TEST REPORT

Test Report No. : UL-RPT-RP10505077JD08B V3.0

Manufacturer	:	Aviat Networks
Model No.	:	EEH-U5-0084-012
FCC ID	:	VK6-ODU600HB
Test Standard(s)	:	FCC Parts 15.207, 15.209(a) & 15.247

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

Date of Issue: 15 January 2016

Checked by:

Sarah Williams
Engineer, Radio Laboratory

Company Signatory:

Steven White
Service Lead, Radio Laboratory
UL VS LTD

ilac-MRA 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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1. Customer Information

Company Name:	Aviat Networks
Address:	4 Bell Drive Hamilton International Technology Park Blantyre Glasgow Lanarkshire G72 0FB United Kingdom

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:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
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:	10 December 2015 to 31 December 2015

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.207	Transmitter AC Conducted Emissions	✓
Part 15.247(a)(2)	Transmitter Minimum 6 dB Bandwidth	✓
Part 15.247(e)	Transmitter Power Spectral Density	✓
Part 15.247(b)(3)	Transmitter Maximum Average Output Power	✓
Part 15.247(d)	Transmitter Band Edge Conducted Emissions	✓
Part 15.247(d) / 15.209(a)	Transmitter Radiated Emissions	✓

Key to Results

✓ = Complied ✗ = Did not comply

2.3. Methods and Procedures

Reference:	ANSI C63.10 (2013)
Title:	American National Standard of Procedures for Compliance Testing Unlicensed Wireless Devices
Reference:	KDB 558074 D01 v03r03 June 9, 2015
Title:	Guidance for Performing Compliance Measurements on Digital Transmission System (DTS) devices 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-U5-0084-012
Test Sample Serial Number:	ZLS13040004
Hardware Version:	N/A
Software Version:	3.1.0(41.3271)
FCC ID:	VK6-ODU600HB

3.2. Description of EUT

The equipment under test (EUT) was a 5.8 GHz Microwave Radio Unit.

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	
Channel Bandwidths:	5 MHz, 10 MHz, 20 MHz & 30 MHz	
Modulation Schemes:	QPSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM & 1024QAM	
Power Supply Requirement(s):	Nominal	-48 VDC
Maximum Conducted Output Power:	27.4 dBm	
Antenna Gains:	4 ft Parabolic Antenna: (Tested)	35.0 dBi
	15 ft Parabolic Antenna: (End Product)	45.9 dBi
	2 ft Flat Panel Antenna: (End Product, Tested)	28.0 dBi
Transmit Frequency Range:	5809.5 MHz to 5849.5 MHz	
Channel Spacing:	5 MHz	
Transmit Channels Tested:	**Channel ID**	**Channel Frequency (MHz)**
	Bottom	5812.0
	Middle	5829.5
	Top	5847.0
Channel Spacing:	10 MHz	
Transmit Channels Tested:	**Channel ID**	**Channel Frequency (MHz)**
	Bottom	5814.5
	Middle	5829.5
	Top	5844.5
Channel Spacing:	20 MHz	
Transmit Channels Tested:	**Channel ID**	**Channel Frequency (MHz)**
	Bottom	5819.5
	Middle	5829.5
	Top	5839.5
Channel Spacing:	30 MHz	
Transmit Channels Tested:	**Channel ID**	**Channel Frequency (MHz)**
	Bottom	5824.5
	Middle	5829.5
	Top	5834.5

3.5. Support Equipment

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

Description:	4 ft Parabolic Antenna
Brand Name:	Andrew Antennas
Model Name or Number:	HP4-57W-P3A/A
Serial Number:	10ACZ10602232

Description:	2 ft Flat Panel Antenna
Brand Name:	Radio Frequency Systems
Model Name or Number:	MA0528-28AN
Serial Number:	02205

Description:	Indoor Unit
Brand Name:	Aviat Networks
Model Name or Number:	CTR 8540
Serial Number:	EBT1323C708

Description:	Test Laptop
Brand Name:	Lenovo
Model Name or Number:	ThinkPad L440
Serial Number:	R9019EA4

Description:	DC Power Supply
Brand Name:	Hewlett Packard
Model Name or Number:	6674A
Serial Number:	ITM00512445

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 channel bandwidths & modulation schemes.

4.2. Configuration and Peripherals

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

- For all tests, the EUT was powered through a co-axial cable connected to the supporting indoor unit (CTR 8540). The CTR 8540 was in turn powered by a laboratory DC power supply.
- Controlled using the EUT's GUI portal on a browser running on a test laptop connected to the CTR 8540 via ethernet. The relevant test channels, channel bandwidths and modulation schemes were selected as required for each test.
- All supported modulation schemes and channel bandwidths were initially investigated on middle channel. The worst case modes are detailed in the relevant sections.
- The power supply & CTR 8540 were placed outside the semi-anechoic chamber for radiated tests.
- For transmitter radiated emissions test, a smaller 4 ft parabolic antenna which was of the same type as the 15 ft parabolic antenna that would be used in the field was tested. This was done in accordance with FCC OET guidance which states a smaller antenna can be used of the same type installed with data being extrapolated up to the specification of the actual antenna.

  The antenna gain for the 4 ft antenna used for testing was 35 dBi, the antenna gain for the 15 ft end product is 45.9 dBi, the difference being 10.9 dB.

  Within the entire radiated emissions measurement range, a clearance equal to the difference in gains between the two antennas has been achieved between the limit line and any emissions and/or the system noise floor; thus ensuring that any emissions emanating from either the antenna or enclosure pass the emissions limit.

  Transmitter radiated emissions test was additionally performed on a 2 foot flat panel antenna which had an antenna gain of 28 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 AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	31 December 2015
Test Sample Serial Number:	ZLS13040004		

FCC Reference:	Part 15.207
Test Method Used:	ANSI C63.10 Section 6.2

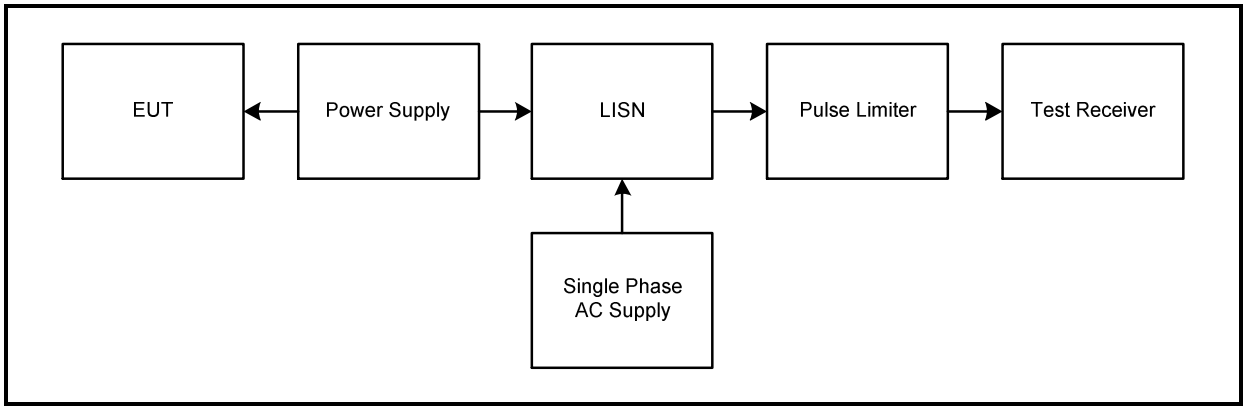
Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	40

Note(s):

1. The EUT was powered from a power supply which was connected to a 120 VAC 60 Hz single phase supply via a LISN.
2. The RF output port on the EUT was terminated with a 50 Ω load during this test.
3. Pre-scans were performed and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.
4. A pulse limiter was fitted between the LISN and the test receiver.

Test setup:



Transmitter AC Conducted Spurious Emissions (continued)

Results: Live / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
8.916	Live	26.9	60.0	33.1	Complied
9.960	Live	19.0	60.0	41.0	Complied
11.967	Live	29.7	60.0	30.3	Complied
15.923	Live	24.3	60.0	35.7	Complied
16.346	Live	24.0	60.0	36.0	Complied
29.508	Live	26.2	60.0	33.8	Complied

Results: Live / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
8.966	Live	20.4	50.0	29.6	Complied
10.000	Live	30.2	50.0	19.8	Complied
11.891	Live	23.4	50.0	26.6	Complied
15.963	Live	22.4	50.0	27.6	Complied
20.013	Live	22.5	50.0	27.5	Complied
29.202	Live	20.6	50.0	29.4	Complied

Transmitter AC Conducted Spurious Emissions (continued)

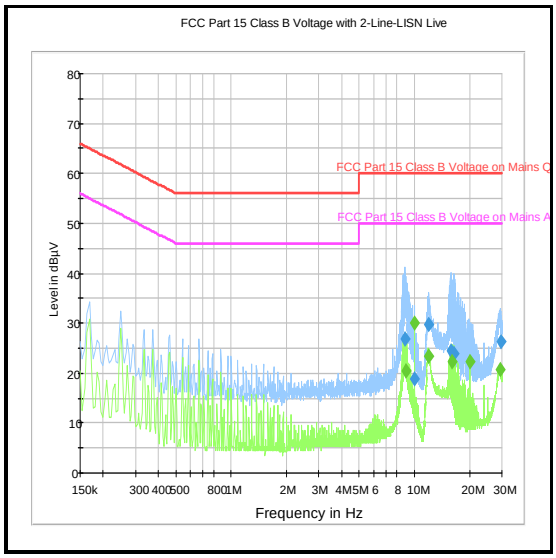
Results: Neutral / Quasi Peak

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
8.916	Neutral	27.0	60.0	33.0	Complied
9.596	Neutral	22.2	60.0	37.8	Complied
11.751	Neutral	29.3	60.0	30.7	Complied
15.923	Neutral	23.7	60.0	36.3	Complied
16.359	Neutral	24.3	60.0	35.7	Complied
29.130	Neutral	24.2	60.0	35.8	Complied

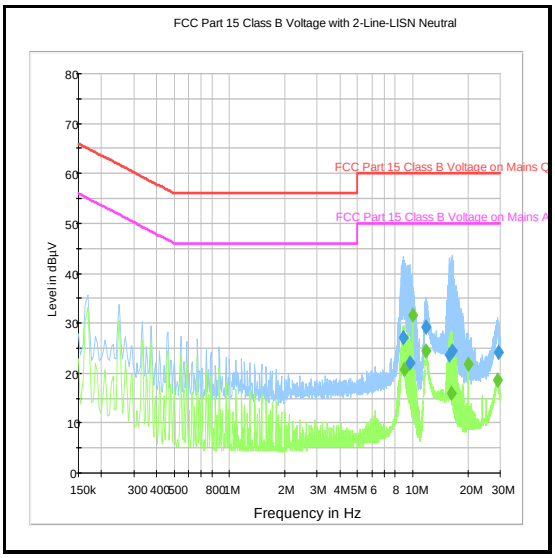
Results: Neutral / Average

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
8.957	Neutral	20.7	50.0	29.3	Complied
10.001	Neutral	31.6	50.0	18.4	Complied
11.774	Neutral	24.5	50.0	25.5	Complied
16.310	Neutral	16.0	50.0	34.0	Complied
20.013	Neutral	21.8	50.0	28.2	Complied
29.081	Neutral	18.6	50.0	31.4	Complied

Transmitter AC Conducted Spurious Emissions (continued)



Live



Neutral

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1625	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	07 Jan 2016	12
A067	LISN	Rohde & Schwarz	ESH3-Z5	890603/002	27 Aug 2016	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	02 Mar 2016	12
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	16 Oct 2016	12

5.2.2. Transmitter Minimum 6 dB Bandwidth

Test Summary:

Test Engineer:	Kiren Mistry	**Test Date:**	01 December 2015
Test Sample Serial Number:	ZLS13040004		

FCC Reference:	Part 15.247(a)(2)
Test Method Used:	KDB 558074 Section 8.2 Option 2

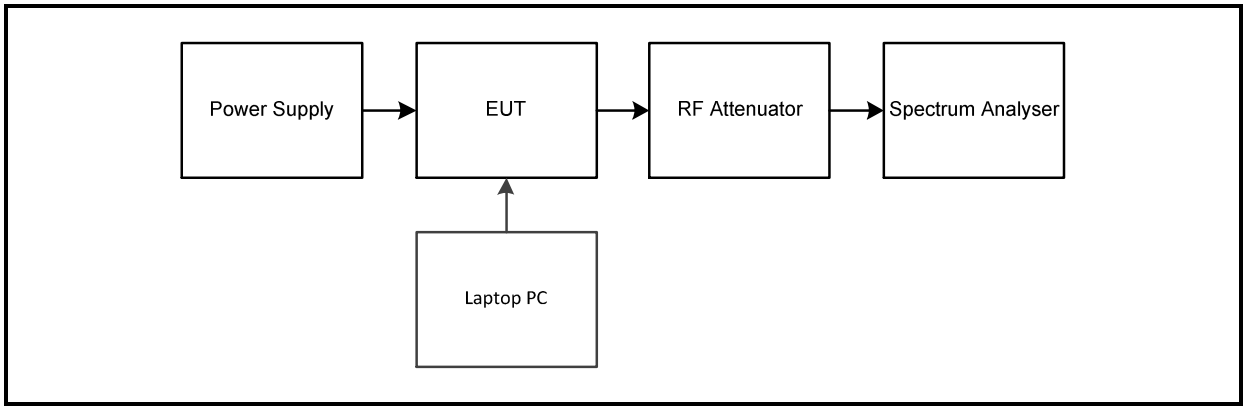
Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	40

Note(s):

1. All modulation schemes supported by the EUT were investigated on the middle channel of each supported channel bandwidth in accordance with KDB 558074 Section 8.0 Option 2 measurement procedure. The modes that produced the narrowest bandwidth and therefore deemed worst case were:
    - 5 MHz Channel Bandwidth - 128QAM
    - 10 MHz Channel Bandwidth - 64QAM
    - 20 MHz Channel Bandwidth - 256QAM
    - 20 MHz Channel Bandwidth - 1024QAM
2. Final measurements were performed using the above modulation schemes on the bottom, middle and top channels.
3. The spectrum analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold. The spectrum analyser's 'n dB down' function was used to obtain the 6 dB bandwidth relative to the peak level. These results are documented in the tables below.
4. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

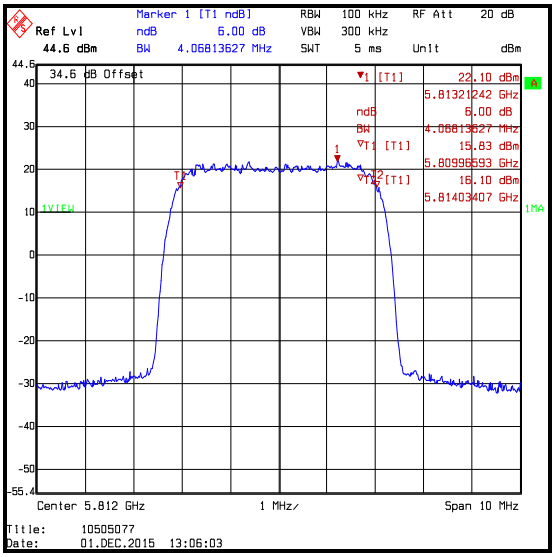
Test setup:



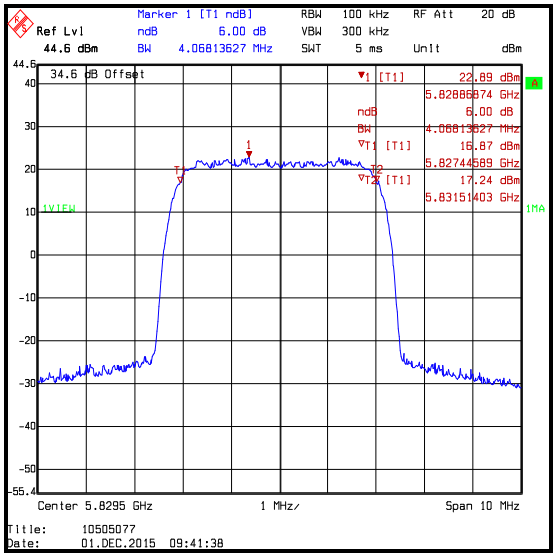
Transmitter Minimum 6 dB Bandwidth (continued)

Results: 5 MHz Channel Bandwidth / 128QAM

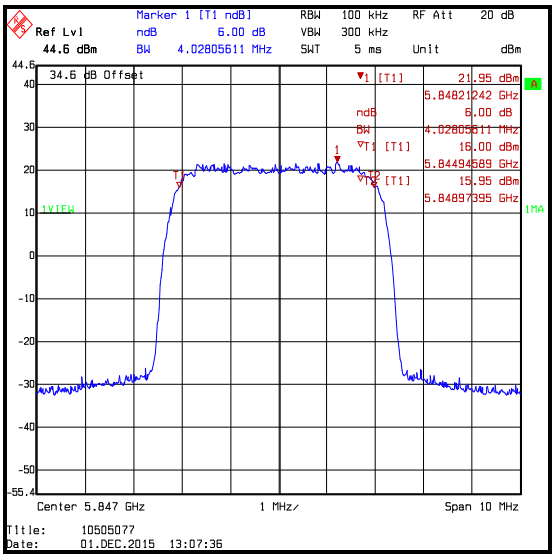
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	4068.136	≥500	3568.136	Complied
Middle	4068.136	≥500	3568.136	Complied
Top	4028.056	≥500	3528.056	Complied



Bottom Channel



Middle Channel

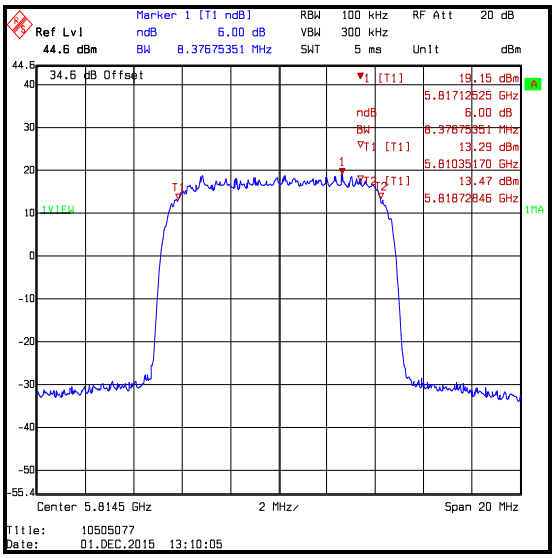


Top Channel

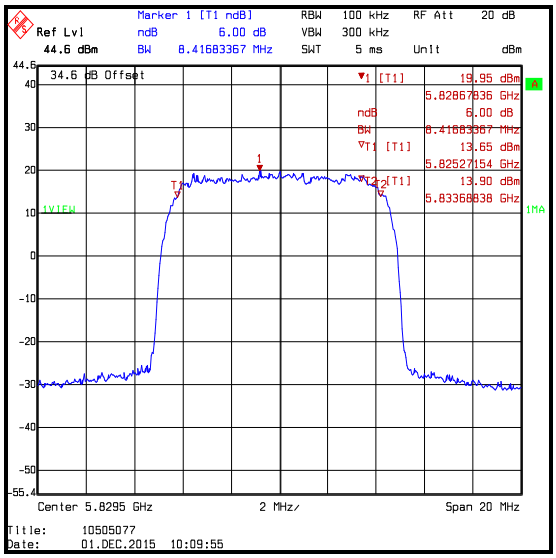
Transmitter Minimum 6 dB Bandwidth (continued)

Results: 10 MHz Channel Bandwidth / 64QAM

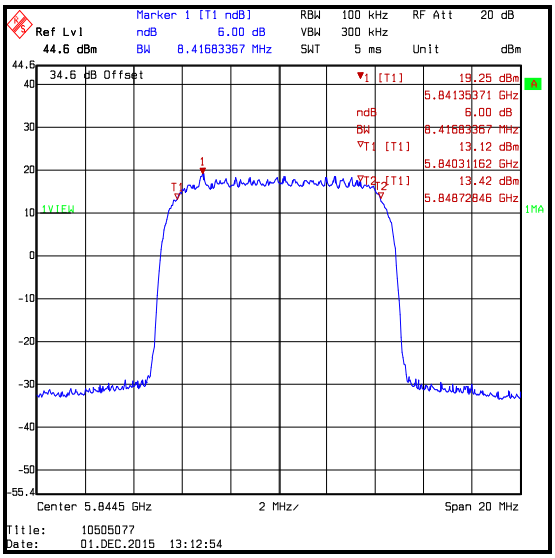
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	8376.754	≥500	7876.754	Complied
Middle	8416.834	≥500	7916.834	Complied
Top	8416.834	≥500	7916.834	Complied



Bottom Channel



Middle Channel

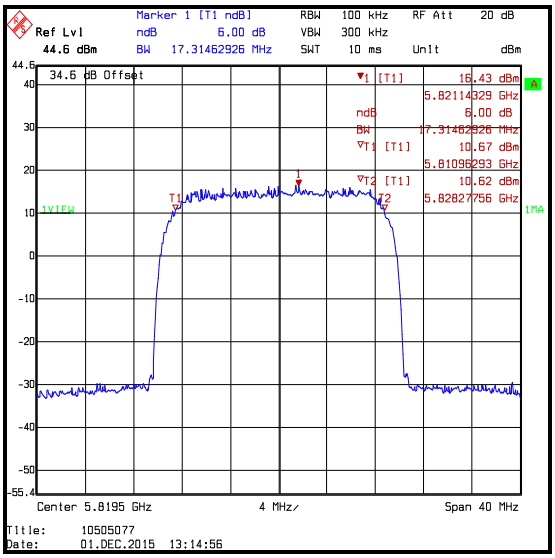


Top Channel

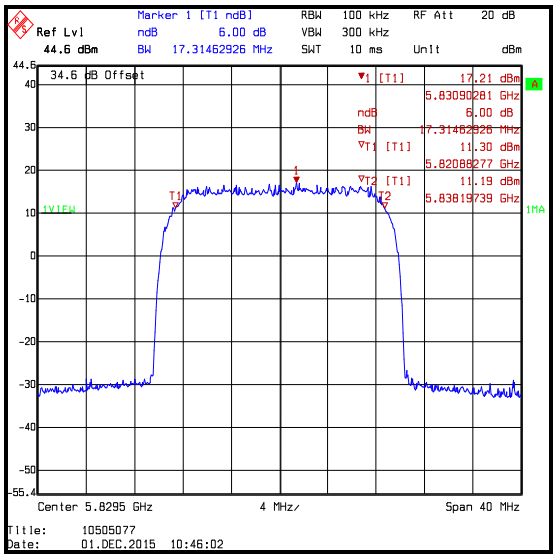
Transmitter Minimum 6 dB Bandwidth (continued)

Results: 20 MHz Channel Bandwidth / 256QAM

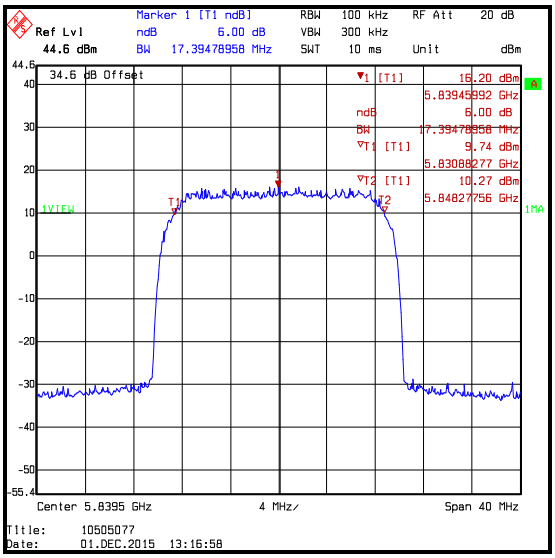
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	17314.629	≥500	16814.629	Complied
Middle	17314.629	≥500	16814.629	Complied
Top	17394.790	≥500	16894.790	Complied



Bottom Channel



Middle Channel

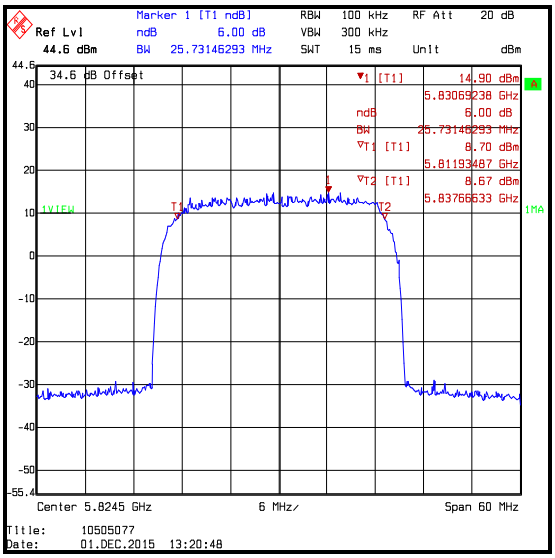


Top Channel

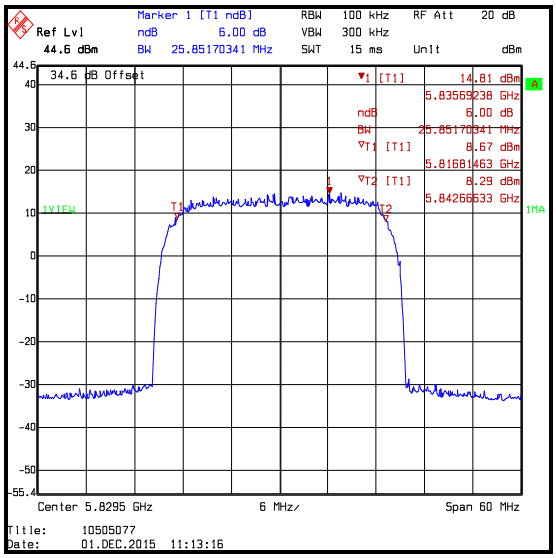
Transmitter Minimum 6 dB Bandwidth (continued)

Results: 30 MHz Channel Bandwidth / 1024QAM

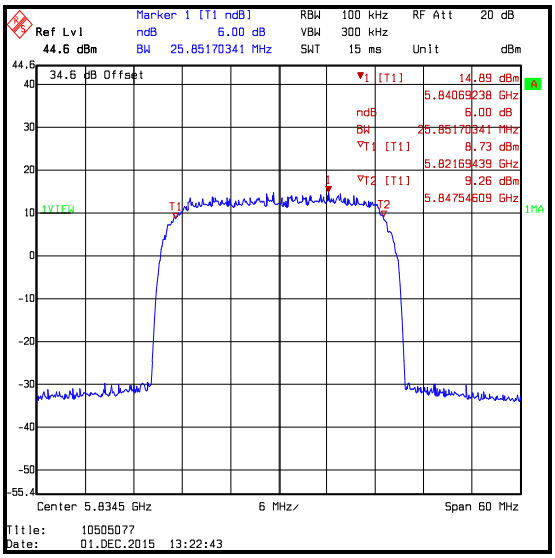
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	25731.463	≥500	25231.463	Complied
Middle	25851.703	≥500	25351.703	Complied
Top	25851.703	≥500	25351.703	Complied



Bottom Channel



Middle Channel



Top Channel

Transmitter Minimum 6 dB Bandwidth (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1785	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	23 Apr 2016	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB30	842659/016	11 Aug 2016	12
A2139	Attenuator	AtlanTec RF	AN18-10	090918-04#1	Calibrated before use	-
A2528	Attenuator	AtlanTec RF	AN18W5-20	832828#3	Calibrated before use	-
S0551	DC Power Supply	Hewlett Packard	6674A	ITM00512445	Calibrated before use	-
M1251	Digital Multimeter	Fluke	175	89170179	26 May 2016	12
M1227	Power Sensor	Agilent	8487D	3318A02122	01 Jun 2016	12
M1145	Power Meter	Hewlett Packard	437B	3737U26557	11 Aug 2016	12
G085	Signal Generator	Hewlett Packard	83650L	3614A00104	11 Nov 2016	12

5.2.3. Transmitter Power Spectral Density

Test Summary:

Test Engineer:	Kiren Mistry	**Test Date:**	03 December 2015
Test Sample Serial Number:	ZLS13040004		

FCC Reference:	Part 15.247(e)
Test Method Used:	KDB 558074 Section 10.3

Environmental Conditions:

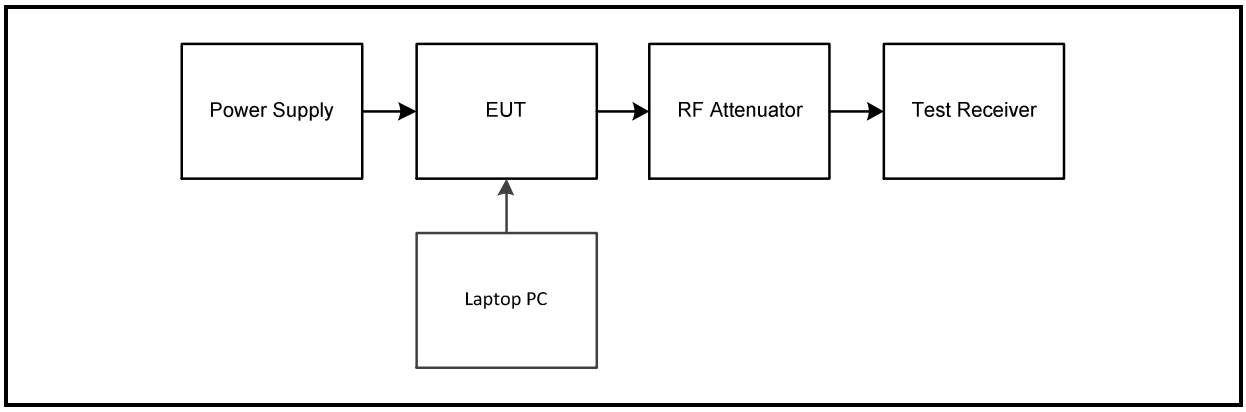
Temperature (°C):	23
Relative Humidity (%):	50

Note(s):

1. All modulation schemes supported by the EUT were investigated on the middle channel of each supported channel bandwidth in accordance with KDB 558074 Section 10.3 Method AVGPSD-1. The modes that produced the highest power and therefore deemed worst case were:
    - 5 MHz Channel Bandwidth / QPSK
    - 10 MHz Channel Bandwidth / QPSK
    - 20 MHz Channel Bandwidth / QPSK
    - 30 MHz Channel Bandwidth / QPSK
2. Final measurements were performed using the above modulation schemes on the bottom, middle and top channels.
3. The EUT was transmitting at 100% duty cycle.
4. For 5 MHz channel bandwidth: The test receiver resolution bandwidth was set to 3 kHz and video bandwidth 10 kHz. An RMS detector was used and sweep time set to auto couple. Trace averaging was employed over 100 sweeps. The span was set to greater than 1.5 times the 99% occupied bandwidth. The highest peak of the measured signal was recorded.
5. For 10 MHz & 20 MHz channel bandwidths: The test receiver resolution bandwidth was set to 10 kHz and video bandwidth 30 kHz. An RMS detector was used and sweep time set to auto couple. Trace averaging was employed over 100 sweeps. The span was set to greater than 1.5 times the 99% occupied bandwidth. The highest peak of the measured signal was recorded.
6. For 30 MHz channel bandwidth: The test receiver resolution bandwidth was set to 50 kHz and video bandwidth 200 kHz. An RMS detector was used and sweep time set to auto couple. Trace averaging was employed over 100 sweeps. The span was set to greater than 1.5 times the 99% occupied bandwidth. The highest peak of the measured signal was recorded.
7. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the test receiver to compensate for the loss of the attenuator and RF cable.

Transmitter Power Spectral Density (continued)

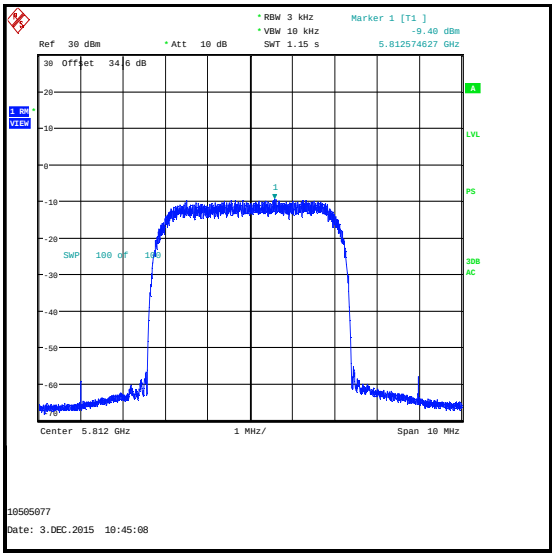
Test setup:



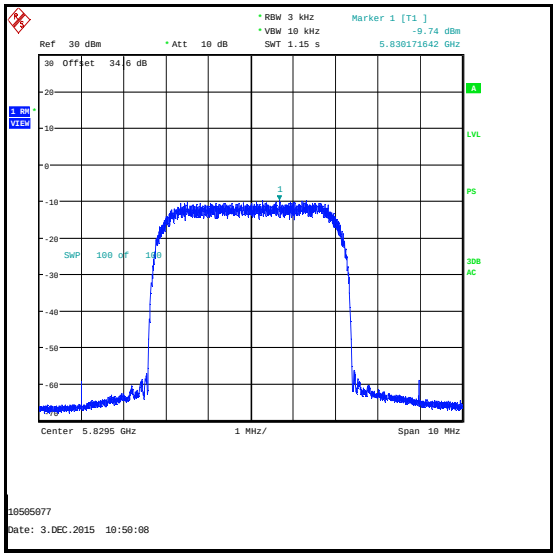
Transmitter Power Spectral Density (continued)

Results: 5 MHz Channel Bandwidth / QPSK

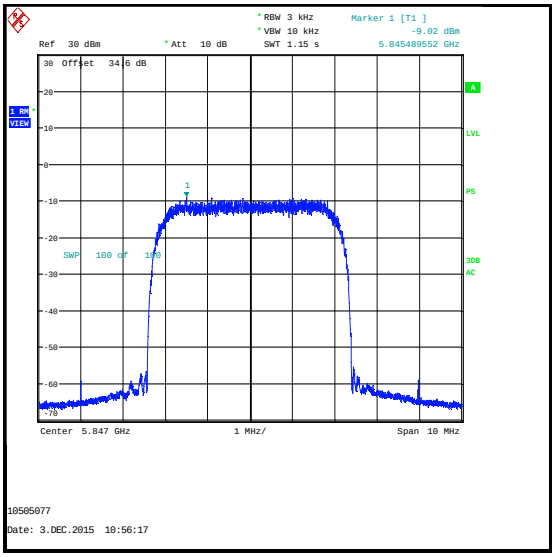
Channel	PSD (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	-9.4	8.0	17.4	Complied
Middle	-9.7	8.0	17.7	Complied
Top	-9.0	8.0	17.0	Complied



Bottom Channel



Middle Channel

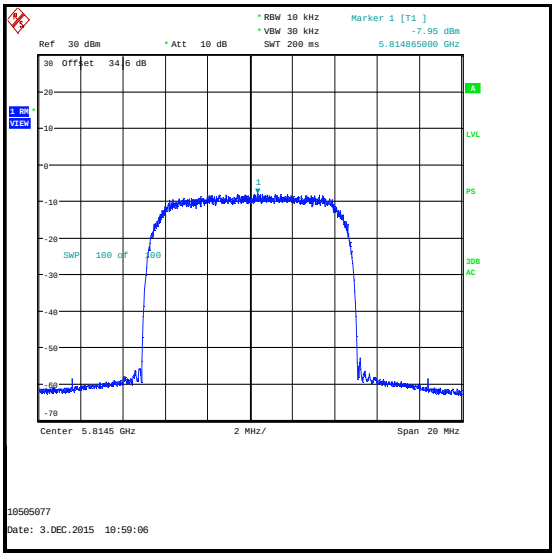


Top Channel

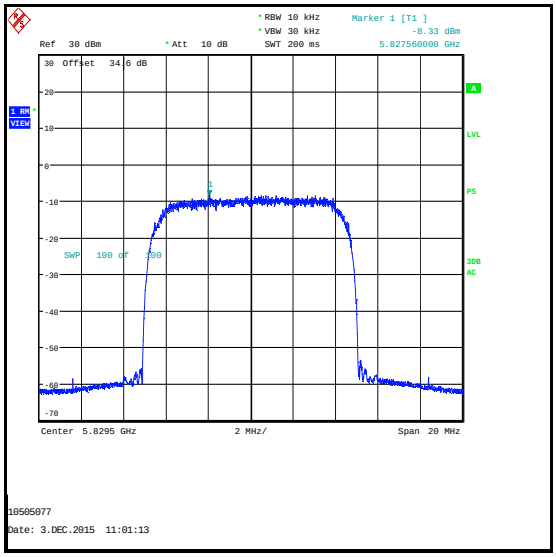
Transmitter Power Spectral Density (continued)

Results: 10 MHz Channel Bandwidth / QPSK

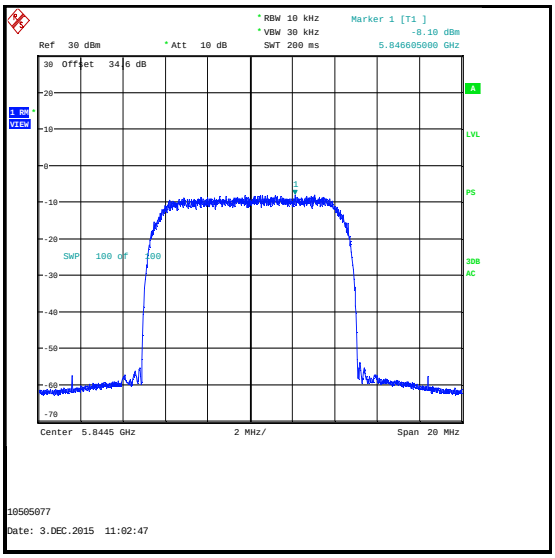
Channel	PSD (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	-8.0	8.0	16.0	Complied
Middle	-8.3	8.0	16.3	Complied
Top	-8.1	8.0	16.1	Complied



Bottom Channel



Middle Channel

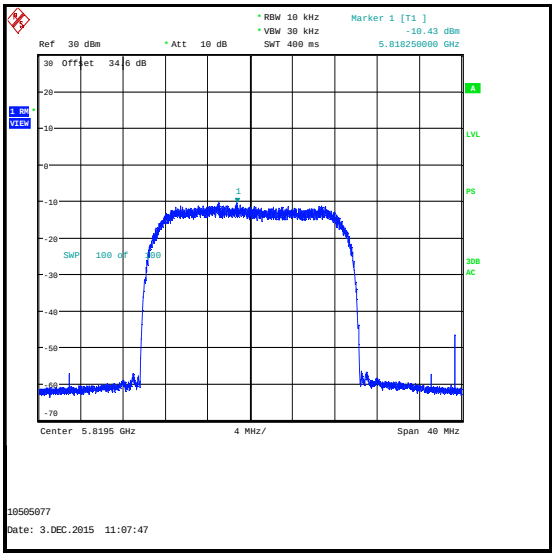


Top Channel

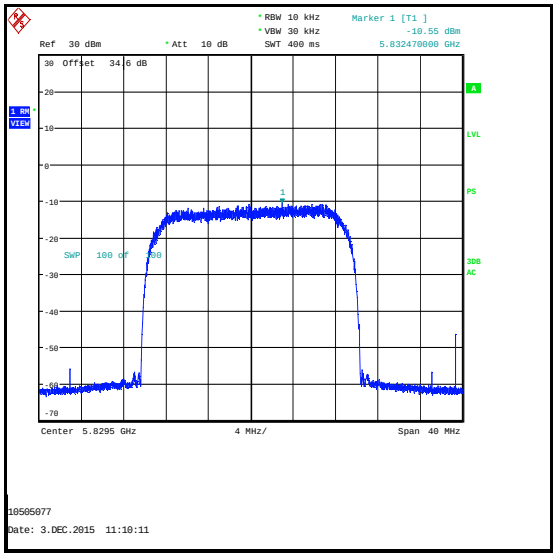
Transmitter Power Spectral Density (continued)

Results: 20 MHz Channel Bandwidth / QPSK

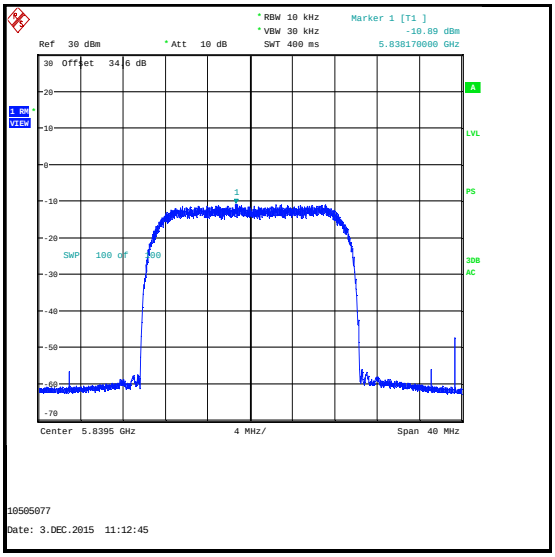
Channel	PSD (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	-10.4	8.0	18.4	Complied
Middle	-10.6	8.0	18.6	Complied
Top	-10.9	8.0	18.9	Complied



Bottom Channel



Middle Channel

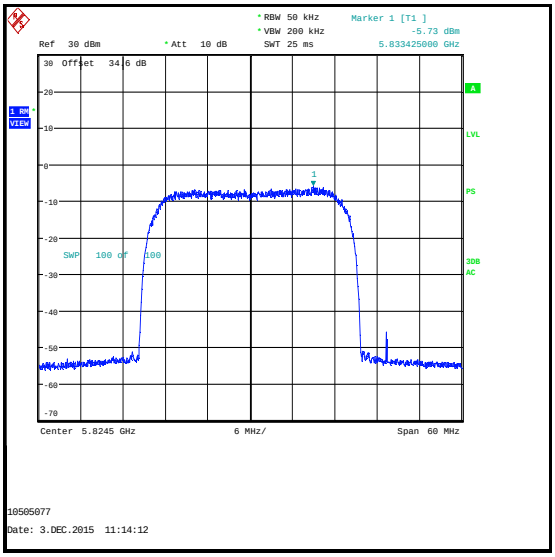


Top Channel

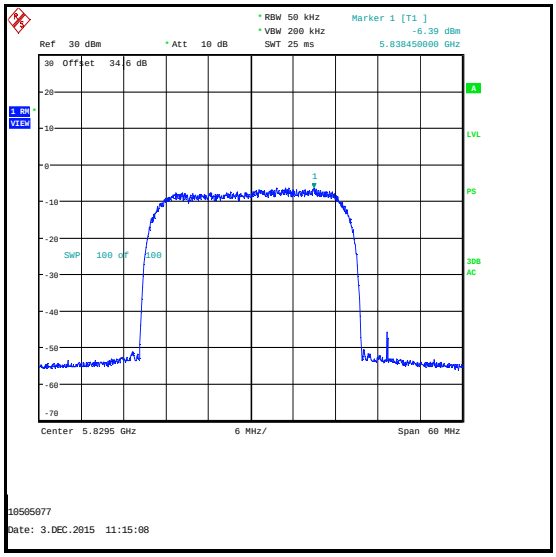
Transmitter Power Spectral Density (continued)

Results: 30 MHz Channel Bandwidth / QPSK

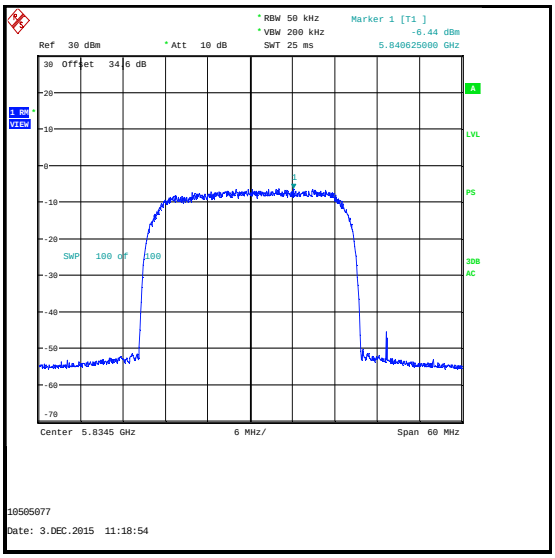
Channel	PSD (dBm / 3 kHz)	Limit (dBm / 3 kHz)	Margin (dB)	Result
Bottom	-5.7	8.0	13.7	Complied
Middle	-6.4	8.0	14.4	Complied
Top	-6.4	8.0	14.4	Complied



Bottom Channel



Middle Channel



Top Channel

Transmitter Power Spectral Density (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1785	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	23 Apr 2016	12
M1630	Test Receiver	Rohde & Schwarz	ESU 40	100233	20 Feb 2016	12
A2139	Attenuator	AtlanTec RF	AN18-10	090918-04#1	Calibrated before use	-
A2528	Attenuator	AtlanTec RF	AN18W5-20	832828#3	Calibrated before use	-
S0551	DC Power Supply	Hewlett Packard	6674A	ITM00512445	Calibrated before use	-
M1251	Digital Multimeter	Fluke	175	89170179	26 May 2016	12
M1227	Power Sensor	Agilent	8487D	3318A02122	01 Jun 2016	12
M1145	Power Meter	Hewlett Packard	437B	3737U26557	11 Aug 2016	12
G085	Signal Generator	Hewlett Packard	83650L	3614A00104	11 Nov 2016	12

5.2.4. Transmitter Maximum Average Output Power

Test Summary:

Test Engineer:	Kiren Mistry	**Test Date:**	01 December 2015
Test Sample Serial Number:	ZLS13040004		

FCC Reference:	Part 15.247(b)(3)
Test Method Used:	KDB 558074 Section 9.2.2.2

Environmental Conditions:

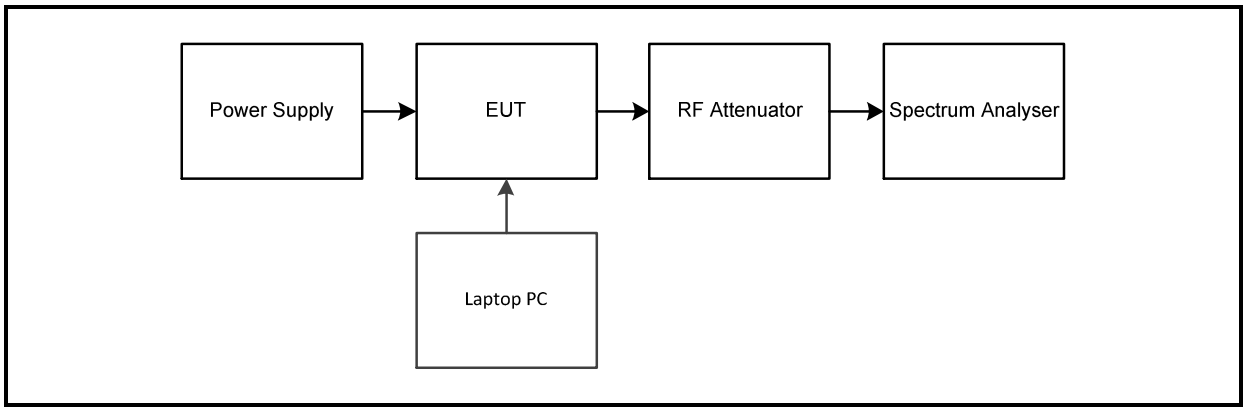
Temperature (°C):	25
Relative Humidity (%):	40

Note(s):

1. All modulation schemes supported by the EUT were investigated on the middle channel of each supported channel bandwidth in accordance with KDB 558074 Section 9.2.2.2 Method AVGSA-1. The modes that produced the highest conducted output power and therefore deemed worst case were:
    - 5 MHz Channel Bandwidth / QPSK
    - 10 MHz Channel Bandwidth / QPSK
    - 20 MHz Channel Bandwidth / QPSK
    - 30 MHz Channel Bandwidth / QPSK
2. Final measurements were performed using the above modulation schemes on the bottom, middle and top channels.
3. The EUT was transmitting at 100% duty cycle.
4. For 5 MHz & 10 MHz channel bandwidths: The spectrum analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. An RMS detector was used and sweep time set to auto couple. Trace averaging was employed over 100 sweeps. The span was set to greater than 1.5 times the 99% occupied bandwidth. The power was integrated across the occupied bandwidth of the signal using the channel power function of the spectrum analyser.
5. For 20 MHz & 30 MHz channel bandwidths: The spectrum analyser resolution bandwidth was set to 300 kHz and video bandwidth 1 MHz. An RMS detector was used and sweep time set to auto couple. Trace averaging was employed over 100 sweeps. The span was set to greater than 1.5 times the 99% occupied bandwidth. The power was integrated across the occupied bandwidth of the signal using the channel power function of the spectrum analyser.
6. 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 loss of the attenuator and RF cable.

Transmitter Maximum Average Output Power (continued)

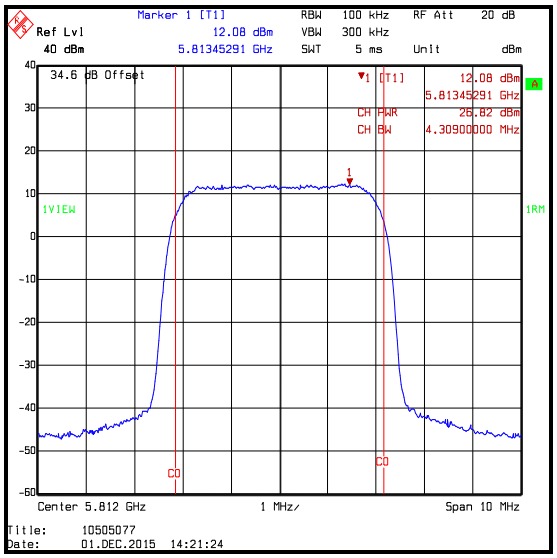
Test setup:



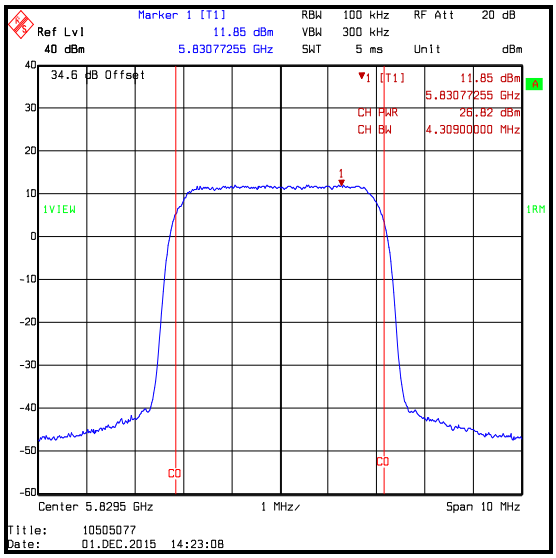
Transmitter Maximum Average Output Power (continued)

Results: 5 MHz Channel Bandwidth / QPSK

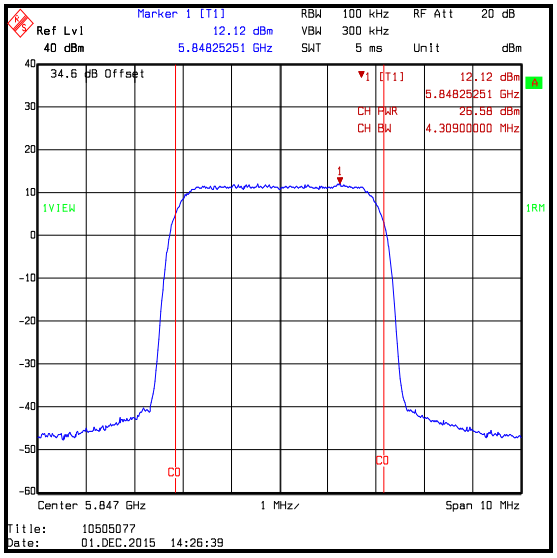
Channel	Conducted Output Power (dBm)	Conducted Output Power Limit (dBm)	Margin (dB)	Result
Bottom	26.8	30.0	3.2	Complied
Middle	26.8	30.0	3.2	Complied
Top	26.6	30.0	3.4	Complied



Bottom Channel



Middle Channel

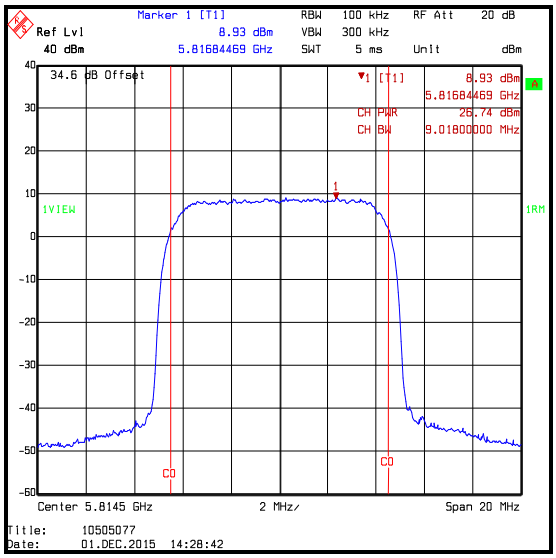


Top Channel

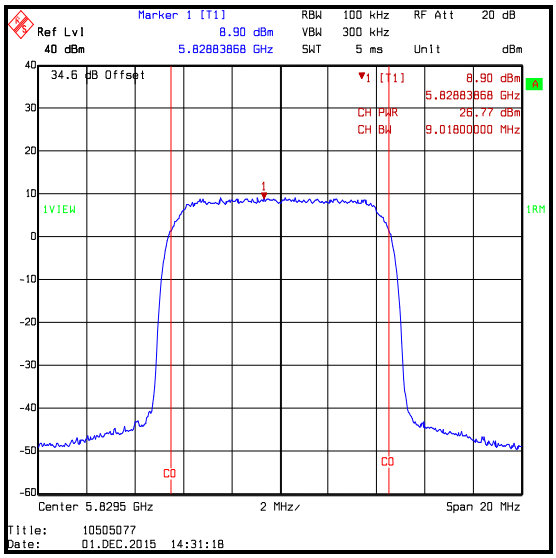
Transmitter Maximum Average Output Power (continued)

Results: 10 MHz Channel Bandwidth / QPSK

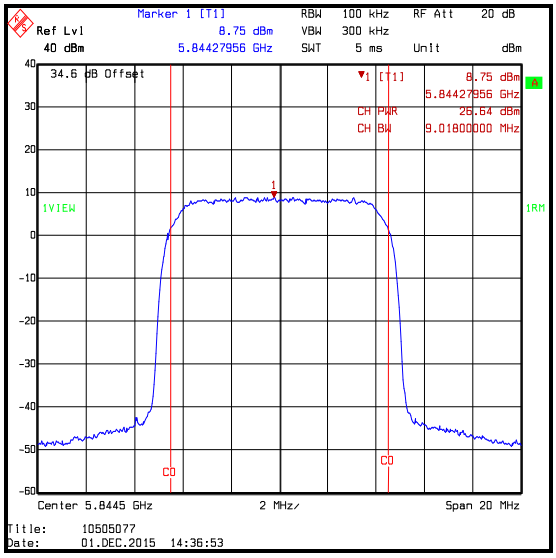
Channel	Conducted Output Power (dBm)	Conducted Output Power Limit (dBm)	Margin (dB)	Result
Bottom	26.7	30.0	3.3	Complied
Middle	26.8	30.0	3.2	Complied
Top	26.6	30.0	3.4	Complied



Bottom Channel



Middle Channel

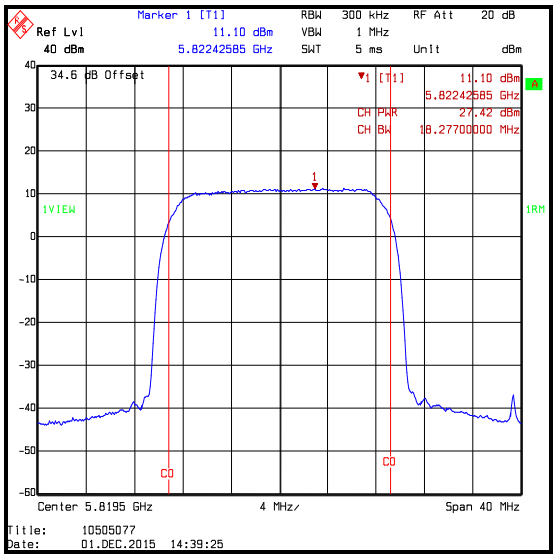


Top Channel

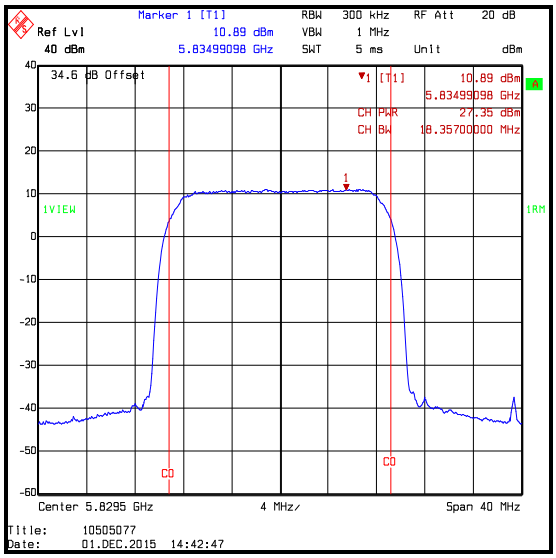
Transmitter Maximum Average Output Power (continued)

Results: 20 MHz Channel Bandwidth / QPSK

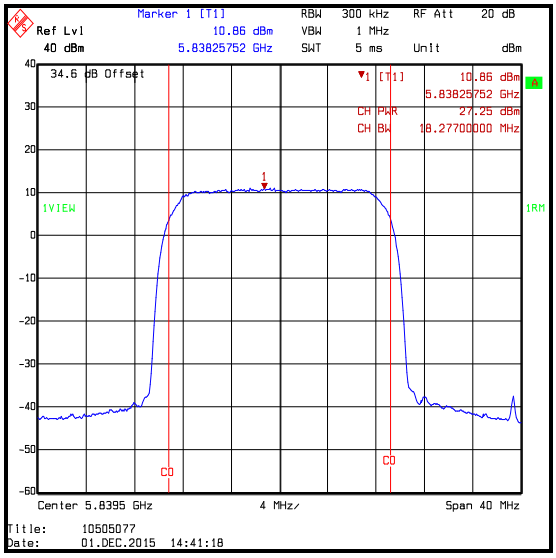
Channel	Conducted Output Power (dBm)	Conducted Output Power Limit (dBm)	Margin (dB)	Result
Bottom	27.4	30.0	2.6	Complied
Middle	27.4	30.0	2.6	Complied
Top	27.3	30.0	2.7	Complied



Bottom Channel



Middle Channel

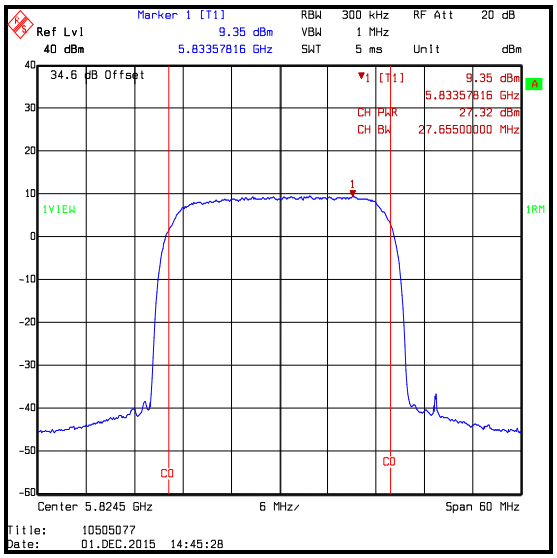


Top Channel

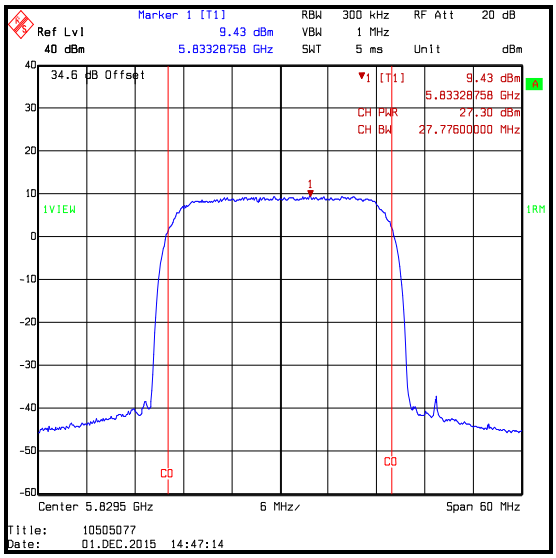
Transmitter Maximum Average Output Power (continued)

Results: 30 MHz Channel Bandwidth / QPSK

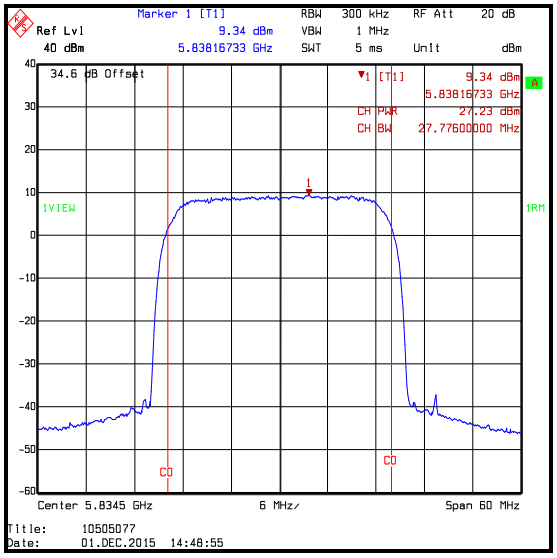
Channel	Conducted Output Power (dBm)	Conducted Output Power Limit (dBm)	Margin (dB)	Result
Bottom	27.3	30.0	2.7	Complied
Middle	27.3	30.0	2.7	Complied
Top	27.2	30.0	2.8	Complied



Bottom Channel



Middle Channel



Top Channel

Transmitter Maximum Average Output Power (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1785	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	23 Apr 2016	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB30	842659/016	11 Aug 2016	12
A2139	Attenuator	AtlanTec RF	AN18-10	090918-04#1	Calibrated before use	-
A2528	Attenuator	AtlanTec RF	AN18W5-20	832828#3	Calibrated before use	-
S0551	DC Power Supply	Hewlett Packard	6674A	ITM00512445	Calibrated before use	-
M1251	Digital Multimeter	Fluke	175	89170179	26 May 2016	12
M1227	Power Sensor	Agilent	8487D	3318A02122	01 Jun 2016	12
M1145	Power Meter	Hewlett Packard	437B	3737U26557	11 Aug 2016	12
G085	Signal Generator	Hewlett Packard	83650L	3614A00104	11 Nov 2016	12

5.2.5. Transmitter Band Edge Conducted Emissions

Test Summary:

Test Engineers:	Kiren Mistry & Sandeep Bharat	**Test Date:**	03 December 2015
Test Sample Serial Number:	ZLS13040004		

FCC Reference:	Part 15.247(d)
Test Method Used:	KDB 558074 Section 11 & ANSI C63.10 Section 6.10.4

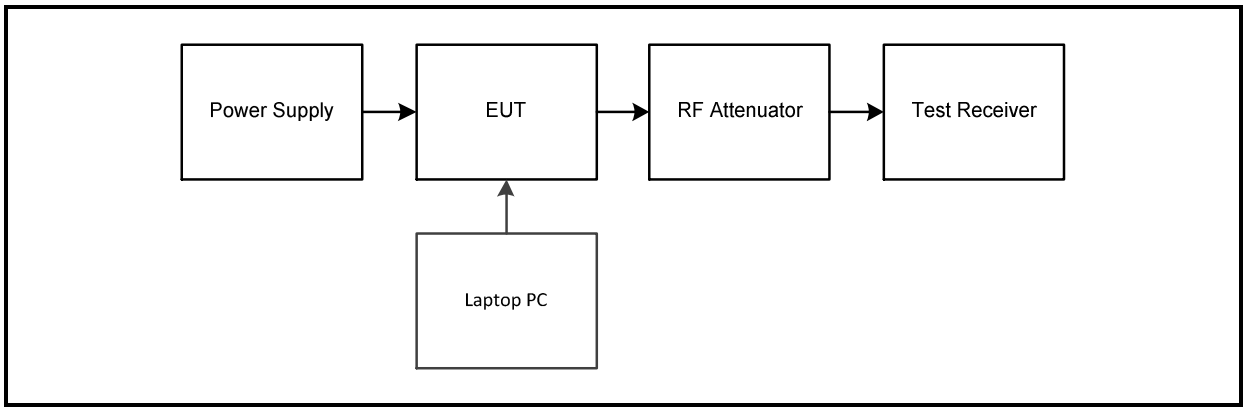
Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	40

Note(s):

1. Conducted measurements at band edges were used in conjunction with radiated limits. The EUT was set to transmit on the top channel when performing measurements at the upper band edge on modes that produced the highest power & widest bandwidth.
2. The modes that produced the highest power and widest bandwidth were:
    - 5 MHz Channel Bandwidth – QPSK & 32QAM
    - 10 MHz Channel Bandwidth – QPSK
    - 20 MHz Channel Bandwidth – QPSK
    - 30 MHz Channel Bandwidth – QPSK & 16QAM
3. A non-restricted band is adjacent to the upper band edge so the -30 dBc limit applies as the maximum average output power was used to demonstrate compliance, in accordance with FCC KDB 558078 Section 11.1 (b) and §15.247(d). The band edge emissions were measured using a 100 kHz bandwidth and peak detector. The -30 dBc limit was relative from the peak of the top channel carrier.
4. The test receiver was connected to the RF port on the EUT using suitable attenuation and RF cable. An RF level offset was entered on the test receiver to compensate for the loss of the attenuator and RF cable.
5. Lower band edge measurement results can be found in a separate report UL-RPT-RP10505077JD08A.

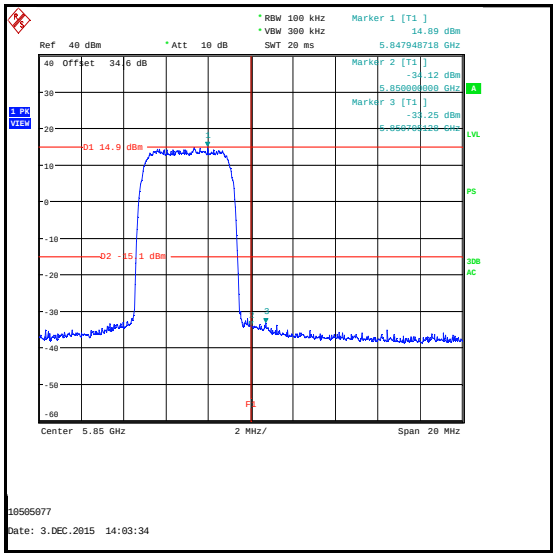
Test setup:



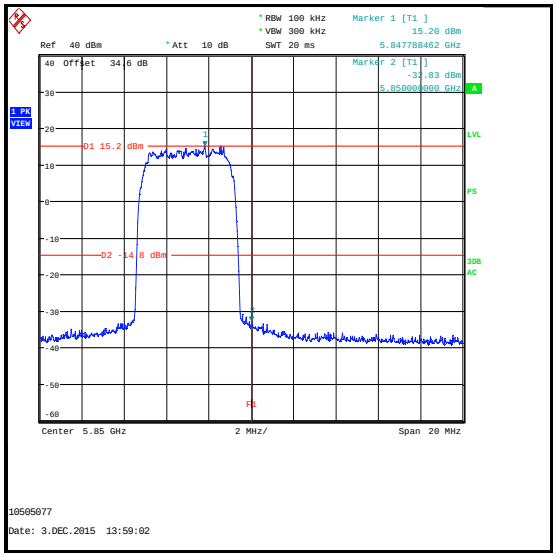
Transmitter Band Edge Conducted Emissions (continued)

Results: 5 MHz Channel Bandwidth

Modulation Scheme	Peak Band Edge Level (dBm)	-30 dBc Limit (dBm)	Margin (dB)	Result
QPSK	-34.1	-15.1	19.0	Complied
32QAM	-32.8	-14.8	18.0	Complied



QPSK

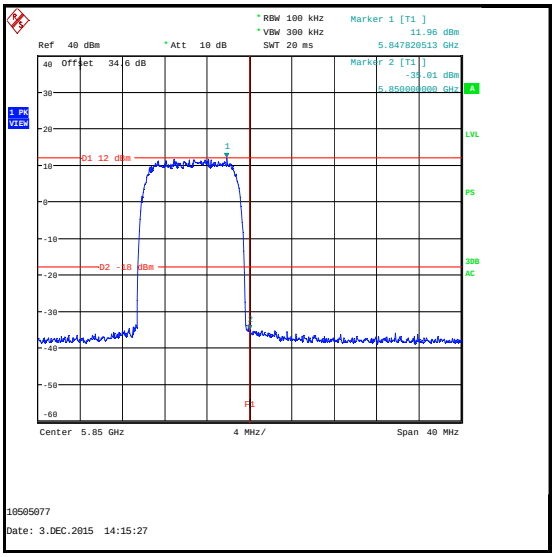


32QAM

Transmitter Band Edge Conducted Emissions (continued)

Results: 10 MHz Channel Bandwidth

Modulation Scheme	Peak Band Edge Level (dBm)	-30 dBc Limit (dBm)	Margin (dB)	Result
QPSK	-35.0	-18.0	17.0	Complied

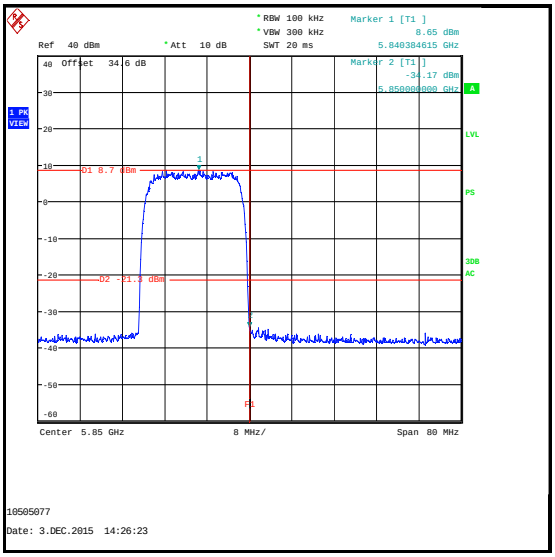


QPSK

Transmitter Band Edge Conducted Emissions (continued)

Results: 20 MHz Channel Bandwidth

Modulation Scheme	Peak Band Edge Level (dBm)	-30 dBc Limit (dBm)	Margin (dB)	Result
QPSK	-34.2	-21.3	12.9	Complied

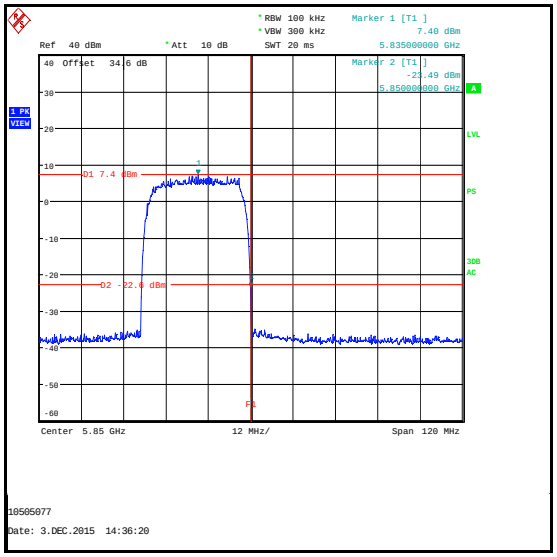


QPSK

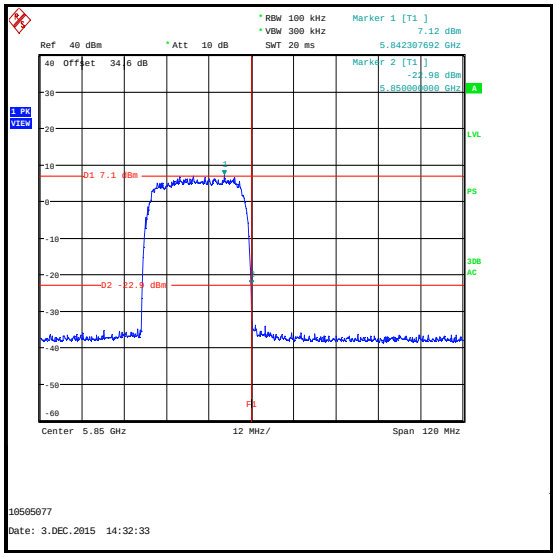
Transmitter Band Edge Conducted Emissions (continued)

Results: 30 MHz Channel Bandwidth

Modulation Scheme	Peak Band Edge Level (dBm)	-30 dBc Limit (dBm)	Margin (dB)	Result
QPSK	-23.5	-22.6	0.9	Complied
16QAM	-23.0	-22.9	0.1	Complied



QPSK



16QAM

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1785	Thermohygrometer	JM Handelspunkt	30.5015.13	Not stated	23 Apr 2016	12
M1630	Test Receiver	Rohde & Schwarz	ESU 40	100233	20 Feb 2016	12
A2139	Attenuator	AtlanTec RF	AN18-10	090918-04#1	Calibrated before use	-
A2528	Attenuator	AtlanTec RF	AN18W5-20	832828#3	Calibrated before use	-
M260	Signal Generator	Rohde & Schwarz	SMP02	829076/008	27 Apr 2016	12
S0551	DC Power Supply	Hewlett Packard	6674A	ITM00512445	Calibrated before use	-
M1251	Digital Multimeter	Fluke	175	89170179	26 May 2016	12

5.2.6. Transmitter Radiated Emissions – 2 ft Flat Panel Antenna

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	07 December 2015
Test Sample Serial Number:	ZLS13040004		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.5
Frequency Range	30 MHz to 1000 MHz

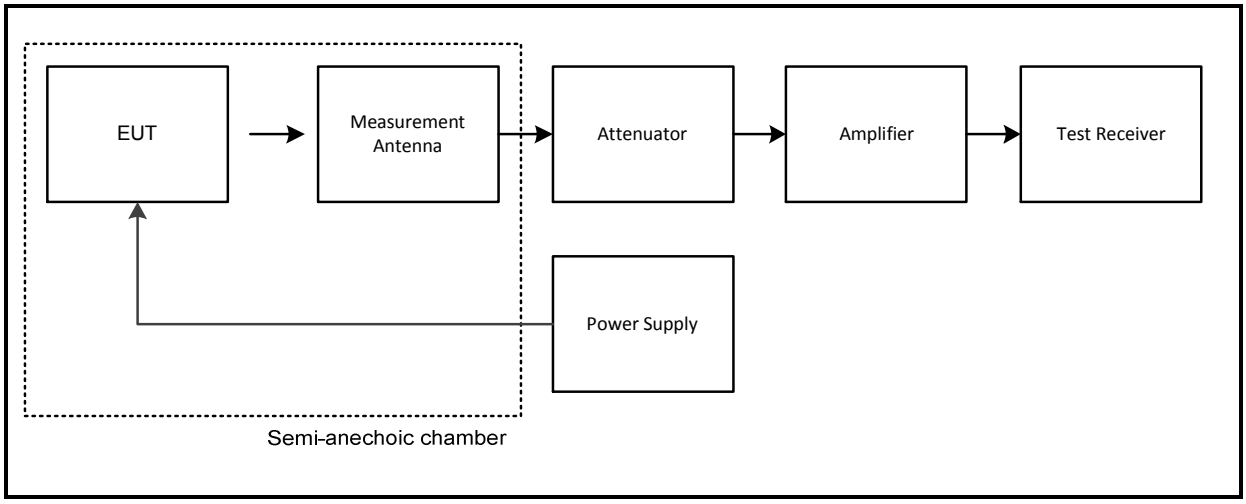
Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	45

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. Preliminary investigations showed similar emission levels below 1 GHz for each channel of operation. Therefore pre-scans were performed with the EUT set to the middle channel only.
3. The EUT was set to transmit QPSK signals on 20 MHz Channel Bandwidth as this mode was seen to produce the highest output power and therefore deemed worst case for this test.
4. All 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. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
5. 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.

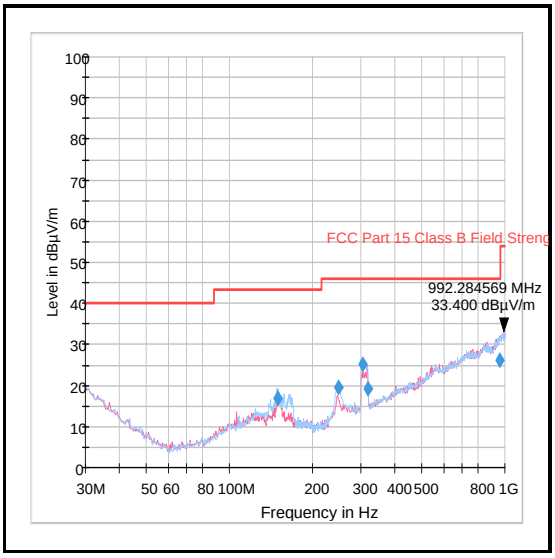
Test setup for radiated measurements:



Transmitter Radiated Emissions (continued)

Results: Middle Channel / 20 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
992.285	Vertical	33.4	54.0	20.6	Complied



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	19 Mar 2016	12
M1945	Thermohygrometer	JM Handelspunkt	30.5015.01	0112	23 Apr 2016	12
M1273	Test Receiver	Rohde & Schwarz	ESIB26	100275	19 Mar 2016	12
A1834	Attenuator	Hewlett Packard	8491B	10444	05 Mar 2016	12
G0543	Pre-Amplifier	Sonoma	310N	230801	10 Feb 2016	3
A490	Bilog Antenna	Chase	CBL6111A	1590	30 Apr 2016	12

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Dates:**	07 December 2015 to 11 December 2015
Test Sample Serial Number:	ZLS13040004		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	KDB 558074 Sections 11 & 12 referencing ANSI C63.10 Sections 6.3 and 6.6
Frequency Range	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	24 to 26
Relative Humidity (%):	42 to 48

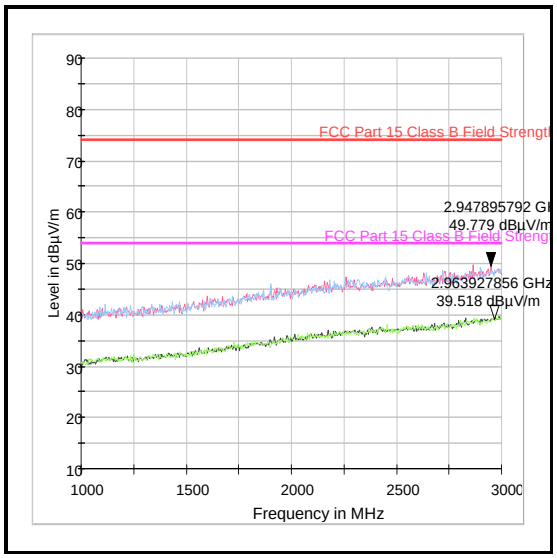
Note(s):

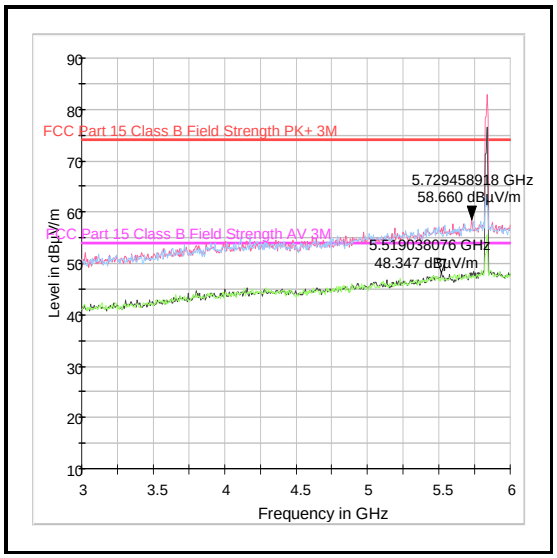
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The EUT was set to transmit QPSK signals on 20 MHz Channel Bandwidth as this mode was seen to produce the highest output power and therefore deemed worst case for this test.
3. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak and average noise floor readings of the measuring receiver were recorded as shown in the table below.
4. The emission shown at 5829.5 MHz on the 3 GHz to 6 GHz plot is the EUT fundamental.
5. All pre-scans and any final measurements were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable. Radiation Absorbent Material (RAM) was placed on the floor between the EUT and the measurement antenna. Maximum emission levels were determined on any detected emissions by height searching the measurement antenna over the range 1 metre to 4 metres.

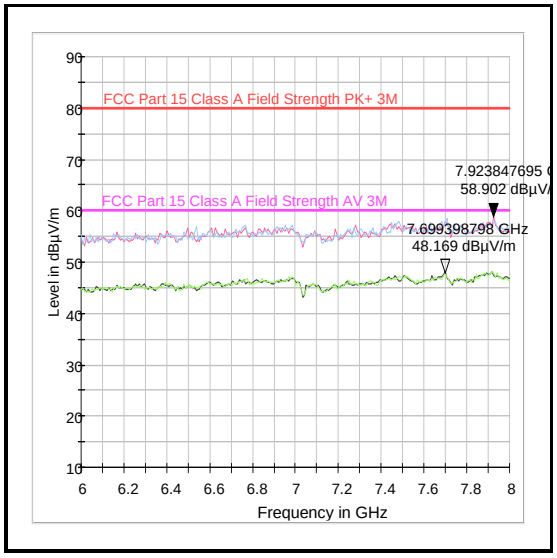
Transmitter Radiated Emissions (continued)

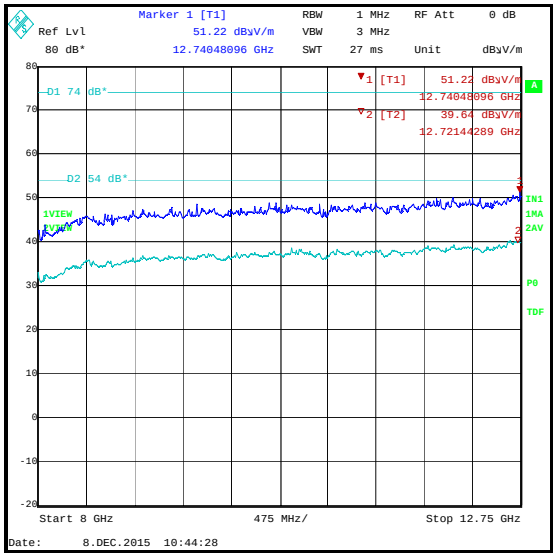
Results: Middle Channel / 20 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Detector	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
7923.848	Peak	58.9	74.0	15.1	Complied
5519.038	Average	48.3	54.0	5.7	Complied

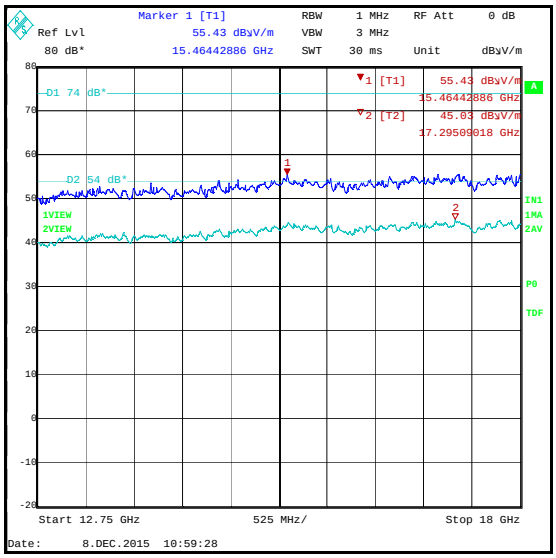


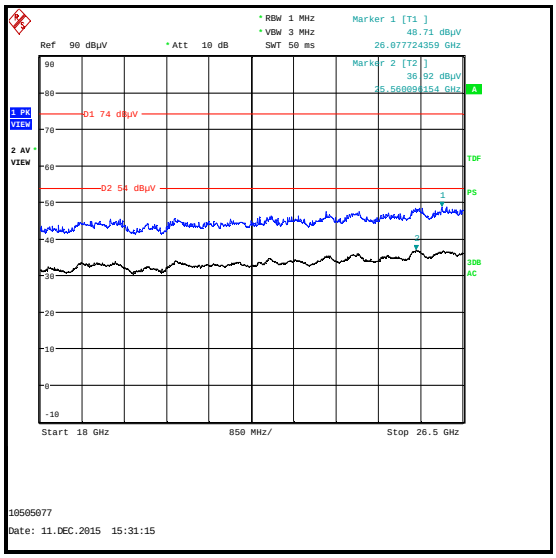


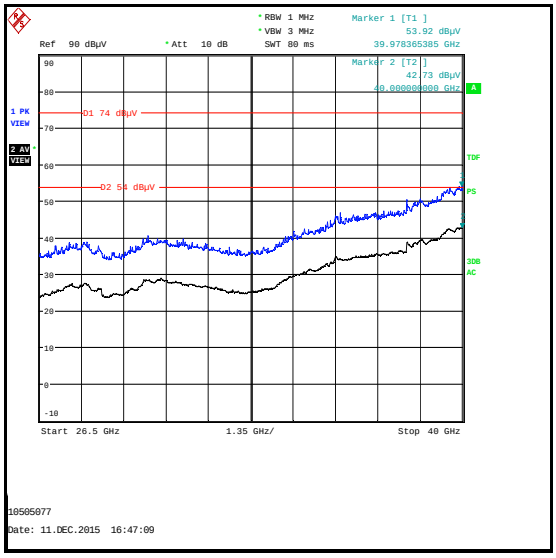




Transmitter Radiated Emissions (continued)







Transmitter Radiated Emissions (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	19 Mar 2016	12
M1945	Thermohygrometer	JM Handelspunkt	30.5015.01	0112	23 Apr 2016	12
M1273	Test Receiver	Rohde & Schwarz	ESIB26	100275	19 Mar 2016	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	20 Feb 2016	12
A1227	Pre-Amplifier	Agilent	8449B	3008A01566	10 Feb 2016	3
A1834	Attenuator	Hewlett Packard	8491B	10444	05 Mar 2016	12
A2176	High Pass Filter	AtlanTecRF	AFH07000	800980	17 Apr 2016	12
A2474	Band Reject Filter	Wainwright Instruments	WRCJV8	1	Calibrated before use	-
A2699	Antenna	EMCO	3115	6738	27 Apr 2016	12
A255	Antenna	Flann Microwave	16240-20	519	20 Dec 2015	12
A256	Antenna	Flann Microwave	18240-20	400	20 Dec 2015	12
A436	Antenna	Flann Microwave	20240-20	330	21 Dec 2015	12
A203	Antenna	Flann Microwave	22240-20	343	19 May 2016	36
A1785	Pre-Amplifier	Farran Technology	FLNA-28-30	FTL6483	09 Jan 2016	12

5.2.7. Transmitter Radiated Emissions – 4 ft Parabolic Antenna

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Date:**	29 December 2015
Test Sample Serial Number:	ZLS13040004		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	ANSI C63.10 Sections 6.3 and 6.5
Frequency Range	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	36

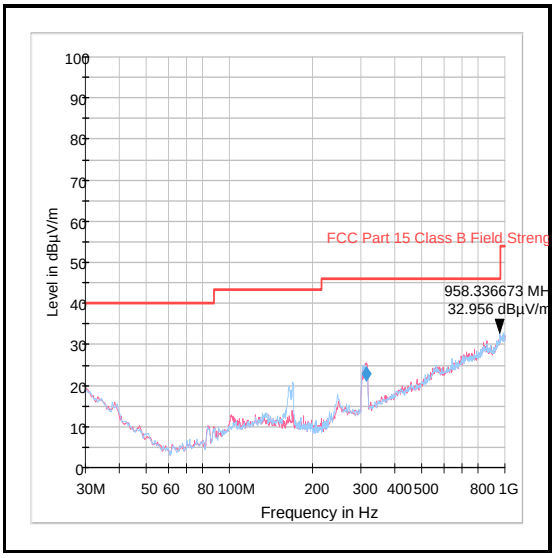
Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. Preliminary investigations showed similar emission levels below 1 GHz for each channel of operation. Therefore pre-scans were performed with the EUT set to the middle channel only.
3. The EUT was set to transmit QPSK signals on 20 MHz Channel Bandwidth as this mode was seen to produce the highest output power and therefore deemed worst case for this test.
4. All 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. Therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
5. 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.

Transmitter Radiated Emissions (continued)

Results: Middle Channel / 20 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Antenna Polarity	Peak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
958.337	Vertical	33.0	54.0	21.0	Complied



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	19 Mar 2016	12
M1945	Thermohygrometer	JM Handelspunkt	30.5015.01	0112	23 Apr 2016	12
M1273	Test Receiver	Rohde & Schwarz	ESIB26	100275	19 Mar 2016	12
A1834	Attenuator	Hewlett Packard	8491B	10444	05 Mar 2016	12
G0543	Pre-Amplifier	Sonoma	310N	230801	10 Feb 2016	3
A490	Bilog Antenna	Chase	CBL6111A	1590	30 Apr 2016	12

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Sandeep Bharat	**Test Dates:**	29 December 2015 & 30 December 2015
Test Sample Serial Number:	ZLS13040004		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Test Method Used:	KDB 558074 Sections 11 & 12 referencing ANSI C63.10 Sections 6.3 and 6.6
Frequency Range	1 GHz to 40 GHz

Environmental Conditions:

Temperature (°C):	24 to 25
Relative Humidity (%):	36 to 44

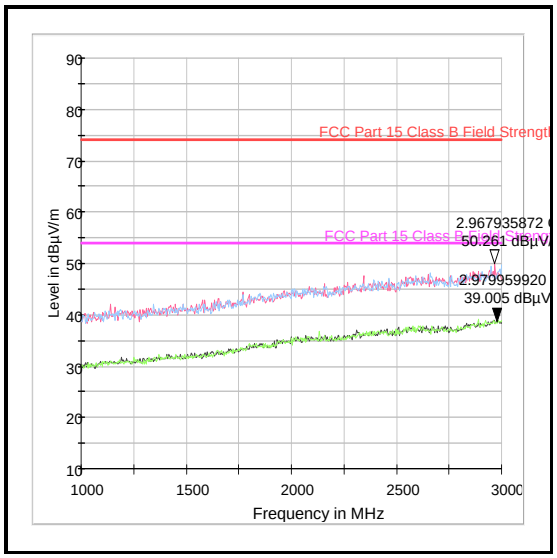
Note(s):

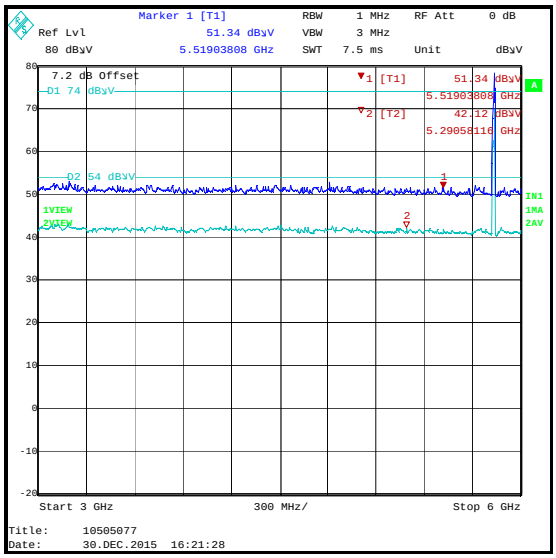
1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The EUT was set to transmit QPSK signals on 20 MHz Channel Bandwidth as this mode was seen to produce the highest output power and therefore deemed worst case for this test.
3. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak and average noise floor readings of the measuring receiver were recorded as shown in the table below.
4. The emission shown at 5829.5 MHz on the 3 GHz to 6 GHz plot is the EUT fundamental.
5. All pre-scans and any final measurements were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 1.5 m above the reference ground plane in the centre of the chamber turntable. Radiation Absorbent Material (RAM) was placed on the floor between the EUT and the measurement antenna. Maximum emission levels were determined on any detected emissions by height searching the measurement antenna over the range 1 metre to 4 metres.

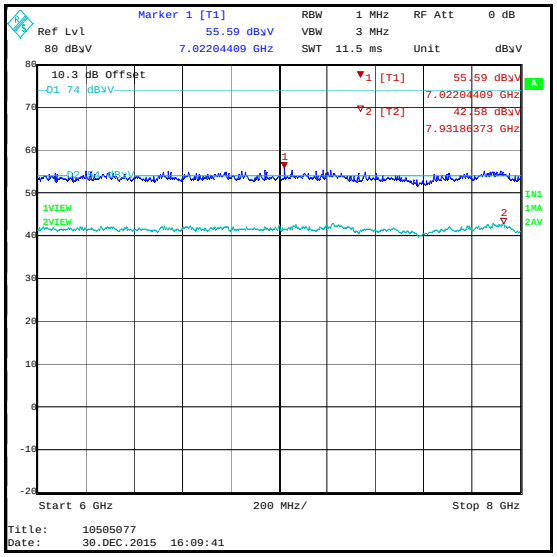
Transmitter Radiated Emissions (continued)

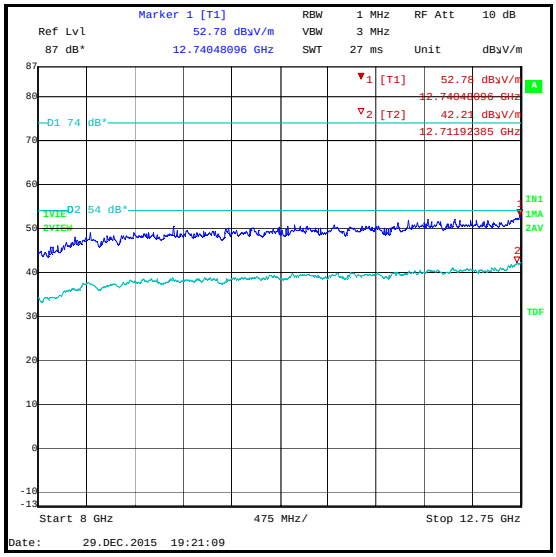
Results: Middle Channel / 20 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Detector	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
16800.601	Peak	55.7	74.0	18.3	Complied
16032.565	Average	43.0	54.0	11.0	Complied

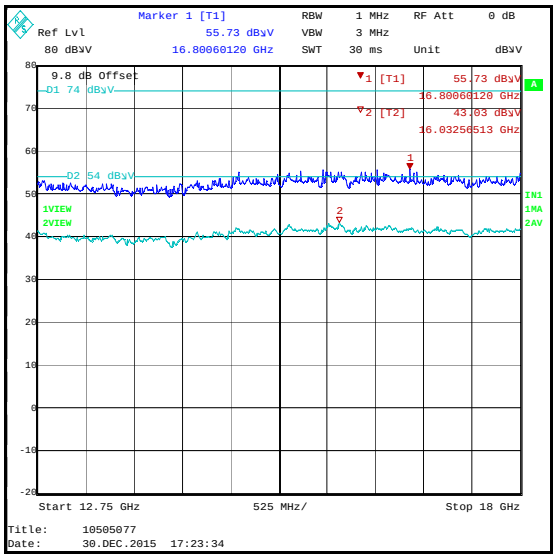


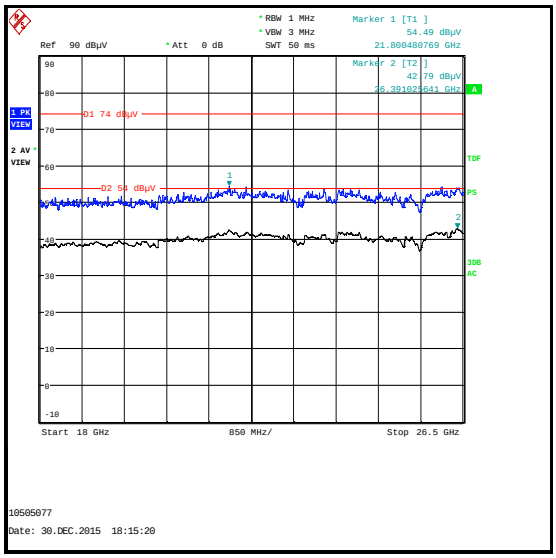


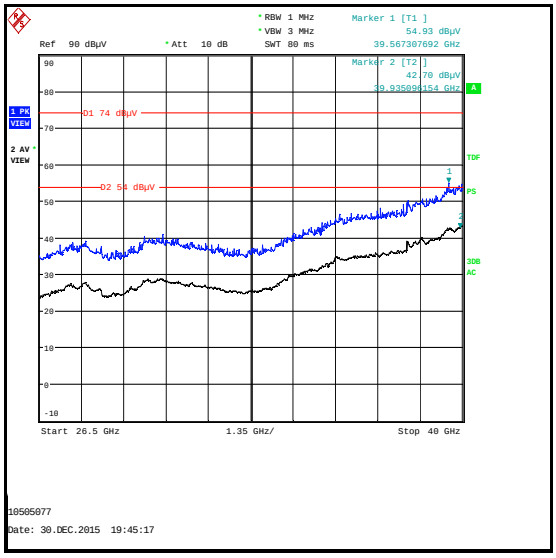




Transmitter Radiated Emissions (continued)







Transmitter Radiated Emissions (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	19 Mar 2016	12
M1945	Thermohygrometer	JM Handelspunkt	30.5015.01	0112	23 Apr 2016	12
M1273	Test Receiver	Rohde & Schwarz	ESIB26	100275	19 Mar 2016	12
M1630	Test Receiver	Rohde & Schwarz	ESU40	100233	20 Feb 2016	12
A1227	Pre-Amplifier	Agilent	8449B	3008A01566	10 Feb 2016	3
A1834	Attenuator	Hewlett Packard	8491B	10444	05 Mar 2016	12
A2176	High Pass Filter	AtlanTecRF	AFH07000	800980	17 Apr 2016	12
A2474	Band Reject Filter	Wainwright Instruments	WRCJV8	1	Calibrated before use	-
A2699	Antenna	EMCO	3115	6738	27 Apr 2016	12
A255	Antenna	Flann Microwave	16240-20	519	20 Dec 2015	12
A256	Antenna	Flann Microwave	18240-20	400	20 Dec 2015	12
A436	Antenna	Flann Microwave	20240-20	330	21 Dec 2015	12
A203	Antenna	Flann Microwave	22240-20	343	19 May 2016	36
A1785	Pre-Amplifier	Farran Technology	FLNA-28-30	FTL6483	09 Jan 2016	12

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
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±4.69 dB
Conducted Maximum Average Output Power	5725 MHz to 5850 MHz	95%	±1.13 dB
Spectral Power Density	5725 MHz to 5850 MHz	95%	±1.13 dB
6 dB Bandwidth	5725 MHz to 5850 MHz	95%	±3.92 %
Conducted Spurious Emissions	5725 MHz to 5850 MHz	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
2.0	-	-	FCC ID updated
3.0	-	-	Section 4.2 updated

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