TEST REPORT

Test Report No. : UL-RPT-RP12663640-1616A

Customer	:	Raspberry Pi (Trading) Ltd
Model No.	:	Raspberry Pi 4 Model B
FCC ID	:	2ABCB-RPI4B
Technology	:	WLAN
Test Standard(s)	:	FCC Parts 15.207, 15.209(a) & 15.407
Test Laboratory	:	UL VS LTD, Basingstoke, Hampshire, RG24 8AH, United Kingdom

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2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 1.0

Date of Issue: 30 May 2019

Checked by:

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Senior Test Engineer, Radio Laboratory

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Customer Information

Company Name:	Raspberry Pi (Trading) Ltd
Address:	Maurice Wilkes Building Cowley Road Cambridge CB4 0DS United Kingdom

Report Revision History

Version Number	Issue Date	Revision Details	Revised By
1.0	30/05/2019	Initial Version	Sarah Williams

Table of Contents

1. Attestation of Test Results

1.1. Description of EUT

The Equipment Under Test was a single board computer. It contains a *Bluetooth* and 2.4 and 5 GHz WLAN module powered from an AC/DC power supply. The antenna is integral.

1.2. General Information

Specification Reference:	47CFR15.407 and 47CFR15.403
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) – Sections 15.403 and 15.407
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
Site Registration:	621311
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	17 April 2019 to 10 May 2019

1.3. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.35(c)	Transmitter Duty Cycle	Note 1
Part 15.403(i)	Transmitter 26 dB Emission Bandwidth	✓
Part 15.407(e)	Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band)	✓
Part 15.407(a)(1)(iv)	Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band)	✓
Part 15.407(a)(2)	Transmitter Maximum Conducted Output Power (5.25-5.35 GHz & 5.47-5.725 GHz bands)	✓
Part 15.407(a)(3)	Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band)	✓
Part 15.407(a)(1)(iv)	Transmitter Maximum Power Spectral Density (5.15-5.25 GHz band)	✓
Part 15.407(a)(2)	Transmitter Maximum Power Spectral Density (5.25-5.35 GHz & 5.47-5.725 GHz bands)	✓
Part 15.407(a)(3)	Transmitter Maximum Power Spectral Density (5.725-5.85 GHz band)	✓
Part 15.407(b)/15.209(a)	Transmitter Out of Band Radiated Emissions	✓
Part 15.407(b)/15.209(a)	Transmitter Band Edge Radiated Emissions	✓
Part 15.407(g)	Transmitter Frequency Stability (Temperature & Voltage Variation)	Note 2
Part 15.407(h)(1)	Transmitter Power Control	Note 3
Part 15.207	Transmitter AC Conducted Emissions	✓
Key to Results ✓ = Complied ✗ = Did not comply		

Note(s):

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

1.4. Deviations from the Test Specification

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

2. Summary of Testing

2.1. Facilities and Accreditation

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

Site 1	X
Site 2	X
Site 17	X

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

2.2. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 789033 D02 General U-NII Test Procedures New Rules v02r01 December 14, 2017
Title:	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E)
Reference:	KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions

2.3. Calibration and Uncertainty

Measuring Instrument Calibration

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

Measurement Uncertainty

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

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

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

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

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Duty Cycle	5.15 GHz to 5.850 GHz	95%	±1.14 %
26 dB Emission Bandwidth	5.15 GHz to 5.850 GHz	95%	±4.59 %
Minimum 6 dB Emission Bandwidth	5.15 GHz to 5.850 GHz	95%	±4.59 %
Maximum Conducted Output Power	5.15 GHz to 5.850 GHz	95%	±1.13 dB
Maximum Power Spectral Density	5.15 GHz to 5.850 GHz	95%	±1.13 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±4.65 dB
Radiated Spurious Emissions	1 GHz to 40 GHz	95%	±2.94 dB
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±2.40 dB

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

2.4. Test and Measurement Equipment

Test Equipment Used for Transmitter Conducted Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2004	Thermohygrometer	Testo	608-H1	45046425	06 Jan 2020	12
M2033	Signal Analyser	Rohde & Schwarz	FSV13	101667	29 Jan 2020	12
M2024	Power Sensor	Boonton	55006	9824	11 Jan 2020	12
A3027	Attenuator	Broadwave Technologies Inc.	351-311-006	#1	Calibrated before use	-
A3004	RF Switch	Pickering Interfaces	64-102-002	XZ363230	Calibrated before use	-
A3180	Attenuator	Pasternack	PE7047-3	Not stated	Calibrated before use	-
G0615	Signal Generator	Rohde & Schwarz	SMBV100A	260473	08 May 2020	36
A3005	Replay Test Rack	N/A	N/A	N/A	Calibration not required	-

Test Measurement Software/Firmware Used for Transmitter Conducted Tests

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

Test and Measurement Equipment (continued)

Test Equipment Used for Transmitter Radiated Emissions

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	06 Jan 2020	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	16 Feb 2020	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	20 Sep 2019	12
A2523	Attenuator	AtlanTecRF	AN18W5-10	832827#	04 Mar 2020	12
A2893	Pre Amplifier	Schwarzbeck	BBV 9721	9721-021	15 Feb 2020	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	16 Feb 2020	12
A3138	Antenna	Schwarzbeck	BBHA 9120 B	00702	03 Oct 2019	12
A3139	Antenna	Schwarzbeck	HWRD750	00027	04 Oct 2019	12
A3095	High Pass Filter	AtlanTecRF	AFH-07000	18051600012	09 Apr 2020	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	04 Oct 2019	12
M2040	Thermohygrometer	Testo	608-H1	45124934	06 Jan 2020	12
A3161	Antenna	Teseq	CBL6111D	50859	17 Dec 2019	12
A3083	Low Pass Filter	AtlanTecRF	AFL-01000	18010900076	09 Feb 2020	12

Test Equipment Used for Transmitter Band Edge Radiated Emissions

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2016	Thermohygrometer	Testo	608-H1	45046428	06 Jan 2020	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	08 Feb 2020	12
A3056	Pre-Amplifier	Com-Power	PAM-118A	18040040	08 Feb 2020	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	04 Dec 2019	12
A1818	Antenna	EMCO	3115	00075692	08 Feb 2020	12
A2141	Attenuator	AtlanTecRF	AN18-10	090918-04	18 Feb 2020	12

Test Equipment Used for Transmitter AC Conducted Emissions

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2037	Thermohygrometer	Testo	608-H1	45124925	06 Jan 2020	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	23 Aug 2019	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	10 Apr 2020	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	18 Dec 2019	12

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Raspberry Pi
Model Name or Number:	Raspberry Pi 4 Model B
Test Sample Serial Number:	000000007add4646 *(Conducted sample)*
Hardware Version:	V1.0
Software Version:	V1.0
FCC ID:	2ABCB-RPI4B

Brand Name:	Raspberry Pi
Model Name or Number:	Raspberry Pi 4 Model B
Test Sample Serial Number:	0000000027a0c96b *(Radiated sample #1)*
Hardware Version:	V1.0
Software Version:	V1.0
FCC ID:	2ABCB-RPI4B

Brand Name:	Raspberry Pi
Model Name or Number:	Raspberry Pi 4 Model B
Test Sample Serial Number:	000000003f9edf4a *(Radiated sample #2)*
Hardware Version:	V1.0
Software Version:	V1.0
FCC ID:	2ABCB-RPI4B

3.2. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.3. Additional Information Related to Testing

Technology Tested:	WLAN (IEEE 802.11a,n,ac) / U-NII		
Type of Unit:	Transceiver		
Modulation:	BPSK, QPSK, 16QAM, 64QAM & 256QAM		
Data rates:	802.11a	6, 9, 12, 18, 24, 36, 48 & 54 Mbps (SISO)	
	802.11n HT20	MCS0 to MCS7 (SISO)	
	802.11n HT40	MCS0 to MCS7 (SISO)	
	802.11ac VHT20	MCS0 to MCS8 (SISO)	
	802.11ac VHT40	MCS0 to MCS9 (SISO)	
	802.11ac VHT80	MCS0 to MCS9 (SISO)	
Power Supply Requirement(s):	Nominal	5.0 VDC	
Maximum Conducted Output Power:	20 MHz	14.5 dBm	
	40 MHz	14.4 dBm	
	80 MHz	13.3 dBm	

Channel Spacing:	20 MHz		
Transmit Frequency Band:	5150 MHz to 5250 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	36	5180
	Middle	40	5200
	Top	48	5240
Transmit Frequency Band:	5250 MHz to 5350 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	52	5260
	Middle	56	5280
	Top	64	5320
Transmit Frequency Band:	5470 MHz to 5725 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	100	5500
	Middle	116	5580
	Top	140	5700
Transmit Frequency Band:	5725 MHz to 5850 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	149	5745
	Middle	157	5785
	Top	165	5825

Additional Information Related to Testing (continued)

Channel Spacing:	40 MHz		
Transmit Frequency Band:	5150 MHz to 5250 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	38	5190
	Top	46	5230
Transmit Frequency Band:	5250 MHz to 5350 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	54	5270
	Top	62	5310
Transmit Frequency Band:	5470 MHz to 5725 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	102	5510
	Middle	110	5550
	Top	134	5670
Transmit Frequency Band:	5725 MHz to 5850 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	151	5755
	Top	159	5795

Additional Information Related to Testing (continued)

Channel Spacing:	80 MHz		
Transmit Frequency Band:	5150 MHz to 5250 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Single	42	5210
Transmit Frequency Band:	5250 MHz to 5350 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Single	58	5290
Transmit Frequency Band:	5470 MHz to 5725 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	106	5530
	Top	122	5610
Transmit Frequency Band:	5725 MHz to 5850 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Single	155	5775

3.4. Description of Available Antennas

The radio utilizes an integrated antenna, with the following maximum gain:

Frequency Range (MHz)	Antenna Gain (dBi)
5150-5850	2.3

3.5. Description of Test Setup

Support Equipment

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

Description:	LCD Monitor
Brand Name:	Logik
Model Name or Number:	L22FE12A
Serial Number:	1309020661

Description:	USB Mouse
Brand Name:	Raspberry Pi
Model Name or Number:	RPI-MOUSE
Serial Number:	Not marked or stated

Description:	USB Keyboard
Brand Name:	Raspberry Pi
Model Name or Number:	RPI-KYB
Serial Number:	Not marked or stated

Description:	Power Supply. 100-230 VAC Input / 5 VDC output
Brand Name:	Belkin
Model Name or Number:	F7U011dr
Serial Number:	Not marked or stated

Description:	16 GB Micro SD card
Brand Name:	SanDisk
Model Name or Number:	HCI
Serial Number:	Not marked or stated

Description:	HDMI Cable Type A to Type D. Quantity 1. Length 1.05 metres
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Ethernet cable. Quantity 1. Length 1.0 metres
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Support Equipment (continued)

Description:	USB cable. Quantity 3. Length 3.0 metres
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	USB Hub
Brand Name:	Hama
Model Name or Number:	00078498
Serial Number:	09825891600

Description:	Ethernet Router
Brand Name:	Netgear
Model Name or Number:	GS605
Serial Number:	1YG194390218E

Description:	HDMI Hub
Brand Name:	Sumvision
Model Name or Number:	Cyclone Micro
Serial Number:	SUM091104017

Description:	Cat 5 Ethernet Cable. Quantity 1. Length 2.0 metres
Brand Name:	AWN
Model Name or Number:	2835
Serial Number:	E87647

Description:	Test Laptop
Brand Name:	Lenovo
Model Name or Number:	L440
Serial Number:	R9-019EA1 14/04

Description:	Generic Headphones (ear buds)
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Support Equipment (continued)

Description:	USB Thumb Drive
Brand Name:	Sandisk
Model Name or Number:	Ultra flair USB 3.0
Serial Number:	BM182025896Z

Description:	USB Thumb Drive
Brand Name:	Sandisk
Model Name or Number:	Ultra flair USB 3.0
Serial Number:	BM190125896Z

Operating Modes

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

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

Configuration and Peripherals

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

- The customer's test application and supplied instructions were used to place the EUT into WLAN test mode. The supplied commands were entered into the console menu on the EUT. Test commands stated in the wlan_testing_3.sh file located on the /home/pi drive of the EUT were used to configure the EUT to enable a continuous transmission and to select the test channels, data rates and modulation schemes as required.
- The customer requested the following data rates to be used for all measurements.
    - 802.11a SISO - BPSK / 6 Mbps
    - 802.11n HT20 / SISO – BPSK / MCS0
    - 802.11n HT40 / SISO – BPSK / MCS0
    - 802.11ac VHT80 / SISO – BPSK / MCS0x1
- Testing was performed using the power settings defined in the table in the power settings section below.
- RF cables and attenuators connecting the test equipment to the EUT were calibrated before use and the calibration data incorporated into the conducted measurement results.
- The EUT was powered via an AC/DC switch mode power supply.
- AC conducted emissions test was tested with the EUT transmitting on the middle channel using a data rate of 6 Mbps (802.11a), as this mode was found to transmit the highest power.
- Transmitter spurious emissions were performed with the EUT transmitting with a data rate of 6 Mbps (802.11a). This was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and as this mode emits the highest output power level, it was deemed to be the worst case.
- Radiated spurious emissions were performed with the EUT in the Y plane (worst case) while connected to its power supply. Tests were performed with the EUT connected to its AC adaptor and USB cable. All other ports were terminated with suitable terminations.
- The LCD monitor was connected to the EUT using a 1.05 metre long HDMI cable.
- The keyboard and mouse were connected to the USB port on the EUT.
- AC conducted tests were performed with all ports terminated, employing all available accessories.

Power Settings

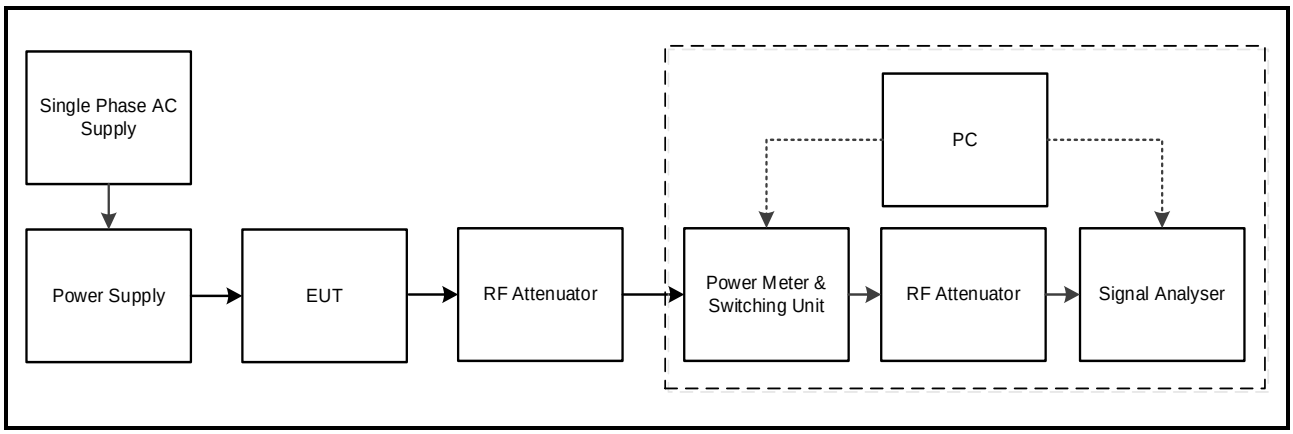
The power settings below have been used for testing:

Channel:	Mode	Q value Used
36	a (6 Mbps)	55
64	a (6 Mbps)	55
100	a (6 Mbps)	43
140	a (6 Mbps)	46
149	a (6 Mbps)	51
165	a (6 Mbps)	54
36	HT20 (MCS0)	38
64	HT20 (MCS0)	55
100	HT20 (MCS0)	43
140	HT20 (MCS0)	43
149	HT20 (MCS0)	55
165	HT20 (MCS0)	55
38	HT40 (MCS0)	50
62	HT40 (MCS0)	55
102	HT40 (MCS0)	55
134	HT40 (MCS0)	58
151	HT40 (MCS0)	58
159	HT40 (MCS0)	58
42	VHT80 (MCS0x1)	44
58	VHT80 (MCS0x1)	44
106	VHT80 (MCS0x1)	48
155	VHT80 (MCS0x1)	61

Test Setup Diagrams

Conducted Tests:

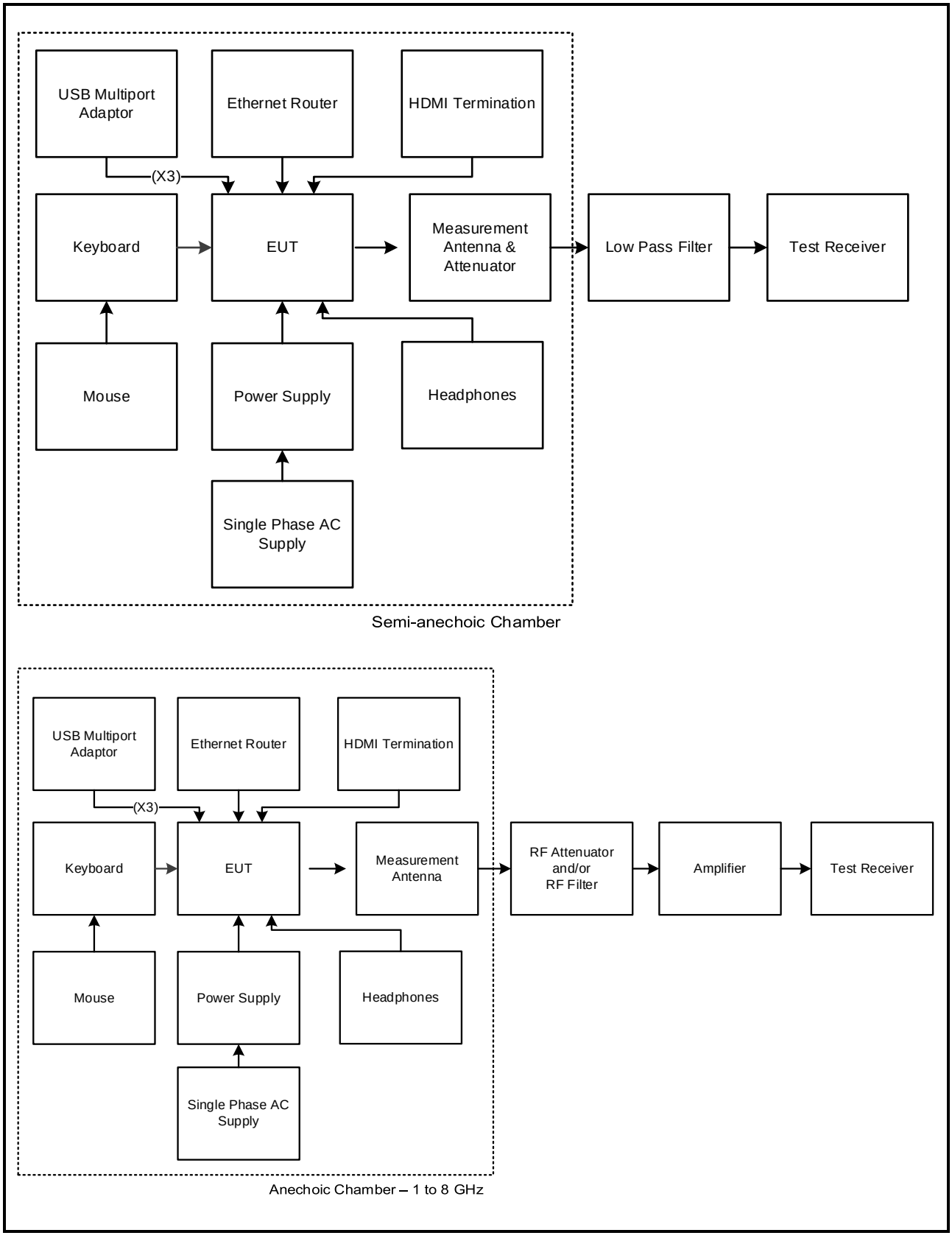
Test Setup for Conducted Transmitter Tests



Test Setup Diagrams (continued)

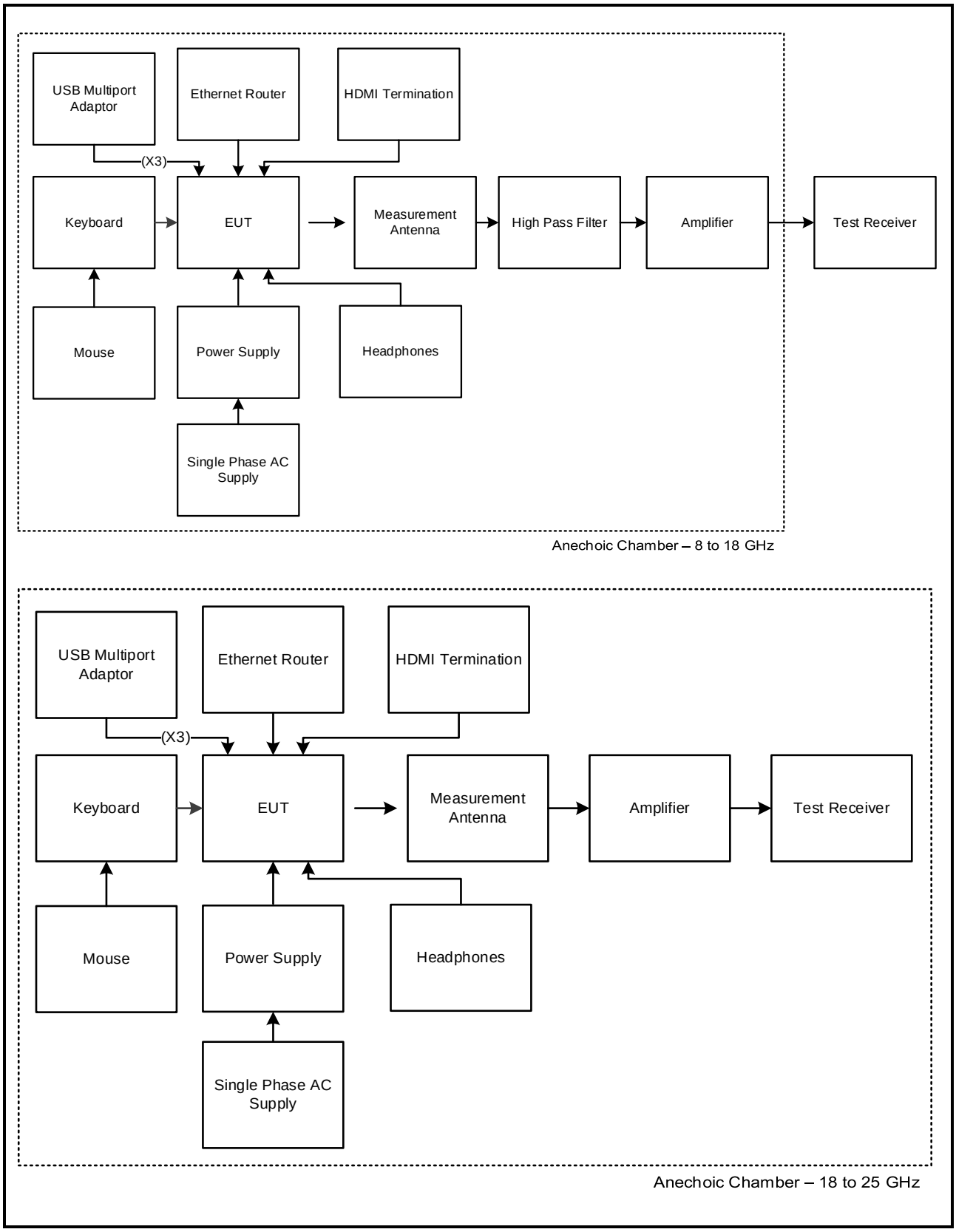
Radiated Tests:

Test Setup for Transmitter Radiated Emissions



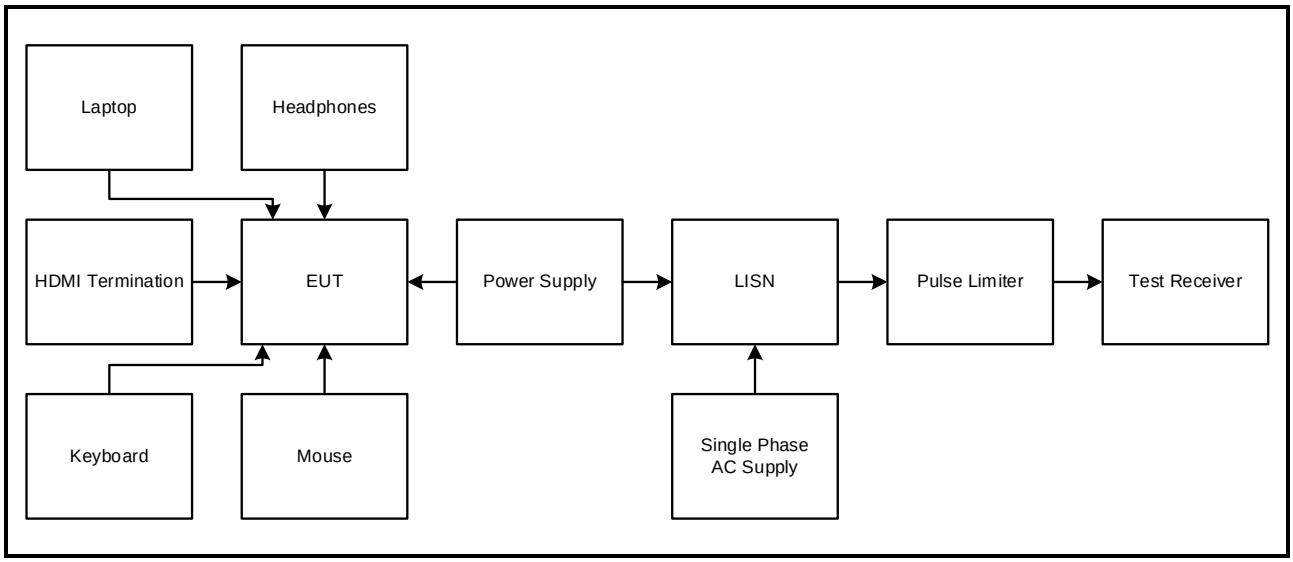
Test Setup Diagrams (continued)

Test setup for radiated measurements (continued):



Test Setup Diagrams (continued)

Test Setup for Transmitter AC Conducted Emissions



4. Antenna Port Test Results

4.1. Transmitter Duty Cycle

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

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

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

Note(s):

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

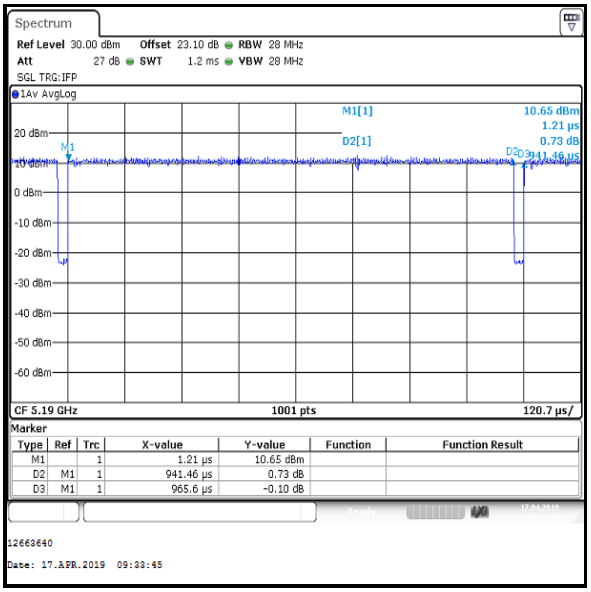
   10 log 1 / (On Time / [Period or 100ms whichever is the lesser]).

2. Plots below are for data rates with a duty cycle less than 98%. Results for all other modes having a duty cycle >98% are archived on the UL VS LTD IT server and available for inspection if required.

Transmitter Duty Cycle (continued)

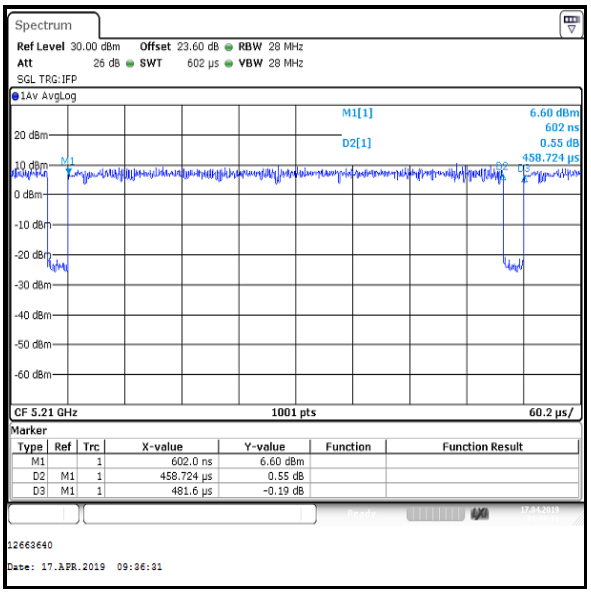
Results: 802.11n / 40 MHz / MCS0

Pulse Duration (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
0.942	0.966	97.5	0.1



Results: 802.11ac / 80 MHz / MCS0x1

Pulse Duration (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
0.459	0.482	95.3	0.2



4.2. Transmitter 26 dB Emission Bandwidth

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

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

Environmental Conditions:

Temperatures (°C):	23
Relative Humidity (%):	36

Note(s):

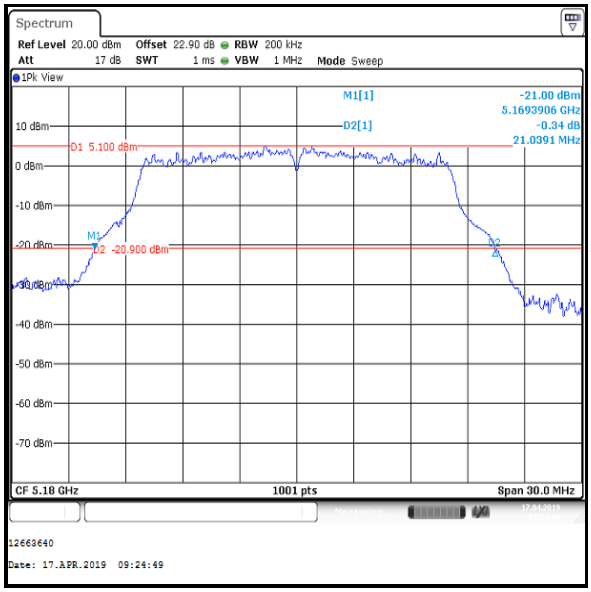
1. Measurements were performed in accordance with KDB 789033 Section II.C.1. Emission Bandwidth (EBW) test procedure on the relevant channels in all supported operating bands.
2. The signal analyser's resolution bandwidth was set to approximately 1% of the measured 26 dB emission bandwidth.
3. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cables. An RF level offset was entered on the signal analyser to compensate for the loss of the switch, attenuators and RF cables.

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

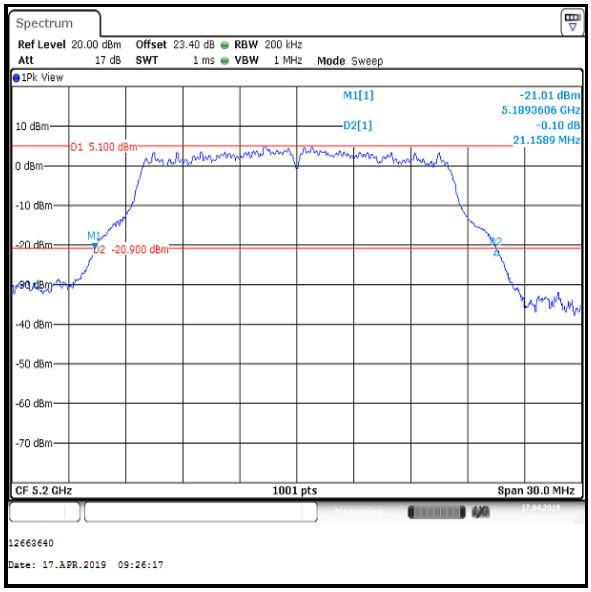
4.2.1. 5.15-5.25 GHz band

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

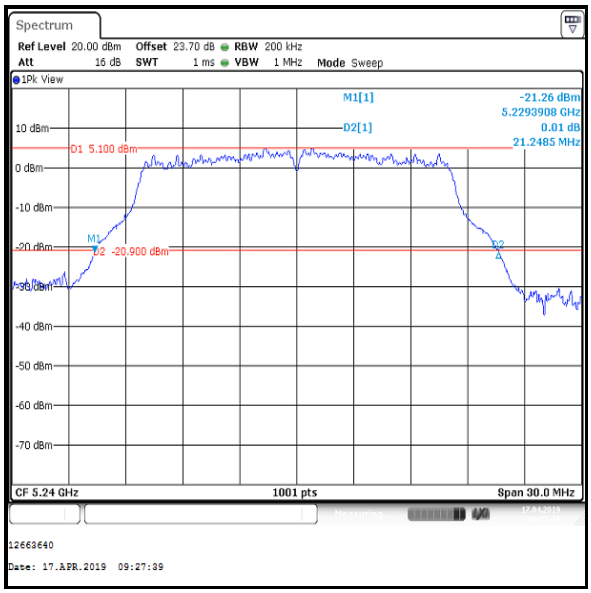
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.039
Middle	5200	21.159
Top	5240	21.249



Bottom Channel



Middle Channel

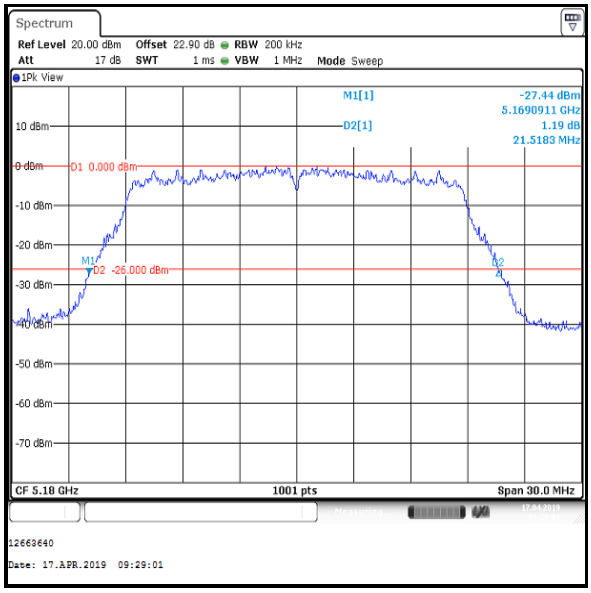


Top Channel

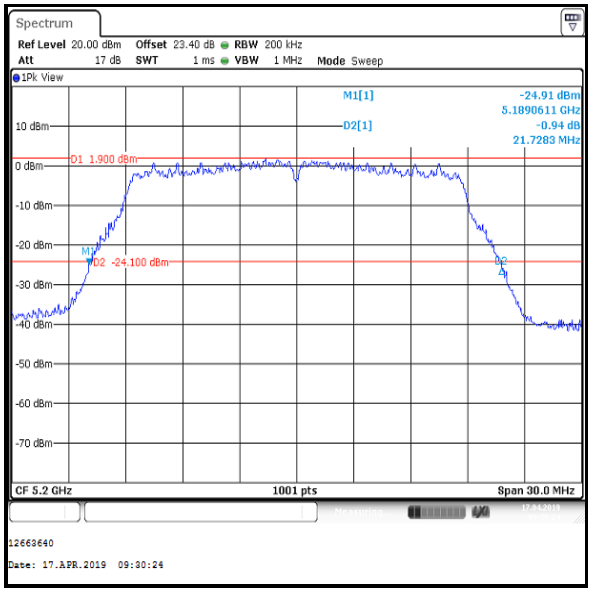
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

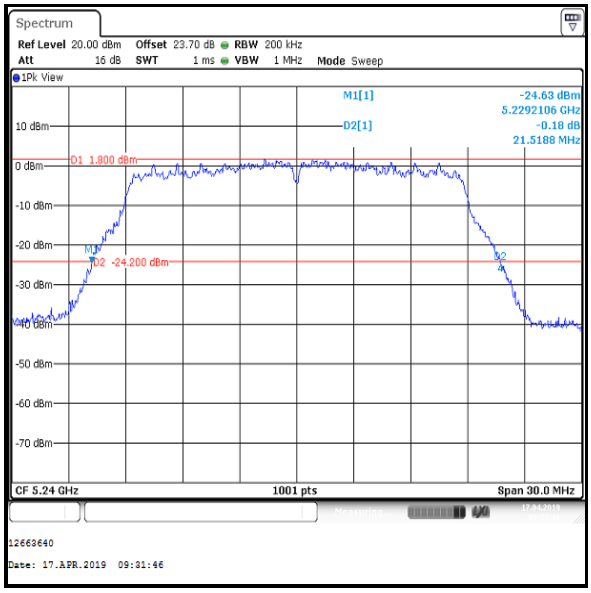
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.518
Middle	5200	21.728
Top	5240	21.519



Bottom Channel



Middle Channel

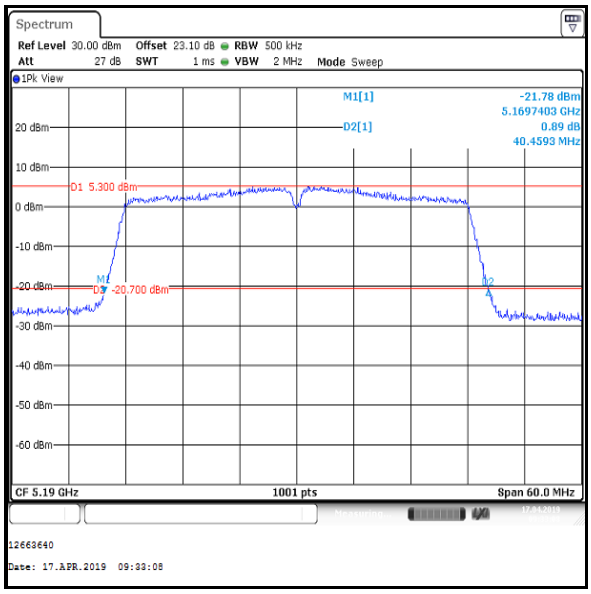


Top Channel

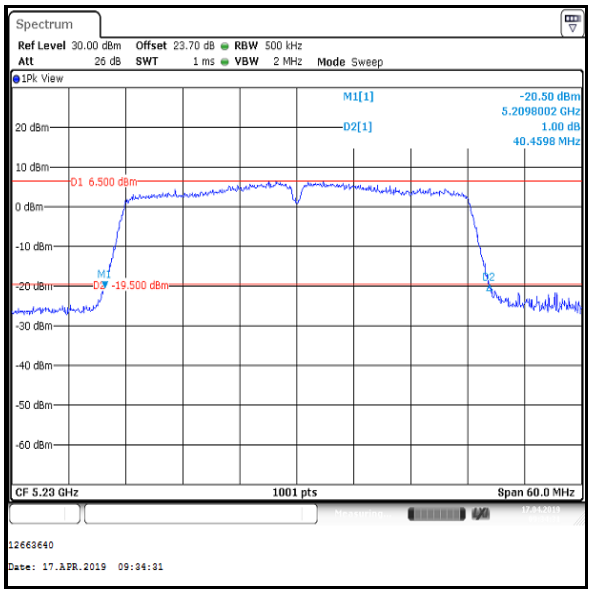
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.459
Top	5230	40.460



Bottom Channel

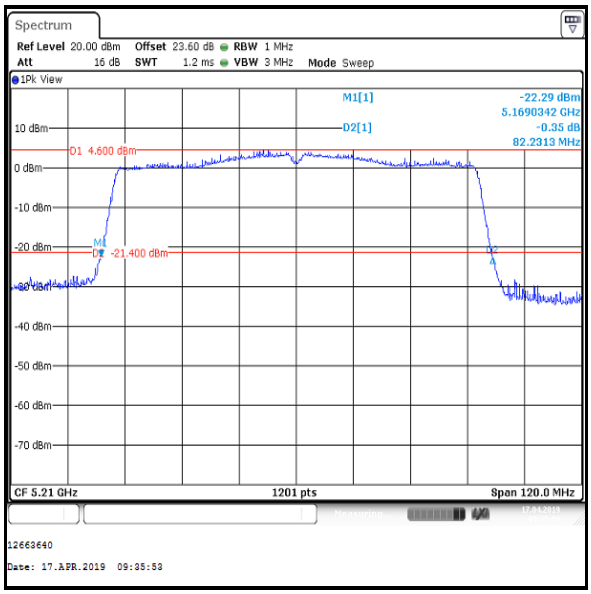


Top Channel

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

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.231



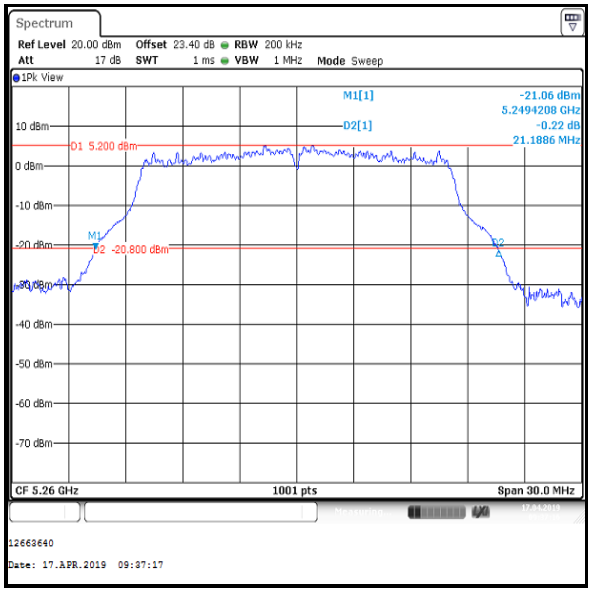
Single Channel

Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)

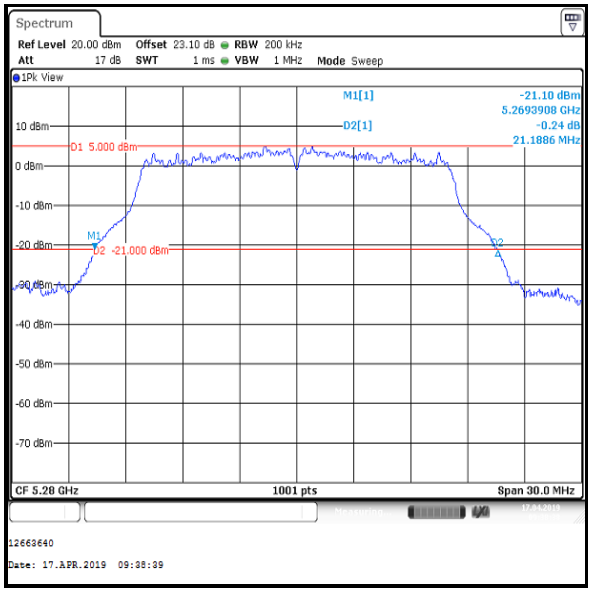
4.2.2. 5.25-5.35 GHz band

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

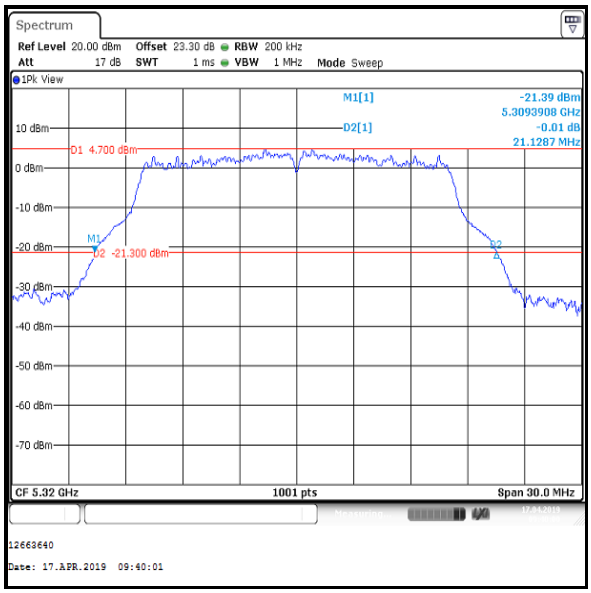
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5260	21.189
Middle	5280	21.189
Top	5320	21.129



Bottom Channel



Middle Channel

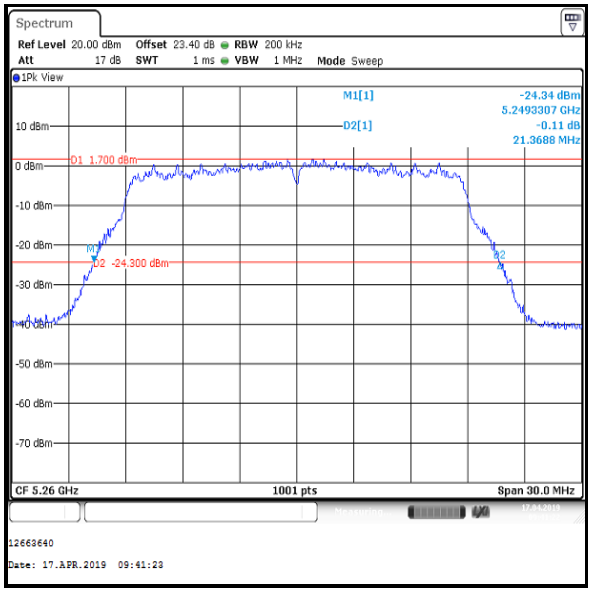


Top Channel

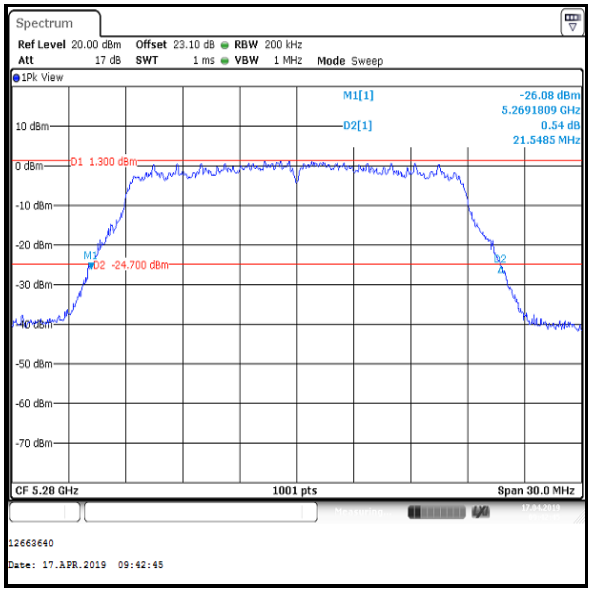
Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

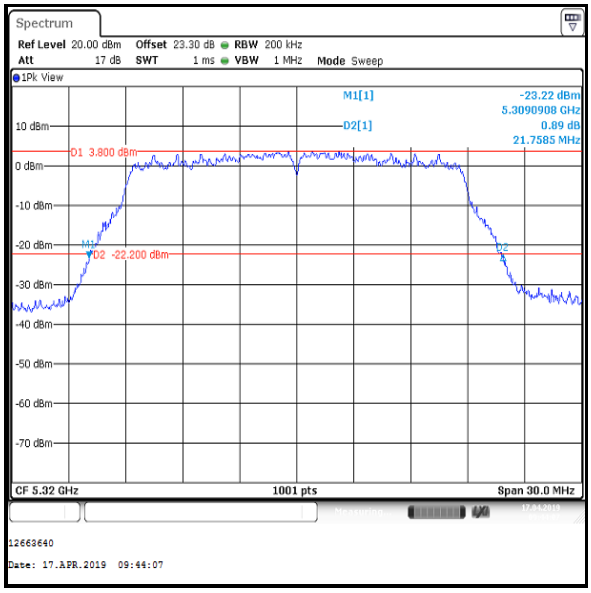
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5260	21.369
Middle	5280	21.549
Top	5320	21.758



Bottom Channel



Middle Channel

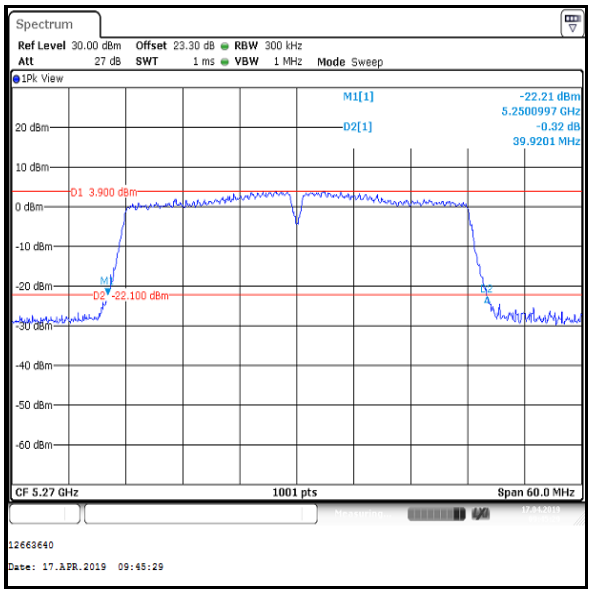


Top Channel

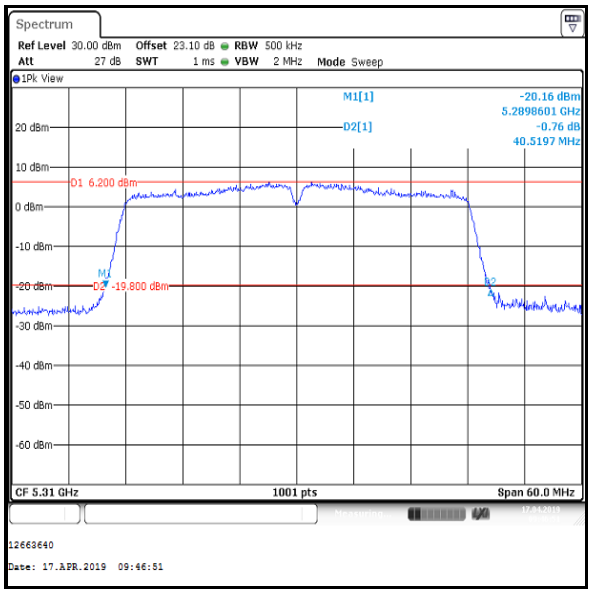
Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5270	39.920
Top	5310	40.520



Bottom Channel

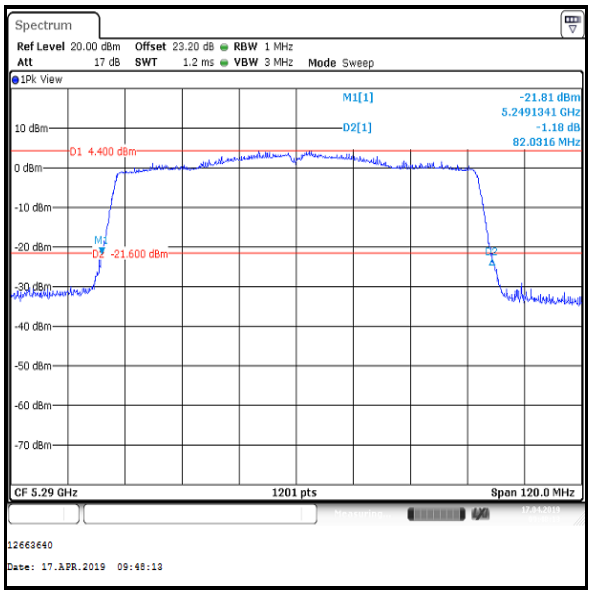


Top Channel

Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5290	82.032



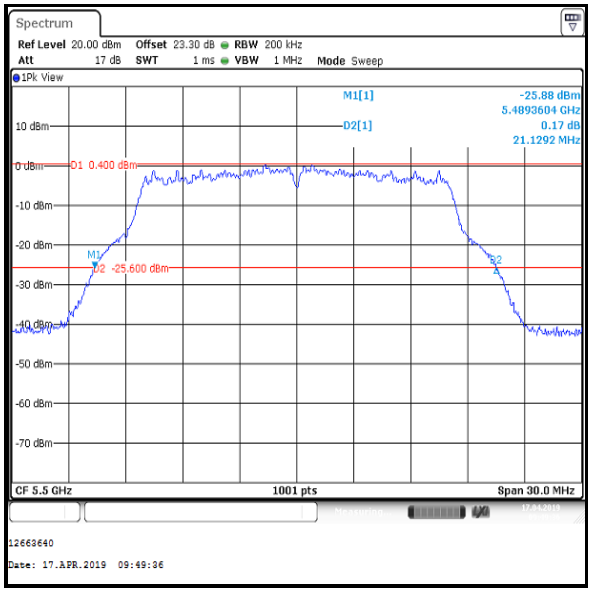
Single Channel

Transmitter 26 dB Emission Bandwidth (5.47-5.725 GHz band) (continued)

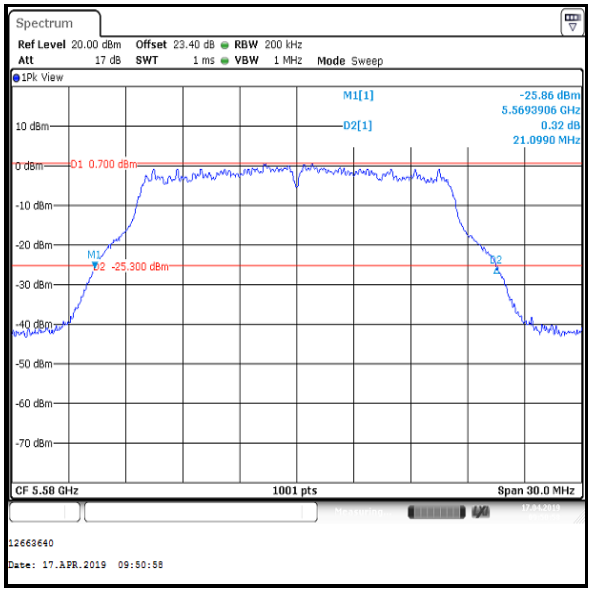
4.2.3. 5.47-5.725 GHz band

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

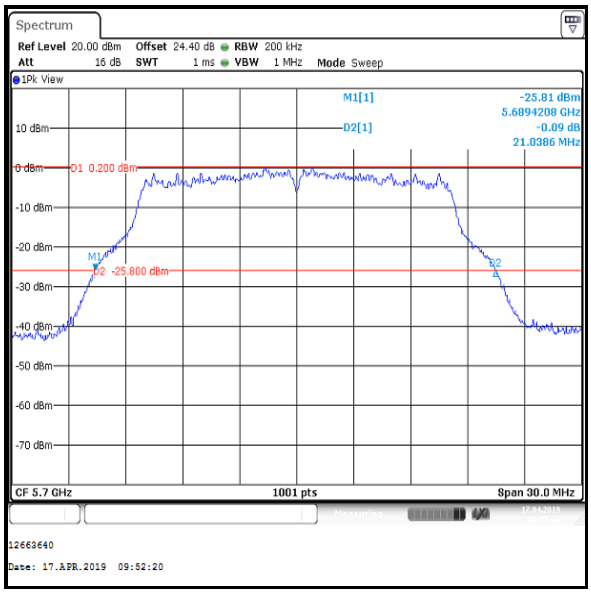
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5500	21.129
Middle	5580	21.099
Top	5700	21.039



Bottom Channel



Middle Channel

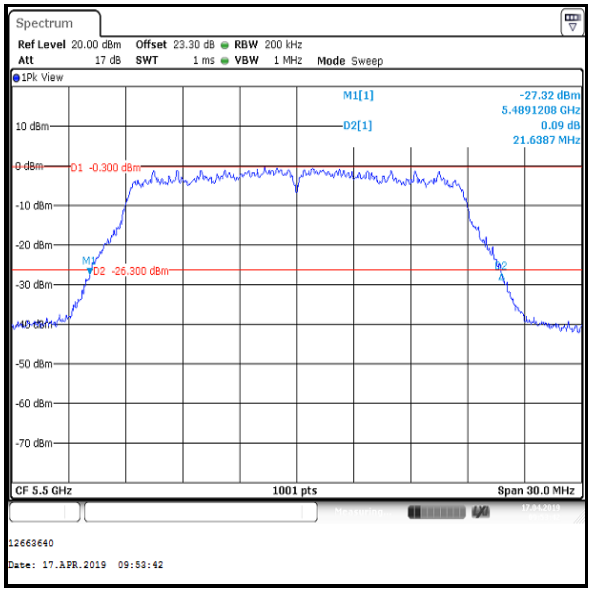


Top Channel

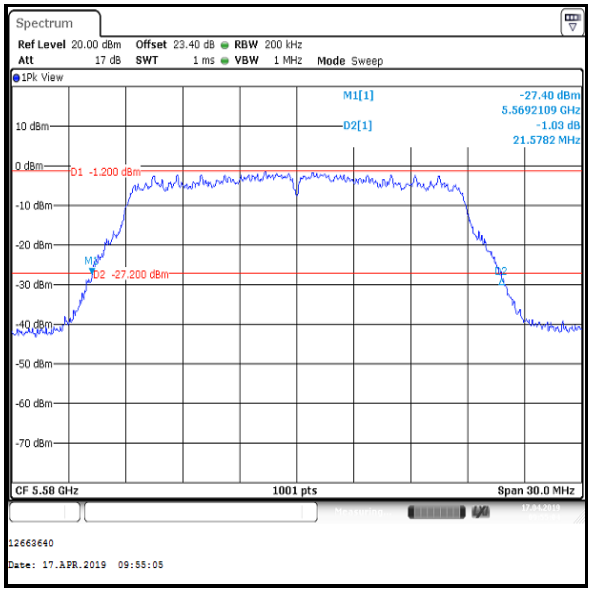
Transmitter 26 dB Emission Bandwidth (5.47-5.725 GHz band) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

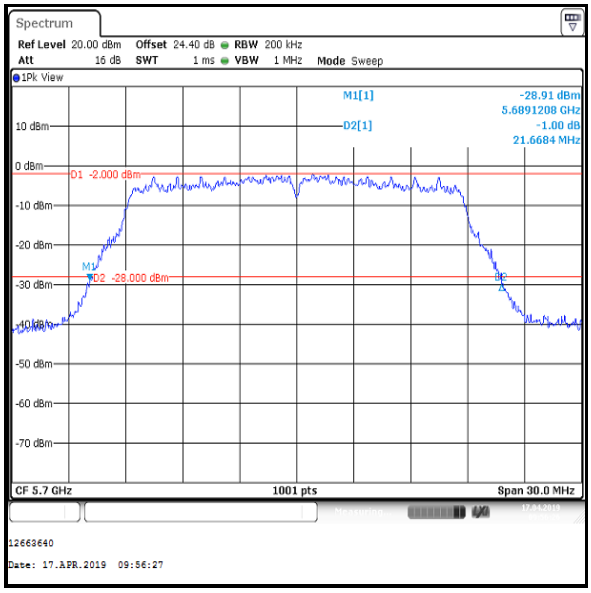
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5500	21.639
Middle	5580	21.578
Top	5700	21.668



Bottom Channel



Middle Channel

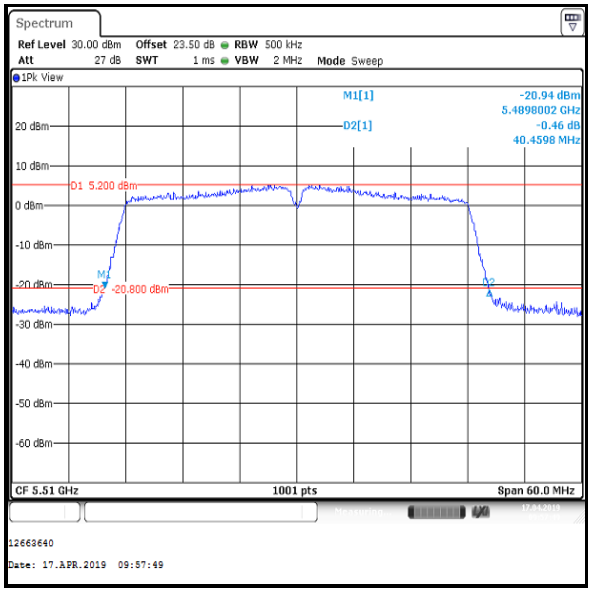


Top Channel

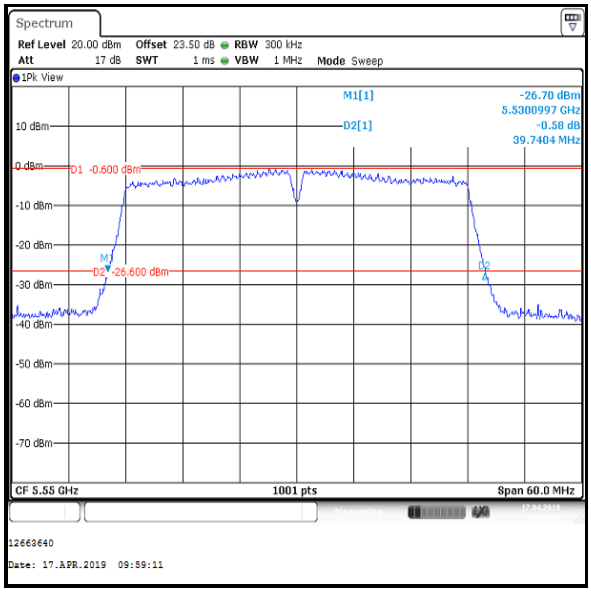
Transmitter 26 dB Emission Bandwidth (5.47-5.725 GHz band) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

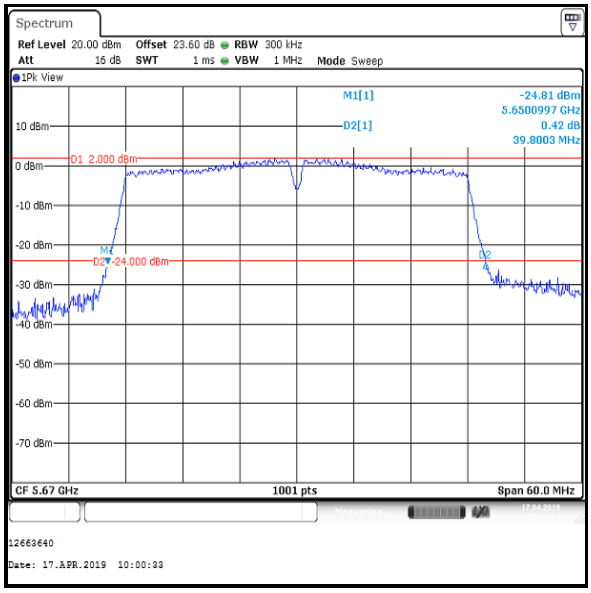
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5510	40.460
Middle	5550	39.740
Top	5670	39.800



Bottom Channel



Middle Channel

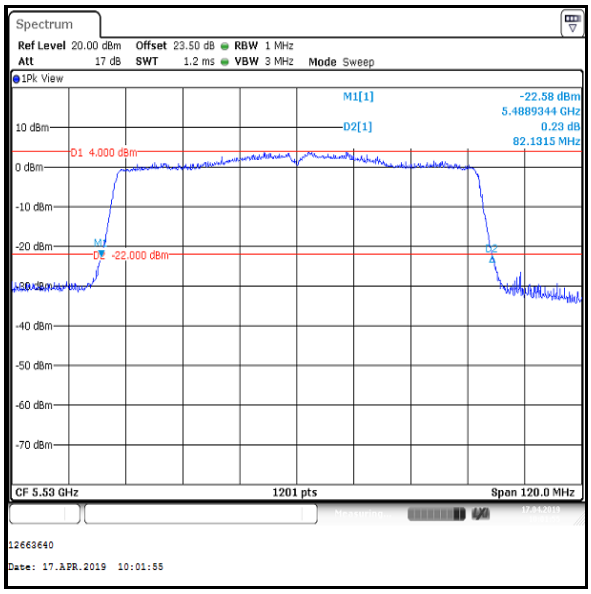


Top Channel

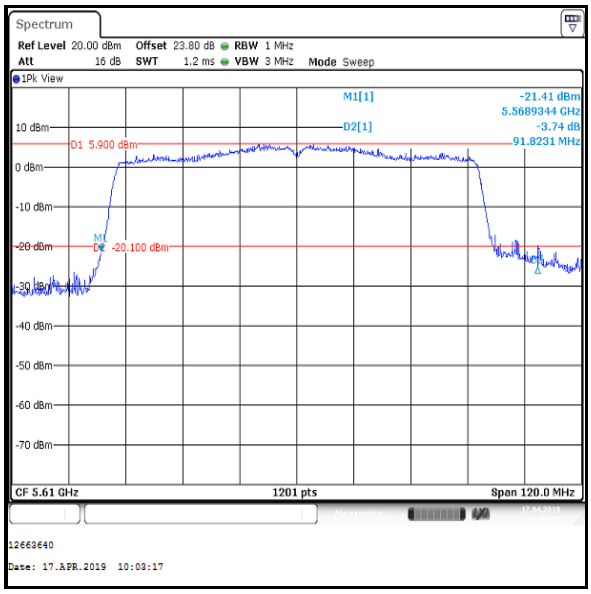
Transmitter 26 dB Emission Bandwidth (5.47-5.725 GHz band) (continued)

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5530	82.132
Top	5610	91.823



Bottom Channel



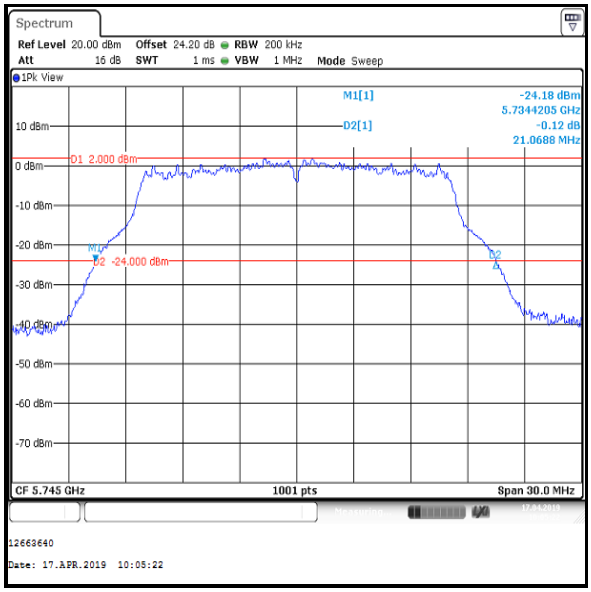
Top Channel

Transmitter 26 dB Emission Bandwidth (5.725-5.85 GHz band) (continued)

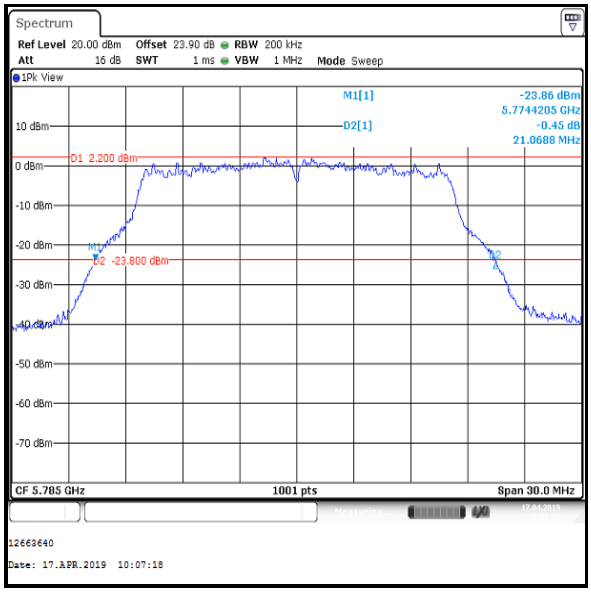
4.2.4. 5.725-5.85 GHz band

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

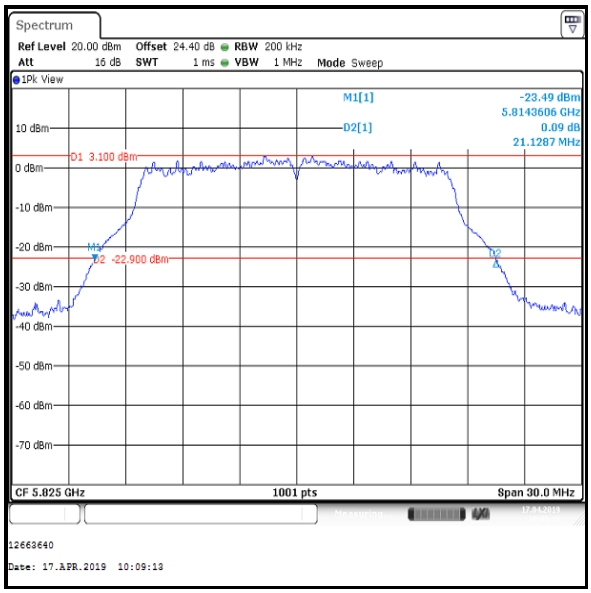
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5745	21.069
Middle	5785	21.069
Top	5825	21.129



Bottom Channel



Middle Channel

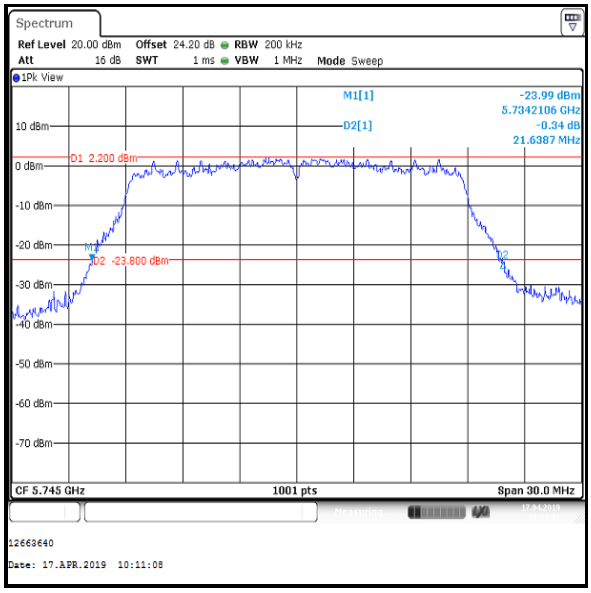


Top Channel

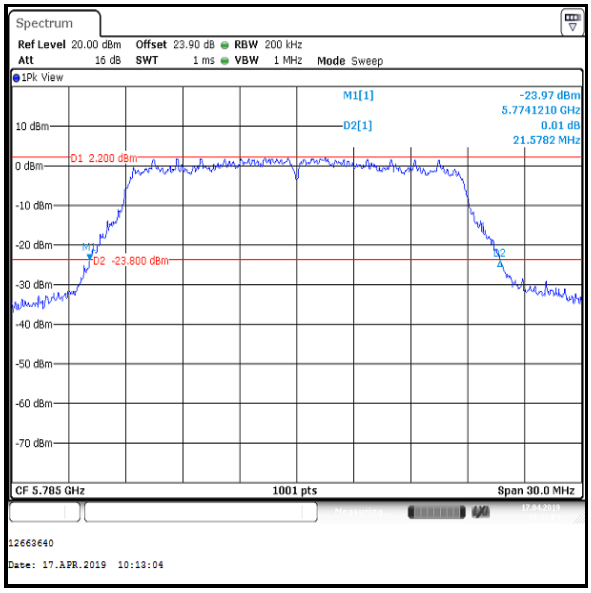
Transmitter 26 dB Emission Bandwidth (5.725-5.85 GHz band) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

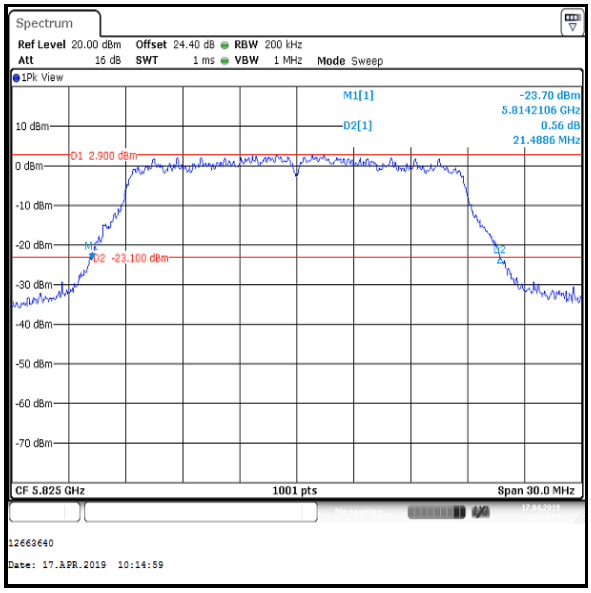
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5745	21.639
Middle	5785	21.578
Top	5825	21.489



Bottom Channel



Middle Channel

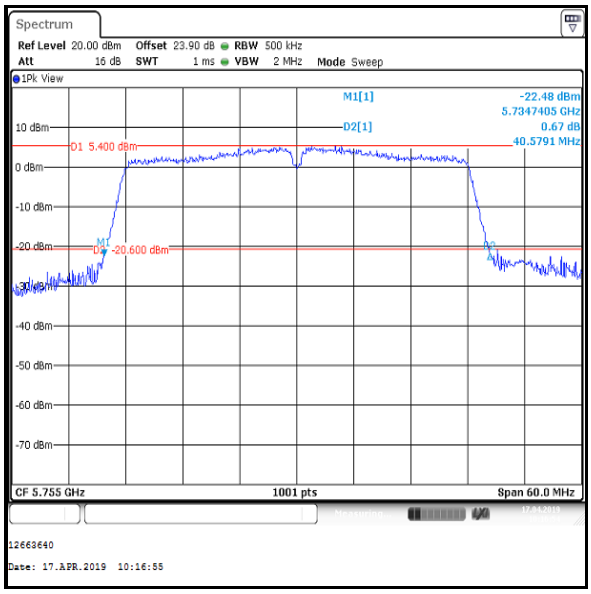


Top Channel

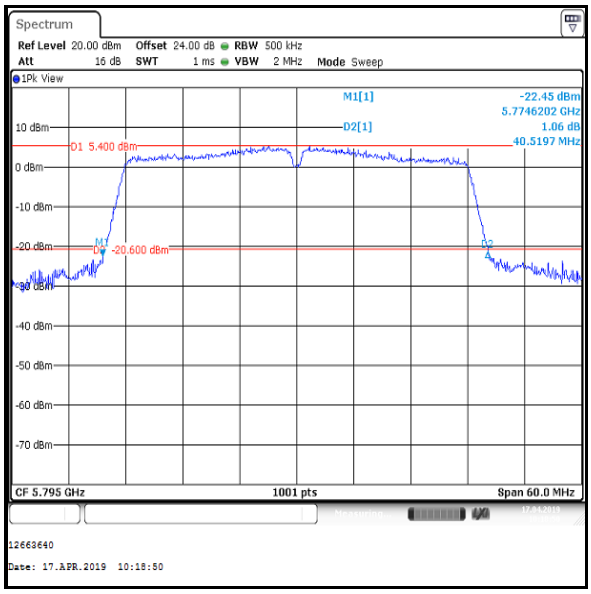
Transmitter 26 dB Emission Bandwidth (5.725-5.85 GHz band) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5755	40.579
Top	5795	40.520



Bottom Channel

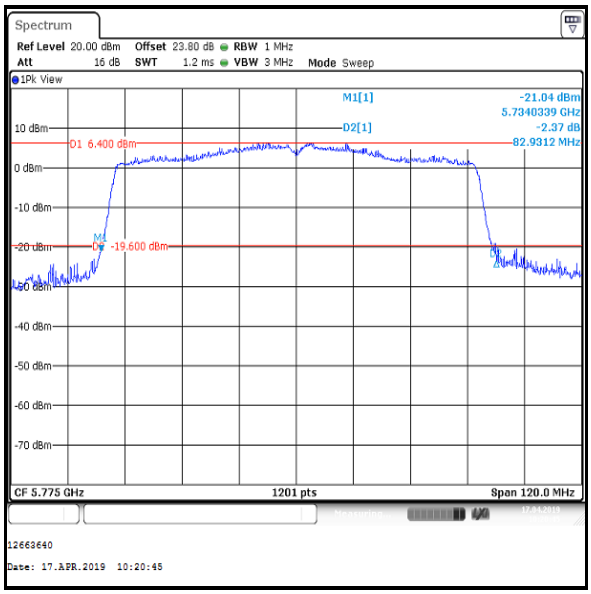


Top Channel

Transmitter 26 dB Emission Bandwidth (5.725-5.85 GHz band) (continued)

Results: 802. 11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5775	82.931



Single Channel

4.3. Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band)

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

FCC Reference:	Part 15.407(e)
Test Method Used:	KDB 789033 D02 Section II.C.2.

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

Note(s):

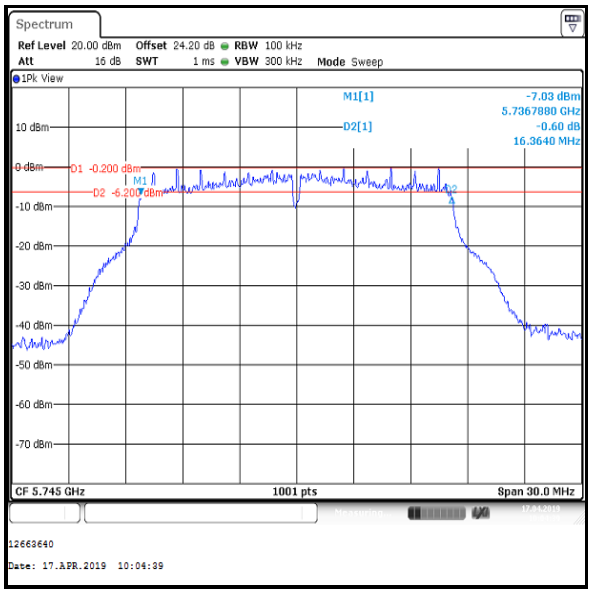
1. Measurements were performed in accordance with KDB 789033 Section II.C.2. Minimum Emission Bandwidth for the band 5.725-5.85 GHz measurement procedure on the relevant channels in all supported operating bands.
2. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cables. An RF level offset was entered on the signal analyser to compensate for the loss of the switch, attenuators and RF cables.

Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band) (continued)

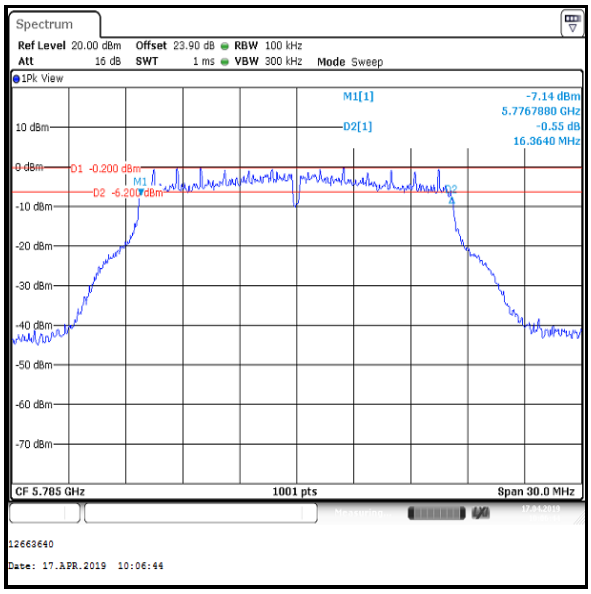
4.3.1. 5.725-5.85 GHz band

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

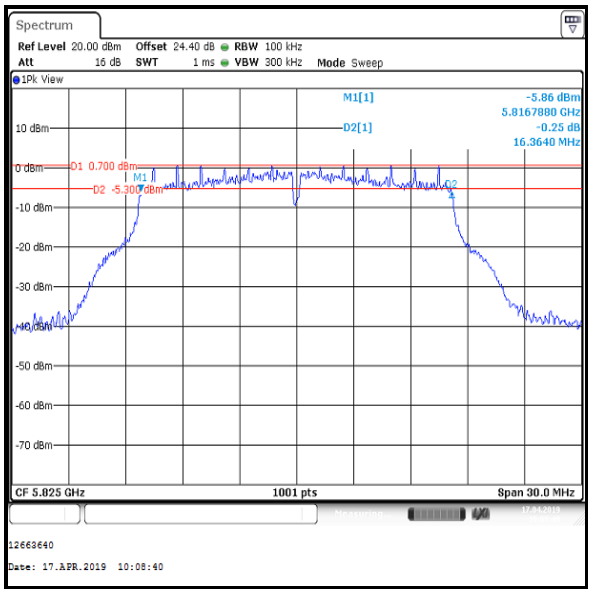
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	16364	≥500	15864	Complied
Middle	16364	≥500	15864	Complied
Top	16364	≥500	15864	Complied



Bottom Channel



Middle Channel

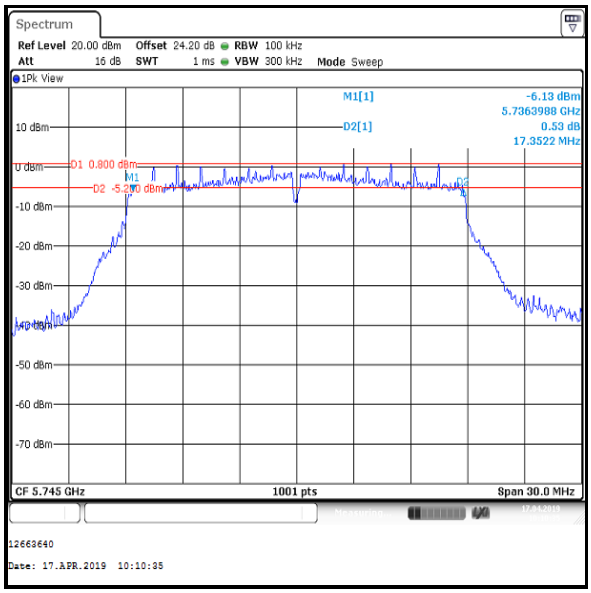


Top Channel

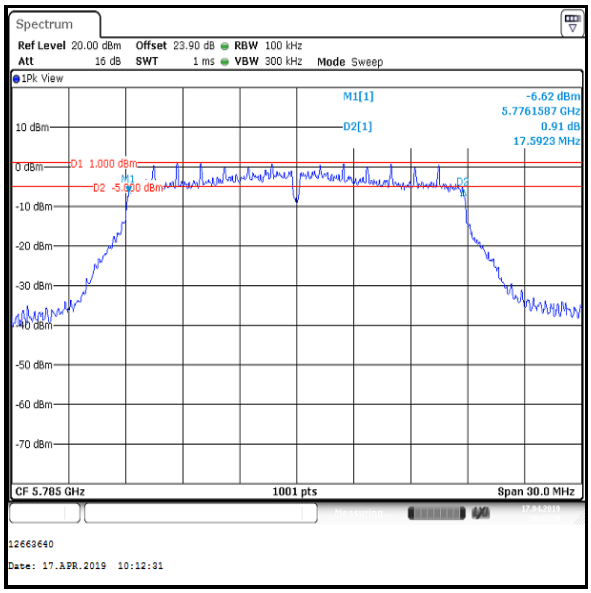
Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

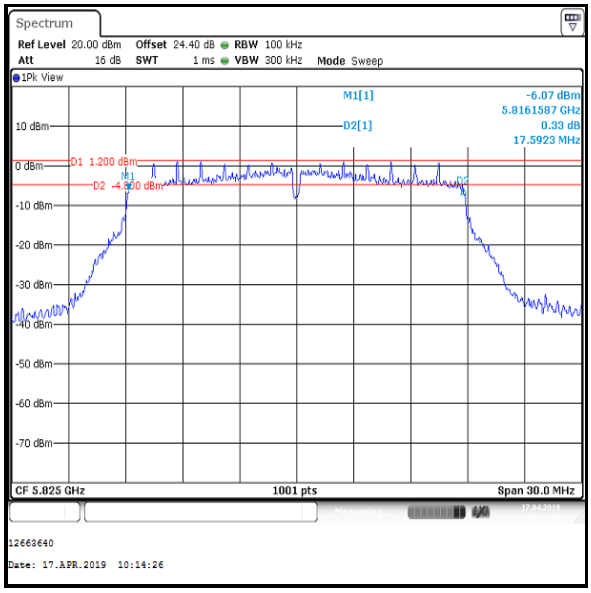
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	17352	≥500	16852	Complied
Middle	17592	≥500	17092	Complied
Top	17592	≥500	17092	Complied



Bottom Channel



Middle Channel

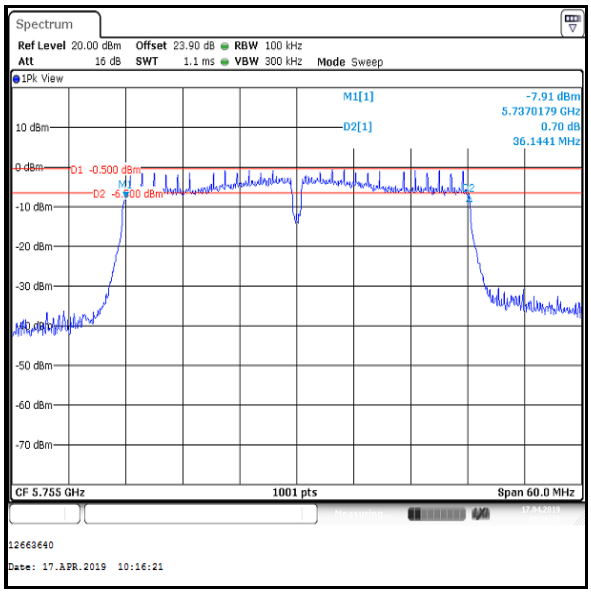


Top Channel

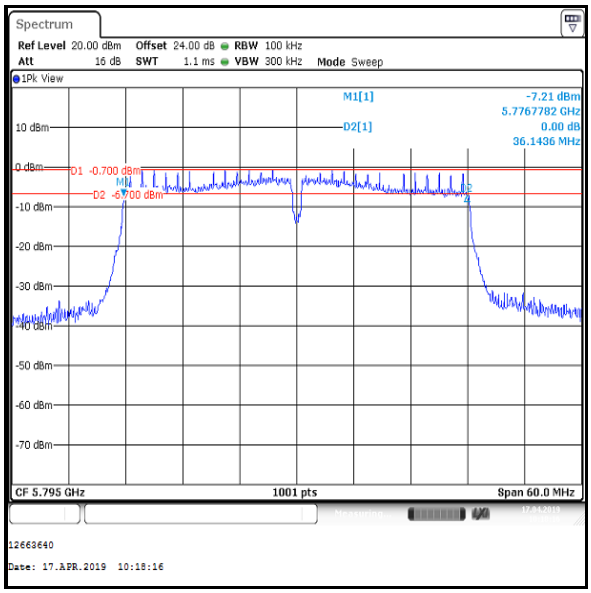
Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	36144	≥500	35644	Complied
Top	36144	≥500	35644	Complied



Bottom Channel

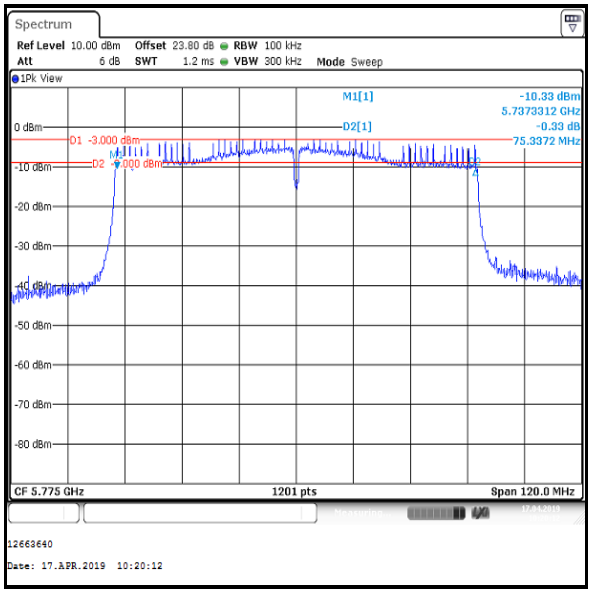


Top Channel

Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band) (continued)

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Single	75337	≥500	74837	Complied



Single Channel

4.4. Transmitter Maximum Conducted Output Power

4.4.1. 5.15-5.25 GHz band

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

FCC Reference:	Part 15.407(a)(1)(iv)
Test Method Used:	KDB 789033 D02 Section II.E.2.b) and II.E.2.d)

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

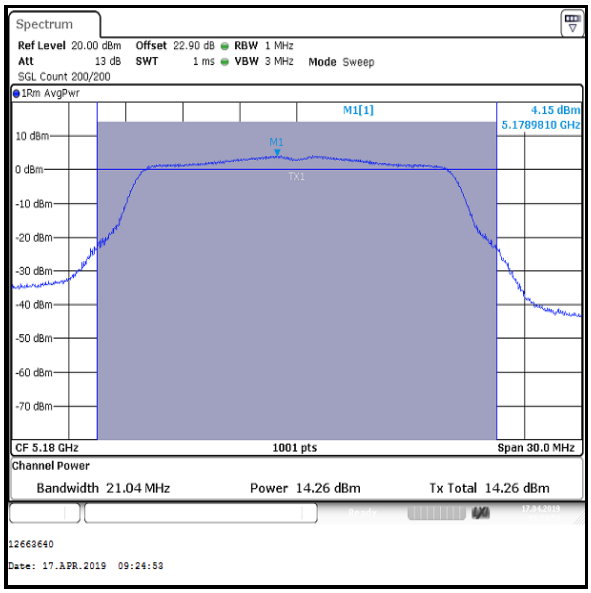
Note(s):

1. For conducted power tests where the duty cycle is >98%, the measurements were performed using a signal analyser in accordance with FCC KDB 789033 II.E.2.b) Method SA-1. Where the duty cycle is <98%, the measurements were performed in accordance with FCC KDB 789033 II.E.2.d) Method SA-2. The signal analyser's integration function was used to integrate across the 26 dB emission bandwidth. The resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. An RMS detector was used and sweep time was set to auto and 200 traces performed. The span was set to encompass the entire 26 dB emission bandwidth. The channel power results are recorded in the tables below.
2. For data rates where the EUT was transmitting at <98% duty cycle, the calculated duty cycle in Section 4.1 was added to the measured power in order to compute the average power during the actual transmission time.
3. The Part 15.407(a)(1)(iv) limit shall not exceed 250 mW (24.0 dBm).
4. For all modes of operation, the antenna gain is < 6 dBi.
5. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

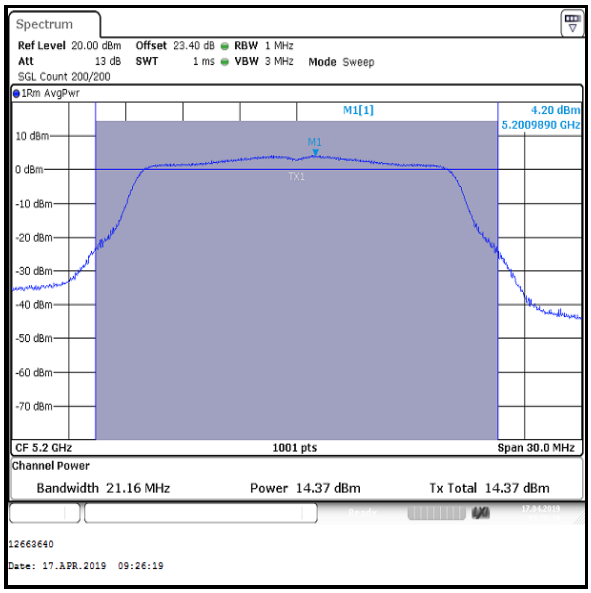
Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

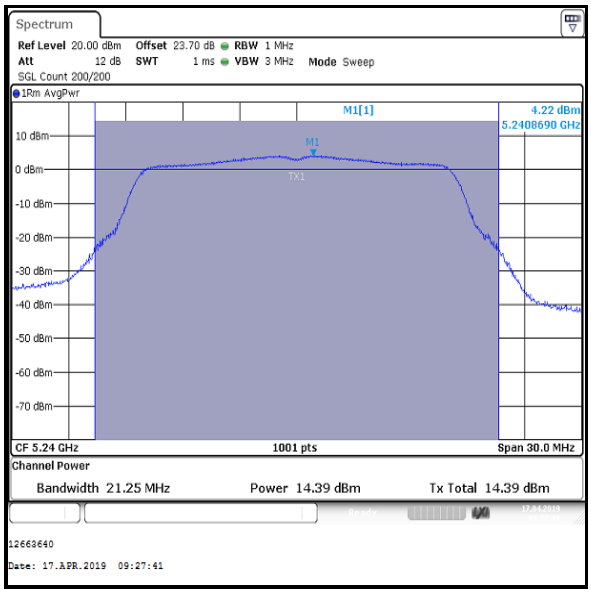
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5180	14.3	24.0	9.7	Complied
Middle	5200	14.4	24.0	9.6	Complied
Top	5240	14.4	24.0	9.6	Complied



Bottom Channel



Middle Channel

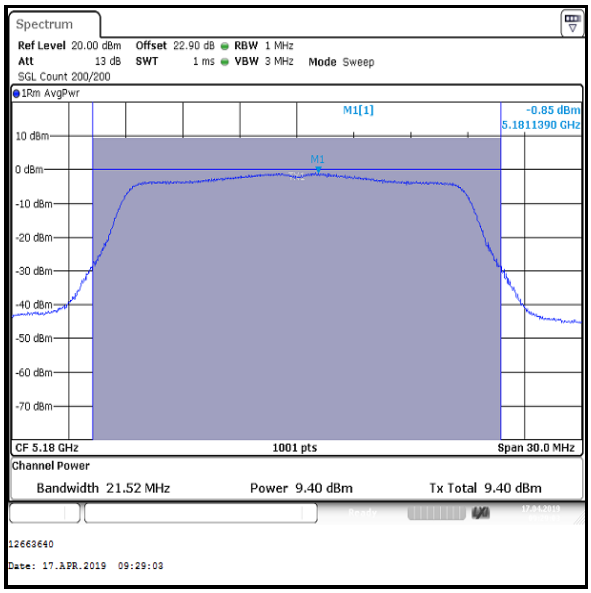


Top Channel

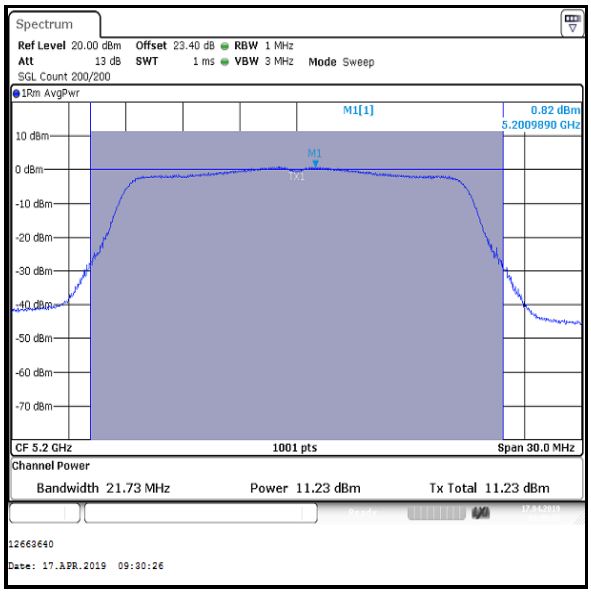
Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

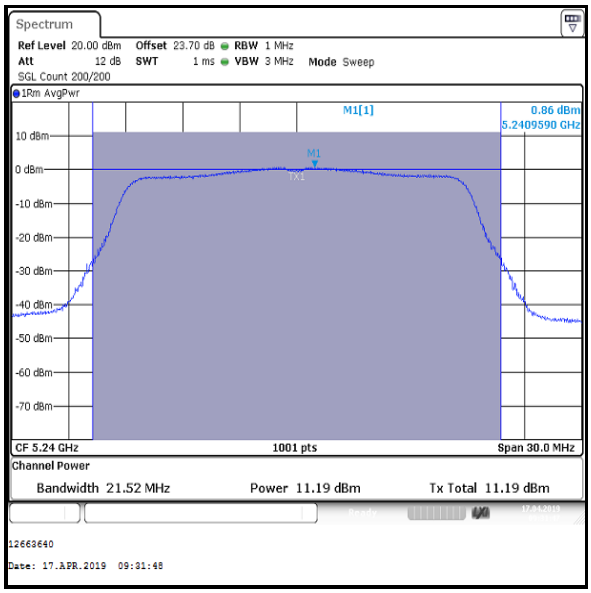
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5180	9.4	24.0	14.6	Complied
Middle	5200	11.2	24.0	12.8	Complied
Top	5240	11.2	24.0	12.8	Complied



Bottom Channel



Middle Channel

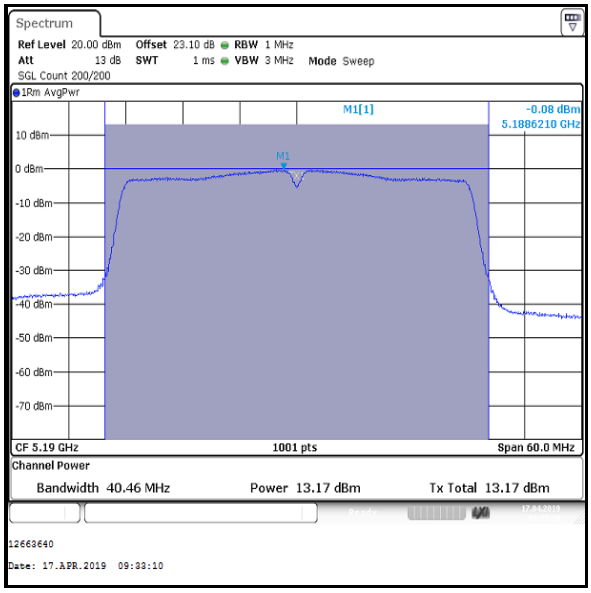


Top Channel

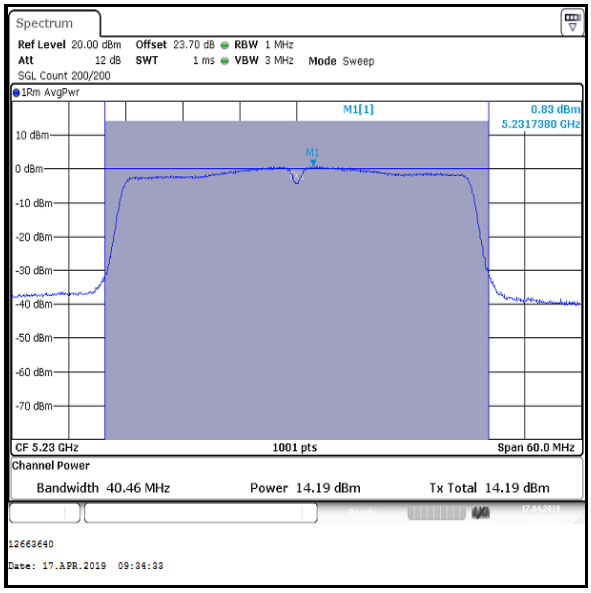
Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5190	13.2	0.1	13.3	24.0	10.7	Complied
Top	5230	14.2	0.1	14.3	24.0	9.7	Complied



Bottom Channel

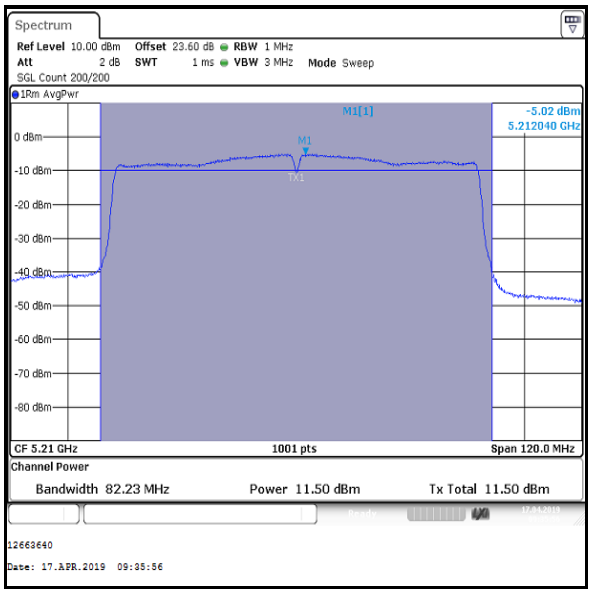


Top Channel

Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band) (continued)

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Single	5210	11.5	0.2	11.7	24.0	12.3	Complied



Single Channel

Transmitter Maximum Conducted Output Power (5.25-5.35 GHz band)

4.4.2. 5.25-5.35 GHz band

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

FCC Reference:	Part 15.407(a)(2)
Test Method Used:	KDB 789033 D02 Section II.E.2.b) and II.E.2.d)

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

Note(s):

1. For conducted power tests where the duty cycle is >98%, the measurements were performed using a signal analyser in accordance with FCC KDB 789033 II.E.2.b) Method SA-1. Where the duty cycle is <98%, the measurements were performed in accordance with FCC KDB 789033 II.E.2.d) Method SA-2. The signal analyser's integration function was used to integrate across the 26 dB emission bandwidth. The resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. An RMS detector was used and sweep time was set to auto and 200 traces performed. The span was set to encompass the entire 26 dB emission bandwidth. The channel power results are recorded in the tables below.
2. For data rates where the EUT was transmitting at <98% duty cycle, the calculated duty cycle in Section 4.1 was added to the measured power in order to compute the average power during the actual transmission time.
3. The FCC Part 15.407(a)(2) limit is the lesser of 250 mW (24.0 dBm) or 11 dBm + 10 $\log_{10}$ B, where B is the previously measured 26 dB emission bandwidth in MHz. For U-NII-2A band, the 26 dB EBW is greater than 20 MHz.

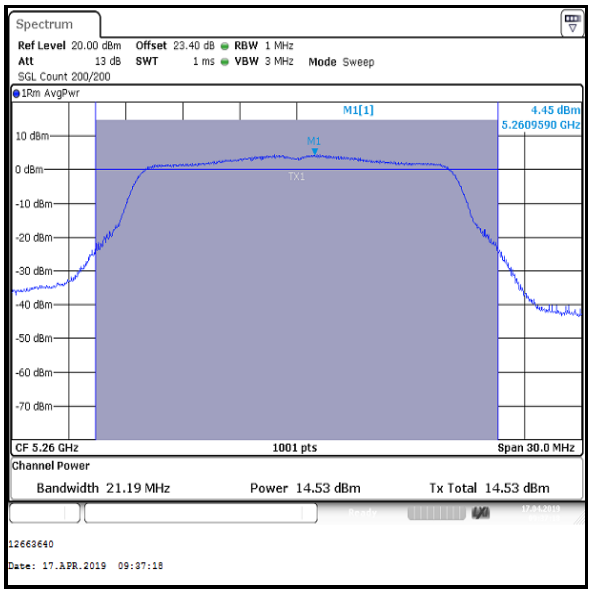
$$\begin{gathered}\text{For B} > 20\text{ MHz} \rightarrow \\ \rightarrow \log_{10}\text{B} > \log_{10} 20 \rightarrow \\ \rightarrow 10\log_{10}\text{B} > 10\log_{10} 20 \rightarrow \\ \rightarrow 11 + 10\log_{10}\text{B} > 11 + 10\log_{10} 20 \rightarrow \\ \rightarrow 11 + 10\log_{10}\text{B} > 24.0\text{ dBm}\end{gathered}$$

   Therefore for measured emission bandwidths greater than 20 MHz, the lesser of the two limits is the fixed limit of 250 mW (24.0 dBm). This was applied to the results.
4. For all modes of operation, the antenna gain is < 6 dBi.
5. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

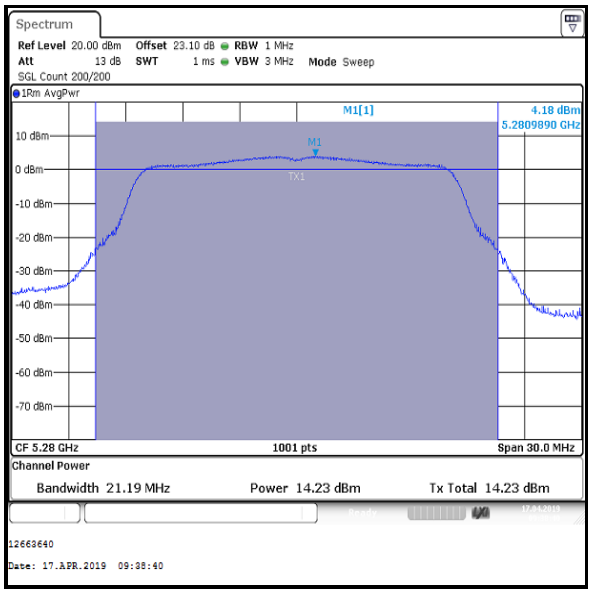
Transmitter Maximum Conducted Output Power (5.25-5.35 GHz band) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

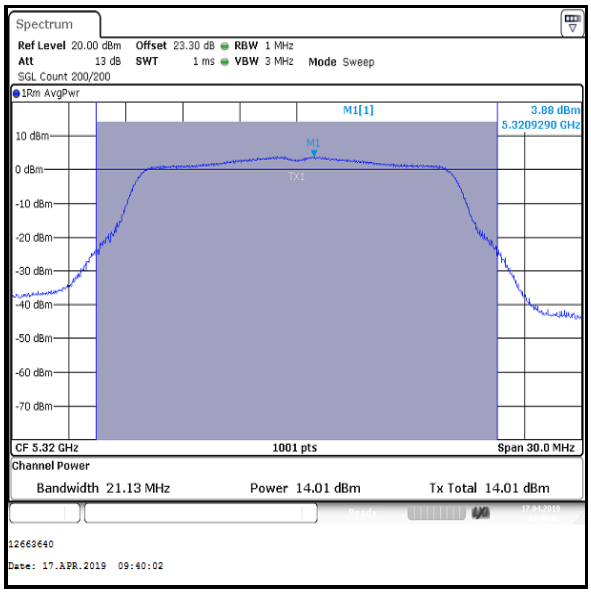
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5260	14.5	24.0	9.5	Complied
Middle	5280	14.2	24.0	9.8	Complied
Top	5320	14.0	24.0	10.0	Complied



Bottom Channel



Middle Channel

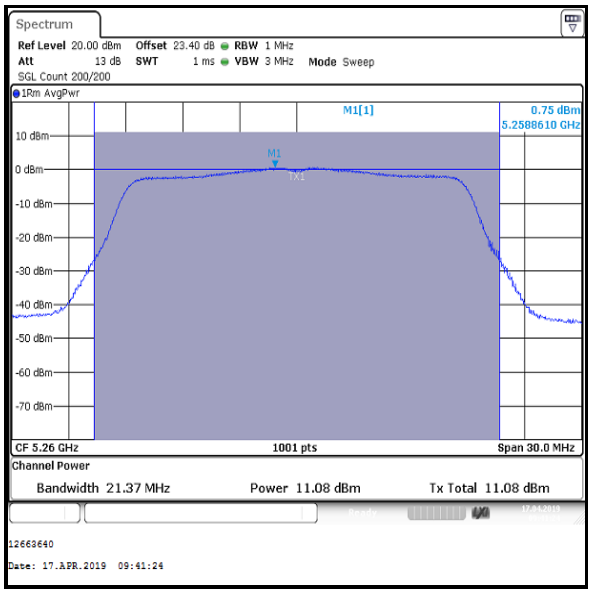


Top Channel

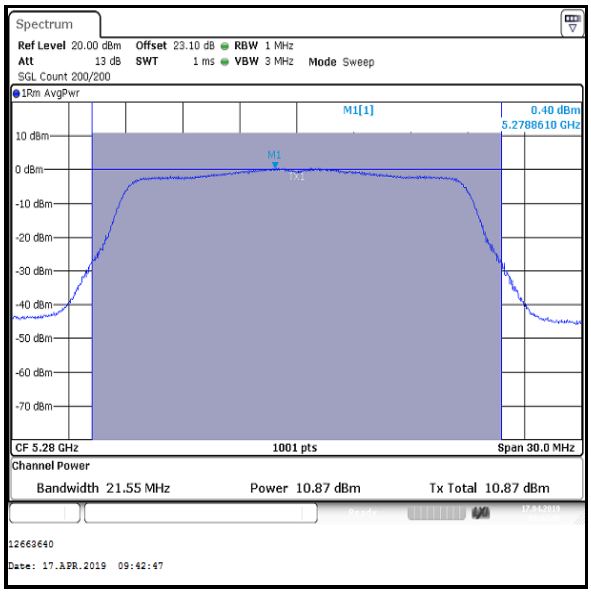
Transmitter Maximum Conducted Output Power (5.25-5.35 GHz band) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

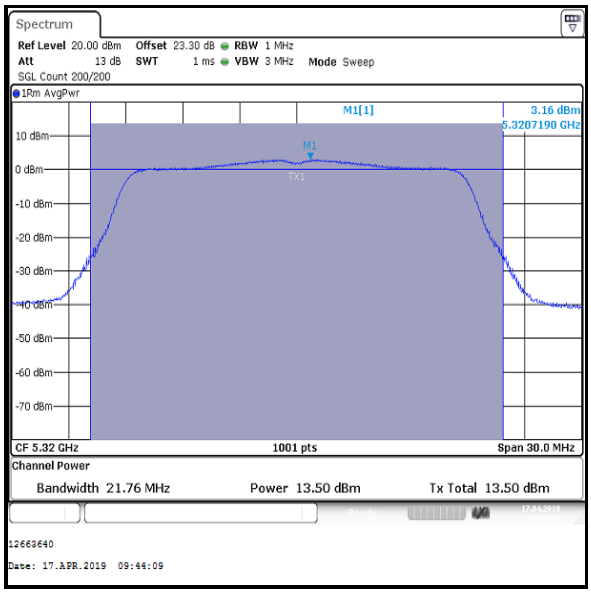
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5260	11.1	24.0	12.9	Complied
Middle	5280	10.9	24.0	13.1	Complied
Top	5320	13.5	24.0	10.5	Complied



Bottom Channel



Middle Channel

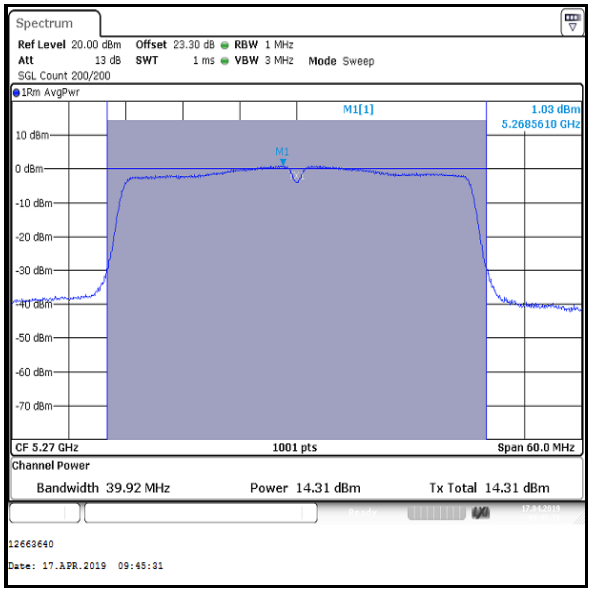


Top Channel

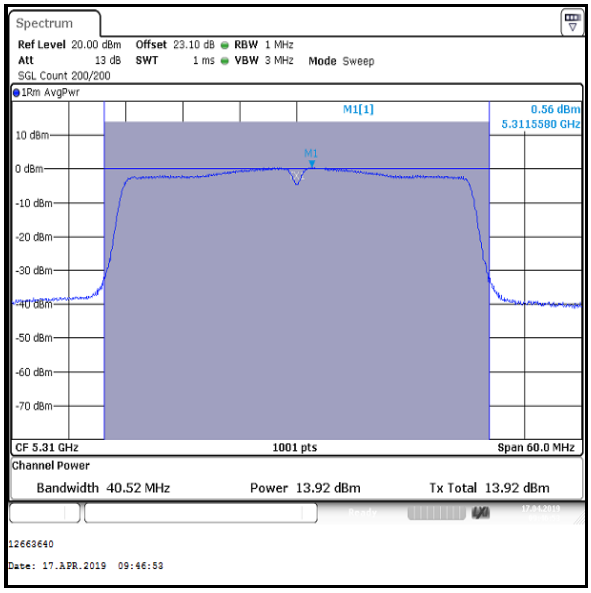
Transmitter Maximum Conducted Output Power (5.25-5.35 GHz band) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5270	14.3	0.1	14.4	24.0	9.6	Complied
Top	5310	13.9	0.1	14.0	24.0	10.0	Complied



Bottom Channel

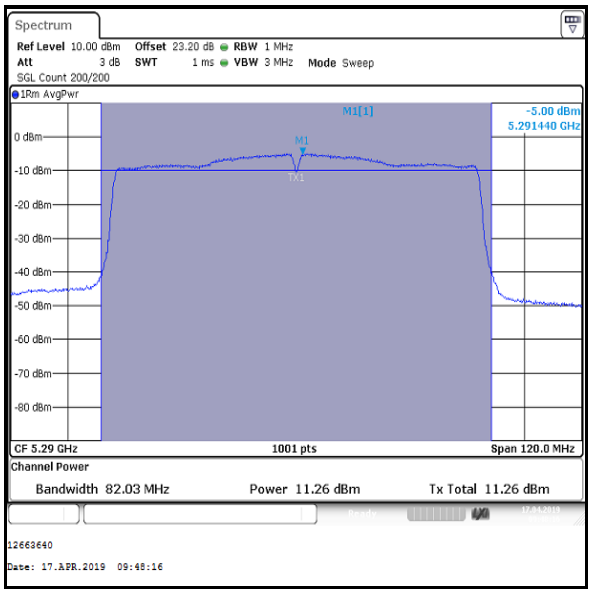


Top Channel

Transmitter Maximum Conducted Output Power (5.25-5.35 GHz band) (continued)

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Single	5290	11.3	0.2	11.5	24.0	12.5	Complied



Single Channel

Transmitter Maximum Conducted Output Power (5.47-5.725 GHz band)

4.4.3. 5.47-5.725 GHz band

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

FCC Reference:	Part 15.407(a)(2)
Test Method Used:	KDB 789033 D02 Section II.E.2.b) and II.E.2.d)

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

Note(s):

1. For conducted power tests where the duty cycle is >98%, the measurements were performed using a signal analyser in accordance with FCC KDB 789033 II.E.2.b) Method SA-1. Where the duty cycle is <98%, the measurements were performed in accordance with FCC KDB 789033 II.E.2.d) Method SA-2. The signal analyser's integration function was used to integrate across the 26 dB emission bandwidth. The resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. An RMS detector was used and sweep time was set to auto and 200 traces performed. The span was set to encompass the entire 26 dB emission bandwidth. The channel power results are recorded in the tables below.
2. For data rates where the EUT was transmitting at <98% duty cycle, the calculated duty cycle in Section 4.1 was added to the measured power in order to compute the average power during the actual transmission time.
3. The FCC Part 15.407(a)(2) limit is the lesser of 250 mW (24.0 dBm) or 11 dBm + 10 $\log_{10}$ B, where B is the previously measured 26 dB emission bandwidth in MHz. For U-NII-2C band, the 26 dB EBW is greater than 20 MHz.

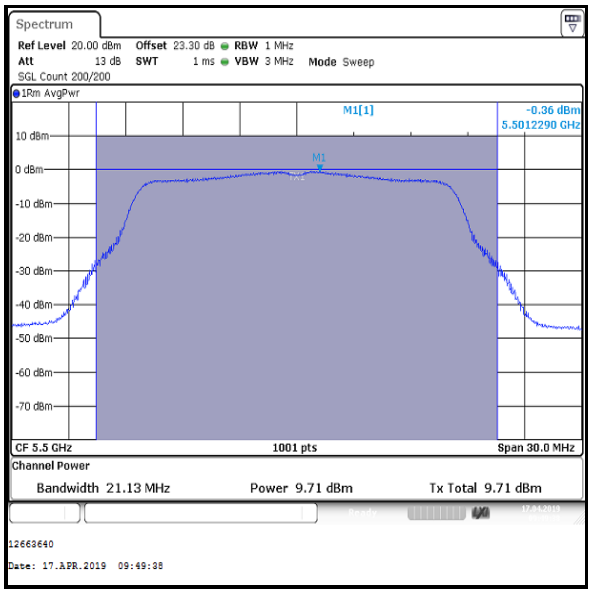
$$\begin{gathered}\text{For B} > 20\text{ MHz} \rightarrow \\ \rightarrow \log_{10}\text{B} > \log_{10} 20 \rightarrow \\ \rightarrow 10\log_{10}\text{B} > 10\log_{10} 20 \rightarrow \\ \rightarrow 11 + 10\log_{10}\text{B} > 11 + 10\log_{10} 20 \rightarrow \\ \rightarrow 11 + 10\log_{10}\text{B} > 24.0\text{ dBm}\end{gathered}$$

   Therefore for measured emission bandwidths greater than 20 MHz, the lesser of the two limits is the fixed limit of 250 mW (24.0 dBm). This was applied to the results.
4. For all modes of operation, the antenna gain is < 6 dBi.
5. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

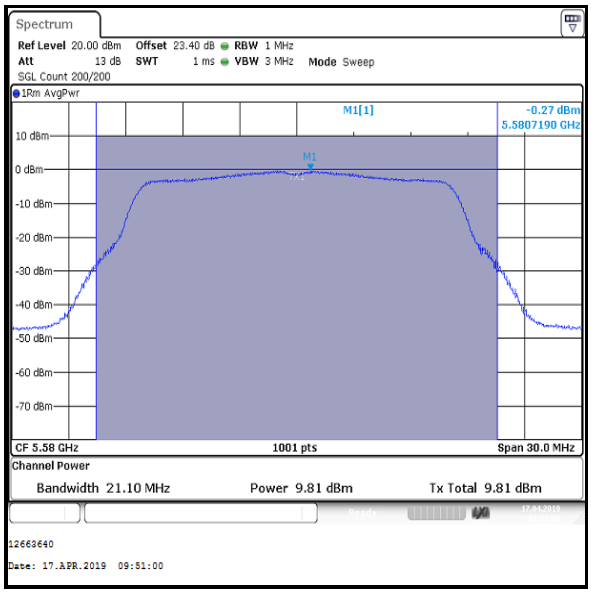
Transmitter Maximum Conducted Output Power (5.47-5.725 GHz band) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

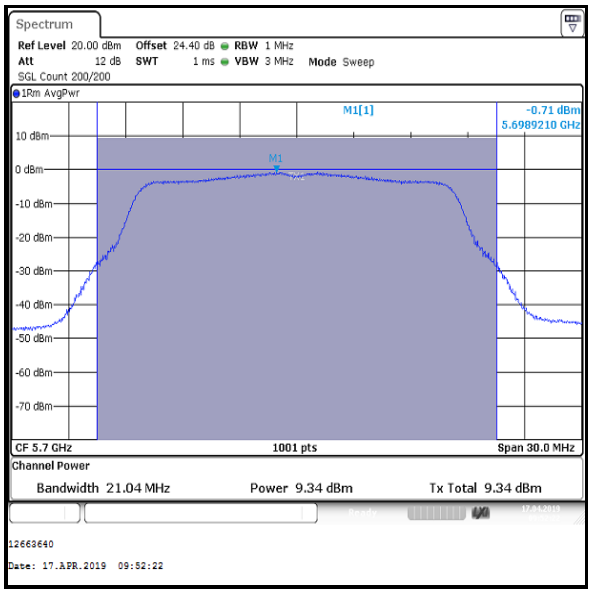
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5500	9.7	24.0	14.3	Complied
Middle	5580	9.8	24.0	14.2	Complied
Top	5700	9.3	24.0	14.7	Complied



Bottom Channel



Middle Channel

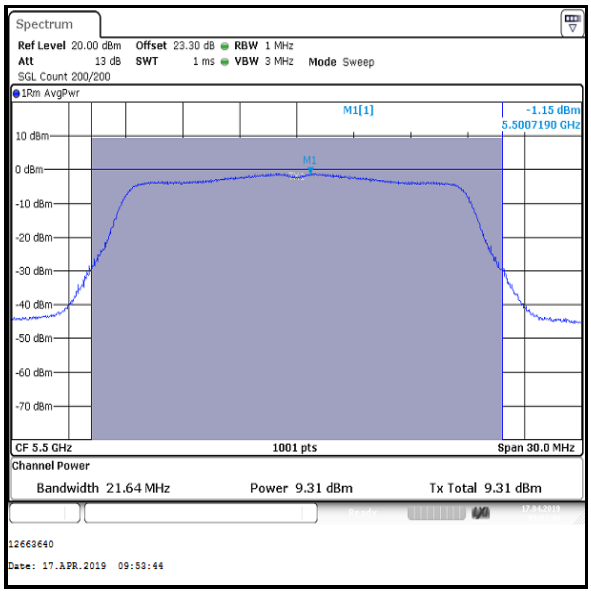


Top Channel

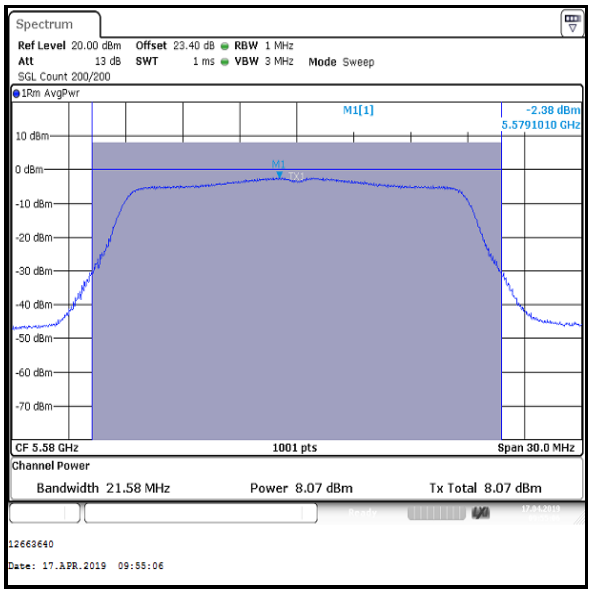
Transmitter Maximum Conducted Output Power (5.47-5.725 GHz band) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

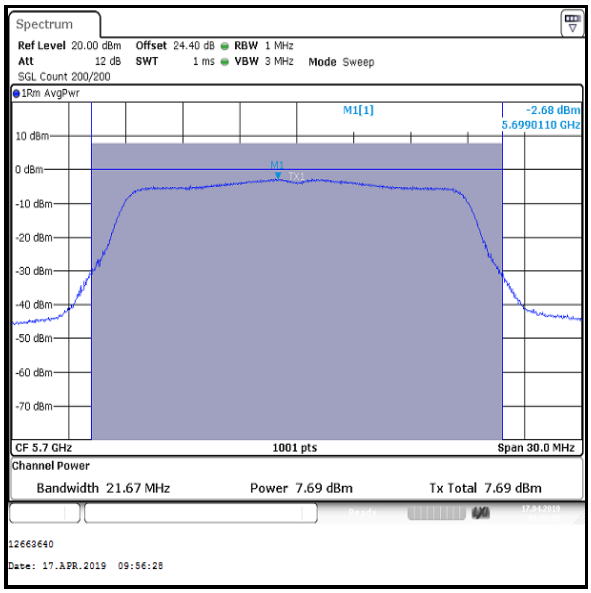
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5500	9.3	24.0	14.7	Complied
Middle	5580	8.1	24.0	15.9	Complied
Top	5700	7.7	24.0	16.3	Complied



Bottom Channel



Middle Channel

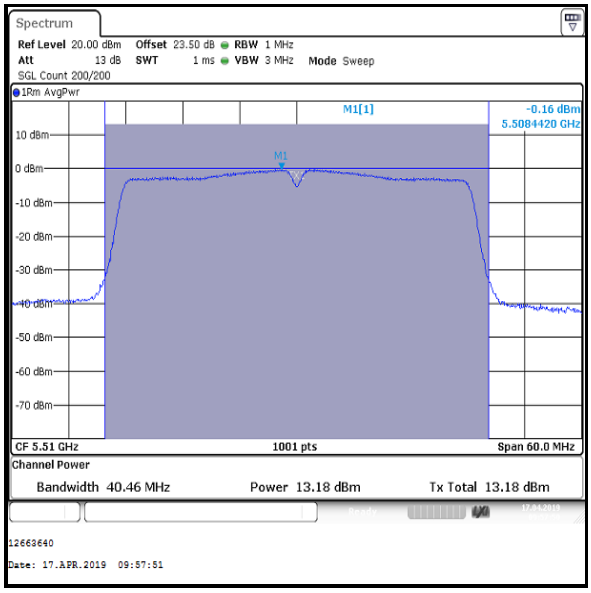


Top Channel

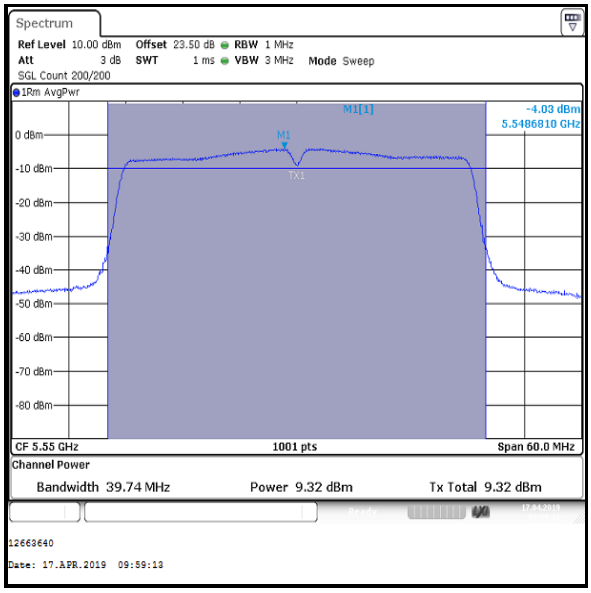
Transmitter Maximum Conducted Output Power (5.47-5.725 GHz band) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

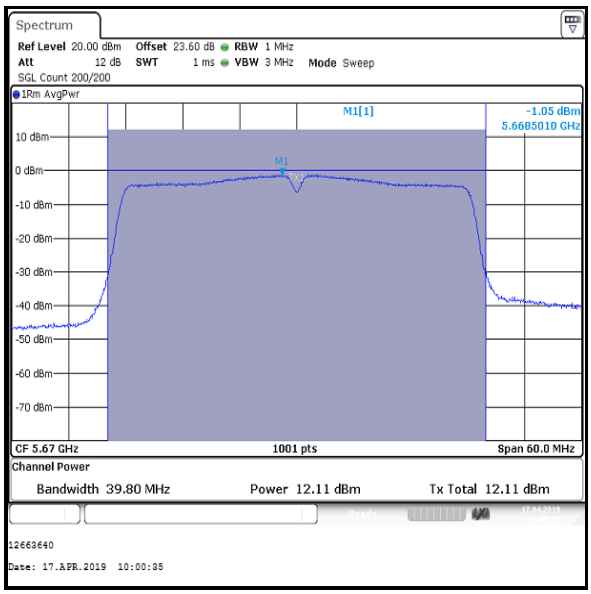
Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5510	13.2	0.1	13.3	24.0	10.7	Complied
Middle	5550	9.3	0.1	9.4	24.0	14.6	Complied
Top	5670	12.1	0.1	12.2	24.0	11.8	Complied



Bottom Channel



Middle Channel

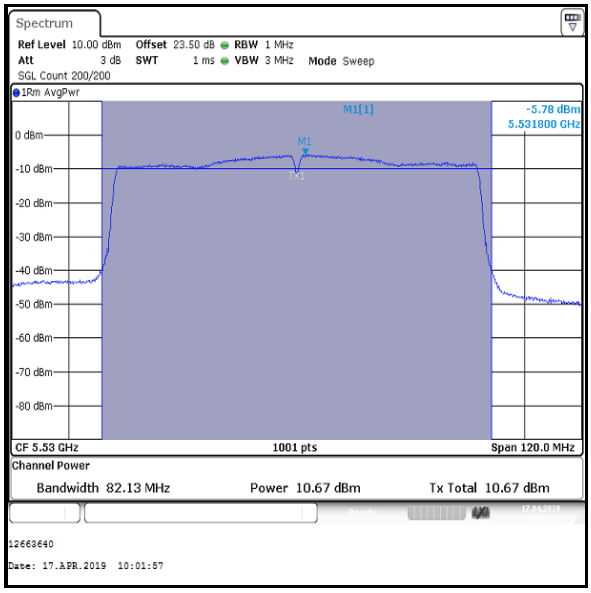


Top Channel

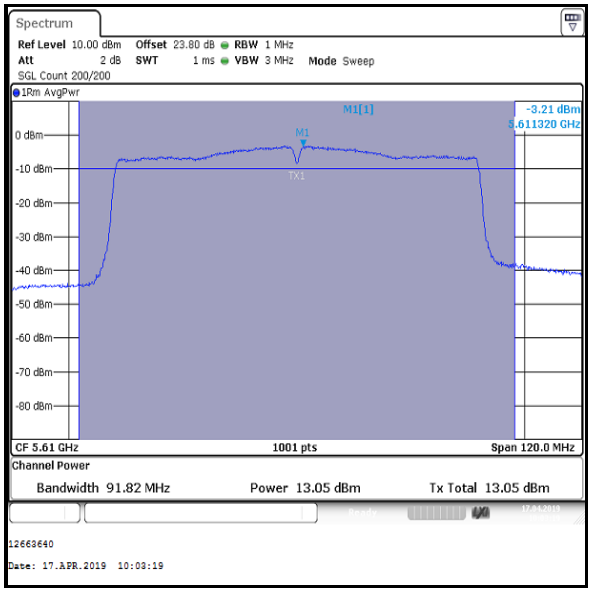
Transmitter Maximum Conducted Output Power (5.47-5.725 GHz band) (continued)

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5530	10.7	0.2	10.9	24.0	13.1	Complied
Top	5610	13.1	0.2	13.3	24.0	10.7	Complied



Bottom Channel



Top Channel

Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band)

4.4.4. 5.725-5.85 GHz band

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

FCC Reference:	Part 15.407(a)(3)
Test Method Used:	KDB 789033 D02 Section II.E.2.b) and II.E.2.d)

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

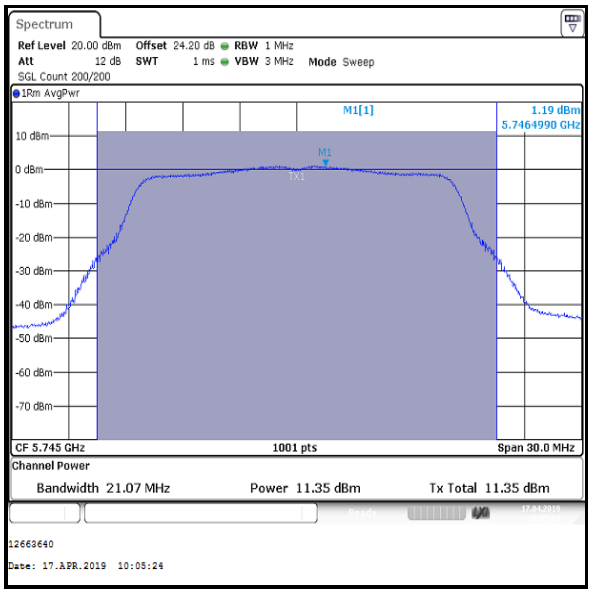
Note(s):

1. For conducted power tests where the duty cycle is >98%, the measurements were performed using a signal analyser in accordance with FCC KDB 789033 II.E.2.b) Method SA-1. Where the duty cycle is <98%, the measurements were performed in accordance with FCC KDB 789033 II.E.2.d) Method SA-2. The signal analyser's integration function was used to integrate across the 26 dB emission bandwidth. The resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. An RMS detector was used and sweep time was set to auto and 200 traces performed. The span was set to encompass the entire 26 dB emission bandwidth. The channel power results are recorded in the tables below.
2. For data rates where the EUT was transmitting at <98% duty cycle, the calculated duty cycle in Section 4.1 was added to the measured power in order to compute the average power during the actual transmission time.
3. The FCC Part 15.407(a)(3) limit shall not exceed 1 W (30.0 dBm).
4. For all modes of operation, the antenna gain is < 6 dBi.
5. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

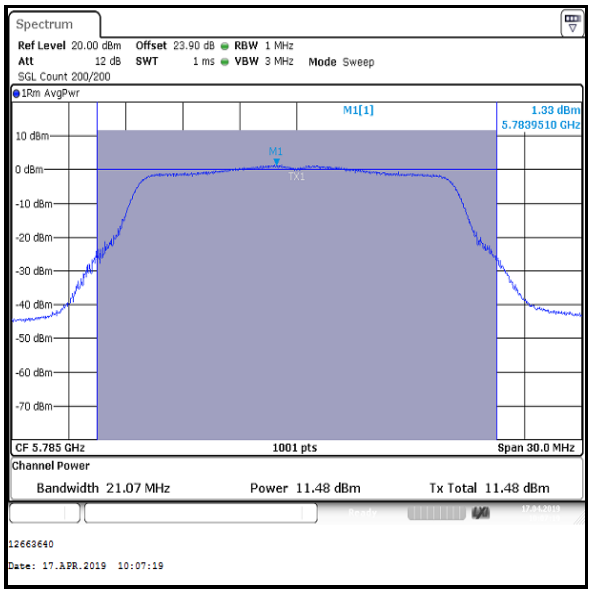
Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

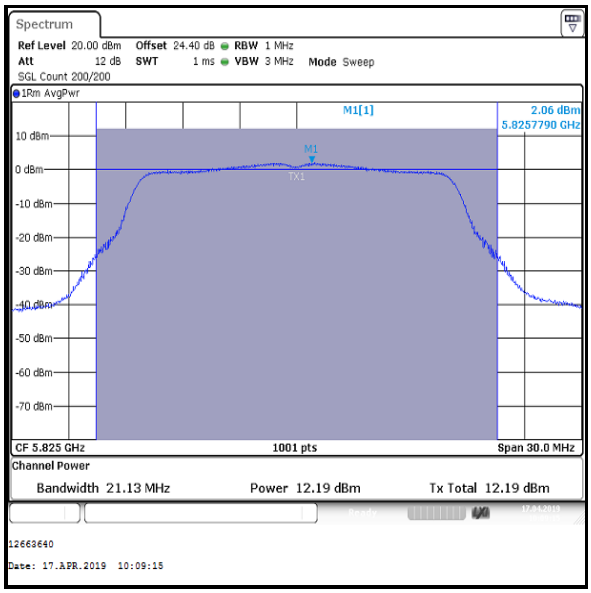
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5745	11.4	30.0	18.6	Complied
Middle	5785	11.5	30.0	18.5	Complied
Top	5825	12.2	30.0	17.8	Complied



Bottom Channel



Middle Channel

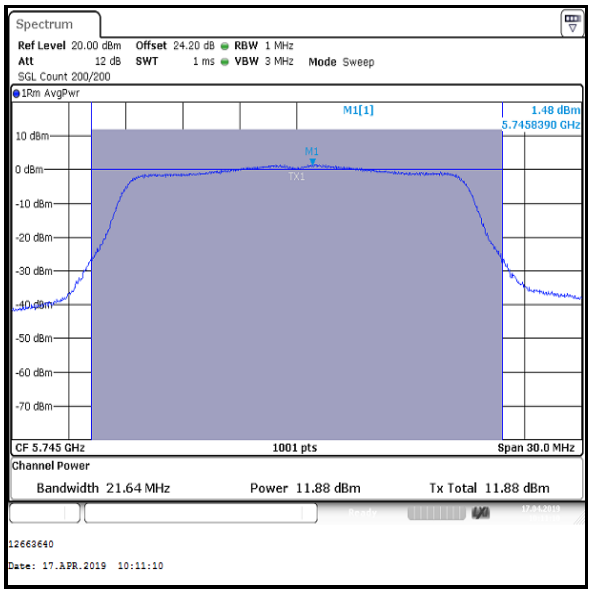


Top Channel

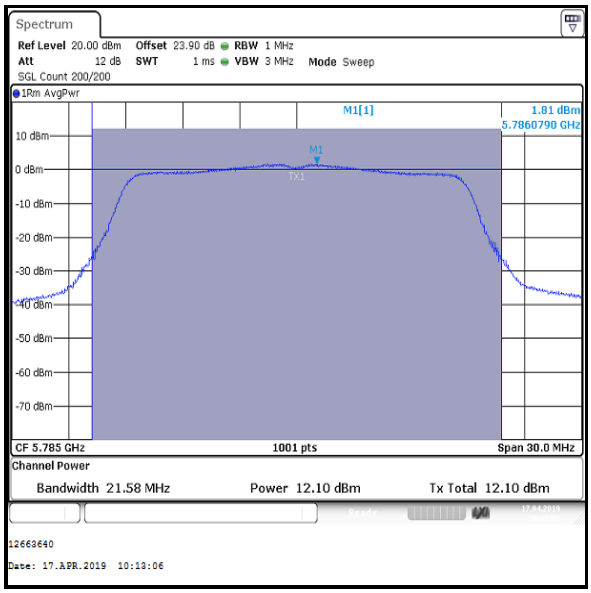
Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

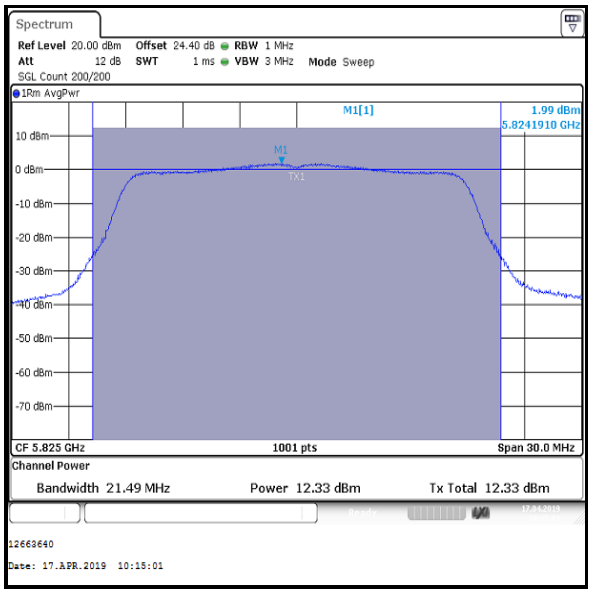
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5745	11.9	30.0	18.1	Complied
Middle	5785	12.1	30.0	17.9	Complied
Top	5825	12.3	30.0	17.7	Complied



Bottom Channel



Middle Channel

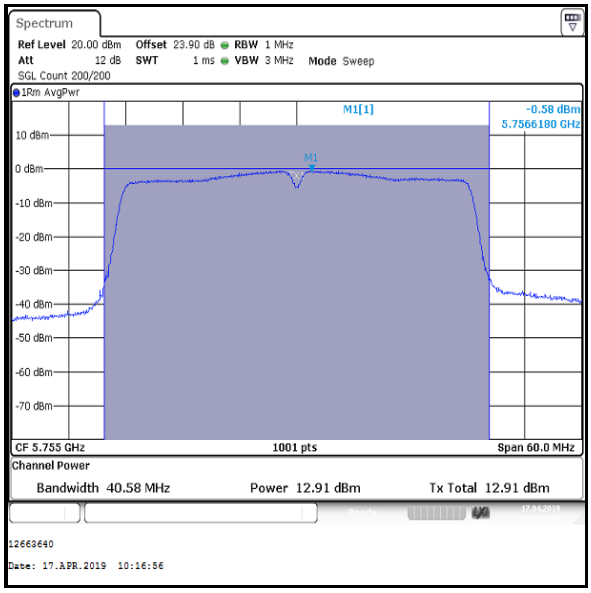


Top Channel

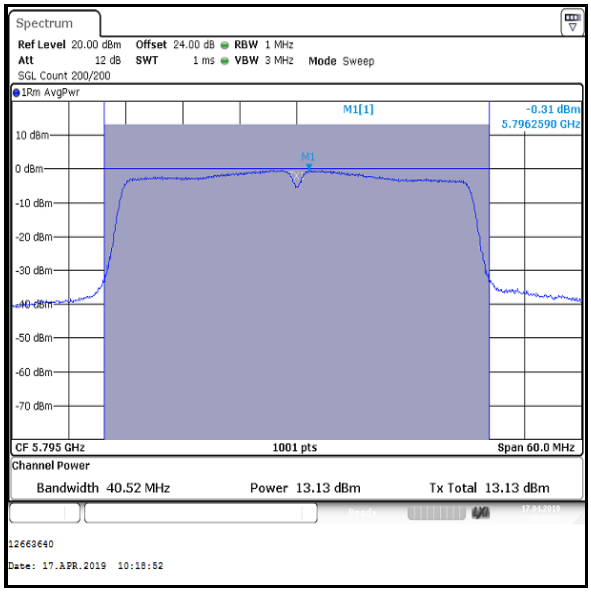
Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5755	12.9	0.1	13.0	30.0	17.0	Complied
Top	5795	13.1	0.1	13.2	30.0	16.8	Complied



Bottom Channel

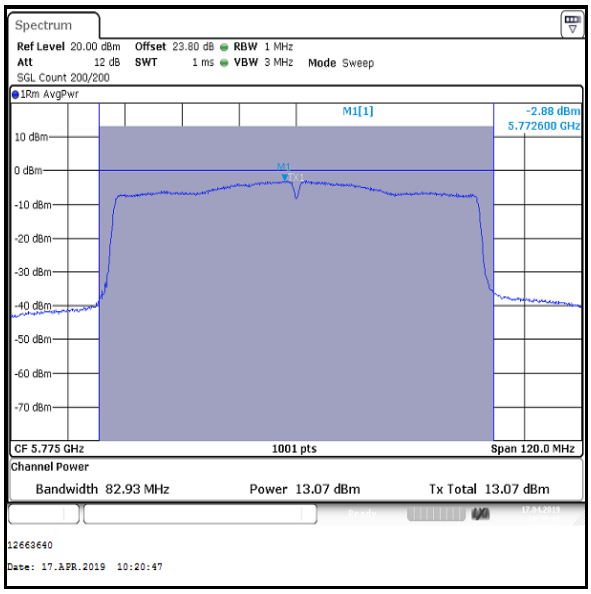


Top Channel

Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band) (continued)

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Single	5775	13.1	0.2	13.3	30.0	16.7	Complied



Single Channel

4.5. Transmitter Maximum Power Spectral Density

4.5.1. 5.15-5.25 GHz band

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

FCC Reference:	Part 15.407(a)(1)(iv)
Test Method Used:	KDB 789033 D02 Section II.F. referencing II.E.2.b) and II.E.2.d)

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

Note(s):

1. Transmitter Maximum Power Spectral Density tests were performed using a signal analyser in accordance with KDB 789033 II. F referencing II.E.2.b) Method SA-1 where the duty cycle is >98% and II.E.2.d) Method SA-2 where the duty cycle was <98%
2. For data rates where the EUT was transmitting at <98% duty cycle, the calculated duty cycle in Section 4.1 was added to the measured maximum power spectral density in order to compute the average maximum power spectral density during the actual transmission time.
3. FCC Part 15.407(a)(1)(iv) limit for PSD is <11 dBm/MHz.
4. For all modes of operation, the antenna gain is < 6 dBi.
5. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.
6. As the power spectral density test uses the same test method as the output power test, before the power is integrated across the 26 dB bandwidth, the conducted power spectral density plots are located in the conducted output power section 4.4 of this test report. The peak spectral density was measured by placing a marker on the peak of the signal and the results entered in the tables below.

Transmitter Maximum Power Spectral Density (5.15-5.25 GHz band) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

Channel	Frequency (MHz)	PSD (dBm /MHz)	Limit (dBm /MHz)	Margin (dB)	Result
Bottom	5180	4.2	11.0	6.8	Complied
Middle	5200	4.2	11.0	6.8	Complied
Top	5240	4.2	11.0	6.8	Complied

Results: 802.11n / 20 MHz / BPSK / MCS0

Channel	Frequency (MHz)	PSD (dBm /MHz)	Limit (dBm /MHz)	Margin (dB)	Result
Bottom	5180	-0.8	11.0	11.8	Complied
Middle	5200	0.8	11.0	10.2	Complied
Top	5240	0.9	11.0	10.1	Complied

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	PSD (dBm/MHz)	Duty cycle correction factor (dB)	Corrected PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
Bottom	5190	-0.1	0.1	0.0	11.0	11.0	Complied
Top	5230	0.8	0.1	0.9	11.0	10.1	Complied

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	PSD (dBm/MHz)	Duty cycle correction factor (dB)	Corrected PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
Single	5210	-5.0	0.2	-4.8	11.0	15.8	Complied

Transmitter Maximum Power Spectral Density (5.25-5.35 GHz band)

4.5.2. 5.25-5.35 GHz band

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

FCC Reference:	Part 15.407(a)(2)
Test Method Used:	KDB 789033 D02 Section II.F. referencing II.E.2.b) and II.E.2.d)

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

Note(s):

1. Transmitter Maximum Power Spectral Density tests were performed using a signal analyser in accordance with KDB 789033 II. F referencing II.E.2.b) Method SA-1 where the duty cycle is >98% and II.E.2.d) Method SA-2 where the duty cycle was <98%
2. For data rates where the EUT was transmitting at <98% duty cycle, the calculated duty cycle in Section 4.1 was added to the measured maximum power spectral density in order to compute the average maximum power spectral density during the actual transmission time.
3. FCC Part 15.407(a)(2) limit for PSD in the 5.25-5.35 GHz band is <11 dBm/MHz.
4. For all modes of operation, the antenna gain is < 6 dBi.
5. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.
6. As the power spectral density test uses the same test method as the output power test, before the power is integrated across the 26 dB bandwidth, the conducted power spectral density plots are located in the conducted output power section 4.4 of this test report. The peak spectral density was measured by placing a marker on the peak of the signal and the results entered in the tables below.

Transmitter Maximum Power Spectral Density (5.25-5.35 GHz band) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

Channel	Frequency (MHz)	PSD (dBm /MHz)	Limit (dBm /MHz)	Margin (dB)	Result
Bottom	5260	4.5	11.0	6.5	Complied
Middle	5280	4.2	11.0	6.8	Complied
Top	5320	3.9	11.0	7.1	Complied

Results: 802.11n / 20 MHz / BPSK / MCS0

Channel	Frequency (MHz)	PSD (dBm /MHz)	Limit (dBm /MHz)	Margin (dB)	Result
Bottom	5260	0.8	11.0	10.2	Complied
Middle	5280	0.4	11.0	10.6	Complied
Top	5320	3.2	11.0	7.8	Complied

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	PSD (dBm/MHz)	Duty cycle correction factor (dB)	Corrected PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
Bottom	5270	1.0	0.1	1.1	11.0	9.9	Complied
Top	5310	0.6	0.1	0.7	11.0	10.3	Complied

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	PSD (dBm/MHz)	Duty cycle correction factor (dB)	Corrected PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
Single	5290	-5.0	0.2	-4.8	11.0	15.8	Complied

Transmitter Maximum Power Spectral Density (5.47-5.725 GHz band)

4.5.3. 5.47-5.725 GHz band

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

FCC Reference:	Part 15.407(a)(2)
Test Method Used:	KDB 789033 D02 Section II.F. referencing II.E.2.b) and II.E.2.d)

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

Note(s):

1. Transmitter Maximum Power Spectral Density tests were performed using a signal analyser in accordance with KDB 789033 II. F referencing II.E.2.b) Method SA-1 where the duty cycle is >98% and II.E.2.d) Method SA-2 where the duty cycle was <98%
2. For data rates where the EUT was transmitting at <98% duty cycle, the calculated duty cycle in Section 4.1 was added to the measured maximum power spectral density in order to compute the average maximum power spectral density during the actual transmission time.
3. FCC Part 15.407(a)(2) limit for PSD in the 5.47-5.725 GHz band is <11 dBm/MHz.
4. For all modes of operation, the antenna gain is < 6 dBi.
5. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.
6. As the power spectral density test uses the same test method as the output power test, before the power is integrated across the 26 dB bandwidth, the conducted power spectral density plots are located in the conducted output power section 4.4 of this test report. The peak spectral density was measured by placing a marker on the peak of the signal and the results entered in the tables below.

Transmitter Maximum Power Spectral Density (5.47-5.725 GHz band) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

Channel	Frequency (MHz)	PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
Bottom	5500	-0.4	11.0	11.4	Complied
Middle	5580	-0.3	11.0	11.3	Complied
Top	5700	-0.7	11.0	11.7	Complied

Results: 802.11n / 20 MHz / BPSK / MCS0

Channel	Frequency (MHz)	PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
Bottom	5500	-1.1	11.0	12.1	Complied
Middle	5580	-2.4	11.0	13.4	Complied
Top	5700	-2.7	11.0	13.7	Complied

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	PSD (dBm/MHz)	Duty cycle correction factor (dB)	Corrected PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
Bottom	5510	-0.2	0.1	-0.1	11.0	11.1	Complied
Middle	5550	-4.0	0.1	-3.9	11.0	14.9	Complied
Top	5670	-1.0	0.1	-0.9	11.0	11.9	Complied

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	PSD (dBm/MHz)	Duty cycle correction factor (dB)	Corrected PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
Bottom	5530	-5.8	0.2	-5.6	11.0	16.6	Complied
Top	5610	-3.2	0.2	-3.0	11.0	14.0	Complied

Transmitter Maximum Power Spectral Density

4.5.4. 5.725-5.85 GHz band

Test Summary:

Test Engineer:	Max Passell	**Test Date:**	17 April 2019
Test Sample Serial Number:	000000007add4646		

FCC Reference:	Part 15.407(a)(3)
Test Method Used:	KDB 789033 D02 Section II.F. referencing II.E.2.b) and II.E.2.d)

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	36

Note(s):

1. Transmitter Maximum Power Spectral Density tests were performed using a signal analyser in accordance with KDB 789033 II. F referencing II.E.2.b) Method SA-1 where the duty cycle is >98% and II.E.2.d) Method SA-2 where the duty cycle was <98%
2. For data rates where the EUT was transmitting at <98% duty cycle, the calculated duty cycle in Section 4.1 was added to the measured maximum power spectral density in order to compute the average maximum power spectral density during the actual transmission time.
3. FCC Part 15.407(a)(3) limit for PPSD in the 5.725-5.85 GHz operating band is <30 dBm/500 kHz.
4. In accordance with ANSI C63.10 Section 4.1.4.1, use of bandwidths greater than those specified can produce higher readings. Compliance against the applicable limits is shown using a 1 MHz resolution bandwidth. This was deemed worst case.
5. For all modes of operation, the antenna gain is < 6 dBi.
6. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.
7. As the power spectral density test uses the same test method as the output power test, before the power is integrated across the 26 dB bandwidth, the conducted power spectral density plots are located in the conducted output power section 4.4 of this test report. The peak spectral density was measured by placing a marker on the peak of the signal and the results entered in the tables below.

Transmitter Maximum Power Spectral Density (5.725-5.85 GHz band) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

Channel	Frequency (MHz)	PSD (dBm/MHz)	Limit (dBm / 500 kHz)	Margin (dB)	Result
Bottom	5745	1.2	30.0	28.8	Complied
Middle	5785	1.3	30.0	28.7	Complied
Top	5825	2.1	30.0	27.9	Complied

Results: 802.11n / 20 MHz / BPSK / MCS0

Channel	Frequency (MHz)	PSD (dBm/MHz)	Limit (dBm / 500 kHz)	Margin (dB)	Result
Bottom	5745	1.5	30.0	28.5	Complied
Middle	5785	1.8	30.0	28.2	Complied
Top	5825	2.0	30.0	28.0	Complied

Results: 802.11n / 40 MHz / BPSK / MCS0

Channel	Frequency (MHz)	PSD (dBm/MHz)	Duty cycle correction factor (dB)	Corrected PSD (dBm/MHz)	Limit (dBm / 500 kHz)	Margin (dB)	Result
Bottom	5755	-0.6	0.1	-0.5	30.0	30.5	Complied
Top	5795	-0.3	0.1	-0.2	30.0	30.2	Complied

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Channel	Frequency (MHz)	PSD (dBm/MHz)	Duty cycle correction factor (dB)	Corrected PSD (dBm/MHz)	Limit (dBm / 500 kHz)	Margin (dB)	Result
Single	5775	-2.9	0.2	-2.7	30.0	32.7	Complied

5. Radiated Test Results

5.1. Transmitter Out of Band Radiated Emissions <1 GHz

Test Summary:

Test Engineer:	John Ferdinand	**Test Dates:**	09 May 2019 & 10 May 2019
Test Sample Serial Number:	000000003f9edf4a		

FCC Reference:	Parts 15.407(b)(1),(6),(7) & 15.209(a)
Test Method Used:	KDB 789033 II.G. & ANSI C63.10 Sections 6.3 and 6.5
Frequency Range:	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	21 to 23
Relative Humidity (%):	38 to 41

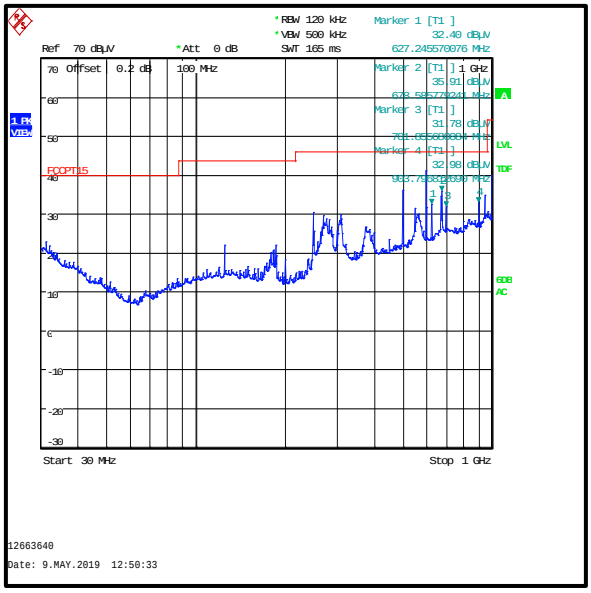
Note(s):

1. The final measured value, for the given emission in the field strength result tables, incorporates the calibrated antenna factor and cable loss.
2. Pre-scans were performed with the EUT transmitting in the band 5.15 to 5.25 GHz band with a data rate of 6 Mbps (802.11a) on middle channel in this band as it produced the highest power spectral density and was therefore deemed worst case. An inquiry was made to the FCC and the response was pre-scans could be performed in the band with the highest power spectral density and all final measurements should be performed on any emissions seen in each band.
3. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the middle channel only.
4. All other emissions shown on the pre-scan were investigated and found to be ambient, or >20 dB below the applicable limit or below the measurement system noise floor.
5. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
6. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth 500 kHz. The sweep time was set to auto. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
7. Final measurements were performed on the marker frequencies and the results entered into the table below. The test receiver resolution bandwidth was set to 120 kHz, using a CISPR quasi-peak detector and span wide enough to see the whole emission.

Transmitter Out of Band Radiated Emissions (5.15-5.25 GHz band operation) (continued)

Results: Quasi-Peak / Middle Channel / 802.11a / 6 Mbps

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
124.997	Vertical	22.5	43.5	21.0	Complied
240.843	Vertical	29.6	46.0	16.4	Complied



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

5.2. Transmitter Out of Band Radiated Emissions >1 GHz

5.2.1. 5.15-5.25 GHz band

Transmitter Out of Band Radiated Emissions (5.15-5.25 GHz band operation)

Test Summary:

Test Engineers:	John Ferdinand & Andrew Harding	**Test Dates:**	27 April 2019 to 30 April 2019
Test Sample Serial Number:	000000003f9edf4a		

FCC Reference:	Part 15.407(b)(1),(7) & 15.209(a)
Test Method Used:	KDB 789033 II.G. & ANSI C63.10 Sections 6.3 and 6.6
Frequency Range:	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	21 to 23
Relative Humidity (%):	37 to 42

Note(s):

1. FCC Part 15.407(b)(1) states for transmitters operating in the band 5.15 to 5.25 GHz: all emissions outside of the 5.15 to 5.35 GHz band will not exceed -27 dBm/MHz. Part(b)(7) states the provisions of 15.205 apply e.g. restricted bands of operation.
2. Pre-scans were performed with the EUT transmitting on the middle channel in this band with a data rate of 6 Mbps (802.11a) as it produced the highest power spectral density and was therefore deemed worst case. An inquiry was made to the FCC and the response was pre-scans could be performed in the band with the highest power spectral density and all final measurements should be performed on any emissions seen in each band.
3. All emissions shown on the pre-scan plots were investigated and found to be ambient, or 20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak and average noise floor readings of the measuring receiver were recorded.
4. Appropriate RF filters and attenuators were used during pre-scans and final measurements. Insertion losses were entered on the spectrum analyser as RF levels offsets.
5. The emission shown on the 1 GHz to 8 GHz plots is the EUT fundamental.
6. Measurements were performed across the two restricted bands closest to the band of operation with the EUT transmitting on the bottom channel of this band and bottom channel of 5.47 to 5.725 GHz range. Plots are included in this section of the test report. Peak and average measurements were made.
7. Measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

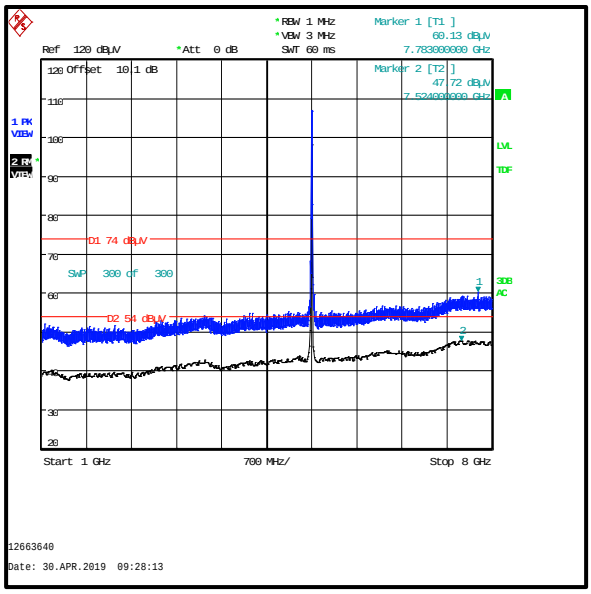
Transmitter Out of Band Radiated Emissions (5.15-5.25 GHz band operation) (continued)

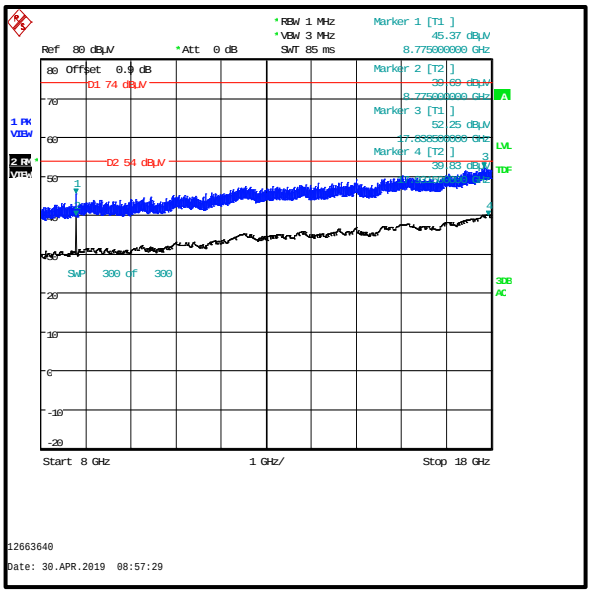
Results: Field Strength / Peak

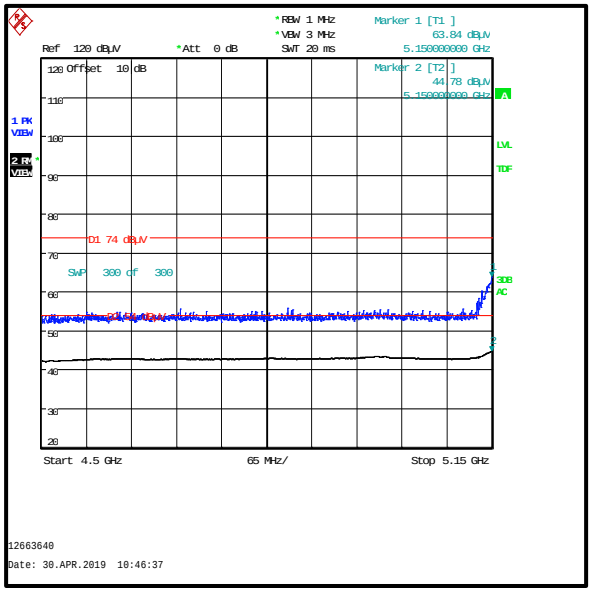
Frequency (MHz)	Antenna Polarity	Level (dBuV)	Limit (dBuV)	Margin (dB)	Result
17838.500	Vertical	52.3	74.0	21.7	Complied

Results: Field Strength / Average

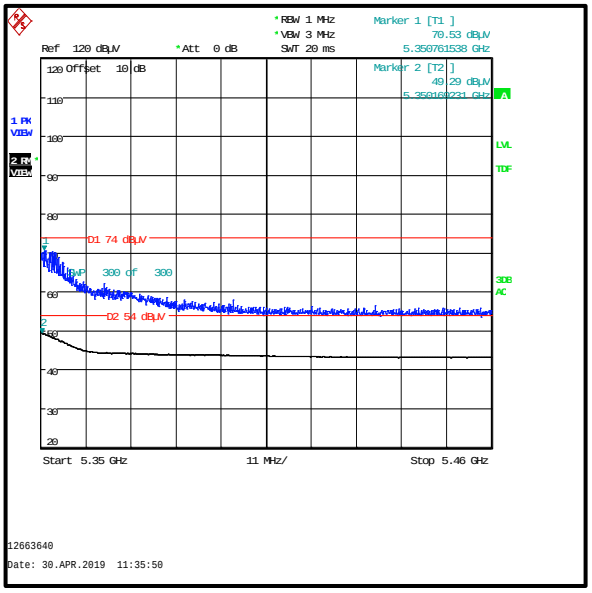
Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
17931.500	Vertical	39.8	54.0	14.2	Complied





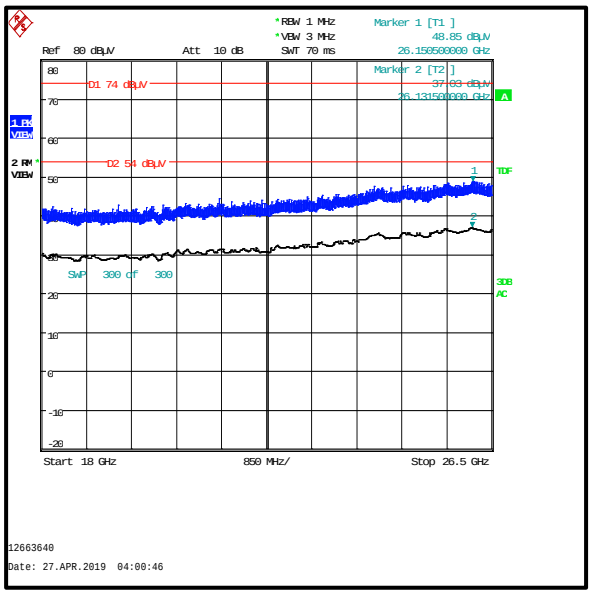


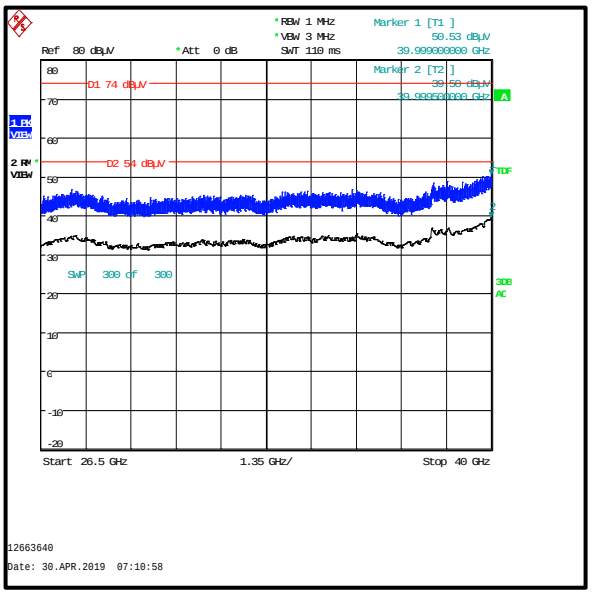
Restricted Band 4.5 GHz to 5.15 GHz



Restricted Band 5.35 GHz to 5.46 GHz

Transmitter Out of Band Radiated Emissions (5.15-5.25 GHz band operation) (continued)





5.2.2. 5.25-5.35 GHz band

Transmitter Out of Band Radiated Emissions (5.25-5.35 GHz band operation)

Test Summary:

Test Engineers:	John Ferdinand & Andrew Harding	**Test Dates:**	27 April 2019 to 30 April 2019
Test Sample Serial Number:	000000003f9edf4a		

FCC Reference:	Part 15.407(b)(2),(7) & 15.209(a)
Test Method Used:	KDB 789033 II.G. & ANSI C63.10 Sections 6.3 and 6.6
Frequency Range:	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	21 to 23
Relative Humidity (%):	37 to 42

Note(s):

1. FCC Part 15.407(b)(2) states for transmitters operating in the band 5.25 to 5.35 GHz: all emissions outside of the 5.15-5.35 GHz band will not exceed -27 dBm/MHz. Part(b)(7) states the provisions of 15.205 apply e.g. restricted bands of operation.
2. Pre-scans were performed with the EUT transmitting in the band 5.15 to 5.25 GHz band with a data rate of 6 Mbps (802.11a) on middle channel in this band as it produced the highest power spectral density and was therefore deemed worst case. An inquiry was made to the FCC and the response was pre-scans could be performed in the band with the highest power spectral density and all final measurements should be performed on any emissions seen in each band.
3. All emissions shown on the pre-scan plots were investigated and found to be ambient, or >20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak and average noise floor readings of the measuring receiver were recorded in the 5.15-5.25 GHz results (section 5.2.1) of this report.
4. Appropriate RF filters and attenuators were used during pre-scans and final measurements. Insertion losses were entered on the spectrum analyser as RF levels offsets.
5. Measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

5.2.3. 5.47-5.725 GHz band

Transmitter Out of Band Radiated Emissions (5.47-5.725 GHz band operation)

Test Summary:

Test Engineers:	John Ferdinand & Andrew Harding	**Test Dates:**	27 April 2019 to 30 April 2019
Test Sample Serial Number:	000000003f9edf4a		

FCC Reference:	Part 15.407(b)(3),(7) & 15.209(a)
Test Method Used:	KDB 789033 II.G. & ANSI C63.10 Sections 6.3 and 6.6
Frequency Range:	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	21 to 23
Relative Humidity (%):	37 to 42

Note(s):

1. FCC Part 15.407(b)(3) states for transmitters operating in the band 5.47 to 5.725 GHz: all emissions outside of the band will not exceed -27 dBm/MHz. Part(b)(7) states the provisions of 15.205 apply e.g. restricted bands of operation.
2. Pre-scans were performed with the EUT transmitting in the band 5.15 to 5.25 GHz band with a data rate of 6 Mbps (802.11a) on middle channel in this band as it produced the highest power spectral density and was therefore deemed worst case. An inquiry was made to the FCC and the response was pre-scans could be performed in the band with the highest power spectral density and all final measurements should be performed on any emissions seen in each band.
3. All emissions shown on the pre-scan plots were investigated and found to be ambient, or >20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak and average noise floor readings of the measuring receiver were recorded in the 5.15-5.25 GHz results (section 5.2.1) of this report.
4. Appropriate RF filters and attenuators were used during pre-scans and final measurements. Insertion losses were entered on the spectrum analyser as RF levels offsets.
5. Measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

5.2.4. 5.725-5.85 GHz band

Transmitter Out of Band Radiated Emissions (5.725-5.85 GHz band operation)

Test Summary:

Test Engineers:	John Ferdinand & Andrew Harding	**Test Dates:**	27 April 2019 to 30 April 2019
Test Sample Serial Number:	000000003f9edf4a		

FCC Reference:	Part 15.407(b)(4)(i),(7) & 15.209(a)
Test Method Used:	KDB 789033 II.G. & ANSI C63.10 Sections 6.3 and 6.6
Frequency Range:	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	21 to 23
Relative Humidity (%):	37 to 42

Note(s):

1. FCC Part 15.407(b)(4)(i) states for transmitters operating in the band 5.725 to 5.85 GHz: all emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge. Part(b)(7) states the provisions of 15.205 apply e.g. restricted bands of operation.
2. Pre-scans were performed with the EUT transmitting in the band 5.15 to 5.25 GHz band with a data rate of 6 Mbps (802.11a) on middle channel in this band as it produced the highest power spectral density and was therefore deemed worst case. An inquiry was made to the FCC and the response was pre-scans could be performed in the band with the highest power spectral density and all final measurements should be performed on any emissions seen in each band.
3. All emissions shown on the pre-scan plots were investigated and found to be ambient, or >20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak and average noise floor readings of the measuring receiver were recorded in the 5.15-5.25 GHz results (section 5.2.1) of this report.
4. Appropriate RF filters and attenuators were used during pre-scans and final measurements. Insertion losses were entered on the spectrum analyser as RF levels offsets.
5. Measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

5.3. Transmitter Band Edge Radiated Emissions

5.3.1. 5.15-5.25 GHz band

Test Summary:

Test Engineer:	John Ferdinand	**Test Date:**	25 April 2019
Test Sample Serial Number:	000000003f9edf4a		

FCC Reference:	Parts 15.407(b)(1),(7), 15.205 & 15.209(a)
Test Method Used:	ANSI C63.10 Section 6.10 & KDB 789033 II.G.

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	43

Note(s):

1. The customer declared the following data rates to be used for all measurements as:
    - 802.11a / BPSK / 6 Mbps
    - 802.11n HT20 / BPSK / MCS0
    - 802.11n HT40 / BPSK / MCS0
    - 802.11ac VHT80 / BPSK / MCS0x1
2. Lower band edge measurements were performed with the EUT transmitting on the bottom channel. Upper band edge measurements were performed with the EUT transmitting on the top channel.
3. For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. However, there are restricted bands of operation below the lower band edge at 4.5-5.15 GHz and also above the upper band edge at 5.35-5.46 GHz therefore the provisions of FCC Part 15.205 apply. Tests were performed in these restricted bands of operation, the results are included in the transmitter 5.15-5.25 GHz band radiated spurious emission section of this test report.
4. Field strength measurements using peak and average detectors were performed in the restricted bands below 5.15 GHz and above 5.35 GHz. Field strength and EIRP results were found to be compliant with the restricted band limits and Part 15.407 out-of-band limits.
5. For all average measurments if this section, 300 sweeps were used. This satisfies the requirement for the minimum number of sweep points, as stated in KDB 789033 Section II.G.6.c) Method AD (vi).
6. In accordance with KDB 789033 Section II.G.6.c) Method AD (vii), for average measurements, data rates where the EUT was transmitting <98% duty cycle, the duty cycle correction factor calculated in section 4.1 was added to the measured result.

Transmitter Band Edge Radiated Emissions (5.15-5.25 GHz band operation) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

Results: Lower Band Edge / Peak

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5147.821	67.3	74.0	6.7	Complied
5150	66.3	74.0	7.7	Complied

Results: Upper Band Edge / Peak

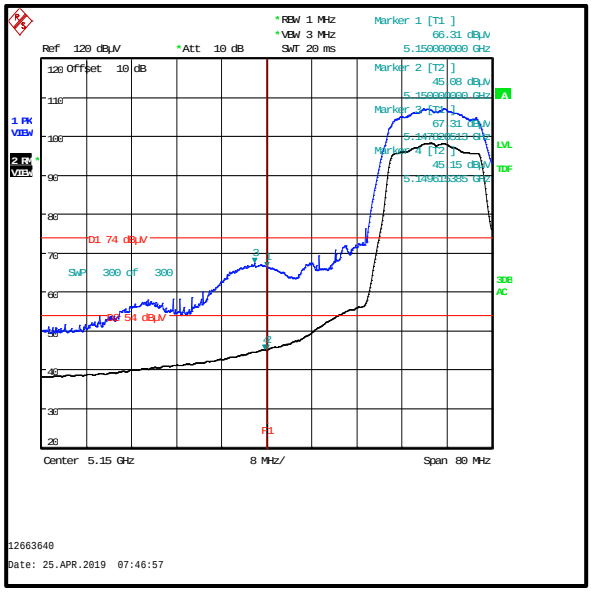
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	50.2	74.0	23.8	Complied
5385.000	51.4	74.0	22.6	Complied

Results: Lower Band Edge / Average

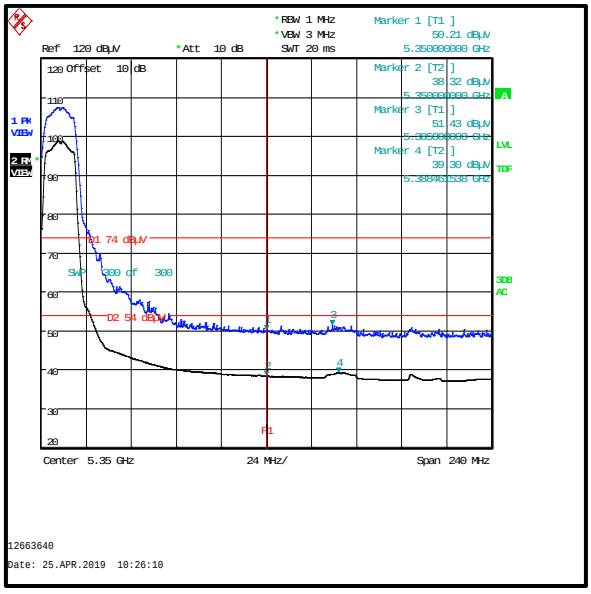
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5149.615	45.2	54.0	8.8	Complied
5150	45.1	54.0	8.9	Complied

Results: Upper Band Edge / Average

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	38.3	54.0	15.7	Complied
5388.462	39.3	54.0	14.7	Complied



Lower Band Edge



Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.15-5.25 GHz band operation) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

Results: Lower Band Edge / Peak

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5149.615	56.8	74.0	17.2	Complied
5150	54.6	74.0	19.4	Complied

Results: Upper Band Edge / Peak

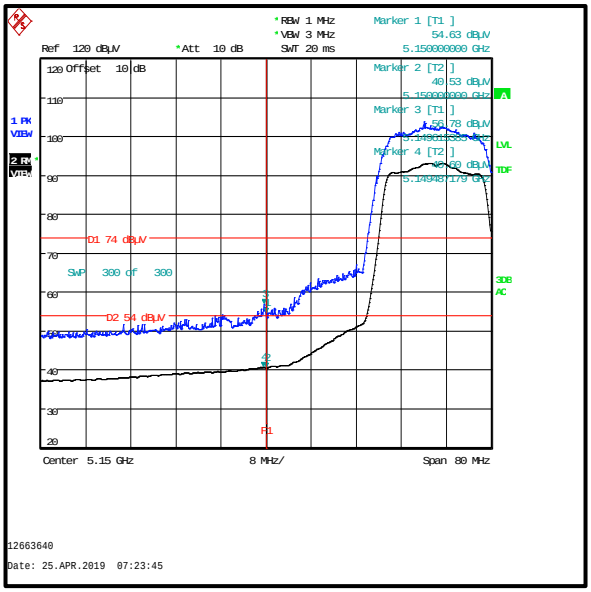
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	48.7	74.0	25.3	Complied
5392.308	50.1	74.0	23.9	Complied

Results: Lower Band Edge / Average

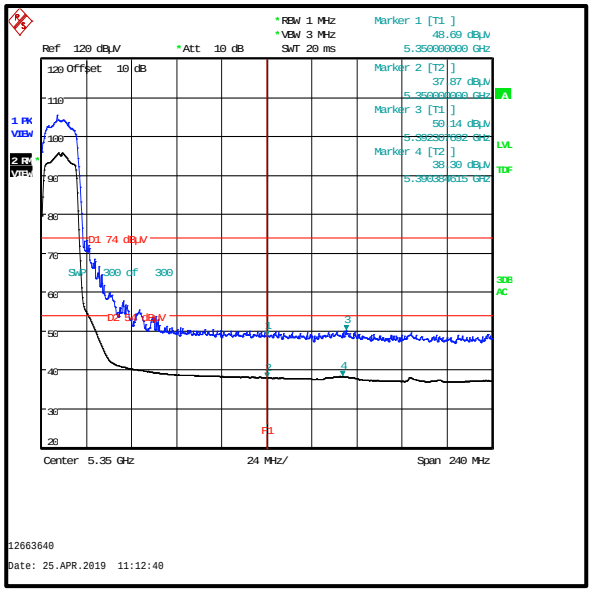
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5149.487	40.6	54.0	13.4	Complied
5150	40.5	54.0	13.5	Complied

Results: Upper Band Edge / Average

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	37.9	54.0	16.1	Complied
5390.385	38.3	54.0	15.7	Complied



Lower Band Edge



Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.15-5.25 GHz band operation) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

Results: Lower Band Edge / Peak

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5149.808	68.6	74.0	5.4	Complied
5150	66.5	74.0	7.5	Complied

Results: Upper Band Edge / Peak

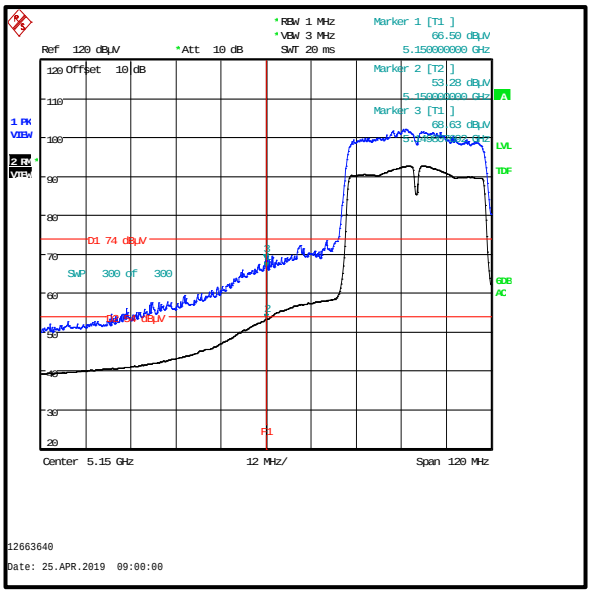
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	50.6	74.0	23.4	Complied
5364.808	52.3	74.0	21.7	Complied

Results: Lower Band Edge / Average

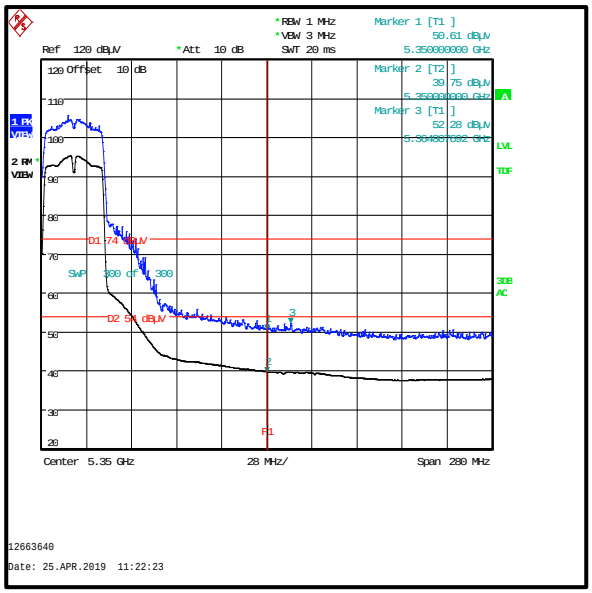
Frequency (MHz)	Level (dBµV/m)	Duty Cycle correction factor (dB)	Corrected Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5150	53.3	0.1	53.4	54.0	0.6	Complied

Results: Upper Band Edge / Average

Frequency (MHz)	Level (dBµV/m)	Duty Cycle correction factor (dB)	Corrected Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	39.8	0.1	40.0	54.0	14.0	Complied



Lower Band Edge



Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.15-5.25 GHz band operation) (continued)

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Results: Lower Band Edge / Peak

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5148.397	66.5	74.0	7.5	Complied
5150	65.0	74.0	9.0	Complied

Results: Upper Band Edge / Peak

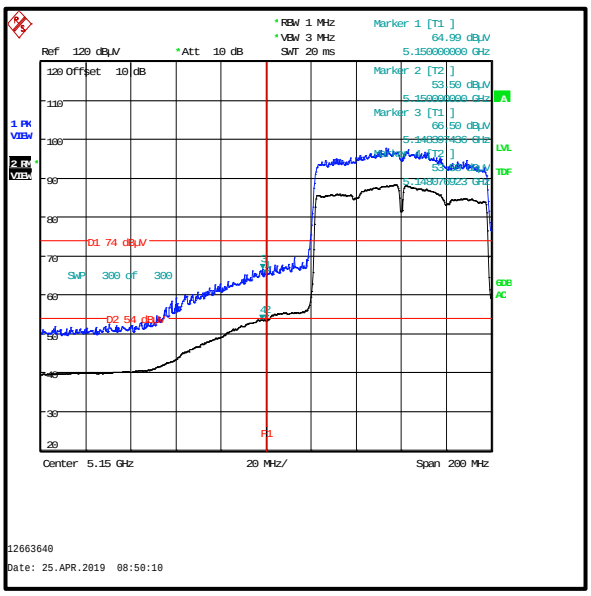
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	63.0	74.0	11.0	Complied
5353.846	64.0	74.0	10.0	Complied

Results: Lower Band Edge / Average

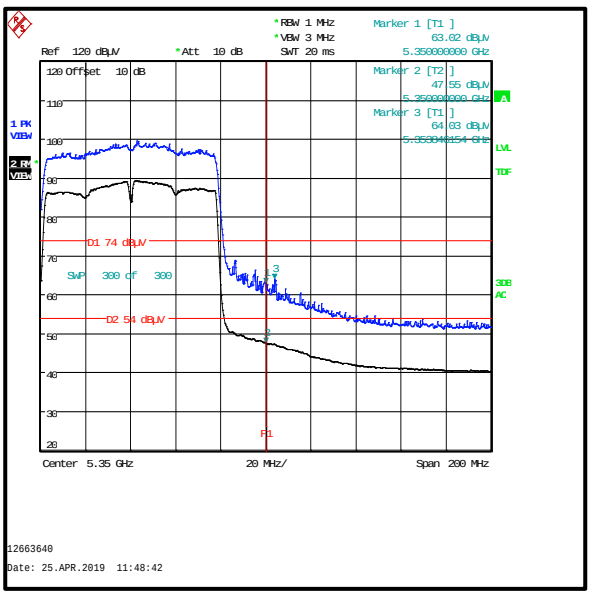
Frequency (MHz)	Level (dBµV/m)	Duty Cycle correction factor (dB)	Corrected Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5148.077	53.6	0.2	53.8	54.0	0.2	Complied
5150	53.5	0.2	53.7	54.0	0.3	Complied

Results: Upper Band Edge / Average

Frequency (MHz)	Level (dBµV/m)	Duty Cycle correction factor (dB)	Corrected Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	47.6	0.2	47.8	54.0	6.2	Complied



Lower Band Edge



Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.25-5.35 GHz band)

5.3.2. 5.25-5.35 GHz band

Test Summary:

Test Engineer:	John Ferdinand	**Test Dates:**	25 April 2019 & 26 April 2019
Test Sample Serial Number:	000000003f9edf4a		

FCC Reference:	Parts 15.407(b)(2),(7), 15.205 & 15.209(a)
Test Method Used:	ANSI C63.10 Section 6.10 & KDB 789033 II.G.

Environmental Conditions:

Temperature (°C):	20 to 21
Relative Humidity (%):	42 to 43

Note(s):

1. The customer declared the following data rates to be used for all measurements as:
    - 802.11a / BPSK / 6 Mbps
    - 802.11n HT20 / BPSK / MCS0
    - 802.11n HT40 / BPSK / MCS0
    - 802.11ac VHT80 / BPSK / MCS0x1
2. Lower band edge measurements were performed with the EUT transmitting on the bottom channel. Upper band edge measurements were performed with the EUT transmitting on the top channel.
3. For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. However, there are restricted bands of operation below the lower band edge at 4.5-5.15 GHz and also above the upper band edge at 5.35-5.46 GHz therefore the provisions of FCC Part 15.205 apply. Tests were performed in these restricted bands of operation, the results are included in the transmitter 5.15-5.25 GHz band radiated spurious emission section of this test report.
4. Field strength measurements using peak and average detectors were performed in the restricted bands below 5.15 GHz and above 5.35 GHz. Field strength and EIRP results were found to be compliant with the restricted band limits and Part 15.407 out-of-band limits.
5. For all average measurments if this section, 300 sweeps were used. This satisfies the requirement for the minimum number of sweep points, as stated in KDB 789033 Section II.G.6.c) Method AD (vi).
6. In accordance with KDB 789033 Section II.G.6.c) Method AD (vii), for average measurements, data rates where the EUT was transmitting <98% duty cycle, the duty cycle correction factor calculated in section 4.1 was added to the measured result.

Transmitter Band Edge Radiated Emissions (5.25-5.35 GHz band operation) (continued)

Results: 802.11a / 20 MHz / BPSK / 6 Mbps

Results: Lower Band Edge / Peak

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5105.769	50.3	74.0	23.7	Complied
5150	48.6	74.0	25.4	Complied

Results: Upper Band Edge / Peak

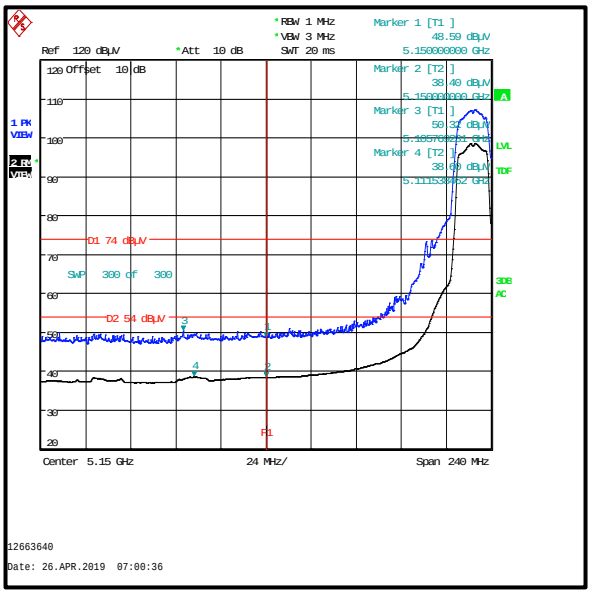
Frequency (MHz)	Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
5350	61.7	74.0	12.3	Complied
5354.231	62.1	74.0	11.9	Complied

Results: Lower Band Edge / Average

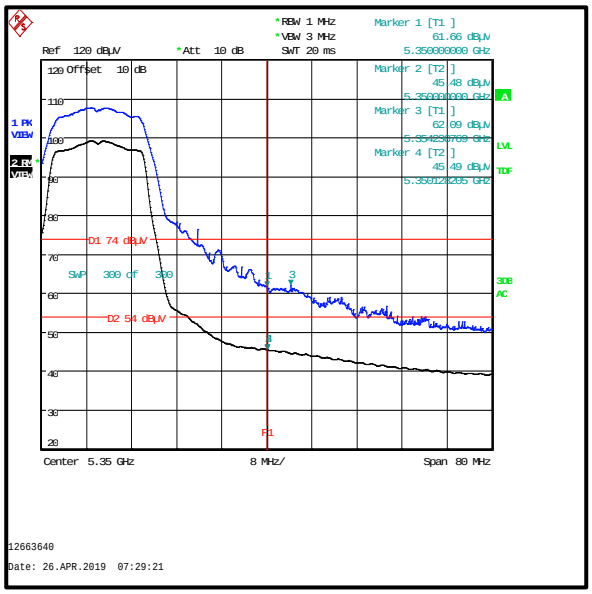
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5111.538	38.6	54.0	15.4	Complied
5150	38.4	54.0	15.6	Complied

Results: Upper Band Edge / Average

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	45.5	54.0	8.5	Complied



Lower Band Edge



Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.25-5.35 GHz band operation) (continued)

Results: 802.11n / 20 MHz / BPSK / MCS0

Results: Lower Band Edge / Peak

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5139.231	50.6	74.0	23.4	Complied
5150	49.7	74.0	24.3	Complied

Results: Upper Band Edge / Peak

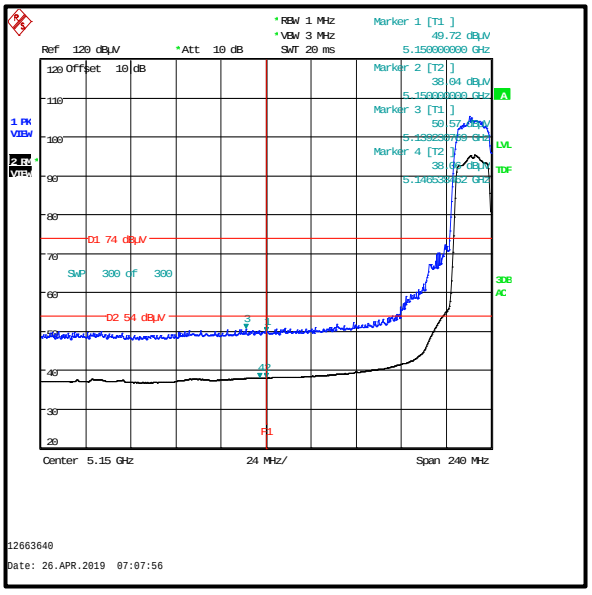
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	60.0	74.0	14	Complied
5354.744	61.7	74.0	12.3	Complied

Results: Lower Band Edge / Average

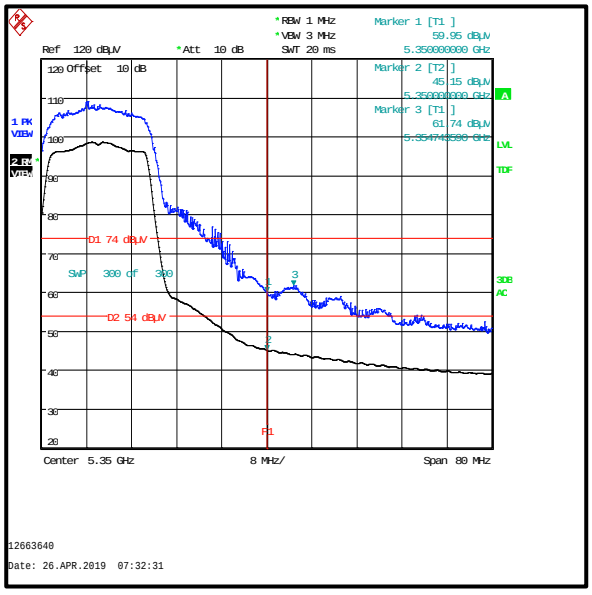
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5146.538	38.1	54.0	15.9	Complied
5150	38.0	54.0	16.0	Complied

Results: Upper Band Edge / Average

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	45.2	54.0	8.8	Complied



Lower Band Edge



Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.25-5.35 GHz band operation) (continued)

Results: 802.11n / 40 MHz / BPSK / MCS0

Results: Lower Band Edge / Peak

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5145.962	51.8	74.0	22.2	Complied
5150	50.5	74.0	23.5	Complied

Results: Upper Band Edge / Peak

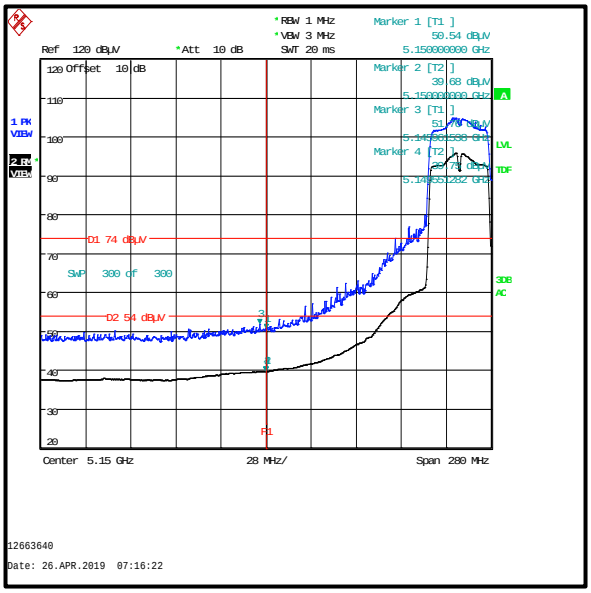
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	65.3	74.0	8.7	Complied
5350.962	68.7	74.0	5.3	Complied

Results: Lower Band Edge / Average

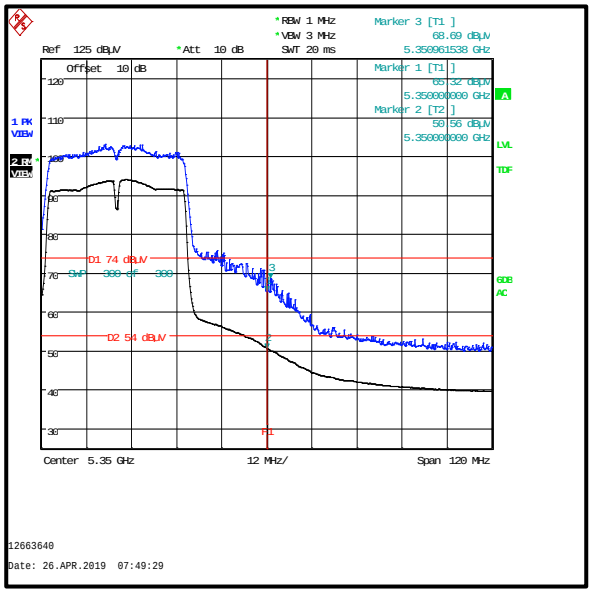
Frequency (MHz)	Level (dBµV/m)	Duty Cycle correction factor (dB)	Corrected Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5149.551	39.8	0.1	39.9	54.0	14.1	Complied
5150	39.7	0.1	39.8	54.0	14.2	Complied

Results: Upper Band Edge / Average

Frequency (MHz)	Level (dBµV/m)	Duty Cycle correction factor (dB)	Corrected Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	50.6	0.1 50.6	50.7	54.0	3.3	Complied



Lower Band Edge



Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.25-5.35 GHz band operation) (continued)

Results: 802.11ac / 80 MHz / BPSK / MCS0x1

Results: Lower Band Edge / Peak

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5148.397	66.5	74.0	7.5	Complied
5150	65.0	74.0	9.0	Complied

Results: Upper Band Edge / Peak

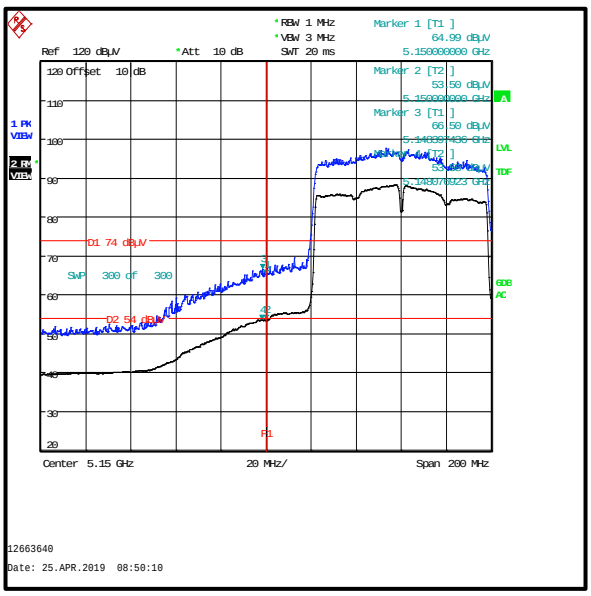
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	63.0	74.0	11.0	Complied
5353.846	64.0	74.0	10.0	Complied

Results: Lower Band Edge / Average

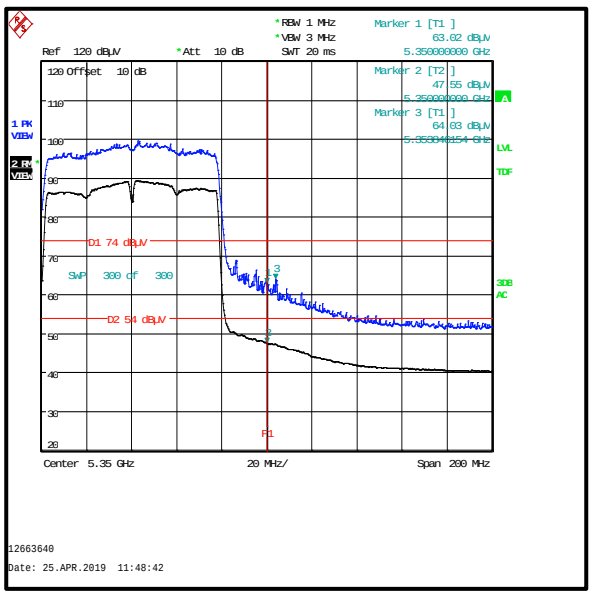
Frequency (MHz)	Level (dBµV/m)	Duty Cycle correction factor (dB)	Corrected Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5148.077	53.6	0.2	53.8	54.0	0.2	Complied
5150	53.5	0.2	53.7	54.0	0.3	Complied

Results: Upper Band Edge / Average

Frequency (MHz)	Level (dBµV/m)	Duty Cycle correction factor (dB)	Corrected Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5350	47.6	0.2	47.8	54.0	6.2	Complied



Lower Band Edge



Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.47-5.725 GHz band)

5.3.3. 5.47-5.725 GHz band

Test Summary:

Test Engineer:	John Ferdinand	**Test Date:**	26 April 2019
Test Sample Serial Number:	000000003f9edf4a		

FCC Reference:	Parts 15.407(b)(3),(7), 15.205 & 15.209(a)
Test Method Used:	ANSI C63.10 Section 6.10 & KDB 789033 II.G.

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	42

Note(s):

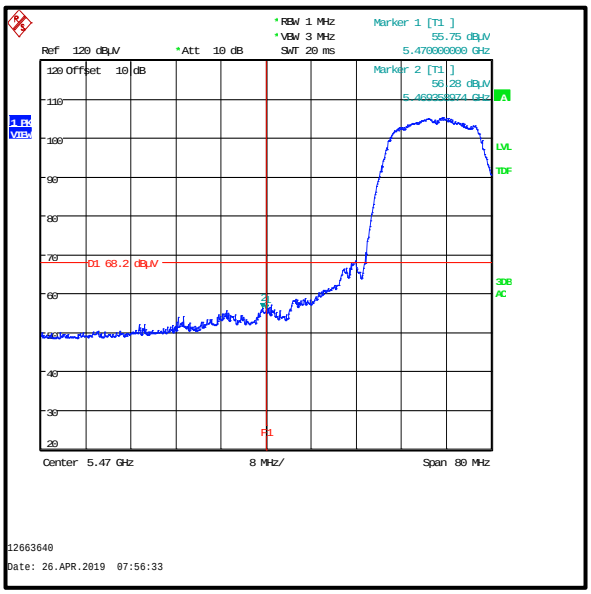
1. The customer declared the following data rates to be used for all measurements as:
    - 802.11a / BPSK / 6 Mbps
    - 802.11n HT20 / BPSK / MCS0
    - 802.11n HT40 / BPSK / MCS0
    - 802.11ac VHT80 / BPSK / MCS0x1
2. Lower band edge measurements were performed with the EUT transmitting on the bottom channel. Upper band edge measurements were performed with the EUT transmitting on the top channel.
3. For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of -27 dBm/MHz. However, there are restricted bands of operation below the lower band edge at 4.5-5.15 GHz and also at 5.35-5.46 GHz therefore the provisions of FCC Part 15.205 apply. Tests were performed in these restricted bands of operation with the EUT transmitting on the bottom and top channels within 5.47-5.725 GHz band, the results are included in the transmitter 5.15-5.25 GHz band radiated spurious emissions section of this test report.
4. For completeness, results are also shown as EIRP in dBm and also as field strength in dBµV/m. Measured field strength was converted to EIRP in accordance with KDB 789033 II.G.2.c)(iii) using a conversion factor of 95.2.

Transmitter Band Edge Radiated Emissions (5.47-5.725 GHz band operation) (continued)

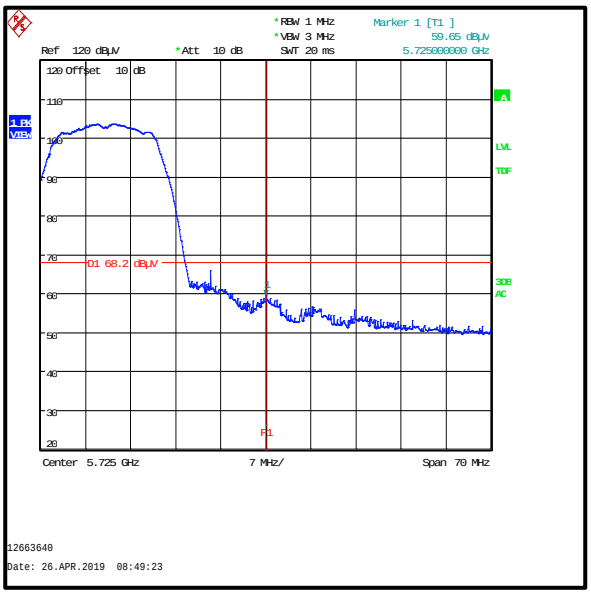
Results: 802.11a / 20 MHz / BPSK / 6 Mbps / Peak

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Result
5469.359	-38.9	-27.0	11.9	Complied
5470	-39.4	-27.0	12.4	Complied
5725	-35.5	-27.0	8.5	Complied

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5469.359	56.3	68.2	11.9	Complied
5470	55.8	68.2	12.4	Complied
5725	59.7	68.2	8.5	Complied



Lower Band Edge



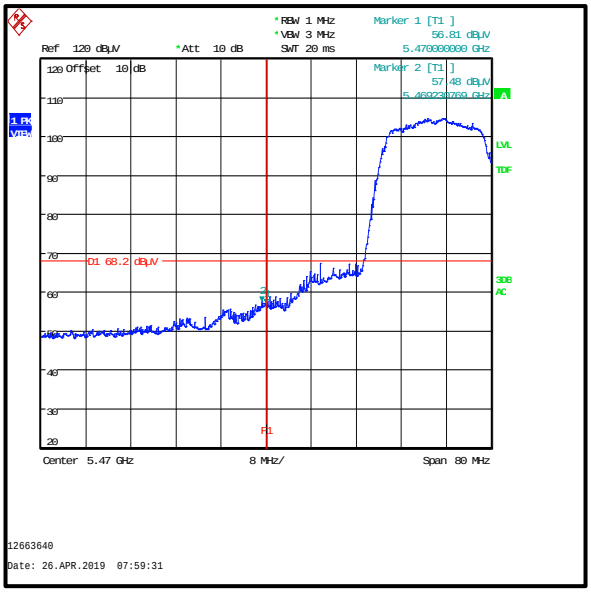
Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.47-5.725 GHz band operation) (continued)

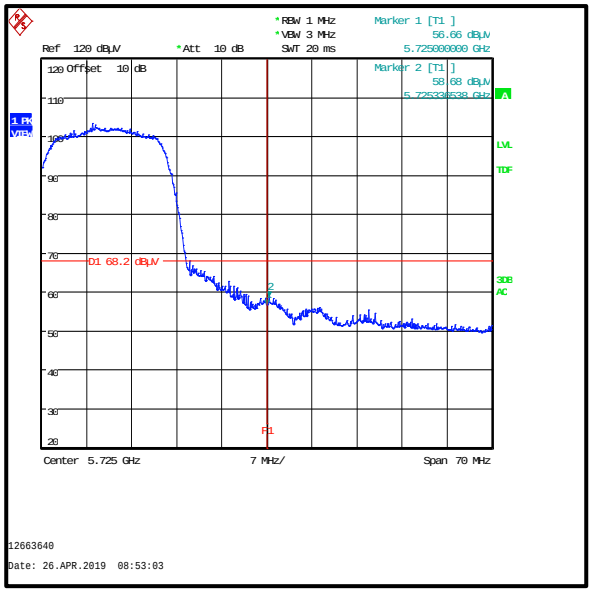
Results: 802.11n / 20 MHz / BPSK / MCS0 / Peak

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Result
5469.231	-37.7	-27.0	10.7	Complied
5470	-38.4	-27.0	11.4	Complied
5725	-38.5	-27.0	11.5	Complied
5725.337	-36.5	-27.0	9.5	Complied

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5469.231	57.5	68.2	10.7	Complied
5470	56.8	68.2	11.4	Complied
5725	56.7	68.2	11.5	Complied
5725.337	58.7	68.2	9.5	Complied



Lower Band Edge



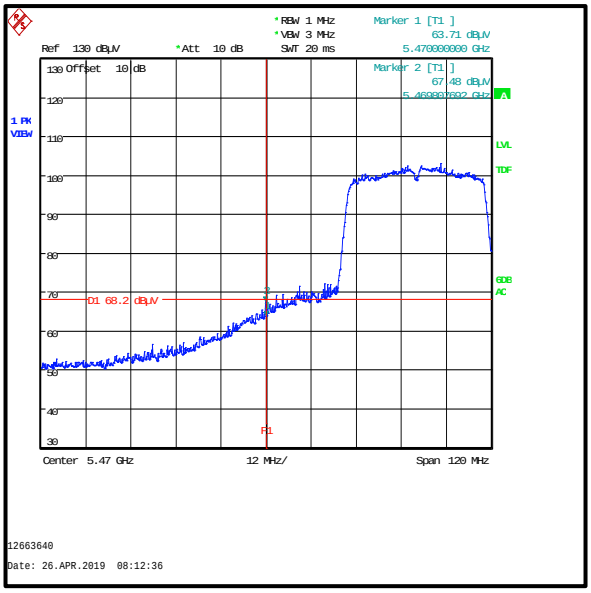
Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.47-5.725 GHz band operation) (continued)

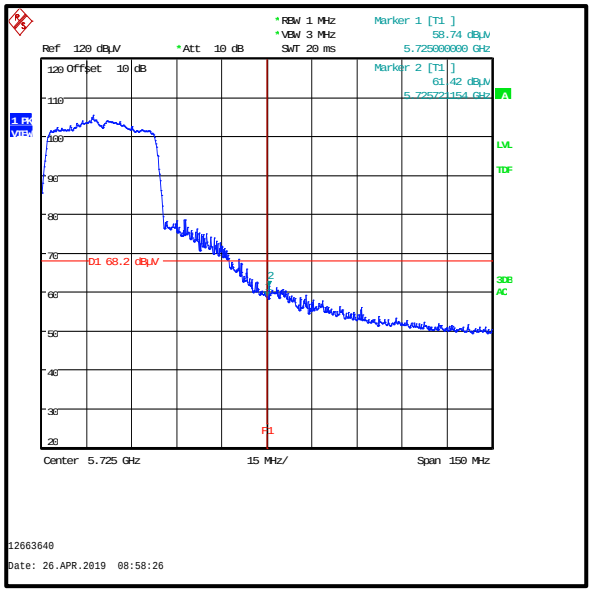
Results: 802.11n / 40 MHz / BPSK / MCS0 / Peak

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Result
5469.808	-27.7	-27.0	0.7	Complied
5470	-31.5	-27.0	4.5	Complied
5725	-36.5	-27.0	9.5	Complied
	-33.8	-27.0	6.8	Complied

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5469.808	67.5	68.2	0.7	Complied
5470	63.7	68.2	4.5	Complied
5725	58.7	68.2	9.5	Complied
5725.721	61.4	68.2	6.8	Complied



Lower Band Edge



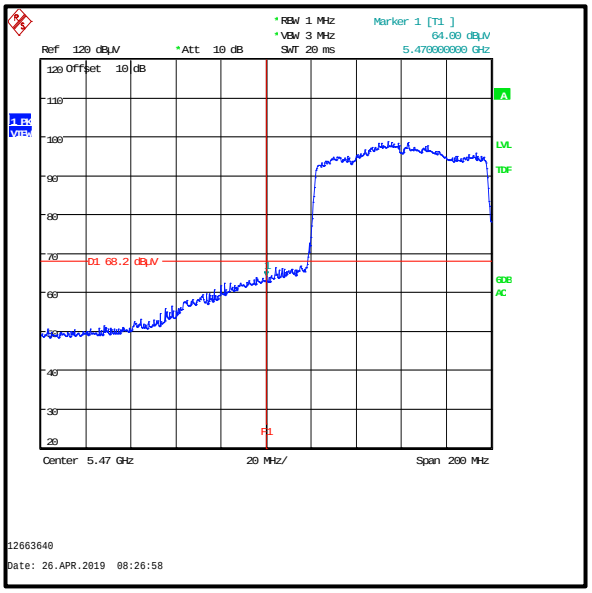
Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.47-5.725 GHz band operation) (continued)

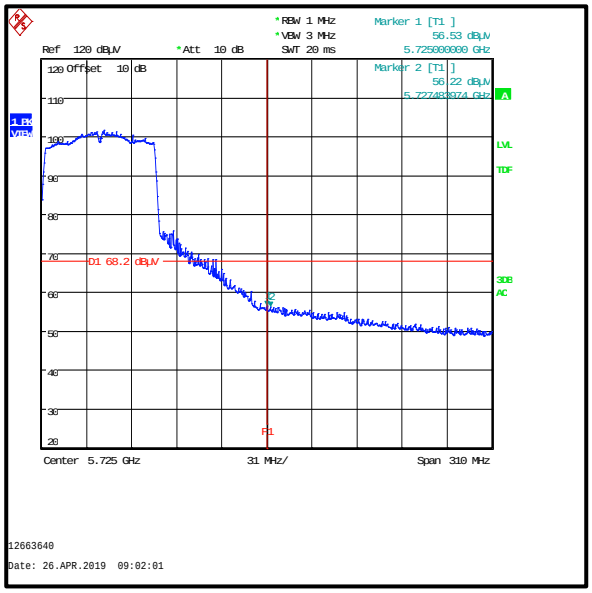
Results: 802.11ac / 80 MHz / BPSK / MCS0x1 / Peak

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Result
5470	-31.2	-27.0	4.2	Complied
5725	-38.7	-27.0	11.7	Complied

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5470	64.0	68.2	4.2	Complied
5725	56.5	68.2	11.7	Complied



Lower Band Edge



Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.725-5.85 GHz band)

5.3.4. 5.725-5.85 GHz band

Test Summary:

Test Engineer:	John Ferdinand	**Test Date:**	26 April 2019
Test Sample Serial Number:	000000003f9edf4a		

FCC Reference:	Parts 15.407(b)(4)(i),(7), 15.205 & 15.209(a)
Test Method Used:	ANSI C63.10 Section 6.10 & KDB 789033 II.G.

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	42

Note(s):

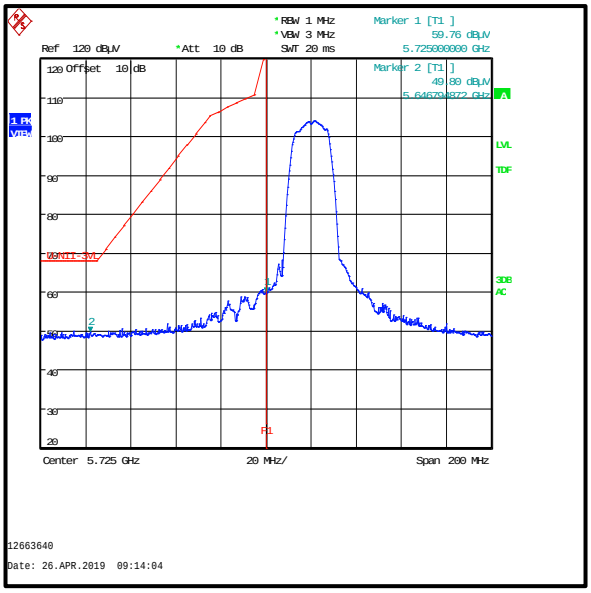
1. The customer declared the following data rates to be used for all measurements as:
    - 802.11a / BPSK / 6 Mbps
    - 802.11n HT20 / BPSK / MCS0
    - 802.11n HT40 / BPSK / MCS0
    - 802.11ac VHT80 / BPSK / MCS0x1
2. Lower band edge measurements were performed with the EUT transmitting on the bottom channel. Upper band edge measurements were performed with the EUT transmitting on the top channel.
3. For completeness, results are also shown as EIRP in dBm and also as field strength in dBµV/m. Measured field strength was converted to EIRP in accordance with KDB 789033 G.2.c)(iii) using a conversion factor of 95.2.

Transmitter Band Edge Radiated Emissions (5.725-5.85 GHz band operation) (continued)

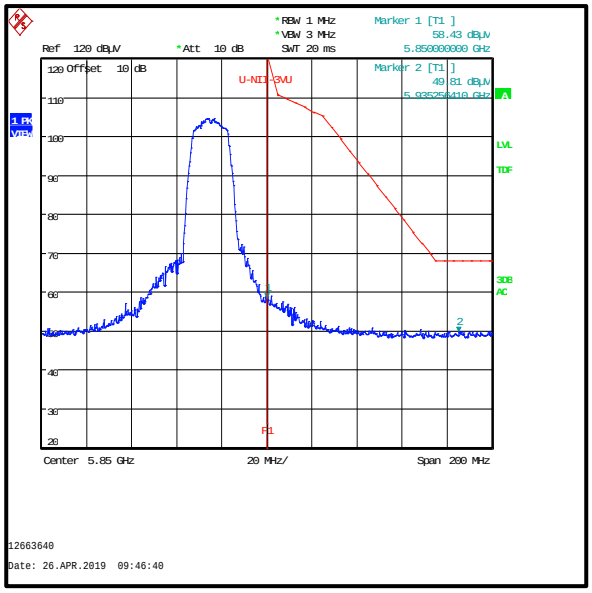
Results: 802.11a / 20 MHz / BPSK / 6 Mbps / Peak

Frequency (MHz)	Level (dBm)	Limit (dBm/MHz)	Margin (dB)	Result
5646.795	-45.4	-27.0	18.4	Complied
5725	-35.4	27.0	62.4	Complied
5850	-36.8	27.0	63.8	Complied
5935.256	-45.4	-27.0	18.4	Complied

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5646.795	49.8	68.2	18.4	Complied
5725	59.8	122.2	62.4	Complied
5850	58.4	122.2	63.8	Complied
5935.256	49.8	68.2	18.4	Complied



Lower Band Edge



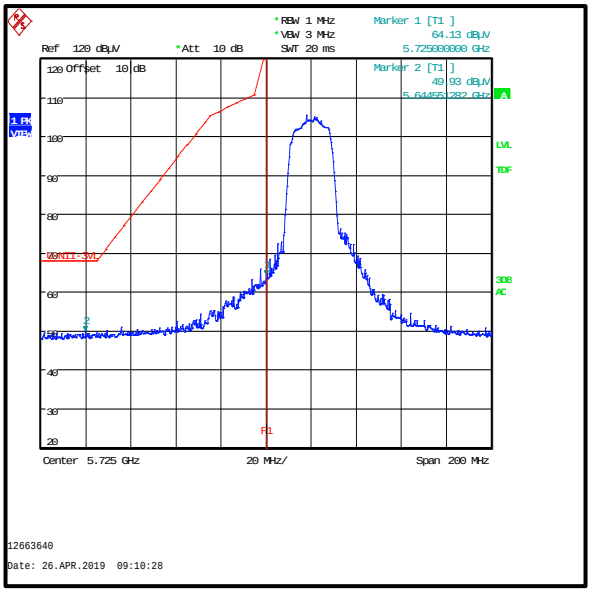
Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.725-5.85 GHz band operation) (continued)

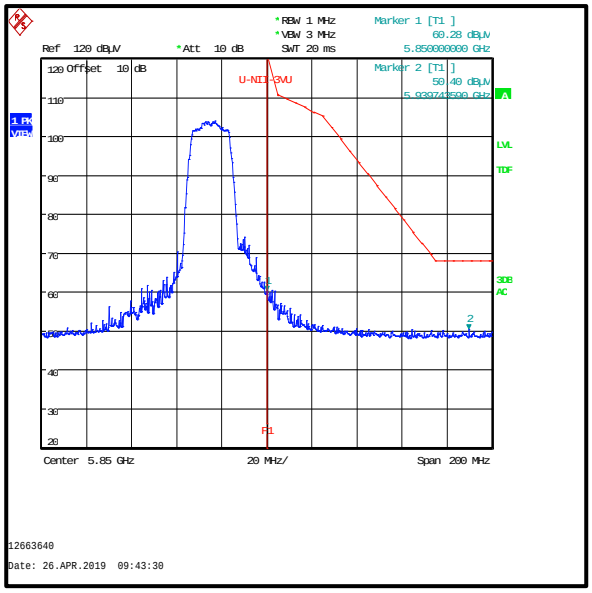
Results: 802.11n / 20 MHz / BPSK / MCS0 / Peak

Frequency (MHz)	Level (dBm)	Limit (dBm/MHz)	Margin (dB)	Result
5644.551	-45.3	-27.0	18.3	Complied
5725	-31.1	27.0	58.1	Complied
5850	-34.9	27.0	61.9	Complied
5939.744	-44.8	-27.0	17.8	Complied

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5644.551	49.9	68.2	18.3	Complied
5725	64.1	122.2	58.1	Complied
5850	60.3	122.2	61.9	Complied
5939.744	50.4	68.2	17.8	Complied



Lower Band Edge



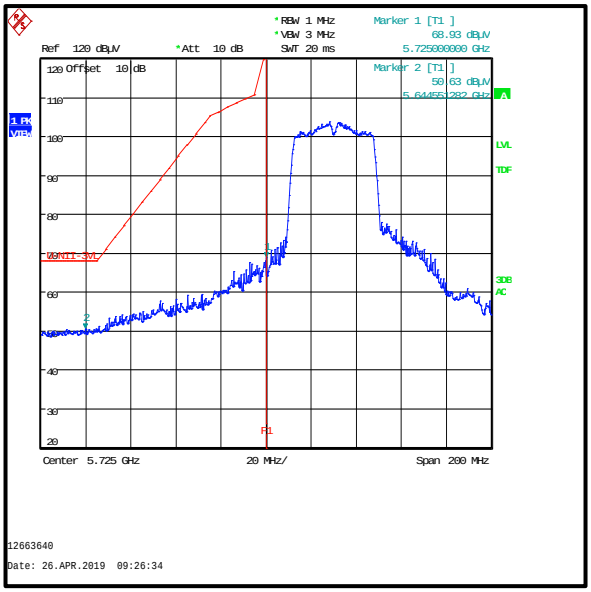
Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.725-5.85 GHz band operation) (continued)

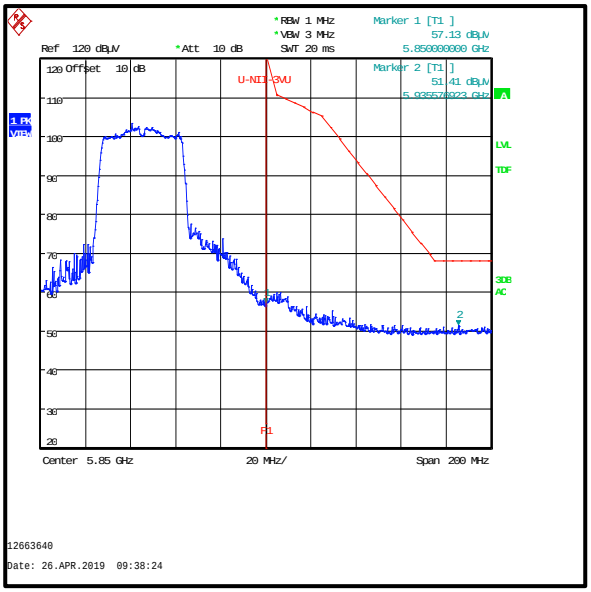
Results: 802.11n / 40 MHz / BPSK / MCS0/ Peak

Frequency (MHz)	Level (dBm)	Limit (dBm/MHz)	Margin (dB)	Result
5644.551	-44.6	-27.0	17.6	Complied
5725	-26.1	27.0	53.1	Complied
5850	-37.9	27.0	64.9	Complied
5935.577	-43.8	-27.0	16.8	Complied

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5644.551	50.6	68.2	17.6	Complied
5725	68.9	122.2	53.1	Complied
5850	57.1	122.2	64.9	Complied
5935.577	51.4	68.2	16.8	Complied



Lower Band Edge



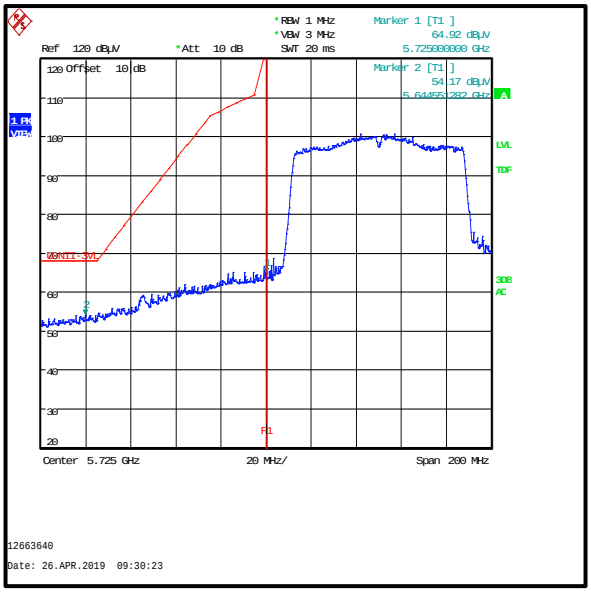
Upper Band Edge

Transmitter Band Edge Radiated Emissions (5.725-5.85 GHz band operation) (continued)

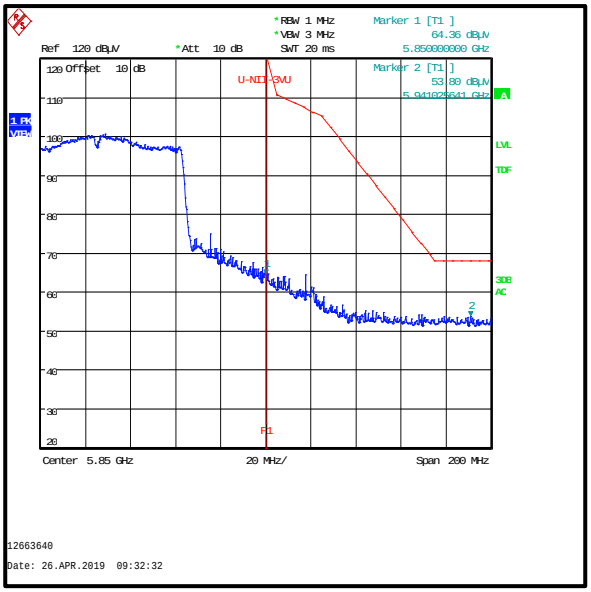
Results: 802.11ac / 80 MHz / BPSK / MCS0x1 / Peak

Frequency (MHz)	Level (dBm)	Limit (dBm/MHz)	Margin (dB)	Result
5644.551	-41.0	-27.0	14.0	Complied
5725	-30.3	27.0	57.3	Complied
5850	-30.8	27.0	57.8	Complied
5941.026	-41.4	-27.0	14.4	Complied

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
5644.551	54.2	68.2	14.0	Complied
5725	64.9	122.2	57.3	Complied
5850	64.4	122.2	57.8	Complied
5941.026	53.8	68.2	14.4	Complied



Lower Band Edge



Upper Band Edge

6. AC Power Line Conducted Emissions Test Results

6.1. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Victor Carmon	**Test Date:**	24 April 2019
Test Sample Serial Number:	0000000027a0c96b		

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

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	46

Note(s):

1. The EUT was connected to the AC to DC switch mode power supply which was connected to 120 VAC 60 Hz single phase supply via a LISN.
2. In accordance with FCC KDB 174176 Q4, tests were performed with a 240 VAC 60 Hz single phase supply as this was within the voltage range marked on the EUT's power supply.
3. A pulse limiter was fitted between the LISN and the test receiver.
4. 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.

Transmitter AC Conducted Spurious Emissions (continued)

Results: Live / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.150	Live	46.6	66.0	19.4	Complied
0.164	Live	39.8	65.3	25.5	Complied
0.443	Live	36.8	57.0	20.2	Complied
0.515	Live	36.4	56.0	19.6	Complied
1.019	Live	31.5	56.0	24.5	Complied
11.423	Live	30.8	60.0	29.2	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.150	Live	25.5	56.0	30.5	Complied
0.159	Live	25.7	55.5	29.8	Complied
0.438	Live	27.0	47.1	20.1	Complied
0.519	Live	24.8	46.0	21.2	Complied
0.983	Live	22.4	46.0	23.6	Complied
11.477	Live	22.3	50.0	27.7	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

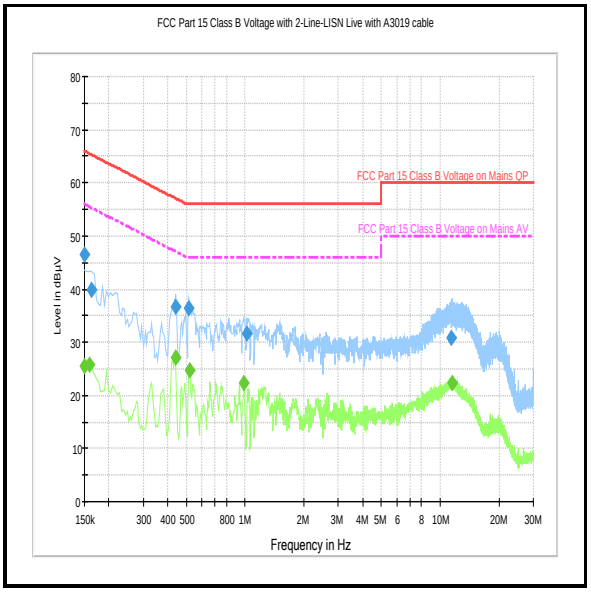
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.155	Neutral	39.6	65.8	26.2	Complied
0.236	Neutral	27.3	62.3	35.0	Complied
0.443	Neutral	36.8	57.0	20.2	Complied
0.515	Neutral	38.3	56.0	17.7	Complied
0.996	Neutral	34.0	56.0	22.0	Complied
11.486	Neutral	31.6	60.0	28.4	Complied

Results: Neutral / Average / 120 VAC 60 Hz

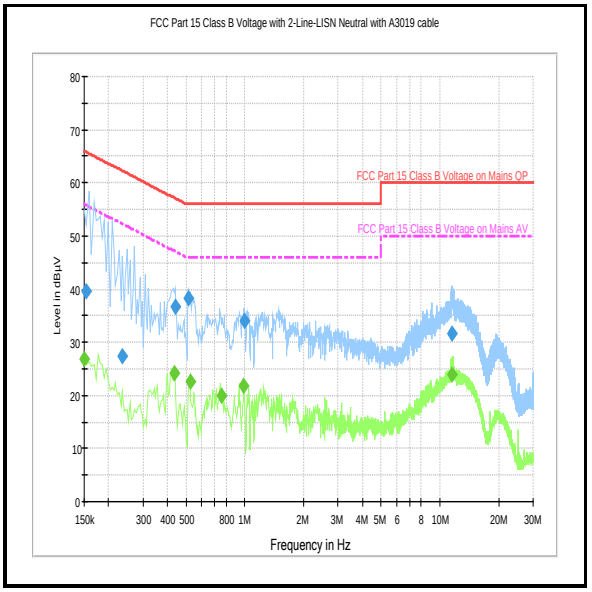
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.150	Neutral	26.9	56.0	29.1	Complied
0.434	Neutral	24.2	47.2	23.0	Complied
0.524	Neutral	22.6	46.0	23.4	Complied
0.762	Neutral	20.0	46.0	26.0	Complied
0.983	Neutral	21.7	46.0	24.3	Complied
11.544	Neutral	24.0	50.0	26.0	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: 120 VAC 60 Hz



Live



Neutral

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter AC Conducted Spurious Emissions (continued)

Results: Live / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.177	Live	37.5	64.6	27.1	Complied
0.222	Live	35.5	62.7	27.2	Complied
0.492	Live	36.6	56.1	19.5	Complied
1.167	Live	34.0	56.0	22.0	Complied
1.554	Live	33.9	56.0	22.1	Complied
11.409	Live	33.1	60.0	26.9	Complied

Results: Live / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.267	Live	27.9	51.2	23.3	Complied
0.353	Live	26.2	48.9	22.7	Complied
0.672	Live	26.8	46.0	19.2	Complied
1.140	Live	25.8	46.0	20.2	Complied
2.468	Live	24.4	46.0	21.6	Complied
10.910	Live	24.6	50.0	25.4	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

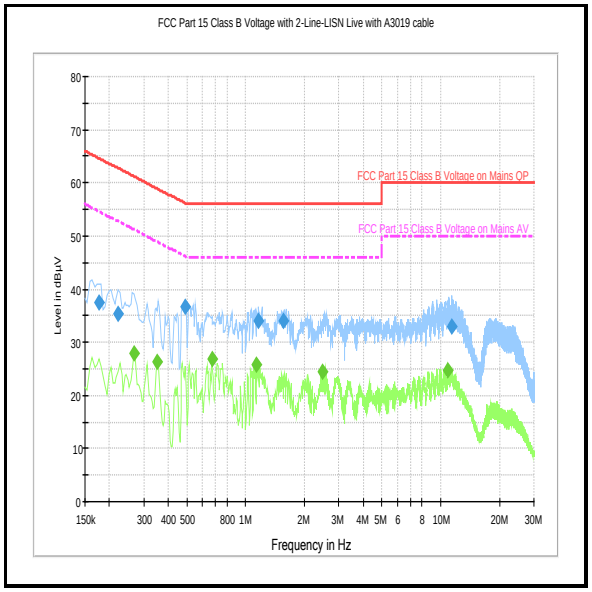
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.492	Neutral	37.3	56.1	18.8	Complied
1.122	Neutral	36.4	56.0	19.6	Complied
1.590	Neutral	36.5	56.0	19.5	Complied
2.076	Neutral	34.4	56.0	21.6	Complied
2.558	Neutral	33.6	56.0	22.4	Complied
11.108	Neutral	32.0	60.0	28.0	Complied

Results: Neutral / Average / 240 VAC 60 Hz

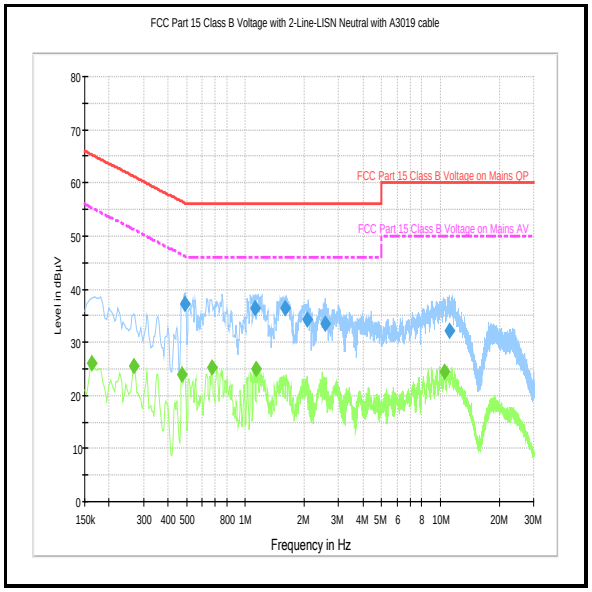
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.164	Neutral	26.0	55.3	29.3	Complied
0.267	Neutral	25.6	51.2	25.6	Complied
0.474	Neutral	23.9	46.4	22.6	Complied
0.672	Neutral	25.3	46.0	20.7	Complied
1.140	Neutral	24.9	46.0	21.1	Complied
10.433	Neutral	24.5	50.0	25.5	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: 240 VAC 60 Hz



Live



Neutral

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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