



TEST REPORT

Test Report No. : UL-RPT-RP10258871JD01A V2.0

Manufacturer : General Dynamics Broadband UK Ltd
Model No. : APJ
FCC ID : PKTUSBSTKAPJ
Technology : LTE Band 14, 10 MHz Channel Bandwidth
Test Standard(s) : FCC Parts 90.210(n), 90.539(e), 90.542(a)(6), 90.542(a)(7), 90.543(c), 90.543(e)(2) & 90.543(f).

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 tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

Date of Issue: 16 June 2014

Checked by:

Ian Watch
Senior Engineer, Radio Laboratory

Issued by :

pp
John Newell
Quality Manager,
UL VS LTD



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

UL VS LTD

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1. Customer Information













Company Name:	General Dynamics Broadband UK Ltd
Address:	Unit 7 Greenways Business Park Bellinger Close Chippenham Wiltshire SN15 1BN United Kingdom

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR90
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 90 Subpart R Private Land Mobile Radio Services. Subpart R Regulations Governing the licensing And Use of Frequencies in the 763-775 and 793-805 MHz Bands
Site Registration:	209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	31 March 2014 to 20 May 2014

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
90.542(a)(6) / 90.542(a)(7) / 2.1046	Transmitter Carrier Output Power and Effective Radiated Power (ERP)	
2.1049	Transmitter Occupied Bandwidth	
90.210(n) / 2.1051	Transmitter Conducted Emissions Mask	
90.543(c) / 2.1051	Transmitter Conducted Emissions	
90.543(e)(2) / 2.1051	Transmitter Conducted Emissions Limitations	
90.543(c) / 2.1051	Transmitter Conducted Band Edge Emissions	
90.543(c) / 2.1053	Transmitter Radiated Emissions	
90.543(e)(2) / 90.543(f) / 2.1053	Transmitter Radiated Emissions Limitations	
90.543(c) / 2.1053	Transmitter Radiated Band Edge Emissions	
90.539(e) / 2.1055	Transmitter Frequency Stability	
Key to Results		
 = Complied  = Did not comply		

2.3. Methods and Procedures

Reference:	ANSI/TIA-603-C-2004
Title:	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards.
Reference:	KDB 971168 D01 v02r01 June 7, 2013
Title:	Measurement Guidance for Certification of Licensed Digital Transmitters

2.4. Deviations from the Test Specification

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

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	General Dynamics Broadband
Model Name or Number:	APJ
Test Sample Serial Number:	APJHC30005C15
Hardware Version Number:	Pass 1
Software Version Number:	Release 4
FCC ID Number:	PKTUSBSTKAPJ

Description:	Remote Antenna Accessory
Brand Name:	IPWireless
Model Name or Number:	LTE-ODUP001-IPW
Serial Number:	Not marked or stated

3.2. Description of EUT

The Equipment Under Test was an LTE Band 14 USB stick.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Tested Technology:	LTE	
Type of Equipment	USB Stick	
Channel Bandwidth:	10 MHz	
Modulation Type:	QPSK and 16QAM	
Duty Cycle:	100 %	
Antenna Type:	Proprietary for integral and external antenna	
Antenna Gain:	-2.0 dBi (Internal Antenna) +2.0 dBi (External Antenna)	
Power Supply Requirement:	Nominal	5.0 VDC
	Minimum	4.25 VDC
	Maximum	5.75 VDC
Transmit Frequency Range:	788 MHz to 798 MHz	
Transmit Channels Tested:	N_{ut}	Channel Frequency (MHz)
	23330	793.0

3.5. Support Equipment

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

Description:	USB MTR Test Board
Brand Name:	IPWireless
Model Name or Number:	None stated
Serial Number:	None stated

Description:	Laptop PC
Brand Name:	Toshiba
Model Name or Number:	Satellite Pro A100
Serial Number:	67070971Q

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	Latitude D620
Serial Number:	00052

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 10 MHz channel bandwidth. QPSK and 16QAM modulations were both tested, along with the resource blocks set to 1 and 49. For a resource block setting of 1, testing was carried out on starting block number of 1 and 50.

4.2. Configuration and Peripherals

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

- For all tests apart from frequency stability, the EUT was connected to a test laptop USB port and the laptop was connected to 120 VAC 60 Hz AC supply.
- The manufacturer supplied a USB MTR Test Board. This allowed variation of the supply voltage to the EUT. This was used for transmitter frequency stability tests only.
- The EUT has two RF ports. The main RF port is used for transmit and receive, the second port is receive only (diversity receive). Transmitter testing was performed on the main RF port, the diversity port was terminated for all bench testing.
- The EUT has an internal antenna and also two Hirose MS 162A connector ports, which allow the use of an external antenna. Conducted measurements were also performed on these ports, by using Hirose MS162A to SMA connectors supplied by the manufacturer.
- The EUT was connected to a Rohde & Schwarz CMW500 Wideband Radio Communication Tester, operating in transceiver mode. Output power, resource block settings and modulation schemes used during testing were controlled by the Rohde & Schwarz CMW500.
- Radiated emissions testing were performed on both the internal and external antennas. The internal antenna gain was declared as -2 dBi and the external antenna gain declared as +2 dBi

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6. Measurement Uncertainty* for details.

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

5.2. Test Results

5.2.1. Transmitter Carrier Output Power and Effective Radiated Power (ERP)

Test Summary:

Test Engineer:	Nick Steele	Test Date:	31 March 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.542(a)(6); 90.542(a)(7) and 2.1046
Test Method Used:	As detailed in KDB 971168 D01 Section 5.2.1

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	48

Note(s):

- The EUT was connected to a Rohde & Schwarz CMW500 via the through ports of a directional coupler in order to establish a communication link and configure the EUT. The coupled port of the directional coupler was connected to a spectrum analyser via a suitable RF cable and RF attenuator. The RF path loss between the EUT and the spectrum analyser was measured before testing took place and the value entered as an RF level offset on the spectrum analyser.
- Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 50. For single resource blocks, measurements were performed with the starting of blocks 1 and 49.
- The internal antenna has a maximum antenna gain of -2.0 dBi. As the limit is an ERP limit, the gain in dBi has been converted to dBd. The gain in dBd was calculated as:

$$-2.0 \text{ dBi} - 2.15 \text{ dB} = -4.15 \text{ dBd}$$
- The external antenna has a maximum antenna gain of 2.0 dBi. As the limit is an ERP limit, the gain in dBi has been converted to dBd. The gain in dBd was calculated as:

$$2.0 \text{ dBi} - 2.15 \text{ dB} = -0.15 \text{ dBd}$$
- The conducted output power was measured and the antenna gain was added to obtain the ERP. The ERP was compared to the respective 90.542 limits to obtain the margins.
- According to Parts 90.542(6) and 90.542(7), the ERP of devices operating in the 788 MHz to 798 MHz band, must be limited to 30 Watts (44.77 dBm) for control and mobile stations, and 3 Watts (34.77 dBm) for portable stations. A 30 Watt limit has been applied to the test results, however it is noted that the 3 Watt portable stations limit has also been met.

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)**Results: 10 MHz Channel Bandwidth / QPSK / Internal Antenna**

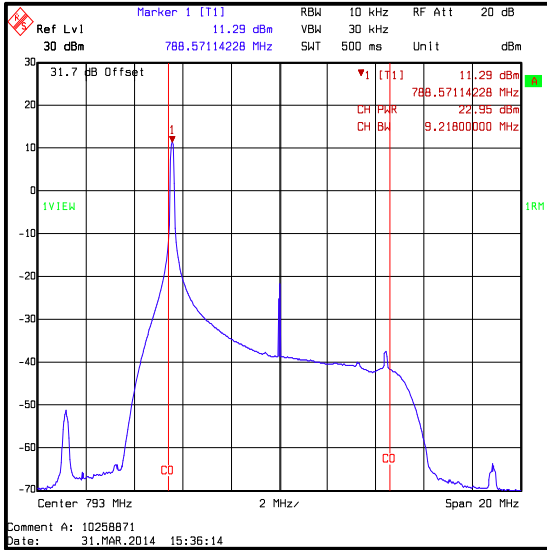
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
793.0	1	0	23.0	-4.15	18.85	44.77	25.92	Complied
793.0	1	49	23.0	-4.15	18.85	44.77	25.92	Complied
793.0	50	0	22.8	-4.15	18.65	44.77	26.12	Complied

Results: 10 MHz Channel Bandwidth / QPSK / External Antenna

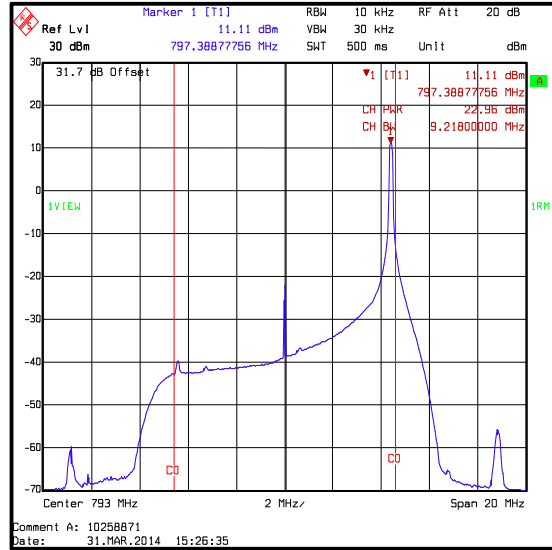
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
793.0	1	0	23.0	-0.15	22.85	44.77	21.92	Complied
793.0	1	49	23.0	-0.15	22.85	44.77	21.92	Complied
793.0	50	0	22.8	-0.15	22.65	44.77	22.12	Complied

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

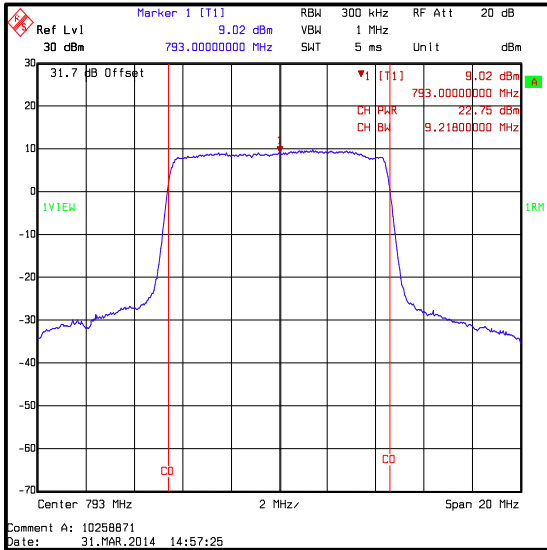
Results: 10 MHz Channel Bandwidth / QPSK



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)



QPSK / 50 Resource Blocks

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)**Results: 10 MHz Channel Bandwidth / 16QAM / Internal Antenna**

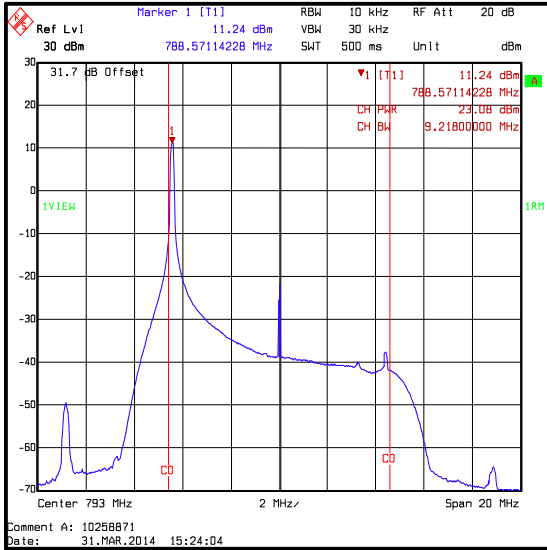
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
793.0	1	0	23.1	-4.15	18.95	44.77	25.82	Complied
793.0	1	49	23.0	-4.15	18.85	44.77	25.92	Complied
793.0	50	0	22.7	-4.15	18.55	44.77	26.22	Complied

Results: 10 MHz Channel Bandwidth / 16QAM / External Antenna

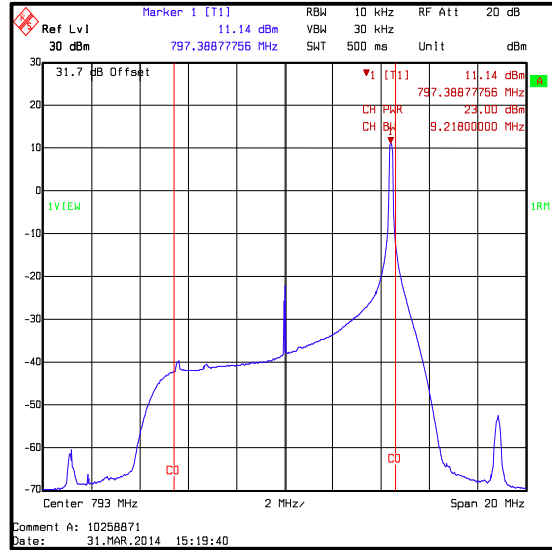
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
793.0	1	0	23.1	-0.15	22.95	44.77	21.82	Complied
793.0	1	49	23.0	-0.15	22.85	44.77	21.92	Complied
793.0	50	0	22.7	-0.15	22.55	44.77	22.22	Complied

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

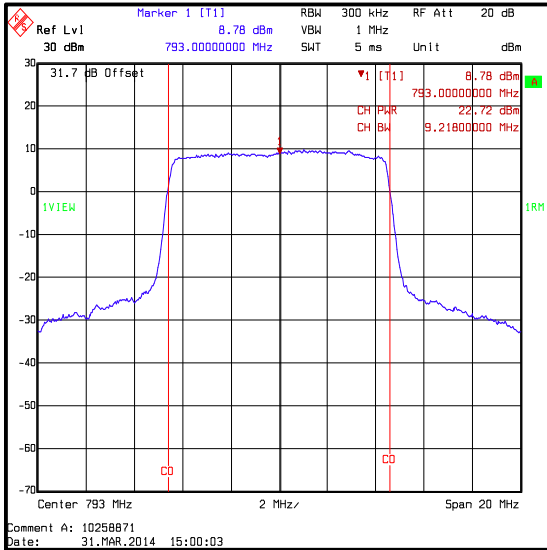
Results: 10 MHz Channel Bandwidth / 16QAM



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)



16QAM / 50 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)
M1657	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	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	-
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12

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

Test Engineer:	Nick Steele	Test Date:	31 March 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Part 2.1049
Test Method Used:	As detailed in KDB 971168 D01 Section 4.2 and Notes below

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	48

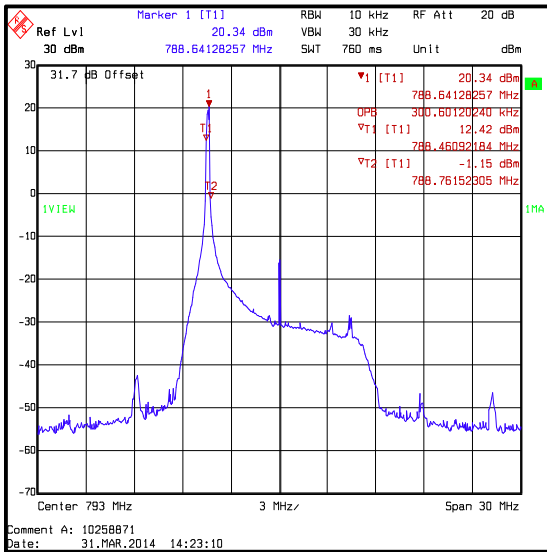
Note(s):

1. The EUT was connected to a Rohde & Schwarz CMW500 via the through ports of a directional coupler in order to establish a communication link and configure the EUT. The coupled port of the directional coupler was connected to a spectrum analyser via a suitable RF cable and RF attenuator. The RF path loss between the EUT and the spectrum analyser was measured before testing took place and the value entered as an RF level offset on the spectrum analyser.
2. 99% occupied bandwidth measurements were performed with the EUT transmitting QPSK and 16QAM modulation schemes with resource blocks of 1 and 50. For single resource blocks, measurements were performed with the starting blocks of 1 and 49.

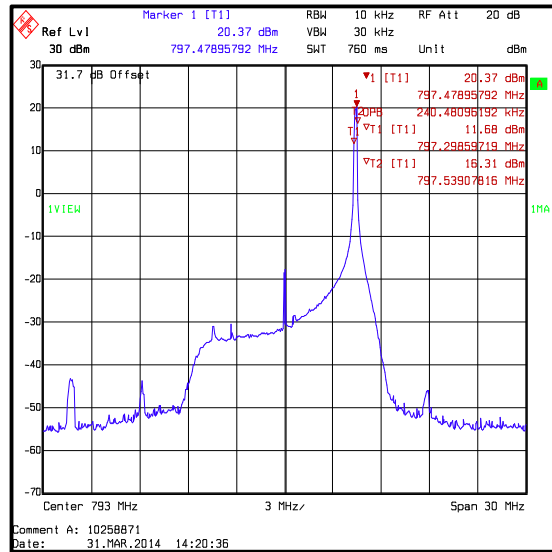
Transmitter Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth / QPSK

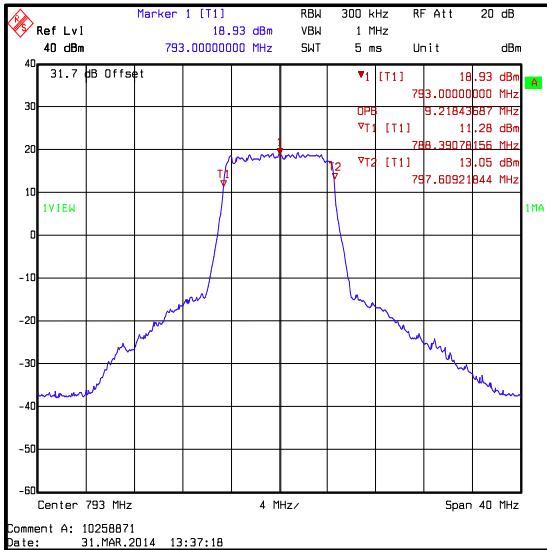
Frequency	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
793.0	1	0	10	30	0.301
793.0	1	49	10	30	0.240
793.0	50	0	300	1000	9.218



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

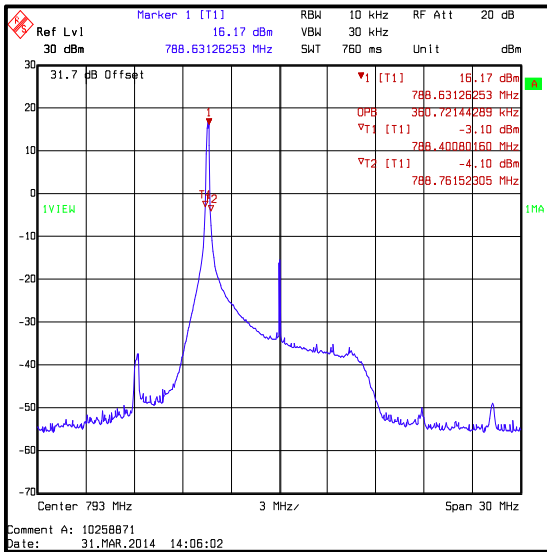


QPSK / 50 Resource Blocks

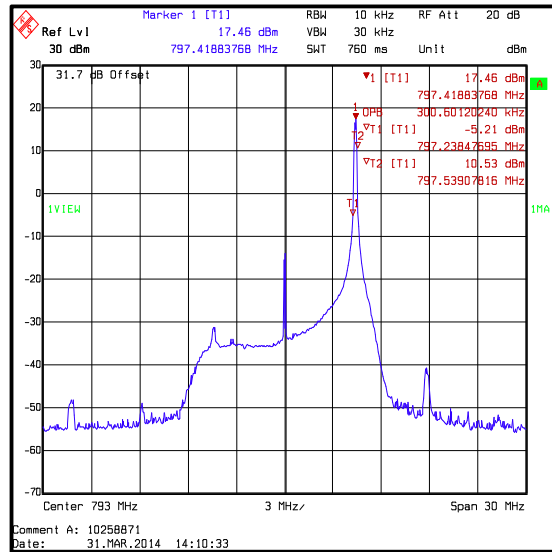
Transmitter Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth / 16QAM

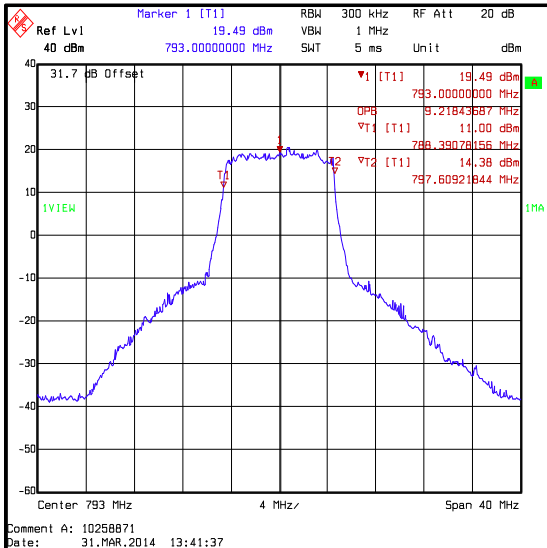
Frequency	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
793.0	1	0	10	30	0.361
793.0	1	49	10	30	0.301
793.0	50	0	300	1000	9.218



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)



16QAM / 1 Resource Blocks

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	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	-

5.2.3. Transmitter Conducted Emission Mask**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	31 March 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.210(n) and 2.1051
Test Method Used:	As detailed in KDB 971168 D01 Section 6.0 with deviations as specified in Part 90.210 and Notes below

Environmental Conditions:

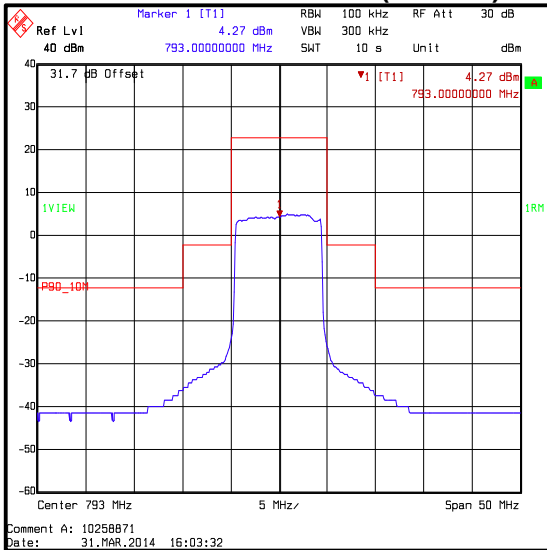
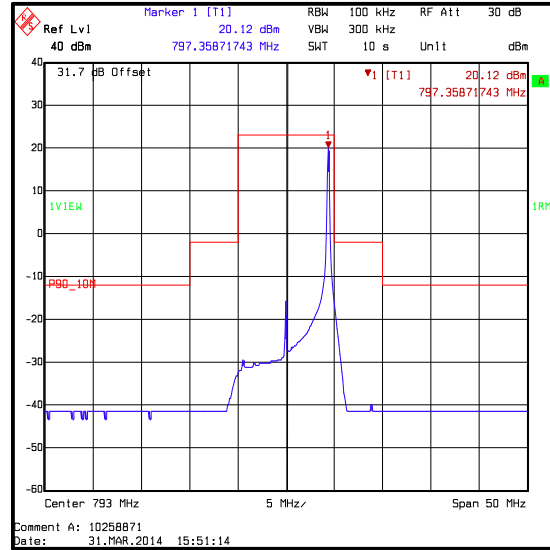
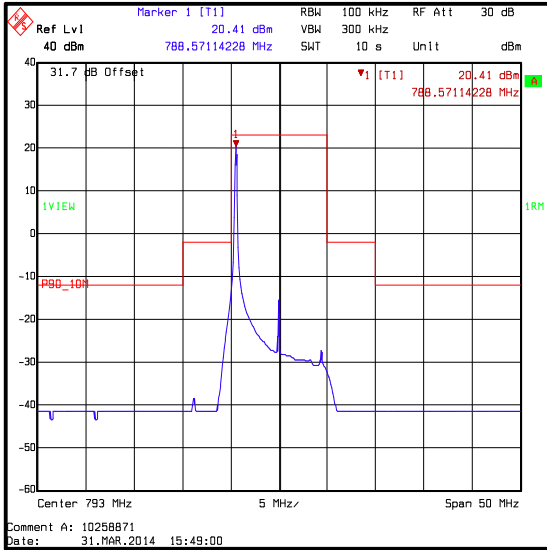
Temperature (°C):	23
Relative Humidity (%):	48

Note(s):

1. The EUT was connected to a Rohde & Schwarz CMW500 via the through ports of a directional coupler in order to establish a communication link and configure the EUT. The coupled port of the directional coupler was connected to a spectrum analyser via a suitable RF cable and RF attenuator. The RF path loss between the EUT and the spectrum analyser was measured before testing took place and the value entered as an RF level offset on the spectrum analyser.
2. The power of the modulated signal was measured on a spectrum analyser using an RMS detector and 10 second sweep time in order to maximise the level.
3. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 50. For single resource blocks, measurements were performed with the starting blocks of 1 and 49.
4. Part 90.210 emissions mask B was applied to all measurements.
5. As the EUT is unable to produce a full power un-modulated carrier, the mask was referenced to the total power contained in the channel bandwidth.

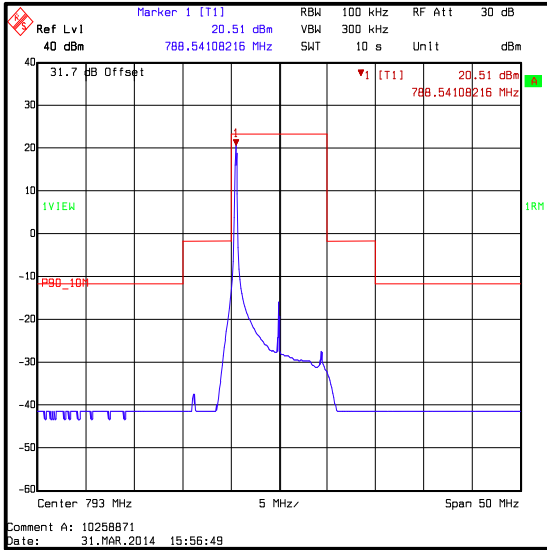
Transmitter Conducted Emission Mask (continued)

Results: 10 MHz Channel Bandwidth / QPSK

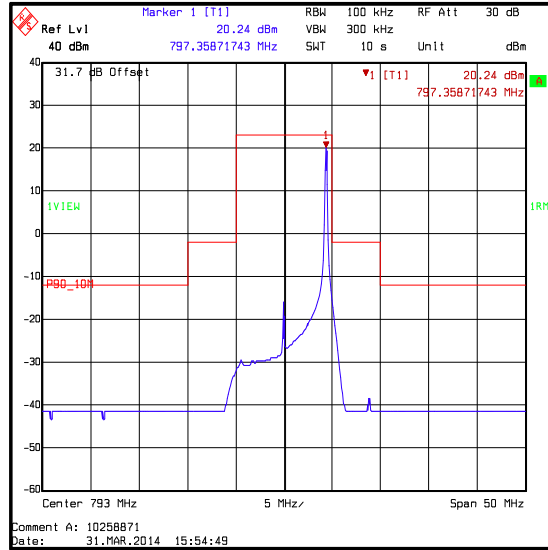


Transmitter Conducted Emission Mask (continued)

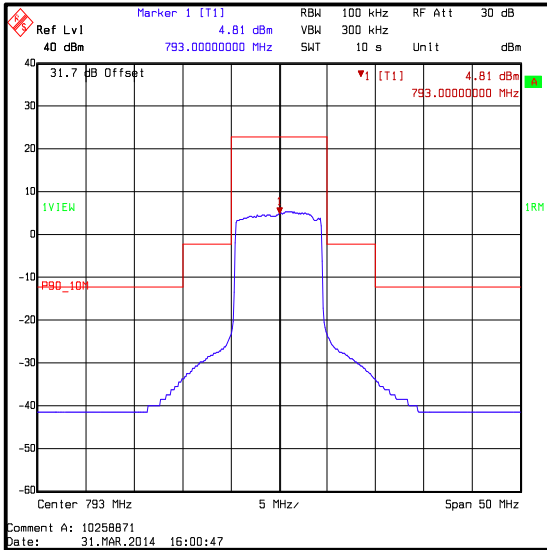
Results: 10 MHz Channel Bandwidth / 16QAM



16QAM 1 Resource Block (0 Offset)



16QAM 1 Resource Block (49 Offset)



16QAM 50 Resource Blocks

Transmitter Conducted Emission Mask (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	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	-
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12

5.2.4. Transmitter Conducted Emissions**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	01 April 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.543(c) and 2.1051
Test Method Used:	As detailed in KDB 971168 D01 Section 6.0 referencing FCC Part 2.1051 and Notes below
Frequency Range:	9 kHz to 8 GHz

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	44

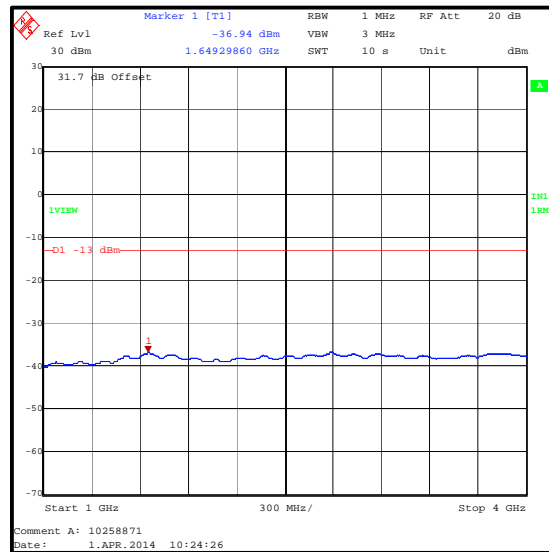
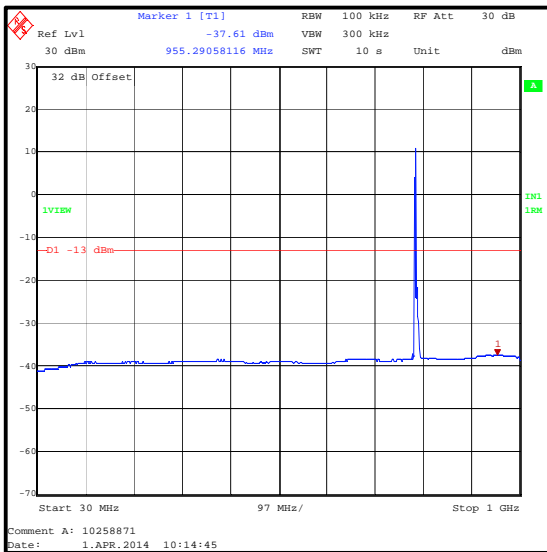
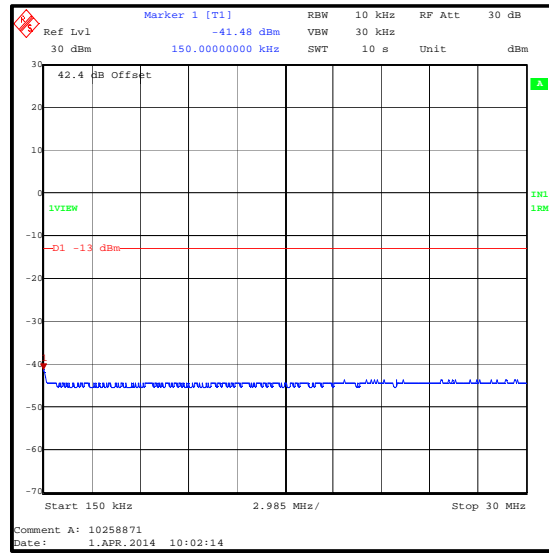
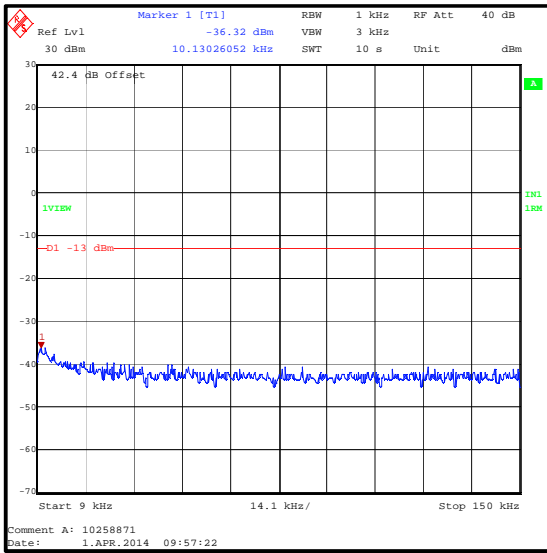
Note(s):

1. The EUT was connected to a Rohde & Schwarz CMW500 via the through ports of a directional coupler in order to establish a communication link and configure the EUT. The coupled port of the directional coupler was connected to a spectrum analyser via a suitable RF cable and RF attenuator. The RF path loss between the EUT and the spectrum analyser was measured before testing took place and the value entered as an RF level offset on the spectrum analyser.
2. Pre-scans were performed with the EUT transmitting at maximum power on the top channel.
3. The EUT was transmitting using 16QAM Modulation scheme, with a single resource blocks with an offset of 0, as this produced the highest power level and therefore deemed worst case. Please see section 5.2.3 of this report, for power measurements.
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 has been recorded in the table below.

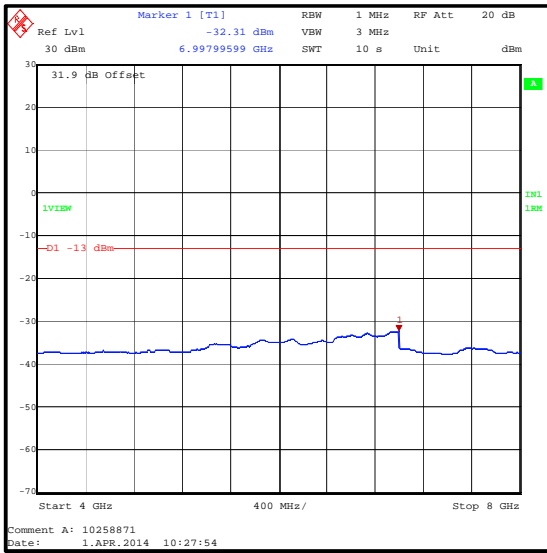
Results: 10 MHz Channel Bandwidth / Top Channel / 16QAM / 1 RB 0 Offset

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
6997.800	-32.3	-13.0	19.3	Complied

Transmitter Conducted Emissions (continued)



Transmitter Conducted Emissions (continued)



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB 26	100046K	01 Oct 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	-
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12

5.2.5. Transmitter Conducted Emissions Limitations**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	02 April 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.543(e)(2) and 2.1051
Test Method Used:	As detailed in KDB 971168 D01 Section 6.0 referencing FCC Part 2.1051 and Notes below
Frequency Ranges:	769 MHz to 775 MHz 799 MHz to 805 MHz

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	42

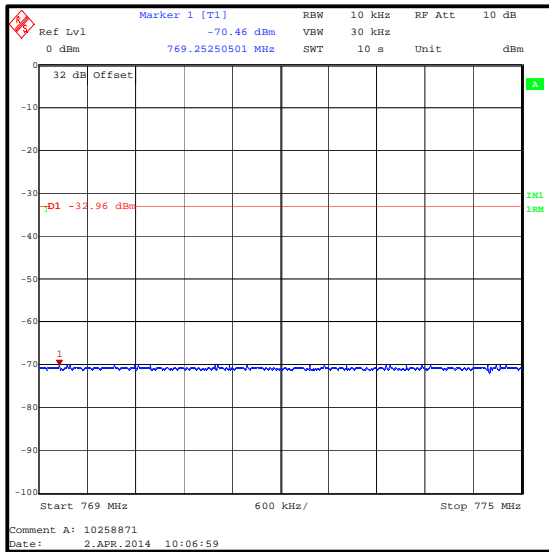
Note(s):

1. The EUT was connected to a Rohde & Schwarz CMW500 via the through ports of a directional coupler in order to establish a communication link and configure the EUT. The coupled port of the directional coupler was connected to a spectrum analyser via a suitable RF cable and RF attenuator. The RF path loss between the EUT and the spectrum analyser was measured before testing took place and the value entered as an RF level offset on the spectrum analyser.
2. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 50. For single resource blocks, measurements were performed with the starting blocks of 1 and 49.
3. The highest level emissions were recorded in the results tables. All other emissions were >20 dB below the applicable limit or below the level of the noise floor of the measuring receiver. The highest level of the measurement system noise floor was recorded in the results tables where no spurious emissions were observed on the result plots.
4. The limit for 90.543(e)(2) is $65 + 10\log_{10}(P) = -35$ dBm in a 6.25 kHz bandwidth. As it was not possible to set the resolution bandwidth to 6.25 kHz on the test equipment, the bandwidth was set to 10 kHz. The limit was adjusted by $10 \log_{10}(10 \text{ kHz} / 6.25 \text{ kHz}) = 2.04$ dB. The limit shown in the plots for the 769 MHz to 799 MHz and 799 MHz to 805 MHz bands was set to $-35 \text{ dBm} + 2.04 \text{ dB} = -32.96 \text{ dBm}$.

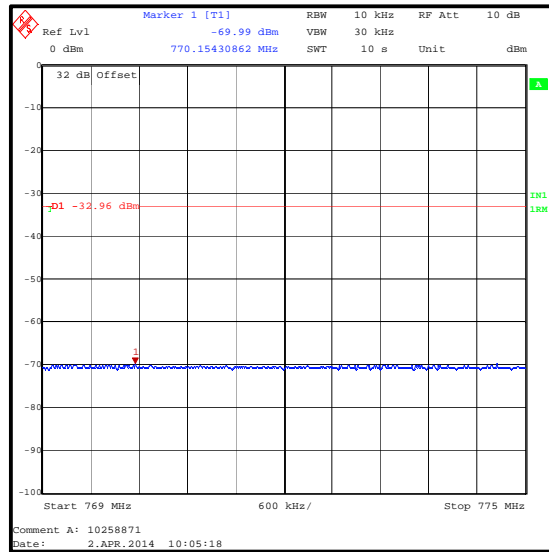
Transmitter Conducted Emissions Limitations (continued)

Results: 769 MHz to 775 MHz / QPSK

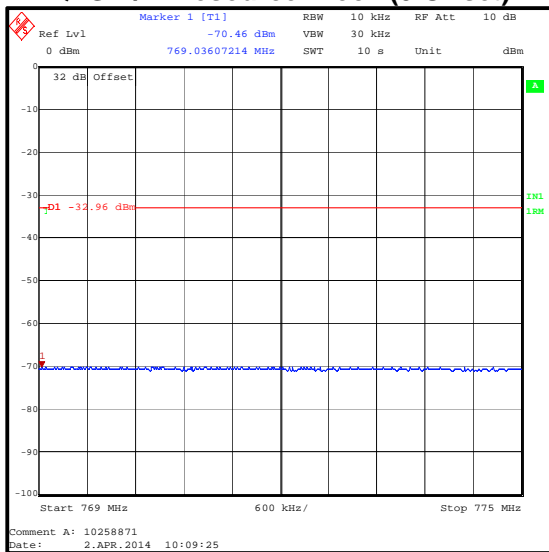
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
769.253	1	0	-70.46	-32.96	37.50	Complied
770.154	1	49	-69.99	-32.96	37.03	Complied
769.036	50	0	-70.46	-32.96	37.50	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

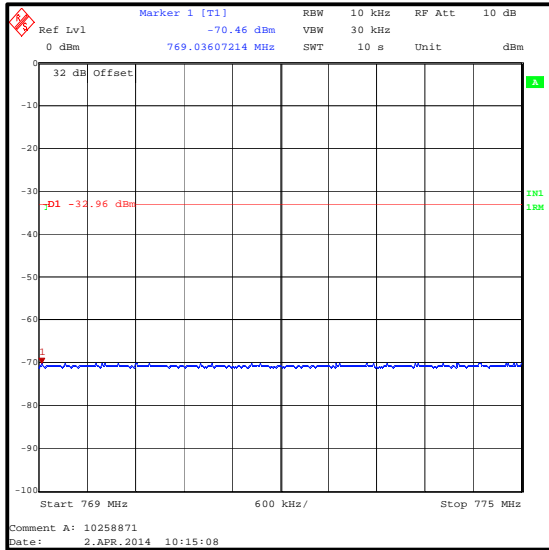


QPSK / 50 Resource Blocks

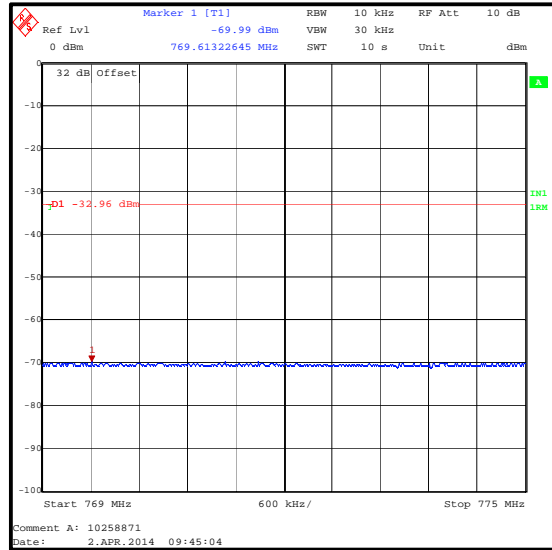
Transmitter Conducted Emissions Limitations (continued)

Results: 769 MHz to 775 MHz / 16QAM

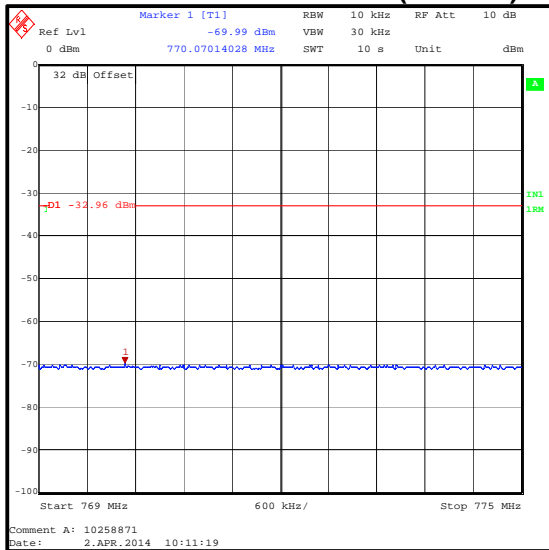
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
769.036	1	0	-70.46	-32.96	37.50	Complied
769.613	1	49	-69.99	-32.96	37.03	Complied
770.070	50	0	-69.99	-32.96	37.03	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)

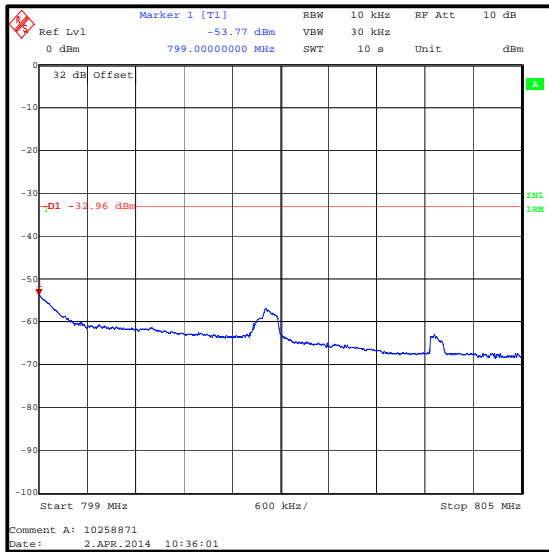


16QAM / 50 Resource Blocks

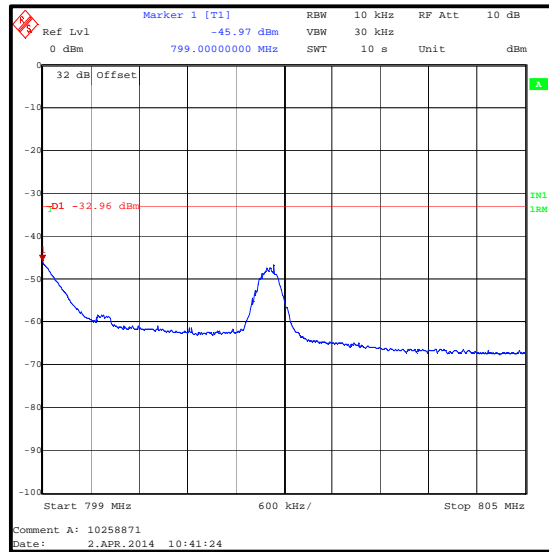
Transmitter Conducted Emissions Limitations (continued)

Results: 799 MHz to 805 MHz / QPSK

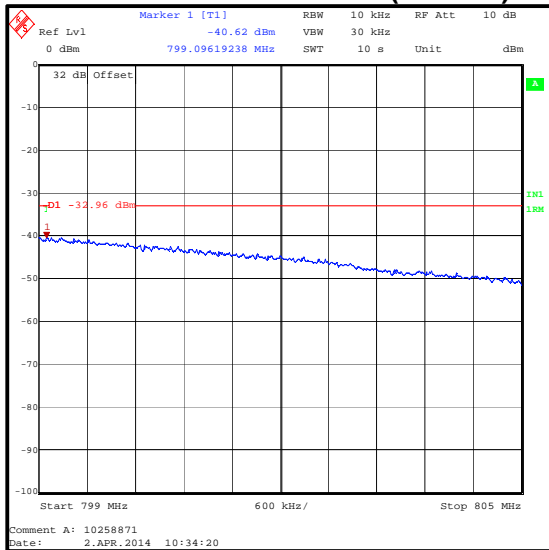
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
799.000	1	0	-53.77	-32.96	20.81	Complied
799.000	1	49	-45.97	-32.96	13.01	Complied
799.096	50	0	-40.62	-32.96	7.66	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

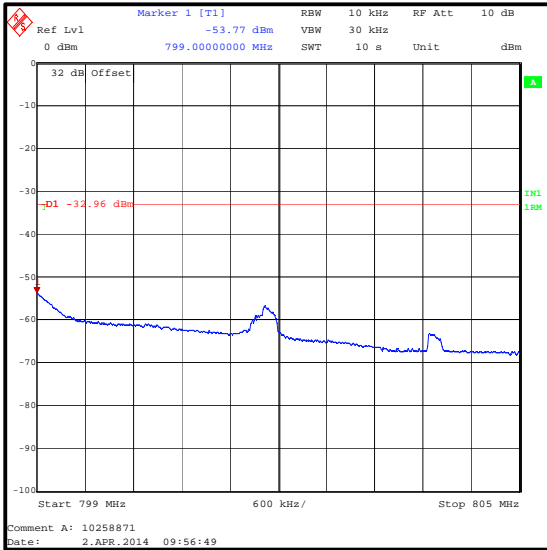


QPSK / 50 Resource Blocks

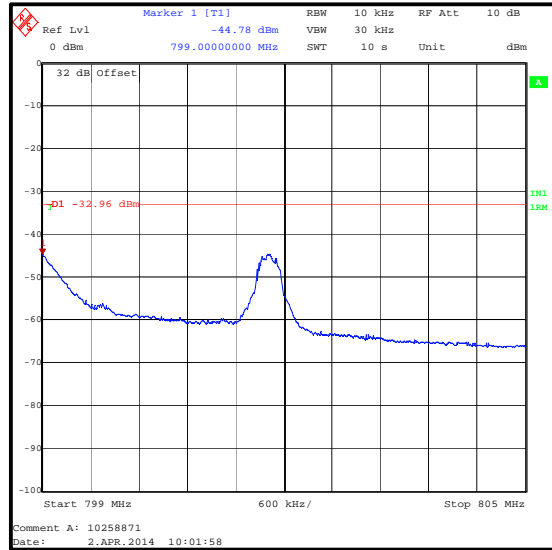
Transmitter Conducted Emissions Limitations (continued)

Results: 799 MHz to 805 MHz / 16QAM

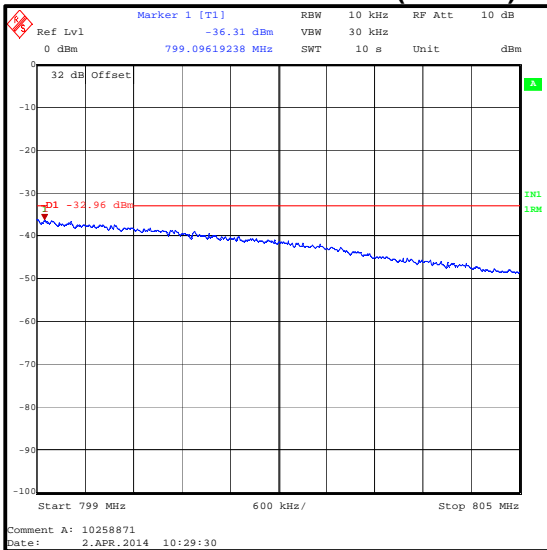
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
799.000	1	0	-53.77	-32.96	20.81	Complied
799.000	1	49	-44.78	-32.96	11.82	Complied
799.096	50	0	-36.31	-32.96	3.35	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)



16QAM / 50 Resource Blocks

Transmitter Conducted Emissions Limitations (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	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	-
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12

5.2.6. Transmitter Conducted Emissions at Band Edge**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	31 March 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.543(c), 90.543(e)(5) and 2.1051
Test Method Used:	As detailed in KDB 971168 D01 Section 6.0 referencing FCC Part 2.1051 and Notes below

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	48

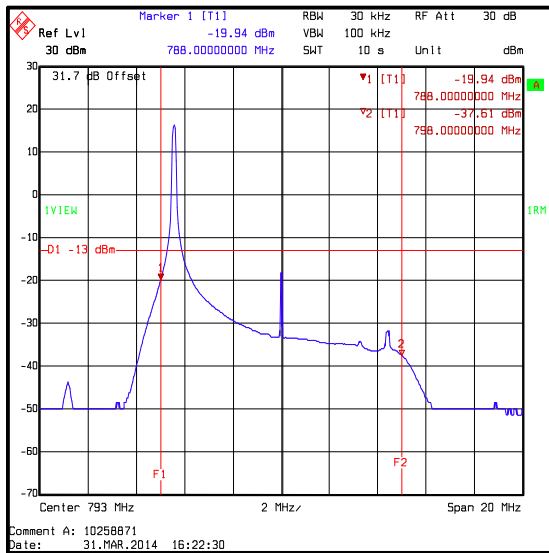
Note(s):

1. The EUT was connected to a Rohde & Schwarz CMW500 via the through ports of a directional coupler in order to establish a communication link and configure the EUT. The coupled port of the directional coupler was connected to a spectrum analyser via a suitable RF cable and RF attenuator. The RF path loss between the EUT and the spectrum analyser was measured before testing took place and the value entered as an RF level offset on the spectrum analyser.
2. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 50. For single resource blocks, measurements were performed with the starting blocks of 1 and 49.
3. In accordance with Part 90.543(e)(5), a resolution bandwidth of 30 kHz has been employed for band edge measurements.

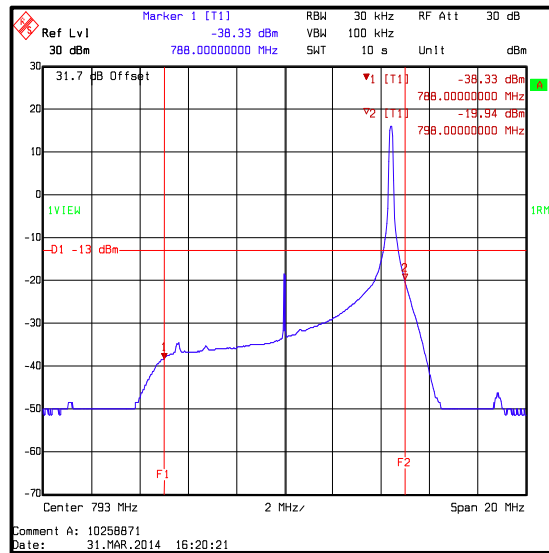
Transmitter Conducted Emissions at Band Edges (continued)

Results: 10 MHz Channel Bandwidth / QPSK

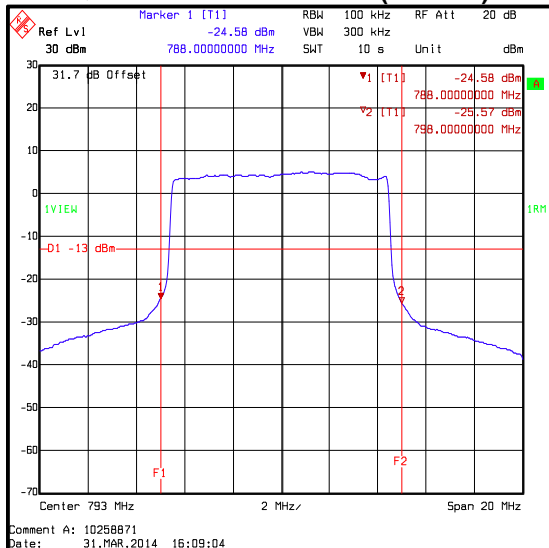
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
793	1	0	-19.9	-13.0	6.9	Complied
798	1	0	-37.6	-13.0	24.6	Complied
793	1	49	-38.3	-13.0	25.3	Complied
798	1	49	-19.9	-13.0	6.9	Complied
793	50	0	-24.6	-13.0	11.6	Complied
798	50	0	-25.6	-13.0	12.6	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

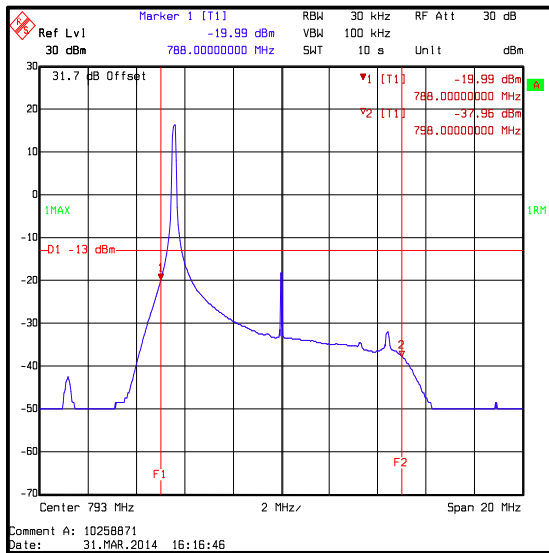


QPSK / Resource Block 50

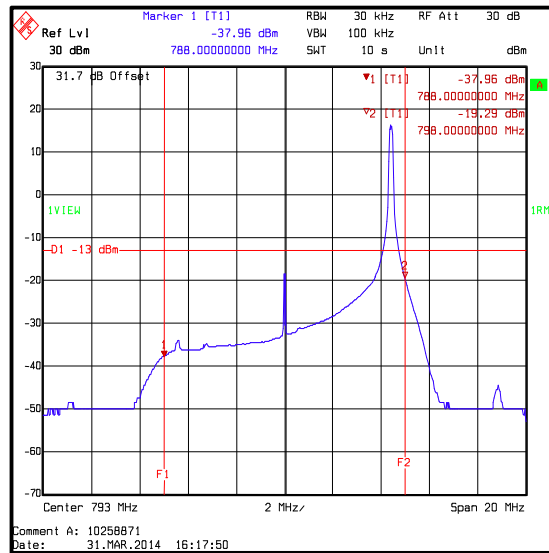
Transmitter Conducted Emissions at Band Edges (continued)

Results: 10 MHz Channel Bandwidth / 16QAM

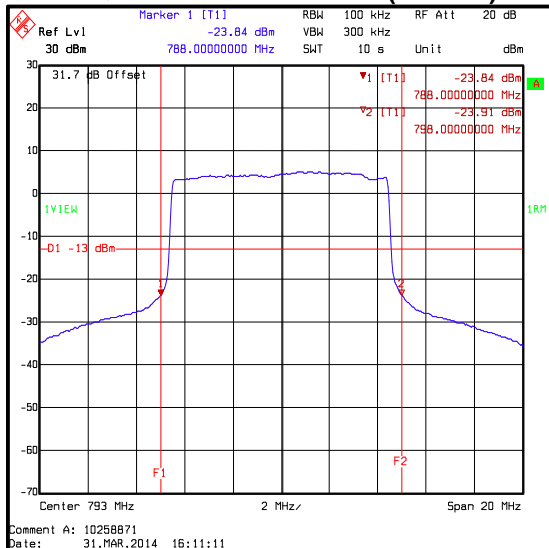
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
793	1	0	-20.0	-13.0	7.0	Complied
798	1	0	-38.0	-13.0	25.0	Complied
793	1	49	-38.0	-13.0	25.0	Complied
798	1	49	-19.3	-13.0	6.3	Complied
793	50	0	-23.8	-13.0	10.8	Complied
798	50	0	-23.9	-13.0	10.9	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)



16QAM / Resource Block 50

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	14 Mar 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	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	-
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	25 Jun 2014	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	15 May 2014	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2014	12

5.2.7. Transmitter Radiated Emissions – Internal Antenna**Test Summary:**

Test Engineer:	Nick Steele	Test Dates:	08 May 2014 & 13 May 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.543(c) and 2.1053
Test Method Used:	As detailed in ANSI TIA-603-C-2004 Section 2.2.12. referencing FCC Part 2.1053
Frequency Range:	30 MHz to 8 GHz

Environmental Conditions:

Temperature (°C):	23 to 24
Relative Humidity (%):	31 to 36

Note(s):

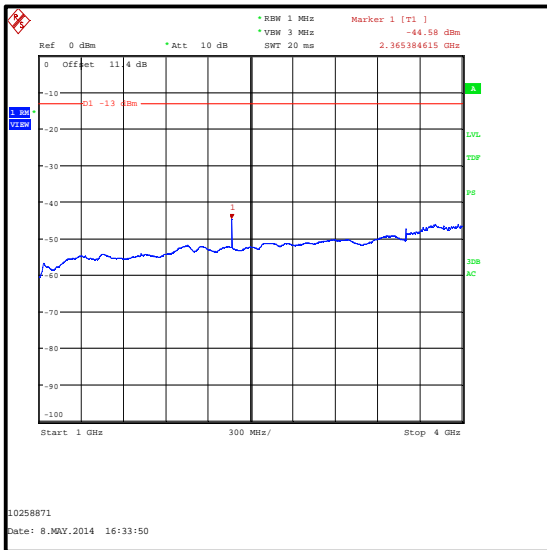
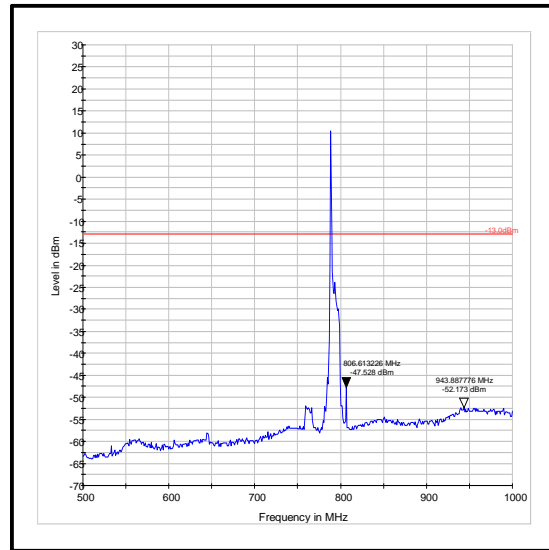
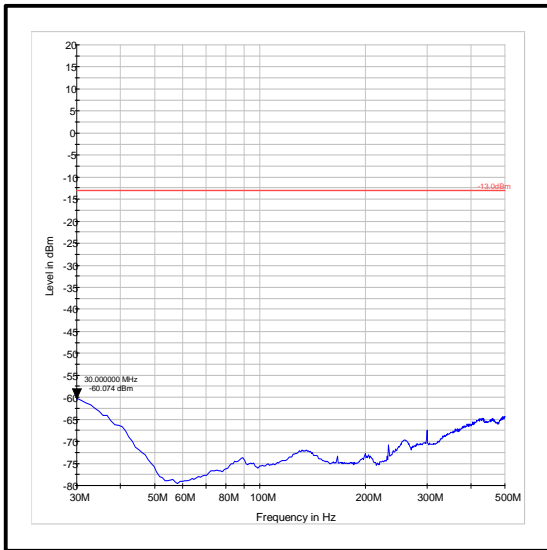
1. The EUT was set to transmit with 16QAM modulation applied with 1 Resource Block and an offset of 0 as this was found to have the highest output power and therefore deemed worst case.
2. The emission seen on the 30 MHz to 1 GHz plot at approximately 793.0 MHz is the EUT carrier.
3. The highest level spurious emission shown on the pre-scan plots was recorded. All other spurious emissions were at least 20 dB below the specification limit or below the measurement system noise floor.
4. 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.
5. 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.

Results:

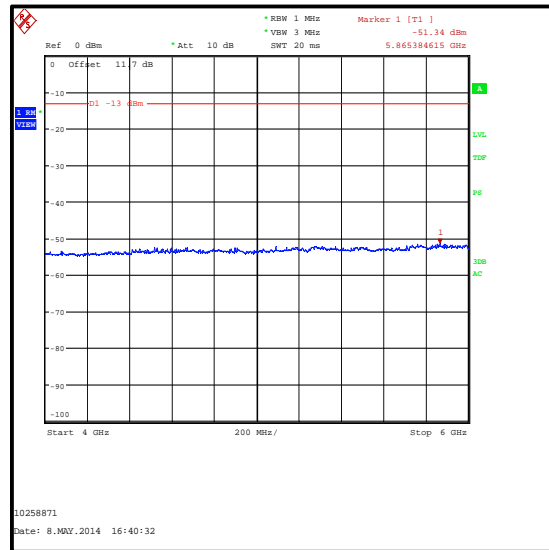
Frequency (MHz)	Antenna Polarisation	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
2365.385	Horizontal	-44.6	-13.0	31.6	Complied

Transmitter Radiated Emissions – Internal Antenna (continued)

Results: 10 MHz Channel Bandwidth



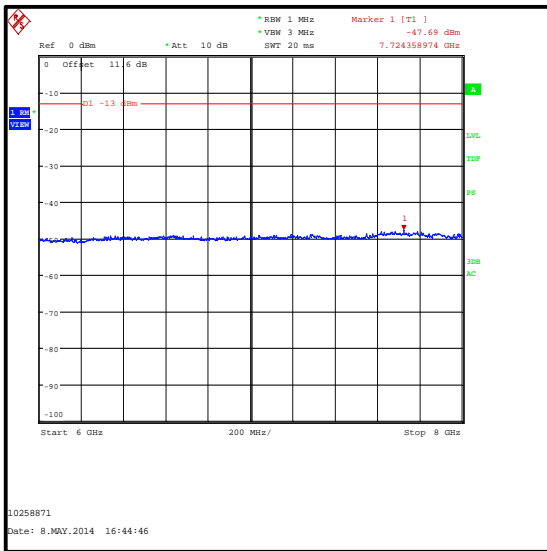
10258871
Date: 8.NOV.2014 16:33:50



10258871
Date: 8.NOV.2014 16:40:32

Transmitter Radiated Emissions - Internal Antenna (continued)

Results: 10 MHz Channel Bandwidth



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	18 May 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	15 Feb 2015	12
A490	Antenna	Chase	CBL6111A	1590	29 Apr 2015	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	13 Mar 2015	12
L1118	Pre Amplifier	Agilent	8449B	3008A02100	13 Jan 2015	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	02 May 2015	12
A148	High Pass Filter	Filtronc	5H036	32218	17 May 2015	24
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

5.2.8. Transmitter Radiated Emissions – External Antenna**Test Summary:**

Test Engineer:	Nick Steele	Test Dates:	13 May 2014 & 14 May 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.543(c) and 2.1053
Test Method Used:	As detailed in ANSI TIA-603-C-2004 Section 2.2.12. referencing FCC Part 2.1053
Frequency Range:	30 MHz to 8 GHz

Environmental Conditions:

Temperature (°C):	22 to 23
Relative Humidity (%):	31 to 40

Note(s):

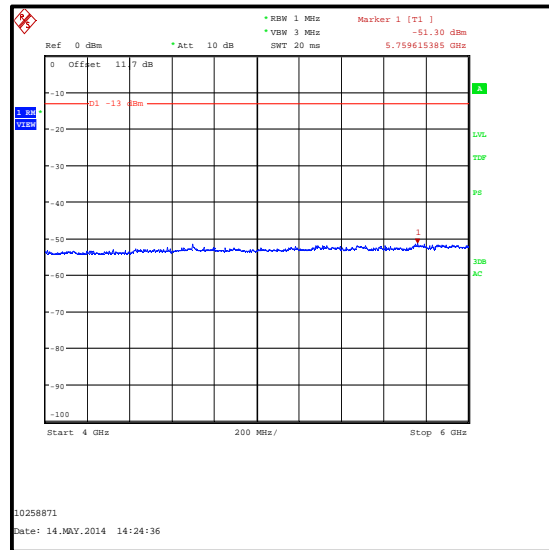
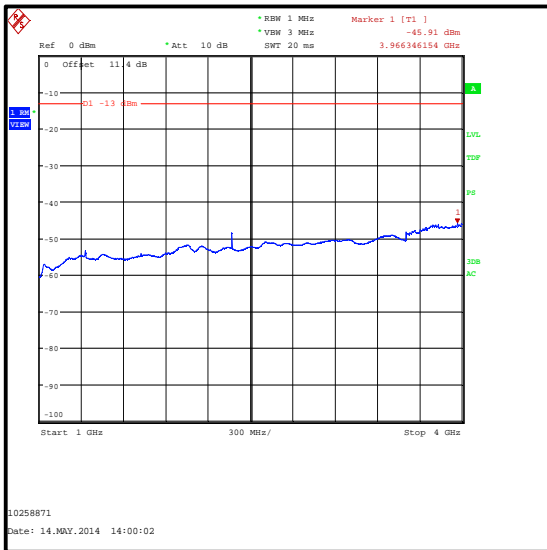
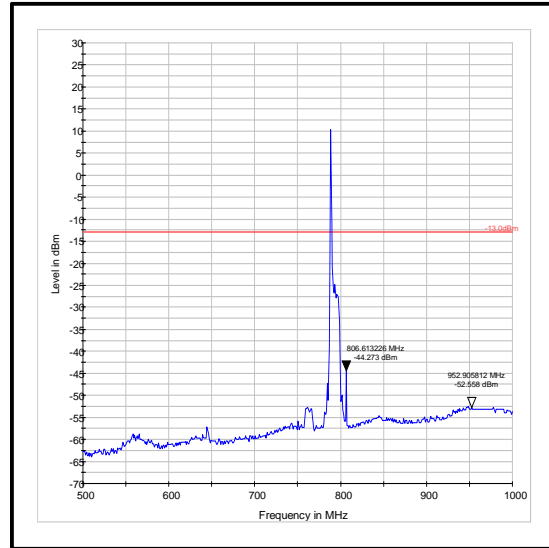
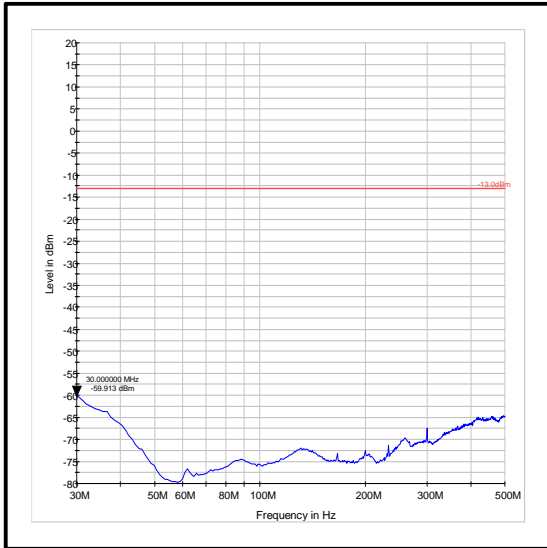
1. The EUT was set to transmit with 16QAM modulation applied with 1 Resource Block and an offset of 0 as this was found to have the highest output power and therefore deemed worst case.
2. The emission seen on the 30 MHz to 1 GHz plot at approximately 793.0 MHz is the EUT carrier.
3. The highest level spurious emission shown on the pre-scan plots was recorded. All other spurious emissions were at least 20 dB below the specification limit or below the measurement system noise floor.
4. 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.
5. 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.

Results:

Frequency (MHz)	Antenna Polarisation	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
806.613	Vertical	-44.3	-13.0	31.3	Complied

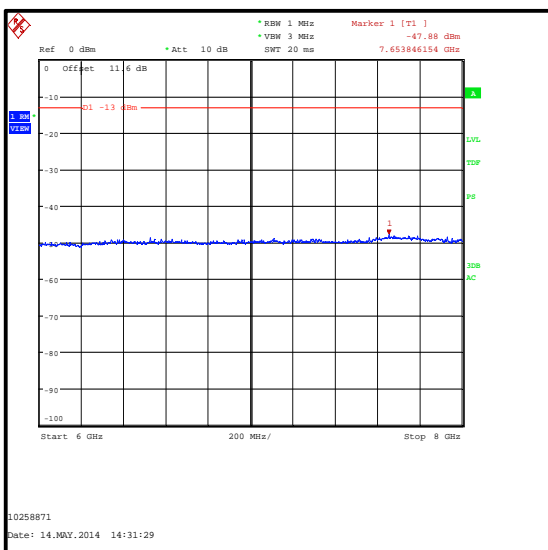
Transmitter Radiated Emissions – External Antenna (continued)

Results: 10 MHz Channel Bandwidth



Transmitter Radiated Emissions – External Antenna (continued)

Results: 10 MHz Channel Bandwidth



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	18 May 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	15 Feb 2015	12
A490	Antenna	Chase	CBL6111A	1590	29 Apr 2015	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	13 Mar 2015	12
L1118	Pre Amplifier	Agilent	8449B	3008A02100	13 Jan 2015	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	02 May 2015	12
A148	High Pass Filter	Filtronc	5H036	32218	17 May 2015	24
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

5.2.9. Transmitter Radiated Spurious Emissions Limitations – Internal Antenna**Test Summary:**

Test Engineer:	Nick Steele	Test Dates:	12 May 2014 & 14 May 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.543(e)(2), 90.543(f) and 2.1053
Test Method Used:	As detailed in KDB 971168 D01 Section 5.8. referencing FCC Part 2.1053 and Notes below
Frequency Ranges:	769 to 775 MHz 799 to 805 MHz 1559 to 1610 MHz

Environmental Conditions:

Temperature (°C):	22 to 23
Relative Humidity (%):	32 to 40

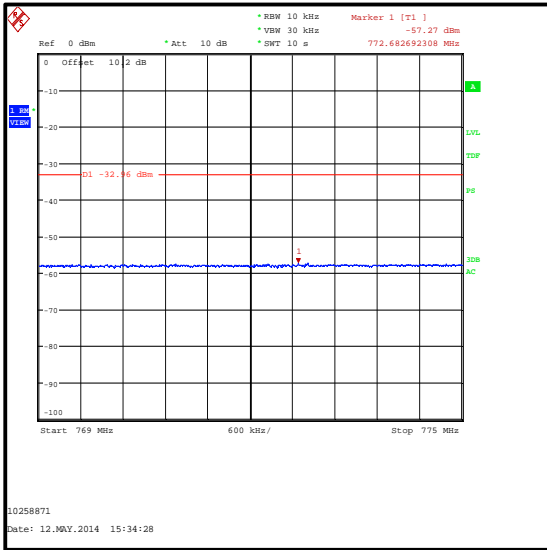
Note(s):

- Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 50. For single resource blocks, measurements were performed with the starting blocks of 1 and 49.
- All other emissions were >20 dB below the applicable limit or below the level of the noise floor of the measuring receiver.
- The limit for 90.543(e)(2) is $65 + 10\log_{10}(P) = -35$ dBm in a 6.25 kHz bandwidth. As it was not possible to set the resolution bandwidth on the test equipment, the bandwidth was set to 10 kHz. The limit was adjusted by $10\log_{10}(10\text{ kHz} / 6.25\text{ kHz}) = 2.04$ dB. The limit shown in the plots for the 769 MHz to 799 MHz and 799 MHz to 805 MHz bands was set to $-35\text{ dBm} + 2.04\text{ dB} = -32.96\text{ dBm}$.
- The limit for 90.543(f) states emissions in the band 1559 MHz to 1610 MHz shall be limited to -70 dBW/MHz (-40 dBm) equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP (-50 dBm) for discrete emissions of less than 700 Hz bandwidth.
- 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.
- 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.

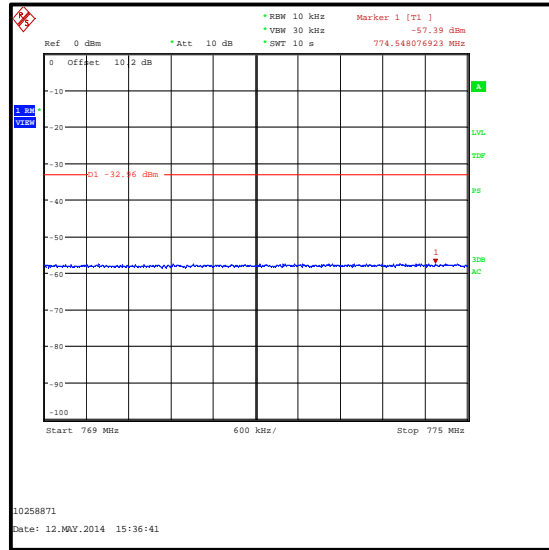
Transmitter Radiated Spurious Emissions Limitations – Internal Antenna (continued)

Results: 769 MHz to 775 MHz / QPSK

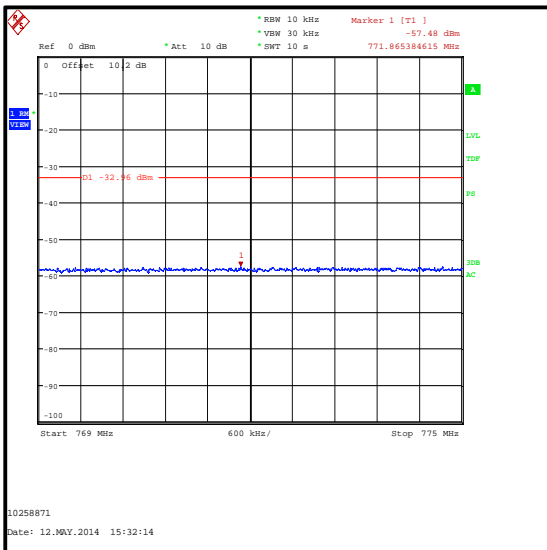
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
772.683	1	0	-57.27	-32.96	24.31	Complied
774.548	1	49	-57.39	-32.96	24.43	Complied
771.865	50	0	-57.48	-32.96	24.52	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

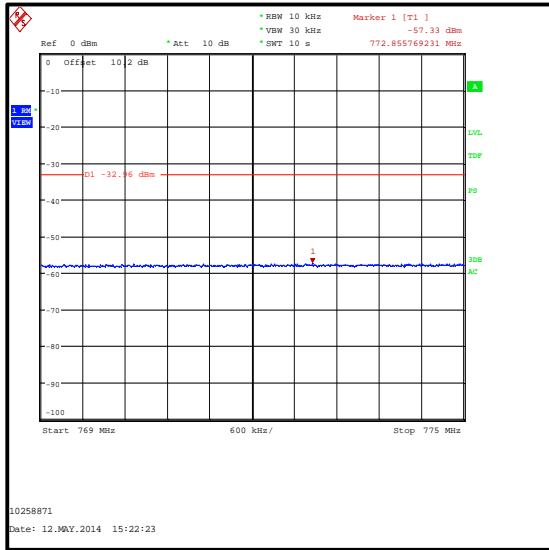


QPSK / 50 Resource Blocks

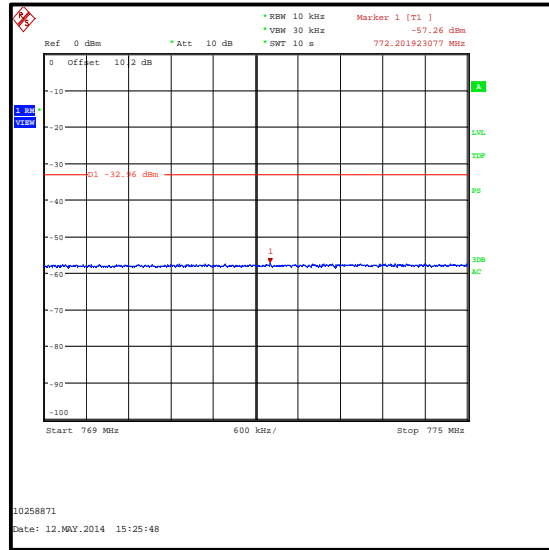
Transmitter Radiated Spurious Emissions Limitations – Internal Antenna (continued)

Results: 769 MHz to 775 MHz / 16QAM

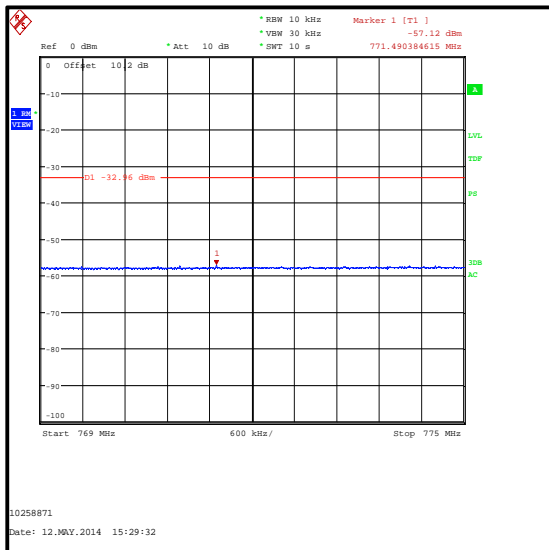
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
772.856	1	0	-57.33	-32.96	24.37	Complied
772.202	1	49	-57.26	-32.96	24.30	Complied
771.490	50	0	-57.12	-32.96	24.16	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)

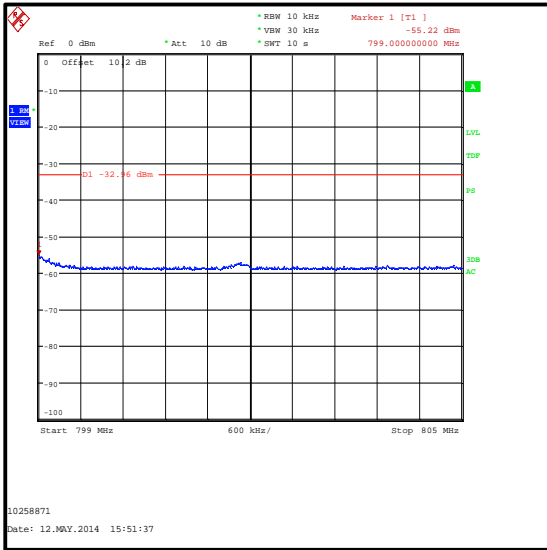


16QAM / 50 Resource Blocks

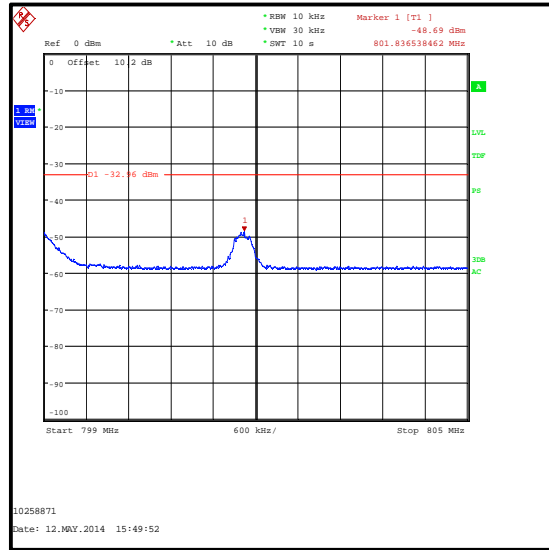
Transmitter Radiated Spurious Emissions Limitations – Internal Antenna (continued)

Results: 799 MHz to 805 MHz / QPSK

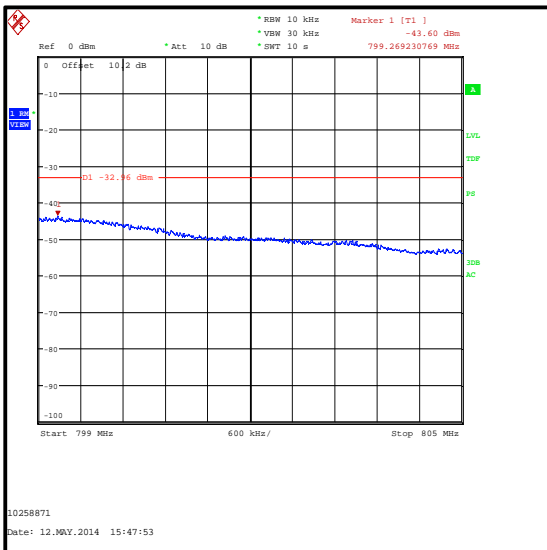
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
799.000	1	0	-55.22	-32.96	22.26	Complied
801.837	1	49	-48.69	-32.96	15.73	Complied
799.269	50	0	-43.60	-32.96	10.64	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

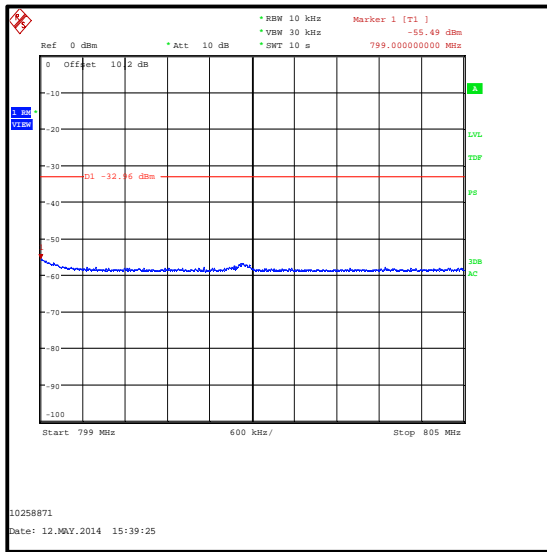


QPSK / 50 Resource Blocks

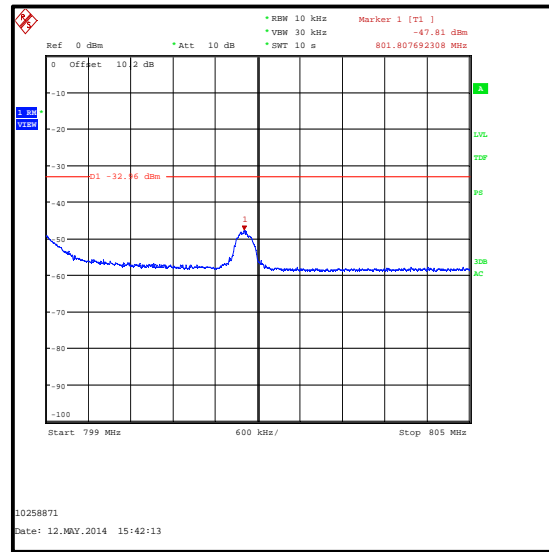
Transmitter Radiated Spurious Emissions Limitations – Internal Antenna (continued)

Results: 799 MHz to 805 MHz / 16QAM

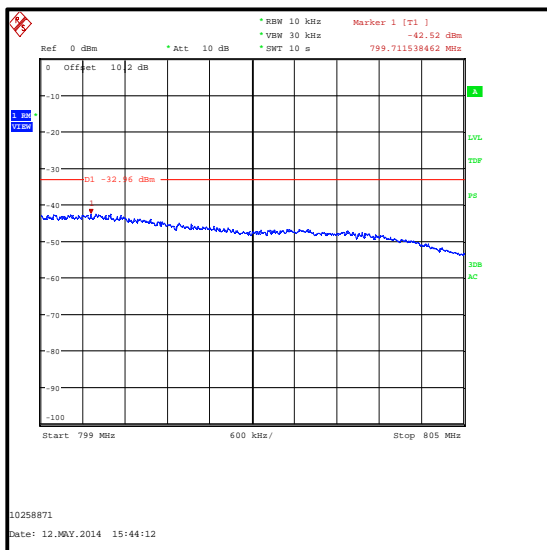
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
799.000	1	0	-55.49	-32.96	22.53	Complied
801.808	1	49	-47.81	-32.96	14.85	Complied
799.712	50	0	-42.52	-32.96	9.56	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)

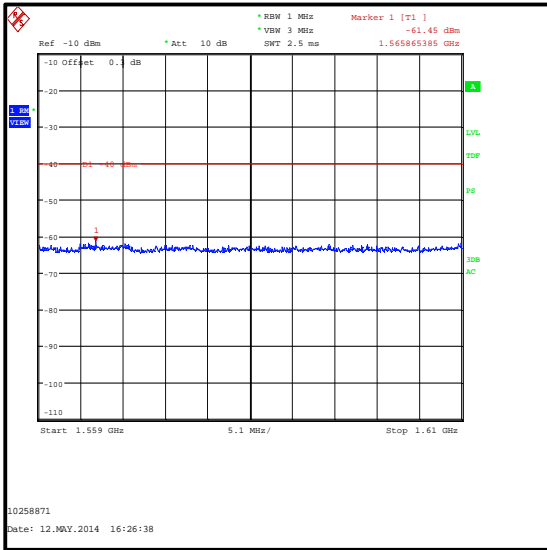


16QAM / 50 Resource Blocks

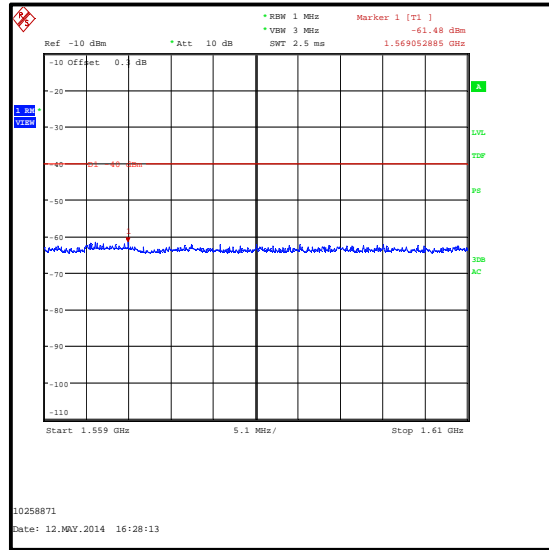
Transmitter Radiated Spurious Emissions Limitations – Internal Antenna (continued)

Results: 1559 MHz to 1610 MHz / QPSK

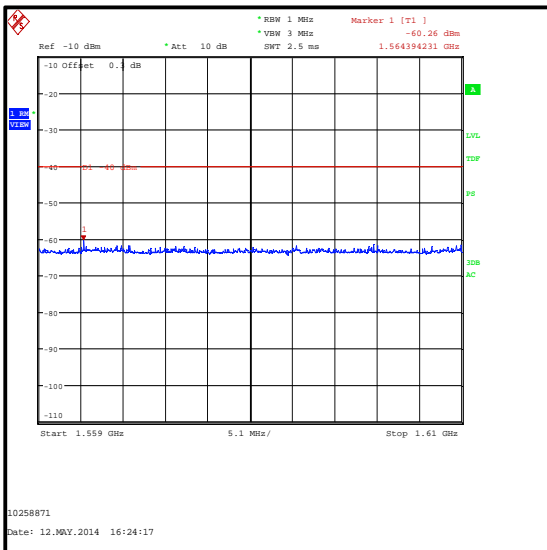
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1565.865	1	0	-61.45	-40.0	21.45	Complied
1569.053	1	49	-61.48	-40.0	21.48	Complied
1564.394	50	0	-60.26	-40.0	20.26	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

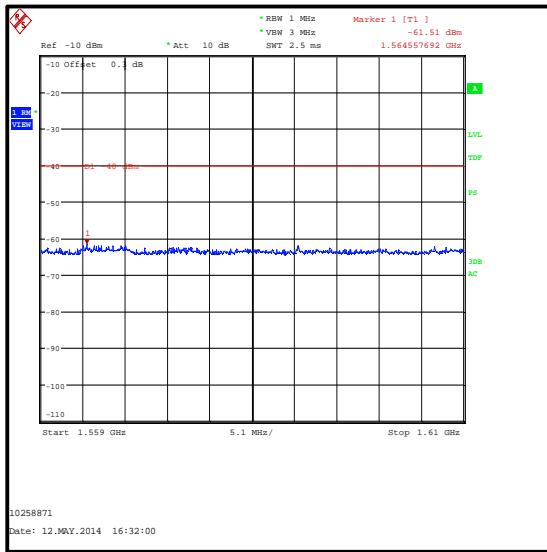


QPSK / 50 Resource Blocks

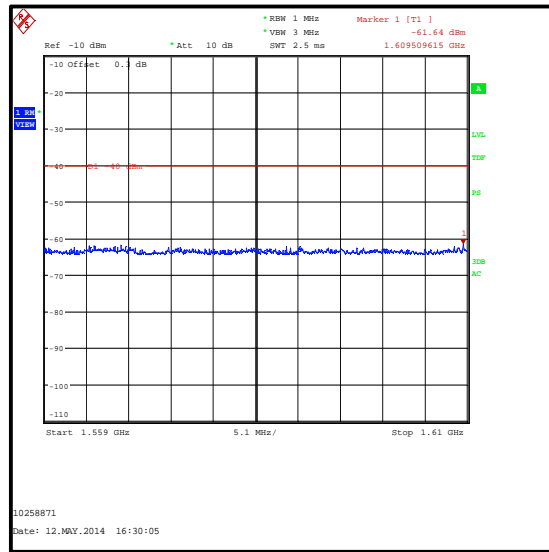
Transmitter Radiated Spurious Emissions Limitations – Internal Antenna (continued)

Results: 1559 MHz to 1610 MHz / 16QAM

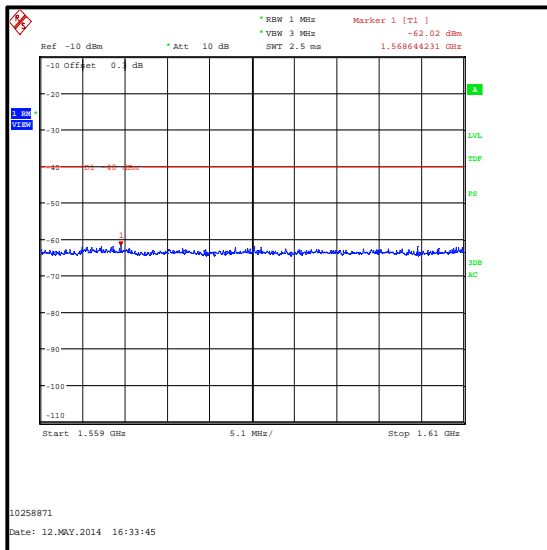
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1564.558	1	0	-61.51	-40.0	21.51	Complied
1609.510	1	49	-61.64	-40.0	21.64	Complied
1568.644	50	0	-62.02	-40.0	22.02	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)



16QAM / 50 Resource Blocks

Transmitter Radiated Spurious Emissions Limitations – Internal Antenna (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	18 May 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	15 Feb 2015	12
A490	Antenna	Chase	CBL6111A	1590	29 Apr 2015	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	13 Mar 2015	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	02 May 2015	12
A148	High Pass Filter	Filtronic	5H036	32218	17 May 2015	24
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12
L1118	Pre Amplifier	Agilent	8449B	3008A02100	13 Jan 2015	12

5.2.10. Transmitter Radiated Spurious Emissions Limitations – External Antenna**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	14 May 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.543(e)(2), 90.543(f) and 2.1053
Test Method Used:	As detailed in KDB 971168 D01 Section 5.8. referencing FCC Part 2.1053
Frequency Ranges:	769 to 775 MHz 799 to 805 MHz 1559 to 1610 MHz

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	40

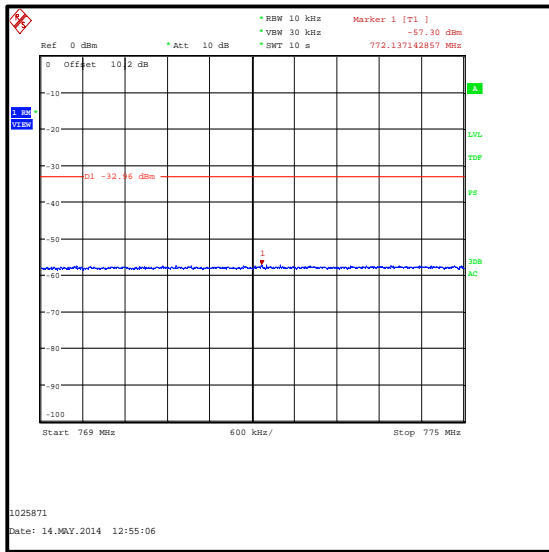
Note(s):

- Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 50. For single resource blocks, measurements were performed with the starting blocks of 1 and 49.
- All other emissions were >20 dB below the applicable limit or below the level of the noise floor of the measuring receiver.
- The limit for 90.543(e)(2) is $65 + 10\log_{10}(P) = -35$ dBm in a 6.25 kHz bandwidth. As it was not possible to set the resolution bandwidth on the test equipment, the bandwidth was set to 10 kHz. The limit was adjusted by $10 \log_{10}(10 \text{ kHz} / 6.25 \text{ kHz}) = 2.04$ dB. The limit shown in the plots for the 769 MHz to 799 MHz and 799 MHz to 805 MHz bands was set to $-35 \text{ dBm} + 2.04 \text{ dB} = -32.96$ dBm.
- The limit for 90.543(f) states emissions in the band 1559 MHz to 1610 MHz shall be limited to -70 dBW/MHz (-40 dBm) equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP (-50 dBm) for discrete emissions of less than 700 Hz bandwidth.
- 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.
- 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.

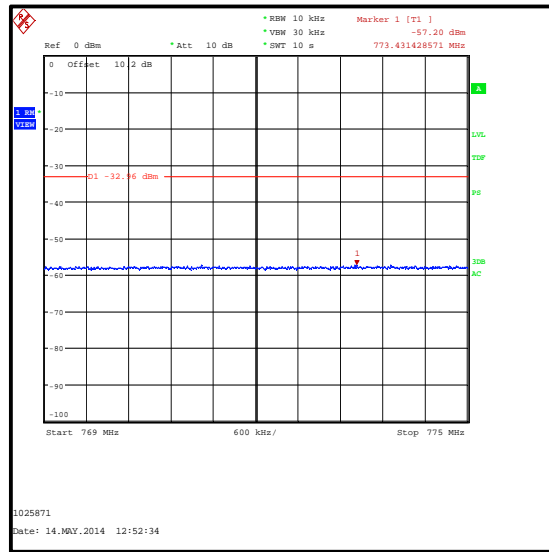
Transmitter Radiated Spurious Emissions Limitations – External Antenna (continued)

Results: 769 MHz to 775 MHz / QPSK

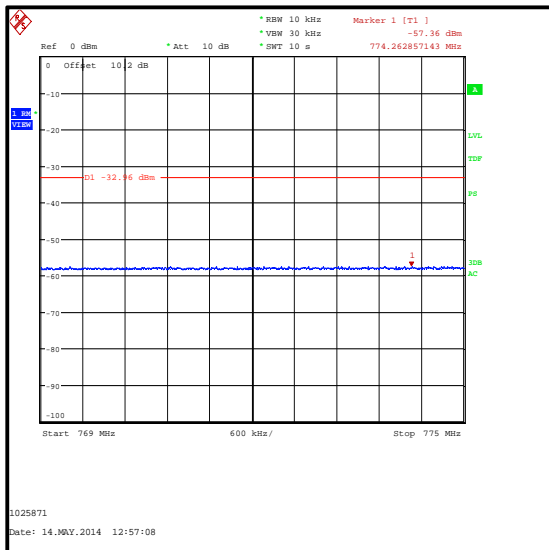
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
772.137	1	0	-57.30	-32.96	24.34	Complied
773.431	1	49	-57.20	-32.96	24.24	Complied
774.263	50	0	-57.36	-32.96	24.40	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

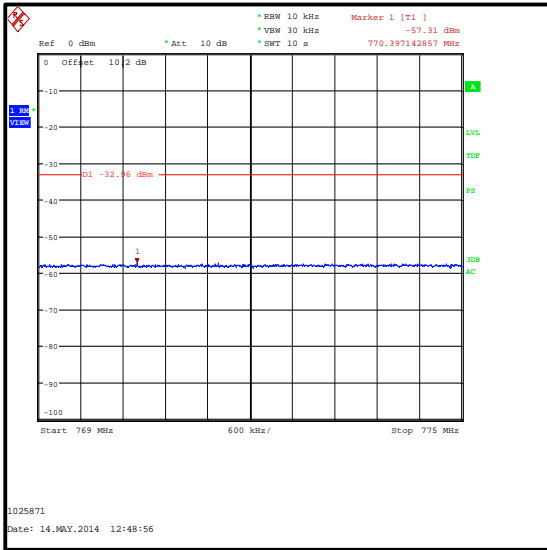


QPSK / 50 Resource Blocks

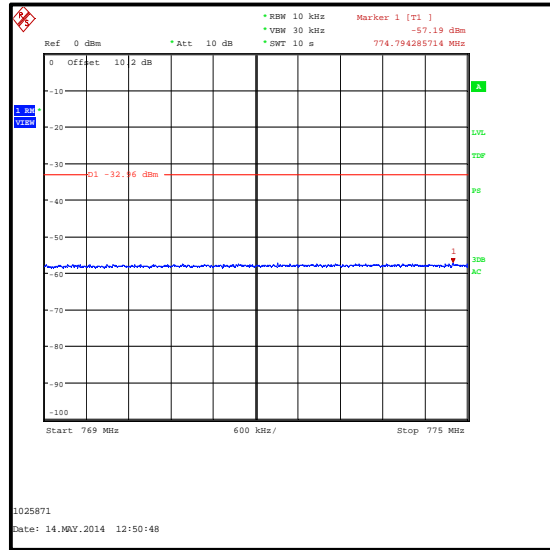
Transmitter Radiated Spurious Emissions Limitations – External Antenna (continued)

Results: 769 MHz to 775 MHz / 16QAM

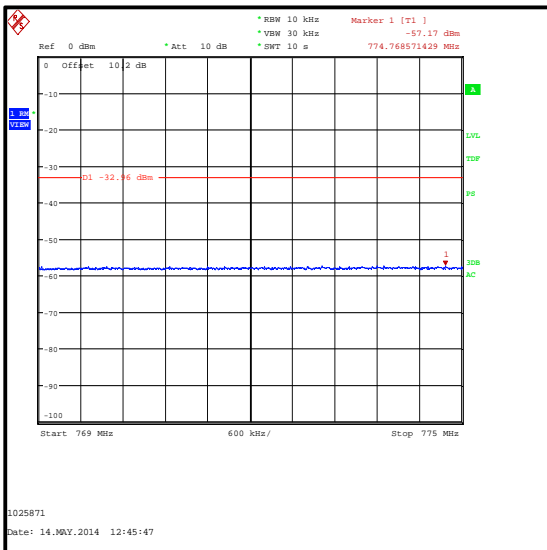
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
770.397	1	0	-57.31	-32.96	24.35	Complied
774.794	1	49	-57.19	-32.96	24.23	Complied
774.769	50	0	-57.17	-32.96	24.21	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)

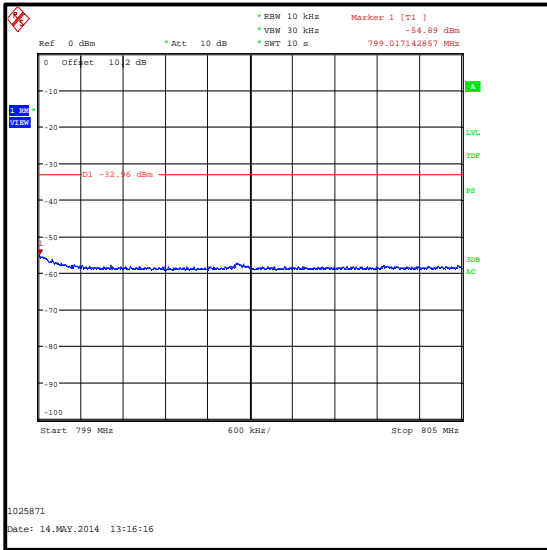


16QAM / 50 Resource Blocks

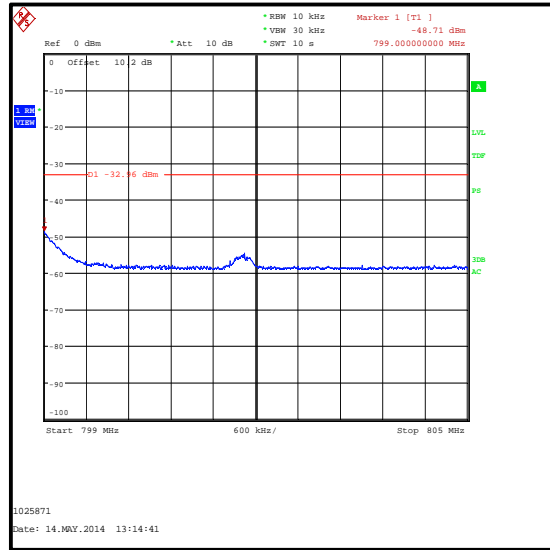
Transmitter Radiated Spurious Emissions Limitations – External Antenna (continued)

Results: 799 MHz to 805 MHz / QPSK

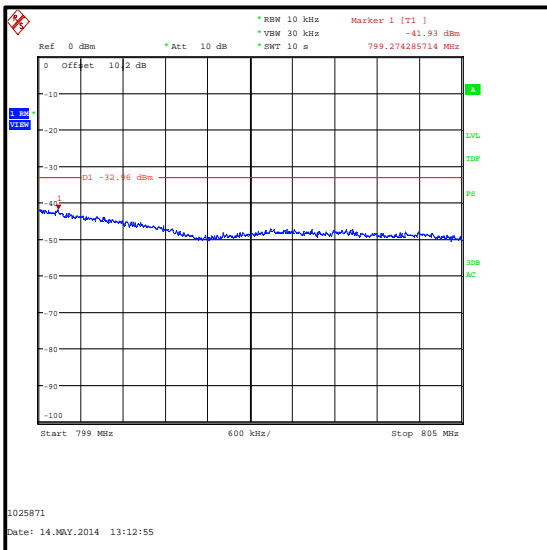
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
799.017	1	0	-54.89	-32.96	21.93	Complied
799.000	1	49	-48.71	-32.96	15.75	Complied
799.274	50	0	-41.93	-32.96	8.97	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

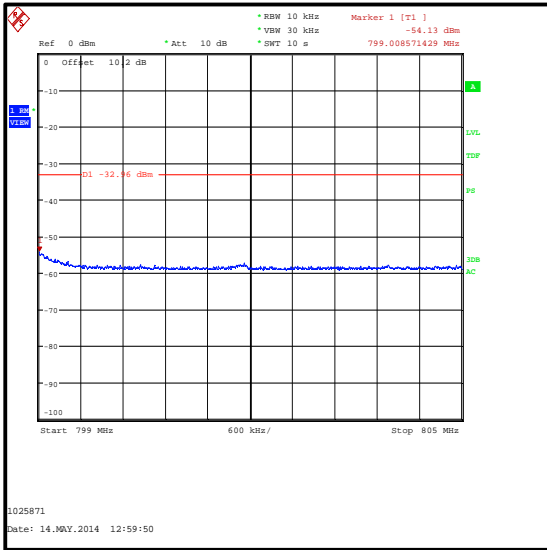


QPSK / 50 Resource Blocks

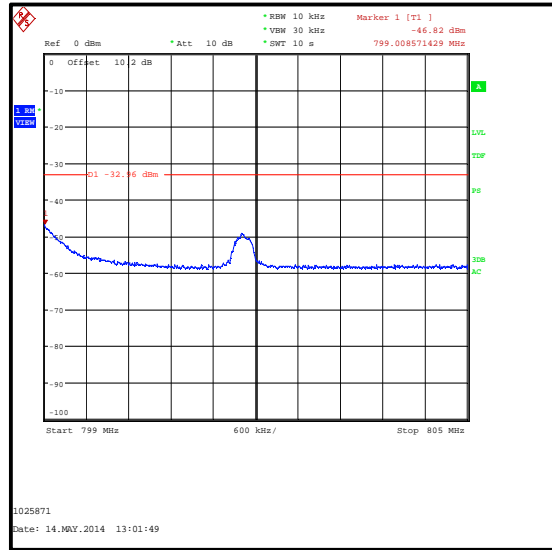
Transmitter Radiated Spurious Emissions Limitations – External Antenna (continued)

Results: 799 MHz to 805 MHz / 16QAM

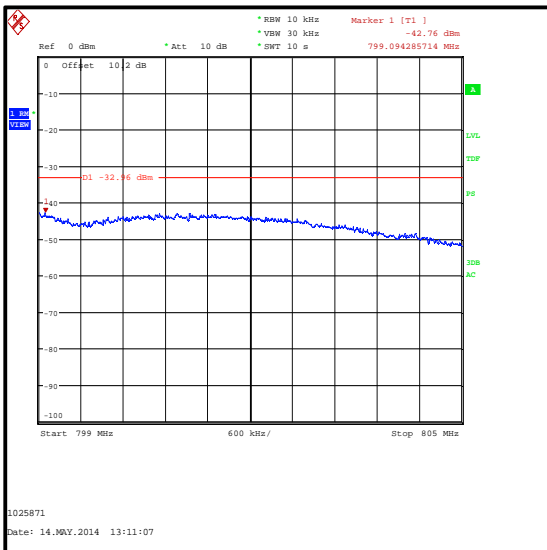
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
799.009	1	0	-54.13	-32.96	21.17	Complied
799.009	1	49	-46.82	-32.96	13.86	Complied
799.094	50	0	-42.76	-32.96	9.80	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)

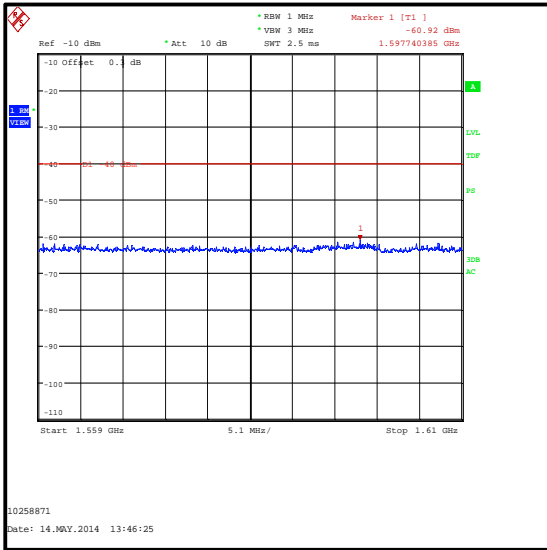


16QAM / 50 Resource Blocks

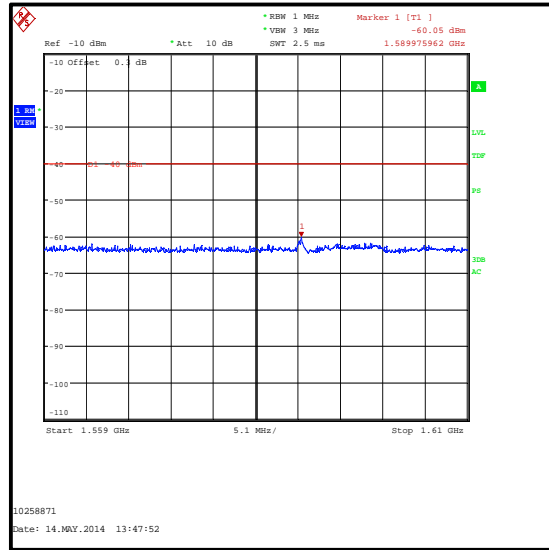
Transmitter Radiated Spurious Emissions Limitations – External Antenna (continued)

Results: 1559 MHz to 1610 MHz / QPSK

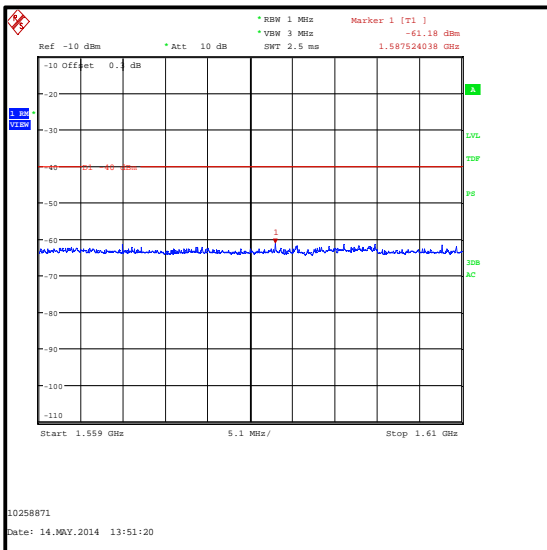
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1597.740	1	0	-60.92	-40.0	20.92	Complied
1589.976	1	49	-60.05	-40.0	20.05	Complied
1587.524	50	0	-61.18	-40.0	21.18	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

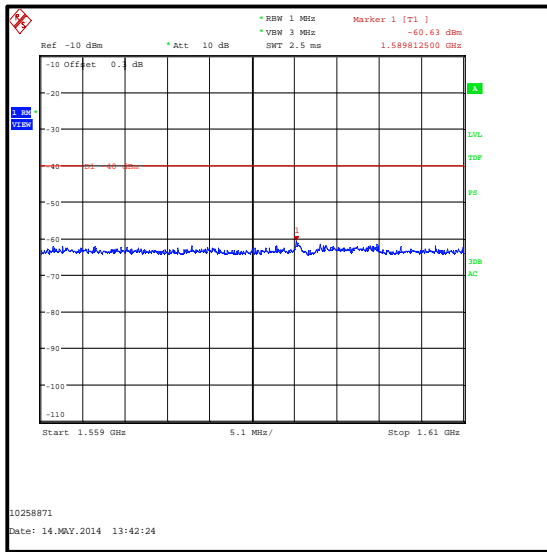


QPSK / 50 Resource Blocks

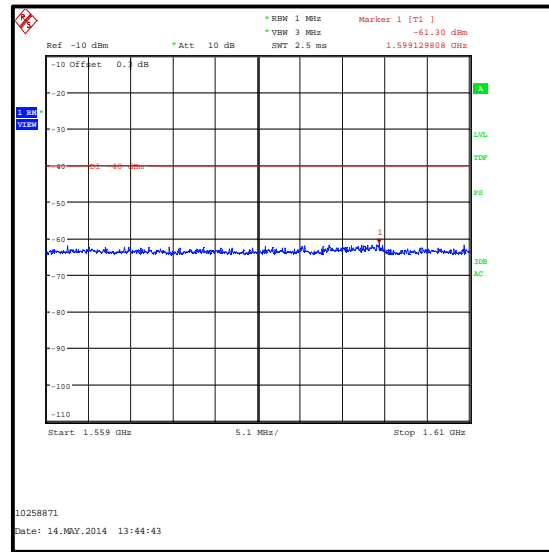
Transmitter Radiated Spurious Emissions Limitations – External Antenna (continued)

Results: 1559 MHz to 1610 MHz / 16QAM

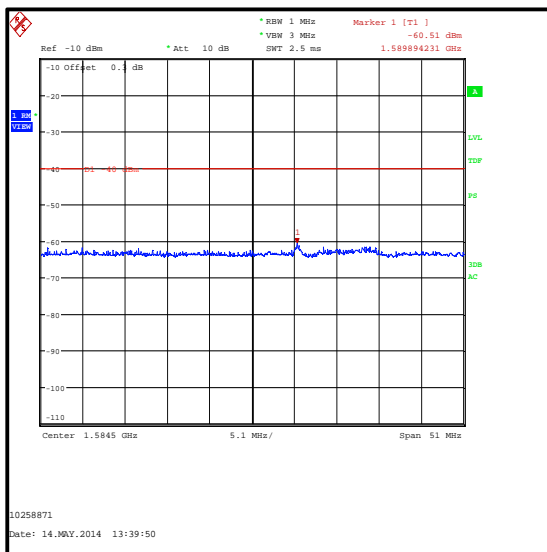
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1589.813	1	0	-60.63	-40.0	20.63	Complied
1599.130	1	49	-61.30	-40.0	21.30	Complied
1589.894	50	0	-60.51	-40.0	20.51	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)



16QAM / 50 Resource Blocks

Transmitter Radiated Spurious Emissions Limitations – External Antenna (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	18 May 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	15 Feb 2015	12
A490	Antenna	Chase	CBL6111A	1590	29 Apr 2015	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	13 Mar 2015	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	02 May 2015	12
A148	High Pass Filter	Filtronic	5H036	32218	17 May 2015	24
A1818	Antenna	EMCO	3115	00075692	14 Nov 2014	12
L1118	Pre Amplifier	Agilent	8449B	3008A02100	13 Jan 2015	12

5.2.11. Transmitter Radiated Emissions at Band Edges – Internal Antenna**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	14 May 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.543(c) and 2.1053
Test Method Used:	As detailed in KDB 971168 D01 Section 5.8.

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	40

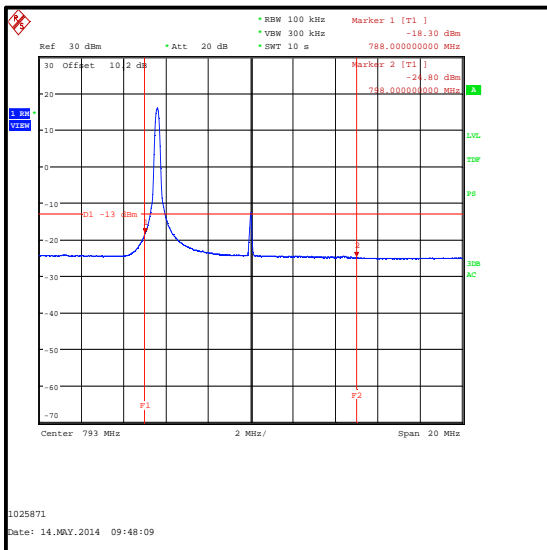
Note(s):

1. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 50. For single resource blocks, measurements were performed with the starting blocks of 1 and 49.

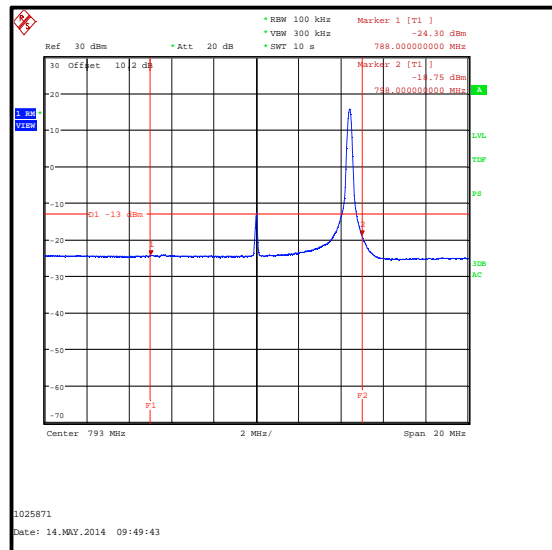
Transmitter Radiated Emissions at Band Edges – Internal Antenna (continued)

Results: 10 MHz Channel Bandwidth / QPSK

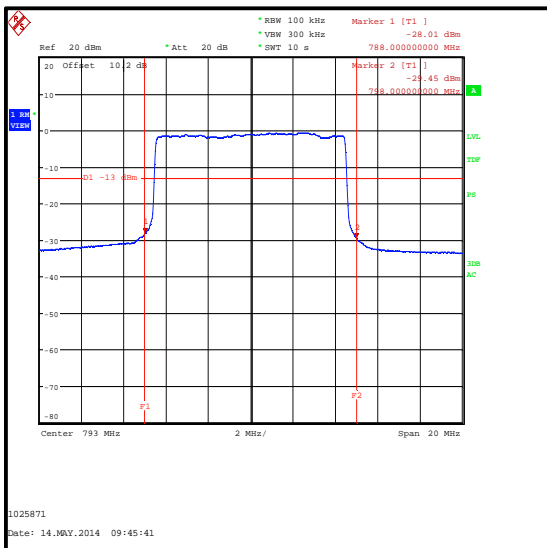
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
788	1	0	-18.3	-13.0	5.3	Complied
798	1	0	-24.8	-13.0	11.8	Complied
788	1	49	-24.3	-13.0	11.3	Complied
798	1	49	-18.8	-13.0	5.8	Complied
788	50	0	-28.0	-13.0	15.0	Complied
798	50	0	-29.5	-13.0	16.5	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

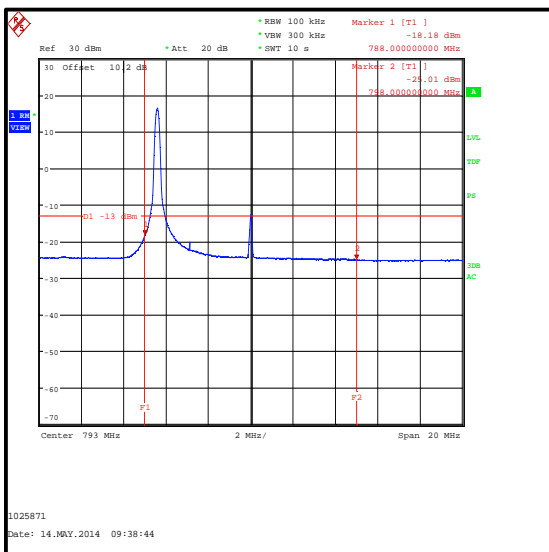


QPSK / 50 Resource Blocks

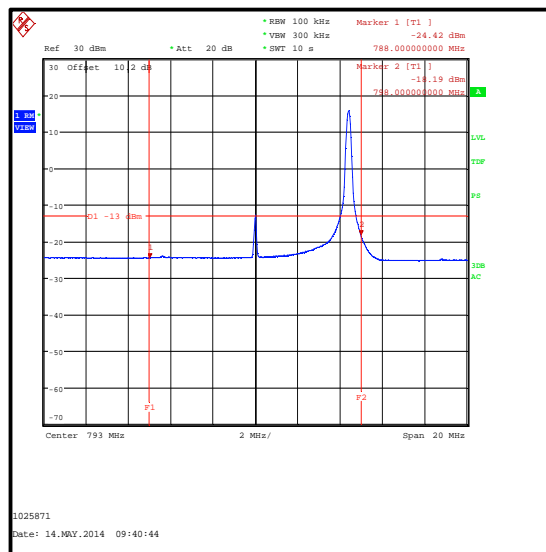
Transmitter Radiated Emissions at Band Edges – Internal Antenna (continued)

Results: 10 MHz Channel Bandwidth / 16QAM

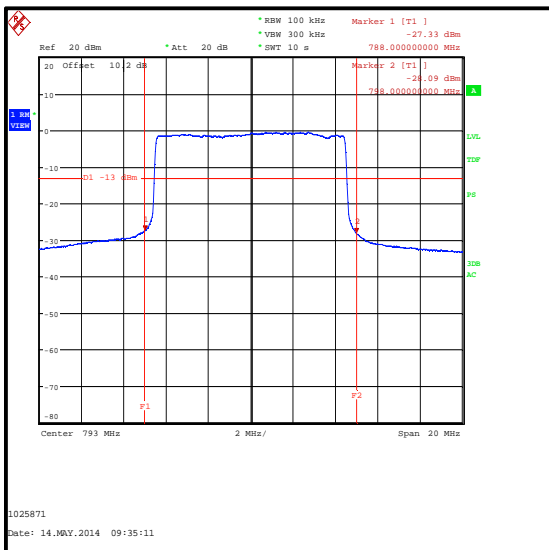
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
788	1	0	-18.2	-13.0	5.2	Complied
798	1	0	-25.0	-13.0	12.0	Complied
788	1	49	-24.4	-13.0	11.4	Complied
798	1	49	-18.2	-13.0	5.2	Complied
788	50	0	-27.3	-13.0	14.3	Complied
798	50	0	-28.1	-13.0	15.1	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)



16QAM / 50 Resource Blocks

Transmitter Radiated Emissions at Band Edges – Internal Antenna (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	13 Mar 2015	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	02 May 2015	12
A288	Antenna	Chase	CBL6111A	1589	20 Aug 2014	12

5.2.12. Transmitter Radiated Emissions at Band Edges – External Antenna**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	14 May 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.543(c) and 2.1053
Test Method Used:	As detailed in KDB 971168 D01 Section 5.8

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	40

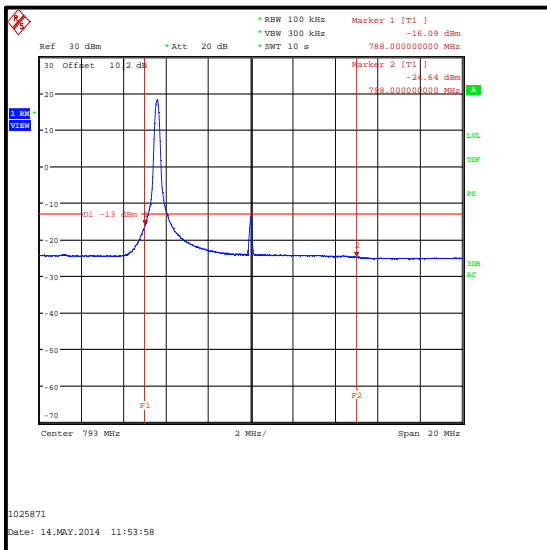
Note(s):

1. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks of 1 and 50. For single resource blocks, measurements were performed with the starting blocks of 1 and 49.

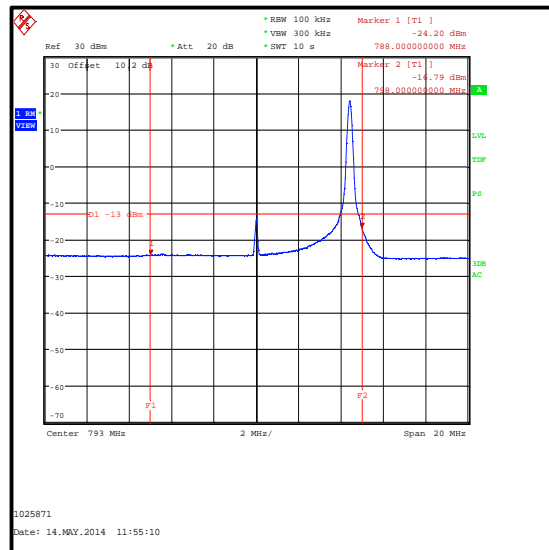
Transmitter Radiated Emissions at Band Edges – External Antenna (continued)

Results: 10 MHz Channel Bandwidth / QPSK

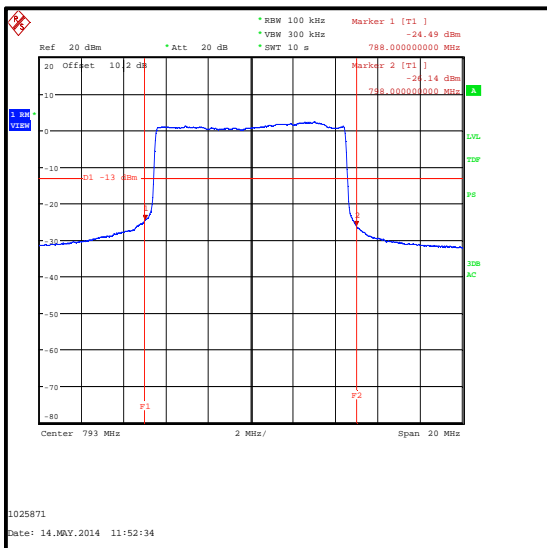
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
793	1	0	-16.1	-13.0	3.1	Complied
798	1	0	-24.6	-13.0	11.6	Complied
793	1	49	-24.2	-13.0	11.2	Complied
798	1	49	-16.8	-13.0	3.8	Complied
793	50	0	-24.5	-13.0	11.5	Complied
798	50	0	-26.1	-13.0	13.1	Complied



QPSK / 1 Resource Block (0 Offset)



QPSK / 1 Resource Block (49 Offset)

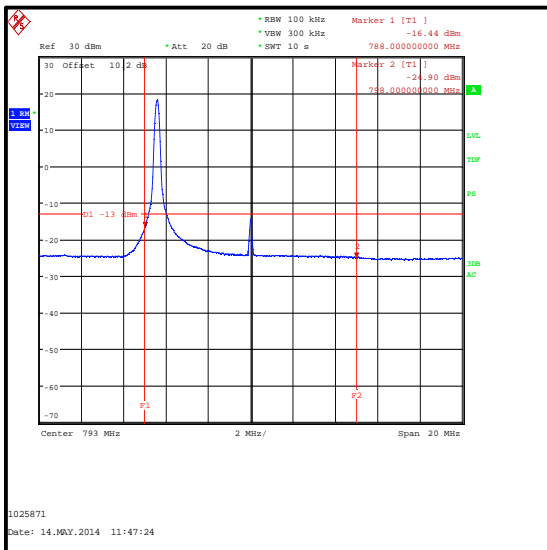


QPSK / 50 Resource Blocks

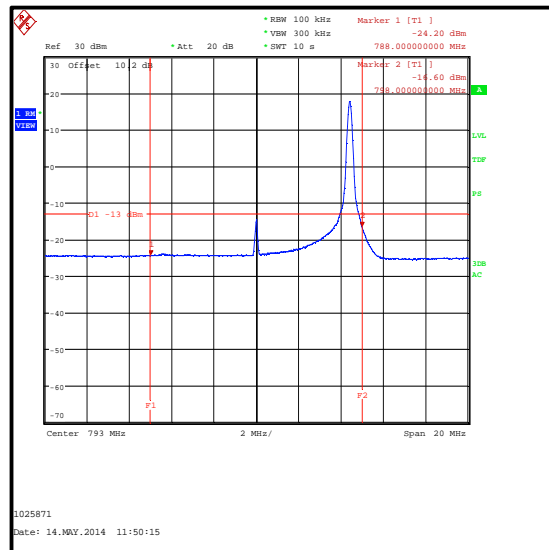
Transmitter Radiated Emissions at Band Edges – External Antenna (continued)

Results: 10 MHz Channel Bandwidth / 16QAM

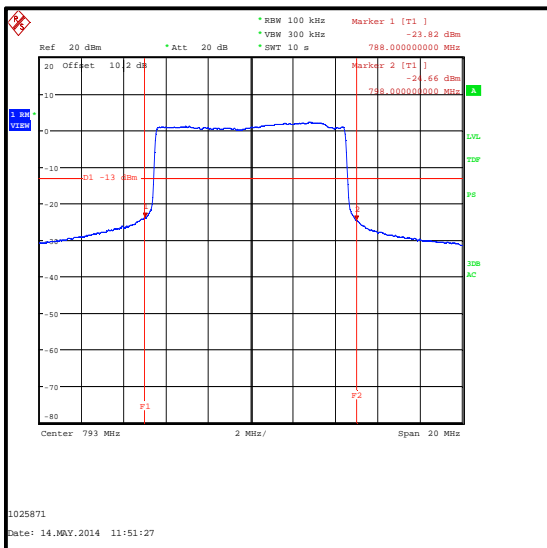
Frequency (MHz)	Resource Block(s)	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
793	1	0	-16.4	-13.0	3.4	Complied
798	1	0	-24.9	-13.0	11.9	Complied
793	1	49	-24.2	-13.0	11.2	Complied
798	1	49	-16.6	-13.0	3.6	Complied
793	50	0	-23.8	-13.0	10.8	Complied
798	50	0	-24.7	-13.0	11.7	Complied



16QAM / 1 Resource Block (0 Offset)



16QAM / 1 Resource Block (49 Offset)



16QAM / 50 Resource Blocks

Transmitter Radiated Emissions at Band Edges – External Antenna (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handlungspunkt	30.5015.13	None stated	14 Mar 2015	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	14 Nov 2014	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	13 Mar 2015	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	02 May 2015	12
A288	Antenna	Chase	CBL6111A	1589	20 Aug 2014	12

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

Test Engineer:	Nick Steele	Test Date:	20 May 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	Parts 90.539(e) and 2.1055
Test Method Used:	As detailed in ANSI TIA-603-C-2004 Section 2.2.2 referencing FCC CFR Part 2.1055 and Notes below

Environmental Conditions:

Ambient Temperature (°C):	22
Ambient Relative Humidity (%):	37

Note(s):

1. Temperature was monitored throughout the test with a calibrated digital thermometer.
2. Frequency measurements were made using a calibrated Rohde & Schwarz CMW 500 Wideband Radio Communication Tester. A variable bench power supply was connected to the USB MTR test board and the EUT was connected to the test board via the USB. The EUT was connected to the CMW 500 over a radio link. The EUT was transmitting at maximum power with an input voltage of 5 VDC.

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

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	793.000025	793.000019	792.999986	793.000020	793.000014	793.000015
-20	793.000011	793.000010	792.999991	792.999995	792.999996	793.000003
-10	793.000018	792.999992	792.999993	792.999994	792.999997	792.999993
0	793.000015	792.999995	793.000004	793.000005	793.000006	793.000008
10	793.000015	793.000006	792.999997	793.000009	792.999992	792.999995
20	793.000013	793.000004	792.999996	793.000011	792.999994	792.999996
30	793.000014	793.000012	793.000012	793.000005	793.000004	792.999993
40	793.000005	793.000011	793.000008	792.999986	793.000003	793.000007
50	792.999986	792.999987	792.999985	792.999991	793.000002	793.000006

Temperature (°C)	Time after Start-up				
	6 minutes (MHz)	7 minutes (MHz)	8 minutes (MHz)	9 minutes (MHz)	10 minutes (MHz)
-30	793.000018	793.000016	793.000017	793.000014	792.999980
-20	793.000005	793.000007	793.000004	792.999997	793.000003
-10	792.999992	792.999991	792.999991	792.999990	792.999996
0	793.000007	793.000009	793.000008	793.000008	793.000007
10	793.000003	793.000005	793.000005	793.000006	793.000006
20	793.000011	792.999990	792.999991	792.999991	792.999991
30	793.000014	792.999991	792.999988	793.000009	793.000008
40	793.000005	792.999989	792.999996	792.999991	792.999994
50	793.000006	793.000007	793.000010	792.999990	792.999993

Frequency with Worst Case Deviation (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
793.000025	25	0.032	1.250	1.218	Complied

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

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12
M1869	Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	145923	06 May 2015	12
M1068	Thermometer	Iso-Tech	RS55	93102884	02 May 2015	12
E0520	Environmental Test Chamber	Thermotron	S-1.2CB	23840	Calibrated before use	-

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

Test Engineer:	Nick Steele	Test Date:	20 May 2014
Test Sample Serial Number:	APJHC30005C15		

FCC Reference:	90.539(e) and 2.1055
Test Method Used:	As detailed in KDB 971168 D01 Section 9.0 referencing FCC CFR Part 2.1055 and Notes below

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	37

Note(s):

1. Voltage was monitored throughout the test with a calibrated digital voltmeter.
2. Frequency measurements were made using a calibrated Rohde & Schwarz CMW 500 Wideband Radio Communication Tester. A variable bench power supply was connected to the USB MTR test board and the EUT was connected to the test board via the USB. The EUT was connected to the CMW 500 over a radio link. The EUT was transmitting at maximum power.

Results:

Supply Voltage (VDC)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
4.25	792.999984	16	0.020	1.250	1.230	Complied
5.75	792.999980	20	0.025	1.250	1.225	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1657	Thermohygrometer	JM Handelpunkt	30.5015.13	None stated	14 Mar 2015	12
M1869	Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	145923	06 May 2015	12
M122	Multimeter	Fluke	77	64910017	24 Apr 2015	12
S0558	DC Power Supply	TTI	EL303R	395825	Calibrated before use	-

6. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Occupied Bandwidth	788 MHz to 798 MHz	95%	±3.92 %
Conducted Carrier Output Power	788 MHz to 798 MHz	95%	±1.13 dB
Transmitter Conducted Emissions Mask	788 MHz to 798 MHz	95%	±2.62 dB
Conducted Emissions	9 kHz to 8 GHz	95%	±2.62 dB
Radiated Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Emissions	1 GHz to 8 GHz	95%	±2.94 dB
Frequency Stability	793 MHz to 798 MHz	95%	±23 Hz

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	7 11, 12 & 14 57 & 58	- -	Changed remote antenna model number to LTE-ODUP001-IPW Corrected external antenna gain and calculations Corrected limitation frequency range

---END OF REPORT---