



# **TEST REPORT**

**Test Report No. :** UL-RPT-RP12505086JD09A

**Customer** : Apple Inc.  
**Model No.** : A2116  
**FCC ID** : BCGA2116  
**Technology** : WLAN  
**Test Standard(s)** : FCC Parts 15.209(a) & 15.247

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

1. This test report shall not be reproduced in full or partial, without the written approval of UL VS LTD.
2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 1.0

**Date of Issue:** 04 January 2019

**Checked by:**

Sarah Williams  
Senior Test Engineer, Radio Laboratory

**Company Signatory:**

Ben Mercer  
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

**Customer Information**

|                      |                                                             |
|----------------------|-------------------------------------------------------------|
| <b>Company Name:</b> | Apple Inc.                                                  |
| <b>Address:</b>      | One Apple Park Way<br>Cupertino, California 95014<br>U.S.A. |
| <b>Contact Name:</b> | Stuart Thomas                                               |

**Report Revision History**

| <b>Version Number</b> | <b>Issue Date</b> | <b>Revision Details</b> | <b>Revised By</b> |
|-----------------------|-------------------|-------------------------|-------------------|
| 1.0                   | 04/01/2019        | Initial Version         | Sarah Williams    |

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

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

The equipment under test was a desktop computer with WLAN and BT radios.

### **1.2. General Information**

|                                 |                                                                                                                           |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>Specification Reference:</b> | 47CFR15.247                                                                                                               |
| <b>Specification Title:</b>     | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart C (Intentional Radiators) - Section 15.247 |
| <b>Specification Reference:</b> | 47CFR15.209                                                                                                               |
| <b>Specification Title:</b>     | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart C (Intentional Radiators) - Section 15.209 |
| <b>Site Registration:</b>       | 621311                                                                                                                    |
| <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>              | 14 October 2018 to 10 December 2018                                                                                       |

### **1.3. Summary of Test Results**

| <b>FCC Reference (47CFR)</b> | <b>Measurement</b>                         | <b>Result</b> |
|------------------------------|--------------------------------------------|---------------|
| Part 15.35(c)                | Transmitter Duty Cycle                     | Note 1        |
| Part 15.247(a)(2)            | Transmitter Minimum 6 dB Bandwidth         | Complied      |
| Part 15.247(e)               | Transmitter Power Spectral Density         | Complied      |
| Part 15.247(b)(3)            | Transmitter Maximum (Average) Output Power | Complied      |
| Part 15.247(d) & 15.209(a)   | Transmitter Radiated Emissions             | Complied      |
| Part 15.247(d) & 15.209(a)   | Transmitter Band Edge Radiated Emissions   | Complied      |

#### **Note(s):**

1. The measurement was performed to assist in the calculation of the level of maximum conducted output power, power spectral density and emissions. The EUT cannot transmit continuously and sweep triggering/signal gating cannot be implemented.
2. For the data rates declared as worst case and reported in this test report, duty cycle was measured to be greater than 98%. Plots for these measurements are archived on the UL VS LTD IT server and available for inspection upon request.
3. There are two vendors of the WiFi/*Bluetooth* radio modules, Vendor 1 and Vendor 2.

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 specification identified above.

## **2. Summary of Testing**

### **2.1. Facilities and Accreditation**

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

|         |   |
|---------|---|
| Site 1  | X |
| Site 2  | - |
| Site 17 | X |

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

### **2.2. Methods and Procedures**

|                   |                                                                                                                                                                                          |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <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 558074 D01 15.247 Meas Guidance v05 August 24, 2018                                                                                                                                  |
| <b>Title:</b>     | Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules |
| <b>Reference:</b> | KDB 662911 D01 Multiple Transmitter Output v02r01 October 31, 2013                                                                                                                       |
| <b>Title:</b>     | Emissions Testing of Transmitters 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                     | 2.4 GHz to 2.4835 GHz | 95%                  | ±1.14 %                |
| Minimum 6 dB Bandwidth         | 2.4 GHz to 2.4835 GHz | 95%                  | ±4.59 %                |
| Spectral Power Density         | 2.4 GHz to 2.4835 GHz | 95%                  | ±1.13 dB               |
| Conducted Maximum Output Power | 2.4 GHz to 2.4835 GHz | 95%                  | ±1.13 dB               |
| Radiated Spurious Emissions    | 30 MHz to 1 GHz       | 95%                  | ±4.65 dB               |
| Radiated Spurious Emissions    | 1 GHz to 25 GHz       | 95%                  | ±2.94 dB               |

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

## 2.4. Test and Measurement Equipment

### Test Equipment Used for Transmitter Conducted Tests (Non-TxBF)

| Asset No. | Instrument       | Manufacturer           | Type No.    | Serial No. | Date Calibration Due     | Cal. Interval (Months) |
|-----------|------------------|------------------------|-------------|------------|--------------------------|------------------------|
| M2042     | Thermohygrometer | Testo                  | 608-H1      | 458046425  | 26 Feb 2019              | 12                     |
| A3027     | Attenuator       | Broadwave Technologies | 351-311-006 | #1         | Calibrated before use    | -                      |
| A3028     | Attenuator       | Broadwave Technologies | 351-311-006 | #2         | Calibrated before use    | -                      |
| A3029     | Attenuator       | Broadwave Technologies | 351-311-006 | #3         | Calibrated before use    | -                      |
| A3004     | RF Switch        | Pickering Interfaces   | 64-102-002  | XZ363230   | Calibrated before use    | -                      |
| M2033     | Signal Analyser  | Rohde & Schwarz        | FSV13       | 101667     | 31 May 2019              | 12                     |
| G0607     | Signal Generator | Rohde & Schwarz        | SMU200A     | 100943     | 10 May 2019              | 36                     |
| A3005     | RePlay Test Rack | N/A                    | N/A         | N/A        | Calibration not required | -                      |

### Test Equipment Used for Transmitter Conducted Tests (TxBF)

| Asset No. | Instrument          | Manufacturer        | Type No.      | Serial No.  | Date Calibration Due  | Cal. Interval (Months) |
|-----------|---------------------|---------------------|---------------|-------------|-----------------------|------------------------|
| M2042     | Thermohygrometer    | Testo               | 608-H1        | 458046425   | 26 Feb 2019           | 12                     |
| M1835     | Signal Analyser     | Rohde & Schwarz     | FSV30         | 103050      | 19 Mar 2019           | 12                     |
| G0615     | Signal Generator    | Rohde & Schwarz     | SMBV100A      | 260473      | 08 May 2020           | 36                     |
| A2097     | Power Splitter      | Mini-Circuits       | ZN4PD1-63W-S+ | SUU98701205 | Calibrated before use | -                      |
| A1535     | Variable Attenuator | Hewlett Packard     | 8495B/8494B   | 00007       | Calibrated before use | -                      |
| A2505     | Directional Coupler | Atlan TecRF         | CDC-003060-20 | 1101230     | Calibrated before use | -                      |
| A2536     | Directional Coupler | Atlan TecRF         | CDC-003060-20 | 14041701720 | Calibrated before use | -                      |
| A2534     | Directional Coupler | Atlan TecRF         | CDC-003060-20 | 14041701718 | Calibrated before use | -                      |
| A2098     | Power Splitter      | Mini-Circuits       | ZN4PD1-63-S+  | SF210501205 | Calibrated before use | -                      |
| A3160     | RF Switch           | Pickering Interface | 60-102B-001   | XZ370188    | Calibrated before use | -                      |

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

| Asset No. | Instrument       | Manufacturer    | Type No.    | Serial No.      | Date Calibration Due | Cal. Interval (Months) |
|-----------|------------------|-----------------|-------------|-----------------|----------------------|------------------------|
| M2040     | Thermohygrometer | Testo           | 608-H1      | 45124934        | 27 Mar 2019          | 12                     |
| K0001     | 5m RSE Chamber   | Rainford EMC    | N/A         | N/A             | 16 Oct 2019          | 12                     |
| M2044     | Test Receiver    | Rohde & Schwarz | ESU26       | 100122          | 17 Apr 2019          | 12                     |
| A3154     | Pre-Amplifier    | Com-Power Corp  | PAM-103     | 18020012        | 14 Sep 2019          | 12                     |
| A553      | Antenna          | Chase           | CBL6111A    | 1593            | 08 Oct 2019          | 12                     |
| A3085     | Low Pass Filter  | AtlanTecRF      | AFL-02000   | AFL-02000       | 26 Jun 2019          | 12                     |
| A3112     | Attenuator       | AtlanTecRF      | AN18-06     | 219706#2        | 08 Oct 2019          | 12                     |
| M2003     | Thermohygrometer | Testo           | 608-H1      | 45046641        | 27 Feb 2019          | 12                     |
| K0017     | 3m RSE Chamber   | Rainford EMC    | N/A         | N/A             | 20 Feb 2019          | 12                     |
| M1995     | Test Receiver    | Rohde & Schwarz | ESU40       | 100428          | 10 Aug 2019          | 12                     |
| A2863     | Pre-Amplifier    | Agilent         | 8449B       | 3008A02100      | 19 Feb 2019          | 12                     |
| A2891     | Pre-Amplifier    | Schwarzbeck     | BBV 9718    | 9718-306        | 20 Feb 2019          | 12                     |
| A2896     | Pre-Amplifier    | Schwarzbeck     | BBV 9721    | 9721-023        | 20 Feb 2019          | 12                     |
| A2889     | Antenna          | Schwarzbeck     | BBHA 9120 B | BBHA 9120 B 653 | 19 Feb 2019          | 12                     |
| A2890     | Antenna          | Schwarzbeck     | HWRD 750    | 014             | 19 Feb 2019          | 12                     |
| A2895     | Antenna          | Schwarzbeck     | BBHA 9170   | 9170-728        | 20 Feb 2019          | 12                     |
| A2916     | Attenuator       | AtlanTecRF      | AN18W5-10   | 832827#1        | 21 Feb 2019          | 12                     |
| A2914     | High Pass Filter | AtlanTecRF      | AFH-03000   | 2155            | 22 Feb 2019          | 12                     |
| A2947     | High Pass Filter | AtlanTecRF      | AFH-07000   | 1601900001      | 22 Feb 2019          | 12                     |

**Test Equipment Used for Transmitter Band Edge Radiated Emissions**

| Asset No. | Instrument       | Manufacturer    | Type No.   | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|-----------|------------------|-----------------|------------|------------|----------------------|------------------------|
| M2040     | Thermohygrometer | Testo           | 608-H1     | 45124934   | 27 Mar 2019          | 12                     |
| K0001     | 5m RSE Chamber   | Rainford EMC    | N/A        | N/A        | 04 Oct 2019          | 12                     |
| M2044     | Test Receiver    | Rohde & Schwarz | ESU26      | 100122     | 17 Apr 2019          | 12                     |
| A3155     | Pre Amplifier    | Com-Power Corp  | PAM-118A   | 18040037   | 14 Sep 2019          | 12                     |
| A3138     | Antenna          | Schwarzbeck     | BBHA 9120B | 00702      | 03 Oct 2019          | 12                     |
| A2523     | Attenuator       | AtlanTecRF      | AN18W5-10  | 8328727#1  | 23 Feb 2019          | 12                     |

**Test Measurement Software/Firmware Used**

| Name             | Version | Release Date |
|------------------|---------|--------------|
| UL VS LTD Replay | v.11    | 22 Nov 2018  |
| iPerf            | 2.0.9   | 01 Jun 2016  |



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

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

|                                   |                                             |
|-----------------------------------|---------------------------------------------|
| <b>Brand Name:</b>                | Apple                                       |
| <b>Model Name or Number:</b>      | A2116                                       |
| <b>Test Sample Serial Number:</b> | C02X2007KFLX ( <i>Conducted sample #1</i> ) |
| <b>Hardware Version:</b>          | EVT                                         |
| <b>Software Version:</b>          | 18A334                                      |
| <b>FCC ID:</b>                    | BCGA2116                                    |

|                                   |                                             |
|-----------------------------------|---------------------------------------------|
| <b>Brand Name:</b>                | Apple                                       |
| <b>Model Name or Number:</b>      | A2116                                       |
| <b>Test Sample Serial Number:</b> | C02WW00WKFMM ( <i>Conducted sample #2</i> ) |
| <b>Hardware Version:</b>          | EVT                                         |
| <b>Software Version:</b>          | 18A334                                      |
| <b>FCC ID:</b>                    | BCGA2116                                    |

|                                   |                                            |
|-----------------------------------|--------------------------------------------|
| <b>Brand Name:</b>                | Apple                                      |
| <b>Model Name or Number:</b>      | A2116                                      |
| <b>Test Sample Serial Number:</b> | C02WW00PKFMM ( <i>Radiated sample #1</i> ) |
| <b>Hardware Version:</b>          | EVT                                        |
| <b>Software Version:</b>          | 18E110z                                    |
| <b>FCC ID:</b>                    | BCGA2116                                   |

|                                   |                                            |
|-----------------------------------|--------------------------------------------|
| <b>Brand Name:</b>                | Apple                                      |
| <b>Model Name or Number:</b>      | A2116                                      |
| <b>Test Sample Serial Number:</b> | C02X200XKFLX ( <i>Radiated sample #2</i> ) |
| <b>Hardware Version:</b>          | EVT                                        |
| <b>Software Version:</b>          | 18E110z                                    |
| <b>FCC ID:</b>                    | BCGA2116                                   |

#### **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 802.11b,g,n) / Digital Transmission System |                                                                                                                                                                                                                                                      |
| <b>Type of Unit:</b>                   | Transceiver                                           |                                                                                                                                                                                                                                                      |
| <b>Modulation Type:</b>                | DBPSK, DQPSK, BPSK, QPSK, 16QAM & 64QAM               |                                                                                                                                                                                                                                                      |
| <b>Data Rates:</b>                     | 802.11b                                               | 1, 2, 5.5 & 11 Mbps<br>(SISO, MIMO with CDD)                                                                                                                                                                                                         |
|                                        | 802.11g                                               | 6, 9, 12, 18, 24, 36, 48 & 54 Mbps<br>(SISO, MIMO with CDD)                                                                                                                                                                                          |
|                                        | 802.11n HT20                                          | MCS0 to MCS7 (1 spatial stream with either SISO or 2/3-chain MIMO CDD/TxBF operation)<br>MCS8 to MCS15 (2 spatial streams on 2 transmit chains with or without TxBF)<br>MCS16 to MCS23 (3 spatial streams on 3 transmit chains with or without TxBF) |
| <b>Power Supply Requirement(s):</b>    | Nominal                                               | 120 VAC 60 Hz                                                                                                                                                                                                                                        |
| <b>Maximum Conducted Output Power:</b> | 26.8 dBm                                              |                                                                                                                                                                                                                                                      |
| <b>Channel Spacing:</b>                | 20 MHz                                                |                                                                                                                                                                                                                                                      |
| <b>Transmit Frequency Range:</b>       | 2412 MHz to 2472 MHz                                  |                                                                                                                                                                                                                                                      |
| <b>Transmit Channels Tested:</b>       | <b>Channel Number</b>                                 | <b>Channel Frequency (MHz)</b>                                                                                                                                                                                                                       |
|                                        | 1                                                     | 2412                                                                                                                                                                                                                                                 |
|                                        | 2                                                     | 2417                                                                                                                                                                                                                                                 |
|                                        | 3                                                     | 2422                                                                                                                                                                                                                                                 |
|                                        | 6                                                     | 2437                                                                                                                                                                                                                                                 |
|                                        | 7                                                     | 2442                                                                                                                                                                                                                                                 |
|                                        | 11                                                    | 2462                                                                                                                                                                                                                                                 |
|                                        | 12                                                    | 2467                                                                                                                                                                                                                                                 |
|                                        | 13                                                    | 2472                                                                                                                                                                                                                                                 |

### 3.4. Description of Available Antennas

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

| <b>Frequency Band (MHz)</b> | <b>G<sub>Antenna 1</sub> / Core 0 (dBi)</b> | <b>G<sub>Antenna 2</sub> / Core 1 (dBi)</b> | <b>G<sub>Antenna 3</sub> / Core 2 (dBi)</b> |
|-----------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|
| 2400 - 2480                 | 3.7                                         | 4.8                                         | 4.3                                         |

Refer to Appendix 1 for directional antenna gain calculations for MIMO modes.

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

#### **Support Equipment**

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

|                              |              |
|------------------------------|--------------|
| <b>Description:</b>          | Test Laptop  |
| <b>Brand Name:</b>           | Apple        |
| <b>Model Name or Number:</b> | MacBook Pro  |
| <b>Serial Number:</b>        | C025200CHH5Q |

|                              |              |
|------------------------------|--------------|
| <b>Description:</b>          | Test Laptop  |
| <b>Brand Name:</b>           | Apple        |
| <b>Model Name or Number:</b> | MacBook Pro  |
| <b>Serial Number:</b>        | C02S200EHH5Q |

|                              |                           |
|------------------------------|---------------------------|
| <b>Description:</b>          | PHF (Personal Hands Free) |
| <b>Brand Name:</b>           | Apple                     |
| <b>Model Name or Number:</b> | Apple EarPods             |
| <b>Serial Number:</b>        | Not marked or stated      |

|                              |                   |
|------------------------------|-------------------|
| <b>Description:</b>          | USB Keyboard      |
| <b>Brand Name:</b>           | Apple             |
| <b>Model Name or Number:</b> | A1243             |
| <b>Serial Number:</b>        | CC2438202G4DQW0AC |

|                              |                   |
|------------------------------|-------------------|
| <b>Description:</b>          | USB Mouse         |
| <b>Brand Name:</b>           | Apple             |
| <b>Model Name or Number:</b> | A1152             |
| <b>Serial Number:</b>        | CC2446203PNDNYPAJ |

|                              |                      |
|------------------------------|----------------------|
| <b>Description:</b>          | USB-C Adapter        |
| <b>Brand Name:</b>           | Apple                |
| <b>Model Name or Number:</b> | A1632                |
| <b>Serial Number:</b>        | Not marked or stated |

|                              |                   |
|------------------------------|-------------------|
| <b>Description:</b>          | Laptop PC         |
| <b>Brand Name:</b>           | Dell              |
| <b>Model Name or Number:</b> | GBITL003          |
| <b>Serial Number:</b>        | 76487-641-1766771 |

**Support Equipment (continued)**

|                              |             |
|------------------------------|-------------|
| <b>Description:</b>          | USB Hub     |
| <b>Brand Name:</b>           | Hama        |
| <b>Model Name or Number:</b> | 00078498    |
| <b>Serial Number:</b>        | 09825891600 |

|                              |                 |
|------------------------------|-----------------|
| <b>Description:</b>          | Ethernet Router |
| <b>Brand Name:</b>           | Netgear         |
| <b>Model Name or Number:</b> | DG834G          |
| <b>Serial Number:</b>        | 1JX167B008C4A   |

|                              |                                              |
|------------------------------|----------------------------------------------|
| <b>Description:</b>          | Ethernt cable. Length 2.0 metres. Quantity 1 |
| <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>          | USB Cable. Length 3.0 metres. Quantity 4 |
| <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**

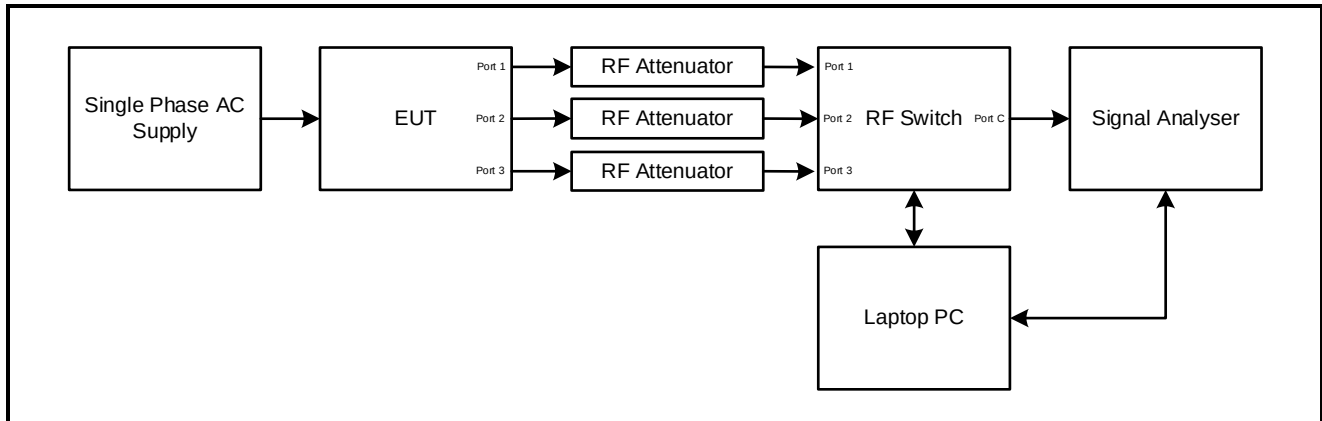
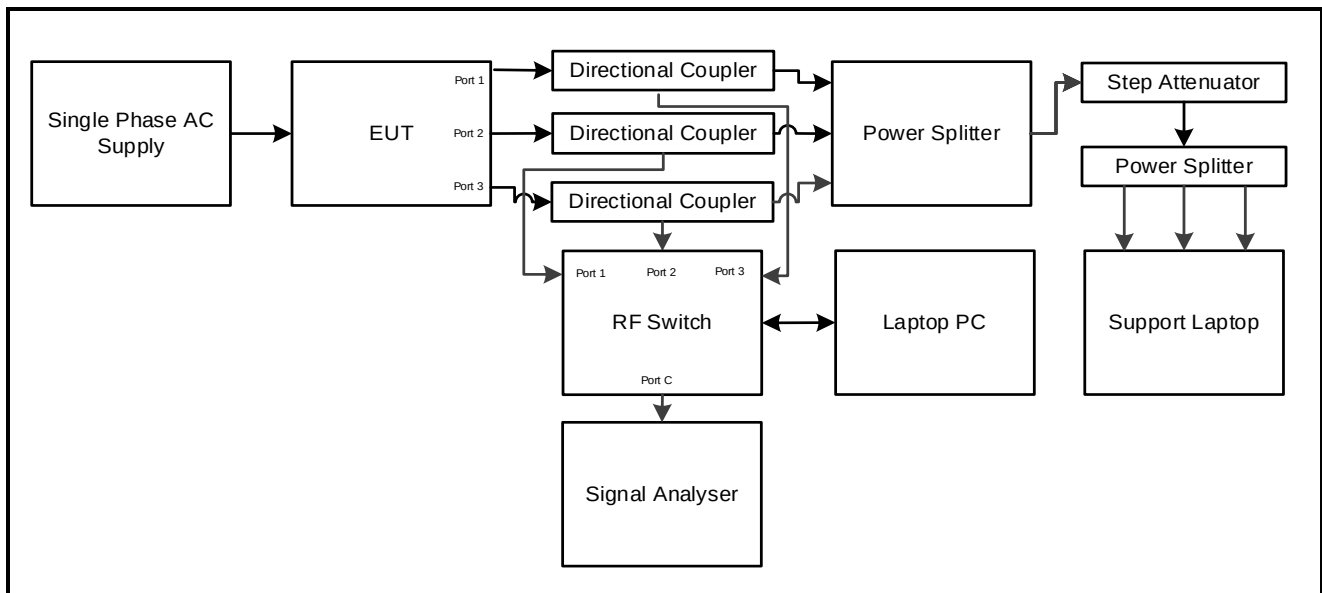
The EUT was tested in the following operating mode(s):

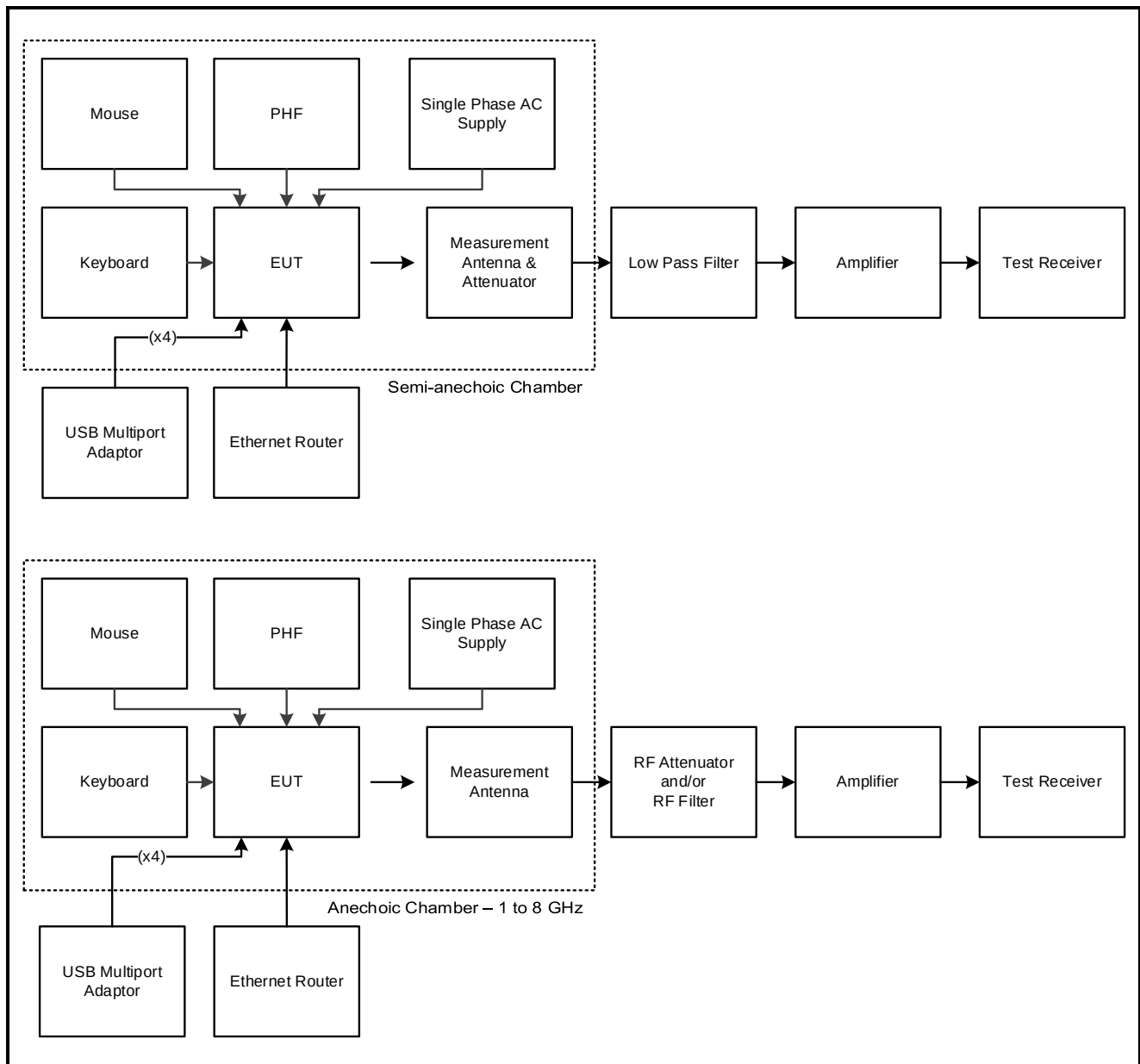
- Non-TxBF modes: Continuously transmitting with a modulated carrier at maximum power on the relevant channels as required using the supported data rates/modulation types.
- TxBF modes: Transmitting a modulated carrier with maximum possible duty cycle at maximum power on the relevant channels as required using the supported data rates/modulation types.

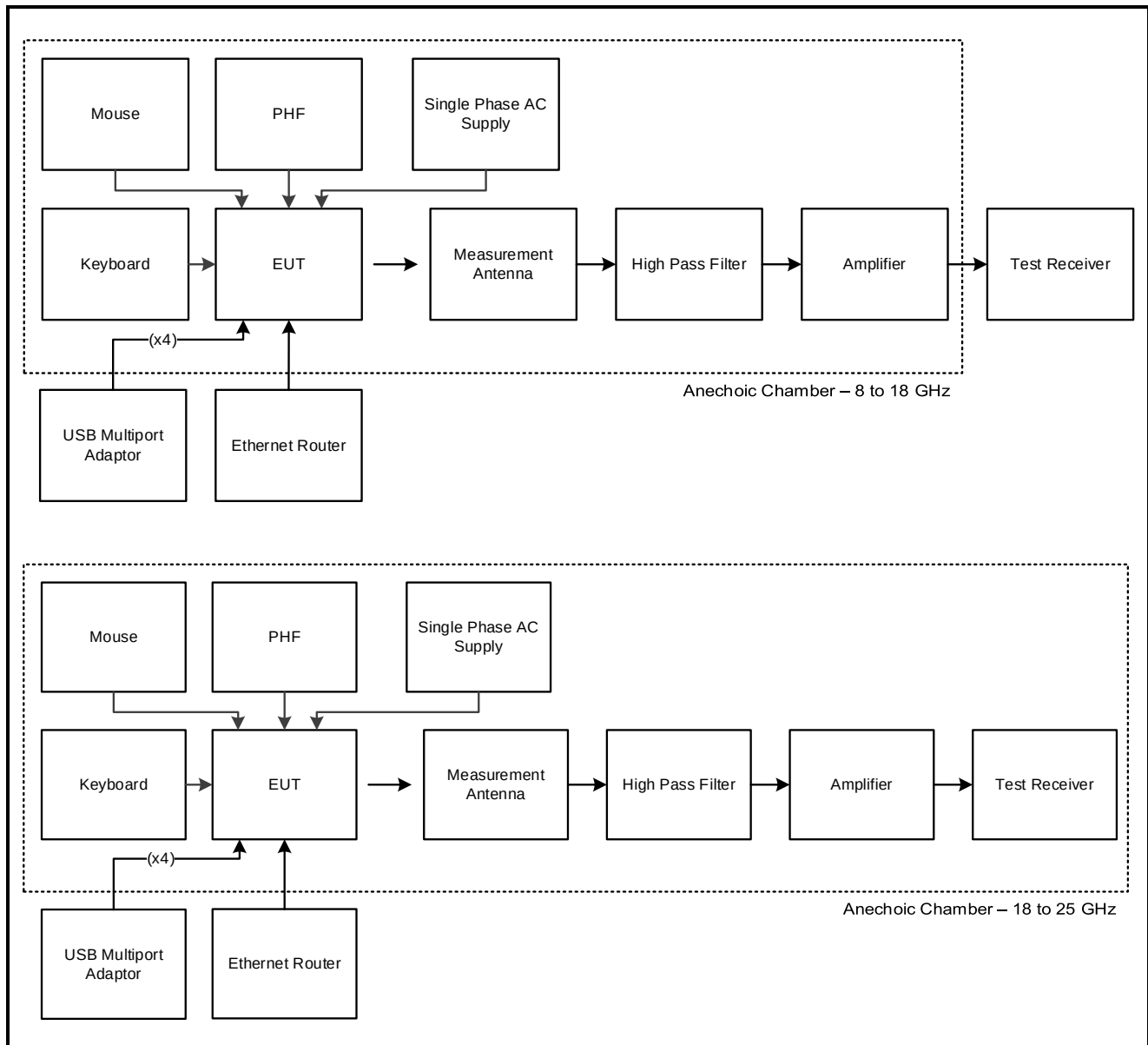
## **Configuration and Peripherals**

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

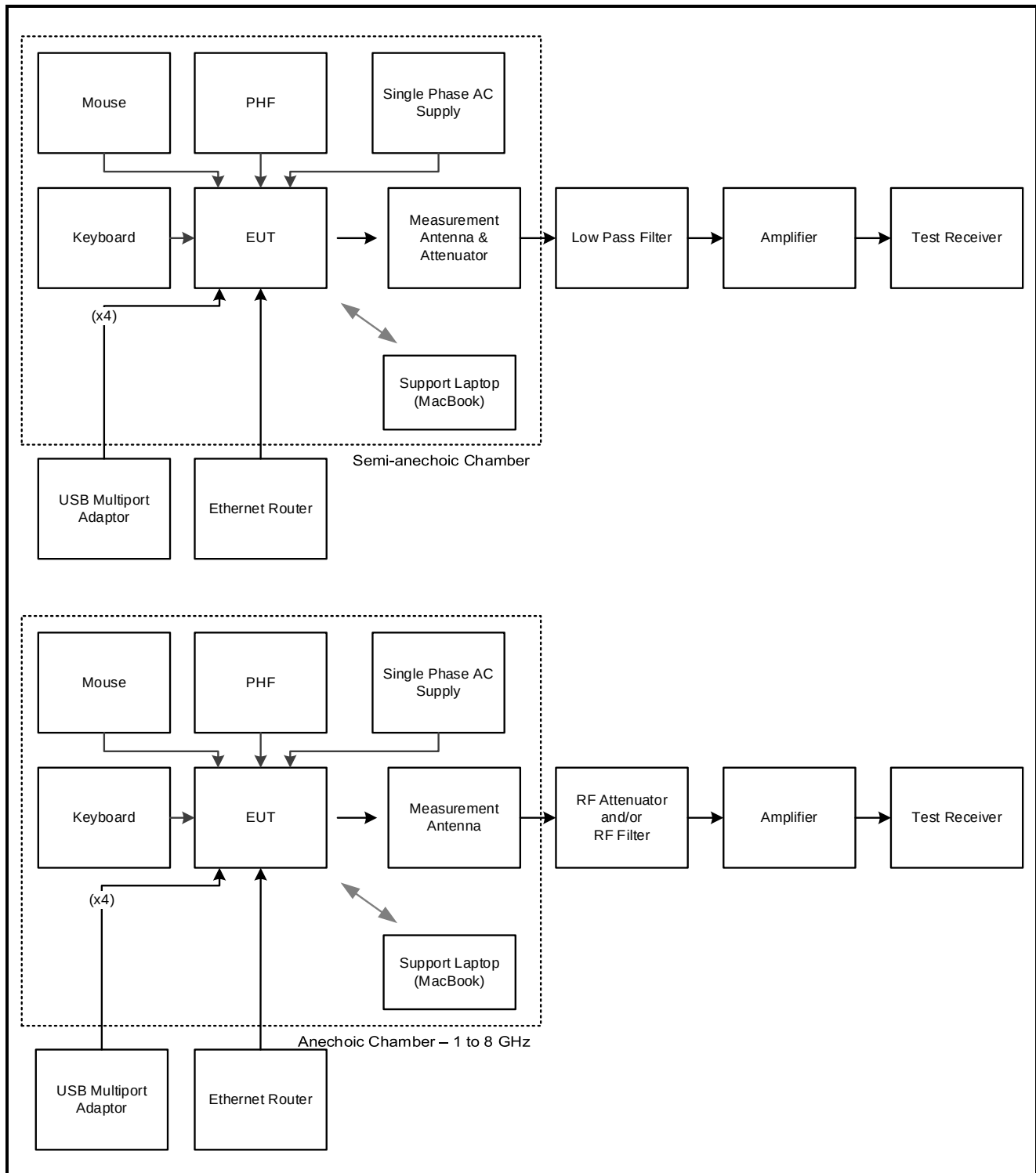
- Controlled in test mode using a software application on the EUT supplied by the customer. The application was used to enable a continuous transmission and to select the test channels as required.
- For TxBF modes, the EUT was communicating via a conducted or radiated RF link with an equivalent device. The EUT ran iPerf bandwidth testing application in client mode to produce maximum throughput. The customer supplied a document containing the setup instructions 'EUT\_TXBF\_operating procedures\_v1.2.pdf'.
- The customer declared the following data rates to be used for all measurements as:
  - o 802.11b / SISO – DBPSK / 1 Mbps
  - o 802.11g / SISO – BPSK / 6 Mbps
  - o 802.11n HT20 / SISO – BPSK / MCS0
  - o 802.11b / MIMO / 2Tx CDD – DBPSK / 1 Mbps
  - o 802.11b / MIMO / 3Tx CDD – DBPSK / 1 Mbps
  - o 802.11n HT20 / MIMO / 2Tx CDD – BPSK/ MCS0
  - o 802.11n HT20 / MIMO / 3Tx CDD – BPSK / MCS0
  - o 802.11n HT20 / MIMO / 2Tx TxBF – BPSK/ MCS0
  - o 802.11n HT20 / MIMO / 3Tx TxBF – BPSK/ MCS0
- The EUT has three separate antennas which correspond to three separate antenna ports. Core 0, Core 1 and Core 2 correspond to antenna 1, antenna 2 and antenna 3 respectively.
- For the Transmitter Minimum 6 dB Bandwidth test, only SISO modes were tested since the bandwidth does not change depending on chains used.
- The customer supplied U.FL RF cables with the EUT in order to perform conducted measurements. The measured additional path loss was included in any path loss calculations.
- Transmitter spurious emissions were performed with the EUT transmitting with a data rate of 802.11b / 1 Mbps / MIMO 3Tx CDD.
- Transmitter radiated spurious emissions tests were performed with the USB Keyboard, USB Mouse and PHF connected to the EUT. The remaining USB ports were connected with a USB cable to a hub. The USB-C ports were connected via a USB C-A adaptor and USB cable to a hub. The ethernet port was terminated into a router. The router and hub were placed under the floor inside the chamber.
- The EUT was powered from a 120 VAC 60 Hz single phase mains supply.

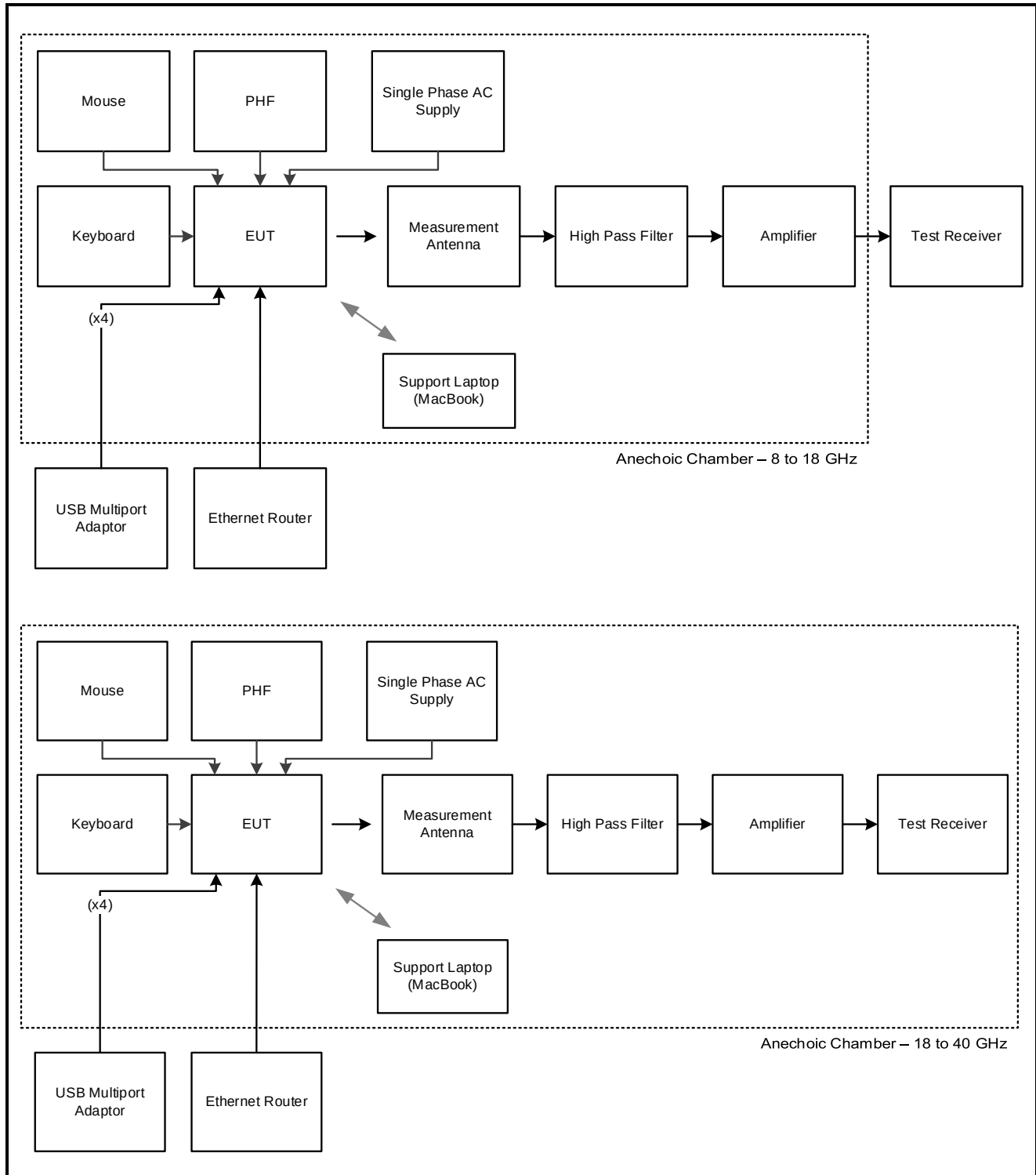
**Test Setup Diagrams****Conducted Tests:****Test Setup for Transmitter Conducted Tests (non TxBF)****Test Setup for Transmitter Conducted Tests (TxBF)**

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

**Test Setup Diagrams (continued)****Test Setup for Transmitter Radiated Emissions (non TxBF) (continued)**



**Test Setup Diagrams (continued)****Test Setup for Transmitter Radiated Emissions (TxBF)**

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

## **4. Antenna Port Test Results**

### **4.1. Transmitter Duty Cycle**

#### **Test Summary:**

|                                   |                                  |                    |                                     |
|-----------------------------------|----------------------------------|--------------------|-------------------------------------|
| <b>Test Engineers:</b>            | Victor Carmon & Matthew Botfield | <b>Test Dates:</b> | 26 November 2018 & 03 December 2018 |
| <b>Test Sample Serial Number:</b> | C02WW00WKFMM                     |                    |                                     |

|                          |                                                               |
|--------------------------|---------------------------------------------------------------|
| <b>FCC Reference:</b>    | Part 15.35(c)                                                 |
| <b>Test Method Used:</b> | FCC KDB 558074 Section 6 referencing ANSI C63.10 Section 11.6 |

#### **Environmental Conditions:**

|                               |          |
|-------------------------------|----------|
| <b>Temperature (°C):</b>      | 22 to 23 |
| <b>Relative Humidity (%):</b> | 39 to 45 |

#### **Note(s):**

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

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

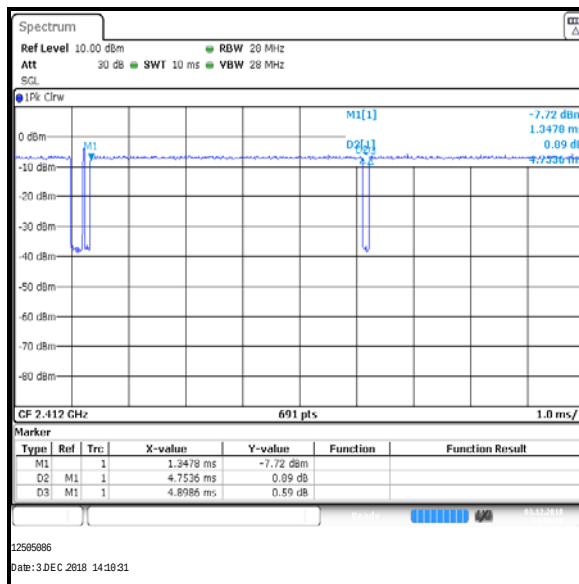
$$802.11n / HT20 / MCS0 / MIMO / 2Tx TxBF / \text{Core 1 duty cycle: } 10 \log (1 / (4.7536/4.8986)) = 0.1 \text{ dB}$$

$$802.11n / HT20 / MCS0 / MIMO / 3Tx TxBF / \text{Core 0 duty cycle: } 10 \log (1 / (3.8440/3.9480)) = 0.1 \text{ dB}$$

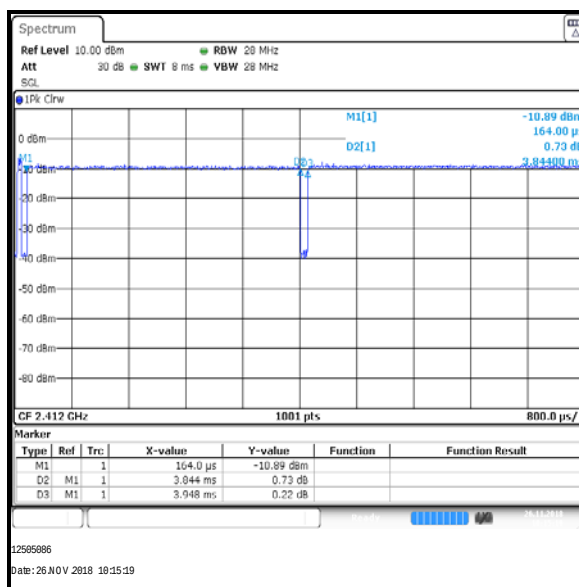
2. For all other modes, the duty cycle was measured and found to be greater than 98%. Plots for these measurements are archived on the UL VS LTD IT server and available for inspection upon request.

**Transmitter Duty Cycle (continued)****Results: 802.11n / HT20 / MIMO / 2Tx TxBF / MCS0 / Core 1**

| Pulse Duration (ms) | Period (ms) | Duty Cycle (dB) |
|---------------------|-------------|-----------------|
| 4.7536              | 4.8986      | 0.1             |

**Results: 802.11n / HT20 / MIMO / 3Tx TxBF / MCS0 / Core 0**

| Pulse Duration (ms) | Period (ms) | Duty Cycle (dB) |
|---------------------|-------------|-----------------|
| 3.8440              | 3.9480      | 0.1             |



## **4.2. Transmitter Minimum 6 dB Bandwidth**

### **Test Summary:**

|                                   |              |                    |                                        |
|-----------------------------------|--------------|--------------------|----------------------------------------|
| <b>Test Engineer:</b>             | Max Passell  | <b>Test Dates:</b> | 21 November 2018 &<br>28 November 2018 |
| <b>Test Sample Serial Number:</b> | C02X2007KFLX |                    |                                        |

|                          |                                                                   |
|--------------------------|-------------------------------------------------------------------|
| <b>FCC Reference:</b>    | Part 15.247(a)(2)                                                 |
| <b>Test Method Used:</b> | FCC KDB 558074 Section 8.2 referencing ANSI C63.10 Section 11.8.1 |

### **Environmental Conditions:**

|                               |          |
|-------------------------------|----------|
| <b>Temperature (°C):</b>      | 20 to 23 |
| <b>Relative Humidity (%):</b> | 38 to 50 |

### **Note(s):**

1. The customer declared the following data rates to be used for all measurements as:

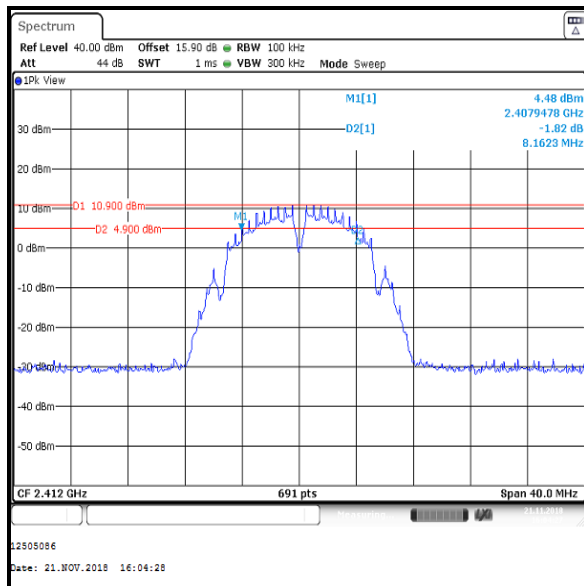
- o 802.11b – DBPSK / 1 Mbps / Core 1
- o 802.11g – BPSK / 6 Mbps / Core 1
- o 802.11n HT20 – BPSK / MCS0 / Core 1

Only SISO modes are reported since the bandwidth does not change depending on chains used.

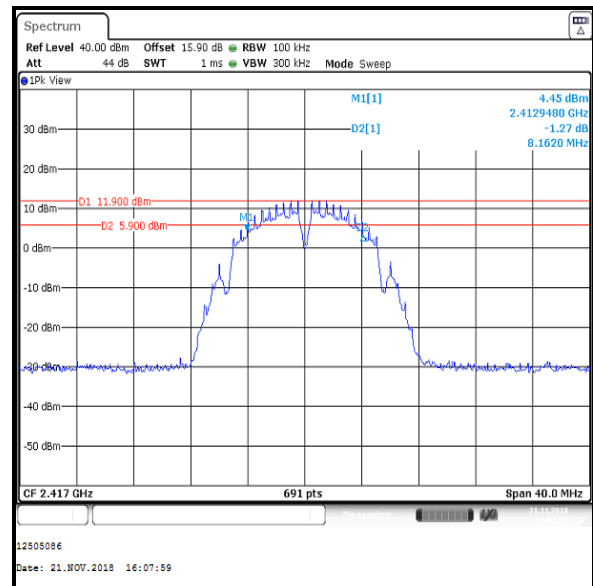
2. Final measurements were performed using the above configurations on the relevant channels in accordance with ANSI C63.10 Section 11.8.1 Option 1 measurement procedure. Additional channels were tested as requested by the customer. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 40 MHz. The DTS bandwidth was measured at 6 dB down from the peak of the signal
3. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cables. An RF offset was entered on the signal analyser to compensate for the loss of the switch, attenuator and RF cables.

**Transmitter Minimum 6 dB Bandwidth (continued)****Results: 802.11b / 20 MHz / DBPSK / 1 Mbps / Core 1**

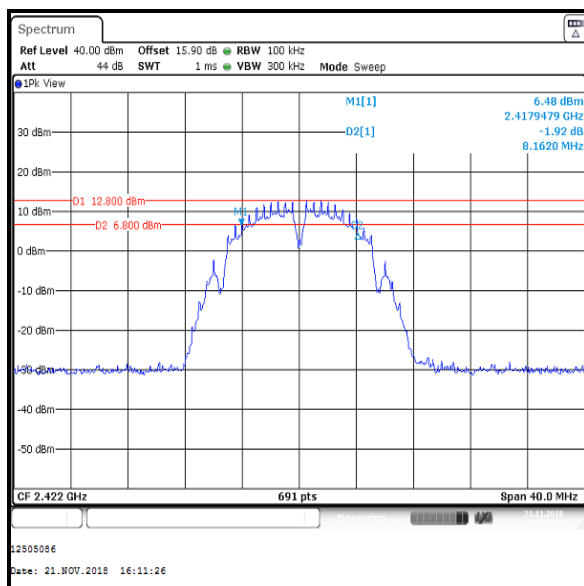
| Channel | 6 dB Bandwidth (kHz) | Limit (kHz) | Margin (kHz) | Result   |
|---------|----------------------|-------------|--------------|----------|
| 1       | 8162                 | ≥500        | 7662         | Complied |
| 2       | 8162                 | ≥500        | 7662         | Complied |
| 3       | 8162                 | ≥500        | 7662         | Complied |
| 6       | 8220                 | ≥500        | 7720         | Complied |
| 7       | 8220                 | ≥500        | 7720         | Complied |
| 11      | 8162                 | ≥500        | 7662         | Complied |
| 12      | 8162                 | ≥500        | 7662         | Complied |
| 13      | 8220                 | ≥500        | 7720         | Complied |

**Transmitter Minimum 6 dB Bandwidth (continued)****Results: 802.11b / 20 MHz / DBPSK / 1 Mbps / Core 1**

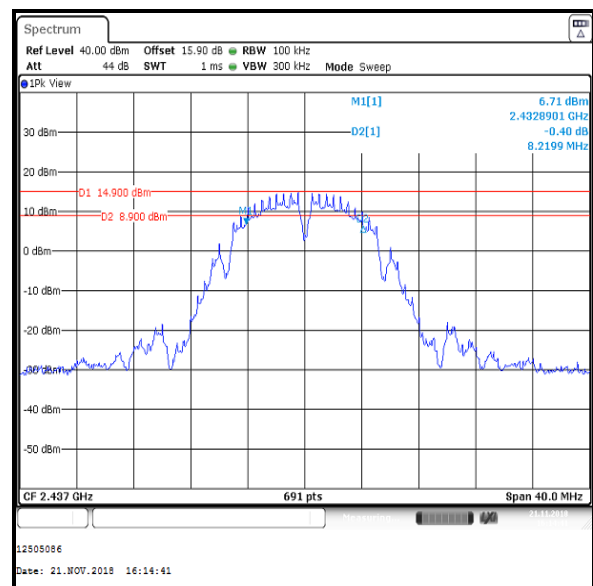
Channel 1



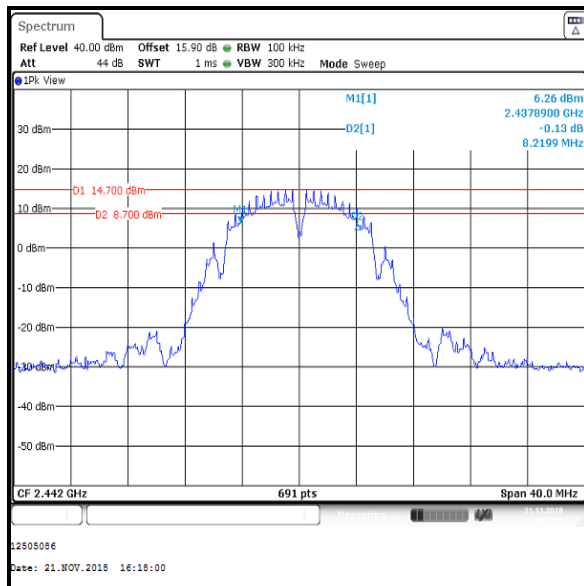
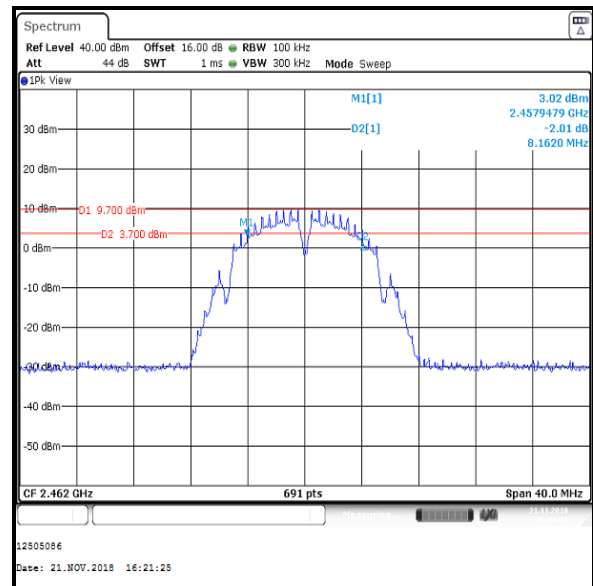
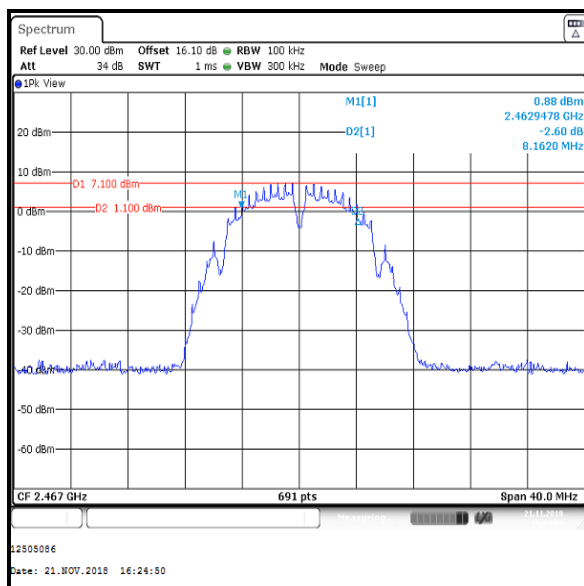
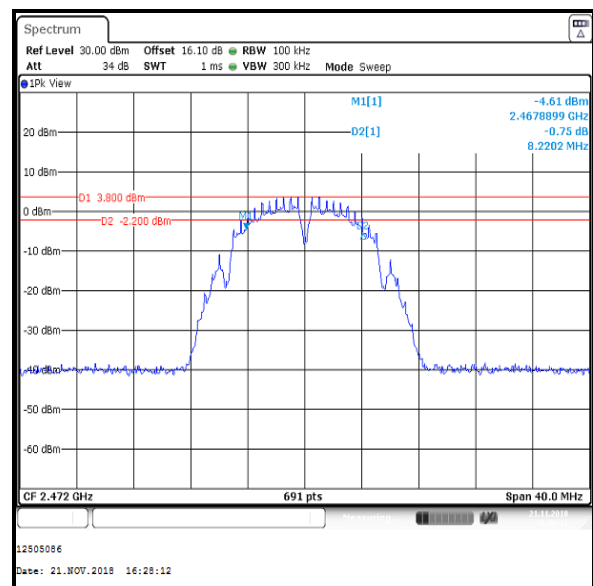
Channel 2



Channel 3



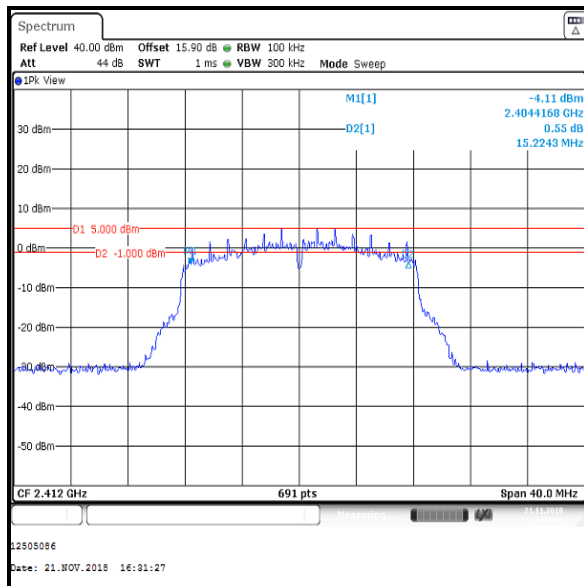
Channel 6

**Transmitter Minimum 6 dB Bandwidth (continued)****Results: 802.11b / 20 MHz / DBPSK / 1 Mbps / Core 1****Channel 7****Channel 11****Channel 12****Channel 13**

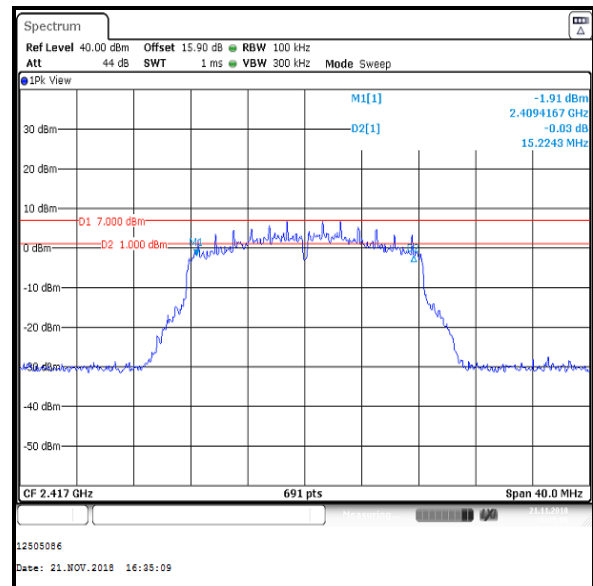


**Transmitter Minimum 6 dB Bandwidth (continued)****Results: 802.11g / 20 MHz / BPSK / 6 Mbps / Core 1**

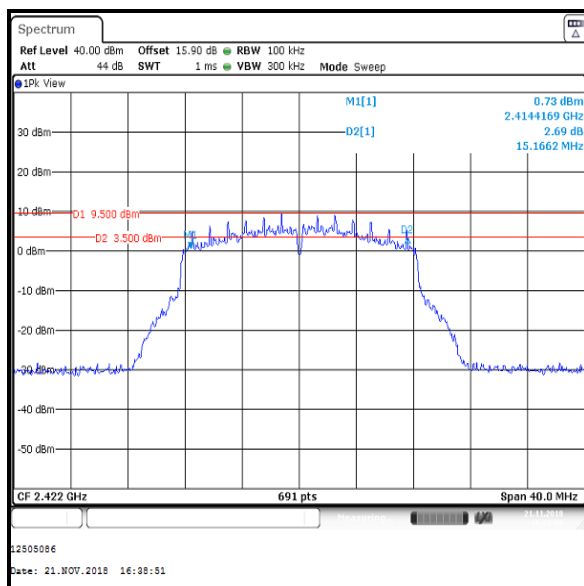
| Channel | 6 dB Bandwidth (kHz) | Limit (kHz) | Margin (kHz) | Result   |
|---------|----------------------|-------------|--------------|----------|
| 1       | 15224                | ≥500        | 14724        | Complied |
| 2       | 15224                | ≥500        | 14724        | Complied |
| 3       | 15166                | ≥500        | 14666        | Complied |
| 6       | 15167                | ≥500        | 14667        | Complied |
| 7       | 15224                | ≥500        | 14724        | Complied |
| 11      | 15166                | ≥500        | 14666        | Complied |
| 12      | 15109                | ≥500        | 14609        | Complied |
| 13      | 15167                | ≥500        | 14667        | Complied |

**Transmitter Minimum 6 dB Bandwidth (continued)****Results: 802.11g / 20 MHz / BPSK / 6 Mbps / Core 1**

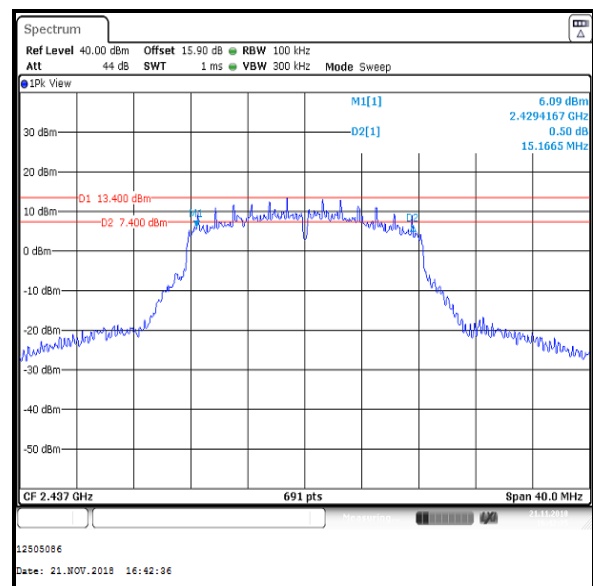
Channel 1



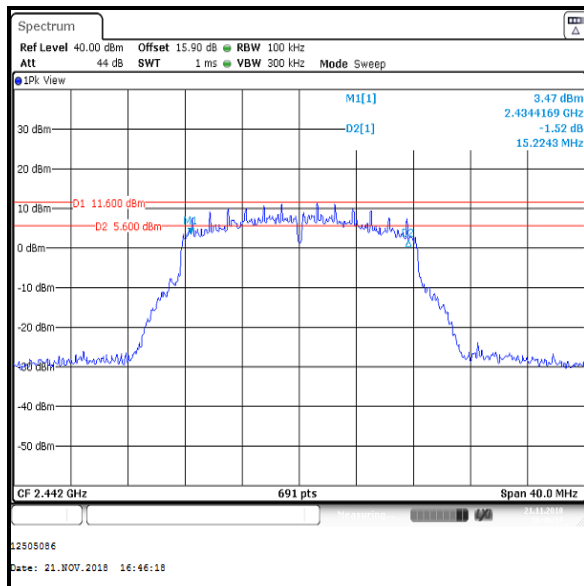
Channel 2



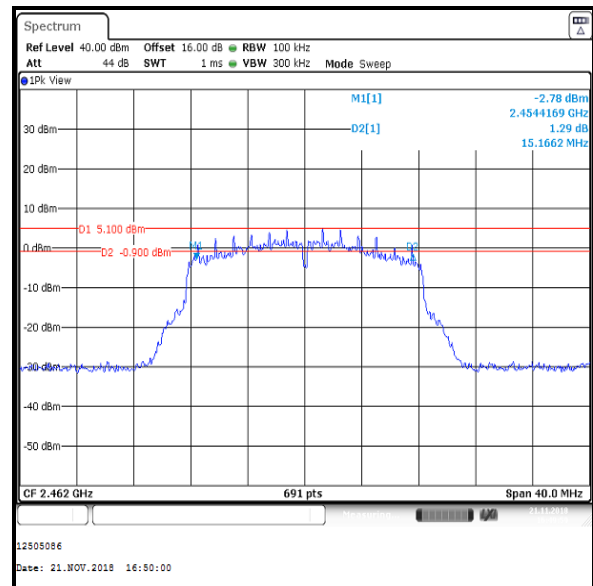
Channel 3



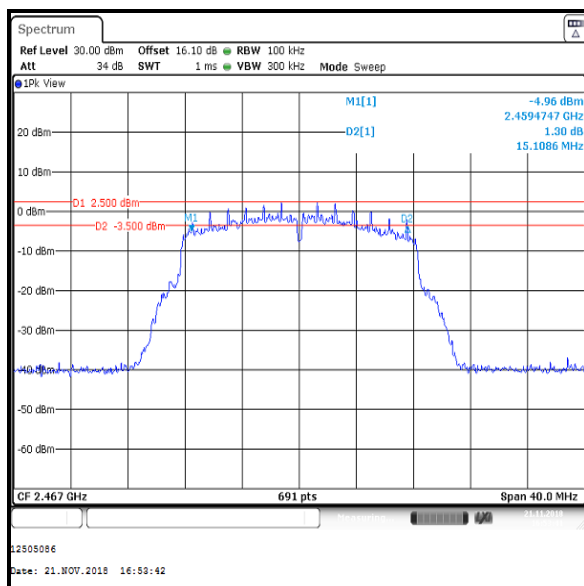
Channel 6

**Transmitter Minimum 6 dB Bandwidth (continued)****Results: 802.11g / 20 MHz / BPSK / 6 Mbps / Core 1**

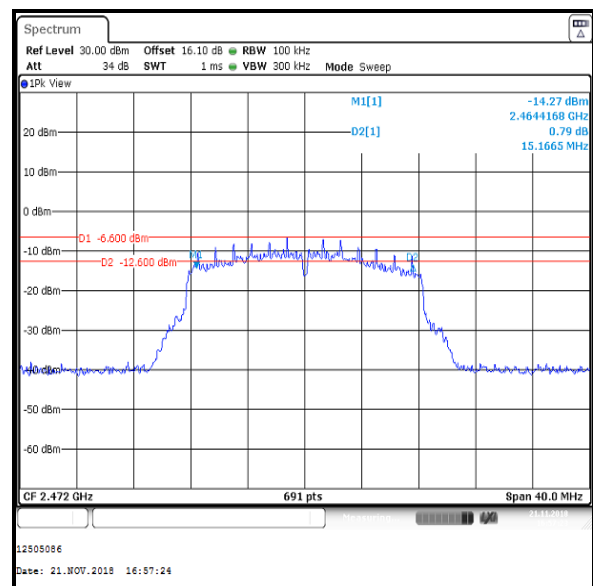
Channel 7



Channel 11



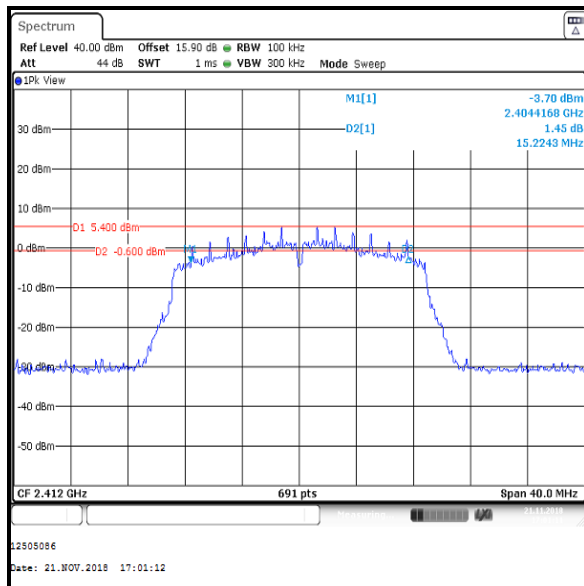
Channel 12



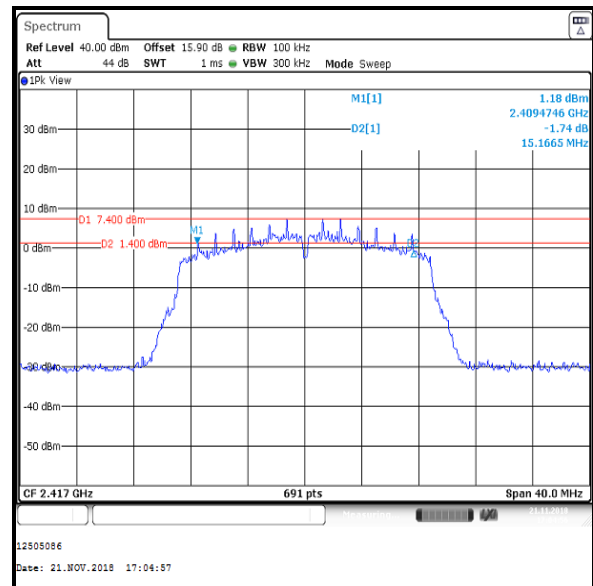
Channel 13

**Transmitter Minimum 6 dB Bandwidth (continued)****Results: 802.11n / HT20 / SISO / BPSK / MCS0 / Core 1**

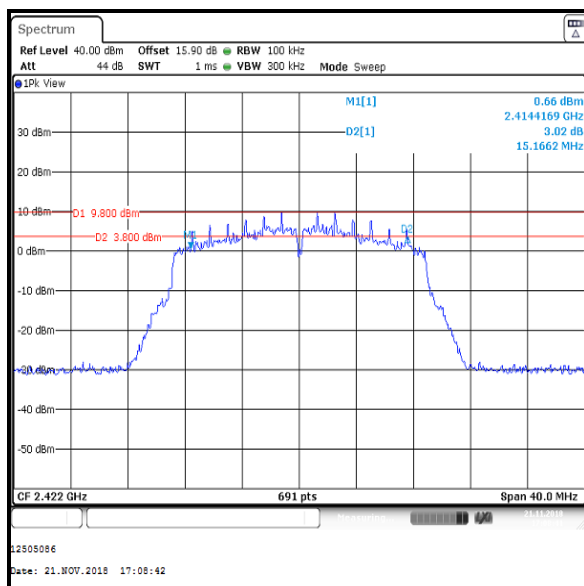
| Channel | 6 dB Bandwidth (kHz) | Limit (kHz) | Margin (kHz) | Result   |
|---------|----------------------|-------------|--------------|----------|
| 1       | 15224                | ≥500        | 14724        | Complied |
| 2       | 15167                | ≥500        | 14667        | Complied |
| 3       | 15166                | ≥500        | 14666        | Complied |
| 6       | 15167                | ≥500        | 14667        | Complied |
| 7       | 15224                | ≥500        | 14724        | Complied |
| 11      | 15166                | ≥500        | 14666        | Complied |
| 12      | 15167                | ≥500        | 14667        | Complied |
| 13      | 15167                | ≥500        | 14667        | Complied |

**Transmitter Minimum 6 dB Bandwidth (continued)****Results: 802.11n / HT20 / SISO / BPSK / MCS0 / Core 1**

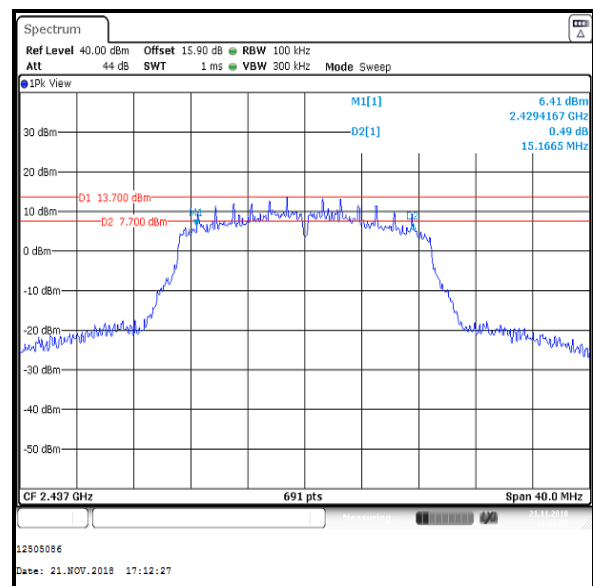
Channel 1



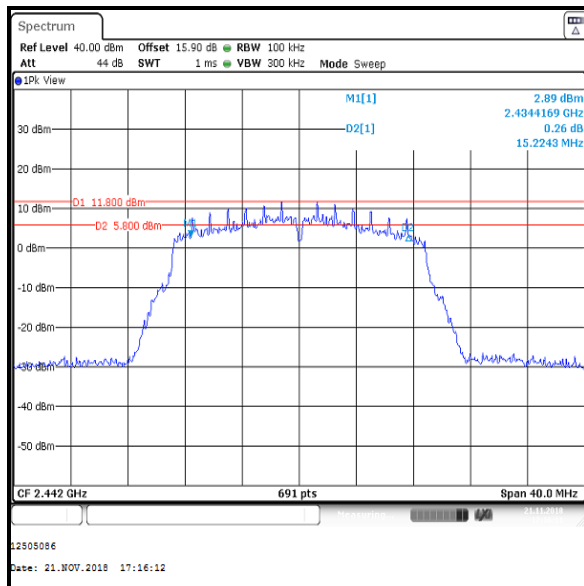
Channel 2



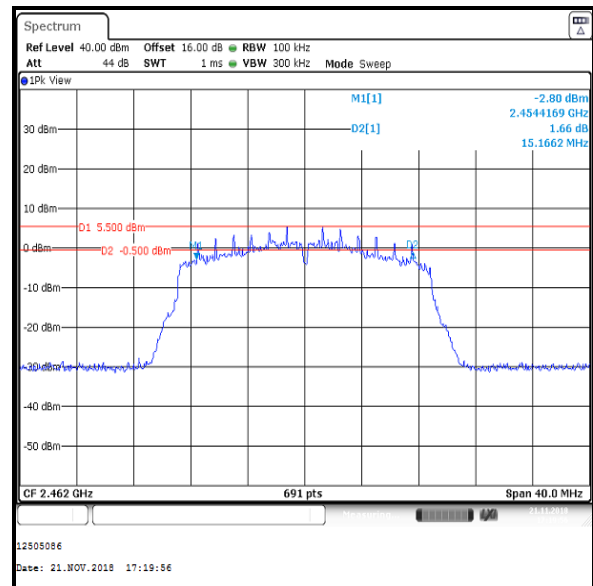
Channel 3



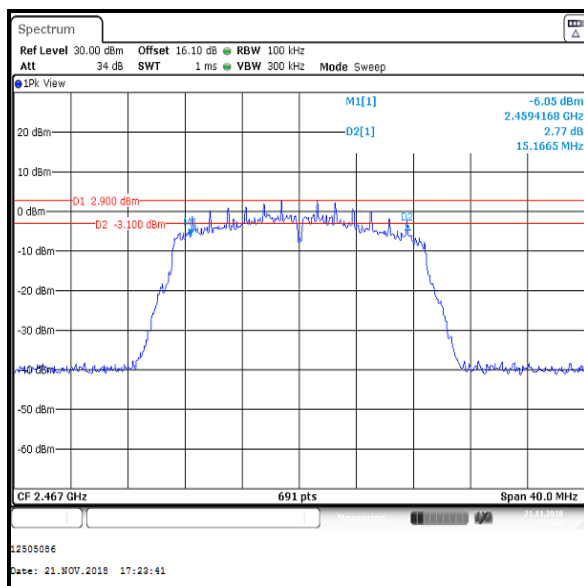
Channel 6

**Transmitter Minimum 6 dB Bandwidth (continued)****Results: 802.11n / HT20 / SISO / BPSK / MCS0 / Core 1**

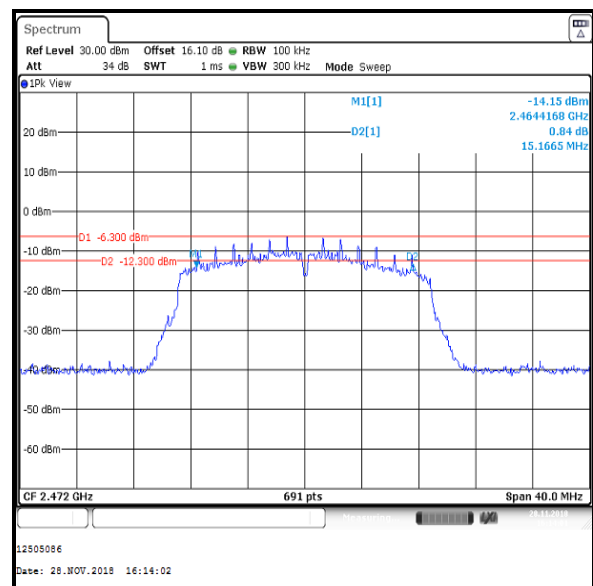
Channel 7



Channel 11



Channel 12



Channel 13

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

|                                    |                                               |                    |                                      |
|------------------------------------|-----------------------------------------------|--------------------|--------------------------------------|
| <b>Test Engineers:</b>             | Max Passell, Victor Carmon & Matthew Botfield | <b>Test Dates:</b> | 21 November 2018 to 30 November 2018 |
| <b>Test Sample Serial Numbers:</b> | C02X2007KFLX & C02WW00WKFMM                   |                    |                                      |

|                          |                                                                               |
|--------------------------|-------------------------------------------------------------------------------|
| <b>FCC Reference:</b>    | Part 15.247(e)                                                                |
| <b>Test Method Used:</b> | FCC KDB 558074 Section 8.4 referencing ANSI C63.10 Sections 11.10.3 & 11.10.5 |

**Environmental Conditions:**

|                               |          |
|-------------------------------|----------|
| <b>Temperature (°C):</b>      | 20 to 23 |
| <b>Relative Humidity (%):</b> | 38 to 51 |

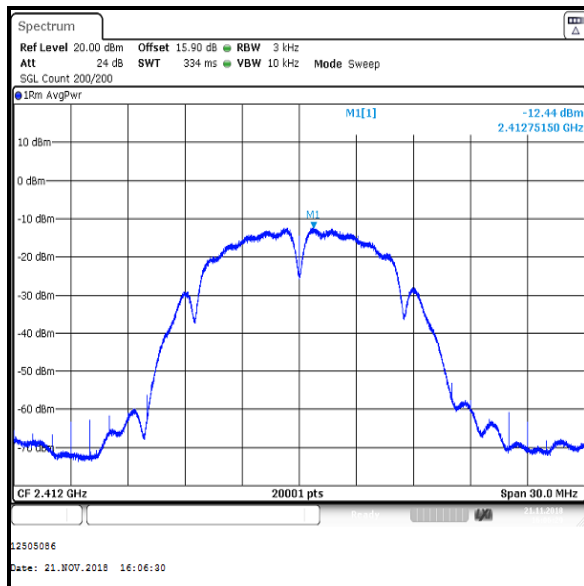
**Transmitter Power Spectral Density (continued)****Note(s):**

1. The customer declared the following data rates to be used for all measurements as:
  - o 802.11b – DBPSK / 1 Mbps / Core 1
  - o 802.11g – BPSK / 6 Mbps / Core 1
  - o 802.11n HT20 – BPSK / MCS0 / Core 1
  - o 802.11b – DBPSK / 1 Mbps / MIMO / 2Tx CDD / Core 1 & Core 2
  - o 802.11b – DBPSK / 1 Mbps / MIMO / 3Tx CDD / Core 0, Core 1 & Core 2
  - o 802.11n HT20 / MIMO / 2Tx CDD / BPSK / MCS0 / Core 1 & Core 2
  - o 802.11n HT20 / MIMO / 3Tx CDD / BPSK / MCS0 / Core 0, Core 1 & Core 2
  - o 802.11n HT20 / MIMO / 2Tx TxBF / BPSK / MCS0 / Core 1 & Core 2
  - o 802.11n HT20 / MIMO / 3Tx TxBF / BPSK / MCS0 / Core 0, Core 1 & Core 2
2. Final measurements were performed using the above configurations on the relevant channels. Additional channels were tested as requested by the customer.
3. For non-Tx BF modes, the EUT was transmitting at >98% duty cycle and testing was performed in accordance with ANSI C63.10 Section 11.10.3 Method AVGPSD-1. The signal analyser resolution bandwidth was set to 3 kHz or 100 kHz and video bandwidth 10 kHz or 300 kHz. An RMS detector was used and sweep time set manually to perform trace averaging over 200 traces. The span was set greater than 1.5 times the 99% emission bandwidth. The highest peak of the measured signal was recorded.
4. For Tx BF modes, the EUT was transmitting at <98% duty cycle and testing was performed in accordance with ANSI C63.10 Section 11.10.5 Method AVGPSD-2. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. An RMS detector was used and sweep time set manually to perform trace averaging over 200 traces. The span was set greater than 1.5 times the 99% emission bandwidth.
5. For 802.11b & 802.11n MIMO CDD, PSD was measured on all ports and then combined using the *measure and sum the spectra across the outputs* technique, stated in FCC KDB 662911 D01 Section E)2)a).
6. For 802.11n MIMO Tx BF, PSD was measured on all ports and then combined using the *measure and sum spectral maxima across the outputs* technique, stated in FCC KDB 662911 D01 Section E)2)b).
7. The signal analyser was connected to the RF port on the EUT using an RF switch, suitable attenuation and RF cables. An RF offset was entered on the signal analyser to compensate for the loss of the switch, attenuator and RF cables.
8. The EUT with serial number C02X2007KFLX was used for non-Tx BF tests, the EUT with serial number C02WW00WKFMM was used for Tx BF tests.

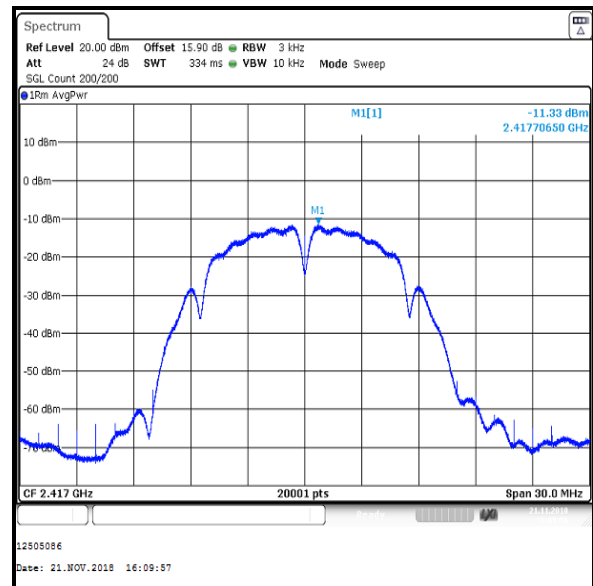


**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / SISO / DBPSK / 1 Mbps / Core 1**

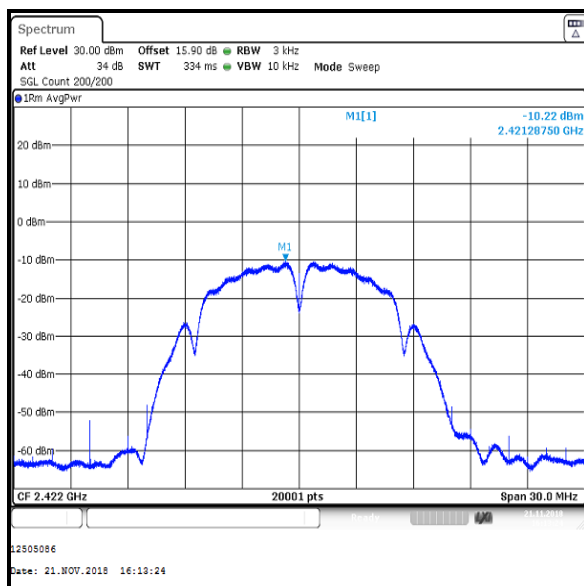
| Channel | Output Power<br>(dBm/3 kHz) | Limit<br>(dBm/3kHz) | Margin<br>(dB) | Result   |
|---------|-----------------------------|---------------------|----------------|----------|
| 1       | -12.4                       | 8.0                 | 20.4           | Complied |
| 2       | -11.3                       | 8.0                 | 19.3           | Complied |
| 3       | -10.2                       | 8.0                 | 18.2           | Complied |
| 6       | -8.4                        | 8.0                 | 16.4           | Complied |
| 7       | -8.8                        | 8.0                 | 16.8           | Complied |
| 11      | -13.5                       | 8.0                 | 21.5           | Complied |
| 12      | -16.0                       | 8.0                 | 24.0           | Complied |
| 13      | -19.4                       | 8.0                 | 27.4           | Complied |

**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / SISO / DBPSK / 1 Mbps / Core 1**

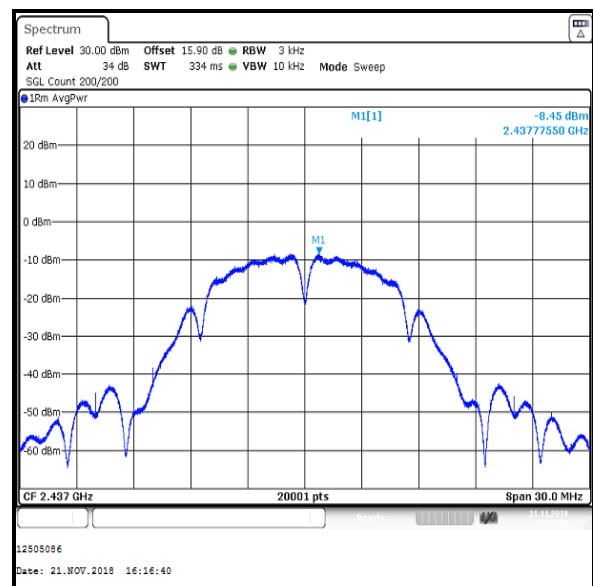
Channel 1



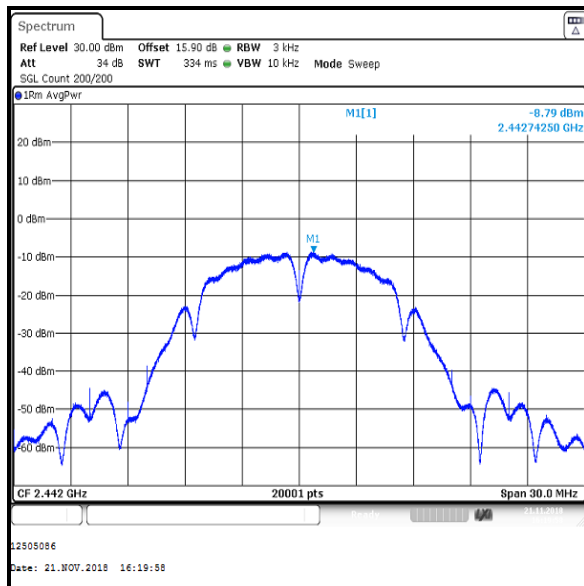
Channel 2



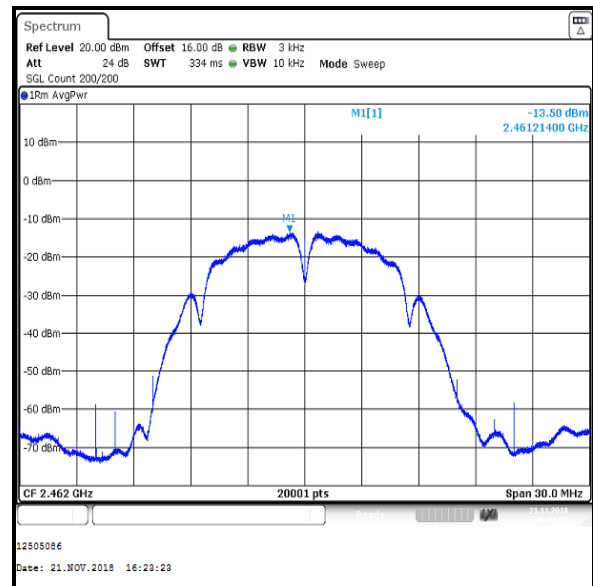
Channel 3



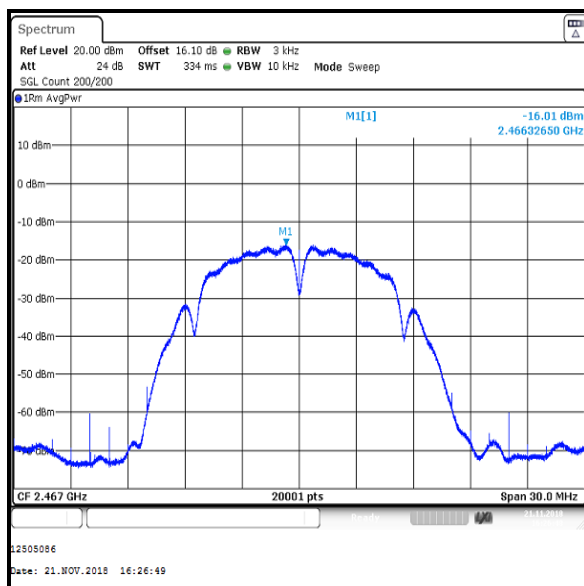
Channel 6

**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / DBPSK / 1 Mbps / Core 1**

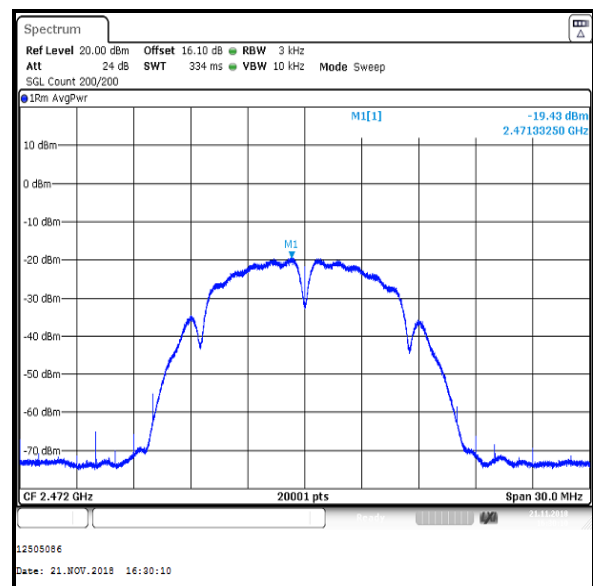
Channel 7



Channel 11



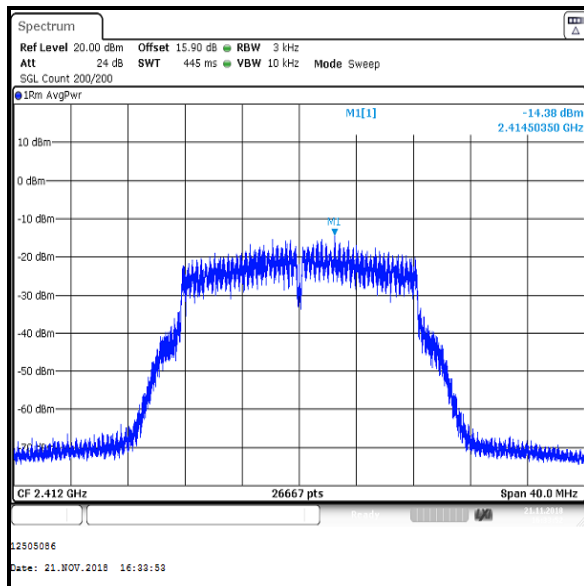
Channel 12



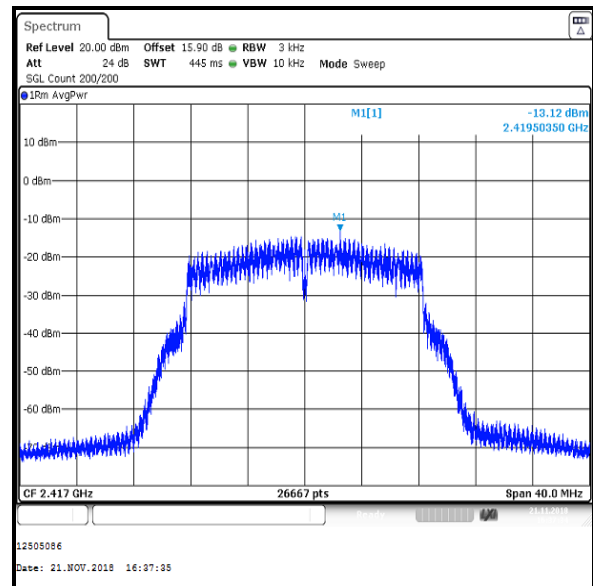
Channel 13

**Transmitter Power Spectral Density (continued)****Results: 802.11g / 20 MHz / BPSK / 6 Mbps / Core 1**

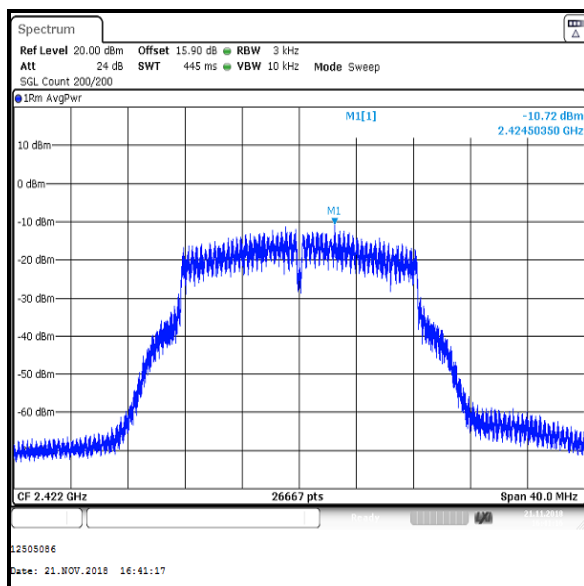
| Channel | Output Power<br>(dBm/3 kHz) | Limit<br>(dBm/3kHz) | Margin<br>(dB) | Result   |
|---------|-----------------------------|---------------------|----------------|----------|
| 1       | -14.4                       | 8.0                 | 22.4           | Complied |
| 2       | -13.1                       | 8.0                 | 21.1           | Complied |
| 3       | -10.7                       | 8.0                 | 18.7           | Complied |
| 6       | -6.7                        | 8.0                 | 14.7           | Complied |
| 7       | -8.4                        | 8.0                 | 16.4           | Complied |
| 11      | -14.9                       | 8.0                 | 22.9           | Complied |
| 12      | -18.3                       | 8.0                 | 26.3           | Complied |
| 13      | -27.4                       | 8.0                 | 35.4           | Complied |

**Transmitter Power Spectral Density (continued)****Results: 802.11g / 20 MHz / BPSK / 6 Mbps / Core 1**

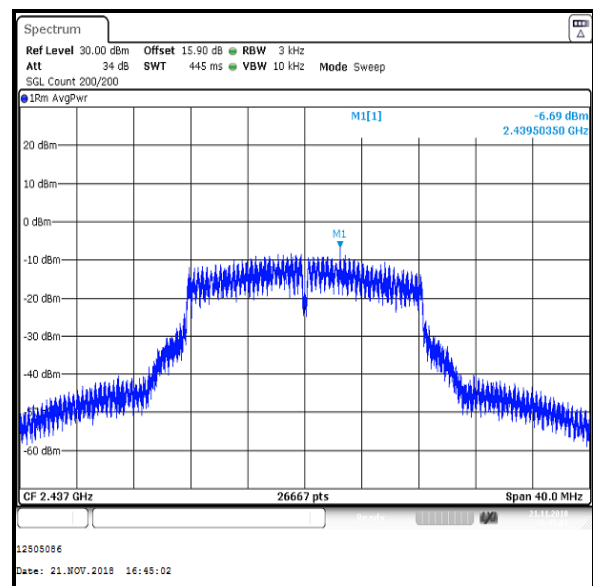
Channel 1



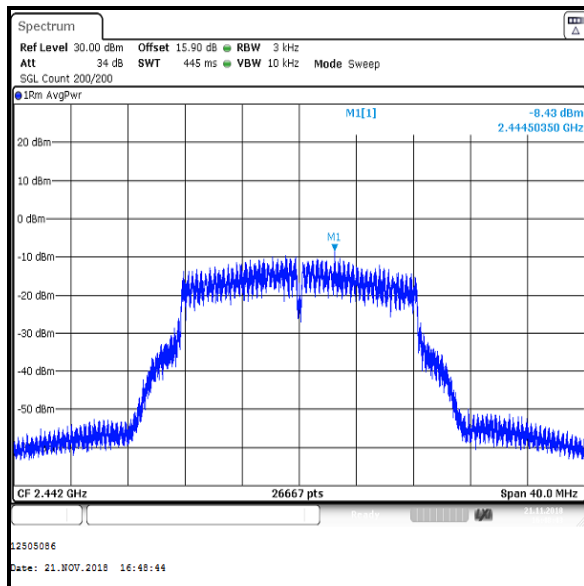
Channel 2



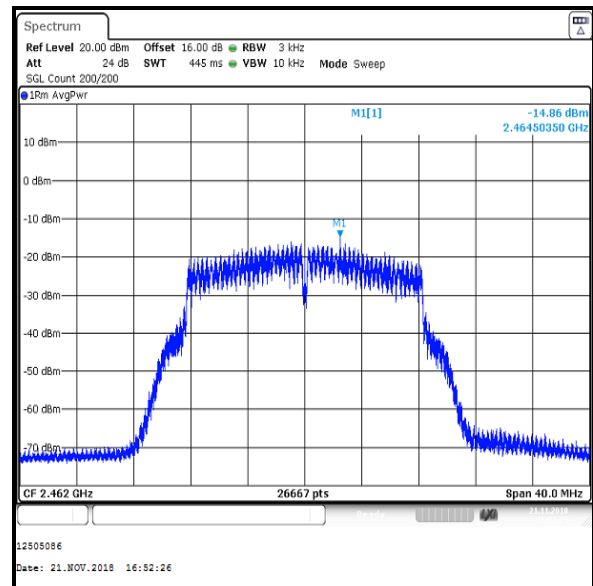
Channel 3



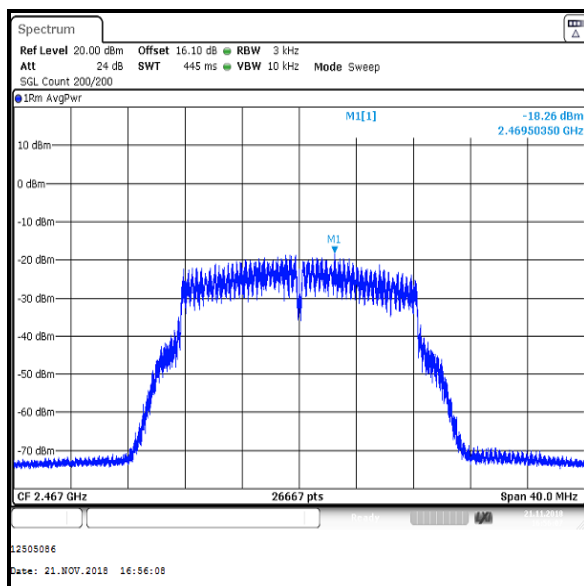
Channel 6

**Transmitter Power Spectral Density (continued)****Results: 802.11g / 20 MHz / BPSK / 6 Mbps / Core 1**

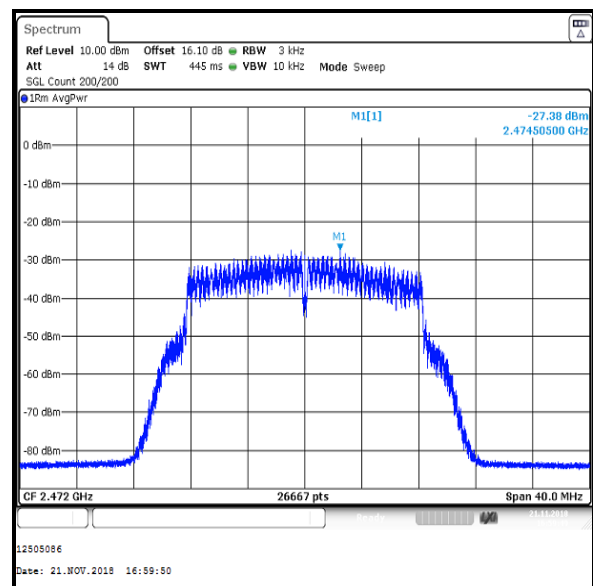
Channel 7



Channel 11



Channel 12

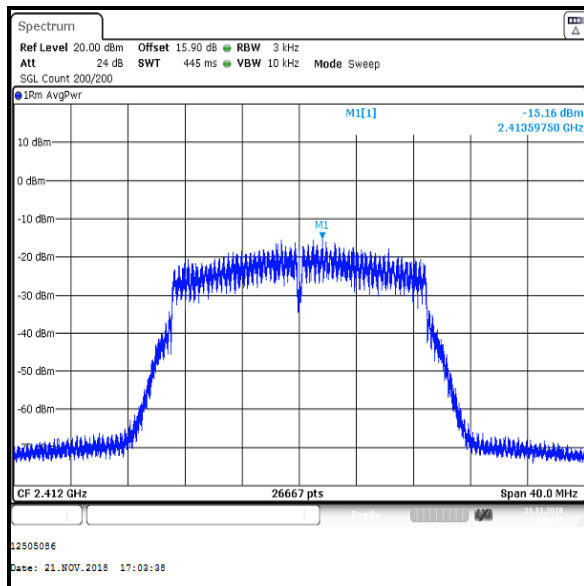


Channel 13

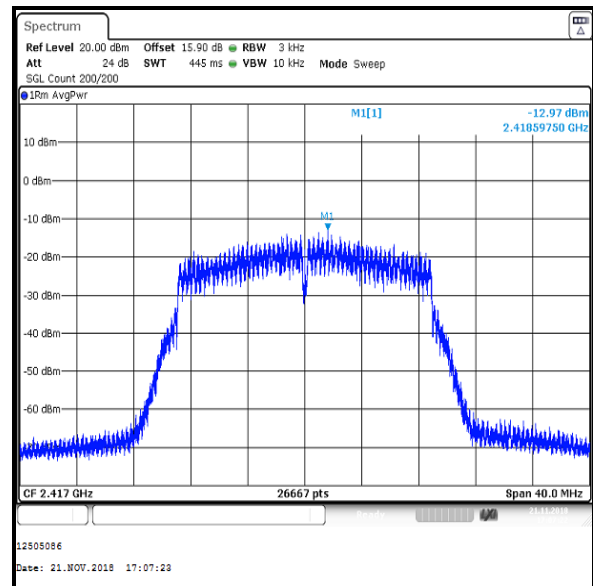
**Transmitter Power Spectral Density (continued)****Results: 802.11n / HT20 / SISO / BPSK / MCS0 / Core 1**

| Channel | Output Power<br>(dBm/3 kHz) | Limit<br>(dBm/3kHz) | Margin<br>(dB) | Result   |
|---------|-----------------------------|---------------------|----------------|----------|
| 1       | -15.2                       | 8.0                 | 23.2           | Complied |
| 2       | -13.0                       | 8.0                 | 21.0           | Complied |
| 3       | -10.8                       | 8.0                 | 18.8           | Complied |
| 6       | -7.5                        | 8.0                 | 15.5           | Complied |
| 7       | -9.1                        | 8.0                 | 17.1           | Complied |
| 11      | -15.3                       | 8.0                 | 23.3           | Complied |
| 12      | -18.2                       | 8.0                 | 26.2           | Complied |

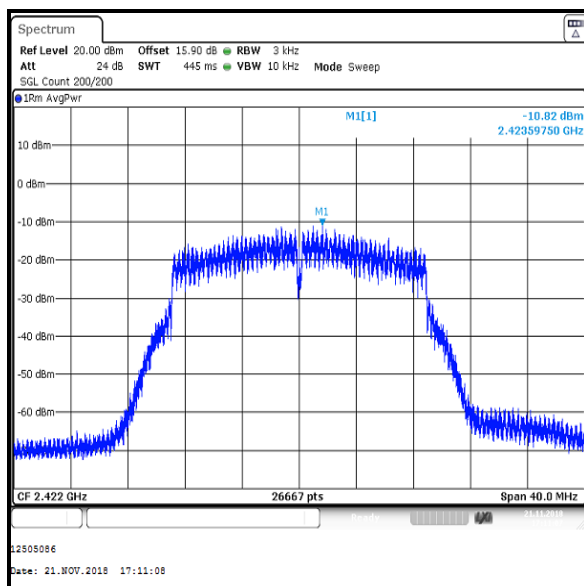
| Channel | Output Power<br>(dBm/100 kHz) | Limit<br>(dBm/3kHz) | Margin<br>(dB) | Result   |
|---------|-------------------------------|---------------------|----------------|----------|
| 13      | -16.0                         | 8.0                 | 24.0           | Complied |

**Transmitter Power Spectral Density (continued)****Results: 802.11n / HT20 / SISO / BPSK / MCS0 / Core 1**

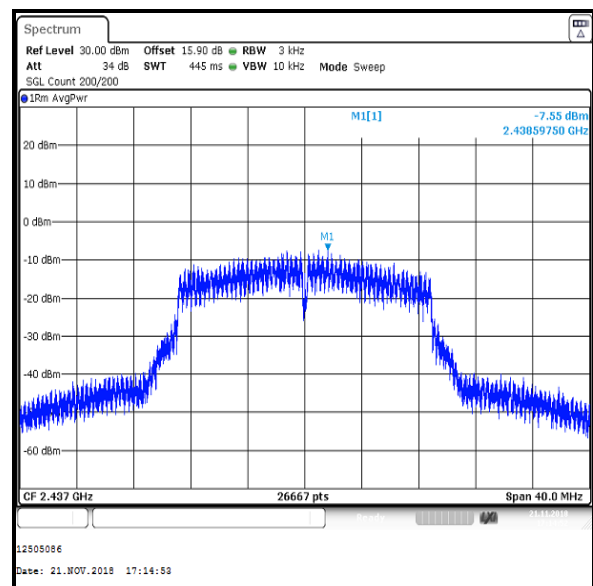
Channel 1



Channel 2

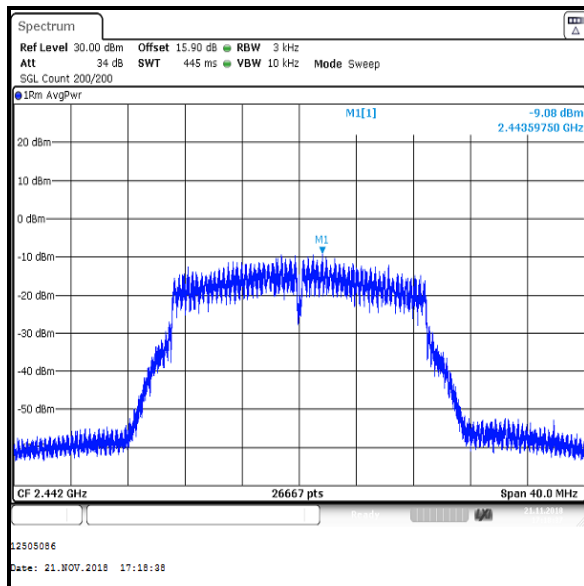


Channel 3

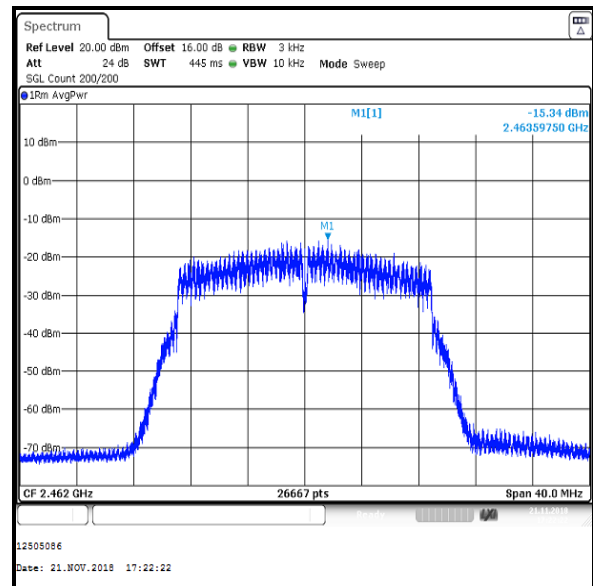


Channel 6

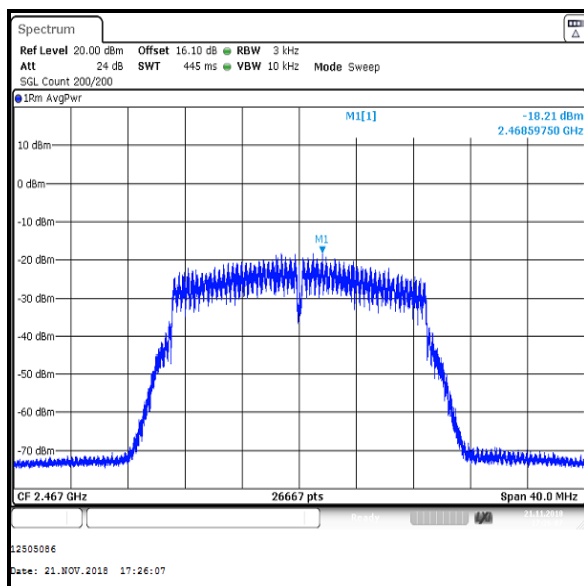


**Transmitter Power Spectral Density (continued)****Results: 802.11n / HT20 / SISO / BPSK / MCS0 / Core 1**

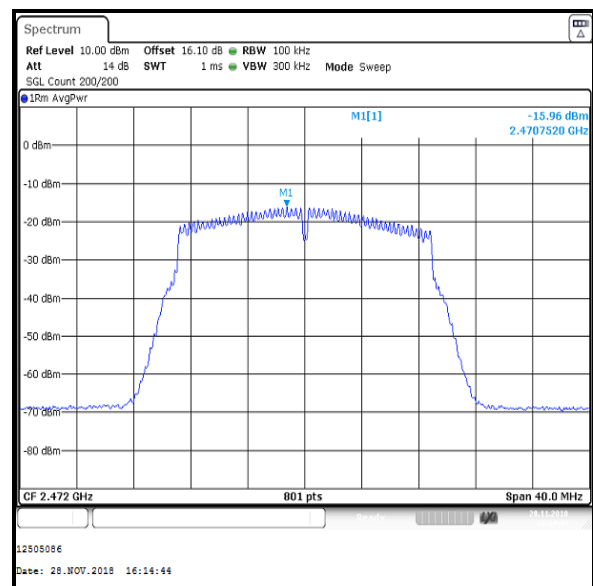
Channel 7



Channel 11



Channel 12

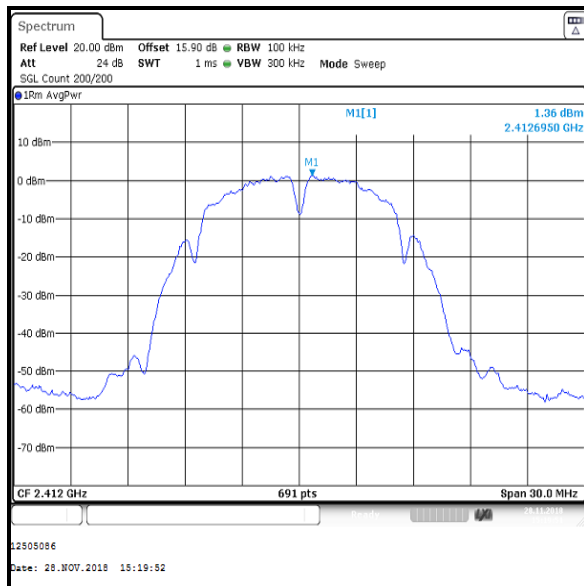
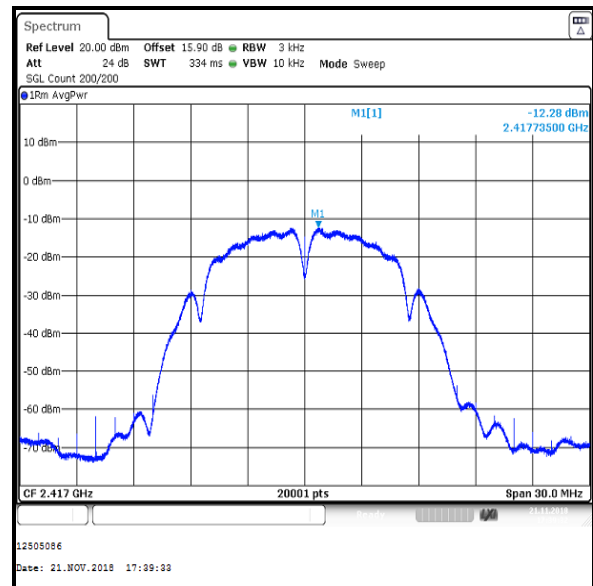
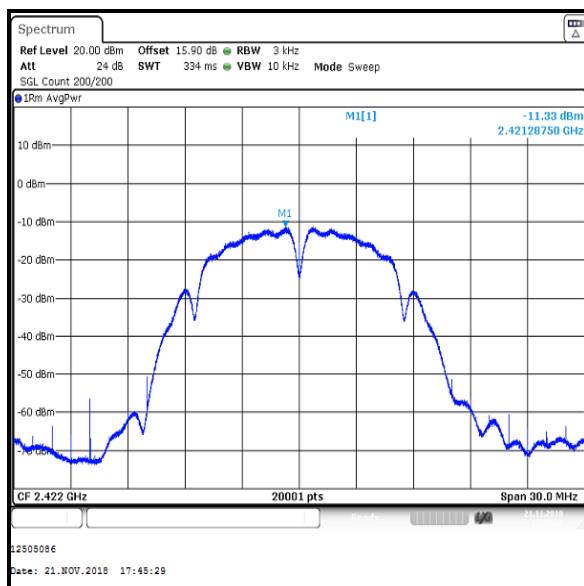
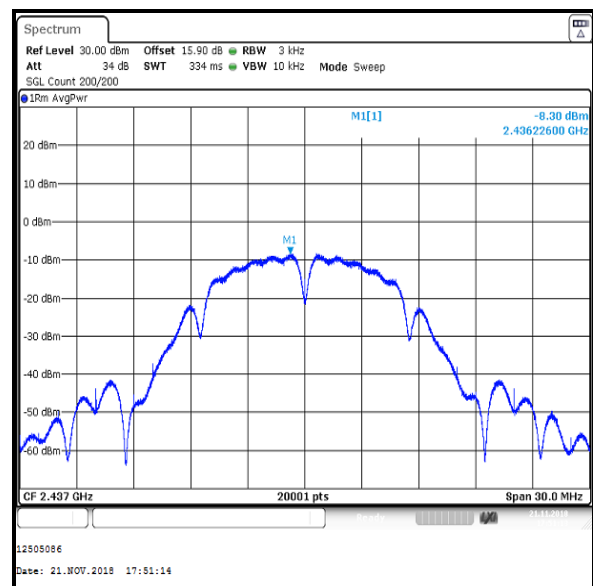


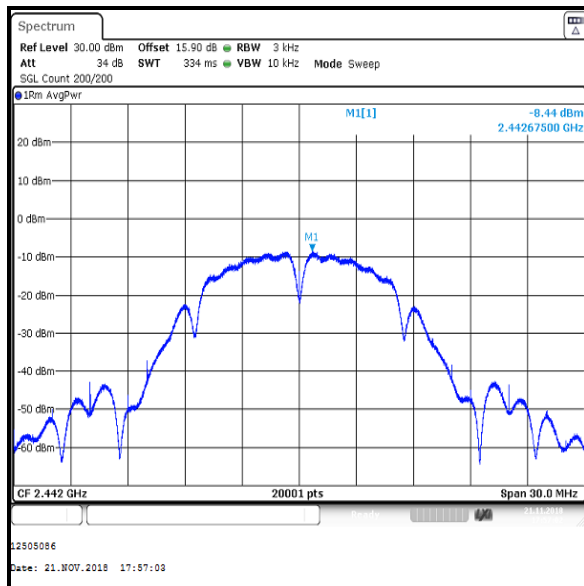
Channel 13

**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 2Tx CDD / DBPSK / 1 Mbps**

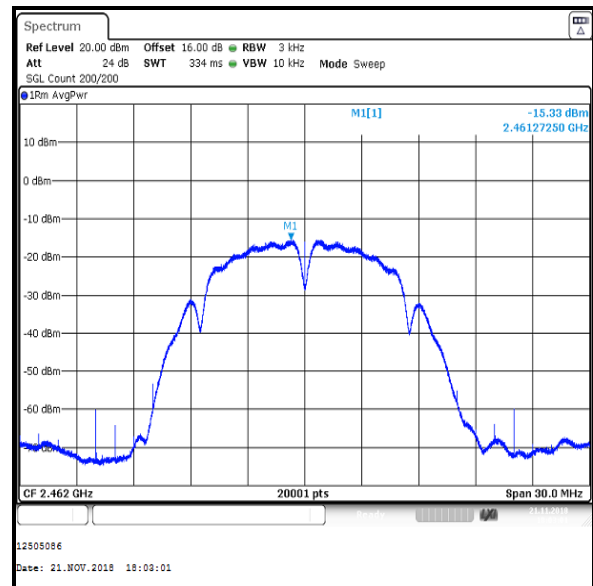
| Channel | PSD at Core 1 (dBm / 100 kHz) | PSD at Core 2 (dBm / 100 kHz) | Combined PSD (dBm / 100 kHz) | PSD Limit (dBm / 3 kHz) | Margin (dB) | Result   |
|---------|-------------------------------|-------------------------------|------------------------------|-------------------------|-------------|----------|
| 1       | 1.4                           | 1.4                           | 4.4                          | 8.0                     | 3.6         | Complied |

| Channel | PSD at Core 1 (dBm / 3 kHz) | PSD at Core 2 (dBm / 3 kHz) | Combined PSD (dBm / 3 kHz) | PSD Limit (dBm / 3 kHz) | Margin (dB) | Result   |
|---------|-----------------------------|-----------------------------|----------------------------|-------------------------|-------------|----------|
| 2       | -12.3                       | -12.4                       | -9.5                       | 8.0                     | 17.5        | Complied |
| 3       | -11.3                       | -11.5                       | -8.5                       | 8.0                     | 16.5        | Complied |
| 6       | -8.3                        | -8.4                        | -5.6                       | 8.0                     | 13.6        | Complied |
| 7       | -8.4                        | -8.5                        | -5.6                       | 8.0                     | 13.6        | Complied |
| 11      | -15.3                       | -15.2                       | -12.6                      | 8.0                     | 20.6        | Complied |
| 12      | -17.1                       | -17.2                       | -14.3                      | 8.0                     | 22.3        | Complied |
| 13      | -20.5                       | -20.5                       | -17.8                      | 8.0                     | 25.8        | Complied |

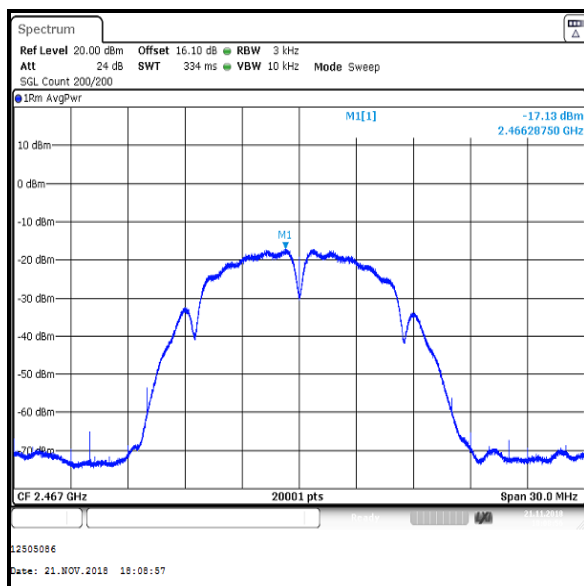
**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 2Tx CDD / DBPSK / 1 Mbps / Core 1****Channel 1****Channel 2****Channel 3****Channel 6**

**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 2Tx CDD / DBPSK / 1 Mbps / Core 1**

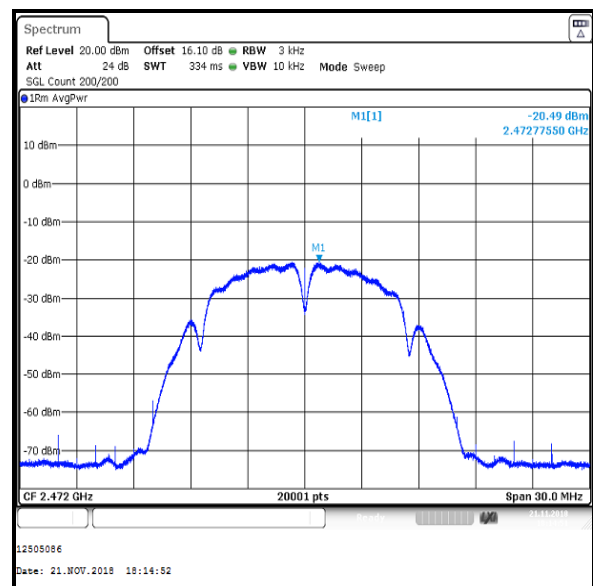
Channel 7



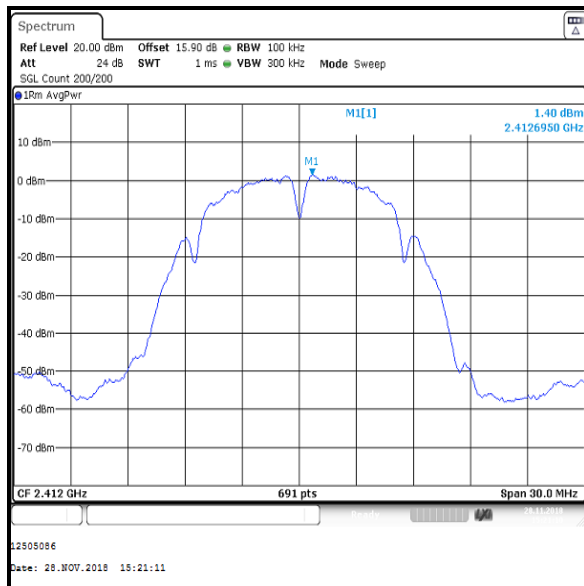
Channel 11



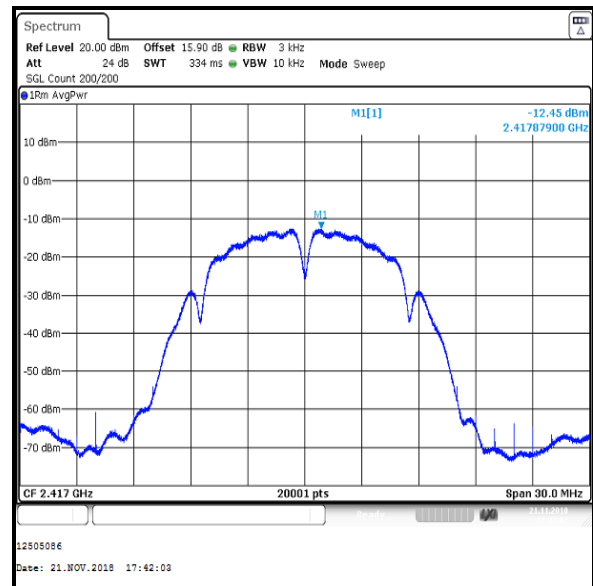
Channel 12



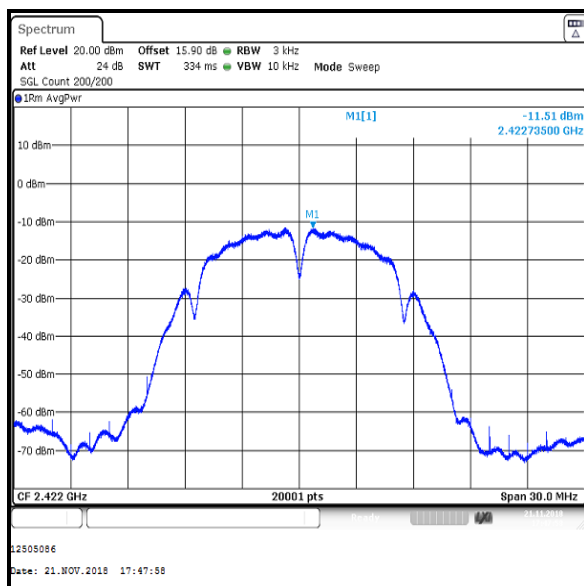
Channel 13

**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 2Tx CDD / DBPSK / 1 Mbps / Core 2**

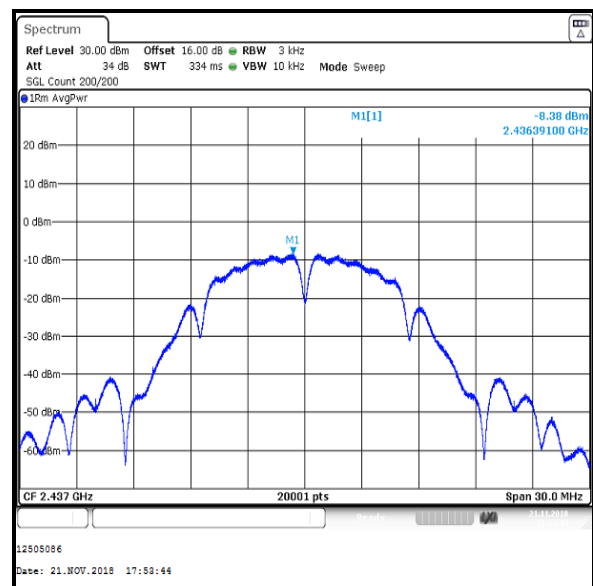
Channel 1



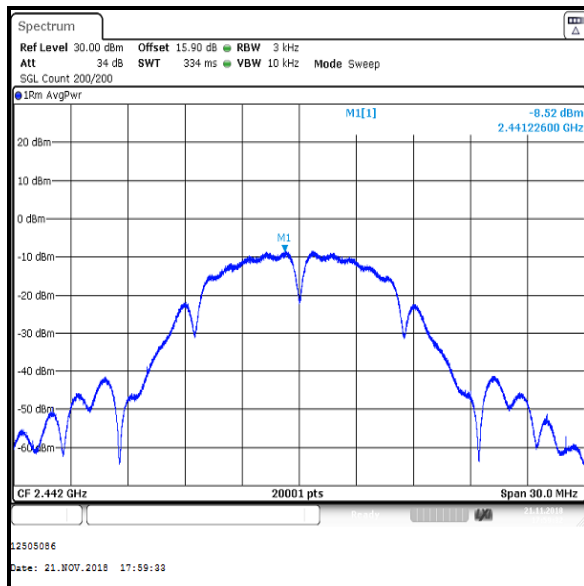
Channel 2



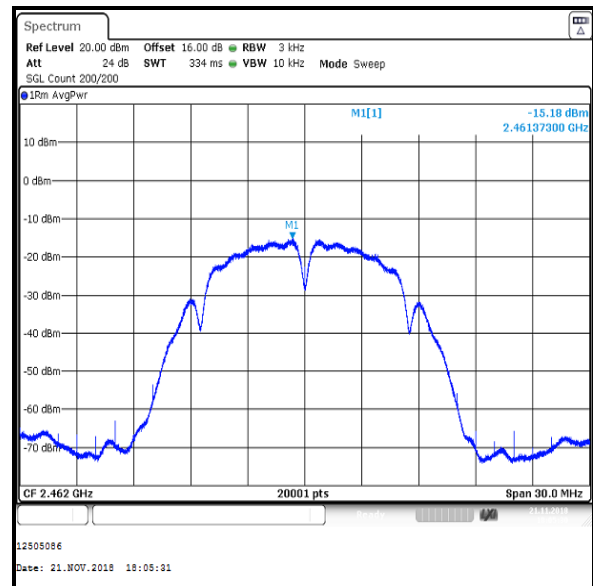
Channel 3



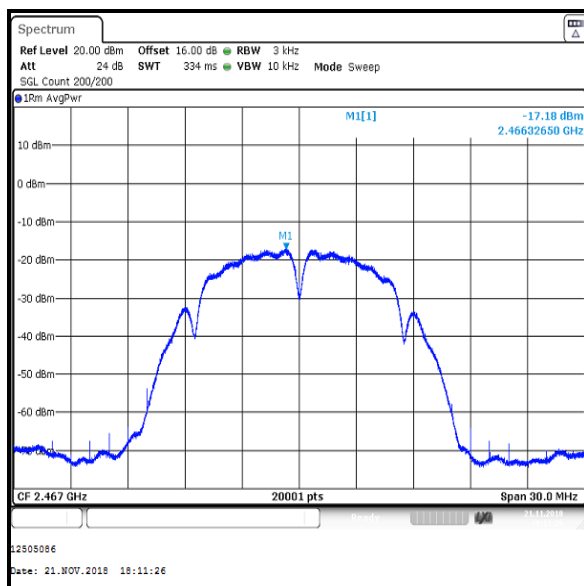
Channel 6

**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 2Tx CDD / DBPSK / 1 Mbps / Core 2**

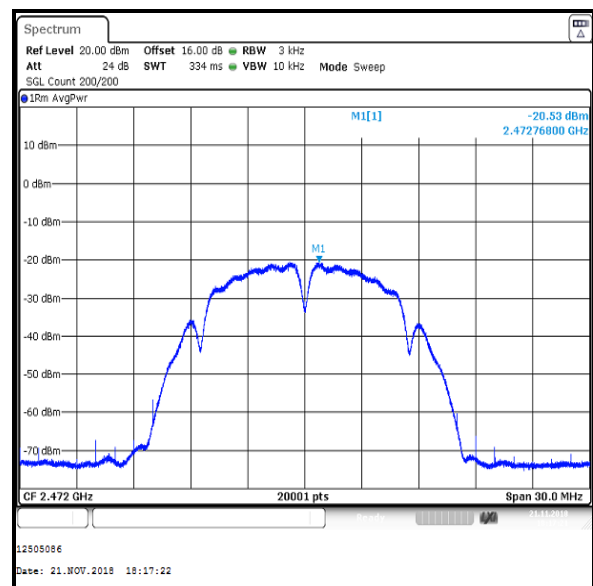
Channel 7



Channel 11



Channel 12



Channel 13

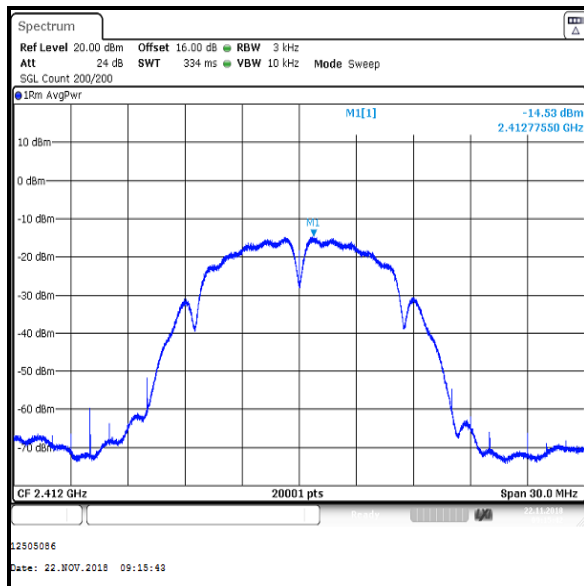
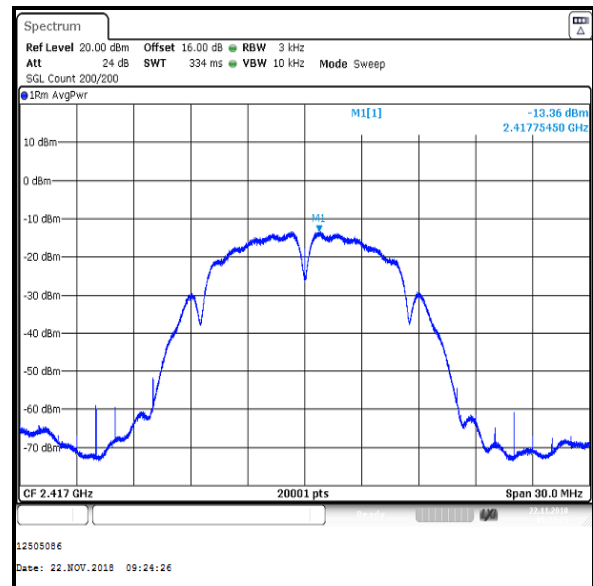
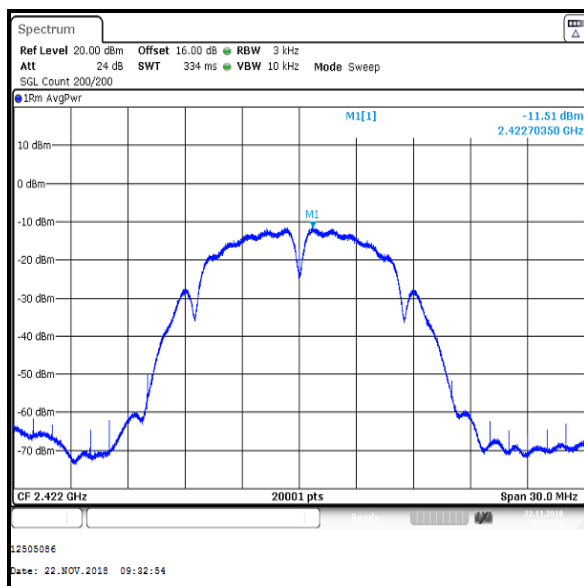
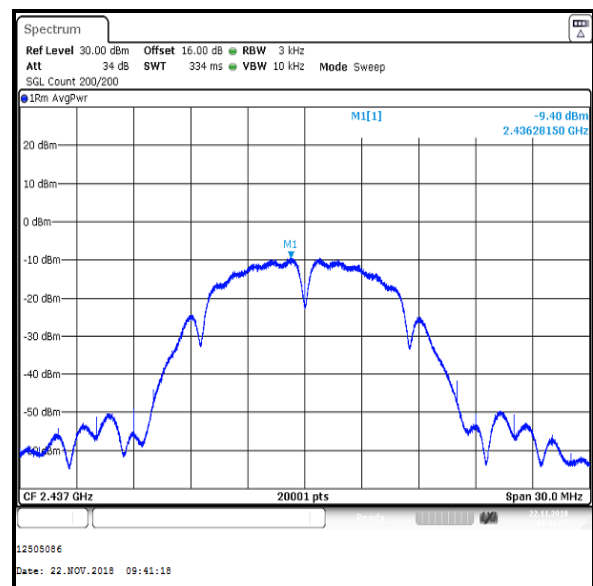
**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 3Tx CDD / DBPSK / 1 Mbps**

| Channel | PSD on Core 0<br>(dBm / 3 kHz) | PSD on Core 1<br>(dBm / 3 kHz) | PSD on Core 2<br>(dBm / 3 kHz) |
|---------|--------------------------------|--------------------------------|--------------------------------|
| 1       | -14.5                          | -15.0                          | -15.1                          |
| 2       | -13.4                          | -13.5                          | -13.5                          |
| 3       | -11.5                          | -11.6                          | -11.8                          |
| 6       | -9.4                           | -9.8                           | -9.7                           |
| 7       | -9.6                           | -9.5                           | -9.9                           |
| 11      | -16.4                          | -16.6                          | -16.5                          |
| 12      | -16.8                          | -17.2                          | -17.0                          |

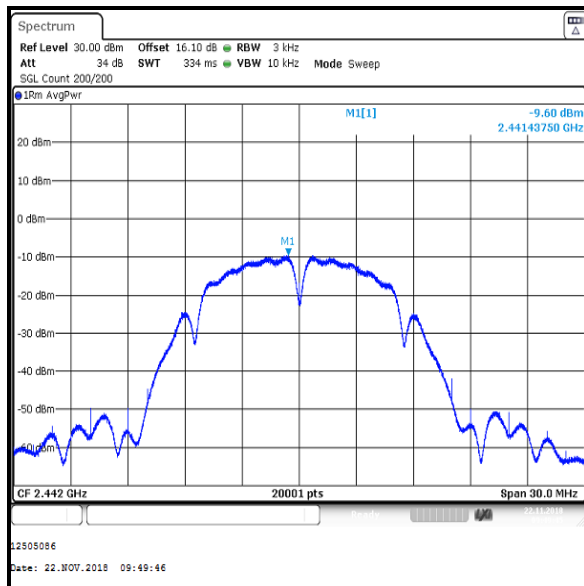
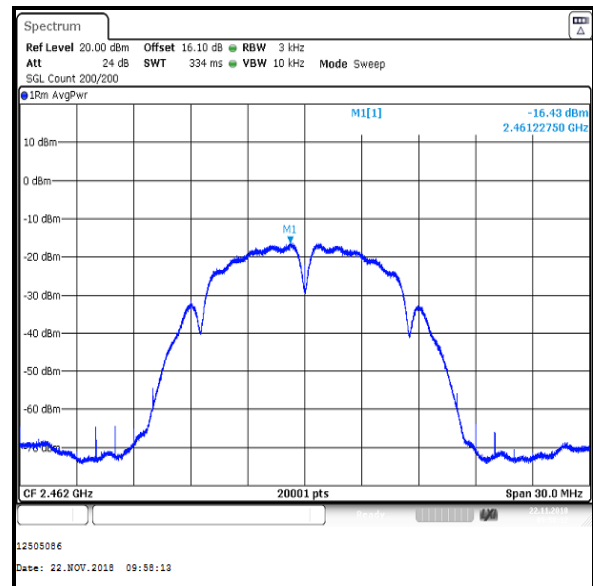
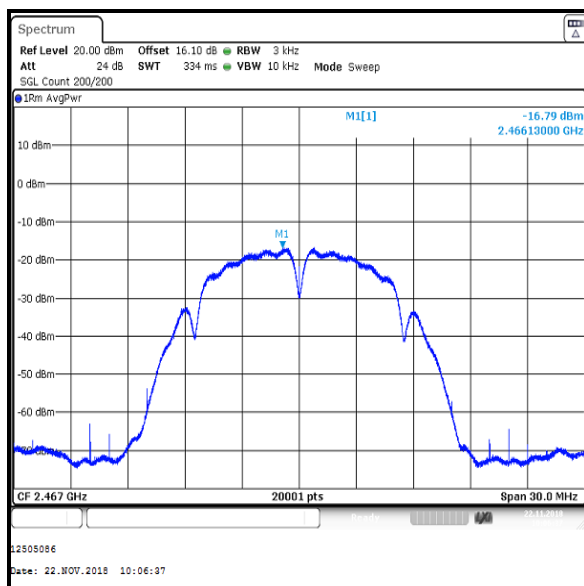
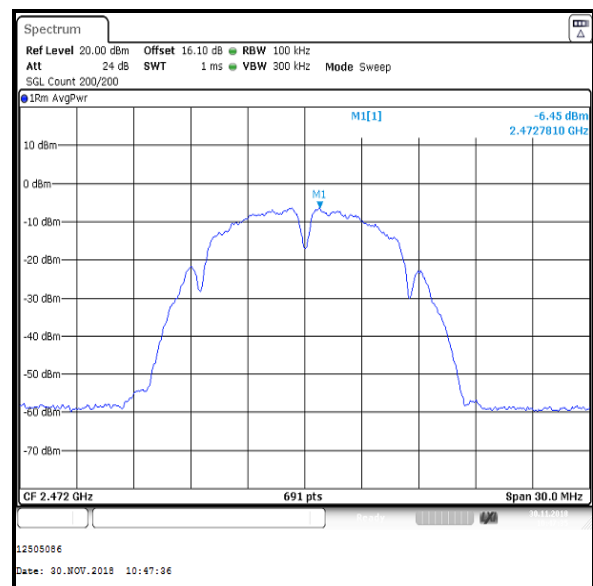
| Channel | Combined PSD<br>(dBm / 3 kHz) | PSD Limit<br>(dBm / 3 kHz) | Margin<br>(dB) | Result   |
|---------|-------------------------------|----------------------------|----------------|----------|
| 1       | -10.4                         | 8.0                        | 18.4           | Complied |
| 2       | -9.0                          | 8.0                        | 17.0           | Complied |
| 3       | -7.2                          | 8.0                        | 15.2           | Complied |
| 6       | -5.1                          | 8.0                        | 13.1           | Complied |
| 7       | -5.2                          | 8.0                        | 13.2           | Complied |
| 11      | -11.9                         | 8.0                        | 19.9           | Complied |
| 12      | -12.5                         | 8.0                        | 20.5           | Complied |

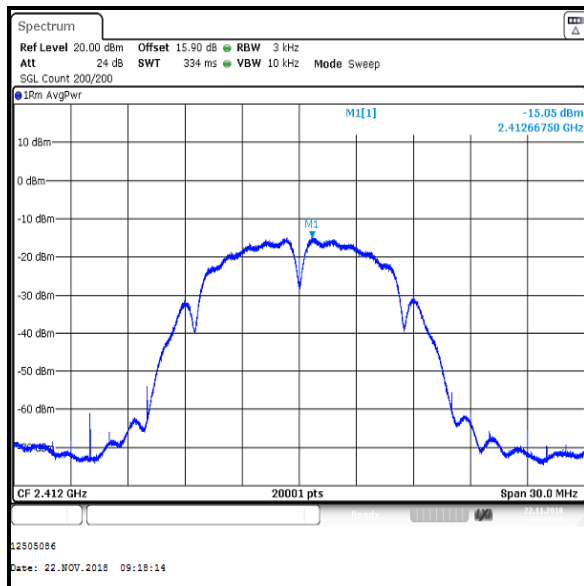
| Channel | PSD on Core 0<br>(dBm / 100 kHz) | PSD on Core 1<br>(dBm / 100 kHz) | PSD on Core 2<br>(dBm / 100 kHz) |
|---------|----------------------------------|----------------------------------|----------------------------------|
| 13      | -6.4                             | -6.5                             | -6.5                             |

| Channel | Combined PSD<br>(dBm / 100 kHz) | PSD Limit<br>(dBm / 3 kHz) | Margin<br>(dB) | Result   |
|---------|---------------------------------|----------------------------|----------------|----------|
| 13      | -1.8                            | 8.0                        | 9.8            | Complied |

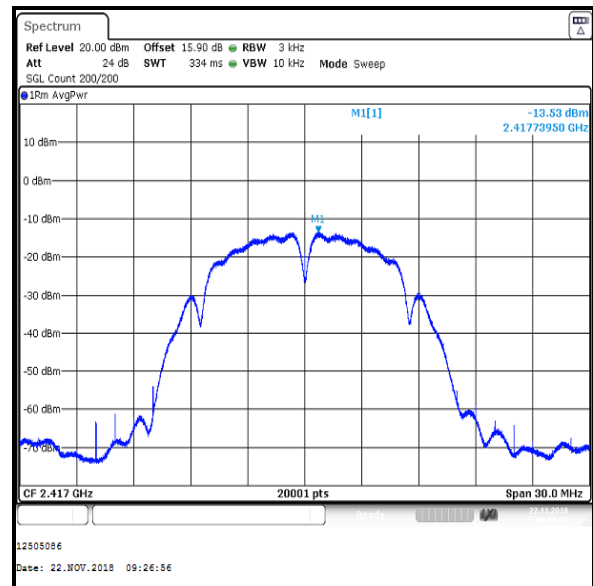
**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 3Tx CDD / DBPSK / 1 Mbps / Core 0****Channel 1****Channel 2****Channel 3****Channel 6**



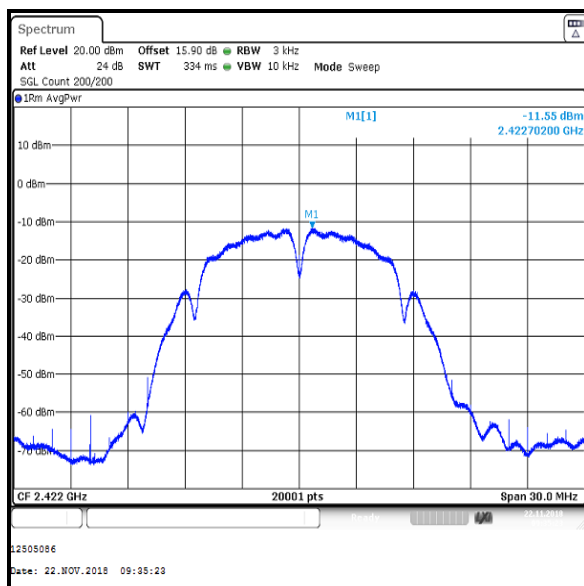
**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 3Tx CDD / DBPSK / 1 Mbps / Core 0****Channel 7****Channel 11****Channel 12****Channel 13**

**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 3Tx CDD / DBPSK / 1 Mbps / Core 1**

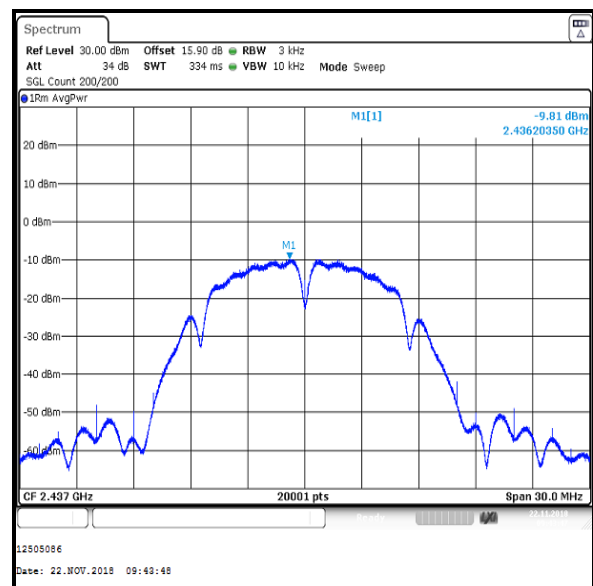
Channel 1



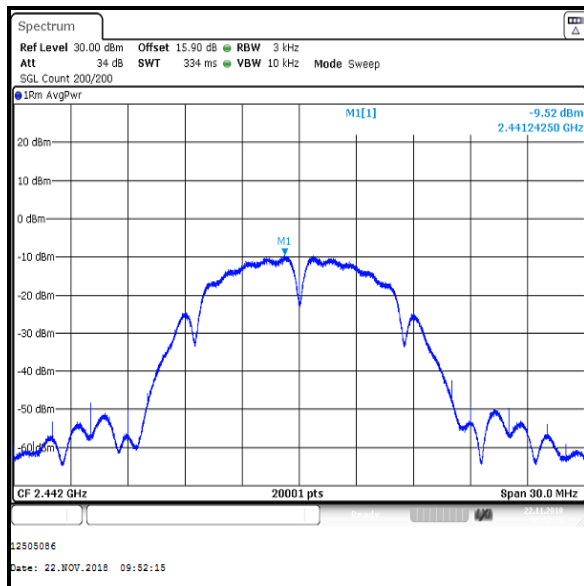
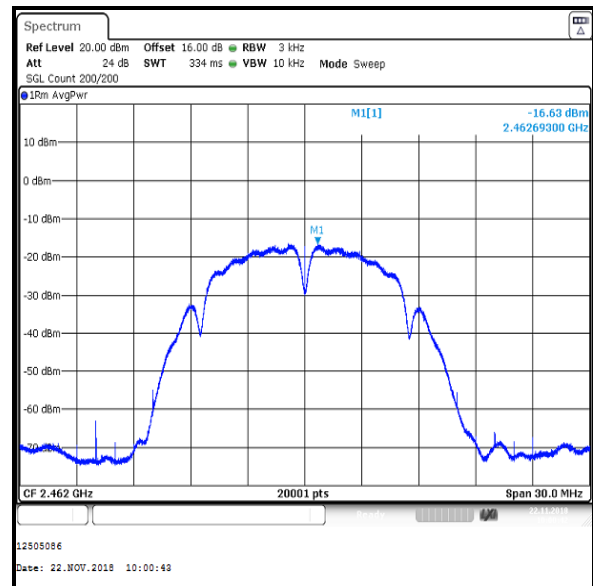
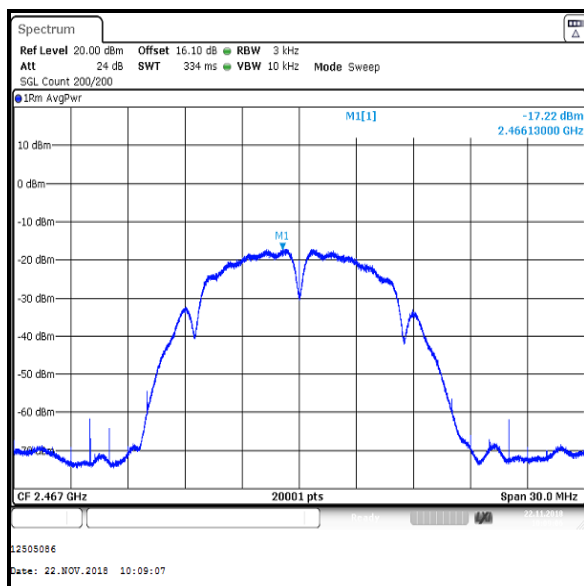
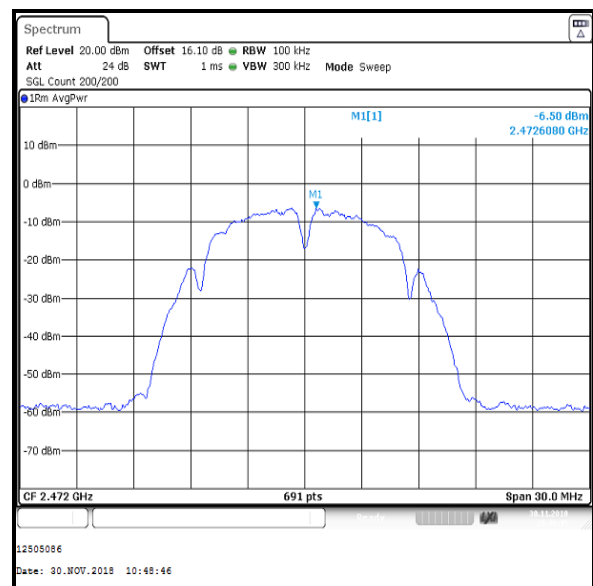
Channel 2

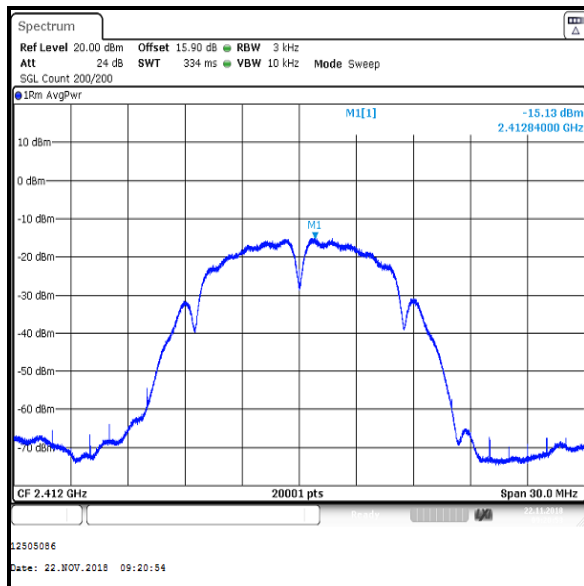
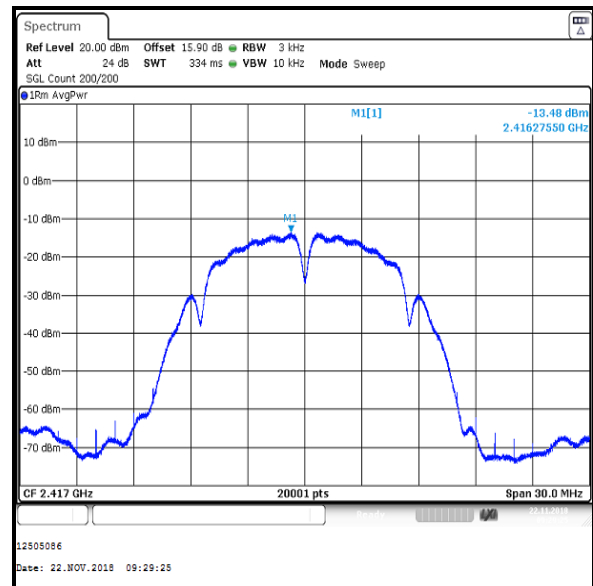
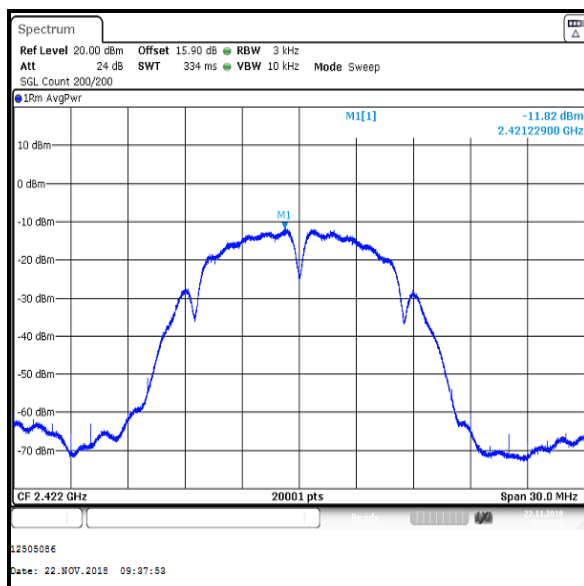
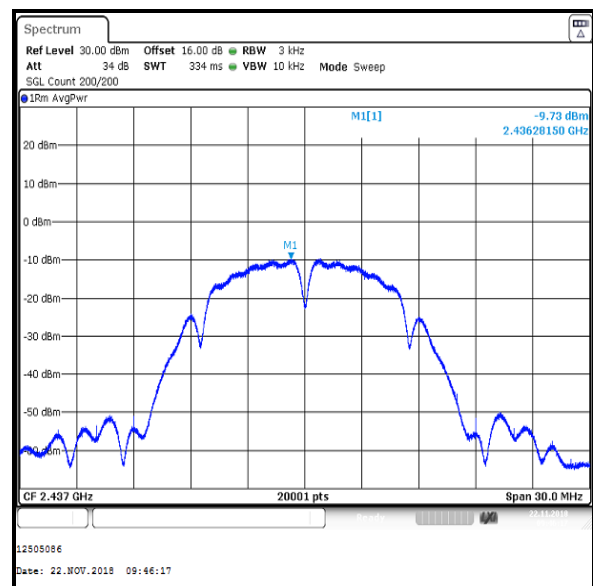


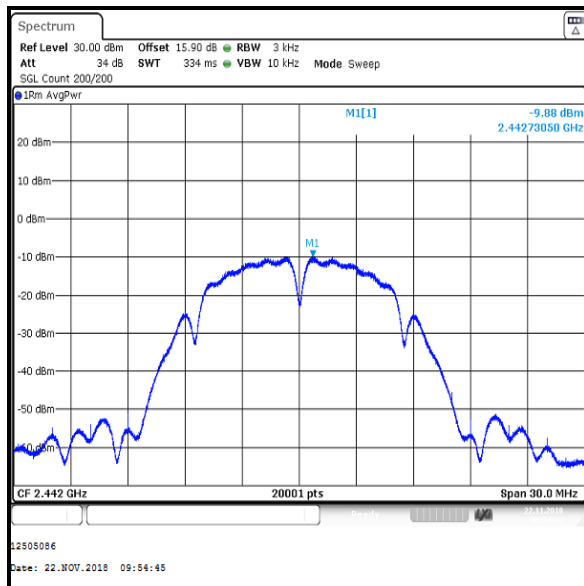
Channel 3



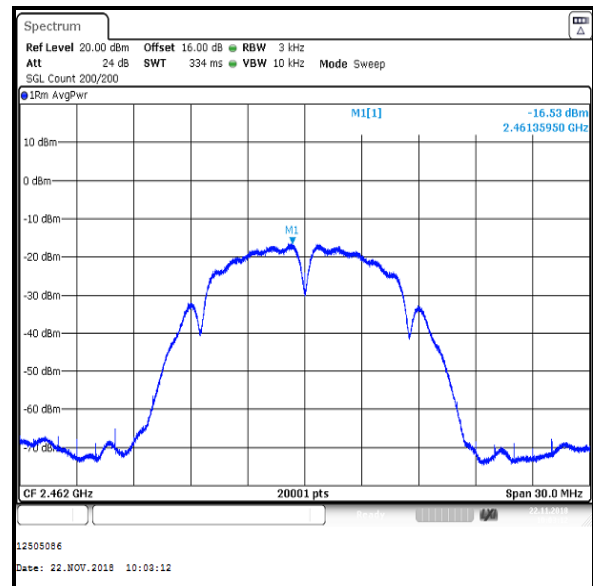
Channel 6

**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 3Tx CDD / DBPSK / 1 Mbps / Core 1****Channel 7****Channel 11****Channel 12****Channel 13**

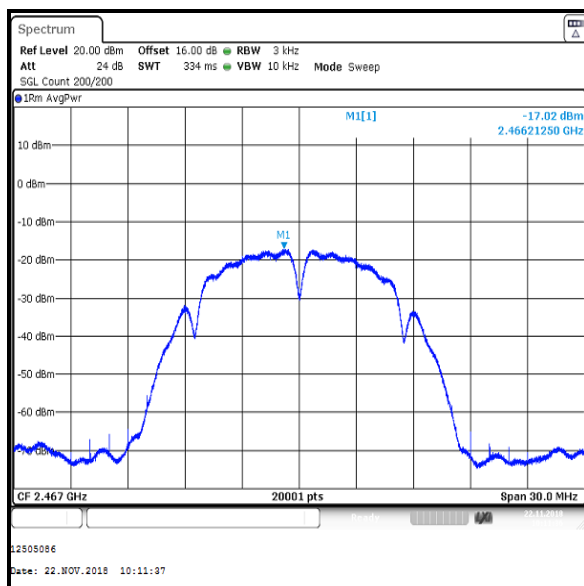
**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 3Tx CDD / DBPSK / 1 Mbps / Core 2****Channel 1****Channel 2****Channel 3****Channel 6**

**Transmitter Power Spectral Density (continued)****Results: 802.11b / 20 MHz / MIMO / 3Tx CDD / DBPSK / 1 Mbps / Core 2**

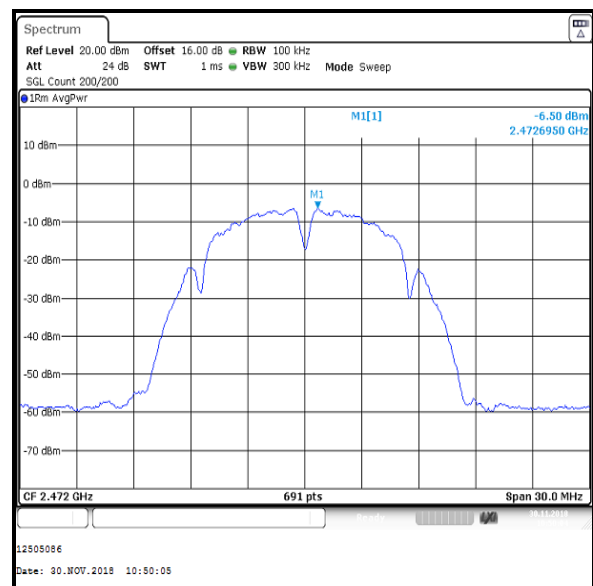
Channel 7



Channel 11



Channel 12



Channel 13

**Transmitter Power Spectral Density (continued)****Results: 802.11n / HT20 / MIMO / 2Tx CDD / BPSK / MCS0**

| Channel | PSD at Core 1 (dBm / 3 kHz) | PSD at Core 2 (dBm / 3 kHz) | Combined PSD (dBm / 3 kHz) | PSD Limit (dBm / 3 kHz) | Margin (dB) | Result   |
|---------|-----------------------------|-----------------------------|----------------------------|-------------------------|-------------|----------|
| 1       | -15.6                       | -15.4                       | -12.6                      | 8.0                     | 20.6        | Complied |
| 2       | -13.5                       | -13.7                       | -10.6                      | 8.0                     | 18.6        | Complied |
| 3       | -10.8                       | -11.2                       | -8.0                       | 8.0                     | 16.0        | Complied |
| 6       | -8.6                        | -9.0                        | -5.8                       | 8.0                     | 13.8        | Complied |
| 7       | -10.2                       | -10.2                       | -7.2                       | 8.0                     | 15.2        | Complied |
| 11      | -16.4                       | -16.1                       | -13.5                      | 8.0                     | 21.5        | Complied |
| 12      | -19.8                       | -19.6                       | -16.8                      | 8.0                     | 24.8        | Complied |

| Channel | PSD at Core 1 (dBm / 100 kHz) | PSD at Core 2 (dBm / 100 kHz) | Combined PSD (dBm / 100 kHz) | PSD Limit (dBm / 3 kHz) | Margin (dB) | Result   |
|---------|-------------------------------|-------------------------------|------------------------------|-------------------------|-------------|----------|
| 13      | -16.4                         | -16.2                         | -13.5                        | 8.0                     | 21.5        | Complied |