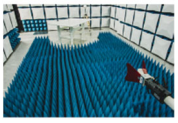
PCTEST
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



MEASUREMENT REPORT FOR MODULE INTEGRATION

Applicant Name:
Allerio Inc.
11 E. Superior St, Suite 548
Duluth, MN 55802
USA

Date of Testing:
04/22 - 05/19/2020
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M2004020055-07.2AV6O

FCC ID:	**2AV6O-AMH100**
Applicant:	**Allerio Inc.**

Model:	AMH100
EUT Type:	Mobile Hub
Integrated Module(s) FCC ID(s):	JJPlus 802.11 Module (FCC ID: W23-WMU62XX) Sierra Wireless LTE Module (FCC ID : N7NEM75S) (x1) Sierra Wireless LTE Modules (FCC ID : N7NEM7455) (x2)
FCC Rule Parts:	15, 22, 24, & 27
Test Procedure(s):	ANSI C63.10-2013, ANSI C63.26-2015, ANSI/TIA-603-E-2016, KDB 971168 D01 v03r01

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 §2.947. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.01

TABLE OF CONTENTS

1.0 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 Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Allerio Mobile Hub FCC ID: 2AV6O-AMH100**. The hub contains WiFi and Bluetooth connectivity (via the JJPlus 802.11 Module (Model: WMU6202) and the onboard 802.11/BT Variscite module) and integrates three FCC certified Sierra Wireless LTE modules (Models: EM7511 (x1) and EM7455 (x2)).

The JJPlus module can operate as an access point in both 2.4GHz and 5GHz. For the hubs onboard WiFi module, it can operate as a client device in 2.4GHz. Of the five integrated modules/chipsets, only two can transmit at a time. A radiated spurious emissions analysis is performed to ensure that the co-location of the antennas of any two modules do not generate any new, non-compliant emissions.

The test data contained in this report pertains to the emissions resulting from the simultaneous transmission of all viable combinations (two modules transmitting at a time).

2.2 Device Capabilities

The following capabilities were investigated in this report for each module:

Modem #1 (Sierra Wireless EM7511, FirstNet/AT&T): LTE Band 41, Band 26/5, Band 14, Band 13, Band 12, Band 7, Band 66/4, Band 2

Modem #2 (Sierra Wireless EM7455, Verizon): LTE Band 5, Band 13, Band 4, Band 2

Modem #3 (Sierra Wireless EM7455, T-Mobile): LTE Band 41, Band 26/5, Band 13, Band 12, Band 7, Band 4, Band 2

Modem #4 (Allerio AMH100 using onboard Variscite chipset): 802.11b/g/n, Bluetooth

Modem #5 (JJPlus WMU6202): 2.4/5GHz 802.11a/b/g/n/ac, Bluetooth

LTE Band 66 (1710 - 1780 MHz) overlaps the entire frequency range of LTE Band 4 (1710 - 1755 MHz). Therefore, test data provided in this report covers Band 4 as well as Band 66.

LTE Band 26 (814.7 – 849 MHz) overlaps the entire frequency range of LTE Band 5 (824 – 849 MHz). Therefore, test data provided in this report covers Band 5 and the portion of Band 26 subject to Part 22.

2.3 Software and Firmware

The test was conducted and verified with software version 0.8.9 installed on the EUT.

2.4 Test Configuration

The EUT was tested per the guidance of ANSI/TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated emissions tests.

2.5 EMI Suppression Device(s)/Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Measurement Procedure

The measurement procedures described in the document titled "Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards" (ANSI/TIA-603-E-2016) and "Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems" (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

3.2 Radiated Power and Radiated Spurious 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. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. 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 above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table 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 tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer. Radiated power levels are also investigated with the receive antenna horizontally and vertically polarized. The maximized power level is recorded using the spectrum analyzer "Channel Power" function with the integration band set to the emissions' occupied bandwidth, a RMS detector, RBW = 100kHz, VBW = 300kHz, and a 1 second sweep time over a minimum of 10 sweeps, per the guidelines of KDB 971168 D01 v03r01.

Per the guidance of ANSI/TIA-603-E-2016, a half-wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

$$P_{d\ [dBm]} = P_{g\ [dBm]} - \text{cable loss}_{\ [dB]} + \text{antenna gain}_{\ [dBd/dBi]}$$

Where, P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to $P_{g\ [dBm]}$ – cable loss $_{[dB]}$.

The calculated P_d levels are then compared to the absolute spurious emission limit of -13dBm which is equivalent to the required minimum attenuation of 43 + 10 $\log_{10}$(Power $_{[Watts]}$).

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 474788 D01.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	11/1/2019	Annual	11/1/2020	100040
Rohde & Schwarz	CMW500	Radio Communication Tester	8/26/2019	Annual	8/26/2020	100976
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	6/5/2019	Annual	6/5/2020	100342
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	6/6/2019	Annual	6/6/2020	103200
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/11/2019	Annual	7/11/2020	102134
Sunol	DRH-118	Horn Antenna (1-18GHz)	10/3/2019	Biennial	10/3/2021	A050307
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	5/19/2018	Biennial	5/19/2020	A051107

Table 5-1. Test Equipment

Note:

Equipment with a calibration date of “N/A” shown in this list was not used to make direct calibrated measurements.

6.0 SAMPLE CALCULATIONS

Spurious Radiated Emission – LTE Band

Example: Middle Channel LTE Mode 2nd Harmonic (1564 MHz)

The average spectrum analyzer reading at 3 meters with the EUT on the turntable was –81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of –81.0 dBm on the spectrum analzyer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 1564 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.501 dBm so this harmonic was 25.501 dBm – (-24.80).

7.0 TEST RESULTS

7.1 Summary

Company Name: Allerio Inc.

Product Name: Mobile Hub

Mode(s): LTE, WiFi, Bluetooth

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1053 22.917(a) 24.238(a) 27.53(c) 27.53(g) 27.53(h)	Undesirable Emissions (Band 12, 13, 26/5, 66/4, 25/2)	> 43 + 10 $\log_{10}$ (P[Watts]) for all out-of-band emissions	RADIATED	PASS	Section 7.2, 7.2
27.53(f)	Undesirable Emissions (Band 13)	< -70 dBW/MHz (for wideband signals) < -80 dBW (for discrete emissions less than 700Hz BW) For all emissions in the band 1559 – 1610 MHz			Section 7.2
27.53(a)	Undesirable Emissions (Band 30)	> 70 + 10 $\log_{10}$ (P[Watts])			Section 7.2
27.53(m)	Undesirable Emissions (Band 7, 41/38)	Undesirable emissions must meet the limits detailed in 27.53(m)			Section 7.2 7.2

Table 7-1. Summary of Radiated Test Results

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.

2. For determination of compliance between transmission of unlicensed and licensed modules, the appropriate licensed radiated spurious emission limit of -13dBm was applied.

3. The JJPlus AP module is the only module that can transmit with any of the other four integrated modules. The test cases shown in this section reflect all possible combinations of the JJPlus module with the other WiFi and LTE modules.

7.2 Radiated Spurious Emissions Measurements

Test Overview

Radiated spurious emissions measurements are performed using the substitution method described in ANSI/TIA-603-E-2016 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using vertically and horizontally polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.8

ANSI/TIA-603-E-2016 – Section 2.2.12

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = Peak
6. Trace mode = Max Hold
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

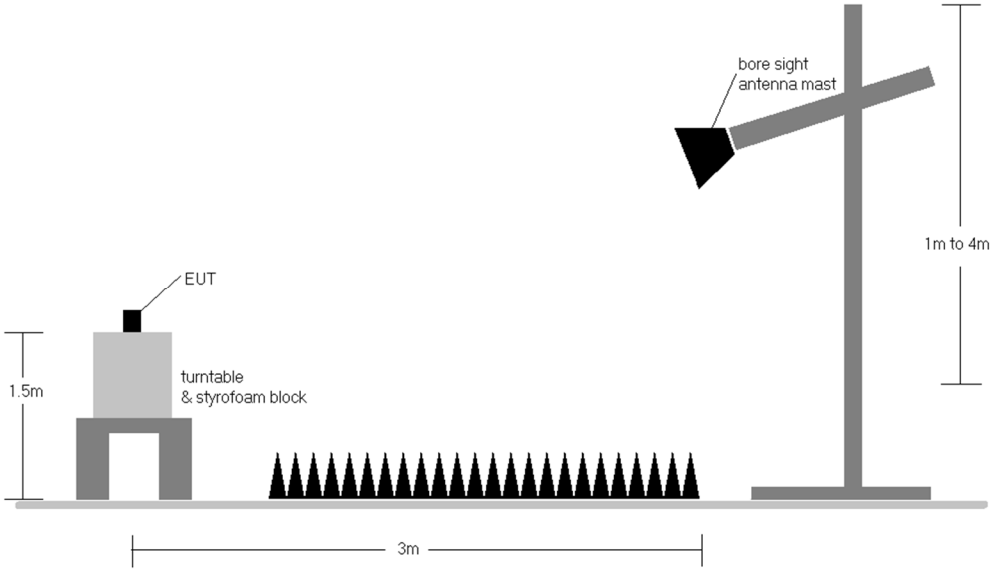


Figure 7-1. Radiated Test Setup >1GHz

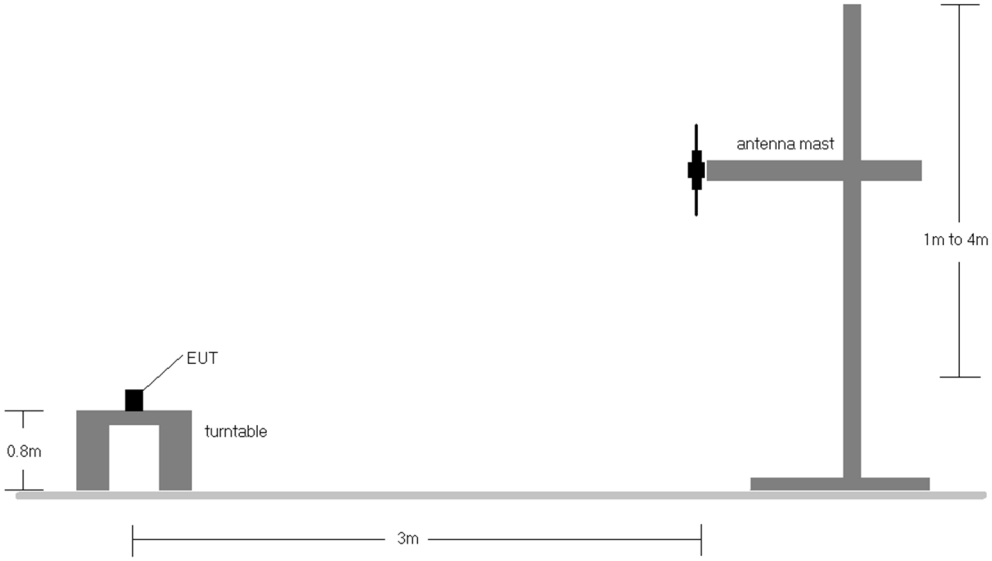


Figure 7-2. Radiated Test Setup <1GHz

Test Notes

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

2) This unit was tested with its standard battery.

3) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter operating at the higher frequency. The worst-case emissions are reported.

4) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

5) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

6) No significant emissions were found above 18GHz.

7) Spurious emissions shown in this section are measured while operating in WiFi and LTE modes. Per KDB 968740, spurious emissions from the WiFi carrier are subject to the rules under which the WiFi carrier operates (Part 15). Spurious emission caused by the LTE carrier must meet the requirements of the rules under which the LTE carrier operates (Parts 22, 24, and 27). If the spurious emission is caused by the simultaneous operation of both devices, the limit is the highest level allowed by either rule part.

8) Emissions due to the EUT's LTE licensed transmitter were investigated, while the EUT was also operating in WiFi mode. The following test cases were investigated –

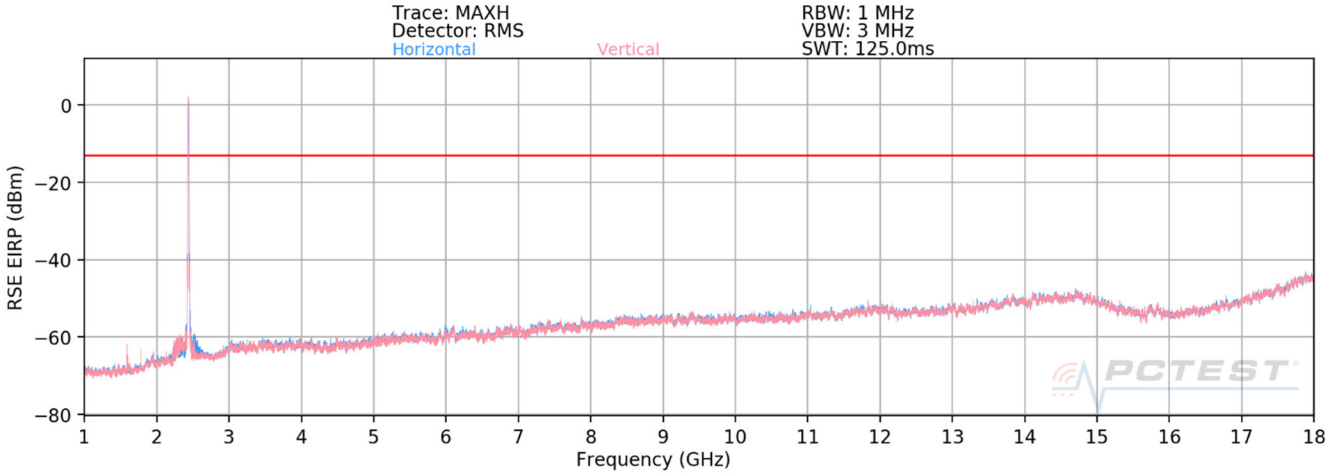
Test Case #1: Modem #1 (FirstNet/AT&T)
- a) B14, 10MHz, Mid Channel + AP(2.4GHz) 802.11b, Ch 6
- b) B14, 10MHz, Mid Channel + AP(5GHz) 802.11a, Ch 64
- c) B66/4, 20MHz, Mid Channel + AP(2.4GHz) 802.11b, Ch 6
- d) B66/4, 20MHz, Mid Channel + AP(5GHz) 802.11a, Ch 64
- e) B41, 20MHz, Mid Channel + AP(2.4GHz) 802.11b, Ch 6
- f) B41, 20MHz, Mid Channel + AP(5GHz) 802.11a, Ch 64

Test Case #2: Modem #2 (Verizon)
- a) B13, 10MHz, Mid Channel + AP(2.4GHz) 802.11b, Ch 6
- b) B13, 10MHz, Mid Channel + AP(5GHz) 802.11a, Ch 64
- c) B4, 20MHz, Mid Channel + AP(2.4GHz) 802.11b, Ch 6
- d) B4, 20MHz, Mid Channel + AP(5GHz) 802.11a, Ch 64

Test Case #3: Modem #3 (T-Mobile)
- a) B12, 10MHz, Mid Channel + AP(2.4GHz) 802.11b, Ch 6
- b) B12, 10MHz, Mid Channel + AP(5GHz) 802.11a, Ch 64
- c) B41, 20MHz, Mid Channel + AP(2.4GHz) 802.11b, Ch 6
- d) B41, 20MHz, Mid Channel + AP(5GHz) 802.11a, Ch 64

Test Case #4: JJPlus Module (AP) + 2AV6O-AMH100 Onboard WiFi chipset (Client)
- a) Client(2.4GHz) 802.11b, Ch 6 + AP(2.4GHz) 802.11b, Ch 11
- b) Client(2.4GHz) 802.11b, Ch 6 + AP(5GHz) 802.11a, Ch 64

Test Case #1: Modem #1 (FirstNet/AT&T)
Band 14



Plot 7-1. Radiated Spurious Plot above 1GHz (B14 10MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)

OPERATING FREQUENCY:	793.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

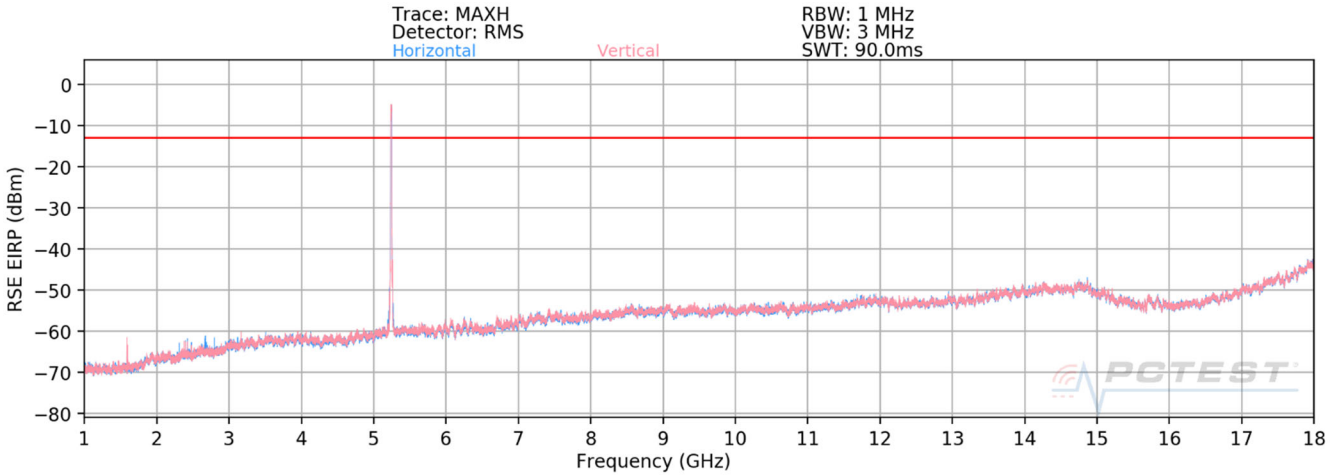
Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2379.00	V	391	95	-75.92	9.43	-66.49	-53.5
3172.00	V	397	47	-73.60	9.37	-64.23	-51.2
3249.50	H	376	45	-53.39	9.55	-43.84	-30.8
3965.00	V	358	101	-72.49	9.54	-62.95	-49.9
4758.00	V	-	-	-73.87	11.02	-62.85	-49.9
5551.00	V	-	-	-72.65	10.97	-61.67	-48.7

Table 7-2. Radiated Spurious Data (B14 10MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)

MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.00	MHz
DISTANCE:	3	meters
NARROWBAND EMISSION LIMIT:	-50	dBm
WIDEBAND EMISSION LIMIT:	-40	dBm/MHz

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1586.00	V	115	138	-72.07	8.64	-63.43	-23.4

Table 7-3. Radiated Spurious Data (B14 10MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6 - Wideband)



Plot 7-2. Radiated Spurious Plot above 1GHz (B14 10MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

OPERATING FREQUENCY:	793.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2379.00	V	112	287	-75.35	9.43	-65.92	-52.9
3172.00	V	113	21	-73.26	9.37	-63.89	-50.9
3965.00	V	358	111	-72.54	9.54	-63.00	-50.0
4758.00	V	-	-	-73.73	11.02	-62.71	-49.7
5551.00	V	-	-	-72.32	10.97	-61.34	-48.3

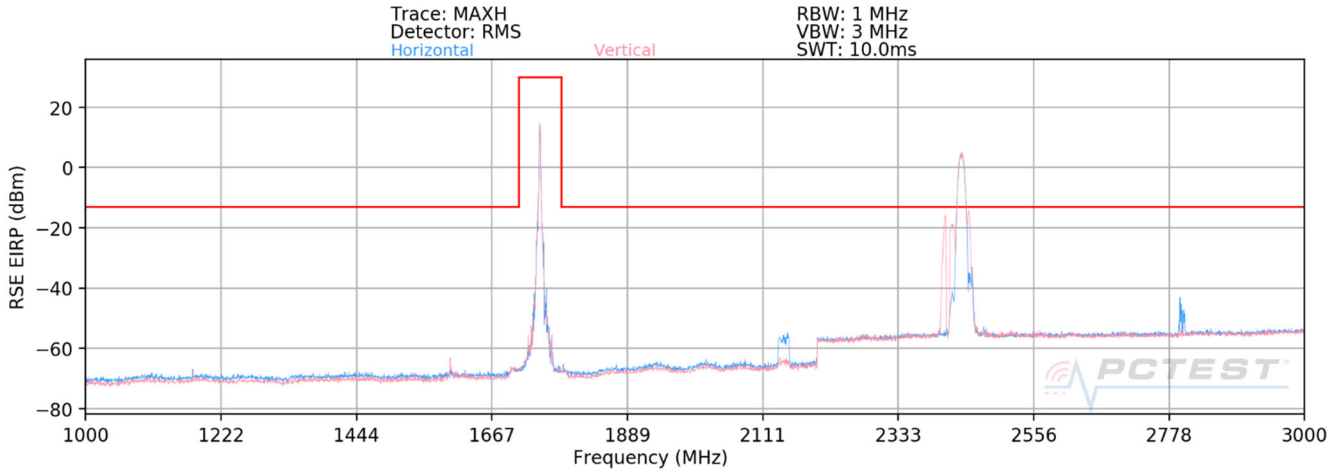
Table 7-4. Radiated Spurious Data (B14 10MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.00	MHz
DISTANCE:	3	meters
NARROWBAND EMISSION LIMIT:	-50	dBm
WIDEBAND EMISSION LIMIT:	-40	dBm/MHz

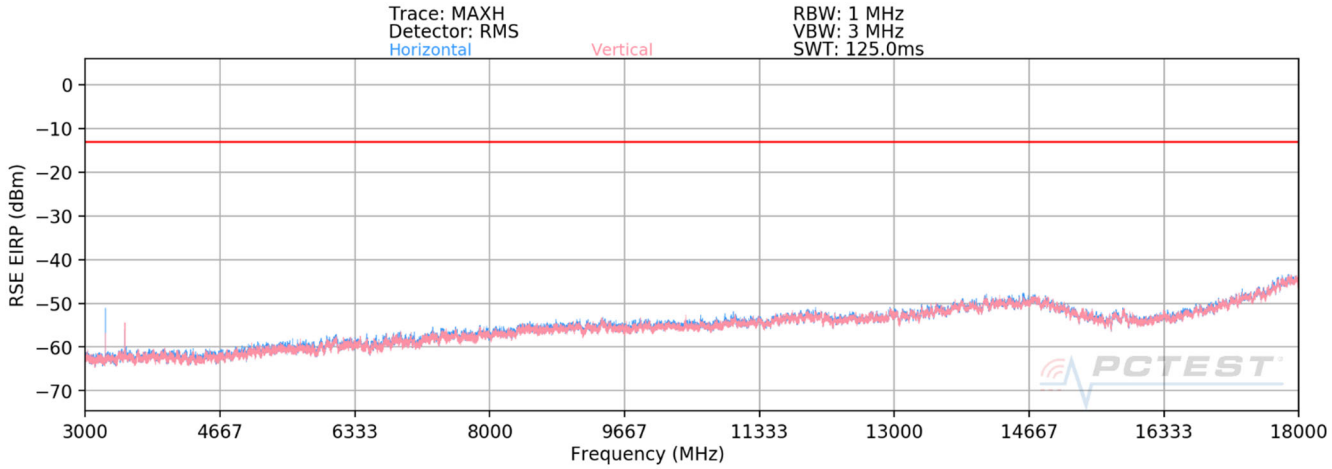
Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1586.00	V	111	134	-72.23	8.64	-63.59	-23.6

Table 7-5. Radiated Spurious Data (B14 10MHz Mid Channel + AP(5GHz) 802.11a Ch 64 - Wideband)

Band 66/4



Plot 7-3. Radiated Spurious Plot above 1GHz (B66/4 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6) Pt. 1

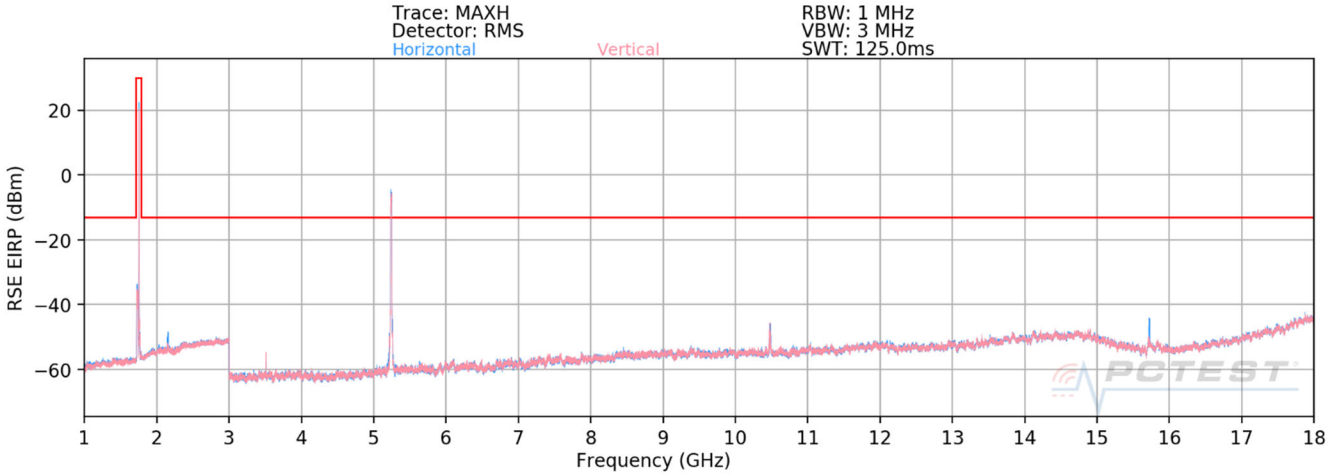


Plot 7-4. Radiated Spurious Plot above 1GHz (B66/4 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6) Pt. 2

OPERATING FREQUENCY:	1745.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	20.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3249.50	H	372	55	-52.48	9.55	-42.93	-29.9
3490.00	H	386	143	-62.37	9.94	-52.42	-39.4
5235.00	H	-	-	-72.43	10.76	-61.67	-48.7
6980.00	H	-	-	-71.85	11.85	-60.00	-47.0

Table 7-6. Radiated Spurious Data (B66/4 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)



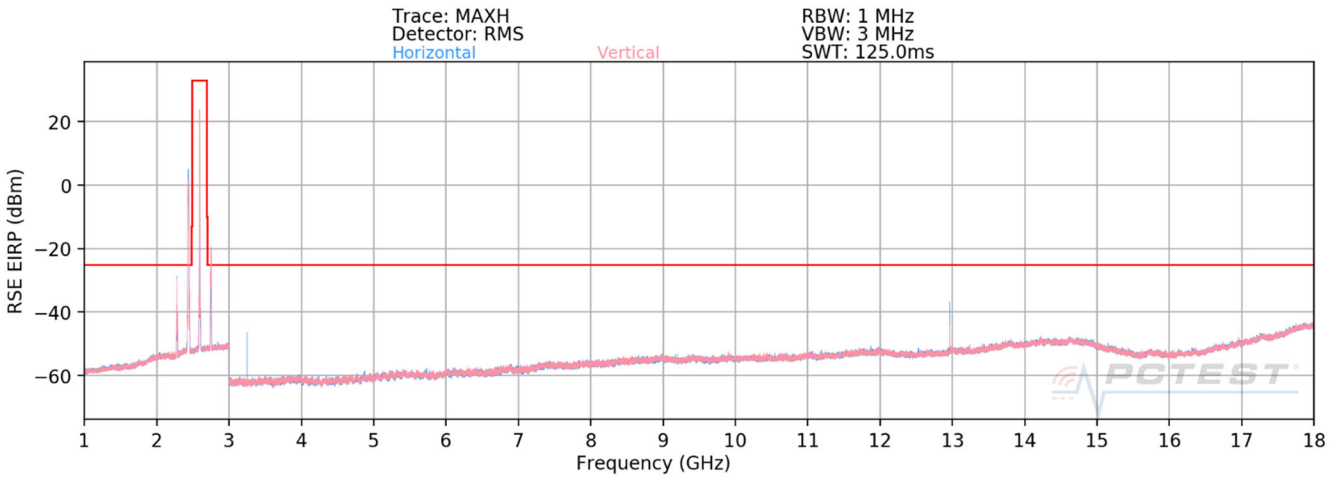
Plot 7-5. Radiated Spurious Plot above 1GHz (B66/4 20MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

OPERATING FREQUENCY:	1745.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	20.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3490.00	H	141	101	-60.87	9.94	-50.92	-37.9
5235.00	H	-	-	-72.81	10.76	-62.05	-49.0
6980.00	H	-	-	-72.61	11.85	-60.76	-47.8

Table 7-7. Radiated Spurious Data (B66/4 20MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

Band 41

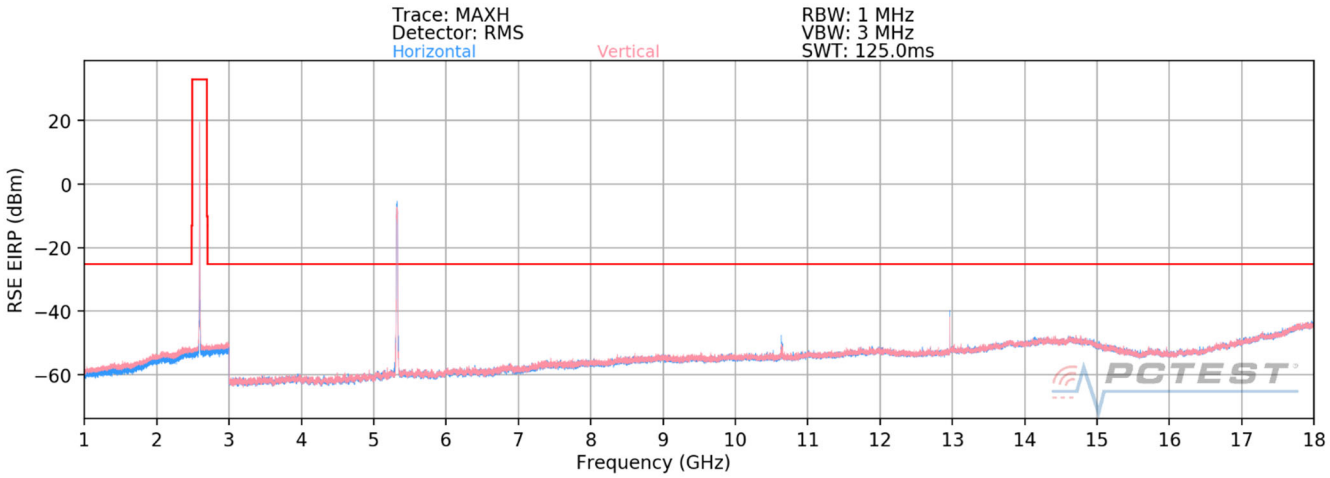


Plot 7-6. Radiated Spurious Plot above 1GHz (B41 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)

OPERATING FREQUENCY:	2593.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	20.0	MHz
DISTANCE:	3	meters
LIMIT:	-25	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2281.00	H	197	233	-60.51	9.69	-50.82	-25.8
2749.00	H	-	-	-66.02	10.19	-55.83	-30.8
2905.00	H	132	136	-67.43	9.96	-57.46	-32.5
3249.50	H	112	219	-54.01	9.55	-44.46	-19.5
5186.00	H	194	319	-68.89	10.77	-58.12	-33.1
7779.00	H	400	64	-67.10	11.47	-55.63	-30.6
10372.00	H	366	286	-66.64	12.48	-54.16	-29.2
12965.00	H	166	328	-45.07	13.34	-31.72	-6.7
15558.00	H	398	320	-69.04	16.37	-52.67	-27.7

Table 7-8. Radiated Spurious Data (B41 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)



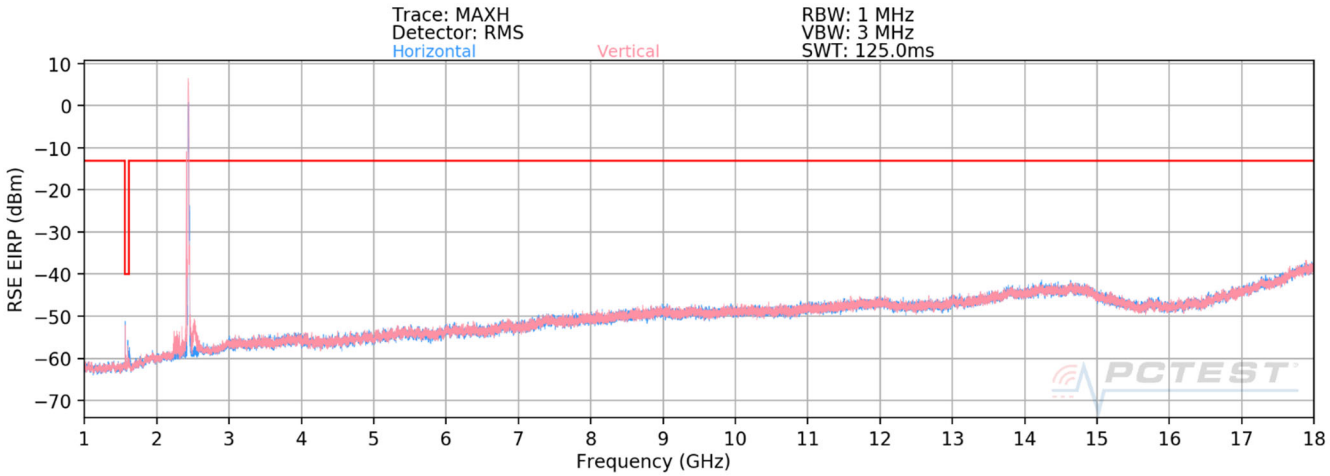
Plot 7-7. Radiated Spurious Plot above 1GHz (B41 20MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

OPERATING FREQUENCY:	2593.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	20.0	MHz
DISTANCE:	3	meters
LIMIT:	-25	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
5186.00	H	134	324	-68.71	10.77	-57.94	-32.9
7779.00	H	398	39	-66.98	11.47	-55.51	-30.5
10372.00	H	-	-	-66.66	12.48	-54.18	-29.2
12965.00	H	169	332	-45.43	13.34	-32.08	-7.1
15558.00	H	157	320	-69.23	16.37	-52.86	-27.9

Table 7-9. Radiated Spurious Data (B41 20MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

Test Case #2: Modem #2 (Verizon)
Band 13



Plot 7-8. Radiated Spurious Plot above 1GHz (B13 10MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)

OPERATING FREQUENCY:	782.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

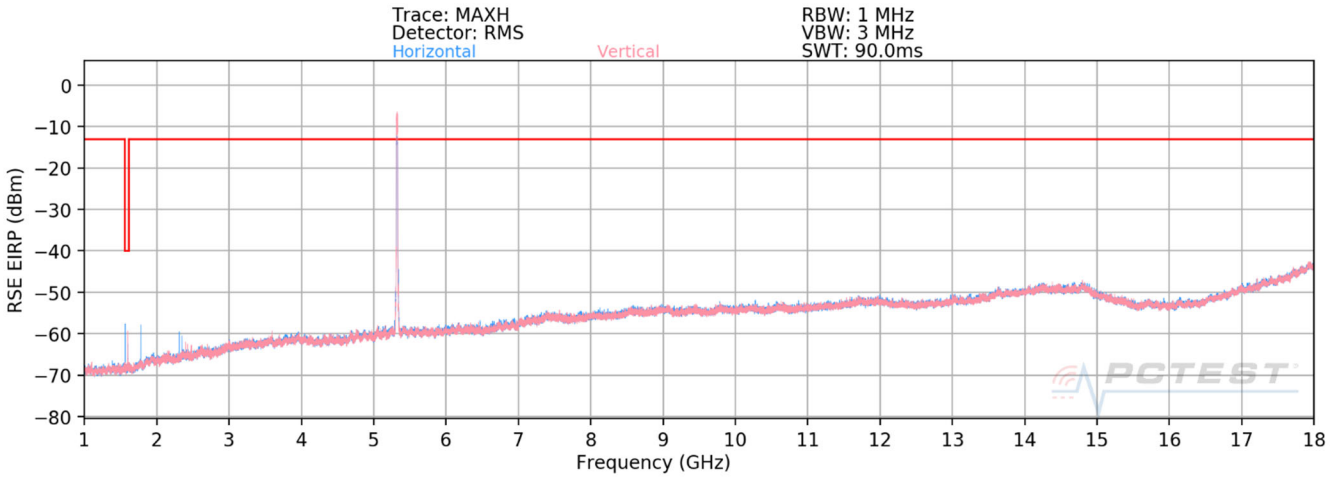
Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2346.00	V	306	273	-69.00	9.46	-59.54	-46.5
3128.00	V	-	-	-74.21	9.37	-64.84	-51.8
3910.00	V	-	-	-72.68	9.40	-63.28	-50.3

Table 7-10. Radiated Spurious Data (B13 10MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)

MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.00	MHz
DISTANCE:	3	meters
NARROWBAND EMISSION LIMIT:	-50	dBm
WIDEBAND EMISSION LIMIT:	-40	dBm/MHz

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1564.00	V	228	197	-67.56	8.56	-59.00	-19.0

Table 7-11. Radiated Spurious Data (B13 10MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6 - Wideband)



Plot 7-9. Radiated Spurious Plot above 1GHz (B13 10MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

OPERATING FREQUENCY:	782.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2346.00	V	155	257	-69.90	9.46	-60.44	-47.4
3128.00	V	-	-	-74.34	9.37	-64.97	-52.0
3910.00	V	-	-	-72.69	9.40	-63.29	-50.3

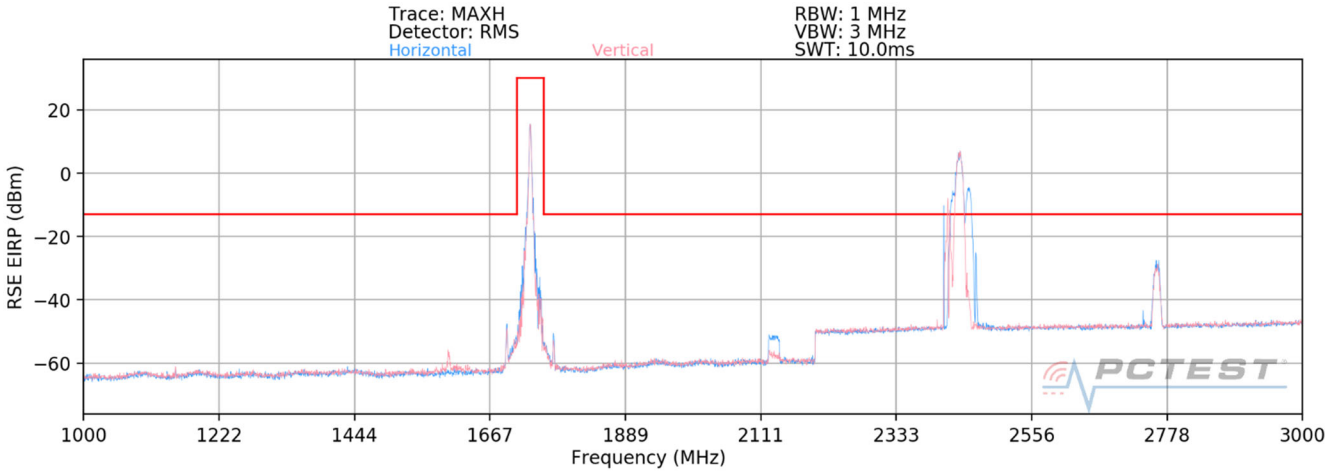
Table 7-12. Radiated Spurious Data (B13 10MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.00	MHz
DISTANCE:	3	meters
NARROWBAND EMISSION LIMIT:	-50	dBm
WIDEBAND EMISSION LIMIT:	-40	dBm/MHz

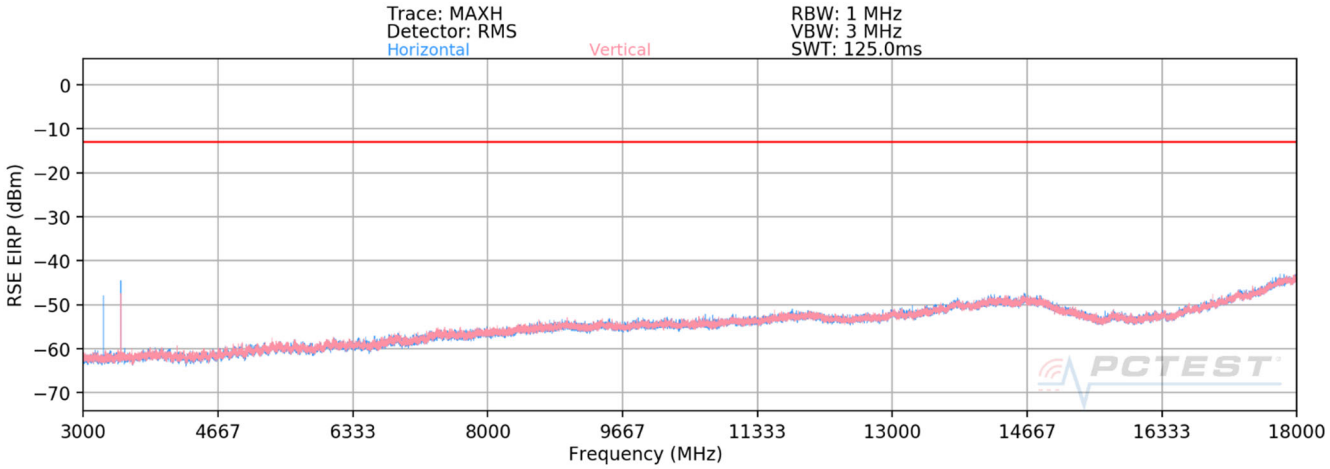
Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1564.00	V	364	182	-68.77	8.56	-60.21	-20.2

Table 7-13. Radiated Spurious Data (B13 10MHz Mid Channel + AP(5GHz) 802.11a Ch 64 - Wideband)

Band 4



Plot 7-10. Radiated Spurious Plot above 1GHz (B4 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6) -1

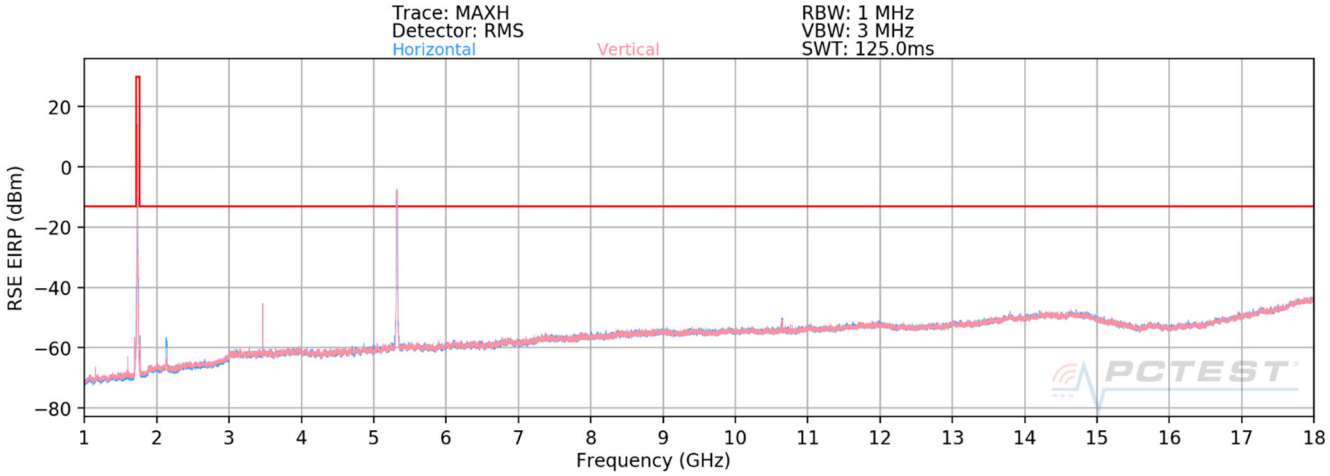


Plot 7-11. Radiated Spurious Plot above 1GHz (B4 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6) -2

OPERATING FREQUENCY:	1732.50	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	20.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3249.50	H	334	147	-52.96	9.55	-43.41	-30.4
3465.00	H	207	360	-57.32	9.91	-47.42	-34.4
5197.50	H	337	126	-71.89	10.79	-61.10	-48.1
6930.00	H	348	307	-69.72	11.77	-57.95	-44.9
8662.50	H	355	328	-67.22	11.05	-56.17	-43.2
10395.00	H	-	-	-68.02	12.51	-55.51	-42.5
12127.50	H	-	-	-66.48	13.00	-53.48	-40.5

Table 7-14. Radiated Spurious Data (B4 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)



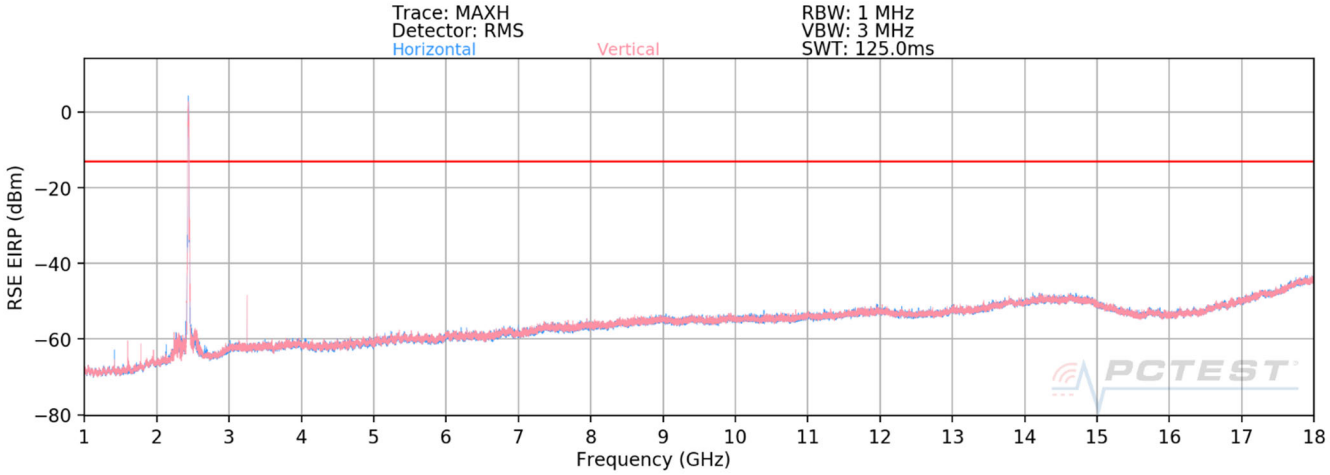
Plot 7-12. Radiated Spurious Plot above 1GHz (B4 20MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

OPERATING FREQUENCY:	1732.50	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	20.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
3465.00	H	120	358	-56.15	9.91	-46.25	-33.2
5197.50	H	111	133	-72.22	10.79	-61.43	-48.4
6930.00	H	363	301	-69.93	11.77	-58.16	-45.2
8662.50	H	-	-	-67.42	11.05	-56.37	-43.4
10395.00	H	-	-	-68.04	12.51	-55.53	-42.5

Table 7-15. Radiated Spurious Data (B4 20MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

Test Case #1: Modem #3 (T-Mobile)
Band 12

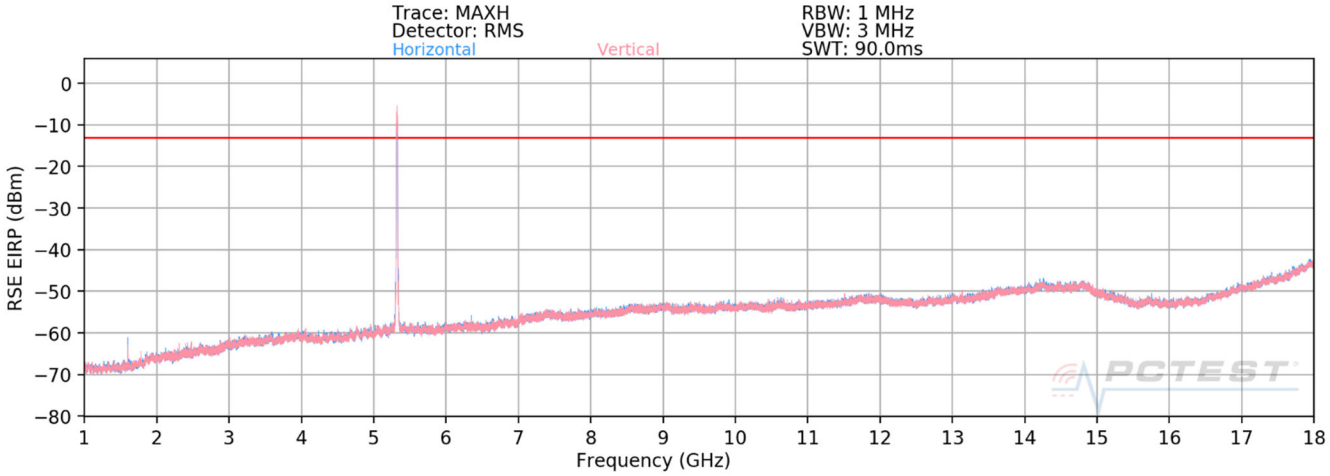


Plot 7-13. Radiated Spurious Plot above 1GHz (B12 10MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)

OPERATING FREQUENCY:	707.50	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1415.00	H	115	339	-73.13	7.66	-65.47	-52.5
2122.50	H	117	319	-74.66	8.89	-65.77	-52.8
2830.00	H	-	-	-76.46	10.12	-66.33	-53.3
3249.50	H	128	319	-53.50	9.93	-43.57	-30.6
3537.50	H	-	-	-73.28	10.61	-62.67	-49.7
4245.00	H	-	-	-72.81	10.95	-61.86	-48.9

Table 7-16. Radiated Spurious Data (B12 10MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)



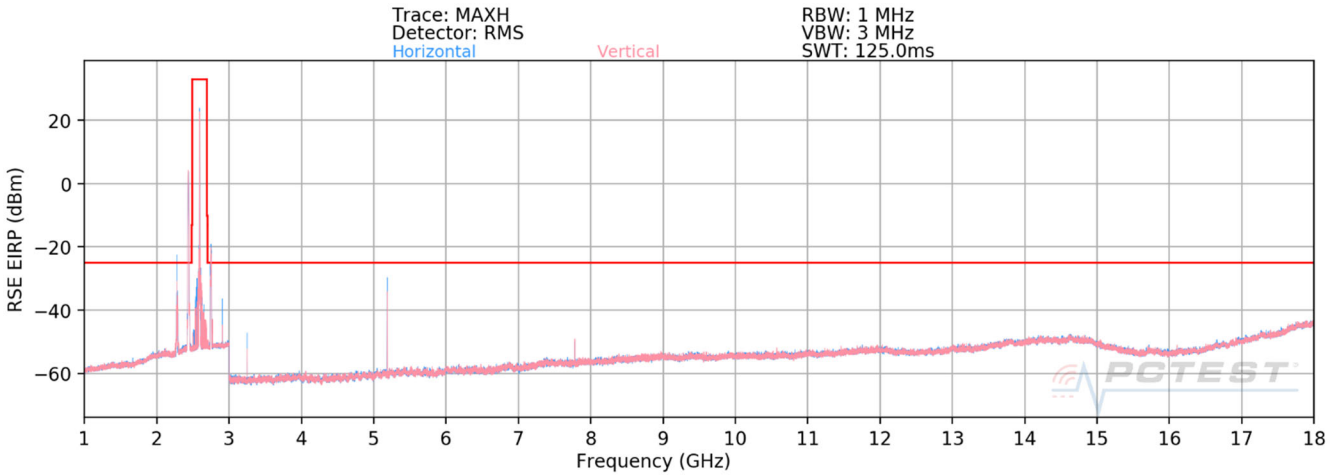
Plot 7-14. Radiated Spurious Plot above 1GHz (B12 10MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

OPERATING FREQUENCY:	707.50	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	10.0	MHz
DISTANCE:	3	meters
LIMIT:	-13	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
1415.00	H	175	335	-72.29	7.66	-64.63	-51.6
2122.50	H	119	319	-74.99	8.89	-66.10	-53.1
2830.00	H	-	-	-76.77	10.12	-66.64	-53.6
3537.50	H	-	-	-75.60	9.93	-65.68	-52.7

Table 7-17. Radiated Spurious Data (B12 10MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

Band 41

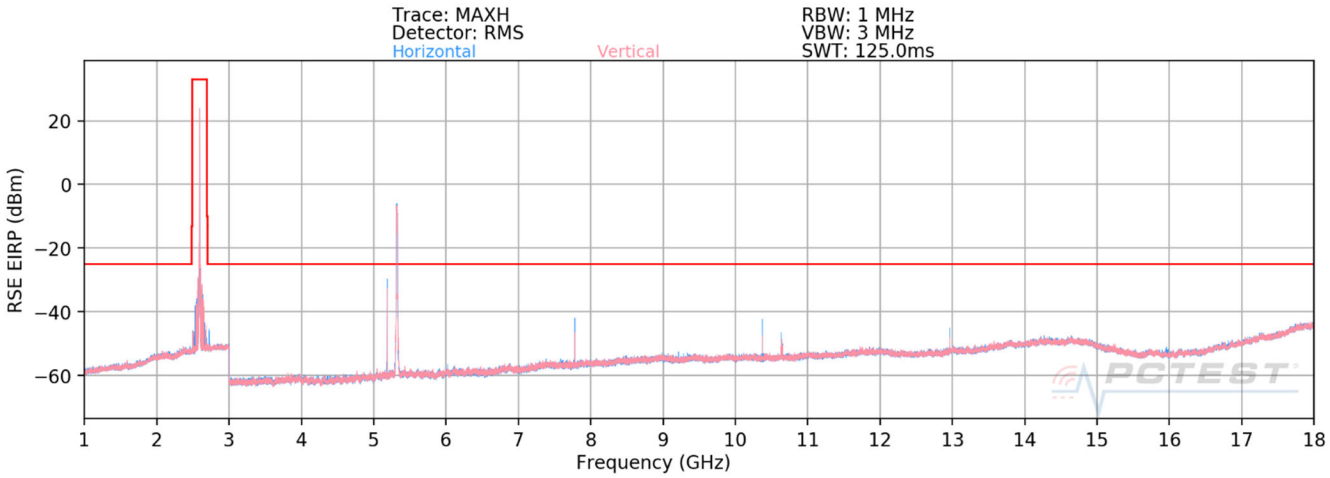


Plot 7-15. Radiated Spurious Plot above 1GHz (B41 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)

OPERATING FREQUENCY:	2593.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	20.0	MHz
DISTANCE:	3	meters
LIMIT:	-25	dBm

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
2281.00	H	242	232	-36.36	9.69	-26.67	-1.7
2749.00	H	204	150	-56.94	10.19	-46.75	-21.7
2905.00	H	116	141	-67.03	9.96	-57.06	-32.1
3249.50	H	308	218	-53.78	9.55	-44.23	-19.2
5186.00	H	116	349	-39.66	10.77	-28.89	-3.9
7779.00	H	361	310	-51.25	11.47	-39.78	-14.8
10372.00	H	-	-	-66.69	12.48	-54.21	-29.2
12965.00	H	158	306	-62.14	13.34	-48.79	-23.8
15558.00	H	116	62	-68.98	16.37	-52.61	-27.6

Table 7-18. Radiated Spurious Data (B41 20MHz Mid Channel + AP(2.4GHz) 802.11b Ch 6)



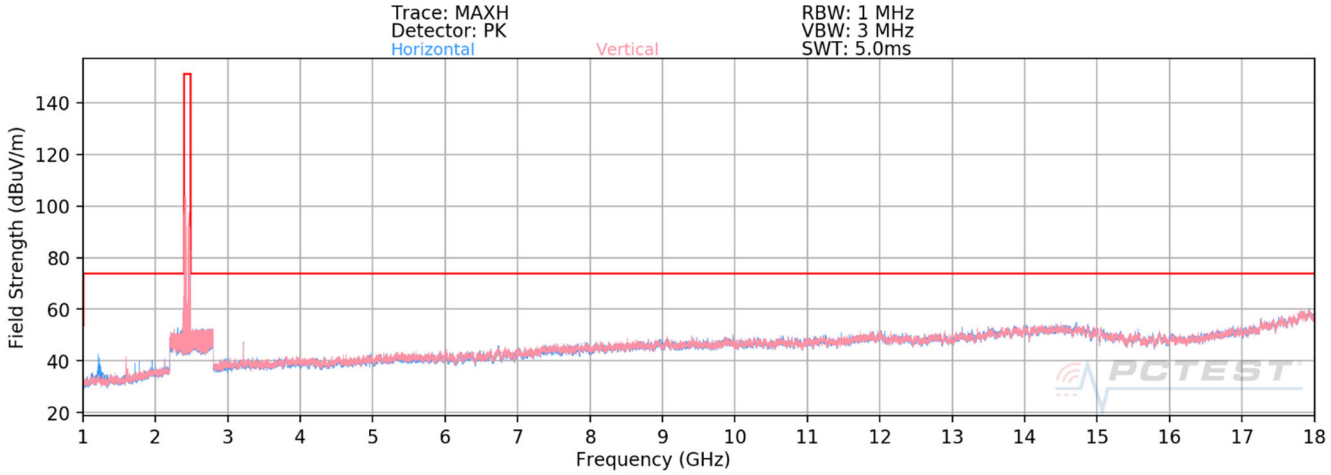
Plot 7-16. Radiated Spurious Plot above 1GHz (B41 20MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

OPERATING FREQUENCY:	2593.00	MHz
MODULATION SIGNAL:	QPSK	
BANDWIDTH:	20.0	MHz
DISTANCE:	3	meters
LIMIT:	-25	dBm

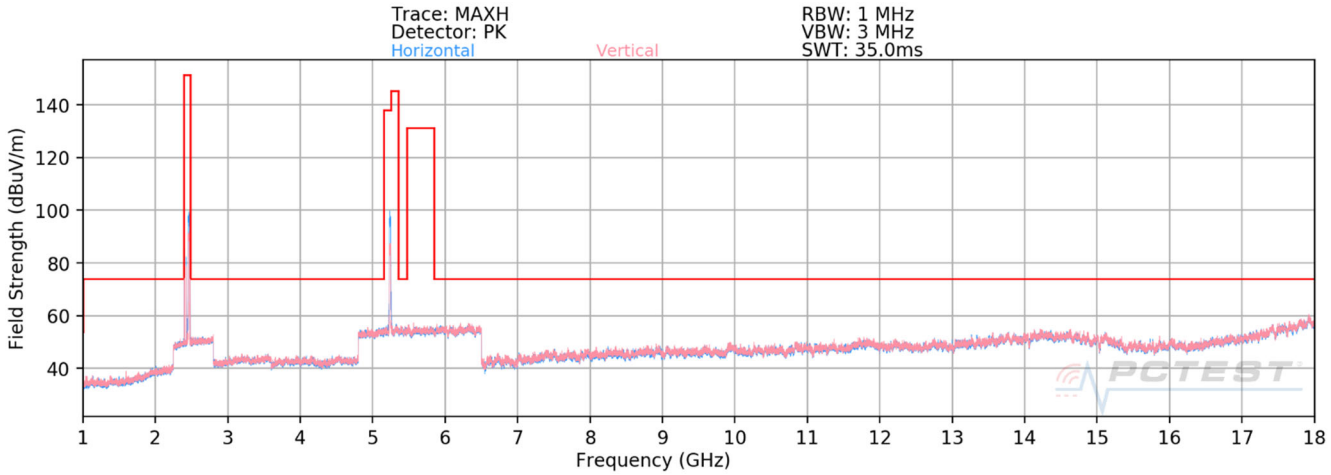
Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	Spurious Emission Level [dBm]	Margin [dB]
5186.00	H	124	348	-39.44	10.77	-28.67	-3.7
7779.00	H	358	293	-52.30	11.47	-40.83	-15.8
10372.00	H	153	52	-49.53	12.48	-37.05	-12.0
12965.00	H	190	311	-54.42	13.34	-41.07	-16.1
15558.00	H	112	289	-68.20	16.37	-51.83	-26.8

Table 7-19. Radiated Spurious Data (B41 20MHz Mid Channel + AP(5GHz) 802.11a Ch 64)

Test Case #4: JJPlus Module (AP) + 2AV6O-AMH100 Onboard WiFi chipset (Client)



Plot 7-17. Radiated Spurious Plot above 1GHz (Client(2.4GHz) 802.11b Ch6 + AP(2.4GHz) 802.11b Ch 11)



Plot 7-18. Radiated Spurious Plot above 1GHz (Client(2.4GHz) 802.11b Ch6 + AP(5GHz) 802.11a Ch 64)

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
3215.80	Avg	H	150	222	-56.69	0.93	51.24	53.98	-2.74
3215.80	Peak	H	150	222	-54.97	0.93	52.96	73.98	-21.02

Table 7-20. Radiated Spurious Data (Client(2.4GHz) 802.11b Ch6 + AP(2.4GHz) 802.11b Ch 11)

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Allerio Mobile Hub FCC ID: 2AV6O-AMH100** complies with all the requirements of Parts 15, 22, 24 & 27 of the FCC Rules for transmission of simultaneous WiFi/BT and LTE operations. The radiated spurious emissions are not impacted by the integrated of the aforementioned modules into the Allerio Mobile Hub.