TEST REPORT

Test Report No. : UL-RPT-RP13041774JD09A V2.0

Customer	:	Apple Inc.
Model No.	:	A2251
FCC ID	:	BCGA2251
Technology	:	WLAN
Test Standard(s)	:	FCC Parts 15.209(a) & 15.407

Test Laboratory : UL VS LTD, Basingstoke, Hampshire, RG24 8AH, United Kingdom

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2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

Date of Issue: 16 April 2020

Checked by:

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Customer Information

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Report Revision History

Version Number	Issue Date	Revision Details	Revised By
1.0	12/03/2020	Initial Version	Sarah Williams
2.0	16/04/2020	Antenna gains for U-NII 2C updated	Sarah Williams

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1. Attestation of Test Results

1.1. Description of EUT

The Equipment Under Test (EUT) was a Laptop Computer with *Bluetooth, Bluetooth* Low Energy and 802.11 a/b/g/n/ac capabilities in the 2.4 GHz and 5.0 GHz bands.

1.2. General Information

Specification Reference:	47CFR15.407 and 47CFR15.403
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) – Sections 15.403 and 15.407
Specification Reference:	47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209
Site Registration:	621311
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	21 October 2019 to 14 April 2020

1.3. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.35(c)	Transmitter Duty Cycle	Note 1
Part 15.403(i)	Transmitter 26 dB Emission Bandwidth	Complied
Part 15.407(e)	Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band)	Complied
Part 15.407(e)	Transmitter Minimum 6 dB Bandwidth (Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz)	Complied
Part 15.407(a)(1)(iv)	Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band)	Complied
Part 15.407(a)(2)	Transmitter Maximum Conducted Output Power (5.25-5.35 GHz & 5.47-5.725 GHz bands)	Complied
Part 15.407(a)(2)	Transmitter Maximum Conducted Output Power (Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz)	Complied
Part 15.407(a)(3)	Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band)	Complied
Part 15.407(a)(1)(iv)	Transmitter Maximum Power Spectral Density (5.15-5.25 GHz band)	Complied
Part 15.407(a)(2)	Transmitter Maximum Power Spectral Density (5.25-5.35 GHz & 5.47-5.725 GHz bands)	Complied
Part 15.407(a)(2)	Transmitter Maximum Power Spectral Density (Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz)	Complied
Part 15.407(a)(3)	Transmitter Maximum Power Spectral Density (5.725-5.85 GHz band)	Complied
Part 15.407(b)/15.209(a)	Transmitter Out of Band Radiated Emissions	Complied
Part 15.407(b)/15.209(a)	Transmitter Band Edge Radiated Emissions	Complied
Part 15.407(g)	Transmitter Frequency Stability (Temperature & Voltage Variation)	Note 2
Part 15.407(h)(1)	Transmitter Power Control	Note 3

Note(s):

1. The measurement was performed to assist in the calculation of the level of average output power, power spectral density and emissions as the EUT employs pulsed operation.
2. Frequency stability is better than 20 ppm which ensures that the signal remains in the allocated bands under all operational conditions stated in the user manual.
3. Transmit Power Control was not tested as the maximum EIRP is less than 500 mW (27 dBm).

1.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specifications identified above.

2. Summary of Testing

2.1. Facilities and Accreditation

The test site and measurement facilities used to collect data are located at Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom. The following table identifies which facilities were utilised for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

Site 1	X
Site 2	-
Site 17	X

UL VS LTD is accredited by UKAS. The tests reported herein have been performed in accordance with its terms of accreditation.

2.2. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 789033 D02 General U-NII Test Procedures New Rules v02r01 December 14, 2017
Title:	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E)
Reference:	KDB662911 D01 Multiple Transmitter Output v02r01 October 31, 2013
Title:	Emissions Testing of Transmitter with Multiple Outputs in the Same Band

2.3. Calibration and Uncertainty

Measuring Instrument Calibration

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value measured (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Duty Cycle	5.15 GHz to 5.850 GHz	95%	±1.14 %
26 dB Emission Bandwidth	5.15 GHz to 5.850 GHz	95%	±4.59 %
Minimum 6 dB Emission Bandwidth	5.15 GHz to 5.850 GHz	95%	±4.59 %
Maximum Conducted Output Power	5.15 GHz to 5.850 GHz	95%	±1.13 dB
Maximum Power Spectral Density	5.15 GHz to 5.850 GHz	95%	±1.13 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±3.30 dB
Radiated Spurious Emissions	1 GHz to 40 GHz	95%	±2.94 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

2.4. Test and Measurement Equipment

Test Equipment Used for Transmitter Conducted Tests (Non-TxBF)

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2004	Thermohygrometer	Testo	608-H1	45046425	05 Jan 2021	12
M2033	Signal Analyser	Rohde & Schwarz	FSV13	101667	24 Jul 2020	12
A3027	Attenuator	Broadwave Technologies	351-311-006	#1	Calibrated before use	-
A3028	Attenuator	Broadwave Technologies	351-311-006	#2	Calibrated before use	-
A3029	Attenuator	Broadwave Technologies	351-311-006	#3	Calibrated before use	-
A3004	RF Switch	Pickering Interfaces	64-102-002	XZ363230	Calibrated before use	-
A3180	Attenuator	Pasternack	PE7047-3	Not stated	Calibrated before use	-
G0615	Signal Generator	Rohde & Schwarz	SMBV100A	260473	08 May 2020	36
A3005	Replay Test Rack	N/A	N/A	N/A	Calibration not required	-

Test Equipment Used for Transmitter Conducted Tests (TxBF)

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2001	Thermohygrometer	Testo	608-H1	45041824	06 Jan 2020	12
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	16 Jan 2020	12
A090	Attenuator	Narda	743-60	01057	Calibrated before use	-
A2505	Directional Coupler	AtlanTecRF	CDC-003060-20	1101230	Calibrated before use	-
A2536	Directional Coupler	AtlanTecRF	CDC-003060-20	14041701720	Calibrated before use	-
A2534	Directional Coupler	AtlanTecRF	CDC-003060-20	14041701718	Calibrated before use	-
A2098	Power Splitter	Mini-Circuits	ZN4PD1-63-S+	SF 210501205	Calibrated before use	-
A2886	Power Splitter	Mini-Circuits	ZN4PD2-63-S+	SUU 47401601#3	Calibrated before use	-
A3160	RF Switch	Pickering Interfaces	60-102B-001	XZ370188	Calibrated before use	-
G0614	Signal Generator	Rohde & Schwarz	SMBV100A	177687	08 May 2020	36
M2036	Signal Analyser	Rohde & Schwarz	FSV30	101791	07 May 2020	12
G0628	Signal Generator	Rohde & Schwarz	SMBV100A	261847	01 Sep 2020	36

Test Measurement Software/Firmware Used for Transmitter Conducted Tests

Name	Version	Release Date
UL VS LTD Replay	20190208	08 February 2019

Test and Measurement Equipment (continued)

Test Equipment Used for Transmitter Radiated Emissions

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2040	Thermohygrometer	Testo	608-H1	45124934	07 Jan 2021	12
K0001	3m RSE Chamber	Rainford	N/A	N/A	16 Oct 2020	12
M2044	Test Receiver	Rohde & Schwarz	ESU26	100122	01 Apr 2020	12
A3083	Low Pass Filter	AtlanTecRF	AFL-01000	18010900076	09 Apr 2020	12
A3154	Pre-Amplifier	Com-Power	PAM-103	18020012	04 Oct 2020	12
A3179	Pre-Amplifier	Hewlett Packard	8449B	3008A00934	09 Oct 2020	12
A3141	Pre-Amplifier	Schwarzbeck	BBV 9718 B	00021	08 Oct 2020	12
A553	Antenna	Chase	CBL6111A	1593	14 Oct 2020	12
A3138	Antenna	Schwarzbeck	BBHA 9120 B	00702	04 Oct 2020	12
A3139	Antenna	Schwarzbeck	HWRD750	00027	07 Oct 2020	12
A2523	Attenuator	AtlanTechRF	AN18W5-10	832827#1	04 Mar 2020	12
A2974	High Pass Filter	AtlanTecRF	AFH-06000	15032501232	07 Nov 2020	12
A3095	High Pass Filter	AtlanTecRF	AFH-07000	18051600012	09 Apr 2020	12
A2479	Band Reject Filter	Wainwright Instruments GmbH	WRCJV8-5100-5150-5250-5300-50SS	2	13 Sep 2020	12
A2480	Band Reject Filter	Wainwright Instruments GmbH	WRCJV8-5200-5250-5350-5400-50SS	2	13 Sep 2020	12
A2481	Band Reject Filter	Wainwright Instruments GmbH	WRCJV16-5440-5470-5725-5755-40SS	2	13 Sep 2020	12
A2482	Band Reject Filter	Wainwright Instruments GmbH	WRCJV8-5665-5725-5850-5910-50SS	2	15 Nov 2020	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	01 Aug 2020	12
M2003	Thermohygrometer	Testo	608-H1	45046641	07 Jan 2021	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	12 Nov 2020	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	08 Aug 2020	12
A2896	Pre-Amplifier	Schwarzbeck	BBV 9721	9721 - 023	08 Feb 2020	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	08 Aug 2020	12
A2895	Antenna	Schwarzbeck	BBHA 9170	9170-728	08 Feb 2020	12
A2916	Attenuator	AtlanTechRF	AN18W5-10	832827#1	20 Feb 2020	12

Test and Measurement Equipment (continued)

Test Equipment Used for Transmitter Band Edge Radiated Emissions

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2040	Thermohygrometer	Testo	608-H1	45124934	07 Jan 2021	12
K0001	3m RSE Chamber	Rainford	N/A	N/A	16 Oct 2020	12
M2044	Test Receiver	Rohde & Schwarz	ESU26	100122	01 Apr 2020	12
A3179	Pre-Amplifier	Hewlett Packard	8449B	3008A00934	09 Oct 2020	12
A3138	Antenna	Schwarzbeck	BBHA 9120 B	00702	04 Oct 2020	12
A2523	Attenuator	AtlanTechRF	AN18W5-10	832827#1	04 Mar 2020	12
M2016	Thermohygrometer	Testo	608-H1	45046428	03 Jan 2021	12
M2003	Thermohygrometer	Testo	608-H1	45046641	07 Jan 2021	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	01 Aug 2020	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	12 Nov 2020	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	08 May 2020	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	08 Aug 2020	12
A2889	Antenna	Schwarzbeck	BBHA 9120B	BBHA 9120 B653	08 Aug 2020	12
A2916	Attenuator	AtlanTechRF	AN18W5-10	832827#1	20 Feb 2020	12

Test Measurement Software/Firmware Used

Name	Version	Release Date
UL VS LTD Replay	1	29 November 2018

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Apple
Model Name or Number:	A2251
Test Sample Serial Number:	C02ZH007P1YX *(Conducted sample #1)*
Hardware Version:	REV 1.0
Software Version:	19C19
FCC ID:	BCGA2251

Brand Name:	Apple
Model Name or Number:	A2251
Test Sample Serial Number:	C02ZG00GP22J *(Conducted sample #2)*
Hardware Version:	REV 1.0
Software Version:	19C19
FCC ID:	BCGA2251

Brand Name:	Apple
Model Name or Number:	A2251
Test Sample Serial Number:	C02ZG00KP22J *(Radiated sample #1)*
Hardware Version:	REV 1.0
Software Version:	19C19
FCC ID:	BCGA2251

Brand Name:	Apple
Model Name or Number:	A2251
Test Sample Serial Number:	C02ZG00UP22J *(Radiated sample #2)*
Hardware Version:	REV 1.0
Software Version:	19C19
FCC ID:	BCGA2251

Brand Name:	Apple
Model Name or Number:	A2251
Test Sample Serial Number:	C02ZH00BP1YX *(Radiated sample #3)*
Hardware Version:	REV 1.0
Software Version:	19C19
FCC ID:	BCGA2251

Identification of Equipment Under Test (EUT) (continued)

Brand Name:	Apple
Model Name or Number:	A2251
Test Sample Serial Number:	C02ZG00FP22J *(Radiated sample #4)*
Hardware Version:	REV 1.0
Software Version:	19C19
FCC ID:	BCGA2251

3.2. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.3. Additional Information Related to Testing

Technology Tested:	WLAN (IEEE 802.11a,n,ac) / U-NII	
Type of Unit:	Transceiver	
Modulation:	BPSK, QPSK, 16QAM, 64QAM & 256QAM	
Data rates:	802.11a	6, 9, 12, 18, 24, 36, 48 & 54 Mbps (SISO)
	802.11n HT20	MCS0 to MCS7 (1 spatial stream), (SISO, or MIMO with CDD/STBC/SDM) with or without TXBF MCS8 to MCS15 (2 spatial streams) (MIMO SDM) with or without TXBF MCS16 to MCS23 (3 spatial streams) (MIMO SDM) with or without TXBF
	802.11n HT40	MCS0 to MCS7 (1 spatial stream), (SISO, or MIMO with CDD/STBC/SDM) with or without TxBF MCS8 to MCS15 (2 spatial streams) (MIMO SDM) with or without TXBF MCS16 to MCS23 (3 spatial streams) (MIMO SDM) with or without TXBF
	802.11ac VHT20	MCS0 to MCS8 (1, 2 or 3 spatial streams) (SISO, or MIMO with CDD/STBC/SDM) with or without TXBF
	802.11ac VHT40	MCS0 to MCS9 (1, 2 or 3 spatial streams) (SISO, or MIMO with CDD/STBC/SDM) with or without TXBF
	802.11ac VHT80	MCS0 to MCS9 (1, 2 or 3 spatial streams) (SISO, or MIMO with CDD/STBC/SDM) with or without TXBF
Power Supply Requirement(s):	Nominal	Constant 3.8 VDC via 120 VAC 60 Hz AC/DC supply
Maximum Conducted Output Power:	20 MHz	18.2 dBm
	40 MHz	18.2 dBm
	80 MHz	17.3 dBm

Additional Information Related to Testing (continued)

Channel Spacing:	20 MHz		
Transmit Frequency Band:	5150 MHz to 5250 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	36	5180
	Middle	40	5200
	Top	48	5240
Transmit Frequency Band:	5250 MHz to 5350 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	52	5260
	Middle	56	5280
	Top	64	5320
Transmit Frequency Band:	5470 MHz to 5725 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	100	5500
	Middle	116	5580
	Top	140	5700
Transmit Frequency Band:	Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz		
Transmit Channel Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Single	144	5720
Transmit Frequency Band:	5725 MHz to 5850 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	149	5745
	Middle	157	5785
	Top	165	5825

Additional Information Related to Testing (continued)

Channel Spacing:	40 MHz		
Transmit Frequency Band:	5150 MHz to 5250 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	38	5190
	Top	46	5230
Transmit Frequency Band:	5250 MHz to 5350 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	54	5270
	Top	62	5310
Transmit Frequency Band:	5470 MHz to 5725 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	102	5510
	Middle	118	5590
	Top	134	5670
Transmit Frequency Band:	Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz		
Transmit Channel Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Single	142	5710
Transmit Frequency Band:	5725 MHz to 5850 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	151	5755
	Top	159	5795

Additional Information Related to Testing (continued)

Channel Spacing:	80 MHz		
Transmit Frequency Band:	5150 MHz to 5250 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Single	42	5210
Transmit Frequency Band:	5250 MHz to 5350 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Single	58	5290
Transmit Frequency Band:	5470 MHz to 5725 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	106	5530
	Top	122	5610
Transmit Frequency Band:	Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz		
Transmit Channel Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Single	138	5690
Transmit Frequency Band:	5725 MHz to 5850 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Single	155	5775

3.4. Description of Available Antennas

The radio utilizes three integrated antennas, with the following maximum gains:

Frequency Band (MHz)	$G_{Antenna\ Core\ 0}$ (dBi)	$G_{Antenna\ Core\ 1}$ (dBi)	$G_{Antenna\ Core\ 2}$ (dBi)
5150 to 5250	5.6	5.0	4.0
5250 to 5350	5.2	4.2	3.3
5470 to 5725	4.3	3.2	3.0
5725 to 5850	4.4	3.2	3.0

Directional Antenna Gain for Correlated Signals (CDD) / Output Power Measurements:

Frequency Band (MHz)	$G_{Antennas\ Core\ 0\ \&\ Core\ 1}$ (dBi)	$G_{Antennas\ Core\ 0\ \&\ Core\ 2}$ (dBi)	$G_{Antennas\ Core\ 1,\ Core\ 0,\ Core\ 2}$ (dBi)
5150 to 5250	5.6	-	5.6
5250 to 5350	5.2	-	5.2
5470 to 5725	4.3	-	4.3
5725 to 5850	4.4	-	4.4

Directional Antenna Gain for Correlated Signals (CDD) / PSD Measurements:

Frequency Band (MHz)	$G_{Antennas\ Core\ 0\ \&\ Core\ 1}$ (dBi)	$G_{Antennas\ Core\ 0\ \&\ Core\ 2}$ (dBi)	$G_{Antennas\ Core\ 1,\ Core\ 0,\ Core\ 2}$ (dBi)
5150 to 5250	8.3	-	9.7
5250 to 5350	7.7	-	9.0
5470 to 5725	6.8	-	8.3
5725 to 5850	6.8	-	8.3

Directional Antenna Gain for Uncorrelated Signals (SDM):

Frequency Band (MHz)	$G_{Antennas\ Core\ 0\ \&\ Core\ 1}$ (dBi)	$G_{Antennas\ Core\ 0\ \&\ Core\ 2}$ (dBi)	$G_{Antennas\ Core\ 1,\ Core\ 0,\ Core\ 2}$ (dBi)
5150 to 5250	5.3	-	4.9
5250 to 5350	4.7	-	4.3
5470 to 5725	3.8	-	3.5
5725 to 5850	3.8	-	3.6

Directional Antenna Gain for Correlated Signals (TXBF):

Frequency Band (MHz)	$G_{Antennas\ Core\ 0\ \&\ Core\ 1}$ (dBi)	$G_{Antennas\ Core\ 0\ \&\ Core\ 2}$ (dBi)	$G_{Antennas\ Core\ 1,\ Core\ 0,\ Core\ 2}$ (dBi)
5150 to 5250	8.3	-	9.7
5250 to 5350	7.7	-	9.0
5470 to 5725	6.8	-	8.3
5725 to 5850	6.8	-	8.3

Refer to Appendix 1 of this test report for directional antenna gain calculations.

3.5. Description of Test Setup

Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	USB-C Power Adapter
Brand Name:	Apple
Model Name or Number:	A1947
Serial Number:	Not marked or stated

Description:	USB-C Cable. Length 2 m.
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Personal Hands Free (PHF)
Brand Name:	Apple
Model Name or Number:	Apple EarPods
Serial Number:	Not marked or stated

Description:	USB-C to USB Adapter. Quantity 3.
Brand Name:	Apple
Model Name or Number:	A1632
Serial Number:	Not marked or stated

Description:	USB Cable Type A. Quantity 3. Length 3 m.
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Test Laptop
Brand Name:	Apple
Model Name or Number:	MacBook Pro
Serial Number:	C02TF03QHT76

Description:	USB Hub
Brand Name:	Belkin
Model Name or Number:	F5U404-BLK
Serial Number:	Not marked or stated

Support Equipment (continued)

Description:	USB Hub
Brand Name:	Hama
Model Name or Number:	Not marked or stated
Serial Number:	00078498

Operating Modes

The EUT was tested in the following operating mode(s):

- Continuously transmitting with a modulated carrier at maximum power on the bottom, middle and top channels as required using the supported data rates/modulation types.

Configuration and Peripherals

The EUT was tested in the following configuration(s):

- Controlled in test mode using a software application on the EUT supplied by the customer. The application was used to enable a continuous transmission and to select the test channels as required.
- For TXBF modes, the EUT was communicating via a conducted RF link with an equivalent device. The EUT ran iPerf bandwidth testing application in client mode to produce maximum throughput. The customer supplied a document containing the setup instructions 'EUT_TXBF_operating procedures_v1.pdf'.
- The customer supplied U.FL RF cables with the EUT in order to perform conducted measurements. The measured additional path loss was included in any path loss calculations.
- Transmitter spurious emissions were performed with the EUT transmitting with a data rate of 802.11n HT20 / MCS0 / MIMO 3Tx CDD & 802.11n HT20 / MCS0 / MIMO 3Tx SDM.
- Transmitter radiated spurious emissions tests were performed with the AC Charger, USB cables and PHF connected to the EUT. The USB-C ports were connected via a USB C-A adaptor and USB cable to a hub. The hub was placed outside the chamber.
- The EUT was powered from a 120 VAC 60 Hz single phase mains supply.

Configuration and Peripherals (continued)

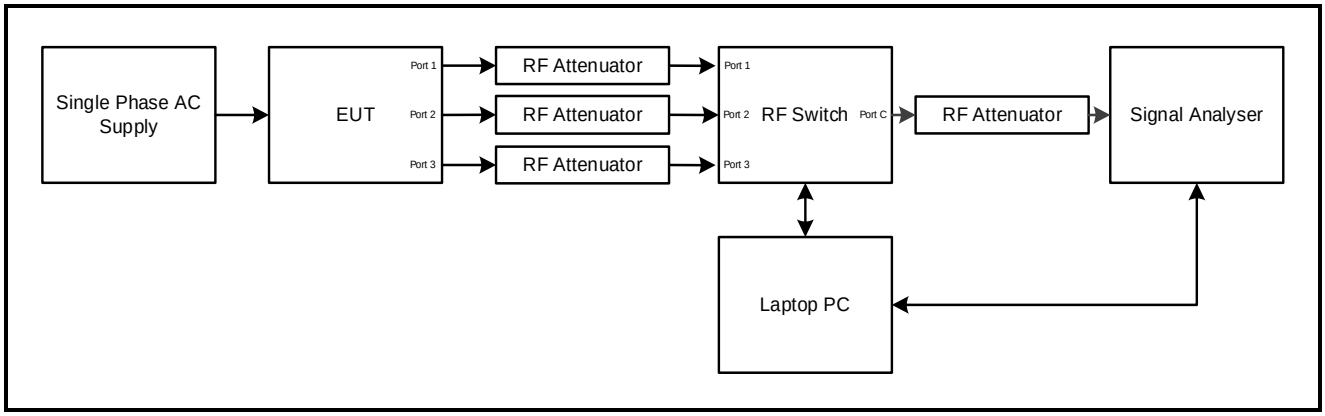
The EUT was tested in the following configuration(s):

- The customer requested the following data rates to be used for all measurements.
  - 802.11a SISO - BPSK / 6 Mbps / Core 0
  - 802.11n HT20 / SISO – BPSK / MCS0 / Core 0
  - 802.11n HT40 / SISO – BPSK / MCS0 / Core 0
  - 802.11ac VHT80 / SISO – BPSK / MCS0 / Core 0
  - 802.11n HT20 / MIMO / 2Tx CDD – BPSK / MCS0 / Core 0 & Core 1
  - 802.11n HT40 / MIMO / 2Tx CDD – BPSK / MCS0 / Core 0 & Core 1
  - 802.11ac VHT80 / MIMO / 2Tx CDD – BPSK / MCS0x1 / Core 0 & Core 1
  - 802.11n HT20 / MIMO / 2Tx SDM – BPSK / MCS8 / Core 0 & Core 1
  - 802.11n HT40 / MIMO / 2Tx SDM – BPSK / MCS8 / Core 0 & Core 1
  - 802.11ac VHT80 / MIMO / 2Tx SDM – BPSK / MCS0x2 / Core 0 & Core 1
  - 802.11n HT20 / MIMO / 2Tx TXBF – BPSK / MCS0 / Core 0 & Core 1
  - 802.11n HT40 / MIMO / 2Tx TXBF – BPSK / MCS0 / Core 0 & Core 1
  - 802.11ac VHT80 / MIMO / 2Tx TXBF – BPSK / MCS0x1 / Core 0 & Core 1
  - 802.11n HT20 / MIMO / 3Tx CDD – BPSK / MCS0 / Core 0, Core 1 & Core 2
  - 802.11n HT40 / MIMO / 3Tx CDD – BPSK / MCS0 / Core 0, Core 1 & Core 2
  - 802.11ac VHT80 / MIMO / 3Tx CDD – BPSK / MCS0x1 / Core 0, Core 1 & Core 2
  - 802.11n HT20 / MIMO / 3Tx SDM – BPSK / MCS16 / Core 0, Core 1 & Core 2
  - 802.11n HT40 / MIMO / 3Tx SDM – BPSK / MCS16 / Core 0, Core 1 & Core 2
  - 802.11ac VHT80 / MIMO / 3Tx SDM – BPSK / MCS0x3 / Core 0, Core 1 & Core 2
  - 802.11n HT20 / MIMO / 3Tx TXBF – BPSK / MCS0 / Core 0, Core 1 & Core 2
  - 802.11n HT40 / MIMO / 3Tx TXBF – BPSK / MCS0 / Core 0, Core 1 & Core 2
  - 802.11ac VHT80 / MIMO / 3Tx TXBF – BPSK / MCS0x1 / Core 0, Core 1 & Core 2
- The EUT has three separate antennas which correspond to three separate antenna ports. Core 0, Core 1 and Core 2 correspond to antenna 1, antenna 2 and antenna 3 respectively.

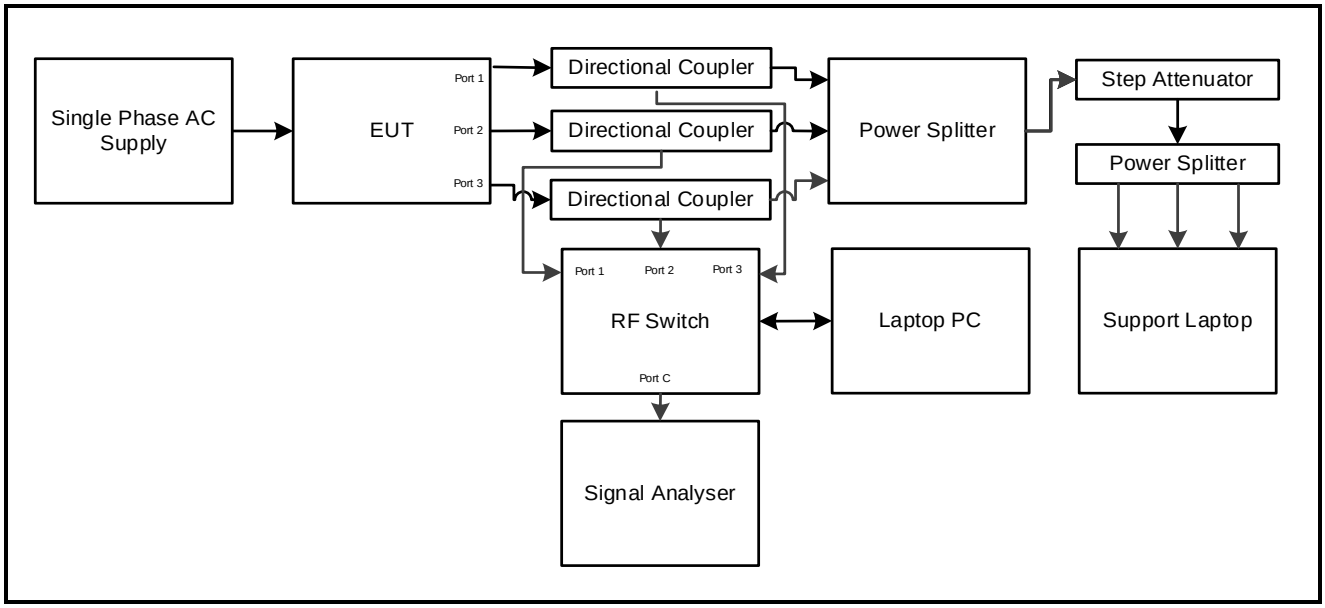
Test Setup Diagrams

Conducted Tests:

Test Setup for Transmitter Conducted Tests (non-TXBF)



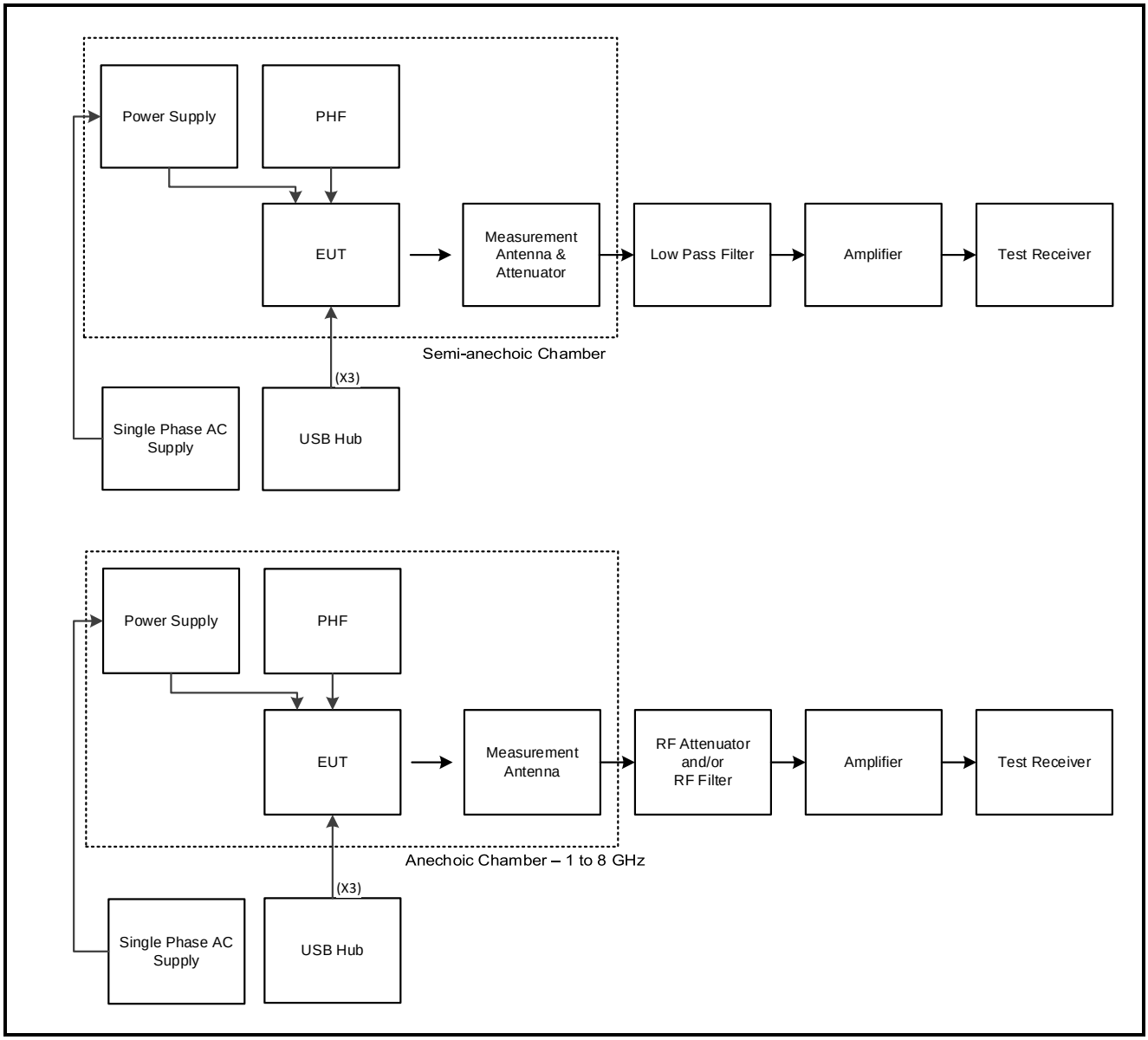
Test Setup for Transmitter Conducted Tests (TXBF)



Test Setup Diagrams (continued)

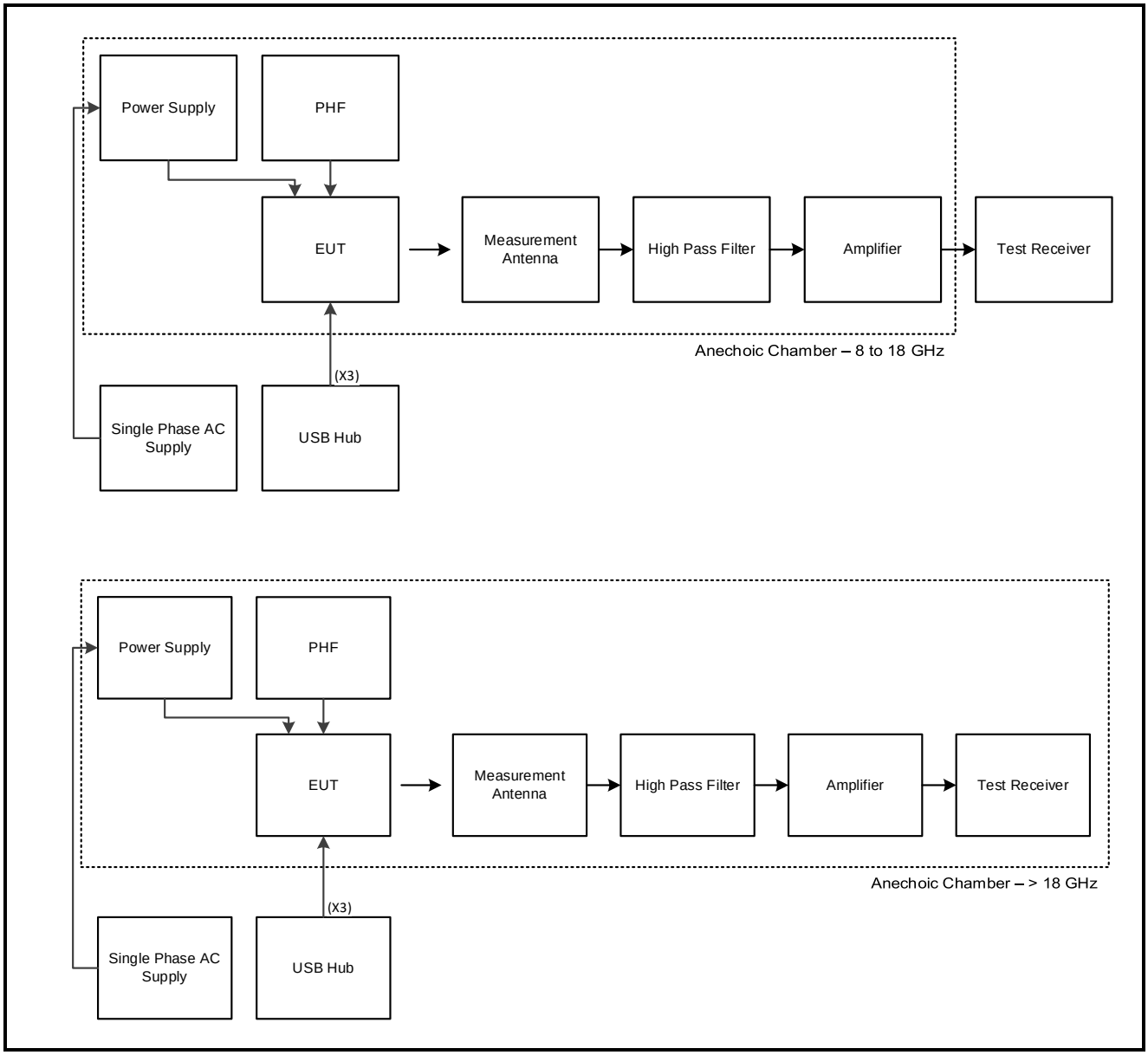
Radiated Tests:

Test Setup for Transmitter Radiated Emissions



Test Setup Diagrams (continued)

Test Setup for Transmitter Radiated Emissions



4. Antenna Port Test Results

4.1. Transmitter Duty Cycle

Test Summary:

Test Engineers:	Max Passell & Matthew Botfield	**Test Dates:**	04 December 2019 to 17 December 2019
Test Sample Serial Numbers:	C02ZH007P1YX & C02ZG00GP22J		

FCC Reference:	Part 15.35(c)
Test Method Used:	KDB 789033 D02 Section II.B.2.b)

Environmental Conditions:

Temperature (°C):	21 to 24
Relative Humidity (%):	35 to 46

Note(s):

1. In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

10 log 1 / (On Time / [Period or 100ms whichever is the lesser]).

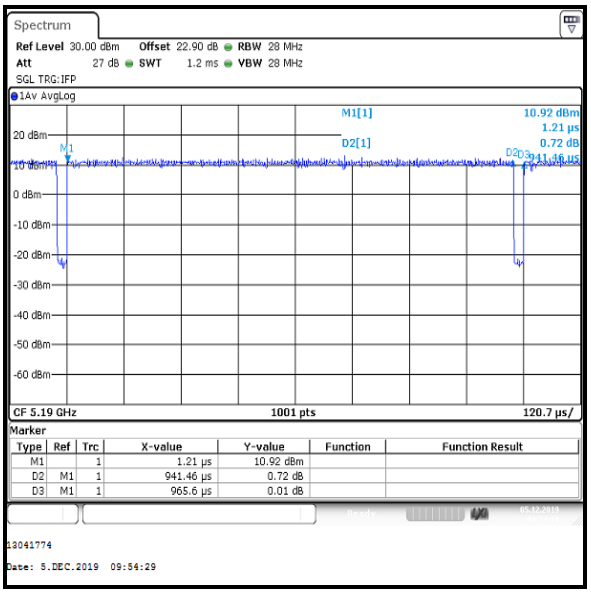
802.11n HT40 / SISO / MCS0 duty cycle: 10 log (1 / (0.9415/0.9656)) = 0.1
802.11ac VHT80 / SISO / MCS0 duty cycle: 10 log (1 / (0.5364/0.5569)) = 0.2
802.11n HT40 / MIMO / 2Tx CDD / MCS0 duty cycle: 10 log (1 / (0.9415/0.9656)) = 0.1
802.11ac VHT80 / MIMO / 2Tx CDD / MCS0x1 duty cycle: 10 log (1 / (0.4587/0.4816)) = 0.2
802.11n HT20 / MIMO / 2Tx SDM / MCS8 duty cycle: 10 log (1 / (0.9817/1.0056)) = 0.1
802.11n HT40 / MIMO / 2Tx SDM / MCS8 duty cycle: 10 log (1 / (0.4950/0.5176)) = 0.2
802.11ac VHT80 / MIMO / 2Tx SDM / MCS0x2 duty cycle: 10 log (1 / (0.2554/0.2773)) = 0.4
802.11n HT20 / MIMO / 2Tx TXBF / MCS0 duty cycle: 10 log (1 / (3.830/3.950)) = 0.1
802.11n HT40 / MIMO / 2Tx TXBF / MCS0 duty cycle: 10 log (1 / (4.610/4.720)) = 0.1
802.11ac VHT80 / MIMO / 2Tx TXBF / MCS0x1 duty cycle: 10 log (1 / (5.100/5.200)) = 0.1
802.11n HT40 / MIMO / 3Tx CDD / MCS0 duty cycle: 10 log (1 / (0.9415/0.9656)) = 0.1
802.11ac VHT80 / MIMO / 3Tx CDD / MCS0 duty cycle: 10 log (1 / (0.4587/0.4816)) = 0.2
802.11n HT20 / MIMO / 3Tx SDM / MCS16 duty cycle: 10 log (1 / (0.6749/0.6976)) = 0.1
802.11n HT40 / MIMO / 3Tx SDM / MCS16 duty cycle: 10 log (1 / (0.3517/0.3731)) = 0.3
802.11ac VHT80 / MIMO / 3Tx SDM / MCS0X3 duty cycle: 10 log (1 / (0.1916/0.2131)) = 0.5
802.11n HT20 / MIMO / 3Tx TXBF / MCS0 duty cycle: 10 log (1 / (3.840/3.950)) = 0.1
802.11n HT40 / MIMO / 3Tx TXBF / MCS0 duty cycle: 10 log (1 / (4.610/4.710)) = 0.1
802.11ac VHT80 / MIMO / 3Tx TXBF / MCS0 duty cycle: 10 log (1 / (5.100/5.200)) = 0.1

2. Plots below are for data rates with a duty cycle less than 98%. Results for all other modes having a duty cycle >98% are archived on the UL VS LTD IT server and available for inspection if required.
3. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cables. An RF level offset was entered on the signal analyser to compensate for the loss of the switch, attenuators and RF cables.

Transmitter Duty Cycle (continued)

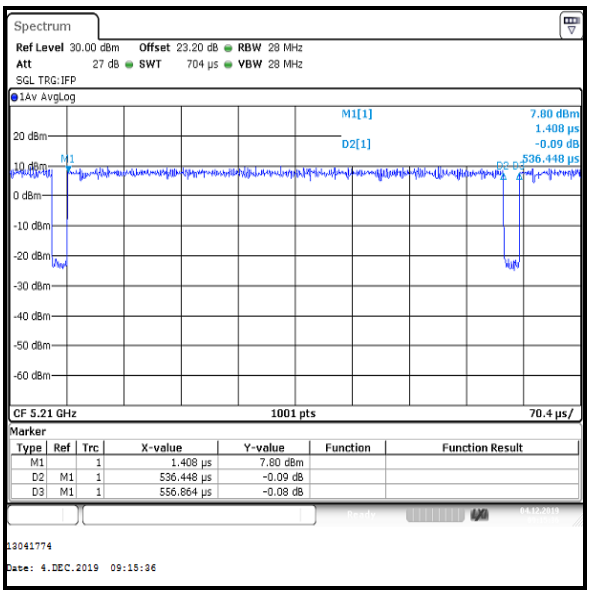
Results: 802.11n / 40 MHz / SISO / MCS0

Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.9415	0.9656	0.1



Results: 802.11ac / 80 MHz / SISO / MCS0

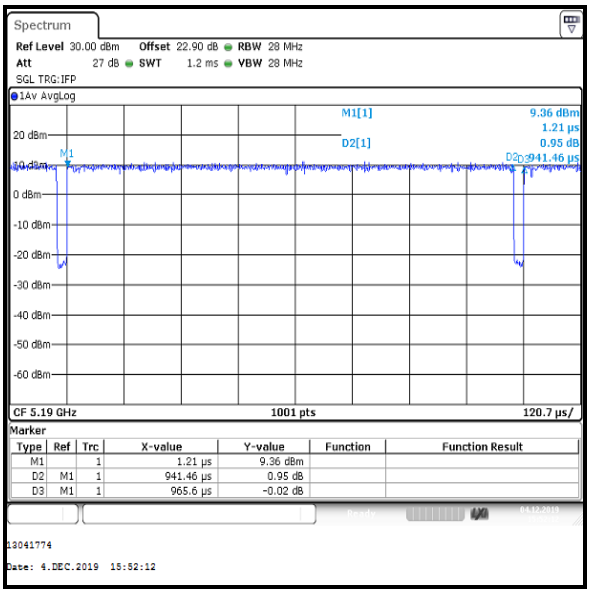
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.5364	0.5569	0.2



Transmitter Duty Cycle (continued)

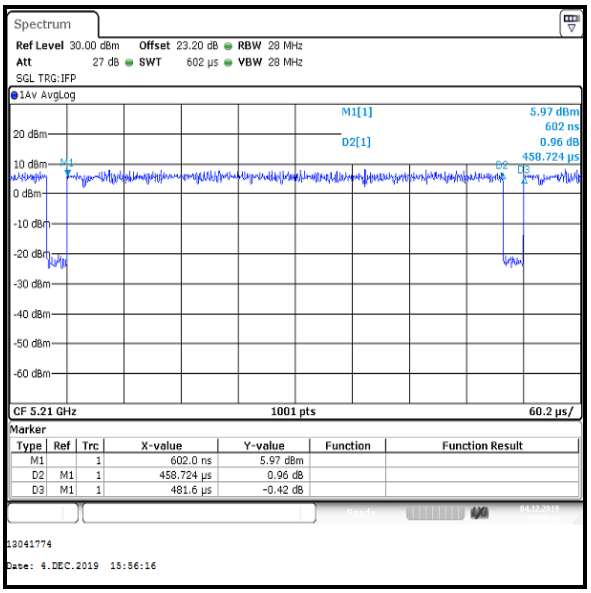
Results: 802.11n / 40 MHz / MIMO / 2Tx CDD / MCS0

Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.9415	0.9656	0.1



Results: 802.11ac / 80 MHz / MIMO / 2Tx CDD / MCS0

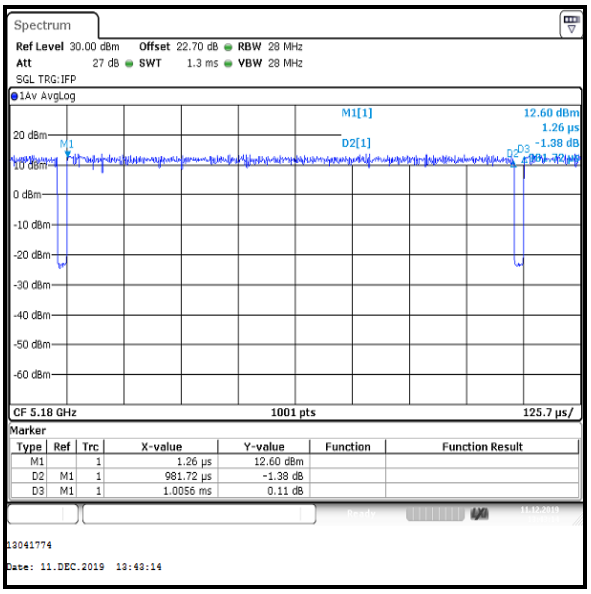
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.4587	0.4816	0.2



Transmitter Duty Cycle (continued)

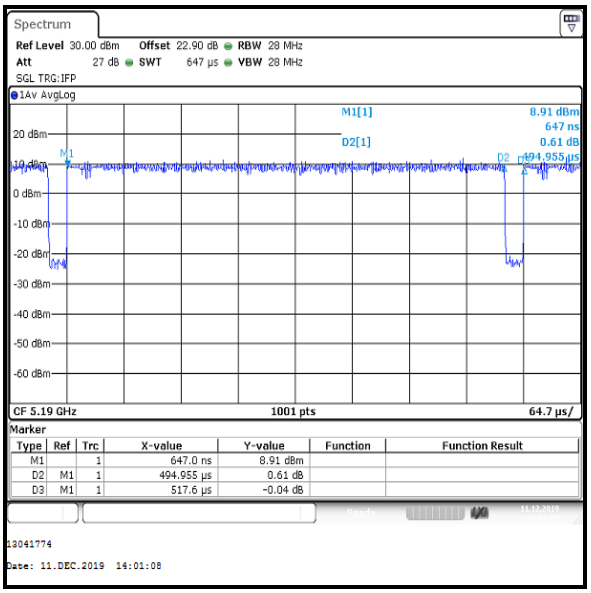
Results: 802.11n / 20 MHz / MIMO / 2Tx SDM / MCS8

Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.9817	1.0056	0.1



Results: 802.11n / 40 MHz / MIMO / 2Tx SDM / MCS8

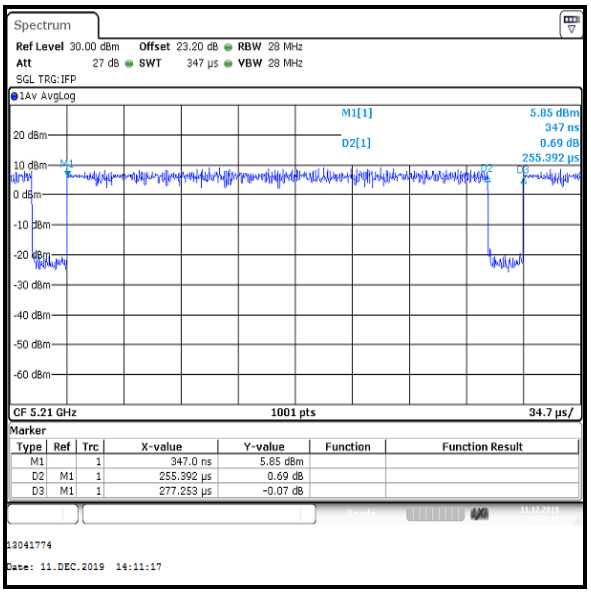
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.4950	0.5176	0.2



Transmitter Duty Cycle (continued)

Results: 802.11ac / 80 MHz / MIMO / 2Tx SDM / MCS0x2

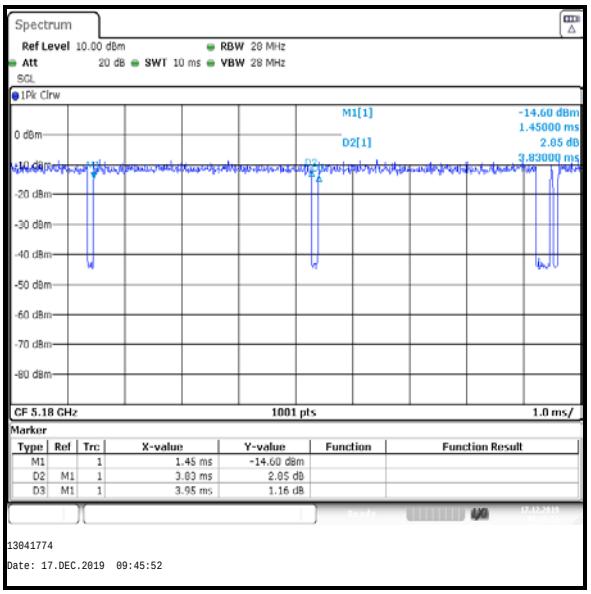
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.2554	0.2773	0.4



Transmitter Duty Cycle (continued)

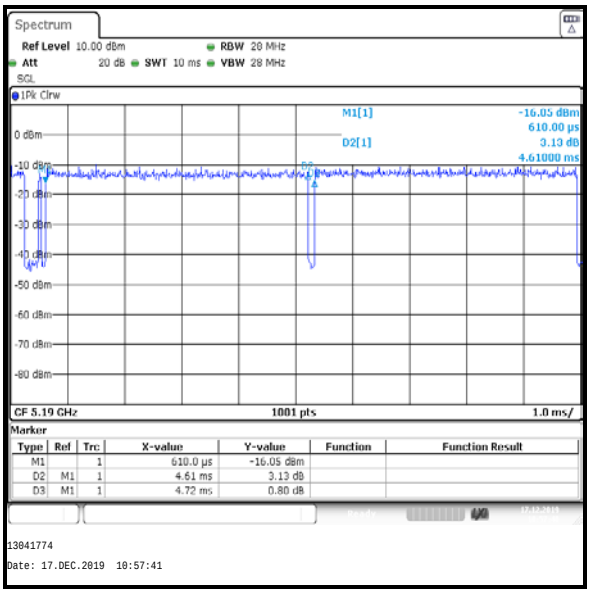
Results: 802.11n / 20 MHz / MIMO / 2Tx TXBF / MCS0

Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
3.830	3.950	0.1



Results: 802.11n / 40 MHz / MIMO / 2Tx TXBF / MCS0

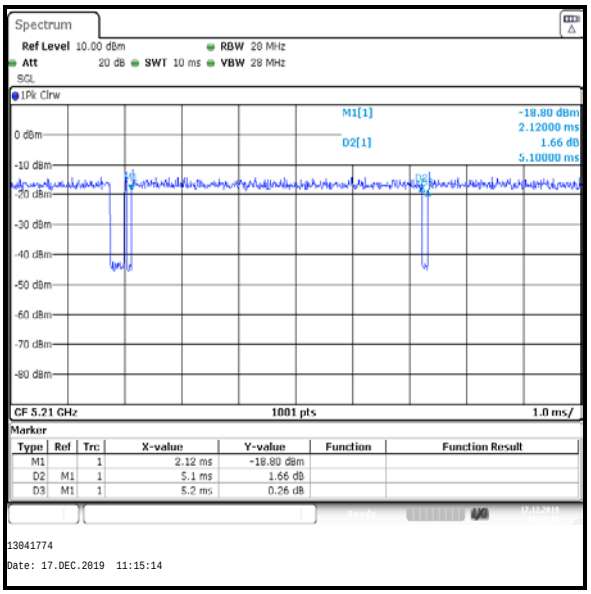
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
4.610	4.720	0.1



Transmitter Duty Cycle (continued)

Results: 802.11ac / 80 MHz / MIMO / 2Tx TXBF / MCS0

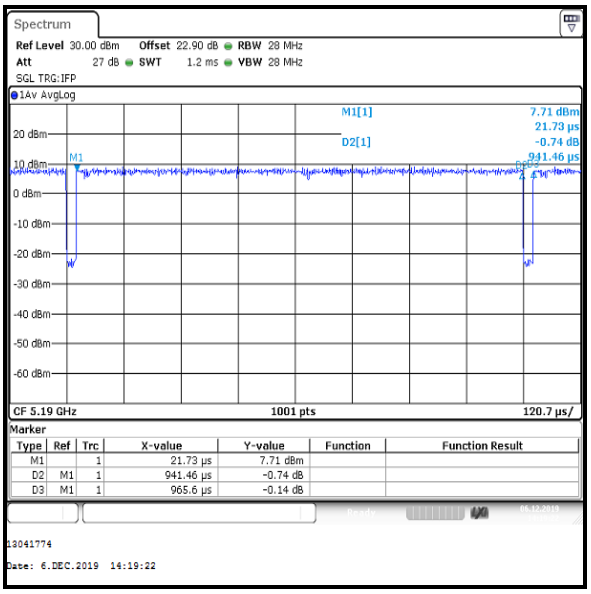
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
5.100	5.200	0.1



Transmitter Duty Cycle (continued)

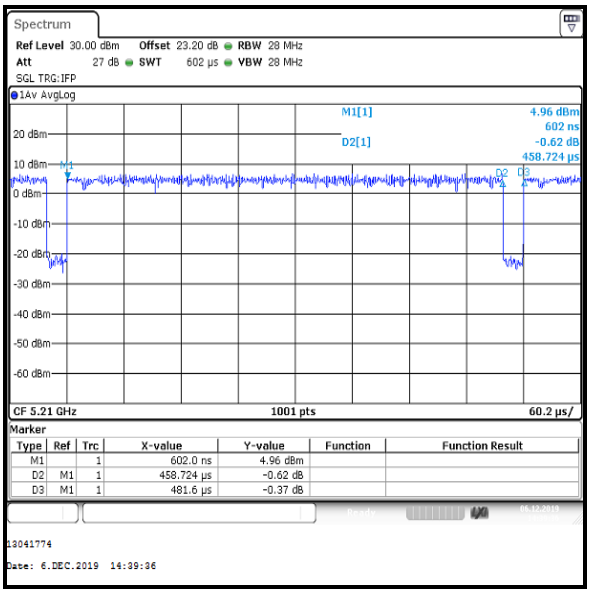
Results: 802.11n / 40 MHz / MIMO / 3Tx CDD / MCS0

Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.9415	0.9656	0.1



Results: 802.11ac / 80 MHz / MIMO / 3Tx CDD / MCS0

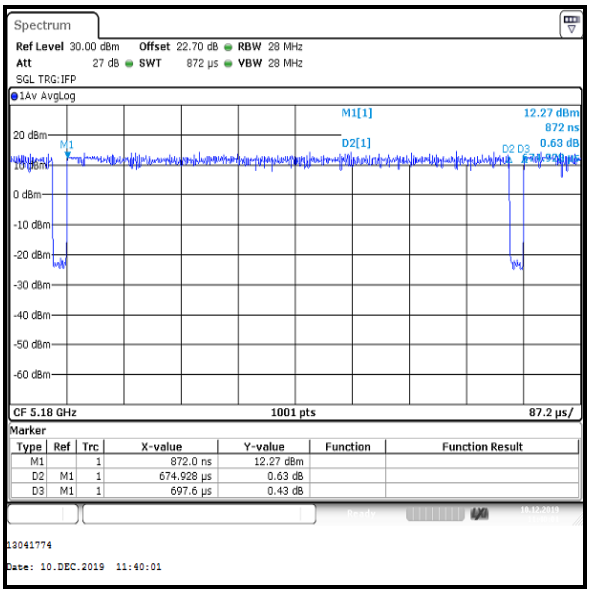
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.4587	0.4816	0.2



Transmitter Duty Cycle (continued)

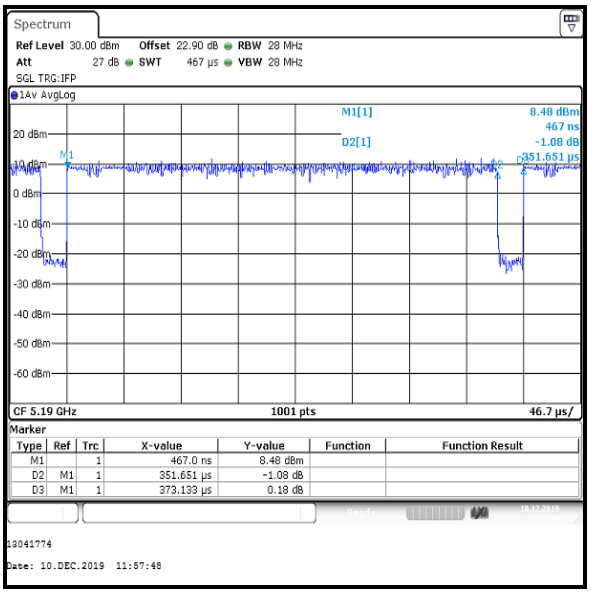
Results: 802.11n / 20 MHz / MIMO / 3Tx SDM / MCS16

Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.6749	0.6976	0.1



Results: 802.11n / 40 MHz / MIMO / 3Tx SDM / MCS16

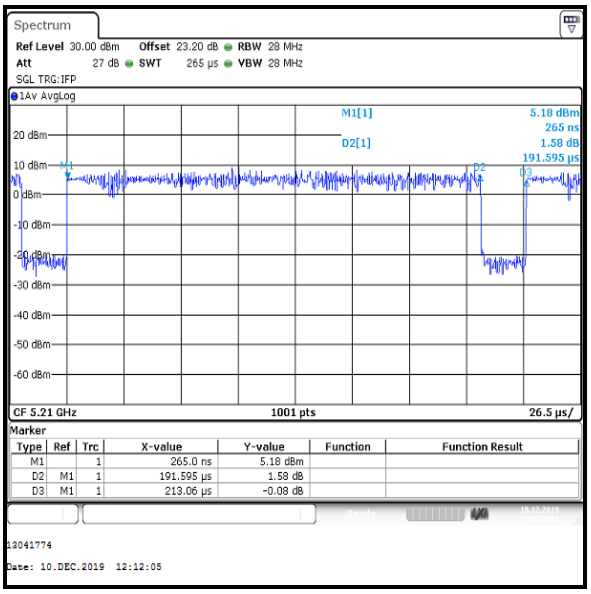
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.3517	0.3731	0.3



Transmitter Duty Cycle (continued)

Results: 802.11ac / 80 MHz / MIMO / 3Tx SDM / MCS0x3

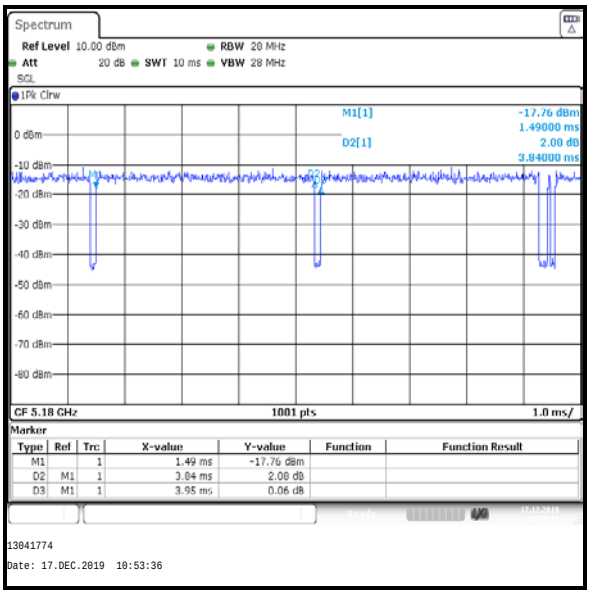
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
0.1916	0.2131	0.5



Transmitter Duty Cycle (continued)

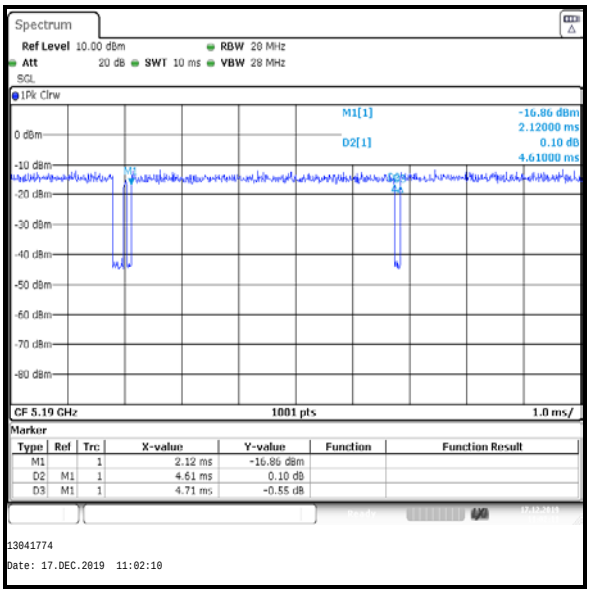
Results: 802.11n / 20 MHz / MIMO / 3Tx TXBF / MCS0

Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
3.840	3.950	0.1



Results: 802.11n / 40 MHz / MIMO / 3Tx TXBF / MCS0

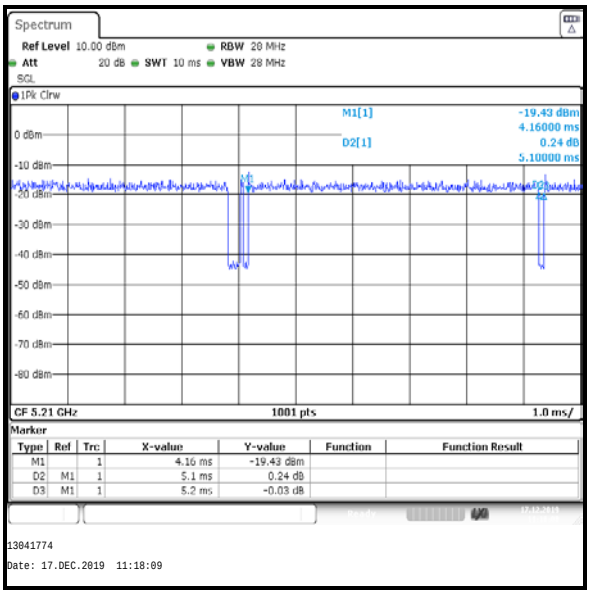
Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
4.610	4.710	0.1



Transmitter Duty Cycle (continued)

Results: 802.11ac / 80 MHz / MIMO / 3Tx TXBF / MCS0

Pulse Duration (ms)	Period (ms)	Duty Cycle Correction factor (dB)
5.100	5.200	0.1



4.2. Transmitter 26 dB Emission Bandwidth

Test Summary:

Test Engineers:	Max Passell & Matthew Botfield	**Test Dates:**	03 December 2019 to 08 April 2020
Test Sample Serial Numbers:	C02ZH007P1YX & C02ZG00GP22J		

FCC Reference:	Part 15.403(i)
Test Method Used:	KDB 789033 D02 Section II.C.1.

Environmental Conditions:

Temperatures (°C):	21 to 24
Relative Humidity (%):	28 to 46

Note(s):

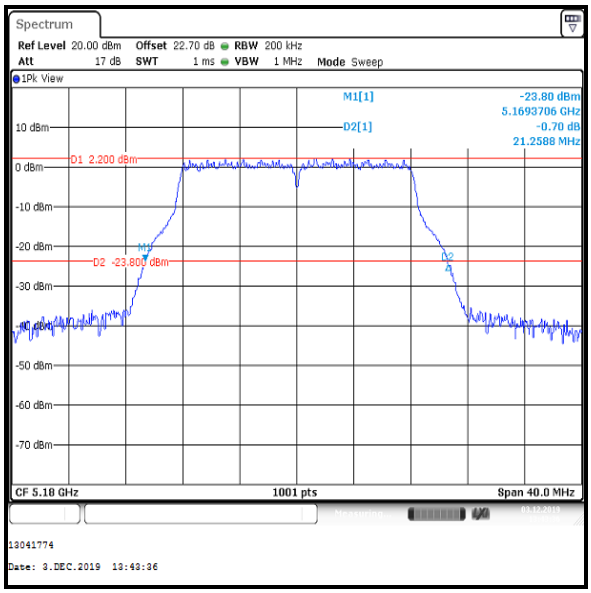
1. Measurements were performed on data rates detailed in Section 3.5 on the relevant channels.
2. The signal analyser's resolution bandwidth was set to approximately 1% of the measured 26 dB emission bandwidth.
3. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cables. An RF level offset was entered on the signal analyser to compensate for the loss of the switch, attenuators and RF cables.
4. For channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz, emission bandwidth measurements were performed twice. Measurements of the entire 26 dB emission bandwidth that is contained on both U-NII-2C and U-NII-3 bands, were used for power measurements. Measurements on the emission's portion that is contained only within the U-NII-2C band, were used to calculate the conducted power limit on U-NII-2C tests. These are labelled as 'Reference plots'.
5. The EUT with serial number C02ZH007P1YX was used for non-TXBF tests, the EUT with serial C02ZG00GP22J number was used for TXBF tests.

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

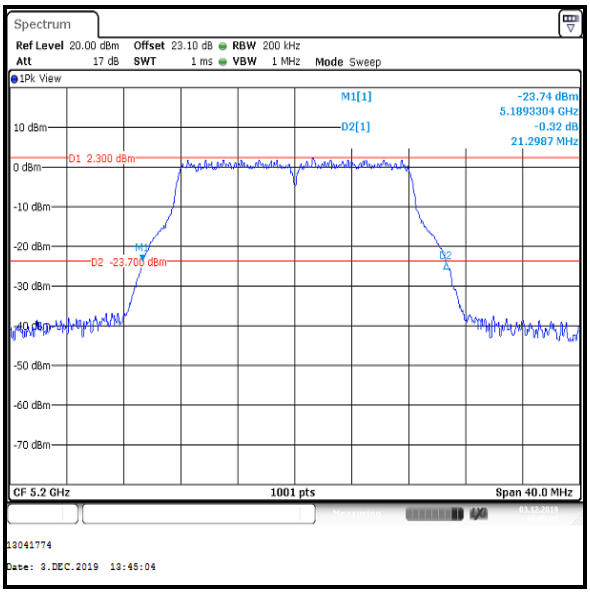
4.2.1. 5.15-5.25 GHz band

Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 0

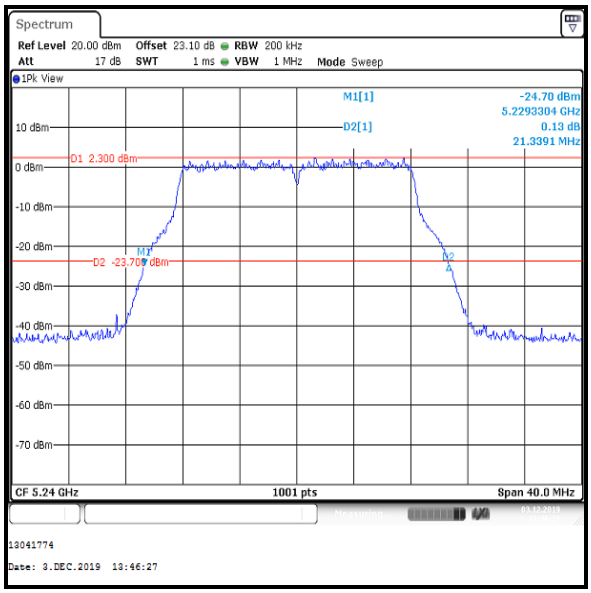
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.259
Middle	5200	21.299
Top	5240	21.339



Bottom Channel



Middle Channel

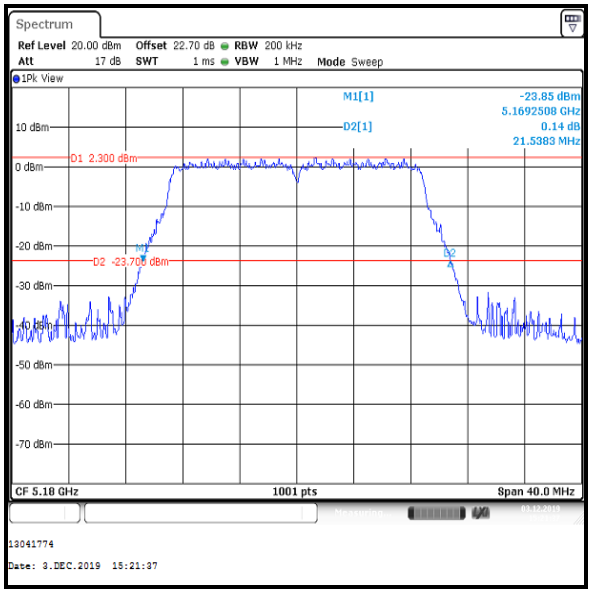


Top Channel

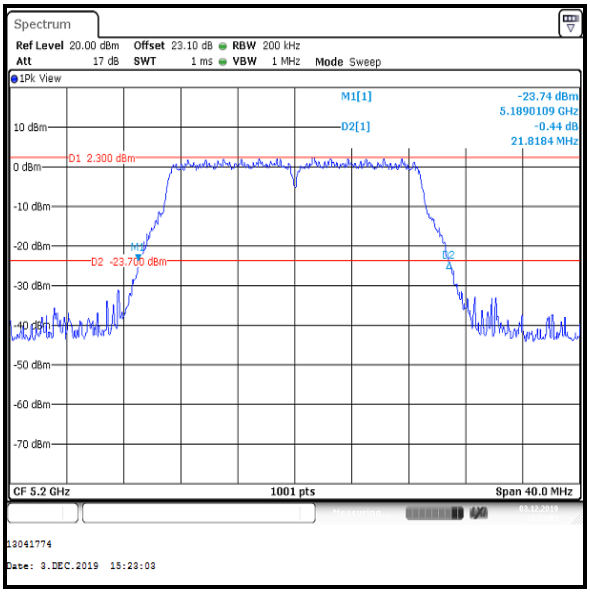
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 0

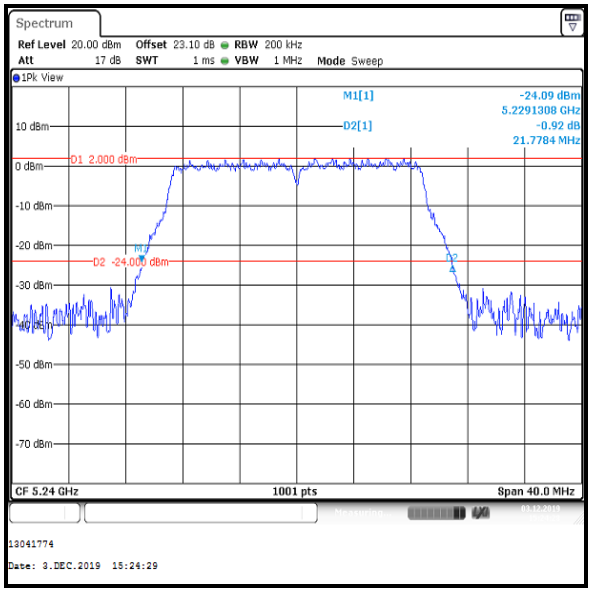
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.538
Middle	5200	21.818
Top	5240	21.778



Bottom Channel



Middle Channel

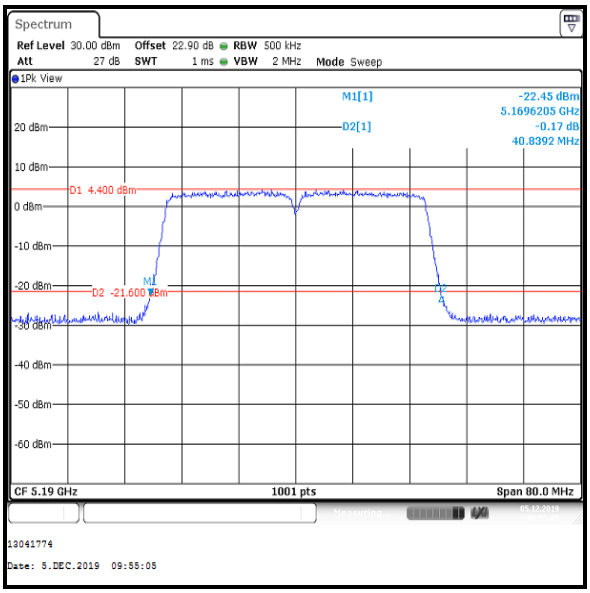


Top Channel

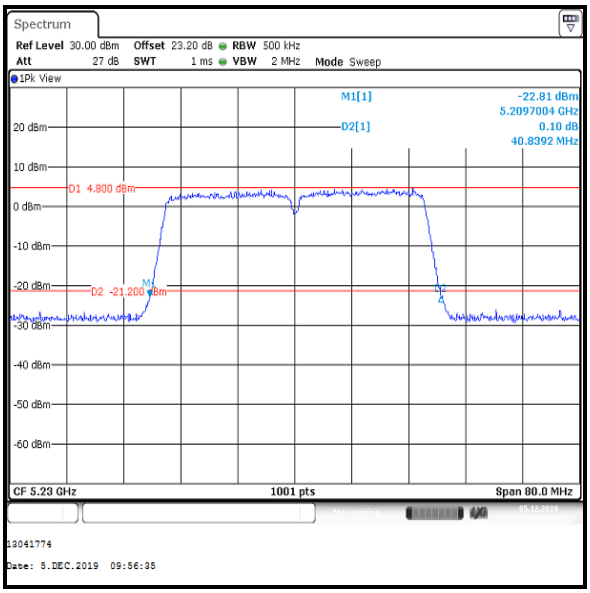
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.839
Top	5230	40.839



Bottom Channel

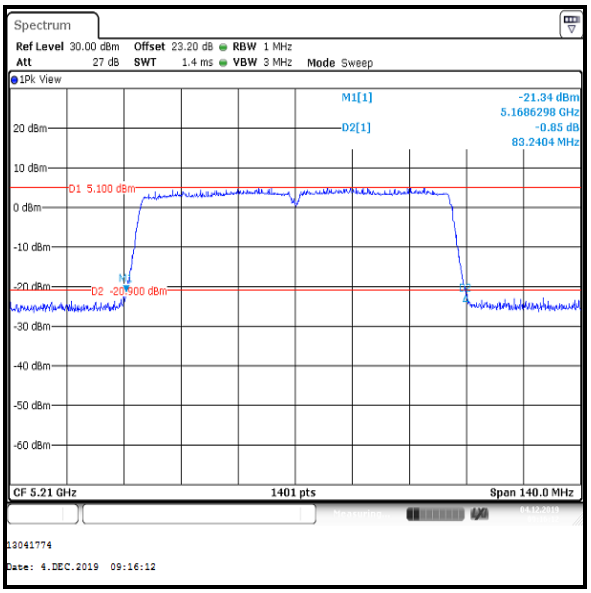


Top Channel

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	83.240

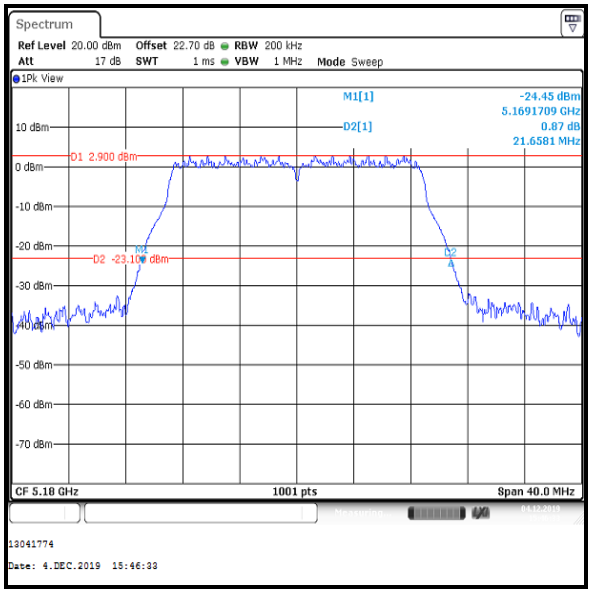


Single Channel

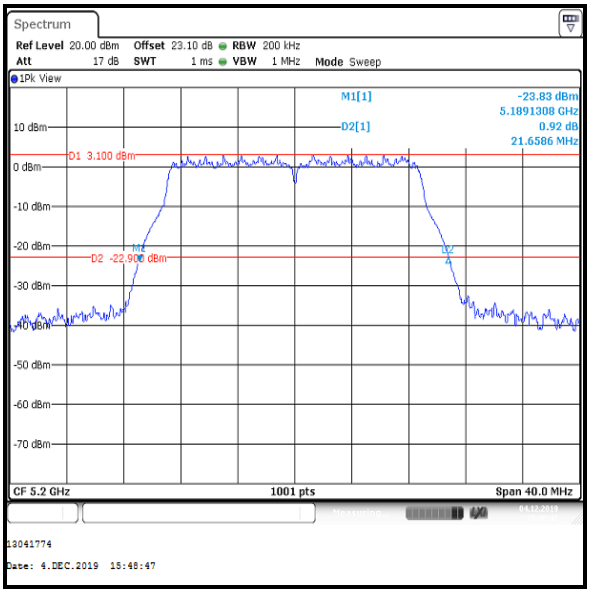
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 2Tx CDD / BPSK / MCS0 / Core 0

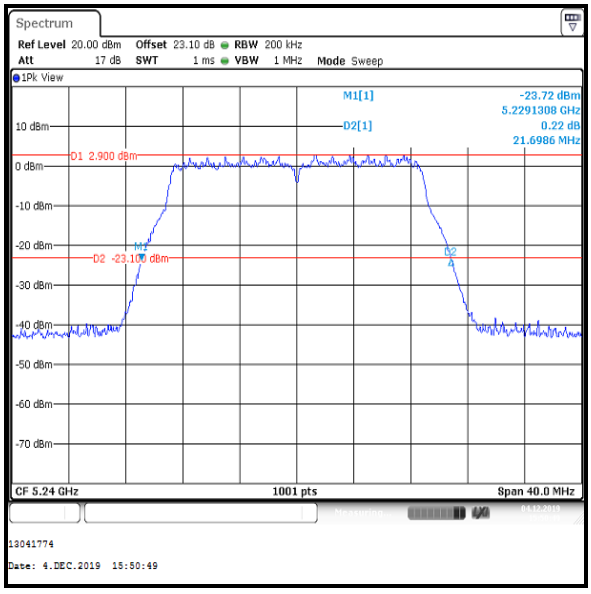
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.658
Middle	5200	21.659
Top	5240	21.699



Bottom Channel



Middle Channel

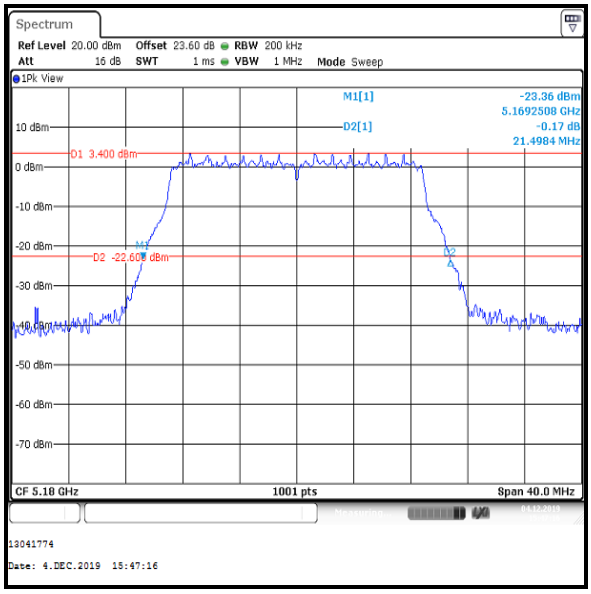


Top Channel

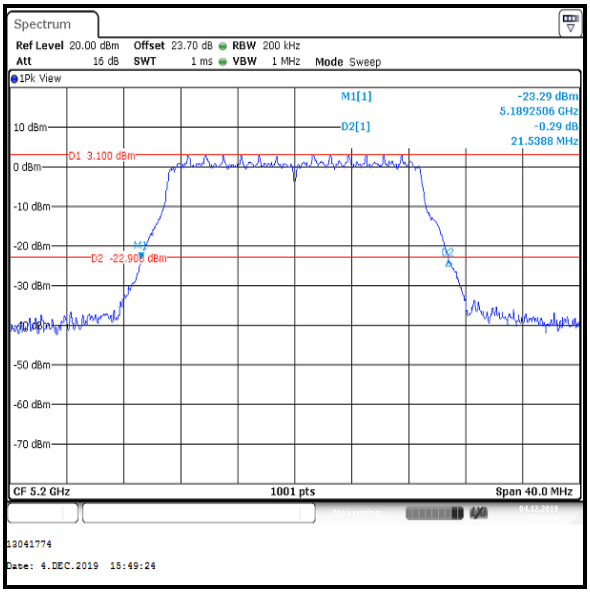
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 2Tx CDD / BPSK / MCS0 / Core 1

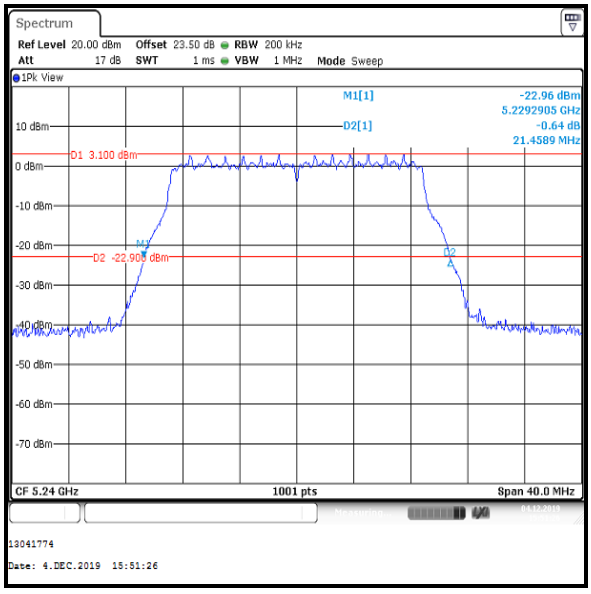
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.498
Middle	5200	21.539
Top	5240	21.459



Bottom Channel



Middle Channel

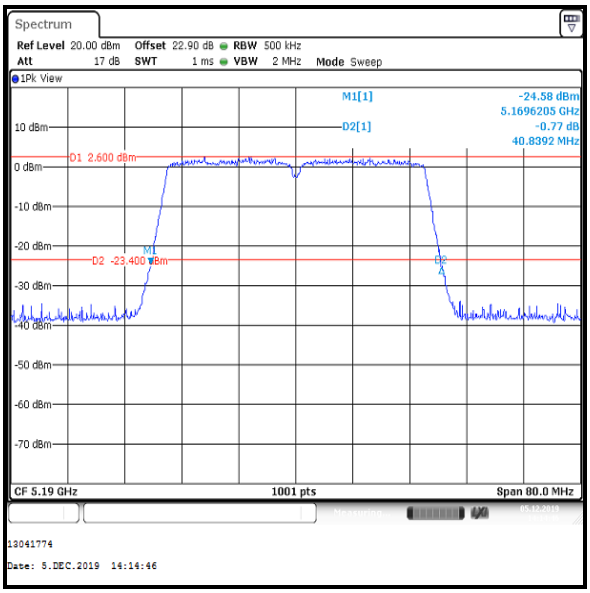


Top Channel

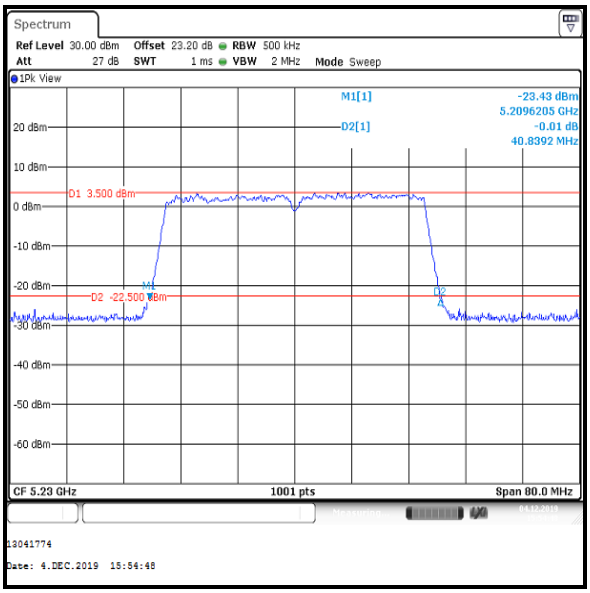
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 2Tx CDD / BPSK / MCS0 / Core 0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.839
Top	5230	40.839



Bottom Channel

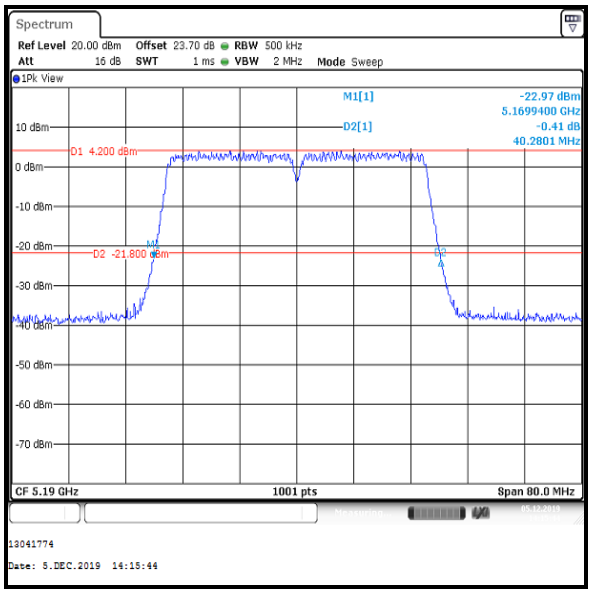


Top Channel

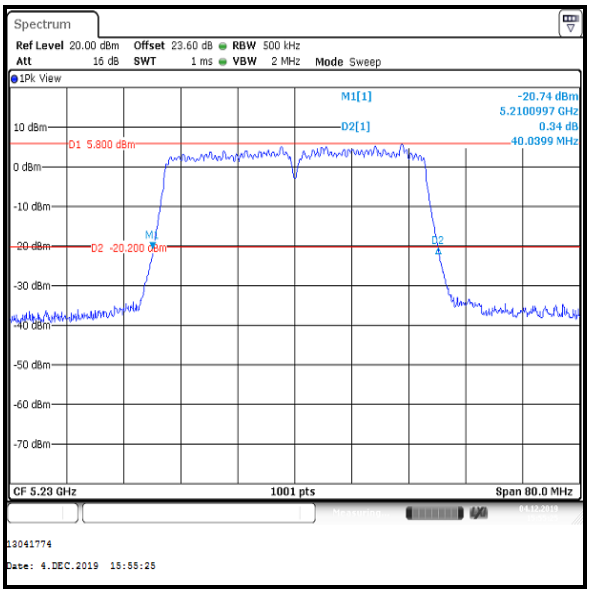
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 2Tx CDD / BPSK / MCS0 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.280
Top	5230	40.040



Bottom Channel

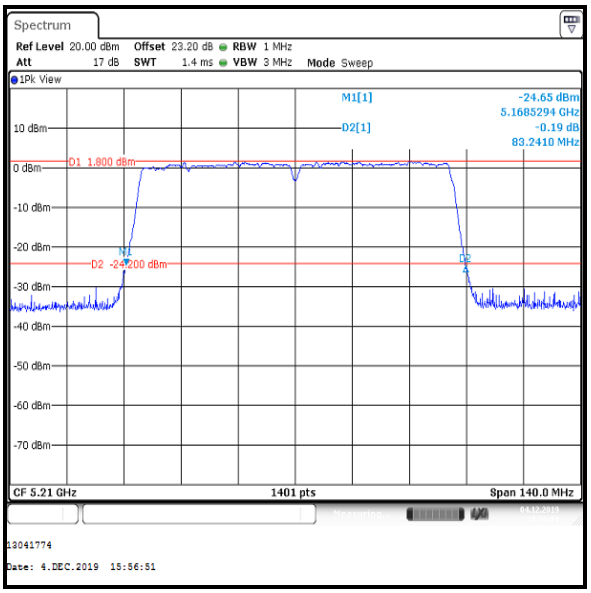


Top Channel

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11ac / 80 MHz / MIMO / 2Tx CDD / BPSK / MCS0x1 / Core 0

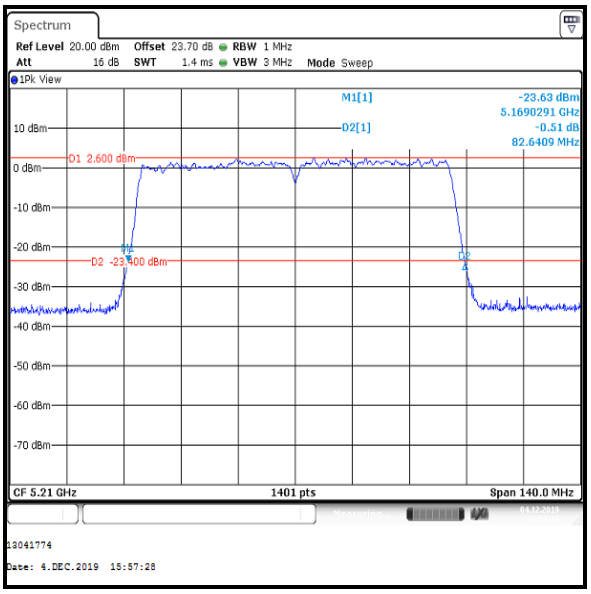
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	83.241



Single Channel

Results: 802.11ac / 80 MHz / MIMO / 2Tx CDD / BPSK / MCS0x1 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.641

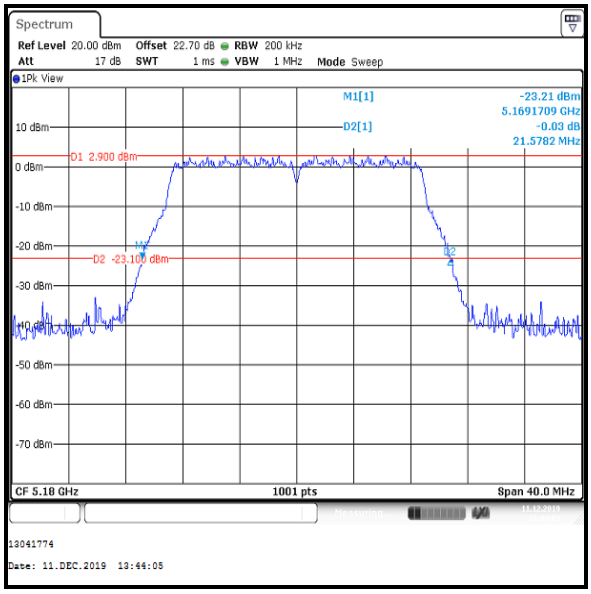


Single Channel

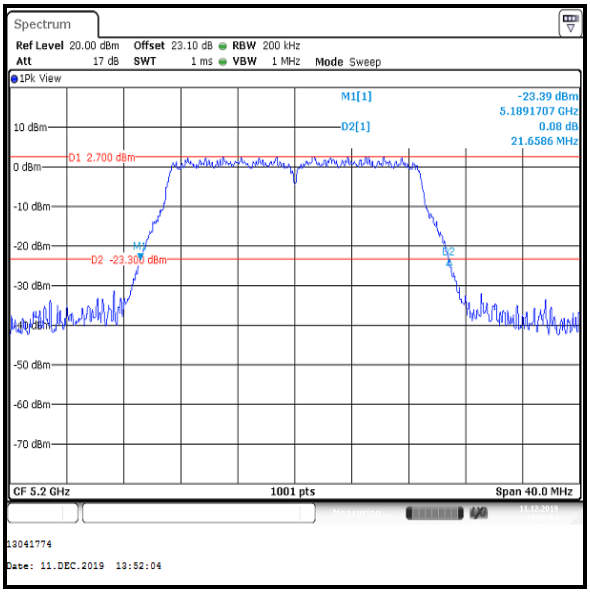
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 2Tx SDM / BPSK / MCS8 / Core 0

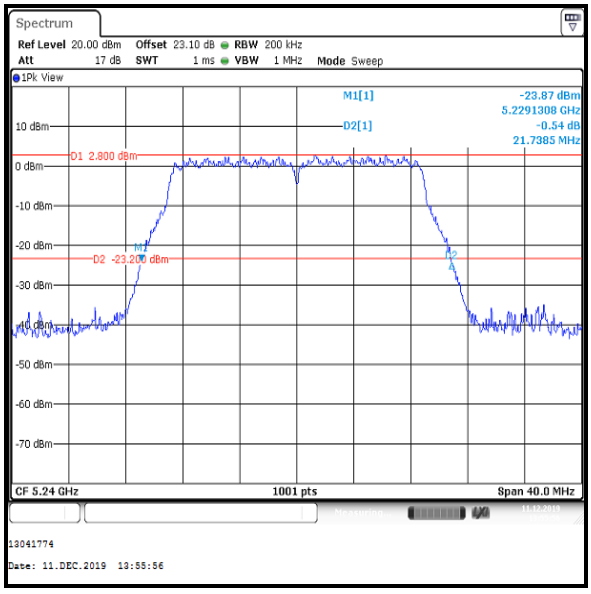
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.578
Middle	5200	21.659
Top	5240	21.739



Bottom Channel



Middle Channel

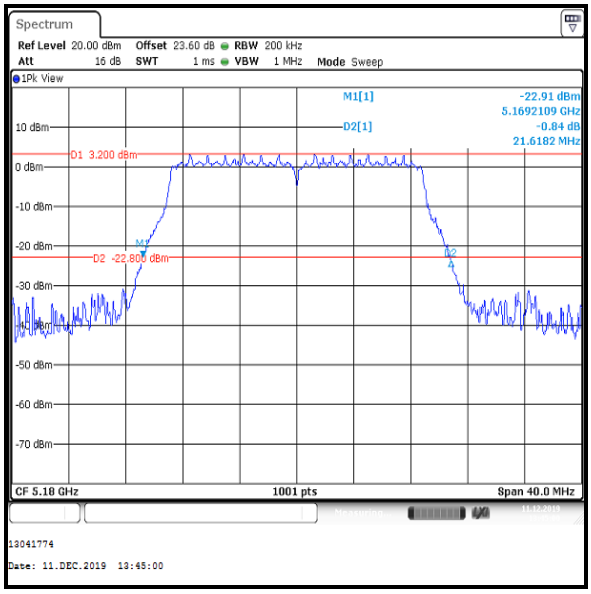


Top Channel

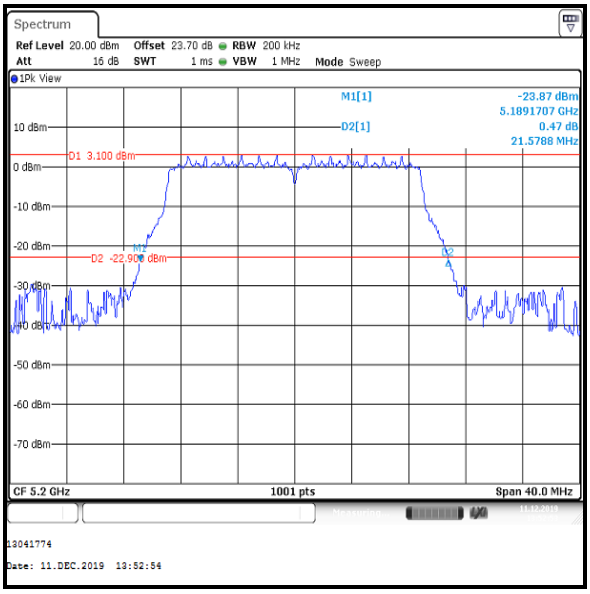
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 2Tx SDM / BPSK / MCS8 / Core 1

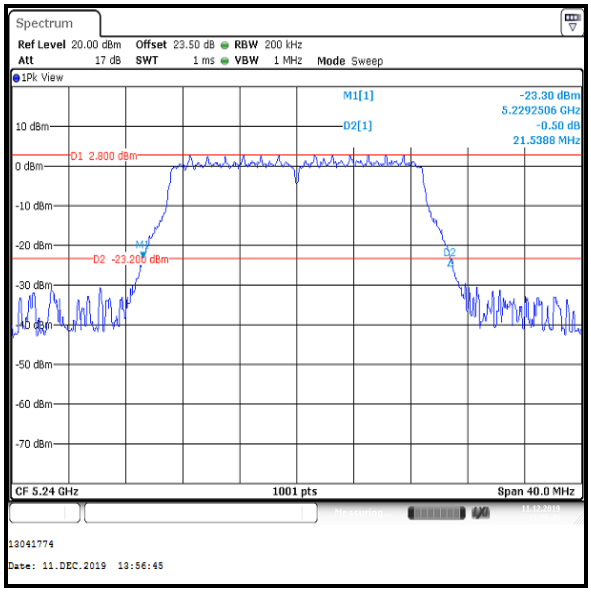
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.618
Middle	5200	21.579
Top	5240	21.539



Bottom Channel



Middle Channel

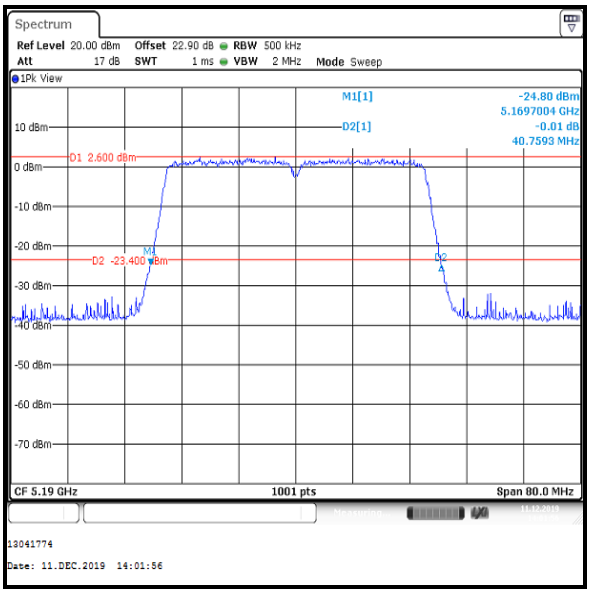


Top Channel

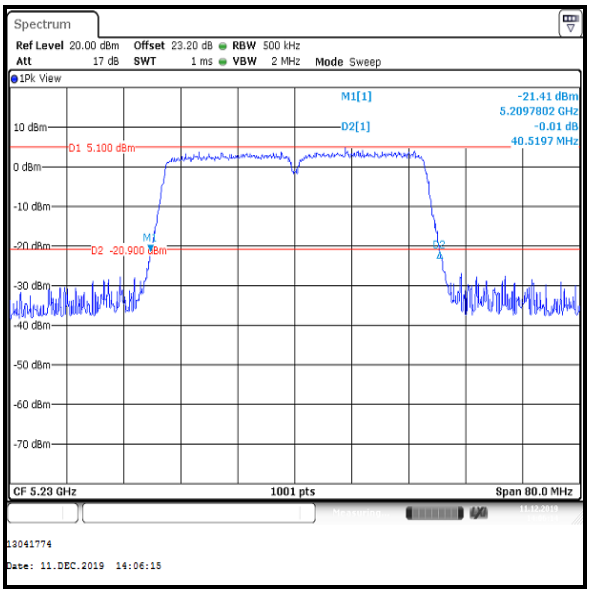
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 2Tx SDM / BPSK / MCS8 / Core 0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.759
Top	5230	40.520



Bottom Channel

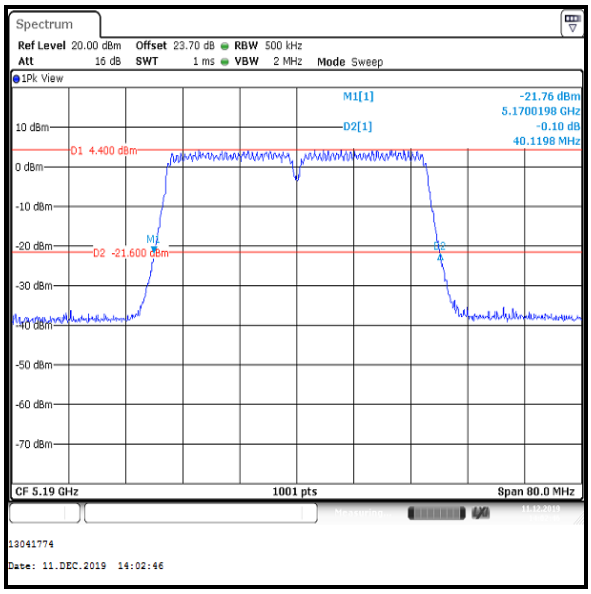


Top Channel

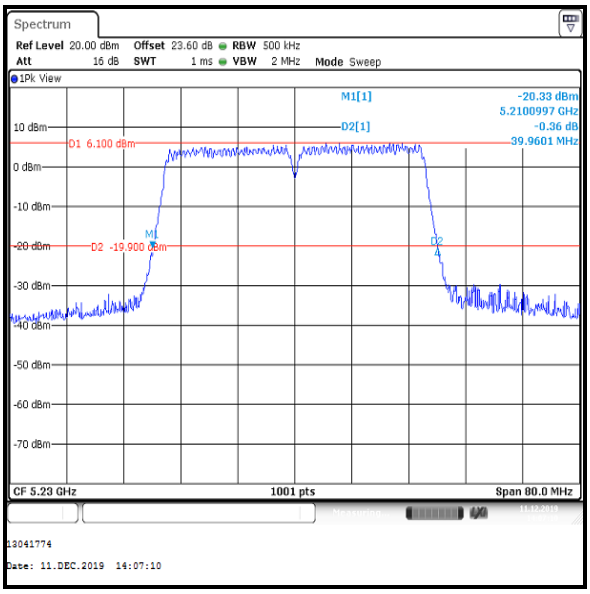
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 2Tx SDM / BPSK / MCS8 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.120
Top	5230	39.960



Bottom Channel

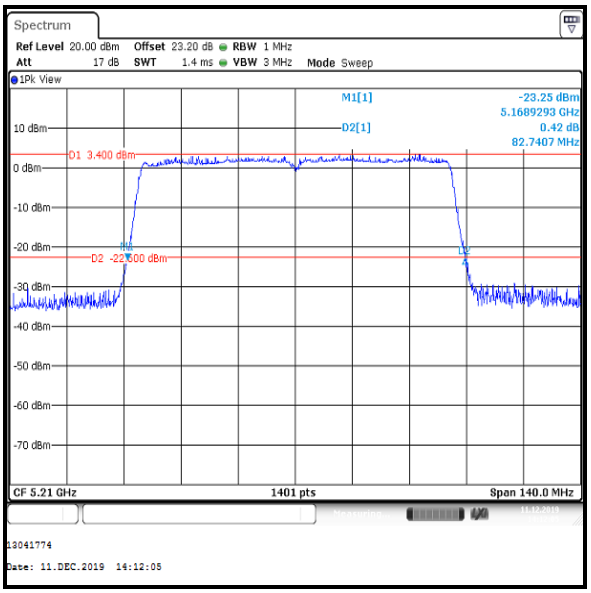


Top Channel

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11ac / 80 MHz / MIMO / 2Tx SDM / BPSK / MCS0x2 / Core 0

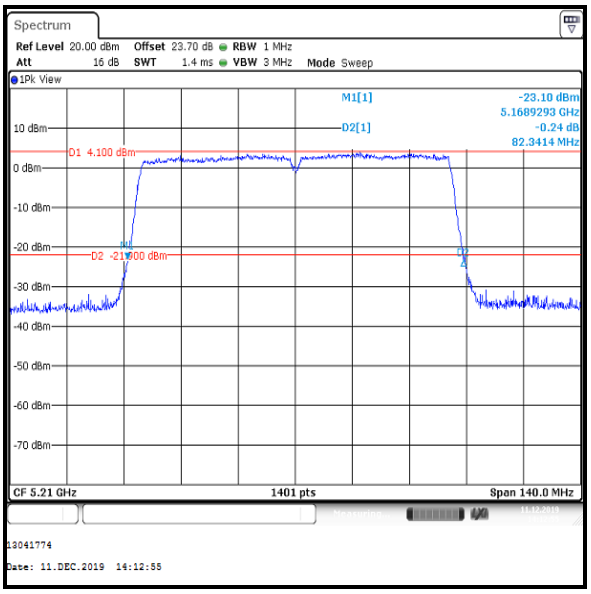
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.741



Single Channel

Results: 802.11ac / 80 MHz / MIMO / 2Tx SDM / BPSK / MCS0x2 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.341

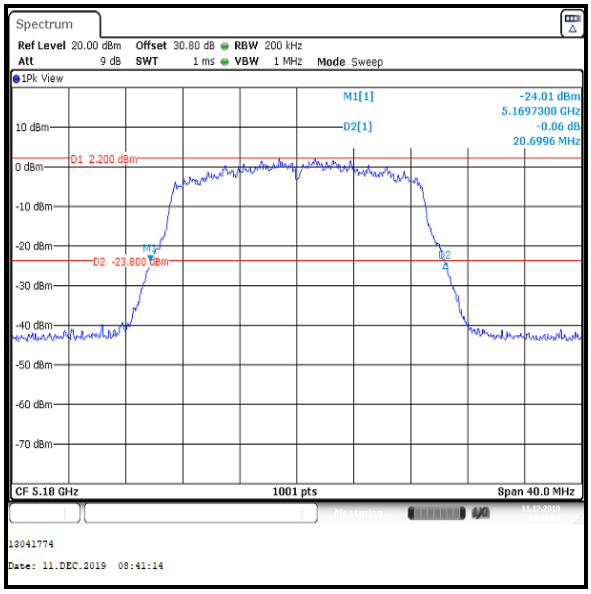


Single Channel

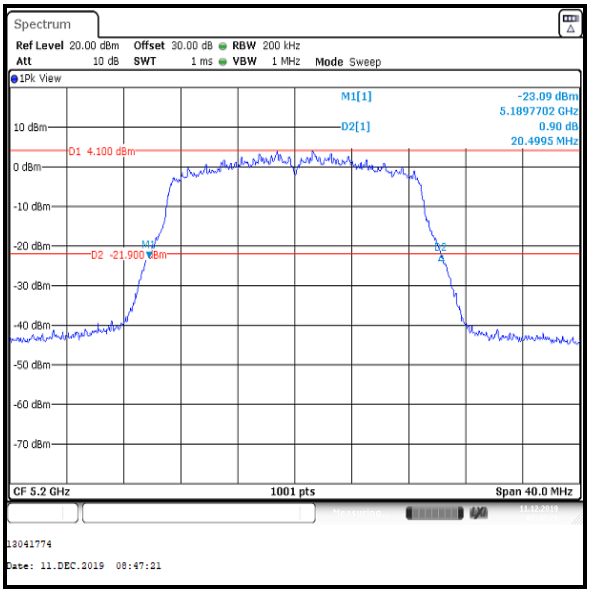
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 2Tx TXBF / BPSK / MCS0 / Core 0

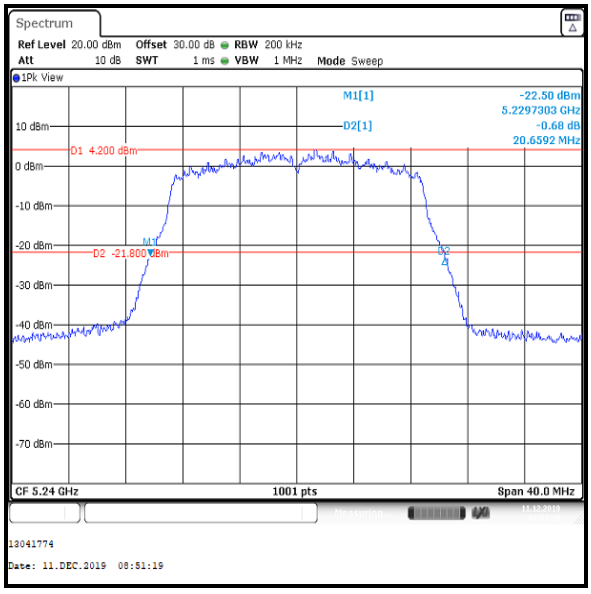
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	20.700
Middle	5200	20.500
Top	5240	20.659



Bottom Channel



Middle Channel

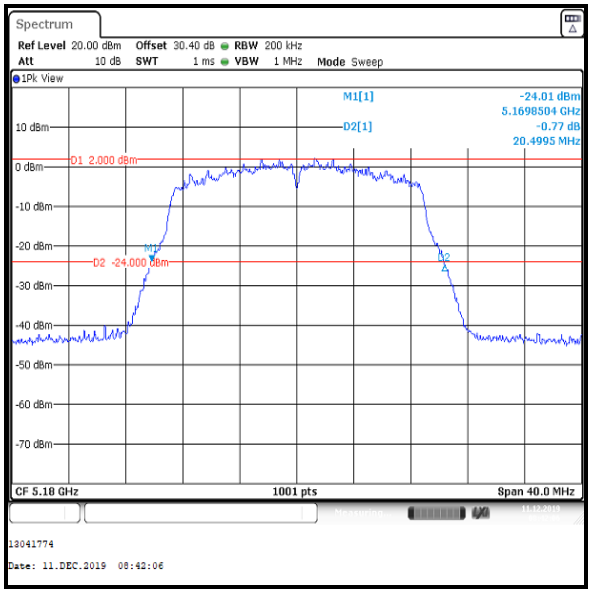


Top Channel

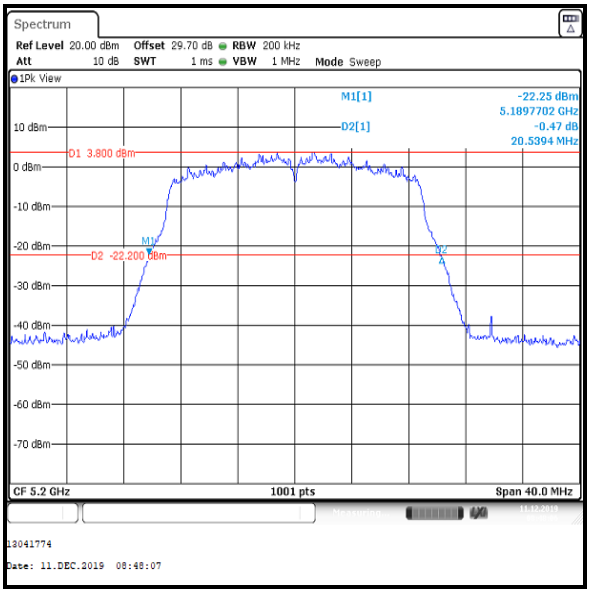
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 2Tx TXBF / BPSK / MCS0 / Core 1

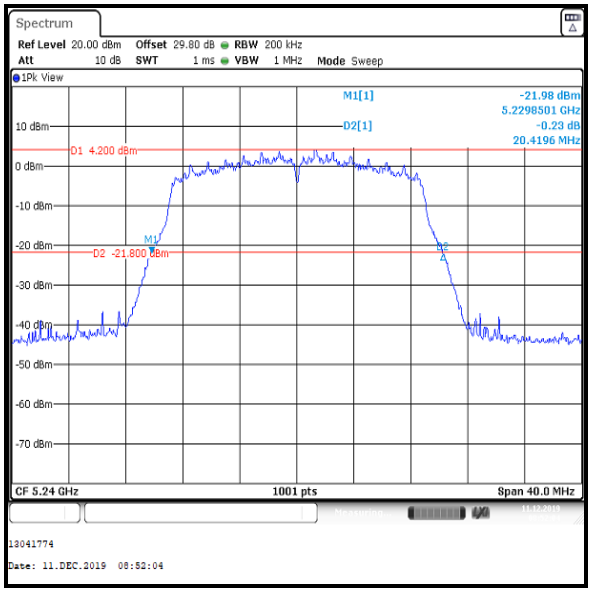
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	20.500
Middle	5200	20.539
Top	5240	20.420



Bottom Channel



Middle Channel

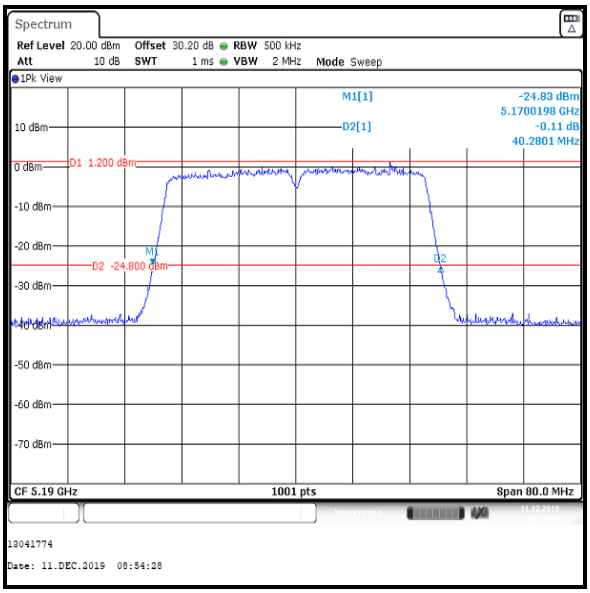


Top Channel

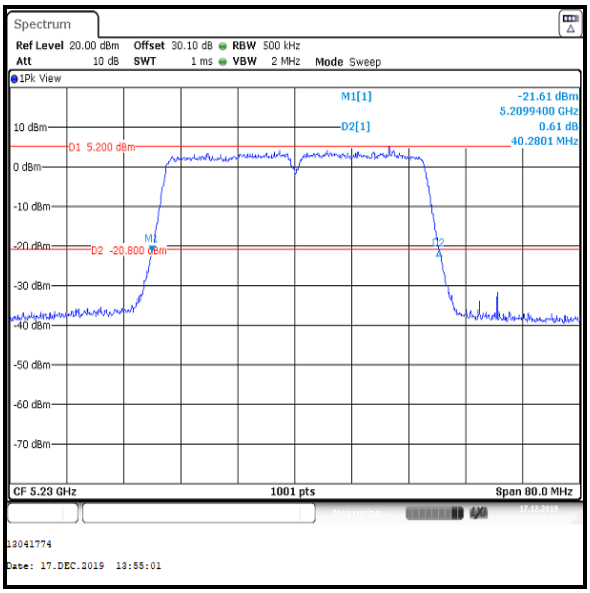
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 2Tx TXBF / BPSK / MCS0 / Core 0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.280
Top	5230	40.280



Bottom Channel

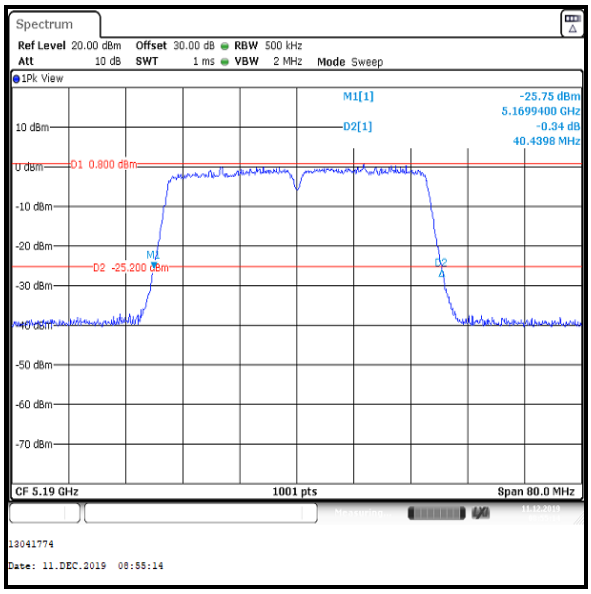


Top Channel

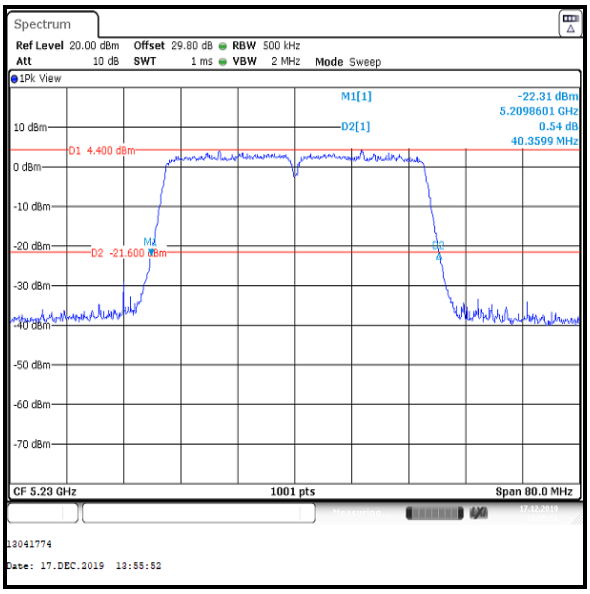
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 2Tx TXBF / BPSK / MCS0 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.440
Top	5230	40.360



Bottom Channel

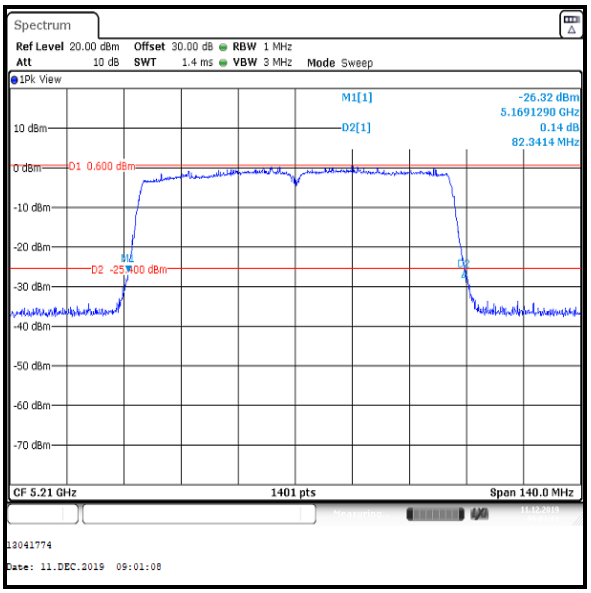


Top Channel

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11ac / 80 MHz / MIMO / 2Tx TXBF / BPSK / MCS0x1 / Core 0

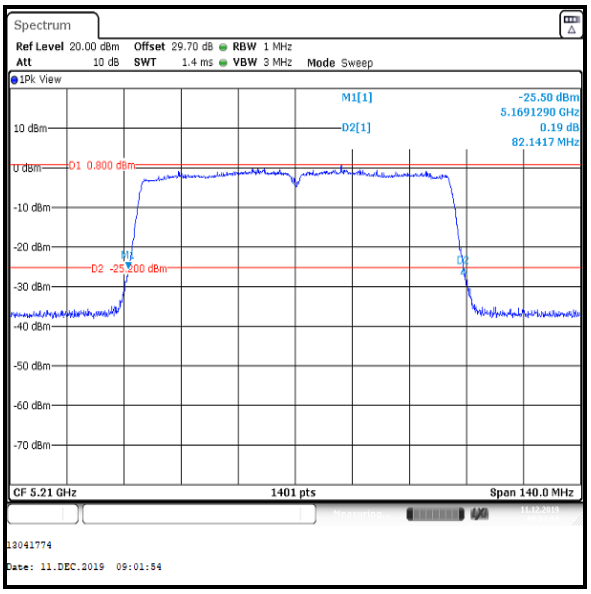
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.341



Single Channel

Results: 802.11ac / 80 MHz / MIMO / 2Tx TXBF / BPSK / MCS0x1 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.142

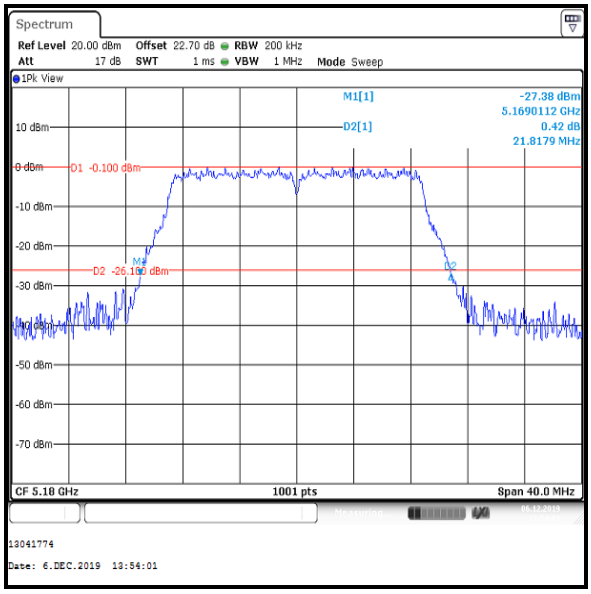


Single Channel

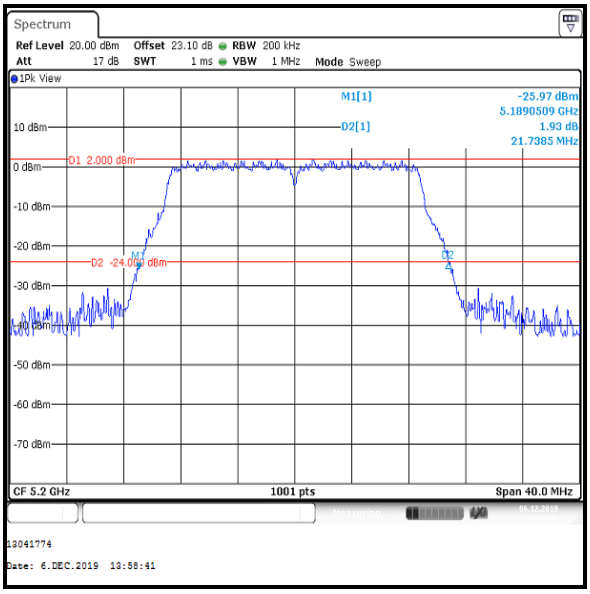
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 3Tx CDD / BPSK / MCS0 / Core 0

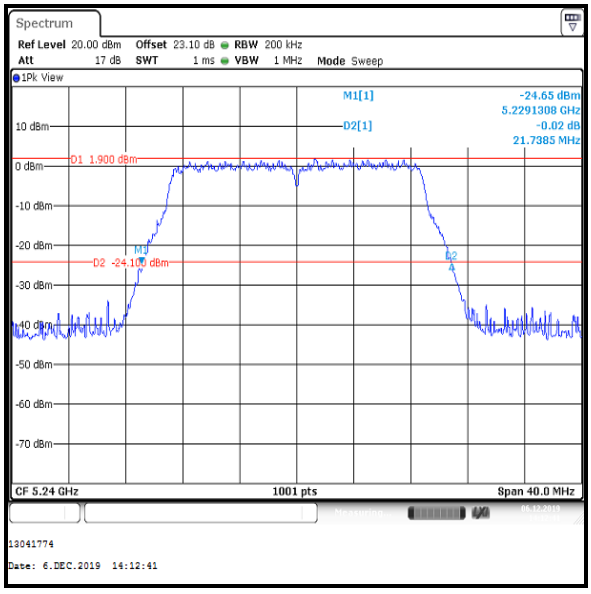
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.818
Middle	5200	21.739
Top	5240	21.739



Bottom Channel



Middle Channel

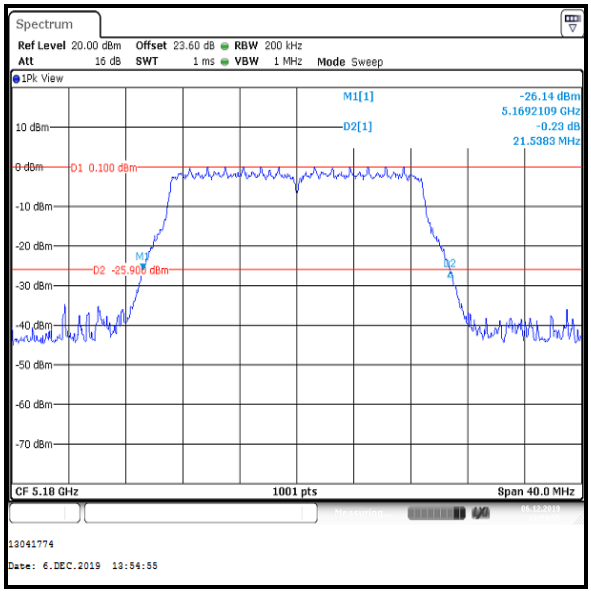


Top Channel

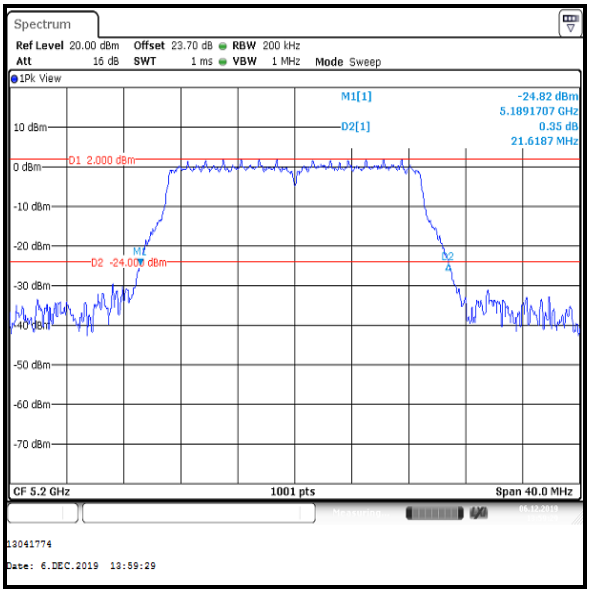
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 3Tx CDD / BPSK / MCS0 / Core 1

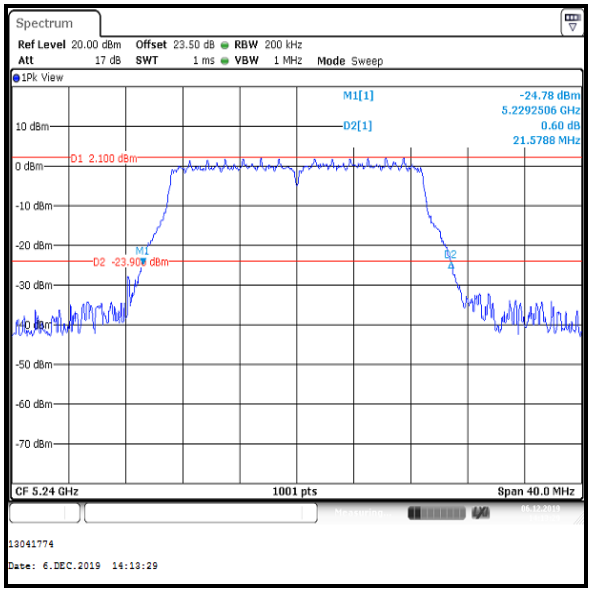
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.538
Middle	5200	21.619
Top	5240	21.579



Bottom Channel



Middle Channel

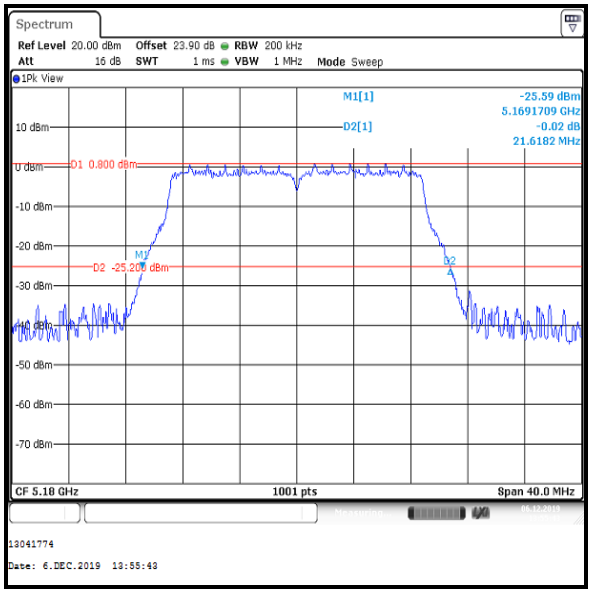


Top Channel

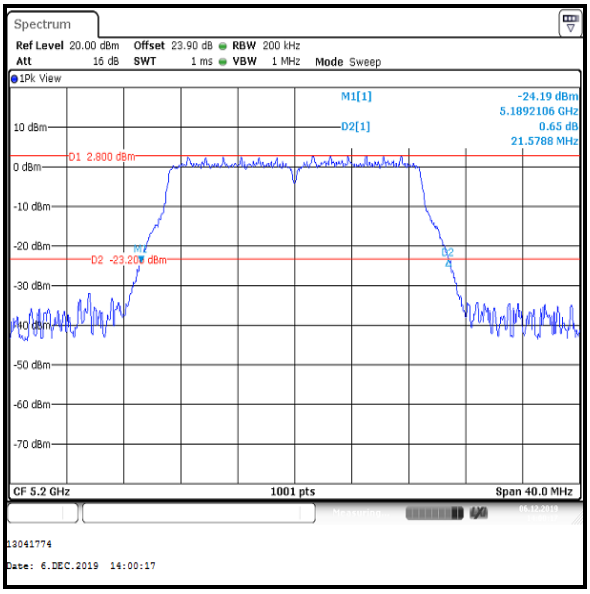
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 3Tx CDD / BPSK / MCS0 / Core 2

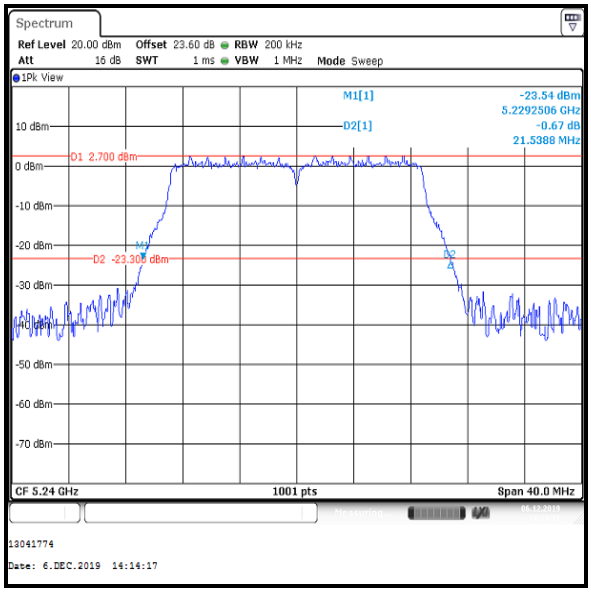
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.618
Middle	5200	21.579
Top	5240	21.539



Bottom Channel



Middle Channel

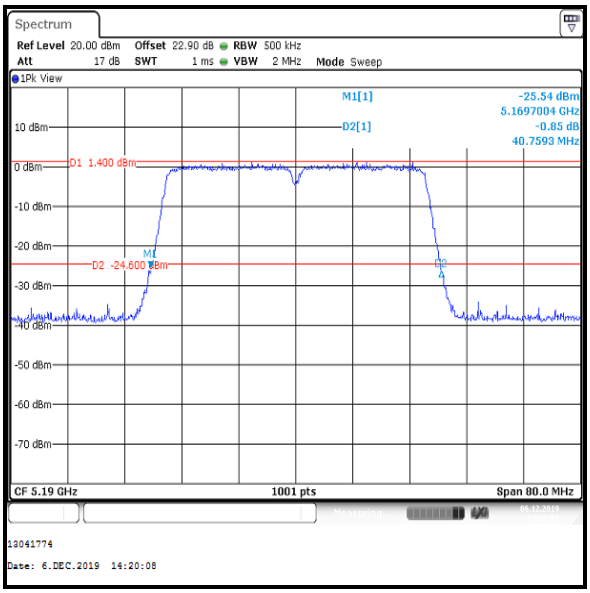


Top Channel

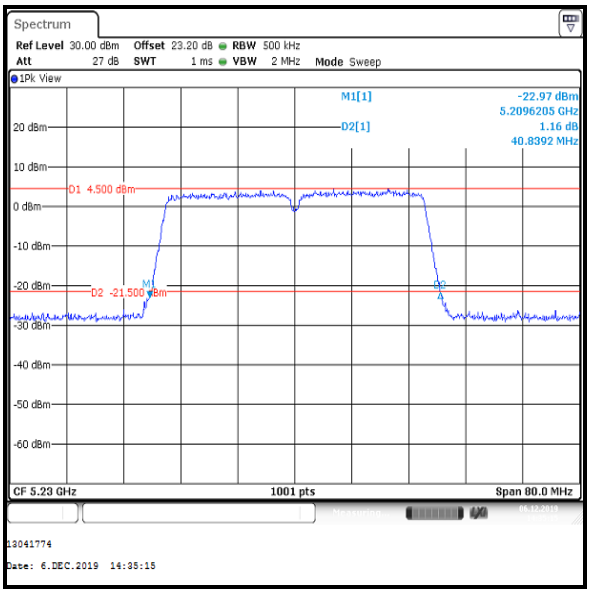
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 3Tx CDD / BPSK / MCS0 / Core 0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.759
Top	5230	40.839



Bottom Channel

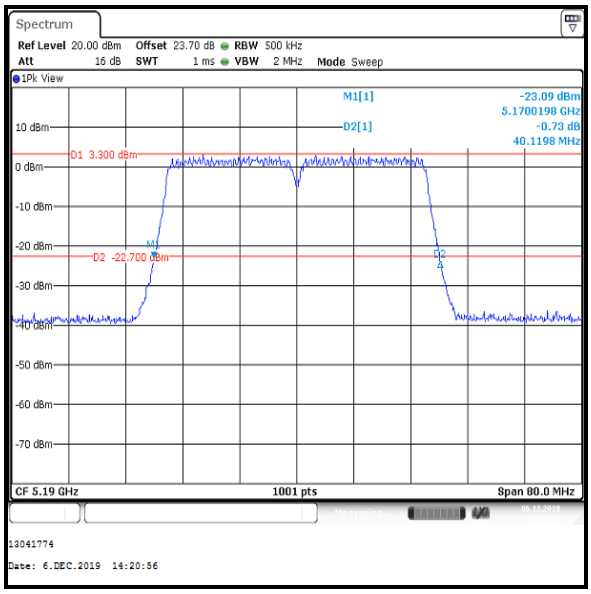


Top Channel

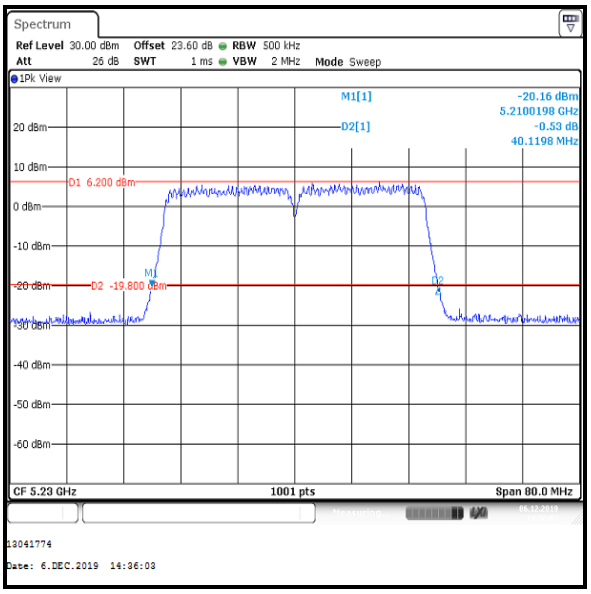
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 3Tx CDD / BPSK / MCS0 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.120
Top	5230	40.120



Bottom Channel

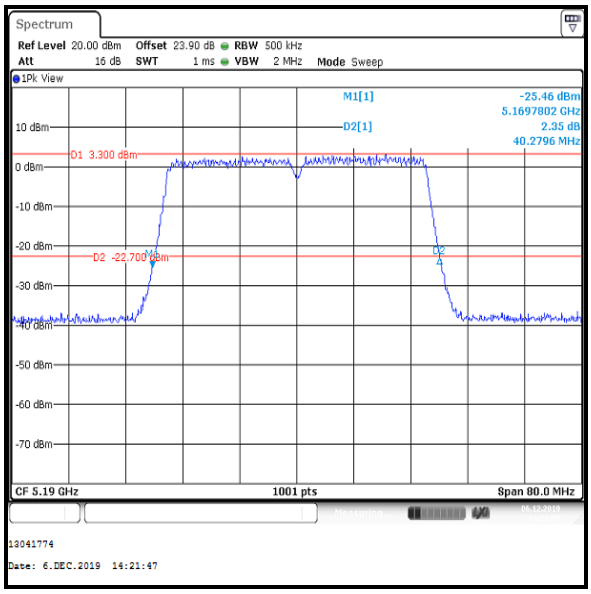


Top Channel

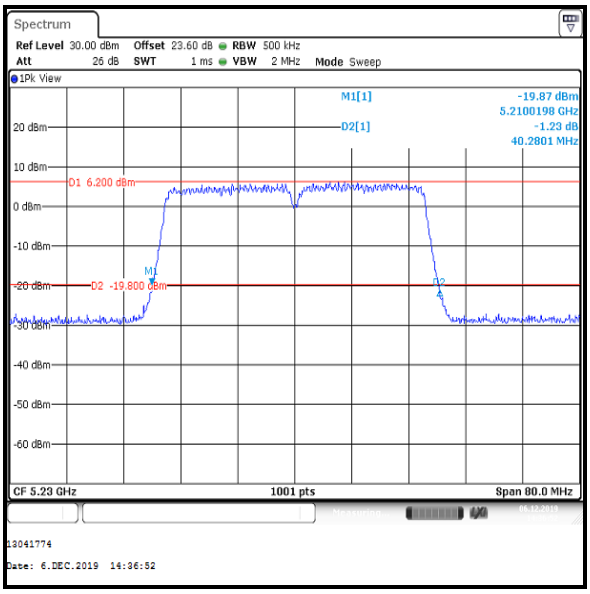
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 3Tx CDD / BPSK / MCS0 / Core 2

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.280
Top	5230	40.280



Bottom Channel

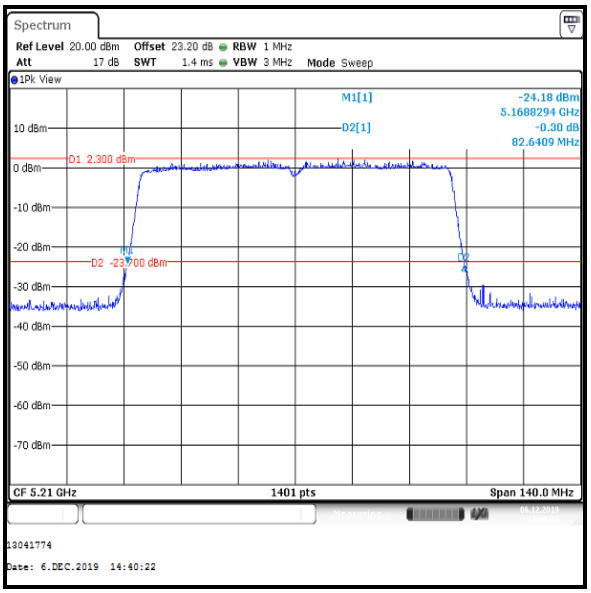


Top Channel

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11ac / 80 MHz / MIMO / 3Tx CDD / BPSK / MCS0x1 / Core 0

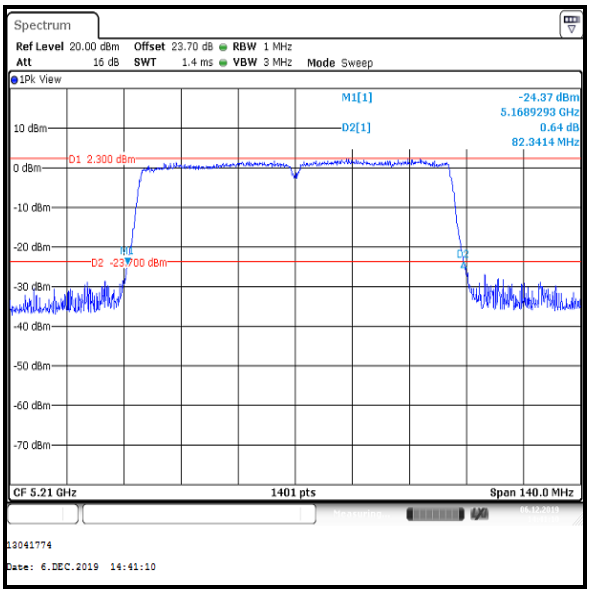
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.641



Single Channel

Results: 802.11ac / 80 MHz / MIMO / 3Tx CDD / BPSK / MCS0x1 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.341

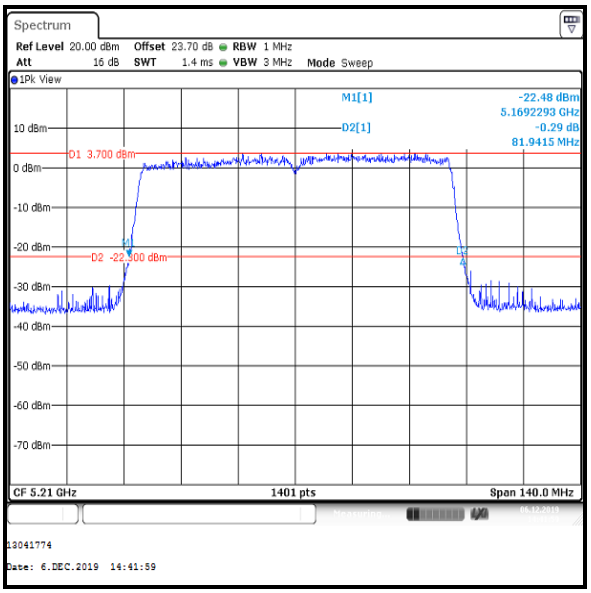


Single Channel

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11ac / 80 MHz / MIMO / 3Tx CDD / BPSK / MCS0x1 / Core 2

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	81.942

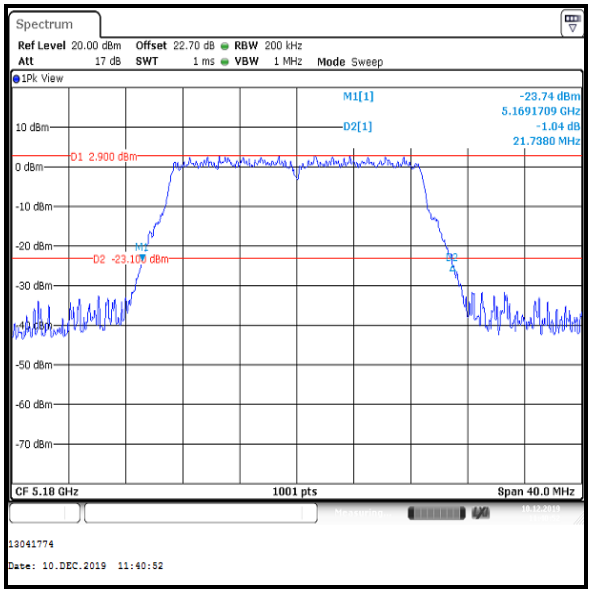


Single Channel

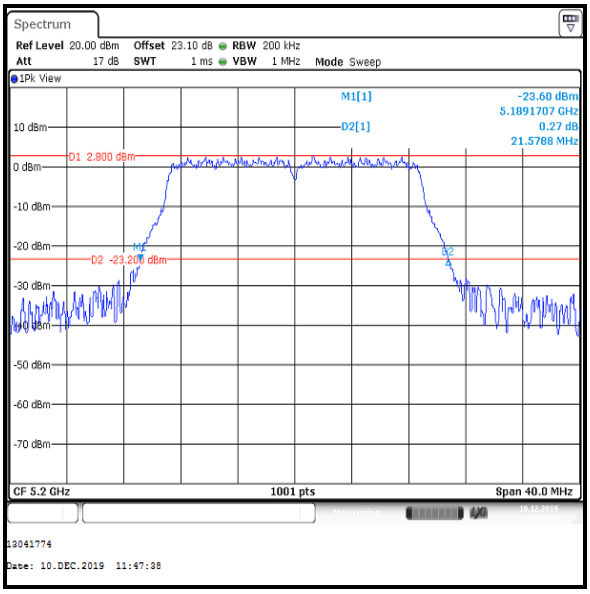
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 3Tx SDM / BPSK / MCS16 / Core 0

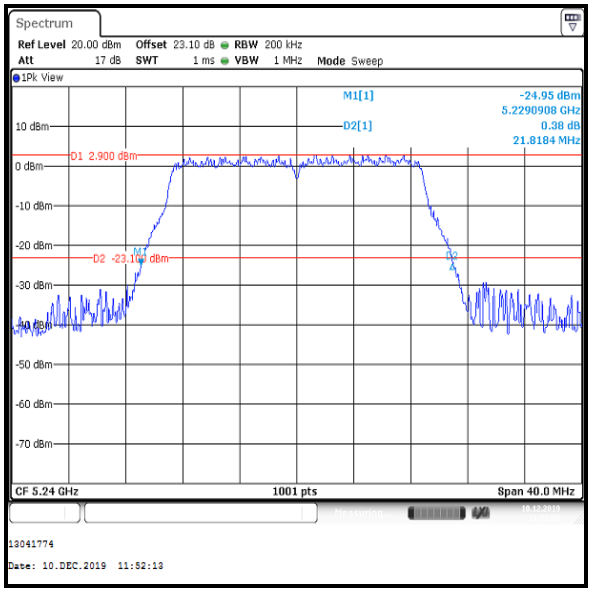
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.738
Middle	5200	21.579
Top	5240	21.818



Bottom Channel



Middle Channel

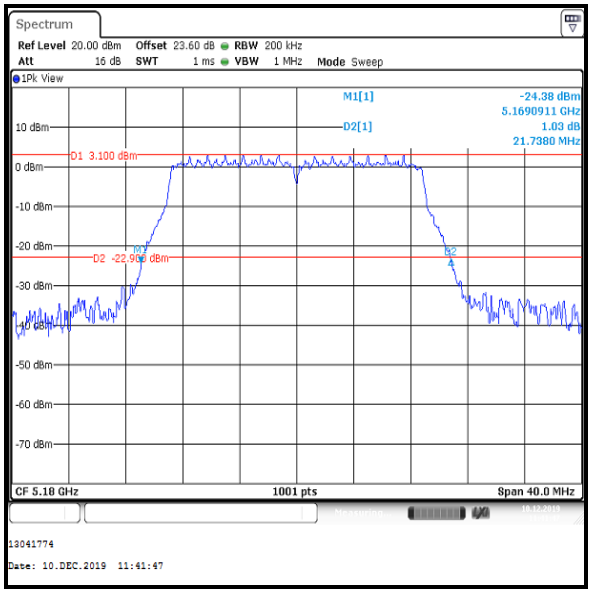


Top Channel

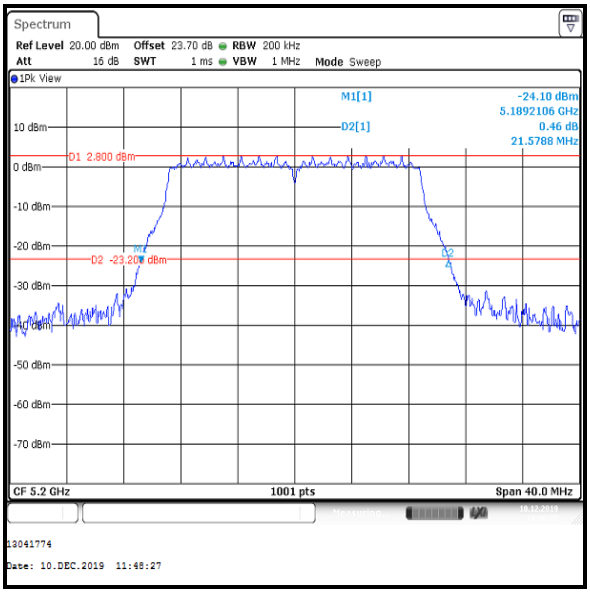
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 3Tx SDM / BPSK / MCS16 / Core 1

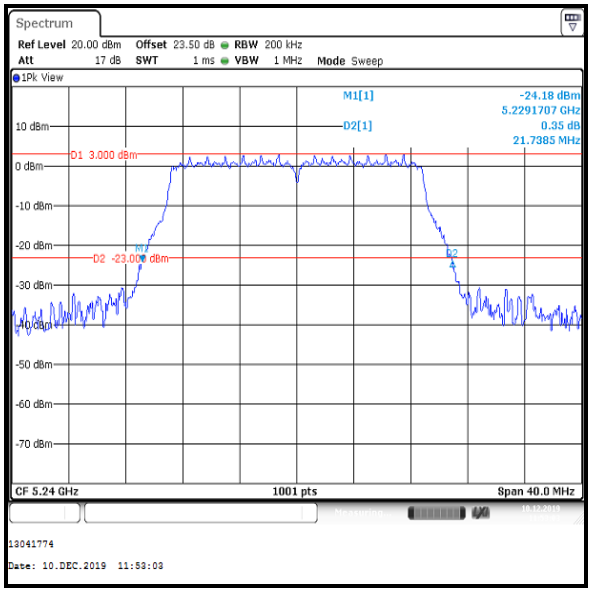
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.738
Middle	5200	21.579
Top	5240	21.739



Bottom Channel



Middle Channel

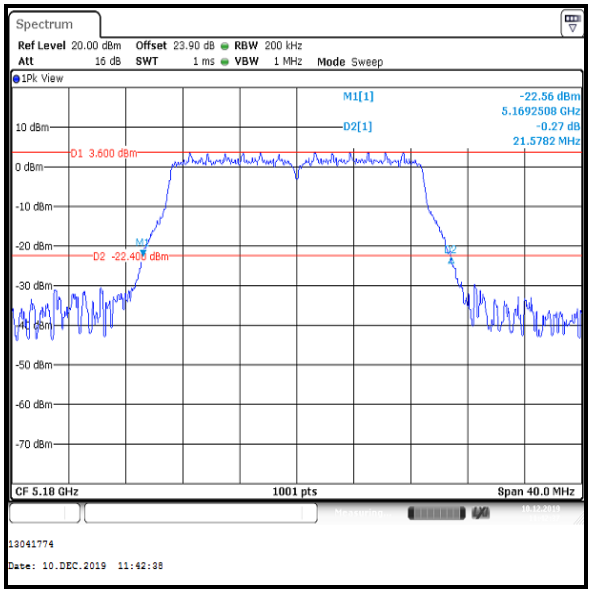


Top Channel

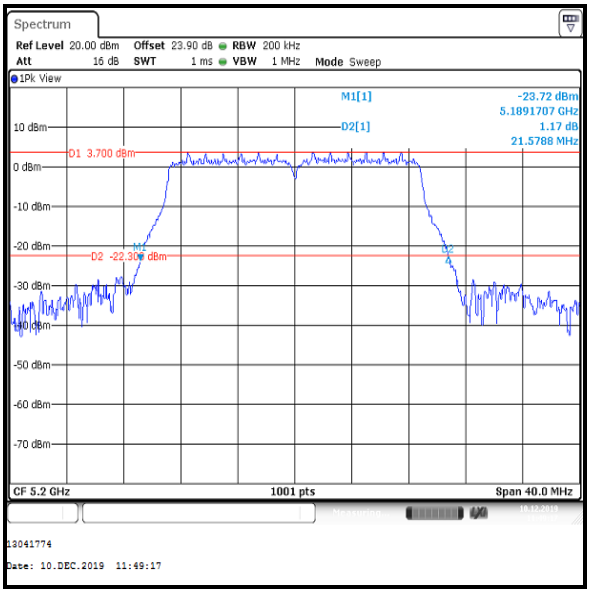
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 3Tx SDM / BPSK / MCS16 / Core 2

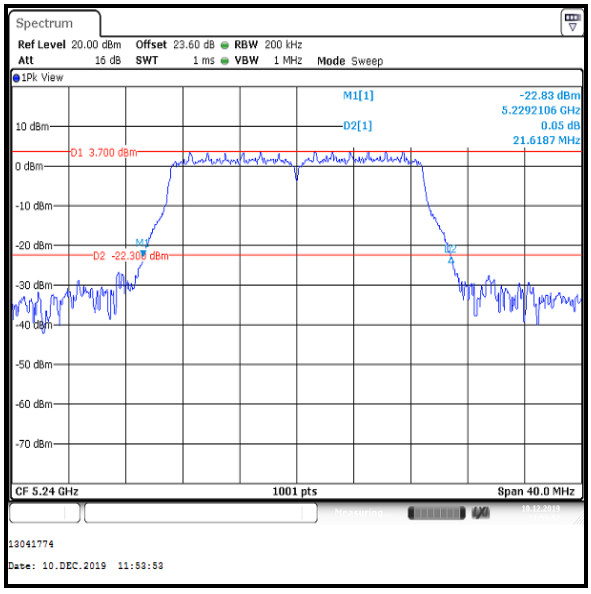
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.578
Middle	5200	21.579
Top	5240	21.619



Bottom Channel



Middle Channel

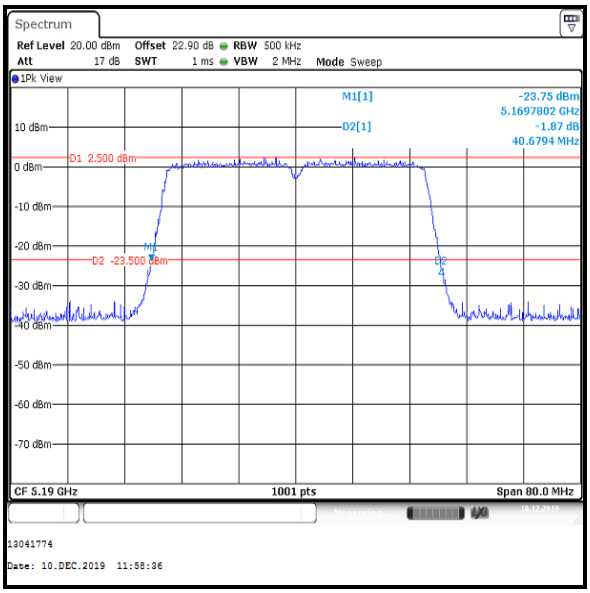


Top Channel

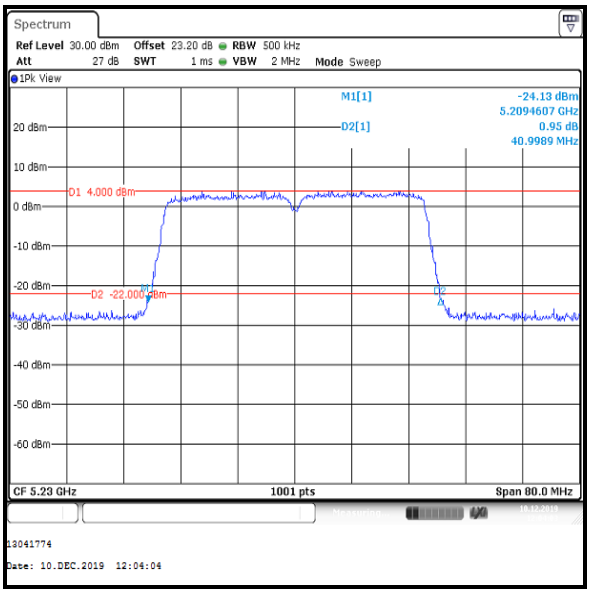
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 3Tx SDM / BPSK / MCS16 / Core 0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.679
Top	5230	40.999



Bottom Channel

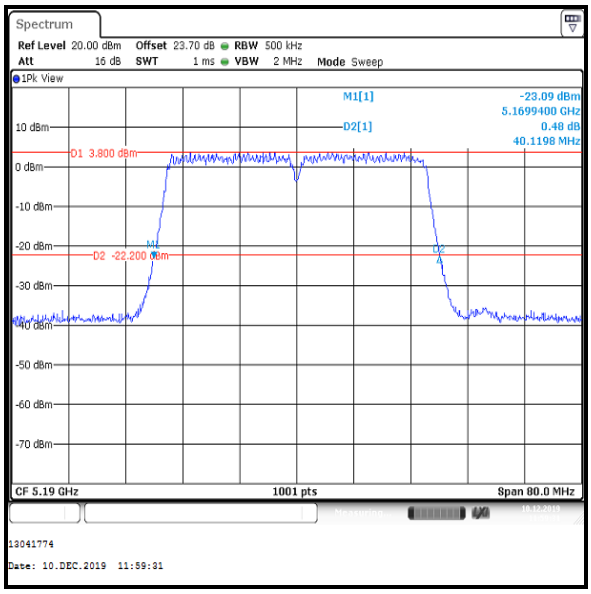


Top Channel

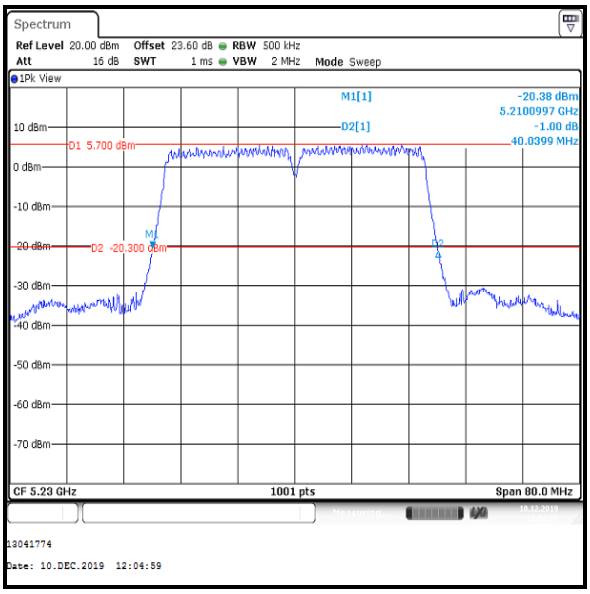
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 3Tx SDM / BPSK / MCS16 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.120
Top	5230	40.040



Bottom Channel

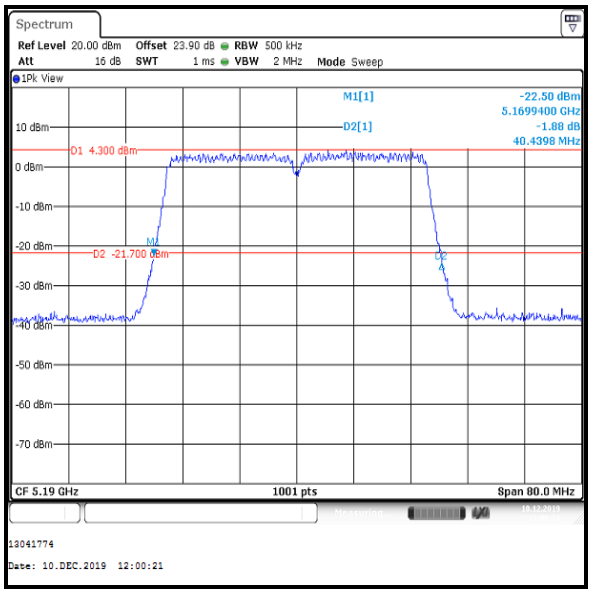


Top Channel

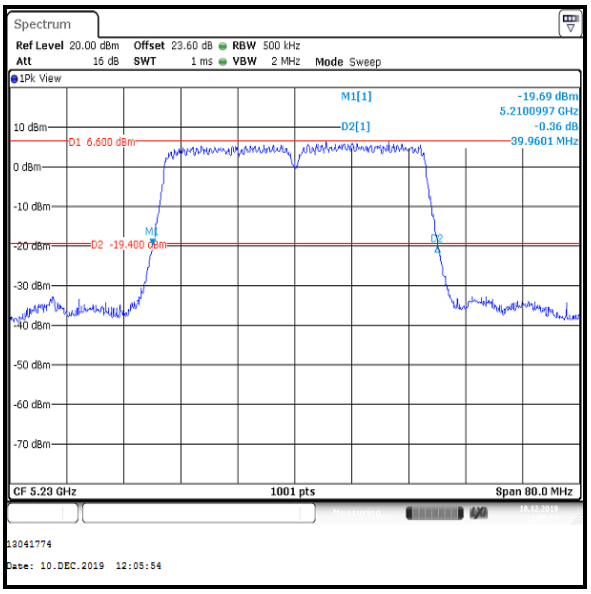
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 3Tx SDM / BPSK / MCS16 / Core 2

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.440
Top	5230	39.960



Bottom Channel

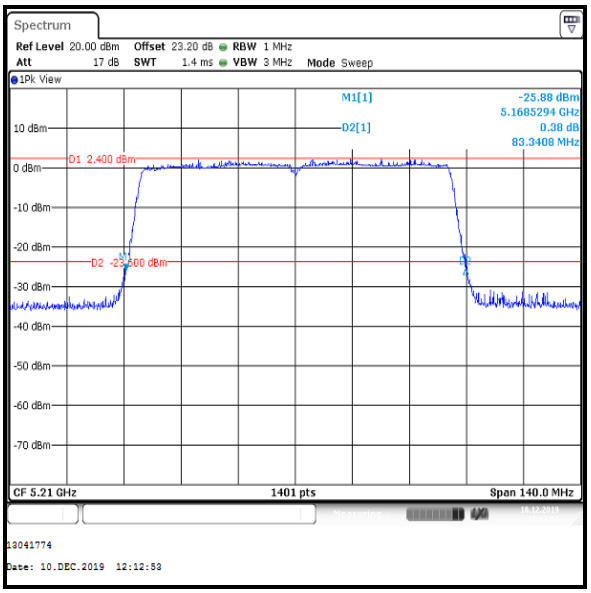


Top Channel

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11ac / 80 MHz / MIMO / 3Tx SDM / BPSK / MCS0x3 / Core 0

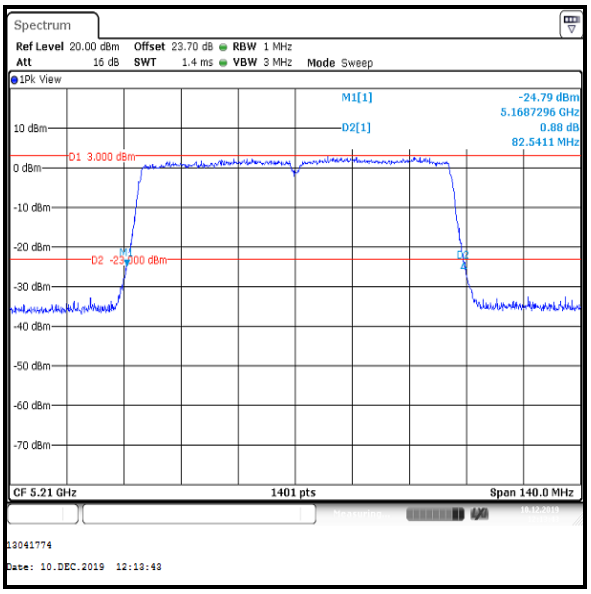
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	83.341



Single Channel

Results: 802.11ac / 80 MHz / MIMO / 3Tx SDM / BPSK / MCS0x3 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.541

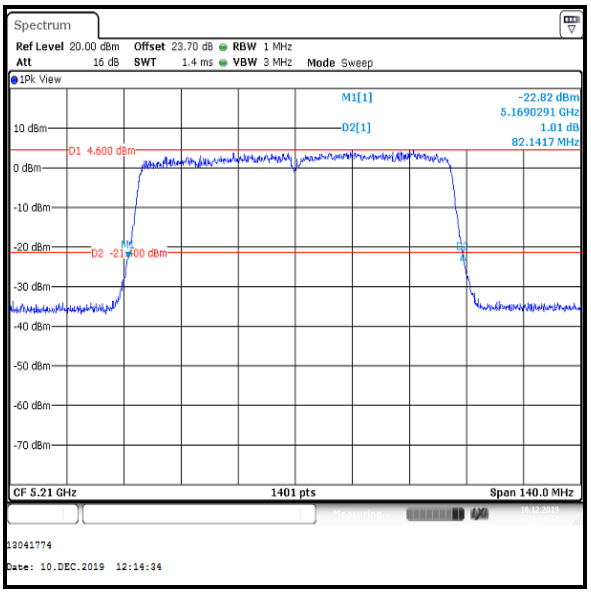


Single Channel

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11ac / 80 MHz / MIMO / 3Tx SDM / BPSK / MCS0x3 / Core 2

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.142

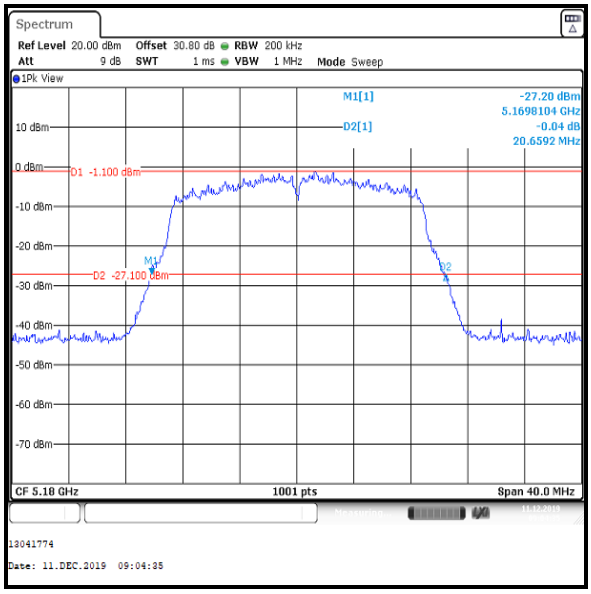


Single Channel

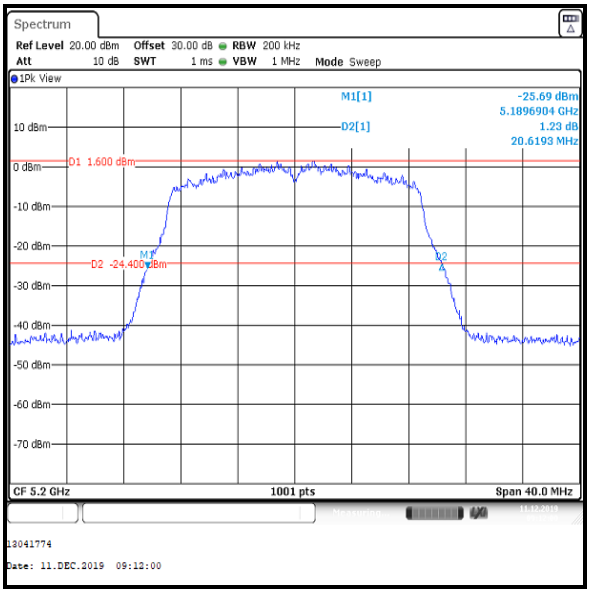
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 3Tx TXBF / BPSK / MCS0 / Core 0

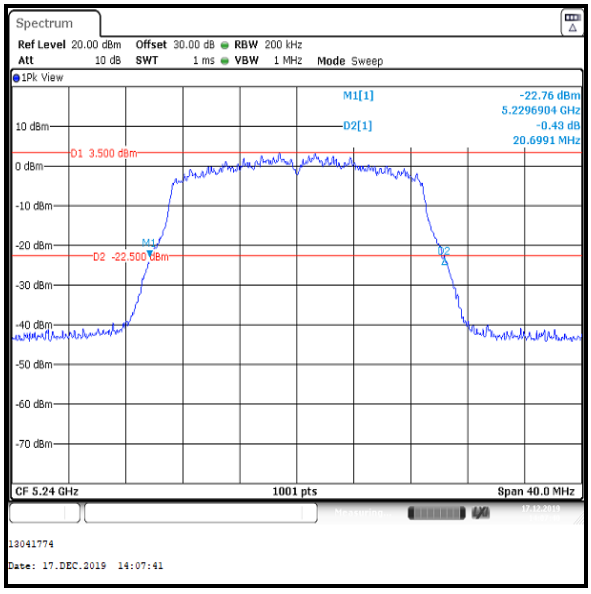
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	20.659
Middle	5200	20.619
Top	5240	20.699



Bottom Channel



Middle Channel

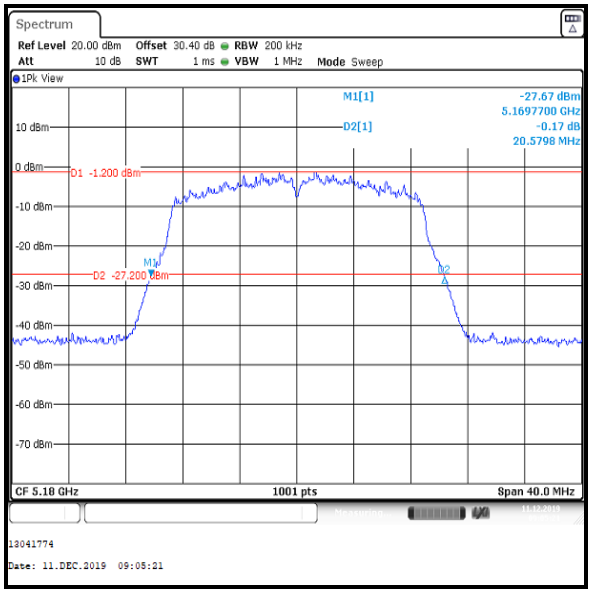


Top Channel

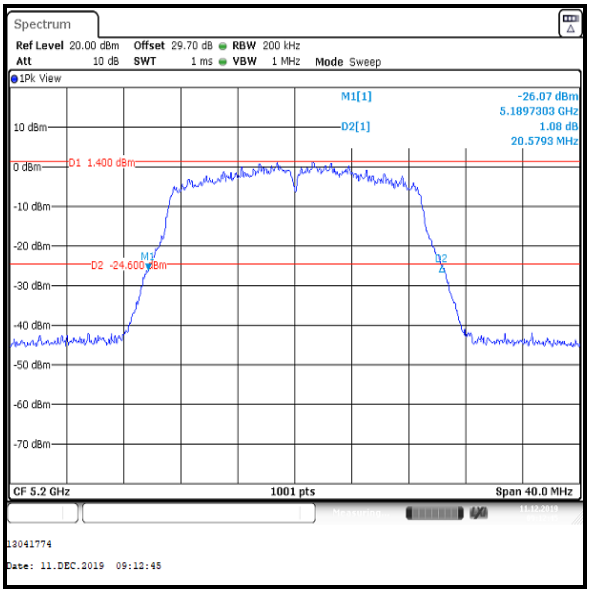
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 3Tx TXBF / BPSK / MCS0 / Core 1

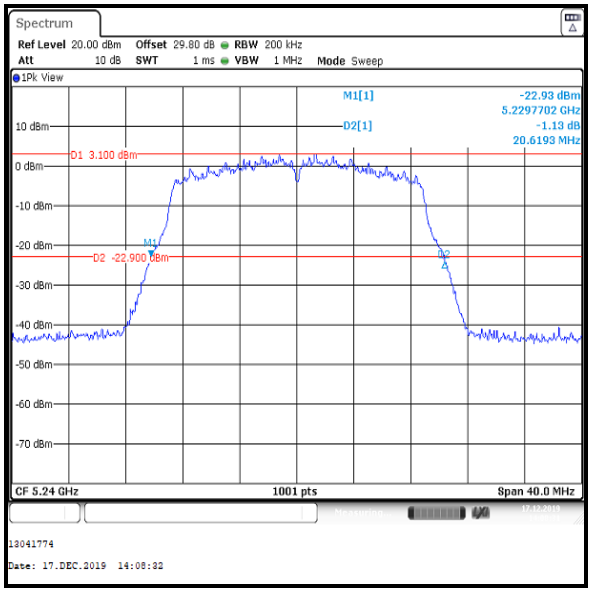
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	20.580
Middle	5200	20.579
Top	5240	20.619



Bottom Channel



Middle Channel

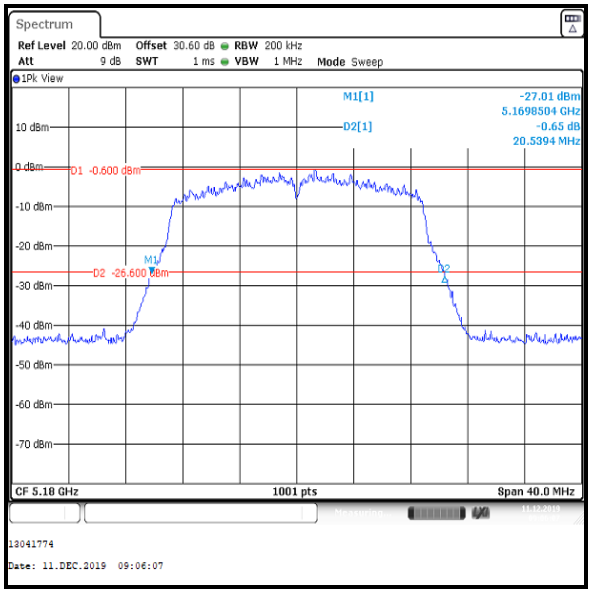


Top Channel

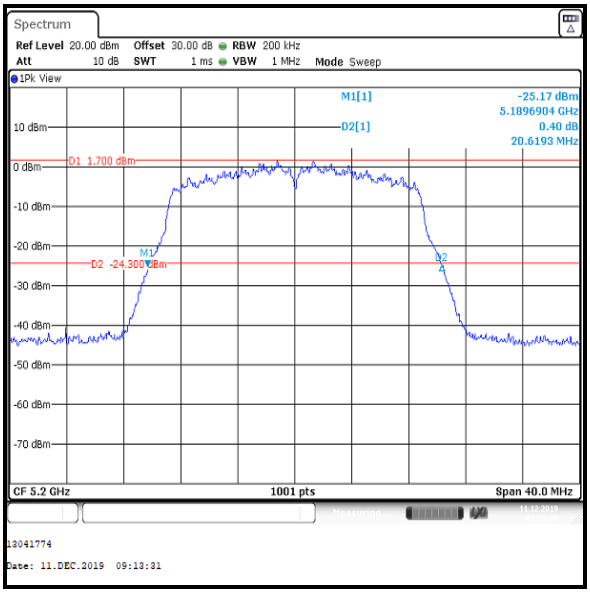
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / MIMO / 3Tx TXBF / BPSK / MCS0 / Core 2

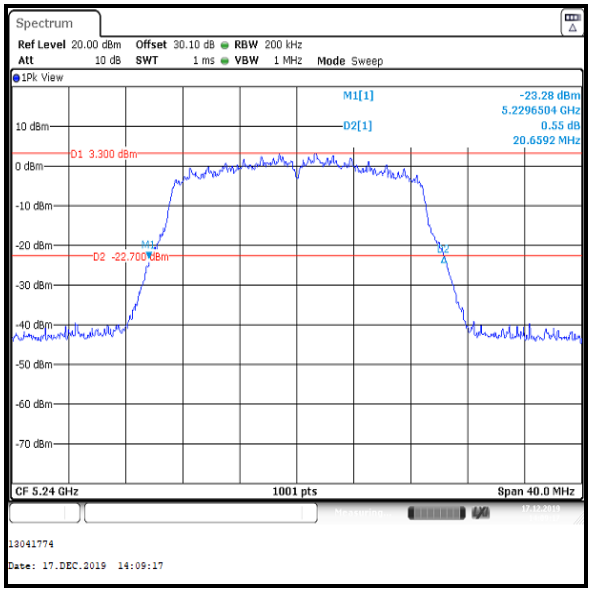
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	20.539
Middle	5200	20.619
Top	5240	20.659



Bottom Channel



Middle Channel

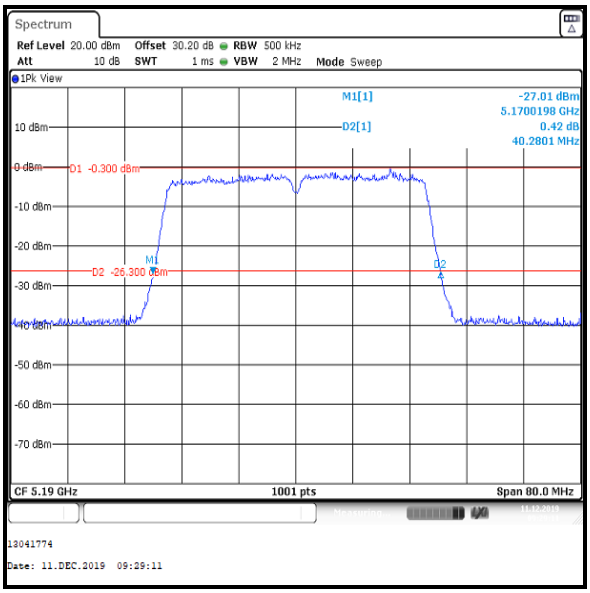


Top Channel

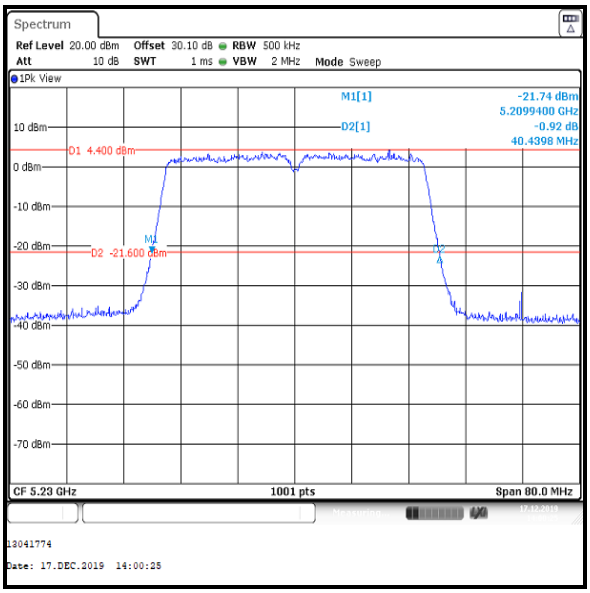
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 3Tx TXBF / BPSK / MCS0 / Core 0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.280
Top	5230	40.440



Bottom Channel

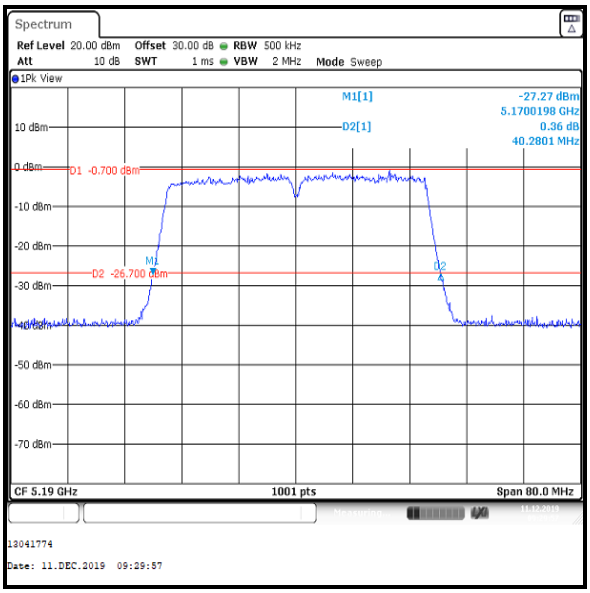


Top Channel

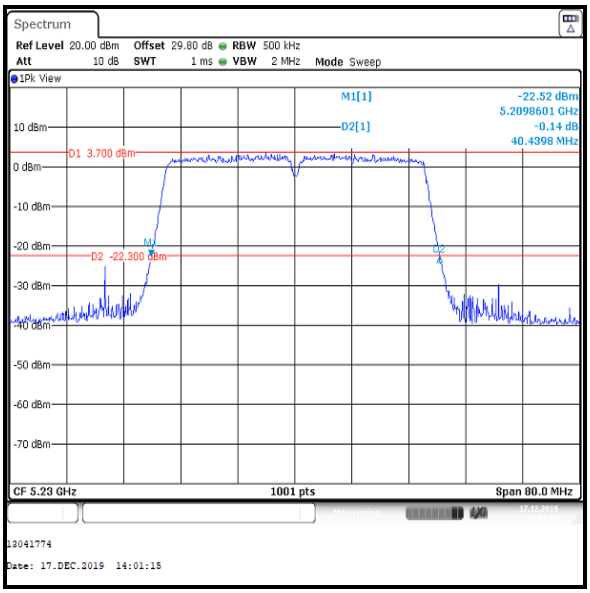
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / MIMO / 3Tx TXBF / BPSK / MCS0 / Core 1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.280
Top	5230	40.440



Bottom Channel



Top Channel