



# TEST REPORT

**Test Report No. :** UL-RPT-RP11624992JD06A V2.0

**Customer** : Apple Inc.  
**Model No.** : A1842  
**FCC ID** : BCGA1842  
**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:** 23 August 2017

**Checked by:**

Ian Watch  
Senior Test Engineer, Radio Laboratory

**Company Signatory:**

Sarah Williams  
Senior Test Engineer, Radio Laboratory  
UL VS LTD



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## UL VS LTD

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG, UK  
Telephone: +44 (0)1256 312000  
Facsimile: +44 (0)1256 312001

**Report Revision History**

<b>Version Number</b>	<b>Issue Date</b>	<b>Revision Details</b>	<b>Revised By</b>
1.0	08/08/2017	Initial Version	Ian Watch
2.0	23/08/2017	Changed Model No. to A1842 Changed description of EUT in Section 1.1	Ian Watch

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## **1. Attestation of Test Results**

### **1.1. Description of EUT**

The device is an interactive digital media player which plays content onto a screen through an HDMI port. It incorporates Wi-Fi and Bluetooth radios.

### **1.2. General Information**

<b>Specification Reference:</b>	47CFR15.407 and 47CFR15.403
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) – Sections 15.403 and 15.407
<b>Specification Reference:</b>	47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209
<b>Site Registration:</b>	209735
<b>Location of Testing:</b>	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
<b>Test Dates:</b>	22 May 2017 to 08 August 2017

### 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 Peak Power Spectral Density (5.15-5.25 GHz band)	Complied
Part 15.407(a)(2)	Transmitter Peak Power Spectral Density (5.25-5.35 GHz & 5.47-5.725 GHz bands)	Complied
Part 15.407(a)(2)	Transmitter Peak 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 Peak 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).
4. There are two vendors of the WiFi/*Bluetooth* radio modules, Vendor 1 and Vendor 2.
5. The WiFi/*Bluetooth* radio modules have the same mechanical outline (i.e. the same packaging dimension and pin layout), use the same on-board antenna matching circuit, have an identical antenna structure and are built and tested to conform to the same specification and to operate within the same tolerances.

Baseline testing was performed on the two vendors to determine the worst case.

**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	
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**

<b>Reference:</b>	ANSI C63.10-2013
<b>Title:</b>	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
<b>Reference:</b>	KDB 789033 D02 General U-NII Test Procedures New Rules v01r04 May 2, 2017
<b>Title:</b>	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E)
<b>Reference:</b>	KDB662911 D01 Multiple Transmitter Output v02r01 October 31, 2013
<b>Title:</b>	Emissions Testing of Transmitter with Multiple Outputs in the Same Band

## **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 5.85 GHz	95%	±1.14 %
26 dB Emission Bandwidth	5.15 GHz to 5.85 GHz	95%	±4.59 %
Minimum 6 dB Emission Bandwidth	5.15 GHz to 5.85 GHz	95%	±4.59 %
Maximum Conducted Output Power	5.15 GHz to 5.85 GHz	95%	±1.13 dB
Maximum Power Spectral Density	5.15 GHz to 5.85 GHz	95%	±1.13 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 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 Duty Cycle, 26 dB Emission Bandwidth, Minimum 6 dB Bandwidth (5.725-5.85 GHz band), Maximum Conducted Output Power and Power Spectral Density

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2005	Thermohygrometer	Testo	608-H1	45046700	22 Feb 2018	12
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	06 Mar 2018	12
A2952	RF Switch	Pickering	64-102-002	XZ361012	Calibrated before use	-
A2930	Attenuator	AtlanTecRF	AB18W5-10	000907-18#1	Calibrated before use	-
A2846	Attenuator	Radiall	R411.810.121	23944722	Calibrated before use	-
M1804	Signal Generator	Rohde & Schwarz	SMP22	100026	03 Feb 2018	42

### Test Equipment Used for Transmitter Radiated Emissions

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
K0017	3m RSE Chamber	Rainford	N/A	N/A	14 Apr 2018	12
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Feb 2018	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	13 Apr 2018	12
A2863	Pre Amplifier	Agilent	8449B	3008A02100	11 Apr 2018	12
A2943	Attenuator	AtlanTecRF	AN18W5-06	208147#2	31 Mar 2018	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	11 Apr 2018	12
A2889	Antenna	Schwarzbeck	BBHA 9120B	BBHA9120B653	11 Apr 2018	12
A2903	Antenna	Schwarzbeck	VULB 9163	9163-944	22 Aug 2017	12
A2947	High Pass Filter	AtlanTecRF	AFH-07000	160190001	06 Mar 2018	12
A2971	Low Pass Filter	AtlanTecRF	AFL -02000	1506292845	06 Mar 2018	12
A2892	Antenna	Schwarzbeck	BHA 9170	9170 727	11 Apr 2018	12
A2893	Pre-Amplifier	Schwarzbeck	BBV 9721	9721-021	11 Apr 2018	12

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

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	16 Nov 2017	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	28 Oct 2017	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	09 Nov 2017	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	06 Mar 2018	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	22 Feb 2018	12
A253	Antenna	Flann Microwave	12240-20	128	08 Nov 2017	12

### **3. Equipment Under Test (EUT)**

#### **3.1. Identification of Equipment Under Test (EUT)**

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C02TK026J4C7 ( <i>Radiated sample #1</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	BCGA1842

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C07TK007J4C6 ( <i>Radiated sample #2</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	BCGA1842

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C07TK02MJ4C7 ( <i>Conducted sample</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	BCGA1842

#### **3.2. Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.

**3.3. Additional Information Related to Testing**

<b>Technology Tested:</b>	WLAN (IEEE 802.11a,n,ac) / U-NII	
<b>Type of Unit:</b>	Transceiver	
<b>Modulation:</b>	BPSK, QPSK, 16QAM, 64QAM & 256QAM	
<b>Data rates:</b>	802.11a	6, 9, 12, 18, 24, 36, 48 & 54 Mbit/s
	802.11n HT20	MCS0 to MCS7 (1 spatial stream) with or without CDD / (SISO, or MIMO with CDD/STBC) MCS8 to MCS15 (2 spatial streams) (MIMO SDM)
	802.11n HT40	MCS0 to MCS7 with or without CDD / (SISO, or MIMO with CDD/STBC) MCS8 to MCS15 (MIMO SDM)
	802.11ac VHT20	MCS0 to MCS8 (1 spatial stream) with or without CDD / (SISO, or MIMO with CDD/STBC) MCS0 to MCS8 (2 spatial streams) (MIMO SDM)
	802.11ac VHT40	MCS0 to MCS9 (1 spatial stream) with or without CDD / (SISO, or MIMO with CDD/STBC) MCS0 to MCS9 (2 spatial streams) (MIMO SDM)
	802.11ac VHT80	MCS0 to MCS9 (1 spatial stream) with or without CDD / (SISO, or MIMO with CDD/STBC) MCS0 to MCS9 (2 spatial streams) (MIMO SDM)
<b>Power Supply Requirement(s):</b>	Nominal	120 VAC 60 Hz
<b>Maximum Conducted Output Power:</b>	20 MHz	23.5 dBm
	40 MHz	22.3 dBm
	80 MHz	23.8 dBm

**Additional Information Related to Testing (continued)**

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

**Additional Information Related to Testing (continued)**

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

**Additional Information Related to Testing (continued)**

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

### **3.4. Description of Available Antennas**

The radio utilizes two integrated antennas, with the following maximum gains:

<b>Frequency Band (MHz)</b>	<b>G<sub>Antenna 1</sub> (dBi)</b>	<b>G<sub>Antenna 2</sub> (dBi)</b>
5150 to 5250	1.9	1.7
5250 to 5350	2.0	1.9
5470 to 5725	0.7	1.2
5725 to 5850	-0.1	1.6

<b>Frequency Band (MHz)</b>	<b>Directional Antenna Gain for Power Measurements (dBi)</b>	<b>Directional Antenna Gain for PSD Measurements (dBi)</b>
5150 to 5250	1.9	4.8
5250 to 5350	2.0	4.9
5470 to 5725	1.2	4.0
5725 to 5850	1.6	3.8

Refer to Appendix 1 of this test report for directional antenna gain calculations.



### **3.5. Description of Test Setup**

#### **Support Equipment**

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

<b>Description:</b>	Goldeneye Adaptor
<b>Brand Name:</b>	Goldeneye
<b>Model Name or Number:</b>	X892
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	USB to lightning cable
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Kanzi
<b>Serial Number:</b>	316D67

<b>Description:</b>	Laptop PC
<b>Brand Name:</b>	Lenovo
<b>Model Name or Number:</b>	L440
<b>Serial Number:</b>	R9-019E9Z 14/04

<b>Description:</b>	Laptop PC
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Macbook Pro
<b>Serial Number:</b>	C02Q81PFG3QD

<b>Description:</b>	HDMI Cable. Length 1.8 metres
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	Multi Media player adaptor
<b>Brand Name:</b>	Sumvision
<b>Model Name or Number:</b>	Cyclone Micro
<b>Serial Number:</b>	UL VS LTD Asset No. A1986

<b>Description:</b>	Power Cable. Length 1.8 metres.
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

**Support Equipment (continued)**

<b>Description:</b>	Ethernet Hub
<b>Brand Name:</b>	Netgear
<b>Model Name or Number:</b>	GS605
<b>Serial Number:</b>	1YG19430021A1

<b>Description:</b>	Ethernet Cable. Length 2.0 metres.
<b>Brand Name:</b>	Not marked or stated
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	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):

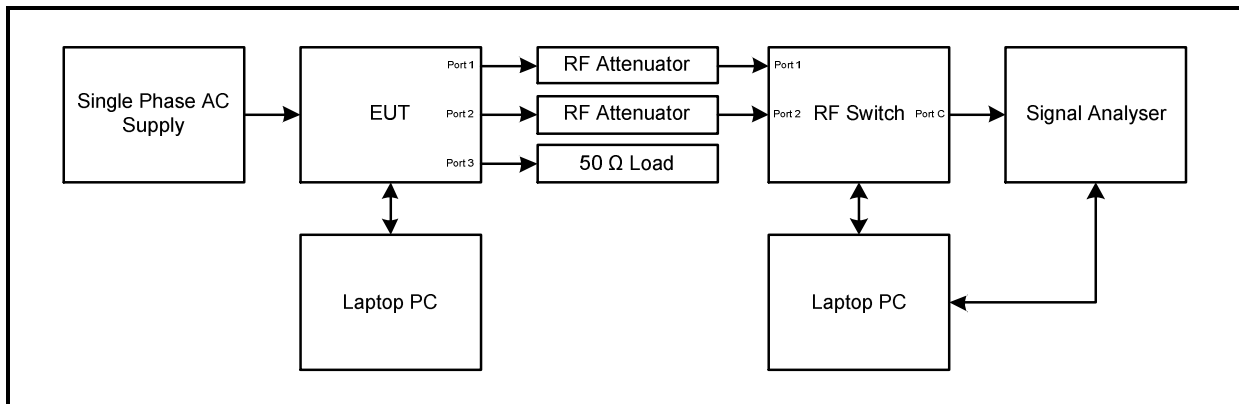
- Controlled in test mode using a software application on the laptop PC supplied by the customer. The application was used to enable a continuous transmission and to select the test channels as required. The customer supplied a document containing the setup instructions 'EUT\_setup\_v3.2.docx'. The laptop PC was connected to the EUT via a Goldeneye adaptor and USB to lightning cable.
- The customer requested the following data rates to be used for all measurements. The worst case SISO modes of operation were those with the highest EIRP.

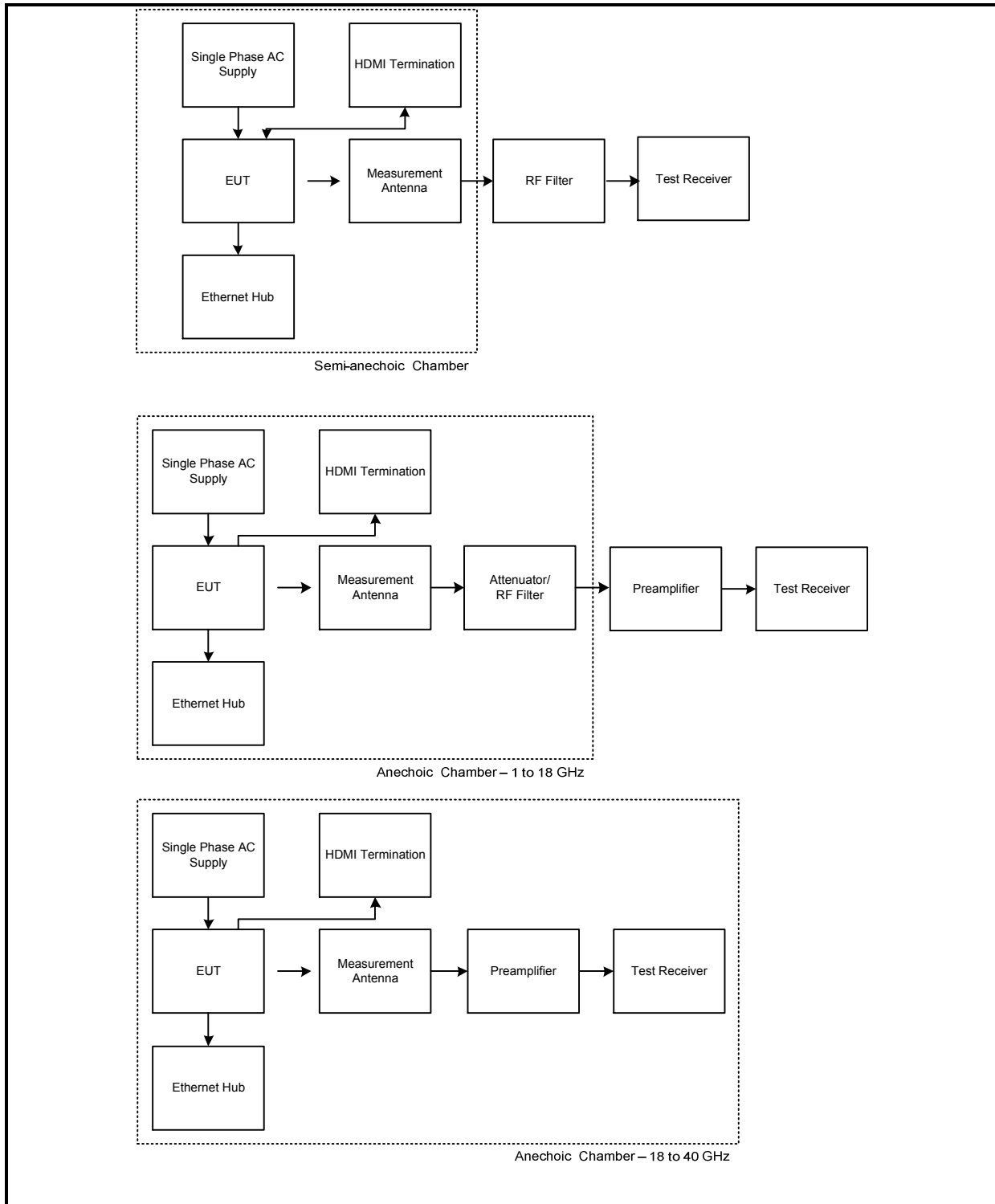
On frequency bands 5150-5250 MHz and 5250-5350 MHz:

- 802.11a SISO – BPSK / 6 Mbit/s / Port 1
- 802.11n HT20 / SISO – BPSK / 6.5 Mbit/s / MCS0 / Port 1
- 802.11n HT40 / SISO – BPSK / 13.5 Mbit/s / MCS0 / Port 1
- 802.11ac VHT80 / SISO – BPSK / 29.3 Mbit/s / MCS0 / Port 1
- 802.11n HT20 / MIMO / 2Tx CDD – BPSK / 6.5 Mbit/s / MCS0
- 802.11n HT40 / MIMO / 2Tx CDD – BPSK / 13.5 Mbit/s / MCS0
- 802.11ac VHT80 / MIMO / 2Tx CDD – BPSK / 29.3 Mbit/s / MCS0x1

On frequency bands 5470-5725 MHz and 5725-5850 MHz:

- 802.11a SISO – BPSK / 6 Mbit/s / Port 2
- 802.11n HT20 / SISO – BPSK / 6.5 Mbit/s / MCS0 / Port 2
- 802.11n HT40 / SISO – BPSK / 13.5 Mbit/s / MCS0 / Port 2
- 802.11ac VHT80 / SISO – BPSK / 29.3 Mbit/s / MCS0 / Port 2
- 802.11n HT20 / MIMO / 2Tx CDD – BPSK / 6.5 Mbit/s / MCS0
- 802.11n HT40 / MIMO / 2Tx CDD – BPSK / 13.5 Mbit/s / MCS0
- 802.11ac VHT80 / MIMO / 2Tx CDD – BPSK / 29.3 Mbit/s / MCS0x1
- The EUT has two separate antennas which correspond to two separate antenna ports. Port 1 and Port 2 correspond to antenna 1 and antenna 2 respectively.
- During radiated emissions tests, the HDMI port was terminated into a Cyclone multimedia player adaptor. Once placed in test mode, the Goldeneye adaptor and USB to lightning cable were removed and replaced with an Ethernet cable terminated into an Ethernet hub.
- Transmitter spurious emissions were performed with the EUT transmitting in an 802.11n / HT20 / MCS0 / MIMO configuration. This was found to be the worst case with regards to emissions after preliminary investigations and, as this mode emits the highest transmit power spectral density, it was deemed to be the worst case.
- The conducted sample with serial number C07TK02MJ4C7 was used for 26 dB bandwidth, minimum 6 dB bandwidth, duty cycle, maximum output power and peak power spectral density tests.
- The radiated samples with serial numbers C07TK026J4C7 & C07TK007J4C6 were used for all other tests.
- The EUT was powered from a 120 VAC 60 Hz single phase mains supply.

**Test Setup Diagrams****Conducted Tests:****Test Setup for Transmitter Duty Cycle, 26 dB Emission Bandwidth, Minimum 6 dB Bandwidth, Maximum Conducted Output Power & Power Spectral Density**

**Radiated Tests:****Test Setup for Transmitter Radiated Emissions**

## 4. Antenna Port Test Results

### 4.1. Transmitter Duty Cycle

#### Test Summary:

Test Engineer:	Georgios Vrezas	Test Dates:	07 July 2017 & 29 July 2017
Test Sample Serial Number:	C07TK02MJ4C7		

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

#### Environmental Conditions:

Temperature (°C):	21 to 25
Relative Humidity (%):	42 to 49

#### 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:

$$10 \log 1 / (\text{On Time} / [\text{Period or } 100\text{ms whichever is the lesser}]).$$

$$802.11n \text{ HT40} / \text{SISO} / \text{MCS0} \text{ duty cycle: } 10 \log (1 / (940.520 / 965.840)) = 0.1$$

$$802.11ac \text{ VHT80} / \text{SISO} / \text{MCS0x1} \text{ duty cycle: } 10 \log (1 / (458.266 / 481.721)) = 0.2$$

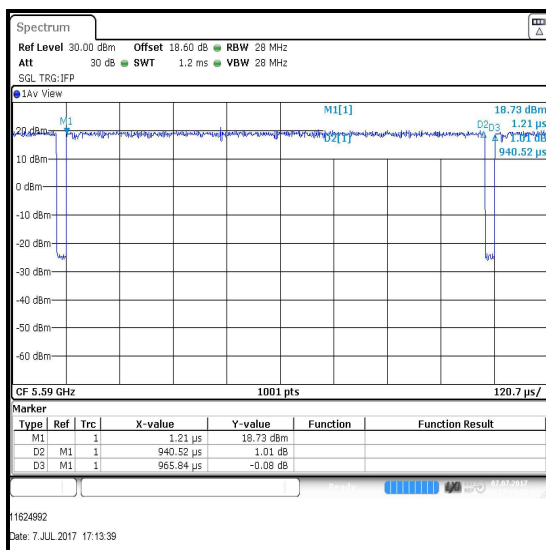
$$802.11n \text{ HT40} / \text{MIMO} / 2\text{TxD} / \text{MCS0} / \text{duty cycle: } 10 \log (1 / (941.730 / 965.840)) = 0.1$$

$$802.11ac \text{ VHT80} / \text{MIMO} / 2\text{TxD} / \text{MCS0x1} \text{ duty cycle: } 10 \log (1 / (458.266 / 481.721)) = 0.2$$

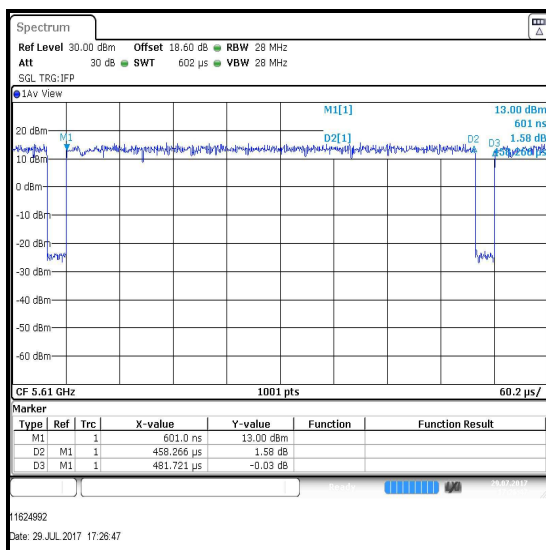
2. Measurements were performed on all EUT ports and found to be identical. Therefore only results for port 2 are presented in this section of the test report.
3. Plots below are for data rates with a duty cycle less than 98%. Results for all other modes having a duty cycle >98% are archived on the UL VS LTD IT server and available for inspection if required.
4. 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 / HT40 / SISO / MCS0**

Pulse Duration (μs)	Period (μs)	Duty Cycle (dB)
940.520	965.840	0.1

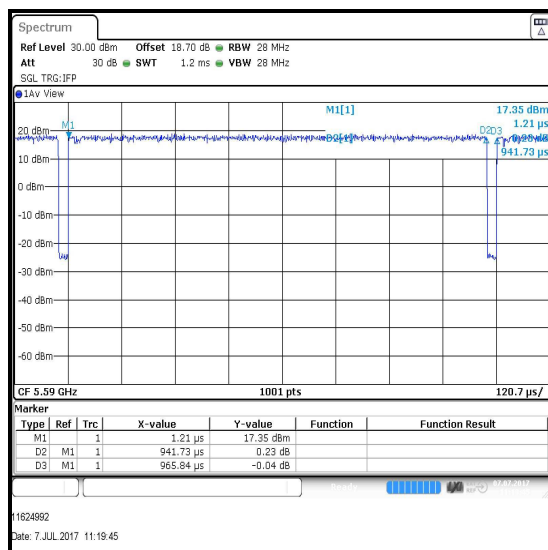
**Results: 802.11ac / VHT80 / SISO / MCS0x1**

Pulse Duration (μs)	Period (μs)	Duty Cycle (dB)
458.266	481.721	0.2

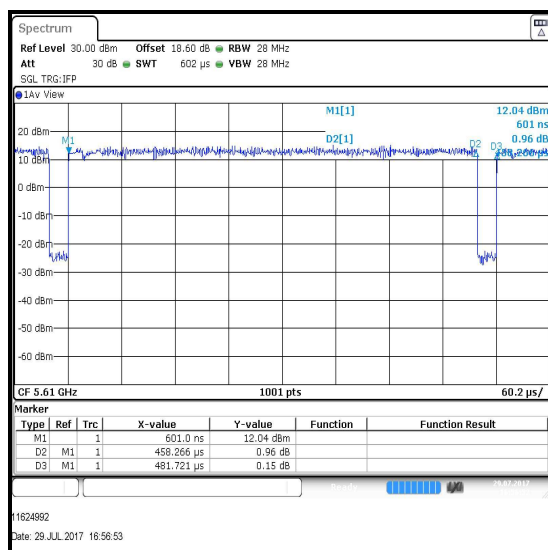


**Transmitter Duty Cycle (continued)****Results: 802.11n / HT40 / MIMO / 2Tx CDD / MCS0**

Pulse Duration (µs)	Period (µs)	Duty Cycle (dB)
941.730	965.840	0.1

**Results: 802.11ac / VHT80 / MIMO / 2Tx CDD / MCS0x1**

Pulse Duration (µs)	Period (µs)	Duty Cycle (dB)
458.266	481.721	0.2





**4.2. Transmitter 26 dB Emission Bandwidth****Test Summary:**

<b>Test Engineer:</b>	Georgios Vrezas	<b>Test Dates:</b>	06 July 2017 to 29 July 2017
<b>Test Sample Serial Number:</b>	C07TK02MJ4C7		

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

**Environmental Conditions:**

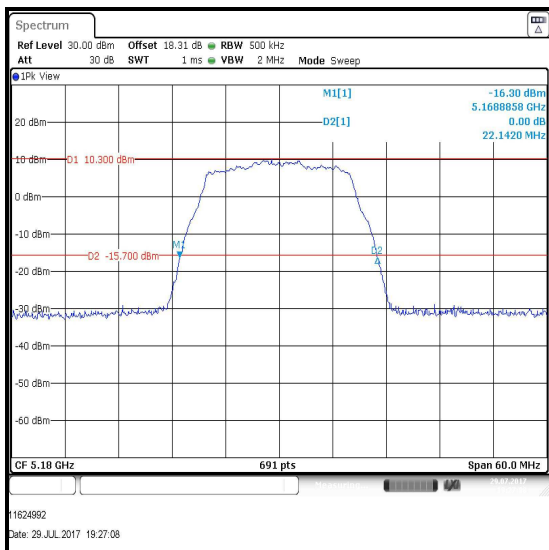
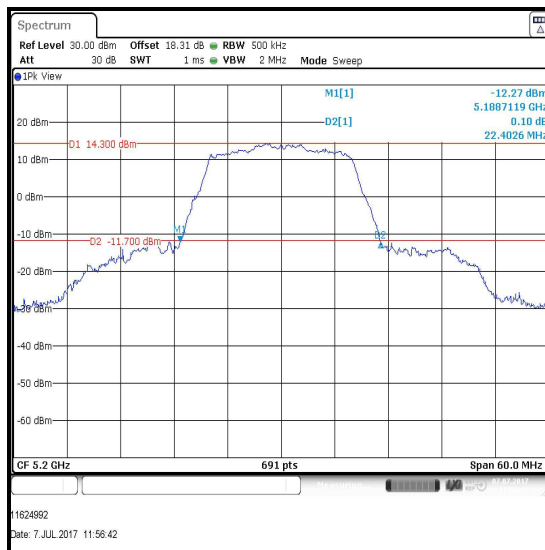
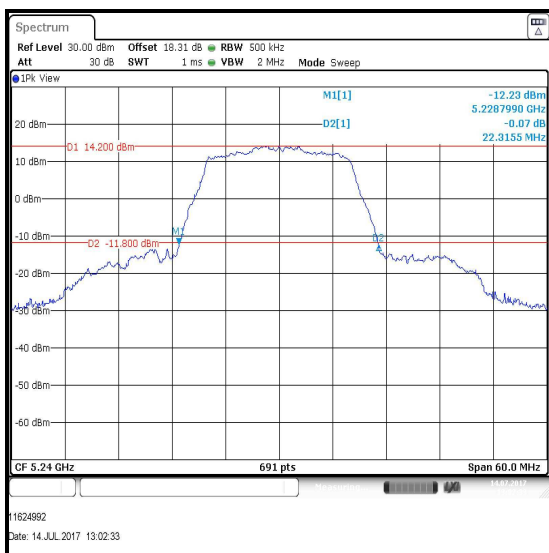
<b>Temperature (°C):</b>	21 to 25
<b>Relative Humidity (%):</b>	42 to 49

**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'.

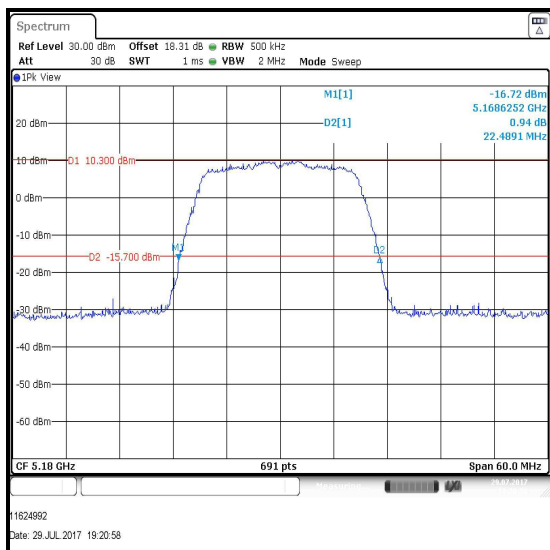
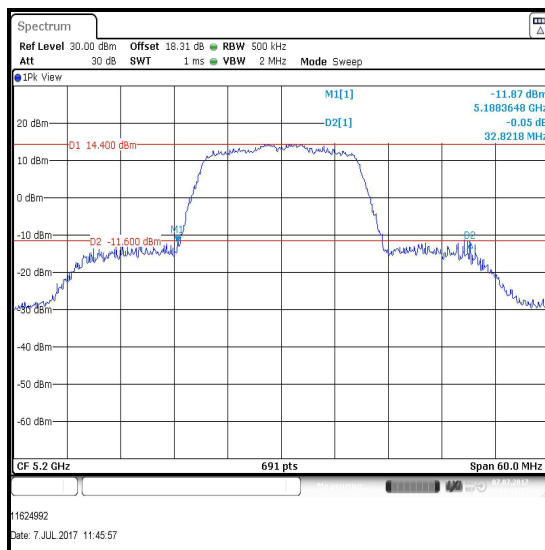
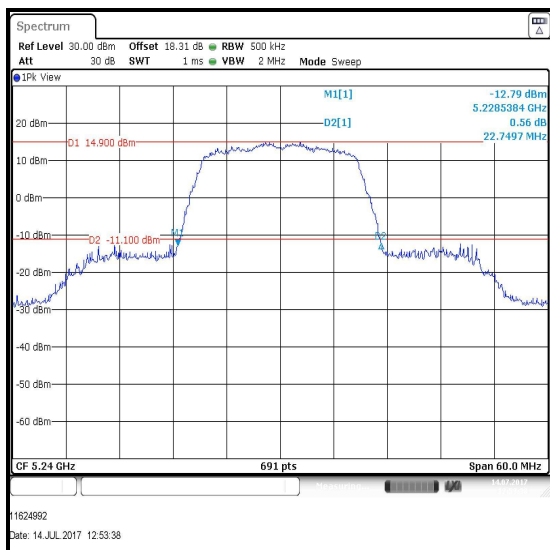
**Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)****4.2.1 5.15-5.25 GHz band****Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbit/s / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	22.142
Middle	5200	22.403
Top	5240	22.316

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

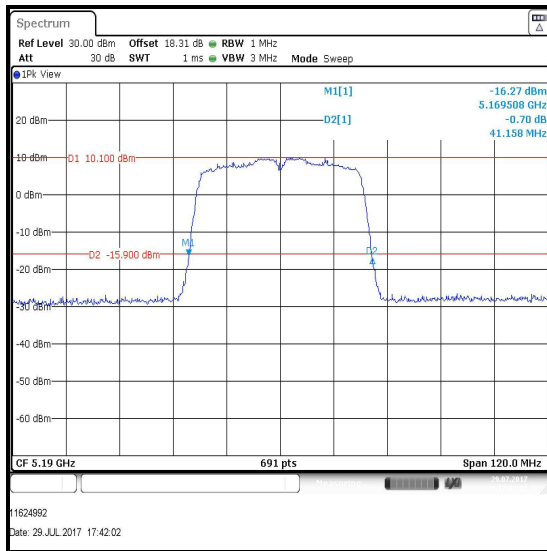
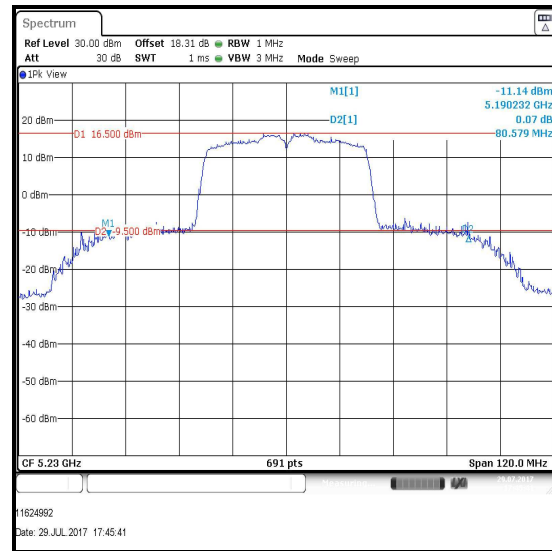
**Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)****Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	22.489
Middle	5200	32.822
Top	5240	22.750

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

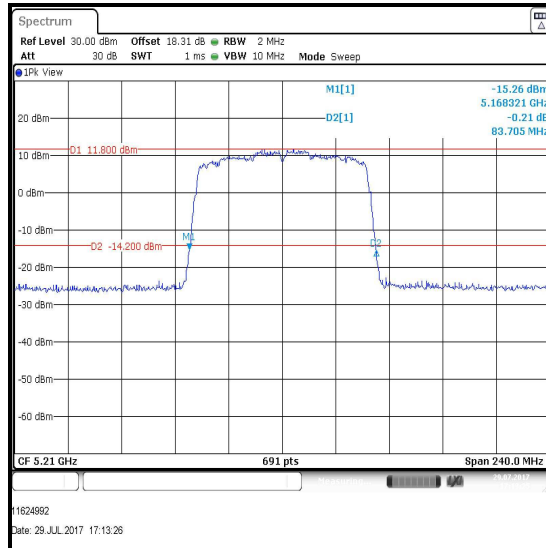
**Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)****Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	41.158
Top	5230	80.579

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

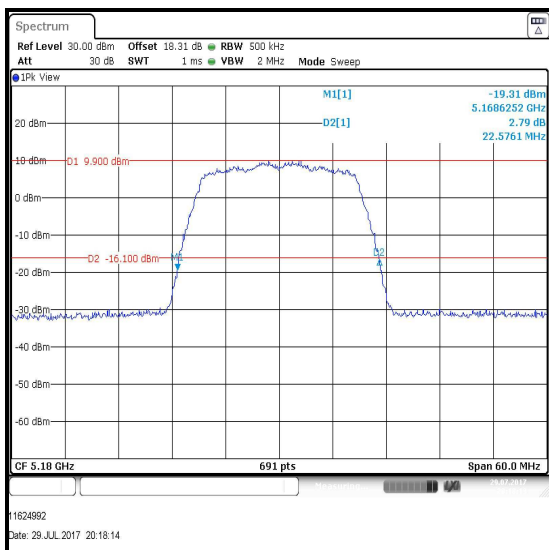
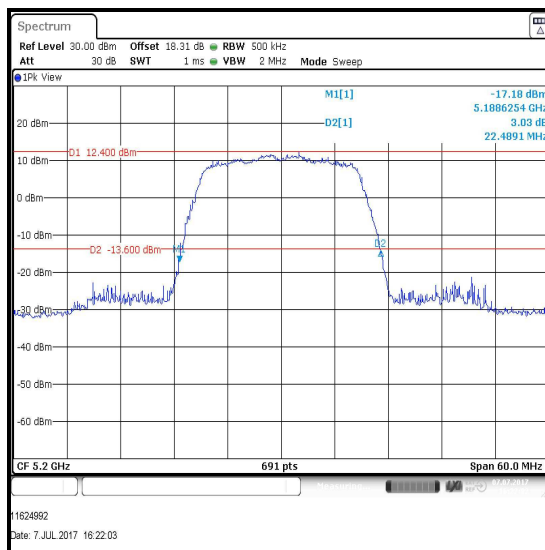
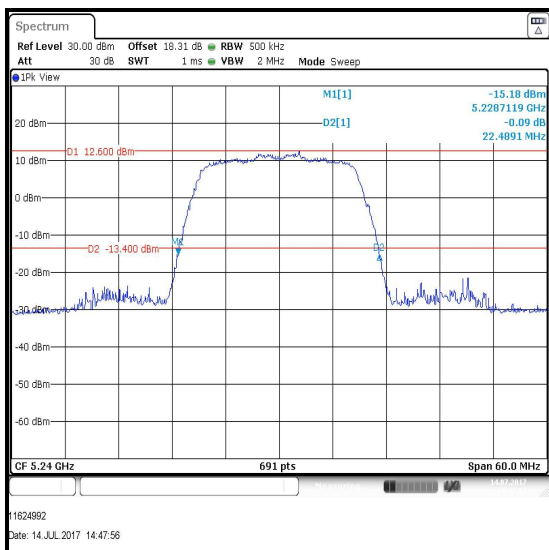
**Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)****Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0x1 / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	83.705

**Single Channel**

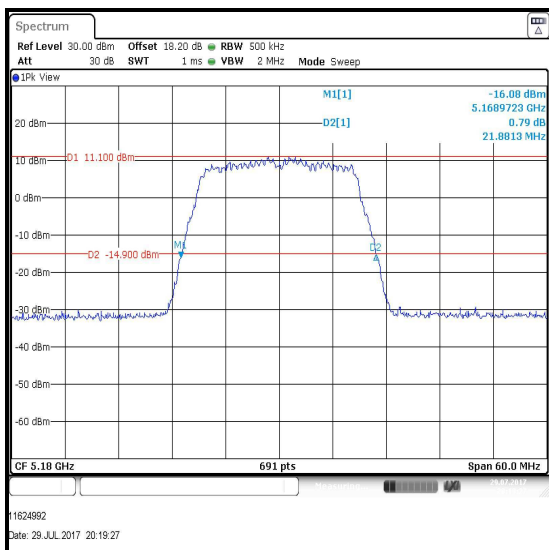
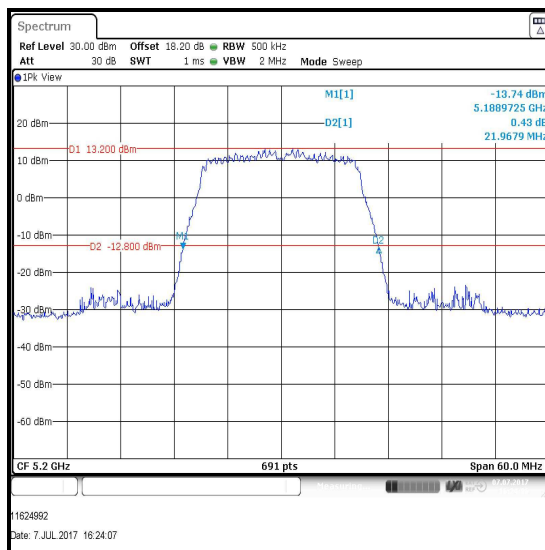
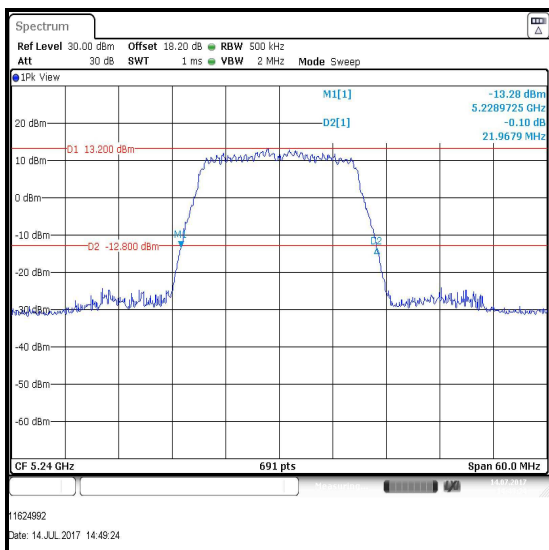
**Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)****Results: 802.11n / 20 MHz / MIMO / BPSK / MCS0 / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	22.576
Middle	5200	22.489
Top	5240	22.489

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

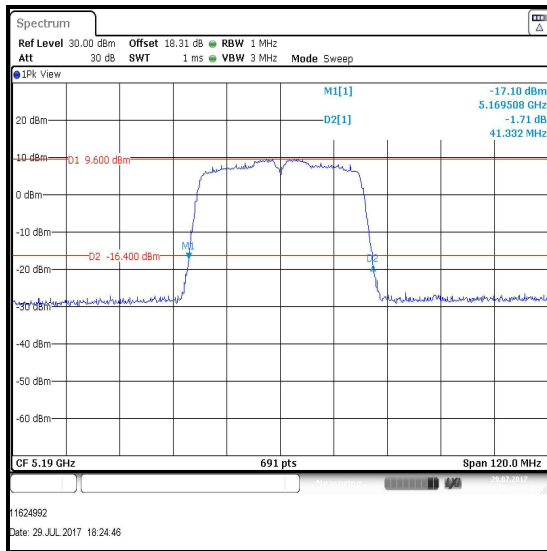
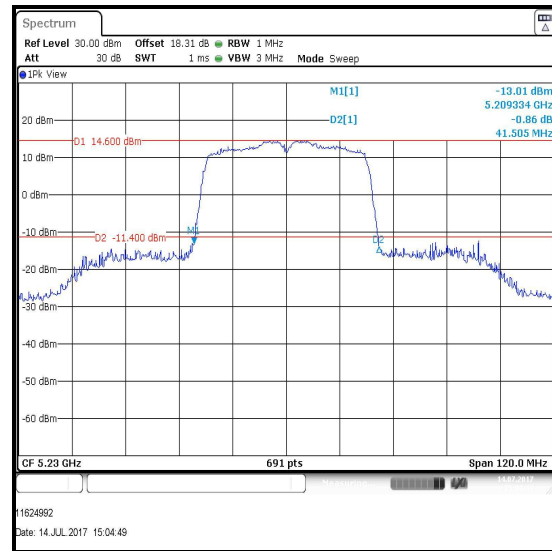
**Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)****Results: 802.11n / 20 MHz / MIMO / BPSK / MCS0 / Port 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5180	21.881
Middle	5200	21.968
Top	5240	21.968

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

**Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)****Results: 802.11n / 40 MHz / MIMO / BPSK / MCS0 / Port 1**

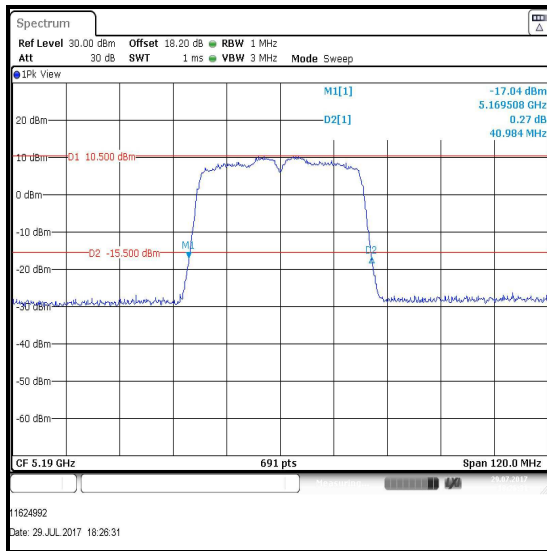
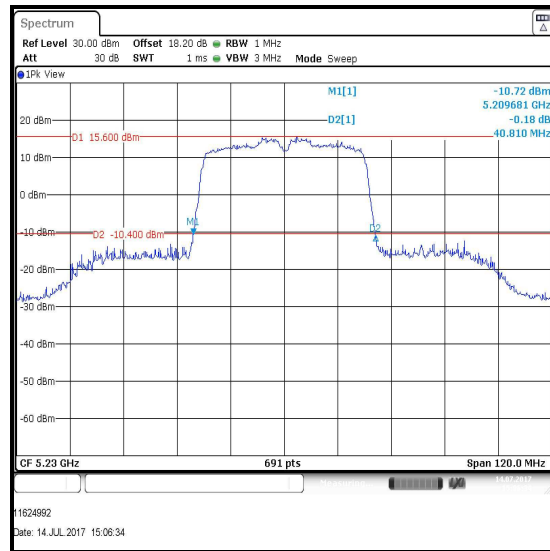
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	41.332
Top	5230	41.505

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



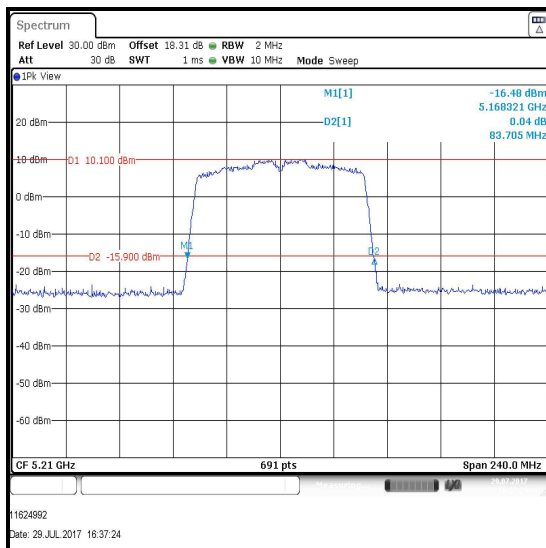
**Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)****Results: 802.11n / 40 MHz / MIMO / BPSK / MCS0 / Port 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5190	40.984
Top	5230	40.810

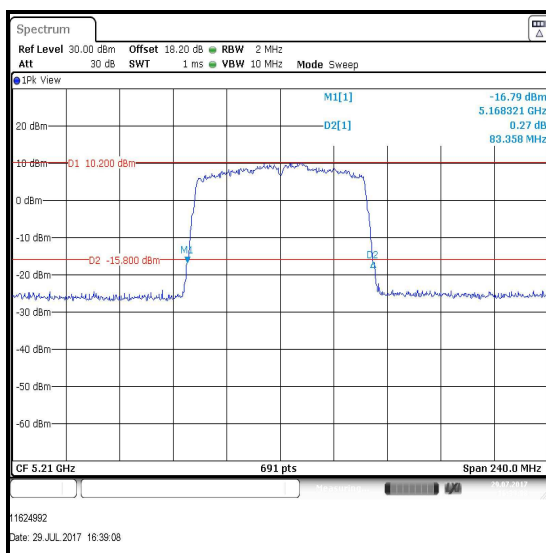
**Bottom Channel****Top Channel**

**Transmitter 26 dB Emission Bandwidth (5.15-5.25 GHz band) (continued)****Results: 802.11ac / 80 MHz / MIMO / BPSK / MCS0x1 / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	83.705

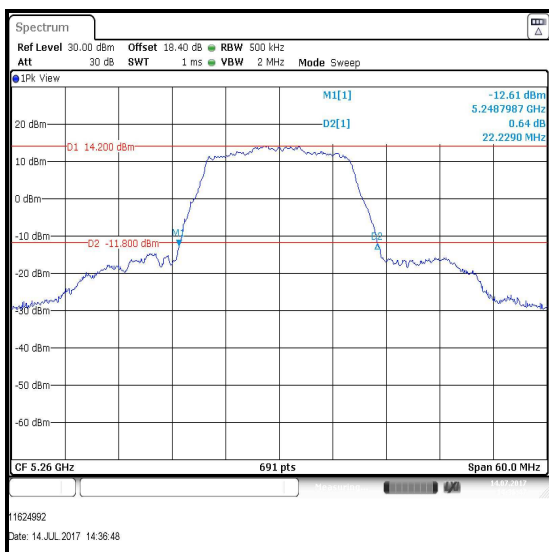
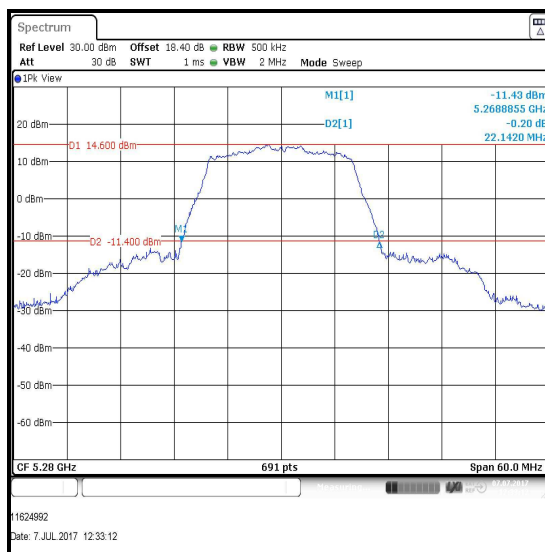
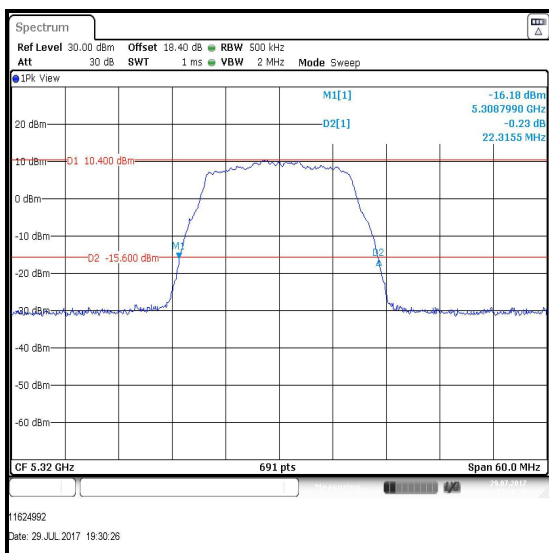
**Single Channel****Results: 802.11ac / 80 MHz / MIMO / BPSK / MCS0x1 / Port 2**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5210	83.358

**Single Channel**

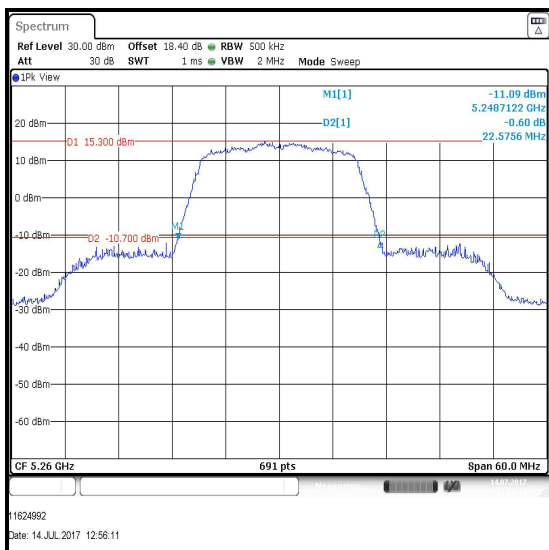
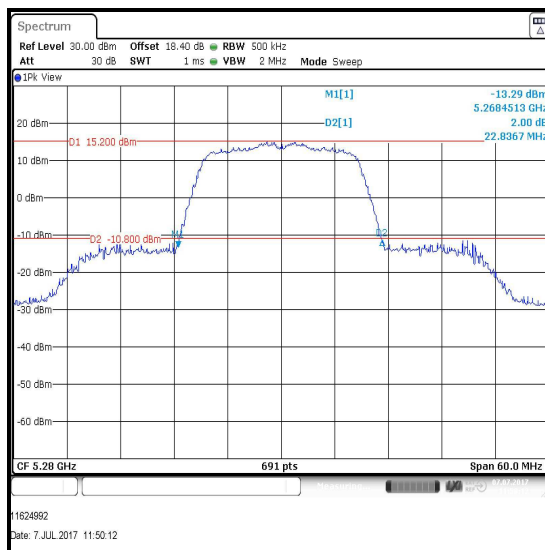
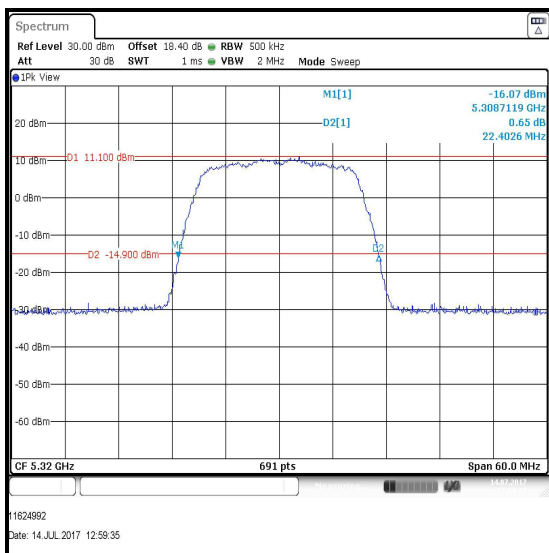
**Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)****4.2.2 5.25-5.35 GHz band****Results: 802.11a / 20 MHz / SISO / BPSK / 6 Mbit/s / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5260	22.229
Middle	5280	22.142
Top	5320	22.316

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

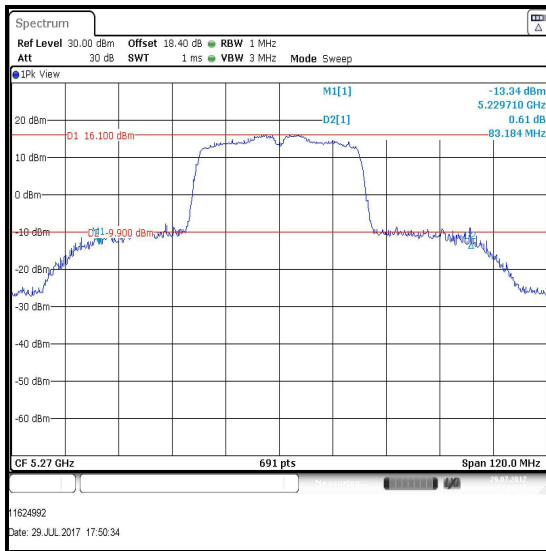
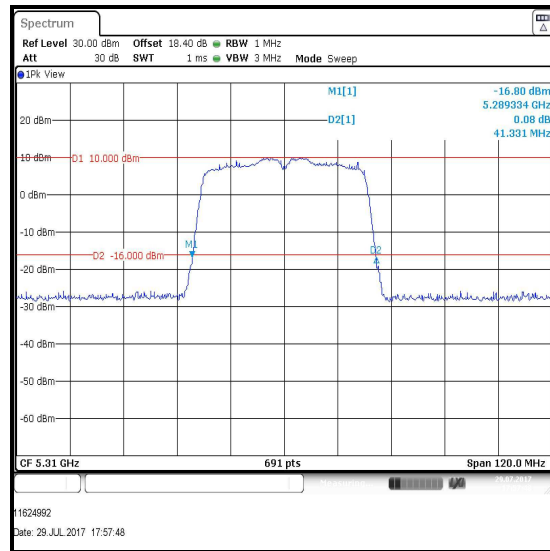
**Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)****Results: 802.11n / 20 MHz / SISO / BPSK / MCS0 / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5260	22.576
Middle	5280	22.837
Top	5320	22.403

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

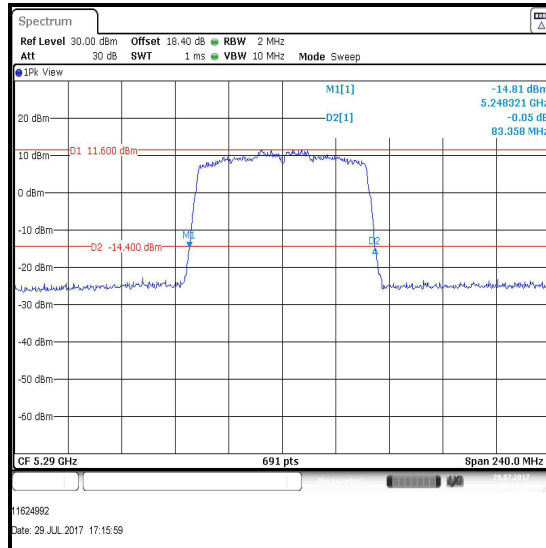
**Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)****Results: 802.11n / 40 MHz / SISO / BPSK / MCS0 / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Bottom	5270	83.184
Top	5310	41.331

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

**Transmitter 26 dB Emission Bandwidth (5.25-5.35 GHz band) (continued)****Results: 802.11ac / 80 MHz / SISO / BPSK / MCS0x1 / Port 1**

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)
Single	5290	83.358

**Single Channel**