# TEST REPORT

## Test Report No. : UL-RPT-RP12718494JD12A V2.0

| | | |
|---|---|---|
| **Customer** | : | Apple Inc. |
| **Model No./HVIN** | : | A1991 |
| **PMN** | : | Mac Pro |
| **FCC ID** | : | BCGA1991 |
| **ISED Certification No.** | : | IC: 579C-A1991 |
| **Technologies** | : | *Bluetooth* – Low Energy;<br>*Bluetooth* – BR/EDR;<br>2.4 GHz WLAN & 5 GHz WLAN |
| **Test Standard(s)** | : | FCC Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b)<br>ISED Canada RSS-247 5.5, 6.2.1.2, 6.2.4.2 &<br>RSS-Gen 6.13, 8.9 & 8.10 |
| **Test Laboratory** | : | UL VS LTD, Basingstoke, Hampshire, RG24 8AH, United Kingdom |

1. This test report shall not be reproduced except in full, 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 2.0 supersedes all previous versions.

**Date of Issue:** 18 September 2019

**Checked by:**

Ben Mercer
Senior Test Engineer, Radio Laboratory

**Company Signatory:**

Sarah Williams
Senior Test Engineer, Radio Laboratory
UL VS LTD

## Customer Information

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

## Report Revision History

| Version Number | Issue Date | Revision Details | Revised By |
|---|---|---|---|
| 1.0 | 22/07/2019 | Initial Version | Ben Mercer |
| 2.0 | 18/09/2019 | Address TCB questions | Sarah Williams |

# Table of Contents

# 1. Attestation of Test Results

## 1.1. Description of EUT

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

## 1.2. General Information

| | |
|---|---|
| **Specification Reference:** | 47CFR15.247 |
| **Specification Title:** | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart C (Intentional Radiators) - Section 15.247 |
| **Specification Reference:** | 47CFR15.209 |
| **Specification Title:** | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart C (Intentional Radiators) - Section 15.209 |
| **Specification Reference:** | 47CFR15.407 |
| **Specification Title:** | Code of Federal Regulations Volume 47 (Telecommunications):<br>Part 15 Subpart E (Unlicensed National Information Infrastructure Devices) – Sections 15.407 |
| **Specification Reference:** | RSS-Gen Issue 5 April 2018 |
| **Specification Title:** | General Requirements for Compliance of Radio Apparatus |
| **Specification Reference:** | RSS-247 Issue 2 February 2017 |
| **Specification Title:** | Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices |
| **FCC Test Firm Registration No.:** | 621311 |
| **ISED Canada Site Registration No.:** | 3245B |
| **Test Dates:** | 04 July 2019 to 08 July 2019 |

## 1.3. Summary of Test Results

| FCC Reference (47CFR) | ISED Canada Reference | Measurement | Result |
|---|---|---|---|
| **Bluetooth Basic Rate & 5 GHz WLAN (SISO)** | | | |
| 15.209(a)/15.247(d) /15.407(b) | RSS-Gen 6.13 / RSS-247 5.5, 6.2.1.2, & 6.2.4.2 | Transmitter Out of Band Radiated Emissions | Complied |
| **Bluetooth LE & 5 GHz WLAN (SISO)** | | | |
| 15.209(a)/15.247(d) /15.407(b) | RSS-Gen 6.13 / RSS-247 5.5, 6.2.1.2, & 6.2.4.2 | Transmitter Out of Band Radiated Emissions | Complied |
| **2.4 GHz WLAN (MIMO) & 5 GHz WLAN (SISO)** | | | |
| 15.209(a)/15.247(d) /15.407(b) | RSS-Gen 6.13 / RSS-247 5.5, 6.2.1.2, & 6.2.4.2 | Transmitter Out of Band Radiated Emissions | Complied |
| **Bluetooth Basic Rate & 2.4 GHz WLAN (MIMO)** | | | |
| 15.209(a)/15.247(d) | RSS-Gen 6.13 / RSS-247 5.5 | Transmitter Out of Band Radiated Emissions | Complied |
| **Bluetooth LE & 2.4 GHz WLAN (MIMO)** | | | |
| 15.209(a)/15.247(d) | RSS-Gen 6.13 / RSS-247 5.5 | Transmitter Out of Band Radiated Emissions | Complied |
| **Bluetooth Basic Rate & 2.4 GHz WLAN (MIMO) & 5 GHz WLAN (SISO)** | | | |
| 15.209(a)/15.247(d) /15.407(b) | RSS-Gen 6.13 / RSS-247 5.5, 6.2.1.2, & 6.2.4.2 | Transmitter Out of Band Radiated Emissions | Complied |
| **Bluetooth LE & 2.4 GHz WLAN (MIMO) & 5 GHz WLAN (SISO)** | | | |
| 15.209(a)/15.247(d) /15.407(b) | RSS-Gen 6.13 / RSS-247 5.5, 6.2.1.2, & 6.2.4.2 | Transmitter Out of Band Radiated Emissions | Complied |
| **2.4 GHz WLAN (SISO) & 5 GHz WLAN (MIMO)** | | | |
| 15.209(a)/15.247(d) /15.407(b) | RSS-Gen 6.13 / RSS-247 5.5, 6.2.1.2, & 6.2.4.2 | Transmitter Out of Band Radiated Emissions | Complied |
| **Bluetooth Basic Rate & 2.4 GHz WLAN (SISO) & 5 GHz WLAN (MIMO)** | | | |
| 15.209(a)/15.247(d) /15.407(b) | RSS-Gen 6.13 / RSS-247 5.5, 6.2.1.2, & 6.2.4.2 | Transmitter Out of Band Radiated Emissions | Complied |
| **Bluetooth LE & 2.4 GHz WLAN (SISO) & 5 GHz WLAN (MIMO)** | | | |
| 15.209(a)/15.247(d) /15.407(b) | RSS-Gen 6.13 / RSS-247 5.5, 6.2.1.2, & 6.2.4.2 | Transmitter Out of Band Radiated Emissions | Complied |

**Note(s):**

1. 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 worst case.

2. The EUT supports Simultaneous-In-Band (SIB) and Simultaneous-Dual-Band (SDB) transmission. Testing was performed to verify compliance of radiated spurious emissions against applicable limits when the EUT was simultaneously transmitting in the 2.4 GHz and 5 GHz bands. Only radiated spurious emissions related to intermodulation products are recorded in this test report. The highest out-of-band noise floor levels were recorded if no intermodulation products were observed across the required measurement ranges.

## 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 17 | X |

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

## 2.2. Methods and Procedures

| | |
|---|---|
| **Reference:** | ANSI C63.10-2013 |
| **Title:** | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| **Reference:** | KDB 558074 D01 DTS Meas Guidance v05r02 April 2, 2019 |
| **Title:** | Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247 |
| **Reference:** | KDB 789033 D02 General U-NII Test Procedures New Rules v02r01 December 14, 2017 |
| **Title:** | Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E) |

## 2.3. Calibration and Uncertainty

### Measuring Instrument Calibration

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

### Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value measured (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

| Measurement Type | Range | Confidence Level (%) | Calculated Uncertainty |
|---|---|---|---|
| Radiated Spurious Emissions | 30 MHz to 1 GHz | 95% | ±4.65 dB |
| Radiated Spurious Emissions | 1 GHz to 40 GHz | 95% | ±2.94 dB |

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

## 2.4. Test and Measurement Equipment

### Test Equipment Used for Transmitter Radiated Emissions Tests

| Asset No. | Instrument | Manufacturer | Type No. | Serial No. | Date Calibration Due | Cal. Interval (Months) |
|---|---|---|---|---|---|---|
| M2040 | Thermohygrometer | Testo | 608-H1 | 45124934 | 06 Jan 2020 | 12 |
| K0001 | 3m RSE Chamber | Rainford EMC | N/A | N/A | 04 Oct 2019 | 12 |
| M2044 | Test Receiver | Rohde & Schwarz | ESU26 | 100122 | 01 Apr 2020 | 12 |
| A3154 | Pre-Amplifier | Com-Power | PAM-103 | 18020012 | 14 Sep 2019 | 12 |
| A3179 | Pre-Amplifier | Hewlett Packard | 8449B | 3008A00934 | 04 Apr 2020 | 12 |
| A2893 | Pre-Amplifier | Schwarzbeck | BBV 9721 | 9721-021 | 15 Feb 2020 | 12 |
| A3093 | High Pass Filter | AtlanTecRF | AFH-03000 | 18051800077 | 09 Apr 2020 | 12 |
| A2974 | High Pass Filter | AtlanTecRF | AFH-06000 | 15032501232 | 04 Jan 2020 | 12 |
| A3085 | Low Pass Filter | AtlanTecRF | AFL-02000 | 18051600014 | 09 Apr 2020 | 12 |
| A3095 | High Pass Filter | AtlanTecRF | AFH-07000 | 18051600012 | 09 Apr 2020 | 12 |
| A2474 | 5.8 GHz Band Reject Filter | Wainwright Instruments | WRCJV8-5665-5725-5850-5910-50SS | 1 | 10 Apr 2020 | 12 |
| A3139 | Antenna | Schwarzbeck | Schwarzbeck | Schwarzbeck | 04 Oct 2019 | 12 |
| A553 | Antenna | Chase | CBL6111A | 1593 | 08 Oct 2019 | 12 |
| A2523 | Attenuator | AtlanTecRF | AN18W5-10 | 832827#1 | 04 Mar 2020 | 12 |
| A3138 | Antenna | Schwarzbeck | BBHA 9120 B | 00702 | 03 Oct 2019 | 12 |
| A2892 | Antenna | Schwarzbeck | BBHA 9170 | 9170-727 | 16 Feb 2020 | 12 |
| M2003 | Thermohygrometer | Testo | 608-H1 | 45046641 | 06 Jan 2020 | 12 |
| K0017 | 3m RSE Chamber | Rainford | N/A | N/A | 16 Feb 2020 | 12 |
| M1995 | Test Receiver | Rohde & Schwarz | ESU40 | 100428 | 08 May 2020 | 12 |
| A2863 | Pre-Amplifier | Agilent | 8449B | 3008A02100 | 12 Feb 2020 | 12 |
| A2889 | Antenna | Schwarzbeck | BBHA 9120 B | BBHA 9120 B 653 | 12 Feb 2020 | 12 |
| A2916 | Attenuator | AtlanTecRF | AN18W5-10 | 832827#1 | 20 Feb 2020 | 12 |
| A2915 | Low Pass Filter | AtlanTecRF | AFL-04000 | 2156 | 20 Feb 2020 | 12 |
| A3182 | 2.4 GHz Band Reject Filter | Wainwright Instruments | WRCTF12+9-2398-2400-2483.5-2485.5-30EE | 2 | 09 May 2020 | 12 |
| G0614 | Signal Generator | Rohde & Schwarz | SMB100A | 177687 | 08 May 2020 | 12 |
| M1145 | Power Meter | Hewlett Packard | 437B | 3737U26557 | 03 Sep 2019 | 12 |
| M1011 | RF Power Sensor | Hewlett Packard | 8485D | 2847A00141 | 05 Jul 2019 | 12 |
| A3097 | Horn Antenna | Link Microtek | AM1-18HA | 15275 | 30 Aug 2021 | 12 |
| A3141 | Pre-Amplifier | Schwarzbeck | BBV 9718 B | 00021 | 21 Nov 2019 | 12 |

# 3. Equipment Under Test (EUT)

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

| | |
|---|---|
| **Brand Name:** | Apple |
| **Model No. / HVIN:** | A1991 |
| **Test Sample Serial Number:** | C02YF00CMFLF *(Radiated sample #1)* |
| **Hardware Version:** | REV 1.0 |
| **Software Version:** | 18F98 |
| **FCC ID:** | BCGA1991 |
| **ISED Certification Number:** | IC: 579C-A1991 |

| | |
|---|---|
| **Brand Name:** | Apple |
| **Model No. / HVIN:** | A1991 |
| **Test Sample Serial Number:** | C02YD006MFLQ *(Radiated sample #2)* |
| **Hardware Version:** | REV 1.0 |
| **Software Version:** | 18F98 |
| **FCC ID:** | BCGA1991 |
| **ISED Certification Number:** | IC: 579C-A1991 |

## 3.2. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

## 3.3. Additional Information Related to Testing

| | | | |
|---|---|---|---|
| **Technology Tested:** | *Bluetooth* Low Energy (Digital Transmission System) | | |
| **Type of Unit:** | Transceiver | | |
| **Channel Spacing:** | 2 MHz | | |
| **Transmit Frequency Range:** | 2400 MHz to 2483.5 MHz | | |
| **Transmit Channels Tested:** | **Channel ID** | **Channel Number** | **Channel Frequency (MHz)** |
| | Bottom | 37 | 2402 |
| | Top | 39 | 2480 |

| | | | |
|---|---|---|---|
| **Tested Technology:** | *Bluetooth* (FHSS) | | |
| **Mode:** | Basic Rate | | |
| **Modulation:** | GFSK | | |
| **Packet Type: (Maximum Payload)** | DH5 | | |
| **Data Rate (Mbps):** | 1 | | |
| **Transmit Frequency Range:** | 2400 MHz to 2483.5 MHz | | |
| **Transmit Channels Tested:** | **Channel ID** | **Channel Number** | **Channel Frequency (MHz)** |
| | Bottom | 0 | 2402 |
| | Top | 78 | 2480 |

| | | | |
|---|---|---|---|
| **Technology Tested:** | WLAN (IEEE 802.11b/g/n) / Digital Transmission System | | |
| **Channel Spacing:** | 20 MHz | | |
| **Modulation:** | BPSK | | |
| **Data Rate:** | 802.11b (SISO) | 1Mbps | |
| | 802.11b (MIMO) | 1Mbps with CDD | |
| **Transmit Frequency Range:** | 2400 MHz to 2483.5 MHz | | |
| **Transmit Channels Tested:** | **Channel ID** | **Channel Number** | **Channel Frequency (MHz)** |
| | Bottom | 1 | 2412 |
| | Top | 13 | 2472 |

## Additional Information Related to Testing (continued)

| | | | |
|---|---|---|---|
| **Technology Tested:** | WLAN (IEEE 802.11a/n/ac) / U-NII / LE-LAN | | |
| **Channel Spacing:** | 20 MHz | | |
| **Modulation:** | BPSK | | |
| **Data Rate:** | 802.11n (SISO) | MCS0 | |
| | 802.11n HT20 (MIMO) | MCS0 with CDD | |
| **Transmit Frequency Range:** | 5150 MHz to 5850 MHz | | |
| **Transmit Channels Tested:** | **Channel ID** | **Channel Number** | **Channel Frequency (MHz)** |
| | Bottom | 36 | 5180 |
| | Top | 165 | 5825 |

## 3.4. Description of Available Antennas

The radio utilizes integrated antennas with the following maximum gains:

**Bluetooth:**

| Antenna Port | Antenna Gain (dBi) |
|---|---|
| 0 | 4.5 |

**2.4GHz WLAN:**

| Antenna Port | Antenna Gain (dBi) |
|---|---|
| 0 | 4.6 |
| 1 | 4.3 |
| 2 | 4.5 |

**5GHz WLAN:**

| Frequency Band (MHz) | Antenna Port | Antenna Gain (dBi) |
|---|---|---|
| 5150 to 5250 | 0 | 5.0 |
| | 1 | 4.5 |
| | 2 | 4.5 |
| 5725 to 5850 | 0 | 6.1 |
| | 1 | 5.7 |
| | 2 | 4.6 |

## 3.5. Description of Test Setup

### Support Equipment

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

| | |
|---|---|
| **Description:** | Test Laptop |
| **Brand Name:** | Apple |
| **Model Name or Number:** | MacBook Pro |
| **Serial Number:** | C02S21YFG8WQ |

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

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

| | |
|---|---|
| **Description:** | USB Mouse |
| **Brand Name:** | Apple |
| **Model Name or Number:** | A1152 |
| **Serial Number:** | CC2446203PNDNYPAJ |

| | |
|---|---|
| **Description:** | USB Keyboard |
| **Brand Name:** | Apple |
| **Model Name or Number:** | A1243 |
| **Serial Number:** | CC2438202G4DQW0AC |

| | |
|---|---|
| **Description:** | USB Hub |
| **Brand Name:** | Hama |
| **Model Name or Number:** | 00078498 |
| **Serial Number:** | 09825891600 |

| | |
|---|---|
| **Description:** | Ethernet Router |
| **Brand Name:** | Netgear |
| **Model Name or Number:** | DG834G |
| **Serial Number:** | 1JX167B008C4A |

## Support Equipment (continued)

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

| | |
|---|---|
| **Description:** | USB Cable. Length 3.0 metres. Quantity 4 |
| **Brand Name:** | Not marked or stated |
| **Model Name or Number:** | Not marked or stated |
| **Serial Number:** | Not marked or stated |

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

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

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

## Operating Modes

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

- Transmitting at maximum power on bottom and top channels using all combinations of technologies supported in the 2.4 and 5 GHz bands.

## Configuration and Peripherals

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

- *Bluetooth* Basic Rate: Tests were performed with the EUT transmitting in Basic Rate mode as this mode was found to transmit higher power than EDR mode.
- *Bluetooth* LE: Tests were performed with the EUT transmitting in LE mode as this mode was found to transmit higher power than LE2M mode.
- 2.4 GHz WLAN: Tests were performed with the EUT transmitting using either 802.11b / CDD / 1Mbps / MIMO (3Tx CDD) or 802.11b / 1Mbps / SISO configuration as these modes were found to transmit the highest power level and were deemed to be worst case.
- 5 GHz WLAN: Tests were performed with the EUT transmitting using either 802.11n / HT20 / MCS0 / MIMO (3Tx CDD) or 802.11n / HT20 / MCS0 / SISO configuration as these modes were found to transmit the highest power level and were deemed to be worst case.
- Transmitting with the following combinations:
    - *Bluetooth* Basic Rate and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, *Bluetooth* on bottom channel and 5 GHz WLAN on top channel.
    - *Bluetooth* Basic Rate and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, *Bluetooth* on top channel and 5 GHz WLAN on bottom channel.
    - *Bluetooth* LE and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, *Bluetooth* LE on bottom channel and 5 GHz WLAN on top channel.
    - *Bluetooth* LE and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, *Bluetooth* LE on top channel and 5 GHz WLAN on bottom channel.
    - 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, 2.4 GHz WLAN on bottom channel and 5 GHz WLAN on top channel.
    - 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, 2.4 GHz WLAN on top channel and 5 GHz WLAN on bottom channel.
    - *Bluetooth* Basic Rate and 2.4 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, *Bluetooth* on bottom channel and 2.4 GHz WLAN on top channel.
    - *Bluetooth* Basic Rate and 2.4 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, *Bluetooth* on top channel and 2.4 GHz WLAN on bottom channel.
    - *Bluetooth* LE and 2.4 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, *Bluetooth* LE on bottom channel and 2.4 GHz WLAN on top channel.

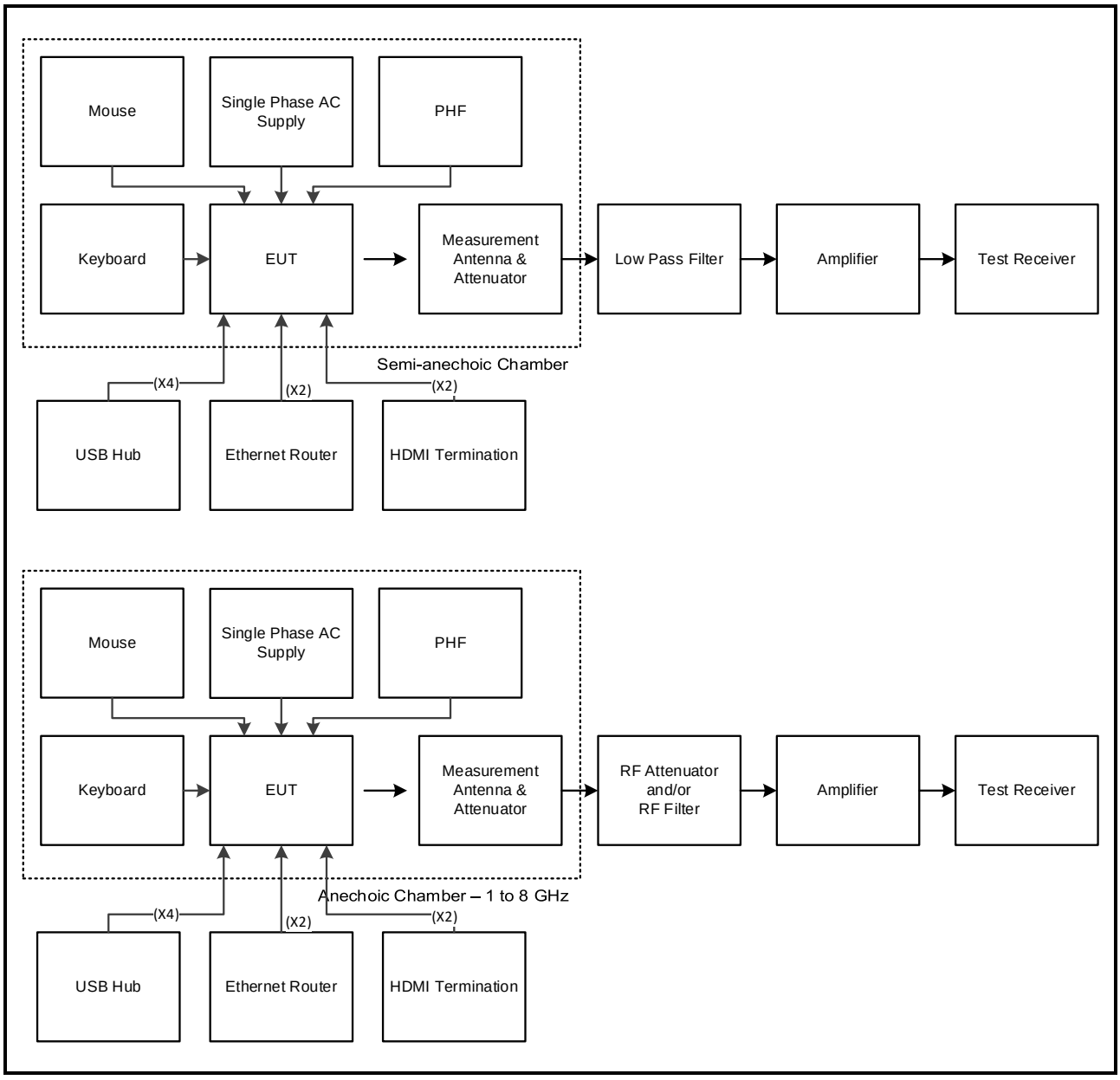
## Configuration and Peripherals (continued)

- *Bluetooth* LE and 2.4 GHz WLAN co-location, with the EUT configured to simultaneously transmit two signals at maximum output power, *Bluetooth* LE on top channel and 2.4 GHz WLAN on bottom channel.
- *Bluetooth* Basic Rate, 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit three signals at maximum output power, *Bluetooth* on bottom channel, 2.4 GHz WLAN on top channel and 5 GHz WLAN on bottom channel.
- *Bluetooth* Basic Rate, 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit three signals at maximum output power, *Bluetooth* on bottom channel, 2.4 GHz WLAN on top channel and 5 GHz WLAN on top channel.
- *Bluetooth* Basic Rate, 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit three signals at maximum output power, *Bluetooth* on top channel, 2.4 GHz WLAN on bottom channel and 5 GHz WLAN on bottom channel.
- *Bluetooth* Basic Rate, 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit three signals at maximum output power, *Bluetooth* on top channel, 2.4 GHz WLAN on bottom channel and 5 GHz WLAN on top channel.
- *Bluetooth* LE, 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit three signals at maximum output power, *Bluetooth* LE on bottom channel, 2.4 GHz WLAN on top channel and 5 GHz WLAN on bottom channel.
- *Bluetooth* LE, 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit three signals at maximum output power, *Bluetooth* LE on bottom channel, 2.4 GHz WLAN on top channel and 5 GHz WLAN on top channel.
- *Bluetooth* LE, 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit three signals at maximum output power, *Bluetooth* LE on top channel, 2.4 GHz WLAN on bottom channel and 5 GHz WLAN on bottom channel.
- *Bluetooth* LE, 2.4 GHz WLAN and 5 GHz WLAN co-location, with the EUT configured to simultaneously transmit three signals at maximum output power, *Bluetooth* LE on top channel, 2.4 GHz WLAN on bottom channel and 5 GHz WLAN top channel.

- The EUT was powered from a 120 VAC 60 Hz single phase mains supply.
- Radiated spurious emissions tests were performed with the USB Keyboard, USB Mouse and PHF connected to the EUT. The remaining USB ports were connected via a USB cable to a hub. The USB-C ports were connected via a USB C-A adaptor and USB cable to a hub. The ethernet ports were terminated into a router. The HDMI ports were terminated into a Hub. The router and hubs were placed under the floor inside the chamber.

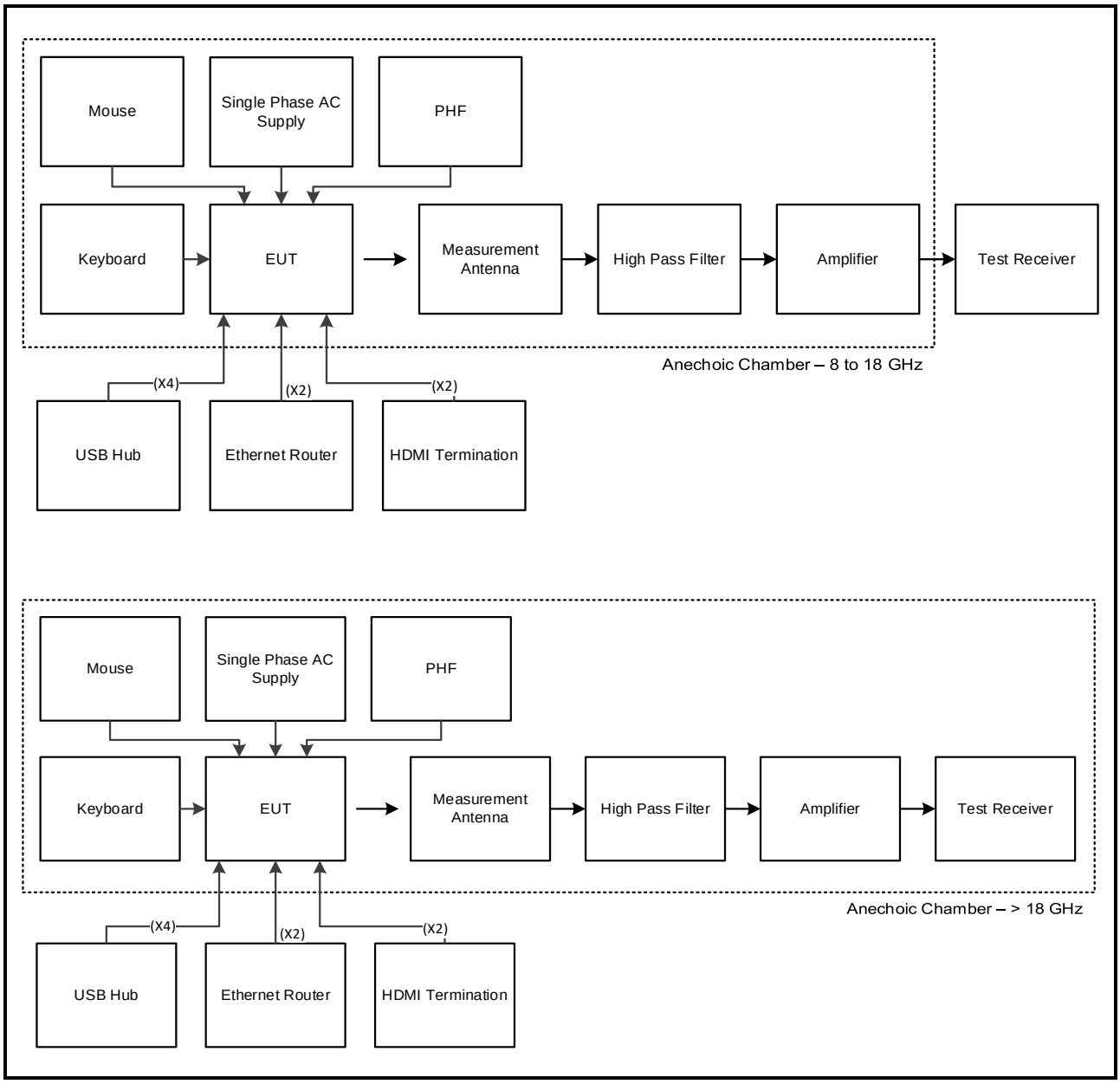
## Test Setup Diagrams

## Transmitter Radiated Emissions



## Test Setup Diagrams (continued)

## Test Setup for Transmitter Radiated Emissions (continued)



# 4. Radiated Test Results

## 4.1. Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 5 GHz WLAN (SISO) top channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli,<br>Mark Perry,<br>John Ferdinand,<br>David Doyle &<br>Mohamed Toubella | **Test Dates:** | 05 July 2019 to<br>08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 & 6.2.4.2 |
| **Test Method Used:** | KDB 789033 II.G & ANSI C63.10 Sections 6.3, 6.5 and 6.6 |
| **Frequency Range:** | 30 MHz to 40 GHz |
| **Configuration:** | *Bluetooth* Basic Rate bottom channel / 5 GHz WLAN (SISO) top channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

### Note(s):

1. All intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* fundamental is shown on the 1 GHz to 3 GHz plot.
3. The 5 GHz WLAN fundamental is shown on the 3 GHz to 6 GHz plot.
4. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
5. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
6. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
7. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
8. Measurements above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017 and K0001) 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.

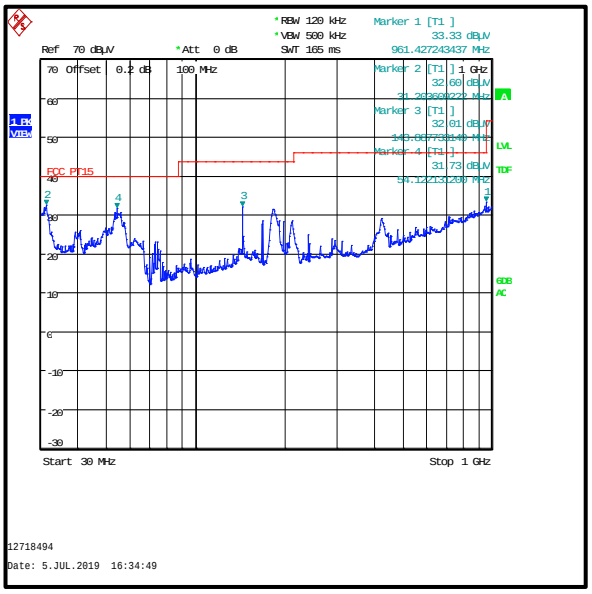
## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 5 GHz WLAN top channel (continued)

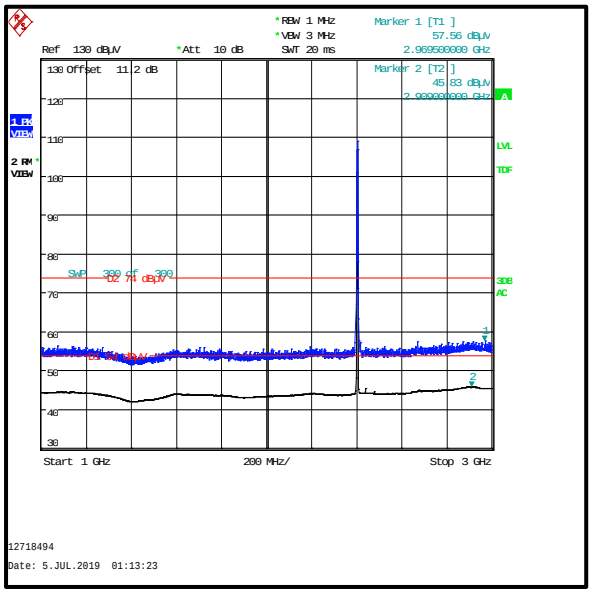
## Results: Peak

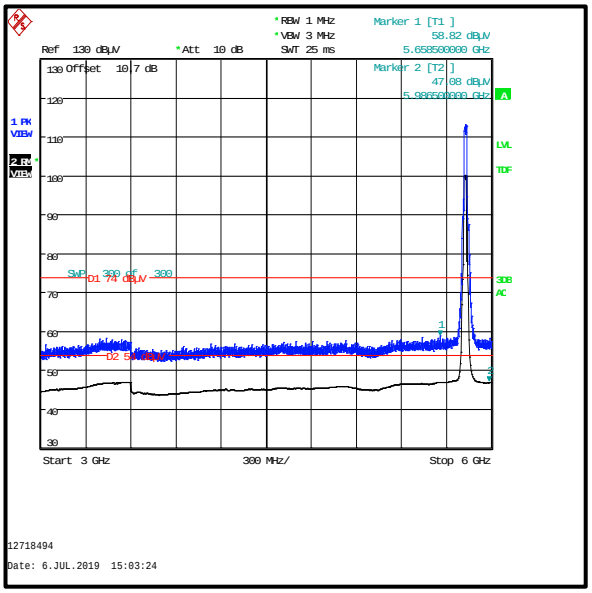
| Frequency (MHz) | Antenna Polarity | Peak Level (dBµV/m) | Peak Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See note 1 | | | | | |

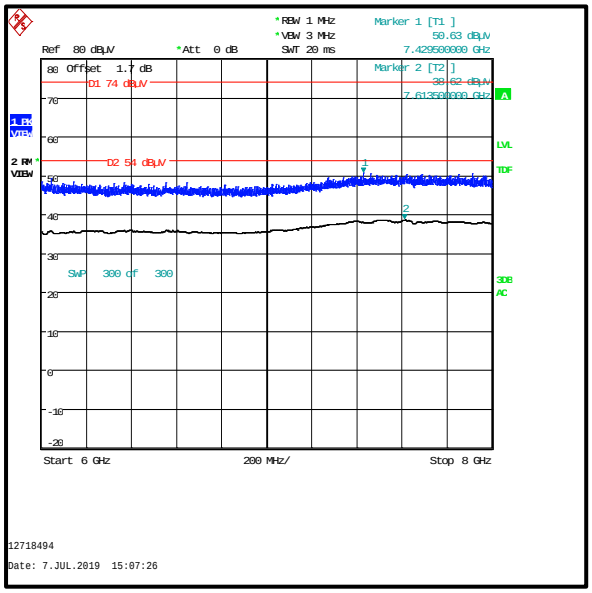
## Results: Average

| Frequency (MHz) | Antenna Polarity | Average Level (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See note 1 | | | | | |

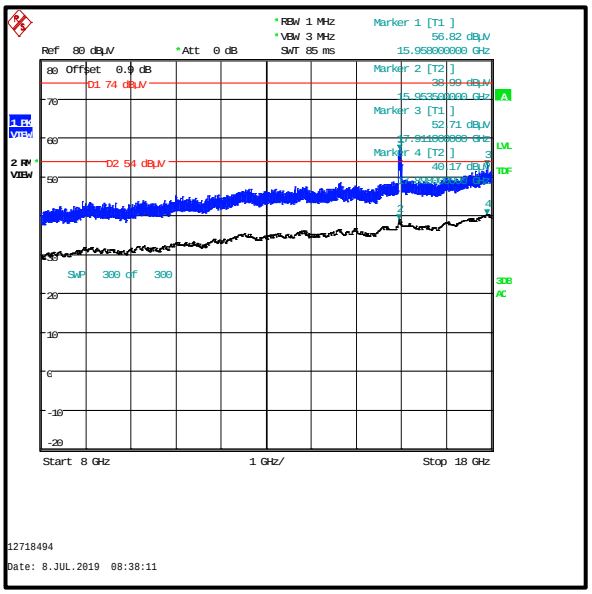


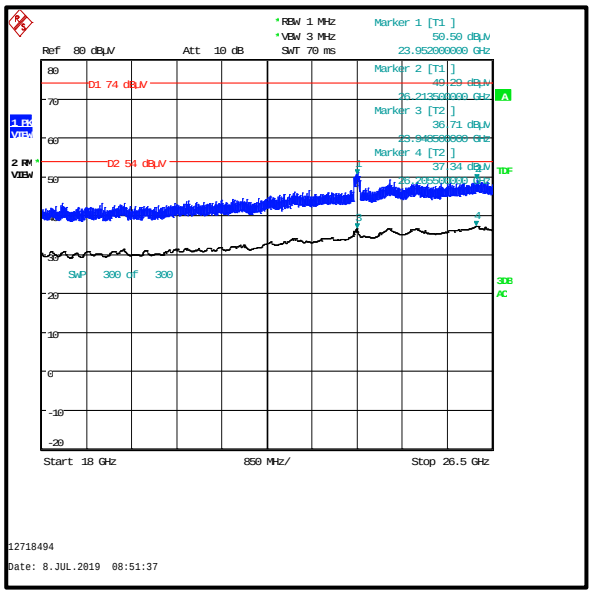



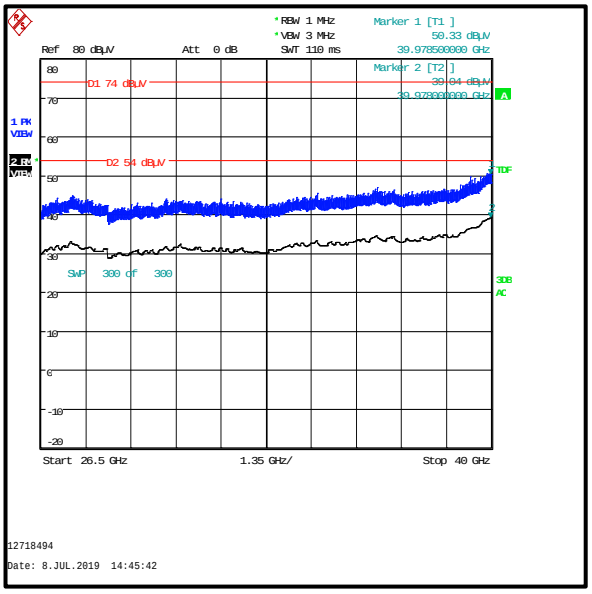



## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 5 GHz WLAN (SISO) top channel (continued)



## 4.2. Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 5 GHz WLAN (SISO) bottom channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli,<br>Mark Perry,<br>John Ferdinand,<br>David Doyle &<br>Mohamed Toubella | **Test Dates:** | 05 July 2019 to<br>08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 & 6.2.1.2 |
| **Test Method Used:** | KDB 789033 II.G & ANSI C63.10 Sections 6.3, 6.5 and 6.6 |
| **Frequency Range:** | 30 MHz to 40 GHz |
| **Configuration:** | *Bluetooth* Basic Rate top channel / 5 GHz WLAN (SISO) bottom channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

### Note(s):

1. All intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* fundamental is shown on the 1 GHz to 3 GHz plot.
3. The 5 GHz WLAN fundamental is shown on the 3 GHz to 6 GHz plot.
4. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
5. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
7. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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.
8. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.

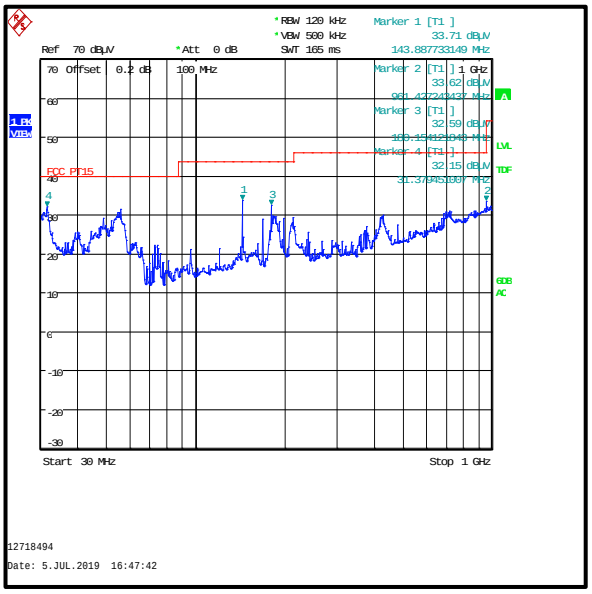
## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 5 GHz WLAN (SISO) bottom channel (continued)

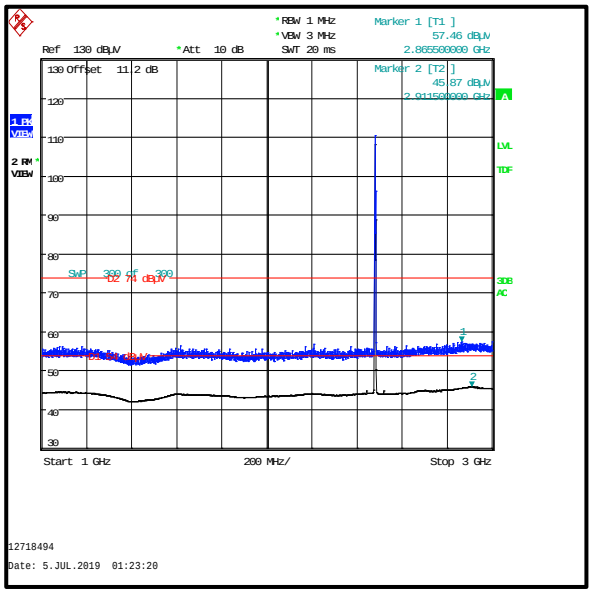
## Results: Peak

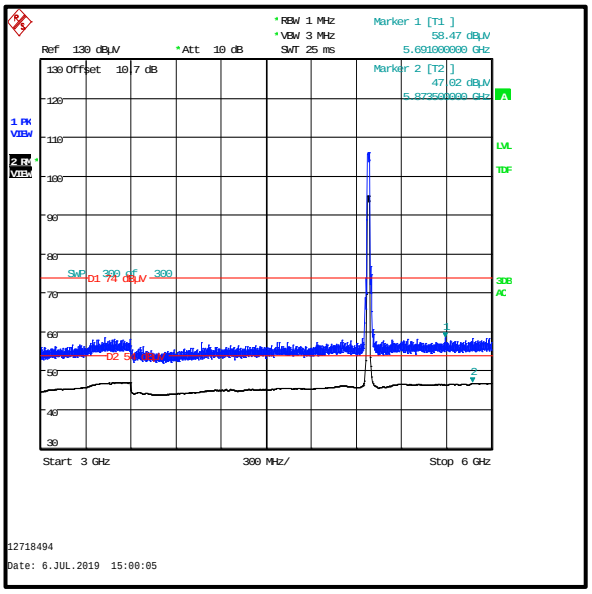
| Frequency (MHz) | Antenna Polarity | Peak Level (dBµV/m) | Peak Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See note 1 | | | | | |

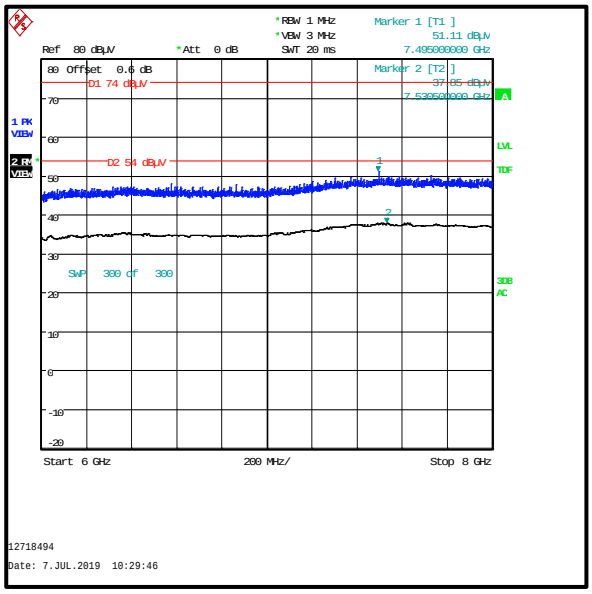
## Results: Average

| Frequency (MHz) | Antenna Polarity | Average Level (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See note 1 | | | | | |

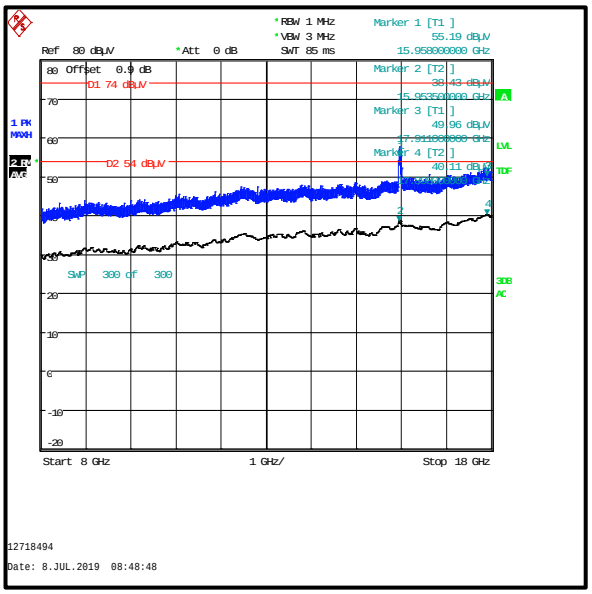


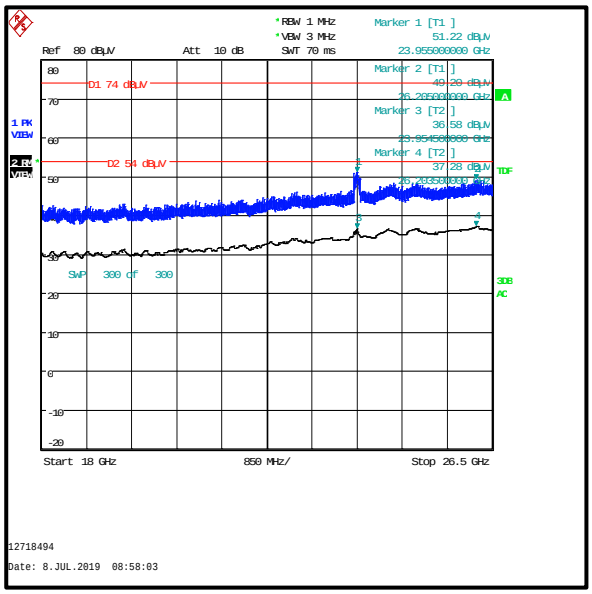



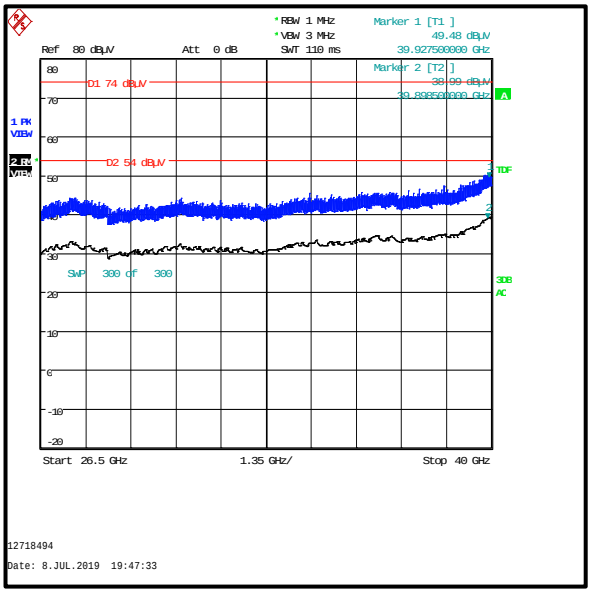



## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 5 GHz WLAN (SISO) bottom channel (continued)



## 4.3. Transmitter Out of Band Radiated Emissions - *Bluetooth* LE bottom channel / 5 GHz WLAN (SISO) top channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli,<br>Mark Perry,<br>John Ferdinand,<br>David Doyle &<br>Mohamed Toubella | **Test Dates:** | 05 July 2019 to<br>08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 & 6.2.4.2 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1<br>KDB 558074 Sections 8.5 & 8.6,<br>KDB 789033 II.G |
| **Frequency Range:** | 30 MHz to 40 GHz |
| **Configuration:** | *Bluetooth* LE bottom channel / 5 GHz WLAN (SISO) top channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

### Note(s):

1. All intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* LE fundamental is shown on the 1 GHz to 3 GHz plot.
3. The 5 GHz WLAN fundamental is shown on the 3 GHz to 6 GHz plot.
4. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
5. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
7. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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.
8. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.

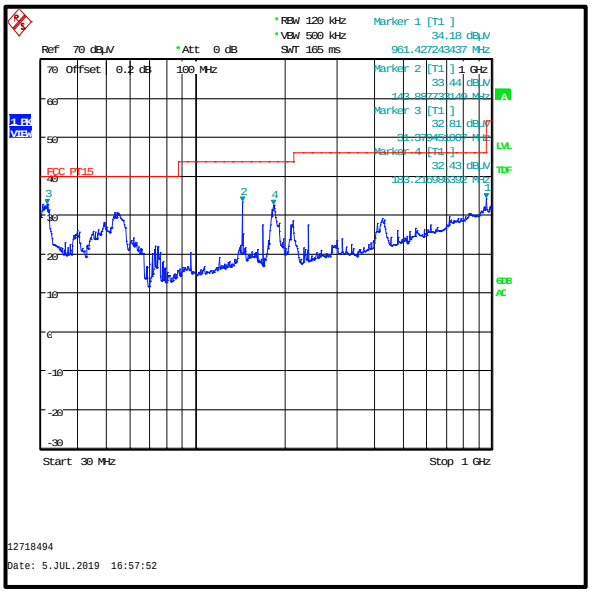
## Transmitter Out of Band Radiated Emissions - *Bluetooth* LE bottom channel / 5 GHz WLAN (SISO) top channel (continued)

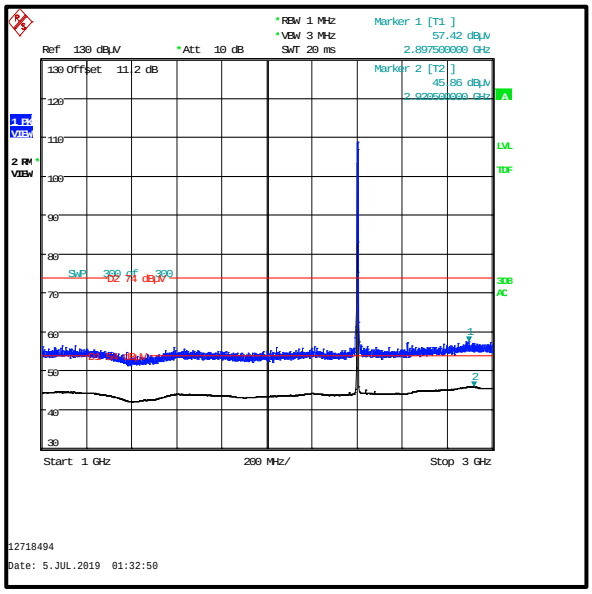
### Results: Peak

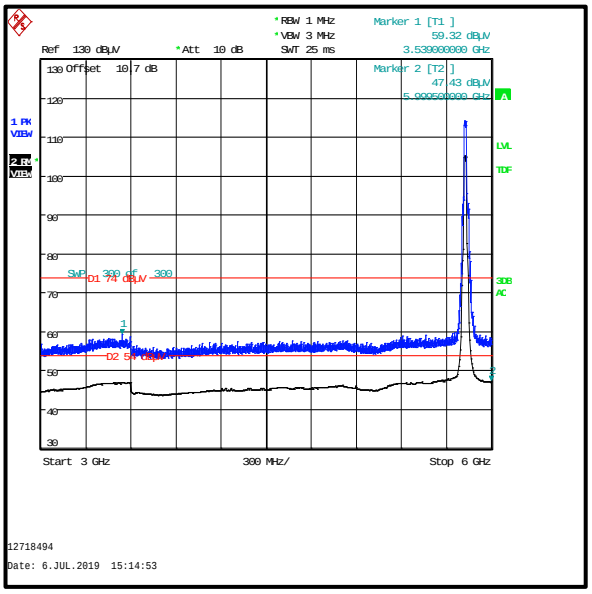
| Frequency (MHz) | Antenna Polarity | Peak Level (dBµV/m) | Peak Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See note 1 | | | | | |

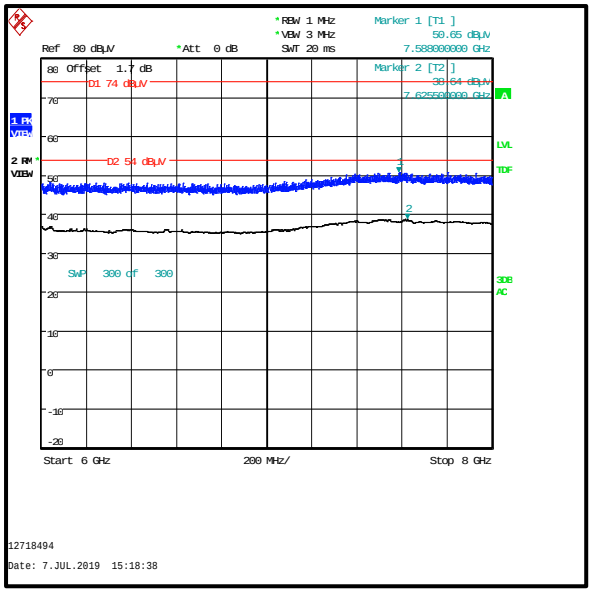
### Results: Average

| Frequency (MHz) | Antenna Polarity | Average Level (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See note 1 | | | | | |

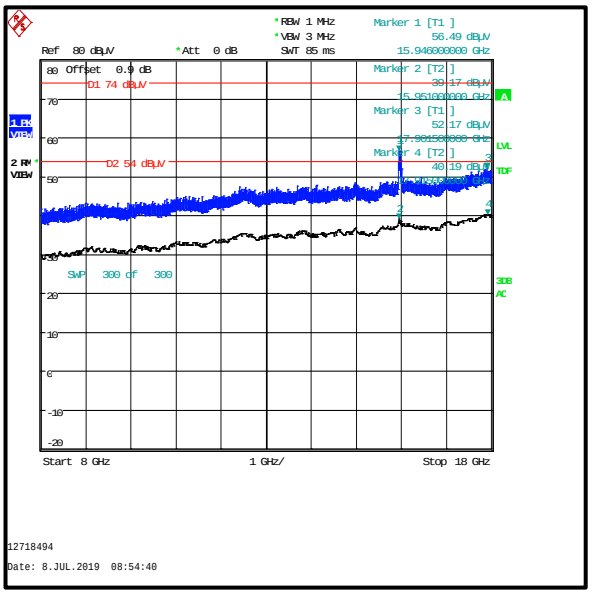


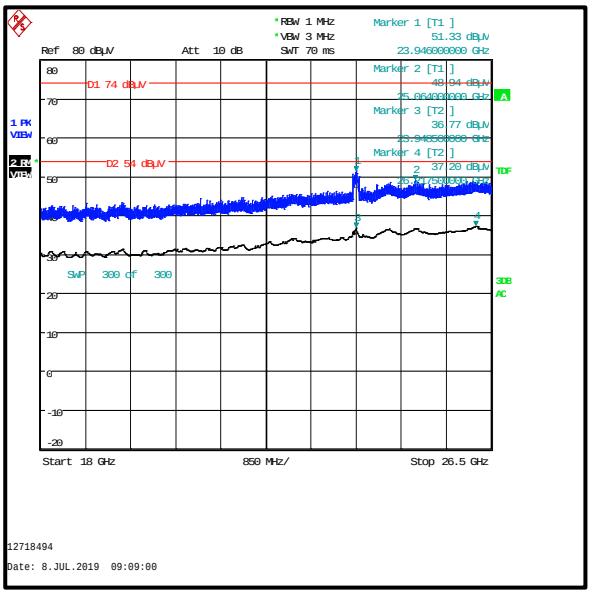



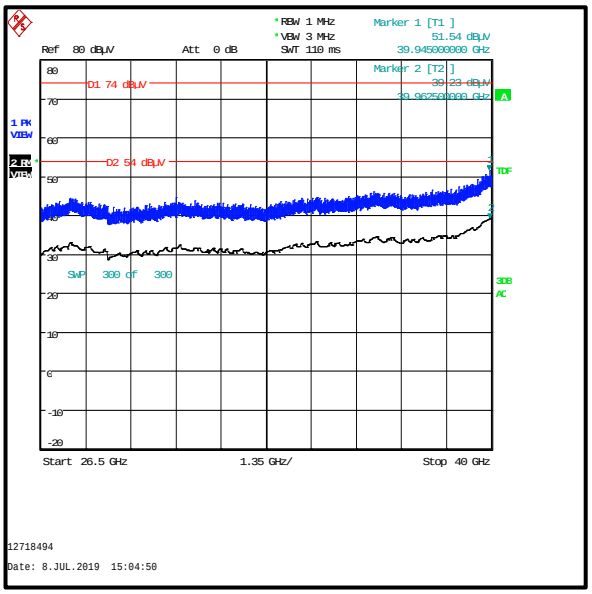



## Transmitter Out of Band Radiated Emissions - *Bluetooth* LE bottom channel / 5 GHz WLAN (SISO) top channel (continued)



## 4.4. Transmitter Out of Band Radiated Emissions - *Bluetooth* LE top channel / 5 GHz WLAN (SISO) bottom channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli,<br>Mark Perry,<br>John Ferdinand,<br>David Doyle &<br>Mohamed Toubella | **Test Dates:** | 05 July 2019 to<br>08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 & 6.2.1.2 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1,<br>KDB 558074 Sections 8.5 & 8.6,<br>KDB 789033 II.G |
| **Frequency Range:** | 30 MHz to 40 GHz |
| **Configuration:** | *Bluetooth* LE top channel / 5 GHz WLAN (SISO) bottom channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

### Note(s):

1. All intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* LE fundamental is shown on the 1 GHz to 3 GHz plot.
3. The 5 GHz WLAN fundamental is shown on the 3 GHz to 6 GHz plot.
4. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
5. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
7. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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.
8. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.

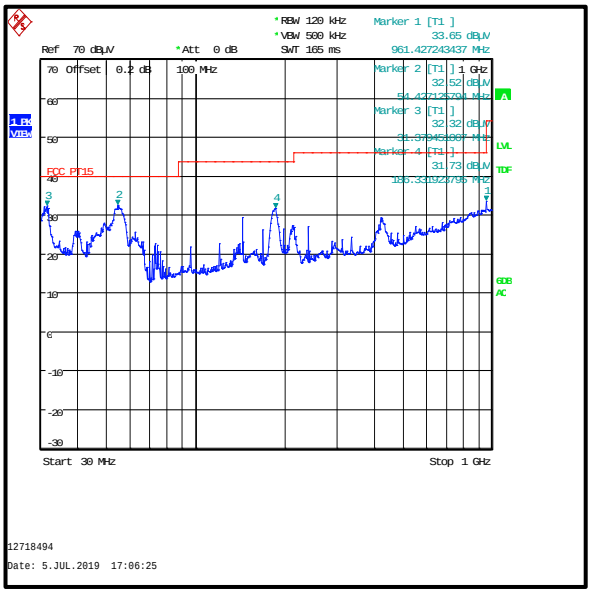
## Transmitter Out of Band Radiated Emissions - *Bluetooth* LE top channel / 5 GHz WLAN (SISO) bottom channel (continued)

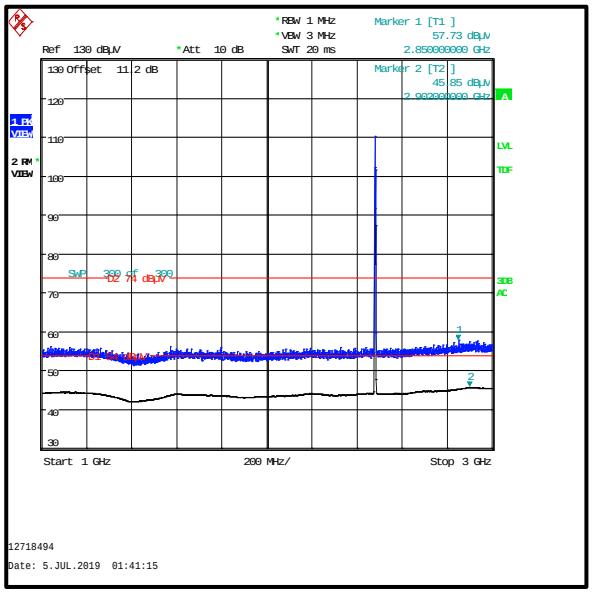
## Results: Peak

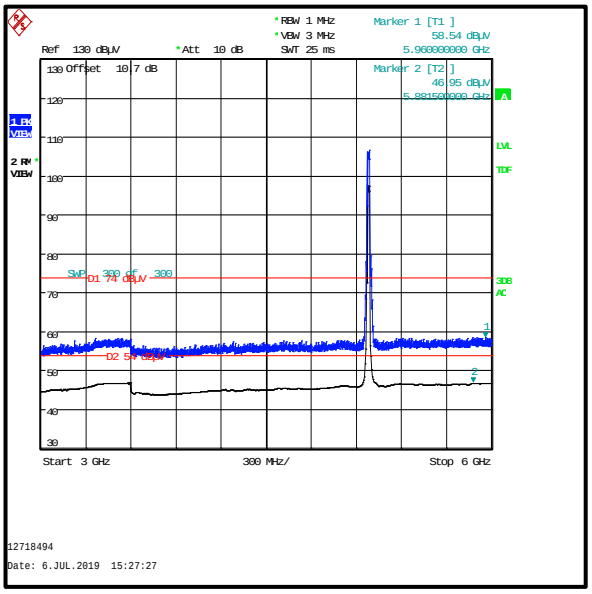
| Frequency (MHz) | Antenna Polarity | Peak Level (dBµV/m) | Peak Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See note 1 | | | | | |

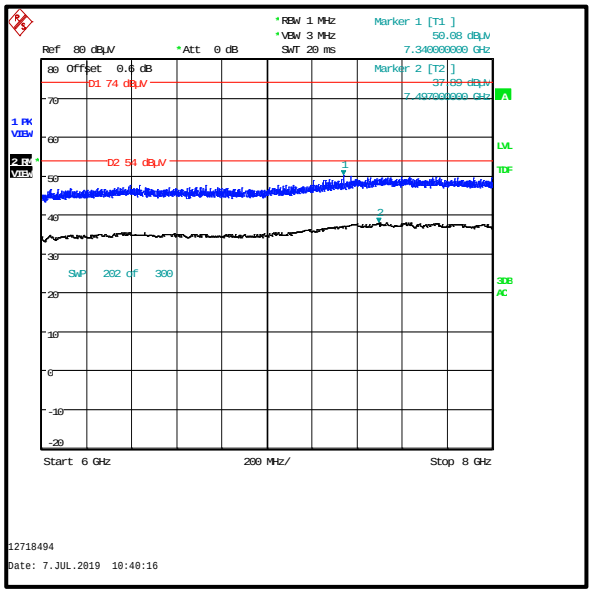
## Results: Average

| Frequency (MHz) | Antenna Polarity | Average Level (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See note 1 | | | | | |

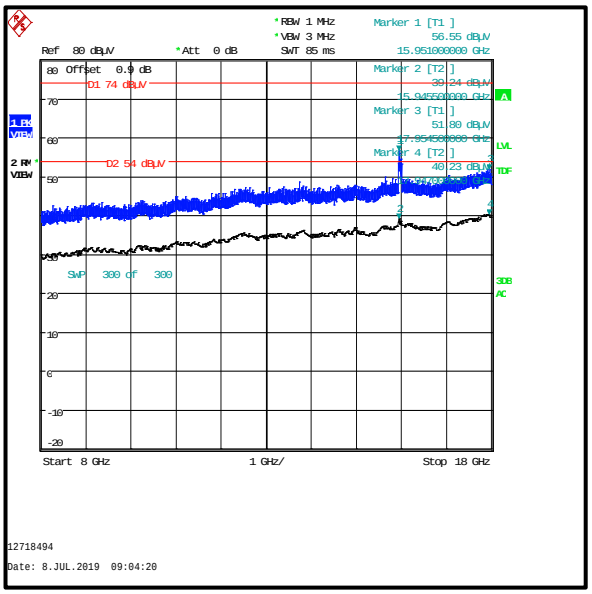


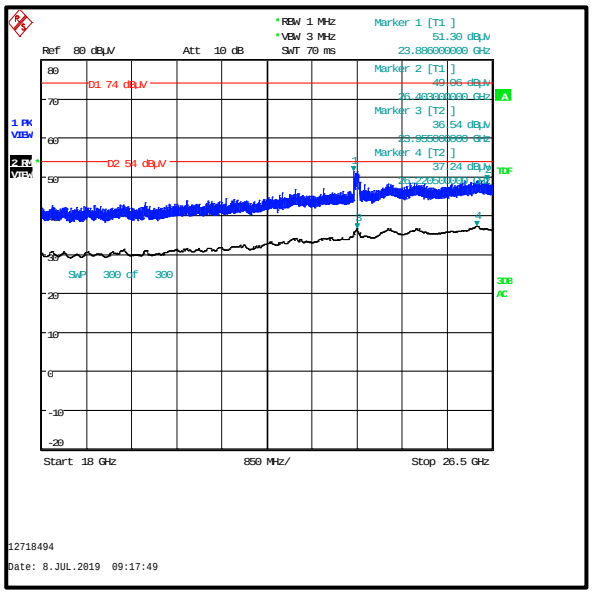



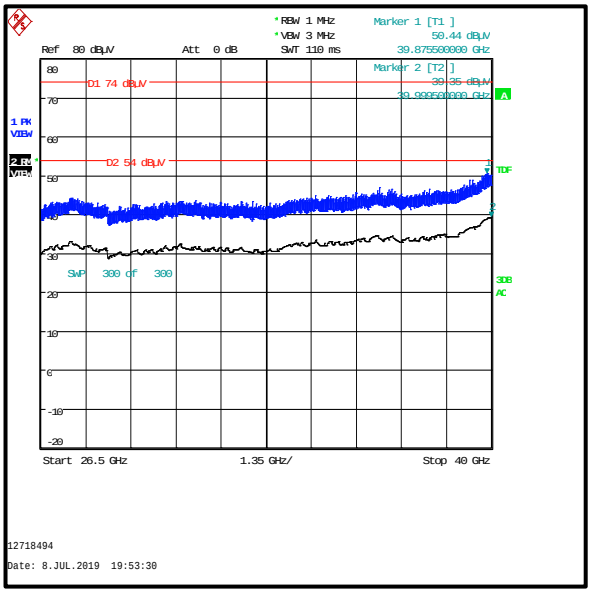



## Combination 4 - Transmitter Out of Band Radiated Emissions - *Bluetooth* LE top channel / 5 GHz WLAN (SISO) bottom channel (continued)



## 4.5. Transmitter Out of Band Radiated Emissions - 2.4 GHz WLAN (MIMO) bottom channel / 5 GHz WLAN (SISO) top channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli,<br>Mark Perry,<br>John Ferdinand,<br>David Doyle &<br>Mohamed Toubella | **Test Dates:** | 05 July 2019 to<br>08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 & 6.2.4.2 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1,<br>KDB 558074 Sections 8.5 & 8.6,<br>KDB 789033 II.G |
| **Frequency Range:** | 30 MHz to 40 GHz |
| **Configuration:** | 2.4 GHz WLAN (MIMO) bottom channel / 5 GHz WLAN (SISO) top channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

### Note(s):

1. All intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The 2.4 GHz WLAN fundamental is shown on the 1 GHz to 3 GHz plot.
3. The 5 GHz WLAN fundamental is shown on the 3 GHz to 6 GHz plot.
4. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
5. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
7. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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.
8. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.

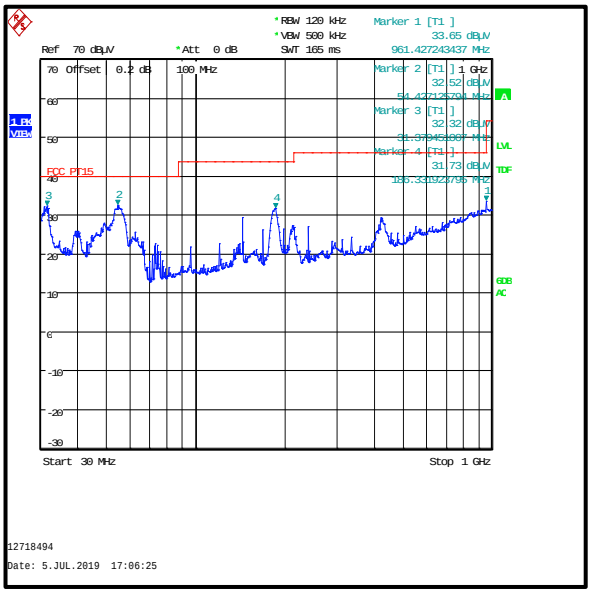
## Transmitter Out of Band Radiated Emissions - 2.4 GHz WLAN (MIMO) bottom channel / 5 GHz WLAN (SISO) top channel (continued)

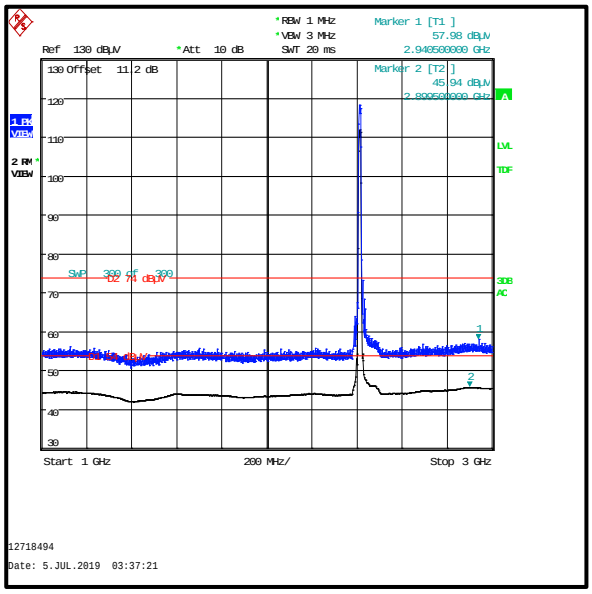
### Results: Peak

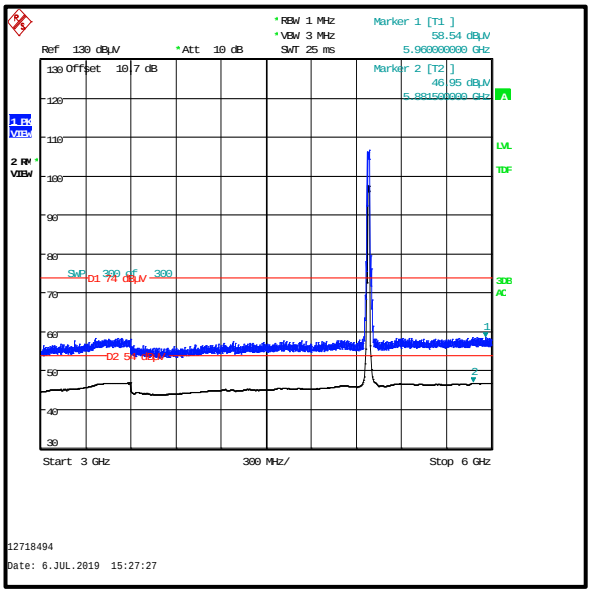
| Frequency (MHz) | Antenna Polarity | Peak Level (dBµV/m) | Peak Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See Note 1 | | | | | |

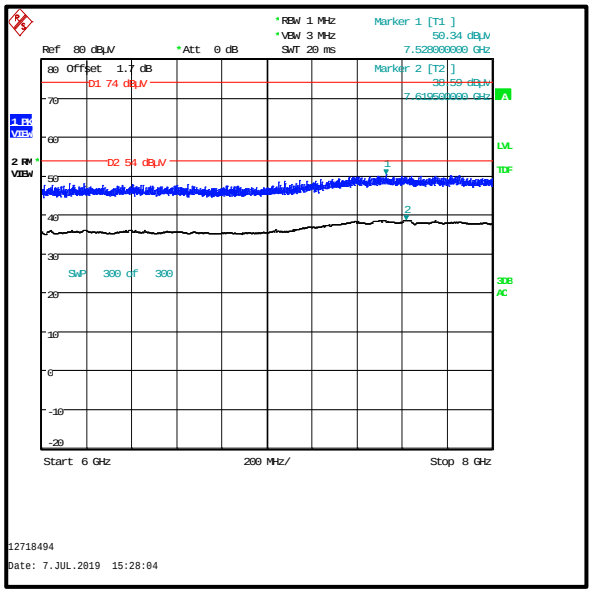
### Results: Average

| Frequency (MHz) | Antenna Polarity | Average Level (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See Note 1 | | | | | |

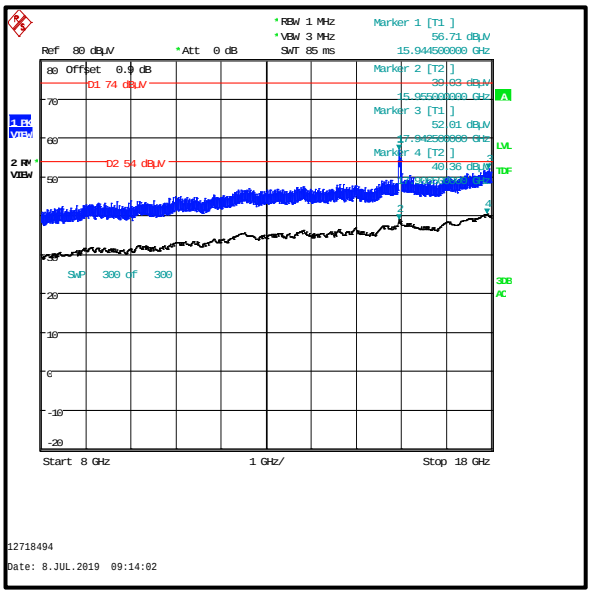


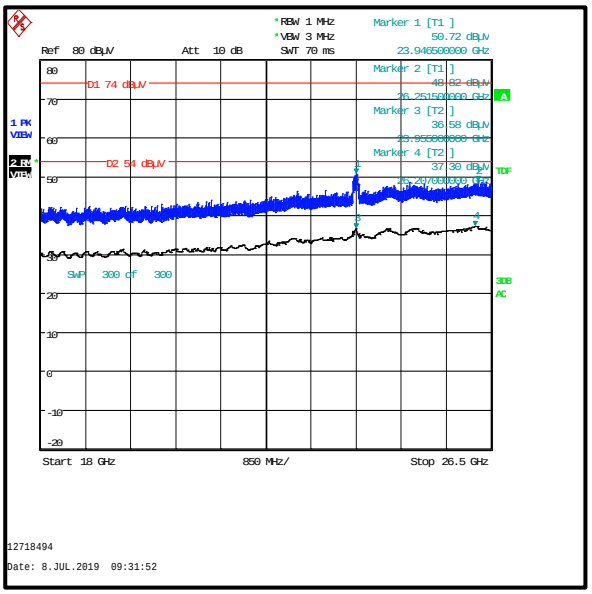



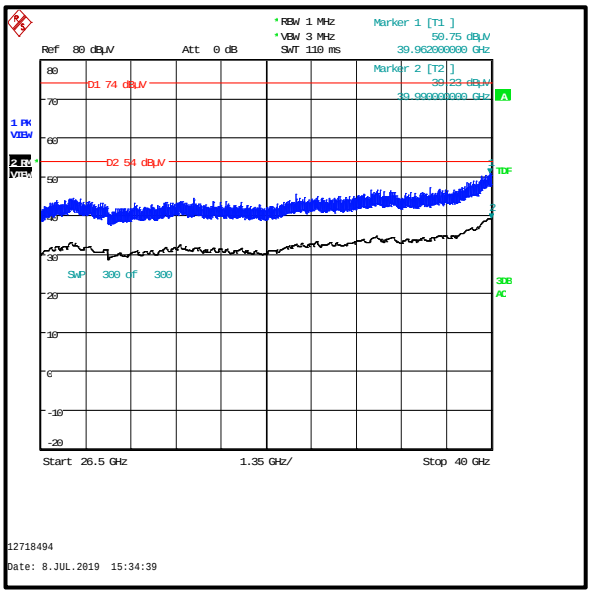



## Transmitter Out of Band Radiated Emissions - 2.4 GHz WLAN (MIMO) bottom channel / 5 GHz WLAN (SISO) top channel (continued)



## 4.6. Transmitter Out of Band Radiated Emissions - 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli,<br>Mark Perry,<br>John Ferdinand,<br>David Doyle &<br>Mohamed Toubella | **Test Dates:** | 05 July 2019 to<br>08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 & 6.2.1.2 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1,<br>KDB 558074 Sections 8.5 & 8.6,<br>KDB 789033 II.G |
| **Frequency Range:** | 30 MHz to 40 GHz |
| **Configuration:** | 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

### Note(s):

1. All intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The 2.4 GHz WLAN fundamental is shown on the 1 GHz to 3 GHz plot.
3. The 5 GHz WLAN fundamental is shown on the 3 GHz to 6 GHz plot.
4. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
5. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
7. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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.
8. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.

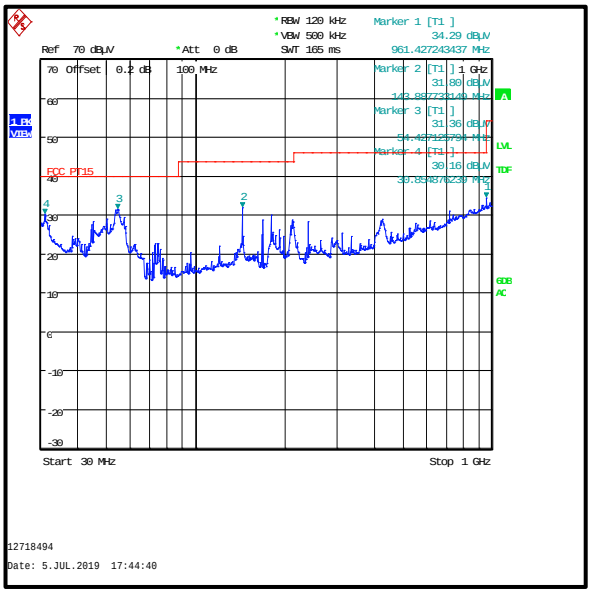
## Transmitter Out of Band Radiated Emissions - 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel (continued)

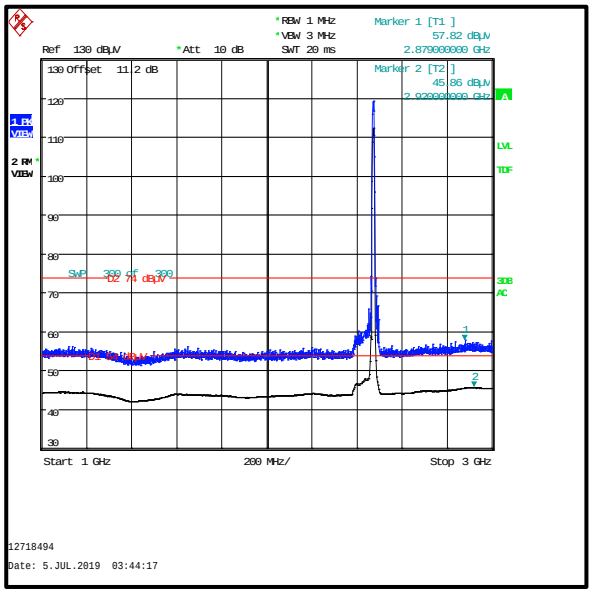
### Results: Peak

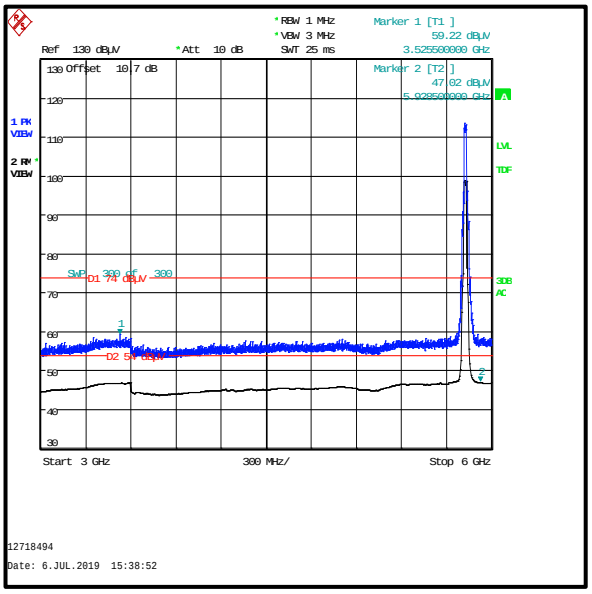
| Frequency (MHz) | Antenna Polarity | Peak Level (dBµV/m) | Peak Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See Note 1 | | | | | |

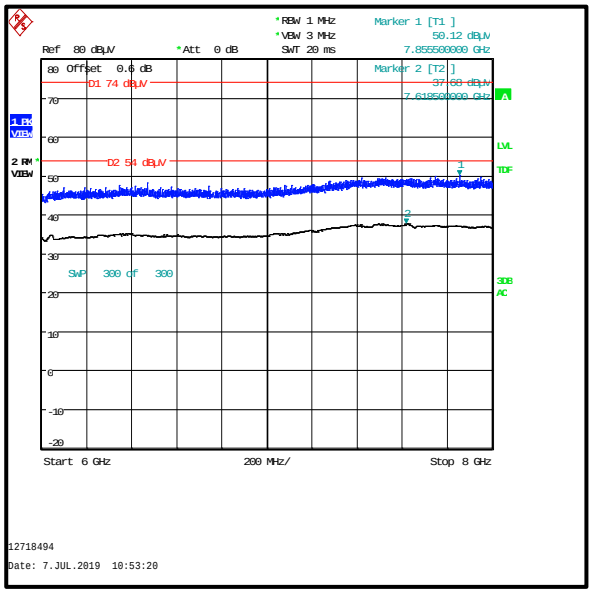
### Results: Average

| Frequency (MHz) | Antenna Polarity | Average Level (dBµV/m) | Average Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| See Note 1 | | | | | |

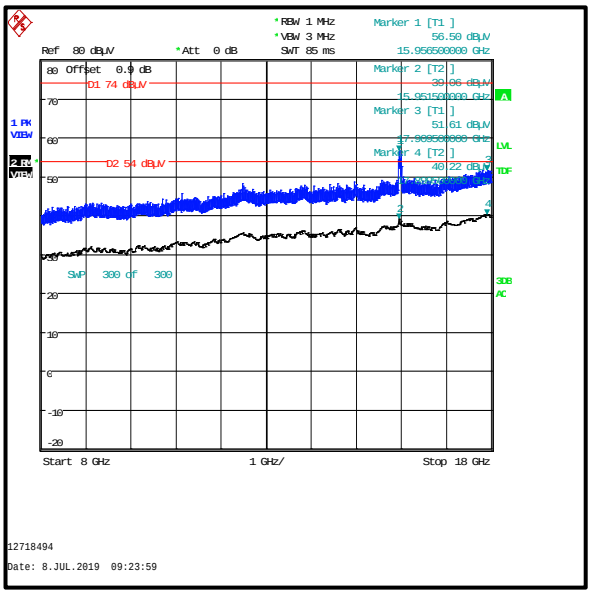


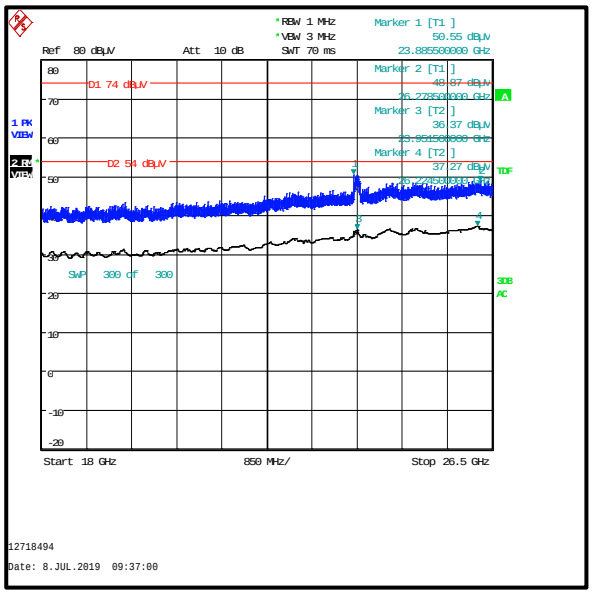



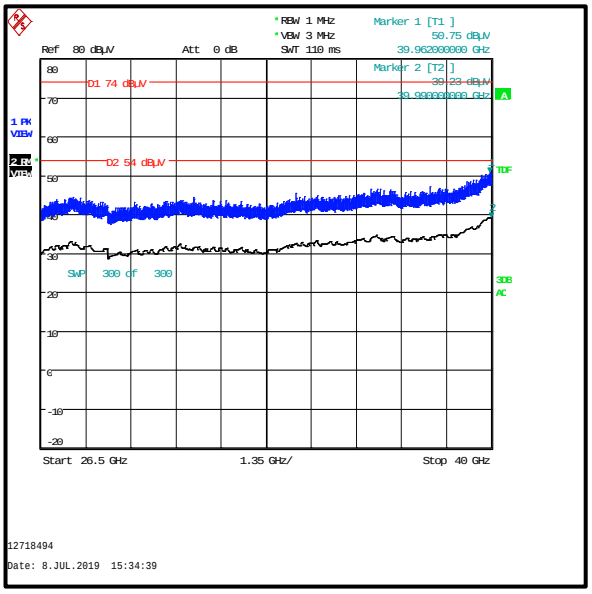



## Transmitter Out of Band Radiated Emissions - 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel (continued)



## 4.7. Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli, Mark Perry, David Doyle, James O'Reilly & John Ferdinand | **Test Dates:** | 04 July 2019 to 08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a) & 15.247(d) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1, KDB 558074 Sections 8.5 & 8.6 |
| **Frequency Range:** | 30 MHz to 26.5 GHz |
| **Configuration:** | *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel (continued)

## Note(s):

1. All other intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* and 2.4 GHz WLAN fundamentals are shown on the 1 GHz to 3 GHz plot.
3. The emission at approximately 2332 MHz is an intermodulation product produced by the second harmonic of the *Bluetooth* signal minus the 2.4 GHz WLAN signal.
4. The emission at approximately 2542 MHz is an intermodulation product produced by the second harmonic of the 2.4 GHz WLAN signal minus the *Bluetooth* signal.
5. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
6. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
7. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
8. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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. For final measurements the maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres
9. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
10. *-20 dBc limit.
11. **Corrected level incorporating a duty cycle correction factor. See Appendix 1 for more information.

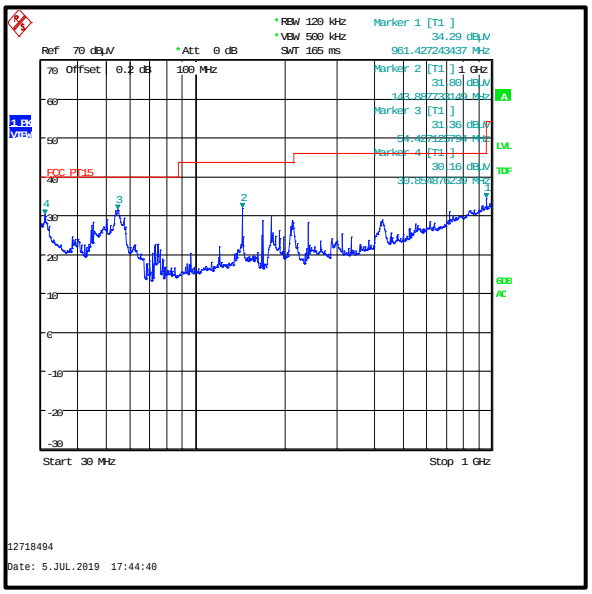
## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel (continued)

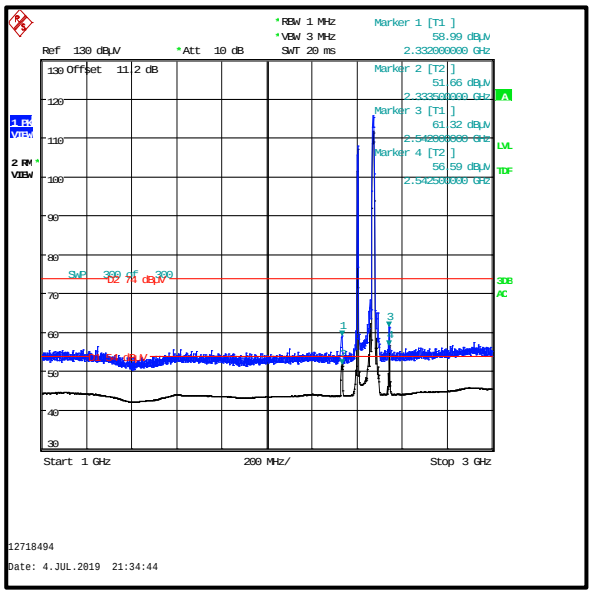
### Results: Peak

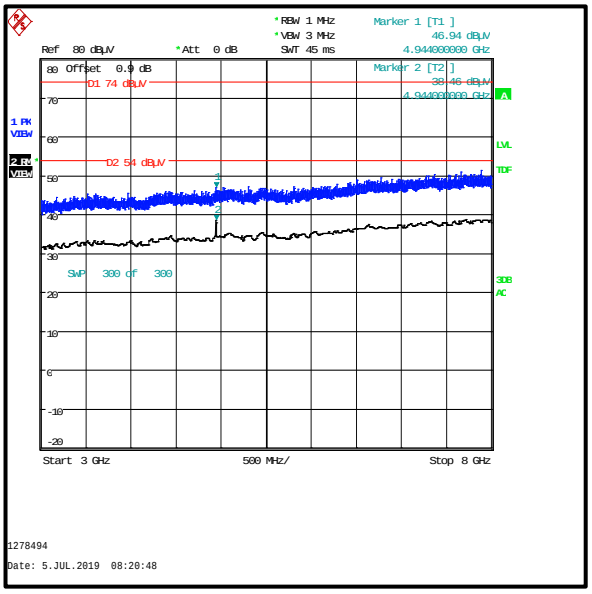
| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2332.110 | Vertical | 53.7 | 74.0 | 20.3 | Complied |
| 2541.997 | Vertical | 47.6 | 88.7* | 41.1 | Complied |

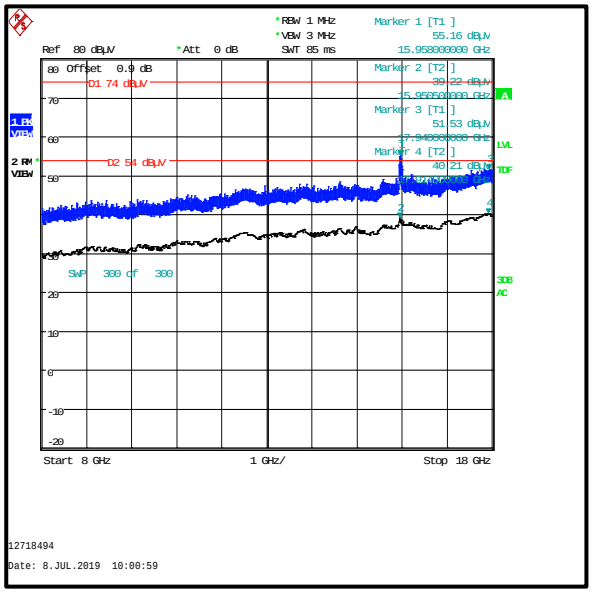
### Results: Average

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2332.110 | Vertical | 34.7** | 54.0 | 19.3 | Complied |

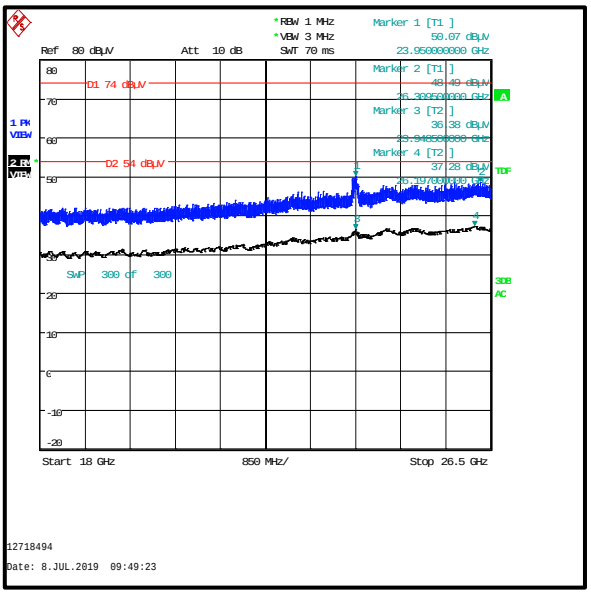


## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel (continued)



## 4.8. Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 2.4 GHz WLAN (MIMO) bottom channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli, Mark Perry, David Doyle, James O'Reilly & John Ferdinand | **Test Dates:** | 04 July 2019 to 08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a) & 15.247(d) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1, KDB 558074 Sections 8.5 & 8.6 |
| **Frequency Range:** | 30 MHz to 26.5 GHz |
| **Configuration:** | *Bluetooth* Basic Rate top channel / 2.4 GHz WLAN (MIMO) bottom channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 2.4 GHz WLAN (MIMO) bottom channel (continued)

## Note(s):

1. All other intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* and 2.4 GHz WLAN fundamentals are shown on the 1 GHz to 3 GHz plot.
3. The emission at approximately 2344 MHz is an intermodulation product produced by the second harmonic of the 2.4 GHz WLAN signal minus the *Bluetooth* signal.
4. The emission at approximately 2548 MHz is an intermodulation product produced by the second harmonic of the *Bluetooth* signal minus the 2.4 GHz WLAN signal.
5. The emission at approximately 4824 MHz is the second harmonic of the 2.4 GHz WLAN signal and was therefore not measured.
6. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
7. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
8. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
9. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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. For final measurements the maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres
10. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
11. *-20 dBc limit.
12. **Corrected level incorporating a duty cycle correction factor. See Appendix 1 for more information.

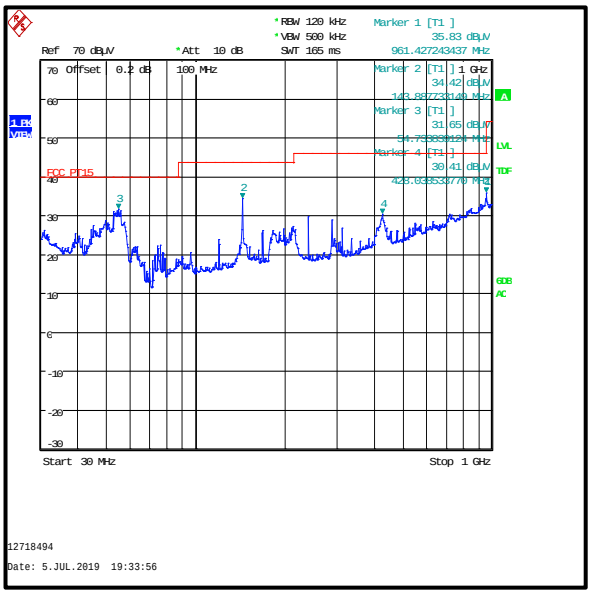
## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 2.4 GHz WLAN (MIMO) bottom channel (continued)

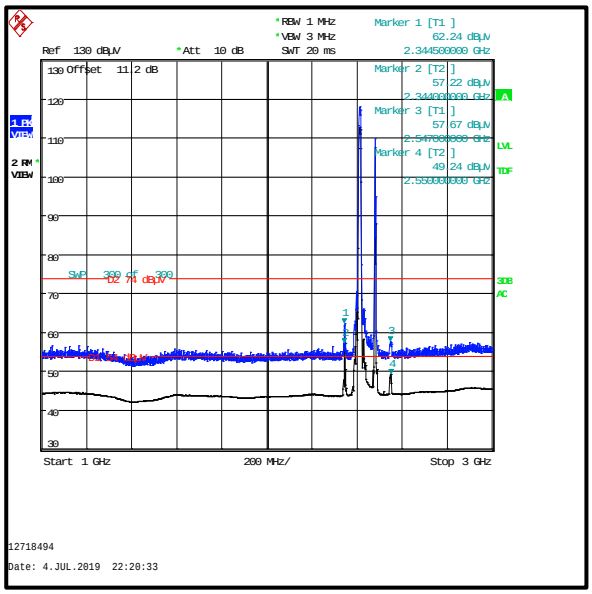
### Results: Peak

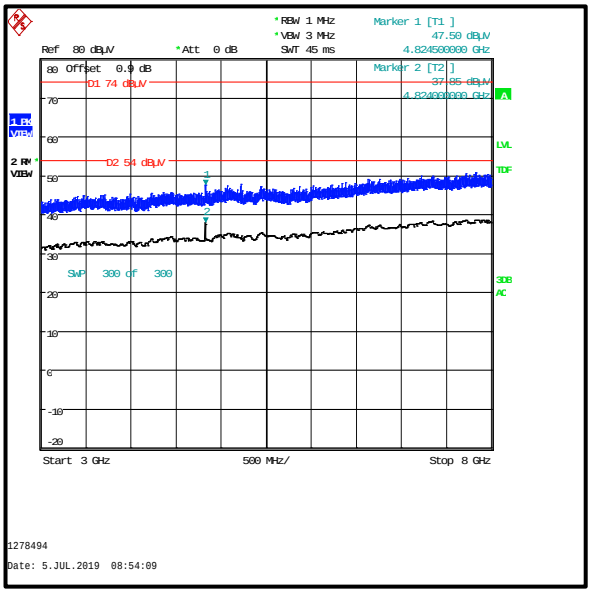
| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2344.033 | Vertical | 56.8 | 74.0 | 17.2 | Complied |
| 2549.744 | Vertical | 48.3 | 89.9* | 41.6 | Complied |

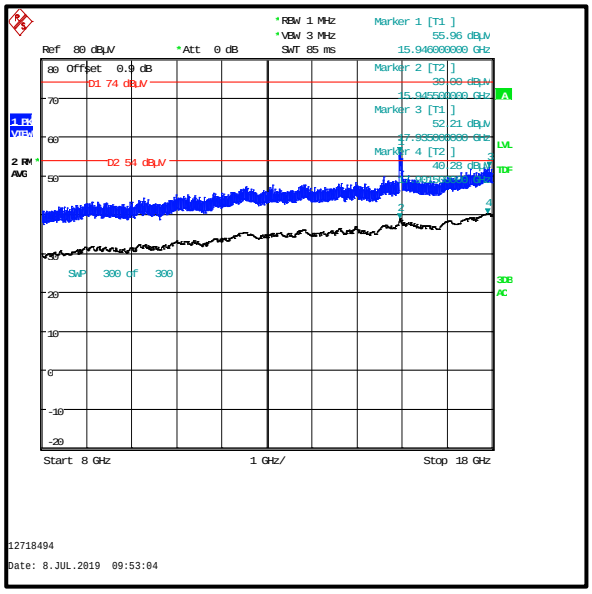
### Results: Average

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2343.969 | Vertical | 37.8** | 54.0 | 16.2 | Complied |

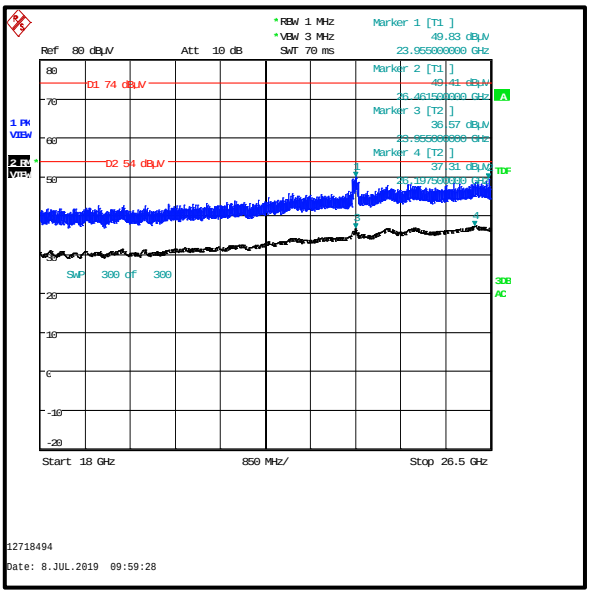


## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 2.4 GHz WLAN (MIMO) bottom channel (continued)



## 4.9. Transmitter Out of Band Radiated Emissions - *Bluetooth* LE bottom channel / 2.4 GHz WLAN (MIMO) top channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli, Mark Perry, David Doyle, James O'Reilly & John Ferdinand | **Test Dates:** | 04 July 2019 to 08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a) & 15.247(d) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1, KDB 558074 Sections 8.5 & 8.6 |
| **Frequency Range:** | 30 MHz to 26.5 GHz |
| **Configuration:** | *Bluetooth* LE bottom channel / 2.4 GHz WLAN (MIMO) top channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

### Note(s):

1. All other intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* LE and 2.4 GHz WLAN fundamentals are shown on the 1 GHz to 3 GHz plot.
3. The emission at approximately 2332 MHz is an intermodulation product produced by the second harmonic of the *Bluetooth* signal minus the 2.4 GHz WLAN signal.
4. The emission at approximately 2542 MHz is an intermodulation product produced by the second harmonic of the 2.4 GHz WLAN signal minus the *Bluetooth* signal.
5. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
6. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
7. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
8. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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. For final measurements the maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres
9. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
10. *-20 dBc limit.

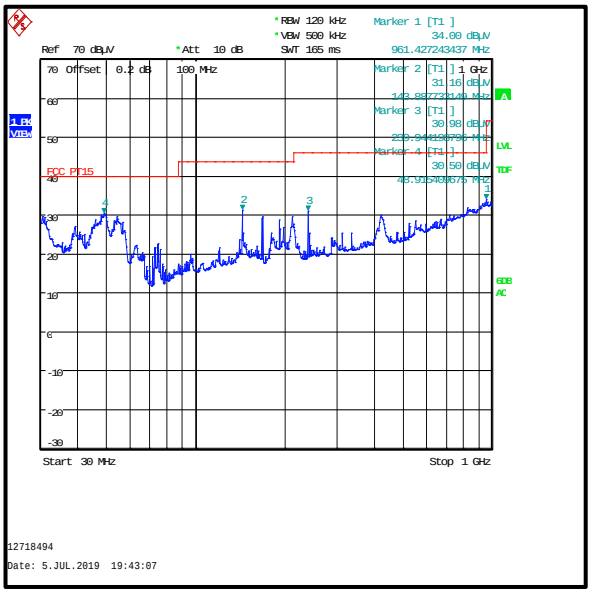
## Transmitter Out of Band Radiated Emissions - *Bluetooth* LE bottom channel / 2.4 GHz WLAN (MIMO) top channel (continued)

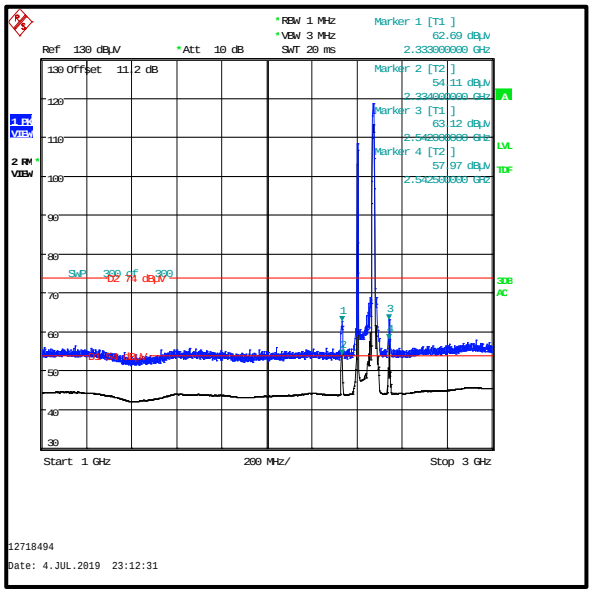
### Results: Peak

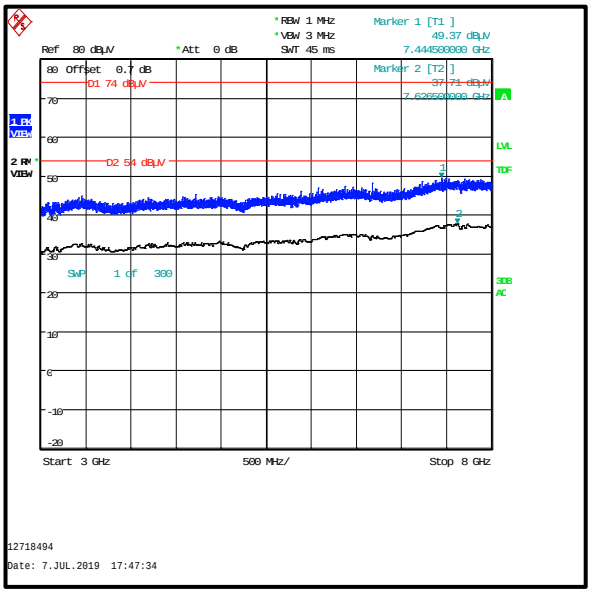
| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2330.892 | Vertical | 53.5 | 74.0 | 10.5 | Complied |
| 2542.062 | Vertical | 45.8 | 87.7* | 41.9 | Complied |

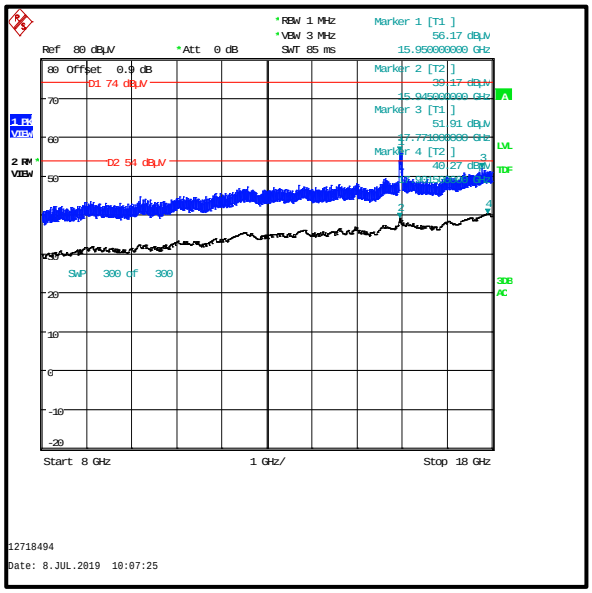
### Results: Average

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2330.315 | Vertical | 46.0 | 54.0 | 8.0 | Complied |

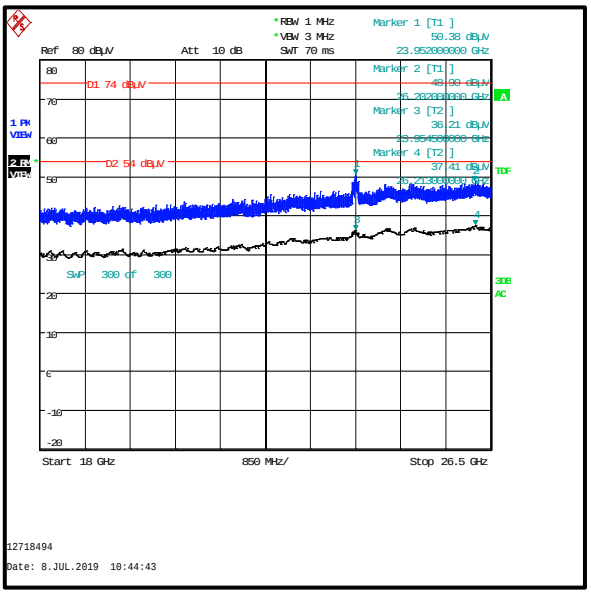


## Transmitter Out of Band Radiated Emissions - *Bluetooth* LE bottom channel / 2.4 GHz WLAN (MIMO) top channel (continued)



## 4.10. Transmitter Out of Band Radiated Emissions - *Bluetooth* LE top channel / 2.4 GHz WLAN (MIMO) bottom channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli, Mark Perry, David Doyle, James O'Reilly & John Ferdinand | **Test Dates:** | 04 July 2019 to 08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a) & 15.247(d) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1, KDB 558074 Sections 8.5 & 8.6 |
| **Frequency Range:** | 30 MHz to 26.5 GHz |
| **Configuration:** | *Bluetooth* LE top channel / 2.4 GHz WLAN (MIMO) bottom channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

### Note(s):

1. All other intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* LE and 2.4 GHz WLAN fundamentals are shown on the 1 GHz to 3 GHz plot.
3. The emission at approximately 2344 MHz is an intermodulation product produced by the second harmonic of the 2.4 GHz WLAN signal minus the *Bluetooth* signal.
4. The emission at approximately 2548 MHz is an intermodulation product produced by the second harmonic of the *Bluetooth* signal minus the 2.4 GHz WLAN signal.
5. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
6. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
7. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
8. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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. For final measurements the maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres
9. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
10. *-20 dBc limit.

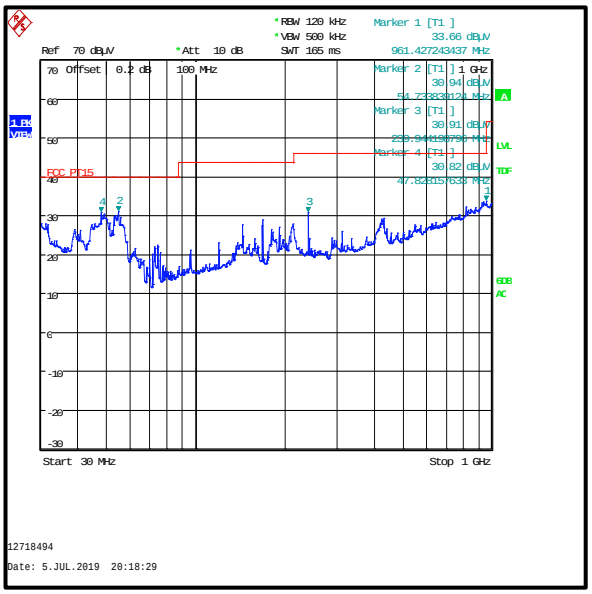
## Transmitter Out of Band Radiated Emissions - *Bluetooth* LE top channel / 2.4 GHz WLAN (MIMO) bottom channel (continued)

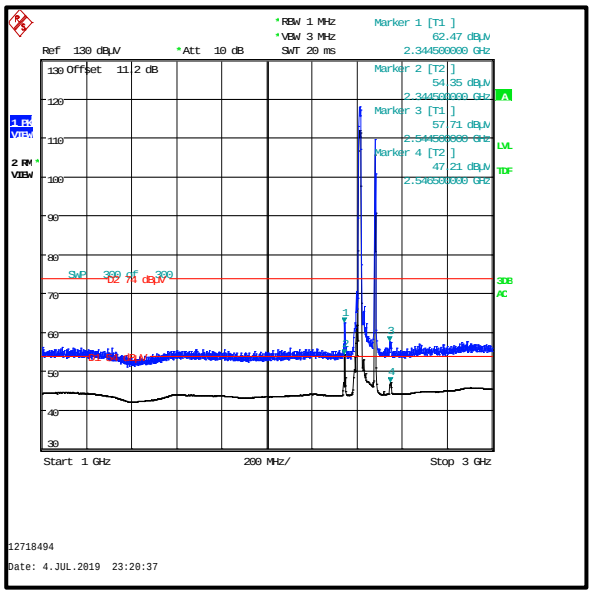
### Results: Peak

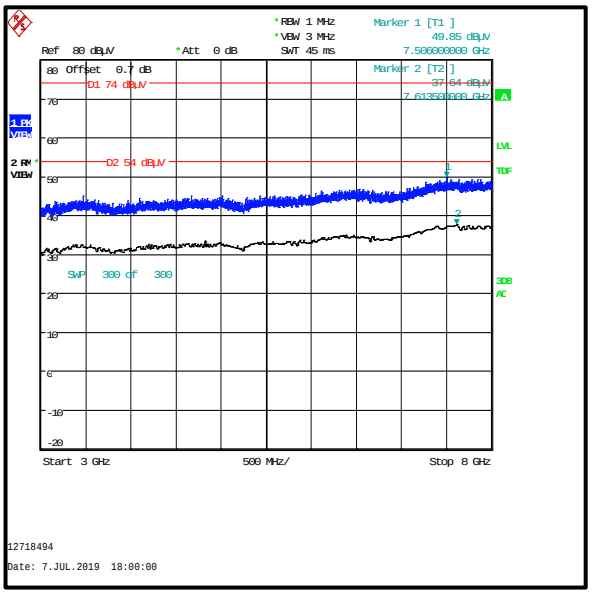
| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2343.585 | Vertical | 56.7 | 74.0 | 17.3 | Complied |
| 2549.487 | Vertical | 48.4 | 85.7* | 37.3 | Complied |

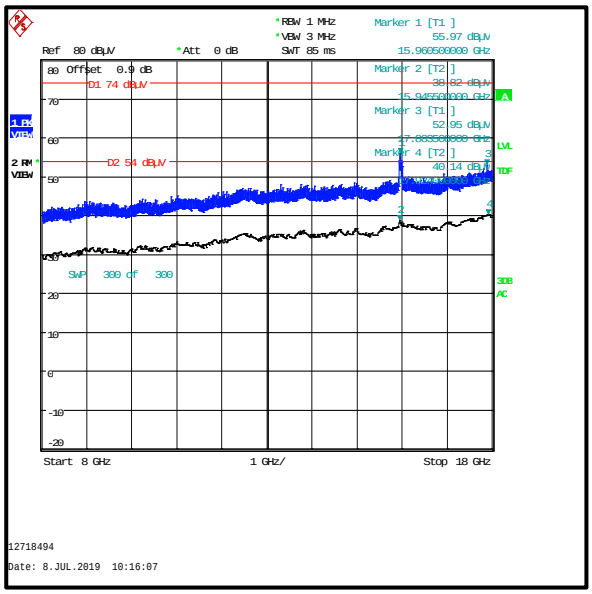
### Results: Average

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2343.905 | Vertical | 52.4 | 54.0 | 1.6 | Complied |

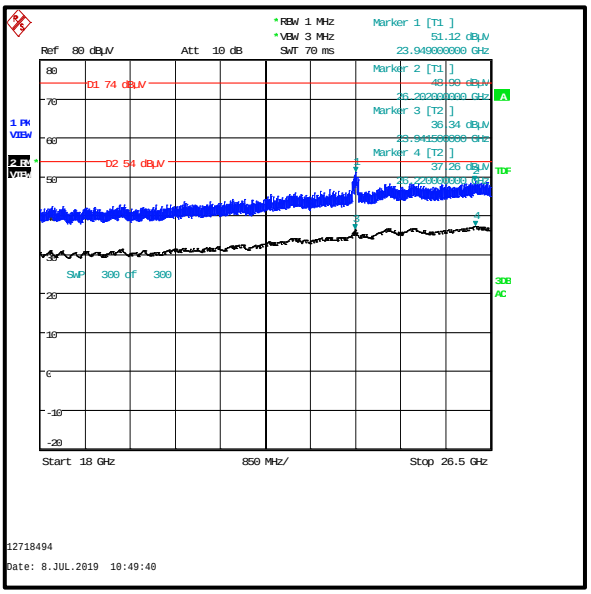


## Transmitter Out of Band Radiated Emissions - *Bluetooth* LE top channel / 2.4 GHz WLAN (MIMO) bottom channel (continued)



## 4.11. Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli, Mark Perry, David Doyle, James O'Reilly, John Ferdinand & Mohamed Toubella | **Test Dates:** | 04 July 2019 to 08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5, 6.2.1.2 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1, KDB 558074 Sections 8.5 & 8.6, KDB 789033 II.G |
| **Frequency Range:** | 30 MHz to 40 GHz |
| **Configuration:** | *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel (continued)

## Note(s):

1. All other intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* and 2.4 GHz WLAN fundamentals are shown on the 1 GHz to 3 GHz plot.
3. The 5 GHz WLAN fundamental is shown on the 3 GHz to 6 GHz plot.
4. The emission at approximately 2332 MHz is an intermodulation product produced by the second harmonic of the *Bluetooth* signal minus the 2.4 GHz WLAN signal.
5. The emission at approximately 2542 MHz is an intermodulation product produced by the second harmonic of the 2.4 GHz WLAN signal minus the *Bluetooth* signal.
6. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
7. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
8. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
9. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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. For final measurements the maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres
10. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
11. *-20 dBc limit.
12. **Corrected level incorporating a duty cycle correction factor. See Appendix 1 for more information.

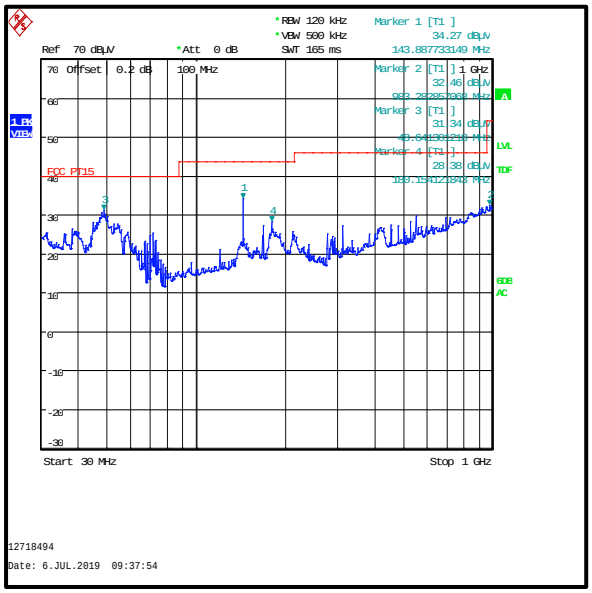
## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel (continued)

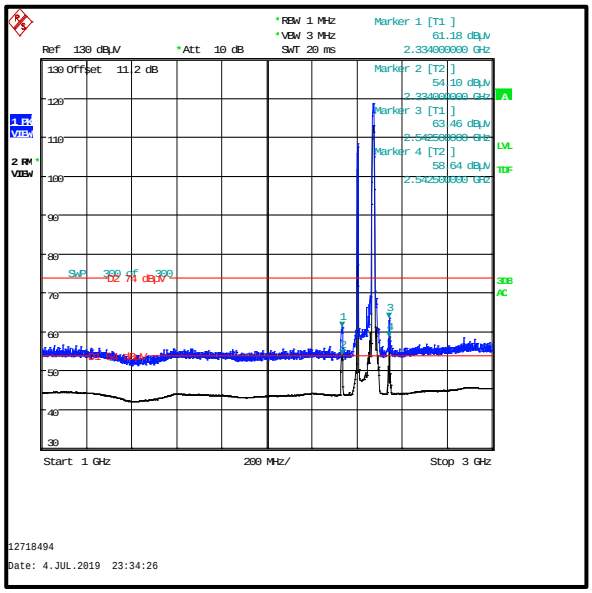
### Results: Peak

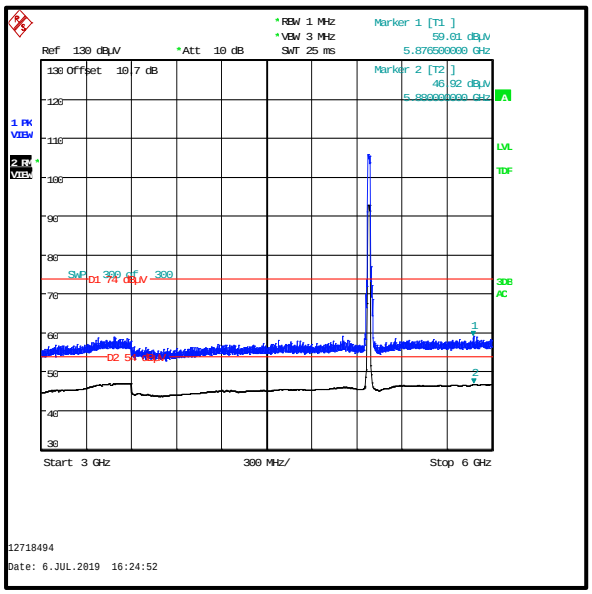
| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2330.700 | Vertical | 53.2 | 74.0 | 20.8 | Complied |
| 2541.923 | Vertical | 47.7 | 88.7* | 41.0 | Complied |

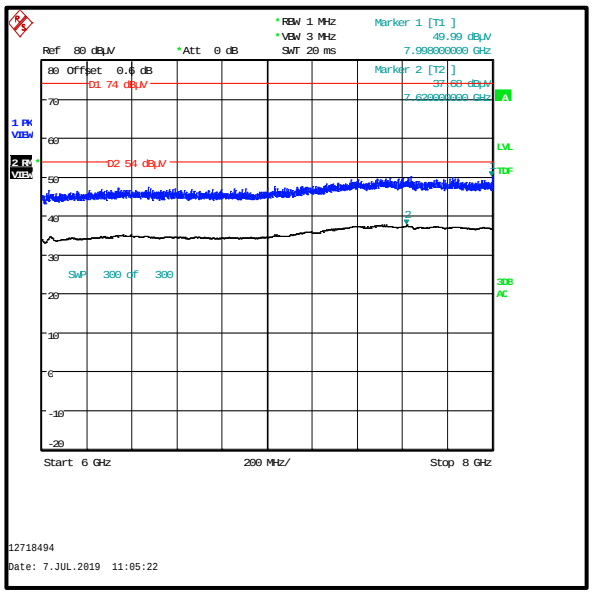
### Results: Average

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2330.635 | Vertical | 34.2** | 54.0 | 19.8 | Complied |

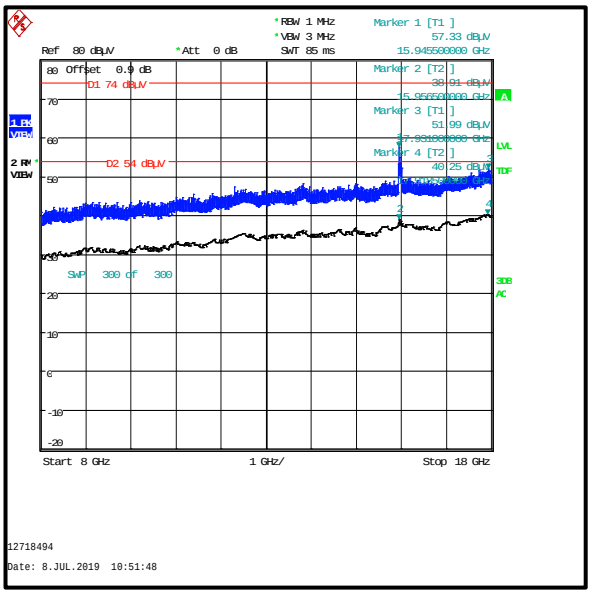


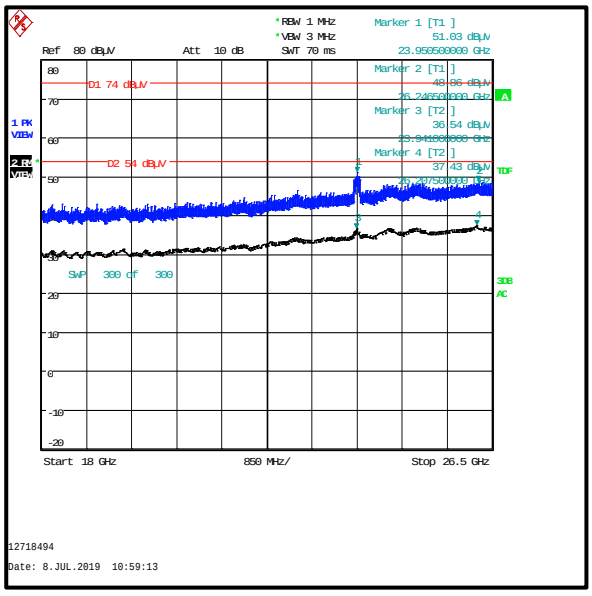



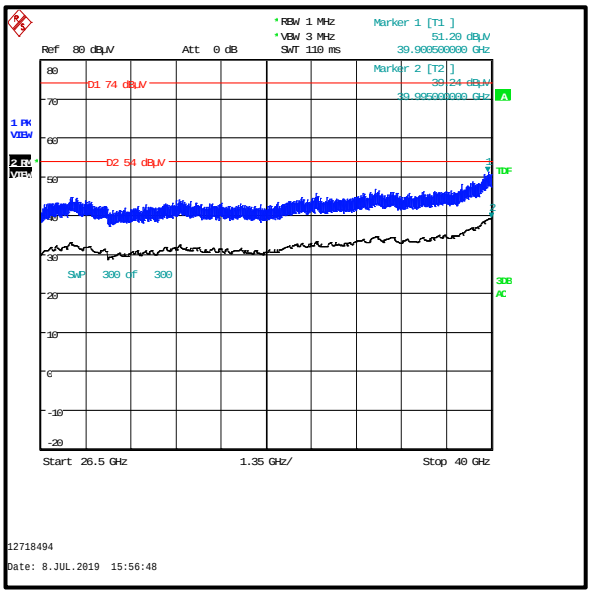



## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel (continued)



## 4.12. Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) top channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli, Mark Perry, David Doyle, James O'Reilly, John Ferdinand & Mohamed Toubella | **Test Dates:** | 04 July 2019 to 08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5, 6.2.4.2 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1<br>KDB 558074 Sections 8.5 & 8.6,<br>KDB 789033 II.G |
| **Frequency Range:** | 30 MHz to 40 GHz |
| **Configuration:** | *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) top channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) top channel (continued)

## Note(s):

1. All other intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* and 2.4 GHz WLAN fundamentals are shown on the 1 GHz to 3 GHz plot.
3. The 5 GHz WLAN fundamental is shown on the 3 GHz to 6 GHz plot.
4. The emission at approximately 2332 MHz is an intermodulation product produced by the second harmonic of the *Bluetooth* signal minus the 2.4 GHz WLAN signal.
5. The emission at approximately 2542 MHz is an intermodulation product produced by the second harmonic of the 2.4 GHz WLAN signal minus the *Bluetooth* signal.
6. The emissions at approximately 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
7. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
8. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
9. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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. For final measurements the maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres
10. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
11. *-20 dBc limit.
12. **Corrected level incorporating a duty cycle correction factor. See Appendix 1 for more information.

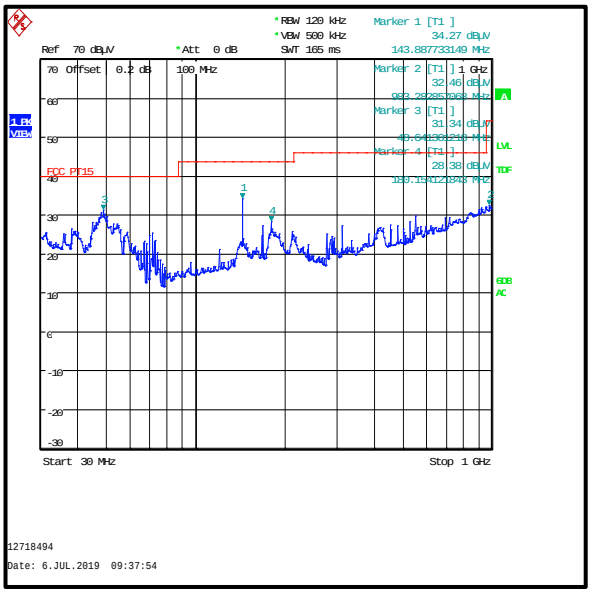
## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) top channel (continued)

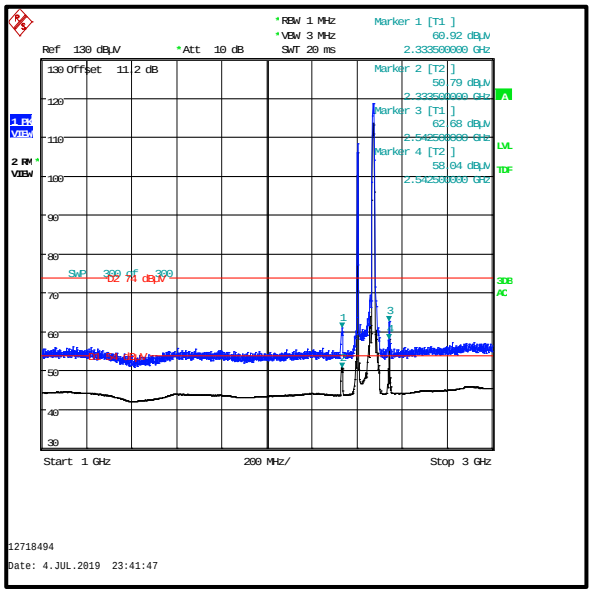
### Results: Peak

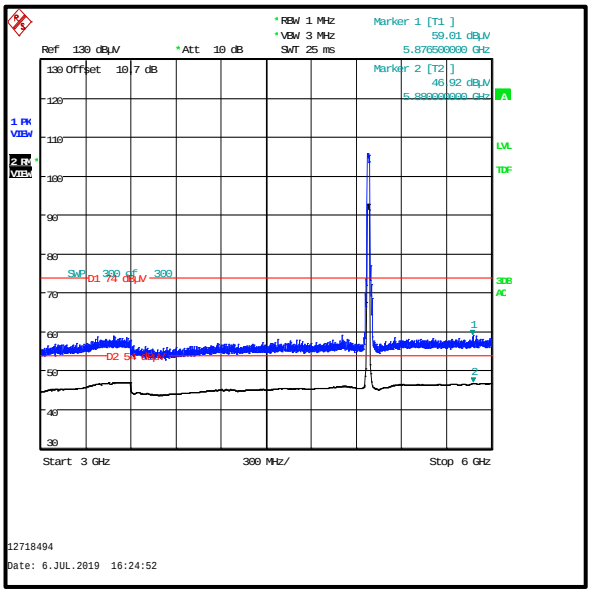
| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2330.951 | Vertical | 51.5 | 74.0 | 22.5 | Complied |
| 2542.003 | Vertical | 48.2 | 88.7* | 40.5 | Complied |

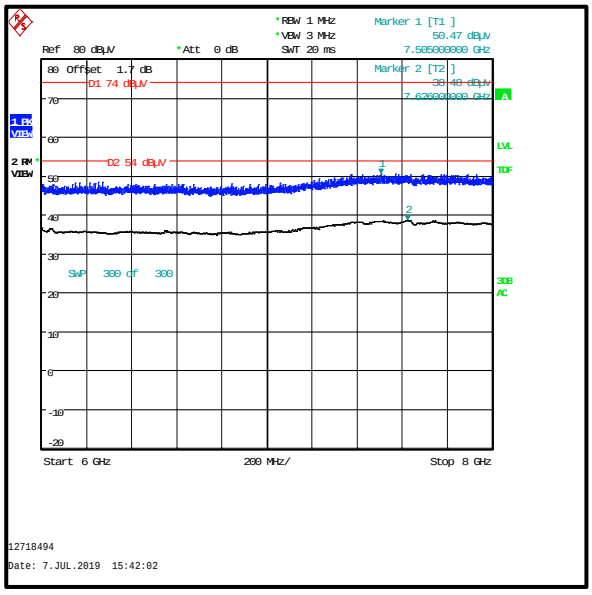
### Results: Average

| Frequency (MHz) | Antenna Polarity | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 2330.705 | Vertical | 32.5** | 54.0 | 21.5 | Complied |

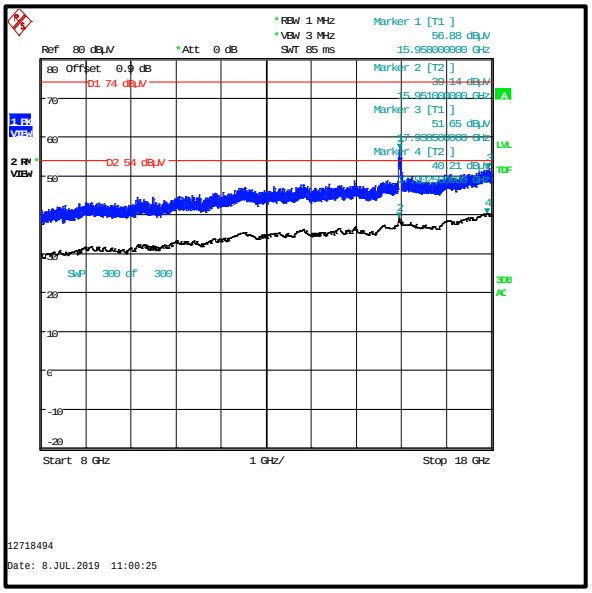


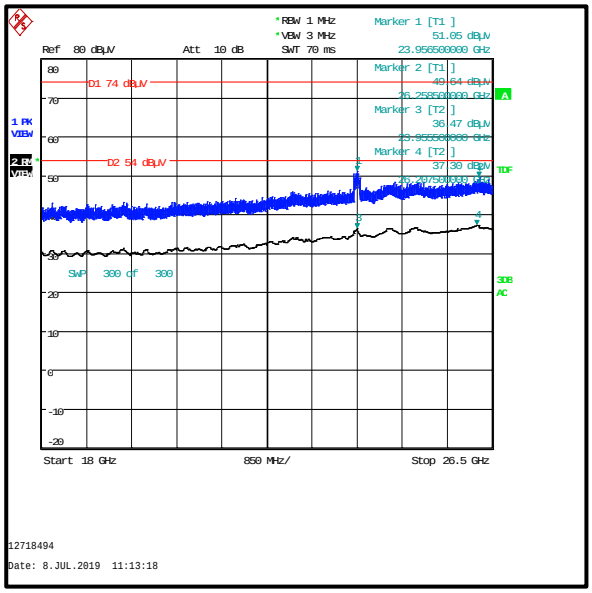



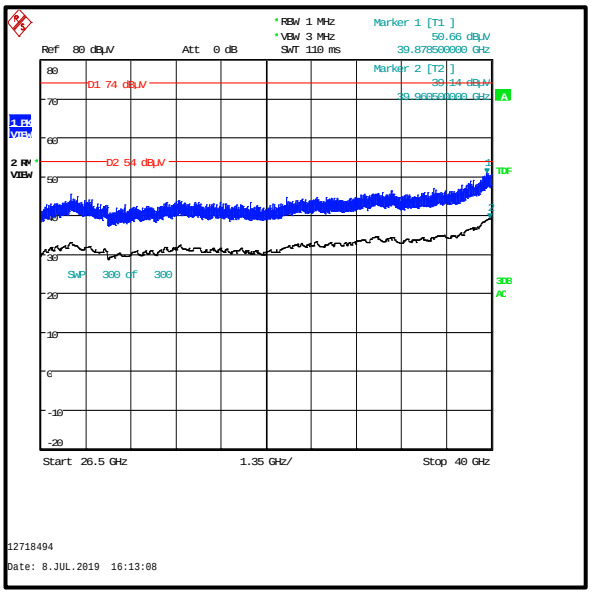



## Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) top channel (continued)



## 4.13. Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 2.4 GHz WLAN (MIMO) bottom channel / 5 GHz WLAN (SISO) bottom channel

### Test Summary:

| | | | |
|---|---|---|---|
| **Test Engineers:** | Marco Zunarelli, Mark Perry, David Doyle, James O'Reilly, John Ferdinand & Mohamed Toubella | **Test Dates:** | 04 July 2019 to 08 July 2019 |
| **Test Sample Serial Numbers:** | C02YF00CMFLF & C02YD006MFLQ | | |

| | |
|---|---|
| **FCC Reference:** | Parts 15.33, 15.205(a), 15.209(a), 15.247(d) & 15.407(b) |
| **ISED Canada Reference:** | RSS-Gen 6.13 & 8.9 / RSS-247 5.5, 6.2.1.2 |
| **Test Method Used:** | ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11, 11.12.2.4 & 11.12.2.5.1, KDB 558074 Sections 8.5 & 8.6, KDB 789033 II.G |
| **Frequency Range:** | 30 MHz to 40 GHz |
| **Configuration:** | *Bluetooth* Basic Rate top channel / 2.4 GHz WLAN (MIMO) bottom channel / 5 GHz WLAN (SISO) bottom channel |

### Environmental Conditions:

| | |
|---|---|
| **Temperature (°C):** | 22 to 26 |
| **Relative Humidity (%):** | 41 to 56 |

## Transmitter Out of Band Radiated Emissions (*Bluetooth* Basic Rate top channel / 2.4 GHz WLAN (MIMO) bottom channel / 5 GHz WLAN (SISO) bottom channel) (continued)

## Note(s):

1. All other intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The *Bluetooth* and 2.4 GHz WLAN fundamentals are shown on the 1 GHz to 3 GHz plot.
3. The 5 GHz WLAN fundamental is shown on the 3 GHz to 6 GHz plot.
4. The emission at approximately 2344 MHz is an intermodulation product produced by the second harmonic of the 2.4 GHz WLAN signal minus the *Bluetooth* signal.
5. The emission at approximately 2548 MHz is an intermodulation product produced by the second harmonic of the *Bluetooth* signal minus the 2.4 GHz WLAN signal.
6. The emissions approximately at 16 GHz and 24 GHz were investigated and found not to be intermodulation products.
7. Pre-scans were made against the FCC Part 15 general limits for radiated emissions.
8. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) 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.
9. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0001 & 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. For final measurements the maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres
10. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth to 500 kHz, for measurements below 1 GHz. For measurements above 1 GHz the resolution bandwidth was set to 1 MHz and video bandwidth to 3 MHz, with the sweep time set to auto. Markers were placed on the highest measured level.
11. *-20 dBc limit.
12. **Corrected level incorporating a duty cycle correction factor. See Appendix 1 for more information.