NVLAP
Testing
NVLAP Lab Code 200087-0

Application For Grant of Certification

FOR

Model: A03653
5180-5240, and 5745-5825 MHz (U-NII)
Unlicensed National Information Infrastructure (U NII) and
License-Exempt Local Area Network (LE-LAN) Devices

FCC ID: IPH-03653
IC: 1792A-03653

FOR

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

FCC Designation: US5305
IC Test Site Registration: 3041A-1

Test Report Number: 181029

Authorized Signatory: Scot D Rogers
Scot D. Rogers

NVLAP
Testing
NVLAP Lab Code 200087-0

ROGERS LABS, INC.
4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

Engineering Test Report For Grant of Certification Application

FOR

Unlicensed National Information Infrastructure (U-NII) and License-Exempt Local Area Network (LE-LAN) Devices 47 CFR, Part 15E 15.407 (New Rules) Industry Canada RSS-247 Issue 2

For

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

License-Exempt U-NII, Local Area Network equipment
U-NII-1 and U-NII-3 operation
Model: A03653

Frequency Range: 5180-5240, and 5745-5825 MHz
FCC ID: IPH-03653
IC: 1792A-03653

Test Date: October 29, 2018

Certifying Engineer: Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
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Revisions

Revision 1 Issued December 10, 2018

Foreword

The following information is submitted for consideration in obtaining Equipment Grants of Certification for License Exempt, Unlicensed National Information Infrastructure (U-NII) Intentional Radiator operating under 47 CFR Paragraph 15E (15.407), U-NII-1 and U-NII-3 new rules, 5180-5240, and 5745-5825 MHz bands, and Industry Canada RSS-GEN Issue 5, and RSS-247 Issue 2, LE-LAN transmitter.

Name of Applicant: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062

M/N: A03653

FCC ID: IPH-03653 Industry Canada ID: 1792A-03653

Frequency Range: 5180-5240 MHz and 5745-5825 MHz (U-NII-1 and U-NII-3 under new rules 15.407, 802.11a/n (20 MHz), n (40 MHz) and ac (80 MHz) channels) and limited transmitter operations per regulations for operation in Canada

Mode	Channel	Peak Power (W)	Average Power (W)	99% OBW (kHz)
U-NII-1a	20 MHz mode	0.132	0.020	18,269
U-NII-1n	20 MHz mode	0.155	0.019	18,269
U-NII-1n40	40 MHz mode	0.169	0.015	37,260
U-NII-1ac	80 MHz mode	0.173	0.014	76,442
U-NII-3a	20 MHz mode	0.212	0.023	18,365
U-NII-3n	20 MHz mode	0.219	0.022	18,365
U-NII-3n	40 MHz mode	0.227	0.021	37,981
U-NII-3ac	80 MHz mode	0.221	0.017	76,442

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Frequency Bands 15.205, RSS-GEN 8.10	-0.1	Complies
AC Line Conducted 15.207, RSS-GEN 7.2.4	-9.1	Complies
Radiated Emissions 15.209, RSS-GEN 7.2.5	-8.6	Complies
Harmonic Emissions per 15.407, RSS-247	-17.2	Complies
Power Spectral Density per 15.407, RS-247	-4.2	Complies

Equipment Tested

Equipment	Model / PN	Serial Number
EUT	A03653	40448
EUT#2	A03653	40492
USB Cable	320-00541-00	N/A
AC Adapter	362-00096-00	N/A
DC Power Cable	320-01296-0x	N/A
Laptop Computer	Latitude E6320	FCN03Q1
USB Printer	Dell 0N5819	5D1SL61
DC Adapter (GTM-70)	320-00683-20	N/A
DC Adapter (GTM-60)	320-00683-00	N/A
DC Adapter (GTM-36)	320-00422-80	N/A
DC Adapter (BC-30)	320-00922-0x	N/A
DC Adapter (FMI-75)	010-12375-70	N/A

Software Version: 1.25

Test results in this report relate only to the items tested

Equipment Function and Configuration

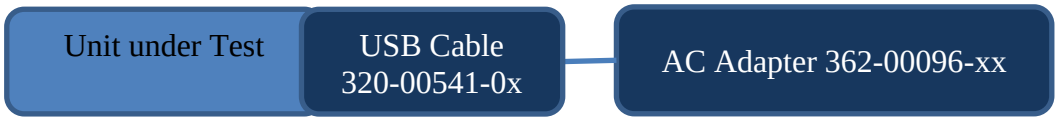
The EUT is a GPS receiver and display unit providing GPS reception and graphical display of location, navigation, and other information for the user. The GPS design offers use as a hand-held, transportation mounted or portable configuration for use in navigational applications. The design offers cabled and wireless interface capabilities for use with compatible equipment and installations. The design incorporates transmitter circuitries operating in the 2402-2480 MHz, 5150-5250 MHz and 5725-5850 MHz bands. The EUT provides a single USB interface port for cabled communications and power for operation and internal battery recharge.

The transmitters designs provide low power operation across the 2402-2480 MHz band, higher power Digital Transmission System operation in reduced frequency band of 2412-2462 MHz, and License-Exempt, Unlicensed National Information Infrastructure (U-NII), Local Area Network Transmission System operation in the U-NII-1 band 5180-5240 MHz, and U-NII-3 band 5745-5825 MHz. Low power operating modes include Bluetooth® Basic Rate (GFSK), 2EDR (PI/4 DQPSK), 3EDR (8DPSK), and BLE (GMSK). Digital Transmission systems in the 2412-2462 MHz operation using 802.11b,g,n modulations and U-NII operation using 802.11a/n/ac modulations in the 5 GHz band. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. The EUT offers no other interface connections than those in the configuration options shown below as described by the manufacturer. The EUT operates from internal battery or external power received from compatible installations. For testing purposes, the EUT received powered from internal battery and/or external AC or DC supply and support equipment. During testing, the test system was configured to operate in manufacturer defined modes. Some configurations presented below are not applicable for this report and have been tested and documented in other relevant documentation. Two samples were provided for testing, one representative of production hardware design, and the other modified for testing purposes replacing the integral antennas with RF connection ports. The antenna modification offered testing facility the ability to connect test equipment to the temporary antenna port for antenna port conducted emission testing. The test samples were provided with test software enabling testing personnel the ability to enable transmitter functions on defined channels and modes. As requested by the manufacturer and required by regulations, the equipment was tested for emissions compliance using the available configurations with the worst-case data presented. Test results in this report relate only to the products described in this report.

Equipment Configuration

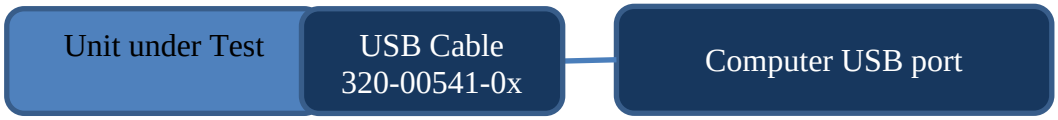
1) Unit operating off internal battery

2) Unit connected to (and powered by) AC adapter through USB cable (GPN: 320-00541-00)



3) Unit connected to DC power cable (GPN: 320-01296-0x)

4) Unit connected to Computer USB port through cable assembly (GPN: 320-00541-00/02)



5) Unit connected to (GTM-70; 320-00683-20, GTM-60; 320-00683-00, GTM-36; 320-00422-80)

6) Unit connected to BC-30 cable assembly (GPN: 320-00922-xx)

7) Unit connected to FMI cable assembly (GPN: 010-12375-00)

Applicant Company information

Applicants Company	Garmin International, Inc.
Applicants Address	1200 East 151st Street, Olathe, KS 66062
FCC Identifier	IPH-03653
Industry Canada Identifier	1792A-03653
Manufacturer Company	Garmin International, Inc.
Manufacturer Address	1200 East 151st Street, Olathe, KS 66062

Equipment information

Product Marketing Name (PMN): The PMN is the name or model number under which the product will be marketed/offered for sale in Canada. If the product has PMN, it must be provided.	A03653
Unique Product Number (UPN): The applicant made up of a maximum of 11 alphanumeric characters (A-Z, 0-9), assigns the UPN.	A03653
Hardware Version Identification Number (HVIN): The HVIN identifies hardware specifications of a product version. The HVIN replaces the ISED Model Number in the legacy E-filing System. An HVIN is required for all products for certification applications.	A03653
Host Marketing Name (HMN) (if applicable): The HMN is the name or model number of a final product, which contains a certified radio module.	
Brand Name	
Model Number	A03653
Test Rule Part(s)	47 CFR 15E, 15.407, RSS-247
Test Frequency Range	5.15-5.25 and 5.725-5.85 GHz
Project Number	181029
Submission Type	FCC: Certification, IC: Certification

Product Details

Items	Description
Product Type	Single chain 5 GHz U-NII-1 and U-NII-3
Radio Type	Transceiver
Power Type	Internal Rechargeable Battery or External AC or DC Supply
Frequency Range	5150-5250 MHz / 5725-5850 MHz
Channel Number	Channels 36, 40, 44,149, 157, and 165 for 802.11a/n 20MHz bandwidth; Channels 38, 46, 151. And 159 for 802.11n40 40MHz bandwidth; and Channels 42 and 155 for 802.11 a/c 80MHz bandwidth
Carrier Frequencies	Please refer to 802.11 Standard for Carrier Frequencies
Antenna	Integrated antenna information Omni Directional PFIA (unity gain)
Communication Mode	Device provides 5 GHz, U-NII 1 and U-NII-3 operation
Beamforming Function	Without beamforming
Operating Mode	5150-5250 MHz (U-NII-1) and 5725-5825 MHz (U-NII-3)

Antenna and Bandwidth

Antenna	Number of TX chains		
Bandwidth Mode	20 MHz	40 MHz	80 MHz
IEEE 802.11a	Single Chain	Single Chain	N/A
IEEE 802.11n	Single Chain	Single Chain	N/A
IEEE 802.11ac	N/A	N/A	Single Chain

Application for Certification

(1) Manufacturer: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062

(2) Identification: M/N: A03653
FCC ID: IPH-03653 IC: 1792A-03653

(3) Instruction Book:
Refer to Exhibit for Instruction Manual.

(4) Description of Circuit Functions:
Refer to Exhibit of Operational Description.

(5) Block Diagram with Frequencies:
Refer to Exhibit of Operational Description.

(6) Report of Measurements:
Report of measurements follows in this Report.

(7) Photographs: Construction, Component Placement, etc.:
Refer to Exhibit for photographs of equipment.

(8) List of Peripheral Equipment Necessary for operation. The equipment operates from internal battery or direct current power provided from compatible power sources. The EUT offers single USB interface port for power and communications as presented in this filing.

(9) Transition Provisions of 47 CFR 15.37 are not requested.

(10) Not Applicable. The unit is not a scanning receiver.

(11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.

(12) The equipment is not software defined and this section is not applicable.

(13) Applications for certification of U-NII devices in the 5.15-5.35 GHz and the 5.47-5.85 GHz bands must include a high-level operational description of the security procedures that control the radio frequency operating parameters and ensure that unauthorized modifications cannot be made. The required information has been provided in Operational Description Exhibit filed with the application.

(14) Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used. This information is provided in this report and Test Setup Exhibits provided with the application filing.

Applicable Standards & Test Procedures

The following information is submitted in accordance with e-CFR dated October 29, 2018, Part 2, Subpart J, Part 15, Subpart 15E, Industry Canada RSS-GEN Issue 5, and RSS-247 Issue 2. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2013, KDB 789033 D02 General UNII Test Procedures New Rules v02r01, KDB 926956 v02, RSS-247 Issue 2, and RSS-GEN Issue 5.

Testing Procedures

AC Line Conducted Emission Test Procedure

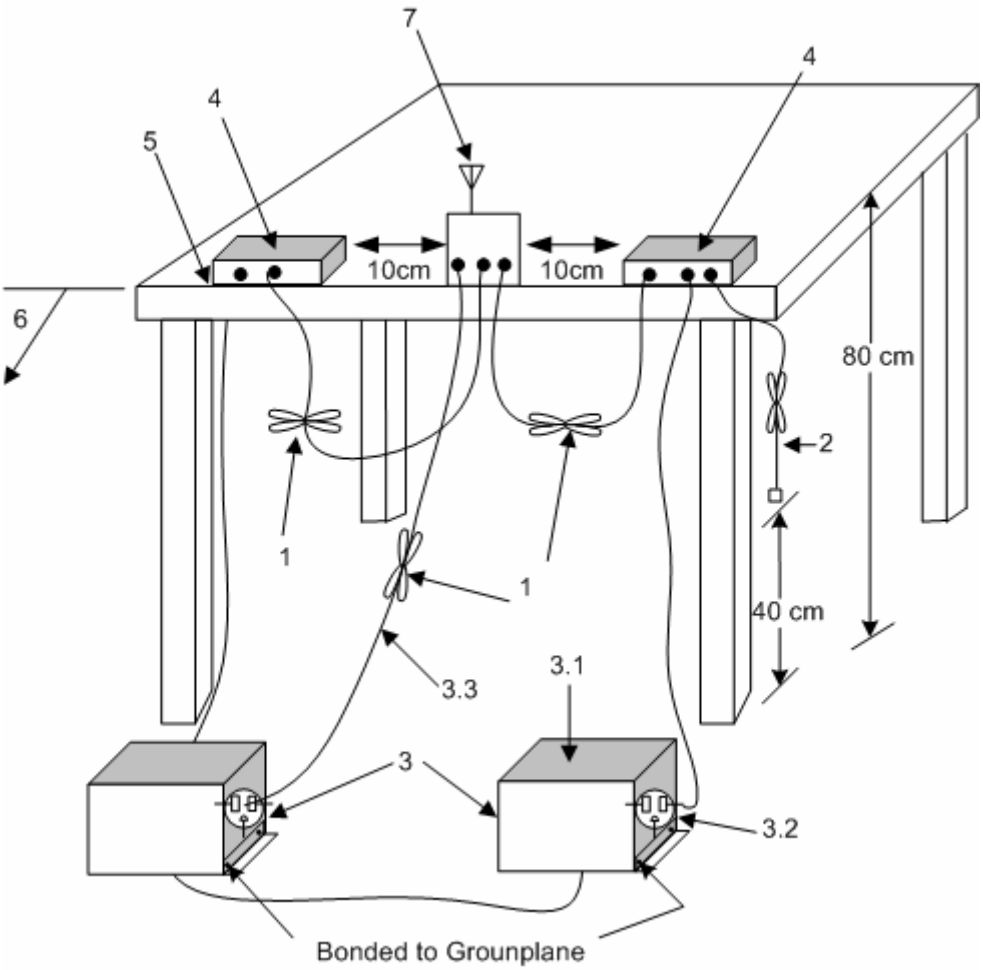
Testing for the AC line-conducted emissions was performed as defined in ANSI C63.10-2013. The test setup, including the EUT, was arranged in the test configurations as presented during testing. The test configuration was placed on a 1 x 1.5-meter bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50-µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table. Refer to diagram one showing typical test arrangement and photographs in exhibits for EUT placement used during testing.

Radiated Emission Test Procedure

Radiated emissions testing was performed as required in 47 CFR 15, RSS-247 and specified in ANSI C63.10-2013. The EUT was placed on a rotating 0.9 x 1.2-meter platform, elevated as required above the ground plane at a distance of 3 meters from the FSM antenna. EMI energy was maximized by equipment placement permitting orientation in three orthogonal axes, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken using a spectrum analyzer. The frequency spectrum from 9 kHz to 25,000 MHz was searched for during preliminary investigation. Refer to diagrams two and three showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.

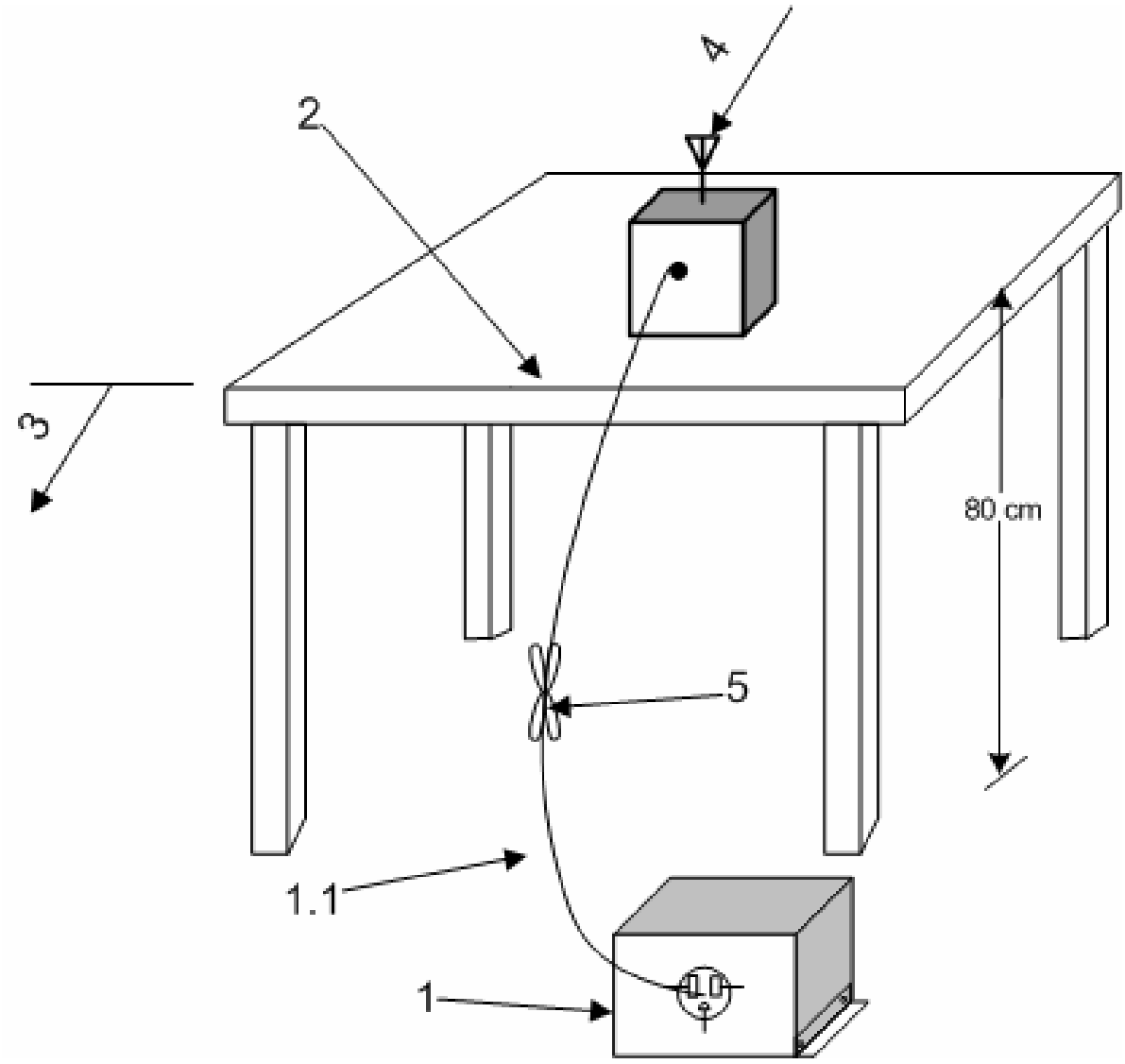
Antenna Port Conducted Emission Test Procedure

The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port Antenna Port conducted emissions testing was performed presented in the regulations and specified in ANSI C63.10-2013. Testing was completed on a laboratory bench in a shielded room. The active antenna port of the device was connected to appropriate attenuation and the spectrum analyzer. Refer to diagram four showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.



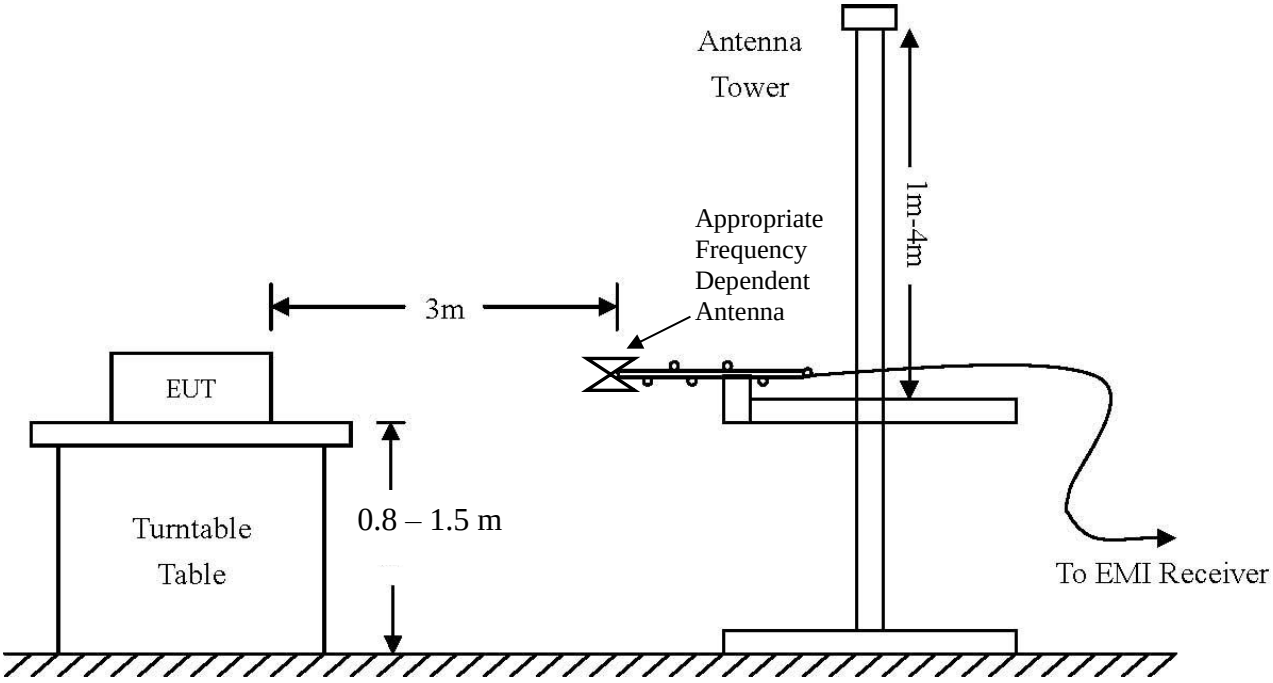
1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long see (see 6.2.3.1).
2. I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see 6.2.2).
3. EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN can be placed on top of, or immediately beneath, reference ground plane (see 6.2.2 and 6.2.3).
   3.1 All other equipment powered from additional LISN(s).
   3.2 Multiple-outlet strip can be used for multiple power cords of non-EUT equipment.
   3.3 LISN at least 80 cm from nearest part of EUT chassis.
4. Non-EUT components of EUT system being tested.
5. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.3.1).
6. Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see 6.2.2 for options).
7. Antenna may be integral or detachable. If detachable, the antenna shall be attached for this test.

Diagram 1 Test arrangement for Conducted emissions



1—A LISN is optional for radiated measurements between 30 MHz and 1000 MHz but not allowed for measurements below 30 MHz and above 1000 MHz (see 6.3.1). If used, then connect EUT to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. The LISN may be placed on top of, or immediately beneath, the reference ground plane (see 6.2.2 and 6.2.3.2).
1.1—LISN spaced at least 80 cm from the nearest part of the EUT chassis.
2—Antenna can be integral or detachable, depending on the EUT (see 6.3.1).
3—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long (see 6.3.1).
4—For emission measurements at or below 1 GHz, the table height shall be 80 cm. For emission measurements above 1 GHz, the table height shall be 1.5 m for measurements, except as otherwise specified (see 6.3.1 and 6.6.3.1).

Diagram 2 Test arrangement for radiated emissions of tabletop equipment



AC Line Conducted Emissions (0.150 -30 MHz)		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Emissions (30-1000 MHz)		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
Emissions (Above 1000 MHz)		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

Diagram 3 Test arrangement for radiated emissions tested on Open Area Test Site (OATS)

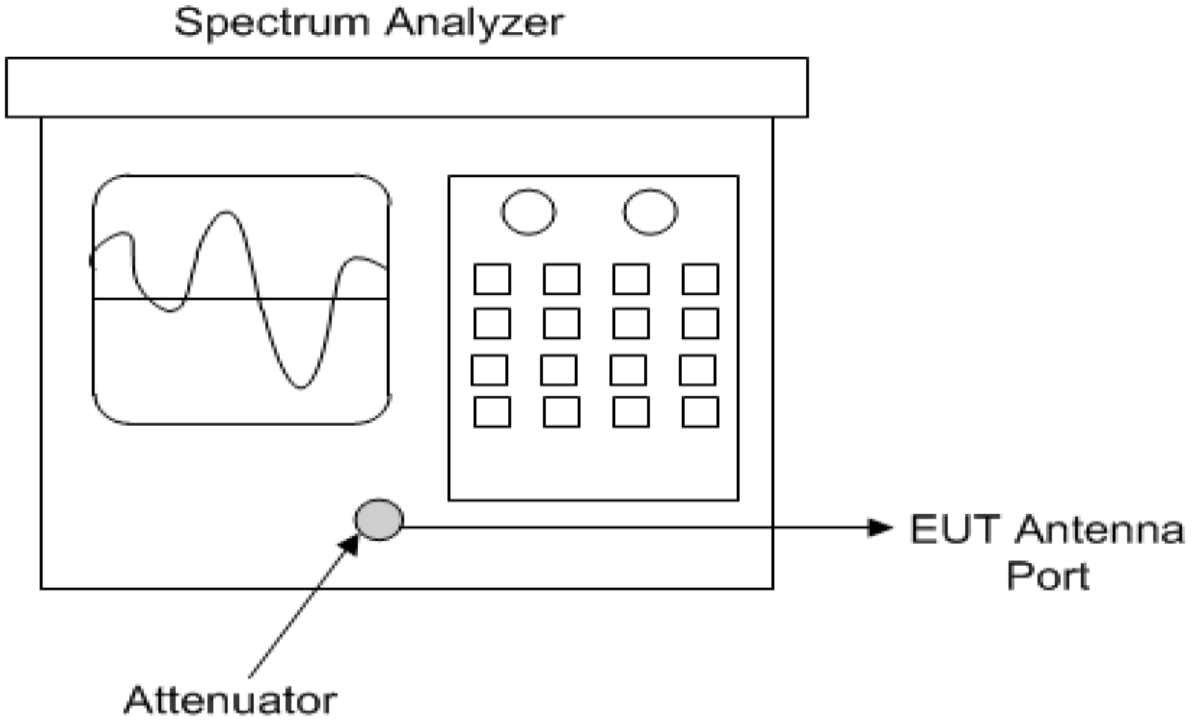


Diagram 4 Test arrangement for Antenna Port Conducted emissions

Test Site Locations

Conducted EMI	AC line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 West 259th Terrace, Louisburg, KS
Radiated EMI	The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 West 259th Terrace, Louisburg, KS
Registered Site #	FCC Site: US5305 and Industry Canada Registration: 3041A-1
NVLAP Accreditation	Lab code 200087-0

List of Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	5/2/2018	5/2/2019
☒ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126)	.15-30MHz	10/16/2018	10/16/2019
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/16/2018	10/16/2019
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/16/2018	10/16/2019
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303071)	9kHz-40 GHz	10/16/2018	10/16/2019
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
☒ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/16/2018	10/16/2019
☐ Antenna	EMCO	3147 (40582)	200-1000MHz	10/16/2018	10/16/2019
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/2/2018	5/2/2020
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/16/2018	10/24/2019
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/15/2017	5/15/2019
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/16/2018	10/16/2019
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/16/2018	10/16/2019
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/2/2018	5/2/2019
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	12/22/2017	12/22/2018
☒ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2019
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/16/2018	10/16/2019
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/16/2018	10/16/2019
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/16/2018	10/16/2019
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/16/2018	10/16/2019
☒ Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	5/2/2018	5/2/2019
☐ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	5/2/2018	5/2/2019
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ Attenuator	Fairview	SA6NFNF100W-14 (1625)	30-1800 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (14362)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (14452)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	JFW Industries	50FH-010-10 (1)	30-18000 MHz	5/2/2018	5/2/2019
☒ Weather station	Davis	6312 (A81120N075)		10/26/2018	10/26/2019

Units of Measurements

Conducted EMI Data is in dBµV; dB referenced to one microvolt

Radiated EMI Data is in dBµV/m; dB/m referenced to one microvolt per meter

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured
A.F. = Receive antenna factor, Gain = amplification gains and/or cable losses
RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB) - Gain (dB)

Environmental Conditions

Ambient Temperature 20.9° C

Relative Humidity 35%

Atmospheric Pressure 1017.9 mb

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the 47 CFR Part 15C, RSS-Gen, and RSS-247 emission requirements. There were no deviations to the specifications.

Intentional Radiators

The following information is submitted in support demonstration of compliance with the requirements of 47 CFR, Subpart C, paragraph 15.247 and Industry Canada RSS-247 and RSS-Gen the following information is submitted.

Antenna Requirements

The EUT incorporates integral antenna system and offers no provision for connection to alternate antenna system. The antenna connection point complies with the unique antenna connection requirements. There are no deviations or exceptions to the specification.

Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Test procedures of ANSI C63.10-2013 were used during testing. No other significant emission was observed which fell into the restricted bands of operation. Computed emission values consider the received radiated field strength, receive antenna correction factor, amplifier gain stage, and test system cable losses.

Table 1 Harmonic Radiated Emissions in Restricted Bands Data (802.11a)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
U-NII-1 Operation Worst-case							
5150.0	63.2	N/A	42.2	64.4	N/A	43.4	54.0
5350.0	53.4	N/A	40.0	54.5	N/A	41.0	54.0
15540.0	63.7	N/A	50.4	63.4	N/A	50.2	54.0
15600.0	60.1	N/A	47.0	59.3	N/A	46.7	54.0
15720.0	60.2	N/A	47.3	60.1	N/A	47.0	54.0
20720.0	59.6	N/A	46.8	60.0	N/A	46.8	54.0
20800.0	59.4	N/A	46.6	60.2	N/A	46.6	54.0
20960.0	60.1	N/A	46.6	59.1	N/A	46.6	54.0
U-NII-3 Operation Worst-case							
11490.0	60.8	N/A	48.3	61.2	N/A	48.4	54.0
11570.0	61.6	N/A	48.1	61.1	N/A	48.1	54.0
11650.0	62.2	N/A	48.3	61.1	N/A	48.3	54.0
22980.0	60.1	N/A	47.1	60.4	N/A	47.1	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range below 1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 2 Radiated Emissions in Restricted Bands Data (802.11n)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
U-NII-1 Operation Worst-case							
5150.0	63.3	N/A	42.2	64.6	N/A	43.1	54.0
5350.0	52.5	N/A	39.4	54.3	N/A	41.4	54.0
15540.0	60.3	N/A	47.2	59.5	N/A	46.8	54.0
15600.0	60.5	N/A	47.1	59.6	N/A	46.7	54.0
15720.0	60.1	N/A	47.3	60.5	N/A	47.5	54.0
20720.0	59.5	N/A	46.5	60.2	N/A	46.7	54.0
20800.0	59.7	N/A	46.6	59.6	N/A	46.7	54.0
20960.0	59.6	N/A	46.6	59.4	N/A	46.7	54.0
U-NII-3 Operation Worst-case							
11490.0	61.1	N/A	48.4	61.6	N/A	48.7	54.0
11570.0	60.6	N/A	48.0	61.8	N/A	48.3	54.0
11650.0	61.5	N/A	48.2	61.6	N/A	48.6	54.0
22980.0	59.6	N/A	47.1	60.4	N/A	47.1	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range below 1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 3 Radiated Emissions in Restricted Bands Data (802.11n40)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
U-NII-1 Operation Worst-case							
5150.0	69.1	N/A	46.9	74.0	N/A	53.9	54.0
5350.0	52.3	N/A	38.8	54.3	N/A	40.8	54.0
15570.0	63.5	N/A	50.5	63.9	N/A	50.4	54.0
15690.0	63.5	N/A	50.1	63.2	N/A	50.2	54.0
20760.0	60.1	N/A	46.9	60.1	N/A	47.0	54.0
20920.0	59.2	N/A	46.6	59.6	N/A	46.5	54.0
U-NII-3 Operation Worst-case							
11510.0	61.2	N/A	47.9	61.0	N/A	47.9	54.0
11590.0	61.5	N/A	48.4	61.4	N/A	48.6	54.0
23180.0	60.4	N/A	47.3	60.7	N/A	47.3	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range below 1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 4 Radiated Emissions in Restricted Bands Data (802.11ac)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
U-NII-1 Operation Worst-case							
5150.0	65.0	N/A	45.2	72.9	N/A	50.6	54.0
5350.0	52.2	N/A	38.7	53.3	N/A	39.9	54.0
15630.0	60.5	N/A	47.9	61.5	N/A	47.9	54.0
20840.0	60.2	N/A	46.7	59.8	N/A	46.6	54.0
U-NII-3 Operation Worst-case							
11550.0	61.1	N/A	47.9	61.2	N/A	48.0	54.0
23100.0	59.9	N/A	47.2	60.2	N/A	47.2	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range below 1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the emissions requirements of 47 CFR 15.205, RSS-GEN Issue 5, and RSS-247 Issue 2. The EUT provided a worst-case minimum margin of -0.1 dB below the emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

AC Line Conducted EMI Procedure

The EUT was arranged in typical equipment configurations as offered by manufacturer and presented above in equipment configuration. AC Line Conducted emission testing was performed with the EUT placed on a 1 x 1.5-meter bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. Testing for the AC line-conducted emissions followed the procedures of ANSI C63.10-2013. The EUT was configured as presented in the AC Line conducted configurations as directed by the manufacture and presented above in equipment configuration. The AC adapter for the EUT was connected to the LISN for AC line-conducted emissions testing. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the test configuration. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor, internal to the LISN. Power line conducted emissions testing was carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequencies of each of the emissions, which demonstrated the highest amplitudes. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz and data recorded.

Refer to figures one and two showing plots of the AC Adapter configuration worst-case line conducted emissions. Refer to figures three and four for plots of the EUT – USB Computer interface AC Line conducted emissions.

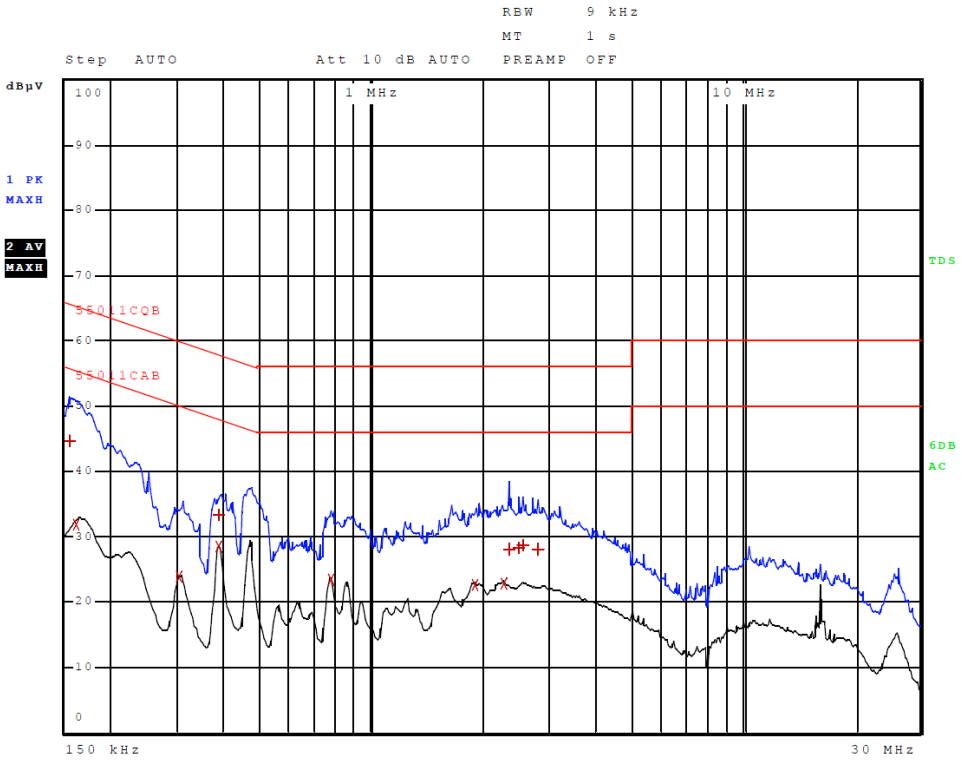


Figure 1 AC Line Conducted emissions of EUT line 1 (#2, EUT – 362-00096-00)

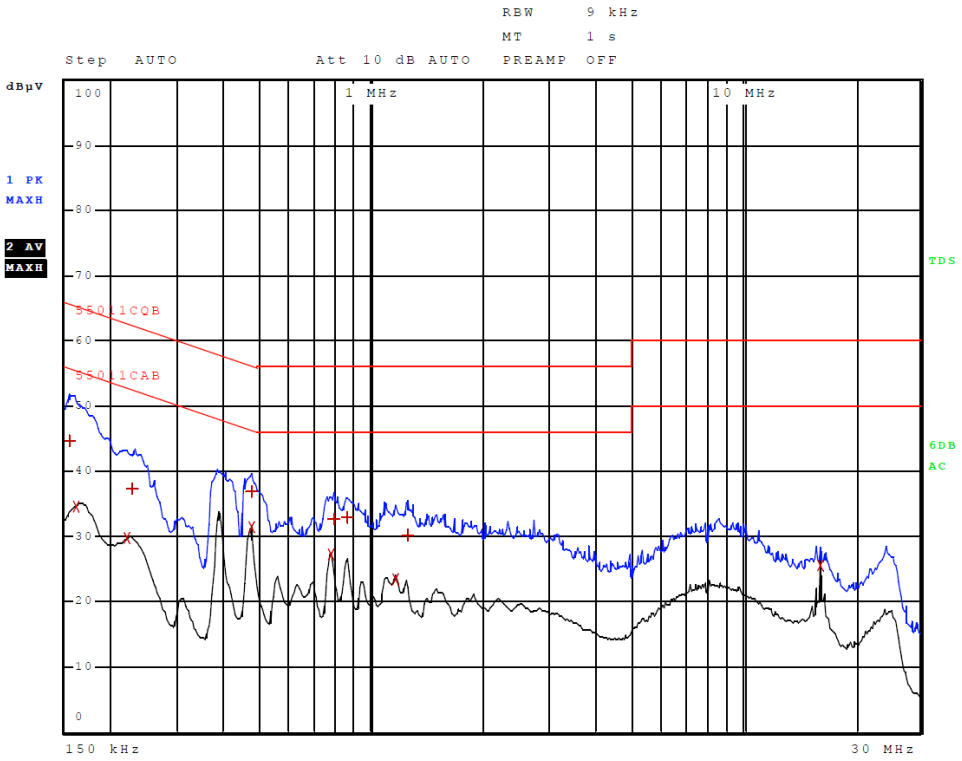


Figure 2 AC Line Conducted emissions of EUT line 2 (#2, EUT – 362-00096-00)

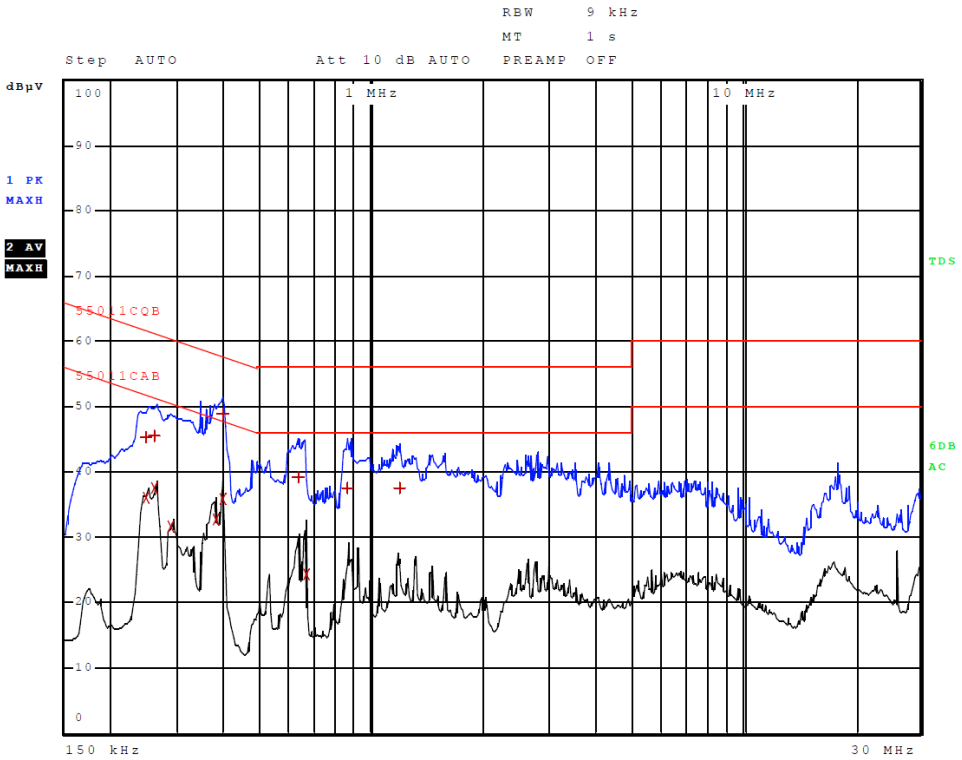


Figure 3 AC Line Conducted emissions of EUT line 1 (#4, EUT – Computer)

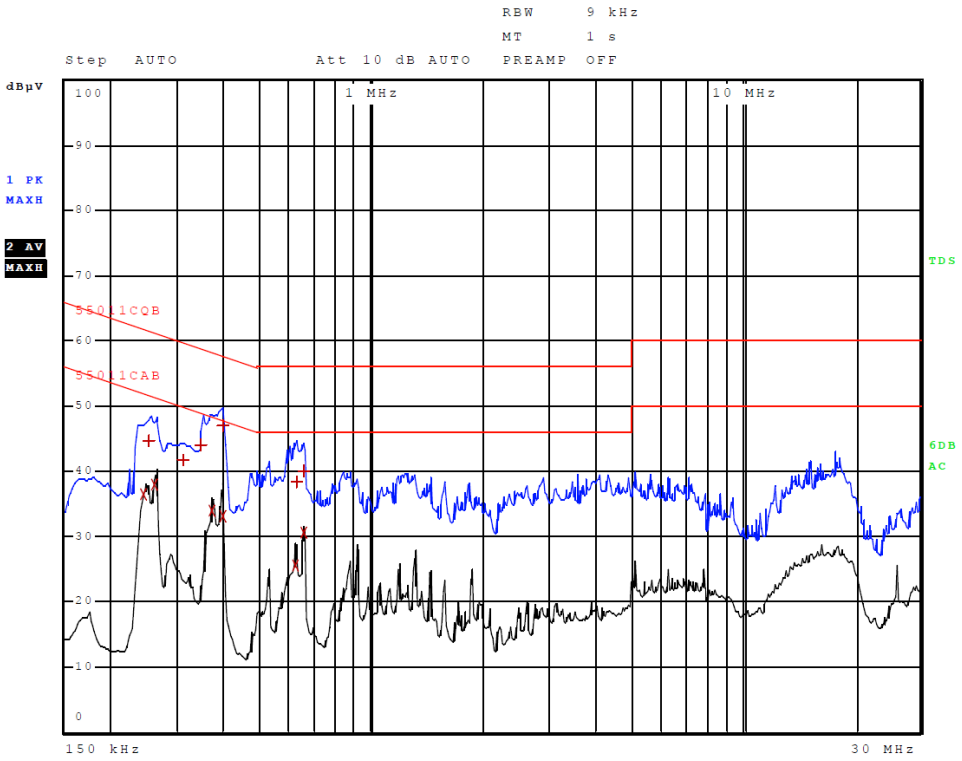


Figure 4 AC Line Conducted emissions of EUT line 2 (#4, EUT – Computer)

Table 5 AC Line Conducted Emissions Data L1 (#2, EUT – 362-00096-00)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	154.000000000 kHz	44.65	Quasi Peak	-21.13
2	162.000000000 kHz	31.76	Average	-23.60
2	306.000000000 kHz	23.80	Average	-26.28
2	386.000000000 kHz	28.56	Average	-19.59
1	390.000000000 kHz	33.30	Quasi Peak	-24.76
2	778.000000000 kHz	23.39	Average	-22.61
2	1.898000000 MHz	22.54	Average	-23.46
2	2.258000000 MHz	22.84	Average	-23.16
1	2.342000000 MHz	27.99	Quasi Peak	-28.01
1	2.498000000 MHz	28.17	Quasi Peak	-27.83
1	2.550000000 MHz	28.63	Quasi Peak	-27.37
1	2.798000000 MHz	28.11	Quasi Peak	-27.89

Other emissions present had amplitudes at least 20 dB below the limit.

Table 6 AC Line Conducted Emissions Data L2 (#2, – 362-00096-00)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	154.000000000 kHz	44.69	Quasi Peak	-21.09
2	162.000000000 kHz	34.65	Average	-20.71
2	222.000000000 kHz	29.83	Average	-22.92
1	230.000000000 kHz	37.32	Quasi Peak	-25.13
2	470.000000000 kHz	31.50	Average	-15.02
1	474.000000000 kHz	36.82	Quasi Peak	-19.63
2	774.000000000 kHz	27.24	Average	-18.76
1	786.000000000 kHz	32.72	Quasi Peak	-23.28
1	858.000000000 kHz	32.88	Quasi Peak	-23.12
2	1.158000000 MHz	23.37	Average	-22.63
1	1.250000000 MHz	30.19	Quasi Peak	-25.81
2	16.164000000 MHz	25.58	Average	-24.42

Other emissions present had amplitudes at least 20 dB below the limit.

Table 7 AC Line Conducted Emissions Data L1 (#4, EUT – Computer)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	250.000000000 kHz	45.35	Quasi Peak	-16.41
2	250.000000000 kHz	36.07	Average	-15.69
2	262.000000000 kHz	37.46	Average	-13.91
1	262.000000000 kHz	45.53	Quasi Peak	-15.83
2	290.000000000 kHz	31.63	Average	-18.90
2	378.000000000 kHz	32.70	Average	-15.62
2	394.000000000 kHz	35.80	Average	-12.18
1	394.000000000 kHz	48.84	Quasi Peak	-9.14
1	630.000000000 kHz	39.22	Quasi Peak	-16.78
2	662.000000000 kHz	24.35	Average	-21.65
1	862.000000000 kHz	37.60	Quasi Peak	-18.40
1	1.182000000 MHz	37.50	Quasi Peak	-18.50

Other emissions present had amplitudes at least 20 dB below the limit.

Table 8 AC Line Conducted Emissions Data L2 (#4, EUT – Computer)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	246.000000000 kHz	36.46	Average	-15.43
1	254.000000000 kHz	44.66	Quasi Peak	-16.97
2	262.000000000 kHz	37.97	Average	-13.40
1	310.000000000 kHz	41.76	Quasi Peak	-18.21
1	350.000000000 kHz	43.93	Quasi Peak	-15.03
2	370.000000000 kHz	33.99	Average	-14.51
2	394.000000000 kHz	33.13	Average	-14.85
1	394.000000000 kHz	46.91	Quasi Peak	-11.07
2	622.000000000 kHz	25.62	Average	-20.38
1	626.000000000 kHz	38.27	Quasi Peak	-17.73
2	654.000000000 kHz	30.57	Average	-15.43
1	654.000000000 kHz	39.96	Quasi Peak	-16.04

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the AC Line Conducted Emissions requirements of 47 CFR Part 15C, RSS-247 and RSS-Gen. The EUT configurations #2 worst-case configuration demonstrated a minimum margin of -15.0 dB below the requirement. The EUT configuration #4 worst-case configuration demonstrated a minimum margin of -9.1 dB below the requirement. Other emissions were present with amplitudes at least 20 dB below the limit and worst-case amplitudes recorded.

General Radiated Emissions Procedure

The EUT was arranged in a typical equipment configuration and operated through all available mode during testing. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies, which produced the highest emissions. Each radiated emission was then maximized at the OATS location before final radiated measurements were performed. Final data was taken with the EUT located on the OATS at 3 meters distance between the EUT and the receiving antenna. The frequency spectrum from 9 kHz to 60,000 MHz was searched for general radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna position between horizontal and vertical polarization. Antennas used were Loop from 9 kHz to 30 MHz, Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 1000 MHz, Log Periodic from 200 MHz to 1 GHz and or double Ridge or pyramidal horns and mixers above 1 GHz, notch filters and appropriate amplifiers and external mixers were utilized.

Table 9 General Radiated Emissions Data

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
42.8	28.4	23.7	N/A	36.5	31.4	N/A	40.0
216.2	20.9	17.9	N/A	28.3	28.5	N/A	40.0
275.3	14.9	9.1	N/A	15.8	9.1	N/A	47.0
323.4	16.3	11.2	N/A	15.8	10.3	N/A	47.0
430.8	19.3	12.8	N/A	21.7	12.5	N/A	47.0
948.4	26.9	20.4	N/A	26.8	19.2	N/A	47.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded for frequency range below 1000 MHz. Peak and Average amplitude emissions are recorded for frequency range above 1000 MHz.

Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the radiated emissions requirements of 47 CFR part 15 and Industry Canada RSS-247 Issue 2 Intentional Radiators. The EUT demonstrated a minimum margin of -8.6 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Operation in the 5150-5250 and 5725-5850 MHz Frequency U-NII-1 and U-NII-3 Bands

Testing followed FCC 789033 D02 General U-NII Test Procedures New Rules v02r01.
The manufacturer provided a second test sample which provided direct connection to the antenna port. A power meter was used to measure fundamental transmitter output power. A spectrum analyzer / receiver was used to produce plots and make other antenna port conducted measurements for compliance testing. Test software was provided to operate the transmitter. This software provided the ability to set test channel, operational mode, and modulation scheme. The antenna port was connected to coaxial cable with 50-ohm attenuator and receiver, spectrum analyzer, or power meter during testing. The design was also tested for radiated emissions using sample #1 representative of production equipment. Radiated emissions testing was performed on the Open Area Test Site (OATS) with the transmitter operating. The test sample was placed on a turntable elevated as required above the ground plane as required at a 3 meters distance from the FSM antenna located on the OATS for testing radiated emissions. The peak and quasi-peak amplitude of the frequencies below 1000 MHz were measured using a spectrum analyzer. The peak and average amplitude of emissions above 1000 MHz were measured using a spectrum analyzer. Emissions data was recorded from the measurement results. Data presented reflects measurement result corrected to account for measurement system gains and losses. Plots were made of transmitter performance for reference and demonstration of compliance. In addition, all Manufacturers of U-NII devices are responsible for ensuring frequency stability such that the emissions are maintained within the band of operation under all conditions of normal operation as specified in the user's manual. The manufacturer has attested the equipment operates within the required frequency spectrum under normal operational conditions. This report documents emissions governed under the U-NII-1 and U-NII-3 bands operating in the 5180-5240 and 5745-5825 MHz frequency bands.

Per **15.407 Technical Requirements**

(a) power limitations

(1) For the Band 5.15-5.25 GHz

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1-megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

Per **RSS-247 Issue 2**

6. Technical requirements for license-exempt local area network devices and digital transmission systems operating in the 5 GHz band

This section provides standards for License-Exempt Local Area Network (LE-LAN) devices operating in the bands 5150-5250 MHz, 5250-5350 MHz, 5470-5600 MHz, 5650-5725 MHz and 5725-5850 MHz and for DTSs operating in the band 5725-5850 MHz that employ digital modulation technology but are not designed for LE-LAN operation.

Devices with occupied bandwidths which overlap different bands shall comply with all operational requirements for each band.

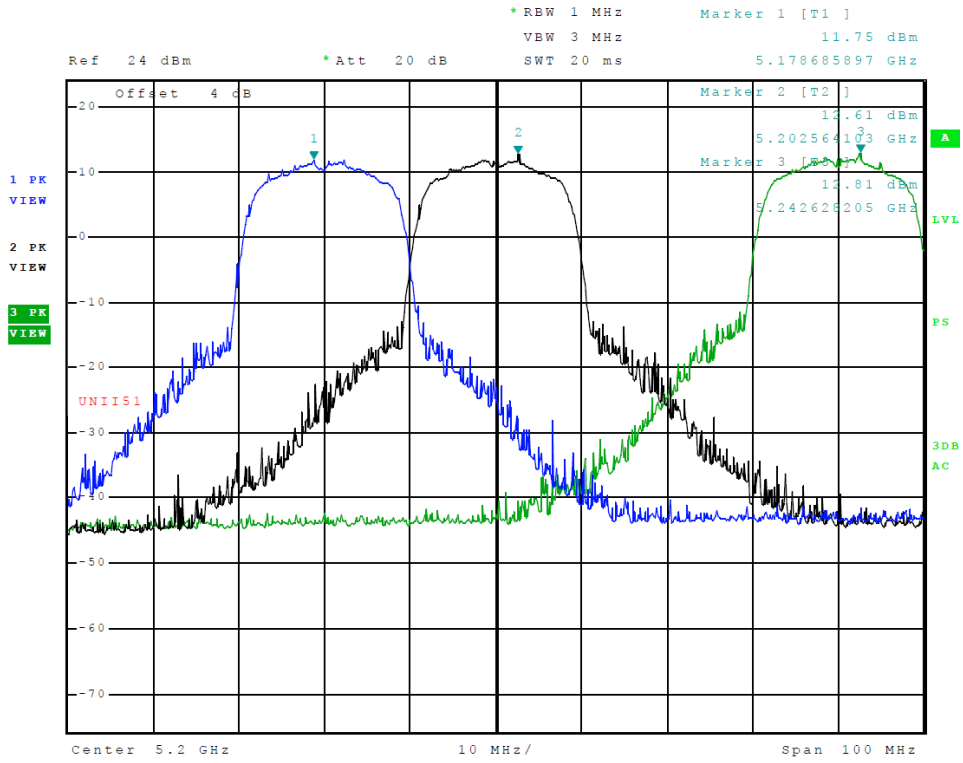


Figure 5 Plot of Transmitter Emissions (Across 5150-5250 MHz Band, 802.11a)

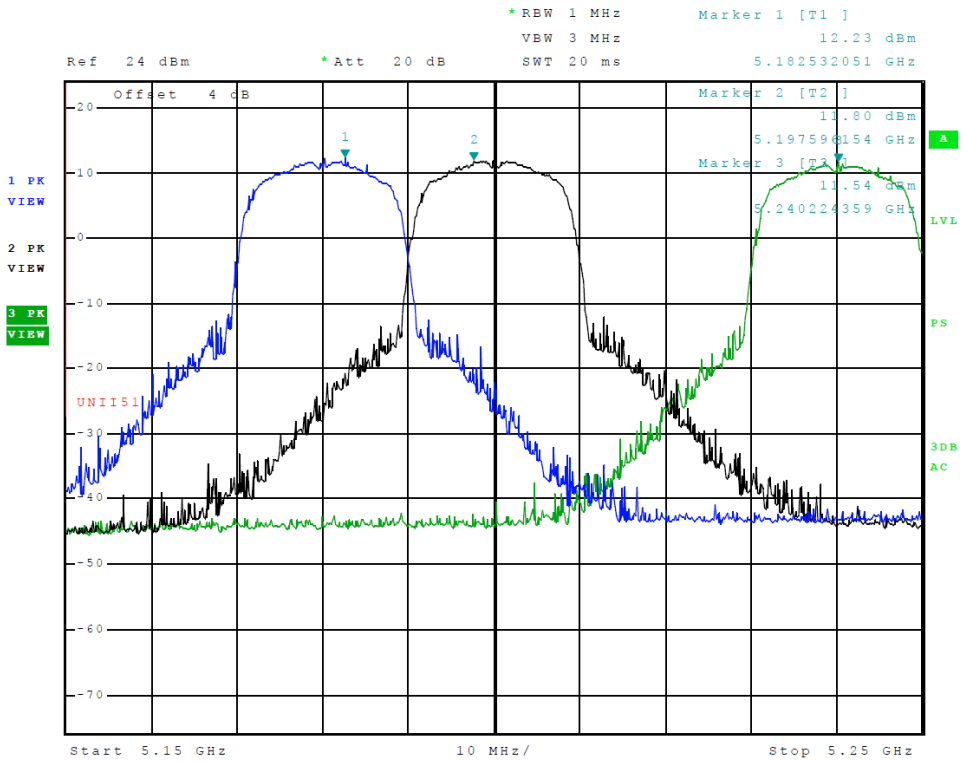


Figure 6 Plot of Transmitter Emissions (Across 5150-5250 MHz Band, 802.11n)

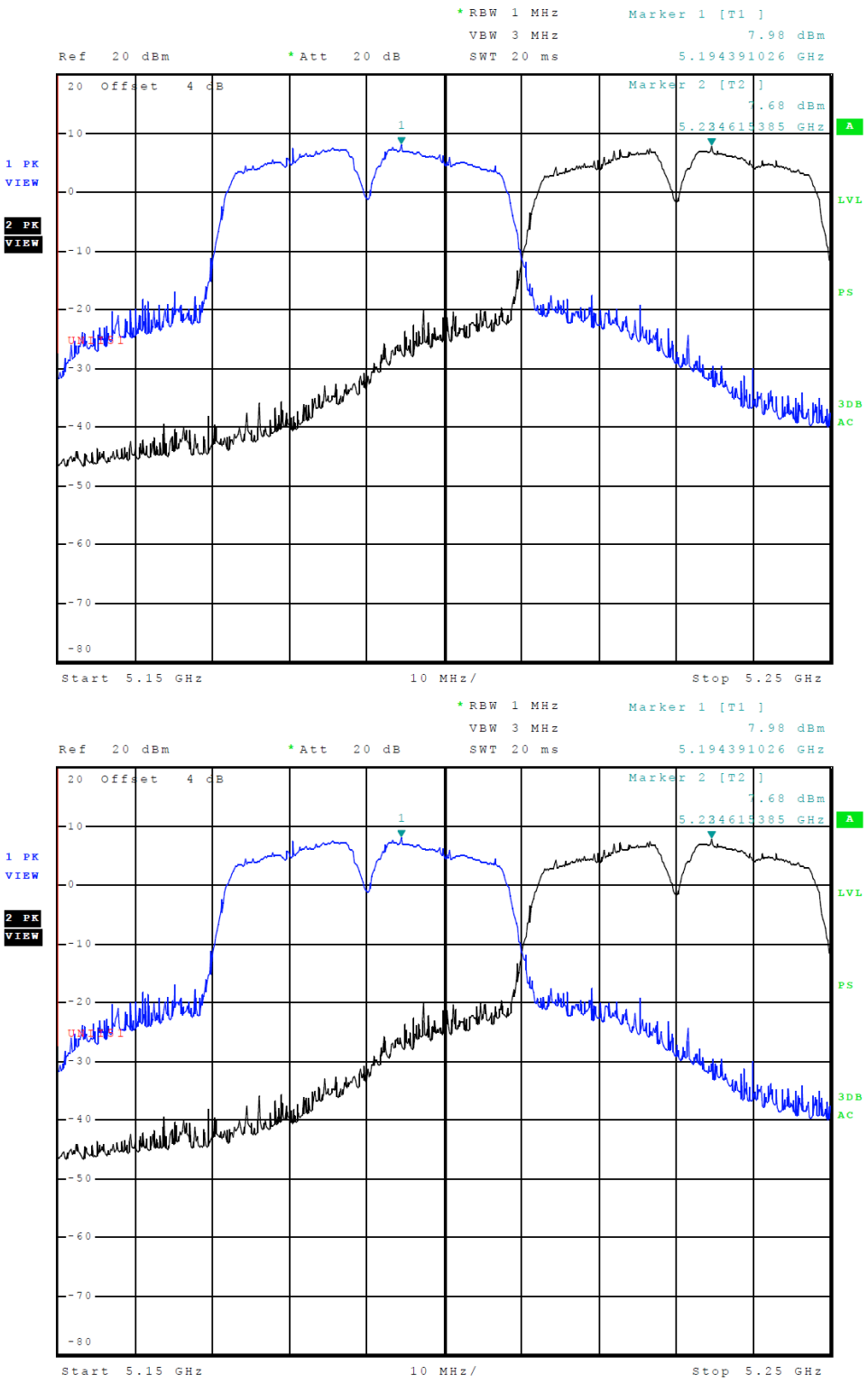


Figure 7 Plot of Transmitter Emissions (Across 5150-5250 MHz Band, 802.11n40)

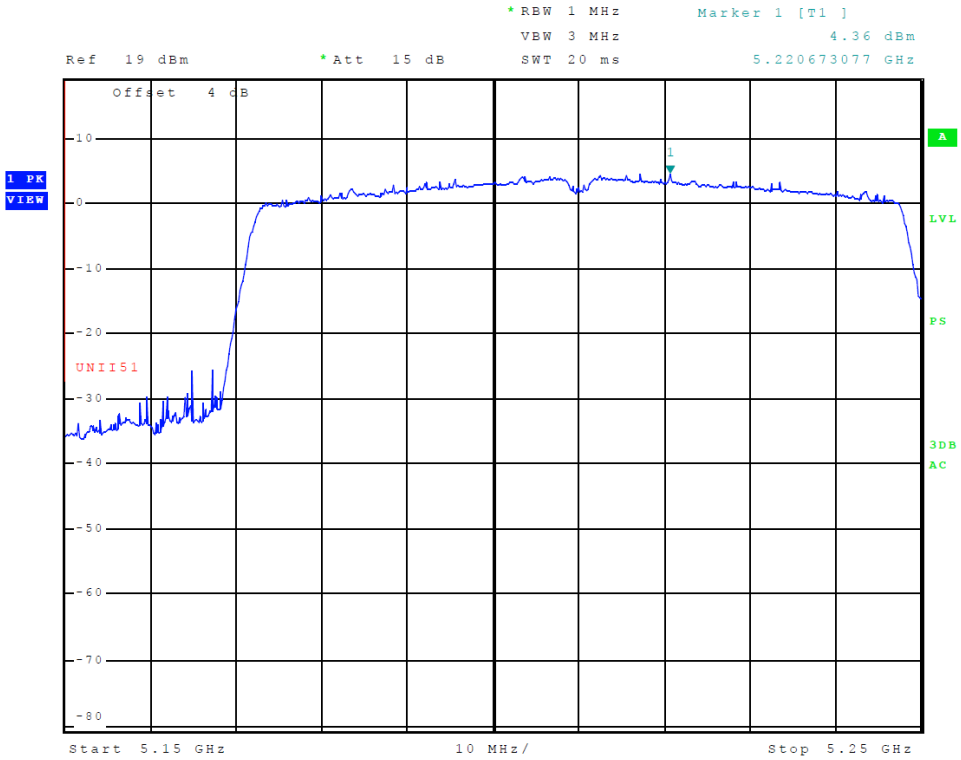


Figure 8 Plot of Transmitter Emissions (Across 5150-5250 MHz Band, 802.11ac)

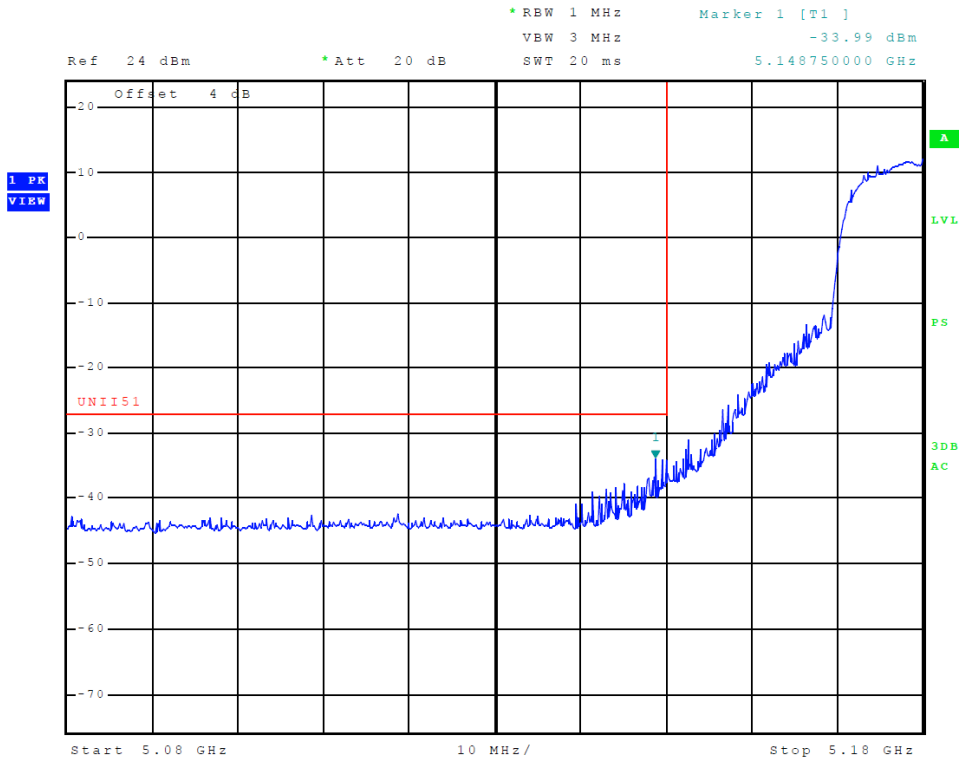


Figure 9 Plot of Lower Band Edge (Across 5150-5250 MHz Band, 802.11a)

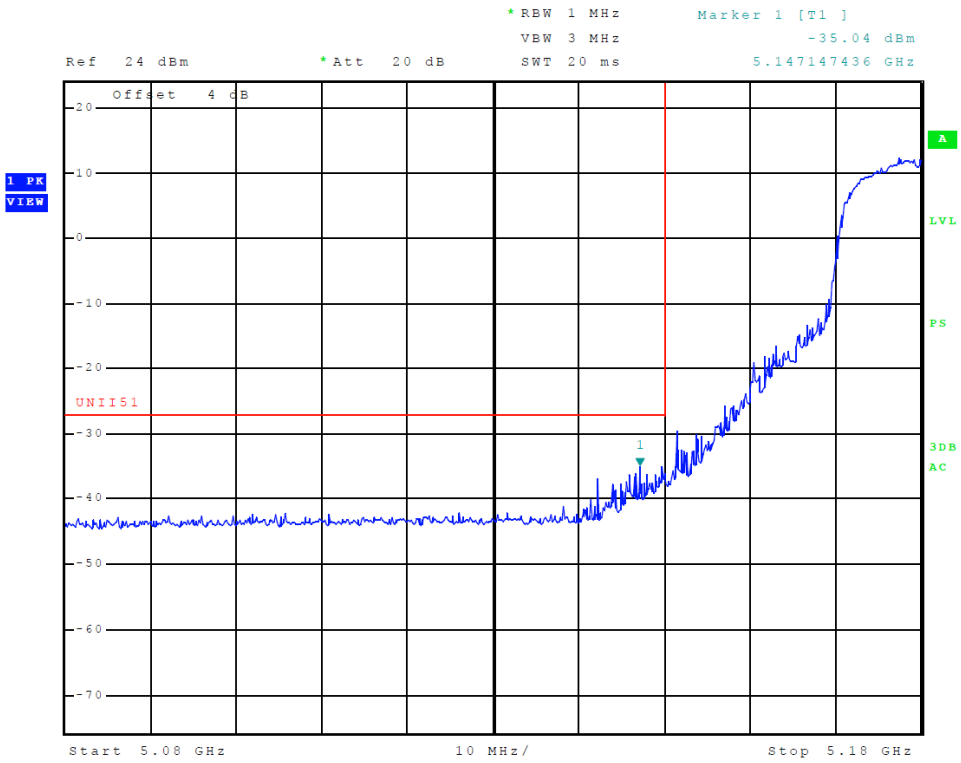


Figure 10 Plot of Lower Band Edge (Across 5150-5250 MHz Band, 802.11n)

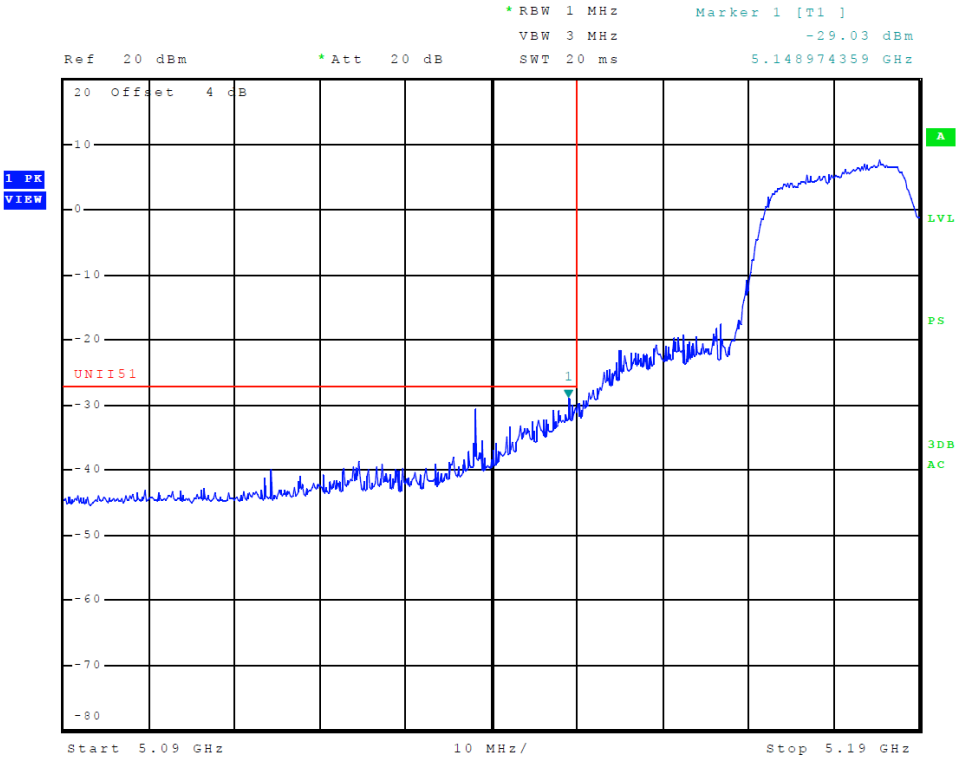


Figure 11 Plot of Lower Band Edge (Across 5150-5250 MHz Band, 802.11n40)

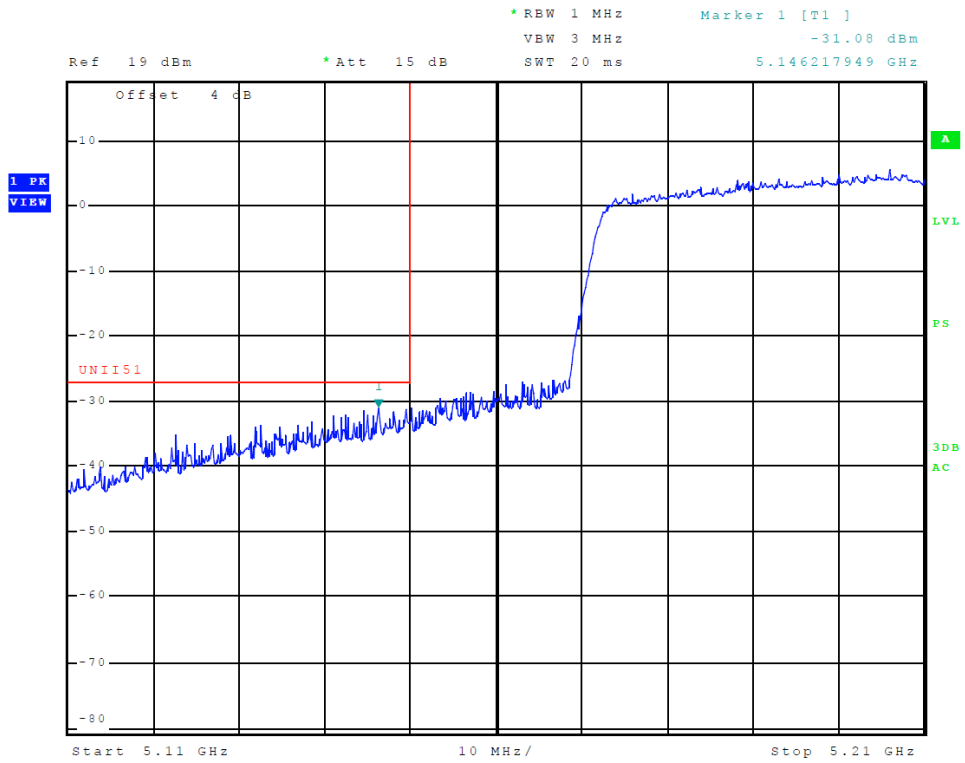


Figure 12 Plot of Lower Band Edge (Across 5150-5250 MHz Band, 802.11ac)

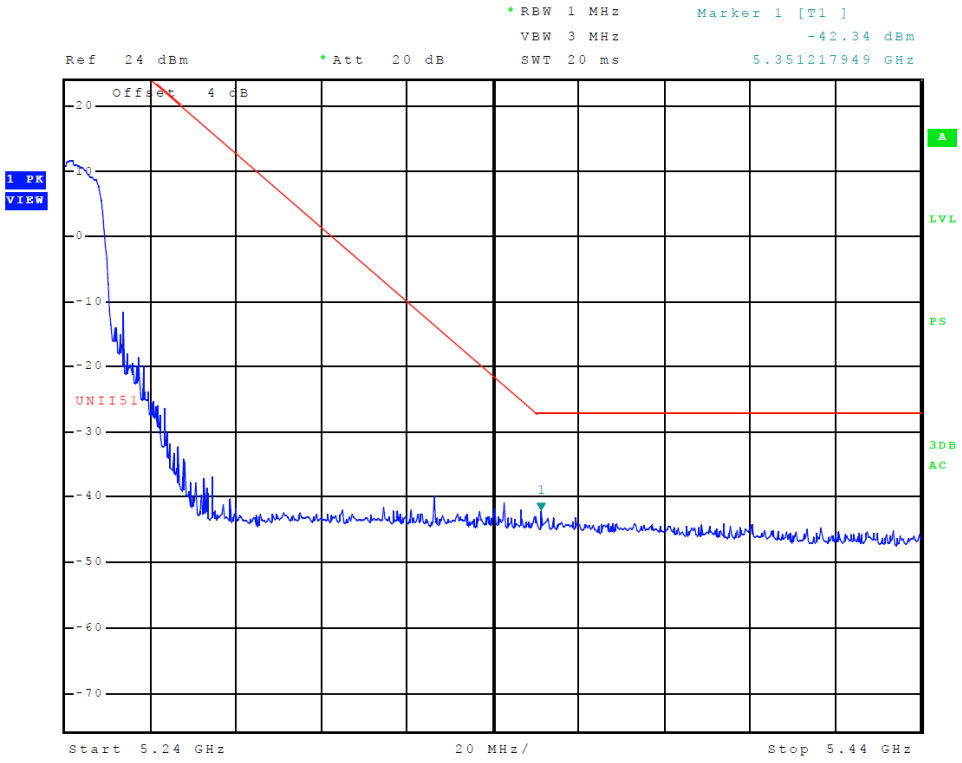


Figure 13 Plot of Upper Band Edge (Across 5150-5250 MHz Band, 802.11a)

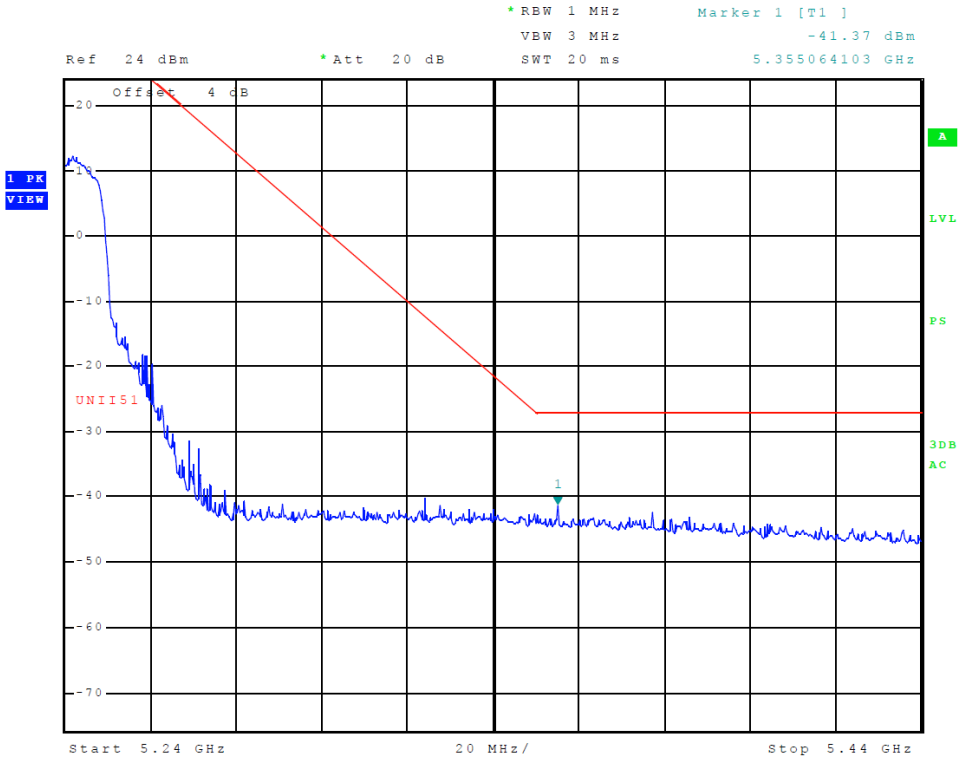


Figure 14 Plot of Upper Band Edge (Across 5150-5250 MHz Band, 802.11n)

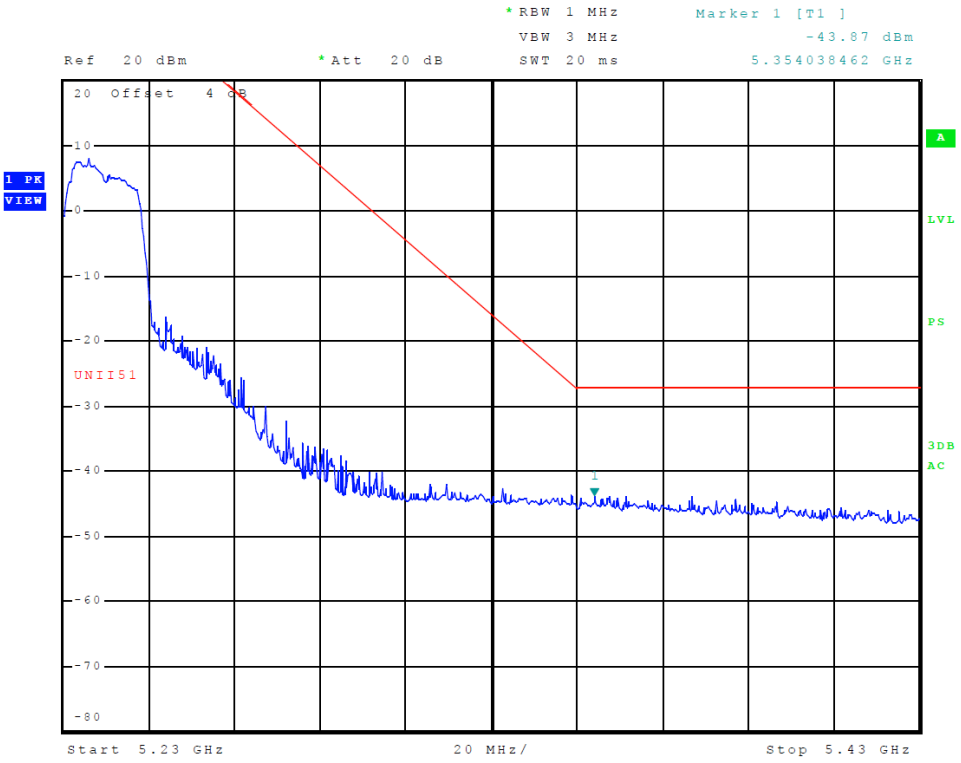


Figure 15 Plot of Upper Band Edge (Across 5150-5250 MHz Band, 802.11n40)

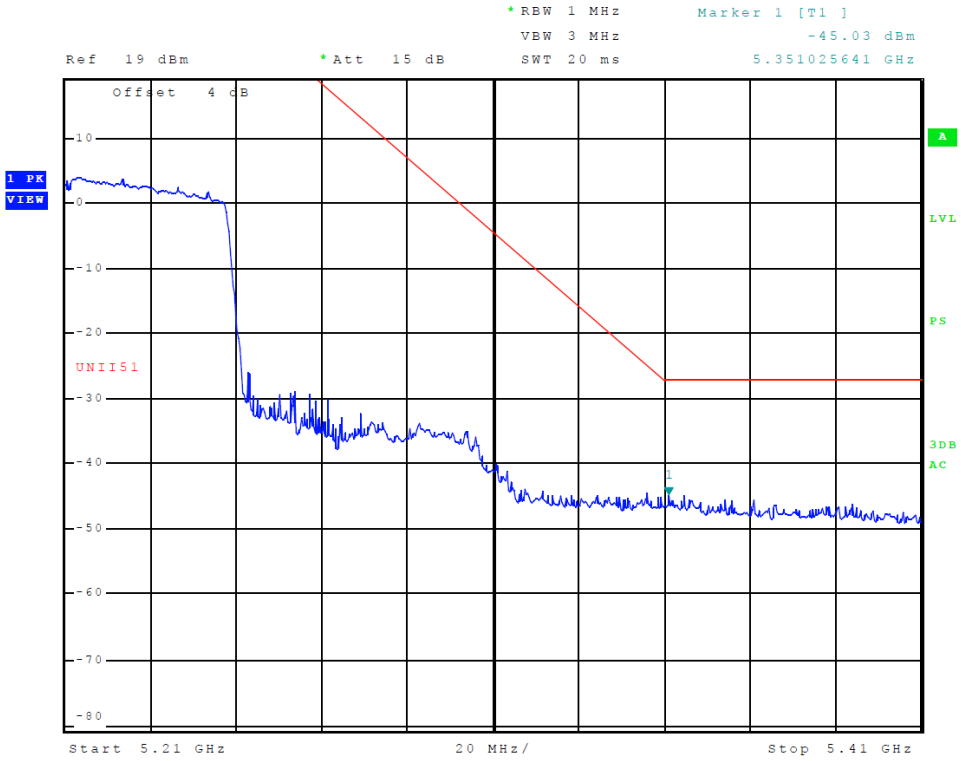


Figure 16 Plot of Upper Band Edge (Across 5150-5250 MHz Band, 802.11ac)

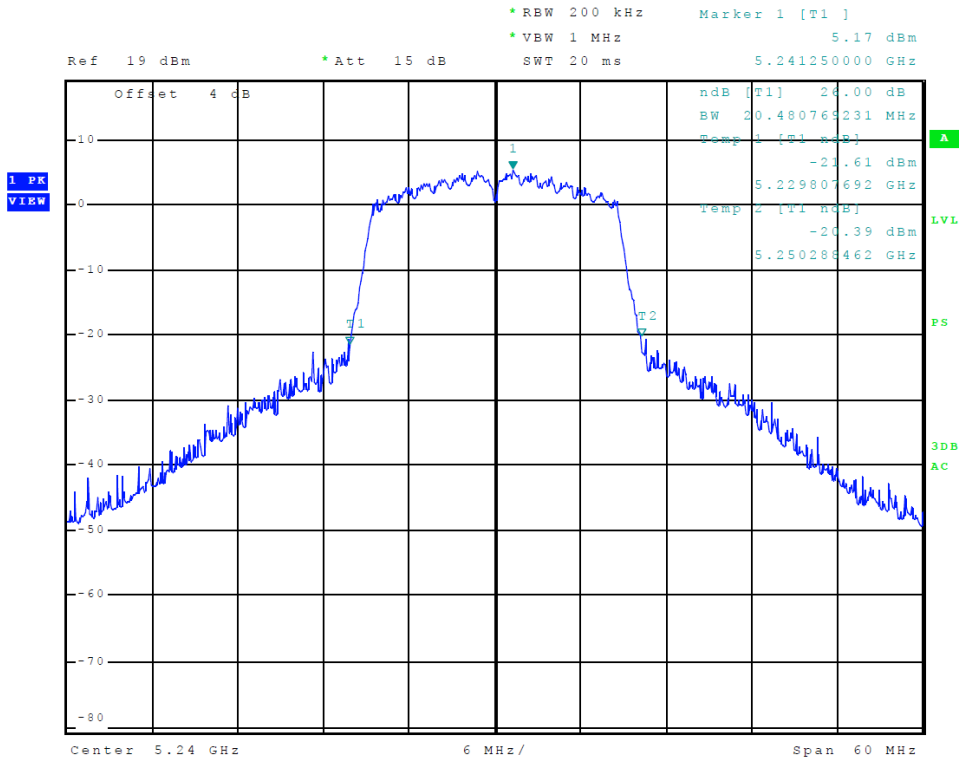


Figure 17 Plot of Transmitter 26-dB Occupied Bandwidth (5150-5250 MHz Band 802.11a)

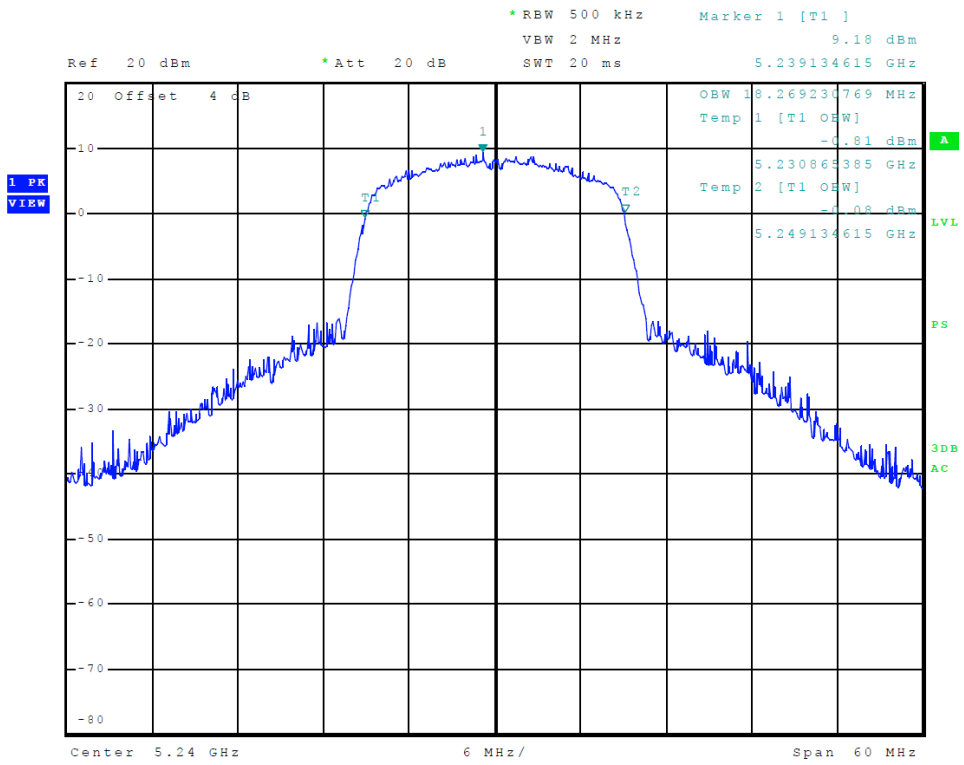


Figure 18 Plot of Transmitter 99% Occupied Bandwidth (5150-5250 MHz Band 802.11a)

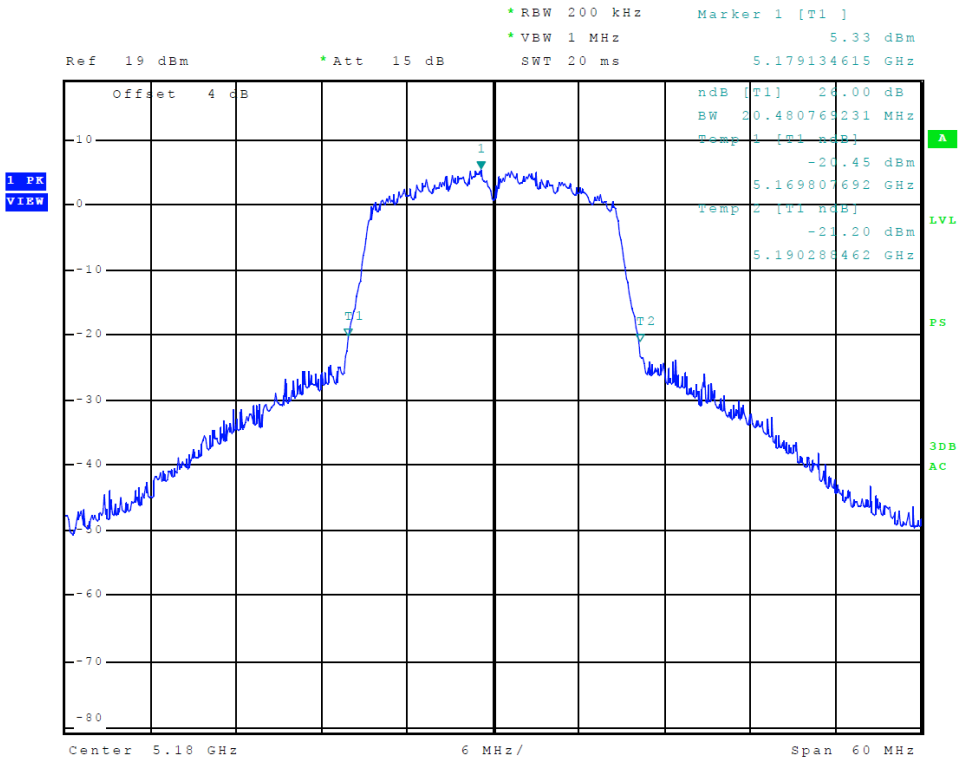


Figure 19 Plot of Transmitter 26-dB Occupied Bandwidth (5150-5250 MHz Band 802.11n)

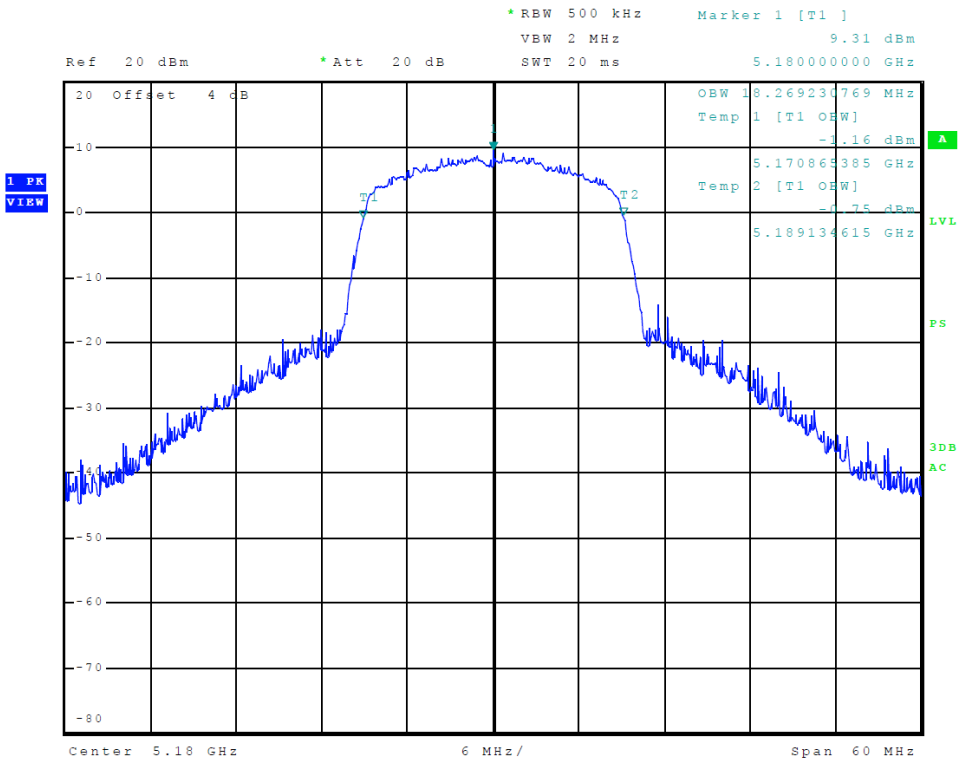


Figure 20 Plot of Transmitter 99% Occupied Bandwidth (5150-5250 MHz Band 802.11n)

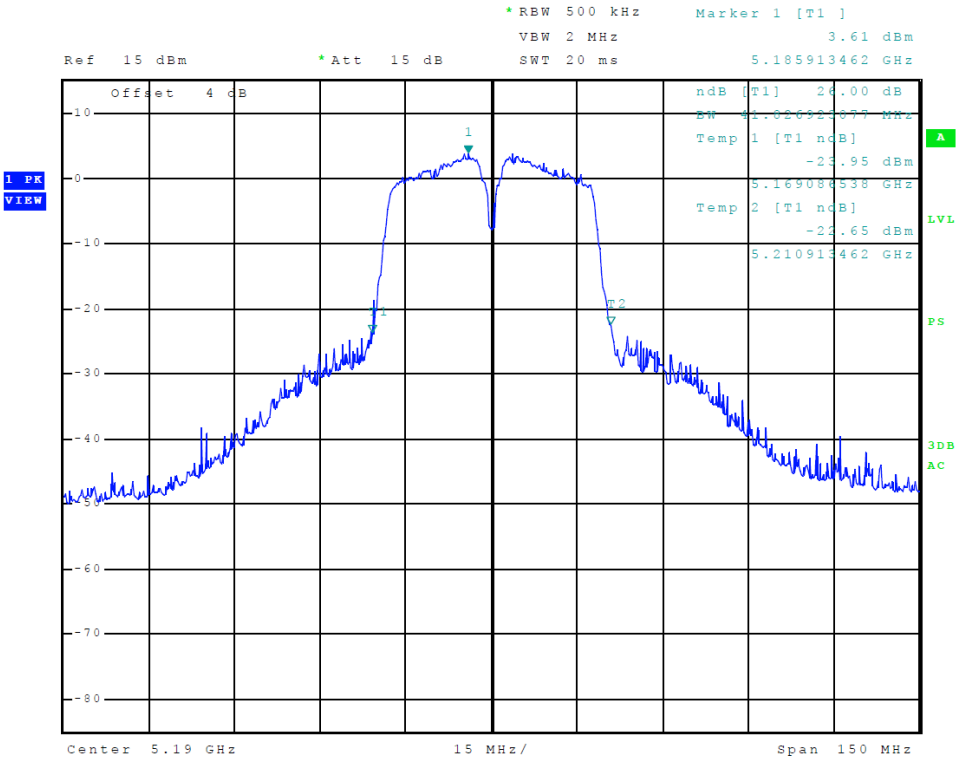


Figure 21 Plot of Transmitter 26-dB Occupied Bandwidth (5150-5250 MHz Band 802.11n40)

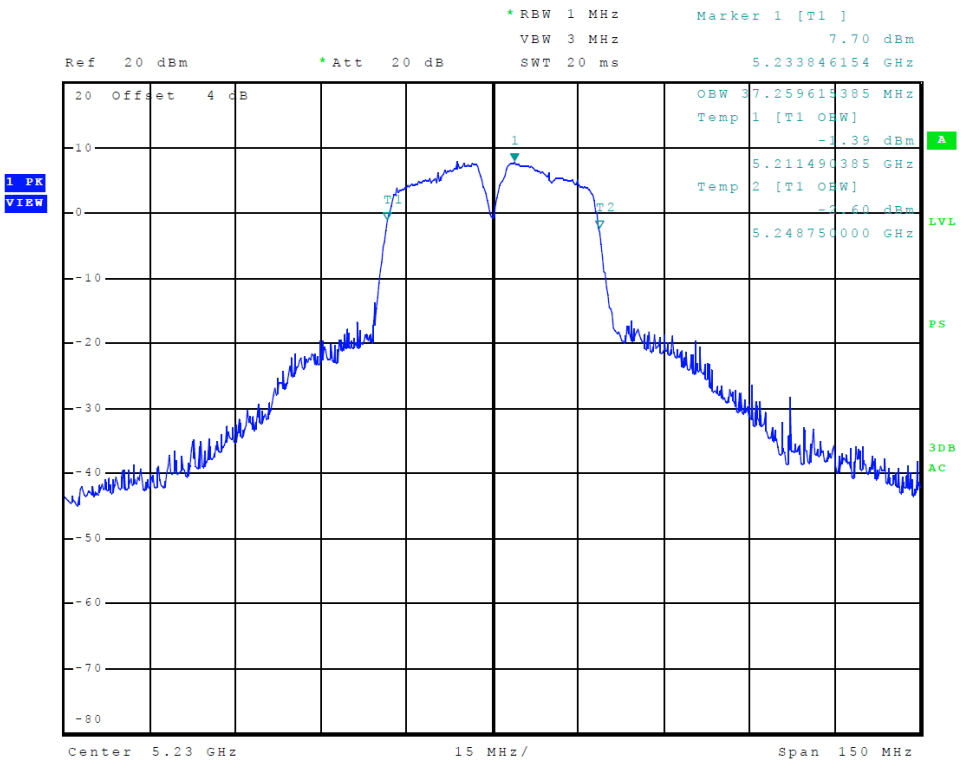


Figure 22 Plot of Transmitter 99% Occupied Bandwidth (5150-5250 MHz Band 802.11n40)

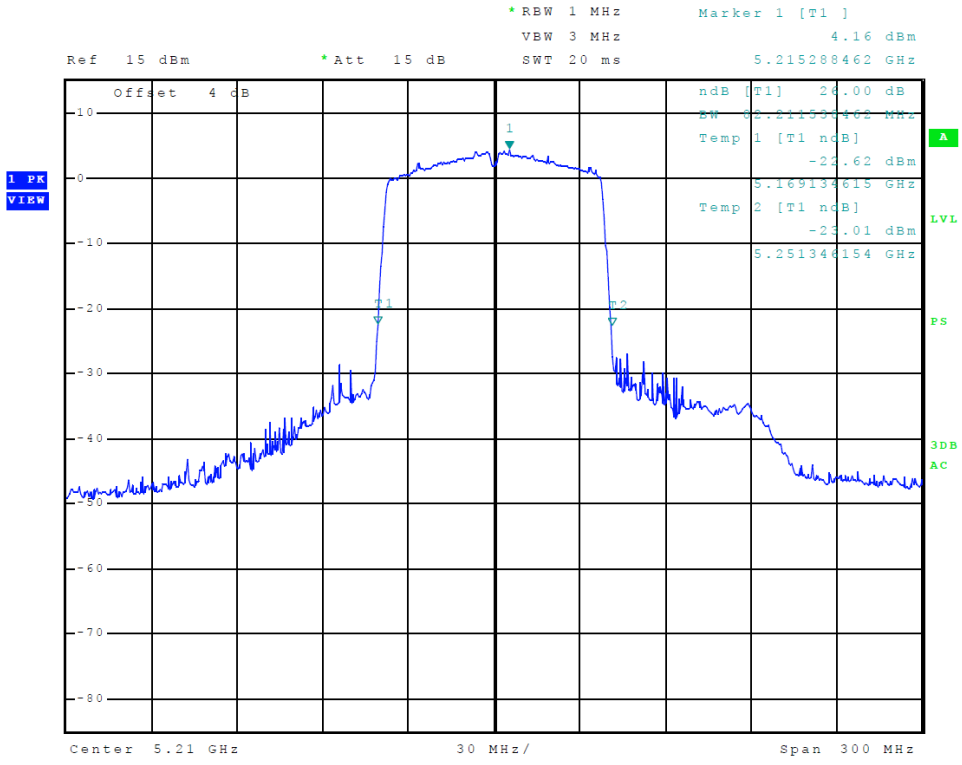


Figure 23 Plot of Transmitter 26-dB Occupied Bandwidth (5150-5250 MHz Band 802.11ac)

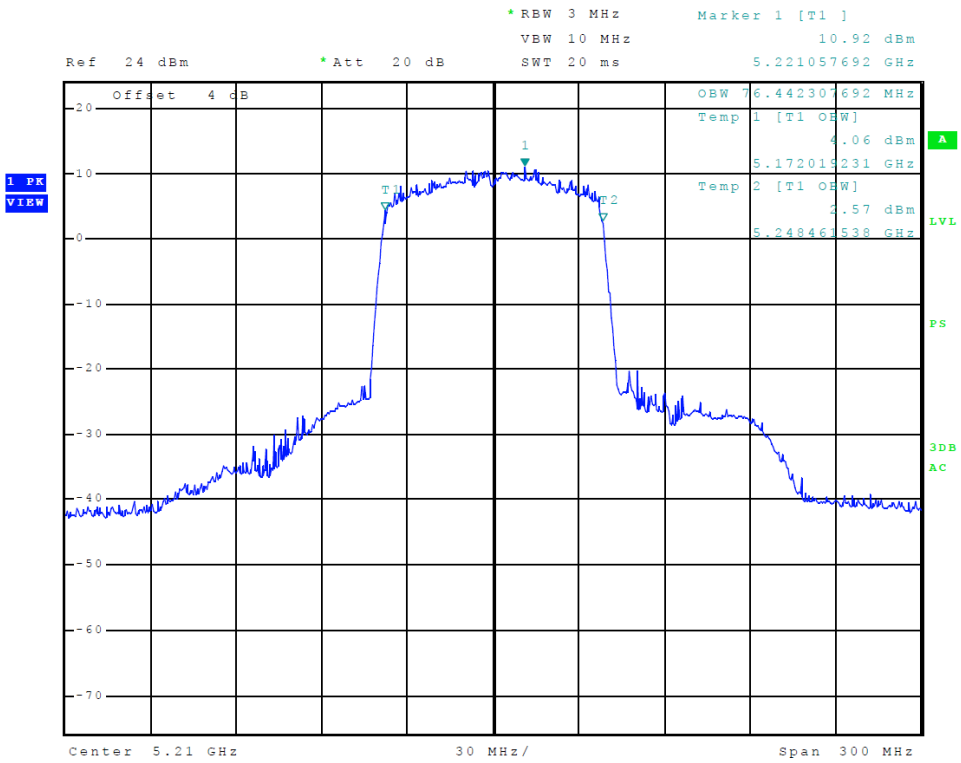


Figure 24 Plot of Transmitter 99% Occupied Bandwidth (5150-5250 MHz Band 802.11ac)

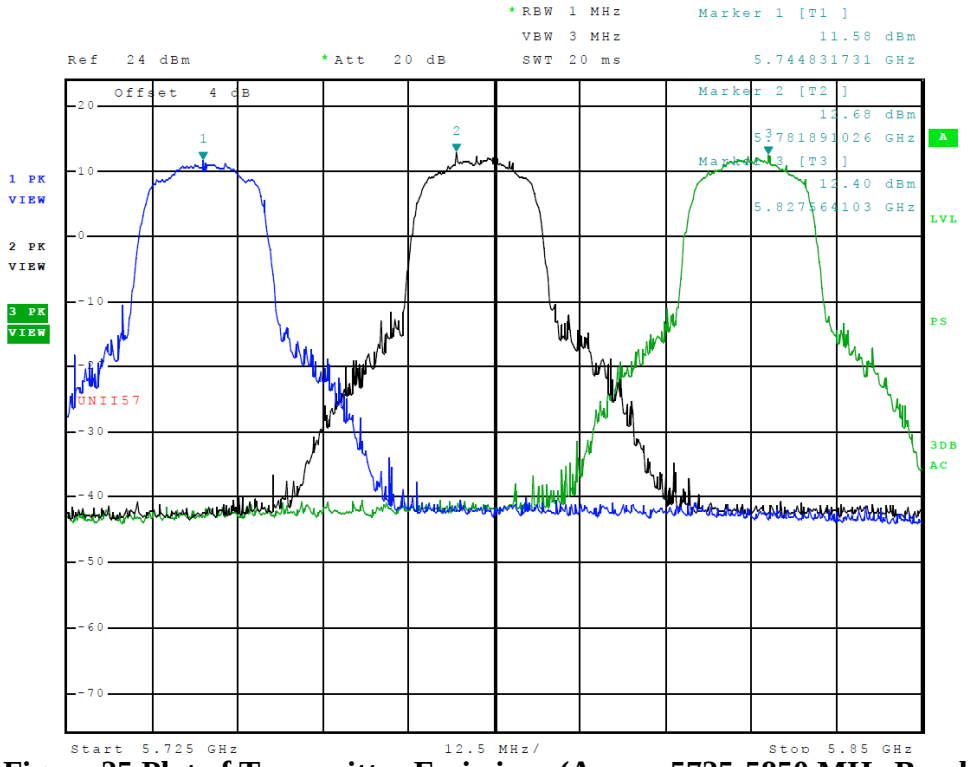


Figure 25 Plot of Transmitter Emissions (Across 5725-5850 MHz Band, 802.11a)

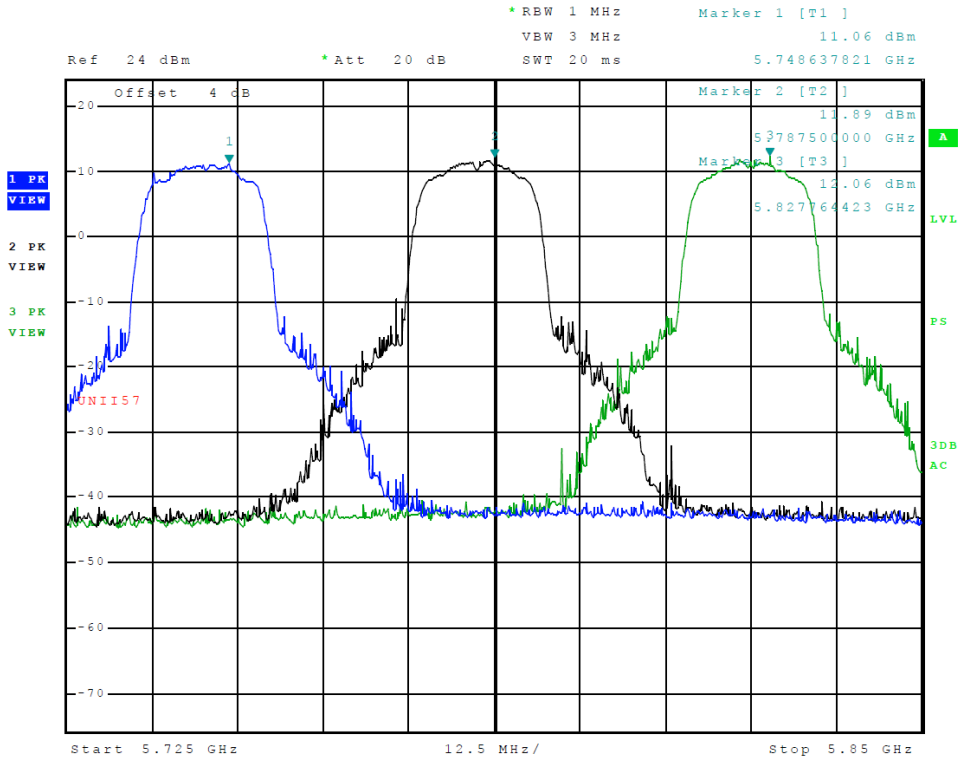


Figure 26 Plot of Transmitter Emissions (Across 5725-5850 MHz Band, 802.11n)

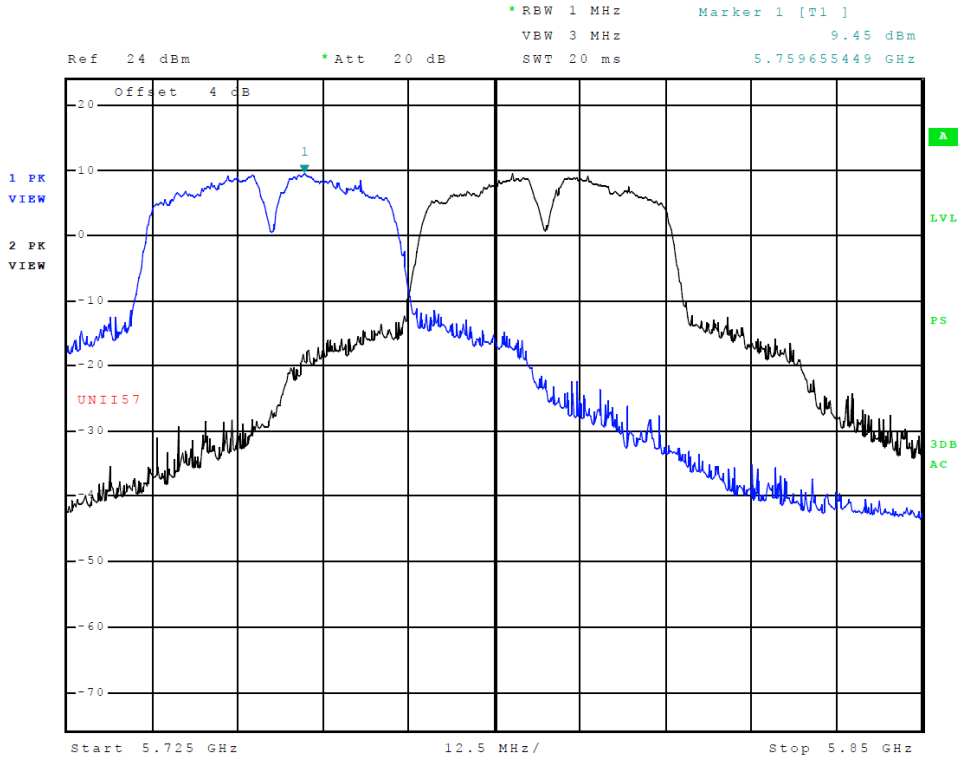


Figure 27 Plot of Transmitter Emissions (Across 5725-5850 MHz Band, 802.11n40)

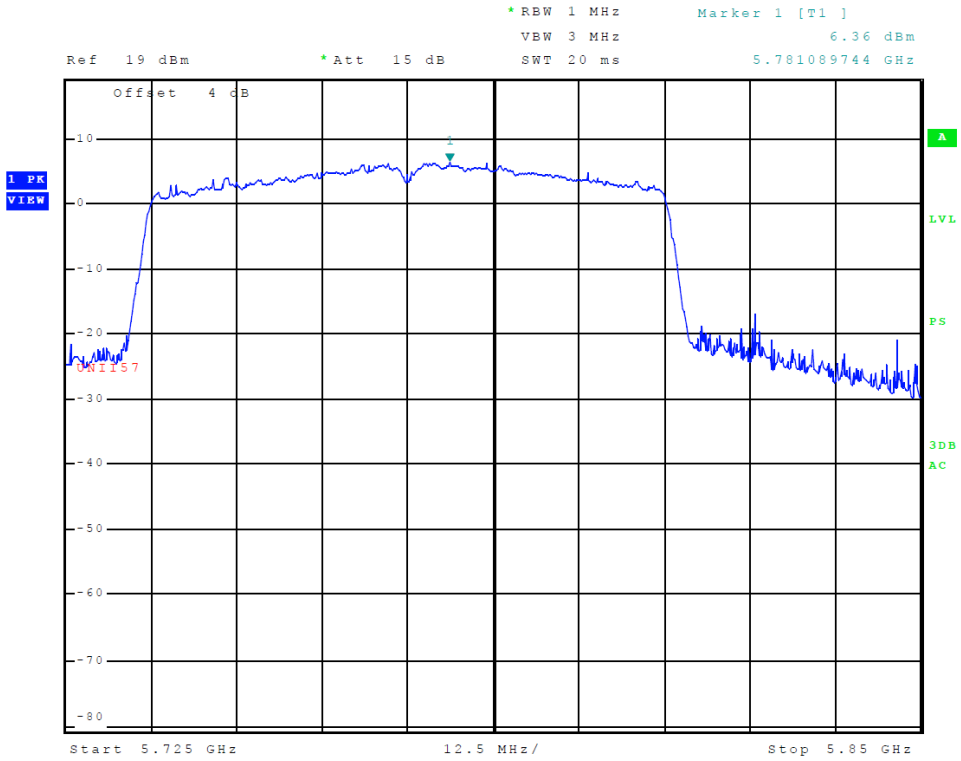


Figure 28 Plot of Transmitter Emissions (Across 5725-5850 MHz Band, 802.11ac)

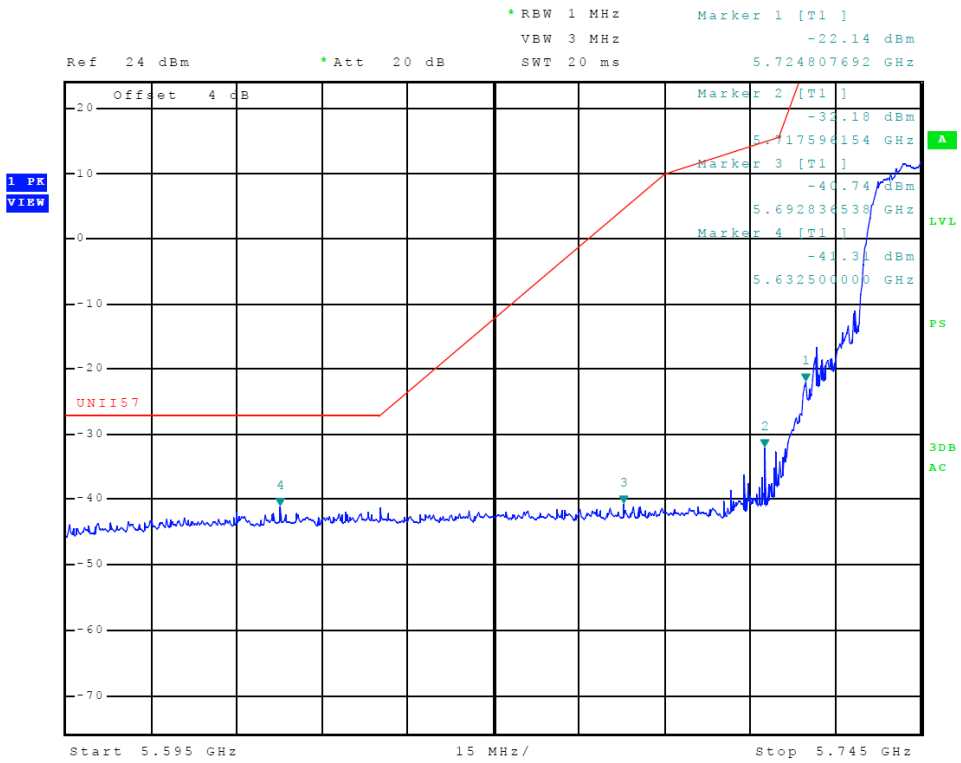


Figure 29 Plot of Lower Band Edge (Across 5725-5850 MHz Band, 802.11a)

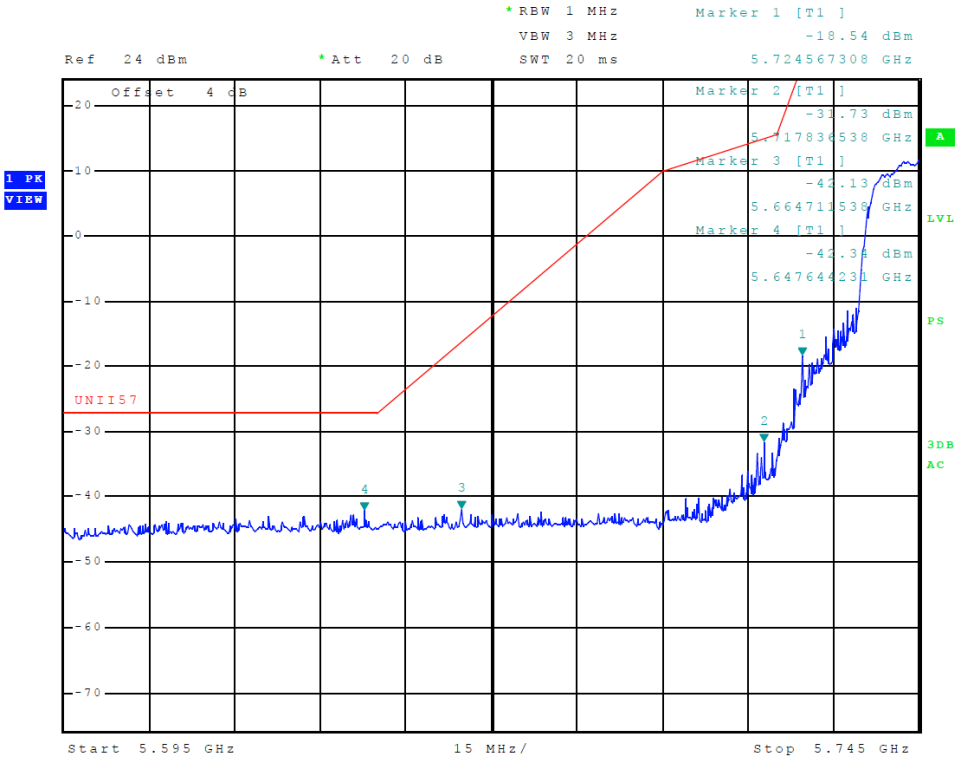


Figure 30 Plot of Lower Band Edge (Across 5725-5850 MHz Band, 802.11n)

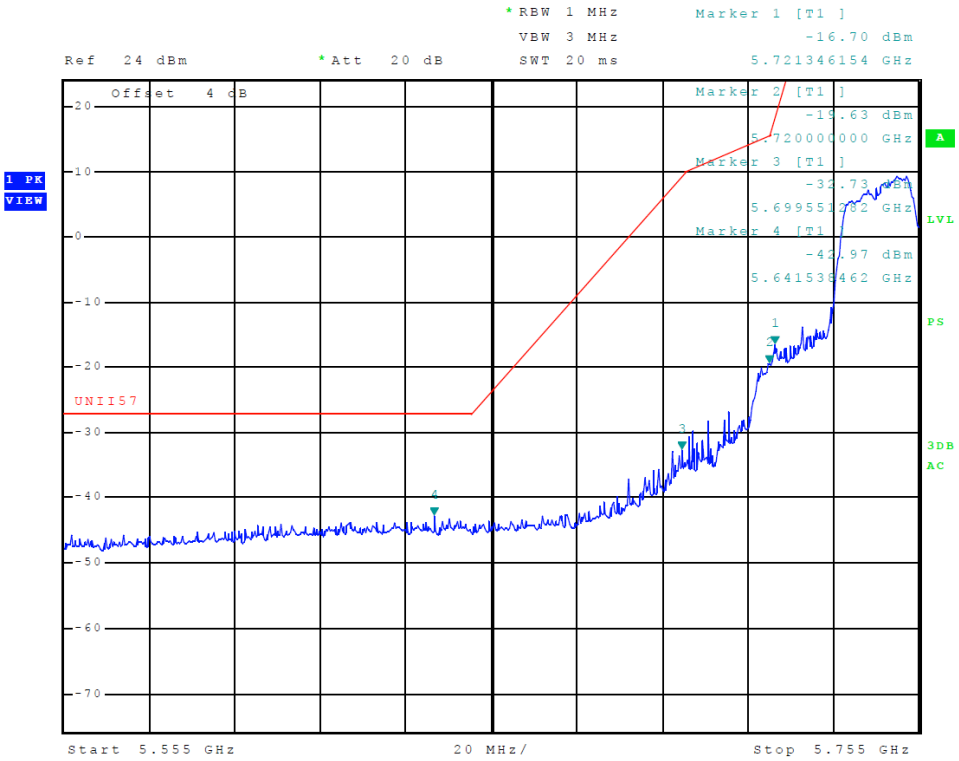


Figure 31 Plot of Lower Band Edge (Across 5725-5850 MHz Band, 802.11n40)

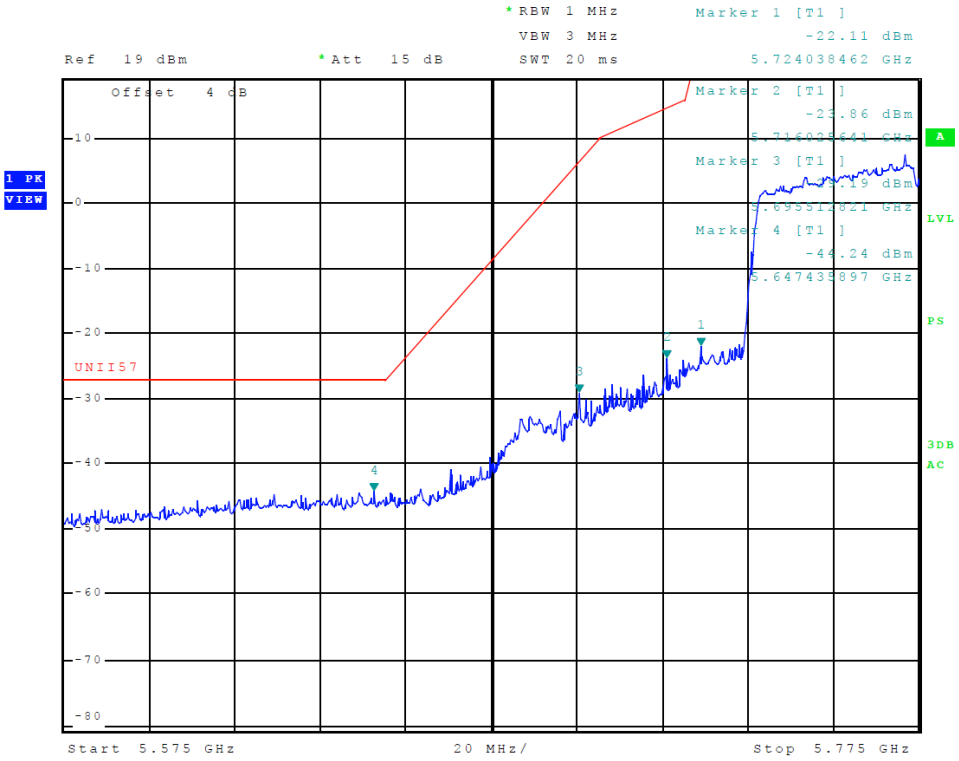


Figure 32 Plot of Lower Band Edge (Across 5725-5850 MHz Band, 802.11ac)

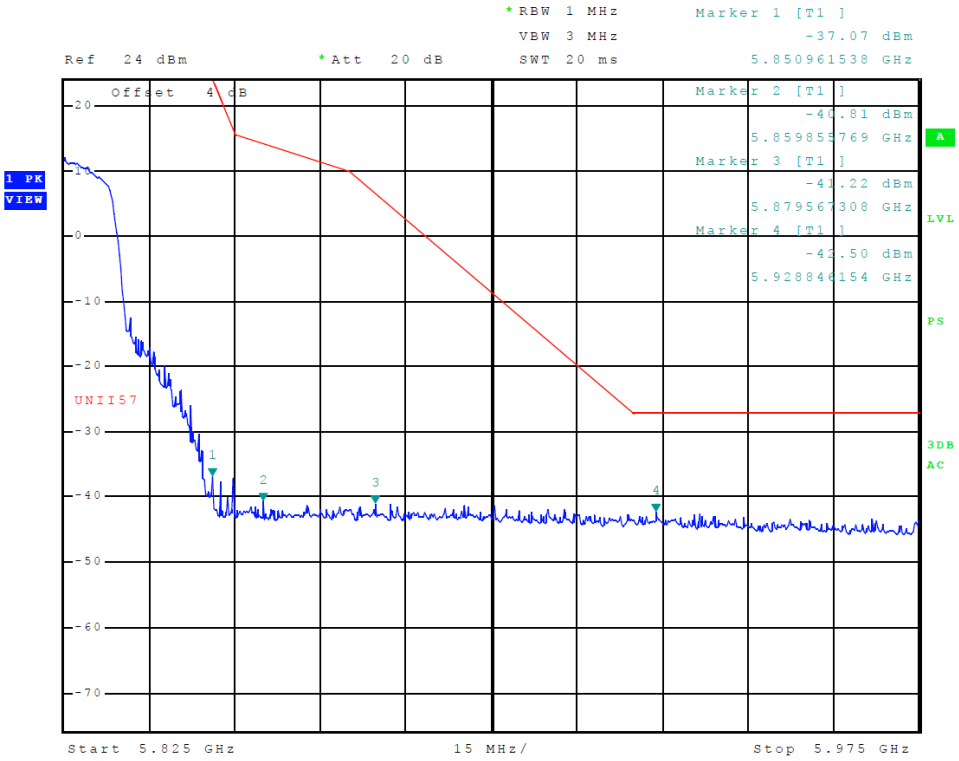


Figure 33 Plot of Upper Band Edge (Across 5725-5850 MHz Band, 802.11a)

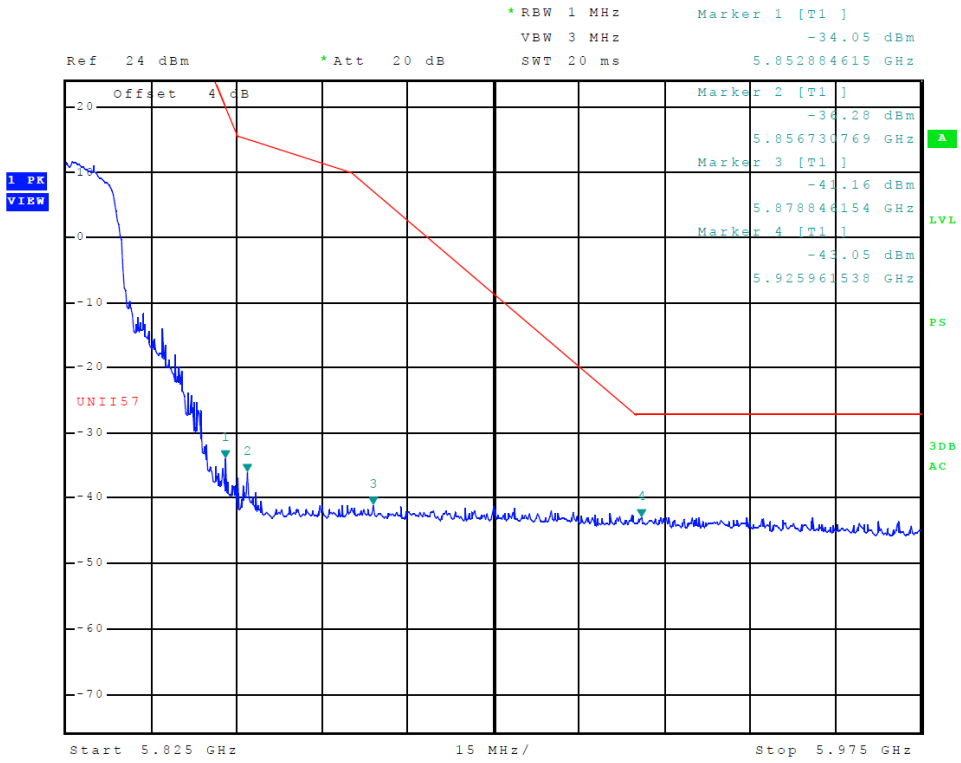


Figure 34 Plot of Upper Band Edge (Across 5725-5850 MHz Band, 802.11n)

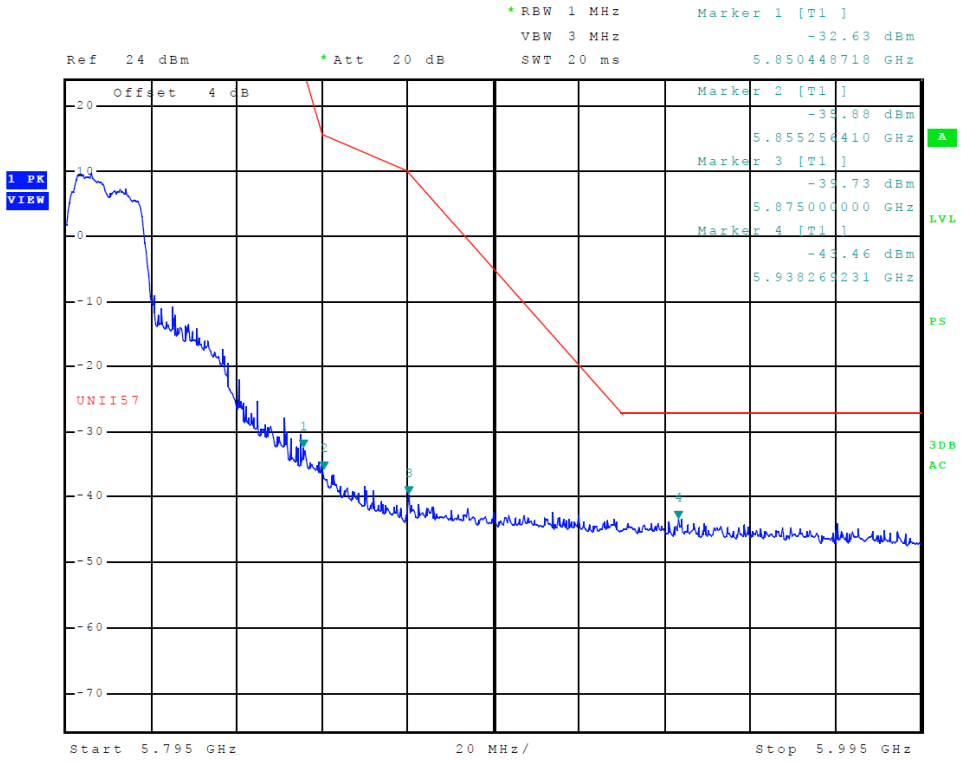


Figure 35 Plot of Upper Band Edge (Across 5725-5850 MHz Band, 802.11n40)

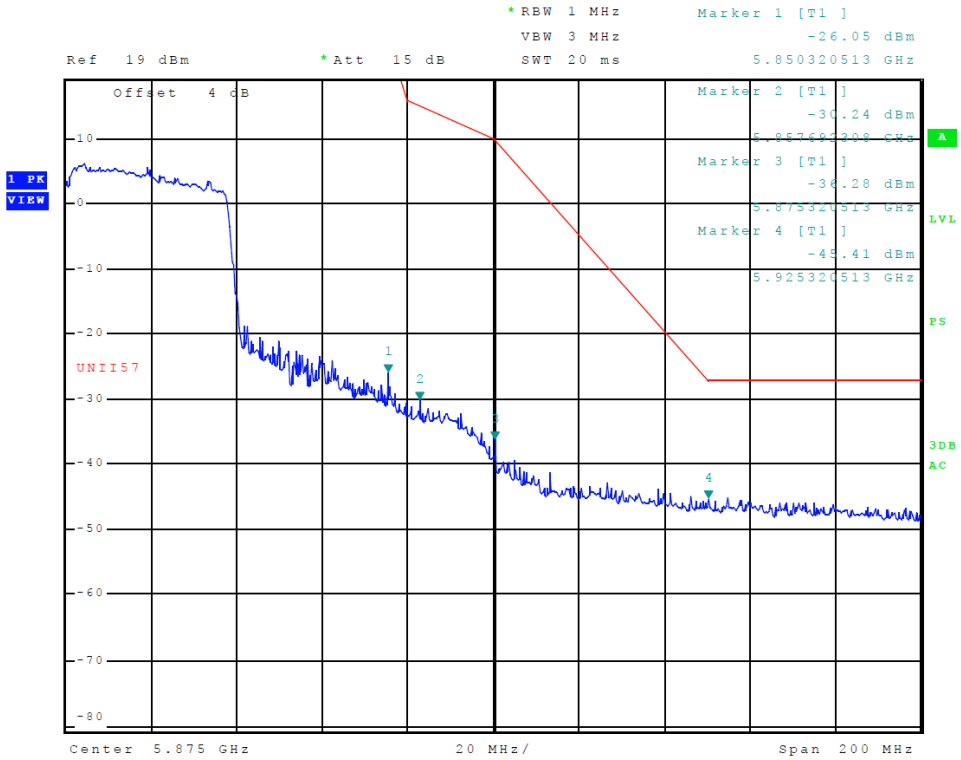


Figure 36 Plot of Upper Band Edge (Across 5725-5850 MHz Band, 802.11ac)

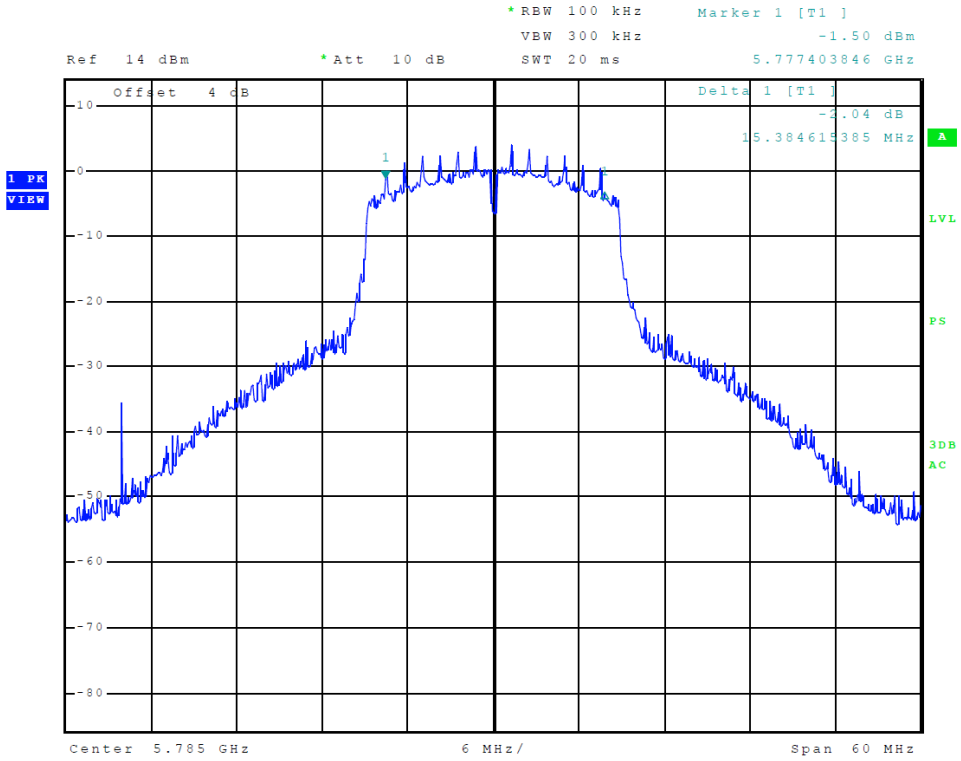


Figure 37 Plot of Transmitter 6-dB Occupied Bandwidth (5725-5850 MHz Band 802.11a)

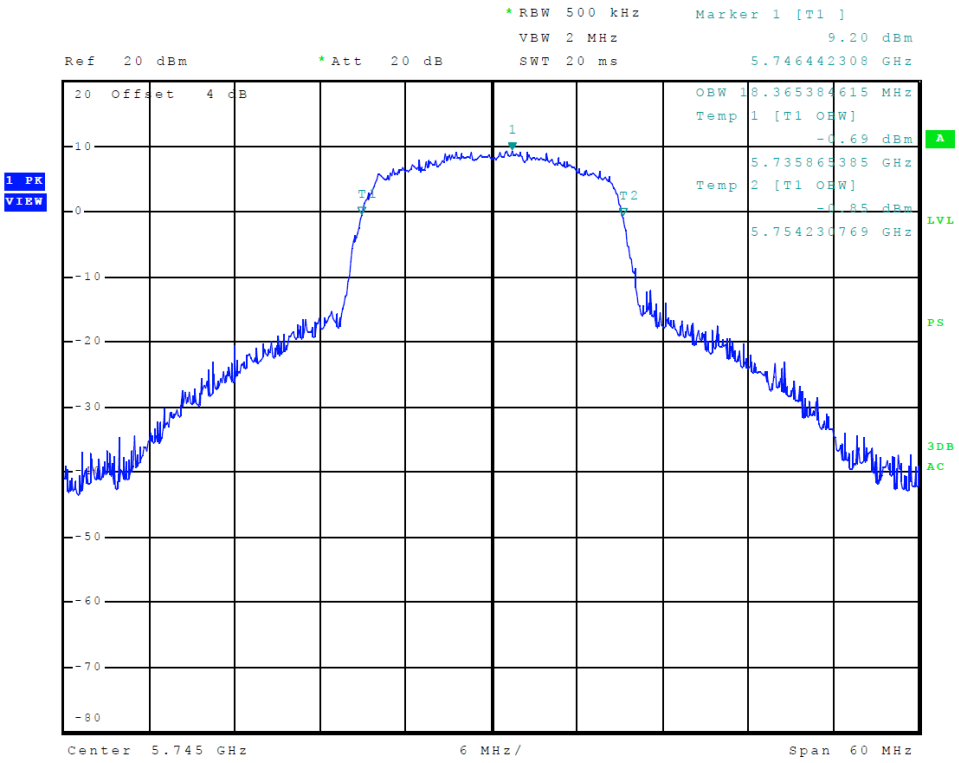


Figure 38 Plot of Transmitter 99% Occupied Bandwidth (5725-5850 MHz Band 802.11a)

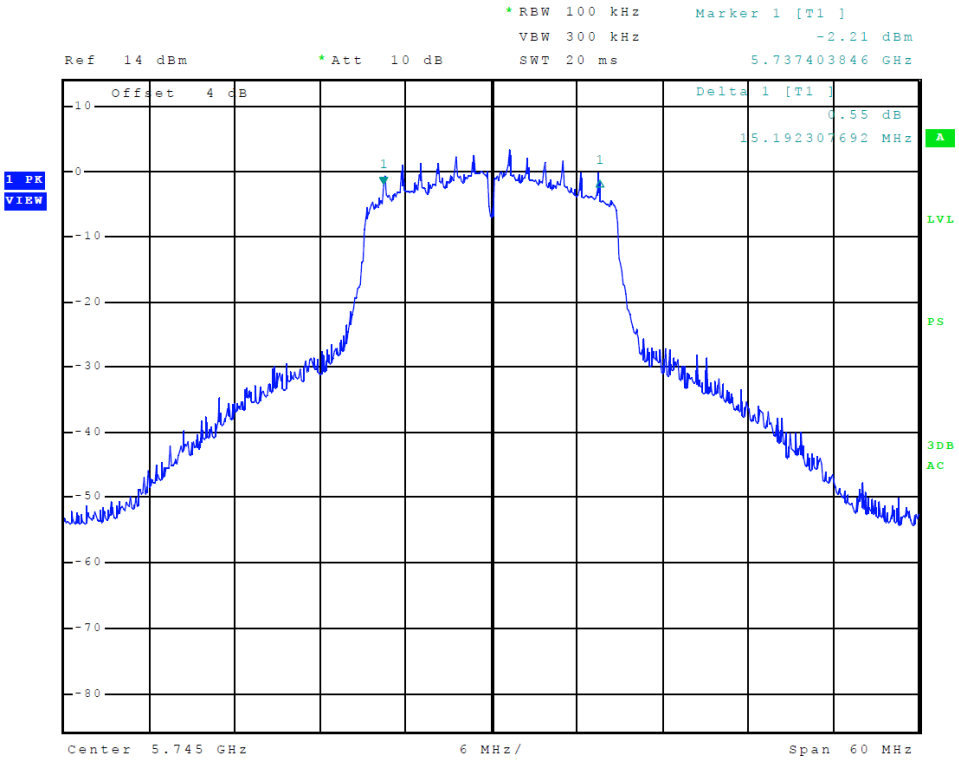


Figure 39 Plot of Transmitter 6-dB Occupied Bandwidth (5725-5850 MHz Band 802.11n)

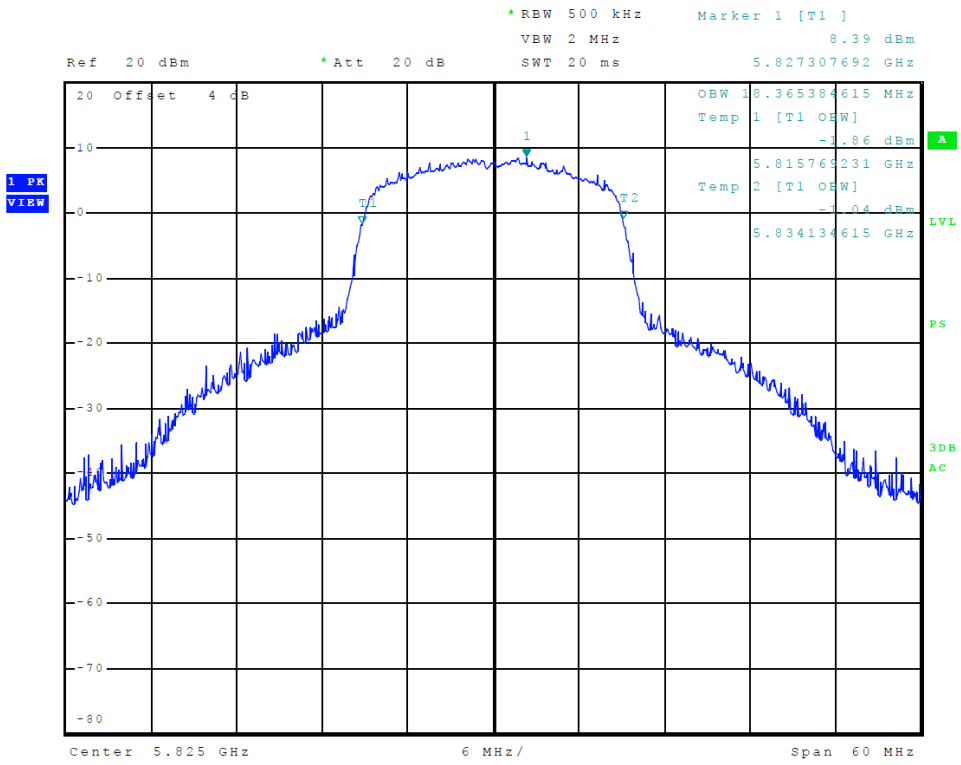


Figure 40 Plot of Transmitter 99% Occupied Bandwidth (5725-5850 MHz Band 802.11n)

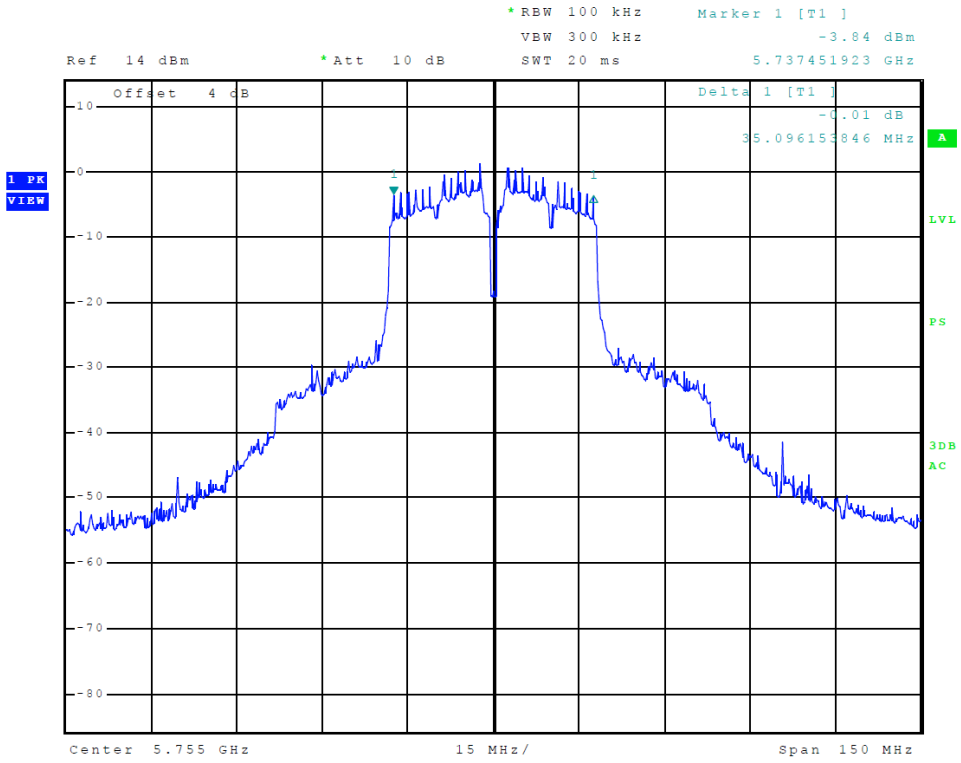


Figure 41 Plot of Transmitter 6-dB Occupied Bandwidth (5725-5850 MHz Band 802.11n40)

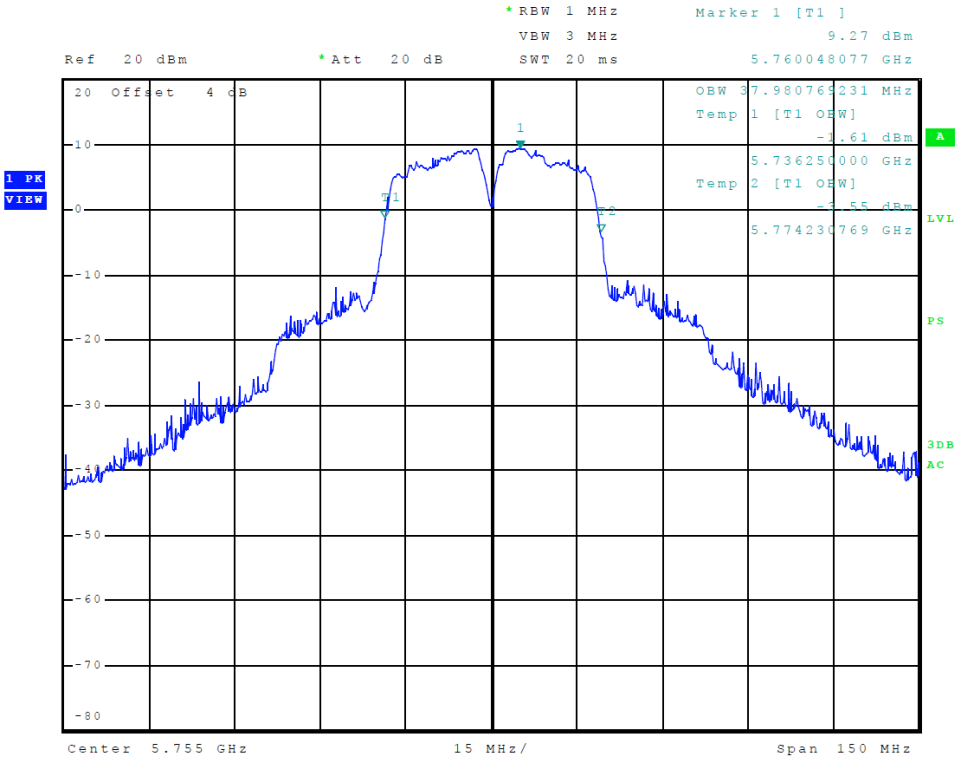


Figure 42 Plot of Transmitter 99% Occupied Bandwidth (5725-5850 MHz Band 802.11n40)

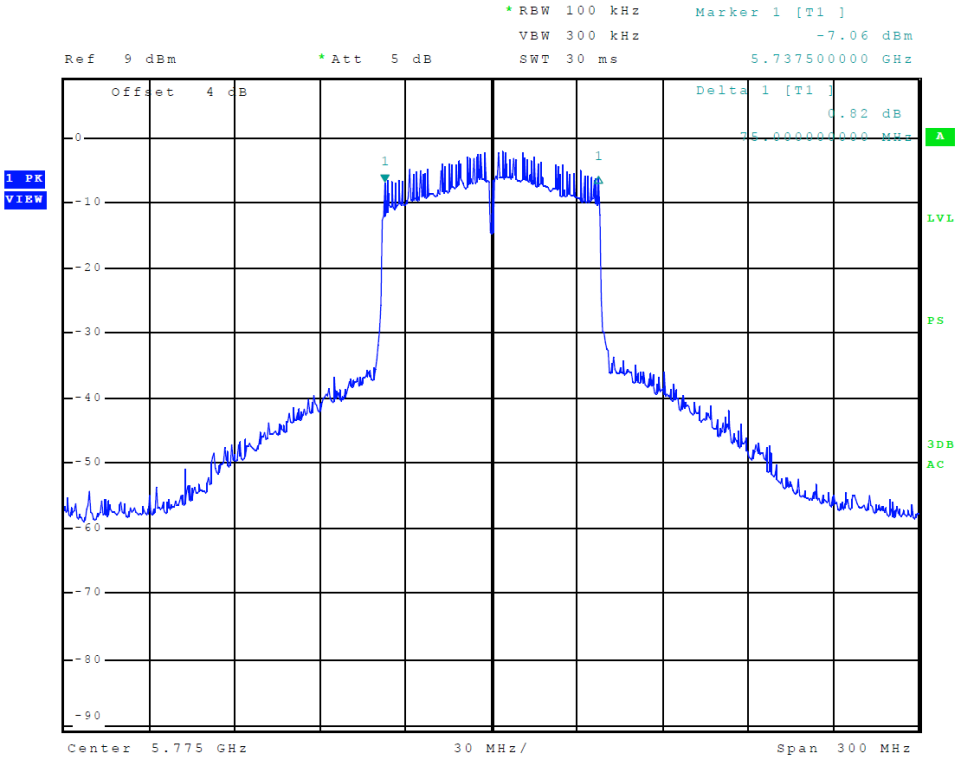


Figure 43 Plot of Transmitter 6-dB Occupied Bandwidth (5725-5850 MHz Band 802.11ac)

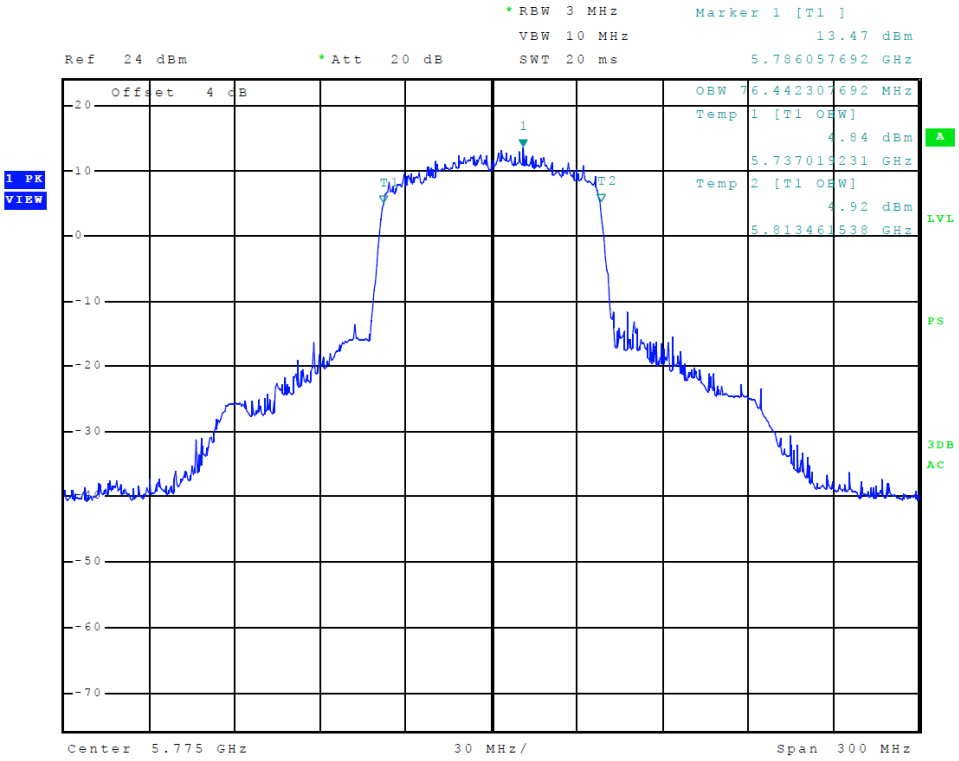


Figure 44 Plot of Transmitter 99% Occupied Bandwidth (5725-5850 MHz Band 802.11ac)

Transmitter Emissions Data

Table 10 Transmitter Radiated Emission 5150-5250 MHz Band, 802.11a

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
20 MHz Channel					
5180.0	--	--	--	--	--
10360.0	60.1	47.1	60.6	47.0	68.3
15540.0	63.7	50.4	63.4	50.2	68.3
20720.0	59.6	46.8	60.0	46.8	68.3
25900.0	61.4	48.0	61.0	48.0	68.3
5200.0	--	--	--	--	--
10400.0	60.1	47.0	59.3	46.7	68.3
15600.0	62.5	49.8	62.9	49.9	68.3
20800.0	59.4	46.6	60.2	46.6	68.3
26000.0	60.2	47.7	61.1	47.7	68.3
5240.0	--	--	--	--	--
10480.0	60.2	47.3	60.1	47.0	68.3
15720.0	63.7	50.2	62.4	50.2	68.3
20960.0	60.1	46.6	59.1	46.6	68.3
26200.0	60.4	47.4	60.6	47.5	68.3
Band Edges					
5150.0	63.2	42.2	64.4	43.4	54.0
5350.0	53.4	40.0	54.5	41.0	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 11 Transmitter Radiated Emission 5150-5250 MHz Band, 802.11n

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
20 MHz Channel					
5180.0	--	--	--	--	--
10360.0	60.3	47.2	59.5	46.8	68.3
15540.0	63.4	50.4	63.1	50.3	68.3
20720.0	59.5	46.5	60.2	46.7	68.3
25900.0	61.3	47.7	61.1	47.7	68.3
5200.0	--	--	--	--	--
10400.0	60.5	47.1	59.6	46.7	68.3
15600.0	62.9	49.9	62.6	49.9	68.3
20800.0	59.7	46.6	59.6	46.7	68.3
26000.0	60.6	47.7	60.6	47.7	68.3
5240.0	--	--	--	--	--
10480.0	60.1	47.3	60.5	47.5	68.3
15720.0	63.0	50.3	63.8	50.1	68.3
20960.0	59.6	46.6	59.4	46.7	68.3
26200.0	61.1	47.5	60.5	47.5	68.3
Band Edges					
5150.0	63.3	42.2	64.6	43.1	54.0
5350.0	52.5	39.4	54.3	41.4	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 12 Transmitter Radiated Emission 5150-5250 MHz Band, 802.11n40

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
40 MHz Channel					
5190.0	--	--	--	--	--
10380.0	59.7	46.9	59.8	46.6	68.3
15570.0	63.5	50.5	63.9	50.4	68.3
20760.0	60.1	46.9	60.1	47.0	68.3
25950.0	61.6	48.1	60.9	48.1	68.3
5230.0	--	--	--	--	--
10460.0	61.1	47.9	61.5	47.2	68.3
15690.0	63.5	50.1	63.2	50.2	68.3
20920.0	59.2	46.6	59.6	46.5	68.3
26150.0	60.3	47.5	60.4	47.5	68.3
Band Edges					
5150.0	69.1	46.9	74.0	53.9	54.0
5350.0	52.3	38.8	54.3	40.8	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 13 Transmitter Radiated Emission 5150-5250 MHz Band, 802.11ac

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
5210.0	--	--	--	--	--
10420.0	61.1	47.1	60.3	47.1	68.3
15630.0	60.5	47.9	61.5	47.9	68.3
20840.0	60.2	46.7	59.8	46.6	68.3
26050.0	61.2	47.8	61.1	47.8	68.3
Band Edges					
5150.0	65.0	45.2	72.9	50.6	54.0
5350.0	52.2	38.7	53.3	39.9	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 14 Transmitter Radiated Emission 5725-5850 MHz Band, 802.11a

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
20 MHz Channel					
5745.0	--	--	--	--	--
11490.0	60.8	48.3	61.2	48.4	68.3
17235.0	63.4	50.0	63.3	50.1	68.3
22980.0	60.1	47.1	60.4	47.1	68.3
28725.0	61.8	48.4	61.1	48.4	68.3
5785.0	--	--	--	--	--
11570.0	61.6	48.1	61.1	48.1	68.3
17355.0	62.2	49.4	63.2	49.9	68.3
23140.0	60.6	47.1	60.3	47.1	68.3
28925.0	60.8	48.3	61.4	48.2	68.3
5825.0	--	--	--	--	--
11650.0	62.2	48.3	61.1	48.3	68.3
17475.0	63.1	50.5	63.5	50.7	68.3
23300.0	60.4	47.0	60.3	47.1	68.3
29125.0	61.2	48.0	61.1	47.8	68.3
Band Edges					
5725.0	74.4	51.6	78.9	56.5	78.2
5850.0	65.6	43.4	70.4	47.4	78.2

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 15 Transmitter Radiated Emission 5725-5850 MHz Band, 802.11n

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
20 MHz Channel					
5745.0	--	--	--	--	--
11490.0	61.1	48.4	61.6	48.7	68.3
17235.0	63.0	50.3	63.6	50.2	68.3
22980.0	59.6	47.1	60.4	47.1	68.3
28725.0	61.3	48.5	61.8	48.4	68.3
5785.0	--	--	--	--	--
11570.0	60.6	48.0	61.8	48.3	68.3
17355.0	62.5	49.8	62.3	49.7	68.3
23140.0	60.3	47.2	60.2	47.1	68.3
28925.0	61.0	48.3	61.6	48.3	68.3
5825.0	--	--	--	--	--
11650.0	61.5	48.2	61.6	48.6	68.3
17475.0	63.2	50.8	63.8	50.9	68.3
23300.0	59.8	47.1	60.5	47.1	68.3
29125.0	61.1	48.0	61.3	48.0	68.3
Band Edges					
5725.0	77.8	54.7	83.3	60.6	78.2
5850.0	67.9	44.9	74.2	48.7	78.2

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 16 Transmitter Radiated Emission 5725-5850 MHz Band, 802.11n40

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
40 MHz Channel					
5755.0	--	--	--	--	--
11510.0	61.2	47.9	61.0	47.9	68.3
17265.0	64.3	51.3	64.5	51.3	68.3
23020.0	61.3	47.3	60.4	47.3	68.3
28775.0	61.2	48.5	61.3	48.4	68.3
5795.0	--	--	--	--	--
11590.0	61.5	48.4	61.4	48.6	68.3
17385.0	63.6	50.8	64.2	51.1	68.3
23180.0	60.4	47.3	60.7	47.3	68.3
28975.0	60.9	48.4	61.6	48.4	68.3
Band Edges					
5725.0	76.3	59.7	83.4	67.6	78.2
5850.0	67.2	46.2	70.1	47.3	78.2

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 17 Transmitter Radiated Emission 5725-5850 MHz Band, 802.11ac

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
5775.0	--	--	--	--	--
11550.0	61.1	47.9	61.2	48.0	68.3
17325.0	67.0	53.4	67.0	53.3	68.3
23100.0	59.9	47.2	60.2	47.2	68.3
28875.0	60.8	48.3	61.4	48.3	68.3
Band Edges					
5725.0	74.2	52.8	79.8	57.8	78.2
5850.0	71.1	50.0	74.6	53.0	78.2

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 18 Transmitter Antenna Port Data (U-NII-1)

Frequency MHz	Conducted Antenna Port Peak / Average Output Power (Watts)	99% Occupied Bandwidth (kHz)	Peak Power Spectral Density (dBm/MHz)
20 MHz Mode 802.11a			
5180	0.129 / 0.020	18,269	12.6
5200	0.129 / 0.020	18,173	12.5
5240	0.132 / 0.020	18,269	12.4
20 MHz Mode 802.11n			
5180	0.155 / 0.019	18,269	12.7
5200	0.147 / 0.019	18,269	12.7
5240	0.128 / 0.019	18,269	12.8
40 MHz Mode 802.11n40			
5190	0.165 / 0.015	37,019	7.9
5230	0.169 / 0.013	37,260	8.4
80 MHz Mode 802.11ac			
5210	0.173 / 0.014	76,442	4.6

Table 19 Transmitter Antenna Port Data (U-NII-3)

Frequency MHz	Conducted Antenna Port Peak / Average Output Power (Watts)	99% Occupied Bandwidth (kHz)	6-dB Occupied Bandwidth (kHz)	Peak Power Spectral Density (dBm/500kHz)
20 MHz Mode 802.11a				
5745	0.212 / 0.023	18,365	15,192	9.1
5785	0.212 / 0.022	18,269	15,385	8.7
5825	0.212 / 0.023	18,269	15,192	8.6
20 MHz Mode 802.11n				
5745	0.213 / 0.022	18,269	15,192	9.3
5785	0.209 / 0.021	18,365	15,192	9.0
5825	0.219 / 0.022	18,365	15,192	9.2
40 MHz Mode 802.11n40				
5755	0.227 / 0.021	37,981	35,096	6.1
5795	0.227 / 0.021	37,981	35,096	6.5
80 MHz Mode 802.11ac				
5775	0.221 / 0.017	76,442	75000.0	2.8

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the radiated emissions requirements of 47 CFR Part 15.407 and Industry Canada RSS-247 Issue 2. The maximum measured peak conducted power delivered to antenna was 0.173-Watts in the U-NII-1 Band and 0.227-Watts in the U-NII-3 Band. The radiated harmonic emissions provided a minimum margin of -17.2 dB below requirements. The Power Spectral Density provided a minimum margin of -4.2 dB below requirements. There were no other significantly measurable emissions in the restricted bands other than those presented in this report. Other emissions were present with amplitudes at least 20 dB below the requirements. There were no other deviations or exceptions to the requirements.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Additional Test Equipment
- Annex C Rogers Qualifications
- Annex D Rogers Labs Certificate of Accreditation

Annex A Measurement Uncertainty Calculations

The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4. Result of measurement uncertainty calculations are recorded below. Component and process variability of production devices similar to those tested may result in additional deviations. The manufacturer has the sole responsibility of continued compliance.

Measurement	Expanded Measurement Uncertainty $U_{(lab)}$
3 Meter Horizontal 0.009-1000 MHz Measurements	4.16
3 Meter Vertical 0.009-1000 MHz Measurements	4.33
3 Meter Measurements 1-18 GHz	5.14
3 Meter Measurements 18-40 GHz	5.16
10 Meter Horizontal Measurements 0.009-1000 MHz	4.15
10 Meter Vertical Measurements 0.009-1000 MHz	4.32
AC Line Conducted	1.75
Antenna Port Conducted power	1.17
Frequency Stability	1.00E-11
Temperature	1.6˚C
Humidity	3%

Annex B Additional Test Equipment

List of Test Equipment	Calibration	Date (m/d/y)	Due
Antenna: Schwarzbeck Model: BBA 9106/VHBB 9124 (9124-627)		5/2/2018	5/2/2019
Antenna: Schwarzbeck Model: VULP 9118 A (VULP 9118 A-534)		5/2/2018	5/2/2019
Antenna: EMCO 6509		10/16/2018	10/16/2020
Antenna: EMCO 3143 (9607-1277) 20-1200 MHz		5/2/2018	5/2/2019
Antenna: EMCO Dipole Set 3121C		2/23/2018	2/23/2019
Antenna: C.D. B-101		2/23/2018	2/23/2019
Antenna: Solar 9229-1 & 9230-1		2/23/2018	2/23/2019
Cable: Belden 8268 (L3)		10/16/2018	10/16/2019
Cable: Time Microwave: 4M-750HF290-750		10/16/2018	10/16/2019
Frequency Counter: Leader LDC-825 (8060153		5/2/2018	5/2/2019
Oscilloscope Scope: Tektronix 2230		2/23/2018	2/23/2019
Wattmeter: Bird 43 with Load Bird 8085		2/23/2018	2/23/2019
R.F. Generator: SMB100A6 s/n 100623		5/2/2018	5/2/2019
R.F. Generator: SBMBV100A s/n: 260771		5/2/2018	5/2/2019
R.F. Generators: HP 606A, HP 8614A, HP 8640B		2/23/2018	2/23/2019
R.F. Power Amp 65W Model: 470-A-1010		2/23/2018	2/23/2019
R.F. Power Amp 50W M185- 10-501		2/23/2018	2/23/2019
R.F. Power Amp A.R. Model: 10W 1010M7		2/23/2018	2/23/2019
R.F. Power Amp EIN Model: A301		2/23/2018	2/23/2019
LISN: Compliance Eng. Model 240/20		5/2/2018	5/2/2019
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08		5/2/2018	5/2/2019
Audio Oscillator: H.P. 201CD		2/23/2018	2/23/2019
ESD Test Set 2010i		2/23/2018	2/23/2019
Oscilloscope Scope: Tektronix MDO 4104		2/23/2018	2/23/2019
EMC Transient Generator HVT TR 3000		2/23/2018	2/23/2019
AC Power Source (Ametech, California Instruments)		2/23/2018	2/23/2019
Fast Transient Burst Generator Model: EFT/B-101		2/23/2018	2/23/2019
Field Intensity Meter: EFM-018		2/23/2018	2/23/2019
KEYTEK Ecat Surge Generator		2/23/2018	2/23/2019
ESD Simulator: MZ-15		2/23/2018	2/23/2019
Shielded Room not required			

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 27 years' experience in the field of electronics. Engineering experience includes six years in the automated controls industry and remaining years working with the design, development and testing of radio communications and electronic equipment.

Positions Held

Systems Engineer:	A/C Controls Mfg. Co., Inc.	6 Years
Electrical Engineer:	Rogers Consulting Labs, Inc.	5 Years
Electrical Engineer:	Rogers Labs, Inc.	Current

Educational Background

1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.

2) Bachelor of Science Degree in Business Administration Kansas State University.

3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D Rogers
Scot D. Rogers

Annex D Rogers Labs Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200087-0

Rogers Labs, Inc.
Louisburg, KS

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

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

2018-02-21 through 2019-03-31
Effective Dates

DEPARTMENT OF COMMERCE * UNITED STATES OF AMERICA *

For the National Voluntary Laboratory Accreditation Program