PCTEST
18855 Adams Court Morgan Hill, CA 95037 USA
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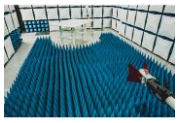


MEASUREMENT REPORT
FCC PART 15.407 / ISED RSS-247 UNII 802.11a/n/ac

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
07/24/2020 – 09/3/2020
Test Site/Location:
PCTEST Lab. Morgan Hill, CA, USA
Test Report Serial No.:
1C2008270049-08.BCG

FCC ID:	**BCG-A2374**
IC:	**579C-A2374**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model/HVIN:	A2374
EUT Type:	Smart Speaker
Frequency Range:	5180 – 5825MHz
Modulation Type:	OFDM
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15 Subpart E (15.407)
ISED Specification:	RSS-247 Issue 2
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02 v02r01

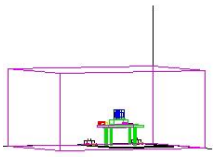
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013 and KDB 789033 D02 v02r01. Test results reported herein relate only to the 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.

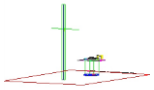
Randy Ortanez
President

ACCREDITED
CERT #2041.02

TABLE OF CONTENTS



MEASUREMENT REPORT



UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	Conducted Power	
			Max. Power (mW)	Max. Power (dBm)
1	20	5180 - 5240	44.668	16.50
2A		5260 - 5320	44.668	16.50
2C		5500 - 5720	44.668	16.50
3		5745 - 5825	31.550	14.99
1	80	5210	6.310	8.00
3		5775	6.252	7.96

FCC EUT Overview

UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	Conducted Power	
			Max. Power (mW)	Max. Power (dBm)
1	20	5180 - 5240	31.623	15.00
2A		5260 - 5320	44.668	16.50
2C		5500 - 5700	44.668	16.50
3		5745 - 5825	31.550	14.99
1	80	5210	6.310	8.00
3		5775	6.252	7.96

ISED EUT Overview

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 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST located in Morgan Hill, CA 95037, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 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 (22831) 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 **Apple Smart Speaker FCC ID: BCG-A2374**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter.

Test Device Serial No.: H0KD20QTPV2P, H0KD20QPPV2P, H0KD20QRPV2P, H0KD20Q7PV2P

2.2 Device Capabilities

This device contains the following capabilities:

802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, HDR4, HDR8, LE), UWB, Thread

Band 1		Band 2A		Band 2C		Band 3	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
36	5180	52	5260	100	5500	149	5745
:	:	:	:	:	:	:	:
42	5210	56	5280	116	5580	157	5785
:	:	:	:	:	:	:	:
48	5240	64	5320	144	5720	165	5825

Table 2-1. 802.11a / 802.11n (20MHz) Frequency / Channel Operations

Band 1		Band 3	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
42	5210	155	5775

Table 2-2: 802.11ac (80MHz BW) Frequency / Channel Operations

Notes:

1. The EUT does not support any 40MHz bandwidth channels, and only supports Bands UNII-1 & UNII-3 for 80MHz.

2. 5GHz NII operation is possible in 20MHz channel bandwidth and 80MHz channel bandwidth. The maximum measured 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 B)2)b) of KDB 789033 D02 v02r01 and ANSI C63.10-2013. 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:

Measured Duty Cycles		
802.11 Mode/Band		**Duty Cycle [%]**
5GHz	a	98.3
	n (HT20) MCS0	98.1
	n (HT20) MCS7	86.0
	ac (HT80) MCS0	96.2

Table 2-3. Measured Duty Cycles

3. Data Rates Tested: 6, 9, 12, 18, 24, 36, 48, 54Mbps (802.11a)
   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 – 20MHz)
   29.3/32.5 (ac – 80MHz BW)

4. The device supports a simultaneous multi radio transmission feature, which allows multiple radios to transmit simultaneously on the same antenna. The table blow shows all the possible multi radio Tx combinations:

Simultaneous Tx Configuration	WLAN	Bluetooth	UNII
	802.11b/g/n	BDR, EDR, HDR-4M, HDR-8M, LE	802.11a/n/ac
Configuration 1	×	✓	✓

Table 2-4: Simultaneous Transmission Configuration

✓= Support ; × = NOT Support

Notes:

Simultaneous multi radio transmission feature is not supported for UWB and Thread as they use separate antennas.

2.3 Antenna Description

The following antenna was used for testing.

Frequency [GHz]	Antenna Gain [dBi]
5.150 – 5.250	2.60
5.250 – 5.350	3.90
5.470– 5.725	3.60
5.725 – 5.850	3.30

Table 2-5. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple Mac Book	Model:	A1398	S/N:	C02QT94WG8WP
	w/AC/DC Adapter	Model:	A1435	S/N:	N/A
2	Apple USB-C Cable	Model:	Chimp	S/N:	4027E0
	Apple USB-C Cable	Model:	Sock Monkey	S/N:	N/A
3	AC/DC Adapter	Model:	A2305	S/N:	N/A

Table 2-6: Test Support Equipment List

2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 789033 D02 v02r01. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, and 7.5 for antenna port conducted emissions test setups.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz and above 18GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through two orthogonal planes of X-orientation (flatbed) and Y-orientation (landscape). Only the worst case emissions were reported in this test report.

For AC line conducted emissions and radiated emissions below 1GHz, the following configuration was investigated and reported.

- EUT powered by AC/DC adapter via USB-C cable

All possible simultaneous transmission configurations have been investigated and the worst case config has been reported.

Description	Bluetooth	802.11a/n/ac 5GHz
Channel	Hopping	36
Operating Frequency (MHz)	2402-2480	5180
Mode	GFSK ePA	802.11n

Table 2-7: Worst Case Simultaneous Transmission Configuration

2.6 Software and Firmware

The test was conducted with firmware version 18J8386 installed on the EUT.

2.7 EMI Suppression Device(s)/Modifications

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

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 789033 D02 v02r01 were used in the measurement of the EUT**.**

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

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 7m x 3.66m x 2.7m shielded enclosure. The shielded enclosure is manufactured by AP Americas. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-6. A 1m x 1.5m 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/50µH 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. The external power line filter is EPCOS 2X60A Power Line Filter (100dB Attenuation, 14kHz-18GHz) and the two EPCOs 2X48A filters (100dB Minimum Insertion Loss, 14kHz - 10GHz). 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. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to 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 groundplane. 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 spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is 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.

Line conducted emissions test results are shown in Section 7.8. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.50.40.

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. 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. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

Per KDB 414788, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was rotated about its vertical axis while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

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 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.

3.4 Environmental Conditions

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

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."

- The antennas of the EUT are **permanently attached.**
- There are no provisions for connections to an external antenna.

Conclusion:

The EUT unit complies with the requirement of §15.203.

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 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)
Conducted Bench Top Measurements	1.30
Line Conducted Disturbance	2.34
Radiated Disturbance (<1GHz)	4.15
Radiated Disturbance (>1GHz)	4.59
Radiated Disturbance (>18GHz)	4.96

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 C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	3/4/2020	Annual	3/4/2021	MY49430244
Anritsu	ML2496A	Power Meter	10/29/2019	Annual	10/29/2020	184005
Anritsu	MA2411B	Pulse Power Sensor	10/29/2019	Annual	10/29/2020	1726261
Anritsu	MA2411B	Pulse Power Sensor	10/29/2019	Annual	10/29/2020	1726262
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	10/29/2019	Annual	10/29/2020	T058701-02
COM-POWER	LIN-120A	LISN	3/4/2020	Annual	3/4/2021	241297
ETS-Lindgren	3142E–PA	Pre-Amplifier (30MHz - 6GHz)	9/19/2019	Annual	9/19/2020	213236
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	1/6/2020	Annual	1/6/2021	224569
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	4/21/2020	Annual	4/21/2021	205956
Rohde & Schwarz	ESW26	EMI Test Receiver	6/1/2020	Annual	6/1/2021	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	9/13/2019	Annual	9/13/2020	101570
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	9/19/2019	Annual	9/19/2020	100051
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	11/14/2019	Annual	11/14/2020	101057
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/12/2020	Annual	3/12/2021	100546

Table 6-1. Test Equipment List

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCG-A2374

FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407	RSS-Gen [6.7]	26dB Bandwidth	N/A	CONDUCTED	N/A	Section 7.2
15.407(e)	RSS-Gen [6.7]	6dB Bandwidth	>500kHz(5725-5850MHz)		PASS	Section 7.3
15.407 (a.1.iv), (a.2), (a.3)	RSS-247 [6.2]	Maximum Conducted Output Power	Maximum conducted powers must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.4
15.407 (a.1.iv), (a.2), (a.3)	RSS-247 [6.2]	Maximum Power Spectral Density	Maximum conducted powers must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.5
15.407(h)	RSS-247 [6.3]	Dynamic Frequency Selection	See 15.407 (h) & RSS-247 [6.3]	RADIATED	PASS	See DFS Test Report (1C2008270049-07.BCG)
15.407 (b.1), (2), (3), (4)	RSS-247 [6.2]	Out of band and Band edge Emissions	Out of band and Band edge Emissions must meet the limits detailed in 15.407(b) (RSS-247 [6.2])		PASS	Section 7.6
15.205, 15.407(b.1), (4), (5), (6)	RSS-Gen [8.9]]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])		PASS	Section 7.6, 7.7
15.407	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 (RSS-Gen [8.8]) limits	AC LINE CONDUCTED	PASS	Section 7.8

Table 7-1. Summary of Test Results

Notes:

1) All channels, modes, and modulations/data rates were investigated among all UNII bands. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "UNII Automation," Version 4.8.
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "Chamber Automation," Version 1.3.1.

7.2 26dB Bandwidth Measurement

§15.407; RSS-Gen [6.7]

Test Overview and Limit

The bandwidth at 26dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26dB bandwidth.

The 26dB bandwidth is used to determine the conducted power limits.

Test Procedure Used

ANSI C63.10-2013 – Section 12.4
KDB 789033 D02 v02r01 – Section C

Test Settings

1. The signal 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 intermediate power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold

Test Setup

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

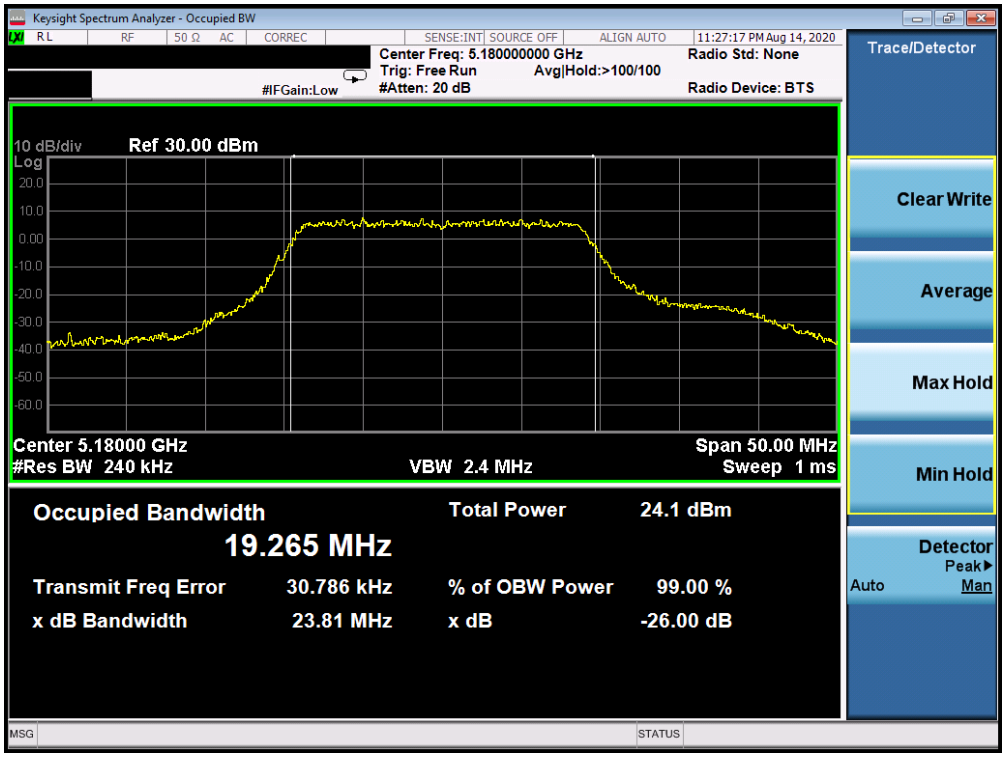
Figure 7-1. Test Instrument & Measurement Setup

Test Notes

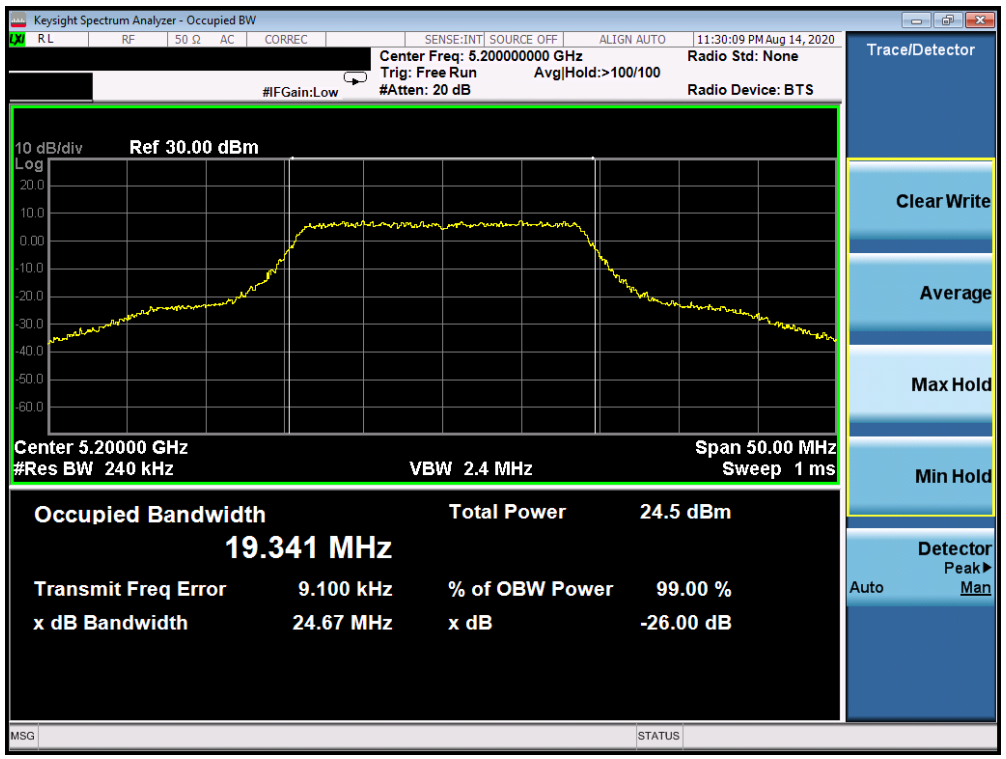
1. All modes were investigated and only the worst case is reported.

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	n (20MHz)	6.5/7.2 (MCS0)	23.81
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	24.67
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	28.87
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	125.80
Band 2A	5260	52	n (20MHz)	6.5/7.2 (MCS0)	25.62
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	25.55
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	23.94
Band 2C	5500	100	n (20MHz)	6.5/7.2 (MCS0)	23.94
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	24.70
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	28.43

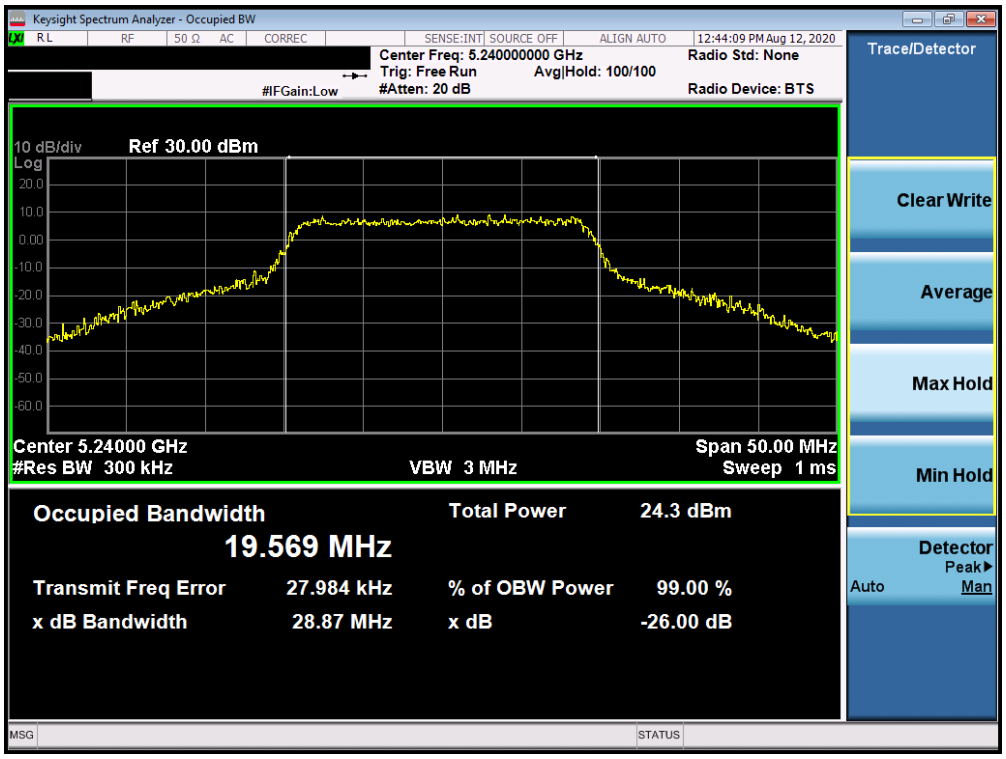
Table 7-2. Conducted Bandwidth Measurements



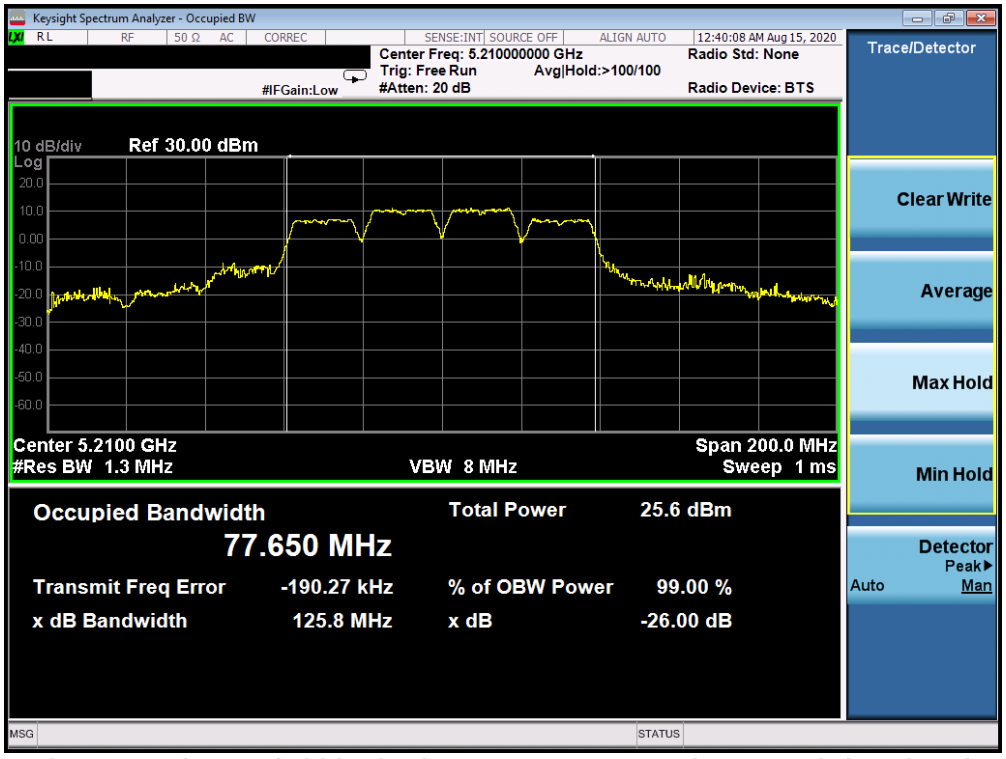
Plot 7-1. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)



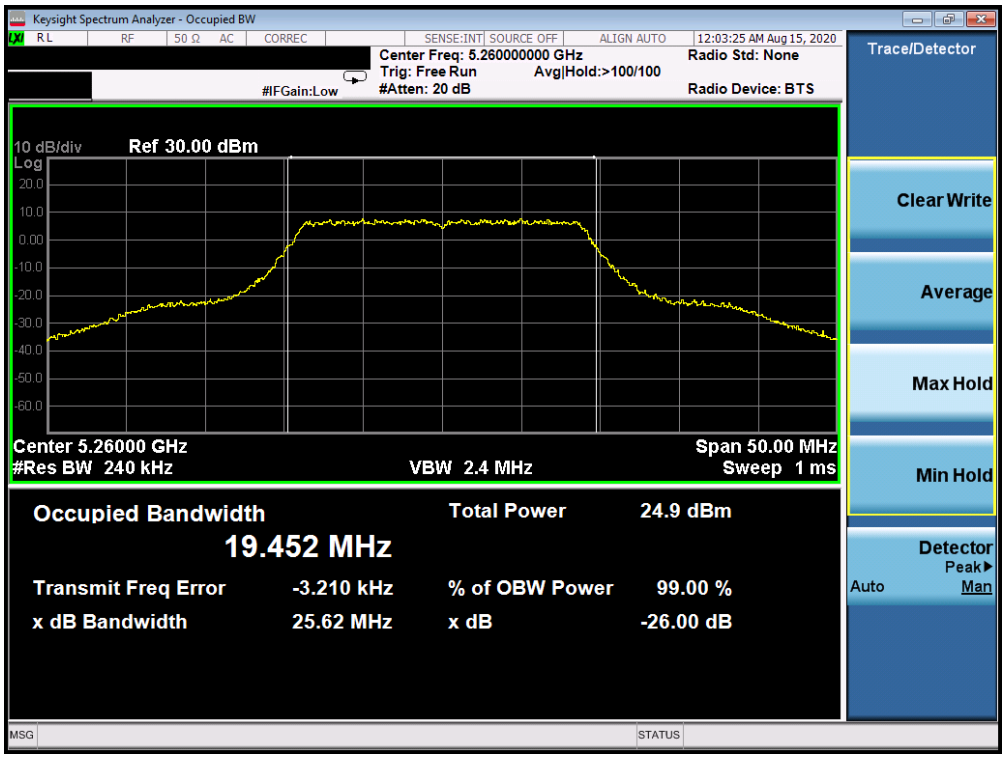
Plot 7-2. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



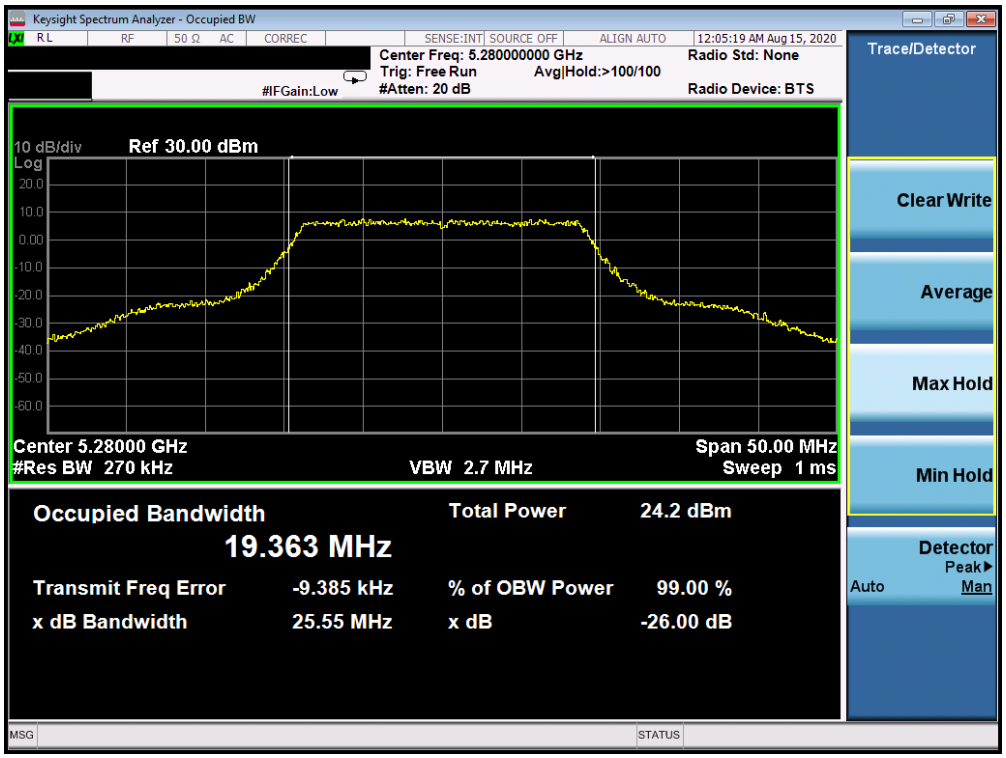
Plot 7-3. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48))



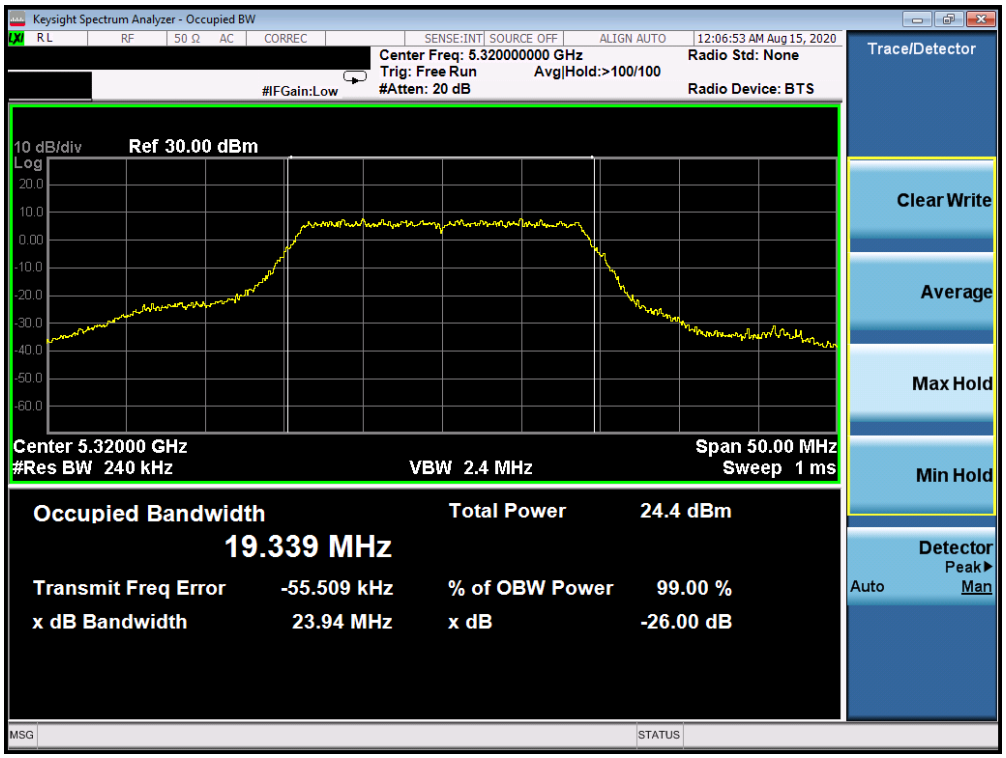
Plot 7-4: 26dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



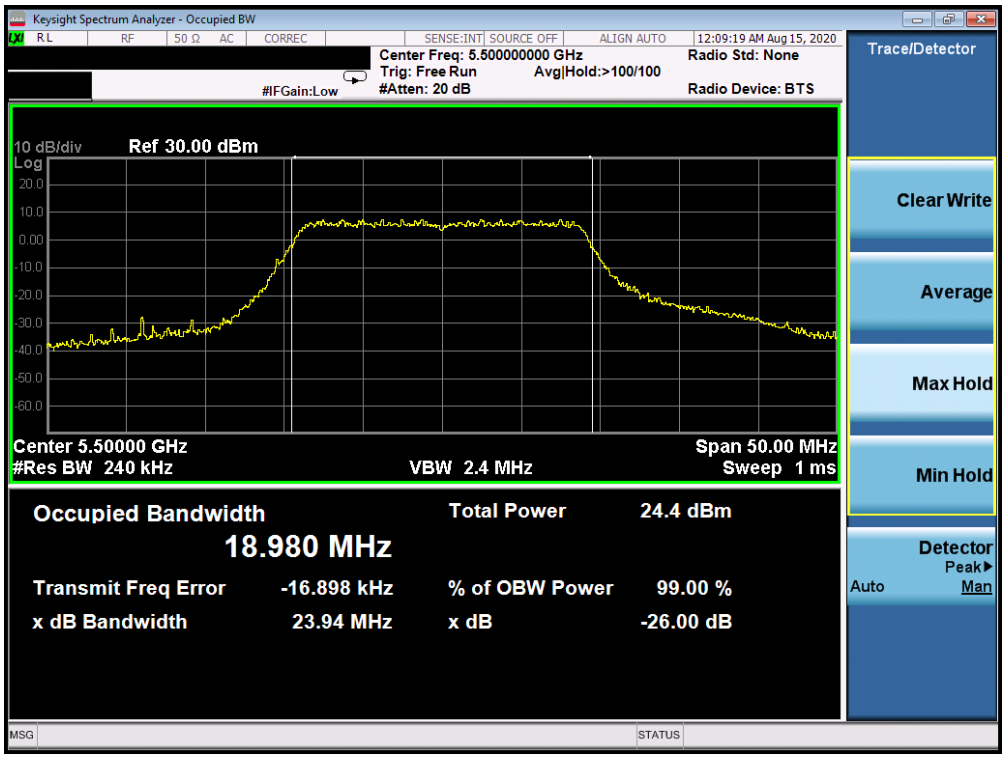
Plot 7-5. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)



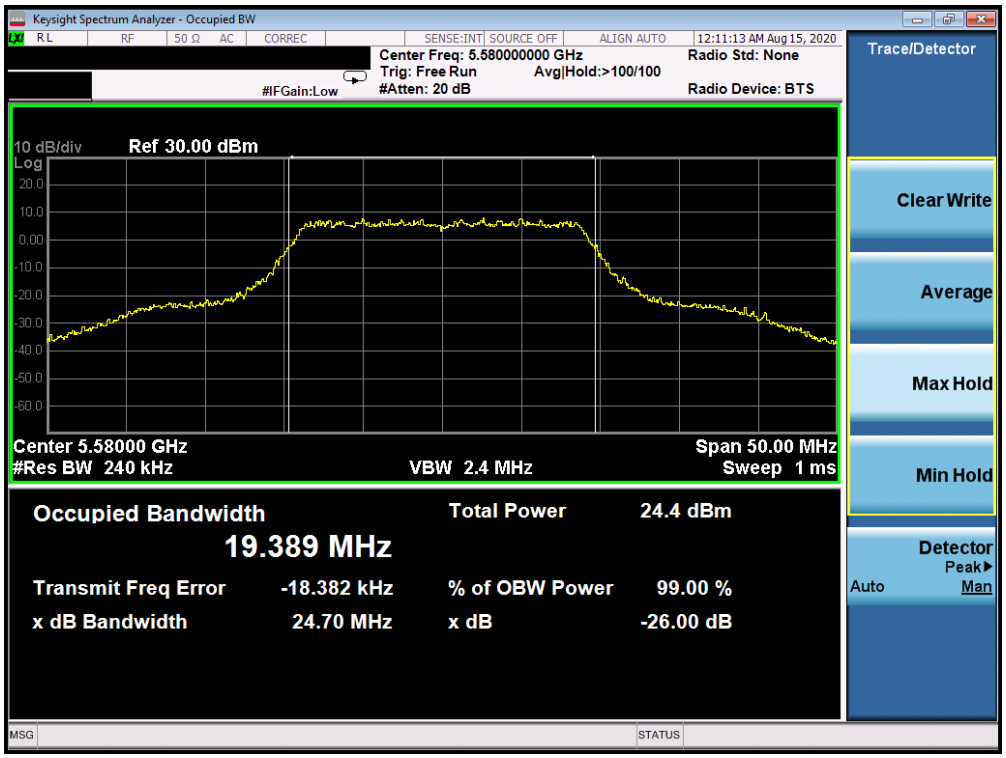
Plot 7-6. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



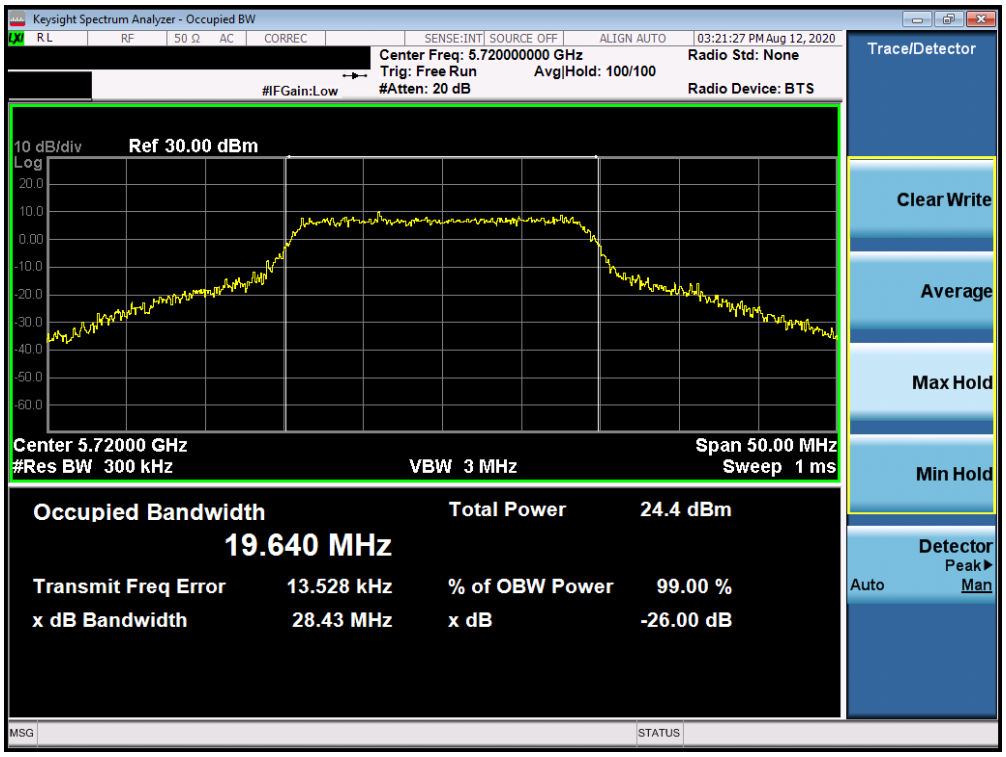
Plot 7-7. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



Plot 7-8. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)



Plot 7-9. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)



Plot 7-10. 26dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)

7.3 6dB Bandwidth Measurement

§15.407 (e); RSS-Gen [6.7]

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 6dB bandwidth.

In the 5.725 – 5.850GHz band, the 6dB bandwidth must be ≥ 500kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 6.9.2
KDB 789033 D02 v02r01 – Section C

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple

Test Setup

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

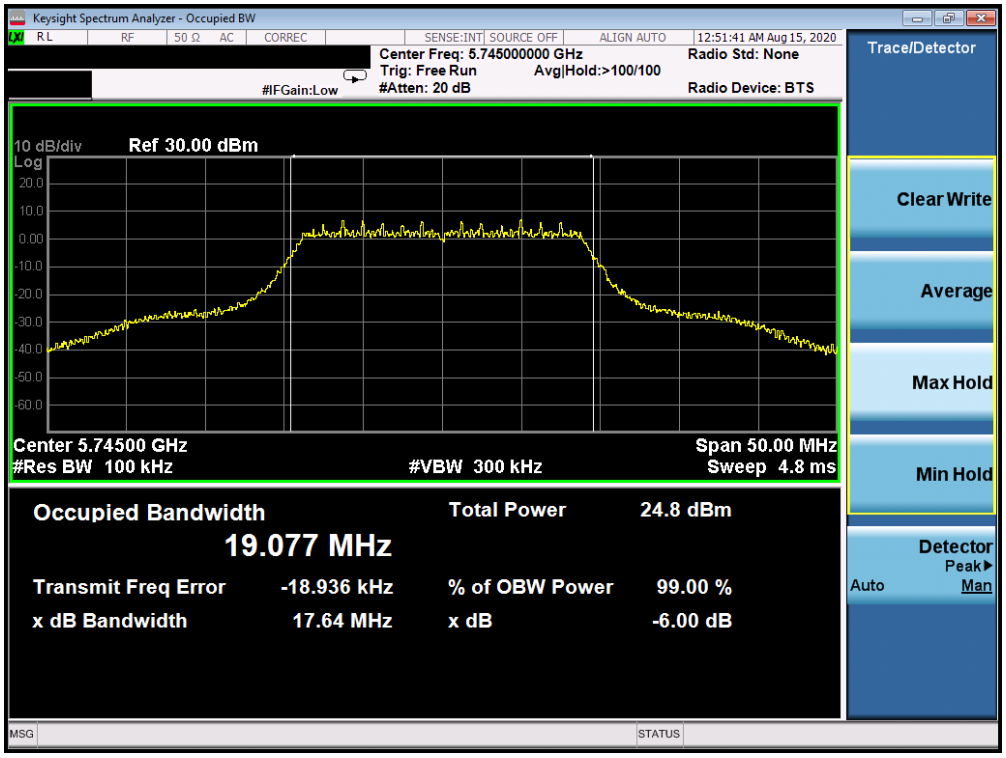
Figure 7-2. Test Instrument & Measurement Setup

Test Notes

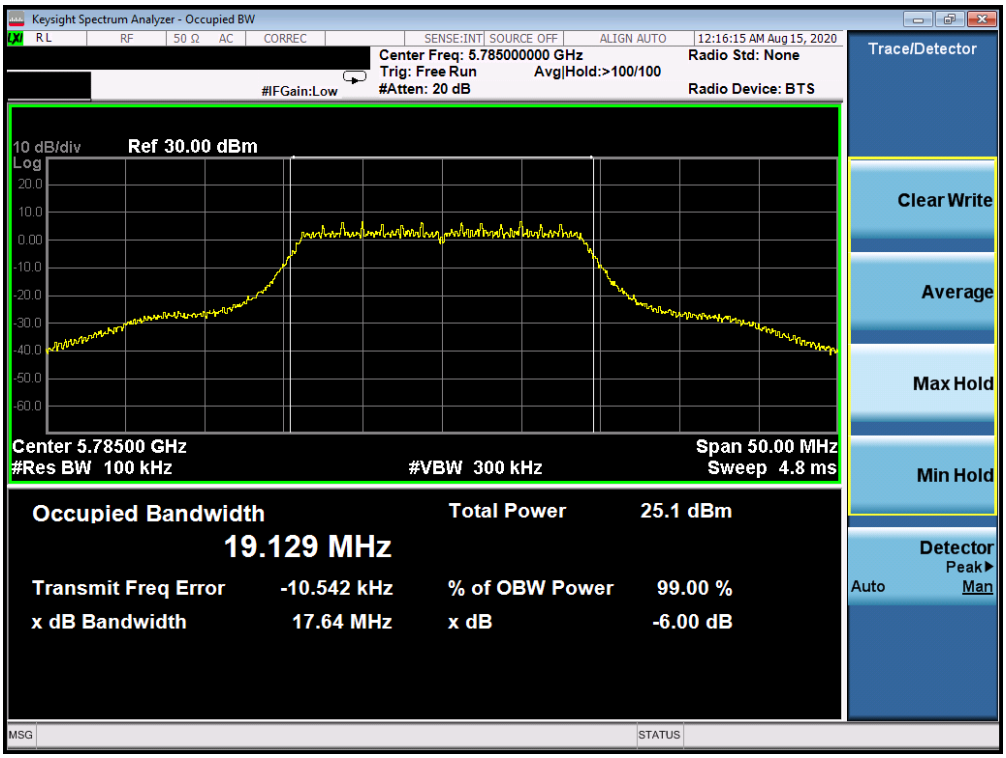
1. All modes were investigated and only the worst case is reported.

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured 6dB Bandwidth [MHz]
Band 3	5745	149	n (20MHz)	6.5/7.2 (MCS0)	17.64
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	17.64
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	17.63
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	75.42

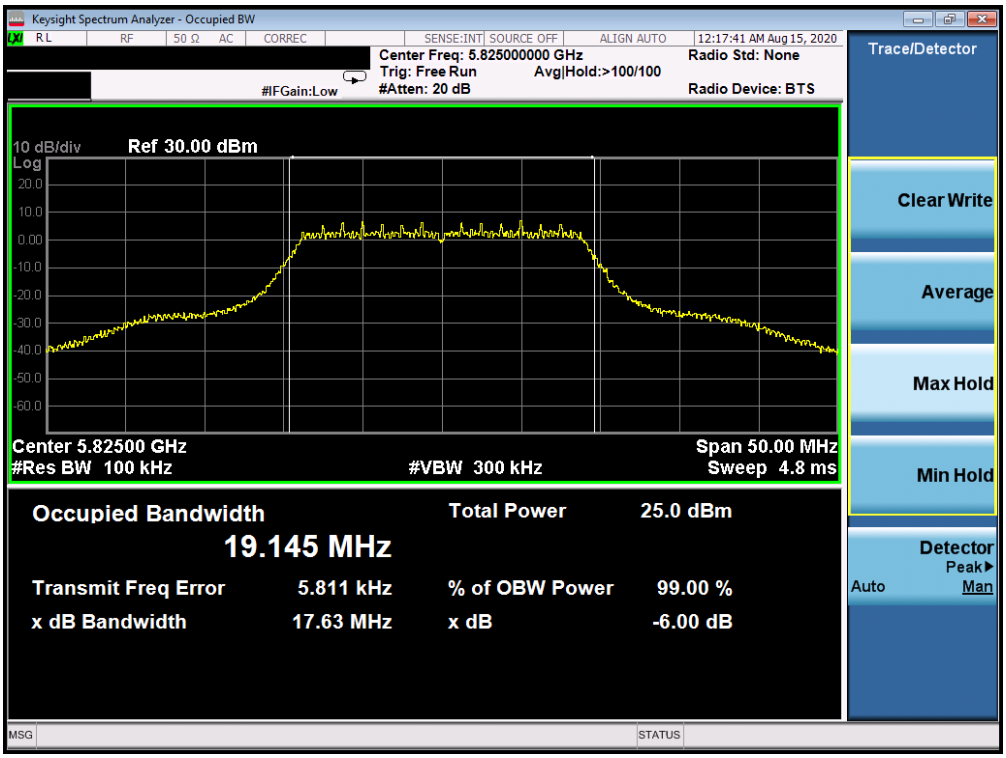
Table 7-3: Conducted Bandwidth Measurements



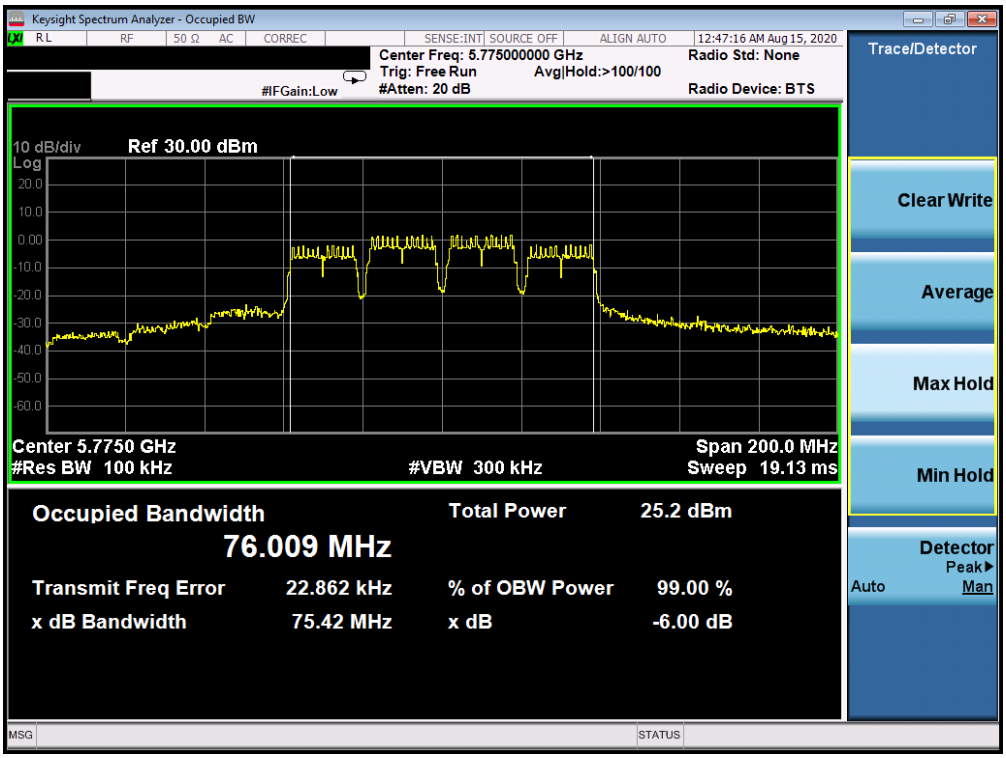
Plot 7-11: 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-12: 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)



Plot 7-13: 6dB Bandwidth Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)



Plot 7-14: 6dB Bandwidth Plot (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)

7.4 Conducted Output Power and Max EIRP Measurement

§15.407(a.1.iv) §15.407(a.2) §15.407(a.3); RSS-247 [6.2]

Test Overview and Limits

A transmitter antenna terminal of the EUT is connected to the input of an RF pulse power sensor. Measurement is made using a broadband average power meter while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. B is the 99% OBW per ISED RSS-247 and 26dB BW is per FCC 15.407.

In the 5.15 – 5.25GHz band, the maximum permissible conducted output power is 250mW (23.98dBm). The maximum e.i.r.p. shall not exceed the lesser of 200 mW or 10 + 10 $\log_{10}$B, dBm.

In the 5.25 – 5.35GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) or 11 dBm + 10$\log_{10}$(26dB BW) = 11 dBm + 10$\log_{10}$(23.94) = 24.79dBm. The maximum e.i.r.p. shall not exceed the lesser of 1.0 W or 17 + 10 $\log_{10}$B, dBm.

In the 5.47 – 5.725GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) or 11 dBm + 10$\log_{10}$(26dB BW) = 11 dBm + 10$\log_{10}$ (23.94) = 24.79dBm. The maximum e.i.r.p. shall not exceed the lesser of 1.0 W or 17 + 10 $\log_{10}$B, dBm.

In the 5.725 – 5.850GHz band, the maximum permissible conducted output power is 1W (30dBm). The maximum e.i.r.p. is 36 dBm.

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.3.2 Method PM-G
KDB 789033 D02 v02r01 – Section E)3)b) Method PM-G

Test Settings

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 7-3. Test Instrument & Measurement Setup for Power Meter Measurements

Test Notes

1. Per RSS-247 Section 6.2.3, transmission on channels which overlap the 5600-5650 MHz is prohibited. This device operates under these frequencies only under the control of a certified master device and does not support active scanning on these channels. This device does not transmit any beacons or initiate any transmissions in UNII Bands 2A or 2C.

Freq [MHz]	Channel	Detector	IEEE Transmission Mode			Conducted Power Limit [dBm]	Conducted Power Margin [dB]
			802.11a	802.11n (MCS0)	802.11n (MCS7)		
5180	36	AVG	15.00	14.96	14.43	23.98	-8.98
5200	40	AVG	16.48	16.49	14.47	23.98	-7.49
5240	48	AVG	16.42	16.50	14.49	23.98	-7.48
5260	52	AVG	16.50	16.45	14.50	23.98	-7.48
5300	60	AVG	16.48	16.50	14.48	23.98	-7.48
5320	64	AVG	11.46	11.50	11.50	23.98	-12.48
5500	100	AVG	13.00	13.00	13.00	23.98	-10.98
5520	104	AVG	16.46	16.50	14.50	23.98	-7.48
5580	116	AVG	16.46	16.47	14.50	23.98	-7.51
5660	132	AVG	15.50	15.50	14.49	23.98	-8.48
5680	136	AVG	14.50	14.50	14.50	23.98	-9.48
5700	140	AVG	7.98	7.94	7.97	23.98	-16.00
5720	144	AVG	14.47	14.50	14.49	23.98	-9.48
5745	149	AVG	14.99	14.90	14.50	30.00	-15.01
5785	157	AVG	13.00	12.98	12.97	30.00	-17.00
5825	165	AVG	13.00	12.64	12.97	30.00	-17.00

Table 7-4. FCC 20MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
			802.11ac		
5210	42	AVG	8.00	23.98	-15.98
5775	155	AVG	7.96	30.00	-22.04

Table 7-5: FCC 80MHz BW (UNII) Maximum Conducted Output Power

Freq [MHz]	Channel	Detector	IEEE Transmission Mode			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			802.11a	802.11n (MCS0)	802.11n (MCS7)						
5180	36	AVG	15.00	15.00	14.50	-	-	2.60	17.60	23.01	-5.41
5200	40	AVG	15.00	14.96	14.49	-	-	2.60	17.60	23.01	-5.41
5240	48	AVG	15.00	15.00	14.46	-	-	2.60	17.60	23.01	-5.41
5260	52	AVG	16.50	16.45	14.50	23.98	-7.48	3.90	20.40	30.00	-9.60
5300	60	AVG	16.48	16.50	14.48	23.98	-7.48	3.90	20.40	30.00	-9.60
5320	64	AVG	11.46	11.50	11.50	23.98	-12.48	3.90	15.40	30.00	-14.60
5500	100	AVG	13.00	13.00	13.00	23.98	-10.98	3.60	16.60	30.00	-13.40
5520	104	AVG	16.46	16.50	14.50	23.98	-7.48	3.60	20.10	30.00	-9.90
5580	116	AVG	16.46	16.47	14.50	23.98	-7.51	3.60	20.07	30.00	-9.93
5660	132	AVG	15.50	15.50	14.49	23.98	-8.48	3.60	19.10	30.00	-10.90
5680	136	AVG	14.50	14.50	14.50	23.98	-9.48	3.60	18.10	30.00	-11.90
5700	140	AVG	7.98	7.94	7.97	23.98	-16.00	3.60	11.58	30.00	-18.42
5720	144	AVG	14.47	14.50	14.49	23.98	-9.48	3.60	18.10	30.00	-11.90
5745	149	AVG	14.99	14.90	14.50	30.00	-15.01	3.30	18.29	-	-
5785	157	AVG	13.00	12.98	12.97	30.00	-17.00	3.30	16.30	-	-
5825	165	AVG	13.00	12.64	12.97	30.00	-17.00	3.30	16.30	-	-

Table 7-6: ISED 20MHz BW (UNII) Maximum Conducted Output Power and Max EIRP

Freq [MHz]	Channel	Detector	IEEE Transmission Mode	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
			802.11ac						
5210	42	AVG	8.00	23.98	-15.98	2.60	10.60	23.01	-12.41
5775	155	AVG	7.96	30.00	-22.04	3.30	11.26	-	-

Table 7-7: ISED 80MHz BW (UNII) Maximum Conducted Output Power and Max EIRP

7.5 Maximum Power Spectral Density

§15.407(a.1.iv) §15.407(a.2) §15.407(a.3); RSS-247 [6.2]

Test Overview and Limit

The spectrum analyzer was connected to the antenna terminal while the EUT was operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. Method SA-1, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, was used to measure the power spectral density.

In the 5.15 – 5.25GHz, 5.25 – 5.35GHz, 5.47 – 5.725GHz bands, the maximum permissible power spectral density is 11dBm/MHz.

In the 5.15 – 5.25GHz band, the e.i.r.p. spectral density shall not exceed 10 dBm in any 1 MHz band.

In the 5.725 – 5.850GHz band, the maximum permissible power spectral density is 30dBm/500kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.2.2
KDB 789033 D02 v02r01 – Section F

Test Settings

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire emission bandwidth of the signal
3. RBW = 1MHz
4. VBW = 3MHz
5. Number of sweep points ≥ 2 x (span/RBW)
6. Sweep time = auto
7. Detector = power averaging (RMS)
8. Trigger was set to free run for all modes
9. Trace was averaged over 100 sweeps
10. The peak search function of the spectrum analyzer was used to find the peak of the spectrum

Test Setup

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

Figure 7-4. Test Instrument & Measurement Setup

Test Notes

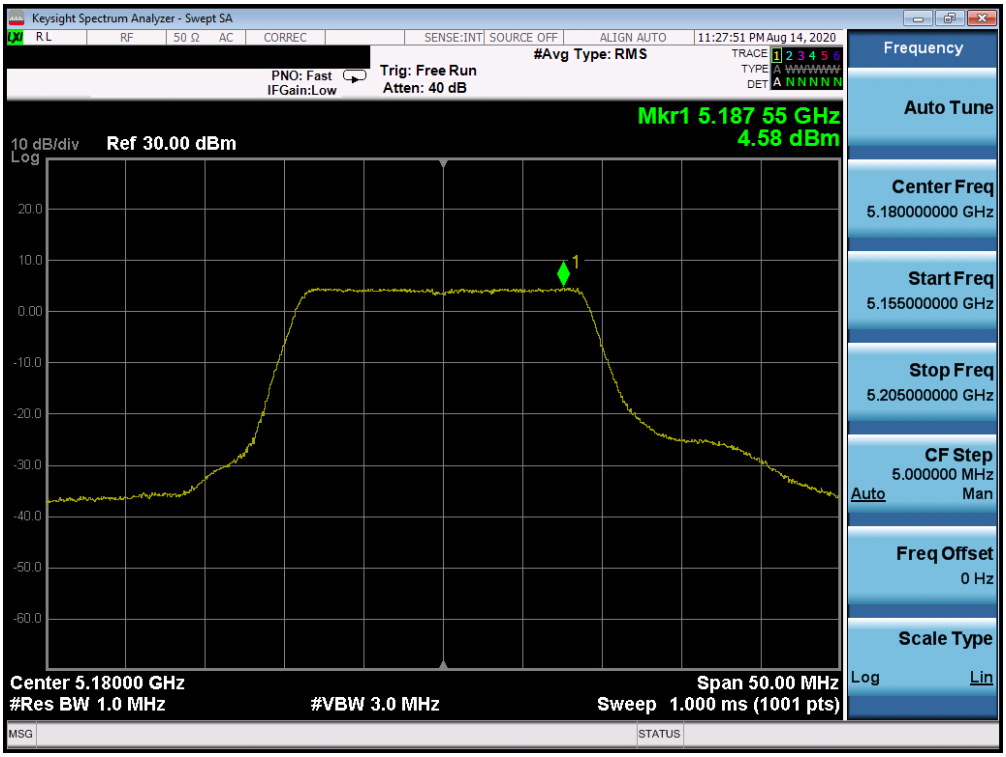
1. All modes were investigated and only the worst case is reported.

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5180	36	n (20MHz)	6.5/7.2 (MCS0)	4.58	11.0	-6.42
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	4.72	11.0	-6.28
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	5.43	11.0	-5.57
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	0.70	11.0	-10.30
Band 2A	5260	52	n (20MHz)	6.5/7.2 (MCS0)	4.83	11.0	-6.17
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	4.91	11.0	-6.09
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	4.92	11.0	-6.09
Band 2C	5500	100	n (20MHz)	6.5/7.2 (MCS0)	5.07	11.0	-5.94
	5580	116	n (20MHz)	6.5/7.2 (MCS0)	5.06	11.0	-5.94
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	5.61	11.0	-5.39

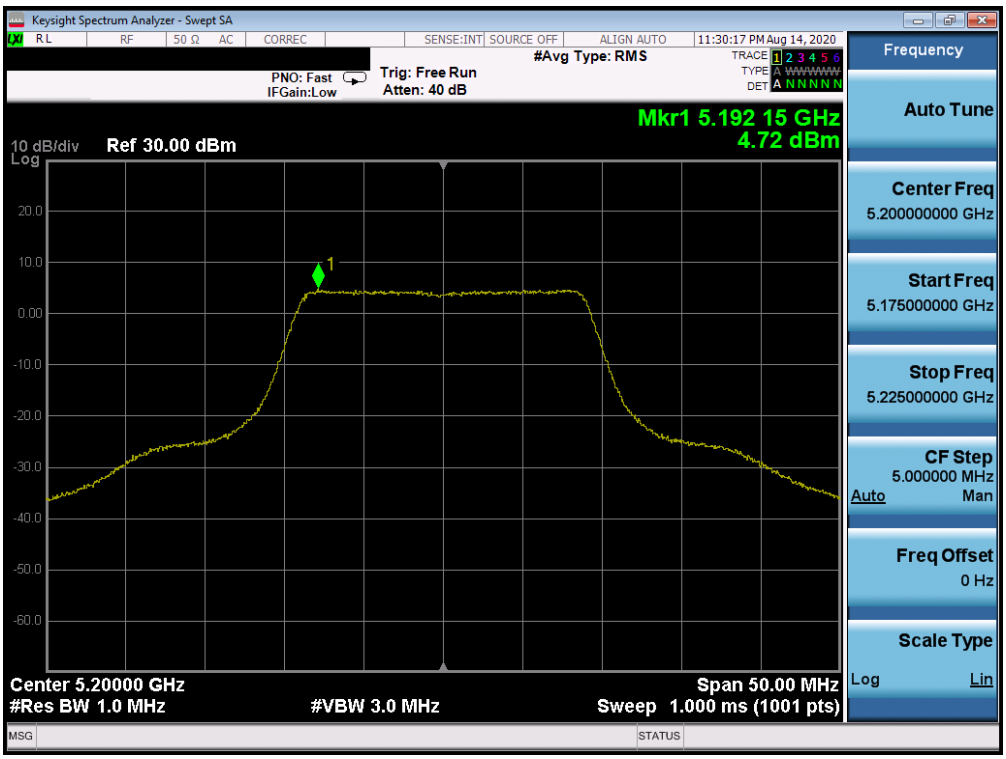
Table 7-8. Bands 1, 2A, 2C Conducted Power Density Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm/MHz]	Antenna Gain [dBi]	e.i.r.p. Power Density [dBm/MHz]	ISED Max e.i.r.p. Power Density [dBm/MHz]	Margin [dB]
Band 1	5180	36	n (20MHz)	6.5/7.2 (MCS0)	4.58	2.60	7.18	10.0	-2.82
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	4.72	2.60	7.32	10.0	-2.68
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	5.44	2.60	8.04	10.0	-1.97
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	0.70	2.60	3.30	10.0	-6.70

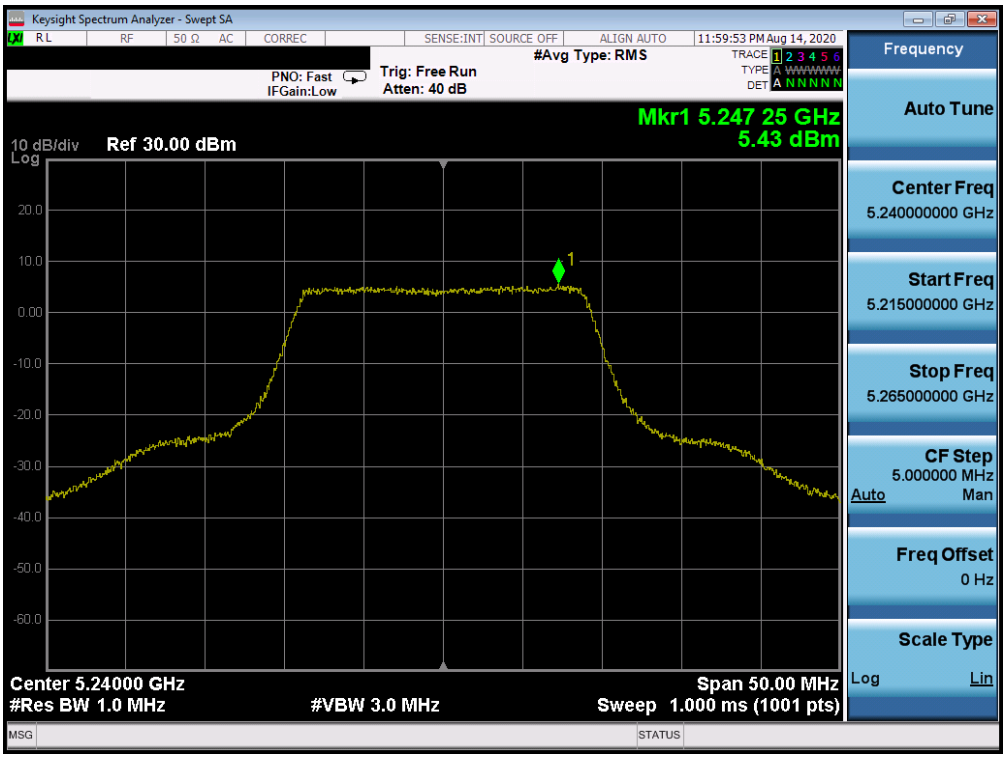
Table 7-9: Band 1 e.i.r.p. Conducted Power Spectral Density Measurements (ISED)



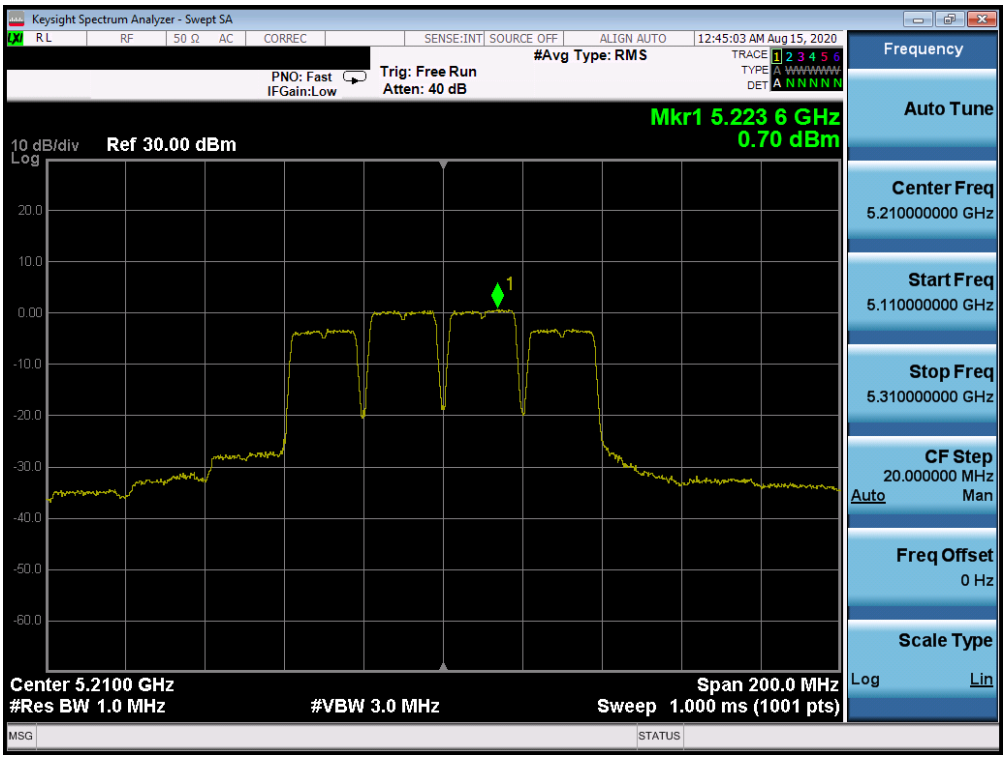
Plot 7-15. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 36)



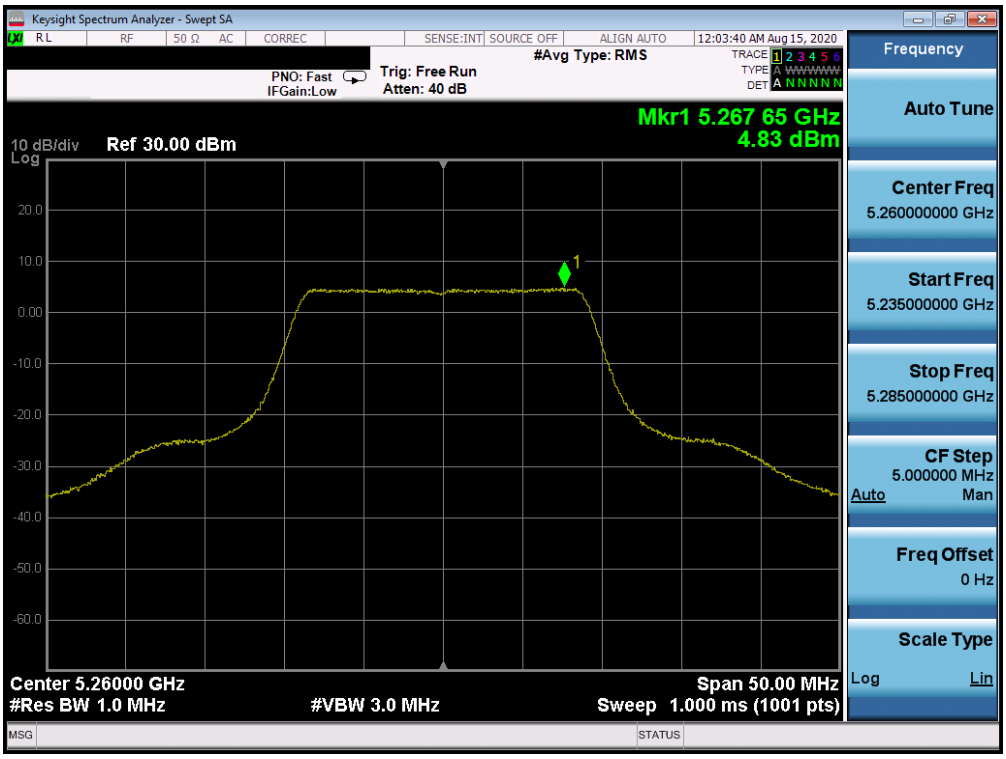
Plot 7-16. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



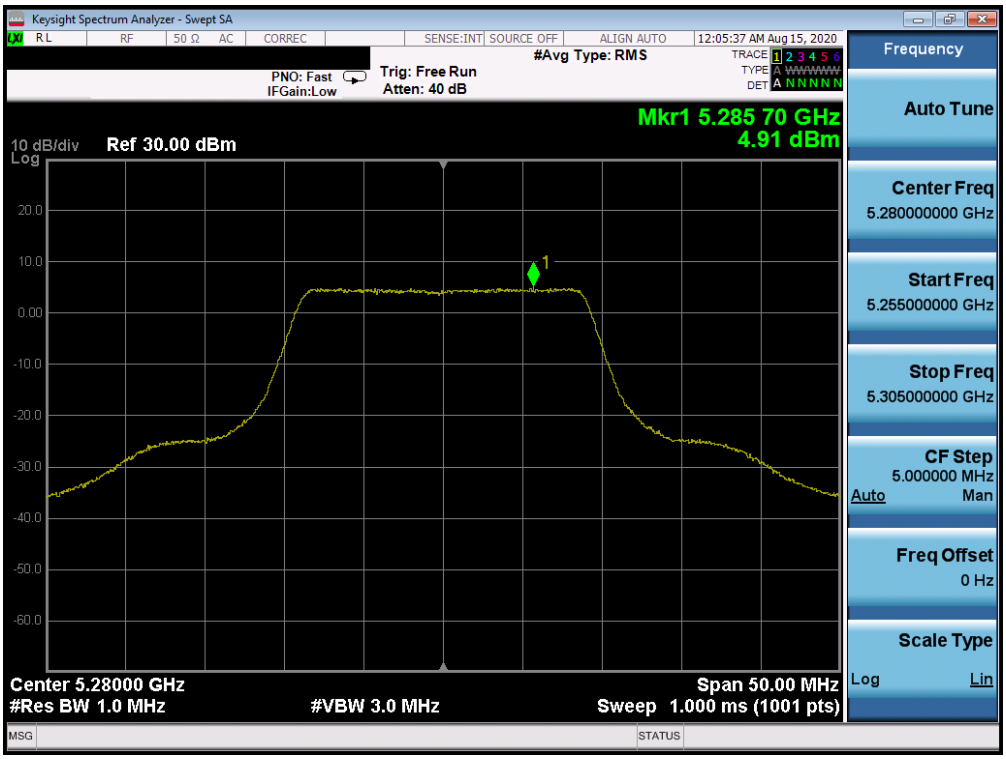
Plot 7-17. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 1) – Ch. 48)



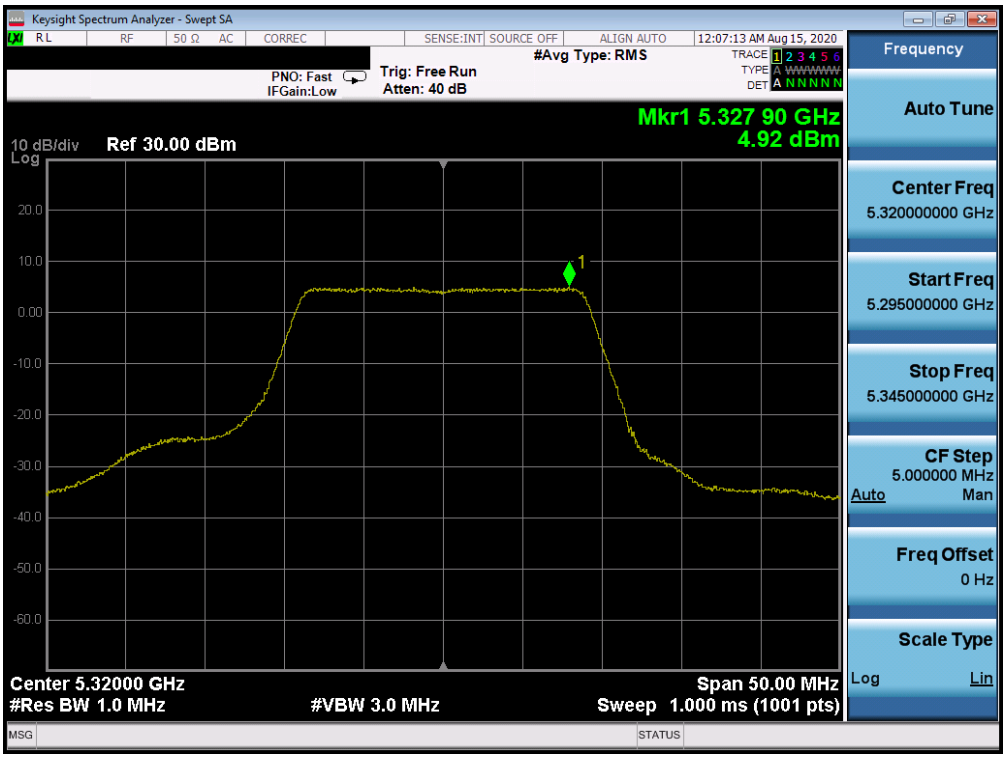
Plot 7-18. Power Spectral Density Plot (80MHz BW 802.11n (UNII Band 2A) – Ch. 42)



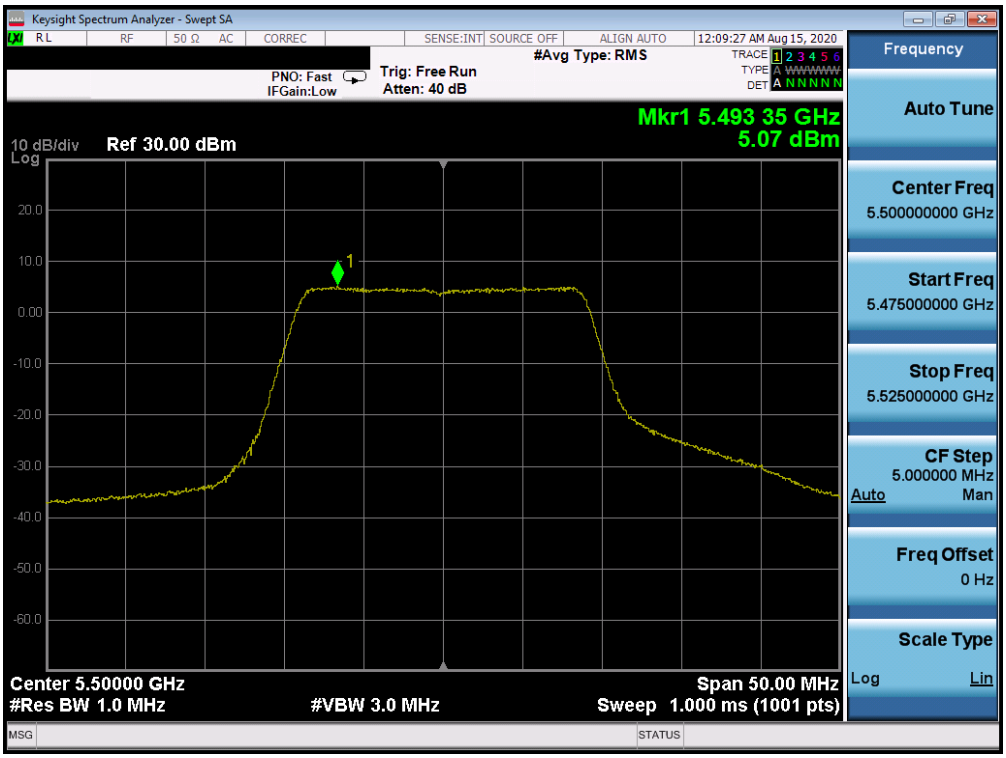
Plot 7-19. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 52)



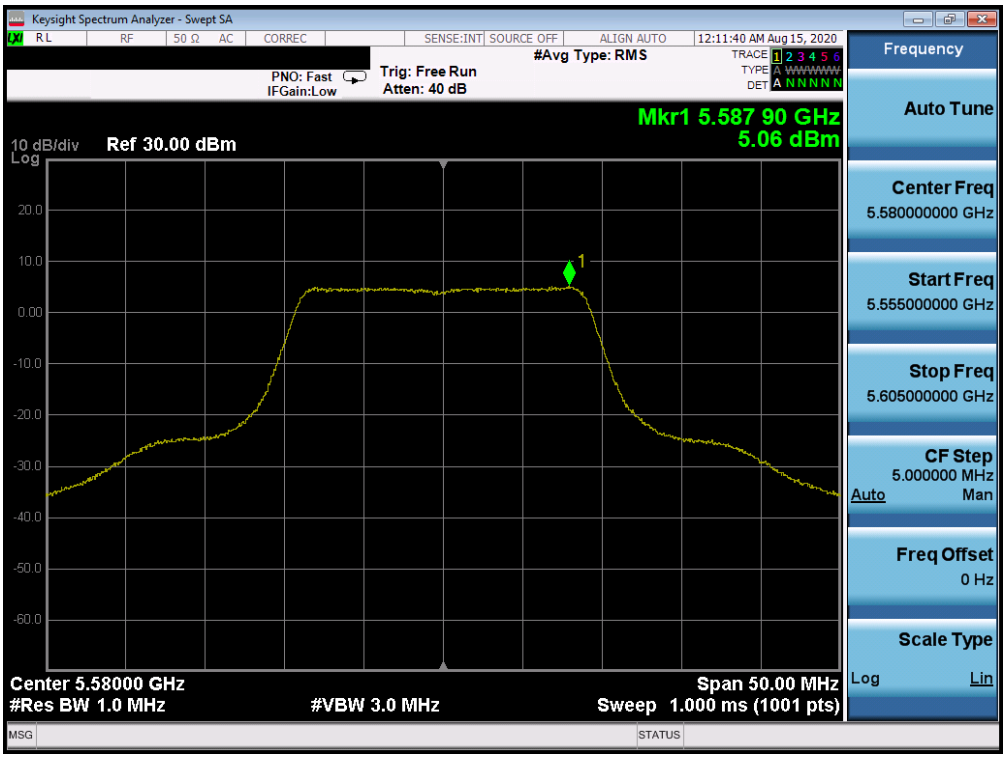
Plot 7-20. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



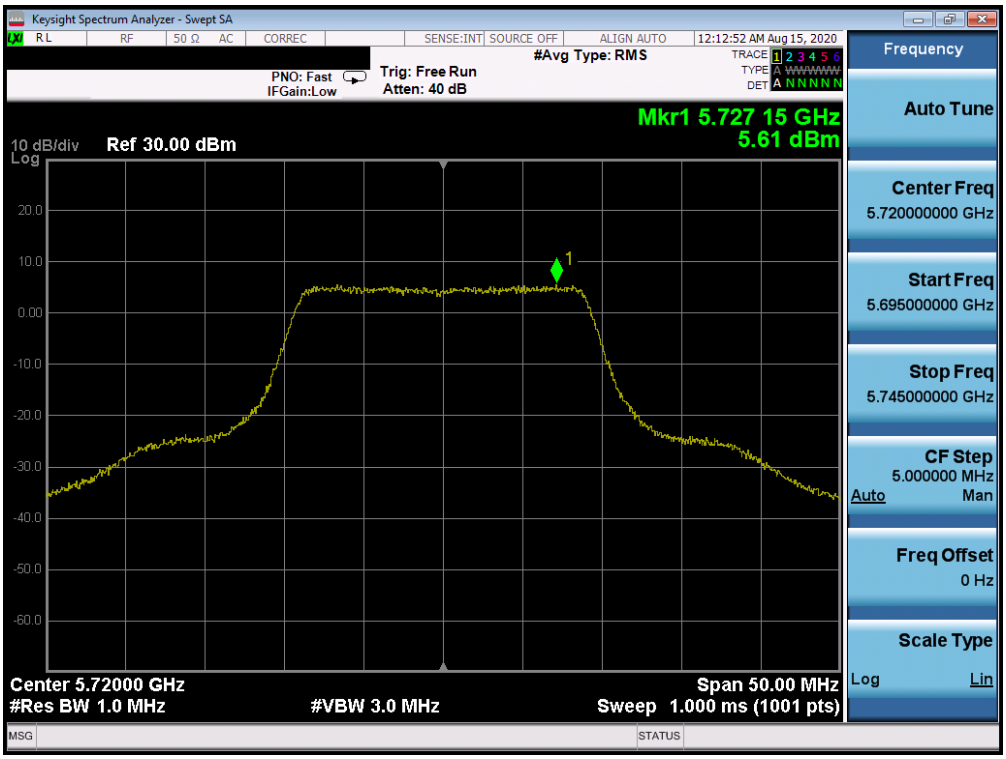
Plot 7-21. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2A) – Ch. 64)



Plot 7-22. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 100)



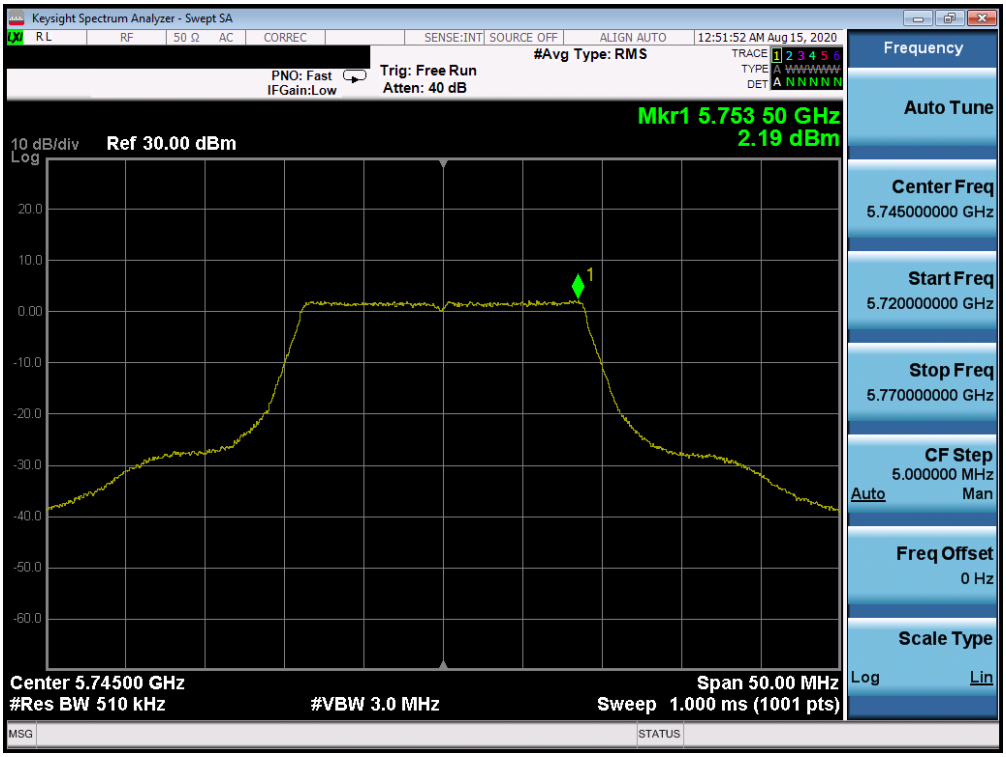
Plot 7-23. Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 116)



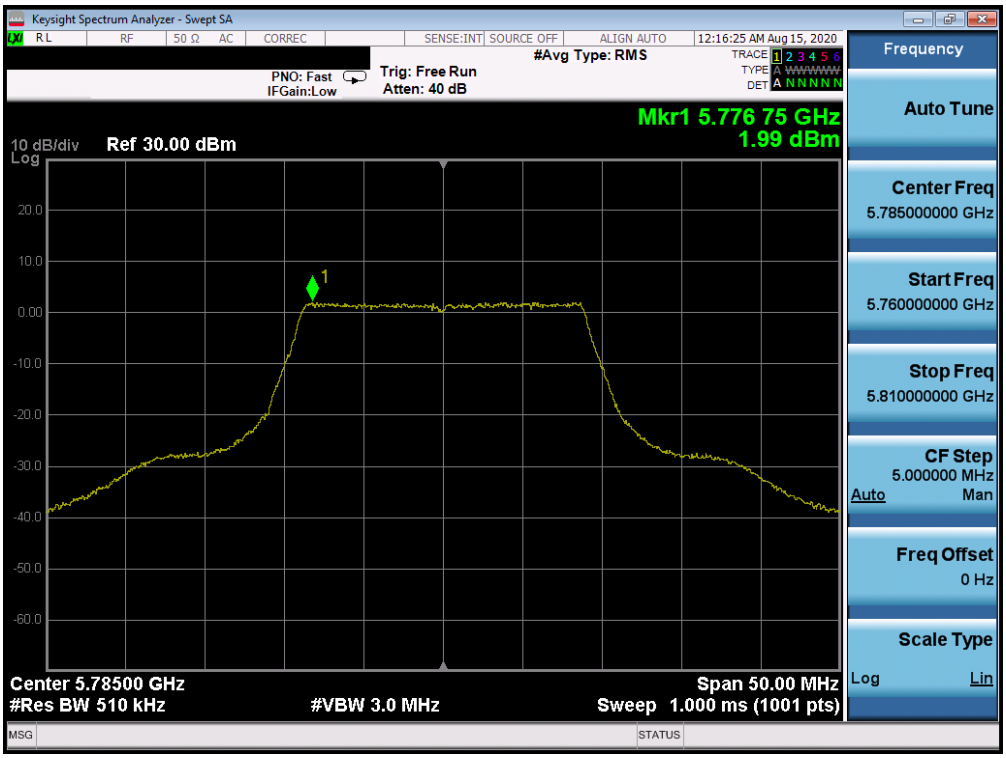
Plot 7-24: Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 2C) – Ch. 144)

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Density [dBm/500kHz]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5745	149	n (20MHz)	6.5/7.2 (MCS0)	2.19	30.0	-27.81
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	1.99	30.0	-28.01
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	2.30	30.0	-27.70
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	-1.99	30.0	-31.99

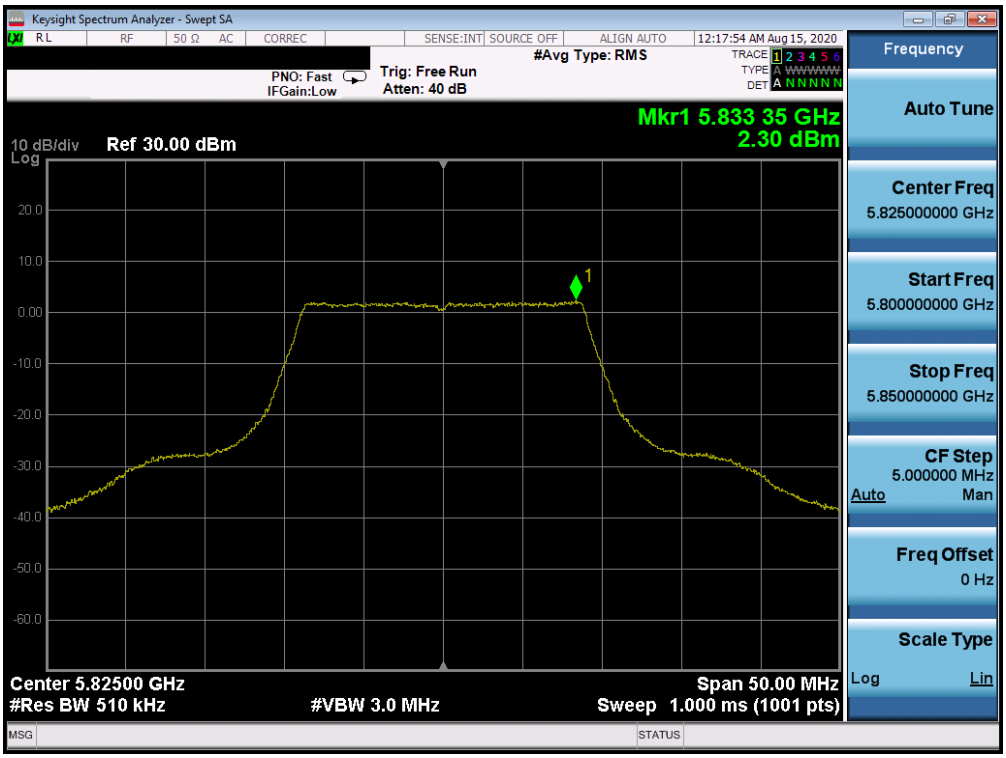
Table 7-10: Band 3 Conducted Power Spectral Density Measurements



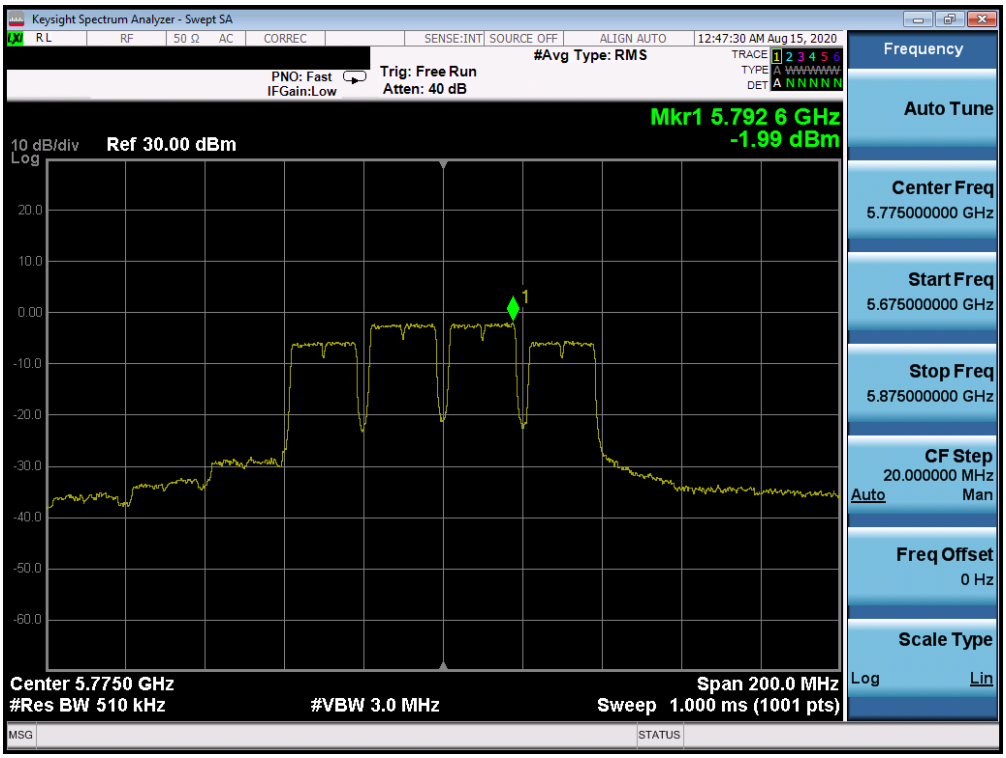
Plot 7-25: Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 149)



Plot 7-26: Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 157)



Plot 7-27: Power Spectral Density Plot (20MHz BW 802.11n (UNII Band 3) – Ch. 165)



Plot 7-28: Power Spectral Density Plot (80MHz BW 802.11n (UNII Band 3) – Ch. 155)

7.6 Radiated Spurious Emission Measurements – Above 1 GHz

§15.407(b) §15.205 & §15.209; RSS-Gen [8.9]

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 its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. All channels, modes (e.g. 802.11a, 802.11n (20MHz BW), and modulations/data rates were investigated among all UNII bands. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

For transmitters operating in the 5.15-5.25 GHz and 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz.

For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz.

For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 7 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-11 per Section 15.209 and RSS-Gen (8.9).

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

Table 7-11. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Sections 12.7.7.2, 12.7.6, 12.7.5
KDB 789033 D02 v02r01 – Section G

Test Settings

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 = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be ≥ 2 x span/RBW)
6. Average type = power (RMS)
7. Sweep time = auto
8. Trace (RMS) averaging was performed over at least 100 traces

Peak Field Strength Measurements

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

Test Setup

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

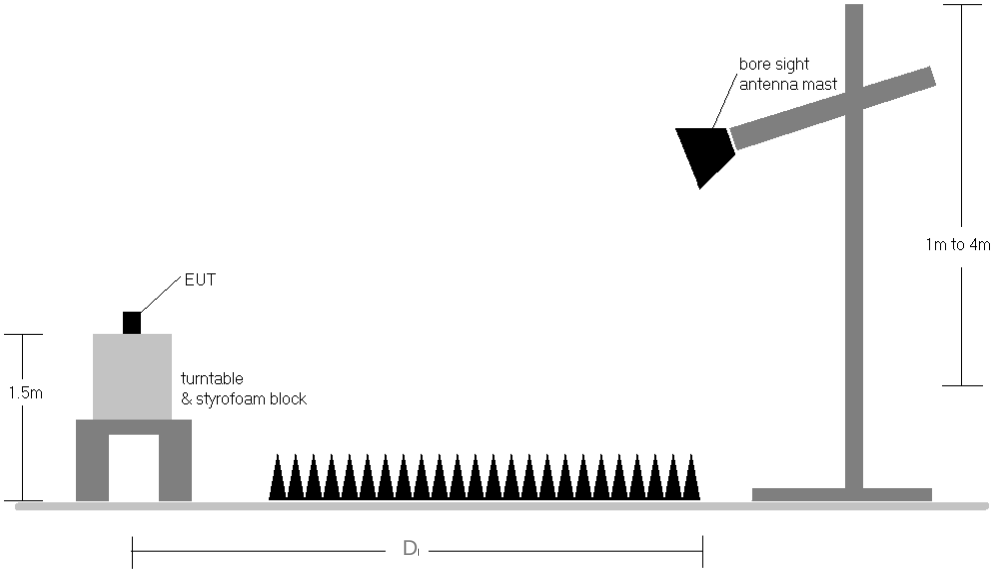


Figure 7-5. Test Instrument & Measurement Setup

Test Notes

1. All emissions that lie in restricted bands specified in Section 15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-11.
2. All spurious emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-9. All spurious emissions that do not lie in a restricted band are subject to a peak limit of -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 of 68.2dBµV/m.
3. The antenna is manipulated through typical positions, polarity and height during the tests. The EUT is manipulated through 2 orthogonal planes of X and Y.
4. This unit was tested while powered with an AC 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 worse-case emissions are reported.
6. "D" is 3 meter distance for 1GHz – 18GHz measurements and 1 meter distance for above 18GHz measurements.
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.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Sample Calculations

Determining Spurious Emissions Levels

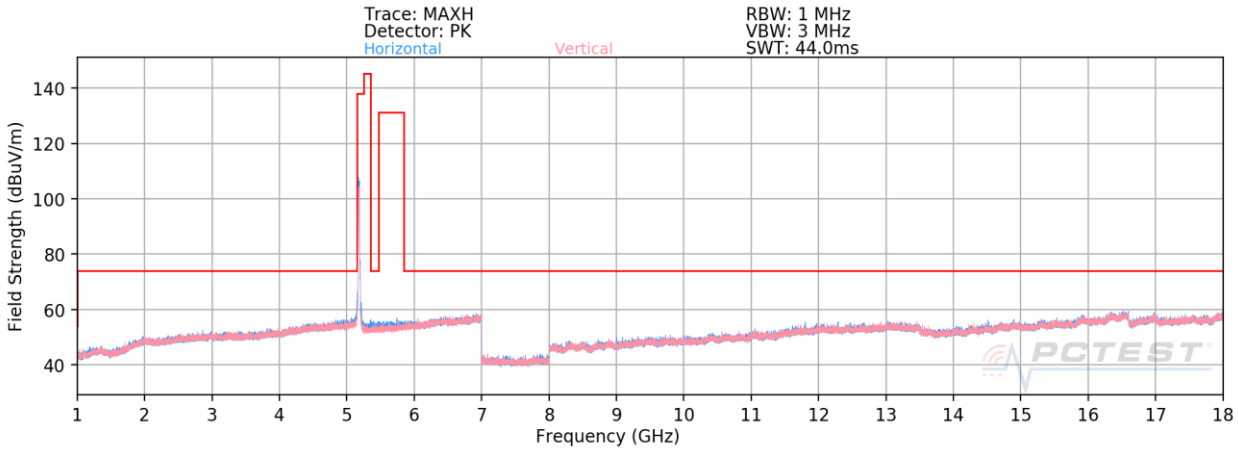
- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$ – Preamplifier Gain $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

Radiated Band Edge Measurement Offset

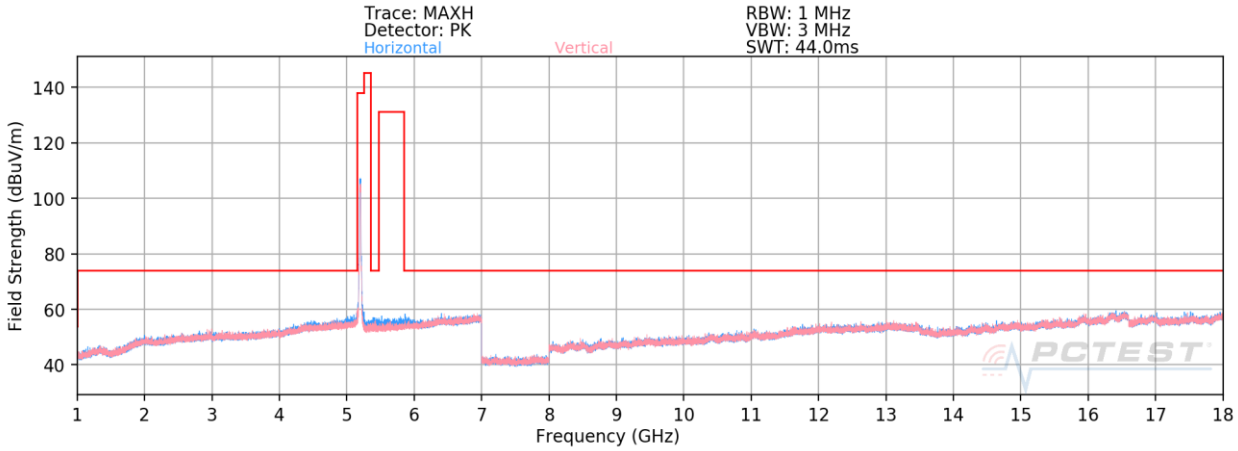
- The amplitude offset shown in the radiated restricted band edge plots in Section 7.6.3 was calculated using the formula:

  Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) – Preamplifier Gain

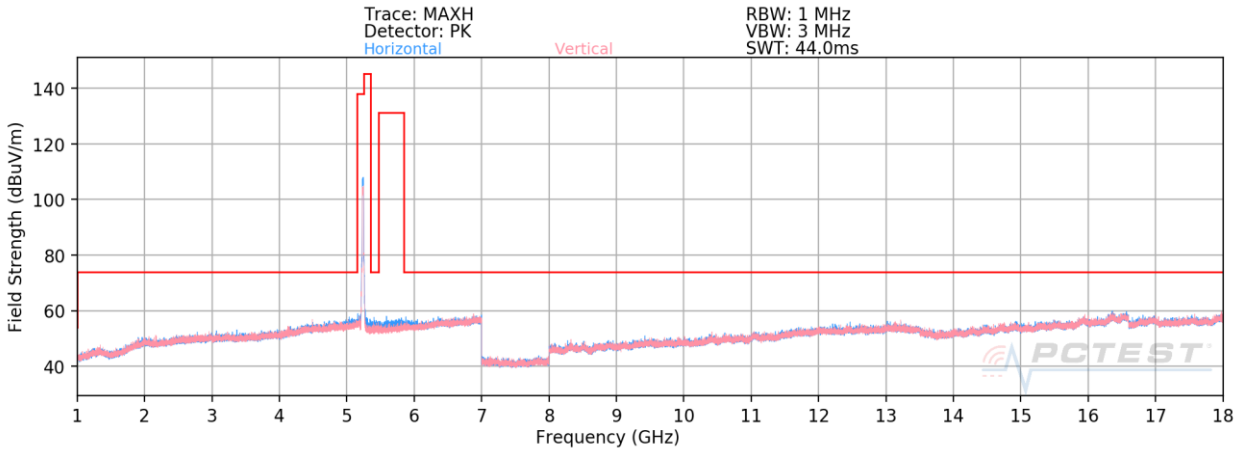
7.6.1 Radiated Spurious Emission Measurements



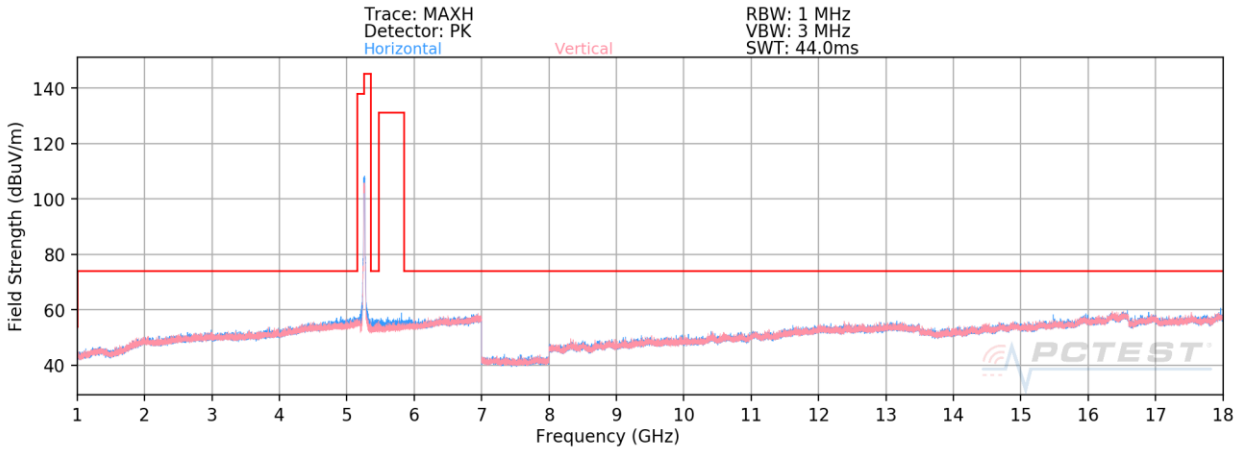
Plot 7-29. Radiated Spurious Emissions above 1GHz (802.11n – UNII 1 Ch. 36)



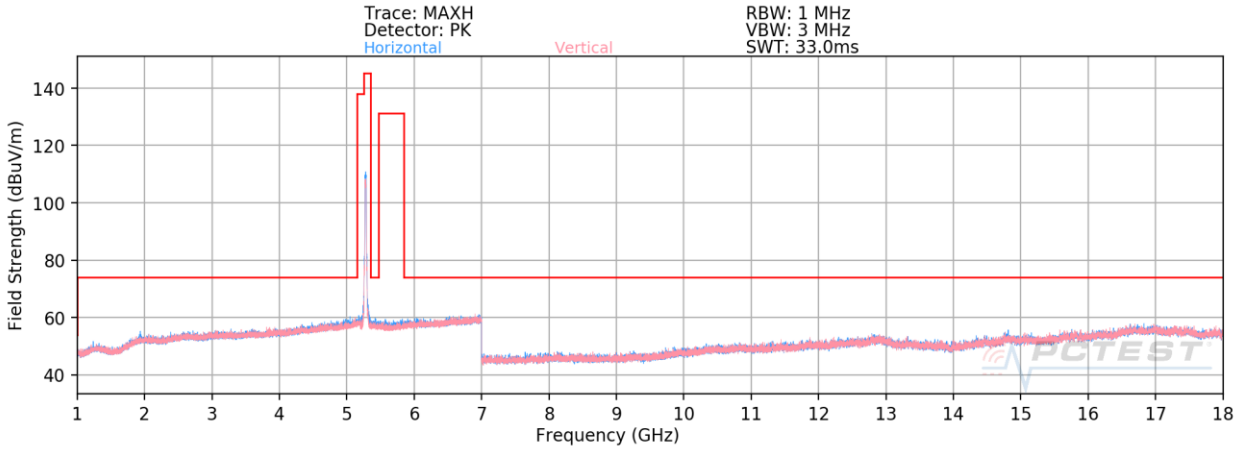
Plot 7-30. Radiated Spurious Emissions above 1GHz (802.11n – UNII 1 Ch. 40)



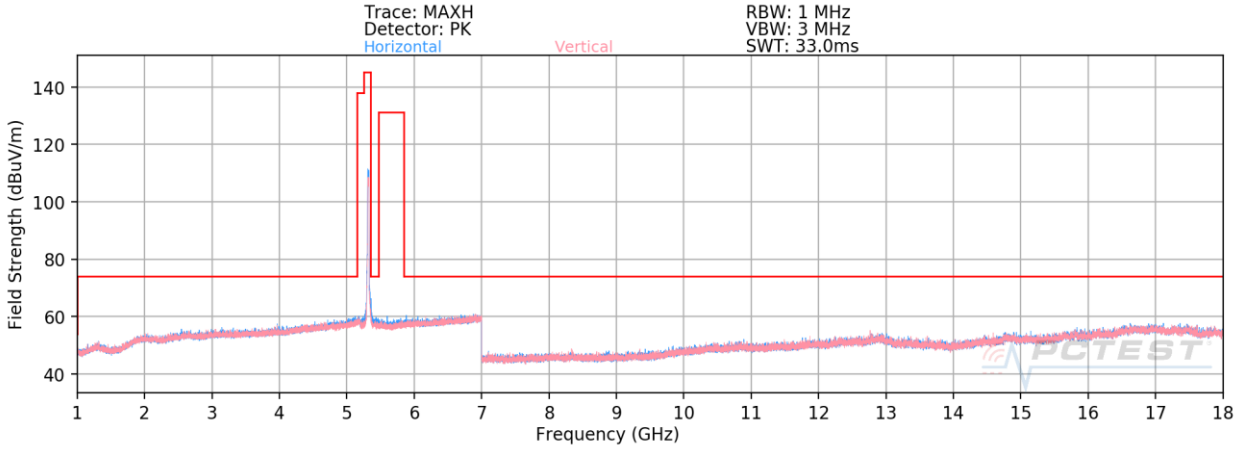
Plot 7-31. Radiated Spurious Emissions above 1GHz (802.11n – UNII 1 Ch. 48)



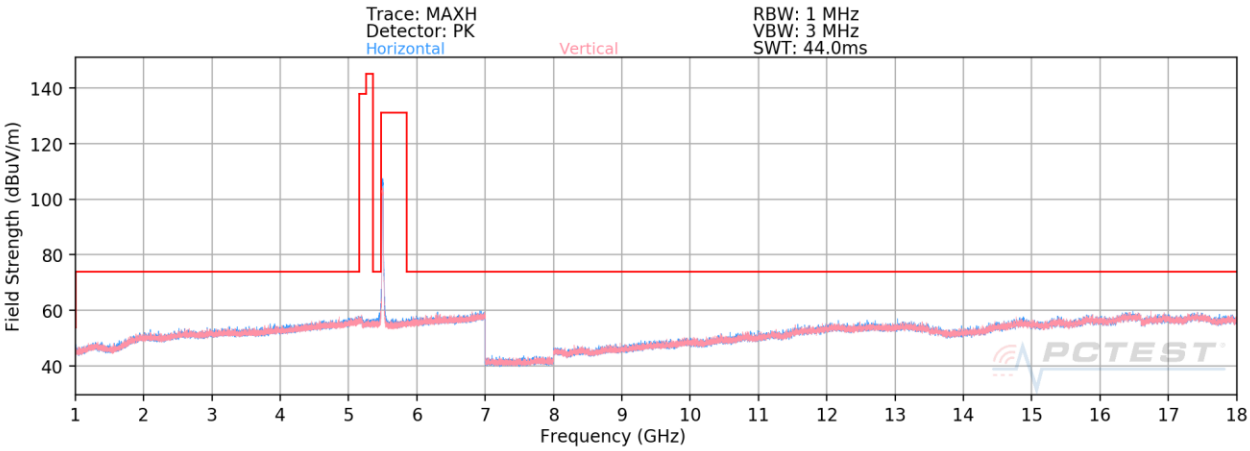
Plot 7-32: Radiated Spurious Emissions above 1GHz (802.11n – UNII 2A Ch. 52)



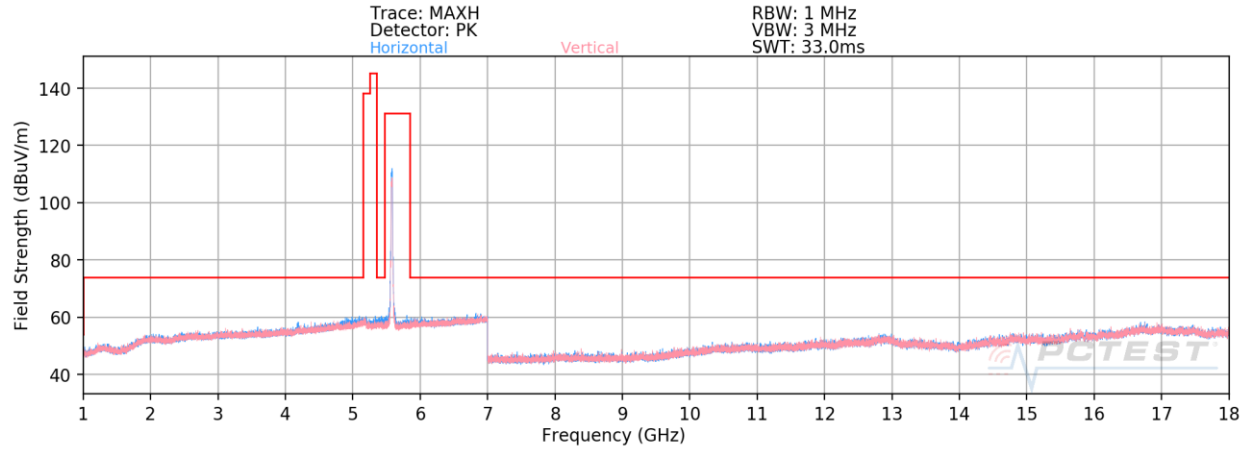
Plot 7-33: Radiated Spurious Emissions above 1GHz (802.11n – UNII 2A Ch. 56)



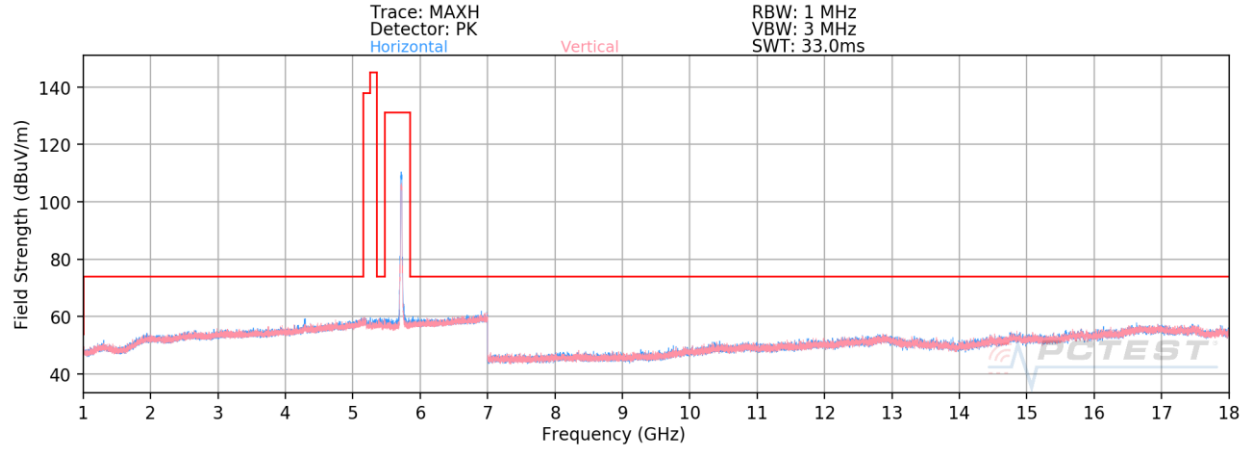
Plot 7-34: Radiated Spurious Emissions above 1GHz (802.11n – UNII 2A Ch. 64)



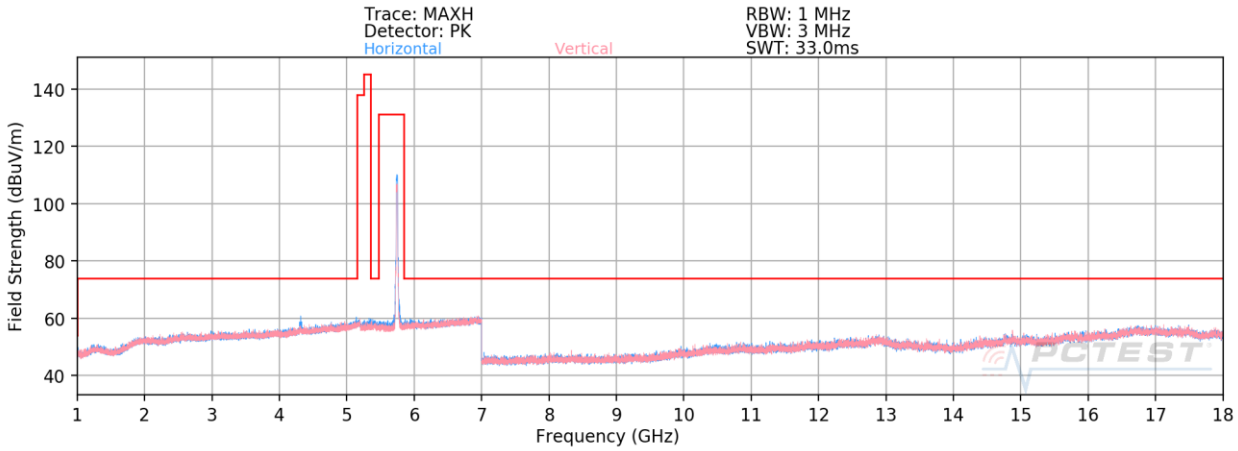
Plot 7-35: Radiated Spurious Emissions above 1GHz (802.11n – UNII 2C Ch. 100)



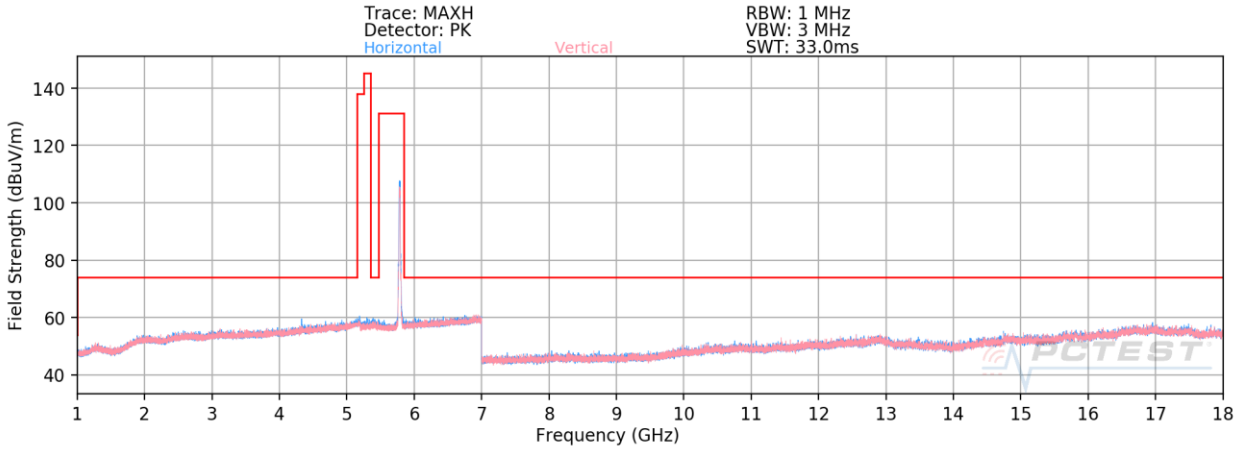
Plot 7-36: Radiated Spurious Emissions above 1GHz (802.11n – UNII 2C Ch. 116)



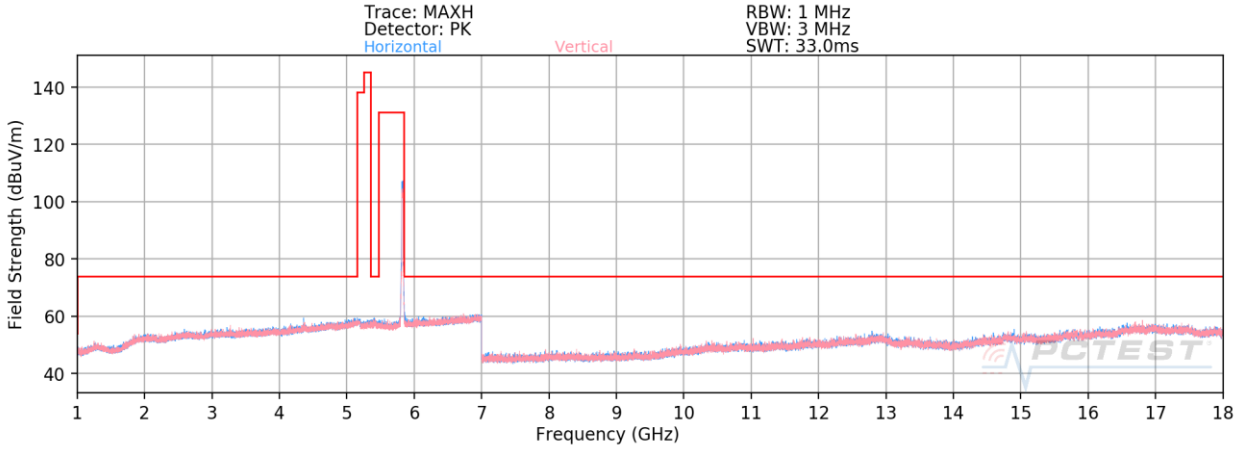
Plot 7-37: Radiated Spurious Emissions above 1GHz (802.11n – UNII 2C Ch. 144)



Plot 7-38: Radiated Spurious Emissions above 1GHz (802.11n – UNII 3 Ch. 149)

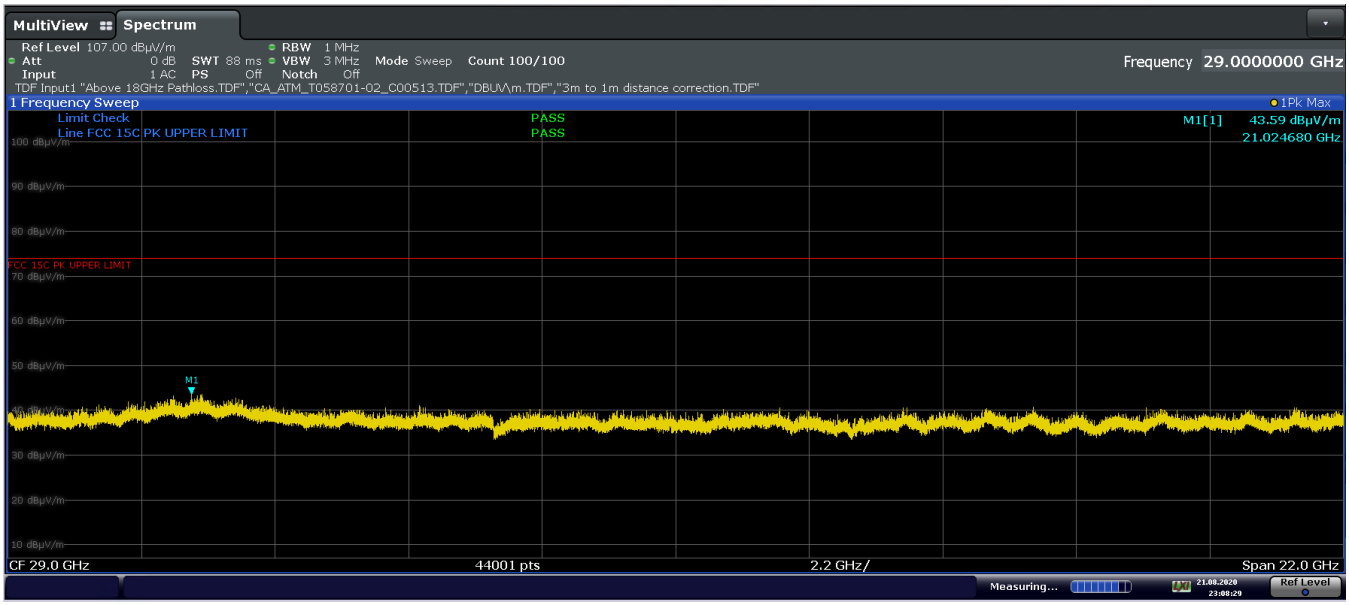


Plot 7-39: Radiated Spurious Emissions above 1GHz (802.11n – UNII 3 Ch. 157)

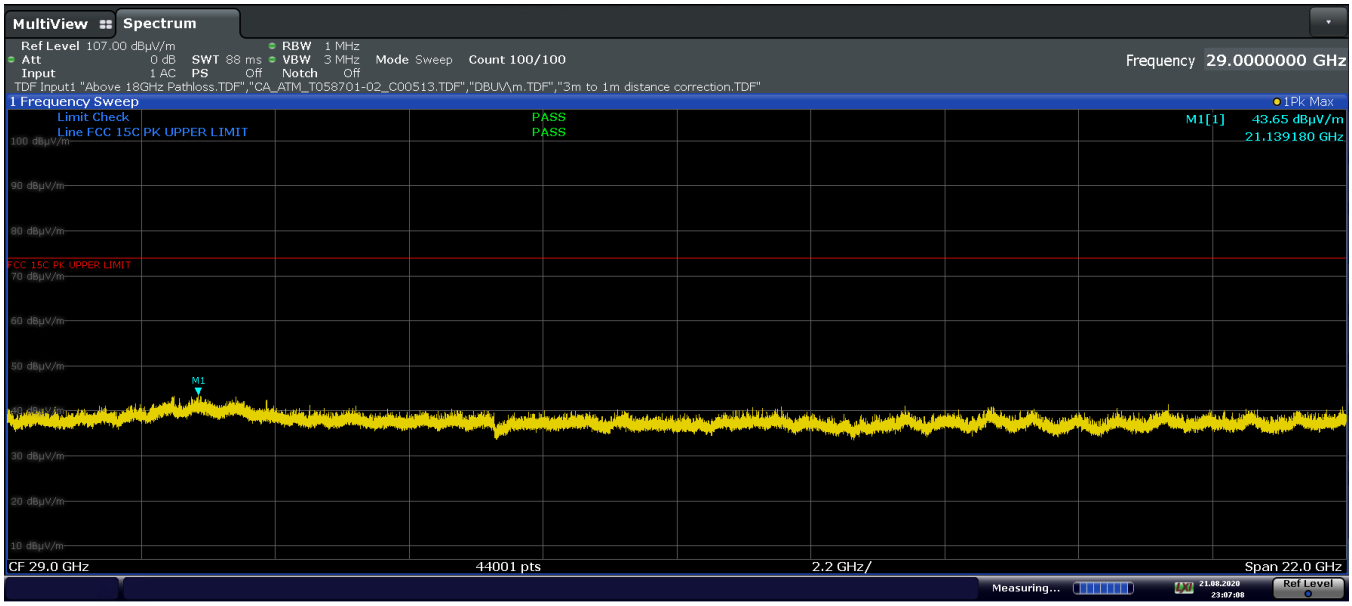


Plot 7-40: Radiated Spurious Emissions above 1GHz (802.11n – UNII 3 Ch. 165)

Radiated Spurious Emissions Measurements (Above 18GHz)



Plot 7-41. Radiated Spurious Plot 18-40GHz –H Polarity (802.11n – Ch. 165)



Plot 7-42: Radiated Spurious Plot 18-40GHz –V Polarity (802.11n – Ch. 165)

Radiated Spurious Emission Measurements 1-18GHz

15.407(b) §15.205 & §15.209; RSS-Gen [8.9]

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5180MHz
Channel:	36

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]
5145.13	Average	H	225	354	-73.55	17.37	50.82	53.98	-3.16
5145.13	Peak	H	225	354	-61.06	17.37	63.31	73.98	-10.67
5361.70	Average	H	232	356	-77.16	17.69	47.53	53.98	-6.45
5361.70	Peak	H	232	356	-65.12	17.69	59.57	73.98	-14.41
6429.06	Peak	H	224	155	-67.86	19.64	58.78	68.20	-9.42
10360.00	Peak	H	-	-	-71.06	14.74	50.68	68.20	-17.52
15540.00	Average	H	-	-	-82.97	19.68	43.71	53.98	-10.27
15540.00	Peak	H	-	-	-72.31	19.68	54.37	73.98	-19.61

Table 7-12. Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5200MHz
Channel:	40

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]
5149.68	Average	H	245	82	-73.80	17.37	50.57	53.98	-3.41
5149.68	Peak	H	245	82	-60.76	17.37	63.61	73.98	-10.37
5392.25	Average	H	212	355	-76.01	17.68	48.67	53.98	-5.31
5392.25	Peak	H	212	355	-63.66	17.68	61.02	73.98	-12.96
5937.92	Peak	H	241	345	-66.74	18.88	59.14	68.20	-9.06
10400.00	Average	H	-	-	-71.30	15.29	50.99	68.20	-17.21
15600.00	Peak	H	-	-	-81.69	19.56	44.87	53.98	-9.10
15600.00	Peak	H	-	-	-70.18	19.56	56.38	73.98	-17.59

Table 7-13. Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5240MHz
Channel:	48

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]
4398.80	Average	H	318	63	-77.92	16.38	45.46	53.98	-8.52
4398.80	Peak	H	318	63	-66.49	16.38	56.89	73.98	-17.09
4921.75	Average	H	273	88	-75.26	17.00	48.74	53.98	-5.24
4921.75	Peak	H	273	88	-63.56	17.00	60.44	73.98	-13.54
5449.95	Average	H	212	347	-75.94	17.82	48.88	53.98	-5.10
5449.95	Peak	H	212	347	-64.04	17.82	60.78	73.98	-13.20
5937.35	Peak	H	395	114	-65.95	18.87	59.92	68.20	-8.28
10480.00	Peak	H	-	-	-70.85	14.53	50.68	68.20	-17.52
15720.00	Average	H	-	-	-82.07	20.10	45.03	53.98	-8.95
15720.00	Peak	H	-	-	-70.18	20.09	56.91	73.98	-17.07

Table 7-14: Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5260MHz
Channel:	52

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]
4200.00	Average	H	-	-	-76.34	14.75	45.41	53.98	-8.57
4200.00	Peak	H	-	-	-64.77	14.75	56.98	73.98	-17.00
5054.00	Average	H	-	-	-75.66	16.47	47.81	53.98	-6.17
5054.00	Peak	H	-	-	-64.98	16.47	58.49	73.98	-15.49
5458.00	Average	H	210	34	-75.25	17.44	49.19	53.98	-4.79
5458.00	Peak	H	210	34	-64.44	17.44	60.00	73.98	-13.98
5954.00	Peak	H	222	69	-65.73	18.38	59.65	68.20	-8.55
10520.00	Peak	H	-	-	-70.49	14.54	51.05	68.20	-17.15
15780.00	Average	V	-	-	-82.09	21.34	46.25	53.98	-7.73
15780.00	Peak	V	-	-	-70.66	21.34	57.68	73.98	-16.30

Table 7-15. Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5280MHz
Channel:	56

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]
4497.00	Peak	H	-	-	-65.82	15.43	56.61	68.20	-11.59
5082.00	Average	H	239	127	-75.17	16.61	48.44	53.98	-5.54
5082.00	Peak	H	239	127	-63.85	16.61	59.76	73.98	-14.22
5350.00	Average	H	262	118	-75.03	17.46	49.43	53.98	-4.55
5350.00	Peak	H	262	118	-63.38	17.46	61.08	73.98	-12.90
5925.00	Peak	H	-	-	-65.84	18.14	59.30	68.20	-8.90
10560.00	Peak	H	-	-	-70.91	14.17	50.26	68.20	-17.94
15840.00	Average	V	-	-	-82.18	21.61	46.43	53.98	-7.55
15840.00	Peak	V	-	-	-70.54	21.61	58.07	73.98	-15.91

Table 7-16: Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5320MHz
Channel:	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]
4975.00	Average	H	245	79	-74.01	16.23	49.22	53.98	-4.76
4975.00	Peak	H	245	79	-62.29	16.23	60.94	73.98	-13.04
5350.00	Average	H	245	73	-73.56	17.46	50.90	53.98	-3.08
5350.00	Peak	H	245	73	-59.67	17.46	64.79	73.98	-9.19
5976.00	Peak	H	220	66	-66.22	18.19	58.97	68.20	-9.23
10640.00	Peak	H	-	-	-70.27	14.67	51.40	68.20	-16.80
15960.00	Average	H	-	-	-84.63	21.15	43.52	53.98	-10.46
15960.00	Peak	H	-	-	-72.88	21.15	55.27	73.98	-18.71

Table 7-17: Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5500MHz
Channel:	100

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]
4117.00	Average	H	118	211	-75.20	14.37	46.17	53.98	-7.81
4117.00	Peak	H	118	211	-64.08	14.37	57.29	73.98	-16.69
5091.00	Average	H	223	170	-75.92	16.06	47.14	53.98	-6.84
5091.00	Peak	H	223	170	-64.26	16.06	58.80	73.98	-15.18
5460.00	Average	H	213	81	-73.83	17.71	50.88	53.98	-3.10
5460.00	Peak	H	213	81	-56.71	17.71	68.00	73.98	-5.98
5925.00	Peak	H	192	77	-65.23	18.22	59.99	68.20	-8.21
11000.00	Average	H	-	-	-81.87	15.27	40.40	53.98	-13.58
11000.00	Peak	H	-	-	-70.39	15.27	51.88	73.98	-22.10
16500.00	Peak	V	169	160	-68.89	21.37	59.48	68.20	-8.72

Table 7-18: Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5580MHz
Channel:	116

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]
4189.48	Average	H	233	90	-71.31	14.76	50.45	53.98	-3.53
4189.48	Peak	H	233	90	-60.41	14.76	61.35	73.98	-12.63
4978.00	Average	H	235	72	-74.34	16.30	48.96	53.98	-5.02
4978.00	Peak	H	235	72	-75.36	16.36	60.45	73.98	-13.52
5360.00	Average	H	195	339	-60.80	16.76	49.37	53.98	-4.61
5360.00	Peak	H	195	339	-75.70	17.54	62.62	73.98	-11.36
5927.00	Peak	H	220	9	-60.80	16.76	58.37	68.20	-9.83
11160.00	Average	H	-	-	-75.70	17.54	41.04	53.98	-12.94
11160.00	Peak	H	-	-	-71.88	15.65	50.77	73.98	-23.21
16740.00	Peak	V	164	63	-71.03	22.90	58.87	68.20	-9.33

Table 7-19: Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5720MHz
Channel:	144

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]
4268.13	Average	H	259	92	-71.65	15.59	50.94	53.98	-3.04
4268.13	Peak	H	259	92	-60.66	15.59	61.93	73.98	-12.05
4884.00	Average	H	251	82	-74.36	15.91	48.55	53.98	-5.43
4884.00	Peak	H	251	82	-62.74	15.91	60.17	73.98	-13.81
5358.00	Average	H	193	349	-75.22	17.52	49.30	53.98	-4.68
5358.00	Peak	H	193	349	-64.59	17.52	59.93	73.98	-14.05
6209.00	Peak	H	208	205	-65.44	18.68	60.24	73.98	-13.74
11440.00	Average	H	325	18	-81.78	16.36	41.58	53.98	-12.40
11440.00	Peak	H	325	18	-70.69	16.36	52.67	73.98	-21.31
17160.00	Peak	H	-	-	-69.79	21.80	59.01	68.20	-9.19

Table 7-20: Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5745MHz
Channel:	149

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]
4316.00	Average	H	221	91	-70.90	14.93	51.03	53.98	-2.95
4316.00	Peak	H	221	91	-59.91	14.93	62.02	73.98	-11.96
5130.00	Average	H	209	69	-75.90	16.74	47.84	53.98	-6.14
5130.00	Peak	H	209	69	-64.12	16.74	59.62	73.98	-14.36
5364.00	Average	H	194	136	-75.37	17.54	49.17	53.98	-4.81
5364.00	Peak	H	194	136	-63.62	17.54	60.92	73.98	-13.06
5936.00	Peak	H	211	340	-66.25	18.12	58.87	68.20	-9.33
11490.00	Average	H	-	-	-83.15	16.43	40.28	53.98	-13.70
11490.00	Peak	H	-	-	-72.19	16.43	51.24	73.98	-22.74
17235.00	Peak	V	159	73	-71.17	22.05	57.88	68.20	-10.32

Table 7-21: Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5785MHz
Channel:	157

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]
4346.00	Peak	H	216	91	-71.38	15.06	50.68	53.98	-3.30
4346.00	Peak	H	216	91	-60.30	15.06	61.76	73.98	-12.22
5113.00	Average	H	223	69	-76.77	16.75	46.98	53.98	-7.00
5113.00	Peak	H	223	69	-65.37	16.75	58.38	73.98	-15.60
5364.00	Average	H	201	343	-75.82	17.71	48.89	53.98	-5.08
5364.00	Peak	H	201	343	-63.79	17.54	60.75	73.98	-13.23
5926.00	Peak	H	181	338	-66.40	18.39	58.99	68.20	-9.21
11570.00	Average	H	-	-	-83.86	16.26	39.40	53.98	-14.58
11570.00	Peak	H	-	-	-72.37	16.26	50.89	73.98	-23.09
17355.00	Peak	V	151	71	-72.30	22.82	57.52	68.20	-10.68

Table 7-22: Radiated Measurements

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5825MHz
Channel:	165

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]
4374.00	Peak	H	201	96	-71.77	15.42	50.65	53.98	-3.33
4374.00	Peak	H	201	96	-60.16	15.42	62.26	73.98	-11.72
5100.00	Average	H	225	75	-76.83	16.63	46.80	53.98	-7.18
5100.00	Peak	H	225	75	-65.42	16.63	58.21	73.98	-15.77
5361.37	Average	H	186	340	-75.78	17.54	48.76	53.98	-5.22
5372.25	Peak	H	186	340	-63.56	17.58	61.02	73.98	-12.96
5937.92	Peak	H	229	10	-66.79	18.15	58.36	68.20	-9.84
11650.00	Average	-	-	-	-84.02	16.71	39.69	53.98	-14.29
11650.00	Peak	-	-	-	-71.96	16.71	51.75	73.98	-22.23
17475.00	Peak	V	158	73	-72.27	22.03	56.76	68.20	-11.44

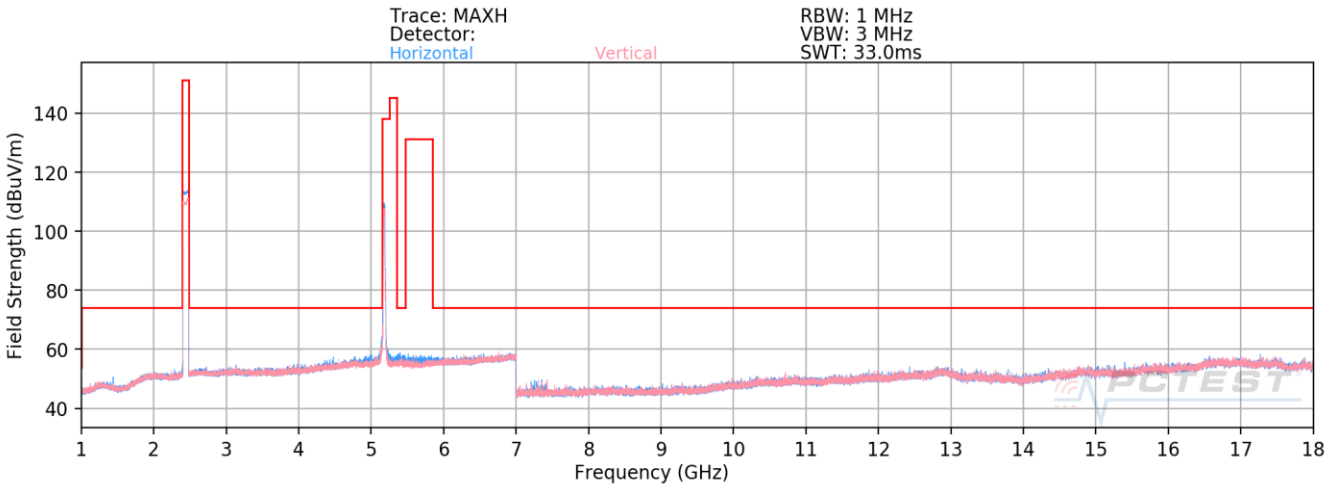
Table 7-23: Radiated Measurements

7.6.2 Simultaneous TX Radiated Spurious Emission Measurements

§15.407(b) §15.247(d) §15.205 §15.209; RSS-Gen [8.9]

Description	Bluetooth	802.11a/n/ac 5GHz
Channel	Hopping	36
Operating Frequency (MHz)	2402-2480	5180
Mode	GFSK ePA	802.11n

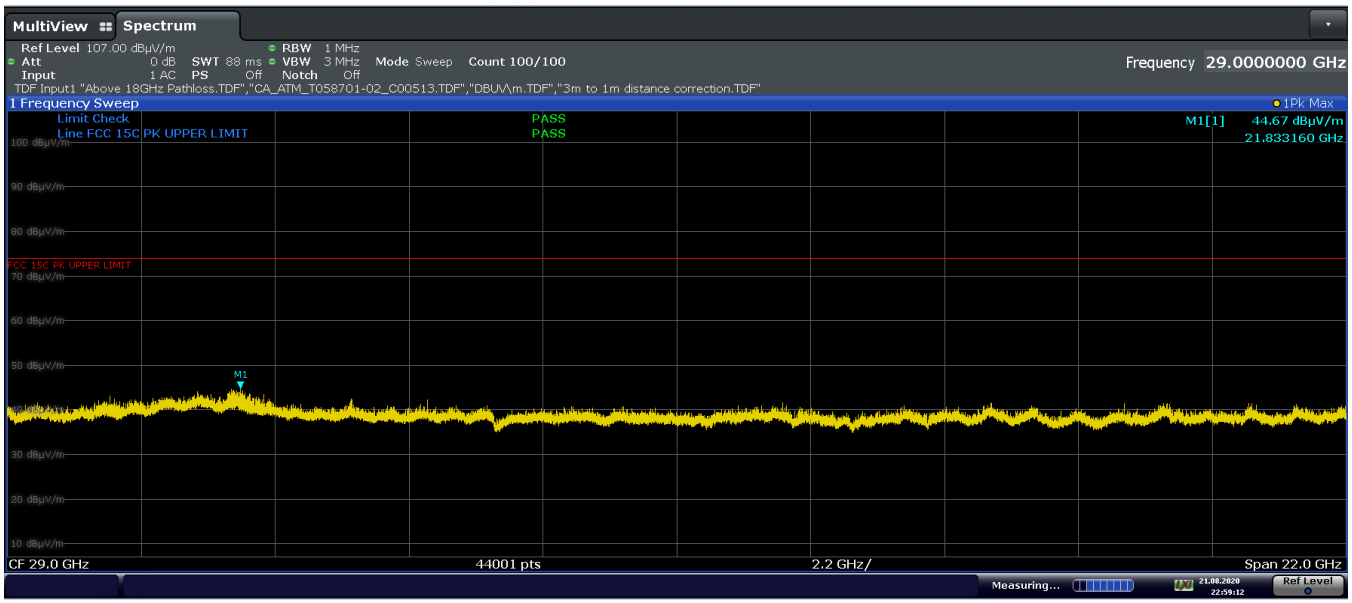
Table 7-24: Worst Case Simultaneous Transmission Configuration



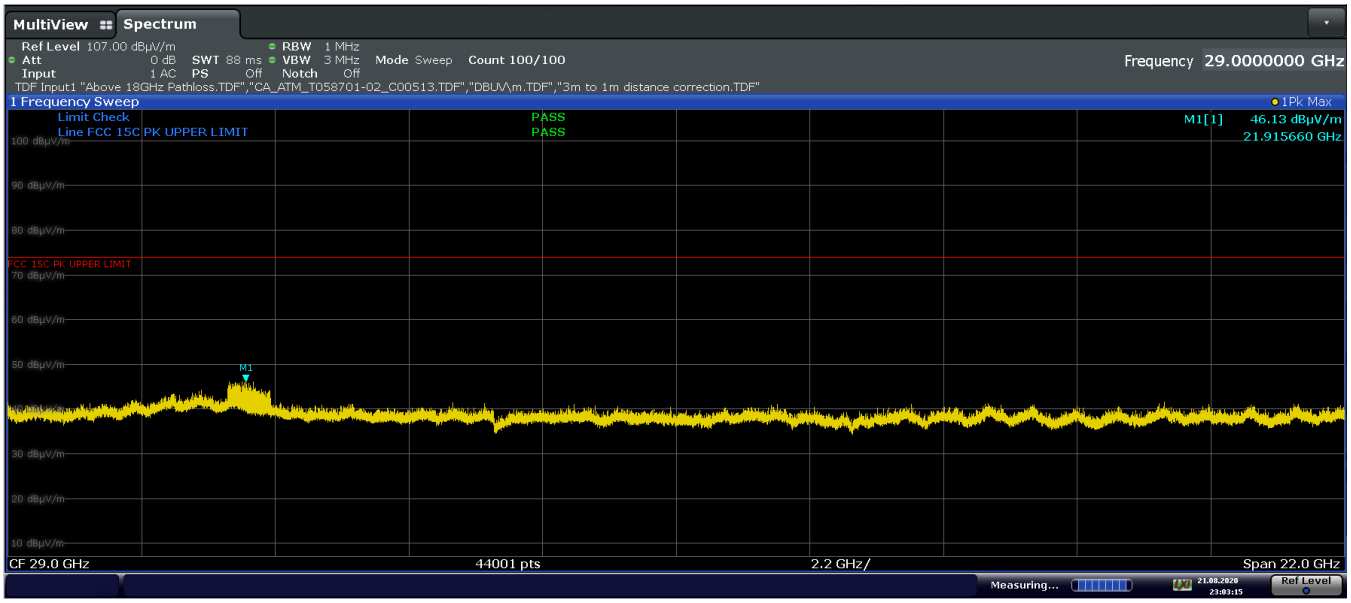
Plot 7-43: Radiated Spurious Emissions – Simultaneous Transmission 1GHz – 18GHz

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]
4882.00	Average	H	-	-	-74.93	15.47	47.54	53.98	-6.44
4882.00	Peak	H	-	-	-62.78	15.47	59.69	73.98	-14.29
5146.43	Average	H	255	215	-75.68	15.93	47.25	53.98	-6.73
5146.43	Peak	H	255	215	-63.74	15.93	59.19	73.98	-14.79
5419.29	Average	H	242	300	-75.41	16.28	47.87	53.98	-6.11
5419.29	Peak	H	242	300	-63.31	16.28	59.97	73.98	-14.01
5929.31	Peak	H	175	275	-64.60	17.34	59.74	68.23	-8.49
7323.00	Average	H	188	248	-70.27	13.56	50.29	53.98	-3.69
7323.00	Peak	H	188	248	-69.59	13.56	50.97	73.98	-23.01
7919.00	Peak	H	-	-	-67.37	10.00	49.63	68.23	-18.60
10360.00	Peak	H	-	-	-72.24	19.06	53.82	68.23	-14.41
12205.00	Average	H	152	252	-77.02	19.77	49.75	53.98	-4.23
12205.00	Peak	H	152	252	-75.29	19.77	51.48	73.98	-22.50
15540.00	Average	H	-	-	-85.63	26.65	48.02	53.98	-5.96
15540.00	Peak	H	-	-	-74.33	26.65	59.32	73.98	-14.66

Table 7-25: BT and UNII Emission Measurements 1GHz – 18GHz in Simultaneous Transmission Mode



Plot 7-44: Radiated Spurious Emissions – Simultaneous Transmission 18GHz – 40GHz Pol H



Plot 7-45: Radiated Spurious Emissions – Simultaneous Transmission 18GHz – 40GHz Pol V

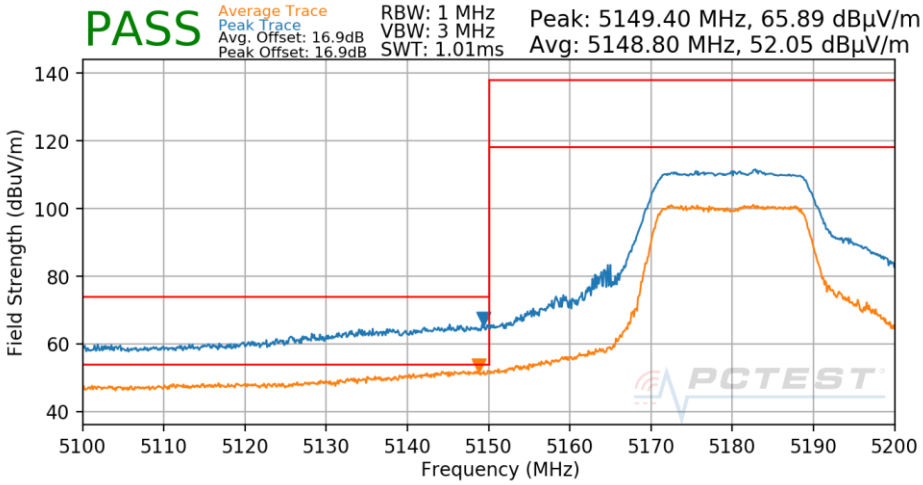
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
19528.00	Average	H	124	309	-52.11	-5.54	-9.54	39.81	53.98	-14.17
19528.00	Peak	H	124	309	-48.35	-5.54	-9.54	43.57	73.98	-30.41
22320.00	Average	V	126	312	-49.51	-5.82	-9.54	42.13	53.98	-11.85
22320.00	Peak	V	126	312	-48.50	-5.82	-9.54	43.14	73.98	-30.84
20720.00	Average	V	172	254	-55.80	-5.85	-9.54	35.81	53.98	-18.17
20720.00	Peak	V	172	254	-44.83	-5.85	-9.54	46.78	73.98	-27.20

Table 7-26: BT and UNII Emission Measurements 18GHz – 40GHz in Simultaneous Transmission Mode

7.6.3 Radiated Restricted Band Edge Measurements (20MHz BW)

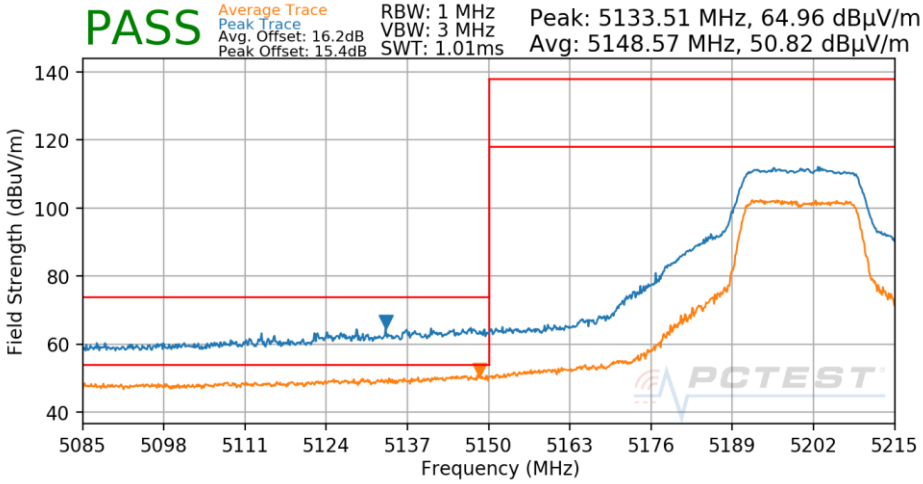
§15.407(b.1)(b.2) §15.205 §15.209; RSS-Gen [8.9]

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS7
Distance of Measurements:	3 Meters
Operating Frequency:	5180MHz
Channel:	36



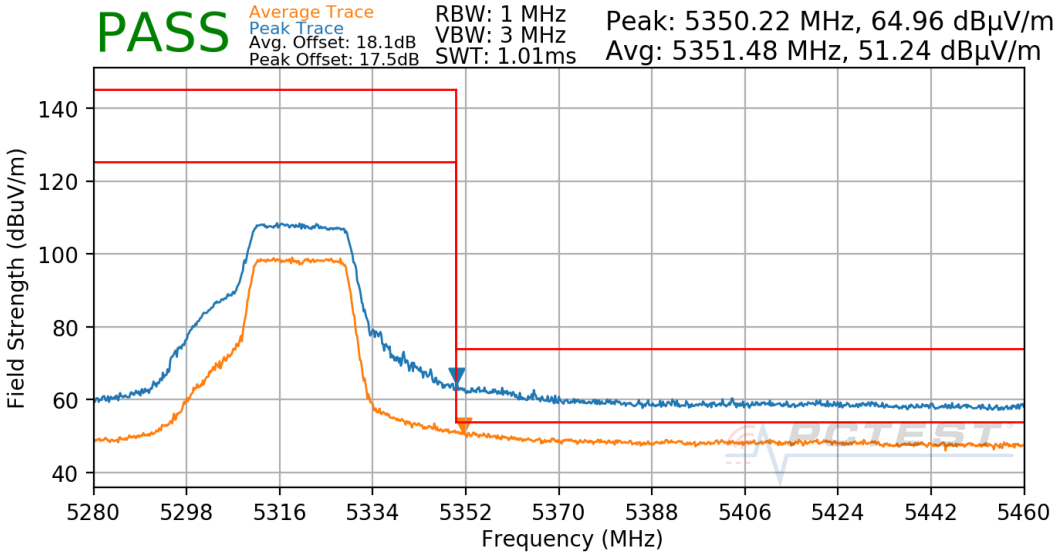
Plot 7-46: Radiated Restricted Lower Band Edge Plot (UNII Band 1)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS7
Distance of Measurements:	3 Meters
Operating Frequency:	5200MHz
Channel:	40



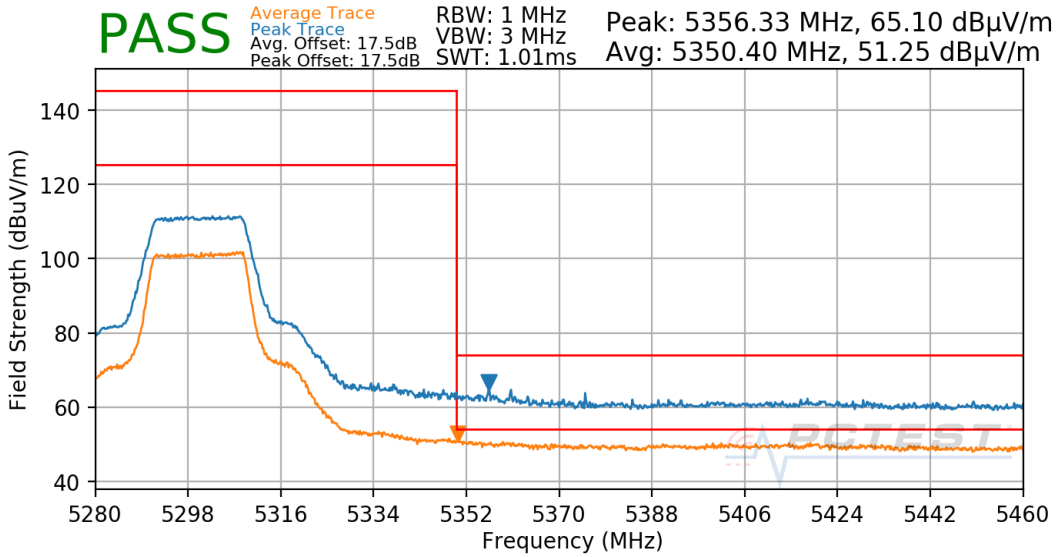
Plot 7-47: Radiated Restricted Lower Band Edge Plot (UNII Band 1)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS7
Distance of Measurements:	3 Meters
Operating Frequency:	5320MHz
Channel:	64



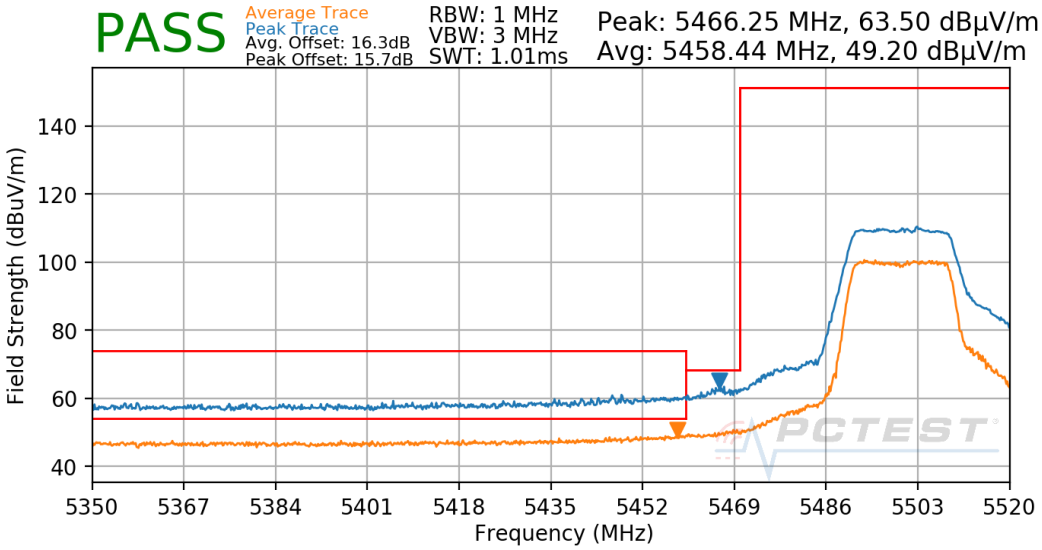
Plot 7-48: Radiated Upper Band Edge Plot (UNII Band 2A)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5300MHz
Channel:	60



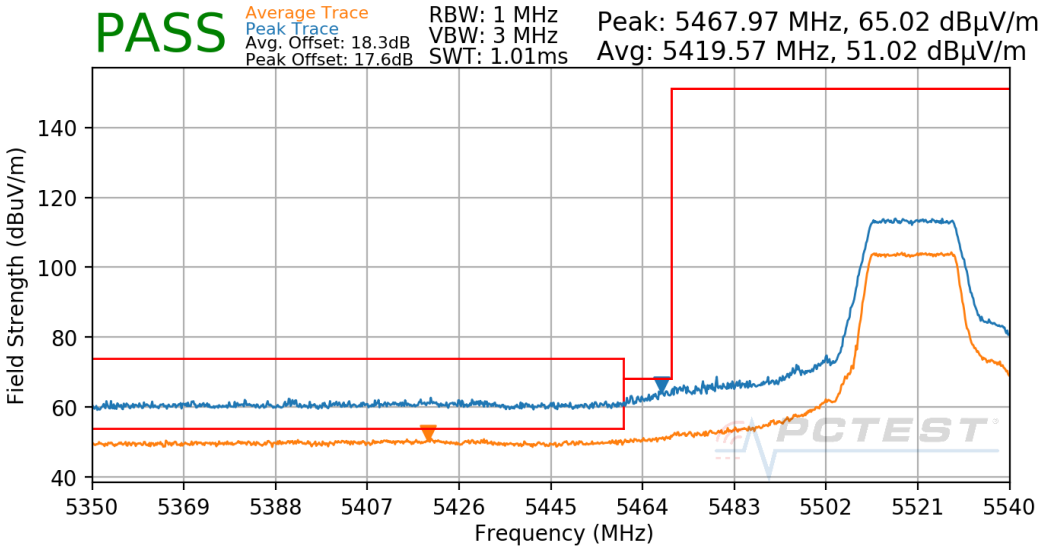
Plot 7-49: Radiated Upper Band Edge Plot (UNII Band 2A)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS7
Distance of Measurements:	3 Meters
Operating Frequency:	5500MHz
Channel:	100



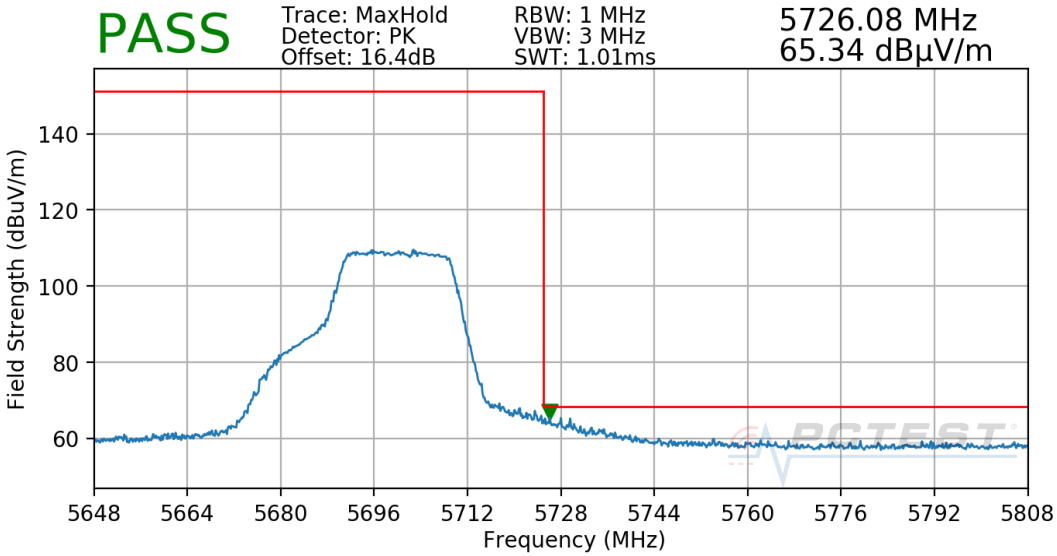
Plot 7-50: Radiated Lower Band Edge Plot (UNII Band 2C)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5520MHz
Channel:	104



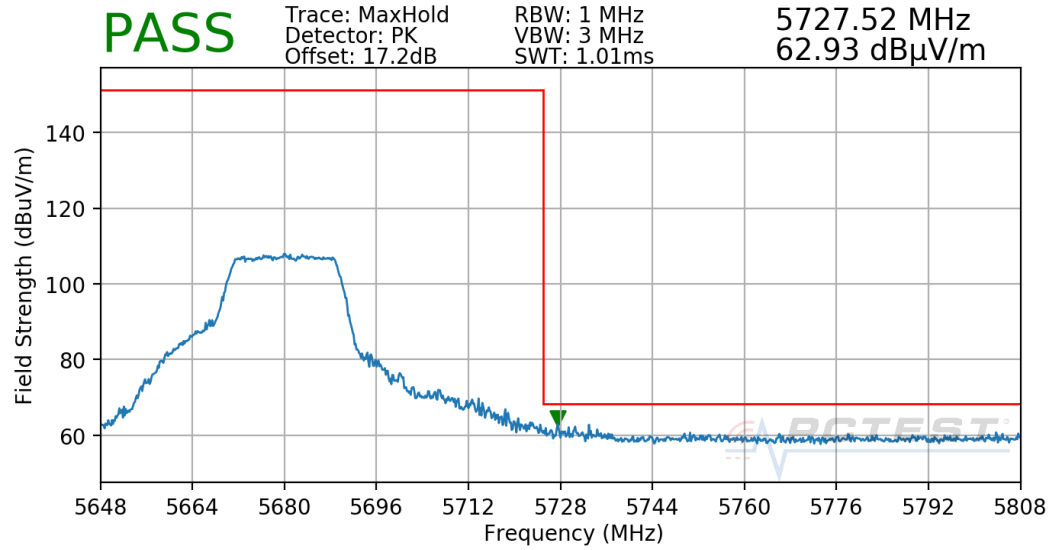
Plot 7-51: Radiated Lower Band Edge Plot (UNII Band 2C)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS7
Distance of Measurements:	3 Meters
Operating Frequency:	5700MHz
Channel:	140



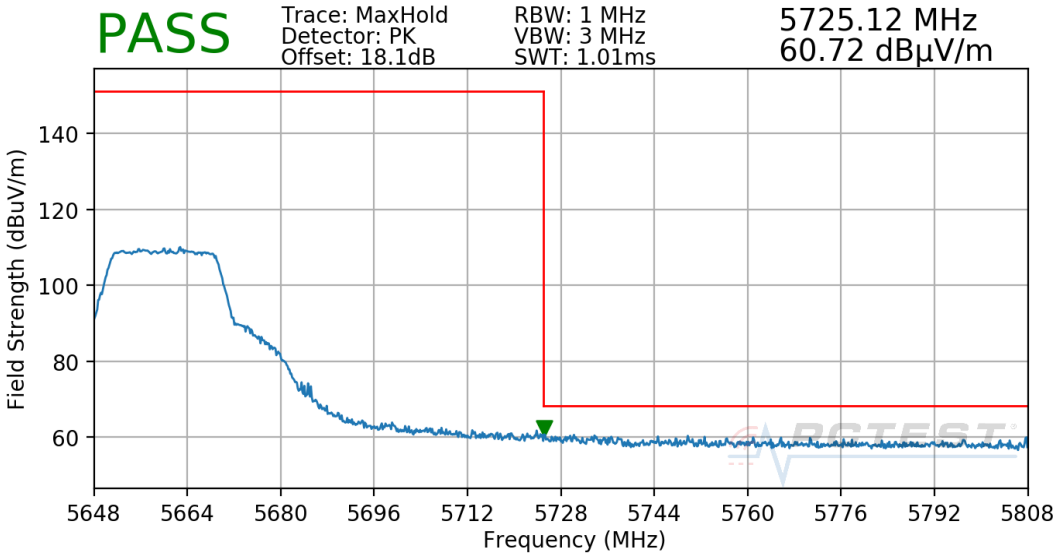
Plot 7-52: Radiated Upper Band Edge Plot (Peak – UNII Band 2C)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS7
Distance of Measurements:	3 Meters
Operating Frequency:	5680MHz
Channel:	136



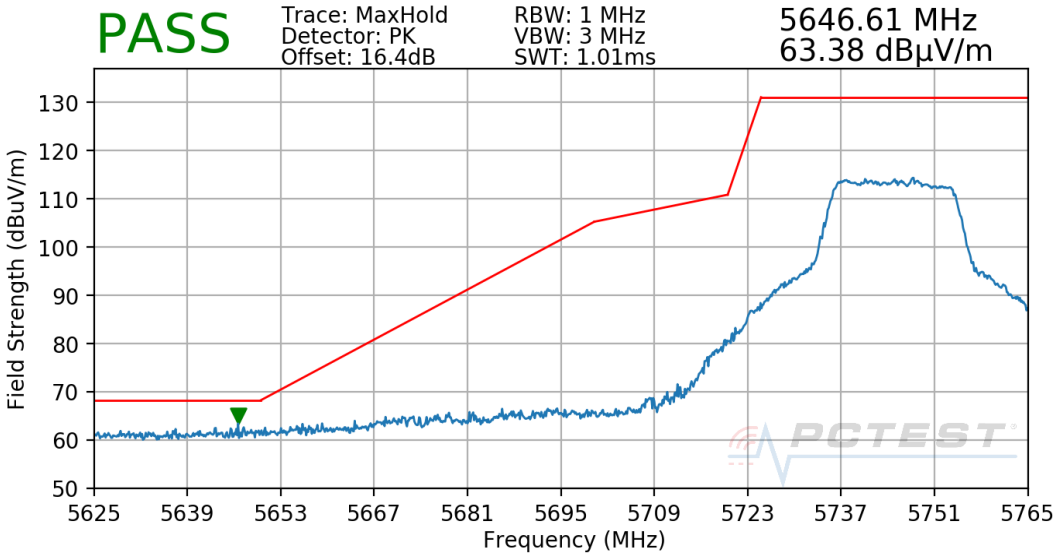
Plot 7-53: Radiated Upper Band Edge Plot (Peak – UNII Band 2C)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS7
Distance of Measurements:	3 Meters
Operating Frequency:	5660MHz
Channel:	132



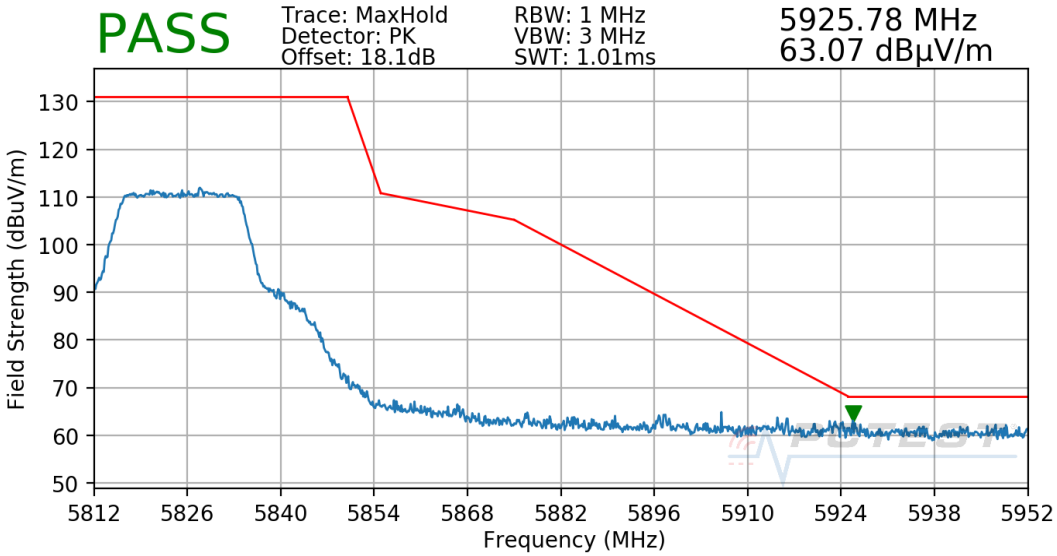
Plot 7-54: Radiated Upper Band Edge Plot (Peak – UNII Band 2C)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS7
Distance of Measurements:	3 Meters
Operating Frequency:	5745MHz
Channel:	149



Plot 7-55: Radiated Lower Band Edge Plot (Peak – UNII Band 3)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS7
Distance of Measurements:	3 Meters
Operating Frequency:	5825MHz
Channel:	165

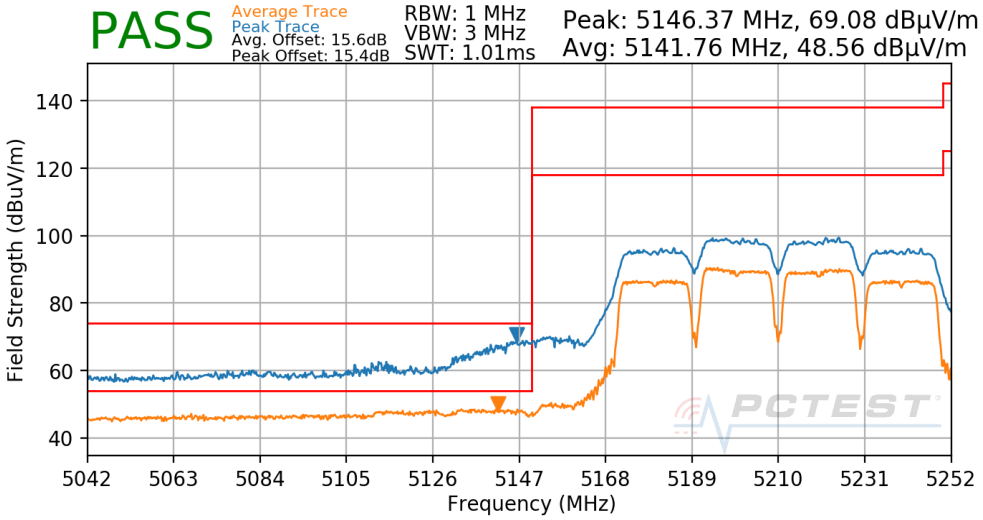


Plot 7-56: Radiated Upper Band Edge Plot (Peak – UNII Band 3)

7.6.4 Radiated Band Edge Measurements (80MHz BW)

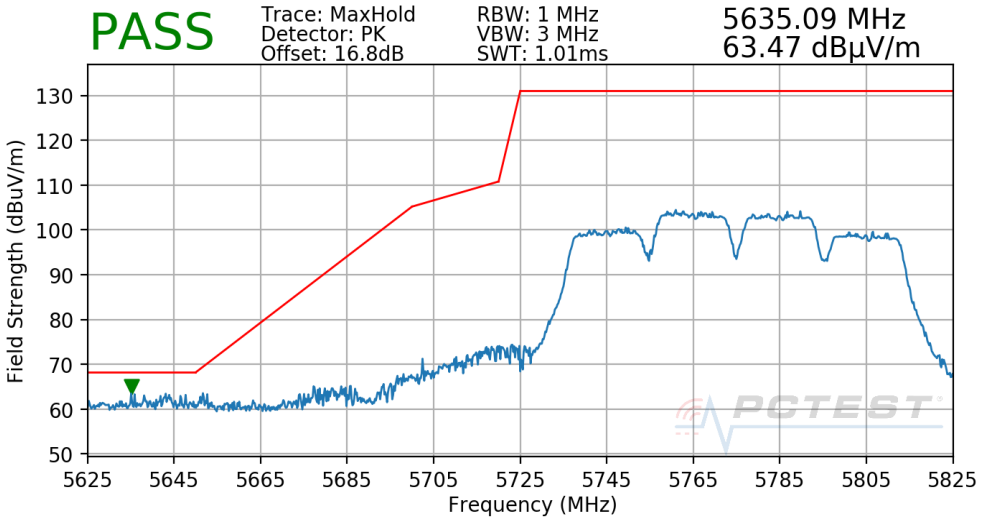
§15.407(b.1)(b.2) §15.205 §15.209; RSS-Gen [8.9]

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5210MHz
Channel:	42



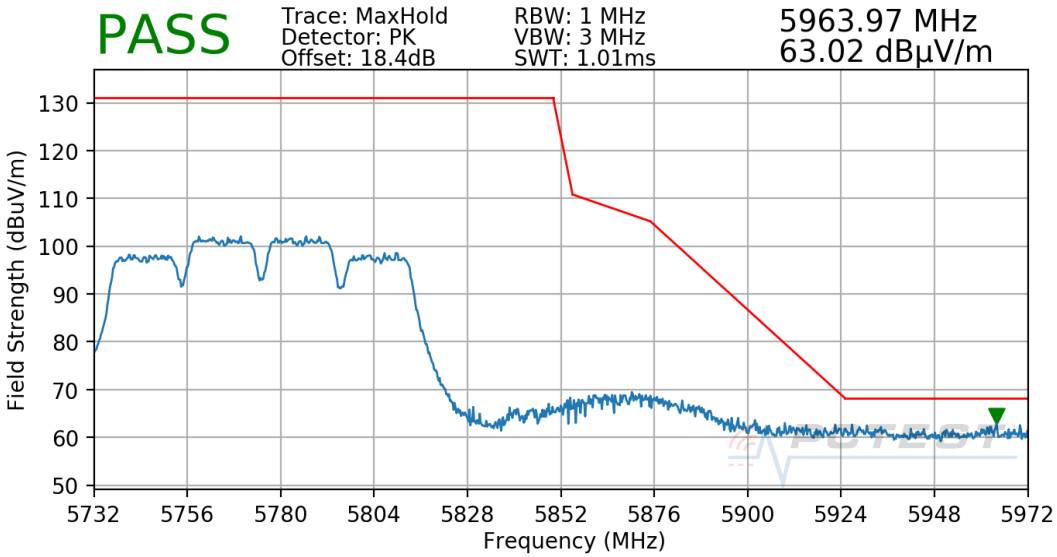
Plot 7-57: Radiated Lower Band Edge Plot (UNII Band 1)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5775MHz
Channel:	155



Plot 7-58: Radiated Lower Band Edge Plot (Peak – UNII Band 3)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5775MHz
Channel:	155



Plot 7-59: Radiated Upper Band Edge Plot (Peak – UNII Band 3)

7.7 Radiated Spurious Emissions – Below 1GHz

§15.209; RSS-Gen [8.9]

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 and Table 7 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-27 per Section 15.209 and RSS-Gen (8.9).

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 7-27: Radiated Limits

Test Procedures Used

ANSI C63.10-2013

Test Settings

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 = peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

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. VBW = 300kHz
4. Detector = quasi-peak
5. Sweep time = auto couple
6. Trace mode = max hold

Test Setup

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

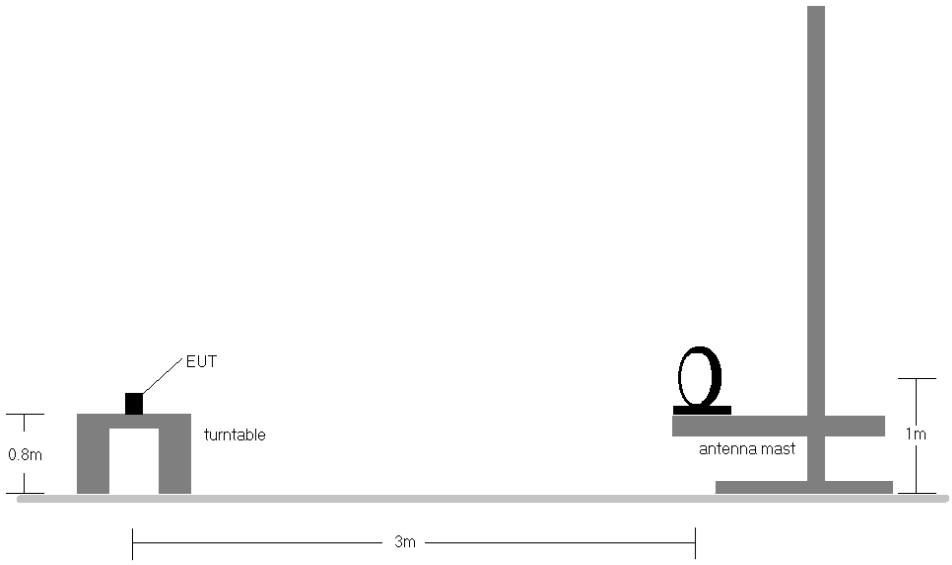


Figure 7-6. Radiated Test Setup < 30Mhz

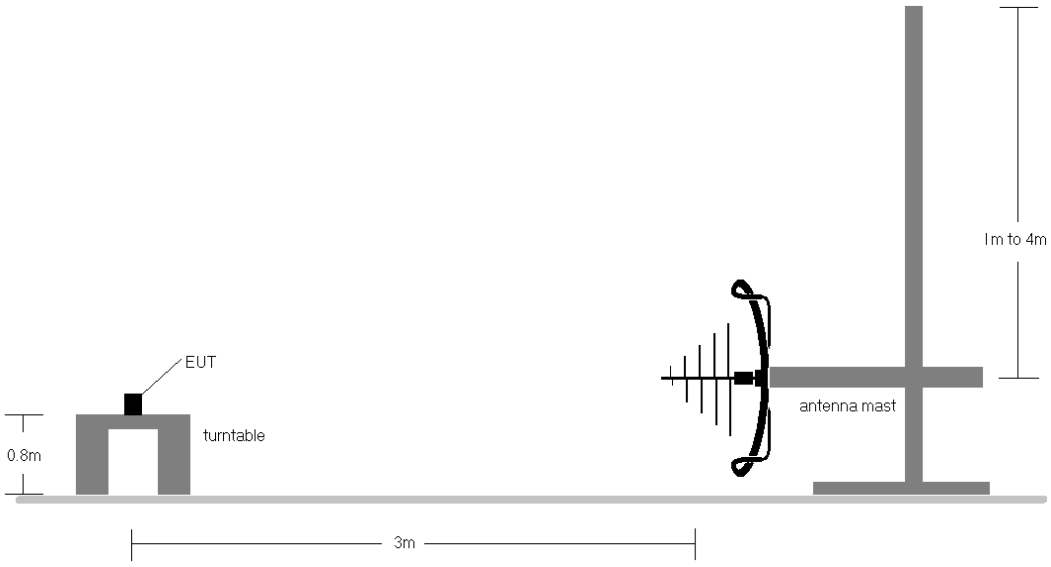


Figure 7-7. Radiated Test Setup < 1GHz

Test Notes

1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen(8.10) are below the limit shown in Table 7-27.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The loop antenna was positioned in three orthogonal positions (X front, Y side, Z top). The EUT is manipulated through two orthogonal planes (X and Y).
3. This unit was tested while powered by an AC power source.
4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector for emissions within 6dB of the limit. The worst-case emissions are reported.
5. Emissions were measured at a 3 meter test distance.
6. Emissions are investigated while operating on the worst channel, 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.
10. The unit was tested with all possible modes and only the highest emission is reported.

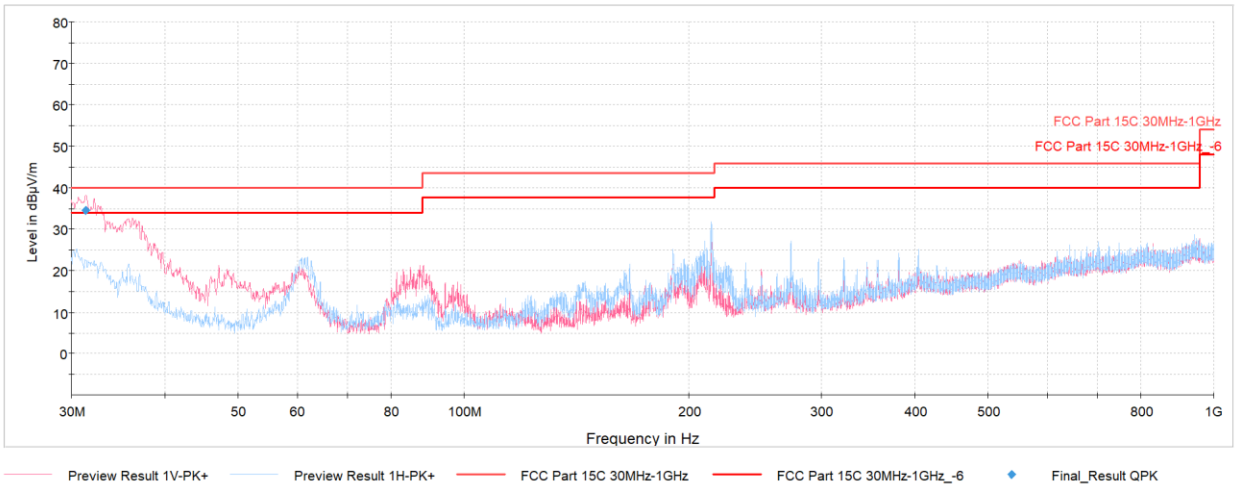
Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level [dBµV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m]
- AFCL [dB/m] = (Antenna Factor [dB/m] + Cable Loss [dB] + Attenuator [dB]) – Preamplifier Gain [dB]
- Margin [dB] = Field Strength Level [dBµV/m] – Limit [dBµV/m]

7.7.1 Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209; RSS-Gen [8.9]



Plot 7-60. Radiated Spurious Plot below 1GHz (802.11n – UNII 3 Ch. 165)

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]
31.36	Quasi-Peak	V	107	211	-59.54	-12.95	34.51	40.00	-5.49
36.21	Peak	V	100	142	-58.30	-15.93	32.77	40.00	-7.23
47.17	Peak	V	100	37	-64.95	-20.67	21.38	40.00	-18.62
61.43	Peak	H	250	172	-62.88	-21.21	22.91	40.00	-17.09
87.47	Peak	V	100	123	-64.49	-21.14	21.37	40.00	-18.63
214.25	Peak	H	100	102	-59.17	-16.02	31.81	43.52	-11.71

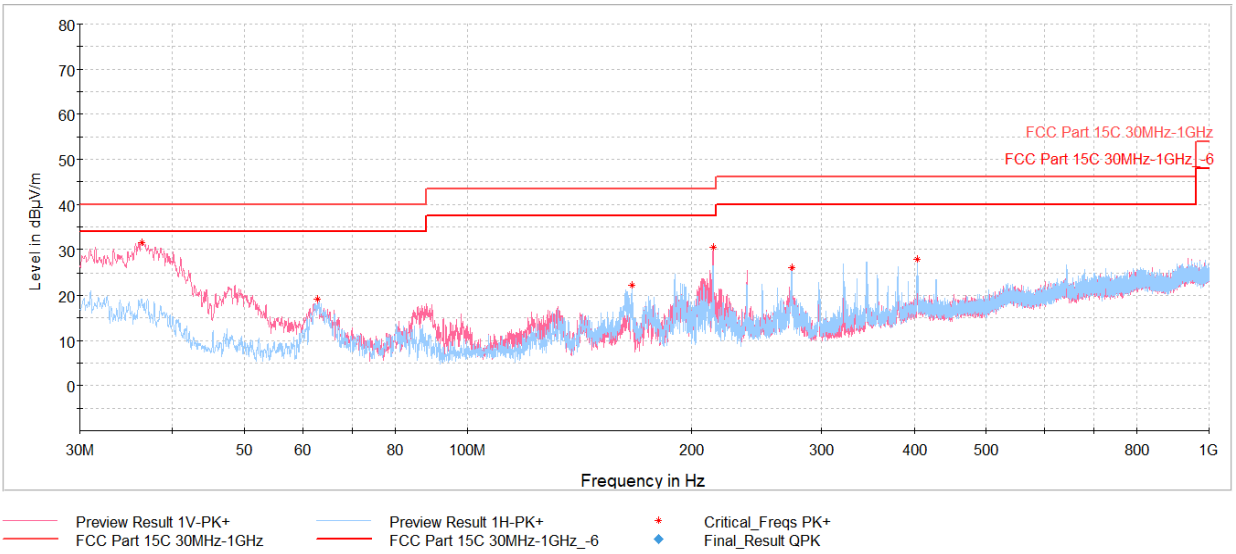
Table 7-28. Radiated Spurious Emissions below 1GHz (802.11n – UNII 3 Ch. 165)

7.7.2 Simultaneous Tx Radiated Spurious Emission Measurements (Below 1GHz)

§15.209; RSS-Gen [8.9]

Description	Bluetooth	802.11a/n/ac 5GHz
Channel	Hopping	165
Operating Frequency (MHz)	2402-2480	5825
Mode	GFSK ePA	802.11n

Table 7-29: Worst Case Simultaneous Transmission Configuration



Plot 7-61: Radiated Spurious Emission – Simultaneous Transmission below 1GHz

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]
36.40	Peak	V	100	206	-59.43	-16.03	31.54	40.00	-8.46
62.83	Peak	V	250	118	-66.67	-21.14	19.19	40.00	-20.81
166.33	Peak	H	100	75	-67.13	-17.54	22.33	43.52	-21.19
214.20	Peak	V	100	160	-60.58	-16.02	30.40	43.52	-13.12
273.47	Peak	H	100	148	-67.60	-13.23	26.17	46.02	-19.85
403.98	Peak	H	100	15	-70.77	-8.12	28.11	46.02	-17.91

Table 7-30: Radiated Spurious Emission – Simultaneous Transmission below 1GHz

7.8 AC Line-Conducted Emissions Measurements

§15.207; RSS-Gen [8.8]

Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN 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 AC Line conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207 and RSS-Gen (8.8).

Frequency of emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

Table 7-31. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Average Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Test Setup

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

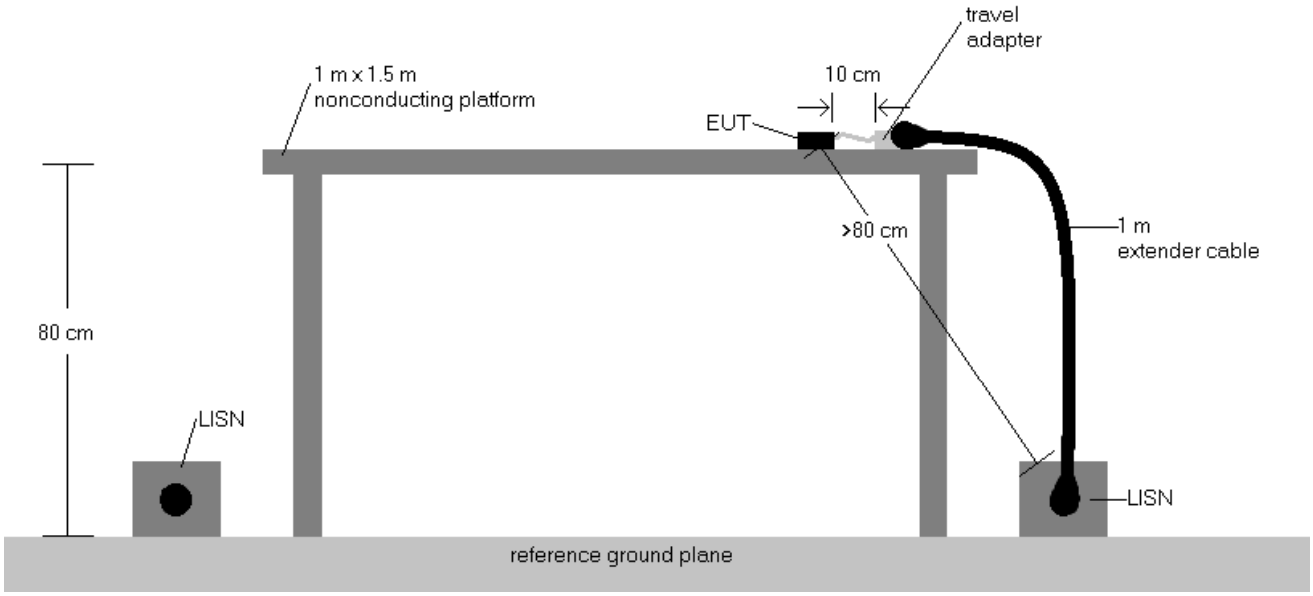
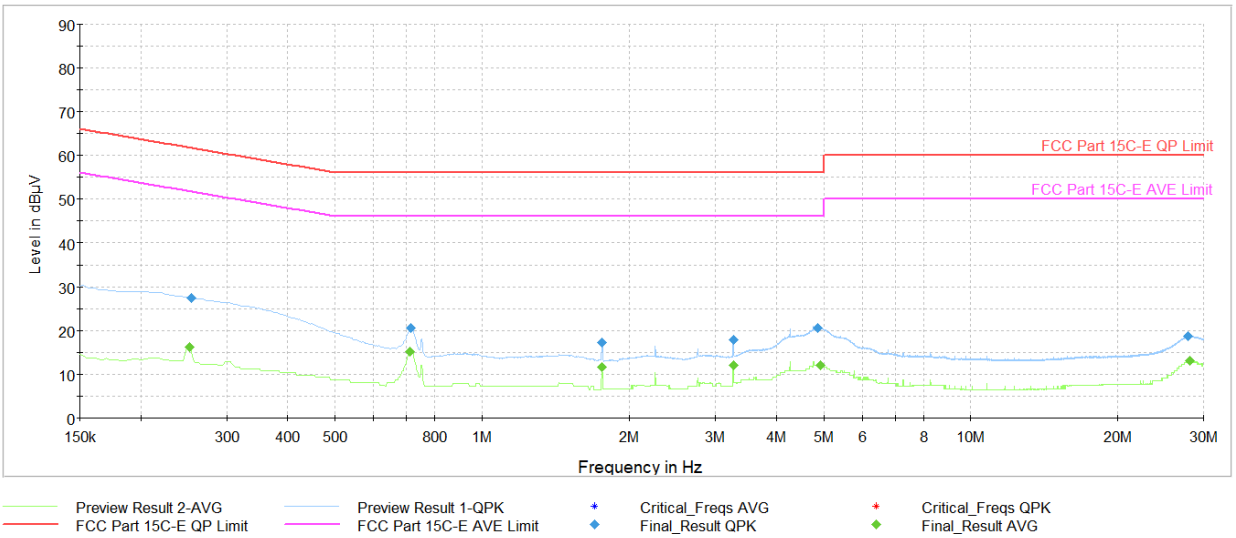


Figure 7-8. Test Instrument & Measurement Setup

Test Notes

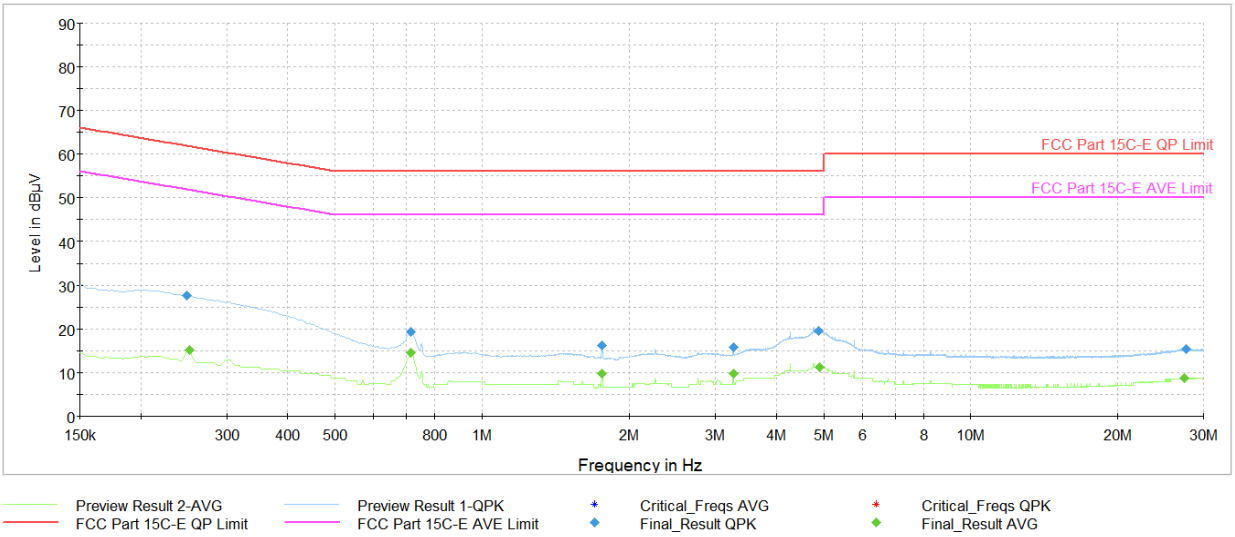
1. All modes of operation were investigated and the worst-case emissions are reported. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in Part 15.207 and RSS-Gen(8.8).
3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dBμV) = QP/AV Analyzer/Receiver Level (dBμV) + Corr. (dB)
5. Margin (dB) = QP/AV Level (dBμV) - QP/AV Limit (dBμV)
6. The unit was tested with all possible modes and only the highest emissions are reported.
7. Traces shown in plot are made using quasi-peak and average detectors.
8. Deviations to the Specifications: None.



Plot 7-62. AC Line Conducted Emission with 802.11n UNII Band 3 – Ch.165 (L1 with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.251	FINAL	—	16.25	51.72	-35.47	L1	GND
0.254	FINAL	27.5	—	61.64	-34.17	L1	GND
0.713	FINAL	—	15.20	46.00	-30.80	L1	GND
0.715	FINAL	20.6	—	56.00	-35.45	L1	GND
1.754	FINAL	17.4	—	56.00	-38.62	L1	GND
1.754	FINAL	—	11.68	46.00	-34.32	L1	GND
3.260	FINAL	—	12.16	46.00	-33.84	L1	GND
3.260	FINAL	17.8	—	56.00	-38.16	L1	GND
4.848	FINAL	20.5	—	56.00	-35.48	L1	GND
4.911	FINAL	—	12.15	46.00	-33.85	L1	GND
27.825	FINAL	18.7	—	60.00	-41.34	L1	GND
28.156	FINAL	—	13.18	50.00	-36.82	L1	GND

Table 7-32: AC Line Conducted Emission with 802.11n UNII Band 3 – Ch.165 (L1 with AC/DC Adapter)



Plot 7-63. AC Line Conducted Emission with 802.11n UNII Band 3 – Ch.165 (N with AC/DC Adapter)

Frequency [MHz]	Process State	QuasiPeak [dBµV]	Average [dBµV]	Limit [dBµV]	Margin [dB]	Line	PE
0.249	FINAL	27.6	—	61.79	-34.15	N	GND
0.251	FINAL	—	15.13	51.72	-36.59	N	GND
0.715	FINAL	19.4	—	56.00	-36.58	N	GND
0.715	FINAL	—	14.59	46.00	-31.41	N	GND
1.754	FINAL	—	9.78	46.00	-36.22	N	GND
1.757	FINAL	16.2	—	56.00	-39.77	N	GND
3.260	FINAL	—	9.84	46.00	-36.16	N	GND
3.260	FINAL	15.9	—	56.00	-40.15	N	GND
4.884	FINAL	19.5	—	56.00	-36.49	N	GND
4.891	FINAL	—	11.31	46.00	-34.69	N	GND
27.362	FINAL	—	8.65	50.00	-41.35	N	GND
27.598	FINAL	15.3	—	60.00	-44.68	N	GND

Table 7-33: AC Line Conducted Emission with 802.11n UNII Band 3 – Ch.165 (N with AC/DC Adapter)

8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **Apple Smart Speaker FCC ID: BCG-A2374** is in compliance with Part 15 Subpart E (15.407) of the FCC Rules and RSS-247 of the Innovation, Science and Economic Development Canada Rules.