



TEST REPORT

Test Report No. : UL-RPT-RP14149259-716A

Customer : GAI-Tronics (a division of Hubbell Ltd.)
Model No. : 231-02-304J-612
Contains FCC ID : 2A8ZW-COMMANDER
Technology : LTE – Bands 4, 12 & 66
Test Standard(s) : FCC Parts 2.1053, 27.53(g) & 27.53(h)(1)
Test Laboratory : UL International (UK) Ltd, Basingstoke, Hampshire, RG24 8AH,
United Kingdom

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2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 3.0 supersedes all previous versions.

Date of Issue: 09 January 2023

Checked by:

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Customer Information

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Report Revision History

Version Number	Issue Date	Revision Details	Revised By
1.0	30/11/2022	Initial Version	Ben Mercer
2.0	15/12/2022	TCB requested updates & Band 4 band edge results added	Ben Mercer
3.0	09/01/2023	Updated antenna gains	Ben Mercer

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1 Attestation of Test Results

1.1 Description of EUT

The equipment under test was a rugged cellular telephone containing an LTE module (FCC ID: 2A8ZW-COMMANDER).

1.2 General Information

Specification Reference:	47CFR27
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 27 Subpart C (Miscellaneous Wireless Communication Services)
Site Registration:	685609
FCC Lab. Designation No.:	UK2011
Location of Testing:	Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, G24 8AH, United Kingdom
Test Dates:	02 March 2022 to 15 December 2022

1.3 Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
LTE Band 4		
Part 2.1053 & 27.53(h)(1)	Transmitter Out of Band Radiated Emissions	Note 1
Part 2.1053 & 27.53(h)(1)	Transmitter Radiated Emissions at Band Edges	
LTE Band 12		
Part 2.1053 / 27.53(g)	Transmitter Out of Band Radiated Emissions	
Part 2.1053 / 27.53(g)	Transmitter Radiated Emissions at Band Edges	
LTE Band 66		
Part 2.1053 & 27.53(h)(1)	Transmitter Out of Band Radiated Emissions	
Part 2.1053 & 27.53(h)(1)	Transmitter Radiated Emissions at Band Edges	
Key to Results		
 = Complied  = Did not comply		

Notes

1. LTE Band 4 is a subset of LTE Band 66 with the same output power, therefore measurements performed in LTE Band 66 demonstrate compliance for LTE Band 4.

1.4 Deviations from the Test Specification

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

2 Summary of Testing

2.1 Facilities and Accreditation

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

Site 1	X
Site 2	-
Site 17	-

UL International (UK) Ltd is accredited by the United Kingdom Accreditation Service (UKAS). UKAS is one of the signatories to the International Laboratory Accreditation Co-operation (ILAC) Arrangement for the mutual recognition of test reports. The tests reported herein have been performed in accordance with its terms of accreditation.

2.2 Methods and Procedures

Reference:	ANSI C63.26-2015
Title:	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
Reference:	FCC KDB 971168 D01 v03r01, April 9, 2018
Title:	Measurement Guidance for Certification of Licensed Digital Transmitters
Reference:	PVG.04, 16 September 2021, Version 5.3.0
Title:	Guidelines for Radiated Spurious Emission Testing

2.3 Calibration and Uncertainty

Measuring Instrument Calibration

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

Measurement Uncertainty & Decision Rule

Overview

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.

Decision Rule

The decision rule applied is based upon the accuracy method criteria. The measurement uncertainty is met, and the result is considered in conformance with the requirement criteria if the observed value is within the prescribed limit.

Measurement Uncertainty

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
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	±5.32 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±3.30 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.

2.4 Test and Measurement Equipment

Test Equipment Used for Transmitter Radiated Emissions Tests

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2040	Thermohygrometer	Testo	608-H1	45124934	09 Dec 2022	12
M2037	Thermohygrometer	Testo	608-H1	45124925	08 Dec 2023	12
K0001	3m RSE Chamber	Rainford EMC	N/A	N/A	05 Sep 2023	12
M2044	Test Receiver	Rohde & Schwarz	ESU26	100122	29 Apr 2022	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	19 May 2023	12
A3179	Pre-Amplifier	Hewlett Packard	8449B	3008A00934	14 Sep 2023	12
A3154	Pre-Amplifier	Com Power	PAM-103	18020012	24 Aug 2022	12
A2523	Attenuator	AtlanTecRF	AN18W5-10	832827#1	27 Jan 2023	12
A3093	High Pass Filter	AtlanTecRF	AFH-03000	18051800077	27 Jan 2023	12
A3138	Antenna	Schwarzbeck	BBHA 9120 B	00702	22 Aug 2023	12
A553	Antenna	Chase	CBL6111A	1593	23 Nov 2022	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	29 Nov 2022	12
A3083	Low Pass Filter	AtlanTecRF	AFL-01000	18010900076	27 Jan 2023	12
A3095	High Pass Filter	AtlanTecRF	AFH-07000	18051800077	27 Jan 2023	12
A3155	Pre-Amplifier	Com Power	PAM-118A	18040037	24 Aug 2022	12
A3265	Pre-Amplifier	Schwarzbeck	BBV 9721	9721-069	03 Nov 2022	12
A2892	Antenna	Schwarzbeck	BBHA 9170	9170-727	02 Nov 2022	12
A3165	Antenna	ETS-Lindgren	6502	00224383	12 Oct 2022	12
A2924	Attenuator	AtlanTecRF	AN18W5-20	832828#7	27 Jan 2023	12

3 Equipment Under Test (EUT)

3.1 Identification of Equipment Under Test (EUT)

Brand Name:	Cellular Commander
Model Name or Number:	231-02-304J-612
Test Sample IMEI Number:	868822042808665 (<i>Radiated sample #1</i>)
Hardware Version:	P400 PCB V3
Software Version:	1.46
Contains FCC ID:	2A8ZW-COMMANDER

Brand Name:	Cellular Commander
Model Name or Number:	231-02-304J-612
Test Sample IMEI Number:	868822043372539 (<i>Radiated sample #2</i>)
Hardware Version:	P400 PCB V3
Software Version:	1.46
Contains FCC ID:	2A8ZW-COMMANDER

3.2 Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.3 Additional Information Related to Testing

Technology Tested:	LTE VoLTE- Band 4		
Type of Equipment:	Transceiver		
Channel Bandwidth:	1.4 MHz		
Modulation:	QPSK / 16QAM		
Power Supply Requirement(s):	12.0 VDC		
Transmit Frequency Range:	1710 MHz to 1755 MHz		
Channel Bandwidth:	1.4 MHz		
Transmit Channels Tested:	Channel ID	N _{ul}	Frequency of Uplink (MHz)
	Bottom	19957	1710.7
	Top	20393	1754.3

Additional information related to testing (continued)

Technology Tested:	LTE VoLTE- Band 12		
Type of Equipment:	Transceiver		
Channel Bandwidth:	1.4 MHz & 10 MHz		
Modulation:	QPSK / 16QAM		
Power Supply Requirement(s):	12.0 VDC		
Transmit Frequency Range:	699 MHz to 716 MHz		
Channel Bandwidth:	1.4 MHz		
Transmit Channels Tested:	Channel ID	N_{ul}	Uplink Frequency (MHz)
	Bottom	23017	699.7
	Middle	23095	707.5
	Top	23173	715.3
Channel Bandwidth:	10 MHz		
Transmit Channels Tested:	Channel ID	N_{ul}	Uplink Frequency (MHz)
	Middle	23095	707.5

Technology Tested:	LTE VoLTE- Band 66		
Type of Equipment:	Transceiver		
Channel Bandwidth:	1.4 MHz & 10 MHz		
Modulation:	QPSK / 16QAM		
Power Supply Requirement(s):	12.0 VDC		
Transmit Frequency Range:	1710 MHz to 1780 MHz		
Channel Bandwidth:	1.4 MHz		
Transmit Channels Tested:	Channel ID	N_{ul}	Frequency of Uplink (MHz)
	Bottom	131979	1710.7
	Middle	132322	1745.0
	Top	132665	1779.3
Channel Bandwidth:	10 MHz		
Transmit Channels Tested:	Channel ID	N_{ul}	Frequency of Uplink (MHz)
	Middle	132322	1745.0

3.4 Description of Available Antennas

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

Frequency Range (MHz)	Antenna Gain (dBi)
699 to 716	1.0
1710 to 1780	4.2

3.5 Description of Test Setup

Support Equipment

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

Description:	AC to DC Power Supply
Brand Name:	Sinpro
Model Name or Number:	APU20B-105
Serial Number:	1930029539

Description:	Base Station Simulator
Brand Name:	Rohde & Schwarz
Model Name or Number:	CMW500
Serial Number:	145920 (UL Asset M1859)

Operating Modes

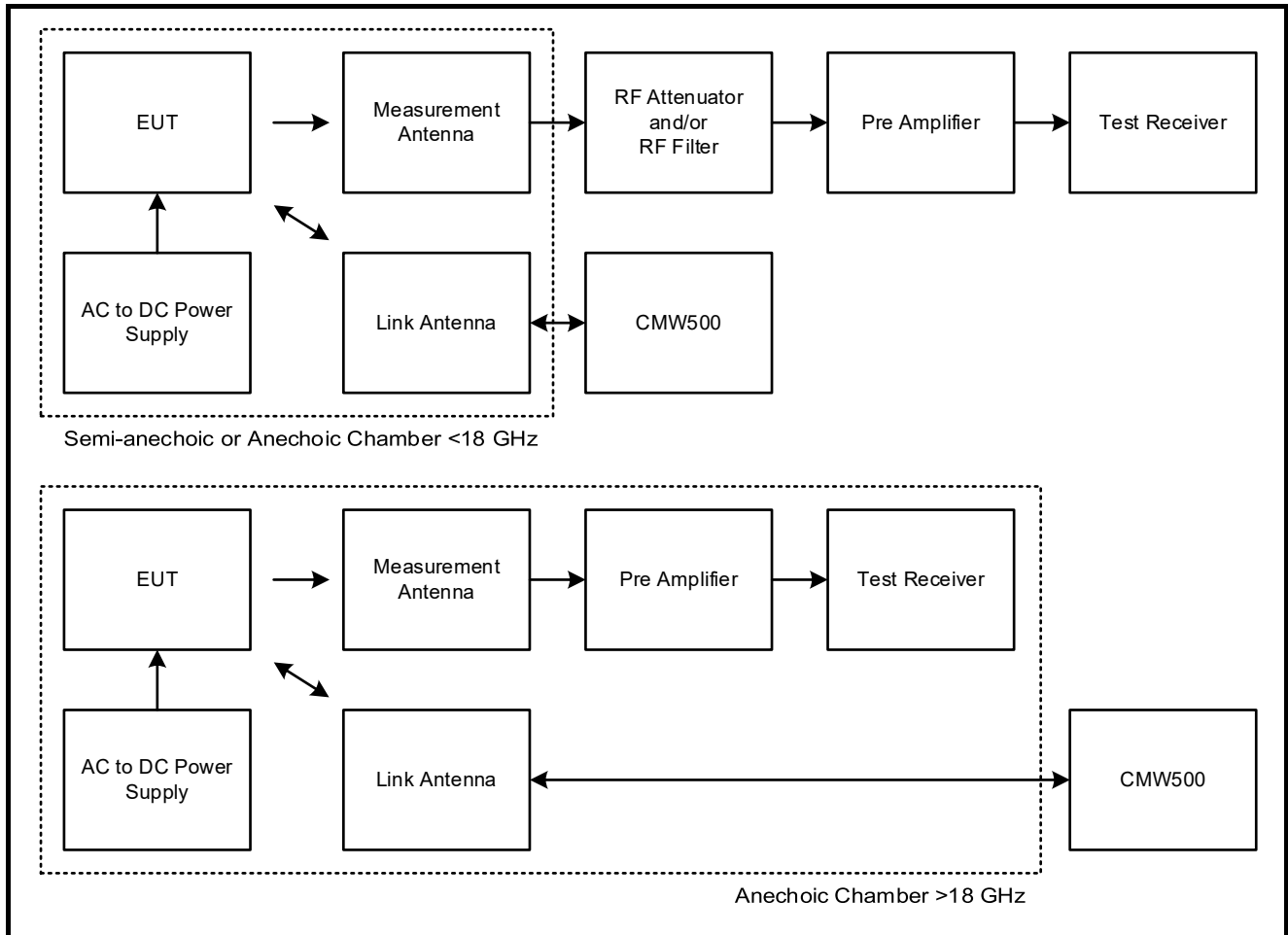
The EUT was tested in the following operating mode(s):

- Transmitting at maximum power on bottom, middle or top channel as required.
- Worst-case modes were determined and tested as:
 - Transmitter Out of Band Radiated Emissions were tested with a 10MHz Channel Bandwidth with a 1RB26 allocation, as per PVG.04, Date: 16 September 2021, Version 5.3.0.
 - Transmitter Radiated Emissions at Band Edges were tested with a 1.4MHz Channel Bandwidth with the allocation set to 2RB0 for the Lower Band Edge and 2RB4 for the Upper Band Edge.

Configuration and Peripherals

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

- The EUT was connected to a Rohde and Schwarz CMW500 LTE system simulator, operating in a transceiver mode.
- The EUT was powered from an AC to DC Power Supply. The input was connected to a 120 VAC 60 Hz single phase mains supply.
- The EUT was placed in three orthogonal orientations X, Y and Z to determine the worst case orientation for radiated spurious emissions. This was determined to be the Z position. All pre-scans and final measurements were performed in this orientation.
- There were no active ports to terminate.

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

4 Radiated Test Results

4.1 Transmitter Radiated Emissions at Band Edges – LTE Band 4

Test Summary:

Test Engineer:	Nick Steele	Test Date:	14 December 2022
Test Sample IMEI Number:	868822043372539		

FCC Reference:	Parts 2.1053 & 27.53(h)(1)
Test Method Used:	KDB 971168 Section 6 referencing ANSI C63.26 Section 5.7

Environmental Conditions:

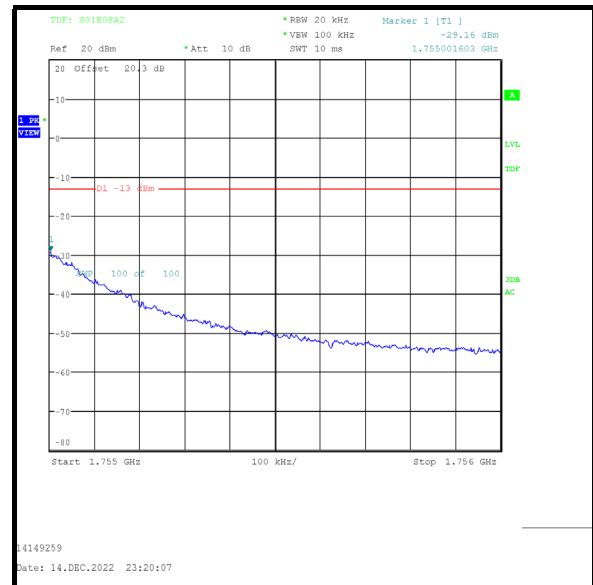
Temperature (°C):	20
Relative Humidity (%):	32

Note(s):

1. Measurements were performed with the EUT transmitting with QPSK modulation, 2 RB, 0 offset for bottom channel and with 16QAM modulation, 2 RB, 4 offset for top channel.
2. Measurements were performed in a fully anechoic chamber (Asset Number K0001) 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. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Radiated Emissions at Band Edges – LTE Band 4 (continued)**Results:**

Frequency (MHz)	Resource Blocks	Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1710.000	2	0	-33.3	-13.0	20.3	Complied
1755.002	2	4	-29.2	-13.0	16.2	Complied

**Lower Band Edge****Upper Band Edge**

4.2 Transmitter Out of Band Radiated Emissions – LTE Band 12

Test Summary:

Test Engineer:	Nick Steele	Test Dates:	02 March 2022 to 04 March 2022
Test Sample IMEI Number:	868822042808665		

FCC Reference:	Parts 2.1053 & 27.53(g)
Test Method Used:	KDB 971168 Section 6 referencing ANSI C63.26 Section 5.7
Frequency Range	9 kHz to 8 GHz

Environmental Conditions:

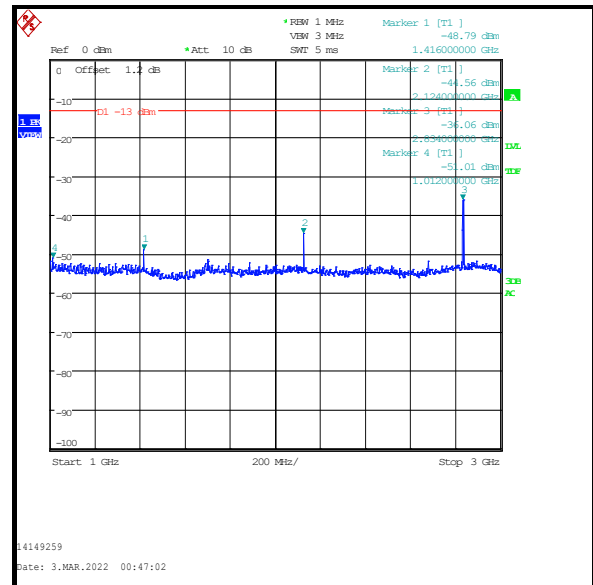
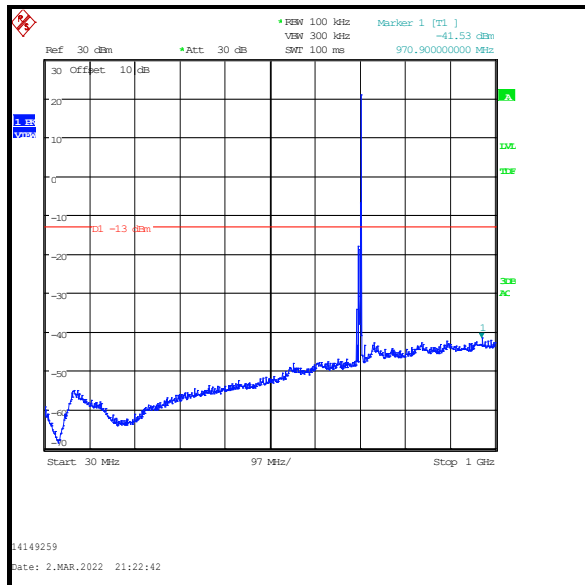
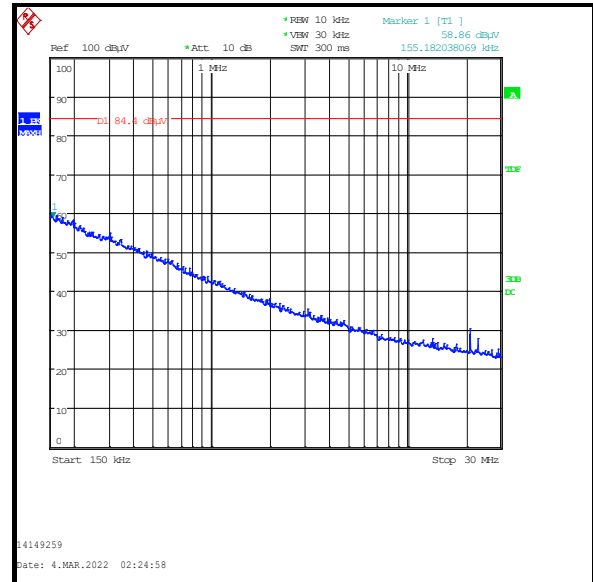
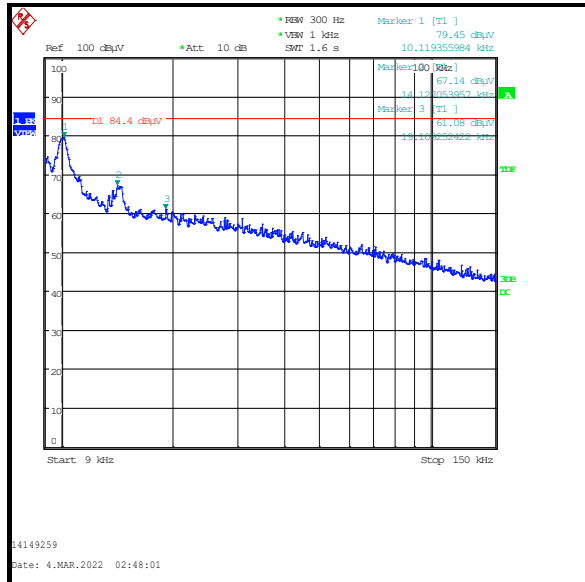
Temperature (°C):	20 to 21
Relative Humidity (%):	40 to 41

Note(s):

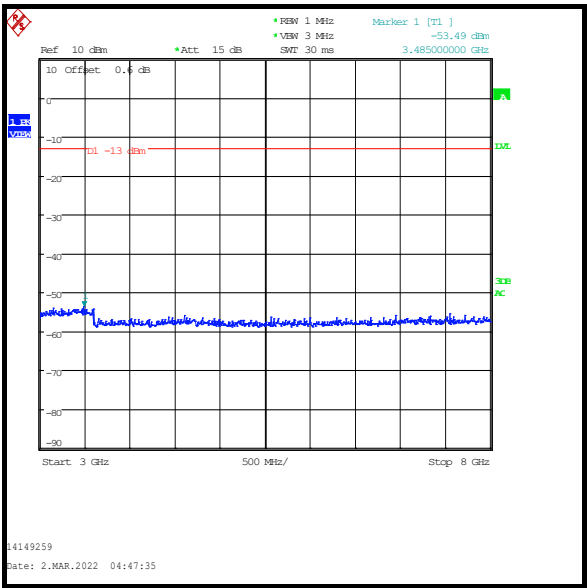
1. The emissions seen on the 9kHz to 150kHz plot, at approximately 10.119kHz and 14.127kHz, were generated by the turntable motor and were not coming from the EUT.
2. The emission seen on the 30 MHz to 1 GHz plot at approximately 707.5 MHz is the EUT uplink.
3. All emissions shown on the pre-scans were investigated and found to be ambient, or > 20 dB below the appropriate limit or below the noise floor of the measurement system. Therefore, the highest emission pre scan value was recorded in the table below.
1. Measurements below 30 MHz were performed in a semi-anechoic chamber (Asset Number K0001) at 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. The limit was extrapolated to 3 metres in accordance ANSI C63.10 clause 6.4.3; measurements may be performed at a closer distance and the measured level extrapolated to the specified measurement distance using the method described in clause 6.4.4.2. The -13 dBm limit was converted to a field strength limit of 84.4 dBµV/m at 3 m.
4. Measurements from 30 MHz to 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
5. Pre-scans above 1 GHz were performed in a fully-anechoic chamber (Asset Number K0001) 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. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions – LTE Band 12 (continued)**Results: Middle Channel**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
2834.000	-36.1	-13.0	23.1	Complied



Transmitter Out of Band Radiated Emissions – LTE Band 12 (continued)



4.3 Transmitter Radiated Emissions at Band Edges – LTE Band 12**Test Summary:**

Test Engineer:	John Ferdinand	Test Date:	03 March 2022
Test Sample IMEI Number:	868822042808665		

FCC Reference:	Parts 2.1053 & 27.53(g)
Test Method Used:	KDB 971168 Section 6 referencing ANSI C63.26 Section 5.7

Environmental Conditions:

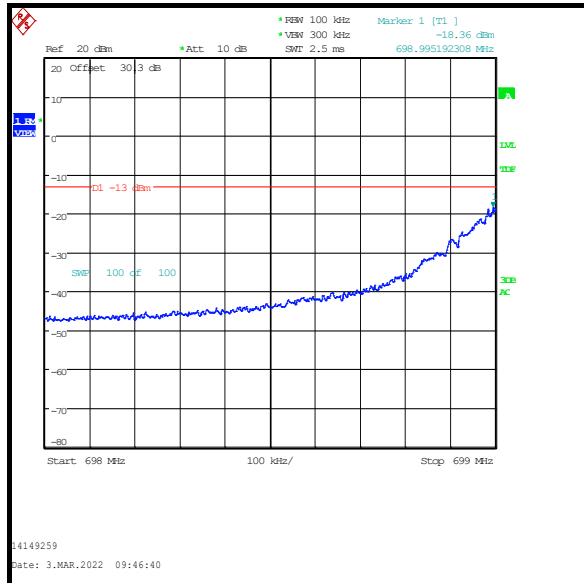
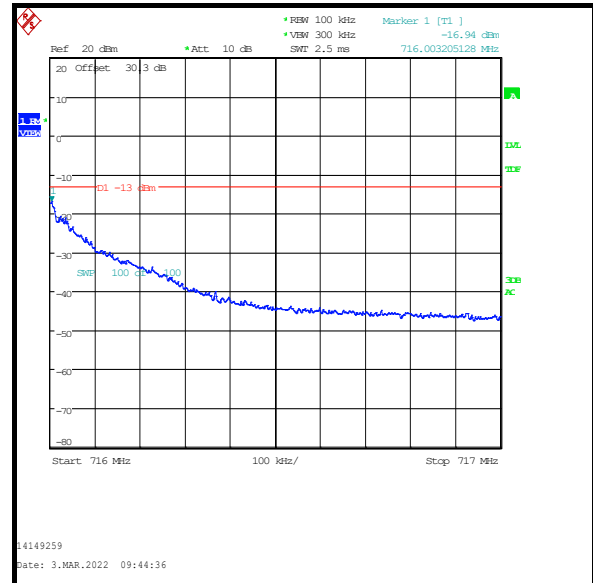
Temperature (°C):	21
Relative Humidity (%):	40

Note(s):

1. Measurements were performed with the EUT transmitting with QPSK modulation, 2 RB, 0 offset for bottom channel and with 16QAM modulation, 2 RB, 4 offset for top channel.
2. Measurements were performed in a fully anechoic chamber (Asset Number K0001) 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. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Radiated Emissions at Band Edges – LTE Band 12 (continued)**Results:**

Frequency (MHz)	Resource Blocks	Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
698.995	2	0	-18.4	-13.0	5.4	Complied
716.003	2	4	-16.9	-13.0	3.9	Complied

**Lower Band Edge****Upper Band Edge**

4.4 Transmitter Out of Band Radiated Emissions – LTE Band 66

Test Summary:

Test Engineer:	Nick Steele	Test Dates:	02 March 2022 & 03 March 2022
Test Sample IMEI Number:	868822042808665		

FCC Reference:	Parts 2.1053 & 27.53(h)(1)
Test Method Used:	KDB 971168 Section 6 referencing ANSI C63.26 Section 5.7
Frequency Range	9 kHz to 20 GHz

Environmental Conditions:

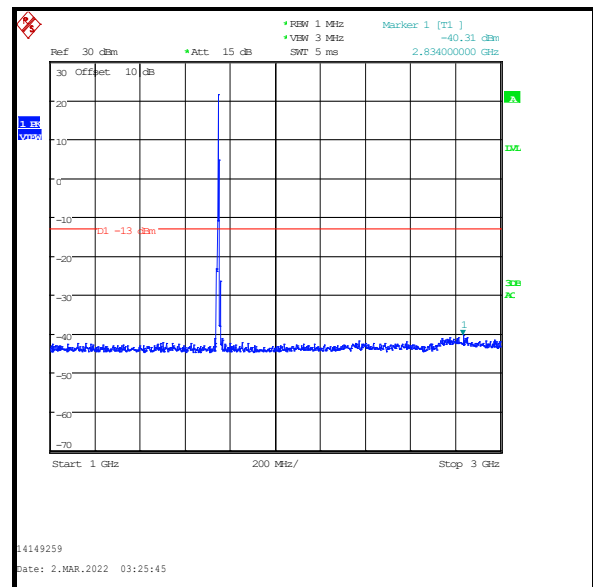
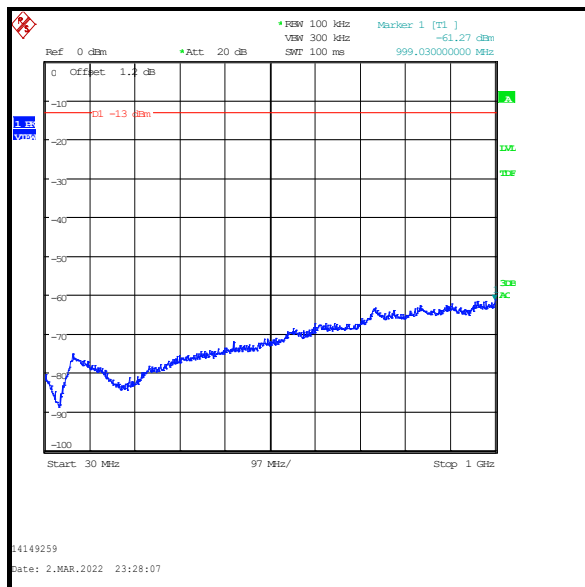
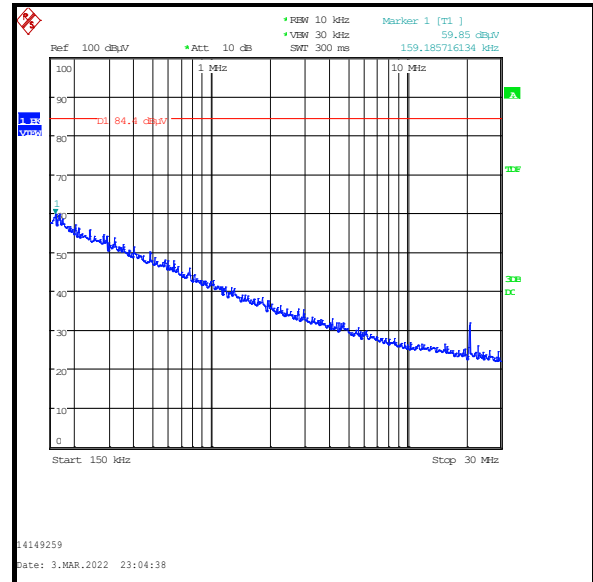
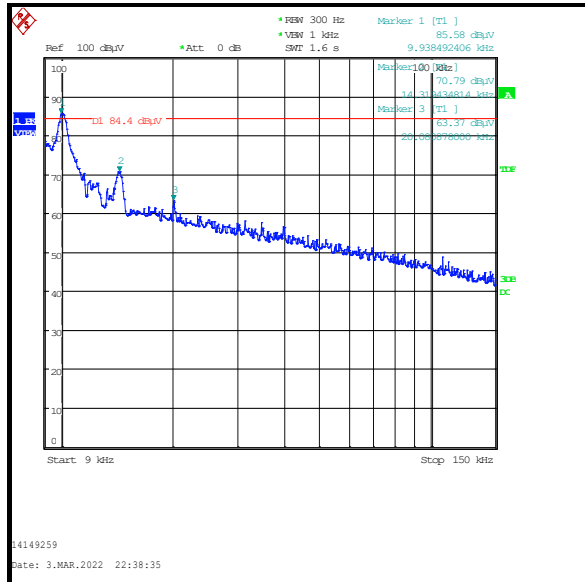
Temperature (°C):	20 to 21
Relative Humidity (%):	40 o 41

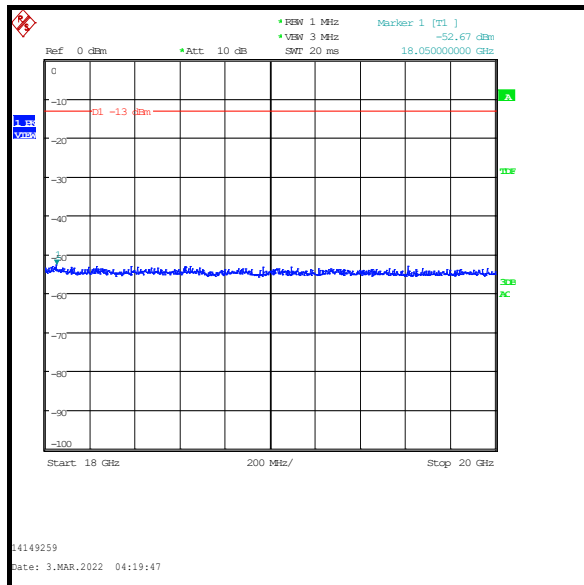
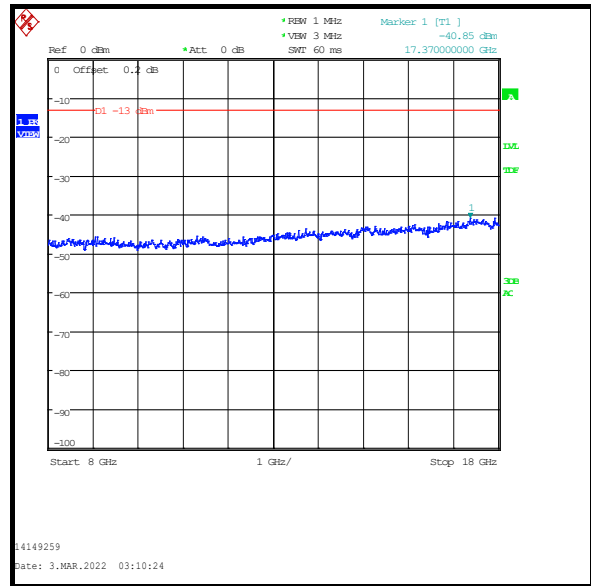
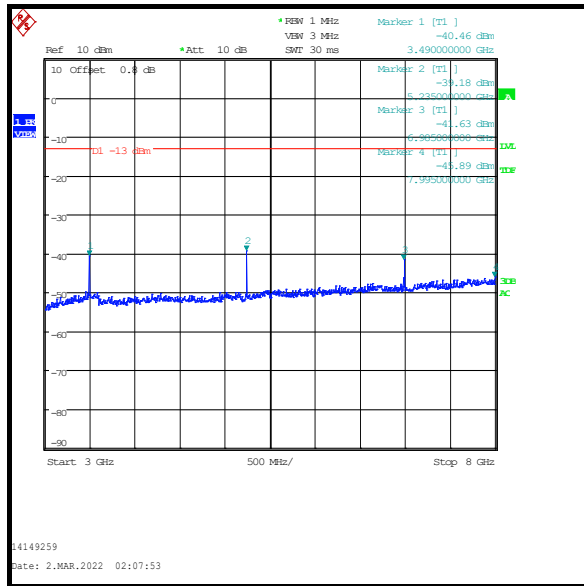
Note(s):

1. The emissions seen on the 9kHz to 150kHz plot, at approximately 9.938kHz and 14.319kHz, were generated by the turntable motor and were not coming from the EUT.
2. The emission seen on the 1 GHz to 3 GHz plot at approximately 1745 MHz is the EUT uplink.
3. All emissions shown on the pre-scans were investigated and found to be ambient, or > 20 dB below the appropriate limit or below the noise floor of the measurement system. Therefore, the highest emission pre scan value was recorded in the table below.
2. Measurements below 30 MHz were performed in a semi-anechoic chamber (Asset Number K0001) at 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. The limit was extrapolated to 3 metres in accordance ANSI C63.10 clause 6.4.3; measurements may be performed at a closer distance and the measured level extrapolated to the specified measurement distance using the method described in clause 6.4.4.2. The -13 dBm limit was converted to a field strength limit of 84.4 dBµV/m at 3 m.
4. Measurements from 30 MHz to 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
5. Pre-scans above 1 GHz were performed in a fully-anechoic chamber (Asset Number K0001) 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. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Out of Band Radiated Emissions – LTE Band 66 (continued)**Results: Middle Channel**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
5235.000	-39.2	-13.0	26.2	Complied



Transmitter Out of Band Radiated Emissions – LTE Band 66 (continued)

4.5 Transmitter Radiated Emissions at Band Edges – LTE Band 66**Test Summary:**

Test Engineer:	John Ferdinand	Test Date:	03 March 2022
Test Sample IMEI Number:	868822042808665		

FCC Reference:	Parts 2.1053 & 27.53(h)(1)
Test Method Used:	KDB 971168 Section 6 referencing ANSI C63.26 Section 5.7

Environmental Conditions:

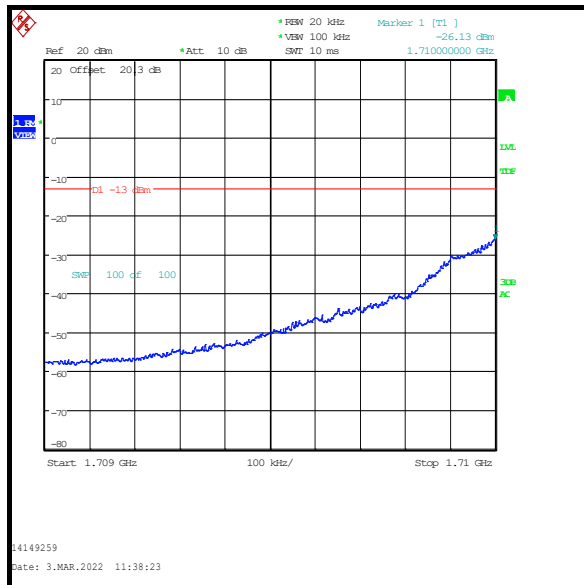
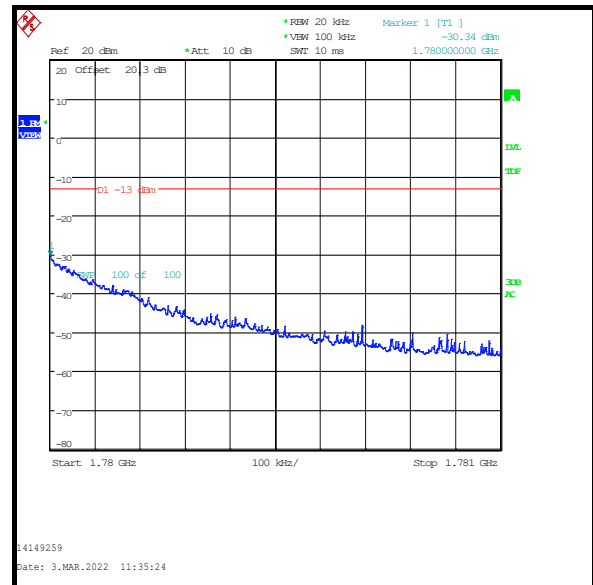
Temperature (°C):	21
Relative Humidity (%):	40

Note(s):

- Measurements were performed with the EUT transmitting with QPSK modulation, 2 RB, 0 offset for bottom channel and with 16QAM modulation, 2 RB, 4 offset for top channel.
- Measurements were performed in a fully anechoic chamber (Asset Number K0001) 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. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Transmitter Radiated Emissions at Band Edges – LTE Band 66 (continued)**Results:**

Frequency (MHz)	Resource Blocks	Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1710.000	2	0	-26.1	-13.0	13.1	Complied
1780.000	2	4	-30.3	-13.0	17.3	Complied

**Lower Band Edge****Upper Band Edge****--- END OF REPORT ---**