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Emissions
Test Report

EUT Name: eero

Model No.: J010001

CFR 47 Part 15.407 2019 and RSS 247: 2017

Prepared for:

eero LLC
660 3rd Street
San Francisco, CA 94107

Prepared by:

TUV Rheinland of North America, Inc.
5015 Brandin Ct. Fremont CA 94538 USA

Report/Issue Date: 9/23/2019
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Report Number: 31962534.001

Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
0	6/21/19	Original Document	OC
1	7/3/19	Customer Details added	OC
1.1	8/15/19	Antenna beamforming information updated	OC
1.2	9/9/19	TCB Review	OC
1.3	9/23/19	TCB Review	OC

Note: Latest revision report will replace all previous reports.

Statement of Compliance

Manufacturer:	eero LLC 660 3rd Street San Francisco, CA 94107
Requester / Applicant:	eero LLC
Name of Equipment:	eero
Model No.	J010001
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.407 2019 and RSS 247: 2017
Test Dates:	May 6th, 2019 to May 22nd, 2019

Guidance Documents:

Emissions: ANSI C63.10-2013, KDB 789033 D02 General UNII Test Procedures New Rules v02r01, KDB 662911 D01 Multiple Transmitter Output v02r01

Test Methods:

Emissions: ANSI C63.10-2013, KDB 789033 D02 General UNII Test Procedures New Rules v02r01, KDB 662911 D01 Multiple Transmitter Output v02r01

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

Osvaldo Casorla		Richard Decker	
Test Engineer	Date September 23, 2019	A2LA Signatory	Date September 23, 2019

FREMONT			
US1131	**Testing Cert #3331.02**	**INDUSTRY CANADA 2932D**	**1097 (A-0268)**

1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.407 2019 and RSS 247: 2017 based on the results of testing performed on May 6th, 2019 to May 22nd, 2019 on the eero Model J010001 manufactured by eero LLC. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 5150-5250 MHz and 5725-5850 MHz frequency bands are covered in this document.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.4	Worse Case (Measured)	Result
Maximum Output Power	CFR47 15.407 (a)	27.06 dBm (802.11n HT20 6.5 Mbps)	**Complied**
Maximum Output Power	RSS 247 Sect.6.2.1.1	22.79 dBm (802.11ac VHT80 MCS0)	**Complied**
DTS Bandwidth (6dB)	CFR47 15.407 (a) RSS-247 5.2(a)	16.4 MHz (802.11a NoHT 6 Mbps)	**Complied**
Peak Power Spectral Density	CFR47 15.407 (a)	15.38 dBm (802.11n HT20 6.5 Mbps)	**Complied**
Peak Power Spectral Density	RSS 247 Sect.6.2	9.87 dBm EIRP (802.11ac NoHT 6 Mbps)	**Complied**
Out of Band Emissions: U-NII-1 Restricted Band Edge	CFR47 15.407 (a)	-0.11 dB Margin @ 5149.6 MHz, Average (802.11a NoHT 6 Mbps)	**Complied**
Out of Band Emissions: U-NII-3 Unrestricted Band Edge	*CFR47 15.407 (b)(4)(i)* *RSS 247 Sect.6.2.1.2*	See Plots	**Complied**
Transmitter Spurious Emissions	CFR47 15.209, CFR47 15.407 (b) RSS-GEN Sect.8.9, RSS-247 Sect. 6.2.1.2	-4.42 dB Margin @ 17360.54 MHz, Average (802.11a NoHT 6Mbps Channel 157)	**Complied**
AC Power Conducted Emission	CFR47 15.207 RSS-GEN Sect.8.8	Class B	**Complied**

Note: 1. This test report covers 5150-5250MHz and 5725-5850 MHz bands.
2. Measurements are conducted for 2x2 MIMO total power non-beamforming.

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

UV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA 94538, are recognized by the Commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No. US1131). The laboratory Scopes of Accreditation include Title 47 CFR Parts 15, 18 and 90. The accreditations are updated every three years.

2.1.2 NIST / A2LA

TUV Rheinland of North America EMC test facilities are accredited by the American Association for Laboratory Accreditation (A2LA). The laboratories have been assessed and accredited by A2LA in accordance with ISO Standard 17025:2017 (Testing Certificate #3331.02). The Scope of Laboratory Accreditation includes emission and immunity testing. The accreditations are updated annually.

2.1.3 Canada – Industry Canada

The Pleasanton 5-meter Semi-Anechoic Chamber, Registration No. 2932M-1, has been accepted by Industry Canada to perform testing to 3 and 5 meters based on the test procedures described in ANSI C63.4-2014. The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D-1, has been accepted by Industry Canada to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2014.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA 94538, have been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0268

VCCI Registration No. for Fremont: A-0268

2.1.5 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

2.2 Test Facilities

Test facilities are located at 1279 Quarry Lane, Ste. A, Pleasanton, California 94566, U.S.A. and 5015 Brandin Ct. Fremont CA 94538 USA (Fremont is the Pleasanton Annex).

2.2.1 Emission Test Facility

The Semi-Anechoic Chambers and AC Line Conducted measurement facilities used to collect radiated and conducted emissions data have been constructed in accordance with ANSI C63.7:1992. The Fremont 10 meter semi-anechoic chamber has been measured in accordance with and verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2014 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04), at test distances of 3 and 10 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02). The Pleasanton 5 meter semi-anechoic chamber has been verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2009 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04) at a test distance of 3 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02).

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities. The term standard uncertainty is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurement and the fraction may be viewed as the coverage probability or level of confidence of the interval.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.3.2 Measurement Uncertainty

Per CISPR 16-4-2	**U_{lab}**	**U_{cispr}**
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.3 dB

Voltech PM6000A

The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 5.0%.	Per CISPR 16-4-2 Methods

2.3.3 Measurement Uncertainty Immunity

The estimated expanded uncertainty for ESD immunity measurements is ± 8.2%.	Per IEC 61000-4-2
The estimated expanded uncertainty for radiated immunity measurements is ± 4.10 dB.	Per IEC 61000-4-3
The estimated expanded uncertainty for EFT fast transient immunity measurements is ± 5.84%.	Per IEC 61000-4-4
The estimated expanded uncertainty for surge immunity measurements is ± 5.84 %.	Per IEC 61000-4-4
The estimated expanded uncertainty for conducted immunity measurements with CDN is ± 3.66 dB	Per IEC 61000-4-6
The estimated expanded uncertainty for power frequency magnetic field immunity is ± 11.6%.	Per IEC 61000-4-8
The estimated expanded uncertainty for voltage variation and interruption measurements is ± 3.48%.	Per IEC 61000-4-11

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

2.5 Product Description

The Model J010001, eero, is a 2x2 is a home WiFi router. It is intended to work as a dual band (2.4GHz and 5GHz) wireless router. The router will be in compliance with regulatory standards of regions it will be operating in.

2.6 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

2.7 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of a EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

2.8 Unique Antenna Connector

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

2.8.1 Results

The eero has internal Flex PCB dipole antennas

They are connected via RF connectors that are not easily accessible to the end user.

Refer to Table below for additional antenna information.

	Max Antenna Gain	Max Beamforming Gain
Bluetooth	4.15	
Wi-Fi		
2.4 GHz	3.4	6.12
U-NII-1	3.11	6.01
U-NII-3	3.97	6.48

2.9 Worst Case Test Modes

The worst case chain was determined by using a Spectrum Analyzer as described by ANSI C63.10-2013 Section 12.3.3.4.

2.9.1 Worse Case Chain

Each chain was measured with the Spectrum Analyzer while the remaining chains were terminated with 50 ohms.

Power setting=25, HT20 mode, Channel 44 (5220 MHz)

Chain 0	Chain 1
22.69	**22.88**

Chain 1 is found worse case with respect to output power.

2.10 Duty Cycle

CDD mode duty cycles were measured by the gated power meter used for measurements in section 4.1 of this report. Beamforming (802.11ac) duty cycles were measured with a spectrum analyzer.

Mode	Measured Duty Cycle	Duty Cycle Correction Factor (dB)
802.11a (No HT) – NII 1	96%	0.18
802.11n HT20 – NII 1	98%	0.09
802.11n HT40 – NII 1	97%	0.13
802.11ac VHT80 – NII 1	94%	0.27
802.11a (No HT) – NII 3	97%	0.13
802.11n HT20 – NII 3	98%	0.09
802.11n HT40 – NII 3	96%	0.18
802.11ac VHT80 – NII 3	93%	0.32

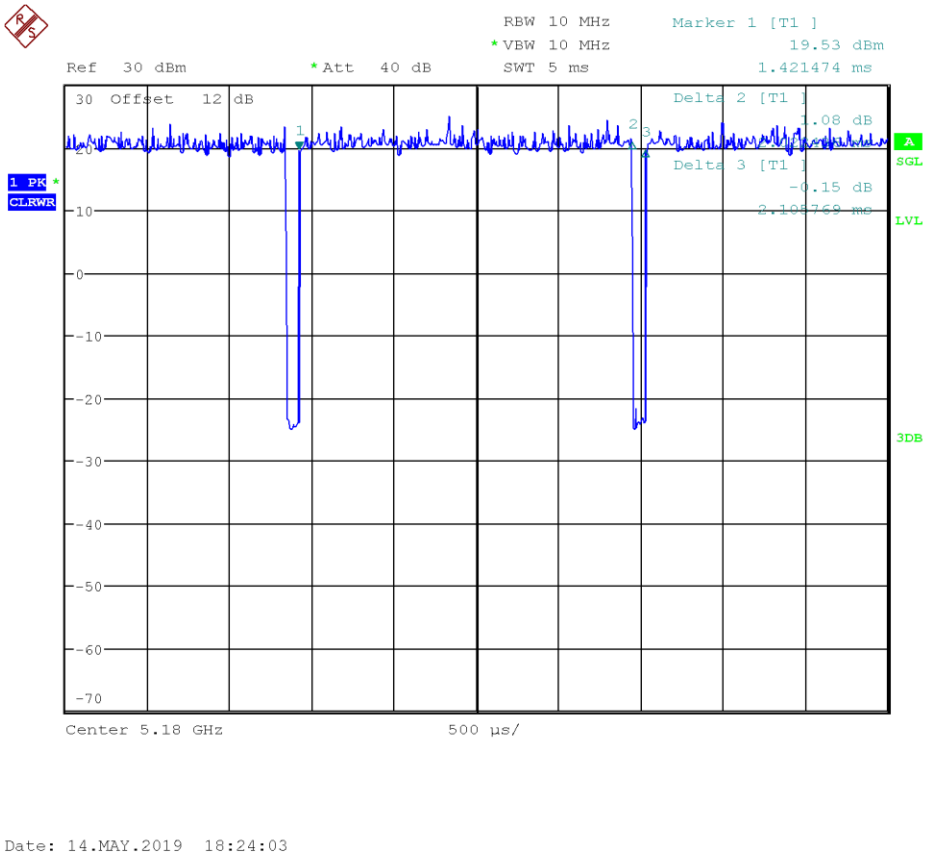


Figure 1: Duty Cycle for 802.11a (No HT)

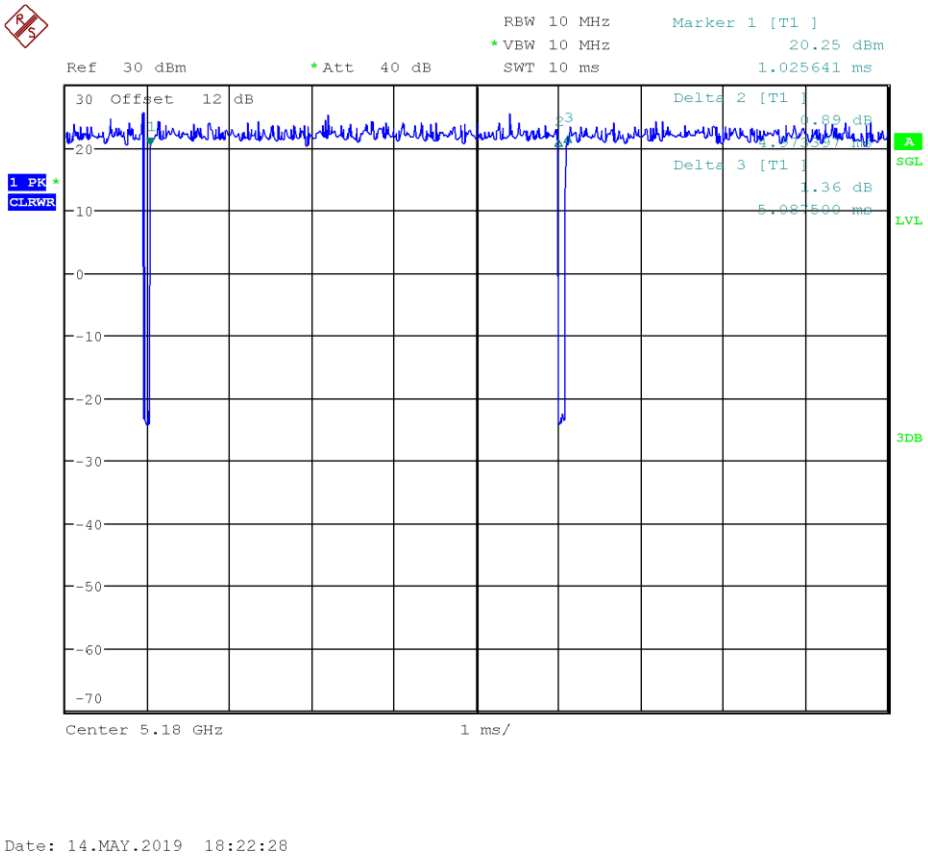


Figure 2: Duty Cycle for 802.11n HT20

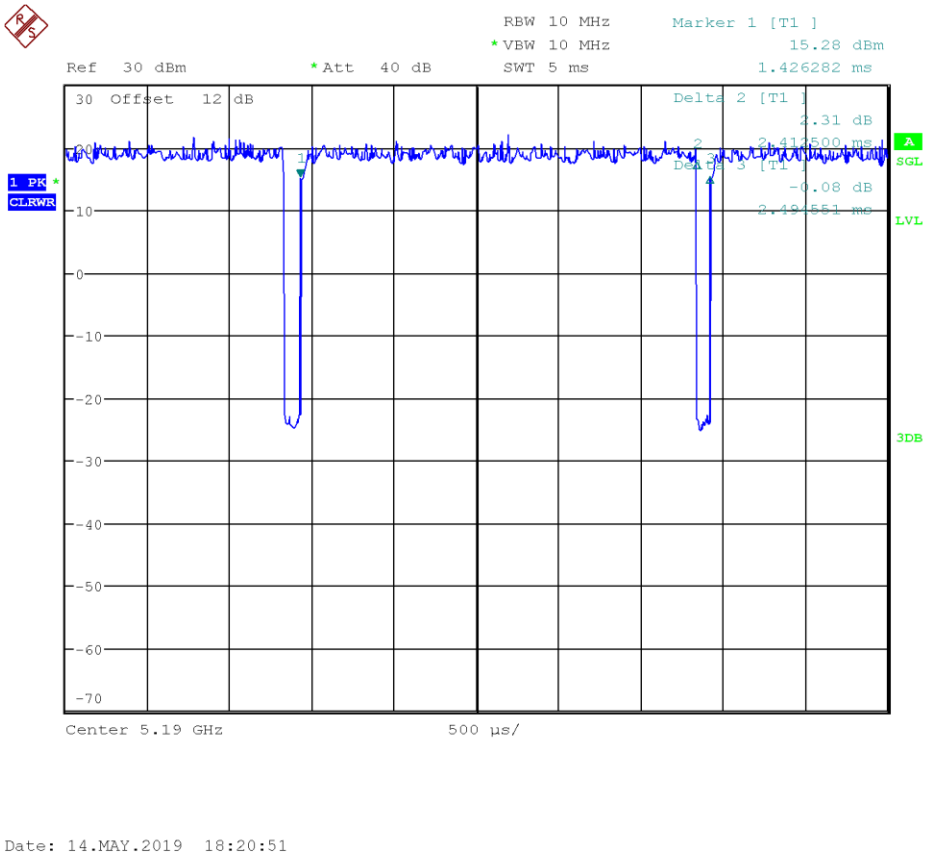


Figure 3: Duty Cycle for 802.11n HT40

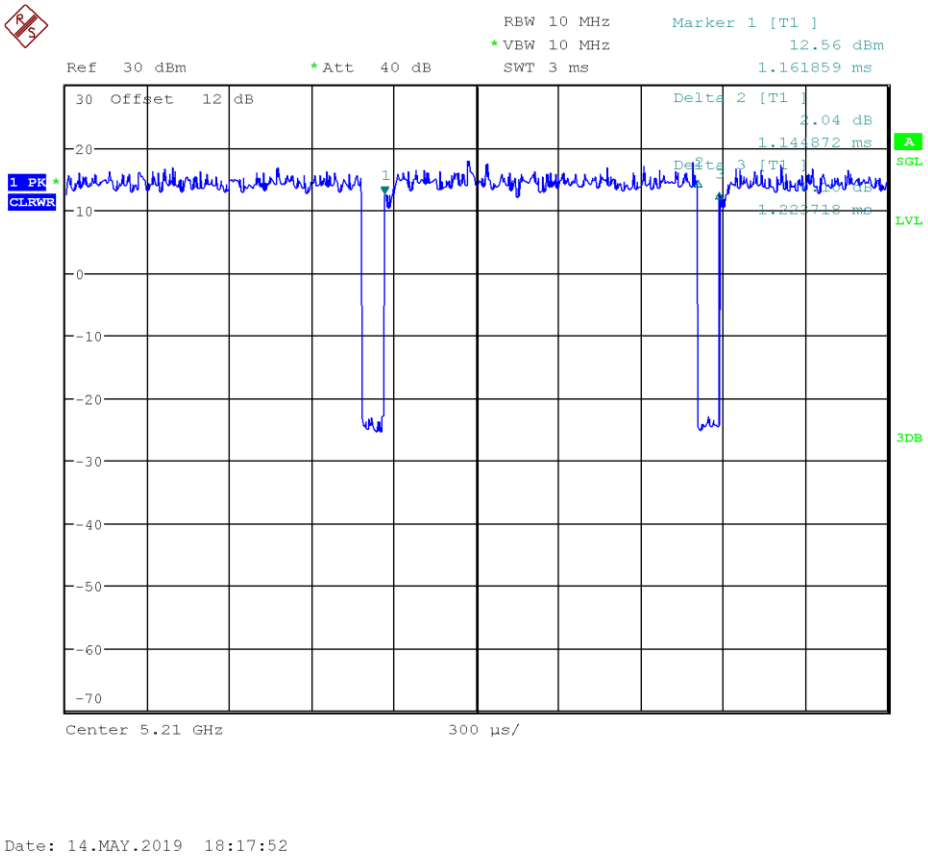


Figure 4: Duty Cycle for 802.11ac VHT80

3 Emissions

Testing was performed in accordance with CFR 47 Part 15.407 2019 and RSS 247: 2017. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

3.1 Output Power

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

3.1.1 Limit(s)

The maximum output power and harmonics shall not exceed CFR47 Part 15.407 (a):2019 and RSS 247 Sect. 6.2.1 and 5.4.

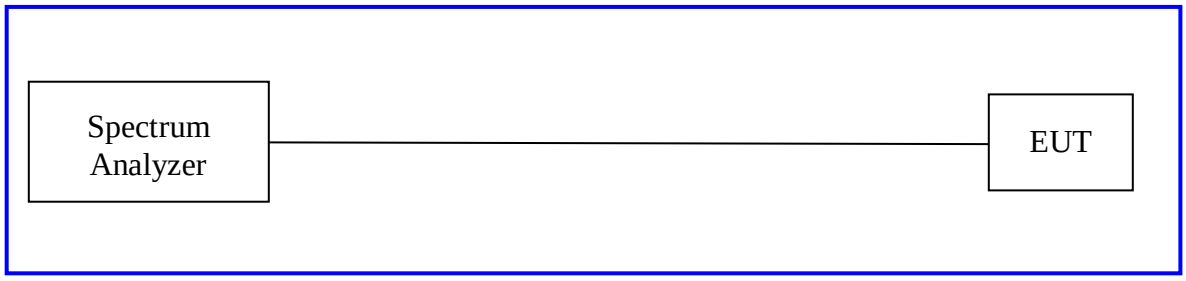
The maximum allowed transmit powers are

Frequency (MHz)	*§15.407*	*RSS-247*
5150-5250	*30 dBm (Conducted)*	*24 dBm (EIRP)*
5725-5850	*30 dBm (Conducted)*	*30 dBm (Conducted)*

3.1.2 Test Method

The ANSI C63.10-2013 Section 12.3.2.4 SA-2 conducted method was used to measure the channel power output. The preliminary investigation was performed at different data rate/ chain to determine the highest power output for each mode (Section 3.5 of this report). The worst findings were conducted on the low, middle and high channels, where applicable, in each operating range per CFR47 Part 15.407(a) and RSS 247 Sect. 6.2.1.1; 5150 MHz to 5250 MHz. The worst mode results indicated below.

3.1.3 Test Setup:



Each chain was measured individually using a Spectrum Analyzer channel power per 12.3.2.4 SA-2 Method and then summed per ANSI 63.10 section 14.3.1.

3.1.4 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

3.1.4.1 FCC Power Measurements

Table 2: FCC RF Output Powers

U-NII-1 (5150-5250MHz) – Non Beam Forming										
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Chain 1 RMS (dBm)	Chain 2 RMS (dBm)	Total RMS Power (dBm)	Limit (dBm)	Margin (dB)	Results
802.11a No HT 6mbps	36	20	5180	19.25	18.49	19.03	21.96	30	-8.04	Pass
	44	20	5220	25	22.17	21.96	25.25	30	-4.75	Pass
	48	20	5240	23.4	19.77	20.80	23.50	30	-6.50	Pass
802.11n HT20 6.5mbps	36	20	5180	21.25	20.28	20.02	23.25	30	-6.75	Pass
	44	20	5220	25	22.69	22.88	25.88	30	-4.12	Pass
	48	20	5240	23.4	19.78	20.62	23.32	30	-6.68	Pass
802.11n HT40+ MCS0	38	40	5190	17.25	16.53	17.06	19.95	30	-10.05	Pass
	46	40	5230	22.4	17.78	18.97	21.56	30	-8.44	Pass
802.11ac VHT80 MCS0	42	80	5210	17.5	16.46	16.89	19.96	30	-10.04	Pass

U-NII-3 (5725-5850MHz) – Non Beam Forming										
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Chain 1 RMS (dBm)	Chain 2 RMS (dBm)	Total RMS Power (dBm)	Limit (dBm)	Margin (dB)	Results
802.11a No HT 6mbps	149	20	5745	25	19.76	19.50	22.77	30	-7.23	Pass
	157	20	5785	25	21.81	21.86	24.98	30	-5.02	Pass
	165	20	5825	25	21.82	22.14	25.13	30	-4.87	Pass
802.11n HT20 6.5mbps	149	20	5745	25	23.13	23.24	26.28	30	-3.72	Pass
	157	20	5785	25	22.59	22.59	25.69	30	-4.31	Pass
	165	20	5825	25	23.77	24.14	27.06	30	-2.94	Pass
802.11n HT40+ MCS0	151	40	5755	25	22.23	22.20	25.40	30	-4.60	Pass
	159	40	5795	25	22.48	22.89	25.88	30	-4.12	Pass
802.11ac VHT80 MCS0	155	80	5775	22.5	19.85	20.36	23.44	30	-6.56	Pass

U-NII-1 (5150-5250MHz) – Beam Forming										
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Chain 1 RMS (dBm)	Chain 2 RMS (dBm)	Total RMS Power (dBm)	Limit (dBm)	Margin (dB)	Results
802.11a No HT 6mbps	36	20	5180	19.25	18.49	19.03	21.96	29.99	-8.03	Pass
	44	20	5220	25	22.17	21.96	25.25	29.99	-4.74	Pass
	48	20	5240	23.4	19.77	20.80	23.50	29.99	-6.49	Pass
802.11n HT20 6.5mbps	36	20	5180	21.25	20.28	20.02	23.25	29.99	-6.74	Pass
	44	20	5220	25	22.69	22.88	25.88	29.99	-4.11	Pass
	48	20	5240	23.4	19.78	20.62	23.32	29.99	-6.67	Pass
802.11n HT40+ MCS0	38	40	5190	17.25	16.53	17.06	19.95	29.99	-10.04	Pass
	46	40	5230	22.4	17.78	18.97	21.56	29.99	-8.43	Pass
802.11ac VHT80 MCS0	42	80	5210	17.5	16.46	16.89	19.96	29.99	-10.03	Pass

U-NII-3 (5725-5850MHz) – Beam Forming										
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Chain 1 RMS (dBm)	Chain 2 RMS (dBm)	Total RMS Power (dBm)	Limit (dBm)	Margin (dB)	Results
802.11a No HT 6mbps	149	20	5745	25	19.76	19.50	22.77	29.52	-6.74	Pass
	157	20	5785	25	21.81	21.86	24.98	29.52	-4.54	Pass
	165	20	5825	25	21.82	22.14	25.13	29.52	-4.39	Pass
802.11n HT20 6.5mbps	149	20	5745	25	23.13	23.24	26.28	29.52	-3.24	Pass
	157	20	5785	25	22.59	22.59	25.69	29.52	-3.83	Pass
	165	20	5825	25	23.77	24.14	27.06	29.52	-2.46	Pass
802.11n HT40+ MCS0	151	40	5755	25	22.23	22.20	25.40	29.52	-4.12	Pass
	159	40	5795	25	22.48	22.89	25.88	29.52	-3.64	Pass
802.11ac VHT80 MCS0	155	80	5775	22.5	19.85	20.36	23.44	29.52	-6.08	Pass

3.1.4.1.1 FCC UNII-1 Plots

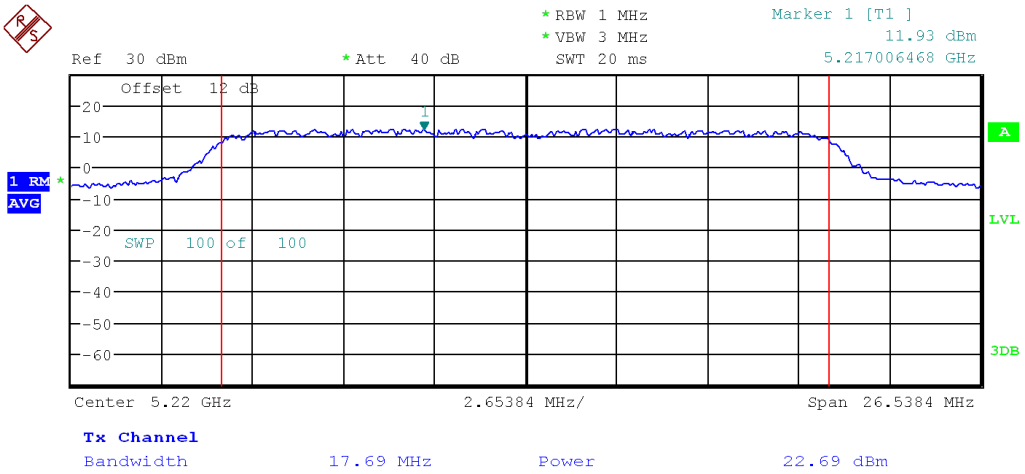


Figure 5: Output Power, Channel 44 802.11 HT20, Chain 0

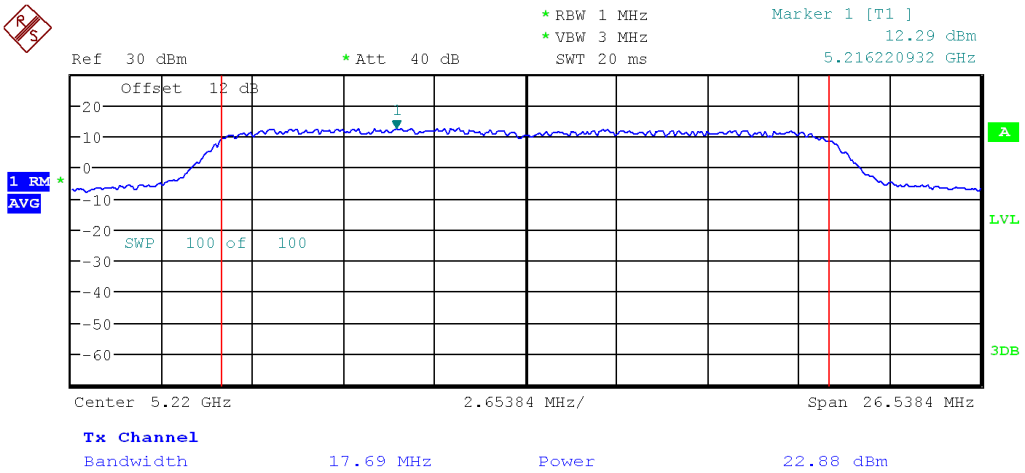


Figure 6: Output Power, Channel 44 802.11 HT20, Chain 1

3.1.4.1.1 FCC UNII-3 Plots

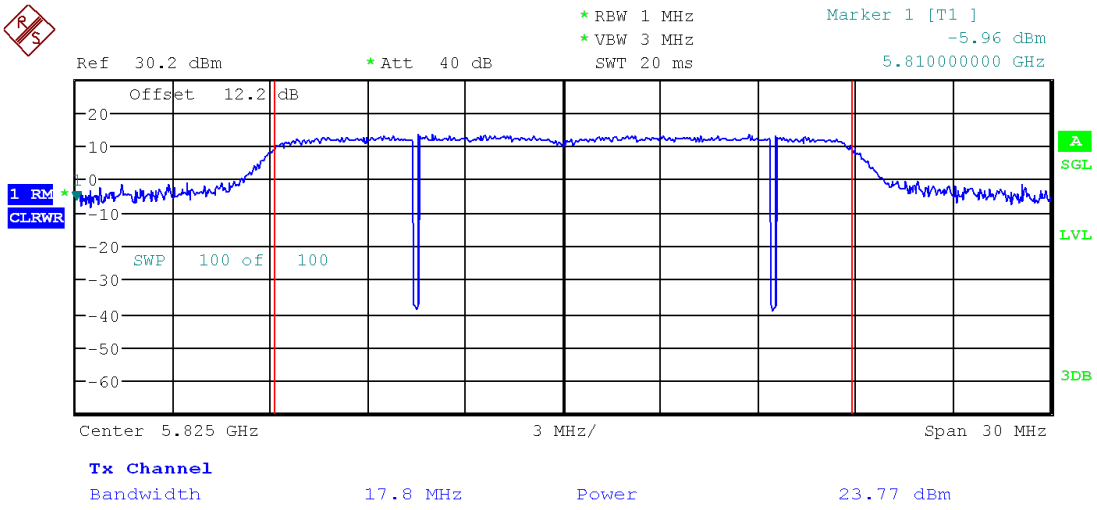


Figure 7: Output Power, Channel 165 802.11 HT20, Chain 0

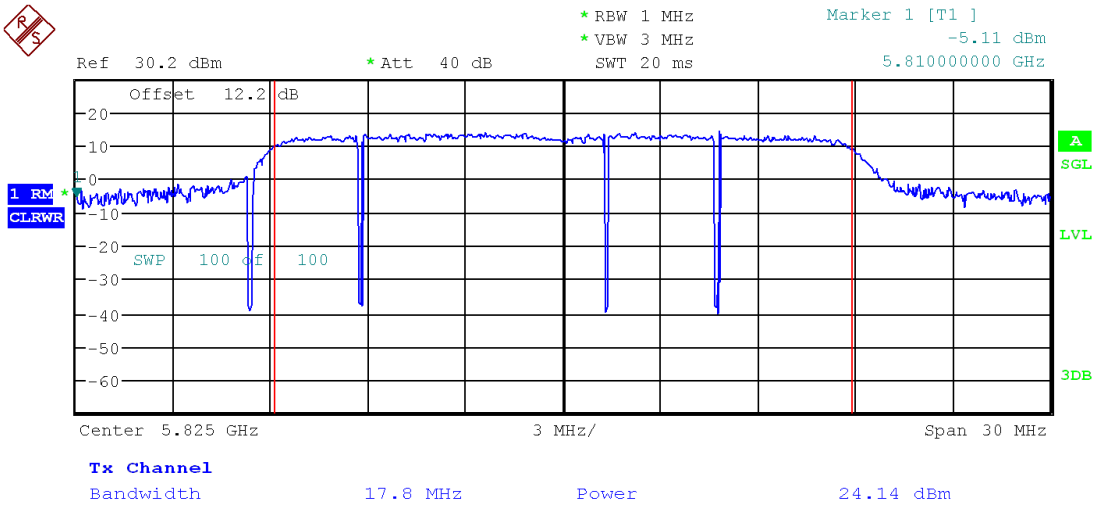


Figure 8: Output Power, Channel 165 802.11 HT20, Chain 1

3.1.4.2 ISED Power Measurements

Table 3: ISED RF Output Powers

U-NII-1 (5150-5250MHz) – Non Beam Forming												
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Chain 1 RMS (dBm)	Chain 2 RMS (dBm)	Total RMS Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
802.11a No HT 6mbps	36	20	5180	14.5	14.03	14.54	17.30	3.11	20.59	22.14	-1.55	Pass
	44	20	5220	14.5	13.94	14.51	17.24	3.11	20.53	22.14	-1.61	Pass
	48	20	5240	14.5	13.85	14.28	17.08	3.11	20.37	22.15	-1.78	Pass
802.11n HT20 6.5mbps	36	20	5180	14.75	13.99	14.57	17.30	3.11	20.50	22.45	-1.95	Pass
	44	20	5220	15.0	14.40	14.83	17.63	3.11	20.83	22.46	-1.63	Pass
	48	20	5240	15.0	14.38	14.81	17.61	3.11	20.81	22.46	-1.65	Pass
802.11n HT40+ MCS0	38	40	5190	16.5	16.31	16.71	19.52	3.11	22.77	23.00	-0.23	Pass
	46	40	5230	16.5	16.29	16.72	19.52	3.11	22.76	23.00	-0.24	Pass
802.11ac VHT80 MCS0	42	80	5210	17.0	16.30	16.50	19.41	3.11	22.79	23.00	-0.21	Pass

U-NII-3 (5725-5850MHz) – Non Beam Forming										
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Chain 1 RMS (dBm)	Chain 2 RMS (dBm)	Total RMS Power (dBm)	Limit (dBm)	Margin (dB)	Results
802.11a No HT 6mbps	149	20	5745	25	19.76	19.50	22.77	30	-7.23	Pass
	157	20	5785	25	21.81	21.86	24.98	30	-5.02	Pass
	165	20	5825	25	21.82	22.14	25.13	30	-4.87	Pass
802.11n HT20 6.5mbps	149	20	5745	25	23.13	23.24	26.28	30	-3.72	Pass
	157	20	5785	25	22.59	22.59	25.69	30	-4.31	Pass
	165	20	5825	25	23.77	24.14	27.06	30	-2.94	Pass
802.11n HT40+ MCS0	151	40	5755	25	22.23	22.20	25.40	30	-4.60	Pass
	159	40	5795	25	22.48	22.89	25.88	30	-4.12	Pass
802.11ac VHT80 MCS0	155	80	5775	22.5	19.85	20.36	23.44	30	-6.56	Pass

U-NII-1 (5150-5250MHz) – Beam Forming												
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Chain 1 RMS (dBm)	Chain 2 RMS (dBm)	Total RMS Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
802.11a No HT 6mbps	36	20	5180	11.75	11.30	11.05	14.19	6.01	20.37	22.14	-1.77	Pass
	44	20	5220	11.75	11.34	11.44	14.40	6.01	20.59	22.14	-1.56	Pass
	48	20	5240	11.75	11.19	11.40	14.31	6.01	20.49	22.15	-1.65	Pass
802.11n HT20 6.5mbps	36	20	5180	12.25	11.74	11.49	14.63	6.01	20.72	22.45	-1.72	Pass
	44	20	5220	12.25	11.61	11.55	14.59	6.01	20.69	22.46	-1.77	Pass
	48	20	5240	12.25	11.52	11.88	14.71	6.01	20.81	22.46	-1.64	Pass
802.11n HT40+ MCS0	38	40	5190	14.00	13.51	13.46	16.50	6.01	22.64	23.00	-0.36	Pass
	46	40	5230	14.00	13.52	13.85	16.70	6.01	22.84	23.00	-0.16	Pass
802.11ac VHT80 MCS0	42	80	5210	14.50	13.54	13.77	14.50	6.01	16.67	23.00	-0.05	Pass

U-NII-3 (5725-5850MHz) – Beam Forming								
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Total RMS Power (dBm)	Limit (dBm)	Margin (dB)	Results
802.11a No HT 6mbps	149	20	5745	25.0	22.77	30	-7.23	Pass
	157	20	5785	25.0	24.98	30	-5.02	Pass
	165	20	5825	25.0	25.13	30	-4.87	Pass
802.11n HT20 6.5mbps	149	20	5745	25.0	26.28	30	-3.72	Pass
	157	20	5785	25.0	25.69	30	-4.31	Pass
	165	20	5825	25.0	27.06	30	-2.94	Pass
802.11n HT40+ MCS0	151	40	5755	25.0	25.40	30	-4.6	Pass
	159	40	5795	25.0	25.88	30	-4.12	Pass
802.11ac VHT80 MCS0	155	80	5775	22.5	23.44	30	-6.67	Pass

3.1.4.2.1 IC UNII-1 Plots

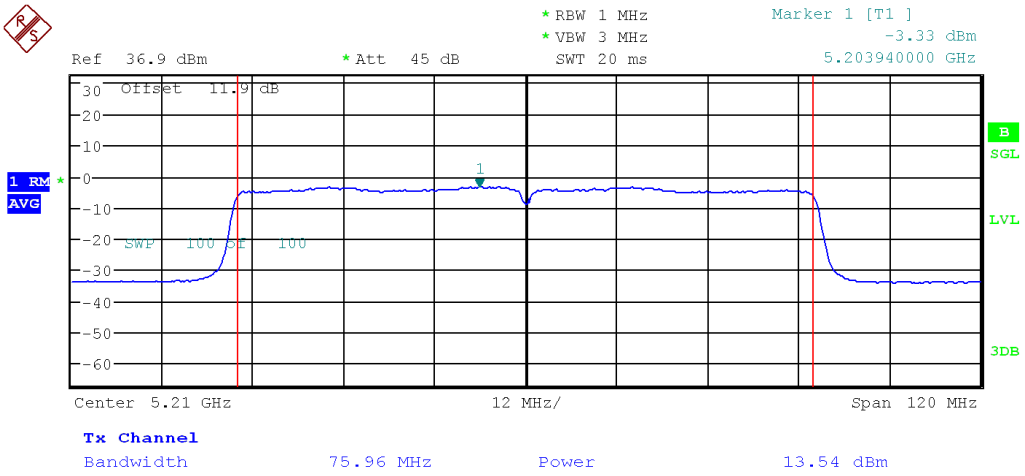


Figure 9: Output Power, Channel 42 802.11 ac80, Chain 0

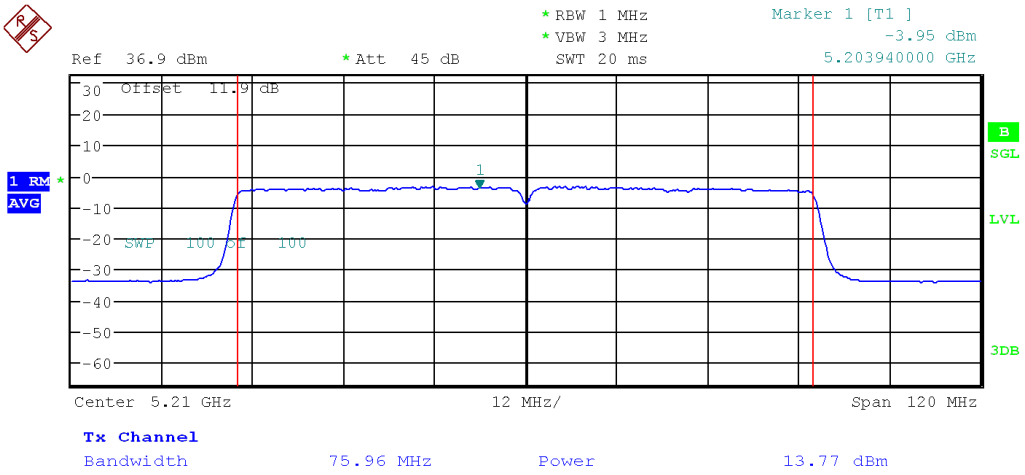


Figure 10: Output Power, Channel 42 802.11 ac80, Chain 1

3.1.4.2.2 IC UNII-3 Plots

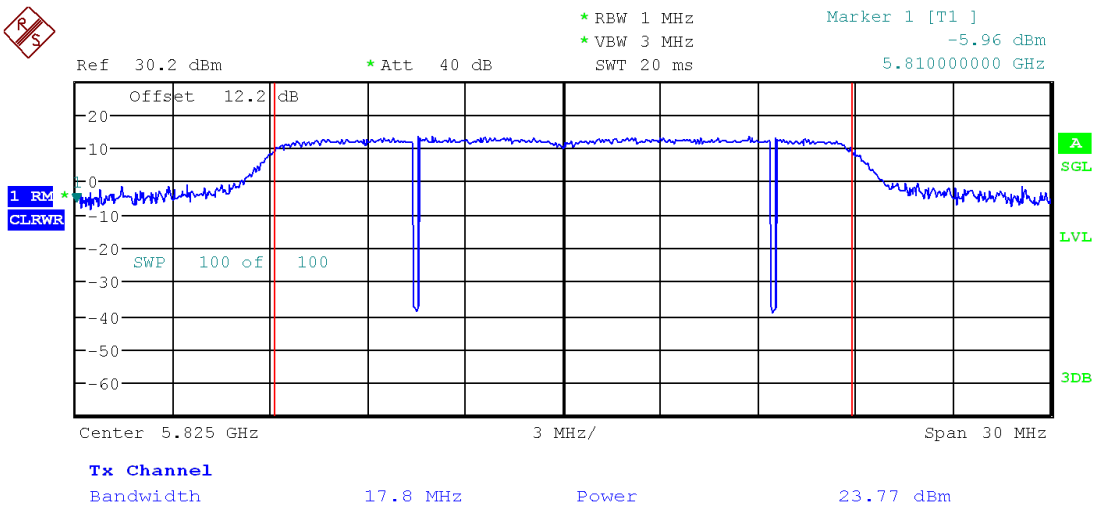


Figure 11: Output Power, Channel 165 802.11 HT20, Chain 0

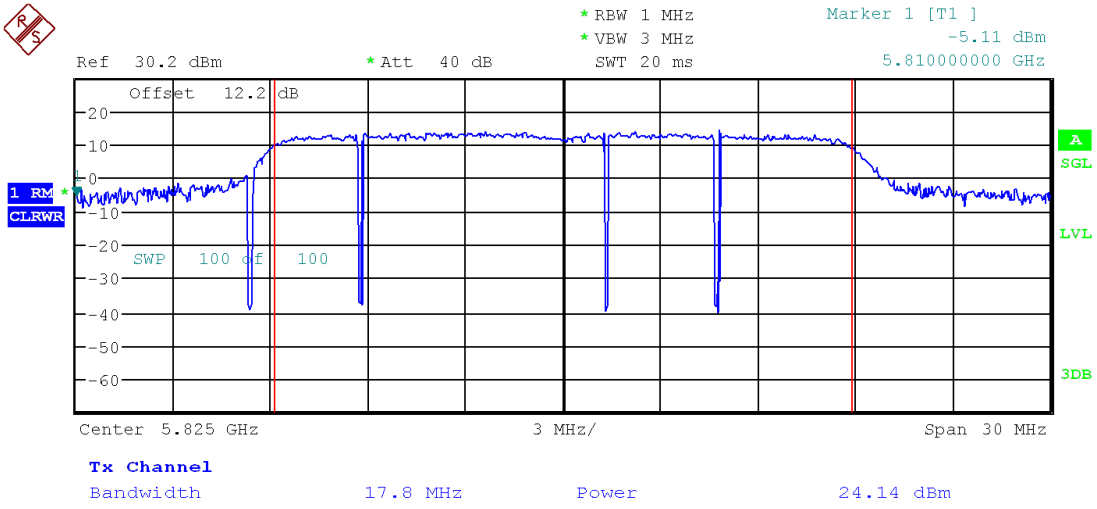


Figure 12: Output Power, Channel 165 802.11 HT20, Chain 1

3.2 Occupied Bandwidth and Emission Bandwidth (6dB)

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

The 6 dB bandwidth is defined the bandwidth of 6 dBr from highest transmitted level of the fundamental frequency.

3.2.1 Limit(s)

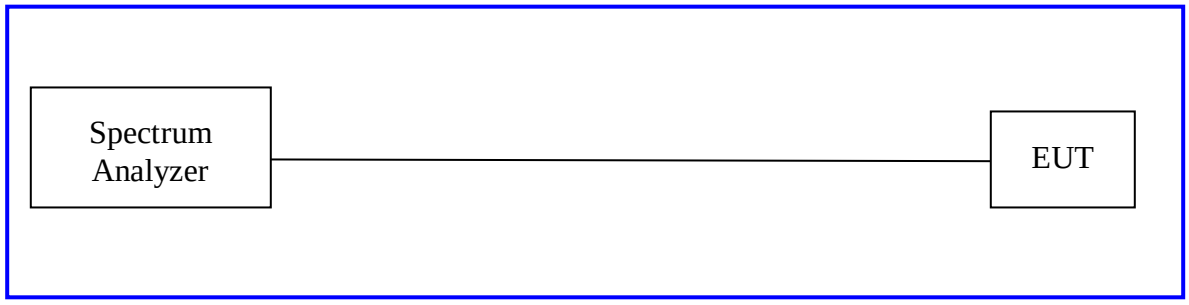
There is limits for the bandwidths in the U-NII-1 Band, U-NII-1 Band shall not overlap U-NII-2A otherwise subject to DFS rules. The 99% bandwidth was used to determine the limit for maximum conducted output power per RSS-247 section 6.2.1.1 and to verify transmission in the U-NII-1 Band (5150-5250MHz).

For the U-NII-3 Band (5725-5850MHz) the minimum 6 dB bandwidth shall be at least 500 kHz per §15.407(e).

3.2.2 Test Method

The conducted method was used to measure the occupied bandwidth. The measurement was performed with modulation per CFR47 15.407(a) and RSS Gen Sect.6.6. For U-NII-1, the measurements were performed on 3 channels, where applicable, for the operating frequency range; 5150-5250 MHz to verify that the occupied bandwidth does not impede into the U-NII-2A band (5250-5350MHz) to verify that DFS is not required. For occupied bandwidth measurements, procedures given by ANSI 63.10-2013 section 6.9.3 were used. For DTS Bandwidth (6dB), procedures given by ANSI 63.10-2013 section 11.8.1 were used. The test plan for these measurements were based on guidance from ANSI 63.10-2013 sections 5.6.2.1 and 5.6.2.2.

3.2.3 Test Setup:



See section 4.1.2.1 table 2 for power settings.

3.2.4 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 4: Occupied Bandwidth – U-NII-1 Test Results

Mode	Channel	99% Bandwidth (MHz)		
		OBW	FL	FH
802.11a NoHT 6Mbps	36	16.4	5171.8	5188.2
	44	26.7	5206.8	5233.5
	48	19.16	5230.2	5249.5
802.11n HT20 6.5Mbps	36	17.8	5171.1	5188.9
	44	27.8	5206.2	5233.9
	48	18.52	5230.8	5249.3
802.11n HT40+ MCS0	38	36.1	5172.0	5208.1
	46	37.56	5211.3	5248.8
802.11ac VHT80 MCS0	42	76.0	5172.1	5248.1

Reference: KDB 789033 D02 General UNII Test Procedures New Rules v02r01, section III.B.2.a.i

Table 5: Occupied and DTS Bandwidth– U-NII-3 Test Results

Mode	Channel	99% Bandwidth (MHz)			6 dB Bandwidth
		OBW	FL	FH	(MHz)
802.11a NoHT 6Mbps	149	28.3	5730.8	5759.2	16.40
	157	26.8	5771.5	5798.3	16.45
	165	28.2	5810.9	5839.1	16.47
802.11n HT20 6.5Mbps	149	28.8	5730.6	5759.4	17.66
	157	27.7	5771.1	5798.8	17.69
	165	29.7	5810.1	5839.8	17.70
802.11n HT40+ MCS0	151	41.6	5733.9	5775.6	35.46
	159	46.0	5771.6	5817.6	35.37
802.11ac VHT80 MCS0	155	76.9	5736.5	5813.4	74.53
Note: All measurements was performed on Chain 1.					

3.2.4.1 Measurement Plots

3.2.4.1.1 UNII-1

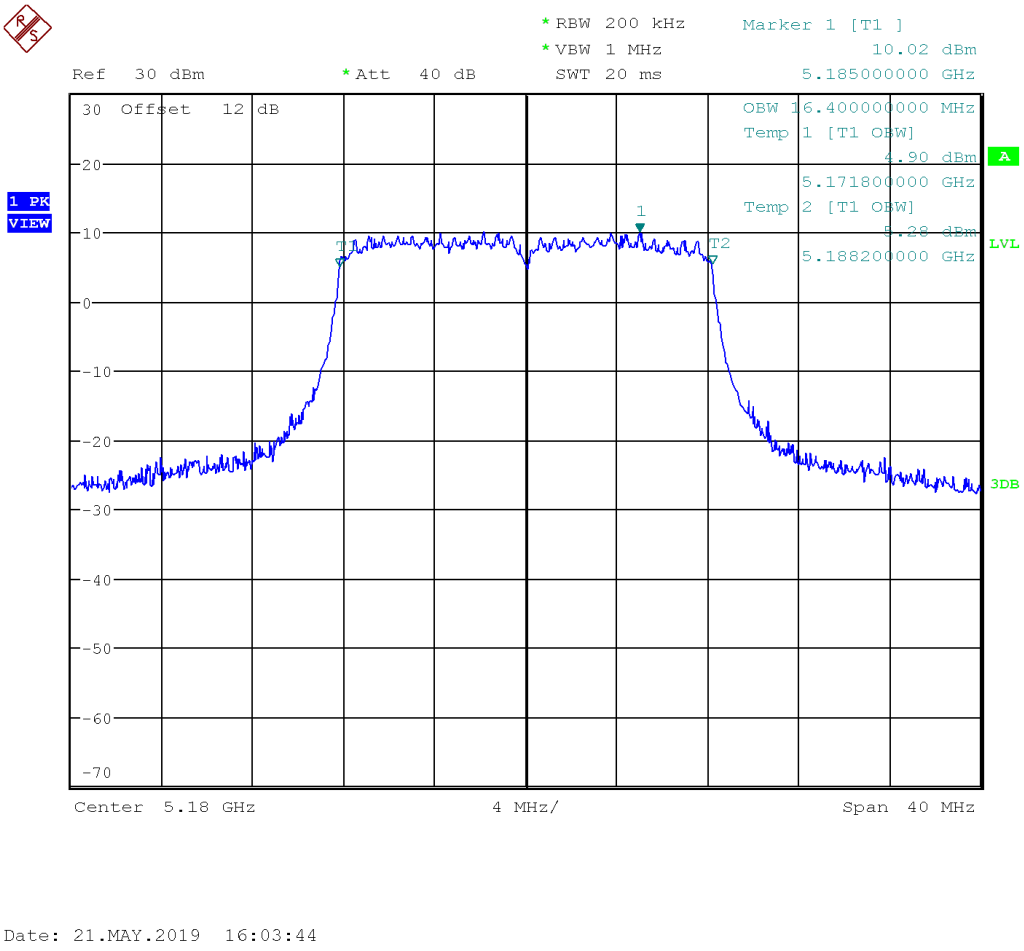


Figure 13: 99% Occupied Bandwidth, Channel 36 at 802.11a 6Mbps, Chain 1

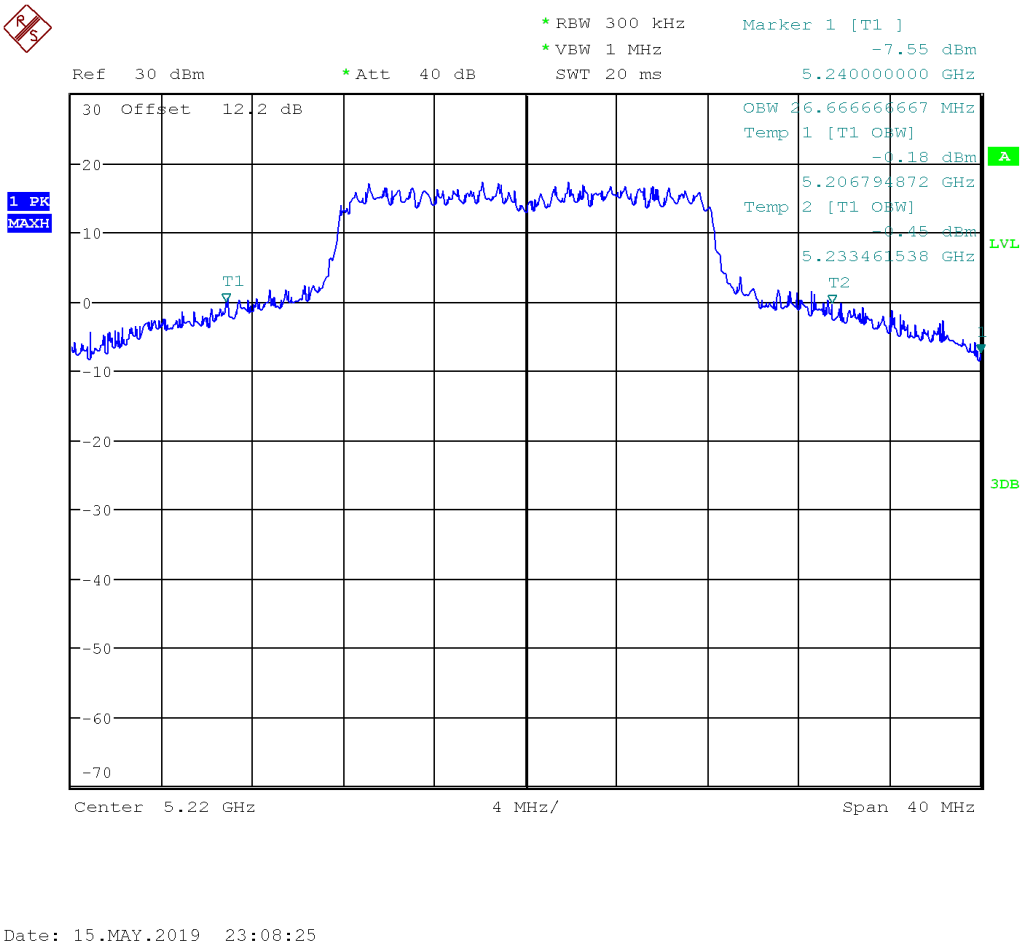


Figure 14: 99% Occupied Bandwidth, Channel 44 at 802.11a 6Mbps, Chain 1

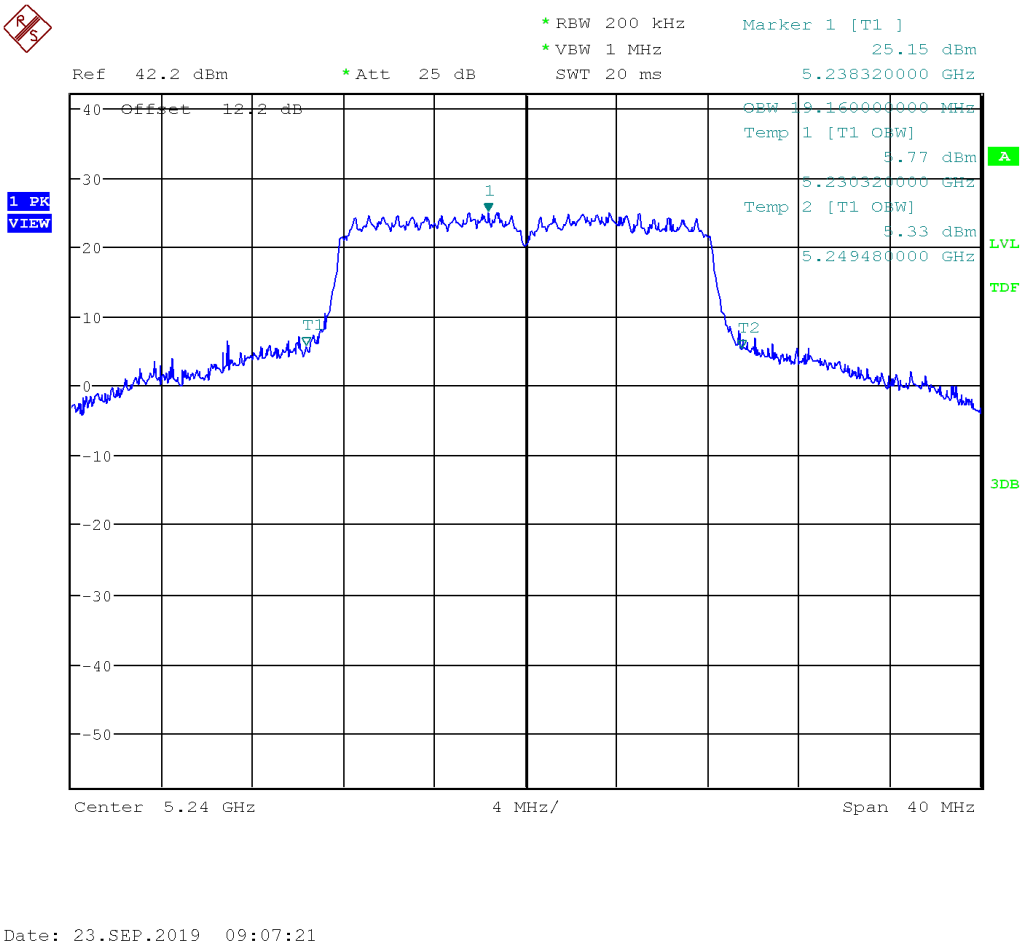


Figure 15: 99% Occupied Bandwidth, Channel 48 at 802.11a 6Mbps, Chain 1

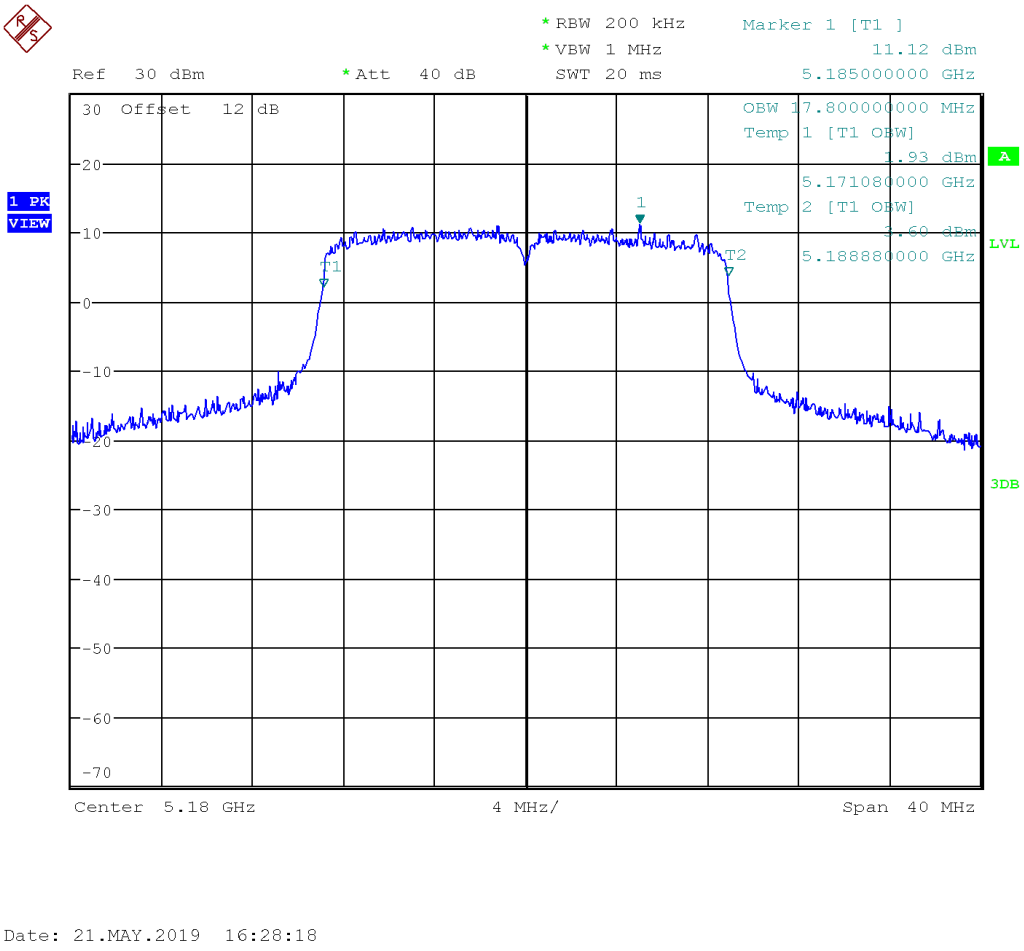


Figure 16: 99% Occupied Bandwidth, Channel 36 at 802.11n HT20 6.5Mbps, Chain 1

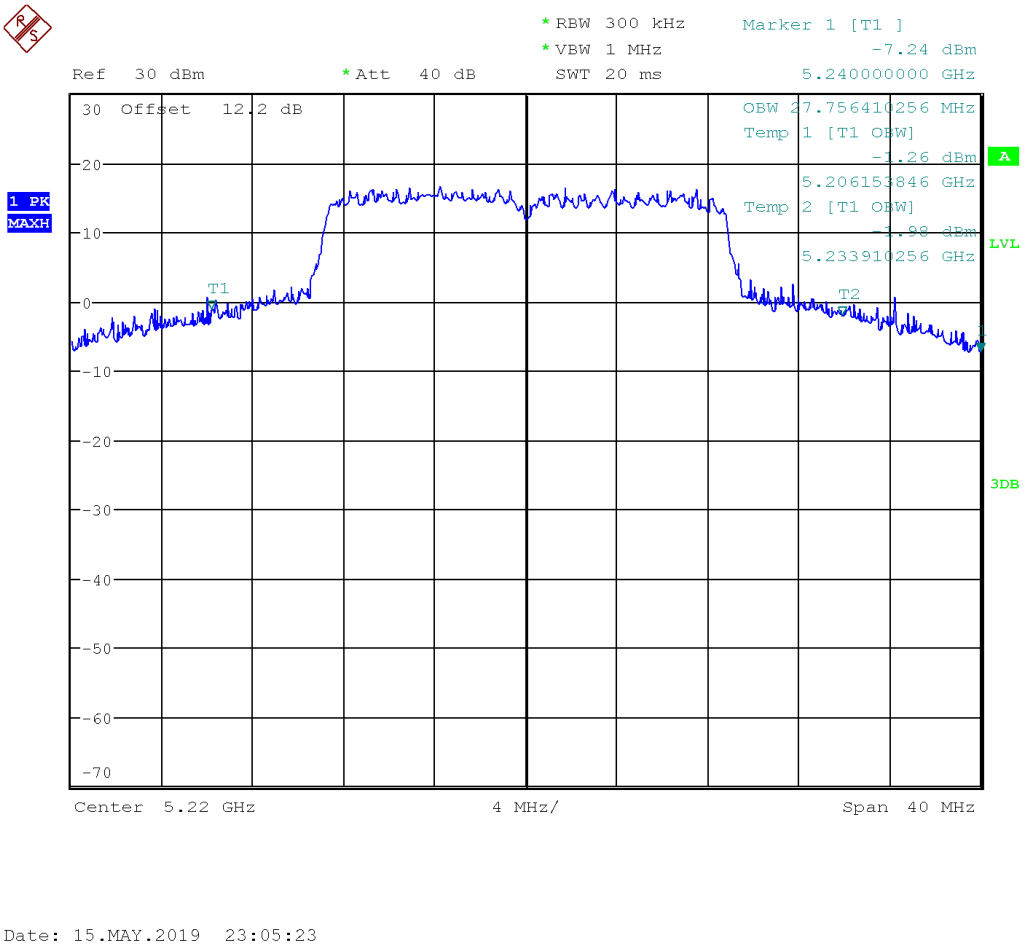


Figure 17: 99% Occupied Bandwidth, Channel 44 at 802.11n HT20 6.5Mbps, Chain 1

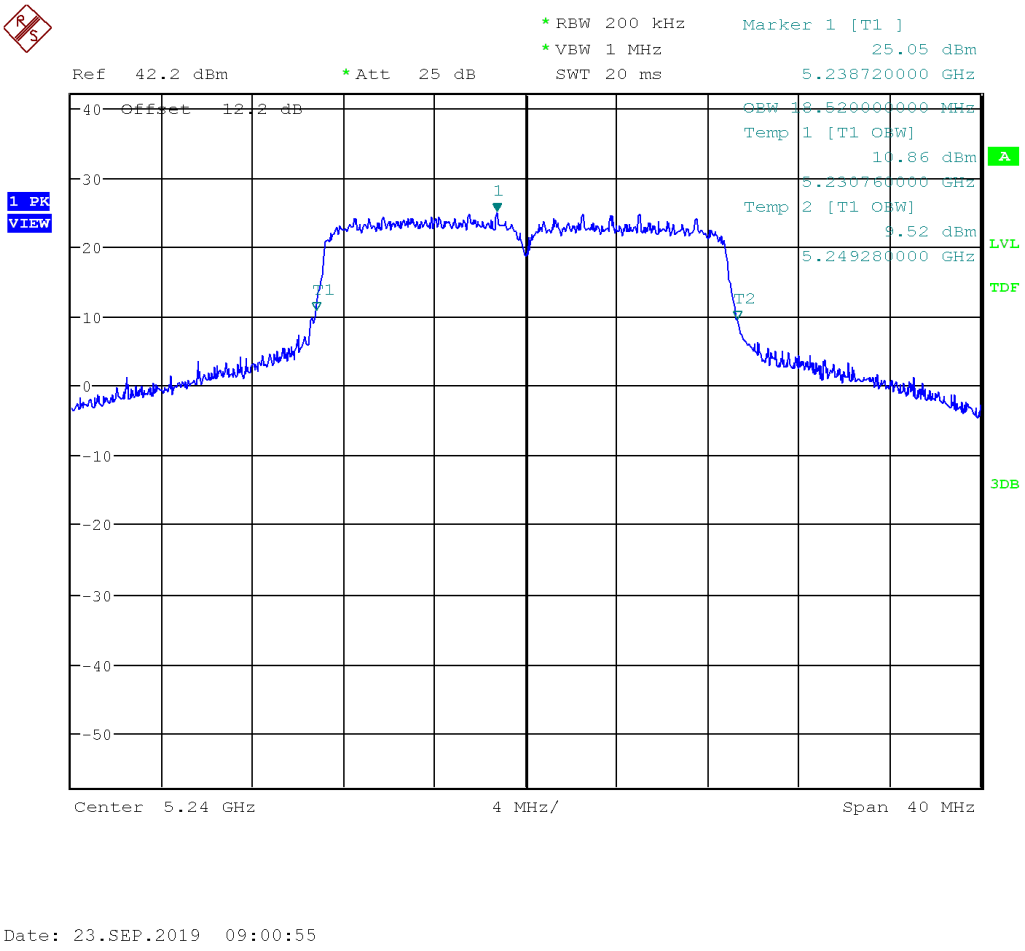


Figure 18: 99% Occupied Bandwidth, Channel 48 at 802.11n HT20 6.5Mbps, Chain 1

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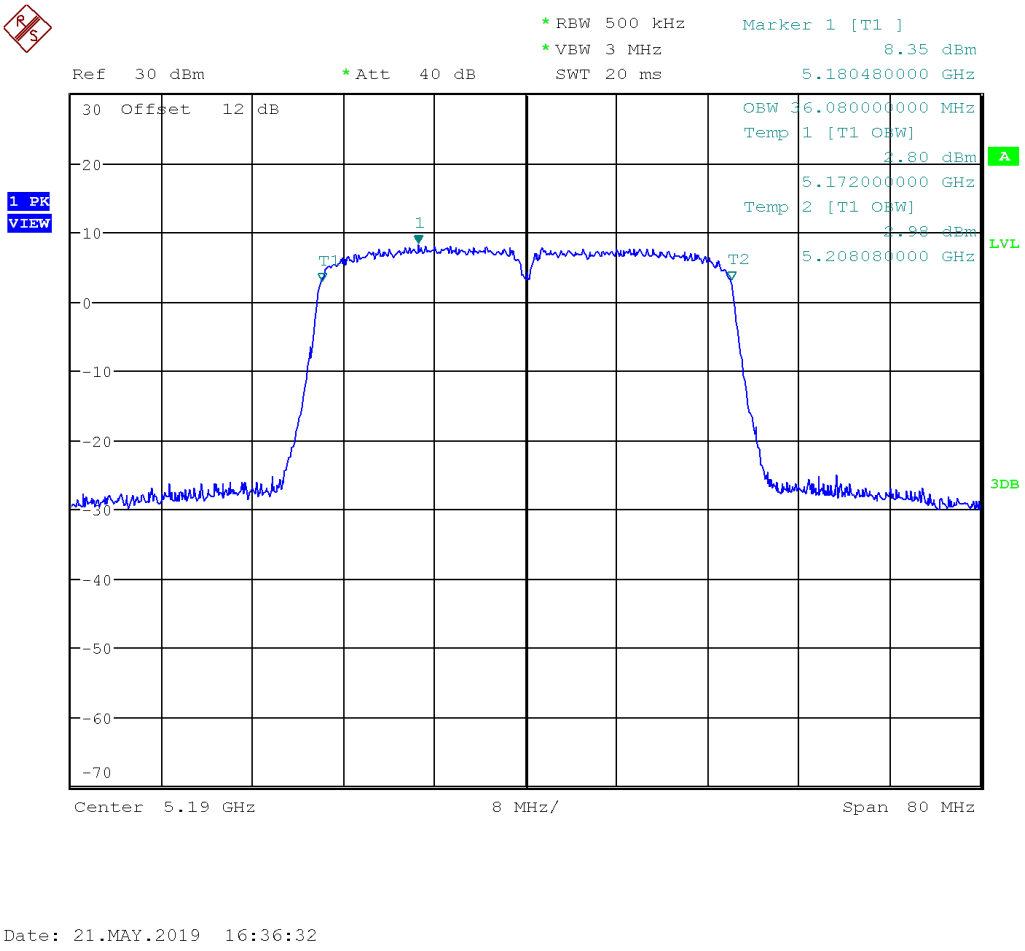

Figure 19: 99% Occupied Bandwidth, Channel 38 at 802.11n HT40+ MCS0, Chain 1

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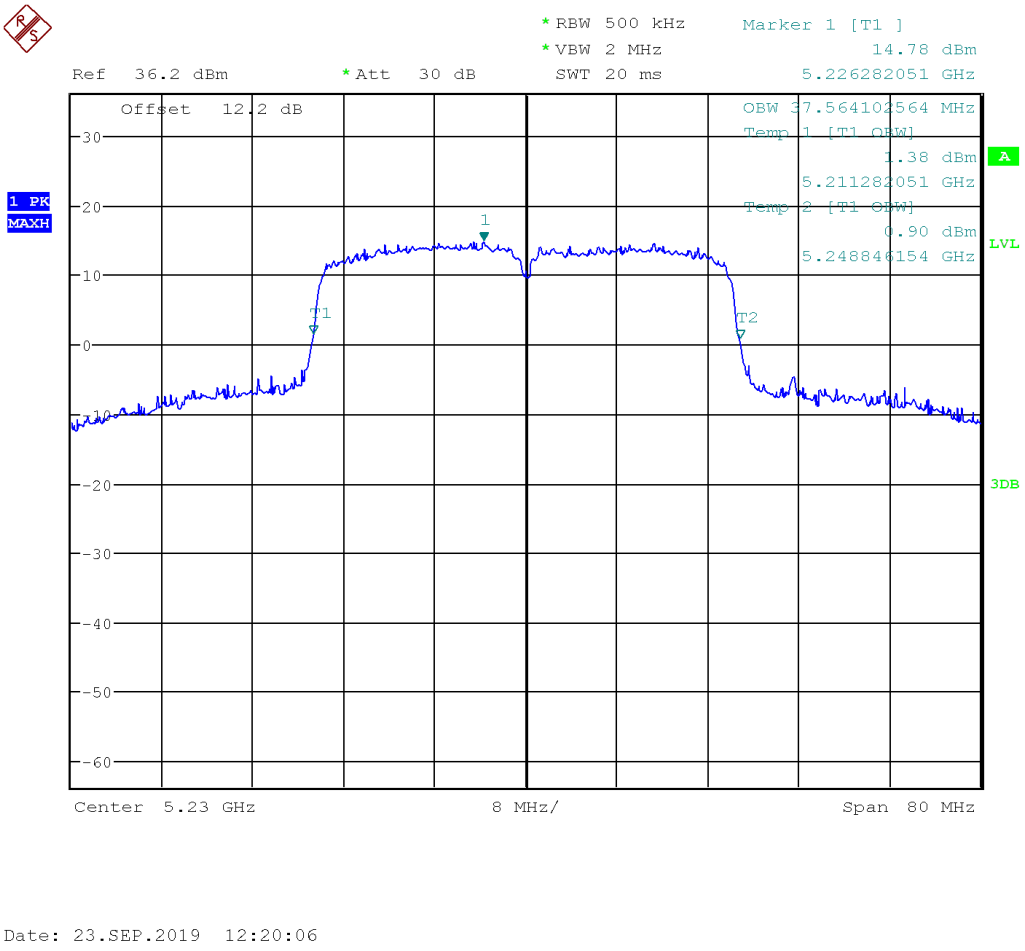

Figure 20: 99% Occupied Bandwidth, Channel 46 at 802.11n HT40+ MCS0, Chain 1

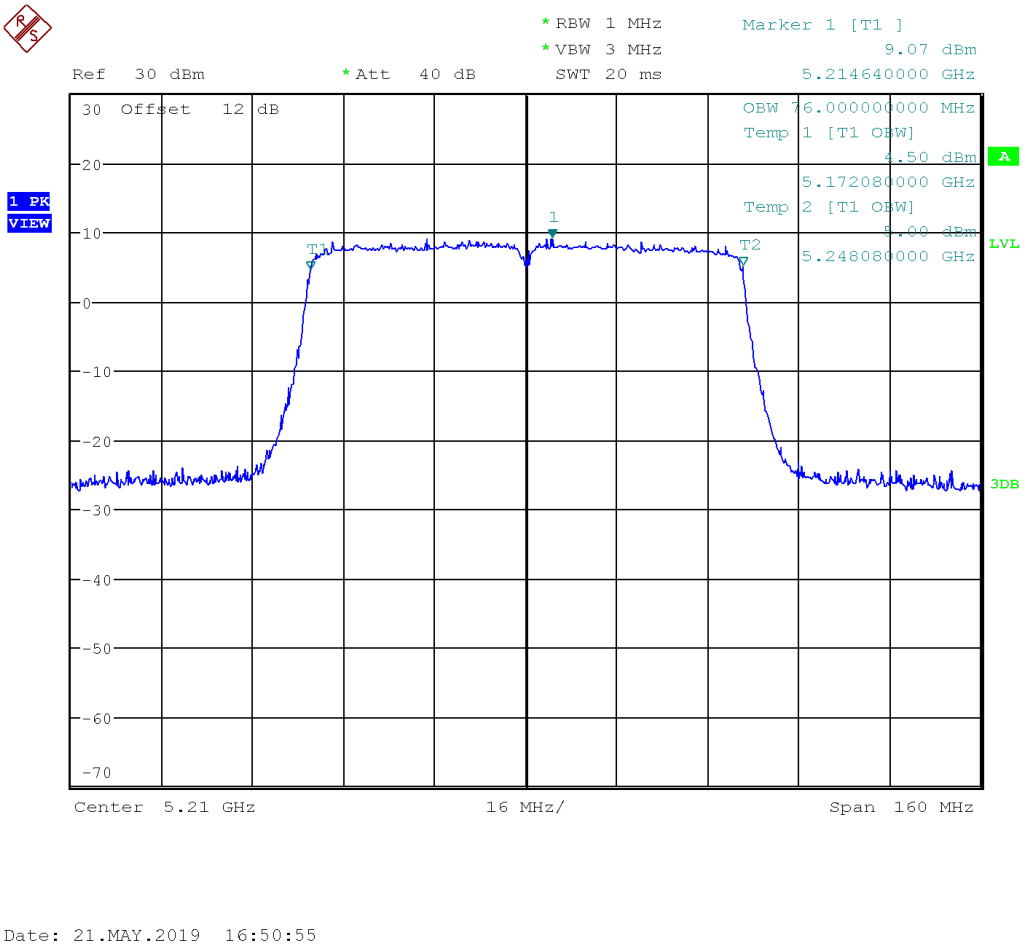

Figure 21: 99% Occupied Bandwidth, Channel 42 at 802.11ac VHT80 MCS0, Chain 1

3.2.4.1.2 UNII-3

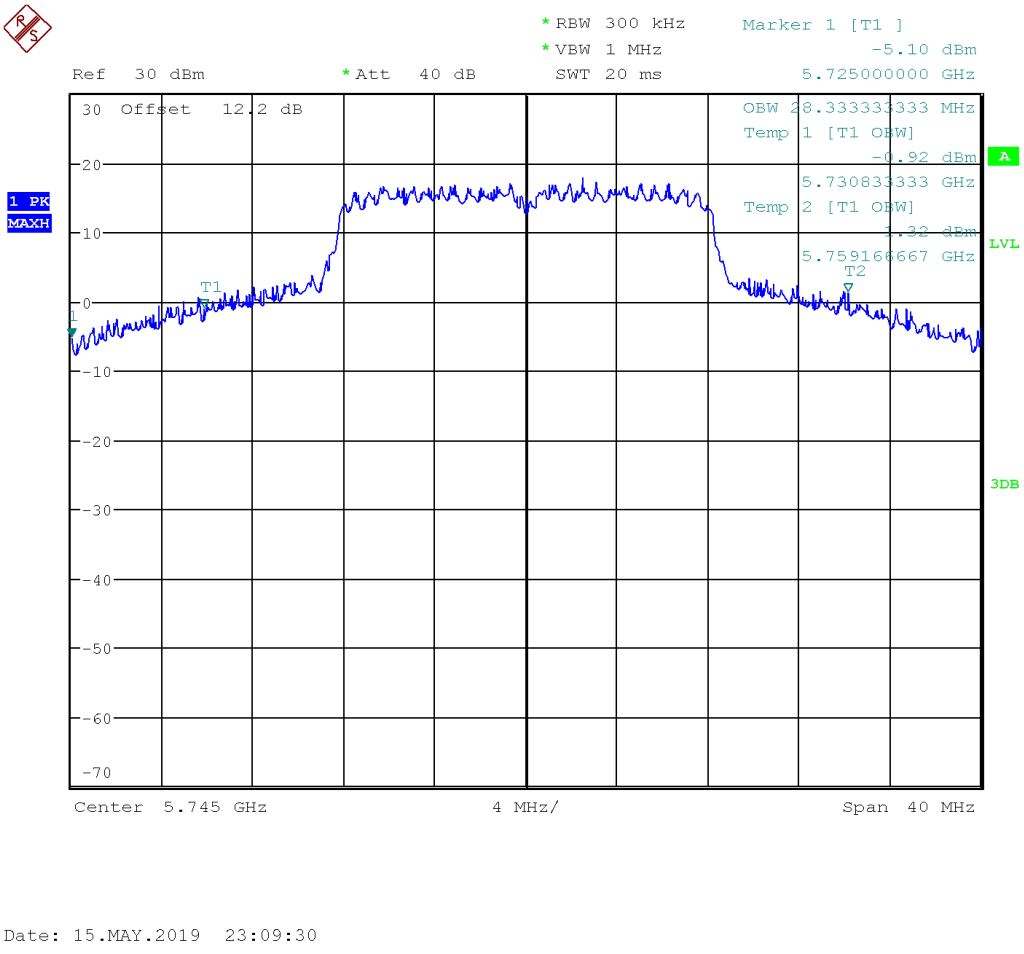

Figure 22: 99% Occupied Bandwidth, Channel 149 at 802.11a 6Mbps, Chain 1

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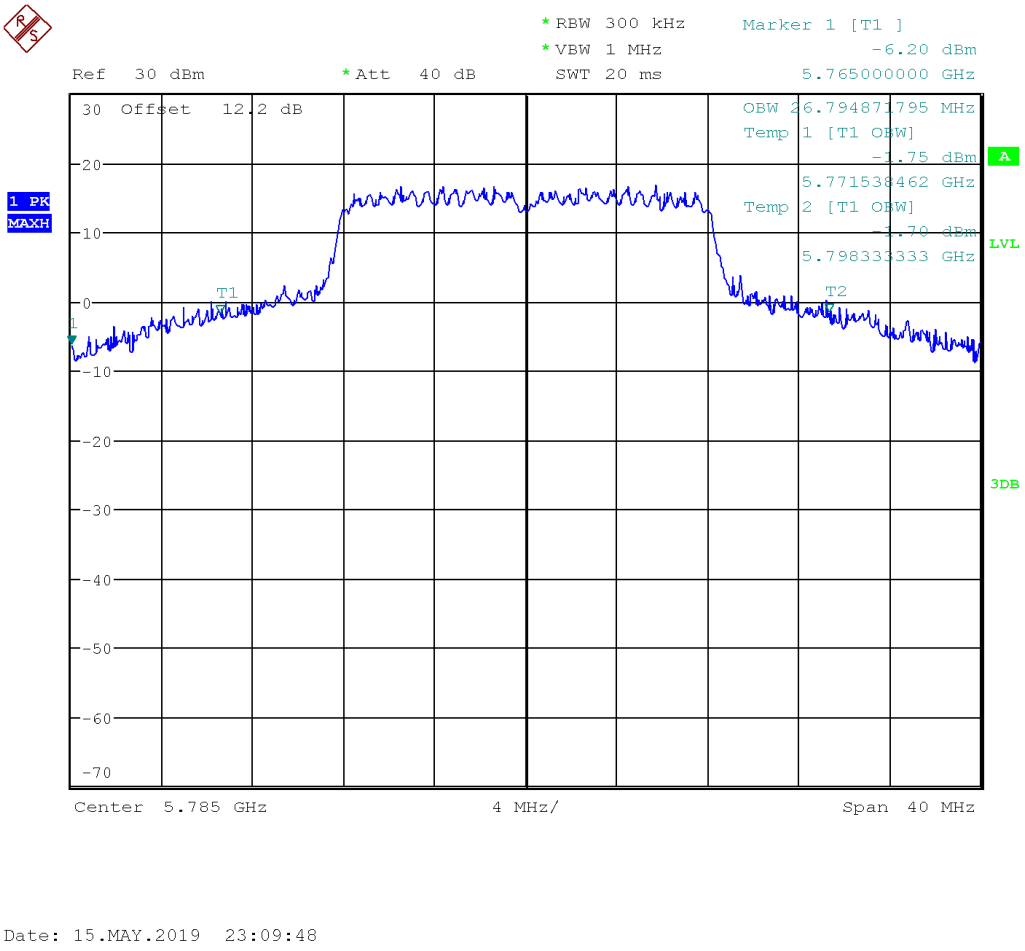

Figure 23: 99% Occupied Bandwidth, Channel 157 at 802.11a 6Mbps, Chain 1

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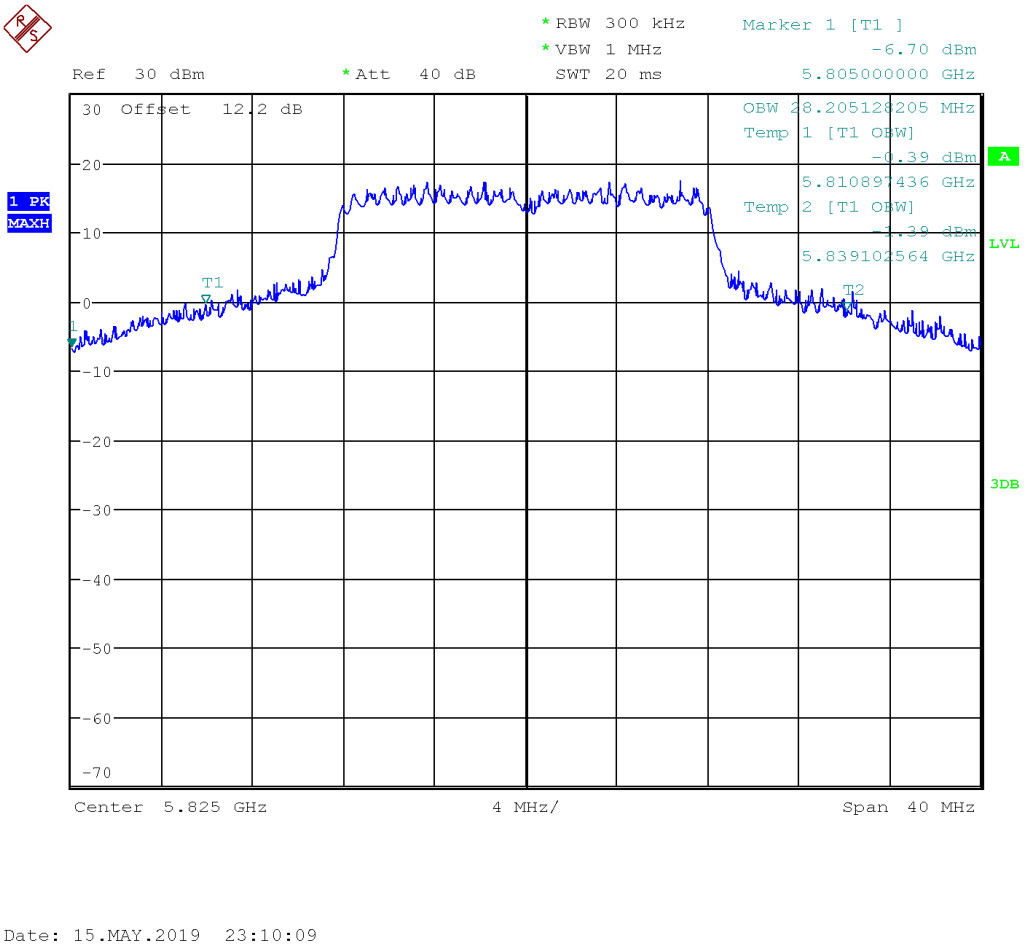

Figure 24: 99% Occupied Bandwidth, Channel 165 at 802.11a 6Mbps, Chain 1

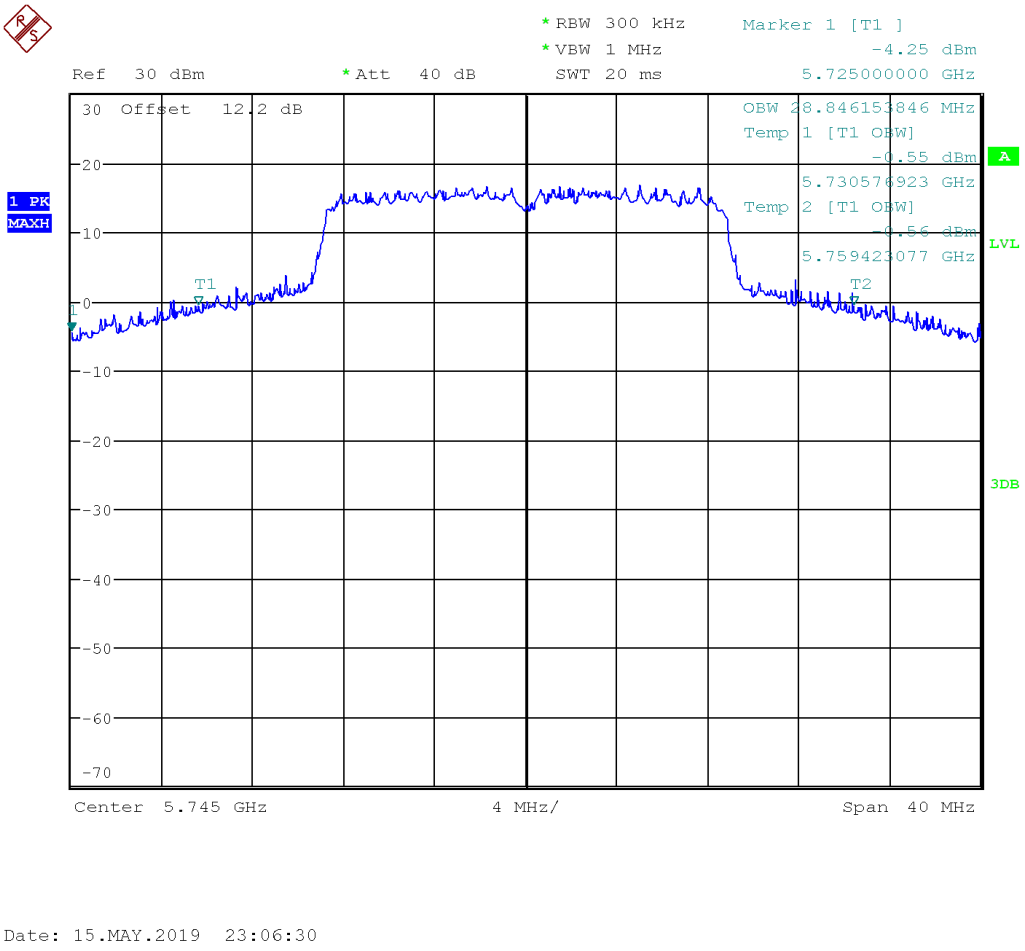

Figure 25: 99% Occupied Bandwidth, Channel 149 at 802.11n HT20 6.5Mbps, Chain 1

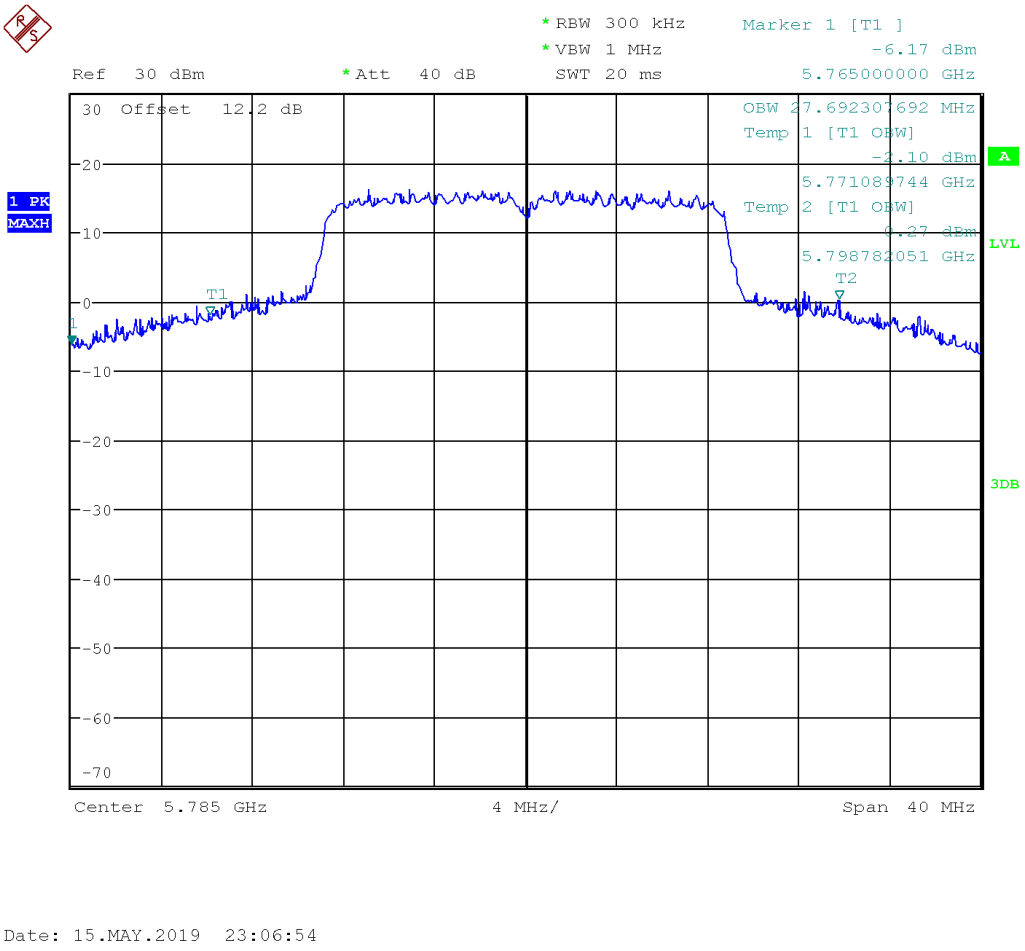

Figure 26: 99% Occupied Bandwidth, Channel 157 at 802.11n HT20 6.5Mbps, Chain 1

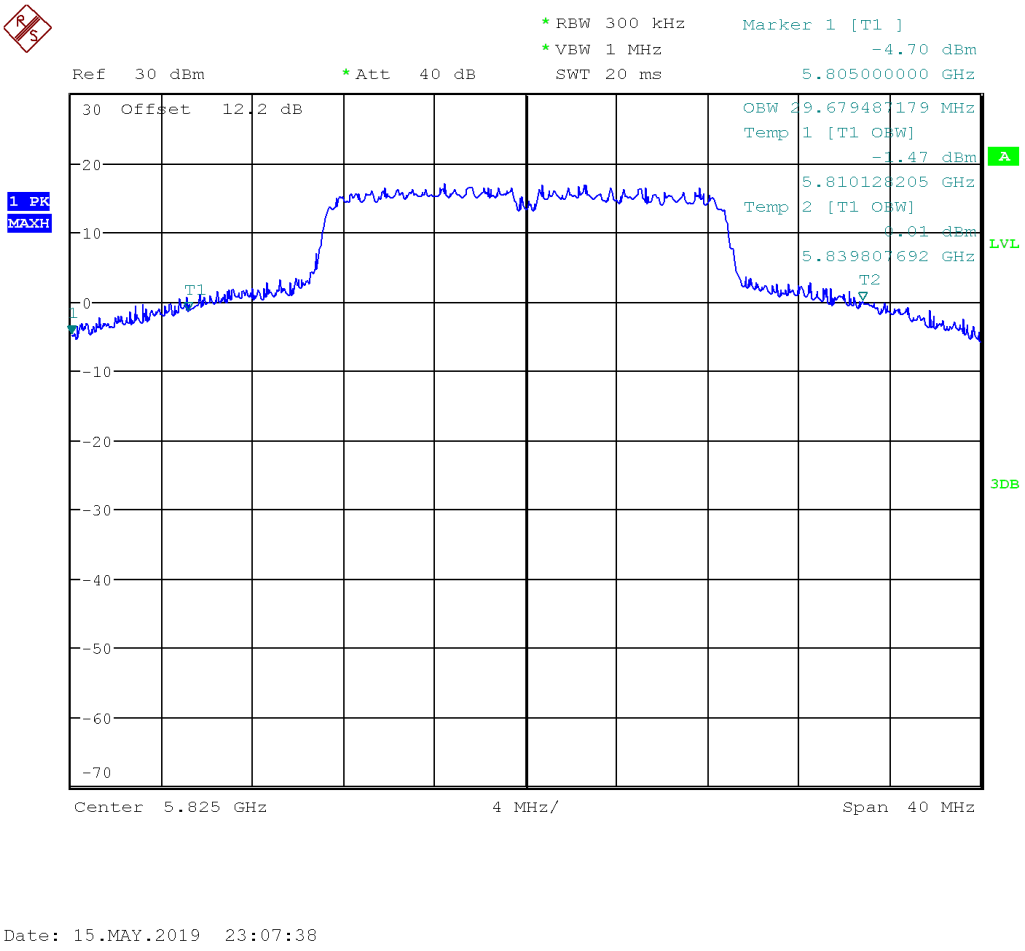

Figure 27: 99% Occupied Bandwidth, Channel 165 at 802.11n HT20 6.5Mbps, Chain 1

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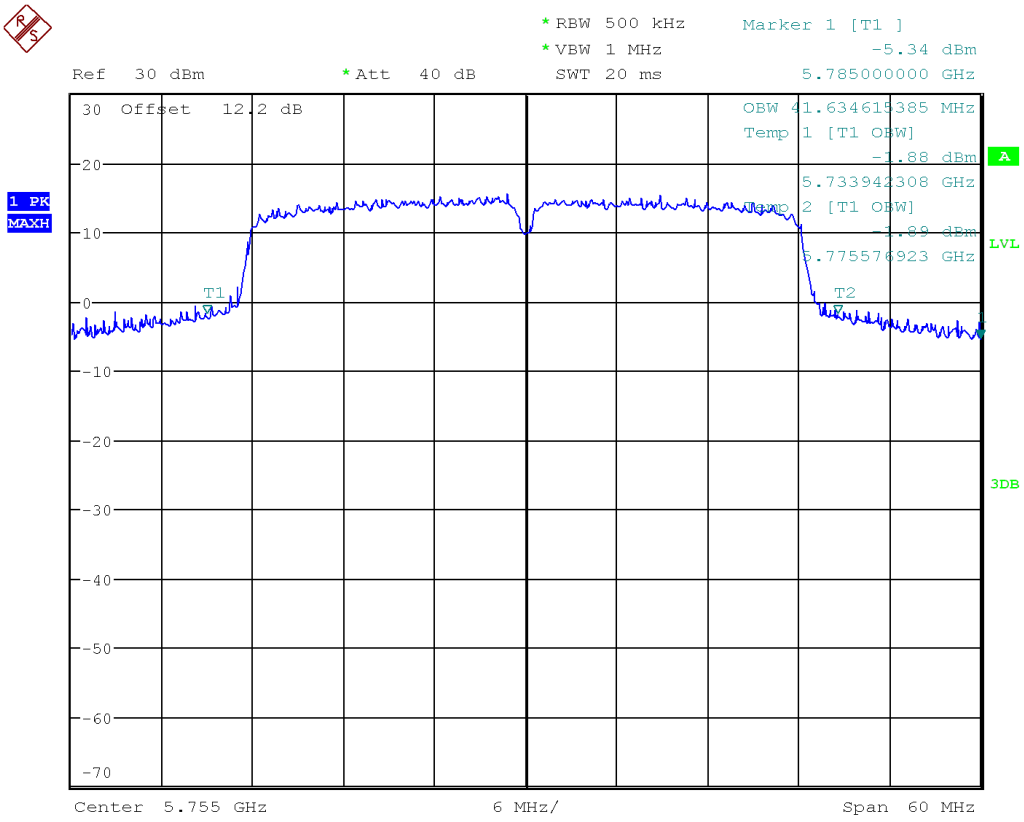


Figure 28: 99% Occupied Bandwidth, Channel 151 at 802.11n HT40+ MCS0, Chain 1

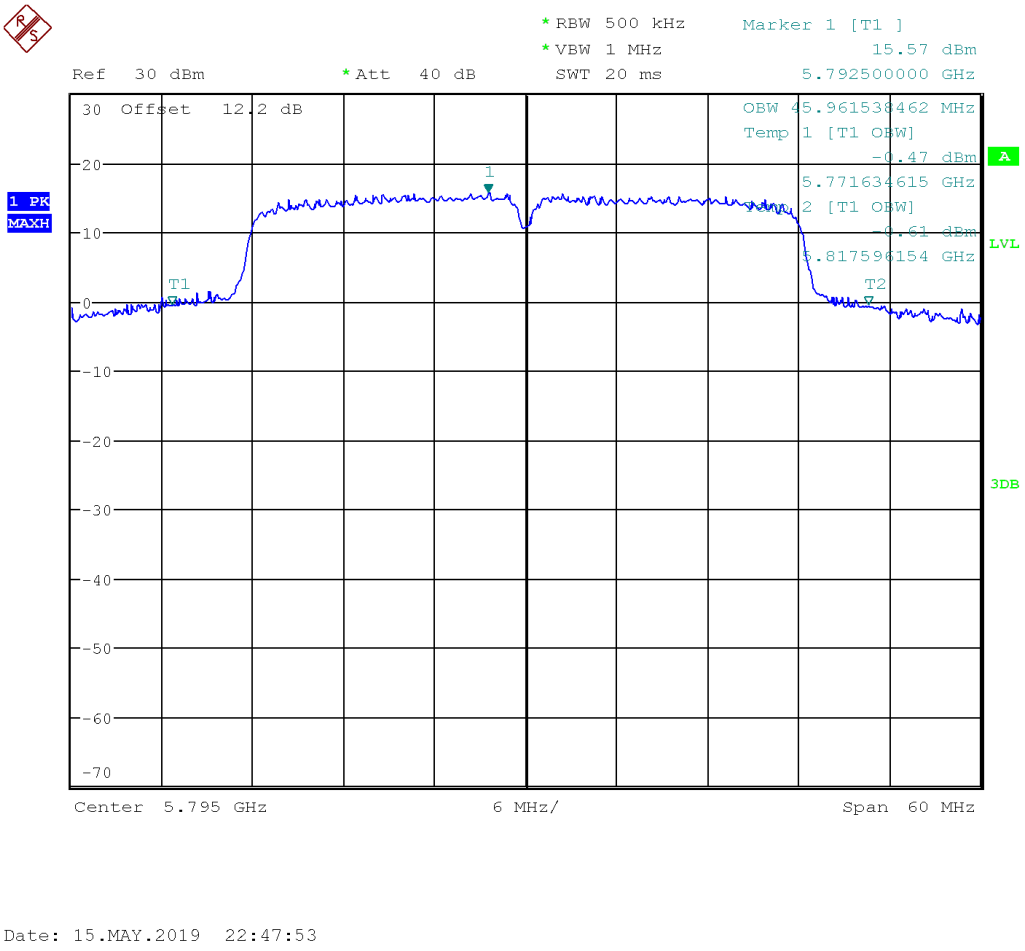


Figure 29: 99% Occupied Bandwidth, Channel 159 at 802.11n HT40+ MCS0, Chain 1

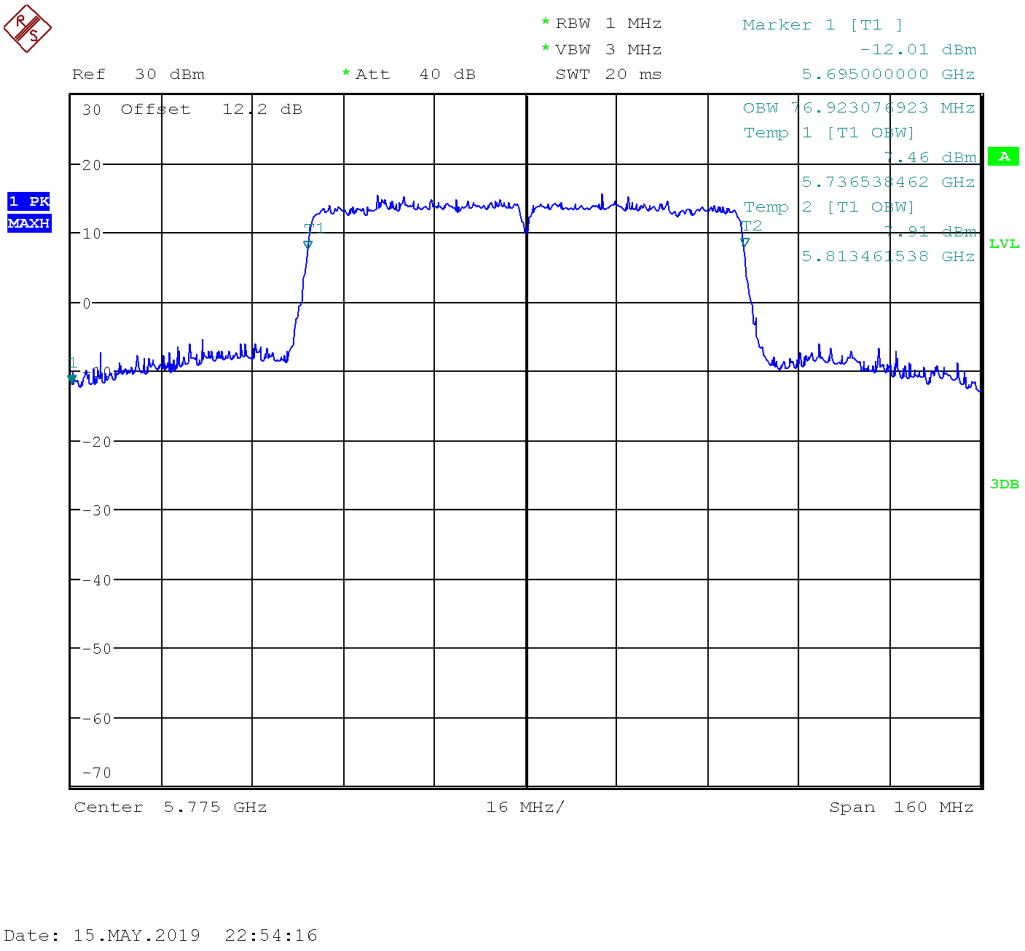


Figure 30: 99% Occupied Bandwidth, Channel 155 at 802.11ac VHT80 MCS0, Chain 1

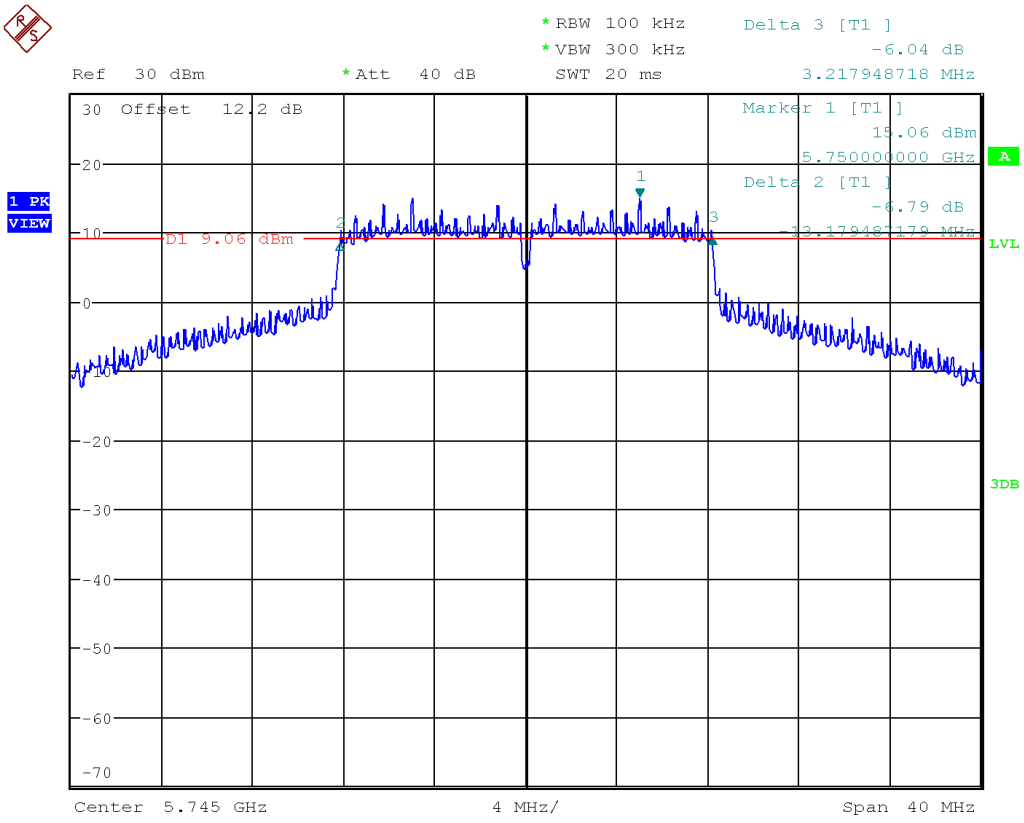


Figure 31: DTS Bandwidth, Channel 149 at 802.11a 6Mbps, Chain 1

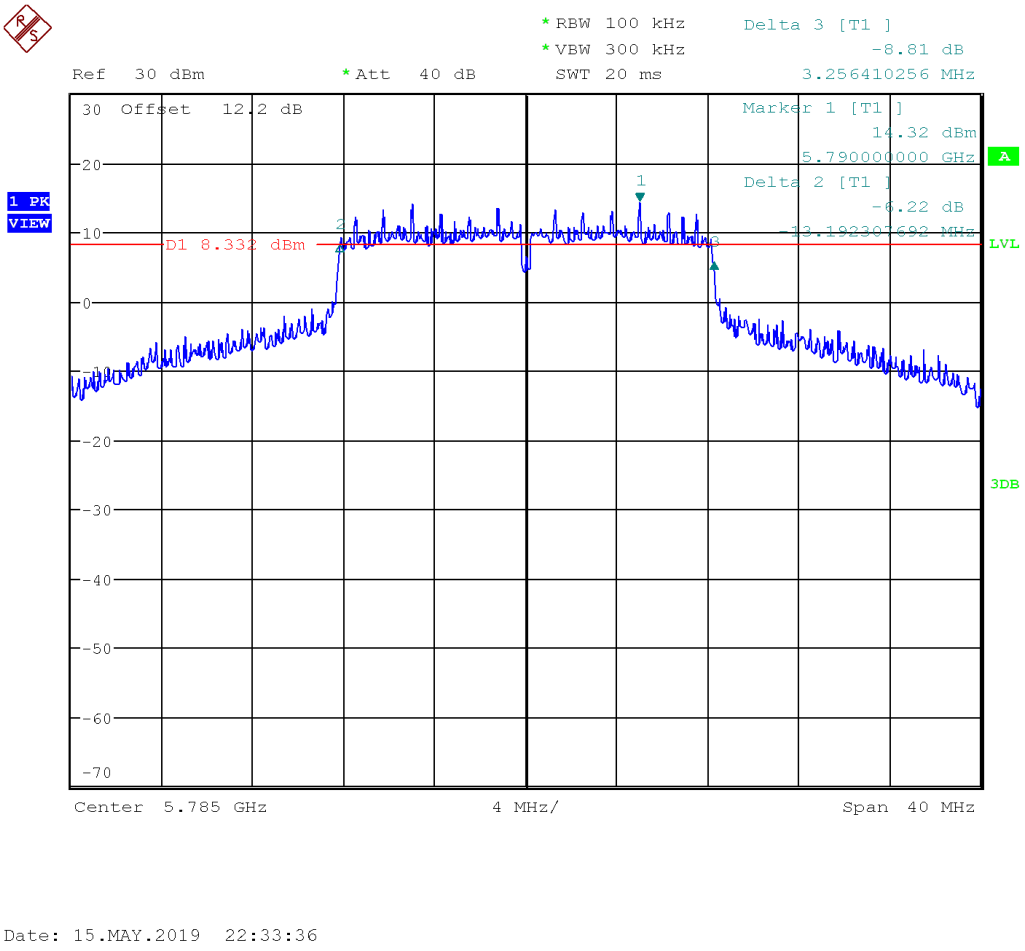


Figure 32: DTS Bandwidth, Channel 157 at 802.11a 6Mbps, Chain 1

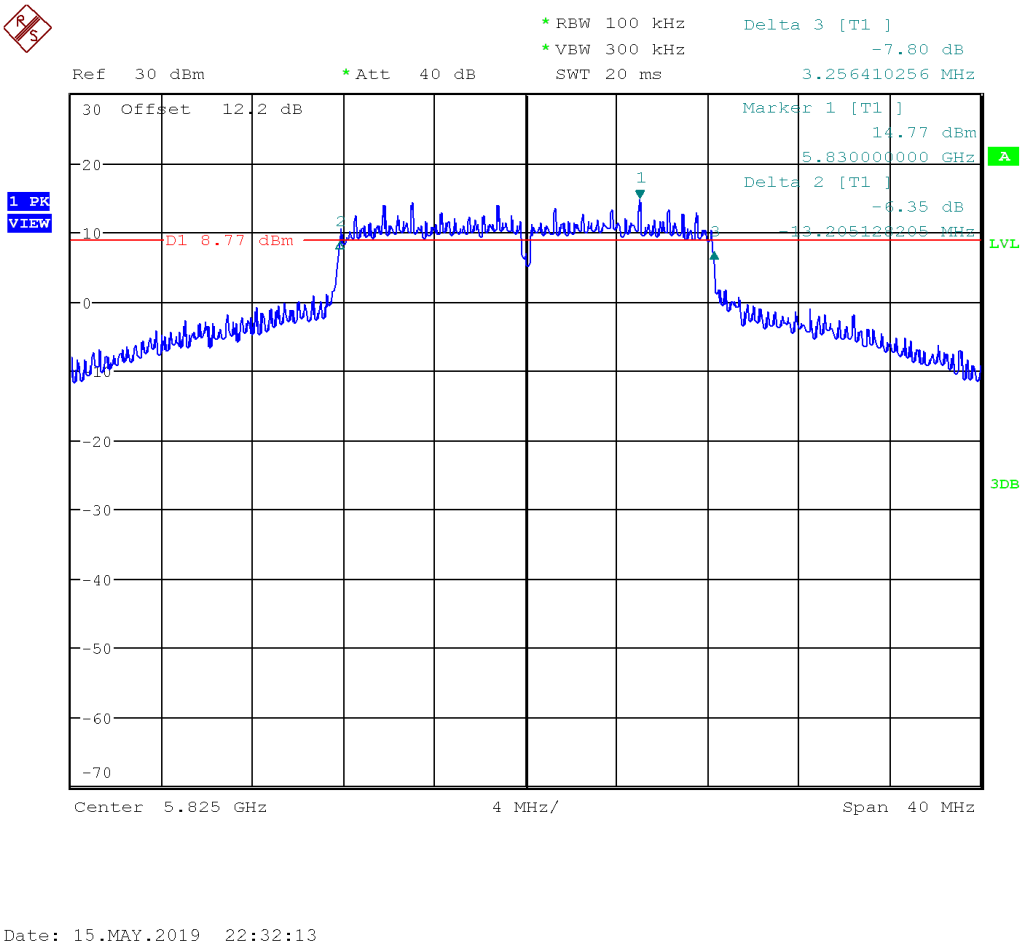


Figure 33: DTS Bandwidth, Channel 165 at 802.11a 6Mbps, Chain 1

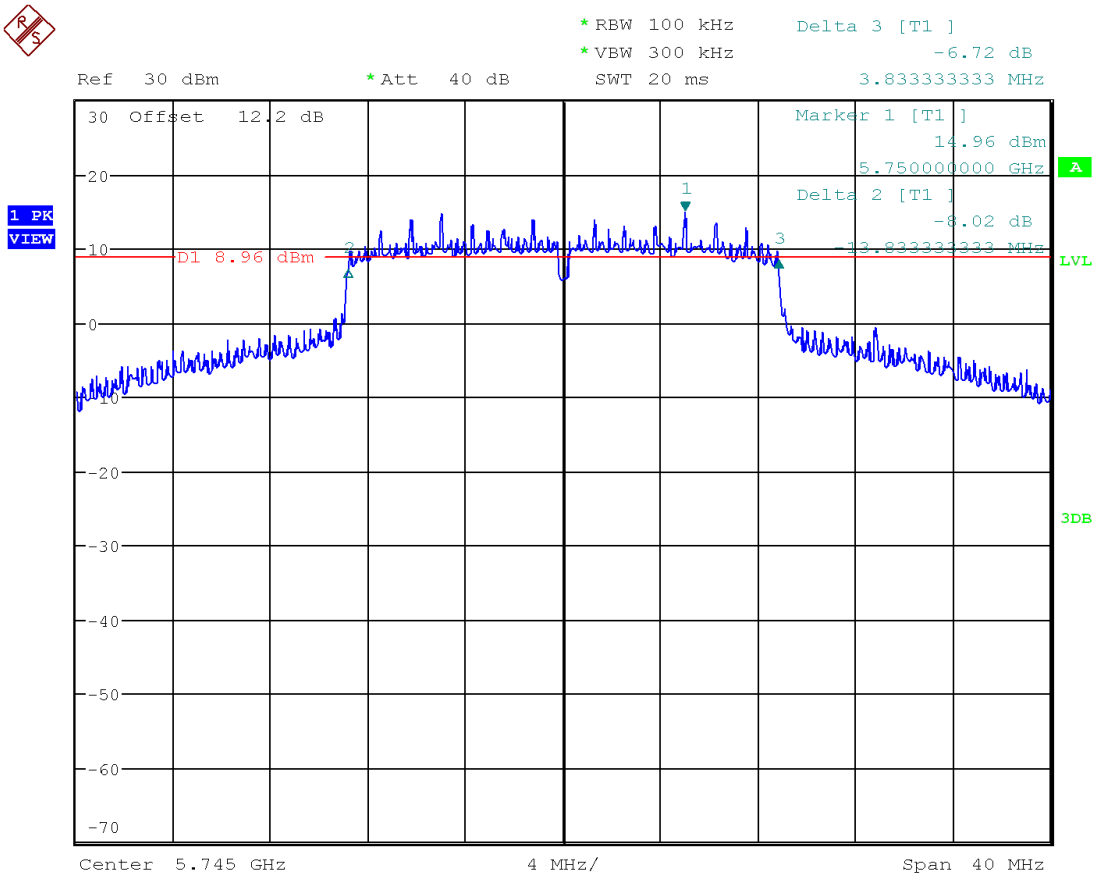
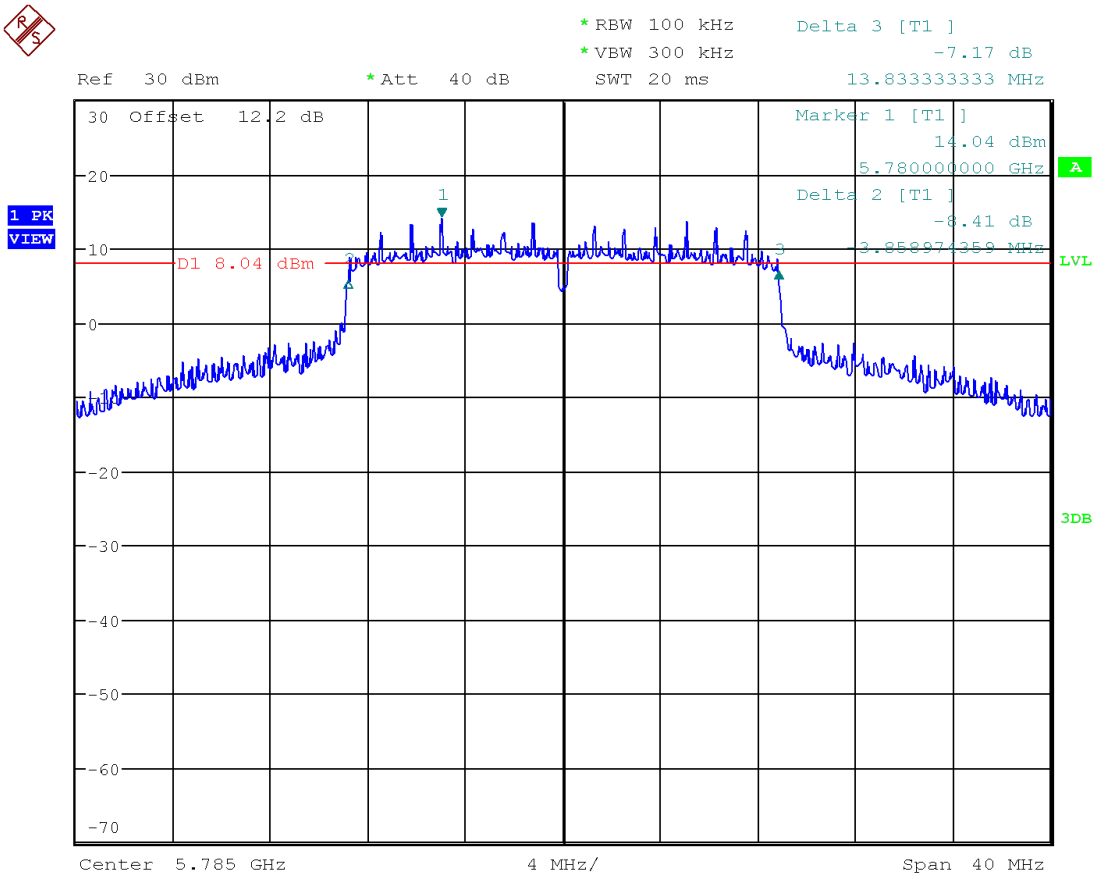


Figure 34: DTS Bandwidth, Channel 149 at 802.11n HT20 6.5Mbps, Chain 1



Date: 15.MAY.2019 22:37:41

Figure 35: DTS Bandwidth, Channel 157 at 802.11n HT20 6.5Mbps, Chain 1

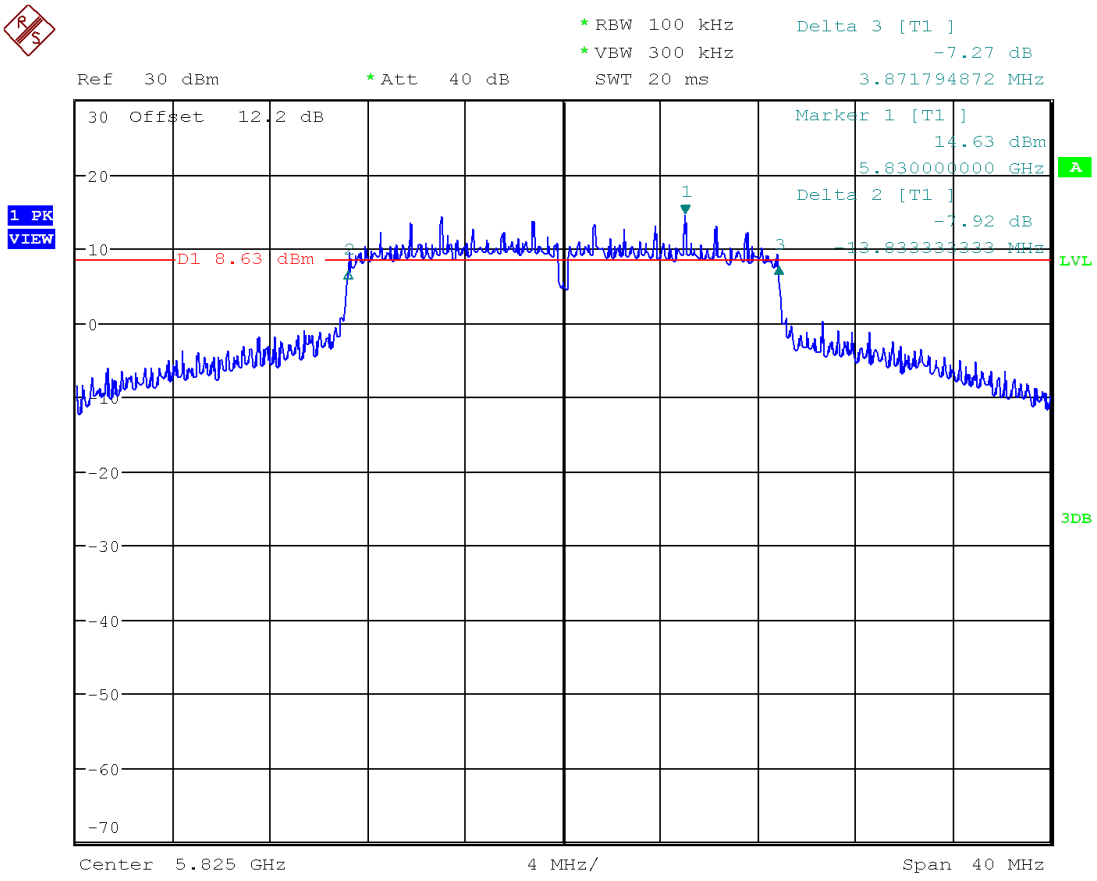


Figure 36: DTS Bandwidth, Channel 165 at 802.11n HT20 6.5Mbps, Chain 1

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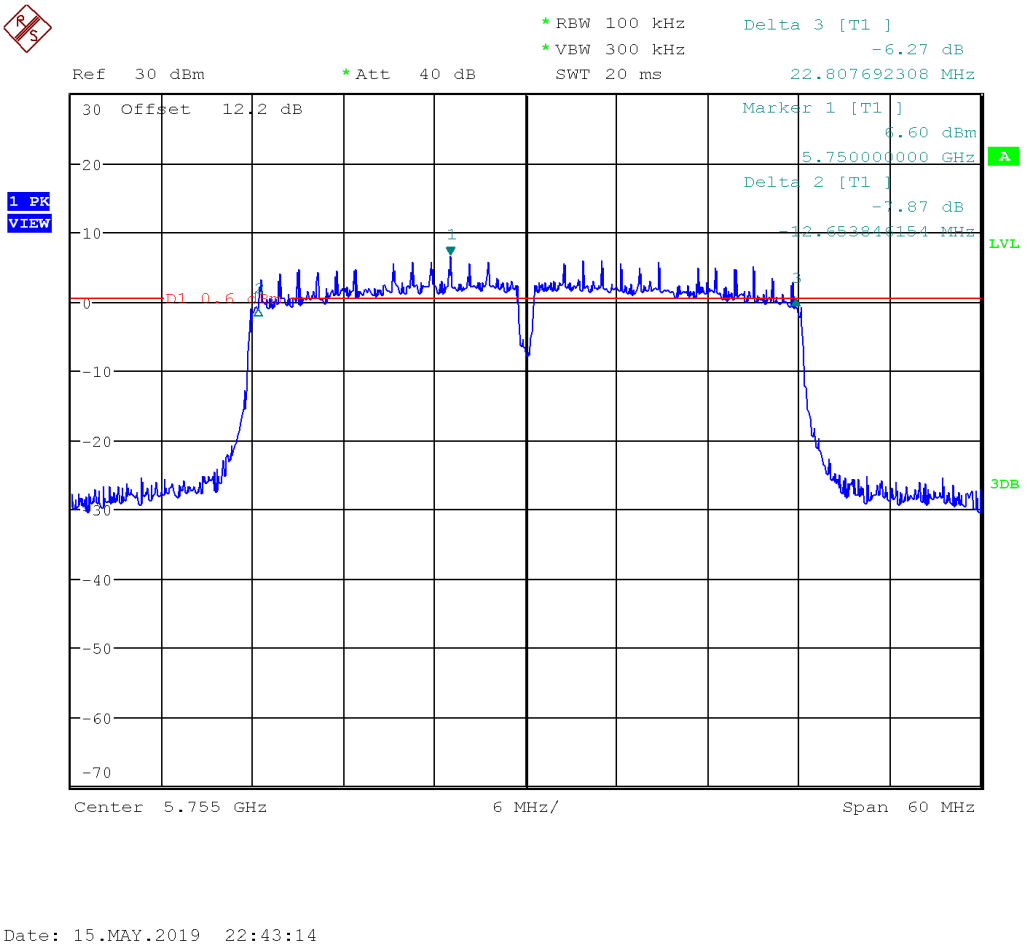

Figure 37: DTS Bandwidth, Channel 151 at 802.11n HT40+ MCS0, Chain 1

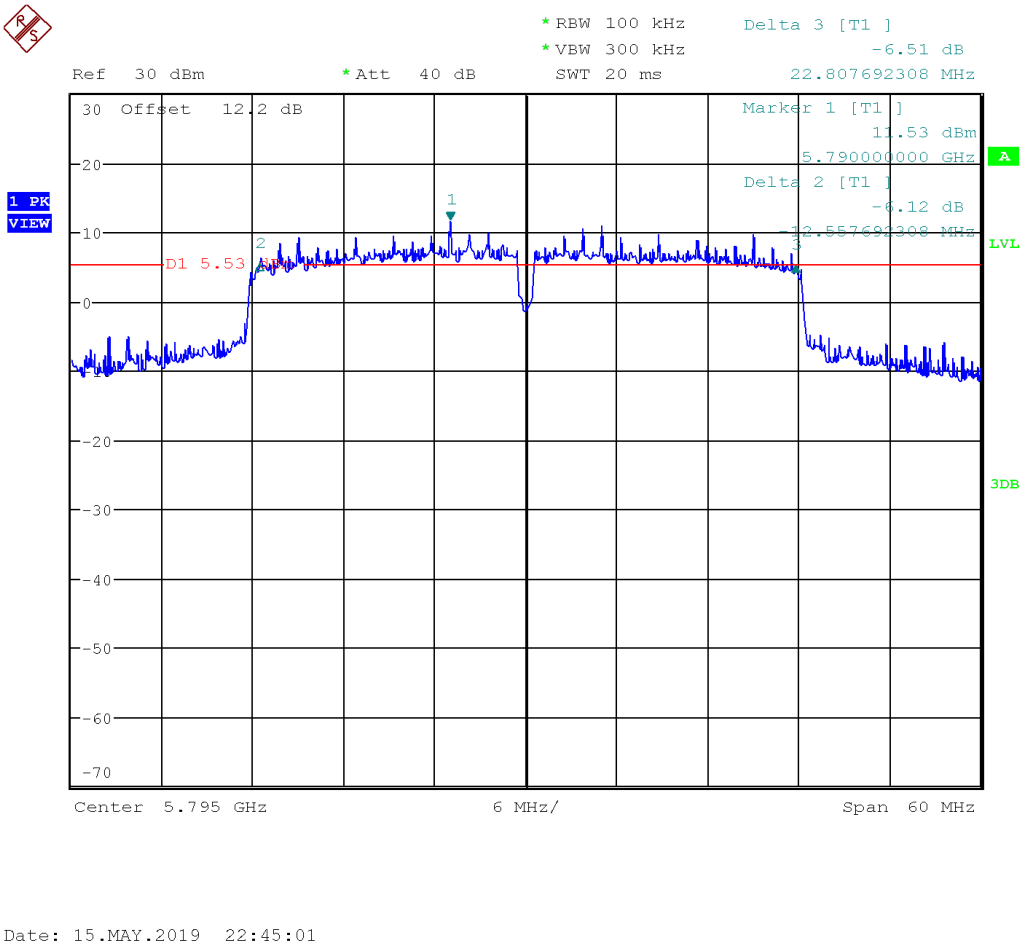

Figure 38: DTS Bandwidth, Channel 159 at 802.11n HT40+ MCS0, Chain 1

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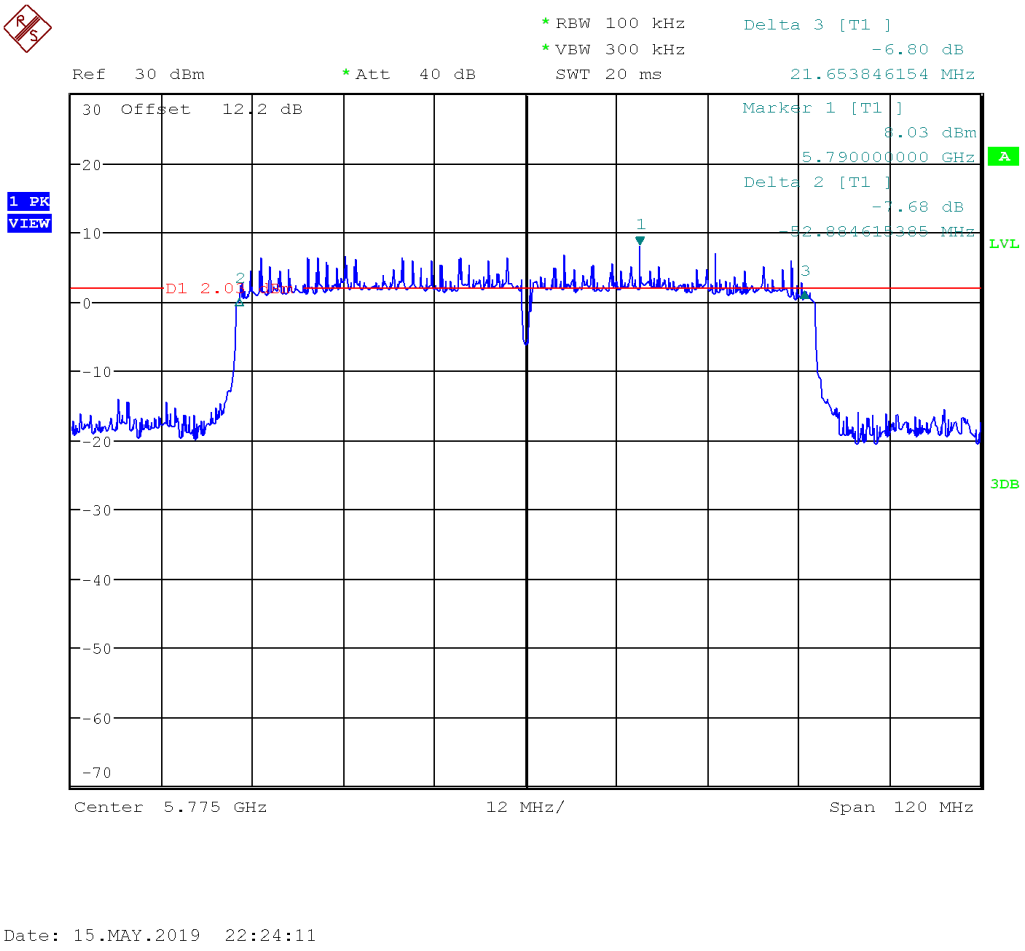


Figure 39: DTS Bandwidth, Channel 155 at 802.11ac VHT80 MCS0, Chain 1

3.3 Peak Power Spectral Density (PPSD)

3.3.1 Limit(s)

U-NII-1 Band (5150-5250MHz):

FCC Part 15.407 (a):

17 dBm in any 1 MHz band

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS 247 Section 6.2.1.1:

10 dBm in any 1 MHz band, E.I.R.P.

U-NII-3 Band (5725-5850MHz):

FCC Part 15.407(a):

30 dBm in any 500KHz band

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS 247 Section 6.2.4.1:

30 dBm in any 500KHz band

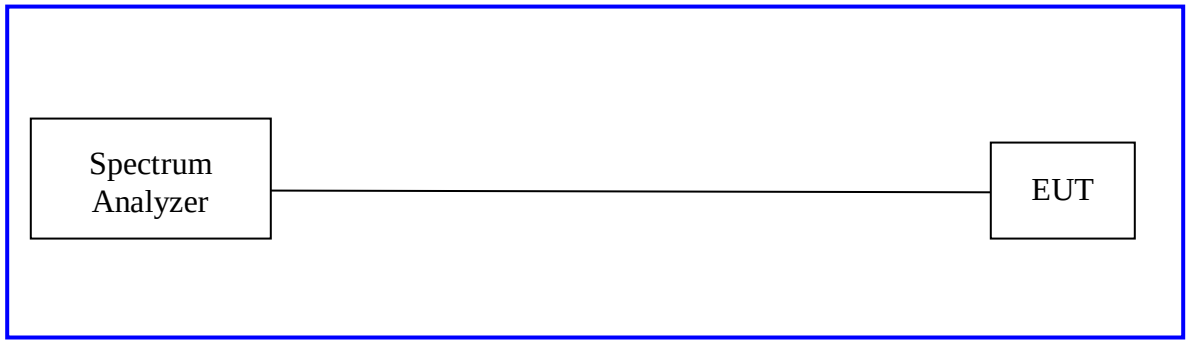
If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.2 Test Method

The conducted method was used to measure the power spectral density per ANSI C63.10-2013 section 12.5 and 14.3.2.3. A pre-evaluation was performed to find the worst case modes (Section 3.5 of this report). The worst findings were conducted on the low, middle and high channels, where applicable, in the operating frequency ranges of 5150-5250MHz and 5725-5850MHz.

U-NII-3 (5725-5850MHz) Peak power spectral density not measured as the RF output power is lower than the PPSD limit (30 dBm/500KHz) with a worse case occupied bandwidth of 16.4MHz.

3.3.3 Test Setup:



3.3.4 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

U-NII-3 (5725-5850MHz) Peak power spectral density implies compliance as the RF output power is lower than the PPSD limit (30 dBm/500KHz).

1MHz and 500kHz RBW is used because it is less than the respective 26dB EBW.

Table 6: Peak Power Spectral Density – Test Results – FCC

U-NII-1 (5150-5250MHz) – Non Beam Forming									
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Total PPSD (dBm/ MHz)	Duty Cycle (%)	Limit (dBm/ MHz)	Margin (dB)	Results
802.11a No HT 6mbps	36	20	5180	19.25	10.83	96	17.0	-6.17	Pass
	44	20	5220	25	15.26	96	17.0	-1.74	Pass
	48	20	5240	23.4	13.90	96	17.0	-3.10	Pass
802.11n HT20 6.5mbps	36	20	5180	21.25	11.94	98	17.0	-5.06	Pass
	44	20	5220	25	15.28	98	17.0	-1.72	Pass
	48	20	5240	23.4	13.88	98	17.0	-3.12	Pass
802.11n HT40+ MCS0	38	40	5190	17.25	6.14	97	17.0	-10.86	Pass
	46	40	5230	22.4	10.75	97	17.0	-6.25	Pass
802.11ac VHT80 MCS0	42	80	5210	17.5	2.76	94	17.0	-14.23	Pass

U-NII-3 (5725-5850MHz) – Non Beam Forming									
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Total PPSD (dBm/ 500 kHz)	Duty Cycle (%)	Limit (dBm/ 500 kHz)	Margin (dB)	Results
802.11a No HT 6mbps	149	20	5745	25.0	13.40	97	30.0	-16.60	Pass
	157	20	5785	25.0	12.89	97	30.0	-17.11	Pass
	165	20	5825	25.0	12.95	97	30.0	-17.05	Pass
802.11n HT20 6.5mbps	149	20	5745	25.0.	13.01	98	30.0	-16.99	Pass
	157	20	5785	25.0	12.44	98	30.0	-17.56	Pass
	165	20	5825	25.0.	12.57	98	30.0	-17.43	Pass
802.11n HT40+ MCS0	151	40	5755	25.0	9.95	96	30.0	-20.05	Pass
	159	40	5795	25.0	9.54	96	30.0	-20.46	Pass
802.11ac VHT80 MCS0	155	80	5775	22.5	4.82	93	30.0	-25.18	Pass

U-NII-1 (5150-5250MHz) – Beam Forming									
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Total PPSD (dBm/ MHz)	Duty Cycle (%)	Limit (dBm/ MHz)	Margin (dB)	Results
802.11a No HT 6mbps	36	20	5180	19.25	10.83	96	16.99	-6.16	Pass
	44	20	5220	25	15.26	96	16.99	-1.73	Pass
	48	20	5240	23.4	13.90	96	16.99	-3.09	Pass
802.11n HT20 6.5mbps	36	20	5180	21.25	11.94	98	16.99	-5.05	Pass
	44	20	5220	25	15.28	98	16.99	-1.71	Pass
	48	20	5240	23.4	13.88	98	16.99	-3.11	Pass
802.11n HT40+ MCS0	38	40	5190	17.25	6.14	97	16.99	-10.85	Pass
	46	40	5230	22.4	10.75	97	16.99	-6.24	Pass
802.11ac VHT80 MCS0	42	80	5210	17.5	2.76	94	16.99	-14.23	Pass

U-NII-3 (5725-5850MHz) – Beam Forming									
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Total PPSD (dBm/ 500 kHz)	Duty Cycle (%)	Limit (dBm/ 500 kHz)	Margin (dB)	Results
802.11a No HT 6mbps	149	20	5745	25.0	13.40	97	29.52	-16.12	Pass
	157	20	5785	25.0	12.89	97	29.52	-16.63	Pass
	165	20	5825	25.0	12.95	97	29.52	-16.57	Pass
802.11n HT20 6.5mbps	149	20	5745	25.0.	13.01	98	29.52	-16.51	Pass
	157	20	5785	25.0	12.44	98	29.52	-17.08	Pass
	165	20	5825	25.0.	12.57	98	29.52	-16.95	Pass
802.11n HT40+ MCS0	151	40	5755	25.0	9.95	96	29.52	-19.57	Pass
	159	40	5795	25.0	9.54	96	29.52	-19.98	Pass
802.11ac VHT80 MCS0	155	80	5775	22.5	4.82	93	29.52	-24.70	Pass

Table 7: Peak Power Spectral Density – Test Results – ISED

U-NII-1 (5150-5250MHz) – Non Beam Forming									
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Total EIRP PPSD (dBm/ MHz)	Duty Cycle (%)	Limit EIRP (dBm/ MHz)	Margin (dB)	Results
802.11a No HT 6mbps	36	20	5180	14.5	9.87	96	10	-0.13	Pass
	44	20	5220	14.5	9.83	96	10	-0.17	Pass
	48	20	5240	14.5	9.65	96	10	-0.35	Pass
802.11n HT20 6.5mbps	36	20	5180	14.75	9.58	98	10	-0.42	Pass
	44	20	5220	15.0	9.76	98	10	-0.24	Pass
	48	20	5240	15.0	9.74	98	10	-0.26	Pass
802.11n HT40+ MCS0	38	40	5190	16.5	9.16	97	10	-0.84	Pass
	46	40	5230	16.5	8.95	97	10	-1.05	Pass
802.11ac VHT80 MCS0	42	80	5210	17.0	5.68	94	10	-4.32	Pass

U-NII-3 (5725-5850MHz) – Non Beam Forming									
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Total PPSD (dBm/ 500 kHz)	Duty Cycle (%)	Limit (dBm/ 500 kHz)	Margin (dB)	Results
802.11a No HT 6mbps	149	20	5745	25.0	13.40	97	30.0	-16.60	Pass
	157	20	5785	25.0	12.89	97	30.0	-17.11	Pass
	165	20	5825	25.0	12.95	97	30.0	-17.05	Pass
802.11n HT20 6.5mbps	149	20	5745	25.0.	13.01	98	30.0	-16.99	Pass
	157	20	5785	25.0	12.44	98	30.0	-17.56	Pass
	165	20	5825	25.0.	12.57	98	30.0	-17.43	Pass
802.11n HT40+ MCS0	151	40	5755	25.0	9.95	96	30.0	-20.05	Pass
	159	40	5795	25.0	9.54	96	30.0	-20.46	Pass
802.11ac VHT80 MCS0	155	80	5775	22.5	4.82	93	30.0	-25.18	Pass

U-NII-1 (5150-5250MHz) – Beam Forming									
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Total EIRP PPSD (dBm/ MHz)	Duty Cycle (%)	Limit EIRP (dBm/ MHz)	Margin (dB)	Results
802.11a No HT 6mbps	36	20	5180	11.75	9.58	96	10	-0.42	Pass
	44	20	5220	11.75	9.64	96	10	-0.36	Pass
	48	20	5240	11.75	9.72	96	10	-0.28	Pass
802.11n HT20 6.5mbps	36	20	5180	12.25	9.75	98	10	-0.25	Pass
	44	20	5220	12.25	9.63	98	10	-0.37	Pass
	48	20	5240	12.25	9.77	98	10	-0.23	Pass
802.11n HT40+ MCS0	38	40	5190	14.00	8.86	97	10	-1.14	Pass
	46	40	5230	14.00	9.10	97	10	-0.90	Pass
802.11ac VHT80 MCS0	42	80	5210	14.50	6.05	94	10	-3.95	Pass

U-NII-3 (5725-5850MHz) – Beam Forming									
Mode	Channel	Bandwidth (MHz)	Frequency (MHz)	Power Settings	Total PPSD (dBm/ 500 kHz)	Duty Cycle (%)	Limit (dBm/ 500 kHz)	Margin (dB)	Results
802.11a No HT 6mbps	149	20	5745	25.0	13.40	97	30.0	-16.60	Pass
	157	20	5785	25.0	12.89	97	30.0	-17.11	Pass
	165	20	5825	25.0	12.95	97	30.0	-17.05	Pass
802.11n HT20 6.5mbps	149	20	5745	25.0.	13.01	98	30.0	-16.99	Pass
	157	20	5785	25.0	12.44	98	30.0	-17.56	Pass
	165	20	5825	25.0.	12.57	98	30.0	-17.43	Pass
802.11n HT40+ MCS0	151	40	5755	25.0	9.95	96	30.0	-20.05	Pass
	159	40	5795	25.0	9.54	96	30.0	-20.46	Pass
802.11ac VHT80 MCS0	155	80	5775	22.5	4.82	93	30.0	-25.18	Pass

3.3.4.1 Measurement Plots

3.3.4.2 FCC

3.3.4.2.1 UNII-1

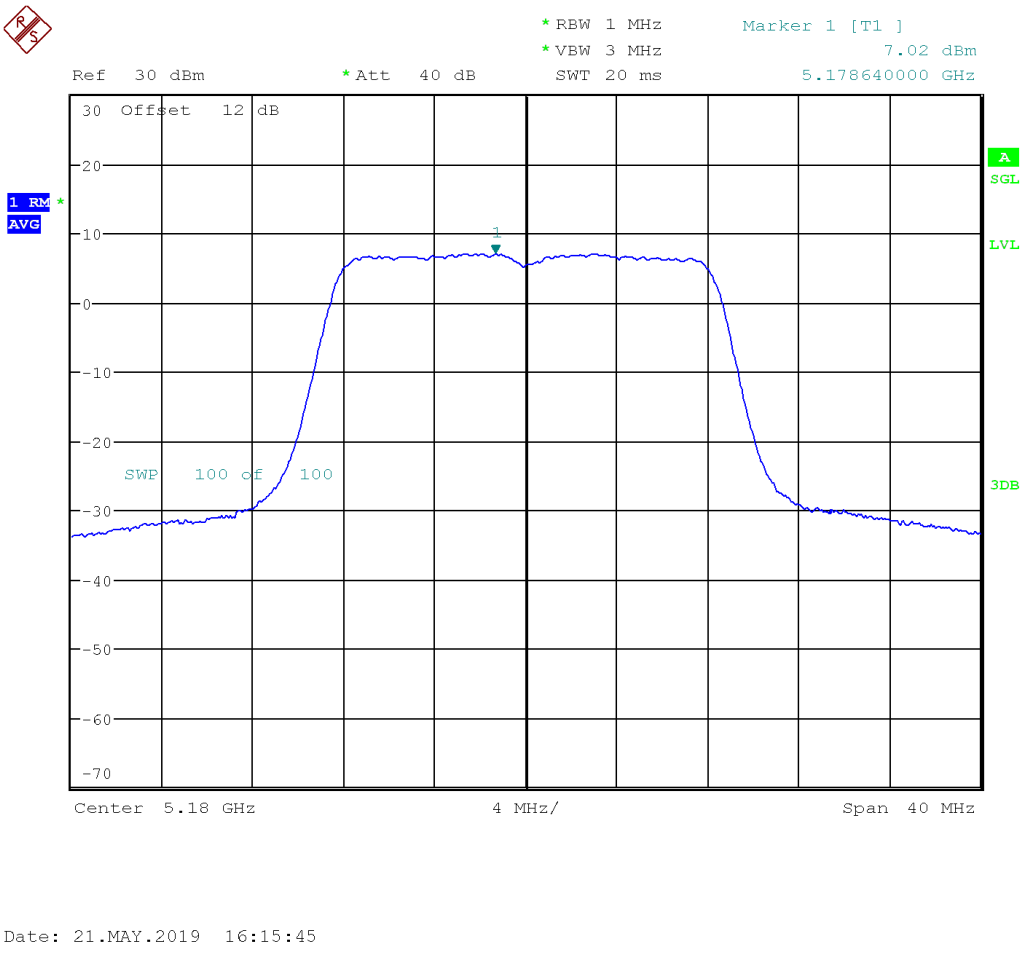


Figure 40: Power Spectral Density, Channel 36 802.11a NoHT 6 Mbps, Chain 0

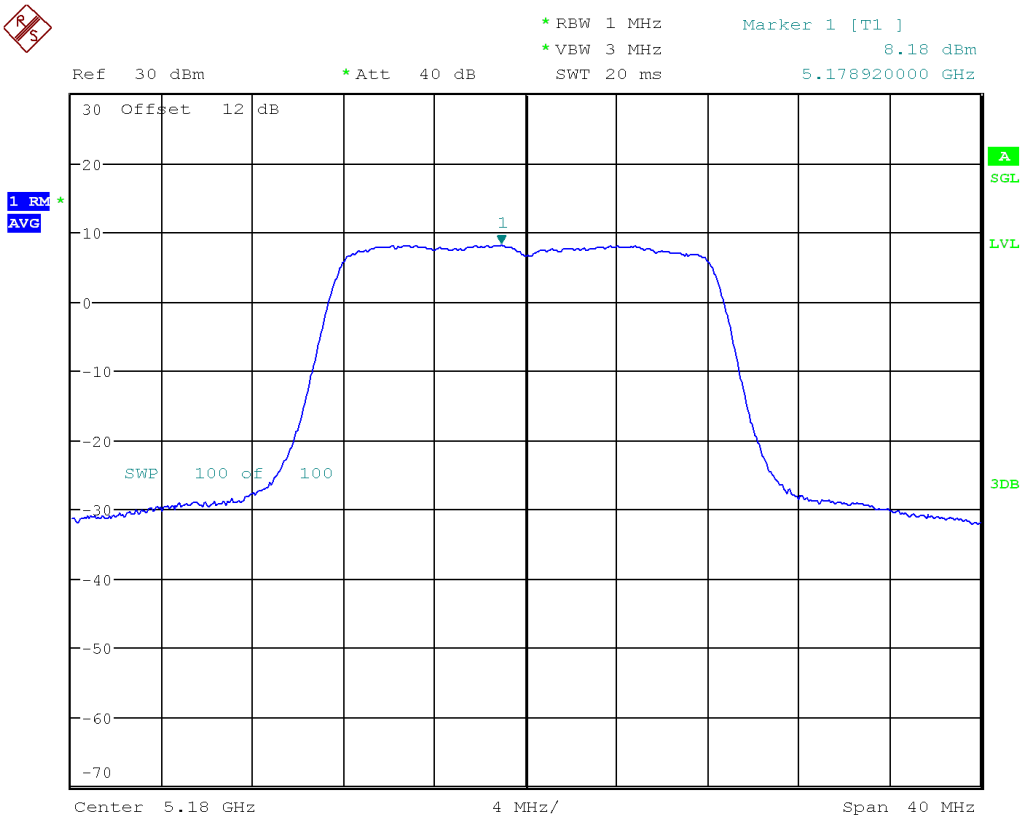


Figure 41: Power Spectral Density, Channel 36 802.11a NoHT 6 Mbps, Chain 1

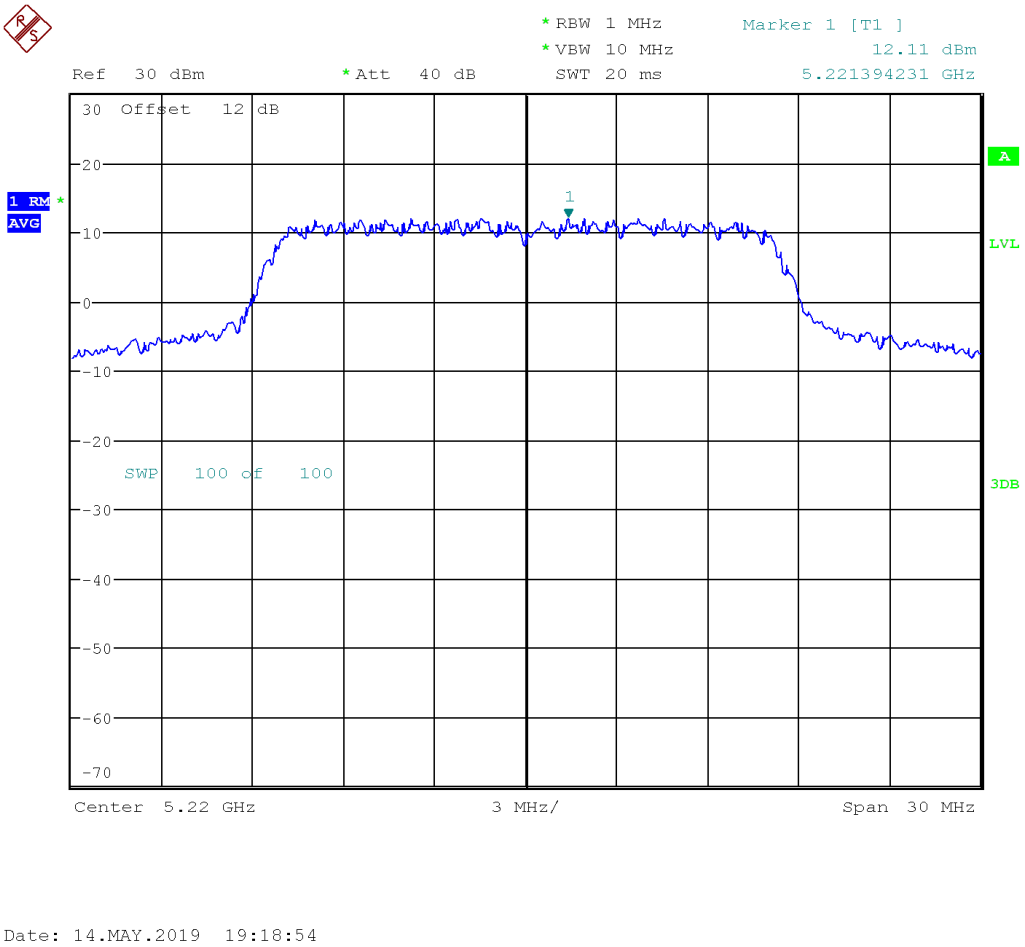


Figure 42: Power Spectral Density, Channel 44 802.11a NoHT 6 Mbps, Chain 0

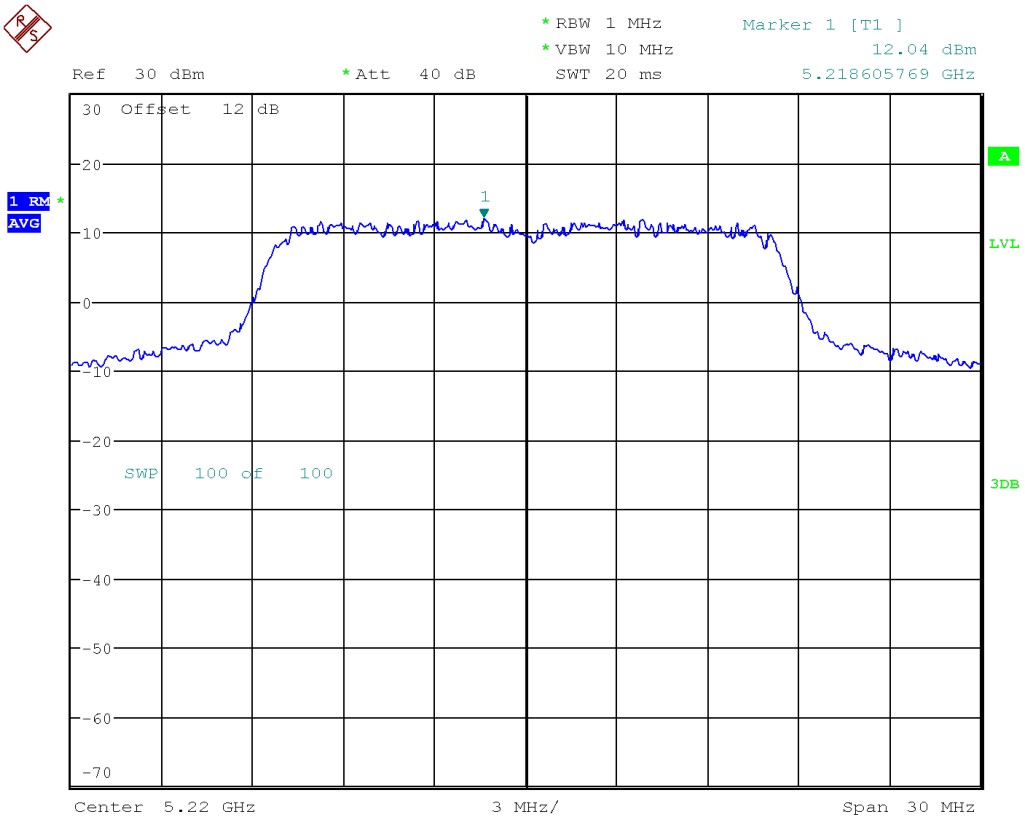


Figure 43: Power Spectral Density, Channel 44 802.11a NoHT 6 Mbps, Chain 1

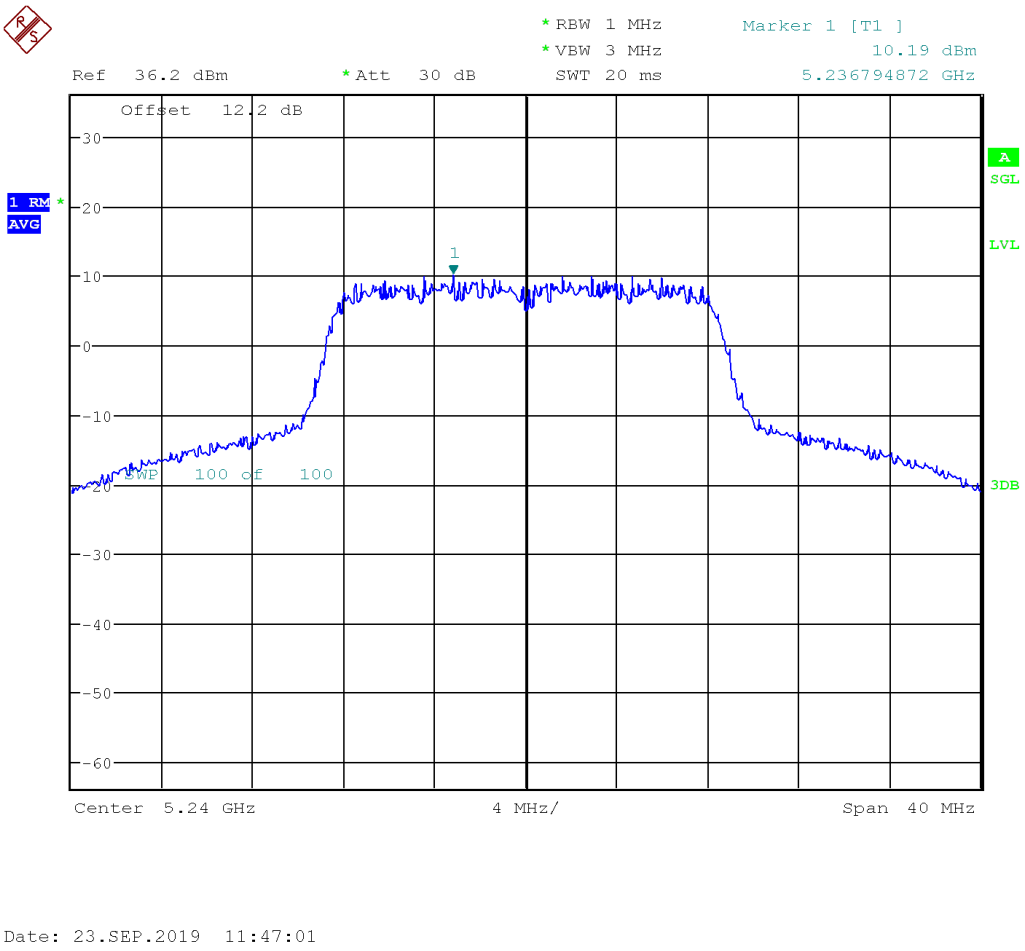


Figure 44: Power Spectral Density, Channel 48 802.11a NoHT 6 Mbps, Chain 0

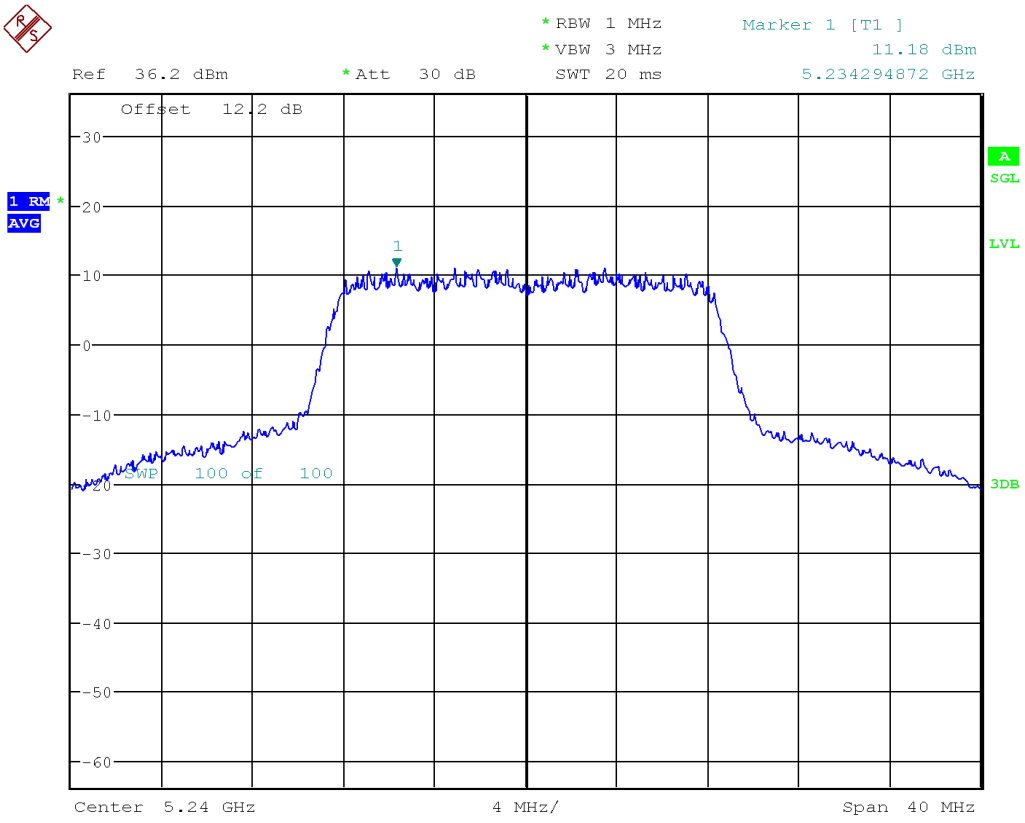


Figure 45: Power Spectral Density, Channel 48 802.11a NoHT 6 Mbps, Chain 1

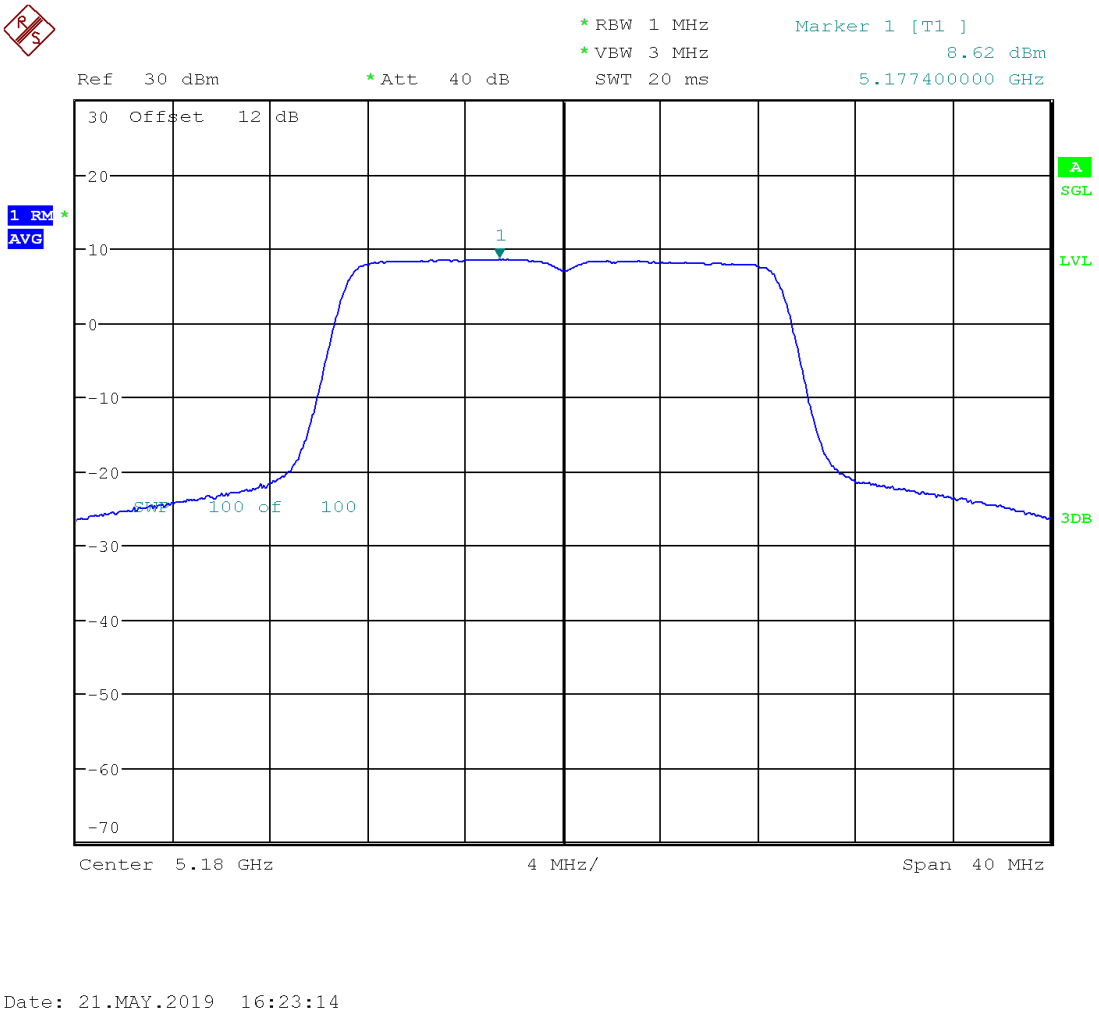


Figure 46: Power Spectral Density, Channel 36 802.11n HT20 6.5 Mbps, Chain 0

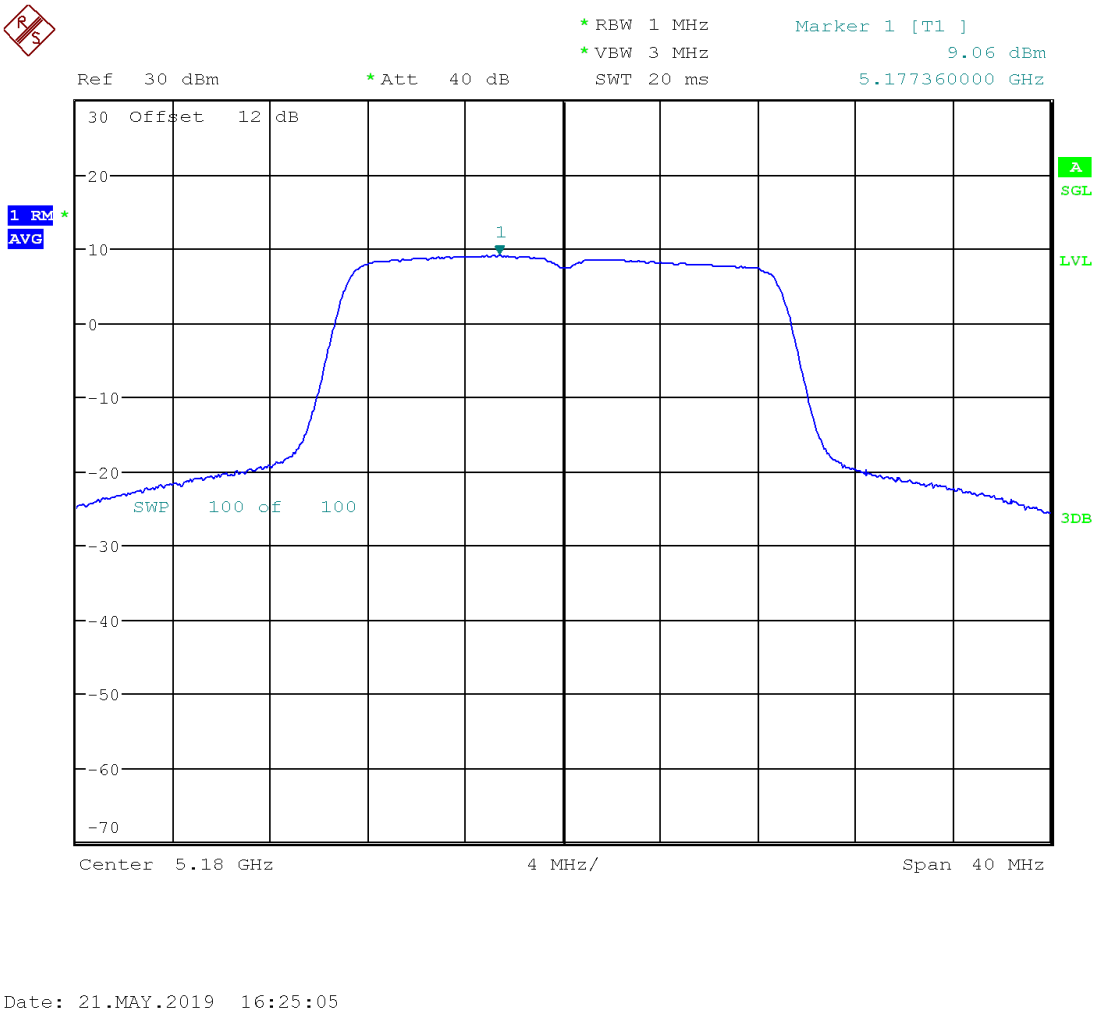


Figure 47: Power Spectral Density, Channel 36 802.11n HT20 6.5 Mbps, Chain 1

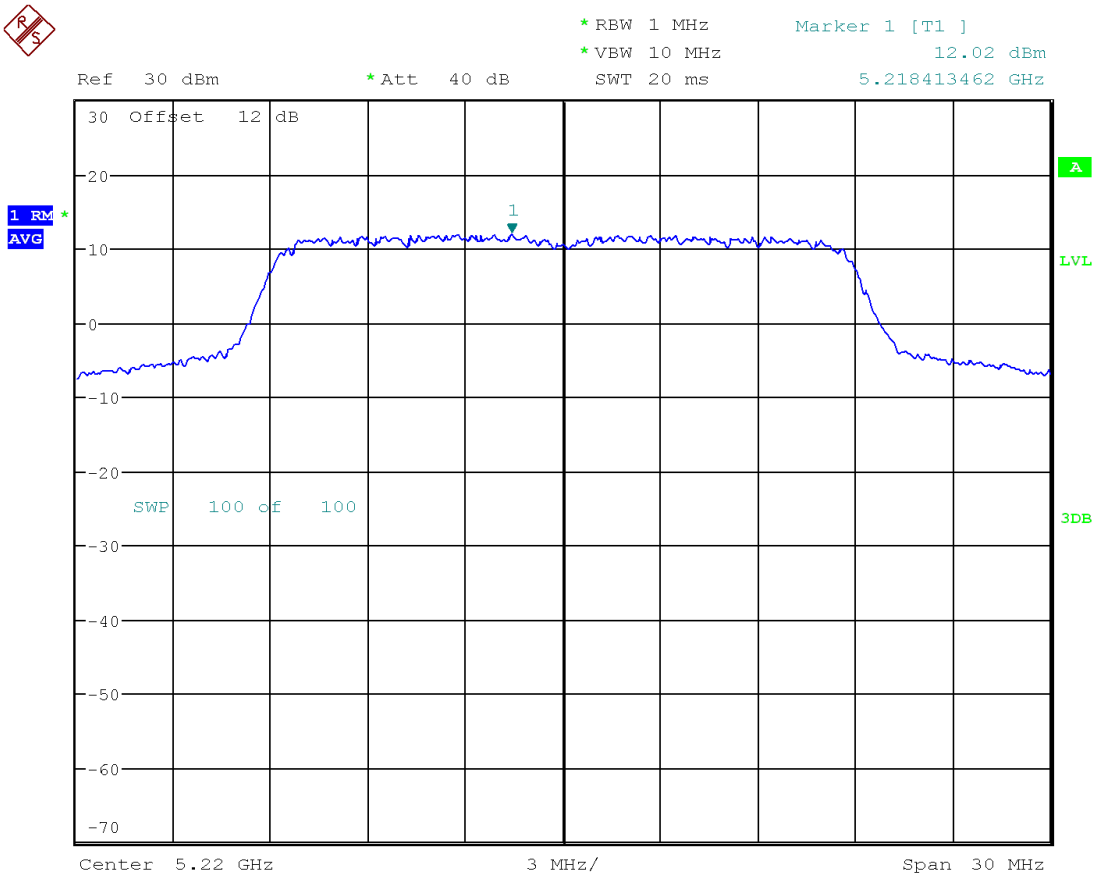


Figure 48: Power Spectral Density, Channel 44 802.11n HT20 6.5 Mbps, Chain 0

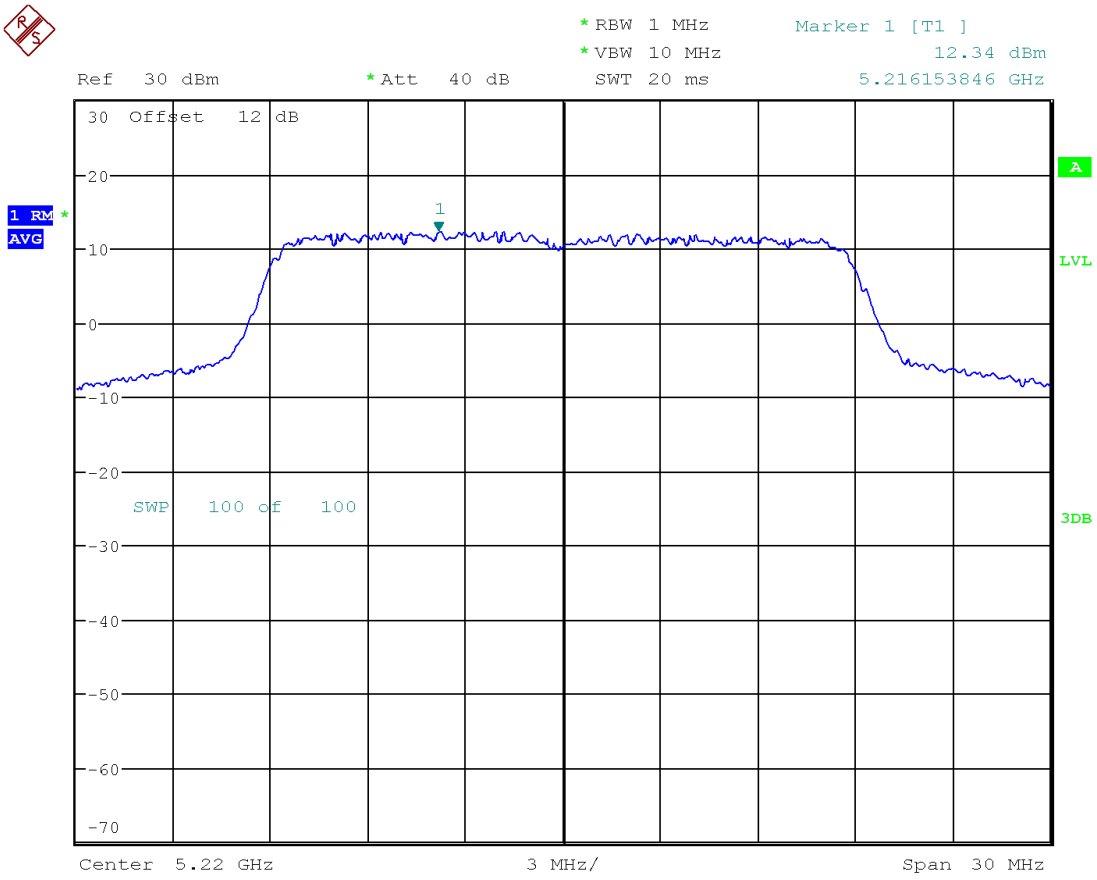


Figure 49: Power Spectral Density, Channel 44 802.11n HT20 6.5 Mbps, Chain 1

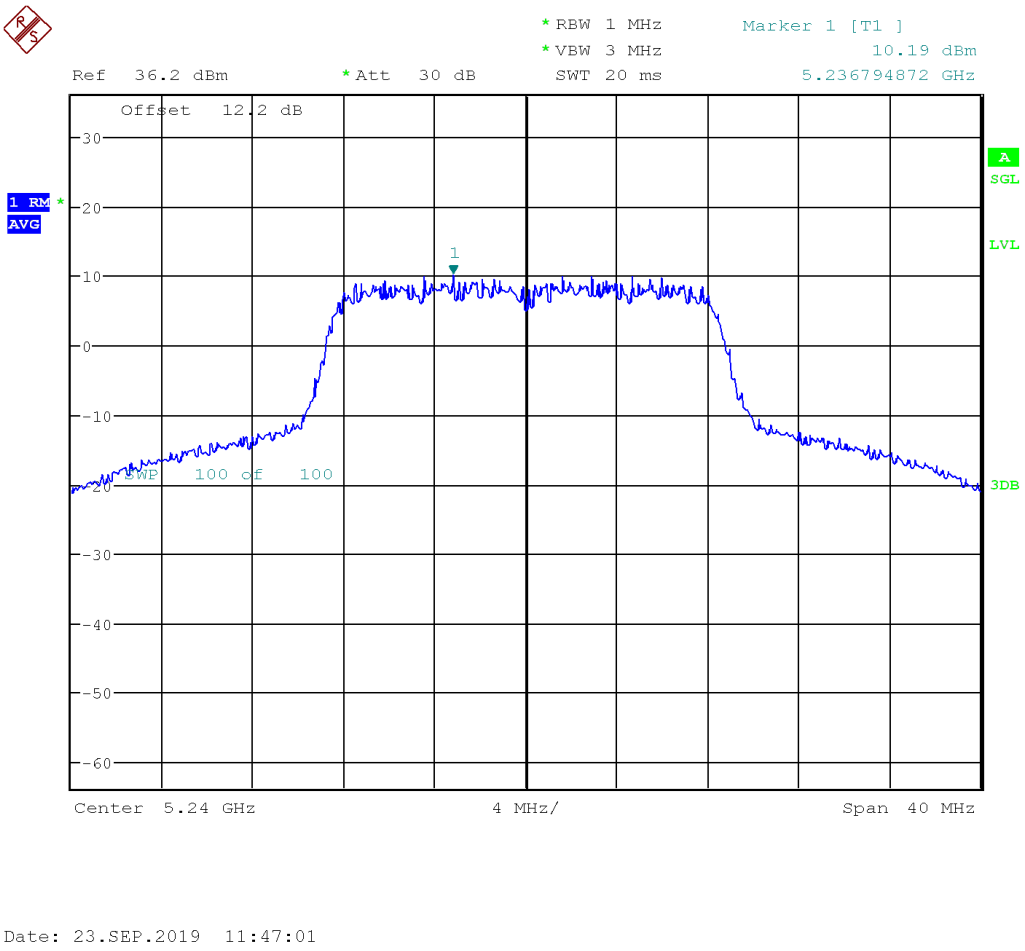


Figure 50: Power Spectral Density, Channel 48 802.11n HT20 6.5 Mbps, Chain 0

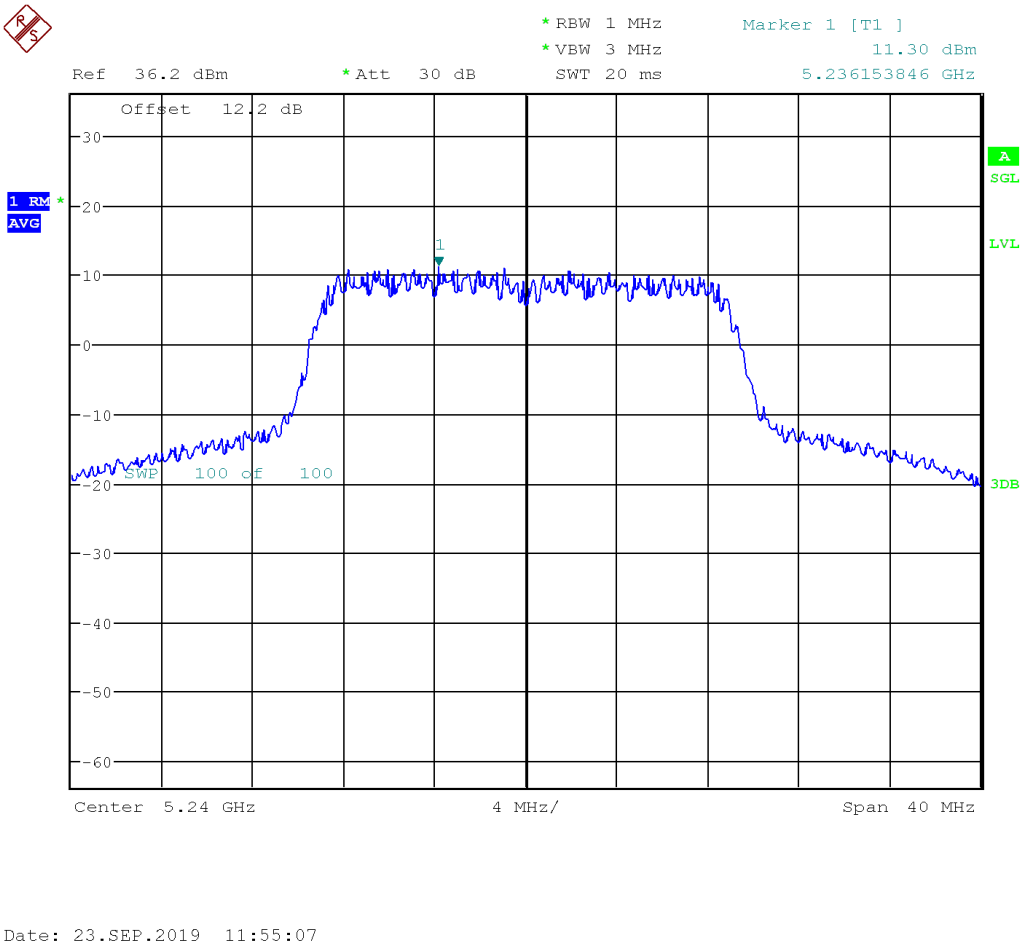


Figure 51: Power Spectral Density, Channel 48 802.11n HT20 6.5 Mbps, Chain 1

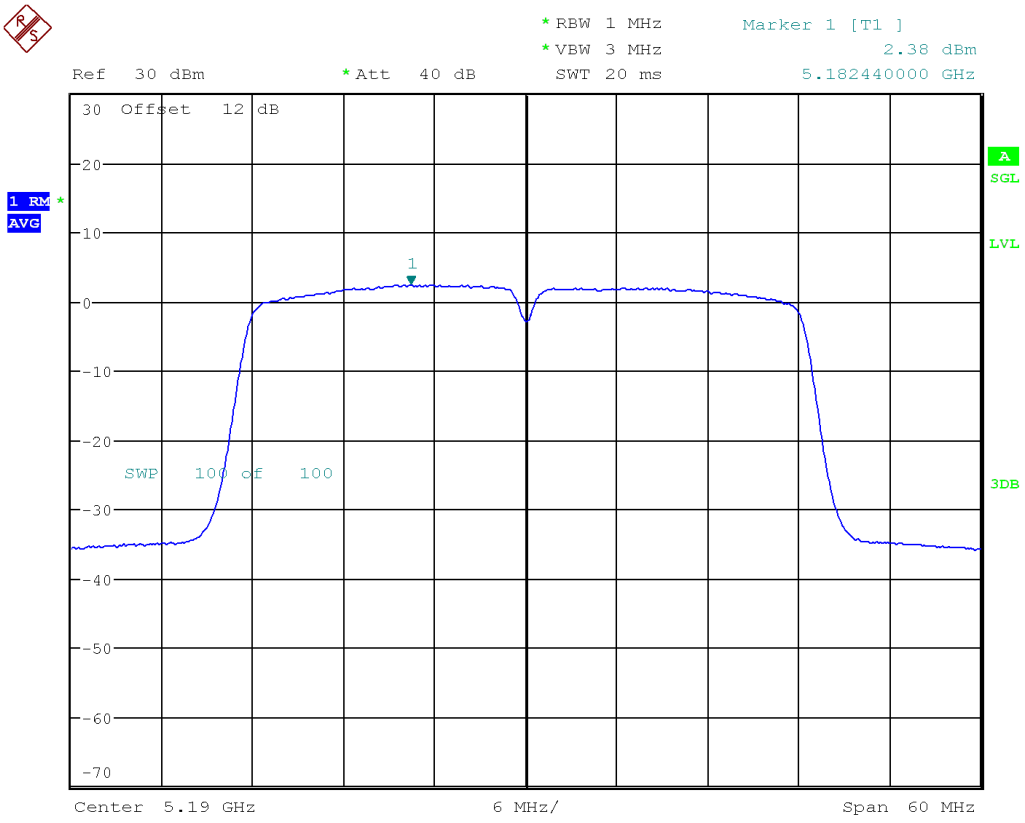


Figure 52: Power Spectral Density, Channel 38 802.11n HT40+ MCS0, Chain 0

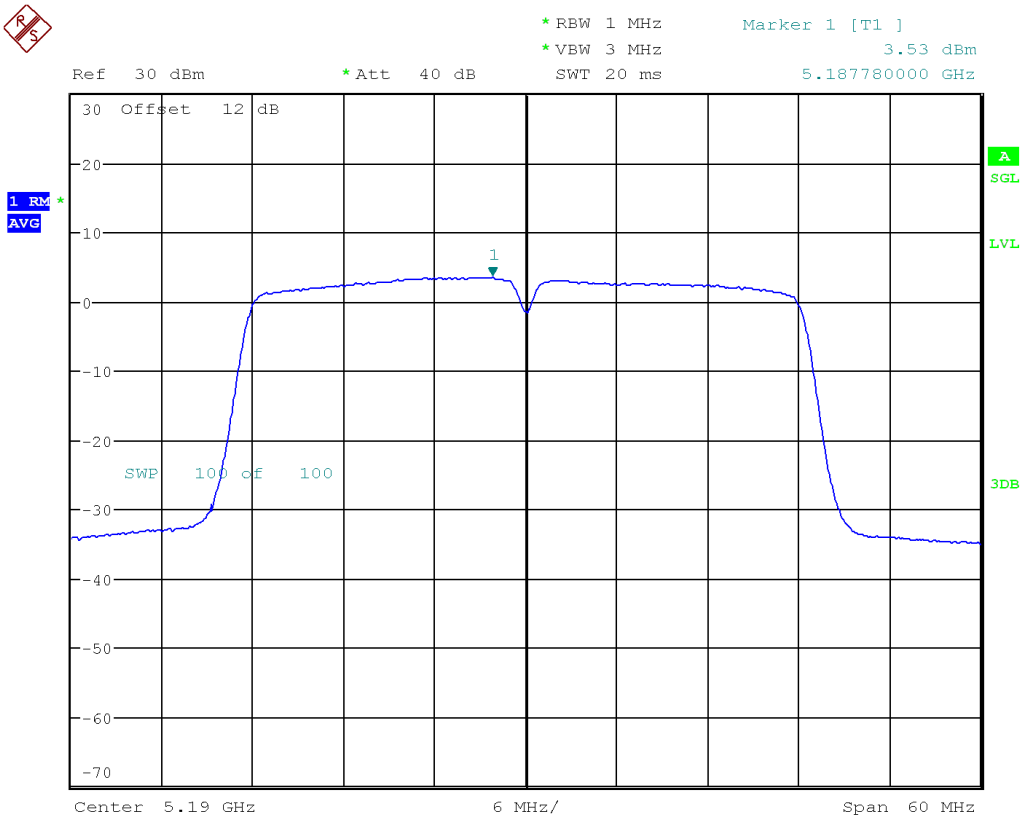


Figure 53: Power Spectral Density, Channel 38 802.11n HT40+ MCS0, Chain 1

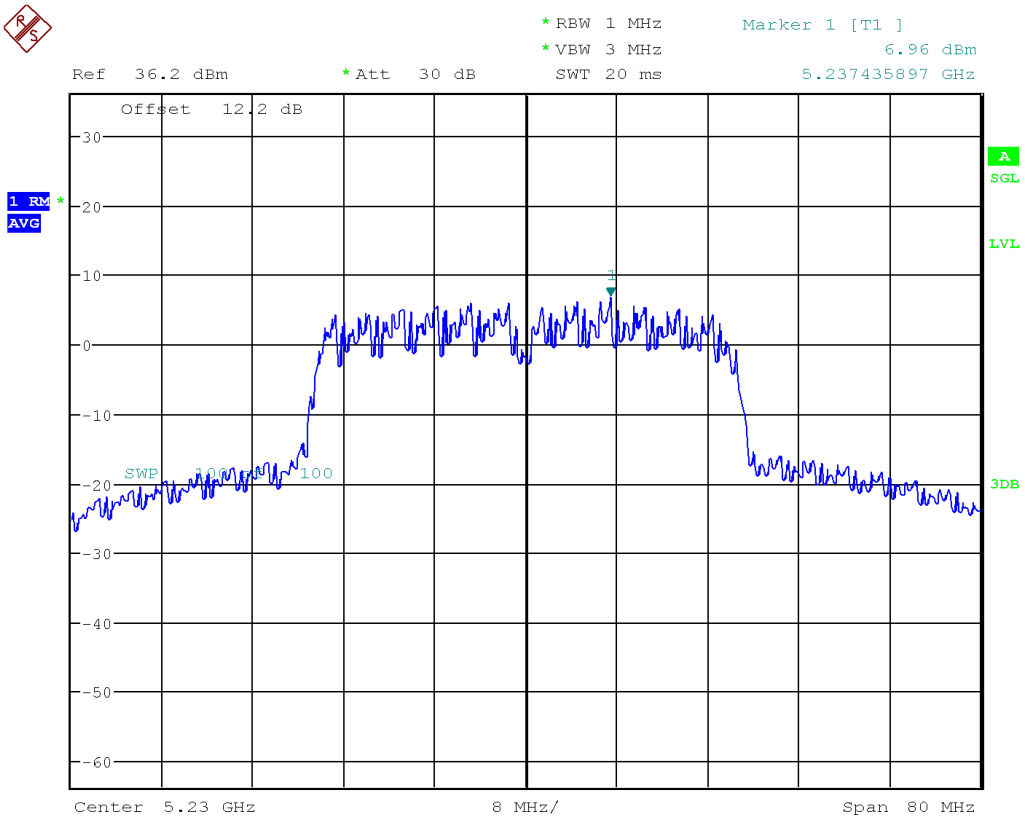


Figure 54: Power Spectral Density, Channel 46 802.11n HT40+ MCS0, Chain 0

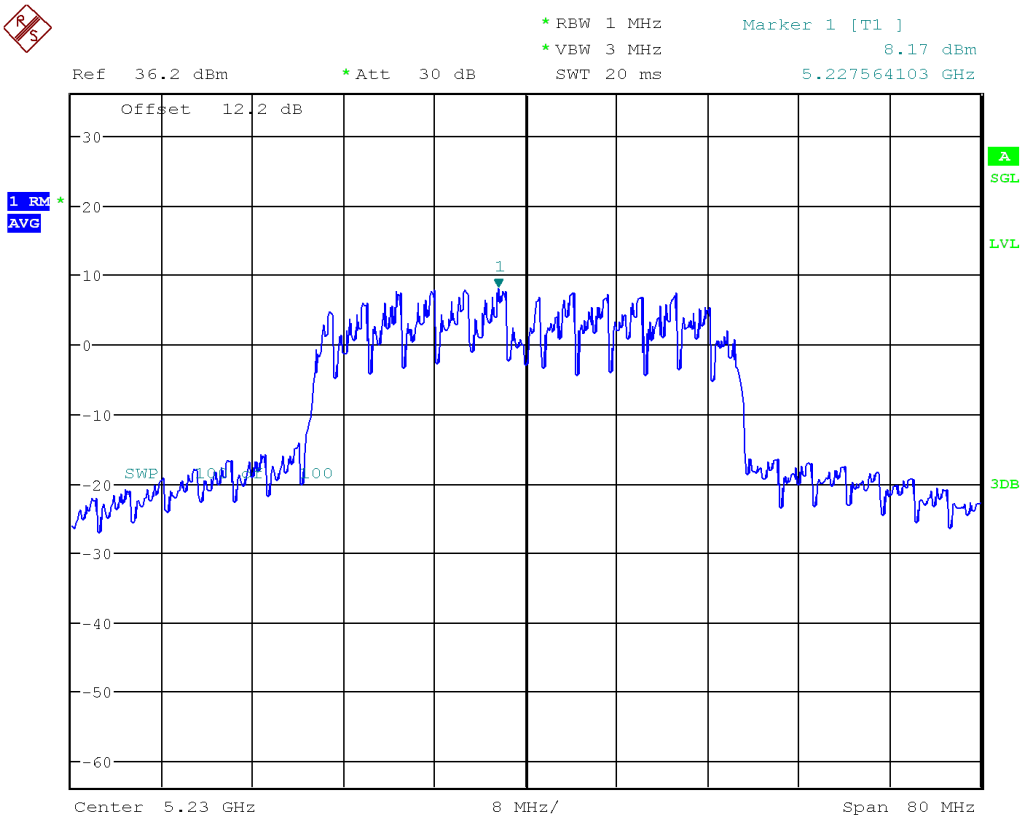


Figure 55: Power Spectral Density, Channel 46 802.11n HT40+ MCS0, Chain 1

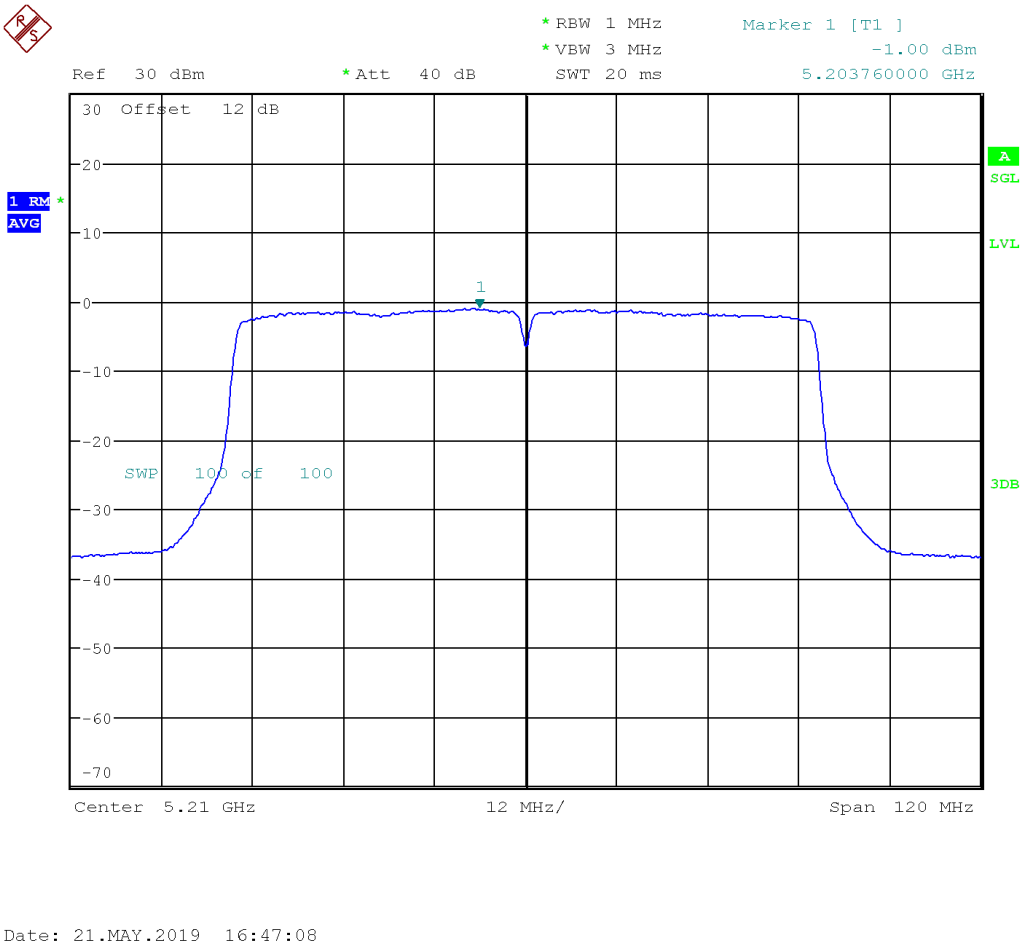


Figure 56: Power Spectral Density, Channel 42 802.11ac VHT80 MCS0, Chain 0

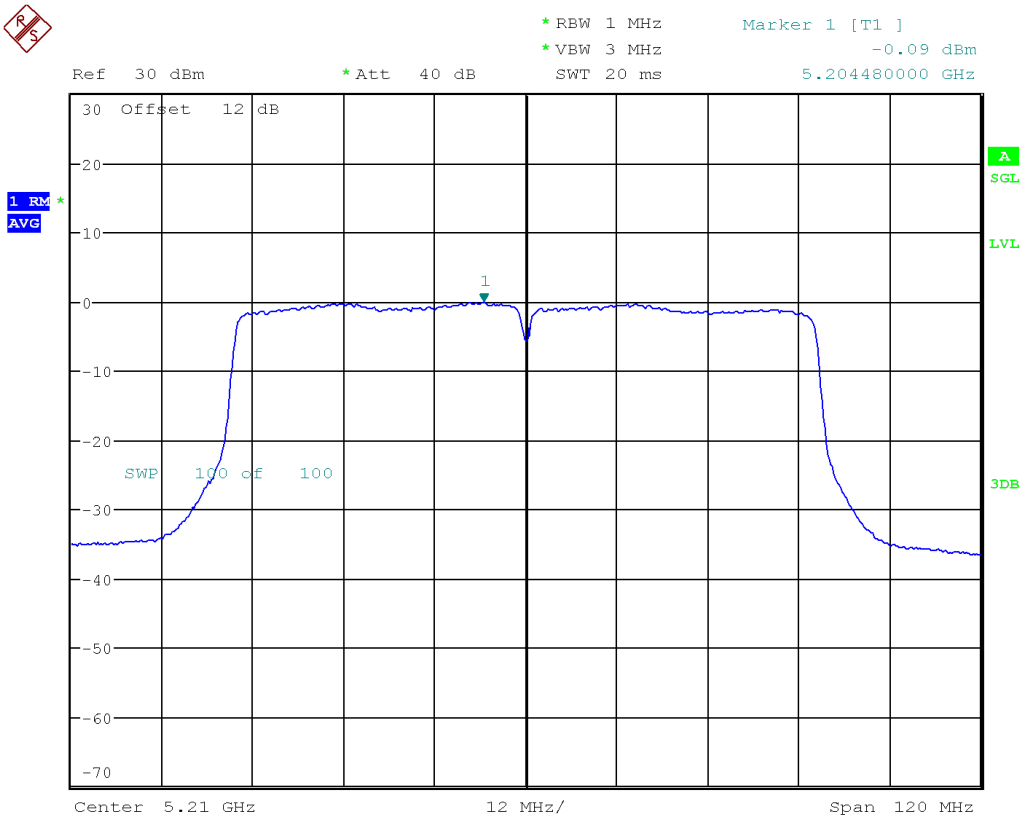


Figure 57: Power Spectral Density, Channel 42 802.11ac VHT80 MCS0, Chain 1

3.3.4.2.2 UNII-3

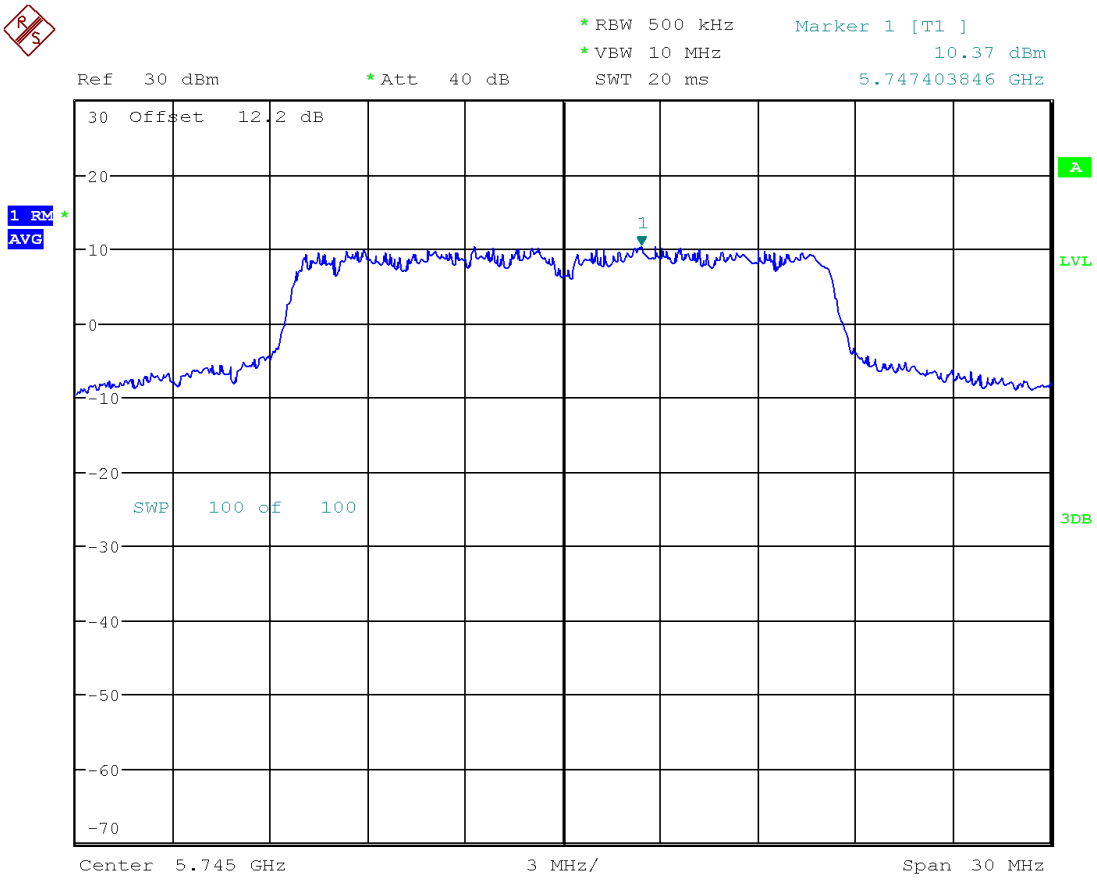


Figure 58: Power Spectral Density, Channel 149 802.11a NoHT 6 Mbps, Chain 0

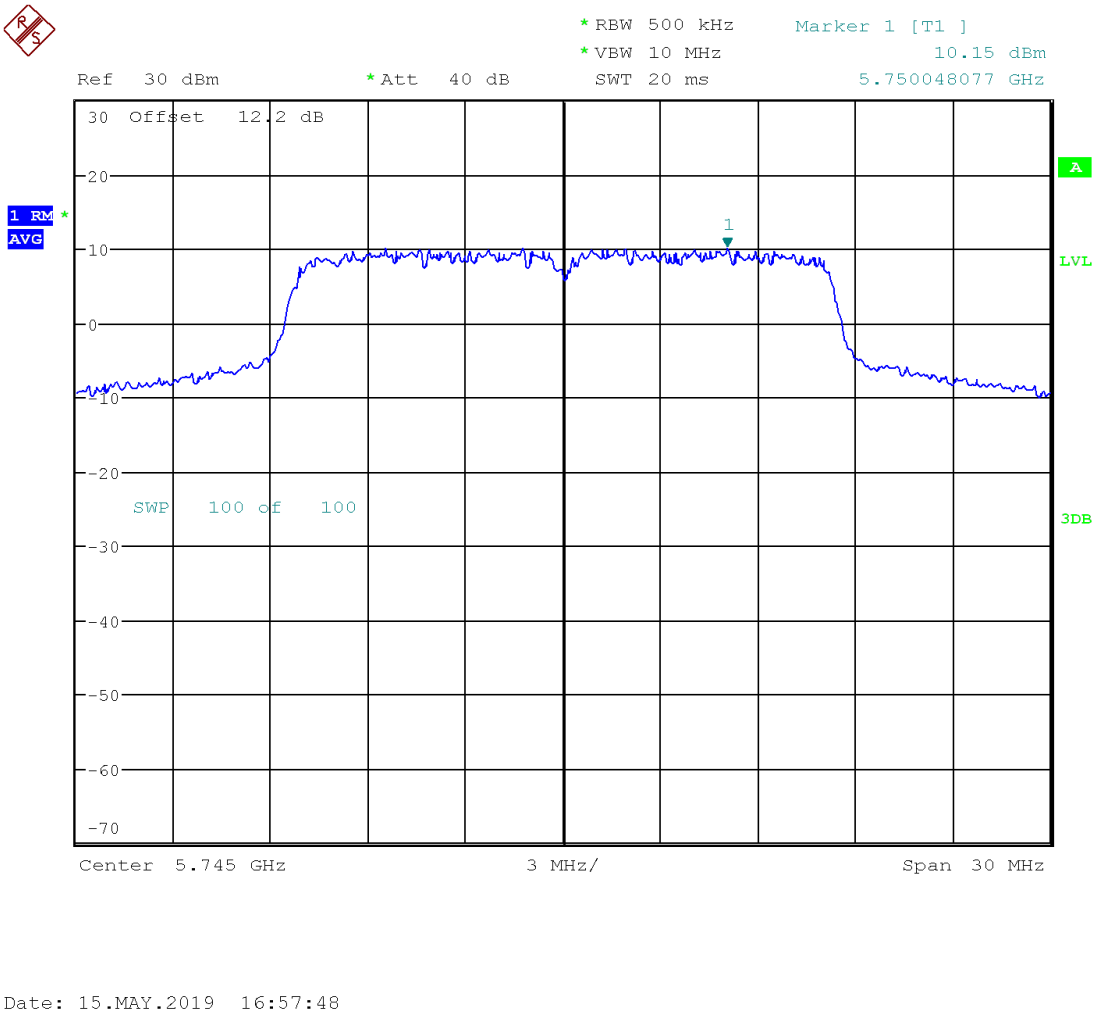


Figure 59: Power Spectral Density, Channel 149 802.11a NoHT 6 Mbps, Chain 1

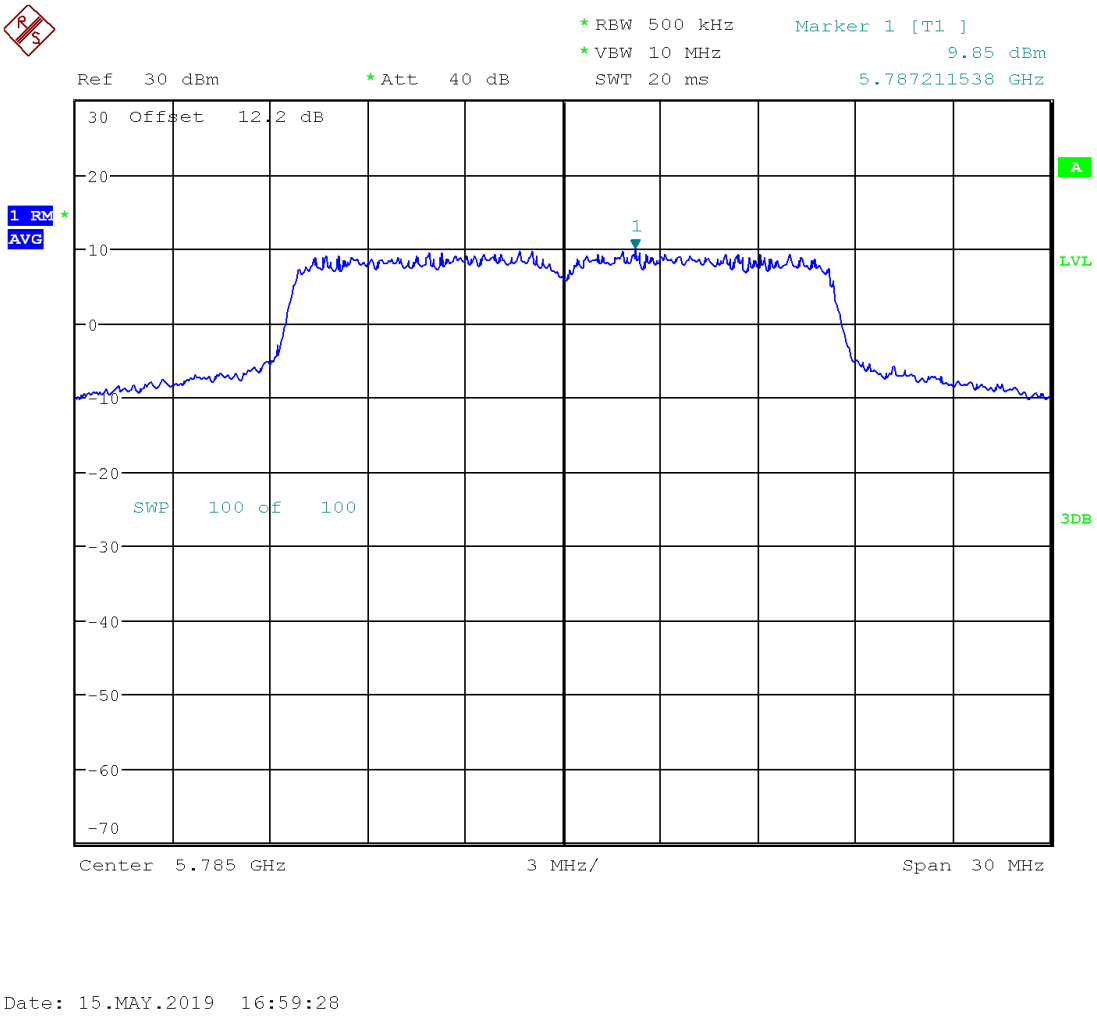


Figure 60: Power Spectral Density, Channel 157 802.11a NoHT 6 Mbps, Chain 0

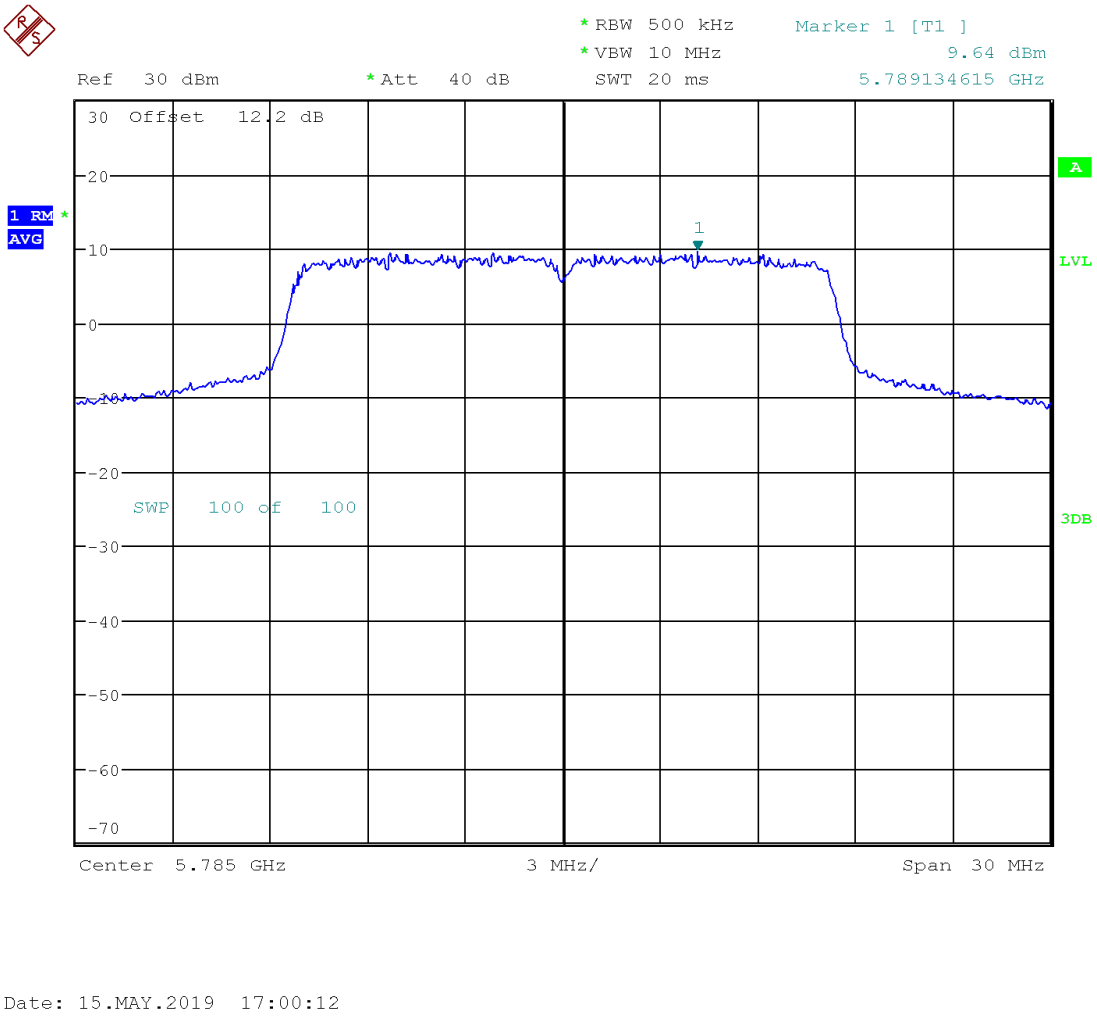


Figure 61: Power Spectral Density, Channel 157 802.11a NoHT 6 Mbps, Chain 1

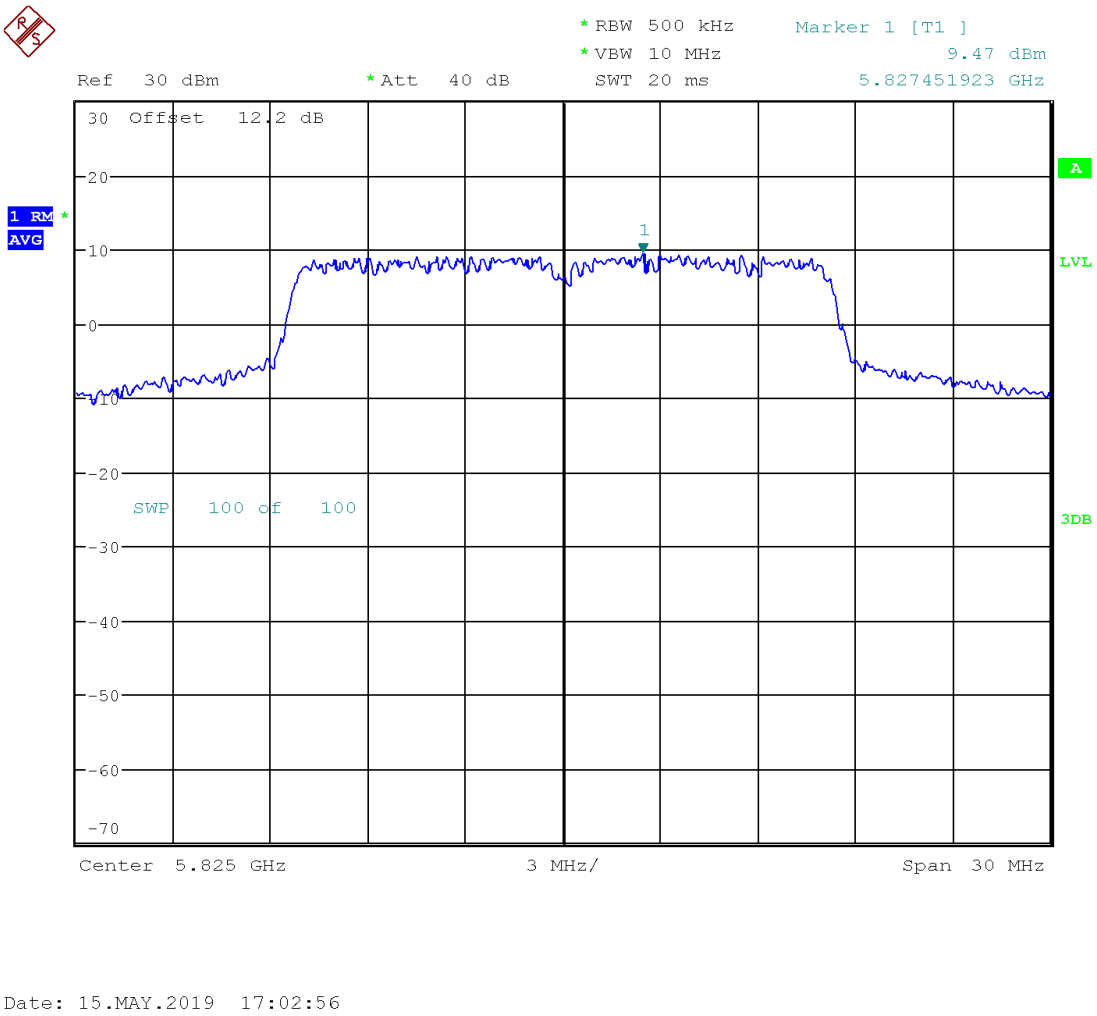


Figure 62: Power Spectral Density, Channel 165 802.11a NoHT 6 Mbps, Chain 0

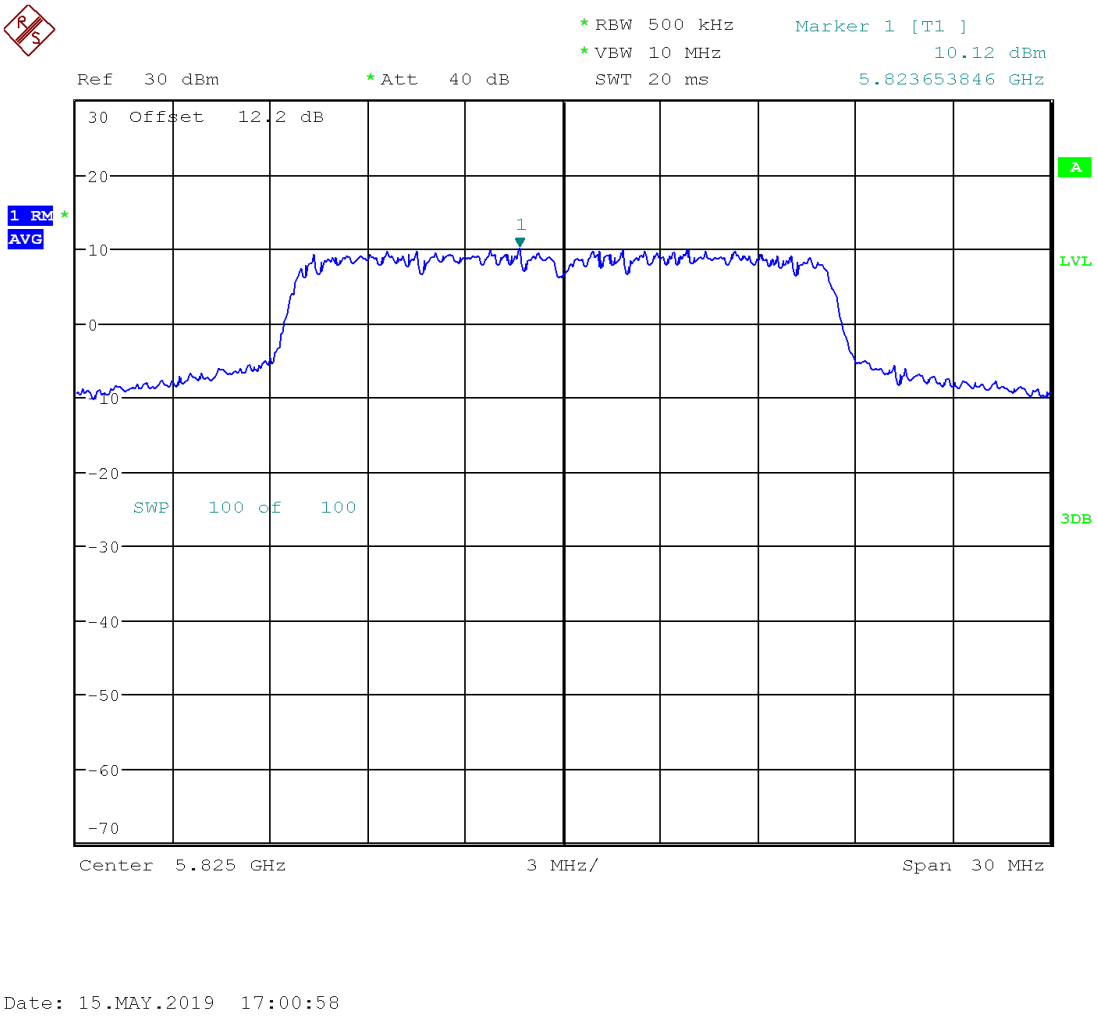


Figure 63: Power Spectral Density, Channel 165 802.11a NoHT 6 Mbps, Chain 1

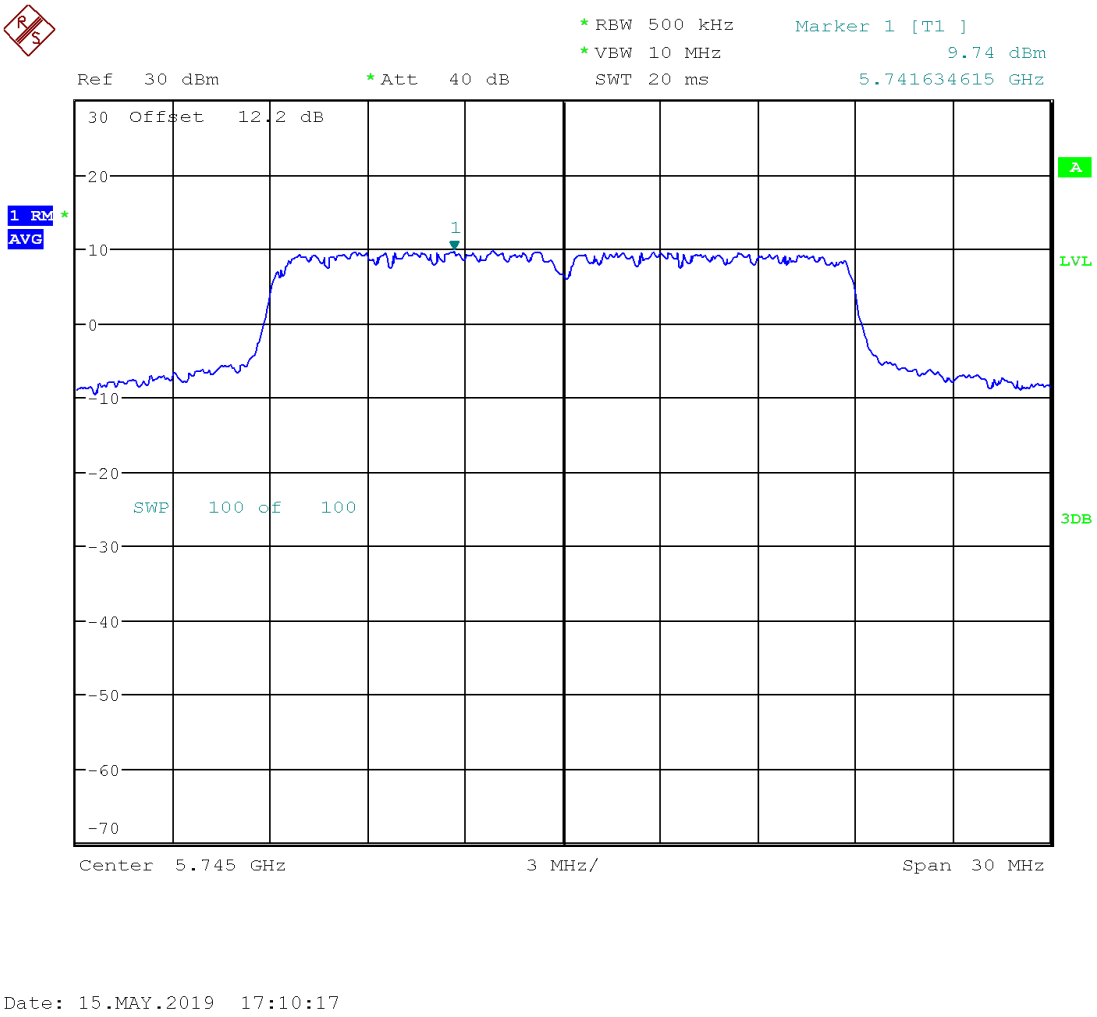


Figure 64: Power Spectral Density, Channel 149 802.11n HT20 6.5 Mbps, Chain 0

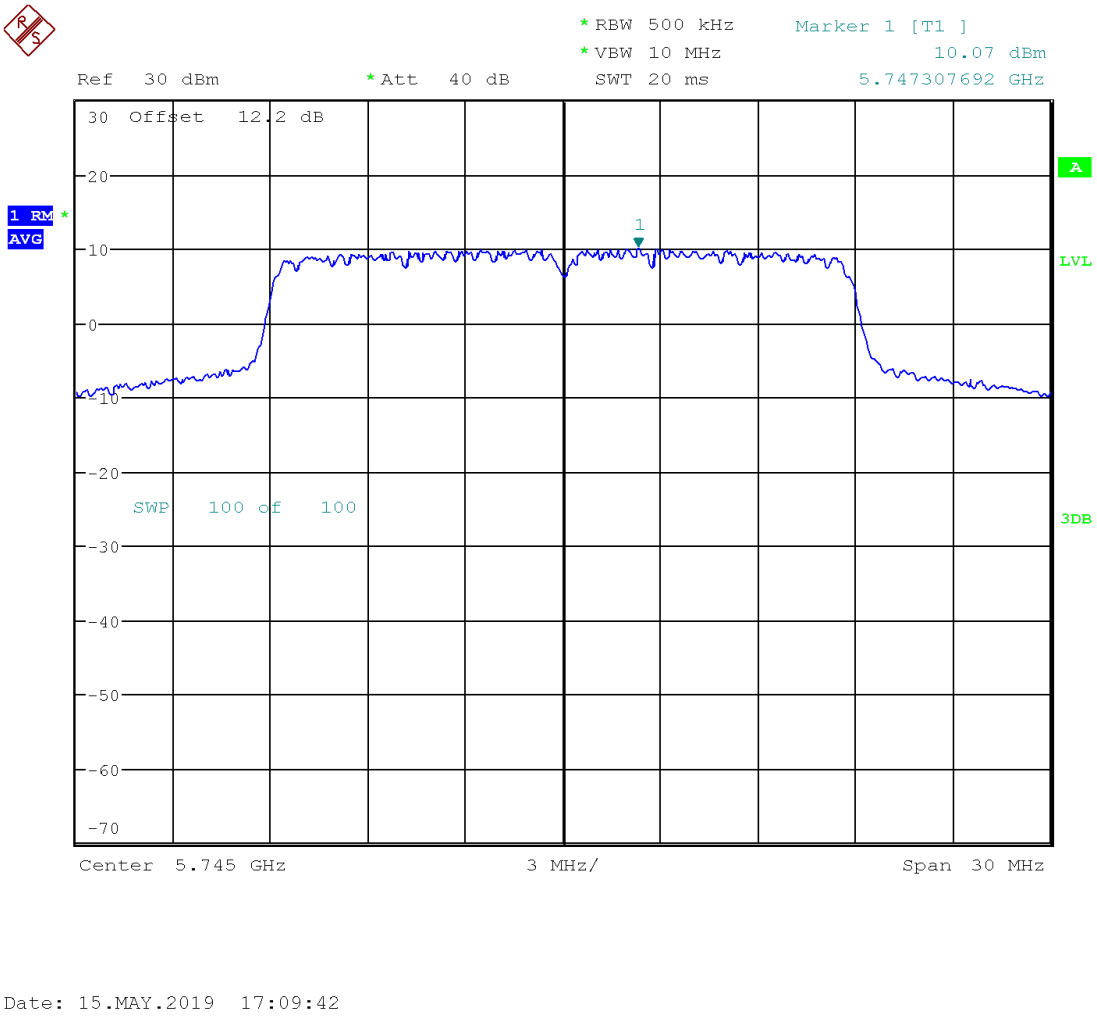


Figure 65: Power Spectral Density, Channel 149 802.11n HT20 6.5 Mbps, Chain 1

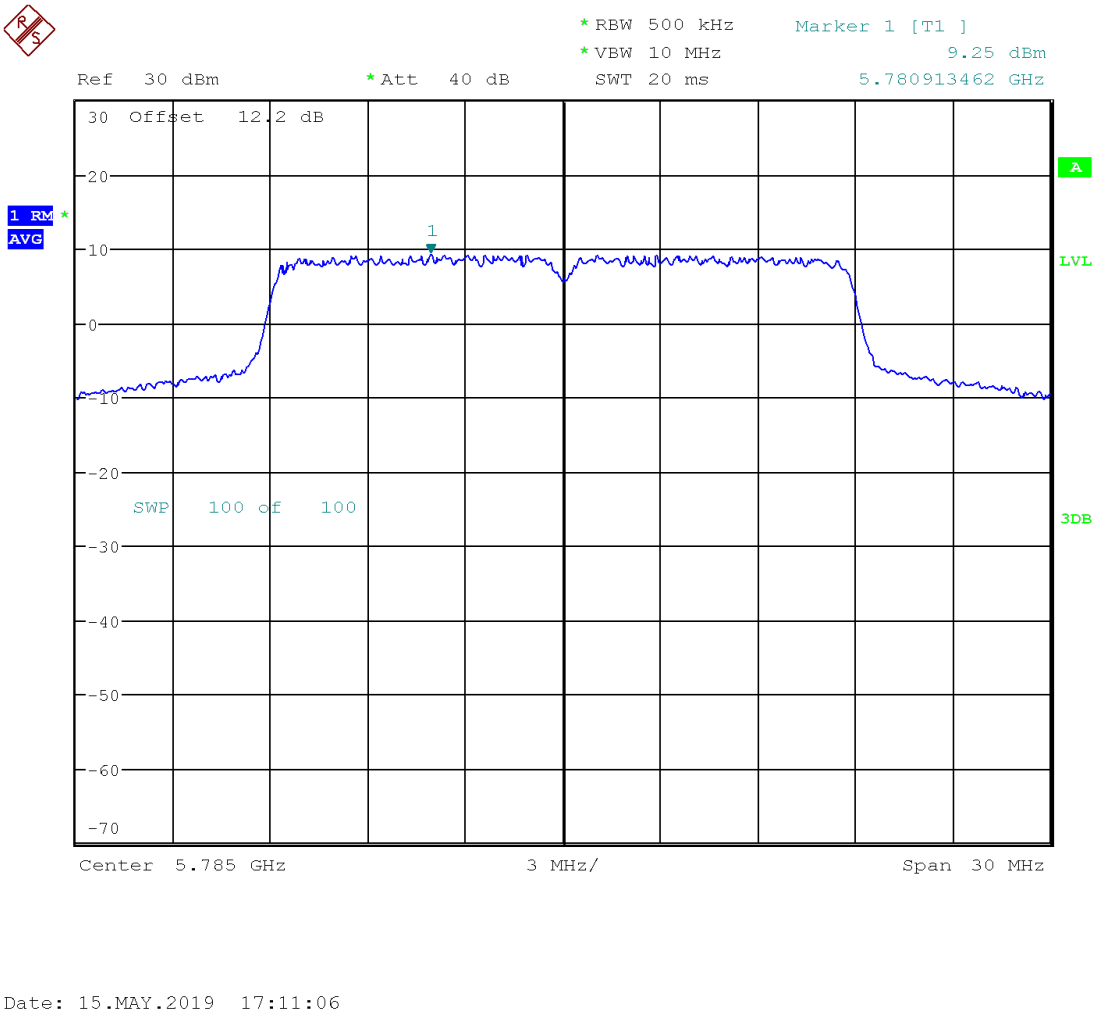


Figure 66: Power Spectral Density, Channel 157 802.11n HT20 6.5 Mbps, Chain 0

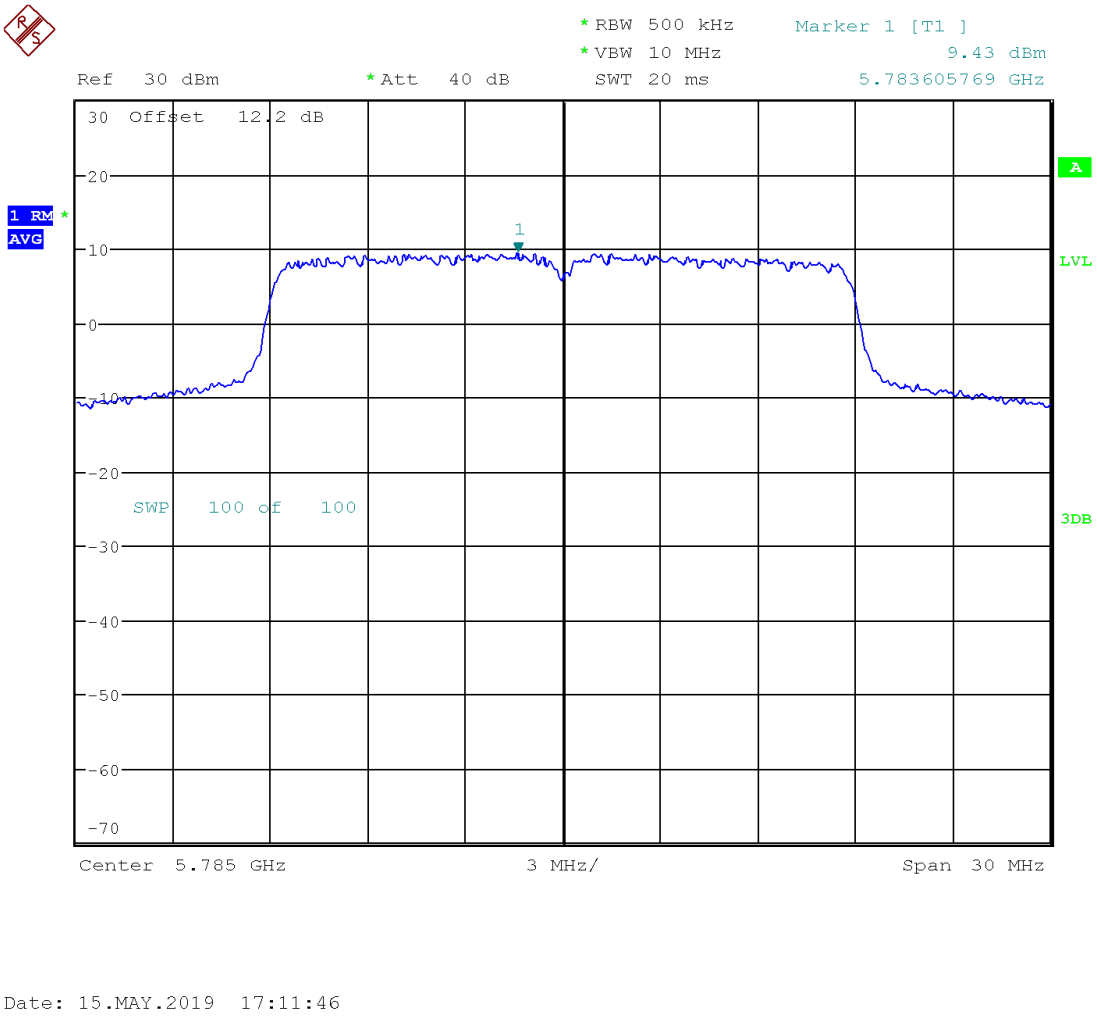


Figure 67: Power Spectral Density, Channel 157 802.11n HT20 6.5 Mbps, Chain 1

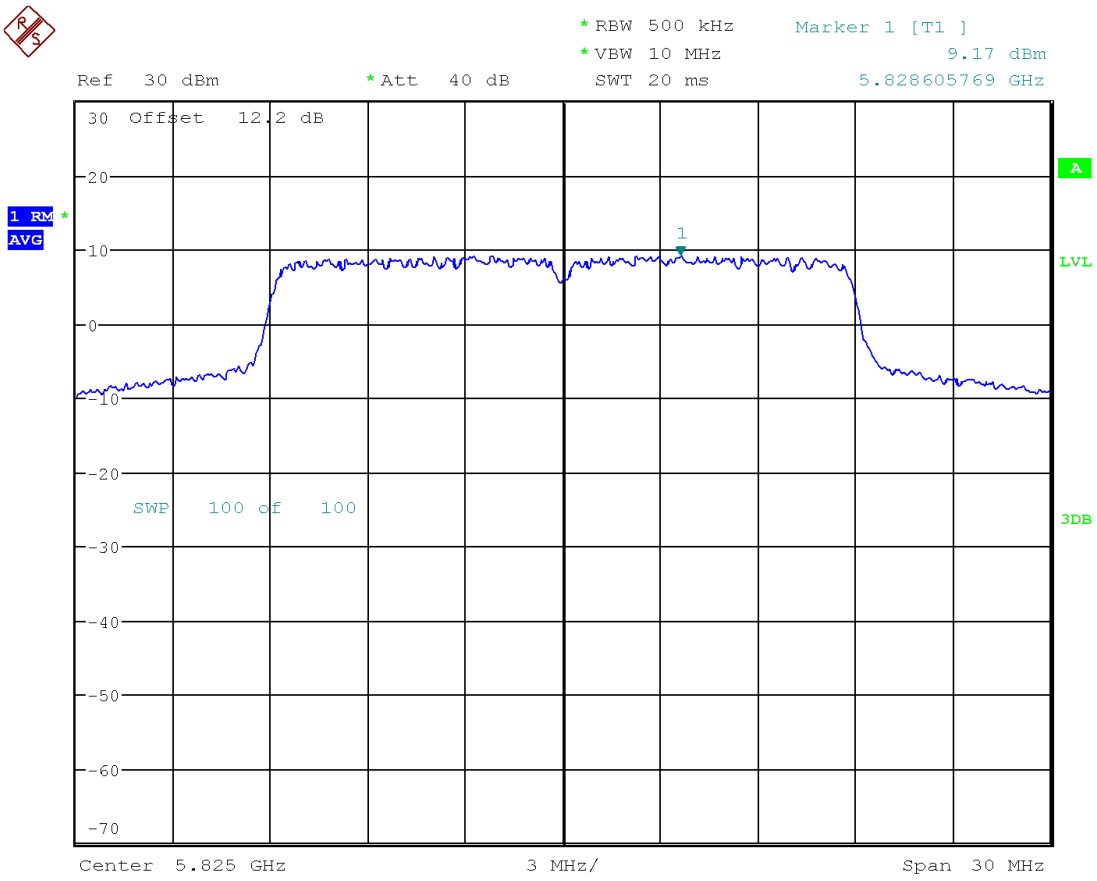


Figure 68: Power Spectral Density, Channel 165 802.11n HT20 6.5 Mbps, Chain 0

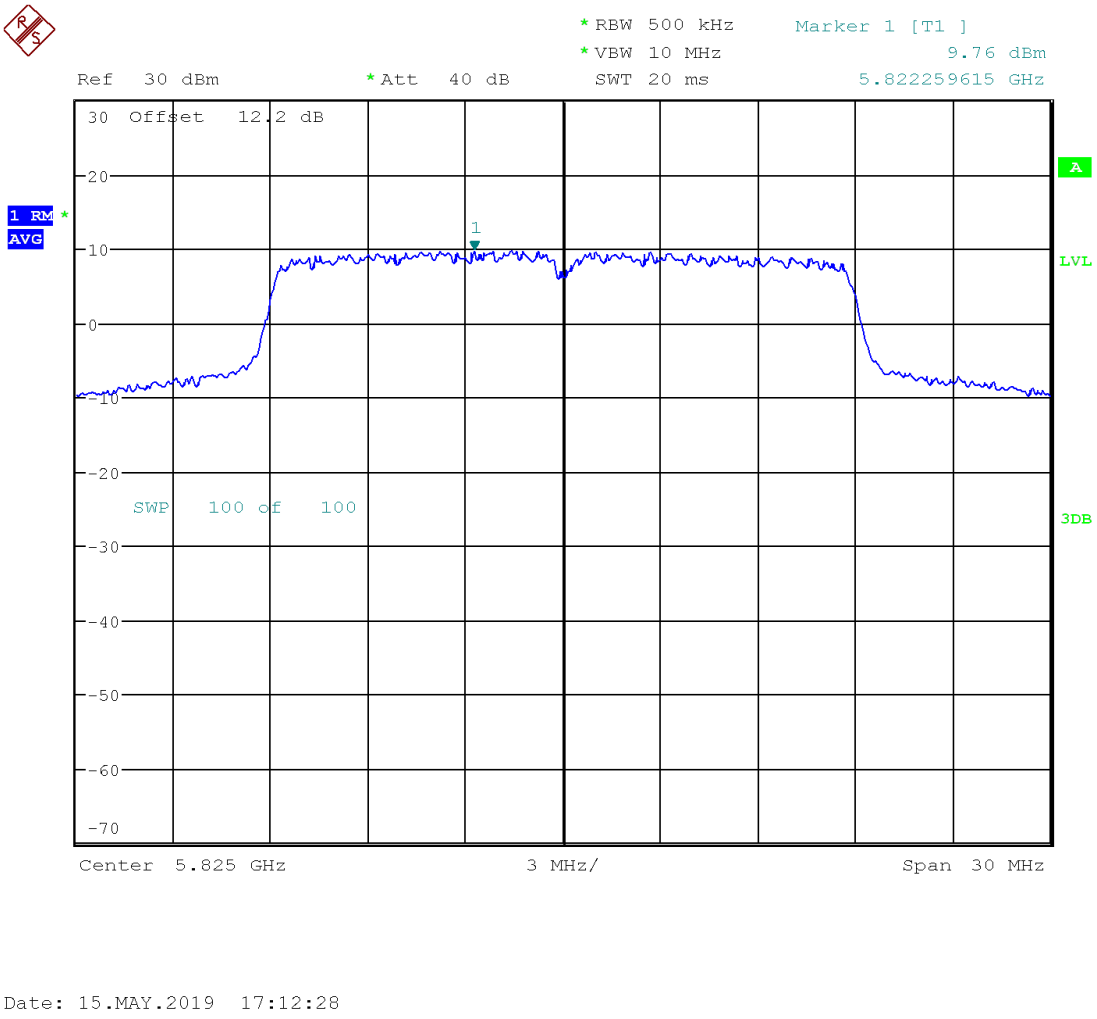


Figure 69: Power Spectral Density, Channel 165 802.11n HT20 6.5 Mbps, Chain 1

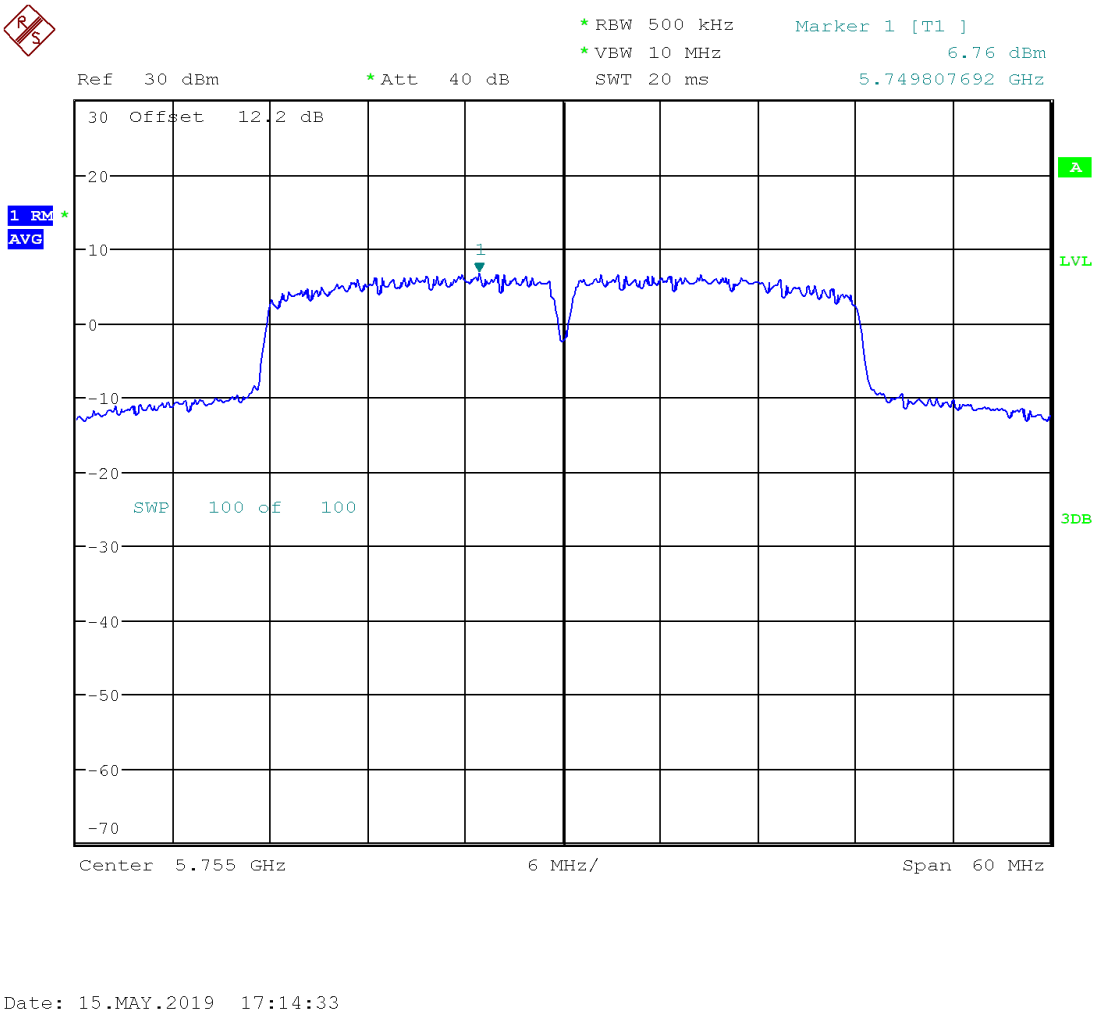


Figure 70: Power Spectral Density, Channel 151 802.11n HT40+ MCS0, Chain 0

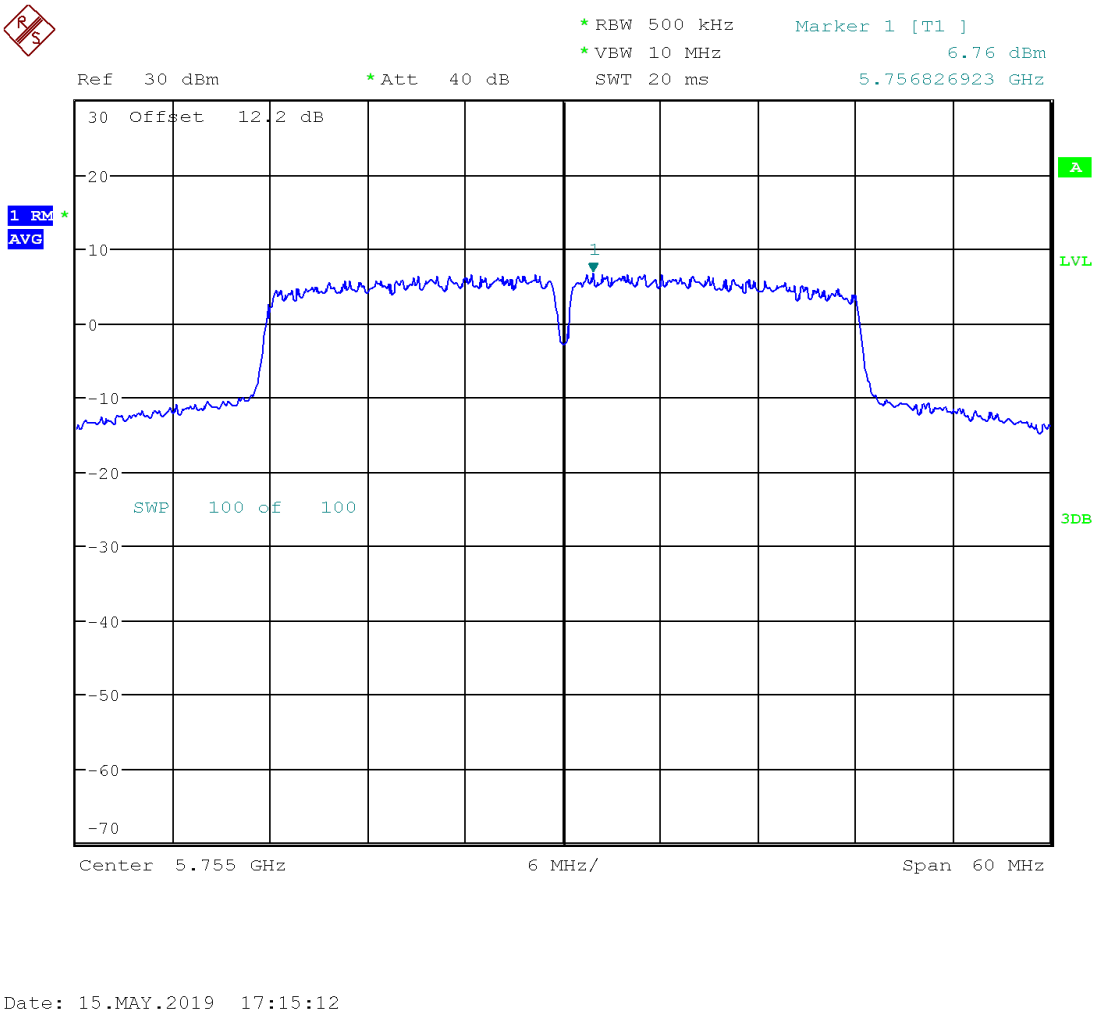


Figure 71: Power Spectral Density, Channel 151 802.11n HT40+ MCS0, Chain 1

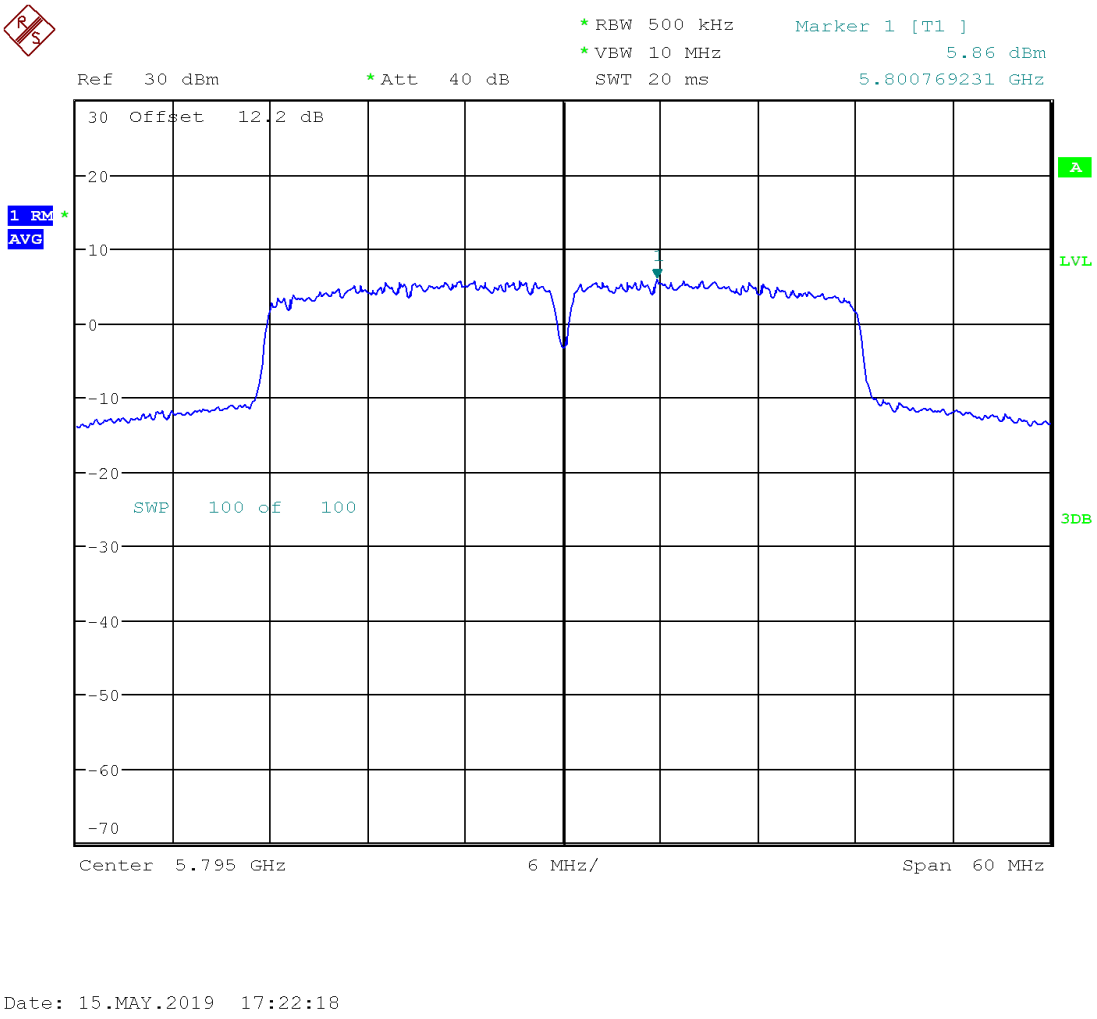


Figure 72: Power Spectral Density, Channel 159 802.11n HT40+ MCS0, Chain 0

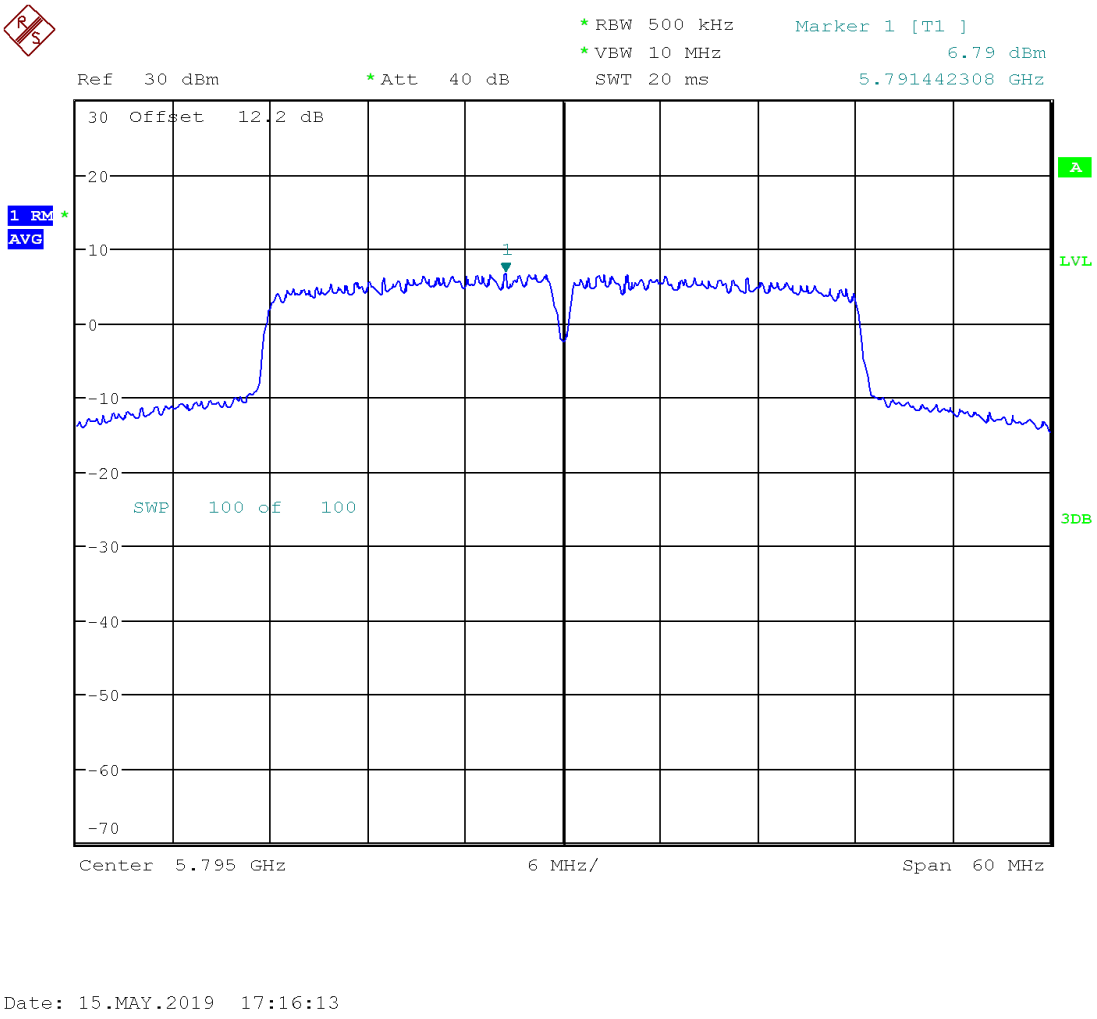


Figure 73: Power Spectral Density, Channel 159 802.11n HT40+ MCS0, Chain 1

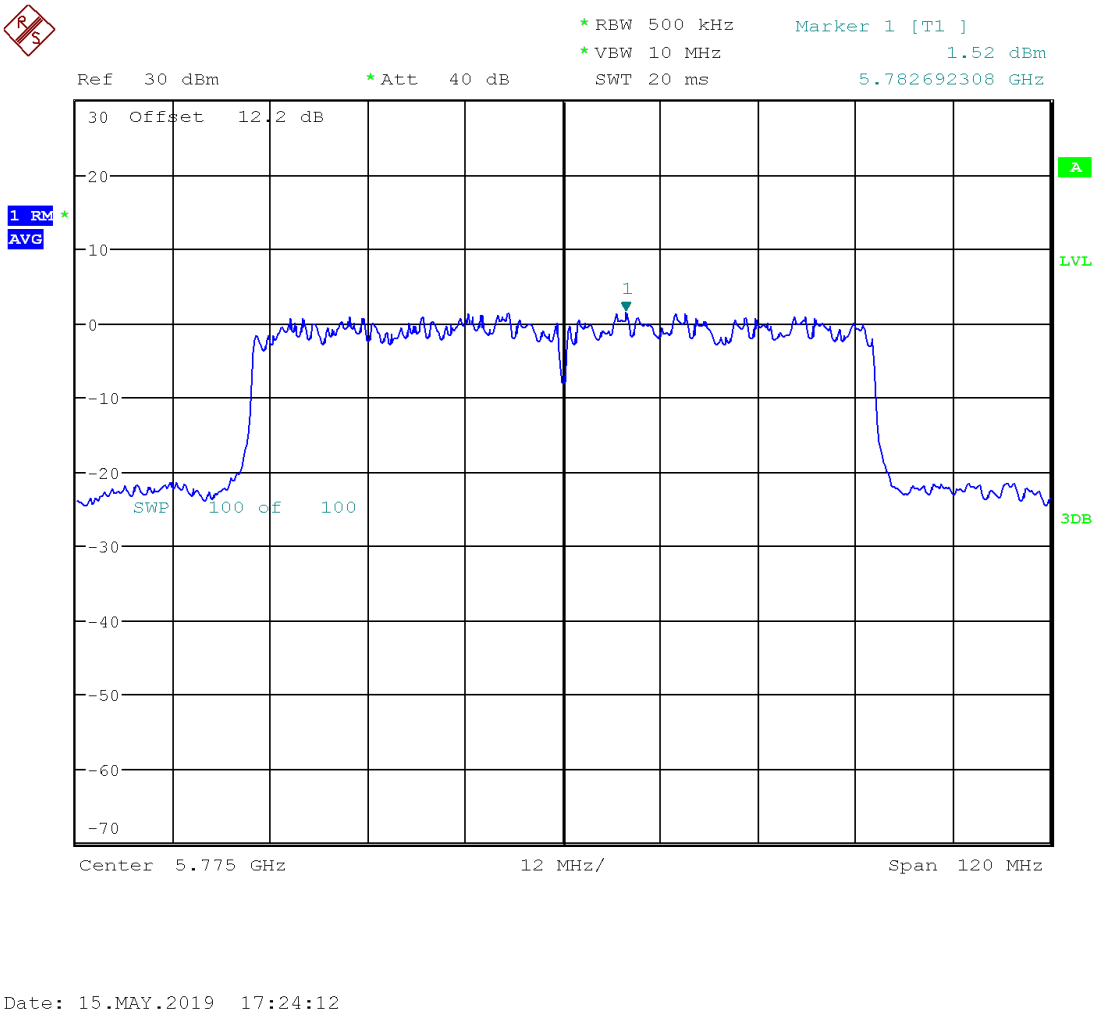


Figure 74: Power Spectral Density, Channel 155 802.11ac VHT80 MCS0, Chain 0

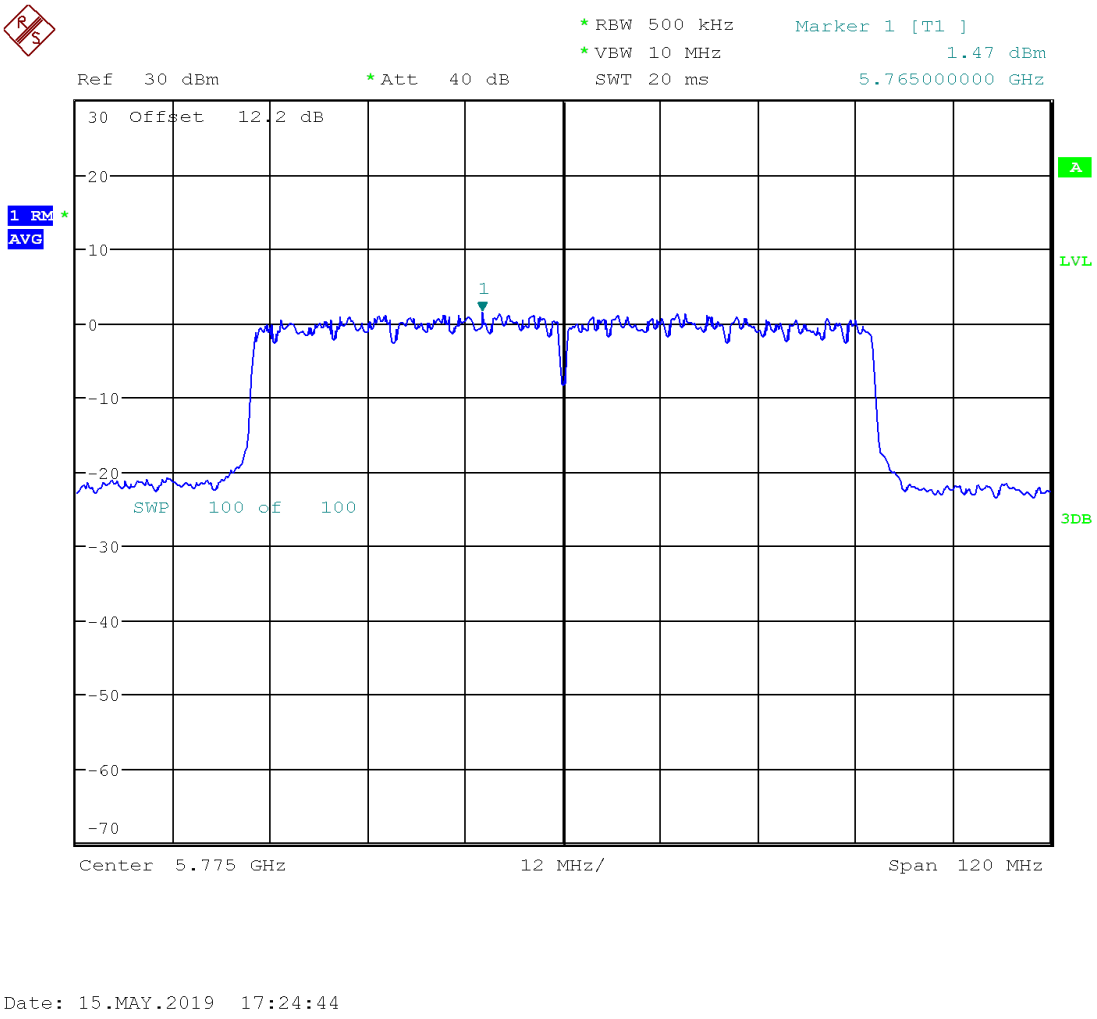


Figure 75: Power Spectral Density, Channel 155 802.11ac VHT80 MCS0, Chain 1

3.3.4.3 ISED

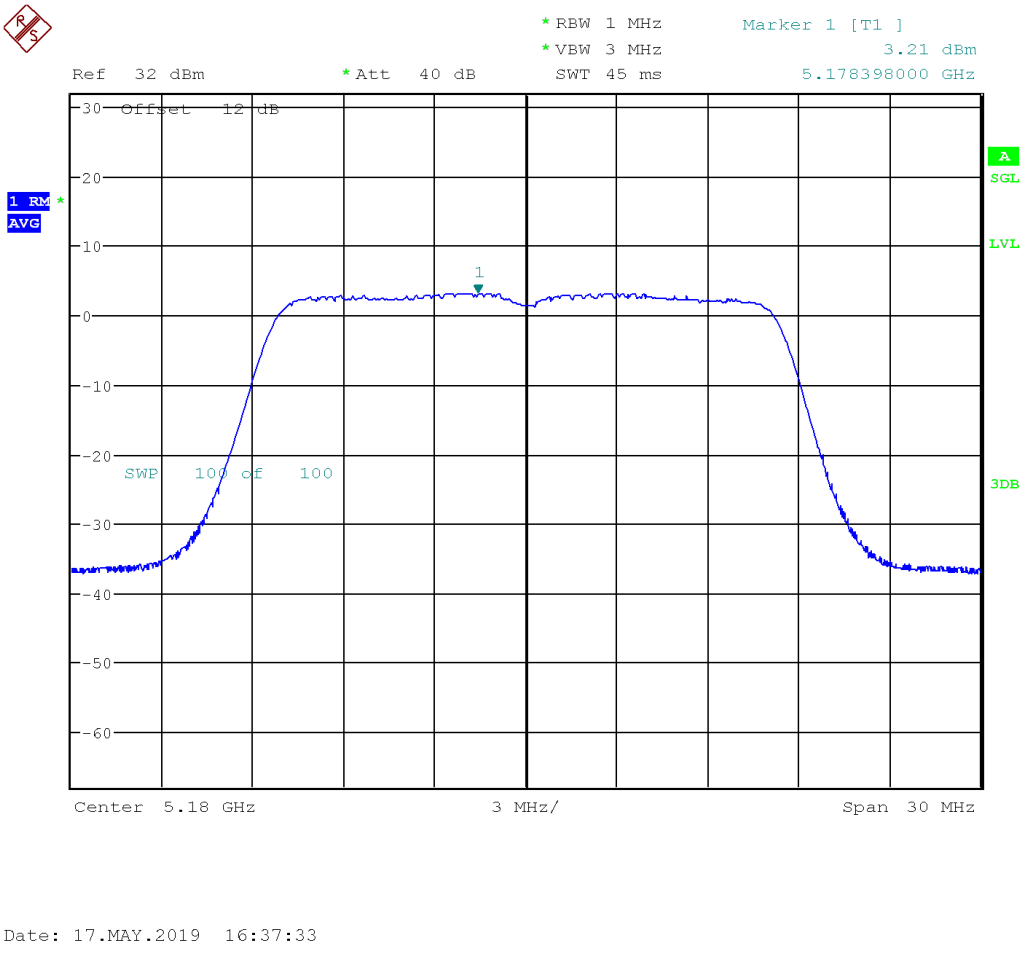


Figure 76: Power Spectral Density, Channel 36 802.11a NoHT 6 Mbps, Chain 0

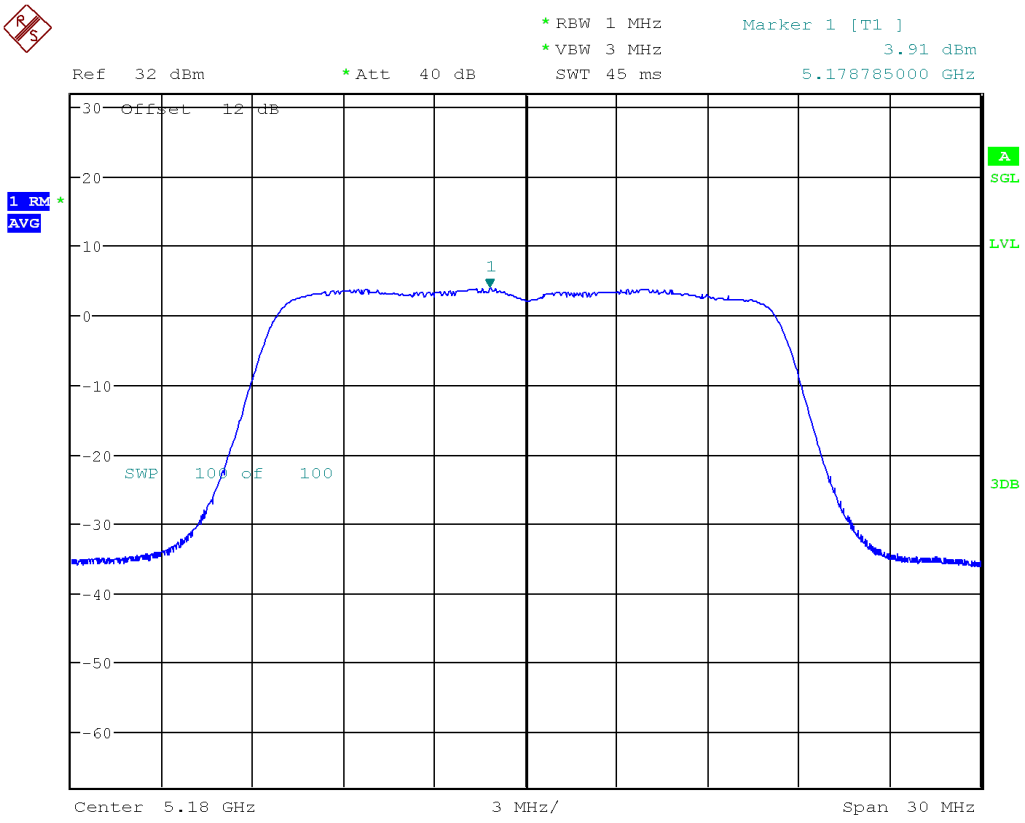


Figure 77: Power Spectral Density, Channel 36 802.11a NoHT 6 Mbps, Chain 1

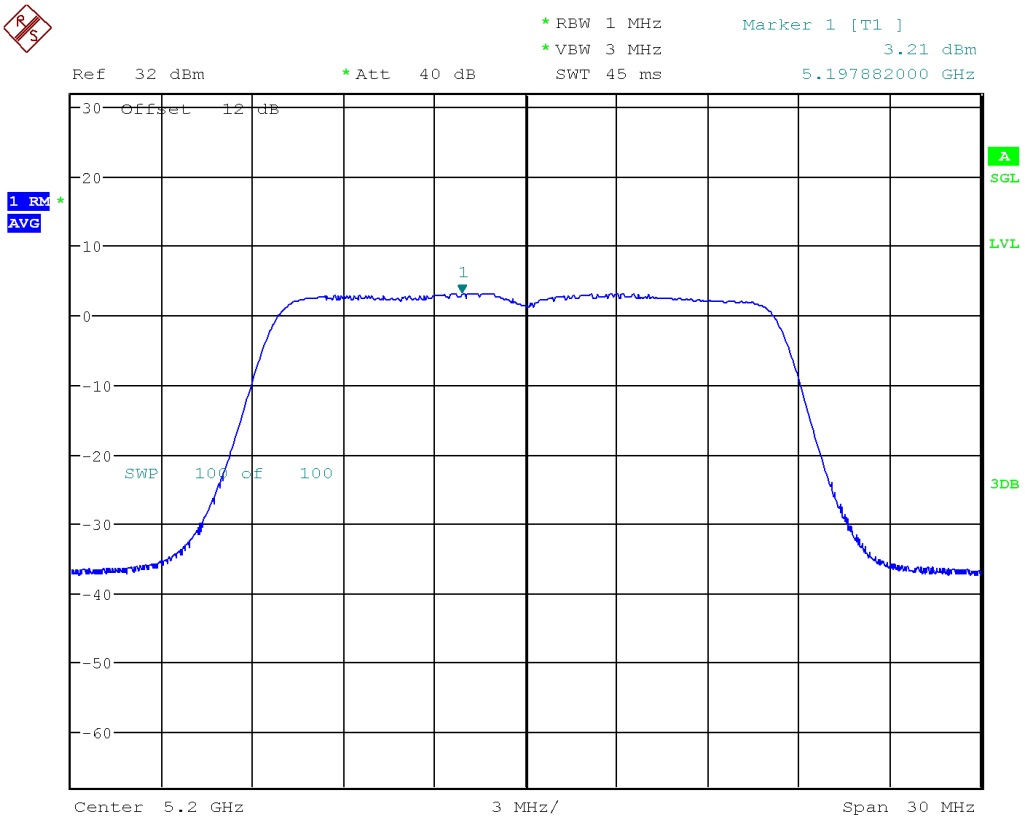


Figure 78: Power Spectral Density, Channel 44 802.11a NoHT 6 Mbps, Chain 0

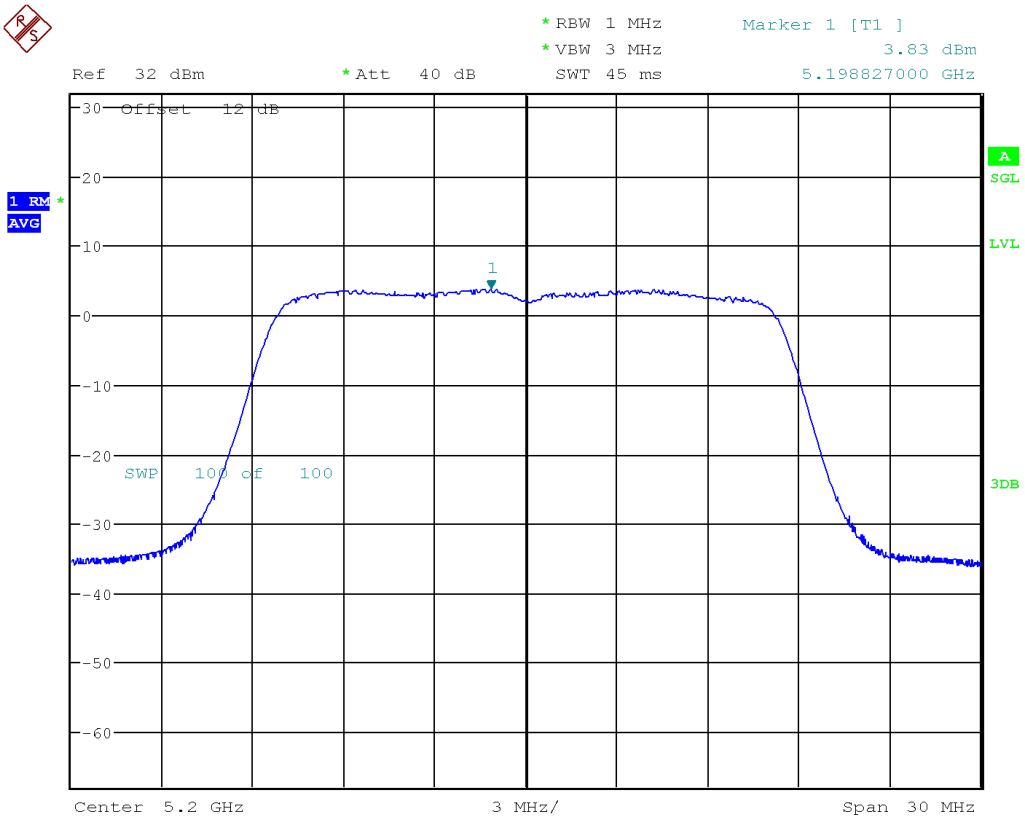


Figure 79: Power Spectral Density, Channel 44 802.11a NoHT 6 Mbps, Chain 1

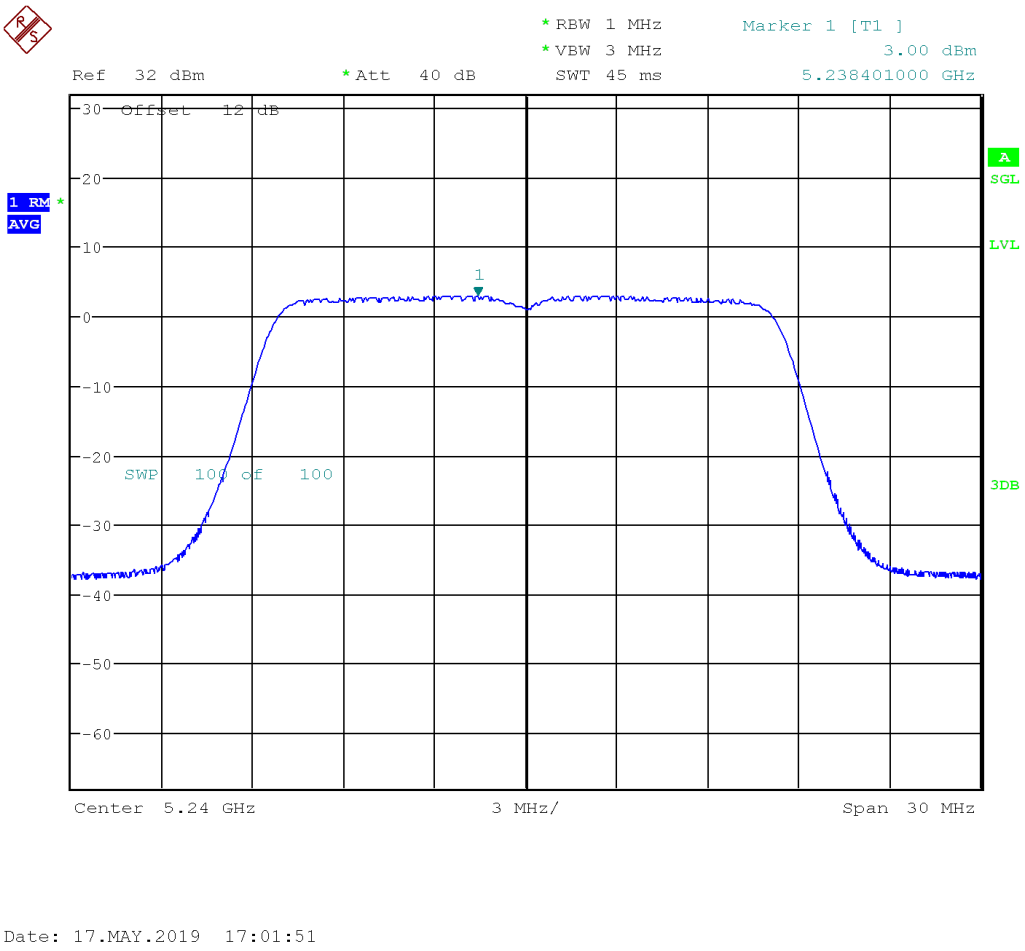


Figure 80: Power Spectral Density, Channel 48 802.11a NoHT 6 Mbps, Chain 0

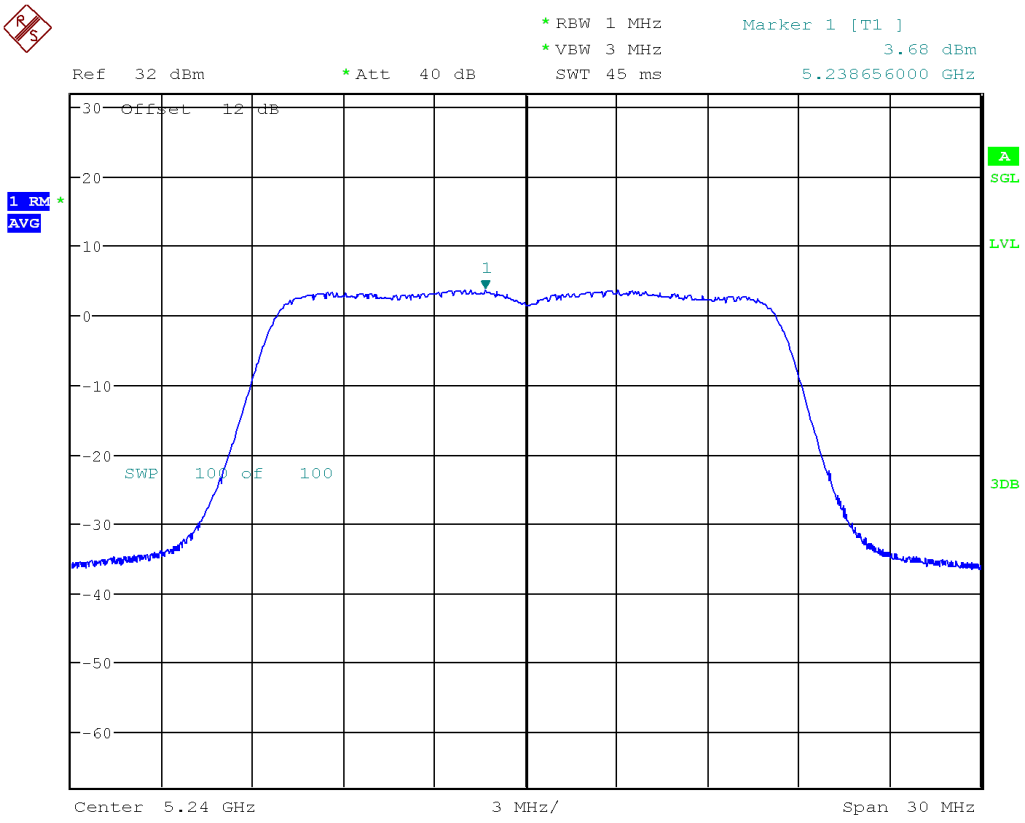


Figure 81: Power Spectral Density, Channel 48 802.11a NoHT 6 Mbps, Chain 1

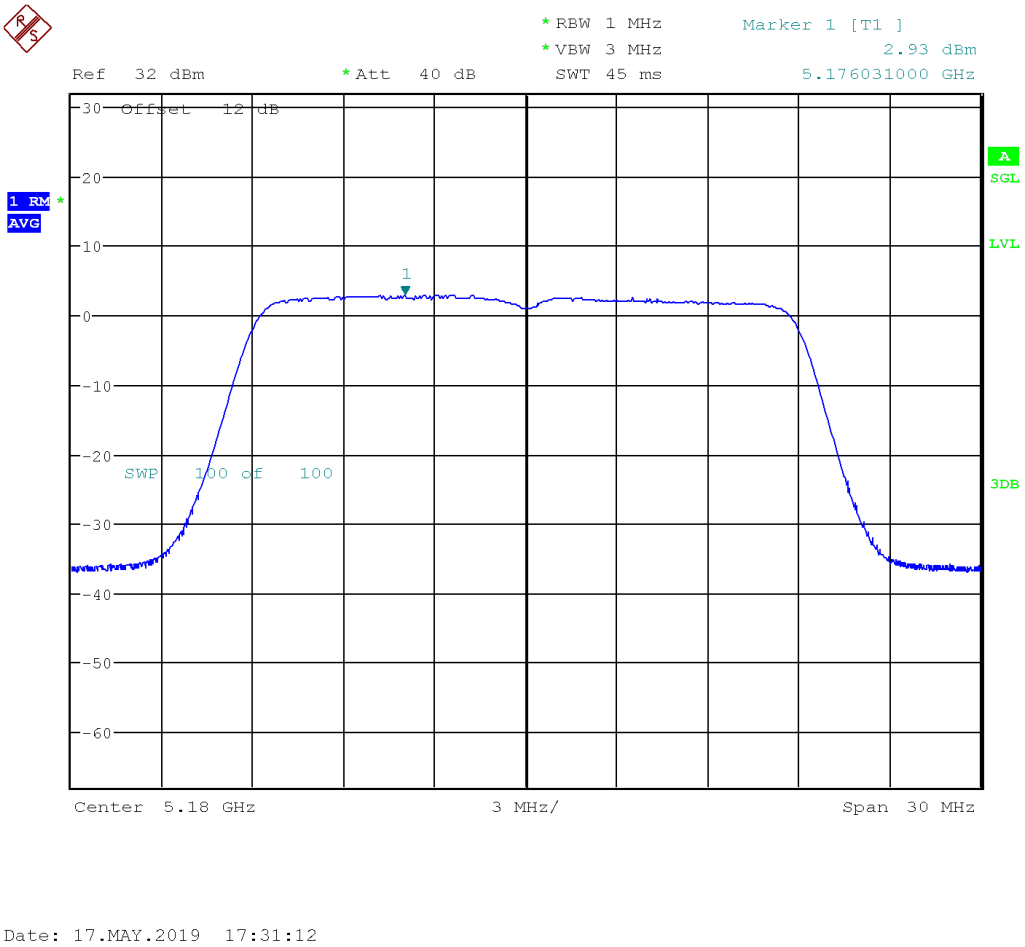


Figure 82: Power Spectral Density, Channel 36 802.11n HT20 6.5 Mbps, Chain 0

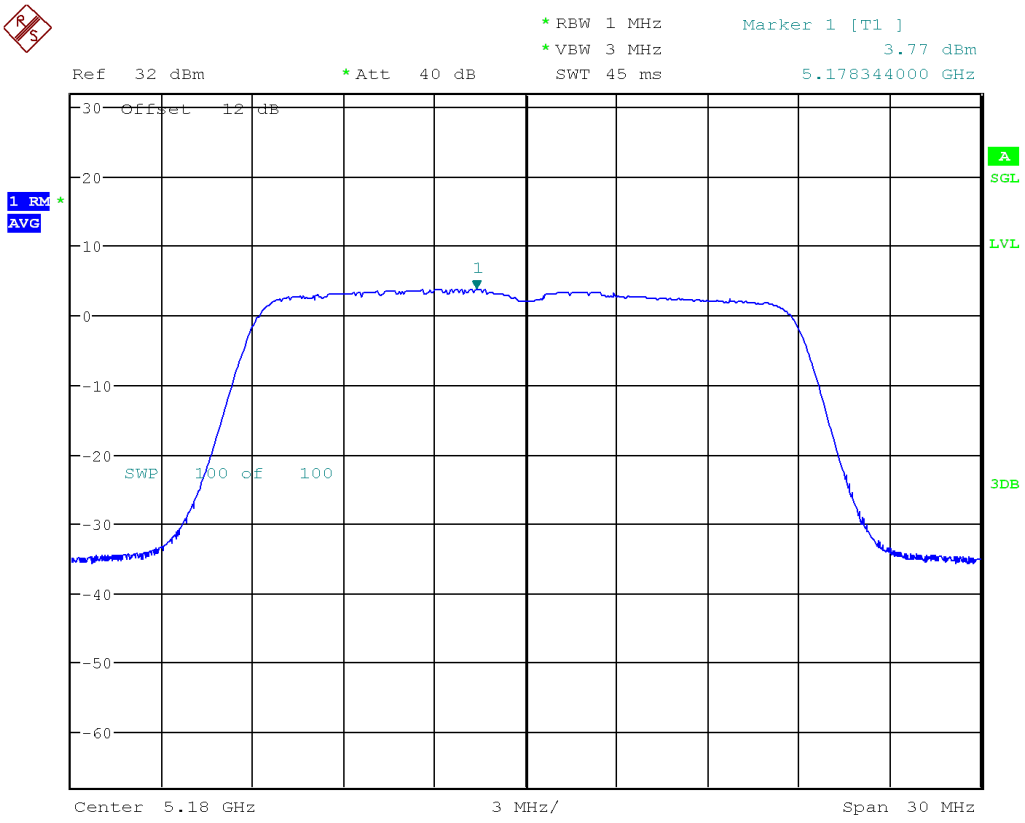


Figure 83: Power Spectral Density, Channel 36 802.11n HT20 6.5 Mbps, Chain 1

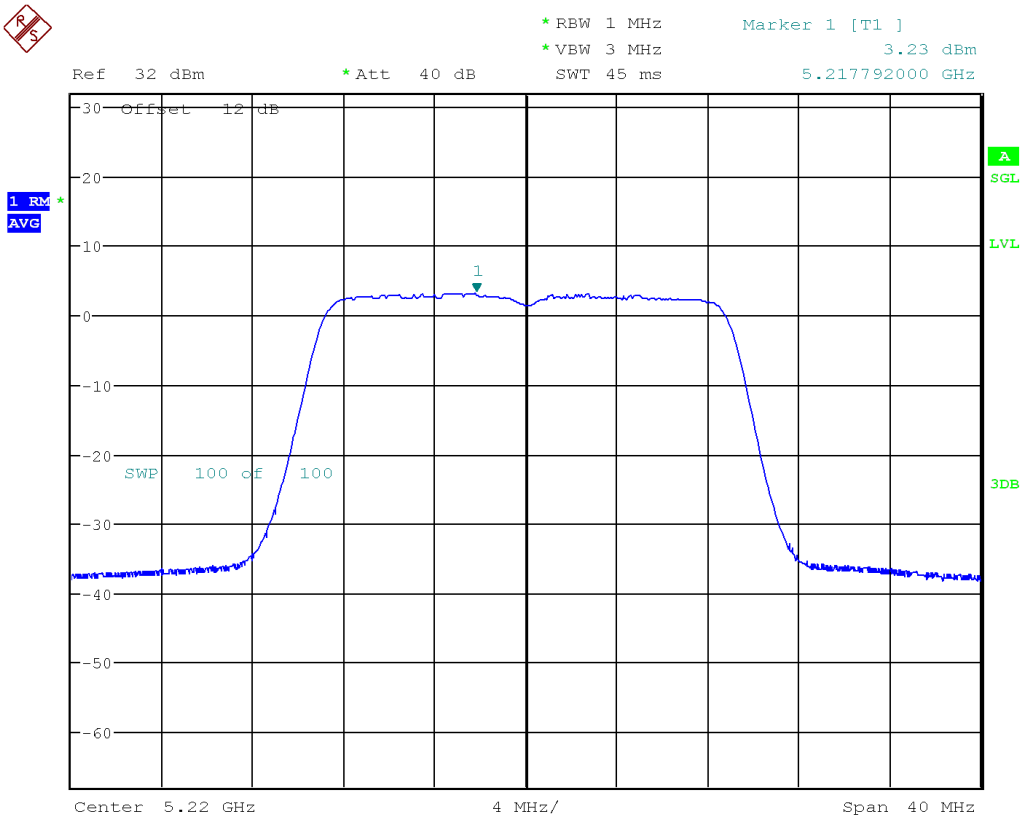


Figure 84: Power Spectral Density, Channel 44 802.11n HT20 6.5 Mbps, Chain 0

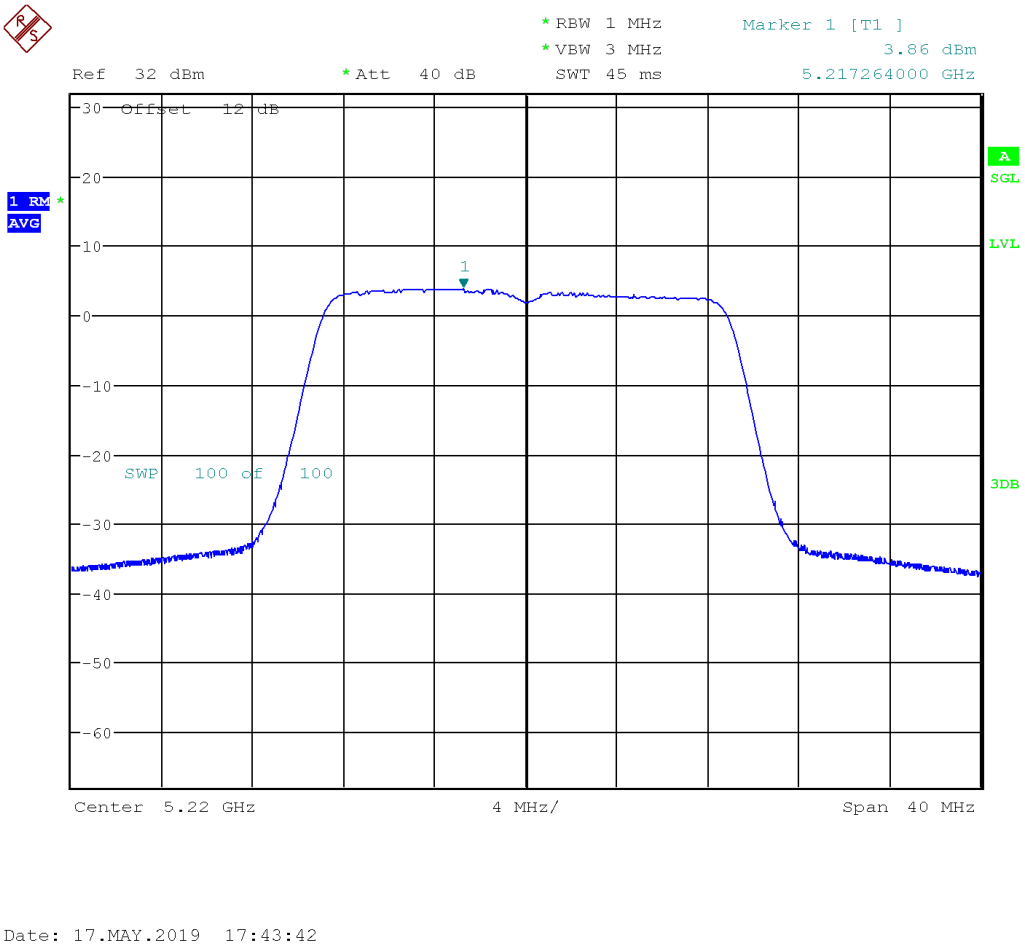


Figure 85: Power Spectral Density, Channel 44 802.11n HT20 6.5 Mbps, Chain 1

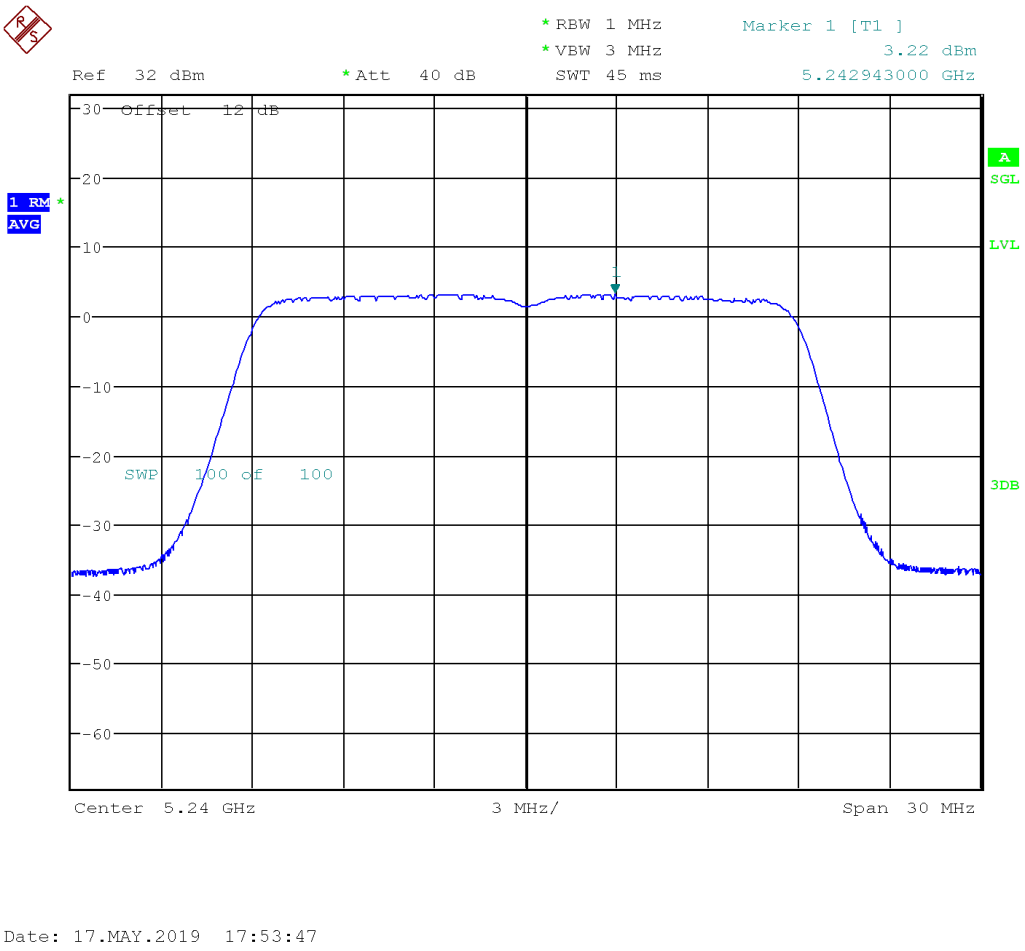


Figure 86: Power Spectral Density, Channel 48 802.11n HT20 6.5 Mbps, Chain 0

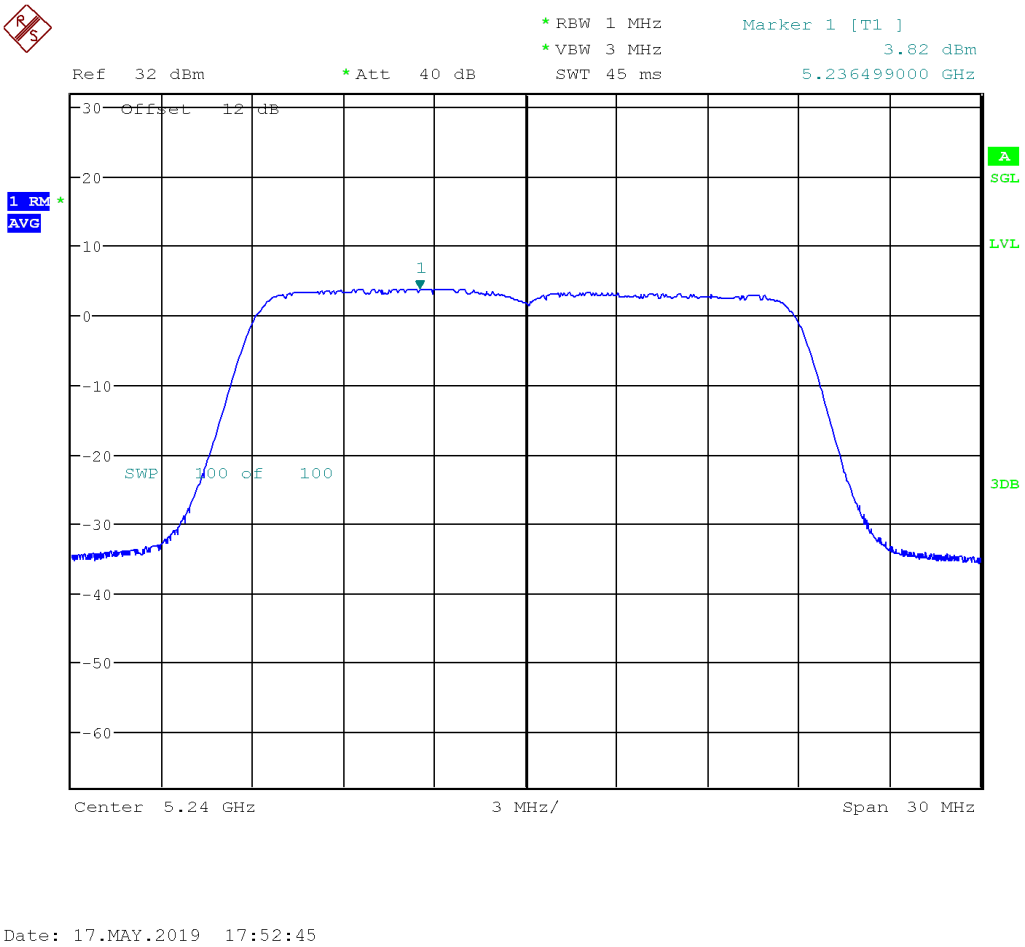


Figure 87: Power Spectral Density, Channel 48 802.11n HT20 6.5 Mbps, Chain 1

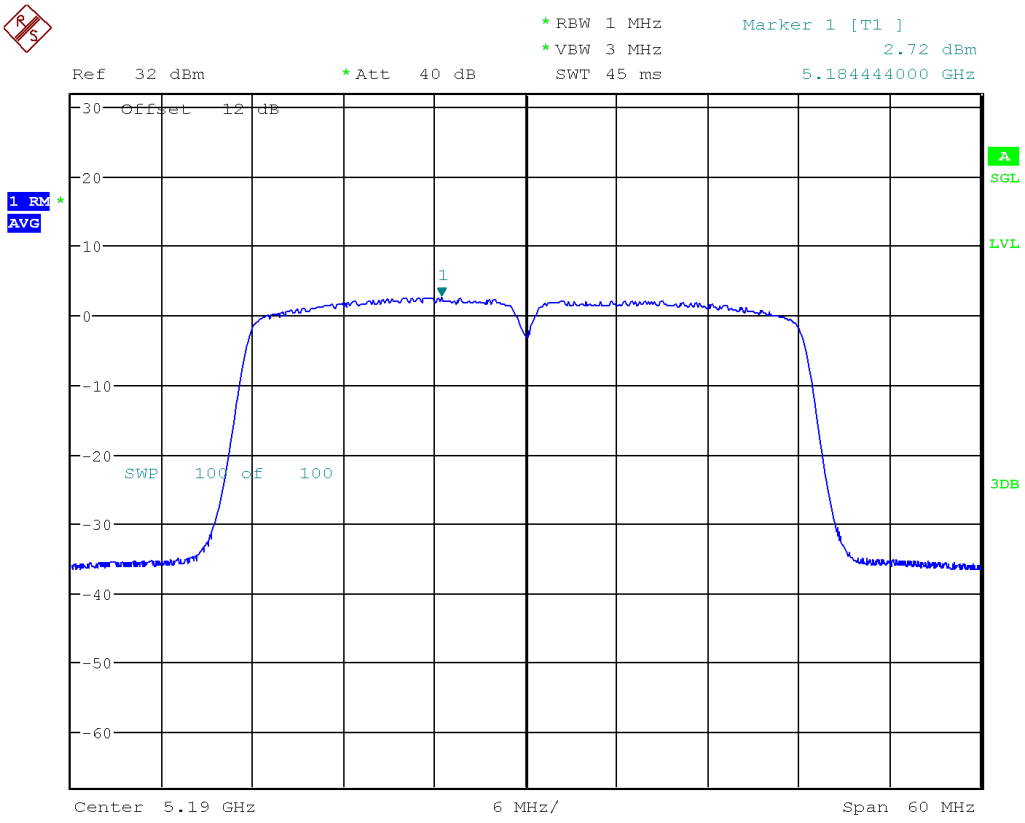


Figure 88: Power Spectral Density, Channel 38 802.11n HT40+ MCS0, Chain 0

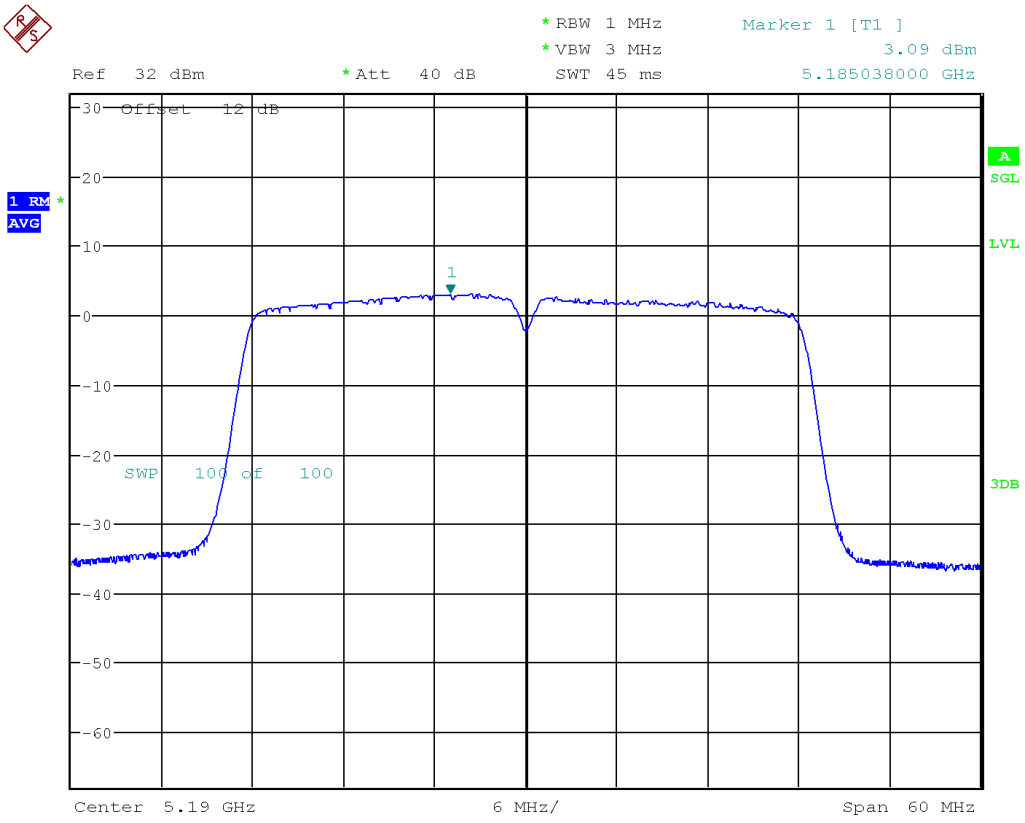


Figure 89: Power Spectral Density, Channel 38 802.11n HT40+ MCS0, Chain 1

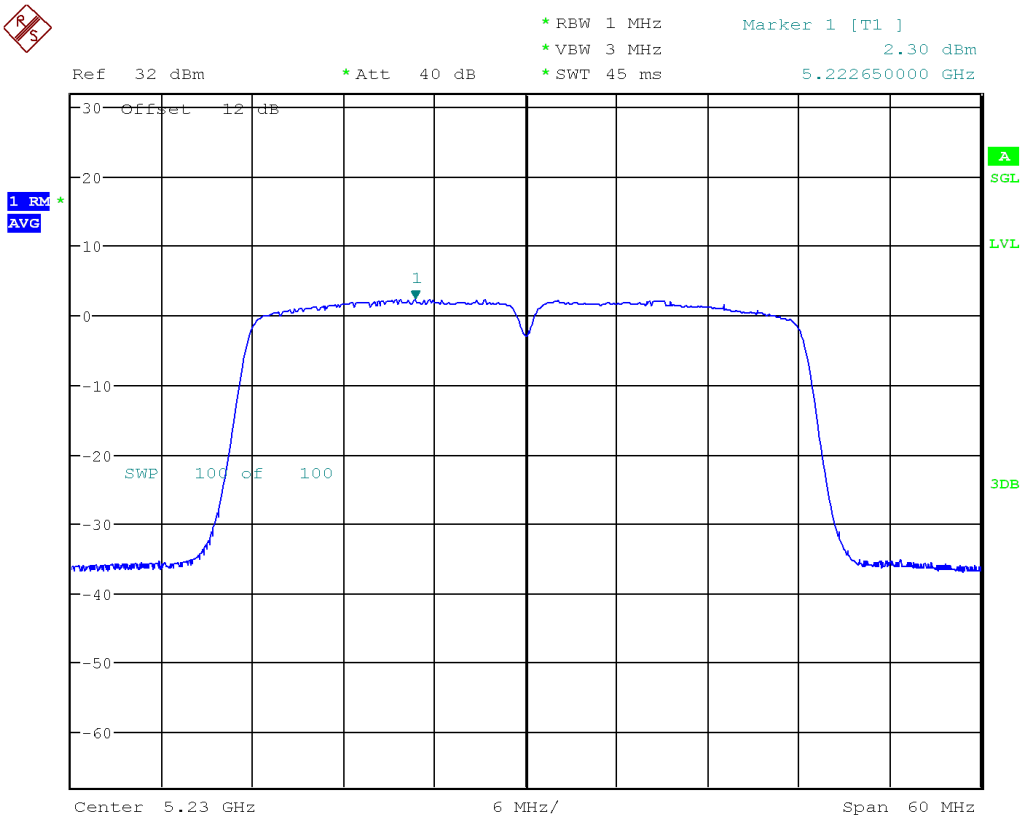


Figure 90: Power Spectral Density, Channel 46 802.11n HT40+ MCS0, Chain 0

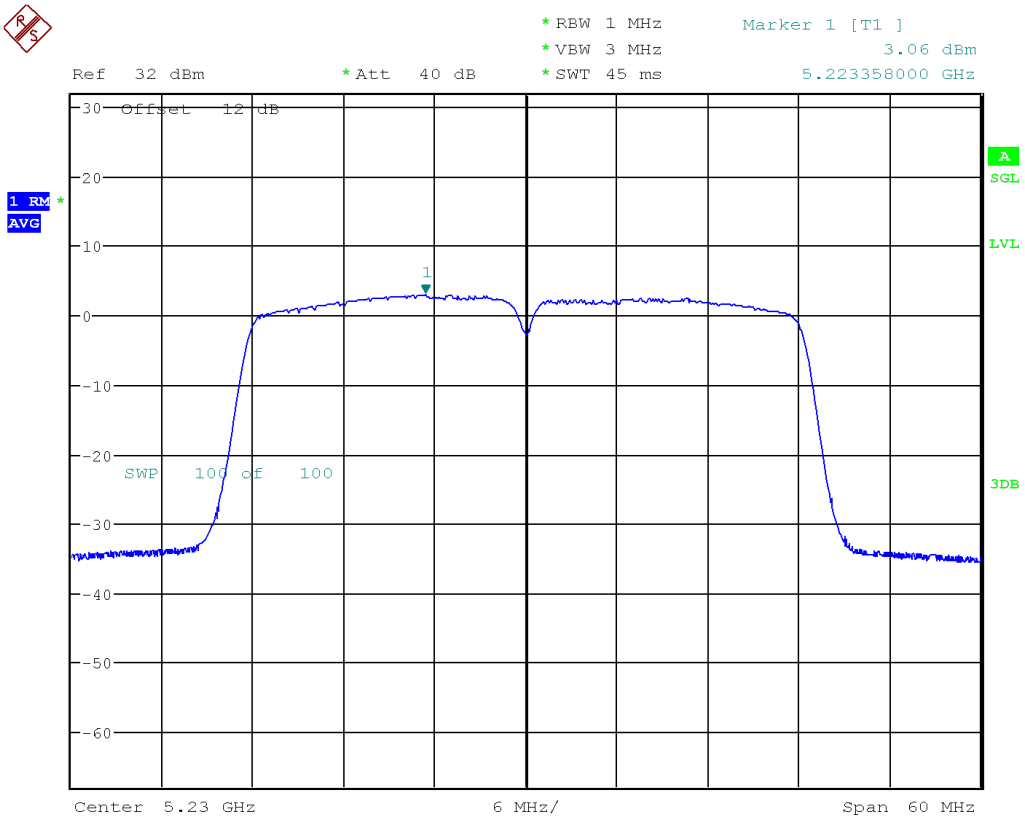


Figure 91: Power Spectral Density, Channel 46 802.11n HT40+ MCS0, Chain 1

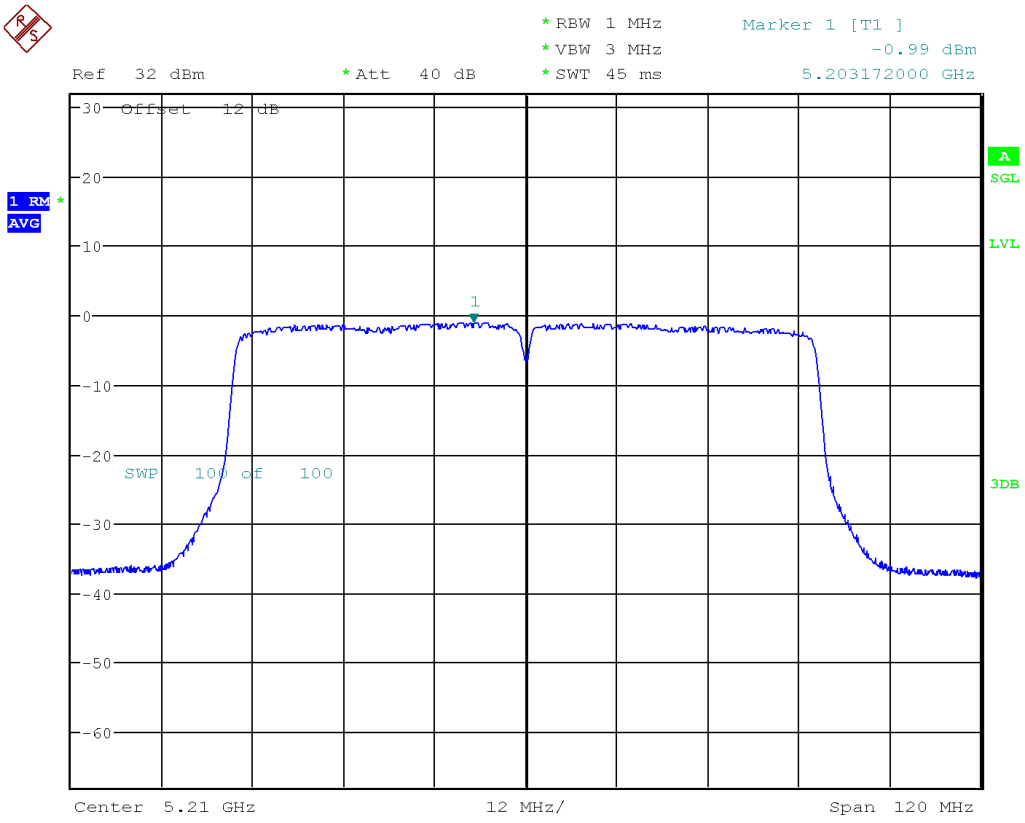


Figure 92: Power Spectral Density, Channel 42 802.11ac VHT80 MCS0, Chain 0

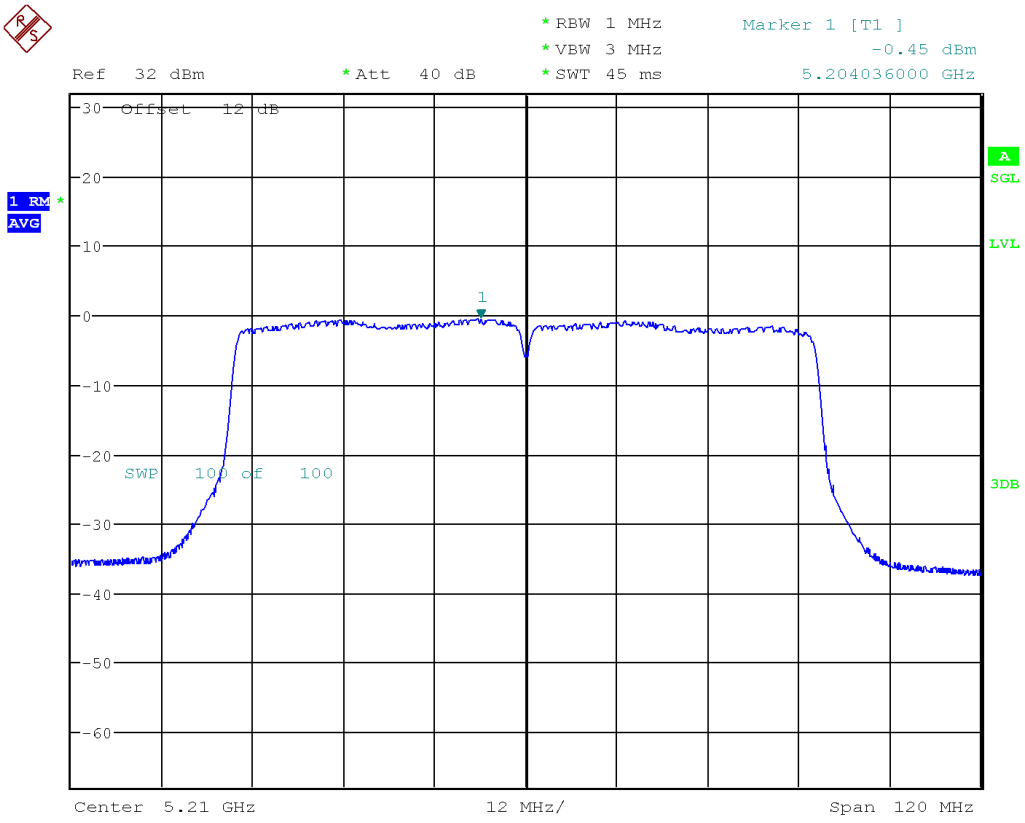


Figure 93: Power Spectral Density, Channel 42 802.11ac VHT80 MCS0, Chain 1

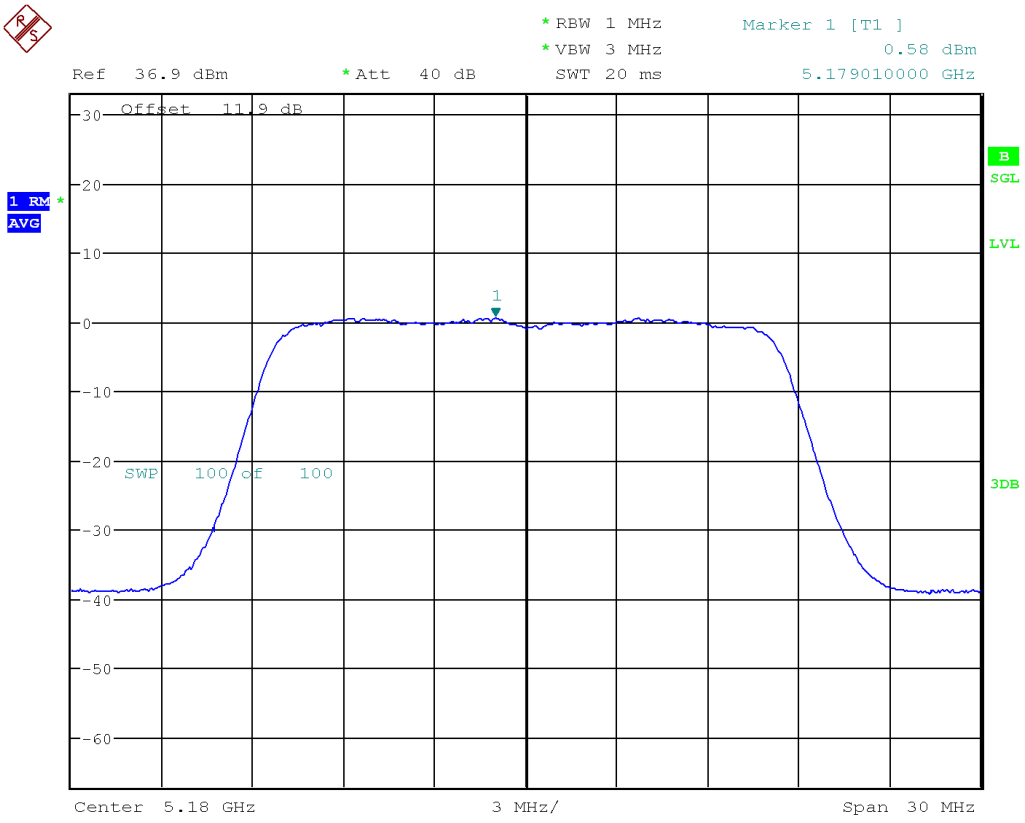


Figure 94: Power Spectral Density Beamforming, Channel 36 802.11a NoHT 6 Mbps, Chain 0

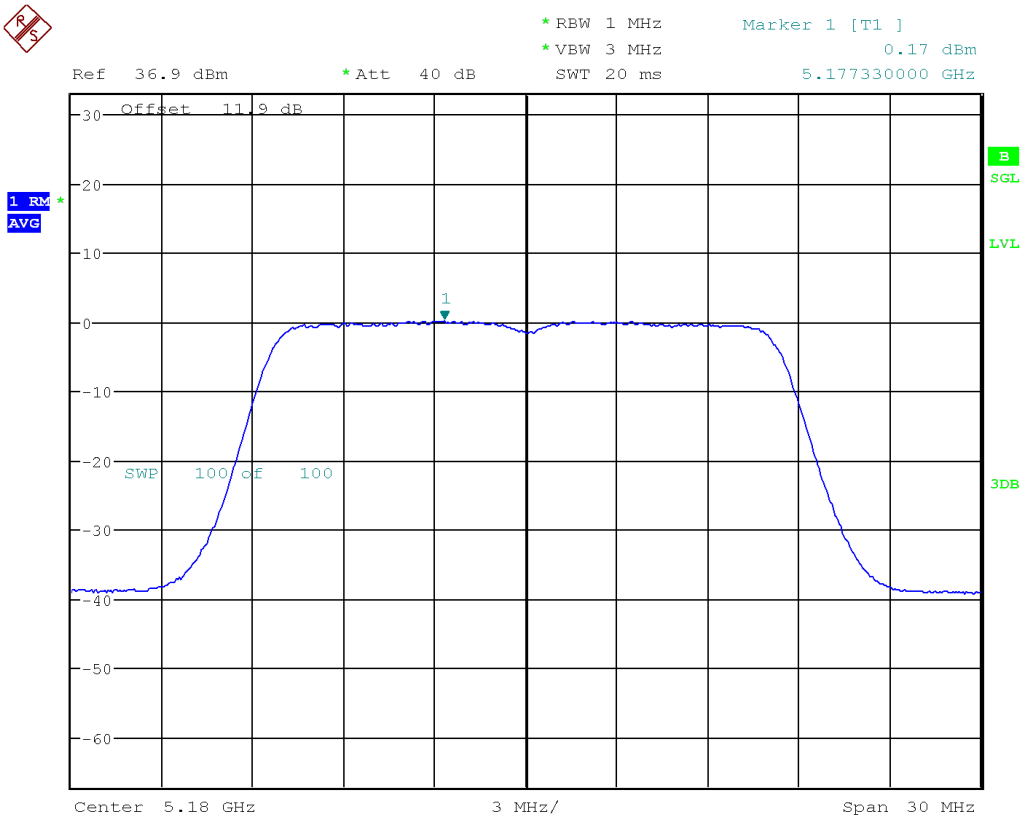


Figure 95: Power Spectral Density Beamforming, Channel 36 802.11a NoHT 6 Mbps, Chain 1

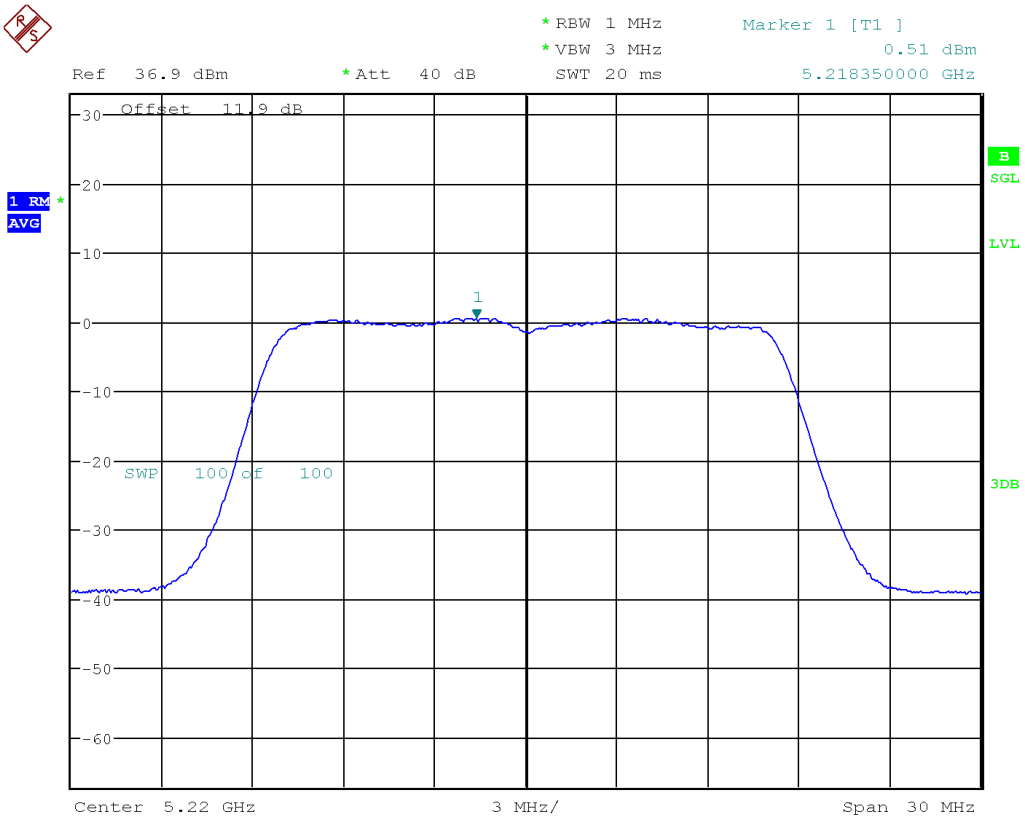


Figure 96: Power Spectral Density Beamforming, Channel 44 802.11a NoHT 6 Mbps, Chain 0

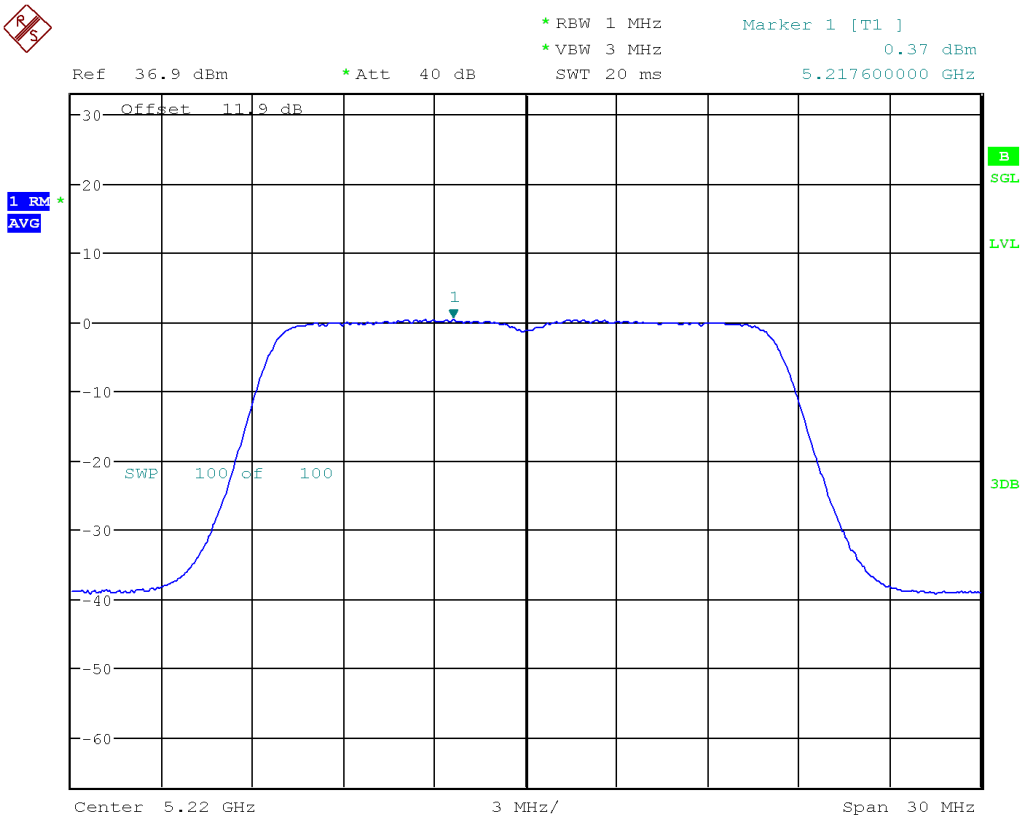


Figure 97: Power Spectral Density Beamforming, Channel 44 802.11a NoHT 6 Mbps, Chain 1

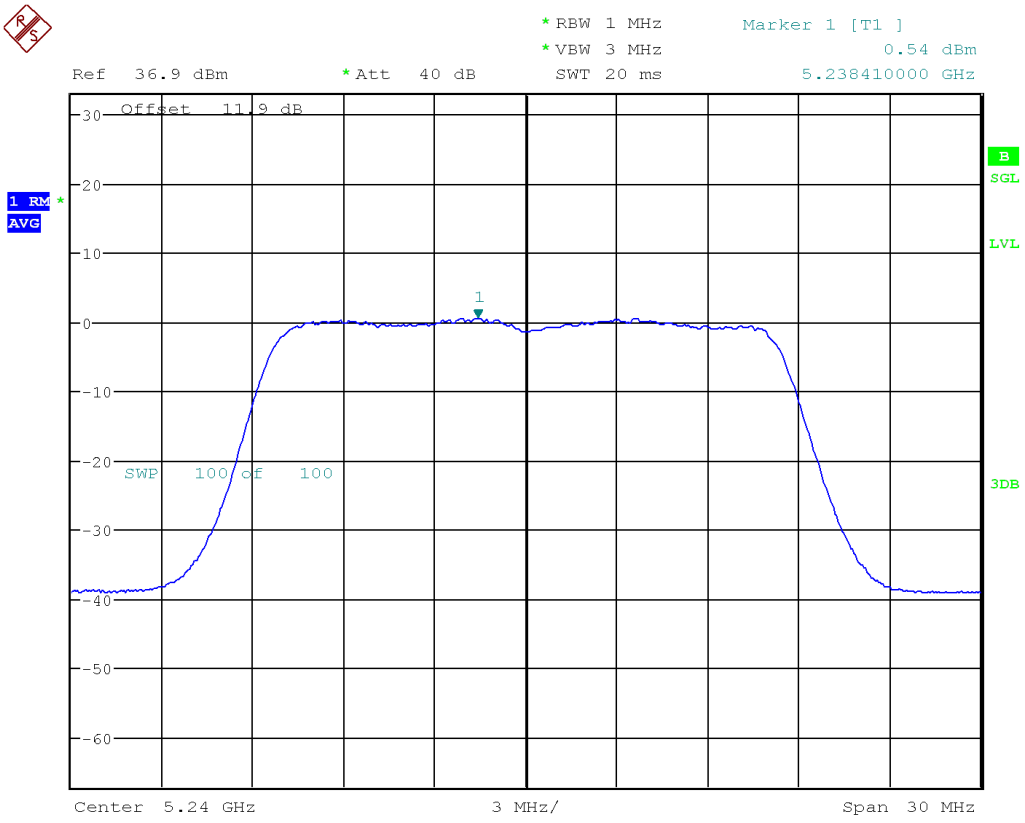


Figure 98: Power Spectral Density Beamforming, Channel 48 802.11a NoHT 6 Mbps, Chain 0

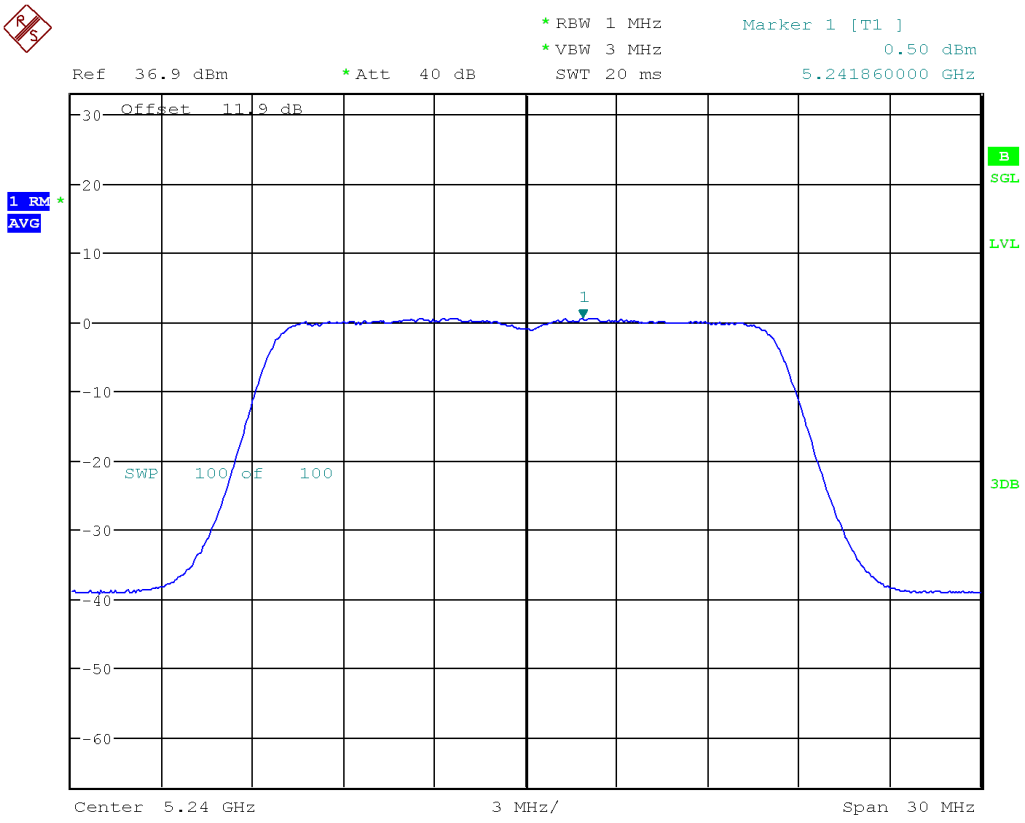


Figure 99: Power Spectral Density Beamforming, Channel 48 802.11a NoHT 6 Mbps, Chain 1

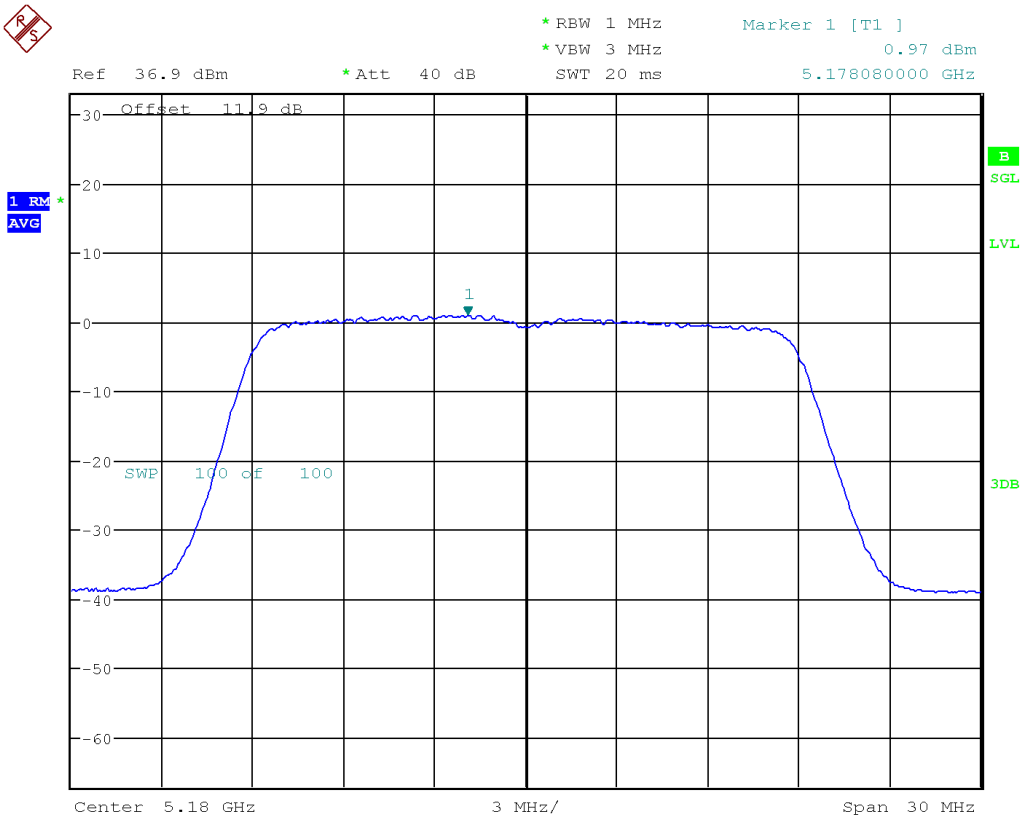


Figure 100: Power Spectral Density Beamforming, Channel 36 802.11n HT20 6.5 Mbps, Chain 0

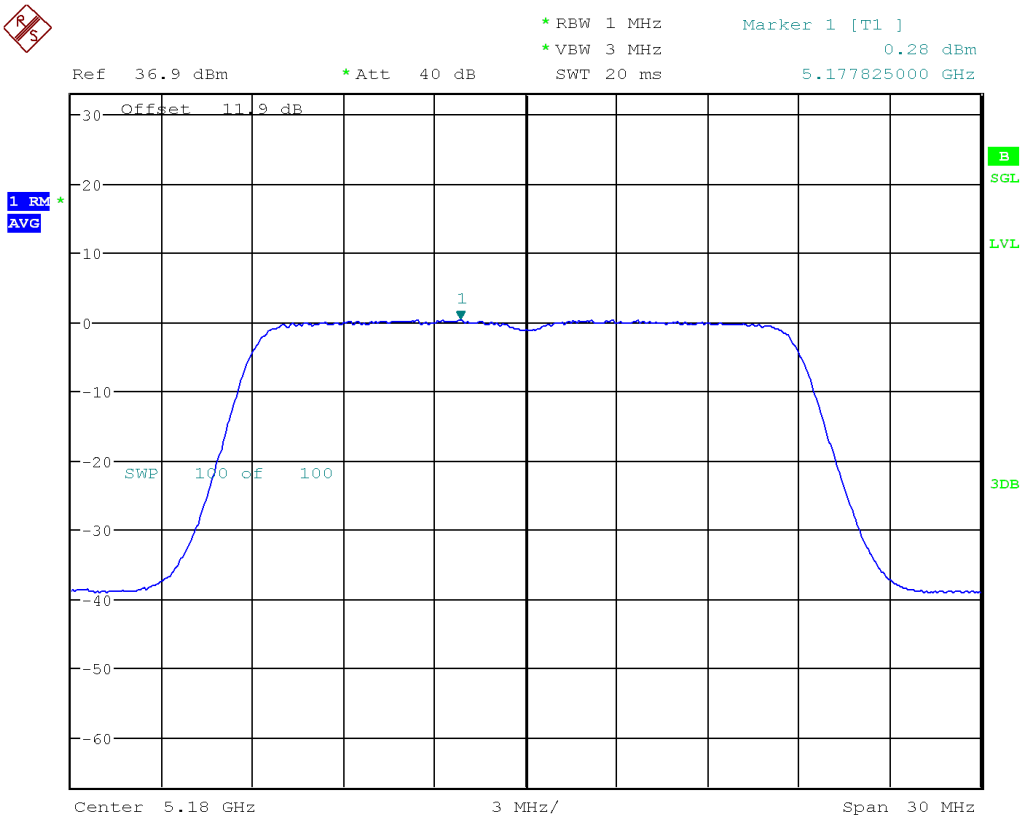


Figure 101: Power Spectral Density Beamforming, Channel 36 802.11n HT20 6.5 Mbps, Chain 1

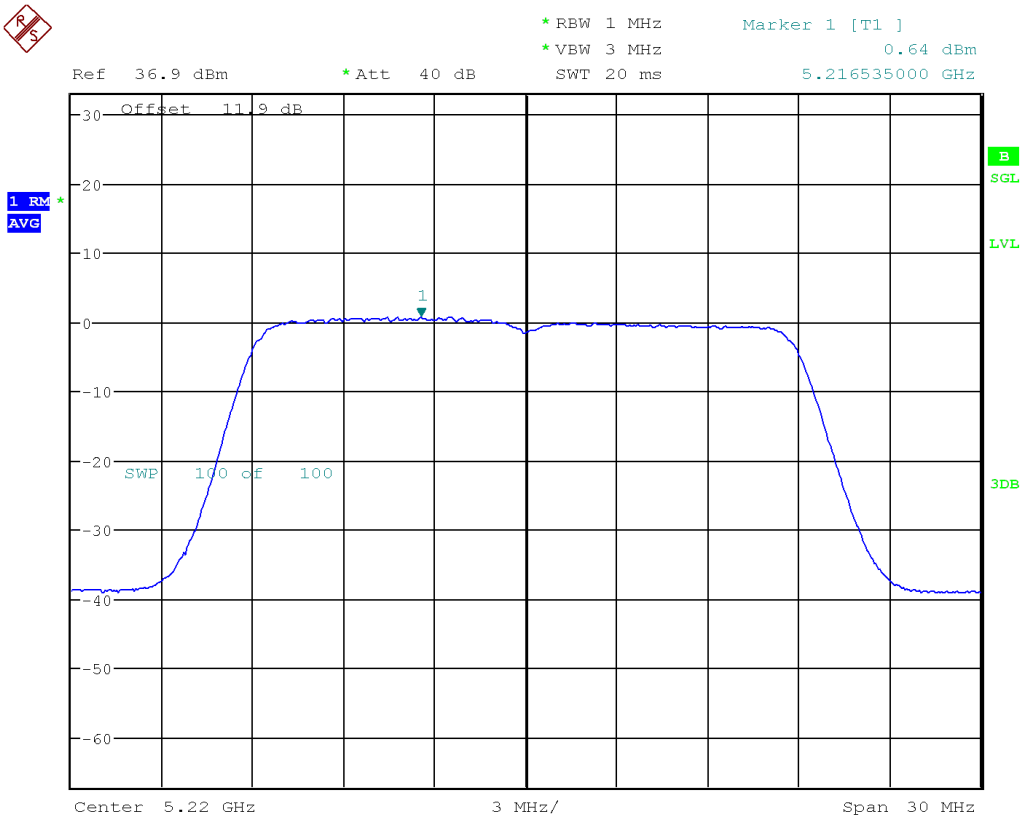


Figure 102: Power Spectral Density Beamforming, Channel 44 802.11n HT20 6.5 Mbps, Chain 0

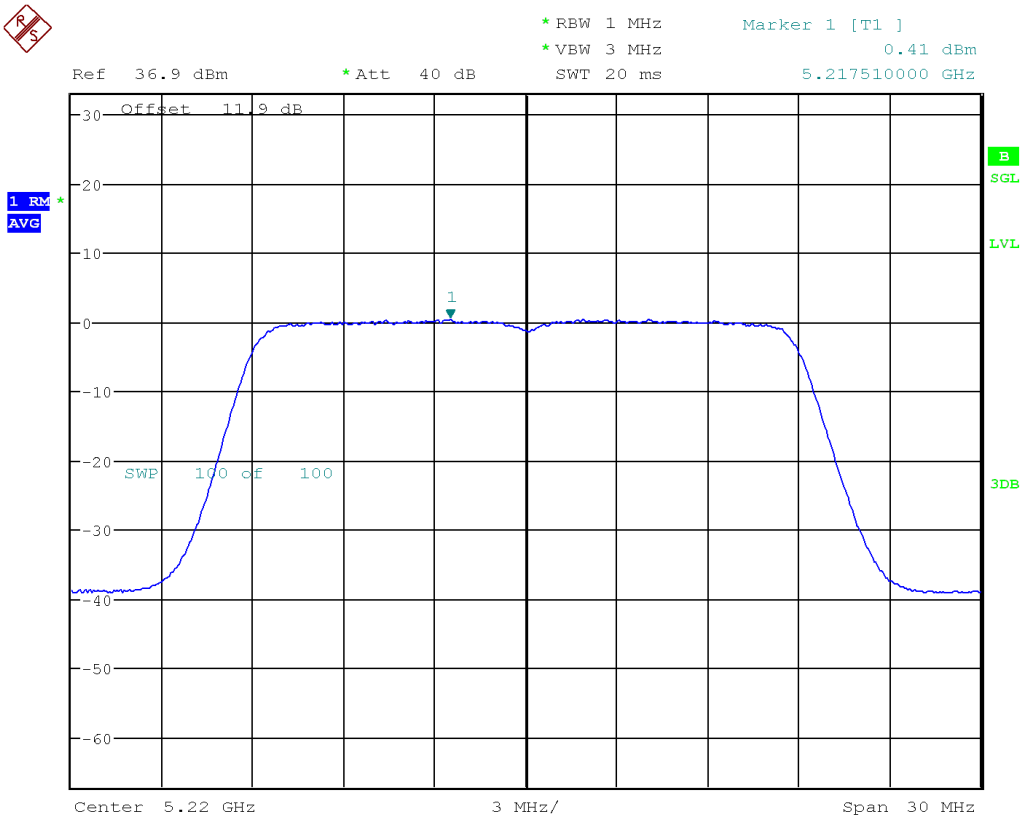


Figure 103: Power Spectral Density Beamforming, Channel 44 802.11n HT20 6.5 Mbps, Chain 1

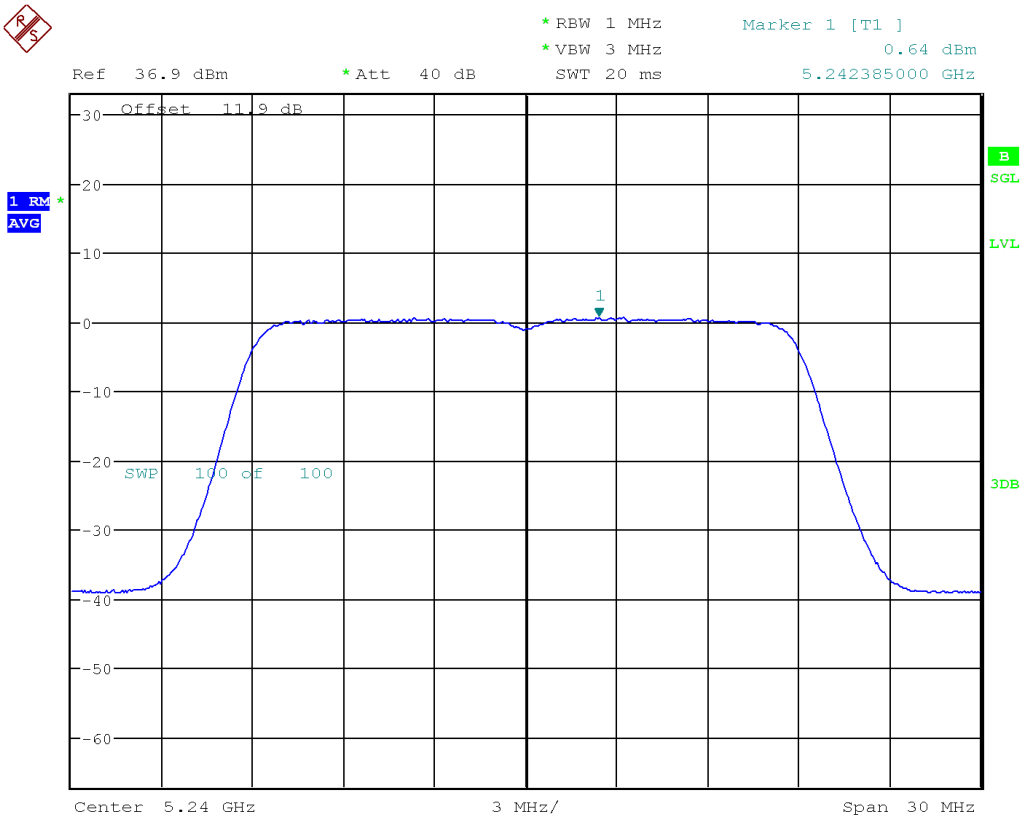


Figure 104: Power Spectral Density Beamforming, Channel 48 802.11n HT20 6.5 Mbps, Chain 0

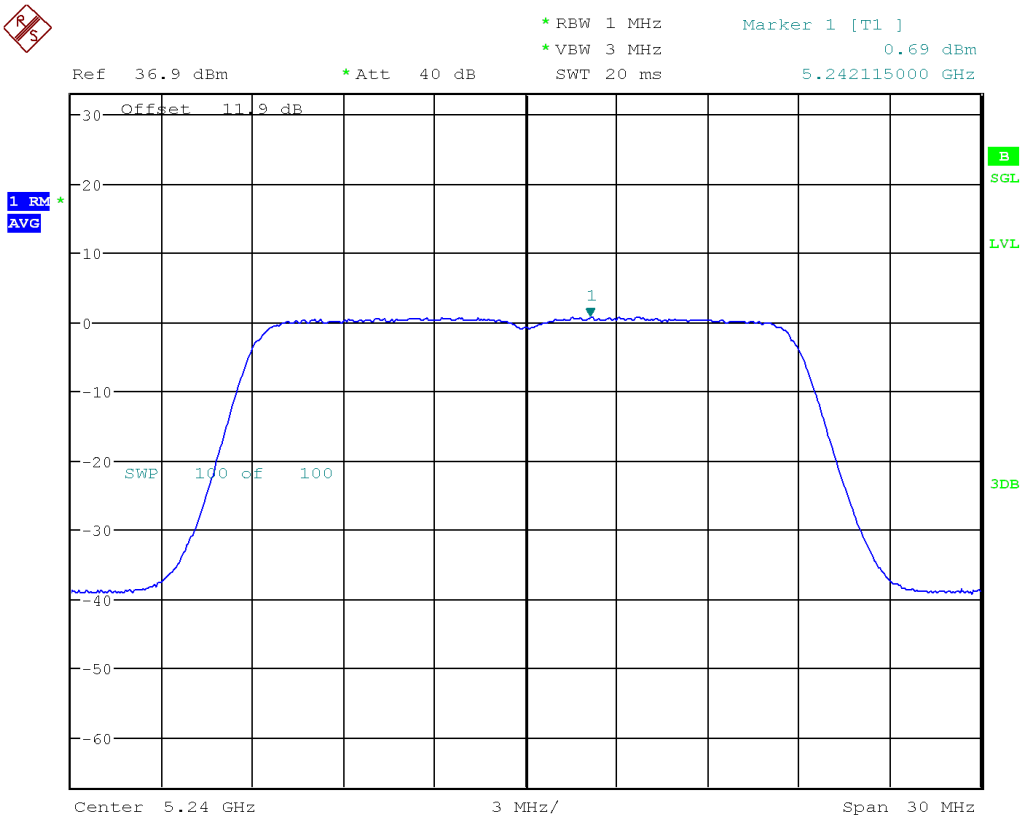


Figure 105: Power Spectral Density Beamforming, Channel 48 802.11n HT20 6.5 Mbps, Chain 1

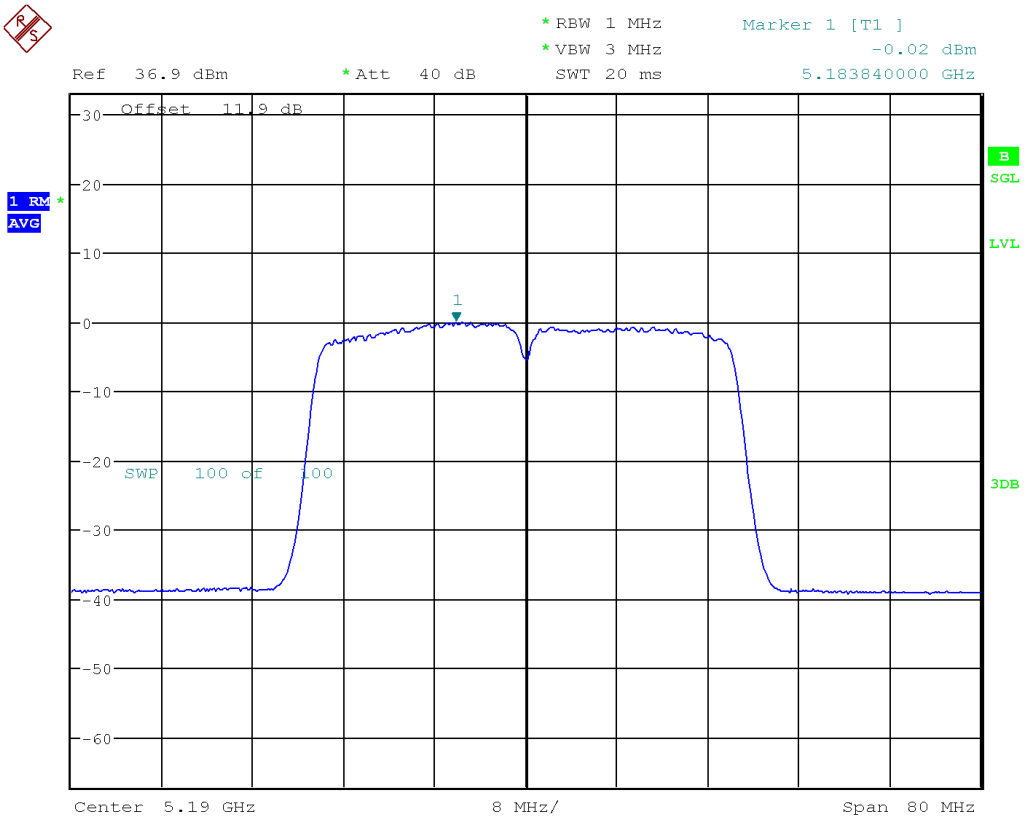


Figure 106: Power Spectral Density Beamforming, Channel 38 802.11n HT40+ MCS0, Chain 0

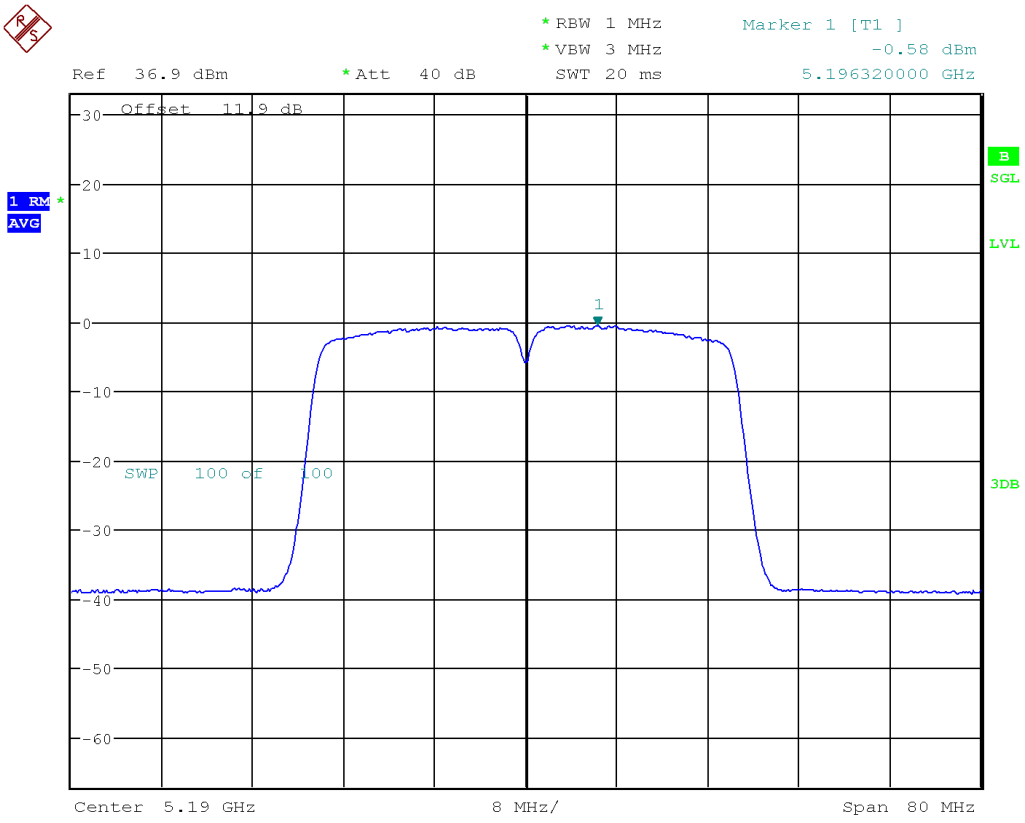


Figure 107: Power Spectral Density Beamforming, Channel 38 802.11n HT40+ MCS0, Chain 1

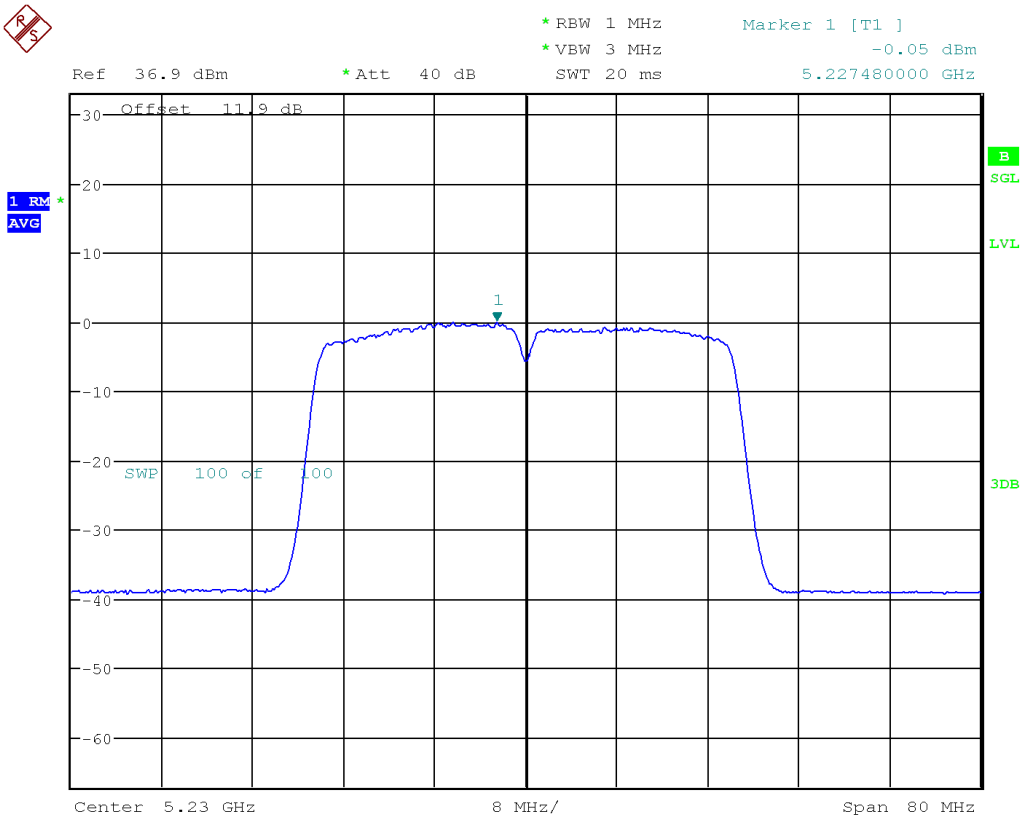


Figure 108: Power Spectral Density Beamforming, Channel 46 802.11n HT40+ MCS0, Chain 0

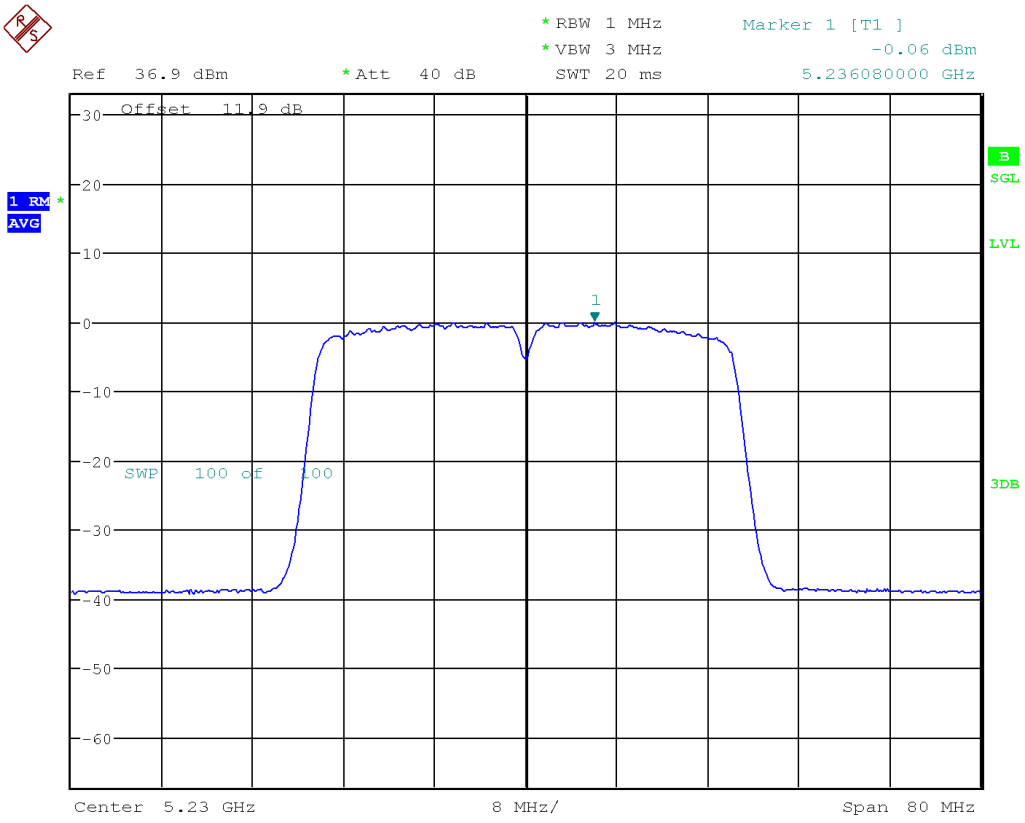


Figure 109: Power Spectral Density Beamforming, Channel 46 802.11n HT40+ MCS0, Chain 1

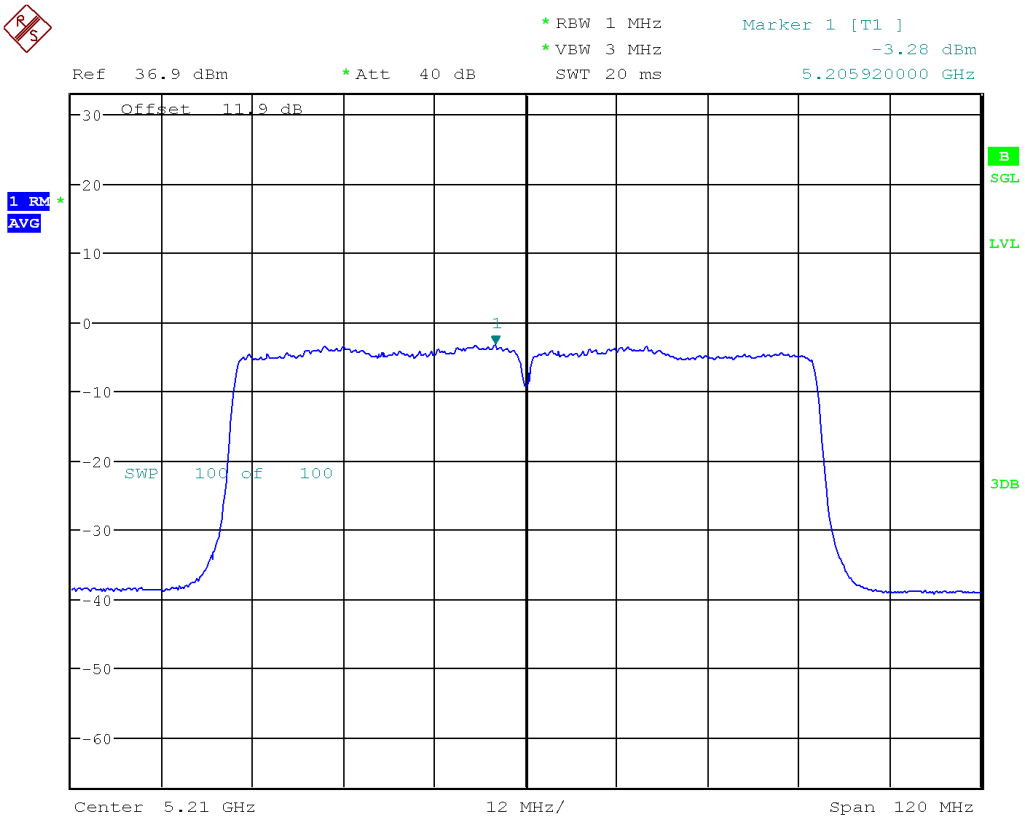


Figure 110: Power Spectral Density Beamforming, Channel 42 802.11ac VHT80 MCS0, Chain 0

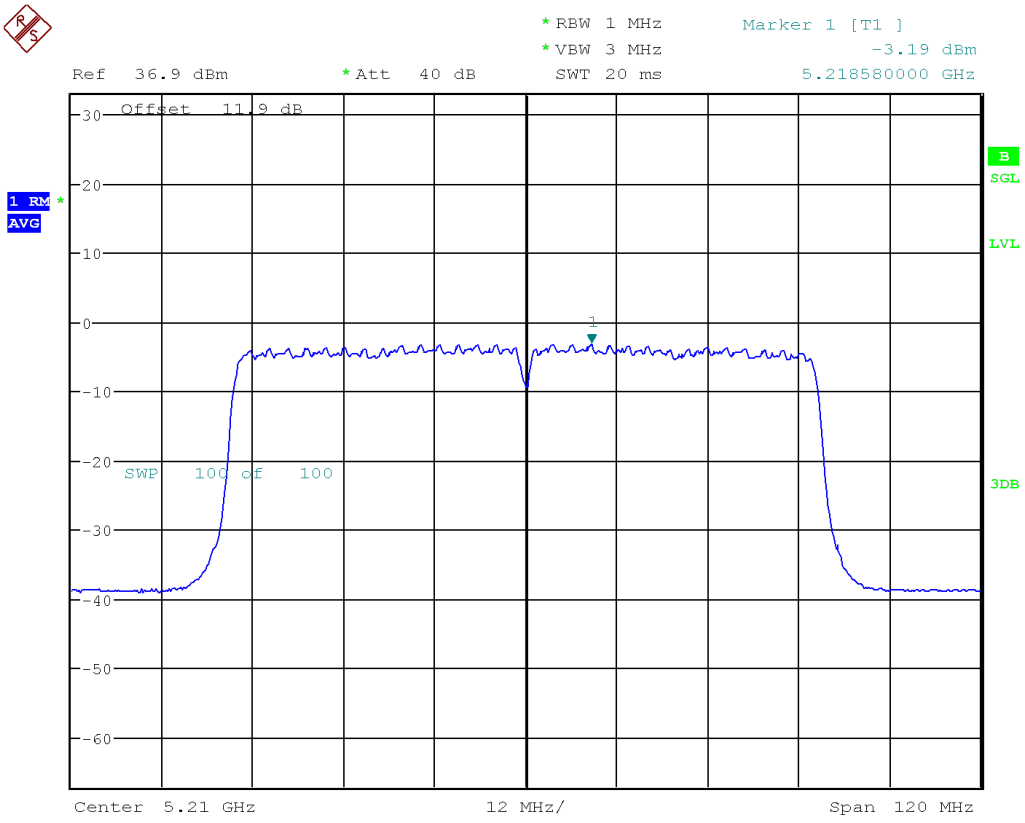


Figure 111: Power Spectral Density Beamforming, Channel 42 802.11ac VHT80 MCS0, Chain 1

3.4 Out of Band Emissions: UNII-1 Restricted Band Edge

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.407, RSS-247 Sect. 6.2, RSS-GEN Sect. 8.9 and 8.10.

3.4.1 Limit(s)

§15.205(a) Restricted Bandedge at 4.5-5.15GHz:

Peak Detector Limit: 74 dBuV/m
Average Detector Limit: 54 dBuV/m

3.4.2 Test Method

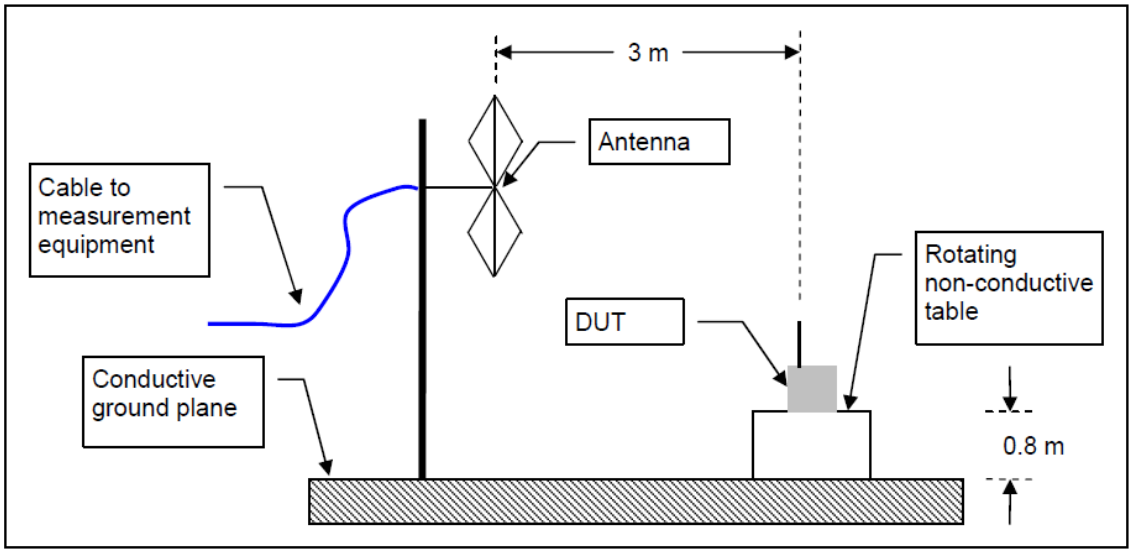
Radiated measurements per ANSI C63.10-2013 Section 6.10.5 were used to measure the undesirable emission requirement in restricted bands. The measurement was performed with modulation. This test was conducted on 3 channels, where applicable, in each mode on the EUT. The power settings used are in section 4.1.4.1 of this report.

3.4.3 Test Setup

Spectrum Analyzer Settings:

	Peak Measurement	Average Measurement
Detector	Peak	Peak
Trace	Max Hold	Max Hold
RBW	1 MHz	1 MHz
VBW	3 MHz	10 Hz
Sweep Points	501	501
Sweep Time	Coupled	Coupled
Span	See Plots	See Plots, (Maximum of RBW/2 per sweep point)

The Average Measurement is corrected with a Duty Cycle Correction Factor.



The DUT was stimulated by manufacturer provided test software that is not available to the end user.

3.4.4 Test Results

Table 8: Emissions at the UNII-1 Low Band-Edge – Test Results

Test Conditions: Radiated Measurement, Normal Temperature and Voltage	
Antenna Type: Flex PCB dipole	**Power Setting:** See Section 3.1.4
Antenna Gain: Not Applicable	
Signal State: Continuous TX	
Ambient Temp.: 22° C	**Relative Humidity:**38%

Freq. (MHz)	Mode	Channel	Detector (Average/ Peak)	Measured (dBuV/m)	Limit (dBuV/m)	Margin	Results
5149.6951	802.11a (No HT) 6Mbps	36	Peak	67.21	68.23	-1.02	Pass
5149.6951	802.11a (No HT) 6Mbps	36	Average	53.89	54	-0.11	Pass
5144.7875	802.11a (No HT) 6Mbps	36	Peak	60.56	68.23	-7.67	Pass
5144.7875	802.11a (No HT) 6Mbps	36	Average	46.3	54	-7.7	Pass
5149.971	802.11n (HT20) 6.5Mbps	36	Peak	65.77	68.23	-2.46	Pass
5149.971	802.11n (HT20) 6.5Mbps	36	Average	53.09	54	-0.91	Pass
5139.838	802.11n (HT20) 6.5Mbps	36	Peak	65.82	68.23	-2.41	Pass
5139.838	802.11n (HT20) 6.5Mbps	36	Average	52.62	54	-1.38	Pass

Freq. (MHz)	Mode	Channel	Detector (Average/ Peak)	Measured (dBuV/m)	Limit (dBuV/m)	Margin	Results
5129.029	802.11n HT40 MCS0	36	Peak	57.75	68.23	-10.48	Pass
5129.029	802.11n HT40 MCS0	36	Average	45.5	54	-8.5	Pass
5148.471	802.11n HT40 MCS0	36	Peak	64.16	68.23	-4.07	Pass
5148.471	802.11n HT40 MCS0	36	Average	52.65	54	-1.35	Pass
5128.436	802.11ac VHT80 MCS0	36	Peak	61.2	68.23	-7.03	Pass
5128.436	802.11ac VHT80 MCS0	36	Average	51.14	54	-2.86	Pass
5147.888	802.11ac VHT80 MCS0	36	Peak	63.67	68.23	-4.56	Pass
5147.888	802.11ac VHT80 MCS0	36	Average	53.6	54	-0.4	Pass

3.4.4.1 Plots: UNII-1 Low Band Edge

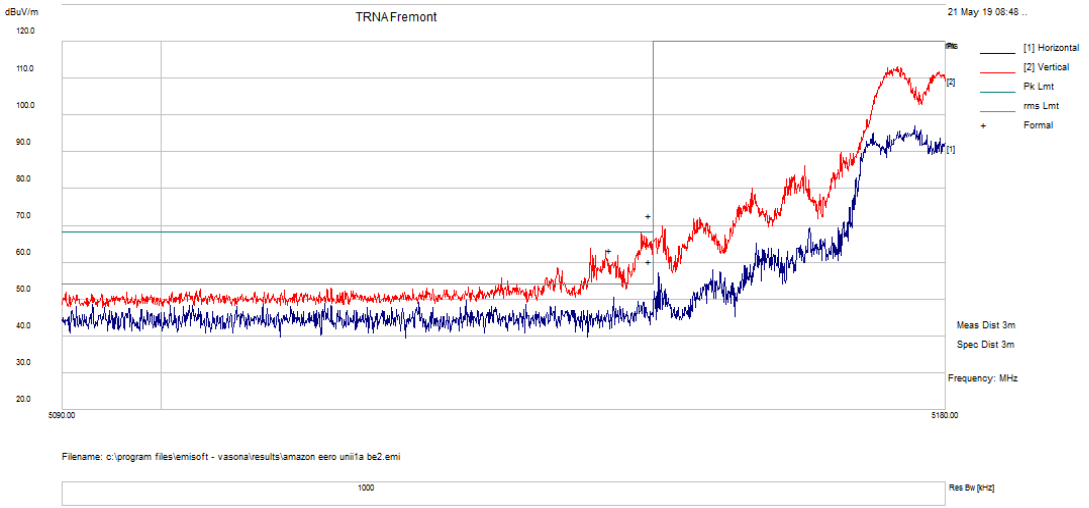


Figure 112: UNII-1 Low Band Edge for 802.11a No HT 6Mbps at 5180 MHz-peak

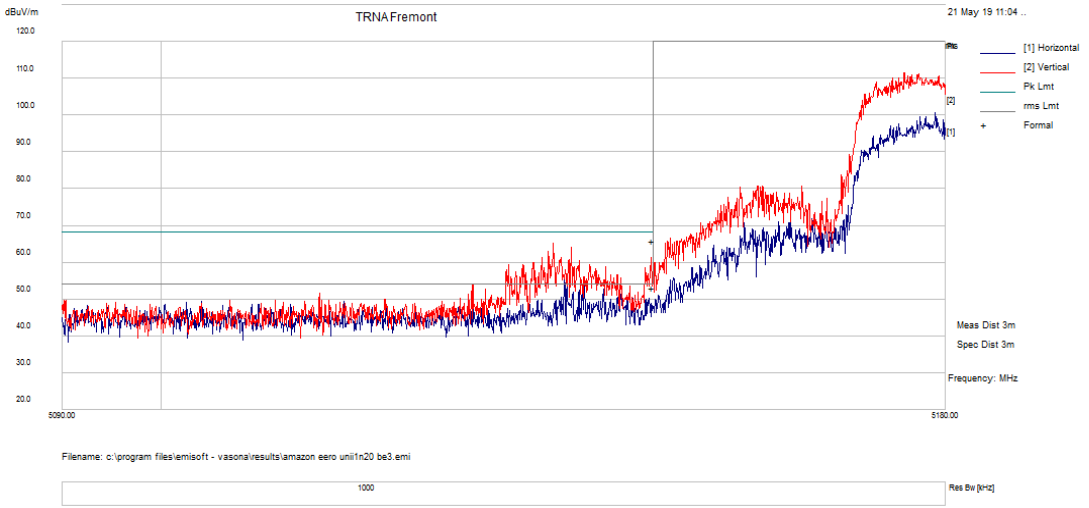


Figure 113: UNII-1 Low Band Edge for 802.11n HT20 6.5Mbps at 5180 MHz-peak

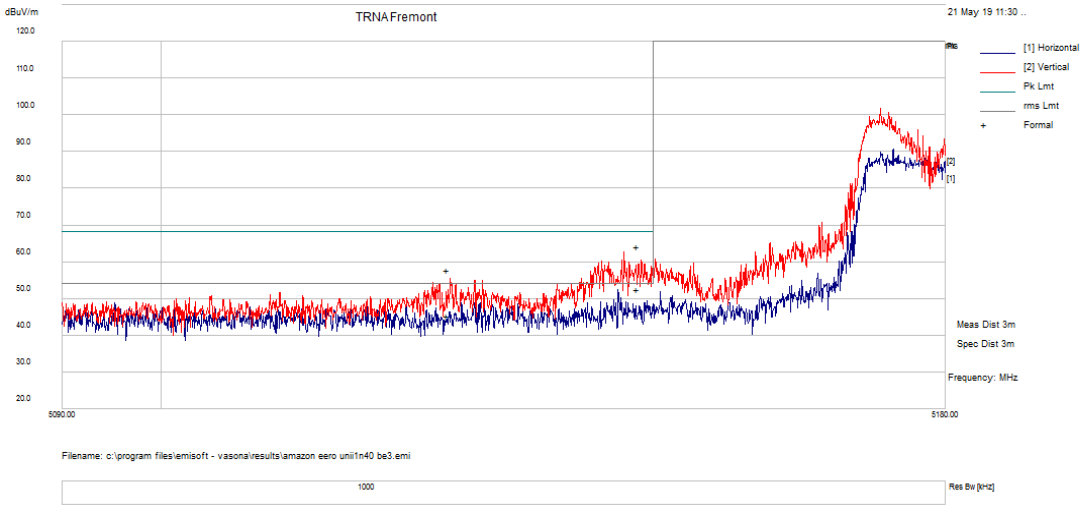


Figure 114: UNII-1 Low Band Edge for 802.11n HT40 MCS0 at 5190 MHz-Peak

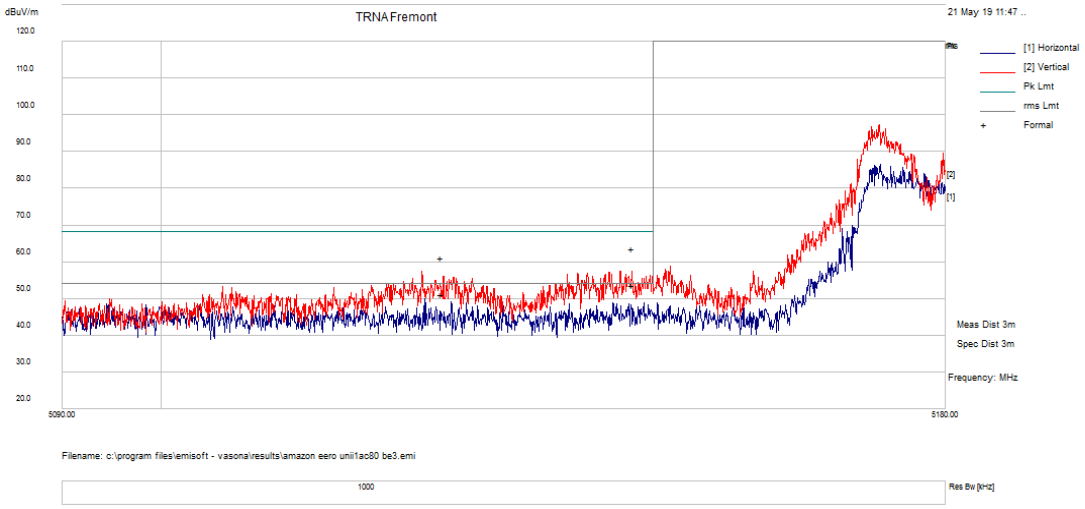


Figure 115: UNII-1 Low Band Edge for 802.11ac VHT80 MCS0 at 5210 MHz-Peak

3.5 Out of Band Emissions: UNII-3 Unrestricted Band Edge

3.5.1 Limit(s)

CFR47 15.407 (b)(4)(i) and RSS 247 Sect.6.2.1.2: The maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

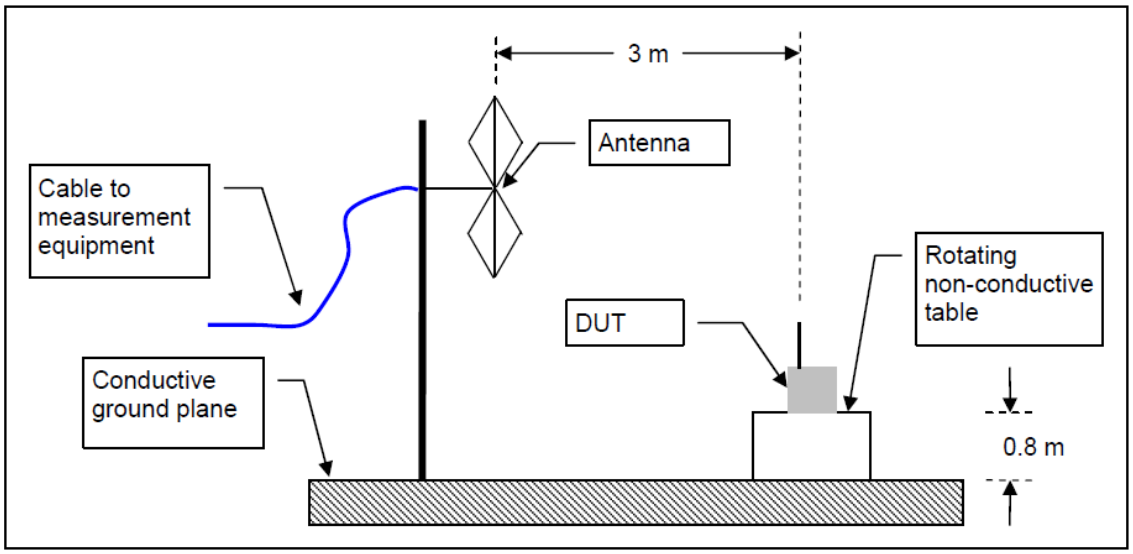
3.5.2 Test Method

Radiated measurements per ANSI C63.10-2013 Section 12.7.7.3 were used to measure the undesirable emission requirement in restricted bands. The measurement was performed with modulation. This test was conducted on the low channel for the low bandedge and the high channel for the high bandedge, in each applicable mode on the EUT. Preliminary tests were done to find the worse case modes (section 3.5.2 of this report). The power settings that were implemented are in section 4.1.4.1 of this report.

3.5.3 Test Setup

Spectrum Analyzer Settings:

	Peak Measurement
Detector	Peak
Trace	Max Hold
RBW	1 MHz
VBW	3 MHz
Sweep Points	501
Sweep Time	Coupled
Span	See Plots



The DUT was stimulated by manufacturer provided test software that is not available to the end user.

3.5.4 Results

Freq. (MHz)	Mode	Channel	Detector (Average/ Peak)	Measured (dBuV/m)	Limit (dBuV/m)	Margin	Results
5680.95	802.11a (No HT) 6Mbps	149	Peak	69.84	91.17	-21.33	Pass
5660.475	802.11a (No HT) 6Mbps	149	Peak	53.65	76.01	-22.36	Pass
5931.43	802.11a (No HT) 6Mbps	165	Peak	54.57	68.23	-13.66	Pass
5896.64	802.11a (No HT) 6Mbps	165	Peak	70.28	88.76	-18.48	Pass
5673.25	802.11n (HT20) 6.5Mbps	149	Peak	66	85.48	-19.47	Pass
5715.25	802.11n (HT20) 6.5Mbps	149	Peak	84.82	109.5	-24.68	Pass
5910.73	802.11n (HT20) 6.5Mbps	165	Peak	62.63	80.07	-17.44	Pass
5934.16	802.11n (HT20) 6.5Mbps	165	Peak	51.6	68.23	-16.63	Pass

Freq. (MHz)	Mode	Channel	Detector (Average/ Peak)	Measured (dBuV/m)	Limit (dBuV/m)	Margin	Results
5640	802.11n HT40 MCS0	151	Peak	64.92	68.23	-3.31	Pass
5656.625	802.11n HT40 MCS0	151	Peak	71	73.15	-2.15	Pass
5941.1	802.11n HT40 MCS0	159	Peak	64.1	73.85	-6.95	Pass
5920.84	802.11n HT40 MCS0	159	Peak	66.9	73.85	-6.95	Pass
5642.1	802.11ac VHT80 MCS0	155	Peak	66.57	68.23	-1.66	Pass
5656.209	802.11ac VHT80 MCS0	155	Peak	69.39	72.84	-3.45	Pass
5935.313	802.11ac VHT80 MCS0	155	Peak	65.76	68.23	-2.47	Pass
5920.94	802.11ac VHT80 MCS0	155	Peak	70.17	73.79	-3.62	Pass

3.5.5 Measurement Plots

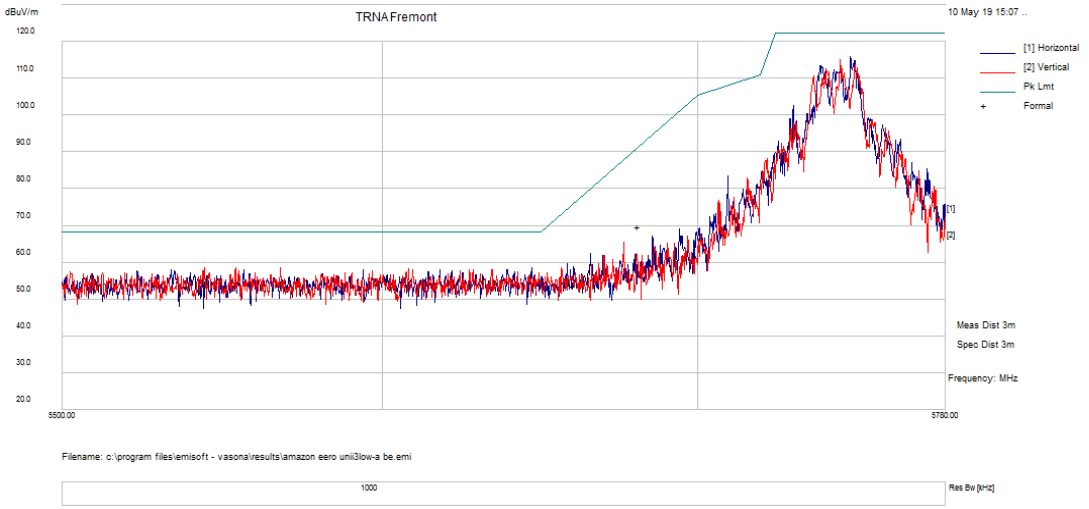


Figure 116: Low U-NII-3 band edge for 802.11a NoHT 6Mbps at Channel 149

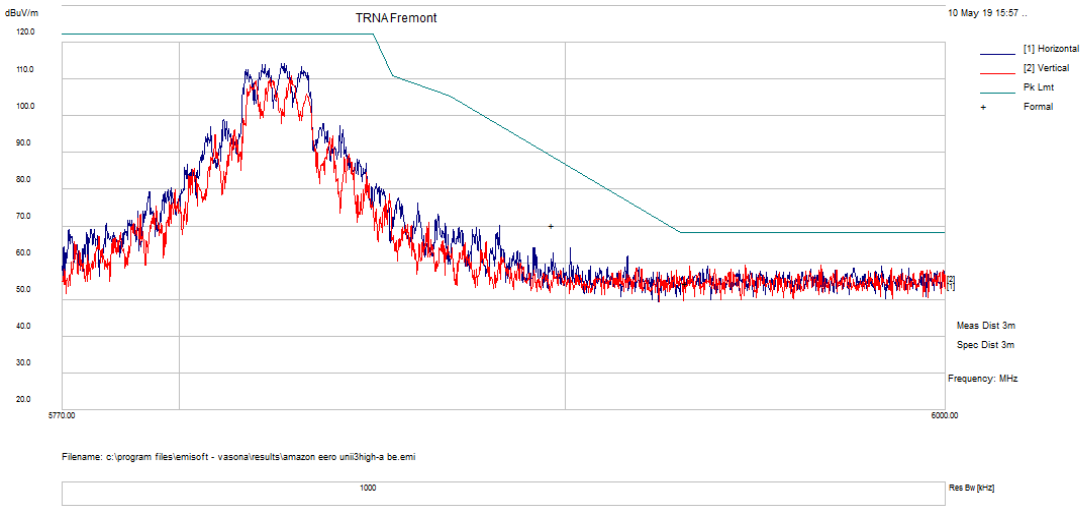


Figure 117: High U-NII-3 band edge for 802.11a NoHT 6Mbps at Channel 149

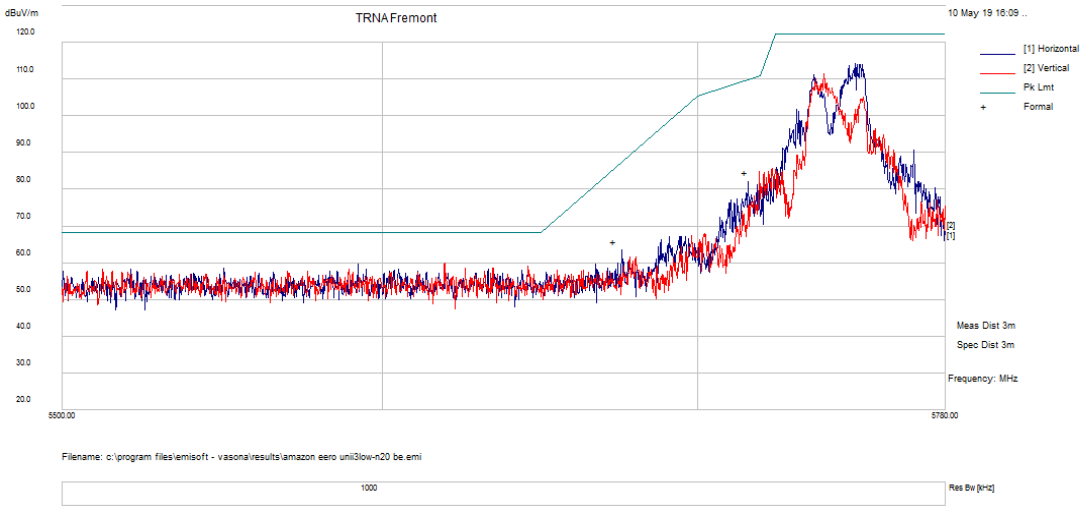


Figure 118: Low U-NII-3 band edge for 802.11n HT20 6.5Mbps at Channel 149

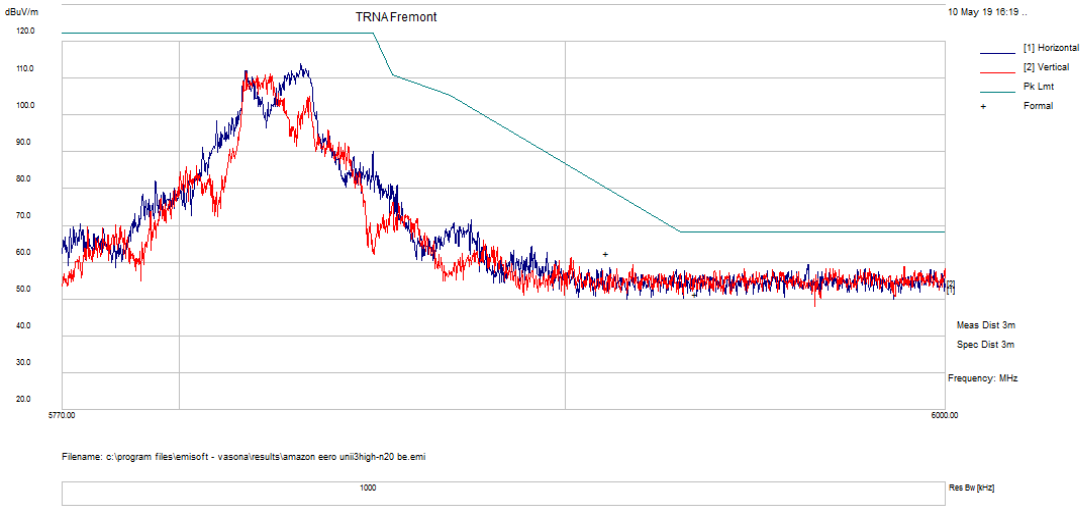


Figure 119: High U-NII-3 band edge for 802.11n HT20 6.5Mbps at Channel 149

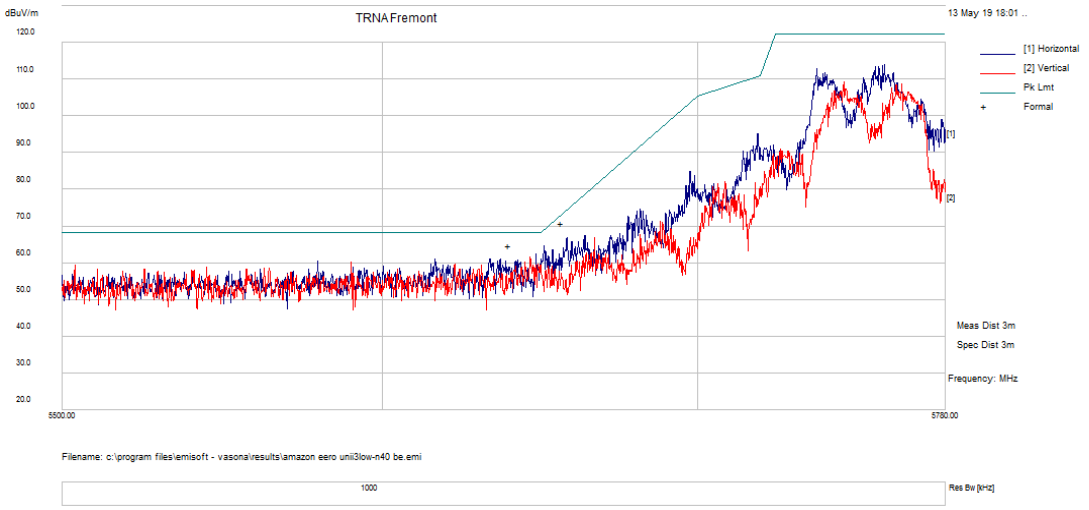


Figure 120: Low U-NII-3 band edge for 802.11n HT40+ MCS0 at Channel 151

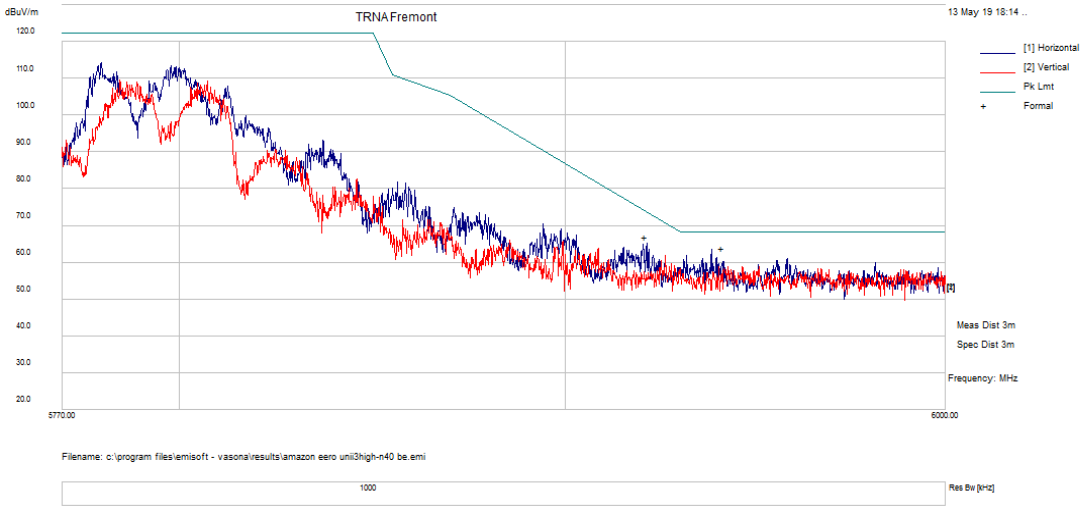


Figure 121: High U-NII-3 band edge for 802.11n HT40+ MCS0 at Channel 151

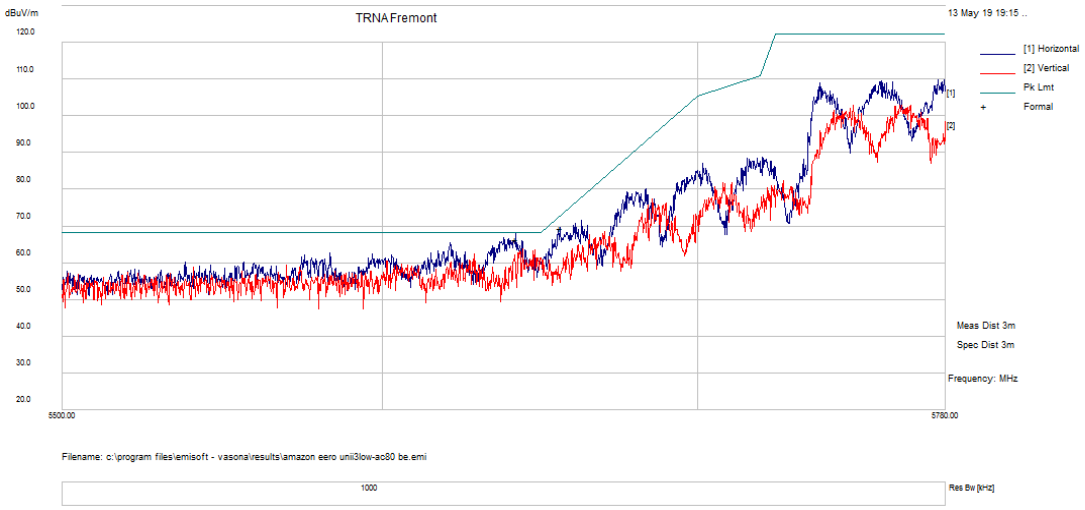


Figure 122: Low U-NII-3 band edge for 802.11ac VHT80 MCS0 at Channel 155

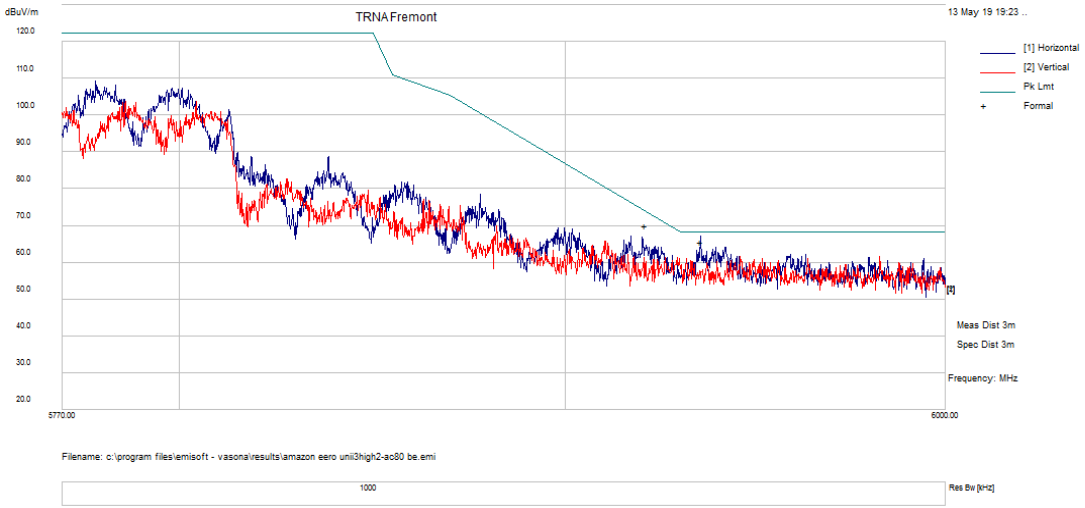


Figure 123: High U-NII-3 band edge for 802.11ac VHT80 MCS0 at Channel 155

3.6 Transmitter Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205:2016, 15.209:2016, 15.407(b:2016), RSS 247 Sect. 6:2017, RSS GEN Sect.8.9 and 8.10:2014

3.6.1 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209, RSS 247 Sect. 6, RSS GEN Sect. 8.9 and 8.10

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F(kHz)	300
0.490-1.705.....	24000/F(kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

According to CFR47 15.407 (b) and RSS 247 Sect. 6.2.1.2, all harmonics and spurious emissions which are outside the 5150 MHz - 5250 MHz, 5250 MHz – 5350 MHz, or 5470 MHz – 5725 MHz shall not exceed -27 dBm/MHz. This is equivalent to 68.2 dBuV/m at 3 meter distance.

3.6.2 Test Methodology

3.6.2.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

Pres-scans were performed to determine the worst, data rate/ chains (section 3.5.2 of this report).

3.6.2.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

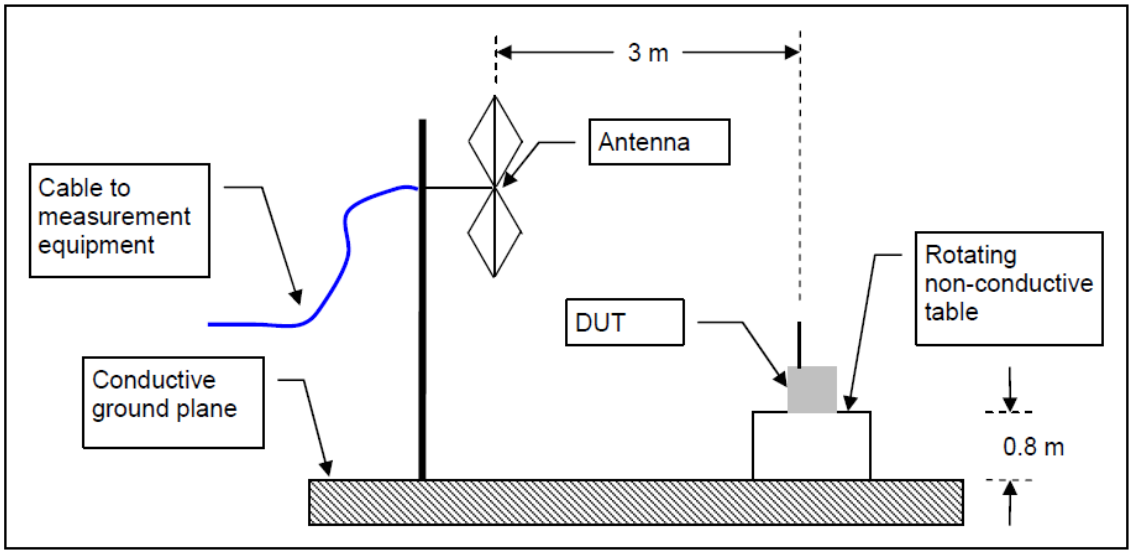
3.6.2.3 Deviations

None.

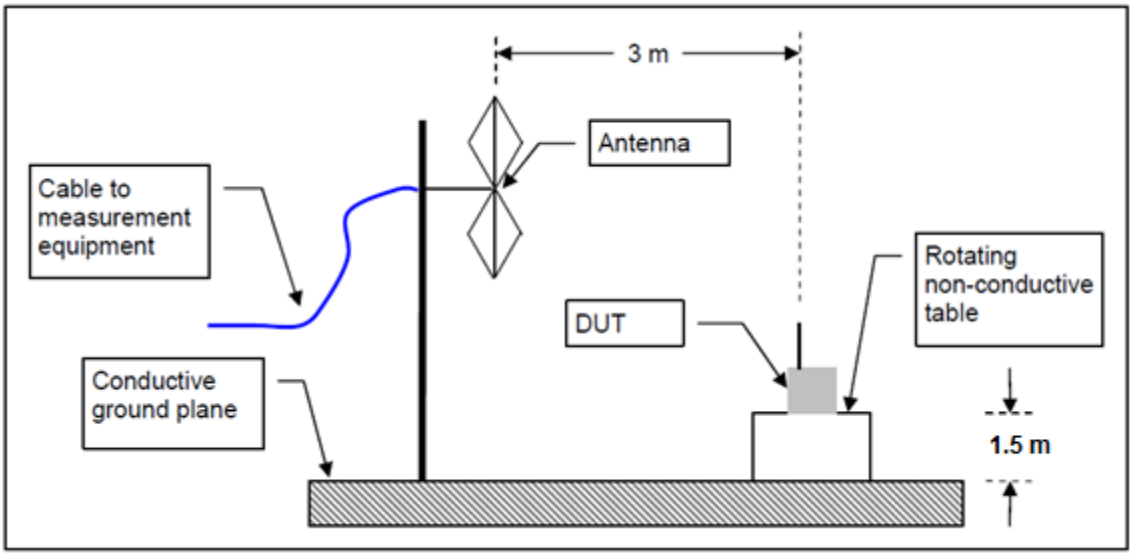
3.6.3 Test Setup:

3.6.3.1

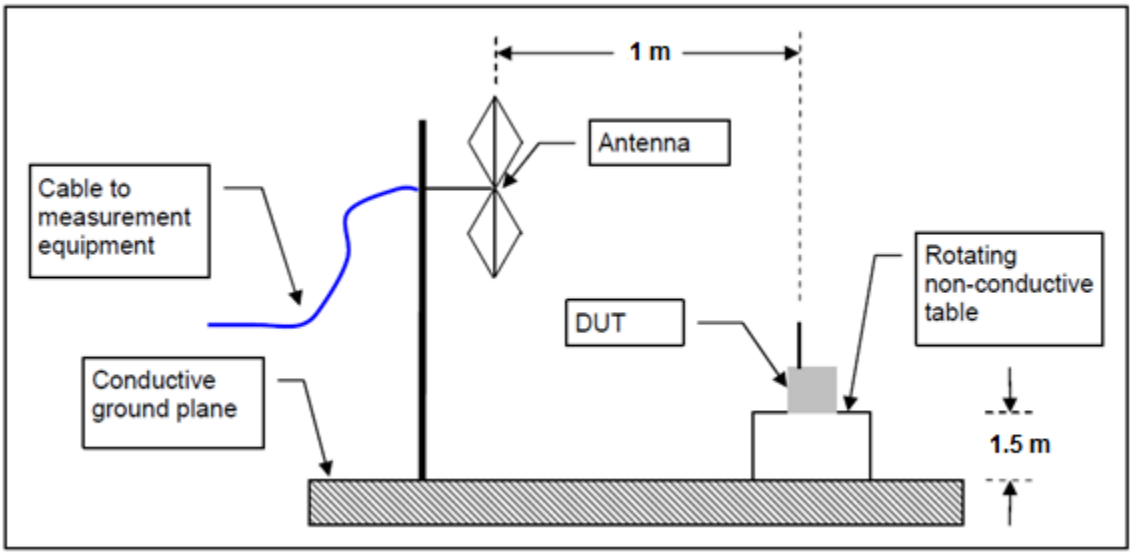
30MHz-1GHz



1-18GHz



18-40GHz



The DUT was stimulated by manufacturer provided test software that is not available to the end user.

3.6.4 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and test plan.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

3.6.4.1 Results and Plots:

3.6.4.1.1 UNII-1

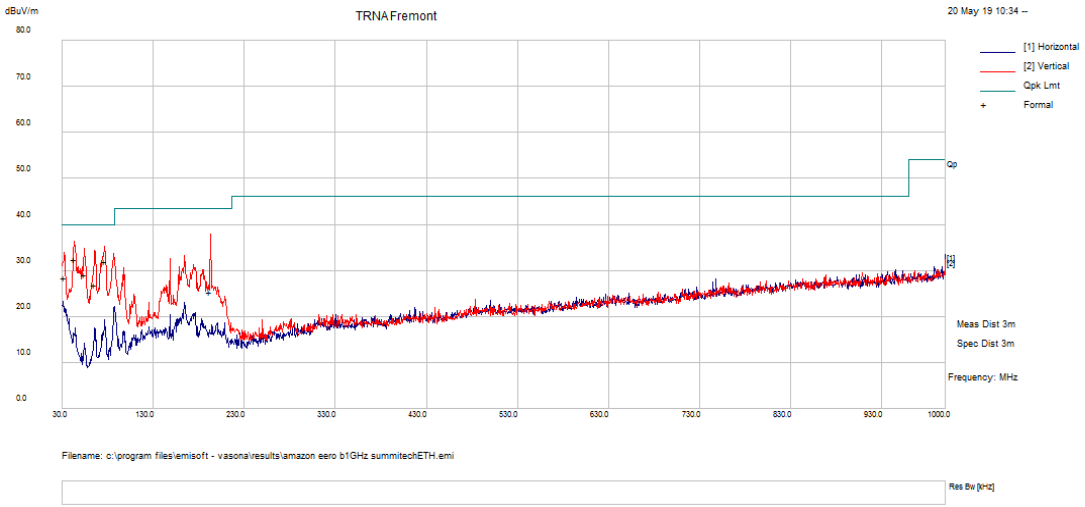


Figure 124: 30MHz-1GHz 802.11a Mode Channel 44

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
43.56781	47.72	1.81	-16.94	32.6	Quasi Max	V	120	360	40	-7.4	Pass
76.815	50.42	2.22	-20.57	32.07	Quasi Max	V	123	112	40	-7.93	Pass
54.77188	48.43	1.97	-21.13	29.27	Quasi Max	V	104	0	40	-10.73	Pass
65.76406	45.51	2.11	-20.69	26.93	Quasi Max	V	113	340	40	-13.07	Pass
192.9016	38.62	2.89	-16.14	25.37	Quasi Max	V	103	354	43.5	-18.13	Pass
32.46281	35.84	1.62	-8.86	28.6	Quasi Max	V	176	360	40	-11.41	Pass

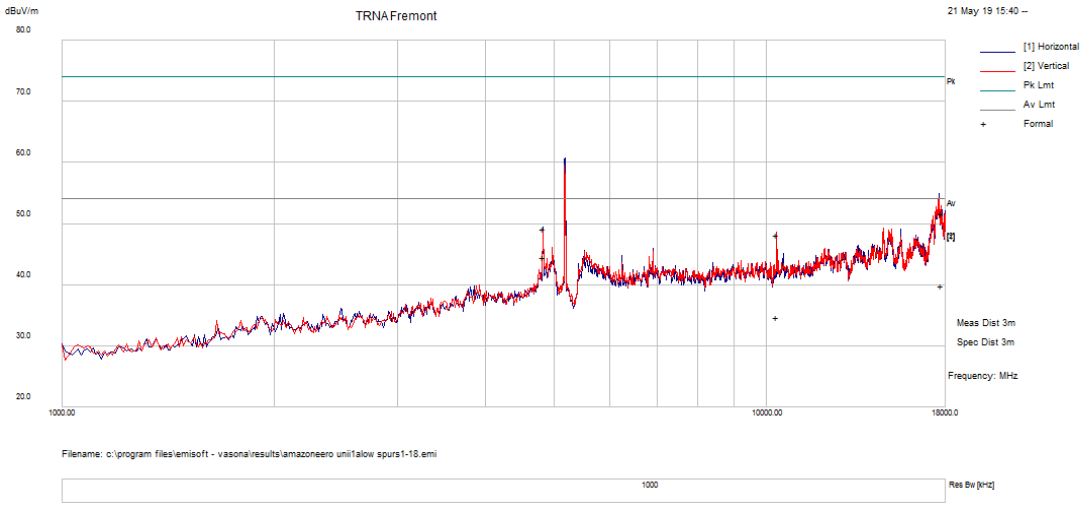


Figure 125: 1-18GHz 802.11a Mode Channel 36

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
4824.005	64.86	4.35	-20.07	49.13	Peak Max	H	214	268	74	-24.87	Pass
4824.005	60.35	4.35	-20.07	44.62	Average Max	H	214	268	54	-9.38	Pass
10359.44	55.54	6.35	-13.64	48.26	Peak Max (NRB)	V	213	359	68.23	-19.97	Pass
17790.49	32.67	9.1	-1.83	39.95	Average Max	H	214	330	54	-14.05	Pass
17790.49	44.38	9.1	-1.83	51.66	Peak Max	H	214	330	74	-22.34	Pass
5186.25	75.57	4.41	-19.27	60.71	Fundamental	H	220	0	-	-	-

Note: NRB = Non Restricted Band

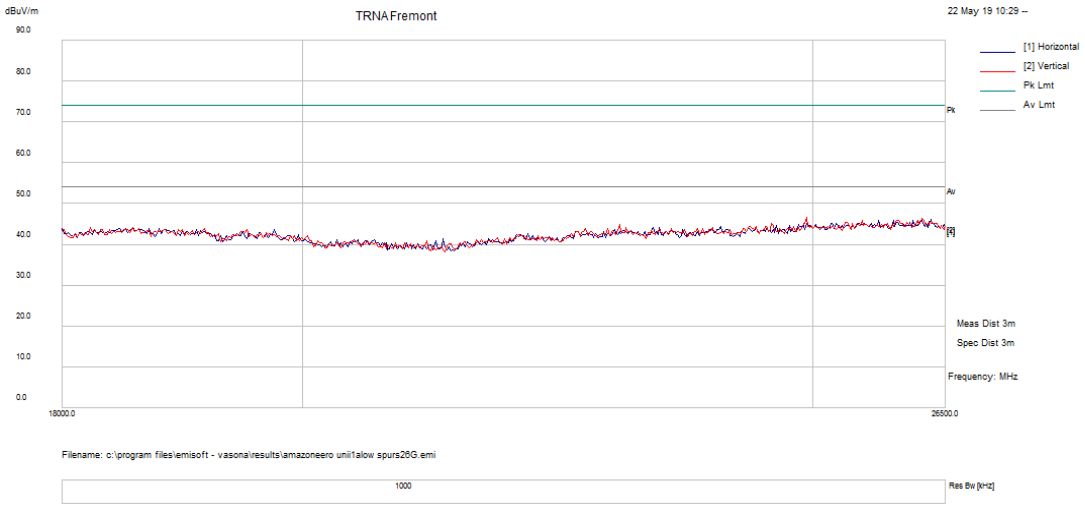


Figure 126: 18-26.5 GHz 802.11a Mode Channel 36

There are no emissions found within 6dB of the limit line.

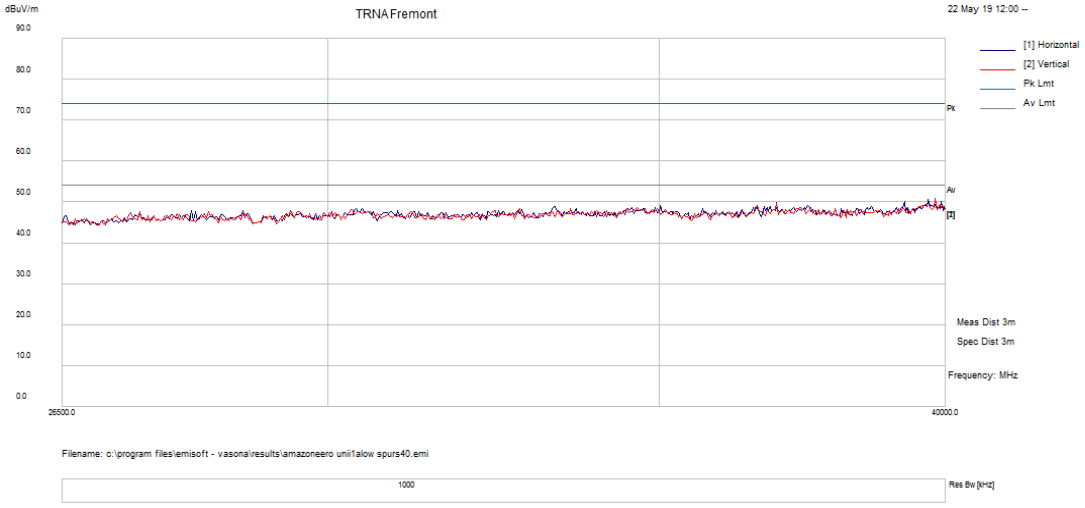


Figure 127: 26.5-40 GHz 802.11a Mode Channel 36

There are no emissions found within 6dB of the limit line.

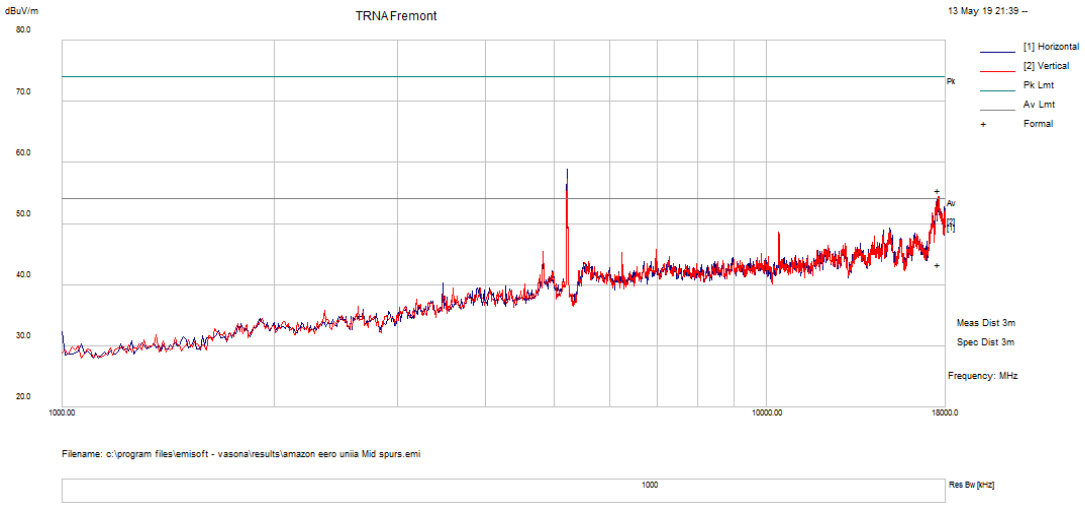


Figure 128: 1-18GHz 802.11a Mode Channel 44

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
17596.25	47.84	8.89	-1.19	55.54	Peak Max	V	178	172	74	-18.46	Pass
17596.25	35.68	8.89	-1.19	43.39	Average Max	V	178	172	54	-10.62	Pass
5218.125	73.58	4.45	-19.16	58.87	Fundamental	H	200	157	-	-	-
10436.48	50.96	6.4	-13.41	43.94	Peak Max (NRB)	V	185	316	68.23	-24.29	Pass

Note: NRB = Non Restricted Band

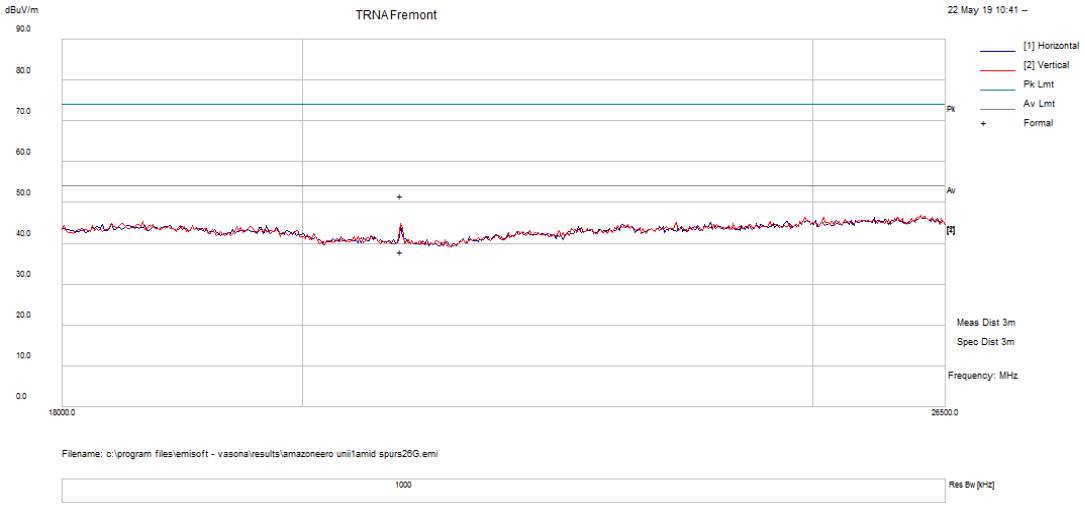


Figure 129: 18-26.5 GHz 802.11a Mode Channel 44

There are no emissions found within 6dB of the limit line.

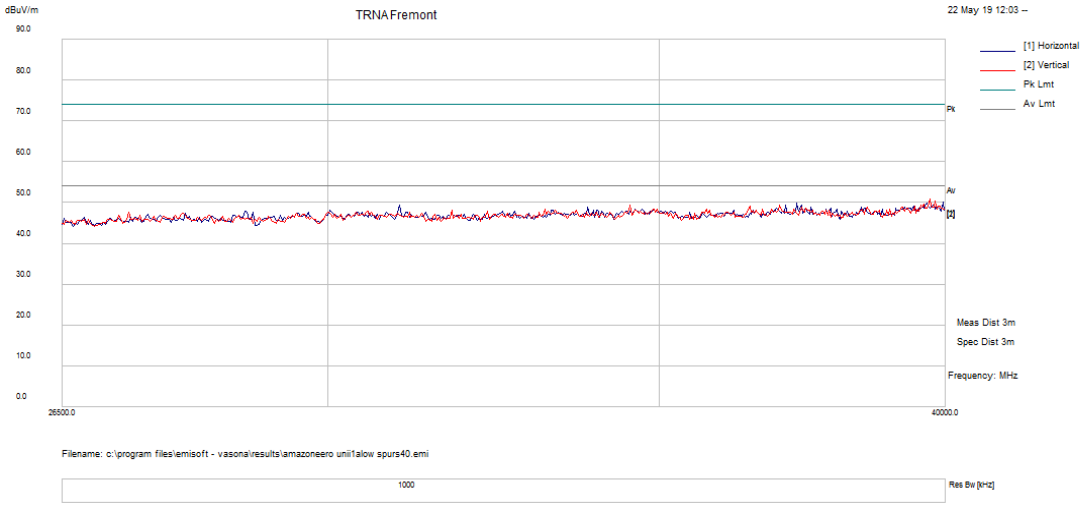


Figure 130: 26.5-40 GHz 802.11a Mode Channel 44

There are no emissions found within 6dB of the limit line.

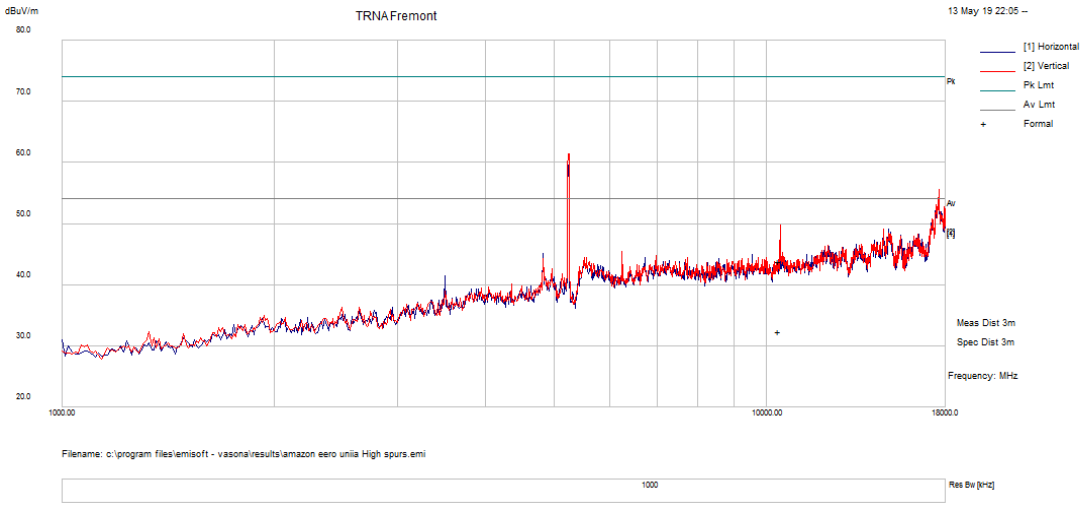


Figure 131: 1-18GHz 802.11a Mode Channel 48

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
17606.53	47.43	8.86	-1.22	55.07	Peak Max	V	227	144	74	-18.94	Pass
17606.53	35.41	8.86	-1.22	43.05	Average Max	V	227	144	54	-10.95	Pass
10478.99	60.55	6.34	-13.18	53.72	Peak Max (NRB)	V	221	316	68.23	-14.51	Pass
5250	76.06	4.45	-19.05	61.47	Fundamental	V	200	70	-	-	-

Note: NRB = Non Restricted Band

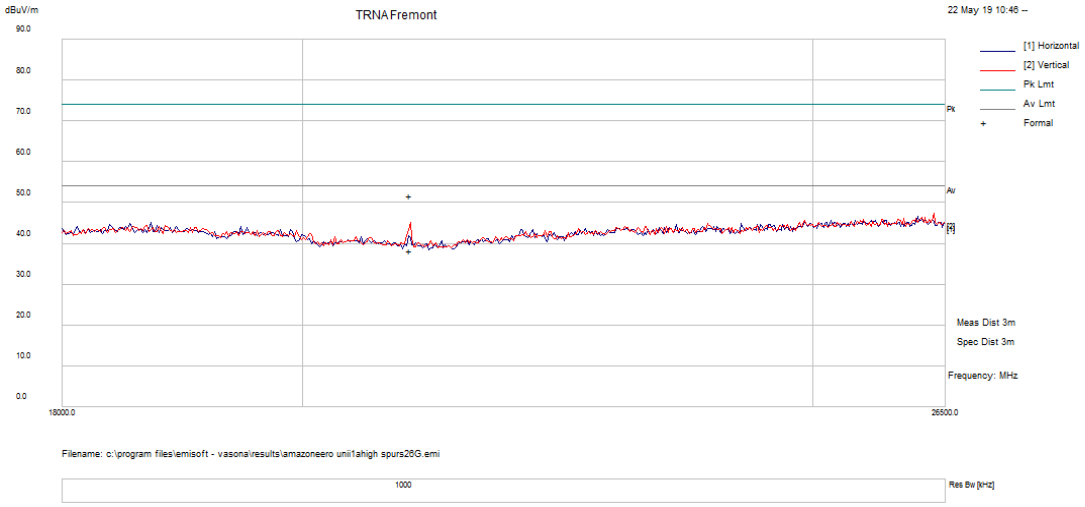


Figure 132: 18-26.5 GHz 802.11a Mode Channel 44

There are no emissions found within 6dB of the limit line.

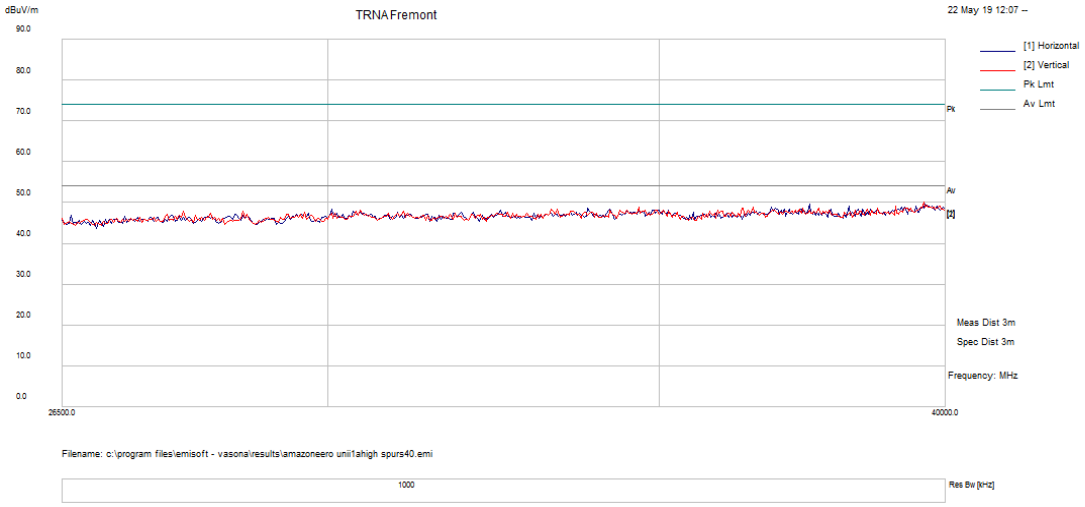


Figure 133: 26.5-40 GHz 802.11a Mode Channel 44

There are no emissions found within 6dB of the limit line.

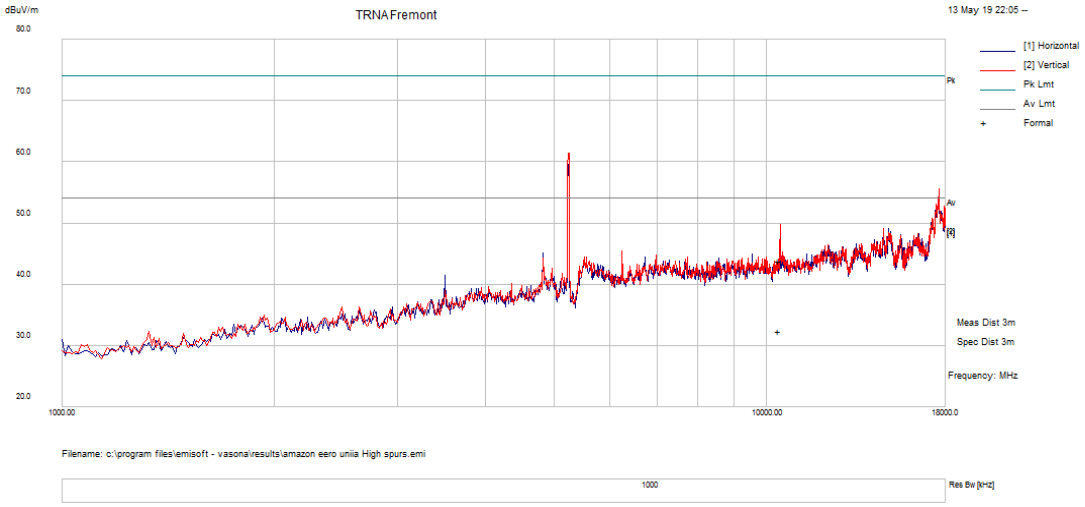


Figure 134: 1-18GHz 802.11ac80 Mode Channel 42

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
4823.853	65.33	4.35	-20.07	49.6	Peak Max	H	213	80	74	-24.4	Pass
4823.853	61.1	4.35	-20.07	45.37	Average Max	H	213	80	54	-8.63	Pass
17596.92	46.79	8.89	-1.16	54.51	Peak Max (NRB)	V	214	118	68.23	-13.72	Pass
5186.25	66.94	4.41	-19.27	52.08	Fundamental	H	220	0	-	-	-

Note: NRB = Non Restricted Band

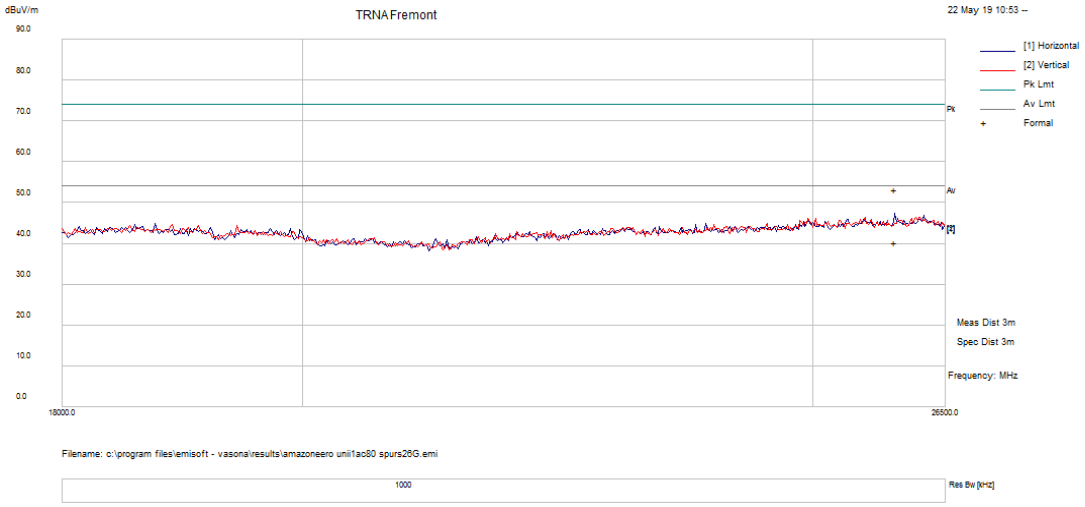


Figure 135: 18-26.5 GHz 802.11ac80 Mode Channel 42

There are no emissions found within 6dB of the limit line.

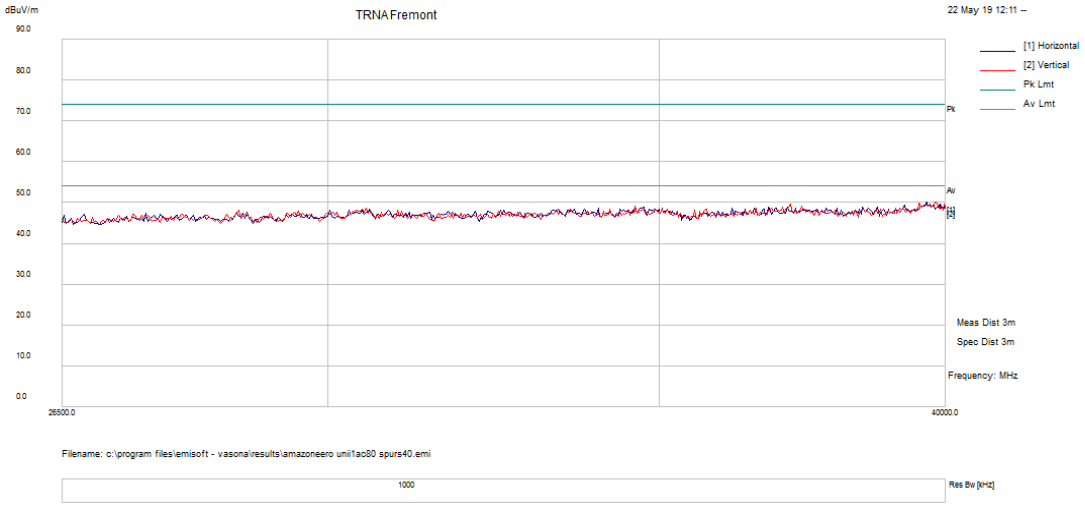


Figure 136: 26.5-40 GHz 802.11ac80 Mode Channel 42

There are no emissions found within 6dB of the limit line.

3.6.4.1.2 UNII-3

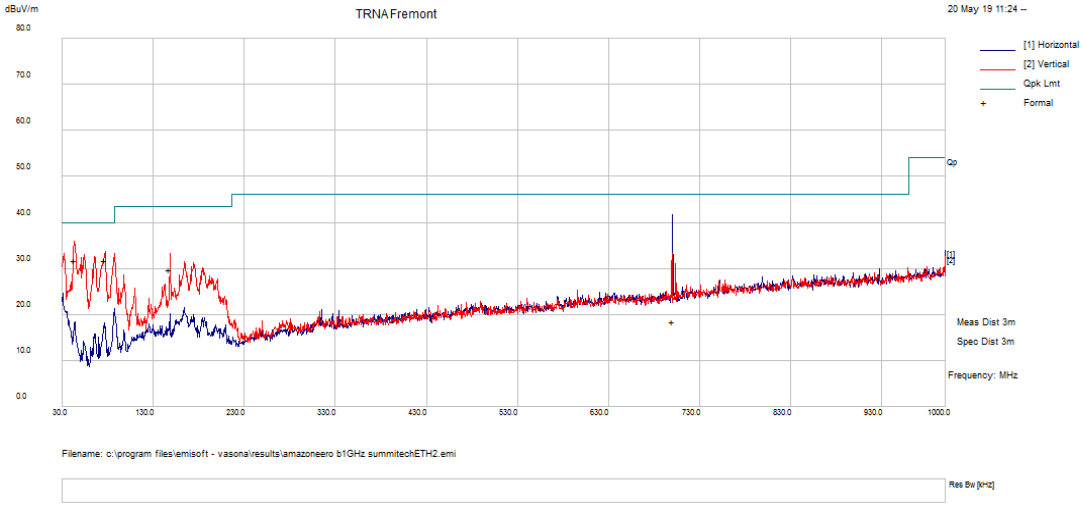


Figure 137: 30MHz-1GHz 802.11a Mode Channel 149

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
43.26563	46.76	1.81	-16.69	31.87	Quasi Max	V	140	360	40	-8.13	Pass
700.5753	22.48	4.42	-8.31	18.6	Quasi Max	H	100	250	46	-27.4	Pass
77.15344	50.24	2.22	-20.59	31.88	Quasi Max	V	134	0	40	-8.12	Pass
148.3394	42.91	2.7	-15.77	29.84	Quasi Max	V	120	352	43.5	-13.66	Pass

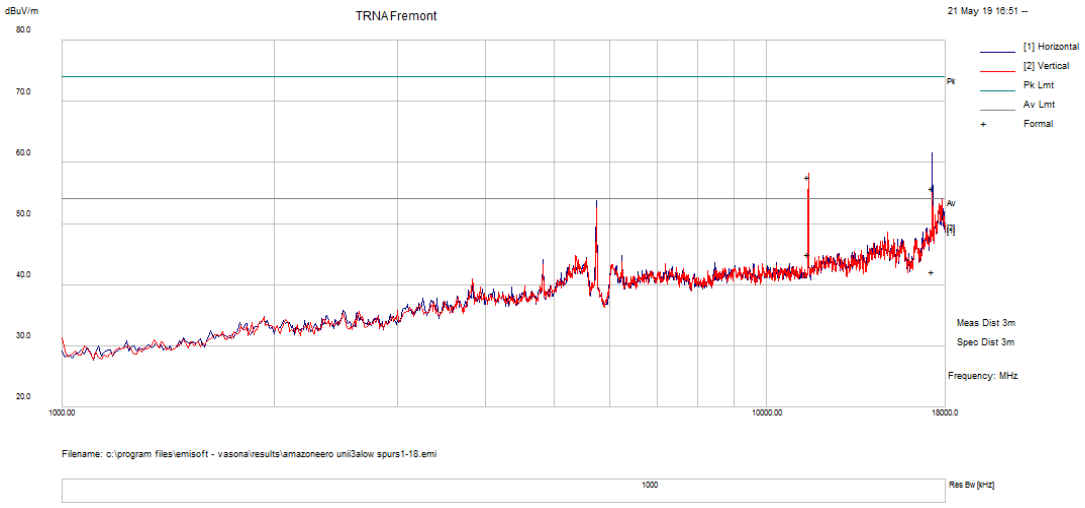


Figure 138: 1-18GHz 802.11a Mode Channel 149

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
11488.34	63.69	6.87	-12.79	57.77	Peak Max	V	212	174	74	-16.23	Pass
11488.34	51.03	6.87	-12.79	45.11	Average Max	V	212	174	54	-8.89	Pass
17224.96	38.9	8.72	-5.34	42.28	Average Max	H	220	118	54	-11.72	Pass
17224.96	52.53	8.72	-5.34	55.91	Peak Max (NRB)	H	220	118	68.23	-12.32	Pass
5738.75	67.8	4.69	-18.73	53.76	Fundamental	H	220	0	-	-	-

Note: NRB = Non Restricted Band

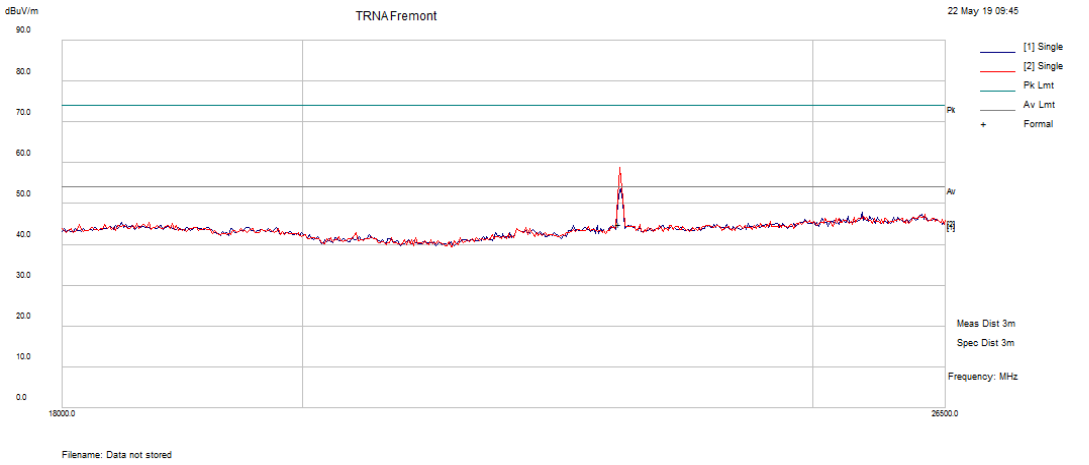


Figure 139: 18-26.5 GHz 802.11a Mode Channel 149

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
22974	47.34	7.6	3.33	58.28	Peak Max	V	202	122	74	-15.72	Pass
22974	32.87	7.6	3.33	43.81	Average Max	V	202	122	54	-10.19	Pass

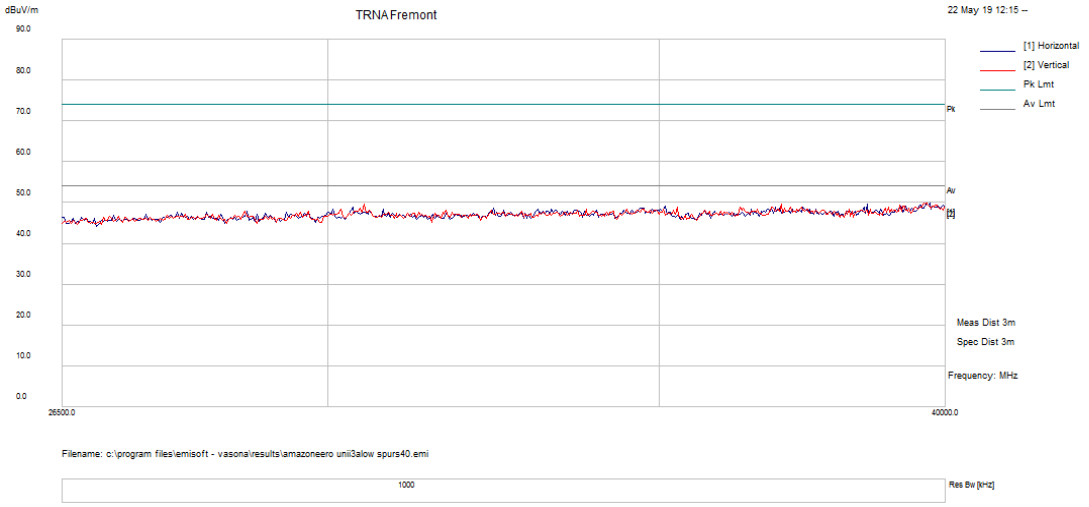


Figure 140: 26.5-40 GHz 802.11a Mode Channel 149

There are no emissions found within 6dB of the limit line.

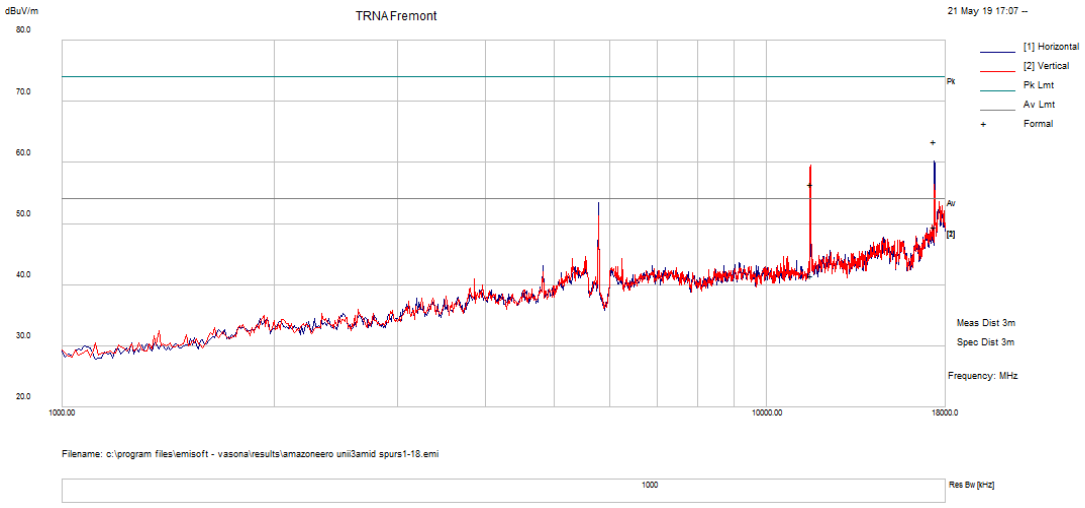


Figure 141: 1-18GHz 802.11a Mode Channel 157

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
11583.58	62.41	6.88	-12.8	56.48	Peak Max	V	214	232	74	-17.52	Pass
11583.58	47.55	6.88	-12.8	41.62	Average Max	V	214	232	54	-12.38	Pass
17360.54	45.2	8.65	-4.26	49.58	Average Max	H	214	157	54	-4.42	Pass
17360.54	59.07	8.65	-4.26	63.45	Peak Max (NRB)	H	214	157	68.23	-4.78	Pass
5781.25	67.2	4.7	-18.53	53.37	Fundamental	H	220	0	-	-	-

Note: NRB = Non Restricted Band

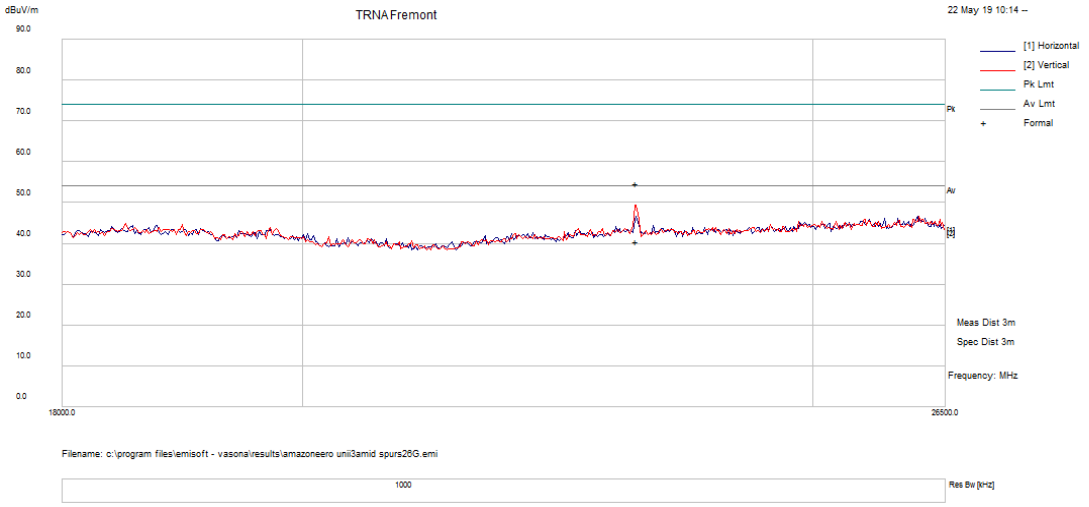


Figure 142: 18-26.5 GHz 802.11a Mode Channel 157

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
23144.74	44.03	7.59	3.16	54.78	Peak Max	V	202	121	74	-19.22	Pass
23144.74	29.73	7.59	3.16	40.48	Average Max	V	202	121	54	-13.52	Pass

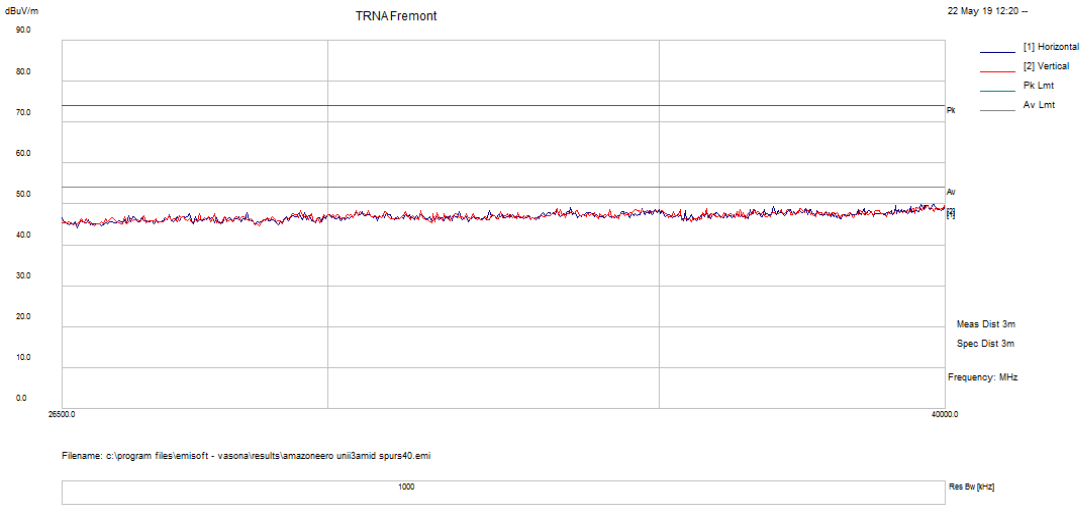


Figure 143: 26.5-40 GHz 802.11a Mode Channel 157

There are no emissions found within 6dB of the limit line.

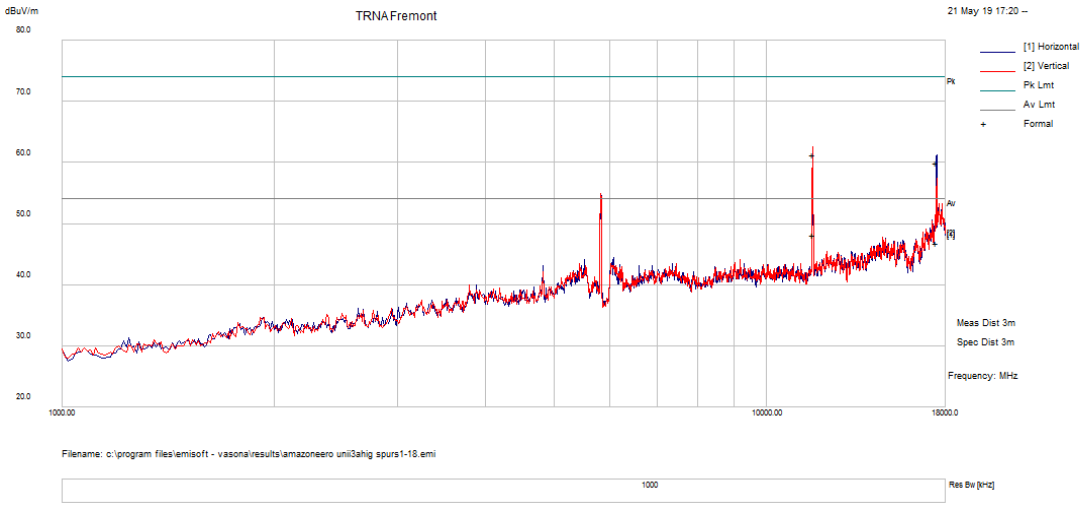


Figure 144: 1-18GHz 802.11a Mode Channel 165

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
11658.65	53.86	6.81	-12.44	48.23	Average Max	V	214	235	54	-5.77	Pass
11658.65	67	6.81	-12.44	61.38	Peak Max	V	214	235	74	-12.63	Pass
17480.37	42.12	8.76	-4.01	46.87	Average Max	H	214	182	54	-7.13	Pass
17480.37	55.23	8.76	-4.01	59.98	Peak Max (NRB)	H	214	182	68.23	-8.25	Pass
5823.75	68.52	4.73	-18.41	54.84	Fundamental	V	220	0	-	-	-

Note: NRB = Non Restricted Band

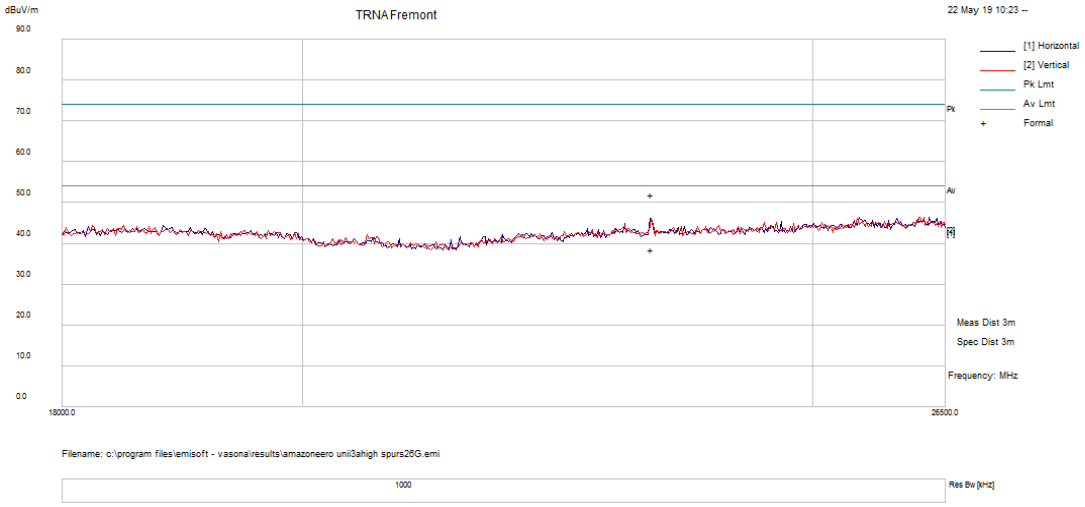


Figure 145: 18-26.5 GHz 802.11a Mode Channel 165

There are no emissions found within 6dB of the limit line.

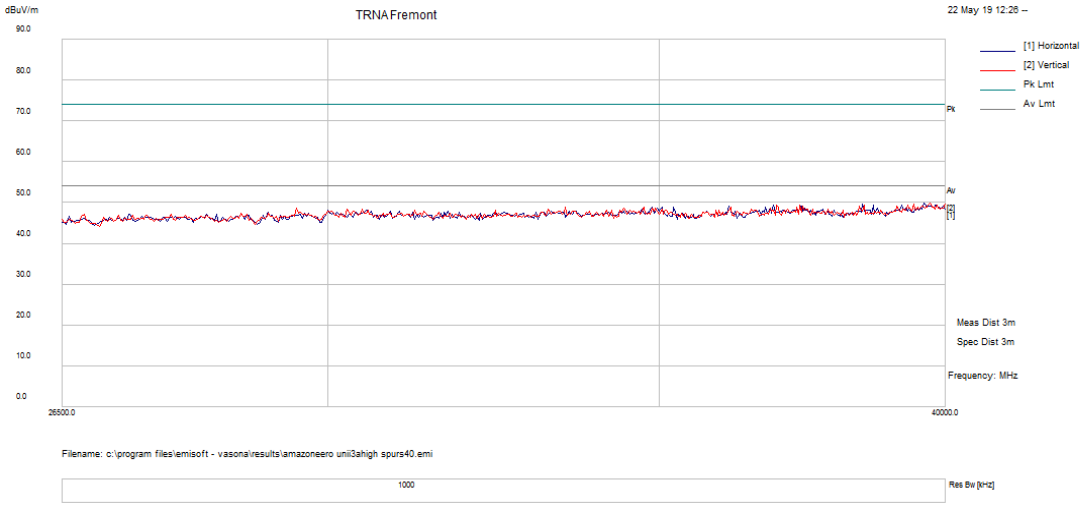


Figure 146: 26.5-40 GHz 802.11a Mode Channel 165

There are no emissions found within 6dB of the limit line.

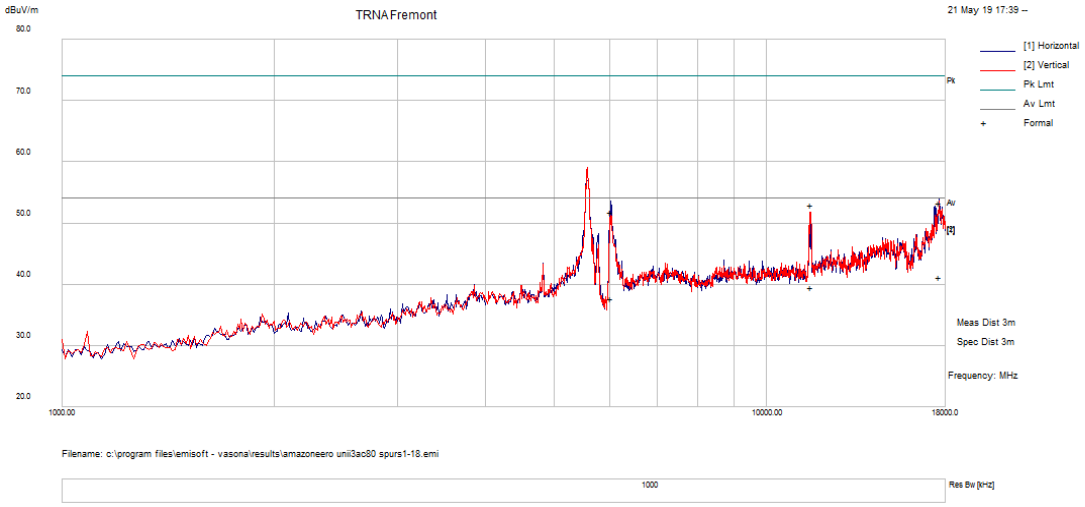


Figure 147: 1-18GHz 802.11ac80 Mode Channel 155

Frequency MHz	Raw dBuV	Cable Loss dB	AF dB/m	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
6025.42	65.15	4.84	-18.06	51.93	Peak Max (NRB)	H	221	79	68.23	-16.3	Pass
6025.42	51.02	4.84	-18.06	37.81	Average Max	H	221	79	54	-16.2	Pass
11583.73	59.02	6.88	-12.8	53.1	Peak Max	V	221	234	74	-20.91	Pass
11583.73	45.53	6.88	-12.8	39.6	Average Max	V	221	234	54	-14.4	Pass
17648.7	34.78	8.71	-2.21	41.28	Average Max	H	221	150	54	-12.72	Pass
17648.7	46.88	8.71	-2.21	53.38	Peak Max (NRB)	H	221	150	68.23	-14.85	Pass
5579.375	73.45	4.54	-18.89	59.11	Fundamental	V	220	0	-	-	-

Note: NRB = Non Restricted Band

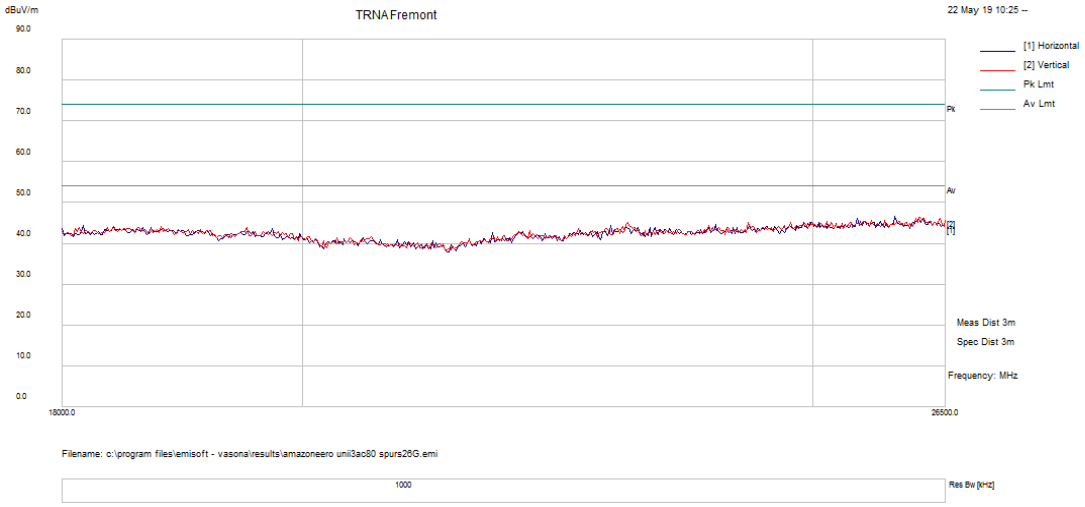


Figure 148: 18-26.5 GHz 802.11ac80 Mode Channel 155

There are no emissions found within 6dB of the limit line.

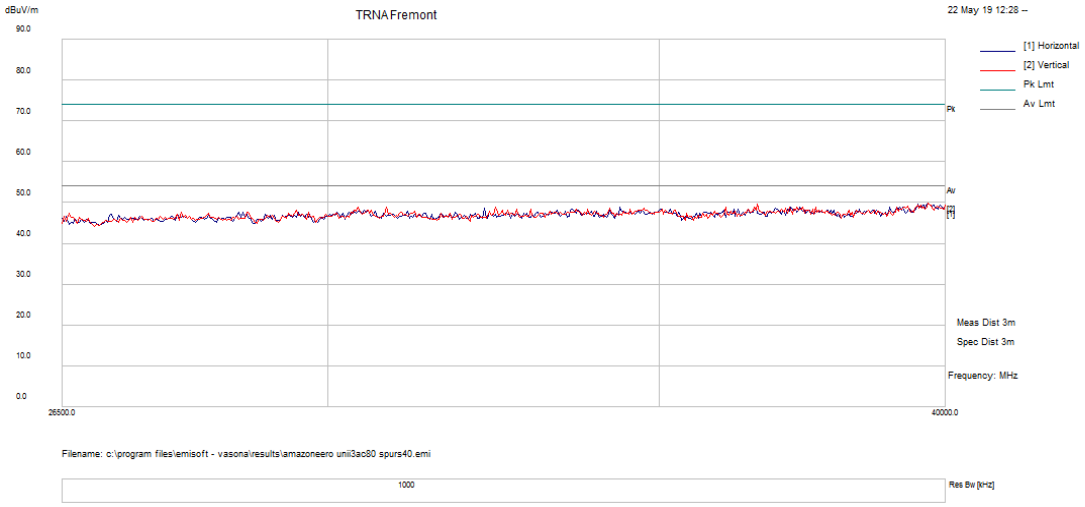


Figure 149: 26.5-40 GHz 802.11ac80 Mode Channel 155

There are no emissions found within 6dB of the limit line.

3.7 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4: 2014. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

3.7.1 Limit(s)

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207: 2016 and RSS GEN: 2014.

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

*Decreases with the logarithm of the frequency.

3.7.2 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50µH / 50Ω LISNs.

Testing is performed in Lab 1. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

3.7.2.1 Deviations

There were no deviations from this test methodology.

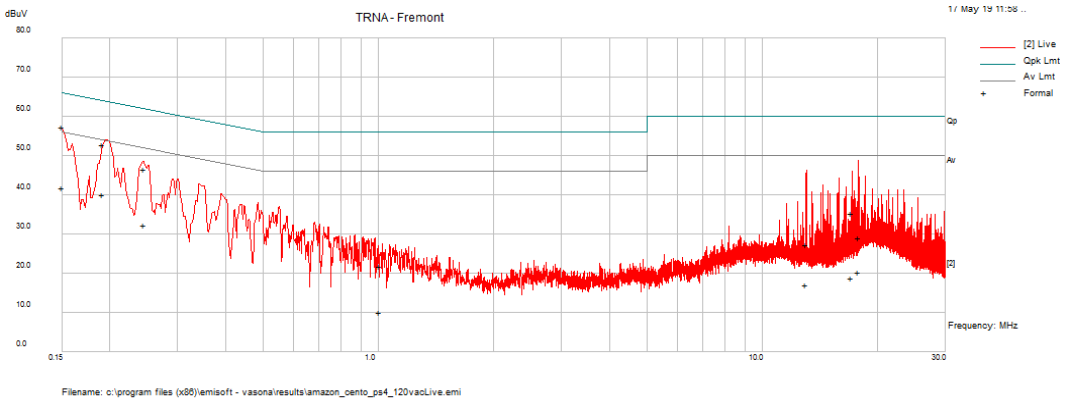
3.7.3 Test Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 9: AC Conducted Emissions – Test Results

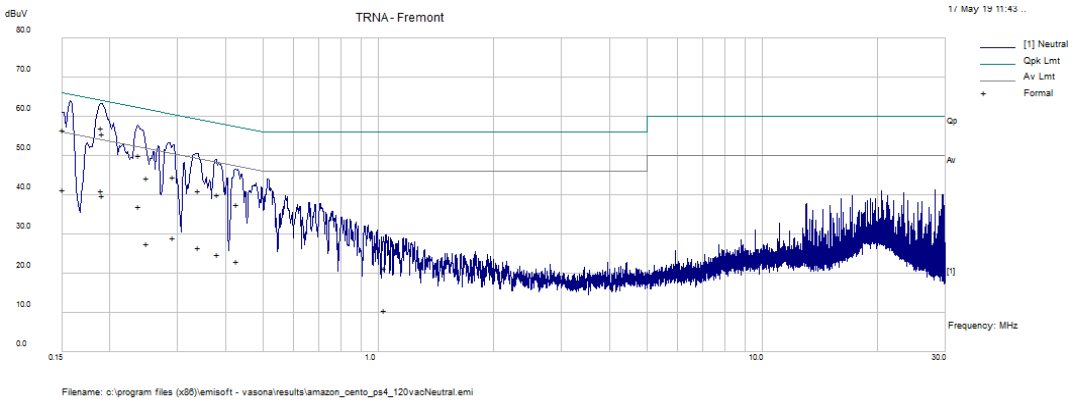
Test Conditions: Conducted Measurement at Normal Conditions only		
Antenna Type: Flex PCB dipole	**Power Level:** See Section 3.1.4.1	
AC Power: 120 Vac/60 Hz	**Configuration:** Tabletop	
Ambient Temperature: 22° C	**Relative Humidity:** 40% RH	
Configuration	**Frequency Range**	**Test Result**
Line 1 (Live)	0.15 to 30 MHz	Pass
Line 2 (Neutral)	0.15 to 30 MHz	Pass

3.7.3.1.1 Live Line



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail
0.150007	30.53	11.2	0.09	41.82	Average	Live	56	-14.18	Pass
0.150007	46.03	11.2	0.09	57.32	Quasi Peak	Live	66	-8.68	Pass
0.192018	29.68	10.25	0.07	40	Average	Live	53.95	-13.95	Pass
0.192018	42.57	10.25	0.07	52.89	Quasi Peak	Live	63.95	-11.06	Pass
0.245255	36.4	10.17	0.05	46.63	Quasi Peak	Live	61.92	-15.29	Pass
0.245255	22.2	10.17	0.05	32.42	Average	Live	51.92	-19.49	Pass
1.008361	0.06	10.12	0.03	10.21	Average	Live	46	-35.79	Pass
1.008361	11.63	10.12	0.03	21.78	Quasi Peak	Live	56	-34.22	Pass
13.01084	17.08	10.39	-0.03	27.44	Quasi Peak	Live	60	-32.56	Pass
13.01084	6.73	10.39	-0.03	17.09	Average	Live	50	-32.91	Pass
17.09842	8.61	10.47	-0.09	18.99	Average	Live	50	-31.01	Pass
17.09842	24.96	10.47	-0.09	35.34	Quasi Peak	Live	60	-24.66	Pass
17.77038	9.88	10.48	-0.11	20.25	Average	Live	50	-29.75	Pass
17.77038	18.81	10.48	-0.11	29.18	Quasi Peak	Live	60	-30.82	Pass

3.7.3.1.1 Neutral Line



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail
0.150878	45.38	11.15	0.09	56.62	Quasi Peak	Neutral	65.95	-9.33	Pass
0.150878	30.22	11.15	0.09	41.46	Average	Neutral	55.95	-14.5	Pass
0.190305	30.76	10.26	0.07	41.08	Average	Neutral	54.02	-12.94	Pass
0.190305	46.65	10.26	0.07	56.98	Quasi Peak	Neutral	64.02	-7.05	Pass
0.191128	45.27	10.26	0.07	55.59	Quasi Peak	Neutral	63.99	-8.39	Pass
0.191128	29.59	10.26	0.07	39.91	Average	Neutral	53.99	-14.08	Pass
0.238569	39.8	10.18	0.05	50.04	Quasi Peak	Neutral	62.15	-12.11	Pass
0.238569	26.98	10.18	0.05	37.22	Average	Neutral	52.15	-14.93	Pass
0.250232	17.4	10.17	0.05	27.62	Average	Neutral	51.75	-24.13	Pass
0.250232	34.11	10.17	0.05	44.33	Quasi Peak	Neutral	61.75	-17.42	Pass
0.292599	34.49	10.13	0.05	44.67	Quasi Peak	Neutral	60.45	-15.78	Pass
0.292599	18.91	10.13	0.05	29.09	Average	Neutral	50.45	-21.36	Pass
0.341483	30.87	10.11	0.04	41.03	Quasi Peak	Neutral	59.17	-18.14	Pass
0.341483	16.54	10.11	0.04	26.69	Average	Neutral	49.17	-22.48	Pass
0.382978	30.05	10.1	0.04	40.18	Quasi Peak	Neutral	58.21	-18.03	Pass
0.382978	14.65	10.1	0.04	24.79	Average	Neutral	48.21	-23.42	Pass
0.429944	27.36	10.1	0.04	37.5	Quasi Peak	Neutral	57.25	-19.75	Pass
0.429944	12.88	10.1	0.04	23.02	Average	Neutral	47.25	-24.23	Pass
1.035926	0.5	10.12	0.03	10.66	Average	Neutral	46	-35.34	Pass
1.035926	11.13	10.12	0.03	21.28	Quasi Peak	Neutral	56	-34.72	Pass

4 Test Equipment List

4.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yyyy	Next Cal mm/dd/yyyy
Thermometer	VWR	61161-378	160702310	01/14/2019	01/14/2020
Vector Signal Generator	Rohde & Schwarz	SMU 200A	102398	07/24/2018	07/24/2019
EMI Receiver	Agilent	MXE N9038A	MY51210195	01/16/2019	01/16/2020
Preamplifier, 9 kHz – 1 GHz	Sonoma	310N	213221	01/16/2019	01/16/2020
Bilog Antenna	Sunol Sciences	JB3	A060502	5/27/2018	5/27/2020
EMI Receiver	Rohde & Schwarz	ESIB40	100180	05/31/2018	05/31/2020
L.I.S.N.	Com-Power	LI-215	192000	01/16/2019	01/16/2020
Transient Limiter	Com-Power	LIT-930	531582	01/16/2019	01/16/2020
Signal Generator	R&S	SMP	1035.5005.02	01/16/2019	01/16/2020
Wide Band Amplifier System	IFI	CMX5002	650-0795	NCR	NCR
RF Power Amplifier 100W .7-6GHz	AR	100S1G6	0346687	NCR	NCR
Antenna, Bilog, < 1 GHz	EMCO	3143	9505-1122	NCR	NCR
Antenna, Horn, > 1 GHz	EMCO	3115	9602-4676	NCR	NCR
Signal Generator	HP	8648A	3426A00658	01/16/2019	01/16/2020
RF Power Amplifier	Amplifier Research	75A220M3	16070	NCR	NCR
Directional Coupler	Werlatone	C1795	4047	01/16/2019	01/16/2020
RF Power Meter	Booton	9200B	331601AE	01/16/2019	01/16/2020
Power Sensor	Booton	952001B	331601AE	01/16/2019	01/16/2020
6 dB Attenuator	Bird	100-A-FFN-06	SC6dB01	01/16/2019	01/16/2020
Coupler-Decoupler Network	FCC	FCC-801-M3-32A	06070	01/16/2019	01/16/2020
ESD Simulator	Haefely	ONYX30	184495	07/25/2017	07/25/2019
Surge, EFT, Volt Dips Test Generator	Thermo Fisher	EMC Pro	0609316	06/06/2018	06/06/2019
E-Field Monitor	Walker Scientific	ELF-600/66D	K72488050601	01/16/2019	01/16/2020
Magnetic field generator	FCC	F1000-4-8-G-125 A	06025	CBU	VBU
Mag Field Immunity Loop	FCC	F1000-4-8/9/10-L-1M	06015	CBU	VBU
Universal Power Analyzer	Voltech	PM6000	100006700084	01/16/2019	01/16/2020

Reference Impedance Network	Voltech	IEC61000-3	IG131/0536	01/16/2019	01/16/2020
1.6 GHz Low Pass Filter	K&L Microwave	8L120-X1600-0/09135-0249	UA691-35	N/A (See Note)	

Note: Equipment is characterized before use.

5 EMC Test Plan

5.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

5.2 Customer

Table 10: Customer Information

Company Name	eero LLC
Address	660 3rd Street
City, State, Zip	San Francisco, CA 94107
Country	USA

Table 11: Technical Contact Information

Name	Clifford Clarke
E-mail	compliance@eero.com

5.3 Equipment Under Test (EUT)

The information provided in the following table should be listed as it should appear in the final report. For those products that have only a model name, list the model number as *non-applicable* and vice-versa.

Table 12: EUT Designation

Product Name	eero
Model Number	J010001
System Name	N/A
Product Description	Home wi-fi router

5.4 Product Specifications

Table 13: EUT Specifications

EUT Specifications	
AC Input	100-240V AC, 50 – 60 Hz
Environment	Indoor
Operating Temperature Range:	0-35°C
Multiple Feeds:	☐ Yes and how many ☒ No
Product Marketing Name (PMN)	eero
Hardware Version Identification Number (HVIN)	A01
Firmware Version Identification Number (FVIN)	eeroOS
RF Test Software Version	BusyBox v1.23.2
Operating Modes	802.11a 802.11n (HT20, HT40) 802.11ac (VHT20, VHT40,VHT80)
Transmitter Frequency Band	5.15-5.25 GHz, U-NII-1 Band 5.725-5.85GHz, U-NII-3 Band
Power Setting @ Operating Channel	See Section 3.1.4
Antenna Type	See Table 16
Antenna Gain	See Table 14
Modulation Type	☐ AM ☐ FM ☒ OFDM ☐ Other describe:
TX/RX Chain (s)	MIMO 2x2
Directional Gain Type	☒ Correlated (CDD) ☒ Beam-Forming ☐ Other describe:
Type of Equipment	☒ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☐ Other:
Note: All 2 chains will be on / transmitted at all times with the same power levels and antenna gains per chain.	

Table 14: Antenna Information

Number	Antenna Type	Max Gain (dBi)	Max Gain (dBi)	
		2.4GHz	5150-5250 MHz	5725-5850 MHz
Antenna 0	Internal, Flex PCB dipole	3.4	3.11	3.97
Antenna 1	Internal, Flex PCB dipole			

Number	Antenna Type	Beam Forming Gain (dBi)	Beam Forming Gain (dBi)	
		2.4GHz	5150-5250 MHz	5725-5850 MHz
Antenna 0	Internal, Flex PCB dipole	6.12	6.01	6.48
Antenna 1	Internal, Flex PCB dipole			

Table 15: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
Ethernet	Ethernet	☐ Yes	☒ Metric: < 3.0m	☒ Unshielded

Table 16: Accessory Equipment

Equipment	Manufacturer	Model	Serial	Comment
AC/DC Converter	Luxshare	C110011	N/A	Power supply that ships with EUT
Note: All eero devices are serialized at the time of manufacturer. The devices used for the certification testing were assembled in the factory but did not go through the regular marking process so they were not serialized.				

Table 17: Ancillary Equipment (used for test purposes only)

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Lenovo	Thinkpad	N/A	Setup EUT operating channels via QRCT with Ethernet connection to EUT
Note: None.				

Table 18: Description of Sample used for Testing

Sample Number	Device	Serial Number	Configuration	Used For
1	Home wi-fi router	Unit #1	Radiated Sample	TX Spurious Emissions, Bandedge
2	Home wi-fi router	Unit #1	Radiated Sample	AC Mains Conducted Emissions
3	Home wi-fi router	Unit #2	Conducted Sample	All other conducted Measurments
Note: -				

Table 19: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Photo (X-Axis)	Setup Photo (Y-Axis)	Setup Photo (Z-Axis)
1, 2, 3	Flex PCB dipole	Transmit	EUT upright	N/A	N/A
Note: Manufacturer has declared that the EUT is designed to operate in a fixed, upright position.					

5.5 Test Specifications

Testing requirements

Table 20: Test Specifications

Emissions and Immunity	
Standard	**Requirement**
CFR 47 Part 15.407: 2019	All
RSS 247 Issue 2, 2017	All

END OF REPORT