# TEST REPORT

## Test Report No.: UL-RPT-RP11631392JD01A

| | | |
|---|---|---|
| **Manufacturer** | : | Braster Spolka Akcyjna |
| **Model No.** | : | BRA-1.0 |
| **FCC ID** | : | 2ALTBRA-V10 |
| **Technology** | : | WLAN |
| **Test Standard(s)** | : | FCC Parts 15.209(a) & 15.247 |

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:** 10 May 2017

**Checked by:**

Sarah Williams
Engineer, Radio Laboratory

**Company Signatory:**

Ian Watch
Senior Engineer, Radio Laboratory
UL VS LTD

0644

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

**UL VS LTD**

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# 1. Customer Information

| | |
|---|---|
| **Company Name:** | Braster Spolka Akcyjna |
| **Address:** | Szeligi, ul.<br>Cichy Ogrod 7<br>05-850 Ozarow Mazowiecki<br>Poland |

# 2. Summary of Testing

## 2.1. General Information

| | |
|---|---|
| **Specification Reference:** | 47CFR15.247 |
| **Specification Title:** | Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247 |
| **Specification Reference:** | 47CFR15.209 |
| **Specification Title:** | Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209 |
| **Site Registration:** | 209735 |
| **Location of Testing:** | UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom |
| **Test Dates:** | 28 March 2017 to 28 April 2017 |

## 2.2. Summary of Test Results

| FCC Reference (47CFR) | Measurement | Result |
|---|---|---|
| Part 15.207 | Transmitter AC Conducted Emissions | Note 1 |
| Part 15.247(a)(2) | Transmitter Minimum 6 dB Bandwidth | ✓ |
| Part 15.35(c) | Transmitter Duty Cycle | Note 2 |
| Part 15.247(e) | Transmitter Power Spectral Density | ✓ |
| Part 15.247(b)(3) | Transmitter Maximum Output Power | ✓ |
| Part 15.247(d) & 15.209(a) | Transmitter Radiated Emissions | ✓ |
| Part 15.247(d) & 15.209(a) | Transmitter Band Edge Radiated Emissions | ✓ |

**Key to Results**

✓ = Complied ✗ = Did not comply

**Note(s):**

1. Customer has declared that the EUT will never transmit while connected to the mains network via a charger. This is limited by hardware.
2. The measurement was performed to assist in the calculation of the level of emissions. The EUT cannot transmit continuously and sweep triggering/signal gating cannot be implemented.

## 2.3. Methods and Procedures

| | |
|---|---|
| **Reference:** | ANSI C63.10-2013 |
| **Title:** | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| **Reference:** | KDB 558074 D01 DTS Meas Guidance v04 April 5, 2017 |
| **Title:** | Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247 |

## 2.4. 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.

# 3. Equipment Under Test (EUT)

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

| | |
|---|---|
| **Brand Name:** | Braster |
| **Model Name or Number:** | BRA-1.0 |
| **Test Sample Serial Number:** | BRA-002AD7 *(Conducted sample)* |
| **Hardware Version:** | v.4.3 |
| **Software Version:** | Custom test firmware |
| **FCC ID:** | 2ALTBRA-V10 |

| | |
|---|---|
| **Brand Name:** | Braster |
| **Model Name or Number:** | BRA-1.0 |
| **Test Sample Serial Number:** | BRA-0030BC *(Radiated sample)* |
| **Hardware Version:** | v.4.3 |
| **Software Version:** | Custom test firmware |
| **FCC ID:** | 2ALTBRA-V10 |

## 3.2. Description of EUT

The equipment under test was an in-home breast examination system. It contains an IEEE 802.11 WLAN transceiver that supports 802.11b and 802.11g.

## 3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

## 3.4. Additional Information Related to Testing

| | | |
|---|---|---|
| **Technology Tested:** | WLAN (IEEE 802.11b,g) / Digital Transmission System | |
| **Type of Unit:** | Transceiver | |
| **Modulation Type:** | DBPSK, DQPSK, BPSK, QPSK, 16QAM & 64QAM | |
| **Data Rates:** | 802.11b | 1, 2, 5.5 & 11 Mbps |
| | 802.11g | 6, 9, 12, 18, 24, 36, 48 & 54 Mbps |
| **Power Supply Requirement(s):** | Nominal | 3.7 VDC via internal Lithium-polymer battery |
| **Maximum Conducted Output Power:** | 24.0 dBm | |
| **Declared Antenna Gain:** | -6.2 dBi | |
| **Channel Spacing:** | 20 MHz | |
| **Transmit Frequency Range:** | 2412 MHz to 2472 MHz | |
| **Transmit Channels Tested:** | **Channel Number** | **Channel Frequency (MHz)** |
| | 1 | 2412 |
| | 6 | 2437 |
| | 13 | 2472 |

## 3.5. Support Equipment

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

| | |
|---|---|
| **Brand Name:** | Not marked or stated |
| **Description:** | USB type A to mini B cable (Length: 100 cm) |
| **Model Name or Number:** | Not marked or stated |
| **Serial Number:** | Not marked or stated |

| | |
|---|---|
| **Brand Name:** | Lenovo |
| **Description:** | Laptop PC |
| **Model Name or Number:** | L440 |
| **Serial Number:** | R9-019E9Z 14/04 |

# 4. Operation and Monitoring of the EUT during Testing

## 4.1. Operating Modes

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

- Continuously transmitting with a modulated carrier at maximum power on the relevant channels as required using the supported data rates/modulation types.

## 4.2. Configuration and Peripherals

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

- Controlled using the bespoke application *DfuSe Demo V3.0.5* on a laptop PC supplied by the customer. The application was used to enable a continuous transmission mode and to select the test channels, data rates and modulation schemes as required. The procedure to set up and control the EUT was supplied by the customer in a document titled "*Information for setting up the Braster device V.1.0"* dated 20/02/2017*,* which is stored on the company server.
- The EUT was connected to a test laptop via a USB type A to mini type B cable. Upon selection of the relevant channel and data rate, the USB cable was disconnected from the EUT to enable transmission.
- All supported modes and channel widths were initially investigated on one channel. The modes that produced the highest power, power spectral density and widest bandwidth for all bands were:
    - 802.11b – DQPSK / 11 Mbps
    - 802.11g – 64QAM / 54 Mbps
- Transmitter spurious emissions were performed with the EUT transmitting with a data rate of 54 Mbps. This was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and, as this mode emits the highest output power level, it was deemed to be the worst case.
- The conducted sample with serial number BRA-002AD7 was used for minimum 6 dB bandwidth, duty cycle, maximum output power and power spectral density tests.
- The radiated sample with serial number BRA-0030BC was used for all other tests.

# 5. Measurements, Examinations and Derived Results

## 5.1. 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.

## 5.2. Test Results

### 5.2.1. Transmitter Minimum 6 dB Bandwidth

**Test Summary:**

| | | | |
|---|---|---|---|
| **Test Engineer:** | Georgios Vrezas | **Test Date:** | 28 March 2017 |
| **Test Sample Serial Number:** | BRA-002AD7 | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.247(a)(2) |
| **Test Method Used:** | FCC KDB 558074 Section 8.1 |

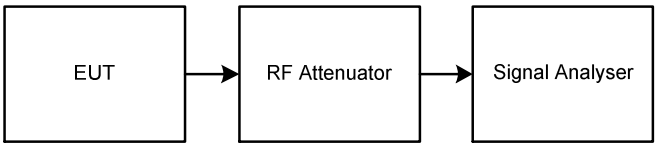
**Environmental Conditions:**

| | |
|---|---|
| **Temperature (°C):** | 23 |
| **Relative Humidity (%):** | 39 |

**Note(s):**

1. All configurations supported by the EUT were investigated on one channel in accordance with KDB 558074 Section 8.1 Option 1 measurement procedure. 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.
2. The data rates that produced the narrowest bandwidth and therefore deemed worst case were:
    - 802.11b - DQPSK / 11 Mbps
    - 802.11g - 64QAM / 54 Mbps
3. Final measurements were performed using the above configurations on the relevant channels in accordance with KDB 558074 Section 8.1 Option 1 measurement procedure.
4. Plots for all data rates are archived on the Company server and available for inspection upon request.
5. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

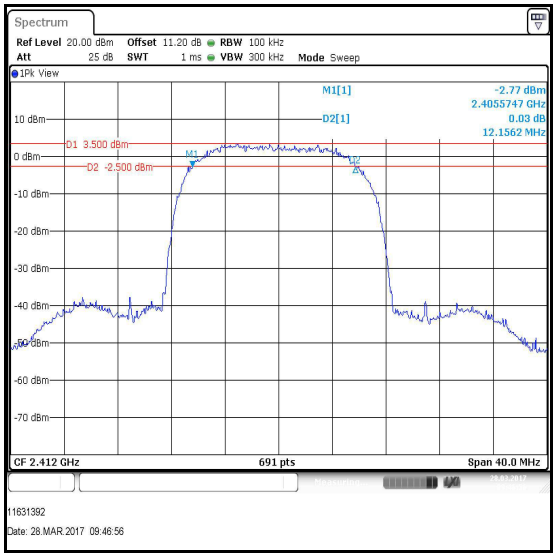
**Test setup:**



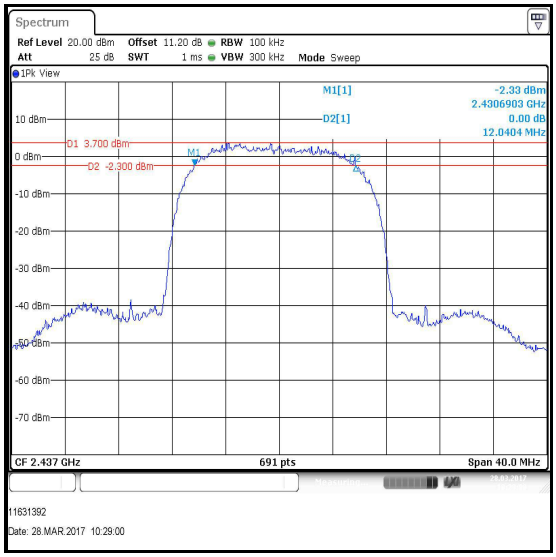
## Transmitter Minimum 6 dB Bandwidth (continued)

## Results: 802.11b / 20 MHz / DQPSK / 11 Mbps

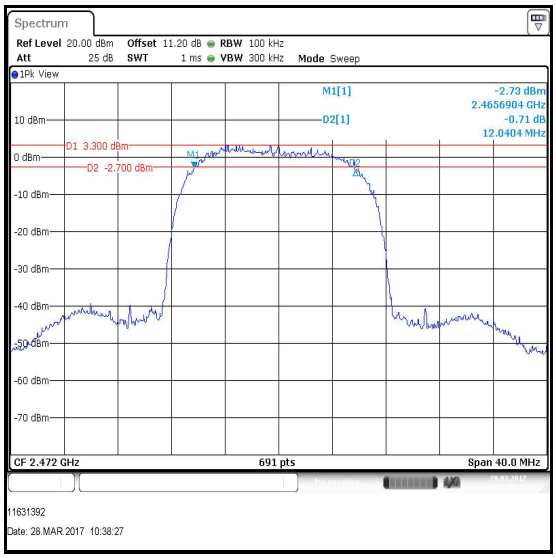
| Channel | 6 dB Bandwidth (kHz) | Limit (kHz) | Margin (kHz) | Result |
|---|---|---|---|---|
| 1 | 12156 | ≥500 | 11656 | Complied |
| 6 | 12040 | ≥500 | 11540 | Complied |
| 13 | 12040 | ≥500 | 11540 | Complied |




Channel 1




Channel 6

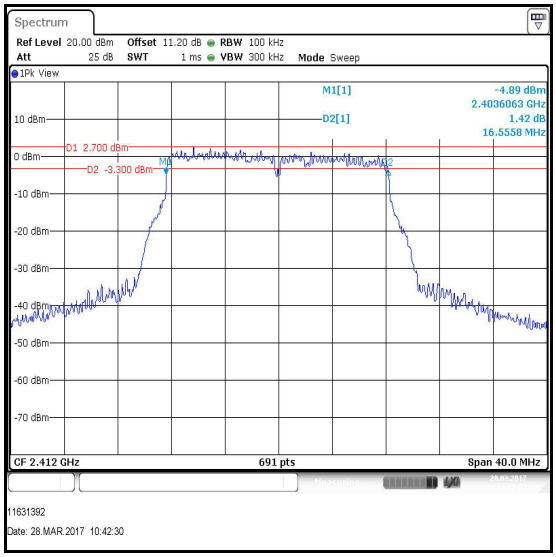



Channel 13

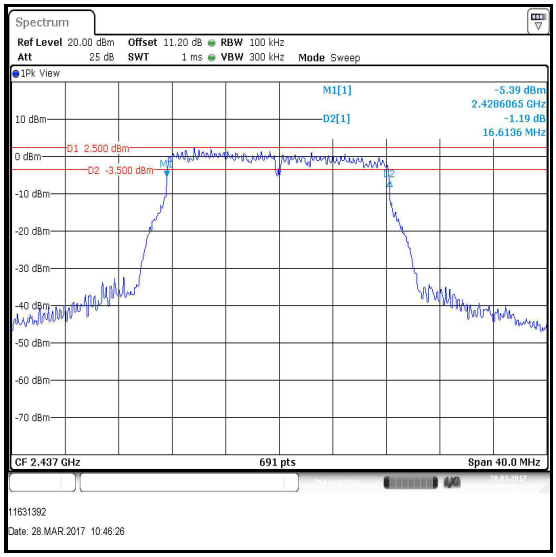
## Transmitter Minimum 6 dB Bandwidth (continued)

## Results: 802.11g / 20 MHz / 64QAM / 54 Mbps

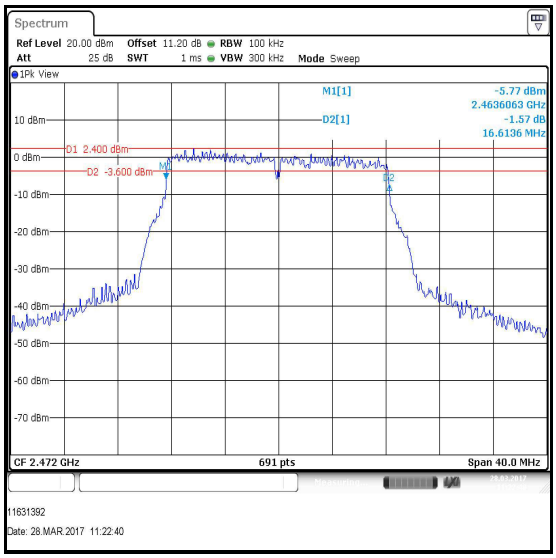
| Channel | 6 dB Bandwidth (kHz) | Limit (kHz) | Margin (kHz) | Result |
|---|---|---|---|---|
| 1 | 16556 | ≥500 | 16056 | Complied |
| 6 | 16614 | ≥500 | 16114 | Complied |
| 13 | 16614 | ≥500 | 16114 | Complied |




Channel 1




Channel 6




Channel 13

## Transmitter Minimum 6 dB Bandwidth (continued)

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M2002 | Thermohygrometer | Testo | 608-H1 | 45041825 | 22 Feb 2018 | 12 |
| M1873 | Signal Analyser | Rohde & Schwarz | FSV30 | 103074 | 27 Jun 2017 | 12 |
| M1804 | Signal Generator | Rohde & Schwarz | SMP22 | 100026 | 17 Feb 2018 | 24 |
| A2930 | Attenuator | AtlanTecRF | AB18W5-10 | 000907-18#1 | Calibrated before use | - |

## 5.2.2. Transmitter Duty Cycle

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Georgios Vrezas | **Test Date:** | 28 March 2017 |
| **Test Sample Serial Number:** | BRA-002AD7 | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.35(c) |
| **Test Method Used:** | FCC KDB 558074 Section 6.0 |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 23 |
| **Relative Humidity (%):** | 39 |

### Note(s):

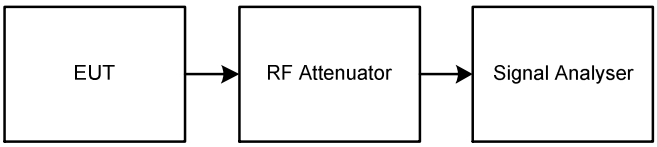
1. In order to assist with the determination of the average level of fundamental and spurious emissions field strength, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a signal analyser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

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

*802.11b / 20 MHz / 11 Mbps duty cycle 10 log (1 / (838.910/874.910)) = 0.2 dB*

*802.11g / 20 MHz / 54 Mbps duty cycle 10 log (1 / (175.776/222.989)) = 1.0 dB*

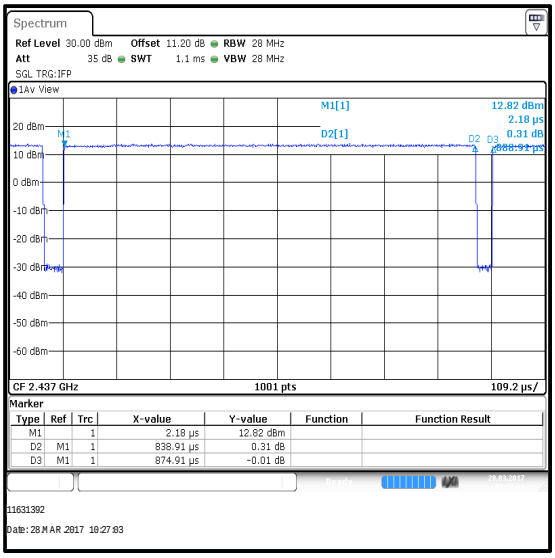
### Test setup:



## Transmitter Duty Cycle (continued)

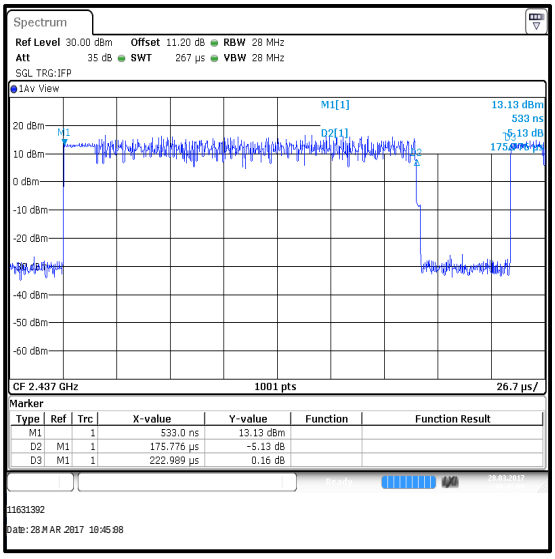
## Results: 802.11b / 20 MHz / 11 Mbps

| Pulse Duration (µs) | Period (µs) | Duty Cycle (dB) |
|---|---|---|
| 838.910 | 874.910 | 0.2 |




## Results: 802.11g / 20 MHz / 54 Mbps

| Pulse Duration (µs) | Period (µs) | Duty Cycle (dB) |
|---|---|---|
| 175.776 | 222.989 | 1.0 |



## Transmitter Duty Cycle (continued)

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M2002 | Thermohygrometer | Testo | 608-H1 | 45041825 | 22 Feb 2018 | 12 |
| M1873 | Signal Analyser | Rohde & Schwarz | FSV30 | 103074 | 27 Jun 2017 | 12 |
| M1804 | Signal Generator | Rohde & Schwarz | SMP22 | 100026 | 17 Feb 2018 | 24 |
| A2930 | Attenuator | AtlanTecRF | AB18W5-10 | 000907-18#1 | Calibrated before use | - |

## 5.2.3. Transmitter Power Spectral Density

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Georgios Vrezas | **Test Date:** | 28 April 2017 |
| **Test Sample Serial Number:** | BRA-002AD7 | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.247(e) |
| **Test Method Used:** | FCC KDB 558074 Section10.2 |

### Environmental Conditions:

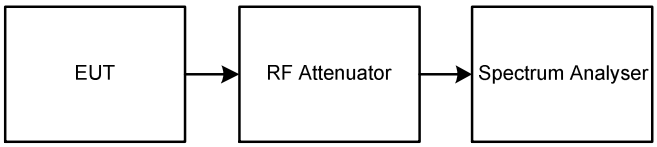
| | |
|---|---|
| **Temperature (°C):** | 27 |
| **Relative Humidity (%):** | 29 |

### Note(s):

1. All supported modes and channel widths were initially investigated on one channel. The modes that produced the highest power spectral density were:
    - o 802.11b - DQPSK / 11 Mbps
    - o 802.11g - 64QAM / 54 Mbps

    Final measurements were performed using the above configurations on the relevant channels.
2. Testing was performed in accordance with KDB 558074 Section 10.2 Method PKPSD. The spectrum analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time set to auto couple and trace mode was Max Hold. The span was set to 1.5 times the DTS bandwidth. A marker was placed at the peak of the signal and the results recorded in the table below.
3. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the spectrum analyser to compensate for the loss of the attenuator and RF cable.

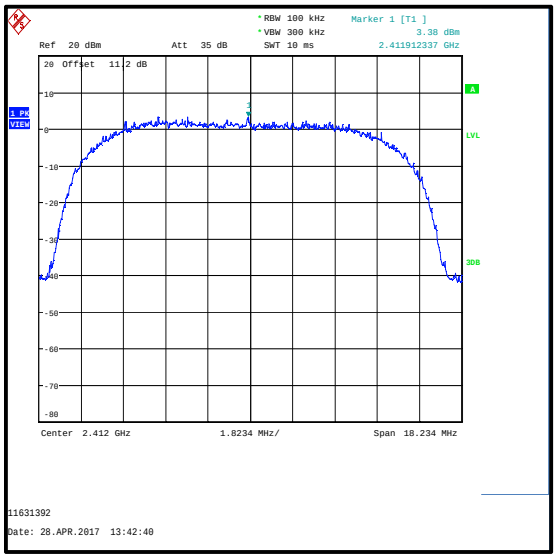
### Test setup:



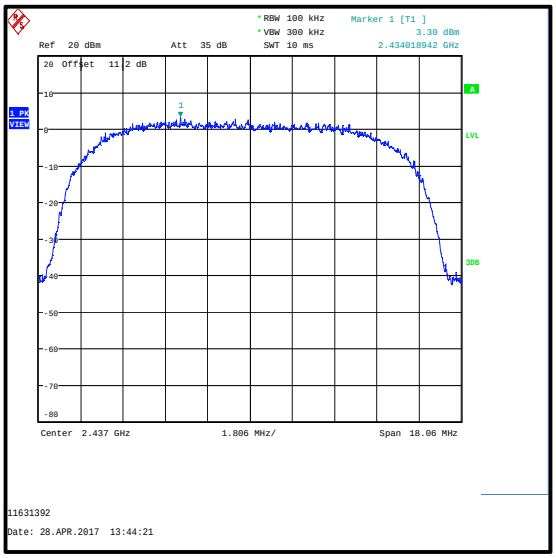
## Transmitter Power Spectral Density (continued)

## Results: 802.11b / 20 MHz / DQPSK / 11 Mbps

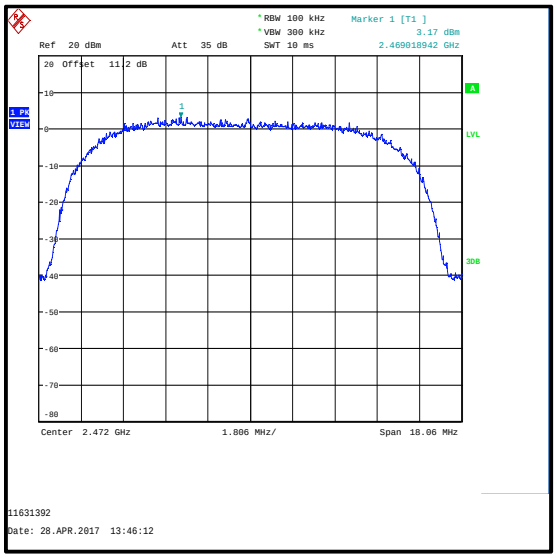
| Channel | Output Power (dBm/100 kHz) | Limit (dBm/3 kHz) | Margin (dB) | Result |
|---|---|---|---|---|
| 1 | 3.4 | 8.0 | 4.6 | Complied |
| 6 | 3.3 | 8.0 | 4.7 | Complied |
| 13 | 3.2 | 8.0 | 4.8 | Complied |




**Channel 1**




**Channel 6**

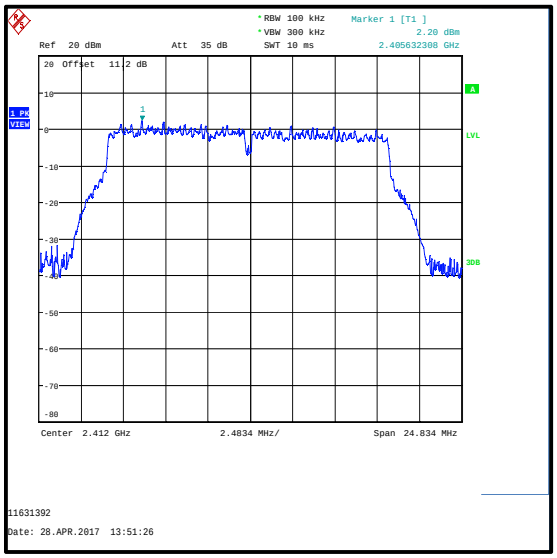



**Channel 13**

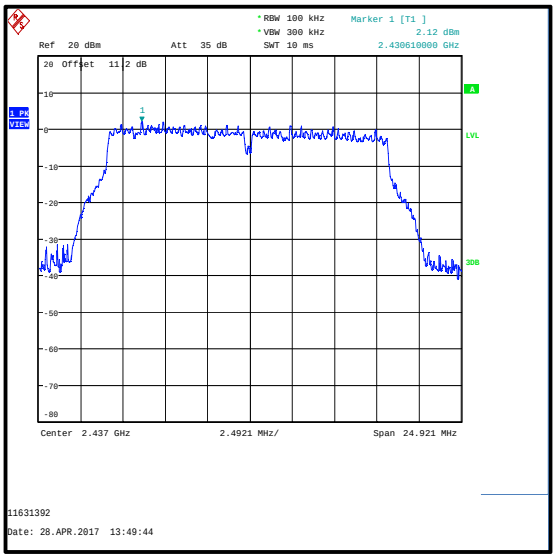
## Transmitter Power Spectral Density (continued)

## Results: 802.11g / 20 MHz / 64QAM / 54 Mbps

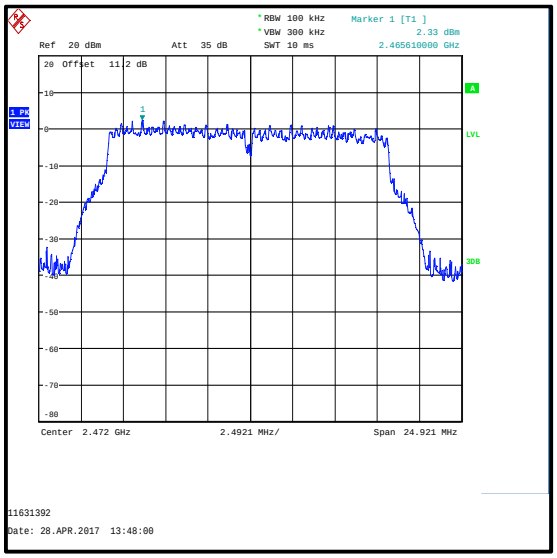
| Channel | Output Power (dBm/100 kHz) | Limit (dBm/3 kHz) | Margin (dB) | Result |
|---|---|---|---|---|
| 1 | 2.2 | 8.0 | 5.8 | Complied |
| 6 | 2.1 | 8.0 | 5.9 | Complied |
| 13 | 2.3 | 8.0 | 5.7 | Complied |




Channel 1




Channel 6




Channel 13

## Transmitter Power Spectral Density (continued)

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M2002 | Thermohygrometer | Testo | 608-H1 | 45041825 | 22 Feb 2018 | 12 |
| L1188 | Spectrum Analyser | Rohde & Schwarz | FSU8 | 200235 | 07 Mar 2018 | 12 |
| M1804 | Signal Generator | Rohde & Schwarz | SMP22 | 100026 | 17 Feb 2018 | 24 |
| A2930 | Attenuator | AtlanTecRF | AB18W5-10 | 000907-18#1 | Calibrated before use | - |

## 5.2.4. Transmitter Maximum Output Power

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Georgios Vrezas | **Test Date:** | 03 April 2017 |
| **Test Sample Serial Number:** | BRA-002AD7 | | |

| | |
|---|---|
| **FCC Reference:** | Part 15.247(b)(3) |
| **Test Method Used:** | FCC KDB 558074 Section 9.1.3 |

### Environmental Conditions:

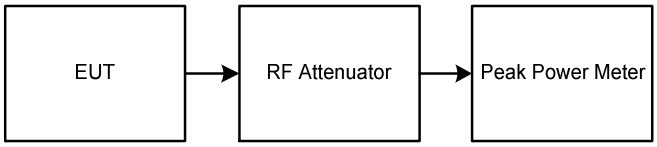
| | |
|---|---|
| **Temperature (°C):** | 22 |
| **Relative Humidity (%):** | 36 |

### Note(s):

1. All supported modes and channel widths were initially investigated on one channel. The modes that produced the highest power spectral density were:
    - o 802.11b - DQPSK / 11 Mbps
    - o 802.11g - 64QAM / 54 Mbps

    Final measurements were performed using the above configurations on the relevant channels.
2. The peak power meter was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the peak power meter to compensate for the loss of the attenuator and RF cable.

### Test setup:



## Transmitter Maximum Output Power (continued)

## Results: 802.11b / 20 MHz / DQPSK / 11 Mbps

### Conducted Peak Limit Comparison

| Channel | Conducted Power (dBm) | Conducted Power Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|
| 1 | 17.0 | 30.0 | 13.0 | Complied |
| 6 | 17.1 | 30.0 | 12.9 | Complied |
| 13 | 17.2 | 30.0 | 12.8 | Complied |

### De Facto EIRP Limit Comparison

| Channel | Corrected Conducted Power (dBm) | Declared Antenna Gain (dBi) | EIRP (dBm) | De Facto EIRP Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|---|---|
| 1 | 17.0 | -6.2 | 10.8 | 36.0 | 25.2 | Complied |
| 6 | 17.1 | -6.2 | 10.9 | 36.0 | 25.1 | Complied |
| 13 | 17.2 | -6.2 | 11.0 | 36.0 | 25.0 | Complied |

## Results: 802.11g / 20 MHz / 64QAM / 54 Mbps

### Conducted Peak Limit Comparison

| Channel | Conducted Power (dBm) | Conducted Power Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|
| 1 | 23.9 | 30.0 | 6.1 | Complied |
| 6 | 23.9 | 30.0 | 6.1 | Complied |
| 13 | 24.0 | 30.0 | 6.0 | Complied |

### De Facto EIRP Limit Comparison

| Channel | Corrected Conducted Power (dBm) | Declared Antenna Gain (dBi) | EIRP (dBm) | De Facto EIRP Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|---|---|
| 1 | 23.9 | -6.2 | 17.7 | 36.0 | 18.3 | Complied |
| 6 | 23.9 | -6.2 | 17.7 | 36.0 | 18.3 | Complied |
| 13 | 24.0 | -6.2 | 17.8 | 36.0 | 18.2 | Complied |

### Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M1656 | Thermohygrometer | JM Handelspunkt | 30.5015.13 | None stated | 22 Feb 2018 | 12 |
| M2019 | Peak Power Sensor | Boonton | 55006 | 10078 | 01 Mar 2018 | 12 |
| A1396 | Attenuator | Huber & Suhner | 6810.17.B | 757987 | 26 Feb 2018 | 12 |

## 5.2.5. Transmitter Radiated Emissions

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Georgios Vrezas | **Test Date:** | 10 April 2017 |
| **Test Sample Serial Number:** | BRA-0030BC | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.247(d) & 15.209(a) |
| **Test Method Used:** | ANSI C63.10 Sections 6.3 and 6.5 |
| **Frequency Range** | 30 MHz to 1000 MHz |

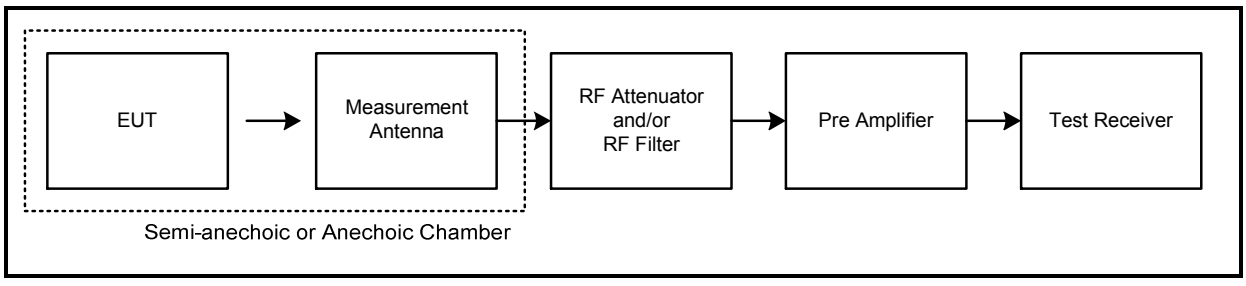
### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 23 |
| **Relative Humidity (%):** | 36 |

### Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the middle channel only.
3. All emissions shown on the pre-scan plots were investigated and found to be ambient, or >20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak reading of the measuring receiver was recorded in the table below.
4. All other emissions shown on the pre-scan plots were investigated and found to be ambient, or >20 dB below the applicable limit or below the measurement system noise floor and therefore not recorded.
5. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
6. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth 500 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
7. *-20 dBc limit applies in non-restricted bands as the conducted maximum output power was measured.

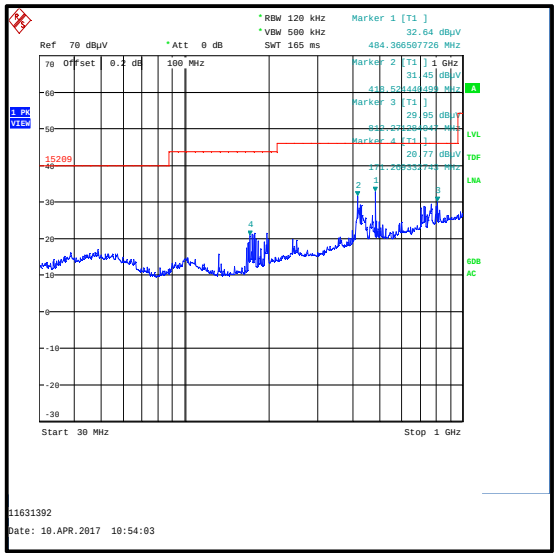
### Test setup for radiated measurements:



## Transmitter Radiated Emissions (continued)

## Results: Middle Channel / 802.11g / 20 MHz / 64QAM / 54 Mbps

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 484.367 | Vertical | 32.6 | 71.7* | 39.1 | Complied |




## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M2003 | Thermohygrometer | Testo | 608-H1 | 45046641 | 28 Feb 2018 | 12 |
| K0017 | 3m RSE Chamber | Rainford EMC | N/A | N/A | 14 Apr 2018 | 12 |
| A2971 | Low Pass Filter | AtlanTecRF | AFL-02000 | 15062902845 | 06 Mar 2018 | 12 |
| M1630 | Rohde & Schwarz | ESU40 | ESU40 | 100233 | 23 Feb 2018 | 12 |
| A2903 | Antenna | Schwarzbeck | VULB 9163 | 9163-944 | 22 Aug 2017 | 12 |

## Transmitter Radiated Emissions (continued)

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Georgios Vrezas | **Test Date:** | 10 April 2017 |
| **Test Sample Serial Number:** | BRA-0030BC | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.247(d) & 15.209(a) |
| **Test Method Used:** | ANSI C63.10 Sections 6.3 and 6.6 & FCC KDB 558074 Sections 11, 12.2.4 & 12.2.5.2 |
| **Frequency Range** | 1 GHz to 25 GHz |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 23 |
| **Relative Humidity (%):** | 36 |

### Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The emission shown approximately at 2437 MHz on the 1 GHz to 3 GHz plot is the EUT fundamental.
3. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
4. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto.
5. *In accordance with ANSI C63.10 Section 6.6.4.3 (Note 1), if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.
6. **-20 dBc limit applies in non-restricted bands as the conducted maximum output power was measured.
7. The reference level for emissions in non-restricted bands was established following KDB 558074 Section 11.2 procedure.

## Transmitter Radiated Emissions (continued)

### Results: Bottom Channel / Peak

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 4818.564 | Vertical | 53.9 | 74.0 | 20.1 | Complied |
| 7238.640 | Horizontal | 50.6 | 74.1** | 23.5 | Complied |
| 9647.132 | Horizontal | 61.7 | 74.1** | 12.4 | Complied |
| 14478.598 | Horizontal | 51.3 | 54.0* | 2.7 | Complied |

### Results: Average / Bottom Channel

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Correction Factor (dB) | Corrected Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|---|---|
| 4821.314 | Vertical | 40.8 | 1.0 | 41.8 | 54.0 | 12.2 | Complied |

### Results: Peak / Middle Channel

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 4866.340 | Vertical | 54.0 | 74.0 | 20.0 | Complied |
| 7308.460 | Horizontal | 54.5 | 74.0 | 19.5 | Complied |
| 9747.679 | Horizontal | 61.3 | 71.7** | 10.4 | Complied |
| 14618.554 | Horizontal | 45.6 | 71.7** | 26.1 | Complied |

### Results: Average / Middle Channel

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Correction Factor (dB) | Corrected Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|---|---|
| 4874.060 | Vertical | 39.9 | 1.0 | 40.9 | 54.0 | 13.1 | Complied |
| 7310.800 | Horizontal | 42.2 | 1.0 | 43.2 | 54.0 | 10.8 | Complied |

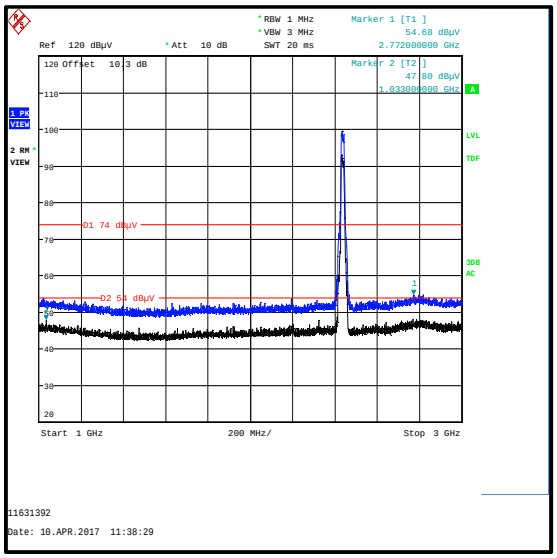
### Results: Peak / Top Channel

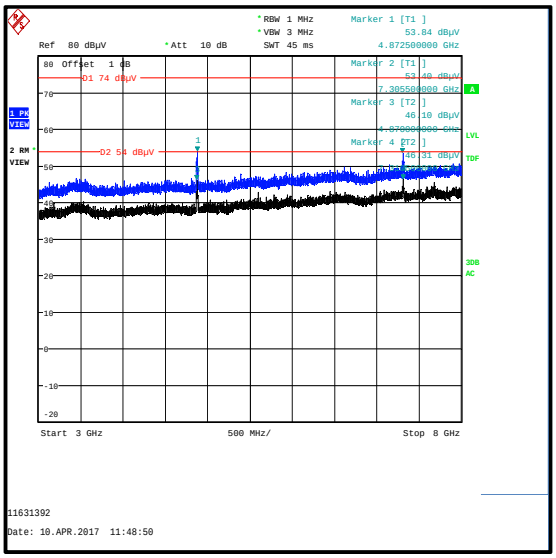
| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 4940.780 | Vertical | 51.9 | 54.0* | 2.1 | Complied |
| 7412.556 | Horizontal | 52.8 | 74.0 | 21.2 | Complied |
| 9890.637 | Horizontal | 60.1 | 67.8** | 7.7 | Complied |
| 14838.460 | Horizontal | 42.3 | 67.8** | 25.5 | Complied |

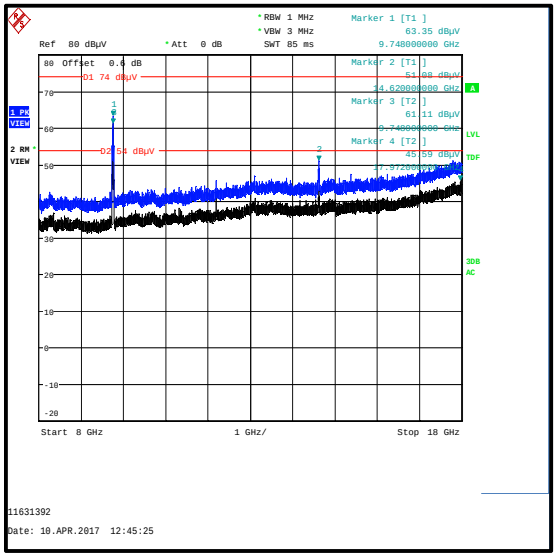
### Results: Average / Top Channel

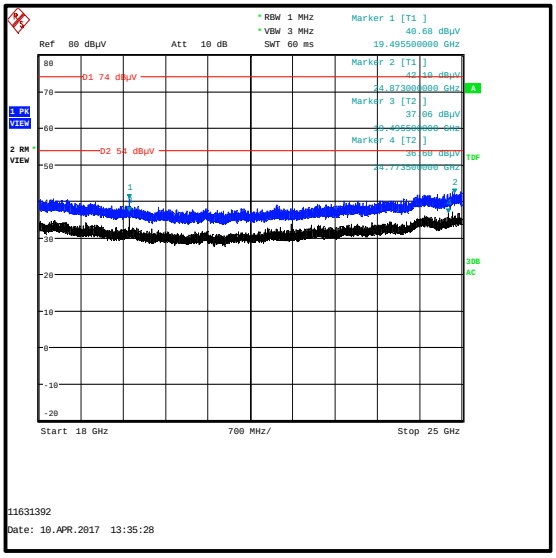
| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Correction Factor (dB) | Corrected Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|---|---|
| 7406.384 | Horizontal | 39.9 | 1.0 | 40.9 | 54.0 | 13.1 | Complied |

## Transmitter Radiated Emissions (continued)




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

## Transmitter Radiated Emissions (continued)

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M2003 | Thermohygrometer | Testo | 608-H1 | 45046641 | 28 Feb 2018 | 12 |
| K0017 | 3m RSE Chamber | Rainford EMC | N/A | N/A | 14 Apr 2018 | 12 |
| M1630 | Test Receiver | Rohde & Schwarz | ESU40 | 100233 | 23 Feb 2018 | 12 |
| A2863 | Pre Amplifier | Agilent | 8449B | 3008A02100 | 11 Apr 2018 | 12 |
| A2891 | Pre Amplifier | Schwarzbeck | BBV 9718 | 9718-306 | 11 Apr 2018 | 12 |
| A2893 | Pre Amplifier | Schwarzbeck | BBV 9721 | 9721-021 | 11 Apr 2018 | 12 |
| A2889 | Antenna | Schwarzbeck | BBHA 9120 B | BBHA 9120 B 653 | 11 Apr 2018 | 12 |
| A2890 | Antenna | Schwarzbeck | HWRD 750 | 014 | 11 Apr 2018 | 12 |
| A2892 | Antenna | Schwarzbeck | BBHA 9170 | 9170-727 | 11 Apr 2018 | 12 |
| A2916 | Attenuator | AtlanTecRF | AN18W5-10 | 832827#1 | 03 Mar 2018 | 12 |
| A2914 | High Pass Filter | AtlanTecRF | AFH-03000 | 2155 | 06 Mar 2018 | 12 |
| A2947 | High Pass Filter | AtlanTecRF | AFH-07000 | 1601900001 | 01 Jun 2017 | 12 |

## 5.2.6. Transmitter Band Edge Radiated Emissions

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineer:** | Georgios Vrezas | **Test Date:** | 03 April 2017 |
| **Test Sample Serial Number:** | BRA-0030BC | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.247(d) & 15.209(a) |
| **Test Method Used:** | ANSI C63.10 Section 6.10 & FCC KDB 558074 Sections 11 & 12 |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 |
| **Relative Humidity (%):** | 36 |

### Note(s):

1. All supported modes and channel widths were initially investigated on one channel. The modes that produced the highest power and widest bandwidth were:
    - 802.11b - DQPSK / 11 Mbps
    - 802.11g - 64QAM / 54 Mbps

    Final measurements were performed with the above configurations.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. As the lower band edge falls within a non-restricted band, only peak measurements are required. In accordance with FCC KDB 558074 Section 11.1, the test method in Section 11.3 was followed: the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. As the maximum conducted (peak) output power was measured using a peak power meter in accordance with FCC KDB 558074 Section 9.1.3 an out-of-band limit line was placed 20 dB (FCC KDB 558074 Section 11.1(a)) below the peak level. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent non-restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.
4. As the upper band edge falls within a restricted band both peak and average measurements were recorded by placing a marker at the edge of the band. For peak measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. An RMS detector was used, sweep time was set to auto and trace mode was trace averaging over 300 sweeps. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.

## Transmitter Band Edge Radiated Emissions (continued)

### Results: 802.11b / 20 MHz / 11 Mbps

### Results: Lower Band Edge / Channel 1

| Frequency (MHz) | Level (dBµV/m) | -20 dBc Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|
| 2397.356 | 62.2 | 74.1 | 11.9 | Complied |
| 2400 | 57.0 | 74.1 | 17.1 | Complied |

### Results: Upper Band Edge / Peak / Channel 13

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|
| 2483.5 | 54.9 | 74.0 | 19.1 | Complied |
| 2486.545 | 55.9 | 74.0 | 18.1 | Complied |

### Results: Upper Band Edge / Average / Channel 13

| Frequency (MHz) | Level (dBµV/m) | Duty Cycle correction (dB) | Corrected Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|---|
| 2483.5 | 43.6 | 0.2 | 43.8 | 54.0 | 10.2 | Complied |
| 2486.144 | 44.8 | 0.2 | 45.0 | 54.0 | 9.0 | Complied |

### Results: 2310 MHz to 2390 MHz Restricted Band / Peak / Channel 1

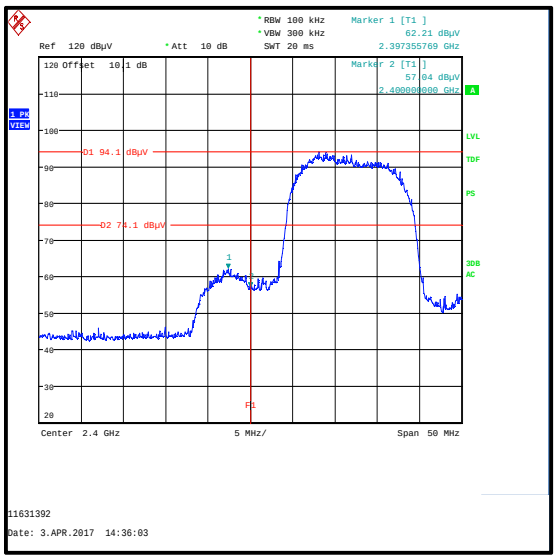
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|
| 2367.564 | 54.8 | 74.0 | 19.2 | Complied |

### Results: 2310 MHz to 2390 MHz Restricted Band / Average / Channel 1

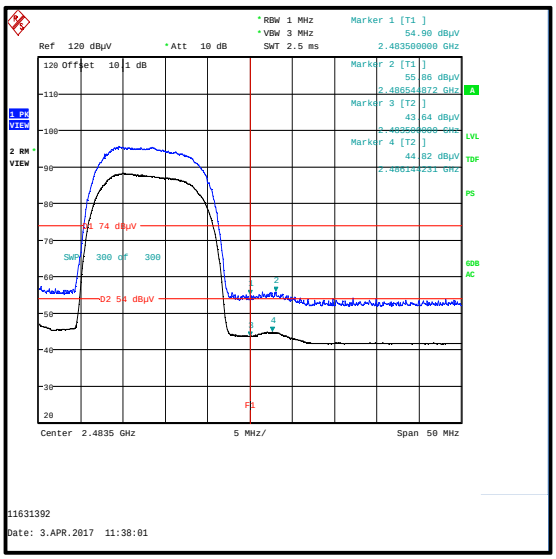
| Frequency (MHz) | Level (dBµV/m) | Duty Cycle correction (dB) | Corrected Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|---|
| 2389.744 | 42.5 | 0.2 | 42.7 | 54.0 | 11.3 | Complied |

## Transmitter Band Edge Radiated Emissions (continued)

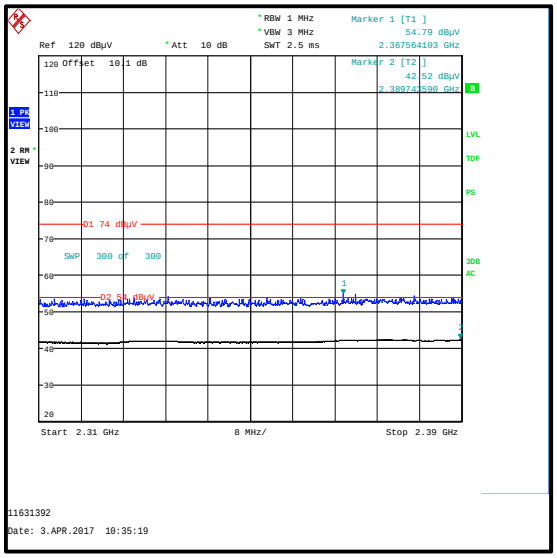
## Results: 802.11b / 20 MHz / 11 Mbps




**Lower Band Edge Peak Measurement**
**Channel 1**




**Upper Band Edge Measurement**
**Channel 13**




**2310 MHz to 2390 MHz Restricted Band Plot**

**Transmitter Band Edge Radiated Emissions (continued)**

**Results: 802.11g / 20 MHz / 54 Mbps**

**Results: Lower Band Edge / Channel 1**

| Frequency (MHz) | Level (dBµV/m) | -20 dBc Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|
| 2399.359 | 68.6 | 72.8 | 4.2 | Complied |
| 2400 | 67.3 | 72.8 | 5.5 | Complied |

**Results: Upper Band Edge / Peak / Channel 13**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|
| 2483.5 | 68.0 | 74.0 | 6.0 | Complied |
| 2483.740 | 71.6 | 74.0 | 2.4 | Complied |

**Results: Upper Band Edge / Average / Channel 13**

| Frequency (MHz) | Level (dBµV/m) | Duty Cycle correction (dB) | Corrected Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|---|
| 2483.5 | 52.3 | 1.0 | 53.3 | 54.0 | 0.7 | Complied |

**Results: Restricted Band / Peak / Channel 1**

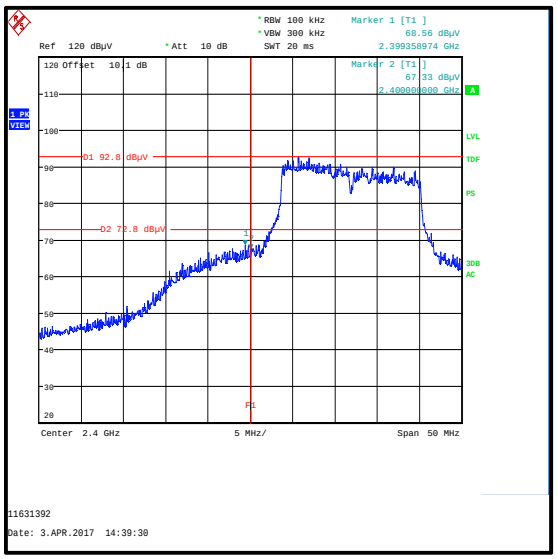
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|
| 2390 | 69.7 | 74.0 | 4.3 | Complied |

**Results: Restricted Band / Average / Channel 1**

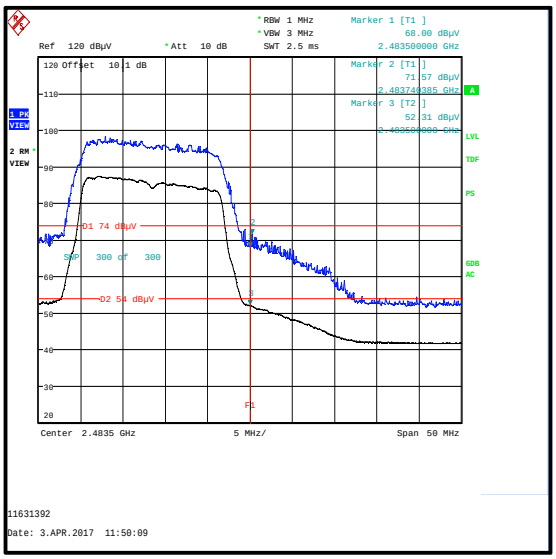
| Frequency (MHz) | Level (dBµV/m) | Duty Cycle correction (dB) | Corrected Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|---|
| 2390 | 52.4 | 1.0 | 53.4 | 54.0 | 0.6 | Complied |

## Transmitter Band Edge Radiated Emissions (continued)

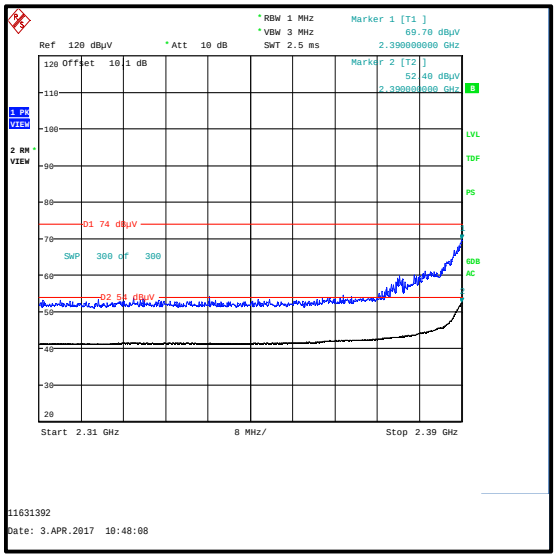
## Results: 802.11g / 20 MHz / 54 Mbps




**Lower Band Edge Peak Measurement Channel 1**




**Upper Band Edge Measurement Channel 13**




**2310 MHz to 2390 MHz Restricted Band Plot**

## Test Equipment Used:

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M1656 | Thermohygrometer | JM Handelspunkt | 30.5015.13 | None stated | 22 Feb 2018 | 12 |
| K0002 | 3m RSE Chamber | Rainford EMC | N/A | N/A | 16 Nov 2017 | 12 |
| M1874 | Test Receiver | Rohde & Schwarz | ESU26 | 100553 | 21 Nov 2017 | 12 |
| A1534 | Pre Amplifier | Hewlett Packard | 8449B | 3008A00405 | 09 Nov 2017 | 12 |
| A1818 | Antenna | EMCO | 3115 | 00075692 | 08 Nov 2017 | 12 |
| A1396 | Attenuator | Huber & Suhner | 6810.17.B | 757987 | 26 Feb 2018 | 12 |

# 6. 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 of the measurand (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 |
|---|---|---|---|
| Minimum 6 dB Bandwidth | 2.4 GHz to 2.4835 GHz | 95% | ±4.59 % |
| Duty Cycle | 2.4 GHz to 2.4835 GHz | 95% | ±1.14 % |
| 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% | ±5.65 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.

## 7. Report Revision History

| Version Number | Revision Details | | |
|---|---|---|---|
| | Page No(s) | Clause | Details |
| 1.0 | - | - | Initial Version |

**--- END OF REPORT ---**