



# TEST REPORT

**Test Report No. : UL-RPT-RP11241886JD07AD V3.0**

**Manufacturer** : Apple Inc.  
**Model No.** : A1779  
**FCC ID** : BCG-E3086A  
**Technology** : CDMA BC1  
**Test Standard(s)** : FCC Part 24 Subpart E

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 3.0 supersedes all previous versions.

**Date of Issue:** 03 August 2016

**Checked by:**

Ian Watch  
Senior Engineer, Radio Laboratory

**Company Signatory:**

Steven White  
Service Lead, Radio Laboratory  
UL VS LTD



This laboratory is accredited by UKAS.  
The tests reported herein have been  
performed in accordance with its terms  
of accreditation.

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## **1. Customer Information**

<b>Company Name:</b>	Apple Inc.
<b>Address:</b>	1 Infinite Loop Cupertino, CA 95014 U.S.A

## 2. Summary of Testing

### 2.1. General Information

<b>Specification Reference:</b>	47CFR24
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 24 Subpart E (Personal Communication Services)
<b>Site Registration:</b>	209735
<b>Location of Testing:</b>	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
<b>Test Dates:</b>	16 June 2016 to 26 July 2016

### 2.2. Summary of Test Results

FCC Reference	Measurement	Result
Part 24.232(c)	Transmitter Output Power and E.I.R.P.	✓
Part 24.232(d)	Transmitter Peak-to-Average Power Ratio (PAPR)	✓
Part 2.1049	Transmitter Occupied Bandwidth	✓
Part 2.1053 / 24.238	Transmitter Out of Band Radiated Emissions	✓
Part 2.1053 / 24.238	Transmitter Band Edge Radiated Emissions	✓
Part 2.1055 / 24.235	Transmitter Frequency Stability (Temperature and Voltage Variation)	✓
<b>Key to Results</b>		
✓ = Complied	✗ = Did not comply	

### 2.3. Methods and Procedures

<b>Reference:</b>	FCC KDB 971168 D01 v02r02, October 17 2014
<b>Title:</b>	Measurement Guidance for Certification of Licensed Digital Transmitters

### 2.4. 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.

### **3. Equipment Under Test (EUT)**

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

<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	A1779
<b>Test Sample ESN:</b>	802CBA76 ( <i>Conducted sample #1</i> )
<b>Test Sample MEID:</b>	Not stated
<b>Hardware Version:</b>	REV1.0
<b>Software Version:</b>	OS: 14A241z BB FW: 0.16.04
<b>FCC ID:</b>	BCG-E3086A

<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	A1779
<b>Test Sample ESN:</b>	80605FD5 ( <i>Conducted sample #63</i> )
<b>Test Sample MEID:</b>	35864007009801
<b>Hardware Version:</b>	REV1.0
<b>Software Version:</b>	OS: 14A241z BB FW: 0.16.04
<b>FCC ID:</b>	BCG-E3086A

<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	A1779
<b>Test Sample ESN:</b>	8009F1B2 ( <i>Radiated sample #36</i> )
<b>Test Sample MEID:</b>	35864007003321
<b>Hardware Version:</b>	REV1.0
<b>Software Version:</b>	OS: 14A241z BB FW: 0.16.04
<b>FCC ID:</b>	BCG-E3086A

<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	A1779
<b>Test Sample ESN:</b>	8010C1F5 ( <i>Radiated sample #38</i> )
<b>Test Sample MEID:</b>	35864007000102
<b>Hardware Version:</b>	REV1.0
<b>Software Version:</b>	OS: 14A241z BB FW: 0.16.04
<b>FCC ID:</b>	BCG-E3086A

<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	A1779
<b>Test Sample ESN:</b>	803ADADF ( <i>Conducted sample #62</i> )
<b>Test Sample MEID:</b>	35864007009804
<b>Hardware Version:</b>	REV1.0
<b>Software Version:</b>	OS: 14A241z BB FW: 0.16.04
<b>FCC ID:</b>	BCG-E3086A

### **3.2. Description of EUT**

The Equipment Under Test was a mobile phone with GSM/GPRS/EGPRS/UMTS/LTE/TD-SCDMA and CDMA technologies. It also supports IEEE 802.11a/b/g/n/ac, Bluetooth®, GPS and NFC. The rechargeable battery is not user accessible.

### **3.3. Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.

### **3.4. Additional Information Related to Testing**

<b>Technology Tested:</b>	CDMA BC1		
<b>Type of Radio Device:</b>	Transceiver		
<b>Modes:</b>	1xRTT, EV-DO Rev 0 & EV-DO Rev A		
<b>Modulation Type:</b>	O-QPSK & H-PSK		
<b>Power Supply Requirement(s):</b>	Nominal	3.8 VDC	
	Minimum	3.5 VDC	
	Maximum	4.4 VDC	
<b>Transmit Frequency Range:</b>	1850 to 1910 MHz		
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	25	1851.25
	Middle	600	1880.0
	Top	1175	1908.75

### **3.5. Support Equipment**

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

<b>Description:</b>	Laptop PC
<b>Brand Name:</b>	Thinkpad
<b>Model Name or Number:</b>	Lenovo L440
<b>Serial Number:</b>	R9-019EA2 14/4

<b>Description:</b>	USB diagnostic cable
<b>Brand Name:</b>	Not stated
<b>Model Name or Number:</b>	Kong
<b>Serial Number:</b>	2074F9

<b>Description:</b>	Personal Hands Free (PHF)
<b>Brand Name:</b>	Apple
<b>Model Name or Number:</b>	Apple Ear Plugs
<b>Serial Number:</b>	Not stated

## **4. Operation and Monitoring of the EUT during Testing**

### **4.1. Operating Modes**

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

- Constantly transmitting at full power on bottom, middle and top channels as required.
- Occupied bandwidth, conducted power and band edge tests were performed with the EUT in 1xRTT and EV-DO modes.
- Transmitter radiated spurious emissions were checked in all modes during pre-scans. 1xRTT RC 1/1 was found to be the worst case and all final measurements were performed with the EUT in this mode.

### **4.2. Configuration and Peripherals**

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

- The EUT was placed into a non-ui mode by using the teraterm application on a UL laptop PC. Instructions were provided by the customer to enable the baseband and radio (*Cellular\_RSE\_setup\_V3.0.doc*). This enabled the EUT to connect via a radiated link with the Rohde & Schwarz CMW 500 system simulator operating in transceiver mode. The CMW 500 was used to configure the EUT operating mode.
- Transmitter radiated spurious emissions tests were performed with the PHF connected to the EUT as the declared by the customer. The EUT was placed in three orthogonal orientations X, Y and Z to determine the worst case orientation for radiated spurious emissions. The worst case orientation for the LAT was Z and for the UAT was Z. Measurements at band edges were performed with the PHF removed as this was found to be the worst case.
- The worst-case radiated emission among all accessories, is determined by the manufacturer to be with the headset connected. The compliance lab performed final testing only with the headset attached.
- Testing for frequency stability and measurements at temperature and voltage extremes were performed using a conducted sample supplied by the customer. Short 4-wire DC flying leads were connected internally to the device in place of the battery, and exited through a hole in the casing. These leads were then extended to a DC power supply for testing purposes.
- For conducted cellular measurements, the RF conducted port was created by removing a micro connector from the PCB antenna and extending it with a short flexible microstrip supplied by the customer. This microstrip exited the device through a hole in the casing and was terminated in a proprietary micro-coax to SMA adaptor.
- The device contains two cellular antennas which do not transmit simultaneously.
  - LAT – Lower Antenna (Primary)
  - UAT – Upper Antenna (Secondary)

Where applicable, both antennas have been tested to demonstrate compliance

## **5. Measurements, Examinations and Derived Results**

### **5.1. General Comments**

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6. Measurement Uncertainty* for details.

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.

## **5.2. Test Results**

### **5.2.1. Transmitter E.I.R.P. - LAT**

#### **Test Summary:**

Test Engineer:	John Ferdinand	Test Dates:	16 June 2016 to 07 July 2016
Test Sample ESN:	802CBA76		

FCC Reference:	Part 24.232(c)
Test Method Used:	KDB 971168 D01 Section 2.2 footnote 1 & notes below

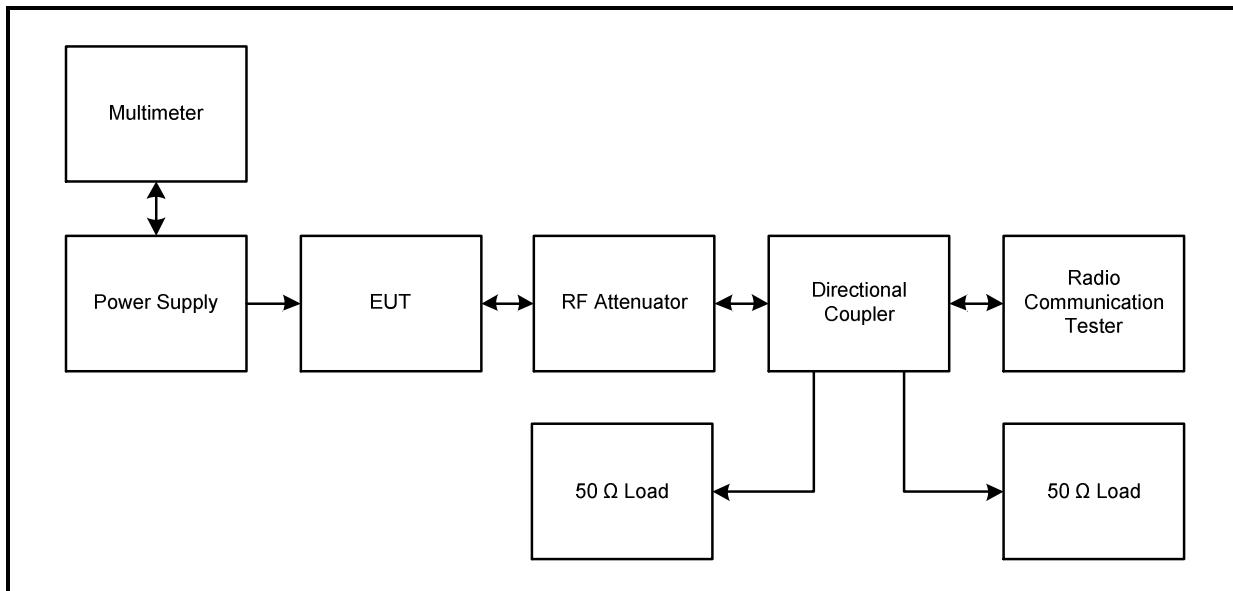
#### **Environmental Conditions:**

Temperature (°C):	20 to 24
Relative Humidity (%):	38 to 43

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

1. Transmitter average output power was measured using a Rohde & Schwarz CMW 500 following current Rohde & Schwarz measurement procedures. All configurations were tested with the EUT transmitting at maximum power on the bottom, middle and top channels. An RF level offset was entered on the CMW 500 to compensate for the loss of the attenuator and RF cables.
2. The manufacturer stated a maximum antenna gain of -2.25 dBi. The antenna gain was added to the conducted output power to obtain the radiated power. The highest power recorded was subtracted from the limit to show the margin.

#### **Test setup:**



**Transmitter E.I.R.P. (continued)****Results: 1xRTT**

Radio Configuration (RC)	Service Option (SO)	Conducted Output Power (dBm)		
		Ch. 25 / 1851.25 MHz	Ch. 600 / 1880.0 MHz	Ch. 1175 / 1908.75
		Average	Average	Average
RC1	2 (Loopback)	25.1	25.2	25.0
	55 (Loopback)	25.1	25.2	24.9
RC2	9 (Loopback)	25.1	25.2	25.0
	55 (Loopback)	25.1	25.2	25.0
RC3	2 (Loopback)	25.1	25.2	25.0
	55 (Loopback)	25.1	25.2	25.0
	32 (Test Data)	25.0	25.2	25.0
RC4	2 (Loopback)	25.0	25.1	25.0
	55 (Loopback)	25.0	25.2	25.0
	32 (Test Data)	25.1	25.1	25.0
RC5	55 (Loopback)	25.1	25.2	25.0

Channel	Frequency (MHz)	Highest Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1851.25	25.1	-2.25	22.85	33.0	10.15	Complied
Middle	1880.0	25.2	-2.25	22.95	33.0	10.05	Complied
Top	1908.75	25.0	-2.25	22.75	33.0	10.25	Complied

**Transmitter E.I.R.P. (continued)****Results: EV-DO Rev. 0**

FTAP Rate	RTAP Rate	Average Conducted Output Power (dBm)		
		Ch. 25 / 1851.25 MHz	Ch. 600 / 1880.0 MHz	Ch. 1175 / 1908.75
307.2 kbit/s	153.6 kbit/s	24.2	24.9	24.6

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1851.25	24.2	-2.25	21.95	33.0	11.05	Complied
Middle	1880.0	24.9	-2.25	22.65	33.0	10.35	Complied
Top	1908.75	24.6	-2.25	22.35	33.0	10.75	Complied

**Results: EV-DO Rev. A**

FETAP Format	RETAP Data Payload Size	Average Conducted Output Power (dBm)		
		Ch. 25 / 1851.25 MHz	Ch. 600 / 1880.0 MHz	Ch. 1175 / 1908.75
307.2 kbit/s	4096 bits	23.9	24.7	24.5

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1851.25	23.9	-2.25	21.65	33.0	11.35	Complied
Middle	1880.0	24.7	-2.25	22.45	33.0	10.55	Complied
Top	1908.75	24.5	-2.25	22.25	33.0	10.75	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	#1	02 Apr 2017	12
A2502	Directional Coupler	AtlanTecRF	CDC-003060	22501837	Calibrated before use	-
M1876	Radio Comms Tester	Rohde & Schwarz	CMW500	145919	Calibrated before use	-
M1869	Radio Comms Tester	Rohde & Schwarz	CMW500	145923	05 Apr 2017	12
M1883	Signal Analyser	Rohde & Schwarz	FSV	103003	09 May 2017	12
A2924	Attenuator	AtlanTecRF	AN18W5-20	None Stated	Calibrated before use	-

### **5.2.2. Transmitter E.I.R.P. - UAT**

#### **Test Summary:**

<b>Test Engineer:</b>	John Ferdinand	<b>Test Date:</b>	26 July 2016
<b>Test Sample ESN:</b>	803ADADF		

<b>FCC Reference:</b>	Part 24.232(c)
<b>Test Method Used:</b>	KDB 971168 D01 Section 2.2 footnote 1 & notes below

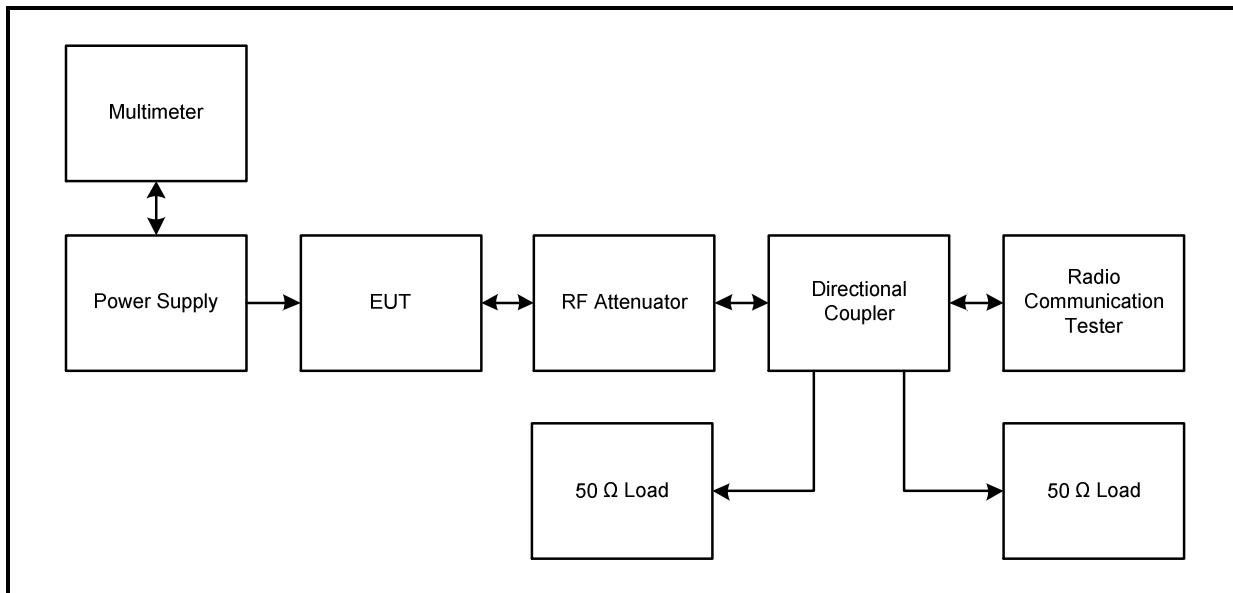
#### **Environmental Conditions:**

<b>Temperature (°C):</b>	24
<b>Relative Humidity (%):</b>	40

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

1. Transmitter average output power was measured using a Rohde & Schwarz CMW 500 following current Rohde & Schwarz measurement procedures. All configurations were tested with the EUT transmitting at maximum power on the bottom, middle and top channels. An RF level offset was entered on the CMW 500 to compensate for the loss of the attenuator and RF cables.
2. The manufacturer stated a maximum antenna gain of 0.35 dBi. The antenna gain was added to the conducted output power to obtain the radiated power. The highest power recorded was subtracted from the limit to show the margin.

#### **Test setup:**



**Transmitter E.I.R.P. (continued)****Results: 1xRTT**

Radio Configuration (RC)	Service Option (SO)	Conducted Output Power (dBm)		
		Ch. 25 / 1851.25 MHz	Ch. 600 / 1880.0 MHz	Ch. 1175 / 1908.75
		Average	Average	Average
RC1	2 (Loopback)	20.2	20.2	20.2
	55 (Loopback)	20.2	20.2	20.2
RC2	9 (Loopback)	20.2	20.2	20.2
	55 (Loopback)	20.2	20.2	20.2
RC3	2 (Loopback)	20.2	20.2	20.2
	55 (Loopback)	20.2	20.2	20.2
	32 (Test Data)	20.2	20.2	20.2
RC4	2 (Loopback)	20.2	20.2	20.3
	55 (Loopback)	20.2	20.2	20.3
	32 (Test Data)	20.2	20.2	20.3
RC5	55 (Loopback)	20.2	20.2	20.3

Channel	Frequency (MHz)	Highest Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1851.25	20.2	0.35	20.55	33.0	12.45	Complied
Middle	1880.0	20.2	0.35	20.55	33.0	12.45	Complied
Top	1908.75	20.3	0.35	20.65	33.0	12.35	Complied

**Transmitter E.I.R.P. (continued)****Results: EV-DO Rev. 0**

FTAP Rate	RTAP Rate	Average Conducted Output Power (dBm)		
		Ch. 25 / 1851.25 MHz	Ch. 600 / 1880.0 MHz	Ch. 1175 / 1908.75
307.2 kbit/s	153.6 kbit/s	19.6	19.9	19.9

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1851.25	19.6	0.35	19.95	33.0	13.05	Complied
Middle	1880.0	19.9	0.35	20.25	33.0	12.75	Complied
Top	1908.75	19.9	0.35	20.25	33.0	12.75	Complied

**Results: EV-DO Rev. A**

FETAP Format	RETAP Data Payload Size	Average Conducted Output Power (dBm)		
		Ch. 25 / 1851.25 MHz	Ch. 600 / 1880.0 MHz	Ch. 1175 / 1908.75
307.2 kbit/s	4096 bits	19.5	19.9	19.9

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1851.25	19.5	0.35	19.85	33.0	13.15	Complied
Middle	1880.0	19.9	0.35	20.25	33.0	12.75	Complied
Top	1908.75	19.9	0.35	20.25	33.0	12.75	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	#1	02 Apr 2017	12
A2502	Directional Coupler	AtlanTecRF	CDC-003060	22501837	Calibrated before use	-
M1876	Radio Comms Tester	Rohde & Schwarz	CMW500	145919	Calibrated before use	-
M1869	Radio Comms Tester	Rohde & Schwarz	CMW500	145923	05 Apr 2017	12
M1883	Signal Analyser	Rohde & Schwarz	FSV	103003	09 May 2017	12
A2924	Attenuator	AtlanTecRF	AN18W5-20	None Stated	Calibrated before use	-

### **5.2.3. Transmitter Peak-To-Average Power Ratio (PAPR)**

#### **Test Summary:**

Test Engineer:	John Ferdinand	Test Date:	08 July 2016
Test Sample ESN:	802CBA76		

FCC Reference:	24.232(d)
Test Method Used:	KDB 971168 D01 Section 5.7.1

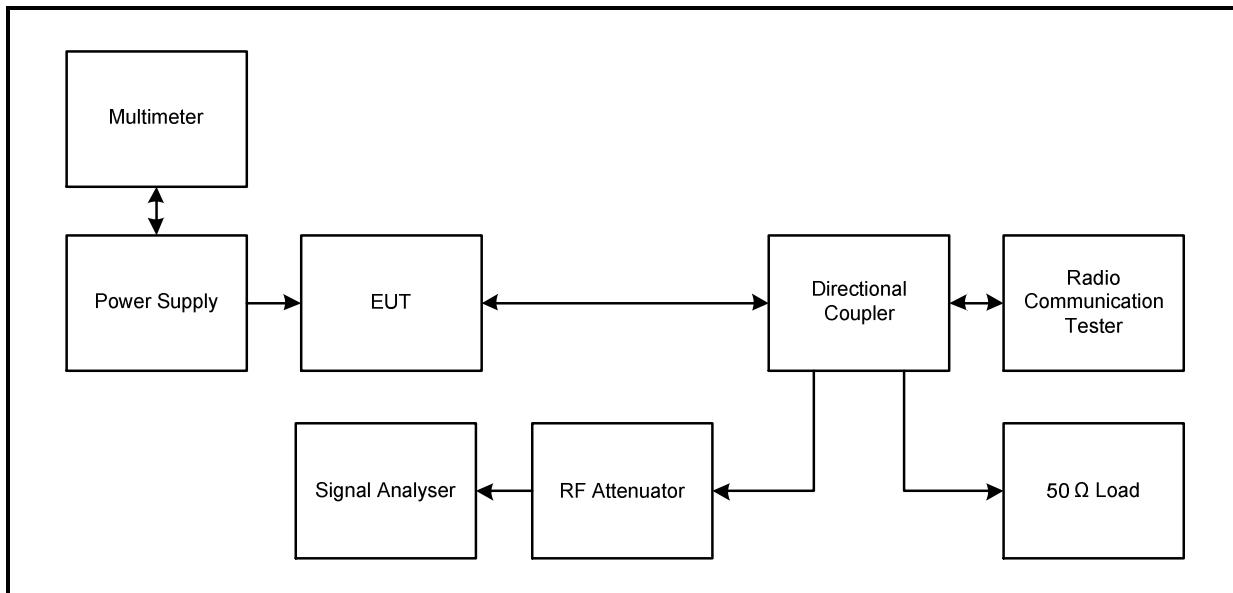
#### **Environmental Conditions:**

Temperature (°C):	24
Relative Humidity (%):	46

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

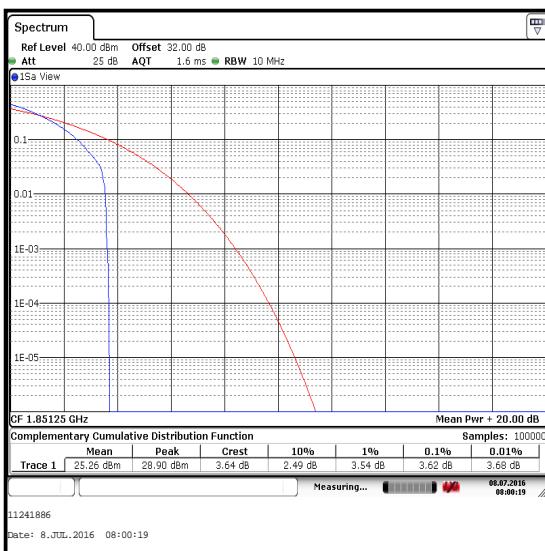
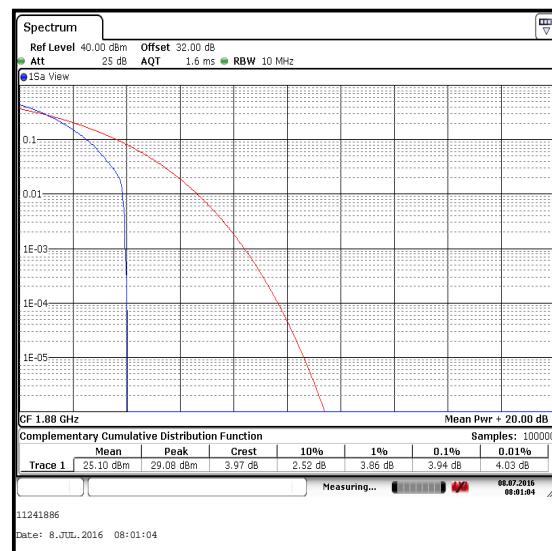
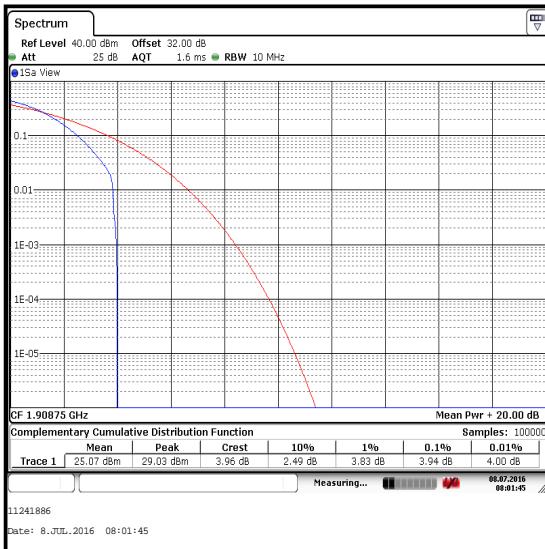
1. The CCDF function of a signal analyser was used to measure PAPR when the EUT was transmitting on the middle channel in 1xRTT and EV-DO modes. Maximum PAPR levels associated with a probability of 0.1% were recorded. Measurements on bottom and top channels show identical results to the middle channel, these results are not recorded in this report..
2. The signal analyser was connected to the RF port on the EUT via the coupled port of an RF coupler using suitable attenuation and RF cables. An RF level offset was entered on the signal analyser to compensate for the loss of the coupler, attenuator and RF cables.

#### **Test setup:**



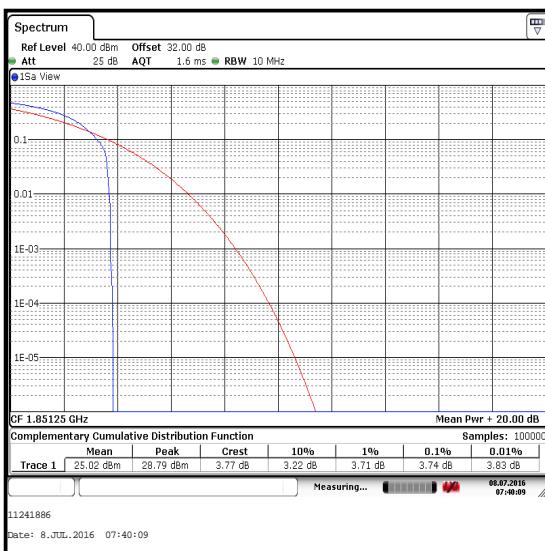
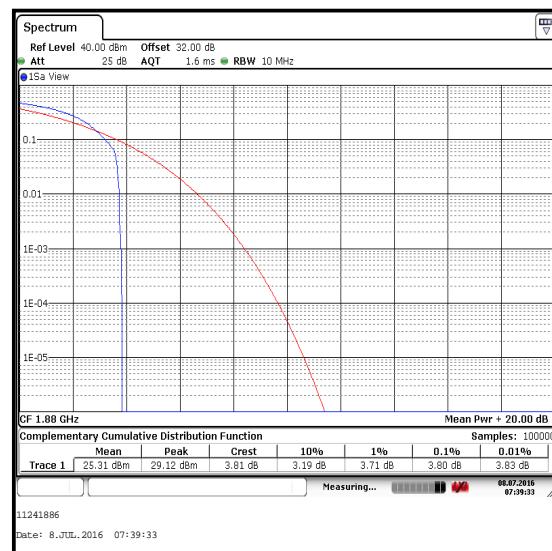
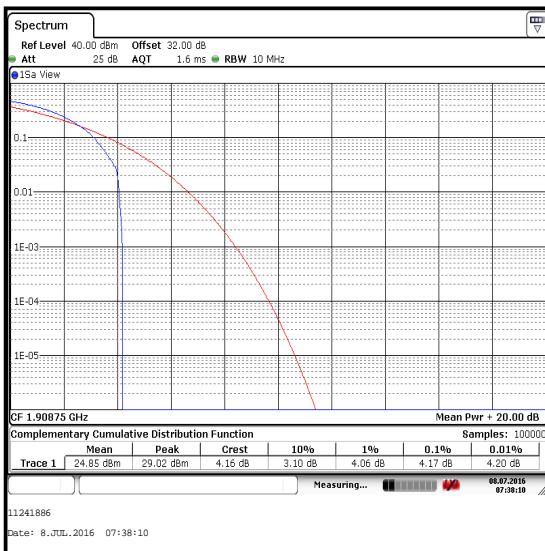
**Transmitter Peak-To-Average Power Ratio (continued)****Results: 1xRTT**

Channel	Frequency (MHz)	Peak (dBm)	Average (dBm)	PAPR (dB)	PAPR Limit (dB)	Margin (dB)	Result
Bottom	1851.25	28.9	25.3	3.62	13.0	9.38	Complied
Middle	1880.0	29.1	25.1	3.94	13.0	9.06	Complied
Top	1908.75	29.0	25.1	3.94	13.0	9.06	Complied

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

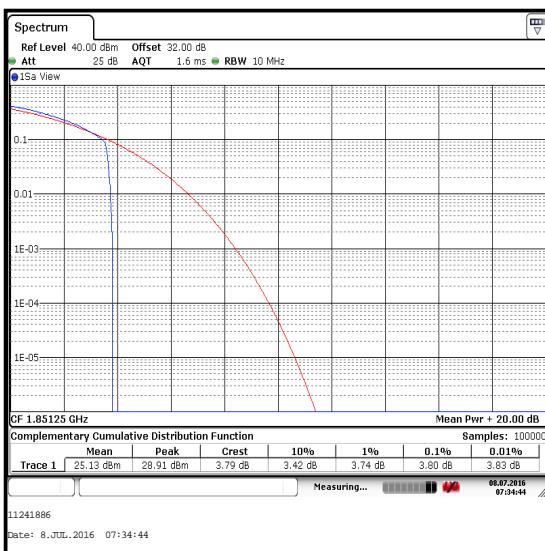
**Transmitter Peak-To-Average Power Ratio (continued)****Results: EV-DO Rev. 0**

Channel	Frequency (MHz)	Peak (dBm)	Average (dBm)	PAPR (dB)	PAPR Limit (dB)	Margin (dB)	Result
Bottom	1851.25	28.8	25.0	3.74	13.0	9.26	Complied
Middle	1880.0	29.1	25.3	3.80	13.0	9.20	Complied
Top	1908.75	29.0	24.9	4.17	13.0	8.83	Complied

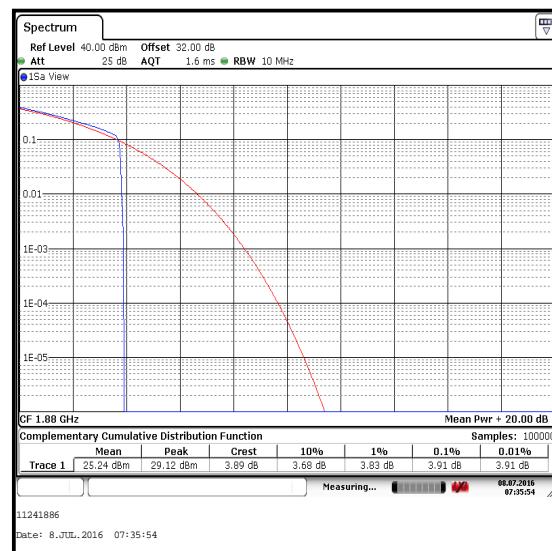
**Bottom Channel****Middle Channel****Top Channel**

Transmitter Peak-To-Average Power Ratio (continued)Results: EV-DO Rev. A

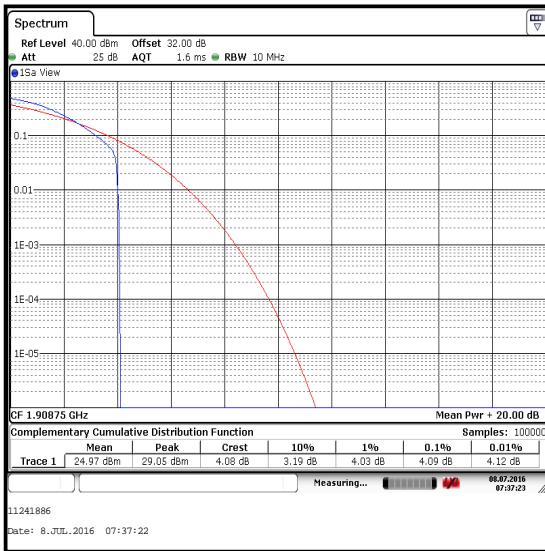
Channel	Frequency (MHz)	Peak (dBm)	Average (dBm)	PAPR (dB)	PAPR Limit (dB)	Margin (dB)	Result
Bottom	1851.25	28.9	25.1	3.80	13.0	9.2	Complied
Middle	1880.0	29.1	25.2	3.91	13.0	9.09	Complied
Top	1908.75	29.1	25.0	4.09	13.0	8.91	Complied



Bottom Channel



Middle Channel



Top Channel

**Transmitter Peak-To-Average Power Ratio (continued)****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelpunkt	30.5015.13	#1	02 April 2017	12
A2502	Directional Coupler	AtlanTecRF	CDC-003060	22501837	Calibrated before use	-
M1883	Signal Analyser	Rohde & Schwarz	FSV	103003	09 May 2017	12
A2920	Attenuator	AlanTecRF	AN18W5-20	None Stated	Calibrated before use	-

### **5.2.3.1. Transmitter Occupied Bandwidth**

#### **Test Summary:**

<b>Test Engineer:</b>	John Ferdinand	<b>Test Dates:</b>	16 June 2016 to 04 July 2016
<b>Test Sample ESN:</b>	8009F1B2		

<b>FCC Reference:</b>	Part 2.1049
<b>Test Method Used:</b>	FCC KDB 971168 D01 Sections 4.1 & 4.2

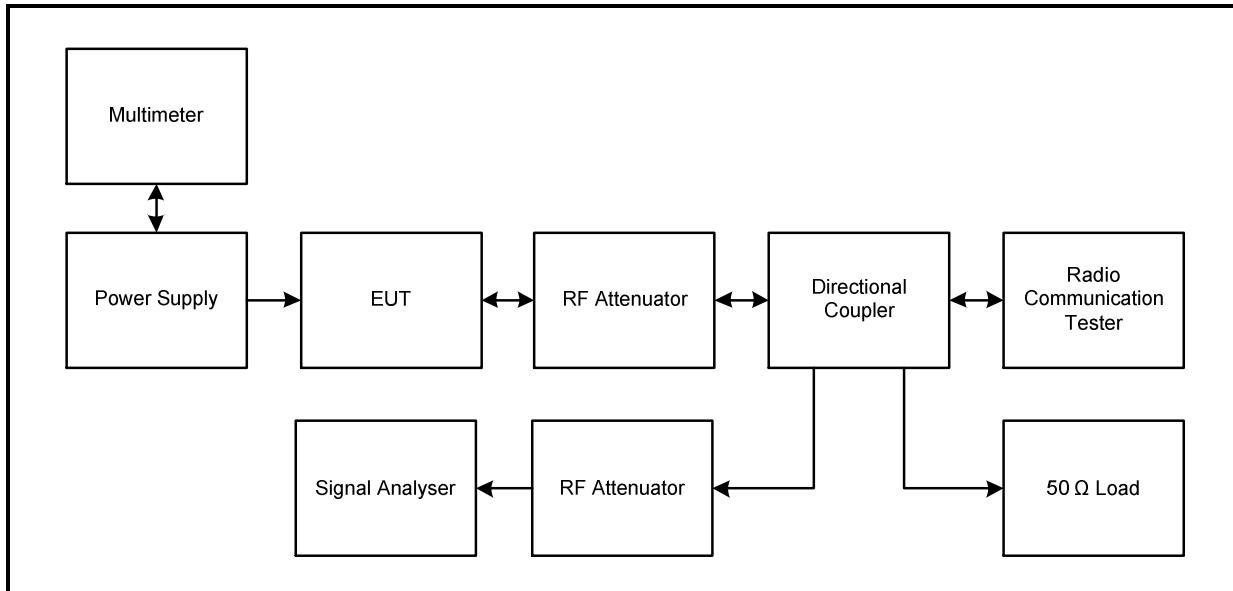
#### **Environmental Conditions:**

<b>Temperature (°C):</b>	20 to 24
<b>Relative Humidity (%):</b>	38 to 43

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

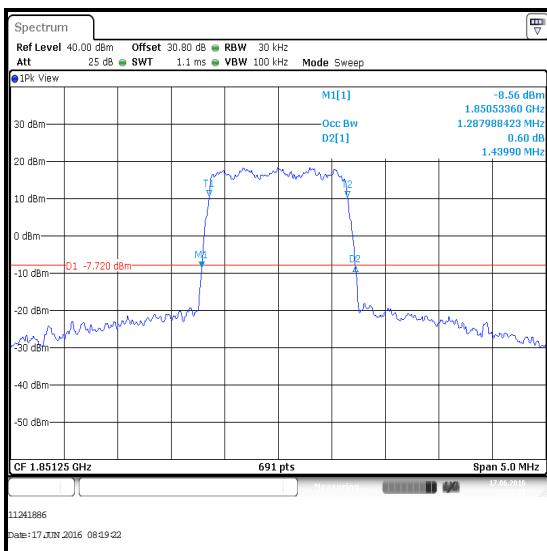
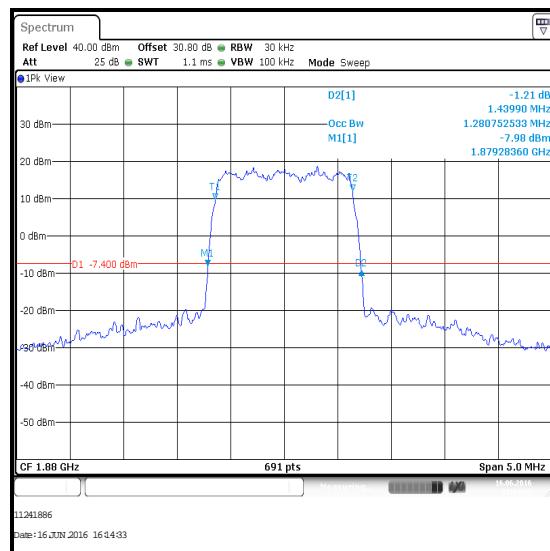
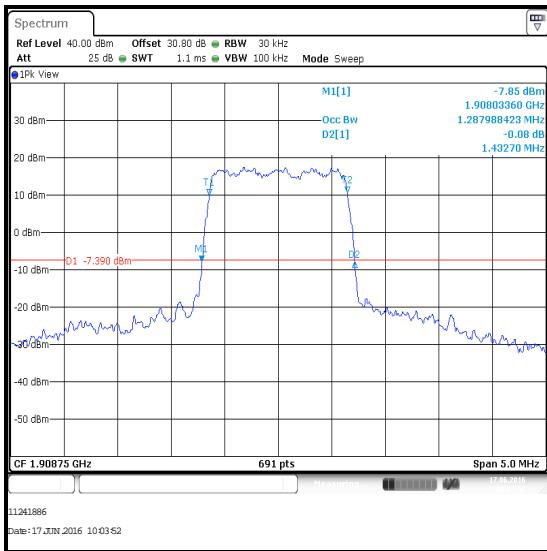
1. Occupied bandwidth (99% bandwidth) was measured using a signal analyser occupied bandwidth function. -26 dB bandwidths were also measured and recorded.
2. The RF port of the EUT was connected to the signal analyser via RF cables, directional coupler and suitable attenuation.

#### **Test setup:**



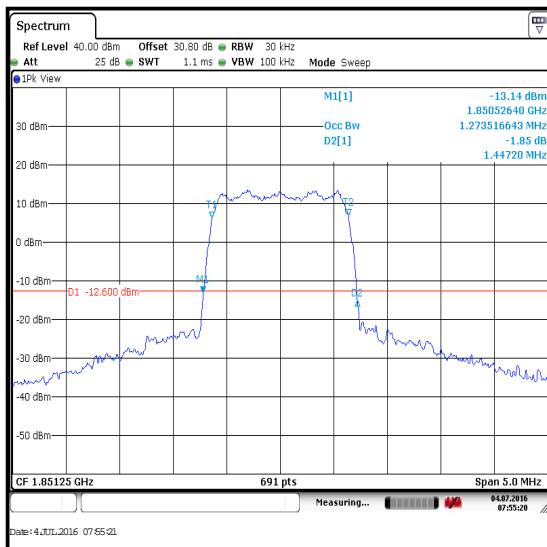
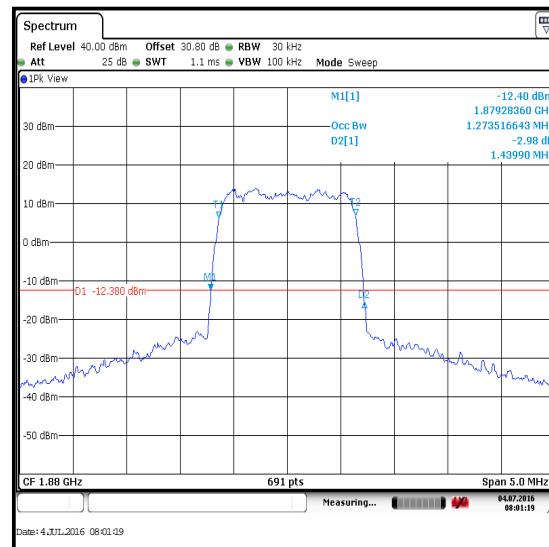
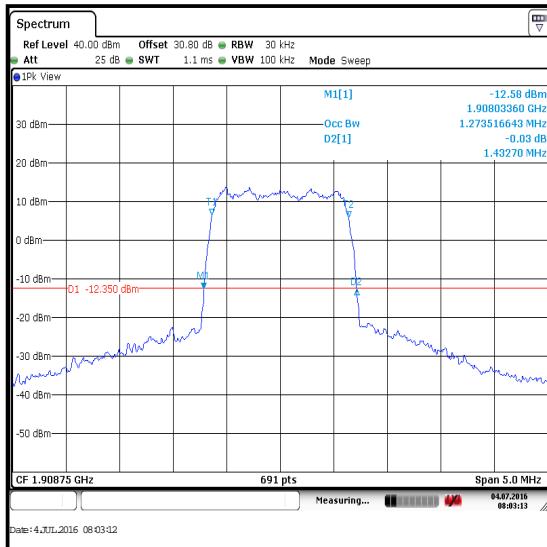
**Transmitter Occupied Bandwidth (continued)****Results: 1xRTT**

Channel	Frequency (MHz)	99% Occupied Bandwidth (kHz)	-26 dB Bandwidth (kHz)
Bottom	1851.25	1287.988	1439.900
Middle	1880.0	1280.753	1439.900
Top	1908.75	1287.988	1432.700

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

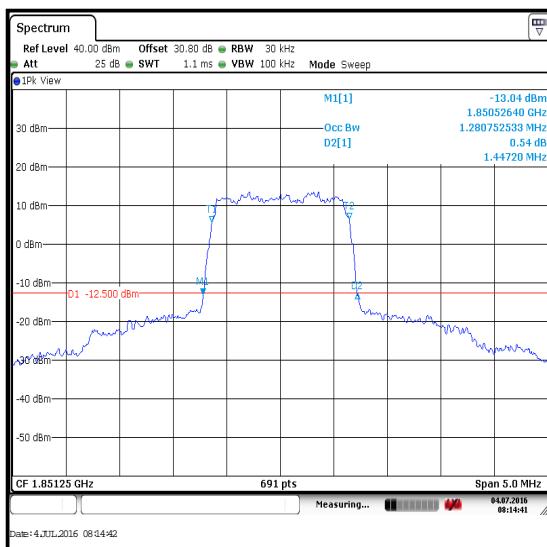
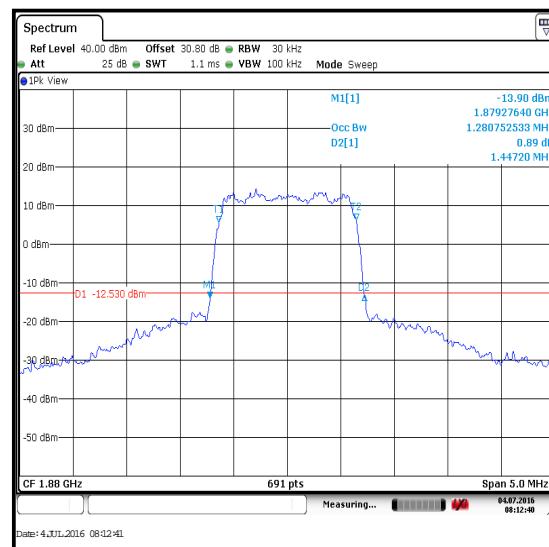
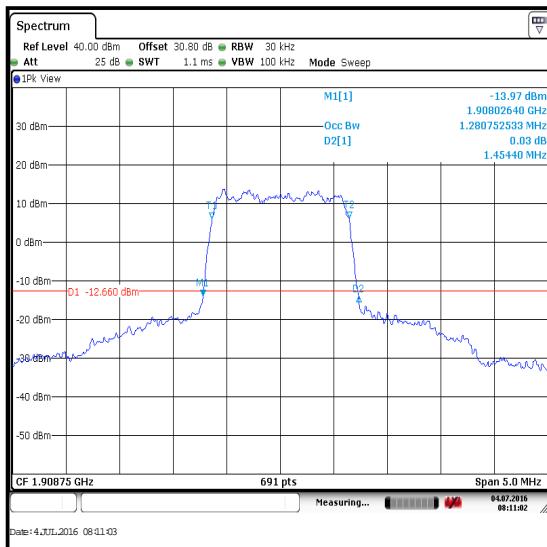
**Transmitter Occupied Bandwidth (continued)****Results: EV-DO Rev. 0**

Channel	Frequency (MHz)	99% Occupied Bandwidth (kHz)	-26 dB Bandwidth (kHz)
Bottom	1851.25	1273.517	1447.200
Middle	1880.0	1273.517	1439.900
Top	1908.75	1273.517	1432.700

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

**Transmitter Occupied Bandwidth (continued)****Results: EV-DO Rev. A**

Channel	Frequency (MHz)	99% Occupied Bandwidth (kHz)	-26 dB Bandwidth (kHz)
Bottom	1851.25	1280.753	1447.200
Middle	1880.0	1280.753	1447.200
Top	1908.75	1280.753	1454.400

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

**Transmitter Occupied Bandwidth (continued)****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	#1	02 April 2017	12
A2502	Directional Coupler	AtlanTecRF	CDC-003060	22501837	Calibrated before use	-
M1883	Signal Analyser	Rohde & Schwarz	FSV	103003	09 May 2017	12
A2920	Attenuator	AlanTecRF	AN18W5-20	None stated	Calibrated before use	-
A2924	Attenuator	AlanTecRF	AN18W5-20	None stated	Calibrated before use	-

**5.2.4. Transmitter Out of Band Radiated Emissions - LAT****Test Summary:**

<b>Test Engineer:</b>	John Ferdinand	<b>Test Dates:</b>	18 June 2016 to 05 July 2016
<b>Test Sample ESN:</b>	8009F1B2		

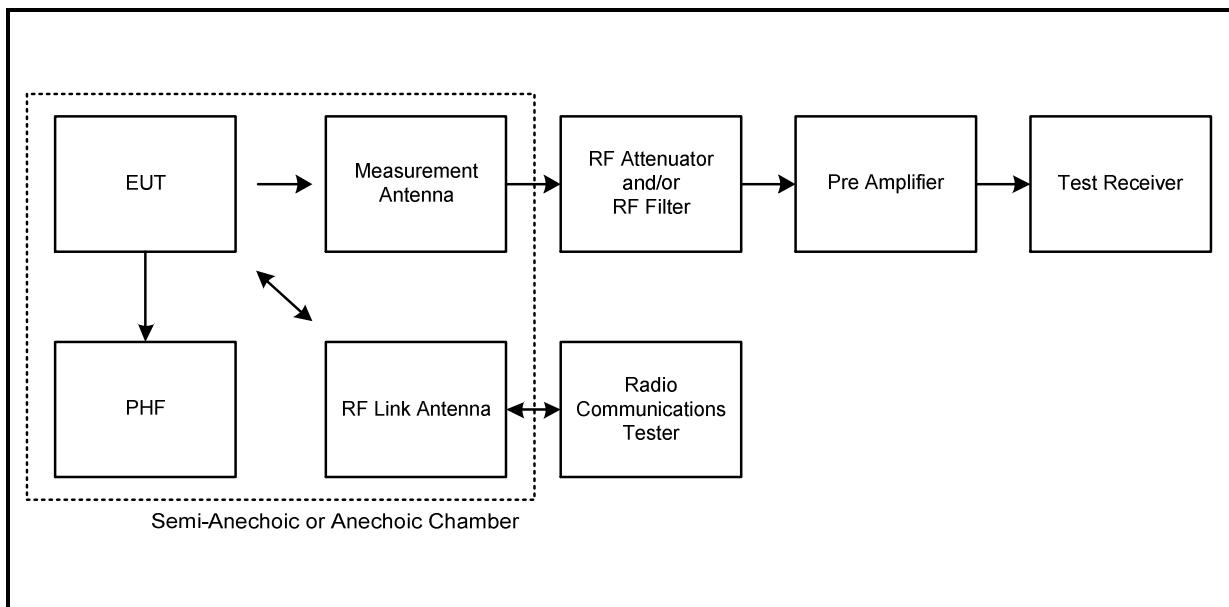
<b>FCC Reference:</b>	Parts 2.1053 & 24.238
<b>Test Method Used:</b>	Part 24.238(b), KDB 971168 D01 Section 6, Section 7 & Notes below
<b>Frequency Range:</b>	30 MHz to 19.1 GHz
<b>Configuration:</b>	1xRTT RC1/1

**Environmental Conditions:**

<b>Temperature (°C):</b>	20 to 24
<b>Relative Humidity (%):</b>	38 to 43

**Note(s):**

1. The uplink traffic channel is shown on the 1 GHz to 3 GHz plot.
2. All emissions shown on the pre-scan plots were investigated. Final measurements were made using appropriate RF filters and attenuators where required.
3. Middle channel prescan results are recorded in this report and are representative of bottom and top channel results which are held on the UL IT server and available for inspection on request.
4. Pre-scans were performed in a fully anechoic chamber (Asset Number K0002) 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. Final measurements were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres 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. 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 pre-scans, with markers placed on the highest measured levels. Final measurements were performed on the spurious emission frequencies using an average detector and the results entered into the tables below.
5. Radiated spurious emission testing between 150 kHz and 30 MHz was performed for support of the NFC test report. No spurious emissions were observed above the noise floor of the measurement system.

**Transmitter Out of Band Radiated Emissions - LAT (continued)****Test setup:**

**Transmitter Out of Band Radiated Emissions – LAT (continued)****Results: 1xRTT RC1/1 - Bottom Channel**

Frequency (MHz)	Average Level (dBm)	Limit (dBm)	Margin (dB)	Result
3702.492	-24.0	-13.0	11.0	Complied

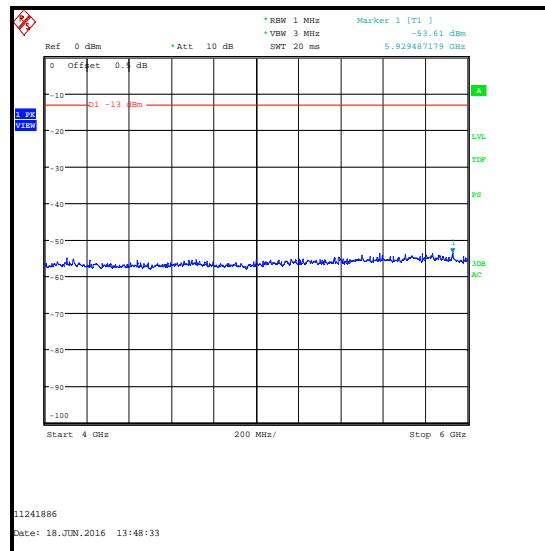
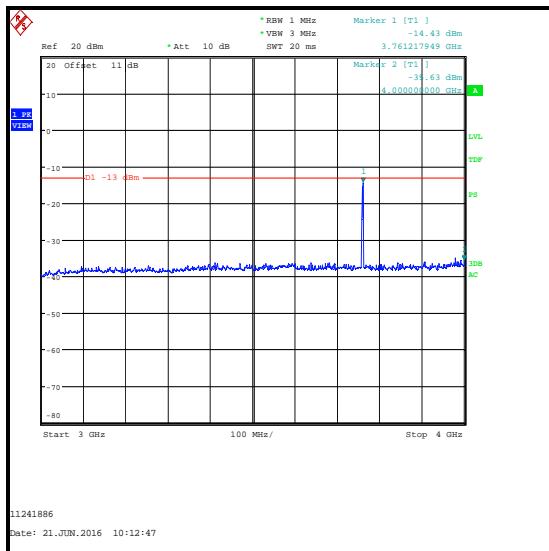
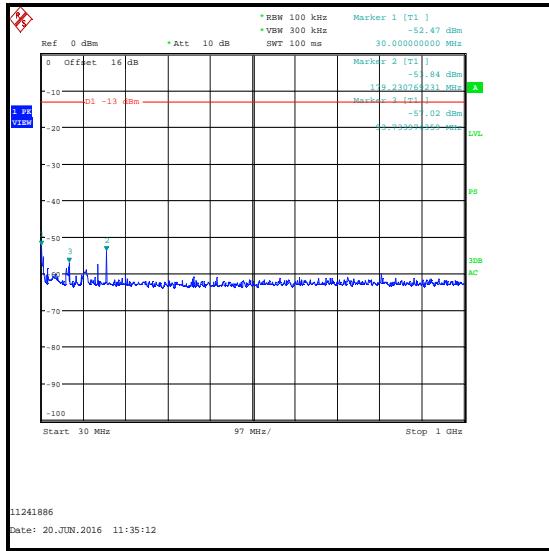
**Results: 1xRTT RC1/1 - Middle Channel**

Frequency (MHz)	Average Level (dBm)	Limit (dBm)	Margin (dB)	Result
3759.864	-23.2	-13.0	10.2	Complied

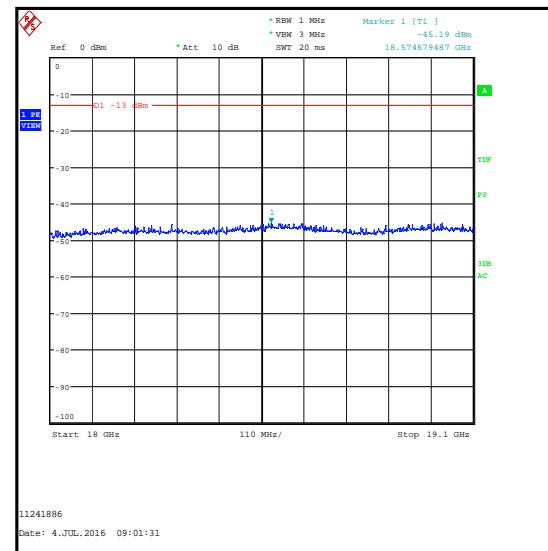
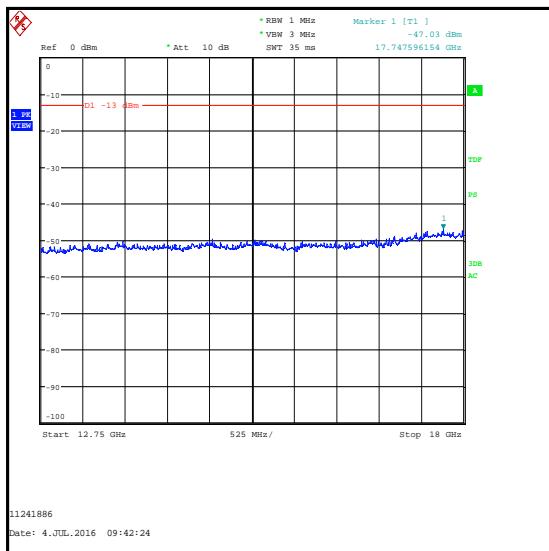
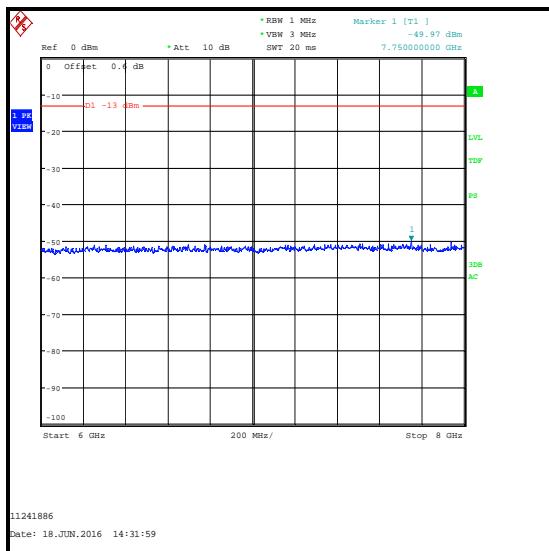
**Results: 1xRTT RC1/1 - Top Channel**

Frequency (MHz)	Average Level (dBm)	Limit (dBm)	Margin (dB)	Result
3817.371	-22.1	-13.0	9.1	Complied

## Transmitter Out of Band Radiated Emissions – LAT (continued)



## Transmitter Out of Band Radiated Emissions – LAT (continued)



**Transmitter Out of Band Radiated Emissions – LAT (continued)****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelpunkt	30.5015.13	#1	02 Apr 2017	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	21 Dec 2016	12
A1534	Pre-Amplifier	Hewlett Packard	8449B	3008A00405	19 Dec 2016	12
A288	Antenna	Chase	CBL6111A	1589	27 Aug 2016	12
A1818	Antenna	EMCO	00075692	3118	17 Dec 2016	12
A253	Antenna	Flann Microwave	12240-20	128	17 Dec 2016	12
A254	Antenna	Flann Microwave	14240-20	139	17 Dec 2016	12
A255	Antenna	Flann Microwave	16240-20	519	17 Dec 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 Mar 2017	12
M1020	Signal Generator	Rohde & Schwarz	SME03	834617/030	21 Dec 2016	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Thermal Power Sensor	Rohde & Schwarz	NRV-Z52	100115	15 Apr 2018	24
A1936	Antenna	Schwarzbeck	UBAA 9114	9114-223	07 May 2017	36
A239	6 dB Attenuator	Huber & Suhner	6806.17.B	None Stated	26 Apr 2017	12
K0017	3m RSE chamber	Rainford	N/A	N/A	19 May 2017	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	653	07 Apr 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	07 Jan 2017	12
A1975	High Pass Filter	AtlanTecRF	AFH-03000	090424010	26 Apr 2017	12
A2467	High Pass Filter	Wainwright	WHJE5-920	SN2	09 Mar 2017	12

**5.2.5. Transmitter Out of Band Radiated Emissions - UAT****Test Summary:**

<b>Test Engineer:</b>	John Ferdinand	<b>Test Dates:</b>	18 June 2016 to 04 July 2016
<b>Test Sample ESN:</b>	8009F1B2		

<b>FCC Reference:</b>	Parts 2.1053 & 24.238
<b>Test Method Used:</b>	Part 24.238(b), KDB 971168 D01 Section 6, Section 7 & Notes below
<b>Frequency Range:</b>	30 MHz to 19.1 GHz
<b>Configuration:</b>	1xRTT RC1/1

**Environmental Conditions:**

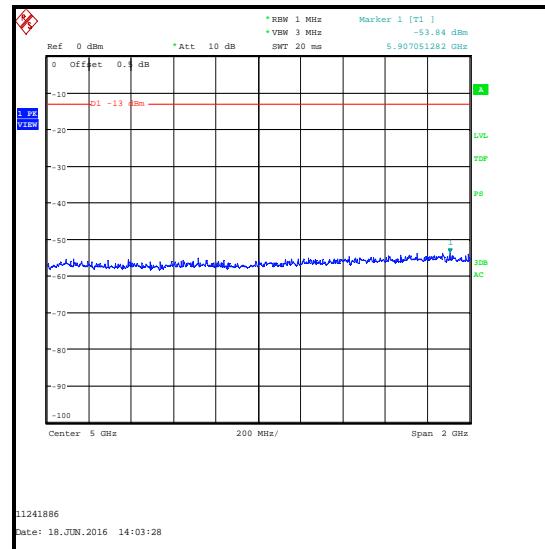
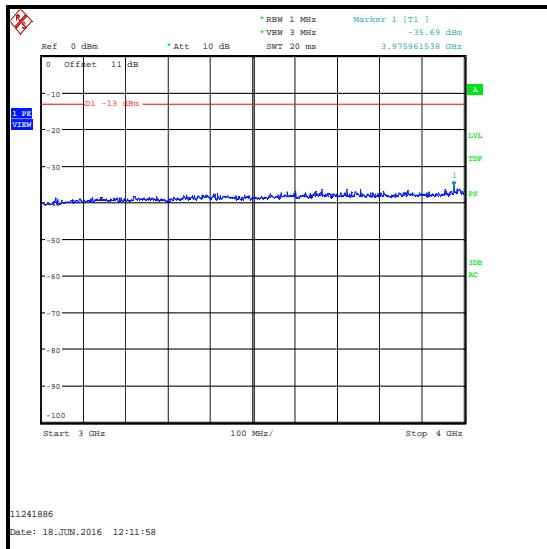
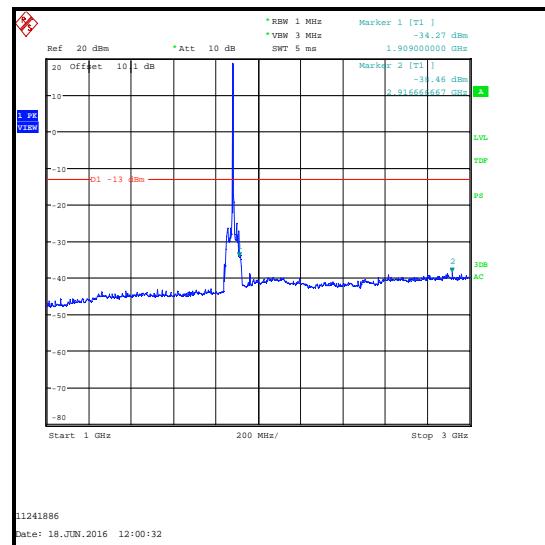
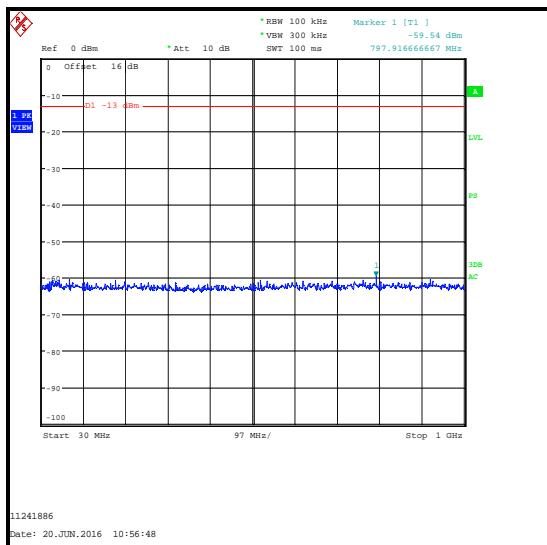
<b>Temperature (°C):</b>	21 to 23
<b>Relative Humidity (%):</b>	38 to 41

**Note(s):**

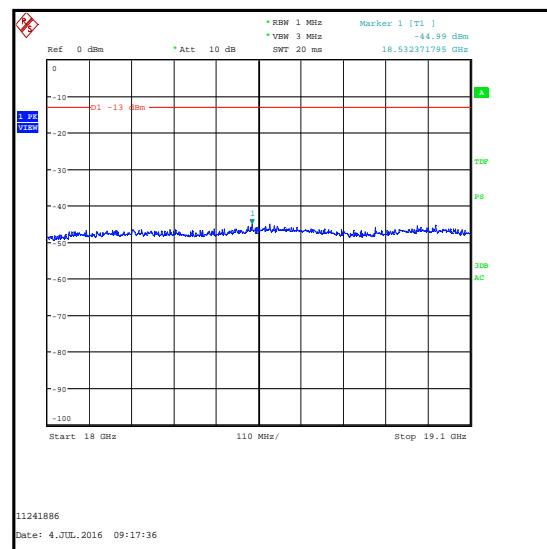
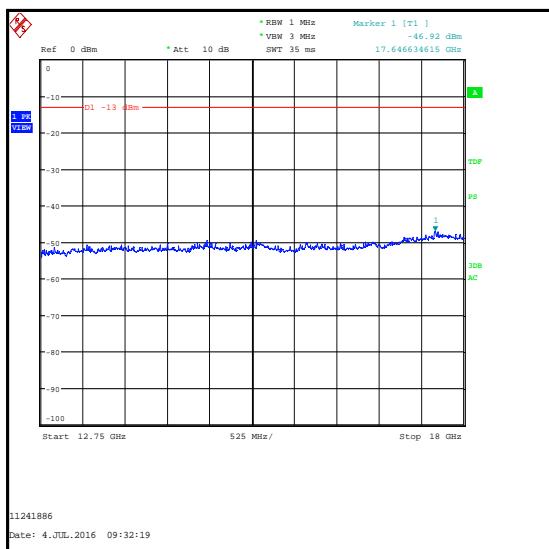
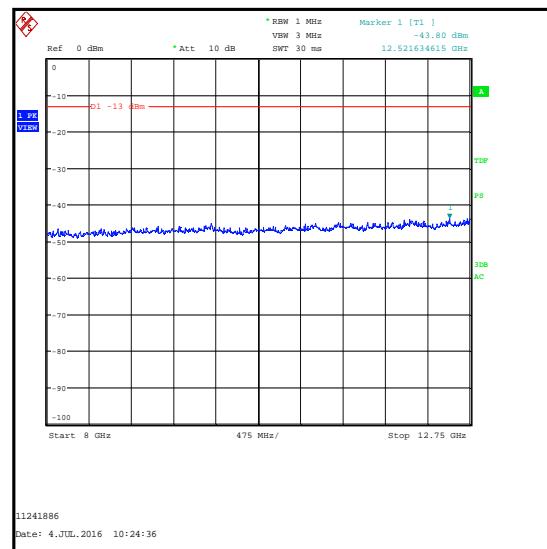
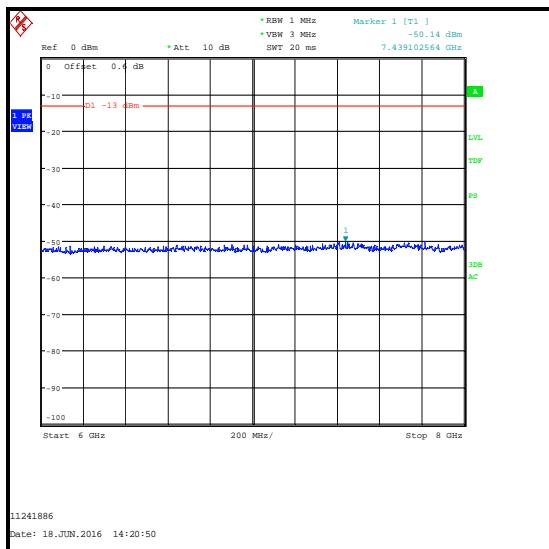
1. The uplink traffic channel is shown on the 1 GHz to 3 GHz plot.
2. All emissions shown on the pre-scan plots were investigated. All emissions shown on the pre-scan plots were found to be below the measurement system noise floor or ambient or > 20 dB below the applicable limit. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
3. Middle channel results are recorded in this report and are representative of bottom and top channel results which are held on the UL IT server and available for inspection on request.
4. Pre-scans were performed in a fully anechoic chamber (Asset Number K0002) 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. A peak detector and trace mode of Max Hold were used to perform pre-scans, with markers placed on the highest measured emission or noise floor levels.
5. Radiated spurious emission testing between 150 kHz and 30 MHz was performed for support of the NFC test report. No spurious emissions were observed above the noise floor of the measurement system.

**Transmitter Out of Band Radiated Emissions – UAT (continued)****Results: 1xRTT RC1/1 - Middle Channel**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
3975.962	-35.7	-13.0	23.7	Complied



## Transmitter Out of Band Radiated Emissions – UAT (continued)



**Transmitter Out of Band Radiated Emissions – UAT (continued)****Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelpunkt	30.5015.13	#1	02 Apr 2017	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	21 Dec 2016	12
A1534	Pre-Amplifier	Hewlett Packard	8449B	3008A00405	19 Dec 2016	12
A288	Antenna	Chase	CBL6111A	1589	27 Aug 2016	12
A1818	Antenna	EMCO	00075692	3118	17 Dec 2016	12
A253	Antenna	Flann Microwave	12240-20	128	17 Dec 2016	12
A254	Antenna	Flann Microwave	14240-20	139	17 Dec 2016	12
A255	Antenna	Flann Microwave	16240-20	519	17 Dec 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 Mar 2017	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	30 Apr 2017	12
A1975	High Pass Filter	AtlanTecRF	AFH-03000	090424010	26 Apr 2017	12
A2467	High Pass Filter	Wainwright	WHJE5-920	SN2	09 Mar 2017	12

**5.2.6. Transmitter Radiated Emissions at Band Edges - LAT****Test Summary:**

Test Engineer:	John Ferdinand	Test Dates:	22 June 2016 & 29 June 2016
Test Sample ESN:	8009F1B2		

FCC Reference:	Part 2.1053 / 24.238
Test Method Used:	Part 24.238(b), KDB 971168 D01 Section 6, Section 7 & notes below

**Environmental Conditions:**

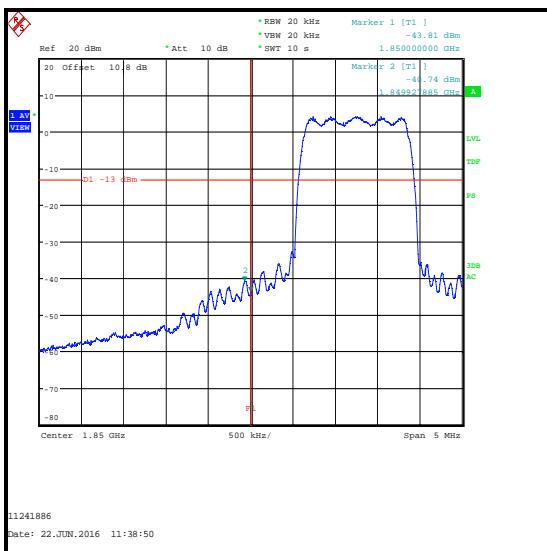
Temperature (°C):	20 to 24
Relative Humidity (%):	38 to 43

**Note(s):**

1. Measurements were performed in a fully anechoic chamber (Asset Number K0002) 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. The measurement antenna was placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.
2. In the first 1.0 MHz immediately outside and adjacent to the band edges, the resolution bandwidth used was greater than 1% of the 26 dB emission bandwidth.

**Transmitter Radiated Emissions at Band Edges – LAT (continued)****Results: 1xRTT**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1849.928	-40.7	-13.0	27.7	Complied
1850	-43.8	-13.0	30.8	Complied
1910	-35.7	-13.0	22.7	Complied



Lower Band Edge



Upper Band Edge

**Transmitter Radiated Emissions at Band Edges – LAT (continued)****Results: EV-DO Rev. 0**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-32.5	-13.0	29.5	Complied
1910	-38.2	-13.0	35.2	Complied



**Transmitter Radiated Emissions at Band Edges – LAT (continued)****Results: EV-DO Rev. A**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1849.856	-31.3	-13.0	18.3	Complied
1850	-32.0	-13.0	19.0	Complied
1910	-32.7	-13.0	19.7	Complied



Lower Band Edge



Upper Band Edge

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	#1	02 Apr 2017	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	21 Dec 2016	12
A1534	Pre-Amplifier	Hewlett Packard	8449B	3008A00405	19 Dec 2016	12
A1818	Antenna	EMCO	00075692	3118	17 Dec 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 Mar 2017	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	30 Apr 2017	12

**5.2.7. Transmitter Radiated Emissions at Band Edges - UAT****Test Summary:**

Test Engineer:	John Ferdinand	Test Dates:	22 June 2016 to 04 July 2016
Test Sample ESN:	8010C1F5		

FCC Reference:	Part 2.1053 / 24.238
Test Method Used:	Part 24.238(b), KDB 971168 D01 Section 6, Section 7 & notes below

**Environmental Conditions:**

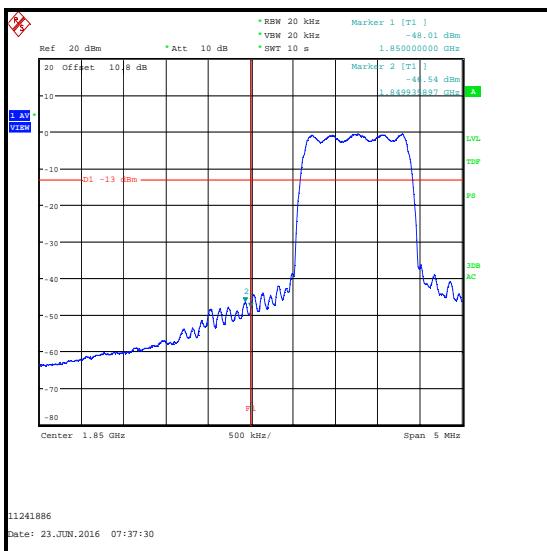
Temperature (°C):	20 to 24
Relative Humidity (%):	38 to 43

**Note(s):**

1. Measurements were performed in a fully anechoic chamber (Asset Number K0002) 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. The measurement antenna was placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT.
2. In the first 1.0 MHz immediately outside and adjacent to the band edges, the channel power function of the test receiver was used to integrate power over the measurement bandwidth. The resolution bandwidth used was greater than 1% of the 26 dB emission bandwidth.

**Transmitter Radiated Emissions at Band Edges – UAT (continued)****Results: 1xRTT**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1849.936	-46.5	-13.0	33.5	Complied
1850	-48.0	-13.0	35.0	Complied
1910	-42.7	-13.0	29.7	Complied



**Transmitter Radiated Emissions at Band Edges – UAT (continued)****Results: EV-DO Rev. 0**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-41.84	-13.0	28.84	Complied
1910	-39.39	-13.0	26.39	Complied



Lower Band Edge



Upper Band Edge

**Transmitter Radiated Emissions at Band Edges – UAT (continued)****Results: EV-DO Rev. A**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-34.9	-13.0	21.9	Complied
1910	-37.0	-13.0	24.0	Complied
1910.072	-35.6	-13.0	22.6	Complied



Lower Band Edge



Upper Band Edge

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	#1	02 Apr 2017	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	21 Dec 2016	12
A1534	Pre-Amplifier	Hewlett Packard	8449B	3008A00405	19 Dec 2016	12
A1818	Antenna	EMCO	00075692	3118	17 Dec 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 Mar 2017	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	30 Apr 2017	12

### **5.2.8. Transmitter Frequency Stability (Temperature Variation)**

#### **Test Summary:**

<b>Test Engineer:</b>	Stefan Ho	<b>Test Date:</b>	28 June 2016
<b>Test Sample ESN:</b>	80BE0350		

<b>FCC Reference:</b>	Part 24.235 and 2.1055
<b>Test Method Used:</b>	KDB 971168 D01 Section 9, FCC Part 2.1055 and notes below
<b>Test Mode:</b>	RC1/1 with Service Option 2

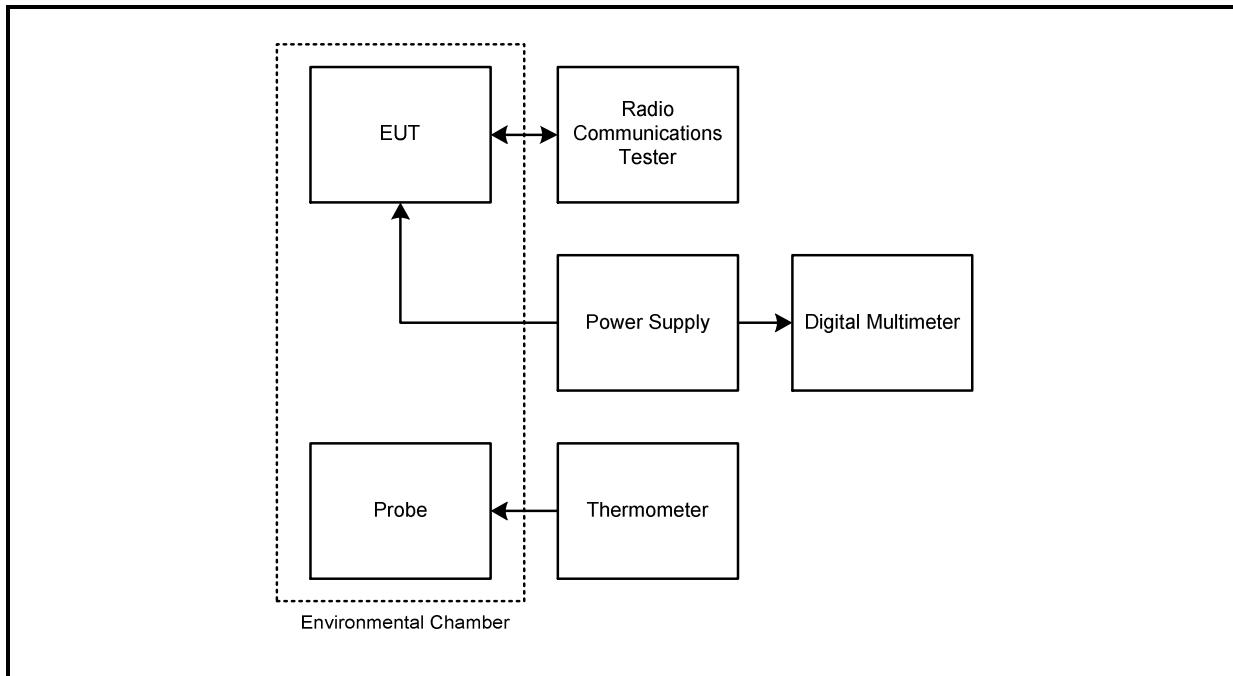
#### **Environmental Conditions:**

<b>Ambient Temperature (°C):</b>	20
<b>Ambient Relative Humidity (%):</b>	42

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

1. Flying leads were connected internally to the EUT in place of the battery. These leads were extended and connected to a bench power supply.
2. Frequency error was measured using a calibrated Rohde & Schwarz CMW 500 Universal Radio Communications Tester in accordance with current Rohde & Schwarz application notes. The EUT was connected by suitable RF cables to the CMW 500. A bi-directional communications link was established between the EUT and CMW 500. The frequency meter value was recorded.
3. Temperature was monitored throughout the test with a calibrated digital thermometer. Nominal voltage was monitored throughout the test with a calibrated digital voltmeter.

#### **Test setup:**



**Transmitter Frequency Stability (Temperature Variation) (continued)****Results: Middle Channel (1880 MHz)**

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	1880.000015	15	0.0080	2.5	2.4920	Complied
-20	1880.000019	19	0.0101	2.5	2.4899	Complied
-10	1880.000019	19	0.0101	2.5	2.4899	Complied
0	1880.000019	19	0.0101	2.5	2.4899	Complied
10	1880.000015	15	0.0080	2.5	2.4920	Complied
20	1880.000011	11	0.0059	2.5	2.4941	Complied
30	1879.999994	-6	0.0032	2.5	2.4968	Complied
40	1879.999990	-10	0.0053	2.5	2.4947	Complied
50	1879.999987	-13	0.0069	2.5	2.4931	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2001	Thermohygrometer	Testo	608-H1	45041824	02 Apr 2017	12
M1869	Radio Comms Tester	Rohde & Schwarz	CMW500	145923	05 Apr 2017	12
S0564	DC power supply	Thurlby Thandar	PL330P	062941	Calibrated before use	-
M1642	Thermometer	Fluke	52II	18890119	25 Apr 2017	12
M122	Multimeter	Fluke	77	64910017	21 Apr 2017	12
M1674	Environmental Chamber	Espec	SU-241	92013139	Calibrated before use	-

**5.2.9. Transmitter Frequency Stability (Voltage Variation)****Test Summary:**

Test Engineer:	Stefan Ho	Test Date:	28 June 2016
Test Sample ESN:	80BE0350		

FCC Reference:	Part 24.235 and 2.1055
Test Method Used:	FCC Part 2.1055 and notes below
Test Mode:	RC1/1 with Service Option 2

**Environmental Conditions:**

Temperature (°C):	20
Ambient Relative Humidity (%):	42

**Note(s):**

1. Flying leads were connected internally to the EUT in place of the battery. These leads were extended and connected to a bench power supply.
2. Frequency error was measured using a calibrated Rohde & Schwarz CMW 500 Universal Radio Communications Tester in accordance with current Rohde & Schwarz application notes. The EUT was connected by suitable RF cables to the CMW 500. A bi-directional communications link was established between the EUT and CMW 500. The frequency meter value was recorded.
3. Voltage was monitored throughout the test with a calibrated digital voltmeter.

**Transmitter Frequency Stability (Voltage Variation) (continued)****Results: Middle Channel (1880 MHz)**

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
3.5	1880.000011	11	0.0059	2.5	2.4941	Complied
4.4	1880.000011	11	0.0059	2.5	2.4941	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2001	Thermohygrometer	Testo	608-H1	45041824	02 Apr 2017	12
M1869	Radio Comms Tester	Rohde & Schwarz	CMW500	145923	05 Apr 2017	12
S0564	DC power supply	Thurlby Thandar	PL330P	062941	Calibrated before use	-
M1642	Thermometer	Fluke	52II	18890119	25 Apr 2017	12
M122	Multimeter	Fluke	77	64910017	21 Apr 2017	12
M1674	Environmental Chamber	Espec	SU-241	92013139	Calibrated before use	-

## **6. 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 of the measurand (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
Conducted Output Power	1850 to 1910 MHz	95%	±1.13 dB
Occupied Bandwidth	1850 to 1910 MHz	95%	±3.92 %
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 19.1 GHz	95%	±2.94 dB
Frequency Stability	1850 to 1910 MHz	95%	±23 Hz

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.

## **7. Report Revision History**

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	- 7 9 14 to 16 All 18 to 20 27 & 33	- - - - - - - -	At the request of the TCB: Changed 'RFID' reference to 'NFC' Updated Section 4.2 Updated UAT power results after retest Changed 'KDB 971168' references to 'KDB 971168 D01' Updated PAPR section Inserted Notes 3 & 5
3.0	- 9	- -	At the request of the TCB: Section 4.2. Inserted Bullet 3

**--- END OF REPORT ---**