



TEST REPORT

Test Report No. : UL-RPT-RP11624992JD08A V2.0

Customer : Apple Inc.
Model No. : A1842
FCC ID : BCGA1842
Technology : *Bluetooth* – Low Energy (High Power Mode)
Test Standard(s) : FCC Parts 15.209(a) & 15.247

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

1. This test report shall not be reproduced in full or partial, without the written approval of UL VS LTD.
2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

Date of Issue: 22 August 2017

Checked by:

Ian Watch
Senior Test Engineer, Radio Laboratory

Company Signatory:

Sarah Williams
Senior Test Engineer, Radio Laboratory
UL VS LTD



The *Bluetooth*[®] word mark and logos are owned by the *Bluetooth* SIG, Inc. and any use of such marks by UL VS LTD is under licence. Other trademarks and trade names are those of their respective owners.

UL VS LTD

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG, UK
Telephone: +44 (0)1256 312000
Facsimile: +44 (0)1256 312001

Report Revision History

Version Number	Issue Date	Revision Details	Revised By
1.0	01/08/2017	Initial Version	Ian Watch
2.0	22/08/2017	Changed Model No. to A1842 Changed description of EUT in Section 1.1	Ian Watch

Table of Contents

Report Revision History	2
Table of Contents.....	3
1. Attestation of Test Results.....	4
1.1. Description of EUT	4
1.2. General Information	4
1.3. Summary of Test Results	4
1.4. Deviations from the Test Specification	4
2. Summary of Testing.....	5
2.1. Facilities and Accreditation	5
2.2. Methods and Procedures	5
2.3. Calibration and Uncertainty	6
2.4. Test and Measurement Equipment	7
3. Equipment Under Test (EUT)	9
3.1. Identification of Equipment Under Test (EUT)	9
3.2. Modifications Incorporated in the EUT	9
3.3. Additional Information Related to Testing	10
3.4. Description of Available Antennas	10
3.5. Description of Test Setup	11
4. Antenna Port Test Results	16
4.1. Transmitter Minimum 6 dB Bandwidth	16
4.2. Transmitter Duty Cycle	19
4.3. Transmitter Maximum Peak Output Power	20
4.4. Transmitter Power Spectral Density	25
5. Radiated Test Results.....	28
5.1. Transmitter Radiated Emissions <1 GHz	28
5.2. Transmitter Radiated Emissions >1 GHz	30
5.3. Transmitter Band Edge Radiated Emissions	32

1. Attestation of Test Results

1.1. Description of EUT

The device is an interactive digital media player which plays content onto a screen through an HDMI port. It incorporates Wi-Fi and Bluetooth radios.

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
Test Dates:	25 May 2017 to 25 July 2017

1.3. Summary of Test Results

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

Note(s):

1. The measurement was performed to assist in the calculation of the level of average radiated emissions at the upper band edge.
2. There are two vendors of the WiFi/*Bluetooth* radio modules, Vendor 1 and Vendor 2.
3. The WiFi/*Bluetooth* radio modules have the same mechanical outline (i.e. the same packaging dimension and pin layout), use the same on-board antenna matching circuit, have an identical antenna structure and are built and tested to conform to the same specification and to operate within the same tolerances.

Baseline testing was performed on the two vendors to determine the worst case.

1.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

2. Summary of Testing

2.1. Facilities and Accreditation

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

Site 1	
Site 2	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 v04 April 5, 2017
Title:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247

2.3. Calibration and Uncertainty

Measuring Instrument Calibration

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

Measurement Uncertainty

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

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

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

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

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Duty Cycle	2.4 GHz to 2.4835 GHz	95%	±1.14 %
Minimum 6 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±4.59 %
Spectral Power Density	2.4 GHz to 2.4835 GHz	95%	±2.94 dB
Conducted Maximum Peak Output Power	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 25 GHz	95%	±2.94 dB

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

2.4. Test and Measurement Equipment

Test Equipment Used for Transmitter Conducted Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1883	Signal Analyser	Rohde & Schwarz	FSV30	103084	02 May 2018	12
A2520	Attenuator	AtlanTecRF	AN18-20	832797#1	Calibrated before use	-
G0614	Signal Generator	Rohde & Schwarz	SMB100A	177687	08 May 2020	36
M2002	Thermohygrometer	Testo	608-H1	45041825	22 Feb 2018	12

Test Equipment Used for Duty cycle Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	22 Feb 2018	12
K0002	3m RSE Chamber	Rainford	N/A	N/A	16 Nov 2017	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	21 Nov 2017	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	09 Nov 2017	12
A1818	Antenna	EMCO	3115	00075692	08 Nov 2017	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	28 Feb 2018	12

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	22 Feb 2018	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	14 Apr 2018	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	11 Apr 2018	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	13 Apr 2018	12
A2903	Antenna	Schwarzbeck	VULB 9163	9163-944	22 Aug 2017	12
A2971	Low Pass Filter	AtlanTecRF	AFL-02000	15062902845	06 Mar 2018	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	03 Mar 2018	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	06 Mar 2018	12
A2891	Preamplifier	Schwarzbeck	BBV 9718	9718-306	11 Apr 2018	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	11 Apr 2018	12
A2893	Preamplifier	Schwarzbeck	BBV 9721	9721-021	11 Apr 2018	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	11 Apr 2018	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	11 Apr 2018	12
A2947	High Pass Filter	AtlanTecRF	AFH-07000	160190001	06 Mar 2018	12

Test Equipment Used for Transmitter Band Edge Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	JM Handelspunkt	608-H1	45046641	22 Feb 2018	12
K0017	3m RSE Chamber	Rainford	N/A	N/A	14 Apr 2018	12
A2863	Amplifier	Hewlett Packard	8449B	3008A02100	11 Apr 2018	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	13 Apr 2018	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	03 Mar 2018	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	11 Apr 2018	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	22 Feb 2018	12
K0002	3m RSE Chamber	Rainford	N/A	N/A	16 Nov 2017	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	21 Nov 2017	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	09 Nov 2017	12
A1818	Antenna	EMCO	3115	00075692	08 Nov 2017	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	28 Feb 2018	12

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Apple Inc.
Model Name or Number:	A1842
Test Sample Serial Number:	C07TK02MJ4C7 (<i>Radiated sample #1</i>)
Hardware Version:	EVT
Software Version:	15J42500h
FCC ID:	BCGA1842

Brand Name:	Apple Inc.
Model Name or Number:	A1842
Test Sample Serial Number:	C02TK026J4C7 (<i>Radiated sample #2</i>)
Hardware Version:	EVT
Software Version:	15J42500h
FCC ID:	BCGA1842

Brand Name:	Apple Inc.
Model Name or Number:	A1842
Test Sample Serial Number:	C07TK00VJ4CM (<i>Conducted sample with RF port</i>)
Hardware Version:	EVT
Software Version:	15J42500h
FCC ID:	BCGA1842

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: LE	1 Ms/s		
Data Rate: LE 2M	2 Ms/s		
Power Supply Requirement(s):	Nominal	120 VAC 60 Hz	
Maximum Conducted Output Power:	20.7 dBm		
Transmit Frequency Range:	2402 MHz to 2480 MHz		
Transmit Channels Tested:	Channel ID	RF Channel	Channel Frequency (MHz)
	Bottom	0	2402
	Middle	19	2440
	Top	39	2480

3.4. Description of Available Antennas

The radio utilizes an integrated antenna, with the following maximum gain:

Frequency Range (MHz)	Antenna Gain (dBi)
2400-2480	-0.10

3.5. Description of Test Setup

Support Equipment

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

Description:	Goldeneye Adaptor
Brand Name:	Goldeneye
Model Name or Number:	X892
Serial Number:	Not marked or stated

Description:	USB to lightning cable
Brand Name:	Apple
Model Name or Number:	Kanzi
Serial Number:	316D67

Description:	Laptop PC
Brand Name:	Apple
Model Name or Number:	Macbook Pro
Serial Number:	C2QRC0BGQCT

Description:	HDMI Cable. Length 1.8 metres
Brand Name:	Apple
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Multi Media player adaptor
Brand Name:	Sumvision
Model Name or Number:	Cyclone Micro
Serial Number:	UL VS LTD Asset No. A1986

Description:	Power Cable. Length 1.8 metres.
Brand Name:	Apple
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Description:	Ethernet Cable. Length 2.0 metres.
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

Support Equipment (continued)

Description:	Ethernet Hub
Brand Name:	Netgear
Model Name or Number:	GS605
Serial Number:	1YG19430021A1

Operating Modes

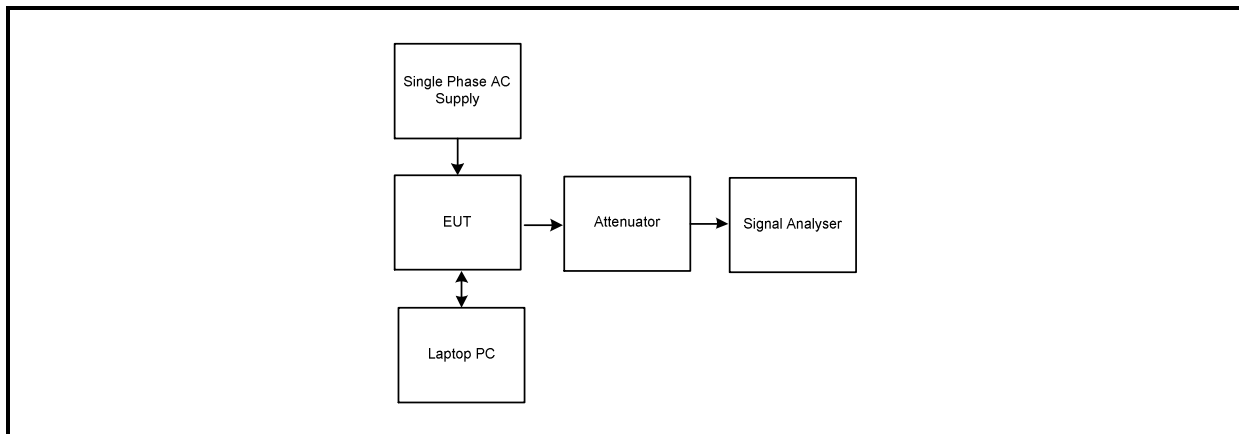
The EUT was tested in the following operating mode(s):

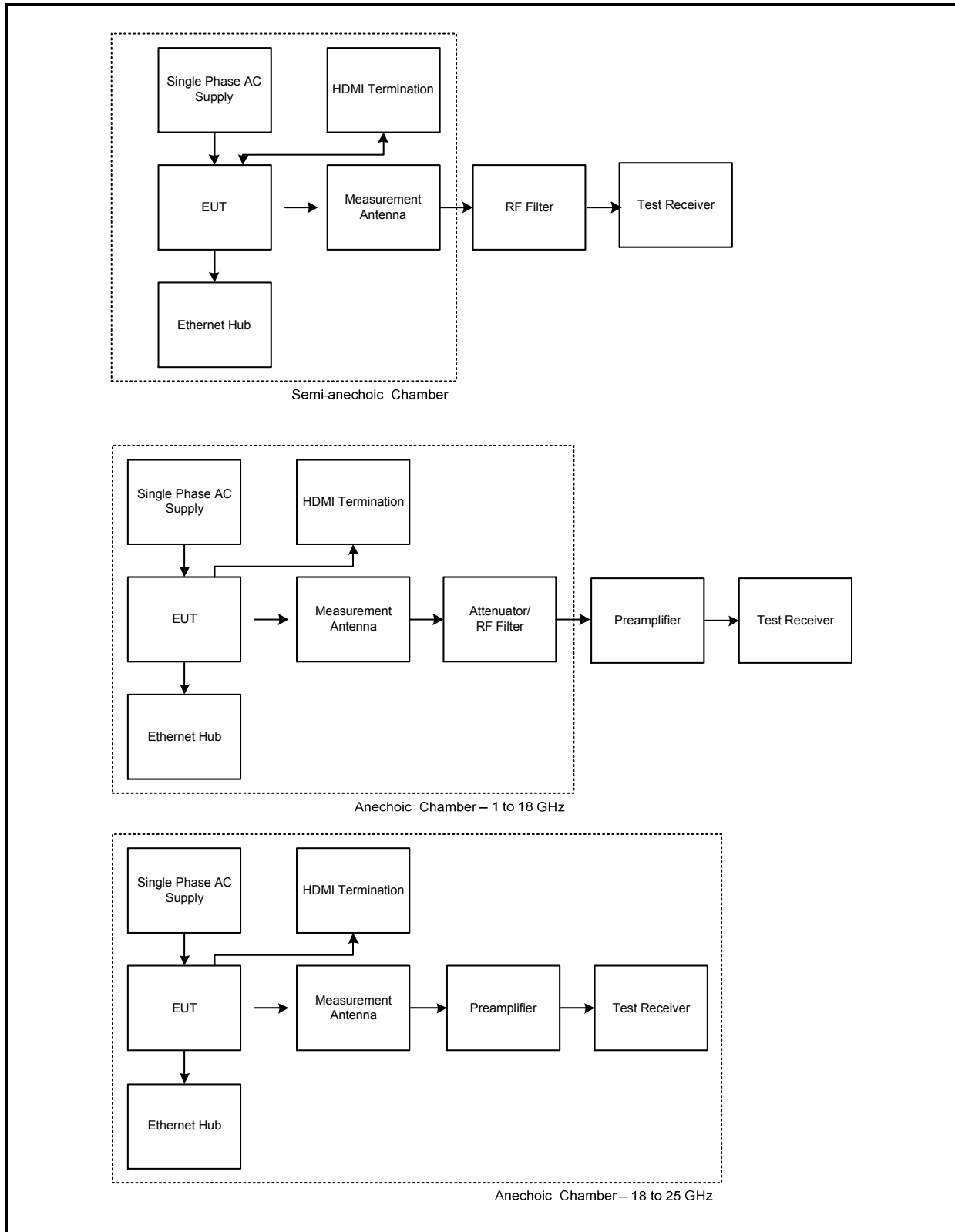
- Transmitting at maximum power in *Bluetooth* LE mode with modulation, maximum possible data length available and Pseudorandom Bit Sequence 9.
- Transmitting at maximum power in *Bluetooth* LE 2M mode with modulation, maximum possible data length available and Pseudorandom Bit Sequence 9.

Configuration and Peripherals

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

- Controlled in test mode using a software application on the laptop PC supplied by the customer. 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 'EUT_setup_v3.2.docx'. The laptop PC was connected to the EUT via a Goldeneye adaptor and USB to lightning cable.
- Transmitter radiated spurious emissions tests were performed with the EUT transmitting in LE 2M mode as this was found to transmit the highest power and had the widest bandwidth.
- All tests were performed with the EUT configured as ePA (High Power Mode).
- During radiated emissions tests, the HDMI port was terminated into a Cyclone multimedia player adaptor. Once placed in test mode, the Goldeneye adaptor and USB to lightning cable were removed and replaced with an Ethernet cable terminated into an Ethernet hub.
- The EUT was powered from a 120 VAC 60 Hz single phase mains supply.

Test Setup Diagrams**Conducted Tests:****Test Setup for Transmitter Minimum 6 dB Bandwidth, Duty Cycle, Power Spectral Density & Maximum Peak Output Power**

Radiated Tests:**Test Setup for Transmitter Radiated Emissions**

4. Antenna Port Test Results

4.1. Transmitter Minimum 6 dB Bandwidth

Test Summary:

Test Engineer:	Stefan Ho	Test Date:	20 June 2017
Test Sample Serial Number:	C07TK00VJ4CM		

FCC Reference:	Part 15.247(a)(2)
Test Method Used:	FCC KDB 558074 Section 8.1 Option 1

Environmental Conditions:

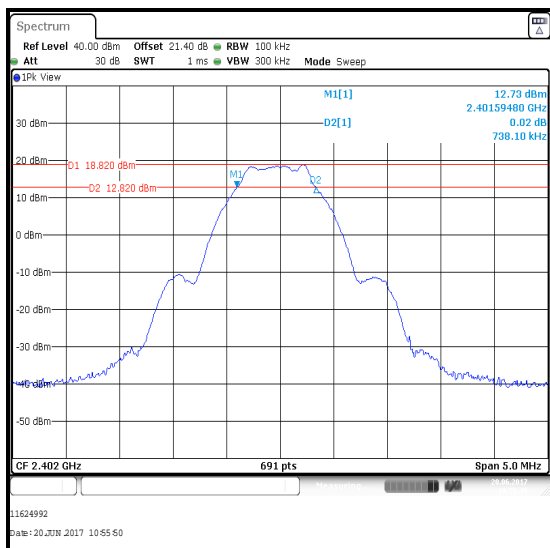
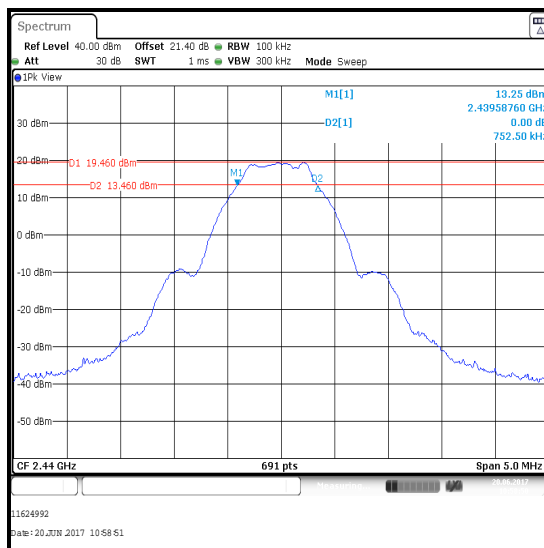
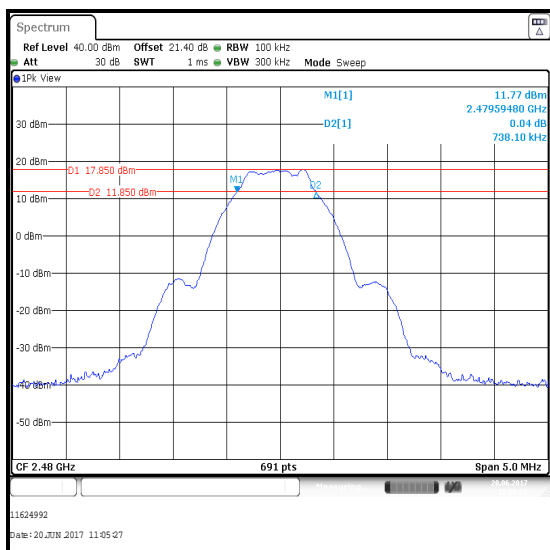
Temperature (°C):	21
Relative Humidity (%):	48

Note(s):

1. 6 dB DTS bandwidth tests were performed using a signal analyser in accordance with FCC KDB 558074 Section 8.1 Option 1 measurement procedure. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The DTS bandwidth was measured at 6 dB down from the peak of the signal.
2. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

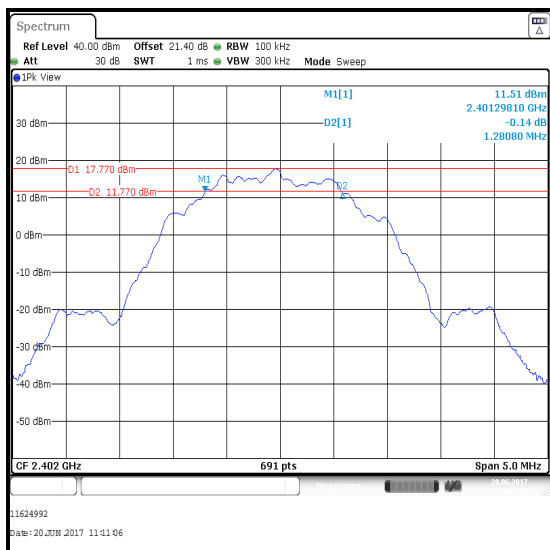
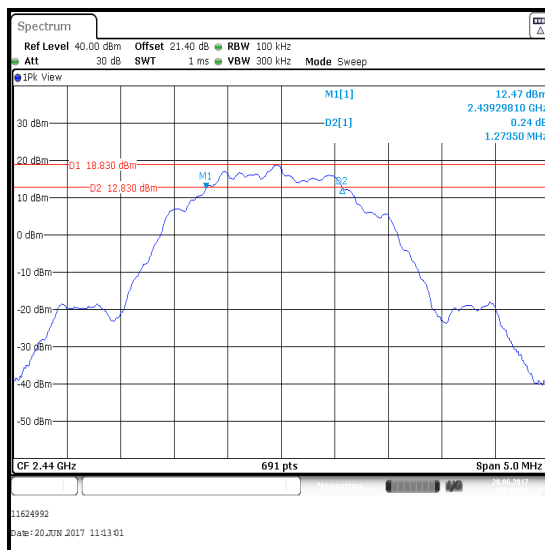
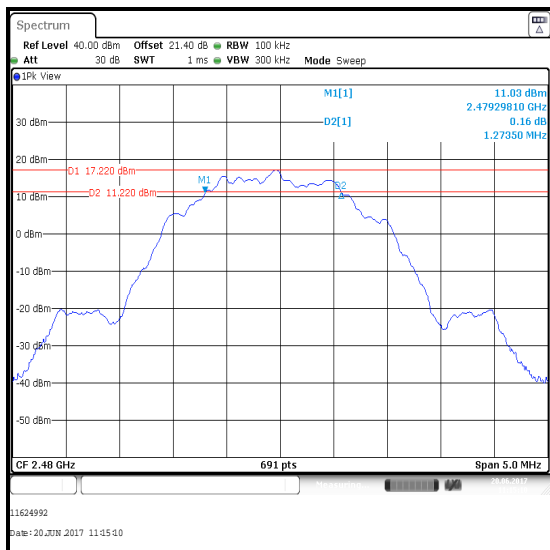
Transmitter Minimum 6 dB Bandwidth (continued)**Results: LE**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	738.100	≥500	238.100	Complied
Middle	752.500	≥500	252.500	Complied
Top	738.100	≥500	238.100	Complied

**Bottom Channel****Middle Channel****Top Channel**

Transmitter Minimum 6 dB Bandwidth (continued)**Results: LE 2M**

Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	1280.080	≥500	780.080	Complied
Middle	1273.500	≥500	773.500	Complied
Top	1273.500	≥500	773.500	Complied

**Bottom Channel****Middle Channel****Top Channel**

4.2. Transmitter Duty Cycle

Test Summary:

Test Engineer:	David Doyle	Test Date:	25 July 2017
Test Sample Serial Number:	C07TK02MJ4C7		

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

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	44

Note(s):

- In order to assist with the determination of the average level of spurious emissions field strength in LE 2M mode, measurements were made of duty cycle to determine the transmission duration and the silent period time of the transmitter. The transmitter duty cycle was measured using a spectrum analyser in the time domain and calculated by using the following calculation:

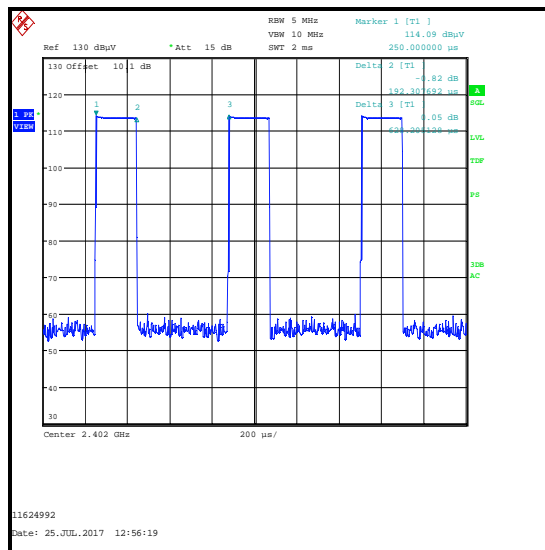
$$10 \log (1 / (\text{On Time} / [\text{Period or } 100 \text{ ms whichever is the lesser}])).$$

$$\text{LE 2M duty cycle: } 10 \log (1 / (192.308 \mu\text{s} / 638.305 \mu\text{s})) = 5.2 \text{ dB}$$

- The LE mode duty cycle was measured and found to be greater than 98%. No duty cycle correction is required.

Results: LE 2M

Pulse Duration (μs)	Period (μs)	Duty Cycle (dB)
192.308	638.305	5.2



4.3. Transmitter Maximum Peak Output Power**Test Summary:**

Test Engineer:	Stefan Ho	Test Date:	20 June 2017
Test Sample Serial Number:	C07TK00VJ4CM		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	FCC KDB 558074 Section 9.1.1 and Notes below

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	60

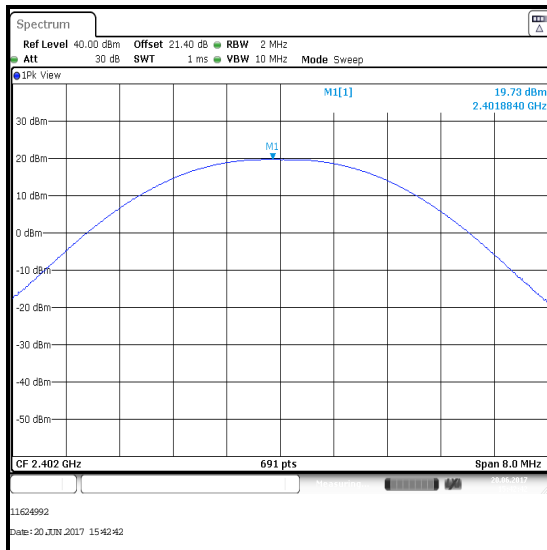
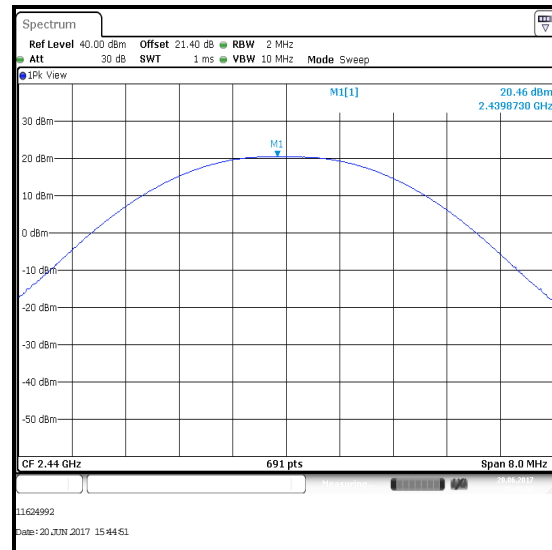
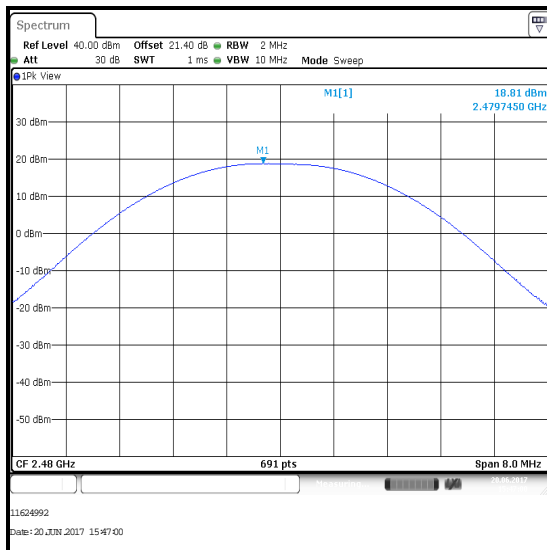
Note(s):

1. Conducted power tests were performed using a signal analyser in accordance with FCC KDB 558074 Section 9.1.1 with the RBW > *DTS bandwidth* procedure.
2. The signal analyser resolution bandwidth was set to 2 MHz and video bandwidth of 10 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The span was set to 8 MHz. A marker was placed at the peak of the signal and the results recorded in the tables below.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.
4. The conducted power was added to the declared antenna gain to obtain the EIRP.

Transmitter Maximum Peak Output Power (continued)**Results: LE**

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	19.7	30.0	10.3	Complied
Middle	20.5	30.0	9.5	Complied
Top	18.8	30.0	11.2	Complied

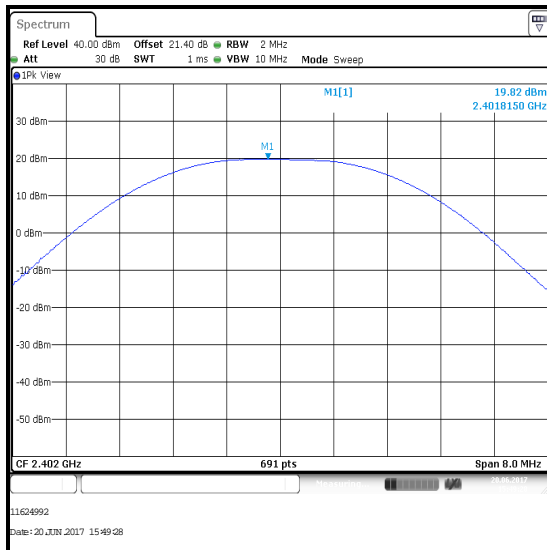
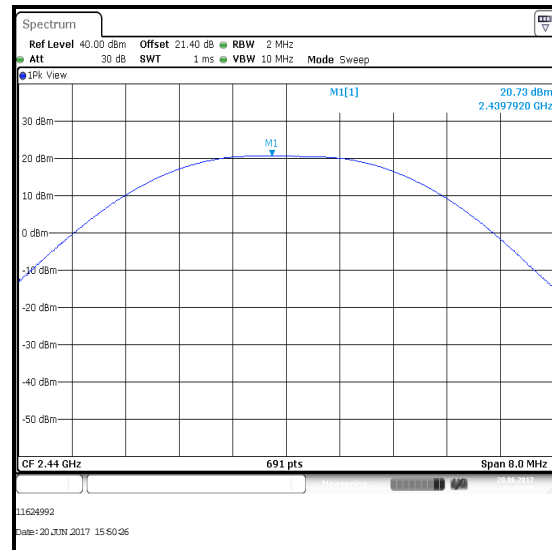
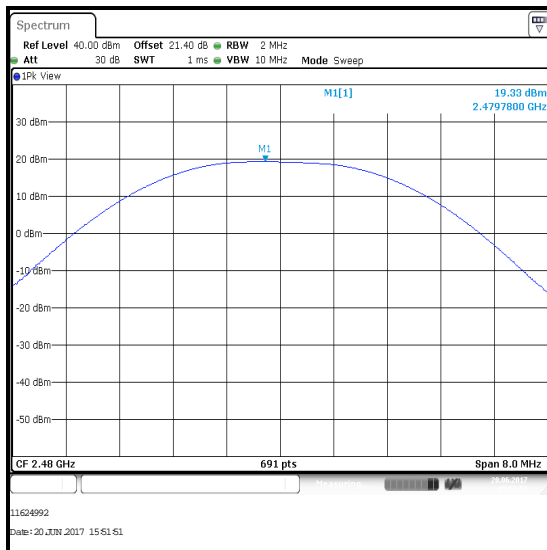
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	19.7	-0.1	19.6	36.0	16.4	Complied
Middle	20.5	-0.1	20.4	36.0	15.6	Complied
Top	18.8	-0.1	18.7	36.0	17.3	Complied

Transmitter Maximum Peak Output Power (continued)**Results: LE****Bottom Channel****Middle Channel****Top Channel**

Transmitter Maximum Peak Output Power (continued)**Results: LE 2M**

Channel	Conducted Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	19.8	30.0	10.2	Complied
Middle	20.7	30.0	9.3	Complied
Top	19.3	30.0	10.7	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	19.8	-0.1	19.7	36.0	16.3	Complied
Middle	20.7	-0.1	20.6	36.0	15.4	Complied
Top	19.3	-0.1	19.2	36.0	16.8	Complied

Transmitter Maximum Peak Output Power (continued)**Results: LE 2M****Bottom Channel****Middle Channel****Top Channel**

4.4. Transmitter Power Spectral Density

Test Summary:

Test Engineer:	Stefan Ho	Test Date:	20 June 2017
Test Sample Serial Number:	C07TK00VJ4CM		

FCC Reference:	Part 15.247(e)
Test Method Used:	FCC KDB 558074 Section 10.2

Environmental Conditions:

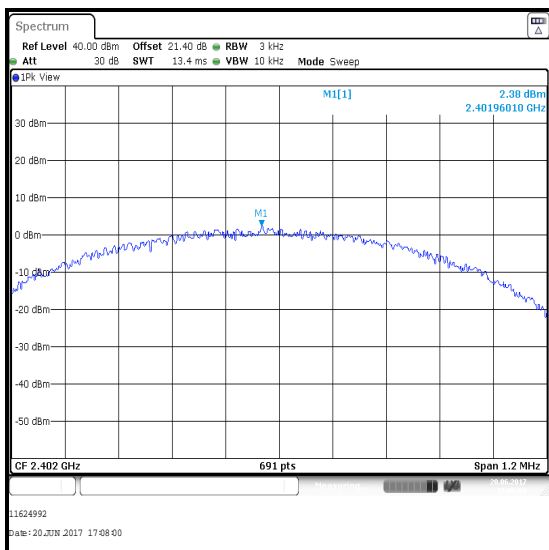
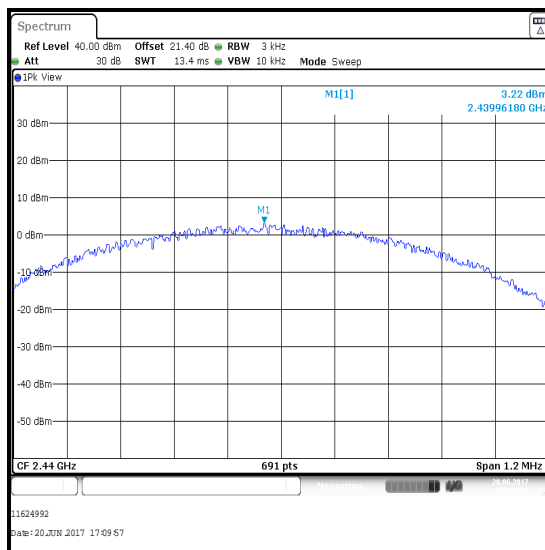
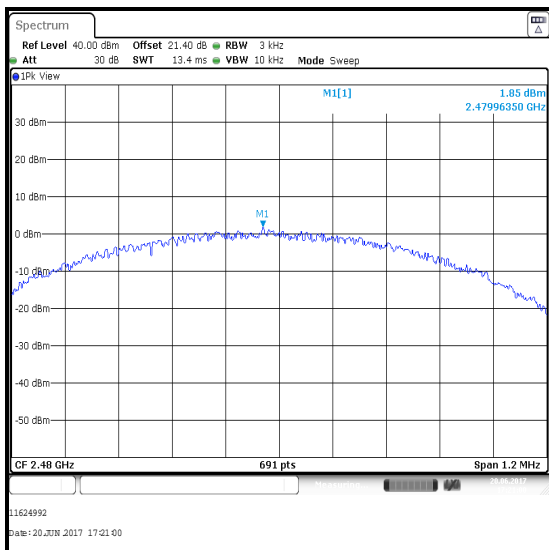
Temperature (°C):	23
Relative Humidity (%):	60

Note(s):

1. Transmitter Power Spectral Density tests were performed using a signal analyser in accordance with FCC KDB 558074 Section 10.2.
2. The signal analyser resolution bandwidth was set to 3 kHz and video bandwidth 10 kHz. A Peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 1.5 times the measured DTS bandwidth. A marker was placed at the peak of the signal and the results recorded in the table below.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the signal analyser to compensate for the loss of the attenuator and RF cable.

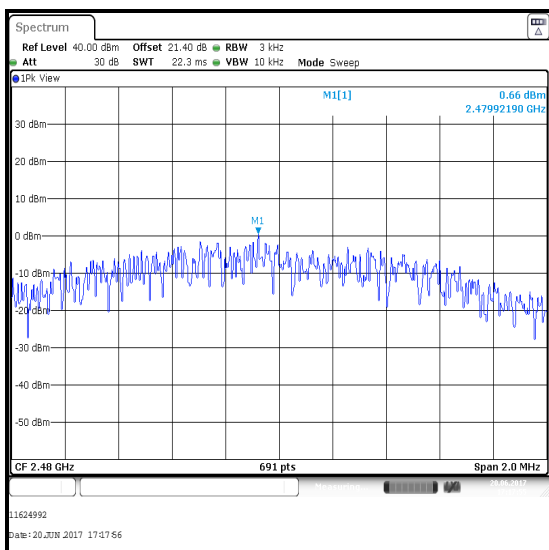
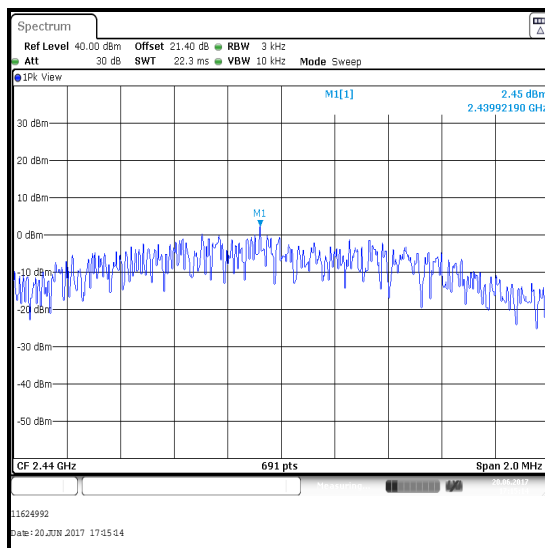
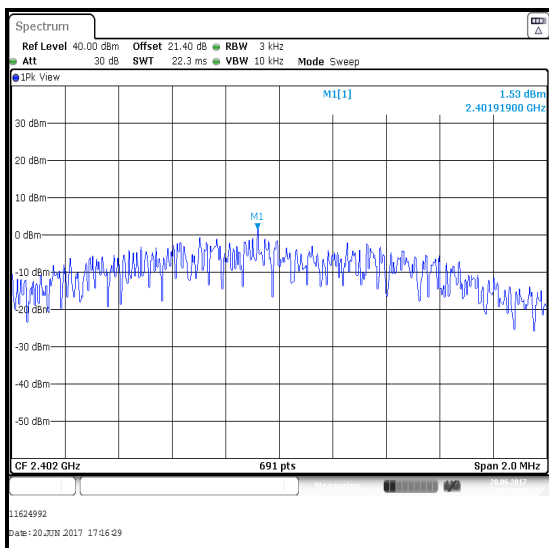
Transmitter Power Spectral Density (continued)**Results: LE**

Channel	Output Power (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	2.4	8.0	5.6	Complied
Middle	3.2	8.0	4.8	Complied
Top	1.9	8.0	6.1	Complied

**Bottom Channel****Middle Channel****Top Channel**

Transmitter Power Spectral Density (continued)**Results: LE 2M**

Channel	Output Power (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	1.5	8.0	6.5	Complied
Middle	2.5	8.0	5.5	Complied
Top	0.7	8.0	7.3	Complied



5. Radiated Test Results

5.1. Transmitter Radiated Emissions <1 GHz

Test Summary:

Test Engineer:	Doug Freegard	Test Date:	25 July 2017
Test Sample Serial Number:	C02TK026J4C7		

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

Environmental Conditions:

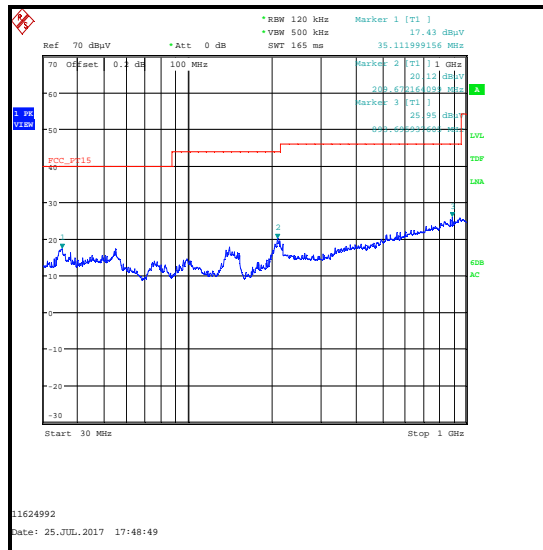
Temperature (°C):	25
Relative Humidity (%):	46

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. All emissions shown on the pre-scans were investigated and found to be ambient, or > 20 dB below the appropriate limit or below the noise floor of the measurement system. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
3. 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.
4. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth 500 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.

Transmitter Radiated Emissions (continued)**Results: Peak / Middle Channel / LE 2M**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
893.697	Vertical	30.0	54.0	24.0	Complied



5.2. Transmitter Radiated Emissions >1 GHz**Test Summary:**

Test Engineer:	Doug Freegard	Test Date:	25 July 2017
Test Sample Serial Number:	C02TK026J4C7		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	FCC KDB 558074 Sections 11 & 12 referencing ANSI C63.10 Sections 6.3 and 6.6
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	46

Note(s):

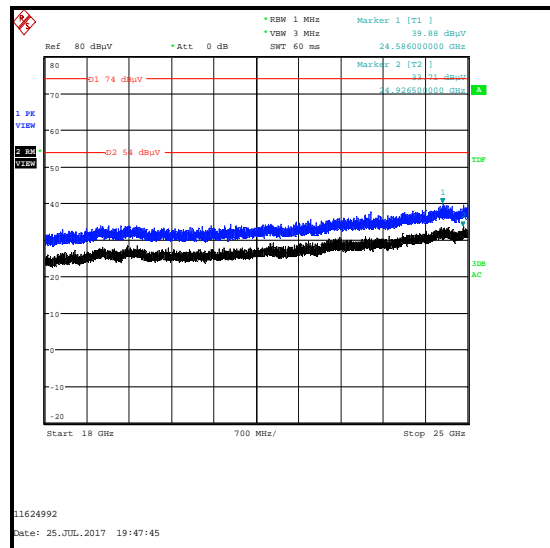
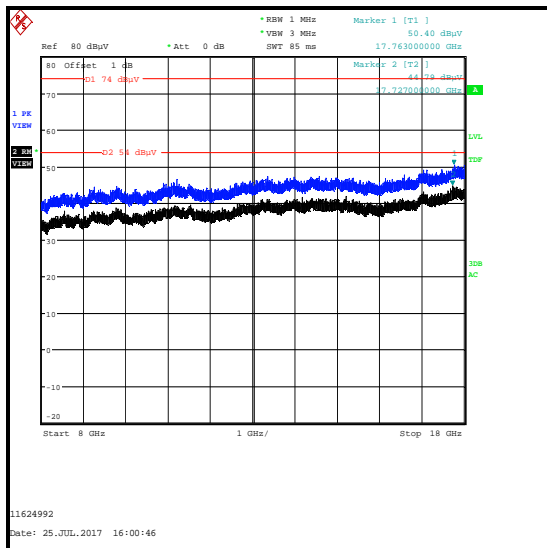
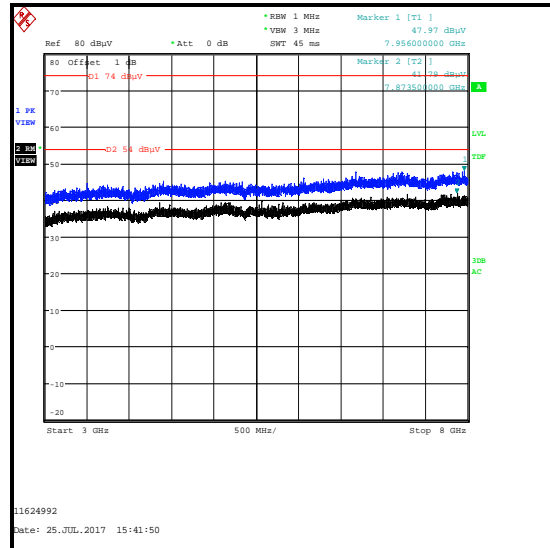
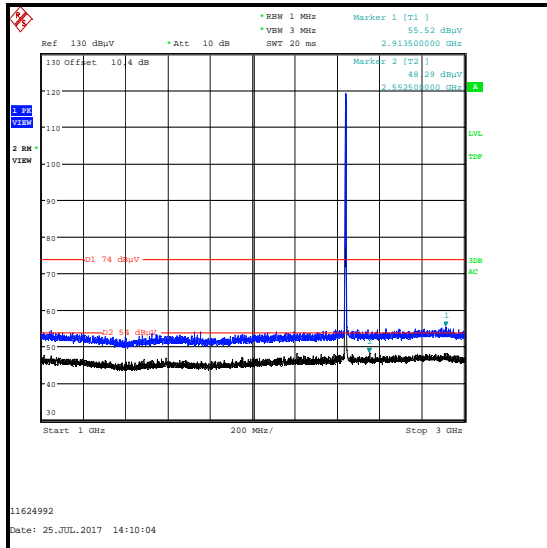
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The emission shown on the 1 GHz to 4 GHz plot is the EUT fundamental.
3. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak and average noise floor readings of the measuring receiver were recorded as shown in the tables below.
4. All other emissions shown on the pre-scans were investigated and found to be ambient, or > 20 dB below the appropriate limit or below the noise floor of the measurement system.
5. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.
6. Pre-scans were performed and a marker placed on the highest measured level of the appropriate plot. The test receiver resolution bandwidth was set to 1 MHz and video bandwidth 3 MHz. The sweep time was set to auto. Peak and average measurements were performed with their own appropriate detectors during the pre-scan measurements.

Results: Peak / Middle Channel / LE 2M

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
2913.500	Vertical	55.2	74.0	18.8	Complied

Results: Average / Middle Channel / LE 2M

Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
2552.500	Vertical	48.3	54.0	5.7	Complied

Transmitter Radiated Emissions (continued)

5.3. Transmitter Band Edge Radiated Emissions**Test Summary:**

Test Engineers:	John Ferdinand, Alan Withers & Andrew Edwards	Test Dates:	25 May 2017 to 25 July 2017
Test Sample Serial Number:	C07TK02MJ4C7		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	KDB 558074 Section 11, 12 & Notes below

Environmental Conditions:

Temperature (°C):	24 to 25
Relative Humidity (%):	42 to 44

Transmitter Band Edge Radiated Emissions (continued)**Note(s):**

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The maximum peak conducted output power was previously measured. In accordance with FCC KDB 558074 Section 11.1(a), the lower band edge measurement was performed with a peak detector and the -20 dBc limit applied.
3. As the lower band edge is adjacent to a non-restricted band, only peak measurements are required. In accordance with FCC KDB 558074 Section 11.1, the test method in Section 11.3 was followed: the test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. The test receiver was left to sweep for a sufficient length of time in order to maximise the carrier level and out-of-band emissions. A marker and corresponding reference level line were placed on the peak of the carrier. As the maximum peak conducted output power was measured using a peak detector in accordance with FCC KDB 558074 Section 9.1.1 an out-of-band limit line was placed 20 dB (FCC KDB 558074 Section 11.1(a)) below the peak level. A marker was placed on the band edge spot frequencies. Marker frequency and levels were recorded.
4. As the upper band edge is adjacent to a restricted band, both peak and average measurements were recorded by placing a marker at the edge of the band. For peak measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold. For average measurements the test receiver resolution bandwidth was set to 1 MHz and the video bandwidth 3 MHz. An RMS detector was used, sweep time was set to auto and trace mode was trace averaging over 300 sweeps. A marker was placed on the band edge spot frequencies and a second marker placed on the highest emission level in the adjacent restricted band of operation (where a higher level emission was present). Marker frequencies and levels were recorded.
5. There is a restricted band 10 MHz below the lower band edge. The test receiver was set up as follows: the RBW set to 1 MHz, the VBW set to 3 MHz, with the sweep time set to auto couple. Peak and average measurements were performed with peak and RMS detectors respectively. Markers were placed on the highest point on each trace.
6. * -20 dBc limit.
7. *The integration method was used in accordance with FCC KDB 558074 Section 13.3.2, in order to meet the average limit when transmitting in LE 2M mode. As the EUT had a duty cycle < 98% the duty cycle correction factor has been applied to the LE 2M upper band edge average result. The corrected level is shown below:

Integration method result + duty cycle = Corrected band edge level

Corrected band edge level at 2483.5 MHz : 45.4 + 5.2 = 50.6 dBμV/m

Transmitter Band Edge Radiated Emissions (continued)**Results: Peak / LE**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2400.000	Horizontal	57.1	95.3*	38.2	Complied
2483.500	Vertical	58.7	74.0	15.3	Complied

Results: Average / LE

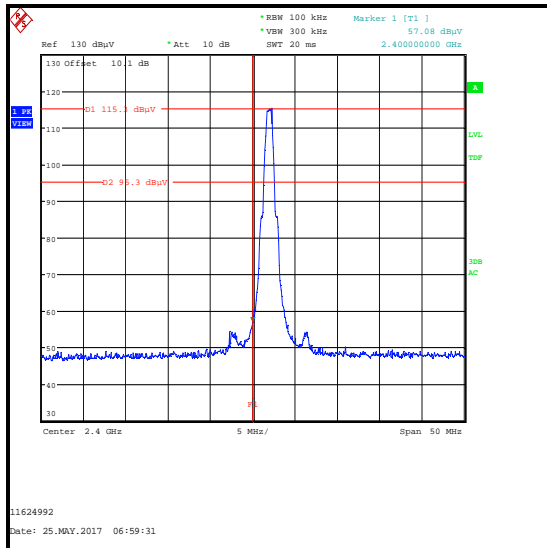
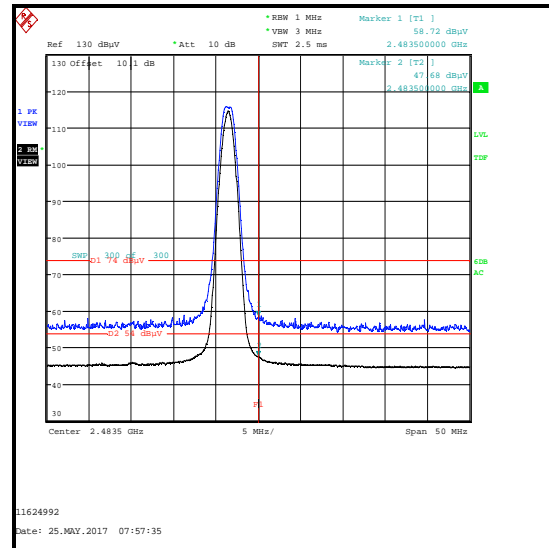
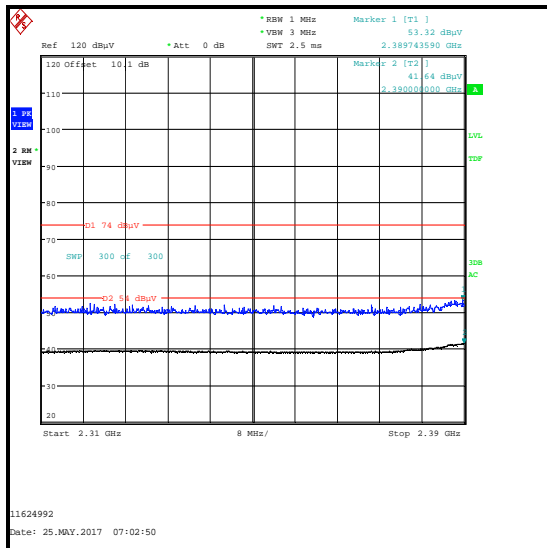
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.500	Vertical	47.7	54.0	6.3	Complied

Results: 2310 MHz to 2390 MHz Restricted Band / Peak / LE

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2389.744	Horizontal	53.3	74.0	20.7	Complied

Results: 2310 MHz to 2390 MHz Restricted Band / Average / LE

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2390.000	Horizontal	41.6	54.0	12.4	Complied

Transmitter Band Edge Radiated Emissions (continued)**Results: LE****Lower Band Edge****Upper Band Edge****2310 MHz to 2390 MHz Restricted Band**

Transmitter Band Edge Radiated Emissions (continued)**Results: Peak / LE 2M**

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2400.000	Horizontal	85.0	98.5*	13.5	Complied
2483.500	Vertical	62.0	74.0	12.0	Complied
2483.821	Vertical	63.6	74.0	10.4	Complied

Results: Average / LE 2M

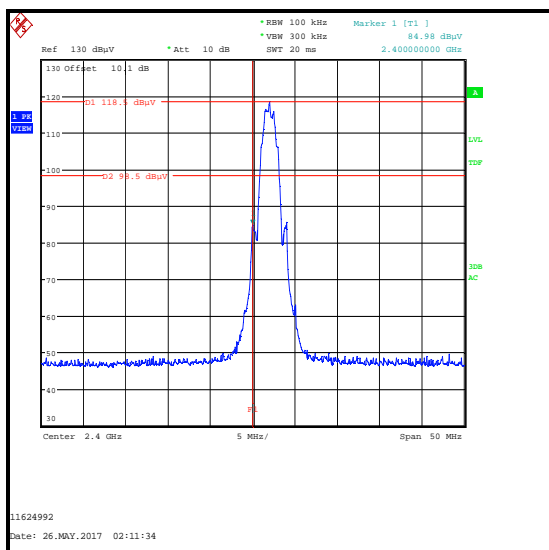
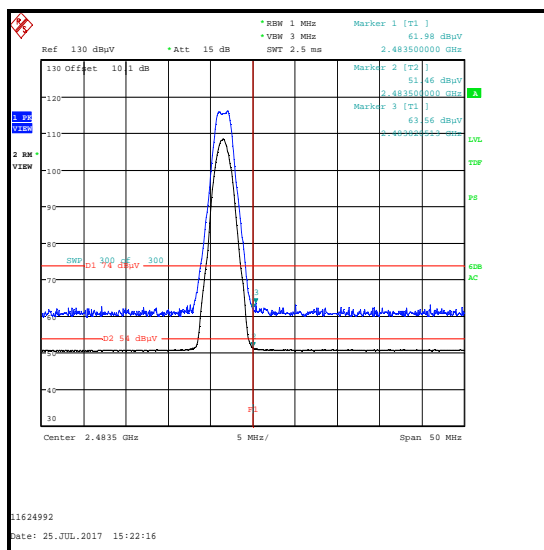
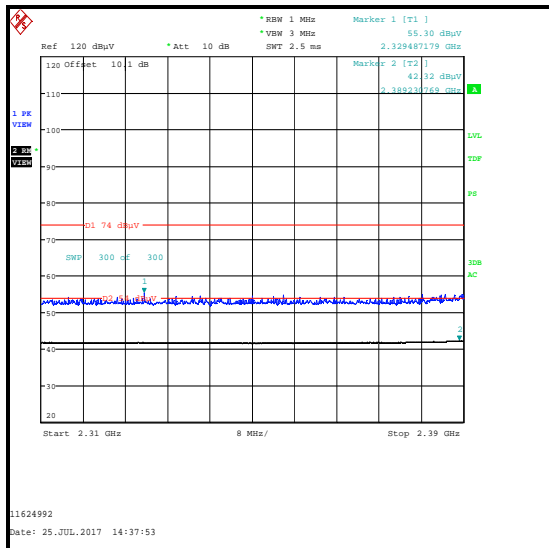
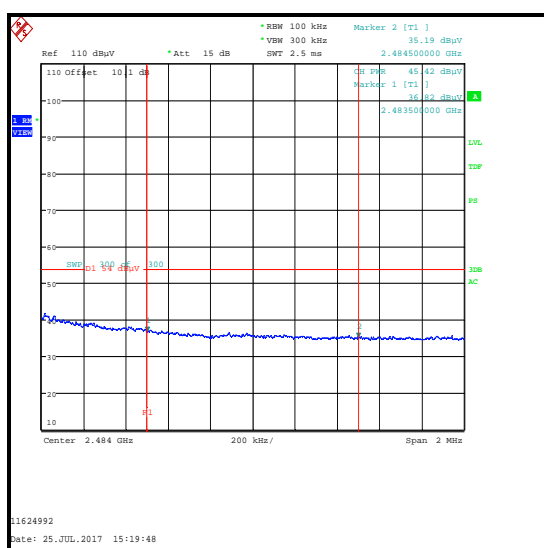
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Duty cycle correction (dB)	Corrected Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.500	Vertical	45.4	5.2	50.6	54.0	3.4	Complied

Results: 2310 MHz to 2390 MHz Restricted Band / Peak / LE 2M

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2329.487	Horizontal	55.3	74.0	18.7	Complied

Results: 2310 MHz to 2390 MHz Restricted Band / Average / LE 2M

Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Duty cycle correction (dB)	Corrected Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2389.231	Horizontal	45.4	5.2	47.5	54.0	6.5	Complied

Transmitter Band Edge Radiated Emissions (continued)**Results: LE 2M****Lower Band Edge****Upper Band Edge****2310 MHz to 2390 MHz Restricted Band****Upper Band Edge Average Measurement / Integration Method at 2483.5 MHz****--- END OF REPORT ---**