TEST REPORT

Test Report No. : UL-RPT-RP13232099-716A V2.0

Customer	:	Grundfos Holding A/S
Model No. / PMN	:	GiM CIU
HVIN	:	CIM 280-US
FCC ID	:	OG3-GIM1A
ISED Certification No.	:	IC: 10447A-GIM1A
Technology	:	*Bluetooth* Low Energy, UMTS & LTE
Test Standard(s)	:	FCC Parts 2.1053, 15.209(a), 15.247(d), 22.917, 24.238, 27.53(c)(2), (c)(5) & (f), 27.53(g) & 27.53(h)(1)(3); ISED Canada RSS-247 Issue 2 section 5.5, RSS-132 Issue 3 section 5.5, RSS-133 Issue 6 section 6.5, RSS-139 Issue 3 section 6.6, RSS-130 Issue 2 section 4.7 & RSS-Gen Issue 5 Section 6.13
Test Laboratory	:	UL International (UK) 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: 08 February 2021

Checked by:

Ian Watch
Senior Test Engineer, Radio Laboratory

Company Signatory:

Sarah Williams
Operations Leader, Radio Laboratory

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UKAS is one of the signatories to the International Laboratory Accreditation Co-operation (ILAC) Arrangement for the mutual recognition of test reports.
The tests reported herein have been performed in accordance with its terms of accreditation.

UL International (UK) Ltd

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Customer Information

Company Name:	Grundfos Holding A/S
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Report Revision History

Version Number	Issue Date	Revision Details	Revised By
1.0	25/01/2021	Initial Version	Ian Watch
2.0	08/02/2021	Changed FCC ID & ISED Canada No. Corrected HVIN. Pages 1 & 9	Ian Watch

Table of Contents

1. Attestation of Test Results

1.1. Description of EUT

The Equipment Under Test was an iSolution monitor containing a *Bluetooth* Low Energy module (FCC ID: OG3-GIM10 / ISED Certification No: IC: 10447A-GIM10) and a UMTS/LTE cellular module (FCC ID: OG3-CIM2X0-3G-4G / ISED Certification No: IC: 10447A-CIM2X034G).

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:	47CFR22
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 22 Subpart H (Cellular Radiotelephone Service)
Specification Reference:	47CFR24
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 24 Subpart E (Broadband Personal Communication Services)
Specification Reference:	47CFR27
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 27 Subpart C (Technical Standards)
Specification Reference:	RSS-Gen Issue 5 March 2019
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
Specification Reference:	RSS-132 Issue 3, January 2013
Specification Title:	Cellular Telephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz
Specification Reference:	RSS-133 Issue 6, Amendment 1, January 2018
Specification Title:	2 GHz Personal Communications Services
Specification Reference:	RSS-139 Issue 3, July 2015
Specification Title:	Advanced Wireless Services Equipment Operating in the Bands 1710-1755 MHz and 2110-2180 MHz
Specification Reference:	RSS-130 Issue 2, February 2019
Specification Title:	Equipment Operating in the Frequency Bands 617-652 MHz, 698-756 MHz and 777-787 MHz
Test Lab. Registration:	FCC: UK2011; ISED Canada CABID: UK0001
Location of Testing:	Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	15 June 2020 to 18 June 2020

1.3. Summary of Test Results

FCC Reference (47CFR)	ISED Canada Reference	Measurement	Result
Transmit Mode: *Bluetooth* Low Energy & UMTS Band II			
15.209(a) / 15.247(d) / 2.1053 & 24.238	RSS-Gen 6.13 / RSS-247 5.5 & RSS-133 6.5	Transmitter Out of Band Radiated Emissions	✓
Transmit Mode: *Bluetooth* Low Energy & UMTS Band V			
15.209(a) / 15.247(d) / 2.1053 & 22.917	RSS-Gen 6.13 / RSS-247 5.5 & RSS-132 5.5	Transmitter Out of Band Radiated Emissions	✓
Transmit Mode: *Bluetooth* Low Energy & LTE Band 2			
15.209(a) / 15.247(d) / 2.1053 & 24.238	RSS-Gen 6.13 / RSS-247 5.5 & RSS-133 6.5	Transmitter Out of Band Radiated Emissions	✓
Transmit Mode *Bluetooth* Low Energy & LTE Band 4			
15.209(a) / 15.247(d) / 2.1053 & 27.53(h)(1) & (h)(3)	RSS-Gen 6.13 / RSS-247 5.5 & RSS-139 6.6	Transmitter Out of Band Radiated Emissions	✓
Transmit Mode *Bluetooth* Low Energy & LTE Band 5			
15.209(a) / 15.247(d) / 2.1053 & 22.917	RSS-Gen 6.13 / RSS-247 5.5 & RSS-132 5.5	Transmitter Out of Band Radiated Emissions	✓
Transmit Mode *Bluetooth* Low Energy & LTE Band 12			
15.209(a) / 15.247(d) / 2.1053 / / 2.1053 & 27.53(g)	RSS-Gen 6.13 / RSS-247 5.5 & RSS-130 4.7	Transmitter Out of Band Radiated Emissions	✓
Transmit Mode: *Bluetooth* Low Energy & LTE Band 13			
15.209(a) / 15.247(d) / 2.1053 & 27.53(c)(2), (c)(5) & (f)	RSS-Gen 6.13 / RSS-247 5.5 & RSS-130 4.7	Transmitter Out of Band Radiated Emissions	✓
Key to Results ✓ = Complied ✗ = Did not comply			

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 17	X

UL International (UK) 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:	ANSI C63.26-2015
Title:	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
Reference:	ANSI C63.4-2014
Title:	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Reference:	KDB 558074 D01 DTS Meas Guidance v05r02 April 2, 2019
Title:	Guidance for Compliance Measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC rules
Reference:	FCC KDB 971168 D01 v03r01, April 9, 2018
Title:	Measurement Guidance for Certification of Licensed Digital Transmitters
Reference:	FCC KDB 442401 June 12 2017
Title:	Radiated emission measurements for licensed radio service equipment

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%	±3.30 dB
Radiated Spurious Emissions	1 GHz to 25 GHz	95%	±2.54 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)
M2003	Thermohygrometer	Testo	608-H1	45046641	07 Jan 2021	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	01 Aug 2020	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	20 Jan 2021	12
A3167	Pre Amplifier	Com Power	PAM-103	18020010	14 Aug 2020	12
A2863	Pre Amplifier	Agilent	8449B	3008A02100	08 Aug 2020	12
A3224	Pre Amplifier	Schwarzbeck	BBV 9718 C	00071	24 Apr 2021	12
A2896	Pre Amplifier	Schwarzbeck	BBV 9721	9721-023	13 Feb 2021	12
A3161	Antenna	Teseq	CBL6111D	50859	07 Jan 2021	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	08 Aug 2020	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	08 Aug 2020	12
A2895	Antenna	Schwarzbeck	BBHA 9170	9170-728	13 Feb 2021	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	06 Feb 2021	12
A2918	Attenuator	AtlanTecRF	AN18W5-20	832828#1	06 Feb 2021	12
A2926	Attenuator	AtlanTecRF	AN18W5-30	85850#2	06 Feb 2021	12
A2256	Band Reject Filter	Wainwright Instruments GmbH	WRCGV832.5/ 837.5-822.5/ 847.5-60/6EE	2	07 Jan 2021	12
A3082	Low Pass Filter	AtlanTecRF	AFL-01000	18010900074	30 Apr 2021	12
A2908	High Pass Filter	Wainwright Instruments GmbH	WHJE5-920-1000-4000-60EE	3	05 Feb 2021	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	06 Feb 2021	12
A2947	High Pass Filter	AtlanTecRF	AFH-07000	1601900001	06 Feb 2021	12
M1145	Power Meter	Hewlett Packard	437B	3737U26557	25 Oct 2020	12
M1011	Power Sensor	Hewlett Packard	8485D	2847A00141	30 Jul 2020	12
G0614	Signal Generator	Rohde & Schwarz	SMB100A	177687	19 May 2023	36
A3097	Antenna	Link Microtek	AM1-18HA	15275	30 Aug 2021	36
A2943	Attenuator	AtlanTecRF	AN18W5-06	208147#2	06 Feb 2021	12
M1649	Attenuator	Hewlett Packard	11708A	26584	14 Aug 2020	12

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Grundfos Holding A/S
Model No. / PMN:	GiM CIU
Test Sample Serial Number:	99448387-02-942-00358
Test Sample IMEI:	358148061006354
HVIN:	CIM 280-US
Hardware Version:	R03
Software Version:	V03.00.03.00001
FCC ID:	OG3-GIM1A
ISED Certification Number:	IC: 10447A-GIM1A

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		
Modulation:	GFSK		
Data Rate:	1 Mbps		
Transmit Frequency Range:	2400 MHz to 2483.5 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Middle	18	2442

Technology Tested:	UMTS1900		
Type of Radio Device:	Transceiver		
Mode:	UMTS FDD II		
Modulation Type:	QPSK		
Channel Spacing:	5 MHz		
Configuration:	HSDPA Sub-Test 1		
Transmit Frequency Range:	1850 to 1910 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Middle	9400	1880.0
Technology Tested:	UMTS850		
Mode:	UMTS FDD V		
Modulation Type:	QPSK		
Channel Spacing:	5 MHz		
Configuration:	HSDPA Sub-Test 1		
Transmit Frequency Range:	824 to 849 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Middle	4183	836.6

Additional Information Related to Testing (continued)

Tested Technology:	LTE Band 2		
Type of Equipment	Transceiver		
Transmit Frequency Range:	1850 to 1910 MHz		
Channel Bandwidth	15 MHz		
Channels Tested:	**Channel ID**	**N_{ul}**	**Frequency of Uplink (MHz)**
	Middle	18900	1880.0
Tested Technology:	LTE Band 4		
Transmit Frequency Range:	1710 to 1755 MHz		
Channel Bandwidth	1.4 MHz		
Channels Tested:	**Channel ID**	**N_{ul}**	**Frequency of Uplink (MHz)**
	Middle	20175	1732.5
Tested Technology:	LTE Band 5		
Transmit Frequency Range:	824 to 849 MHz		
Channel Bandwidth	3 MHz		
Channels Tested:	**Channel ID**	**N_{ul}**	**Frequency of Uplink (MHz)**
	Middle	20525	836.5
Tested Technology:	LTE Band 12		
Transmit Frequency Range:	699 to 716 MHz		
Channel Bandwidth	3 MHz		
Channels Tested:	**Channel ID**	**N_{ul}**	**Frequency of Uplink (MHz)**
	Middle	23095	707.5
Tested Technology:	LTE Band 13		
Transmit Frequency Range:	777 to 787 MHz		
Channel Bandwidth	5 MHz		
Channels Tested:	**Channel ID**	**N_{ul}**	**Frequency of Uplink (MHz)**
	Middle	23230	782

3.4. Description of Available Antennas

The EUT utilizes integrated *Bluetooth* Low Energy antennas and two external cellular antennas with the following maximum gains. The cellular antennas are connected to the EUT by two, 3 metre long coaxial cables. The cellular antenna gains stated below include the cable insertion loss.

Bluetooth Low Energy

Frequency Range (MHz)	Antenna Gain (dBi)
2400-2480	2.0

Cellular

Frequency Range (MHz)	Antenna Gain (dBi)
699 to 716	-7.0
777 to 787	-5.0
824 to 849	0.3
1710 to 1755	1.5
1850 to 1910	-1.2

3.5. Description of Test Setup

Support Equipment

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

Description:	Laptop PC
Brand Name:	Lenovo
Model Name or Number:	ThinkPad L480
Serial Number:	R9-019EA1 14/04

Description:	TTL 323 USB cable. Quantity 1. Length 2 metres
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Cellular antenna. Quantity 2
Brand Name:	M2Mconnectivity
Model Name or Number:	40.03.01
Serial Number:	Not marked or stated

Operating Modes

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

- Transmitting UMTS and *Bluetooth* Low Energy simultaneously at maximum power.
- Transmitting LTE and *Bluetooth* Low Energy simultaneously at maximum power.

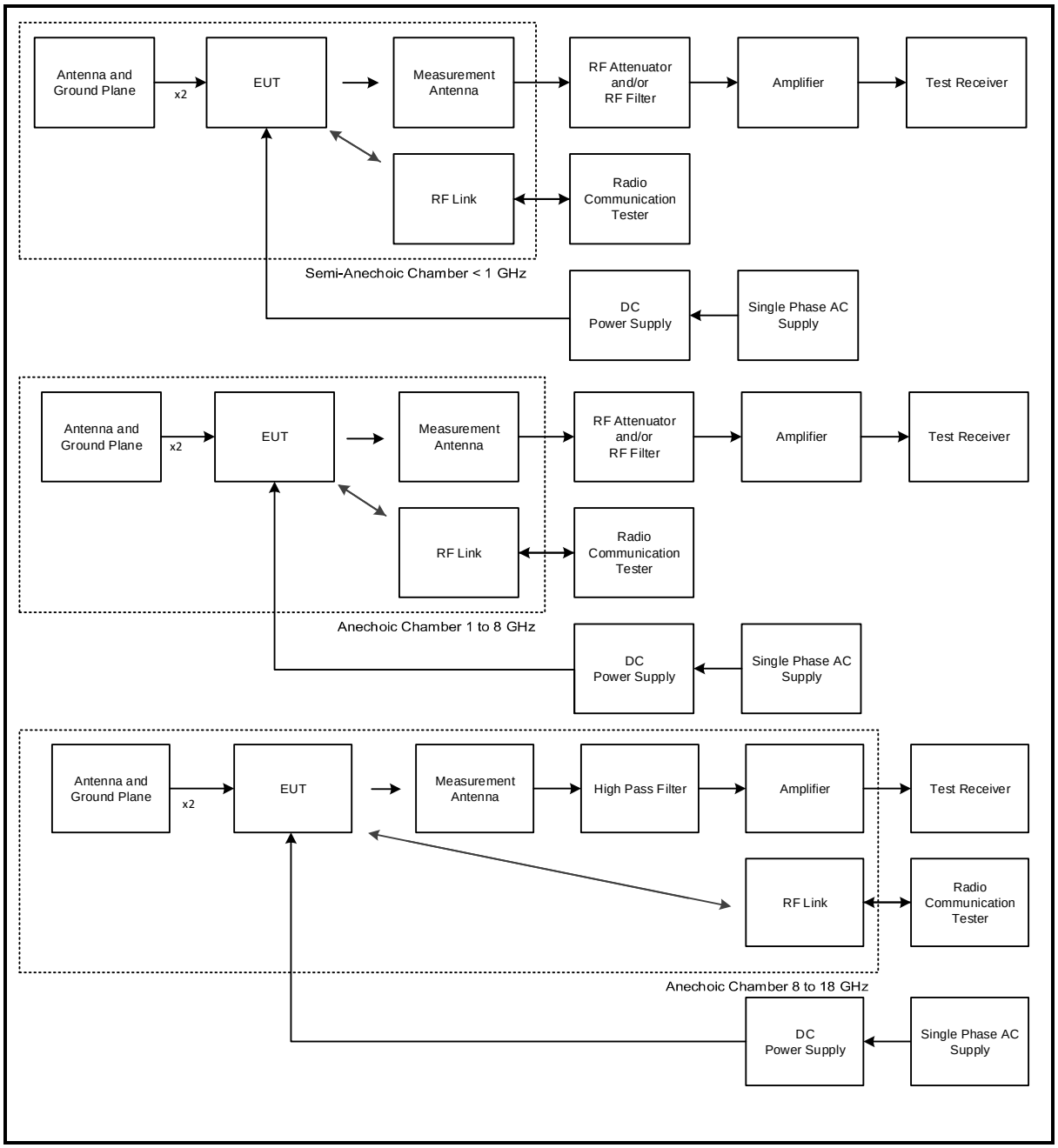
Configuration and Peripherals

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

- The EUT was controlled using a software application supplied by the customer on the laptop PC. The application was used to enable a continuous transmission and to select the test channels as required. The customer supplied a document containing the setup instructions 'Connect GiM to BLE.pdf'. The laptop PC was connected to the EUT via a USB to serial cable.
- The cellular link was controlled using a Rohde & Schwarz CMW500 UMTS / LTE system simulator.
- UMTS Band II and *Bluetooth* Low Energy. The EUT was configured to simultaneously transmit two signals at maximum output power, UMTS 1900 (FDD HSDPA Sub-test 1 on middle channel 9400 / 1880 MHz) and *Bluetooth* Low Energy on middle channel (18 / 2442 MHz).
- UMTS Band V and *Bluetooth* Low Energy. The EUT was configured to simultaneously transmit two signals at maximum output power, UMTS 850 (FDD HSDPA Sub-test 1 on middle channel 4183 / 836.6 MHz) and *Bluetooth* Low Energy on middle channel (18 / 2442 MHz).
- LTE Band 2 and *Bluetooth* Low Energy. The EUT was configured to simultaneously transmit two signals at maximum output power, LTE Band 2 (QPSK / 15 MHz channel bandwidth / 1RB offset 0 on middle channel 18900 / 1880 MHz) and *Bluetooth* Low Energy on middle channel (18 / 2442 MHz).
- LTE Band 4 and *Bluetooth* Low Energy. The EUT was configured to simultaneously transmit two signals at maximum output power, LTE Band 4 (QPSK / 1.4 MHz channel bandwidth / 1RB offset 0 on middle channel 20175 / 1732.5 MHz) and *Bluetooth* Low Energy on middle channel (18 / 2442 MHz).
- LTE Band 5 and *Bluetooth* Low Energy. The EUT was configured to simultaneously transmit two signals at maximum output power, LTE Band 5 (QPSK / 3 MHz channel bandwidth / 1RB offset 0 on middle channel 20525 / 836.5 MHz) and *Bluetooth* Low Energy on middle channel (18 / 2442 MHz).
- LTE Band 12 and *Bluetooth* Low Energy. The EUT was configured to simultaneously transmit two signals at maximum output power (LTE Band 12 QPSK / 3 MHz Channel bandwidth / 1RB offset 0 on middle channel 23095 / 707.5 MHz) and *Bluetooth* Low Energy on middle channel (18 / 2442 MHz).
- LTE Band 13 and *Bluetooth* Low Energy. The EUT was configured to simultaneously transmit two signals at maximum output power LTE Band 13 (QPSK / 5 MHz Channel bandwidth / 1RB offset 0 on middle channel 23230 / 782 MHz) and *Bluetooth* Low Energy on middle channel (18 / 2442 MHz).
- Transmitter radiated measurements were performed with the EUT placed in the worst case orientation with respect to emissions. Two external antennas were connected to the cellular modules. Metal plates (190 mm x 190 mm each) were fitted to the base of each cellular antenna as the antennas require a conductive ground plane.
- As the EUT could be powered from 24 to 250 volts AC/DC, initial investigations were performed with the EUT in X, Y and Z orientations < 1 GHz, using 24 VDC and 120 VAC 60 Hz supplies . Using a 24 VDC power supply was found to be the worst case with respect to radiated emissions and final measurements were performed in this configuration. The DC power supply was placed in the antechamber during tests.

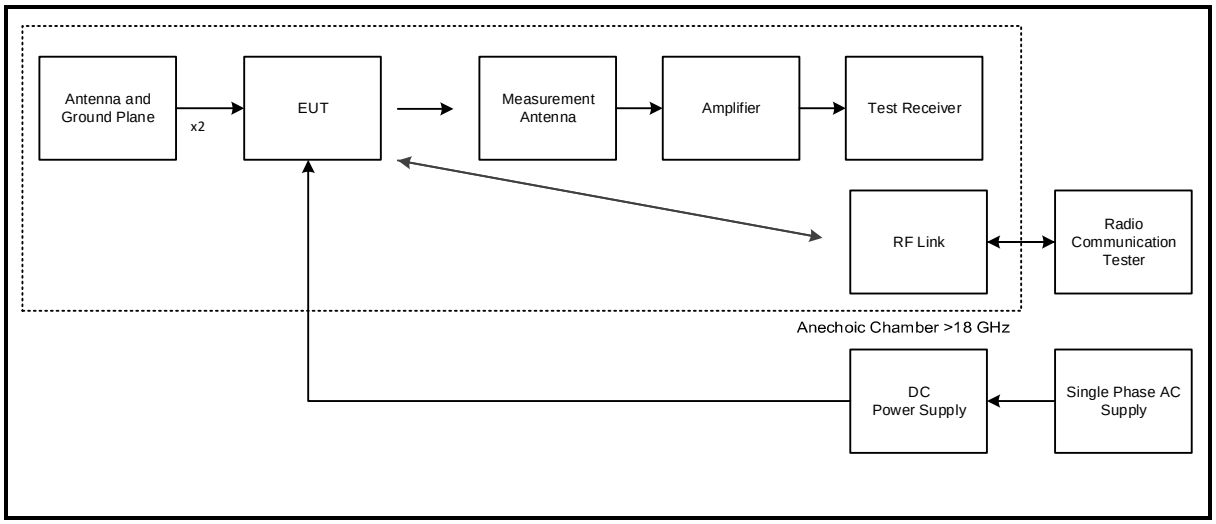
Test Setup Diagrams

Transmitter Radiated Emissions



Test Setup Diagrams (continued)

Transmitter Radiated Emissions



4. Radiated Test Results

4.1. Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & UMTS Band II)

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	15 June 2020 to 18 June 2020
Test Sample Serial Number:	99448387-02-942-00358		

FCC Reference:	Parts 2.1053 / 15.209(a) / 15.247(d) / 24.238
ISED Canada Reference:	RSS-Gen 6.13 / RSS-247 5.5 / RSS-133 6.5
Test Method Used:	ANSI C63.26 section 5.5, KDB 971168 Section 6.1 referencing ANSI C63.4 KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11 & 11.12
Frequency Range:	30 MHz to 25 GHz
Configuration:	*Bluetooth* Low Energy middle channel / UMTS Band II HSDPA sub test 1 middle channel

Environmental Conditions:

Temperature (°C):	23 to 24
Relative Humidity (%):	42 to 53

Note(s):

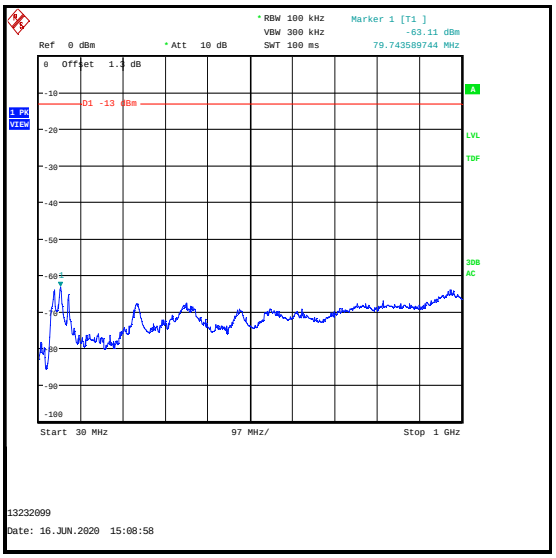
1. All intermodulation products were below the noise floor level or greater than 20 dB from the applicable limit.
2. The UMTS Band II uplink and *Bluetooth* LE fundamental are shown on the 1 GHz to 3 GHz plot.
3. Prescans were tested against FCC Part 24 emission limits.
4. The emissions shown on the prescan plots at approximately 4883 MHz and 7327 MHz are harmonics of the *Bluetooth* LE signal. The emission levels have not increased from the single mode of operation as shown in UL test report UL-RPT-RP13232099-616A.
5. The emissions shown on the prescan plots at approximately 3753 MHz, 5644 MHz, 9394 MHz, 11285 MHz and 13164 MHz are harmonics of the UMTS Band II signal. As the emissions were > 20 dB from the applicable limit and not intermodulation products, they were not final measured.
6. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz, for measurements below 1 GHz. For measurements above 1 GHz, resolution bandwidth was set 1 MHz and video bandwidth 3 MHz, with the sweep time set to auto. A peak detector and trace mode of Max Hold were used to perform prescans, with markers placed on the highest measured levels.
7. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
8. Measurements above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.

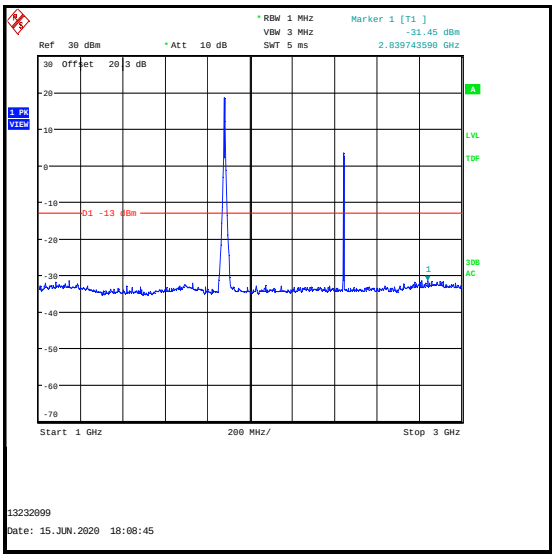
Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & UMTS Band II) (continued)

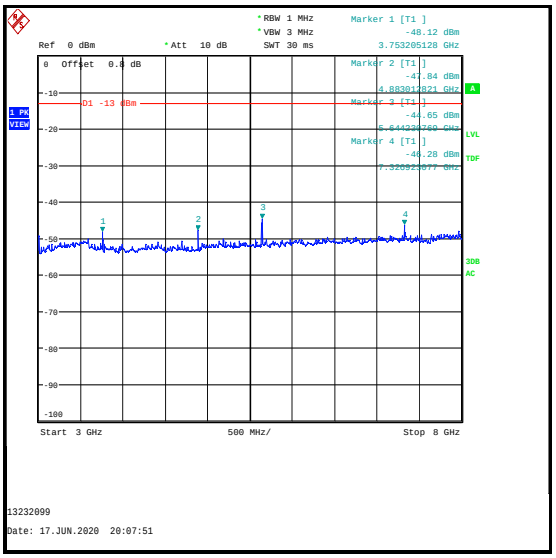
Results: *Bluetooth* LE middle channel / UMTS Band II middle channel

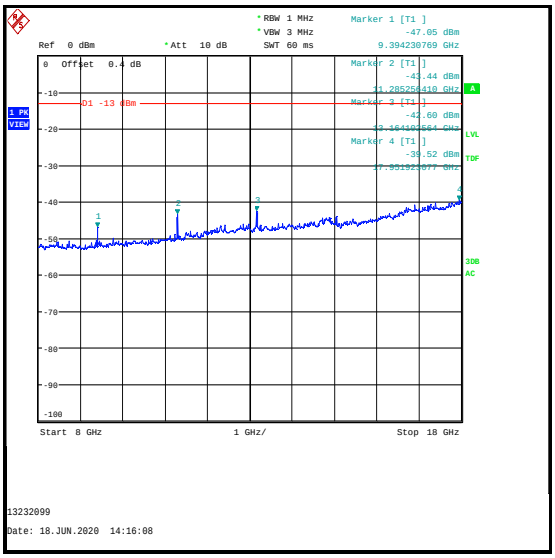
Frequency (MHz)	Antenna Polarity	Emission Level	Applicable Limit	Margin (dB)	Result
See note 1					

Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & UMTS Band II) (continued)

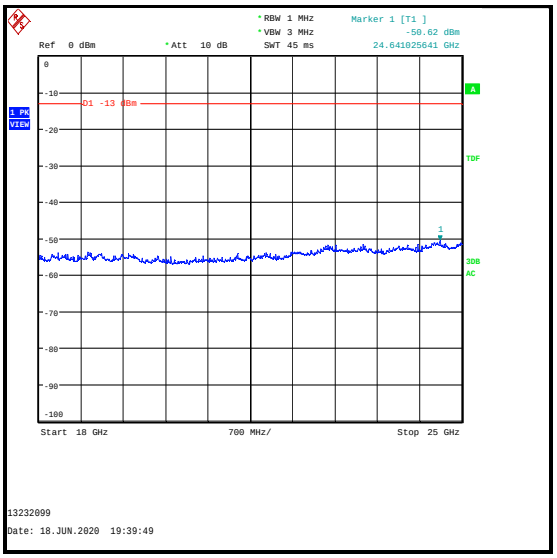








Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & UMTS Band II) (continued)



4.2. Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & UMTS Band V)

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	15 June 2020 to 18 June 2020
Test Sample Serial Number:	99448387-02-942-00358		

FCC Reference:	Parts 2.1053 / 15.209(a) / 15.247(d) / 22.917
ISED Canada Reference:	RSS-Gen 6.13 / RSS-247 5.5 / RSS-132 5.5
Test Method Used:	ANSI C63.26 section 5.5, KDB 971168 Section 6.1 referencing ANSI C63.4 KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11 & 11.12
Frequency Range:	30 MHz to 25 GHz
Configuration:	*Bluetooth* Low Energy middle channel / UMTS HSDPA sub test 1 middle channel

Environmental Conditions:

Temperature (°C):	23 to 24
Relative Humidity (%):	42 to 53

Note(s):

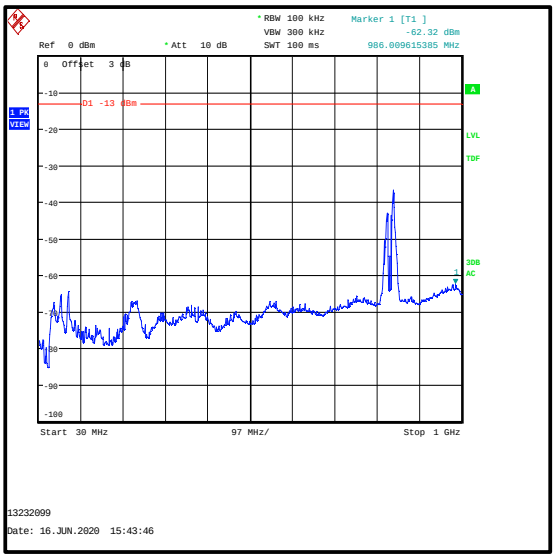
1. All intermodulation products were below the noise floor level or greater than 20 dB from the applicable limit.
2. A band reject filter was used to supress the UMTS Band V uplink.
3. The *Bluetooth* LE fundamental is shown on the 1 GHz to 3 GHz plot.
4. Prescans were tested against FCC Part 22 emission limits.
5. The emissions shown on the prescan plots at approximately 4880 MHz and 7327 MHz are harmonics of the *Bluetooth* LE signal. The emission levels have not increased from the single mode of operation as shown in UL test report UL-RPT-RP13232099-616A.
6. The emission shown on the prescan plots at approximately 5019 MHz is the 6th harmonic of the UMTS Band V signal. As the emission was > 20 dB from the applicable limit and not an intermodulation product, it was not final measured.
7. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz, for measurements below 1 GHz. For measurements above 1 GHz resolution bandwidth was set 1 MHz and video bandwidth 3 MHz, with the sweep time set to auto. A peak detector and trace mode of Max Hold were used to perform prescans, with markers placed on the highest measured levels.
8. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
9. Measurements above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.

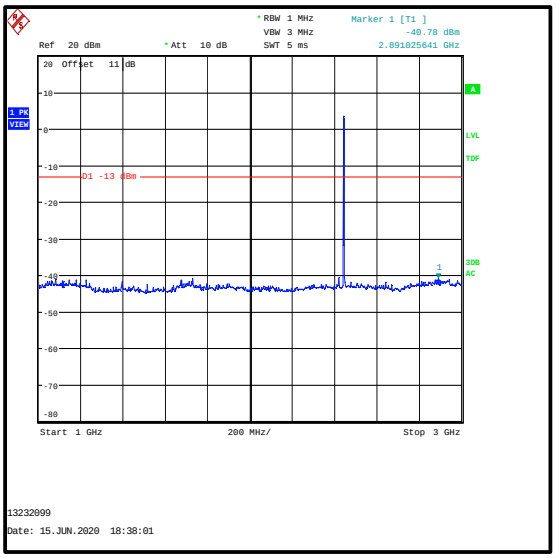
Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & UMTS Band V) (continued)

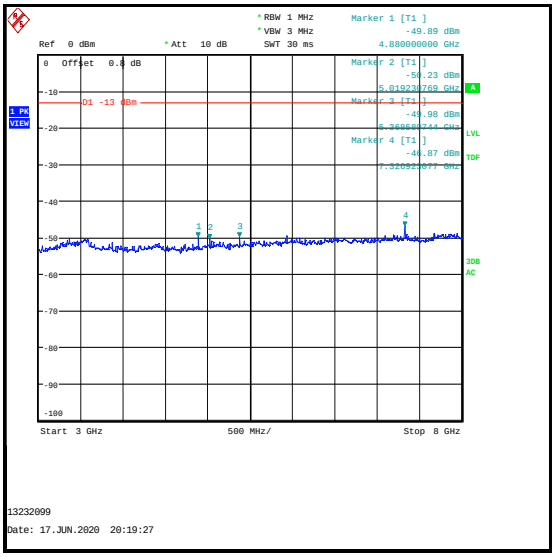
Results: *Bluetooth* LE middle channel / UMTS Band V middle channel

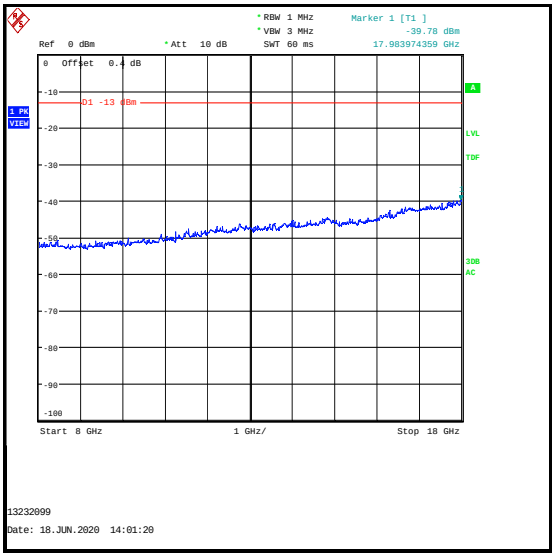
Frequency (MHz)	Antenna Polarity	Emission Level	Applicable Limit	Margin (dB)	Result
See note 1					

Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & UMTS Band V) (continued)

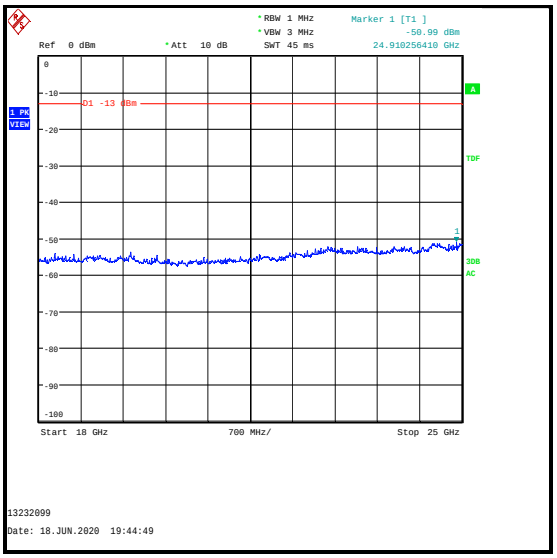








Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & UMTS Band V) (continued)



4.3. Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 2)

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	15 June 2020 to 18 June 2020
Test Sample Serial Number:	99448387-02-942-00358		

FCC Reference:	Parts 2.1053 / 15.209(a) / 15.247(d) / 24.238
ISED Canada Reference:	RSS-Gen 6.13 / RSS-247 5.5 / RSS-133 6.5
Test Method Used:	ANSI C63.26 section 5.5, KDB 971168 Section 6.1 referencing ANSI C63.4 KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11 & 11.12
Frequency Range:	30 MHz to 25 GHz
Configuration:	*Bluetooth* LE middle channel / LTE Band 2 (QPSK / 15 MHz channel Bandwidth / 1RB offset 0) middle channel

Environmental Conditions:

Temperature (°C):	23 to 24
Relative Humidity (%):	42 to 53

Note(s):

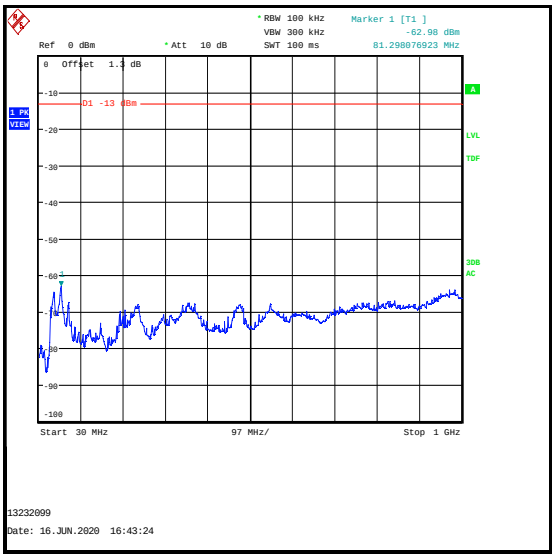
1. All intermodulation products were below the noise floor level or greater than 20 dB from the applicable limit.
2. The LTE Band 2 uplink and *Bluetooth* LE fundamental are shown on the 1 GHz to 3 GHz plot.
3. Prescans were tested against FCC Part 24 emission limits.
4. The emissions shown on the prescan plots at approximately 4880 MHz and 7327 MHz are harmonics of the *Bluetooth* LE signal. The emission levels have not increased from the single mode of operation as shown in UL test report UL-RPT-RP13232099-616A.
5. The emissions shown on the prescan plots at approximately 9362 MHz, 11240 MHz, 14987 MHz and 18729 MHz are harmonics of the LTE Band 2 signal. As the emissions were > 20 dB from the applicable limit and not intermodulation products, they were not final measured.
6. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz, for measurements below 1 GHz. For measurements above 1 GHz resolution bandwidth was set 1 MHz and video bandwidth 3 MHz, with the sweep time set to auto. A peak detector and trace mode of Max Hold were used to perform prescans, with markers placed on the highest measured levels.
7. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
8. Measurements above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.

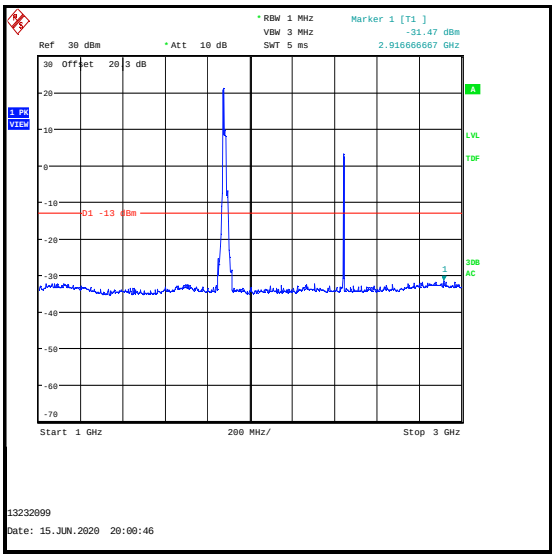
Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 2) (continued)

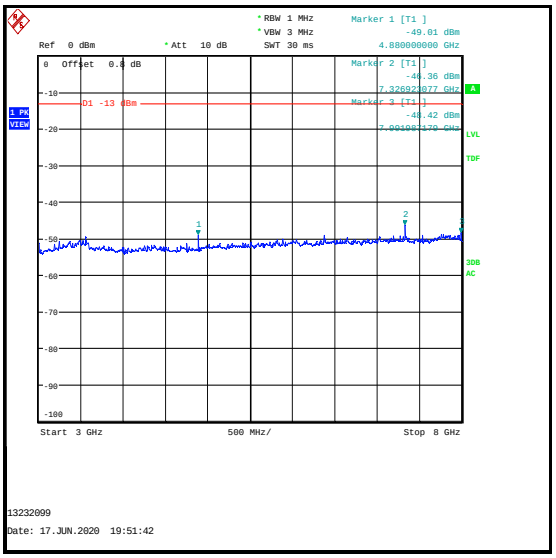
Results: *Bluetooth* LE middle channel / LTE Band 2 middle channel

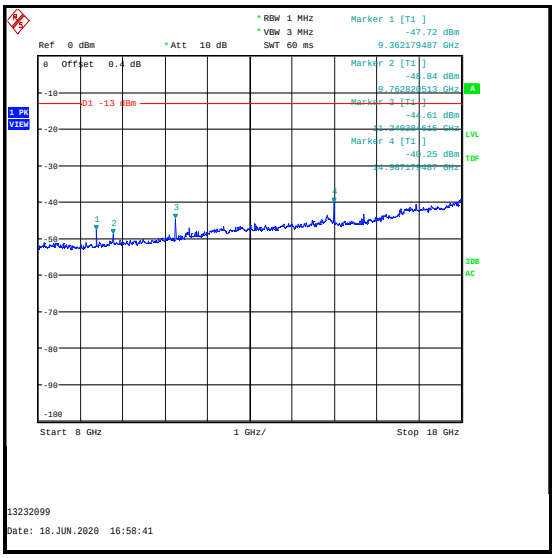
Frequency (MHz)	Antenna Polarity	Emission Level	Applicable Limit	Margin (dB)	Result
See note 1					

Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 2) (continued)

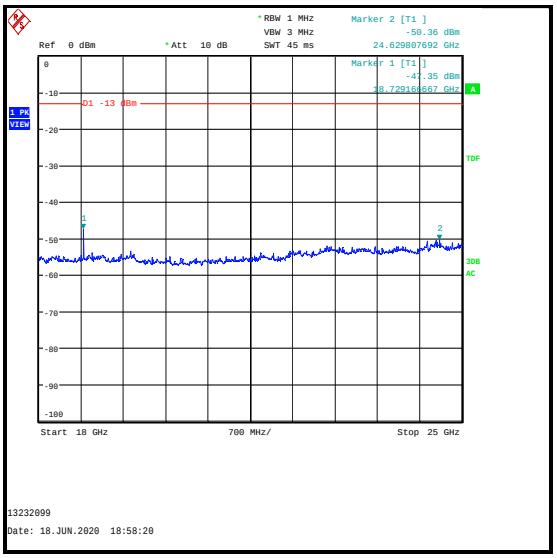








Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 2) (continued)



4.4. Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 4)

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	16 June 2020 to 18 June 2020
Test Sample Serial Number:	99448387-02-942-00358		

FCC Reference:	Parts 2.1053 / 15.209(a) / 15.247(d) / 27.53(h)(1) & (h)(3)
ISED Canada Reference:	RSS-Gen 6.13 / RSS-247 5.5 / RSS-139 6.6
Test Method Used:	ANSI C63.26 section 5.5, KDB 971168 Section 6.1 referencing ANSI C63.4 KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11 & 11.12
Frequency Range:	30 MHz to 25 GHz
Configuration:	*Bluetooth* LE middle channel / LTE Band 4 (QPSK / 1.4 MHz channel Bandwidth / 1RB offset 0) middle channel

Environmental Conditions:

Temperature (°C):	23 to 24
Relative Humidity (%):	42 to 45

Note(s):

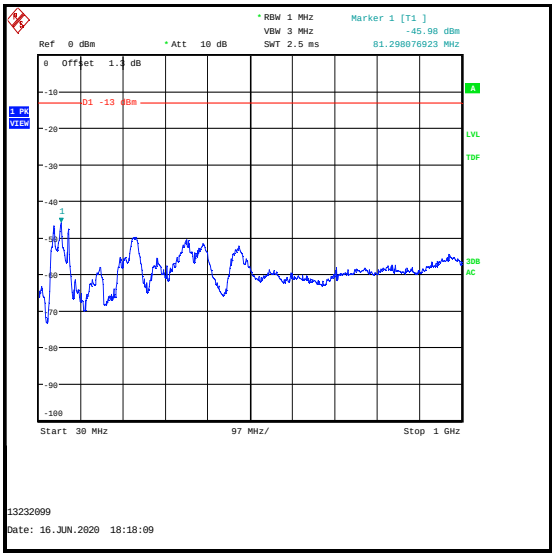
1. All intermodulation products were below the noise floor level or greater than 20 dB from the applicable limit.
2. The LTE Band 4 uplink and *Bluetooth* LE fundamental are shown on the 1 GHz to 3 GHz plot.
3. Prescans were tested against FCC Part 27 emission limits
4. The emission at approximately 3152 MHz is an intermodulation product from the 2nd harmonic of the *Bluetooth* LE signal minus the LTE Band 4 signal. As the emission was > 20 dB from the applicable limit on the prescan, it was not final measured.
5. The emission shown on the prescan plots at approximately 4880 MHz is a harmonic of the *Bluetooth* LE signal. The emission level has not increased from the single mode of operation as shown in UL test report UL-RPT-RP13232099-616A.
6. The emissions shown on the prescan plots at approximately 3465 MHz, 6934 MHz, 8657 MHz, 10387 MHz, 12118 MHz and 13865 MHz are harmonics of the LTE Band 4 signal. As the emissions were > 20 dB from the applicable limit and not intermodulation products, they were not final measured.
7. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz, with the sweep time set to auto. A peak detector and trace mode of Max Hold were used to perform prescans, with markers placed on the highest measured levels.
8. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
9. Measurements above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.

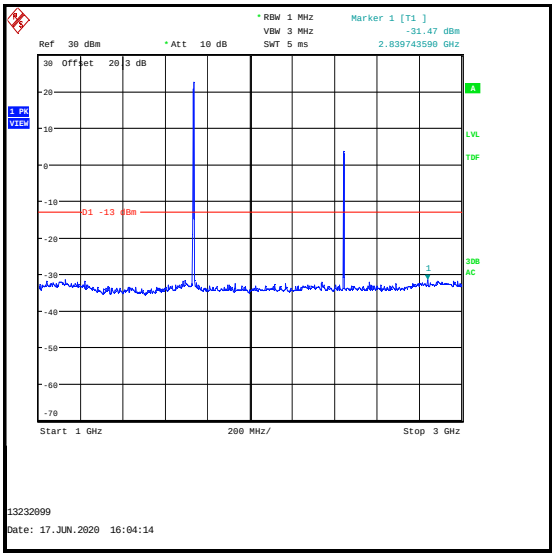
Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 4) (continued)

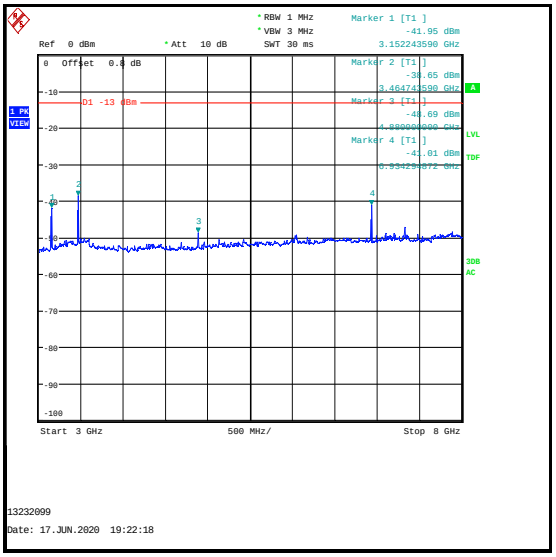
Results: *Bluetooth* LE middle channel / LTE Band 4 middle channel

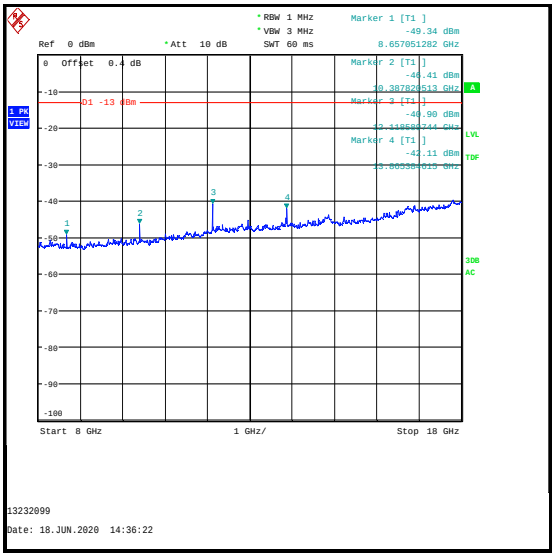
Frequency (MHz)	Antenna Polarity	Emission Level (dBm)	Applicable Limit (dBm)	Margin (dB)	Result
See note 1					

Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 4) (continued)

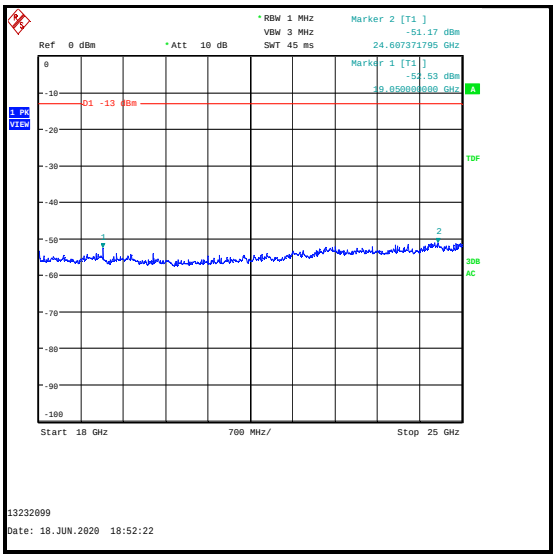








Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 4) (continued)



4.5. Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 5)

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	15 June 2020 to 18 June 2020
Test Sample Serial Number:	99448387-02-942-00358		

FCC Reference:	Parts 2.1053 / 15.209(a) / 15.247(d) / 22.917
ISED Canada Reference:	RSS-Gen 6.13 / RSS-247 5.5 / RSS-132 5.5
Test Method Used:	ANSI C63.26 section 5.5, KDB 971168 Section 6.1 referencing ANSI C63.4 KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11 & 11.12
Frequency Range:	30 MHz to 25 GHz
Configuration:	*Bluetooth* LE middle channel / LTE Band 5 (QPSK / 3 MHz channel Bandwidth / 1RB offset 0) middle channel

Environmental Conditions:

Temperature (°C):	23 to 24
Relative Humidity (%):	42 to 53

Note(s):

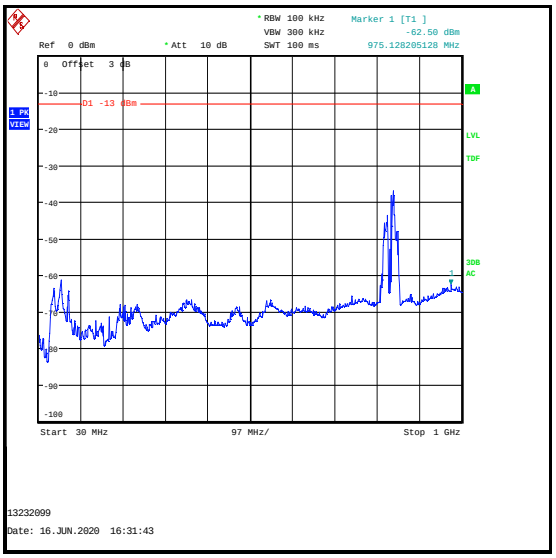
1. All intermodulation products were below the noise floor level or greater than 20 dB from the applicable limit.
2. A band reject filter was used to supress the LTE Band 5 uplink.
3. The *Bluetooth* LE fundamental is shown on the 1 GHz to 3 GHz plot.
4. Prescans were tested against FCC Part 22 emission limits.
5. The emissions shown on the prescan plots at approximately 4880 MHz and 7327 MHz are harmonics of the *Bluetooth* LE signal. The emission levels have not increased from the single mode of operation as shown in UL test report UL-RPT-RP13232099-616A.
6. The emissions shown on the prescan plots at approximately 1670 MHz, 3336 MHz, 7519 MHz, 14202 MHz and 15035 MHz are harmonics of the LTE Band 5 signal. As the emissions were > 20 dB from the applicable limit and not intermodulation products, they were not final measured.
7. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz, for measurements below 1 GHz. For measurements above 1 GHz resolution bandwidth was set 1 MHz and video bandwidth 3 MHz, with the sweep time set to auto. A peak detector and trace mode of Max Hold were used to perform prescans, with markers placed on the highest measured levels.
8. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
9. Measurements above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.

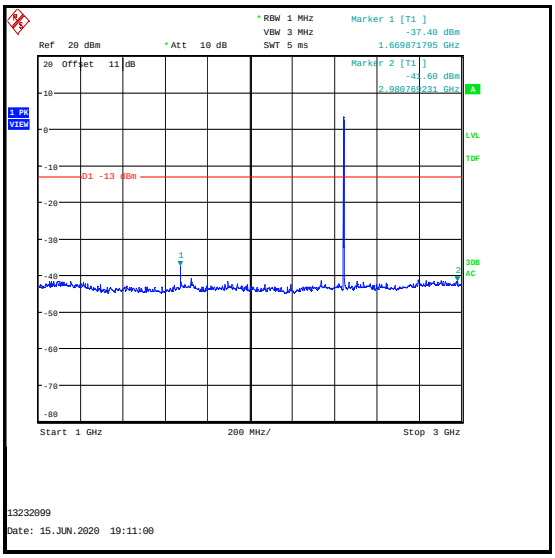
Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 5) (continued)

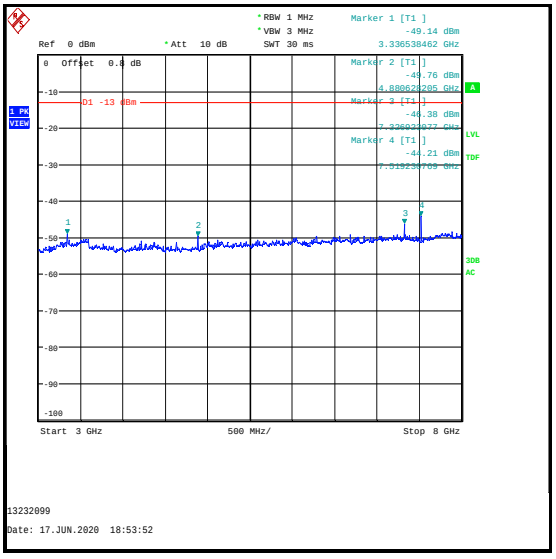
Results: *Bluetooth* LE middle channel / LTE Band 5 middle channel

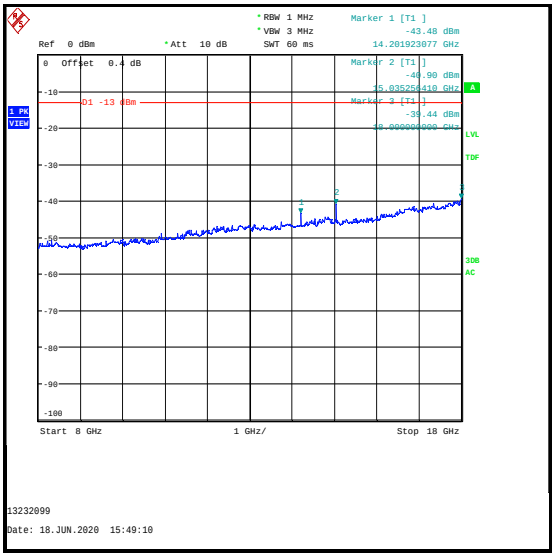
Frequency (MHz)	Antenna Polarity	Emission Level (dBm)	Applicable Limit (dBm)	Margin (dB)	Result
See note 1					

Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 5) (continued)

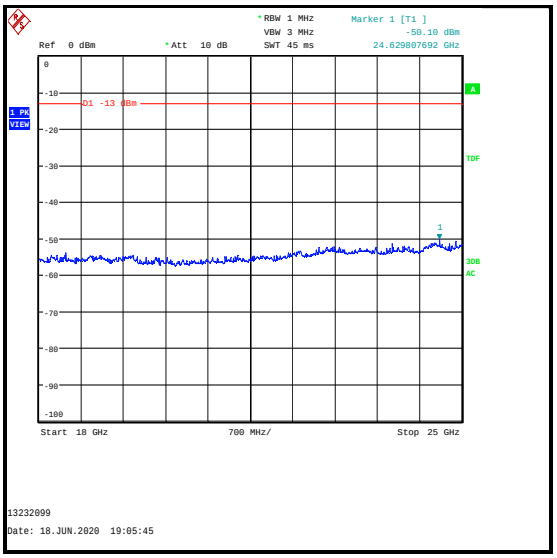








Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 5) (continued)



4.6. Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 12)

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	16 June 2020 to 18 June 2020
Test Sample Serial Number:	99448387-02-942-00358		

FCC Reference:	Parts 2.1053 / 15.209(a) / 15.247(d) / 27.53(g)
ISED Canada Reference:	RSS-Gen 6.13 / RSS-247 5.5 / RSS-130 4.7
Test Method Used:	ANSI C63.26 section 5.5, KDB 971168 Section 6.1 referencing ANSI C63.4 KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11 & 11.12
Frequency Range:	30 MHz to 25 GHz
Configuration:	*Bluetooth* LE middle channel / LTE Band 12 (QPSK / 3 MHz channel Bandwidth / 1RB offset 0) middle channel

Environmental Conditions:

Temperature (°C):	22 to 24
Relative Humidity (%):	42 to 45

Note(s):

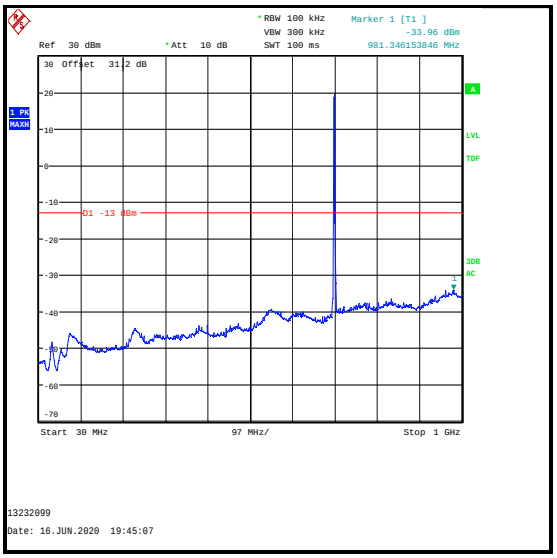
1. All intermodulation products were below the noise floor level or greater than 20 dB from the applicable limit.
2. The LTE Band 12 uplink is shown on the 30 MHz to 1 GHz plot. The *Bluetooth* LE fundamental is shown on the 1 GHz to 3 GHz plot.
3. Prescans were tested against FCC Part 27 and ISED Canada RSS-130 emission limits.
4. The emissions shown on the prescan plots at approximately 4883 MHz and 7327 MHz are harmonics of the *Bluetooth* LE signal. The emission levels have not increased from the single mode of operation as shown in UL test report UL-RPT-RP13232099-616A.
5. The emission shown on the prescan plots at approximately 1413 MHz is a harmonic of the LTE Band 12 signal. As the emission was > 20 dB from the applicable limit and not an intermodulation product, it was not final measured.
6. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz, for measurements below 1 GHz. For measurements above 1 GHz resolution bandwidth was set 1 MHz and video bandwidth 3 MHz, with the sweep time set to auto. A peak detector and trace mode of Max Hold were used to perform prescans, with markers placed on the highest measured levels. In accordance with RSS-130 4.7.1, all testing should be performed using a measurement bandwidth of 100 kHz. Additional measurements > 1 GHz were performed, result plots are stored on the UL International (UK) Ltd IT server and are available for inspection if required.
7. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
8. Measurements above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.

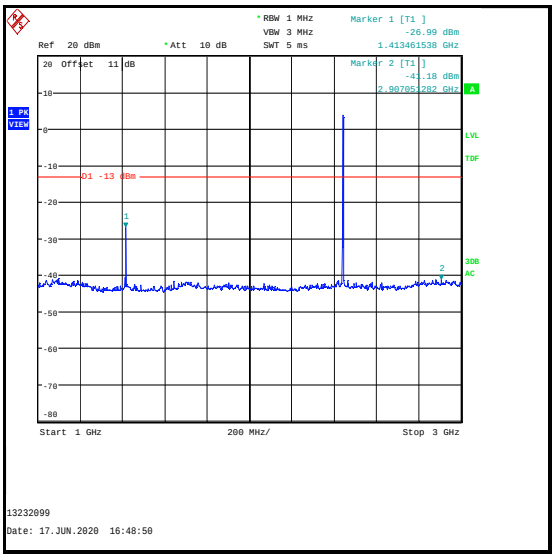
Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 12) (continued)

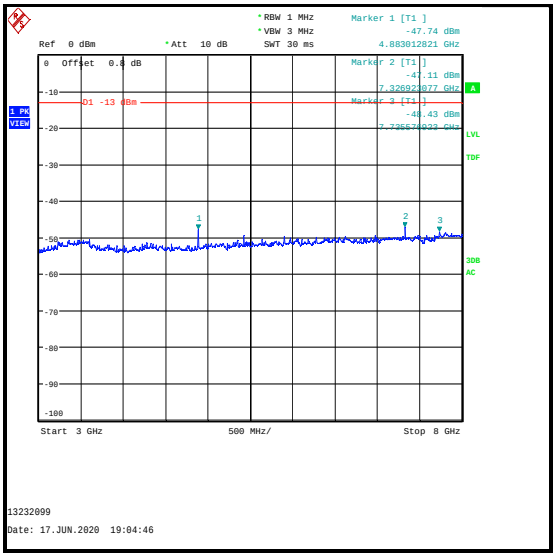
Results: *Bluetooth* LE middle channel / LTE Band 12 middle channel

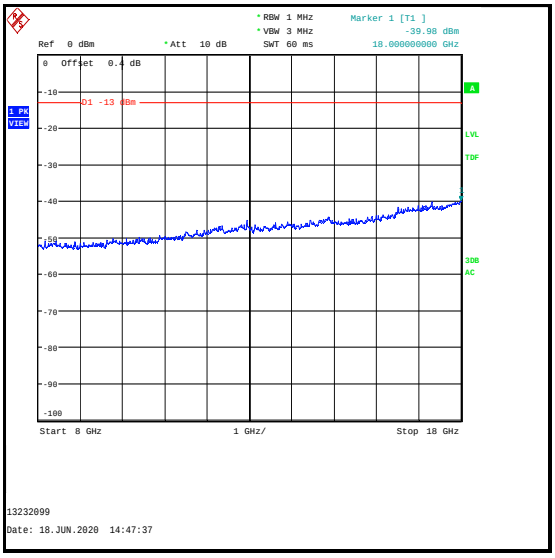
Frequency (MHz)	Antenna Polarity	Emission Level	Applicable Limit	Margin (dB)	Result
See note 1					

Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 12) (continued)

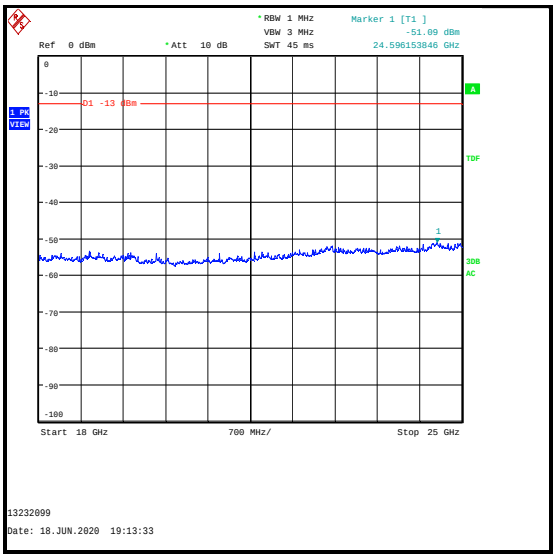








Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 12) (continued)



4.7. Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 13)

Test Summary:

Test Engineer:	Andrew Edwards	**Test Dates:**	16 June 2020 to 18 June 2020
Test Sample Serial Number:	99448387-02-942-00358		

FCC Reference:	Parts 2.1053 / 15.209(a) / 15.247(d) / 27.53(c)(2), (c)(5) & (f)
ISED Canada Reference:	RSS-Gen 6.13 & 8.9 / RSS-247 5.5 / RSS-130 4.7
Test Method Used:	ANSI C63.26 sections 5.2.4 & 5.5, KDB 971168 Section 6.1 referencing ANSI C63.4 KDB 558074 Sections 8.5 & 8.6 referencing ANSI C63.10 Sections 6.3, 6.5, 6.6, 11.11 & 11.12
Frequency Range:	30 MHz to 25 GHz
Configuration:	*Bluetooth* LE middle channel / LTE Band 13 (QPSK / 5 MHz channel Bandwidth / 1RB offset 0) middle channel

Environmental Conditions:

Temperature (°C):	22 to 24
Relative Humidity (%):	42 to 45

Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 13) (continued)

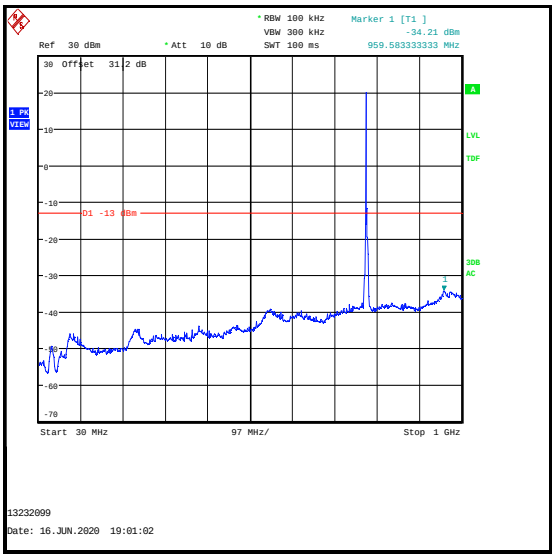
Note(s):

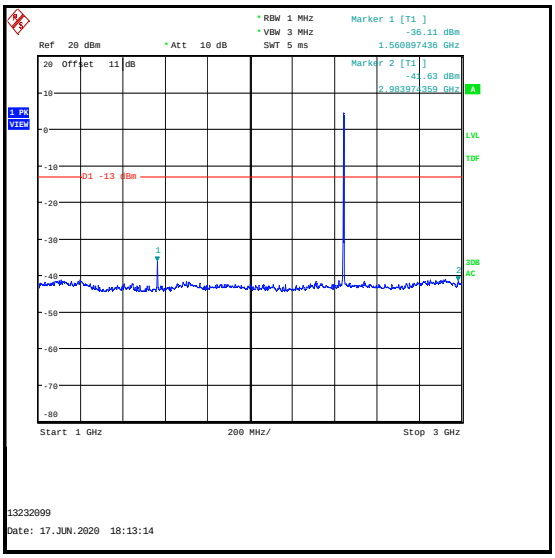
1. All intermodulation products were below the noise floor level or greater than 20 dB from the specification limit.
2. The LTE Band 13 uplink is shown on the 30 MHz to 1 GHz plot. The *Bluetooth* LE fundamental is shown on the 1 GHz to 3 GHz plot.
3. Prescans were tested against FCC Part 27 and ISED Canada RSS-130 emission limits.
4. The emission at 1559.716 MHz is the 2nd harmonic of the LTE Band 13 signal. A final measurement was performed using a 1 MHz RBW and 3 MHz VBW, with the sweep time set to auto. An RMS detector (Power averaging) and trace averaging was performed over 300 sweeps. The peak level was recorded in the table below. A -70 dBW/MHz (-40 dBm/MHz) EIRP limit has been applied in accordance with FCC Part 27.53(f) and ISED Canada RSS 130 4.7.2(b).
5. The emissions shown on the prescan plots at approximately 4883 MHz and 7327 MHz are harmonics of the *Bluetooth* LE signal. The emission levels have not increased from the single mode of operation as shown in UL test report UL-RPT-RP13232099-616A.
6. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz, for measurements below 1 GHz. For measurements above 1 GHz resolution bandwidth was set 1 MHz and video bandwidth 3 MHz, with the sweep time set to auto. A peak detector and trace mode of Max Hold were used to perform prescans, with markers placed on the highest measured levels. In accordance with RSS-130 4.7.1, all testing should be performed using a measurement bandwidth of 100 kHz. Additional measurements > 1 GHz were performed, result plots are stored on the UL International (UK) Ltd IT server and are available for inspection if required.
7. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
8. Measurements above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

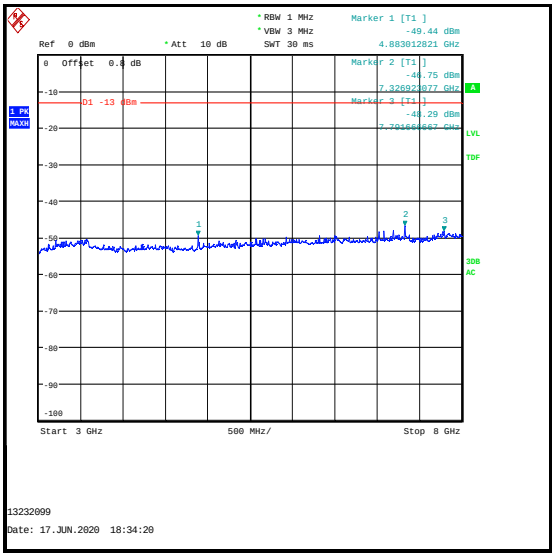
Results: *Bluetooth* LE middle channel / LTE Band 13 middle channel

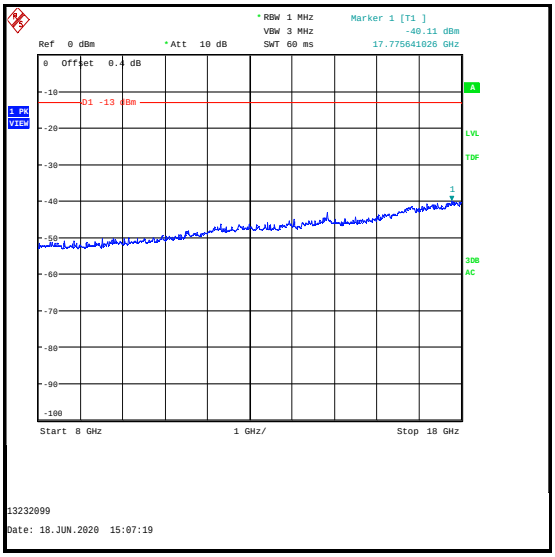
Frequency (MHz)	Antenna Polarity	Emission Level (dBm)	Applicable Limit (dBm)	Margin (dB)	Result
1559.716	Vertical	-40.2	-40.0	0.2	Complied

Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 13) (continued)

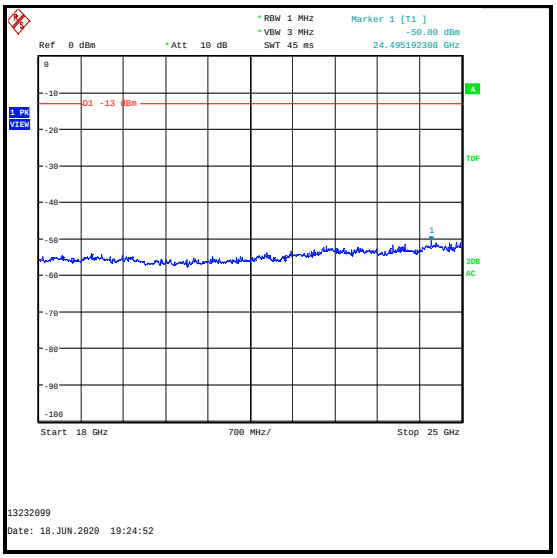








Transmitter Out of Band Radiated Emissions (*Bluetooth* LE & LTE Band 13) (continued)



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