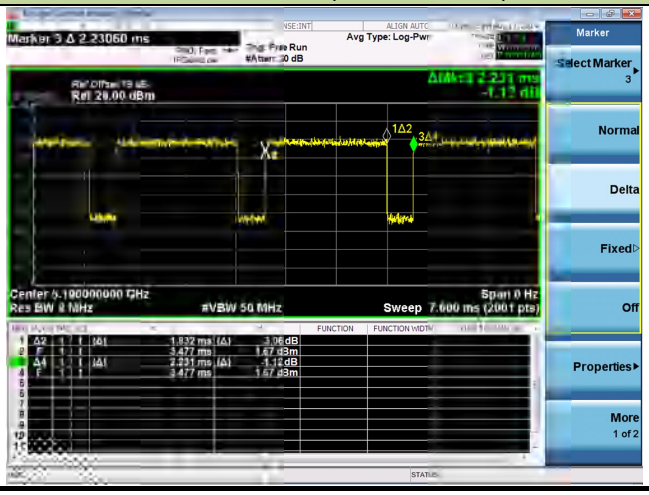
802.11a (T = 4.060ms)



802.11n-HT20 (T = 3.770ms)



802.11n-HT40 (T = 1.832ms)



2.7. 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.

2.8. EMI Suppression Device(s)/Modifications

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

2.9. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

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 an8'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. An80cm 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 device 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	ESR3	MRTSUE06185	1 year	2020/04/15
Two-Line V-Network	R&S	ENV 216	MRTSUE06002	1 year	2020/06/13
Two-Line V-Network	R&S	ENV 216	MRTSUE06003	1 year	2020/06/13
Thermohygrometer	Testo	608-H1	MRTSUE06404	1 year	2020/08/08
Shielding Room	MIX-BEP	Chamber-SR2	MRTSUE06215	N/A	N/A

Radiated Emissions - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2020/08/01
PXA Signal Analyzer	Keysight	N9030B	MRTSUE06395	1 year	2020/09/03
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2019/11/09
Bilog Period Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2020/03/31
Broad Band Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06023	1 year	2019/10/19
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06024	1 year	2019/12/17
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2019/11/16
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2020/06/11
Thermohygrometer	Testo	608-H1	MRTSUE06403	1 year	2020/08/08
Anechoic Chamber	TDK	Chamber-AC1	MRTSUE06212	1 year	2020/04/30

Radiated Emission - AC2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Keysight	N9038A	MRTSUE06125	1 year	2020/08/01
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2019/11/09
Bilog Period Antenna	Schwarzbeck	VULB 9162	MRTSUE06022	1 year	2019/10/19
Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06171	1 year	2019/11/09
Broad Band Horn Antenna	Schwarzbeck	BBHA 9170	MRTSUE06024	1 year	2019/12/17
Broadband Coaxial Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06176	1 year	2019/11/16
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2020/06/11
Temperature/Humidity Meter	Minggao	ETH529	MRTSUE06170	1 year	2019/12/13
Anechoic Chamber	RIKEN	Chamber-AC2	MRTSUE06213	1 year	2020/04/30

Software	**Version**	**Function**
EMI Software	V3	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.

Conducted Emission Measurement - SR2
The maximum measurement uncertainty is evaluated as: 9kHz~150kHz: 3.84dB 150kHz~30MHz: 3.46dB
Radiated Emission Measurement - AC1
The maximum measurement uncertainty is evaluated as: Horizontal: 30MHz~300MHz: 4.07dB 300MHz~1GHz: 3.63dB 1GHz~18GHz: 4.16dB Vertical: 30MHz~300MHz: 4.18dB 300MHz~1GHz: 3.60dB 1GHz~18GHz: 4.76dB
Radiated Emission Measurement - AC2
The maximum measurement uncertainty is evaluated as: Horizontal: 30MHz~300MHz: 3.75dB 300MHz~1GHz: 3.53dB 1GHz~18GHz: 4.28dB Vertical: 30MHz~300MHz: 3.86dB 300MHz~1GHz: 3.53dB 1GHz~18GHz: 4.33dB

7. TEST RESULT

7.1. Summary

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)	Maximum Conducted Output Power	≤ 24dBm U-NII-1 ≤ 30dBm U-NII-3		Pass	Section 7.4
15.407(a)(1)(iv), (3)	Peak Power Spectral Density	≤ 11dBm/MHz U-NII-1 ≤ 30dBm/500kHz U-NII-3		Pass	Section 7.6
15.407(g)	Frequency Stability	N/A		Pass	Section 7.7
15.407(b)(1), (4)(i)	Undesirable Emissions	≤ -27dBm/MHz EIRP Detail see section 7.9	Radiated	Pass	Section 7.8 & 7.9
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	N/A	Section 7.10

Notes:

1) 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.
2) All modes of operation and data rates were investigated. 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.
3) “N/A” means that this item is not applicable, and the detail information refers to relevant section.

7.2. 26dB Bandwidth Measurement

7.2.1.Test Limit

N/A

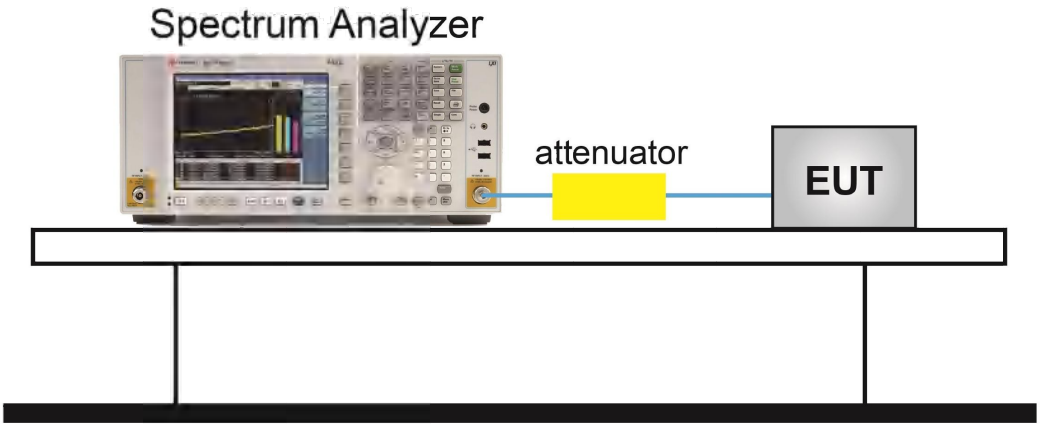
7.2.2.Test Procedure used

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



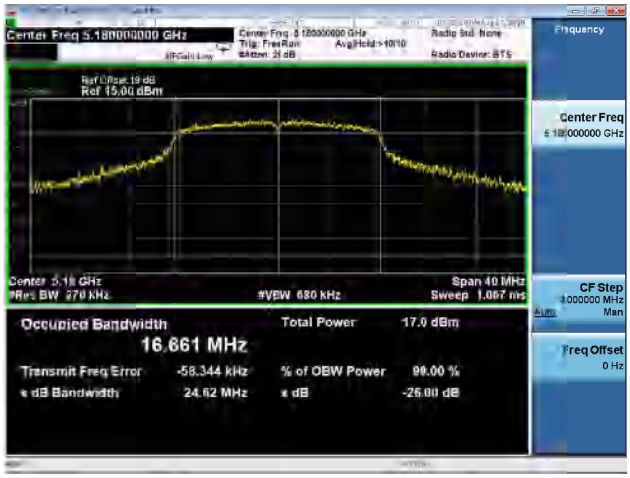
7.2.5.Test Result

Product	Color Radio	Temperature	23°C
Test Engineer	David Lv	Relative Humidity	54%
Test Site	TR3	Test Date	2019/08/17

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
802.11a	6Mbps	36	5180	24.62	16.66
802.11a	6Mbps	44	5220	24.75	16.61
802.11a	6Mbps	48	5240	25.16	16.58
802.11a	6Mbps	144	5745	19.64	16.31
802.11a	6Mbps	149	5785	31.68	17.97
802.11a	6Mbps	157	5825	23.40	16.51
802.11n-HT20	MCS0	36	5180	23.31	17.55
802.11n-HT20	MCS0	44	5220	22.75	17.56
802.11n-HT20	MCS0	48	5240	22.31	17.56
802.11n-HT20	MCS0	144	5745	20.46	17.44
802.11n-HT20	MCS0	149	5785	23.85	17.58
802.11n-HT20	MCS0	157	5825	24.66	17.62
802.11n-HT40	MCS0	38	5190	41.74	35.76
802.11n-HT40	MCS0	46	5230	49.16	35.97
802.11n-HT40	MCS0	142	5755	41.92	35.89
802.11n-HT40	MCS0	151	5795	41.93	35.86

802.11a 26dB Bandwidth & 99% Bandwidth

Channel 36 (5180MHz)



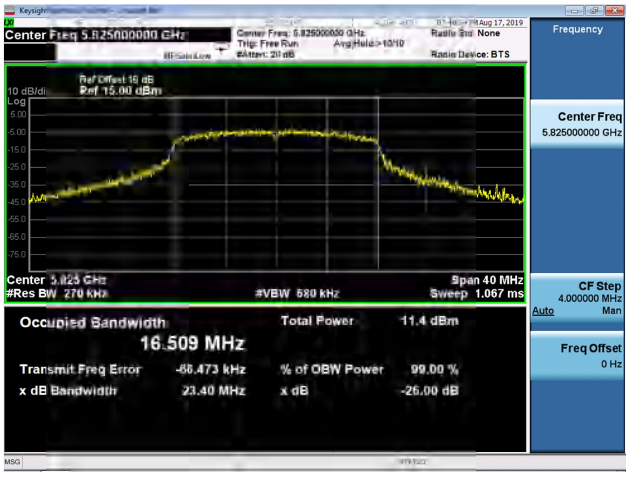
Channel 44 (5220MHz)

Channel 48 (5240MHz)

Channel 149 (5745MHz)

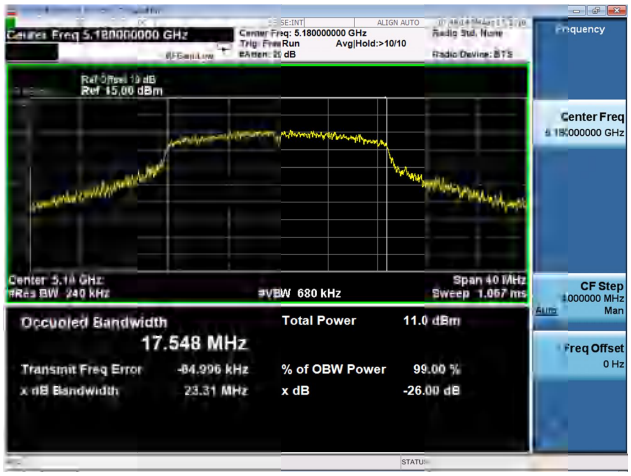
Channel 157 (5785MHz)

Channel 165 (5825MHz)



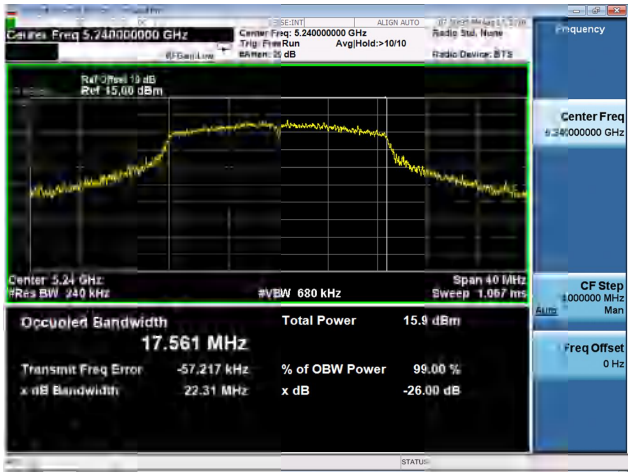
802.11n-HT20 26dB Bandwidth & 99% Bandwidth

Channel 36 (5180MHz)



Channel 44 (5220MHz)

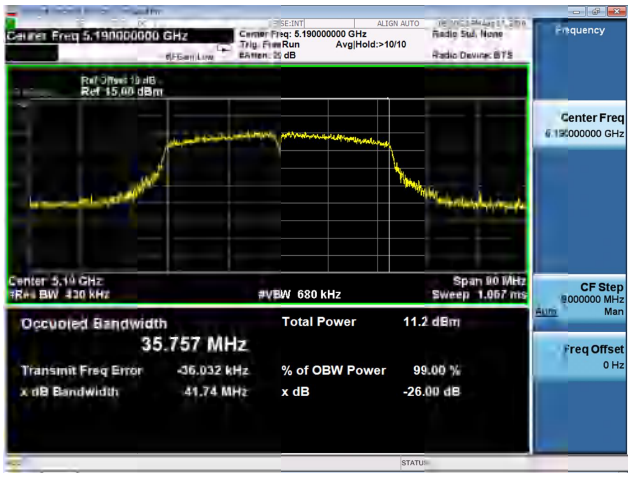
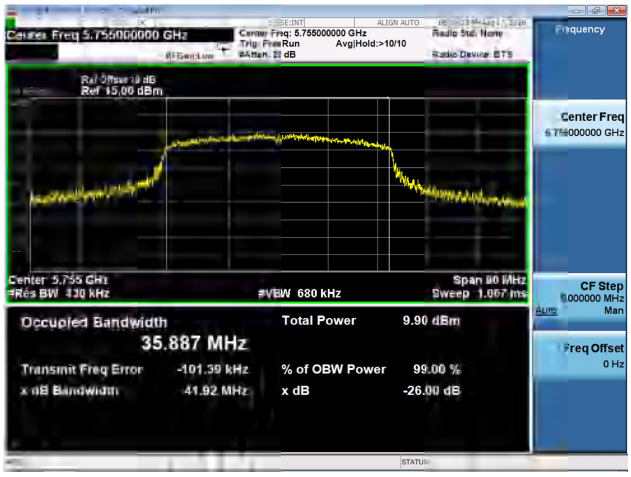
Channel 48 (5240MHz)



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)
	

7.3. 6dB Bandwidth Measurement

7.3.1.Test Limit

The minimum 6dBbandwidth shall be at least 500 kHz.

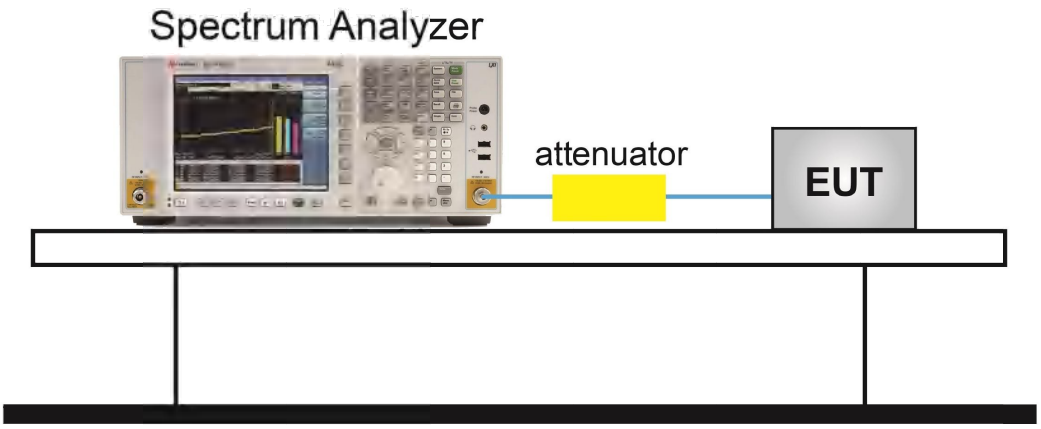
7.3.2.Test Procedure used

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.

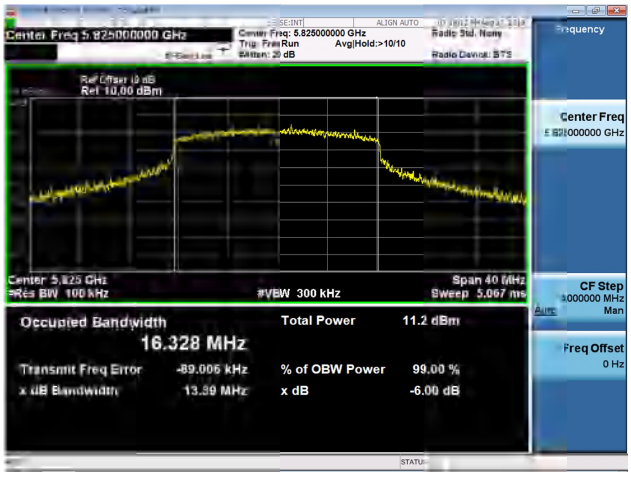
7.3.4.Test Setup

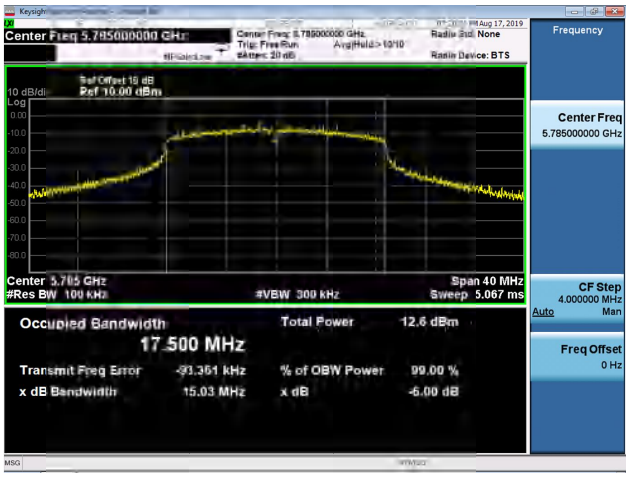
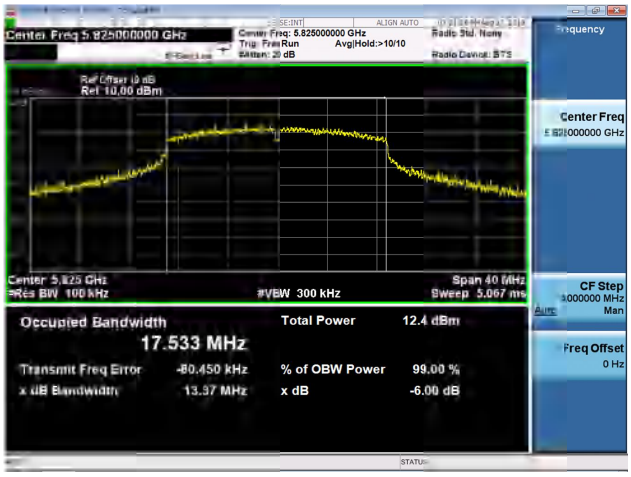


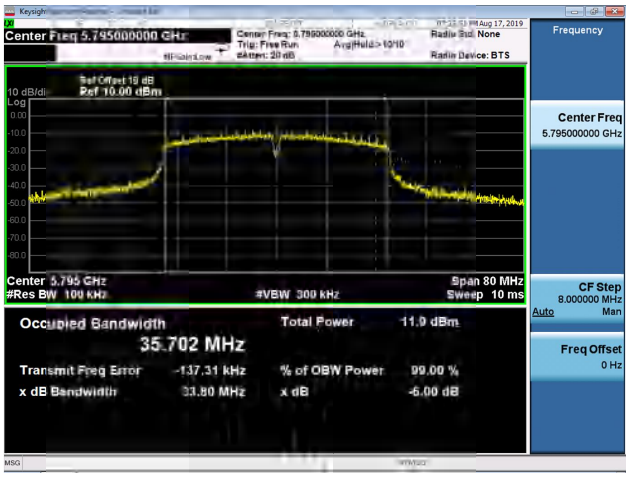
7.3.5.Test Result

Product	Color Radio	Temperature	23°C
Test Engineer	David Lv	Relative Humidity	54%
Test Site	TR3	Test Date	2019/08/17

Test Mode	Data Rate / MCS	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	6Mbps	149	5745	16.28	≥0.5	Pass
802.11a	6Mbps	157	5785	13.90	≥0.5	Pass
802.11a	6Mbps	165	5825	13.39	≥0.5	Pass
802.11n-HT20	MCS0	149	5745	13.18	≥0.5	Pass
802.11n-HT20	MCS0	157	5785	15.03	≥0.5	Pass
802.11n-HT20	MCS0	165	5825	13.37	≥0.5	Pass
802.11n-HT40	MCS0	151	5755	32.45	≥0.5	Pass
802.11n-HT40	MCS0	159	5795	33.80	≥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)
	

7.4. Output Power Measurement

7.4.1.Test Limit

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 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.

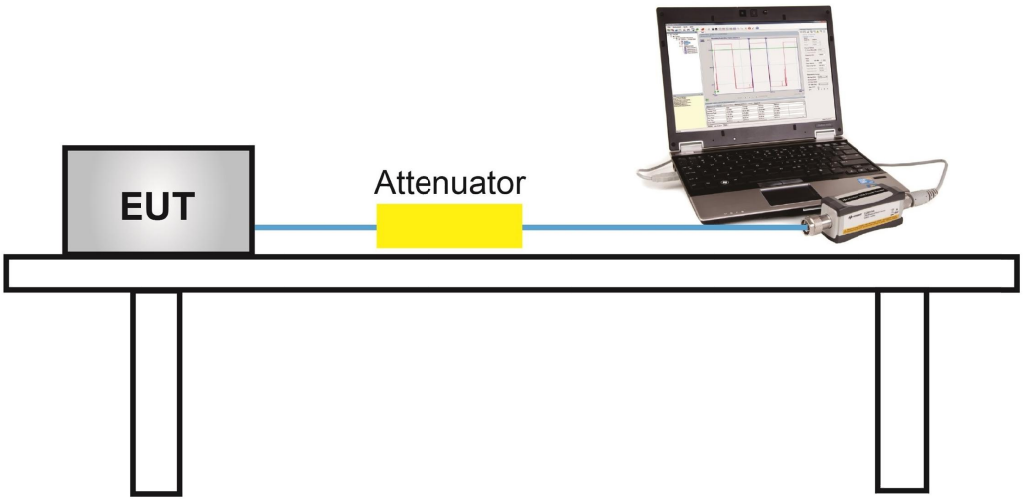
7.4.2.Test Procedure Used

KDB 789033D02v01r04- 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 table, 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/ MCS	Average Power (dBm)
802.11a	20	36	5180	6Mbps	11.36
				24Mbps	11.23
				54Mbps	11.03
802.11n	20	36	5180	MCS0	6.07
				MCS4	5.87
				MCS8	5.67
802.11n	40	38	5190	MCS0	6.34
				MCS4	6.21
				MCS9	6.03

Product	Color Radio	Temperature	24°C
Test Engineer	David Lv	Relative Humidity	59%
Test Site	TR3	Test Date	2019/08/17

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	Average Power (dBm)	Average Power Limit(dBm)	Result
11a	6Mbps	36	5180	11.36	≤ 23.98	Pass
11a	6Mbps	44	5220	11.07	≤ 23.98	Pass
11a	6Mbps	48	5240	11.18	≤ 23.98	Pass
11a	6Mbps	149	5745	6.56	≤ 30.00	Pass
11a	6Mbps	157	5785	10.45	≤ 30.00	Pass
11a	6Mbps	165	5825	6.24	≤ 30.00	Pass
11n-HT20	MCS0	36	5180	6.07	≤ 23.98	Pass
11n-HT20	MCS0	44	5220	9.46	≤ 23.98	Pass
11n-HT20	MCS0	48	5240	9.17	≤ 23.98	Pass
11n-HT20	MCS0	149	5745	4.69	≤ 30.00	Pass
11n-HT20	MCS0	157	5785	6.78	≤ 30.00	Pass
11n-HT20	MCS0	165	5825	6.87	≤ 30.00	Pass
11n-HT40	MCS0	54	5270	6.34	≤ 23.98	Pass
11n-HT40	MCS0	62	5310	10.81	≤ 23.98	Pass
11n-HT40	MCS0	151	5755	5.81	≤ 30.00	Pass
11n-HT40	MCS0	159	5795	6.08	≤ 30.00	Pass

7.5. Power Spectral Density Measurement

7.5.1.Test Limit

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.

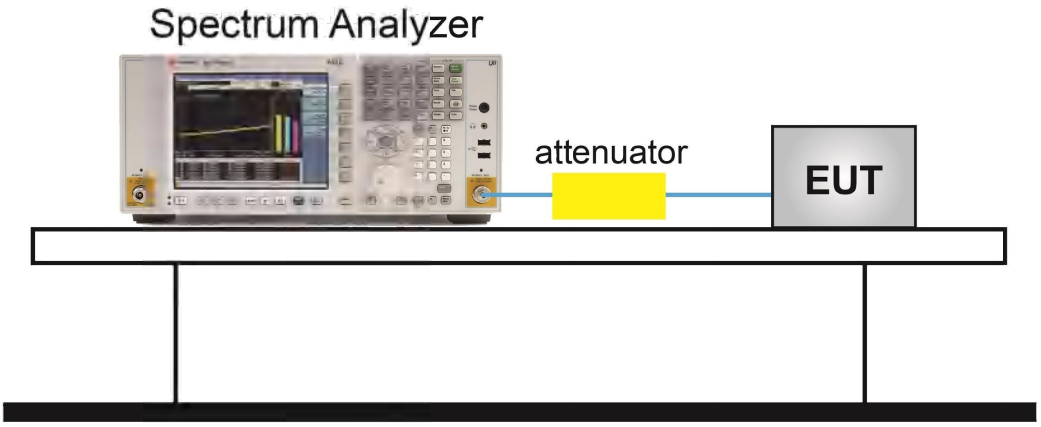
7.5.2.Test Procedure Used

KDB 789033 D02v02r01 - Section F

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 EBW of the signal.
3. RBW = 1MHz, if measurement bandwidth of Maximum PSD is specified in 500 kHz, RBW = 100 kHz
4. VBW = 3MHz
5. Number of sweep points ≥ 2 × (span / RBW)
6. Detector = power averaging (Average)
7. Sweep time = auto
8. Trigger = free run
9. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
10. 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.
11. 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	Color Radio	Temperature	23°C
Test Engineer	David Lv	Relative Humidity	54%
Test Site	TR3	Test Date	2019/08/17

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	PSD (dBm/ MHz)	Duty Cycle (%)	Final PSD (dBm/ MHz)	PSD Limit (dBm/ MHz)	Result
For FCC U-NII 1								
11a	6Mbps	36	5180	1.47	90.83	1.89	≤ 11.00	Pass
11a	6Mbps	44	5220	0.57	90.83	0.98	≤ 11.00	Pass
11a	6Mbps	48	5240	1.36	90.83	1.78	≤ 11.00	Pass
11n-HT20	MCS0	36	5180	-3.46	90.41	-3.02	≤ 11.00	Pass
11n-HT20	MCS0	44	5220	0.33	90.41	0.77	≤ 11.00	Pass
11n-HT20	MCS0	48	5240	0.44	90.41	0.88	≤ 11.00	Pass
11n-HT40	MCS0	38	5190	-7.00	82.12	-6.15	≤ 11.00	Pass
11n-HT40	MCS0	46	5230	-1.22	82.12	-0.37	≤ 11.00	Pass

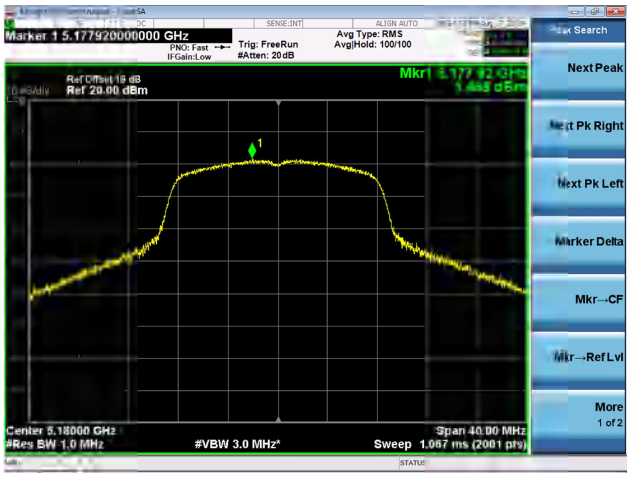
Note: Final PSD (dBm/MHz) = PSD (dBm/MHz) + 10*log(1/duty cycle)

Test Mode	Data Rate/ MCS	Channel No.	Freq. (MHz)	PSD (dBm/ 100kHz)	Duty Cycle (%)	Constant Factor (dB)	Final PSD (dBm/ 500kHz)	Limit (dBm/ 500kHz)	Result
For FCC U-NII 3									
11a	6Mbps	149	5745	-12.16	90.83	6.99	-11.74	≤ 30.00	Pass
11a	6Mbps	157	5785	-8.56	90.83	6.99	-8.14	≤ 30.00	Pass
11a	6Mbps	165	5825	-13.11	90.83	6.99	-12.70	≤ 30.00	Pass
11n-HT20	MCS0	149	5745	-14.36	90.41	6.99	-13.92	≤ 30.00	Pass
11n-HT20	MCS0	157	5785	-11.85	90.41	6.99	-11.42	≤ 30.00	Pass
11n-HT20	MCS0	165	5825	-12.05	90.41	6.99	-11.61	≤ 30.00	Pass
11n-HT40	MCS0	151	5755	-15.17	82.12	6.99	-14.31	≤ 30.00	Pass
11n-HT40	MCS0	159	5795	-15.78	82.12	6.99	-14.93	≤ 30.00	Pass

Note: Final PSD (dBm/ 500kHz) = PSD (dBm/ 100kHz) + Constant Factor (dB) + 10*log (1/Duty Cycle).

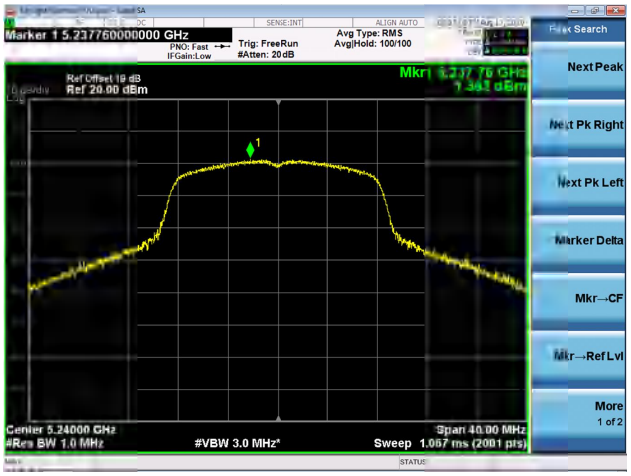
802.11a Power Spectral Density

Channel 36 (5180MHz)

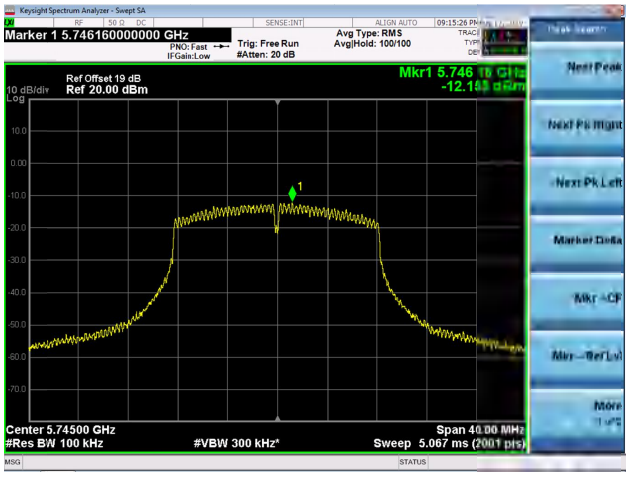


Channel 44 (5220MHz)

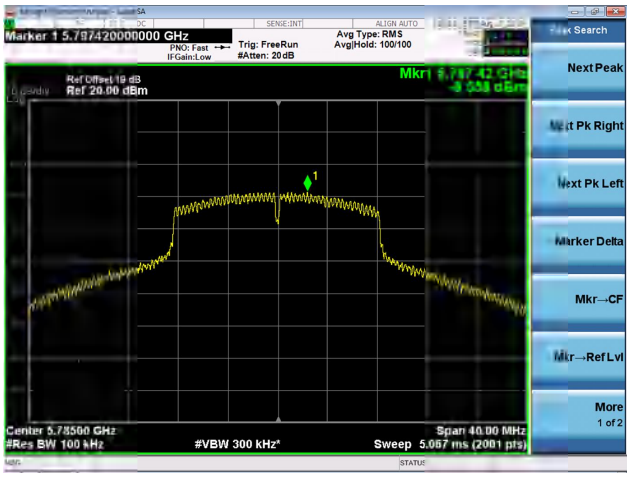
Channel 48 (5240MHz)



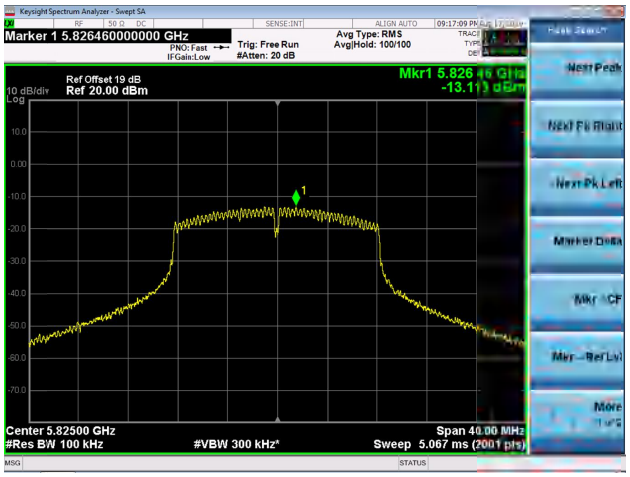
Channel 149 (5745MHz)



Channel 157 (5785MHz)

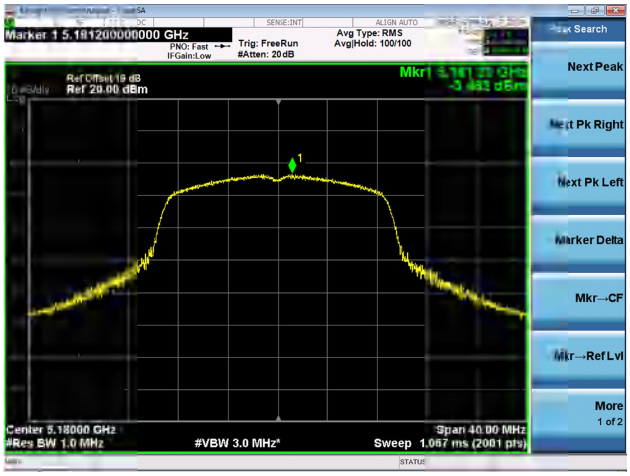


Channel 165(5825MHz)

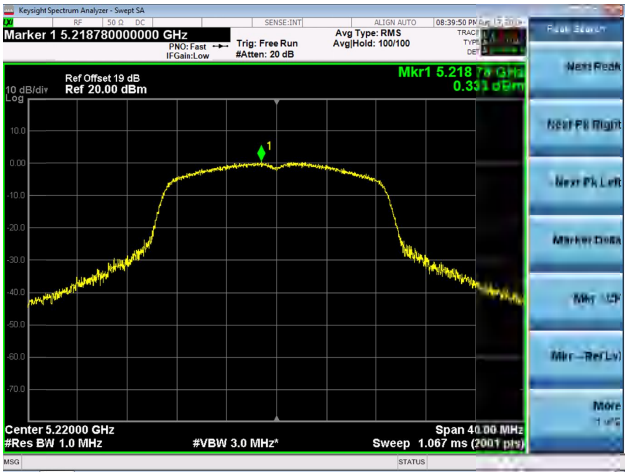


802.11n-HT20 Power Spectral Density

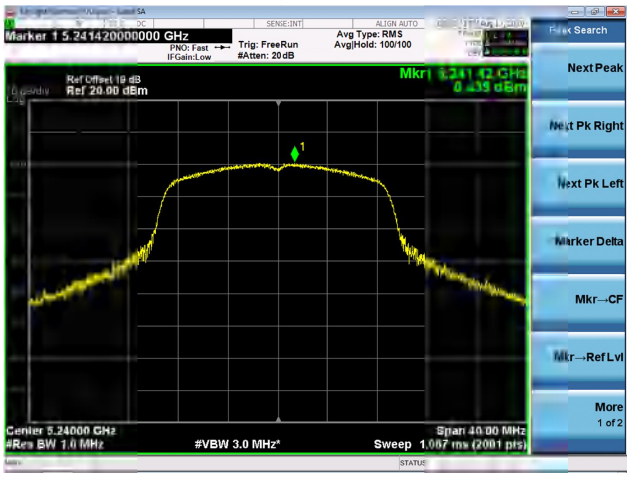
Channel 36 (5180MHz)



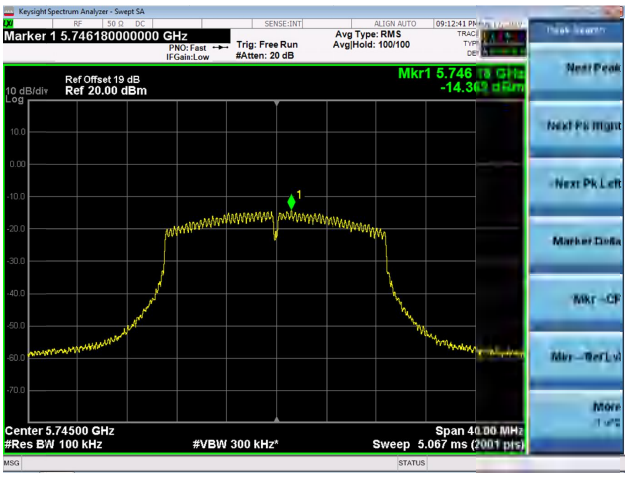
Channel 44 (5220MHz)



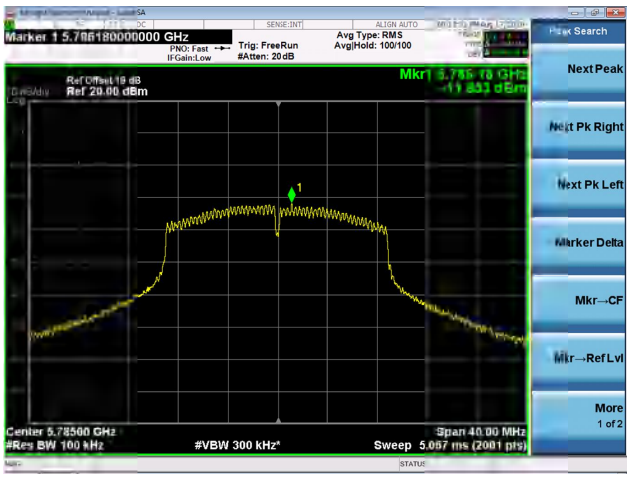
Channel 48 (5240MHz)



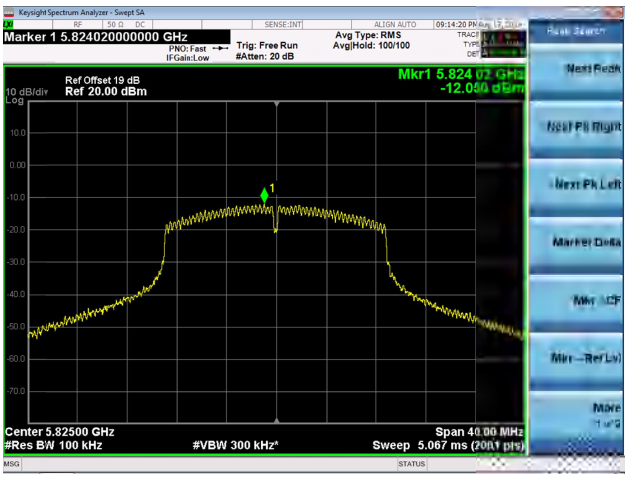
Channel 149 (5745MHz)

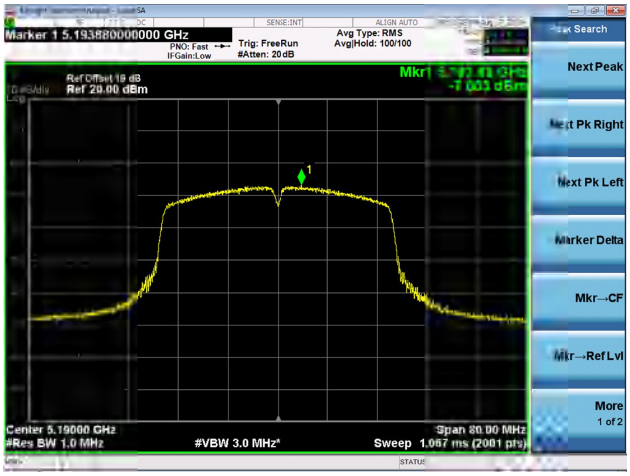
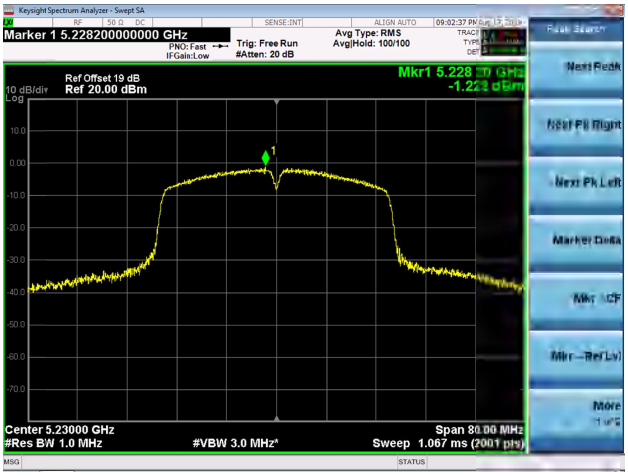
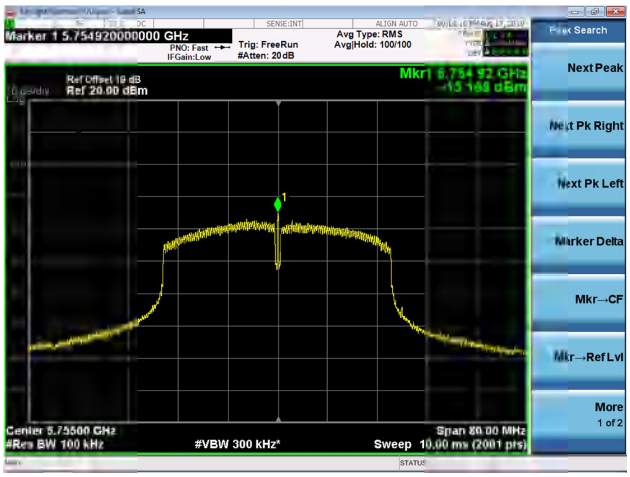
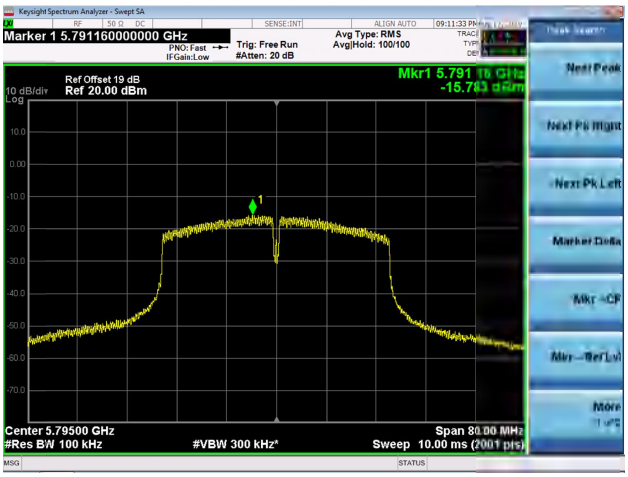


Channel 157 (5785MHz)



Channel 165(5825MHz)



802.11n-HT40 Power Spectral Density	
Channel 38 (5190MHz)	Channel 46 (5230MHz)
	
Channel 151 (5755MHz)	Channel 159 (5795MHz)
	

7.6. Frequency Stability Measurement

7.6.1.Test Limit

Manufactures of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

The transmitter center frequency tolerance shall be ±20 ppm maximum for the 5GHz band (IEEE 802.11 specification).

7.6.2.Test Procedure Used

Frequency Stability Under Temperature Variations:

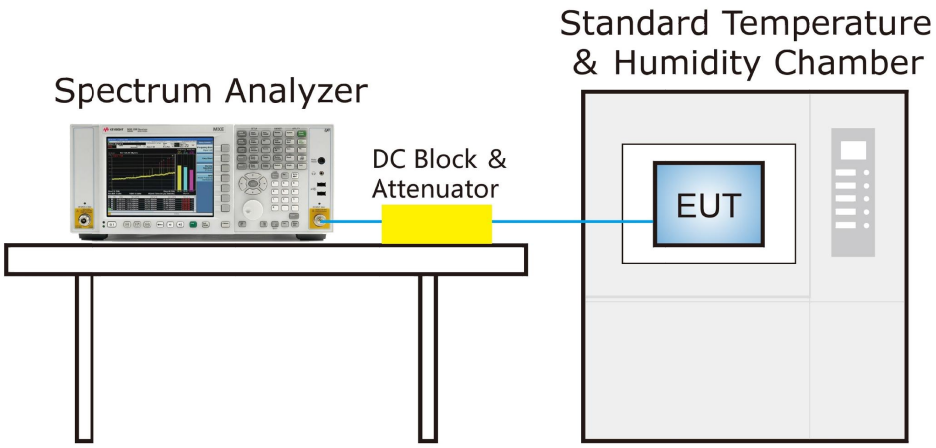
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to highest. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C decreased per stage until the lowest temperature reached.

Frequency Stability Under Voltage Variations:

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation (±15%) and endpoint, recordthe maximum frequency change.

7.6.3.Test Setup



7.6.4.Test Result

Test Engineer	David Lv	Temperature	0 ~ 45°C
Test Time	2019/08/17	Relative Humidity	48 ~ 55%RH
Test Mode	5180MHz (Carrier Mode)	Test Site	TR3

Voltage (%)	Power (VAC)	Temp (°C)	Frequency Tolerance (ppm)			
			0 minutes	2 minutes	5 minutes	10 minutes
100%	12	0	-13.87	-13.43	-13.23	-13.12
		+ 10	-13.74	-13.44	-13.24	-13.11
		+ 20 (Ref)	-13.70	-13.51	-13.26	-13.08
		+ 30	-13.66	-13.43	-13.22	-13.11
		+ 40	-13.67	-13.33	-13.21	-13.09
		+ 45	-13.68	-13.38	-13.23	-13.11
115%	13.8	+ 20	-13.56	-13.43	-13.21	-13.08
85%	10.2	+ 20	-13.48	-13.39	-13.22	-13.05

Note: Frequency Tolerance (ppm) = {[Measured Frequency (Hz) - Declared Frequency (Hz)] / Declared Frequency (Hz)} $*10^6$.

7.7. Radiated Spurious Emission Measurement

7.7.1.Test Limit

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table per Section 15.209.

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [V/m]	Measured Distance [Meters]
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

7.7.2.Test Procedure Used

ANSI C63.10 Section 6.3 (General Requirements)

ANSI C63.10 Section 6.4 (Standard test method below 30MHz)

ANSI C63.10 Section 6.5 (Standard test method above 30MHz to 1GHz)

ANSI C63.10 Section 6.6 (Standard test method above 1GHz)

7.7.3.Test Setting

Table 1 - RBW as a function of frequency

Frequency	RBW
9 ~ 150 kHz	200 ~ 300 Hz
0.15 ~ 30 MHz	9 ~ 10 kHz
30 ~ 1000 MHz	100 ~ 120 kHz
> 1000 MHz	1 MHz

Peak Field Strength Measurements

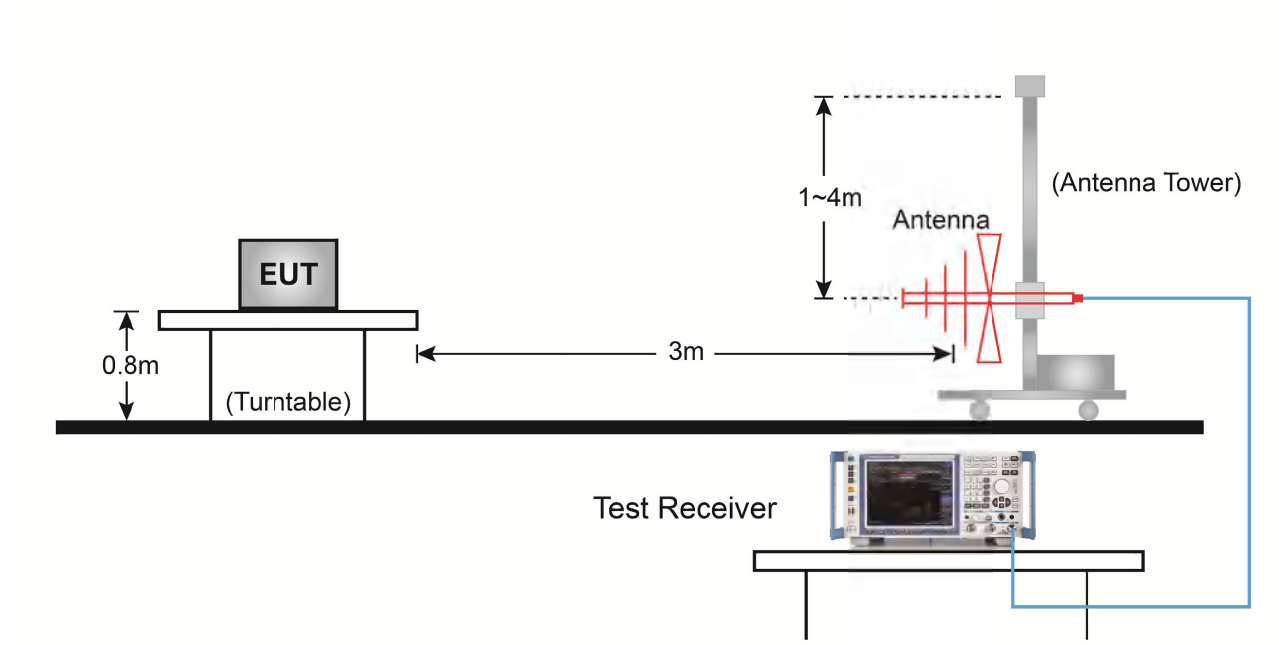
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = as specified in Table 1
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Average Field Strength Measurements

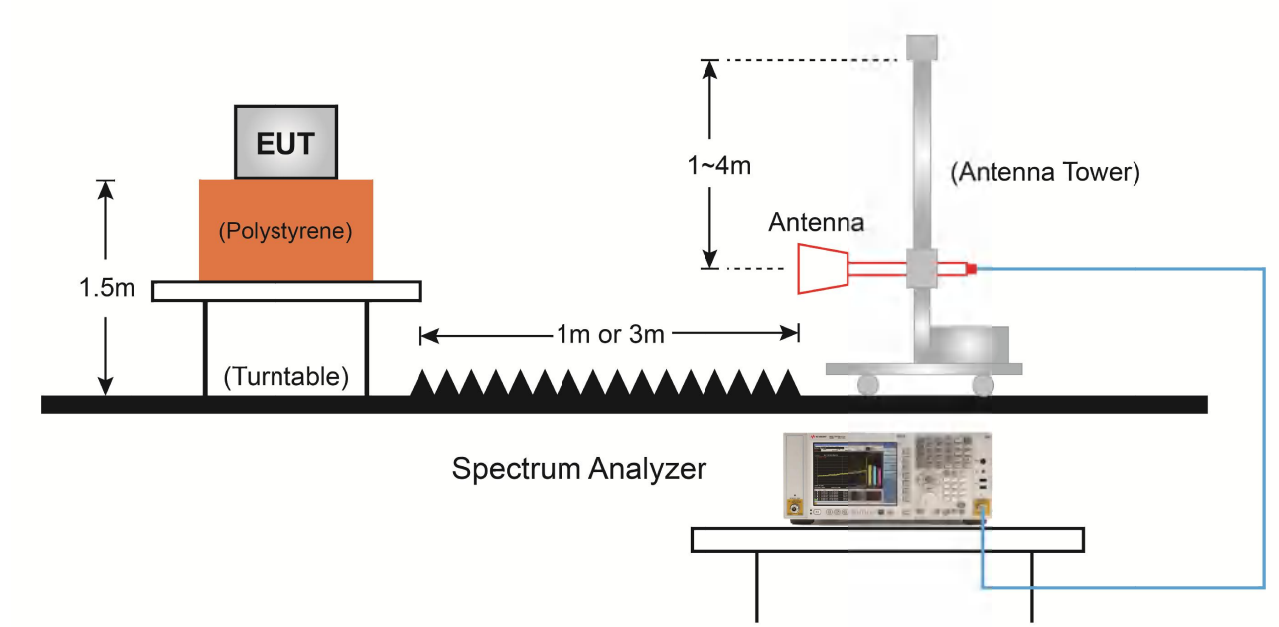
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW ≥ 1/T
4. De As an alternative, the instrument may be set to linear detector mode. Ensure that video filtering is applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode in order to accomplish this. Others have a setting for Average-VBW Type, which can be set to “Voltage” regardless of the display mode
5. Detector = Peak
6. Sweep time = auto
7. Trace mode = max hold
8. Allow max hold to run for at least 50 times (1/duty cycle) traces

7.7.4.Test Setup

30MHz ~ 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:



7.7.5.Test Result

Product	Color Radio	Temperature	26°C
Test Engineer	Dandy Li	Relative Humidity	57 %
Test Site	AC1	Test Date	2019/08/18
Test Mode	802.11a	Test Channel	36
Remark	1. Average measurement was not performed if peak level lower than average limit (54dBμV/m). 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	7613.0	34.0	11.9	45.9	74.0	-28.1	PK	Horizontal
	8310.0	33.5	12.4	45.9	74.0	-28.1	PK	Horizontal
*	9772.0	31.3	15.9	47.2	68.2	-21.0	PK	Horizontal
*	10409.5	33.0	16.8	49.8	68.2	-18.4	PK	Horizontal
	7511.0	35.1	11.9	47.0	74.0	-27.0	PK	Vertical
	8225.0	34.3	12.2	46.5	74.0	-27.5	PK	Vertical
*	8777.5	33.5	13.3	46.8	68.2	-21.4	PK	Vertical
*	9644.5	31.8	15.5	47.3	68.2	-20.9	PK	Vertical

Note 1: "*" is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

Product	Color Radio	Temperature	26°C
Test Engineer	Dandy Li	Relative Humidity	57 %
Test Site	AC1	Test Date	2019/08/18
Test Mode	802.11a	Test Channel	44
Remark	1. Average measurement was not performed if peak level lower than average limit (54dBμV/m). 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	7570.5	33.8	11.8	45.6	74.0	-28.4	PK	Horizontal
	8318.5	33.2	12.3	45.5	74.0	-28.5	PK	Horizontal
*	8658.5	32.4	13.0	45.4	68.2	-22.8	PK	Horizontal
*	9627.5	31.3	15.6	46.9	68.2	-21.3	PK	Horizontal
	7545.0	34.5	11.9	46.4	74.0	-27.6	PK	Vertical
	8250.5	31.9	12.3	44.2	74.0	-29.8	PK	Vertical
*	8667.0	32.0	13.0	45.0	68.2	-23.2	PK	Vertical
*	9636.0	32.0	15.6	47.6	68.2	-20.6	PK	Vertical

Note 1: "*" is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

Product	Color Radio	Temperature	26°C
Test Engineer	Dandy Li	Relative Humidity	57 %
Test Site	AC1	Test Date	2019/08/18
Test Mode	802.11a	Test Channel	48
Remark	1. Average measurement was not performed if peak level lower than average limit (54dBμV/m). 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	7502.5	35.8	12.0	47.8	74.0	-26.2	PK	Horizontal
	8242.0	32.9	12.3	45.2	74.0	-28.8	PK	Horizontal
*	8811.5	32.6	13.4	46.0	68.2	-22.2	PK	Horizontal
*	9729.5	32.5	15.6	48.1	68.2	-20.1	PK	Horizontal
	7502.5	33.8	12.0	45.8	74.0	-28.2	PK	Vertical
	8437.5	34.4	12.4	46.8	74.0	-27.2	PK	Vertical
*	8769.0	32.8	13.4	46.2	68.2	-22.0	PK	Vertical
*	9695.5	32.8	15.5	48.3	68.2	-19.9	PK	Vertical

Note 1: "*" is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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

Product	Color Radio	Temperature	26°C
Test Engineer	Dandy Li	Relative Humidity	57 %
Test Site	AC1	Test Date	2019/08/18
Test Mode	802.11a	Test Channel	149
Remark	1. Average measurement was not performed if peak level lower than average limit (54dBμV/m). 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
	7664.0	39.7	11.7	51.4	74.0	-22.6	Peak	Horizontal
	8284.5	32.3	12.1	44.4	74.0	-29.6	Peak	Horizontal
*	8820.0	34.2	13.4	47.6	68.2	-20.6	Peak	Horizontal
*	9593.5	34.8	15.2	50.0	68.2	-18.2	Peak	Horizontal
	7655.5	38.0	11.6	49.6	74.0	-24.4	Peak	Vertical
	8369.5	34.0	12.3	46.3	74.0	-27.7	Peak	Vertical
*	8701.0	33.9	13.2	47.1	68.2	-21.1	Peak	Vertical
*	9593.5	32.2	15.2	47.4	68.2	-20.8	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

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