TEST REPORT

Test Report No. : UL-RPT-RP11241886JD07L V2.0

Manufacturer	:	Apple
Model No.	:	A1779
FCC ID	:	BCG-E3086A
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: 25 July 2016

Checked by:

Steven White
Service Lead, Radio Laboratory

Company Signatory:

Sarah Willams
Senior Engineer, Radio Laboratory
UL VS LTD

ilac-MRA UKAS TESTING 0644

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:	11 May 2016 to 12 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:	A1779
Test Sample IMEI:	358640070066221 *(Conducted Sample #1)*
Hardware Version:	REV1.0
Software Version:	OS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample IMEI:	358640070087482 *(Radiated LAT Sample#1)*
Hardware Version:	REV1.0
Software Version:	OS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample IMEI:	35864007003816 *(Radiated LAT Sample#2)*
Hardware Version:	REV1.0
Software Version:	OS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample IMEI:	358640070022893 *(Radiated UAT Sample#1)*
Hardware Version:	REV1.0
Software Version:	OS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Equipment Under Test (EUT) (continued)

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample IMEI:	358640070033585 *(Radiated UAT Sample#2)*
Hardware Version:	REV1.0
Software Version:	OS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	C7CRG02QH6DH *(Conducted Sample #2)*
Hardware Version:	REV1.0
Software Version:	OS: 14A241z BB FW: 0.16.04
FCC ID:	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

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 V	
	Minimum	3.5 V	
	Maximum	4.4 V	
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 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.
- 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:	David Doyle	**Test Date:**	12 July 2016
Test Sample IMEI:	358640070066221		

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

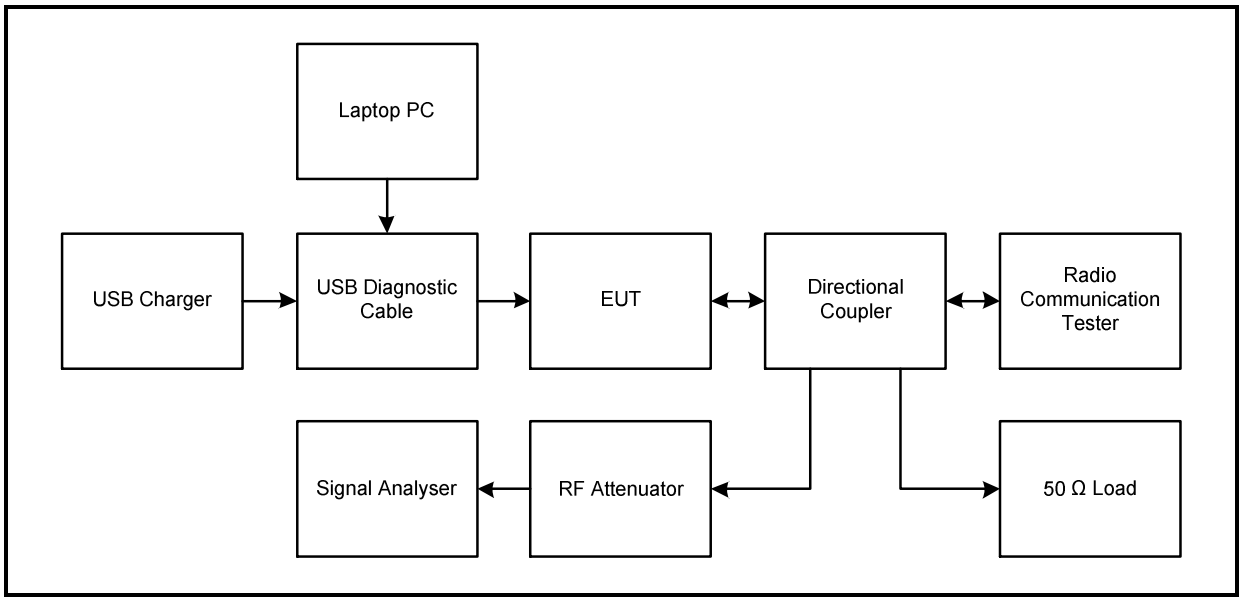
Environmental Conditions:

Temperature (℃):	24
Relative Humidity (%):	41

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 -2.25 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	31.7	-2.25	29.45	33.0	3.55	Complied
Middle	1879.8	31.4	-2.25	29.15	33.0	3.85	Complied
Top	1909.8	31.0	-2.25	28.75	33.0	4.25	Complied

Results: GPRS

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	31.7	-2.25	29.45	33.0	3.55	Complied
Middle	1879.8	31.5	-2.25	29.25	33.0	3.75	Complied
Top	1909.8	30.2	-2.25	27.95	33.0	5.05	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	31.6	-2.25	29.35	33.0	3.65	Complied
Middle	1879.8	31.4	-2.25	29.15	33.0	3.85	Complied
Top	1909.8	31.0	-2.25	28.75	33.0	4.25	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	JM Handelspunkt	30.5015.134	Not stated	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:	David Doyle	**Test Date:**	12 July 2016
Test Sample IMEI:	358640070066221		

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

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	41

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 -2.25 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	30.6	-2.25	28.35	33.0	4.65	Complied
Middle	1879.8	30.6	-2.25	28.35	33.0	4.65	Complied
Top	1909.8	30.1	-2.25	27.85	33.0	5.15	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	30.6	-2.25	28.35	33.0	4.65	Complied
Middle	1879.8	30.5	-2.25	28.25	33.0	4.75	Complied
Top	1909.8	30.2	-2.25	27.95	33.0	5.05	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	JM Handelspunkt	30.5015.134	Not stated	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:	David Doyle	**Test Date:**	12 July 2016
Test Sample IMEI:	358640070066221		

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

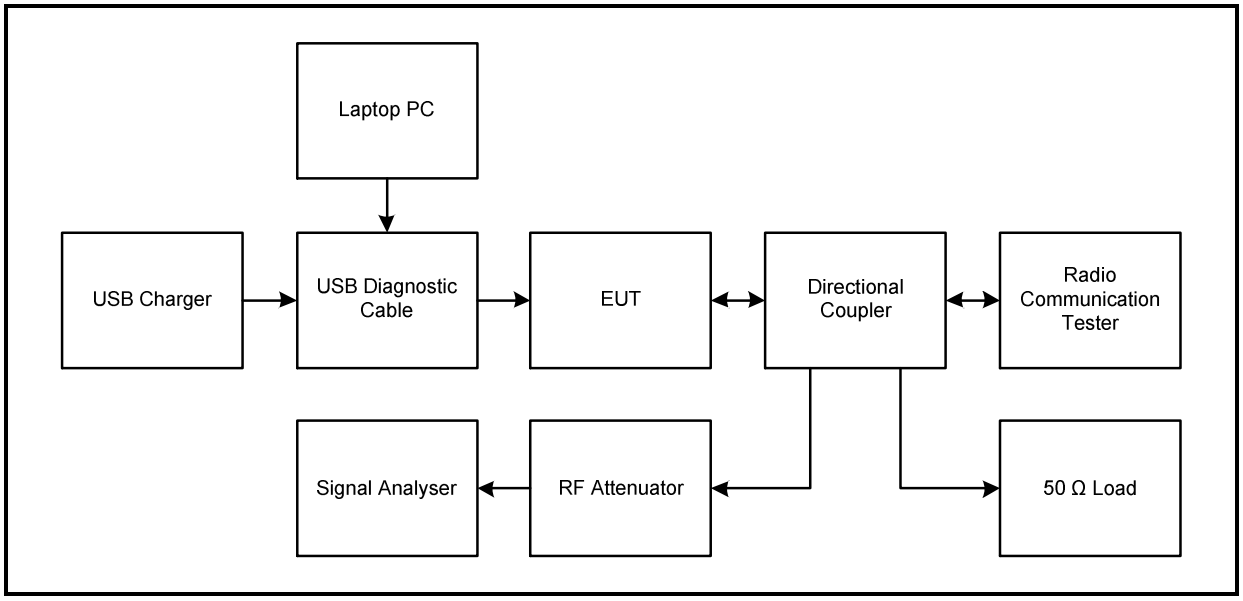
Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	41

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 0.35 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	25.3	0.35	25.65	33.0	7.35	Complied
Middle	1879.8	25.6	0.35	25.95	33.0	7.05	Complied
Top	1909.8	25.5	0.35	25.85	33.0	7.15	Complied

Results: GPRS

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)	Result
Bottom	1850.2	25.3	0.35	25.65	33.0	7.35	Complied
Middle	1879.8	25.6	0.35	25.95	33.0	7.05	Complied
Top	1909.8	25.5	0.35	25.85	33.0	7.15	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	25.3	0.35	25.65	33.0	7.35	Complied
Middle	1879.8	25.7	0.35	26.05	33.0	6.95	Complied
Top	1909.8	25.8	0.35	26.15	33.0	6.85	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	JM Handelspunkt	30.5015.134	Not stated	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:	David Doyle	**Test Date:**	12 July 2016
Test Sample IMEI:	358640070066221		

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

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	41

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 0.35 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	24.0	0.35	24.35	33.0	8.65	Complied
Middle	1879.8	24.3	0.35	24.65	33.0	8.35	Complied
Top	1909.8	23.9	0.35	24.25	33.0	8.75	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	24.7	0.35	25.05	33.0	7.95	Complied
Middle	1879.8	25.1	0.35	25.45	33.0	7.55	Complied
Top	1909.8	25.1	0.35	25.45	33.0	7.55	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	JM Handelspunkt	30.5015.134	Not stated	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:	David Doyle	**Test Date:**	30 June 2016
Test Sample IMEI:	358640070066221		

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

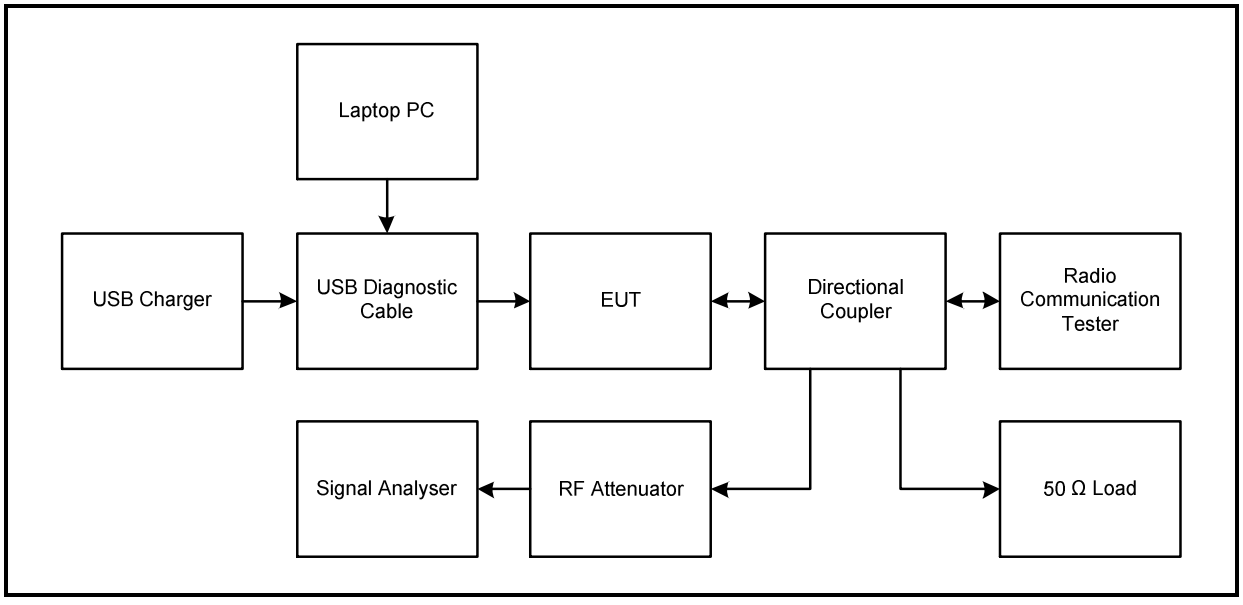
Environmental Conditions:

Temperature (℃):	25
Relative Humidity (%):	35

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.

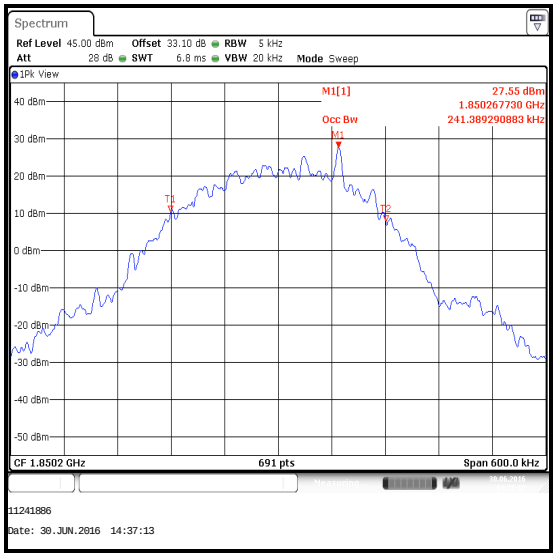
Test setup:



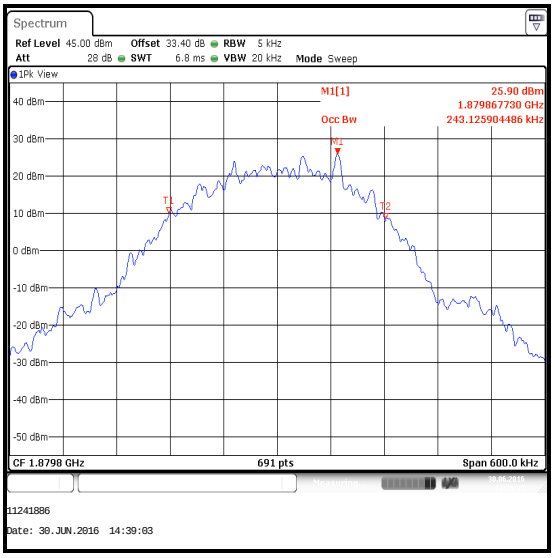
Transmitter Occupied Bandwidth (continued)

Results: GSM Circuit Switched

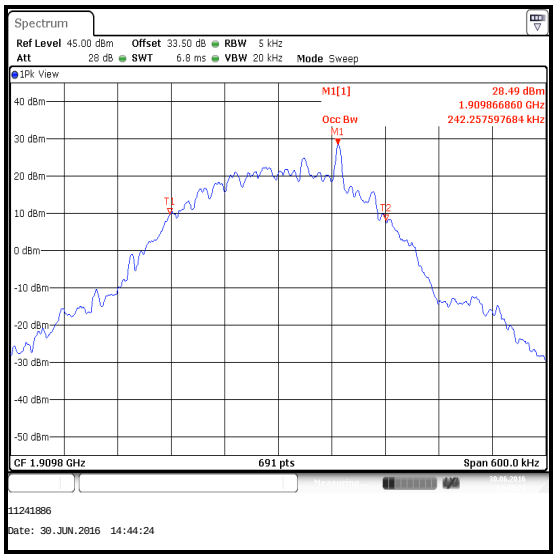
Channel	Frequency (MHz)	Occupied Bandwidth (kHz)
Bottom	1850.2	241.389
Middle	1879.8	243.126
Top	1909.8	242.258



Bottom Channel



Middle Channel

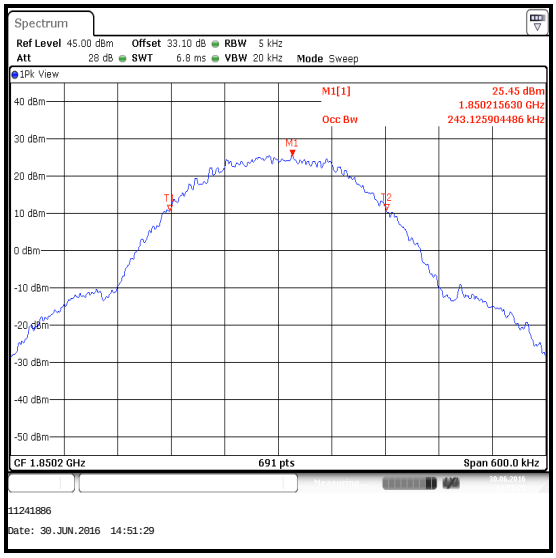


Top Channel

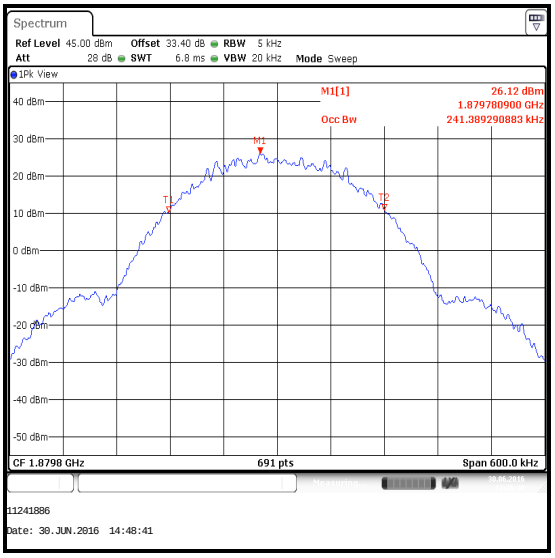
Transmitter Occupied Bandwidth (continued)

Results: GPRS

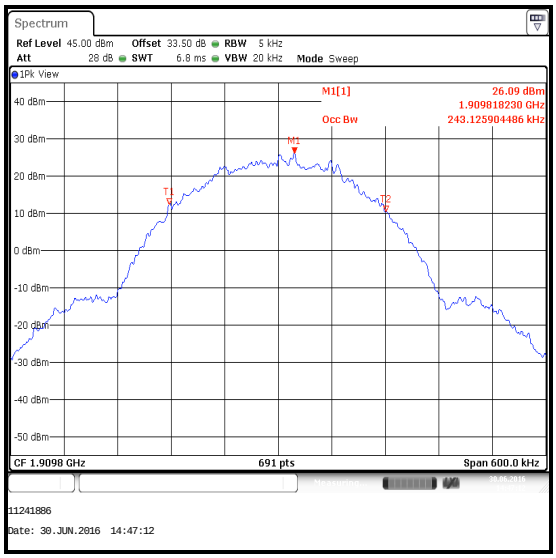
Channel	Frequency (MHz)	Occupied Bandwidth (kHz)
Bottom	1850.2	243.126
Middle	1879.8	241.389
Top	1909.8	243.126



Bottom Channel



Middle Channel

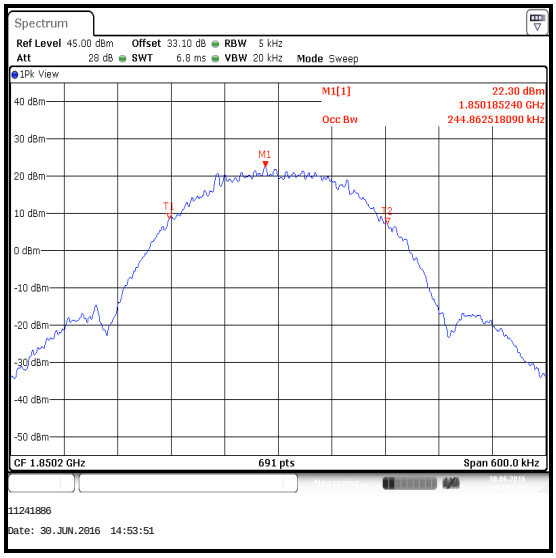


Top Channel

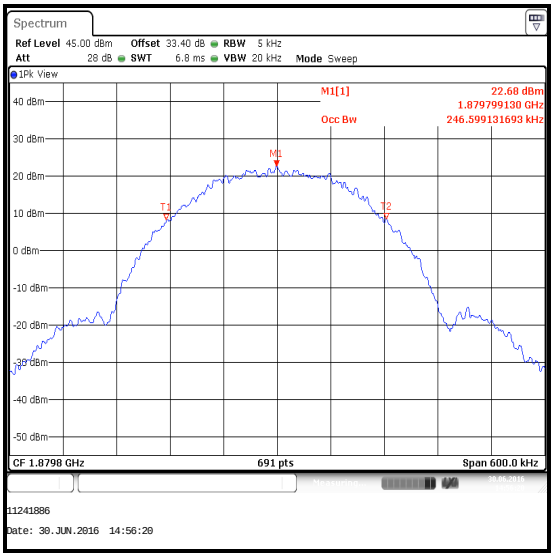
Transmitter Occupied Bandwidth (continued)

Results: EGPRS / MCS5

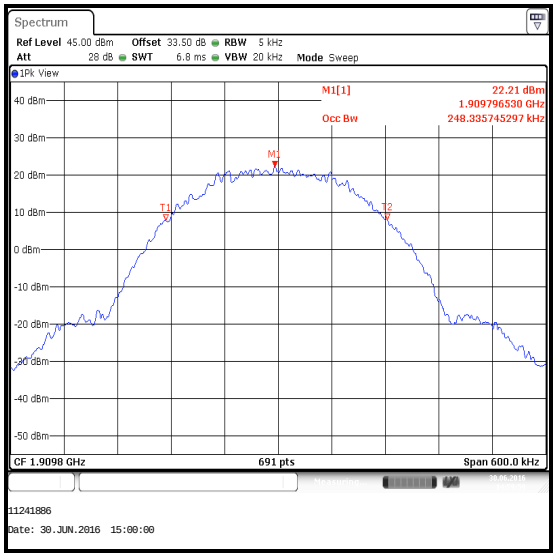
Channel	Frequency (MHz)	Occupied Bandwidth (kHz)
Bottom	1850.2	244.863
Middle	1879.8	246.599
Top	1909.8	248.336



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	JM Handelspunkt	30.5015.134	Not stated	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 Engineers:	David Doyle & Andrew Edwards	**Test Dates:**	13 June 2016 to 08 July 2016
Test Sample IMEI:	358640070087482 & 35864007003816		

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

Environmental Conditions:

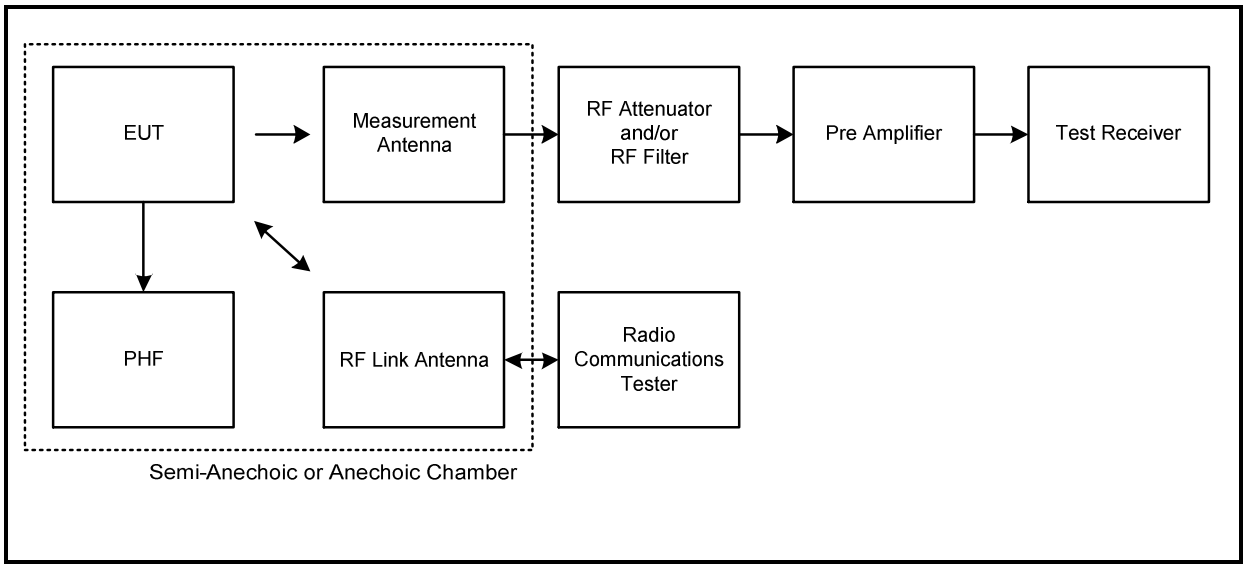
Temperature (°C):	24 to 26
Relative Humidity (%):	38 to 41

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 value of the highest emission is recorded in the table below.
3. Pre-scan measurements below 1 GHz are performed on separate plots with different transducer factors for vertical and horizontal polarisation. The pre-scan plot for 30 MHz to 1 GHz in this test report is for vertical only. All other plots are stored on the company server and are available if required.
4. 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 avavliable for inspection on request.
5. 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.
6. Sample with IMEI 35864007003816 was used for measurements > 17.5 GHz. All other measurements were performed using IMEI 358640070087482.

Transmitter Out of Band Radiated Emissions (continued) - LAT

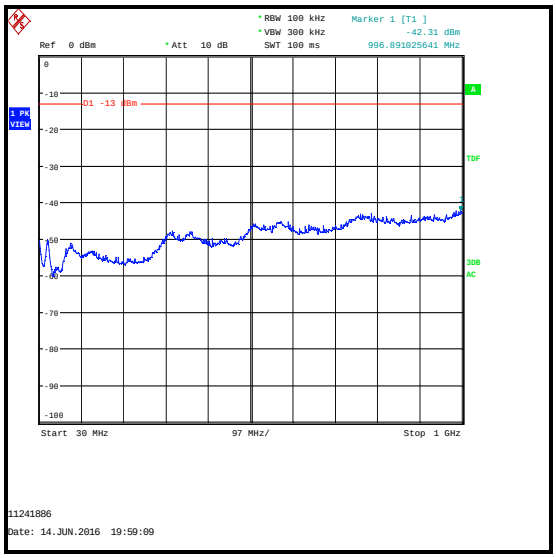
Test setup for radiated measurements:

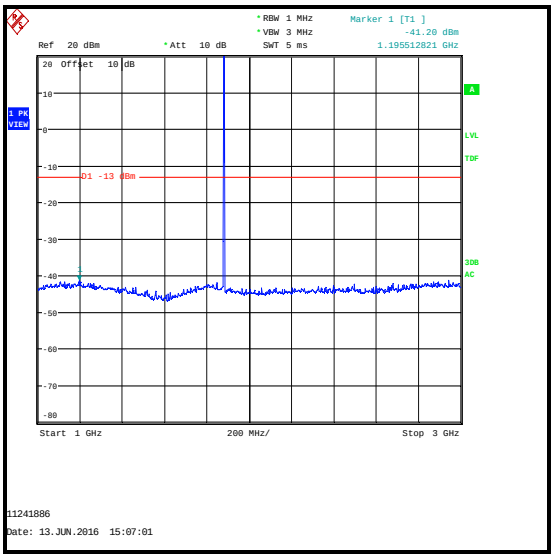


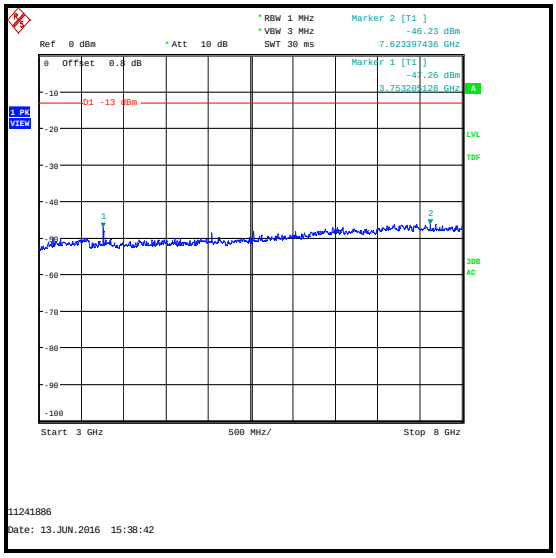
Results: Middle Channel

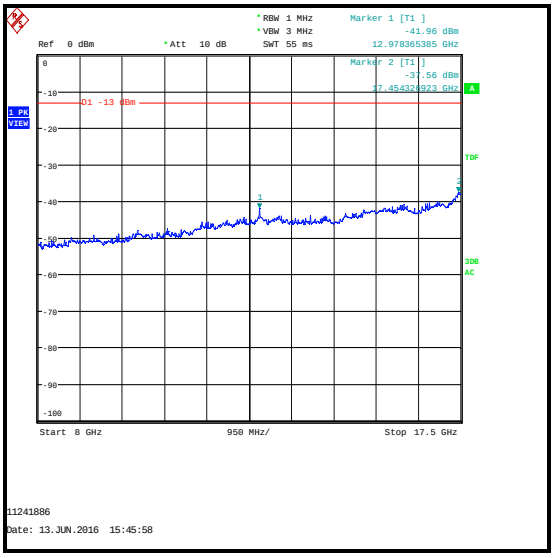
Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
17454.327	-37.6	-13.0	24.6	Complied

Transmitter Out of Band Radiated Emissions (continued) - LAT

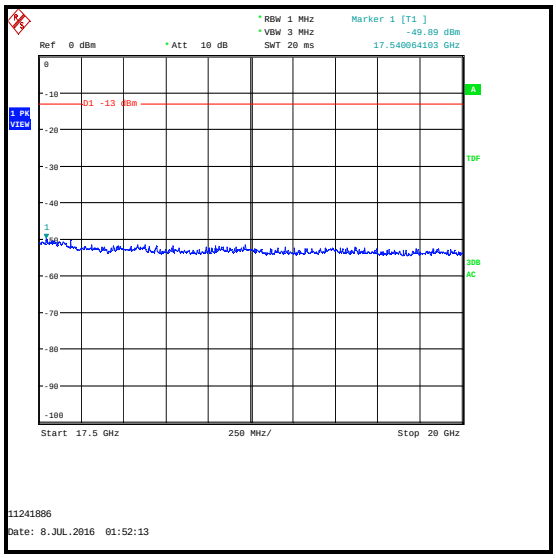








Transmitter Out of Band Radiated Emissions (continued) - LAT



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
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	07 Apr 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
S0582	Power Supply	Schwarzbeck	PS9721	00005	Calibrated before use	-
M1818	Multimeter	Fluke	79 Series II	71811580	27 Apr 2017	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	19 May 2017	12
A2916	Attenuator	AtlanTecRF	AN185W-10	832827#1	19 May 2017	12

5.2.5. Transmitter Out of Band Radiated Emissions - UAT

Test Summary:

Test Engineers:	David Doyle & Andrew Edwards	**Test Dates:**	13 June 2016 to 08 July 2016
Test Sample IMEI:	358640070022893 & 358640070033585		

FCC Reference:	Parts 2.1053 & 24.238
Test Method Used:	Part 24.238(b), KDB 971168 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 (%):	38 to 41

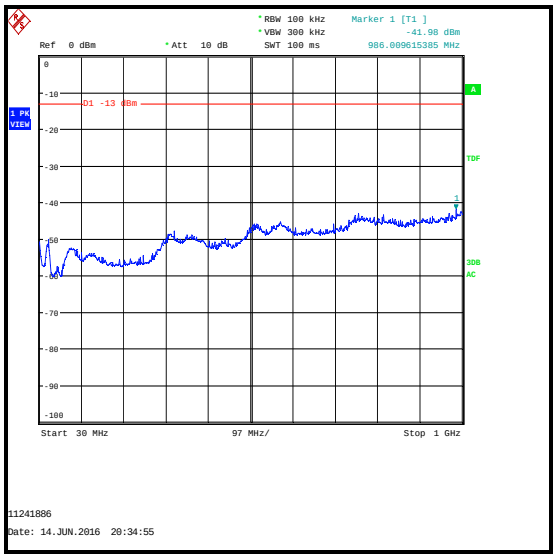
Note(s):

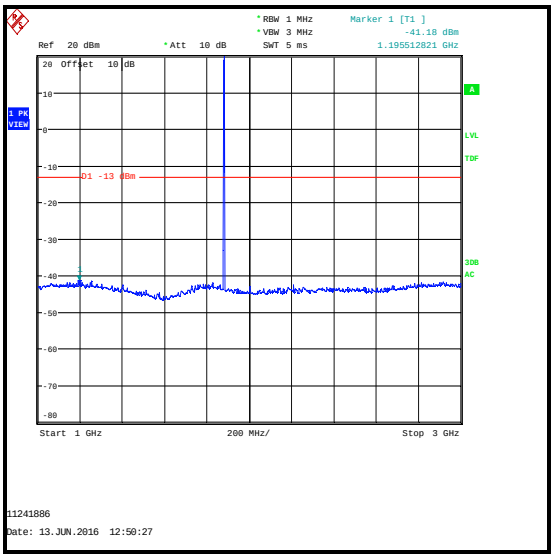
1. The uplink traffic channel is shown on the 1 GHz to 3 GHz plot.
2. All emissions shown on the pre-scan plots were investigated. All emissions shown on the pre-scan plots were found to be below the measurement system noise floor or ambient or > 20 dB below the applicable limit. Therefore the value 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 avavliable 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. Sample with IMEI 358640070033585 was used for measurements > 17.5 GHz. All other measurements were performed using IMEI 358640070022893.

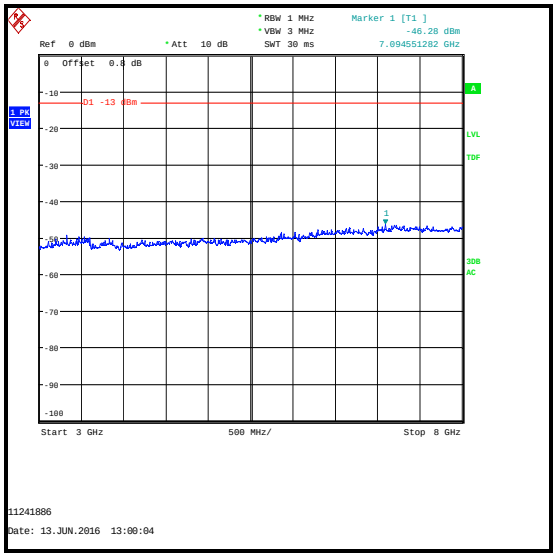
Results: Middle Channel

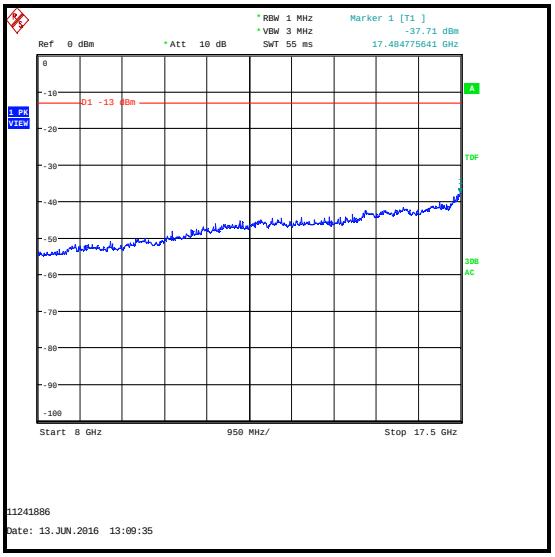
Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
17484.776	-37.7	-13.0	24.7	Complied

Transmitter Out of Band Radiated Emissions (continued) - UAT

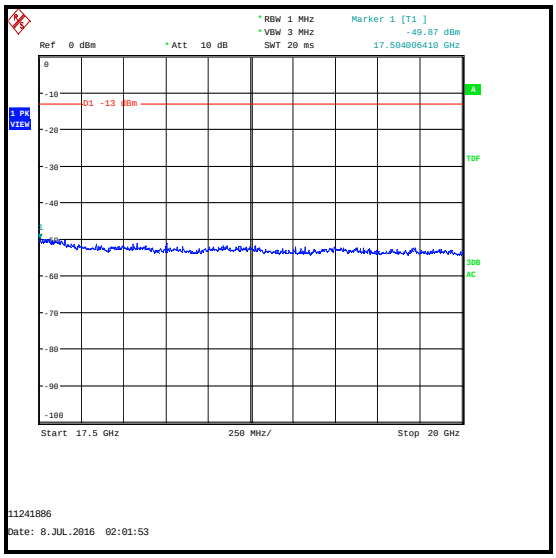








Transmitter Out of Band Radiated Emissions (continued) - UAT



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
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	07 Apr 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
S0582	Power Supply	Schwarzbeck	PS9721	00005	Calibrated before use	-
M1818	Multimeter	Fluke	79 Series II	71811580	27 Apr 2017	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	19 May 2017	12
A2916	Attenuator	AtlanTecRF	AN185W-10	832827#1	19 May 2017	12

5.2.6. Transmitter Band Edge Radiated Emissions - LAT

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	06 July 2016
Test Sample IMEI:	358640070087482		

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

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	38

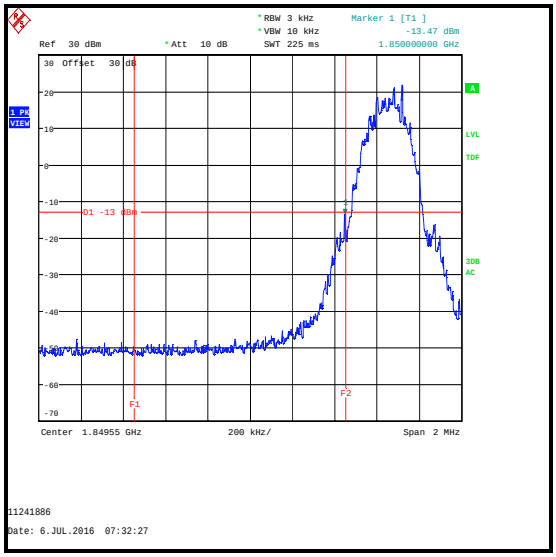
Note(s):

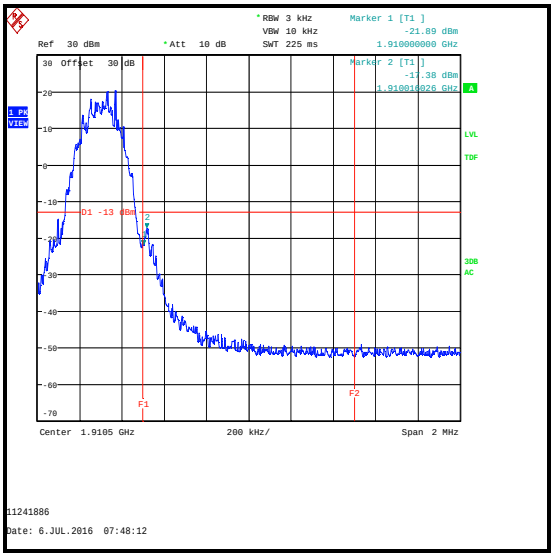
1. Measurements were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. The measurement antenna was placed at a fixed height of 1.5 metres above the test 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 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	-13.5	-13.0	0.5	Complied
1910	-21.9	-13.0	8.9	Complied
1910.016	-17.4	-13.0	4.4	Complied

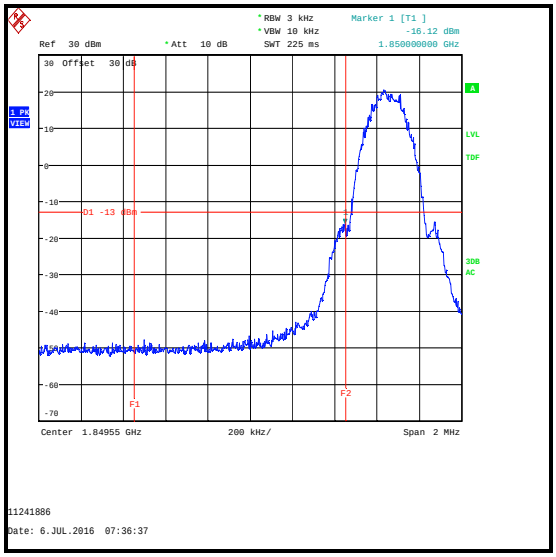


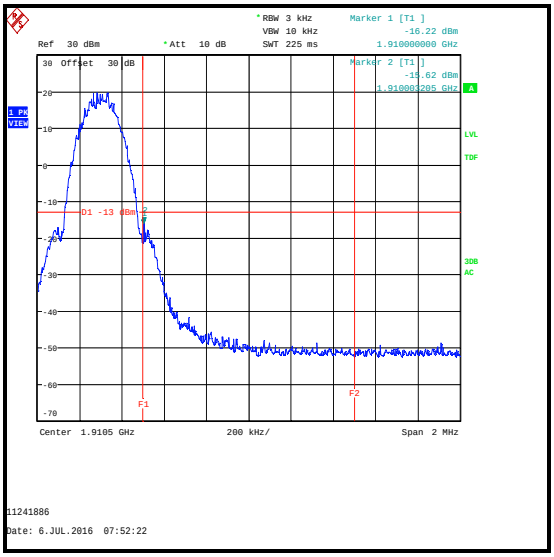


Transmitter Band Edge Radiated Emissions – LAT (continued)

Results: GPRS

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-16.1	-13.0	3.1	Complied
1910	-16.2	-13.0	3.2	Complied
1910.003	-15.6	-13.0	2.6	Complied

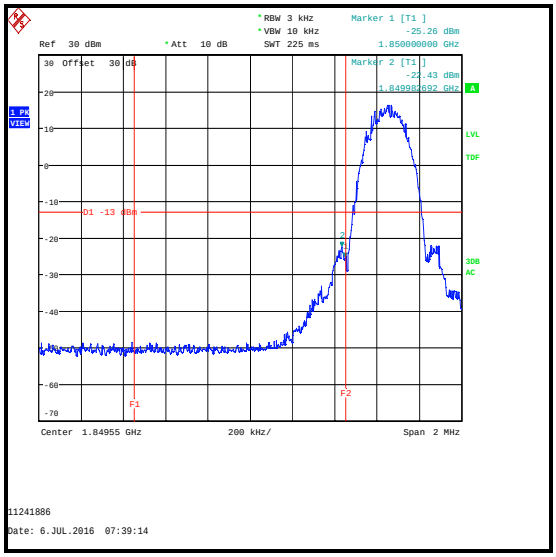


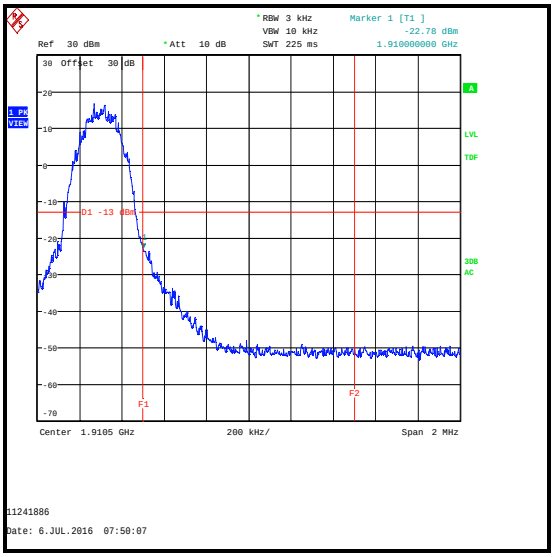


Transmitter Band Edge Radiated Emissions – LAT (continued)

Results: EGPRS / MCS5

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1849.983	-22.4	-13.0	9.4	Complied
1850	-25.3	-13.0	12.3	Complied
1910	-22.8	-13.0	9.8	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
A2926	Attenuator	AtlanTecRF	AN18W5-30	85850#2	19 May 2017	12

5.2.7. Transmitter Band Edge Radiated Emissions - UAT

Test Summary:

Test Engineer:	David Doyle	**Test Date:**	05 July 2016
Test Sample IMEI:	358640070022893		

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

Environmental Conditions:

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

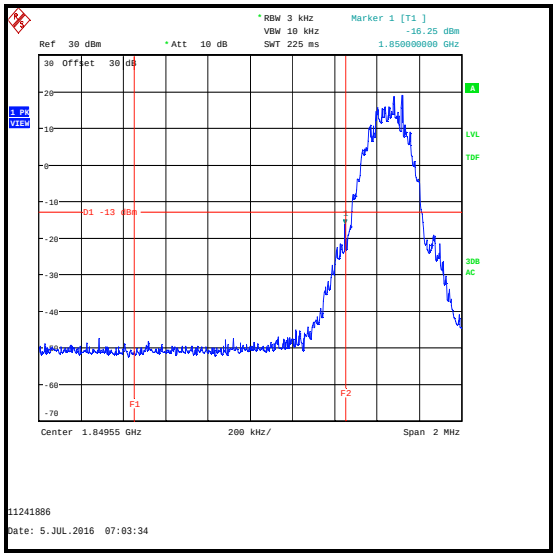
Note(s):

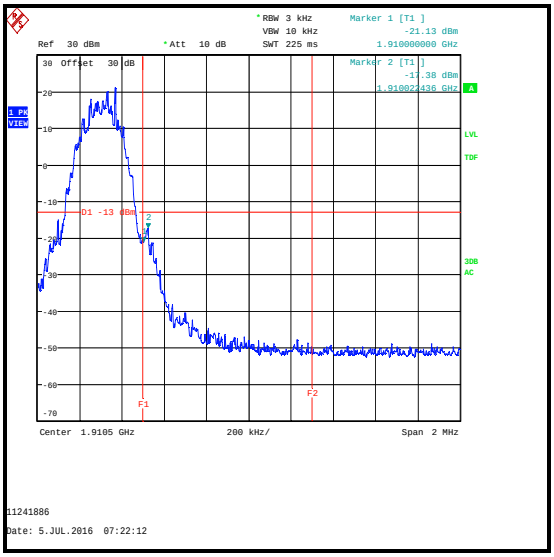
1. Measurements were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. The measurement antenna was placed at a fixed height of 1.5 metres above the test 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 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	-16.2	-13.0	3.2	Complied
1910	-21.1	-13.0	8.1	Complied
1910.022	-17.4	-13.0	4.4	Complied

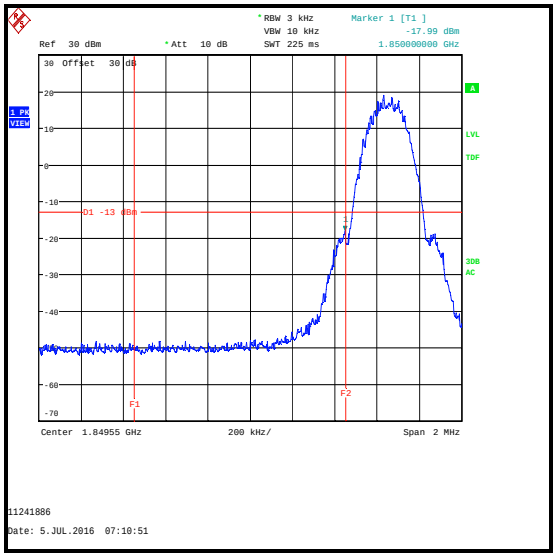


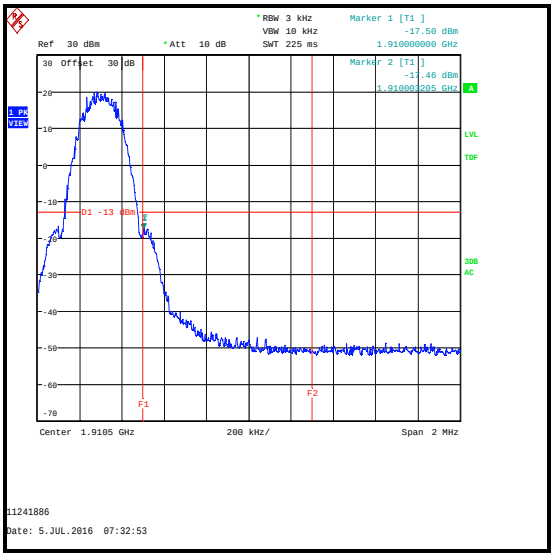


Transmitter Band Edge Radiated Emissions (continued) - UAT

Results: GPRS

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-18.0	-13.0	5.0	Complied
1910	-17.5	-13.0	4.5	Complied
1910.003	-17.5	-13.0	4.5	Complied

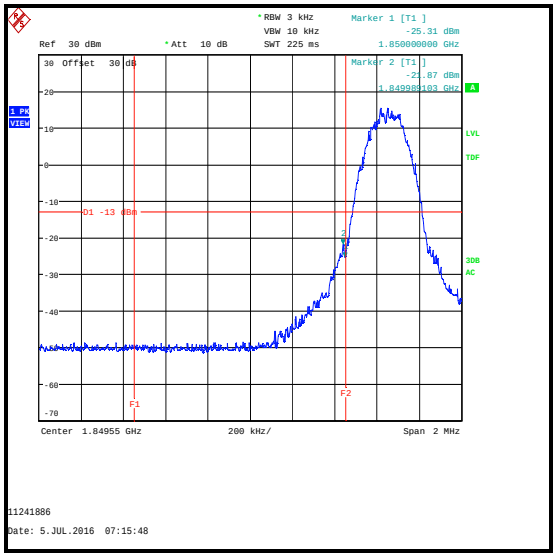


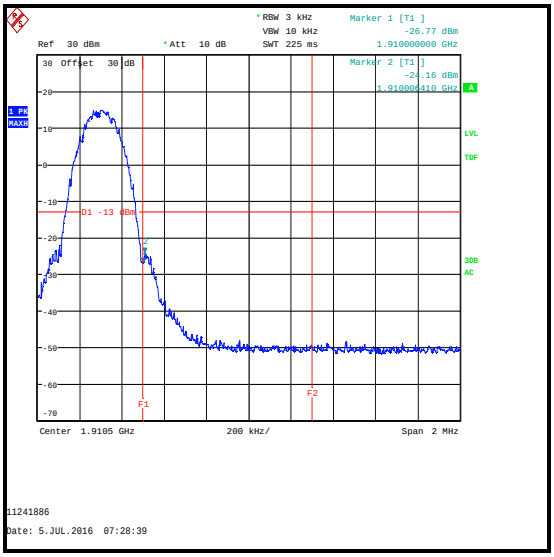


Transmitter Band Edge Radiated Emissions (continued) - UAT

Results: EGPRS / MCS5

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1849.989	-21.9	-13.0	8.9	Complied
1850	-25.3	-13.0	12.3	Complied
1910	-26.8	-13.0	13.8	Complied
1910.006	-24.2	-13.0	11.2	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
A2926	Attenuator	AtlanTecRF	AN18W5-30	85850#2	19 May 2017	12

5.2.8. Transmitter Frequency Stability (Temperature Variation)

Test Summary:

Test Engineer:	Stefan Ho	**Test Date:**	11 May 2016
Test Sample Serial Number:	C7CRG02QH6DH		

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

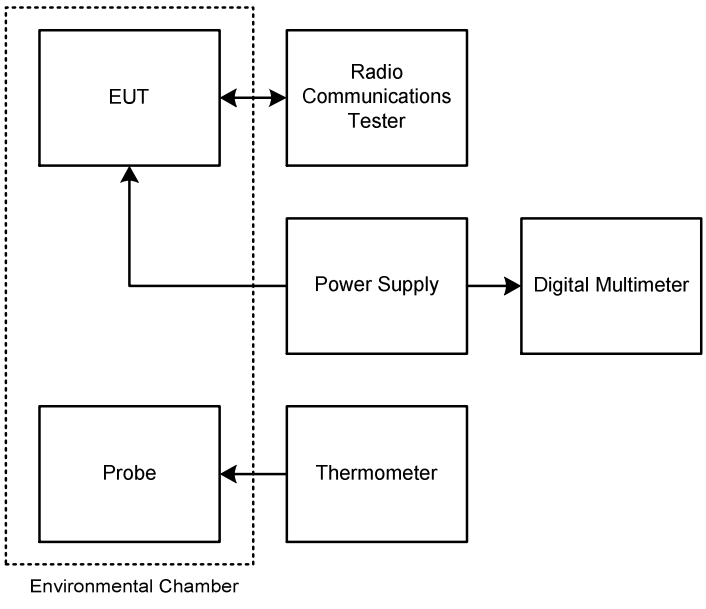
Environmental Conditions:

Ambient Temperature (℃):	23
Ambient Relative Humidity (%):	40

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 at the nominal voltage of 3.8 V.
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 (ºC)	Frequency Error (Hz)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
-30	37	1850.200037	1850.0	0.200037	Complied
-20	20	1850.200020	1850.0	0.200020	Complied
-10	30	1850.200030	1850.0	0.200030	Complied
0	15	1850.200015	1850.0	0.200015	Complied
10	24	1850.200024	1850.0	0.200024	Complied
20	19	1850.199981	1850.0	0.199981	Complied
30	25	1850.200025	1850.0	0.200025	Complied
40	18	1850.200018	1850.0	0.200018	Complied
50	29	1850.199971	1850.0	0.199971	Complied

Results: Top Channel (1909.8 MHz)

Temperature (ºC)	Frequency Error (Hz)	Measured Frequency (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Result
-30	23	1909.800023	1910.0	0.199977	Complied
-20	18	1909.800018	1910.0	0.199982	Complied
-10	19	1909.800019	1910.0	0.199981	Complied
0	19	1909.800019	1910.0	0.199981	Complied
10	16	1909.800016	1910.0	0.199984	Complied
20	11	1909.799989	1910.0	0.200011	Complied
30	7	1909.800007	1910.0	0.199993	Complied
40	7	1909.800007	1910.0	0.199993	Complied
50	20	1909.799980	1910.0	0.200020	Complied

Transmitter Frequency Stability (Temperature Variation) (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	02 Apr 2017	12
M1869	Wideband Radio Comms Tester	Rohde & Schwarz	CMW 500	145923	05 Apr 2017	12
M1674	Environmental Chamber	Espec Corporation	SU-241	90213139	Calibrated before use	-
E013	Environmental Chamber	Sanyo	MTH-4200PR	None stated	Calibrated before use	-
M1642	Thermometer	Fluke	52II	18890119	25 Apr 2017	12
S021	Dual DC power supply	Thurlby Thandar Instruments	PL330QMD	066701	Calibrated before use	-
M122	Multimeter	Fluke	77	64910017	21 Apr 2017	12

5.2.9. Transmitter Frequency Stability (Voltage Variation)

Test Summary:

Test Engineer:	Stefan Ho	**Test Date:**	11 May 2016
Test Sample Serial Number:	C7CRG02QH6DH		

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 (%):	40

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
3.5	14	1850.199986	1850.0	0.199986	Complied
4.4	21	1850.199979	1850.0	0.199979	Complied

Results: Top Channel (1909.8 MHz)

Supply Voltage (V)	Frequency Error (Hz)	Measured Frequency (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Result
3.5	24	1909.799976	1910.0	0.200024	Complied
4.4	25	1909.800025	1910.0	0.199975	Complied

Transmitter Frequency Stability (Voltage Variation) (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	02 Apr 2017	12
M1869	Wideband Radio Comms Tester	Rohde & Schwarz	CMW 500	145923	05 Apr 2017	12
S0576	Dual DC power supply	Thurlby Thandar Instruments	PL330QMD	066701	Calibrated before use	-
M122	Multimeter	Fluke	77	64910017	21 Apr 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	- 7 7 9 All 24 & 28	- - - - - -	At the request of the TCB: Inserted usage of 2nd sample Changed 'RFID' reference to 'NFC' Updated Sections 4.1 and 4.2 Changed 'KDB 971168' references to 'KDB 971168 D01' Inserted Note 6

--- END OF REPORT ---