



# TEST REPORT

## Test Report No. : UL-RPT-RP14149259-316A

**Customer** : GAI-Tronics (a division of Hubbell Ltd.)

**Model No.** : 231-02-304J-612

**Contains FCC ID** : 2A8ZW-COMMANDER

**Technology** : LTE – Band 5

**Test Standard(s)** : FCC Parts 2.1053 & 22.917

**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:**

Ben Mercer  
Lead Project Engineer, Radio Laboratory

**Company Signatory:**

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## Customer Information

<b>Company Name:</b>	GAI-Tronics (a division of Hubbell Ltd.)
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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	Ben Mercer
3.0	09/01/2023	Updated antenna gain	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**

<b>Specification Reference:</b>	47CFR22
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 22 Subpart H (Public Mobile Services)
<b>Site Registration:</b>	685609
<b>FCC Lab. Designation No.:</b>	UK2011
<b>Location of Testing:</b>	Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, G24 8AH, United Kingdom
<b>Test Dates:</b>	02 March 2022 to 04 March 2022

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

<b>FCC Reference (47CFR)</b>	<b>Measurement</b>	<b>Result</b>
Part 2.1053 / 22.917	Transmitter Out of Band Radiated Emissions	
Part 2.1053 / 22.917	Transmitter Radiated Emissions at Band Edges	

#### **Key to Results**

= Complied = Did not comply

### **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**

<b>Reference:</b>	ANSI C63.26-2015
<b>Title:</b>	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
<b>Reference:</b>	FCC KDB 971168 D01 v03r01, April 9, 2018
<b>Title:</b>	Measurement Guidance for Certification of Licensed Digital Transmitters
<b>Reference:</b>	PVG.04, 16 September 2021, Version 5.3.0
<b>Title:</b>	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 18 GHz	95%	±3.16 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
K0001	3m RSE Chamber	Rainford EMC	N/A	N/A	06 Sep 2022	12
M2044	Test Receiver	Rohde & Schwarz	ESU26	100122	29 Apr 2022	12
A3179	Pre-Amplifier	Hewlett Packard	8449B	3008A00934	24 Aug 2022	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	27 Aug 2022	12
A553	Antenna	Chase	CBL6111A	1593	23 Nov 2022	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	29 Nov 2022	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
A2924	Attenuator	AtlanTecRF	AN18W5-20	832828#7	27 Jan 2023	12

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

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

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

<b>Technology Tested:</b>	LTE VoLTE- Band 5		
<b>Type of Equipment:</b>	Transceiver		
<b>Channel Bandwidth:</b>	1.4 MHz & 10 MHz		
<b>Modulation:</b>	QPSK / 16QAM		
<b>Power Supply Requirement(s):</b>	12.0 VDC		
<b>Transmit Frequency Range:</b>	824 MHz to 849 MHz		
<b>Channel Bandwidth:</b>	1.4 MHz		
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>N<sub>ul</sub></b>	<b>Uplink Frequency (MHz)</b>
	Bottom	20407	824.7
	Middle	20525	836.5
	Top	20643	848.3
<b>Channel Bandwidth:</b>	10 MHz		
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>N<sub>ul</sub></b>	<b>Uplink Frequency (MHz)</b>
	Middle	20525	836.5

### **3.4 Description of Available Antennas**

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

Frequency Range (MHz)	Antenna Gain (dBi)
824 to 849	2.8

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

#### **Support Equipment**

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

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

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

## **Operating Modes**

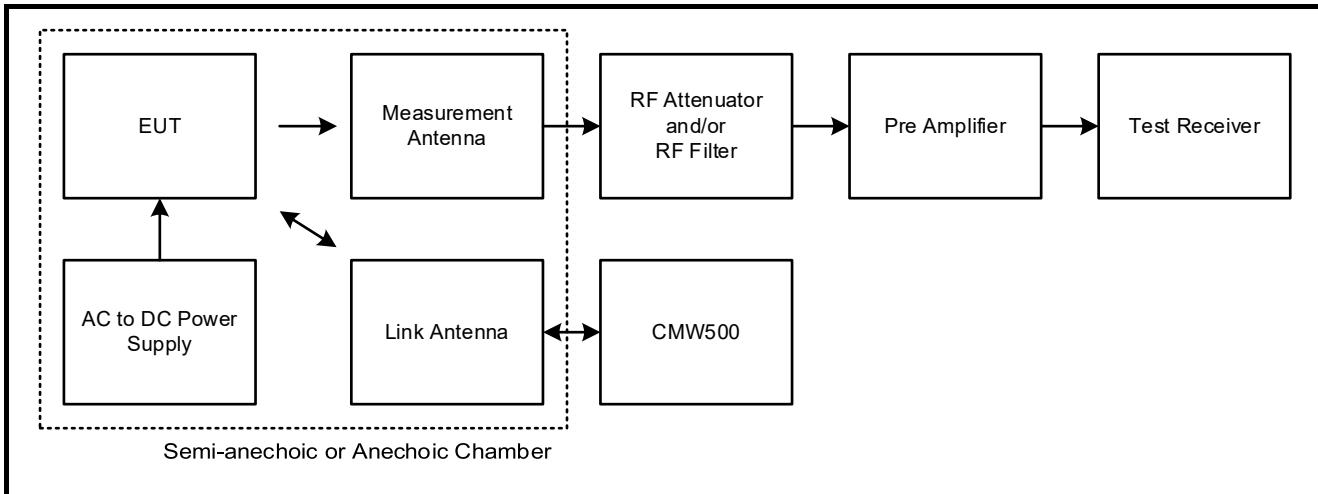
The EUT was tested in the following operating mode(s):

- 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 Out of Band Radiated Emissions**

#### **Test Summary:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	02 March 2022 to 04 March 2022
<b>Test Sample IMEI Number:</b>	868822042808665		

<b>FCC Reference:</b>	Parts 2.1053 & 22.917
<b>Test Method Used:</b>	KDB 971168 Section 6 referencing ANSI C63.26 Section 5.7
<b>Frequency Range</b>	9 kHz to 9 GHz

#### **Environmental Conditions:**

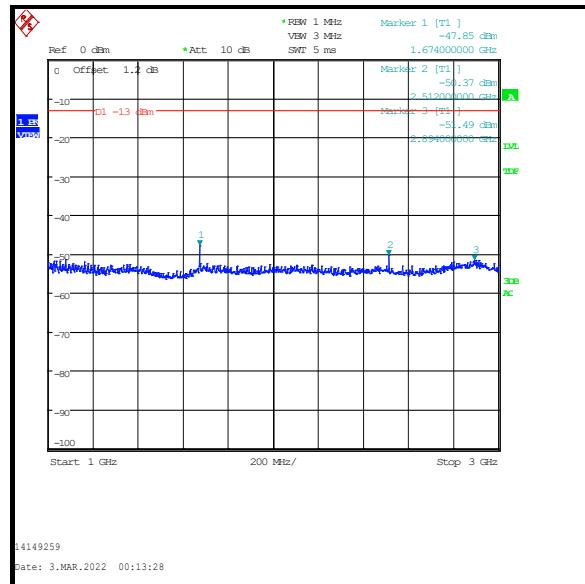
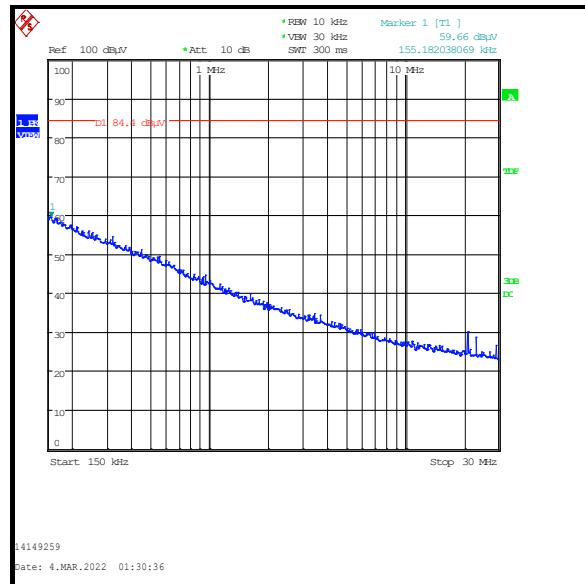
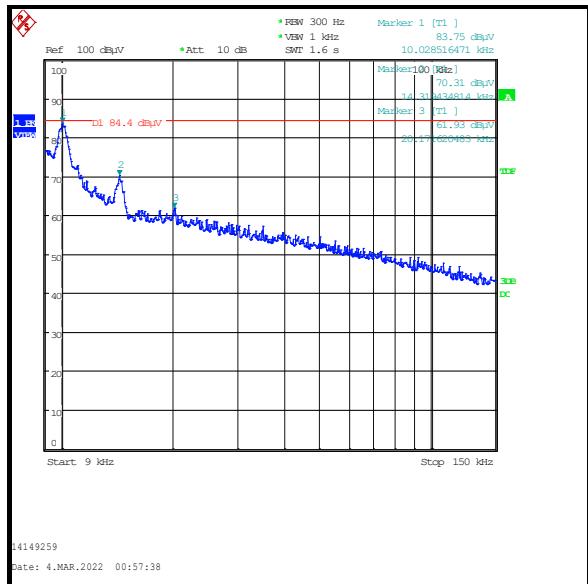
<b>Temperature (°C):</b>	20 to 21
<b>Relative Humidity (%):</b>	40 to 41

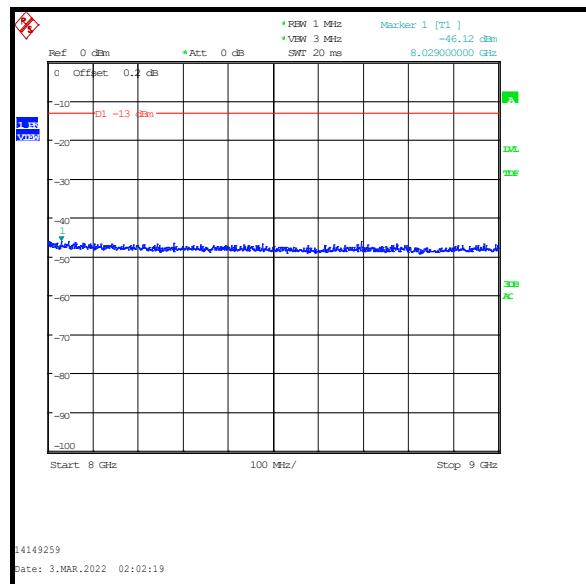
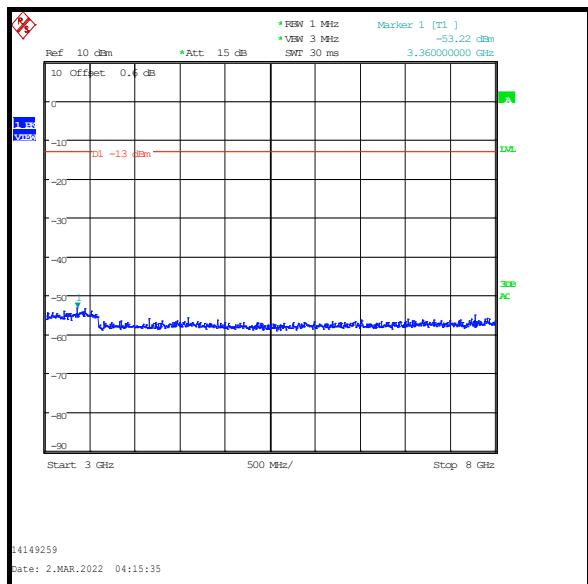
#### **Note(s):**

1. The emissions seen on the 9kHz to 150kHz plot, at approximately 10.028kHz and 14.319kHz, were generated by the turntable motor and did not originate from the EUT.
2. The emission seen on the 30 MHz to 1 GHz plot at approximately 836.5 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.
4. 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 dB $\mu$ V/m at 3 m.
5. 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.
6. 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 (continued)****Results: Middle Channel**

Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1674.000	-47.9	-13.0	34.9	Complied



**Transmitter Out of Band Radiated Emissions (continued)**

## **4.2 Transmitter Radiated Emissions at Band Edges**

### **Test Summary:**

<b>Test Engineer:</b>	John Ferdinand	<b>Test Date:</b>	03 March 2022
<b>Test Sample IMEI Number:</b>	868822042808665		

<b>FCC Reference:</b>	Parts 2.1053 & 22.917
<b>Test Method Used:</b>	KDB 971168 Section 6 referencing ANSI C63.26 Section 5.7

### **Environmental Conditions:**

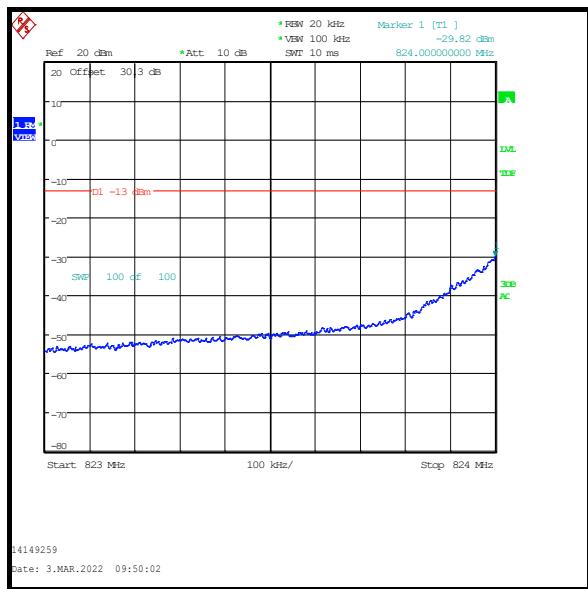
<b>Temperature (°C):</b>	21
<b>Relative Humidity (%):</b>	40

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

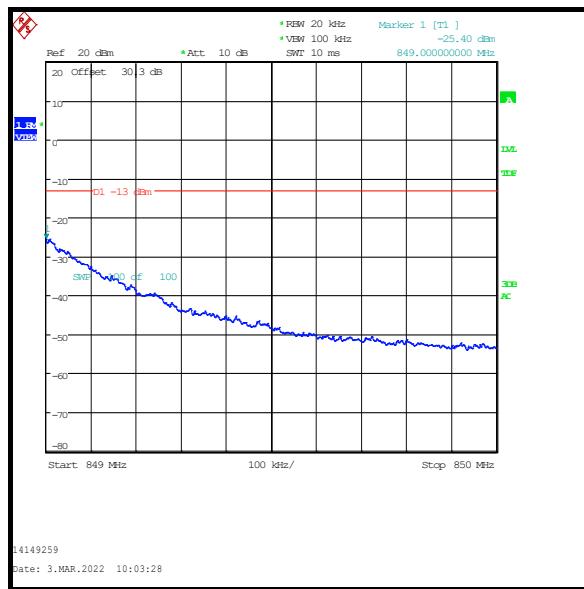
1. Measurements were performed with the EUT transmitting with QPSK modulation, 2 RB, 0 offset for bottom channel and with 16QAM modulation, 2 RB, 4 offset for top channel.
2. Measurements were performed in a fully anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at 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 (continued)****Results:**

Frequency (MHz)	Resource Blocks	Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
824.000	2	0	-29.8	-13.0	16.8	Complied
849.000	2	4	-25.4	-13.0	12.4	Complied



Lower Band Edge



Upper Band Edge

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