



TEST REPORT

Test Report No. : UL-RPT-RP12718494JD10E V2.0

Customer : Apple Inc.
Model No. : A1991
FCC ID : BCGA1991
Technology : WLAN
Test Standard(s) : FCC Parts 15.209(a) & 15.407

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

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

Date of Issue: 18 September 2019

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Customer Information

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Report Revision History

Version Number	Issue Date	Revision Details	Revised By
1.0	17/07/2019	Initial Version	Sarah Williams
2.0	18/09/2019	Address TCB questions	Sarah Williams

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1. Attestation of Test Results

1.1. Description of EUT

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

1.2. General Information

Specification Reference:	47CFR15.407 and 47CFR15.403
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) – Sections 15.403 and 15.407
Specification Reference:	47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209
Site Registration:	621311
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	20 April 2019 to 04 July 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	Complied
Part 15.407(e)	Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band)	Complied
Part 15.407(e)	Transmitter Minimum 6 dB Bandwidth (Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz)	Complied
Part 15.407(a)(1)(iv)	Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band)	Complied
Part 15.407(a)(2)	Transmitter Maximum Conducted Output Power (5.25-5.35 GHz & 5.47-5.725 GHz bands)	Complied
Part 15.407(a)(2)	Transmitter Maximum Conducted Output Power (Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz)	Complied
Part 15.407(a)(3)	Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band)	Complied
Part 15.407(a)(1)(iv)	Transmitter Maximum Power Spectral Density (5.15-5.25 GHz band)	Complied
Part 15.407(a)(2)	Transmitter Maximum Power Spectral Density (5.25-5.35 GHz & 5.47-5.725 GHz bands)	Complied
Part 15.407(a)(2)	Transmitter Maximum Power Spectral Density (Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz)	Complied
Part 15.407(a)(3)	Transmitter Maximum Power Spectral Density (5.725-5.85 GHz band)	Complied
Part 15.407(b)/15.209(a)	Transmitter Out of Band Radiated Emissions	Complied
Part 15.407(b)/15.209(a)	Transmitter Band Edge Radiated Emissions	Complied
Part 15.407(g)	Transmitter Frequency Stability (Temperature & Voltage Variation)	Note 2
Part 15.407(h)(1)	Transmitter Power Control	Note 3

Note(s):

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

1.4. Deviations from the Test Specification

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

2. Summary of Testing

2.1. Facilities and Accreditation

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

Site 1	X
Site 2	-
Site 17	X

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

2.2. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 789033 D02 General U-NII Test Procedures New Rules v02r01 December 14, 2017
Title:	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E)

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

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)
M2040	Thermohygrometer	Testo	608-H1	45124934	06 Jan 2020	12
K0001	3m RSE Chamber	Rainford EMC	N/A	N/A	04 Oct 2019	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	20 Sep 2019	12
M2044	Test Receiver	Rohde & Schwarz	ESU26	100122	01 Apr 2020	12
A3154	Pre-Amplifier	Com-Power	PAM-103	18020012	14 Sep 2019	12
A3179	Pre-Amplifier	Hewlett Packard	8449B	3008A00934	04 Apr 2020	12
A3141	Pre-Amplifier	Schwarzbeck	BBV 9718 B	00021	21 Nov 2019	12
A2896	Pre-Amplifier	Schwarzbeck	BBV 9721	9721 - 023	08 Feb 2020	12
A553	Antenna	Chase	CBL6111A	1593	08 Oct 2019	12
A3138	Antenna	Schwarzbeck	BBHA 9120 B	00702	03 Oct 2019	12
A3139	Antenna	Schwarzbeck	HWRD 750	00027	04 Oct 2019	12
A2895	Antenna	Schwarzbeck	BBHA 9170	9170-728	08 Feb 2020	12
A3112	Attenuator	AtlanTecRF	AN18-06	219706#2	08 Oct 2019	12
A2523	Attenuator	AtlanTecRF	AN18W5-10	832827#1	04 Mar 2020	12
A3085	Low Pass Filter	AtlanTecRF	AFL-02000	180516000 14	09 Apr 2020	12
A3095	High Pass Filter	AtlanTecRF	AFH-07000	180516000 12	09 Apr 2020	12
A2482	5.8 GHz Band Reject Filter	Wainwright Instruments	WRCJV8-5665-5725-5850-5910-50SS	2	10 Apr 2020	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	16 Feb 2020	12
M2003	Thermohygrometer	Testo	608-H1	45046641	06 Jan 2020	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	08 May 2020	12
A2947	High Pass Filter	AtlanTecRF	AFH-07000	1601900001	20 Feb 2020	12
A3142	Pre Amplifier	Schwarzbeck	BBV 9718 B	00020	12 Feb 2020	12
A2980	Antenna	Schwarzbeck	HWRD 750	014	12 Feb 2020	12

Test and Measurement Equipment (continued)**Test Equipment Used for Transmitter Band Edge Radiated Emissions**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2040	Thermohygrometer	Testo	608-H1	45124934	06 Jan 2020	12
K0001	3m RSE Chamber	Rainford EMC	N/A	N/A	04 Oct 2019	12
M2044	Test Receiver	Rohde & Schwarz	ESU26	100122	01 Apr 2020	12
A3179	Pre-Amplifier	Hewlett Packard	8449B	3008A00934	04 Apr 2020	12
A3138	Antenna	Schwarzbeck	BBHA 9120B	00702	03 Oct 2019	12
A2523	Attenuator	AtlanTecRF	AN18W5-10	832827#1	04 Mar 2020	12
M2003	Thermohygrometer	Testo	608-H1	45046641	06 Jan 2020	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	16 Feb 2020	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	08 May 2020	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	20 Sep 2019	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	12 Feb 2020	12
A2889	Antenna	Schwarzbeck	BBHA 9120B	BBHA 9120 B653	12 Feb 2020	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	20 Feb 2020	12

Test Measurement Software/Firmware Used

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

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Apple
Model Name or Number:	A1991
Test Sample Serial Number:	C02YF007MFLF (<i>Conducted sample</i>)
Hardware Version:	REV 1.0
Software Version:	18F98
FCC ID:	BCGA1991

Brand Name:	Apple
Model Name or Number:	A1991
Test Sample Serial Number:	C02YF00CMFLF (<i>Radiated sample #1</i>)
Hardware Version:	REV 1.0
Software Version:	18F98
FCC ID:	BCGA1991

Brand Name:	Apple
Model Name or Number:	A1991
Test Sample Serial Number:	C02YD006MFLQ (<i>Radiated sample #2</i>)
Hardware Version:	REV 1.0
Software Version:	18F98
FCC ID:	BCGA1991

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
	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	Constant 3.8 VDC via 120 VAC 60 Hz AC/DC supply
Maximum Conducted Output Power:	20 MHz	22.1 dBm
	40 MHz	22.3 dBm
	80 MHz	21.8 dBm

Additional Information Related to Testing (continued)

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

Additional Information Related to Testing (continued)

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

Additional Information Related to Testing (continued)

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

3.4. Description of Available Antennas

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

Frequency Range (MHz)	Antenna Gain (dBi)
5150 to 5250	4.5
5250 to 5350	4.2
5470 to 5725	4.9
5725 to 5850	4.6

3.5. Description of Test Setup

Support Equipment

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

Description:	Test Laptop
Brand Name:	Apple
Model Name or Number:	MacBook Pro
Serial Number:	C02Q81PFG3QD

Description:	USB Keyboard
Brand Name:	Apple
Model Name or Number:	A1243
Serial Number:	C02T300BHXOX

Description:	USB Mouse
Brand Name:	Apple
Model Name or Number:	A1152
Serial Number:	Not marked or stated

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

Description:	USB-C to USB Adapter. Quantity 4
Brand Name:	Apple
Model Name or Number:	A1632
Serial Number:	Not marked or stated

Description:	HDMI Monitor
Brand Name:	Dell
Model Name or Number:	S2218H
Serial Number:	Not marked or stated

Description:	USB Hub
Brand Name:	Hama
Model Name or Number:	0078498
Serial Number:	09825891600

Support Equipment (continued)

Description:	Ethernet Router
Brand Name:	Netgear
Model Name or Number:	GS605v3
Serial Number:	1YG194390218E

Description:	Ethernet Cable. Length 3.0 metres. Quantity 2
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	HDMI Cable. Length 3.0 metres. Quantity 2
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

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

Description:	Test Laptop
Brand Name:	Apple
Model Name or Number:	MacBook Pro
Serial Number:	C02VT0AUHX87

Description:	HDMI Hub
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Operating Modes

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

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

Configuration and Peripherals

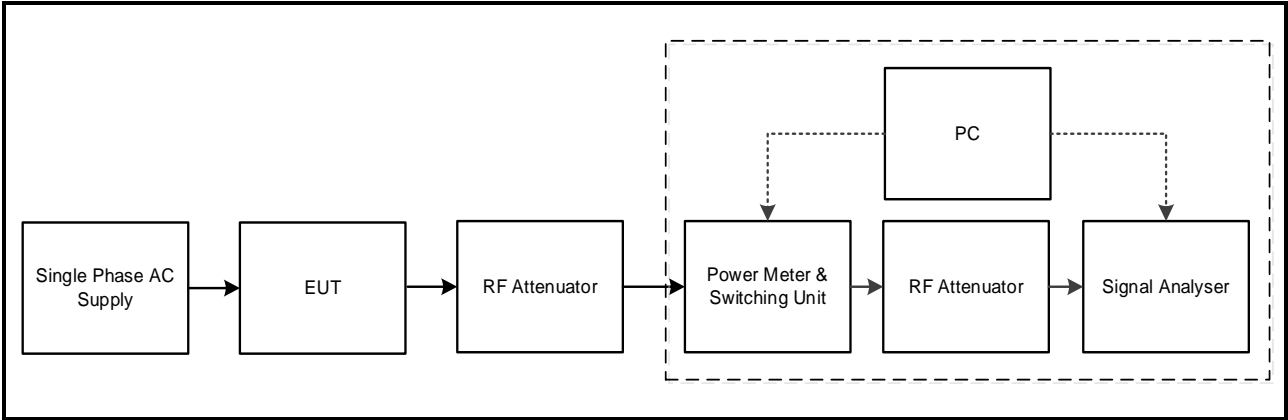
The EUT was tested in the following configuration(s):

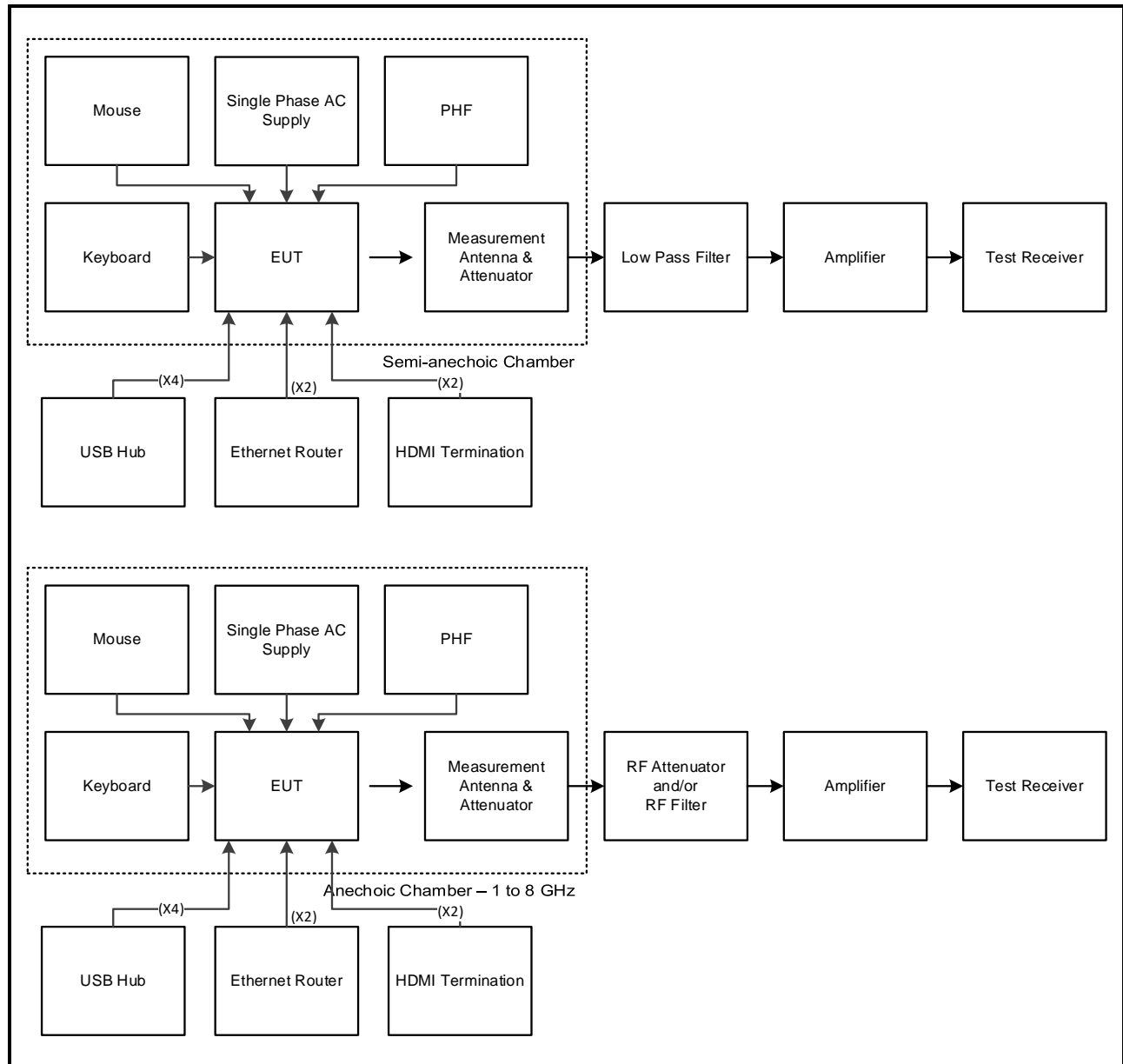
- Controlled in test mode using a software application on the EUT supplied by the customer. The application was used to enable a continuous transmission and to select the test channels as required.
- The customer requested the following data rates to be used for all measurements.
 - 802.11a SISO - BPSK / 6 Mbps / Core 2
 - 802.11n HT20 / SISO – BPSK / MCS0 / Core 2
 - 802.11n HT40 / SISO – BPSK / MCS0 / Core 2
 - 802.11ac VHT80 / SISO – BPSK / MCS0 / Core 2
- The customer supplied U.FL RF cables with the EUT in order to perform conducted measurements. The measured additional path loss was included in any path loss calculations.
- Transmitter spurious emissions were performed with the EUT transmitting with a data rate of 802.11n HT20 / MCS0 as this mode emits the highest power level and was deemed to be worst case.
- Transmitter radiated spurious emissions tests were performed with the USB Keyboard, USB Mouse and PHF connected to the EUT. The remaining USB ports were connected with a USB cable to a hub. The USB-C ports were connected via a USB C-A adaptor and USB cable to a hub. The ethernet ports were terminated into a router. The HDMI ports were terminated into a hub. The router and hubs were placed under the floor inside the chamber.
- The EUT was powered from a 120 VAC 60 Hz single phase mains supply.

Test Setup Diagrams

Conducted Tests:

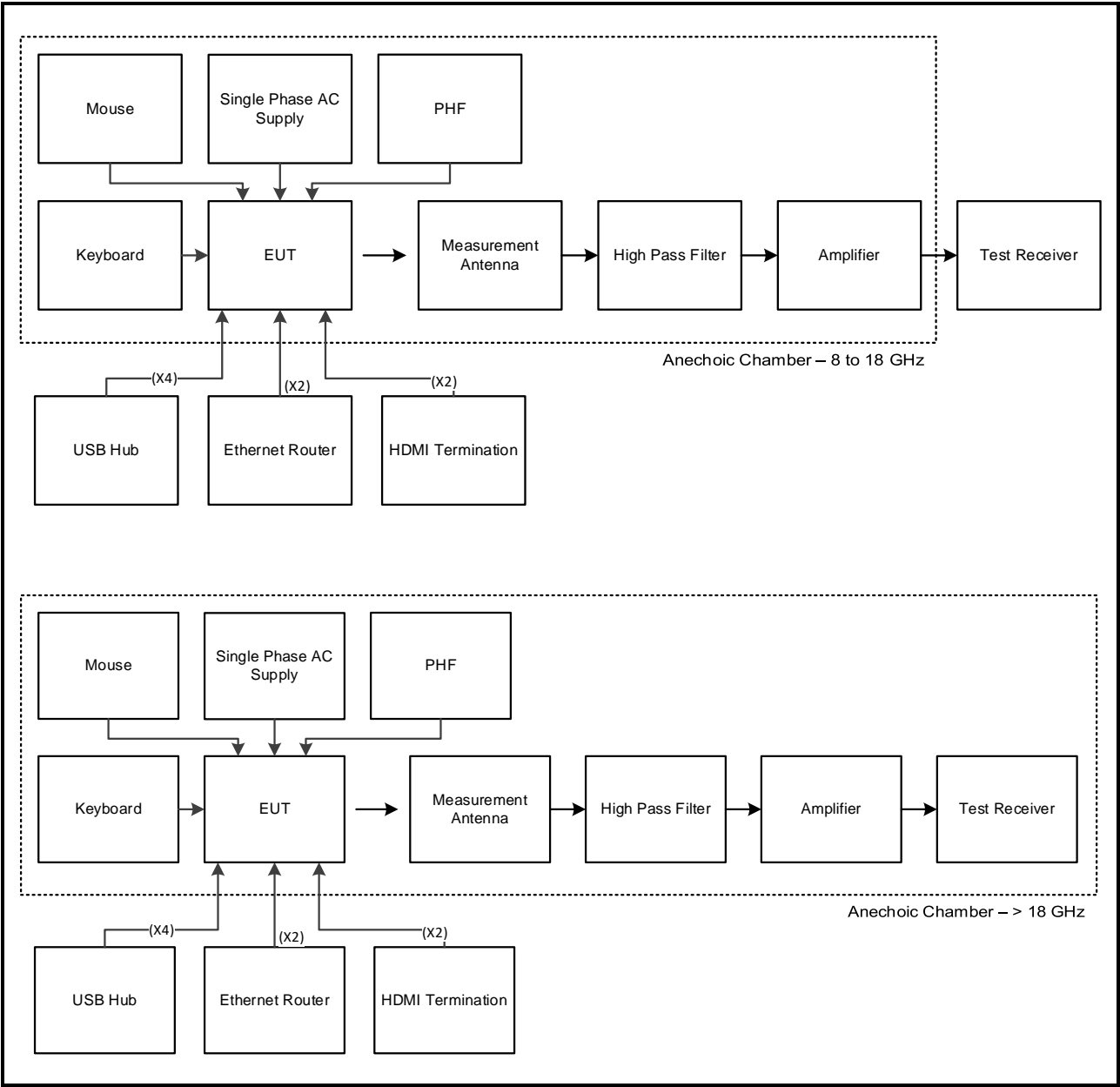
Test Setup for Transmitter Conducted Tests



Test Setup Diagrams (continued)**Radiated Tests:****Test Setup for Transmitter Radiated Emissions**

Test Setup Diagrams (continued)

Test Setup for Transmitter Radiated Emissions (continued)



4. Antenna Port Test Results

4.1. Transmitter Duty Cycle

Test Summary:

Test Engineer:	Max Passell	Test Date:	28 May 2019
Test Sample Serial Number:	C02YF007MFLF		

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

Environmental Conditions:

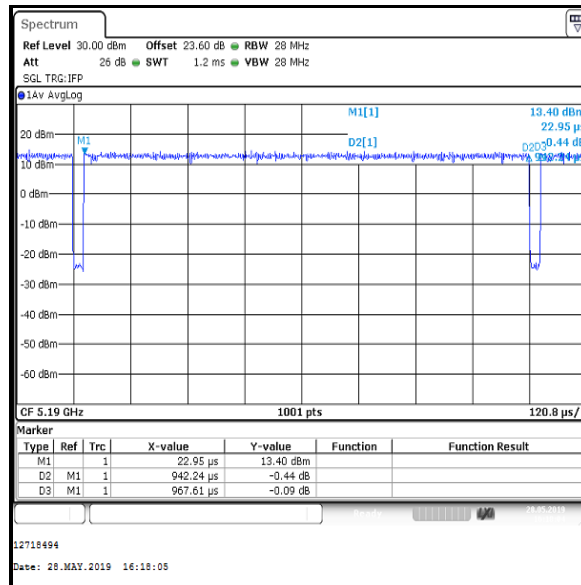
Temperature (°C):	21
Relative Humidity (%):	45

Note(s):

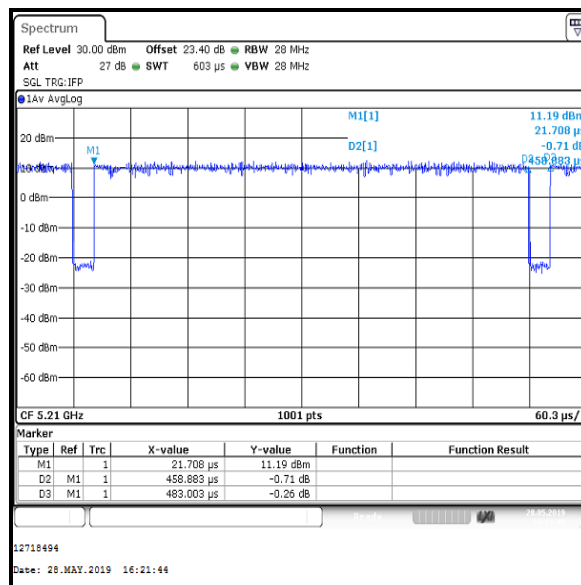
1. In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:
$$10 \log 1 / (\text{On Time} / [\text{Period or } 100\text{ms whichever is the lesser}]).$$
$$802.11n \text{ HT40} / \text{SISO} / \text{MCS0 duty cycle: } 10 \log (1 / (0.9422/0.9676)) = 0.1$$
$$802.11ac \text{ VHT80} / \text{SISO} / \text{MCS0 duty cycle: } 10 \log (1 / (0.4589/0.4830)) = 0.2$$
2. Plots below are for data rates with a duty cycle less than 98%. Results for all other modes having a duty cycle >98% are archived on the UL VS LTD IT server and available for inspection if required.
3. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cables. An RF level offset was entered on the signal analyser to compensate for the loss of the switch, attenuators and RF cables.

Transmitter Duty Cycle (continued)**Results: 802.11n / 40 MHz / MCS0**

Pulse Duration (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction factor (dB)
0.9422	0.9676	97.4	0.1

**Results: 802.11ac / 80 MHz / MCS0**

Pulse Duration (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction factor (dB)
0.4589	0.4830	95.0	0.2



4.2. Transmitter 26 dB Emission Bandwidth

Test Summary:

Test Engineer:	Max Passell	Test Dates:	28 May 2019 to 10 June 2019
Test Sample Serial Number:	C02YF007MFLF		

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

Environmental Conditions:

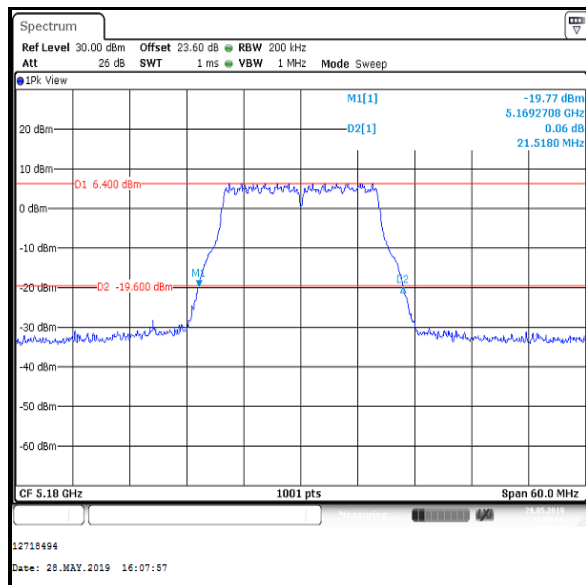
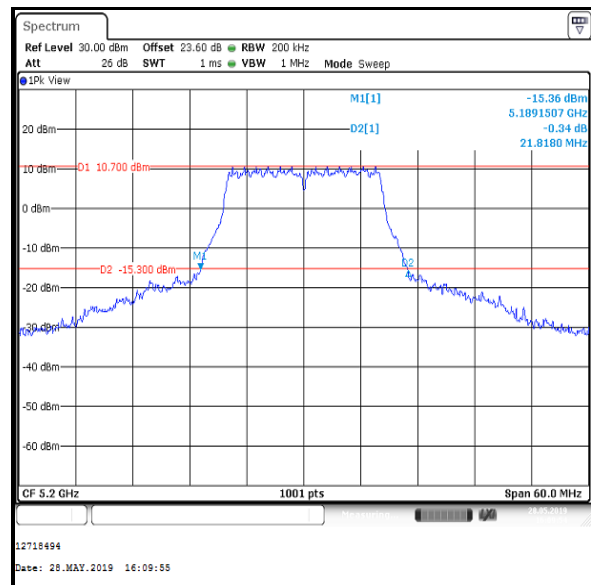
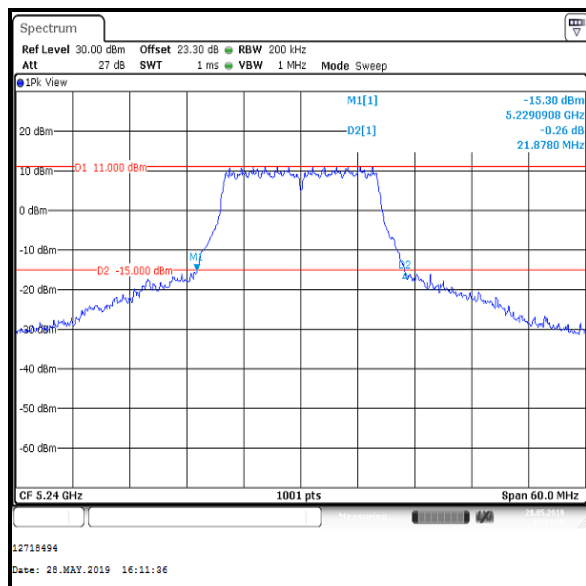
Temperatures (°C):	21 to 23
Relative Humidity (%):	36 to 50

Note(s):

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

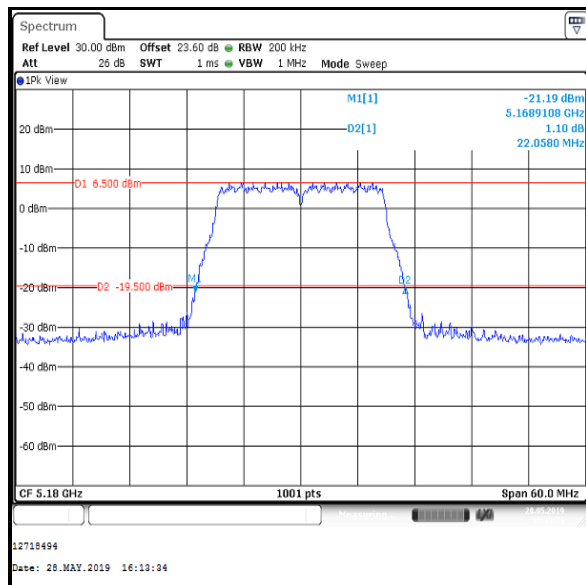
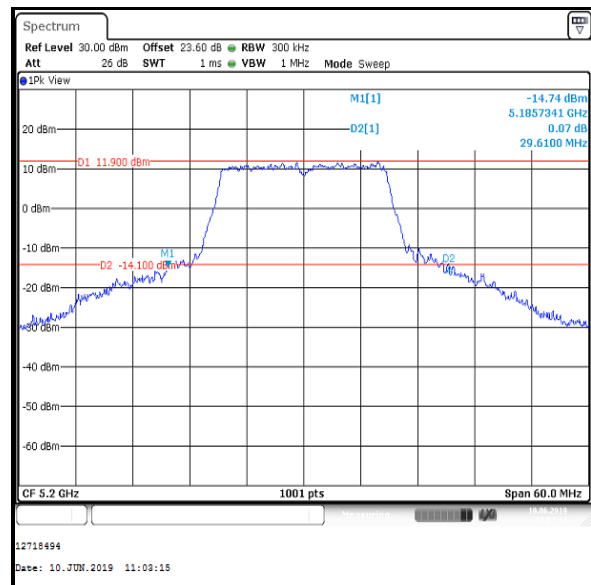
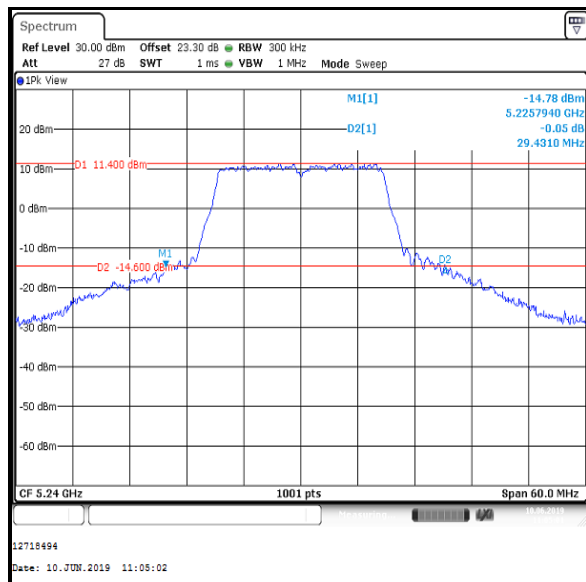
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)**4.2.1. 5.15-5.25 GHz band****Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.518
Middle	5200	21.818
Top	5240	21.878

**Bottom Channel****Middle Channel****Top Channel**

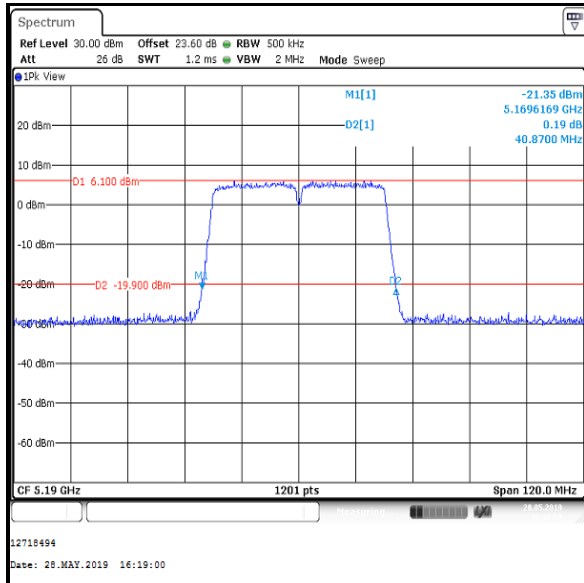
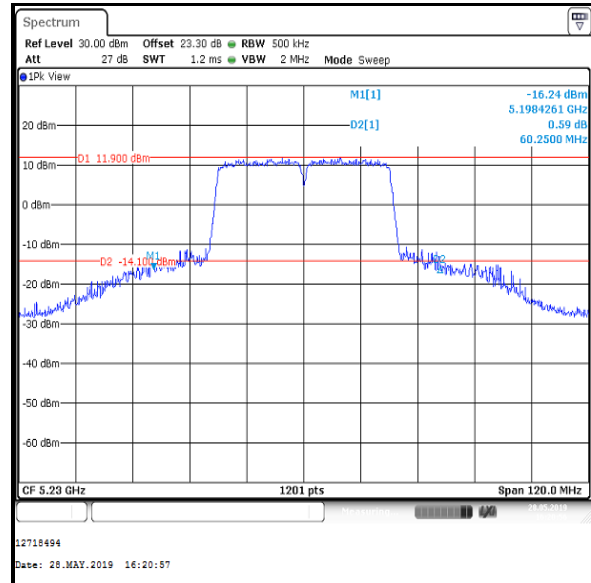
Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	22.058
Middle	5200	29.610
Top	5240	29.431

**Bottom Channel****Middle Channel****Top Channel**

Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

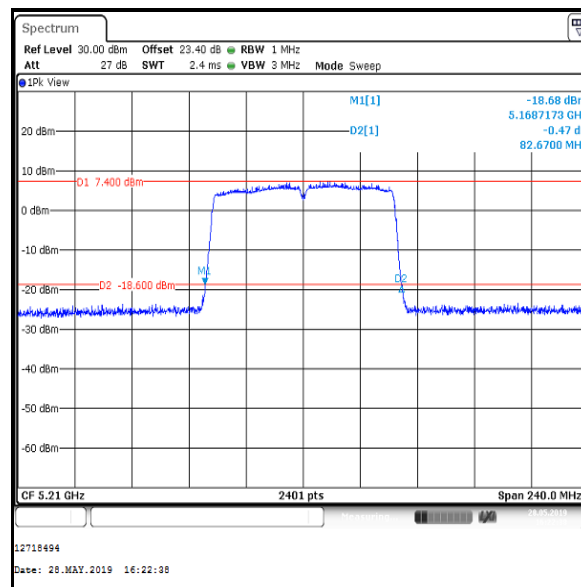
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.870
Top	5230	60.250

**Bottom Channel****Top Channel**

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

Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2

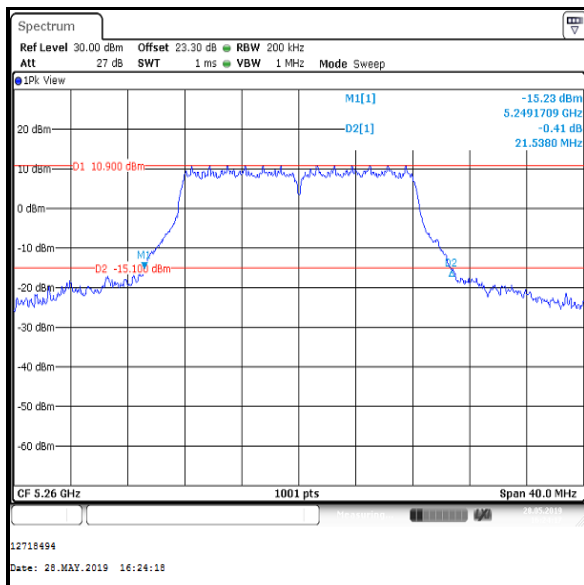
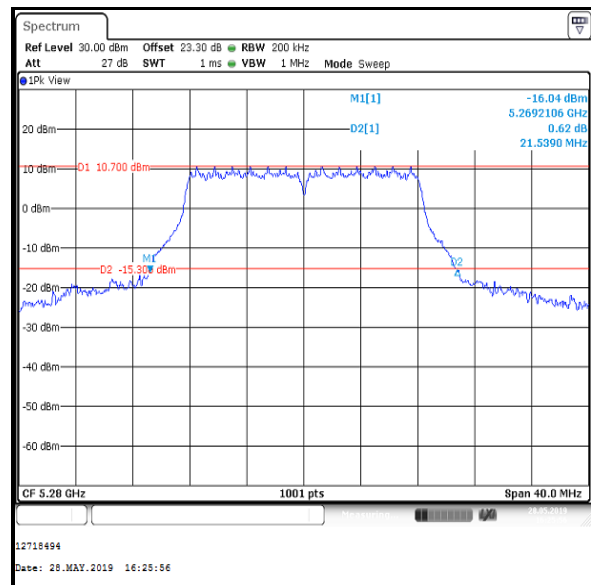
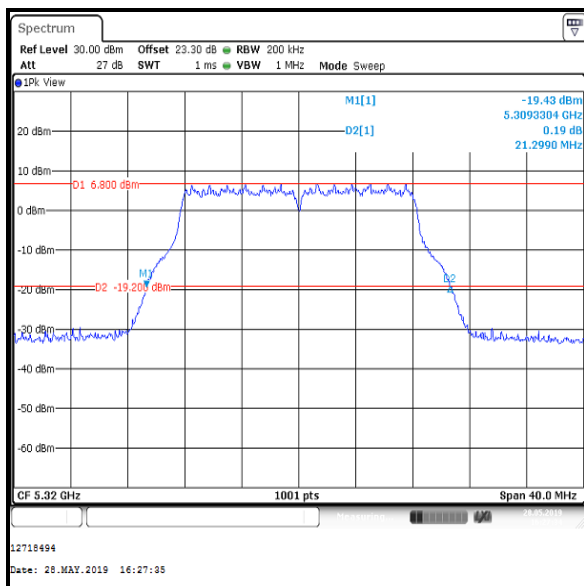
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	82.670



Single Channel

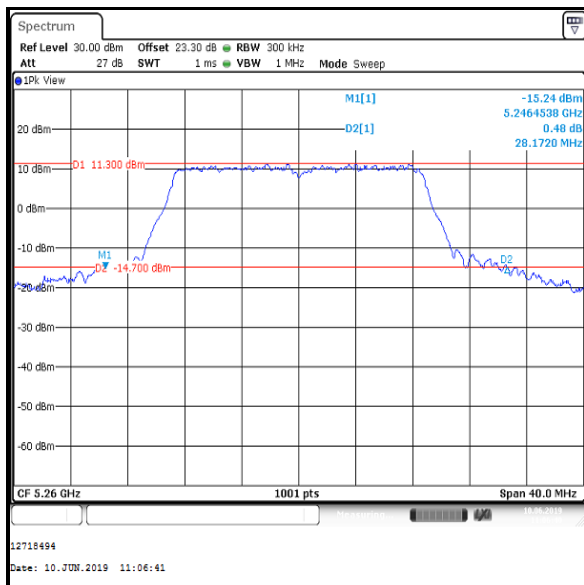
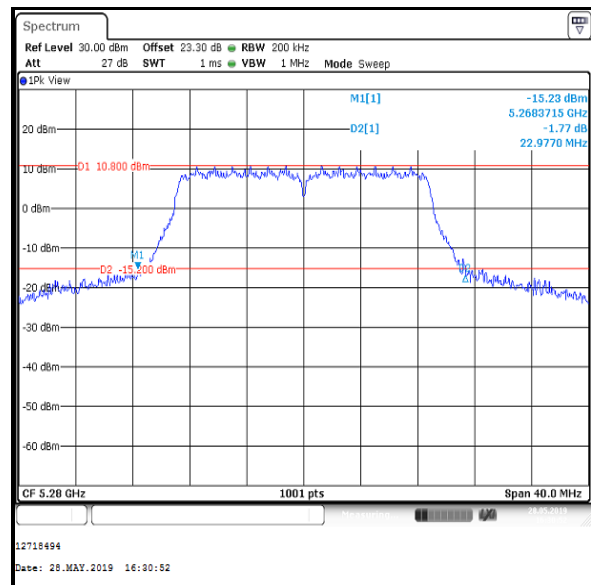
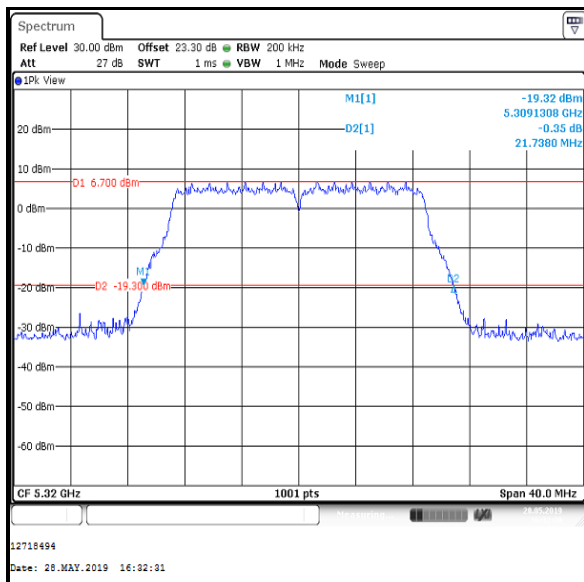
Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)**4.2.2. 5.25-5.35 GHz band****Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5260	21.538
Middle	5280	21.539
Top	5320	21.299

**Bottom Channel****Middle Channel****Top Channel**

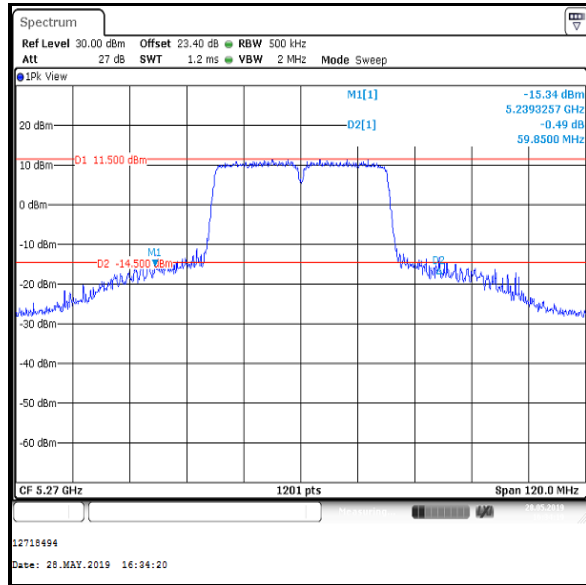
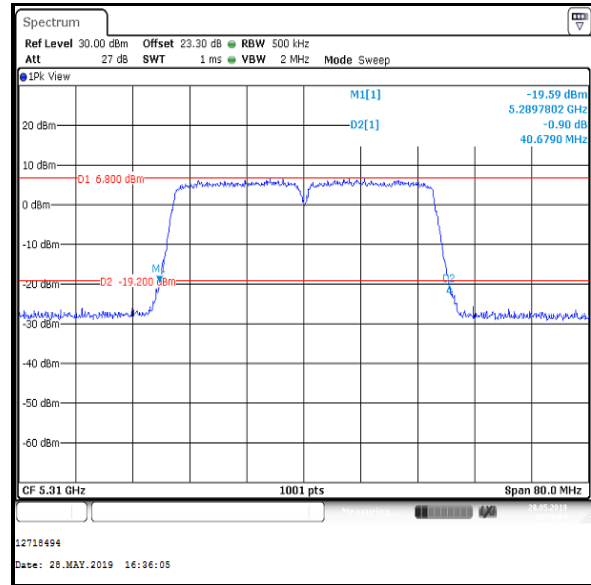
Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5260	28.172
Middle	5280	22.977
Top	5320	21.738

**Bottom Channel****Middle Channel****Top Channel**

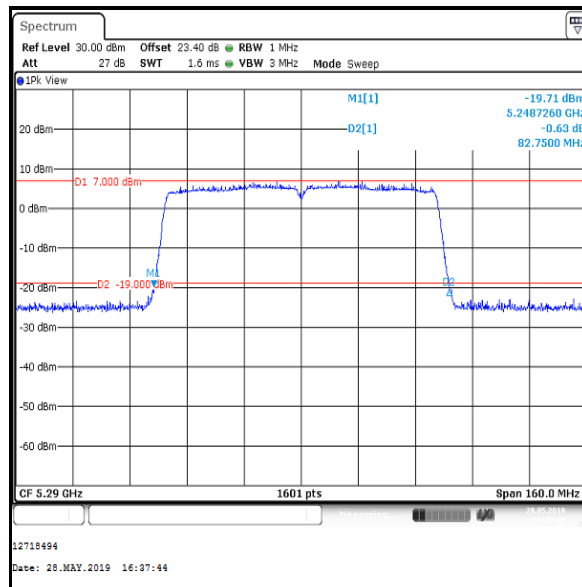
Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5270	59.850
Top	5310	40.679

**Bottom Channel****Top Channel**

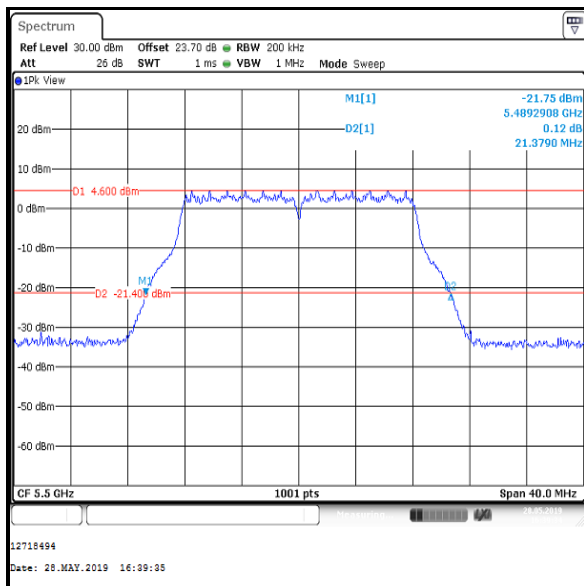
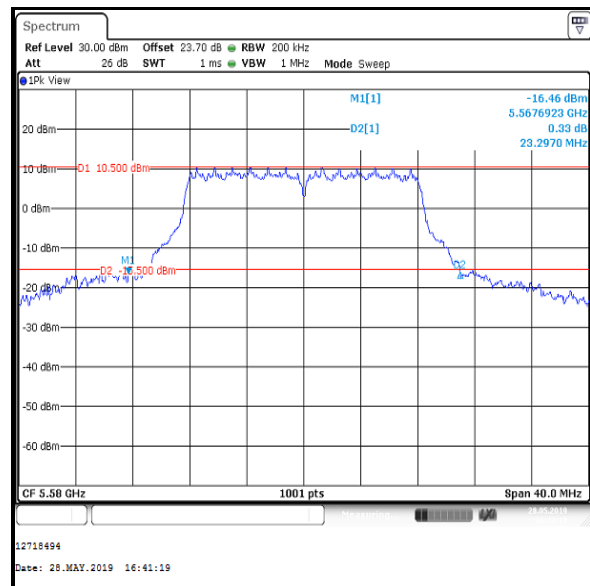
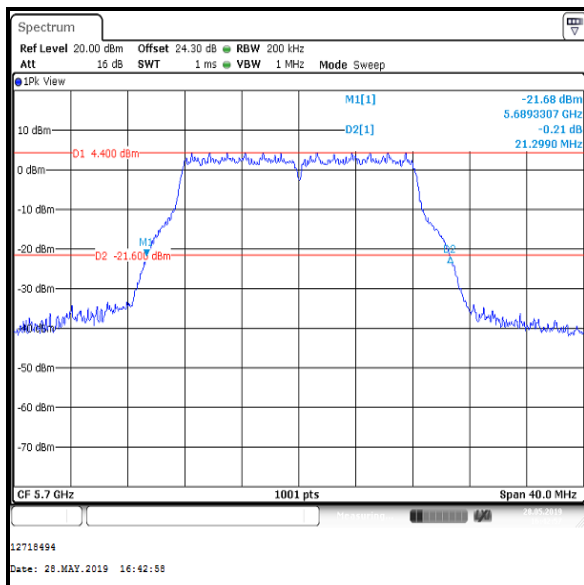
Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)**Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5290	82.750

**Single Channel**

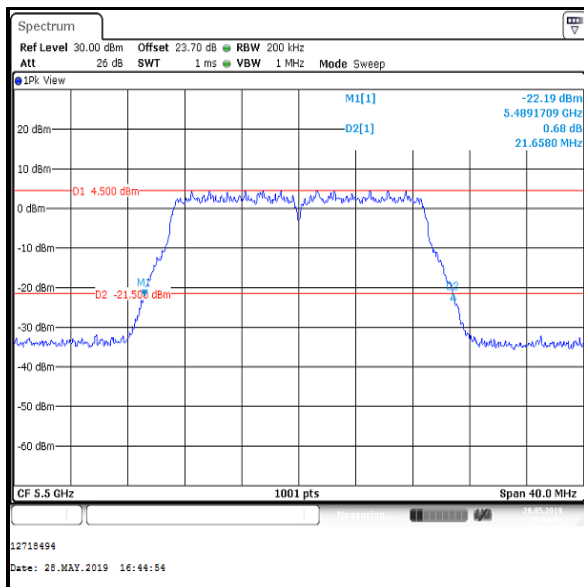
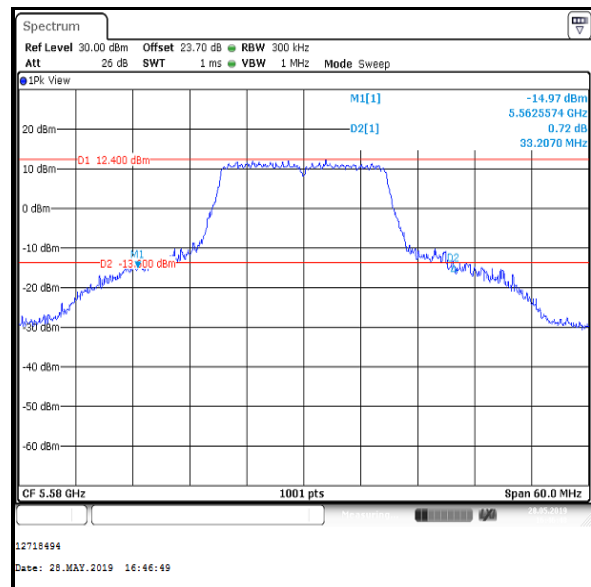
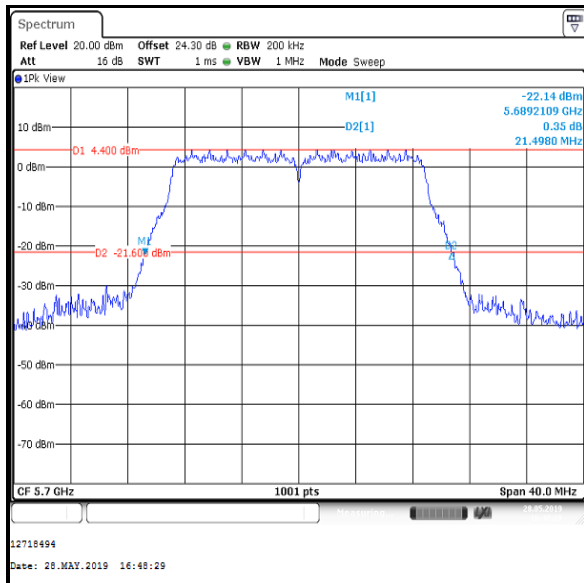
Transmitter 26 dB Emission Bandwidth (5.47-5.725 GHz band) (continued)**4.2.3. 5.47-5.725 GHz band****Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5500	21.379
Middle	5580	23.297
Top	5700	21.299

**Bottom Channel****Middle Channel****Top Channel**

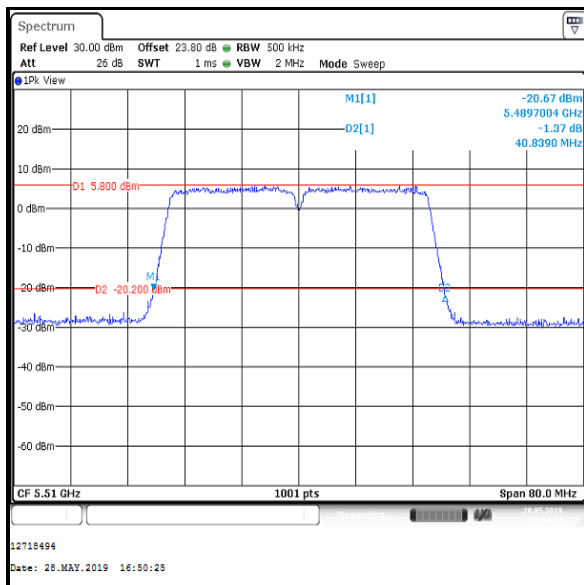
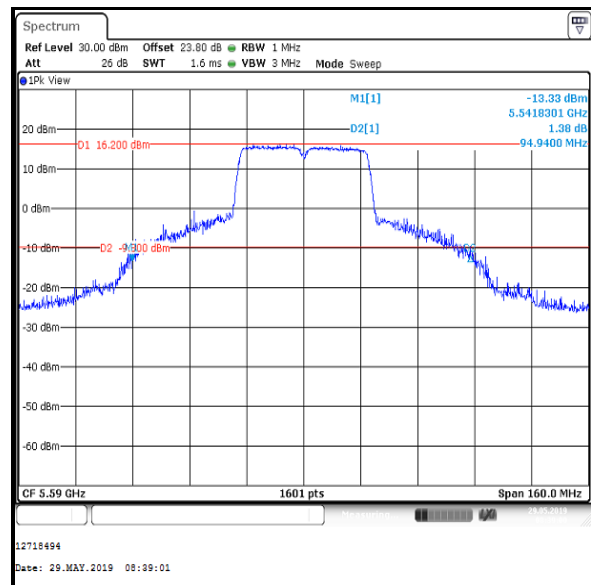
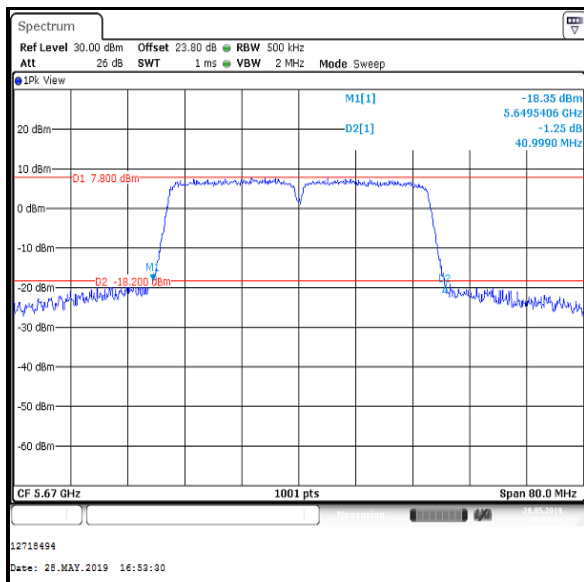
Transmitter 26 dB Emission Bandwidth (5.47-5.725 GHz band) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5500	21.658
Middle	5580	33.207
Top	5700	21.498

**Bottom Channel****Middle Channel****Top Channel**

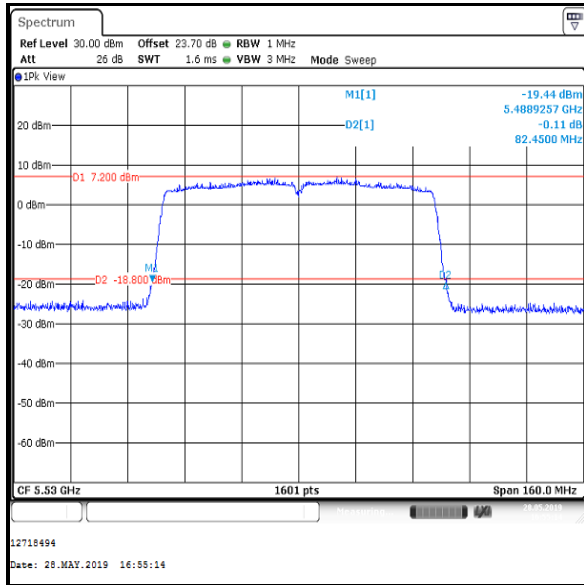
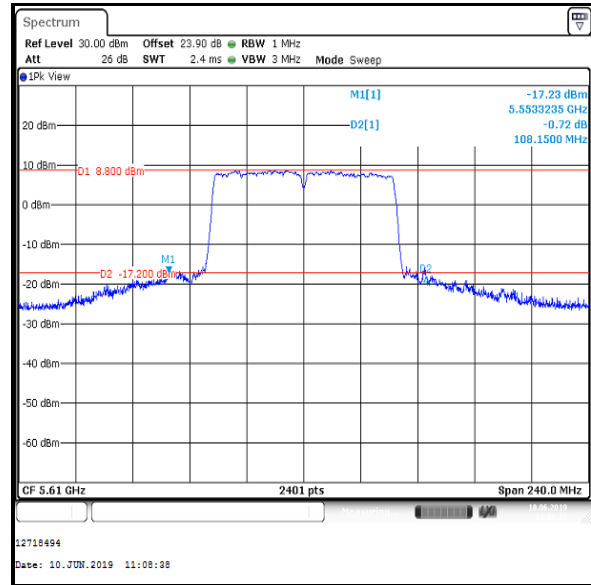
Transmitter 26 dB Emission Bandwidth (5.47-5.725 GHz band) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5510	40.839
Middle	5590	94.940
Top	5670	40.999

**Bottom Channel****Middle Channel****Top Channel**

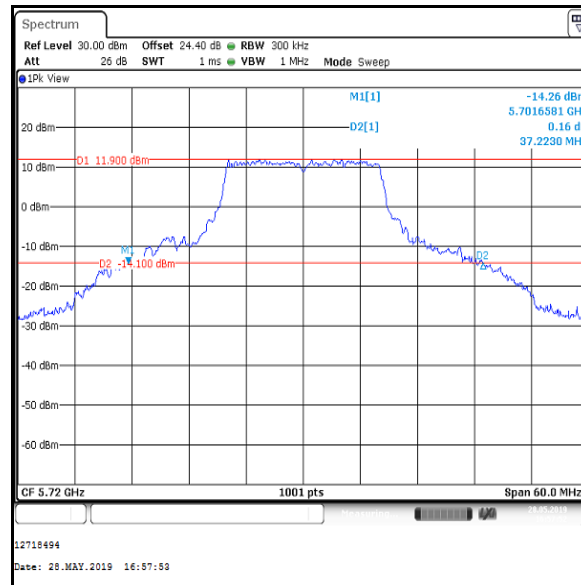
Transmitter 26 dB Emission Bandwidth (5.47-5.725 GHz band) (continued)**Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5530	82.450
Top	5610	108.150

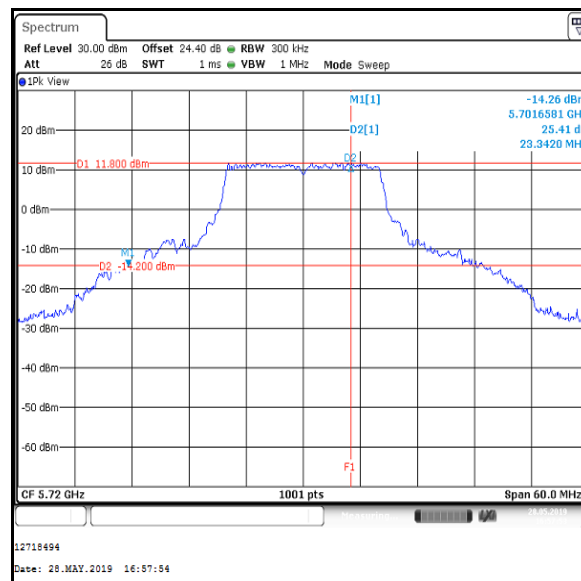
**Bottom Channel****Top Channel**

Transmitter 26 dB Emission Bandwidth (Straddle Channels) (continued)**4.2.4. Channels that straddle the U-NII-2C and U-NII-3 bands****Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5720	37.223

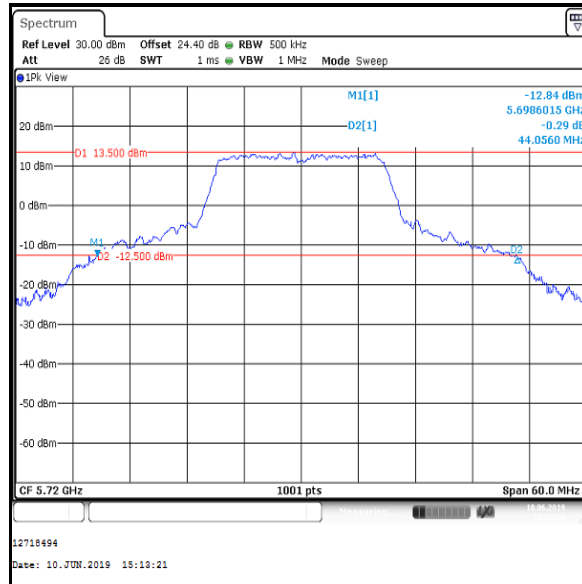
**Single Channel****Results: Reference Plots / 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5720	23.342

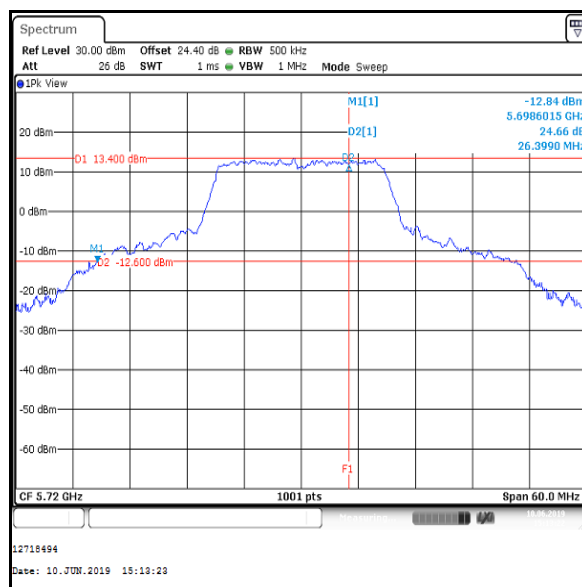
**Single Channel**

Transmitter 26 dB Emission Bandwidth (Straddle Channels) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5720	44.056

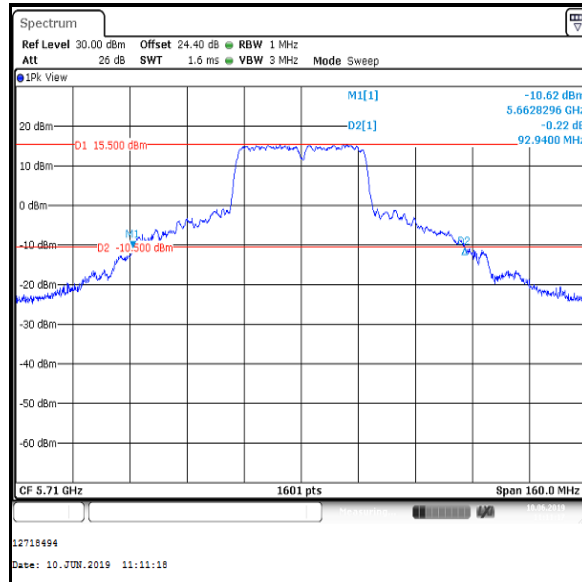
**Single Channel****Results: Reference Plots / 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5720	26.399

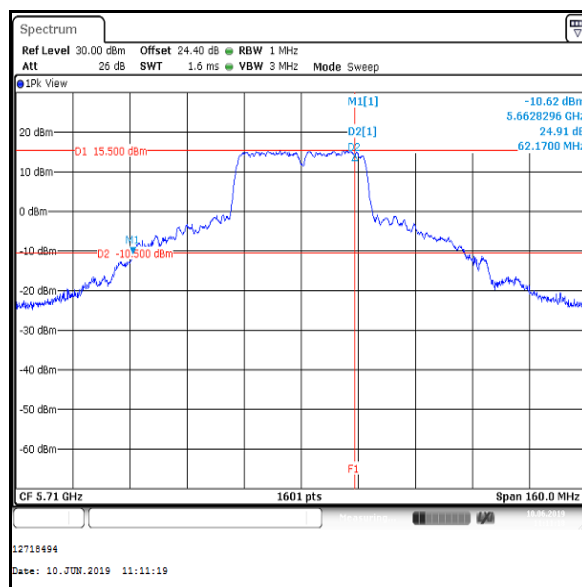
**Single Channel**

Transmitter 26 dB Emission Bandwidth (Straddle Channels) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5710	92.940

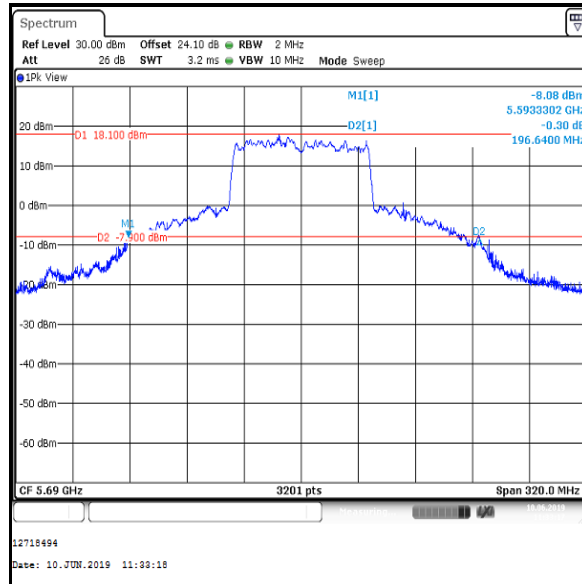
**Single Channel****Results: Reference Plots / 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5710	62.170

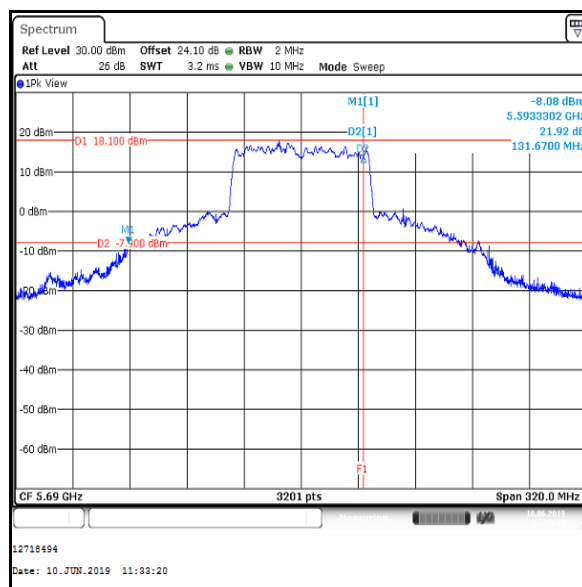
**Single Channel**

Transmitter 26 dB Emission Bandwidth (Straddle Channels) (continued)**Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5690	196.640

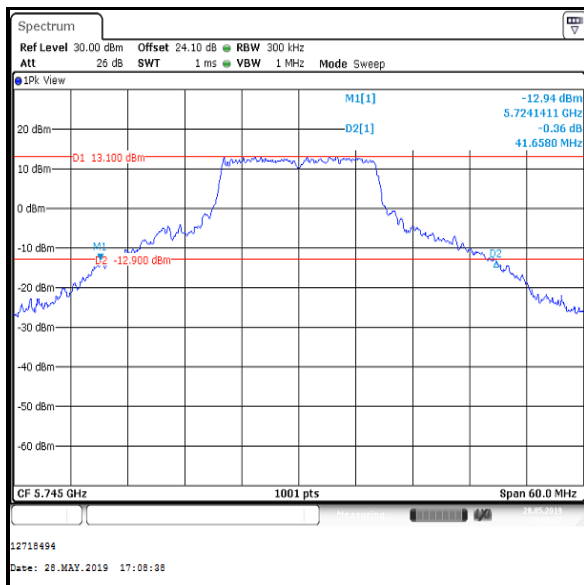
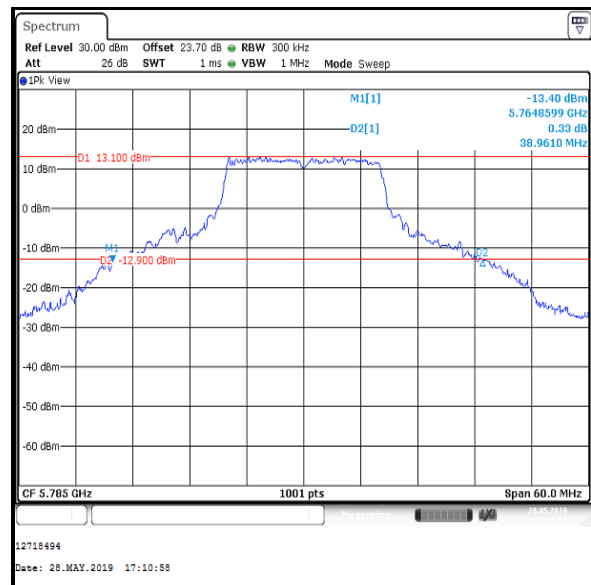
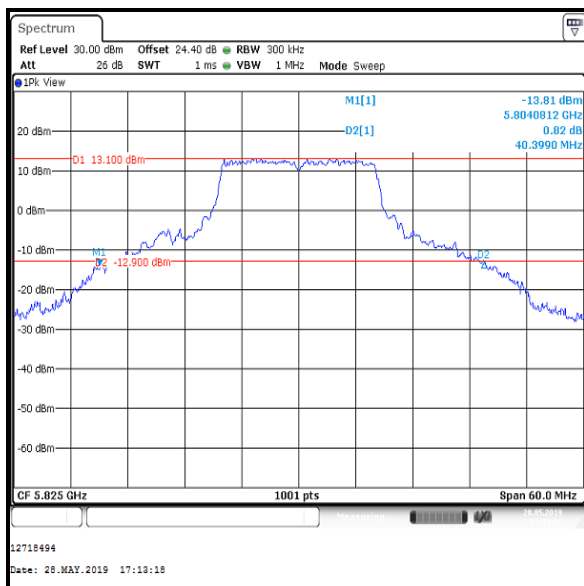
**Single Channel****Results: Reference Plots / 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5690	131.670

**Single Channel**

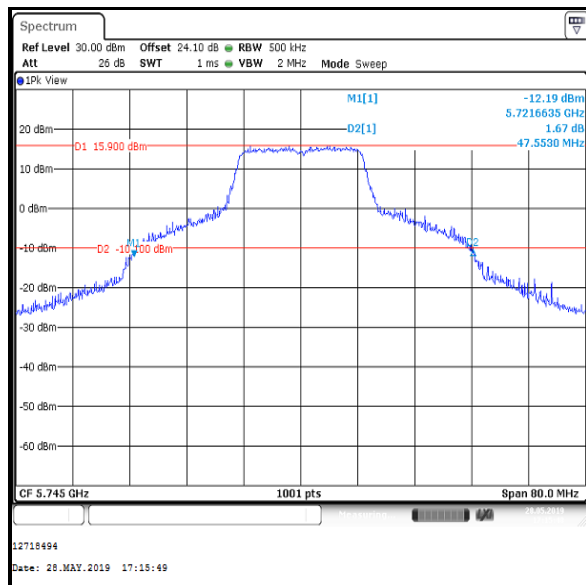
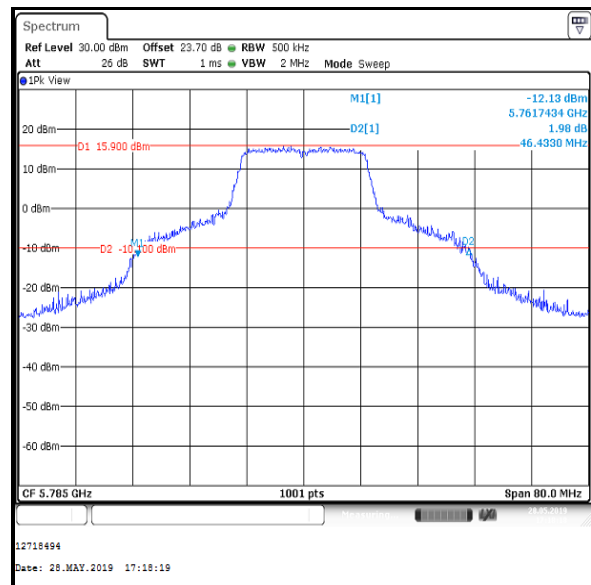
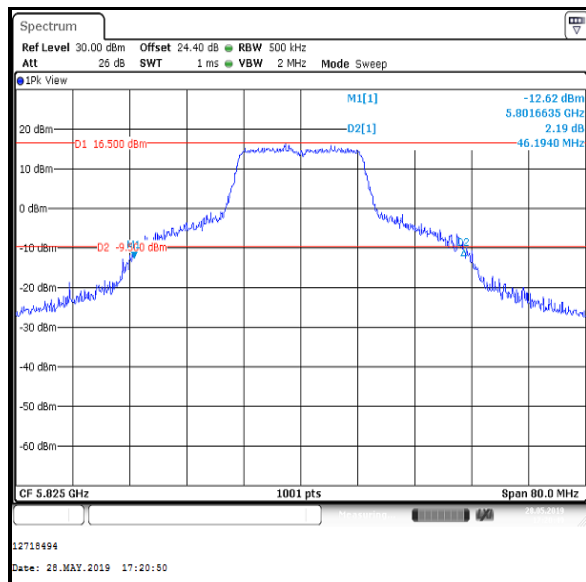
Transmitter 26 dB Emission Bandwidth (5.725-5.85 GHz band) (continued)**4.2.5. 5.725-5.85 GHz band****Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5745	41.658
Middle	5785	38.961
Top	5825	40.399

**Bottom Channel****Middle Channel****Top Channel**

Transmitter 26 dB Emission Bandwidth (5.725-5.85 GHz band) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

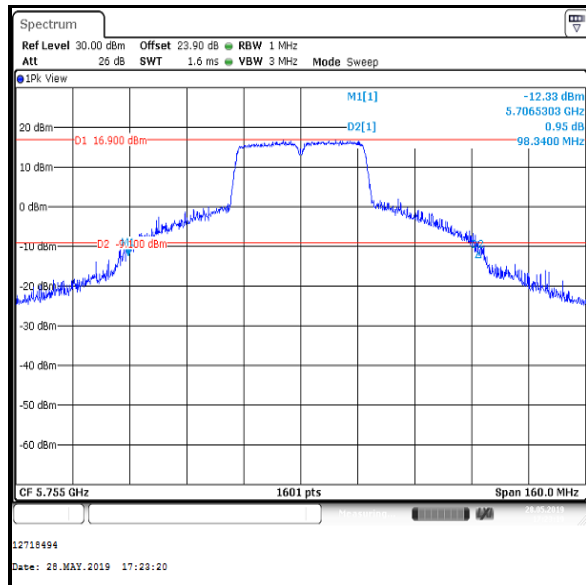
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5745	47.553
Middle	5785	46.433
Top	5825	46.194

**Bottom Channel****Middle Channel****Top Channel**

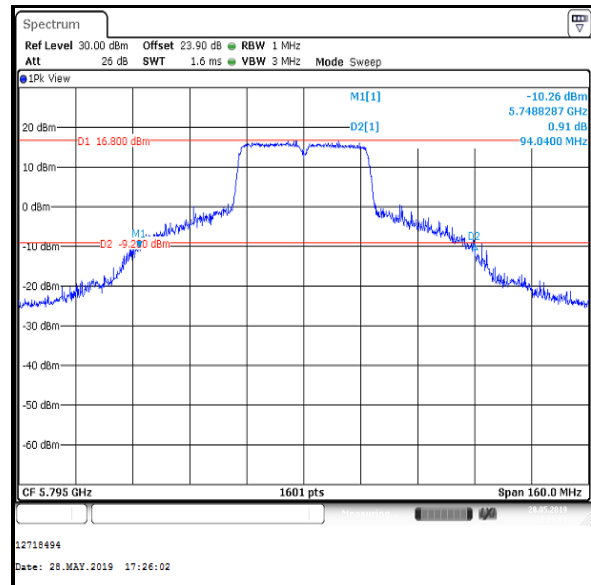
Transmitter 26 dB Emission Bandwidth (5.725-5.85 GHz band) (continued)

Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5755	98.340
Top	5795	94.040



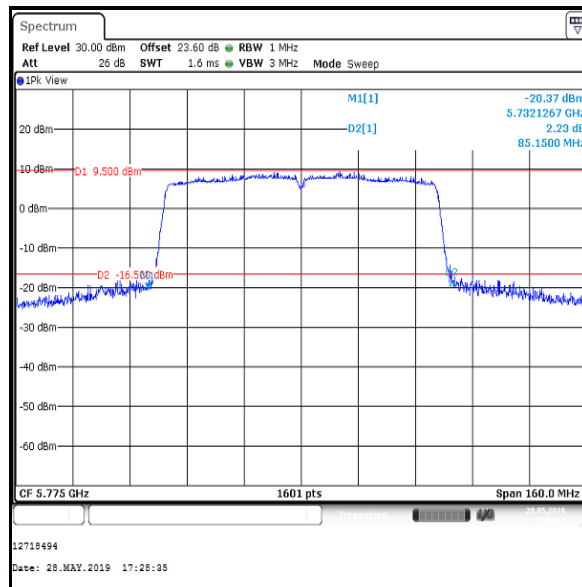
Bottom Channel



Top Channel

Transmitter 26 dB Emission Bandwidth (5.725-5.85 GHz band) (continued)**Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5775	85.150

**Single Channel**

4.3. Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band)**Test Summary:**

Test Engineer:	Max Passell	Test Dates:	28 May 2019 & 10 June 2019
Test Sample Serial Number:	C02YF007MFLF		

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

Environmental Conditions:

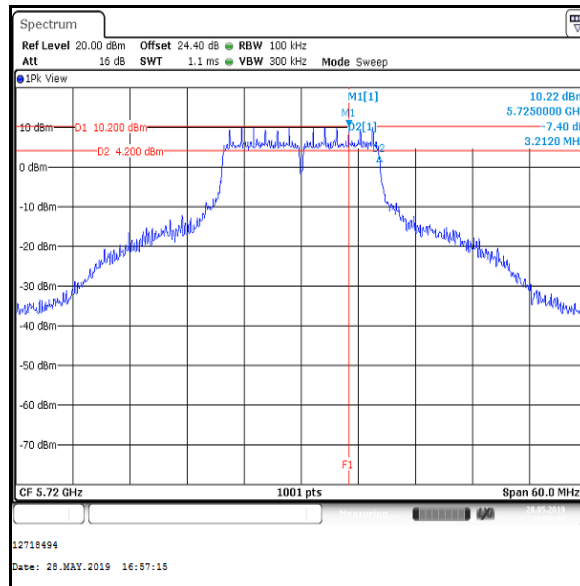
Temperature (°C):	21
Relative Humidity (%):	45 to 50

Note(s):

1. Measurements were performed on data rates detailed in Section 3.5 on the relevant channels.
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.
3. For channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz, measurements were performed on the portion of the emission that is contained within the U-NII-3 band.

Transmitter Minimum 6 dB Bandwidth (Straddle Channels) (continued)**4.3.1. Channels that straddle the U-NII-2C and the U-NII-3 bands at 5.725 GHz****Results: 802.11a / 20 MHz / SISO / BPSK / MCS0 / Core 2**

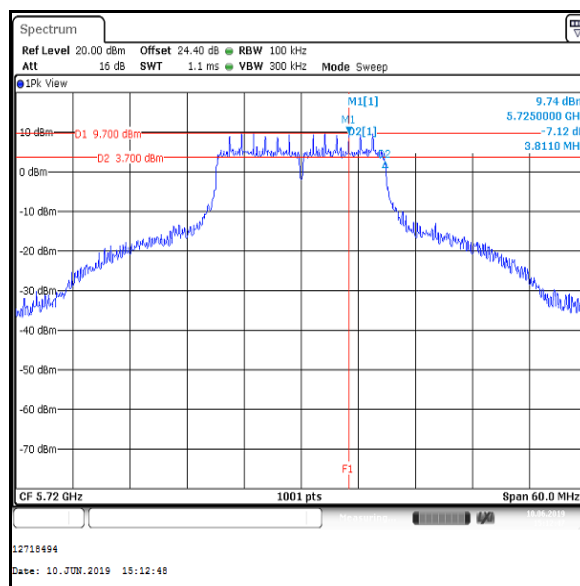
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Single	3212	≥500	2712	Complied



Single Channel

Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2

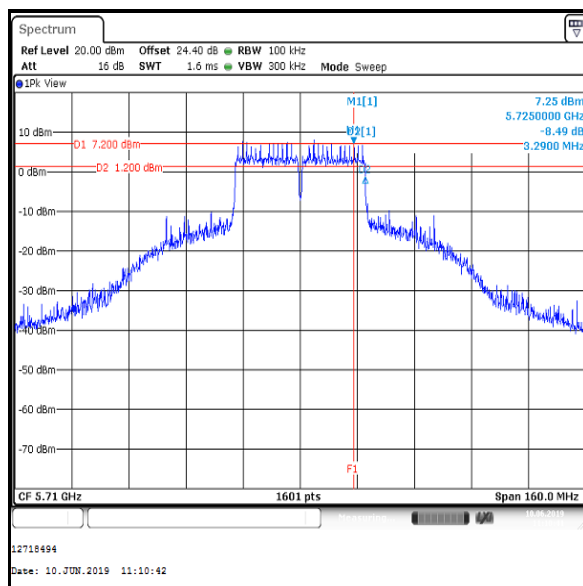
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Single	3811	≥500	3311	Complied



Single Channel

Transmitter Minimum 6 dB Bandwidth (Straddle Channels) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

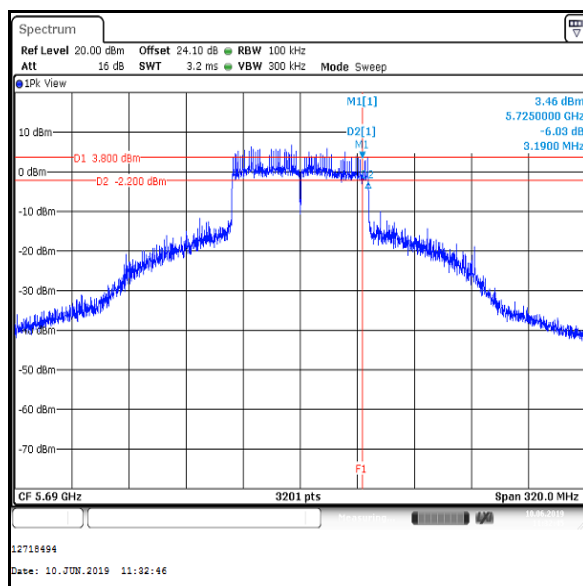
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Single	3290	≥500	2790	Complied



Single Channel

Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2

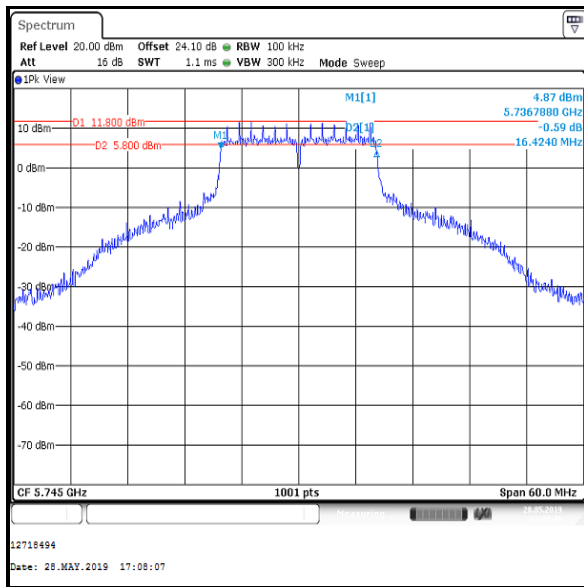
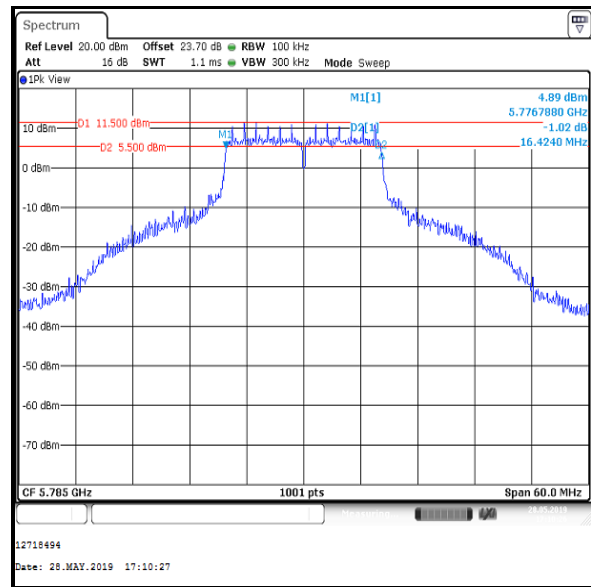
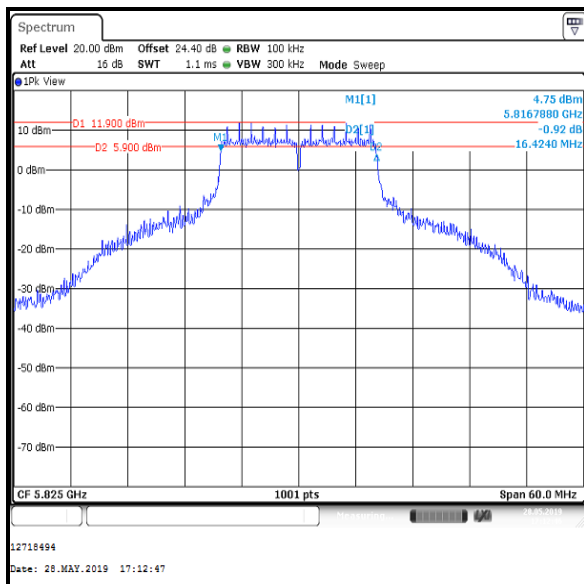
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Single	3190	≥500	2690	Complied



Single Channel

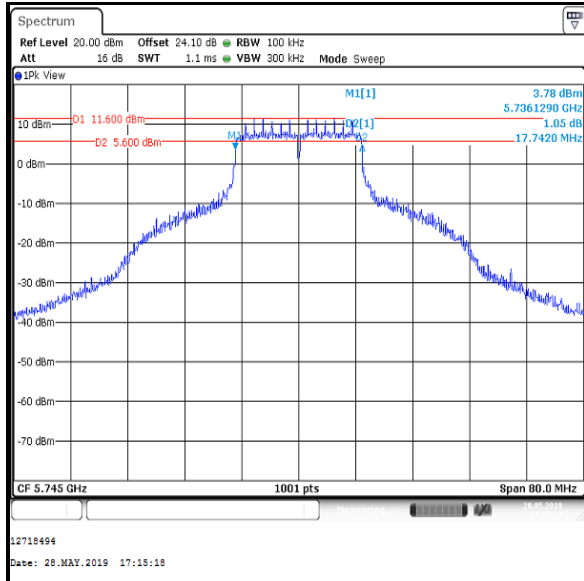
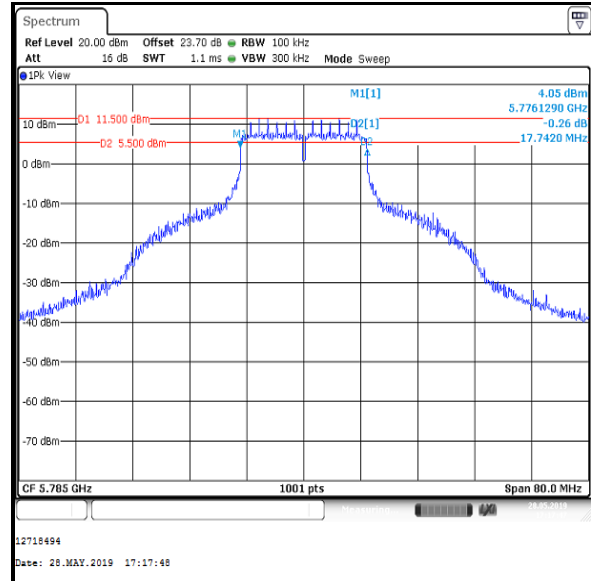
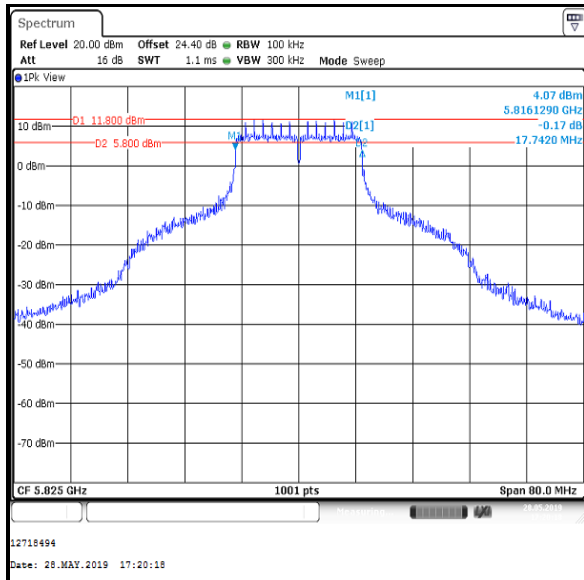
Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band) (continued)**4.3.2. 5.725-5.85 GHz band****Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	16424	≥500	15924	Complied
Middle	16424	≥500	15924	Complied
Top	16424	≥500	15924	Complied

**Bottom Channel****Middle Channel****Top Channel**

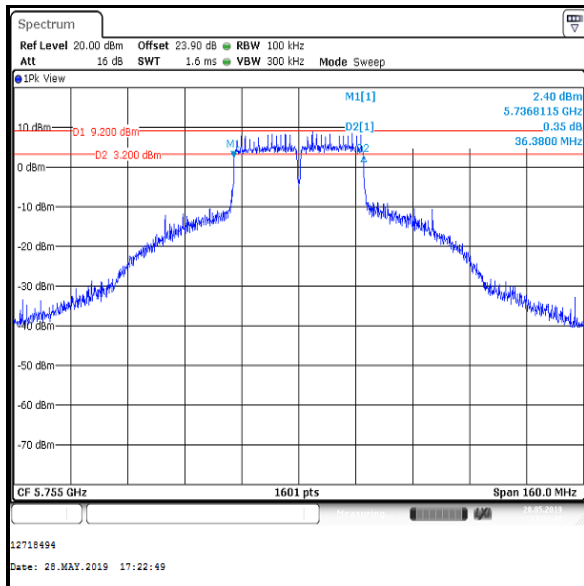
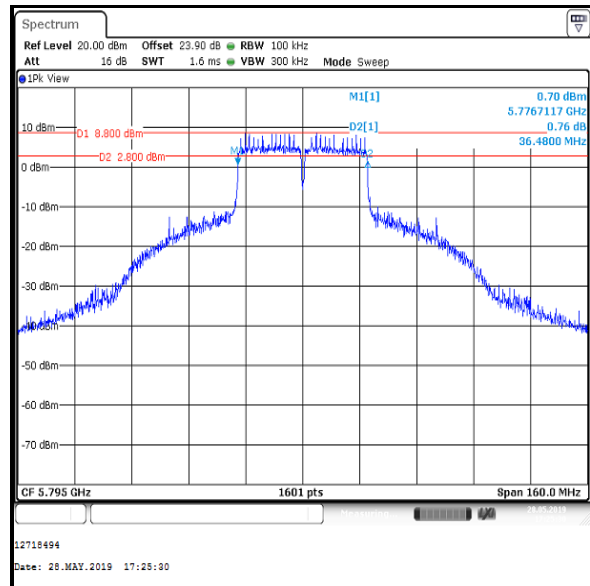
Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	17742	≥500	17242	Complied
Middle	17742	≥500	17242	Complied
Top	17742	≥500	17242	Complied

**Bottom Channel****Middle Channel****Top Channel**

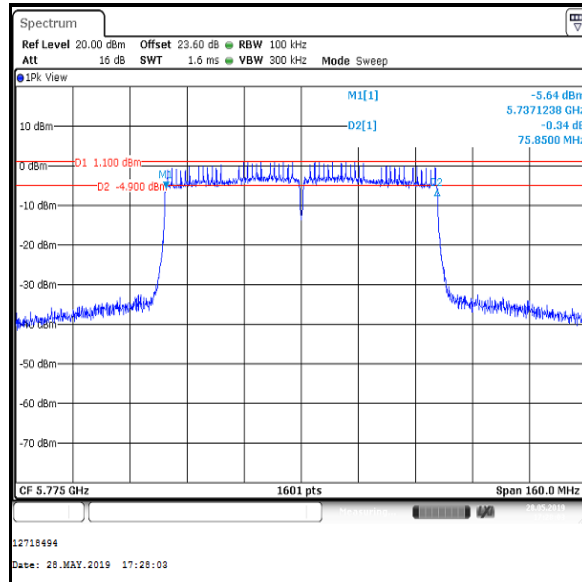
Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	36380	≥500	35880	Complied
Top	36480	≥500	35980	Complied

**Bottom Channel****Top Channel**

Transmitter Minimum 6 dB Bandwidth (5.725-5.85 GHz band) (continued)**Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Single	75850	≥500	75350	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 Dates:	28 May 2019 & 10 June 2019
Test Sample Serial Number:	C02YF007MFLF		

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:

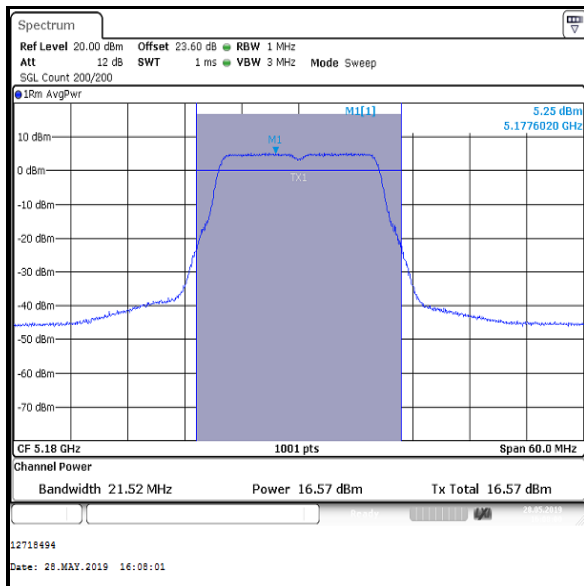
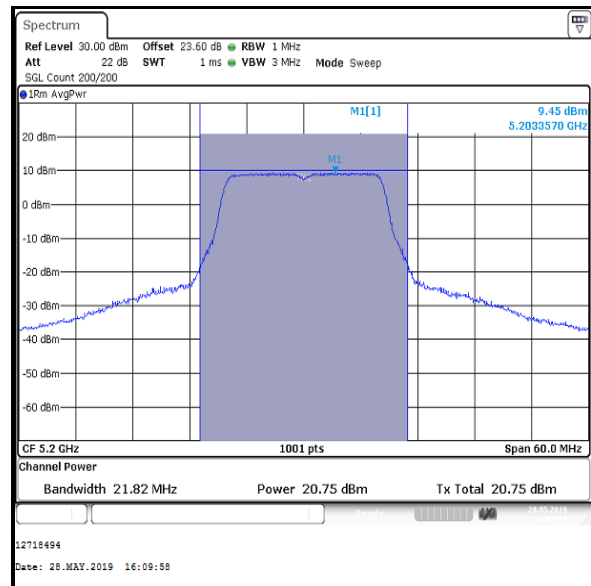
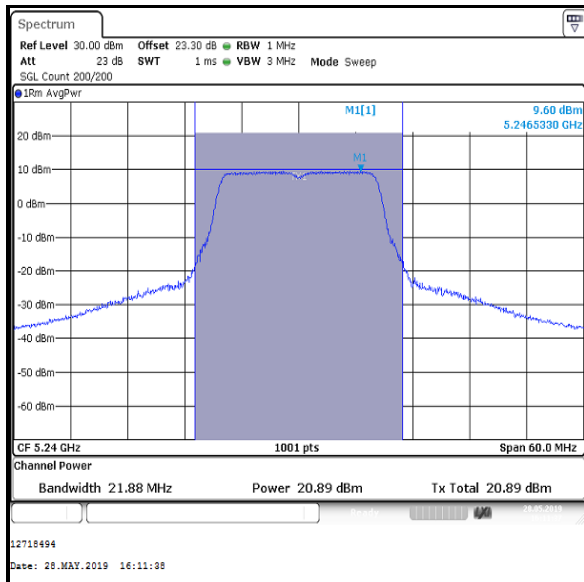
Temperature (°C):	21
Relative Humidity (%):	45 to 50

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. Measurements were performed using configurations detailed in Section 3.5 of this test report on the relevant channels.
3. 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.
4. The Part 15.407(a)(1)(iv) limit shall not exceed 250 mW (24.0 dBm).
5. For all modes of operation, the antenna gain is < 6 dBi.
6. For details on antenna gains refer to Section 3.4 of this test report.
7. 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.

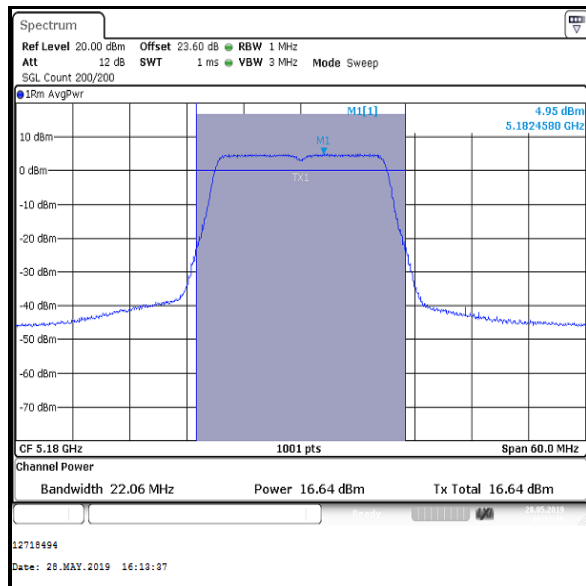
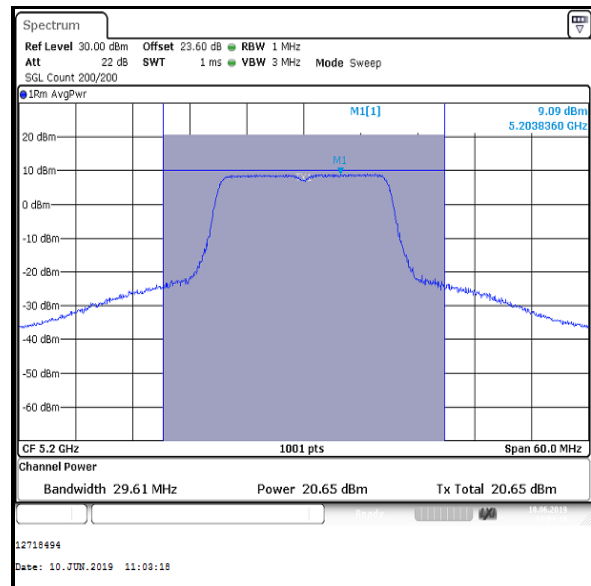
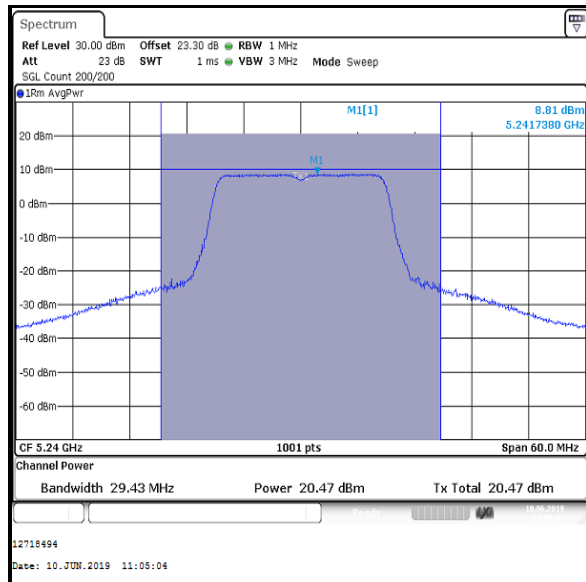
Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band) (continued)**Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5180	16.6	24.0	7.4	Complied
Middle	5200	20.8	24.0	3.2	Complied
Top	5240	20.9	24.0	3.1	Complied

**Bottom Channel****Middle Channel****Top Channel**

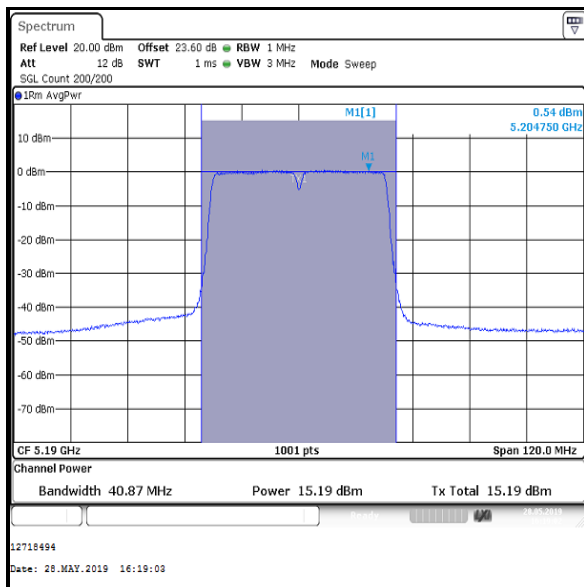
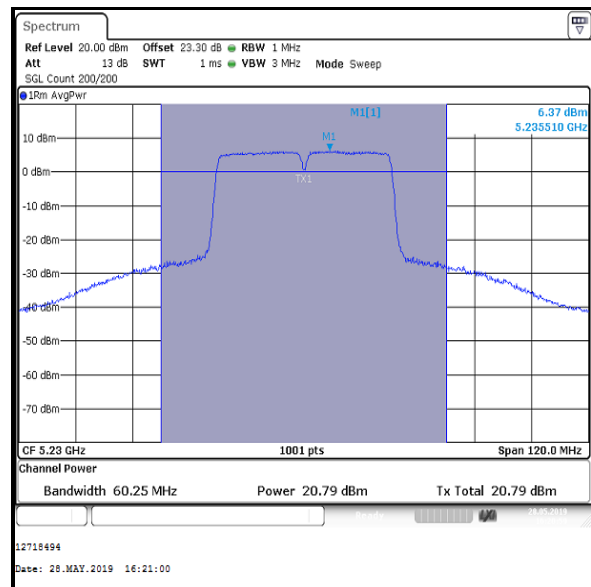
Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5180	16.6	24.0	7.4	Complied
Middle	5200	20.7	24.0	3.3	Complied
Top	5240	20.5	24.0	3.5	Complied

**Bottom Channel****Middle Channel****Top Channel**

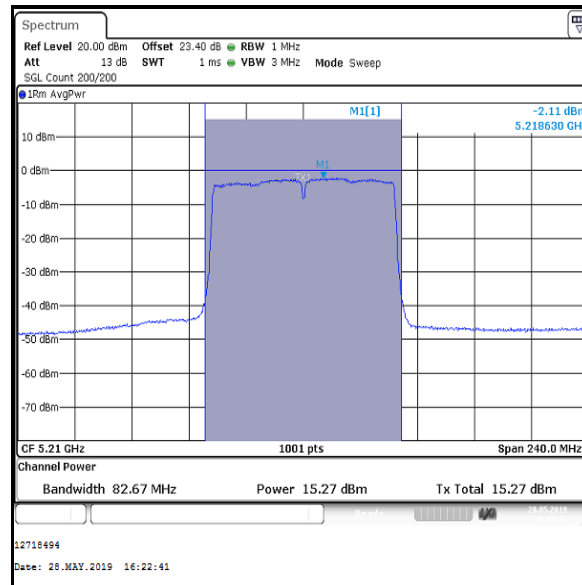
Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5190	15.2	0.1	15.3	24.0	8.7	Complied
Top	5230	20.8	0.1	20.9	24.0	3.1	Complied

**Bottom Channel****Top Channel**

Transmitter Maximum Conducted Output Power (5.15-5.25 GHz band) (continued)**Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Single	5210	15.3	0.2	15.5	24.0	8.5	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 Dates:	28 May 2019 & 10 June 2019
Test Sample Serial Number:	C02YF007MFLF		

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):	21
Relative Humidity (%):	45 to 50

Note(s):

- 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.
- Measurements were performed using configurations detailed in Section 3.5 of this test report on the relevant channels.
- 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.
- The FCC Part 15.407(a)(2) limit is the lesser of 250 mW (24.0 dBm) or $11 \text{ dBm} + 10 \log_{10} B$, 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.

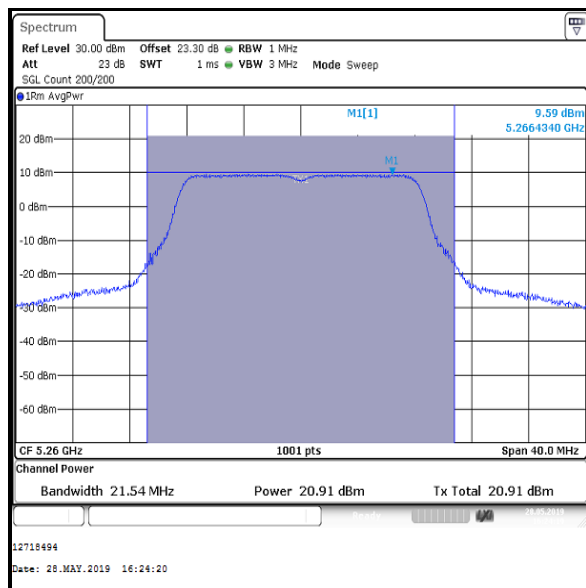
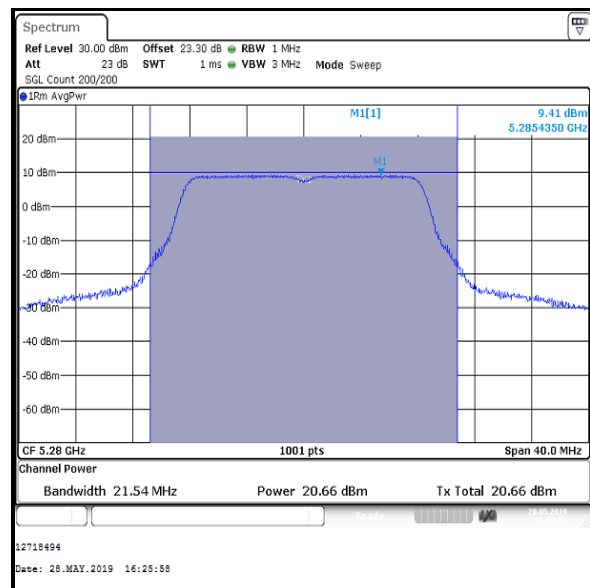
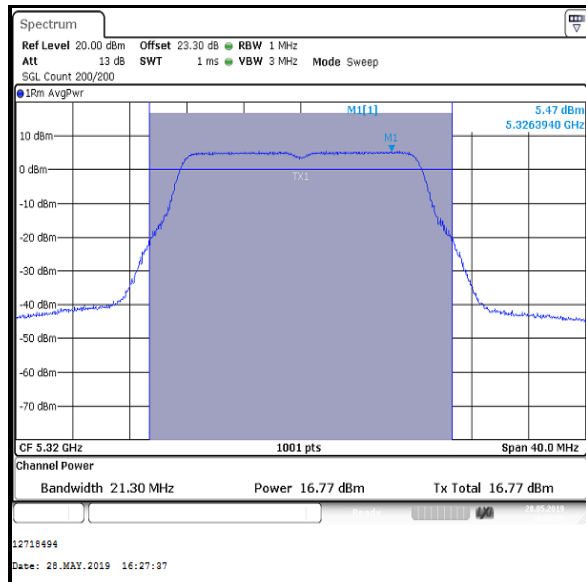
$$\begin{aligned}
 &\text{For } B > 20 \text{ MHz} \rightarrow \\
 &\rightarrow \log_{10} B > \log_{10} 20 \rightarrow \\
 &\rightarrow 10 \log_{10} B > 10 \log_{10} 20 \rightarrow \\
 &\rightarrow 11 + 10 \log_{10} B > 11 + 10 \log_{10} 20 \rightarrow \\
 &\rightarrow 11 + 10 \log_{10} B > 24.0 \text{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

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.

- For all modes of operation, the antenna gain is < 6 dBi.
- For details on antenna gains refer to Section 3.4 of this test report.
- 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.

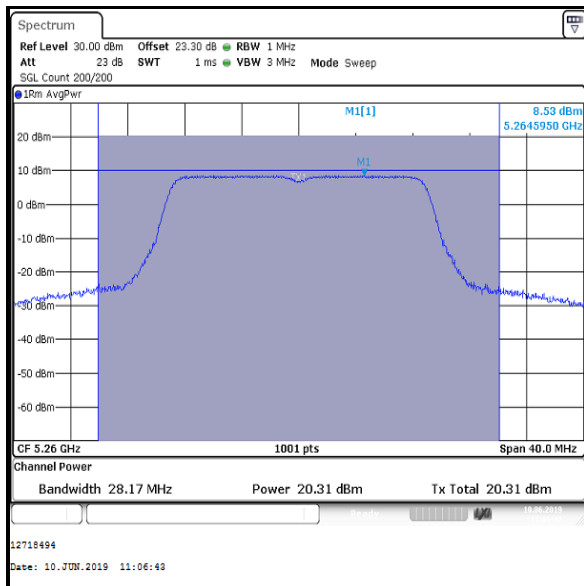
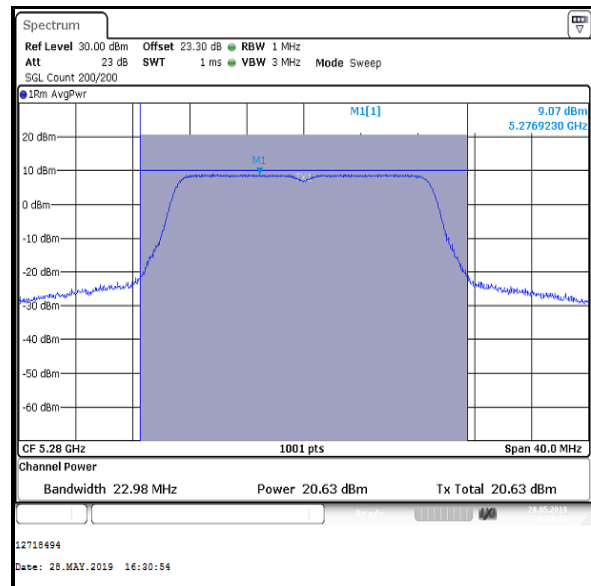
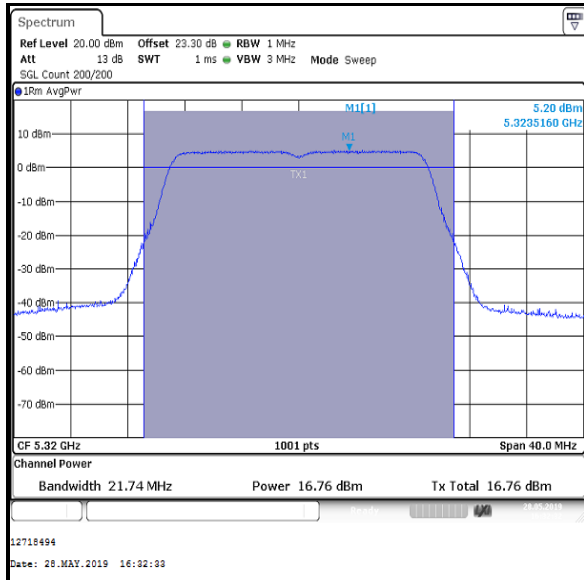
Transmitter Maximum Conducted Output Power (5.25-5.35 GHz band) (continued)**Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5260	20.9	24.0	3.1	Complied
Middle	5280	20.7	24.0	3.3	Complied
Top	5320	16.8	24.0	7.2	Complied

**Bottom Channel****Middle Channel****Top Channel**

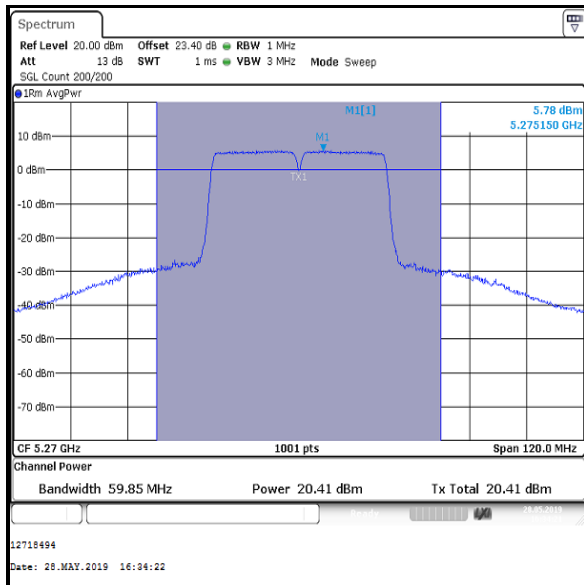
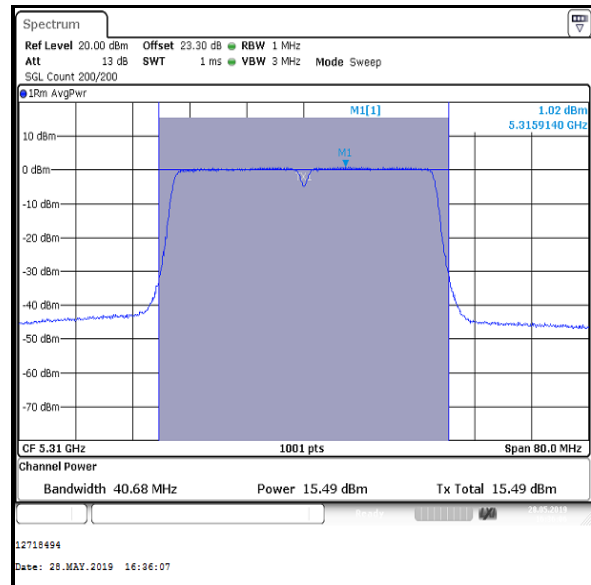
Transmitter Maximum Conducted Output Power (5.25-5.35 GHz band) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5260	20.3	24.0	3.7	Complied
Middle	5280	20.6	24.0	3.4	Complied
Top	5320	16.8	24.0	7.2	Complied

**Bottom Channel****Middle Channel****Top Channel**

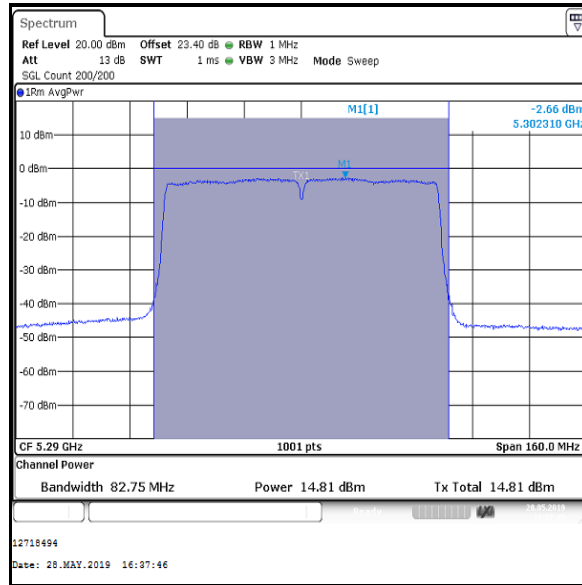
Transmitter Maximum Conducted Output Power (5.25-5.35 GHz band) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5270	20.4	0.1	20.5	24.0	3.5	Complied
Top	5310	15.5	0.1	15.6	24.0	8.4	Complied

**Bottom Channel****Top Channel**

Transmitter Maximum Conducted Output Power (5.25-5.35 GHz band) (continued)**Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Single	5290	14.8	0.2	15.0	24.0	9.0	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 Dates:	28 May 2019 to 10 June 2019
Test Sample Serial Number:	C02YF007MFLF		

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):	21 to 23
Relative Humidity (%):	36 to 50

Note(s):

- 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.
- Measurements were performed using configurations detailed in Section 3.5 of this test report on the relevant channels.
- 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.
- The FCC Part 15.407(a)(2) limit is the lesser of 250 mW (24.0 dBm) or $11 \text{ dBm} + 10 \log_{10} B$, 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.

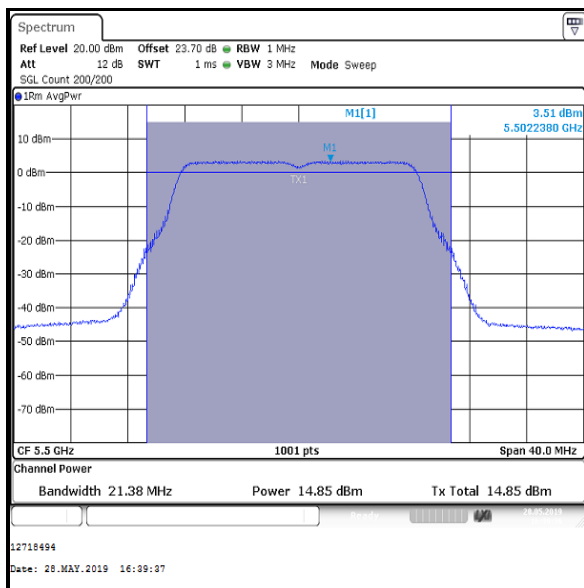
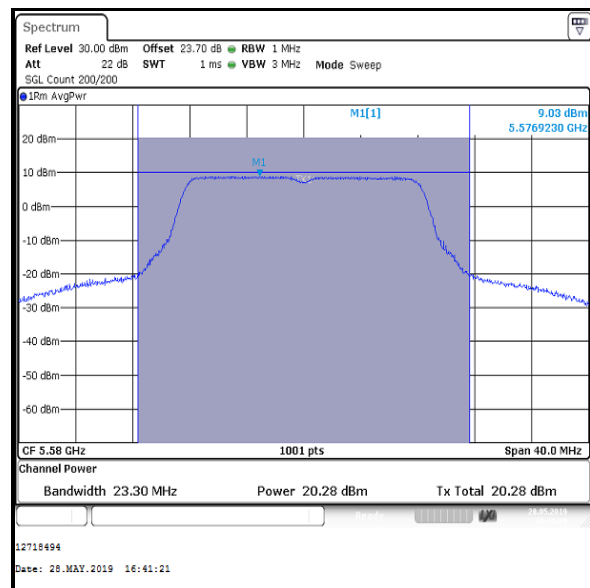
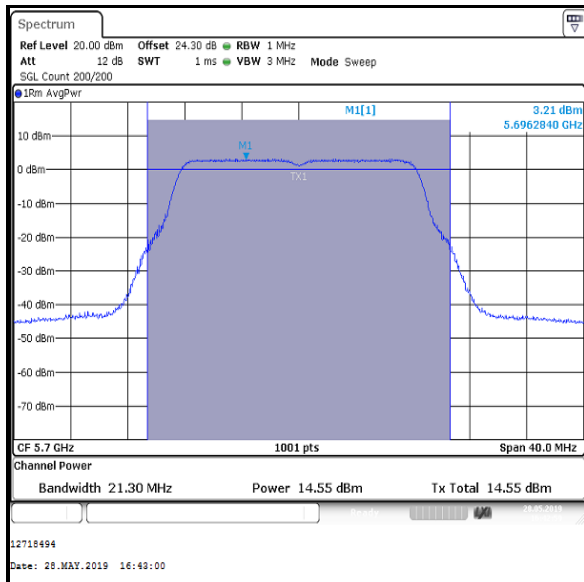
$$\begin{aligned}
 &\text{For } B > 20 \text{ MHz} \rightarrow \\
 &\rightarrow \log_{10} B > \log_{10} 20 \rightarrow \\
 &\rightarrow 10 \log_{10} B > 10 \log_{10} 20 \rightarrow \\
 &\rightarrow 11 + 10 \log_{10} B > 11 + 10 \log_{10} 20 \rightarrow \\
 &\rightarrow 11 + 10 \log_{10} B > 24.0 \text{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

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.

- For all modes of operation, the antenna gain is < 6 dBi.
- For details on antenna gains refer to Section 3.4 of this test report.
- 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.

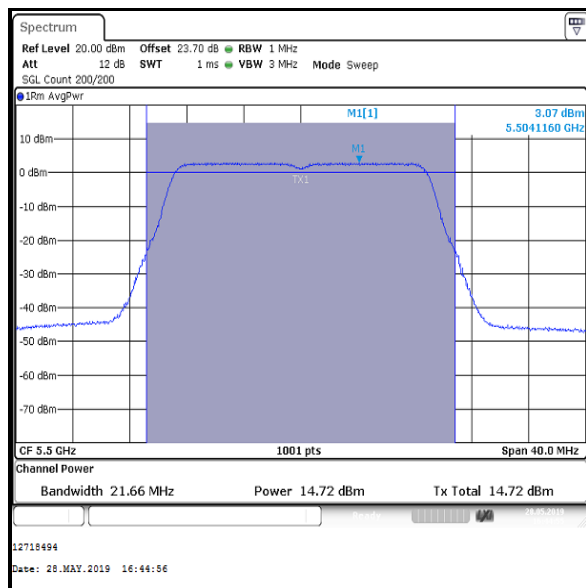
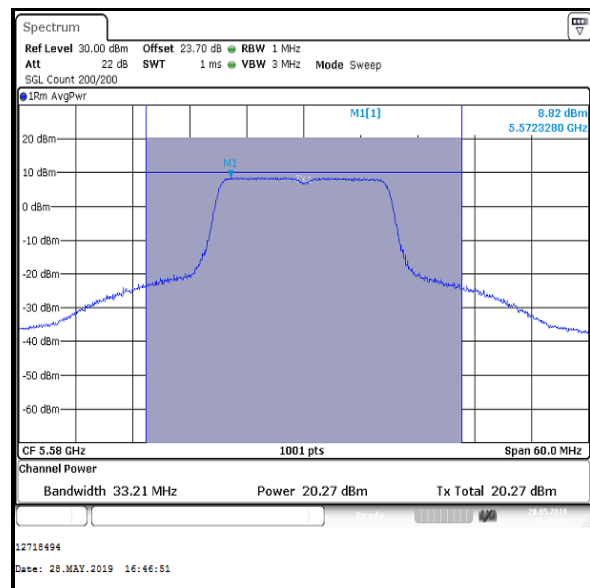
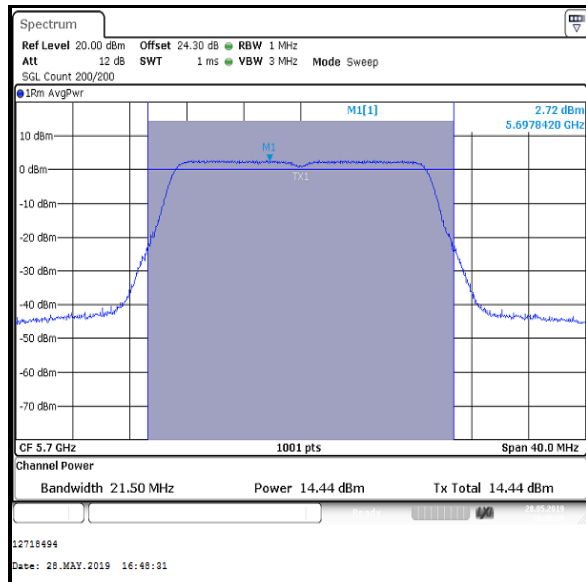
Transmitter Maximum Conducted Output Power (5.47-5.725 GHz band) (continued)**Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5500	14.9	24.0	9.1	Complied
Middle	5580	20.3	24.0	3.7	Complied
Top	5700	14.6	24.0	9.4	Complied

**Bottom Channel****Middle Channel****Top Channel**

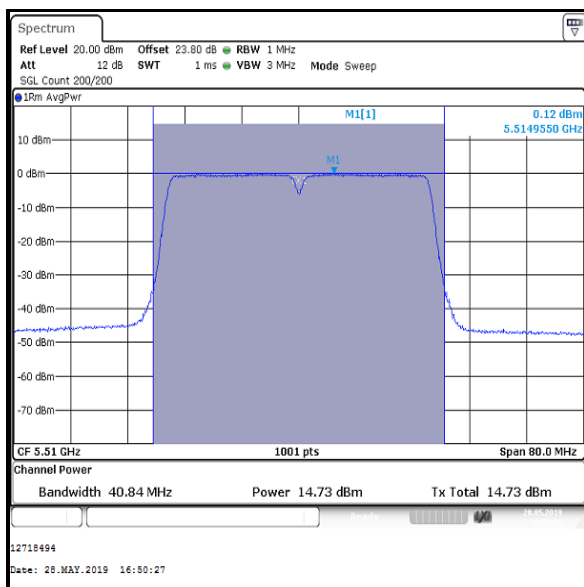
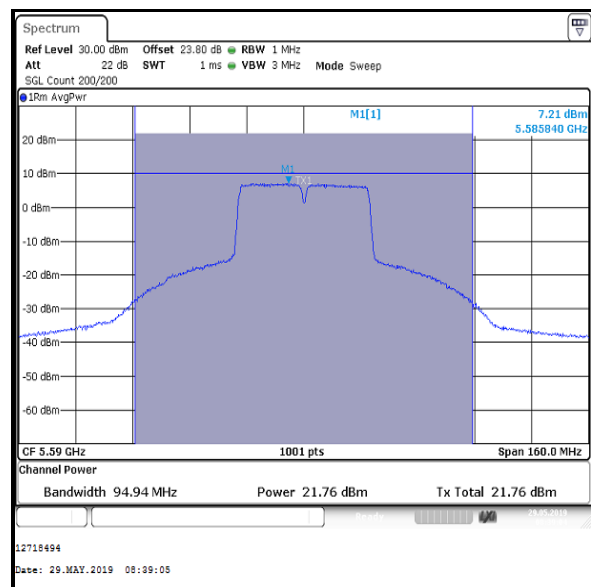
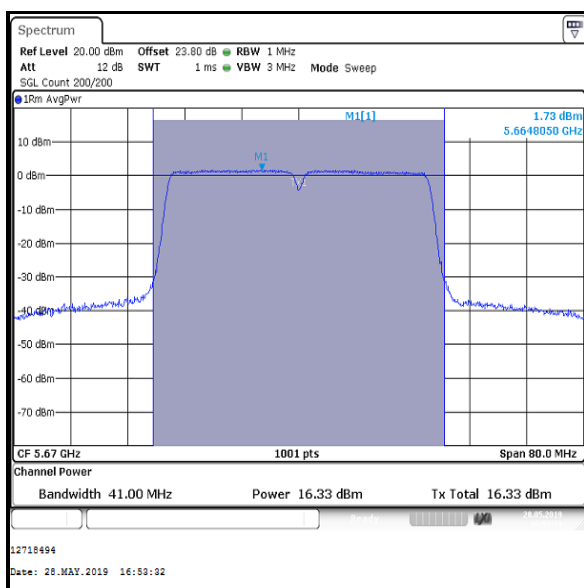
Transmitter Maximum Conducted Output Power (5.47-5.725 GHz band) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5500	14.7	24.0	9.3	Complied
Middle	5580	20.3	24.0	3.7	Complied
Top	5700	14.4	24.0	9.6	Complied

**Bottom Channel****Middle Channel****Top Channel**

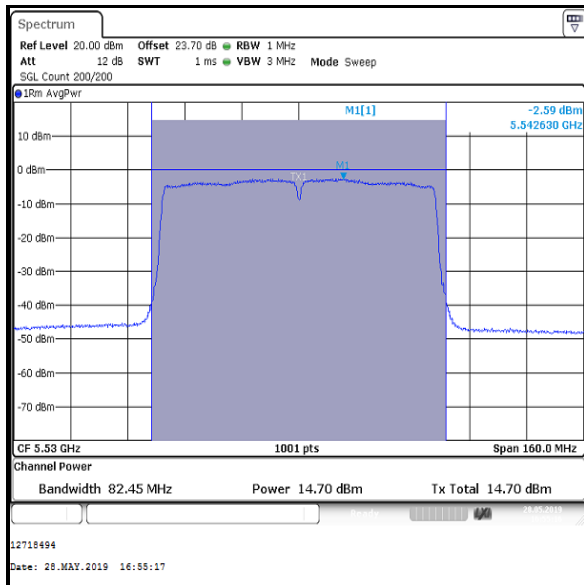
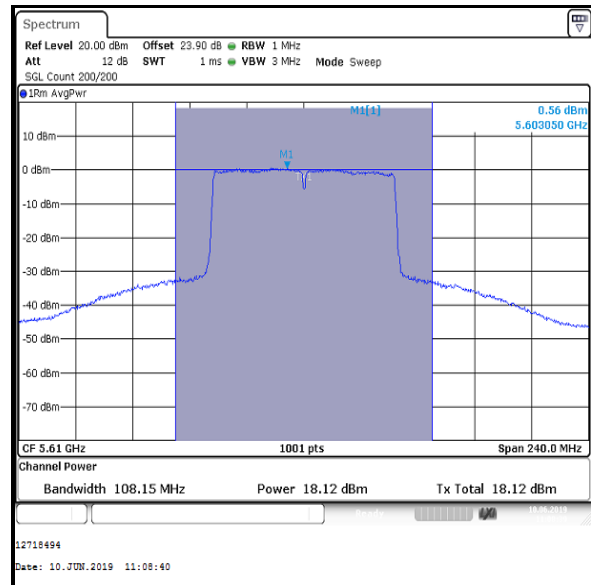
Transmitter Maximum Conducted Output Power (5.47-5.725 GHz band) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5510	14.7	0.1	14.8	24.0	9.2	Complied
Middle	5590	21.8	0.1	21.9	24.0	2.1	Complied
Top	5670	16.3	0.1	16.4	24.0	7.6	Complied

**Bottom Channel****Middle Channel****Top Channel**

Transmitter Maximum Conducted Output Power (5.47-5.725 GHz band) (continued)**Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5530	14.7	0.2	14.9	24.0	9.1	Complied
Top	5610	18.1	0.2	18.3	24.0	5.7	Complied

**Bottom Channel****Top Channel**

Transmitter Maximum Conducted Output Power (Straddle Channels)**4.4.4. Channels that straddle the U-NII-2C and U-NII-3 bands****Test Summary:**

Test Engineer:	Max Passell	Test Dates:	28 May 2019 & 10 June 2019
Test Sample Serial Number:	C02YF007MFLF		

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):	21
Relative Humidity (%):	45 to 50

Note(s):

- Channels that straddle the U-NII-2C and U-NII-3 bands at 5725 MHz need to meet requirements of both U-NII bands. Due to maximum conducted power limit being more stringent on U-NII-2C, compliance is shown against the limits of U-NII-2C. By default, the EUT also complies on U-NII-3.
- 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.
- Measurements were performed using configurations detailed in Section 3.5 of this test report on the relevant channels.
- 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.
- The FCC Part 15.407(a)(2) limit is the lesser of 250 mW (24.0 dBm) or $11 \text{ dBm} + 10 \log_{10} B$, where B is the previously measured 26 dB emission bandwidth in MHz. The 26 dB EBW is greater than 20 MHz.

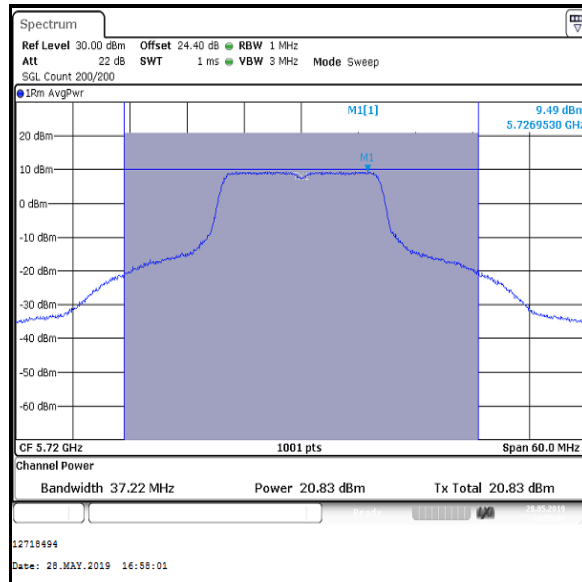
$$\begin{aligned}
 &\text{For } B > 20 \text{ MHz} \rightarrow \\
 &\rightarrow \log_{10} B > \log_{10} 20 \rightarrow \\
 &\rightarrow 10 \log_{10} B > 10 \log_{10} 20 \rightarrow \\
 &\rightarrow 11 + 10 \log_{10} B > 11 + 10 \log_{10} 20 \rightarrow \\
 &\rightarrow 11 + 10 \log_{10} B > 24.0 \text{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

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.

- For all modes of operation, the antenna gain is < 6 dBi.
- For details on antenna gains refer to Section 3.4 of this test report.
- 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 (Straddle Channels) (continued)**Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

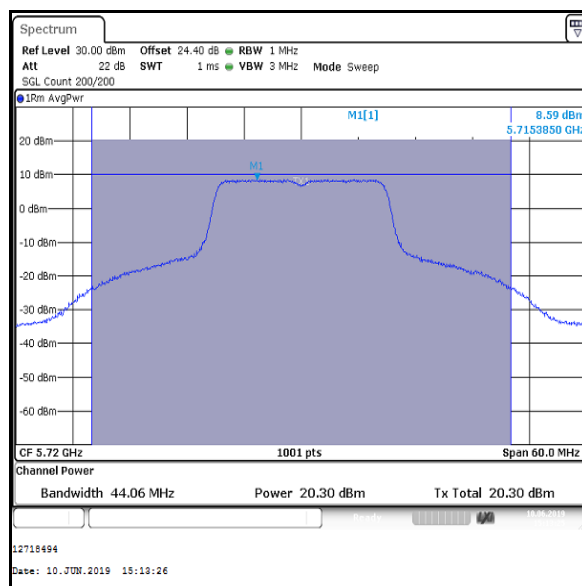
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Single	5720	20.8	24.0	3.2	Complied



Single Channel

Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2

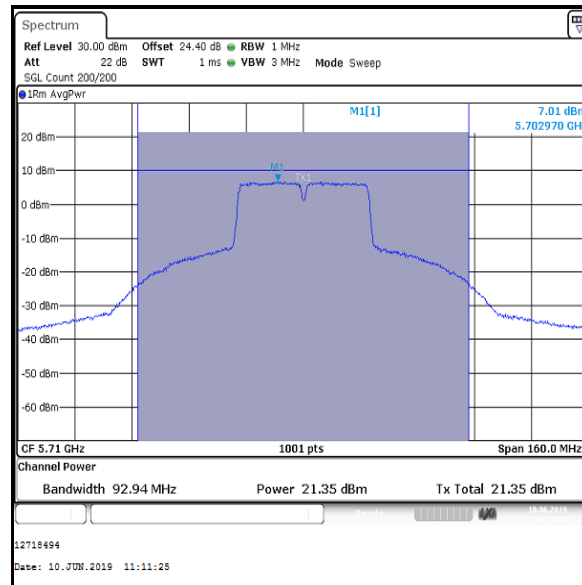
Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Single	5720	20.3	24.0	3.7	Complied



Single Channel

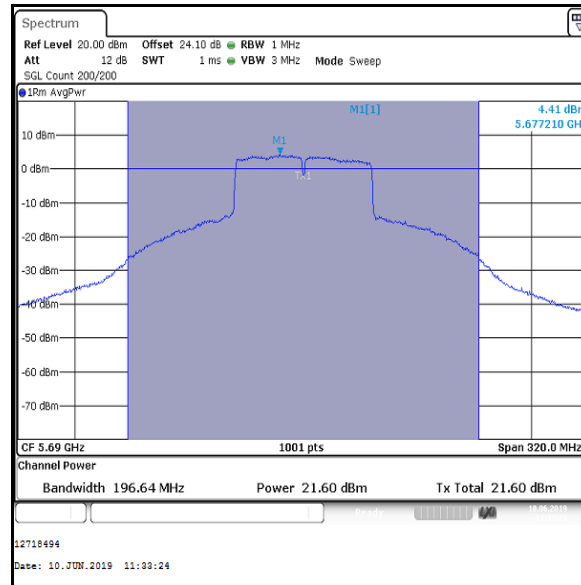
Transmitter Maximum Conducted Output Power (Straddle Channels) (continued)**Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Single	5710	21.4	0.1	21.5	24.0	2.5	Complied

**Single Channel**

Transmitter Maximum Conducted Output Power (Straddle Channels) (continued)**Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Duty cycle correction factor (dB)	Corrected Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Single	5690	21.6	0.2	21.8	24.0	2.2	Complied

**Single Channel**

Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band)**4.4.5. 5.725-5.85 GHz band****Test Summary:**

Test Engineer:	Max Passell	Test Date:	28 May 2019
Test Sample Serial Number:	C02YF007MFLF		

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:

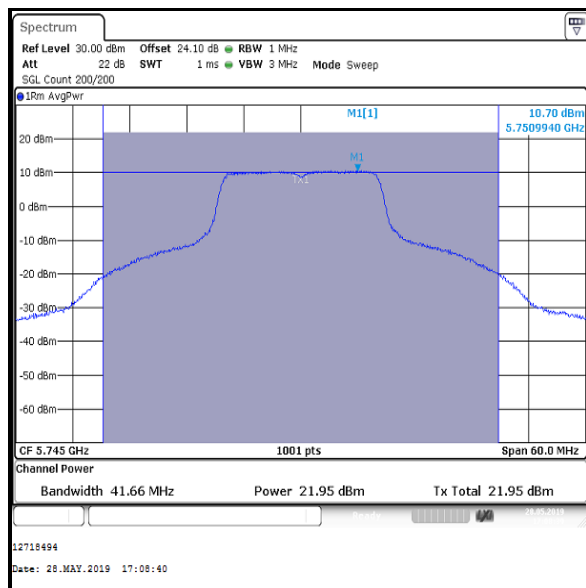
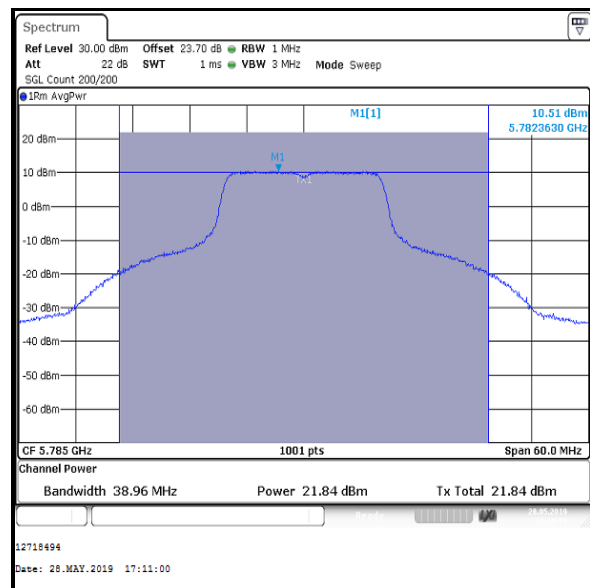
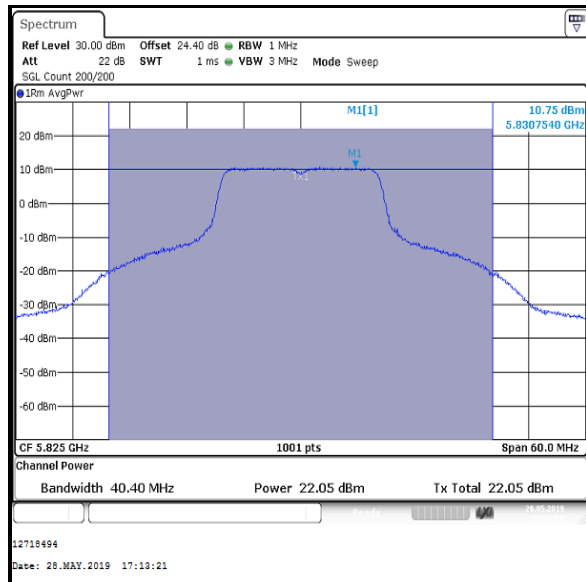
Temperature (°C):	21
Relative Humidity (%):	45

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. Measurements were performed using configurations detailed in Section 3.5 of this test report on the relevant channels.
3. 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.
4. The FCC Part 15.407(a)(3) limit shall not exceed 1 W (30.0 dBm).
5. For all modes of operation, the antenna gain is < 6 dBi.
6. For details on antenna gains refer to Section 3.4 of this test report.
7. 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.

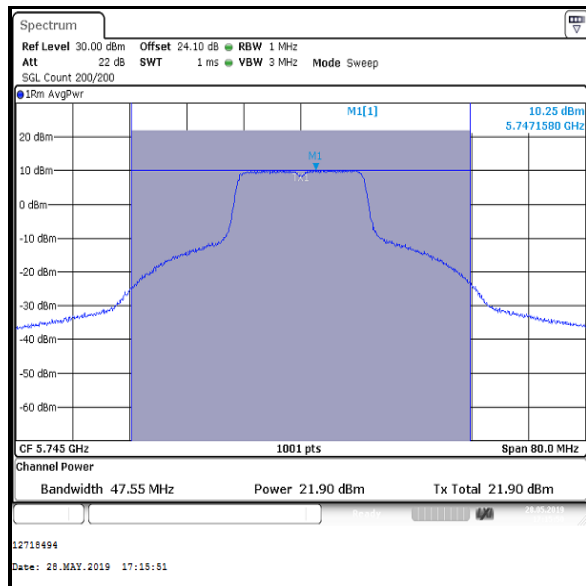
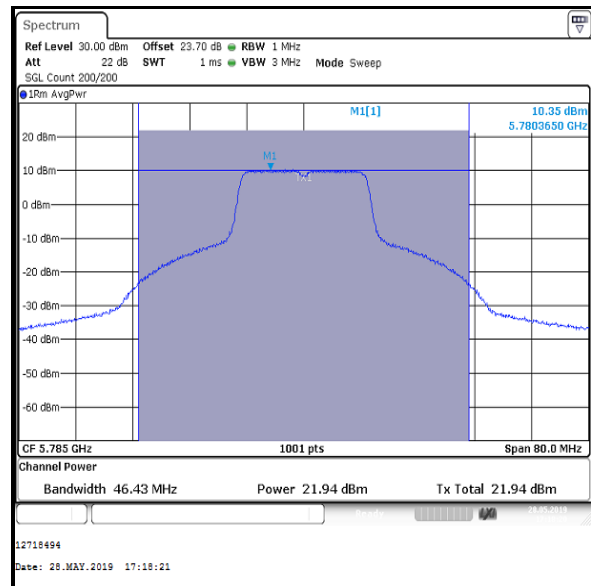
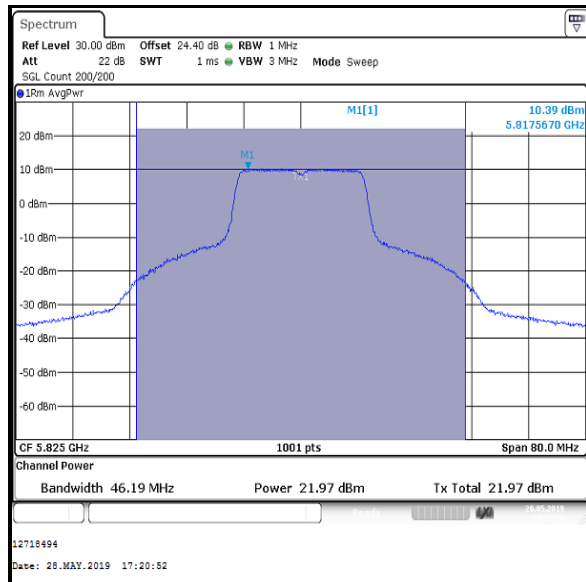
Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band) (continued)**Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbps / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5745	22.0	30.0	8.0	Complied
Middle	5785	21.8	30.0	8.2	Complied
Top	5825	22.1	30.0	7.9	Complied

**Bottom Channel****Middle Channel****Top Channel**

Transmitter Maximum Conducted Output Power (5.725-5.85 GHz band) (continued)**Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Core 2**

Channel	Frequency (MHz)	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	5745	21.9	30.0	8.1	Complied
Middle	5785	21.9	30.0	8.1	Complied
Top	5825	22.0	30.0	8.0	Complied

**Bottom Channel****Middle Channel****Top Channel**