

Test Report No:
85646RRF.001A1

Test Report

USA FCC Part 15.407, 15.209

(*) Identification of item tested	Telematic control unit with wireless technologies, used in automotive industry
(*) Trademark	VW AG
(*) Model and /or type reference	TKCMOD12N00
*) Derived model not tested	TKCMOD11000
Other identification of the product	FCC ID: T8GCONMOD IC: 6434A-CONMOD
(*) Features	Features: GSM, UMTS, LTE, 5G, GNSS, Wi-Fi, BTLE, BT_EDR HW version: H26 SW version: J036
(*) Manufacturer	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH Becker-Goering-Str. 16 76307 KARLSBAD GERMANY
Test method requested, standard	USA FCC Part 15.407 (10-1-24) Edition: Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. USA FCC Part 15.209 (10-1-24) Edition: Radiated emission limits; general requirements. Guidance for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017. ANSI C63.10-2020 / Cor.1-2023 / C63.10a-2024 / Errata to C63.10a-2024: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	José Manuel Gómez Galván EMC Consumer & RF Lab. Manager 
Date of issue	2026-06-05
Report template No	FDT08_26 (*) "Data provided by the client"

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Acronyms

Acronym ID	Acronym Description
Avg Power	Maximum Average Conducted Output Power
DC	Duty Cycle
Detector	Detector used
Ebw	Emission Bandwidth
Freq	Frequency
Freq Rng	Frequency Range
MP	Measurement Point
Max EIRP	Maximum Burst EIRP
Mod	Modulation
Occ Ch BW	Occupied Channel Bandwidth
Operation Band	Operation Band
PSD	Power Spectral Density
Pol	Polarization
Port	Active Port
RU	Resource Unit
TPC	TPC
Unwanted Freq	Unwanted Emissions Frequency
Unwanted Lvl	Unwanted Emissions Level

Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification S.A.U. is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

DEKRA Testing and Certification S.A.U. is an ISED-recognized accredited testing laboratory, CABid: ES1909, Company Number: 4621A, with the appropriate scope of accreditation that covers the performed tests in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

The total uncertainty of the measurement system for the radiated emissions of EUT from 30 MHz to 1 GHz is:
Measurement uncertainty $\leq \pm 5,35$ dB with factor ($k = 2$).

The total uncertainty of the measurement system for the radiated emissions of EUT from 1 GHz to 17 GHz is:
Measurement uncertainty $\leq \pm 4,32$ dB with factor ($k = 2$).

The total uncertainty of the measurement system for the radiated emissions of EUT from 17 GHz to 40 GHz is:
Measurement uncertainty $\leq \pm 5,55$ dB with factor ($k = 2$).

The total uncertainty of the measurement system for the conducted testing of EUT is:

RF Average Output Power: Measurement uncertainty $\leq \pm 2,01$ dB

Duty Cycle: Measurement uncertainty $\leq \pm 0,84$ ms

Power Spectral Density: Measurement uncertainty $\leq \pm 2,01$ dB

Occupied/26 dBc Bandwidth: Measurement uncertainty

$\leq \pm 57,76$ kHz for BW 20MHz;

$\leq \pm 115,53$ kHz for BW 40MHz; and

$\leq \pm 231,06$ kHz for BW 80MHz.

6 dB Bandwidth: Measurement uncertainty

$\leq \pm 34,67$ kHz for BW 20MHz;

$\leq \pm 46,22$ kHz for BW 40MHz; and

$\leq \pm 80,90$ kHz for BW 80MHz.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested", "Manufacturer").
2. The sample of the model TKCMOD12N00 is a telematics control unit with wireless technologies, used in automotive, equipped with one modem, OEM. This unit was designed for automotive usage and contains the following features: GSM, UMTS, LTE, 5G, GNSS, WiFi (a, b, g, n, ac), Bluetooth Low Energy (BTLE) and Bluetooth EDR.
3. Declaration of similarity:

HARMAN AUTOMOTIVE DIVISION
HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
BECKER-GÖRING-STRASSE 16
76307 KARLSBAD, GERMANY



Declaration of similarity

To whom it may concern,

We, **Harman Becker Automotive Systems GmbH**, located in
Becker-Goering-Str. 16; 76307 Karlsbad, Germany

Hereby declare that the following units: TKCMOD12E00, TKCMOD12N00,
TKCMOD11000, TKCMOD12C00, TKCMOD12J00, TKCMOD12R00,
TKCMOD12T00 and TKCMOD13C00

have integrated the same BT/Wifi chipset.

The different naming comes from country specific, features enabled or network
access device type.

Targeted countries	Product Name	Type	NAD-HW	GNSS	Bluetooth h WLAN	NAD Services	CV2X
Rest of the world (offline variant)	TKCMOD11000	V046	EU	x	x		
EU + some other countries	TKCMOD12E00	V037, V042, V043, V044, V049	EU	x	x	x	
Canada/Mexico/USA	TKCMOD12N00	V038, V039, V047	NA	x	x	x	
China (without CV2X)	TKCMOD12C00	V105	CN	x	x	x	
Japan	TKCMOD12J00	V045	RW	x	x	x	
Armenia/Belarus/Kazakhstan/Russia/Uzbekistan	TKCMOD12R00	V048	EU	x	x	x	
Turkey	TKCMOD12T00	V040	EU	x	x	x	
China (with CV2X)	TKCMOD13C00	V106	CN	x	x	x	x

This declaration is intended to be included in the test reports where applies

Regards

HARMAN AUTOMOTIVE DIVISION
Harman Becker Automotive Systems GmbH
Becker-Görling-Straße 16
76307 Karlsbad, Germany

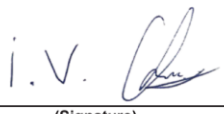




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4. Declaration of Comparability.

 HARMAN A SAMSUNG COMPANY	
Declaration of Comparability	
HARMAN BECKER Automotive Systems GmbH Becker-Göring-Str. 16 D-76307 Karlsbad, Germany	
declares under our sole responsibility, that the product	
Description of object	: Telematic system with BT, WLAN, GNSS, GSM, UMTS, LTE, 5G
Brand/ Customer	: VW AG / VW-Group
Model name	: TKCMOD12E00/ TKCMOD11000 (CONMOD PPE)
Variant	: V037/ V046
Hardware / Software version	: H22 / X152 (corresponds CL1/2/3/4)
is comparable to:	
Description of object	: Telematic system with BT, WLAN, GNSS, GSM, UMTS, LTE, 5G
Brand/ Customer	: VW AG / VW-Group
Model name	: TKCMOD12E00/ TKCMOD11000 (CONMOD PPE)
Variant	: V037/ V046
Hardware / SW version	: H25 / X638 (corresponds CL6)
We declare as authorized responsible person, that the products above have HW and SW changes which have no impact for the certification activities. The application SW is changed from X152 to X638 version and HW is changed from H22 to H25. These changes do not impact the following parameters: used frequency ranges / used frequency bands, the used modulation type, the maximum RF power, the circumstances under which the transmitter operates, the basic frequency and/or stabilizing circuitry, frequency multiplication stages, the basic modulator circuitry or maximum RF power, the field strength ratings, slew rates for clocking of output pins and drivers. In conclusion, we can say that all HW and SW updates do not influence any type approval for TKCMOD12E00 / TKCMOD11000 (ConMod PPE) in Cluster 6 (H25/X638) – variants listed above.	
Declared by:	checked by: Daniel Calin (PM) / 17.07.2024
Mr. STOICA Iulian, Customer Lead Certification	
Bucharest (Place)	17.07.2024 (Date)
	(Signature)
Mr. OLTEANU Marius, Product Compliance Expert.	
Bucharest (Place)	17.07.2024 (Date)
	(Signature)

HW Changes on TCU side.

From HW perspective: all the updates performed on HW level are listed below.

- Change of PCB solder mask to enable the population of a shield at a voltage regulator to improve EMC behavior (1)
- Add shield at voltage regulator to improve EMC behavior (1)
- Add two capacitors at functional LED lines to improve EMC behavior (2)
- Value change of two resistors at backlight LED line to improve EMC behavior (2)
- CAN transceiver replacement, same silicon, same datasheet but better CAN FD performance (3)
- Capacitor value change to improve the switch on behavior of A2B power supply (4)
- Introduce second source for switching transistor in GNSS power supply (5)
- Introduce second source (TDK) for A2B bus inductors (6)

More details please find in the attached document :

- „ConMod-HW-Changes-CL6-H22toH25“



ConMod-HW-Changes-CL6-H22toH25.pptx

SW Changes on TCU side – X152 version to X638 version:

For Cluster 6, the SW update from X152 version to X638 version is listed in the following documents:

- Harman
 - „ConMOD_changes_X152_X638“



ConMOD_changes_X152_X638.xlsx

- Conti
 - „SW_changes_Cluster6_vs_Cluster3“



SW_changes_Cluster6_vs_Cluster3.pdf

- E-Solutions
 - „Delta X152-X638 Pol“



Delta X152-X638 Pol.xlsx

There have been:

- No changes of the used frequency ranges / bands
- No changes of the used modulation type
- No changes of the maximum RF power
- No changes of the circumstances under which the transmitter operates
- No changes of the basic frequency and/or stabilizing circuitry
- No changes of the frequency multiplication stages
- No changes of the basic modulator circuitry or maximum RF power
- No changes of the field strength ratings
- No changes of slew rates for clocking of output pins and drivers

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results. The laboratory is not responsible for such information and it is not covered by accreditation.

Usage of samples

Samples undergoing test have been selected by: The client.

Id	Control Number	Description	Model	Serial N°	Date of Reception	Application
S/01	80434B_86.1	Module CONMOD	TKCMOD 12N00	358845895448302	2026-03-05	Element Under Test
	80434B_71.1	Yellow BOX	--	--	2026-03-05	Auxiliary Element
	80434B_75.1	USB Cable	--	--	2026-03-05	Auxiliary Element
	80434B_82.1	Circular Plate	--	--	2026-03-05	Auxiliary Element
	80434B_83.1	Circular Plate	--	--	2026-03-05	Auxiliary Element
	80434B_84.1	Circular Plate	--	--	2026-03-05	Auxiliary Element
	80434B_85.1	Circular Plate	--	--	2026-03-05	Auxiliary Element
	80434B_88.1	Harness CONMOD	--	--	2026-03-05	Auxiliary Element
S/02	80434B_67.1	Module CONMOD	TKCMOD 12N00	358845895450811	2026-03-05	Element Under Test
	80434B_22.1	USB Cable	--	--	2026-02-27	Auxiliary Element
	80434B_39.1	Yellow BOX	--	--	2026-02-27	Auxiliary Element
	80434B_69.1	MAIN Harness	--	--	2026-03-05	Auxiliary Element

Notes referenced to samples during the project:

Id	Type
S/01	Radiated
S/02	Conducted

Test sample description

Ports..... :	Port name and description		Cable			
			Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾
	RF connector - code			[]	[X]	[]
	RF connector - code			[X]	[X]	[]
	RF connector - code			[X]	[]	[]
--						
Supplementary information to the ports..... :	--					
Rated power supply	Voltage and Frequency		Reference poles			
			L1	L2	L3	N
	[]	AC:	[]	[]	[]	[]
[X]		DC: 12V car battery (4.8 VDC inside of TCU)				
Rated Power	12V DC					
Clock frequencies.....	See Block Diagram					
Other parameters	See Technical description					
Software version	J036					
Hardware version	H26					
Dimensions in cm (W x H x D)						
Mounting position	[]	Table top equipment				
	[]	Wall/Ceiling mounted equipment				
	[]	Floor standing equipment				
	[]	Hand-held equipment				
	[X]	Other: Automotive telematics control unit				
Modules/parts.....	Module/parts of test item			Type	Manufacturer	
	--					
Accessories (not part of the test item)	Description			Type	Manufacturer	
	Cable Harness			--		
	2G/3G4G/5G Antenna			--	Hirschmann/ Molex	
	eCall button/LED			--		
	SOS Loudspeaker			--		
	Wake-up unit Box			--		
	--					
Documents as provided by the applicant	Description			File name	Issue date	
	Technical Description					
	--					

Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
Becker-Goering-Str. 16
76307 KARLSBAD GERMANY

Testing period and place

Test Location	DEKRA TESTING AND CERTIFICATION S.A.U. C/ Margarita Salas Boulevard, 26 - Parque Tecnológico de Andalucía; 29590 Campanillas (Málaga) (Location D)
Date (start)	2026-03-12
Date (finish)	2026-03-17

Document history

Report number	Date	Description
85646RRF.001	2026-05-07	First release.
85646RRF.001A1	2026-06-05	Second release. Modification due to standards update. This test report cancels and replaces to 85646RRF.001.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Karla Castilla Alcalde, Rubén Mora Fernandez and Victoria Olmedo Villalba.

Used instrumentation:

Control No.	Equipment	Model	Manufacturer	Next Calibration
10304	EMI TEST RECEIVER 2Hz-44GHz	ESW44	ROHDE AND SCHWARZ	2026-10-01
07040	EXTENSION FOR OPEN SWITCH UNIT UP TO 40GHz	OSP-B157Wx	ROHDE AND SCHWARZ	2027-08-26
07763	HORN ANTENNA 1-18GHz	BBHA 9120D	SCHWARZBECK MESS-ELEKTRONIK	2029-03-11
06495	HORN ANTENNA 18-40GHz	BBHA 9170	SCHWARZBECK	2027-07-11
07862	PRE-AMPLIFIER G>30dB 18-40GHz	BLMA 1840-3G	BONN ELEKTRONIK	2026-07-09
07769	PREAMPLIFIER 30dB 500MHz-18GHz	BBV 9718 C	SCHWARZBECK	2027-04-08
07039	Rohde&Schwarz	OSP-B157W8	ROHDE AND SCHWARZ	2027-08-14
08130	SEMIANECHOIC ABSORBER LINED CHAMBER	P29419	ALBATROSS	--
08134	SHIELDED ROOM	P29419	ALBATROSS PROJECTS GMBH	--
08661	SHIELDED ROOM	-	SIEPEL	--
07794	SIGNAL AND SPECTRUM ANALYZER 10Hz-40GHz	FSV40	ROHDE AND SCHWARZ	2027-06-10
04848	SOFTWARE FOR EMC/RF TESTING	EMC32	ROHDE AND SCHWARZ	--
07549	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2027-05-05
07550	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2027-05-05
07552	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2027-05-05
07798	WMS32	WMS32	ROHDE AND SCHWARZ	--
09968	HYBRID BILOG ANTENNA 30MHz-6GHz	3142E	ETS LINDGREN	2026-09-22

Testing verdicts

Fail	F
Inconclusive	I
Not applicable	N/A
Not measured	N/M
Pass	P

Summary

Common requirements for all bands

FCC PART 15		
Requirement – Test case	Verdict	Remark
Duty Cycle	P	--
99% Occupied Bandwidth	P	--
26 dB Emission Bandwidth (EBW)	P	--
<u>Supplementary information and remarks:</u> (1) None.		

U-NII-1 Band: 5.15 - 5.25 GHz

FCC PART 15		
Requirement – Test case	Verdict	Remark
FCC 15.407 (a)(1)(iv) Transmitter Maximum conducted Output Power	P	--
FCC 15.407 (a)(1)(iv) Transmitter Maximum Power Spectral Density	P	--
FCC 15.407 (b)(1)(6) Transmitter Out of Band Radiated Emissions	P	--
FCC 15.407 (b)(1) Transmitter Band Edge Radiated Emissions	P	--
<u>Supplementary information and remarks:</u> None.		

Appendix A: Test Common requirements for all Bands

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Section 15.407 Subclause 15.403(i) [Ebw] Transmitter 26 dB Emission Bandwidth (EBW).....57

TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal: 12Vdc

Type of Power Supply: External power supply (Vehicle Battery)

ANTENNA (*):

Type of Antenna: Internal antenna.

Maximum Declared Antenna Gain:

WLAN 5 GHz: Port 2: 3.20 dBi
Port 3: 3.20 dBi

Directional Antenna Gain Calculations for CDD MIMO In-Band Measurements:

For 2Tx CDD MIMO modes, in accordance with KDB 662911 D01 v02r01 Section F)2)f)(ii) y F)2)e)ii), directional gain, directional gain was calculated as follows:

$$\begin{aligned}
 N_{SS} &= 1, N_{ANT} = 2, G_{ANT0} = , G_{ANT1} = \\
 \text{Directional Gain} &= 10 \log \left[\frac{\sum_{j=1}^{N_{SS}} \left(\sum_{k=1}^{N_{ANT}} g_{j,k} \right)^2}{N_{ANT}} \right] = 10 \log \left[\frac{\sum_{j=1}^1 \left(\sum_{k=1}^2 g_{j,k} \right)^2}{2} \right] \\
 &= 10 \log \left[\frac{(g_{1,1} + g_{1,2})^2}{2} \right] = 10 \log \left[\frac{(10^{\frac{G_1}{20}} + 10^{\frac{G_2}{20}})^2}{2} \right] = 10 \log \left[\frac{(10^{\frac{x}{20}} + 10^{\frac{y}{20}})^2}{2} \right] = z
 \end{aligned}$$

TEST FREQUENCIES (*):
UNII-1:

Technology Tested:	WLAN (IEEE 802.11 a,n,ac,ax) 2x2 / U-NII-1	
	802.11a OFDM 6 Mbit/s SISO	
	802.11 n HT20: MCS0 to MCS23 SISO & MIMO 2x2	
	802.11 n HT40: MCS0 to MCS23 SISO & MIMO 2x2	
	802.11 ac VHT20: MCS0 to MCS9 SISO & MIMO 2x2	
	802.11 ac VHT40: MCS0 to MCS9 SISO & MIMO 2x2	
	802.11 ac VHT80: MCS0 to MCS9 SISO & MIMO 2x2	
Setting of cores / ports:	Port 2: SISO Port 2+3: MIMO	
Beamforming:	No.	
Frequency Range:	5150 MHz to 5250 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 36	5180
	Middle: 40	5200
	High: 48	5240
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 38	5190
	High: 46	5230
Channel Spacing:	80 MHz	
Transmit Channels	Middle: 42	5210

The test set-up was made in accordance to the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The EUT was tested in the following operating mode:

- Continuously transmitting with a modulated carrier at maximum power in all required channels using the supported data rates/modulations types.

The field strength at the band edges was evaluated for each mode on the lowest and highest channels at the rated power for the channel under test.

For all modes, the EUT was configured in test mode using a software application. The application was used to enable a continuous transmission and to select the test channels as required. The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

- 802.11a OFDM 6 Mbit/s
- 802.11 n HT20: MCS0
- 802.11 n HT40: MCS0
- 802.11 ac VHT20: MCS0
- 802.11 ac VHT40: MCS0
- 802.11 ac VHT80: MCS0

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and it is connected to the TS8997 using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.



RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1.5 m for the frequency range 17 GHz-26 GHz (17 GHz-40 GHz horn antenna).

For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

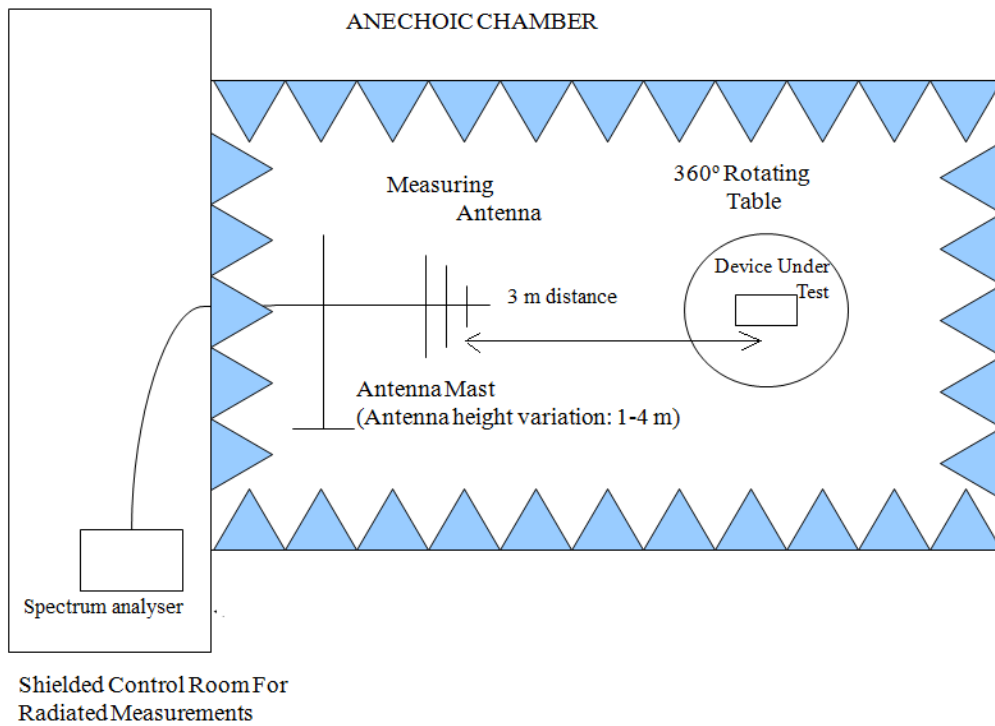
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

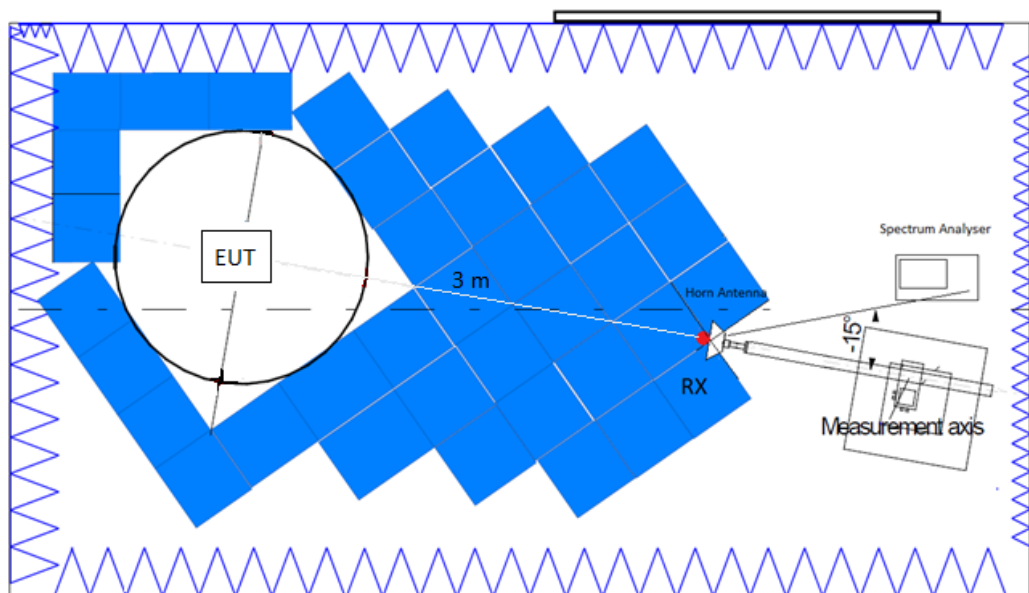
The final measured value, for the given emission, in the tables below incorporates the calibrated antenna factor and cable loss.

A resolution bandwidth/video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

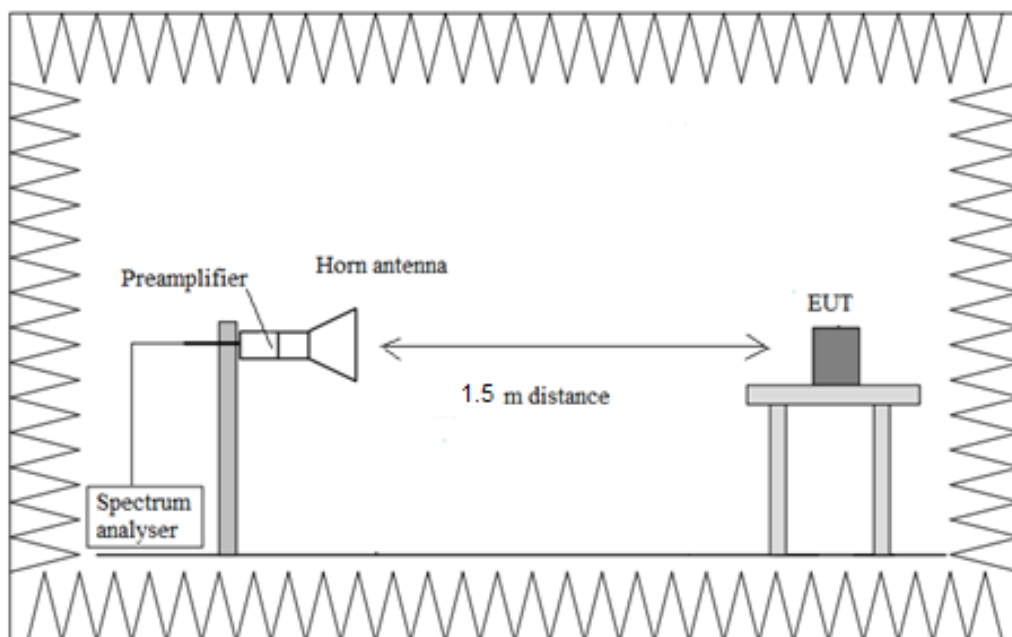
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



SAMPLE CALCULATION

For radiated measurements:

Values measures by the test receiver / analyzer are converted to field strength, in dBuV/m, at the regulatory distance using the following calculation:

$$\text{Unwanted Lvl (dBuV/m)} = \text{Raw Rec (dBuV)} + \text{Preamp (dB)} + \text{Trd Corre. (dB/m)} + \text{SigPath (dB)}$$

Where,

Raw Rec (dBuV): Measured voltage in the receiver / spectrum analyzer in dBuV

Preamp (dB): Path loses due to preamplifier

Trd Corr. (dB/m): Antenna factor in dB/m

SigPath (dB) = Cable loss (dB) – External Gain amplifier (dB) – Distance factor (dB)

Cable loss (dB): Cable loss

External Gain amplifier (dB): Gain from external amplifier (when used)

Distance factor (dB): Distance factor in dB. When measurement distance is different to limit distance

The field strength, calculated by this way is compared with the regulatory limit.

TEST CASES DETAILS

Section 15.35 Subclause (c) [DC] Duty Cycle

Limits

When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

Modulation: 802.11a (OFDM 6 Mbit/s)

Results

Operation Band (MHz)	Port	Freq (MHz)	DC (%)
[5150, 5250]	2	5180.00000	33.33
		5200.00000	33.32
		5240.00000	33.34

Modulation: 802.11n HT20 (OFDM MCS0)

Results

Operation Band (MHz)	Port	Freq (MHz)	DC (%)
[5150, 5250]	2	5180.00000	31.48
		5200.00000	31.48
		5240.00000	31.48
	2+3	5180.00000	21.61
		5200.00000	21.61
		5240.00000	21.61

Modulation: 802.11n HT40 (OFDM MCS0 13.5 Mbit/s)

Results

Operation Band (MHz)	Port	Freq (MHz)	DC (%)
[5150, 5250]	2	5190.00000	20.57
		5230.00000	20.57
	2+3	5190.00000	15.19
		5230.00000	15.19

Modulation: 802.11ac VHT20 (OFDM MCS0)

Results

Operation Band (MHz)	Port	Freq (MHz)	DC (%)
[5150, 5250]	2	5180.00000	28.75
		5200.00000	28.75
		5240.00000	28.75
	2+3	5180.00000	28.76
		5200.00000	28.76
		5240.00000	28.76

Modulation: 802.11ac VHT40 (OFDM MCS0)

Results

Operation Band (MHz)	Port	Freq (MHz)	DC (%)
[5150, 5250]	2	5190.00000	18.50
		5230.00000	18.50
	2+3	5190.00000	18.51
		5230.00000	18.51

Modulation: 802.11ac VHT80 (OFDM MCS0)

Results

Operation Band (MHz)	Port	Freq (MHz)	DC (%)
[5150, 5250]	2	5210.00000	12.80
	2+3		12.81

Verdict

Pass

Tables:
Spectrum Analyzer Parameters

Setting	Instrument Value	Target Value
Measurement Time	1.000 s	1.000 s
Points	1000000	1000000
Time resolution	1.000 µs	1.000 µs

[99dBW] Transmitter 99% Occupied Bandwidth

Limits

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

The following conditions shall be observed for measuring the occupied bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

Modulation: 802.11a (OFDM 6 Mbit/s)

Results

Operation Band (MHz)	Port	Freq (MHz)	Occ Ch BW (MHz)
[5150, 5250]	2	5180.00000	16.600
		5200.00000	16.600
		5240.00000	16.500

Verdict

Pass

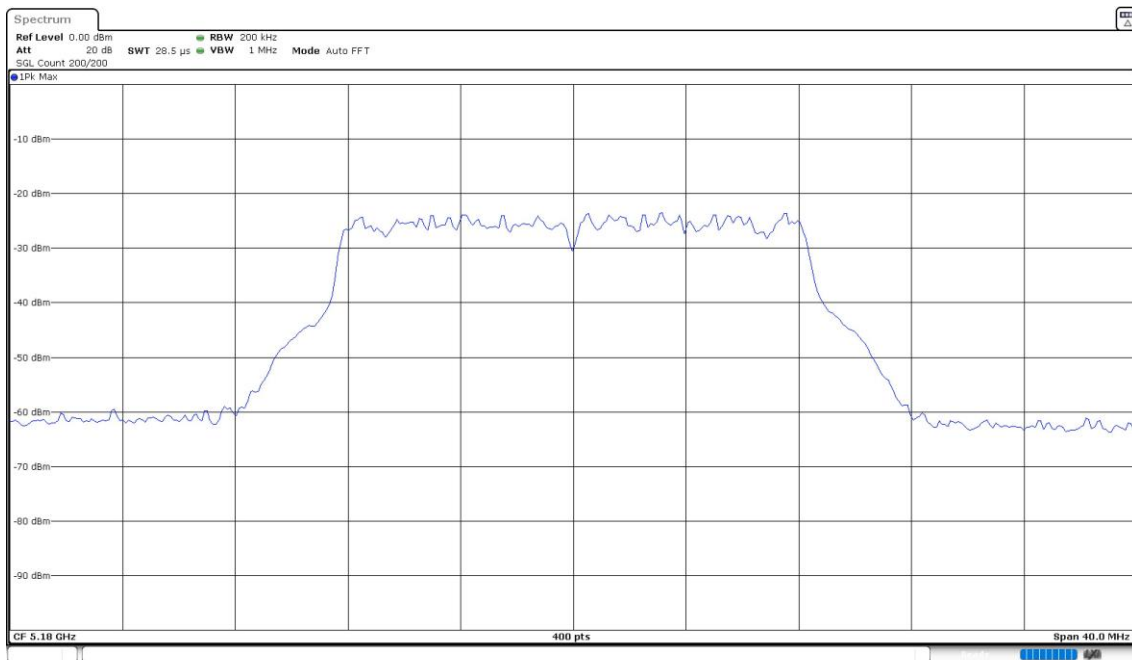
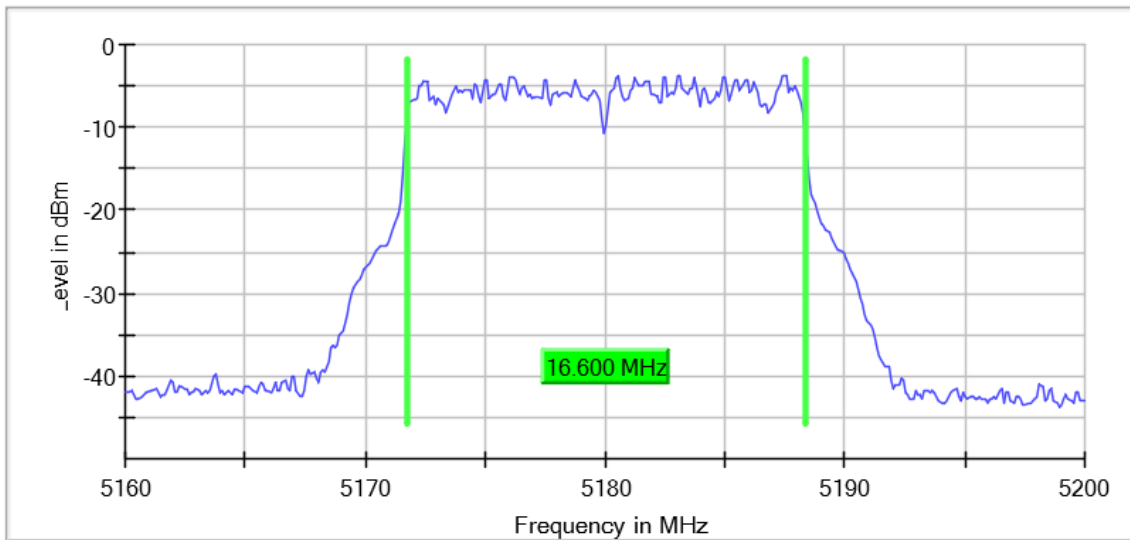
Attachments

Operation Band MHz = [5150, 5250] Active Port = 2

Frequency MHz = 5180.00000 Modulation = 802.11a (OFDM 6 Mbit/s)

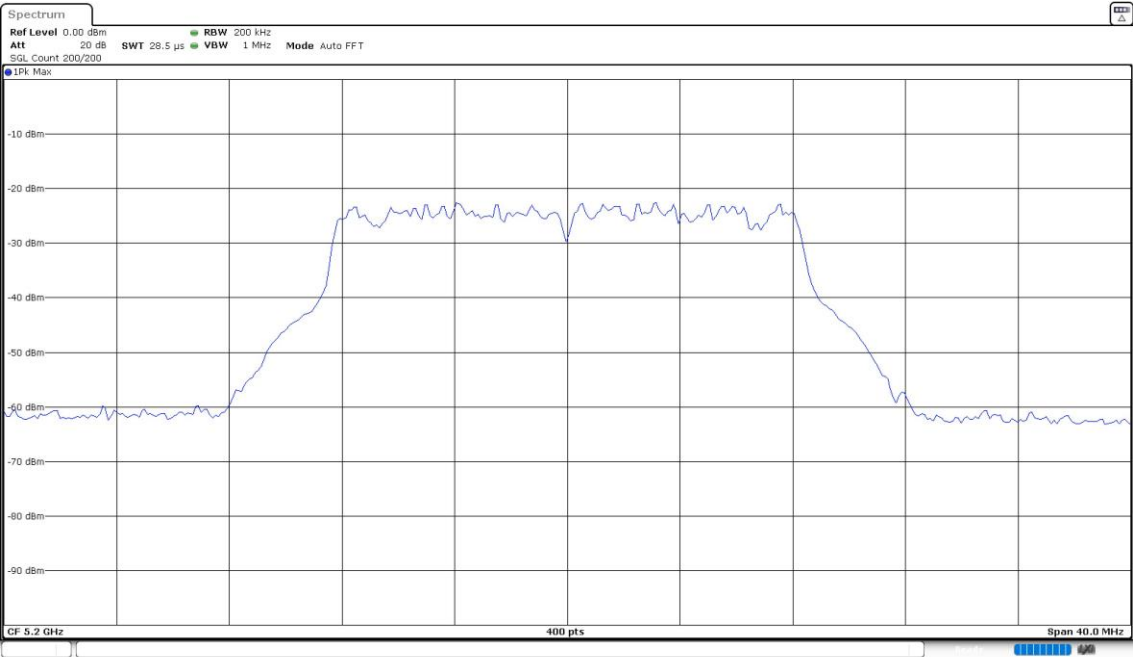
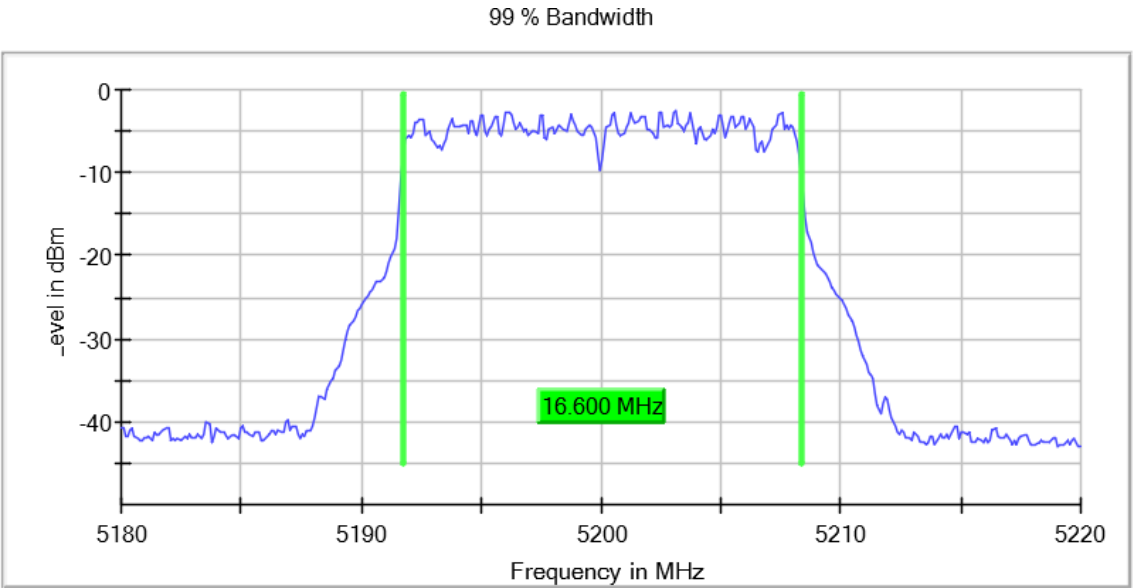
Images:

99 % Bandwidth



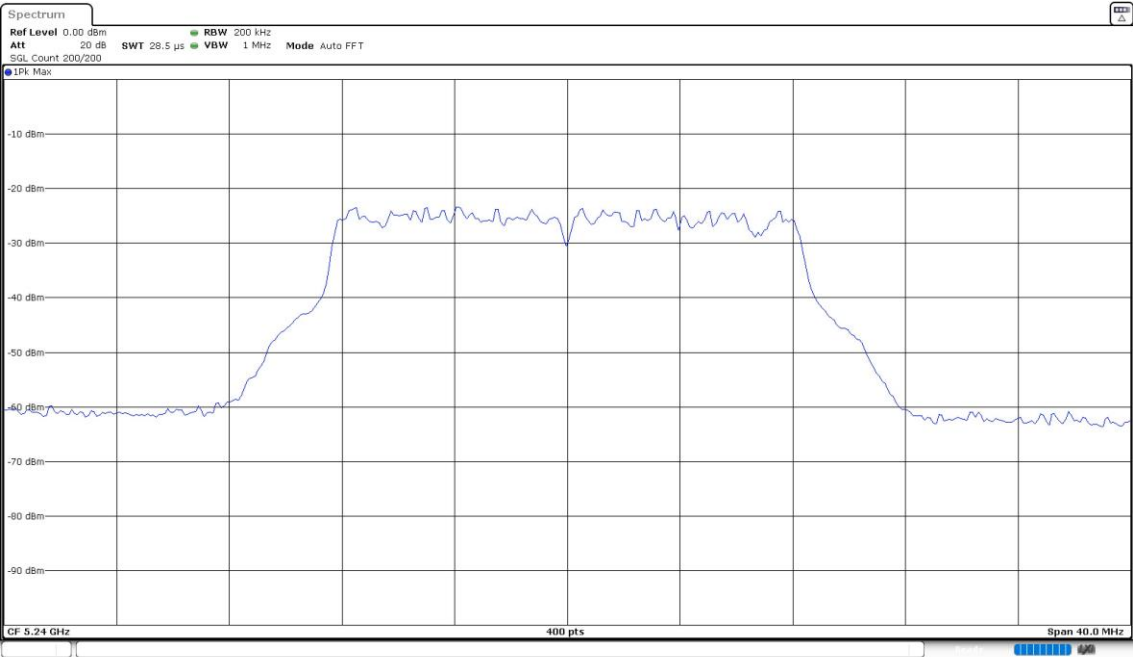
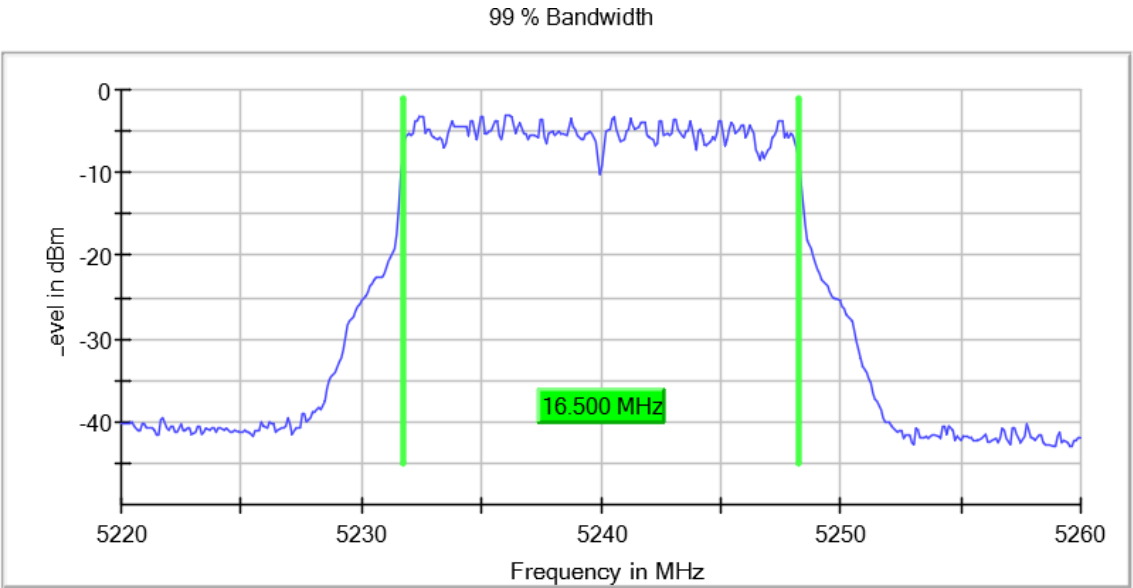
Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5200.00000 Modulation = 802.11a (OFDM 6 Mbit/s)

Images:



Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5240.00000 Modulation = 802.11a (OFDM 6 Mbit/s)

Images:



Modulation: 802.11n HT20 (OFDM MCS0)

Results

Operation Band (MHz)	Port	Freq (MHz)	Occ Ch BW (MHz)
[5150, 5250]	2	5180.00000	17.900
		5200.00000	17.900
		5240.00000	17.900
	2+3	5180.00000	17.900
		5200.00000	17.900
		5240.00000	17.900

Verdict

Pass

Attachments

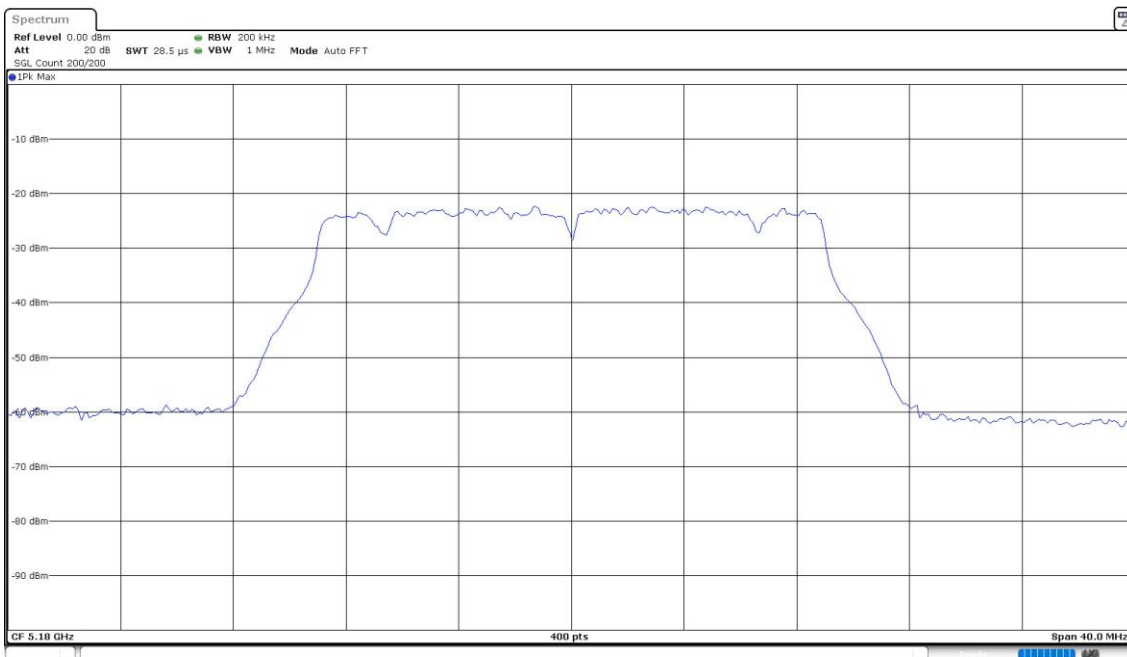
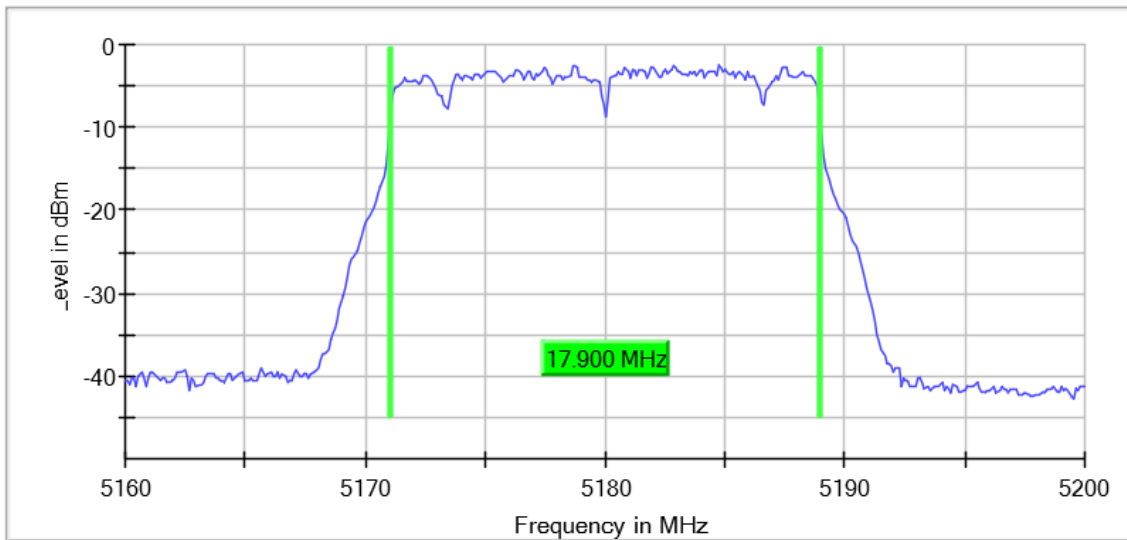
Operation Band MHz = [5150, 5250] Active Port = 2

Frequency MHz = 5180.00000

Modulation = 802.11n HT20 (OFDM MCS0)

Images:

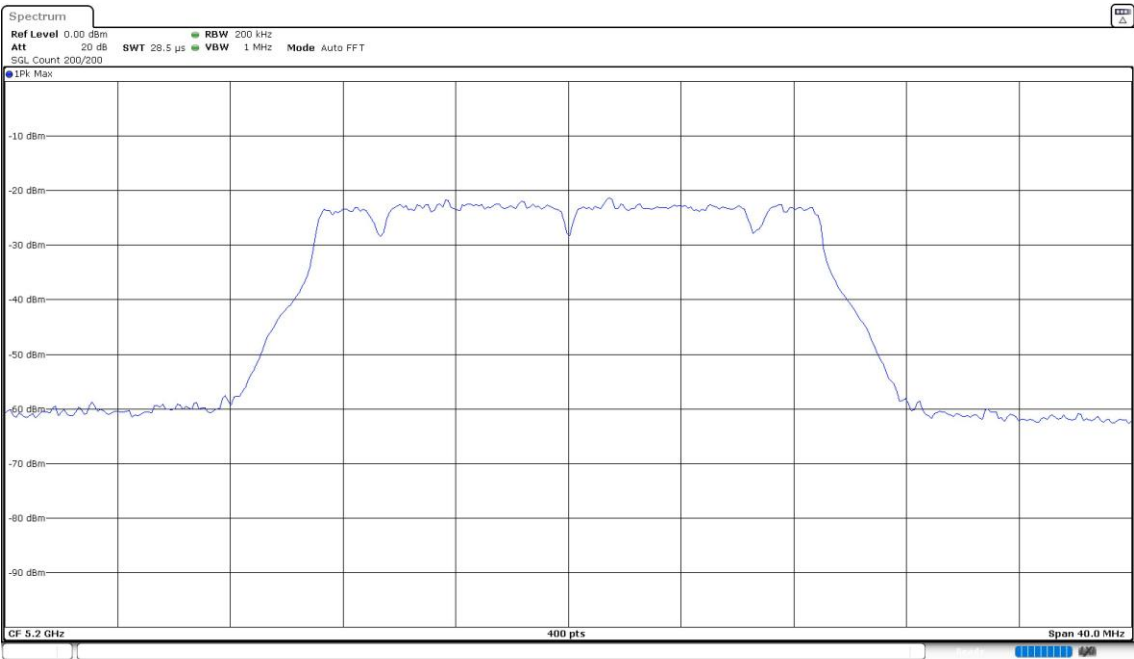
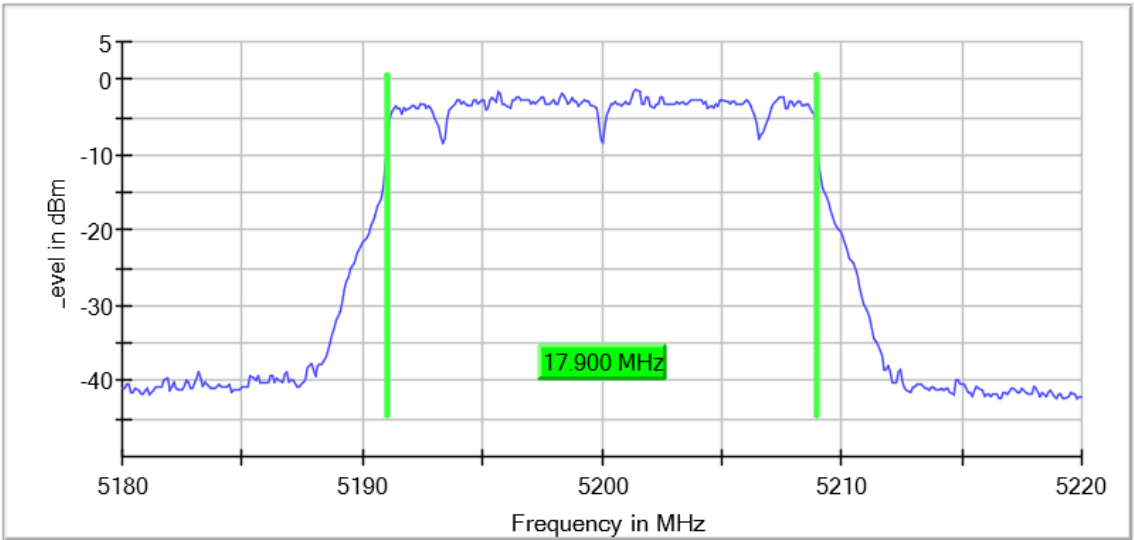
99 % Bandwidth



Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5200.00000 Modulation = 802.11n HT20 (OFDM MCS0)

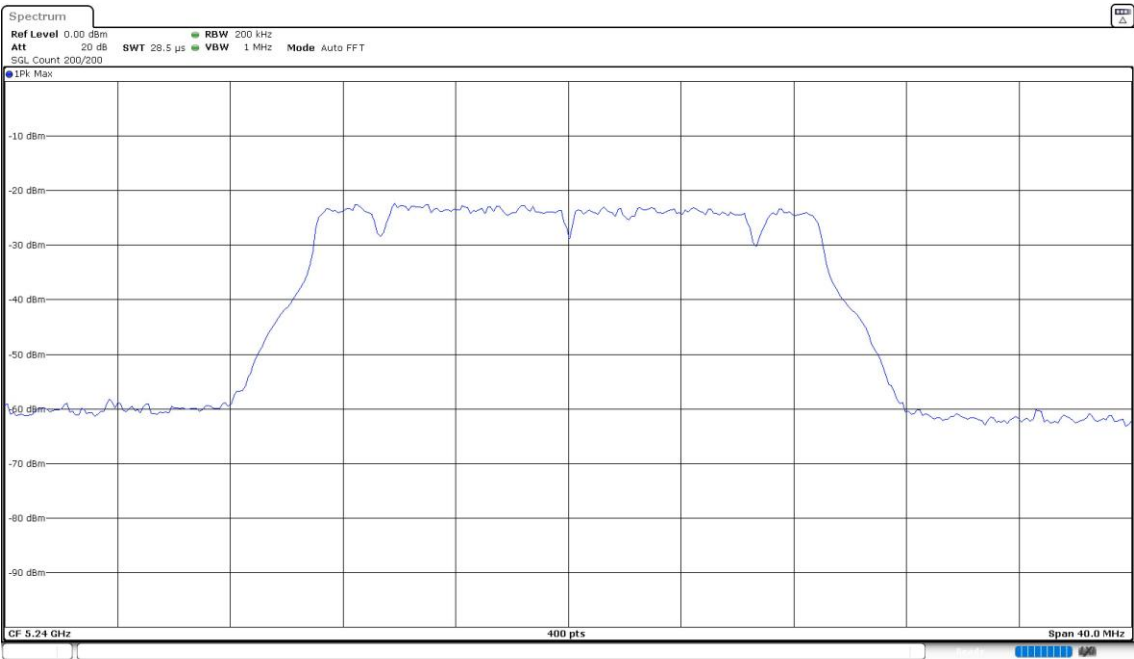
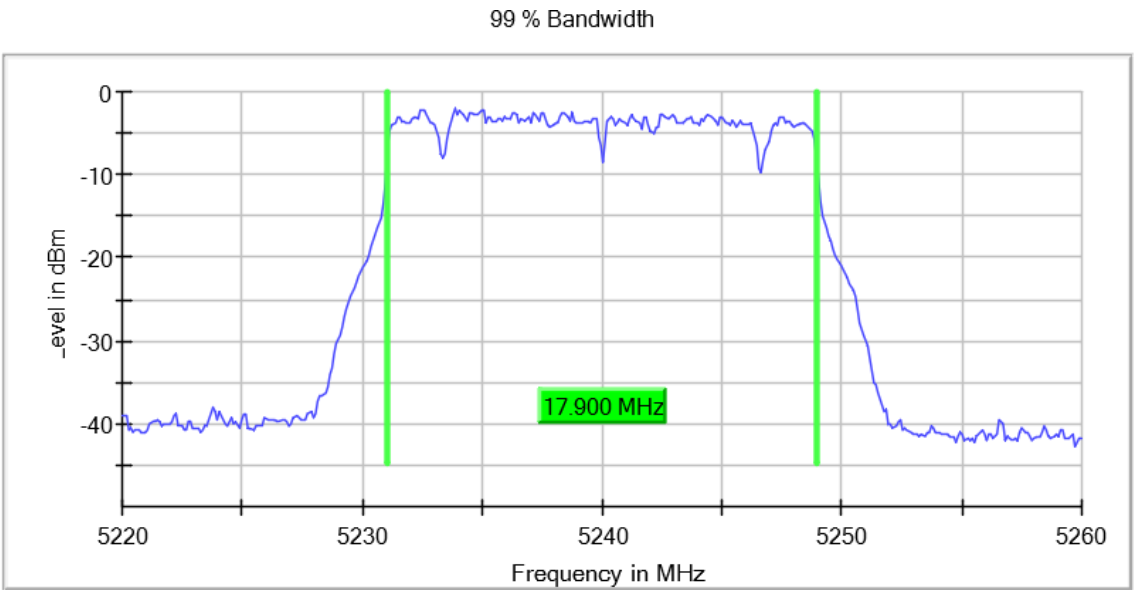
Images:

99 % Bandwidth



Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5240.00000 Modulation = 802.11n HT20 (OFDM MCS0)

Images:



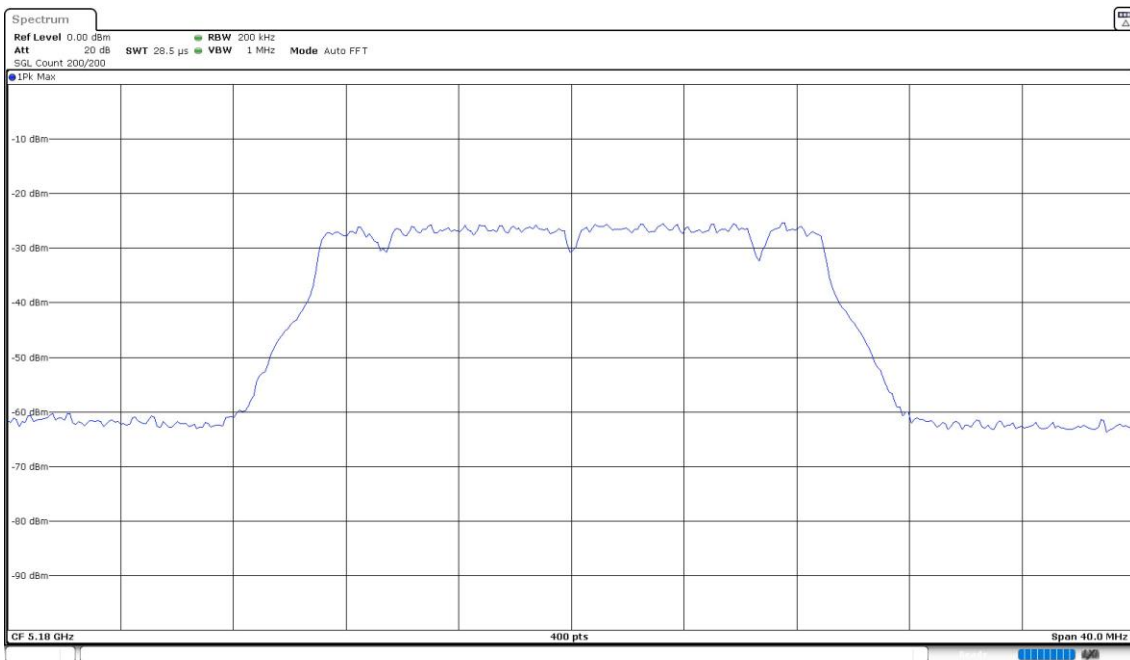
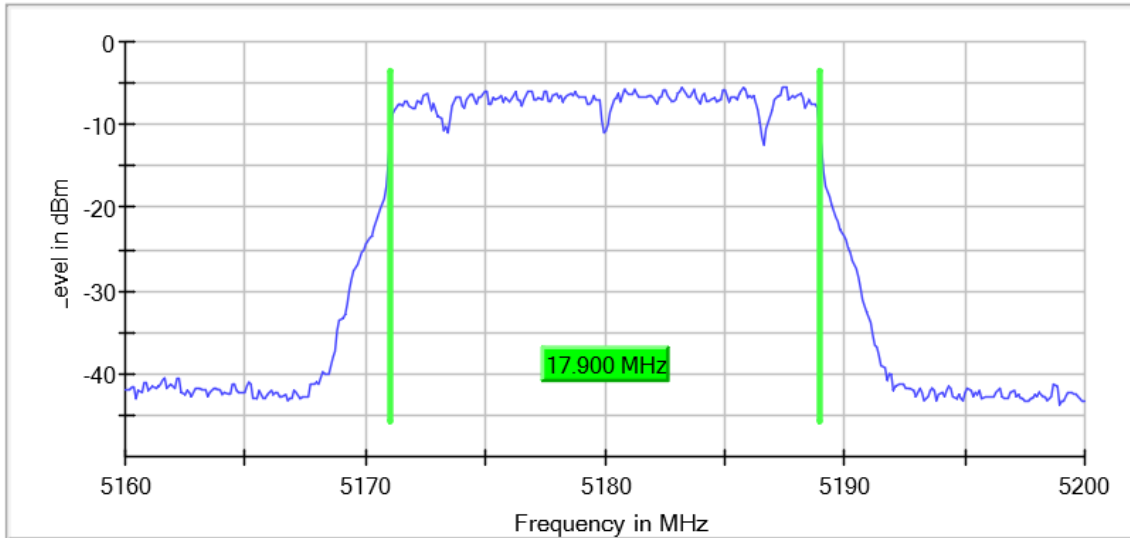
Operation Band MHz = [5150, 5250] Active Port = 2+3

Frequency MHz = 5180.00000

Modulation = 802.11n HT20 (OFDM MCS0)

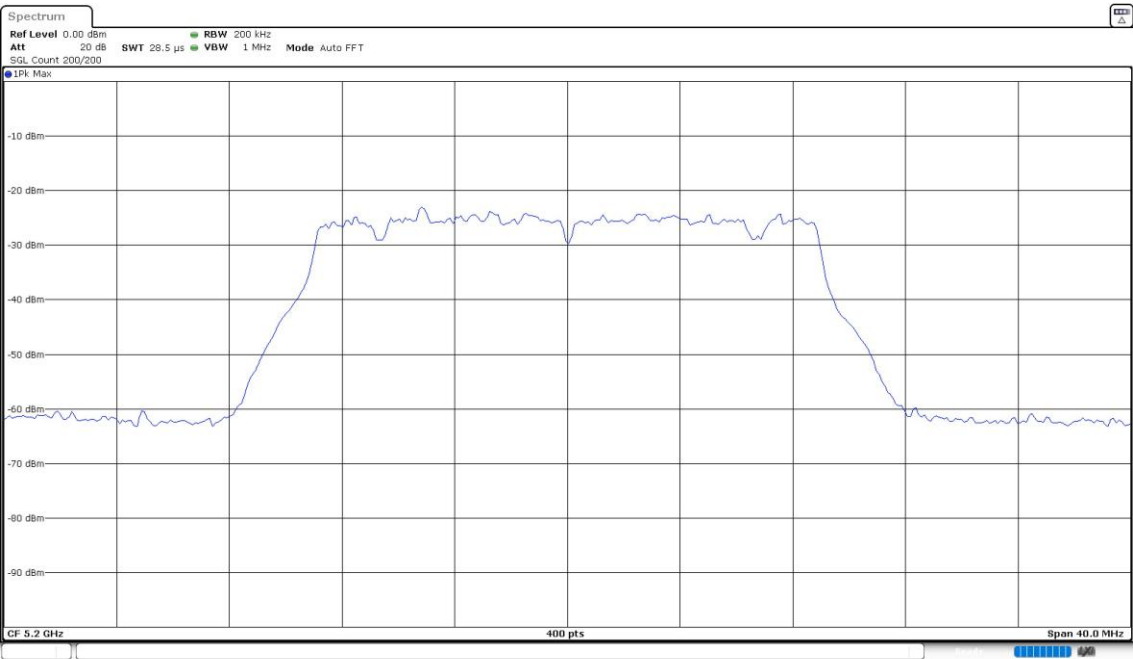
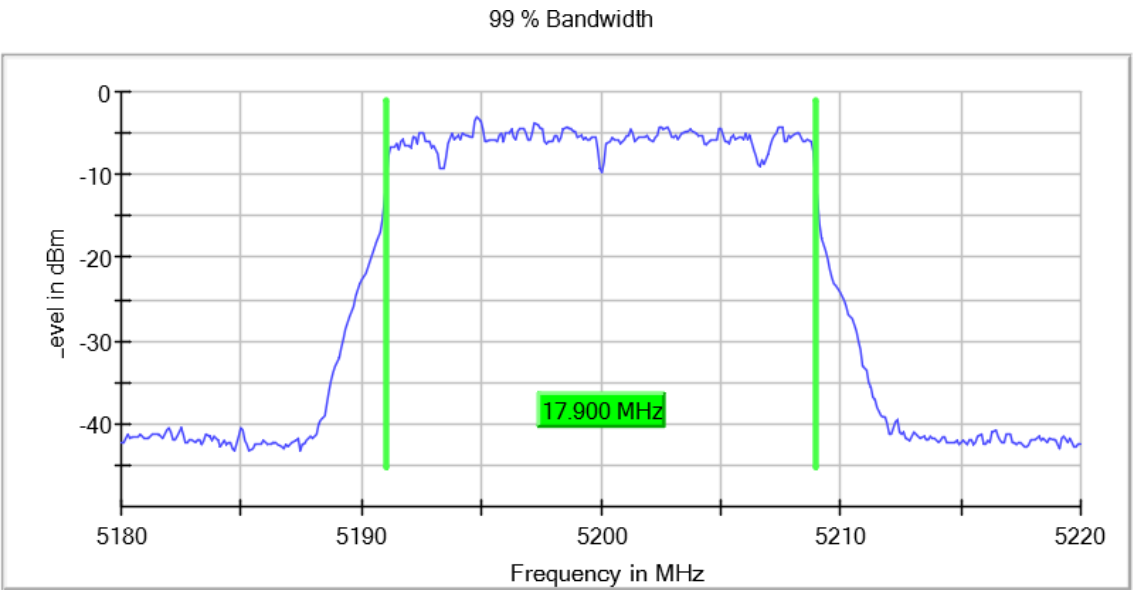
Images:

99 % Bandwidth



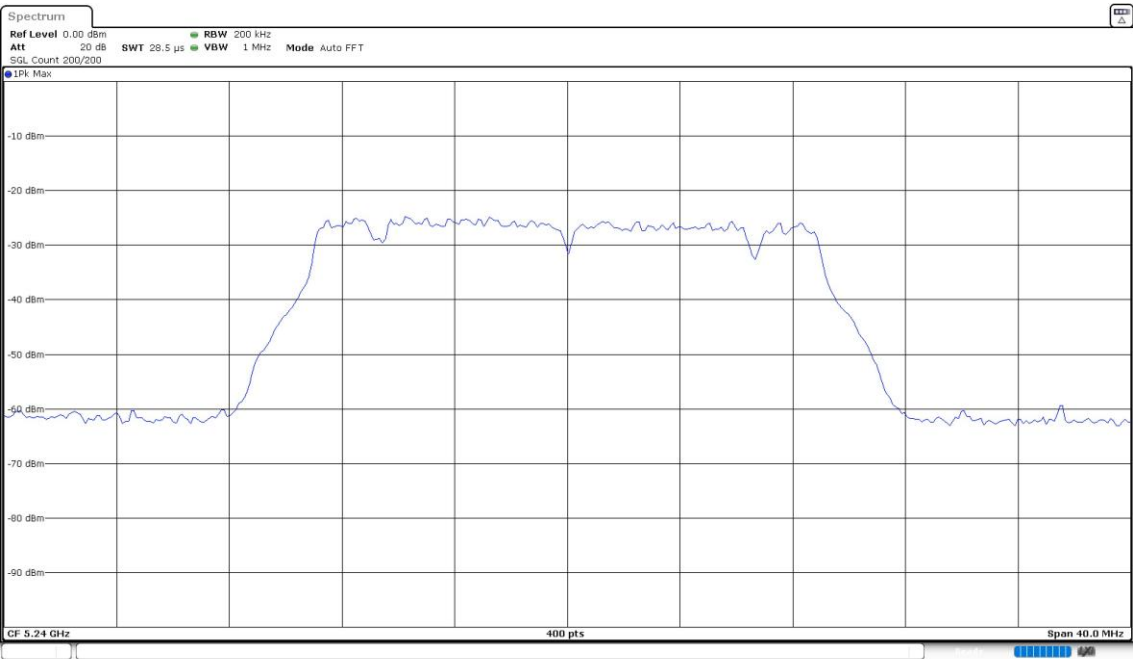
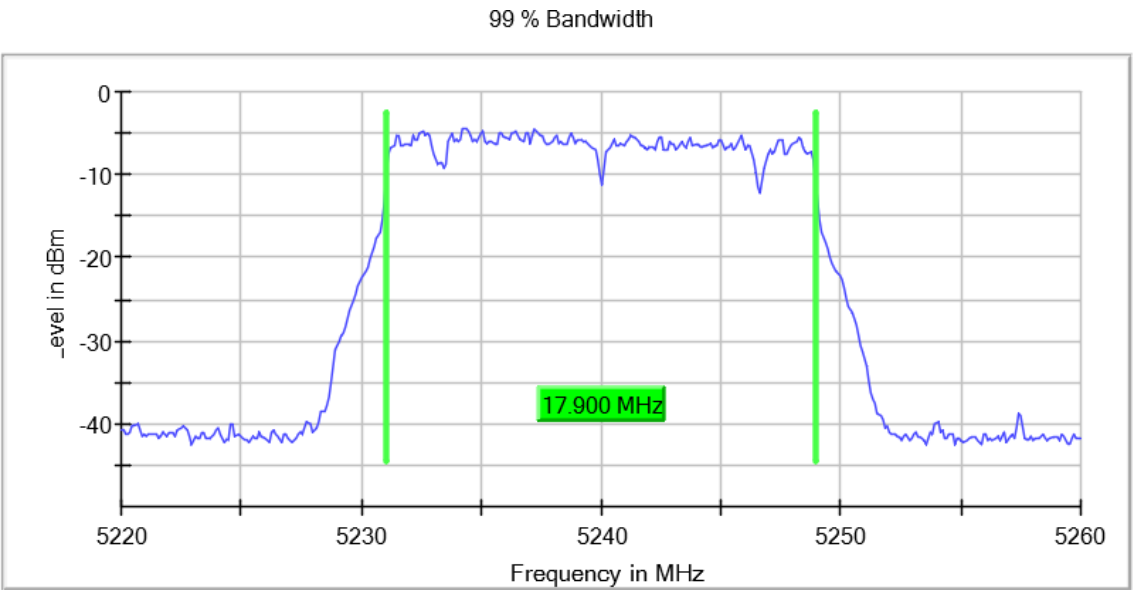
Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5200.00000 Modulation = 802.11n HT20 (OFDM MCS0)

Images:



Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5240.00000 Modulation = 802.11n HT20 (OFDM MCS0)

Images:



Modulation: 802.11n HT40 (OFDM MCS0 13.5 Mbit/s)

Results

Operation Band (MHz)	Port	Freq (MHz)	Occ Ch BW (MHz)
[5150, 5250]	2	5190.00000	36.500
		5230.00000	36.750
	2+3	5190.00000	36.500
		5230.00000	36.750

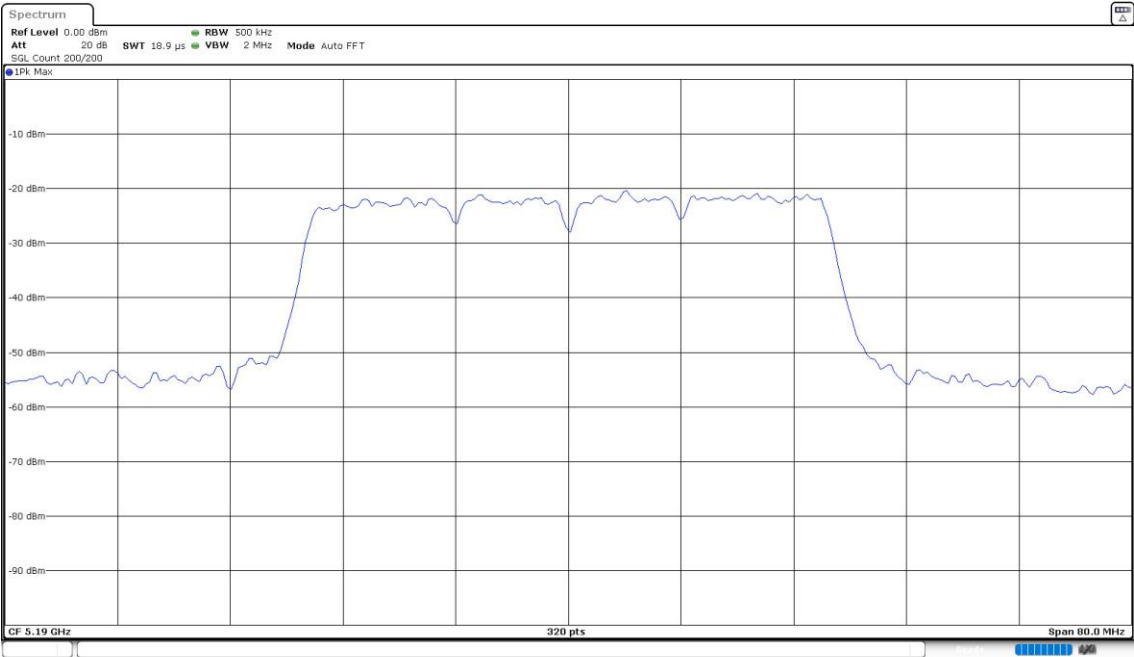
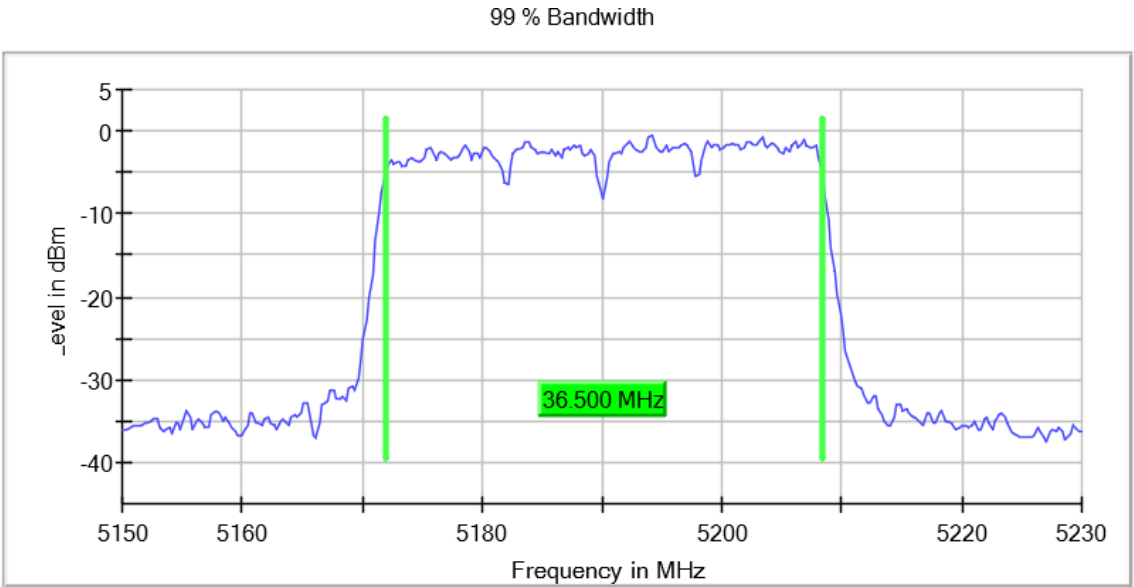
Verdict

Pass

Attachments

Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5190.00000 Modulation = 802.11n HT40 (OFDM MCS0 13.5 Mbit/s)

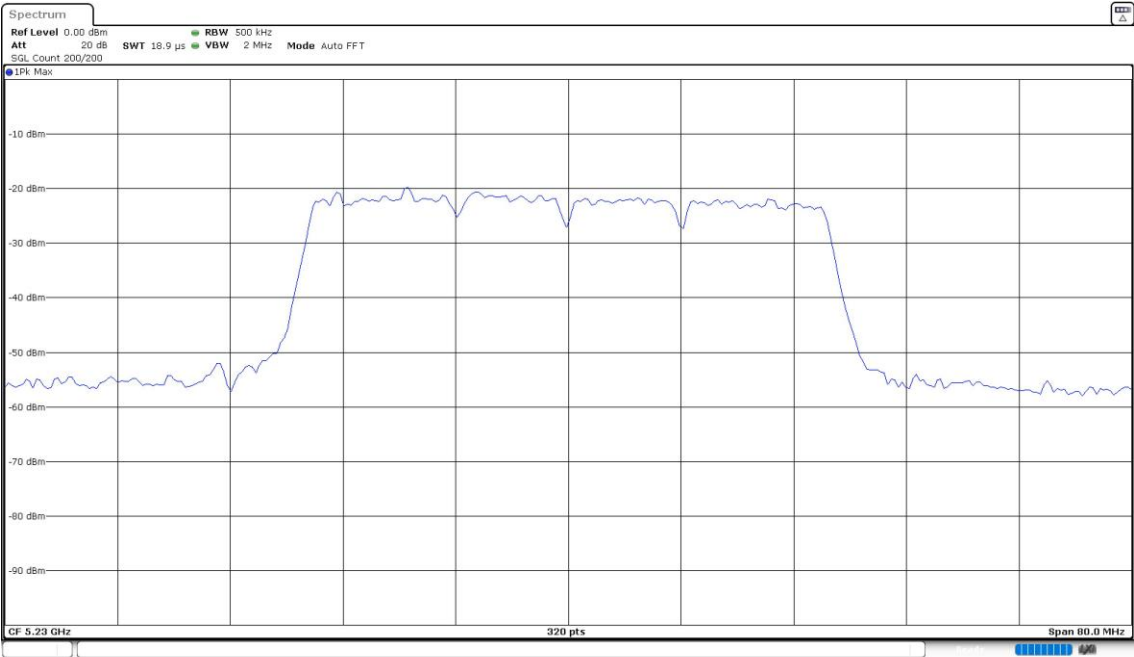
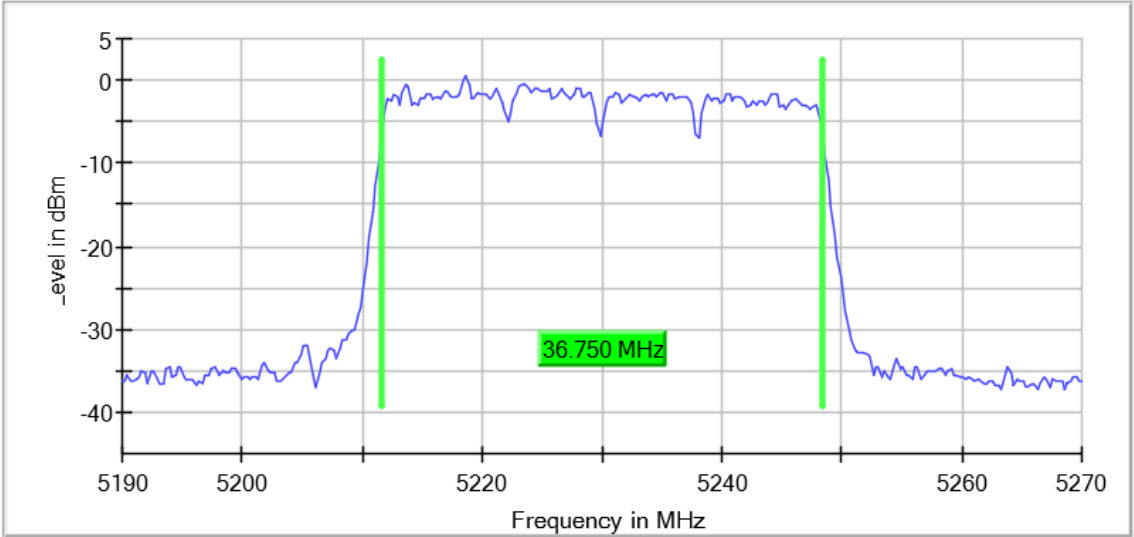
Images:



Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5230.00000 Modulation = 802.11n HT40 (OFDM MCS0 13.5 Mbit/s)

Images:

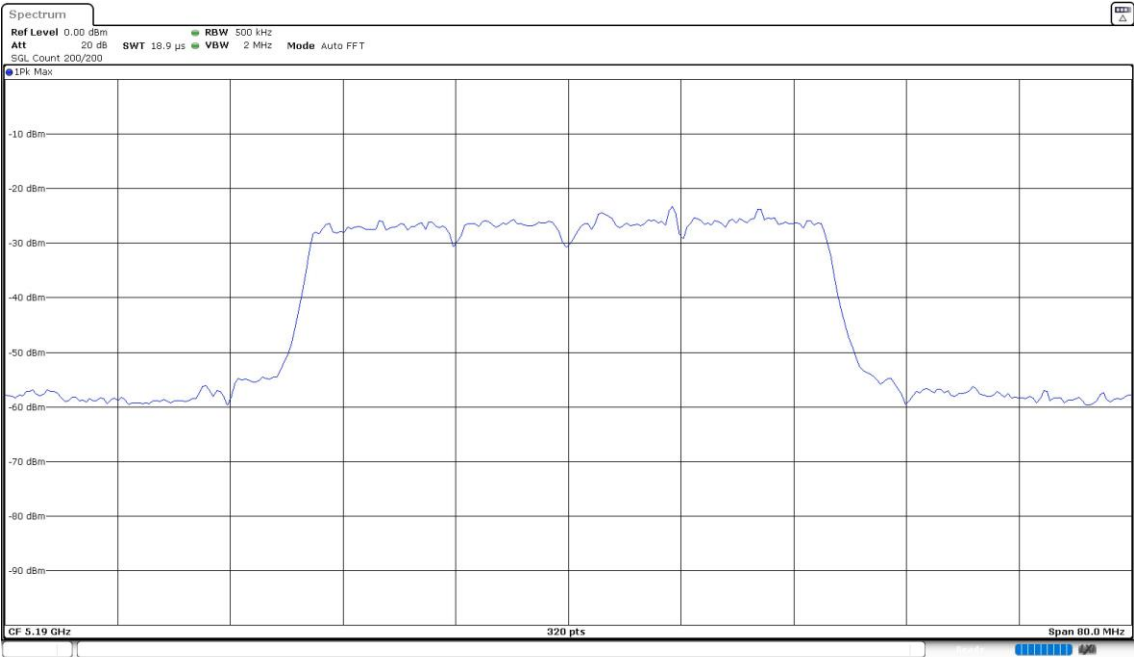
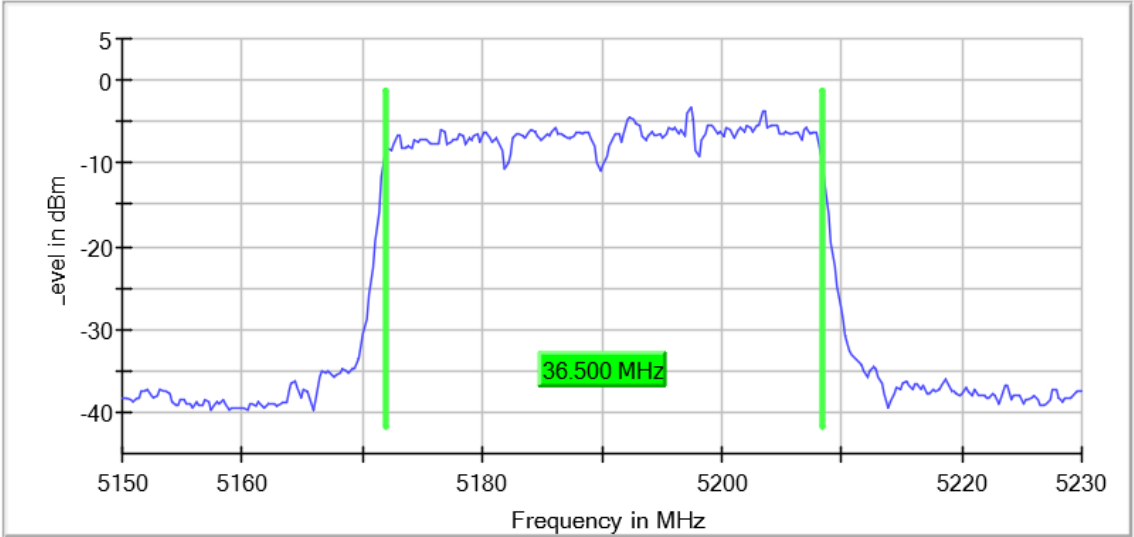
99 % Bandwidth



Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5190.00000 Modulation = 802.11n HT40 (OFDM MCS0)

Images:

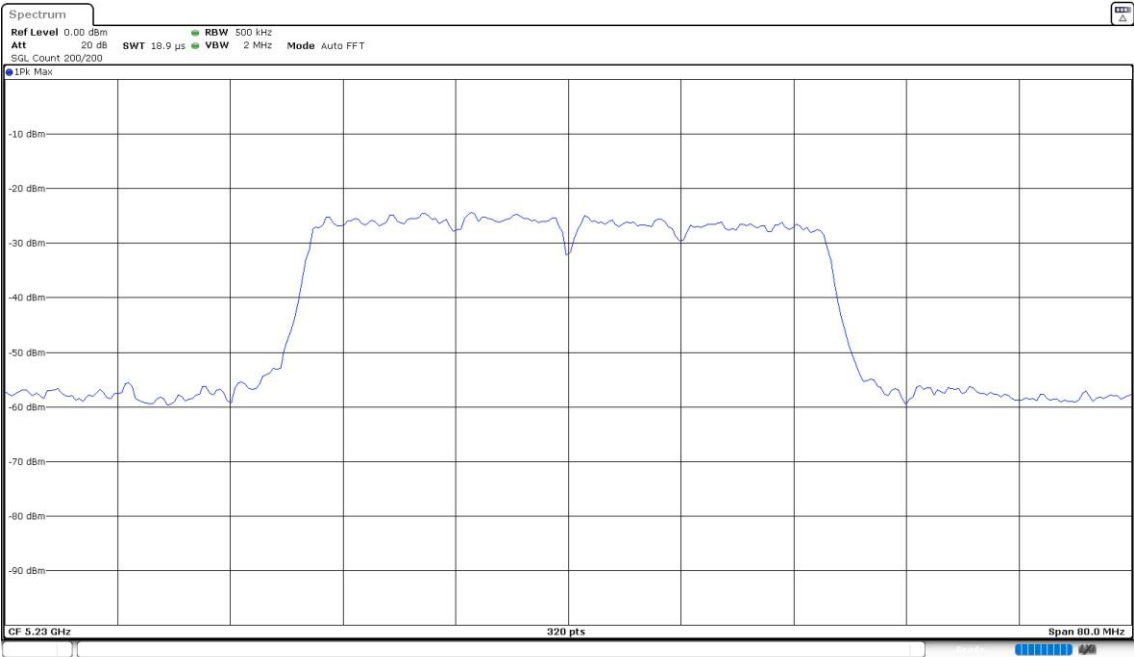
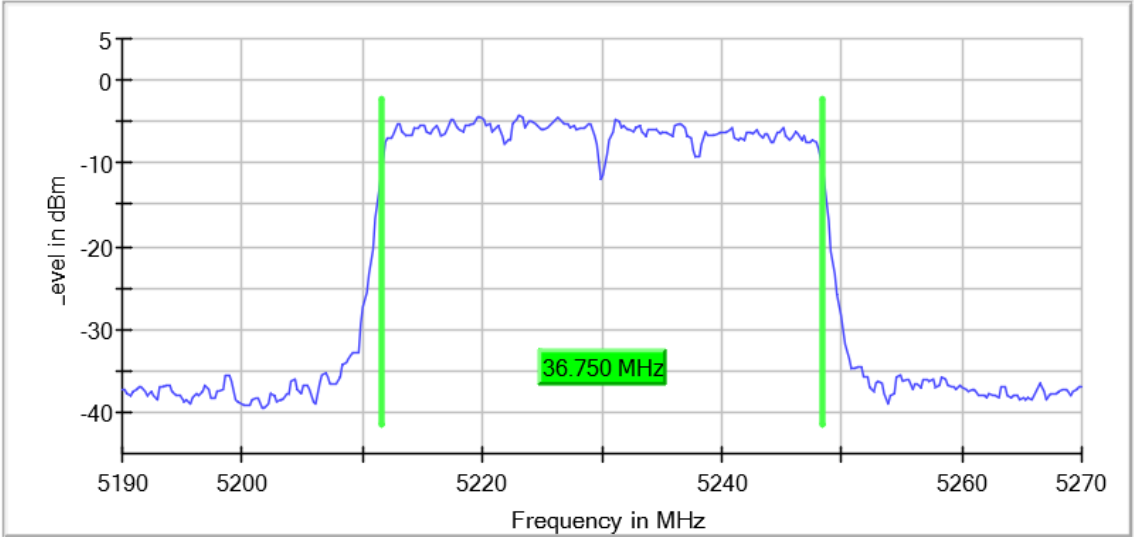
99 % Bandwidth



Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5230.00000 Modulation = 802.11n HT40 (OFDM MCS0)

Images:

99 % Bandwidth



Modulation: 802.11ac VHT20 (OFDM MCS0)

Results

Operation Band (MHz)	Port	Freq (MHz)	Occ Ch BW (MHz)
[5150, 5250]	2	5180.00000	17.900
		5200.00000	17.900
		5240.00000	17.900
	2+3	5180.00000	17.900
		5200.00000	17.900
		5240.00000	17.900

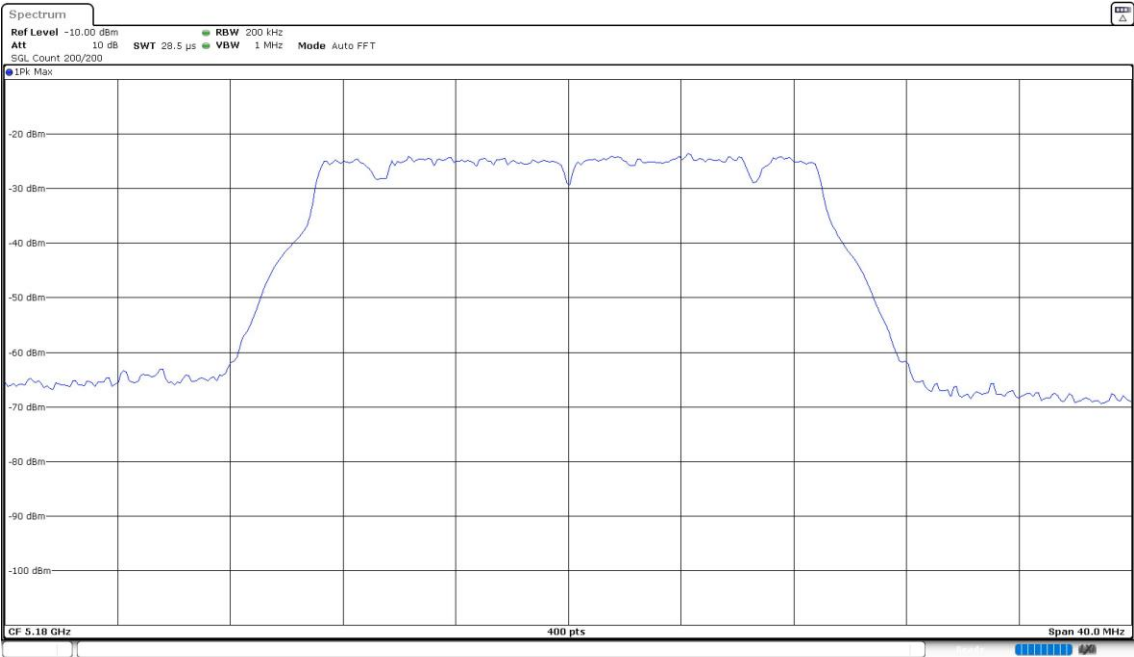
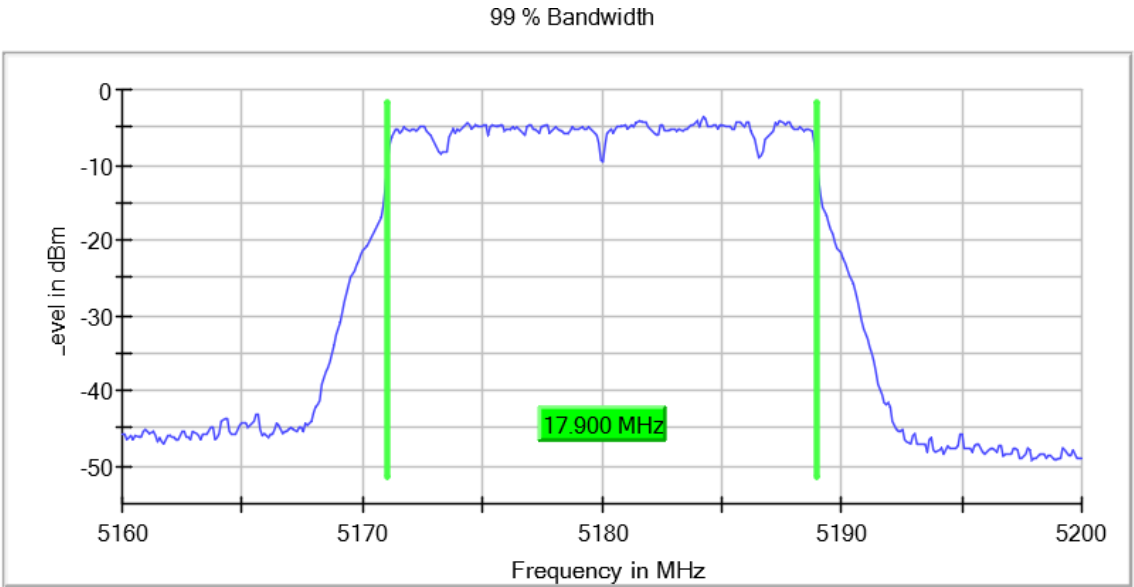
Verdict

Pass

Attachments

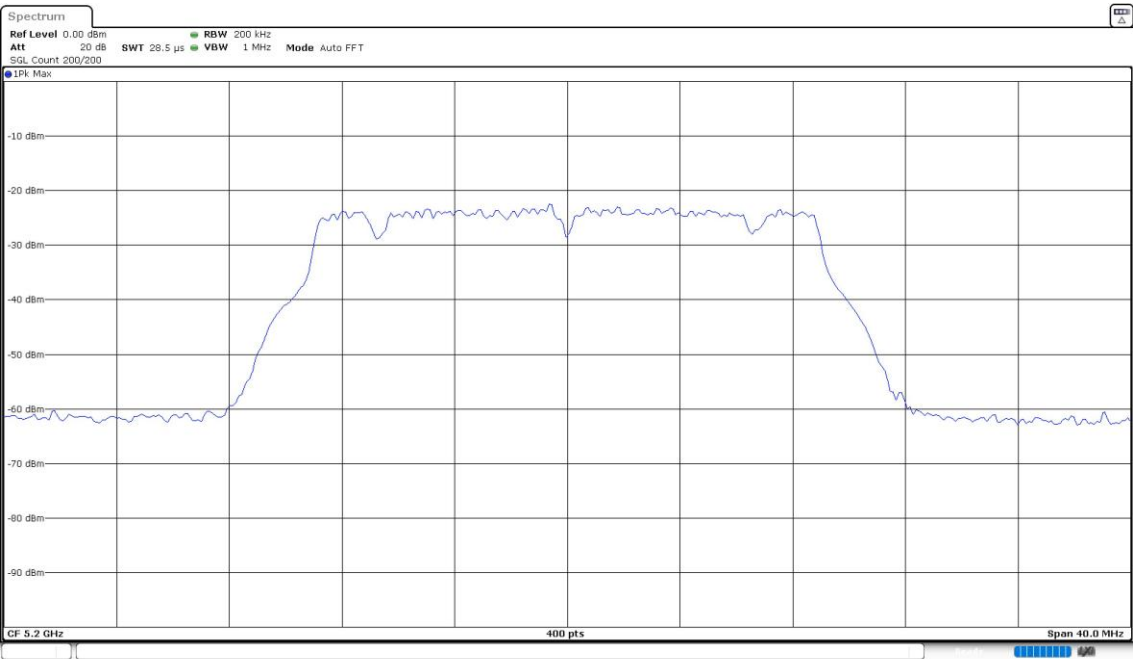
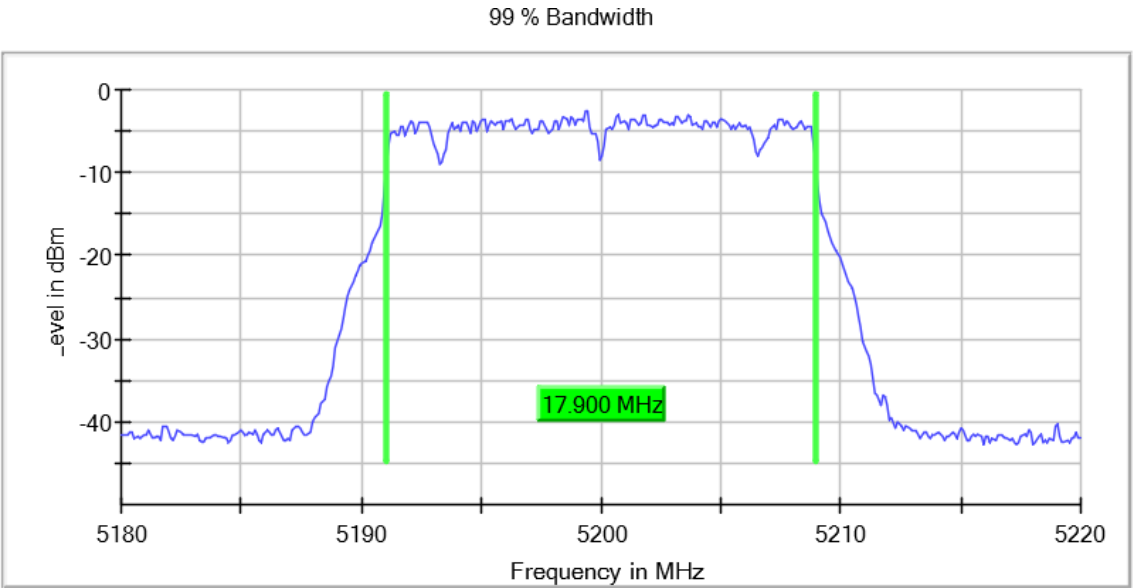
Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5180.00000 Modulation = 802.11ac VHT20 (OFDM MCS0)

Images:



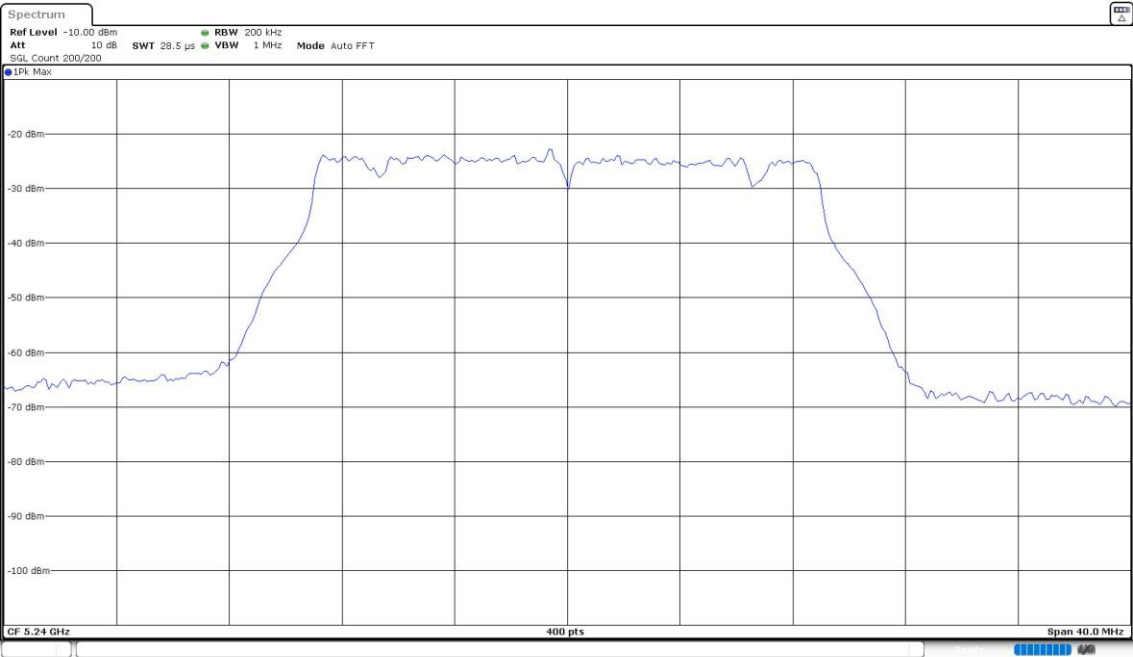
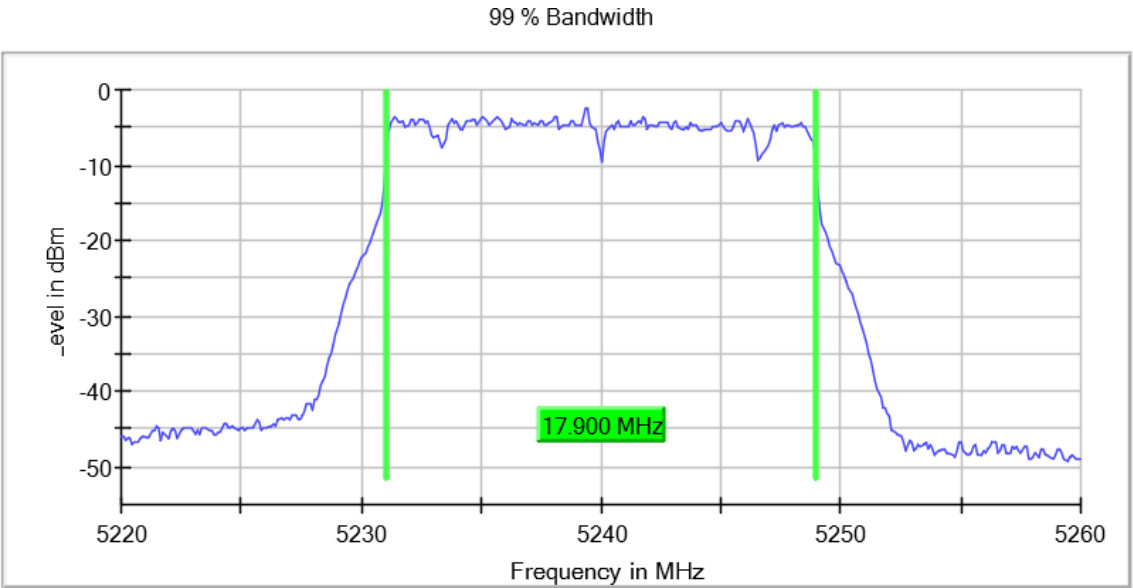
Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5200.00000 Modulation = 802.11ac VHT20 (OFDM MCS0)

Images:



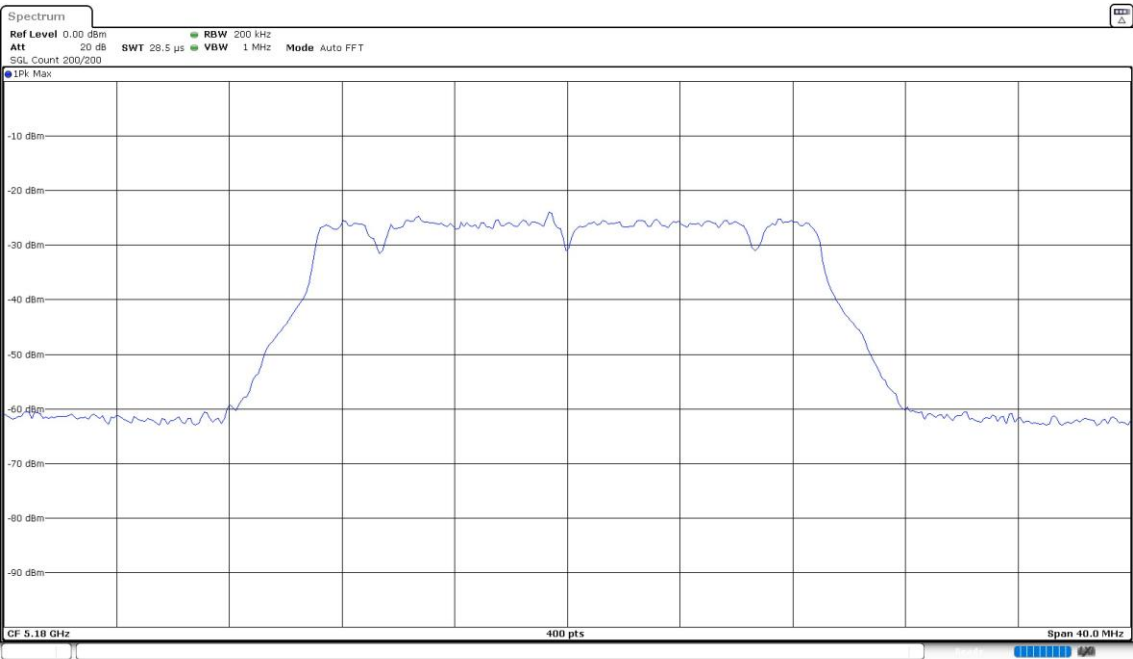
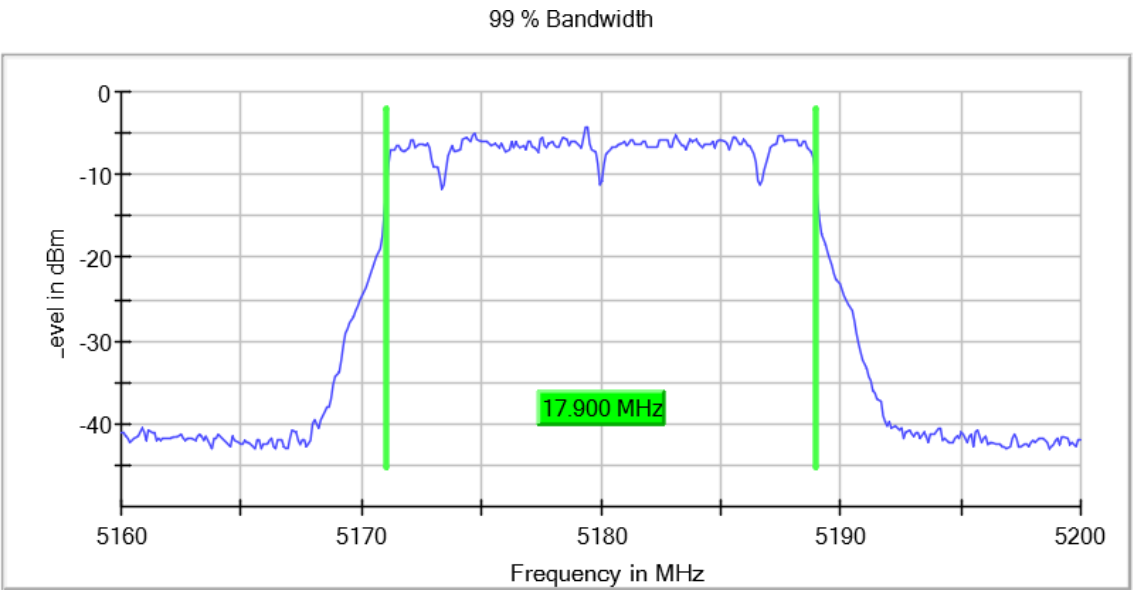
Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5240.00000 Modulation = 802.11ac VHT20 (OFDM MCS0)

Images:



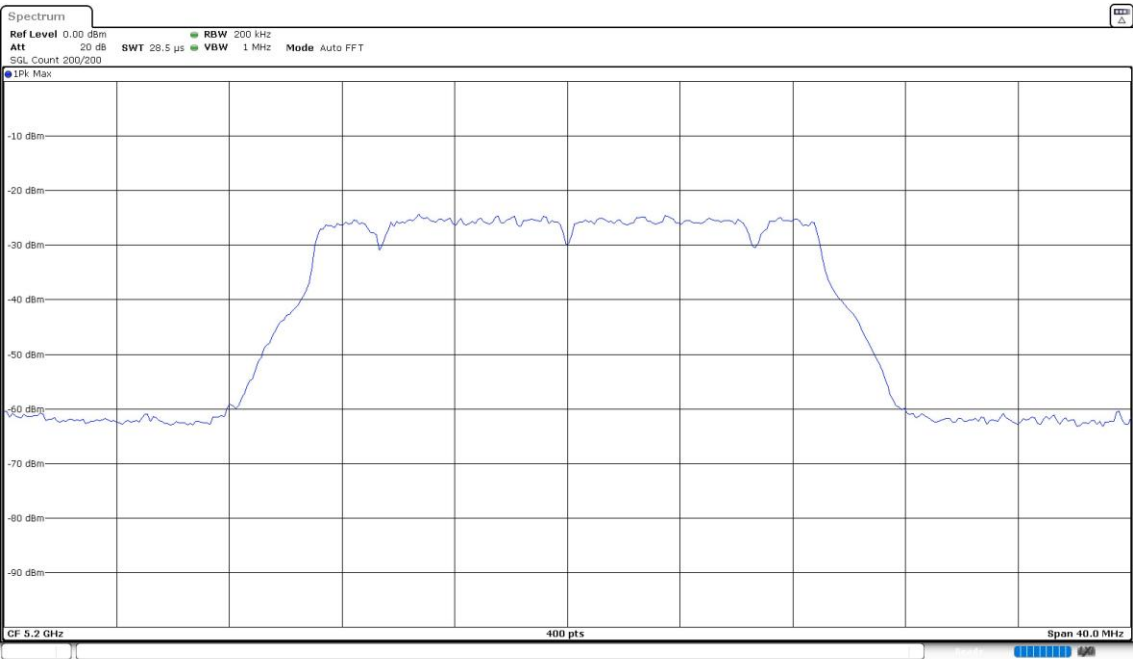
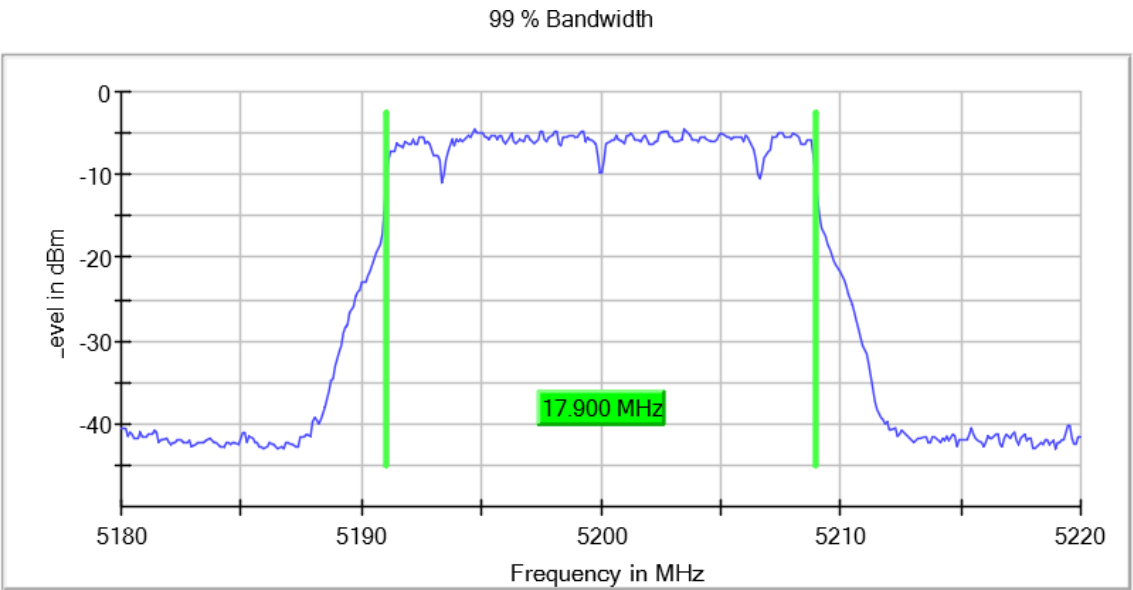
Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5180.00000 Modulation = 802.11ac VHT20 (OFDM MCS0)

Images:



Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5200.00000 Modulation = 802.11ac VHT20 (OFDM MCS0)

Images:



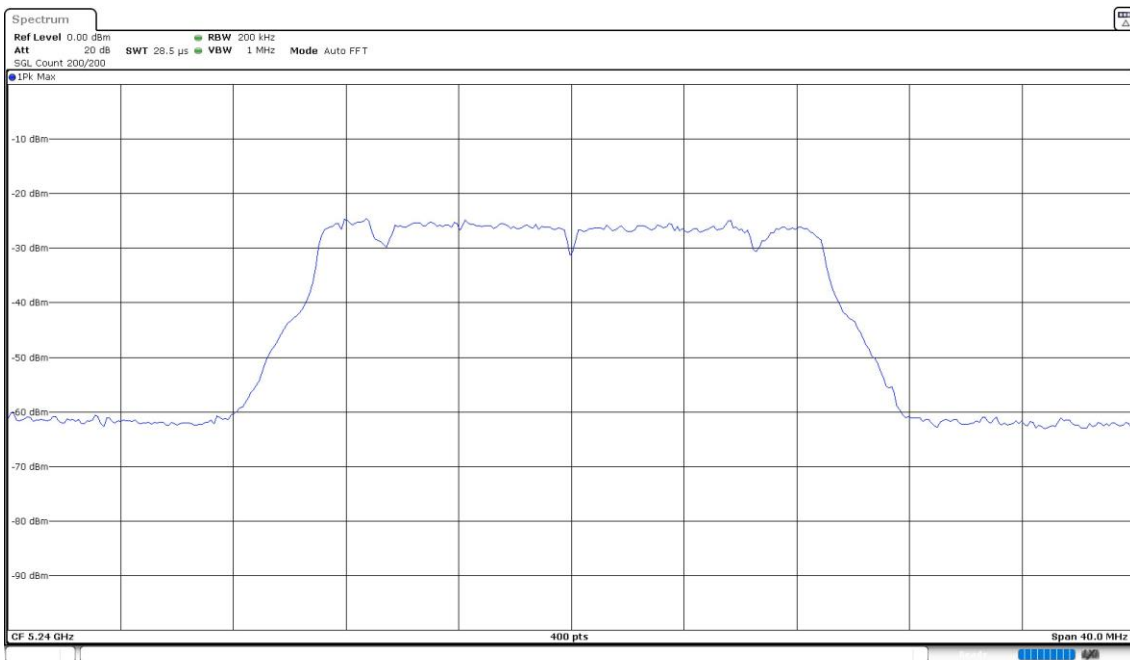
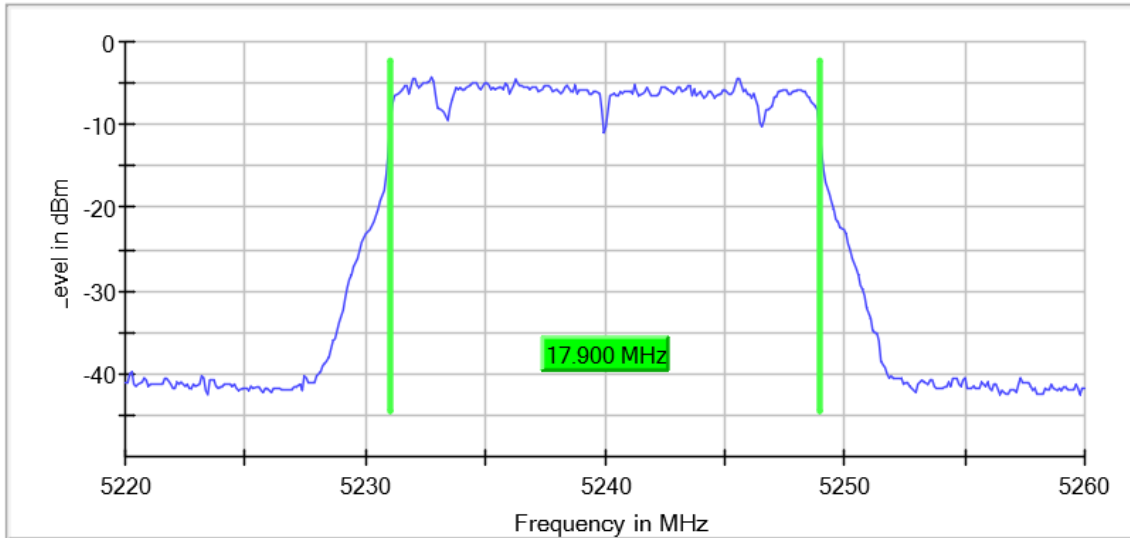
Operation Band MHz = [5150, 5250] Active Port = 2+3

Frequency MHz = 5240.00000

Modulation = 802.11ac VHT20 (OFDM MCS0)

Images:

99 % Bandwidth



Modulation: 802.11ac VHT40 (OFDM MCS0)

Results

Operation Band (MHz)	Port	Freq (MHz)	Occ Ch BW (MHz)
[5150, 5250]	2	5190.00000	36.500
		5230.00000	36.750
	2+3	5190.00000	36.500
		5230.00000	36.500

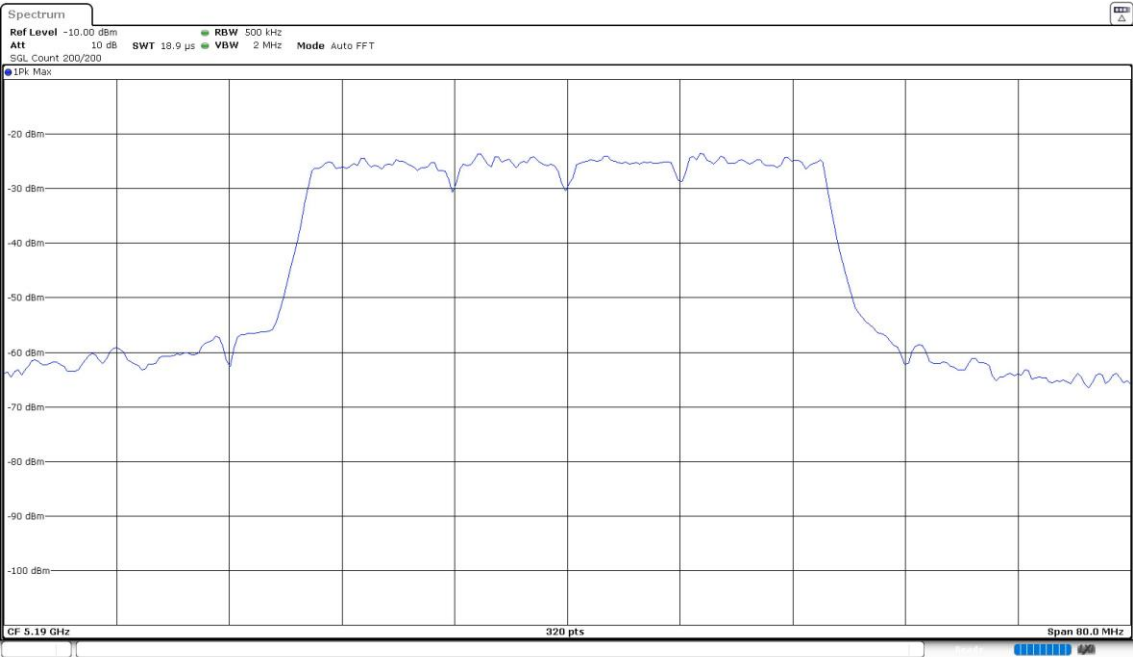
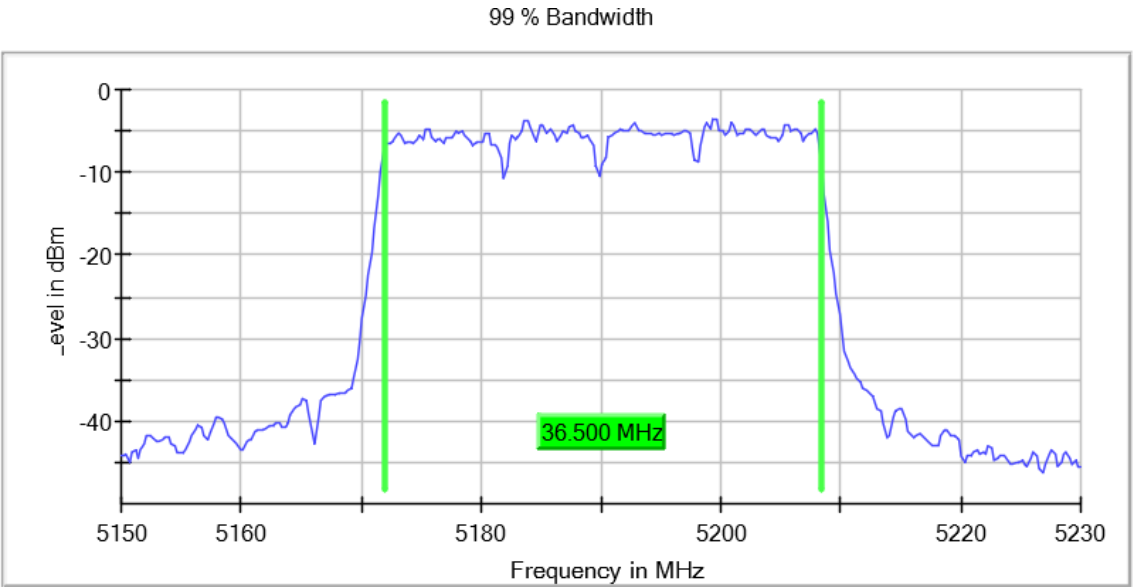
Verdict

Pass

Attachments

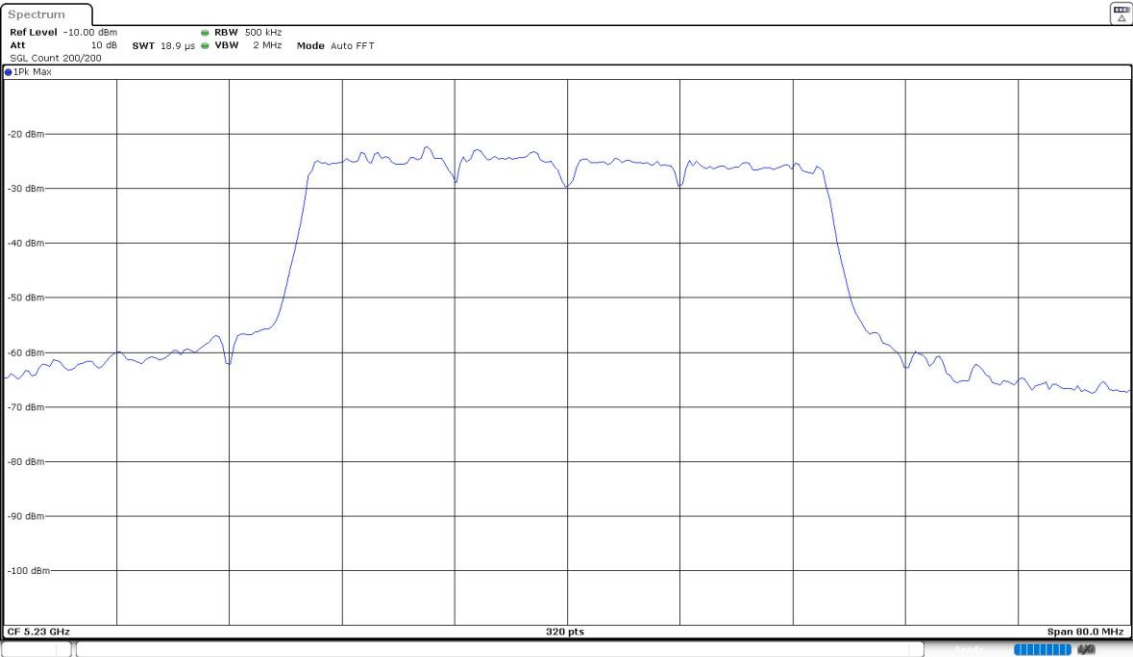
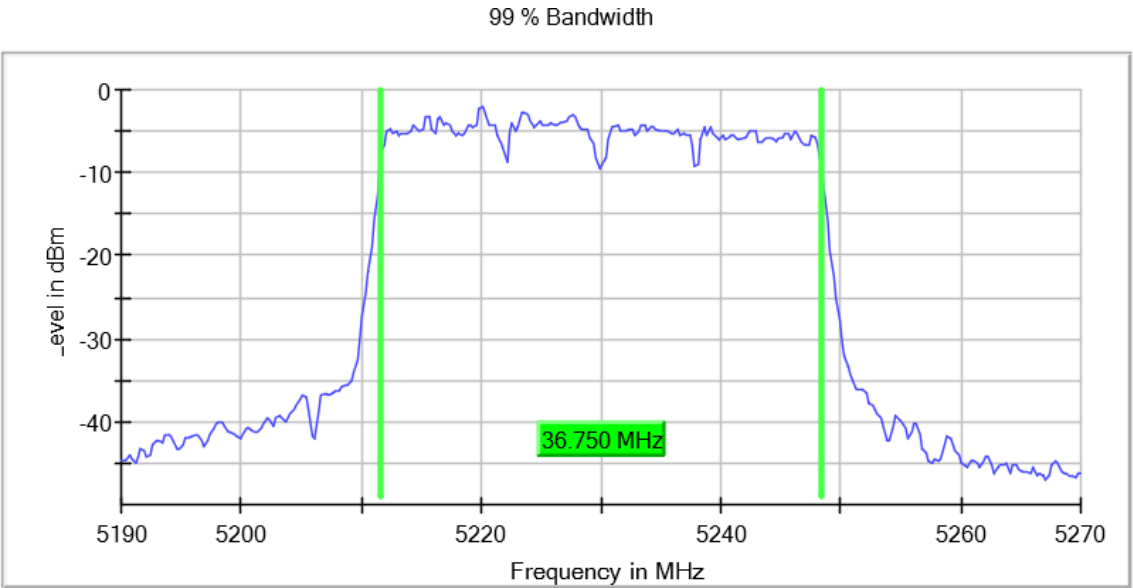
Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5190.00000 Modulation = 802.11ac VHT40 (OFDM MCS0)

Images:



Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5230.00000 Modulation = 802.11ac VHT40 (OFDM MCS0)

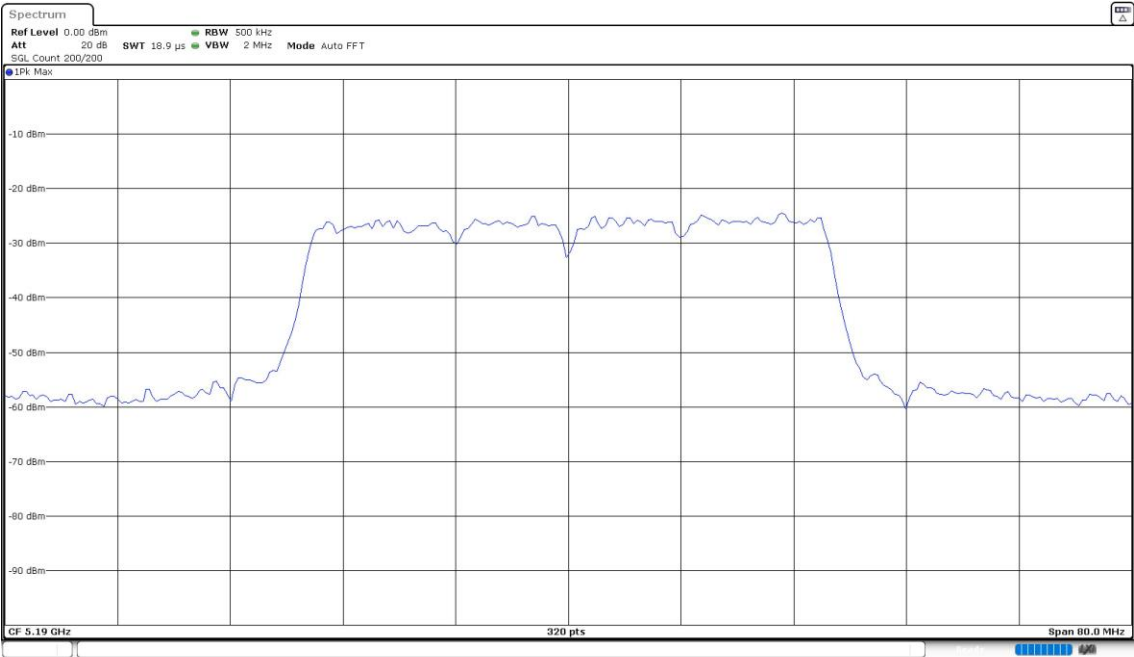
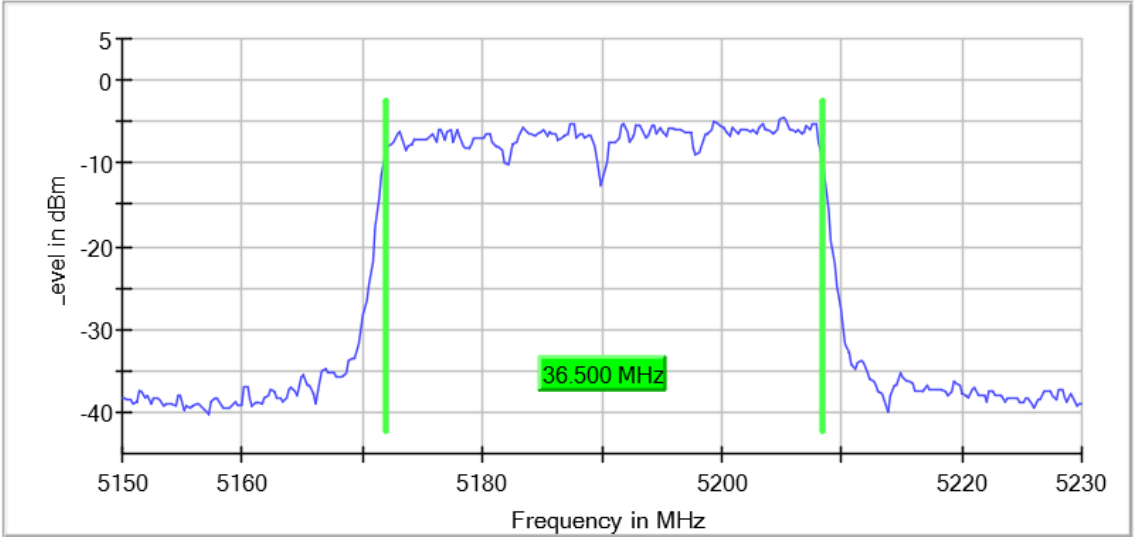
Images:



Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5190.00000 Modulation = 802.11ac VHT40 (OFDM MCS0)

Images:

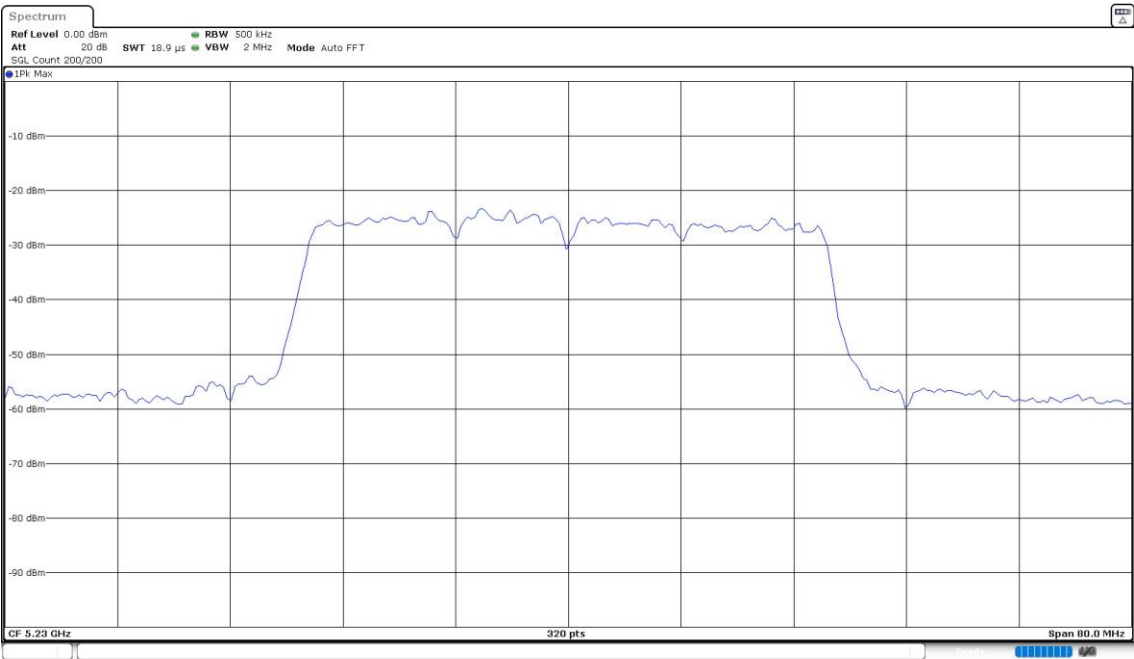
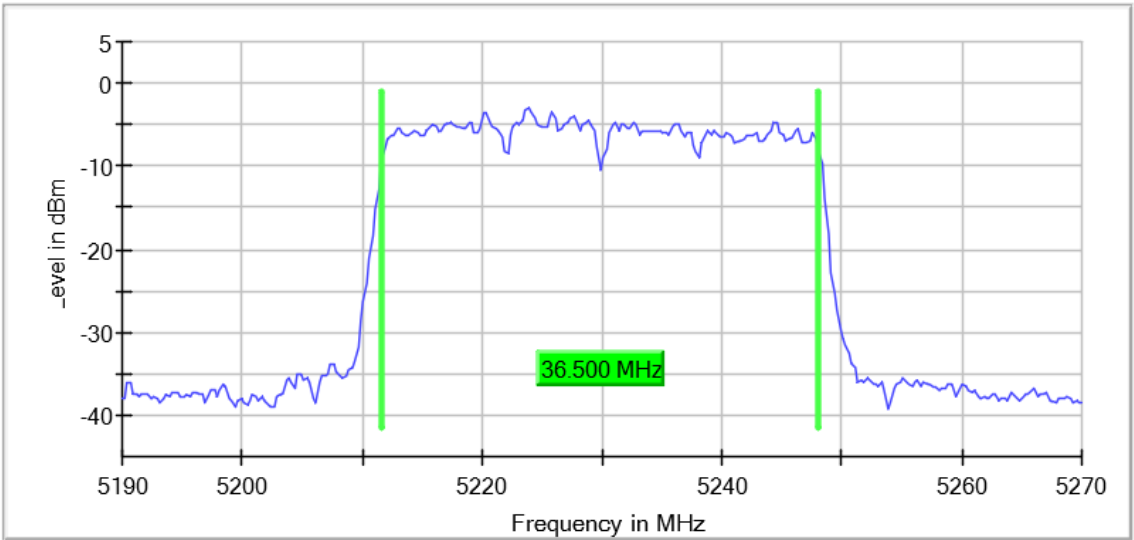
99 % Bandwidth



Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5230.00000 Modulation = 802.11ac VHT40 (OFDM MCS0)

Images:

99 % Bandwidth



Modulation: 802.11ac VHT80 (OFDM MCS0)

Results

Operation Band (MHz)	Port	Freq (MHz)	Occ Ch BW (MHz)
[5150, 5250]	2	5210.00000	76.500
	2+3		76.000

Verdict

Pass

Attachments

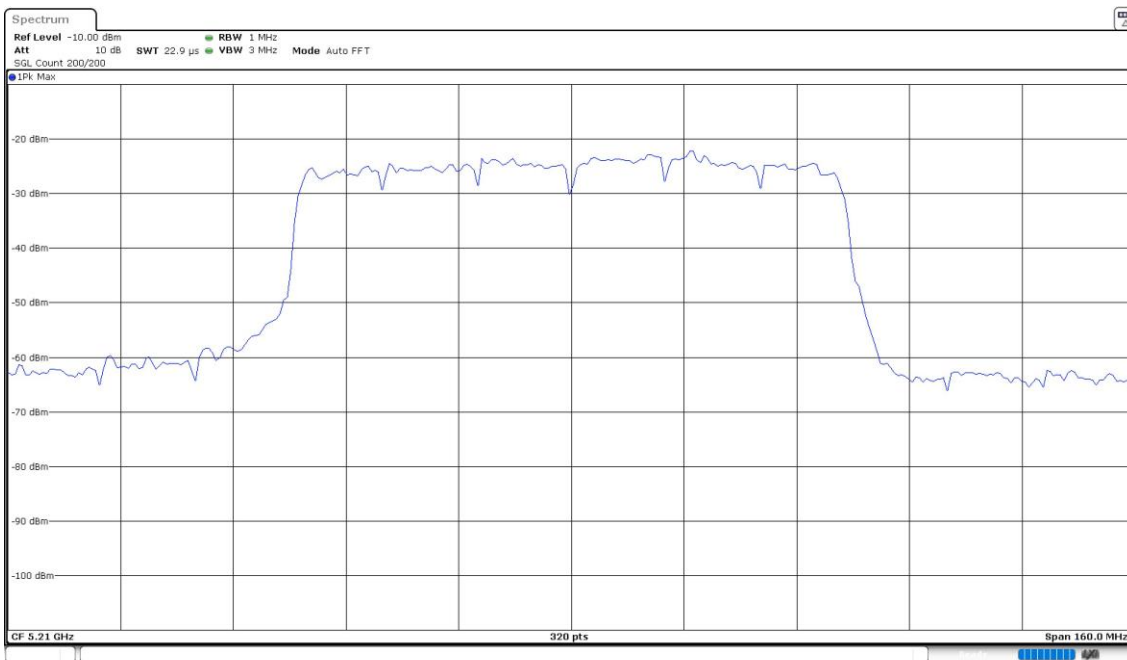
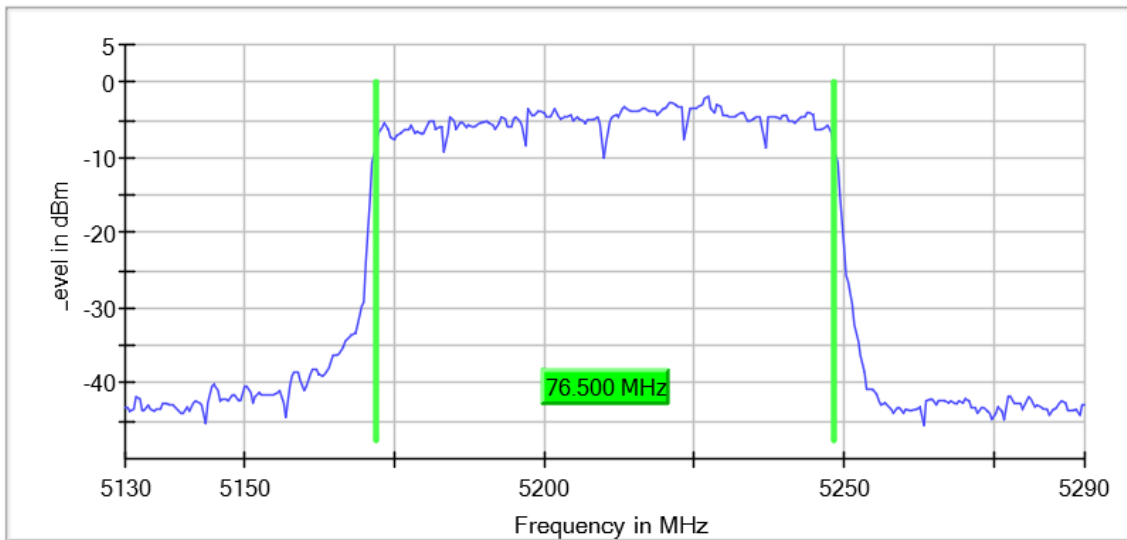
Operation Band MHz = [5150, 5250] Active Port = 2

Frequency MHz = 5210.00000

Modulation = 802.11ac VHT80 (OFDM MCS0)

Images:

99 % Bandwidth



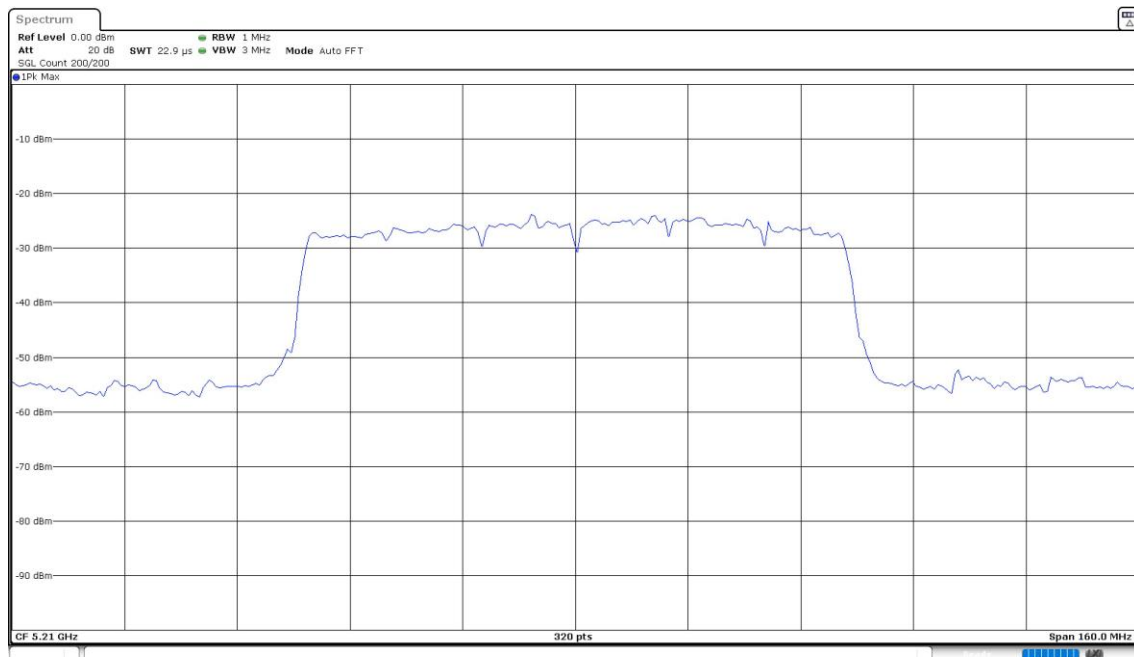
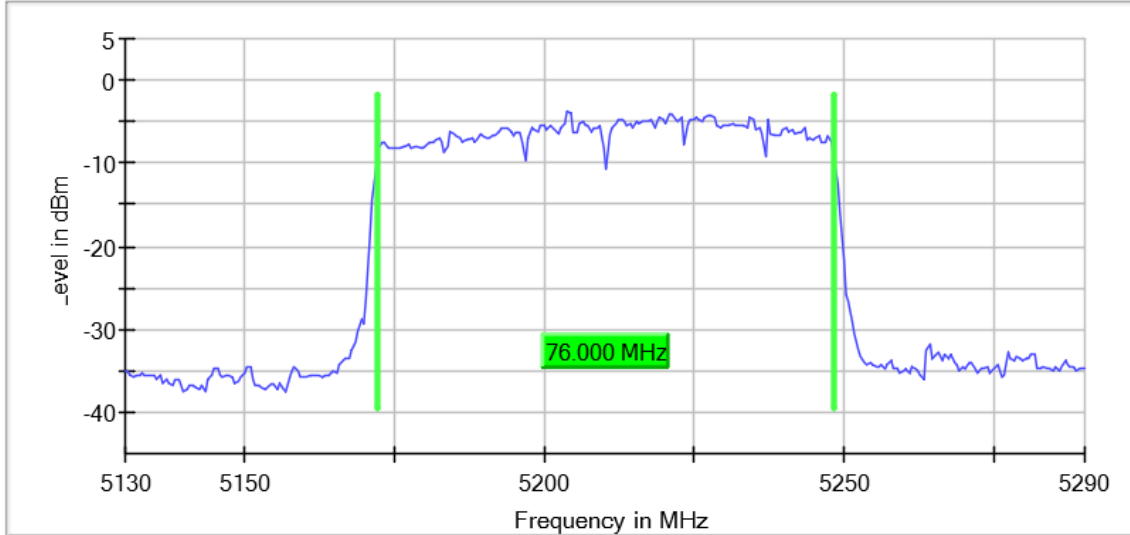
Operation Band MHz = [5150, 5250] Active Port = 2+3

Frequency MHz = 5210.00000

Modulation = 802.11ac VHT80 (OFDM MCS0)

Images:

99 % Bandwidth



Section 15.407 Subclause 15.403(i) [Ebw] Transmitter 26 dB Emission Bandwidth (EBW)

Limits

The 26 dB Emission Bandwidth was measured using the method according to clause C) 1) of 789033 D02 General UNII Test Procedures New Rules v02r01.

Modulation: 802.11a (OFDM 6 Mbit/s)

Results

Operation Band (MHz)	Port	Freq (MHz)	Ebw (MHz)
[5150, 5250]	2	5180.00000	21.200
		5200.00000	21.200
		5240.00000	21.200

Verdict

Pass

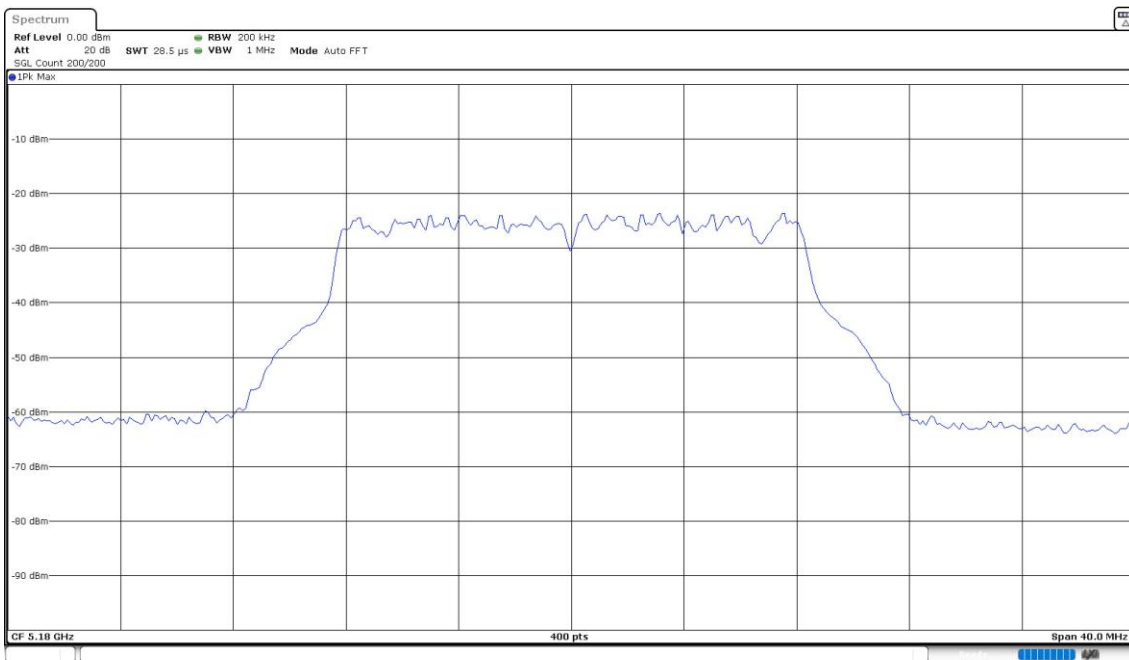
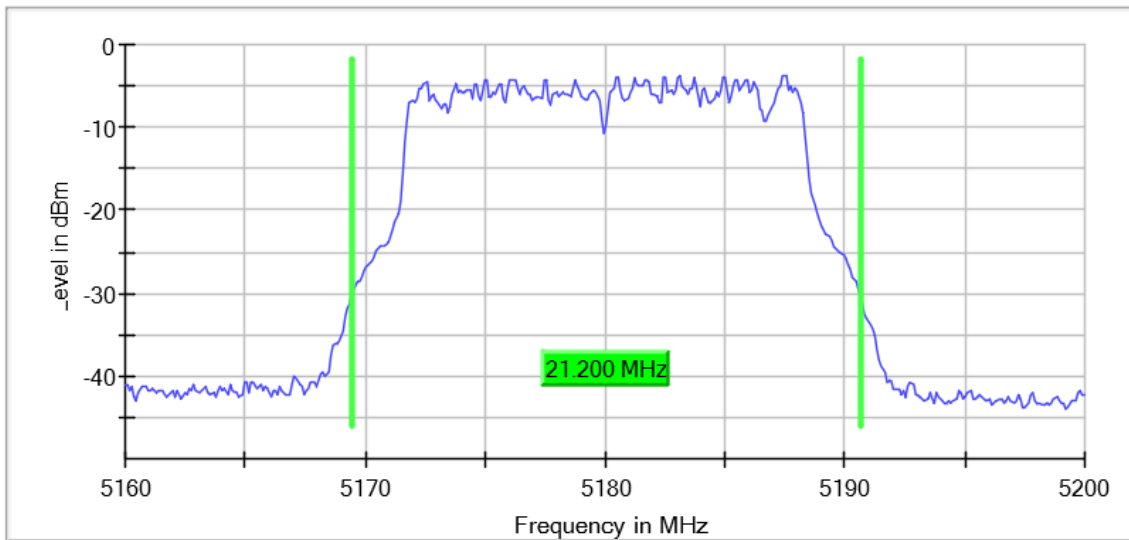
Attachments

Operation Band MHz = [5150, 5250] Active Port = 2

Frequency MHz = 5180.00000 Modulation = 802.11a (OFDM 6 Mbit/s)

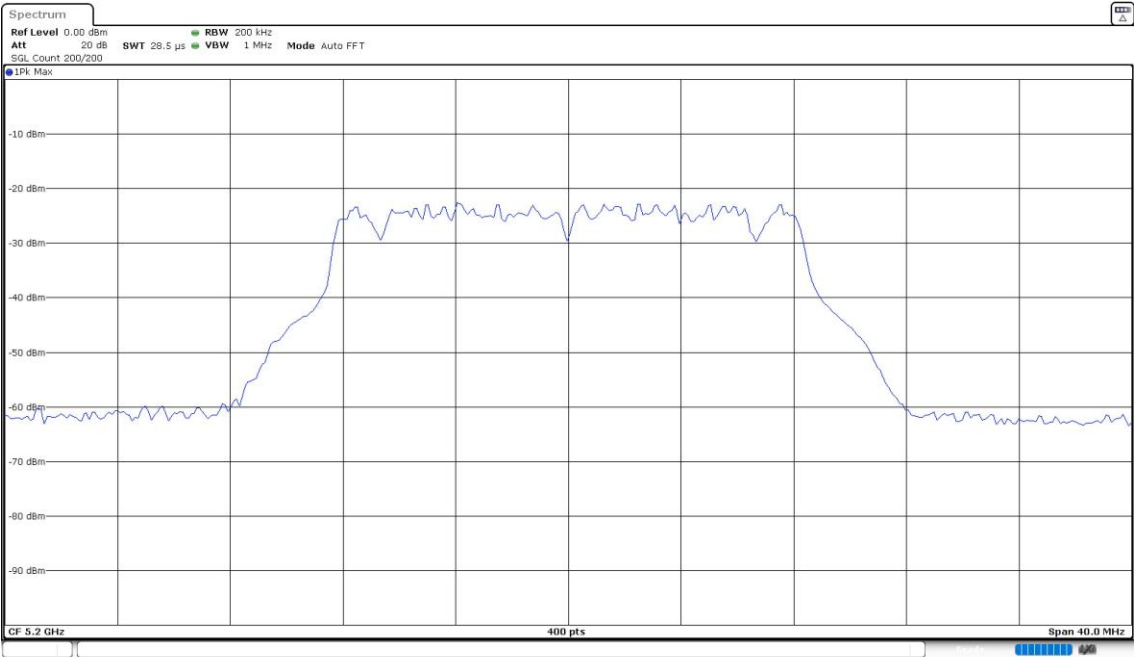
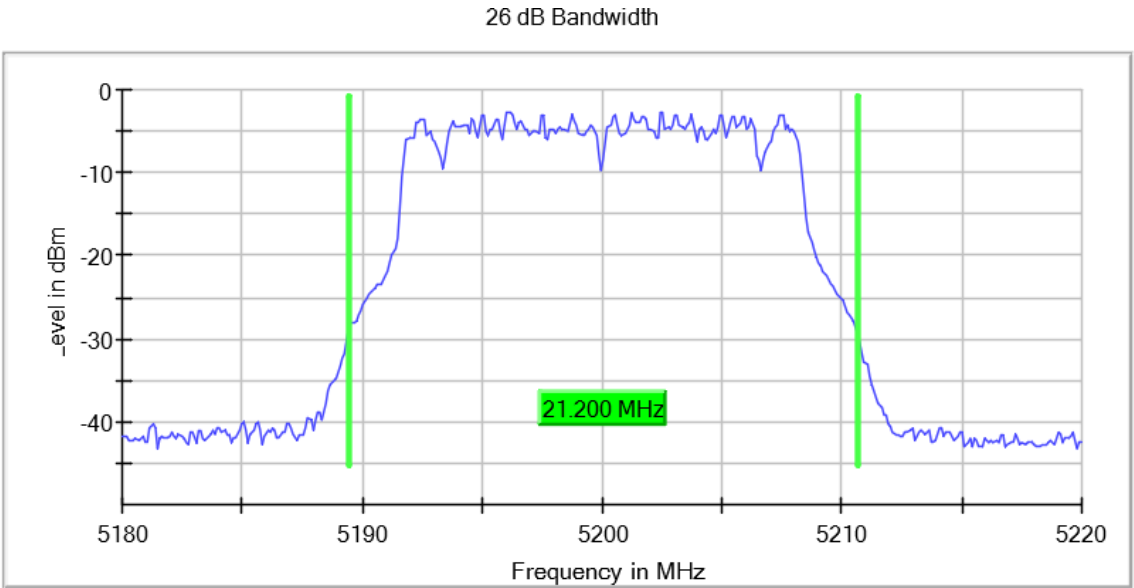
Images:

26 dB Bandwidth



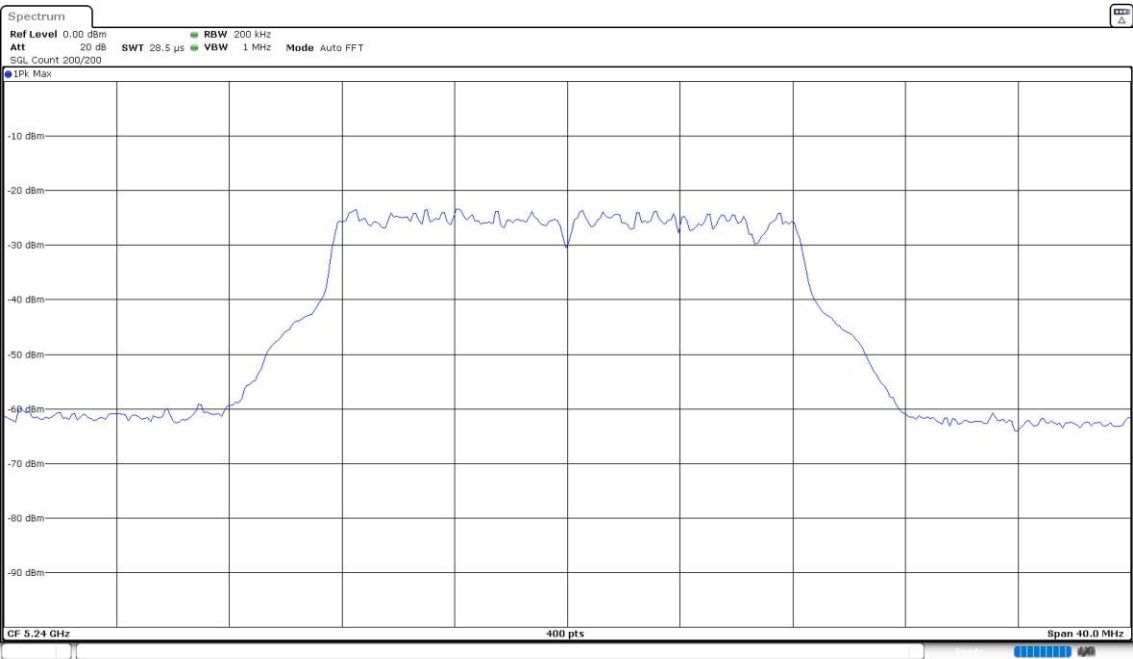
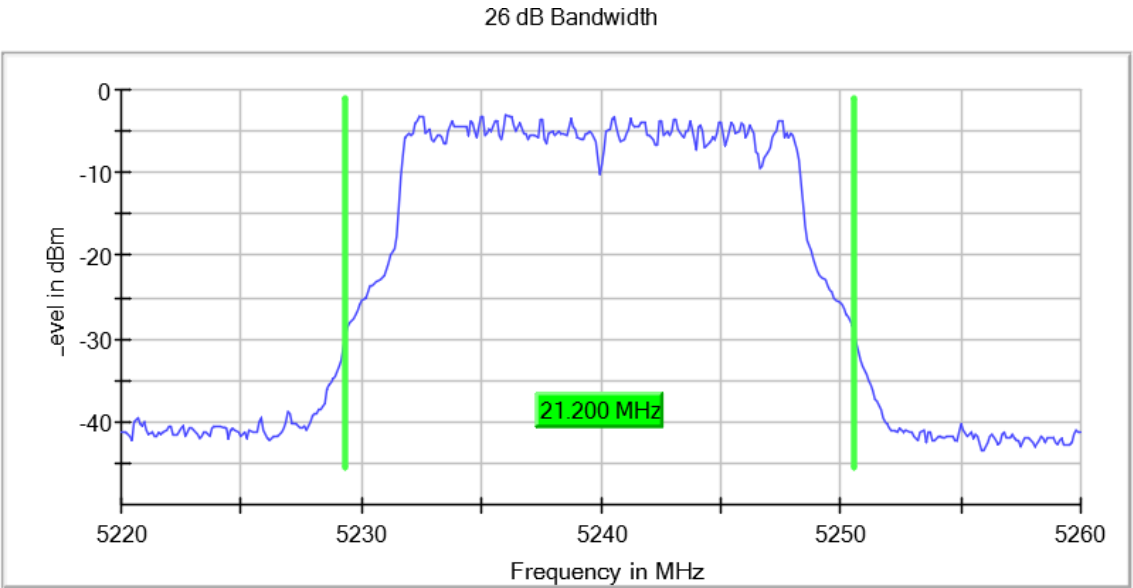
Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5200.00000 Modulation = 802.11a (OFDM 6 Mbit/s)

Images:



Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5240.00000 Modulation = 802.11a (OFDM 6 Mbit/s)

Images:



Modulation: 802.11n HT20 (OFDM MCS0)

Results

Operation Band (MHz)	Port	Freq (MHz)	Ebw (MHz)
[5150, 5250]	2	5180.00000	21.600
		5200.00000	21.600
		5240.00000	21.700
	2+3	5180.00000	21.600
		5200.00000	21.500
		5240.00000	21.600

Verdict

Pass

Attachments

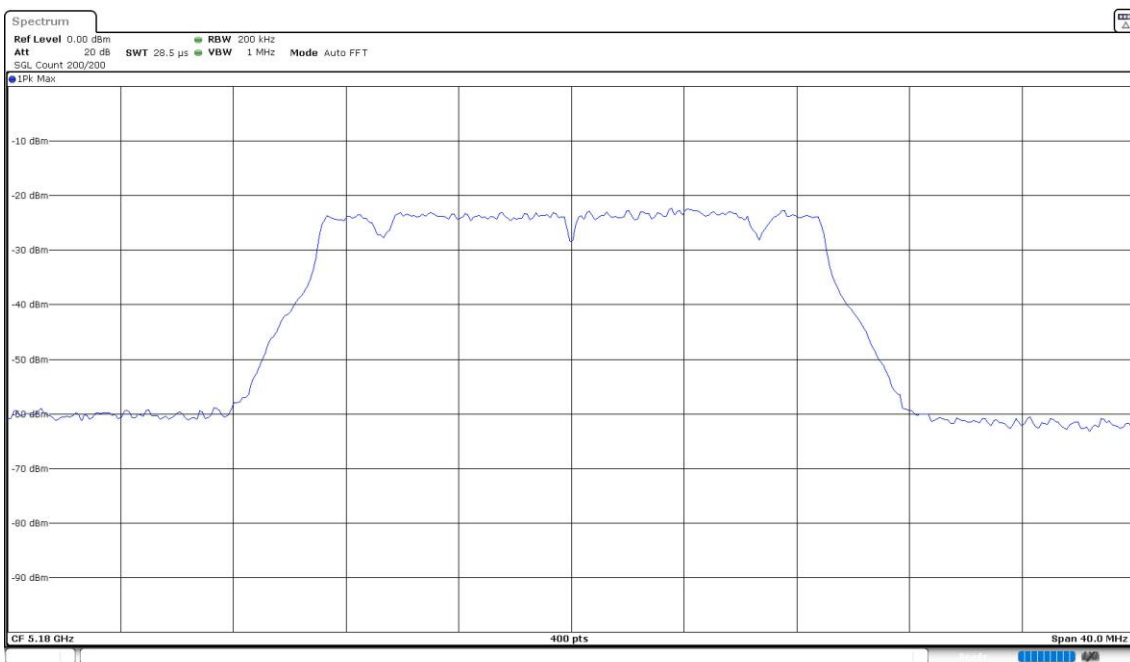
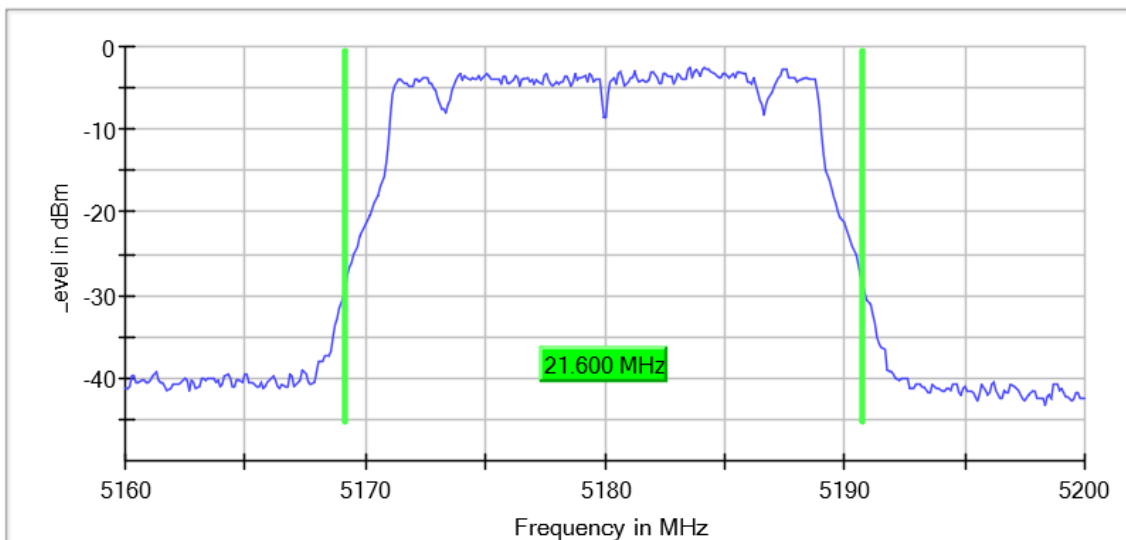
Operation Band MHz = [5150, 5250] Active Port = 2

Frequency MHz = 5180.00000

Modulation = 802.11n HT20 (OFDM MCS0)

Images:

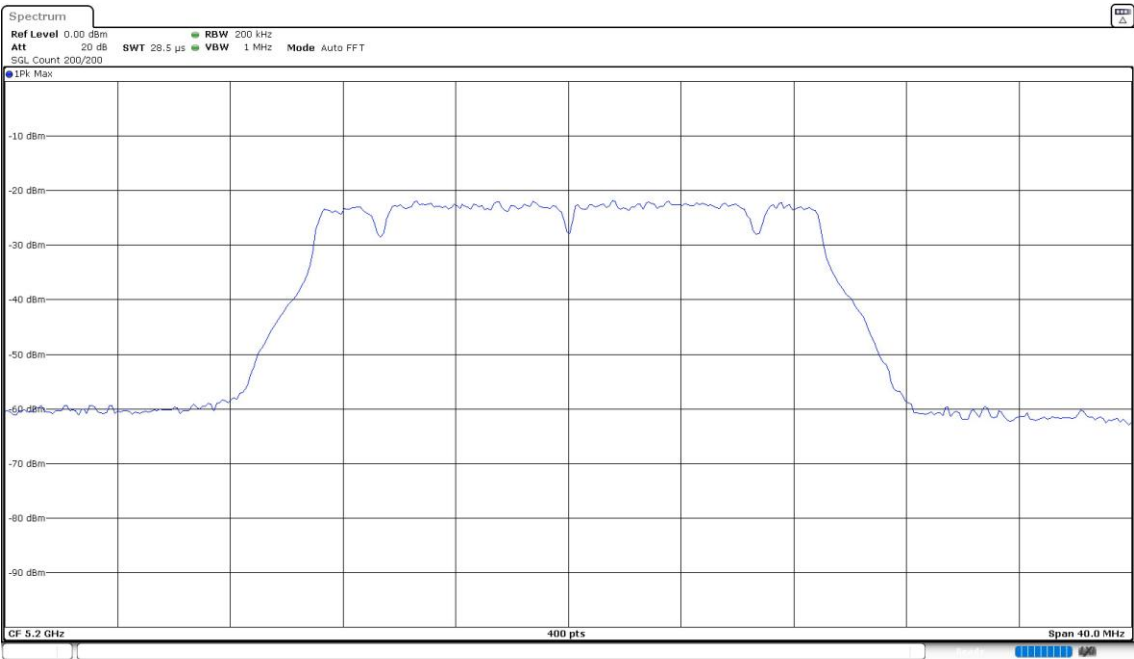
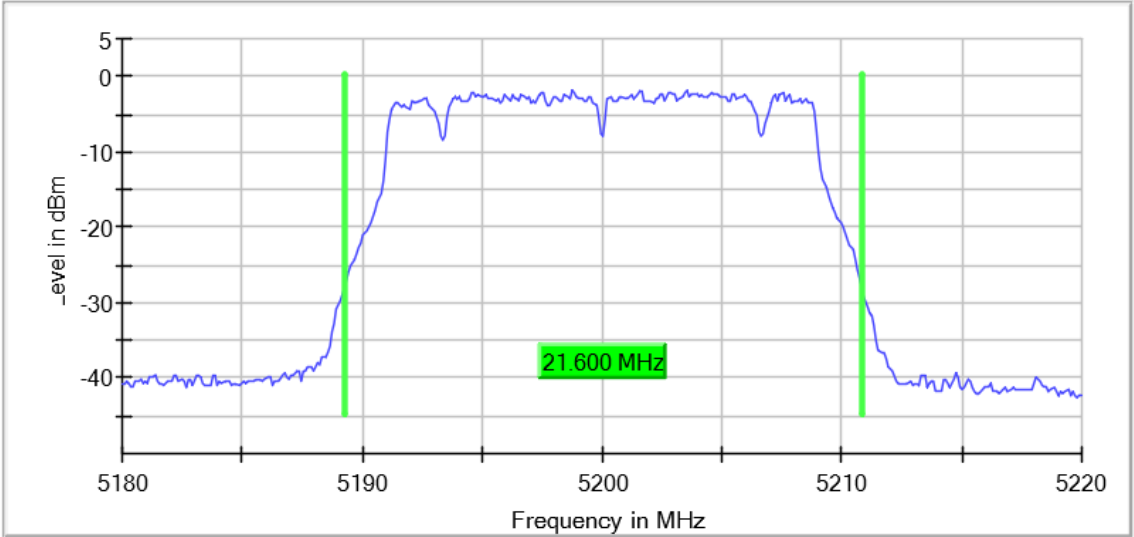
26 dB Bandwidth



Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5200.00000 Modulation = 802.11n HT20 (OFDM MCS0)

Images:

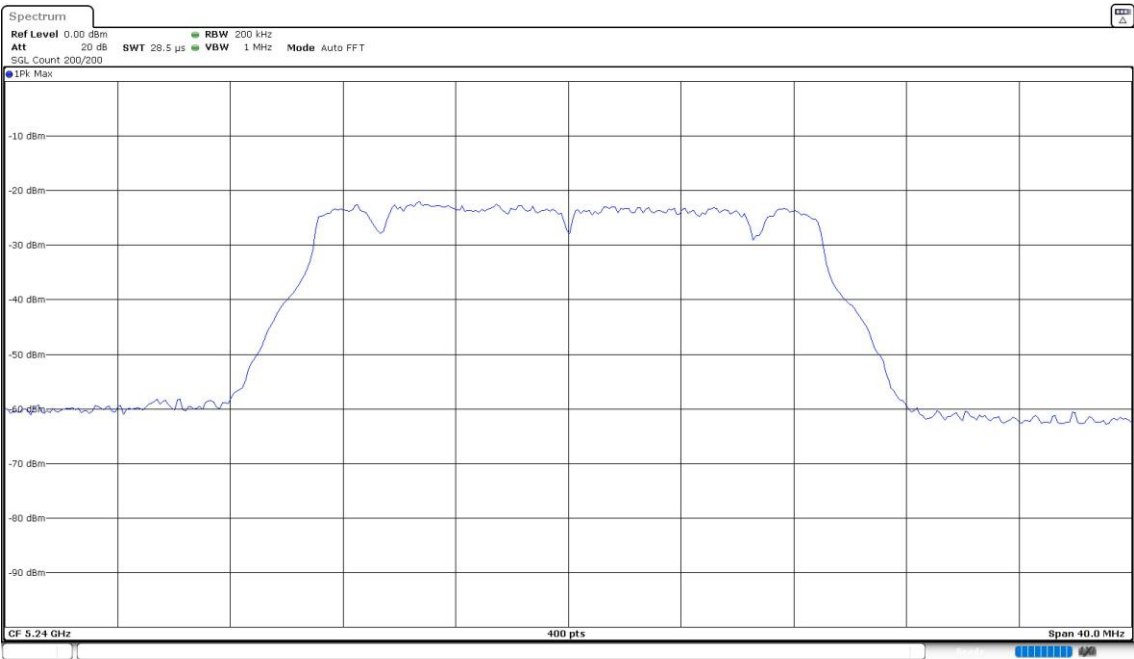
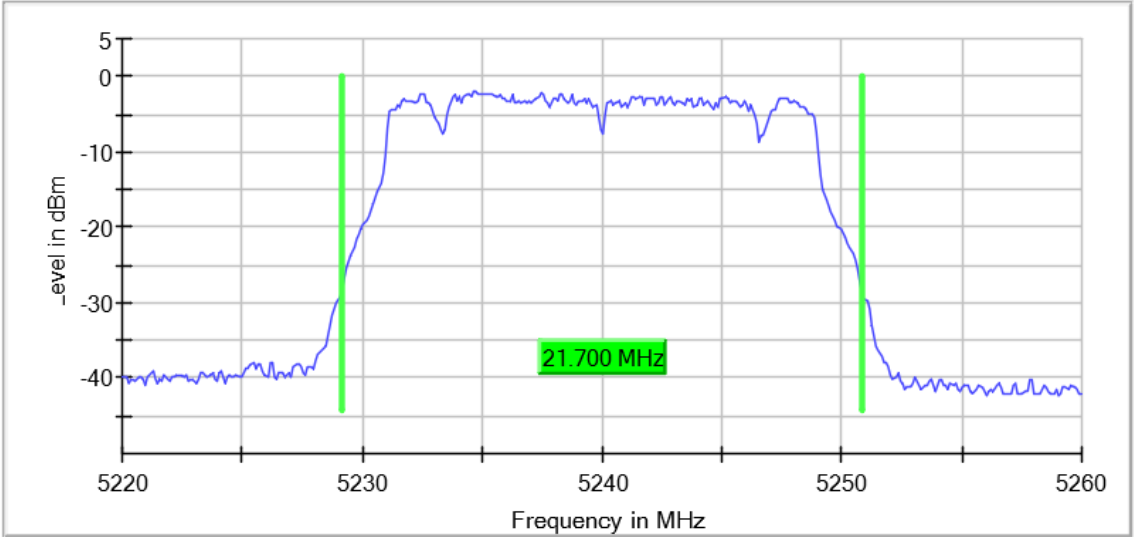
26 dB Bandwidth



Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5240.00000 Modulation = 802.11n HT20 (OFDM MCS0)

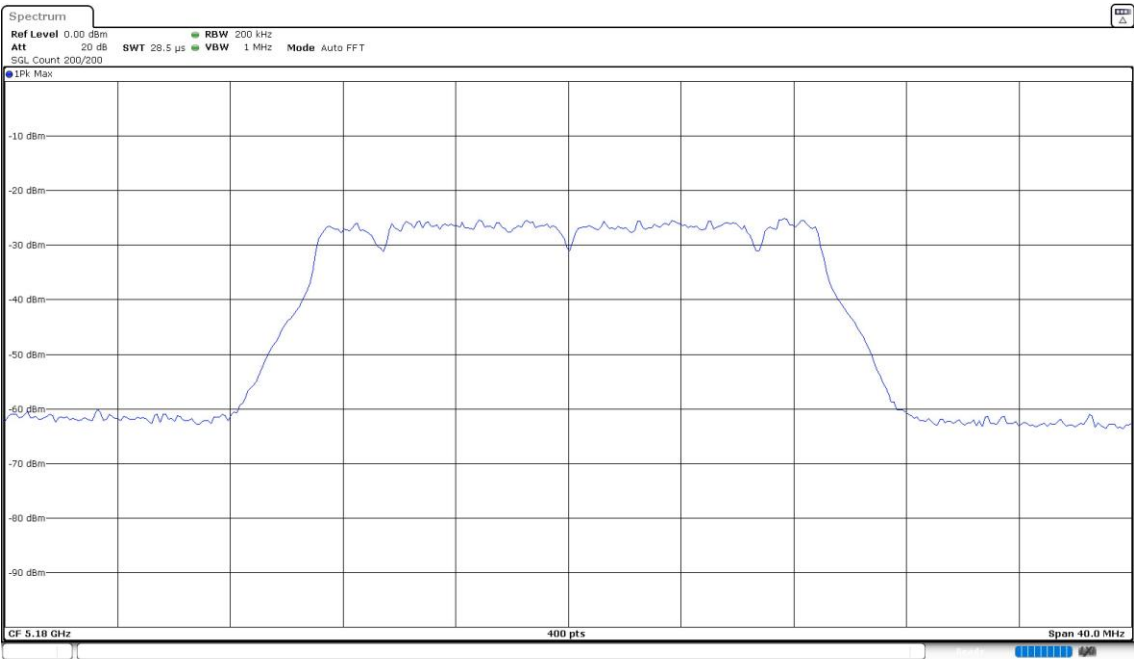
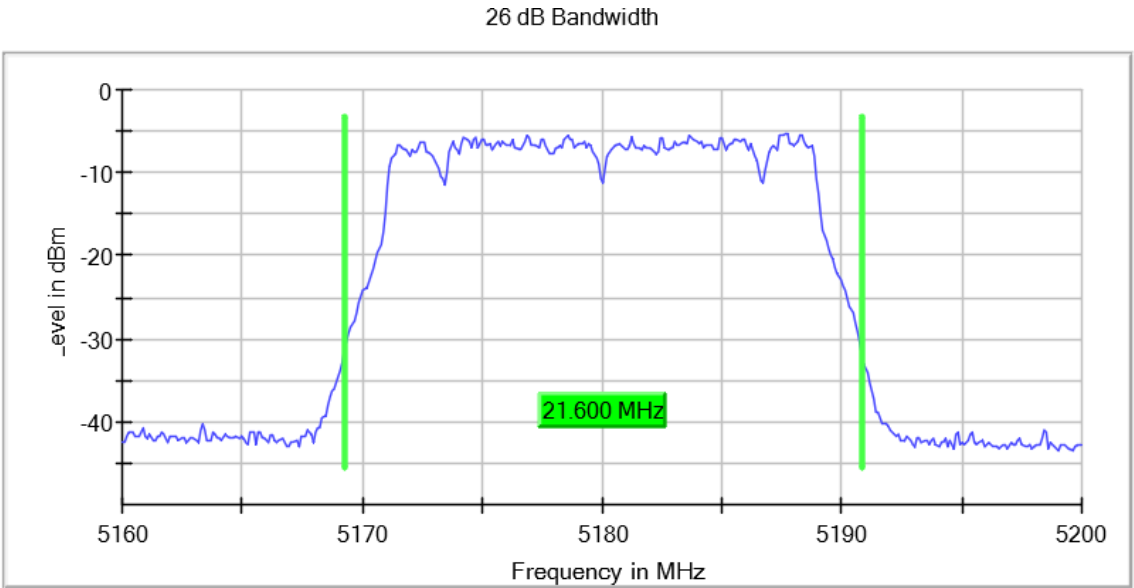
Images:

26 dB Bandwidth



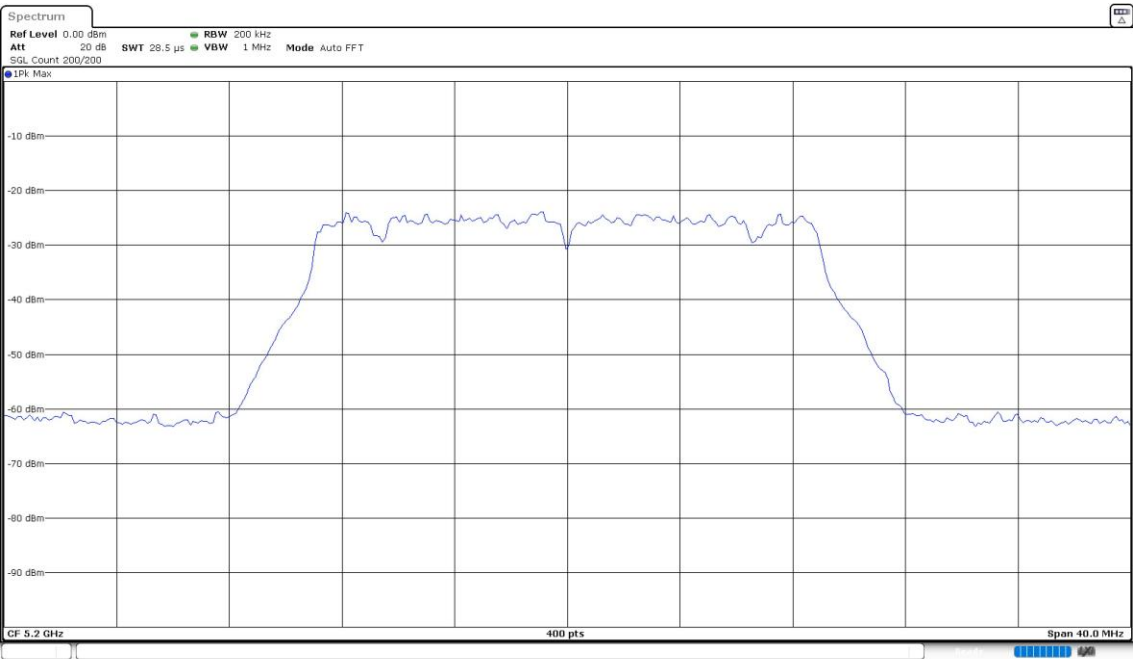
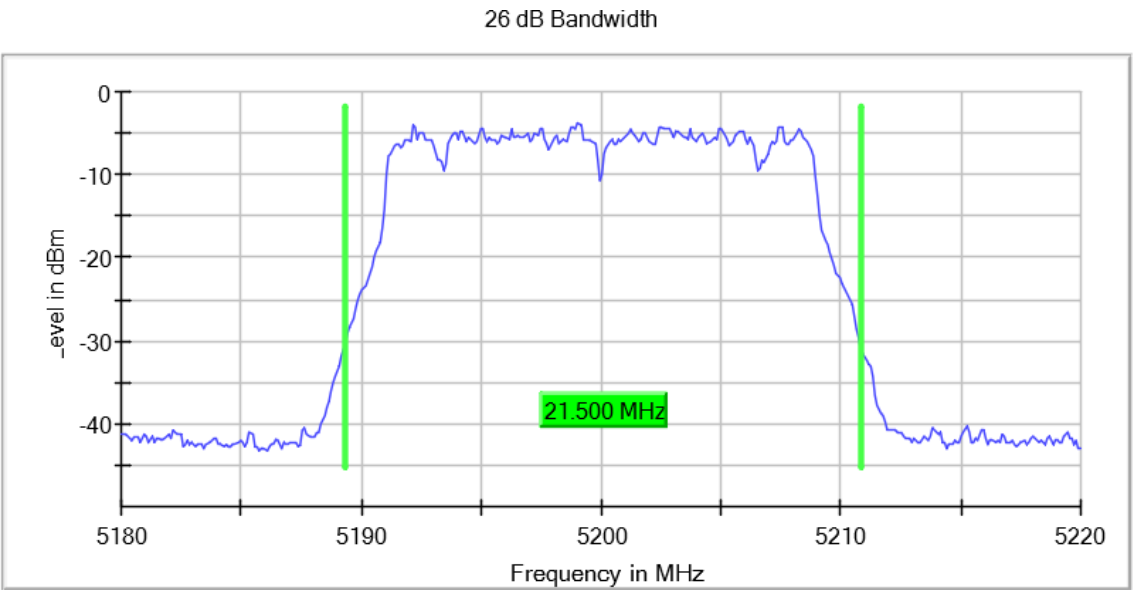
Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5180.00000 Modulation = 802.11n HT20 (OFDM MCS0)

Images:



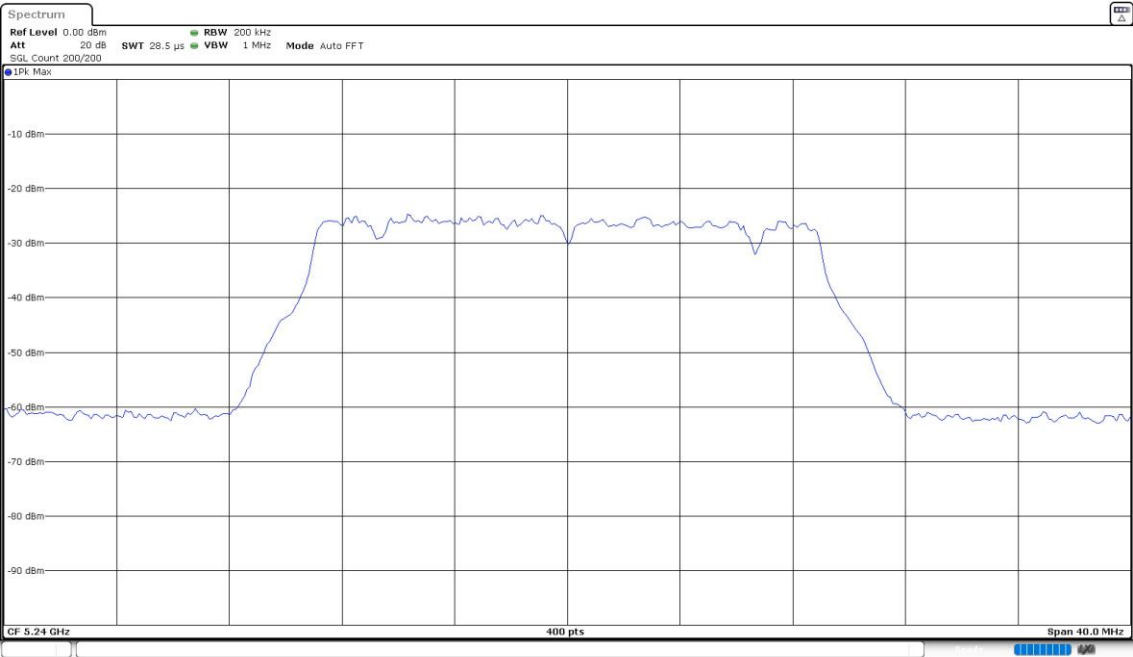
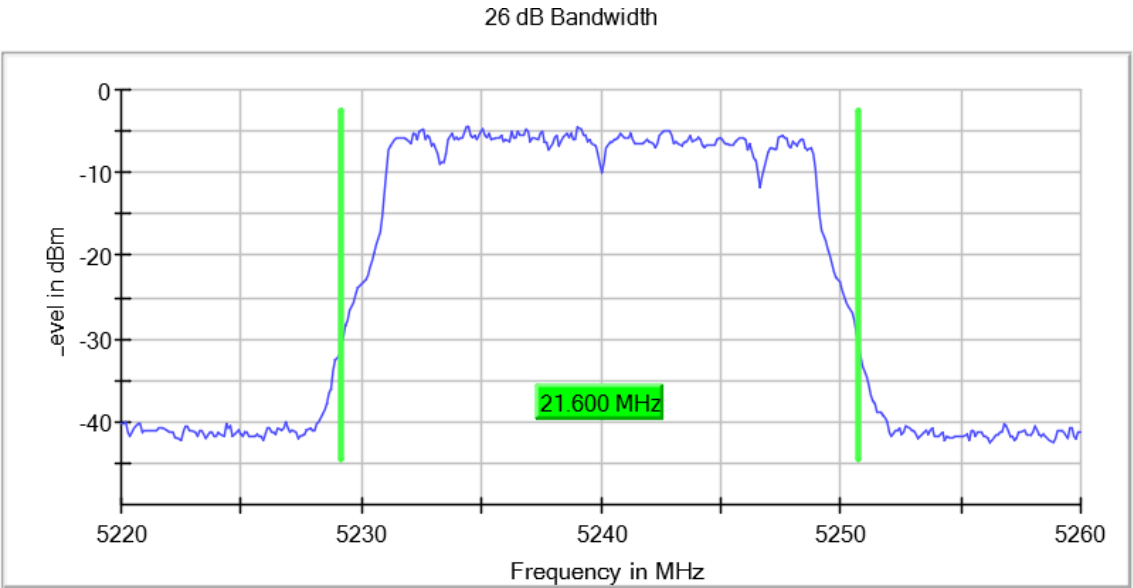
Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5200.00000 Modulation = 802.11n HT20 (OFDM MCS0)

Images:



Operation Band MHz = [5150, 5250] Active Port = 2+3
Frequency MHz = 5240.00000 Modulation = 802.11n HT20 (OFDM MCS0)

Images:



Modulation: 802.11n HT40 (OFDM MCS0 13.5 Mbit/s)

Results

Operation Band (MHz)	Port	Freq (MHz)	Ebw (MHz)
[5150, 5250]	2	5190.00000	39.775
		5230.00000	39.625
	2+3	5190.00000	40.075
		5230.00000	39.775

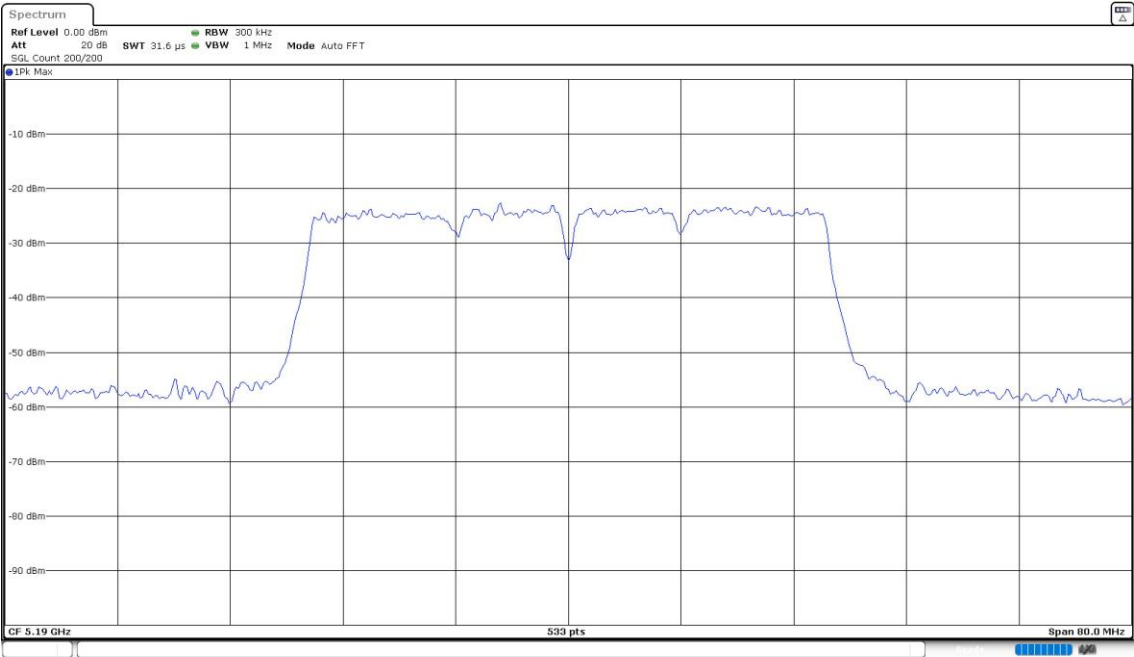
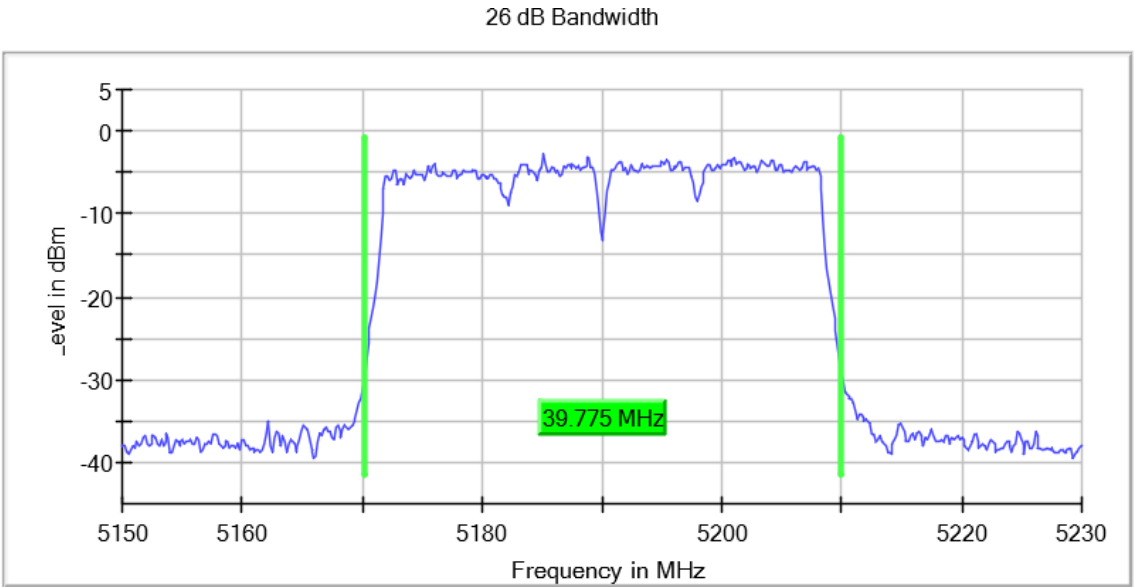
Verdict

Pass

Attachments

Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5190.00000 Modulation = 802.11n HT40 (OFDM MCS0 13.5 Mbit/s)

Images:



Operation Band MHz = [5150, 5250] Active Port = 2
Frequency MHz = 5230.00000 Modulation = 802.11n HT40 (OFDM MCS0 13.5 Mbit/s)

Images:

