

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;
Bluetooth – BR/EDR;
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)
ISED Canada RSS-247 5.5, 6.2.1.2, 6.2.4.2 &
RSS-Gen 6.13, 8.9 & 8.10

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

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2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

Date of Issue: 18 September 2019

Checked by:



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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

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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): 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
Specification Reference:	47CFR15.407
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): 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 (<i>Radiated sample #1</i>)
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 (<i>Radiated sample #2</i>)
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:	<i>Bluetooth</i> 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:	<i>Bluetooth</i> (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:	CC2446203PNDNYP AJ

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):

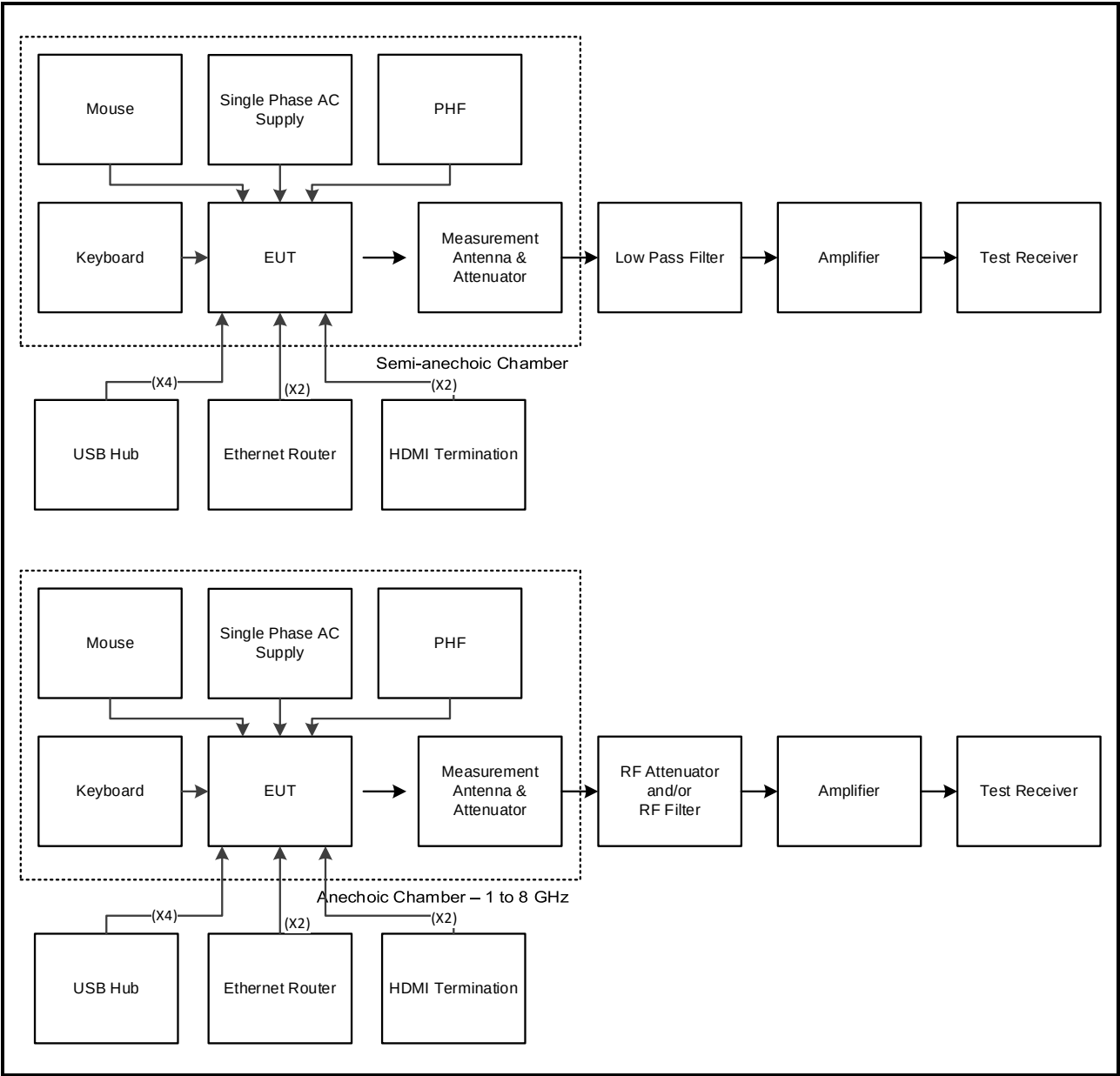
- *Bluetooth* Basic Rate: Tests were performed with the EUT transmitting in Basic Rate mode as this mode was found to transmit higher power than EDR mode.
- *Bluetooth* LE: Tests were performed with the EUT transmitting in LE mode as this mode was found to transmit higher power than LE2M mode.
- 2.4 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:
 - o *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.
 - o *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.
 - o *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.
 - o *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.
 - o 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.
 - o 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.
 - o *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.
 - o *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.
 - o *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.

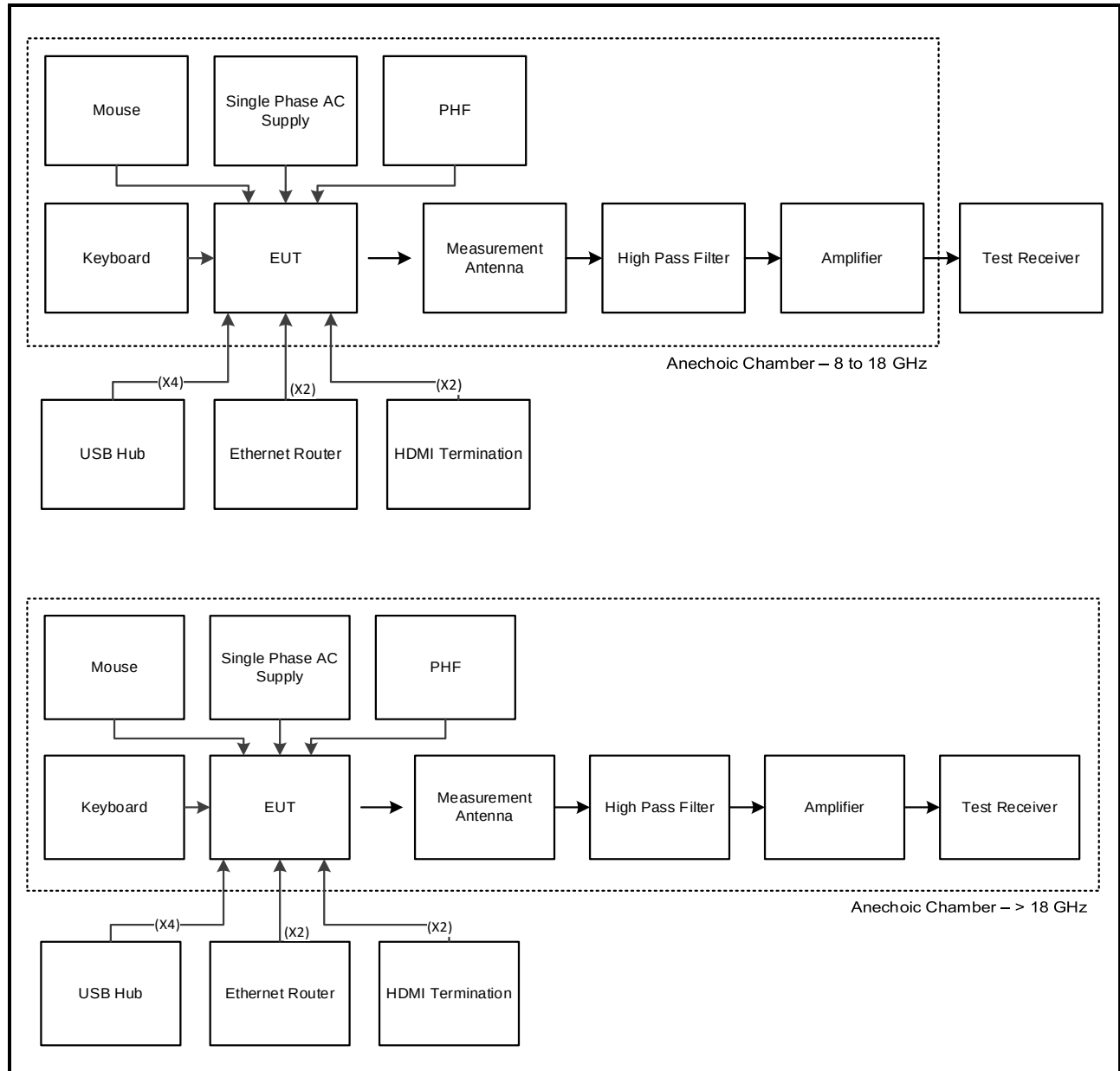
Configuration and Peripherals (continued)

- o *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.
- o *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.
- o *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.
- o *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.
- o *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.
- o *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.
- o *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.
- o *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.
- o *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, Mark Perry, John Ferdinand, David Doyle & Mohamed Toubella	Test Dates:	05 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:	KDB 789033 II.G & ANSI C63.10 Sections 6.3, 6.5 and 6.6
Frequency Range:	30 MHz to 40 GHz
Configuration:	<i>Bluetooth</i> 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.

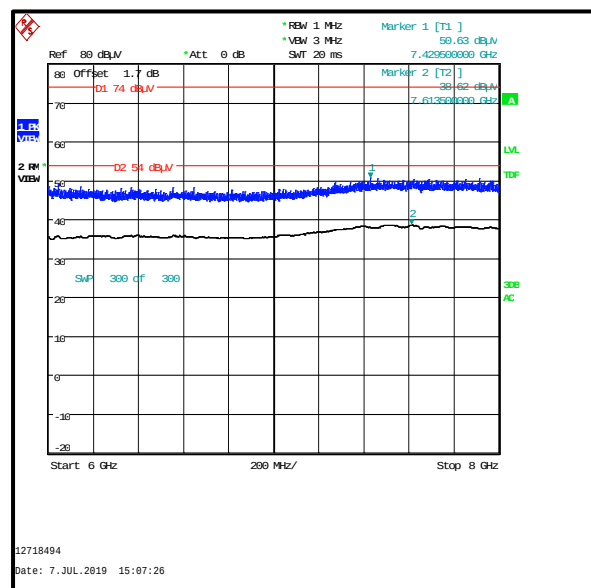
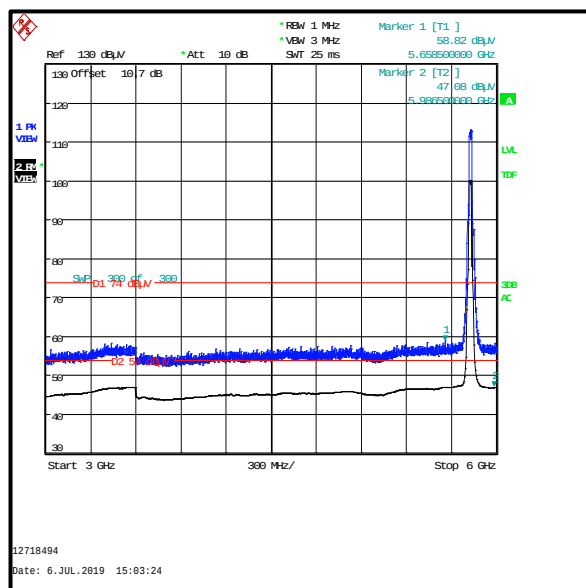
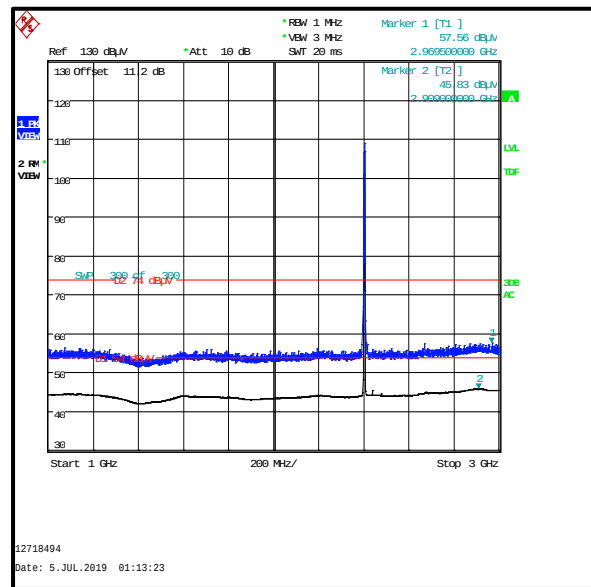
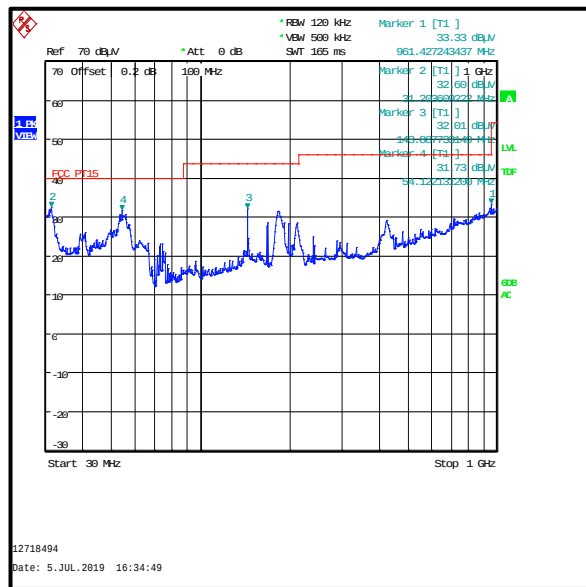
Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 5 GHz WLAN top channel (continued)

Results: Peak

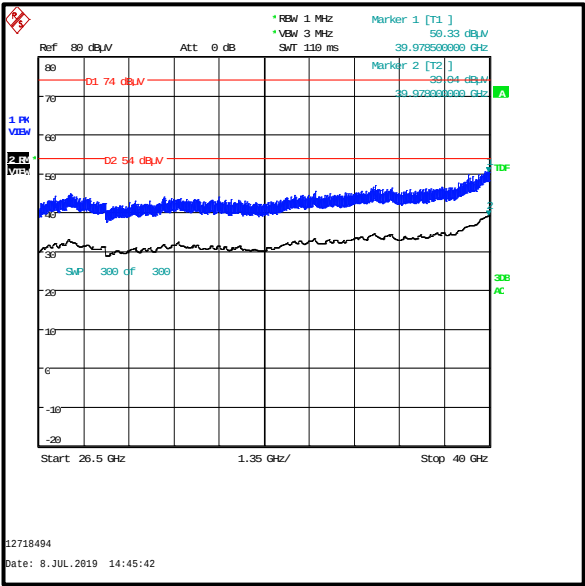
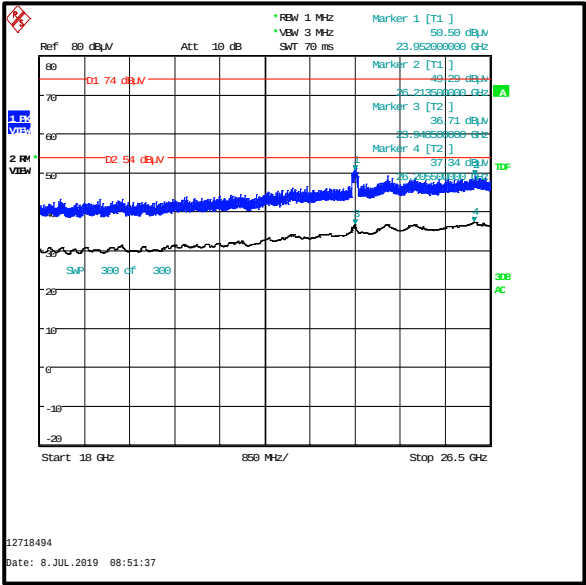
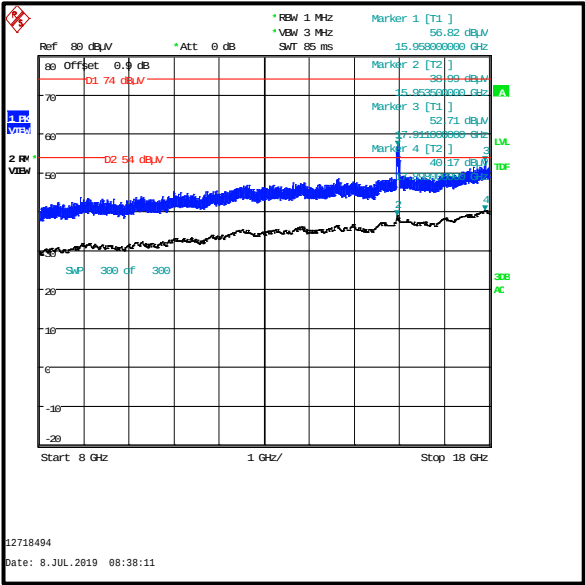
Frequency (MHz)	Antenna Polarity	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)	Result
See note 1					

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, Mark Perry, John Ferdinand, David Doyle & Mohamed Toubella	Test Dates:	05 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:	KDB 789033 II.G & ANSI C63.10 Sections 6.3, 6.5 and 6.6
Frequency Range:	30 MHz to 40 GHz
Configuration:	<i>Bluetooth</i> 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.

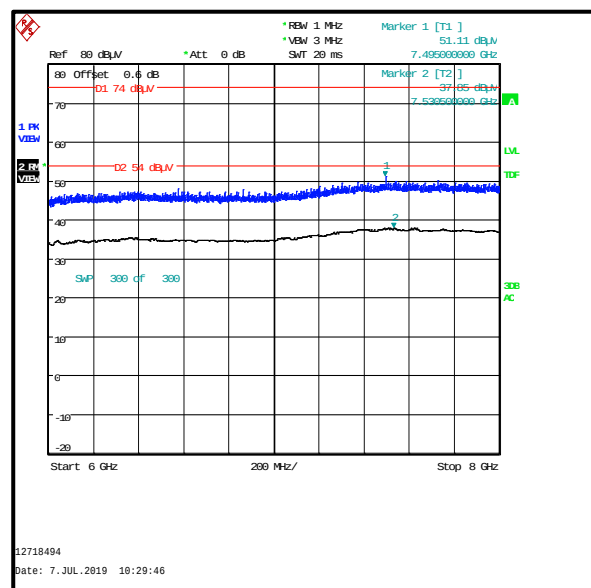
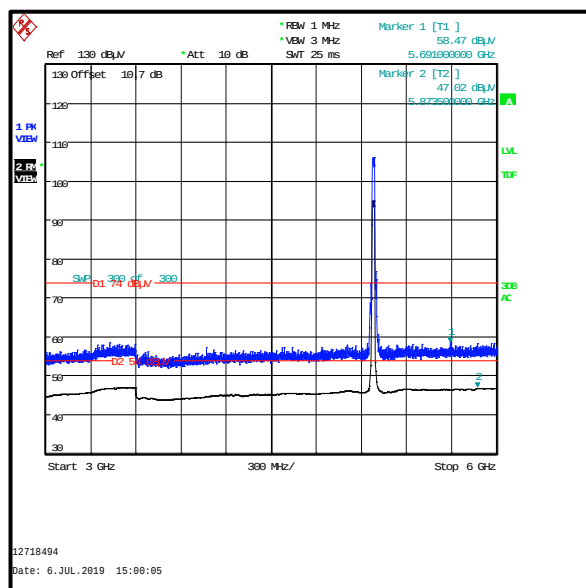
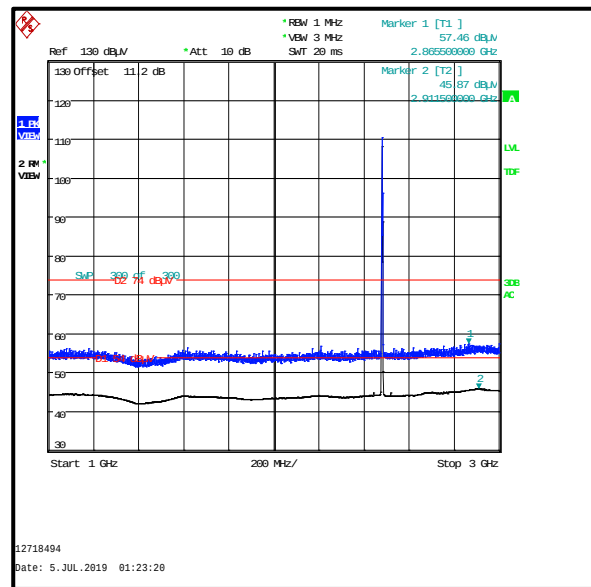
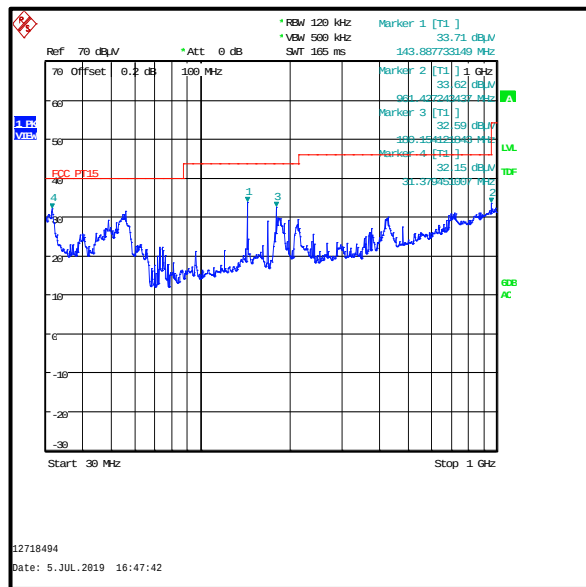
Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 5 GHz WLAN (SISO) bottom channel (continued)

Results: Peak

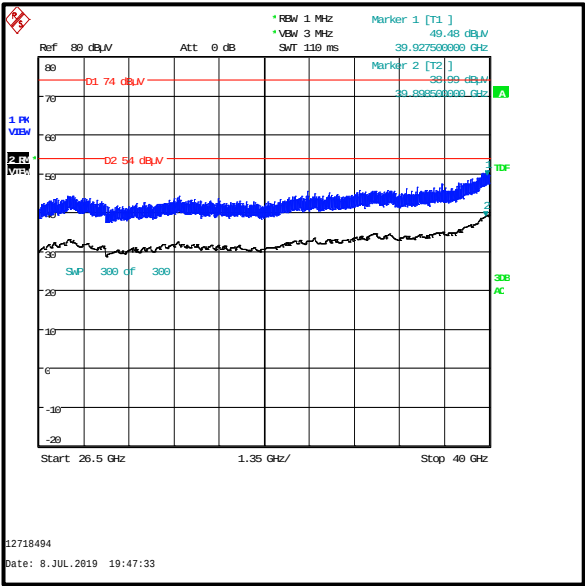
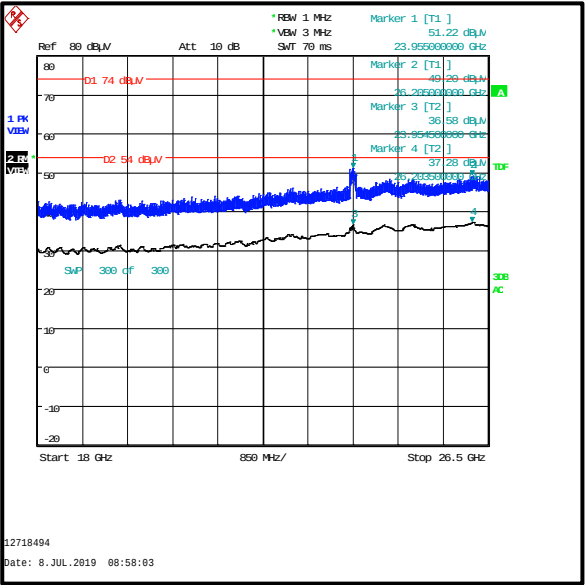
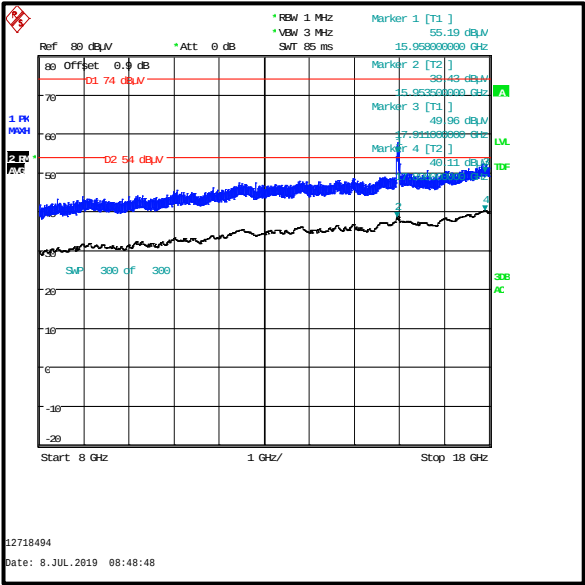
Frequency (MHz)	Antenna Polarity	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)	Result
See note 1					

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, Mark Perry, John Ferdinand, David Doyle & Mohamed Toubella	Test Dates:	05 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 KDB 558074 Sections 8.5 & 8.6, KDB 789033 II.G
Frequency Range:	30 MHz to 40 GHz
Configuration:	<i>Bluetooth</i> 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.

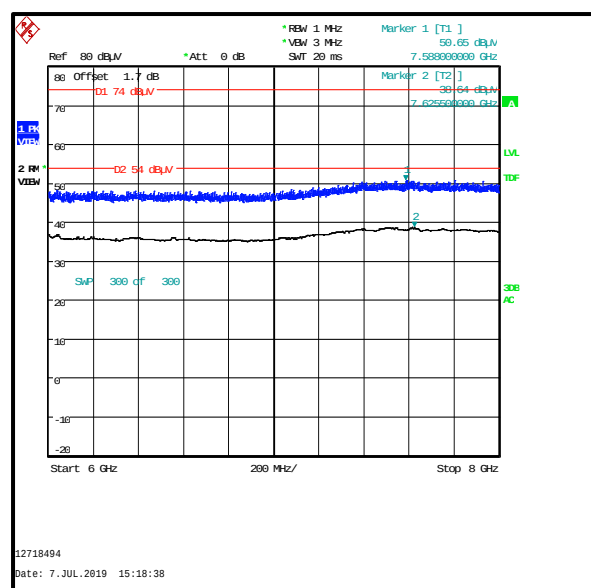
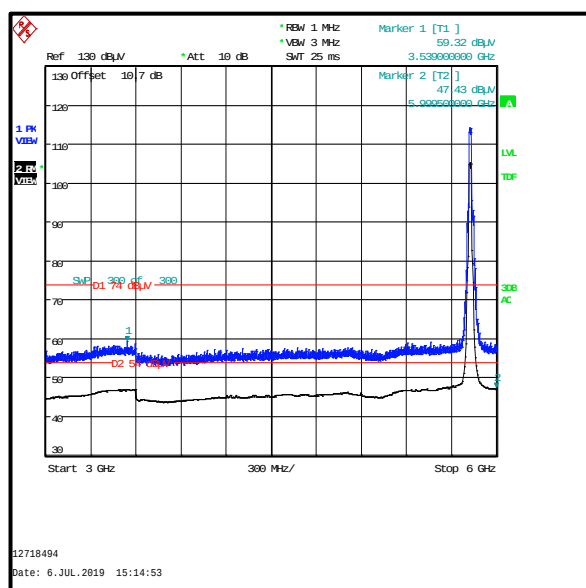
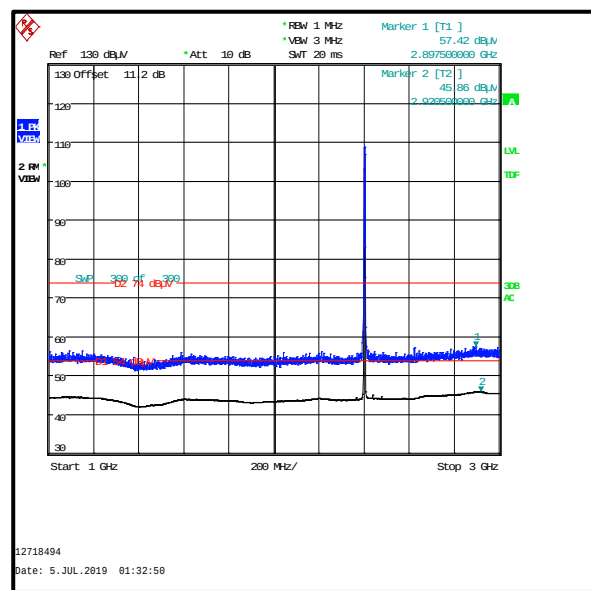
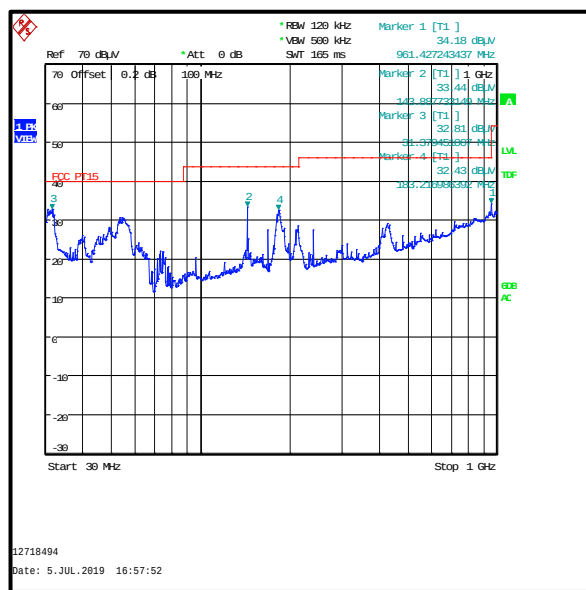
Transmitter Out of Band Radiated Emissions - *Bluetooth* LE bottom channel / 5 GHz WLAN (SISO) top channel (continued)

Results: Peak

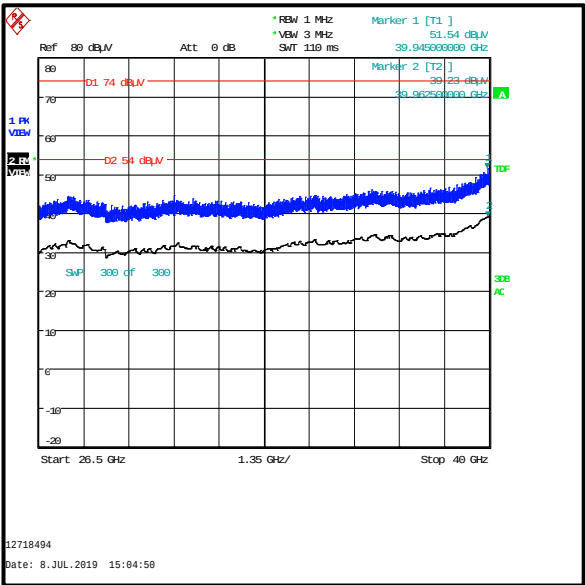
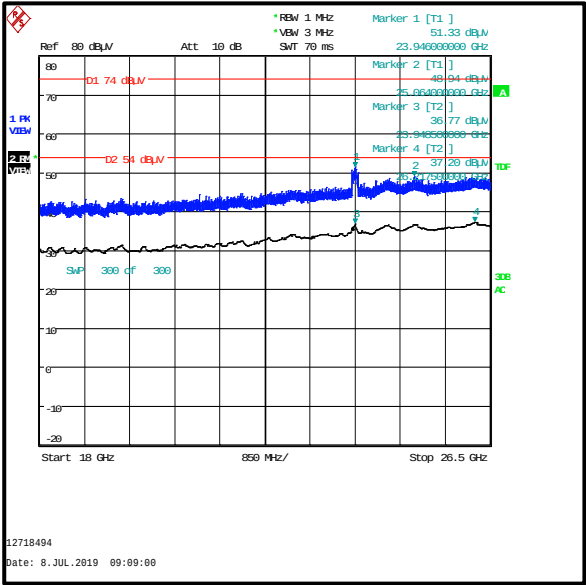
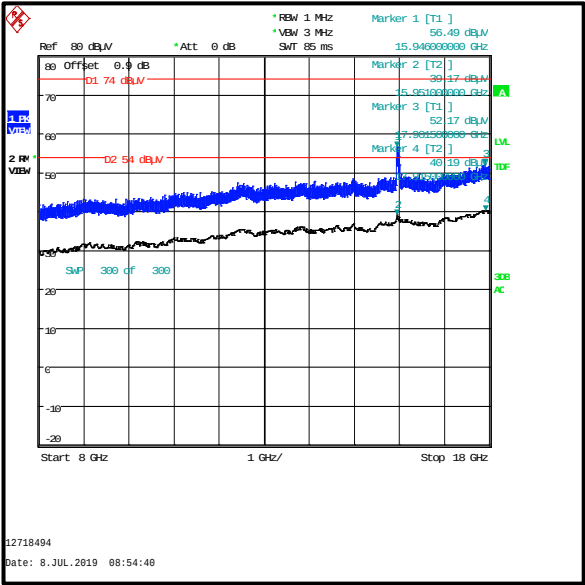
Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
See note 1					

Results: Average

Frequency (MHz)	Antenna Polarity	Average Level (dB μ V/m)	Average Limit (dB μ V/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, Mark Perry, John Ferdinand, David Doyle & Mohamed Toubella	Test Dates:	05 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:	<i>Bluetooth</i> 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.

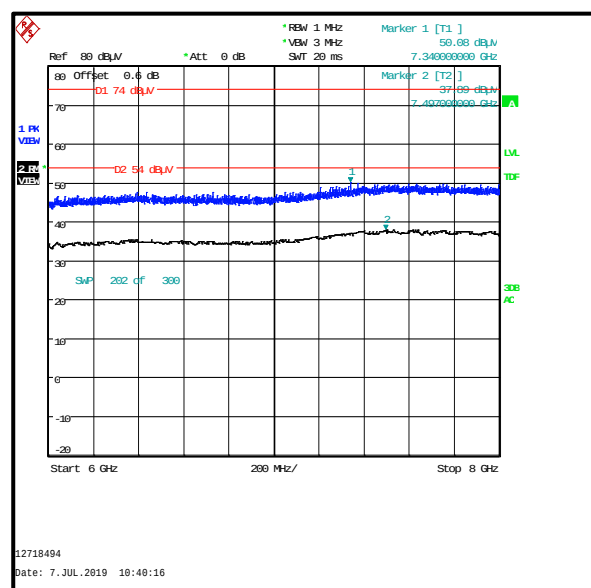
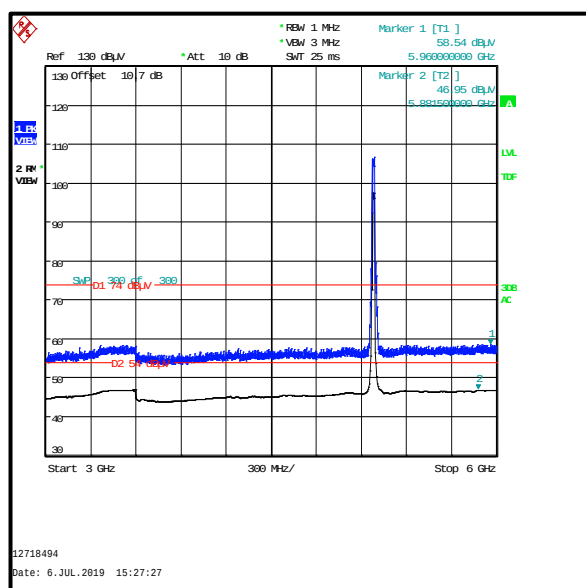
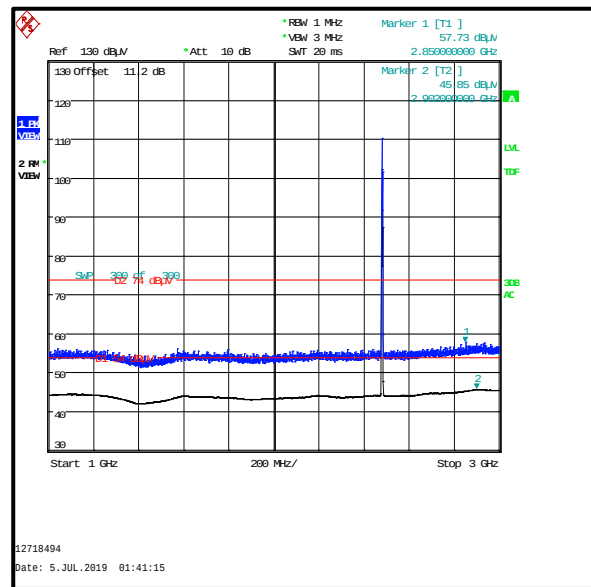
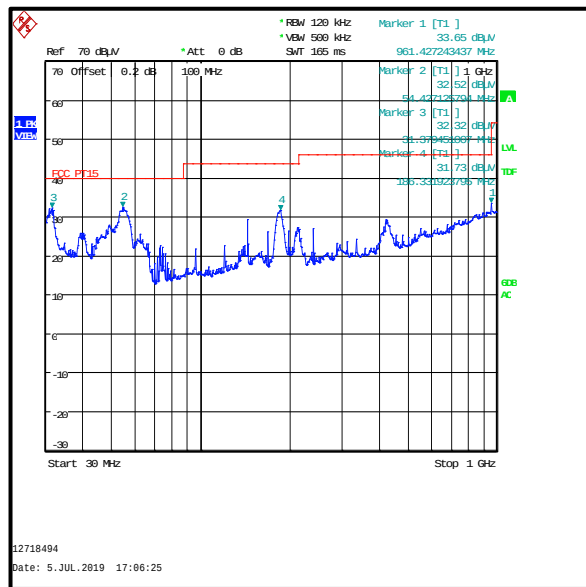
Transmitter Out of Band Radiated Emissions - *Bluetooth* LE top channel / 5 GHz WLAN (SISO) bottom channel (continued)

Results: Peak

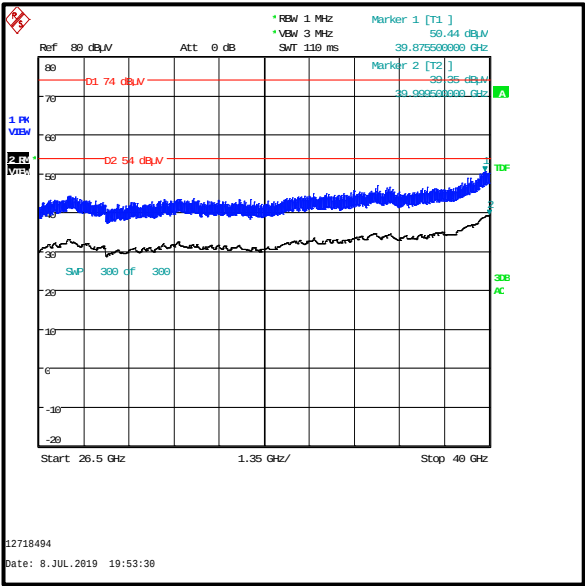
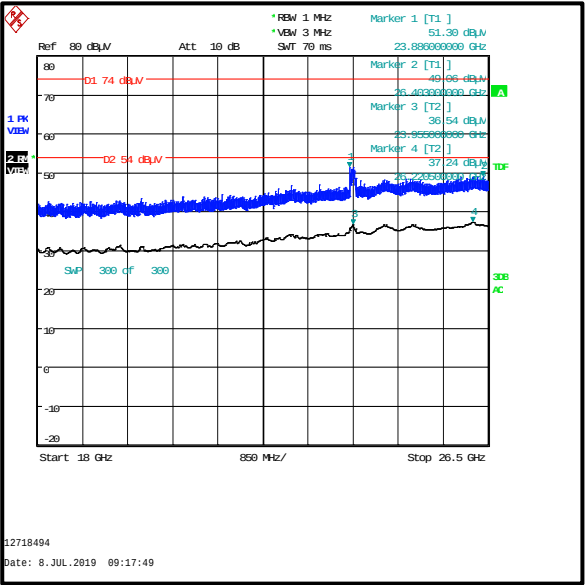
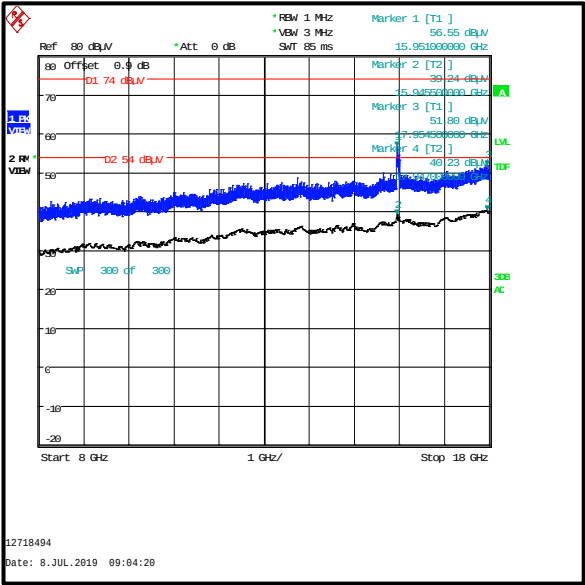
Frequency (MHz)	Antenna Polarity	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)	Result
See note 1					

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, Mark Perry, John Ferdinand, David Doyle & Mohamed Toubella	Test Dates:	05 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, KDB 558074 Sections 8.5 & 8.6, 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.

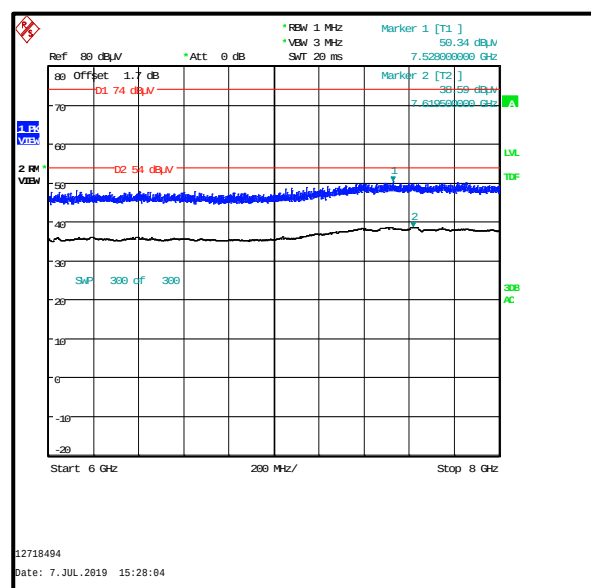
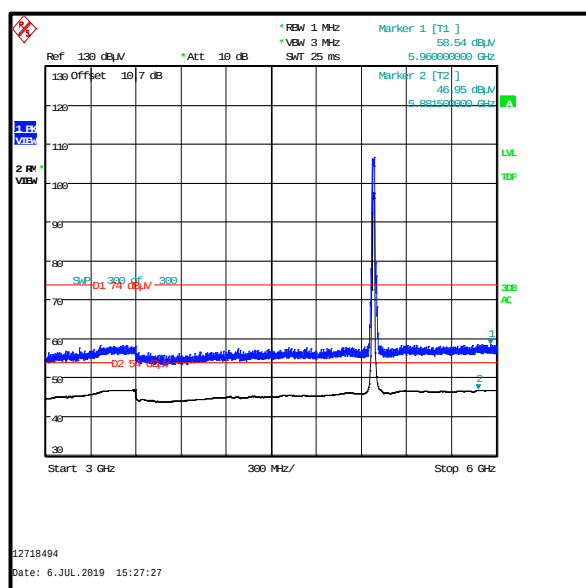
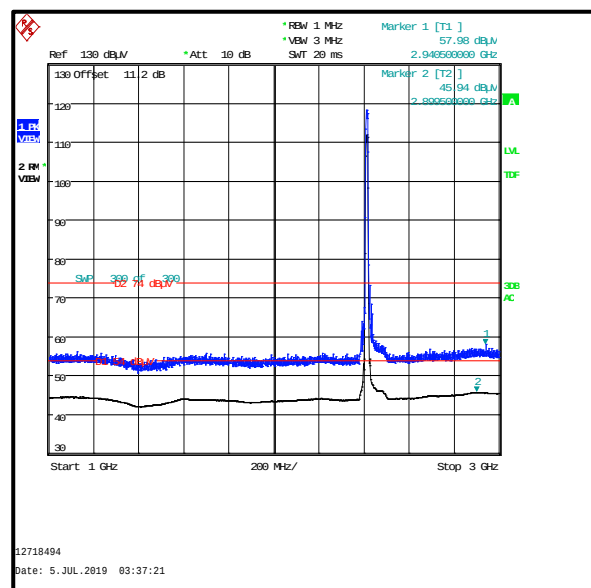
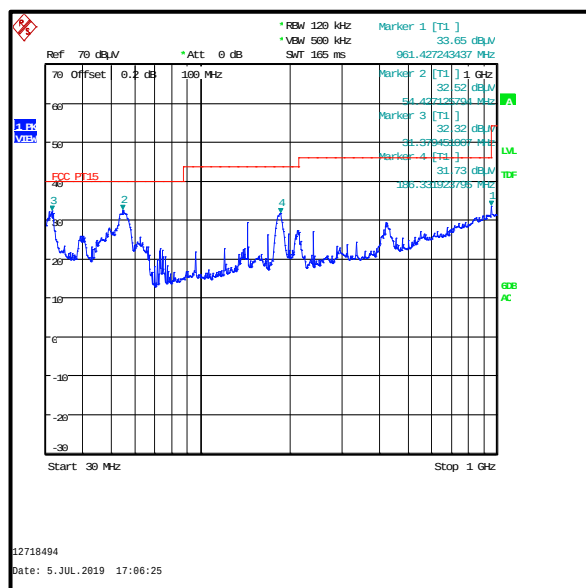
Transmitter Out of Band Radiated Emissions - 2.4 GHz WLAN (MIMO) bottom channel / 5 GHz WLAN (SISO) top channel (continued)

Results: Peak

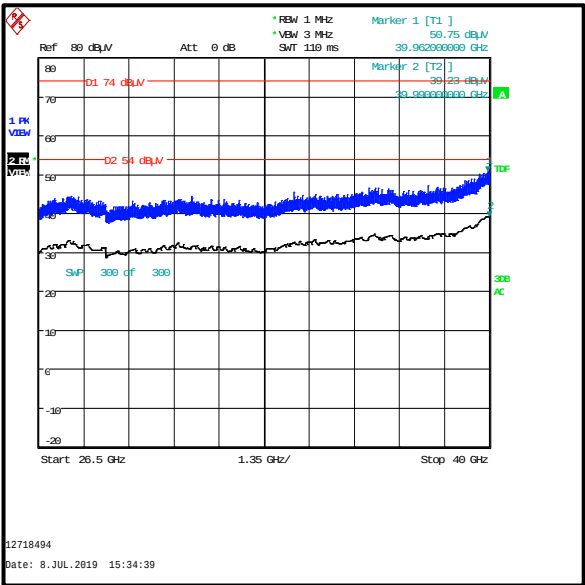
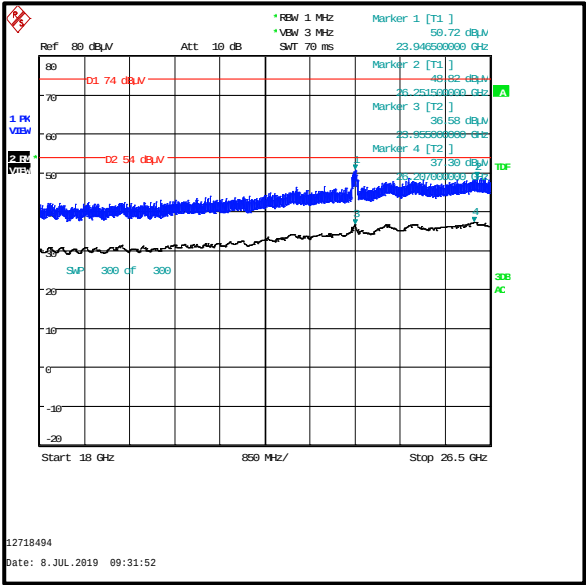
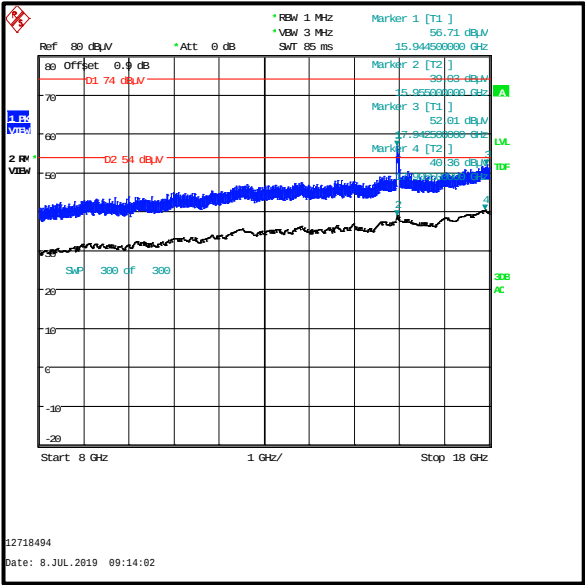
Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Peak Limit (dB μ V/m)	Margin (dB)	Result
See Note 1					

Results: Average

Frequency (MHz)	Antenna Polarity	Average Level (dB μ V/m)	Average Limit (dB μ V/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, Mark Perry, John Ferdinand, David Doyle & Mohamed Toubella	Test Dates:	05 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:	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.

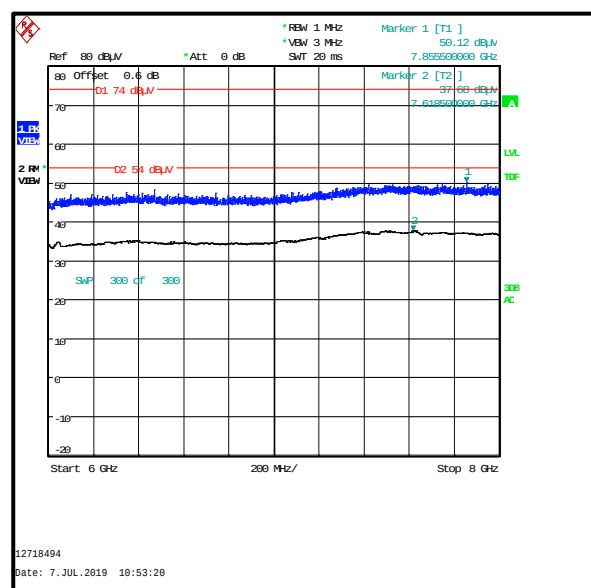
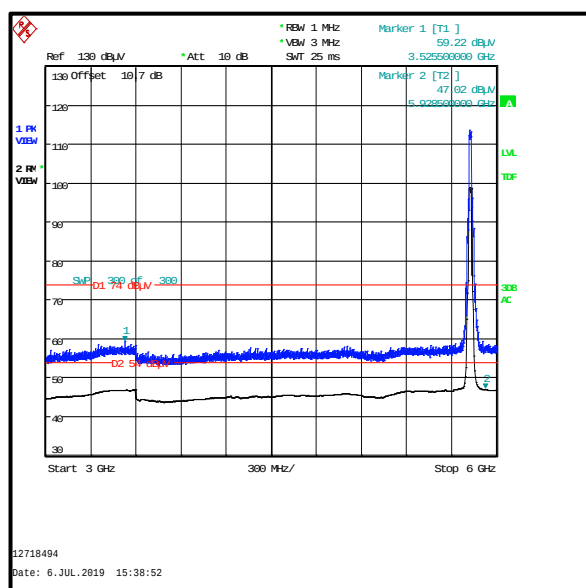
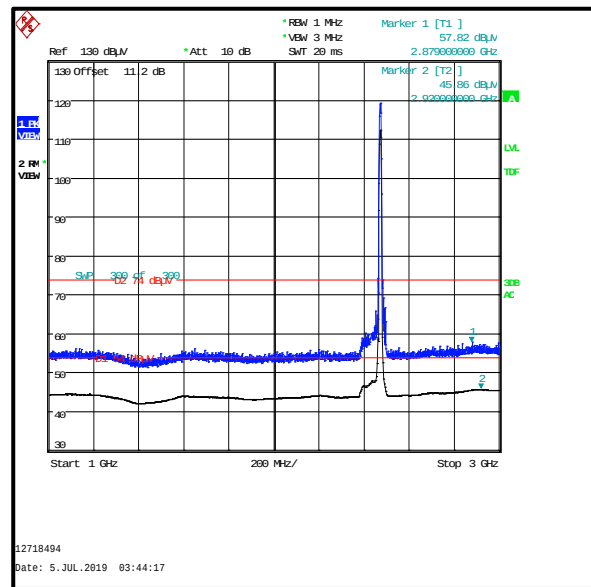
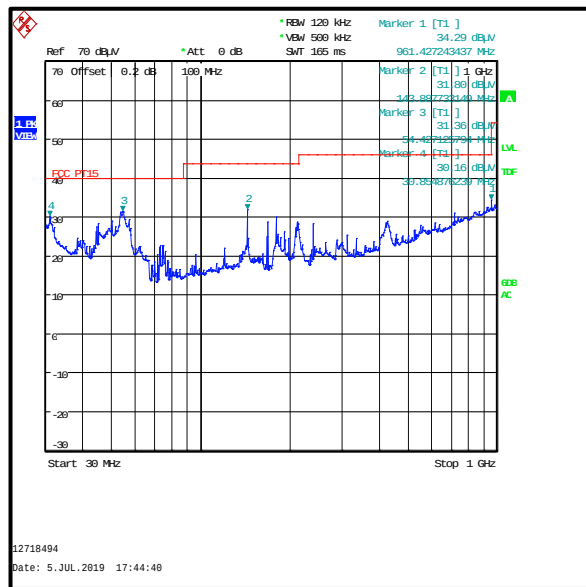
Transmitter Out of Band Radiated Emissions - 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel (continued)

Results: Peak

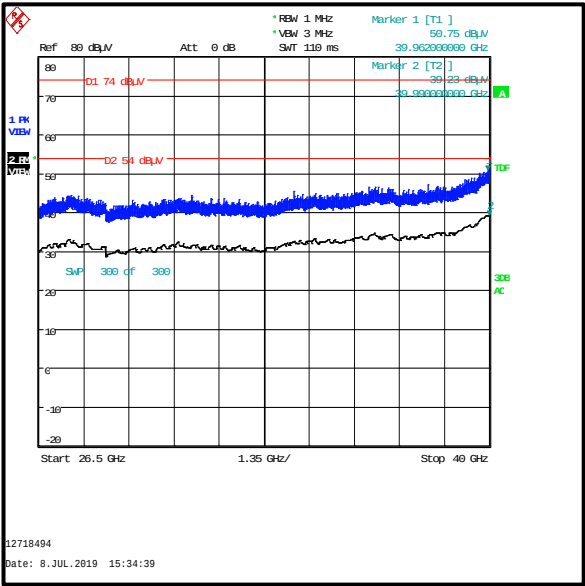
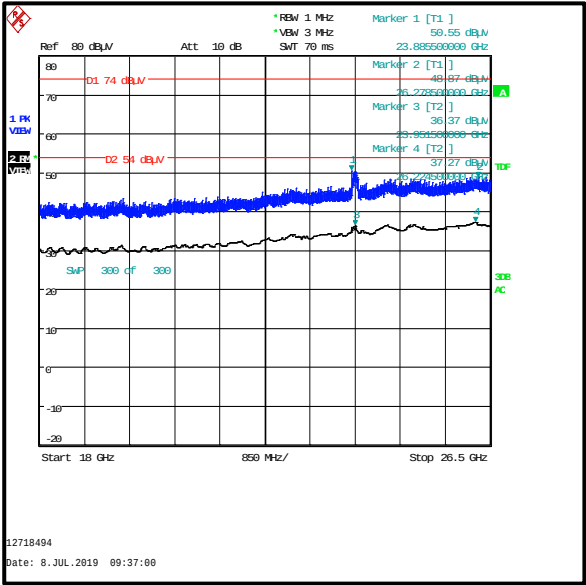
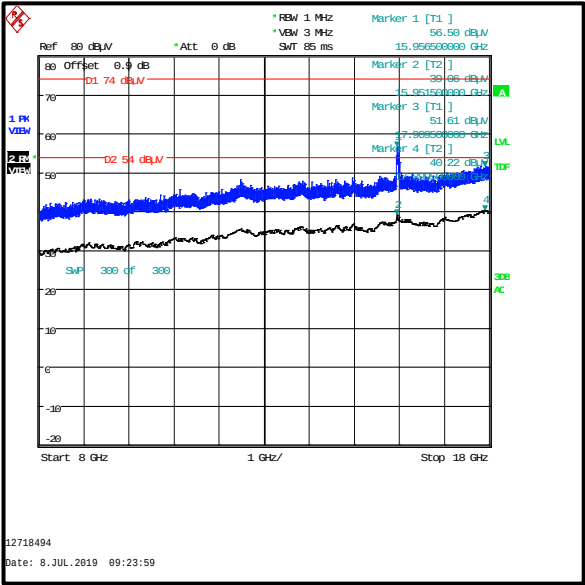
Frequency (MHz)	Antenna Polarity	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)	Result
See Note 1					

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:	<i>Bluetooth</i> 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.

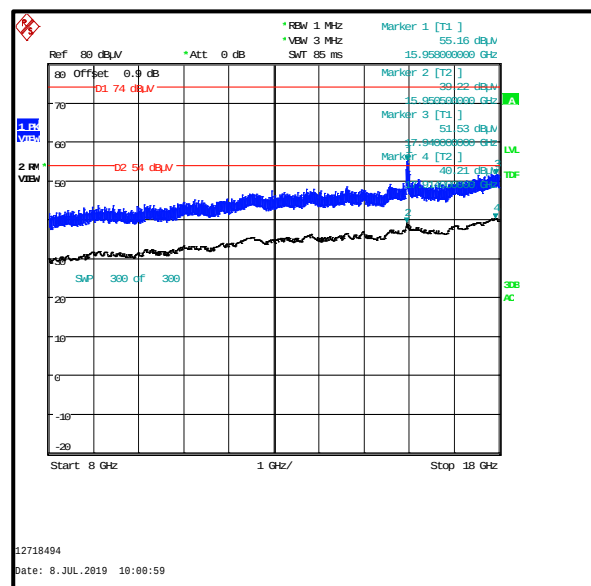
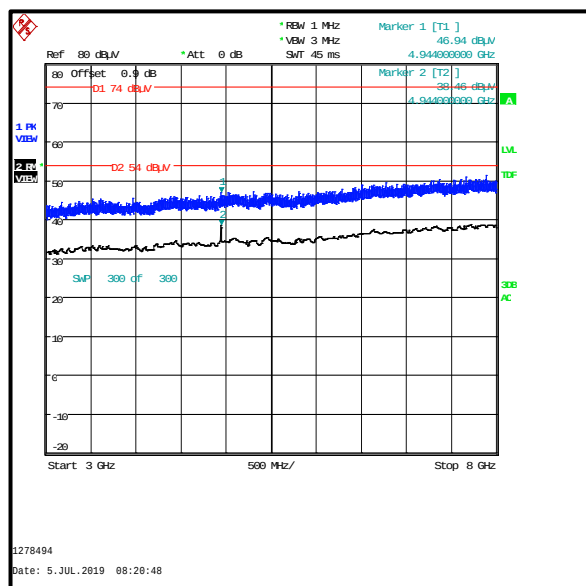
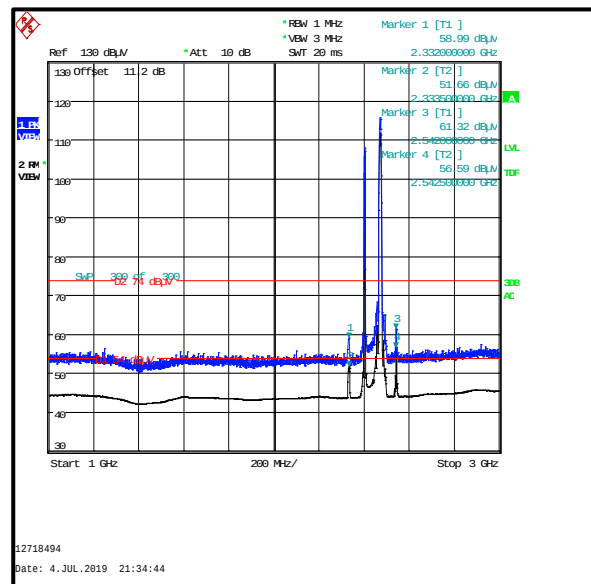
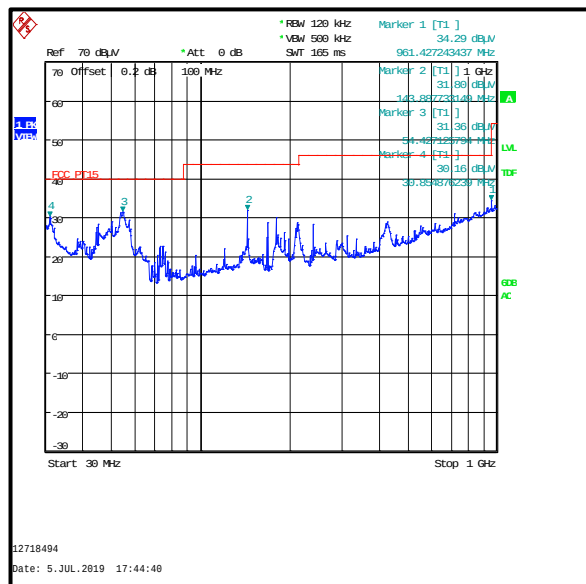
Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel (continued)

Results: Peak

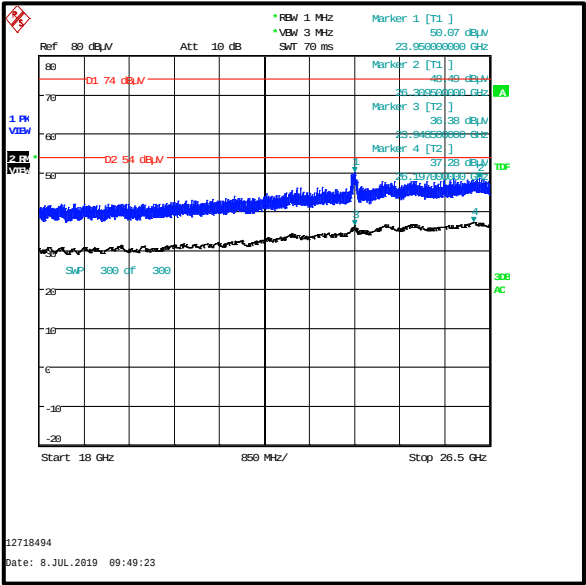
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2332.110	Vertical	53.7	74.0	20.3	Complied
2541.997	Vertical	47.6	88.7*	41.1	Complied

Results: Average

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/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:	<i>Bluetooth</i> 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.

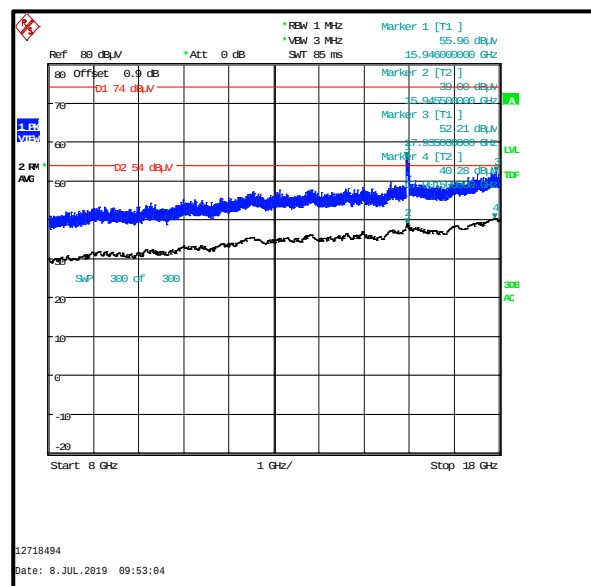
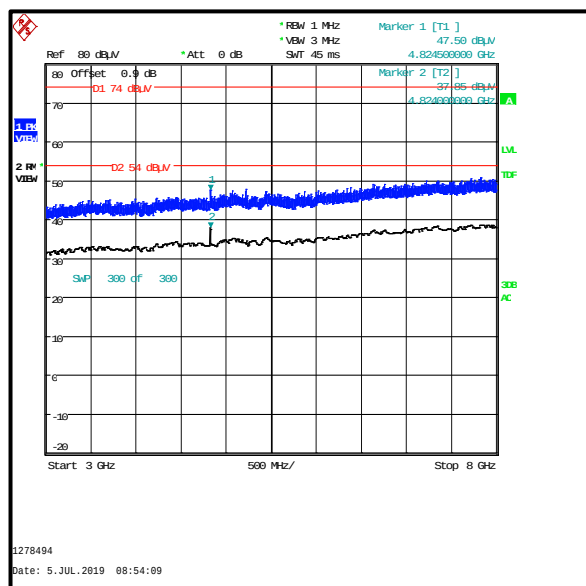
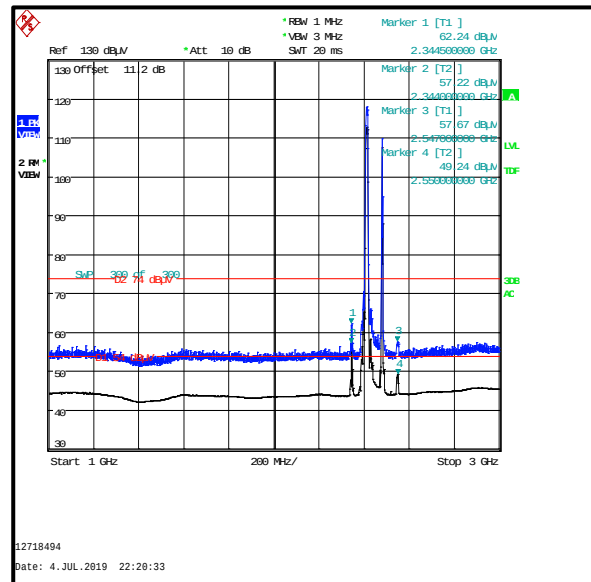
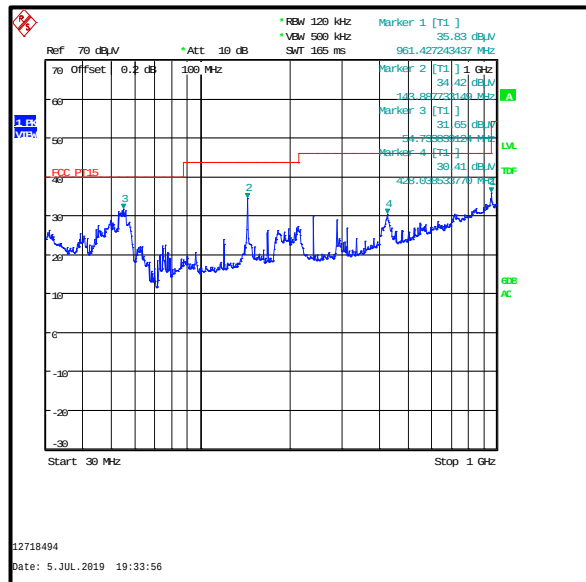
Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate top channel / 2.4 GHz WLAN (MIMO) bottom channel (continued)

Results: Peak

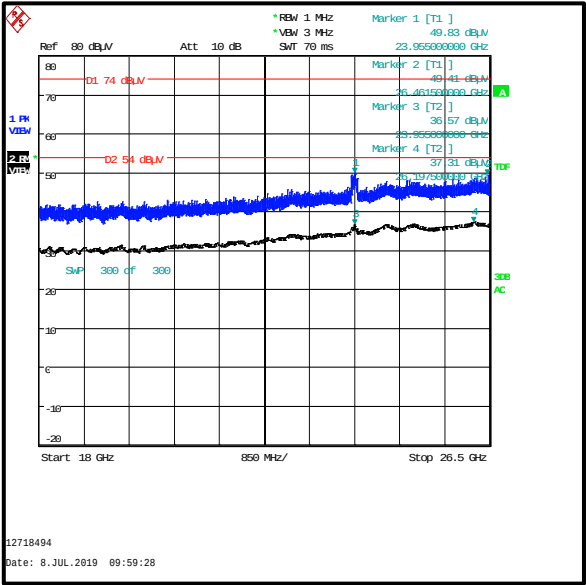
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2344.033	Vertical	56.8	74.0	17.2	Complied
2549.744	Vertical	48.3	89.9*	41.6	Complied

Results: Average

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/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:	<i>Bluetooth</i> 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.

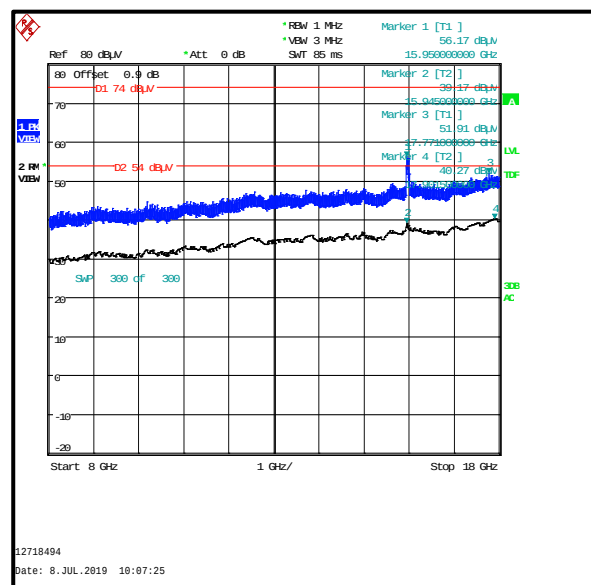
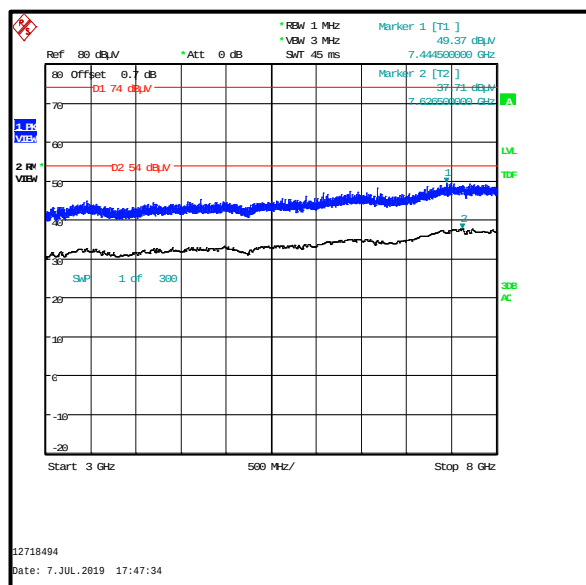
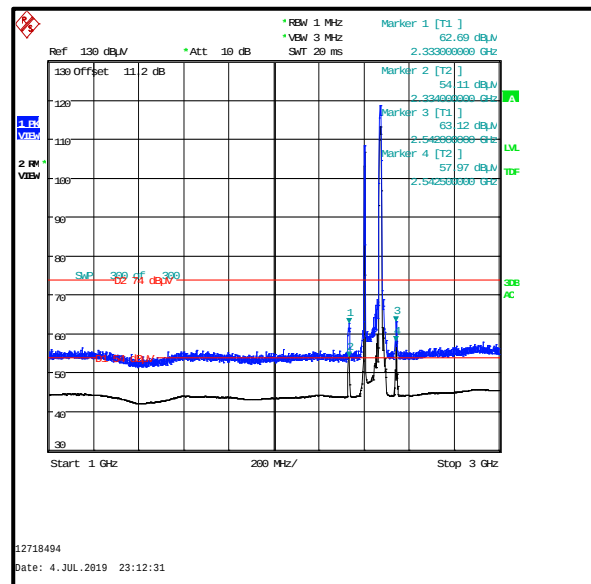
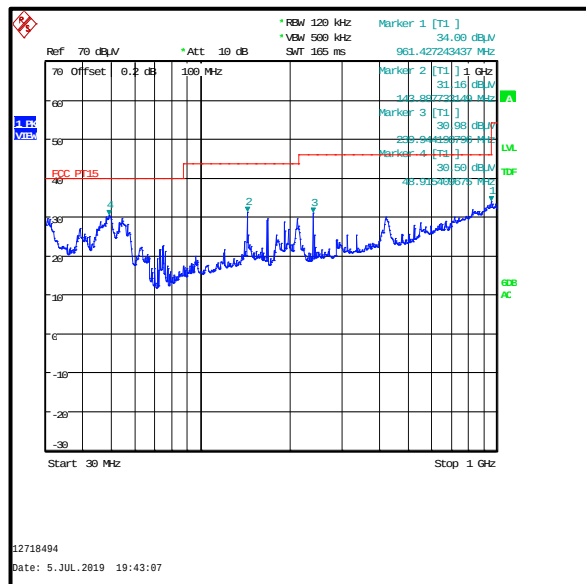
Transmitter Out of Band Radiated Emissions - *Bluetooth* LE bottom channel / 2.4 GHz WLAN (MIMO) top channel (continued)

Results: Peak

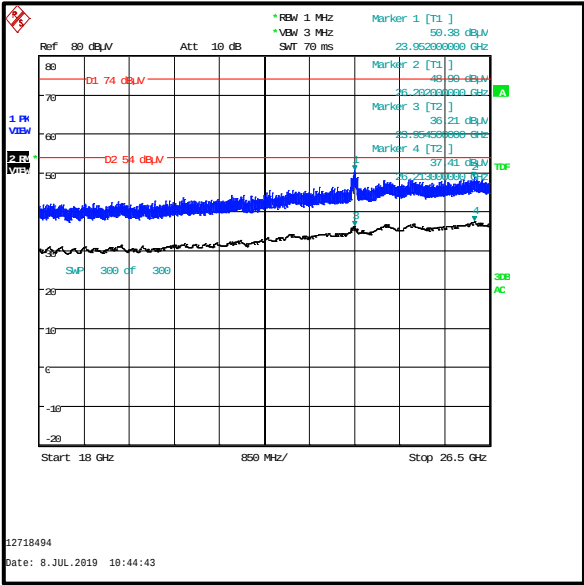
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2330.892	Vertical	53.5	74.0	10.5	Complied
2542.062	Vertical	45.8	87.7*	41.9	Complied

Results: Average

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/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:	<i>Bluetooth</i> 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.

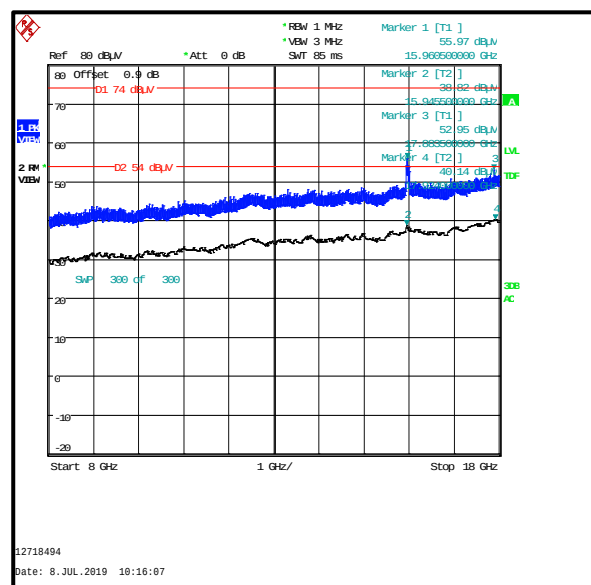
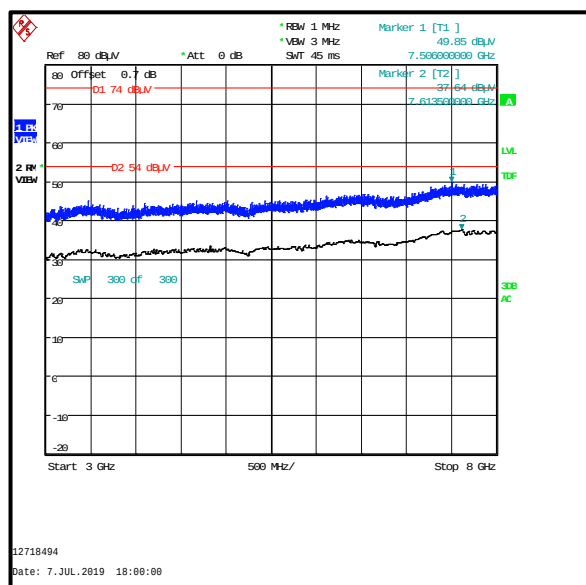
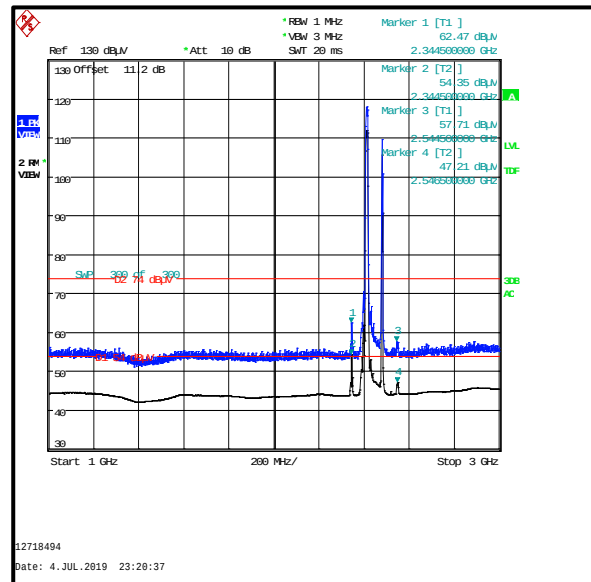
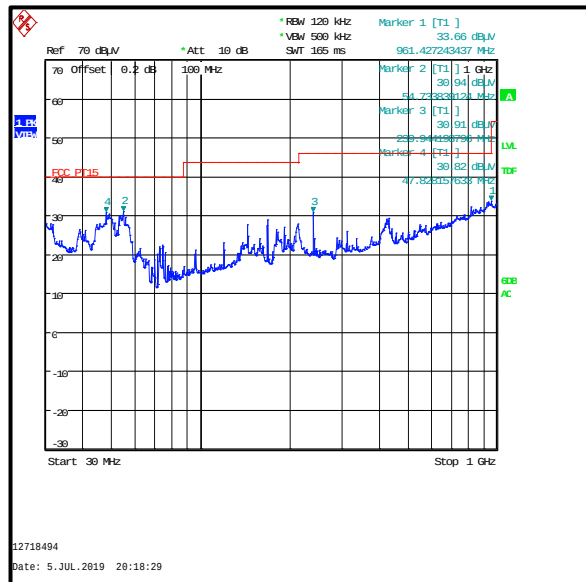
Transmitter Out of Band Radiated Emissions - *Bluetooth* LE top channel / 2.4 GHz WLAN (MIMO) bottom channel (continued)

Results: Peak

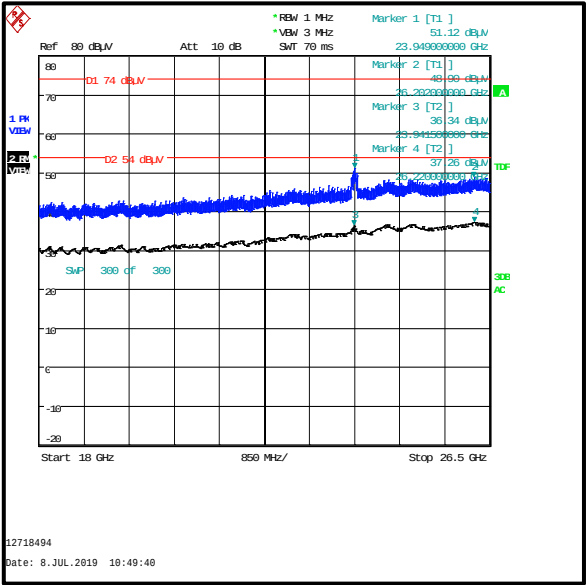
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2343.585	Vertical	56.7	74.0	17.3	Complied
2549.487	Vertical	48.4	85.7*	37.3	Complied

Results: Average

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/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:	<i>Bluetooth</i> 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.

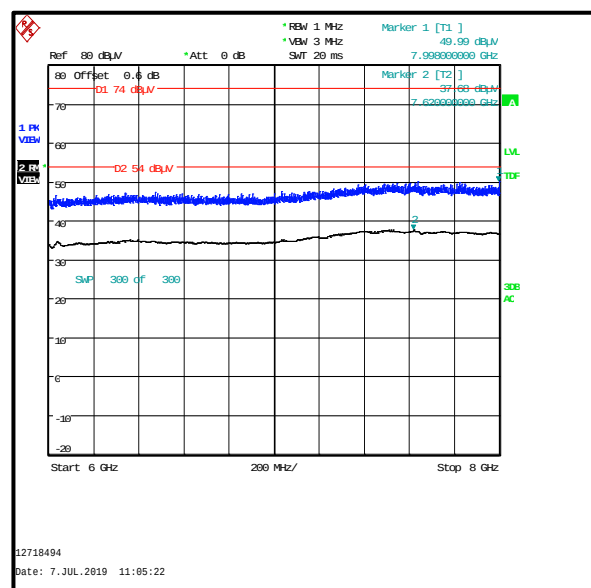
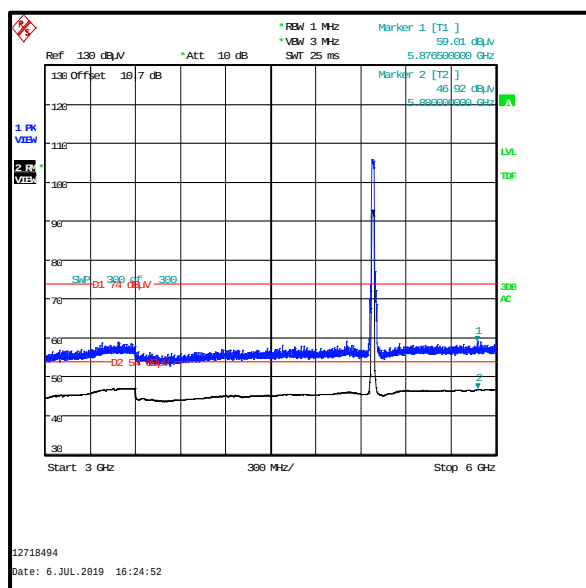
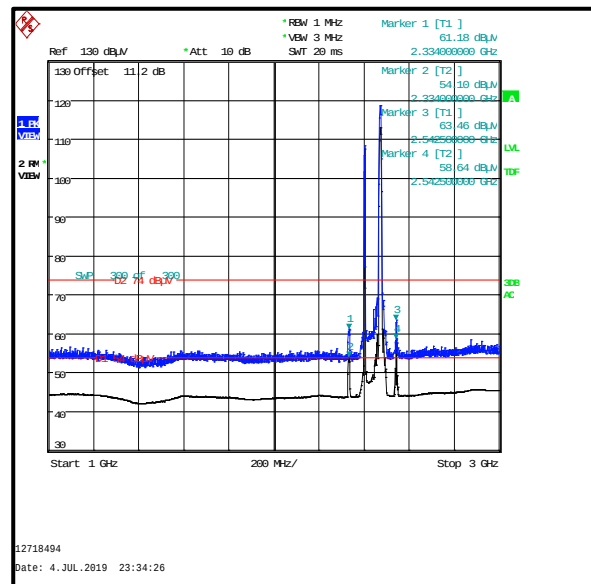
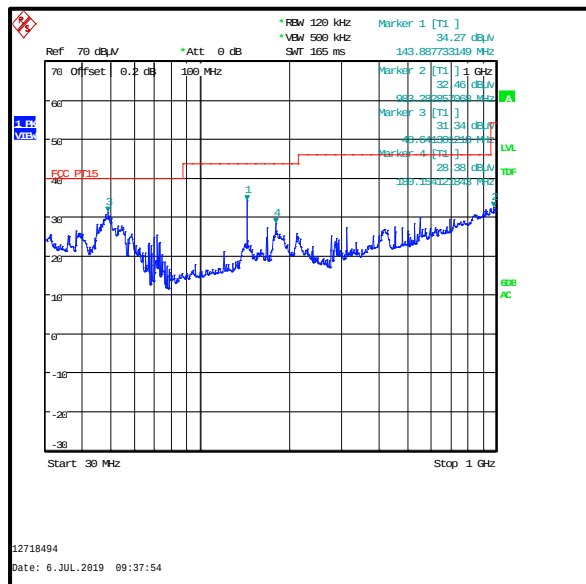
Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) bottom channel (continued)

Results: Peak

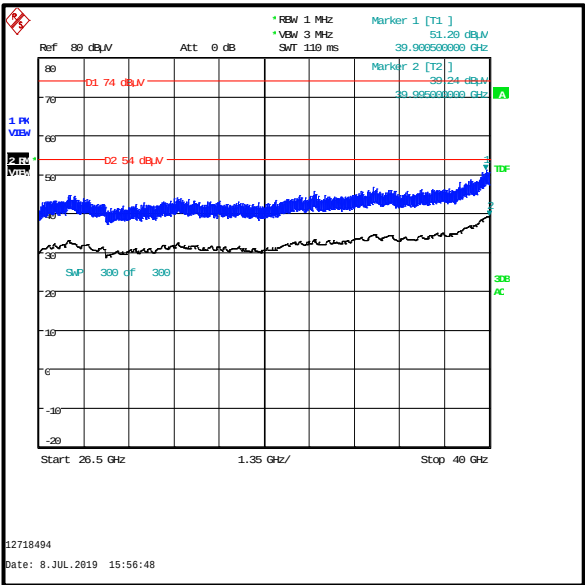
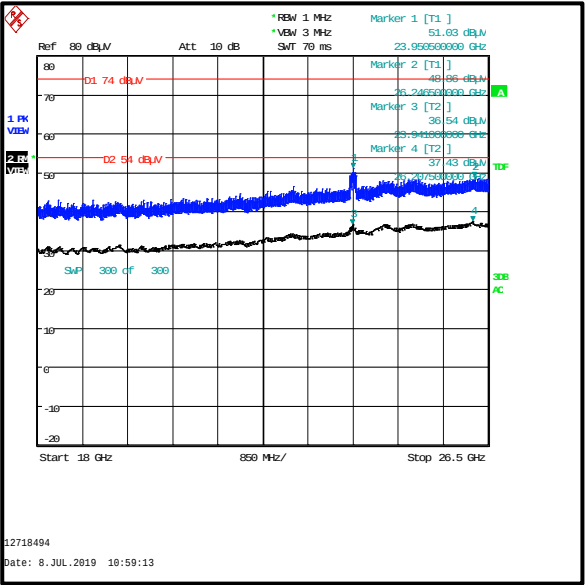
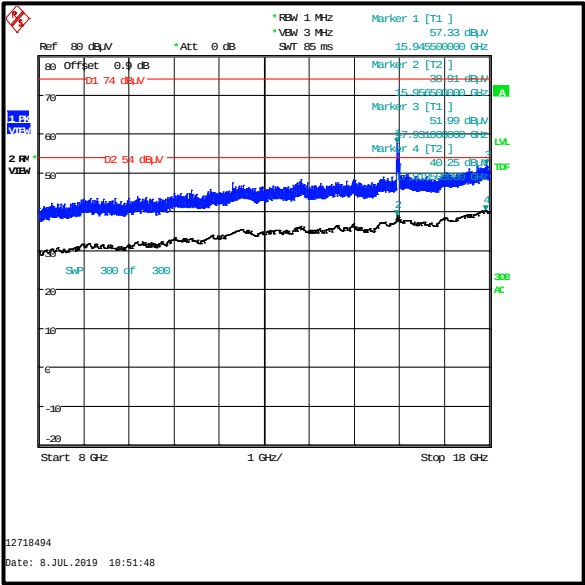
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2330.700	Vertical	53.2	74.0	20.8	Complied
2541.923	Vertical	47.7	88.7*	41.0	Complied

Results: Average

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/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 KDB 558074 Sections 8.5 & 8.6, KDB 789033 II.G
Frequency Range:	30 MHz to 40 GHz
Configuration:	<i>Bluetooth</i> 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.

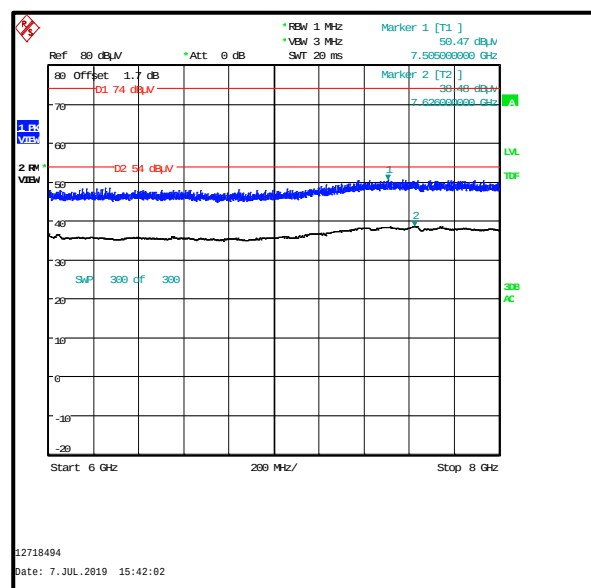
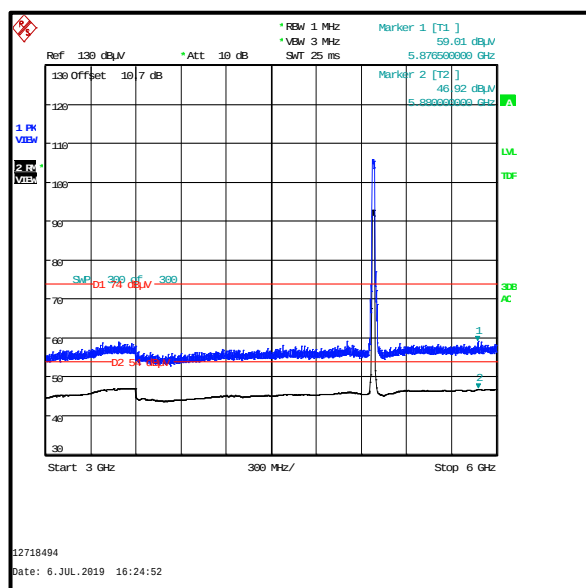
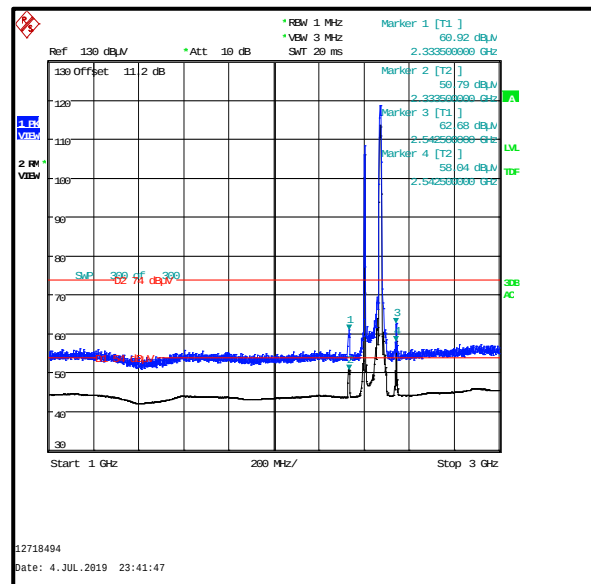
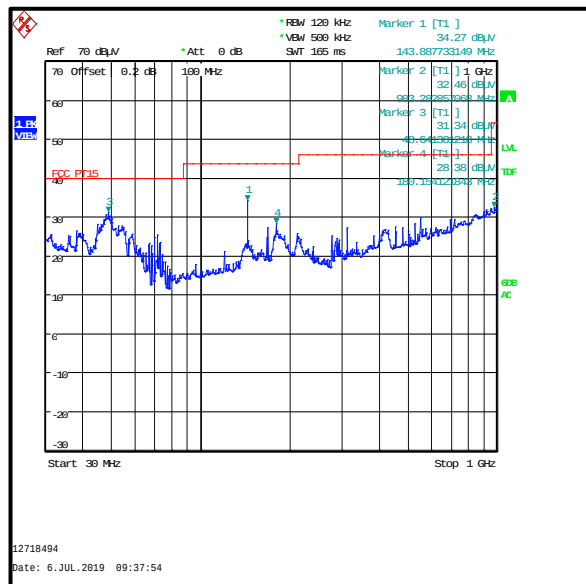
Transmitter Out of Band Radiated Emissions - *Bluetooth* Basic Rate bottom channel / 2.4 GHz WLAN (MIMO) top channel / 5 GHz WLAN (SISO) top channel (continued)

Results: Peak

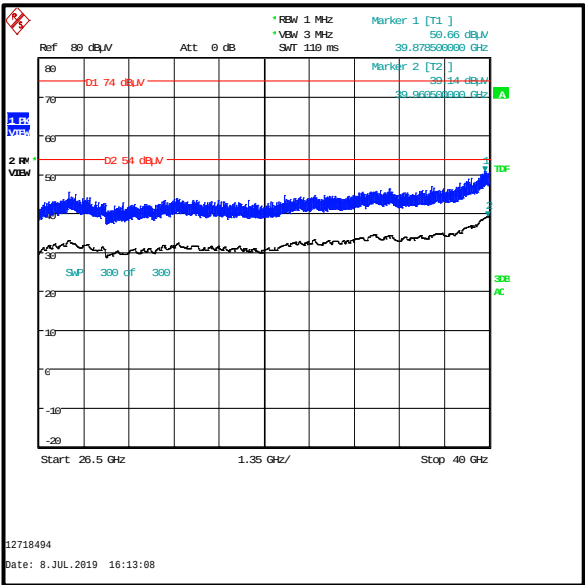
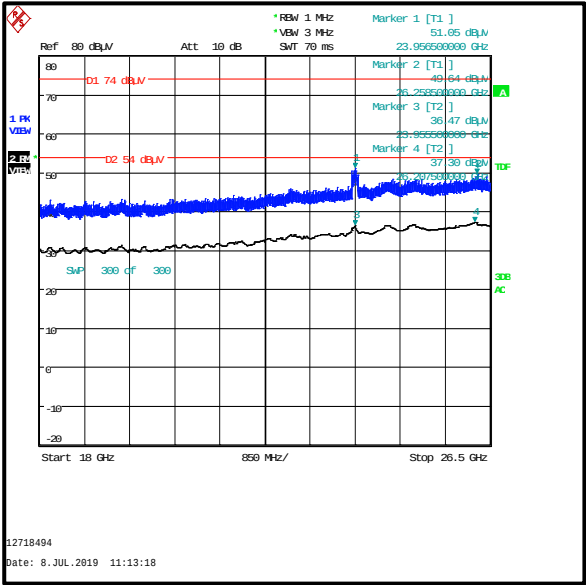
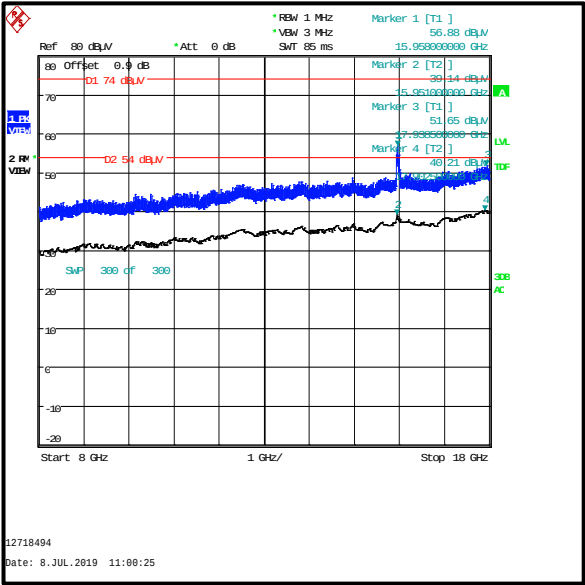
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2330.951	Vertical	51.5	74.0	22.5	Complied
2542.003	Vertical	48.2	88.7*	40.5	Complied

Results: Average

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/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:	<i>Bluetooth</i> 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.