



# TEST REPORT

**Test Report No. :** UL-RPT-RP11618100JD02A V2.0

**Manufacturer** : Dataflex Design Communications Ltd  
**Model No.** : H604V4  
**FCC ID** : 2AASBH604V4  
**Technology** : WLAN  
**Test Standard(s)** : FCC Parts 15.207, 15.209(a), 15.403 & 15.407

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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:** 13 October 2017

**Checked by:**

Ian Watch  
Senior Test Engineer, Radio Laboratory

**Company Signatory:**

Sarah Williams  
Senior Test Engineer, Radio Laboratory  
UL VS LTD



This laboratory is accredited by UKAS.  
The tests reported herein have been  
performed in accordance with its terms  
of accreditation.

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**Customer Information**

|                      |                                                                                                     |
|----------------------|-----------------------------------------------------------------------------------------------------|
| <b>Company Name:</b> | Dataflex Design Communications Ltd                                                                  |
| <b>Address:</b>      | 8 Frederick Sanger Road<br>Surrey Research Park<br>Guildford<br>Surrey<br>GU2 7YD<br>United Kingdom |

## **Summary of Testing**

### **General Information**

|                                 |                                                                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Specification Reference:</b> | 47CFR15.407 and 47CFR15.403                                                                                                                                               |
| <b>Specification Title:</b>     | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) –<br>Sections 15.403 and 15.407 |
| <b>Specification Reference:</b> | 47CFR15.207 and 47CFR15.209                                                                                                                                               |
| <b>Specification Title:</b>     | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209                                     |
| <b>Site Registration:</b>       | 209735                                                                                                                                                                    |
| <b>Location of Testing:</b>     | UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park,<br>Basingstoke, Hampshire, RG24 8AH, United Kingdom                                                        |
| <b>Test Dates:</b>              | 05 June 2017 to 18 August 2017                                                                                                                                            |

**Summary of Test Results**

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

**Note(s):**

1. The measurement was performed to assist in the calculation of the level of average output power, power spectral density, peak excursion and emissions as the EUT does not operate at 100% duty cycle.
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).

**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<br>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                                                                                                                       |
| <b>Reference:</b> | KDB 174176 D01 Line Conducted FAQ v01r01    June 3, 2015                                                                                                                                      |
| <b>Title:</b>     | AC Power-Line Conducted Emissions Frequently Asked Questions                                                                                                                                  |
| <b>Reference:</b> | KDB 905462 D02 U-NII DFS Compliance Procedures v02    April 8, 2016                                                                                                                           |
| <b>Title:</b>     | Compliance Measurement Procedures For Unlicensed-National Information Infrastructure Devices Operating in the 5250-5350 MHz and 5470-5725 MHz Bands Incorporating Dynamic Frequency Selection |

**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.

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

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

|                                   |                      |
|-----------------------------------|----------------------|
| <b>Brand Name:</b>                | Hera 604             |
| <b>Model Name or Number:</b>      | H604V4               |
| <b>Test Sample Serial Number:</b> | 04423851816340100265 |
| <b>Hardware Version:</b>          | EPCB238002           |
| <b>Software Version:</b>          | 1.1.0                |
| <b>FCC ID:</b>                    | 2AASBH604V4          |

### **Description of EUT**

The Equipment Under Test was an M2M indoor router. It supports 802.11a/n in the 5.15 GHz to 5.25 GHz, and 5.725 GHz to 5.850 GHz bands. The WLAN radio has two identical external antennas of 2.0 dBi gain with reverse SMA connectors. The device supports 5 GHz SISO or MIMO operation with either single-stream CDD or multi-stream SDM operation.

The EUT additionally has a GSM/GPRS/EDGE/CDMA/UMTS HSPA/LTE cellular radio (FCC ID: N7NMC7355) connected to a second pair of antennas.

It also features Ethernet and RS-232 serial I/O.

### **Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.

**Additional Information Related to Testing**

|                                 |                               |                                                                                                                                     |                         |            |
|---------------------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------|
| Technology Tested:              | WLAN (IEEE 802.11a,n) / U-NII |                                                                                                                                     |                         |            |
| Type of Unit:                   | Transceiver                   |                                                                                                                                     |                         |            |
| Modulation:                     | BPSK, QPSK, 16QAM & 64QAM     |                                                                                                                                     |                         |            |
| Data rates:                     | 802.11a                       | 6, 9, 12, 18, 24, 36 ,48 & 54 Mbit/s (SISO, or MIMO with CDD)                                                                       |                         |            |
|                                 | 802.11n HT20                  | MCS0 to MCS7 (1 spatial stream) with or without CDD / (SISO, or MIMO with CDD/STBC)<br>MCS8 to MCS15 (2 spatial streams) (MIMO SDM) |                         |            |
|                                 | 802.11n HT40                  | MCS0 to MCS7 with or without CDD / (SISO, or MIMO with CDD/STBC)<br>MCS8 to MCS15 (MIMO SDM)                                        |                         |            |
| Power Supply Requirement(s):    | Nominal                       | 12 VDC via 120 VAC 60 Hz adaptor                                                                                                    |                         |            |
| Antenna Gains:                  | Frequency (GHz)               | Wi-Fi ANT 1                                                                                                                         | Wi-Fi ANT 2             | Array Gain |
|                                 | 5.15 to 5.25 GHz              | 2.0 dBi                                                                                                                             | 2.0 dBi                 | 3 dB       |
|                                 | 5.725 to 5.85 GHz             | 2.0 dBi                                                                                                                             | 2.0 dBi                 | 3 dB       |
| Maximum Conducted Output Power: | 20 MHz                        | 22.3 dBm                                                                                                                            |                         |            |
|                                 | 40 MHz                        | 21.3 dBm                                                                                                                            |                         |            |
| Channel Spacing:                | 20 MHz                        |                                                                                                                                     |                         |            |
| Transmit Frequency Band:        | 5150 MHz to 5250 MHz          |                                                                                                                                     |                         |            |
| Transmit Channels Tested:       | Channel ID                    | Channel Number                                                                                                                      | Channel Frequency (MHz) |            |
|                                 | Bottom                        | 36                                                                                                                                  | 5180                    |            |
|                                 | Middle                        | 40                                                                                                                                  | 5200                    |            |
|                                 | Top                           | 48                                                                                                                                  | 5240                    |            |
| Transmit Frequency Band:        | 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)**

|                                  |                      |                       |                                |
|----------------------------------|----------------------|-----------------------|--------------------------------|
| <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               | 151                   | 5755                           |
|                                  | Top                  | 159                   | 5795                           |

**Support Equipment**

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

|                              |                                 |
|------------------------------|---------------------------------|
| <b>Description:</b>          | 120 VAC to 12 VDC Power Adaptor |
| <b>Brand Name:</b>           | Power Solve                     |
| <b>Model Name or Number:</b> | FJ-SW1201250N                   |
| <b>Serial Number:</b>        | Not marked or stated            |

|                              |                          |
|------------------------------|--------------------------|
| <b>Description:</b>          | Laptop PC                |
| <b>Brand Name:</b>           | Dell                     |
| <b>Model Name or Number:</b> | Precision M65            |
| <b>Serial Number:</b>        | CN-03F242-48643-66F-0462 |

|                              |                                              |
|------------------------------|----------------------------------------------|
| <b>Description:</b>          | Ethernet cables. Quantity 4. Length 2 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                         |

|                              |                                  |
|------------------------------|----------------------------------|
| <b>Description:</b>          | Ethernet cable. Length 10 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             |

|                              |                                         |
|------------------------------|-----------------------------------------|
| <b>Description:</b>          | RJ45 cable. Quantity 2. Length 2 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                    |

|                              |                                                 |
|------------------------------|-------------------------------------------------|
| <b>Description:</b>          | Serial to USB cable. Quantity 2. Length 1 metre |
| <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                            |

|                              |                                  |
|------------------------------|----------------------------------|
| <b>Description:</b>          | Wireless -G ADSL Gateway         |
| <b>Brand Name:</b>           | Linksys                          |
| <b>Model Name or Number:</b> | WAG54G                           |
| <b>Serial Number:</b>        | CF61E100799 (UL Asset No. A2986) |

**Support Equipment (continued)**

|                              |                      |
|------------------------------|----------------------|
| <b>Description:</b>          | USB Hub              |
| <b>Brand Name:</b>           | Hama                 |
| <b>Model Name or Number:</b> | 00078498             |
| <b>Serial Number:</b>        | Not marked or stated |

**Antenna**

The table below lists the antennas that the manufacturer intends to use with this product when operating in the 5150 to 5250 MHz & 5725 to 5850 MHz bands. It additionally shows the cellular antennas utilised on their respective ports:

| Type           | Stated Gain (dBi) | Manufacturer                         | Antenna Name     | Used for Testing | Note |
|----------------|-------------------|--------------------------------------|------------------|------------------|------|
| AN2450-5505BRS | 2.0               | Cortec                               | WLAN Antennas    | X                | 1    |
| Q9018-24W      | 3 to 5            | Asian Creation Communication Co. Ltd | Primary cellular | X                | 2,3  |
| GA-GSM-06      | 3.5               | Gantetech                            | RX diversity     | X                | 2,4  |

X = This antenna was used for testing purposes

**Note(s):**

1. WLAN antennas to be used in final product deployment and connected for radiated emission measurements contained herein.
2. Used for termination of all ports.
3. Cellular primary antenna. Antenna gain is different depending on what band is being used.
4. Cellular receiver diversity antenna.

## **Operation and Monitoring of the EUT during Testing**

### **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 using a bespoke application on the laptop PC supplied by the customer. The application was used to enable continuous transmission and receive modes and to select the test channels, data rates and modulation schemes as required. The instructions were called '*HERA600v4\_Notes\_for\_configuring\_test\_modes.docx*' dated 28 June 2017.
- All supported modes and channel widths were initially investigated on the middle channel of each band of operation. The modes that produced the highest power and widest bandwidth for all bands were:
  - o Highest power
    - U-NII-1
      - 802.11a SISO – Antenna Wi-Fi 1 / 48 Mbit/s
      - 802.11n HT20 SISO – Antenna Wi-Fi 1 / 52 Mbit/s / MCS5
      - 802.11n HT40 SISO – Antenna Wi-Fi 2 / 81 Mbit/s / MCS4
      - 802.11a MIMO with CDD - 6 Mbit/s
      - 802.11n HT20 MIMO with CDD – 52 Mbit/s / MCS5
      - 802.11n HT40 MIMO with CDD – 81 Mbit/s / MCS4
    - U-NII-3
      - 802.11a SISO – Antenna Wi-Fi 1 / 12 Mbit/s
      - 802.11n HT20 SISO – Antenna Wi-Fi 1 / 19.5 Mbit/s / MCS2
      - 802.11n HT40 SISO – Antenna Wi-Fi 1 / 40.5 Mbit/s / MCS2
      - 802.11a MIMO with CDD – 9 Mbit/s
      - 802.11n HT20 MIMO with CDD – 26 Mbit/s / MCS3
      - 802.11n HT40 MIMO with CDD – 27 Mbit/s / MCS1
  - o Highest power spectral density
    - U-NII-1
      - 802.11a SISO – Antenna Wi-Fi 2 / 6 Mbit/s
      - 802.11n HT20 SISO – Antenna Wi-Fi 1 / 6.5 Mbit/s / MCS0
      - 802.11n HT40 SISO – Antenna Wi-Fi 2 / 40.5 Mbit/s / MCS2
      - 802.11a MIMO with CDD – 48 Mbit/s
      - 802.11n HT20 MIMO with CDD – 26 Mbit/s / MCS3
      - 802.11n HT40 MIMO with CDD – 81 Mbit/s / MCS4

**Configuration and Peripherals (continued)**

- U-NII-3
  - 802.11a - SISO Antenna Wi-Fi 2 / 6 Mbit/s
  - 802.11n HT20 SISO – Antenna Wi-Fi 1 / 6.5 Mbit/s / MCS0
  - 802.11n HT40 SISO – Antenna Wi-Fi 2 / 54 Mbit/s / MCS3
  - 802.11a MIMO with CDD – 9 Mbit/s
  - 802.11n HT20 MIMO with CDD – 6.5 Mbit/s / MCS0
  - 802.11n HT40 MIMO with CDD – 54 Mbit/s / MCS3
- o Widest 26 dB bandwidth
  - U-NII-1
    - 802.11a – SISO Antenna Wi-Fi 2 / 9 Mbit/s
    - 802.11n HT20 SISO – Antenna Wi-Fi 2 / 6.5 Mbit/s / MCS0
    - 802.11n HT40 SISO – Antenna Wi-Fi 2 / 13.5 Mbit/s / MCS0
    - 802.11a MIMO with CDD – 9 Mbit/s
    - 802.11n HT20 MIMO with CDD – 6.5 Mbit/s / MCS0
    - 802.11n HT40 MIMO with CDD – 13.5 Mbit/s / MCS0
  - U-NII-3
    - 802.11a SISO – Antenna Wi-Fi 2 / 9 Mbit/s
    - 802.11n HT20 SISO – Antenna Wi-Fi 2 / 6.5 Mbit/s / MCS0
    - 802.11n HT40 SISO – Antenna Wi-Fi 2 / 13.5 Mbit/s / MCS0
    - 802.11a MIMO with CDD – 9 Mbit/s
    - 802.11n HT20 MIMO with CDD – 6.5 Mbit/s / MCS0
    - 802.11n HT40 MIMO with CDD – 13.5 Mbit/s / MCS0

Pre-scan results for all modes are archived on the UL VS LTD IT server and available for inspection if required.

- All supported modes and channel widths were initially investigated on the middle channel of the the 5725 to 5850 MHz band. The modes that produced the narrowest bandwidth for the 5725 to 5850 MHz band were:
  - o Narrowest bandwidth
    - U-NII-3
      - 802.11a SISO – BPSK / 6 Mbit/s
      - 802.11n HT20 SISO – QPSK / 13 Mbit/s / MCS1
      - 802.11n HT40 SISO – BPSK / 13.5 Mbit/s / MCS0
      - 802.11a MIMO with CDD – BPSK / 6 Mbit/s / Port Wi-Fi 1
      - 802.11a MIMO with CDD – QPSK / 12 Mbit/s / Port Wi-Fi 2
      - 802.11n HT20 MIMO with CDD – BPSK / 13 Mbit/s / MCS1
      - 802.11n HT40 MIMO with CDD – BPSK / 13.5 Mbit/s / MCS0

**Configuration and Peripherals (continued)**

- The EUT has two separate MIMO named 'Wi-Fi 1' and 'Wi-Fi 2'. These support using both transmit chains for single-stream operation with CDD, both transmit chains for 2-stream SDM modes, or SISO operation on either single port individually.
- RF cables and attenuators connecting the test equipment to the EUT were calibrated before use and the calibration data incorporated into the conducted measurement results.
- Transmitter spurious emissions were performed with the EUT transmitting with a data rate of 9 Mbit/s MIMO (802.11a). This was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and, as this mode emits the highest transmit output power level, it was deemed to be the worst case.
- Transmitter radiated spurious emissions tests were performed with the EUT in the orientation stated below as they were found to be the worst case during pre-scans. All the accessories were individually connected and measurements made during the pre-scans to determine the worst case combination.
  - o Below 1 GHz
    - In the X-Axis (The EUT was horizontal positioned on its side with the antennas pointing straight at the measurement antenna).
  - o Above 1 GHz
    - In the Z-Axis (on its back with the antennas pointing straight at the measurement antenna).
- Radiated band edge emissions were performed with the EUT and its antennas in the following orientation as this procedure the worst case position for band edge:
  - o U-NII-1
    - SISO – Z Axis. The EUT was positioned on its back with the antennas at a right angle point up to the chamber ceiling.
    - MIMO – X Axis. The EUT was horizontal positioned on its side with the antennas pointing straight at the receiving antenna.
  - o U-NII-3
    - SISO / MIMO – Z Axis. The EUT was positioned on its back with the antennas pointing straight at the receiving antenna.
- All active ports were terminated with the appropriate termination.

## **Measurements, Examinations and Derived Results**

### **General Comments**

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6 Measurement Uncertainty* for details.

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

**Test Results****Transmitter AC Conducted Spurious Emissions****Test Summary:**

|                                   |                      |                   |              |
|-----------------------------------|----------------------|-------------------|--------------|
| <b>Test Engineer:</b>             | Andrew Edwards       | <b>Test Date:</b> | 26 June 2017 |
| <b>Test Sample Serial Number:</b> | 04423851816340100265 |                   |              |

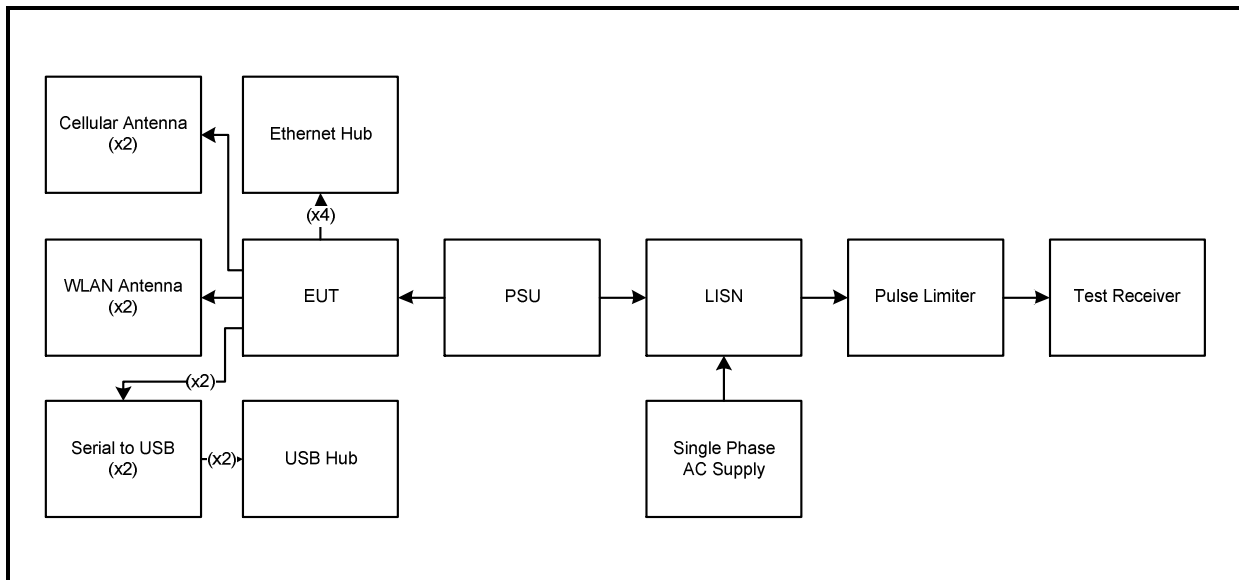
|                          |                                                          |
|--------------------------|----------------------------------------------------------|
| <b>FCC Reference:</b>    | Part 15.207                                              |
| <b>Test Method Used:</b> | ANSI C63.10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

**Environmental Conditions:**

|                               |    |
|-------------------------------|----|
| <b>Temperature (°C):</b>      | 24 |
| <b>Relative Humidity (%):</b> | 50 |

**Note(s):**

1. The EUT was connected to a 120 VAC 60 Hz single phase supply via a LISN.
2. In accordance with FCC KDB 174176 Q4, tests were performed with a 240 VAC 60 Hz single phase supply as this was within the voltage range marked on the power adaptor.
3. A pulse limiter was fitted between the LISN and the test receiver.
4. Pre-scans were performed and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.

**Test setup:**

**Transmitter AC Conducted Spurious Emissions (continued)****Results: Live / Quasi Peak / 120 VAC 60 Hz**

| Frequency (MHz) | Line | Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|------|--------------|--------------|-------------|----------|
| 0.150           | Live | 50.3         | 66.0         | 15.7        | Complied |
| 0.276           | Live | 39.4         | 60.9         | 21.5        | Complied |
| 0.416           | Live | 41.1         | 57.5         | 16.4        | Complied |
| 0.546           | Live | 32.8         | 56.0         | 23.2        | Complied |
| 0.762           | Live | 33.6         | 56.0         | 22.4        | Complied |
| 15.252          | Live | 33.0         | 60.0         | 27.0        | Complied |

**Results: Live / Average / 120 VAC 60 Hz**

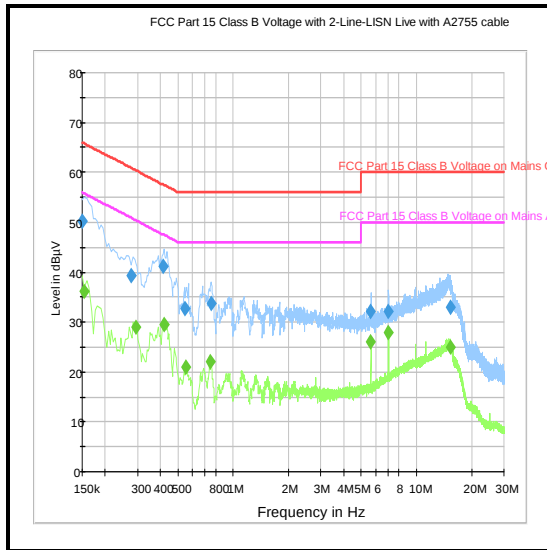
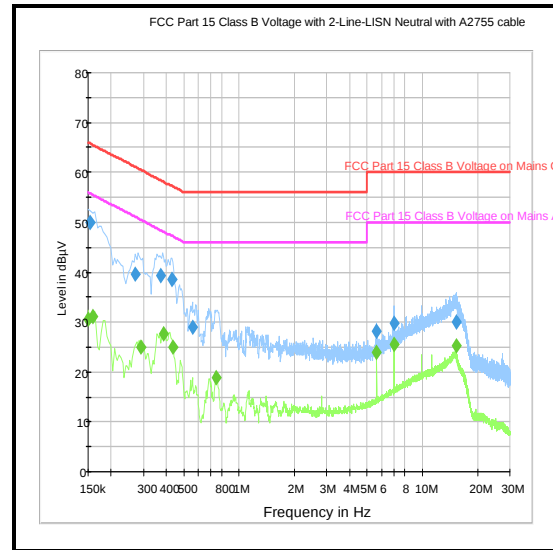
| Frequency (MHz) | Line | Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|------|--------------|--------------|-------------|----------|
| 0.155           | Live | 36.3         | 55.8         | 19.5        | Complied |
| 0.294           | Live | 28.9         | 50.4         | 21.5        | Complied |
| 0.420           | Live | 29.5         | 47.4         | 17.9        | Complied |
| 0.551           | Live | 21.1         | 46.0         | 24.9        | Complied |
| 0.753           | Live | 22.1         | 46.0         | 23.9        | Complied |
| 7.031           | Live | 28.0         | 50.0         | 22.0        | Complied |

**Results: Neutral / Quasi Peak / 120 VAC 60 Hz**

| Frequency (MHz) | Line    | Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|---------|--------------|--------------|-------------|----------|
| 0.155           | Neutral | 50.0         | 65.8         | 15.8        | Complied |
| 0.272           | Neutral | 39.7         | 61.1         | 21.4        | Complied |
| 0.375           | Neutral | 39.4         | 58.4         | 19.0        | Complied |
| 0.429           | Neutral | 38.6         | 57.3         | 18.7        | Complied |
| 0.555           | Neutral | 28.8         | 56.0         | 27.2        | Complied |
| 15.248          | Neutral | 30.0         | 60.0         | 30.0        | Complied |

**Results: Neutral / Average / 120 VAC 60 Hz**

| Frequency (MHz) | Line    | Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|---------|--------------|--------------|-------------|----------|
| 0.150           | Neutral | 30.6         | 56.0         | 25.4        | Complied |
| 0.159           | Neutral | 31.2         | 55.5         | 24.3        | Complied |
| 0.389           | Neutral | 27.6         | 48.1         | 20.5        | Complied |
| 0.434           | Neutral | 25.0         | 47.2         | 22.2        | Complied |
| 7.031           | Neutral | 25.5         | 50.0         | 24.5        | Complied |
| 15.212          | Neutral | 25.2         | 50.0         | 24.8        | Complied |

**Transmitter AC Conducted Spurious Emissions (continued)****Results: 120 VAC 60 Hz****Live****Neutral**

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

**Transmitter AC Conducted Spurious Emissions (continued)****Results: Live / Quasi Peak / 240 VAC 60 Hz**

| Frequency (MHz) | Line | Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|------|--------------|--------------|-------------|----------|
| 0.159           | Live | 49.6         | 65.5         | 15.9        | Complied |
| 0.258           | Live | 45.3         | 61.5         | 16.2        | Complied |
| 0.438           | Live | 44.5         | 57.1         | 12.6        | Complied |
| 0.623           | Live | 37.5         | 56.0         | 18.5        | Complied |
| 0.929           | Live | 35.9         | 56.0         | 20.1        | Complied |
| 1.352           | Live | 35.8         | 56.0         | 20.2        | Complied |

**Results: Live / Average / 240 VAC 60 Hz**

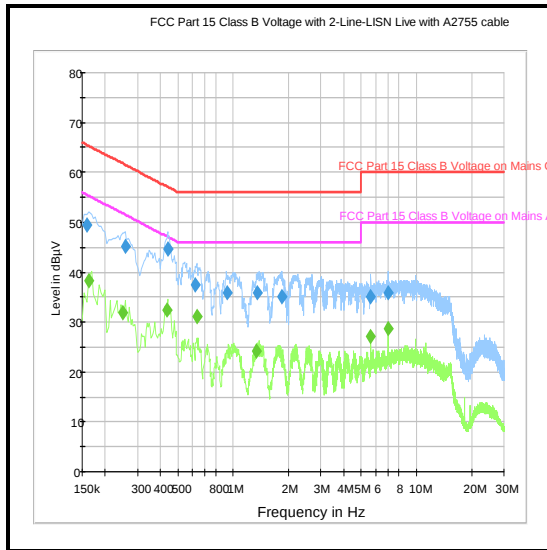
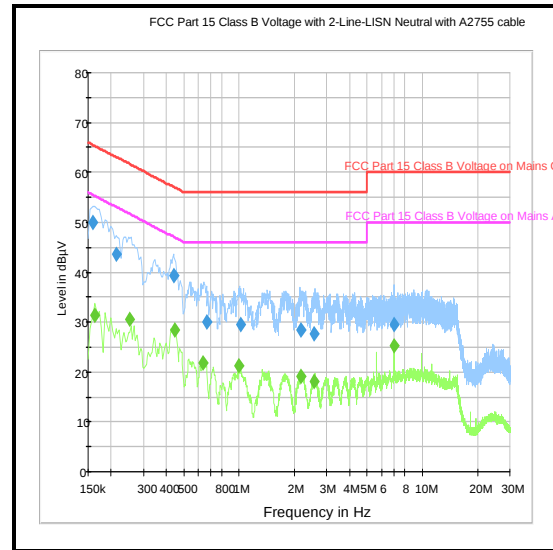
| Frequency (MHz) | Line | Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|------|--------------|--------------|-------------|----------|
| 0.164           | Live | 38.3         | 55.3         | 17.0        | Complied |
| 0.249           | Live | 31.9         | 51.8         | 19.9        | Complied |
| 0.434           | Live | 32.4         | 47.2         | 14.8        | Complied |
| 0.636           | Live | 31.1         | 46.0         | 14.9        | Complied |
| 1.343           | Live | 24.1         | 46.0         | 21.9        | Complied |
| 7.026           | Live | 28.6         | 50.0         | 21.4        | Complied |

**Results: Neutral / Quasi Peak / 240 VAC 60 Hz**

| Frequency (MHz) | Line    | Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|---------|--------------|--------------|-------------|----------|
| 0.159           | Neutral | 50.1         | 65.5         | 15.4        | Complied |
| 0.213           | Neutral | 43.7         | 63.1         | 19.4        | Complied |
| 0.438           | Neutral | 39.4         | 57.1         | 17.7        | Complied |
| 0.668           | Neutral | 30.0         | 56.0         | 26.0        | Complied |
| 1.014           | Neutral | 29.4         | 56.0         | 26.6        | Complied |
| 2.184           | Neutral | 28.5         | 56.0         | 27.5        | Complied |

**Results: Neutral / Average / 240 VAC 60 Hz**

| Frequency (MHz) | Line    | Level (dBμV) | Limit (dBμV) | Margin (dB) | Result   |
|-----------------|---------|--------------|--------------|-------------|----------|
| 0.164           | Neutral | 31.3         | 55.3         | 24.0        | Complied |
| 0.254           | Neutral | 30.7         | 51.6         | 20.9        | Complied |
| 0.447           | Neutral | 28.5         | 46.9         | 18.4        | Complied |
| 0.636           | Neutral | 21.9         | 46.0         | 24.1        | Complied |
| 1.001           | Neutral | 21.3         | 46.0         | 24.7        | Complied |
| 7.026           | Neutral | 25.3         | 50.0         | 24.7        | Complied |

**Transmitter AC Conducted Spurious Emissions (continued)****Results: 240 VAC 60 Hz****Live****Neutral**

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

**Test Equipment Used:**

| Asset No. | Instrument       | Manufacturer    | Type No.      | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|-----------|------------------|-----------------|---------------|------------|----------------------|------------------------|
| M2013     | Thermohygrometer | Testo           | 608-H1        | 45046419   | 20 Jun 2018          | 12                     |
| M1263     | Test Receiver    | Rohde & Schwarz | ESIB7         | 100265     | 07 Nov 2017          | 12                     |
| A649      | LISN             | Rohde & Schwarz | ESH3-Z5       | 825562/008 | 09 Aug 2017          | 12                     |
| A1830     | Pulse Limiter    | Rohde & Schwarz | ESH3-Z2       | 100668     | 09 May 2018          | 12                     |
| M1818     | Multimeter       | Fluke           | 79 Series III | 71811580   | 12 Apr 2018          | 12                     |

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

|                                   |                      |                    |                                   |
|-----------------------------------|----------------------|--------------------|-----------------------------------|
| <b>Test Engineer:</b>             | Philip Harrison      | <b>Test Dates:</b> | 02 June 2017 to<br>18 August 2017 |
| <b>Test Sample Serial Number:</b> | 04423851816340100265 |                    |                                   |

|                          |                                |
|--------------------------|--------------------------------|
| <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>      | 20 to 24 |
| <b>Relative Humidity (%):</b> | 45 to 58 |

**Note(s):**

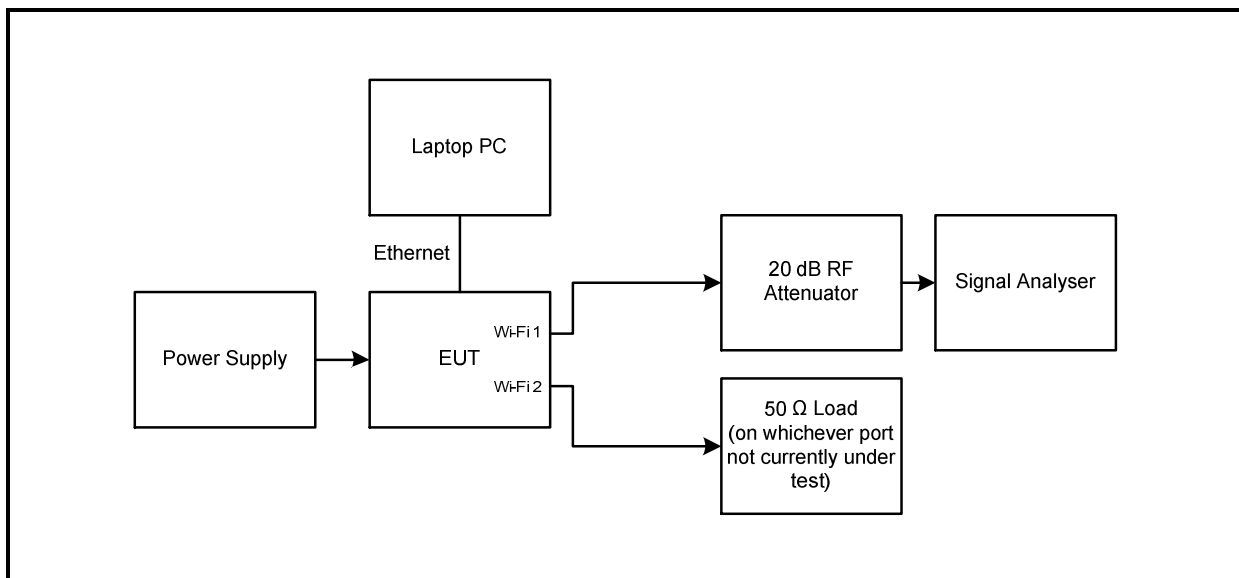
1. All configurations supported by the EUT were investigated on the middle channel of each band in accordance with KDB 789033 Section II.C.1. Emission Bandwidth (EBW) test procedure. The data rates that produced both the widest bandwidth and the highest powers when integrated over were then also tested on the bottom and top channels. The first results of this section details the EBW measurements found to result in the highest power levels. For the power measurements in this report, the highest power output level was recorded when the EUT was configured as:

- U-NII-1
  - o 802.11a SISO – Antenna Wi-Fi 1 / 48 Mbit/s
  - o 802.11n HT20 SISO – Antenna Wi-Fi 1 / 52 Mbit/s / MCS5
  - o 802.11n HT40 SISO – Antenna Wi-Fi 2 / 81 Mbit/s / MCS4
  - o 802.11a MIMO with CDD - 6 Mbit/s
  - o 802.11n HT20 MIMO with CDD – 52 Mbit/s / MCS5
  - o 802.11n HT40 MIMO with CDD – 81 Mbit/s / MCS4
- U-NII-3
  - o 802.11a SISO – Antenna Wi-Fi 1 / 12 Mbit/s
  - o 802.11n HT20 SISO – Antenna Wi-Fi 1 / 19.5 Mbit/s / MCS2
  - o 802.11n HT40 SISO – Antenna Wi-Fi 1 / 40.5 Mbit/s / MCS2
  - o 802.11a MIMO with CDD – 9 Mbit/s
  - o 802.11n HT20 MIMO with CDD – 26 Mbit/s / MCS3
  - o 802.11n HT40 MIMO with CDD – 27 Mbit/s / MCS1

**Transmitter 26 dB Emission Bandwidth (continued)****Note(s) (continued):**

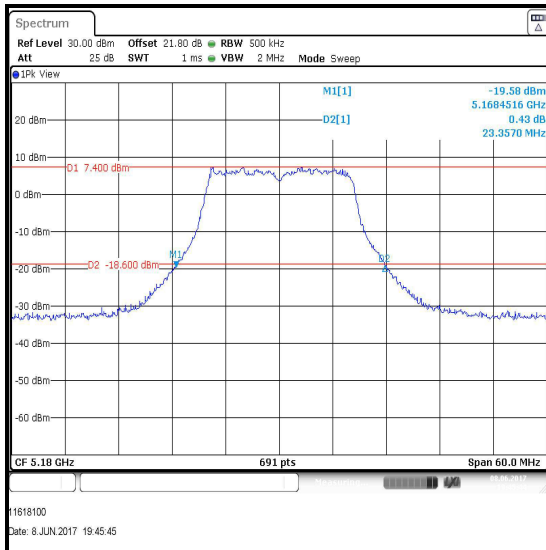
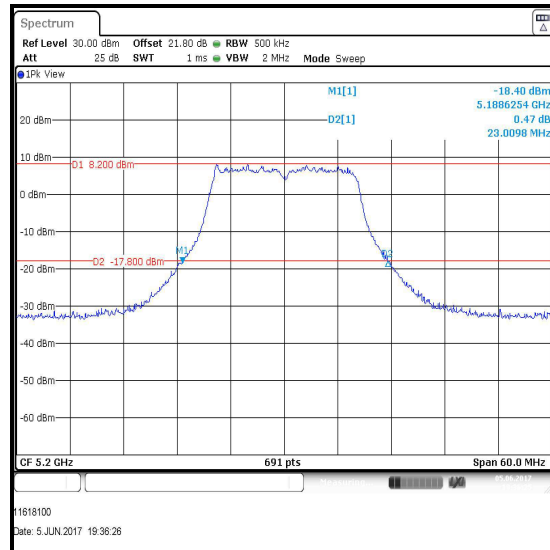
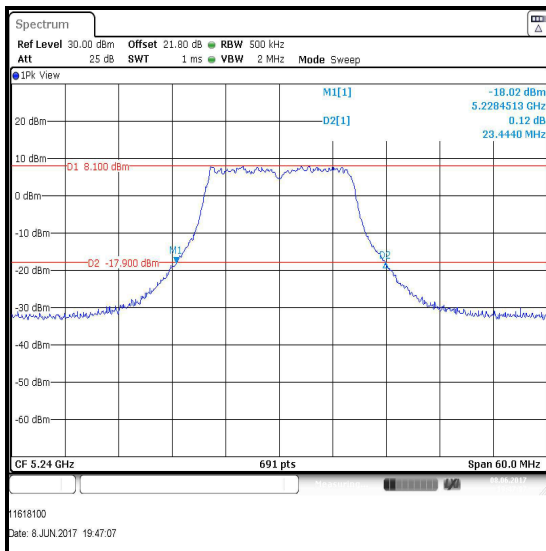
These are followed by the widest 26 dB bandwidths to show operation in-band with no additional DFS requirement. These were found to be:

- U-NII-1
    - o 802.11a – SISO Antenna Wi-Fi 2 / 9 Mbit/s
    - o 802.11n HT20 SISO – Antenna Wi-Fi 2 / 6.5 Mbit/s / MCS0
    - o 802.11n HT40 SISO – Antenna Wi-Fi 2 / 13.5 Mbit/s / MCS0
    - o 802.11a MIMO with CDD – 9 Mbit/s
    - o 802.11n HT20 MIMO with CDD – 6.5 Mbit/s / MCS0
    - o 802.11n HT40 MIMO with CDD – 13.5 Mbit/s / MCS0
  - U-NII-3
    - o 802.11a SISO – Antenna Wi-Fi 2 / 9 Mbit/s
    - o 802.11n HT20 SISO – Antenna Wi-Fi 2 / 6.5 Mbit/s / MCS0
    - o 802.11n HT40 SISO – Antenna Wi-Fi 2 / 13.5 Mbit/s / MCS0
    - o 802.11a MIMO with CDD – 9 Mbit/s
    - o 802.11n HT20 MIMO with CDD – 6.5 Mbit/s / MCS0
    - o 802.11n HT40 MIMO with CDD – 13.5 Mbit/s / MCS0
2. These widest 26 dB bandwidths fall into the 5.25-5.725 GHz band so DFS testing should be applicable. However, see the 99% Bandwidth results section for further details of DFS test requirements.
  3. Plots for all data rates are archived on the UL VS LTD IT server and available for inspection upon request.
  4. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

**Test setup:**

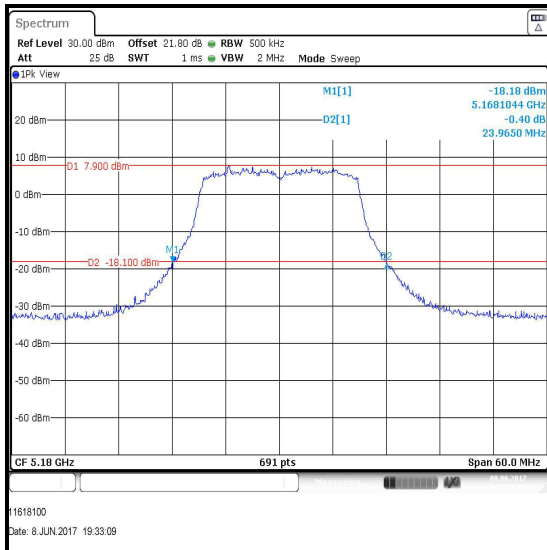
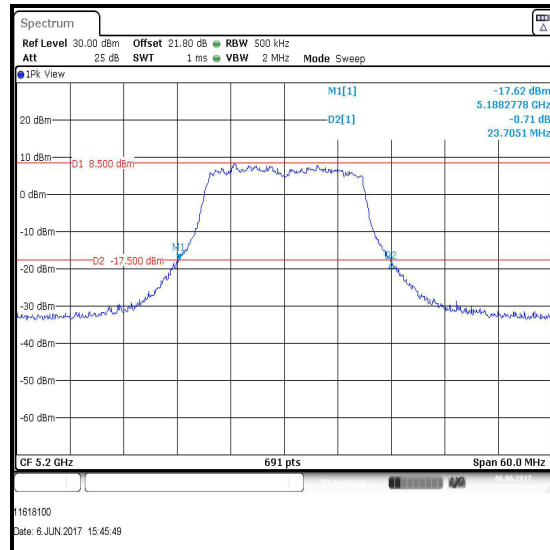
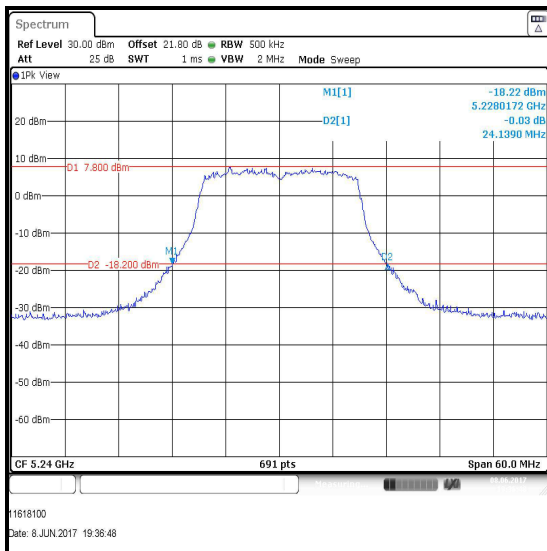
**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11a / 20 MHz / SISO / 5.15-5.25 GHz band / Port Wi-Fi 1**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5180            | 64-QAM            | 48                     | 23.357                         |
| Middle  | 5200            | 64-QAM            | 48                     | 23.010                         |
| Top     | 5240            | 64-QAM            | 48                     | 23.444                         |

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

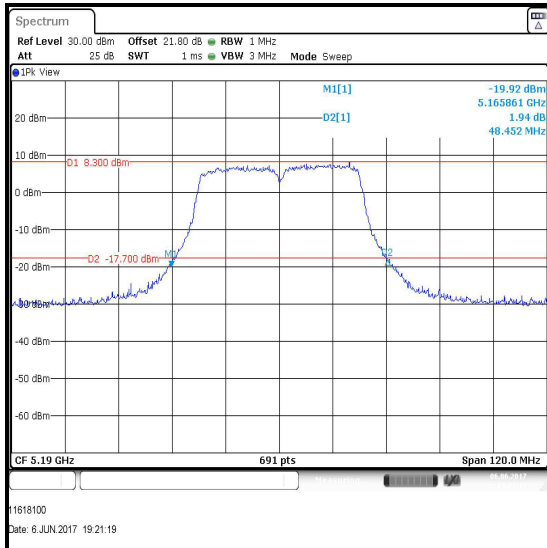
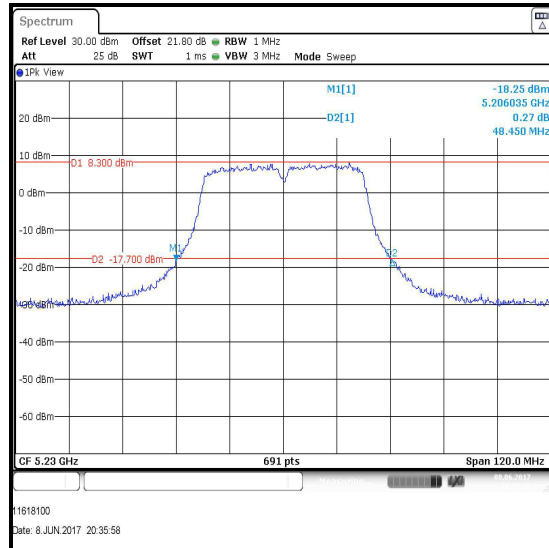
**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11n / 20 MHz / SISO / 5.15-5.25 GHz band / Port Wi-Fi 1**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5180            | 64-QAM            | MCS5                   | 23.965                         |
| Middle  | 5200            | 64-QAM            | MCS5                   | 23.705                         |
| Top     | 5240            | 64-QAM            | MCS5                   | 24.139                         |

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

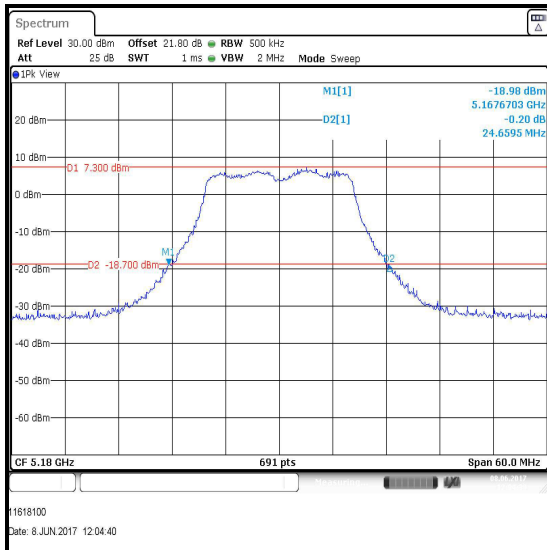
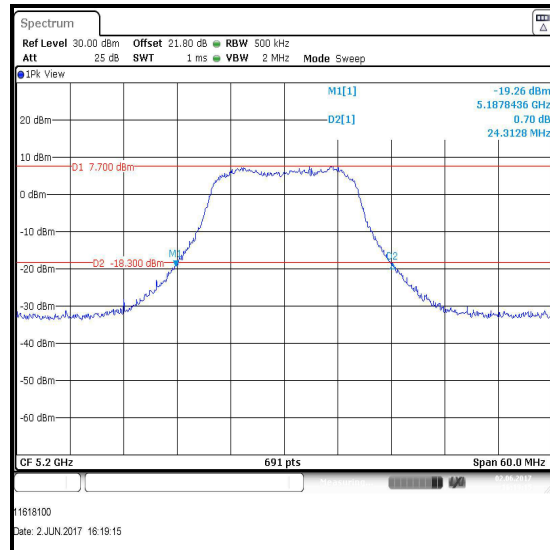
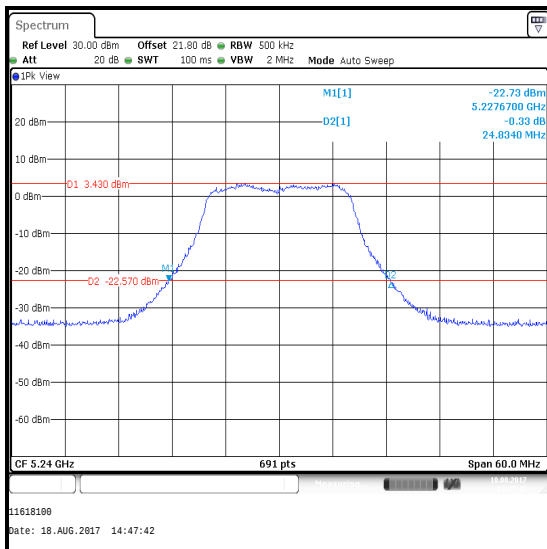
**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11n / 40 MHz / SISO / 5.15-5.25 GHz band / Port Wi-Fi 2**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5190            | 16-QAM            | MCS4                   | 48.452                         |
| Top     | 5230            | 16-QAM            | MCS4                   | 48.450                         |

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

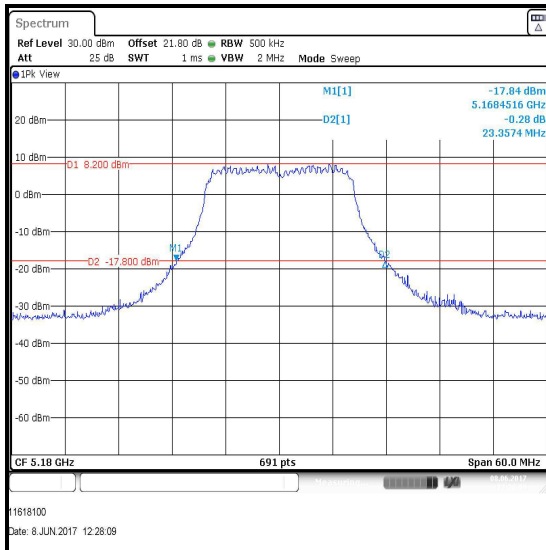
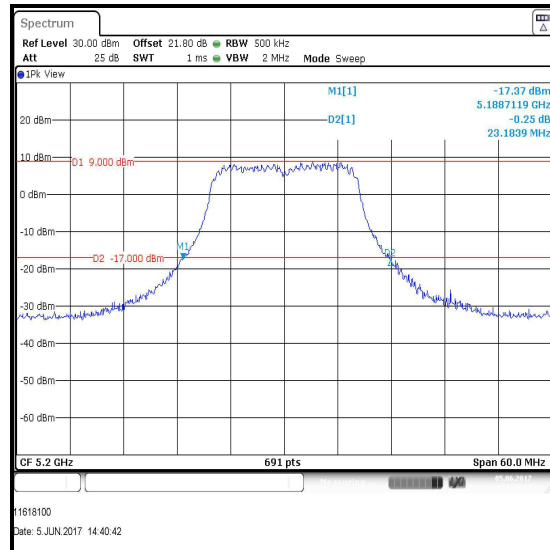
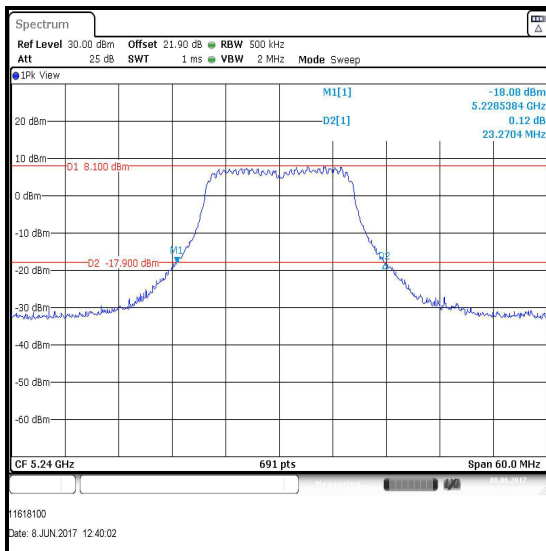
**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11a / 20 MHz / MIMO / 5.15-5.25 GHz band / Port Wi-Fi 1**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5180            | BPSK              | 6 Mbit/s               | 24.659                         |
| Middle  | 5200            | BPSK              | 6 Mbit/s               | 24.313                         |
| Top     | 5240            | BPSK              | 6 Mbit/s               | 24.834                         |

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

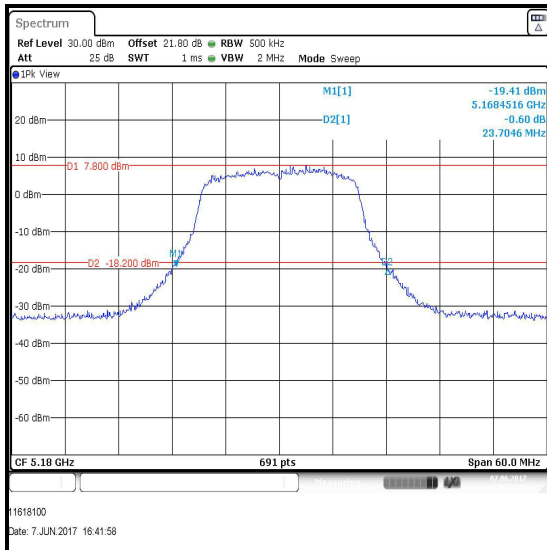
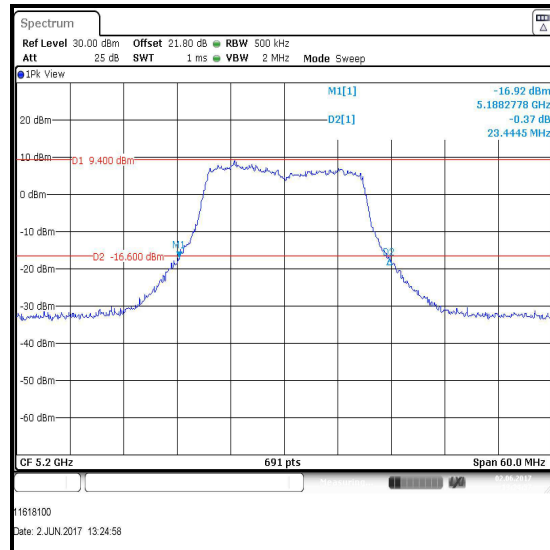
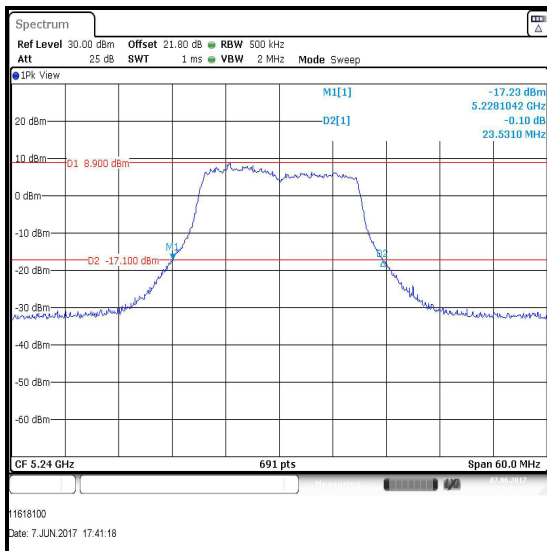
**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11a / 20 MHz / MIMO / 5.15-5.25 GHz band / Port Wi-Fi 2**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5180            | BPSK              | 6 Mbit/s               | 23.357                         |
| Middle  | 5200            | BPSK              | 6 Mbit/s               | 23.184                         |
| Top     | 5240            | BPSK              | 6 Mbit/s               | 23.270                         |

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

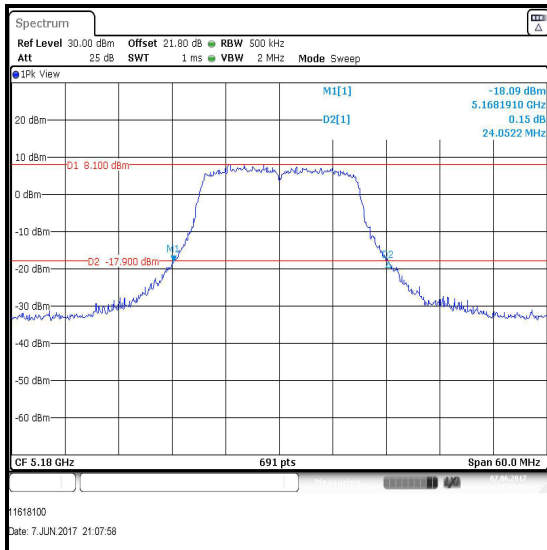
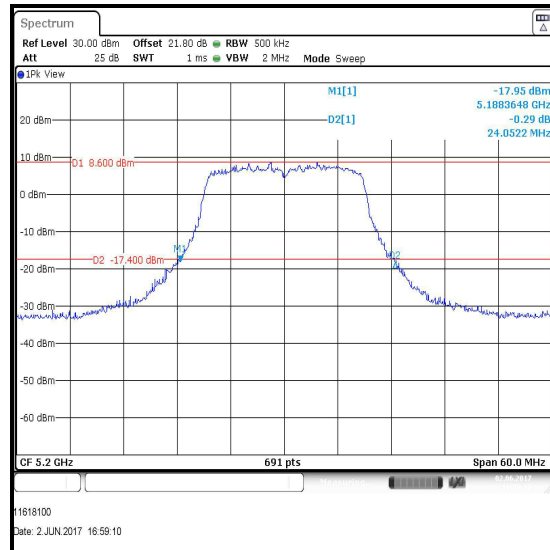
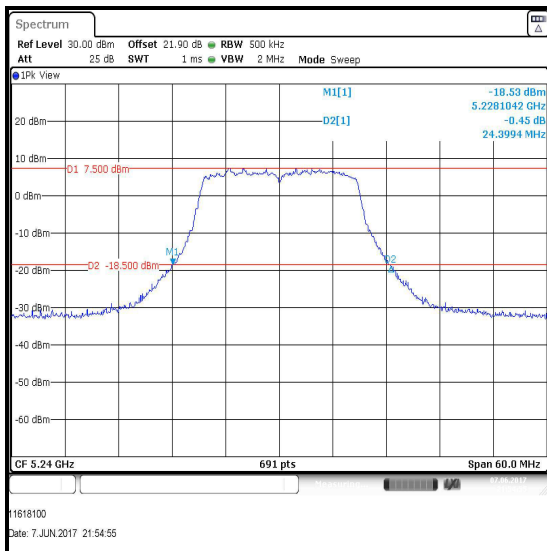
**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11n / 20 MHz / MIMO / 5.15-5.25 GHz band / Port Wi-Fi 1**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5180            | 64-QAM            | MCS5                   | 23.705                         |
| Middle  | 5200            | 64-QAM            | MCS5                   | 23.444                         |
| Top     | 5240            | 64-QAM            | MCS5                   | 23.531                         |

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

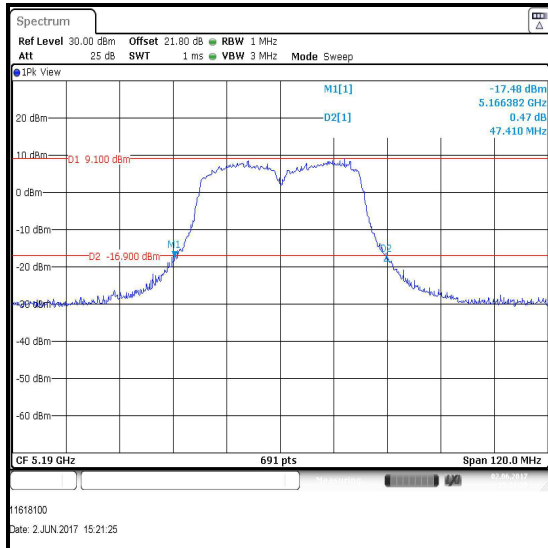
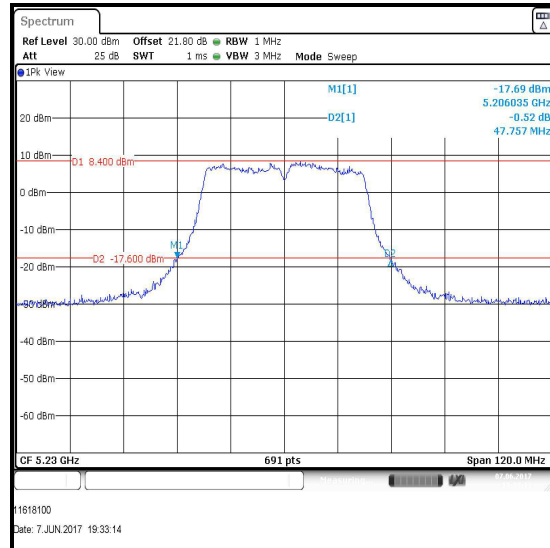
**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11n / 20 MHz / MIMO / 5.15-5.25 GHz band / Port Wi-Fi 2**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5180            | 64-QAM            | MCS5                   | 24.052                         |
| Middle  | 5200            | 64-QAM            | MCS5                   | 24.052                         |
| Top     | 5240            | 64-QAM            | MCS5                   | 24.399                         |

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

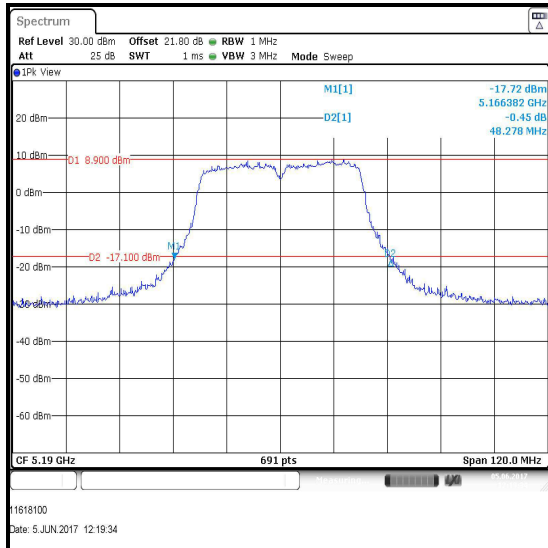
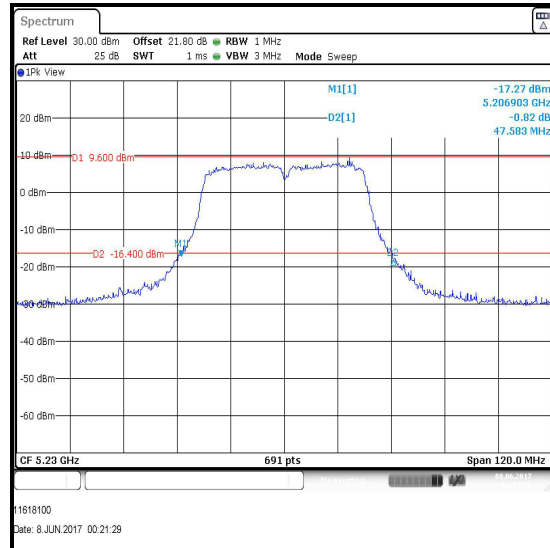
**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11n / 40 MHz / MIMO / 5.15-5.25 GHz band / Port Wi-Fi 1**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5190            | 16-QAM            | MCS4                   | 47.410                         |
| Top     | 5230            | 16-QAM            | MCS4                   | 47.757                         |

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

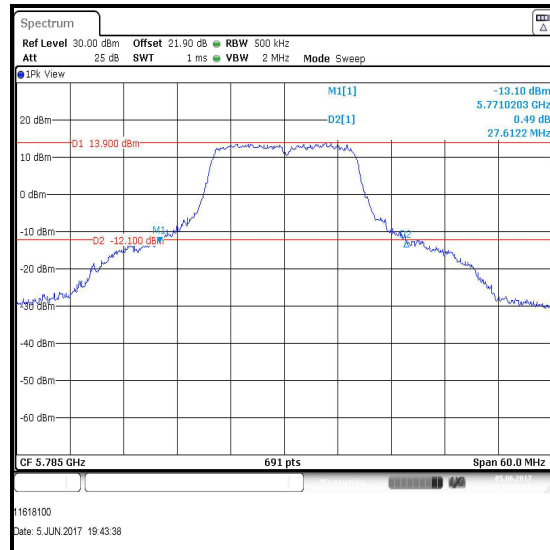
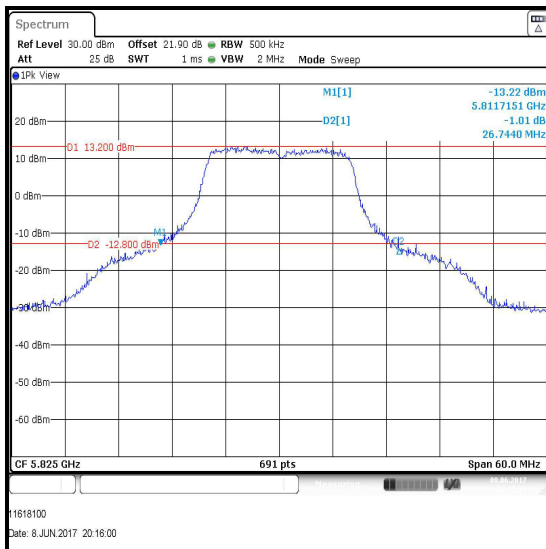
**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11n / 40 MHz / MIMO / 5.15-5.25 GHz band / Port Wi-Fi 2**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5190            | 16-QAM            | MCS4                   | 48.278                         |
| Top     | 5230            | 16-QAM            | MCS4                   | 47.583                         |

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

**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11a / 20 MHz / SISO / 5.725-5.85 GHz band / Port Wi-Fi 1**

| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5745            | QPSK              | 12 Mbit/s              | 29.349                         |
| Middle  | 5785            | QPSK              | 12 Mbit/s              | 27.612                         |
| Top     | 5825            | QPSK              | 12 Mbit/s              | 26.744                         |

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

**Transmitter 26 dB Emission Bandwidth (continued)****Results: 802.11n / 20 MHz / SISO / 5.725-5.85 GHz band / Port Wi-Fi 1**

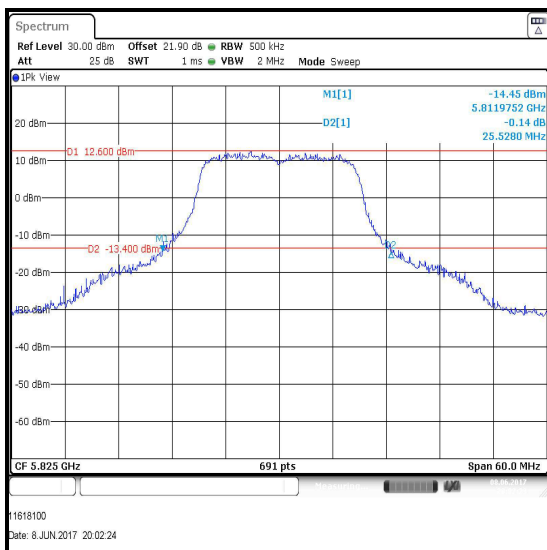
| Channel | Frequency (MHz) | Modulation scheme | Data Rate Mbit/s / MCS | 26 dB Emission Bandwidth (MHz) |
|---------|-----------------|-------------------|------------------------|--------------------------------|
| Bottom  | 5745            | QPSK              | MCS2                   | 31.693                         |
| Middle  | 5785            | QPSK              | MCS2                   | 26.917                         |
| Top     | 5825            | QPSK              | MCS2                   | 25.528                         |



Bottom Channel



Middle Channel



Top Channel