TEST REPORT

Test Report No. : UL-RPT-RP-11909763-3616-FCC-UNII2C

Applicant	:	SIEMENS AG
Model No.	:	MPCIE-R1-ABGNAC-U4
FCC ID	:	LYHRAPACV1
Technology	:	WLAN 5 GHz
Test Standard(s)	:	FCC Parts 15.207 & 15.407(a)(2)

For details of applied tests refer to test result summary

1. This test report shall not be reproduced in full or partial, without the written approval of UL International Germany GmbH.
2. The results in this report apply only to the sample tested.
3. The test results in this report are traceable to the national or international standards.
4. Test Report Version 1.0
5. Result of the tested sample: Pass

Prepared by: Krume, Ivanov
Title: Laboratory Engineer
Date: 13 March 2020

Approved by: Ajit, Phadtare
Title: Lead Test Engineer
Date: 13 March 2020

Deutsche Akkreditierungsstelle
D-PL-19381-02-00

This laboratory is accredited by DAkkS.
The tests reported herein have been performed in accordance with its' terms of accreditation.

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Table of Contents

1. Customer Information....4
1.1. Applicant Information 4
1.2. Manufacturer Information 4

2. Summary of Testing....5
2.1. General Information 5
Applied Standards 5
Location 5
Date information 5
2.2. Summary of Test Results 6
2.3. Methods and Procedures 6
2.4. Deviations from the Test Specification 6

3. Equipment Under Test (EUT) 7
3.1. Identification of Equipment Under Test (EUT) 7
3.2. Description of EUT 7
3.3. Modifications Incorporated in the EUT 7
3.4. Additional Information Related to Testing 8
3.5. Antenna Information 9
3.6. Support Equipment 9
A. Support Equipment (In-house) 9
B. Support Equipment (Manufacturer supplied) 9

4. Operation and Monitoring of the EUT during Testing 10
4.1. Operating Modes 10
4.2. Configuration and Peripherals 11
4.3. Used Power Settings & Port Terminations 12
4.4. Used RF Cables 13

5. Measurements, Examinations and Derived Results....14
5.1. General Comments 14
5.2. Test Results 15
5.2.1. Transmitter AC Conducted Spurious Emissions 15
5.2.2. Transmitter 26 dB Emission Bandwidth 23
5.2.3. Transmitter Duty Cycle 141
5.2.4. Transmitter Maximum Conducted Output Power 175
5.2.5. Transmitter Maximum Power Spectral Density 365

6. Measurement Uncertainty 519

7. Used equipment....520

8. Report Revision History 521

1. Customer Information

1.1.Applicant Information

Company Name:	SIEMENS AG
Company Address:	Östliche Rheinbrückenstr. 50, 76187 Karlsruhe, Germany
Contact Person:	Dr. Malgorzata Janson
Contact E-Mail Address:	malgorzata.janson@siemens.com
Contact Phone No.:	+ 49 721 595 2606

1.2.Manufacturer Information

Company Name:	SIEMENS AG
Company Address:	76181 Karlsruhe, Germany
Contact Person:	Mr. Kilian Löser
Contact E-Mail Address:	kilian.loeser@siemens.com
Contact Phone No.:	+49 911 895-5363

2. Summary of Testing

2.1. General Information

Applied Standards

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:	47CFR15.207
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207
Test Firm Registration:	399704

Location

Location of Testing:	UL International Germany GmbH Hedelfinger Str. 61 70327 Stuttgart Germany

Date information

Order Date:	26 September 2017
EUT arrived:	26 January 2018
Test Dates:	17 February 2020 to 12 March 2020
EUT returned:	-/-

2.2. Summary of Test Results

Clause	Measurement (5.47-5.725 GHz band)	Complied	Did not comply	Not performed	Not applicable
Part 15.207 / Part 15.407(b)(6)	Transmitter AC Conducted Emissions	☒	☐	☐	☐
Part 15.403(i)	Transmitter 26 dB Emission Bandwidth	☒	☐	☐	☐
Part 15.35(c)	Transmitter Duty Cycle	☒	☐	☐	☐
Part 15.407(a)(2)	Transmitter Maximum Conducted Output Power	☒	☐	☐	☐
Part 15.407(a)(2)	Transmitter Power Spectral Density	☒	☐	☐	☐
Part 15.407(b)/15.209(a)	Transmitter Out of Band Conducted Emissions(Note 1)	☐	☐	☒	☐
Part 15.407(b)/15.209(a)	Transmitter Out of Band Radiated Emissions(Note 1)	☐	☐	☒	☐
Part 15.407(b)/15.209(a)	Transmitter Band Edge Radiated Emissions(Note 1)	☐	☐	☒	☐
Part 15.407(g)	Transmitter Frequency Stability(Note 2) (Temperature & Voltage Variation)	☐	☐	☐	☒
Part 15.407(h)(1)	Transmitter Power Control	☐	☐	☐	☒

Note:

1. Refer separate test report : UL-RPT-RP11909763-3616A.pdf
2. As per applicant's user manual 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.

2.3. 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:	KDB 662911 D01 Multiple Transmitter Output v02r01 October 31, 2013
Title:	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
Reference:	KDB 174176 D01 Line Conducted FAQ v01r01June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions

2.4. 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 specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	SIEMENS
Model Name or Number:	MPCIE-R1-ABGNAC-U4
Model Type:	A5E36528526
Serial/ Fixed IP Number:	192.168.0.65 (Conducted Test Sample)
Hardware Version Number:	1
Software Version Number:	V02.00.00
FCC ID:	LYHRAPACV1

Brand Name:	SIEMENS
Model Name or Number:	MPCIE-R1-ABGNAC-U4
Model Type:	A5E36528526
Serial/ Fixed IP Number:	192.168.0.70 (AC Conducted Test Sample)
Hardware Version Number:	1
Software Version Number:	V02.00.00
FCC ID:	LYHRAPACV1

3.2. Description of EUT

The equipment under test was a 4 X 4 MIMO radio module supporting WLAN 2.4 GHz & WLAN 5 GHz technologies.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Technology Tested:	WLAN (IEEE 802.11a,n, ac)		
Type of Unit:	Transceiver		
Test Evaluation Board Power Supply Requirement(s):	Nominal	24.0 V DC	
	Minimum	16.8 V DC	
	Maximum	31.2 V DC	
EUT Power Supply Requirement(s):	Power Range	3.3 V DC ± 5 %	520 mA
	Power Range	5.0 V DC ± 5 %	700 mA
Supported Modulation Types:	BPSK, QPSK, 16QAM, 64QAM, 256QAM		
Supported Data rates:	802.11a	6, 9, 12, 18, 24, 36 ,48 & 54 Mbit/s (SISO or MIMO)	
	802.11n HT20	MCS0 to MCS7 (1 spatial stream) MCS8 to MCS15 (2 spatial streams) MCS16 to MCS23 (3 spatial streams) MCS24 to MCS31 (4 spatial streams)	
	802.11n HT40	MCS0 to MCS7 (1 spatial stream) MCS8 to MCS15 (2 spatial streams) MCS16 to MCS23 (3 spatial streams) MCS24 to MCS31 (4 spatial streams)	
	802.11ac HT20	MCS0 to MCS8 (up to 4 spatial streams)	
	802.11ac HT40	MCS0 to MCS9 (up to 4 spatial streams)	
	802.11ac HT80	MCS0 to MCS9 (up to 4 spatial streams)	
Antenna Gains:	Refer section 3.5 Antenna Information		
Maximum Conducted Output Power:	20 MHz	16.3 dBm	
	40 MHz	11.7 dBm	
	80 MHz	12.5 dBm	
Transceiver Frequency Band:	5470 MHz to 5725 MHz [U-NII-2C Band]		
Nominal Channel Bandwidth	20 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	100	5500
	Bottom +1	104	5520
	Middle	116	5580
	Top -1	136	5680
	Top	140	5700
Nominal Channel Bandwidth	40 MHz		
Transmit Channels Tested:	Bottom	102	5510
	Middle	118	5590
	Top	134	5670
Nominal Channel Bandwidth	80 MHz		
Transmit Channels Tested:	Bottom	106	5530
	Top	122	5610

3.5. Antenna Information

Antenna types with highest antenna gains amongst their supported radiation patterns were used for the EUT testing:

Antenna Type:	9 dBi Antenna
Antenna Radiation Type:	Sector
Antenna Model Number:	ANT795-6DC
Antenna Gain:	9 dBi @ 5 GHz
Antenna Beamwidth:	55°H / 55°V
Antenna Connector Type:	N
Manufacturer Article Number:	6GK5795-6DC00-0AA0
Batch Number:	006.707039

3.6. Support Equipment

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

A. Support Equipment (In-house)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Laptop	Lenovo	L560	MP-16X73B 16/11
2	Lab DC Power Supply	Conrad Electronic	PS-2403D	Not stated
3	Lab Voltage Rectifier Power Supply	Spitzenberger Spies	PAS 5000	A2464 00/2 0200

B. Support Equipment (Manufacturer supplied)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	DC Power Supply Cable (Length: 0.5 m | Quantity: 2 Pcs)	--	Standard 2 wire cable	--
2	M12- RJ45 Ethernet Cable (Length: 2 m | Quantity: 2 Pcs)	SIEMENS	LEONI L INDUSTRIAL ETHERNET FLEXIBLE 6XV1870-2E	--
3	Test Evaluation Board (Quantity: 2 Pcs)	SIEMENS	A5E36374290-AE GTW 18 94V-0	--
4	UMCC- N Connector Cable (Length: 0.25 m | Quantity: 4 Pcs)	SIEMENS	--	--
5	N Connector-50 Ω Terminations (Quantity: 4 Pcs)	SIEMENS	--	--
6	SIMATIC PS 307 Power Supply (Input: AC 120 /230 V | 2.3 /1.2 A | 50-60 Hz) (Output: DC 24 V| 5 A) | (Quantity: 1 Pcs)	SIEMENS	6ES7307-1EA01-0AA0	YSU/HO 165357

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):
☒ **Continuously transmitting modulated carrier with combination of** ➢ **Maximum Power Settings** [refer section 4.3] ➢ **Test Channels** [refer section 3.4] ➢ **Worst Case* SISO and MIMO modes** [refer section 4.3]
*Multiple supported modulation schemes, nominal channel bandwidths and SISO/MIMO configurations were initially investigated to determine the above mentioned worst case data rates in terms of highest output power & widest bandwidth.

4.2. Configuration and Peripherals

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

- **EUT Power Supply:**

o For AC Conducted measurement EUT(the radio module) was mounted on Test Evaluation Board. Using Siemens SIMATIC PS 307 Power Supply, 24 V DC was supplied to this board; which in turn supplying 3.3 V DC to EUT.

o For all conducted measurements EUT(the radio module) was mounted on Test Evaluation Board. Using Lab DC Power Supply 24 V DC was supplied to this board; which in turn supplying 3.3 V DC to EUT.

- **Test Mode Activation:**

o For continuous transmit tests the EUT was controlled using the chipset manufacturers 'cli' console over tera-term and putty. This was run from within the terminal application on the EUT. The application was used to enable continuous transmission mode and to select the test channels, data rates and modulation schemes as required.

- **Worst Case Mode Determination:**

o Multiple supported modulation schemes, nominal channel bandwidths and SISO+MIMO Modes configurations were initially investigated to determine worst case modes.

o The data rates that produced worst case results for each 802.11 mode (a/n/ac) were then used for measurements presented in this report.

- **Conducted Measurements:**

o RF Output Power, Power Spectral Density, Occupied Channel Bandwidths measured separately on each Port with all supported SISO & MIMO Port combinations.

o Duty Cycles were computed with worst case SISO mode; as they found to be independent of number of transmitter chains used.

- **AC Conducted Emissions Measurements:**

o AC conducted tests were performed with all listed Antennas with MIMO Port 1+2+3+4, employing maximum possible Antennas.

o The Toyo EMI Software EP5/CE Ver 4.0.1. was used for these measurements.

- **Applicable to all Tests:**

o All the supplied antennas listed in section 3.5 have been tested with power settings in section 4.3.

o During testing unused EUT ports were terminated as listed in section 4.3.

4.3. Used Power Settings & Port Terminations

The EUT was configured with following GUI Power Settings (PWL), worst case data rates (in terms of highest output power & widest bandwidth) & test channels for 9 dBi Antenna configurations.

5470 MHz to 5725 MHz [U-NII-2C Band]										
9 dBi Antenna										
SISO Port 1 (Note 1)										
Nominal Channel Bandwidth	**20 MHz**									
Worst Case Data Rates	**a-mode: 48 & 54 Mbit n-mode : MCS 2 & 6 ac-mode: MCS 2 & 6**					**40 MHz**				
Test Channel	**100**	**104**	**116**	**136**	**140**	**n-mode : MCS 3 & 4 ac-mode: MCS 3 & 4**			**80 MHz**	
PWL	**12**	**17**	**17**	**17**	**14**	**102**	**118**	**134**	**ac-mode: MCS 1 & 8**	
	12	**17**	**17**	**17**	**14**	**12**	**12**	**12**	**106**	**122**
	12	**17**	**17**	**17**	**14**	**12**	**12**	**12**	**9**	**12**
Note 1: Unused Ports 2,3 & 4 Terminated with 50 Ω										
MIMO Port 1+2 (Note 2)										
Nominal Channel Bandwidth	**20 MHz**									
Worst Case Data Rates	**a-mode: 48 & 54 Mbit n-mode : MCS 0 & 4 ac-mode: MCS 0 & 4**					**40 MHz**				
Test Channel	**100**	**104**	**116**	**136**	**140**	**n-mode : MCS 7 ac-mode: MCS 7**			**80 MHz**	
PWL	**12**	**18**	**18**	N/T*	**18**	**102**	**118**	**134**	**ac-mode: MCS 5 & 9**	
	12	**18**	**18**	N/T*	**18**	**12**	**12**	**12**	**106**	**122**
	12	**18**	**18**	N/T*	**18**	**12**	**12**	**12**	**9**	**12**
Note 2: Unused Ports 3 & 4 Terminated with 50 Ω										
N/T* : CH 136 not tested as it has same PWL as that of CH 140										
MIMO Port 1+2+3 (Note 3)										
Nominal Channel Bandwidth	**20 MHz**									
Worst Case Data Rates	**a-mode: 9 & 12 Mbit n-mode : MCS 3 & 7 ac-mode: MCS 3 & 7**					**40 MHz**				
Test Channel	**100**	**104**	**116**	**136**	**140**	**n-mode : MCS 3 & 5 ac-mode: MCS 3 & 5**			**80 MHz**	
PWL	**13**	**16**	**16**	N/T*	**16**	**102**	**118**	**134**	**ac-mode: MCS 1 & 2**	
	13	**16**	**16**	N/T*	**16**	**13**	**13**	**13**	**106**	**122**
	13	**16**	**16**	N/T*	**16**	**13**	**13**	**13**	**13**	**13**
Note 3: Unused Port 4 Terminated with 50 Ω										
N/T* : CH 136 not tested as it has same PWL as that of CH 140										
MIMO Port 1+2+3+4 (Note 4)										
Note 4: Refer separate test report : UL-RPT-RP11909763-3616A.pdf for 9 dBi Antenna-MIMO Port 1+2+3+4 Testings.										

4.4. Used RF Cables

For AC conducted emission measurements performed with Antennas, EUT ports were connected with following RF cables to the antenna type.
For further details refer Section 3.6.B.

Antenna Type	EUT to Antennas Cable Details
	MIMO Mode Port 1+2+3+4
9 dBi Antenna	UMCC- N Connector Cables

For all conducted measurements performed EUT ports were connected with following RF cables to the Spectrum Analyzer's RF cable.
For further details refer Section 3.6.B.

Antenna Type	EUT to Antennas Cable Details		
	SISO Mode Port 1	**MIMO Mode Port 1+2**	**MIMO Mode Port 1+2+3**
9 dBi Antenna	UMCC- N Connector Cables		

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 6 *Measurement Uncertainty* for details.

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

5.2. Test Results

5.2.1. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineers:	Krume Ivanov & Bernd Woerl	**Test Dates:**	17 & 18 February 2020
Test Sample Serial Number:	192.168.0.70		
Test Site Identification	SR 7/8		

FCC Reference:	Part 15.207
Test Method Used:	ANSI C63.10 Section 6.2 / FCC KDB 174176 and notes below

Environmental Conditions:

Temperature (°C):	21 to 23
Relative Humidity (%):	34 to 40

Settings of the Instrument

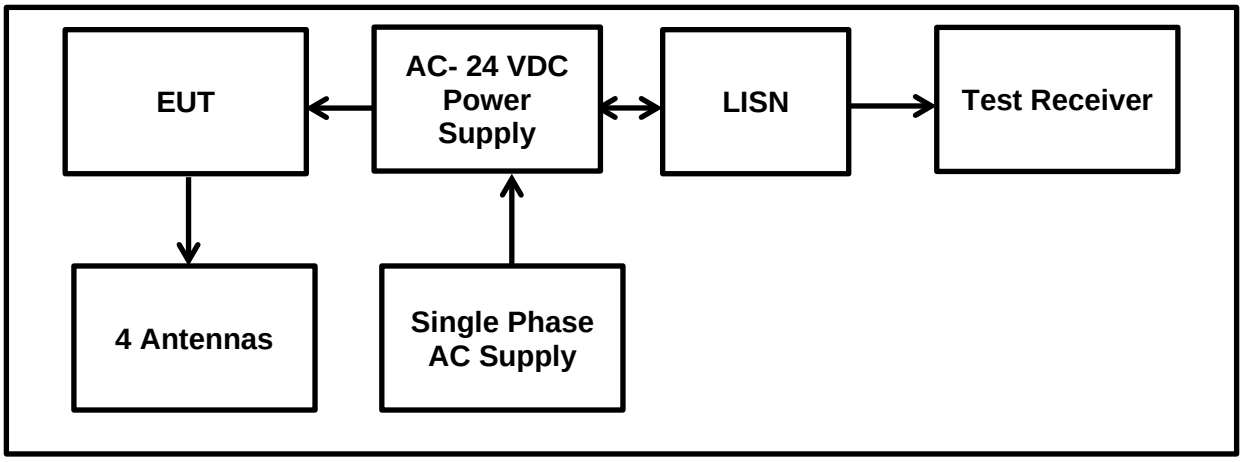
Detector	Quasi Peak/ Average Peak

Notes:

1. Measurement software used: Toyo EMI Software; CE measurement software EP5/CE Ver 4.0.1.
2. The EUT was powered by supplying 24 V DC via SIEMENS SIMATIC PS 307 Power Supply.
3. In accordance with FCC KDB 174176 Q4; the SIEMENS SIMATIC PS 307 Power Supply was connected to 120 VAC 60 Hz single phase supply via a LISN.
4. In accordance with FCC KDB 174176 Q4; the SIEMENS SIMATIC PS 307 Power Supply was connected to 240 VAC 60 Hz single phase supply via a LISN.
5. AC conducted tests were performed with the EUT set to the worst case mode:
    a. maximum power setting (PWL) amongst all supported SISO-MIMO modes
    b. MIMO Port 1+2+3+4 employing maximum possible Antennas
    c. maximum power level setting (PWL 18) | n-Mode | Data rate: MCS1 | Bandwith: 20 MHz | Channel 116 (5580 MHz)
6. Measurements were performed in shielded room (SR7/ 8 Asset Number 1603671). The EUT was placed at a height of 80 cm above the reference ground plane and in a distance of 40 cm from the vertical ground plane at the edge of the table.
7. Pre-scans were performed and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.
8. All other emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor.
9. The final measured value, for the given emission, in the table below incorporates the cable loss. Calculation: Level = test receiver reading + path loss (cable attenuation + correction LISN).

Transmitter AC Conducted Spurious Emissions (continued)

Test setup:



Transmitter AC Conducted Spurious Emissions (continued)

Results: Live (L1) / Quasi Peak / 120 VAC 60 Hz / 9 dBi Antenna

Frequency [MHz]	Line Phase	Reading QP [dB(µV)]	Correction Factor [dB]	Level QP [dB(µV)]	Limit QP [dB(µV)]	Margin QP [dB]	Result
0.17204	Live (L1)	33.1	9.9	43.0	64.9	21.9	Complied
0.20611	Live (L1)	27.4	9.9	37.3	63.4	26.1	Complied
0.27124	Live (L1)	25.4	9.8	35.2	61.1	25.9	Complied
0.34188	Live (L1)	25.0	9.8	34.8	59.2	24.4	Complied
3.37074	Live (L1)	17.3	9.9	27.2	56.0	28.8	Complied
12.90180	Live (L1)	23.0	10.1	33.1	60.0	26.9	Complied

Results: Live (L1) / Average / 120 VAC 60 Hz / 9 dBi Antenna

Frequency [MHz]	Line Phase	Reading AV [dB(µV)]	Correction Factor [dB]	Level AV [dB(µV)]	Limit AV [dB(µV)]	Margin AV [dB]	Result
0.17204	Live (L1)	25.7	9.9	35.6	54.9	19.3	Complied
0.20611	Live (L1)	14.6	9.9	24.5	53.4	28.9	Complied
0.27124	Live (L1)	11.7	9.8	21.5	51.1	29.6	Complied
0.34188	Live (L1)	18.6	9.8	28.4	49.2	20.8	Complied
3.37074	Live (L1)	12.4	9.9	22.3	46.0	23.7	Complied
12.90180	Live (L1)	20.4	10.1	30.5	50.0	19.5	Complied

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Results: Neutral (N) / Quasi Peak / 120 VAC 60 Hz / 9 dBi Antenna

Frequency [MHz]	Line Phase	Reading QP [dB(µV)]	Correction Factor [dB]	Level QP [dB(µV)]	Limit QP [dB(µV)]	Margin QP [dB]	Result
0.17405	Neutral (N)	28.9	9.9	38.8	64.8	26.0	Complied
0.20411	Neutral (N)	27.0	9.9	36.9	63.4	26.5	Complied
0.23216	Neutral (N)	26.1	9.9	36.0	62.4	26.4	Complied
0.43808	Neutral (N)	19.6	9.9	29.5	57.1	27.6	Complied
3.35872	Neutral (N)	7.5	9.9	17.4	56.0	38.6	Complied
12.90180	Neutral (N)	22.4	10.1	32.5	60.0	27.5	Complied

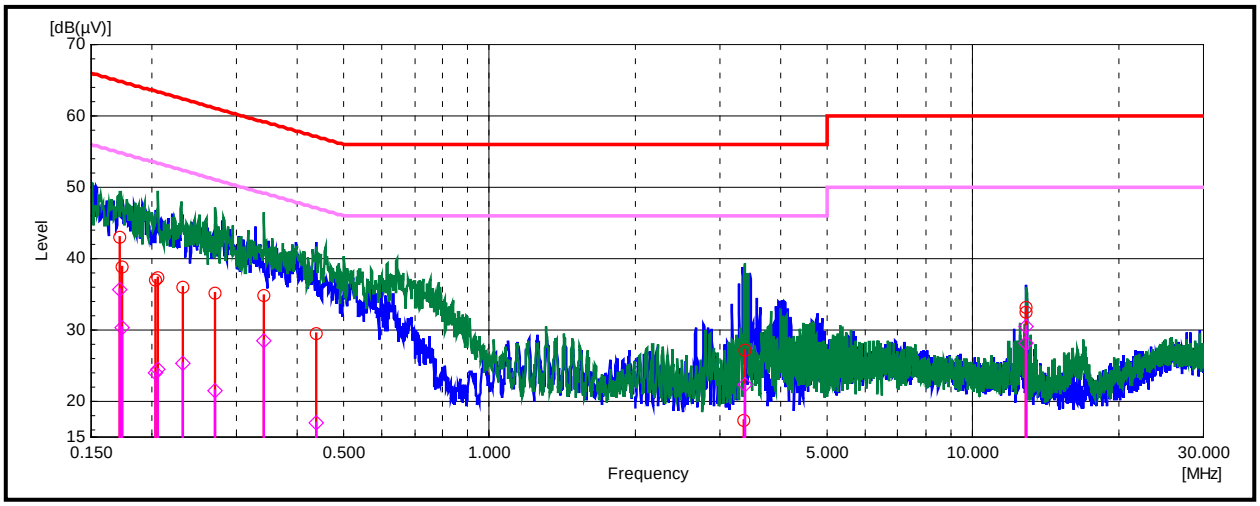
Results: Neutral (N) / Average / 120 VAC 60 Hz / 9 dBi Antenna

Frequency [MHz]	Line Phase	Reading AV [dB(µV)]	Correction Factor [dB]	Level AV [dB(µV)]	Limit AV [dB(µV)]	Margin AV [dB]	Result
0.17405	Neutral (N)	20.4	9.9	30.3	54.8	24.5	Complied
0.20411	Neutral (N)	14.2	9.9	24.1	53.4	29.3	Complied
0.23216	Neutral (N)	15.5	9.9	25.4	52.4	27.0	Complied
0.43808	Neutral (N)	7.1	9.9	17.0	47.1	30.1	Complied
3.35872	Neutral (N)	1.7	9.9	11.6	46.0	34.4	Complied
12.90180	Neutral (N)	18.1	10.1	28.2	50.0	21.8	Complied

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live and Neutral Line / 9 dBi Antenna



Note: The plots show the max hold (peak detector) pre-scan results measured. Blue graph represents the result of the N-Line; green graph - the results for L1-Line. The bar graphs indicate the final measurement result applying the dedicated detector at selected frequencies for each limit line (red cycle for quasi peak limit; violet cycle for average limit).

Legend (Conducted Emissions)	
Items	Description
	Blue graph is the result of peak measurement phase L
	Green graph is the result of peak measurement phase N
	Limit line **Quasi-Peak**
	Limit line **Average**
	Final item **Quasi-Peak**
	Final item **Average**

Transmitter AC Conducted Spurious Emissions (continued) :

Results: Live (L1) / Quasi Peak / 240 VAC 60 Hz / 9 dBi Antenna

Frequency [MHz]	Line Phase	Reading QP [dB(µV)]	Correction Factor [dB]	Level QP [dB(µV)]	Limit QP [dB(µV)]	Margin QP [dB]	Result
0.15501	Live (L1)	28.6	9.9	38.5	65.7	27.2	Complied
0.17856	Live (L1)	27.8	9.9	37.7	64.6	26.9	Complied
0.24770	Live (L1)	24.9	9.8	34.7	61.8	27.1	Complied
0.36593	Live (L1)	21.4	9.8	31.2	58.6	27.4	Complied
3.31864	Live (L1)	29.1	9.9	39.0	56.0	17.0	Complied
12.91182	Live (L1)	24.0	10.1	34.1	60.0	25.9	Complied

Results: Live (L1) / Average / 240 VAC 60 Hz / 9 dBi Antenna

Frequency [MHz]	Line Phase	Reading AV [dB(µV)]	Correction Factor [dB]	Level AV [dB(µV)]	Limit AV [dB(µV)]	Margin AV [dB]	Result
0.15501	Live (L1)	11.3	9.9	21.2	55.7	34.5	Complied
0.17856	Live (L1)	16.1	9.9	26.0	54.6	28.6	Complied
0.24770	Live (L1)	8.9	9.8	18.7	51.8	33.1	Complied
0.36593	Live (L1)	4.5	9.8	14.3	48.6	34.3	Complied
3.31864	Live (L1)	18.5	9.9	28.4	46.0	17.6	Complied
12.91182	Live (L1)	21.9	10.1	32.0	50.0	18.0	Complied

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Results: Neutral (N) / Quasi Peak / 240 VAC 60 Hz / 9 dBi Antenna

Frequency [MHz]	Line Phase	Reading QP [dB(µV)]	Correction Factor [dB]	Level QP [dB(µV)]	Limit QP [dB(µV)]	Margin QP [dB]	Result
0.17956	Neutral (N)	27.5	9.9	37.4	64.5	27.1	Complied
0.20261	Neutral (N)	26.3	9.9	36.2	63.5	27.3	Complied
0.29028	Neutral (N)	23.3	9.8	33.1	60.5	27.4	Complied
0.40000	Neutral (N)	24.2	9.9	34.1	57.9	23.8	Complied
3.37475	Neutral (N)	28.5	9.9	38.4	56.0	17.6	Complied
12.91182	Neutral (N)	24.2	10.1	34.3	60.0	25.7	Complied

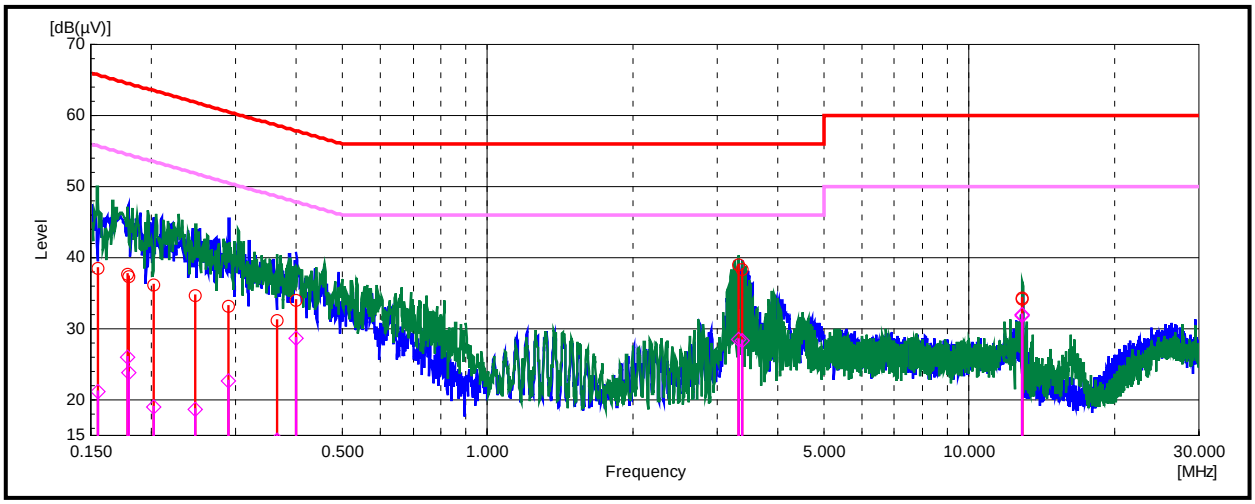
Results: Neutral (N) / Average / 240 VAC 60 Hz / 9 dBi Antenna

Frequency [MHz]	Line Phase	Reading AV [dB(µV)]	Correction Factor [dB]	Level AV [dB(µV)]	Limit AV [dB(µV)]	Margin AV [dB]	Result
0.17956	Neutral (N)	13.9	9.9	23.8	54.5	30.7	Complied
0.20261	Neutral (N)	9.1	9.9	19.0	53.5	34.5	Complied
0.29028	Neutral (N)	12.8	9.8	22.6	50.5	27.9	Complied
0.40000	Neutral (N)	18.8	9.9	28.7	47.9	19.2	Complied
3.37475	Neutral (N)	18.4	9.9	28.3	46.0	17.7	Complied
12.91182	Neutral (N)	21.8	10.1	31.9	50.0	18.1	Complied

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live and Neutral Line / 9 dBi Antenna



Note: The plots show the max hold (peak detector) pre-scan results measured. Blue graph represents the result of the N-Line; green graph - the results for L1-Line. The bar graphs indicate the final measurement result applying the dedicated detector at selected frequencies for each limit line (red cycle for quasi peak limit; violet cycle for average limit).

Legend (Conducted Emissions)	
Items	Description
	Blue graph is the result of peak measurement phase L
	Green graph is the result of peak measurement phase N
	Limit line **Quasi-Peak**
	Limit line **Average**
	Final item **Quasi-Peak**
	Final item **Average**

5.2.2. Transmitter 26 dB Emission Bandwidth

Test Summary:

Test Engineer:	Krume Ivanov & Sercan Usta	**Test Date:**	20 February 2020
Test Sample Serial Number:	192.168.0.65		
Test Site Identification	SR 9		

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

Environmental Conditions:

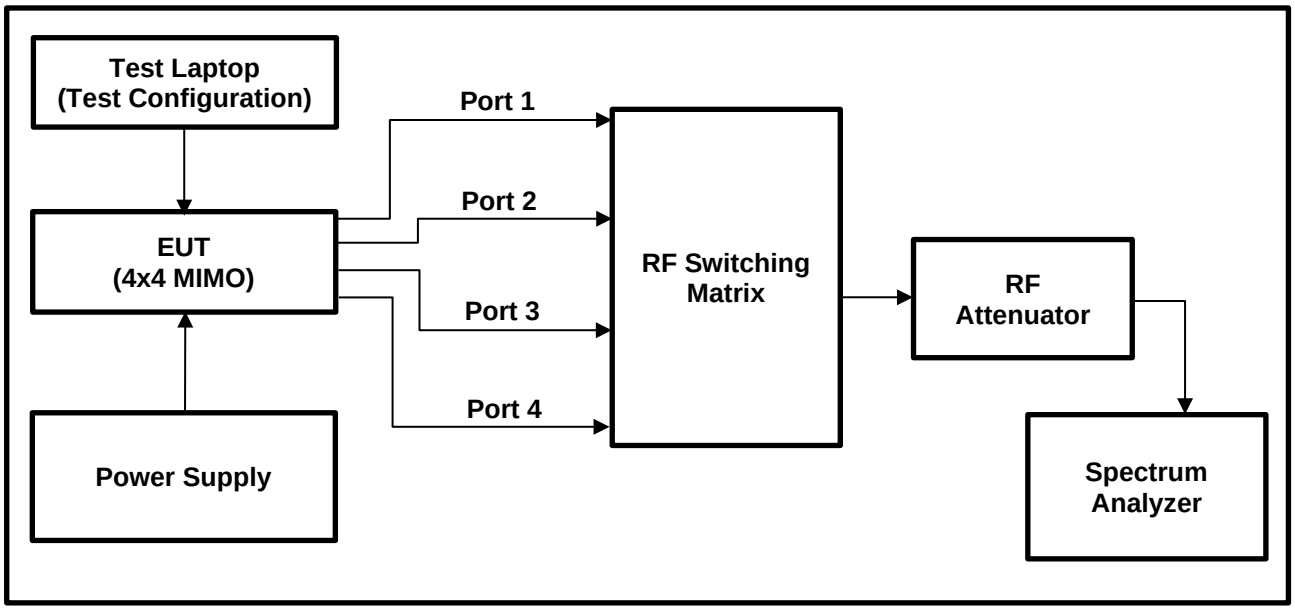
Temperatures (°C):	21
Relative Humidity (%):	25

Notes:

1. All configurations supported by the EUT were investigated on the one channel in accordance with KDB 789033 Section II.C.1. Emission Bandwidth (EBW) test procedure.
2. Final measurements were performed in each supported operating band using the above configurations on the bottom, middle and top or single channels.
3. 26 dB Emission Bandwidth were measured separately with worst case data rates on SISO mode & all MIMO modes.
4. The RF port on the EUT was connected to the spectrum analyser using suitable attenuation and RF cable. The measured values takes into consideration the external attenuation correction factors which is compensated by adding reference level offset of 26.85 dB@ 5.47-5.725 GHz to each of the conducted plots.

Transmitter 26 dB Emission Bandwidth (continued)

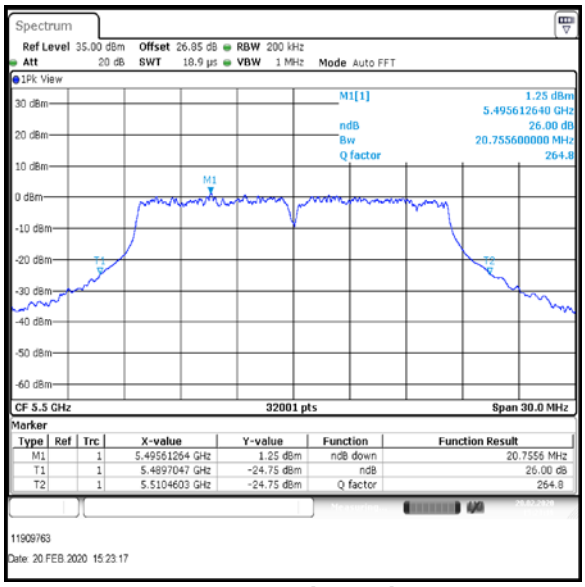
Test setup:



Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 48Mbit / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.756



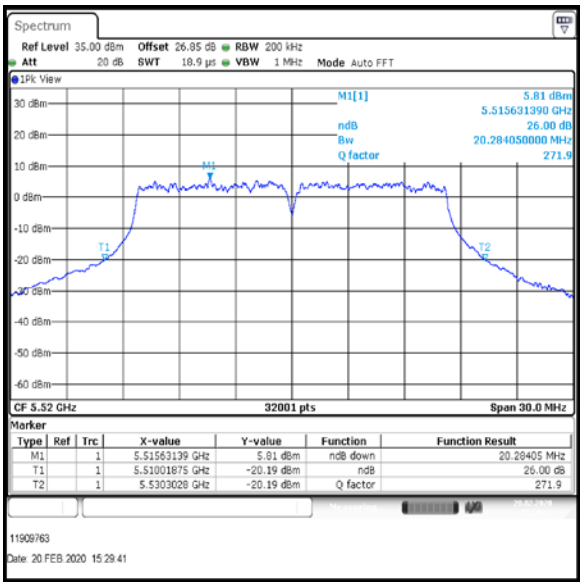
Bottom Channel

Result: Pass

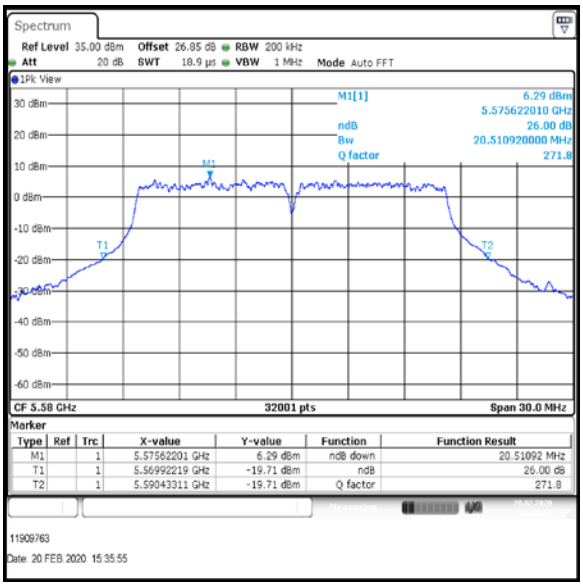
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 48Mbit / SISO / Port 1 / Port 1 / PWL 17 / 9 dBi Antenna

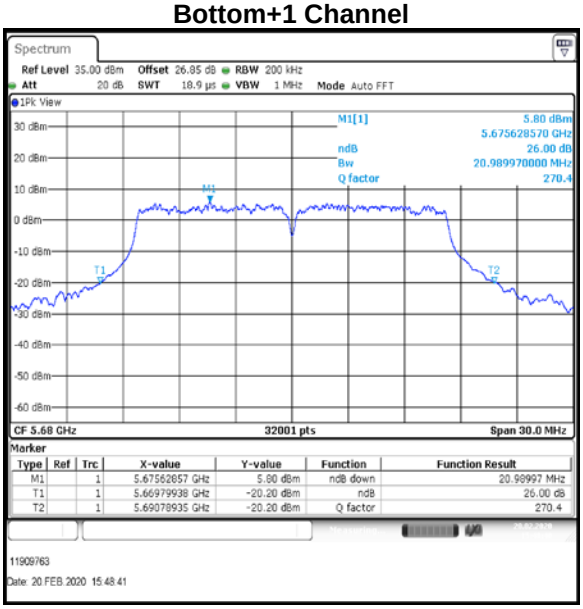
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	20.284
Middle	5580	20.511
Top-1	5680	20.99



Bottom+1 Channel



Middle Channel



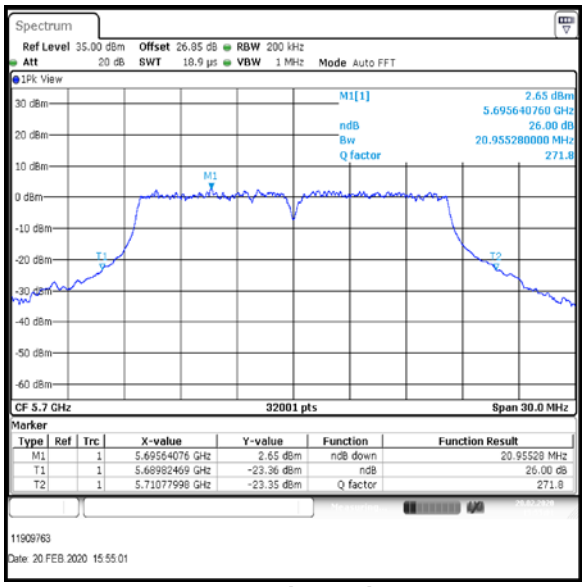
Top-1 Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 48Mbit / SISO / Port 1 / Port 1 / PWL 14 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Top	5700	20.955



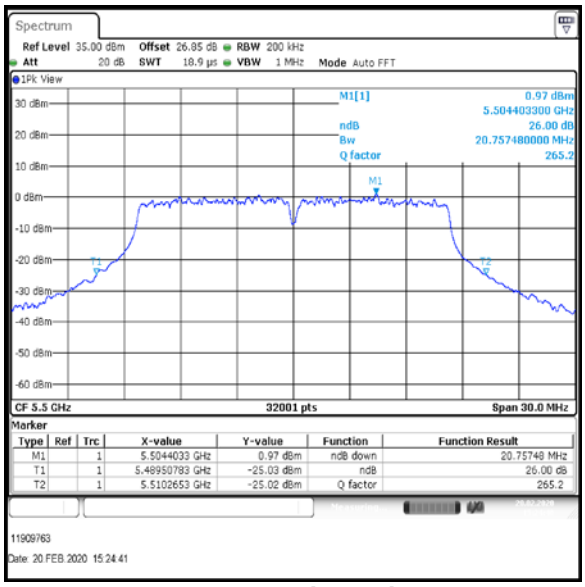
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 54Mbit / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.757



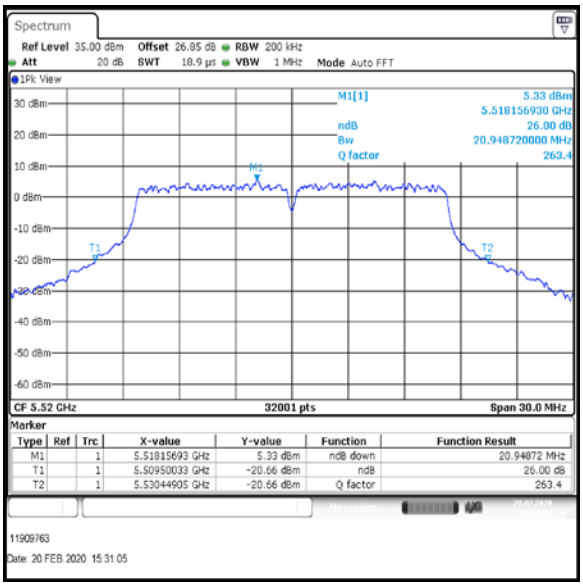
Bottom Channel

Result: Pass

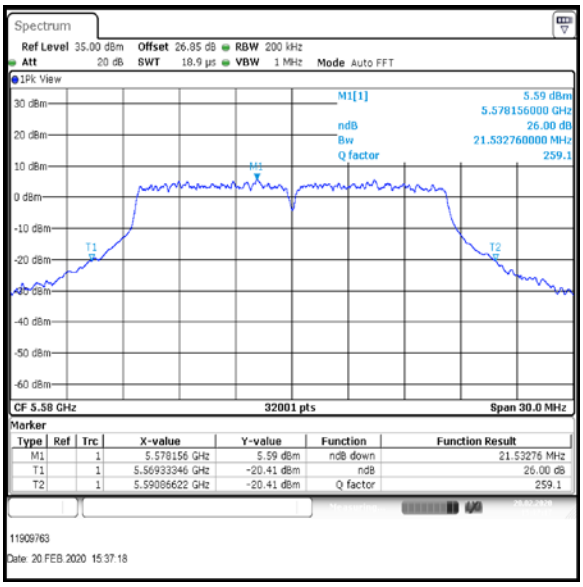
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 54Mbit / SISO / Port 1 / Port 1 / PWL 17 / 9 dBi Antenna

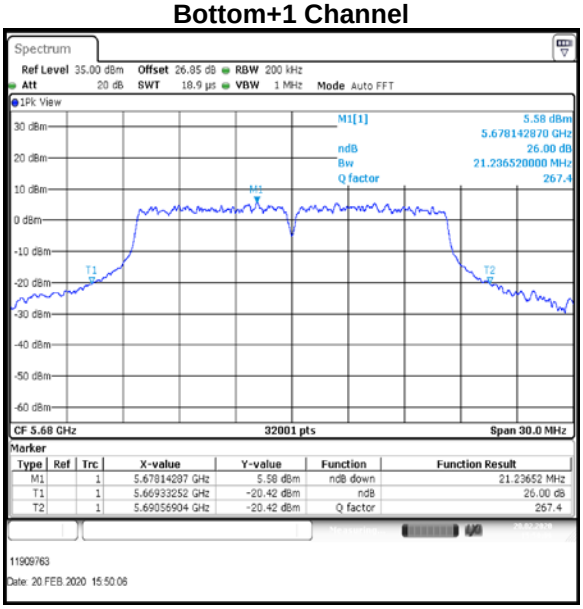
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	20.949
Middle	5580	21.533
Top-1	5680	21.237



Bottom+1 Channel



Middle Channel



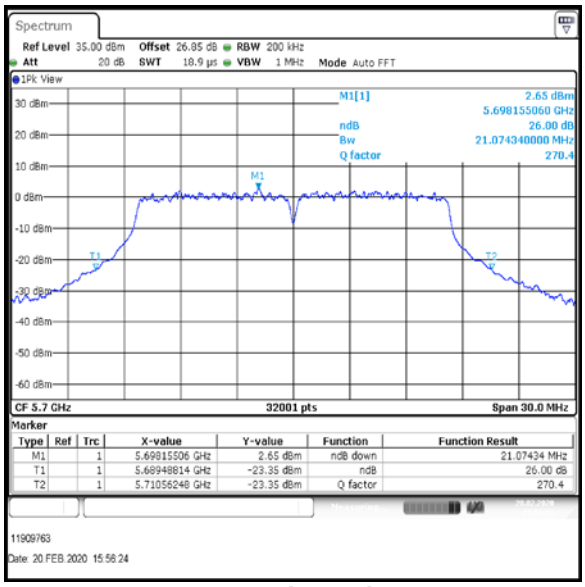
Top-1 Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 54Mbit / SISO / Port 1 / Port 1 / PWL 14 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Top	5700	21.074



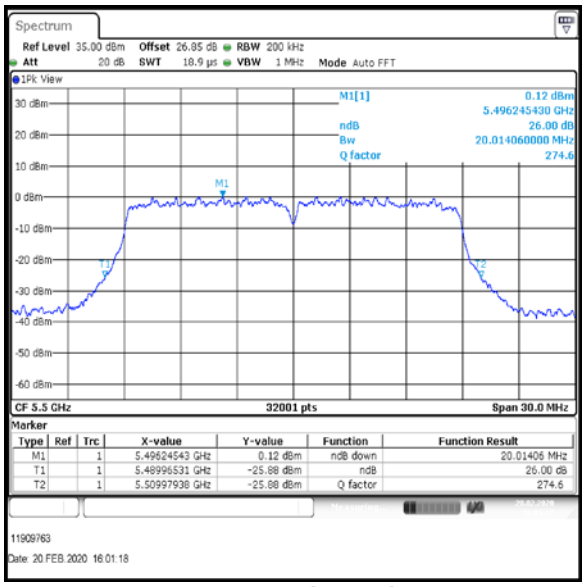
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS2 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.014



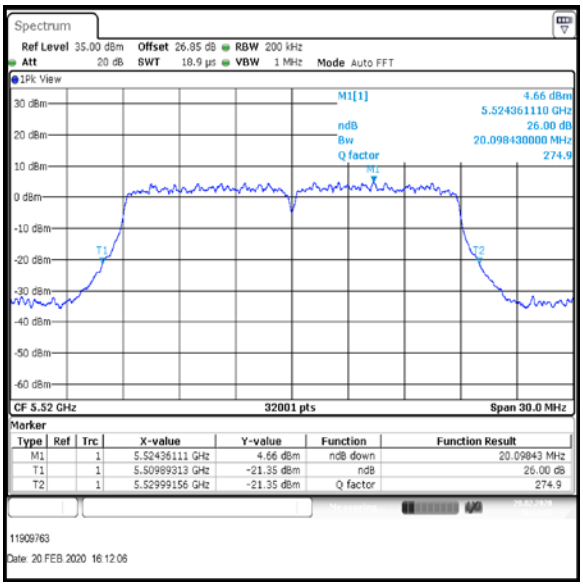
Bottom Channel

Result: Pass

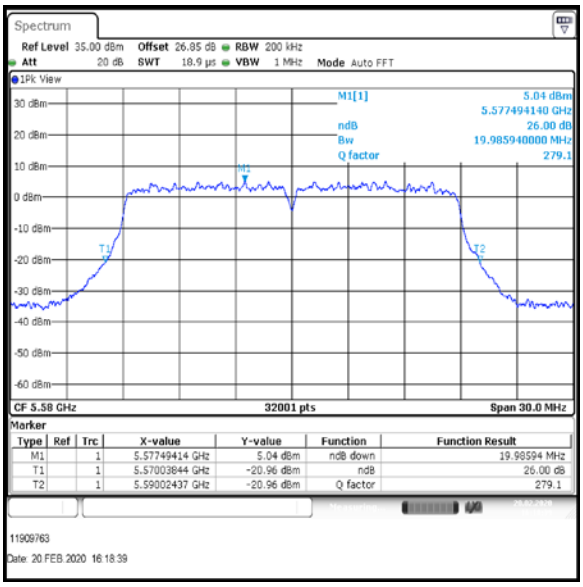
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS2 / SISO / Port 1 / Port 1 / PWL 17 / 9 dBi Antenna

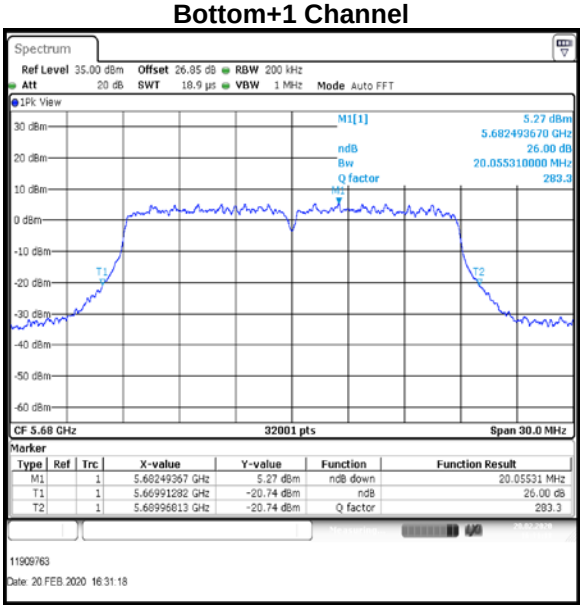
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	20.098
Middle	5580	19.986
Top-1	5680	20.055



Bottom+1 Channel



Middle Channel



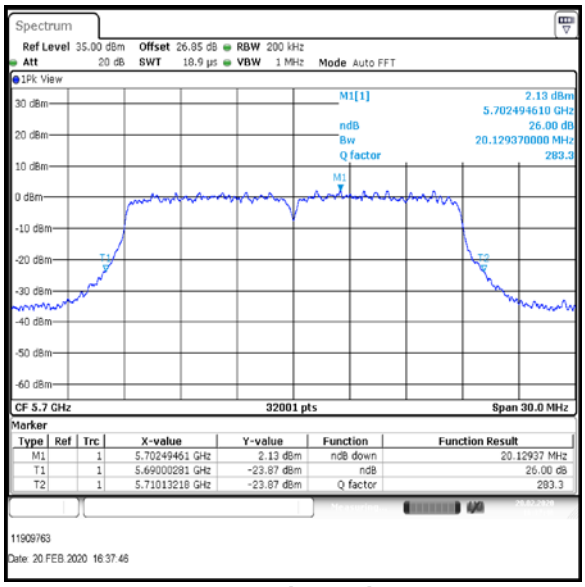
Top-1 Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS2 / SISO / Port 1 / Port 1 / PWL 14 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Top	5700	20.129



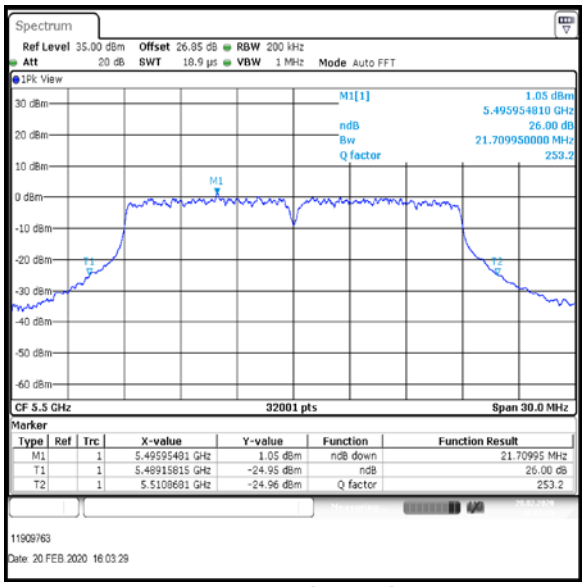
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS6 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	21.71



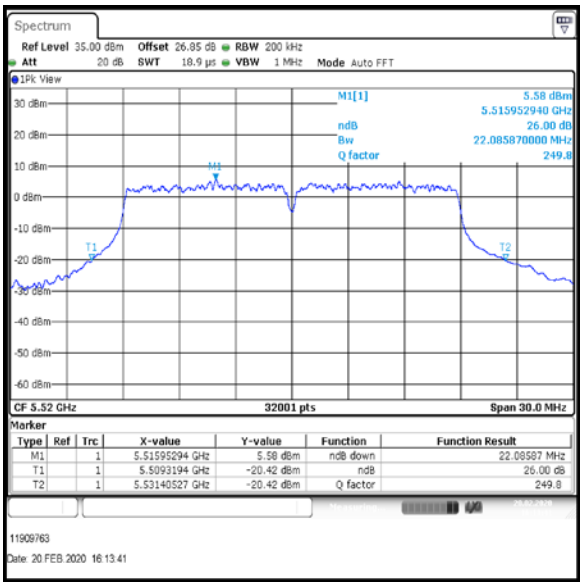
Bottom Channel

Result: Pass

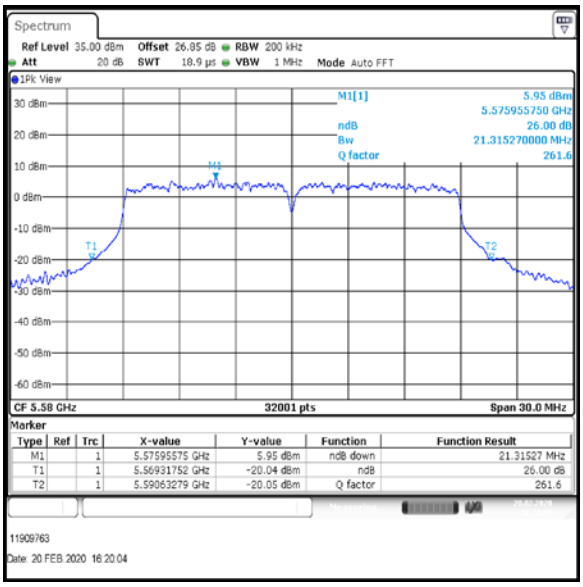
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS6 / SISO / Port 1 / Port 1 / PWL 17 / 9 dBi Antenna

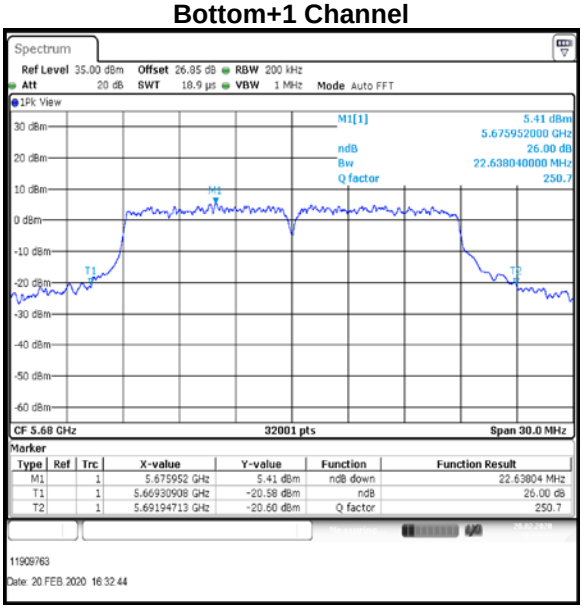
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	22.086
Middle	5580	21.315
Top-1	5680	22.638



Bottom+1 Channel



Middle Channel



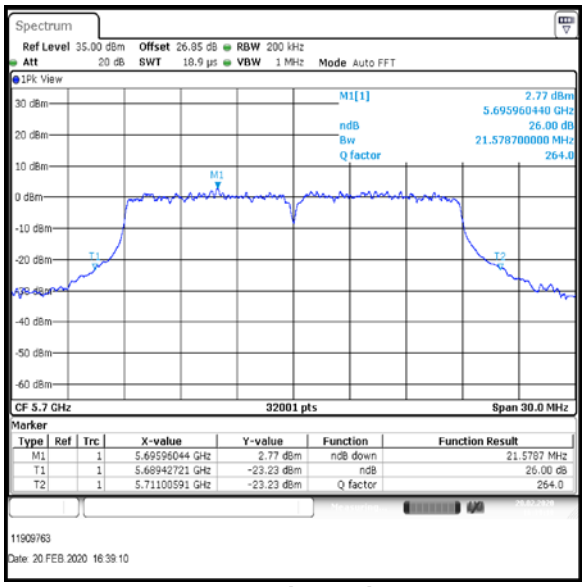
Top-1 Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS6 / SISO / Port 1 / Port 1 / PWL 14 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Top	5700	21.579



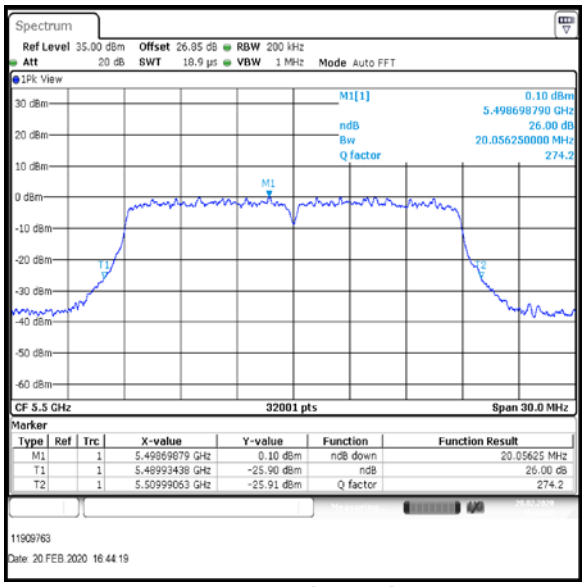
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS2 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.056



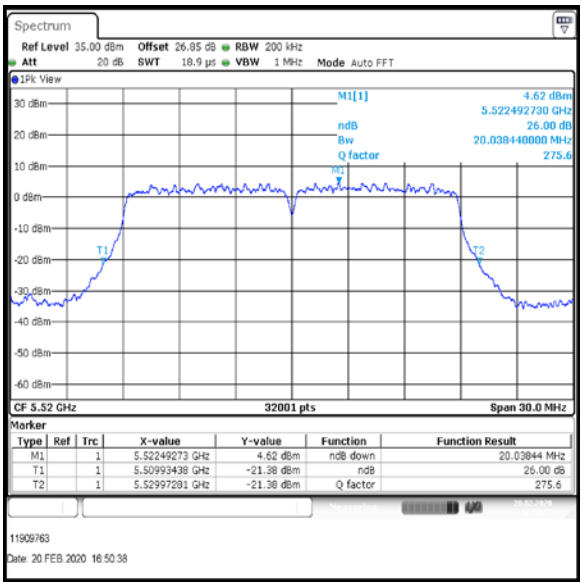
Bottom Channel

Result: Pass

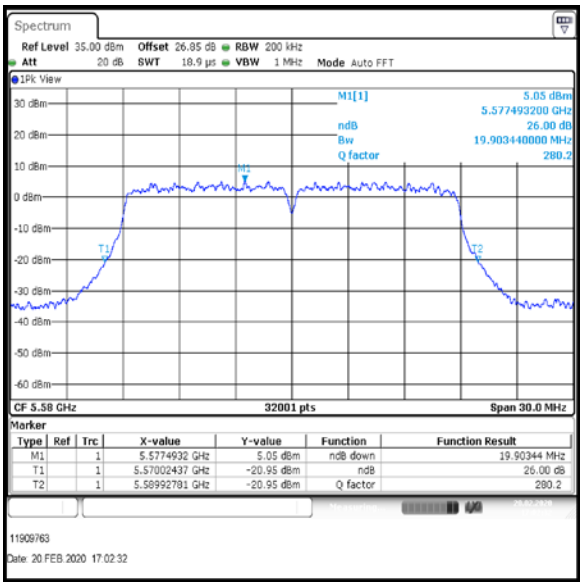
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS2 / SISO / Port 1 / Port 1 / PWL 17 / 9 dBi Antenna

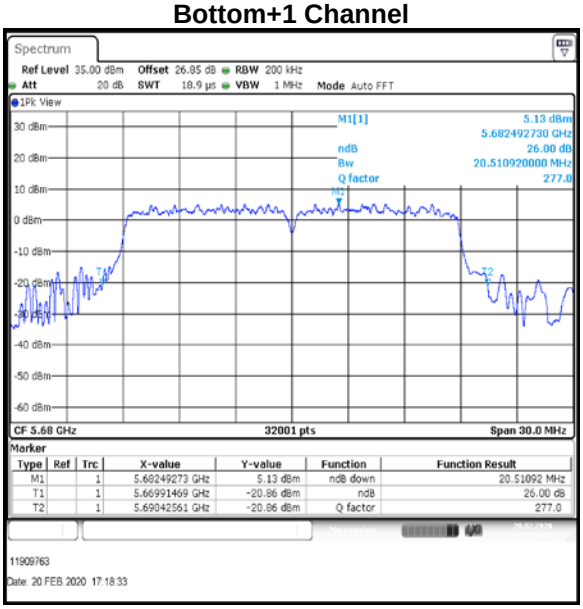
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	20.038
Middle	5580	19.903
Top-1	5680	20.511



Bottom+1 Channel



Middle Channel



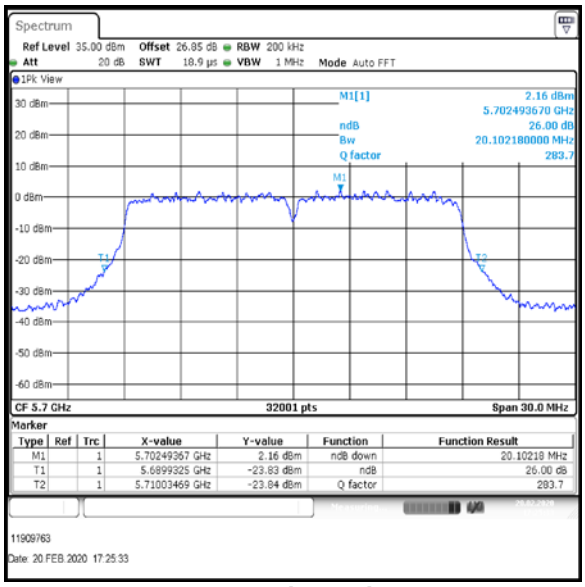
Top-1 Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS2 / SISO / Port 1 / Port 1 / PWL 14 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Top	5700	20.102



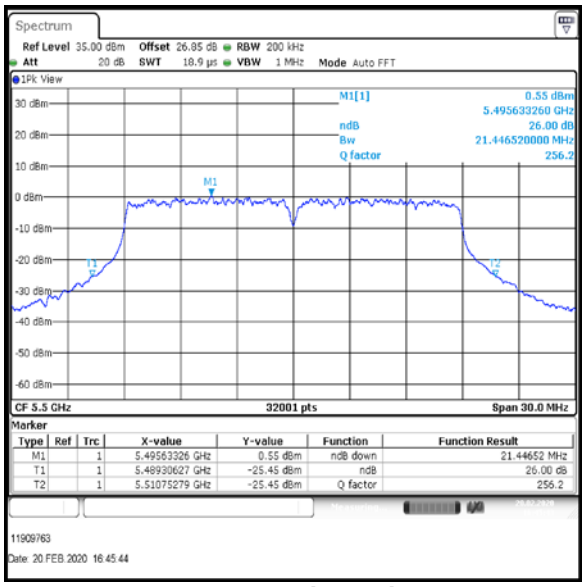
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS6 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	21.447



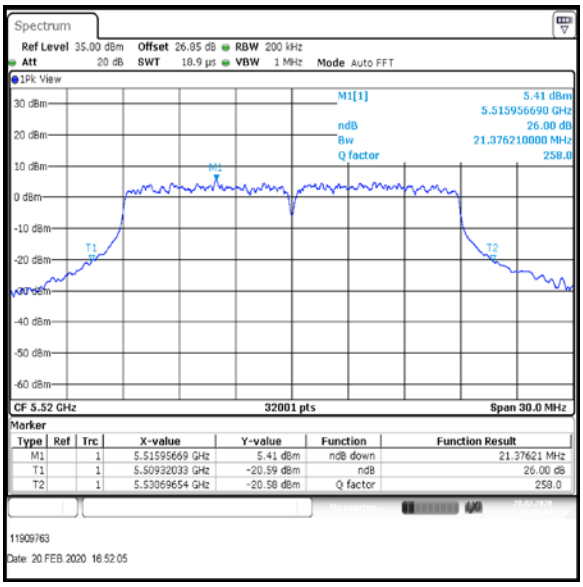
Bottom Channel

Result: Pass

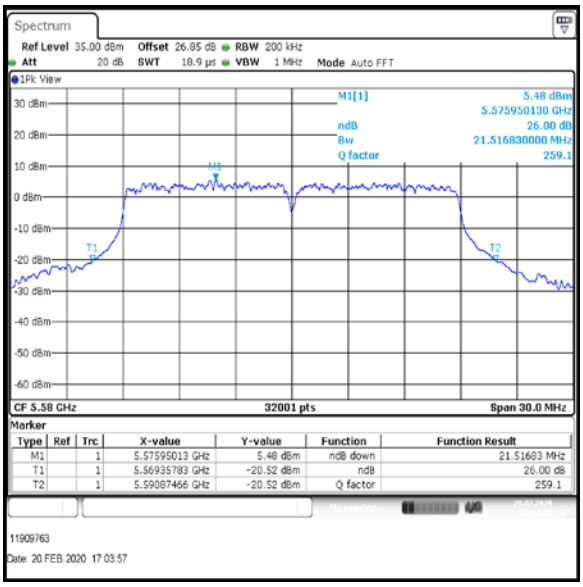
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS6 / SISO / Port 1 / Port 1 / PWL 17 / 9 dBi Antenna

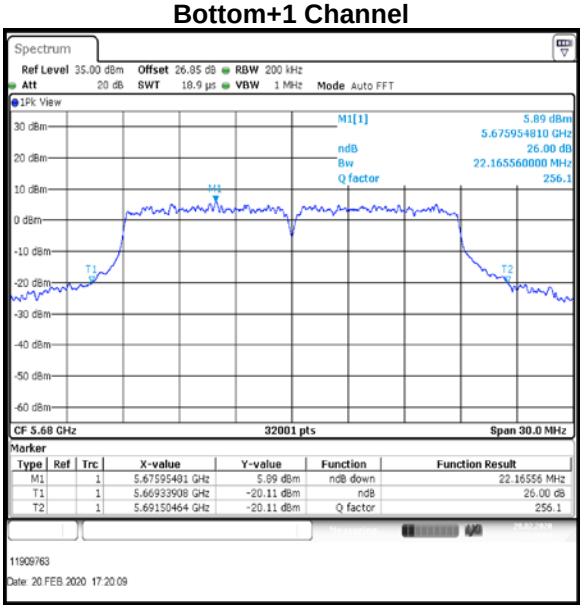
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	21.376
Middle	5580	21.517
Top-1	5680	22.166



Bottom+1 Channel



Middle Channel



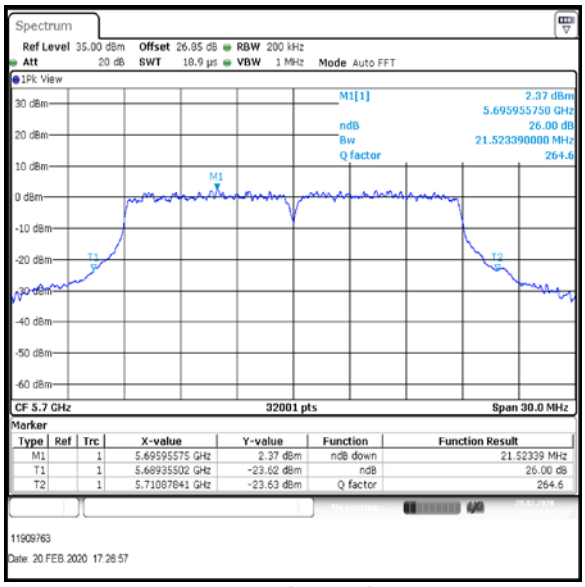
Top-1 Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS6 / SISO / Port 1 / Port 1 / PWL 14 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Top	5700	21.523



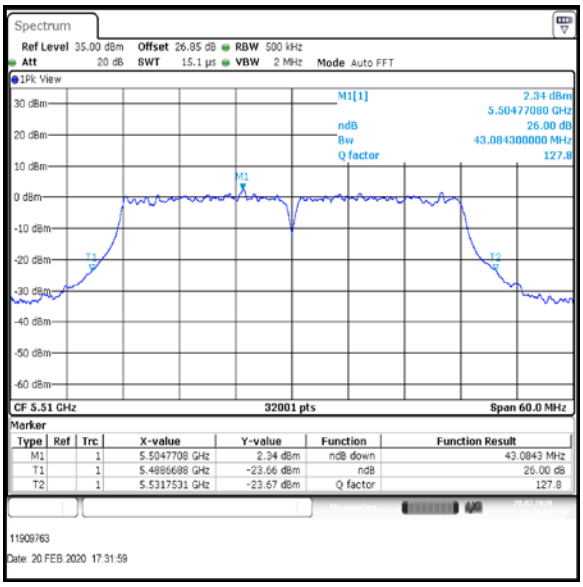
Top Channel

Result: Pass

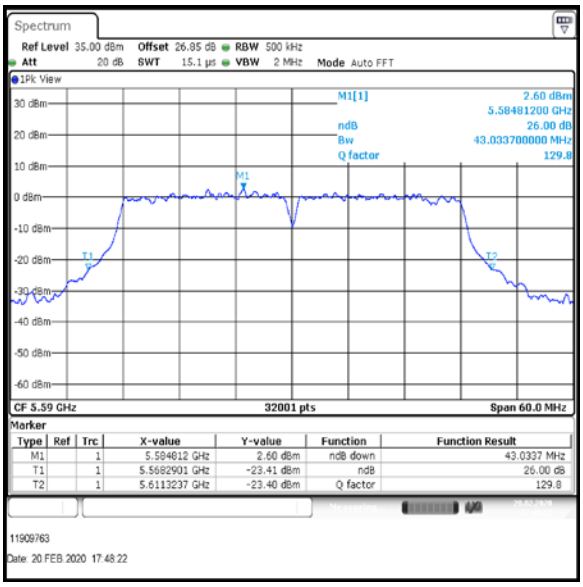
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT40 / MCS3 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

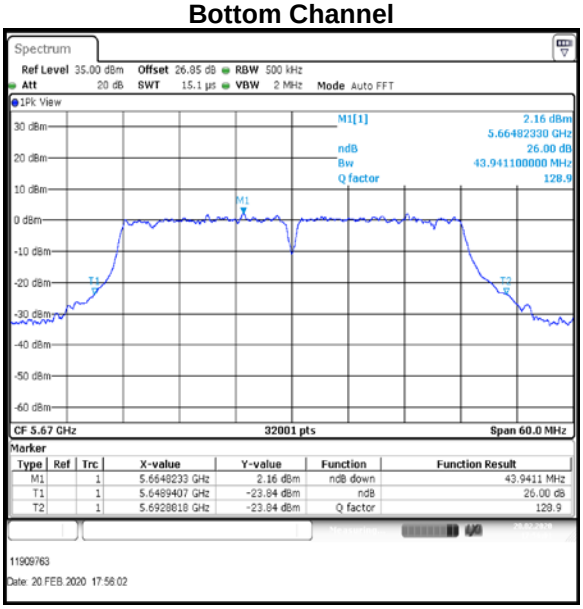
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5510	43.084
Middle	5590	43.034
Top	5670	43.941



Bottom Channel



Middle Channel



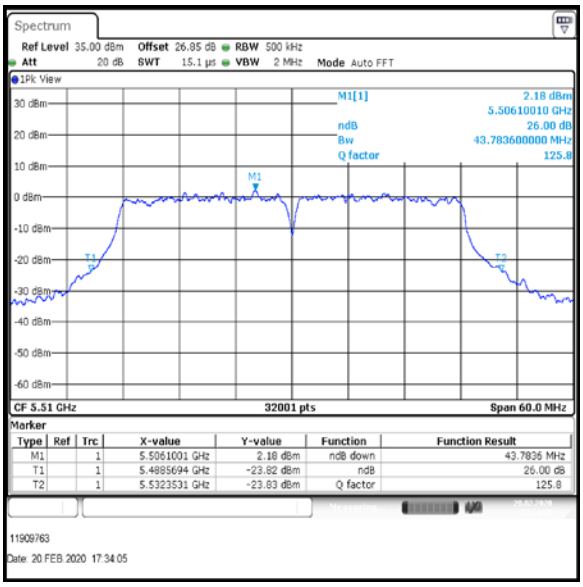
Top Channel

Result: Pass

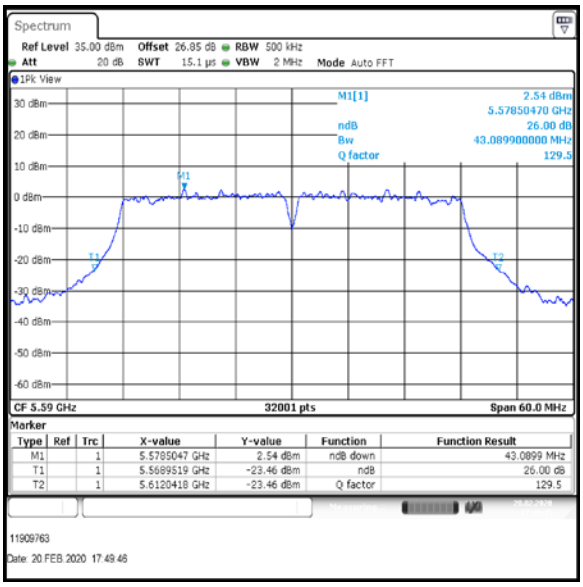
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT40 / MCS4 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

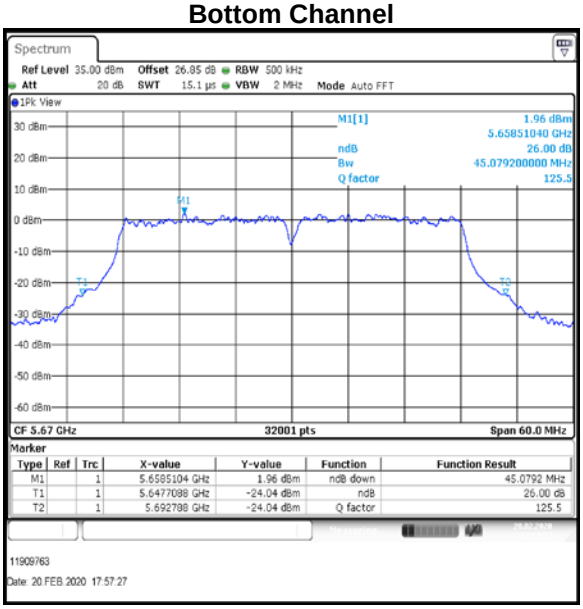
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5510	43.784
Middle	5590	43.09
Top	5670	45.079



Bottom Channel



Middle Channel



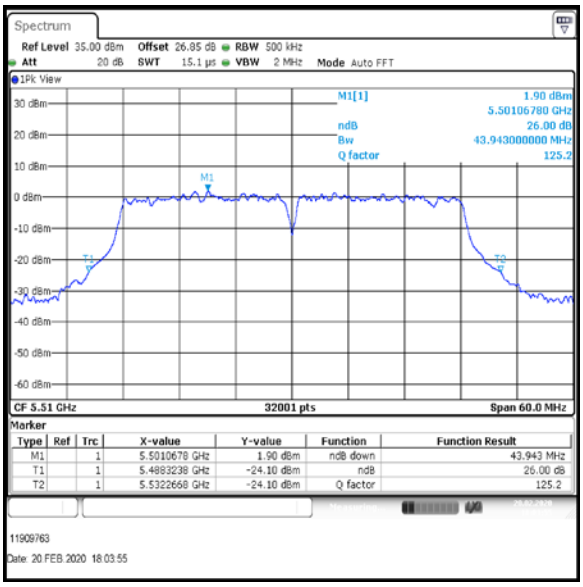
Top Channel

Result: Pass

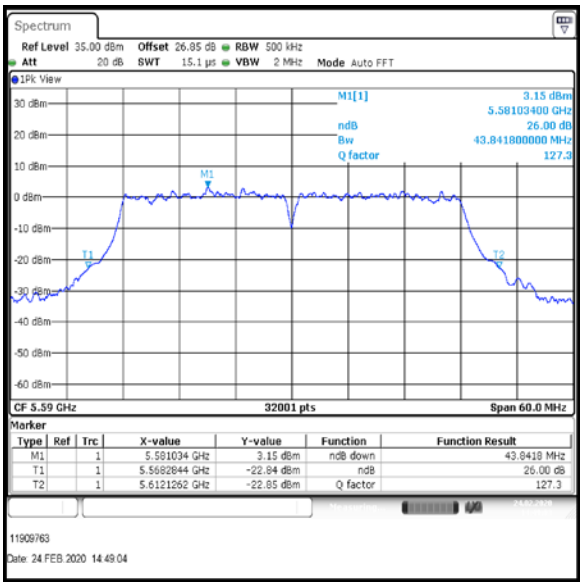
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT40 / MCS3 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

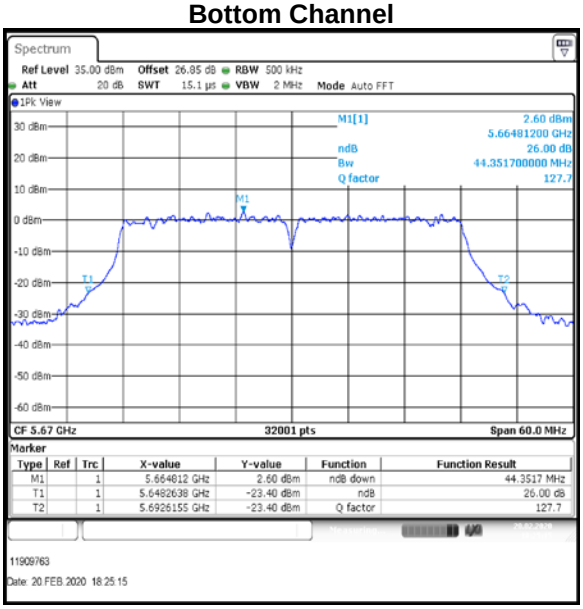
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5510	43.943
Middle	5590	43.842
Top	5670	44.352



Bottom Channel



Middle Channel



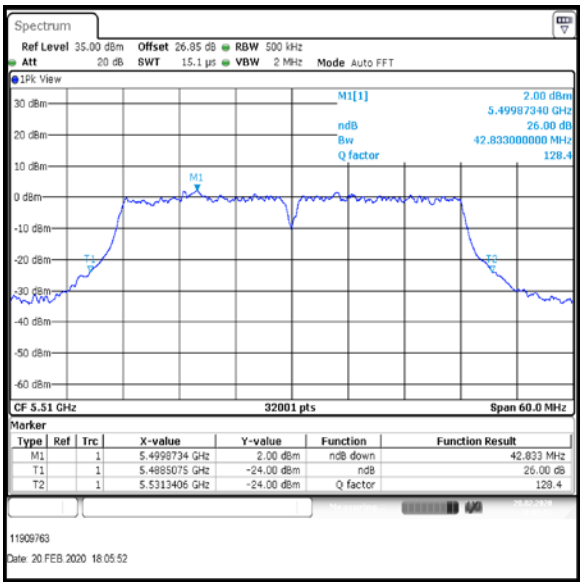
Top Channel

Result: Pass

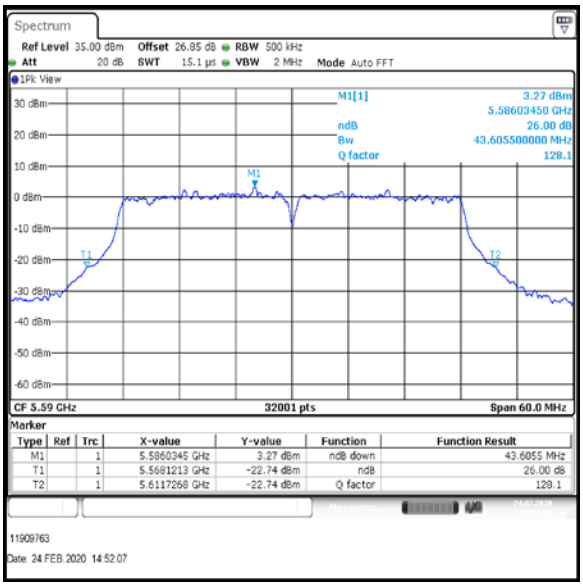
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT40 / MCS4 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

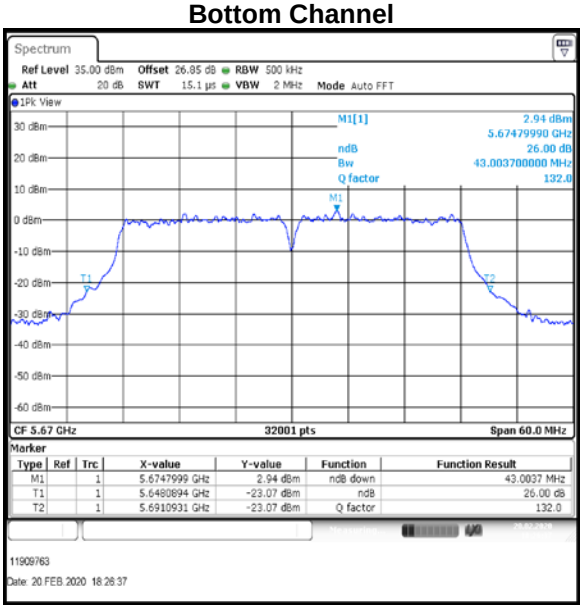
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5510	42.833
Middle	5590	43.606
Top	5670	43.004



Bottom Channel



Middle Channel



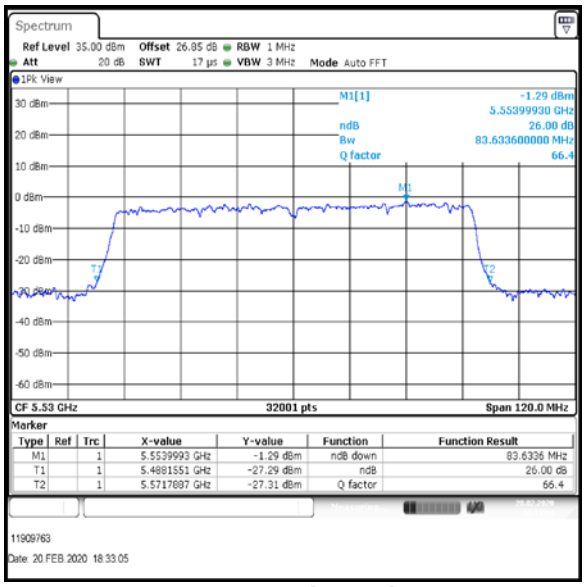
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT80 / MCS1 / SISO / Port 1 / Port 1 / PWL 9 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5530	83.634



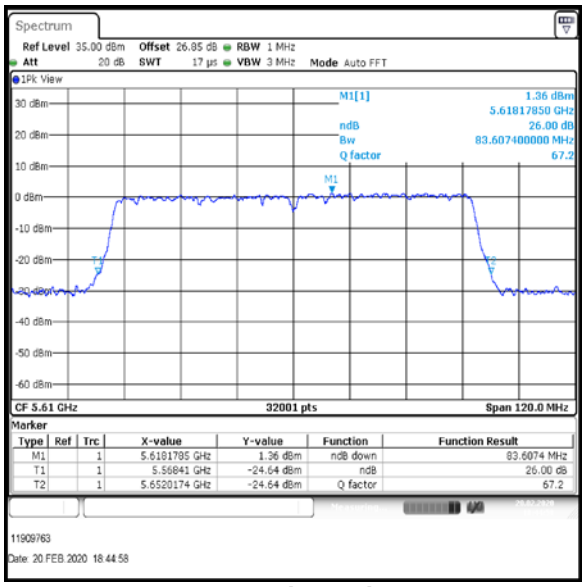
Bottom Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT80 / MCS1 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Top	5610	83.607



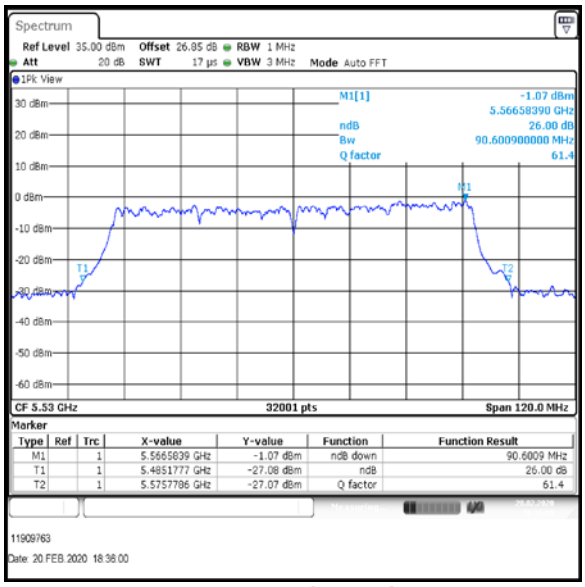
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT80 / MCS8 / SISO / Port 1 / Port 1 / PWL 9 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5530	90.601



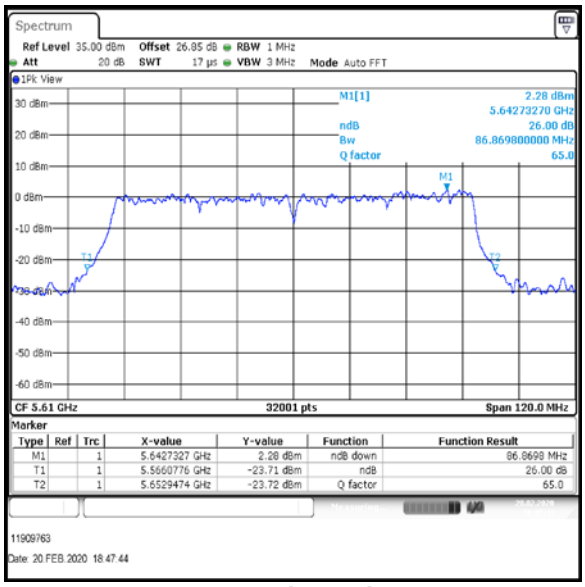
Bottom Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT80 / MCS8 / SISO / Port 1 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Top	5610	86.87



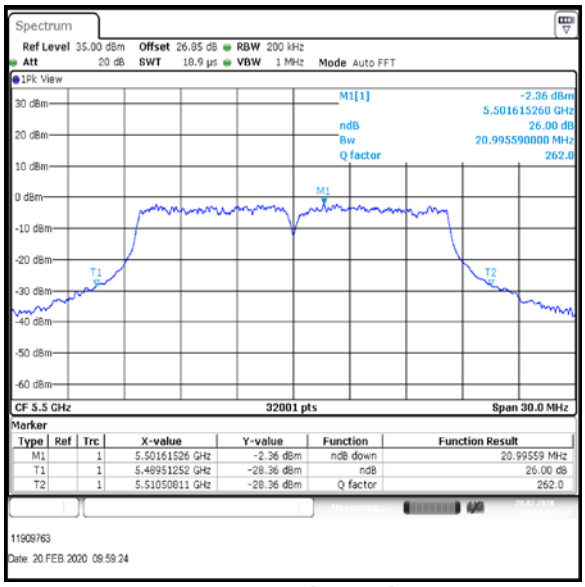
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 48Mbit / MIMO / Port 1+2 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.996



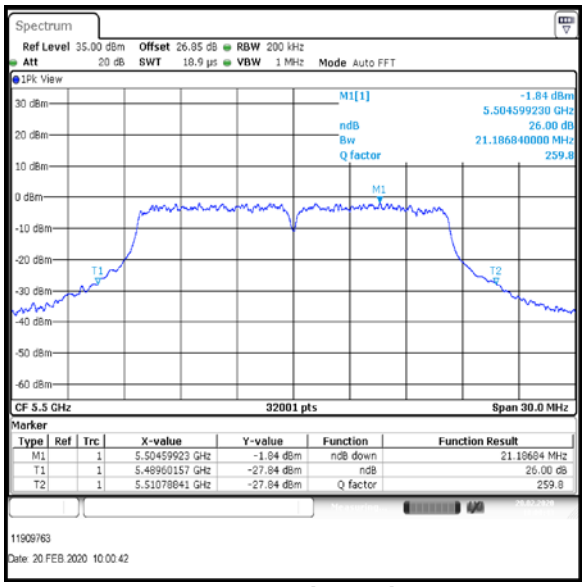
Bottom Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 48Mbit / MIMO / Port 1+2 / Port 2 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	21.187



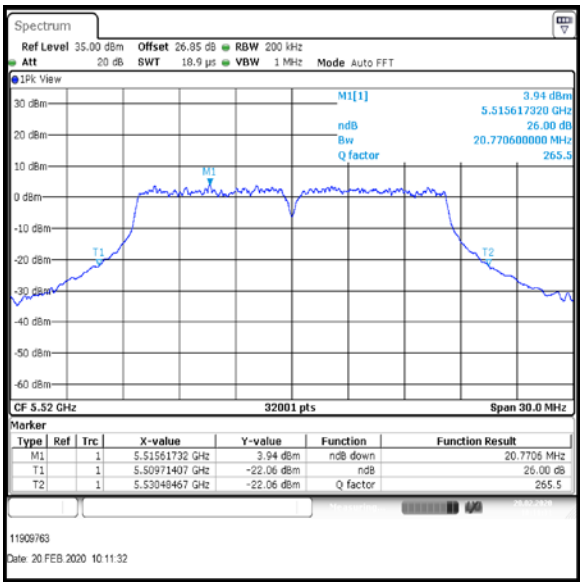
Bottom Channel

Result: Pass

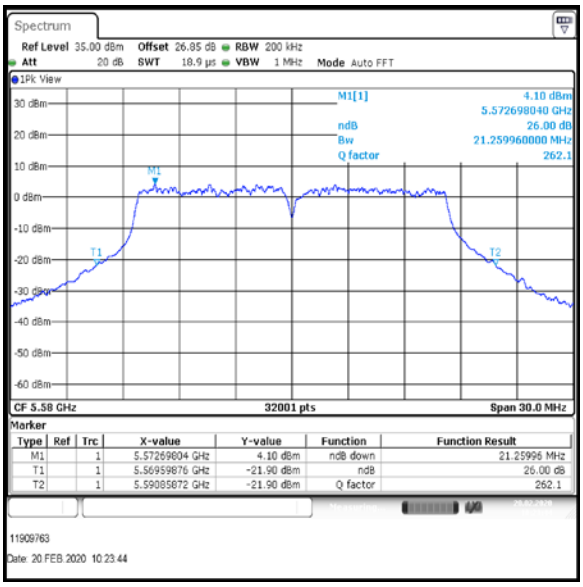
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 48Mbit / MIMO / Port 1+2 / Port 1 / PWL 18 / 9 dBi Antenna

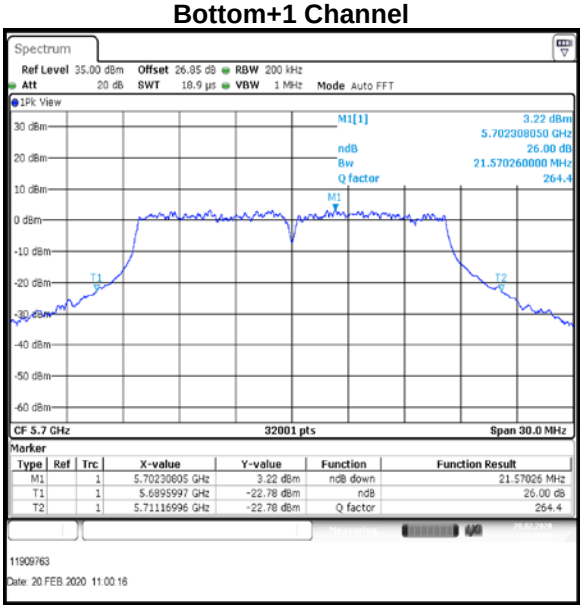
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	20.771
Middle	5580	21.26
Top	5700	21.57



Bottom+1 Channel



Middle Channel



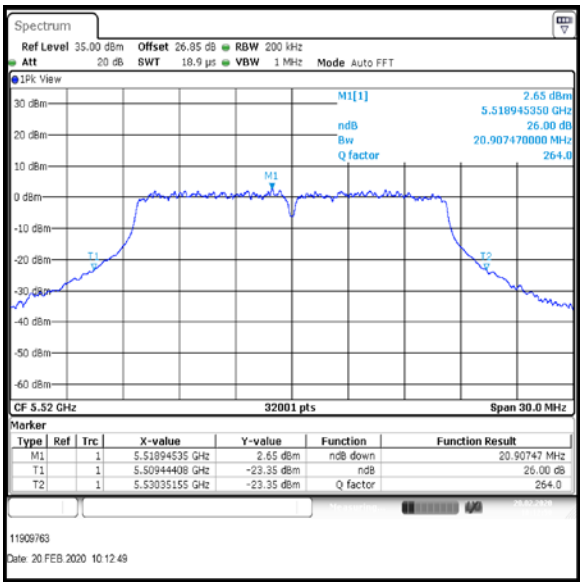
Top Channel

Result: Pass

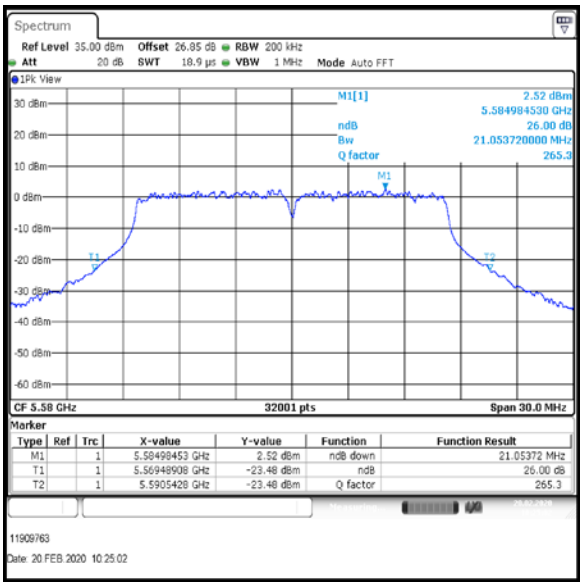
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 48Mbit / MIMO / Port 1+2 / Port 2 / PWL 18 / 9 dBi Antenna

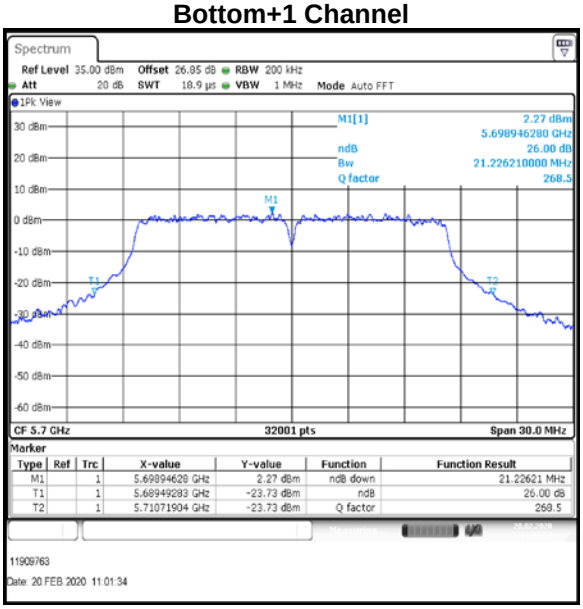
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	20.907
Middle	5580	21.054
Top	5700	21.226



Bottom+1 Channel



Middle Channel



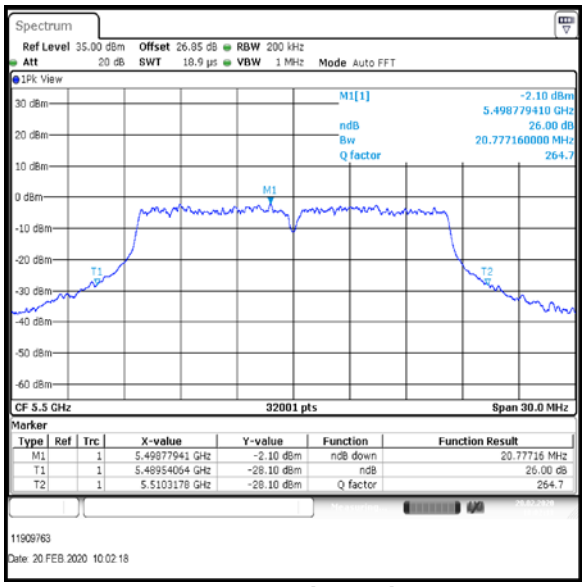
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 54Mbit / MIMO / Port 1+2 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.777



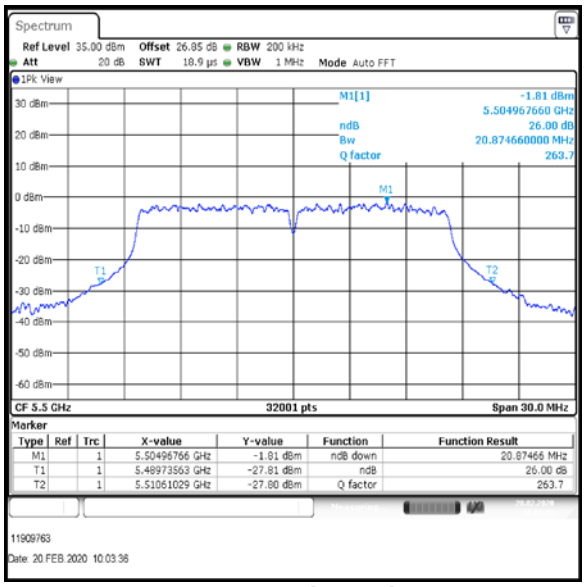
Bottom Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 54Mbit / MIMO / Port 1+2 / Port 2 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.875



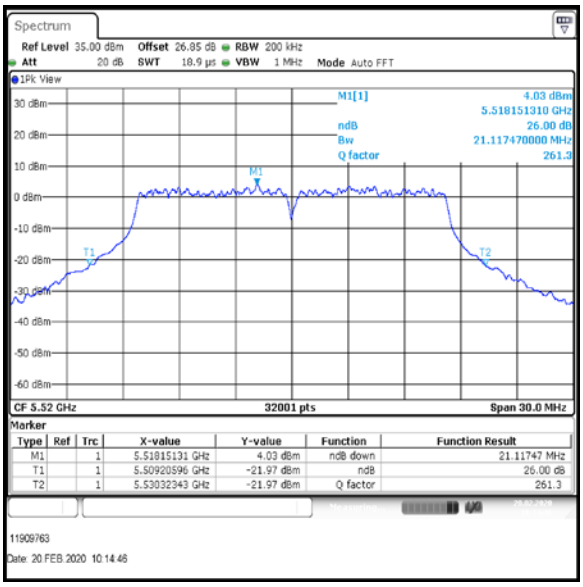
Bottom Channel

Result: Pass

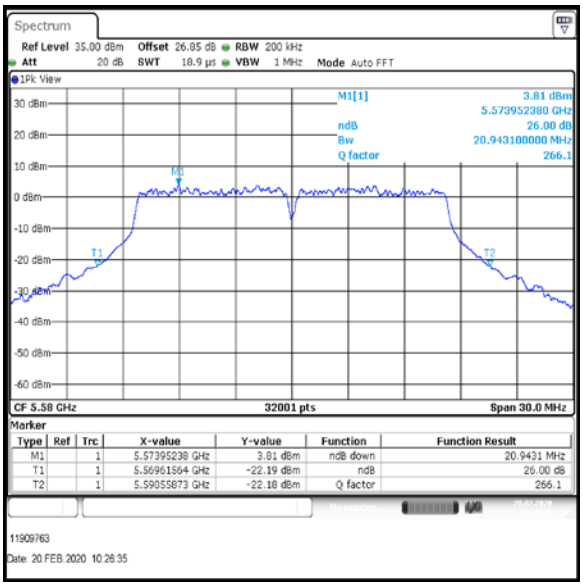
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 54Mbit / MIMO / Port 1+2 / Port 1 / PWL 18 / 9 dBi Antenna

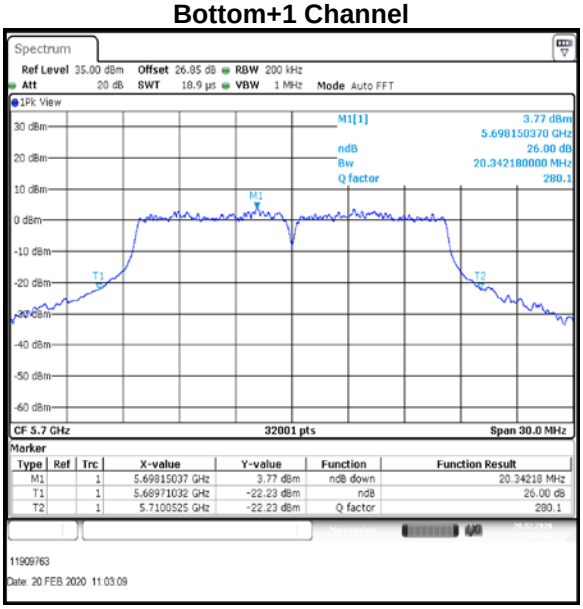
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	21.117
Middle	5580	20.943
Top	5700	20.342



Bottom+1 Channel



Middle Channel



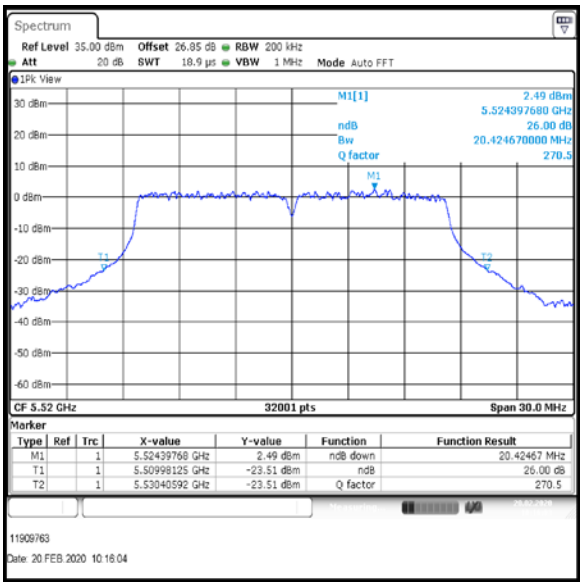
Top Channel

Result: Pass

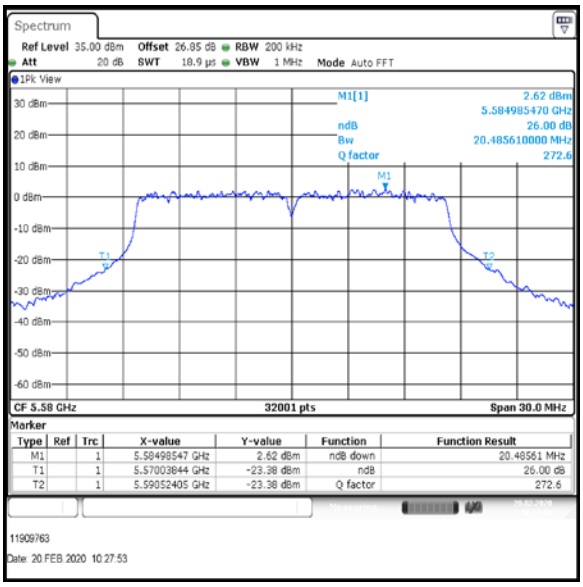
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11a / 20 MHz / 54Mbit / MIMO / Port 1+2 / Port 2 / PWL 18 / 9 dBi Antenna

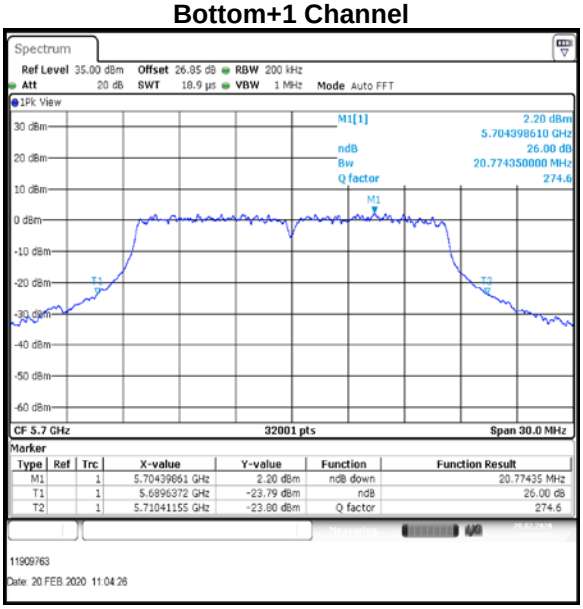
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	20.425
Middle	5580	20.486
Top	5700	20.774



Bottom+1 Channel



Middle Channel



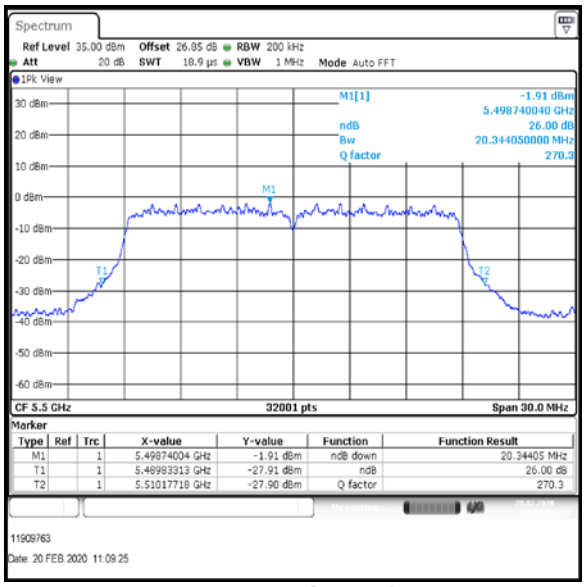
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS0 / MIMO / Port 1+2 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.344



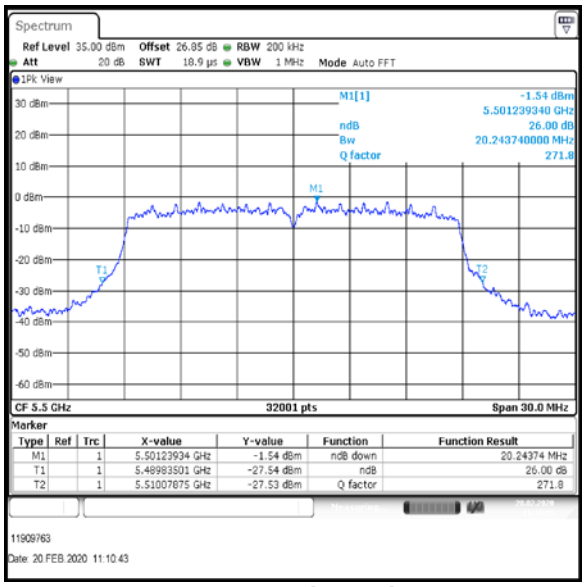
Bottom Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS0 / MIMO / Port 1+2 / Port 2 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.244



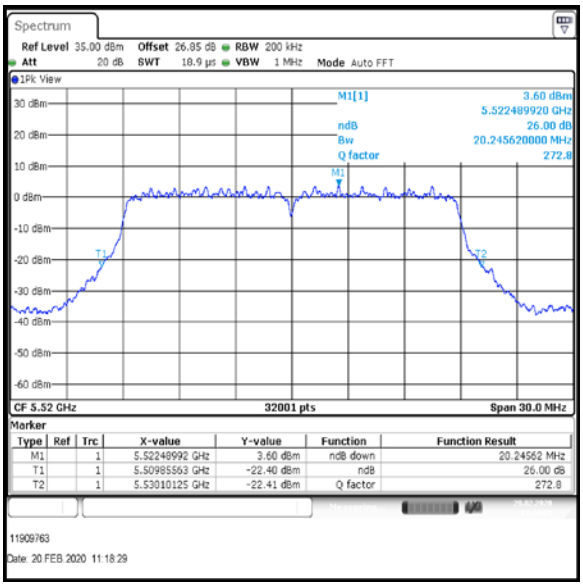
Bottom Channel

Result: Pass

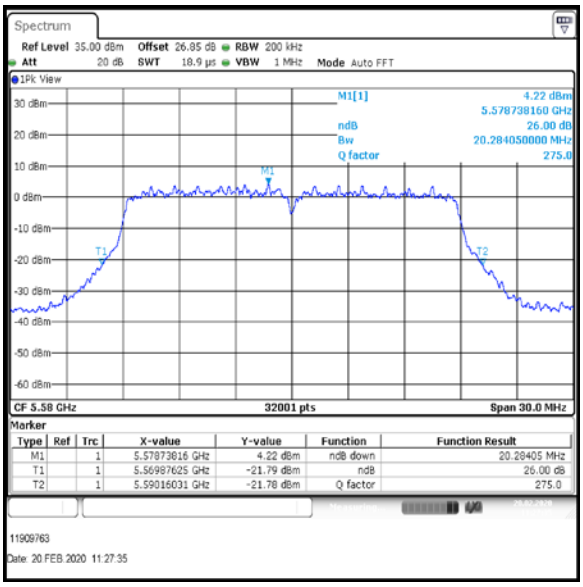
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS0 / MIMO / Port 1+2 / Port 1 / PWL 18 / 9 dBi Antenna

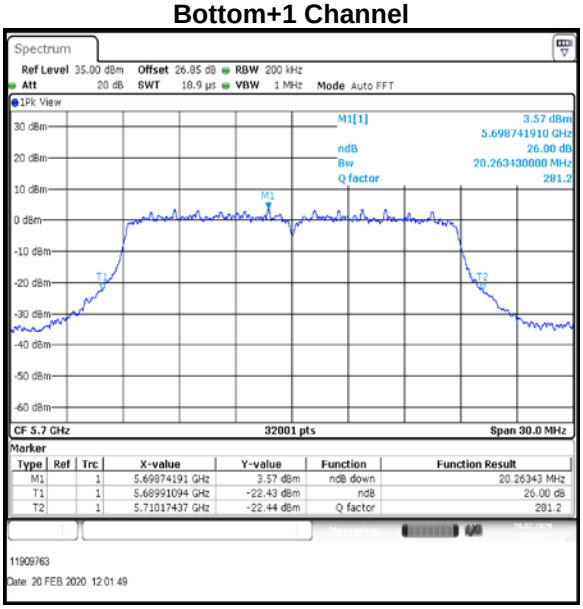
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	20.246
Middle	5580	20.284
Top	5700	20.263



Bottom+1 Channel



Middle Channel



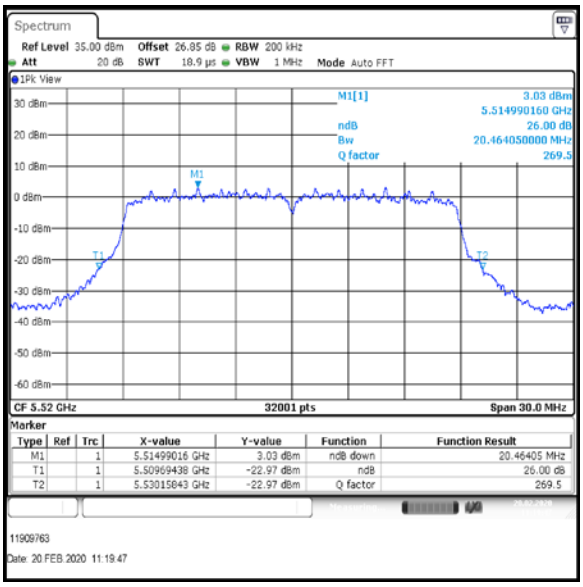
Top Channel

Result: Pass

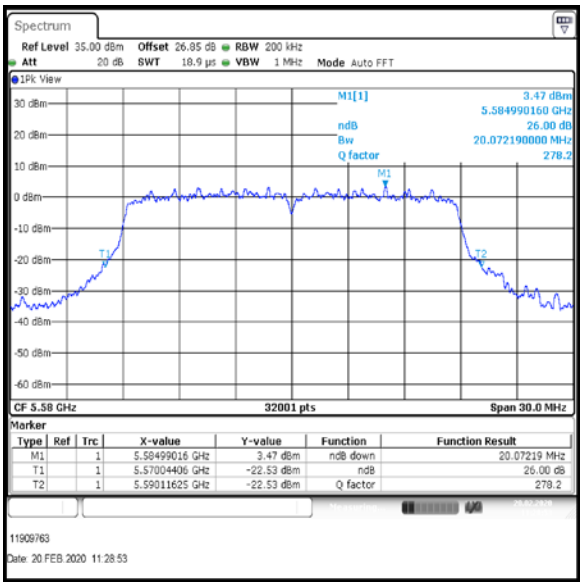
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS0 / MIMO / Port 1+2 / Port 2 / PWL 18 / 9 dBi Antenna

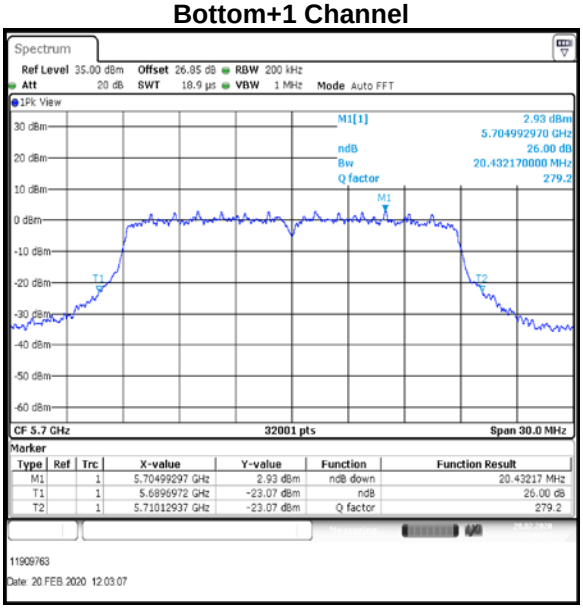
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	20.464
Middle	5580	20.072
Top	5700	20.432



Bottom+1 Channel



Middle Channel



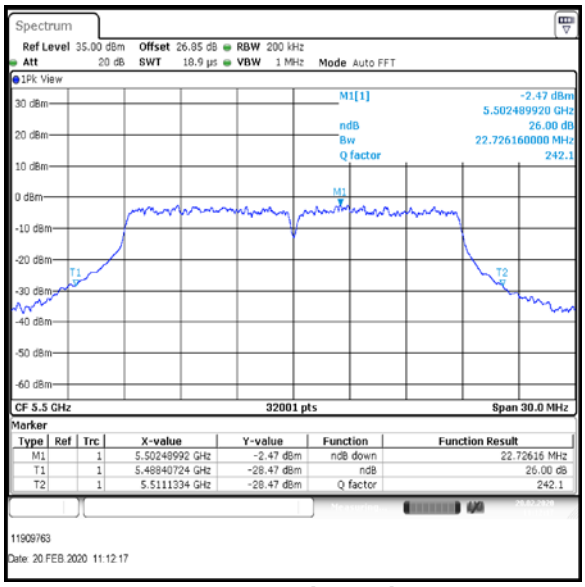
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS4 / MIMO / Port 1+2 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	22.726



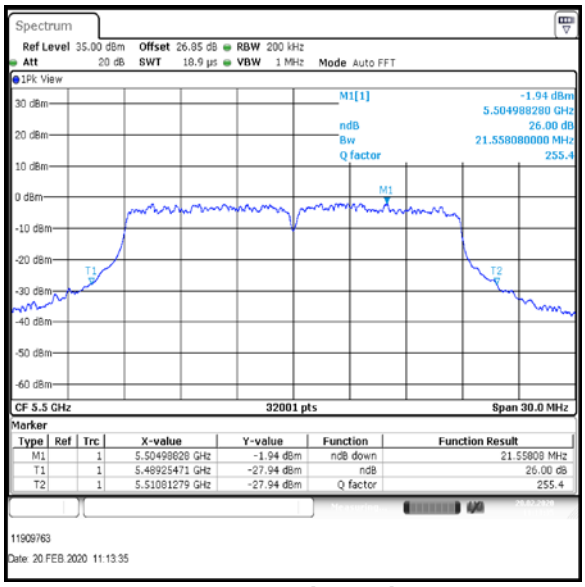
Bottom Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS4 / MIMO / Port 1+2 / Port 2 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	21.558



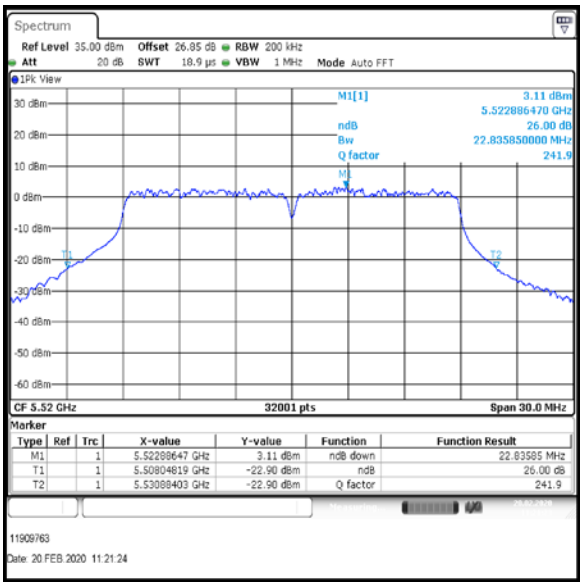
Bottom Channel

Result: Pass

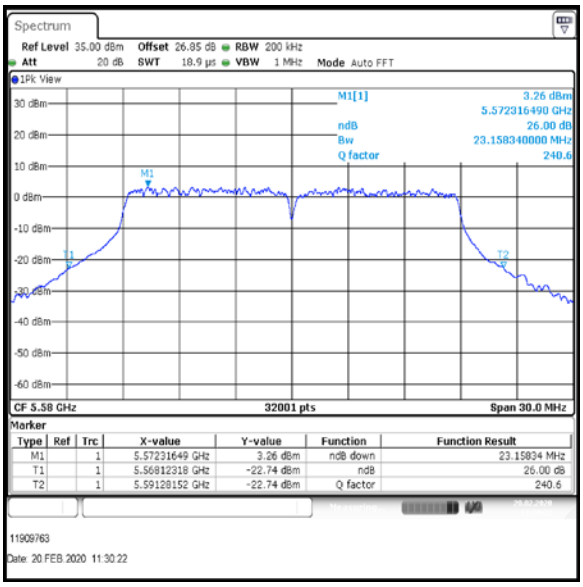
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS4 / MIMO / Port 1+2 / Port 1 / PWL 18 / 9 dBi Antenna

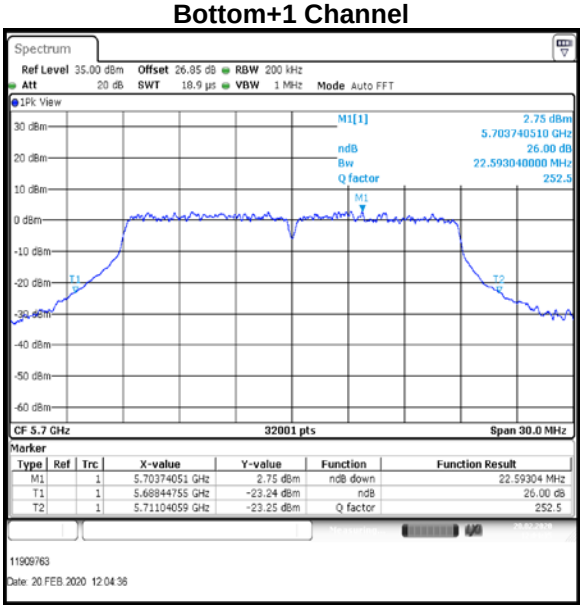
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	22.836
Middle	5580	23.158
Top	5700	22.593



Bottom+1 Channel



Middle Channel



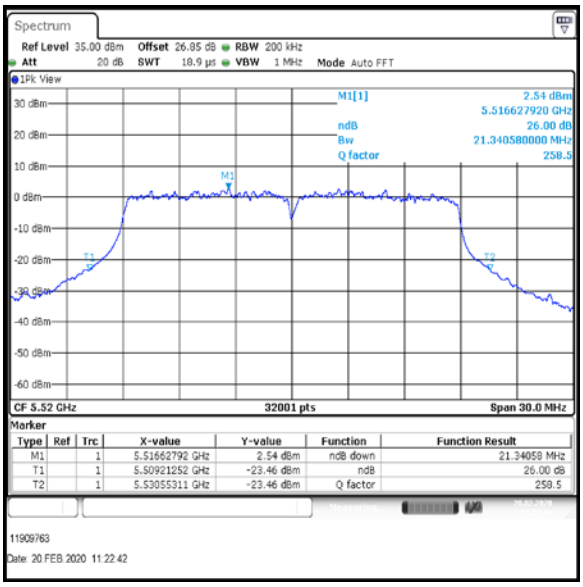
Top Channel

Result: Pass

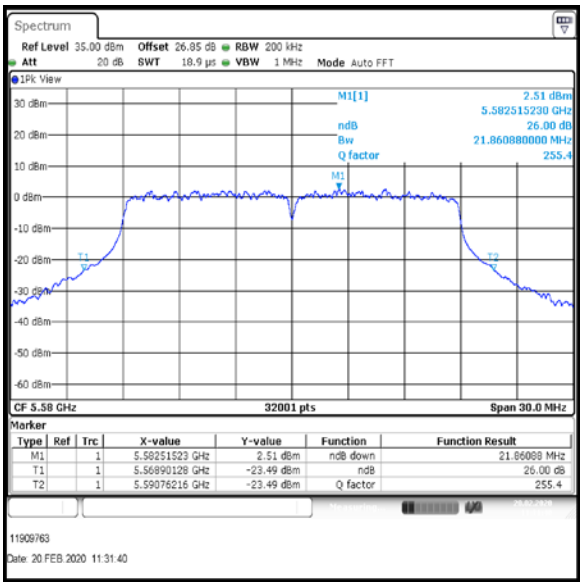
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11n / HT20 / MCS4 / MIMO / Port 1+2 / Port 2 / PWL 18 / 9 dBi Antenna

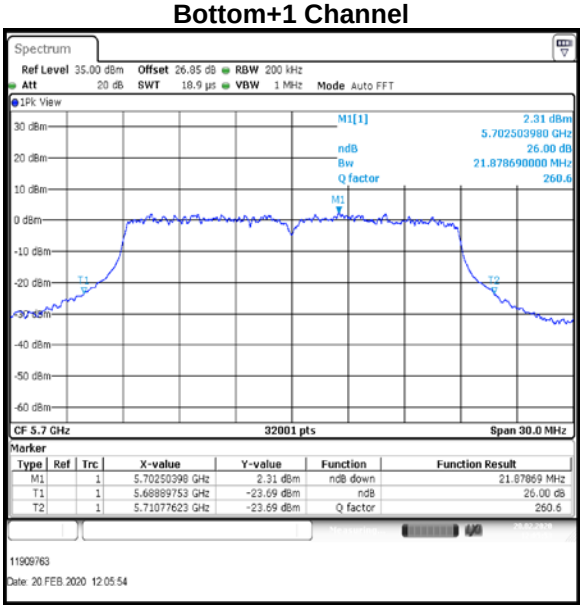
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	21.341
Middle	5580	21.861
Top	5700	21.879



Bottom+1 Channel



Middle Channel



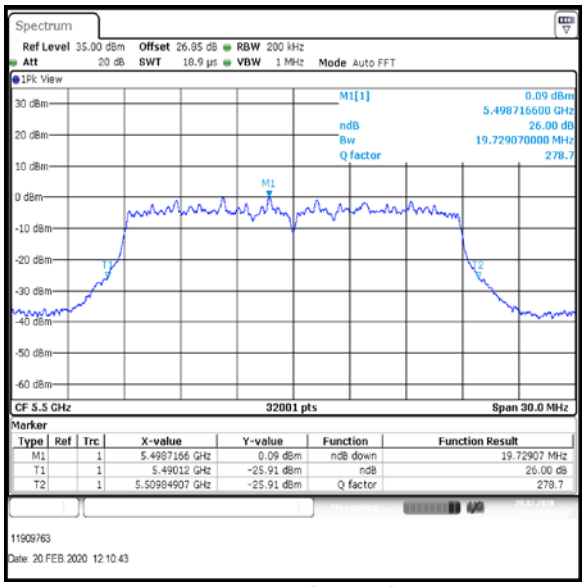
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS0 / MIMO / Port 1+2 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	19.729



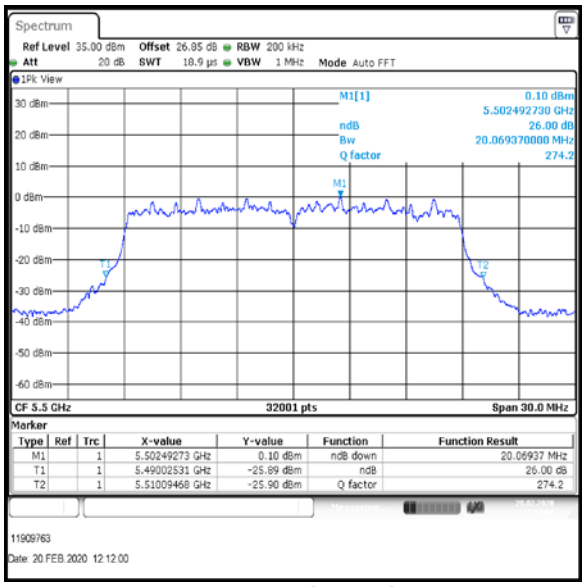
Bottom Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS0 / MIMO / Port 1+2 / Port 2 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	20.069



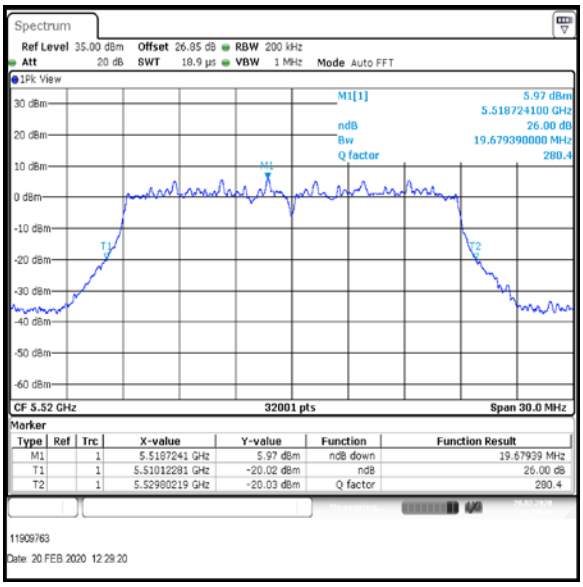
Bottom Channel

Result: Pass

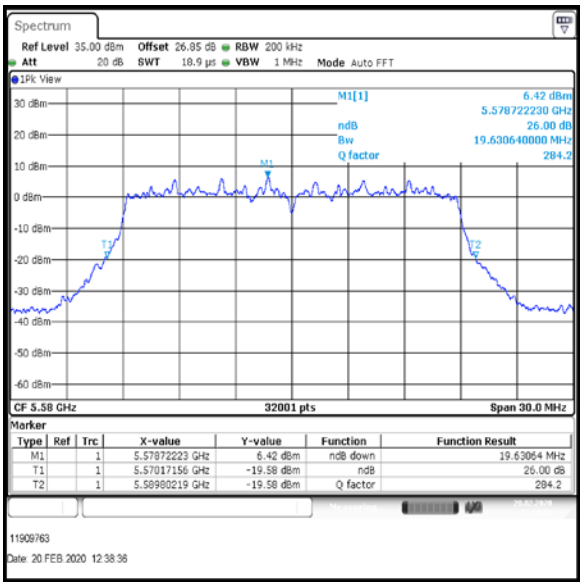
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS0 / MIMO / Port 1+2 / Port 1 / PWL 18 / 9 dBi Antenna

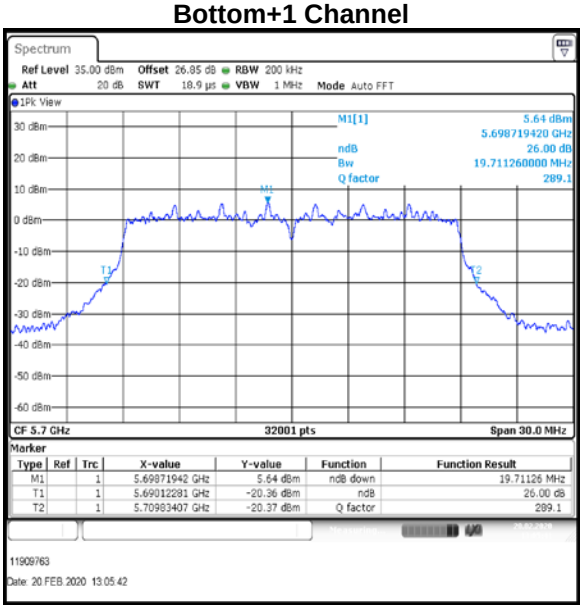
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	19.679
Middle	5580	19.631
Top	5700	19.711



Bottom+1 Channel



Middle Channel



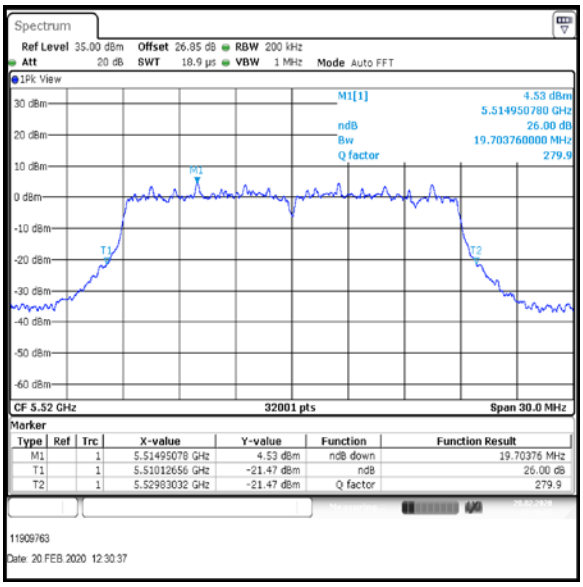
Top Channel

Result: Pass

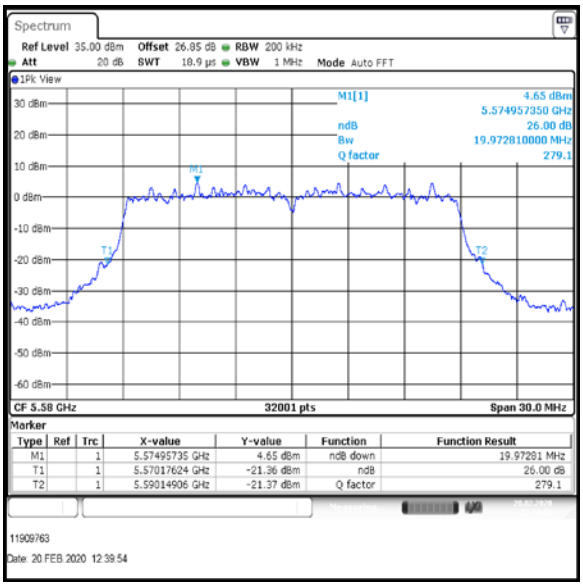
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS0 / MIMO / Port 1+2 / Port 2 / PWL 18 / 9 dBi Antenna

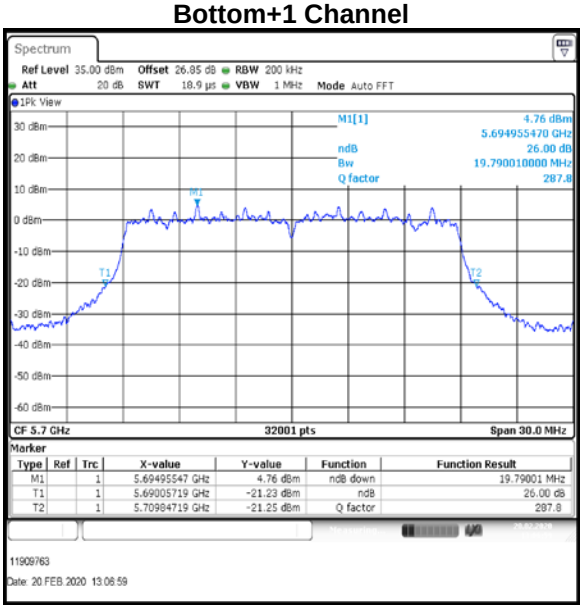
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	19.704
Middle	5580	19.973
Top	5700	19.79



Bottom+1 Channel



Middle Channel



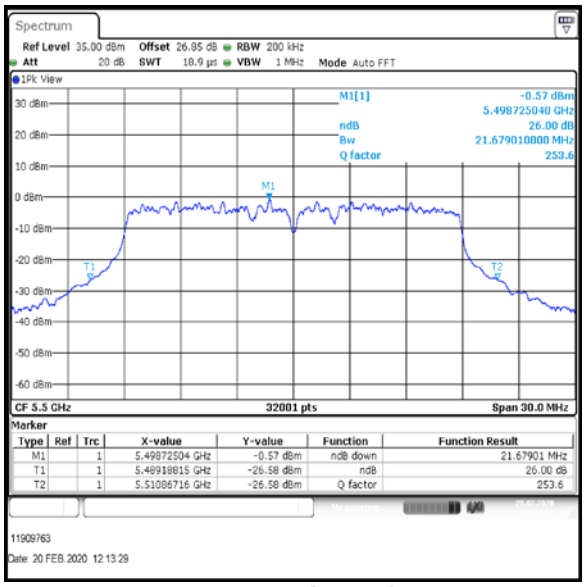
Top Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS4 / MIMO / Port 1+2 / Port 1 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	21.679



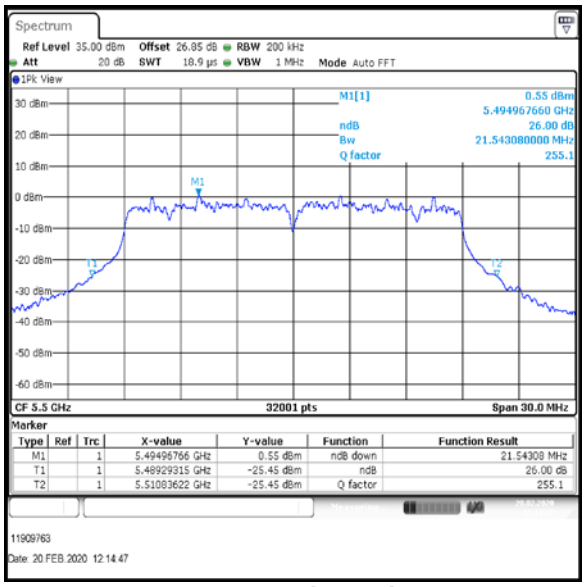
Bottom Channel

Result: Pass

Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS4 / MIMO / Port 1+2 / Port 2 / PWL 12 / 9 dBi Antenna

Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom	5500	21.543



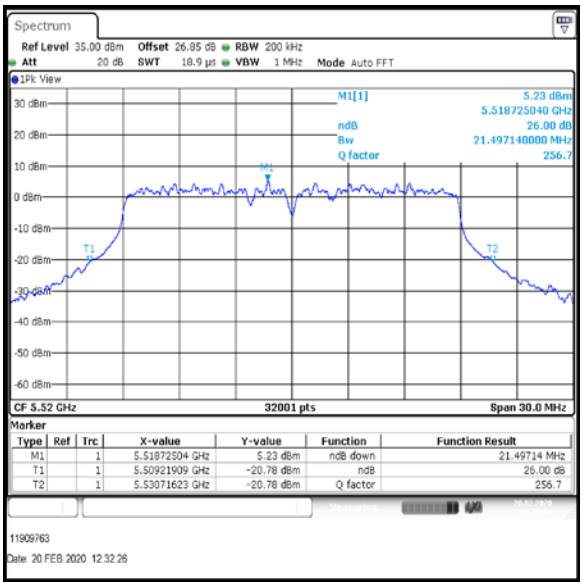
Bottom Channel

Result: Pass

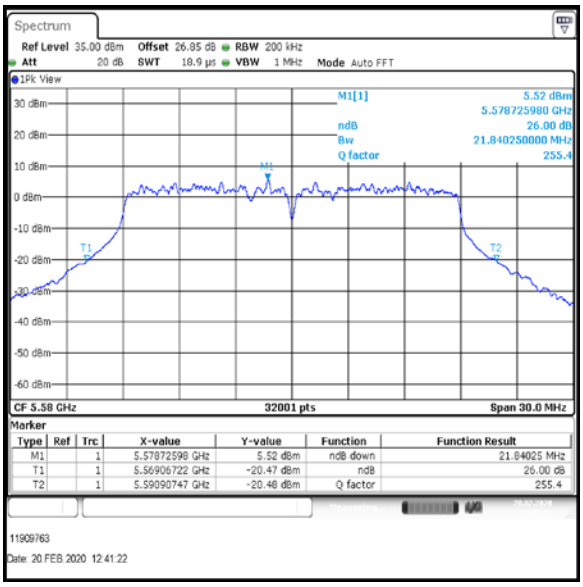
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS4 / MIMO / Port 1+2 / Port 1 / PWL 18 / 9 dBi Antenna

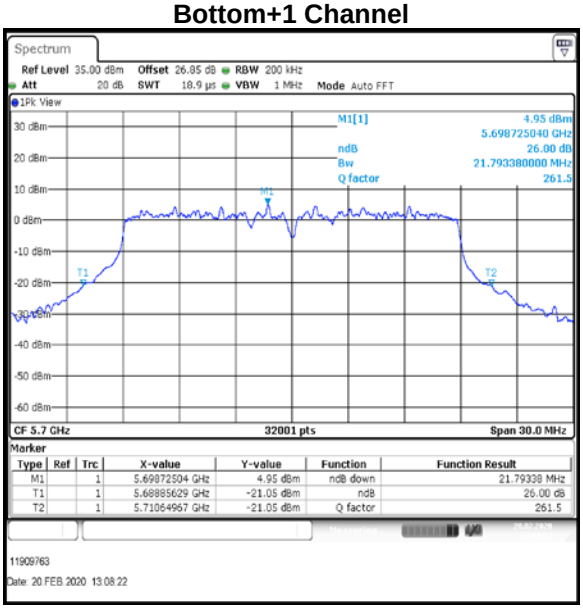
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	21.497
Middle	5580	21.84
Top	5700	21.793



Bottom+1 Channel



Middle Channel



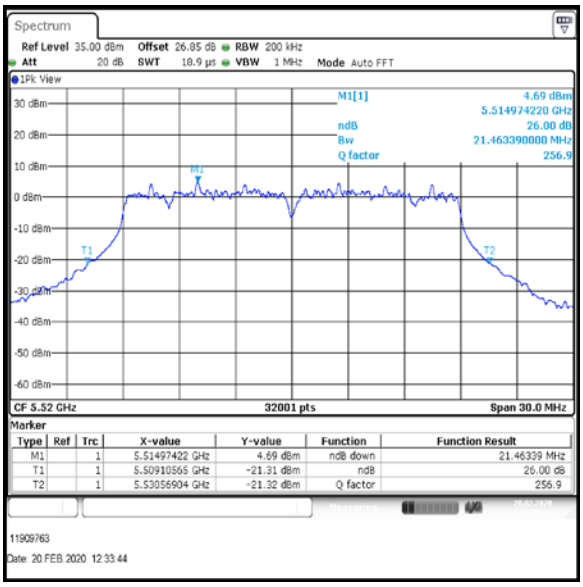
Top Channel

Result: Pass

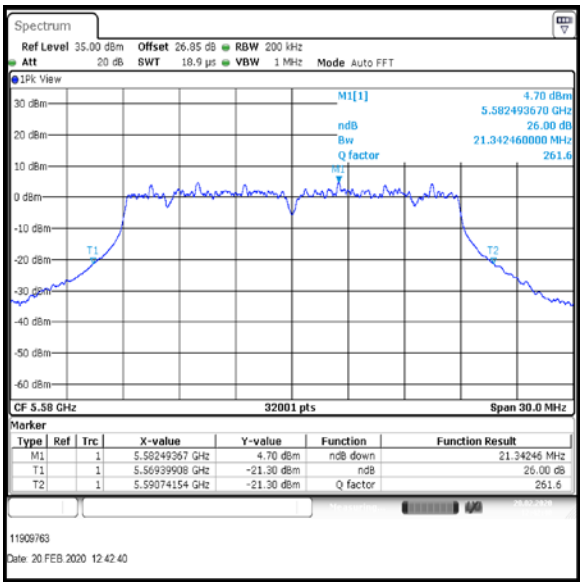
Transmitter 26 dB Emission Bandwidth (continued)

Results: 802.11ac / HT20 / MCS4 / MIMO / Port 1+2 / Port 2 / PWL 18 / 9 dBi Antenna

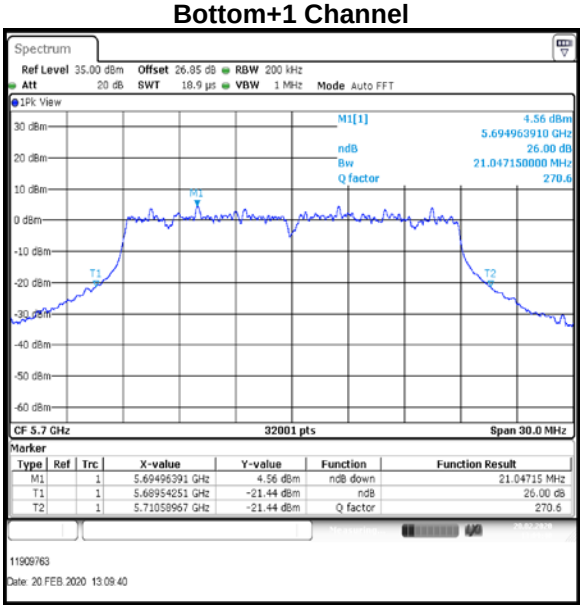
Channel	Frequency (MHz)	26dB Emission Bandwidth (MHz)
Bottom+1	5520	21.463
Middle	5580	21.342
Top	5700	21.047



Bottom+1 Channel



Middle Channel



Top Channel

Result: Pass