NVLAP TESTING ilac-MRA
NVLAP Lab Code 200087-0

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47 CFR, PART 15C - Intentional Radiators
47 CFR Paragraph 15.247 and
Industry Canada RSS-247 Issue 2 and RSS-GEN Issue 5
Application For Grant of Certification

RBD53iG-5HacD2HnD-US
2412-2462 MHz (DTS)
Broadband Digital Transmission System

FCC ID: TV7D53I-5ACD2ND
IC: 7442A-D53IAC

Mikrotikls SIA
Brivibas gatve 214i
Riga Latvia LV-1039

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

Test Report Number: 200526

Test Date: May 26,2020 to June 15, 2020

Authorized Signatory: Scot D Rogers
Scot D. Rogers

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Revisions

Revision 1 Issued August 10, 2020

Report Summary

The following information is submitted for consideration in obtaining Grant of Certification for License Exempt Digital Transmission System Intentional Radiator operating under 47CFR Paragraph 15.247, RSS-247 Issue 2, and RSS-GEN Issue 5 Digital Transmission System operating in the 2412-2462 MHz band.

Name of Applicant: Mikrotikls SIA FRN: 0013617048
Brivibas gatve 214i
Riga Latvia LV-1039

Hardware Version Identification Number: RBD53iG-5HacD2HnD-US

FCC ID: TV7D53I-5ACD2ND IC: 7442A-D53IAC

Frequency Range: 2412-2462 MHz (802.11b/g/n/n40 mode operation)

Operational communication modes include

Mode	Total Sum EIRP Output Power (Watts)	99% OBW (kHz)	6-dB OBW (kHz)
Mode 1, 802.11b	0.062	12,924	9,039
Mode 2, 802.11g	0.043	16,827	16,346
Mode 3, 802.11n	0.042	16,747	16,346
Mode 4, 802.11n40	0.037	36,218	35,897

This report addresses EUT Operations as Digital Transmission System using the following Transmitter modulations: and IEEE 802.11b,g,n, n40

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Frequency Bands 15.205, RSS-GEN 8.10	-0.2	Complies
AC Line Conducted 15.207, RSS-GEN 7.2.4	-12.1	Complies
Radiated Emissions 15.209, RSS-GEN 7.2.5	-3.8	Complies
Harmonic Emissions per 15.247, RSS-247	-0.2	Complies
Peak Power Spectral Density per 15.247, RSS-247	-17.2	Complies

Tests performed include
47CFR
15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one-Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

RSS-247 Issue 2

5.2 Digital transmission systems

DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz

a)The minimum 6 dB bandwidth shall be 500 kHz.

b)The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d),(i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements

d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

5.5 Unwanted emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Equipment Tested

Equipment	Model	Serial Number
EUT	RBD53iG-5HacD2HnD-US	D3DC0B89C839/012
AC Adapter	SAW36-240-1500U	N/A
Computer	Dell Latitude E6520	6CB35Q1

Test results in this report relate only to the items tested

Operational communication modes

Mode	Transmitter Operation
1	802.11b (DSSS)
2	802.11g (OFDM)
3	802.11n (MCS)
4	802.11n40 (MCS32)
5	5180-5240 MHz, 802.11a (OFDM)
6	5180-5240 MHz, 802.11n (MCS7)
7	5190-5243 MHz, 802.11n40 (MCS32)
8	5210 MHz, 802.11ac (QAM)
9	5745-5825 MHz, 802.11a (OFDM)
10	5745-5825 MHz, 802.11n (MCS7)
11	5755-5795 MHz, 802.11n40 (MCS32)
12	5775 MHz, 802.11ac (QAM)

Software Version: 6.46.6 Operational modes: Country Code specific

Antennas: 2.4 GHz 3-dBi, 5GHz 5.5-dBi Planar Inverted F Antennas (PIFA)

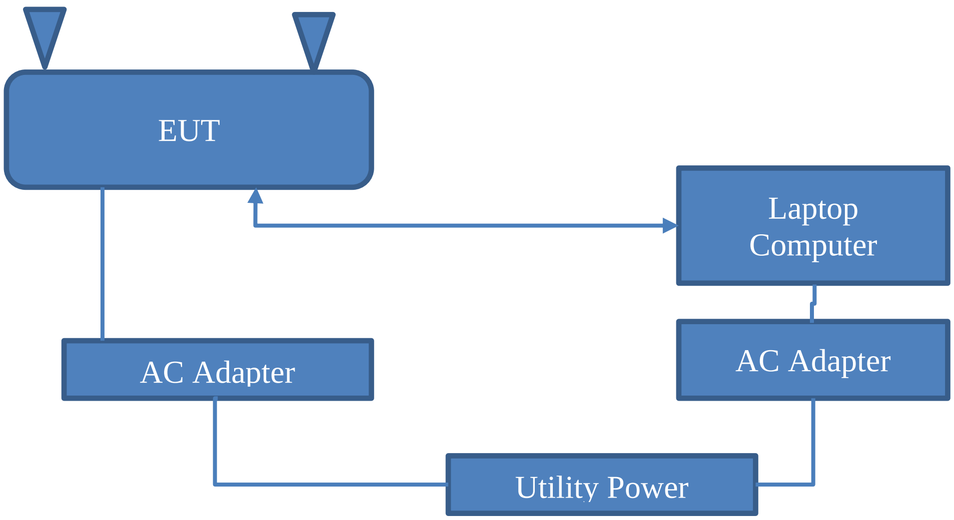
This report addresses EUT 2.4 GHz transmitter operation in modes 1 through 4.

Equipment Function and Configuration

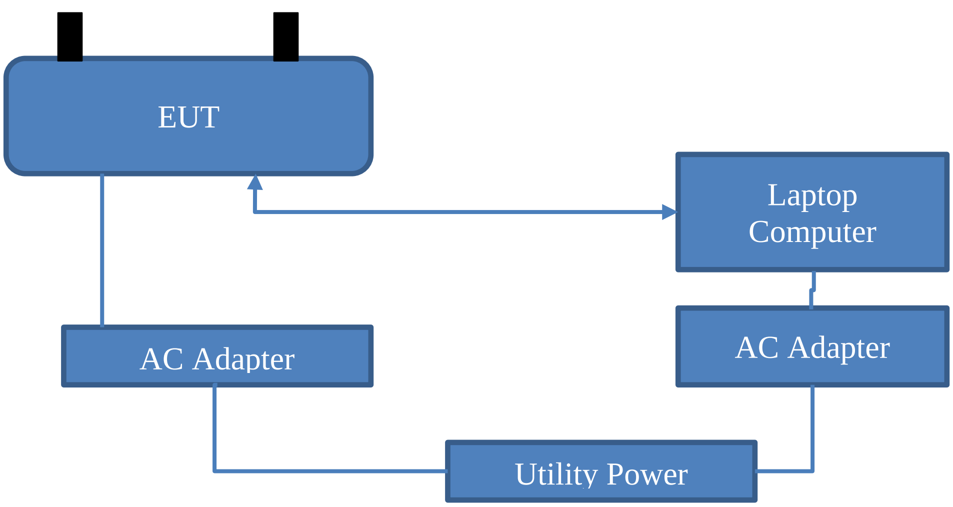
The EUT is an indoor 2.4 GHz and 5 GHz IEEE 802.11 2x2 MiMo (Multiple Input Multiple Output) Digital Transceiver system. The design provides 802.11b/g/n/n40 operational capabilities across the 2412-2462 MHz band as Digital Transmissions System, 802.11a/n/n4/ac operational capabilities across the 5150-5250 MHz band as U-NII-1, and 802.11a/n/n4/ac operational capabilities across the 5725-5850 MHz band as U-NII-3. The system provides wireless communications with compatible equipment operating on the 2.4 and 5 GHz bands using DSSS, OFDM, Modulation and Coding Schemes (MCS), and Quadrature amplitude modulation (QAM) modulations. The EUT offers broadband wireless connectivity to transmit and receive data. The design utilizes integral PIFA antenna systems as documented in this filing. The EUT requires direct current power supplied from Direct Current supply (AC/DC adapter) or Power Over Ethernet (POE). The design provides five RJ45 network ports for communications and interfacing. For testing purposes, the EUT was configured as directed by the manufacturer and communicating with the laptop computer through a network interface port. Manufacturer provided test software was installed on the computer which provided control of the transmitter functions. This configuration provided operational control of the EUT and communication interface between the EUT and supporting computer system. The test software enabled near 100% transmit duty cycle for testing purposes. The design provides no other interfacing options than those presented in this report. Two samples were provided for testing, one as production equipment and the second modified by replacing the attached antenna systems with radio frequency connectors (SMA RF connector). The RF connector allowed testing of transmitter performance at the transmitter antenna ports. For testing purposes, the RBD53iG-5HacD2HnD-US test sample was configured to transmit in available data modes receiving power from the manufacturer provided AC/DC power adapter as presented below. As requested by the manufacturer 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

Configuration #1 (Production design Attached Antennas)



Configuration #2 (Antennas replaced with SMA



Applicant Company information

Applicants Company	MikroTik ("Mikrotīkls, SIA")
Applicants Address	Brivibas gatve 214i, Riga Latvia LV-1039
FCC Identifier	TV7D53I-5ACD2ND
Industry Canada Identifier	7442A-D53IAC
Manufacturer Company	MikroTik ("Mikrotīkls, SIA")
Manufacturer Address	Brivibas gatve 214i, Riga Latvia LV-1039

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.	hAP ac³
Unique Product Number (UPN): The applicant, made up of a maximum of 11 alphanumeric characters (A-Z, 0-9), assigns the UPN.	RBD53iG-5HacD2HnD-US
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.	RBD53iG-5HacD2HnD-US
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	RBD53iG-5HacD2HnD-US
Test Rule Part(s)	47CFR 15.247, 15.407, and RSS-247
Test Frequency Range	2412-2462, 5150-5250, 5725-5850 MHz
Project Number	200526
Submission Type	Certification

Accessories

AC Power Adapter	SAW36-240-1500U

Product Details

Items	Description
Product Type	2.4 GHz WLAN and 5 GHz U-NII
Radio Type	Transceiver
Power Type	External Power Supply
Data Modulation	IEEE 802.11 b: DSSS IEEE 802.11 g/n/n40: OFDM (QPSK/MCS) IEEE 802.11 a/n/n40: OFDM (QPSK/MCS) IEEE 802.11ac: (MCS/16QAM/64QAM/1024QAM)
Number of Channels	802.11b: 11, (bandwidths include 20 MHz) 802.11g/n/n40: up to 11, (bandwidths include 20 and 40 MHz) 802.11a/n/n40: up to 15, (bandwidths include 20 and 40 MHz) 802.11 ac: up to 2, (bandwidth 80 MHz)
Carrier Frequencies	Please refer to Table for Carrier Frequencies
Antenna	1) 2.4 GHz antenna: Integral 3-dBi gain 2) 5 GHz antenna: – Integral 5.5-dBi gain 3) No External antenna options.
Communication Mode	Device operates as a dual channel input / output, 2.4 GHz and 5 GHz Transmission System
Beamforming Function	Without beamforming

Table for Filed Antennas

Ant.	Brand	Model Name	P/N	Antenna Type	Connector	Gain (dBi)	
						2.4 GHz	5 GHz
1	Mikrotikls		N/A	Attached Planar Inverted F Antenna (PIFA)	N/A	3	5.5

Antenna

Antenna	TX chains		
Bandwidth Mode	20 MHz	40 MHz	80 MHz
2.4 GHz 802.11b/g/n/n40			
IEEE 802.11b	1 from above list		
IEEE 802.11g	1 from above list		
IEEE 802.11n (HT20)	1 from above list		
IEEE 802.11n40 (HT40)		1 from above list	
5 GHz U-NII-1, U-NII-3			
IEEE 802.11a	1 from above list		
IEEE 802.11n (HT20)	1 from above list		
IEEE 802.n40 (HT40)		1 from above list	
IEEE 802.11ac			1 from above list

Table for Carrier Frequencies

For 20MHz bandwidth systems, use Channel 1,6,11, 36, 40, 44, 48, 149, 153, 157, 161, 165.

For 40MHz bandwidth systems, use Channel 38, 46, 151, 159.

For 80MHz bandwidth systems, use Channel 42, 155.

Frequency Band	Channel No.	Frequency	Channel No.	Frequency
2400-2483.5MHz	1	2412 MHz	3	2422 MHz
	6	2437 MHz	8	2447 MHz
	11	2462 MHz	9	2452 MHz
5150-5250MHz U-NII-1	36	5180 MHz	44	5220 MHz
	38	5190 MHz	46	5230 MHz
	40	5200 MHz	48	5240 MHz
	42	5210 MHz		
5725-5850MHz U-NII-3	149	5745 MHz	157	5785 MHz
	151	5755 MHz	159	5795 MHz
	153	5765 MHZ	161	5805 MHz
	155	5775 MHZ	165	5825 MHz

Table for Test Modes

Preliminary tests were performed in different data rates to define the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all possible configurations while searching the worst cases. The following table is a list of the test modes investigated for this report.

Test Items	Mode		Channel	Chain(s)
Max. Conducted Output Power	802.11b		1,6,11	1,2
	802.11g		1,6,11	1,2
	802.11n HT20		1,6,11	1,2
	802.11n HT40		3,8,9	1,2
	11 a BPSK		36/40/48/149/157/165	1,2
	11a/n HT20		36/40/48/149/157/165	1,2
	11a/n HT40		38/46/151/159	1,2
	11ac VHT80		42,155	1,2
Power Spectral Density	802.11b		1,6,11	1,2
	802.11g		1,6,11	1,2
	802.11n HT20		1,6,11	1,2
	802.11n HT40		3,8,9	1,2
	11a BPSK		36//40/48/149/157/165	1,2
	11a/n HT20		36/40/48/149/157/165	1,2
	11a/n HT40		38/46/151/159	1,2
	11ac VHT80		42,155	1,2
99% Occupied Bandwidth Measurement	802.11b		1,6,11	1,2
	802.11g		1,6,11	1,2
	802.11n HT20		1,6,11	1,2
	802.11n HT40		3,8,9	1,2
	11a BPSK		36/40/48/149/157/165	1,2
	11a/n HT20		36/40/48/149/157/165	1,2
	11a/n HT40		38/46/151/159	1,2
	11ac VHT80		42,155	1,2

6dB Spectrum Bandwidth Measurement	802.11b		1,6,11	1,2
	802.11g		1,6,11	1,2
	802.11n HT20		1,6,11	1,2
	802.11n HT40		3,8,9	1,2
	802.11a BPSK		149/157/165	1,2
	802.11a/n HT20		149/157/165	1,2
	802.11a/n HT40		151/159	1,2
	802.11ac VHT80		42,155	1,2
Radiated Emission Below 1GHz			-	1,2
Radiated Emission Above 1GHz	802.11b		1,6,11	1,2
	802.11g		1,6,11	1,2
	802.11n HT20		1,6,11	1,2
	802.11n HT40		3,8,9	1,2
	11a BPSK		36/40/48/149/157/165	1,2
	802.11a/n HT20		36/40/48/149/157/165	1,2
	802.11a/n HT40		38/46/151/159	1,2
	802.11ac VHT80		42,155	1,2
Band Edge Emission	802.11b		1,6,11	1,2
	802.11g		1,6,11	1,2
	802.11n HT20		1,6,11	1,2
	802.11n HT40		3,8,9	1,2
	11a BPSK		36/40/48/149/157/165	1,2
	802.11a/n HT20		36/40/48/149/157/165	1,2
	802.11a/n HT40		38/46/151/159	1,2
	802.11ac VHT80		42,155	1,2
Frequency Stability	20MHz	Band 1&3	40/157	1,2
	40MHz	Band 1&3	38/151	1,2
	80MHz	Band 1&3	42,155	1,2

Application for Certification

(1) Manufacturer: Mikrotikls SIA
Brivibas gatve 214i
Riga Latvia LV-1039

(2) Identification: Model: RBD53iG-5HacD2HnD-US
FCC I.D.: TV7D53I-5ACD2ND IC: 7442A-D53IAC

(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 power received from authorized AC/DC power adapter. The EUT provides DC power port and five Ethernet ports for communications. During testing, the EUT was powered from the AC/DC power supply and connected to CPU through the network interface.

(9) Transition Provisions of 47CFR 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. Not applicable to this filing.

(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 e-CFR Title 47 dated May 26,2020 to June 30, 2020, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031(b), and applicable parts of paragraph 15, Part 15C Paragraph 15.247, KDB 662911 D01 Multiple Transmitter Output v02r01, and Industry Canada RSS-247 Issue 2 and RSS-Gen Issue 5. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2013. This report documents compliance for the EUT operations as Digital Transmission Systems operation.

Equipment Testing Procedures

AC Line Conducted Emission Test Procedure

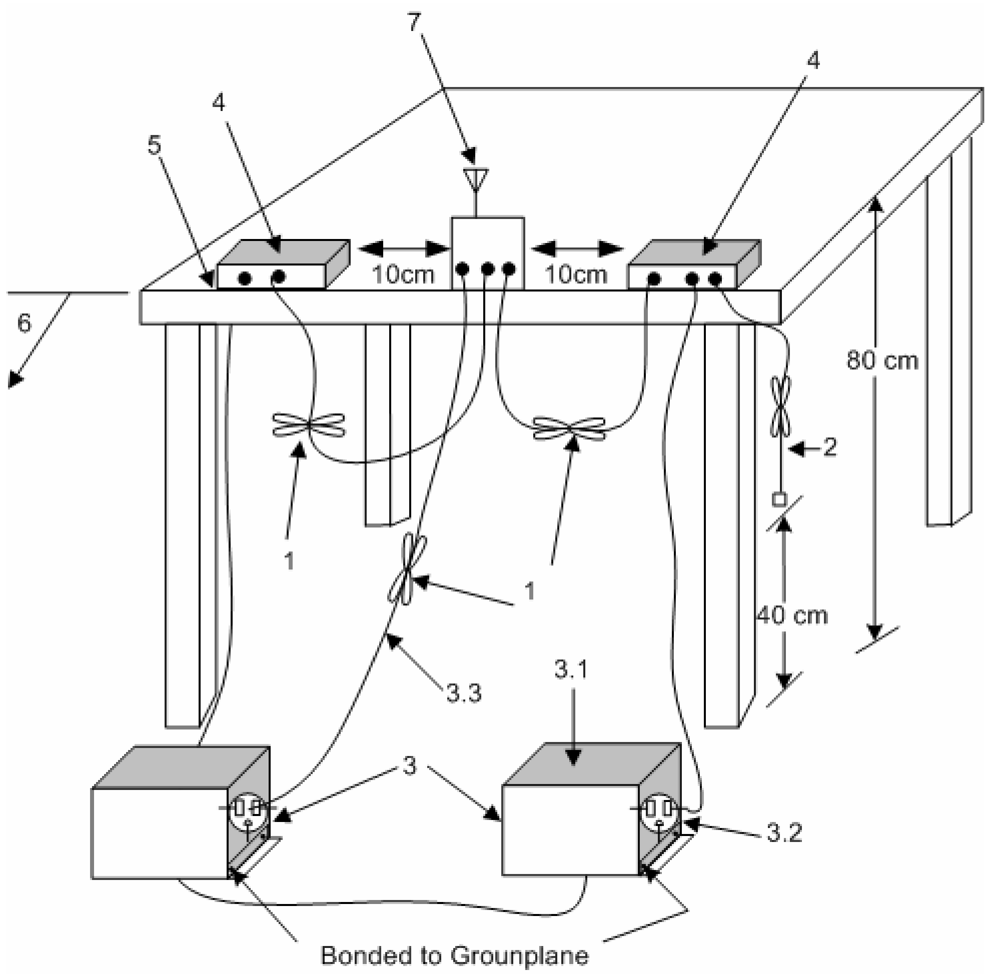
Testing for the AC line-conducted emissions was performed as defined in ANSI C63.10-2013. The test setup, including the EUT, was arranged in the test configurations presented during testing. The test configuration was placed on a 1 x 1.5-meter wooden bench, 0.8 meters high located in a screen room. The 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 15C, RSS-247 Issue 2 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, 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 emissions during preliminary investigation. Refer to diagrams two and three showing typical test setup. Refer to photographs in the test setup exhibits for specific EUT placement during testing.

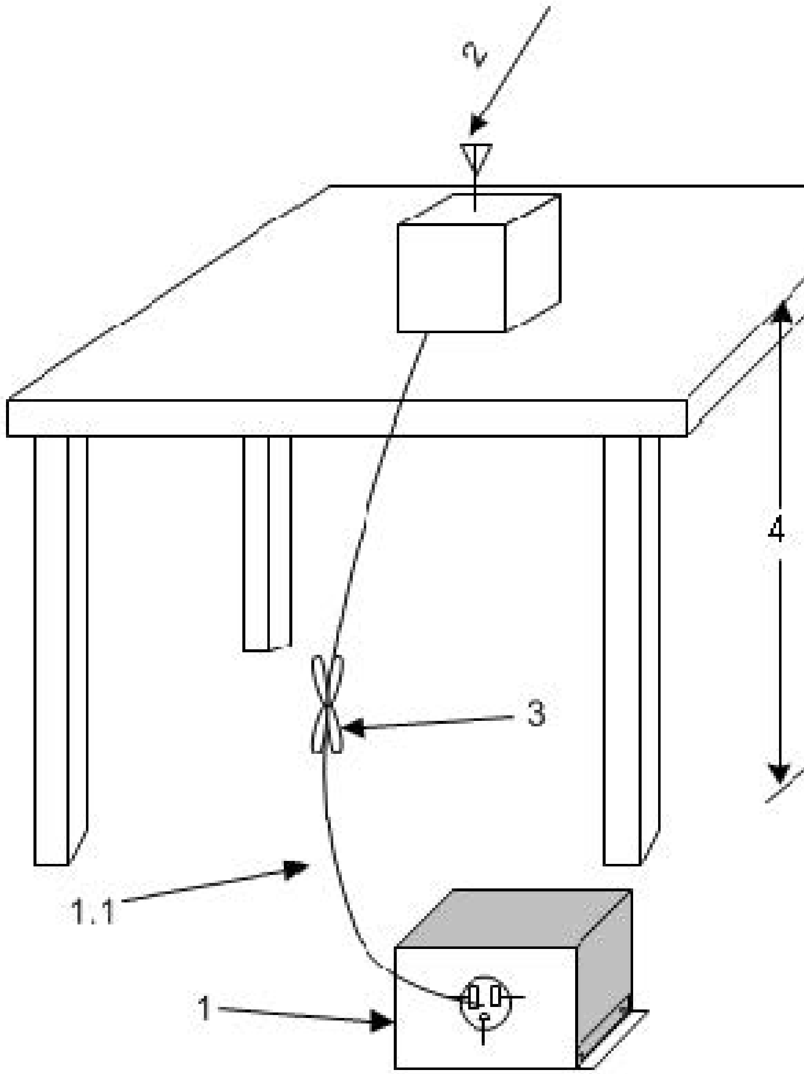
Antenna Port Conducted Emission Test Procedure

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 on test sample #2 as required 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 unlicensed wireless 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.



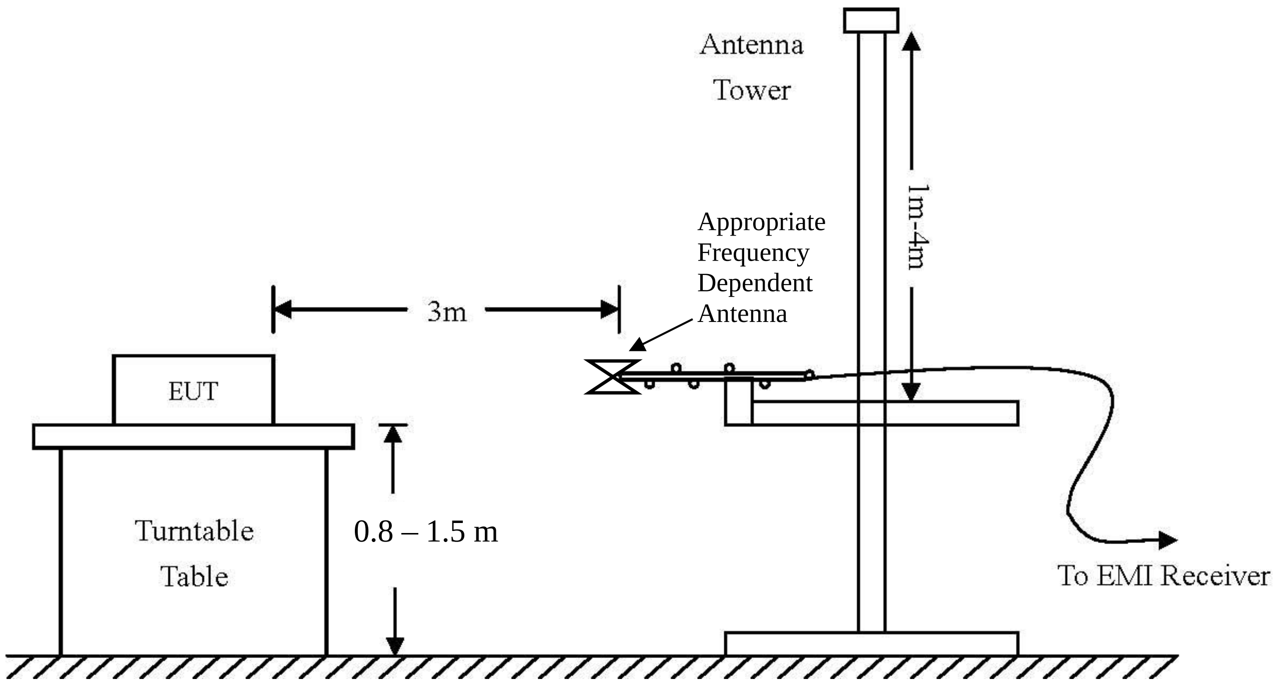
1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long see (see 6.2.3.2).
2. The I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, 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 may 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 edge of tabletop (see 6.2.3.2).
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 nearest part of 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



Frequency: 9 kHz-30 MHz	Frequency: 30 MHz- 1 GHZ	Frequency: Above 1 GHz
Loop Antenna	Broadband Biconilog	Horn
RBW = 9 kHz	RBW = 120 kHz	RBW = 1 MHz
VBW = 30 kHz	VBW = 120 kHz	VBW = 1 MHz
Sweep time = Auto	Sweep time = Auto	Sweep time = Auto
Detector = PK, QP	Detector = PK, QP	Detector = PK, AV
Antenna Height 1m	Antenna Height 1-4m	Antenna Height 1-4m

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

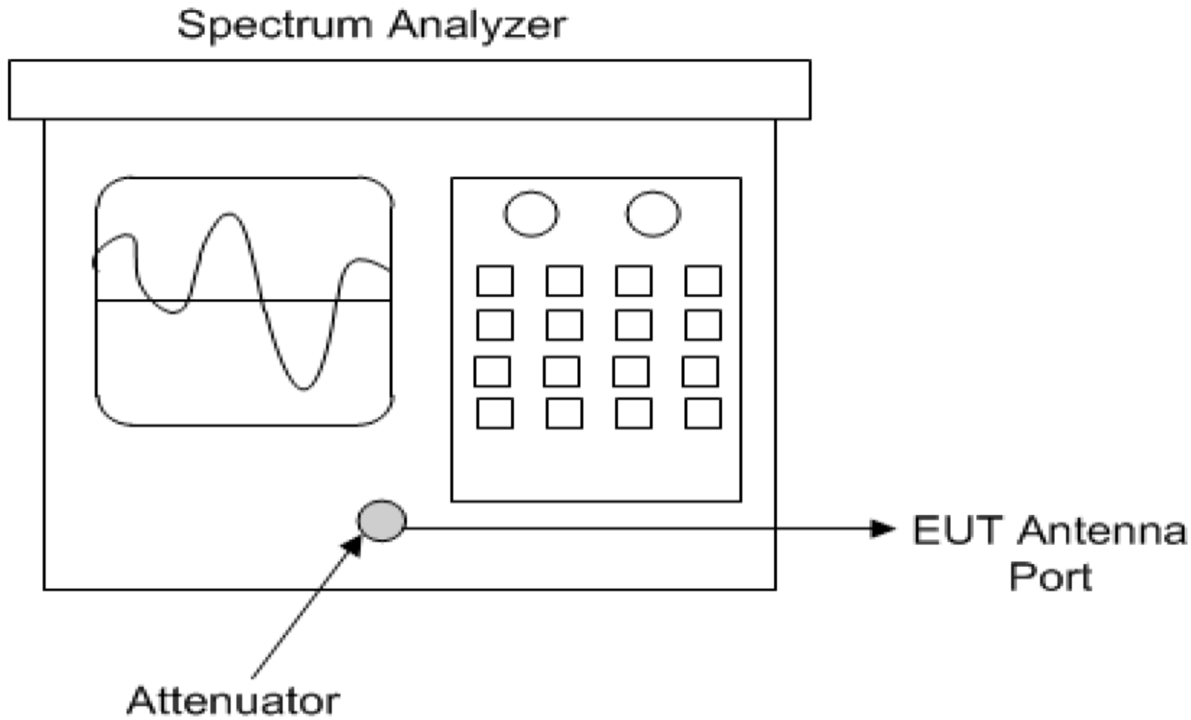


Diagram 4 Test arrangement for Antenna Port Conducted emissions

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
Antenna port	Antenna port conducted emissions testing was 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 information: FCC Site: US5305, ISED: 3041A, CAB Identifier: US0096

NVLAP Accreditation Lab code 200087-0

Units of Measurements

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

Antenna port Conducted Data is in dBm; dB referenced to one milliwatt

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

Note: The limit is expressed for a measurement in dBμV/m when the measurement is taken at a distance of 3 or 10 meters. Data taken for this report was taken at distance of 3 meters. Sample calculation demonstrates corrected field strength reading for Open Area Test Site using the measurement reading and correcting for receive antenna factor, cable losses, and amplifier gains.

Sample Calculation:

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

Environmental Conditions

Ambient Temperature 23.0-24.5° C

Relative Humidity 40-45 %

Atmospheric Pressure 1012.3-1023.4 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-247 Issue 2, and RSS-GEN Issue 5 emission requirements. There were no deviations to the specifications.

Intentional Radiators

The following information is submitted supporting compliance with the requirements of 47 CFR, Subpart C, paragraph 15.247 and Industry Canada RSS-247 Issue 2 and RSS-GEN Issue 5.

Antenna Requirements

The EUT utilizes attached antenna system and offers no provision for antenna replacement. The antenna system complies with the unique antenna connection requirements. The requirements of 15.203 are fulfilled 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 on the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in restricted bands. Emissions were investigated at the antenna port and OATS, using appropriate antennas or pyramidal horns, amplification stages, and 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 radiated emission values account for measured radiated field strength, receive antenna correction factor, amplifier gain stage, and test system cable losses.

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

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dBm)	Vertical Margin (dBm)
2390.0	44.5	31.1	61.2	45.8	54.0	-22.9	-8.2
2483.5	46.1	32.4	58.5	42.4	54.0	-21.6	-11.6
4824.0	51.2	40.8	52.7	43.4	54.0	-13.2	-10.6
4874.0	51.4	41.1	55.2	48.8	54.0	-12.9	-5.2
4924.0	50.4	38.6	59.1	53.8	54.0	-15.4	-0.2
7236.0	52.8	40.0	53.7	41.0	54.0	-14.0	-13.0
7311.0	52.7	40.1	54.2	41.0	54.0	-13.9	-13.0
7386.0	53.2	40.2	54.4	41.0	54.0	-13.8	-13.0
12060.0	58.7	45.0	59.2	46.1	54.0	-9.0	-7.9
12185.0	58.7	46.2	59.8	46.7	54.0	-7.8	-7.3
12310.0	59.6	46.8	61.1	47.2	54.0	-7.2	-6.8

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

Table 2 Harmonic Radiated Emissions in Restricted Bands Data (Mode 2 802.11g)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dBm)	Vertical Margin (dBm)
2390.0	45.2	31.3	57.9	40.9	54.0	-22.7	-13.1
2483.5	50.8	32.8	59.4	42.3	54.0	-21.2	-11.7
4824.0	51.5	42.1	51.9	41.6	54.0	-11.9	-12.4
4874.0	51.9	42.0	55.4	48.5	54.0	-12.0	-5.5
4924.0	52.7	44.6	58.3	53.3	54.0	-9.4	-0.7
7236.0	52.9	40.0	52.8	40.3	54.0	-14.0	-13.7
7311.0	53.4	40.1	53.2	40.3	54.0	-13.9	-13.7
7386.0	53.1	40.2	54.1	40.5	54.0	-13.8	-13.5
12060.0	58.2	45.0	59.2	46.2	54.0	-9.0	-7.8
12185.0	58.7	46.0	60.1	47.5	54.0	-8.0	-6.5
12310.0	59.7	47.0	60.2	47.4	54.0	-7.0	-6.6

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

Table 3 Harmonic Radiated Emissions in Restricted Bands Data (Mode 3 802.11n)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dBm)	Vertical Margin (dBm)
2390.0	45.3	31.4	58.3	42.6	54.0	-22.6	-11.4
2483.5	45.9	32.8	59.0	42.8	54.0	-21.2	-11.2
4824.0	51.7	42.3	52.5	42.4	54.0	-11.7	-11.6
4874.0	51.5	42.3	53.5	45.5	54.0	-11.7	-8.5
4924.0	53.1	45.1	58.2	53.4	54.0	-8.9	-0.6
7236.0	53.4	40.3	53.6	40.4	54.0	-13.7	-13.6
7311.0	53.2	40.4	53.4	40.4	54.0	-13.6	-13.6
7386.0	53.6	40.5	53.6	40.5	54.0	-13.5	-13.5
12060.0	59.4	46.6	59.8	47.2	54.0	-7.4	-6.8
12185.0	62.0	48.6	61.3	47.8	54.0	-5.4	-6.2
12310.0	60.6	47.5	60.8	47.5	54.0	-6.5	-6.5

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

Table 4 Harmonic Radiated Emissions in Restricted Bands Data (Mode 3 802.11n40)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dBm)	Vertical Margin (dBm)
2390.0	45.7	31.9	63.4	47.4	54.0	-22.1	-6.6
2483.5	46.5	32.7	63.4	48.0	54.0	-21.3	-6.0
4844.0	52.1	43.2	52.0	42.7	54.0	-10.8	-11.3
4894.0	52.0	43.2	50.1	38.0	54.0	-10.8	-16.0
4904.0	52.5	43.6	54.0	46.1	54.0	-10.4	-7.9
7266.0	53.4	40.5	53.2	40.4	54.0	-13.5	-13.6
7341.0	53.5	40.5	53.2	40.4	54.0	-13.5	-13.6
7356.0	54.1	40.4	53.4	40.4	54.0	-13.6	-13.6
12110.0	58.5	46.0	59.8	46.3	54.0	-8.0	-7.7
12235.0	61.1	47.8	59.6	47.1	54.0	-6.2	-6.9
12260.0	60.0	47.3	60.4	47.2	54.0	-6.7	-6.8

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

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the emissions requirements of 47CFR 15.205, RSS-GEN and RSS-247, Issue 2 Intentional Radiators. The EUT provided a worst-case minimum margin of -0.2 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 Emissions Procedure

The EUT was arranged in typical equipment configurations and placed on a 1 x 1.5-meter wooden 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 line-conducted emissions were the procedures of ANSI C63.10-2013 paragraph 6. The AC adapter for the EUT was connected to the LISN for 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 EUT. 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 were carried out individually for each current carrying conductor of the EUT support equipment. 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 frequency of each emission displaying the highest amplitude. 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 then the data was recorded with maximum conducted emissions levels.

Refer to figures one and two for plots of the AC Line Conducted emissions of the EUT - AC/DC Adapter configuration and support equipment. Refer to figures three and four displaying plots of the AC Line Conducted emissions of the EUT -POE - AC/DC Adapter configuration and support equipment

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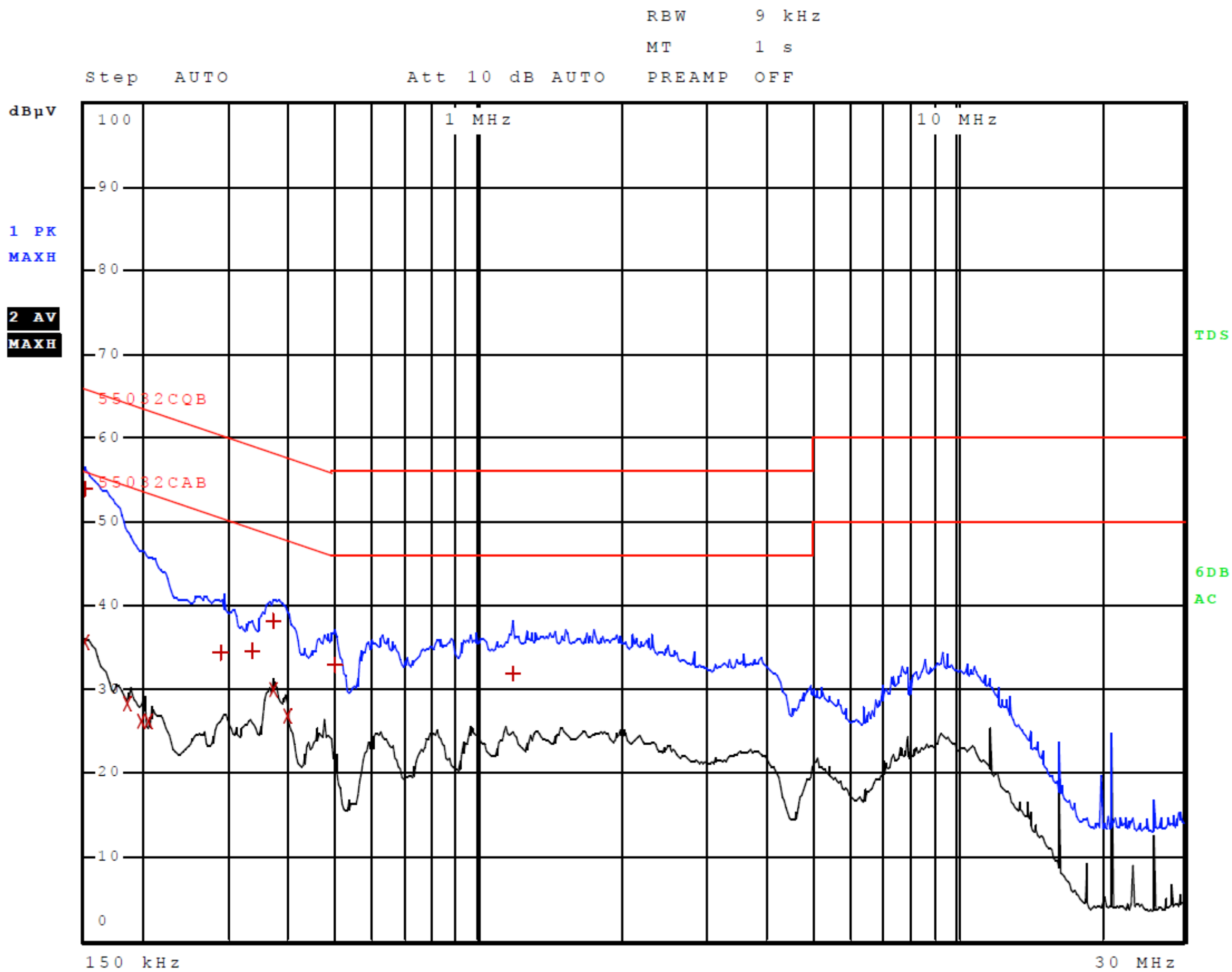

Figure 1 AC Line Conducted Emissions Line 1 (EUT - AC/DC)

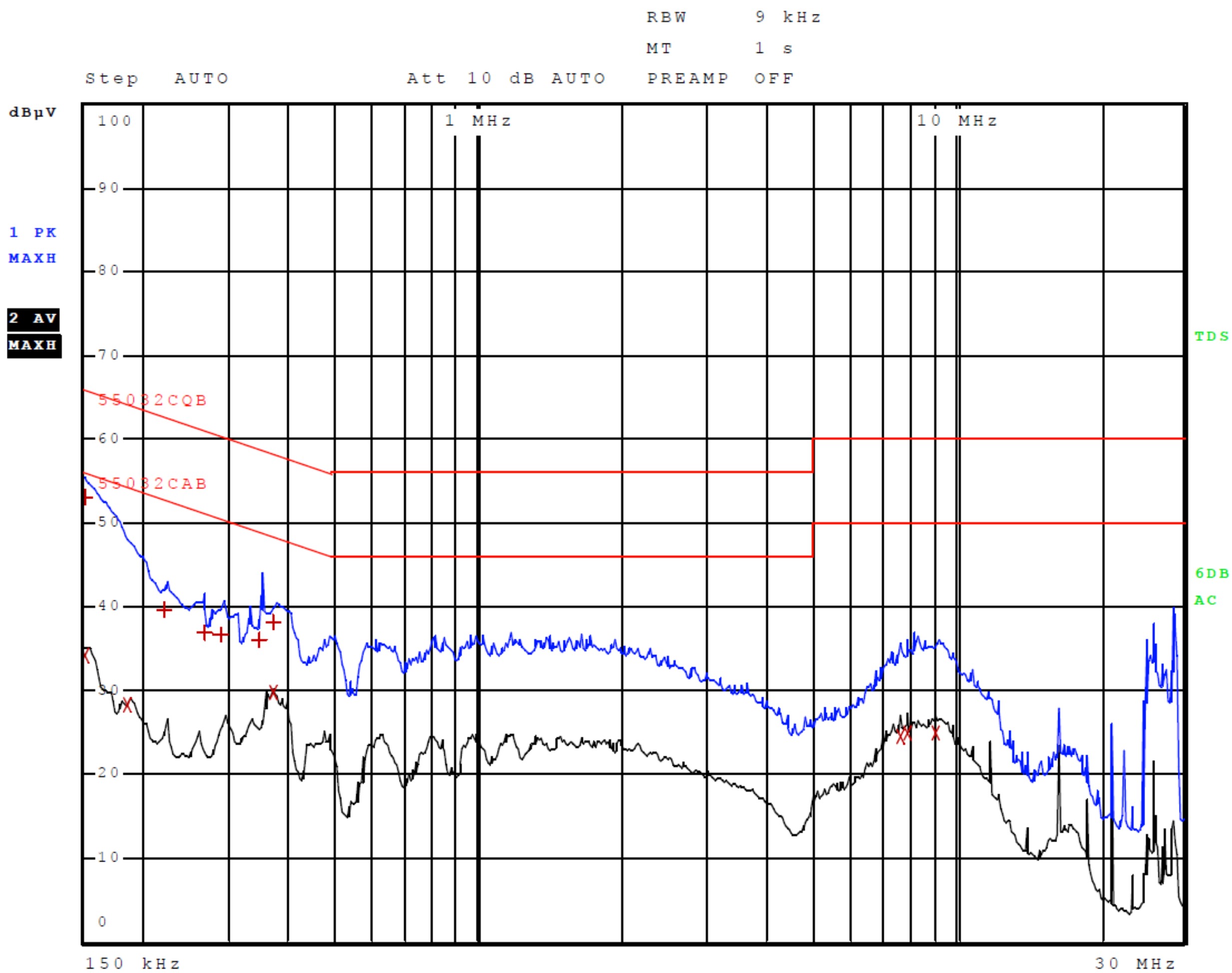

Figure 2 AC Line Conducted Emissions Line 2 (EUT - AC/DC)

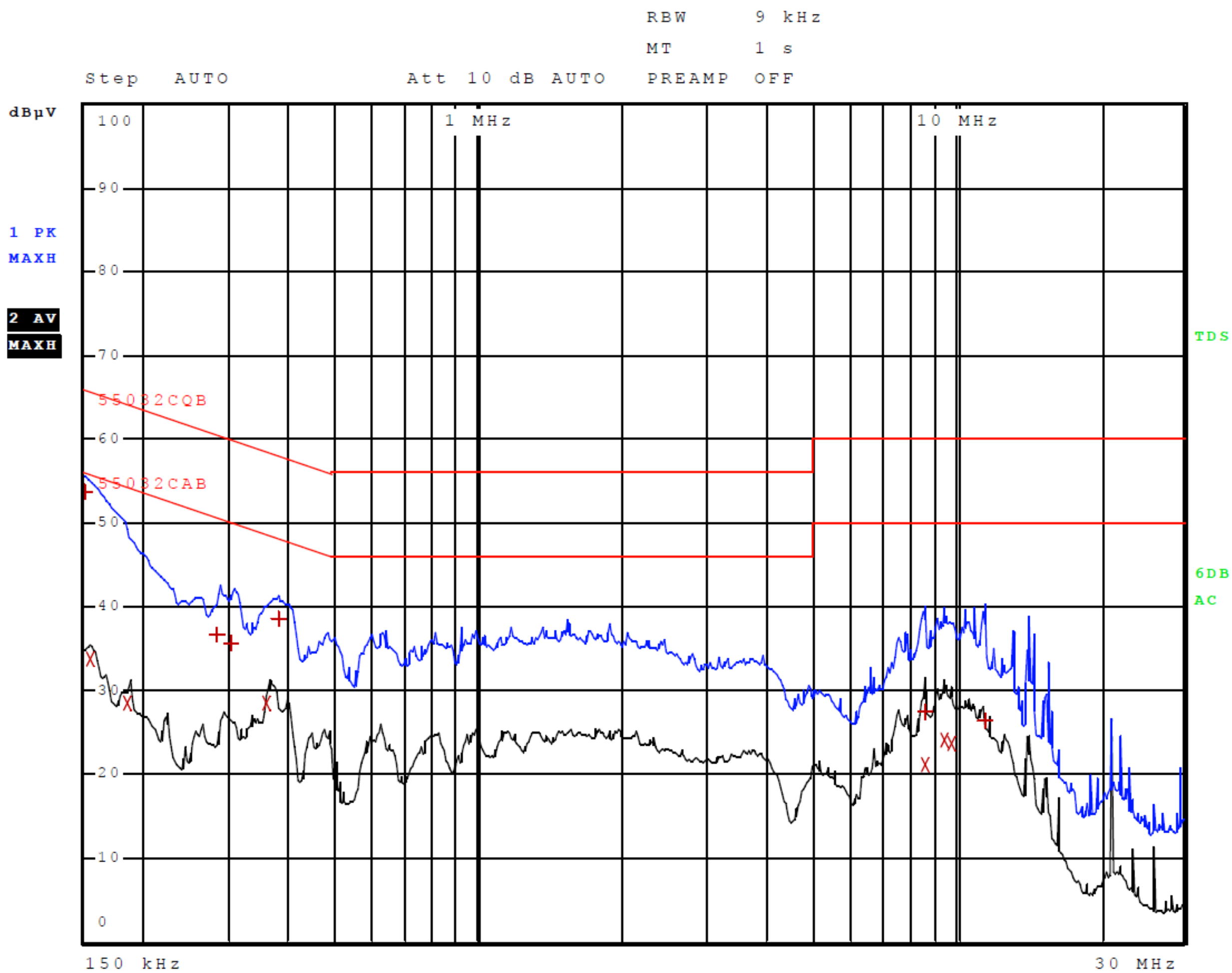

Figure 3 AC Line Conducted Emissions Line 1 (EUT - POE -AC/DC)

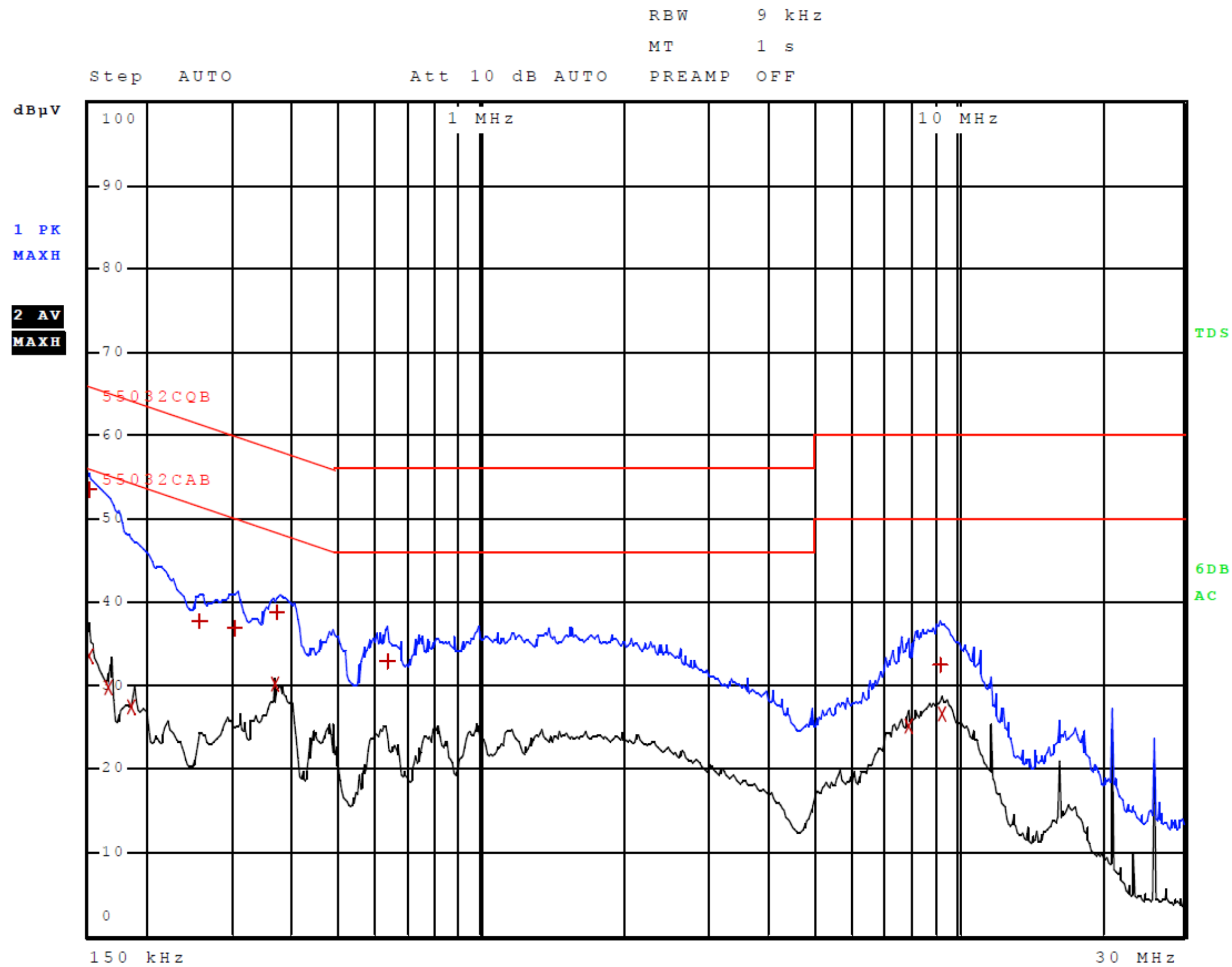

Figure 4 AC Line Conducted Emissions Line 2 (EUT - POE -AC/DC)

Table 5 AC Line Conducted Emissions Data (Highest Emissions Line L1, EUT - AC/DC)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	150.000000000 kHz	35.71	Average	-20.29
1	150.000000000 kHz	53.84	Quasi Peak	-12.16
2	186.000000000 kHz	28.26	Average	-25.95
2	198.000000000 kHz	26.12	Average	-27.57
2	206.000000000 kHz	26.06	Average	-27.30
1	290.000000000 kHz	34.26	Quasi Peak	-26.26
1	334.000000000 kHz	34.50	Quasi Peak	-24.85
2	370.000000000 kHz	30.01	Average	-18.49
1	370.000000000 kHz	38.14	Quasi Peak	-20.36
2	394.000000000 kHz	26.72	Average	-21.26
1	498.000000000 kHz	32.91	Quasi Peak	-23.12
1	1.174000000 MHz	31.78	Quasi Peak	-24.22

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

Table 6 AC Line Conducted Emissions Data (Highest Emissions Line L2, EUT - AC/DC)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	150.000000000 kHz	34.19	Average	-21.81
1	150.000000000 kHz	53.15	Quasi Peak	-12.85
2	186.000000000 kHz	28.26	Average	-25.96
1	222.000000000 kHz	39.55	Quasi Peak	-23.19
1	266.000000000 kHz	36.82	Quasi Peak	-24.43
1	290.000000000 kHz	36.68	Quasi Peak	-23.85
1	350.000000000 kHz	36.10	Quasi Peak	-22.86
2	370.000000000 kHz	29.80	Average	-18.70
1	374.000000000 kHz	38.11	Quasi Peak	-20.31
2	7.632000000 MHz	24.51	Average	-25.49
2	7.928000000 MHz	24.80	Average	-25.20
2	9.036000000 MHz	24.82	Average	-25.18

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

Table 7 AC Line Conducted Emissions Data (Highest Emissions Line L1, EUT-POE-AC/DC)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	53.77	Quasi Peak	-12.23
2	154.000000000 kHz	33.73	Average	-22.05
2	186.000000000 kHz	28.49	Average	-25.72
1	286.000000000 kHz	36.64	Quasi Peak	-23.99
1	306.000000000 kHz	35.63	Quasi Peak	-24.45
2	362.000000000 kHz	28.39	Average	-20.29
1	378.000000000 kHz	38.60	Quasi Peak	-19.72
1	8.632000000 MHz	27.48	Quasi Peak	-32.52
2	8.636000000 MHz	21.17	Average	-28.83
2	9.444000000 MHz	24.10	Average	-25.90
2	9.784000000 MHz	23.59	Average	-26.41
1	11.480000000 MHz	26.33	Quasi Peak	-33.67

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

Table 8 AC Line Conducted Emissions Data (Highest Emissions Line L2, EUT-POE-AC/DC)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	53.54	Quasi Peak	-12.46
2	150.000000000 kHz	33.42	Average	-22.58
2	166.000000000 kHz	29.73	Average	-25.43
2	186.000000000 kHz	27.42	Average	-26.79
1	258.000000000 kHz	37.74	Quasi Peak	-23.75
1	306.000000000 kHz	36.88	Quasi Peak	-23.19
2	366.000000000 kHz	30.17	Average	-18.42
1	374.000000000 kHz	38.81	Quasi Peak	-19.60
1	630.000000000 kHz	32.93	Quasi Peak	-23.07
2	7.924000000 MHz	25.07	Average	-24.93
1	9.244000000 MHz	32.37	Quasi Peak	-27.63
2	9.312000000 MHz	26.59	Average	-23.41

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

Summary of Results for AC Line Conducted Emissions

The EUT test system demonstrated compliance with the AC Line conducted emissions requirements of 47CFR 15.207, RSS-247 Issue 2 and RSS-GEN. The worst-case EUT configuration demonstrated a minimum margin of -12.1 dB below the limit. Measurements were taken using the peak, quasi peak, and average, measurement function for each emissions amplitude and were below the limits stated in the specification. Other emissions were present with recorded data representing worst-case amplitudes.

General Radiated Emissions Procedure

The EUT was arranged in typical equipment configurations and operated through all available modes with worst-case data recorded. 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 emissions measurements were performed. Final data was taken with the EUT located at the OATS at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 9 kHz to 25,000 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 from 1 GHz to 25 GHz, notch filters, and appropriate amplifiers were used during investigation and testing.

Table 9 General Radiated Emissions from EUT Data (Highest Emissions)

Frequency (MHz)	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dBm)	Vertical Margin (dBm)
48.7	34.3	29.9	40.3	36.2	40.0	-10.1	-3.8
50.1	32.6	26.5	35.4	30.0	40.0	-13.5	-10.0
64.5	34.4	29.4	37.7	33.7	40.0	-10.7	-6.3
69.4	35.3	26.1	34.5	28.3	40.0	-13.9	-11.7
71.2	35.2	24.6	38.9	27.1	40.0	-15.4	-12.9
77.7	35.2	30.3	37.6	32.5	40.0	-9.7	-7.5
78.5	34.9	30.8	35.2	31.1	40.0	-9.2	-8.9
145.5	26.7	19.9	33.7	25.6	43.5	-23.6	-17.9
147.6	32.6	26.9	32.9	29.3	43.5	-16.6	-14.2
150.3	29.2	17.9	31.9	24.6	43.5	-25.6	-18.9
154.9	29.6	23.4	33.2	30.3	43.5	-20.1	-13.2

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 47CFR part 15 and Industry Canada RSS-247 Issue 2 Intentional Radiators. The EUT demonstrated a minimum margin of -3.8 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Operation in the 2400-2483.5 MHz Frequency Band

Radiated emissions were measured on the Open Area Test Site (OATS) at a three-meter distance. Production equipment design of the EUT provides no connection to antenna ports. Radiated emissions measurements were performed on the production design test sample as documented in this report. Testing procedures defined in publications ANSI C63.10-2013 and KDB 558074 D01 15.247 Meas Guidance v05r02 were utilized during compliance testing. The EUT was placed on a turntable elevated as required above the ground plane at a distance of 3 meters from the FSM antenna located on the OATS. The peak and quasi-peak amplitude of the frequencies below 1000 MHz were measured using a spectrum analyzer / EMC receiver. The peak and average amplitude of emissions above 1000 MHz were measured using a spectrum analyzer / EMC receiver. Emissions data was recorded from the measurement results. Data presented reflects measurement result corrected to account for measurement system gains and losses. A second test sample was provided for testing. This sample replaced the integral antenna with 50-ohm connectors. Antenna conducted measurements were made on test sample #2 at the antenna port RF connections. Data presented reflects measurement result corrected to account for measurement system gains and losses. Plots were made of transmitter performance for reference purposes. Refer to figures three through twenty for plots of antenna port conducted performance.

Directional correlated antenna calculation (antenna gain 3 dBi and 2 chains). Per KDB 662911 D01 Multiple Transmitter Output v02r01, the directional gain for correlated emissions in-band may be calculated using the following formula:

Directional gain = G_{ANT} + 10 log (N_{ANT}) dBi

Directional gain = 3.0 + 10 log (2) dBi = 6.0 dBi

Note: The power of the transmitter has been adjusted for the gain exceeding 6dBi. Transmitter Power presented in tables 11 and 12 present EIRP power of each chain. Transmitter Power presented in table 13 presents EIRP maximum combined chains.

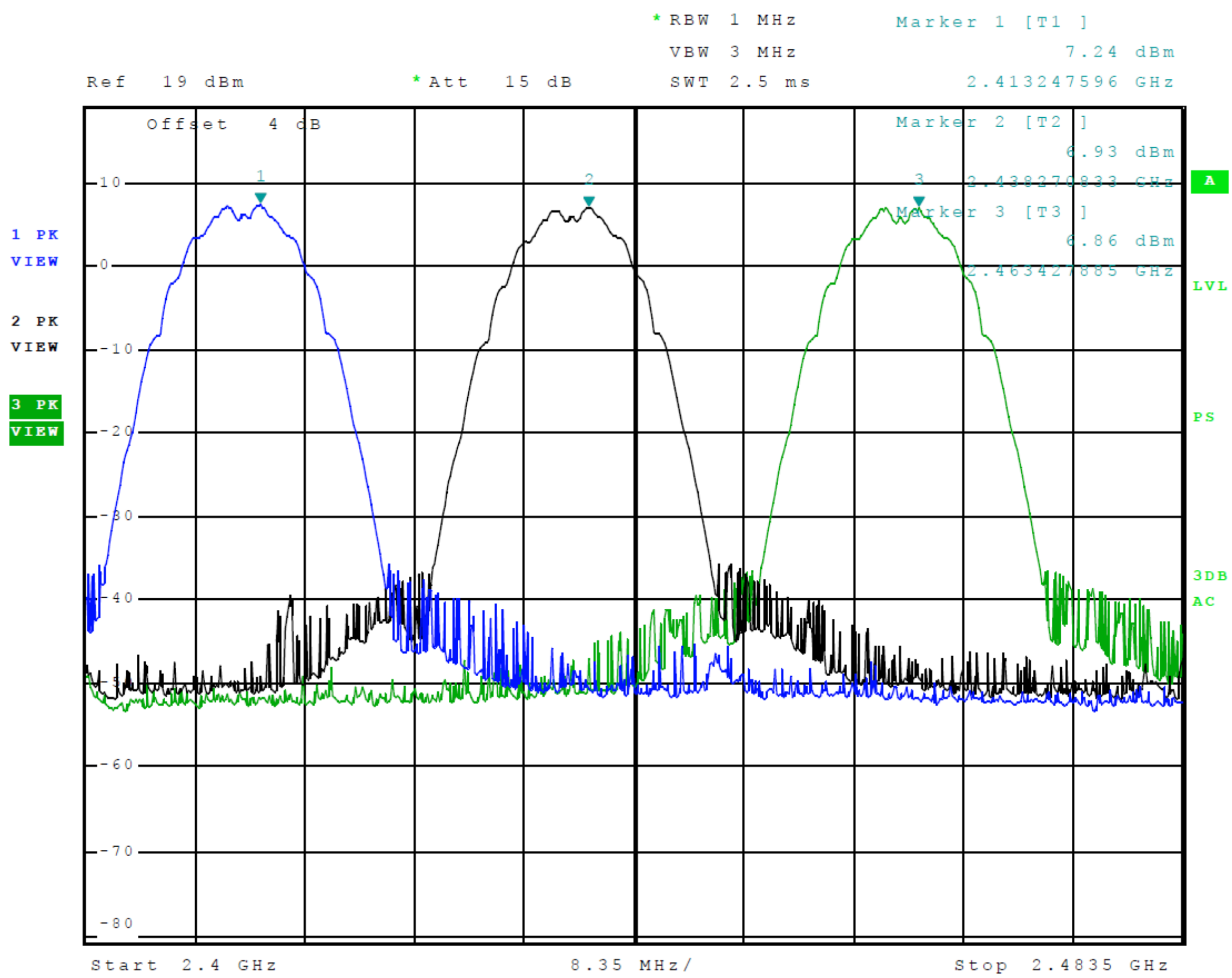

Figure 5 Plot of Transmitter Emissions (Across Operational Band 802.11b) Chain 0

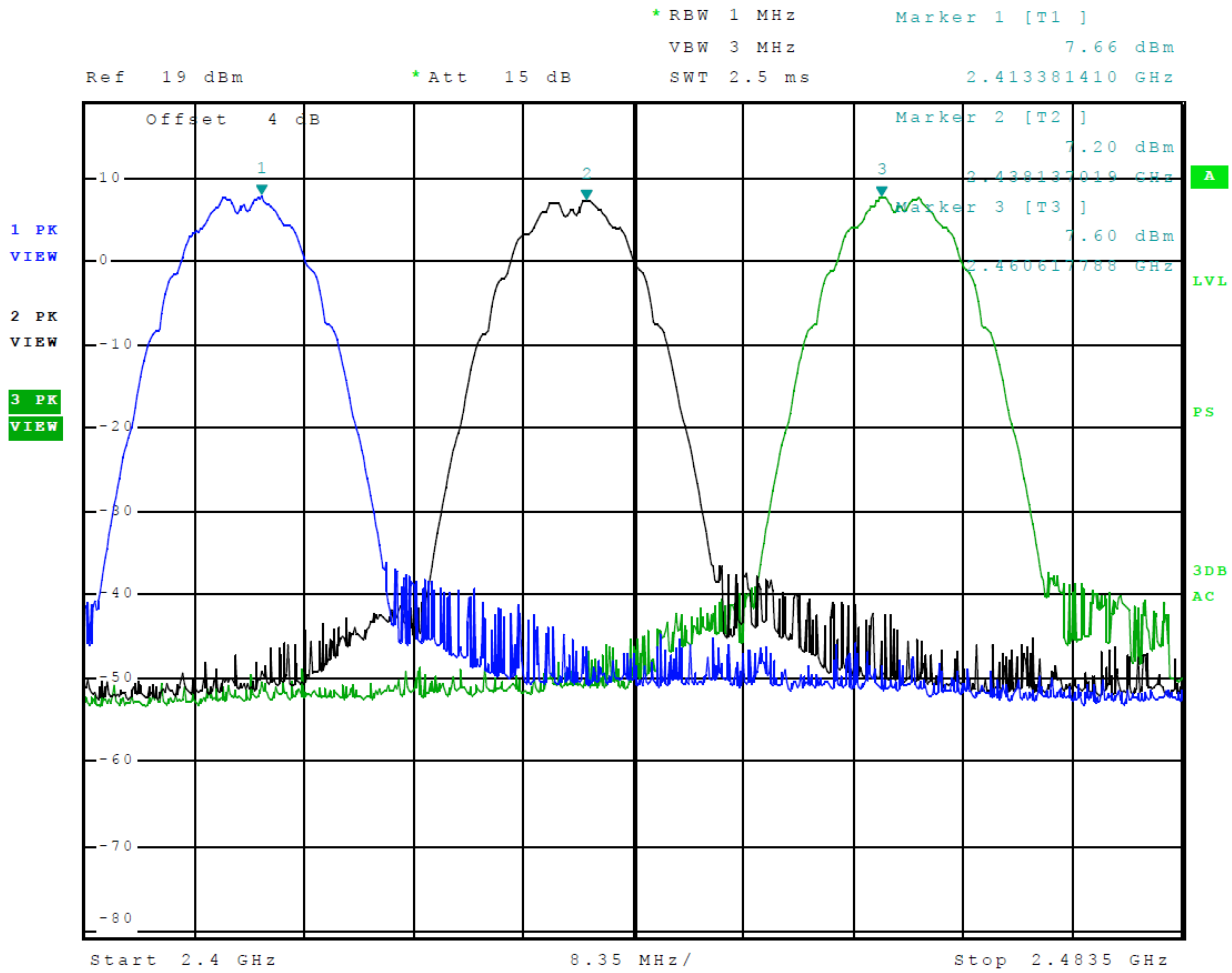

Figure 6 Plot of Transmitter Emissions (Across Operational Band 802.11b) Chain 1

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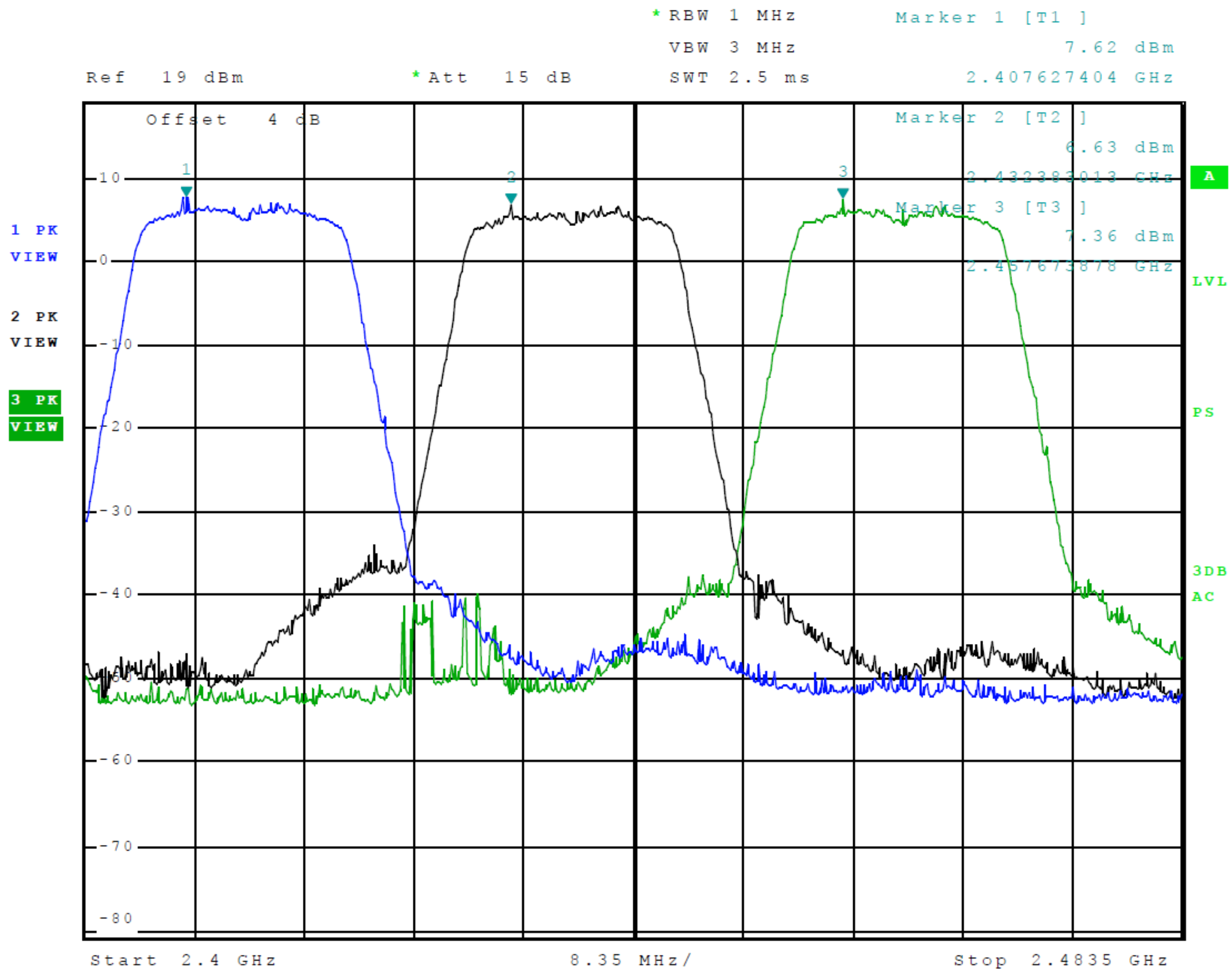

Figure 7 Plot of Transmitter Emissions (Across Operational Band, 802.11g) Chain 0

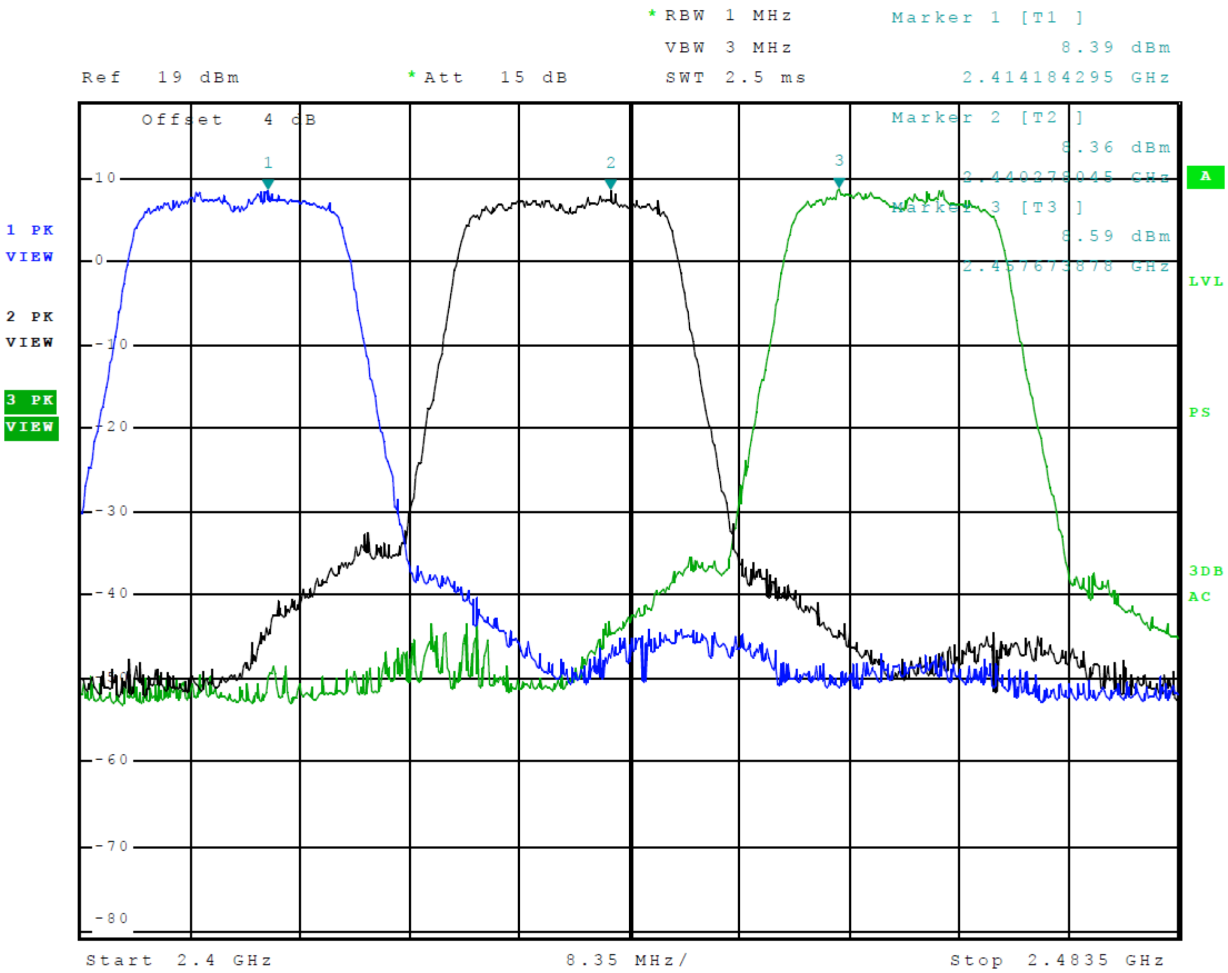

Figure 8 Plot of Transmitter Emissions (Across Operational Band, 802.11g) Chain 1

NVLAP Lab Code 200087-0

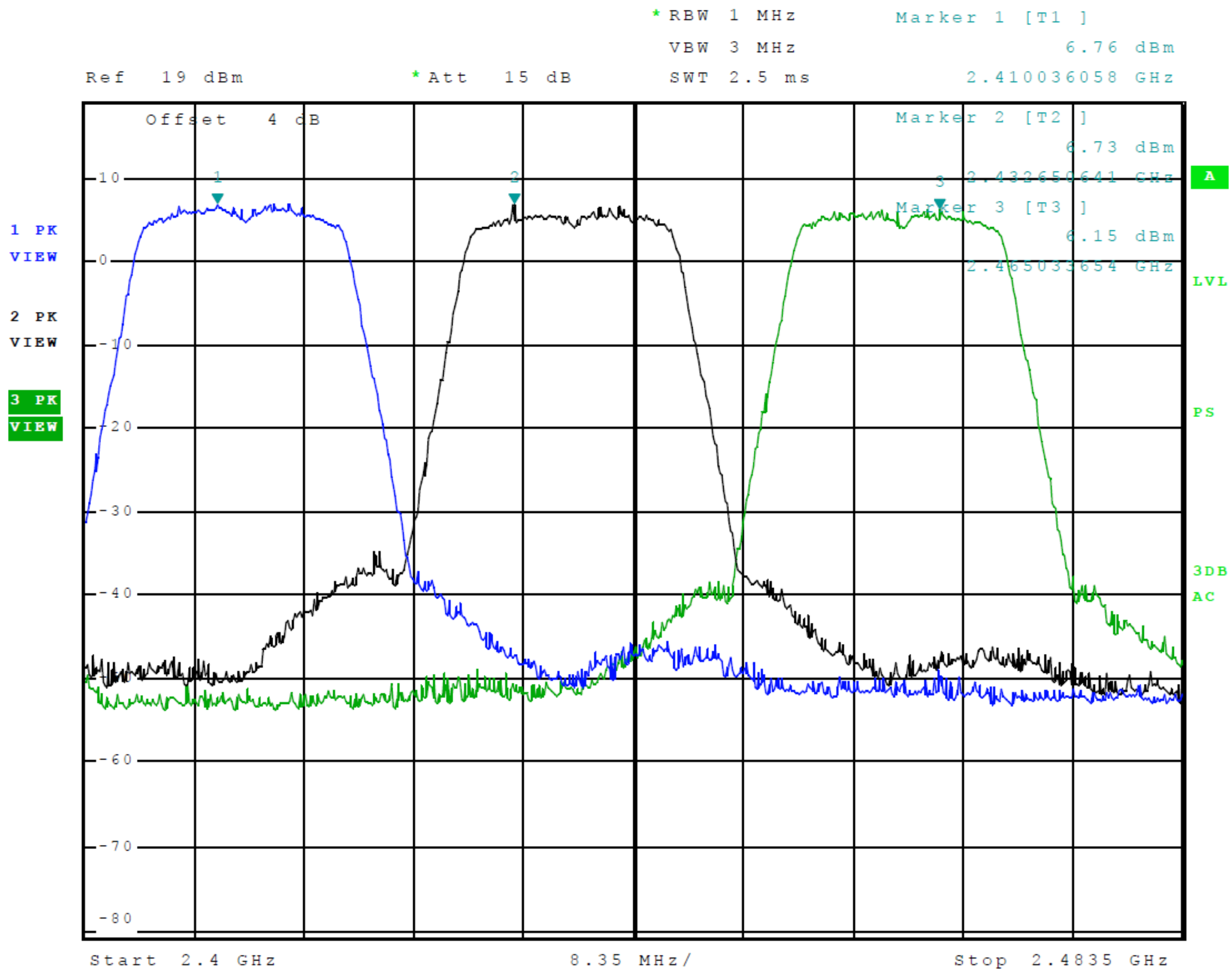

Figure 9 Plot of Transmitter Emissions (Across Operational Band, 802.11n) Chain 0

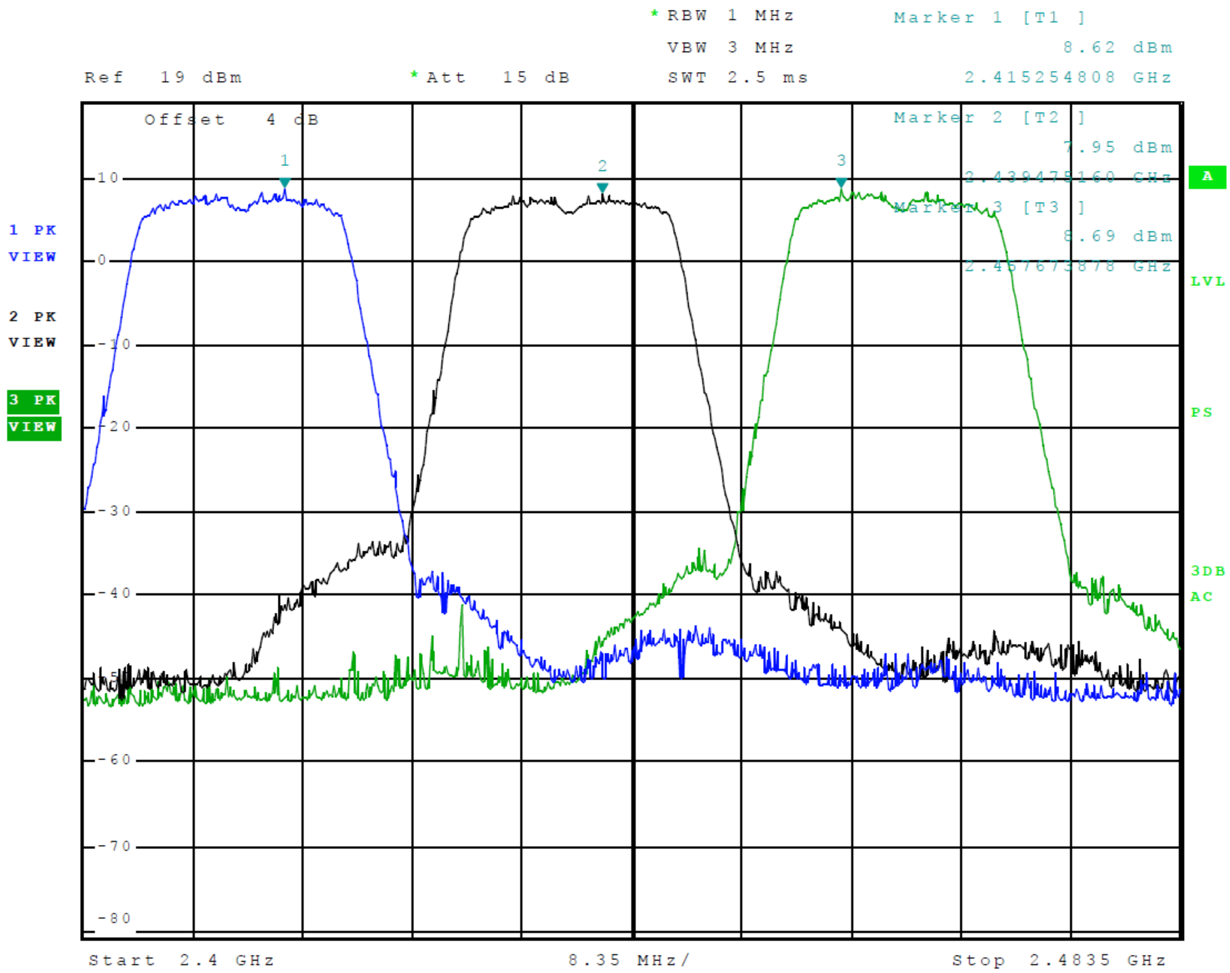

Figure 10 Plot of Transmitter Emissions (Across Operational Band, 802.11n) Chain 1

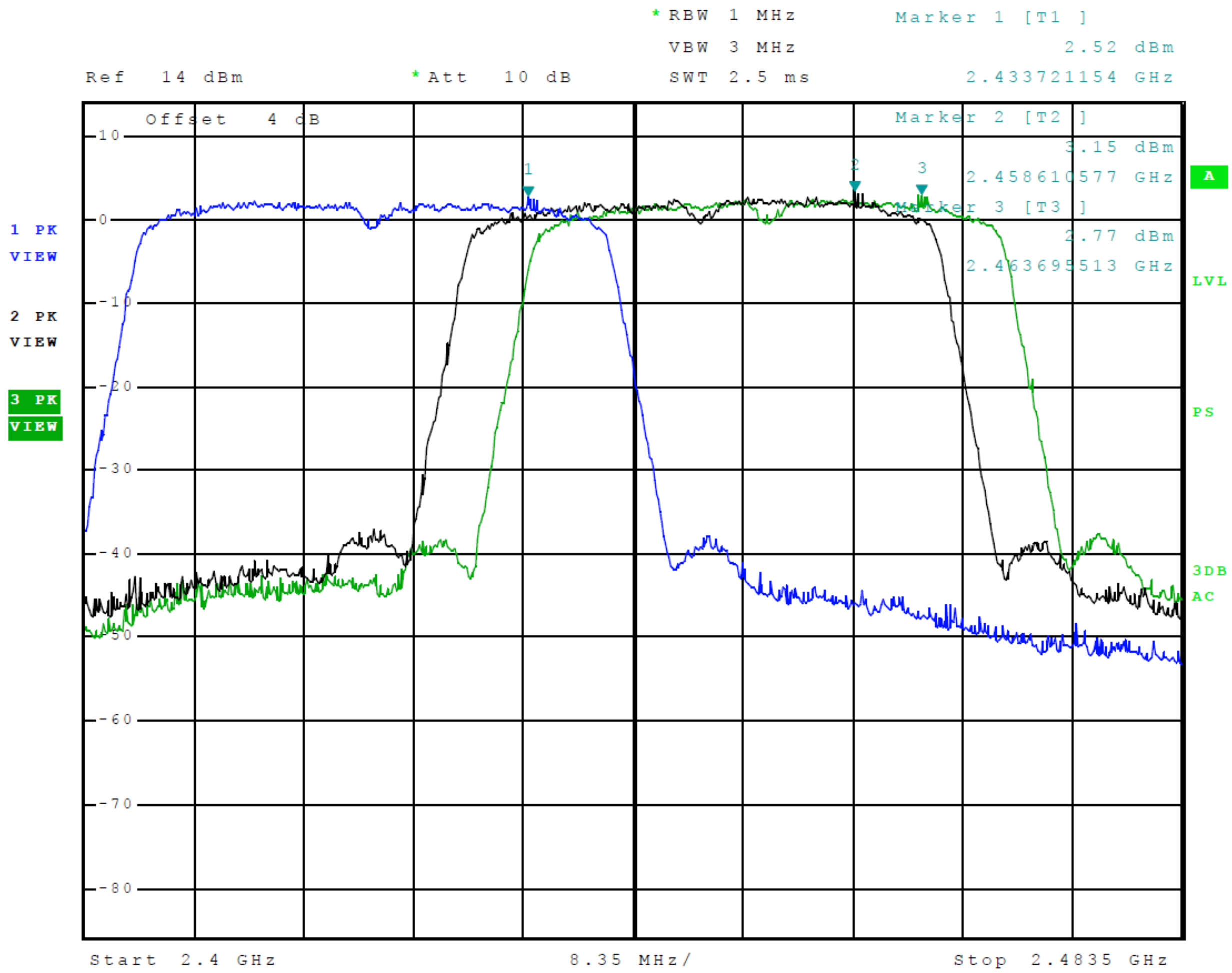

Figure 11 Plot of Transmitter Emissions (Across Operational Band, 802.11n40) Chain 0

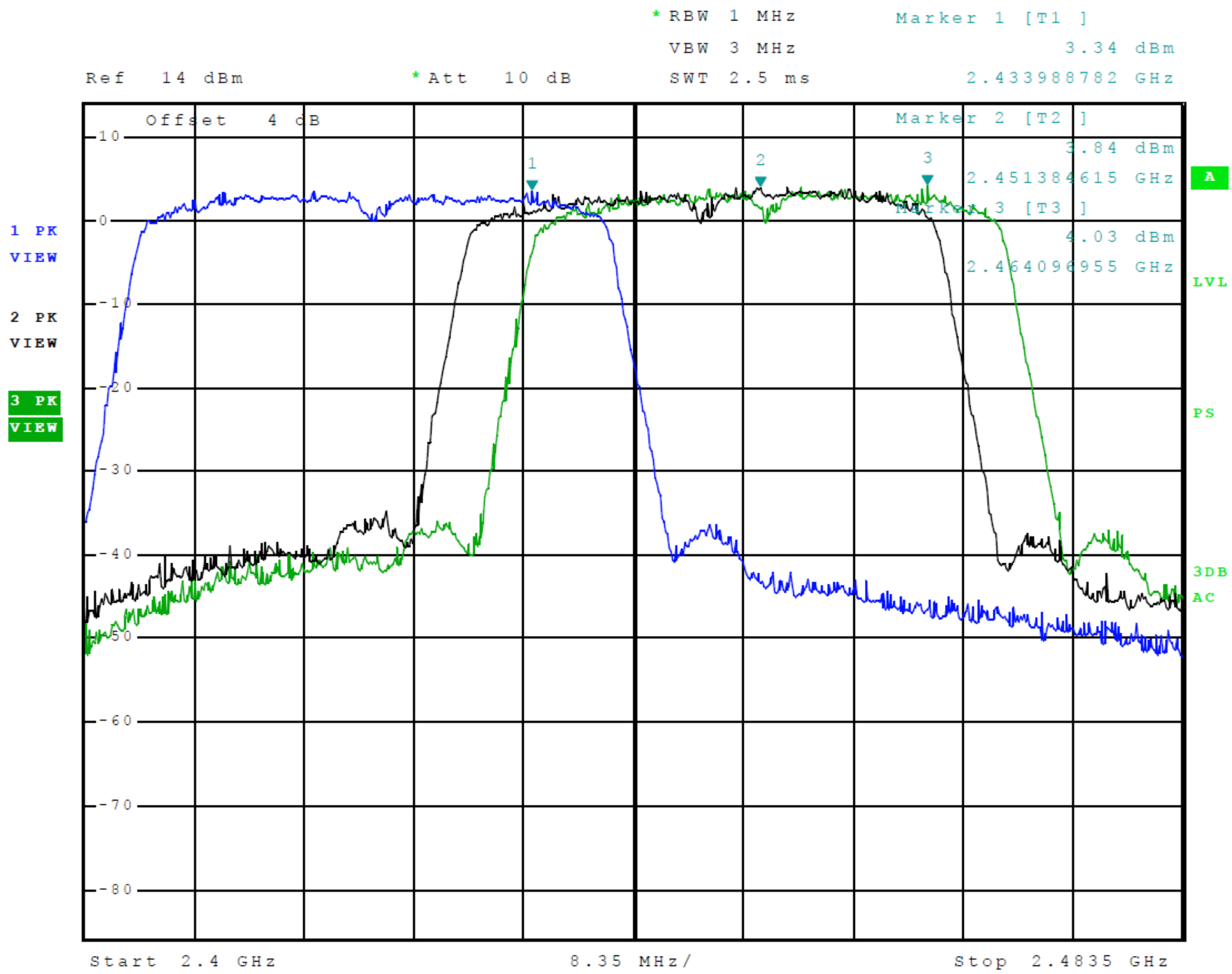

Figure 12 Plot of Transmitter Emissions (Across Operational Band, 802.11n40) Chain 1

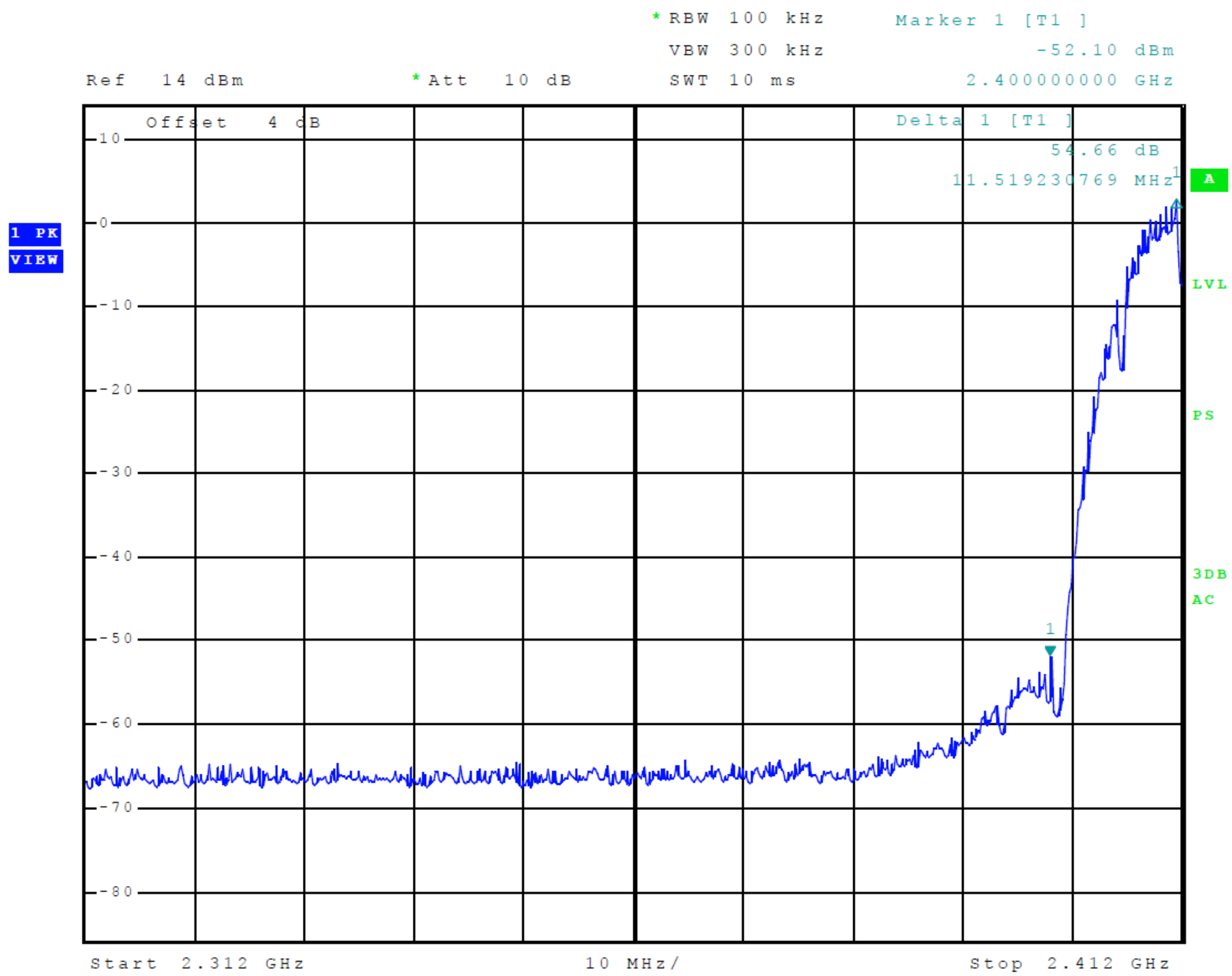

Figure 13 Plot of Transmitter Low Band Edge (802.11b) Chain 0

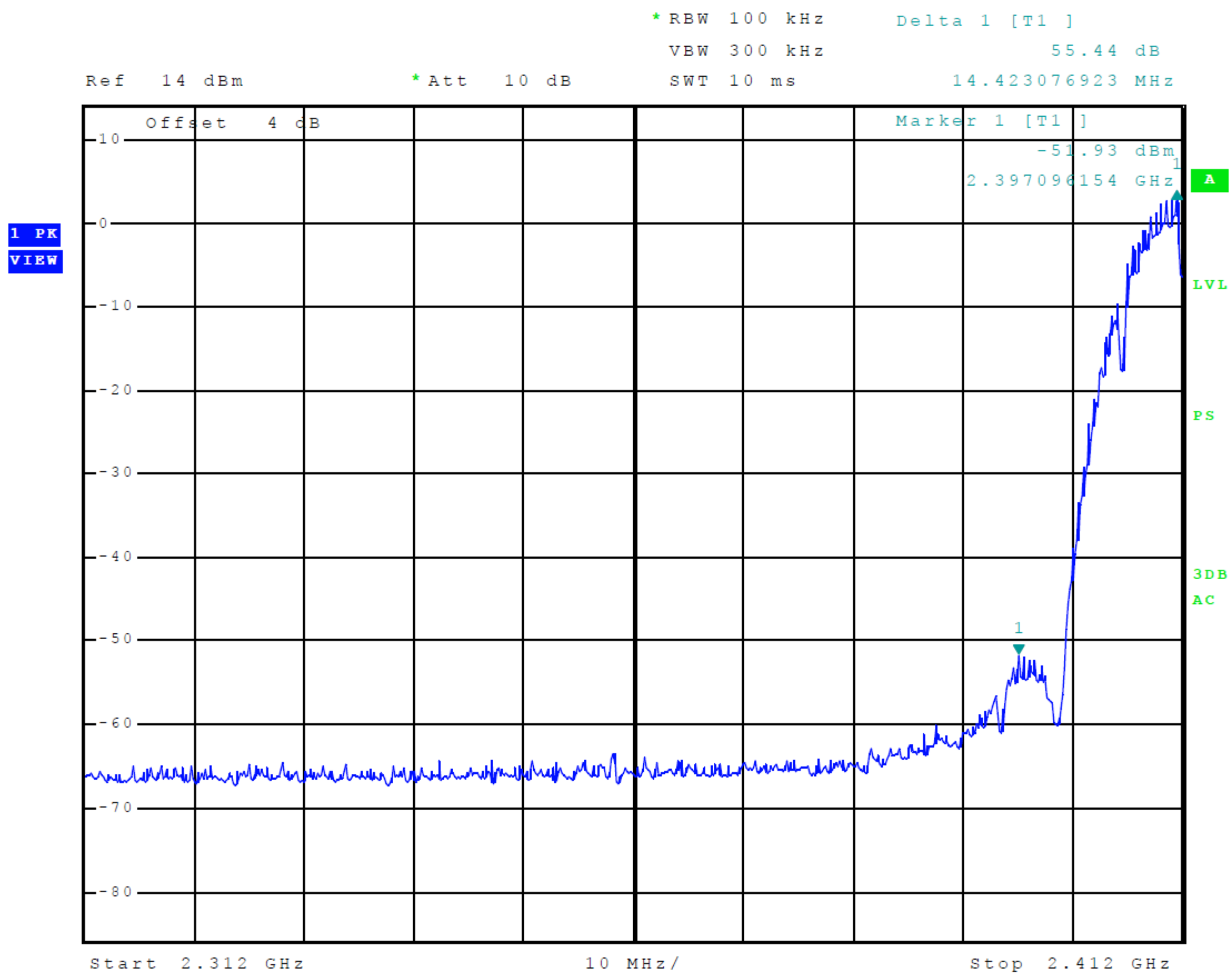

Figure 14 Plot of Transmitter Low Band Edge (802.11b) Chain 1

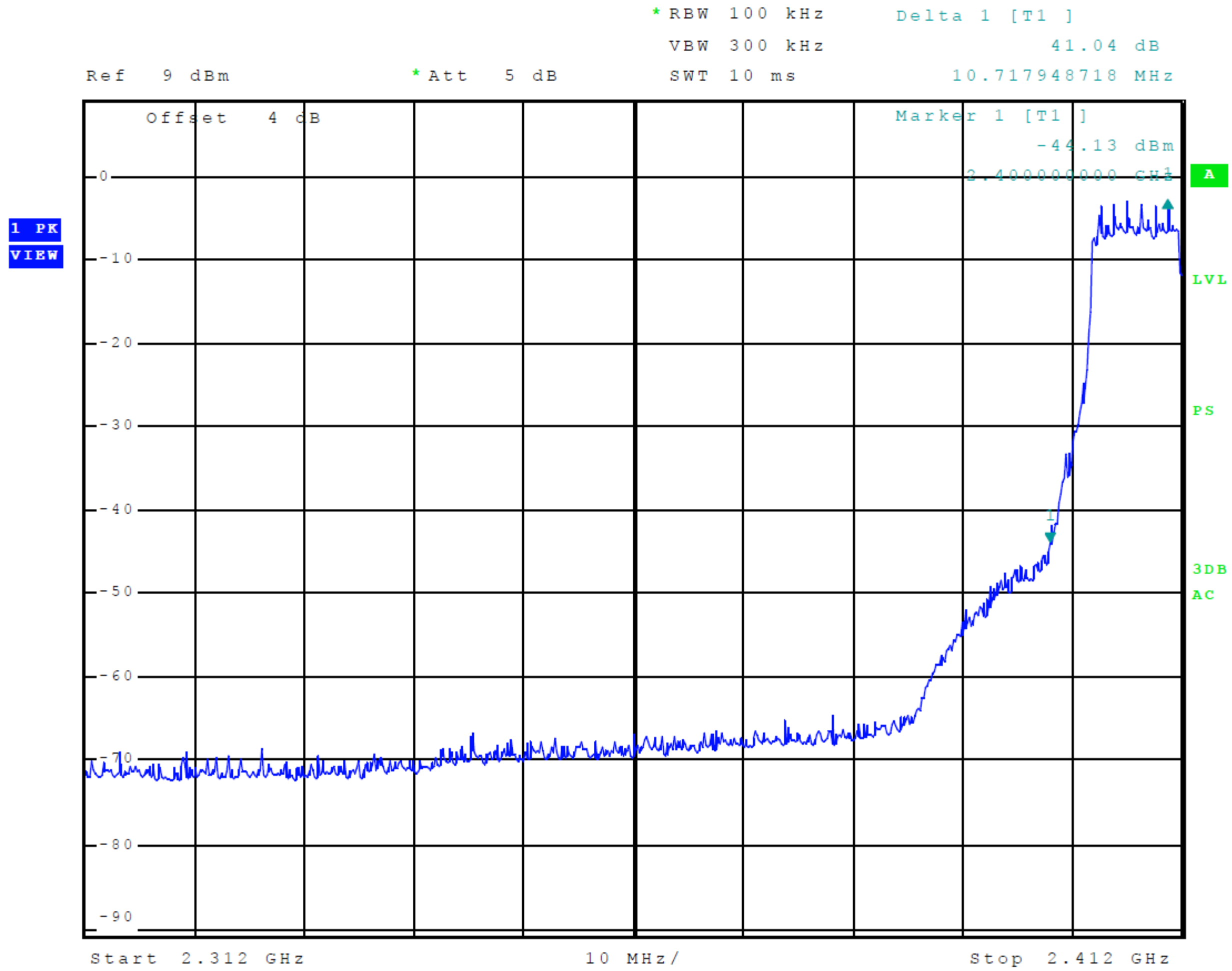

Figure 15 Plot of Transmitter Low Band Edge (802.11g) Chain 0

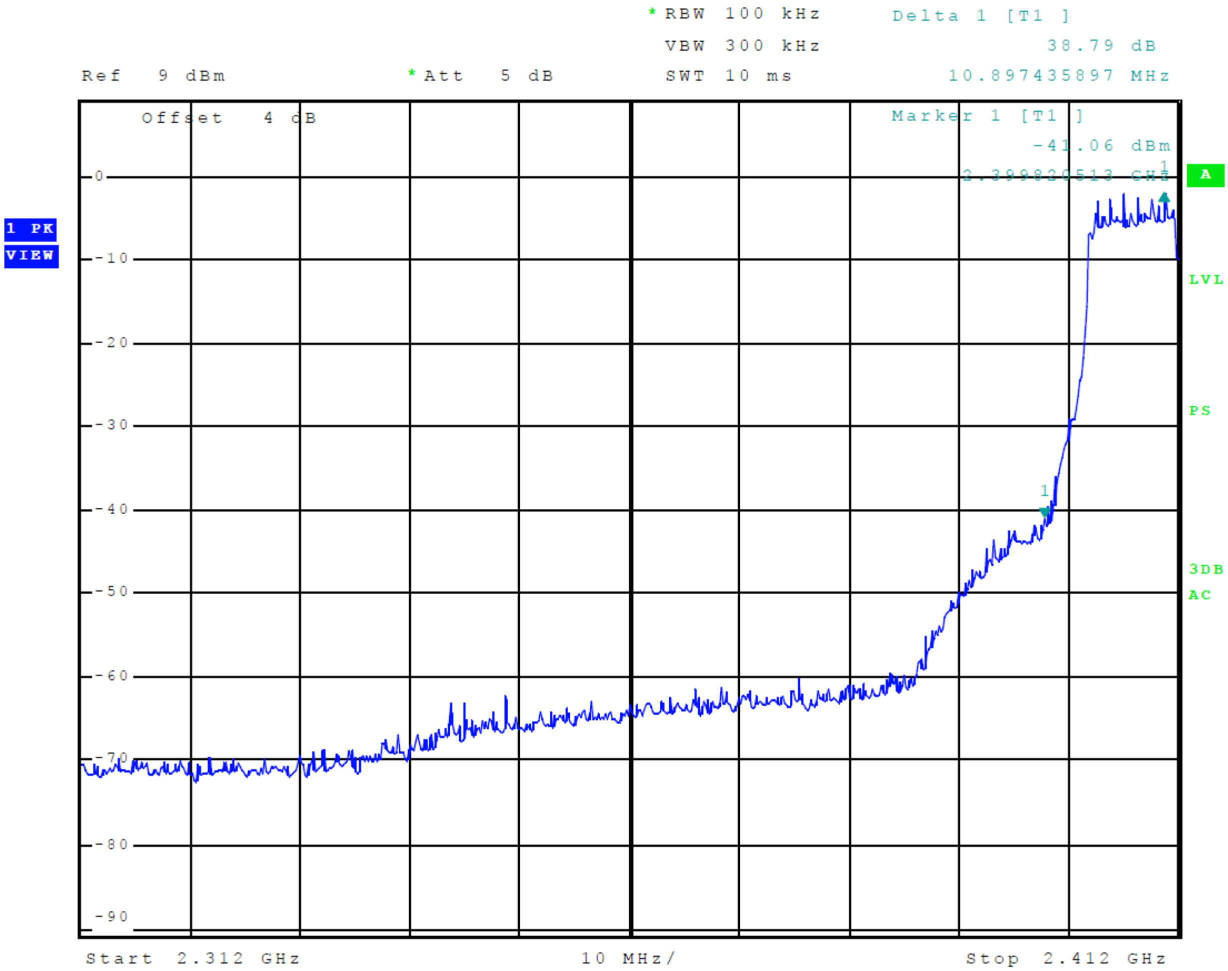

Figure 16 Plot of Transmitter Low Band Edge (802.11g) Chain 1

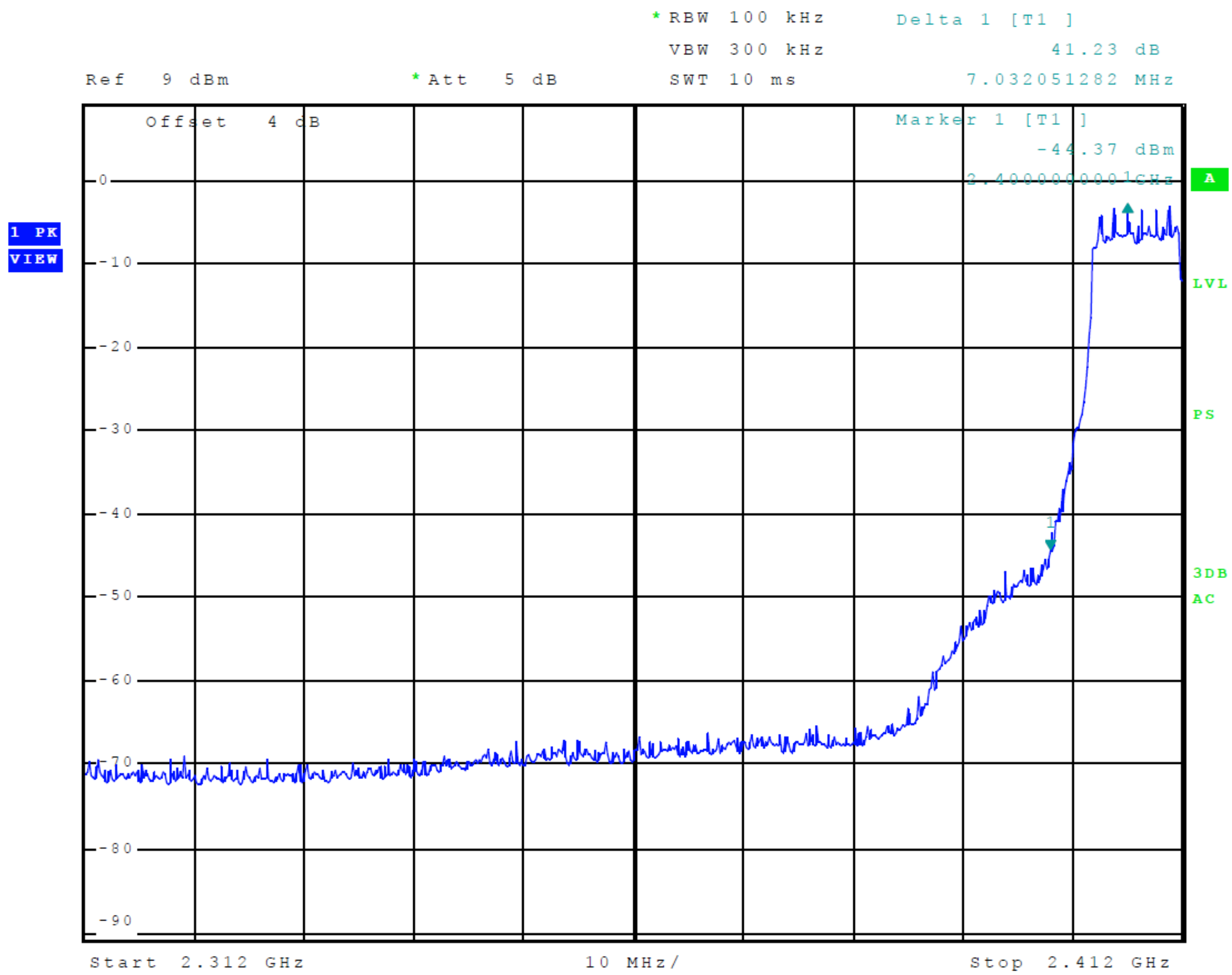

Figure 17 Plot of Transmitter Low Band Edge (802.11n) Chain 0

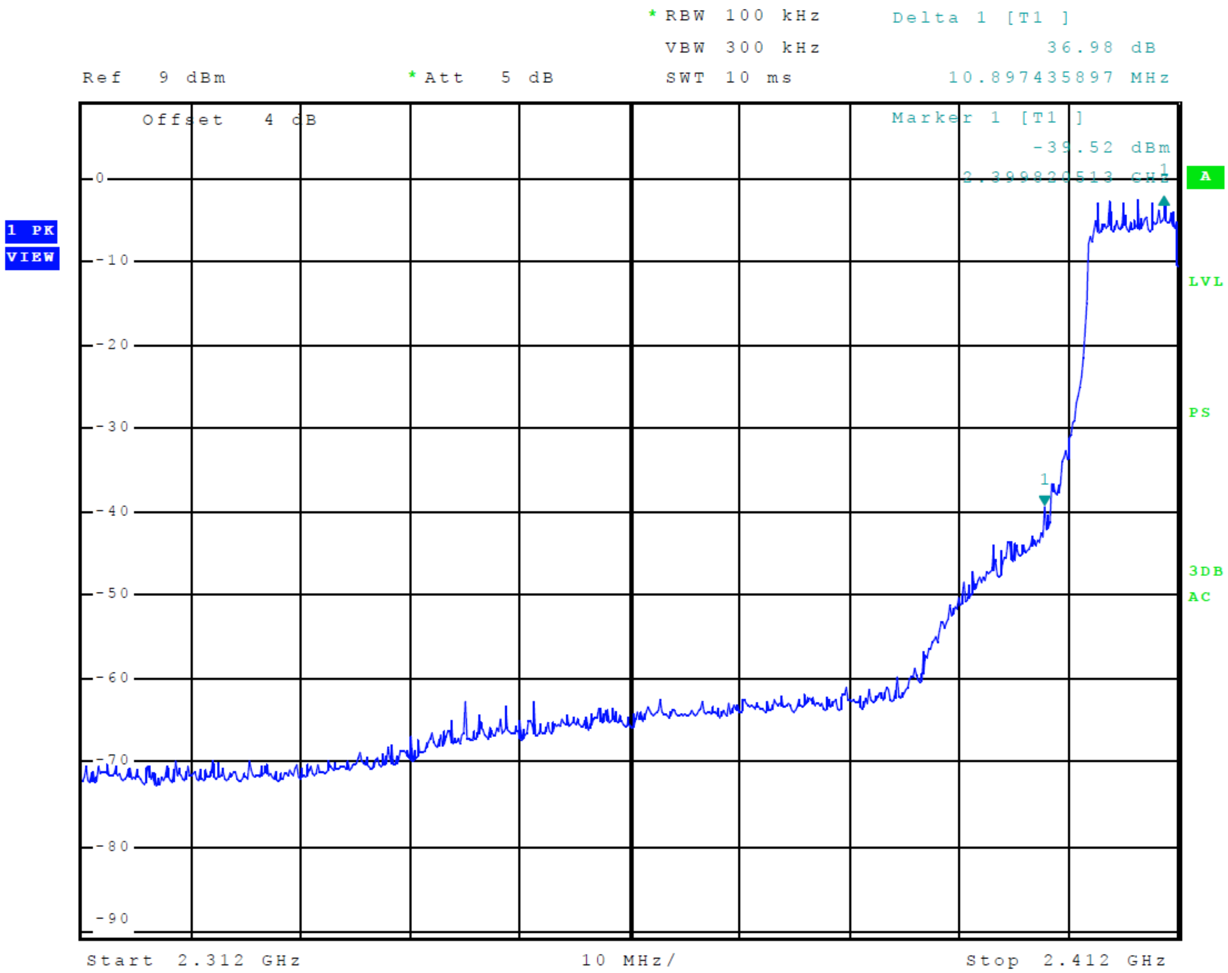

Figure 18 Plot of Transmitter Low Band Edge (802.11n) Chain 1

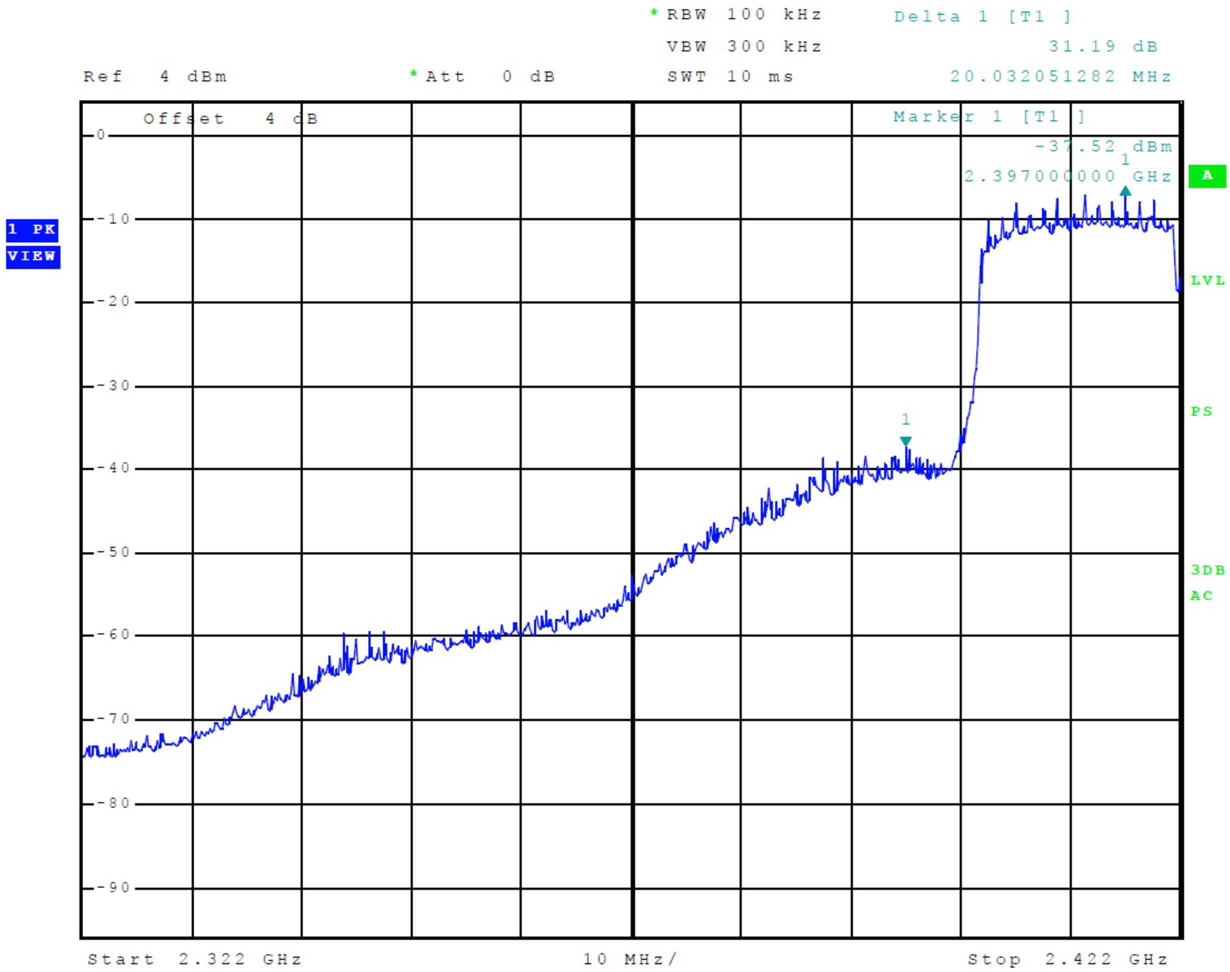

Figure 19 Plot of Transmitter Low Band Edge (802.11n40) Chain 0

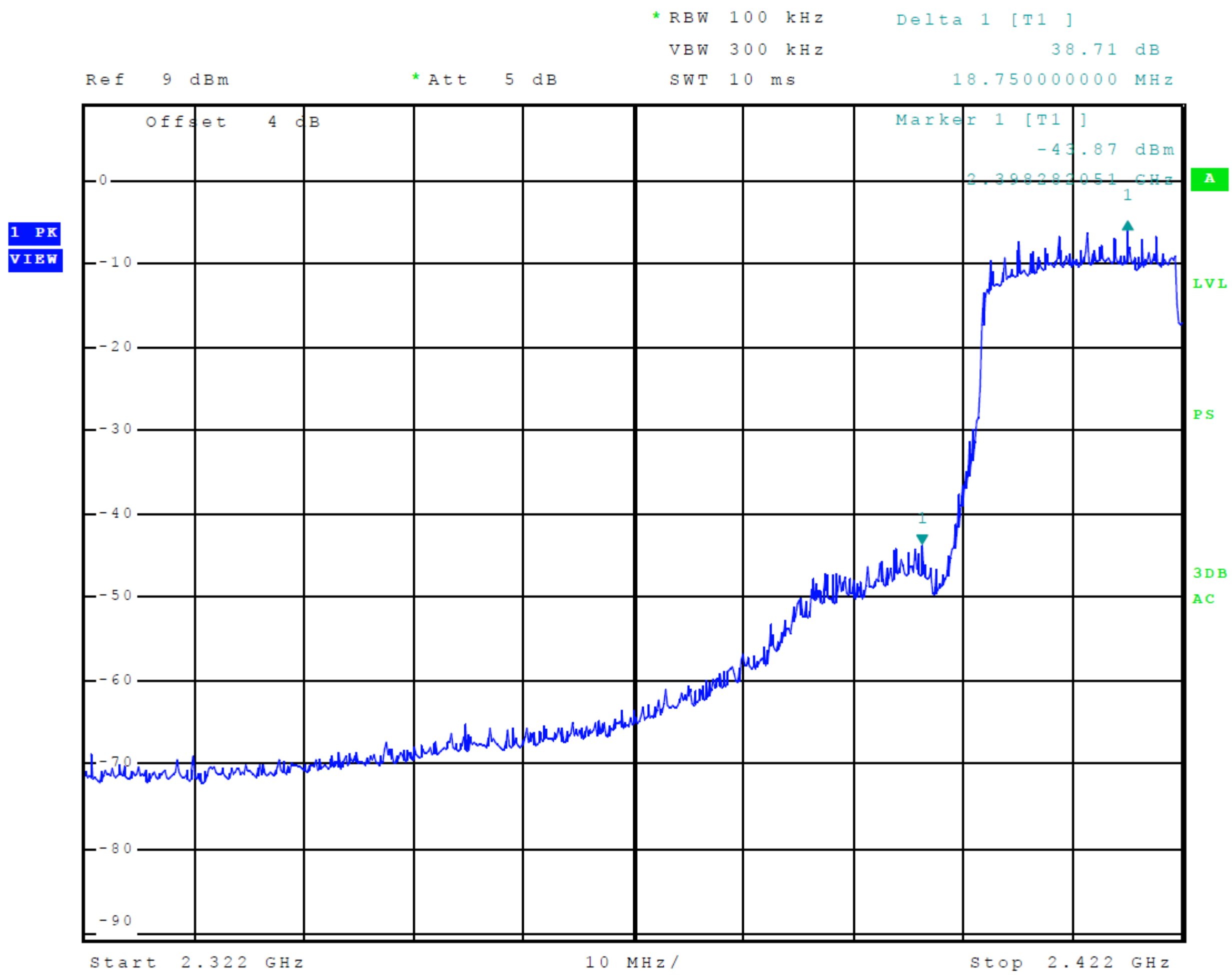

Figure 20 Plot of Transmitter Low Band Edge (802.11n40) Chain 1

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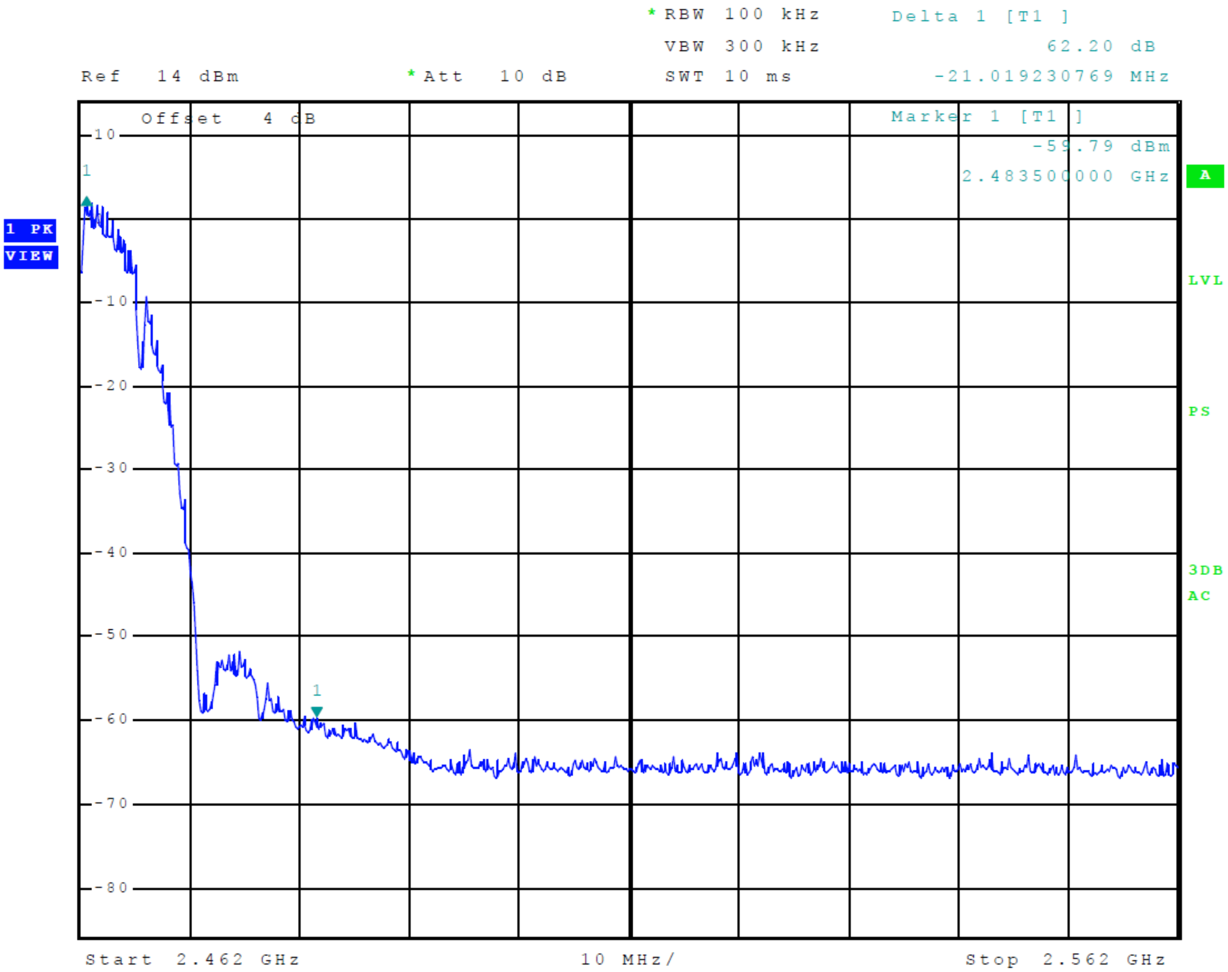

Figure 21 Plot of Transmitter High Band Edge (802.11b) Chain 0

NVLAP Lab Code 200087-0

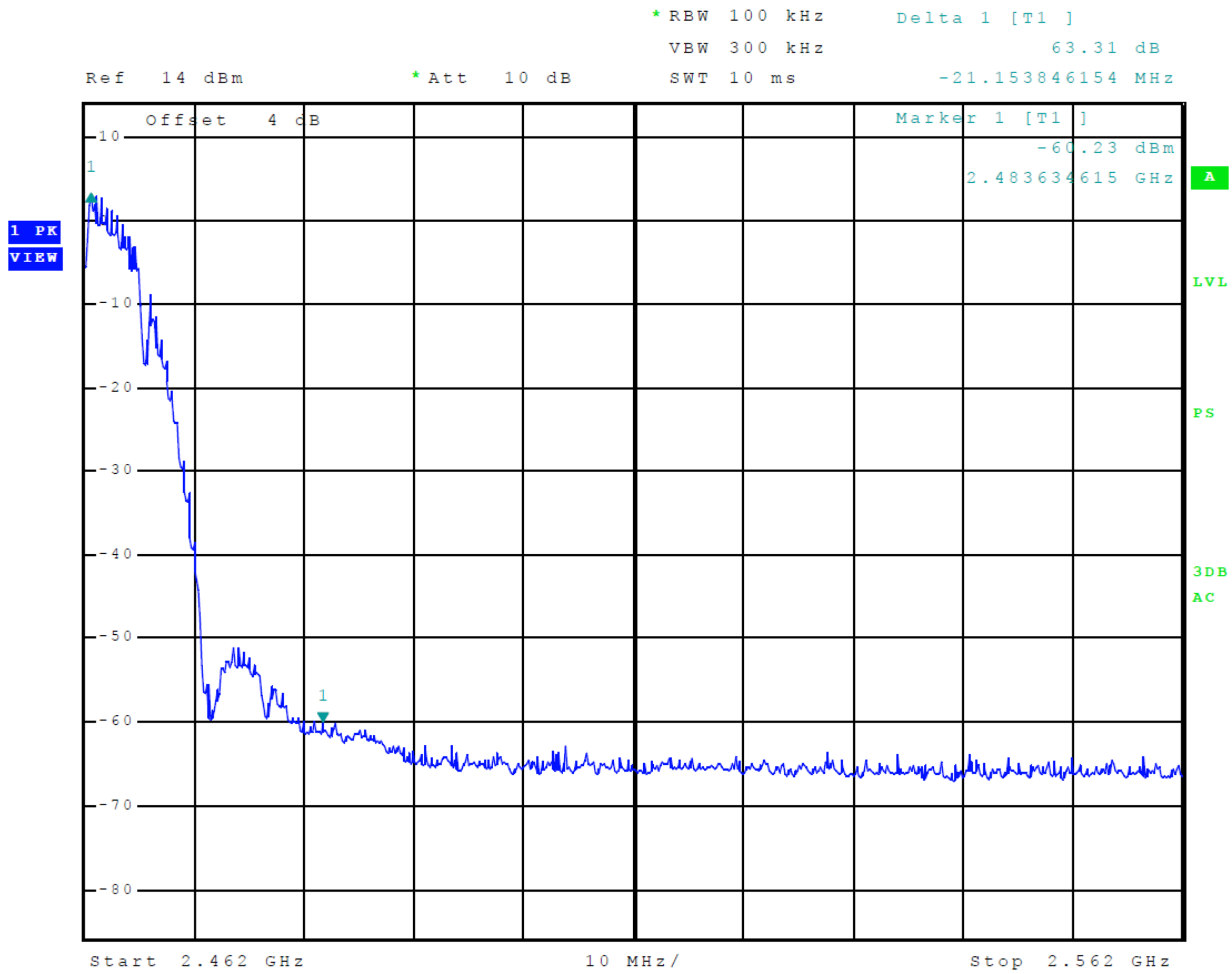

Figure 22 Plot of Transmitter High Band Edge (802.11b) Chain 1

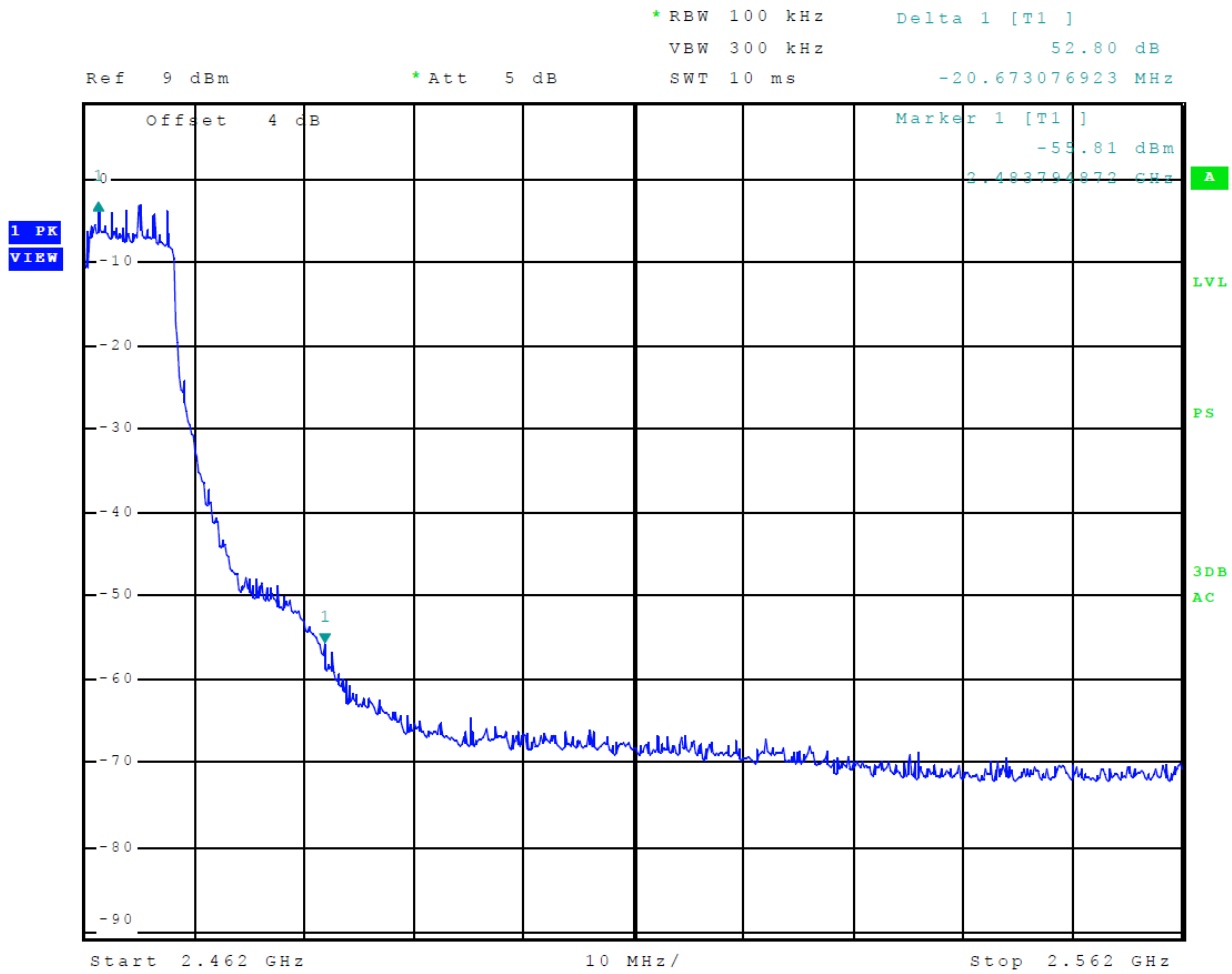

Figure 23 Plot of Transmitter High Band Edge (802.11g) Chain 0

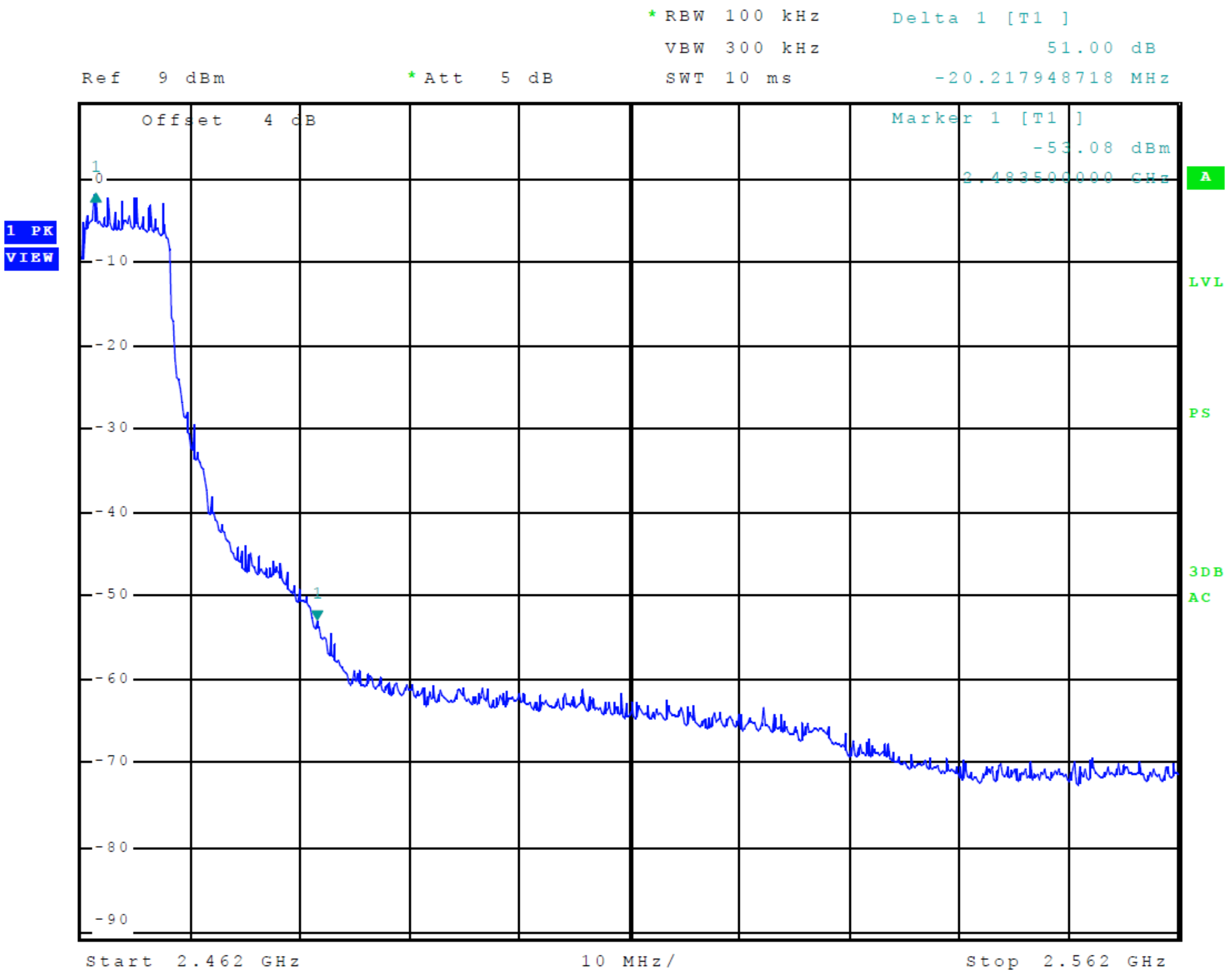

Figure 24 Plot of Transmitter High Band Edge (802.11g) Chain 1

NVLAP Lab Code 200087-0

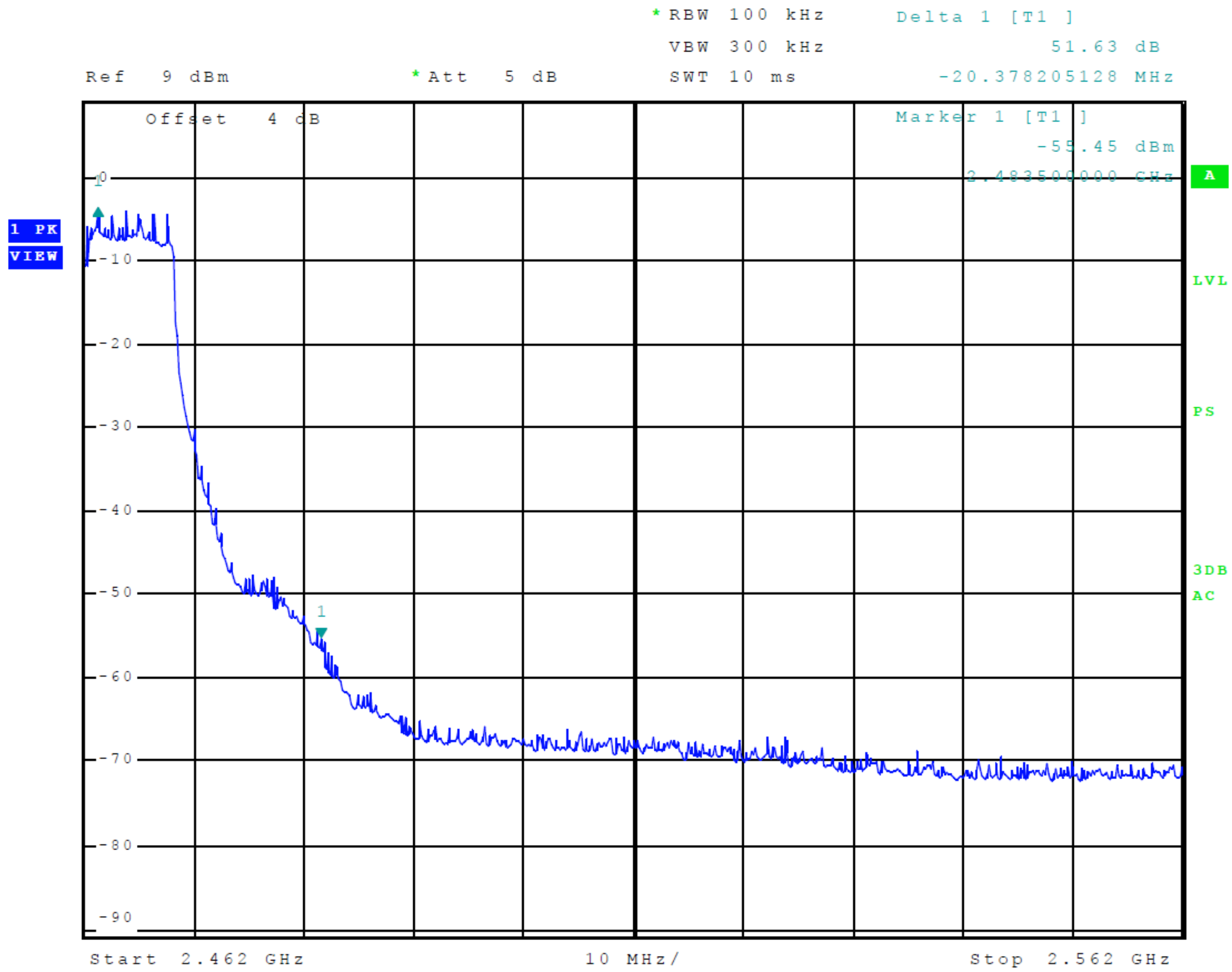

Figure 25 Plot of Transmitter High Band Edge (802.11n) Chain 0

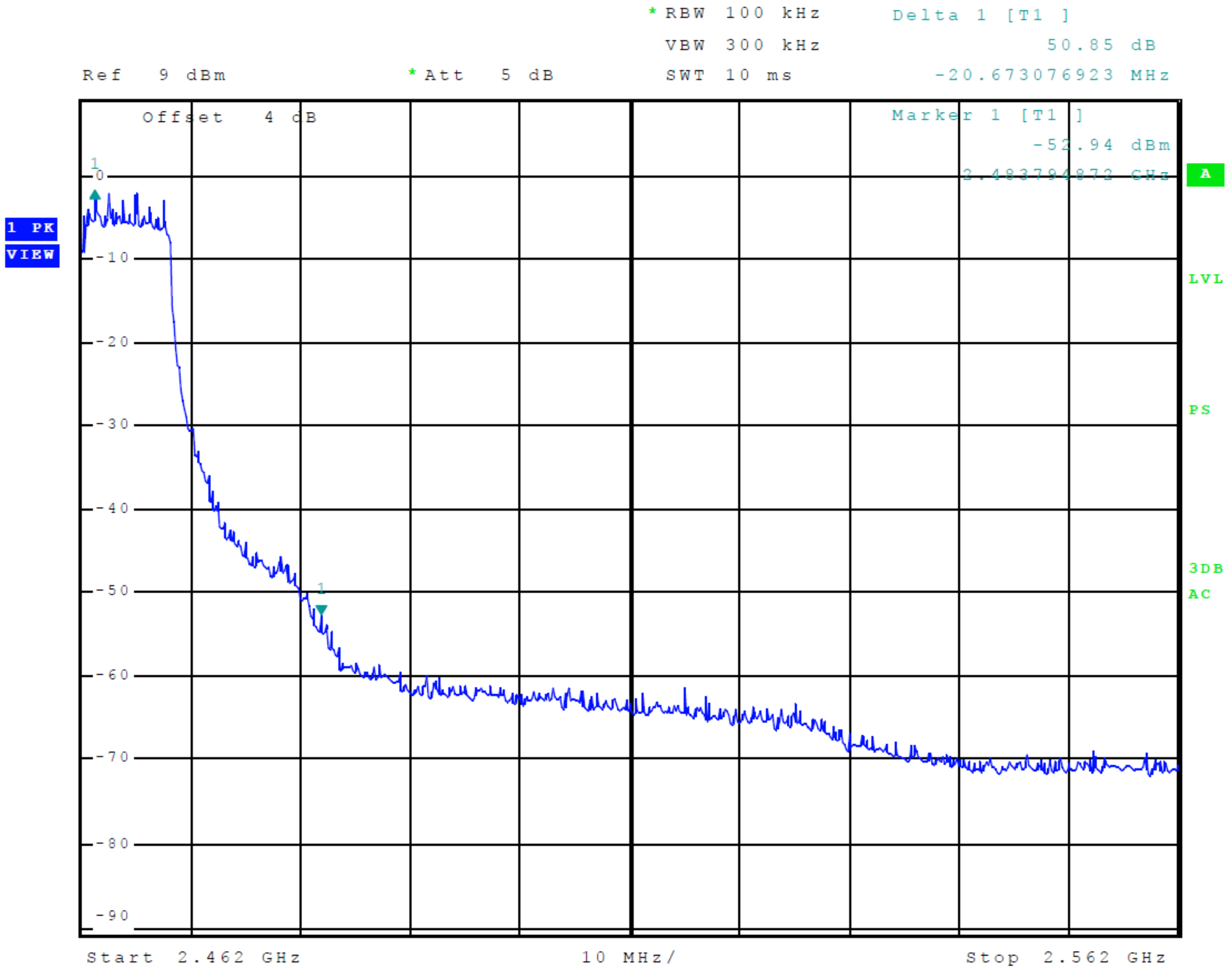

Figure 26 Plot of Transmitter High Band Edge (802.11n) Chain 1

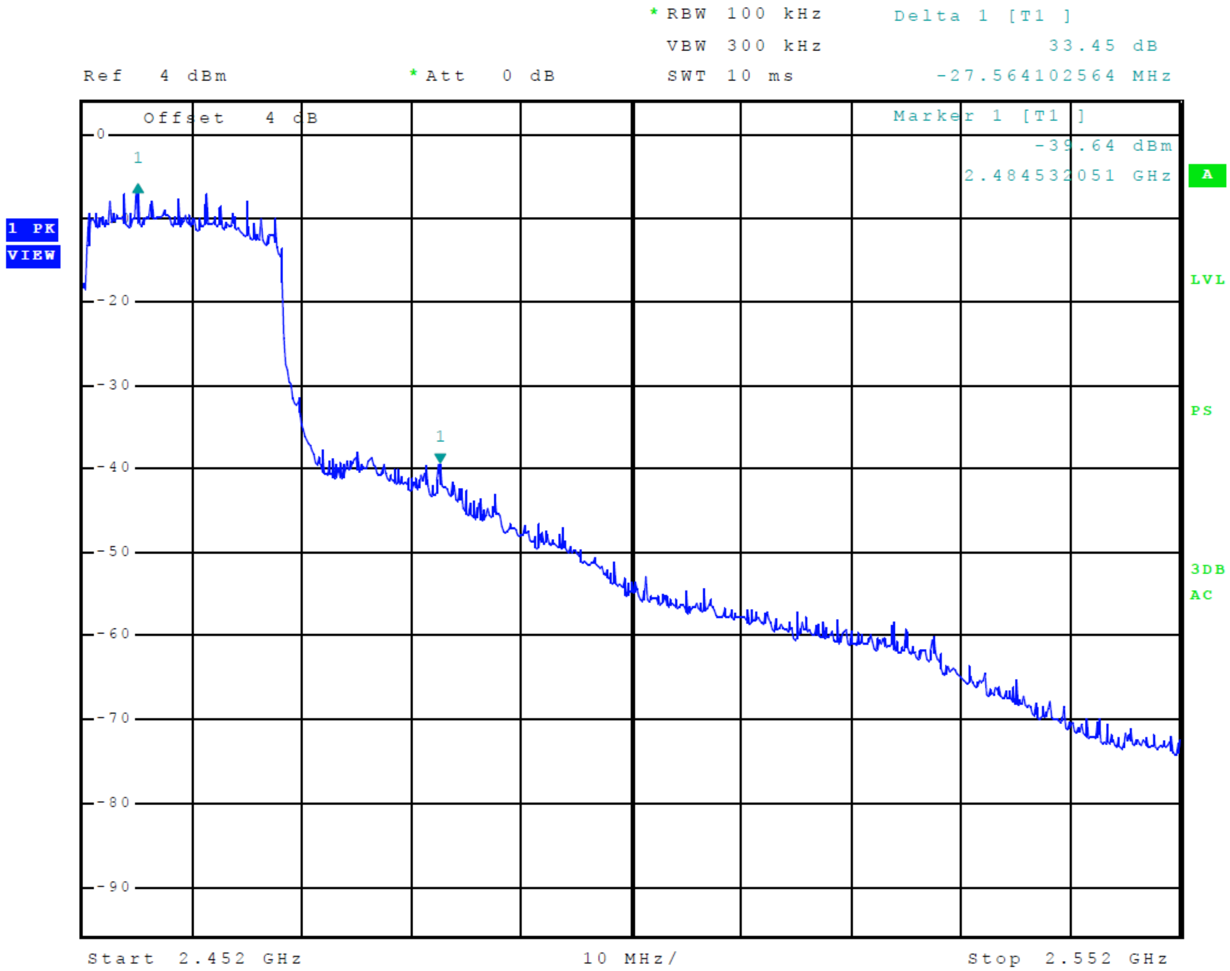

Figure 27 Plot of Transmitter High Band Edge (802.11n40) Chain 0

NVLAP Lab Code 200087-0

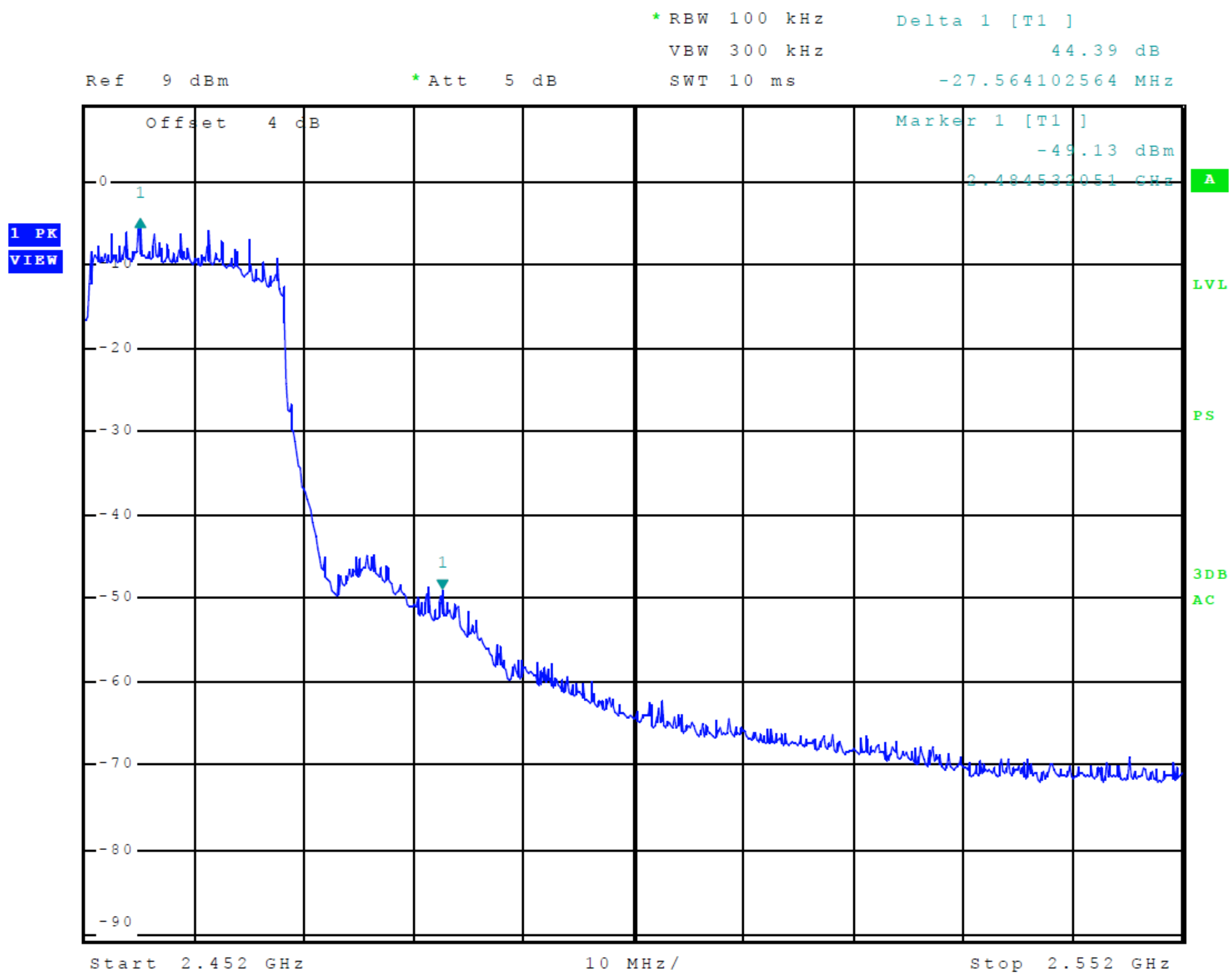

Figure 28 Plot of Transmitter High Band Edge (802.11n40) Chain 1

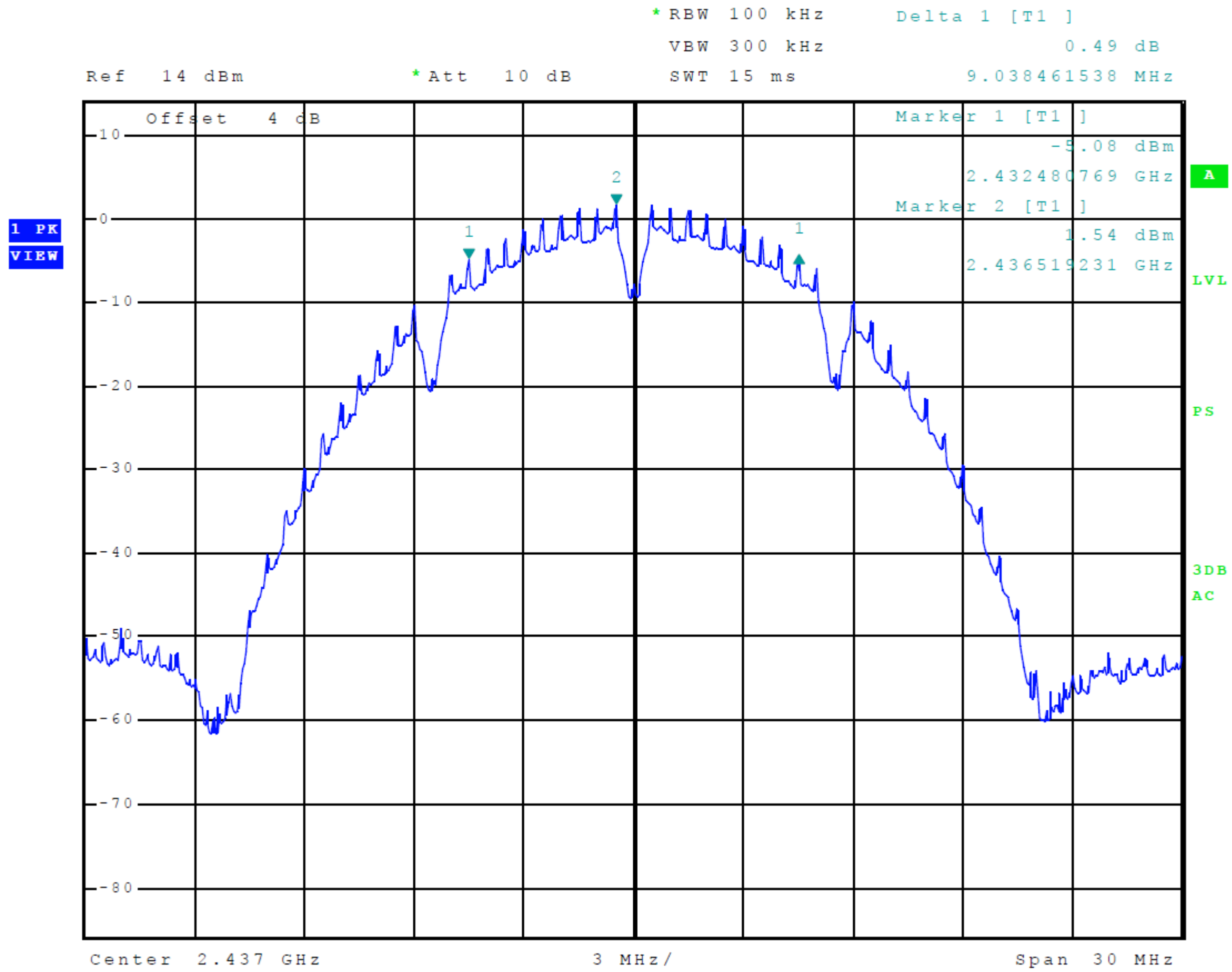

Figure 29 Plot of Transmitter 6-dB Occupied Band Width (802.11b) Chain 0

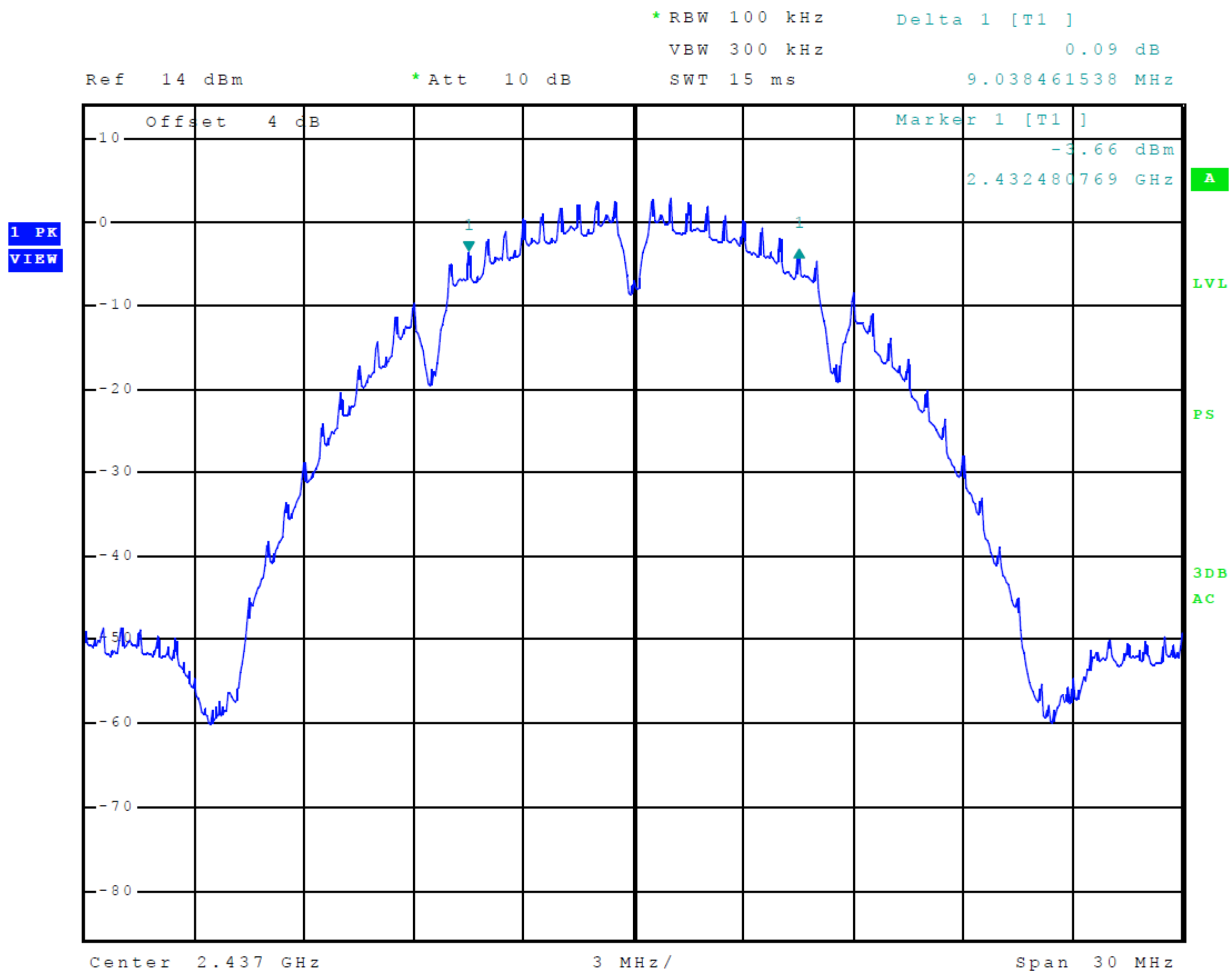

Figure 30 Plot of Transmitter 6-dB Occupied Band Width (802.11b) Chain 1

NVLAP Lab Code 200087-0

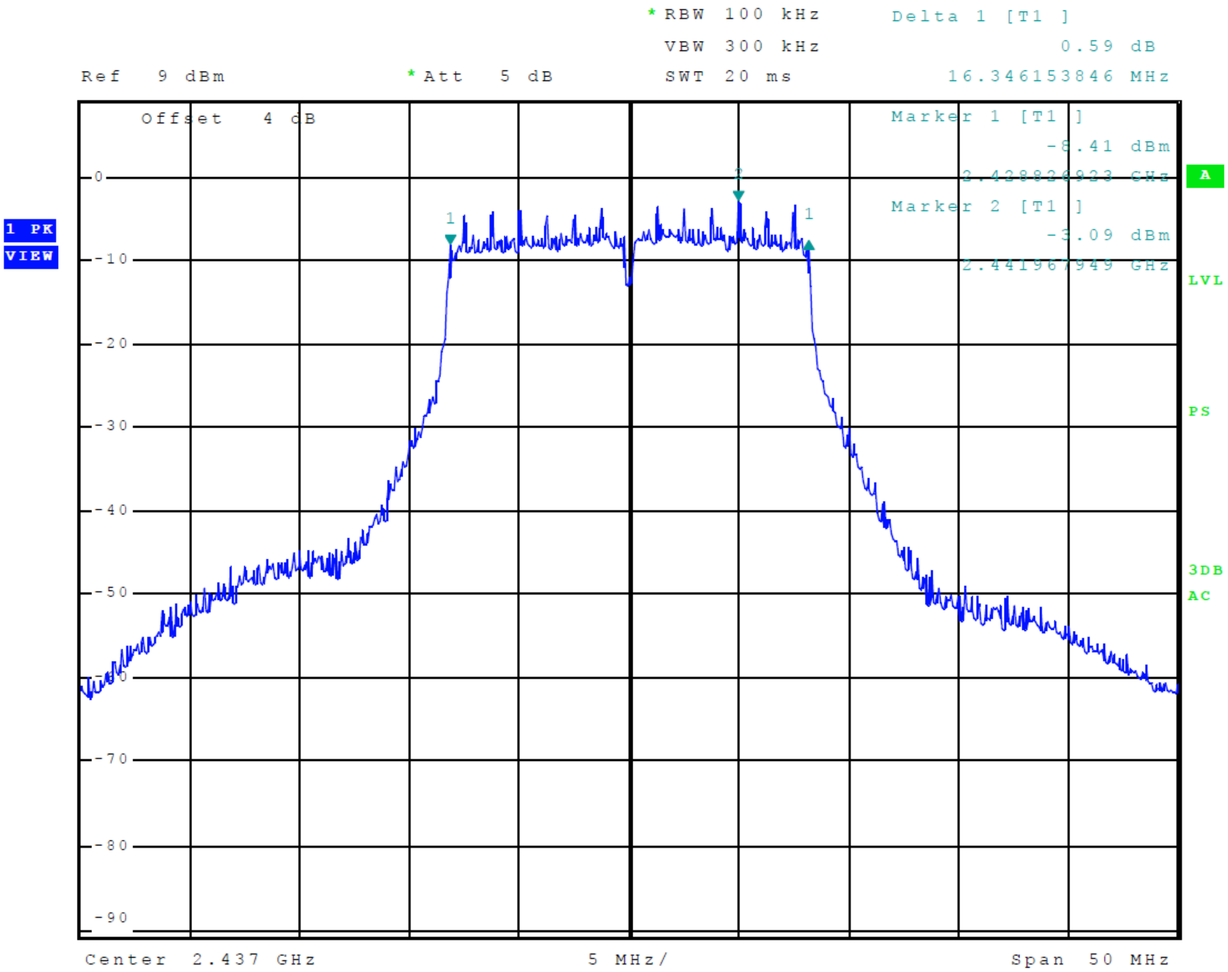

Figure 31 Plot of Transmitter 6-dB Occupied Band Width (802.11g) Chain 0

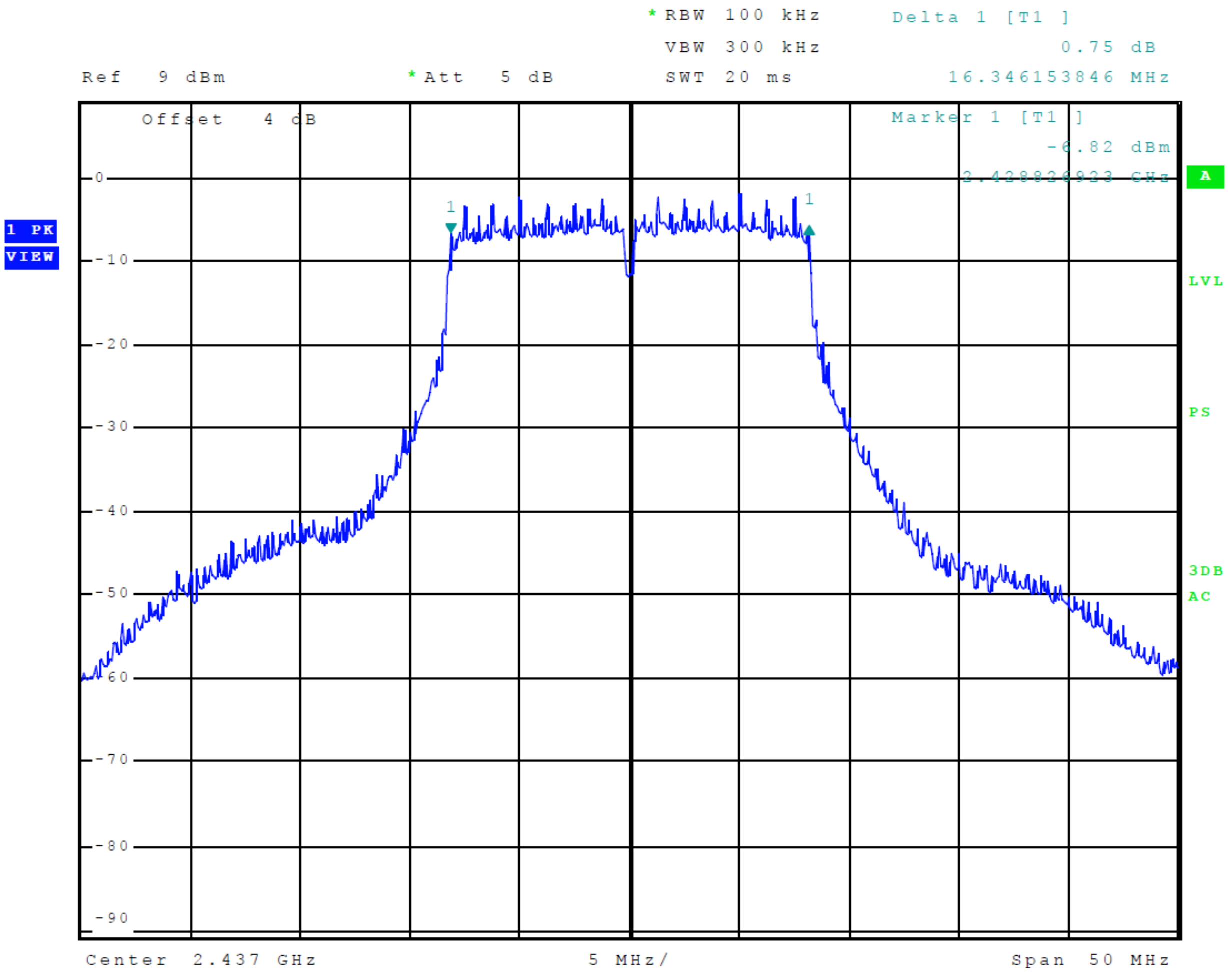

Figure 32 Plot of Transmitter 6-dB Occupied Band Width (802.11g) Chain 1

NVLAP Lab Code 200087-0

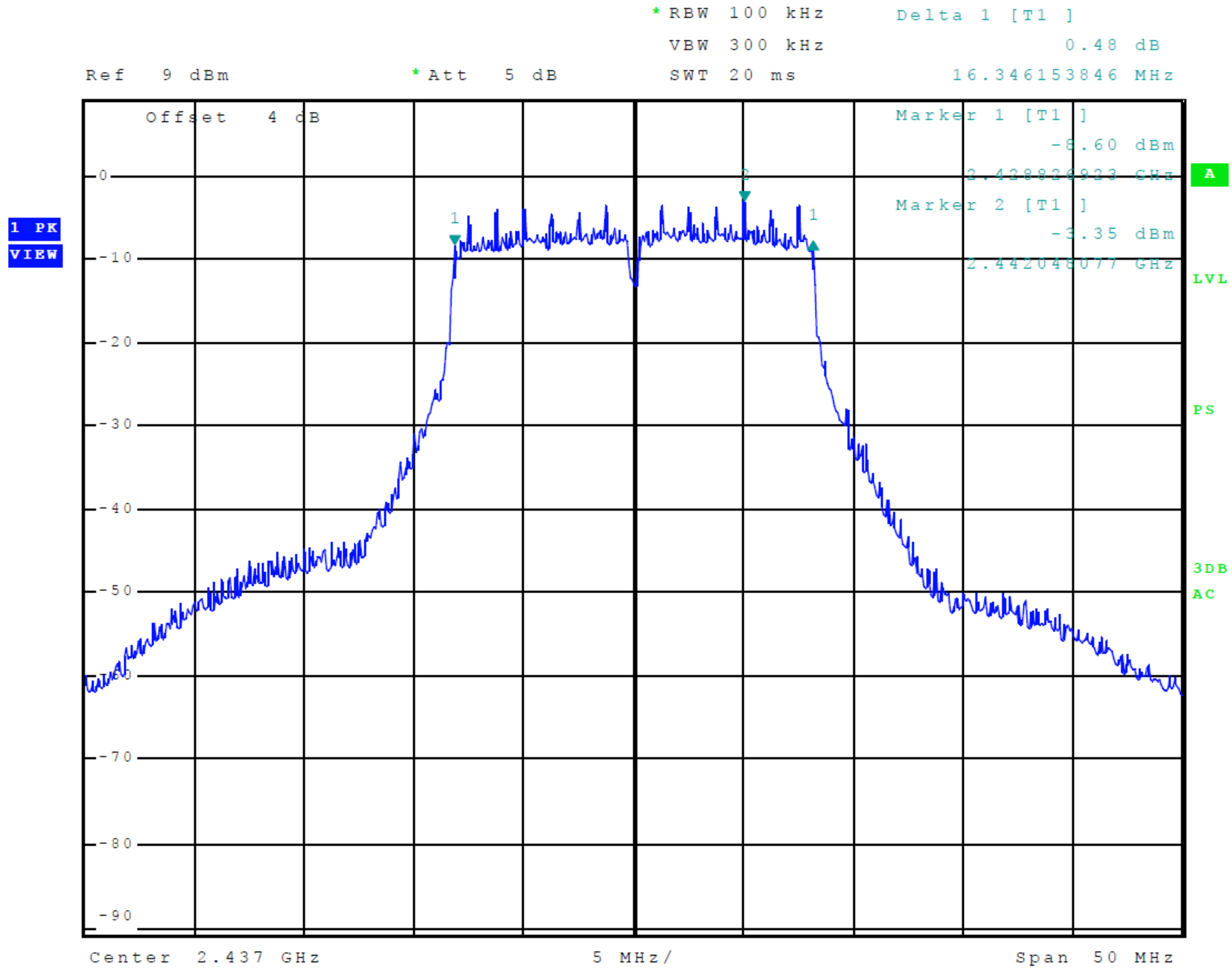

Figure 33 Plot of Transmitter 6-dB Occupied Band Width (802.11n) Chain 0

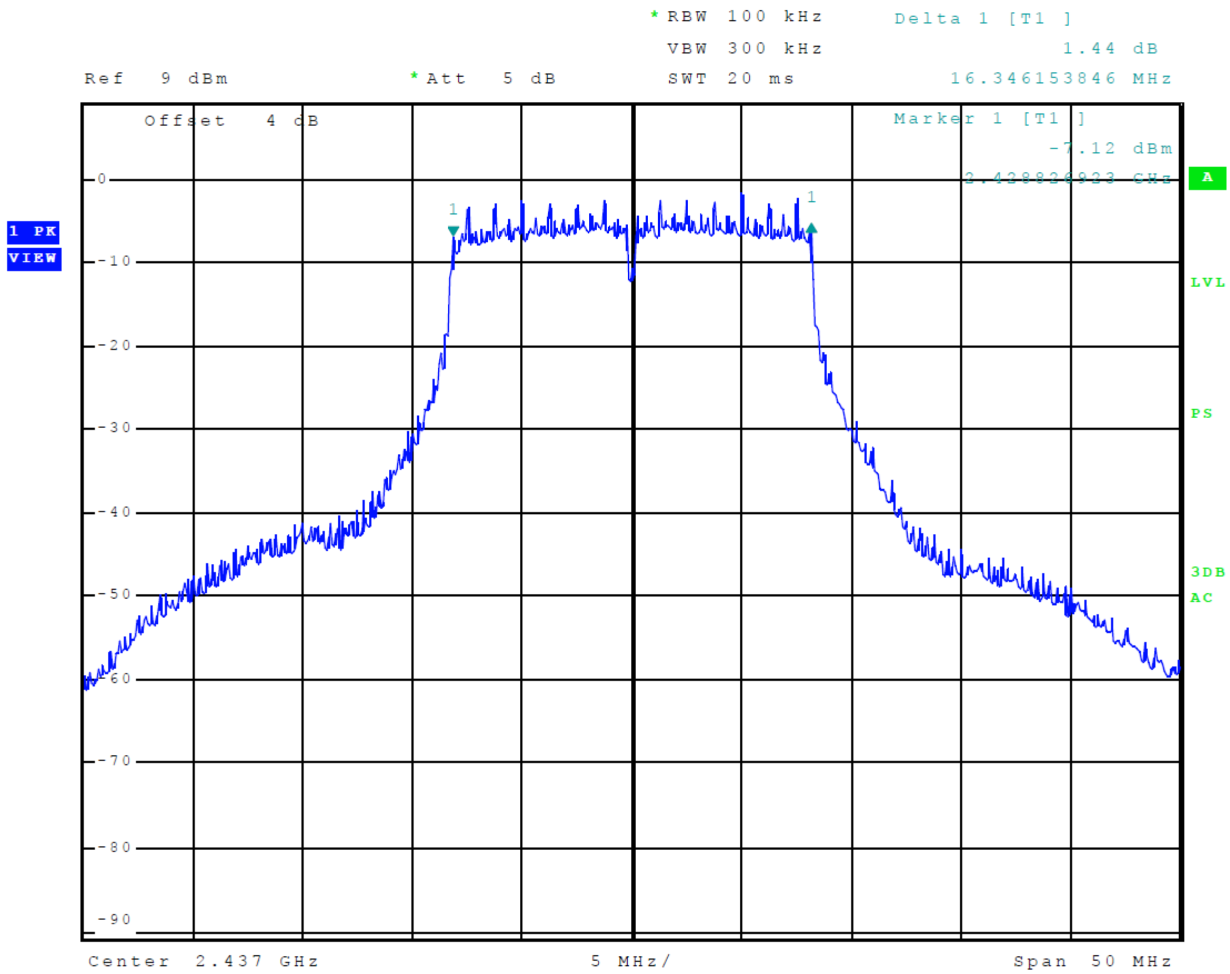

Figure 34 Plot of Transmitter 6-dB Occupied Band Width (802.11n) Chain 1

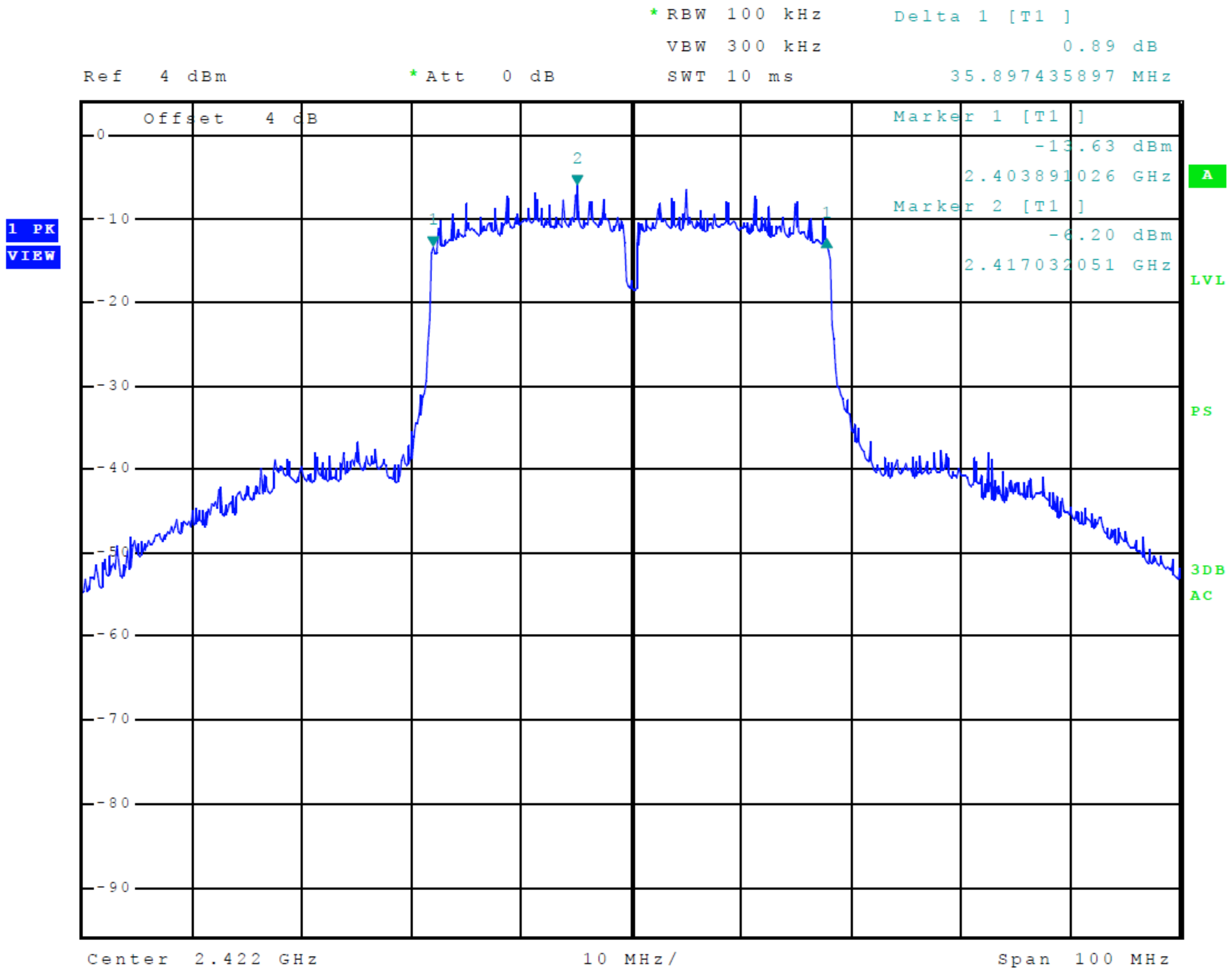

Figure 35 Plot of Transmitter 6-dB Occupied Band Width (802.11n40) Chain 0

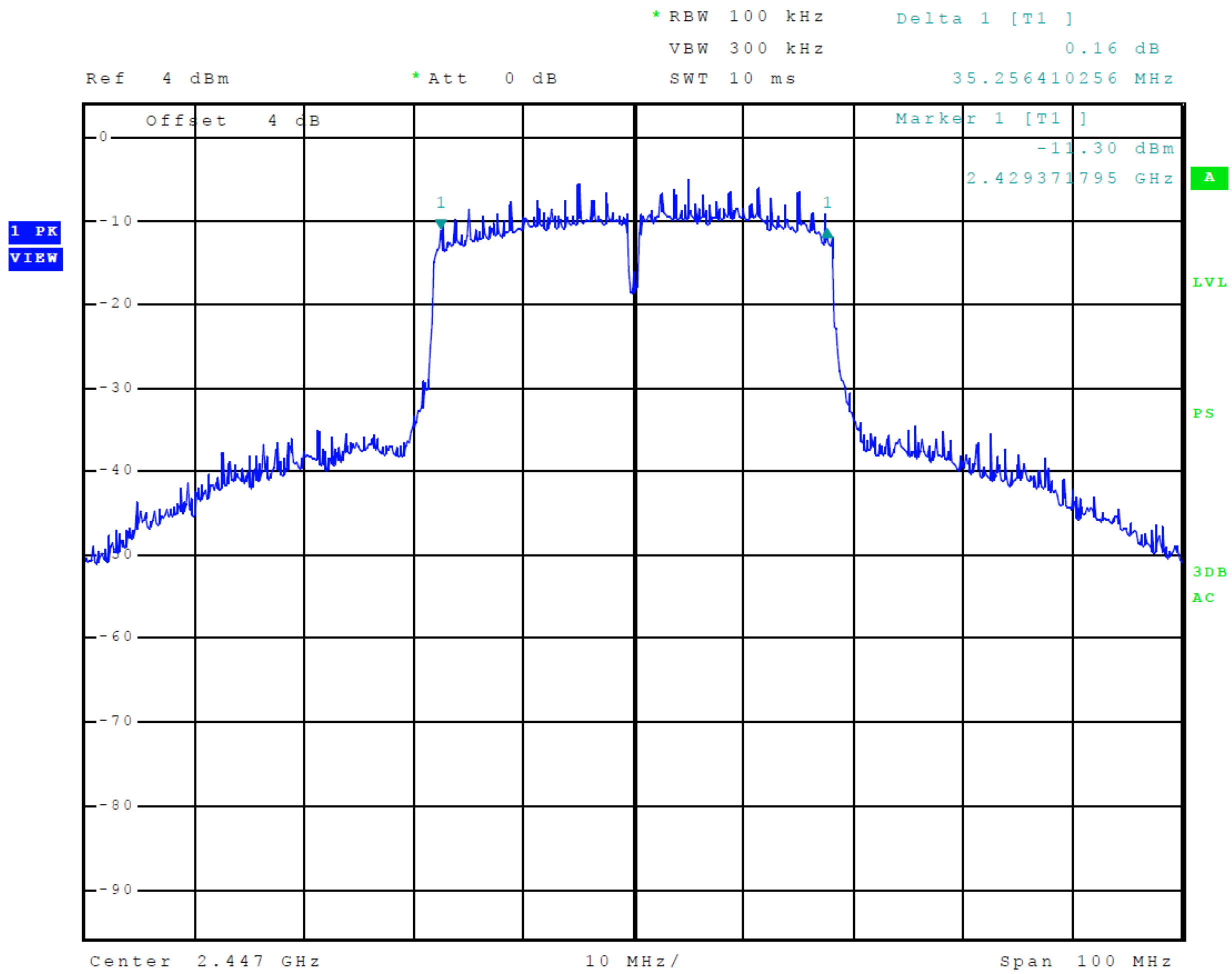

Figure 36 Plot of Transmitter 6-dB Occupied Band Width (802.11n40) Chain 1

NVLAP Lab Code 200087-0

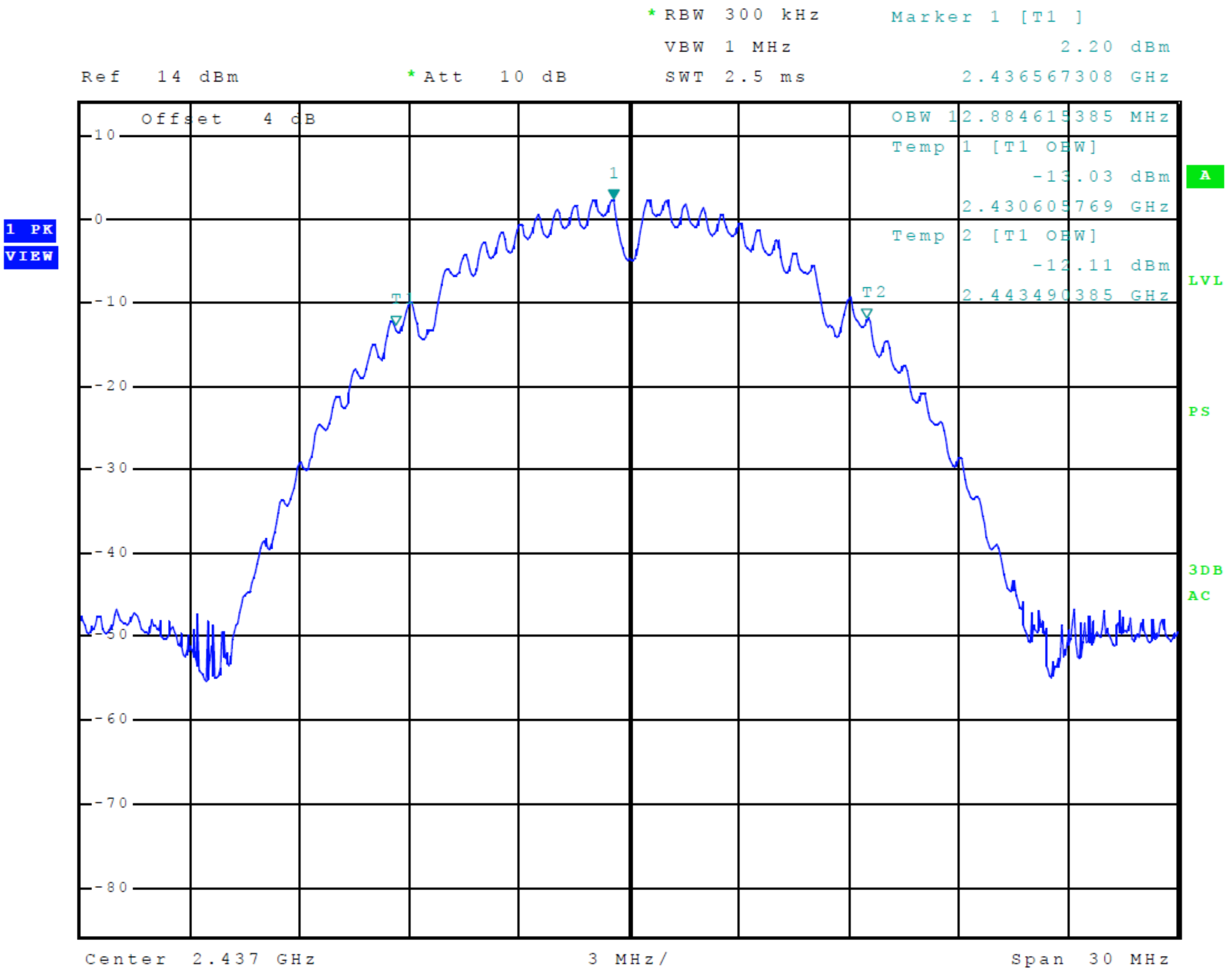

Figure 37 Plot of Transmitter 99% Occupied Band Width (802.11b) Chain 0

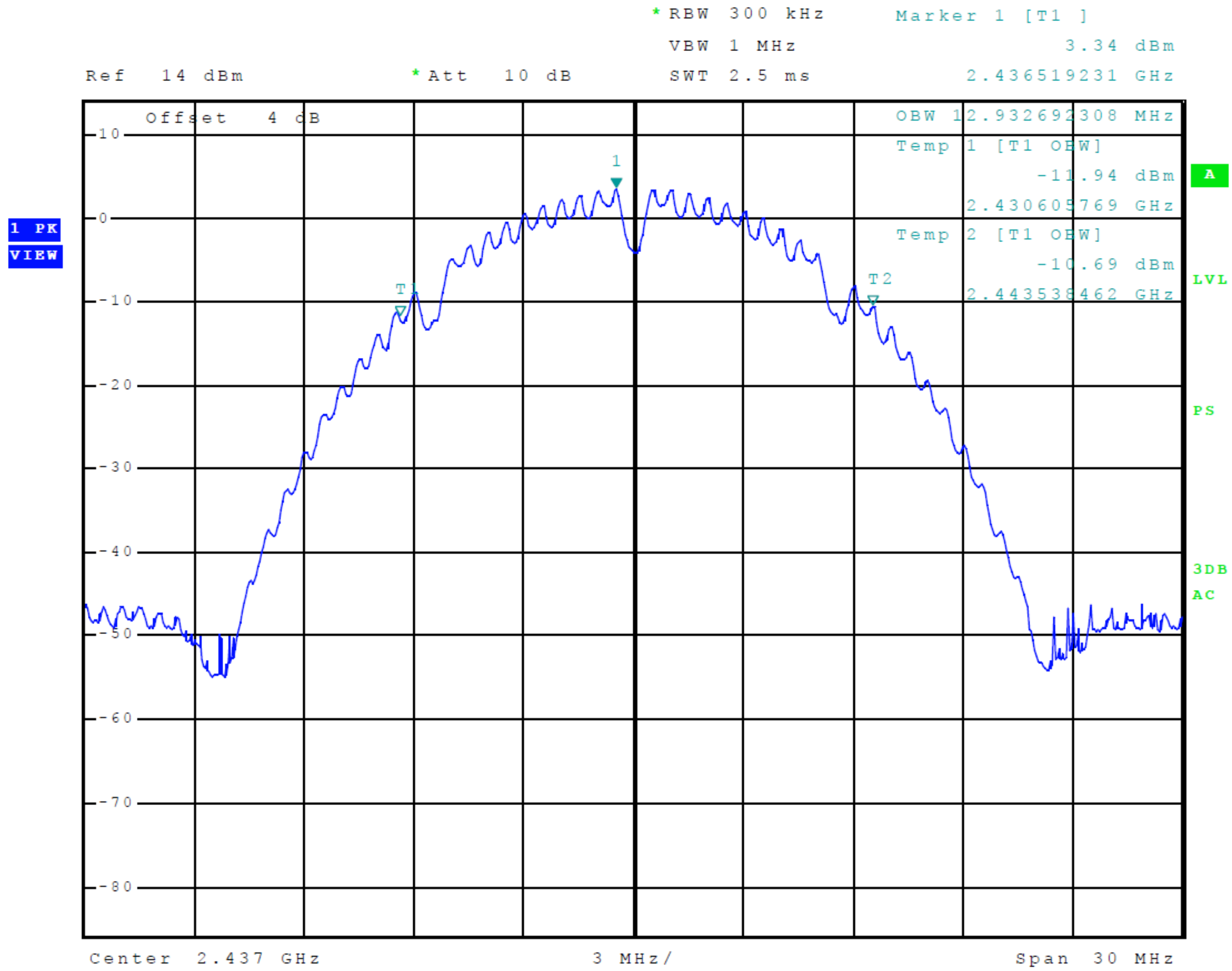

Figure 38 Plot of Transmitter 99% Occupied Band Width (802.11b) Chain 1

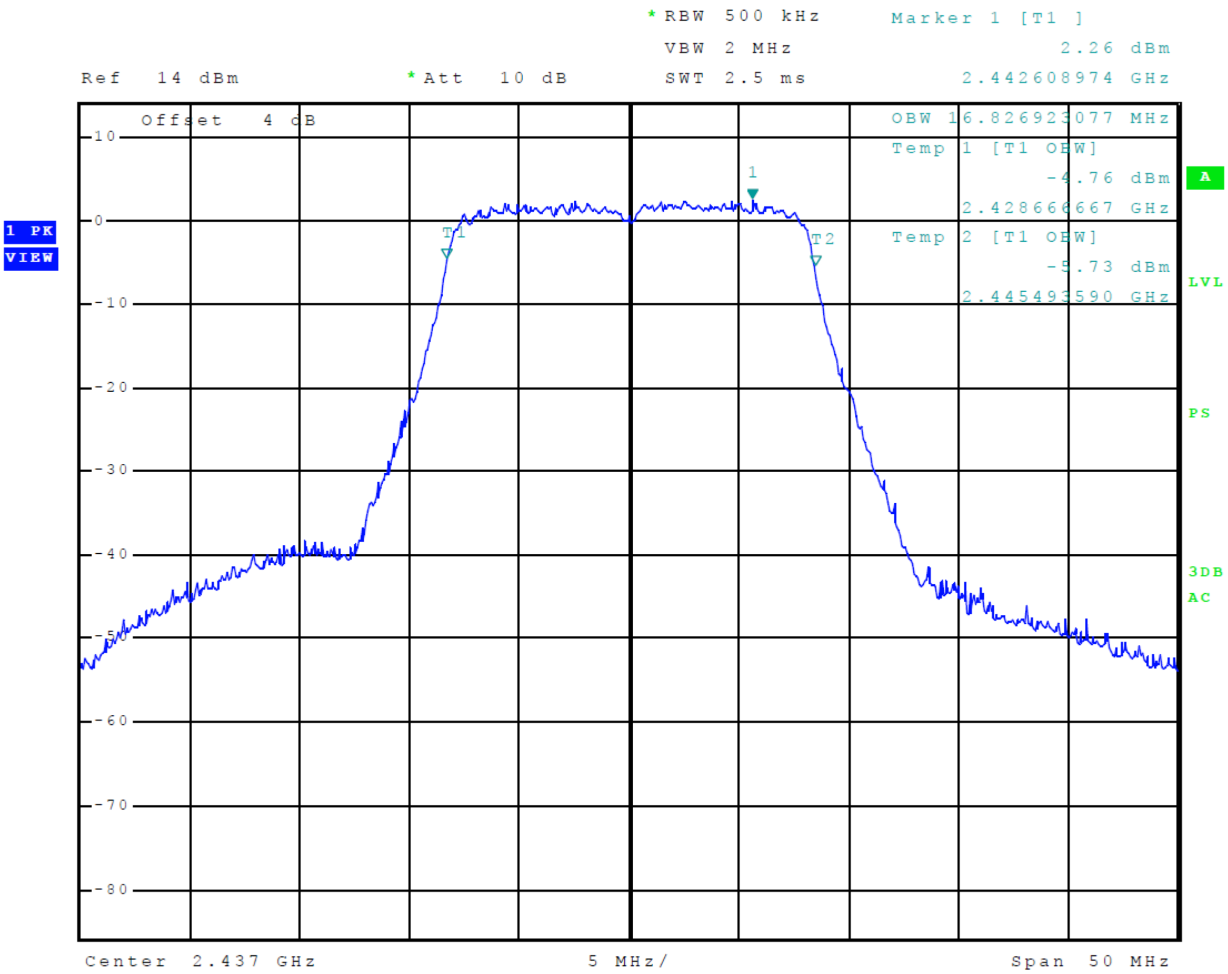

Figure 39 Plot of Transmitter 99% Occupied Band Width (802.11g) Chain 0

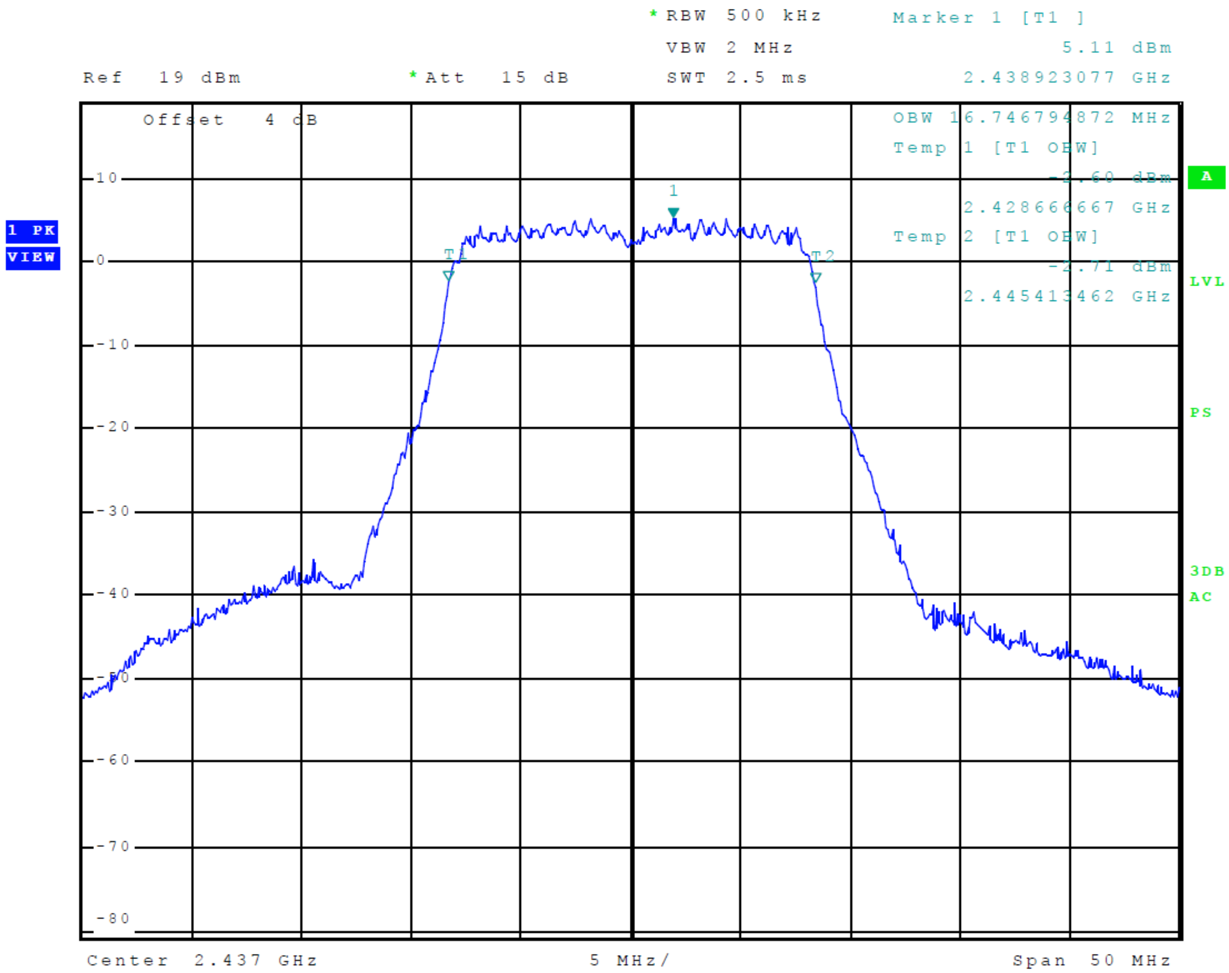

Figure 40 Plot of Transmitter 99% Occupied Band Width (802.11g) Chain 1

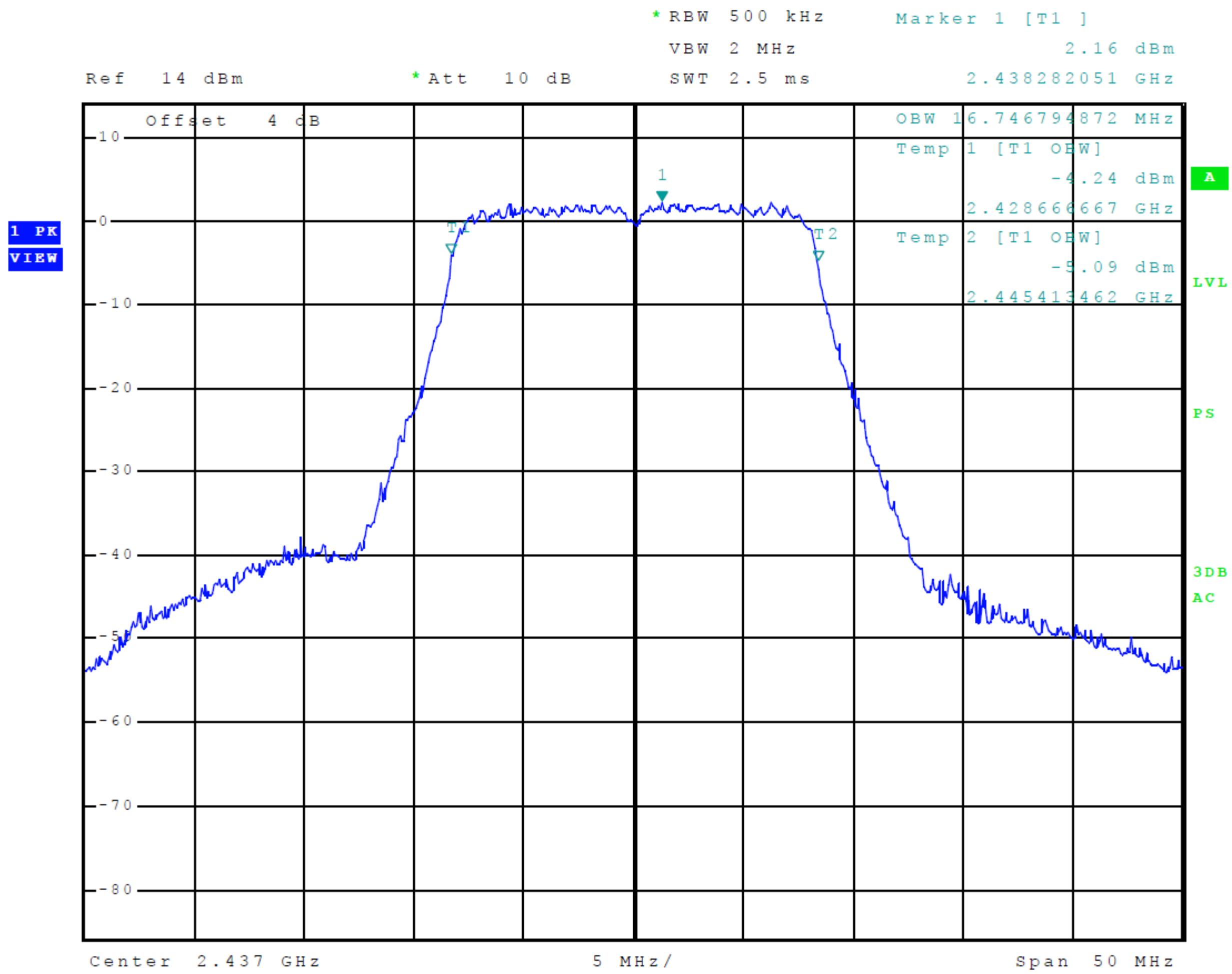

Figure 41 Plot of Transmitter 99% Occupied Band Width (802.11n) Chain 0

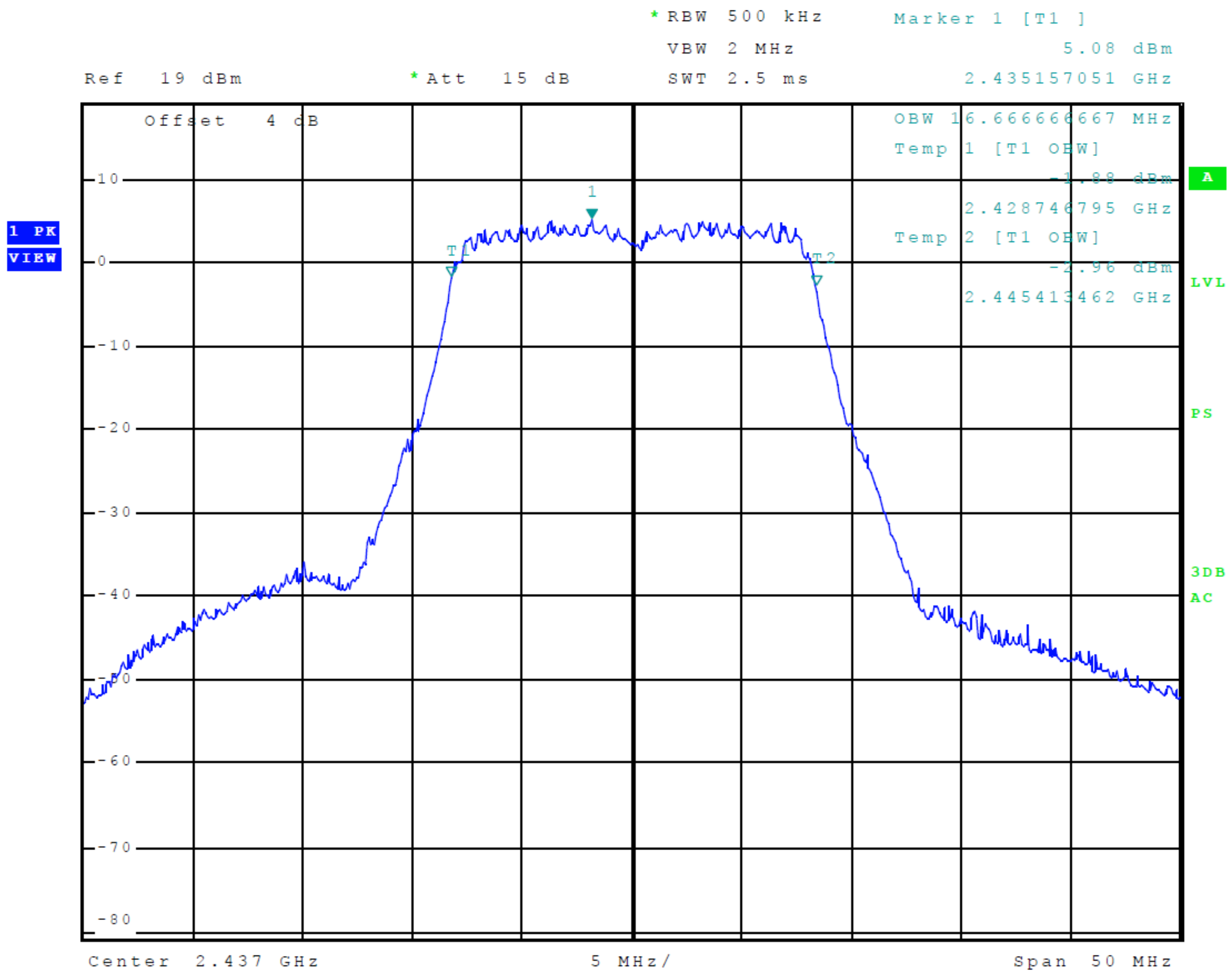

Figure 42 Plot of Transmitter 99% Occupied Band Width (802.11n) Chain 1

NVLAP Lab Code 200087-0

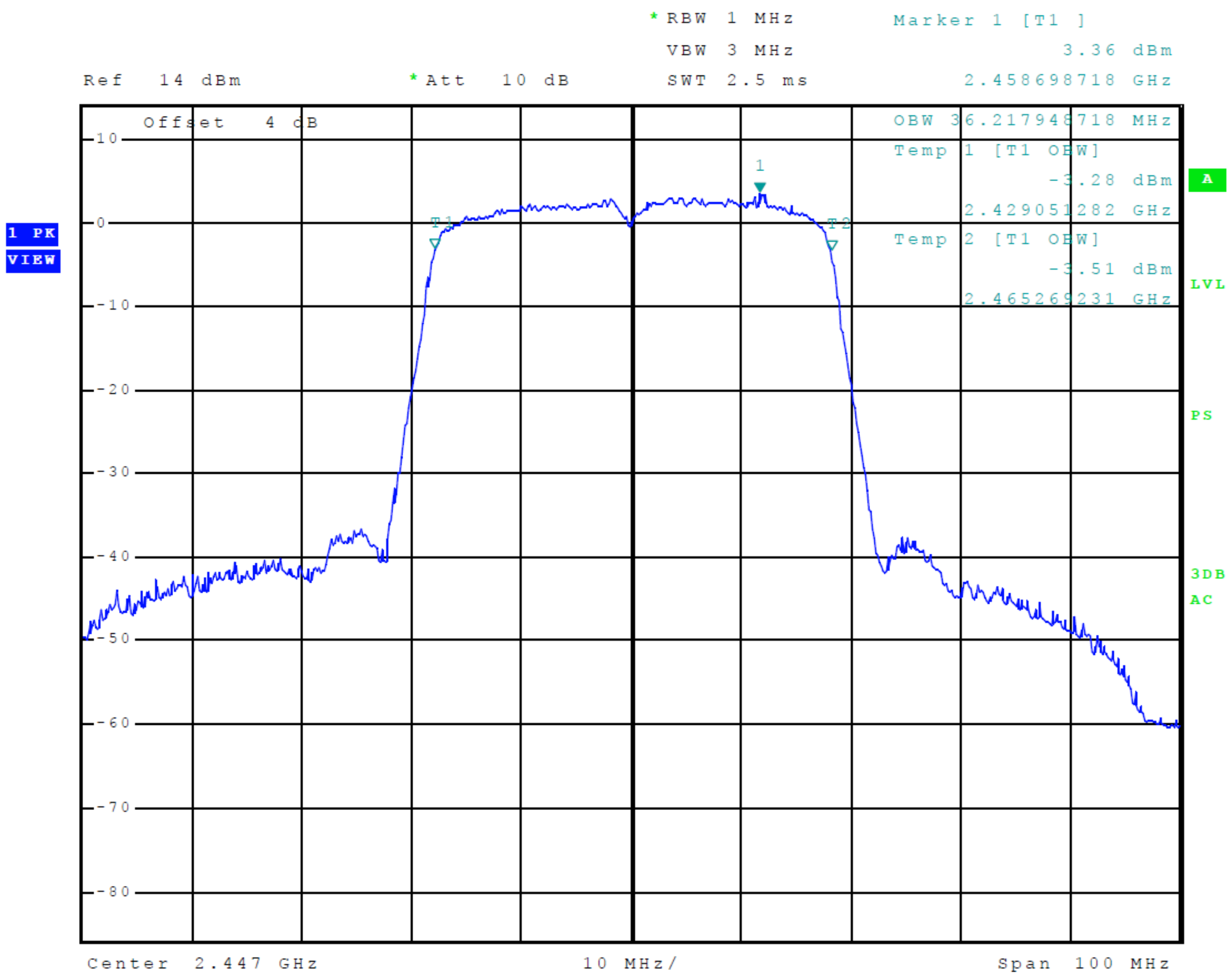

Figure 43 Plot of Transmitter 99% Occupied Band Width (802.11n40) Chain 0

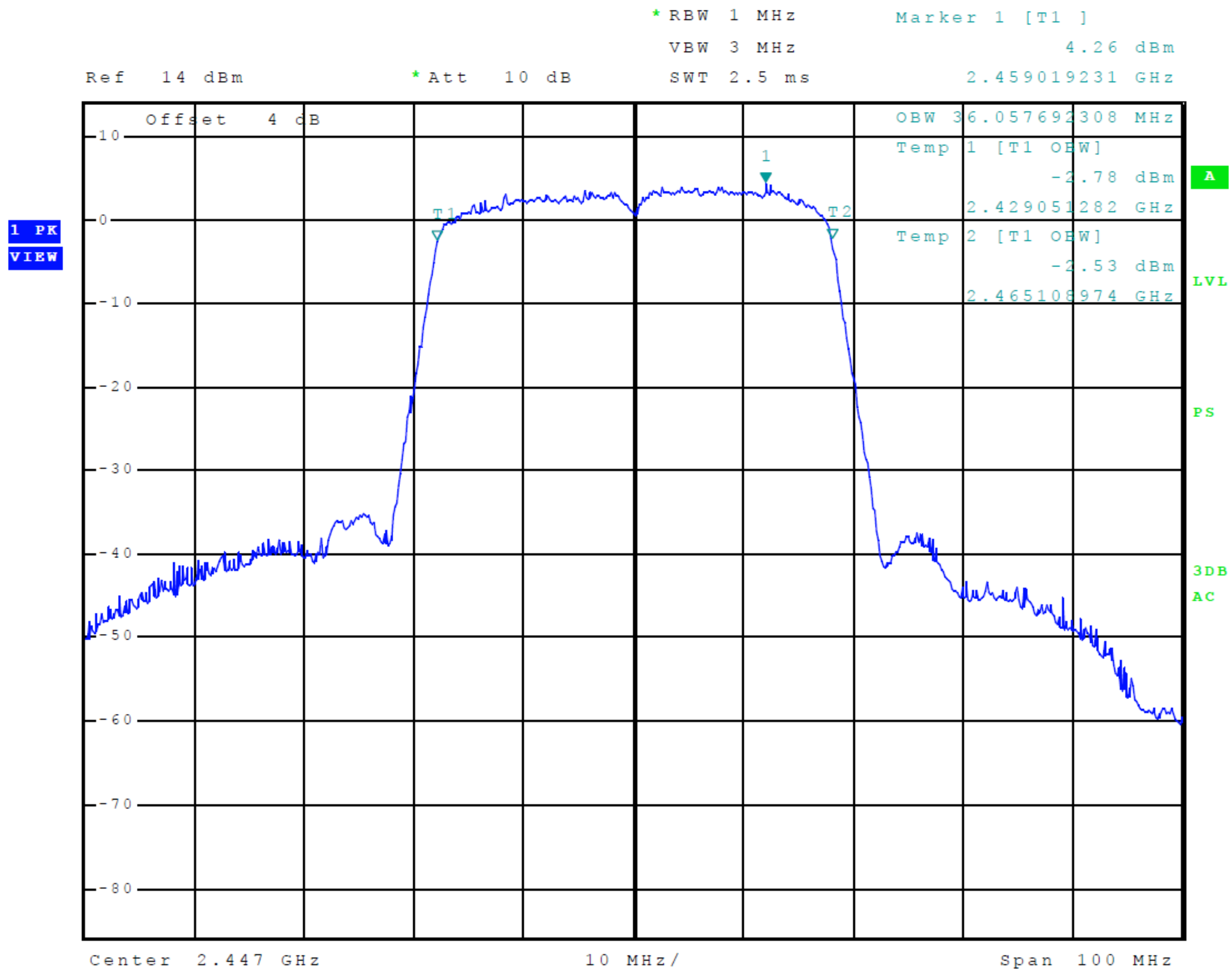

Figure 44 Plot of Transmitter 99% Occupied Band Width (802.11n40) Chain 1

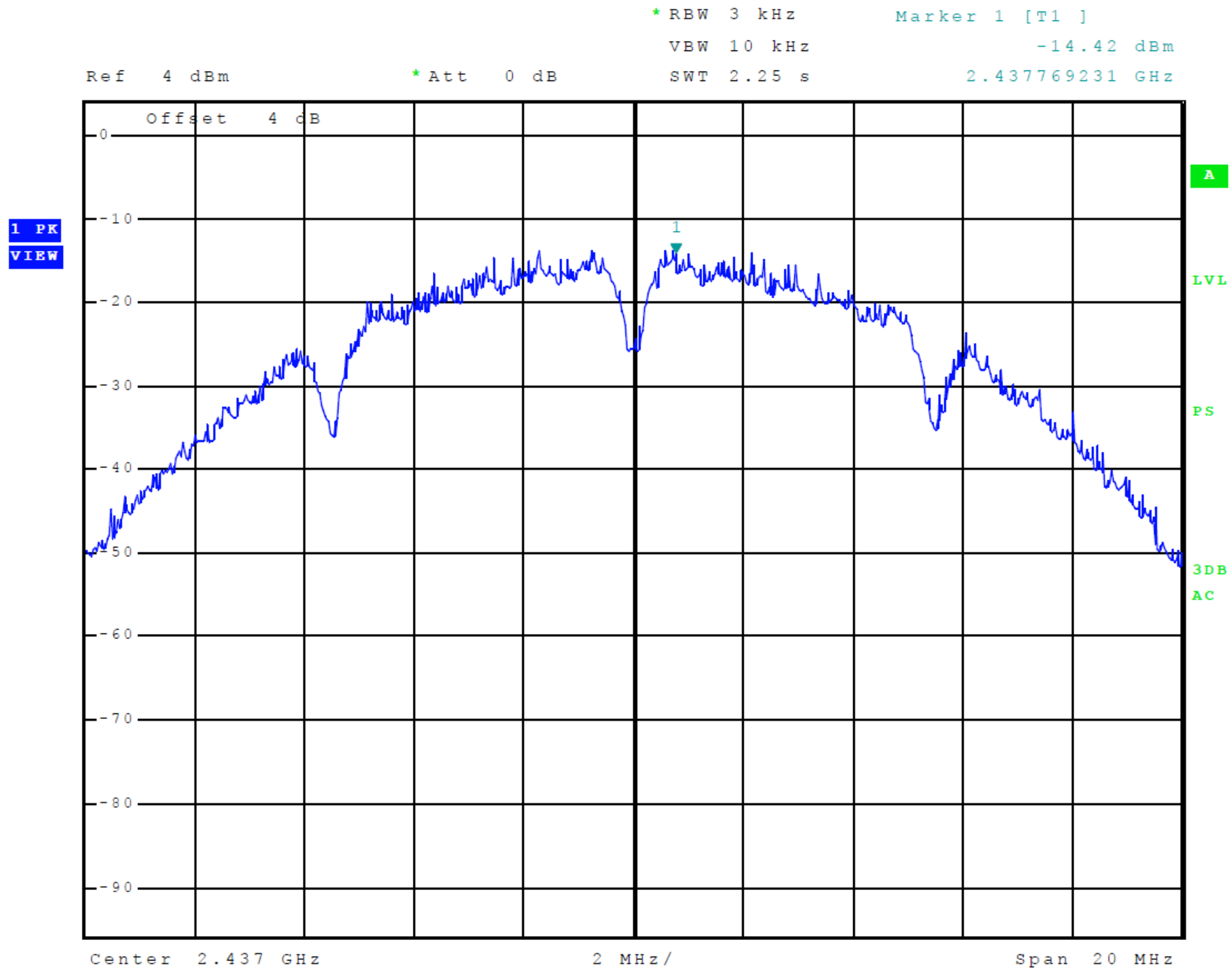

Figure 45 Plot of Transmitter Power Spectral Density (802.11b) Chain 0

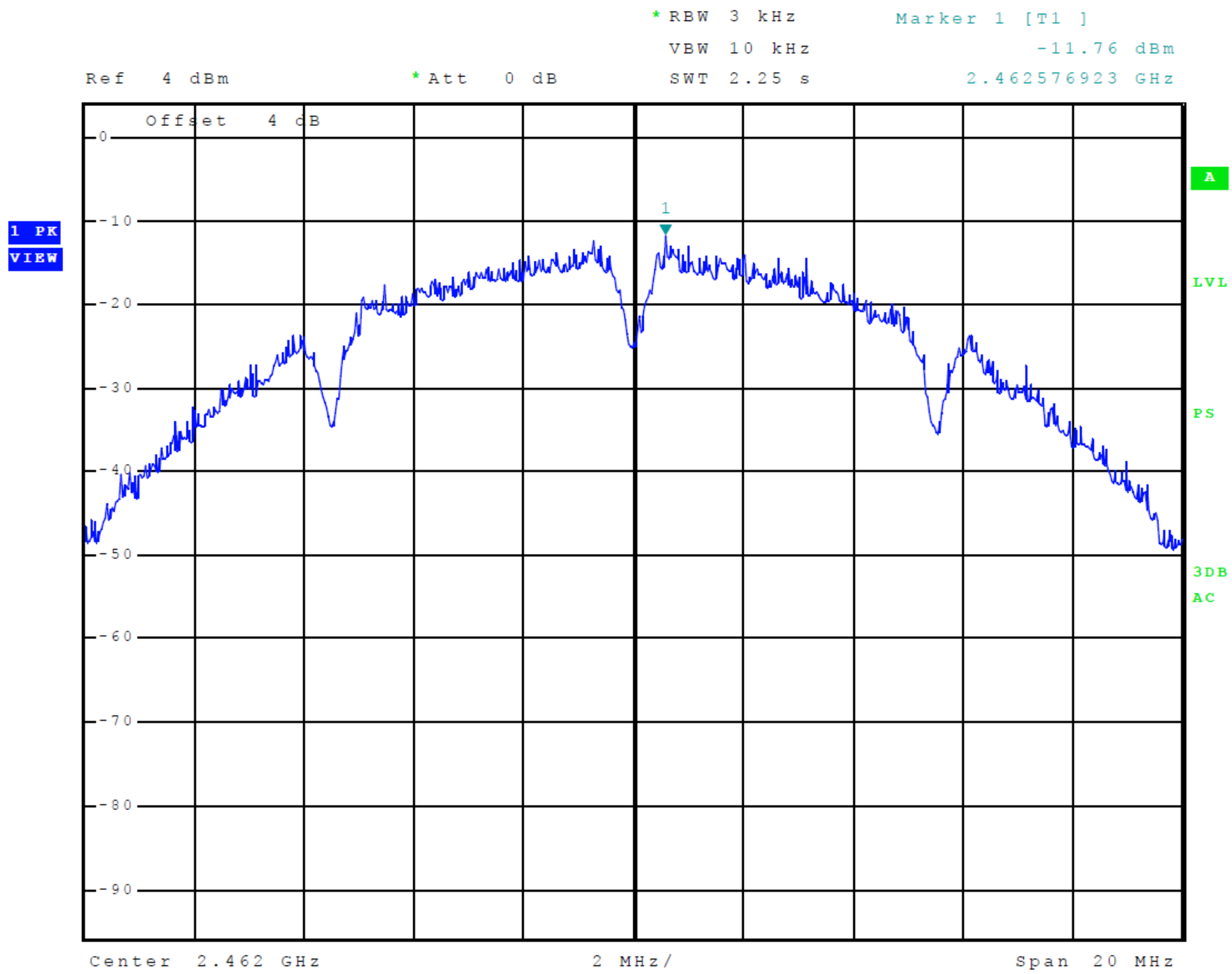

Figure 46 Plot of Transmitter Power Spectral Density (802.11b) Chain 1

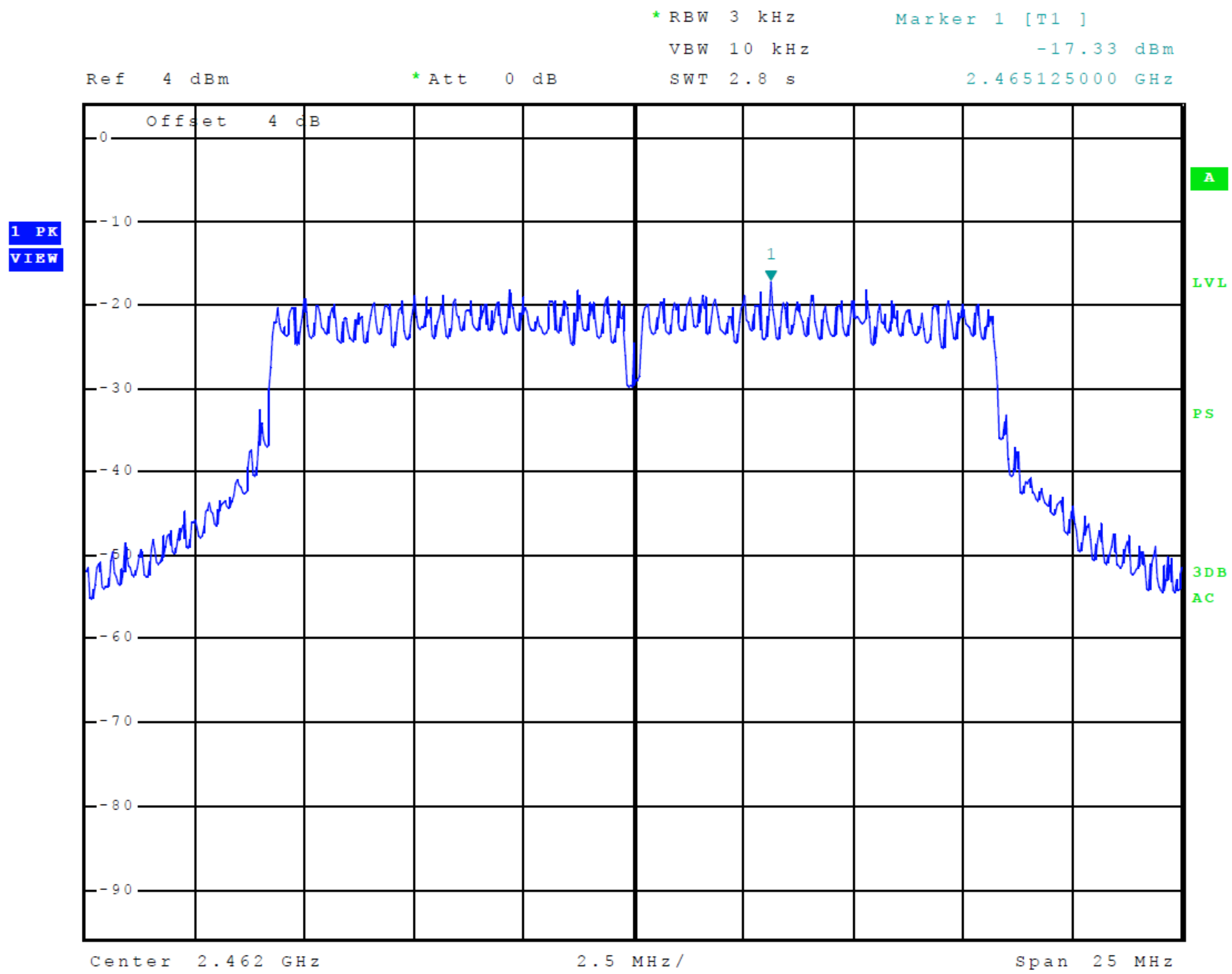

Figure 47 Plot of Transmitter Power Spectral Density (802.11g) Chain 0

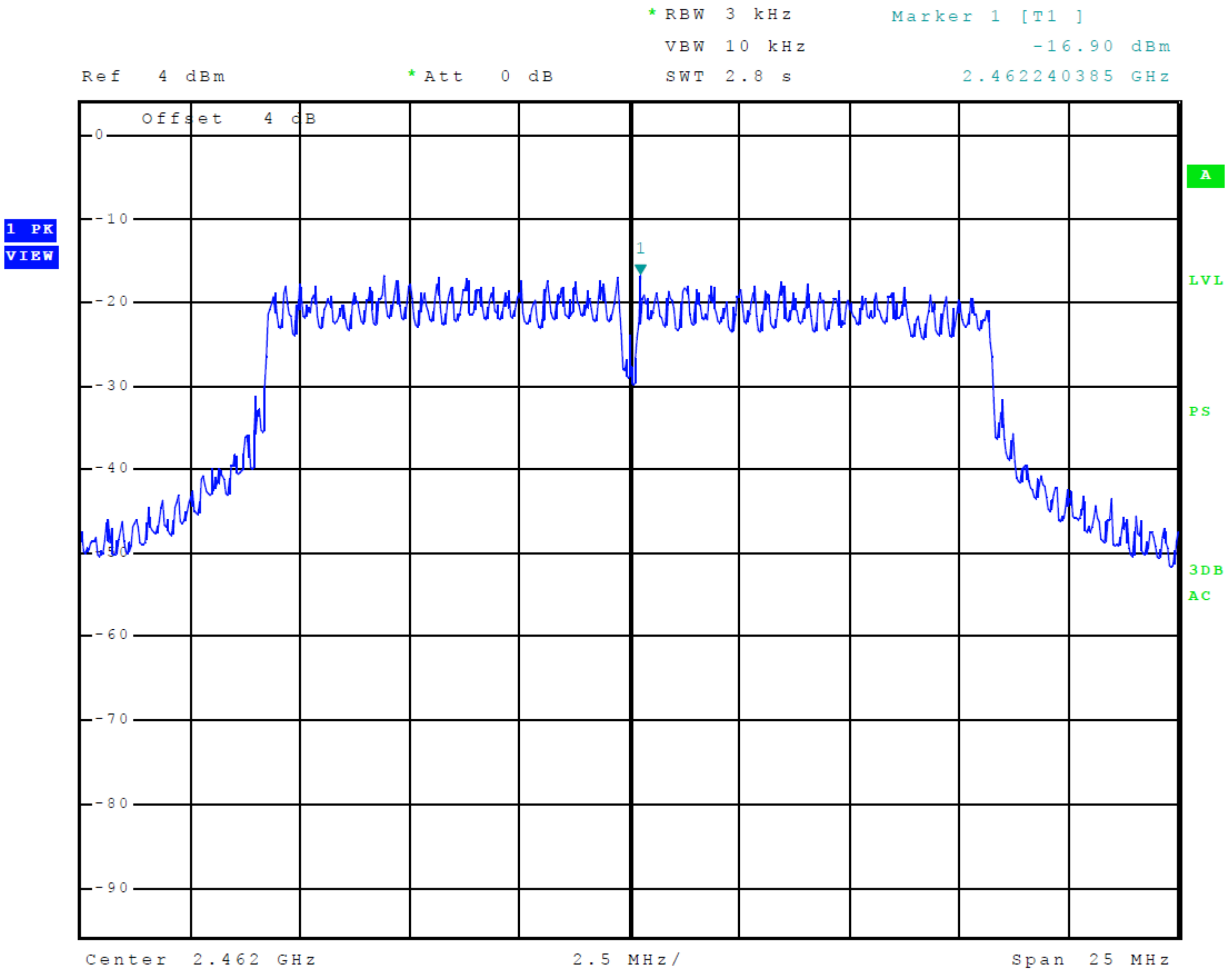

Figure 48 Plot of Transmitter Power Spectral Density (802.11g) Chain 1

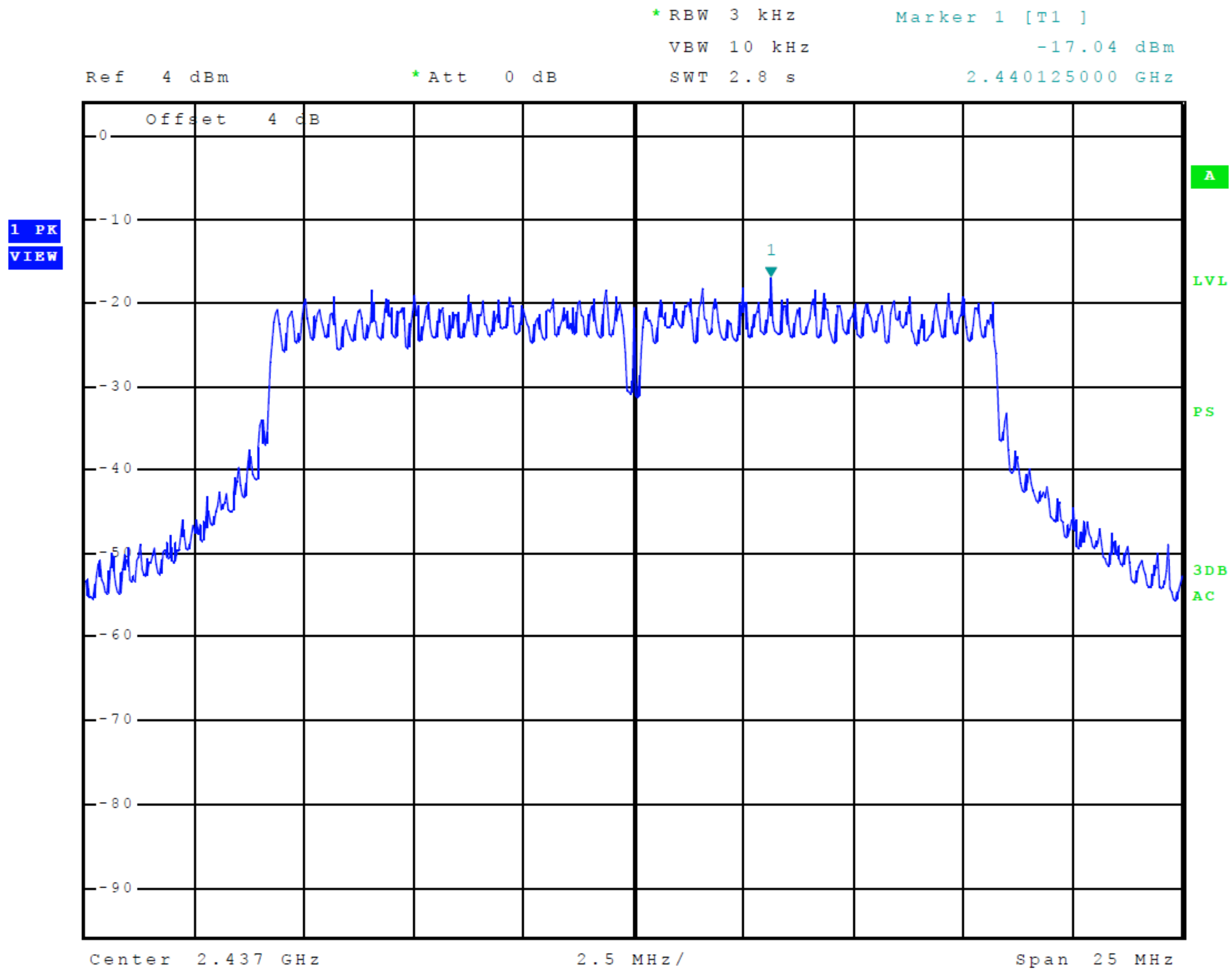

Figure 49 Plot of Transmitter Power Spectral Density (802.11n) Chain 0

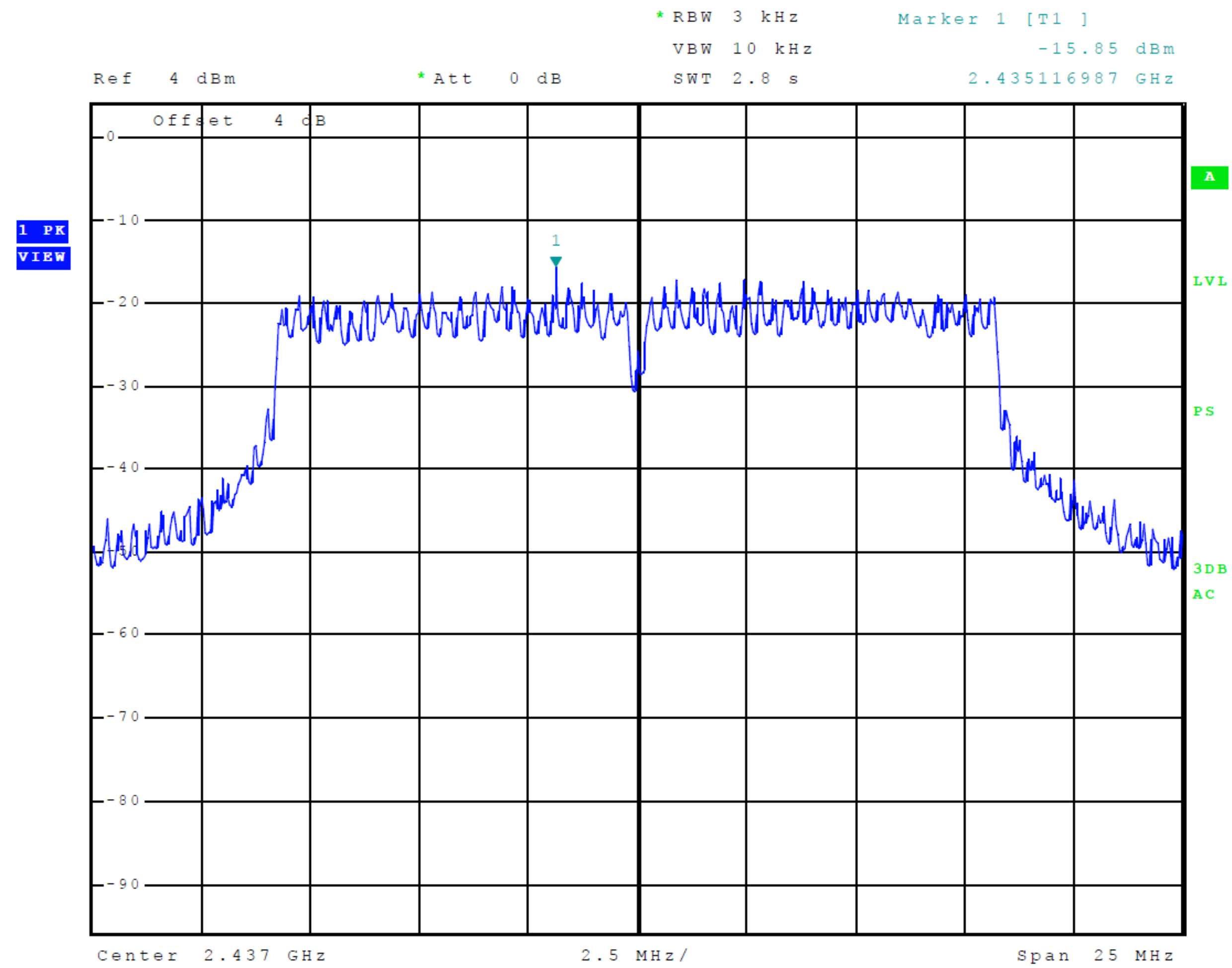

Figure 50 Plot of Transmitter Power Spectral Density (802.11n) Chain 1

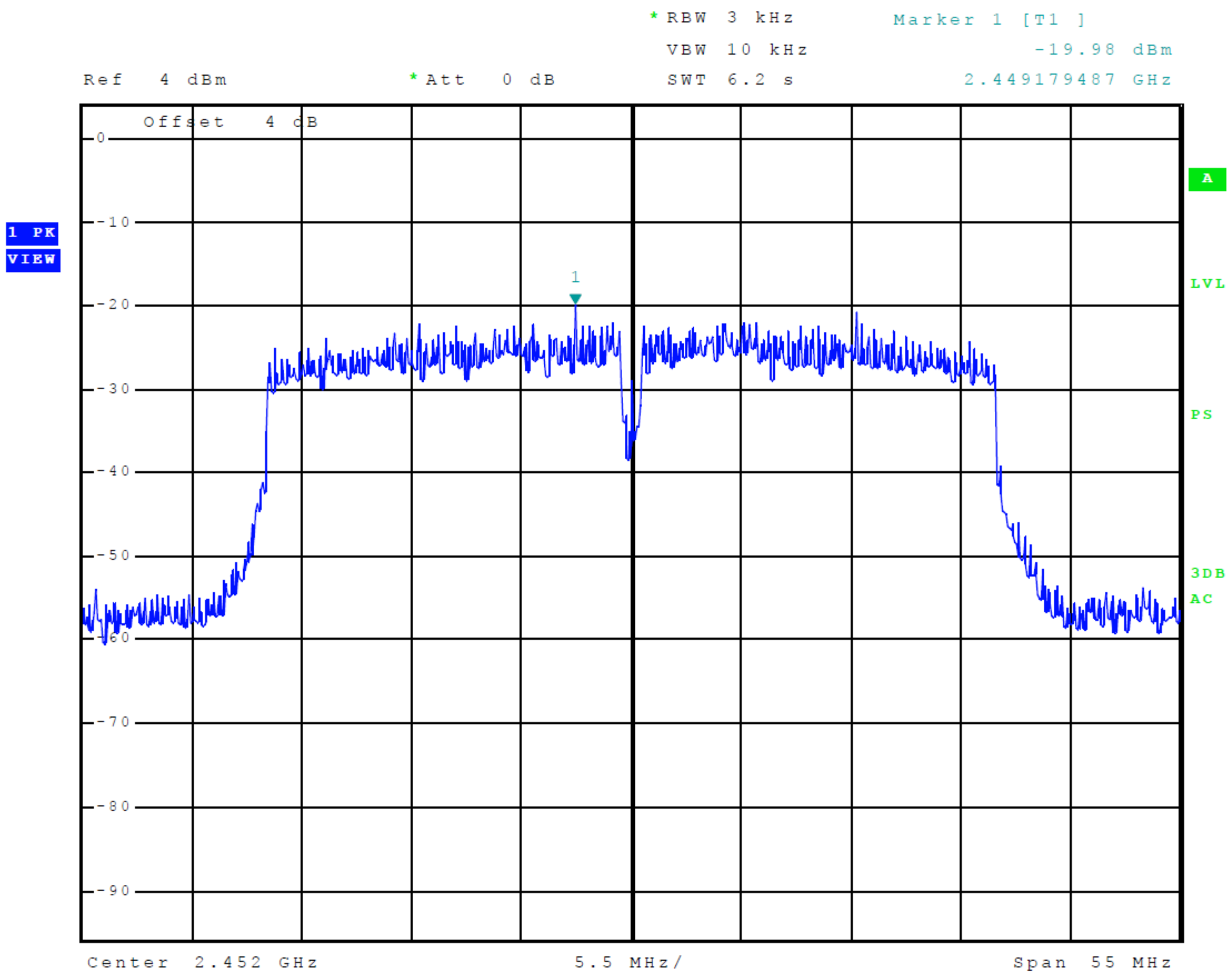

Figure 51 Plot of Transmitter Power Spectral Density (802.11n40) Chain 0

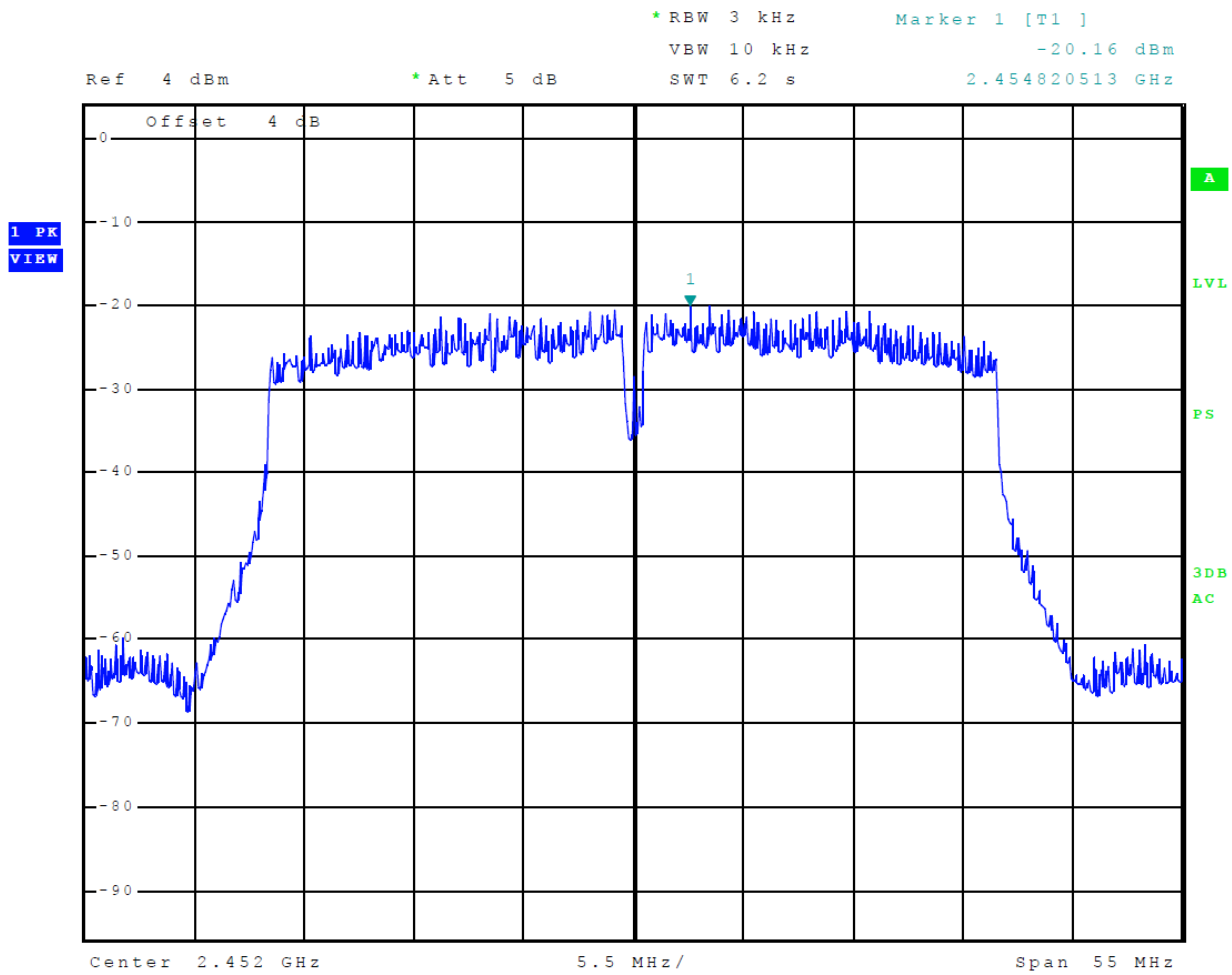

Figure 52 Plot of Transmitter Power Spectral Density (802.11n40) Chain 1

Transmitter Emissions Data

Table 7 Transmitter Radiated Emissions (mode 1 802.11b worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dBm)	Vertical Margin (dBm)
2412.0	--	--	--	--	--	--	--
4824.0	51.2	40.8	52.7	43.4	54.0	-13.2	-10.6
7236.0	52.8	40.0	53.7	41.0	54.0	-14.0	-13.0
9648.0	55.7	42.9	56.4	43.1	54.0	-11.1	-10.9
12060.0	58.7	45.0	59.2	46.1	54.0	-9.0	-7.9
14472.0	60.6	47.7	61.5	49.0	54.0	-6.3	-5.0
16884.0	62.0	49.2	63.6	50.0	54.0	-4.8	-4.0
2437.0	--	--	--	--	--	--	--
4874.0	51.4	41.1	55.2	48.8	54.0	-12.9	-5.2
7311.0	52.7	40.1	54.2	41.0	54.0	-13.9	-13.0
9748.0	54.6	42.2	55.9	43.0	54.0	-11.8	-11.0
12185.0	58.7	46.2	59.8	46.7	54.0	-7.8	-7.3
14622.0	60.8	48.3	63.0	49.1	54.0	-5.7	-4.9
17059.0	61.6	48.9	62.7	49.7	54.0	-5.1	-4.3
2462.0	--	--	--	--	--	--	--
4924.0	50.4	38.6	59.1	53.8	54.0	-15.4	-0.2
7386.0	53.2	40.2	54.4	41.0	54.0	-13.8	-13.0
9848.0	55.4	42.3	56.1	43.0	54.0	-11.7	-11.0
12310.0	59.6	46.8	61.1	47.2	54.0	-7.2	-6.8
14772.0	61.7	48.6	62.8	49.7	54.0	-5.4	-4.3
17234.0	61.5	48.4	62.9	49.5	54.0	-5.6	-4.5

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

Table 8 Transmitter Radiated Emissions (mode 2 802.11g worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dBm)	Vertical Margin (dBm)
2412.0	--	--	--	--	--	--	--
4824.0	51.5	42.1	51.9	41.6	54.0	-11.9	-12.4
7236.0	52.9	40.0	52.8	40.3	54.0	-14.0	-13.7
9648.0	54.7	42.2	56.6	43.6	54.0	-11.8	-10.4
12060.0	58.2	45.0	59.2	46.2	54.0	-9.0	-7.8
14472.0	60.7	47.9	62.0	49.2	54.0	-6.1	-4.8
16884.0	62.1	49.2	63.0	50.3	54.0	-4.8	-3.7
2437.0	--	--	--	--	--	--	--
4874.0	51.9	42.0	55.4	48.5	54.0	-12.0	-5.5
7311.0	53.4	40.1	53.2	40.3	54.0	-13.9	-13.7
9748.0	55.2	42.1	56.1	43.4	54.0	-11.9	-10.6
12185.0	58.7	46.0	60.1	47.5	54.0	-8.0	-6.5
14622.0	61.4	48.4	62.6	49.9	54.0	-5.6	-4.1
17059.0	62.7	48.7	64.1	50.9	54.0	-5.3	-3.1
2462.0	--	--	--	--	--	--	--
4924.0	52.7	44.6	58.3	53.3	54.0	-9.4	-0.7
7386.0	53.1	40.2	54.1	40.5	54.0	-13.8	-13.5
9848.0	55.3	42.1	56.5	43.7	54.0	-11.9	-10.3
12310.0	59.7	47.0	60.2	47.4	54.0	-7.0	-6.6
14772.0	61.7	48.6	63.7	50.2	54.0	-5.4	-3.8
17234.0	61.4	48.3	63.2	49.9	54.0	-5.7	-4.1

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

Table 9 Transmitter Radiated Emissions (mode 3 802.11n worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dBm)	Vertical Margin (dBm)
2412.0	--	--	--	--	--	--	--
4824.0	51.7	42.3	52.5	42.4	54.0	-11.7	-11.6
7236.0	53.4	40.3	53.6	40.4	54.0	-13.7	-13.6
9648.0	57.2	43.9	56.8	43.9	54.0	-10.1	-10.1
12060.0	59.4	46.6	59.8	47.2	54.0	-7.4	-6.8
14472.0	61.8	49.1	61.9	49.1	54.0	-4.9	-4.9
16884.0	63.4	50.2	63.5	50.2	54.0	-3.8	-3.8
2437.0	--	--	--	--	--	--	--
4874.0	51.5	42.3	53.5	45.5	54.0	-11.7	-8.5
7311.0	53.2	40.4	53.4	40.4	54.0	-13.6	-13.6
9748.0	56.5	43.3	56.3	43.3	54.0	-10.7	-10.7
12185.0	62.0	48.6	61.3	47.8	54.0	-5.4	-6.2
14622.0	62.6	49.7	62.3	49.6	54.0	-4.3	-4.4
17059.0	64.3	51.8	64.5	51.8	54.0	-2.2	-2.2
2462.0	--	--	--	--	--	--	--
4924.0	53.1	45.1	58.2	53.4	54.0	-8.9	-0.6
7386.0	53.6	40.5	53.6	40.5	54.0	-13.5	-13.5
9848.0	56.6	43.9	56.4	43.7	54.0	-10.1	-10.3
12310.0	60.6	47.5	60.8	47.5	54.0	-6.5	-6.5
14772.0	62.6	49.9	63.2	50.0	54.0	-4.1	-4.0
17234.0	63.2	50.8	63.7	50.8	54.0	-3.2	-3.2

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

Table 10 Transmitter Radiated Emissions (mode 4 802.11n40 worst-case)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dBm)	Vertical Margin (dBm)
2442.0	--	--	--	--	--	--	--
4844.0	52.1	43.2	52.0	42.7	54.0	-10.8	-11.3
7266.0	53.4	40.5	53.2	40.4	54.0	-13.5	-13.6
9688.0	56.6	43.9	56.7	43.8	54.0	-10.1	-10.2
12110.0	58.5	46.0	59.8	46.3	54.0	-8.0	-7.7
14532.0	62.1	49.3	62.8	49.5	54.0	-4.7	-4.5
16954.0	63.8	50.6	63.4	50.3	54.0	-3.4	-3.7
2447.0	--	--	--	--	--	--	--
4894.0	52.0	43.2	50.1	38.0	54.0	-10.8	-16.0
7341.0	53.5	40.5	53.2	40.4	54.0	-13.5	-13.6
9788.0	56.1	43.2	56.0	43.2	54.0	-10.8	-10.8
12235.0	61.1	47.8	59.6	47.1	54.0	-6.2	-6.9
14682.0	63.0	49.5	62.5	49.6	54.0	-4.5	-4.4
17129.0	64.6	51.3	64.9	51.2	54.0	-2.7	-2.8
2452.0	--	--	--	--	--	--	--
4904.0	52.5	43.6	54.0	46.1	54.0	-10.4	-7.9
7356.0	54.1	40.4	53.4	40.4	54.0	-13.6	-13.6
9808.0	56.8	43.5	57.1	43.4	54.0	-10.5	-10.6
12260.0	60.0	47.3	60.4	47.2	54.0	-6.7	-6.8
14712.0	63.4	50.0	63.5	50.0	54.0	-4.0	-4.0
17164.0	64.4	51.2	63.8	51.1	54.0	-2.8	-2.9

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

Table 11 Transmitter Power, OBW, and Power Spectral Density Emissions: Chain 0

Frequency MHz	EIRP Output Power (Watts)	99% Occupied Bandwidth kHz	6-dB Occupied Bandwidth kHz	Power Spectral Density dBm
802.11 b				
2412.0	0.026	12,836.5	8,509.6	-13.2
2437.0	0.024	12,884.6	9,038.5	-14.4
2462.0	0.025	12,836.5	8,942.3	-12.7
802.11 g				
2412.0	0.019	16,746.8	16,346.2	-18.2
2437.0	0.017	16,827.0	16,346.2	-18.2
2462.0	0.018	16,746.8	16,346.2	-17.3
802.11 n				
2412.0	0.018	16,746.8	16,346.2	-17.7
2437.0	0.017	16,746.8	16,346.2	-17.0
2462.0	0.017	16,746.8	16,346.2	-17.6
802.11 n40				
2422.0	0.016	36,217.9	35,897.4	-20.8
2447.0	0.016	36,217.9	35,256.4	-20.0
2452.0	0.016	36,057.7	35,256.4	-20.0

Table 12 Transmitter Power, OBW, and Power Spectral Density Emissions: Chain 1

Frequency MHz	EIRP Output Power (Watts)	99% Occupied Bandwidth kHz	6-dB Occupied Bandwidth kHz	Power Spectral Density dBm
802.11 b				
2412.0	0.036	12,788.5	9,038.5	-11.8
2437.0	0.034	12,923.7	9,038.5	-12.9
2462.0	0.035	12,836.5	8,990.4	-11.8
802.11 g				
2412.0	0.024	16,586.5	16,346.2	-17.4
2437.0	0.023	16,746.8	16,346.2	-17.3
2462.0	0.024	16,666.7	16,346.2	-16.9
802.11 n				
2412.0	0.024	16,666.7	16,346.2	-17.1
2437.0	0.023	16,666.7	16,346.2	-15.9
2462.0	0.024	16,666.7	16,346.2	-16.5
802.11 n40				
2422.0	0.019	36,057.7	35,256.4	-20.4
2447.0	0.020	36,057.7	35,256.4	-20.6
2452.0	0.019	36,057.7	35,256.4	-20.2

Table 13 Transmitter Power and Power Spectral Density Total (combined chains)

Frequency MHz	Total Sum EIRP Output Power (Watts)	Power Spectral Density dBm
802.11 b		
2412.0	0.062	-9.4
2437.0	0.058	-10.6
2462.0	0.059	-9.2
802.11 g		
2412.0	0.043	-14.8
2437.0	0.040	-14.7
2462.0	0.042	-14.1
802.11 n		
2412.0	0.042	-14.4
2437.0	0.040	-13.4
2462.0	0.041	-14.0
802.11 n40		
2422.0	0.035	-17.6
2447.0	0.037	-17.3
2452.0	0.035	-17.1

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15.247 and Industry Canada RSS-247. The antenna port conducted peak power was 0.081 Watts and average e.i.r.p. power of 0.062 Watts. The worst-case peak power spectral density provided a minimum margin of -17.2 dB below the 3 kHz PSD requirements. The minimum radiated harmonic emission provided -0.2 dB margin below requirements. There were no other significantly measurable emissions in the restricted bands other than those recorded 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.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the 47CFR Part 15C paragraph 15.247 and Industry Canada RSS-247 emissions requirements. There were no deviations or modifications to the specifications.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Test Equipment
- Annex C Rogers Qualifications
- Annex D Laboratory 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 Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	4/21/2020	4/21/2021
☒ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126)	.15-30MHz	10/14/2019	10/14/2020
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/14/2019	10/14/2020
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/14/2019	10/14/2020
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303071)	9kHz-40 GHz	10/14/2019	10/14/2020
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/14/2019	10/14/2020
☒ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/14/2019	10/14/2020
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/14/2019	10/14/2020
☐ Antenna:	EMCO	6509	.001-30 MHz	10/16/2018	10/16/2020
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/14/2019	10/14/2020
☐ Antenna:	Schwarzbeck Model:	BBA 9106/VHBB 9124 (9124-627)		4/21/2020	4/21/2021
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/14/2019	10/14/2020
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	10/14/2019	10/14/2020
☐ Antenna:	Schwarzbeck Model:	VULP 9118 A (VULP 9118 A-534)		4/21/2020	4/21/2021
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	4/21/2020	4/23/2022
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/14/2019	10/14/2020
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	4/21/2020	4/21/2021
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/15/2020	5/15/2021
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/27/2020	1/27/2021
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2027
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/14/2019	10/14/2020
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/14/2019	10/14/2020
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/14/2019	10/14/2020
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/14/2019	10/14/2020
☐ Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	4/21/2020	4/21/2021
☐ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	4/21/2020	4/21/2021
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	4/21/2020	4/21/2021
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	4/21/2020	4/21/2021
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	4/21/2020	4/21/2021
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	4/21/2020	4/21/2021
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	4/21/2020	4/21/2021
☐ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	4/21/2020	4/21/2021
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	4/21/2020	4/21/2021
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	4/21/2020	4/21/2021
☐ Attenuator	Fairview	SA6NFNF100W-40 (1625)	30-18000 MHz	4/21/2020	4/18/2021
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	4/21/2020	4/21/2021
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	4/21/2020	4/21/2021
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	4/21/2020	4/21/2021
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	4/21/2020	4/21/2021
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	4/21/2020	4/21/2021
☒ Weather station	Davis	6312 (A81120N075)		11/4/2019	11/4/2020

List of Test Equipment			Calibration	Date (m/d/y)	Due
☐ Frequency Counter: Leader LDC-825 (8060153				4/21/2020	4/21/2021
☐ LISN: Com-Power Model LI-220A				10/14/2019	10/14/2020
☐ LISN: Com-Power Model LI-550C				10/14/2019	10/14/2020
☐ ISN: Com-Power Model ISN T-8				4/21/2020	4/21/2021
☐ LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08				4/21/2020	4/21/2021
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303070)	9kHz-40 GHz	10/14/2019	10/14/2020
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072)	9kHz-40 GHz	10/14/2019	10/14/2020
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L4M)(281184)	9kHz-40 GHz	10/14/2019	10/14/2020
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)	9kHz-40 GHz	10/14/2019	10/14/2020
☐ Cable	Time Microwave	4M-750HF290-750 (4M)	9kHz-24 GHz	10/14/2019	10/14/2020
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9.3-9.5 notch	30-1800 MHz	4/21/2020	4/21/2021
☐ RF Filter	Micro-Tronics	BRC19565 (001) 9.2-9.6 notch	30-1800 MHz	10/16/2018	4/21/2021
☐ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	4/21/2020	4/21/2021
☐ Analyzer	HP External Mixers	11571, 11970	25GHz-110GHz	4/18/2015	4/18/2025
☐ Analyzer	HP	8591EM (3628A00871)		4/21/2020	4/21/2021
☐ Antenna: Solar 9229-1 & 9230-1				2/22/2020	2/22/2021
☐ CDN: Com-Power Model CDN325E				10/14/2019	10/14/2020
☐ Injection Clamp Luthi Model EM101				10/14/2019	10/14/2020
☐ Oscilloscope Scope: Tektronix MDO 4104				2/22/2020	2/22/2021
☐ EMC Transient Generator HVT TR 3000				2/22/2020	2/22/2021
☐ AC Power Source (Ametech, California Instruments)				2/22/2020	2/22/2021
☐ Field Intensity Meter: EFM-018				2/22/2020	2/22/2021
☐ ESD Simulator: MZ-15				2/22/2020	2/22/2021
☐ R.F. Power Amp ACS 230-50W				not required	
☐ R.F. Power Amp EIN Model: A301				not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7				not required	
☐ R.F. Power Amp A.R. Model: 50U1000				not required	
☒ Shielded Room				not required	

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 35 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 Laboratory Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

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 17025:2017. 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).

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

2020-02-25 through 2021-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program