



TEST REPORT

Test Report No. : UL-RPT-RP11265293JD07L V2.0

Manufacturer : Apple Inc.
Model No. : A1785
FCC ID : BCG-E3088A
Technology : PCS1900
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 2.0 supersedes all previous versions.

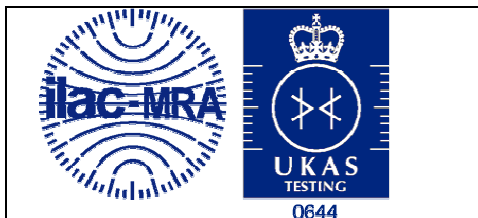
Date of Issue: 03 August 2016

Checked by:

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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.

UL VS LTD

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1. Customer Information








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

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR24
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 24 Subpart E (Personal Communication Services)
Site Registration:	209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	02 June 2016 to 21 July 2016

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 24.232(c)	Transmitter Output Power (EIRP)	
Part 2.1055/24.235	Transmitter Frequency Stability (Temperature and Voltage Variation)	
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	
Key to Results  = Complied  = Did not comply		

2.3. Methods and Procedures

Reference:	FCC KDB 971168 D01 v02r02, October 17 2014
Title:	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) (continued)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Apple
Model Name or Number:	A1785
Test Sample IMEI:	358640070266615 (<i>Conducted Sample #1</i>)
Hardware Version:	REV1.0
Software Version:	iOS: 14A298, BB FW: 0.25.02
FCC ID:	BCG-E3088A

Brand Name:	Apple
Model Name or Number:	A1785
Test Sample IMEI:	358640070295523 (<i>Radiated Sample #1</i>)
Hardware Version:	REV1.0
Software Version:	iOS: 14A298, BB FW: 0.25.02
FCC ID:	BCG-E3088A

Brand Name:	Apple
Model Name or Number:	A1785
Test Sample IMEI:	358640070269536 (<i>Radiated Sample #2</i>)
Hardware Version:	REV1.0
Software Version:	iOS: 14A298, BB FW: 0.25.02
FCC ID:	BCG-E3088A

Brand Name:	Apple
Model Name or Number:	A1785
Test Sample IMEI:	358640070285482 (<i>Conducted Sample #2</i>)
Hardware Version:	REV1.0
Software Version:	iOS: 14A298, BB FW: 0.25.02
FCC ID:	BCG-E3088A

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

Technology Tested:	PCS1900		
Type of Radio Device:	Transceiver		
Mode:	GSM/GPRS/EGPRS		
Modulation Type:	GMSK / 8PSK		
Channel Spacing:	200 kHz		
Power Supply Requirement(s):	Nominal	3.8 VDC	
	Minimum	3.4 VDC	
	Maximum	4.3 VDC	
Transmit Frequency Range:	1850 to 1910 MHz		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	512	1850.2
	Middle	660	1879.8
	Top	810	1909.8

3.5. Support Equipment

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

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	Latitude E5410
Serial Number:	UL Asset No. 00763

Description:	USB diagnostic cable
Brand Name:	Not stated
Model Name or Number:	Kong
Serial Number:	202D5E

Description:	Personal Hands Free (PHF)
Brand Name:	Apple
Model Name or Number:	Apple Ear Plugs
Serial Number:	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, EIRP and band edge tests were performed with the EUT transmitting on a single timeslot. EIRP was also measured with the EUT transmitting on two timeslots.
- EGPRS tests were performed with the EUT using MCS5 (8PSK modulation).
- Transmitter radiated spurious emissions were checked in all modes during pre-scans. Circuit switched voice was found to be the worst case and all final measurements were performed with the EUT transmitting on a single timeslot in this mode.

4.2. Configuration and Peripherals

- 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. 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.
 - o LAT – Lower Antenna (Primary)
 - o 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:	Roy Chen	Test Date:	14 July 2016
Test Sample IMEI:	358640070285482		

FCC Reference:	Part 24.232(c)
Test Method Used:	KDB 971168 D01 Section 5.1.1

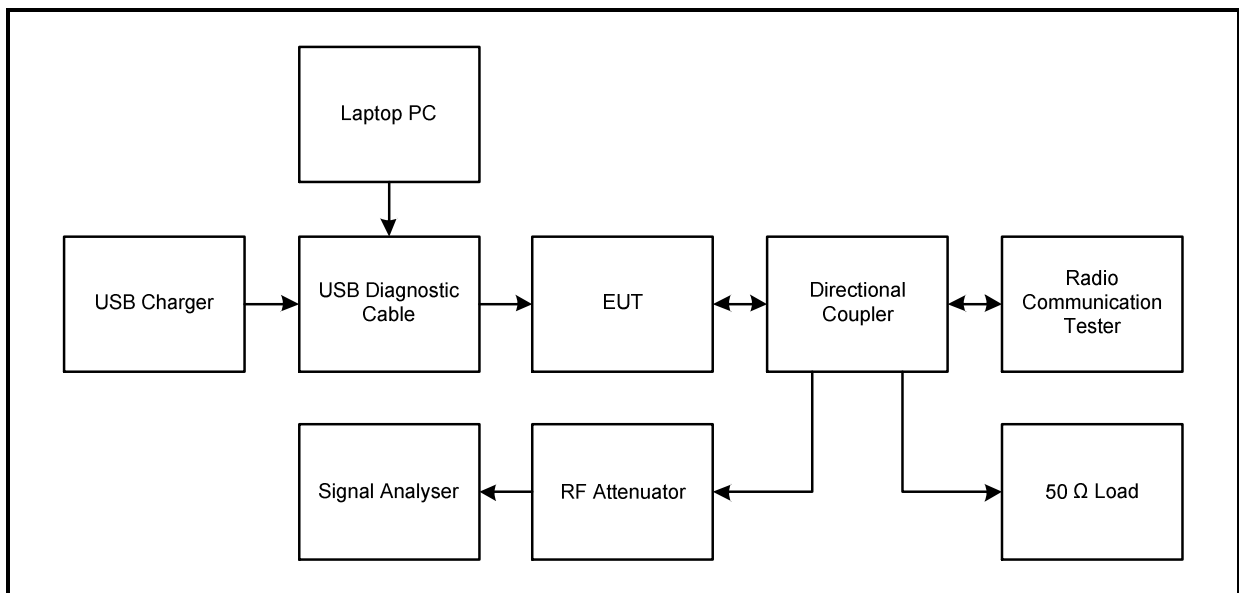
Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	40

Note(s):

1. The signal analyser was connected to the RF port on the EUT via the coupled port on an RF directional 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, attenuators and RF cables. The through port on the RF coupler was connected to an R&S CMW 500 Radio Communications Tester.
2. The EUT was transmitting at maximum power on a single timeslot.
3. The manufacturer stated a maximum antenna gain of 0.9 dBi. The antenna gain was added to the conducted peak output power to obtain the radiated power. The radiated power was subtracted from the limit to show the margin.

Test setup:



Transmitter Output Power (EIRP) (continued)**Results: GSM Circuit Switched**

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	30.5	0.9	31.4	33.0	1.6	Complied
Middle	1879.8	29.9	0.9	30.8	33.0	2.2	Complied
Top	1909.8	29.5	0.9	30.4	33.0	2.6	Complied

Results: GPRS

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	30.6	0.9	31.5	33.0	1.5	Complied
Middle	1879.8	29.9	0.9	30.8	33.0	2.2	Complied
Top	1909.8	29.5	0.9	30.4	33.0	2.6	Complied

Results: EGPRS / MCS5

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	30.6	0.9	31.5	33.0	1.5	Complied
Middle	1879.8	29.9	0.9	30.8	33.0	2.2	Complied
Top	1909.8	29.5	0.9	30.4	33.0	2.6	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608 H1	45041825	02 Apr 2017	12
A2503	Directional Coupler	AtlanTecRF	CDC-003060-10	13122501838	Calibrated before use	-
A2527	Attenuator	AtlanTecRF	AN18W5-20	832828#2	Calibrated before use	-
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	02 Mar 2017	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Thermal Power Sensor	Rohde & Schwarz	NRV-Z52	100155	15 Apr 2018	24
M1021	Signal Generator	Rohde & Schwarz	SMP02	833286/004	19 May 2017	12

Transmitter Output Power (EIRP) (continued)**Test Summary:**

Test Engineer:	Roy Chen	Test Date:	14 July 2016
Test Sample IMEI:	358640070285482		

FCC Reference:	Part 24.232(c)
Test Method Used:	KDB 971168 D01 Section 5.1.1

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	40

Note(s):

1. The signal analyser was connected to the RF port on the EUT via the coupled port on an RF directional 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, attenuators and RF cables. The through port on the RF coupler was connected to an R&S CMW 500 Radio Communications Tester.
2. The EUT was transmitting at maximum power on two adjacent timeslots.
3. The manufacturer stated a maximum antenna gain of 0.9 dBi. The antenna gain was added to the conducted peak output power to obtain the radiated power. The radiated power was subtracted from the limit to show the margin.

Transmitter Output Power (EIRP) (continued)**Results: GPRS / 2 Timeslots**

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	29.8	0.9	30.7	33.0	2.3	Complied
Middle	1879.8	29.1	0.9	30.0	33.0	3.0	Complied
Top	1909.8	28.8	0.9	29.7	33.0	3.3	Complied

Results: EGPRS / MCS5 / 2 Timeslots

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	29.8	0.9	30.7	33.0	2.3	Complied
Middle	1879.8	29.1	0.9	30.0	33.0	3.0	Complied
Top	1909.8	28.8	0.9	29.7	33.0	3.3	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608 H1	45041825	02 Apr 2017	12
A2503	Directional Coupler	AtlanTecRF	CDC-003060-10	13122501838	Calibrated before use	-
A2527	Attenuator	AtlanTecRF	AN18W5-20	832828#2	Calibrated before use	-
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	02 Mar 2017	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Thermal Power Sensor	Rohde & Schwarz	NRV-Z52	100155	15 Apr 2018	24
M1021	Signal Generator	Rohde & Schwarz	SMP02	833286/004	19 May 2017	12

5.2.2. Transmitter E.I.R.P. - UAT**Test Summary:**

Test Engineer:	Roy Chen	Test Date:	14 July 2016
Test Sample IMEI:	358640070285482		

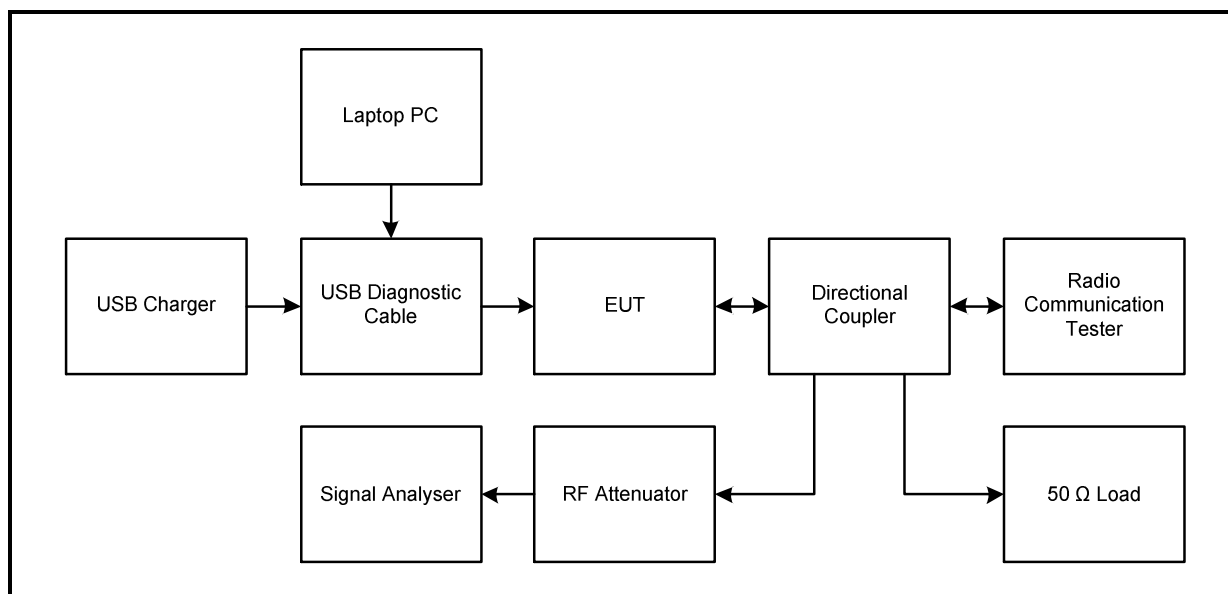
FCC Reference:	Part 24.232(c)
Test Method Used:	KDB 971168 D01 Section 5.1.1

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	40

Note(s):

1. The signal analyser was connected to the RF port on the EUT via the coupled port on an RF directional 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, attenuators and RF cables. The through port on the RF coupler was connected to an R&S CMW 500 Radio Communications Tester.
2. The EUT was transmitting at maximum power on a single timeslot.
3. The manufacturer stated a maximum antenna gain of -0.7 dBi. The antenna gain was added to the conducted peak output power to obtain the radiated power. The radiated power was subtracted from the limit to show the margin.

Test setup:

Transmitter Output Power (EIRP) (continued)**Results: GSM Circuit Switched**

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	24.5	-0.7	23.8	33.0	9.2	Complied
Middle	1879.8	24.5	-0.7	23.8	33.0	9.2	Complied
Top	1909.8	24.0	-0.7	23.3	33.0	9.7	Complied

Results: GPRS

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	24.5	-0.7	23.8	33.0	9.2	Complied
Middle	1879.8	24.6	-0.7	23.9	33.0	9.1	Complied
Top	1909.8	24.0	-0.7	23.3	33.0	9.7	Complied

Results: EGPRS / MCS5

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	24.6	-0.7	23.9	33.0	9.1	Complied
Middle	1879.8	23.5	-0.7	23.8	33.0	9.2	Complied
Top	1909.8	24.1	-0.7	23.4	33.0	9.6	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608 H1	45041825	02 Apr 2017	12
A2503	Directional Coupler	AtlanTecRF	CDC-003060-10	13122501838	Calibrated before use	-
A2527	Attenuator	AtlanTecRF	AN18W5-20	832828#2	Calibrated before use	-
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	02 Mar 2017	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Thermal Power Sensor	Rohde & Schwarz	NRV-Z52	100155	15 Apr 2018	24
M1021	Signal Generator	Rohde & Schwarz	SMP02	833286/004	19 May 2017	12

Transmitter Output Power (EIRP) (continued)**Test Summary:**

Test Engineer:	Roy Chen	Test Date:	14 July 2016
Test Sample IMEI:	358640070285482		

FCC Reference:	Part 24.232(c)
Test Method Used:	KDB 971168 D01 Section 5.1.1

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	40

Note(s):

1. The signal analyser was connected to the RF port on the EUT via the coupled port on an RF directional 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, attenuators and RF cables. The through port on the RF coupler was connected to an R&S CMW 500 Radio Communications Tester.
2. The EUT was transmitting at maximum power on two adjacent timeslots.
3. The manufacturer stated a maximum antenna gain of -0.7 dBi. The antenna gain was added to the conducted peak output power to obtain the radiated power. The radiated power was subtracted from the limit to show the margin.

Transmitter Output Power (EIRP) (continued)**Results: GPRS / 2 Timeslots**

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	23.2	-0.7	22.5	33.0	10.5	Complied
Middle	1879.8	23.4	-0.7	22.7	33.0	10.3	Complied
Top	1909.8	23.0	-0.7	22.3	33.0	10.7	Complied

Results: EGPRS / MCS5 / 2 Timeslots

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	23.3	-0.7	22.6	33.0	10.4	Complied
Middle	1879.8	23.5	-0.7	22.8	33.0	10.2	Complied
Top	1909.8	23.1	-0.7	22.4	33.0	10.6	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608 H1	45041825	02 Apr 2017	12
A2503	Directional Coupler	AtlanTecRF	CDC-003060-10	13122501838	Calibrated before use	-
A2527	Attenuator	AtlanTecRF	AN18W5-20	832828#2	Calibrated before use	-
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	02 Mar 2017	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Thermal Power Sensor	Rohde & Schwarz	NRV-Z52	100155	15 Apr 2018	24
M1021	Signal Generator	Rohde & Schwarz	SMP02	833286/004	19 May 2017	12

5.2.3. Transmitter Occupied Bandwidth

Test Summary:

Test Engineer:	Roy Chen	Test Date:	14 July 2016
Test Sample IMEI:	358640070285482		

FCC Reference:	Part 2.1049
Test Method Used:	KDB 971168 D01 Section 4.2

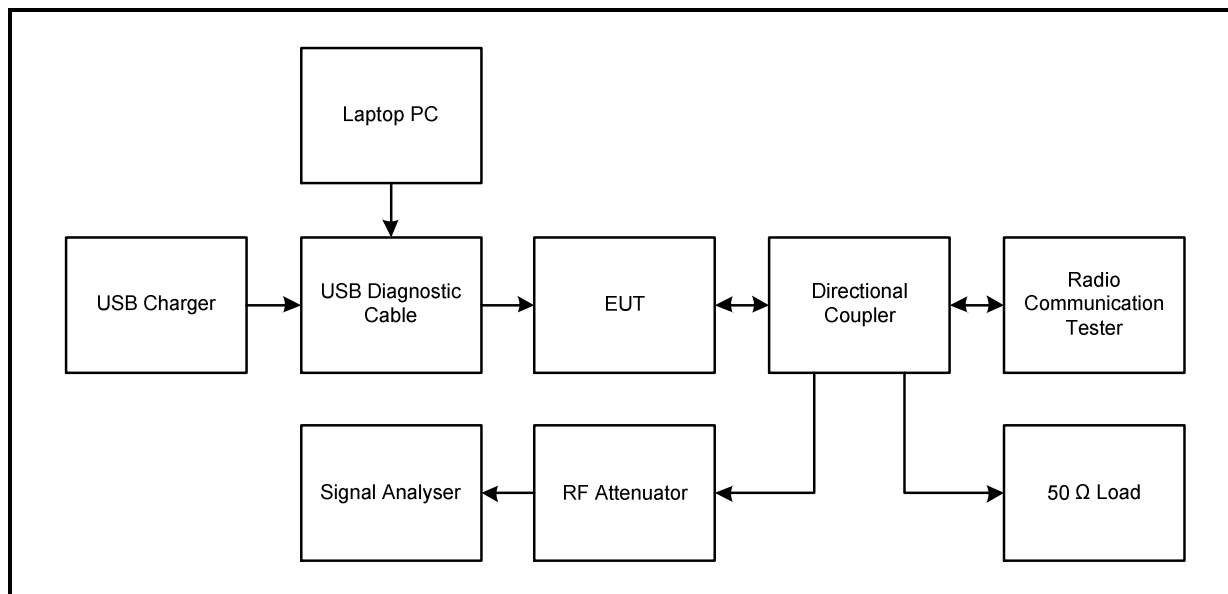
Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	40

Note(s):

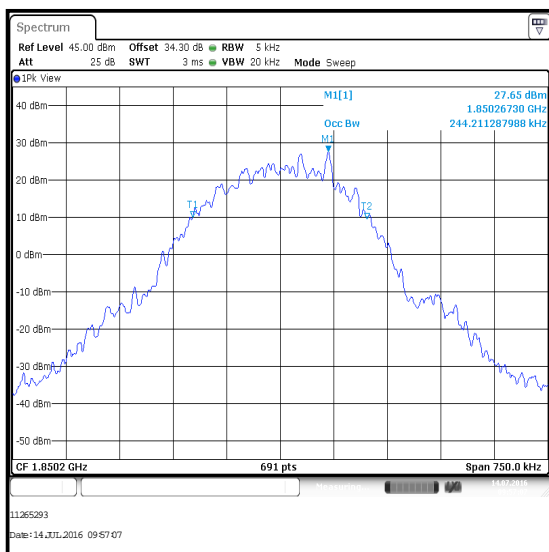
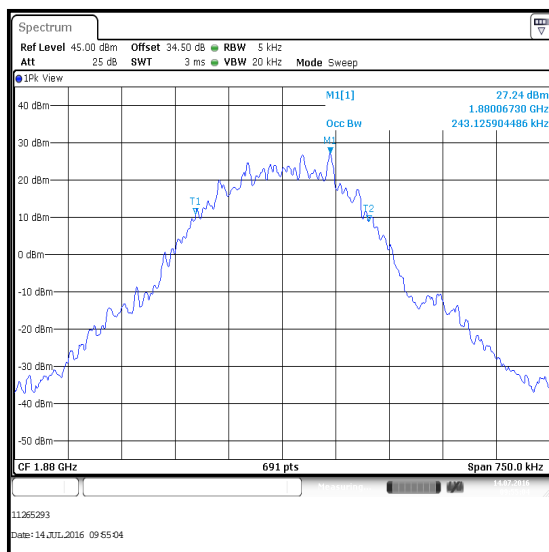
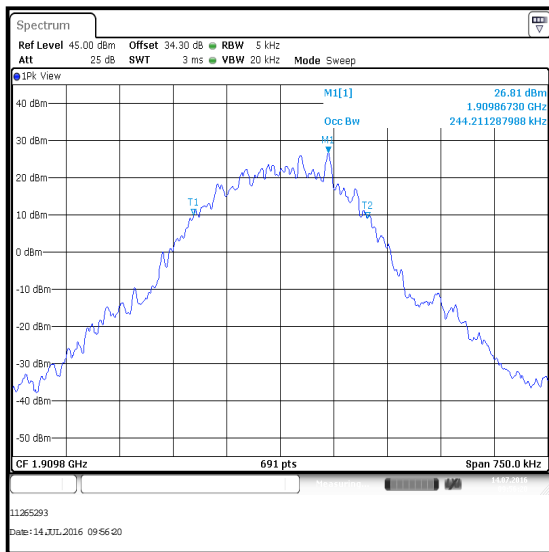
1. Occupied bandwidth (99% bandwidth) was measured using a signal analyser occupied bandwidth function.
2. The RF port of the EUT was connected to the signal analyser via RF cables, directional coupler and suitable attenuation.

Test setup:



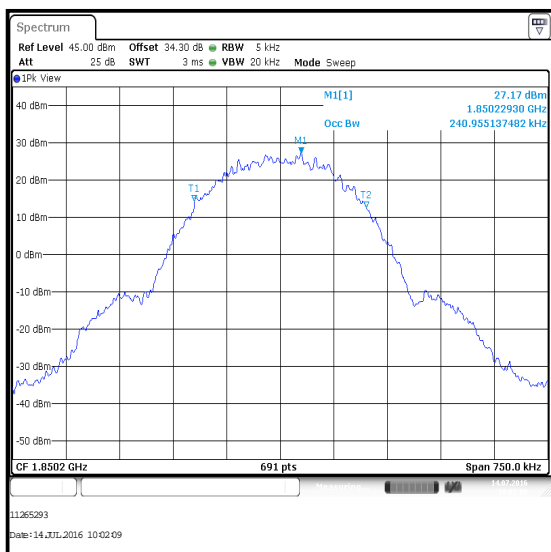
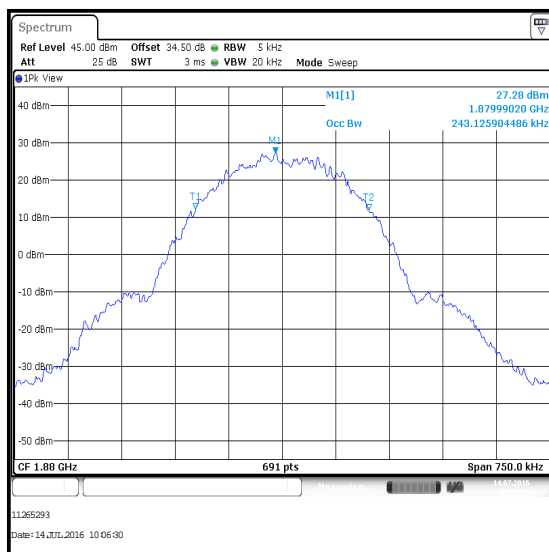
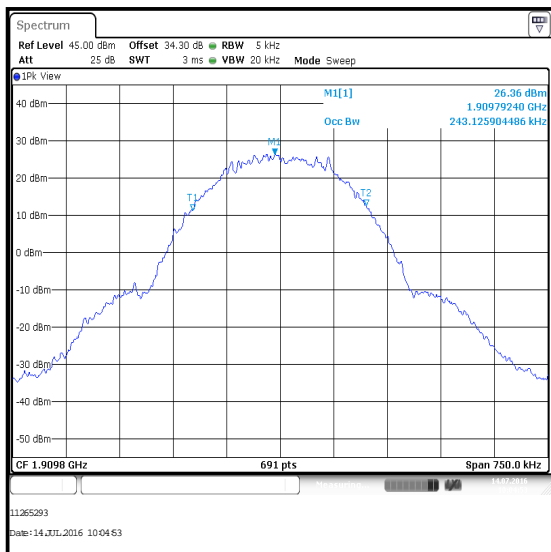
Transmitter Occupied Bandwidth (continued)**Results: GSM Circuit Switched**

Channel	Frequency (MHz)	Occupied Bandwidth (kHz)
Bottom	1850.2	244.211
Middle	1879.8	243.126
Top	1909.8	244.211

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

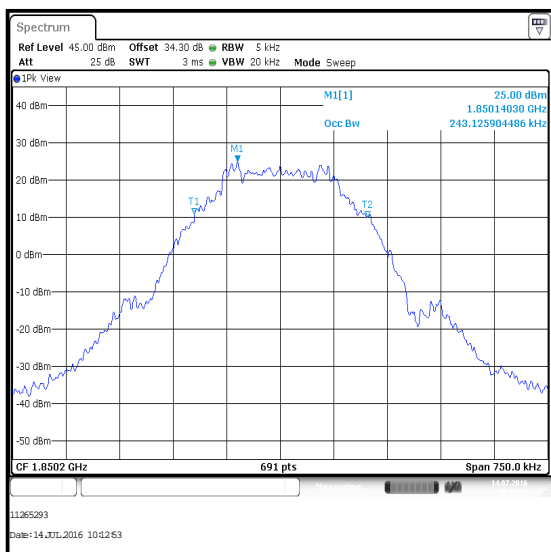
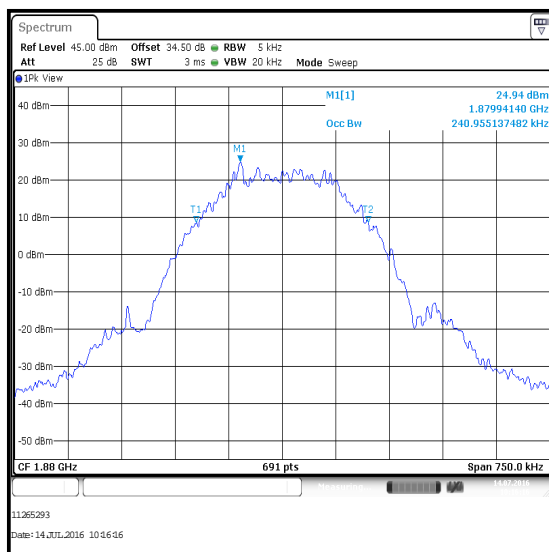
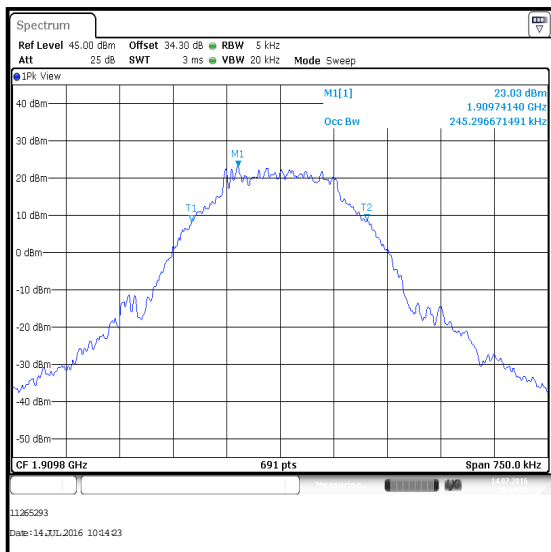
Transmitter Occupied Bandwidth (continued)**Results: GPRS**

Channel	Frequency (MHz)	Occupied Bandwidth (kHz)
Bottom	1850.2	240.955
Middle	1879.8	243.126
Top	1909.8	243.126

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

Transmitter Occupied Bandwidth (continued)**Results: EGPRS / MCS5**

Channel	Frequency (MHz)	Occupied Bandwidth (kHz)
Bottom	1850.2	243.126
Middle	1879.8	240.955
Top	1909.8	245.297

**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)
M2002	Thermohygrometer	Testo	608 H1	45041825	02 Apr 2017	12
A2503	Directional Coupler	AtlanTecRF	CDC-003060-10	13122501838	Calibrated before use	-
A2527	Attenuator	AtlanTecRF	AN18W5-20	832828#2	Calibrated before use	-
M1996	Signal Analyser	Rohde & Schwarz	FSV13	100975	02 Mar 2017	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	11 Apr 2018	24
M1267	Thermal Power Sensor	Rohde & Schwarz	NRV-Z52	100155	15 Apr 2018	24
M1021	Signal Generator	Rohde & Schwarz	SMP02	833286/004	19 May 2017	12

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

Test Engineer:	David Doyle	Test Dates:	19 July 2016 & 21 July 2016
Test Sample IMEI:	358640070295523		

FCC Reference:	Parts 2.1053 & 24.238
Test Method Used:	Part 24.238(b), KDB 971168 D01 Section 6, Section 7 & Notes below
Frequency Range:	30 MHz to 20 GHz
Configuration:	GSM Circuit Switched

Environmental Conditions:

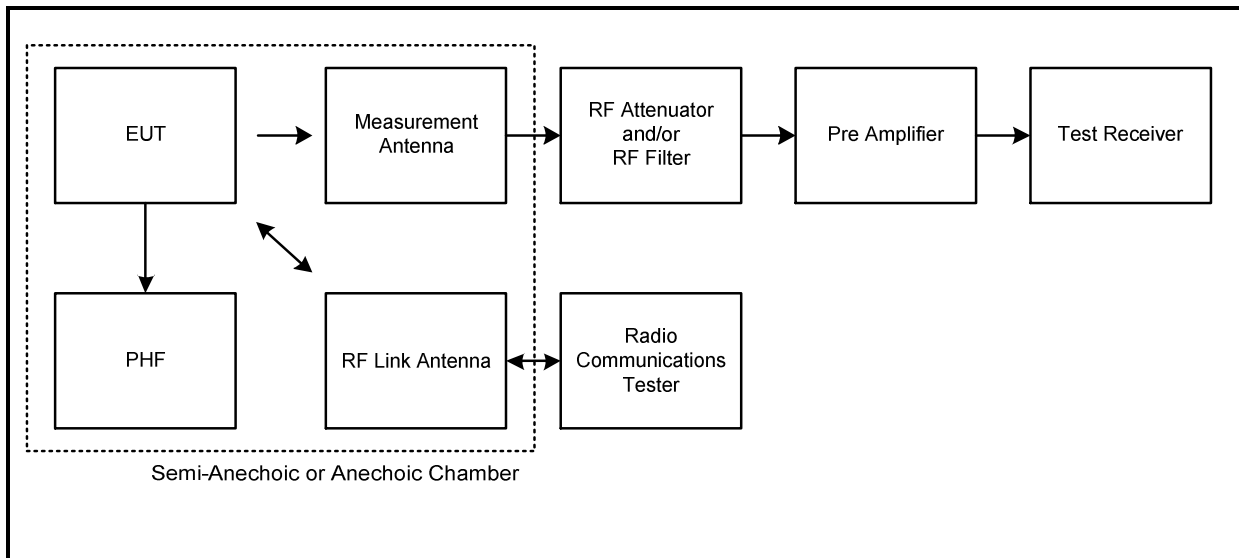
Temperature (°C):	24 to 26
Relative Humidity (%):	42 to 44

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 value of the highest emission is 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. Measurements were performed in a semi-anechoic/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 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. A peak detector and trace mode of Max Hold were used to perform pre-scans, with markers placed on the highest measured 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

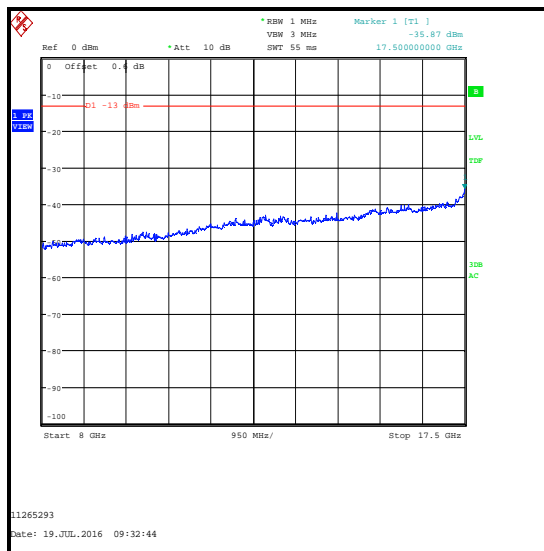
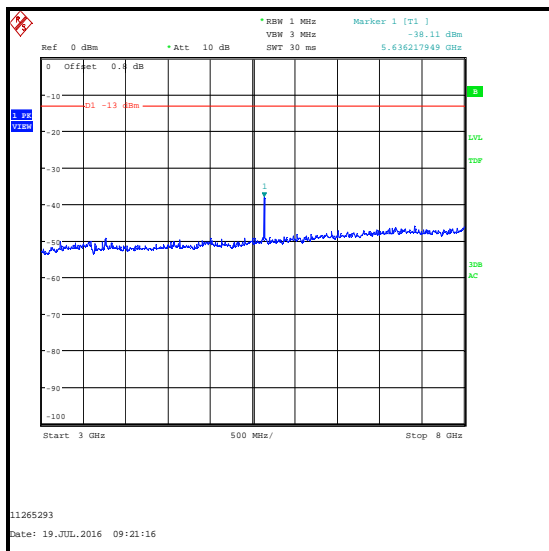
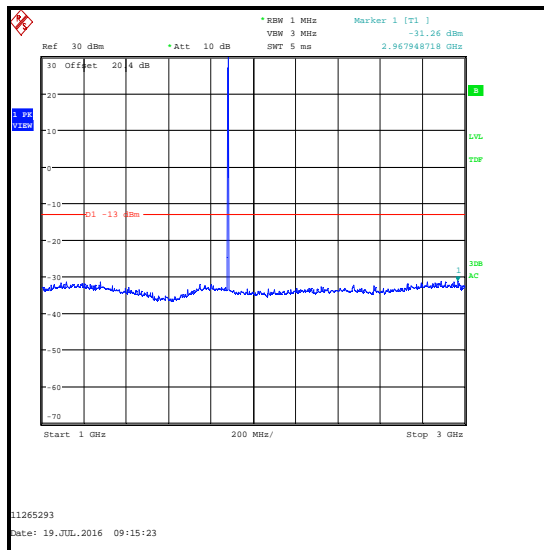
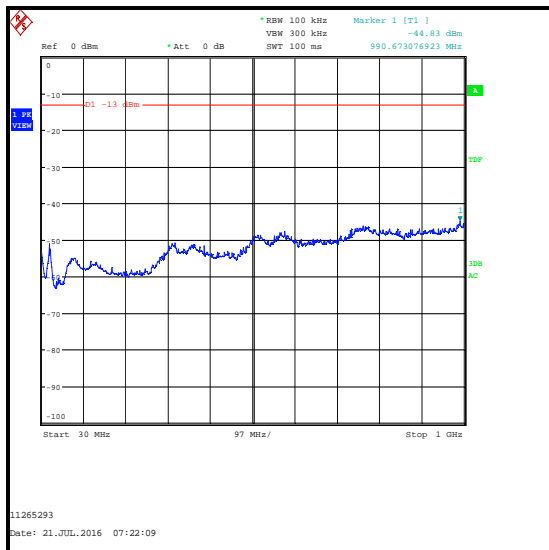
Transmitter Out of Band Radiated Emissions (continued) - LAT

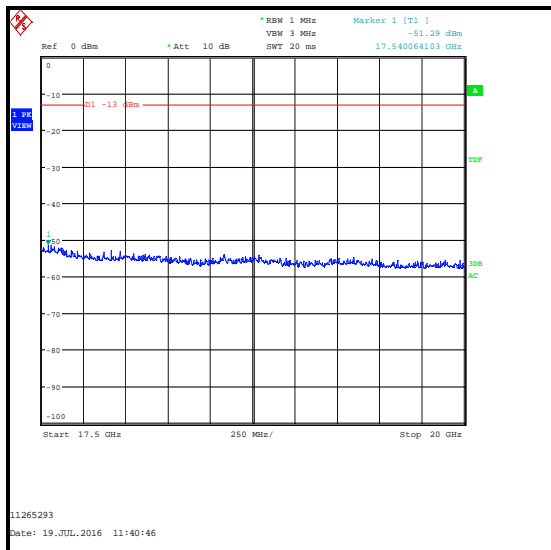
Test setup for radiated measurements:



Results: Middle Channel

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
5636.218	-38.1	-13.0	25.1	Complied

Transmitter Out of Band Radiated Emissions (continued) - LAT

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B	07 Apr 2017	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	06 May 2017	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	07 Apr 2017	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	07 Jan 2017	12
A2891	Pre-Amplifier	Schwarzbeck	BBV 9718	9718-306	07 Apr 2017	12
A2893	Pre-Amplifier	Schwarzbeck	BBV 9721	9721-021	07 Apr 2017	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	19 May 2017	12
A2947	High Pass Filter	AtlanTecRF	AFH-07000	1601900001	01 Jun 2017	12
A2918	Attenuator	AtlanTecRF	AN185W-20	832828#1	19 May 2017	12

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

Test Engineer:	David Doyle	Test Dates:	19 July 2016 & 21 July 2016
Test Sample IMEI:	358640070269536		

FCC Reference:	Parts 2.1053 & 24.238
Test Method Used:	Part 24.238(b), KDB 971168 D01 Section 6, Section 7 & Notes below
Frequency Range:	30 MHz to 20 GHz
Configuration:	GSM Circuit Switched

Environmental Conditions:

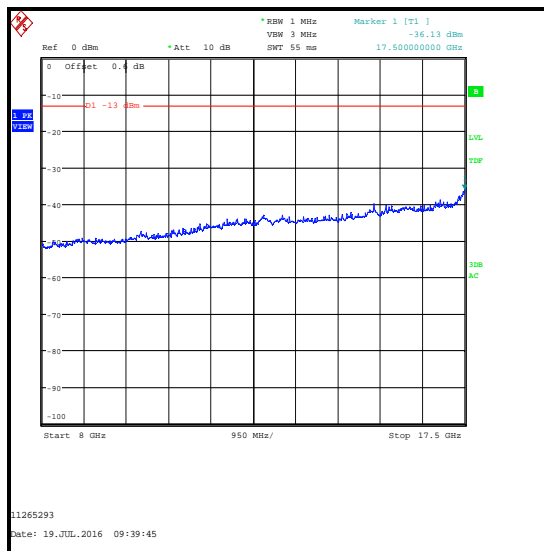
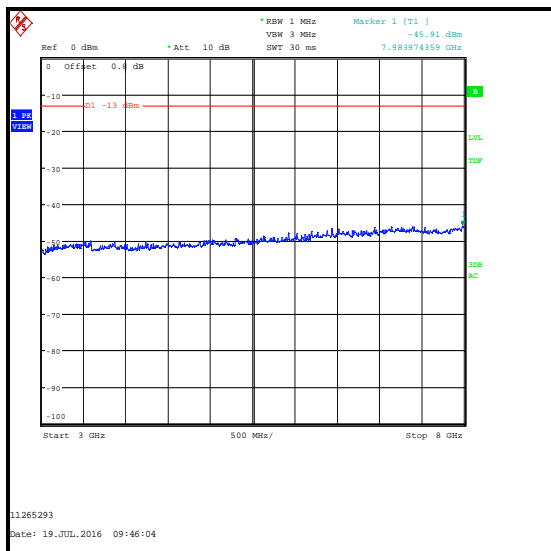
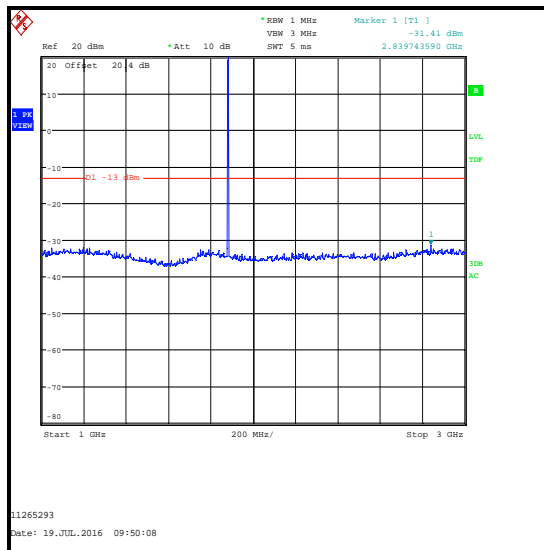
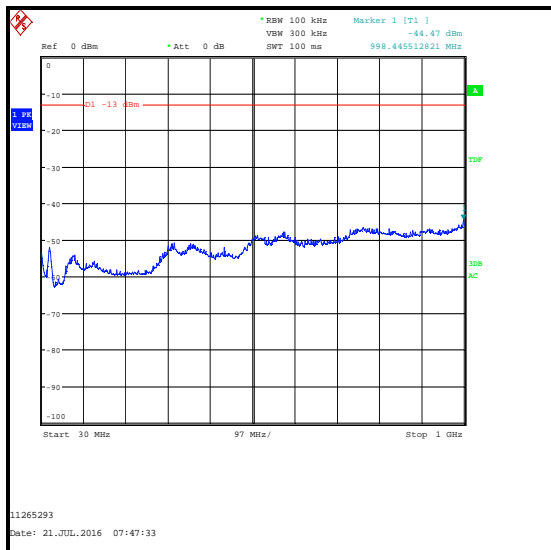
Temperature (°C):	24 to 26
Relative Humidity (%):	42 to 44

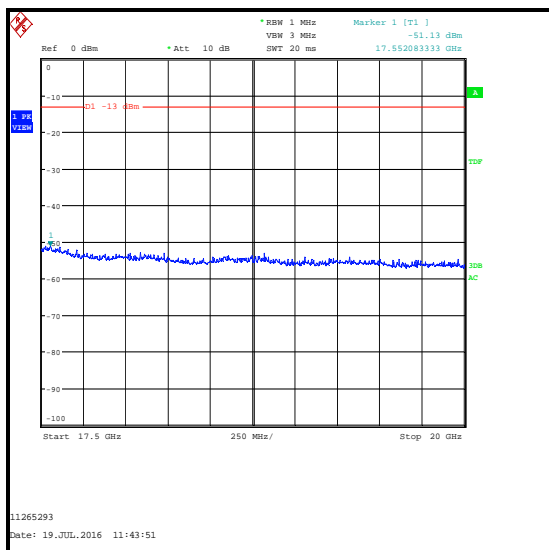
Note(s):

1. The uplink traffic channel is shown on the 1 GHz to 3 GHz plot.
2. No spurious emissions were detected above the noise floor of the measuring receiver, the highest peak noise floor reading of the measuring receiver was recorded.
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. Measurements were performed in a semi-anechoic/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 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. A peak detector and trace mode of Max Hold were used to perform pre-scans, with markers placed on the highest measured 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.

Results: Middle Channel

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
2839.744	-31.4	-13.0	28.4	Complied

Transmitter Out of Band Radiated Emissions (continued) - UAT

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B	07 Apr 2017	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	06 May 2017	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	07 Apr 2017	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	07 Jan 2017	12
A2891	Pre-Amplifier	Schwarzbeck	BBV 9718	9718-306	07 Apr 2017	12
A2893	Pre-Amplifier	Schwarzbeck	BBV 9721	9721-021	07 Apr 2017	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	19 May 2017	12
A2947	High Pass Filter	AtlanTecRF	AFH-07000	1601900001	01 Jun 2017	12
A2918	Attenuator	AtlanTecRF	AN185W-20	832828#1	19 May 2017	12

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

Test Engineer:	David Doyle	Test Date:	21 July 2016
Test Sample IMEI:	358640070295523		

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:

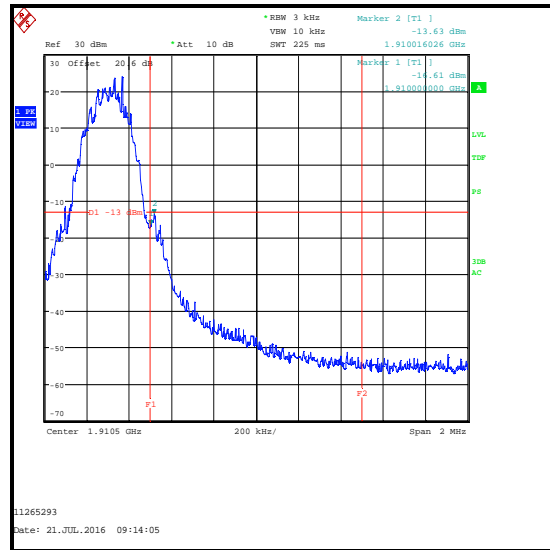
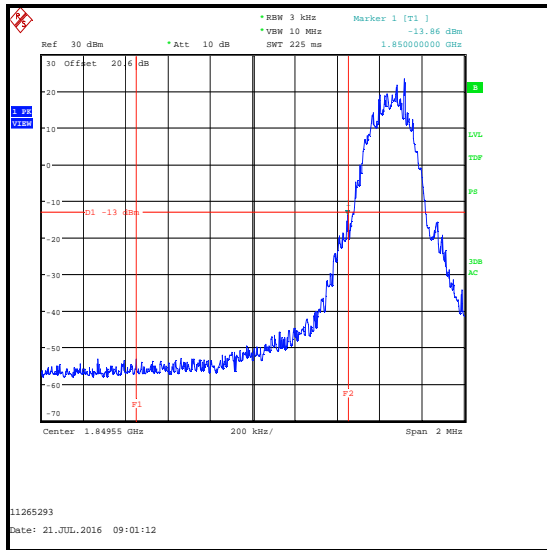
Temperature (°C):	24
Relative Humidity (%):	46

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 operating band, the test receiver resolution bandwidth was set to 3 kHz (1% of 300 kHz, the 26 dB emission bandwidth) and video bandwidth 10 kHz (as close to three times the resolution bandwidth as the test receiver allowed). Sweep time was set to auto and a peak detector with a trace mode of Max Hold was used.

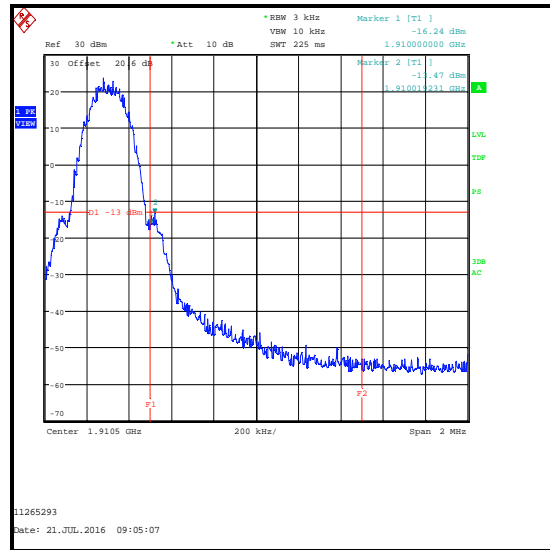
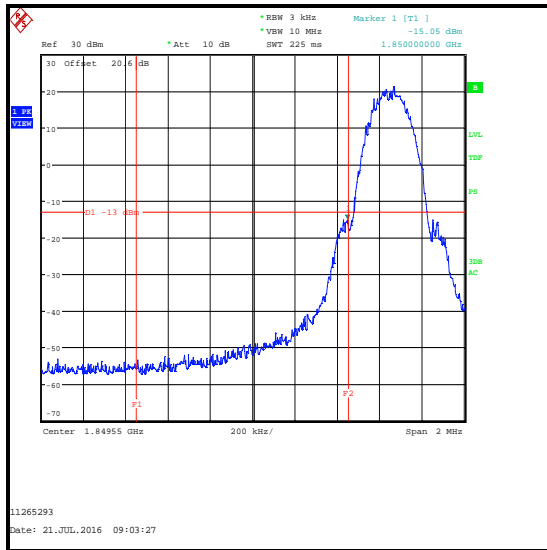
Transmitter Band Edge Radiated Emissions – LAT (continued)**Results: GSM Circuit Switched**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-13.9	-13.0	0.9	Complied
1910	-16.1	-13.0	3.1	Complied
1910.016	-13.6	-13.0	0.6	Complied



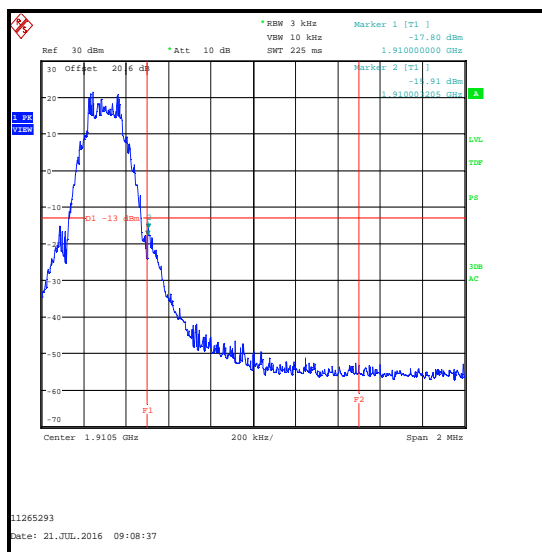
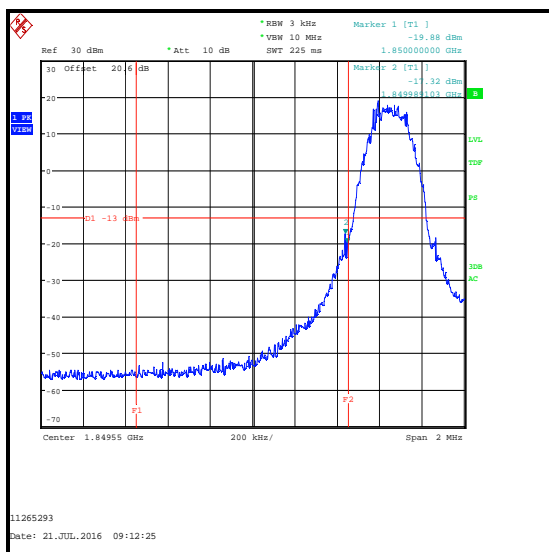
Transmitter Band Edge Radiated Emissions – LAT (continued)**Results: GPRS**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-15.0	-13.0	2.0	Complied
1910	-16.2	-13.0	3.2	Complied
1910.019	-13.5	-13.0	0.5	Complied



Transmitter Band Edge Radiated Emissions – LAT (continued)**Results: EGPRS / MCS5**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1849.989	-17.3	-13.0	4.3	Complied
1850	-19.9	-13.0	6.9	Complied
1910	-17.8	-13.0	4.8	Complied
1910.003	-15.9	-13.0	2.9	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	Not stated	02 Apr 20107	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	21 Dec 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 Mar 2017	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	19 Dec 2016	12
A1818	Antenna	EMCO	3115	00075692	17 Dec 2016	12
A1393	Attenuator	Huber & Suhner	6820.17.B	757456	26 Apr 2017	12

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

Test Engineer:	David Doyle	Test Date:	18 July 2016
Test Sample IMEI:	358640070269536		

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:

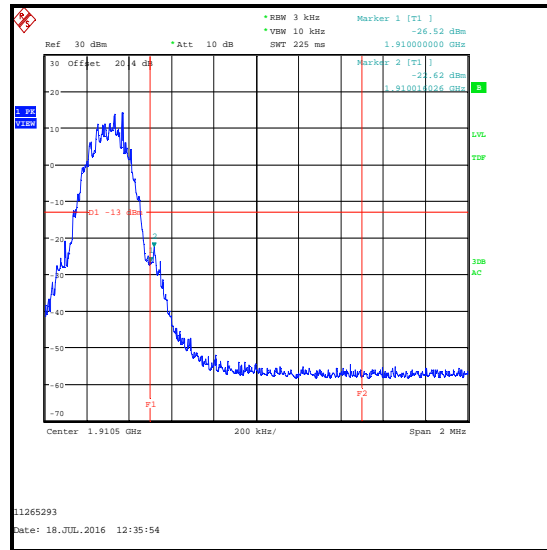
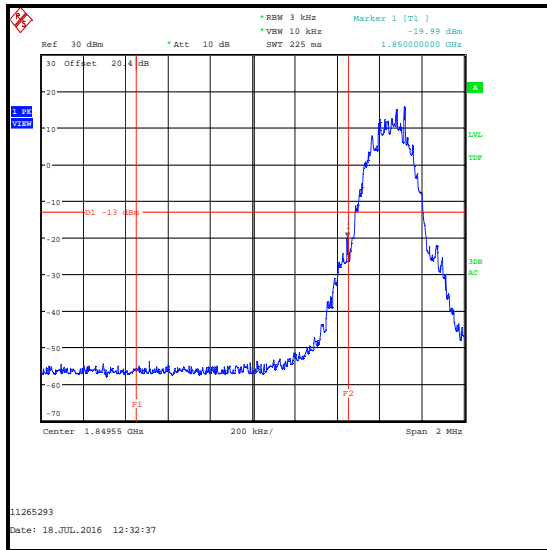
Temperature (°C):	26
Relative Humidity (%):	44

Note(s):

1. Measurements 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. 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 operating band, the test receiver resolution bandwidth was set to 3 kHz (1% of 300 kHz, the 26 dB emission bandwidth) and video bandwidth 10 kHz (as close to three times the resolution bandwidth as the test receiver allowed). Sweep time was set to auto and a peak detector with a trace mode of Max Hold was used.

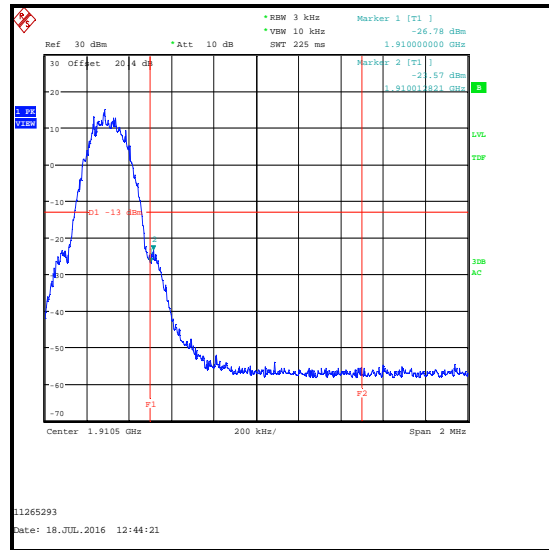
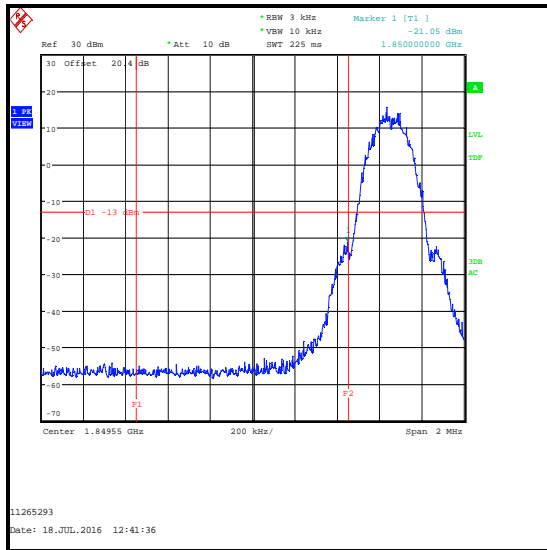
Transmitter Band Edge Radiated Emissions (continued) - UAT**Results: GSM Circuit Switched**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-20.0	-13.0	7.0	Complied
1910	-26.5	-13.0	13.5	Complied
1910.002	-22.6	-13.0	9.6	Complied



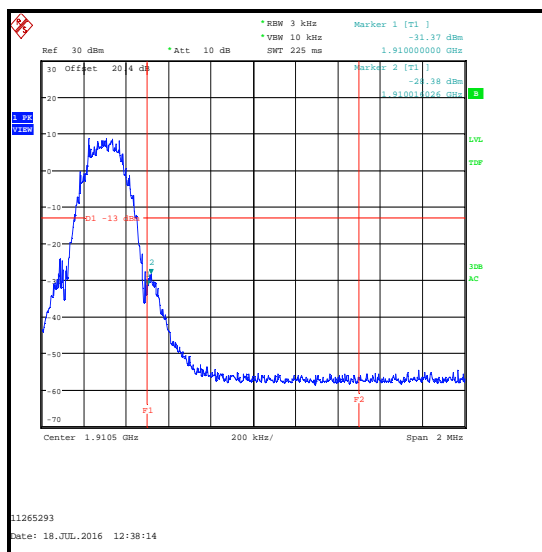
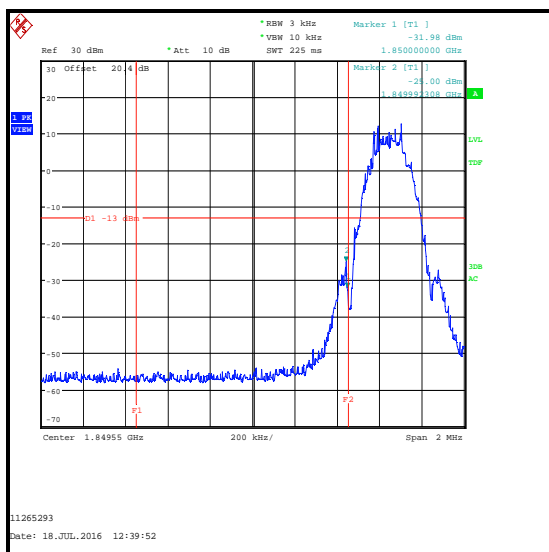
Transmitter Band Edge Radiated Emissions (continued) - UAT**Results: GPRS**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-21.0	-13.0	8.0	Complied
1910	-26.8	-13.0	13.8	Complied
1910.002	-23.6	-13.0	10.6	Complied



Transmitter Band Edge Radiated Emissions (continued) - UAT**Results: EGPRS / MCS5**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1849.992	-25.0	-13.0	12.0	Complied
1850	-32.0	-13.0	19.0	Complied
1910	-31.4	-13.0	18.4	Complied
1910.016	-28.4	-13.0	15.4	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	07 Apr 2017	12
A2918	Attenuator	AtlanTecRF	AN185W-20	832828#1	19 May 2017	12

5.2.8. Transmitter Frequency Stability (Temperature Variation)**Test Summary:**

Test Engineer:	Stefan Ho	Test Dates:	03 June 2016 & 09 June 2016
Test Sample IMEI:	358640070266615		

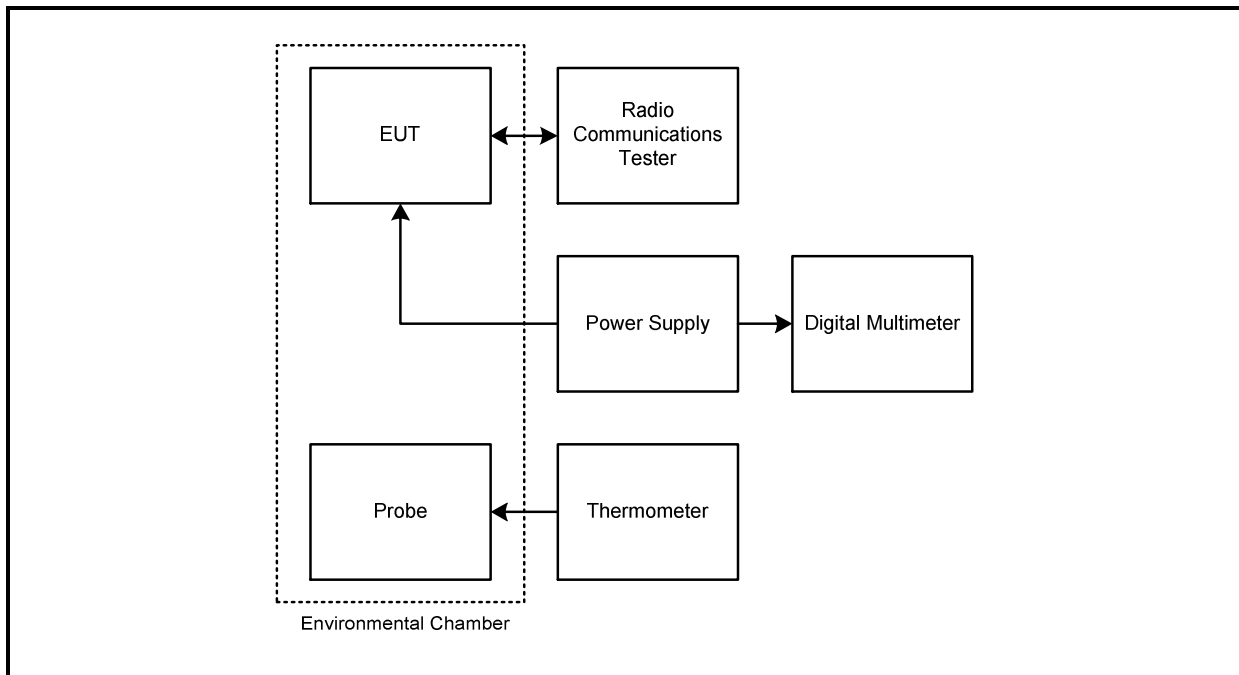
FCC Reference:	Parts 24.235 / 2.1055
Test Method Used:	FCC Part 2.1055 and notes below
Test Mode:	Voice

Environmental Conditions:

Ambient Temperature (°C):	23
Ambient Relative Humidity (%):	46 to 48

Note(s):

1. Flying leads were connected internally to the EUT in place of the battery. These leads extended and connected to a bench power supply.
2. Frequency error was measured using a calibrated Rohde and Schwarz CMW 500 Universal Radio Communications Tester in accordance with current Rohde and 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.

Test setup:

Transmitter Frequency Stability (Temperature Variation) (continued)**Results: Bottom Channel (1850.2 MHz)**

Temperature (°C)	Frequency Error (Hz)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
-30	20	1850.200020	1850.0	0.200020	Complied
-20	28	1850.200028	1850.0	0.200028	Complied
-10	12	1850.200012	1850.0	0.200012	Complied
0	28	1850.200028	1850.0	0.200028	Complied
10	12	1850.200012	1850.0	0.200012	Complied
20	20	1850.200020	1850.0	0.200020	Complied
30	20	1850.200020	1850.0	0.200020	Complied
40	19	1850.199981	1850.0	0.199981	Complied
50	20	1850.200020	1850.0	0.200020	Complied

Results: Top Channel (1909.8 MHz)

Temperature (°C)	Frequency Error (Hz)	Measured Frequency (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Result
-30	15	1909.799985	1910.0	0.200015	Complied
-20	18	1909.800018	1910.0	0.199982	Complied
-10	22	1909.800022	1910.0	0.199978	Complied
0	16	1909.800016	1910.0	0.199984	Complied
10	15	1909.799985	1910.0	0.200015	Complied
20	17	1909.800017	1910.0	0.199983	Complied
30	13	1909.799987	1910.0	0.200013	Complied
40	22	1909.800022	1910.0	0.199978	Complied
50	17	1909.800017	1910.0	0.199983	Complied

Transmitter Frequency Stability (Temperature Variation) (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1869	Wideband Radio Comms Tester	Rohde & Schwarz	CMW 500	145923	05 April 2017	12
M1815	Environmental Chamber	Votsch	VT4002	521/83083	Calibrated before use	-
M1642	Thermometer	Fluke	52II	18890119	25 April 2017	12
S021	Dual DC power supply	Thurlby Thandar Instruments	CPX200	061034	Calibrated before use	-
M1269	Multimeter	Fluke	179	90250210	13 May 2017	12
M2002	Thermohygrometer	Testo	608-H1	45041825	02 April 2017	12

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

Test Engineer:	Stefan Ho	Test Date:	02 June 2016
Test Sample IMEI:	358640070266615		

FCC Reference:	Parts 24.235 / 2.1055
Test Method Used:	FCC Part 2.1055 and notes below
Test Mode:	Voice

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	48

Note(s):

1. Flying leads were connected internally to the EUT in place of the battery. These leads extended and connected to a bench power supply.
2. Frequency error was measured using a calibrated Rohde and Schwarz CMW 500 Universal Radio Communications Tester in accordance with current Rohde and 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.

Results: Bottom Channel (1850.2 MHz)

Supply Voltage (V)	Frequency Error (Hz)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
3.4	21	1850.200021	1850.0	0.200021	Complied
4.3	16	1850.200016	1850.0	0.200016	Complied

Results: Top Channel (1909.8 MHz)

Supply Voltage (V)	Frequency Error (Hz)	Measured Frequency (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Result
3.4	19	1909.800019	1910.0	0.199981	Complied
4.3	22	1909.800022	1910.0	0.199978	Complied

Transmitter Frequency Stability (Voltage Variation) (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1869	Wideband Radio Comms Tester	Rohde & Schwarz	CMW 500	145923	05 April 2017	12
S021	Dual DC power supply	Thurlby Thandar Instruments	CPX200	061034	Calibrated before use	-
M1269	Multimeter	Fluke	179	90250210	13 May 2017	12
M2002	Thermohygrometer	Testo	608-H1	45041825	02 April 2017	12

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
Frequency Stability	1850 to 1910 MHz	95%	± 23 Hz
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 20 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.

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	9	-	At the request of the TCB: Section 4.2. Inserted Bullet 3

--- END OF REPORT ---