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MEASUREMENT REPORT FCC Part 15.247 WLAN 802.11b/g/n

Applicant Name:

H&D Wireless AB
Färögatan 33,
SE-164 51 Kista,
Sweden

Date of Testing:

12/14/16 - 1/24/2017

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Test Report Serial No.:

0Y1612302093-03.XO2

FCC ID:

XO2SPB209A

APPLICANT:

H&D Wireless AB

Application Type:

Class II Permissive Change

Model:

SPB209A

EUT Type:

Wifi/BT/NFC Module

FCC Classification:

Digital Transmission System (DTS)

FCC Rule Part(s):

Part 15.247

Test Procedure(s):

KDB 558074 D01 v03r05

Class II Permissive Change:

Adding external antenna GW.40.2153. Please see FCC change document for details.

Original Grant Date:

10/12/2016

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 558074 D01 v03r05. 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

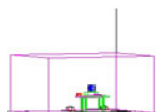


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MEASUREMENT REPORT

FCC Part 15.247



§ 2.1033 General Information

APPLICANT: H&D Wireless AB

APPLICANT ADDRESS: Färögatan 33,
SE-164 51 Kista,, Sweden

TEST SITE: PCTEST ENGINEERING LABORATORY, INC.

TEST SITE ADDRESS: 7185 Oakland Mills Road, Columbia, MD 21046 USA

FCC RULE PART(S): Part 15.247

BASE MODEL: SPB209A

FCC ID: XO2SPB209A

FCC CLASSIFICATION: Digital Transmission System (DTS)

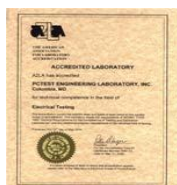
Test Device Serial No.: 164602 ☐ Production ☒ Pre-Production ☐ Engineering

DATE(S) OF TEST: 12/14/16 - 1/24/2017

TEST REPORT S/N: 0Y1612302093-03.XO2

Test Facility / Accreditations

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



- PCTEST facility is an FCC registered (PCTEST Reg. No. 159966) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (2451B-1).
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing Aid Compatibility (HAC) testing, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (2451B-1) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS, CDMA, and EvDO wireless devices and for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO, and CDMA 1xRTT.

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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 Industry Canada Certification and Engineering Bureau.

1.2 PCTEST Test Location

The map below shows the location of the PCTEST LABORATORY, its proximity to the FCC Laboratory, the Columbia vicinity, the Baltimore-Washington Intern'l (BWI) airport, the city of Baltimore and the Washington, DC area. (See Figure 1-1).

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The site coordinates are 39° 10'23" N latitude and 76° 49'50" W longitude. The facility is 0.4 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2014 on January 22, 2015.

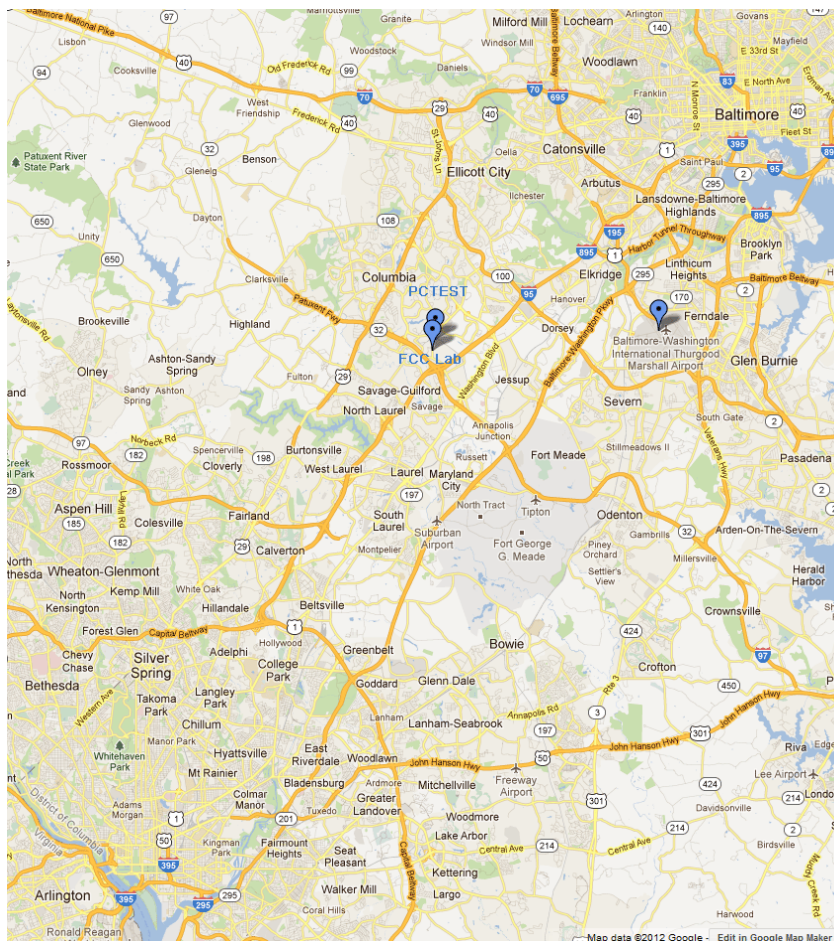


Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **H&D Wireless AB Wifi/BT/NFC Module FCC ID: XO2SPB209A**. The test data contained in this report pertains only to the emissions due to the EUT's WLAN (DTS) transmitter.

2.2 Device Capabilities

This device contains the following capabilities:

802.11b/g/n/a/ac WLAN/UNII, Bluetooth (1x, EDR, LE), NFC

Note: 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 = peak per the guidance of Section 6.0 b) of KDB 558074 D01 v03r05. 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:

Maximum Achievable Duty Cycles		
802.11 Mode/Band		Duty Cycle [%]
2.4GHz	b	99.5
	g	96.5
	n	96.1
	n (40MHz BW)	92.3

Data Rates Supported: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps (b)
 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps (g)
 6.5/7.2Mbps, 13/14.4Mbps, 19.5/21.7Mbps, 26/28.9Mbps, 39/43.3Mbps,
 52/57.8Mbps, 58.5/65Mbps, 65/72.2Mbps (n)
 13.5/15Mbps, 27/30Mbps, 40.5/45Mbps, 54/60Mbps, 81/90Mbps, 108/120Mbps,
 121.5/135Mbps, 135/150Mbps, 162/180Mbps, 180/200Mbps (n 40MHz BW)

2.3 Test Configuration

The EUT was tested per the guidance of KDB 558074 D01 v03r05. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing. See Section 3.2 for radiated emissions test setups.

2.4 EMI Suppression Device(s)/Modifications

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

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3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 v03r05 were used in the measurement of the EUT.

Deviation from measurement procedure.....None

3.2 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. 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. A raised 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. 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. A 72.4cm high PVC support structure is placed on top of the turntable. A 3" (~7.6cm) sheet of high density polystyrene is used as the table top and is placed on top of the PVC supports to bring the total height of the table to 80cm. For measurements above 1GHz, a high density expanded polystyrene block is placed on top of the test table to bring the total table height to 1.5m.

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 was placed on top of the 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, mode of operation, 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.

3.3 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

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4.0 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.”

- Antenna connections uses unique coupling to the intentional radiator.

Conclusion:

The EUT unit complies with the requirement of §15.203.

Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13	2472
7	2442		

Table 4-1. Frequency/ Channel Operations

Ch.	Frequency (MHz)
1 + 5	2422
2 + 6	2427
3 + 7	2432
4 + 8	2437
5 + 9	2442
6 + 10	2447
7 + 11	2452
8 + 12	2457
9 + 13	2462

Table 4-2. Frequency/ Channel Operations (802.11n 40MHz BW)

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5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95% level of confidence. The measurement data shown herein 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 ($\pm$ dB)
Conducted Bench Top Measurements	1.13
Line Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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6.0 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 C63.5-2006.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	RE1	Radiated Emissions Cable Set (UHF/EHF)	7/11/2016	Annual	7/11/2017	RE1
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	7/30/2015	Biennial	7/30/2017	121034
Com-Power	PAM-103	Pre-Amplifier (1-1000MHz)	7/6/2016	Annual	7/6/2017	441119
Emco	3115	Horn Antenna (1-18GHz)	3/10/2016	Biennial	3/10/2018	9704-5182
Emco	3116	Horn Antenna (18 - 40GHz)	3/27/2015	Triennial	3/27/2018	9203-2178
Huber+Suhner	Sucoflex 102A	40GHz Radiated Cable	4/26/2016	Annual	4/26/2017	251425001
K & L	11SH10-3075/U18000	High Pass Filter	7/11/2016	Annual	7/11/2017	11SH10-3075/U18000-2
PCTEST	-	EMC Switch System	7/11/2016	Annual	7/11/2017	NM1
PCTEST	-	EMC Switch System	7/6/2016	Annual	7/6/2017	NM2
Rhode & Schwarz	TS-PR18	Pre-Amplifier	7/6/2016	Annual	7/6/2017	101622
Rohde & Schwarz	TS-PR18	1-18 GHz Pre-Amplifier	7/11/2016	Annual	7/11/2017	100071
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	3/7/2016	Annual	3/7/2017	100040
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	5/16/2016	Annual	5/16/2017	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	7/15/2016	Annual	7/15/2017	100348
Sunol	DRH-118	Horn Antenna (1-18GHz)	7/30/2015	Biennial	7/30/2017	A050307
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	3/14/2016	Biennial	3/14/2018	A051107

Table 6-1. Annual Test Equipment Calibration Schedule

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7.0 TEST RESULTS

7.1 Summary

Company Name: H&D Wireless AB
 FCC ID: XO2SPB209A
 FCC Classification: Digital Transmission System (DTS)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(b)(3)	Transmitter Output Power	< 1 Watt	CONDUCTED	PASS	Sections 7.2
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	RADIATED	PASS	Sections 7.3, 7.4

Table 7-1. Summary of Test Results

Note:

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

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7.2 Output Power Measurement

§15.247(b.3)

Test Overview and Limits

A transmitter antenna terminal of EUT is connected to the input of an RF power sensor. Measurement is made using a broadband power meter capable of making peak and average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

Test Procedure Used

KDB 558074 D01 v03r05 – Section 9.1.2 PKPM1 Peak Power Method

KDB 558074 D01 v03r05 – Section 9.2.3.2 Method AVGPM-G

KDB 662911 D01 v02r01 – Section E)1) Measure-and-Sum Technique

Test Settings

Method PKPM1 (Peak Power Measurement)

Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

Method AVGPM-G (Average Power Measurement)

Average power measurements were performed 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.

Test Setup

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

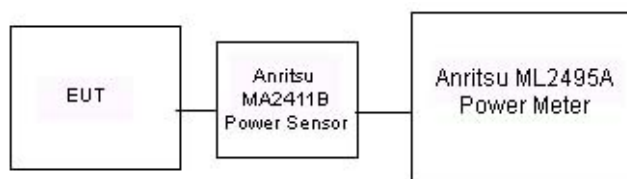


Figure 7-1. Test Instrument & Measurement Setup for Power Meter Measurements

Test Notes

None

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Freq [MHz]	Channel	Detector	2.4GHz Conducted Power [dBm]			
			IEEE Transmission Mode			
			802.11b	802.11g	802.11n	802.11n (40MHz BW)
2412	1	AVG	16.01	13.44	12.28	12.25
		PEAK	18.97	20.93	19.81	19.78
2437	6	AVG	15.76	15.62	15.11	14.98
		PEAK	18.51	23.23	22.52	22.29
2462	11	AVG	15.54	13.11	12.13	12.09
		PEAK	18.28	20.61	19.62	19.72
2467	12	AVG	15.63	9.98	9.03	8.99
		PEAK	18.39	17.55	16.61	16.65
2472	13	AVG	12.34	8.07	6.82	6.98
		PEAK	15.12	15.77	14.47	14.61

Table 7-2. Conducted Output Power Measurements

7.3 Radiated Spurious Emission Measurements – Above 1 GHz

§15.247(d) §15.205 & §15.209

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

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 7-3 per Section 15.209.

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-3. Radiated Limits

Test Procedures Used

KDB 558074 D01 v03r05 – Section 12.1, 12.2.7

Test Settings

Average Field Strength Measurements per Section 12.2.5.1 of KDB 558074 D01 v03r05

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be $\geq 2 \times \text{span/RBW}$)
6. Sweep time = auto
7. Trace (RMS) averaging was performed over at least 100 traces

Peak Field Strength Measurements per Section 12.2.4 of KDB 558074 D01 v03r05

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

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Test Setup

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

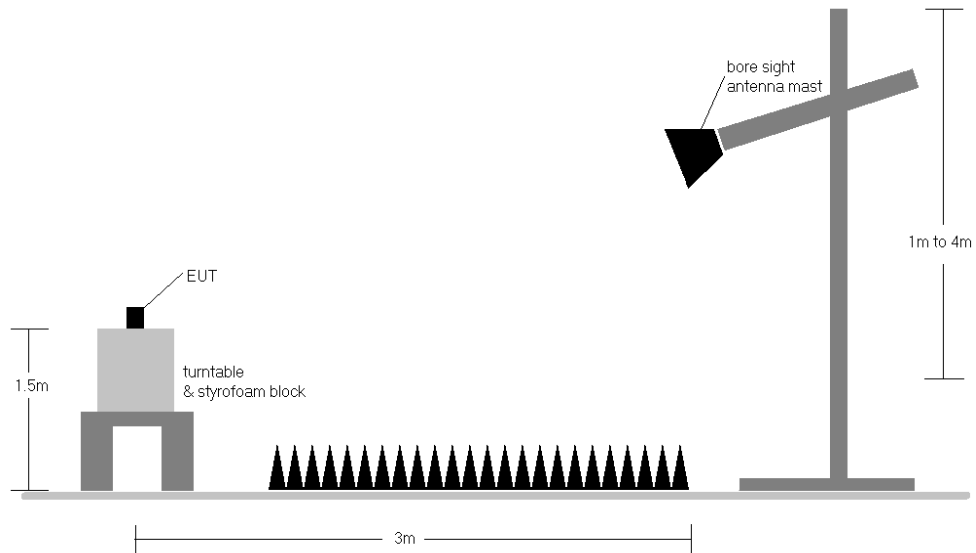


Figure 7-2. Test Instrument & Measurement Setup

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Test Notes

1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of KDB 558074 D01 v03r05 were not used to evaluate this device for compliance to radiated limits. All radiated spurious emissions levels were measured in a radiated test setup.
2. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-3.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested while powered by an DC power source.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
6. 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.
7. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section. Rohde & Schwarz EMC32, Version 9.15.00 automated test software was used to perform the Radiated Spurious Emissions Pre-Scan testing.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level $_{[dB\mu V/m]} = \text{Analyzer Level}_{[dBm]} + 107 + AFCL_{[dB/m]}$
- $AFCL_{[dB/m]} = \text{Antenna Factor}_{[dB/m]} + \text{Cable Loss}_{[dB]}$
- $\text{Margin}_{[dB]} = \text{Field Strength Level}_{[dB\mu V/m]} - \text{Limit}_{[dB\mu V/m]}$

Radiated Band Edge Measurement Offset

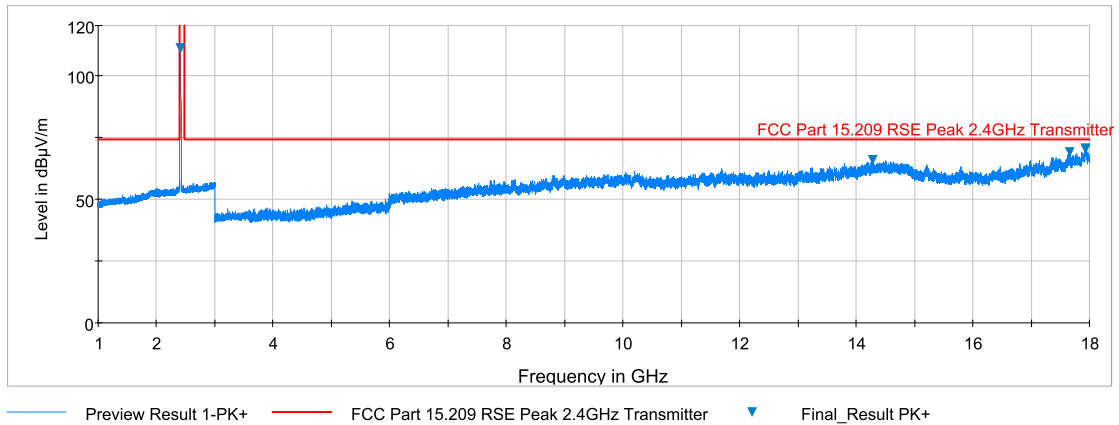
- The amplitude offset shown in the radiated restricted band edge plots in Section 7.2 was calculated using the formula:

$$\text{Offset (dB)} = (\text{Antenna Factor} + \text{Cable Loss} + \text{Attenuator}) - \text{Preamplifier Gain}$$

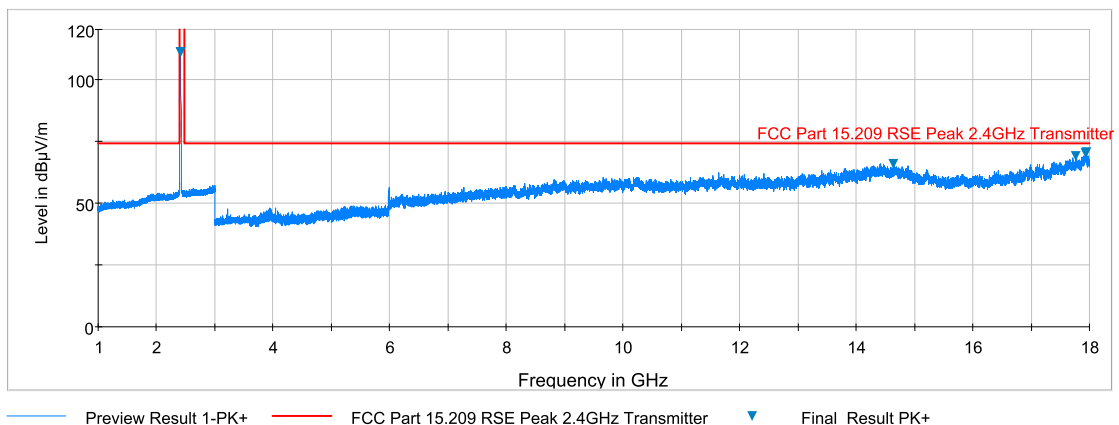
FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.X02	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 15 of 37

7.3.1 Radiated Spurious Emission Measurements

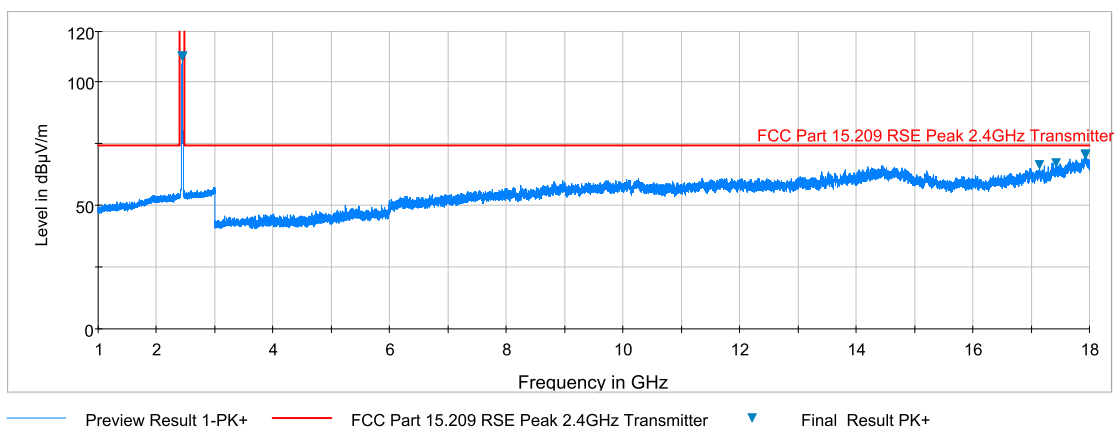
§15.247(d) §15.205 & §15.209



Plot 7-1. Radiated Spurious Plot above 1GHz (802.11b – Ch. 1, Ant. Pol. H)

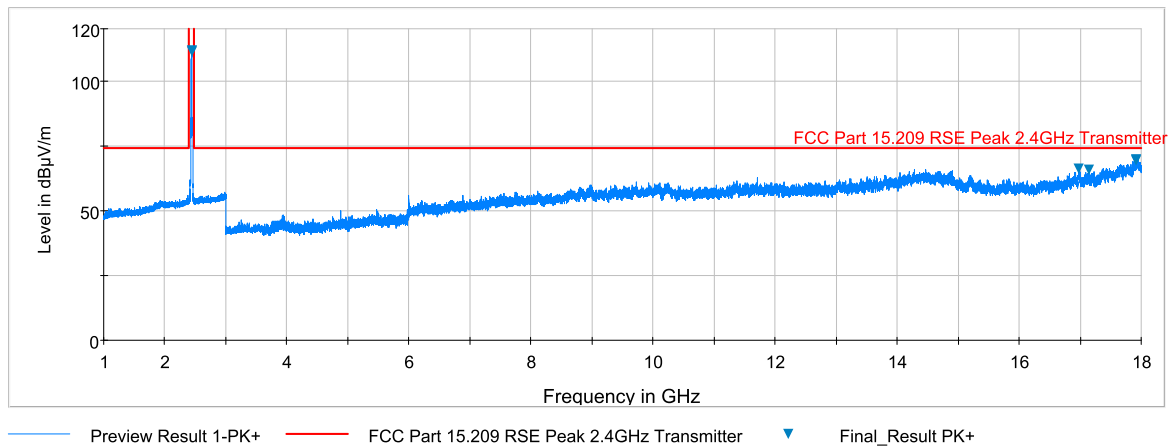


Plot 7-2. Radiated Spurious Plot above 1GHz (802.11b – Ch. 1, Ant. Pol. V)

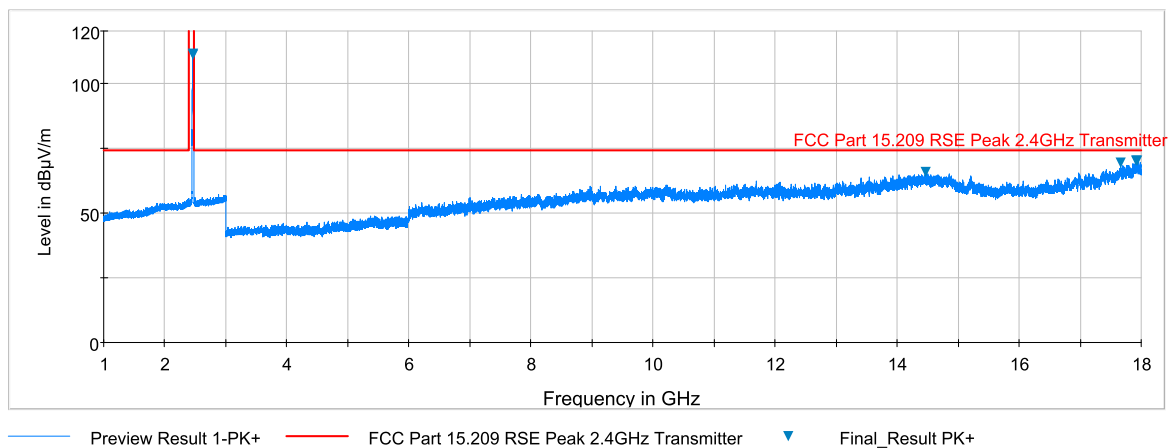


Plot 7-3. Radiated Spurious Plot above 1GHz (802.11b – Ch. 6, Ant. Pol. H)

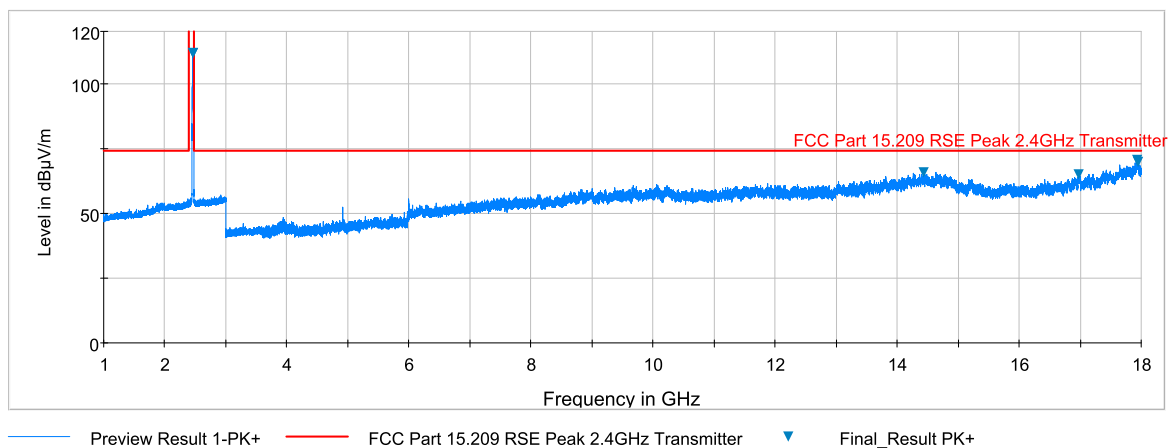
FCC ID: XO2SPB209A	PCTEST ENGINEERING LABORATORY, INC.	FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	H&D Wireless	Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 16 of 37



Plot 7-4. Radiated Spurious Plot above 1GHz (802.11b – Ch. 6, Ant. Pol. V)



Plot 7-5. Radiated Spurious Plot above 1GHz (802.11b – Ch. 11, Ant. Pol. H)

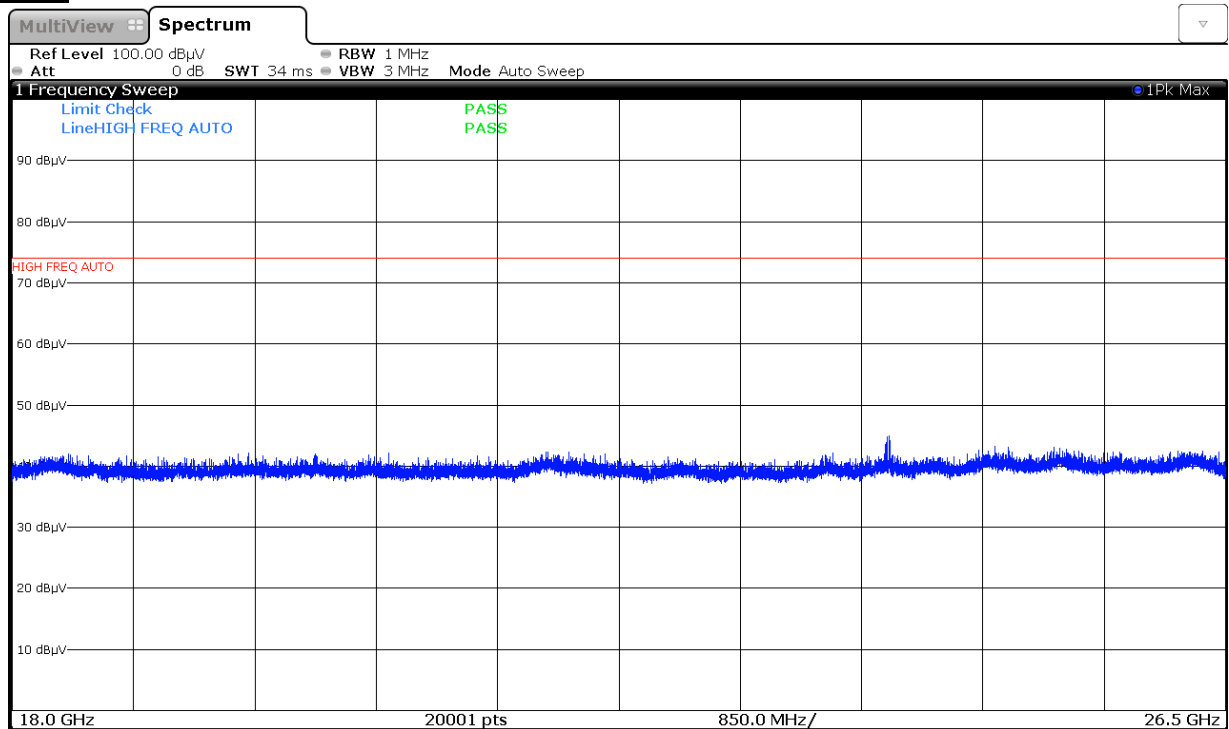


Plot 7-6. Radiated Spurious Plot above 1GHz (802.11b – Ch. 11, Ant. Pol. V)

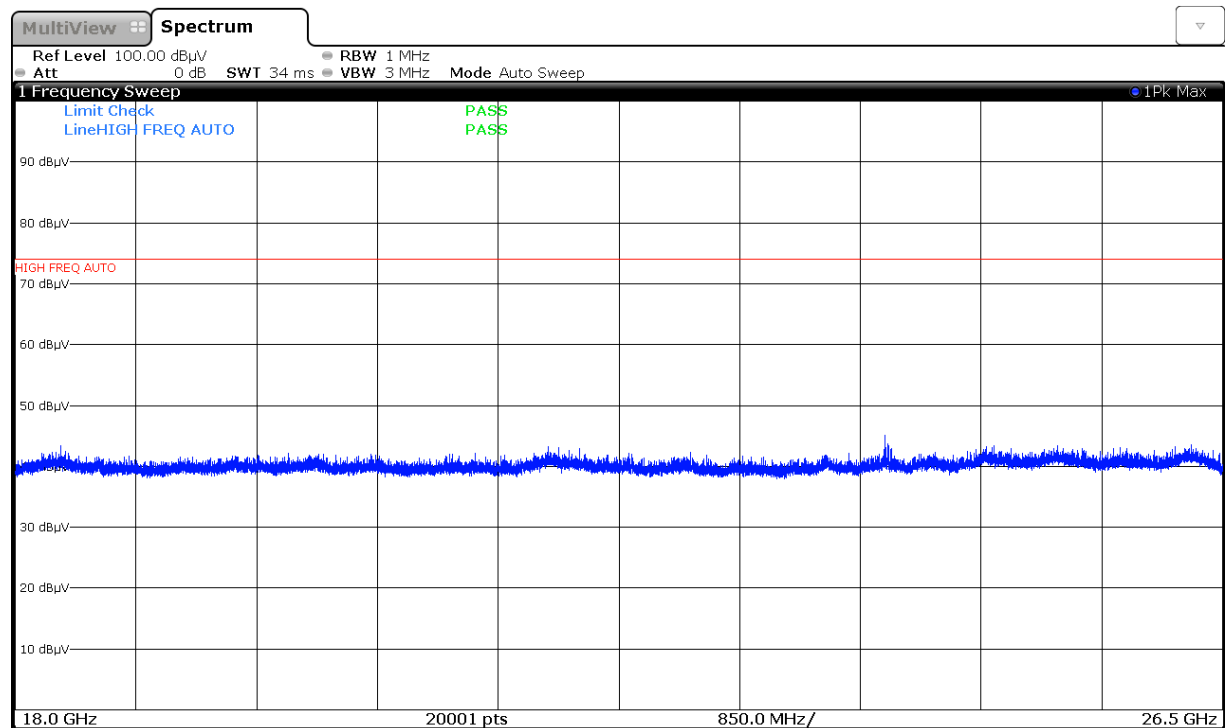
FCC ID: XO2SPB209A	PCTEST ENGINEERING LABORATORY, INC.	FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	H&D Wireless	Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 17 of 37

Radiated Spurious Emissions Measurements (Above 18GHz)

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Plot 7-7. Radiated Spurious Plot above 18GHz (Pol. H)



Plot 7-8. Radiated Spurious Plot above 18GHz (Pol. V)

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 18 of 37

Radiated Spurious Emission Measurements

§15.247(d) §15.205 & §15.209

Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2412MHz
Channel: 01

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]
4824.00	Avg	V	232	119	-65.47	0.61	42.14	53.98	-11.84
4824.00	Peak	V	232	119	-55.42	0.61	52.19	73.98	-21.79
12060.00	Avg	V	-	-	-72.50	14.41	48.91	53.98	-5.07
12060.00	Peak	V	-	-	-60.21	14.41	61.20	73.98	-12.78

Table 7-4. Radiated Measurements

Worst Case Mode: 802.11b
Worst Case Transfer Rate: 1 Mbps
Distance of Measurements: 3 Meters
Operating Frequency: 2437MHz
Channel: 06

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]
4874.00	Avg	V	243	135	-64.09	0.84	43.75	53.98	-10.23
4874.00	Peak	V	243	135	-56.02	0.84	51.82	73.98	-22.16
7311.00	Avg	V	365	121	-67.32	9.58	49.26	53.98	-4.72
7311.00	Peak	V	365	121	-56.06	9.58	60.52	73.98	-13.46
12185.00	Avg	V	-	-	-71.98	15.59	50.61	53.98	-3.37
12185.00	Peak	V	-	-	-59.26	15.59	63.33	73.98	-10.65

Table 7-5. Radiated Measurements

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 19 of 37

Worst Case Mode: 802.11b
 Worst Case Transfer Rate: 1 Mbps
 Distance of Measurements: 3 Meters
 Operating Frequency: 2462MHz
 Channel: 11

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]
4924.00	Avg	V	210	119	-58.57	1.05	49.48	53.98	-4.50
4924.00	Peak	V	210	119	-53.07	1.05	54.98	73.98	-19.00
7386.00	Avg	V	282	350	-67.18	10.37	50.19	53.98	-3.79
7386.00	Peak	V	282	350	-55.92	10.37	61.45	73.98	-12.53
12310.00	Avg	V	-	-	-71.47	15.20	50.73	53.98	-3.25
12310.00	Peak	V	-	-	-58.36	15.20	63.84	73.98	-10.14

Table 7-6. Radiated Measurements

7.3.2 Radiated Restricted Band Edge Measurements

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The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting.

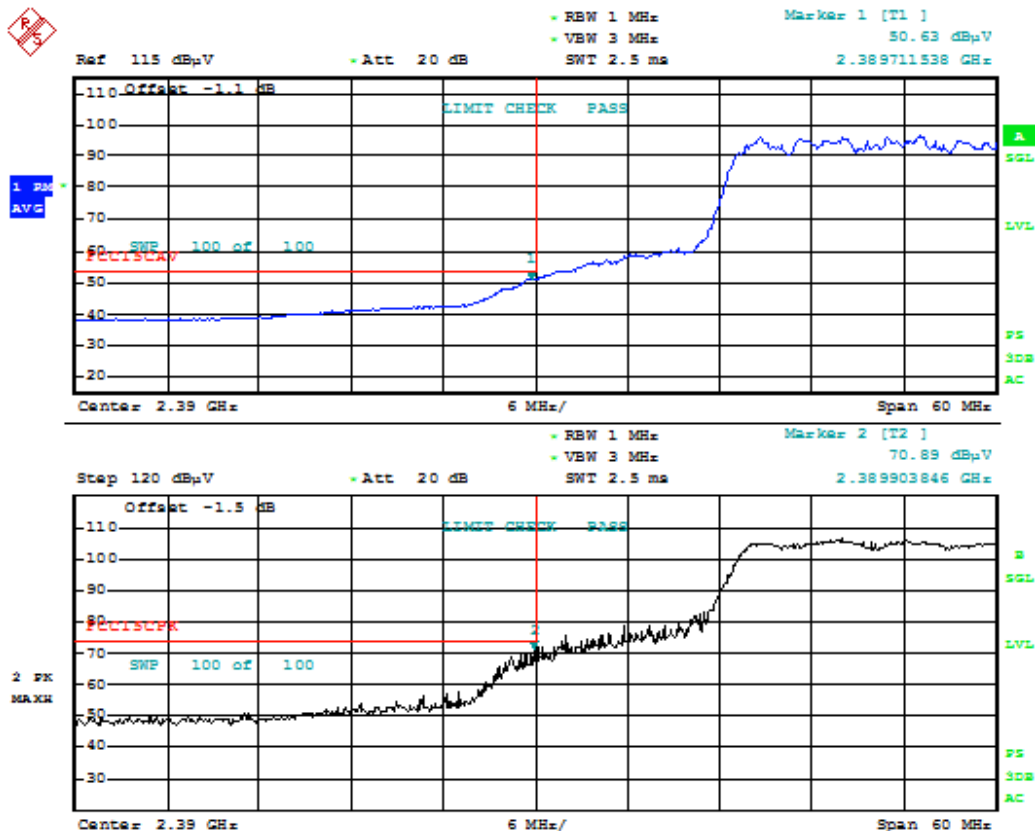
Worst Case Mode: 802.11n

Worst Case Transfer Rate: MCS0

Distance of Measurements: 3 Meters

Operating Frequency: 2412MHz

Channel: 1



Date: 12.DEC.2016 19:12:53

Plot 7-9. Radiated Restricted Lower Band Edge Measurement (Average & Peak)

FCC ID: XO2SPB209A	PCTEST ENGINEERING LABORATORY, INC.	FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	H&D Wireless	Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 21 of 37

Radiated Restricted Band Edge Measurements

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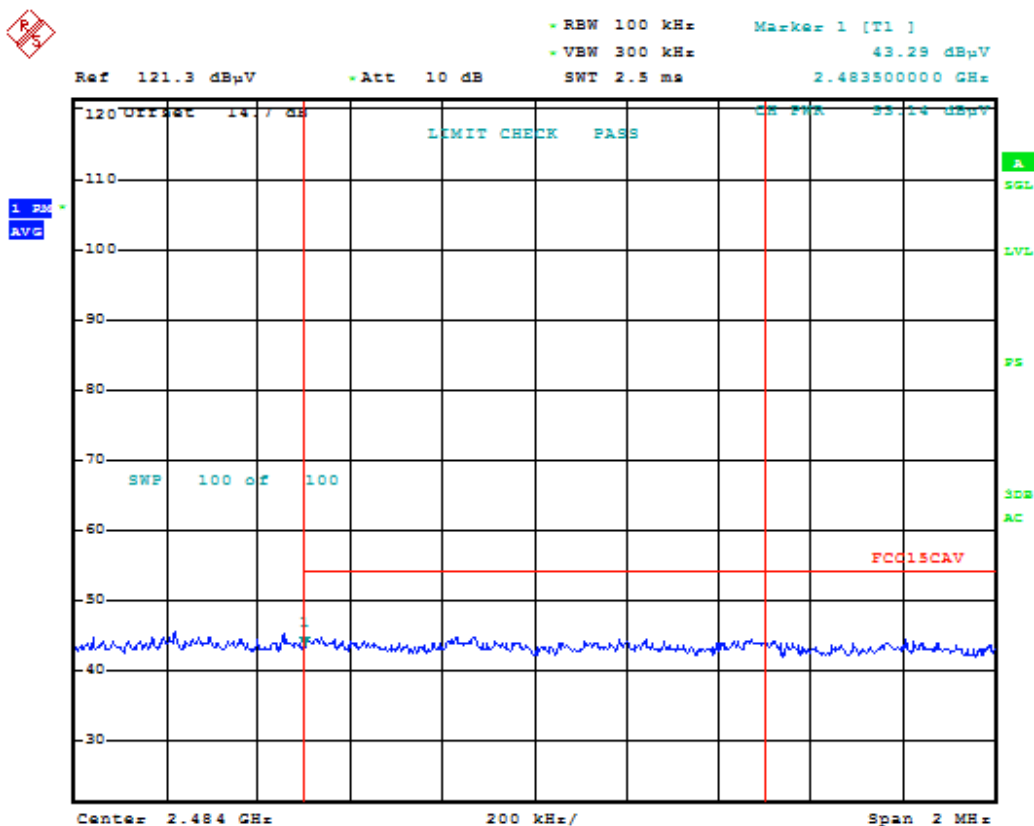
Worst Case Mode: 802.11n

Worst Case Transfer Rate: MCS0

Distance of Measurements: 3 Meters

Operating Frequency: 2462MHz

Channel: 11



Date: 2.JAN.2017 17:48:42

Plot 7-10. Radiated Restricted Upper Band Edge Measurement (Average)

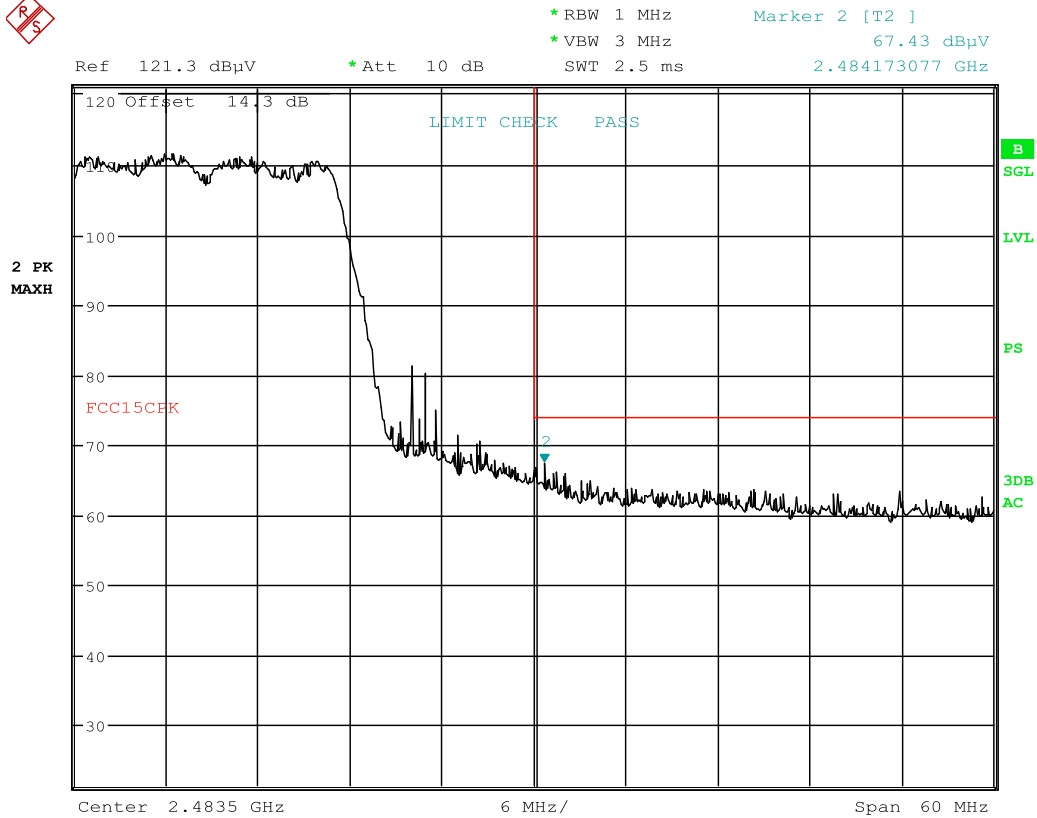
Note:

A channel integration method was used to determine compliance with the out of band average radiated spurious emissions limit in the 2483.5 – 2500MHz band. Per KDB 558074 D01 v03r05 Section 13.3.3, a measurement was performed using a RBW of 100kHz at the 2483.5MHz band edge. The results were integrated up to the 1MHz reference bandwidth to show compliance with the 15.209 radiated limit for emissions greater than 1GHz.

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 22 of 37

Radiated Restricted Band Edge Measurements

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Date: 2.JAN.2017 17:49:20

Plot 7-11. Radiated Restricted Upper Band Edge Measurement (Peak)

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 23 of 37

Radiated Restricted Band Edge Measurements

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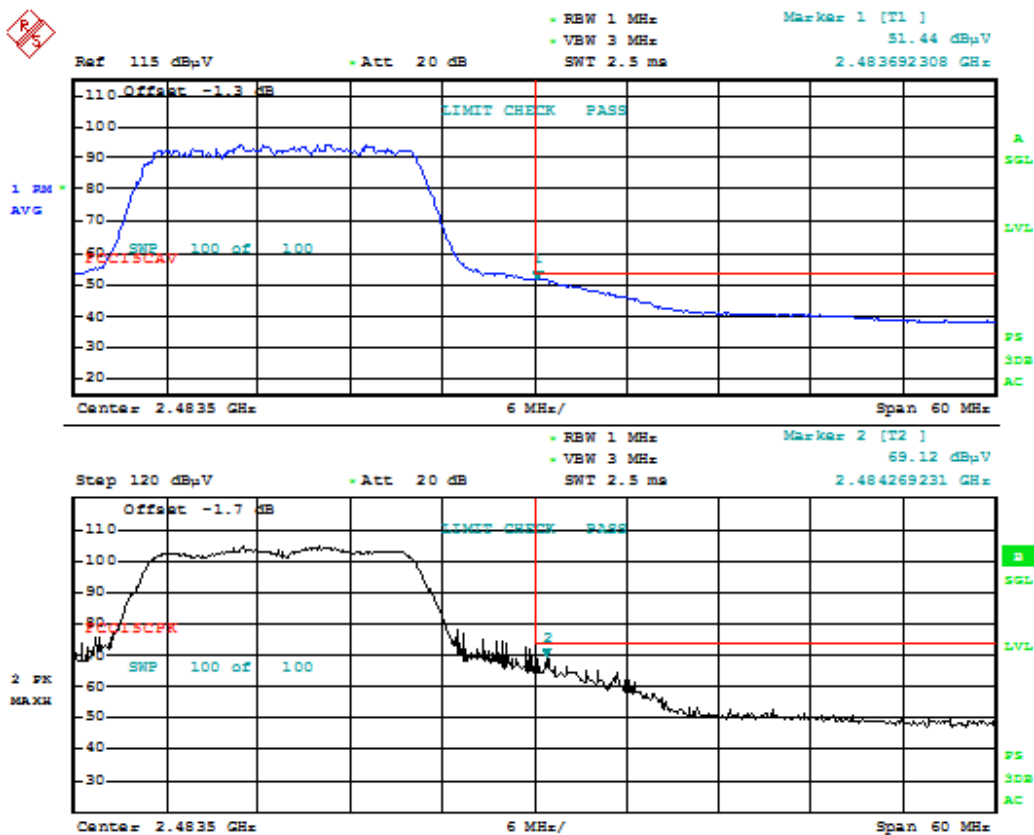
Worst Case Mode: 802.11n

Worst Case Transfer Rate: MCS0

Distance of Measurements: 3 Meters

Operating Frequency: 2467MHz

Channel: 12



Date: 12.DEC.2016 20:23:11

Plot 7-12. Radiated Restricted Upper Band Edge Measurement (Average & Peak)

FCC ID: XO2SPB209A	PCTEST ENGINEERING LABORATORY, INC.	FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	H&D Wireless	Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 24 of 37

Radiated Restricted Band Edge Measurements

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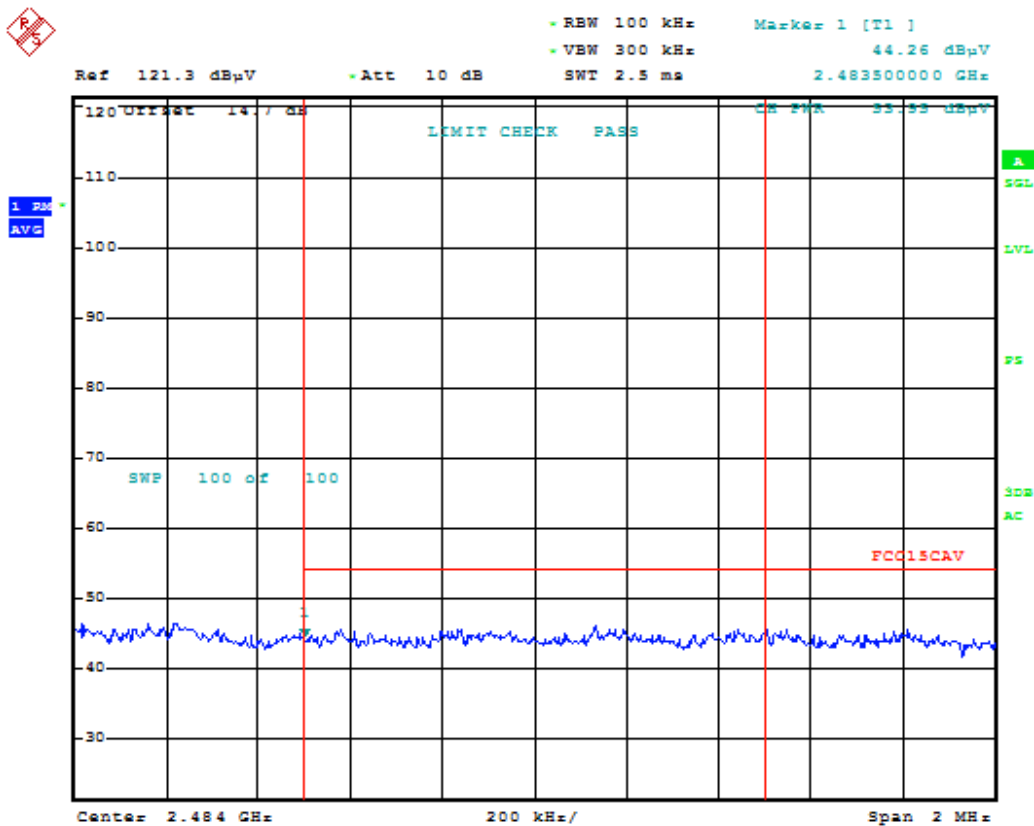
Worst Case Mode: 802.11n

Worst Case Transfer Rate: MCS0

Distance of Measurements: 3 Meters

Operating Frequency: 2472MHz

Channel: 13



Date: 2.JAN.2017 17:42:33

Plot 7-13. Radiated Restricted Upper Band Edge Measurement (Average)

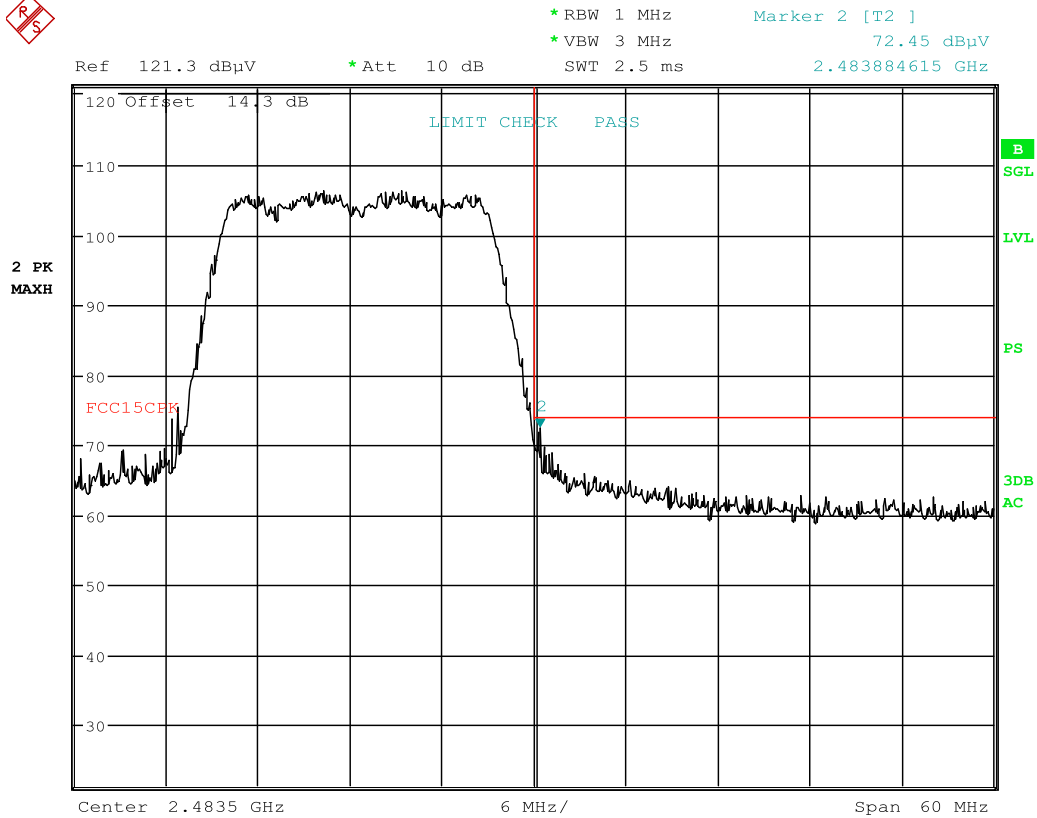
Note:

A channel integration method was used to determine compliance with the out of band average radiated spurious emissions limit in the 2483.5 – 2500MHz band. Per KDB 558074 D01 v03r05 Section 13.3.3, a measurement was performed using a RBW of 100kHz at the 2483.5MHz band edge. The results were integrated up to the 1MHz reference bandwidth to show compliance with the 15.209 radiated limit for emissions greater than 1GHz.

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 25 of 37

Radiated Restricted Band Edge Measurements

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Date: 2.JAN.2017 17:43:35

Plot 7-14. Radiated Restricted Upper Band Edge Measurement (Peak)

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 26 of 37

Radiated Restricted Band Edge Measurements

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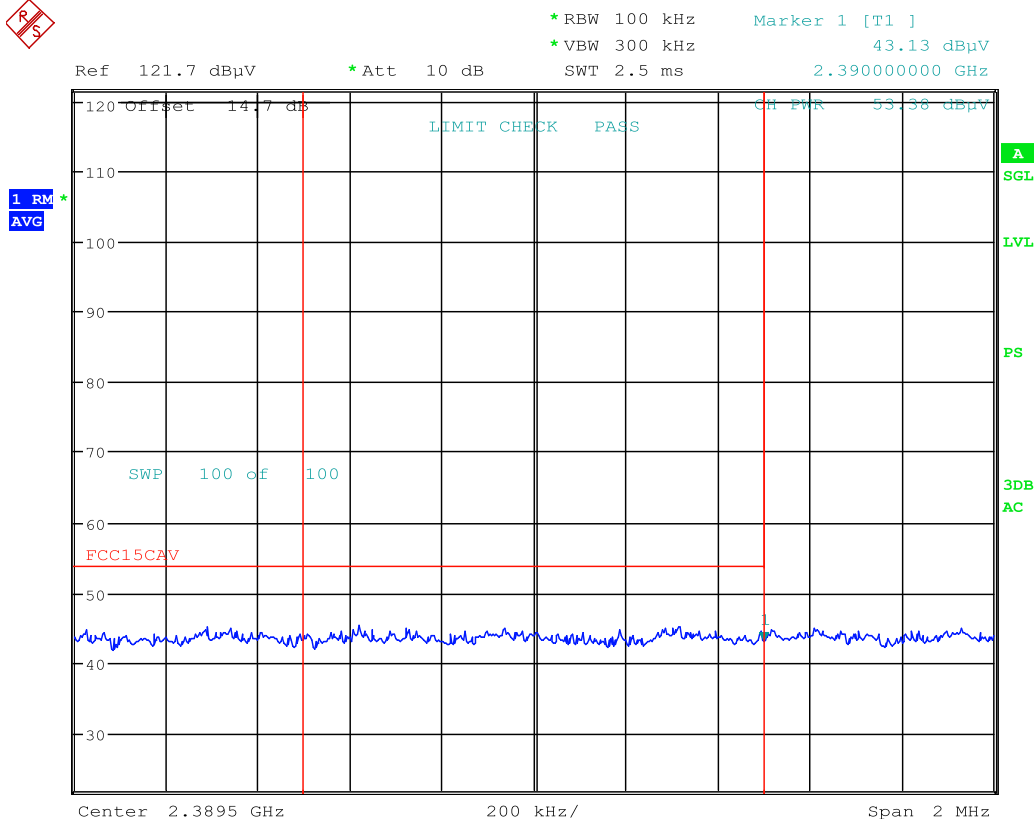
Worst Case Mode: 802.11n (40MHz BW)

Worst Case Transfer Rate: MCS7

Distance of Measurements: 3 Meters

Operating Frequency: 2422MHz

Channel: 1 + 5



Plot 7-15. Radiated Restricted Lower Band Edge Measurement (Average)

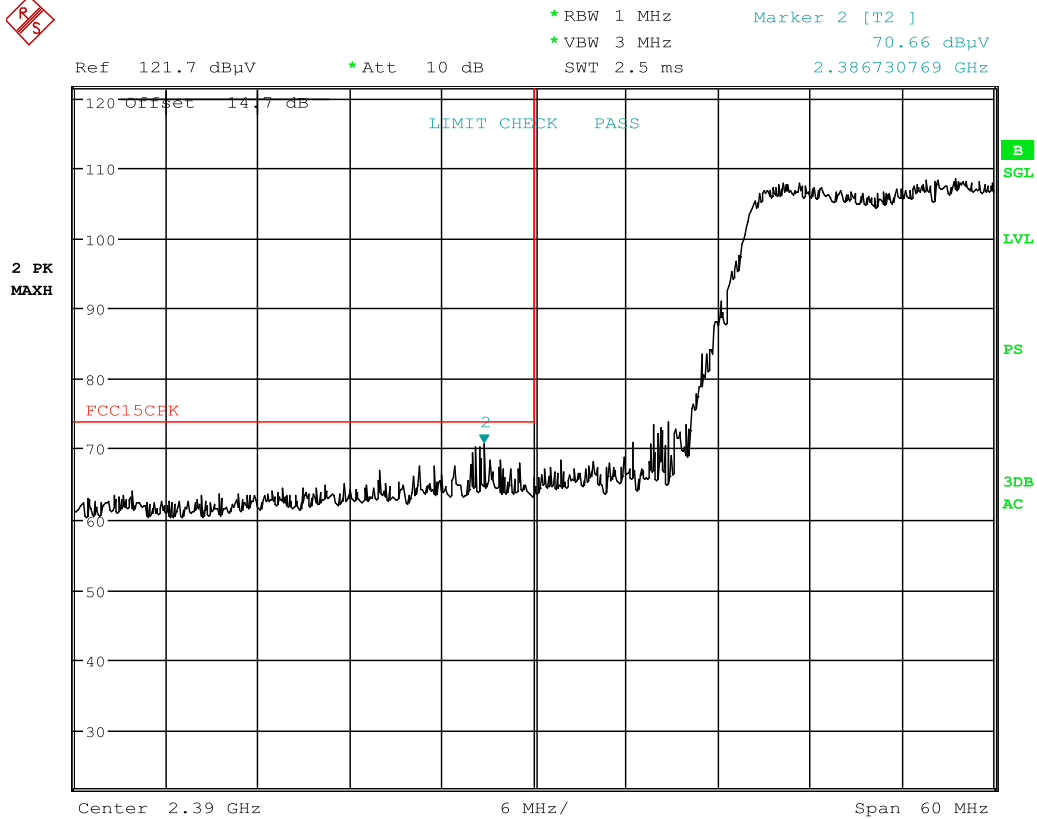
Note:

A channel integration method was used to determine compliance with the out of band average radiated spurious emissions limit in the 2483.5 – 2500MHz band. Per KDB 558074 D01 v03r05 Section 13.3.3, a measurement was performed using a RBW of 100kHz at the 2483.5MHz band edge. The results were integrated up to the 1MHz reference bandwidth to show compliance with the 15.209 radiated limit for emissions greater than 1GHz.

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 27 of 37

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Plot 7-16. Radiated Restricted Lower Band Edge Measurement (Peak)

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 28 of 37



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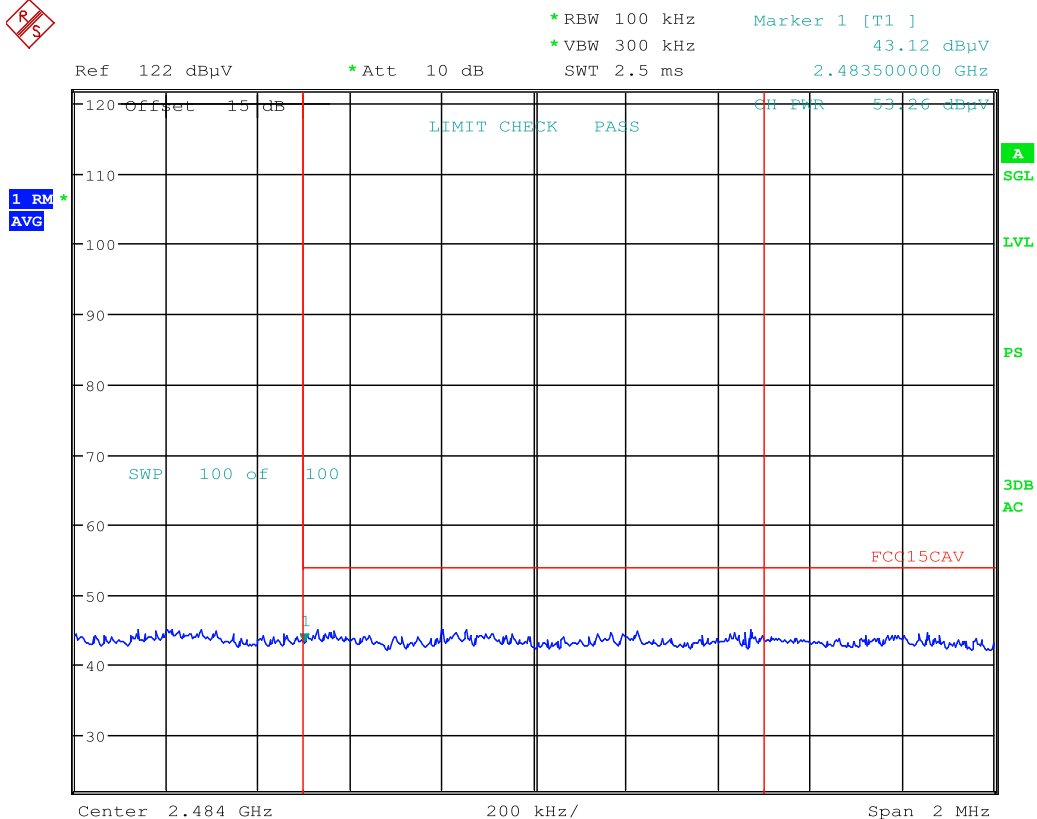
Worst Case Mode: 802.11n (40MHz BW)

Worst Case Transfer Rate: MCS7

Distance of Measurements: 3 Meters

Operating Frequency: 2452MHz

Channel: 7 + 11



Plot 7-17. Radiated Restricted Upper Band Edge Measurement (Average)

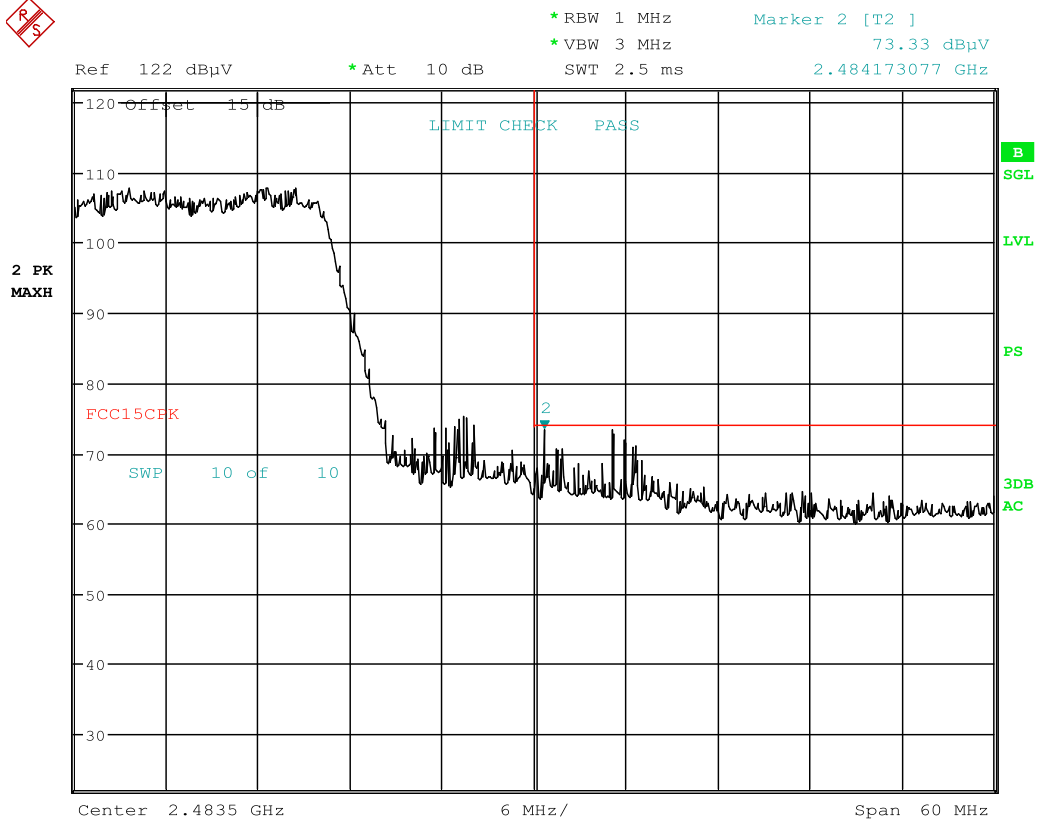
Note:

A channel integration method was used to determine compliance with the out of band average radiated spurious emissions limit in the 2483.5 – 2500MHz band. Per KDB 558074 D01 v03r05 Section 13.3.3, a measurement was performed using a RBW of 100kHz at the 2483.5MHz band edge. The results were integrated up to the 1MHz reference bandwidth to show compliance with the 15.209 radiated limit for emissions greater than 1GHz.

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 29 of 37

Radiated Restricted Band Edge Measurements

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Plot 7-18. Radiated Restricted Upper Band Edge Measurement (Peak)

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.X02	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 30 of 37

Radiated Restricted Band Edge Measurements

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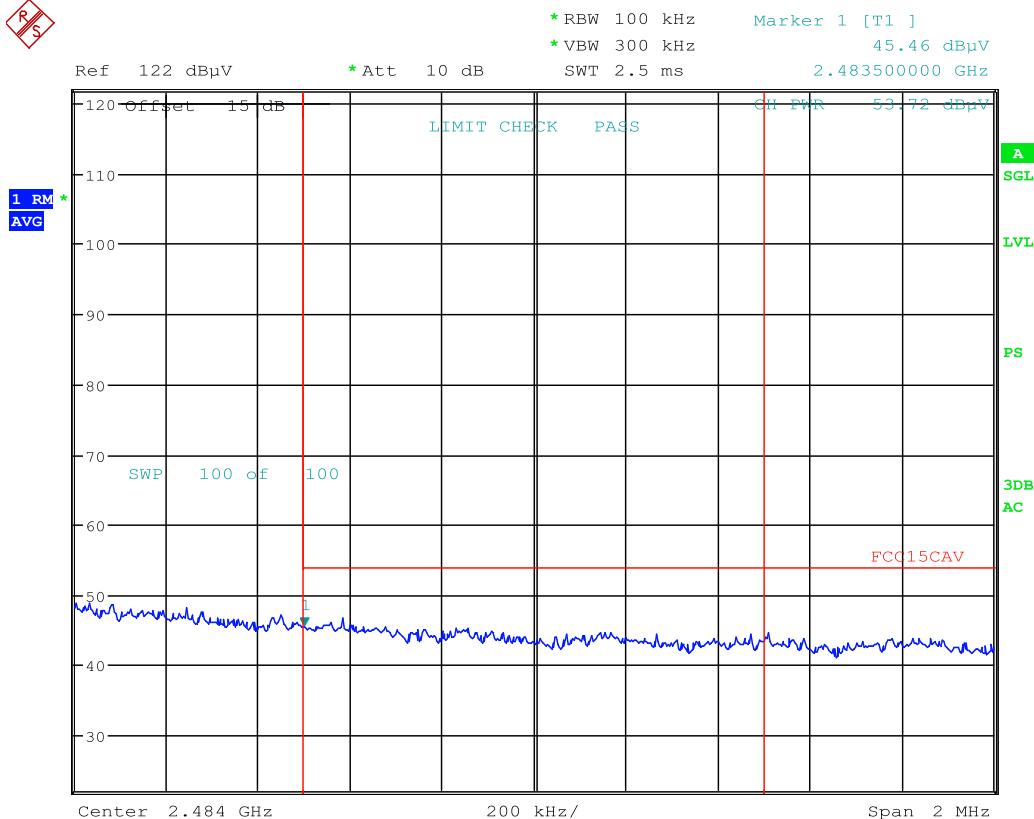
Worst Case Mode: 802.11n (40MHz BW)

Worst Case Transfer Rate: MCS7

Distance of Measurements: 3 Meters

Operating Frequency: 2462MHz

Channel: 9 + 13



Plot 7-19. Radiated Restricted Upper Band Edge Measurement (Average)

Note:

A channel integration method was used to determine compliance with the out of band average radiated spurious emissions limit in the 2483.5 – 2500MHz band. Per KDB 558074 D01 v03r05 Section 13.3.3, a measurement was performed using a RBW of 100kHz at the 2483.5MHz band edge. The results were integrated up to the 1MHz reference bandwidth to show compliance with the 15.209 radiated limit for emissions greater than 1GHz.

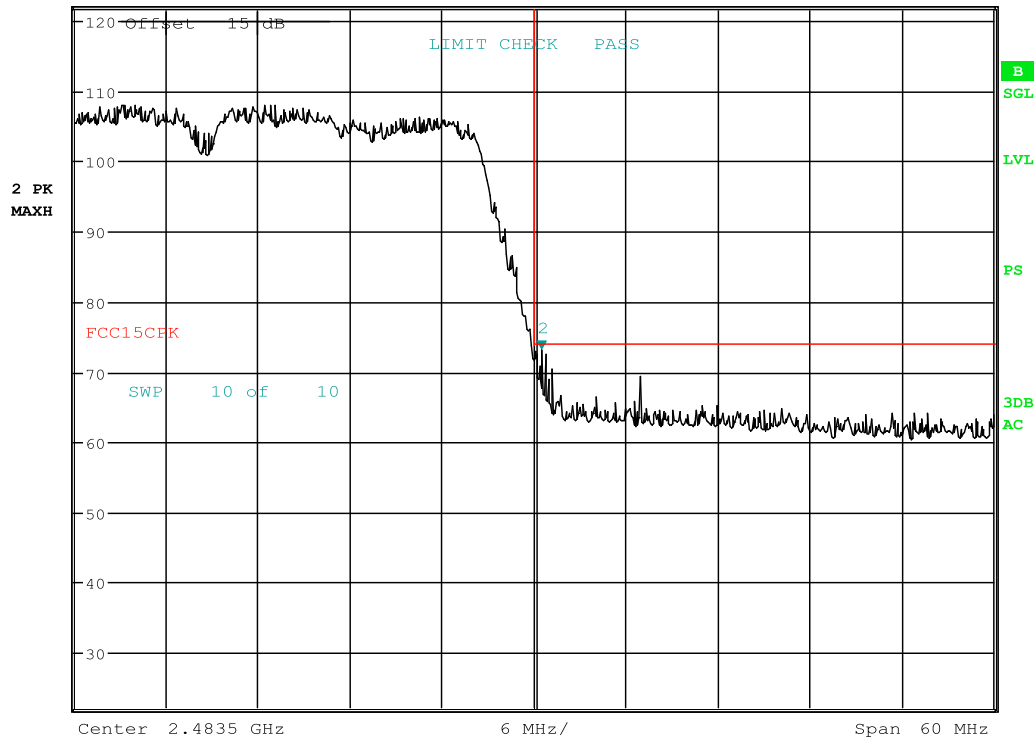
FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 31 of 37

Radiated Restricted Band Edge Measurements

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MARKER 2
 2.483980769 GHz
 Ref 122 dBμV *Att 10 dB
 *RBW 1 MHz Marker 2 [T2]
 *VBW 3 MHz 73.24 dBμV
 SWT 2.5 ms 2.483980769 GHz



Plot 7-20. Radiated Restricted Upper Band Edge Measurement (Peak)

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 32 of 37

7.4 Radiated Spurious Emissions Measurements – Below 1GHz

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Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

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 7-7 per Section 15.209.

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-7. Radiated Limits

Test Procedures Used

ANSI C63.4-2013

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 33 of 37

Test Setup

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

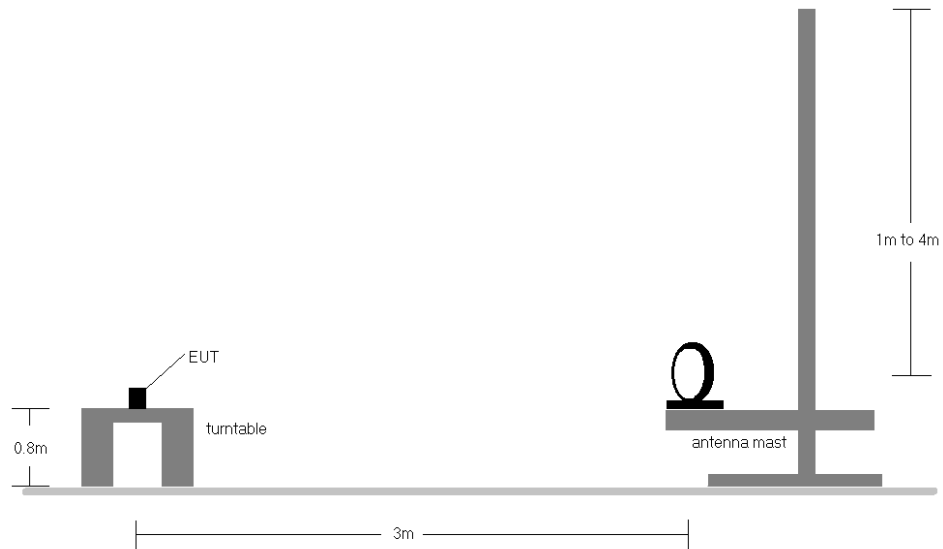


Figure 7-3. Radiated Test Setup < 30Mhz

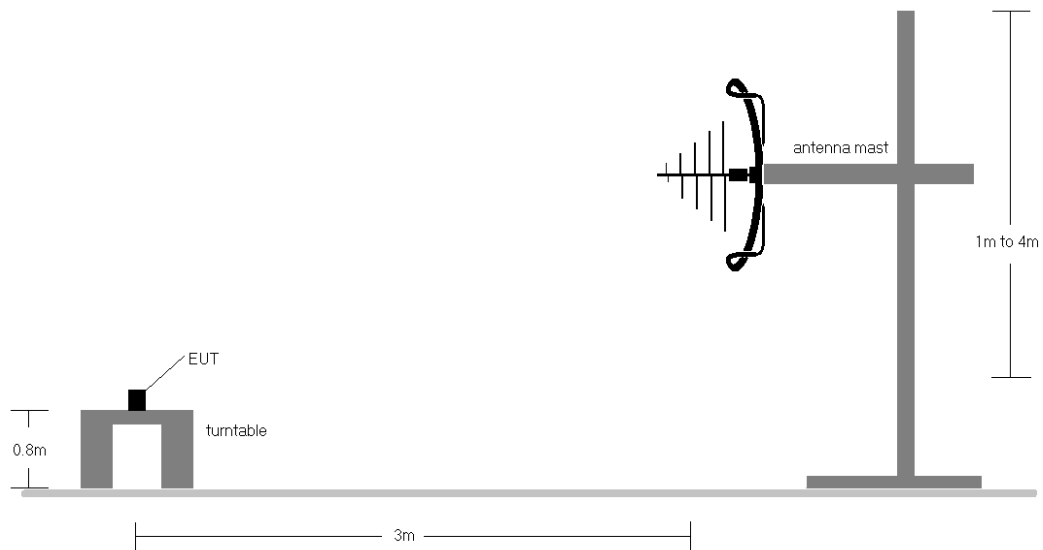


Figure 7-4. Radiated Test Setup < 1GHz

FCC ID: XO2SPB209A	PCTEST ENGINEERING LABORATORY, INC.	FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	H&D Wireless	Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 34 of 37

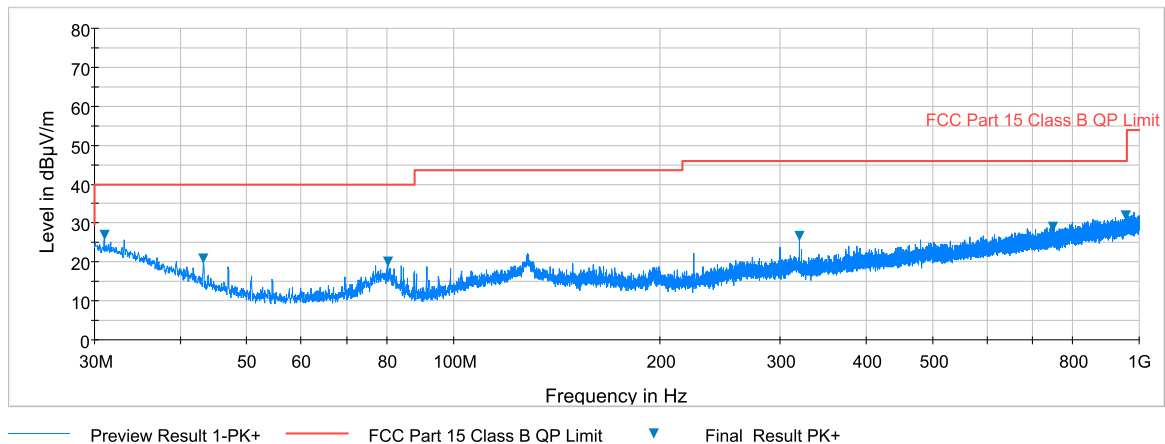
Test Notes

1. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-7.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
3. This unit was tested while powered by an DC power source.
4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
5. Emissions were measured at a 3 meter test distance.
6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
7. No spurious emissions were detected within 20dB of the limit below 30MHz.
8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
9. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. There were no emissions detected in the 30MHz – 1GHz frequency range, as shown in the subsequent plots.

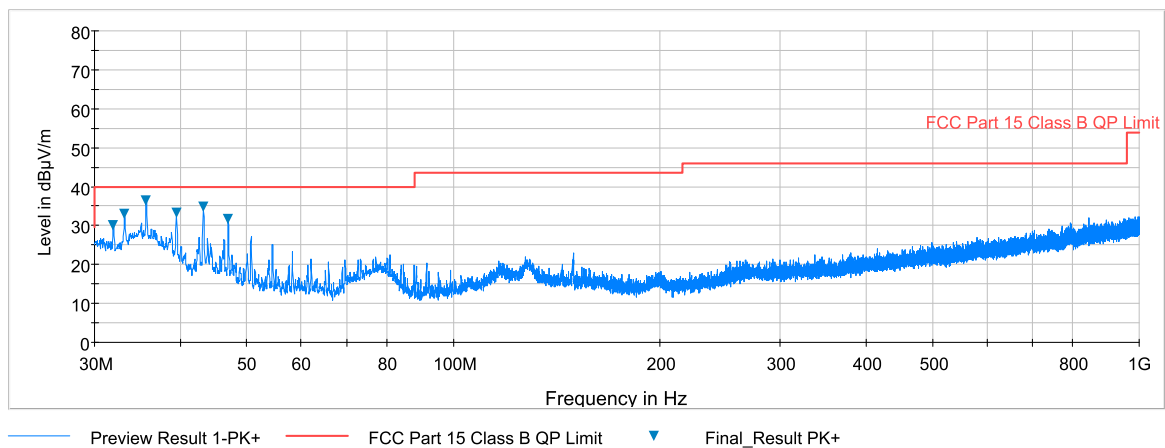
FCC ID: XO2SPB209A		FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 35 of 37

Radiated Spurious Emissions Measurements (Below 1GHz)

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Plot 7-21. Radiated Spurious Plot below 1GHz (Pol. H)



Plot 7-22. Radiated Spurious Plot below 1GHz (Pol. V)

FCC ID: XO2SPB209A	PCTEST ENGINEERING LABORATORY, INC.	FCC Pt. 15.247 802.11b/g/n MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	H&D Wireless	Approved by: Quality Manager
Test Report S/N: 0Y1612302093-03.XO2	Test Dates: 12/14/16 - 1/24/2017	EUT Type: Wifi/BT/NFC Module		Page 36 of 37

8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **H&D Wireless AB Wifi/BT/NFC Module** **FCC ID: XO2SPB209A** is in compliance with Part 15C of the FCC Rules.

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