



TEST REPORT

Test Report No. : UL-RPT-RP-11909763-1116-FCC

Applicant : SIEMENS AG
Model No. : MPCIE-R1-ABGNAC-U4
FCC ID : LYHRAPACV1
Technology : WLAN
Test Standard(s) : FCC Parts 15.207, 15.209(a) & 15.247

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: 16 January 2020

Approved by: Ajit, Phadtare
Title: Lead Test Engineer
Date: 16 January 2020



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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:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
Test Firm Registration:	399704

Location

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

Order Date:	26 September 2017
EUT arrived:	26 January 2018
Test Dates:	08 October 2018 to 22 January 2020
EUT returned:	-/-

2.2. Summary of Test Results

Clause	Measurement	Complied	Did not comply	Not performed	Not applicable
Part 15.207	Transmitter AC Conducted Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.35(c)	Transmitter Duty Cycle ^(Note 1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(e)	Transmitter Power Spectral Density	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(b)(3)	Transmitter Maximum (Average) Output Power	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(d) & 15.209(a)	Transmitter Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.247(d) & 15.209(a)	Transmitter Band Edge Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note:

1. The measurement was performed to assist in the calculation of the level of maximum conducted output power, power spectral density and emissions.

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 558074 D01 15.247 Meas Guidance v05r02 April 2, 2019
Title:	Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules
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 v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions
Reference:	KDB 414788 D01 Radiated Test Site v01r01
Title:	TEST SITES FOR RADIATED EMISSION MEASUREMENTS

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:	192.168.0.176 (Radiated Test Sample)
Hardware Version Number:	1
Software Version Number:	T01.00.00
FCC ID :	LYHRAPACV1

Brand Name:	SIEMENS
Model Name or Number:	MPCIE-R1-ABGNAC-U4
Model Type:	A5E36528526 (Conducted Test Sample)
Serial/ Fixed IP Number:	192.168.0.70 & 192.168.0.60
Hardware Version Number:	1
Software Version Number:	T01.00.00
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 802.11b,g,n) / Digital Transmission System		
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 \pm 5 %	520 mA
	Power Range	5.0 V DC \pm 5 %	700 mA
Temperature Requirement(s):	Nominal	23 °C	
Relative Humidity	30 %		
Modulation Type tested :	DBPSK, DQPSK, BPSK, QPSK, 16QAM & 64QAM		
Data Rates:	802.11b	1, 2, 5.5 & 11 Mbps	
	802.11g	6, 9, 12, 18, 24, 36, 48 & 54 Mbit/s (SISO, or MIMO)	
	802.11n HT20	MCS0 to MCS7 (SISO, or MIMO with CDD/STBC) MCS8 to MCS15 (MIMO SDM)	
	802.11n HT40	MCS0 to MCS7 (SISO, or MIMO) MCS8 to MCS23 (MIMO) MCS24 to MCS31 (MIMO)	
Maximum Conducted Output Power:	16.50 dBm		
Nominal Channel Bandwidth	20 MHz		
Transmit Frequency Range:	2412 MHz to 2462 MHz		
Transmit Channels Tested:	Channel Number	Channel Frequency (MHz)	
	1	2412	
	6	2437	
	11	2462	
Nominal Channel Bandwidth	40 MHz		
Transmit Frequency Range:	2422 MHz to 2442 MHz**		
Transmit Channels Tested:	Channel Number	Channel Frequency (MHz)	
	3	2422	
	6	2437	
	7	2442	
** As per applicant's declaration for 40 MHz Bandwidth Channels 8 & 9 are disabled.			

3.5. Antenna Information

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

Antenna Group:	6 dBi Antenna Group
Antenna Radiation Type:	Omni Directional
Antenna Model Number:	ANT795-6MN
Antenna Gain:	6 dBi @ 2.4 GHz
Antenna Beamwidth:	360°
Antenna Connector Type:	N
Manufacturer Article Number:	6GK5795-6MN10-0AA6
Batch Number:	1000744236

Antenna Group:	9 dBi Antenna Group
Antenna Radiation Type:	Sector
Antenna Model Number:	ANT795-6DC
Antenna Gain:	9 dBi @ 2.4 GHz
Antenna Beamwidth:	75° H / 55° V
Antenna Connector Type:	N
Manufacturer Article Number:	6GK5795-6DC00-0AA0
Batch Number:	006.707039

Antenna Group:	14 dBi Antenna Group
Antenna Radiation Type:	Directed
Antenna Model Number:	ANT792-8DN
Antenna Gain:	14 dBi @ 2.4 GHz
Antenna Beamwidth:	35° H / 30° V
Antenna Connector Type:	N
Manufacturer Article Number:	6GK5792-8DN00-0AA6
Batch Number:	721739

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
4	Power Supply	HEWLETT PACKARD	E3620A	KR75307350

B. Support Equipment (Manufacturer supplied)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	DC Power Supply Cable (Length: 2 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	N-N Connector Antenna Cable (Length: 1 m Quantity: 4 Pcs)	SIEMENS Simatic Net Antenna Cable	6XV1875-5AH10	--
4	Test Evaluation Board (Quantity: 2 Pcs)	SIEMENS	A5E36374290-AE GTW 18 94V-0	--
5	UMCC- N Connector Cable (Length: 0.25 m Quantity: 4 Pcs)	SIEMENS	--	--
6	N Connector-50 Ω Terminations (Quantity: 4 Pcs)	SIEMENS	--	--
7	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 for highest power and Widest bandwidth:**
 - 802.11b: 5.5 Mbit/s / SISO Mode
 - 802.11g: 6 Mbit/s / SISO Mode
 - 802.11n HT20: MCS0 / SISO Mode
 - 802.11n HT40: MCS0 / SISO Mode
 - 802.11b: 5.5 Mbit/s / MIMO Modes
 - 802.11g: 6 Mbit/s / MIMO Modes
 - 802.11n HT20: MCS0 / MIMO Modes
 - 802.11n HT40: MCS0 / MIMO Modes
- **Worst Case for Minimum 6 dB bandwidth:**
 - 802.11b: 1 Mbit/s / SISO Mode
 - 802.11g: 9 Mbit/s / SISO Mode
 - 802.11n HT20: MCS2 / SISO Mode
 - 802.11n HT40: MCS2 / SISO Mode

*Multiple supported modulation schemes, nominal channel bandwidths and SISO/MIMO configurations were initially investigated to determine the above mentioned worst case data rates.

4.2. Configuration and Peripherals

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

- **EUT Power Supply:**

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

- **Test Mode Activation:**

- 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:**

- Multiple supported modulation schemes, nominal channel bandwidths and SISO+MIMO Modes configurations were initially investigated to determine worst case modes.
- The data rates that produced worst case results for each 802.11 mode (b/g/n) were then used for measurements presented in this report.

- **Conducted Measurements:**

- RF Output Power, Power Spectral Density, Occupied Channel Bandwidth measured separately on each Port with all supported SISO & MIMO Port combinations.
- Duty Cycles were computed with worst case SISO mode; as they found to be independent of number of transmitter chains used.
- Conducted spurious emissions measurements were performed with SISO Mode; as this port was found to have the worst case in terms of power settings amongst all supported possible SISO & MIMO Port combinations.

- **AC Conducted Emissions Measurements:**

- AC conducted tests were performed with all listed Antenna Groups with MIMO Port 1+2+3+4, employing maximum possible Antennas.
- The Toyo EMI Software EP5/CE Ver 4.0.1. was used for these measurements.

- **Radiated Band Edge Measurements:**

- Radiated Band edge emissions were performed with Antenna types listed in section 3.5 with all possible MIMO Port combinations.
- Radiated Band edge emissions were performed with the EUT & Antennas in the orientation simulating the worst case spurious emissions.

- **Radiated Cabinet Emission Measurements:**

- Transmitter cabinet radiated emissions were performed by terminating EUT's all 4-MIMO Ports with 50 Ω (proper impedance matching) and with maximum supported power settings amongst all supported SISO & MIMO Port combinations as well as amongst listed Antenna types.
- EMC32 V10.1.0 Software & Toyo EP5/RE Ver 4.0.1 were used for these measurements.

- **Applicable to all Tests:**

- All the supplied antennas listed in section 3.5 have been tested with power settings in section 4.3.
- 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 the GUI Power Settings (PWL), based on supported antenna configurations.

Antenna Group Type	GUI Power Settings (PWL)			
	SISO Mode Port 1	MIMO Mode Port 1+2	MIMO Mode Port 1+2+3	MIMO Mode Port 1+2+3+4
6 dBi Antenna Group	12	12	16	15
9 dBi Antenna Group	15	15	13	12
14 dBi Antenna Group	11	10	8	7
Unused Ports Terminated with 50Ω	2, 3 & 4	3 & 4	4	None

4.4. Used RF Cables

For radiated band edge & AC conducted emission measurements performed with Antennas, EUT ports were connected with following RF cables to the different antenna type.

For further details refer Section 3. B.

Antenna Group Type	EUT to Antennas Cable Details			
	SISO Mode Port 1	MIMO Mode Port 1+2	MIMO Mode Port 1+2+3	MIMO Mode Port 1+2+3+4
6 dBi Antenna Group	UMCC- N Connector Cables			
9 dBi Antenna Group	UMCC- N Connector Cables			
14 dBi Antenna Group	N-N Connector Antenna Cables*			
*Due to bigger antenna size 14 dBi Antenna Group radiated tests have been carried out with N-N Connector Antenna Cable (1 m). An RF level offset was entered in GUI settings to compensate the loss of those N-N Connector Antenna Cable.				

For radiated cabinet emissions measurements performed without Antennas, EUT ports were connected to 50 Ω terminations with following RF cables. For further details refer Section 3. B.

Antenna Group Type	EUT to 50 Ω Terminations Cable Details
	MIMO Mode Port 1+2+3+4
6 dBi Antenna Group	UMCC- N Connector Cables
9 dBi Antenna Group	UMCC- N Connector Cables
14 dBi Antenna Group	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:	Vladmir Eppel & Asim Shahzad	Test Dates:	23 September 2019 & 01 October 2019
Test Sample Serial Number:	192.168.0.60		
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):	23 & 22
Relative Humidity (%):	35 & 38

Settings of the Instrument

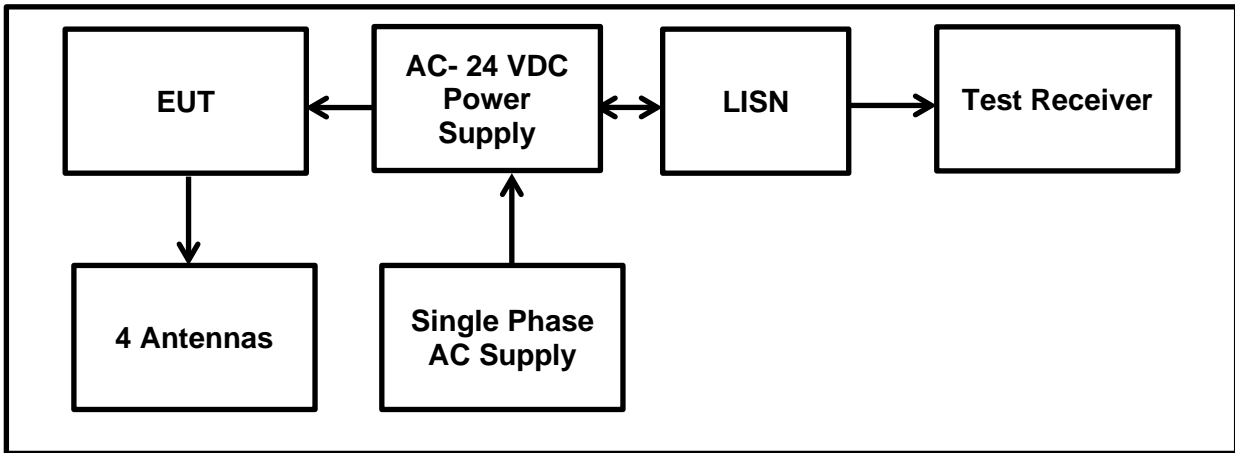
Detector	Quasi Peak/ Average Peak
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Notes:

- Measurement software used: Toyo EMI Software; CE measurement software EP5/CE Ver 4.0.1.
- The EUT was powered by supplying 24 V DC.
- In accordance with FCC KDB 174176 Q4; SIEMENS SIMATIC PS 307 Power Supply was connected to 120 VAC 60 Hz single phase supply via a LISN.
- HEWLETT PACKARD E3620A Power Supply was connected to 240 VAC 60 Hz single phase supply via a LISN.
- AC conducted tests were performed with :
 - each type of listed Antenna Groups.
 - maximum power setting (PWL) amongst all supported SISO & MIMO modes
 - MIMO Port 1+2+3+4 employing maximum possible Antennas
- The EUT was configured in following test modes :
 - 6 dBi Antenna Group: MIMO Port 1+2+3+4 | n Mode | B.W. 40 MHz | PWL 15 | CH 6
 - 9 dBi Antenna Group: MIMO Port 1+2+3+4 | n Mode | B.W. 40 MHz | PWL 12 | CH 6
 - 14 dBi Antenna Group: MIMO Port 1+2+3+4 | n Mode | B.W. 40 MHz | PWL 7 | CH 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.
- 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.
- 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.
- 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 / Quasi Peak / 120 VAC 60 Hz / 6 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
0.16152	Live	32.2	9.9	42.1	65.4	23.3
0.17104	Live	34.9	9.9	44.8	64.9	20.1
0.20511	Live	29.9	9.9	39.8	63.4	23.6
0.27575	Live	27.8	9.8	37.6	60.9	23.3
0.47715	Live	22.8	9.9	32.7	56.4	23.7
3.42685	Live	17.2	9.9	27.1	56	28.9

Results: Live / Average / 120 VAC 60 Hz / 6 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
0.20362	Live	18.6	9.9	28.5	55.4	26.9
0.24197	Live	27.4	9.9	37.3	54.9	17.6
0.41618	Live	16.1	9.9	26	53.4	27.4
0.50066	Live	13.9	9.8	23.7	50.9	27.2
3.36126	Live	8.6	9.9	18.5	46.4	27.9
14.78001	Live	7.7	9.9	17.6	46	28.4

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak / 120 VAC 60 Hz / 6 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
0.16102	Neutral	32.2	9.9	42.1	65.4	23.3
0.18808	Neutral	30.7	9.9	40.6	64.1	23.5
0.20461	Neutral	29.9	9.9	39.8	63.4	23.6
0.23517	Neutral	28.6	9.9	38.5	62.3	23.8
0.26172	Neutral	27.7	9.8	37.5	61.4	23.9
3.43086	Neutral	21.5	9.9	31.4	56	24.6

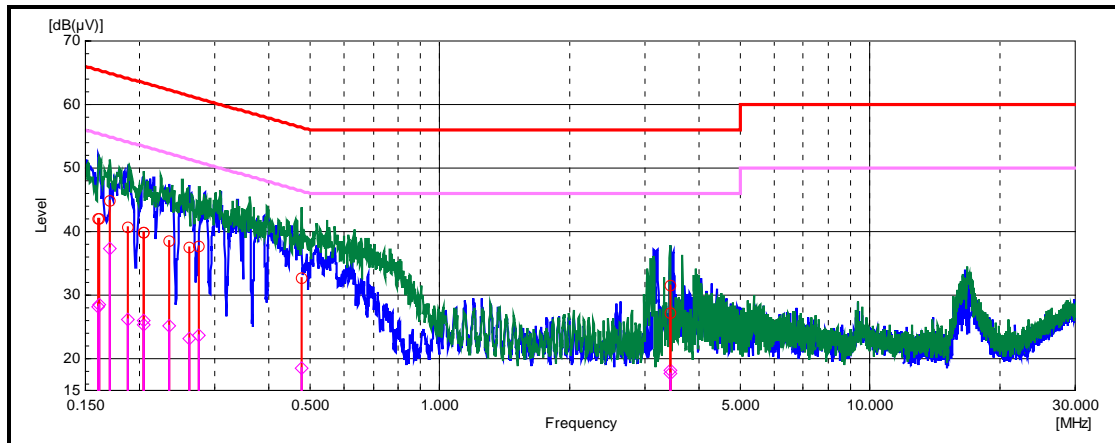
Results: Neutral / Average / 120 VAC 60 Hz / 6 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
0.16102	Neutral	18.2	9.9	28.1	55.4	27.3
0.18808	Neutral	16.2	9.9	26.1	54.1	28
0.20461	Neutral	15.5	9.9	25.4	53.4	28
0.23517	Neutral	15.3	9.9	25.2	52.3	27.1
0.26172	Neutral	13.4	9.8	23.2	51.4	28.2
3.43086	Neutral	8.2	9.9	18.1	46	27.9

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live and Neutral Line



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 / Quasi Peak / 240 VAC 60 Hz / 6 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
10.49187	Live	20.6	10	30.6	60	29.4
13.99214	Live	21.3	10.1	31.4	60	28.6
14.99273	Live	18.6	10.1	28.7	60	31.3
15.31067	Live	20.2	10.1	30.3	60	29.7
15.73121	Live	19.3	10.1	29.4	60	30.6
16.90105	Live	14.3	10.1	24.4	60	35.6

Results: Live / Average / 240 VAC 60 Hz / 6 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
10.49187	Live	17.7	10	27.7	50	22.3
13.99214	Live	16.2	10.1	26.3	50	23.7
14.99273	Live	15.5	10.1	25.6	50	24.4
15.31067	Live	18	10.1	28.1	50	21.9
15.73121	Live	15.2	10.1	25.3	50	24.7
16.90105	Live	7.1	10.1	17.2	50	32.8

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak / 240 VAC 60 Hz / 6 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
0.15535	Neutral	7.3	9.9	17.2	65.7	48.5
0.46097	Neutral	8.2	9.9	18.1	56.7	38.6
0.60293	Neutral	6.3	10	16.3	56	39.7
0.64816	Neutral	6	10	16	56	40
0.73768	Neutral	-1	10	9	56	47
1.09272	Neutral	-2.6	10	7.4	56	48.6

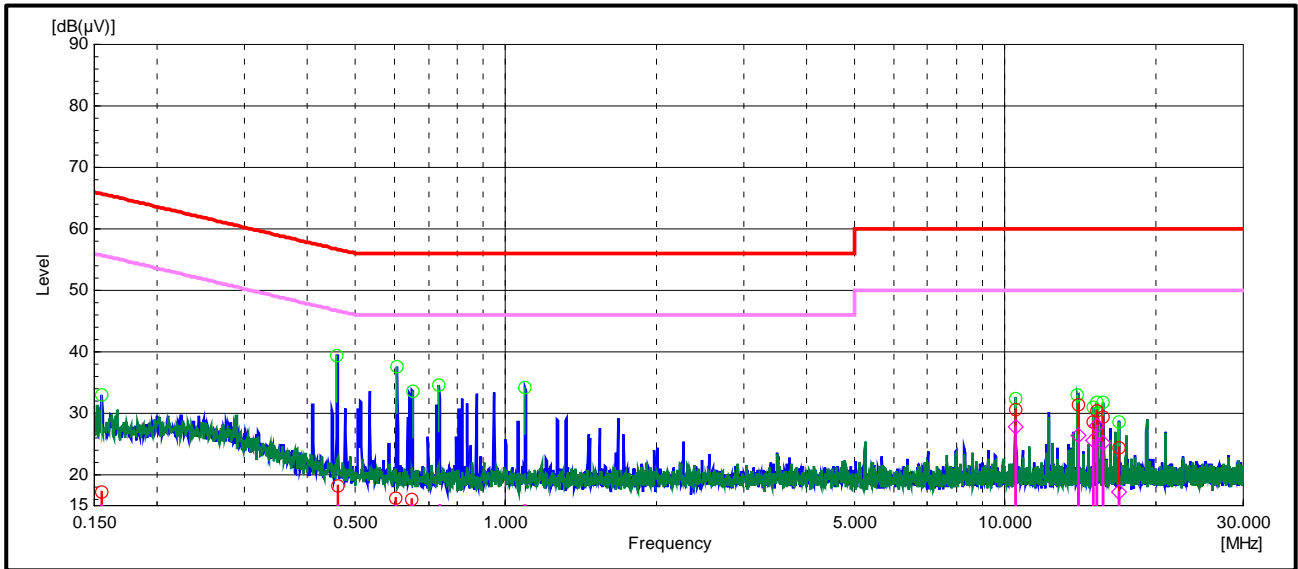
Results: Neutral / Average / 240 VAC 60 Hz / 6 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
0.15535	Neutral	2.4	9.9	12.3	55.7	43.4
0.46097	Neutral	-4	9.9	5.9	46.7	40.8
0.60293	Neutral	-5.6	10	4.4	46	41.6
0.64816	Neutral	-5.6	10	4.4	46	41.6
0.73768	Neutral	-6.5	10	3.5	46	42.5
1.09272	Neutral	-6.5	10	3.5	46	42.5

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live and Neutral Line



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 / Quasi Peak / 120 VAC 60 Hz / 9 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
0.15351	Live	30.9	9.9	40.8	65.8	25
0.18958	Live	29.2	9.9	39.1	64.1	25
0.26423	Live	26.7	9.8	36.5	61.3	24.8
0.33637	Live	24.9	9.8	34.7	59.3	24.6
0.60441	Live	20.2	10	30.2	56	25.8
3.39078	Live	22.4	9.9	32.3	56	23.7

Results: Live / Average / 120 VAC 60 Hz / 9 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
0.15351	Live	17	9.9	26.9	55.8	28.9
0.18958	Live	15.3	9.9	25.2	54.1	28.9
0.26423	Live	12.8	9.8	22.6	51.3	28.7
0.33637	Live	13	9.8	22.8	49.3	26.5
0.60441	Live	6.7	10	16.7	46	29.3
3.39078	Live	6.9	9.9	16.8	46	29.2

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak / 120 VAC 60 Hz / 9 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
0.15301	Neutral	30.7	9.9	40.6	65.8	25.2
0.18607	Neutral	29.1	9.9	39	64.2	25.2
0.28828	Neutral	25.6	9.8	35.4	60.6	25.2
3.33066	Neutral	22.5	9.9	32.4	56	23.6
3.62725	Neutral	24.3	9.9	34.2	56	21.8
16.90982	Neutral	20.8	10.1	30.9	60	29.1

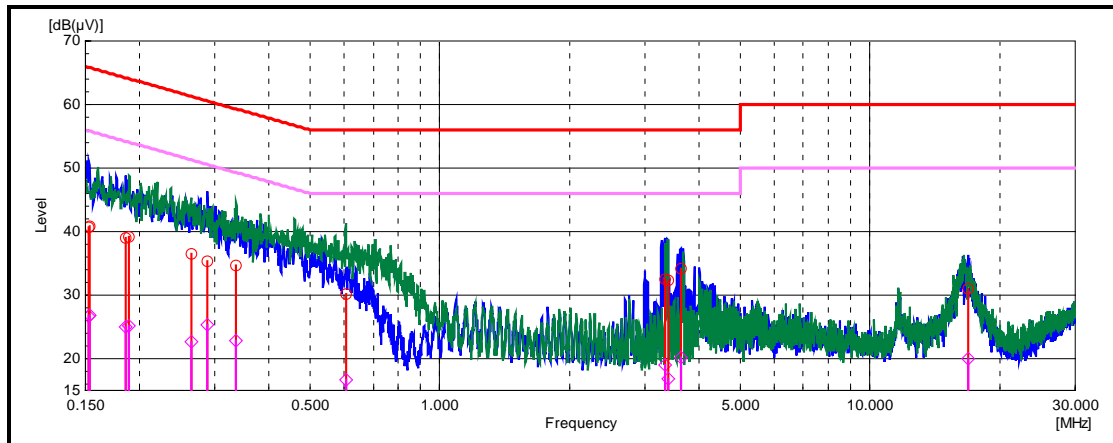
Results: Neutral / Average / 120 VAC 60 Hz / 9 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
0.15301	Neutral	16.7	9.9	26.6	55.8	29.2
0.18607	Neutral	15.1	9.9	25	54.2	29.2
0.28828	Neutral	15.6	9.8	25.4	50.6	25.2
3.33066	Neutral	9.1	9.9	19	46	27
3.62725	Neutral	10.3	9.9	20.2	46	25.8
16.90982	Neutral	9.9	10.1	20	50	30

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live and Neutral Line



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 / Quasi Peak / 240 VAC 60 Hz / 9 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading QP [dB(µV)]	Correction Factor [dB]	Level QP [dB(µV)]	Limit QP [dB(µV)]	Margin QP [dB]
13.98192	Live	22.1	10	32.2	60	27.8
15.31428	Live	17.4	10.1	27.5	60	32.5
15.73722	Live	19.4	10.1	29.5	60	30.5
16.26899	Live	16.2	10.1	26.3	60	33.7
19.22583	Live	16.4	10.1	26.5	60	33.5
20.97269	Live	12.8	10.2	23	60	37

Results: Live / Average / 240 VAC 60 Hz / 9 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(µV)]	Correction Factor [dB]	Level AV [dB(µV)]	Limit AV [dB(µV)]	Margin AV [dB]
13.98192	Live	19.8	10	29.9	50	20.1
15.31428	Live	16.4	10.1	26.5	50	23.5
15.73722	Live	16.5	10.1	26.6	50	23.4
16.26899	Live	15	10.1	25.1	50	24.9
19.22583	Live	12.9	10.1	23	50	27
20.97269	Live	8.2	10.2	18.4	50	31.6

Result: **Pass**

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak / 240 VAC 60 Hz / 9 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
10.48312	Neutral	17.3	10	27.3	60	32.7
12.23532	Neutral	18.5	10	28.5	60	31.5
13.71939	Neutral	13.9	10.1	24	60	36
14.6764	Neutral	15	10.1	25.1	60	34.9
14.99594	Neutral	18	10.1	28.1	60	31.9
16.90386	Neutral	15.2	10.1	25.3	60	34.7
17.49112	Neutral	11.2	10.1	21.3	60	38.7

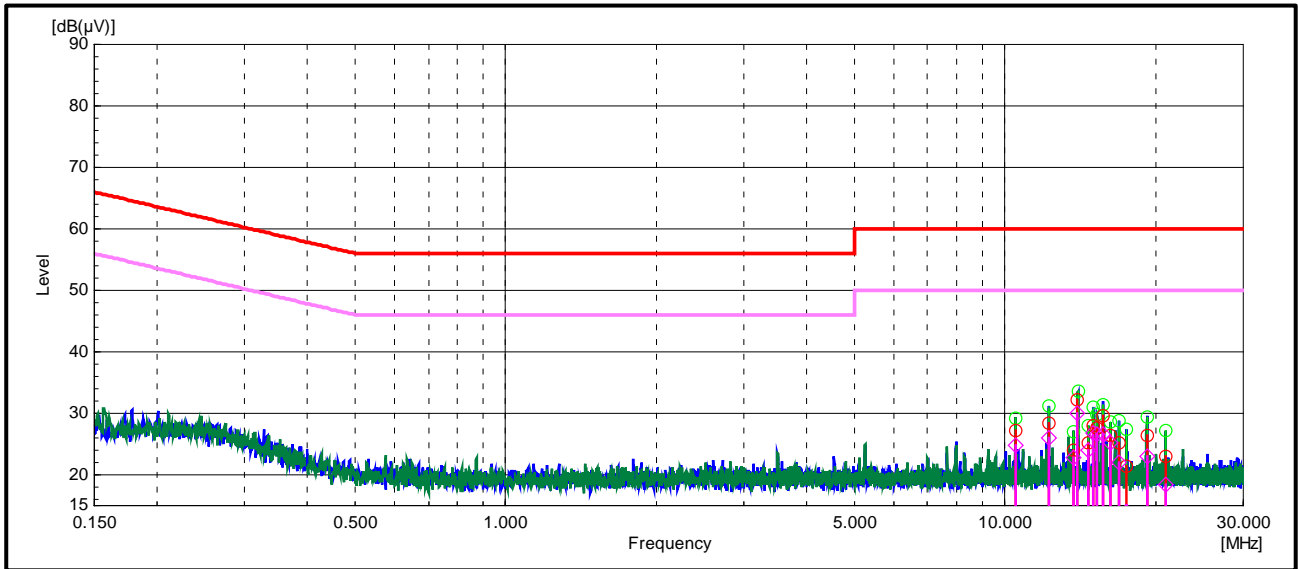
Results: Neutral / Average / 240 VAC 60 Hz / 9 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
10.48312	Neutral	14.9	10	24.9	50	25.1
12.23532	Neutral	15.9	10	25.9	50	24.1
13.71939	Neutral	12.7	10.1	22.8	50	27.2
14.6764	Neutral	14	10.1	24.1	50	25.9
14.99594	Neutral	16.8	10.1	26.9	50	23.1
16.90386	Neutral	11.9	10.1	22	50	28
17.49112	Neutral	4	10.1	14.1	50	35.9

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live and Neutral Line



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 / Quasi Peak / 120 VAC 60 Hz / 14 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
0.17204	Live	33.8	9.9	43.7	64.9	21.2
0.22465	Live	27.8	9.9	37.7	62.6	24.9
0.23016	Live	30.4	9.9	40.3	62.4	22.1
0.37996	Live	23.4	9.9	33.3	58.3	25
0.48116	Live	21.6	9.9	31.5	56.3	24.8
3.33868	Live	23.7	9.9	33.6	56	22.4

Results: Live / Average / 120 VAC 60 Hz / 14 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
0.17204	Live	26.2	9.9	36.1	54.9	18.8
0.22465	Live	19.9	9.9	29.8	52.6	22.8
0.23016	Live	24.1	9.9	34	52.4	18.4
0.37996	Live	10.3	9.9	20.2	48.3	28.1
0.48116	Live	7.3	9.9	17.2	46.3	29.1
3.33868	Live	8.4	9.9	18.3	46	27.7

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak / 120 VAC 60 Hz / 14 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
0.16303	Neutral	29.9	9.9	39.8	65.3	25.5
0.21212	Neutral	27.4	9.9	37.3	63.1	25.8
0.28878	Neutral	25	9.8	34.8	60.6	25.8
0.53026	Neutral	17.9	9.9	27.8	56	28.2
3.74349	Neutral	20.5	9.9	30.4	56	25.6
17.09619	Neutral	15.5	10.1	25.6	60	34.4

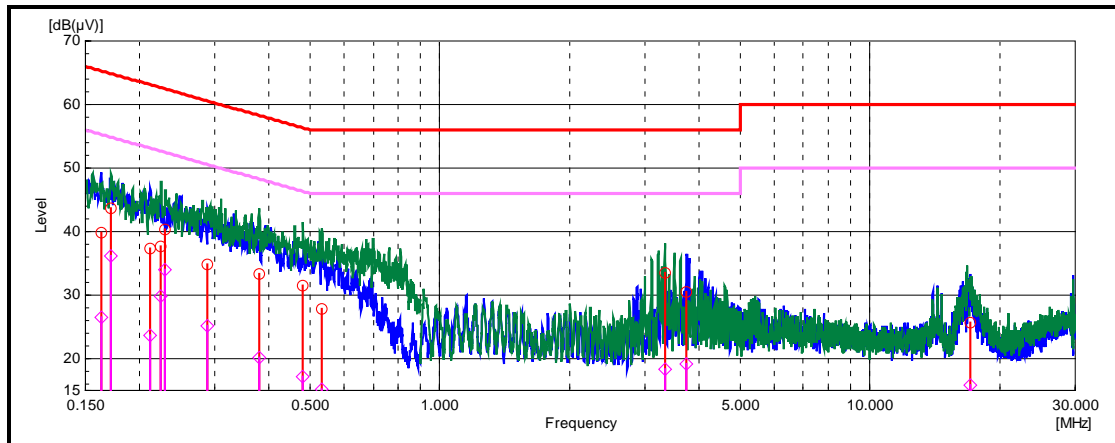
Results: Neutral / Average / 120 VAC 60 Hz / 14 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
0.16303	Neutral	16.6	9.9	26.5	55.3	28.8
0.21212	Neutral	13.8	9.9	23.7	53.1	29.4
0.28878	Neutral	15.3	9.8	25.1	50.6	25.5
0.53026	Neutral	5.3	9.9	15.2	46	30.8
3.74349	Neutral	9.2	9.9	19.1	46	26.9
17.09619	Neutral	5.8	10.1	15.9	50	34.1

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live and Neutral Line



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 / Quasi Peak / 240 VAC 60 Hz / 14 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
13.39935	Live	13.3	10.1	23.4	60	36.6
13.5235	Live	12.8	10.1	22.9	60	37.1
13.71829	Live	14.6	10.1	24.7	60	35.3
14.6745	Live	15.6	10.1	25.7	60	34.3
15.73382	Live	17.5	10.1	27.6	60	32.4
17.48114	Live	11.9	10.1	22	60	38

Results: Live / Average / 240 VAC 60 Hz / 14 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
13.39935	Live	12.2	10.1	22.3	50	27.7
13.5235	Live	10.6	10.1	20.7	50	29.3
13.71829	Live	13.6	10.1	23.7	50	26.3
14.6745	Live	14.2	10.1	24.3	50	25.7
15.73382	Live	14.9	10.1	25.0	50	25
17.48114	Live	8.6	10.1	18.7	50	31.3

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Quasi Peak / 240 VAC 60 Hz / 14 dBi Antenna Group**

Frequency [MHz]	Line Phase	Reading QP [dB(μV)]	Correction Factor [dB]	Level QP [dB(μV)]	Limit QP [dB(μV)]	Margin QP [dB]
12.23803	Neutral	19.6	10	29.6	60	30.4
13.99294	Neutral	23.3	10.1	33.4	60	26.6
13.71939	Neutral	17.5	10.1	27.6	60	36
14.6764	Neutral	15.6	10.1	25.7	60	32.4
19.24134	Neutral	16.1	10.1	26.2	60	34.3
20.9817	Neutral	13.1	10.2	23.3	60	36.7

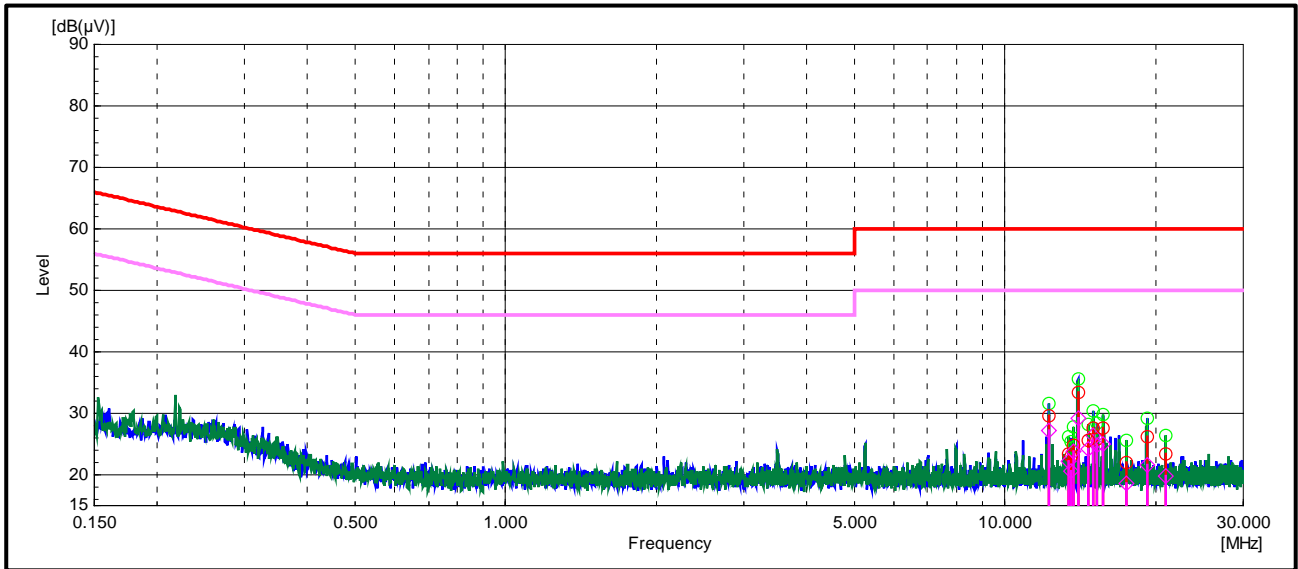
Results: Neutral / Average / 240 VAC 60 Hz / 14 dBi Antenna Group

Frequency [MHz]	Line Phase	Reading AV [dB(μV)]	Correction Factor [dB]	Level AV [dB(μV)]	Limit AV [dB(μV)]	Margin AV [dB]
12.23803	Neutral	17.1	10	27.1	50	22.9
13.99294	Neutral	19.2	10.1	29.3	50	20.7
13.71939	Neutral	16.4	10.1	26.5	50	23.5
14.6764	Neutral	14.8	10.1	24.9	50	25.1
19.24134	Neutral	11.6	10.1	21.7	50	28.3
20.9817	Neutral	9.6	10.2	19.8	50	30.2

Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live and Neutral Line



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 Minimum 6 dB Bandwidth**Test Summary:**

Test Engineer:	Abdoufataou Salifou	Test Date:	09 October 2018
Test Sample Serial Number:	192.168.0.70		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(a)(2)
Test Method Used:	FCC KDB 558074 Section 8.2 referring ANSI C63.10:2013 Section 11.8.1 Option 1

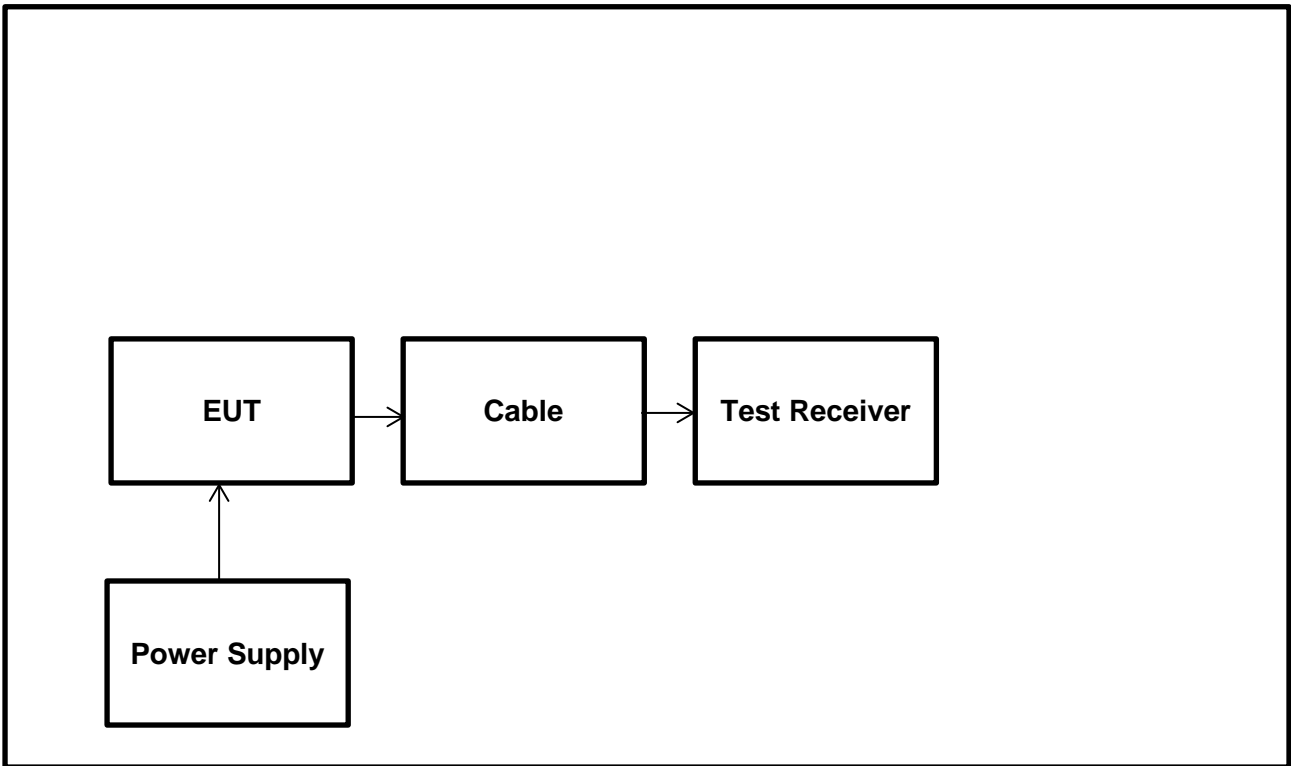
Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	37

Notes:

- Final measurements were performed using the above configurations on the bottom, middle and top channels in accordance FCC KDB 558074 Section 8.2 referring ANSI C63.10 Section 11.8 (11.8.1 Option 1 measurement procedure). The spectrum analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
- Plots for all data rates are archived on the Company server and available for inspection upon request.
- 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. The RF cable attenuation (maximum 2.0 dB@2.4GHz) from the EUT to Analyzer including the 10 dB attenuation at the Spectrum Analyzer input was added as a reference level offset (12.0 dB) to each of the conducted plots.
- Below results for Transmitter Minimum 6 dB Bandwidth are valid for all Antenna Groups included in this report.

Test Setup:

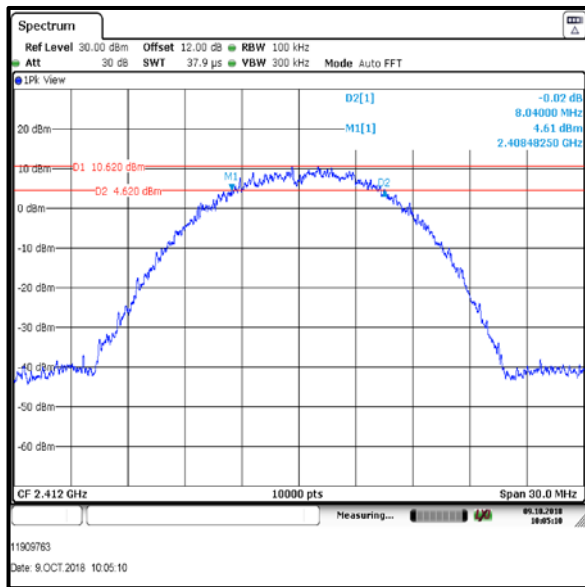


Transmitter Minimum 6 dB Bandwidth (continued)

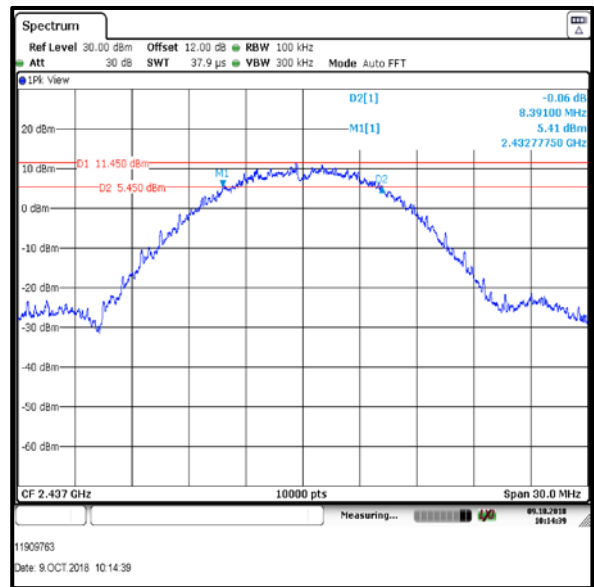
Results: 802.11b / 20 MHz / 1 Mbps / SISO / Port 1

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	8040	≥500	7540	Complied
Middle	8391	≥500	7891	Complied
Top	8301	≥500	7801	Complied

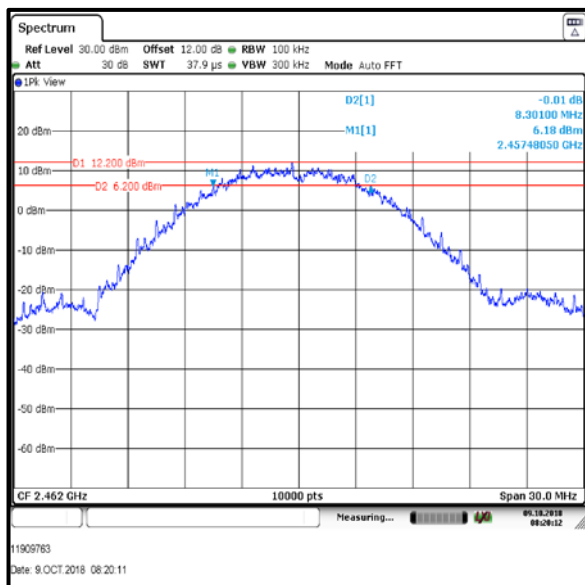
Result: **Pass**



Bottom Channel



Middle Channel



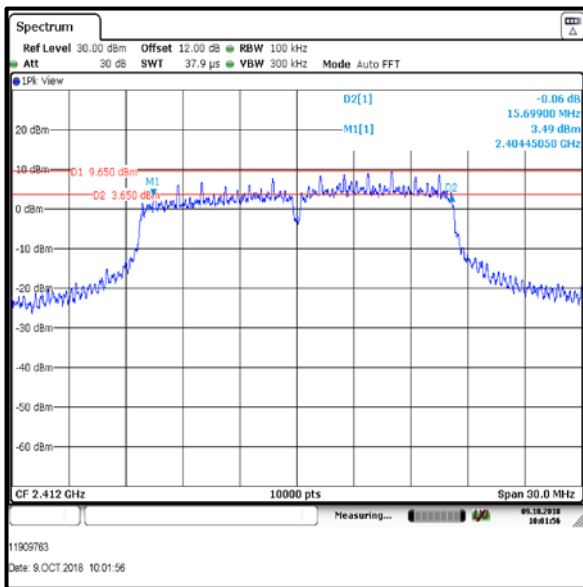
Top Channel

Transmitter Minimum 6 dB Bandwidth (continued)

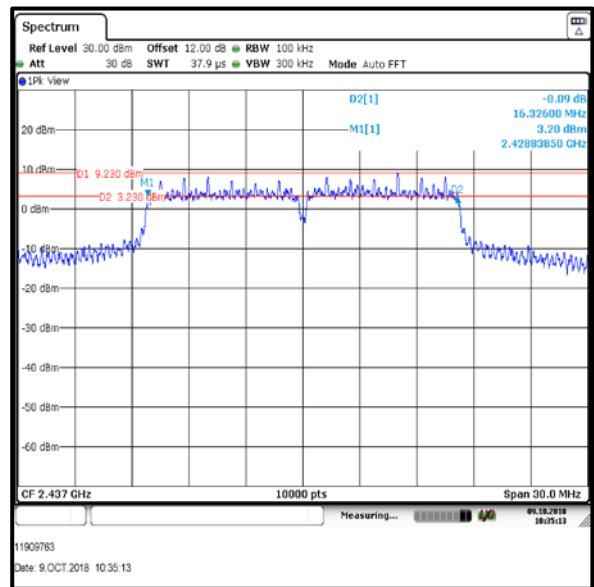
Results: 802.11g / 20 MHz / 9 Mbps / SISO / Port 1

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	15699	≥500	15199	Complied
Middle	16326	≥500	15826	Complied
Top	15723	≥500	15223	Complied

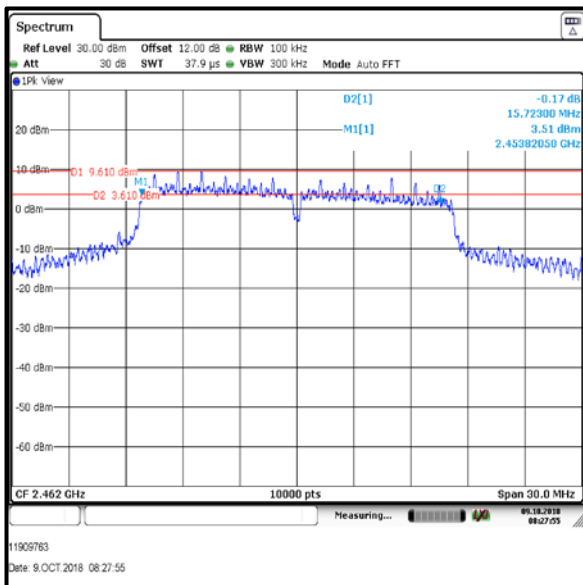
Result: **Pass**



Bottom Channel



Middle Channel



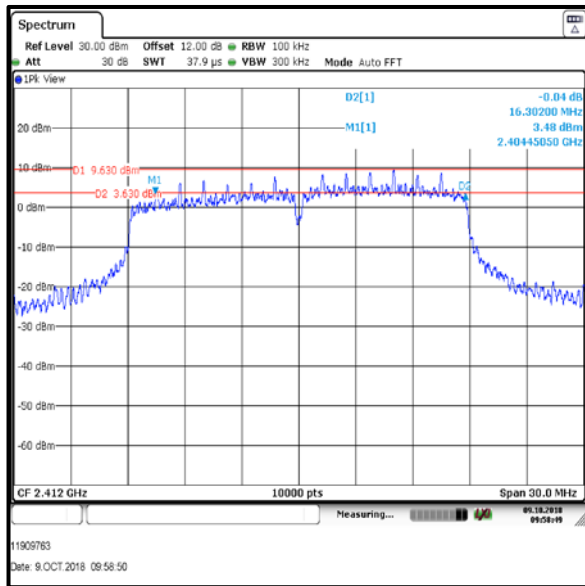
Top Channel

Transmitter Minimum 6 dB Bandwidth (continued)

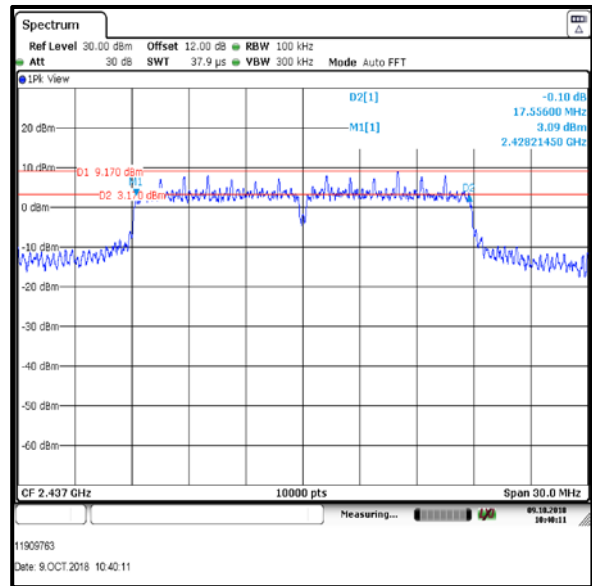
Results: 802.11n / HT20 / MCS2 / SISO / Port 1

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	16302	≥500	15802	Complied
Middle	17556	≥500	17056	Complied
Top	16350	≥500	15850	Complied

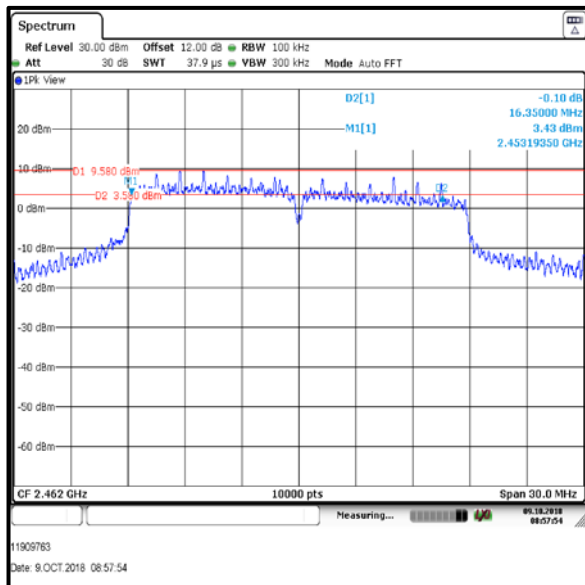
Result: **Pass**



Bottom Channel



Middle Channel



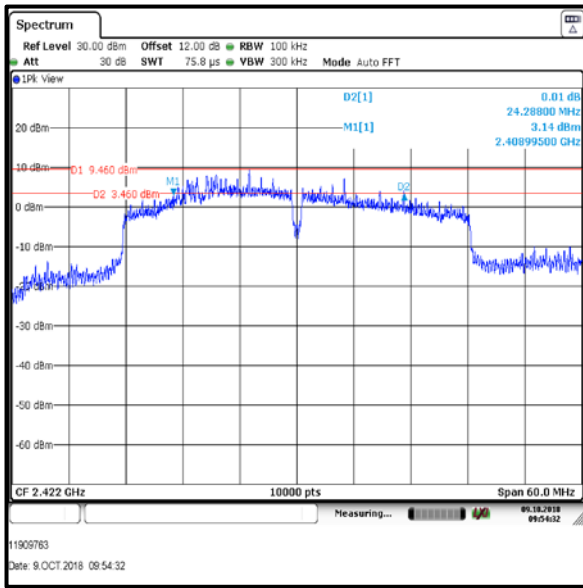
Top Channel

Transmitter Minimum 6 dB Bandwidth (continued)

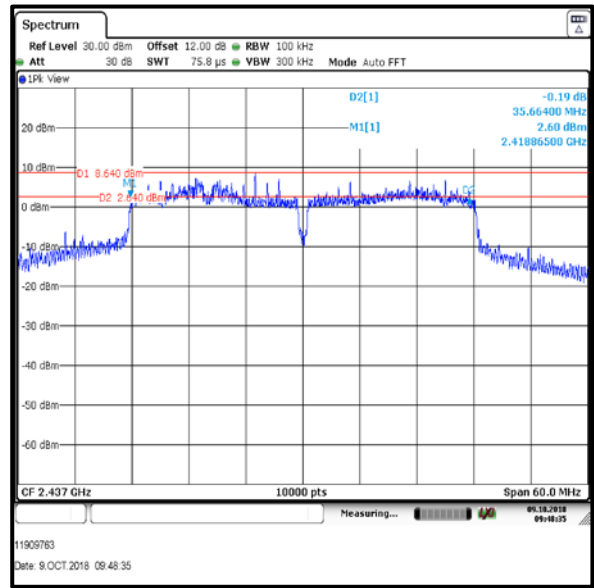
Results: 802.11n / HT40 / MCS2 / SISO / Port 1

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	24288	≥500	23788	Complied
Middle	35664	≥500	Complied	
Top	28947	≥500	28447	Complied

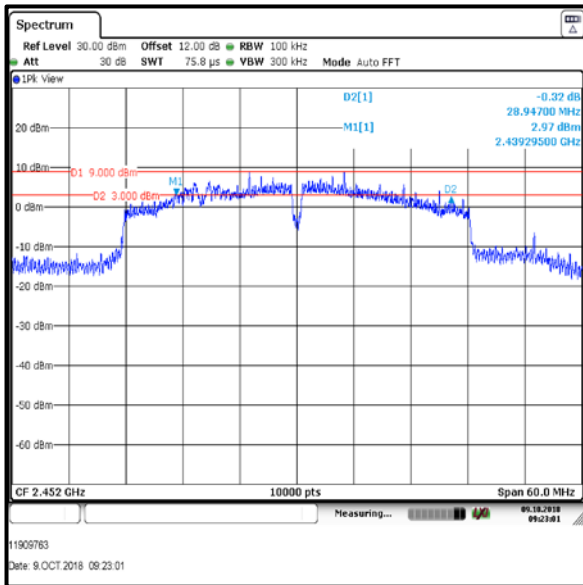
Result: **Pass**



Bottom Channel



Middle Channel



Top Channel

5.2.3. Transmitter Duty Cycle**Test Summary:**

Test Engineer:	Abdoufataou Salifou	Test Date:	08 October 2018
Test Sample Serial Number:	192.168.0.70		
Test Site Identification	SR 9		

FCC Reference:	Part 15.35(c)
Test Method Used:	FCC KDB 558074 Section 6.0

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	39

Notes:

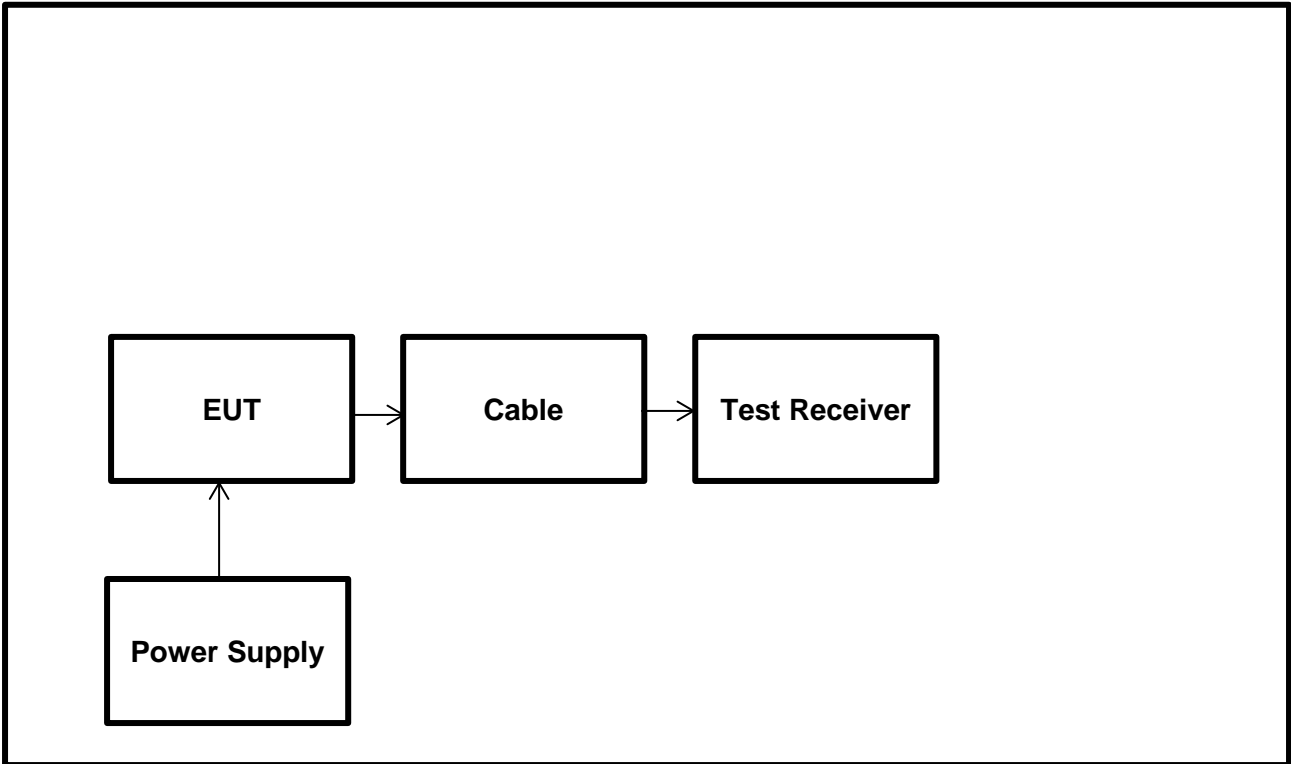
1. During initial investigations it is found that for some modes EUT was transmitting Duty Cycle $\leq 98\%$.
2. In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

$$\text{Duty Cycle (\%)} = 100 \times [\text{On Time } (T_{ON})] / [\text{Period}(T_{ON} + T_{OFF}) \text{ or } 100\text{ms whichever is the lesser}]$$

$$\text{Duty Cycle Correction Factor} = 10 \log 1 / [\text{On Time } (T_{ON})] / [\text{Period}(T_{ON} + T_{OFF}) \text{ or } 100\text{ms whichever is the lesser}]$$
3. Duty cycles were measured with worst case SISO mode; as they found to be same independent of number of transmitter chains used.
4. These results are valid for all supported SISO & MIMO modes as well as for listed Antenna groups.
5. 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. The RF cable attenuation (maximum 2.0 dB@2.4GHz) from the EUT to Analyzer including the 10 dB attenuation at the Spectrum Analyzer input was added as a reference level offset (12.0 dB) to each of the conducted plots.

Transmitter Duty Cycle (continued)

Test setup

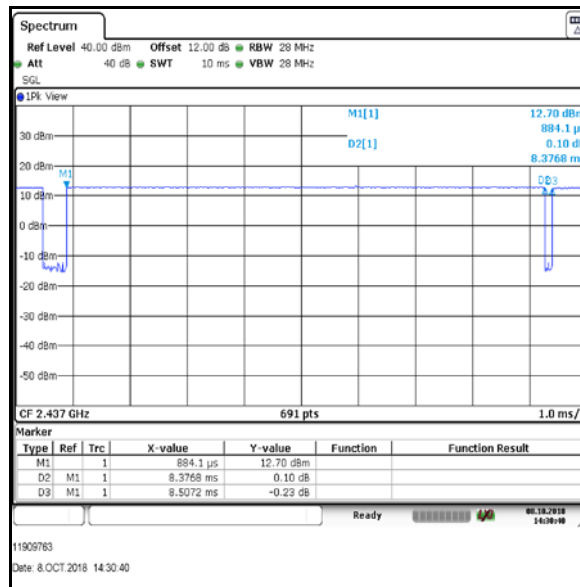


Transmitter Duty Cycle (continued)

Results: 802.11b / 20 MHz / 5.5 Mbps

Pulse On Time (T _{ON}) (ms)	Pulse Period (T _{ON} +T _{OFF}) (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
8.377	8.507	98.47	0.0

Plot: Duty Cycle / 802.11b / 20 MHz / 5.5 Mbps

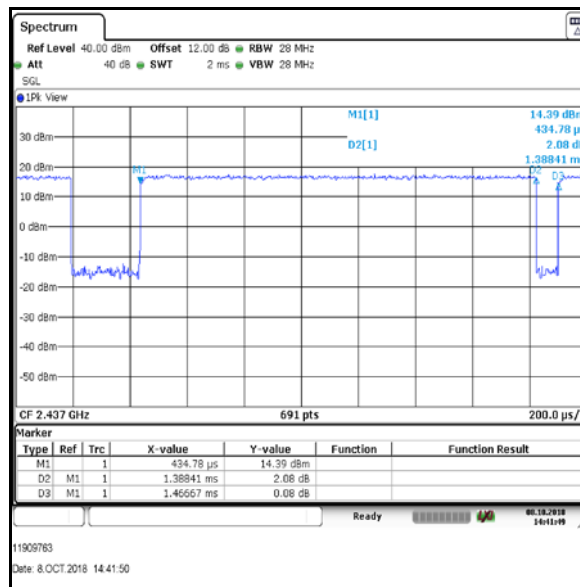


Transmitter Duty Cycle (continued)

Results: 802.11g / 20 MHz / 6 Mbps

Pulse On Time (T _{ON}) (ms)	Pulse Period (T _{ON} +T _{OFF}) (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
1.388	1.467	94.61	0.2

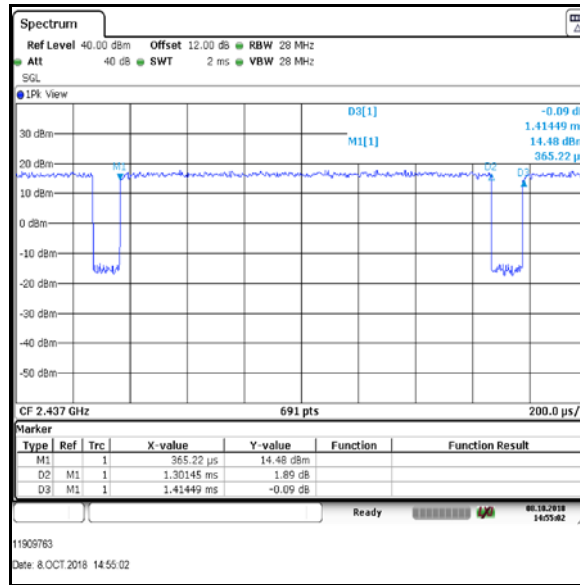
Plot: Duty Cycle /802.11g / 20 MHz / 6 Mbps



Results: 802.11n / HT20 / MCS0 / SISO / Port 1

Pulse On Time (T _{ON}) (ms)	Pulse Period (T _{ON} + T _{OFF}) (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
1.301	1.414	92.00	0.4

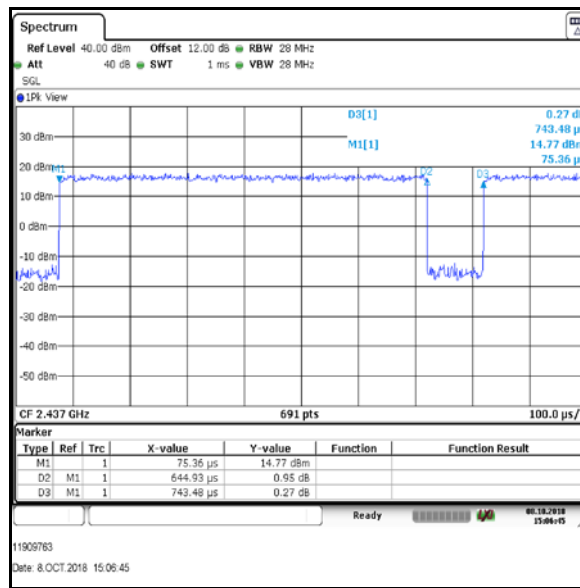
Plot: Duty Cycle/802.11n / HT20 / MCS0 / SISO / Port 1



Results: 802.11n / HT40 / MCS0 / SISO / Port 1

Pulse On Time (T _{ON}) (ms)	Pulse Period (T _{ON} +T _{OFF}) (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
0.645	0.743	86.81	0.6

Plot: Duty Cycle / 802.11n / HT40 / MCS0 / SISO / Port 1



5.2.4. Transmitter Power Spectral Density**Test Summary:**

Test Engineers:	Segun Adeniji & Abdoufataou Salifou	Test Dates:	15 November 2018 to 10 September 2019
Test Sample Serial Number:	192.168.0.70 & 192.168.0.60		
Test Site Identification	SR 9		

FCC Reference:	Part 15.247(e)
Test Method Used:	FCC KDB 558074 Section 8.4 referring ANSI C63.10 Sections 11.10.3 & 11.10.5 FCC KDB 662911 D01 Section E)2)b).

Environmental Conditions:

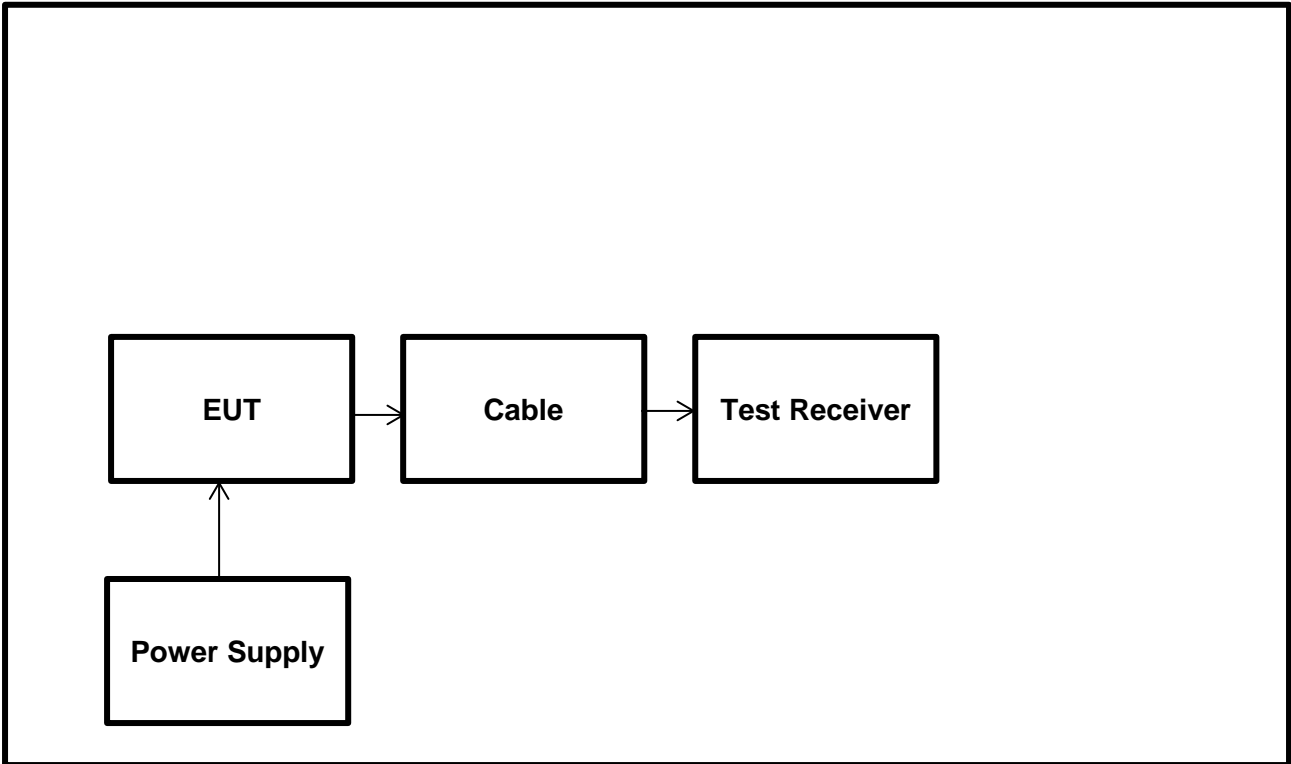
Temperature (°C):	20 to 24
Relative Humidity (%):	30 to 37

Notes:

- Final measurements were performed using the above configurations on the bottom, middle and top channels.
- For 802.11b, the EUT was transmitting at 98% duty cycle and testing was performed in accordance with ANSI C63.10 Section 11.10.3 Method AVGPSD-1. The signal analyser resolution bandwidth was set to 3 kHz and video bandwidth 10 kHz. An RMS detector was used and sweep time set manually to perform trace averaging over at least 100 traces. The span was set to greater than 1.5 times the 99% occupied emission bandwidth. The highest peak of the measured signal was recorded.
- For 802.11g and 802.11n, the EUT was transmitting at <98% duty cycle and testing was performed in accordance with ANSI C63.10 Section 11.10.5 Method AVGPSD-2. The signal analyser resolution bandwidth was set to 3 kHz and video bandwidth 10 kHz. An RMS detector was used and sweep time set manually to perform trace averaging over at least 100 traces. The span was set to greater than 1.5 times the 99% occupied emission bandwidth. The highest peak of the measured signal was recorded. The calculated duty cycle in section 5.2.4 was added to the measured average power spectral density in order to compute the average power spectral density during the actual transmission time.
- For MIMO, PSD was measured on all ports and then combined using the measure and sum spectral maxima across the outputs technique, stated in FCC KDB 662911 D01 Section E)2)b).
- 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. The RF cable attenuation (maximum 2.0 dB@2.4GHz) from the EUT to Analyzer including the 10 dB attenuation at the Spectrum Analyzer input was added as a reference level offset (12.0 dB) to each of the conducted plots.
- Power level settings used in GUI are indicated by PWL.
- Power Spectral Density limits is 8 dBm / 3 kHz for all Antenna Groups.

Transmitter Maximum (Average) Output Power (continued)

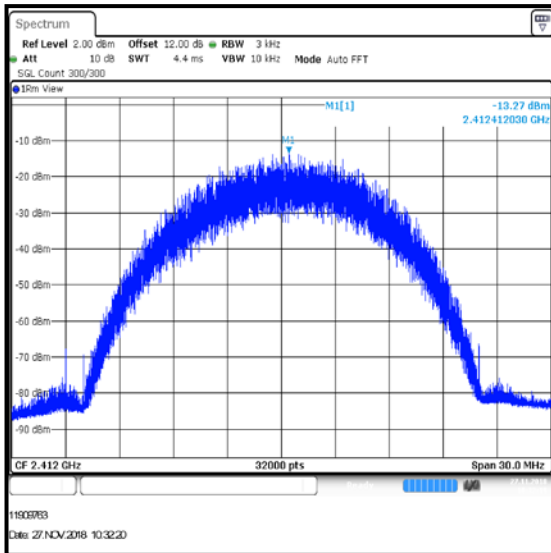
Test setup



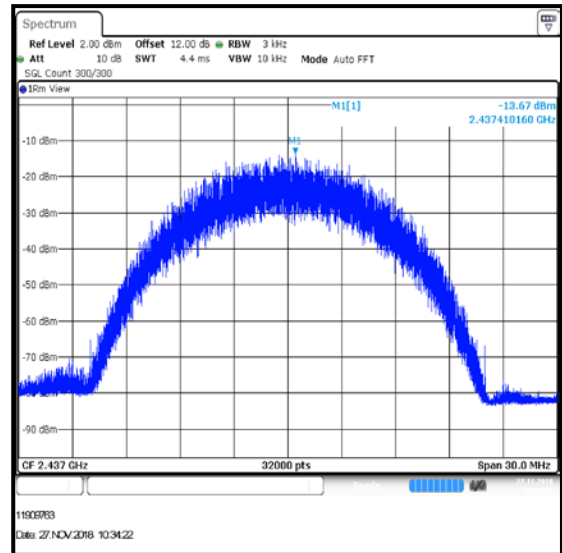
Transmitter Power Spectral Density (continued)

Results: 802.11b / 20 MHz / 5.5 Mbps / SISO / Port 1 / PWL 12 / 6 dBi Antenna Group

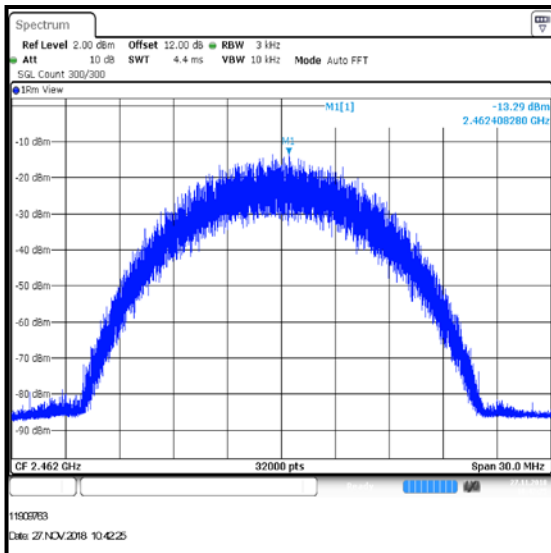
Channel	Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-13.3	8.0	21.3	Complied
Middle	-13.7	8.0	21.7	Complied
Top	-13.3	8.0	21.3	Complied



Bottom Channel



Middle Channel



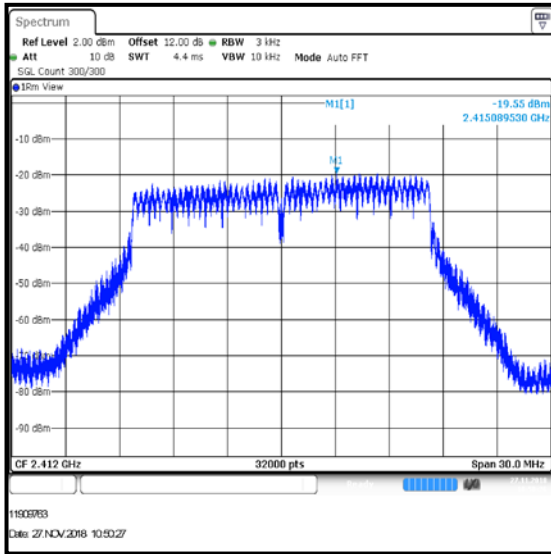
Top Channel

Result: **Pass**

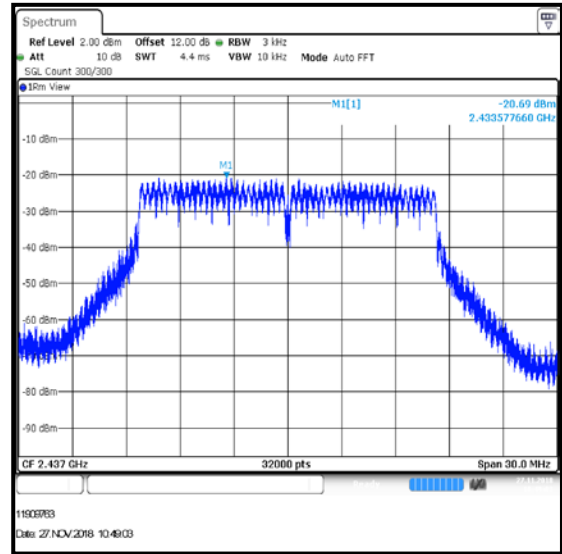
Transmitter Power Spectral Density (continued)

Results: 802.11g / 20 MHz / 6 Mbps / SISO / Port 1 / PWL 12 / 6 dBi Antenna Group

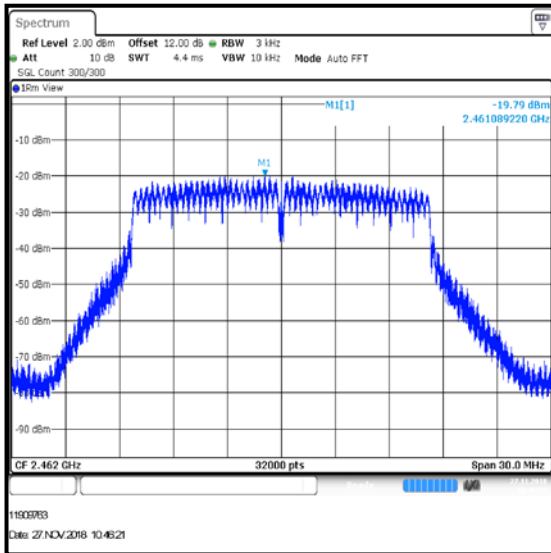
Channel	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-19.6	0.2	-19.4	8.0	27.4	Complied
Middle	-20.7	0.2	-20.5	8.0	28.5	Complied
Top	-19.8	0.2	-19.6	8.0	27.6	Complied



Bottom Channel



Middle Channel



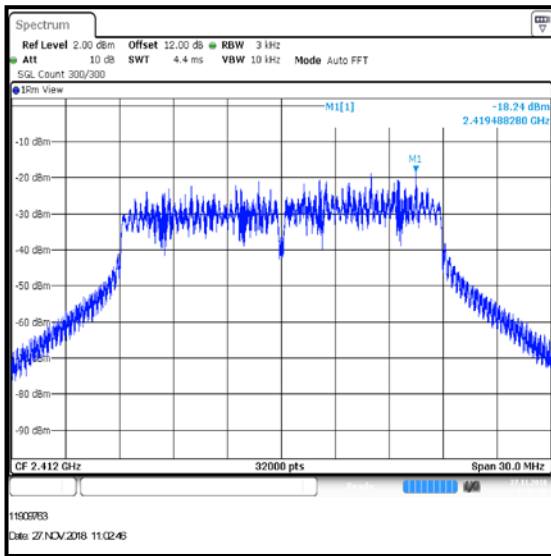
Top Channel

Result: **Pass**

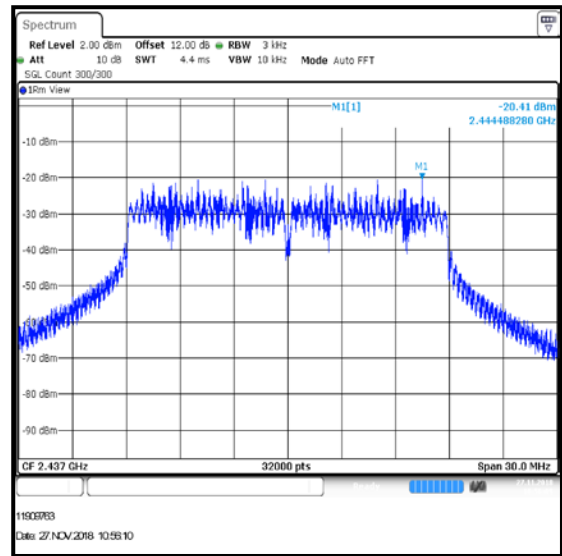
Transmitter Power Spectral Density (continued)

Results: 802.11n / HT20 / MCS0 / SISO / Port 1 / PWL 12 / 6 dBi Antenna Group

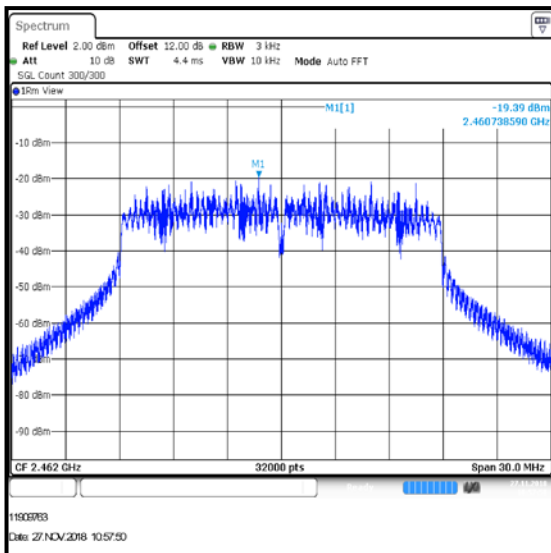
Channel	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-18.2	0.4	-17.8	8.0	25.8	Complied
Middle	-20.4	0.4	-20.0	8.0	28	Complied
Top	-19.4	0.4	-19.0	8.0	27	Complied



Bottom Channel



Middle Channel



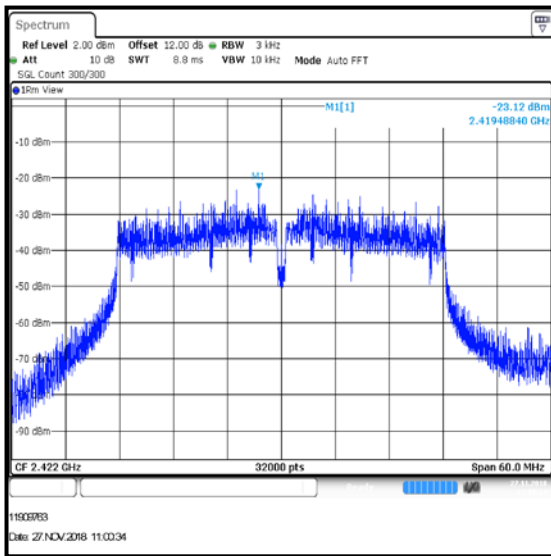
Top Channel

Result: **Pass**

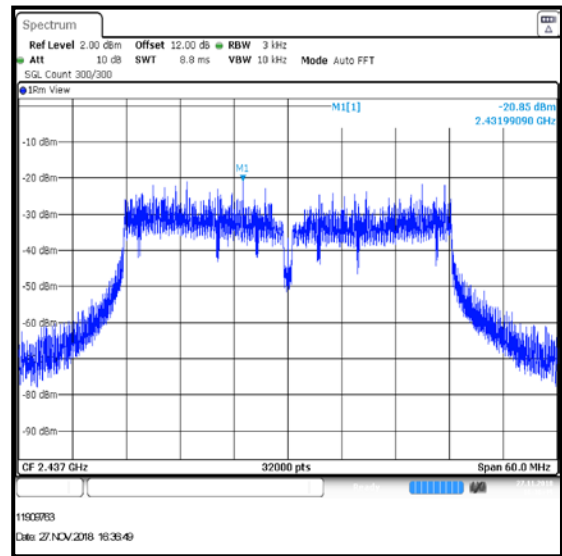
Transmitter Power Spectral Density (continued)

Results: 802.11n / HT40 / MCS0 / SISO / Port 1 / PWL 12 / 6 dBi Antenna Group

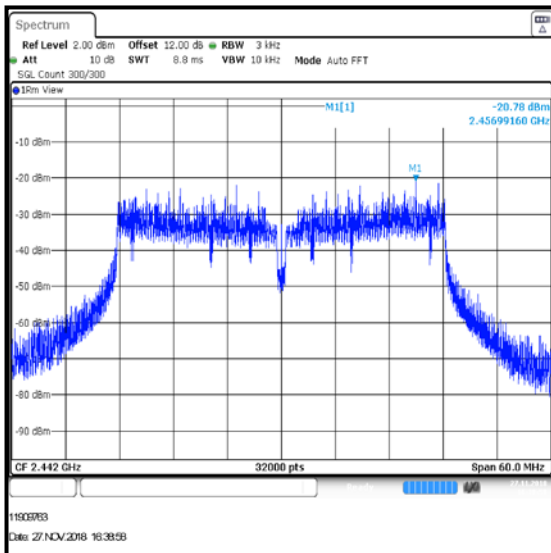
Channel	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-23.1	0.6	-22.5	8.0	30.5	Complied
Middle	-20.9	0.6	-20.3	8.0	28.3	Complied
Top	-20.8	0.6	-20.2	8.0	28.2	Complied



Bottom Channel



Middle Channel



Top Channel

Result: **Pass**



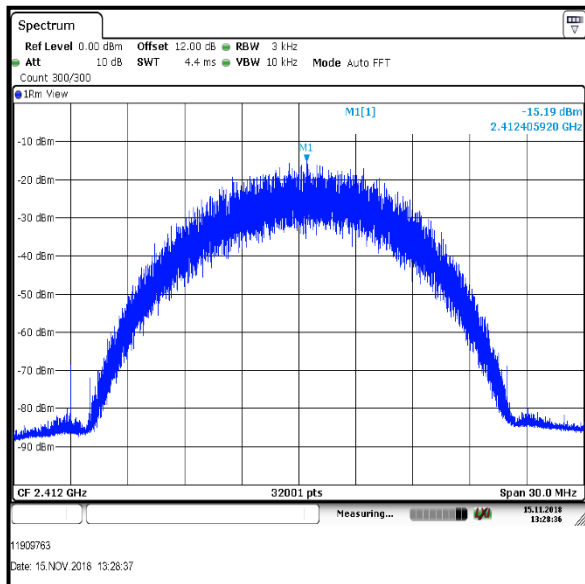
Transmitter Power Spectral Density (continued)

Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 1+2 / PWL 12 / 6 dBi Antenna Group

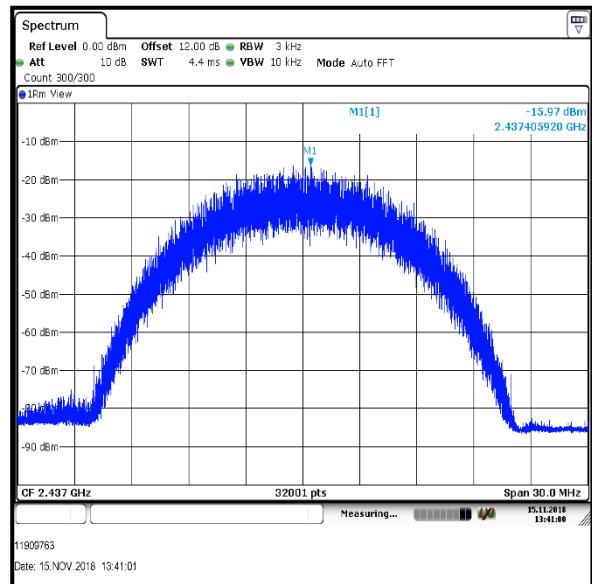
Channel	Output Power Port 1 (dBm/3 kHz)	Output Power Port 2 (dBm/3 kHz)	Port 1+2 Combined Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-15.1	-15.8	-12.4	8.0	20.4	Complied
Middle	-15.9	-15.7	-12.7	8.0	20.7	Complied
Top	-14.9	-14.3	-11.5	8.0	19.5	Complied

Result: **Pass**

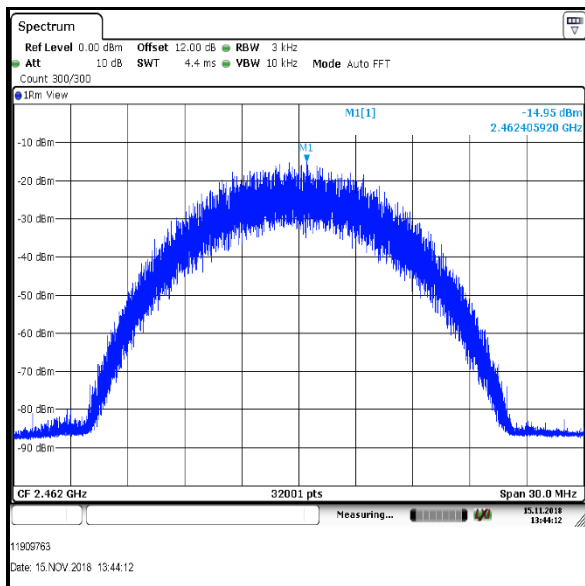
Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 1 / PWL 12 / 6 dBi Antenna Group



Bottom Channel



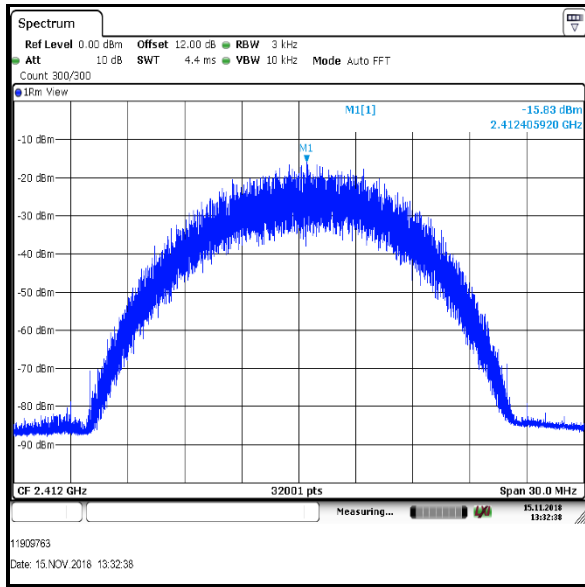
Middle Channel



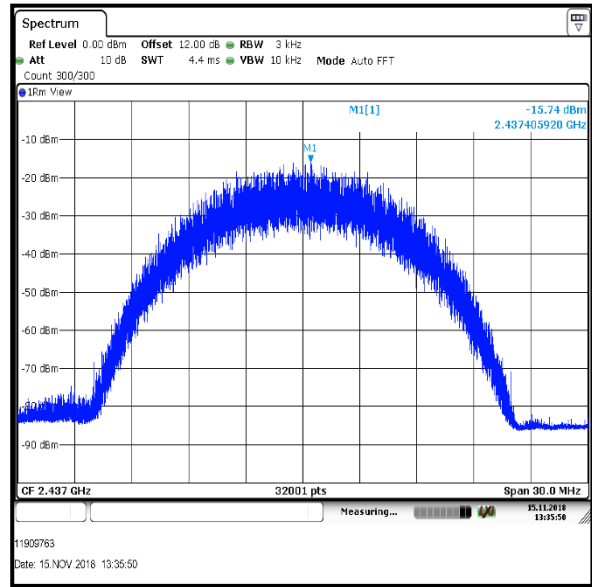
Top Channel

Transmitter Power Spectral Density (continued)

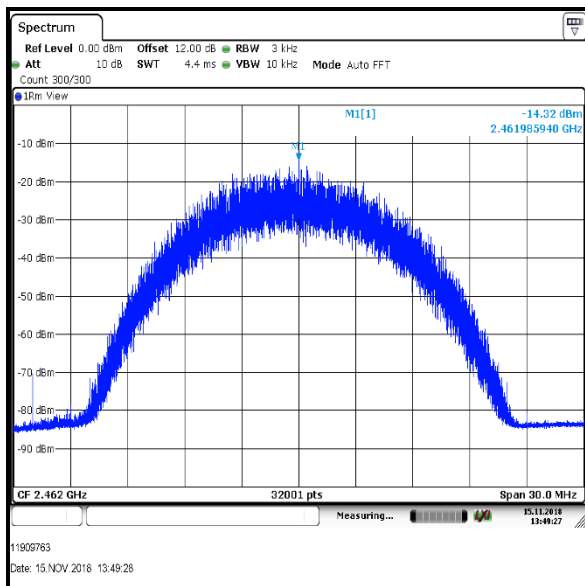
Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 2 / PWL 12 / 6 dBi Antenna Group



Bottom Channel



Middle Channel



Top Channel

Transmitter Power Spectral Density (continued)

Results: 802.11g / 20 MHz / 6 Mbps / MIMO / Port 1+2 / PWR 12 / 6 dBi Antenna Group

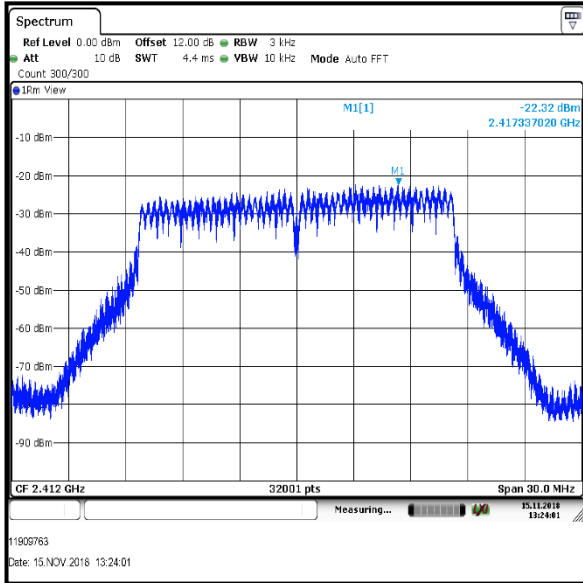
Channel	Port 1			Port 2		
	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)
Bottom	-22.3	0.2	-22.1	-21.1	0.2	-20.9
Middle	-22.9	0.2	-22.7	-21.2	0.2	-21.0
Top	-22.6	0.2	-22.4	-21.4	0.2	-21.2

Channel	Corrected Output Power Port 1 (dBm/3 kHz)	Corrected Output Power Port 2 (dBm/3 kHz)	Port 1+2 Combined Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-22.1	-20.9	-18.4	8.0	26.4	Complied
Middle	-22.7	-21.0	-18.7	8.0	26.7	Complied
Top	-22.4	-21.2	-18.7	8.0	26.7	Complied

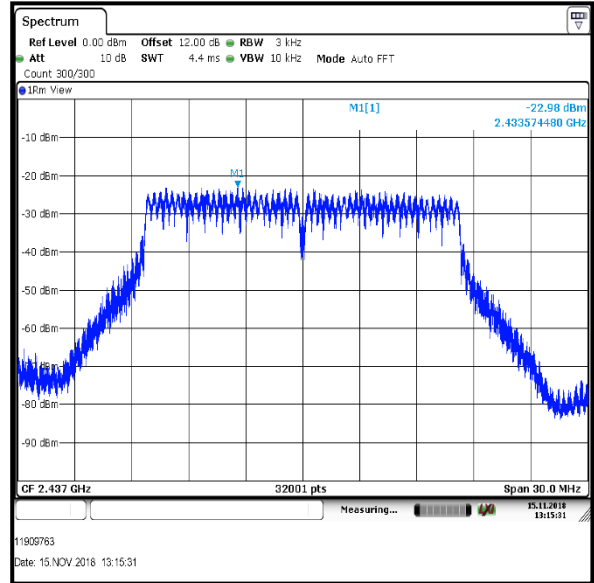
Result: Pass

Transmitter Power Spectral Density (continued)

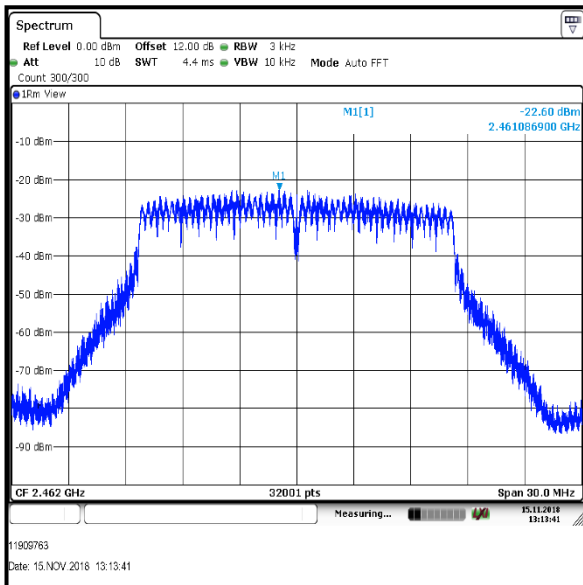
Results: 802.11g / 20 MHz / 6 Mbps / MIMO / Port 1 / PWL 12 / 6 dBi Antenna Group



Bottom Channel



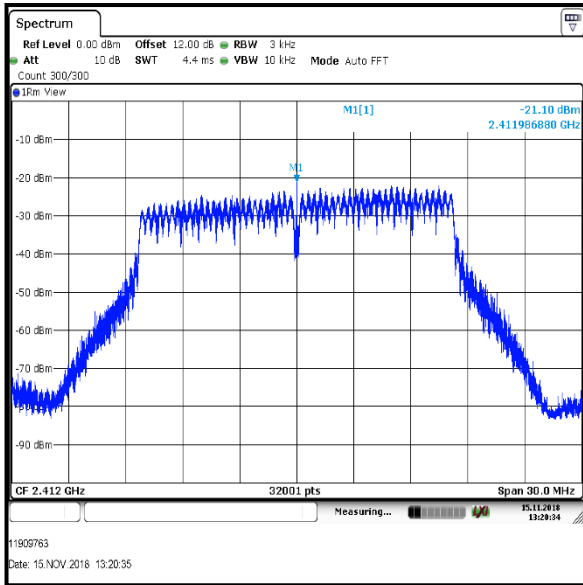
Middle Channel



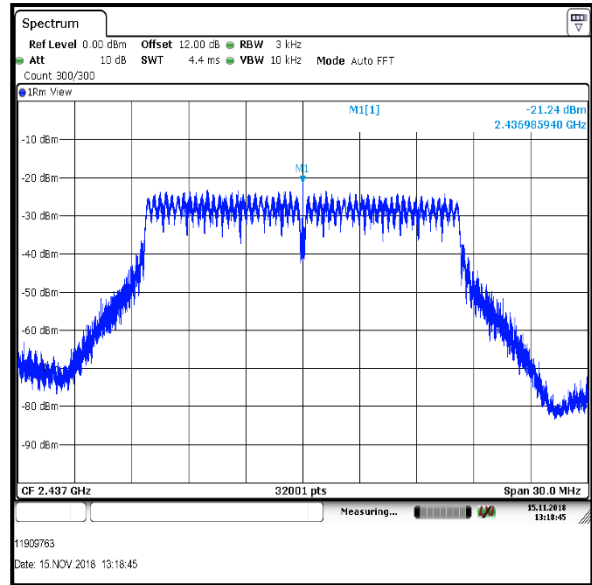
Top Channel

Transmitter Power Spectral Density (continued)

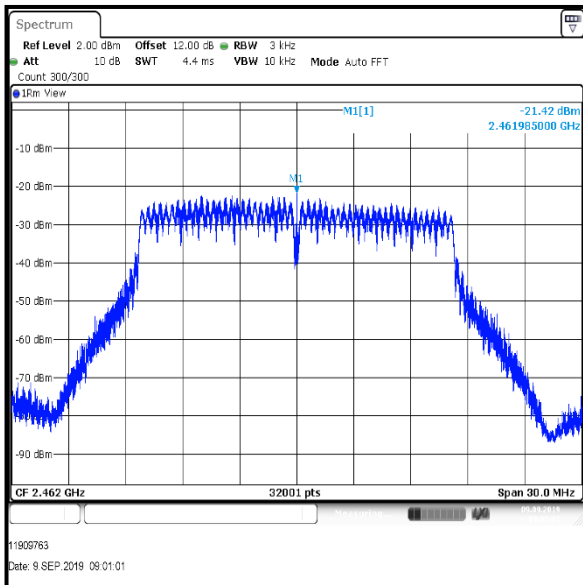
Results: 802.11g / 20 MHz / 6 Mbps / MIMO Port 2 / PWL 12 / 6 dBi Antenna Group



Bottom Channel



Middle Channel



Top Channel

Transmitter Power Spectral Density (continued)**Results: 802.11n / HT20 / MCS0 / MIMO / Port 1+2 / PWL 12 / 6 dBi Antenna Group**

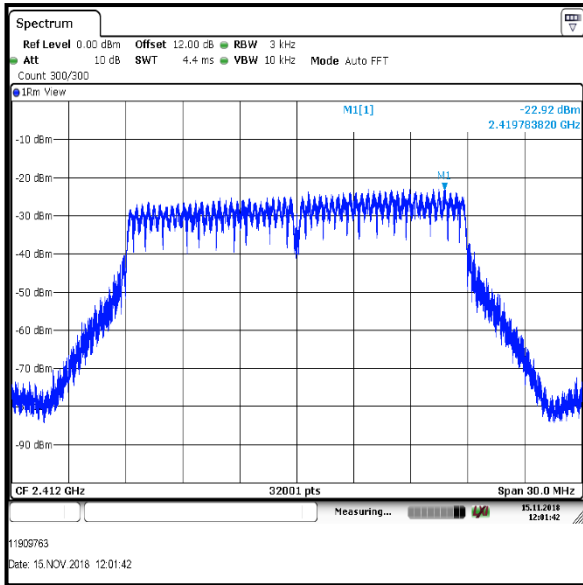
Channel	Port 1			Port 2		
	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)
Bottom	-22.9	0.4	-22.5	-21.8	0.4	-21.4
Middle	-24.2	0.4	-23.8	-20.2	0.4	-19.8
Top	-22.7	0.4	-22.3	-22.3	0.4	-21.9

Channel	Corrected Output Power Port 1 (dBm/3 kHz)	Corrected Output Power Port 2 (dBm/3 kHz)	Port 1+2 Combined Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-22.5	-21.4	-18.9	8.0	26.9	Complied
Middle	-23.8	-19.8	-18.3	8.0	26.3	Complied
Top	-22.3	-21.9	-19.1	8.0	27.1	Complied

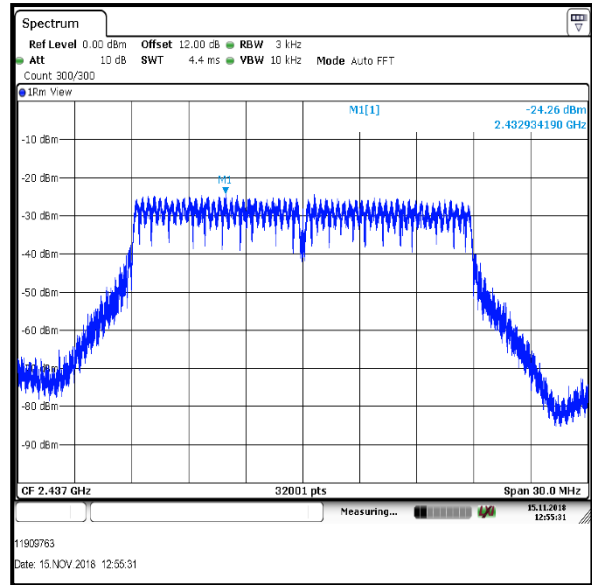
Result: Pass

Transmitter Power Spectral Density (continued)

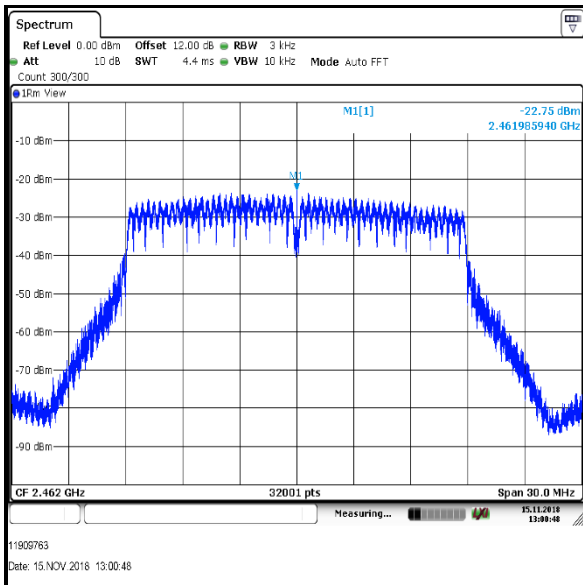
Results: 802.11n / HT20 / MCS0 / MIMO / Port 1/ PWL 12 / 6 dBi Antenna Group



Bottom Channel



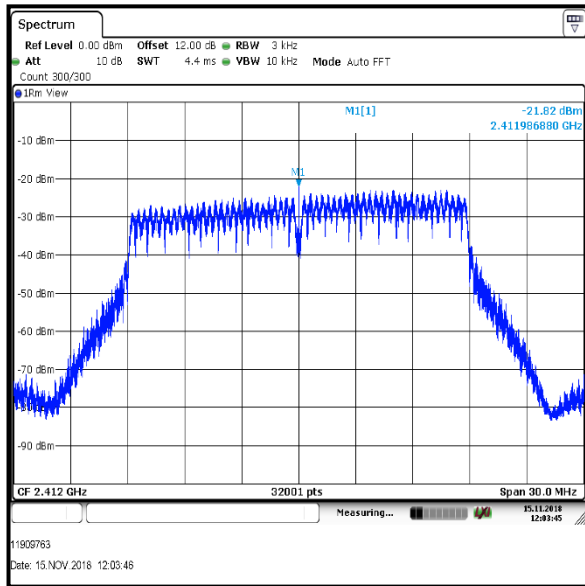
Middle Channel



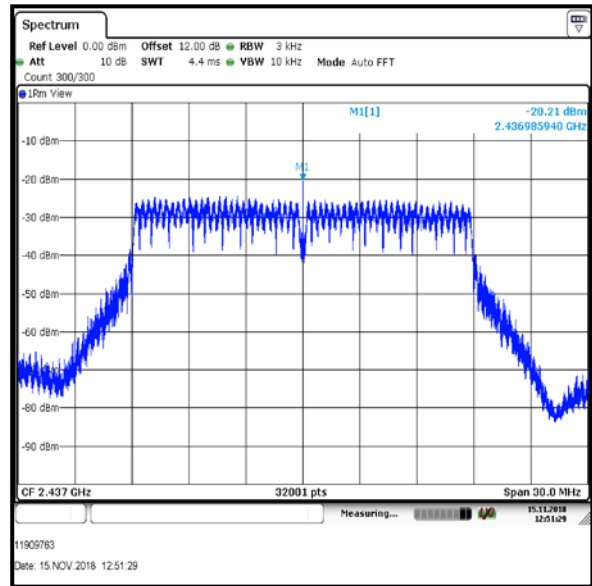
Top Channel

Transmitter Power Spectral Density (continued)

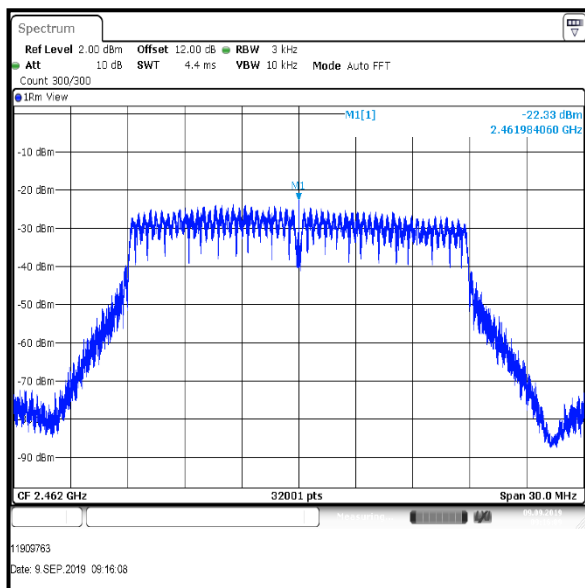
Results: 802.11n / HT20 / MCS0 / MIMO / Port 2 / PWL 12 / 6 dBi Antenna Group



Bottom Channel



Middle Channel



Top Channel

Transmitter Power Spectral Density (continued)

Results: 802.11n / HT40 / MCS0 / MIMO / Port 1+2 / PWL 12 / 6 dBi Antenna Group

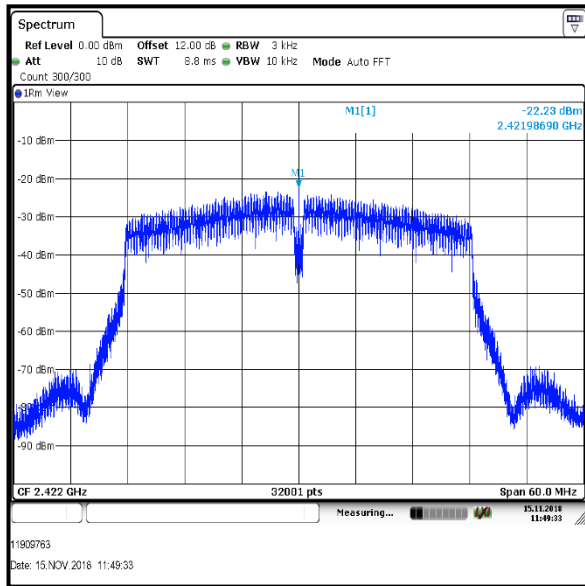
Channel	Port 1			Port 2		
	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)
Bottom	-22.2	0.6	-21.6	-21.6	0.6	-21.0
Middle	-25.2	0.6	-24.6	-21.6	0.6	-21.0
Top	-25.3	0.6	-24.7	-19.7	0.6	-19.1

Channel	Corrected Output Power Port 1 (dBm/3 kHz)	Corrected Output Power Port 2 (dBm/3 kHz)	Port 1+2 Combined Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-21.6	-21.0	-18.2	8.0	26.2	Complied
Middle	-24.6	-21.0	-19.4	8.0	27.4	Complied
Top	-24.7	-19.1	-18.0	8.0	26	Complied

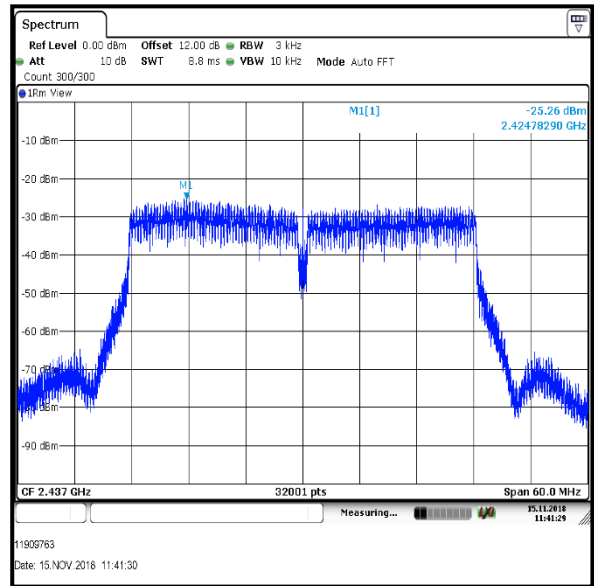
Result: Pass

Transmitter Power Spectral Density (continued)

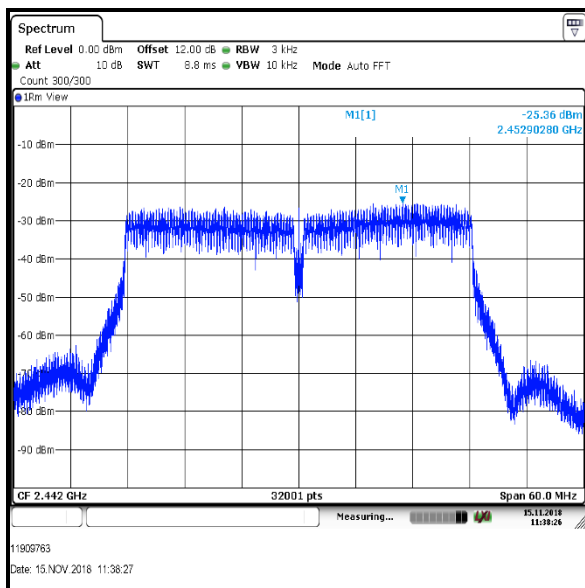
Results: 802.11n / HT40 / MCS0 / MIMO / Port 1 / PWL 12 / 6 dBi Antenna Group



Bottom Channel



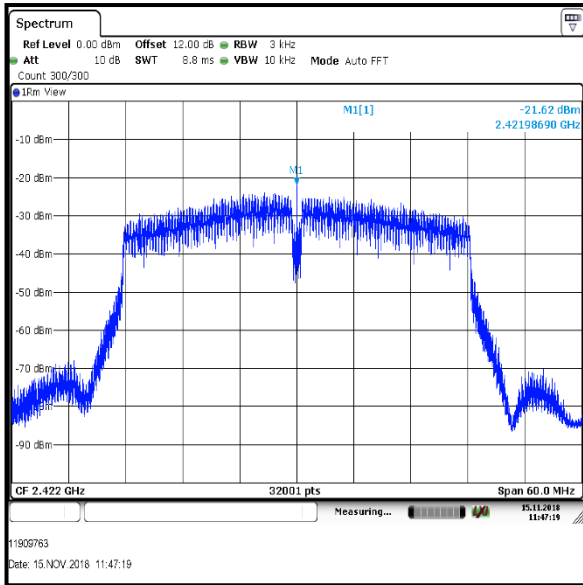
Middle Channel



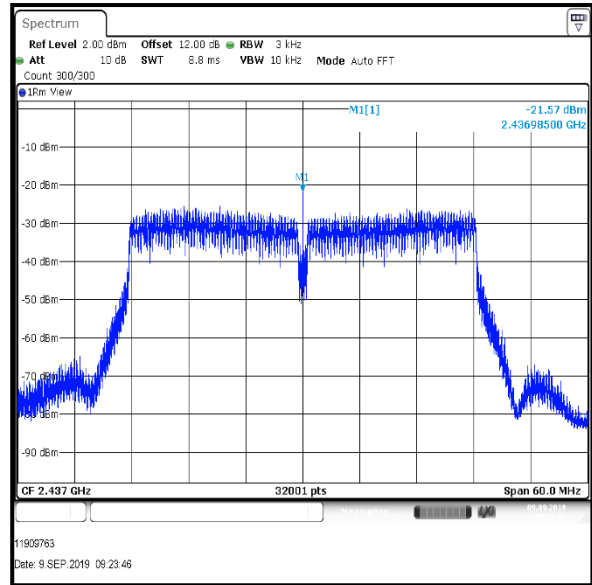
Top Channel

Transmitter Power Spectral Density (continued)

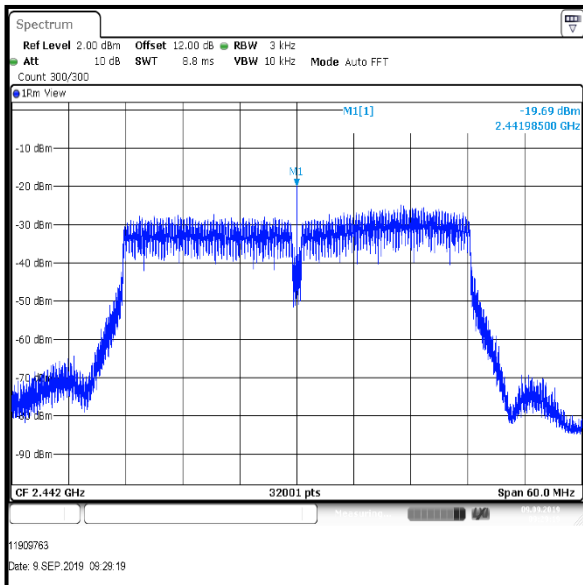
Results: 802.11n / HT40 / MCS0 / MIMO / Port 2 / PWL 12 / 6 dBi Antenna Group



Bottom Channel



Middle Channel



Top Channel

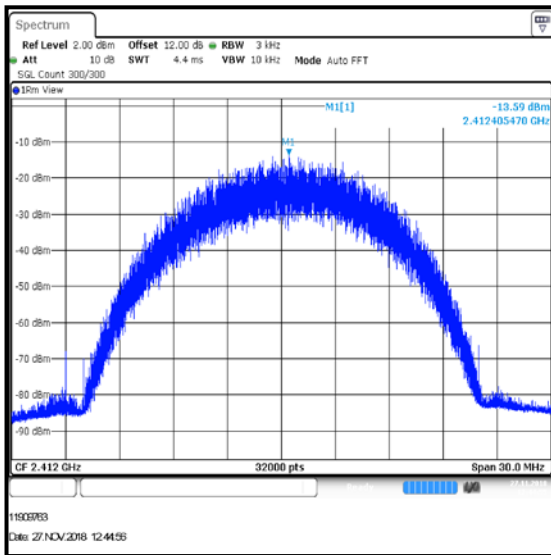
Transmitter Power Spectral Density (continued)

Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 1+2+3 / PWL 16 / 6 dBi Antenna Group

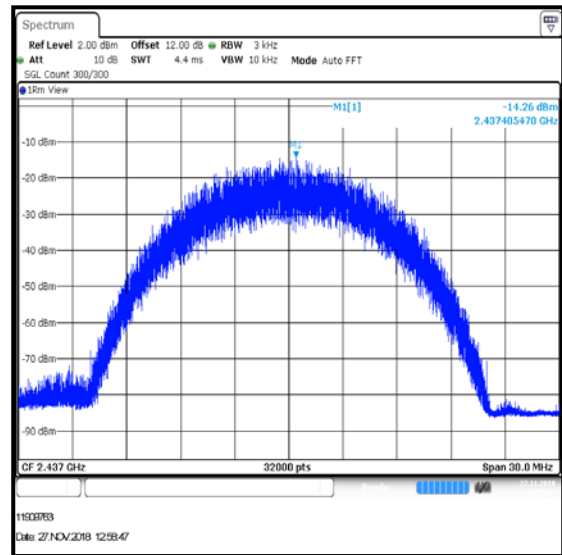
Channel	Output Power Port 1 (dBm/3 kHz)	Output Power Port 2 (dBm/3 kHz)	Output Power Port 3 (dBm/3 kHz)	Port 1+2+3 Combined Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-13.6	-13.7	-13.3	-8.8	8.0	16.8	Complied
Middle	-14.3	-14.2	-13.5	-9.2	8.0	17.2	Complied
Top	-14.2	-14.3	-14.6	-9.6	8.0	17.6	Complied

Result: **Pass**

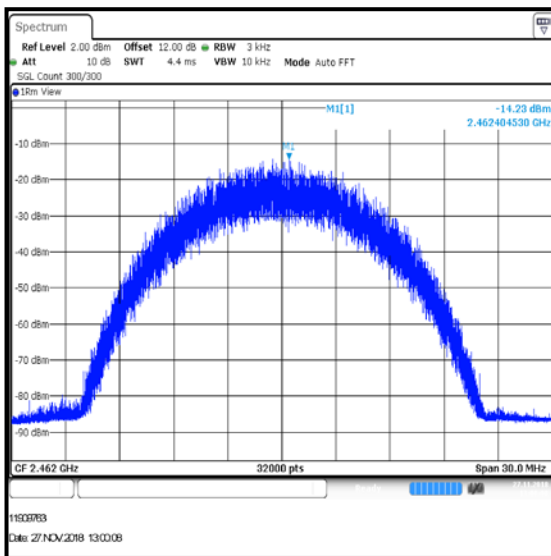
Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 1/ PWL 16 / 6 dBi Antenna Group



Bottom Channel



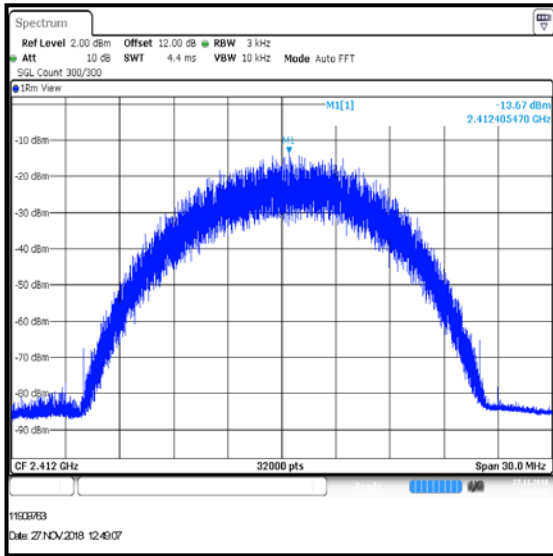
Middle Channel



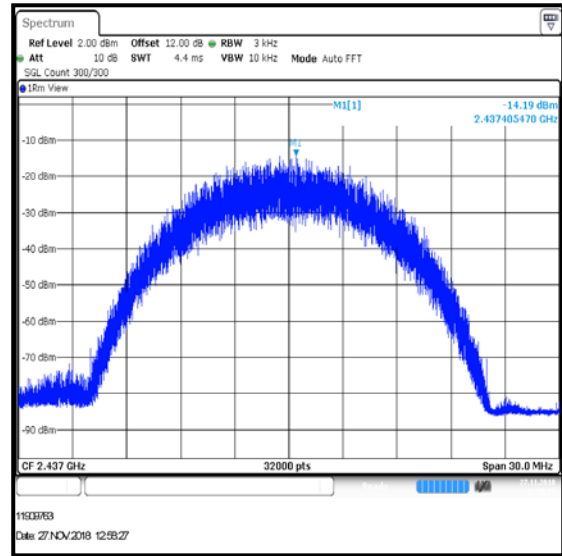
Top Channel

Transmitter Power Spectral Density (continued)

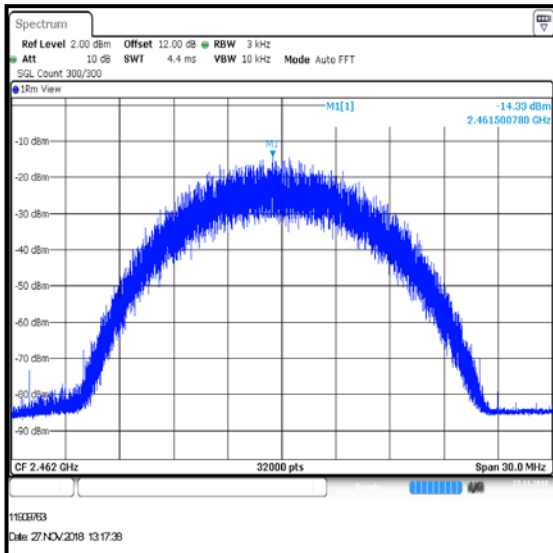
Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 2 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



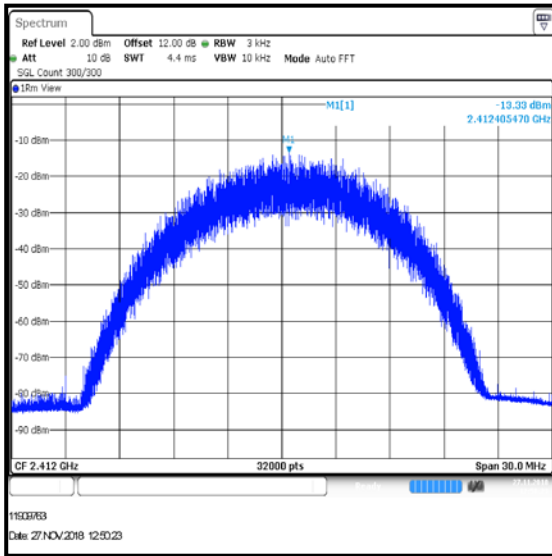
Middle Channel



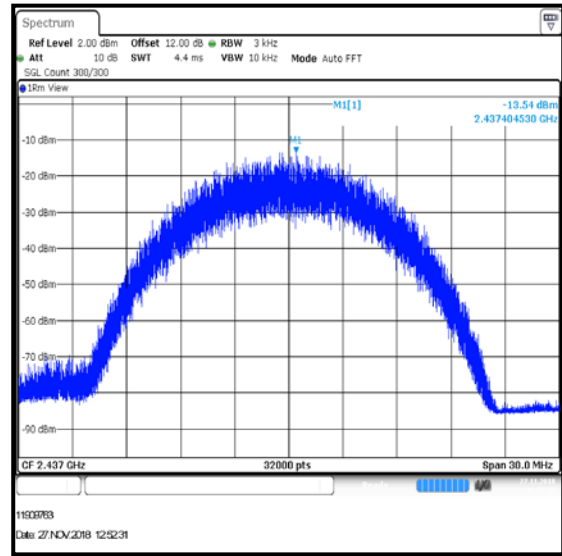
Top Channel

Transmitter Power Spectral Density (continued)

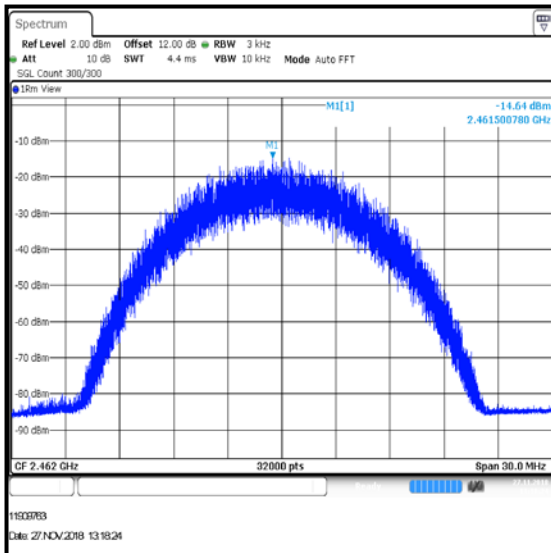
Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 3 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



Middle Channel



Top Channel

Transmitter Power Spectral Density (continued)

Results: 802.11g / 20 MHz / 6 Mbps / MIMO / Port 1+2+3 / PWL 16 / 6 dBi Antenna Group

Channel	Port 1			Port 2		
	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)
Bottom	-21.2	0.2	-21.0	-20.8	0.2	-20.6
Middle	-21.5	0.2	-21.3	-21.7	0.2	-21.5
Top	-20.9	0.2	-20.7	-16.6	0.2	-16.4

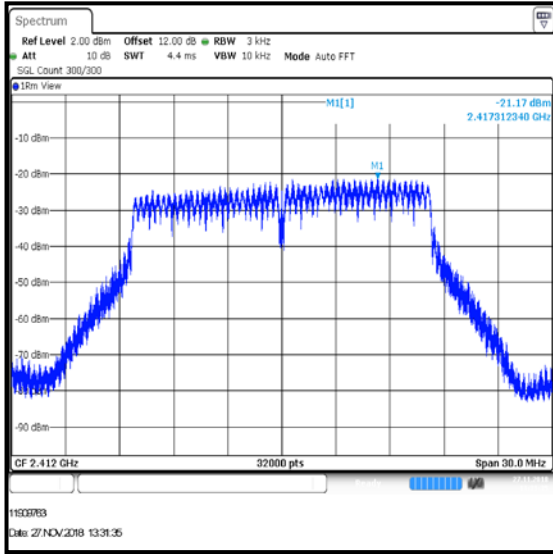
Channel	Port 3		
	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)
Bottom	-20.0	0.2	-19.8
Middle	-21.3	0.2	-21.1
Top	-18.0	0.2	-17.8

Channel	Output Power Port 1 (dBm/3 kHz)	Output Power Port 2 (dBm/3 kHz)	Output Power Port 3 (dBm/3 kHz)	Port 1+2+3 Combined Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-21.0	-20.6	-19.8	-15.7	8.0	23.7	Complied
Middle	-21.3	-21.5	-21.1	-16.5	8.0	24.5	Complied
Top	-20.7	-16.4	-17.8	-13.2	8.0	21.2	Complied

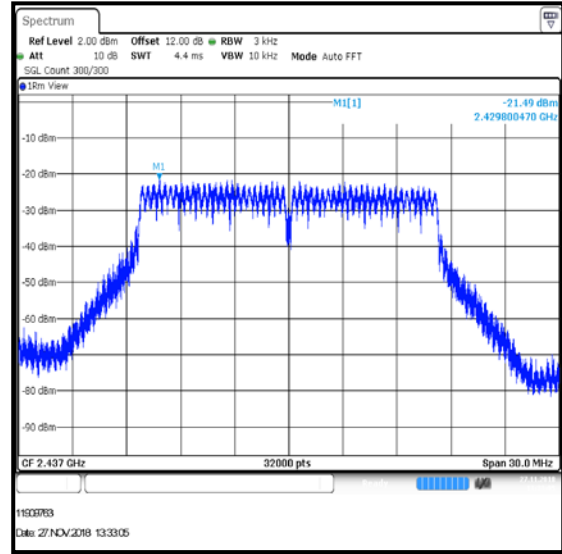
Result: Pass

Transmitter Power Spectral Density (continued)

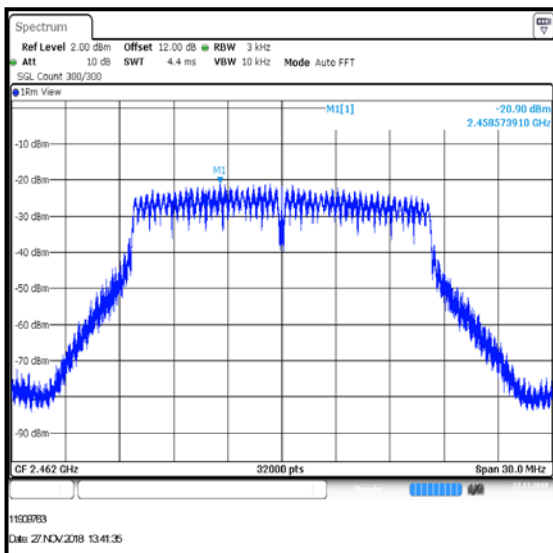
Results: 802.11g / 20 MHz / 6 Mbps / MIMO / Port 1 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



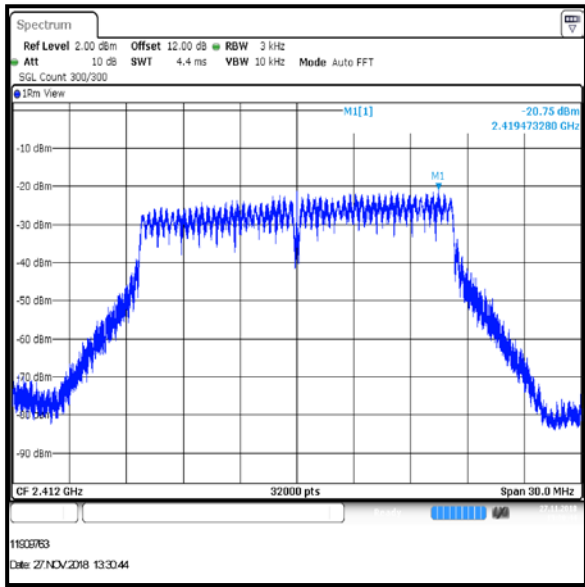
Middle Channel



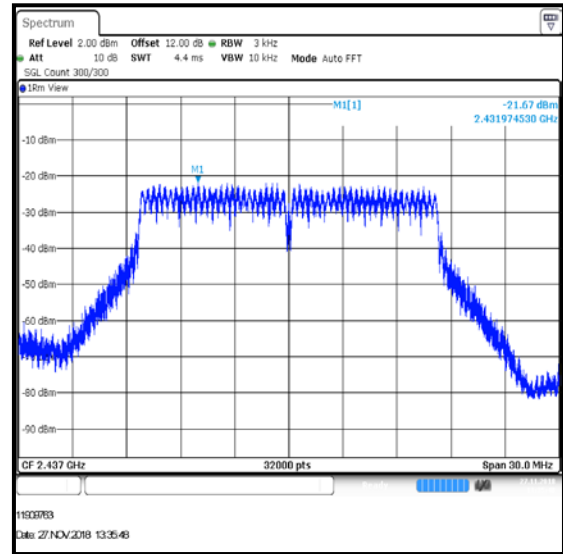
Top Channel

Transmitter Power Spectral Density (continued)

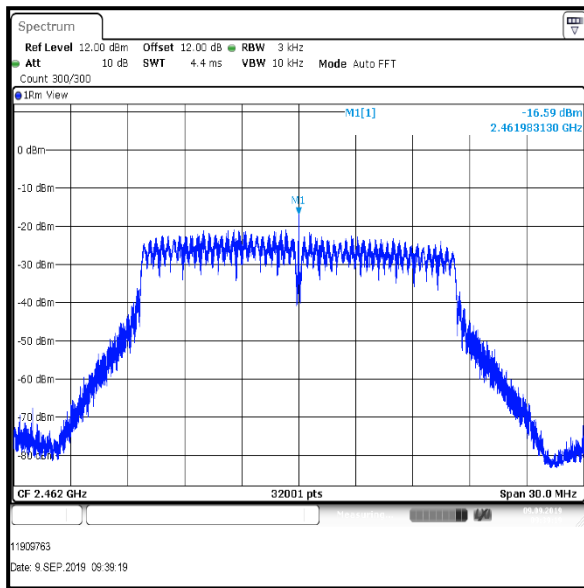
Results: 802.11g / 20 MHz / 6 Mbps / MIMO / Port 2 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



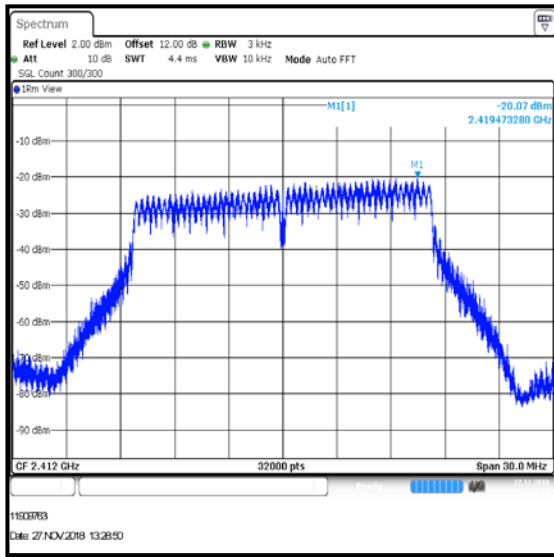
Middle Channel



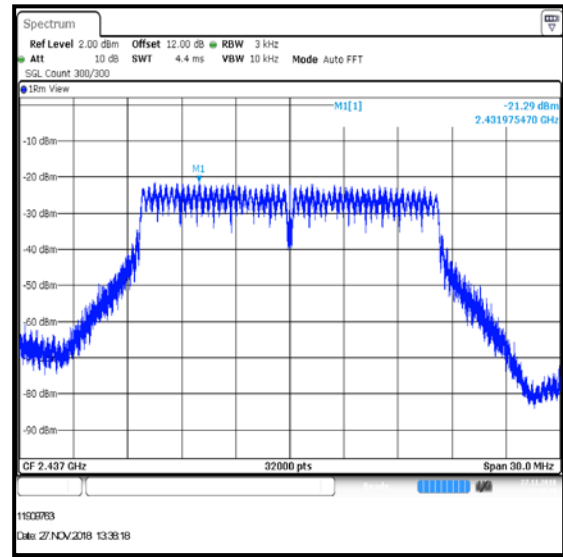
Top Channel

Transmitter Power Spectral Density (continued)

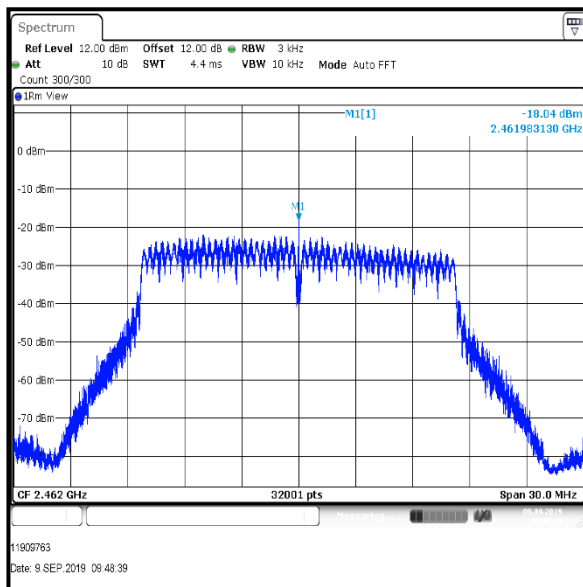
Results: 802.11g / 20 MHz / 6 Mbps / MIMO / Port 3 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



Middle Channel



Top Channel

Transmitter Power Spectral Density (continued)

Results: 802.11n / HT20 / MCS0 / MIMO / Port 1+2+3 / PWL 16 / 6 dBi Antenna Group

Channel	Port 1			Port 2		
	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)
Bottom	-21.8	0.4	-21.4	-19.3	0.4	-18.9
Middle	-22.3	0.4	-21.9	-19.8	0.4	-19.4
Top	-21.7	0.4	-21.3	-18.0	0.4	-17.6

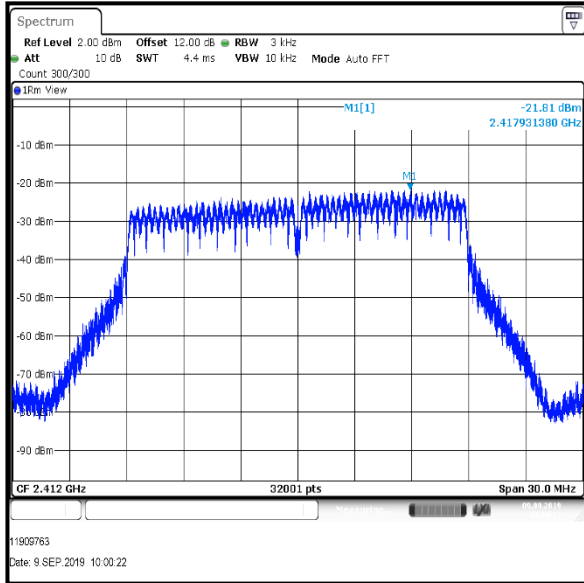
Channel	Port 3		
	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)
Bottom	-20.7	0.4	-20.3
Middle	-20.9	0.4	-20.5
Top	-18.0	0.4	-17.6

Channel	Output Power Port 1 (dBm/3 kHz)	Output Power Port 2 (dBm/3 kHz)	Output Power Port 3 (dBm/3 kHz)	Port 1+2+3 Combined Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-21.4	-18.9	-20.3	-15.3	8.0	23.3	Complied
Middle	-21.9	-19.4	-20.5	-15.7	8.0	23.7	Complied
Top	-21.3	-17.6	-17.6	-13.8	8.0	21.8	Complied

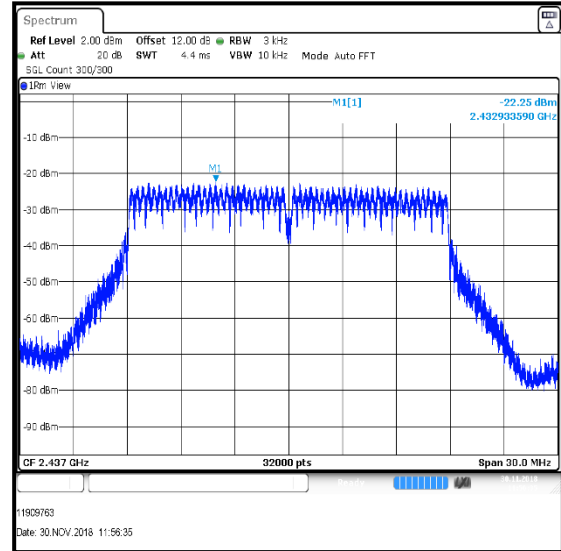
Result: Pass

Transmitter Power Spectral Density (continued)

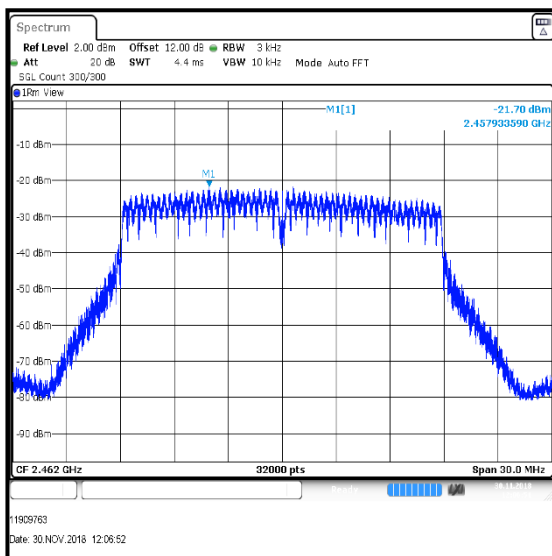
Results: 802.11n / HT20 / MCS0 / MIMO / Port 1 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



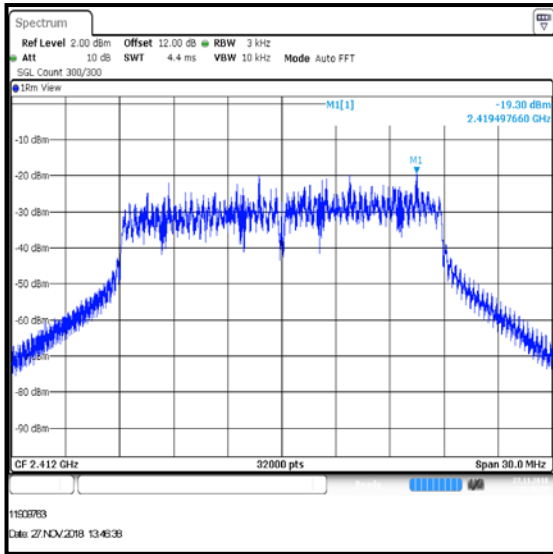
Middle Channel



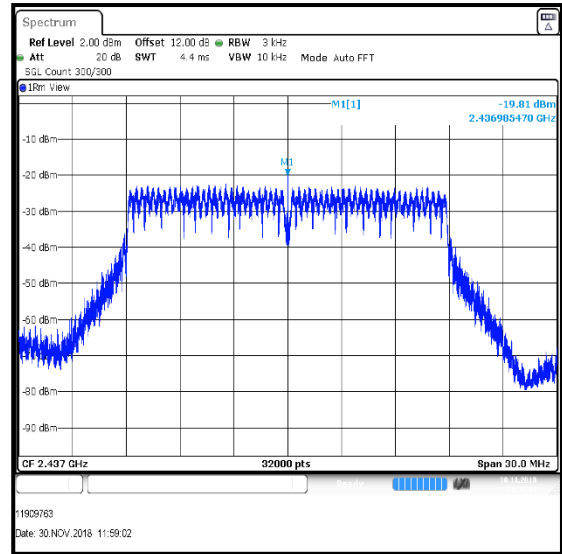
Top Channel

Transmitter Power Spectral Density (continued)

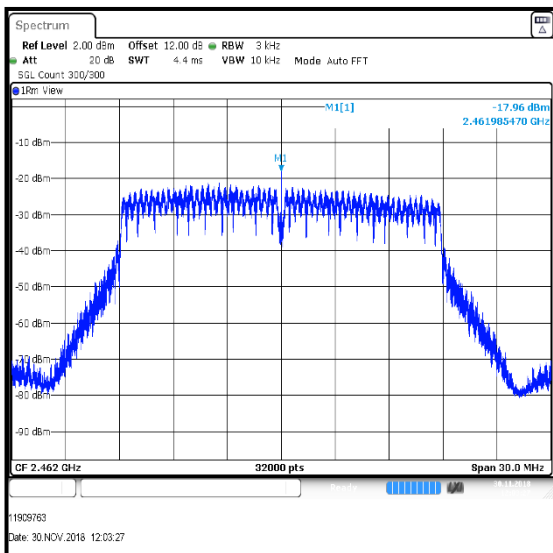
Results: 802.11n / HT20 / MCS0 / MIMO / Port 2 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



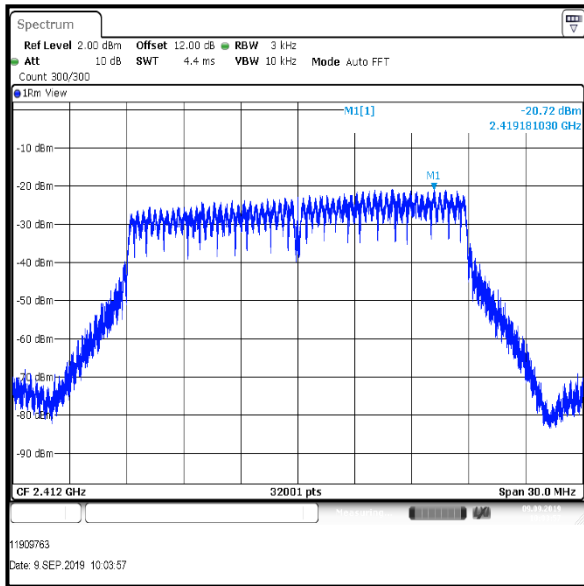
Middle Channel



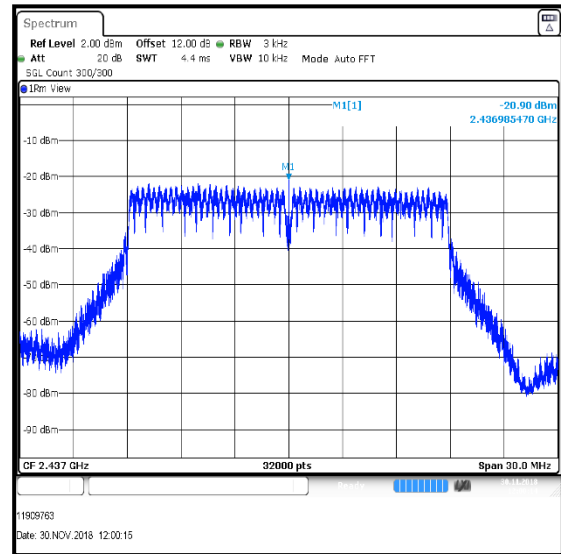
Top Channel

Transmitter Power Spectral Density (continued)

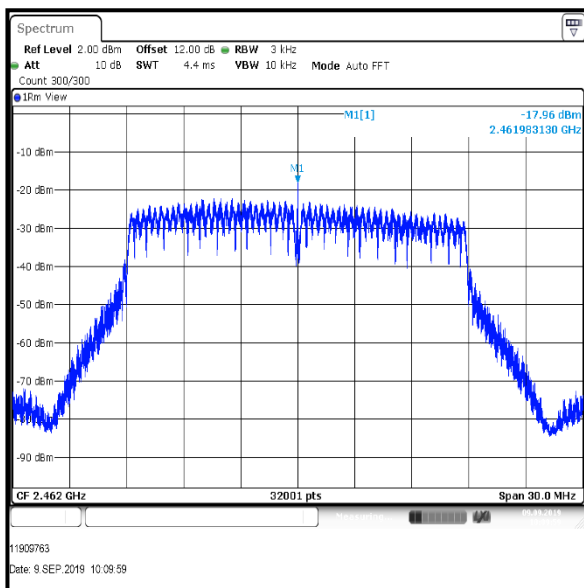
Results: 802.11n / HT20 / MCS0 / MIMO / Port 3 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



Middle Channel



Top Channel

Transmitter Power Spectral Density (continued)

Results: 802.11n / HT40 / MCS0 / MIMO / Port 1+2+3 / PWL 16 / 6 dBi Antenna Group

Channel	Port 1			Port 2		
	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)
Bottom	-23.6	0.6	-23.0	-21.2	0.6	-20.6
Middle	-22.3	0.6	-21.7	-24.1	0.6	-23.5
Top	-24.5	0.6	-23.9	-21.6	0.6	-21.0

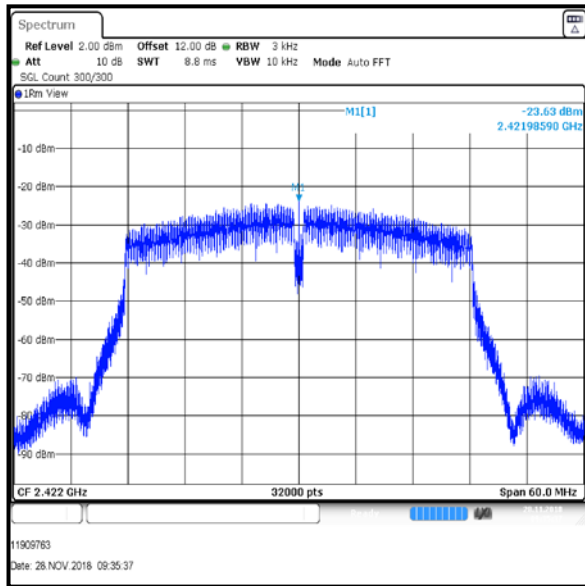
Channel	Port 3		
	Output Power (dBm/3 kHz)	Duty Cycle Correction (dB)	Corrected Output Power (dBm/3 kHz)
Bottom	-21.5	0.6	-20.9
Middle	-20.7	0.6	-20.1
Top	-24.6	0.6	-24.0

Channel	Output Power Port 1 (dBm/3 kHz)	Output Power Port 2 (dBm/3 kHz)	Output Power Port 3 (dBm/3 kHz)	Port 1+2+3 Combined Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-23.0	-20.6	-20.9	-16.6	8.0	24.6	Complied
Middle	-21.7	-23.5	-20.1	-16.8	8.0	24.8	Complied
Top	-23.9	-21.0	-24.0	-18.0	8.0	26	Complied

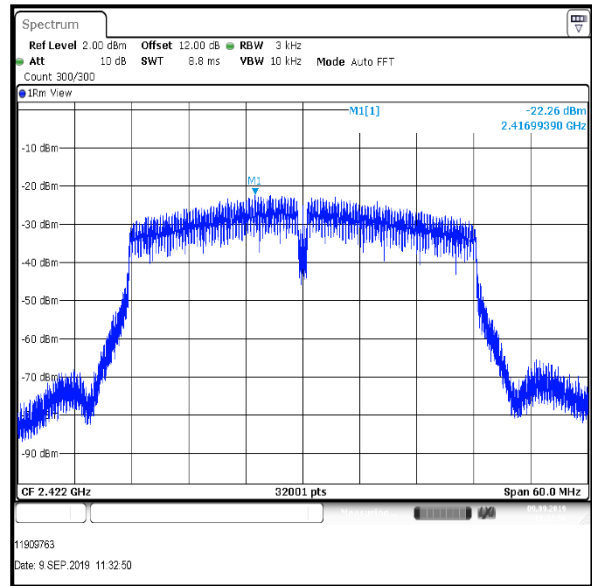
Result: Pass

Transmitter Power Spectral Density (continued)

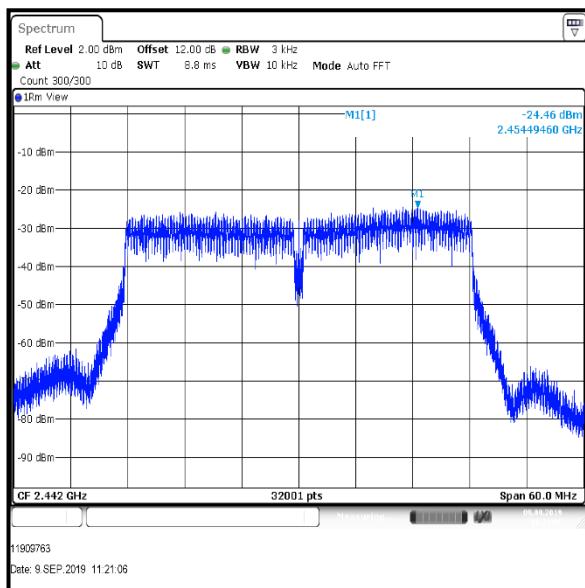
Results: 802.11n / HT40 / MCS0 / MIMO / Port 1 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



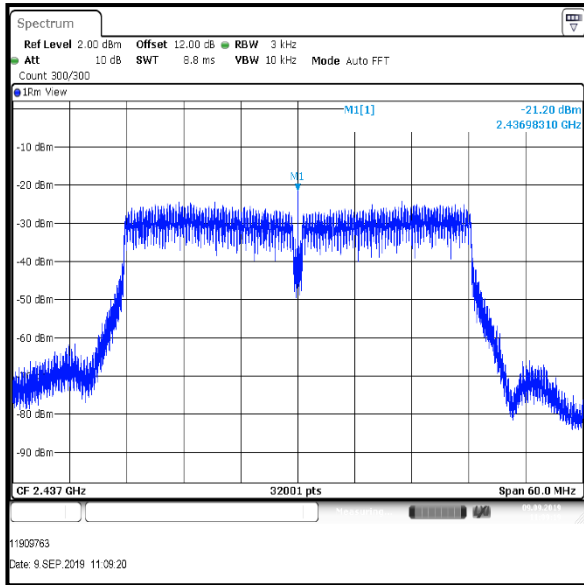
Middle Channel



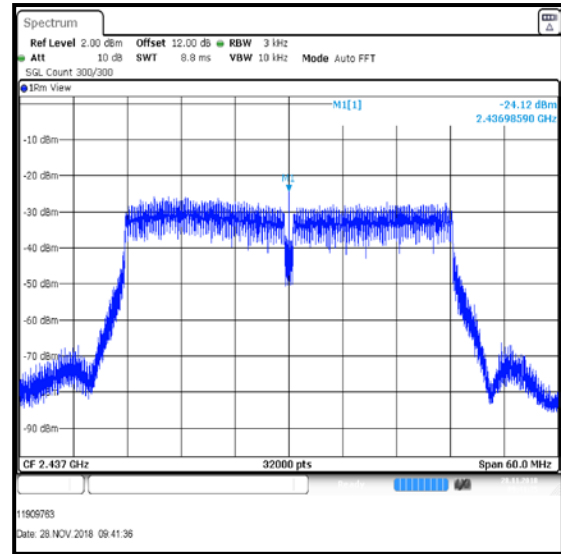
Top Channel

Transmitter Power Spectral Density (continued)

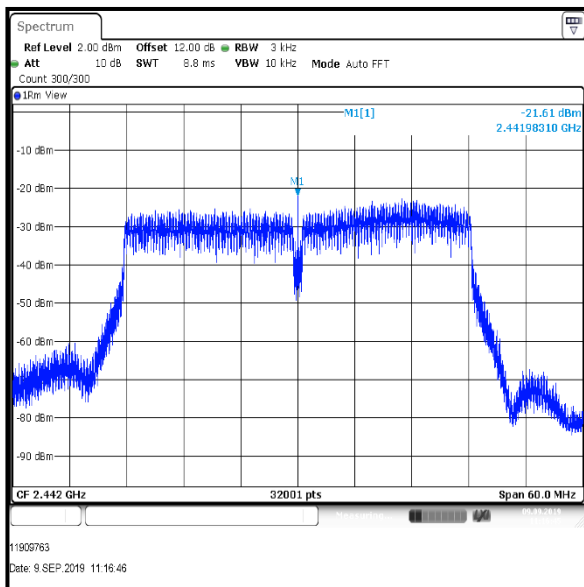
Results: 802.11n / HT40 / MCS0 / MIMO / Port 2 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



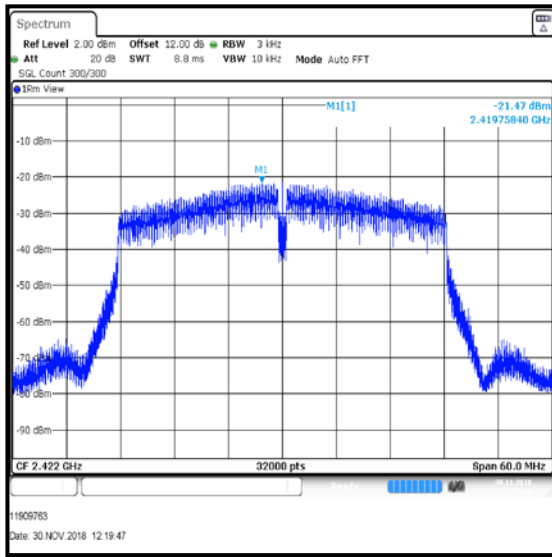
Middle Channel



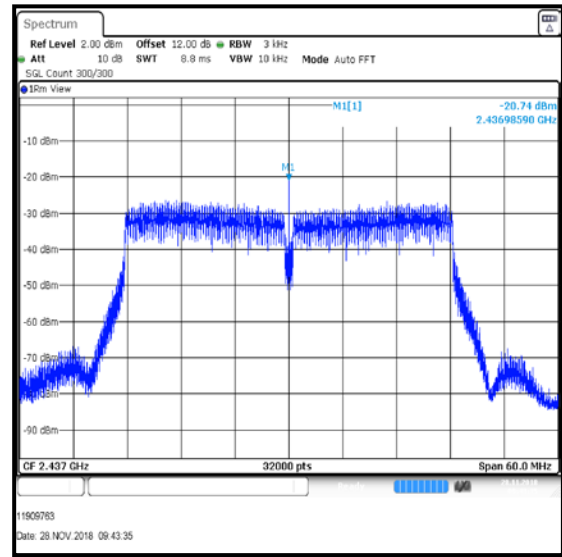
Top Channel

Transmitter Power Spectral Density (continued)

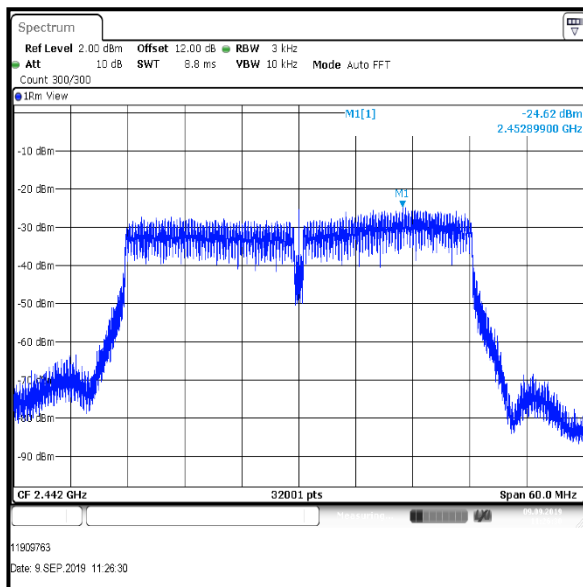
Results: 802.11n / HT40 / MCS0 / MIMO / Port 3 / PWL 16 / 6 dBi Antenna Group



Bottom Channel



Middle Channel



Top Channel

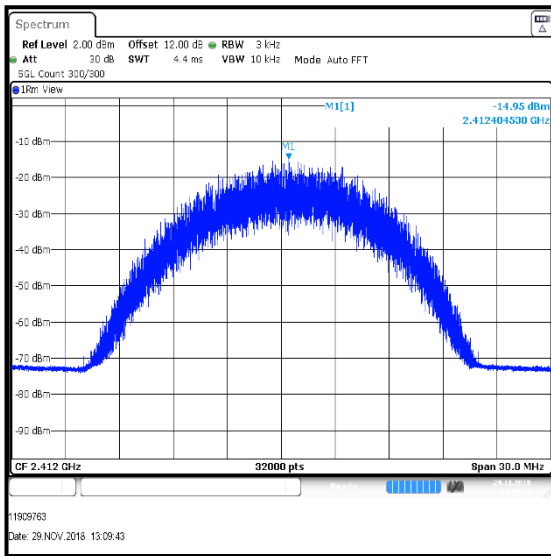
Transmitter Power Spectral Density (continued)

Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 1+2+3+4 / PWL 15 / 6 dBi Antenna Group

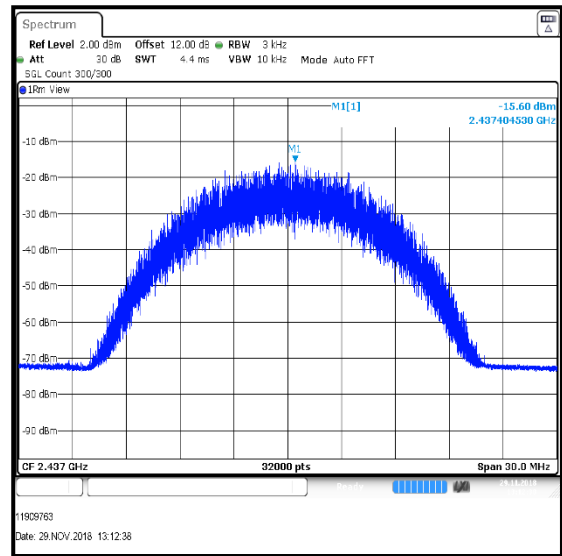
Channel	Output Power Port 1 (dBm/3 kHz)	Output Power Port 2 (dBm/3 kHz)	Output Power Port 3 (dBm/3 kHz)	Output Power Port 4 (dBm/3 kHz)	Port 1+2+3+4 Combined Output Power (dBm/3 kHz)	Limit (dBm/3kHz)	Margin (dB)	Result
Bottom	-15.0	-15.6	-14.9	-16.6	-9.5	8.0	17.5	Complied
Middle	-15.6	-15.5	-15.2	-16.2	-9.6	8.0	17.6	Complied
Top	-14.2	-15.7	-14.9	-19.6	-9.7	8.0	17.7	Complied

Result: **Pass**

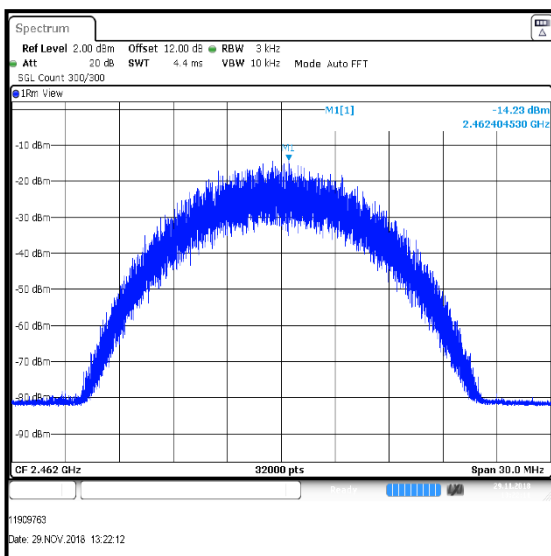
Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 1 / PWL 15 / 6 dBi Antenna Group



Bottom Channel



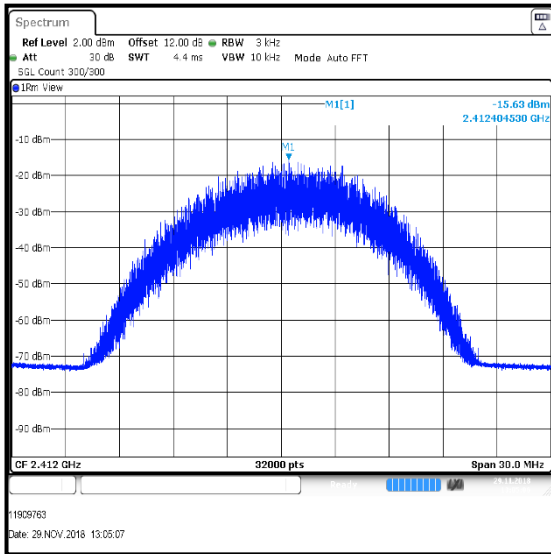
Middle Channel



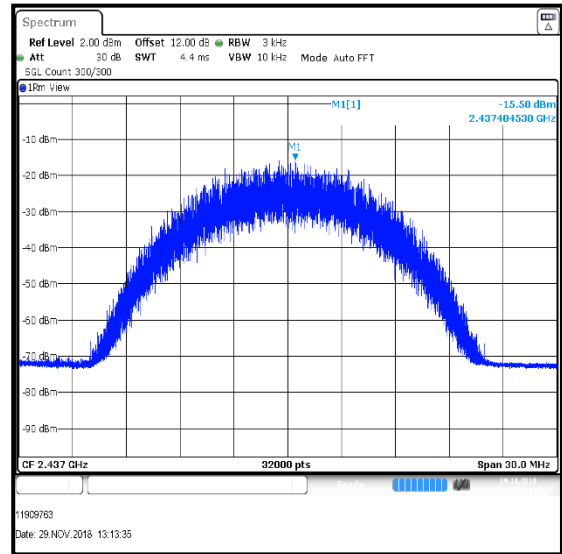
Top Channel

Transmitter Power Spectral Density (continued)

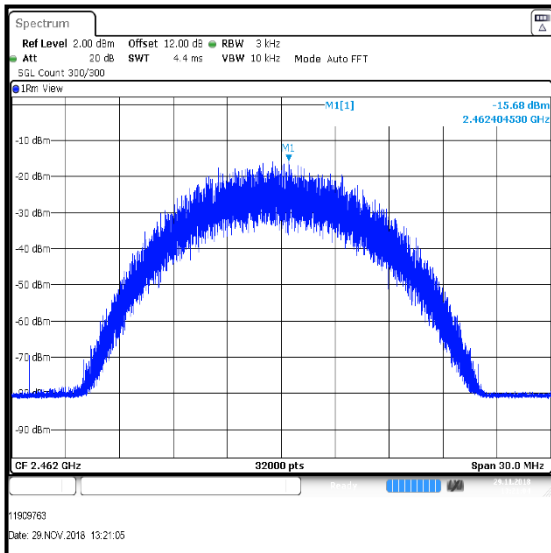
Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 2 / PWL 15 / 6 dBi Antenna Group



Bottom Channel



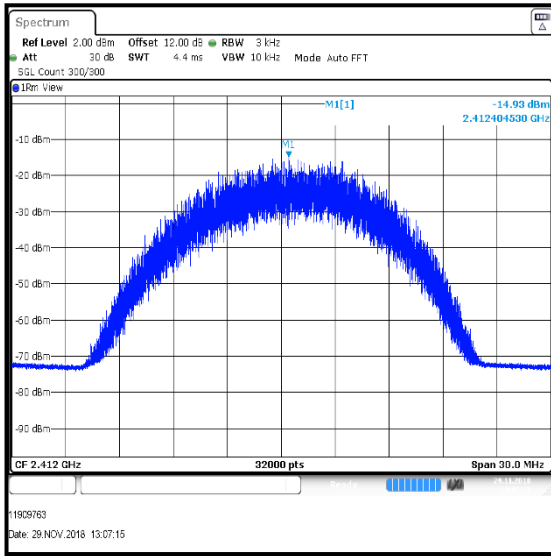
Middle Channel



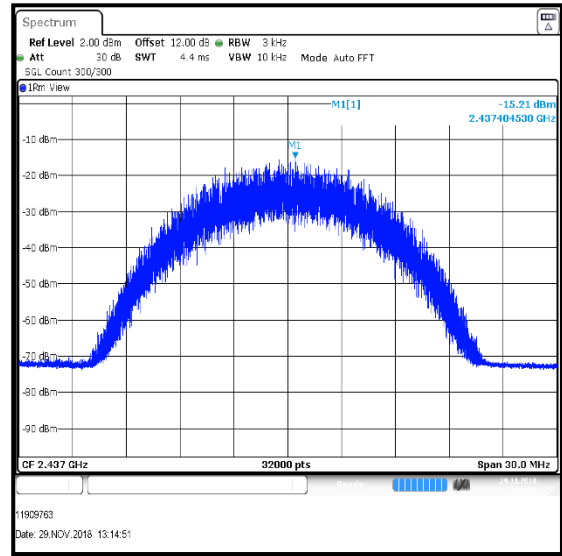
Top Channel

Transmitter Power Spectral Density (continued)

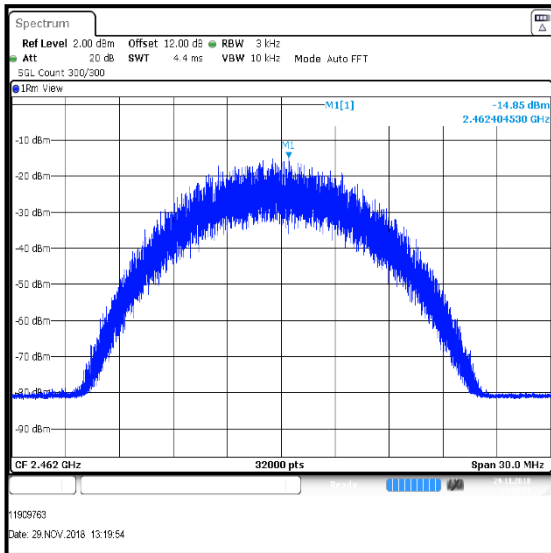
Results: 802.11b / 20 MHz / 5.5 Mbps / MIMO / Port 3 / PWL 15 / 6 dBi Antenna Group



Bottom Channel



Middle Channel



Top Channel