



# **TEST REPORT**

**Test Report No. :** UL-RPT-RP11624992JD08C V2.0

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

**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 1.0.

**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



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## **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**

<b>Version Number</b>	<b>Issue Date</b>	<b>Revision Details</b>	<b>Revised By</b>
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

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## **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**

<b>Specification Reference:</b>	47CFR15.247
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247
<b>Specification Reference:</b>	47CFR15.209
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209
<b>Test Dates:</b>	17 May 2017 to 25 July 2017

### **1.3. Summary of Test Results**

<b>FCC Reference (47CFR)</b>	<b>Measurement</b>	<b>Result</b>
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**

<b>Reference:</b>	ANSI C63.10-2013
<b>Title:</b>	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
<b>Reference:</b>	KDB 558074 D01 DTS Meas Guidance v04 April 5, 2017
<b>Title:</b>	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)**

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

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C07TK026J4C7 ( <i>Radiated sample #2</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	BCGA1842

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C02TK026J4C7 ( <i>Radiated sample #3</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	BCGA1842

<b>Brand Name:</b>	Apple Inc.
<b>Model Name or Number:</b>	A1842
<b>Test Sample Serial Number:</b>	C07TK00VJ4CM ( <i>Conducted sample with RF port</i> )
<b>Hardware Version:</b>	EVT
<b>Software Version:</b>	15J42500h
<b>FCC ID:</b>	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:	11.4 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:

<b>Frequency Range (MHz)</b>	<b>Antenna Gain (dBi)</b>
2400-2480	-0.10

### **3.5. Description of Test Setup**

#### **Support Equipment**

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

<b>Description:</b>	Goldeneye Adaptor
<b>Brand Name:</b>	Goldeneye
<b>Model Name or Number:</b>	X892
<b>Serial Number:</b>	Not marked or stated

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

<b>Description:</b>	Laptop PC
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Macbook Pro
<b>Serial Number:</b>	C2QRC0BGQCT

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

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

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

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

**Support Equipment (continued)**

<b>Description:</b>	Ethernet Hub
<b>Brand Name:</b>	Netgear
<b>Model Name or Number:</b>	GS605
<b>Serial Number:</b>	1YG19430021A1

### **Operating Modes**

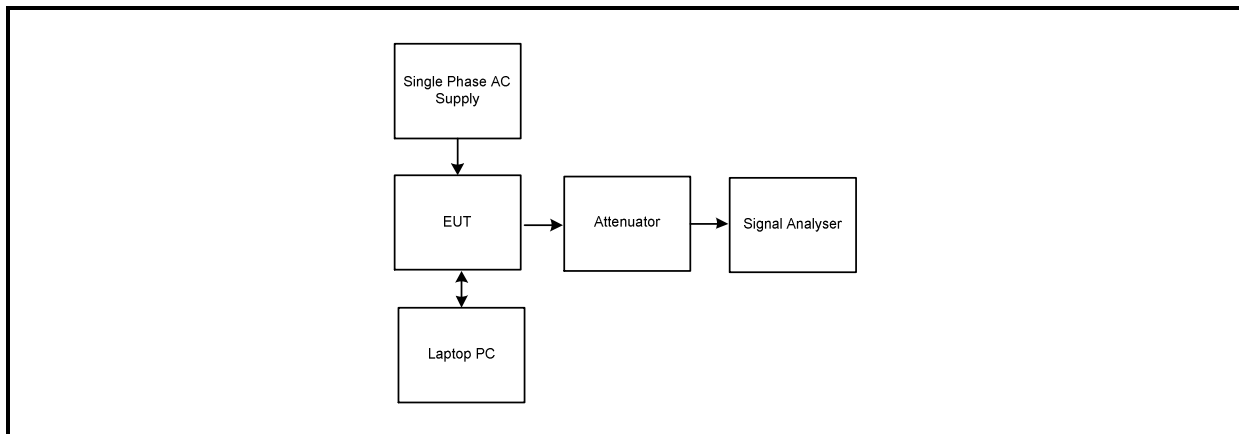
The EUT was tested in the following operating mode(s):

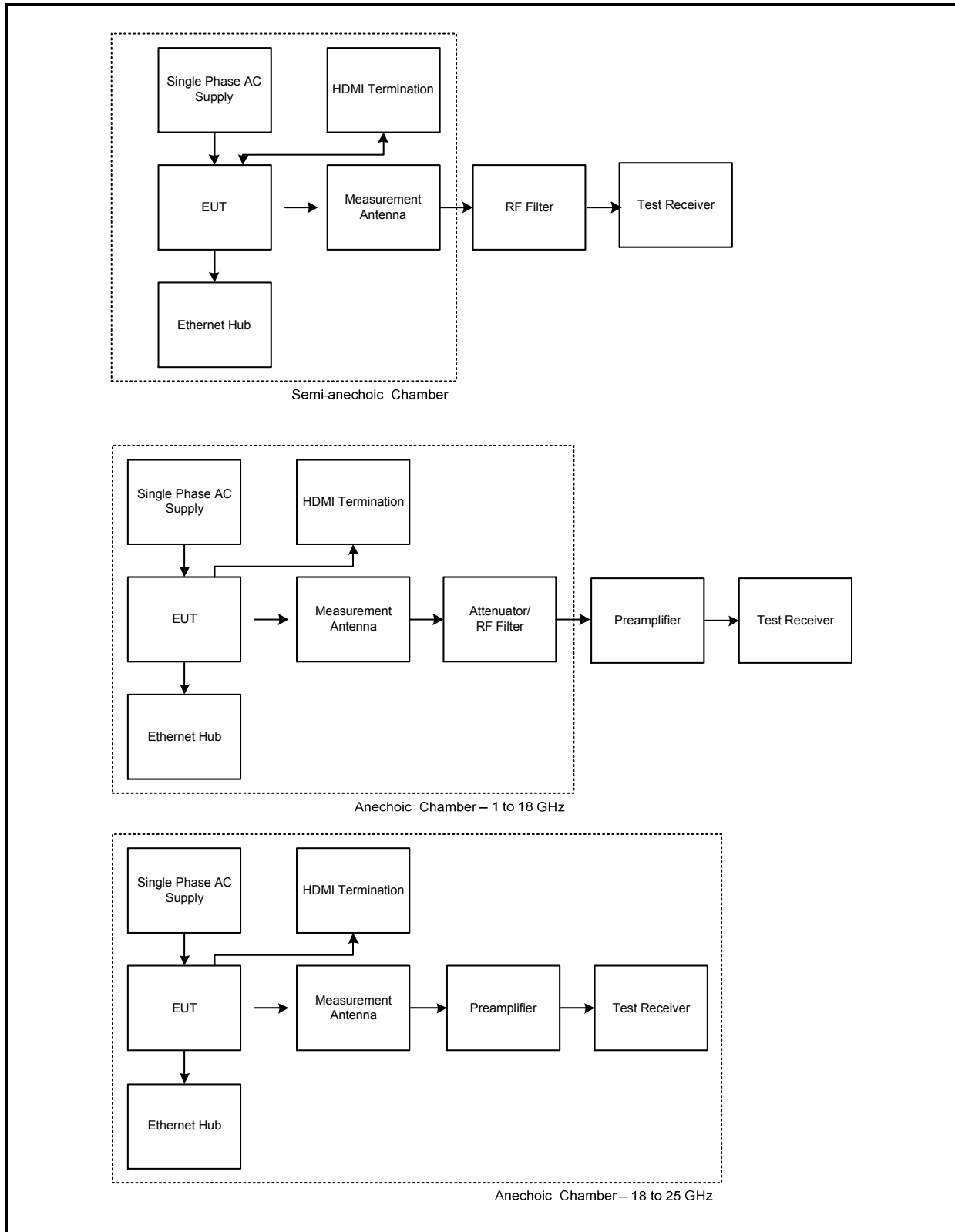
- Transmitting at maximum power in *Bluetooth* LE mode with modulation, maximum possible data length available and Pseudorandom Bit Sequence 9.
- Transmitting at maximum power in *Bluetooth* LE 2M mode with modulation, maximum possible data length available and Pseudorandom Bit Sequence 9.

### **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 mode was found to transmit similar maximum power to LE mode but had the widest bandwidth.
- Transmitter maximum output power, power spectral density, radiated spurious emissions and band edge tests were performed with the EUT configured in iPA mode (Low Power). All other tests were performed with the EUT configured in ePA mode (High Power).
- 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:**

<b>Test Engineer:</b>	Stefan Ho	<b>Test Date:</b>	20 June 2017
<b>Test Sample Serial Number:</b>	C07TK00VJ4CM		

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

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	21
<b>Relative Humidity (%):</b>	48

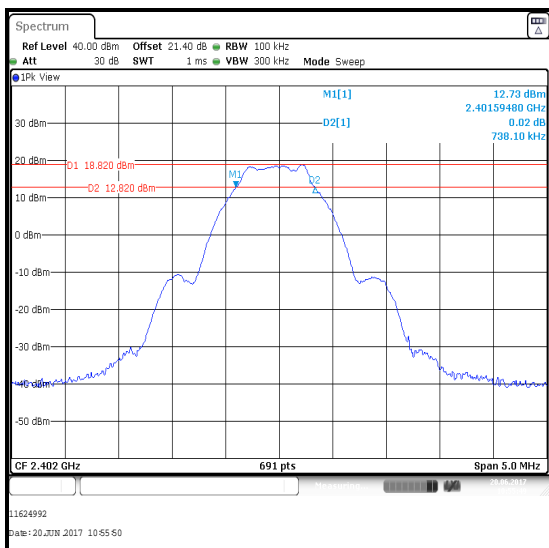
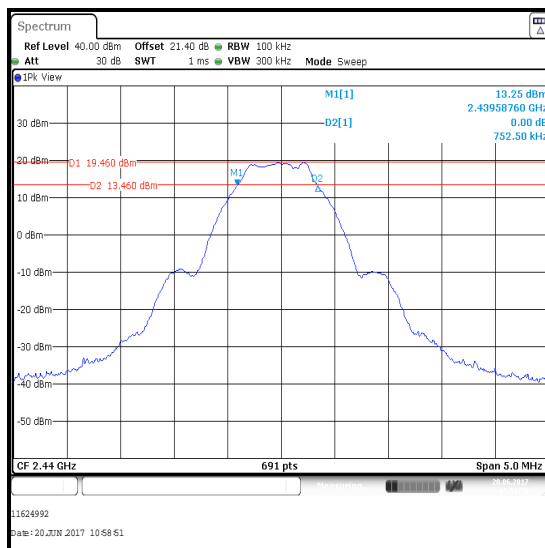
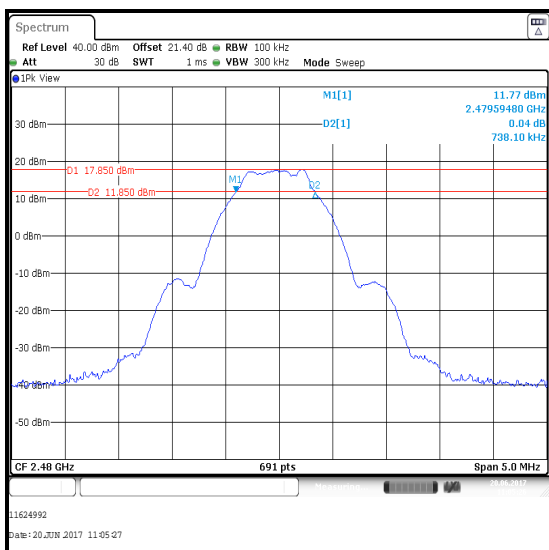
#### **Note(s):**

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.



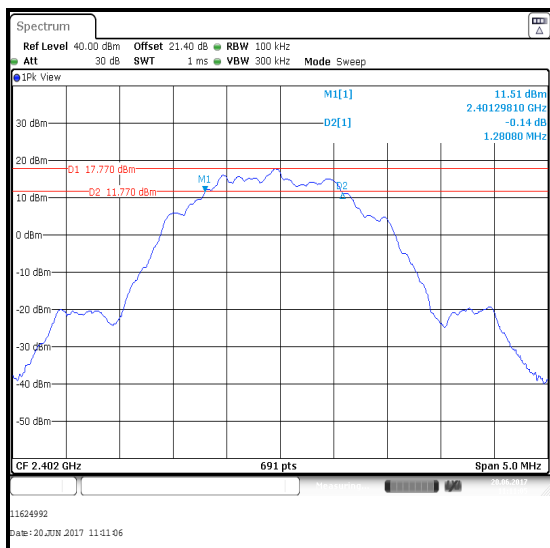
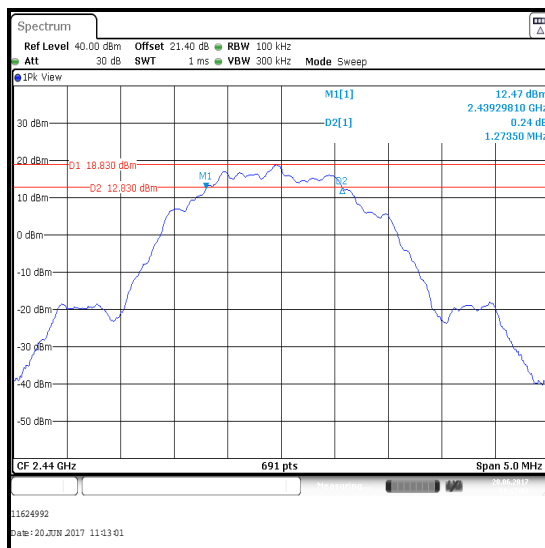
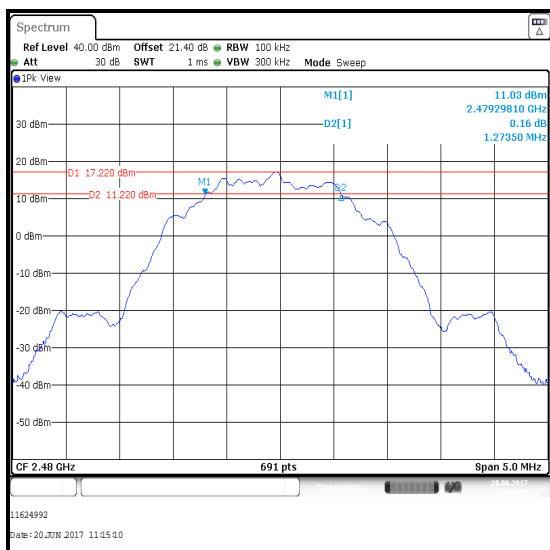
**Transmitter Minimum 6 dB Bandwidth (continued)****Results: LE**

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:

<b>Test Engineer:</b>	Andrew Edwards	<b>Test Date:</b>	25 July 2017
<b>Test Sample Serial Number:</b>	C07TK008J4C6		

<b>FCC Reference:</b>	Part 15.35(c)
<b>Test Method Used:</b>	FCC KDB 558074 Section 6.0

### Environmental Conditions:

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

**Note(s):**

1. 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:

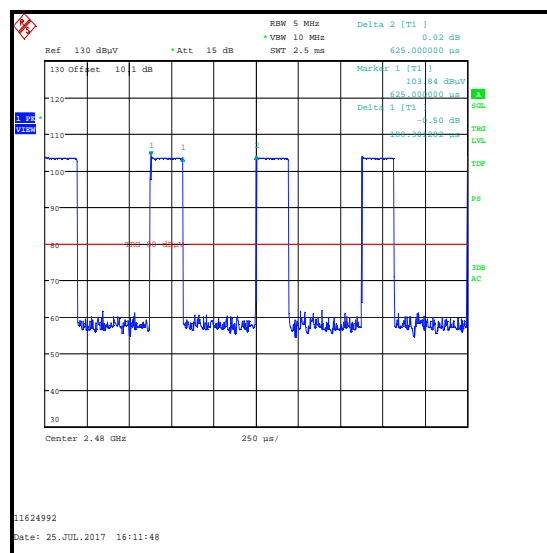
$$10 \log (1 / (\text{On Time} / [\text{Period or } 100 \text{ ms whichever is the lesser}])).$$

LE 2M duty cycle:  $10 \log (1 / (188.301 \mu s / 625.000 \mu s)) = 5.2 \text{ dB}$

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

### Results: LE2M

Pulse Duration ( $\mu\text{s}$ )	Period ( $\mu\text{s}$ )	Duty Cycle (dB)
188.301	625.000	5.2



### **4.3. Transmitter Maximum Peak Output Power**

#### **Test Summary:**

<b>Test Engineer:</b>	Stefan Ho	<b>Test Date:</b>	20 June 2017
<b>Test Sample Serial Number:</b>	C07TK00VJ4CM		

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

#### **Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	60

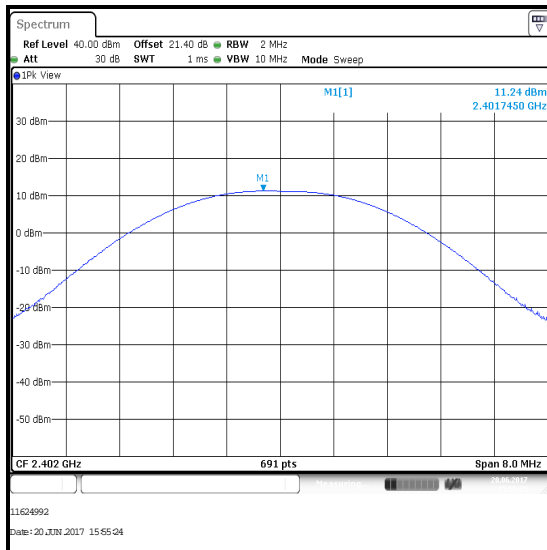
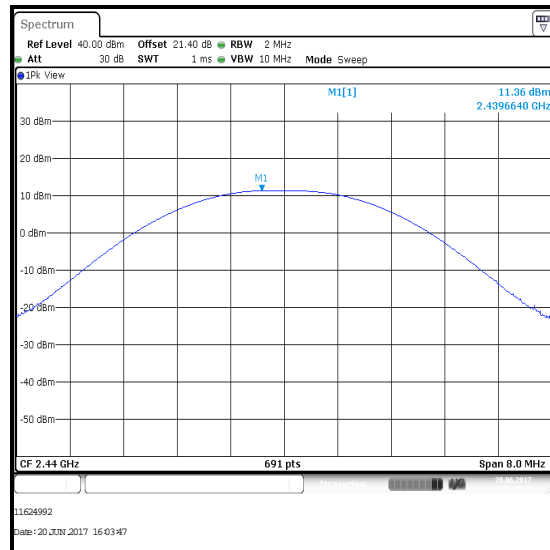
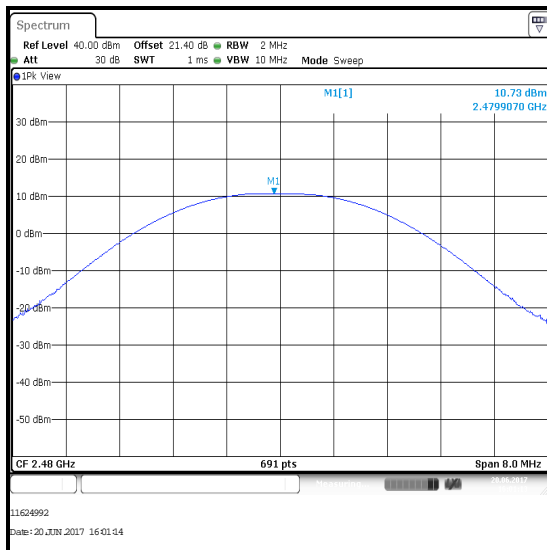
#### **Note(s):**

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	11.2	30.0	18.8	Complied
Middle	11.4	30.0	18.6	Complied
Top	10.7	30.0	19.3	Complied

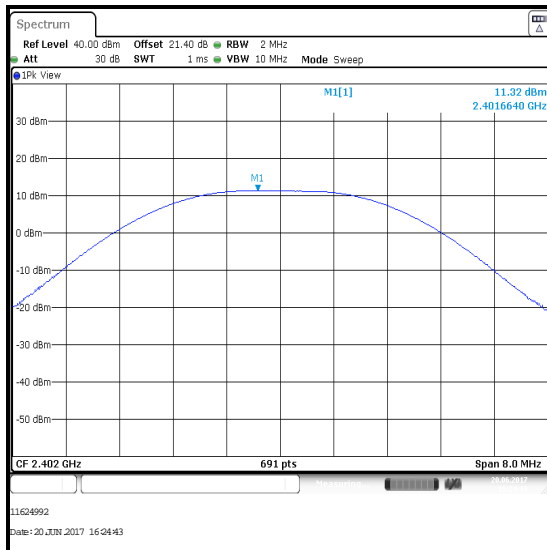
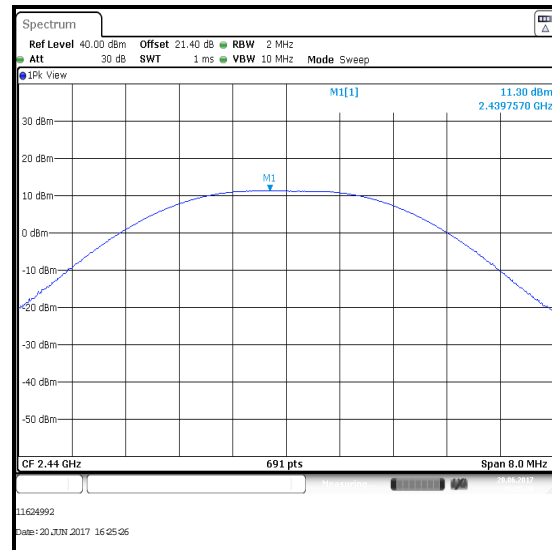
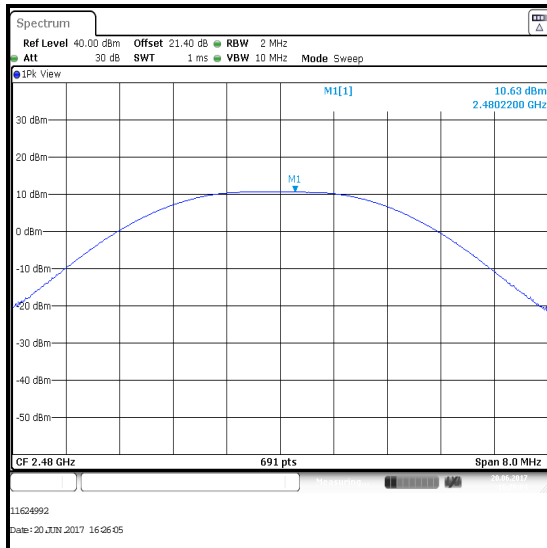
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.2	-0.1	11.1	36.0	24.9	Complied
Middle	11.4	-0.1	11.3	36.0	24.7	Complied
Top	10.7	-0.1	10.6	36.0	25.4	Complied

**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	11.3	30.0	18.7	Complied
Middle	11.3	30.0	18.7	Complied
Top	10.6	30.0	19.4	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	11.3	-0.1	11.2	36.0	24.8	Complied
Middle	11.3	-0.1	11.2	36.0	24.8	Complied
Top	10.6	-0.1	10.5	36.0	25.5	Complied

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



#### **4.4. Transmitter Power Spectral Density**

##### **Test Summary:**

<b>Test Engineer:</b>	Stefan Ho	<b>Test Date:</b>	20 June 2017
<b>Test Sample Serial Number:</b>	C07TK00VJ4CM		

<b>ISED Canada Reference:</b>	RSS-247 5.2(b)
<b>Test Method Used:</b>	ANSI C63.10 Section 11.10.2

##### **Environmental Conditions:**

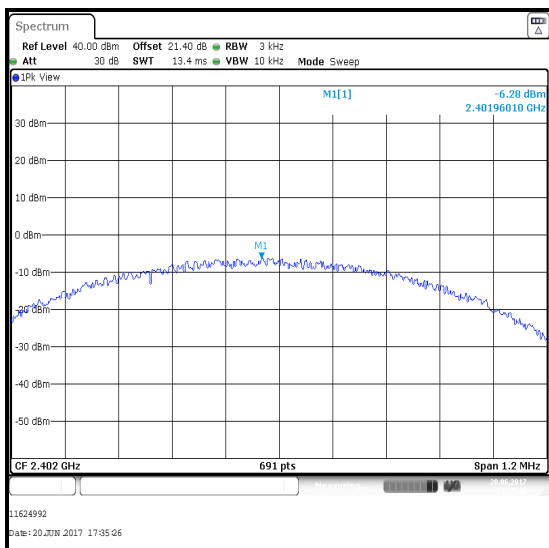
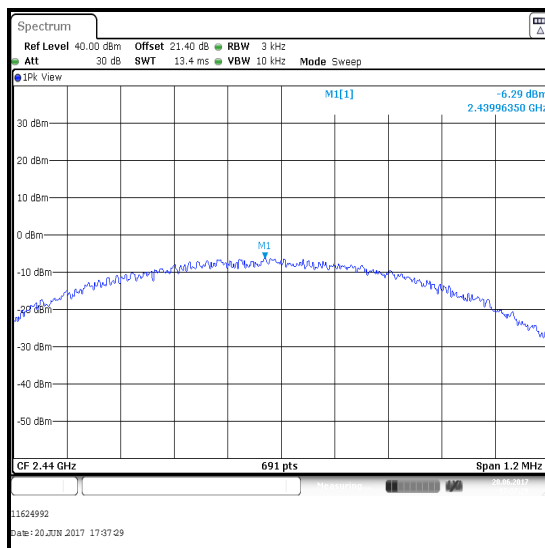
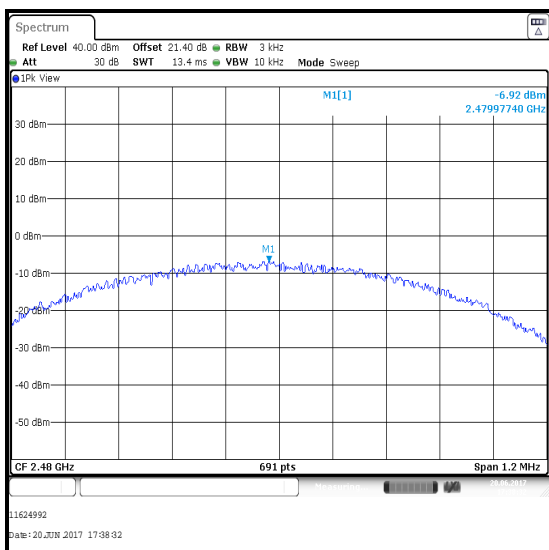
<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	60

##### **Note(s):**

1. Transmitter Power Spectral Density tests in all bands were performed using a spectrum analyser in accordance with ANSI C63.10 Section 11.10.2
2. The spectrum 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 spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the spectrum analyser to compensate for the loss of the attenuator and RF cable.

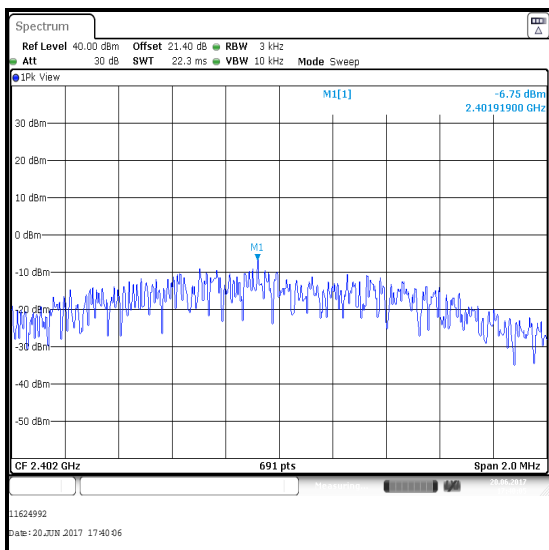
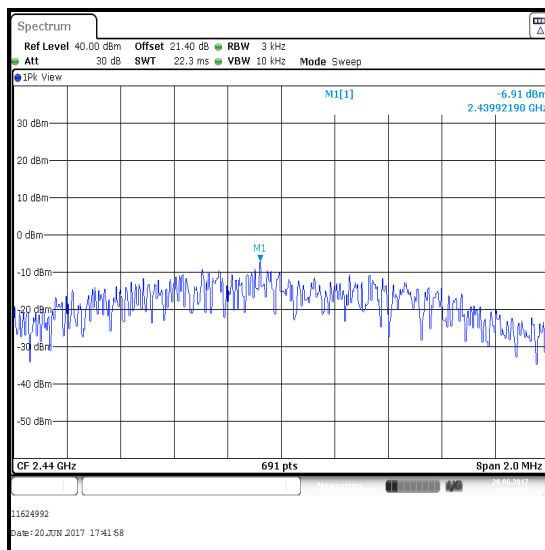
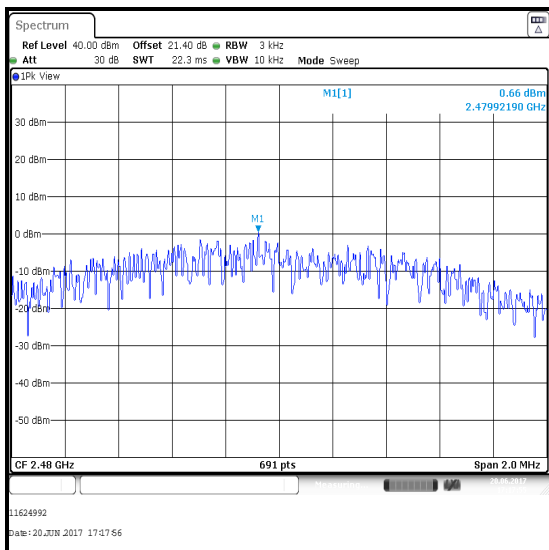
**Transmitter Power Spectral Density (continued)****Results: LE**

Channel	Output Power (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	-6.3	8.0	14.3	Complied
Middle	-6.3	8.0	14.3	Complied
Top	-6.9	8.0	14.9	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	-6.8	8.0	14.8	Complied
Middle	-6.9	8.0	14.9	Complied
Top	-7.4	8.0	15.4	Complied

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

## **5. Radiated Test Results**

### **5.1. Transmitter Radiated Emissions <1 GHz**

#### **Test Summary:**

<b>Test Engineer:</b>	Stuart Martin	<b>Test Date:</b>	23 July 2017
<b>Test Sample Serial Number:</b>	C02TK026J4C7		

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

#### **Environmental Conditions:**

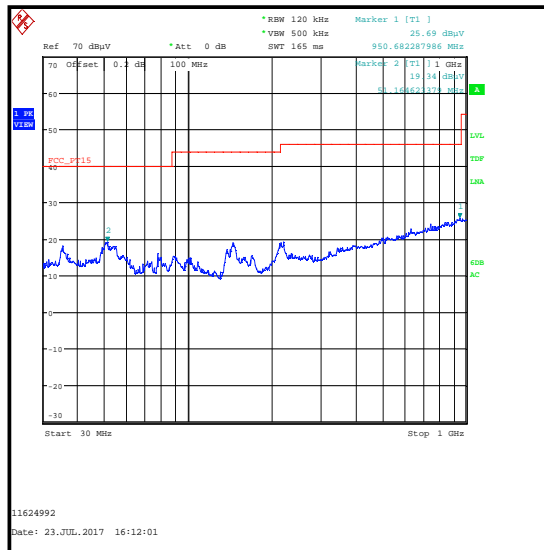
<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	48

#### **Note(s):**

1. Transmitter radiated spurious emissions tests were performed with the EUT transmitting in LE 2M mode as this was found to transmit similar power to LE mode but has a wider emission bandwidth and therefore deemed worst case.
2. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
3. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the middle channel only.
4. All emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the applicable limit or below the measurement system noise floor. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
5. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
6. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 120 kHz and video bandwidth 500 kHz. The sweep time was set to auto. 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 $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
950.682	Vertical	25.7	54.0	28.3	Complied



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

<b>Test Engineers:</b>	Stuart Martin & John Ferdinand	<b>Test Dates:</b>	11 May 2015 to 23 July 2017
<b>Test Sample Serial Numbers:</b>	C07TK026J4C7 & C02TK026J4C7		

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

**Environmental Conditions:**

<b>Temperature (°C):</b>	22 to 23
<b>Relative Humidity (%):</b>	44 to 48

**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 at 2440 MHz.
3. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak and average noise floor readings 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.

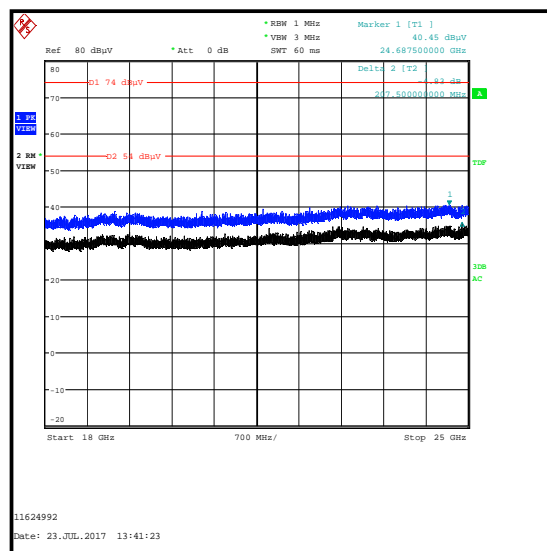
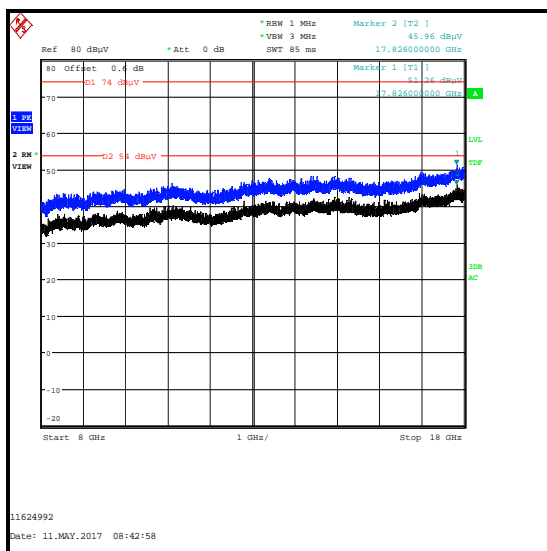
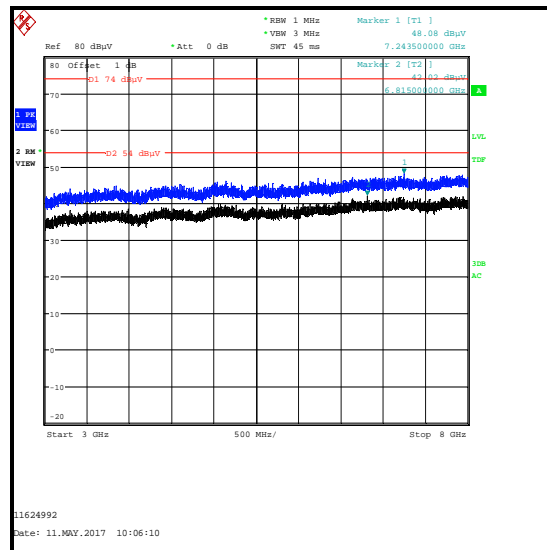
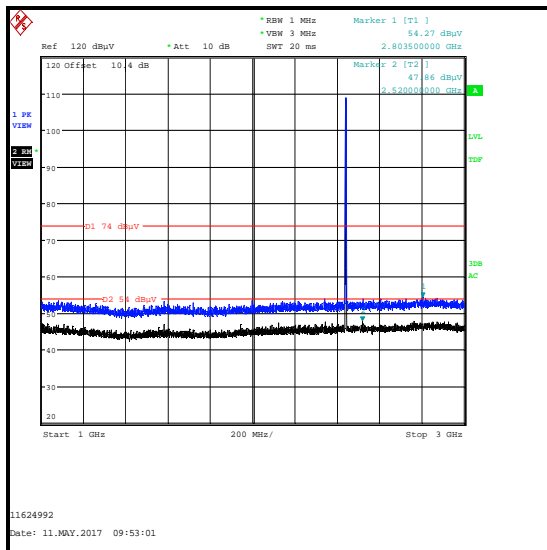
**Results: Peak / Middle Channel / LE 2M**

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)	Result
2803.500	Vertical	54.3	74.0	19.7	Complied

**Results: Average / Middle Channel / LE 2M**

Frequency (MHz)	Antenna Polarity	Average Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
2520.000	Vertical	47.9	54.0	6.1	Complied

## Transmitter Radiated Emissions (continued)



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

<b>Test Engineers:</b>	John Ferdinand & Andrew Edwards	<b>Test Dates:</b>	17 May 2017 to 25 July 2017
<b>Test Sample Serial Number:</b>	C07TK02MJ4C7 & C07TK008J4C6		

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

**Environmental Conditions:**

<b>Temperature (°C):</b>	24 to 25
<b>Relative Humidity (%):</b>	39 to 41



**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 : 41.9 + 5.2 = 47.1 dBμV/m*

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

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400.000	Horizontal	43.2	82.1*	38.9	Complied
2483.500	Horizontal	51.7	74.0	22.3	Complied
2483.534	Horizontal	51.8	74.0	22.2	Complied

**Results: Average / LE**

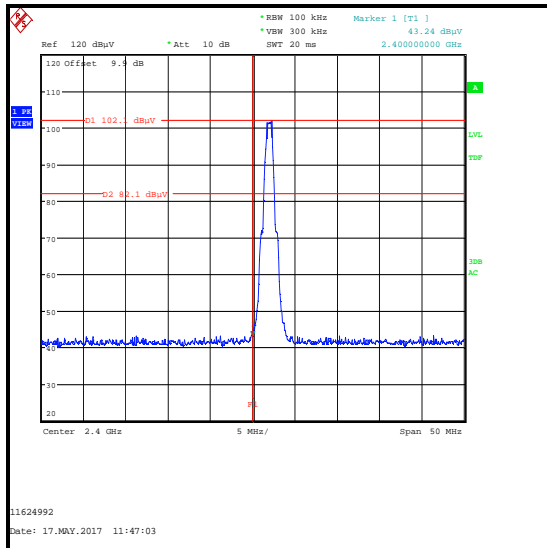
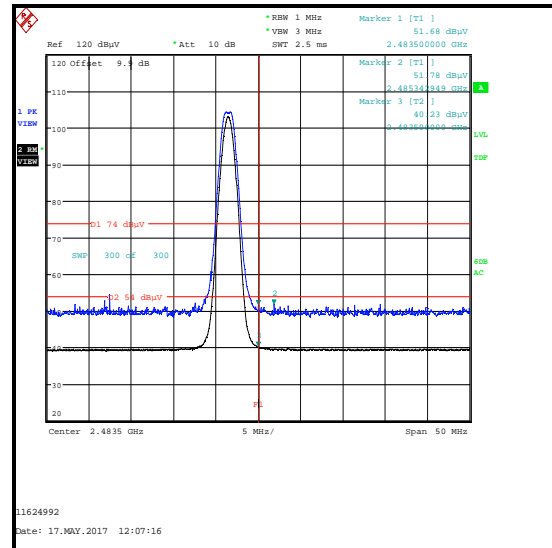
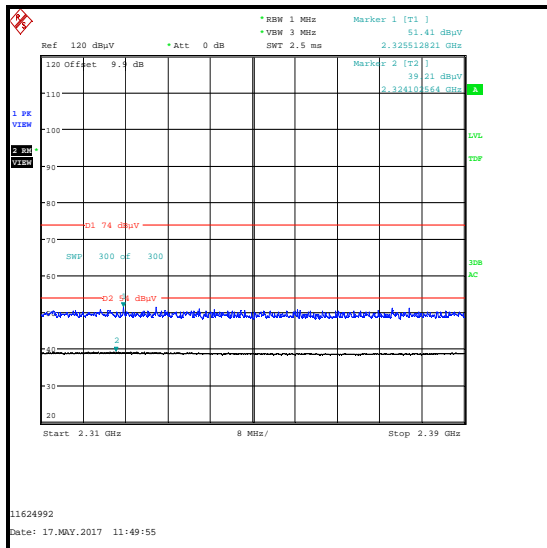
Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.500	Horizontal	40.2	54.0	13.8	Complied

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

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2325.513	Horizontal	51.4	74.0	22.6	Complied

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

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2324.103	Horizontal	39.2	54.0	14.8	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 $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2400.000	Horizontal	67.9	82.9*	15.0	Complied
2483.500	Horizontal	54.0	74.0	20.0	Complied

**Results: Average / LE 2M**

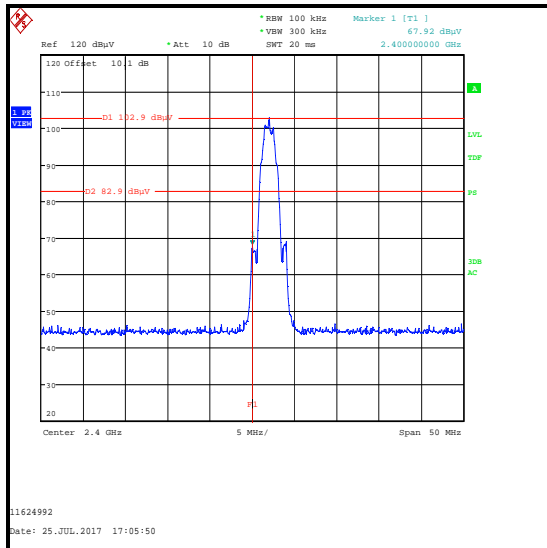
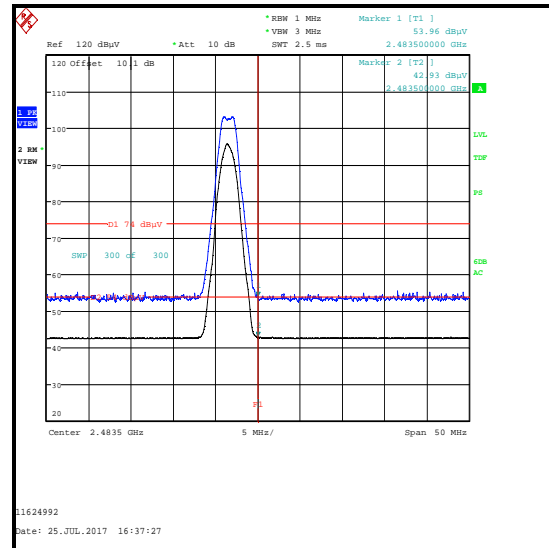
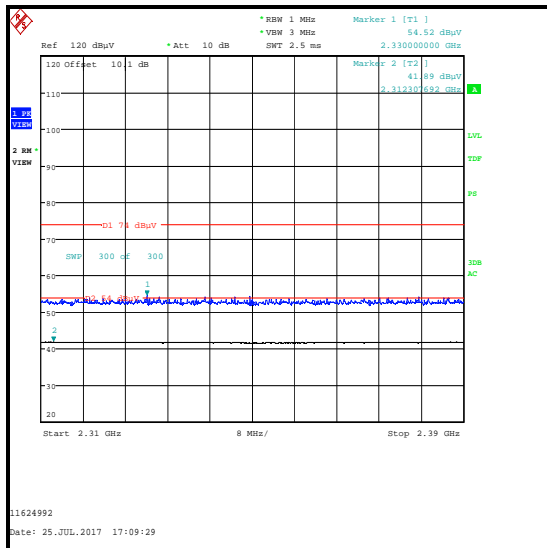
Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Duty cycle correction (dB)	Corrected Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2483.500	Horizontal	42.9	5.2	48.1	54.0	5.9	Complied

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

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2330.000	Horizontal	54.5	74.0	19.5	Complied

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

Frequency (MHz)	Antenna Polarity	Level (dB $\mu$ V/m)	Duty cycle correction (dB)	Corrected Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Result
2312.308	Horizontal	41.9	5.2	47.1	54.0	6.9	Complied

**Transmitter Band Edge Radiated Emissions (continued)****Results: LE 2M****Lower Band Edge****Upper Band Edge****2310 MHz to 2390 MHz Restricted Band****--- END OF REPORT ---**