TEST REPORT

Test Report No. : UL-RPT-RP10041657JD18A

Manufacturer	:	Aviat Networks
Model No.	:	Eclipse ODU 600, 5.8GHz, EEH-U5-0084-011
FCC ID	:	VK6-ODU600LB
IC Certification No.	:	4469A-ODU600LB
Test Standard(s)	:	FCC Parts 15.209(a) & 15.247 and Industry Canada RSS-210 A8.4(4) & A8.5; RSS-Gen 4.6.1, 4.8, 4.9

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2. The results in this report apply only to the sample(s) tested100.
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 1.0

Date of Issue: 30 April 2014

Checked by:

Sarah Williams
Engineer, Radio Laboratory

Issued by :

pp

John Newell
Group Quality Manager
Basingstoke,
UL VS LTD

UKAS TESTING 0644

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

UL VS LTD

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Table of Contents

1. Customer Information

Company Name:	Aviat Networks
Address:	4 Bell Drive Hamilton International Technology Park Blantyre Glasgow Lanarkshire G72 0FB Scotland, UK

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.247
Specification Reference:	47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209
Specification Reference:	RSS-Gen Issue 3 December 2010
Specification Title:	General Requirements and Information for the Certification of Radio Apparatus
Specification Reference:	RSS-210 Issue 8 December 2010
Specification Title:	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
Site Registration:	FCC: 209735; Industry Canada: 3245B-2
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	16 April 2014 to 25 April 2014

2.2. Summary of Test Results

FCC Reference (47CFR)	IC Reference	Measurement	Result
N/A	RSS-Gen 4.6.1	Transmitter 99% Emission Bandwidth	✓
Part 15.247(b)(3)	RSS-Gen 4.8 RSS-210 A8.4(4)	Transmitter Maximum Conducted Output Power	✓
Part 15.247(d)	RSS-Gen 4.9 RSS-210 A8.5	Transmitter Band Edge Conducted Emissions	✓
Part 15.247(d)/ 15.209(a)	RSS-Gen 4.9 RSS-210 A8.5	Transmitter Radiated Emissions	✓
Key to Results ✓ = Complied ✗ = Did not comply			

2.3. Methods and Procedures

Reference:	ANSI C63.4 (2009)
Title:	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Reference:	ANSI C63.10 (2009)
Title:	American National Standard for Testing Unlicensed Wireless Devices
Reference:	KDB 558074 D01 v03r01 April 9, 2013
Title:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

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:	Aviat Networks
Model Name or Number:	Eclipse ODU 600, 5.8GHz, EEH-U5-0084-011
Test Sample Serial Number:	ZLS13040003
Hardware Version Number:	001
Software Version Number:	07.08.16
FCC ID:	VK6-ODU600LB
Industry Canada Certification Number:	4469A-ODU600LB

3.2. Description of EUT

The equipment under test was 5.8 GHz point to point microwave radio transceiver.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Technology tested:	Microwave Fixed Link System	
Type of unit:	Transceiver	
Modulation types:	64QAM & 128QAM	
Data rates:	135 Mbps & 155 Mbps	
Power Supply Requirement(s):	Nominal	-48 VDC
Maximum Conducted Output Power:	28.1 dBm	
Antenna Gains:	Parabolic Antenna: (15 ft End product)	45.9 dBi
	Flat Panel Antenna: (2 ft Tested)	28.0 dBi
Channel Spacing:	30 MHz	
Transmit Frequency Range:	5725.5 MHz to 5765.5 MHz	
Transmit Channels Tested:	**Channel ID**	**Channel Frequency (MHz)**
	Bottom	5740.5
	Middle	5745.5
	Top	5750.5

3.5. Support Equipment

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

Description:	2 ft flat panel antenna, 28 dBi gain
Brand Name:	Radio Frequency Systems
Model Name or Number:	MA0528-28AN
Serial Number:	02205

Description:	INUe Chassis with RAC LL
Brand Name:	Harris Stratex
Model Name or Number:	EXE-002
Serial Number:	EBT1113M738

Description:	Laptop
Brand Name:	Dell
Model Name or Number:	Latitude D610
Serial Number:	B7Y0T1J

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- Continuously transmitting at maximum power on the bottom, middle and top channels as required using the supported data rates/modulation schemes.

4.2. Configuration and Peripherals

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

- The EUT was powered by a DC offset over its RF port from the INUe Chassis (support equipment), which itself was powered by a 48 volts floating DC using a regulated power supply unit.
- The EUT was placed into a continuous transmit mode, with the appropriate modulation scheme enabled, using a bespoke software application which was supplied by the manufacturer.

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 99% Emission Bandwidth

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	16 April 2014
Test Sample Serial Number:	ZLS13040003		

FCC Reference:	N/A
Industry Canada Reference:	RSS-Gen 4.6.1
Test Method Used:	Tested using the occupied bandwidth function of a test receiver

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	40

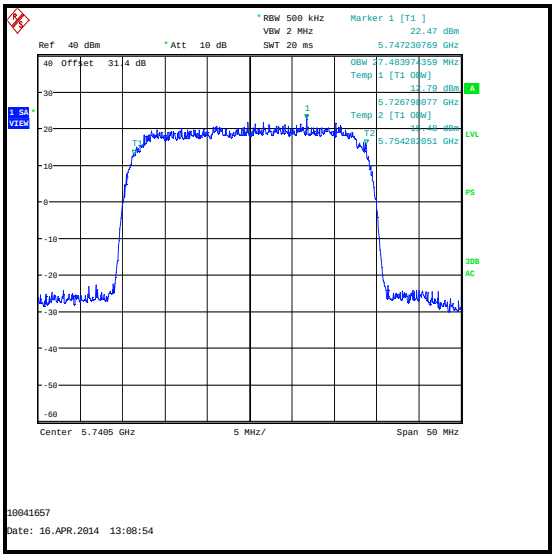
Note(s):

1. The 99% emission bandwidth was measured using the test receiver occupied bandwidth function. The resolution bandwidth was set to 1% of the span and the video bandwidth set to 3 times the resolution bandwidth.
2. The test receiver resolution bandwidth was set to 500 kHz and video bandwidth 2 MHz. A sample detector was used, sweep time was set to auto and the trace mode was Max Hold. The span was set to 50 MHz. The test receiver function set the measurements to be made at 99% of the emission bandwidth. The results are given in the tables below.
3. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable.

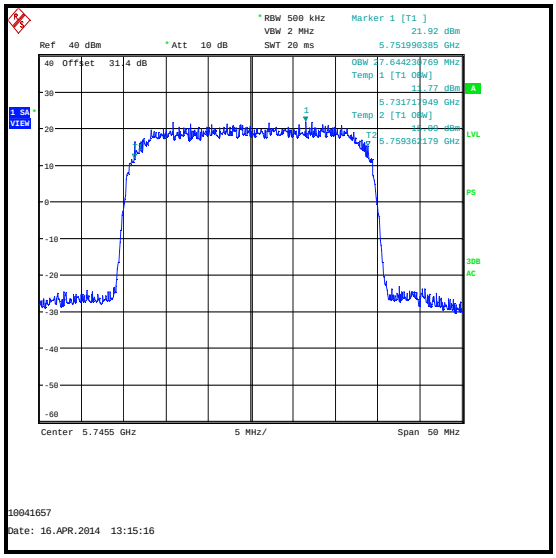
Transmitter 99% Emission Bandwidth (continued)

Results: 30 MHz / 64QAM / 135 Mbps

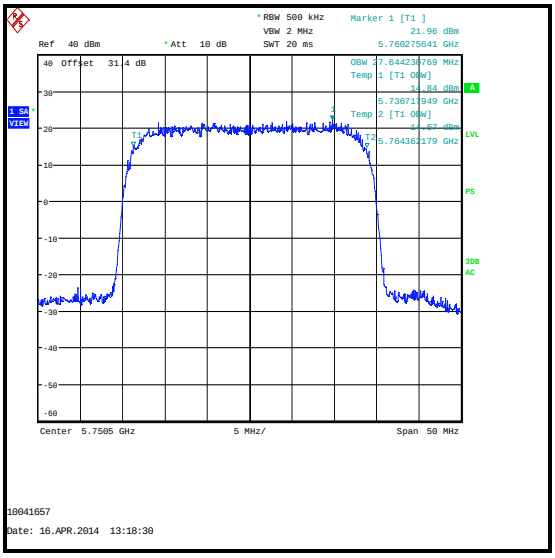
Channel	99% Emission Bandwidth (MHz)
Bottom	27.484
Middle	27.644
Top	27.644



Bottom Channel



Middle Channel

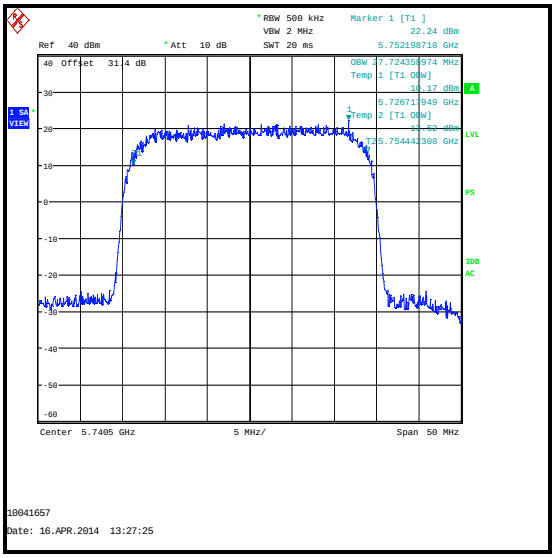


Top Channel

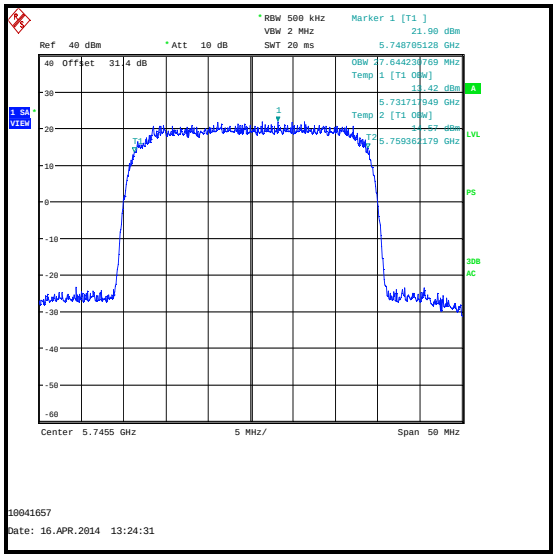
Transmitter 99% Emission Bandwidth (continued)

Results: 30 MHz / 128QAM / 155 Mbps

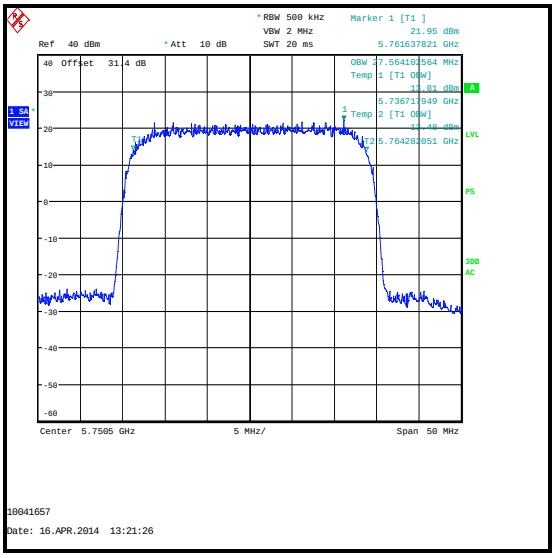
Channel	99% Emission Bandwidth (MHz)
Bottom	27.724
Middle	27.644
Top	27.564



Bottom Channel



Middle Channel



Top Channel

Transmitter 99% Emission Bandwidth (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
S0551	DC Power Supply	Hewlett Packard	6674A	ITM00512445	Calibrated before use	-
M1229	Digital Multimeter	Fluke	179	87640015	26 Jun 2014	12
M1630	Test Receiver	Rohde & Schwarz	ESU 40	100233	13 Mar 2015	12
A1490	Attenuator	Weinschel Corp	23-30-34	BH9156	Calibrated before use	-

5.2.2. Transmitter Maximum Conducted Output Power

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	16 April 2014
Test Sample Serial Number:	ZLS13040003		

FCC Reference:	Part 15.247(b)(3)
Industry Canada Reference:	RSS-Gen 4.8, RSS-210 A8.4(4)
Test Method Used:	KDB 558074 Section 9.2.2.2

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	40

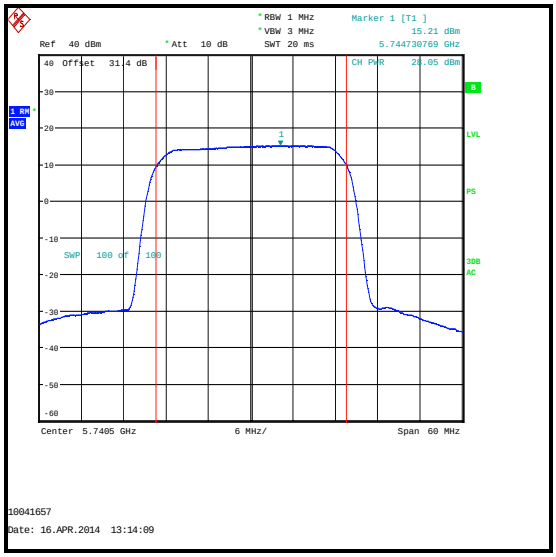
Note(s):

1. The EUT was transmitting at 100% duty cycle and testing was performed in accordance with KDB 558074 Section 9.2.2.2 Method AVGSA-1.
2. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the spectrum analyser to compensate for the losses of the attenuator and RF cable.

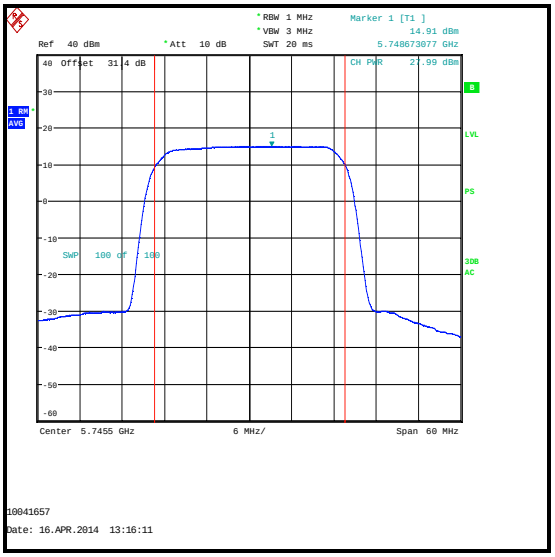
Transmitter Maximum Conducted Output Power (continued)

Results: 30 MHz / 64QAM / 135 Mbps

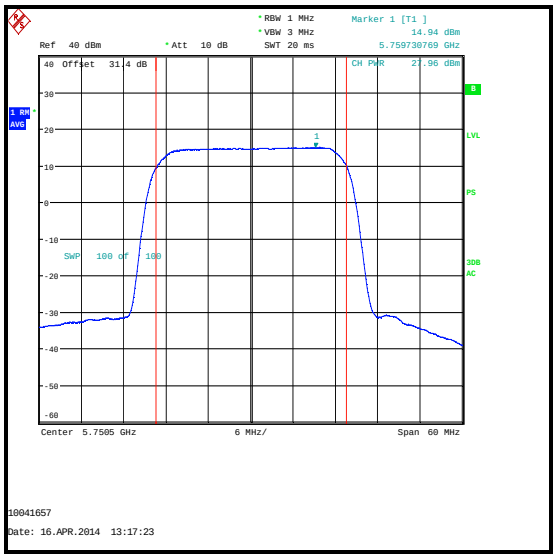
Channel	Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	28.1	30.0	1.9	Complied
Middle	28.0	30.0	2.0	Complied
Top	28.0	30.0	2.0	Complied



Bottom Channel



Middle Channel

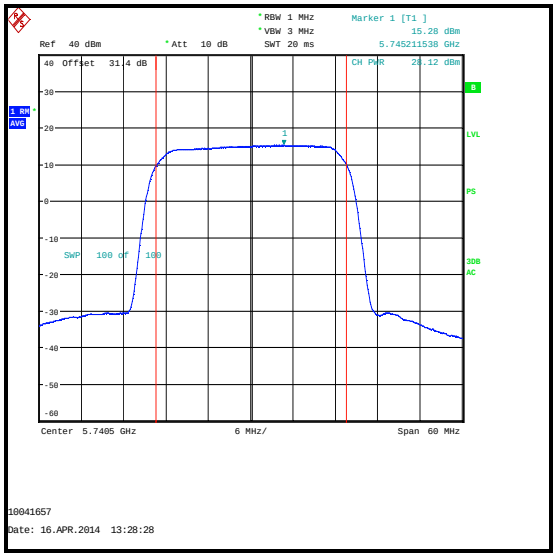


Top Channel

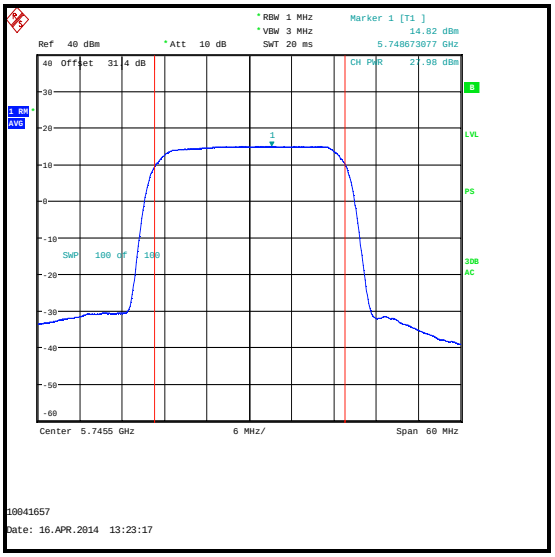
Transmitter Maximum Conducted Output Power (continued)

Results: 30 MHz / 128QAM / 155 Mbps

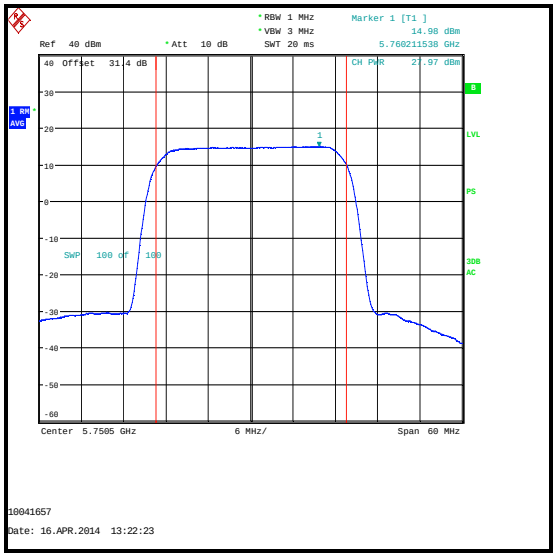
Channel	Power (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	28.1	30.0	1.9	Complied
Middle	28.0	30.0	2.0	Complied
Top	28.0	30.0	2.0	Complied



Bottom Channel



Middle Channel



Top Channel

Transmitter Maximum Conducted Output Power (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
S0551	DC Power Supply	Hewlett Packard	6674A	ITM00512445	Calibrated before use	-
M1229	Digital Multimeter	Fluke	179	87640015	26 Jun 2014	12
M1630	Test Receiver	Rohde & Schwarz	ESU 40	100233	13 Mar 2015	12
A1490	Attenuator	Weinschel Corp	23-30-34	BH9156	Calibrated before use	-

5.2.3. Transmitter Band Edge Conducted Emissions

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	16 April 2014
Test Sample Serial Number:	ZLS13040003		

FCC Reference:	Part 15.247(d)
Industry Canada Reference:	RSS-Gen 4.9 & RSS-210 A8.5
Test Method Used:	FCC KDB 558074 Section 11.3

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	40

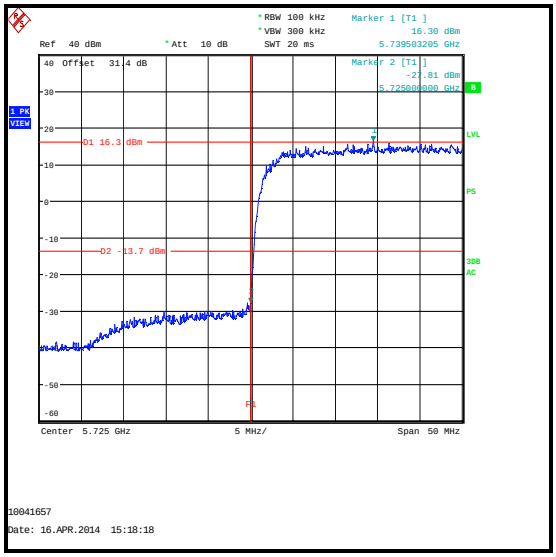
Note(s):

1. Conducted measurements at the band edges were used in conjunction with radiated emissions tests to demonstrate compliance. Since the EUT only transmits in the lower half of the band, it was only set to transmit on the bottom channel as this was deemed to represent the worst case.
2. As the average conducted power measurements were used to demonstrate compliance with the limits, according to KDB 558074 section 11.1(b), any emissions need to be attenuated by at least 30 dB below the peak of the carrier in any 100 kHz bandwidth.

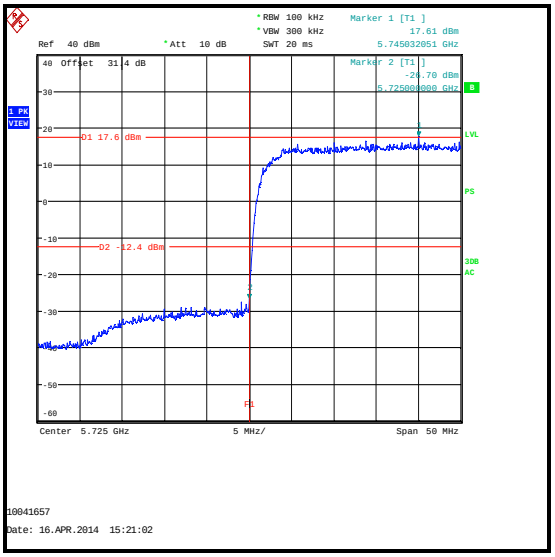
Transmitter Band Edge Radiated Emissions (continued)

Results: Lower Band Edge

Mode	Level at 5725 MHz (dBm)	-30 dBc Limit (dBm)	Margin (dB)	Result
135 Mbps / 64QAM	-27.8	-13.7	14.1	Complied
155 Mbps / 128QAM	-26.7	-12.4	14.3	Complied



Lower Band Edge Peak Measurement – 64QAM



Lower Band Edge Peak Measurement – 128QAM

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
S0551	DC Power Supply	Hewlett Packard	6674A	ITM00512445	Calibrated before use	-
M1229	Digital Multimeter	Fluke	179	87640015	26 Jun 2014	12
M1630	Test Receiver	Rohde & Schwarz	ESU 40	100233	13 Mar 2015	12
A1490	Attenuator	Weinschel Corp	23-30-34	BH9156	Calibrated before use	-

5.2.4. Transmitter Radiated Emissions

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	17 April 2014
Test Sample Serial Number:	ZLS13040003		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9, RSS-210 A8.5
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	30

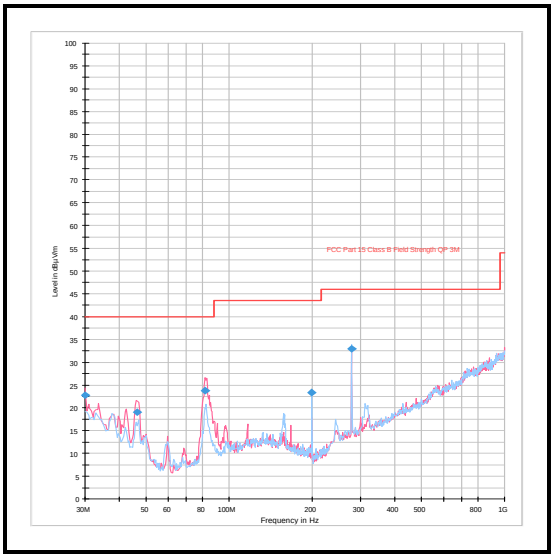
Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the top channel only.
3. All other emissions shown on the pre-scan plots were investigated and found to be ambient, or >20 dB below the applicable 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 were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. The sweep time was set to auto. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
6. Final measurements were performed on the marker frequencies and the results entered into the table below. The test receiver resolution bandwidth was set to 120 kHz, using a CISPR quasi-peak detector and span big enough to see the whole emission.

Results: Top Channel / 135 Mbps / 64QAM

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
279.152	Horizontal	32.9	46.0	13.1	Complied

Transmitter Radiated Emissions (continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

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
G0543	Amplifier	Sonoma	310N	230801	18 May 2014	3
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	11 Feb 2015	12
A490	Antenna	Chase	CBL6111A	1590	18 Apr 2014	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12
S0551	DC Power Supply	Hewlett Packard	6674A	ITM00512445	Calibrated before use	-

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	25 April 2014
Test Sample Serial Number:	ZLS13040003		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9, RSS-210 A8.5
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
Frequency Range	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	42

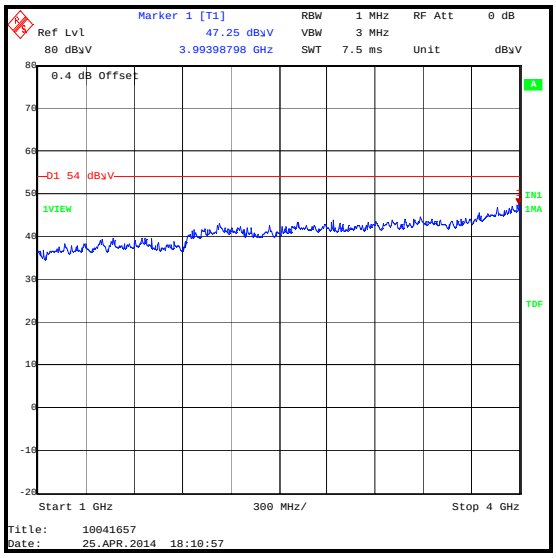
Note(s):

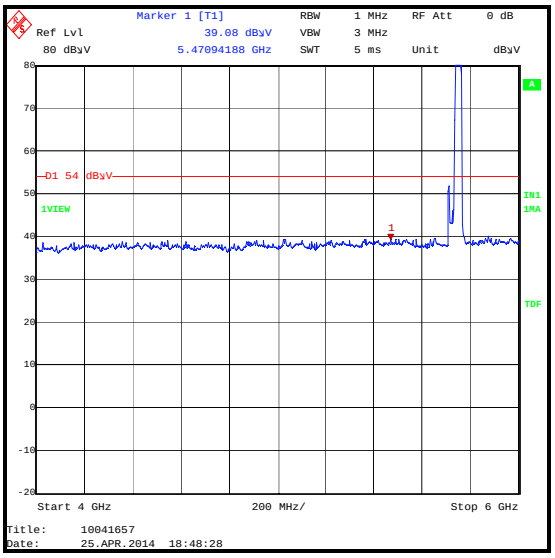
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak level of the noise floor of the measuring receiver was recorded as shown in the table below. The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.
3. The 4 GHz to 6 GHz plot was measured with a band reject filter with a wide but known roll-off characteristic. The carrier visible in this plot is not a true representation of the signal and the EUT was seen to radiate no emissions in this region.
4. 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.

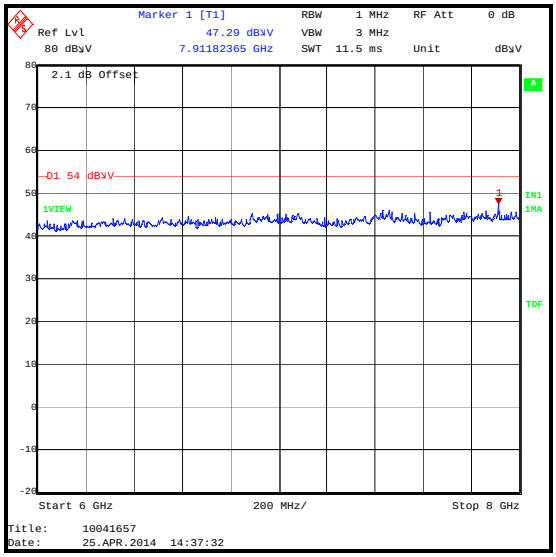
Results:

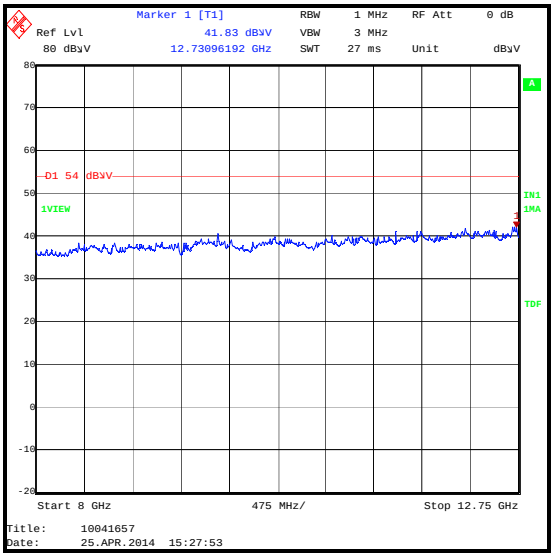
Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
39935.096	Vertical	51.4	54.0	2.6	Complied

Transmitter Radiated Emissions (continued)

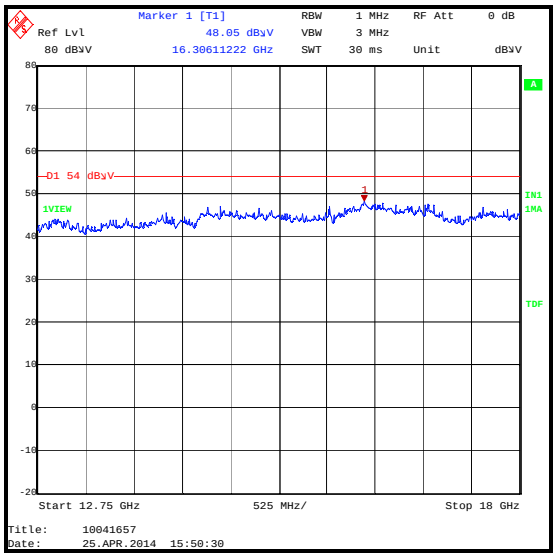


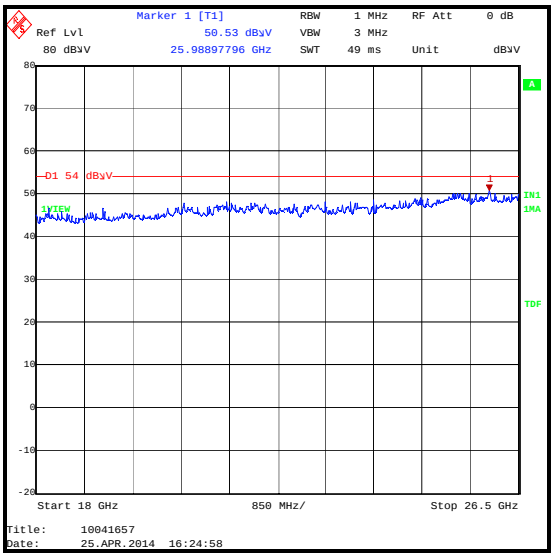


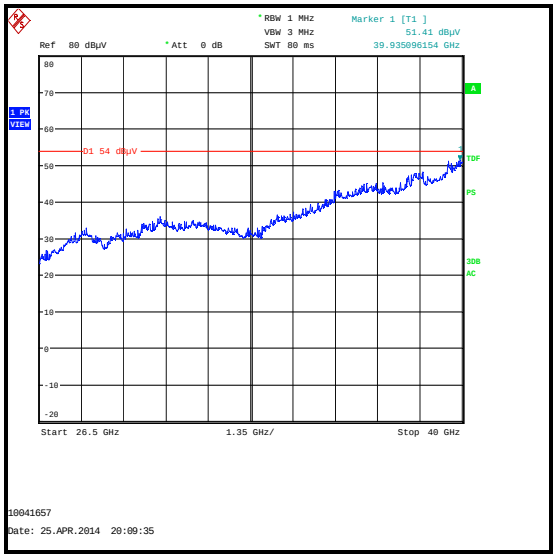




Transmitter Radiated Emissions (continued)







Transmitter Radiated Emissions (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	24 May 2014	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
M1124	Test Receiver	Rohde & Schwarz	ESIB 26	100046K	01 Oct 2014	12
L1118	Pre Amplifier	Hewlett Packard	8449B	3008A02100	13 Jan 2015	12
A2482	Band Reject Filter	Wainwright Instruments	WRCJV8	2	Calibrated before use	-
A2134	Low Pass Filter	AtlanTecRF	AFL-05000	300195	26 Apr 2014	12
A288	Antenna	Chase	CBL6111A	1589	20 Aug 2014	12
A1818	Antenna	EMCO	3115 3115	00075692	14 Nov 2014	12
A253	Antenna	Flann	12240-20	128	14 Nov 2014	12
A254	Antenna	Flann	14240-20	139	14 Nov 2014	12
A255	Antenna	Flann	16240-20	519	14 Nov 2014	12
A256	Antenna	Flann	18240-20	400	14 Nov 2014	12
A436	Antenna	Flann	20240-20	330	14 Nov 2014	12
A203	Antenna	Flann	22240-20	343	19 May 2016	36
S0551	DC Power Supply	Hewlett Packard	6674A	ITM00512445	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
Conducted Output Power	5725 MHz to 5850 MHz	95%	±1.13 dB
99% Emission Bandwidth	5725 MHz to 5850 MHz	95%	±3.92%
Conducted Spurious Emissions	1 MHz to 40 GHz	95%	±2.62 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 40 GHz	95%	±2.94 dB

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

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version

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