



# TEST REPORT

**Test Report No. : UL-RPT-RP85949JD01C V4.0**

**Manufacturer** : General Dynamics Broadband UK Ltd  
**Model No.** : AMW  
**FCC ID** : PKTPEMAMW1  
**Technology.** : LTE Band 12, 5 MHz Channel Bandwidth  
**Test Standard(s)** : FCC Parts 2.1046, 2.1049, 2.1051, 2.1053, 2.1055, 27.50(c)(9), 27.53(f) & 27.54

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 4.0 supersedes all previous versions.

**Date of Issue:** 21 March 2014

**Checked by:**

Sarah Williams  
Engineer, Radio Laboratory

**Issued by :**

pp

John Newell  
Group Quality Manager  
Basingstoke,  
UL VS LTD



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

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## UL VS LTD

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**1. Customer Information**










<b>Company Name:</b>	General Dynamics Broadband UK Ltd
<b>Address:</b>	Unit 7 Greenways Business Park Bellinger Close Chippenham Wilts SN15 1BN United Kingdom

## **2. Summary of Testing**

### **2.1. General Information**

<b>Specification Reference:</b>	47CFR27
<b>Specification Title:</b>	Code of Federal Regulations Volume 47 (Telecommunications): Part 27 Subpart C (Miscellaneous Wireless Communication Services)
<b>Site Registration:</b>	209735
<b>Location of Testing:</b>	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
<b>Test Dates:</b>	13 July 2012 to 04 March 2014

### **2.2. Summary of Test Results**

<b>FCC Reference (47CFR)</b>	<b>Measurement</b>	<b>Result</b>
27.50(c)(9) / 2.1046	Transmitter Carrier Output Power and Effective Radiated Power (ERP)	
2.1049	Transmitter Occupied Bandwidth	
27.53(f) / 2.1051	Transmitter Conducted Spurious Emissions	
27.53(f) / 2.1051	Transmitter Conducted Emissions at Band Edges	
27.53(f) / 2.1053	Transmitter Radiated Spurious Emissions	
27.53(f) / 2.1053	Transmitter Radiated Emissions at Band Edges	
27.54 / 2.1055	Transmitter Frequency Stability	
Key to Results  = Complied  = Did not comply		

### **2.3. Methods and Procedures**

<b>Reference:</b>	ANSI/TIA-603-C-2004
<b>Title:</b>	Land Mobile Communications Equipment, Measurements and performance Standards
<b>Reference:</b>	FCC KDB 971168 D01 v02r01, 7 June 2013
<b>Title:</b>	Measurement Guidance for Certification of Licensed Digital Transmitters

### **2.4. Deviations from the Test Specification**

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

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

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

<b>Brand Name:</b>	General Dynamics Broadband
<b>Model Name or Number:</b>	AMW
<b>Serial Number:</b>	AMWGB84001G12
<b>Hardware Version Number:</b>	Pass 1
<b>Software Version Number:</b>	Release 4
<b>FCC ID:</b>	PKTPEMAMW1

<b>Brand Name:</b>	General Dynamics Broadband
<b>Model Name or Number:</b>	AMW
<b>Serial Number:</b>	AMWGB84001F12
<b>Hardware Version Number:</b>	Pass 1
<b>Software Version Number:</b>	Release 4
<b>FCC ID:</b>	PKTPEMAMW1

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

The equipment under test was a LTE PCI Express Mini Modem.

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

No modifications were applied to the EUT during testing.

**3.4. Additional Information Related to Testing**

<b>Tested Technology:</b>	LTE Band 12		
<b>Type of Equipment</b>	PCI Express mini module		
<b>Channel Bandwidth(s):</b>	5 MHz		
<b>Modulation Type:</b>	QPSK & 16QAM		
<b>Duty Cycle:</b>	100%		
<b>Antenna Gain:</b>	2.5 dBi		
<b>Power Supply Requirement:</b>	Nominal	3.3 V	
	Minimum	3.0 V	
	Maximum	3.6 V	
<b>Transmit Frequency Range:</b>	Band 12 (699 MHz to 716 MHz) Part 27 (698 MHz to 746 MHz)		
<b>Channels Tested:</b>	<b>Channel</b>	<b>N<sub>ul</sub></b>	<b>Frequency of Uplink (MHz)</b>
	Bottom	23035	701.5
	Middle	23095	707.5
	Top	23155	713.5

### **3.5. Support Equipment**

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

<b>Description:</b>	UE PEM V1 NG Adaptor Board
<b>Brand Name:</b>	IPWireless
<b>Model Name or Number:</b>	AAF Pass3
<b>Serial Number:</b>	AAF838000V32

<b>Description:</b>	UE PEM V1 NG Adaptor Board – Voltage Variation
<b>Brand Name:</b>	IPWireless
<b>Model Name or Number:</b>	AAF Pass2
<b>Serial Number:</b>	EEMS 022530 0004

<b>Description:</b>	Laptop PC
<b>Brand Name:</b>	Toshiba
<b>Model Name or Number:</b>	PSAAPE-00H00KEN
<b>Serial Number:</b>	67071048Q

<b>Description:</b>	Antenna
<b>Brand Name:</b>	None
<b>Model Name or Number:</b>	OA-LTE-06-01-IPW
<b>Serial Number:</b>	Not stated



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

### **4.1. Operating Modes**

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

- Transmit Mode - the EUT was set to transmit with maximum output power using a 5 MHz channel bandwidth. QPSK and 16QAM modulations were both tested, along with the Resource Blocks set to 1 and 25.

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

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

- The EUT was connected to the UE PEM V1 NG Adaptor Board, for all tests.
- The EUT was controlled from a laptop PC, using bespoke software supplied by the customer.
- The EUT was connected to a test laptop by using a USB extension cable and the laptop was connected to 120 VAC 60 Hz AC supply.
- The EUT has two U.FL connector ports, the customer supplied two short U.FL to SMA cables, to allow conducted measurements to be performed where necessary.
- The EUT was connected to a Rohde & Schwarz CMW500 LTE system simulator for output power and occupied bandwidth tests. All other tests were performed using an Anristu LTE system simulator, both operating in a transceiver mode.
- For Resource Block setting of 1, testing was carried out on starting block numbers of 1 and 25.
- The EUT has a main RF port and a Receiver Diversity port. Transmitter testing was performed on the main RF port which is a transmit and receive port. The diversity port was terminated for all bench testing.
- For radiated emissions testing, the customer supplied two OA-LTE-06-01-IPW antennas', which were connected to the main and diversity ports. The antenna gain was declared as 2.5 dBi.
- The customer supplied a modified UE PEM V1NG Adaptor Board, which allowed voltage variation directly to the PEM, this was used for Transmitter Frequency Stability Voltage Variation testing only.

## **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* for Measurement Uncertainty 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 Carrier Output Power and Effective Radiated Power (ERP)****Test Summary:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Date:</b>	13 February 2014
<b>Test Sample Serial Number:</b>	AMWGB84001F12		

<b>FCC Reference:</b>	Parts 2.1046 and 27.50(c)(9)
<b>Test Method Used:</b>	As detailed in KDB 971168 Section 5.2.1

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	39

**Note(s):**

1. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 25. For single resource blocks, measurements were performed with the starting of blocks 1 and 25.
2. The customer stated a maximum antenna gain of 8.6 dBi. As the limit is an ERP limit the gain in dBi has been converted to dBd. The dBd was calculated as:

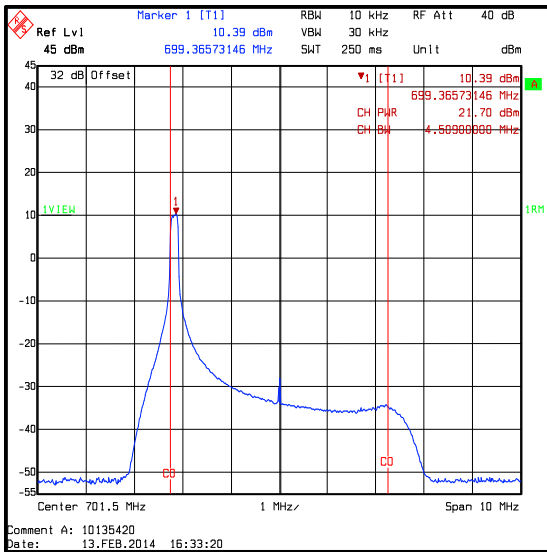
$$8.6 \text{ dBi} - 2.15 \text{ dB} = 6.45 \text{ dBd}$$

3. The plots have an incorrect job number.

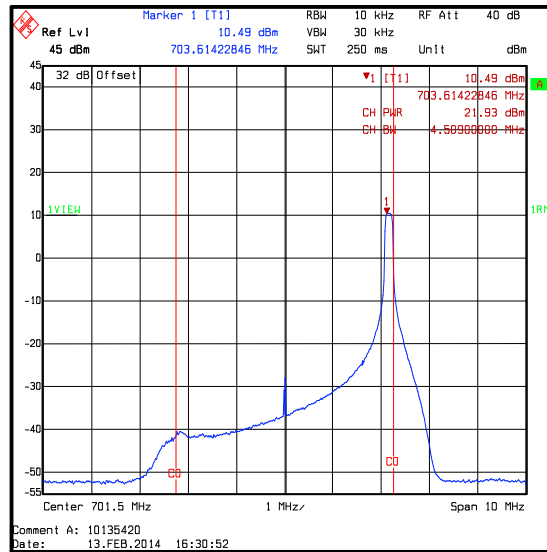
**Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)**

**Results: 5 MHz Channel Bandwidth / Bottom Channel / QPSK**

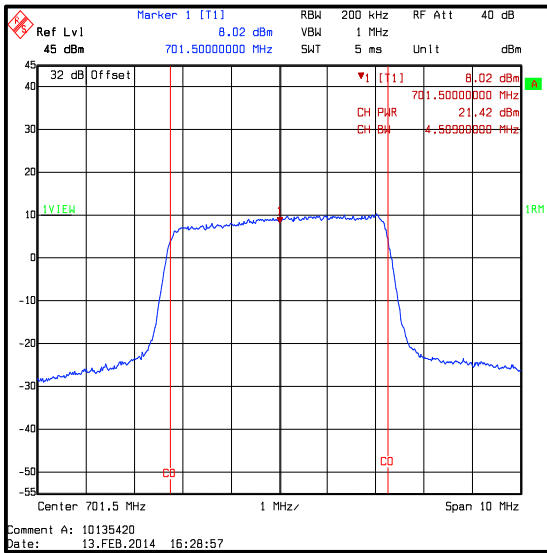
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
701.5	1	0	21.7	6.45	28.15	44.77	16.62	Complied
701.5	1	25	21.9	6.45	28.35	44.77	16.42	Complied
701.5	25	0	21.4	6.45	27.85	44.77	16.92	Complied



**QPSK / 1 Resource Block (0 offset)**



**QPSK / 1 Resource Block (25 offset)**

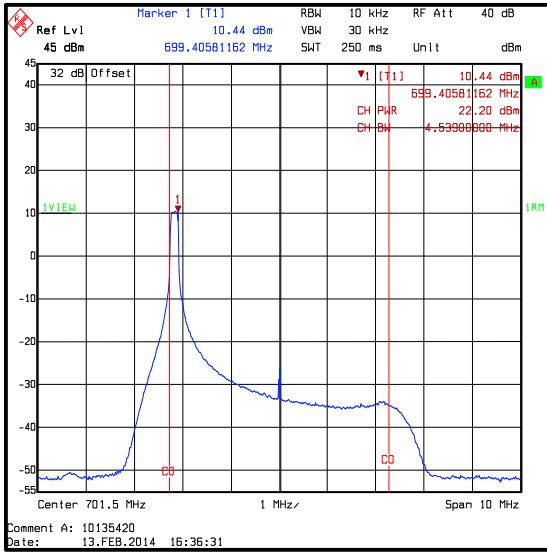


**QPSK / 25 Resource Blocks**

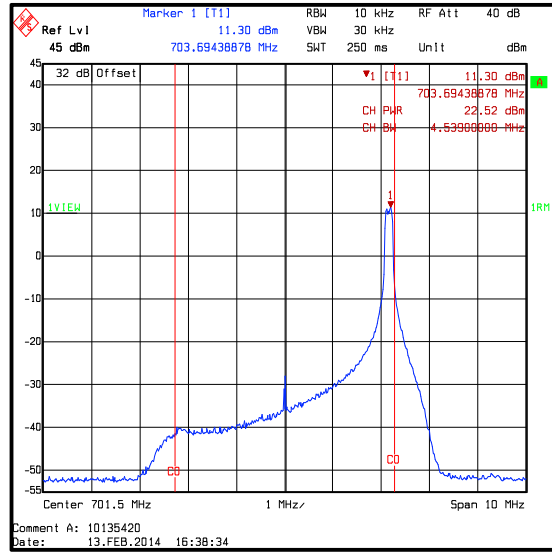
**Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)**

**Results: 5 MHz Channel Bandwidth / Bottom Channel / 16QAM**

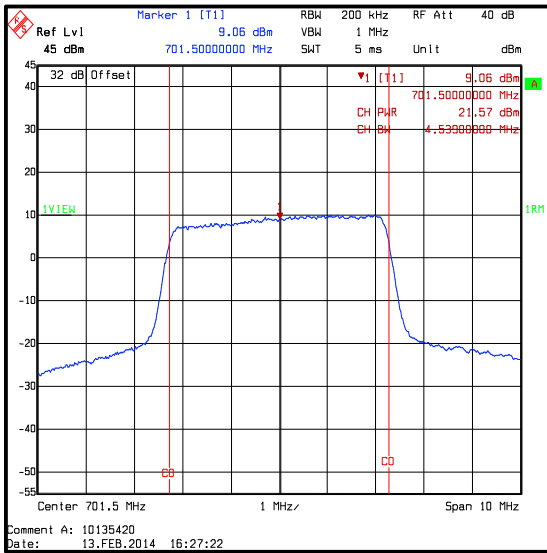
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
701.5	1	0	22.2	6.45	28.65	44.77	16.12	Complied
701.5	1	25	22.5	6.45	28.95	44.77	15.82	Complied
701.5	25	0	21.6	6.45	28.05	44.77	16.72	Complied



**16QAM / 1 Resource Block (0 offset)**



**16QAM / 1 Resource Block (25 offset)**

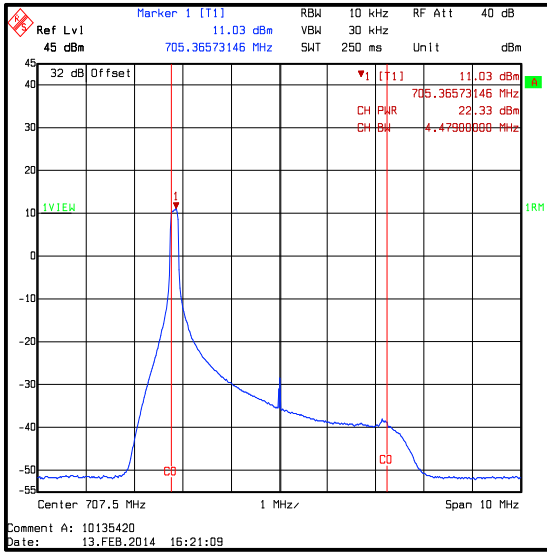


**16QAM / 25 Resource Blocks**

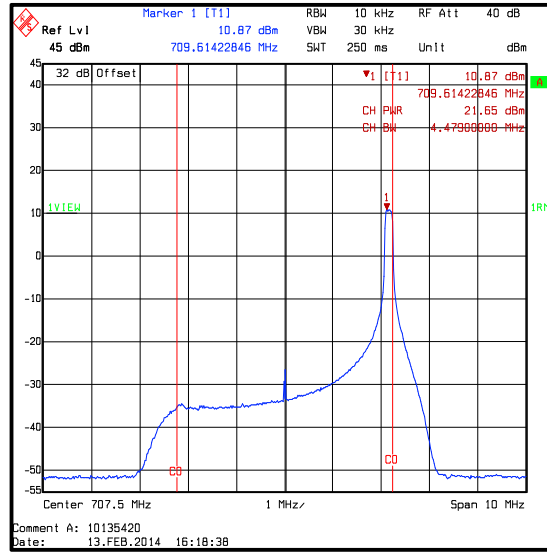
**Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)**

**Results: 5 MHz Channel Bandwidth / Middle Channel / QPSK**

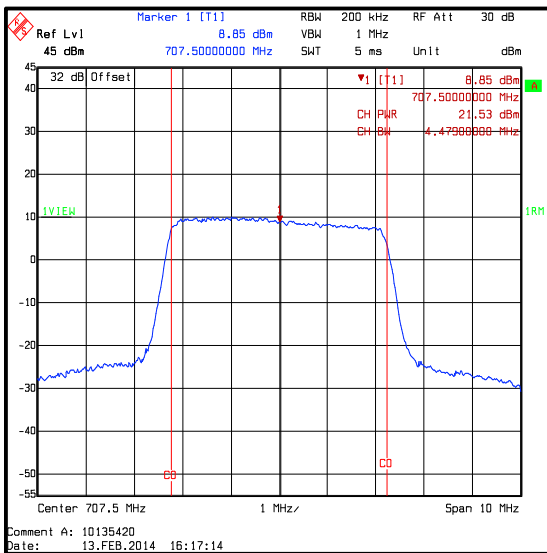
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
707.5	1	0	22.3	6.45	28.75	44.77	16.02	Complied
707.5	1	25	21.7	6.45	28.15	44.77	16.62	Complied
707.5	25	0	21.5	6.45	27.95	44.77	16.82	Complied



**QPSK / 1 Resource Block (0 offset)**



**QPSK / 1 Resource Block (25 offset)**

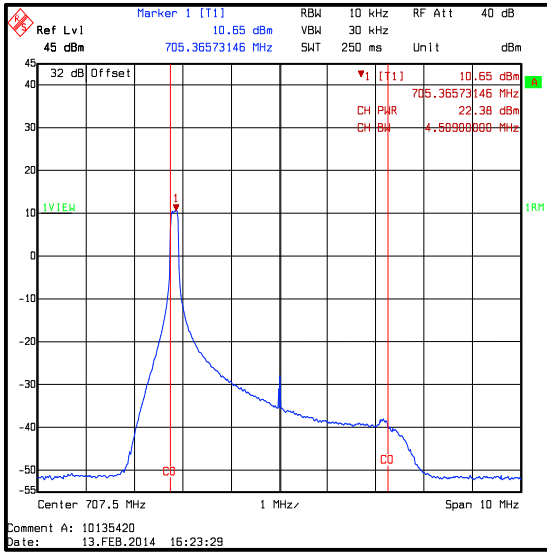


**QPSK / 25 Resource Blocks**

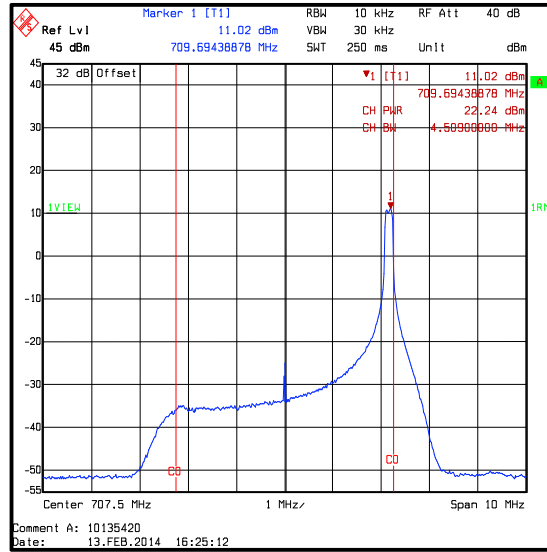
**Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)**

**Results: 5 MHz Channel Bandwidth / Middle Channel / 16QAM**

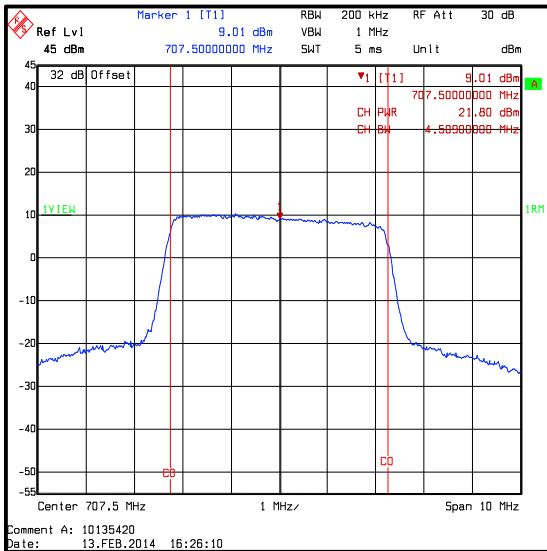
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
707.5	1	0	22.4	6.45	28.85	44.77	15.92	Complied
707.5	1	25	22.2	6.45	28.65	44.77	16.12	Complied
707.5	25	0	21.8	6.45	28.25	44.77	16.52	Complied



**16QAM / 1 Resource Block (0 offset)**



**16QAM / 1 Resource Block (25 offset)**

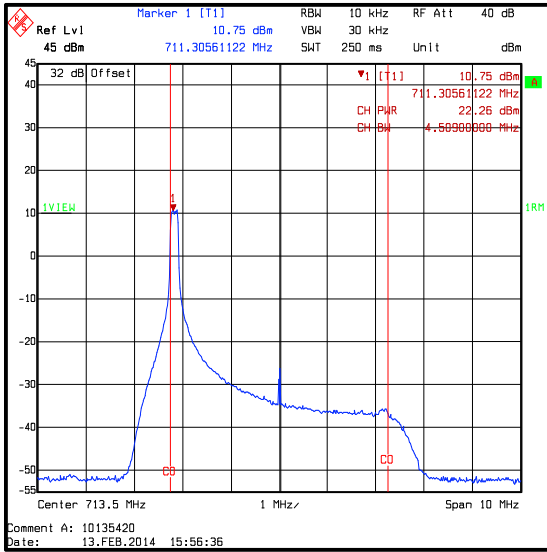


**16QAM / 25 Resource Blocks**

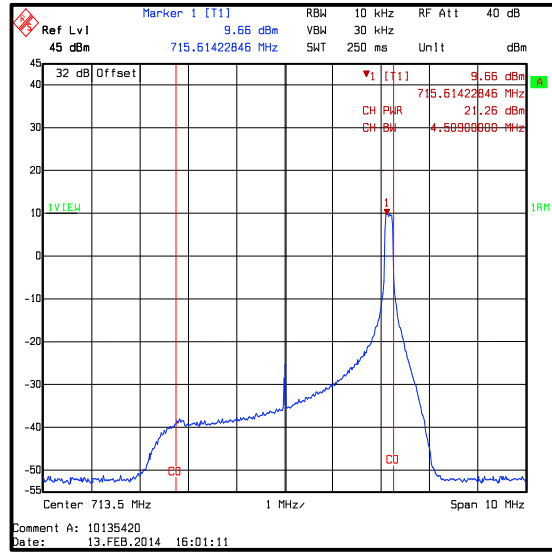
**Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)**

**Results: 5 MHz Channel Bandwidth / Top Channel / QPSK**

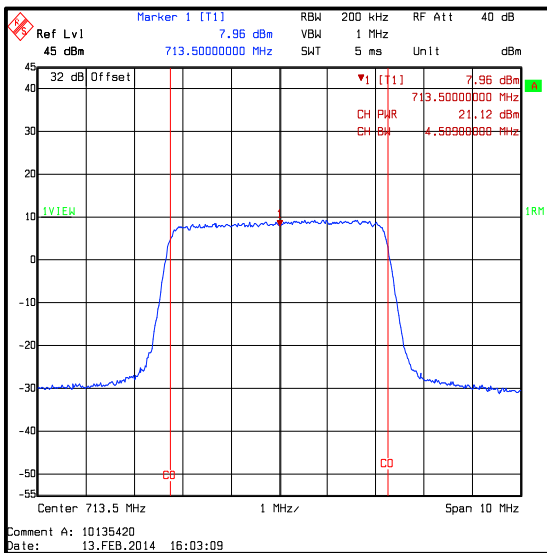
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
713.5	1	0	22.3	6.45	28.75	44.77	16.02	Complied
713.5	1	25	21.3	6.45	27.75	44.77	17.02	Complied
713.5	25	0	21.1	6.45	27.55	44.77	17.22	Complied



**QPSK / 1 Resource Block (0 offset)**



**QPSK / 1 Resource Block (25 offset)**



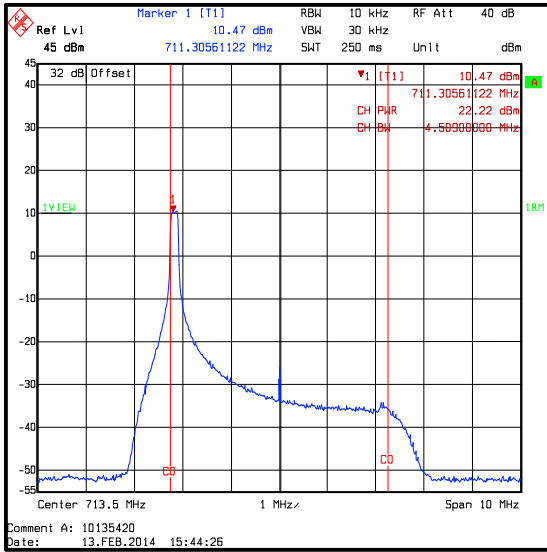
**QPSK / 25 Resource Blocks**



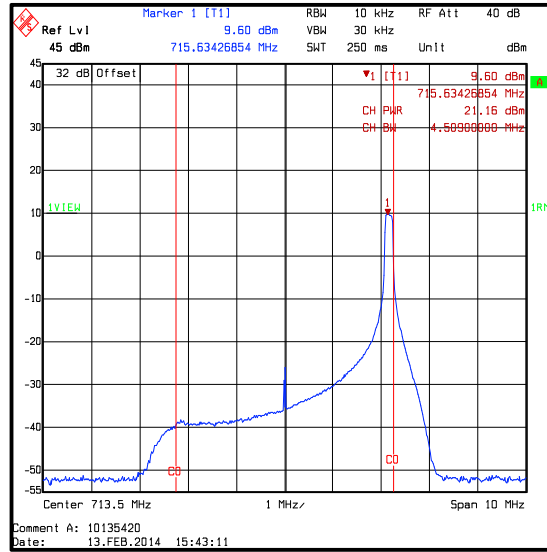
**Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)**

**Results: 5 MHz Channel Bandwidth / Top Channel / 16QAM**

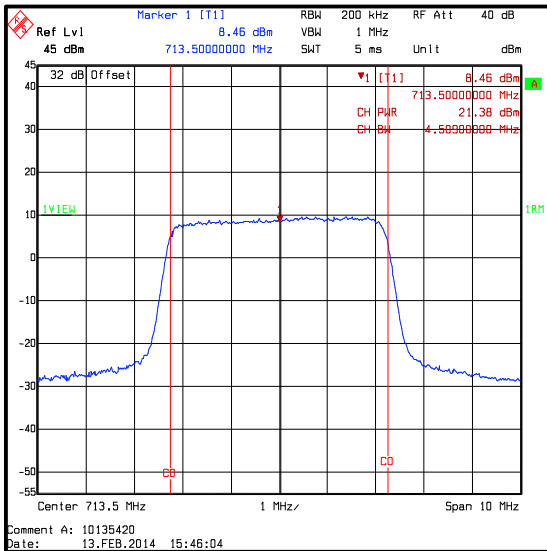
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
713.5	1	0	22.2	6.45	28.65	44.77	16.12	Complied
713.5	1	25	21.2	6.45	27.65	44.77	17.12	Complied
713.5	25	0	21.4	6.45	27.85	44.77	16.92	Complied



**16QAM / 1 Resource Block (0 offset)**



**16QAM / 1 Resource Block (25 offset)**



**16QAM / 25 Resource Blocks**

**Transmitter Carrier Output Power and Effective Radiated Power (ERP) (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	24 May 2014	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842659/016	19 Aug 2014	12
A1999	Attenuator	Huber + Suhner	6820.17.B	07101	05 Apr 2014	12
A1368	Directional Coupler	Pasternack Enterprises	PE2214-10	None stated	Calibrated before use	-
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12

*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.*

**5.2.2. Transmitter Occupied Bandwidth****Test Summary:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	13 February 2014 & 03 March 2014
<b>Test Sample Serial Number:</b>	AMWGB84001F12		

<b>FCC Reference:</b>	Part 2.1049
<b>Test Method Used:</b>	As detailed in KDB 971168 Section 4.2

**Environmental Conditions:**

<b>Temperature (°C):</b>	23
<b>Relative Humidity (%):</b>	39

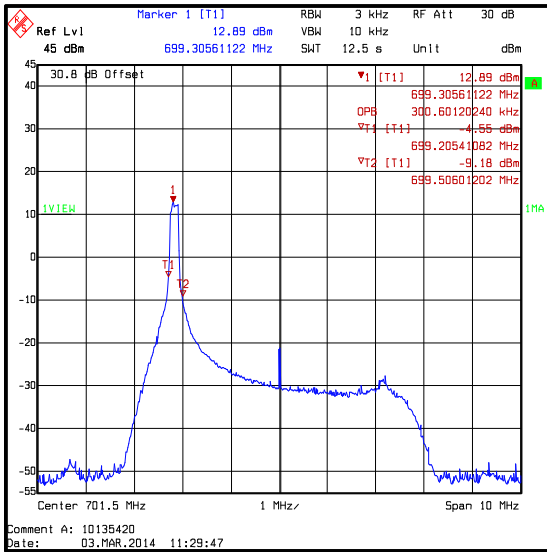
**Note(s):**

1. Occupied bandwidth (99% bandwidth) was measured using a test receiver occupied bandwidth function.
2. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 25. For single resource blocks, measurements were performed with the block starting of blocks 1 and 25.
3. The plots have an incorrect job number.

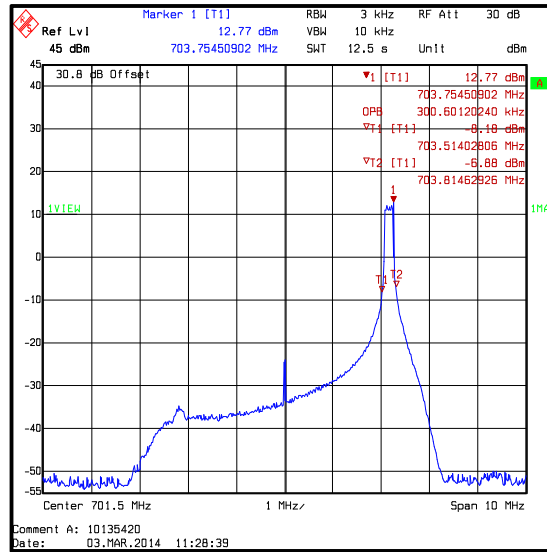
**Transmitter Occupied Bandwidth (continued)**

**Results: 5 MHz Channel Bandwidth / Bottom Channel / QPSK**

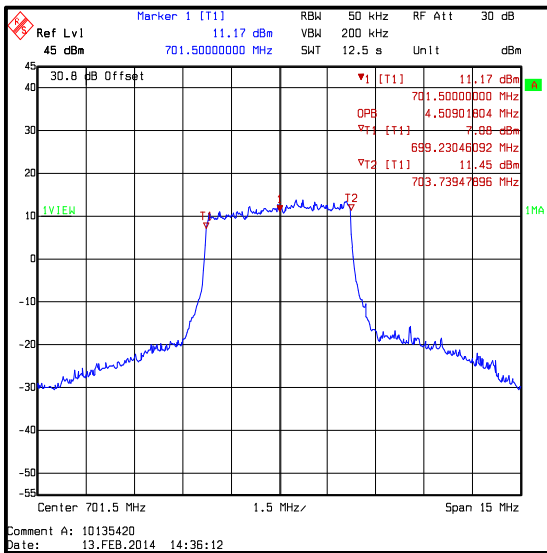
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
701.5	1	0	3	10	0.301
701.5	1	25	3	10	0.301
701.5	25	0	50	200	4.509



**QPSK / 1 Resource Blocks (0 offset)**



**QPSK / 1 Resource Blocks (25 offset)**

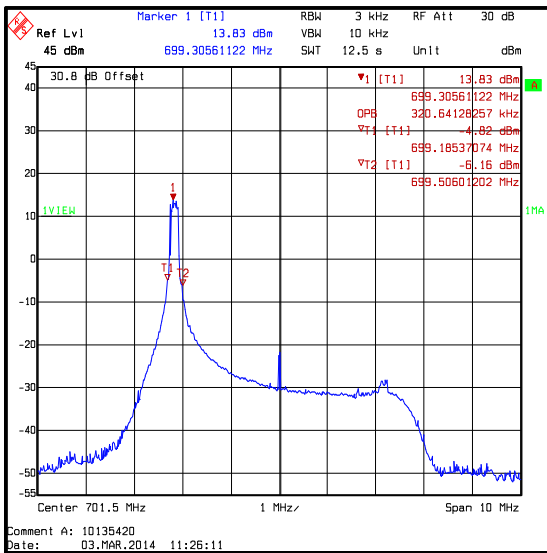


**QPSK / 25 Resource Blocks**

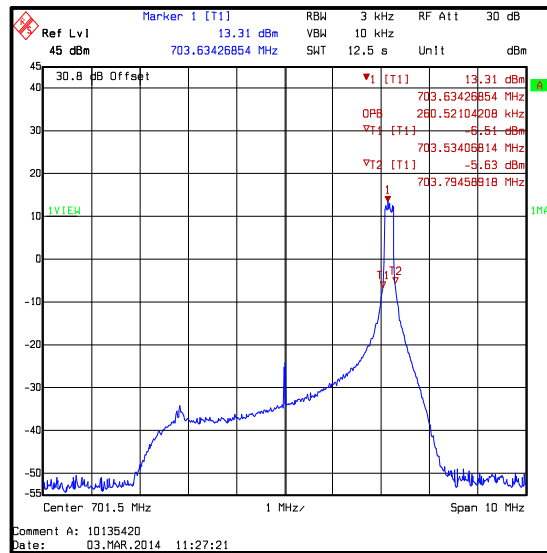
**Transmitter Occupied Bandwidth (continued)**

**Results: 5 MHz Channel Bandwidth / Bottom Channel / 16QAM**

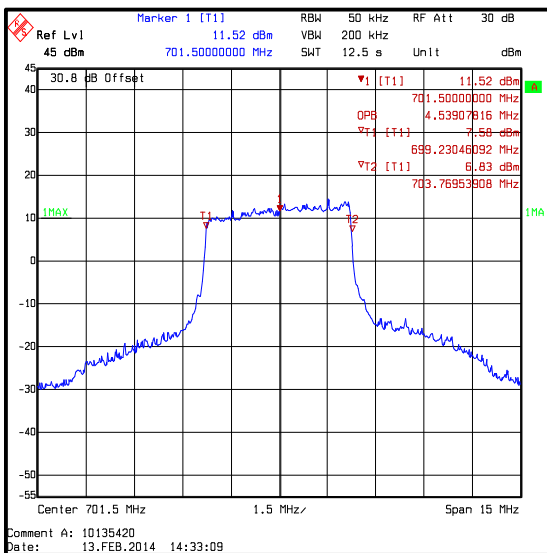
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
701.5	1	0	3	10	0.321
701.5	1	25	3	10	0.261
701.5	25	0	50	200	4.539



**16QAM / 1 Resource Blocks (0 offset)**



**16QAM / 1 Resource Blocks (25 offset)**

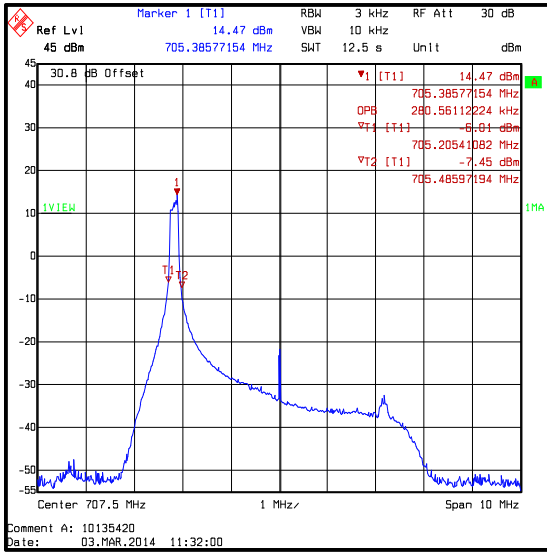


**16QAM / 25 Resource Blocks**

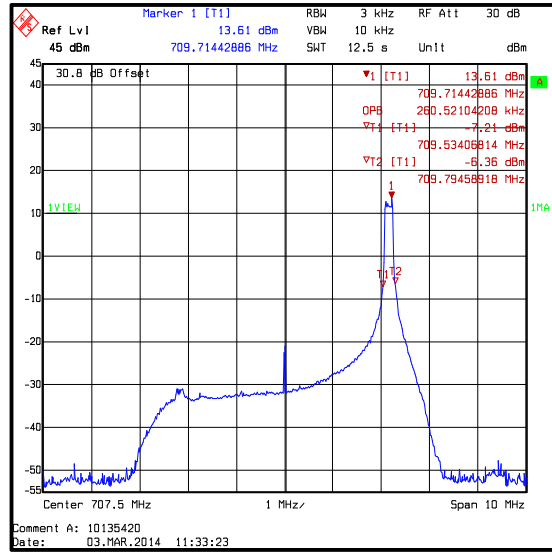
**Transmitter Occupied Bandwidth (continued)**

**Results: 5 MHz Channel Bandwidth / Middle Channel / QPSK**

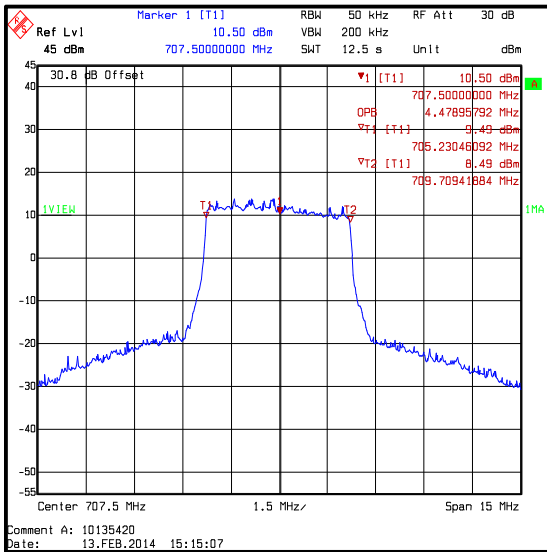
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
707.5	1	0	3	10	0.281
707.5	1	25	3	10	0.261
707.5	25	0	50	200	4.479



**QPSK / 1 Resource Blocks (0 offset)**



**QPSK / 1 Resource Blocks (25 offset)**

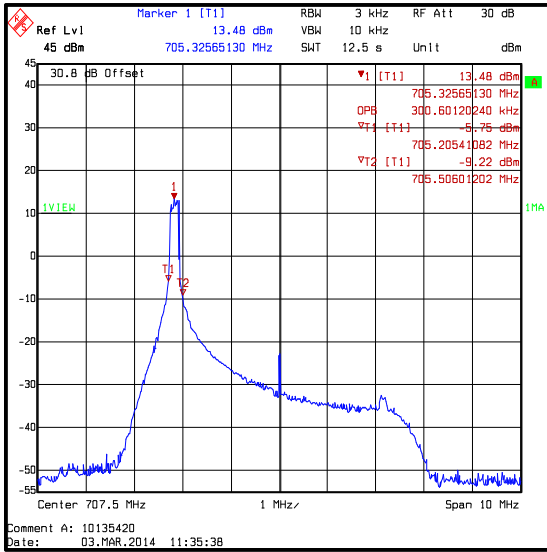


**QPSK / 25 Resource Blocks**

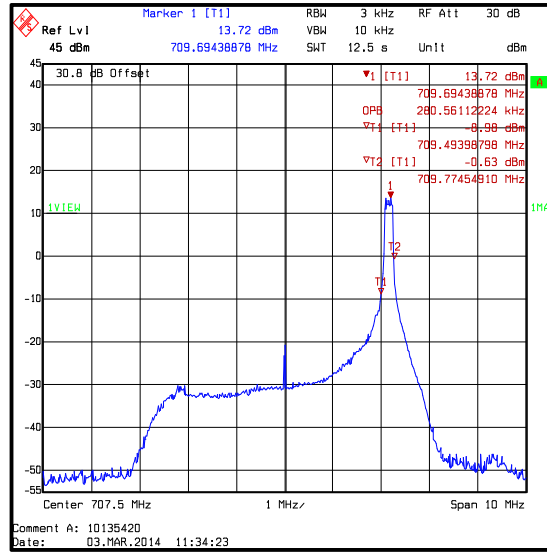
**Transmitter Occupied Bandwidth (continued)**

**Results: 5 MHz Channel Bandwidth / Middle Channel / 16QAM**

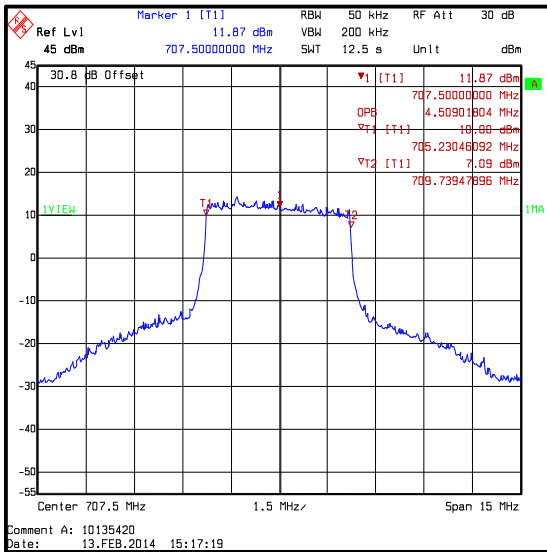
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
707.5	1	0	3	10	0.301
707.5	1	25	3	10	0.281
707.5	25	0	50	200	4.509



**16QAM / 1 Resource Blocks (0 offset)**



**16QAM / 1 Resource Blocks (25 offset)**

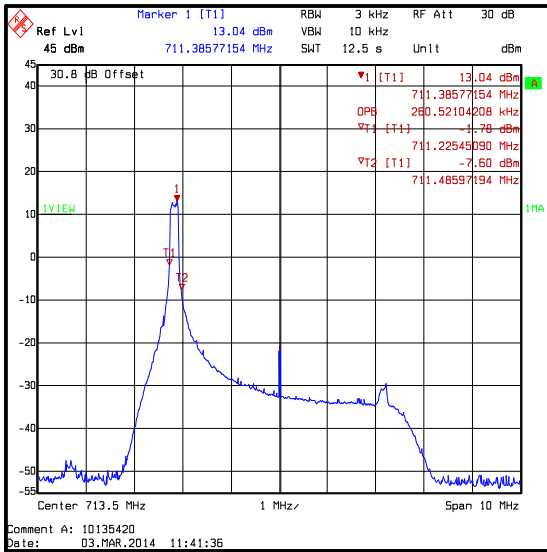


**16QAM / 25 Resource Blocks**

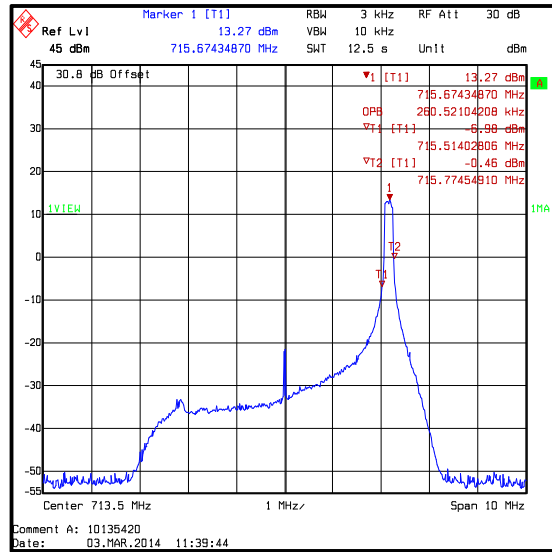
**Transmitter Occupied Bandwidth (continued)**

**Results: 5 MHz Channel Bandwidth / Top Channel / QPSK**

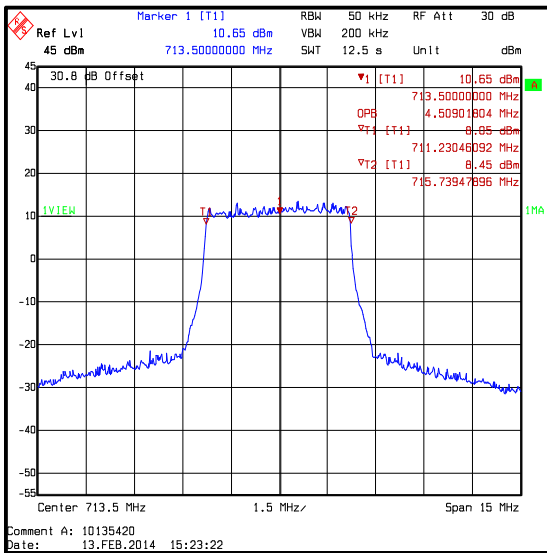
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
713.5	1	0	3	10	0.261
713.5	1	25	3	10	0.261
713.5	25	0	50	200	4.509



**QPSK / 1 Resource Blocks (0 offset)**



**QPSK / 1 Resource Blocks (25 offset)**



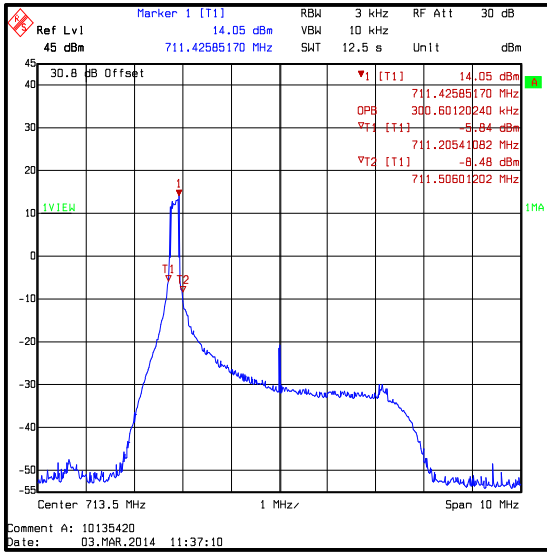
**QPSK / 25 Resource Blocks**



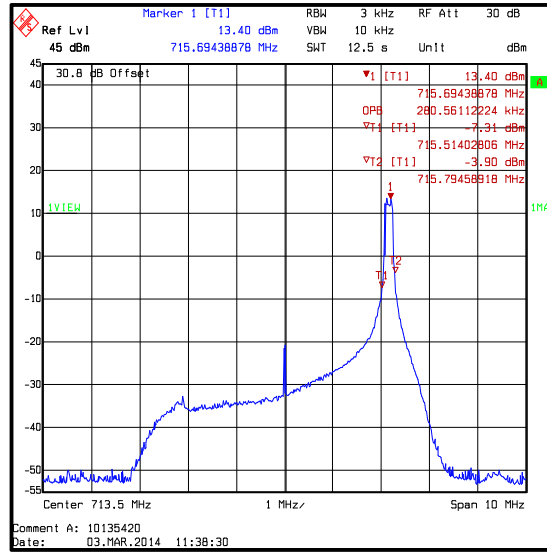
**Transmitter Occupied Bandwidth (continued)**

**Results: 5 MHz Channel Bandwidth / Top Channel / 16QAM**

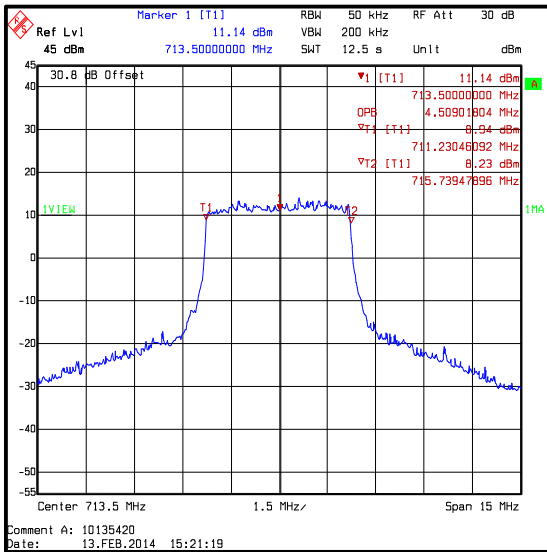
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
713.5	1	0	3	10	0.301
713.5	1	25	3	10	0.281
713.5	25	0	50	200	4.509



**16QAM / 1 Resource Blocks (0 offset)**



**16QAM / 1 Resource Blocks (25 offset)**



**16QAM / 25 Resource Blocks**

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

<b>Asset No.</b>	<b>Instrument</b>	<b>Manufacturer</b>	<b>Type No.</b>	<b>Serial No.</b>	<b>Date Calibration Due</b>	<b>Cal. Interval (Months)</b>
M1659	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	24 May 2014	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842659/016	19 Aug 2014	12
A1999	Attenuator	Huber + Suhner	6820.17.B	07101	05 Apr 2014	12
A1368	Directional Coupler	Pasternack Enterprises	PE2214-10	None stated	Calibrated before use	-

*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.*

**5.2.3. Transmitter Conducted Spurious Emissions****Test Summary:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Date:</b>	27 July 2012
<b>Test Sample Serial Number:</b>	AMWGB84001G12		

<b>FCC Reference:</b>	Parts 2.1051 and 27.53(f)
<b>Test Method Used:</b>	As detailed in ANSI TIA-603.C-2004 Section 2.2.13 referencing FCC Part 2.1051
<b>Frequency Range:</b>	9 kHz to 8 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	28
<b>Relative Humidity (%):</b>	39

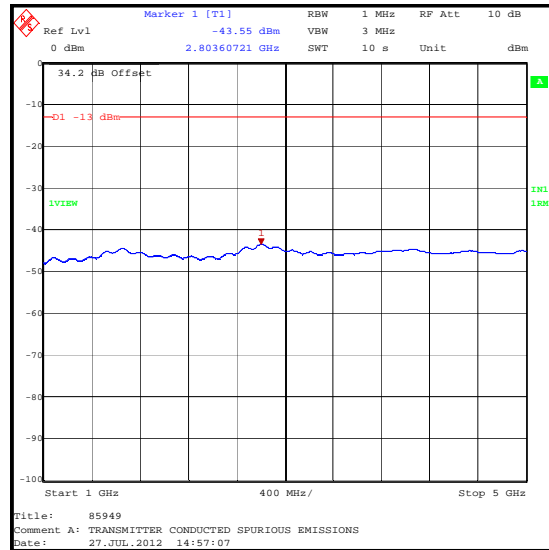
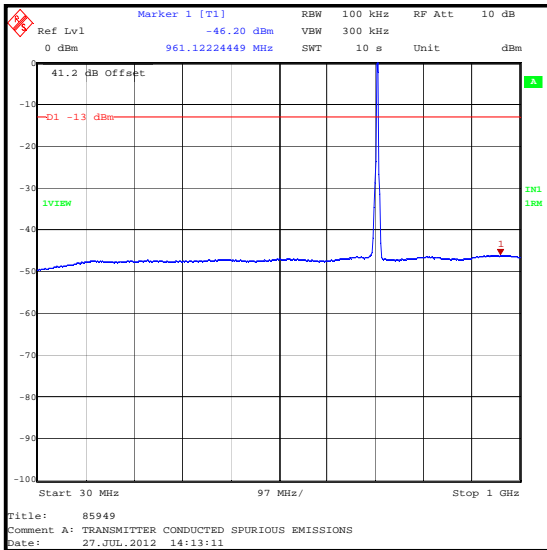
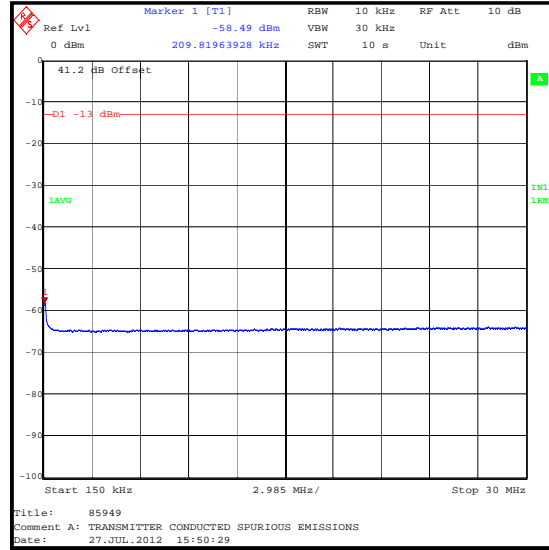
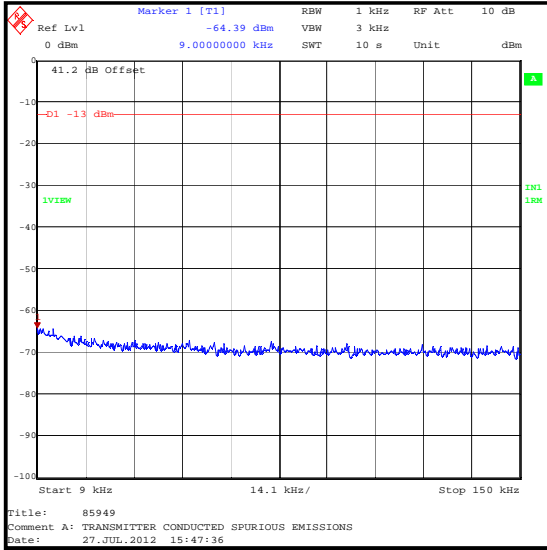
**Note(s):**

1. The EUT was transmitting using 16QAM Modulation scheme, with resource blocks set to 25, as this produced the highest power level and was therefore deemed worst case.
2. Pre scans were performed with the EUT transmitting at maximum power on the top channel.
3. The emission seen on the 30 MHz to 1 GHz plot at approximately 713.5 MHz is the EUT carrier.
4. All emissions were >20 dB below the applicable limit or below the level of the noise floor of the measuring receiver, therefore the highest level of noise floor is recorded in the table below.

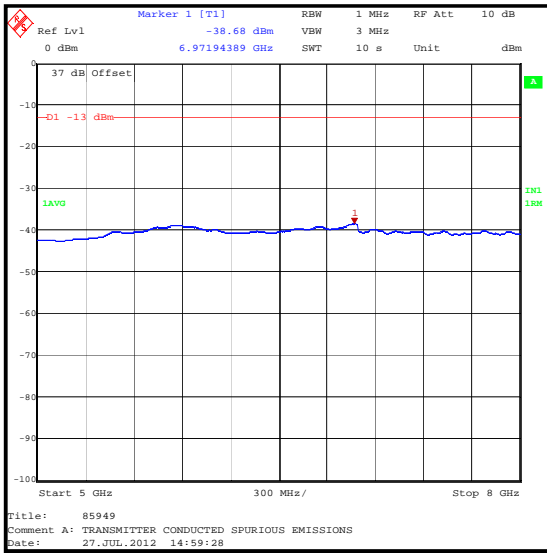
**Results: 5 MHz Channel Bandwidth / Top Channel**

<b>Frequency (MHz)</b>	<b>Peak Emission Level (dBm)</b>	<b>Limit (dBm)</b>	<b>Margin (dB)</b>	<b>Result</b>
6971.944	-38.7	-13.0	25.7	Complied

### Transmitter Conducted Spurious Emissions (continued)



**Transmitter Conducted Spurious Emissions (continued)**



**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A1368	Directional Coupler	Pasternack Enterprises	PE2214-10	None stated	Calibrated before use	-
A1999	Attenuator	Huber + Suhner	6820.17.B	07101	04 Apr 2013	12
L1067	Test Receiver	Rohde & Schwarz	ESIB 40	100262	29 May 2013	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	07 Jun 2013	12
M1021	Signal Generator	Rohde & Schwarz	SMP02	833286/004	09 Jan 2013	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	07 Jun 2013	12

*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.*

**5.2.4. Transmitter Conducted Emissions at Band Edges****Test Summary:**

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	27 July 2012, 30 July 2012 & 03 March 2014
<b>Test Sample Serial Numbers:</b>	AMWGB84001G12 & AMWGB84001F12		

<b>FCC Reference:</b>	Parts 2.1051 and 27.53(f)
<b>Test Method Used:</b>	As detailed in ANSI TIA-603.C-2004 Section 2.2.13 referencing FCC Part 2.1051

**Environmental Conditions:**

<b>Temperature (°C):</b>	24 to 29
<b>Relative Humidity (%):</b>	35 to 38

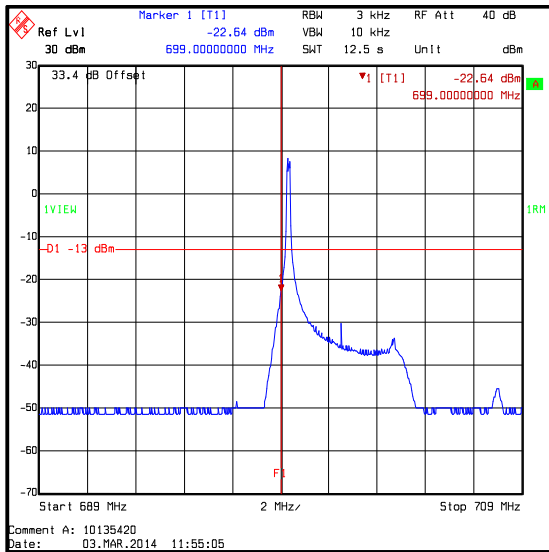
**Note(s):**

1. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 25. For single resource blocks, measurements were performed with the block starting of blocks of 1 for the lower band edge and 25 for the upper band edge.
2. Where a single Resource Block of 1 for the lower Band edge and Resource Block of 25 for the upper band edge was applied, the Resolution Bandwidth was adjusted to be between 1% and 5% of the measured occupied bandwidth. The Video Bandwidth was set to three times the Resolution Bandwidth.
3. The plots for measurements performed on the 3<sup>rd</sup> March have an incorrect job number.

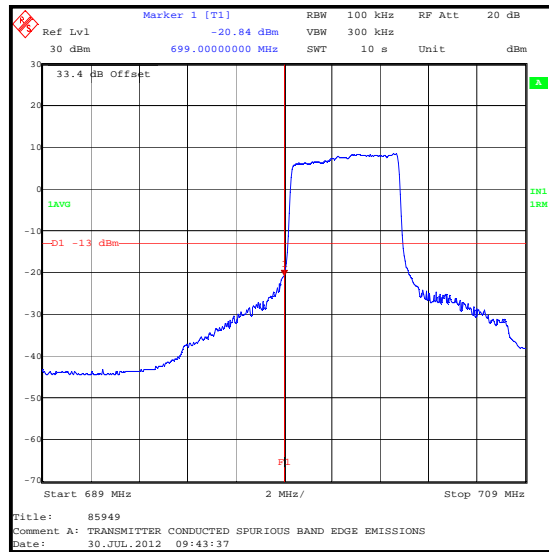
**Transmitter Conducted Emissions at Band Edges (continued)**

**Results: 5 MHz Channel Bandwidth / Bottom Channel / QPSK**

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
699	1	0	-22.6	-13.0	9.6	Complied
699	25	0	-20.8	-13.0	7.8	Complied



**QPSK / 1 Resource Block (0 Offset)**

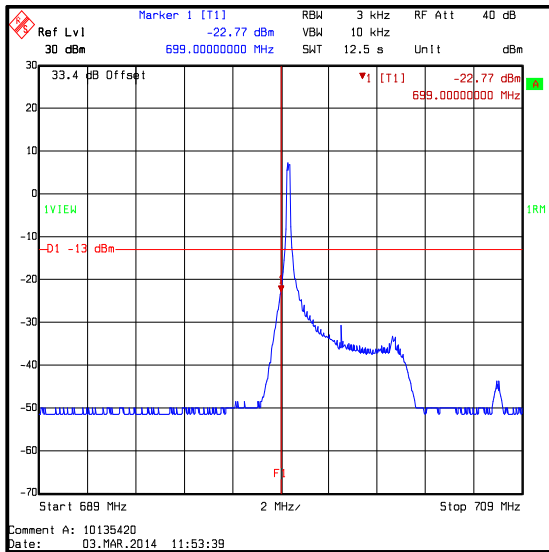


**QPSK / 25 Resource Blocks**

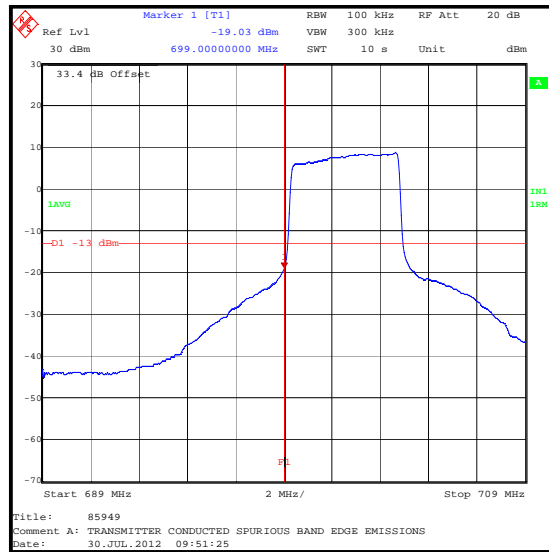
**Transmitter Conducted Emissions at Band Edges (continued)**

**Results: 5 MHz Channel Bandwidth / Bottom Channel / 16QAM**

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
699	1	0	-22.8	-13.0	9.8	Complied
699	25	0	-19.0	-13.0	6.0	Complied



**16QAM / 1 Resource Block (0 Offset)**



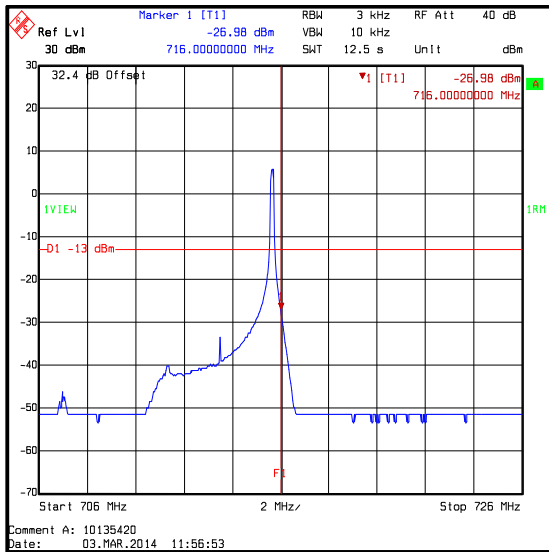
**16QAM / 25 Resource Blocks**



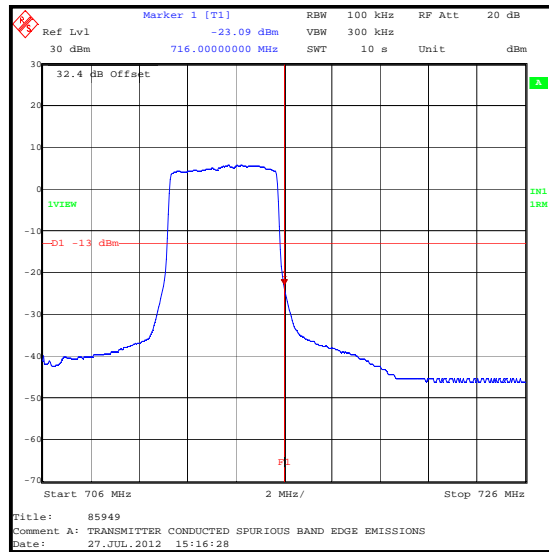
**Transmitter Conducted Emissions at Band Edges (continued)**

**Results: 5 MHz Channel Bandwidth / Top Channel / QPSK**

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
716	1	25	-27.0	-13.0	14.0	Complied
716	25	0	-23.1	-13.0	10.1	Complied



**QPSK / 1 Resource Block (25 Offset)**

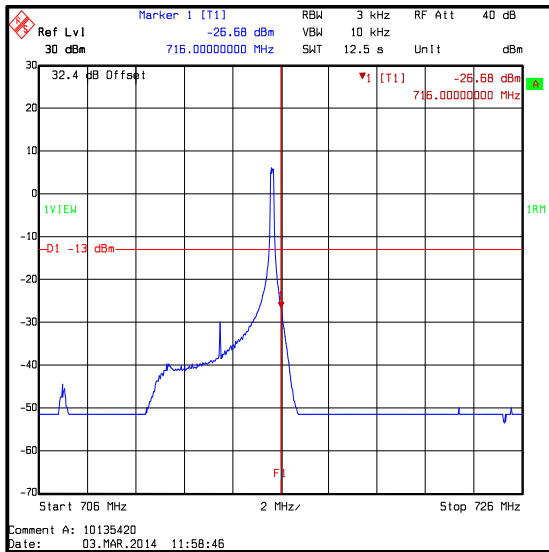


**QPSK / 25 Resource Blocks**

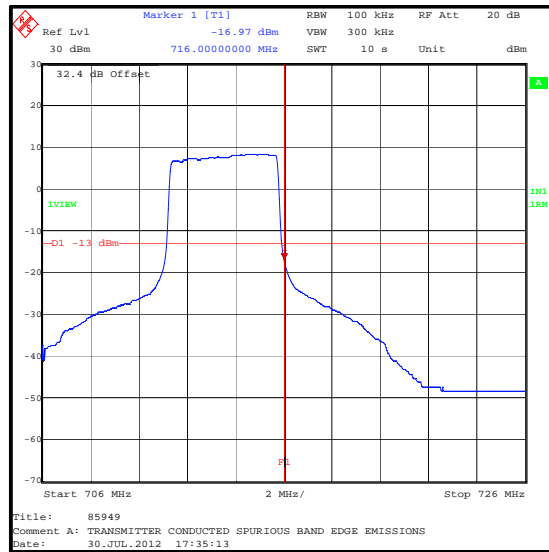
**Transmitter Conducted Emissions at Band Edges (continued)**

**Results: 5 MHz Channel Bandwidth / Top Channel / 16QAM**

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
716	1	25	-26.7	-13.0	13.7	Complied
716	25	-17.0	-13.0	4.0	Complied	



**16QAM / 1 Resource Block (25 Offset)**



**16QAM / 25 Resource Blocks**

**Transmitter Conducted Emissions at Band Edges (continued)****Test Equipment Used 27 July 2012:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
A1368	Directional Coupler	Pasternack Enterprises	PE2214-10	None stated	Calibrated before use	-
A1999	Attenuator	Huber + Suhner	6820.17.B	07101	04 Apr 2013	12
M127	Test Receiver	Rohde & Schwarz	FSEB30	842 659/016	11 Sept 2012	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	07 Jun 2013	12
M1021	Signal Generator	Rohde & Schwarz	SMP02	833286/004	09 Jan 2013	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	07 Jun 2013	12

**Test Equipment Used 03 March 2014:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	24 May 2014	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842659/016	19 Aug 2014	12
A1999	Attenuator	Huber + Suhner	6820.17.B	07101	05 Apr 2014	12
A1368	Directional Coupler	Pasternack Enterprises	PE2214-10	None stated	Calibrated before use	-
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12

*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.*

**5.2.5. Transmitter Radiated Spurious Emissions****Test Summary:**

<b>Test Engineer:</b>	David Doyle	<b>Test Dates:</b>	19 February 2014 & 20 February 2014
<b>Test Sample Serial Number:</b>	AMWGB84001F12		

<b>FCC Reference:</b>	Parts 2.1053 & 27.53(f)
<b>Test Method Used:</b>	As detailed in ANSI TIA-603-C-2004 Section 2.2.12. referencing FCC CFR Part 2.1053
<b>Frequency Range:</b>	30 MHz to 8 GHz

**Environmental Conditions:**

<b>Temperature (°C):</b>	21 to 22
<b>Relative Humidity (%):</b>	35 to 38

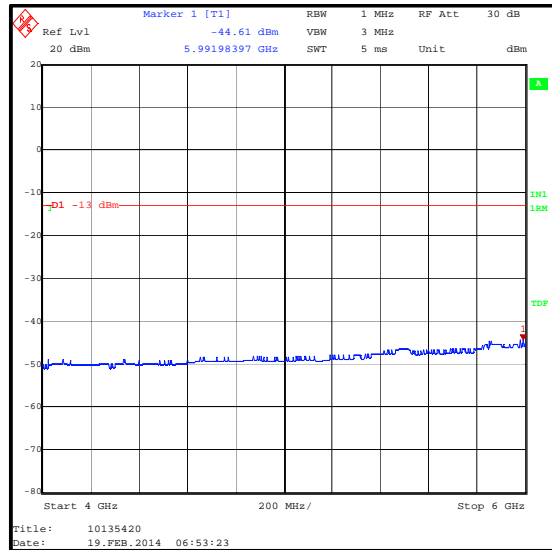
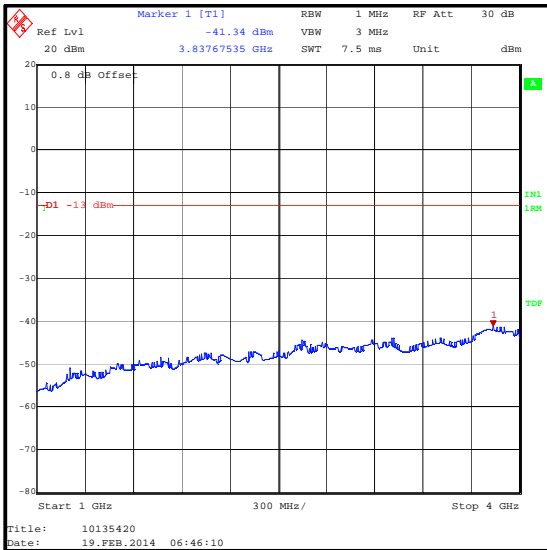
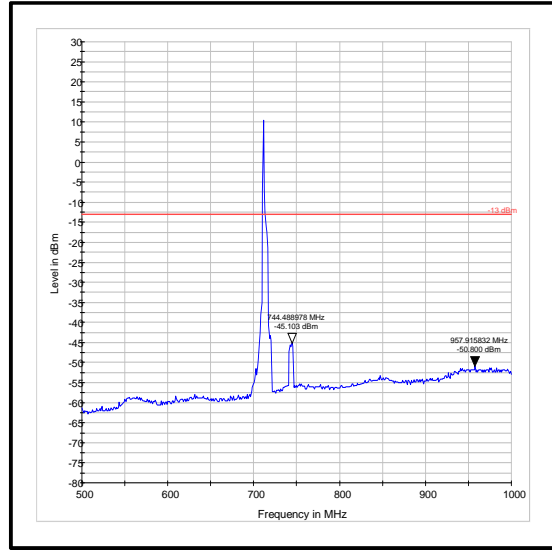
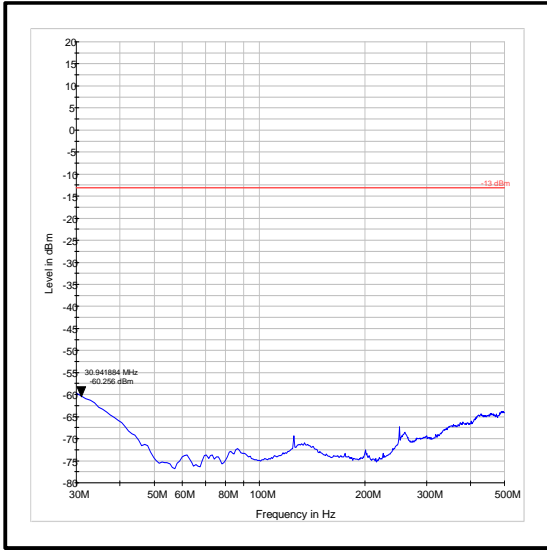
**Note(s):**

1. The EUT was set to transmit with 16QAM modulation applied with 1 Resource Blocks, as this was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and, as this mode emits the highest transmit output power level, it was deemed to be the worst case.
2. For radiated emissions testing, the customer supplied two OA-LTE-06-01-IPW antennas', which were connected to the main and diversity ports. The antenna gain was declared as 2.5 dBi.
3. The emission seen on the 500 MHz to 1 GHz plot at approximately 713.5 MHz is the EUT carrier.
4. The emission seen on the 500 MHz to 1 GHz plot at approximately 744.5 MHz is the downlink from the LTE test set.
5. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest noise floor reading of the measuring receiver was recorded as shown in the table below.
6. Measurements below 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.
7. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 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.
8. The plots have an incorrect job number.

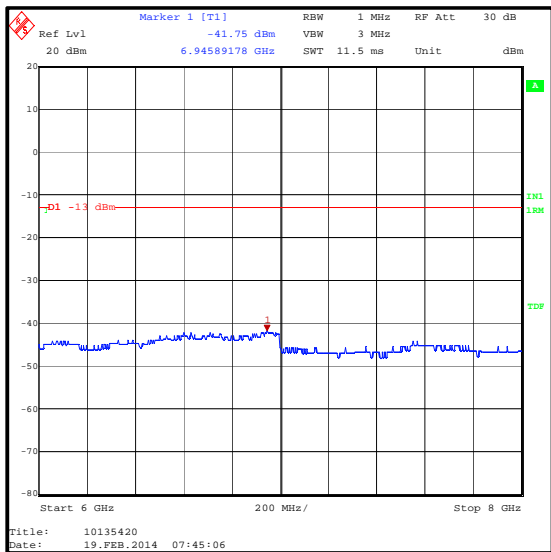
**Results:**

Frequency (MHz)	Antenna Polarisation	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3837.675	Vertical	-41.3	-13.0	28.3	Complied

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



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



**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
G0543	Amplifier	Sonoma	310N	230801	18 May 2014	3
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12
A490	Antenna	Chase	CBL6111A	1590	18 Apr 2014	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	11 Feb 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	24 May 2014	12
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
A1534	Pre-Amplifier	Hewlett Packard	8449B	3008A00405	14 Nov 2014	12
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12
A253	Antenna	Flann Microwave	12240-20	128	14 Nov 2014	12
A254	Antenna	Flann Microwave	14240-20	139	14 Nov 2014	12
A1974	High Pass Filter	AtlanTecRF	AFH-01000	090000283	19 Apr 2014	12

*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.*

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

<b>Test Engineer:</b>	David Doyle	<b>Test Date:</b>	04 March 2014
<b>Test Sample Serial Number:</b>	AMWGB84001F12		

<b>FCC Reference:</b>	Parts 2.1053 and 27.53(f)
<b>Test Method Used:</b>	As detailed in KDB 971168 Section 6.0 referencing FCC Part 27.53

**Environmental Conditions:**

<b>Temperature (°C):</b>	24
<b>Relative Humidity (%):</b>	31

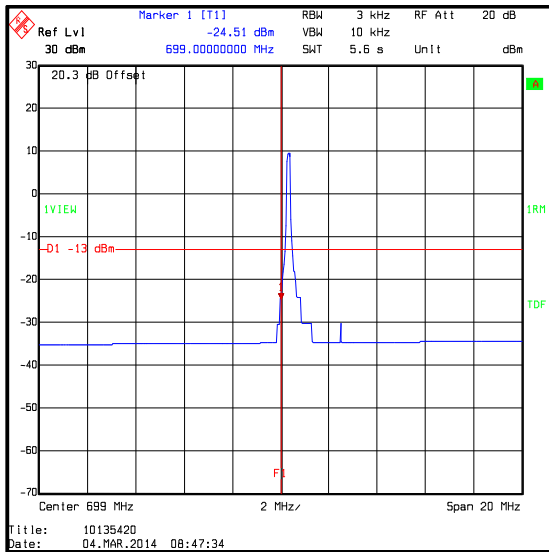
**Note(s):**

1. For radiated emissions testing, the customer supplied two OA-LTE-06-01-IPW antennas', which were connected to the main and diversity ports. The antenna gain was declared as 2.5 dBi.
2. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 25. For single resource blocks, measurements were performed with the block starting of blocks of 1 for the lower band edge and 25 for the upper band edge.
3. In accordance with KDB 971168 Section 6.0, a relaxation of the reference bandwidth has been applied at the edge of the authorised frequency band. The test receivers channel power function was used to integrate over the first 50 kHz outside of the frequency band.
4. The plots have an incorrect job number.

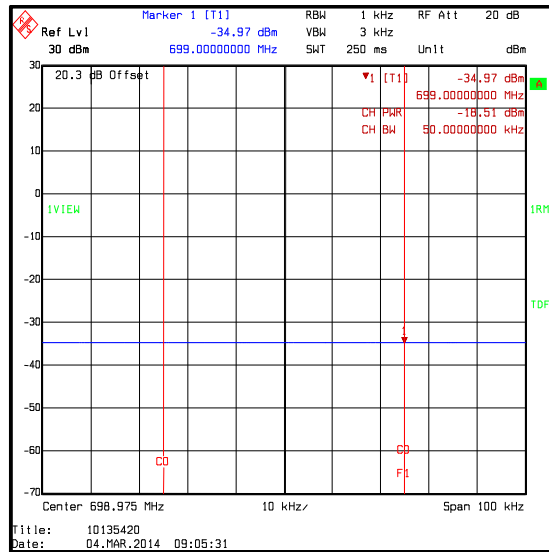
**Transmitter Radiated Emissions at Band Edges (continued)**

**Results: 5 MHz Channel Bandwidth / Bottom channel / QPSK**

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
699	1	0	-24.5	-13.0	11.5	Complied
699	25	0	-18.5	-13.0	5.5	Complied



**QPSK / 1 Resource Block (0 Offset)**



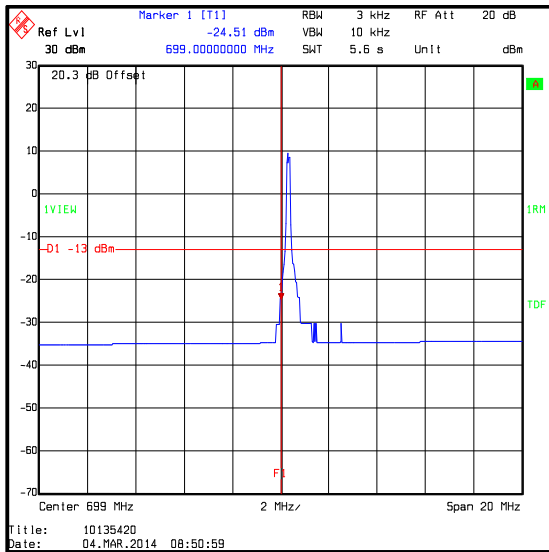
**QPSK / 25 Resource Blocks**



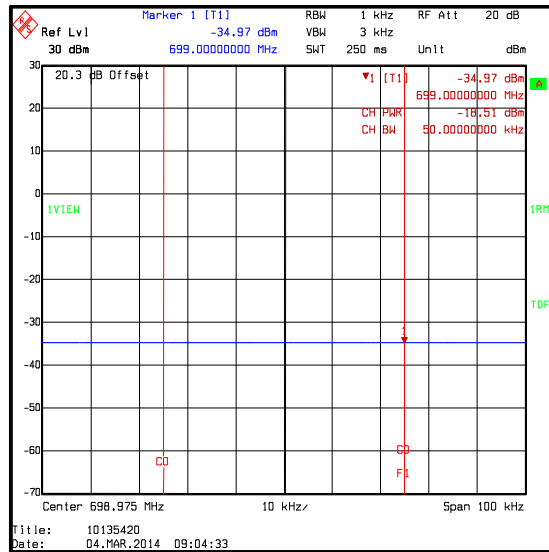
**Transmitter Conducted Emissions at Band Edges (continued)**

**Results: 5 MHz Channel Bandwidth / Bottom Channel / 16QAM**

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
699	1	0	-24.5	-13.0	11.5	Complied
699	25	0	-18.5	-13.0	5.5	Complied



**16QAM / 1 Resource Block (0 Offset)**

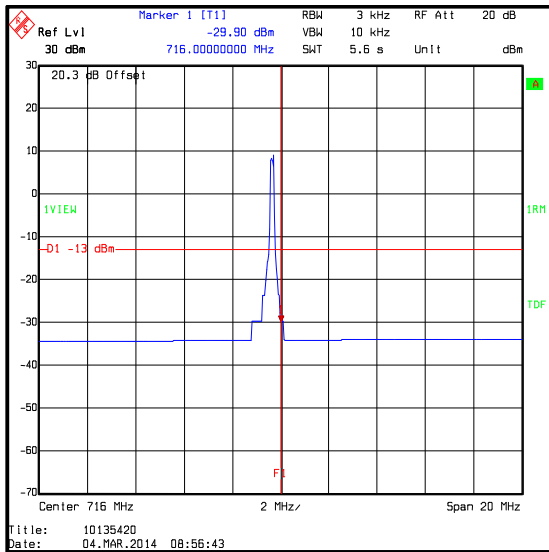


**16QAM / 25 Resource Blocks**

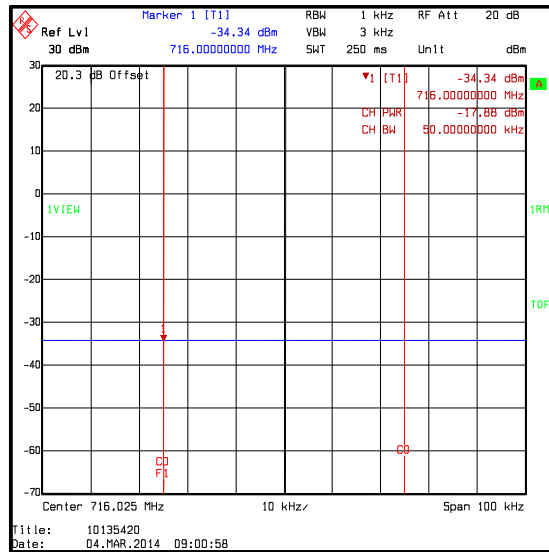
**Transmitter Conducted Emissions at Band Edges (continued)**

**Results: 5 MHz Channel Bandwidth / Top Channel / QPSK**

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
699	1	25	-29.9	-13.0	16.9	Complied
699	25	0	-17.9	-13.0	4.9	Complied



**QPSK / 1 Resource Block (25 Offset)**

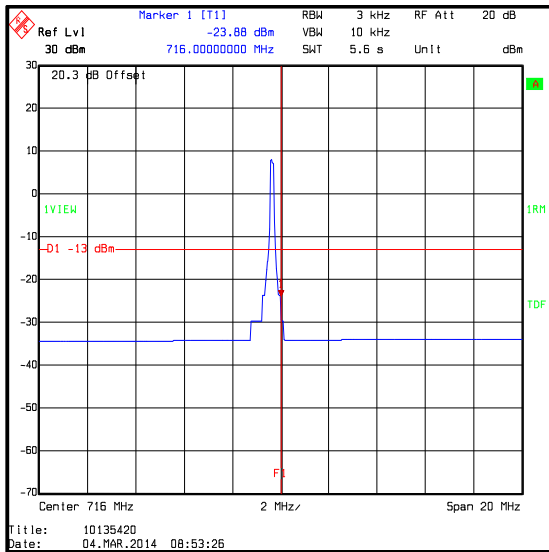


**QPSK / 25 Resource Blocks**

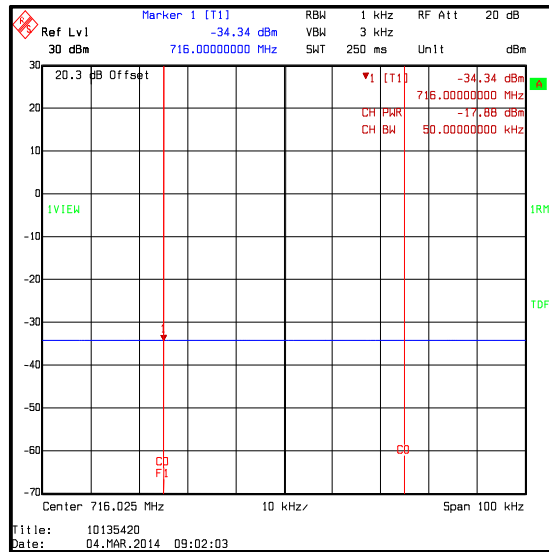
**Transmitter Conducted Emissions at Band Edges (continued)**

**Results: 5 MHz Channel Bandwidth / Top Channel / 16QAM**

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
716	1	25	-23.9	-13.0	10.9	Complied
716	25	0	-17.9	-13.0	4.9	Complied



**16QAM / 1 Resource Block (25 Offset)**



**16QAM / 25 Resource Blocks**

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelpunkt	30.5015.13	Not stated	24 May 2014	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
A288	Antenna	Chase	CBL6111A	1589	20 Aug 2014	12
M127	Test Receiver	Rohde & Schwarz	FSEB 30	842 659/016	19 Aug 2014	12
A1393	Attenuator	Huber & Suhner	6820.17.B	757456	10 May 2014	12

*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.*

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

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	26 July 2012 & 01 August 2012
<b>Test Sample Serial Number:</b>	AMWGB84001G12		

<b>FCC Reference:</b>	Parts 2.1055 & 27.54
<b>Test Method Used:</b>	As detailed in ANSI TIA-603-C-2004 Section 2.2.2 referencing FCC CFR Part 2.1055

**Environmental Conditions:**

<b>Temperature (°C):</b>	25 to 30
<b>Relative Humidity (%):</b>	33 to 34

**Note(s):**

1. Temperature was monitored throughout the test with a calibrated digital thermometer.
2. Measurements were made using the Anristu MT8820C Radio Communications Analyser.
3. The transmit frequency was monitored throughout the test and did not drift outside of the frequency limits of LTE Band 12 – 699 MHz to 716 MHz.

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

Temperature (°C)	Time after Start-up					
	0 minutes (MHz)	1 minute (MHz)	2 minutes (MHz)	3 minutes (MHz)	4 minutes (MHz)	5 minutes (MHz)
-30	701.499983	701.499996	701.500006	701.500005	701.500013	701.500012
-20	701.500008	701.500009	701.500012	701.500013	701.500012	701.500009
-10	701.499994	701.500006	701.500007	701.500011	701.500014	701.500004
0	701.500001	701.500007	701.500011	701.500014	701.500011	701.500009
10	701.500002	701.500006	701.500009	701.500013	701.500014	701.500010
20	701.499995	701.499988	701.499992	701.499990	701.499991	701.499987
30	701.499987	701.499996	701.499987	701.499997	701.499998	701.499987
40	701.499986	701.499998	701.499997	701.499995	701.499996	701.499994
50	701.499988	701.499996	701.500013	701.500006	701.500008	701.500010

Temperature (°C)	Time after Start-up				
	6 minutes (MHz)	7 minutes (MHz)	8 minutes (MHz)	9 minutes (MHz)	10 minutes (MHz)
-30	701.500003	701.499998	701.499999	701.500000	701.499999
-20	701.500010	701.500006	701.500008	701.500007	701.500006
-10	701.500003	701.500007	701.500006	701.500002	701.500003
0	701.500007	701.500004	701.500005	701.500003	701.500002
10	701.500009	701.500009	701.500005	701.500006	701.500005
20	701.499993	701.499986	701.499994	701.499996	701.499997
30	701.499989	701.499993	701.499992	701.499997	701.499999
40	701.499992	701.499994	701.499990	701.499994	701.499992
50	701.500012	701.500007	701.500007	701.500005	701.500003

Frequency closest to Lower Band 12 Edge (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
701.499983	699.0	2.499983	Complied

**Transmitter Frequency Stability (Temperature Variation) (continued)****Results: Top Channel**

Temperature (°C)	Time after Start-up					
	0 minutes (MHz)	1 minute (MHz)	2 minutes (MHz)	3 minutes (MHz)	4 minutes (MHz)	5 minutes (MHz)
-30	713.500005	713.500008	713.500010	713.500008	713.500007	713.500005
-20	713.499990	713.499992	713.499996	713.499999	713.500003	713.500005
-10	713.499989	713.499993	713.499998	713.500002	713.500006	713.500004
0	713.499994	713.499991	713.500008	713.500004	713.500004	713.500002
10	713.499998	713.499994	713.500012	713.500005	713.500006	713.500007
20	713.500013	713.500009	713.500007	713.500002	713.499998	713.499999
30	713.499988	713.499990	713.500000	713.499997	713.499994	713.499990
40	713.499994	713.499999	713.500003	713.500009	713.500011	713.500010
50	713.499987	713.499992	713.499998	713.500002	713.500006	713.500011

Temperature (°C)	Time after Start-up				
	6 minutes (MHz)	7 minutes (MHz)	8 minutes (MHz)	9 minutes (MHz)	10 minutes (MHz)
-30	713.500003	713.500002	713.500002	713.500002	713.500001
-20	713.500003	713.500001	713.500002	713.500002	713.500002
-10	713.500002	713.500003	713.500001	713.500001	713.500001
0	713.500001	713.500002	713.500001	713.500002	713.500001
10	713.500005	713.500006	713.500003	713.500002	713.500002
20	713.500001	713.500002	713.500002	713.500001	713.500001
30	713.500000	713.500001	713.500003	713.500000	713.500000
40	713.500007	713.500000	713.500003	713.500001	713.500001
50	713.500015	713.500005	713.500004	713.500002	713.500002

Frequency closest to Upper Band 12 Edge (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Result
713.500015	716.0	2.499985	Complied

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
E013	Environmental Chamber	Sanyo	MTH-4200PR	None Stated	Calibrated before use	-
L1068	LTE Test Set	Anritsu	MT8820A	6201127386	15 May 2013	12
M1068	Thermometer	Iso-Tech	RS55	93102884	08 Mar 2013	12
M1229	Digital Multimeter	Fluke	179	87640015	18 Jun 2013	12
S0537	DC Power Supply	TTI	EL302D	249928	Calibrated before use	12

*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.*

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

<b>Test Engineer:</b>	Nick Steele	<b>Test Dates:</b>	27 July 2012 & 01 August 2012
<b>Test Sample Serial Number:</b>	AMWGB84001G12		

<b>FCC Reference:</b>	Parts 2.1055 & 27.54
<b>Test Method Used:</b>	As detailed in ANSI TIA-603-C-2004 Section 2.2.2 referencing FCC CFR Part 2.1055

**Environmental Conditions:**

<b>Temperature (°C):</b>	28 to 30
<b>Relative Humidity (%):</b>	34 to 40

**Note(s):**

1. Voltage was monitored throughout the test with a calibrated digital voltmeter.
2. Measurements were made using the Anritsu MT8820C Radio Communications Analyser.
3. The transmit frequency was monitored throughout the test and did not drift outside of the frequency limits of LTE Band 12 – 699 MHz to 716 MHz.

**Results: Bottom Channel**

Supply Voltage (V)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
3.0	701.500007	699.0	2.500007	Complied
3.6	701.500004	699.0	2.500004	Complied

**Results: Top Channel**

Supply Voltage (V)	Measured Frequency (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Result
3.0	713.499998	716.0	2.500002	Complied
3.6	713.500004	716.0	2.499996	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
L1068	LTE Test Set	Anritsu	MT8820A	6201127386	15 May 2013	12
M1229	Digital Multimeter	Fluke	179	87640015	18 Jun 2013	12
S0537	DC Power Supply	TTI	EL302D	249928	Calibrated before use	12

*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.*



## **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".

<b>Measurement Type</b>	<b>Range</b>	<b>Confidence Level (%)</b>	<b>Calculated Uncertainty</b>
Conducted Carrier Output Power	699 MHz to 716 MHz	95%	±1.13 dB
Occupied Bandwidth	699 MHz to 716 MHz	95%	±3.92 %
Conducted Spurious Emissions	9 kHz to 8 GHz	95%	±2.64 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 8 GHz	95%	±2.94 dB
Frequency Stability	699 MHz to 716 MHz	95%	±0.92 ppm

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	-	-	Remove Antenna Type
2.0	8	3.4	Update Antenna Gain from 0 dBi to 19 dBi and recalculate ERP
3.0	8, 10, 24 to 30	3.4, 4.2, 5.2.5	Update Antenna Gain detail and recalculate ERP
4.0	-	-	Updated to UL VS LTD format Receiver tests removed as now covered in UL-RPT-RP10135420JD02A Output power and Occupied bandwidth tests repeated using KDB 971168 Conducted Band edge with single resource blocks repeated Radiated Spurious Emissions repeated Radiated Emissions at Band edge repeated MUs for output power and occupied bandwidth updated Part 27.53 references updated