TEST REPORT

Test Report No. : UL-RPT-RP10983334JD01A

Manufacturer	:	General Dynamics Broadband UK Ltd
Model No.	:	BBR
Product Generation	:	1
FCC ID	:	PKTODUBBR
Technology	:	LTE
Test Standard(s)	:	FCC Parts 2.1049, 2.1051, 74.636(a), 74.637(a)(c) & 74.661

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 1.0.

Date of Issue: 12 May 2016

Checked by:

Ian Watch
Senior Engineer, Radio Laboratory

Company Signatory:

Steven White
Service Lead, Radio Laboratory
UL VS LTD

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:	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:	47CFR74
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 74 Subpart F (Television Broadcast Auxiliary Stations)
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:	15 February 2016 to 01 March 2016

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Note(s)	Result
74.636(a)	Transmitter Power Limitations	-	✓
2.1049	Transmitter Occupied Bandwidth	-	✓
74.636	Transmitter Duty Cycle	-	✓
74.637(a)(2)(i) / 74.637(c)(3) / 2.1051	Transmitter Conducted Emissions Mask	1	✓
74.637(a)(2)(iii) / 74.637(c)(3) / 2.1051	Transmitter Conducted Emissions	-	✓
74.637(a)(2)(iii) / 74.637(c)(3) / 2.1053	Transmitter Radiated Spurious Emissions	-	✓
74.661 / 2.1055	Transmitter Frequency Stability (Temperature and Voltage Variation)	-	✓

Key to Results

✓ **= Complied** ✗ **= Did not comply**

Note(s):

1. Calculations of the emission mask specified in Part 74.637(a)(2)(i), were performed using 6 and 12 MHz as values for the authorised bandwidth, for the 5 and 10 MHz channel bandwidths respectively. The authorised bandwidth and mask parameters were established in pre-filing KDB inquiry consultation with FCC Lab.

2.3. Methods and Procedures

Reference:	FCC KDB 971168 D01 v02r02, October 17 2014
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:	BBR
Product Generation:	1
Test Sample Serial Number:	BBRBG010042A
Hardware Version:	2A
Software Version:	9.2.6
FCC ID:	PKTODUBBR

3.2. Description of EUT

The Equipment Under Test was an LTE TV Broadcast Auxiliary Station that can be used in fixed or mobile applications. It is powered from a 28 VDC supply.

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	Broadcast Auxiliary Station	
Channel Bandwidth:	5 MHz & 10 MHz	
Modulation Types:	QPSK & 16QAM	
Duty Cycle:	60%	
Peak Antenna Gain:	24.0 dBi	
Power Supply Requirement:	Nominal	28.0 VDC
	Minimum	18.0 VDC
	Maximum	33.0 VDC
Transmit / Receive Frequency Range:	2025 MHz to 2110 MHz	
Channels Tested:	**Channel Bandwidth (MHz)**	**Frequency (MHz)**
Bottom Channel	5	2028.5
	10	2031.5
Middle Channel	All	2067.5
Top Channel	5	2106.5
	10	2103.5

3.5. Support Equipment

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

Description:	Laptop PC
Brand Name:	Toshiba
Model Name or Number:	Satellite Pro A100
Serial Number:	67071048Q

Description:	Ethernet cable
Brand Name:	None stated
Model Name or Number:	None stated
Serial Number:	None stated

Description:	Communications Tester
Brand Name:	Rohde & Schwarz
Model Name or Number:	CMW 500
Serial Number:	119871 (UL VS LTD Asset No. L1174)

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 in TDD mode, using 5 MHz and 10 MHz channel bandwidths with maximum resource blocks of 25 and 50 respectively. QPSK and 16QAM modulation modes were tested.

4.2. Configuration and Peripherals

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

- The EUT has one transceiver RF port marked *Tx/Rx* and one receiver port marked *Rx*. Both ports were always terminated with a matched load, by either the connection of a link to a Rohde & Schwarz CMW500 Communications Tester, or by a discrete 50 Ohm load.
- The EUT was given an external data stream using the Ethernet service port, sourced via a test laptop PC, using iPerf commands into a command window and a data file supplied by the customer.
- For conducted transmit tests, the EUT was put into a two port link with a CMW 500 Communications Tester, running a user defined LTE TDD mode. The operating frequencies, bandwidths and modulation modes of the EUT were selected by changing the uplink parameters on the CMW 500. The customer gave test instructions, which were followed to place the unit into the correct test mode. The instructions were noted and stored on the UL VS LTD IT server under the relevant job number as *Documentation/Radio/setup info.docx*
- For conducted transmit tests, the following configuration was used
    - The EUT Tx/Rx port was connected via two 20 dB attenuators to the RF 1 COM port on the CMW 500, configured for both uplink and downlink. The measurement system was connected via suitable attenuation to a directional coupler or splitter inserted at the mid-point node of the attenuators. A resistive splitter was used for used measurements below 1GHz and a coupler was used above 1GHz.
    - The EUT Rx port was connected via 40 dB of attenuation to the RF 3 COM port on the CMW 500, configured for downlink.
    - The measurement layout was configured such that the optimum range of signal levels could be measured whilst all components were used within their operating range.
- For cabinet radiated transmit tests, the EUT was put into a one port conducted link with a CMW 500 Communications Tester, running a user defined LTE TDD mode. The EUT Rx port was terminated with a matched load. The operating frequencies, bandwidths and modulation modes of the EUT were selected by changing the uplink parameters on the CMW 500.
- For the 5 MHz channel bandwidth, the EUT was configured for 25 Resource Blocks as defined in 3GPP 36.141 Rel 8.
- For the 10 MHz channel bandwidth, the EUT was configured for 50 Resource Blocks as defined in 3GPP 36.141 Rel 8.
- For all tests, a DC supply with a total power capability of 400 W was used in order to support transient current demand by the EUT. To meet this requirement, two separate laboratory power supply units were used, with their DC outputs connected in series and the required voltage distributed equally. The combined voltage was measured at the EUT.

5. Measurements, Examinations and Derived Results

5.1. General Comments

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

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

5.2. Test Results

5.2.1. Transmitter Power limitations

Test Summary:

Test Engineer:	Keith Tucker	**Test Date:**	29 February 2016
Test Sample Serial Number:	BBRBG010042A		

FCC Reference:	Parts 74.636(a)
Test Method Used:	FCC KDB 971168 D01 Sections 5.2.2.1 & 5.6

Environmental Conditions:

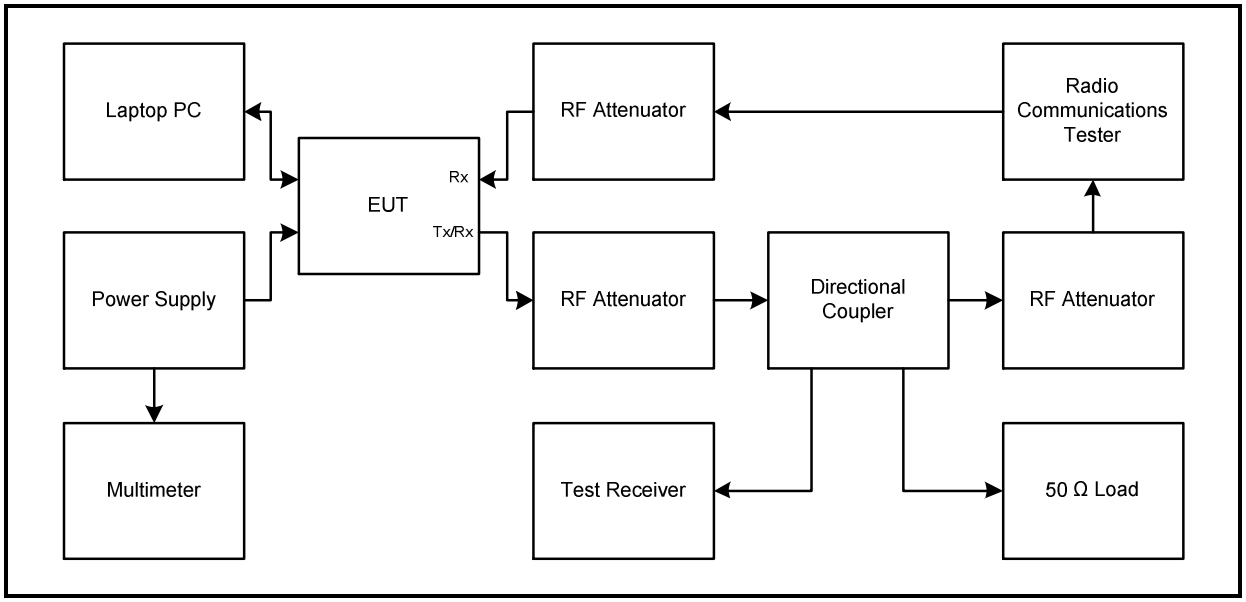
Temperature (°C):	25
Relative Humidity (%):	29

Note(s):

1. Measurements were performed with the EUT transmitting 5 MHz or 10 MHz bandwidths using QPSK or 16QAM modulation schemes.
2. Maximum conducted power was calculated by integrating the spectrum across the OBW of the signal, using the signal analyser's band power measurement function with band limits set equal to the OBW. Measurements of OBW can be found in Section 5.2.2 of this test report.
3. The signal analyser was connected to the Tx/Rx 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 measurement network.
4. The customer stated that the EUT is designed to operate with a maximum antenna gain of 24 dBi. This value has been added to the measured conducted power to obtain the EIRP.
5. This device can operate as a mobile device, therefore the lower EIRP limit of Part 74.636(a) applies. The EIRP limit of 35 dBW was converted to a limit of 65 dBm.
6. Additionally for a mobile device, the maximum allowable transmit power limit in Part 74.636(a) is 12 W. This value was converted to a limit of 40.8 dBm. Note that if the EUT is operated as a fixed device the limit is increased by 10 dBW therefore the test result margins are further increased by 10 dB for EIRP measurements shown in the results table of this report.
7. As the EUT had a constant duty cycle less than 98%, a duty cycle correction of 10 $\log_{10}$ (1/duty cycle) was added to the indicated power to give the mean power (P_{MEAN}). The duty cycle measurement results are shown in Section 5.2.3 of this test report.
8. The signal analyser's number of sweep points was set to greater than twice the span divided by the RBW.

Transmitter Power limitations (continued)

Test setup:



Transmitter Power limitations (continued)

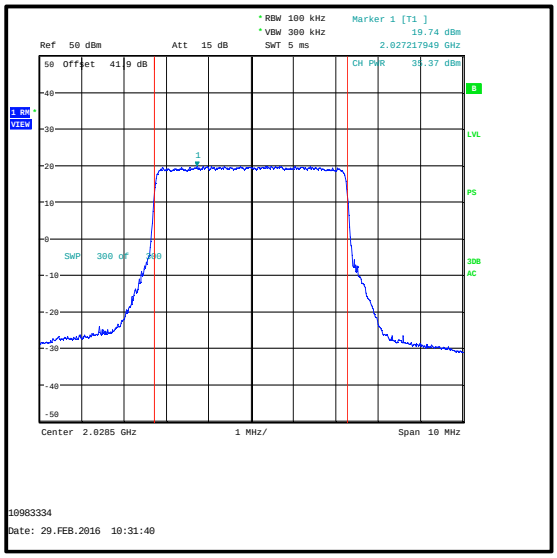
Results: 5 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Modulation	Conducted RF Power (dBm)	Duty cycle correction (dB)	Mean Conducted RF Power (dBm)	RF Power Limit for Mobile (dBm)	Margin (dB)	Result
2028.5	QPSK	35.4	2.3	37.7	40.8	3.1	Complied
2067.5	QPSK	35.5	2.3	37.8	40.8	3.0	Complied
2106.5	QPSK	35.2	2.3	37.5	40.8	3.3	Complied

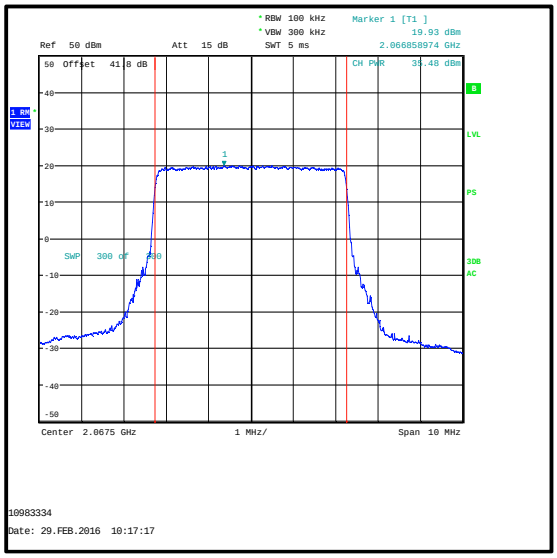
Frequency (MHz)	Conducted RF Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit for Mobile (dBm)	Margin (dB)	Result
2028.5	37.7	24.0	61.7	65.0	3.3	Complied
2067.5	37.8	24.0	61.8	65.0	3.2	Complied
2106.5	37.5	24.0	61.5	65.0	3.5	Complied

Transmitter Power limitations (continued)

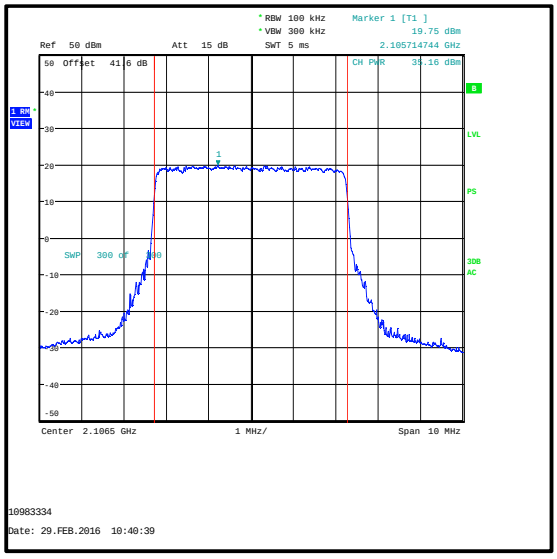
Results: 5 MHz / QPSK



QPSK / Bottom Channel



QPSK / Middle Channel



QPSK / Top Channel

Transmitter Power limitations (continued)

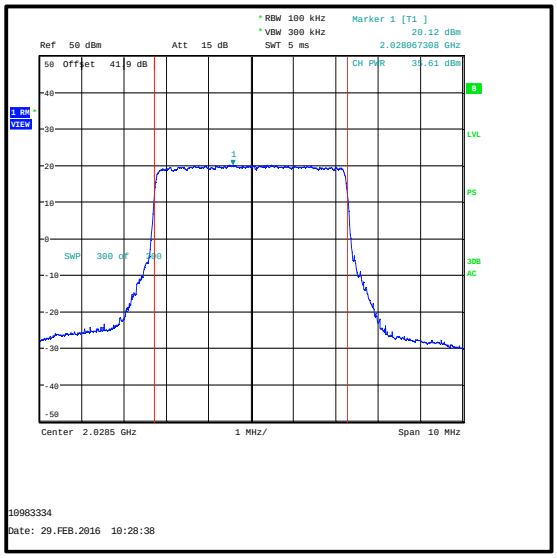
Results: 5 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Modulation	Conducted RF Power (dBm)	Duty cycle correction (dB)	Mean Conducted RF Power (dBm)	RF Power Limit for Mobile (dBm)	Margin (dB)	Result
2028.5	16QAM	35.6	2.3	37.9	40.8	2.9	Complied
2067.5	16QAM	35.7	2.3	38.0	40.8	2.8	Complied
2106.5	16QAM	35.5	2.3	37.8	40.8	3.0	Complied

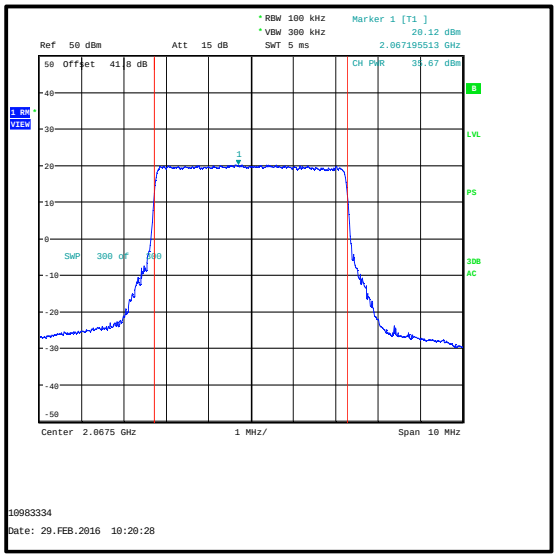
Frequency (MHz)	Conducted RF Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit for Mobile (dBm)	Margin (dB)	Result
2028.5	37.9	24.0	61.9	65.0	3.1	Complied
2067.5	38.0	24.0	62.0	65.0	3.0	Complied
2106.5	37.8	24.0	61.8	65.0	3.2	Complied

Transmitter Power limitations (continued)

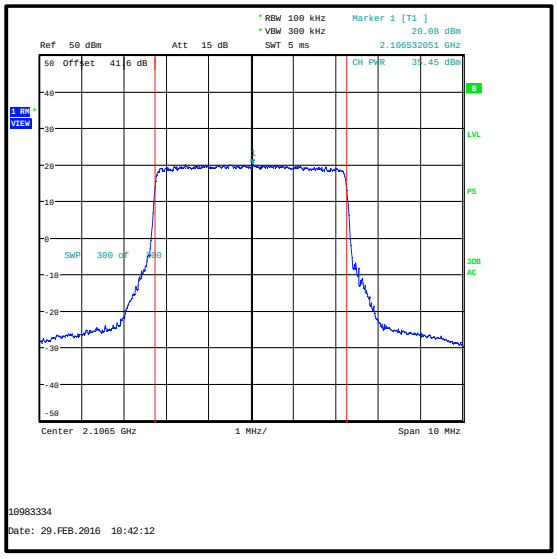
Results: 5 MHz / 16QAM



16QAM / Bottom Channel



16QAM / Middle Channel



16QAM / Top Channel

Transmitter Power limitations (continued)

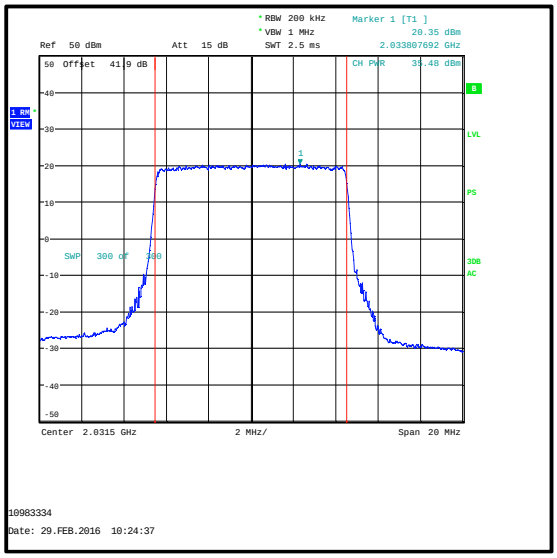
Results: 10 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Modulation	Conducted RF Power (dBm)	Duty cycle correction (dB)	Mean Conducted RF Power (dBm)	RF Power Limit for Mobile (dBm)	Margin (dB)	Result
2031.5	QPSK	35.5	2.3	37.8	40.8	3.0	Complied
2067.5	QPSK	35.8	2.3	38.1	40.8	2.7	Complied
2103.5	QPSK	35.2	2.3	37.5	40.8	3.3	Complied

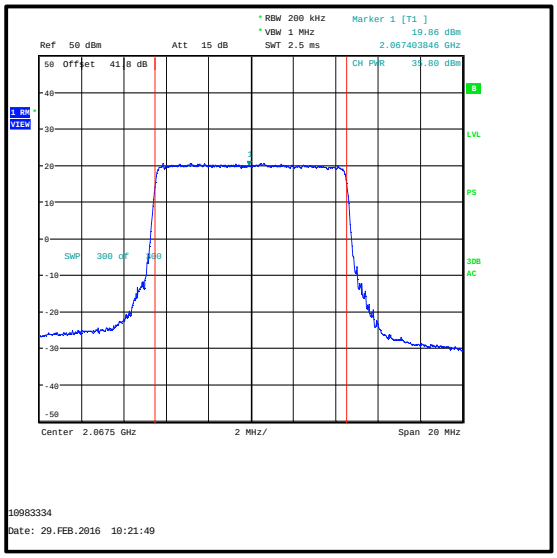
Frequency (MHz)	Conducted RF Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit for Mobile (dBm)	Margin (dB)	Result
2031.5	37.8	24.0	61.8	65.0	3.2	Complied
2067.5	38.1	24.0	62.1	65.0	2.9	Complied
2103.5	37.5	24.0	61.5	65.0	3.5	Complied

Transmitter Power limitations (continued)

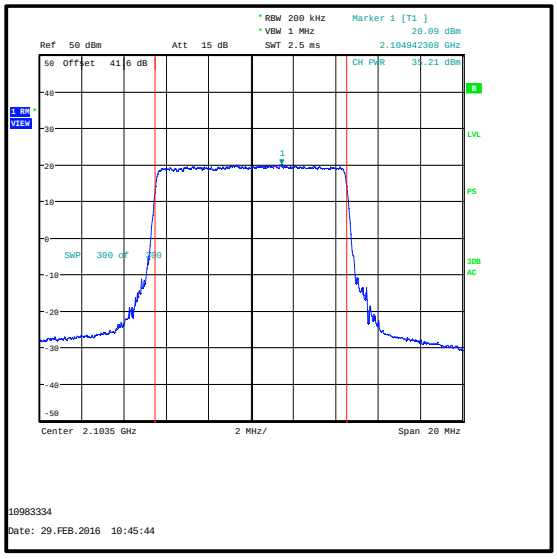
Results: 10 MHz / QPSK



QPSK / Bottom Channel



QPSK / Middle Channel



QPSK / Top Channel

Transmitter Power limitations (continued)

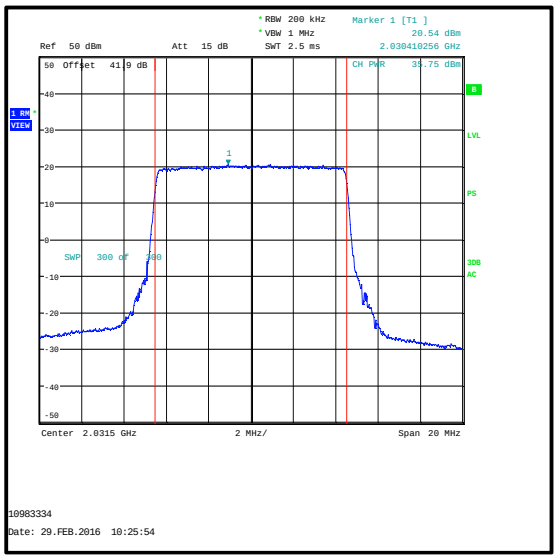
Results: 10 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Modulation	Conducted RF Power (dBm)	Duty cycle correction (dB)	Mean Conducted RF Power (dBm)	RF Power Limit for Mobile (dBm)	Margin (dB)	Result
2031.5	16QAM	35.8	2.2	38.0	40.8	2.8	Complied
2067.5	16QAM	35.8	2.2	38.0	40.8	2.8	Complied
2103.5	16QAM	35.8	2.2	38.0	40.8	2.8	Complied

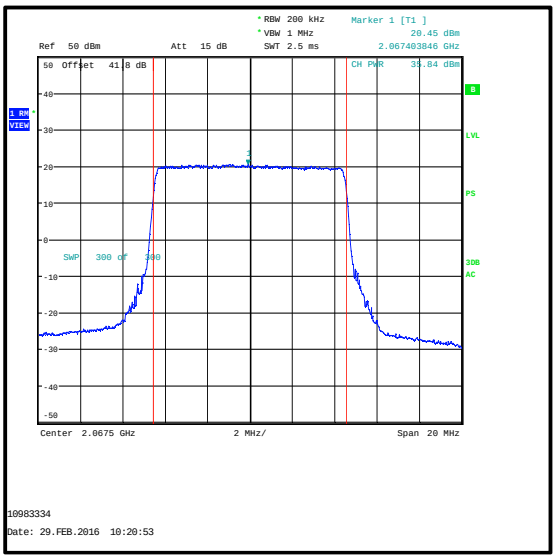
Frequency (MHz)	Combined Conducted RF Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit for Mobile (dBm)	Margin (dB)	Result
2031.5	38.0	24.0	62.0	65.0	3.0	Complied
2067.5	38.0	24.0	62.0	65.0	3.0	Complied
2103.5	38.0	24.0	62.0	65.0	3.0	Complied

Transmitter Power limitations (continued)

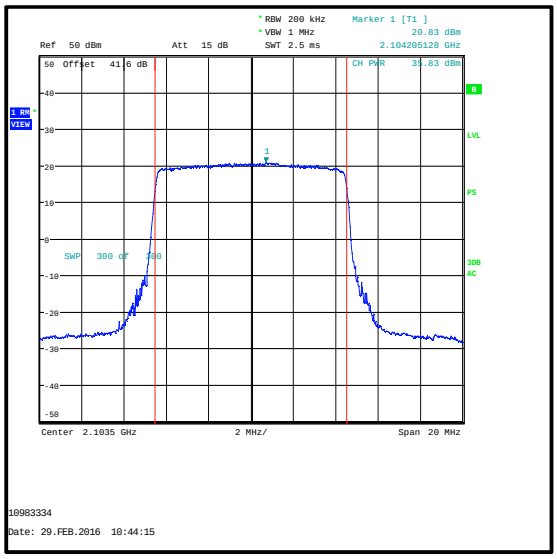
Results: 10 MHz / 16QAM



16QAM / Bottom Channel



16QAM / Middle Channel



16QAM / Top Channel

Transmitter Power limitations (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	23 Apr 2016	12
A1397	Attenuator	Weinschel Associates	WA46-20	A128	Calibrated before use	-
A2534	Directional Coupler	AtlanTecRF	CDC-003060-20	14041701718	Calibrated before use	-
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	12 Jun 2016	12
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	18 Jul 2016	36
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	08 Apr 2016	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	23 Apr 2016	24

5.2.2. Transmitter Occupied Bandwidth

Test Summary:

Test Engineer:	Keith Tucker	**Test Date:**	17 February 2016
Test Sample Serial Number:	BBRBG010042A		

FCC Reference:	Part 2.1049
Test Method Used:	KDB 971168 D01 Section 4.2

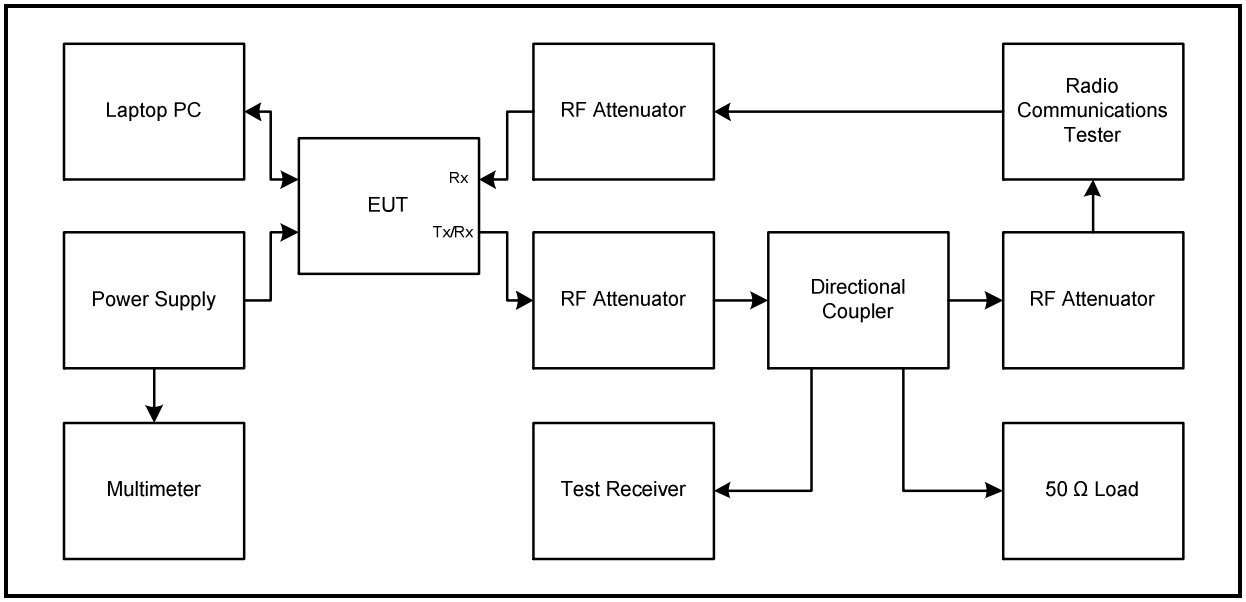
Environmental Conditions:

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

Note(s):

1. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes.
2. The 99% emission bandwidth was measured using the signal analyser occupied bandwidth function. The resolution bandwidth was set in the range of 1% to 5% of the occupied bandwidth and the video bandwidth set to at least 3 times the resolution bandwidth. A peak detector was used.

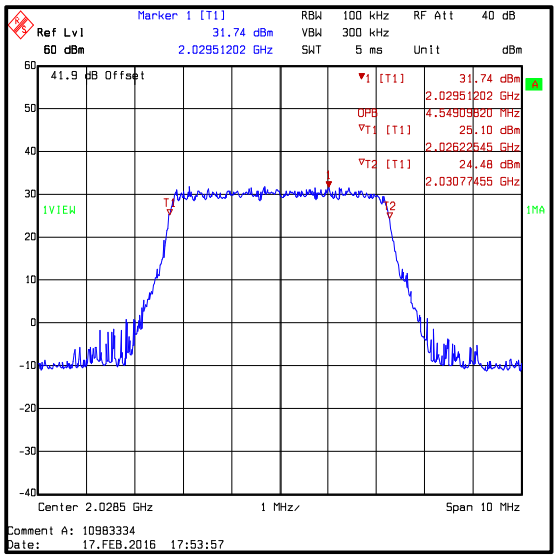
Test setup:



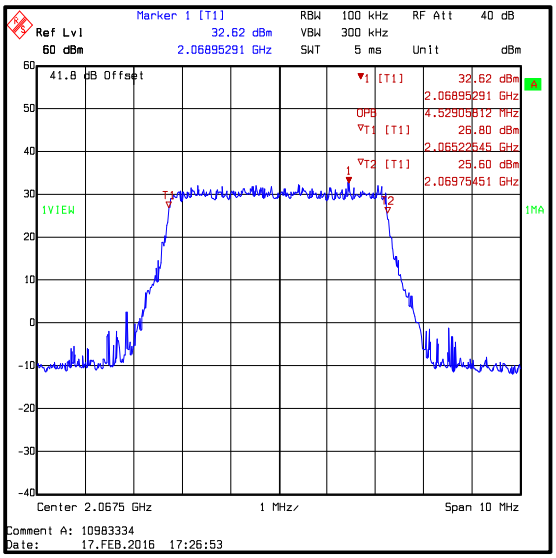
Transmitter Occupied Bandwidth (continued)

Results: 5 MHz Channel Bandwidth

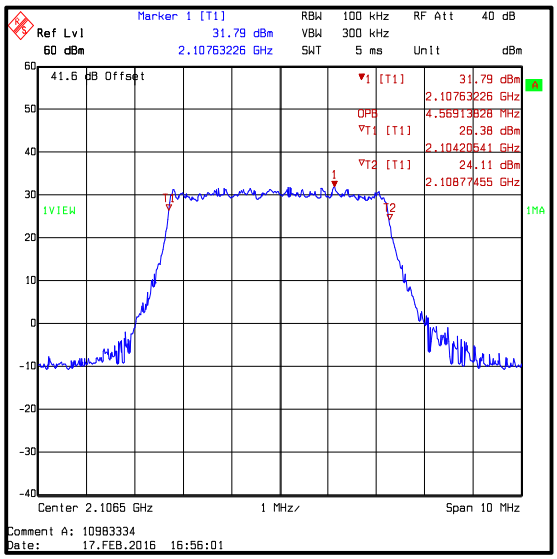
Frequency (MHz)	Modulation	Resource Blocks	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2028.5	QPSK	25	100	300	4.549
2067.5	QPSK	25	100	300	4.529
2106.5	QPSK	25	100	300	4.569



QPSK / Bottom Channel



QPSK / Middle Channel

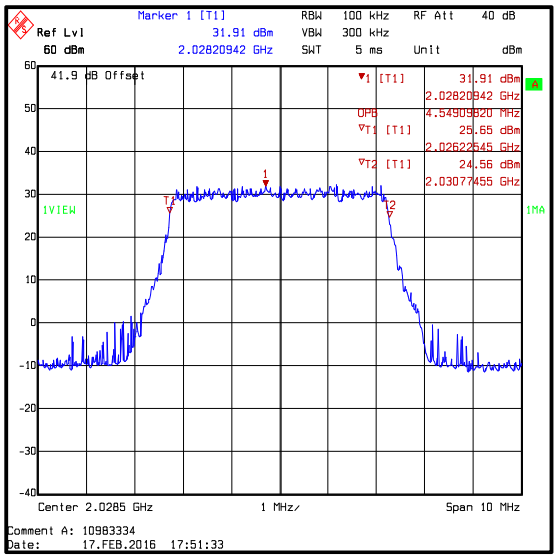


QPSK / Top Channel

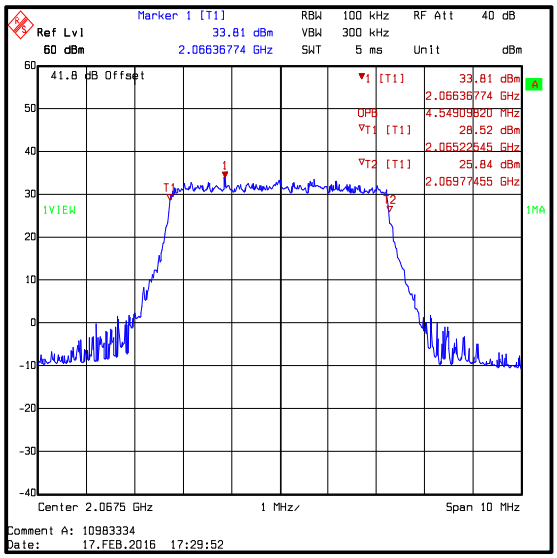
Transmitter Occupied Bandwidth (continued)

Results: 5 MHz Channel Bandwidth

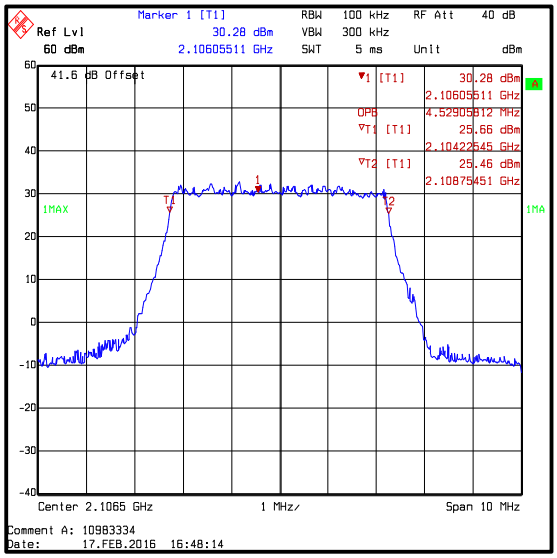
Frequency (MHz)	Modulation	Resource Blocks	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2028.5	16QAM	25	100	300	4.549
2067.5	16QAM	25	100	300	4.549
2106.5	16QAM	25	100	300	4.529



16QAM / Bottom Channel



16QAM / Middle Channel

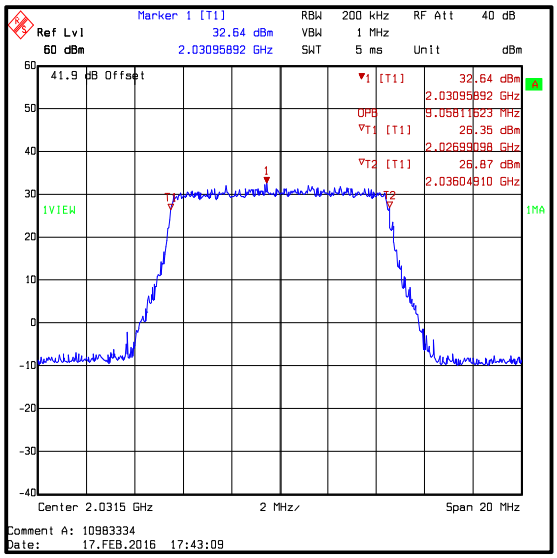


16QAM / Top Channel

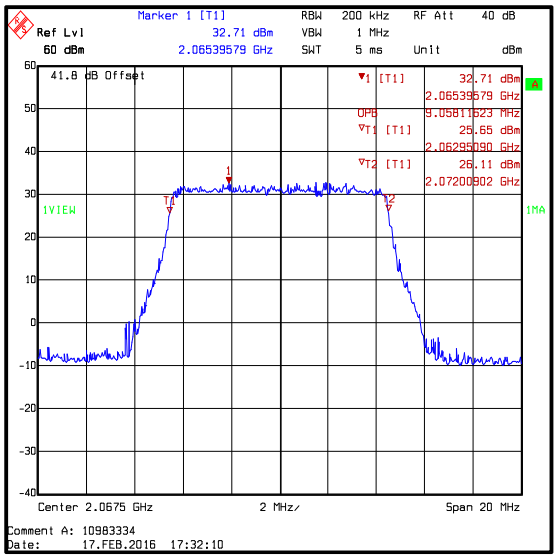
Transmitter Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth

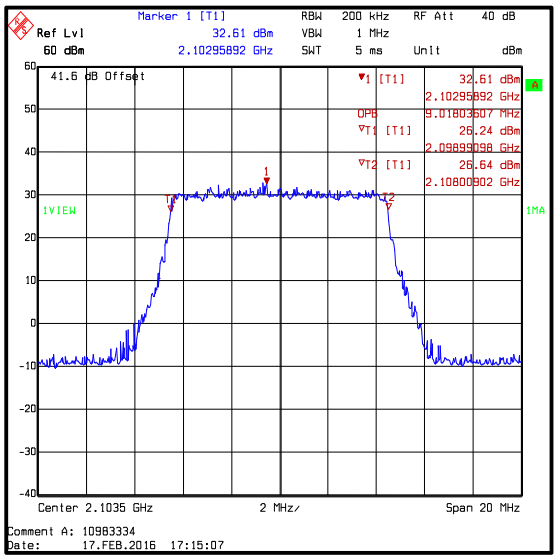
Frequency (MHz)	Modulation	Resource Blocks	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2031.5	QPSK	50	200	1000	9.058
2067.5	QPSK	50	200	1000	9.058
2103.5	QPSK	50	200	1000	9.018



QPSK / Bottom Channel



QPSK / Middle Channel

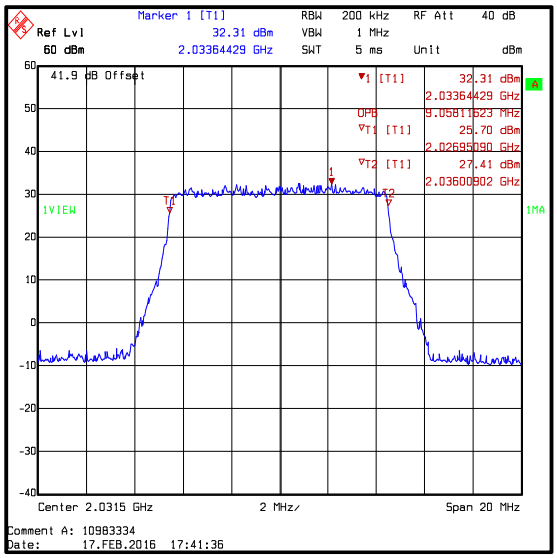


QPSK / Top Channel

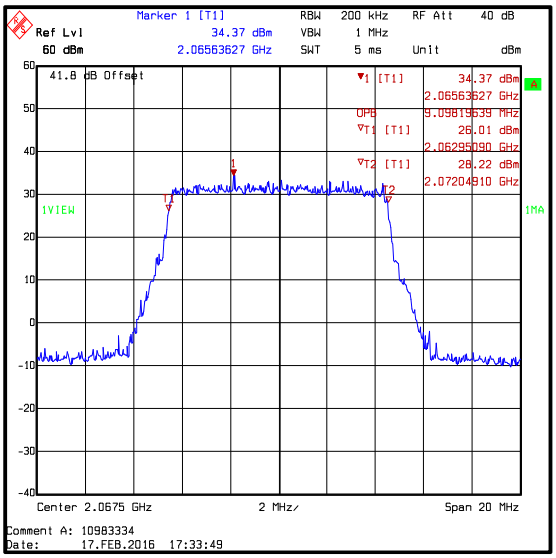
Transmitter Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth

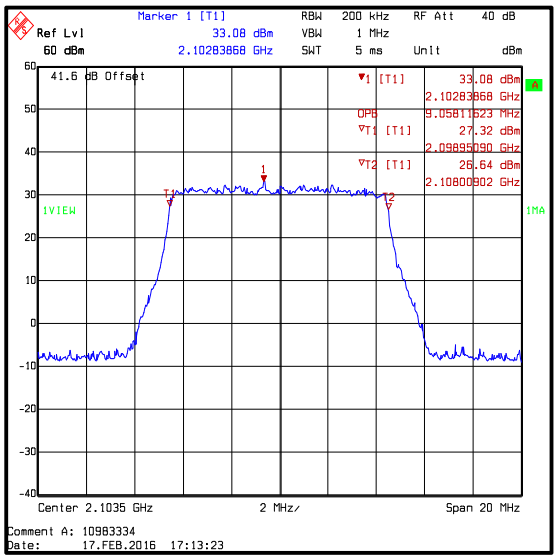
Frequency (MHz)	Modulation	Resource Blocks	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
2031.5	16QAM	50	200	1000	9.058
2067.5	16QAM	50	200	1000	9.098
2103.5	16QAM	50	200	1000	9.058



16QAM / Bottom Channel



16QAM / Middle Channel



16QAM / Top Channel

Transmitter Occupied 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	None stated	23 Apr 2016	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB30	842659/016	11 Aug 2016	12
A296	Attenuator	Narda	766-20	167	Calibrated before use	-
A1397	Attenuator	Weinschel Associates	WA46-20	A128	Calibrated before use	-
A2534	Directional Coupler	AtlanTecRF	CDC-003060-20	14041701718	Calibrated before use	-
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	18 Jul 2016	36
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	08 Apr 2016	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	23 Apr 2016	24

5.2.3. Transmitter Duty Cycle

Test Summary:

Test Engineer:	Keith Tucker	**Test Date:**	15 February 2016
Test Sample Serial Number:	BBRBG010042A		

FCC Reference:	Part 74.636
Test Method Used:	FCC KDB 971168 Section 5.2.2

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	39

Note(s):

1. In order to assist with the determination of the mean power during the transmission time, measurements of duty cycle were made. The transmission burst duration and the total transmission cycle period were measured using a spectrum analyser in the time domain with duty cycle and power correction calculated by using the following calculations:

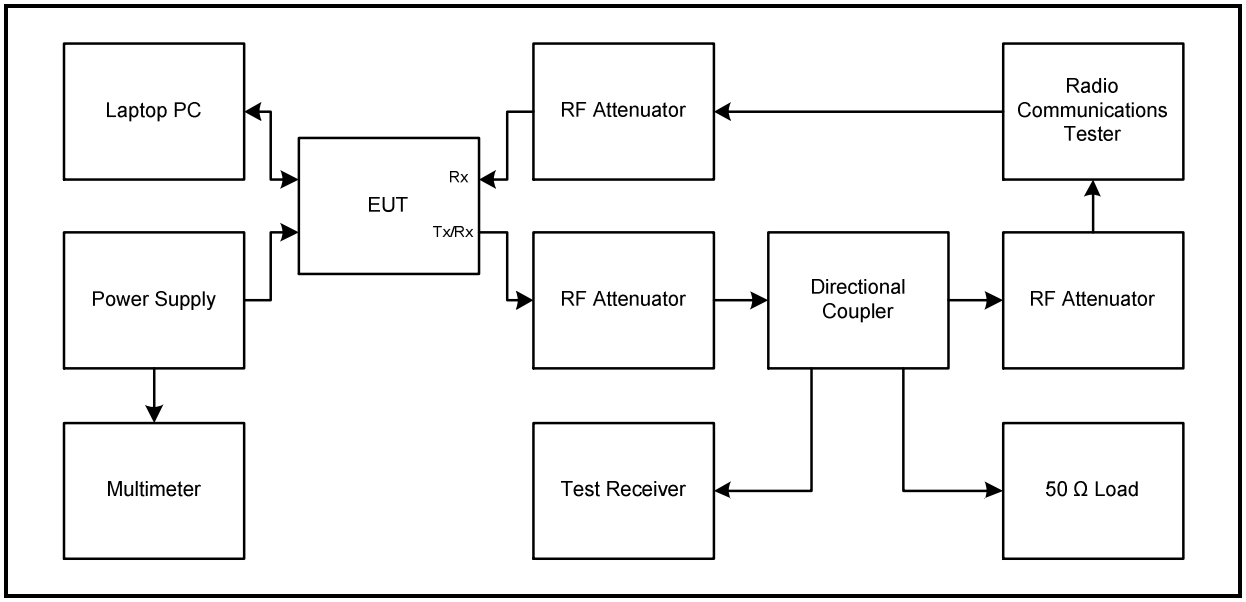
   Duty Cycle = (Transmission On Time / Transmission on + off period)

   Duty Cycle correction (dB) = 10 $\log_{10}$ (1/Duty Cycle).

2. Spectrum analyser zero span method of KDB 971168 Section 5.2.2 was used to measure the duty cycle. The analyser plot used 500 points distributed over 12 ms such that 1 point equates to 24 µs. For a transmission burst of 3 ms, this is considered to be sufficient to permit accurate measurement of the burst duty cycle. 24 µs as a percentage of the burst is 0.8% *(100 x 0.024/3)* or ±0.4%, and equivalent to a variation of ±0.028 dB or less when corrected as Note 1.

3. The duty cycle of both 5 MHz and 10 MHz bandwidths for both QPSK and 16QAM modulation was measured. The duty cycle was independent of carrier frequency.

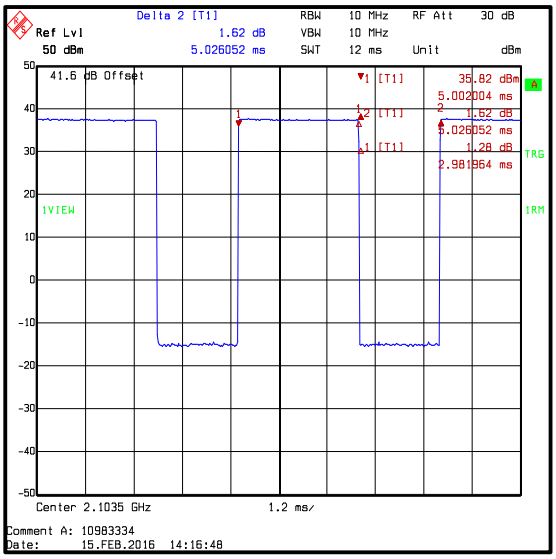
Test setup:



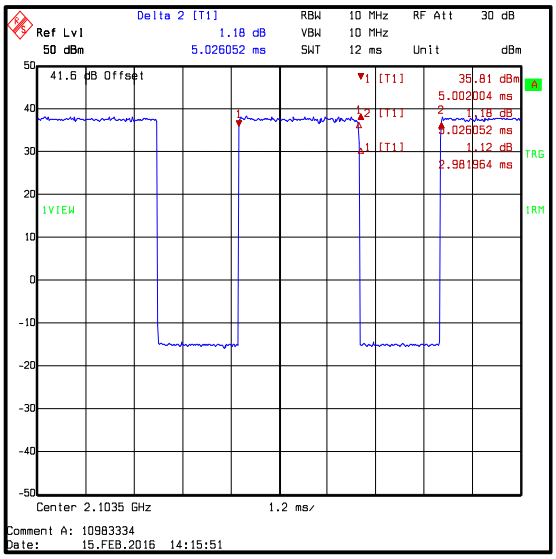
Transmitter Duty Cycle (continued)

Results: 5 MHz bandwidth

Modulation	Pulse Duration (ms)	Period (ms)	Duty cycle (%)	Duty cycle correction (dB)
QPSK	2.9820	5.0261	59.3	2.3
16QAM	2.9820	5.0261	59.3	2.3



QPSK

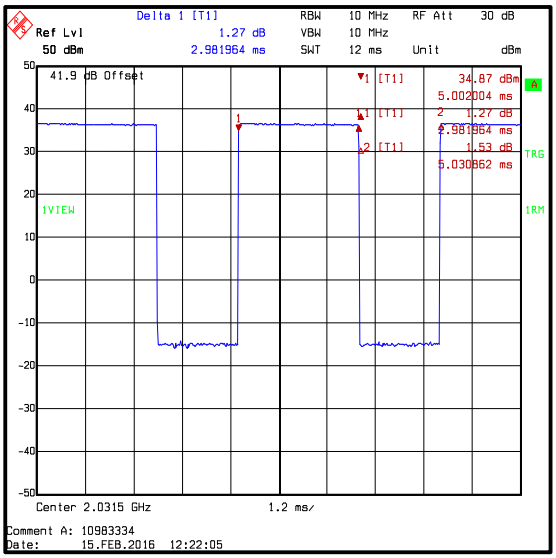


16QAM

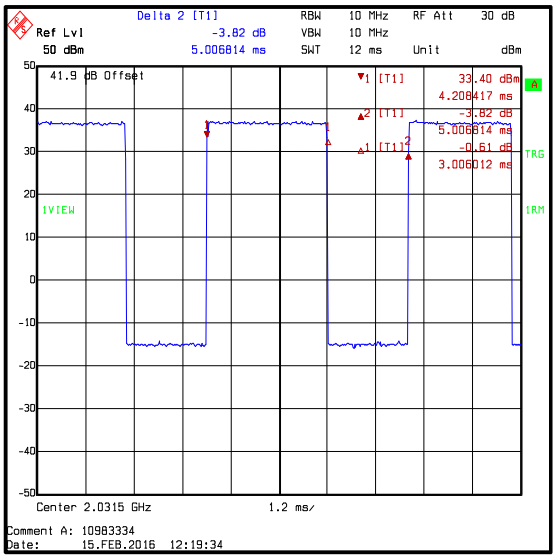
Transmitter Duty Cycle (continued)

Results: 10 MHz bandwidth

Modulation	Pulse Duration (ms)	Period (ms)	Duty cycle (%)	Duty cycle correction (dB)
QPSK	2.982	5.031	59.3	2.3
16QAM	3.006	5.007	60.0	2.2



QPSK



16QAM

Transmitter Duty Cycle (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	None stated	23 Apr 2016	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB30	842659/016	11 Aug 2016	12
A1397	Attenuator	Weinschel Associates	WA46-20	A128	Calibrated before use	-
A2534	Directional Coupler	AtlanTecRF	CDC-003060-20	14041701718	Calibrated before use	-
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	18 Jul 2016	36
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	08 Apr 2016	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	23 Apr 2016	24

5.2.4. Transmitter Conducted Emission Mask

Test Summary:

Test Engineer:	Keith Tucker	**Test Date:**	29 February 2016
Test Sample Serial Number:	BBRBG010042A		

FCC Reference:	Parts 74.637(a)(2)(i), 74.637(c)(3), 2.1051 and notes below
Test Method Used:	KDB 971168 D01 Section 6.0

Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	29

Note(s):

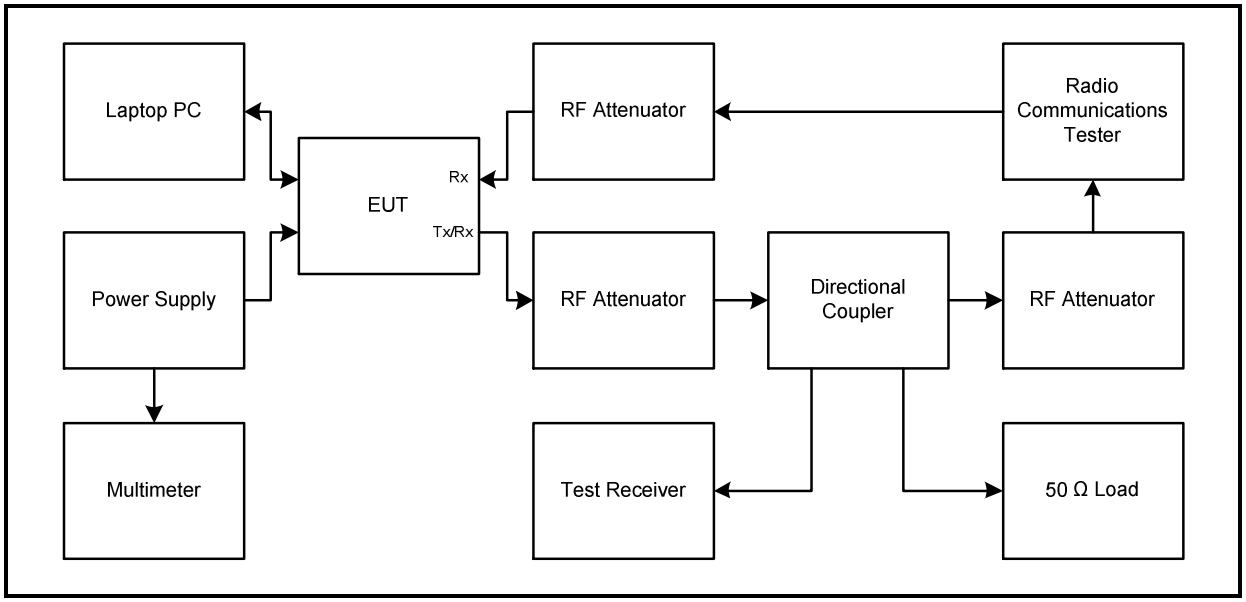
1. Measurements were performed with the EUT transmitting with 5 MHz and 10 MHz channel bandwidths, using QPSK and 16QAM modulation schemes, with full resource blocks.
2. Calculations of the emission mask specified in Part 74.637(a)(2)(i), were performed using 6 and 12 MHz as values for the authorised bandwidth, for the 5 and 10 MHz channel bandwidths respectively. The authorised bandwidth and mask parameters were established in pre-filing KDB inquiry consultation with FCC Lab.
3. The emission mask defined in Part 74.637(a)(2)(i), is based on the use of a 4 kHz resolution bandwidth (B_{REF}). The nearest resolution bandwidth (B_{RES}) of the signal analyser used at or above the 4 kHz reference bandwidth was 5 kHz. Measurements were performed with the signal analyser's resolution bandwidth set to 5 kHz. In accordance with Part 74.637(c)(3), attenuation requirements were therefore decreased by a factor of 1 dB:

   $$10\times\log_{10}[(B_{REF} \text{ in megahertz})/(B_{RES} \text{ in megahertz})] = 10*\log_{10}[(4*10^{-3})/(5*10^{-3})] = -1 \text{ dB}$$

4. The mask reference level was set relative to mean carrier power (P_{MEAN}), as presented in Section 5.2.1 of this test report, using the limit line Y-Offset function of the signal analyser. It was set equal to the difference between the signal analyser reference level and the calculated mean power.
5. The signal analyser was connected to the transmit port of the EUT using suitable attenuation and RF cable. An RF level offset was entered on the spectrum analyser to compensate for the path loss of the measurement system.
6. The signal analyser's number of sweep points was set to greater than twice the span divided by the RBW.
7. No mask incursions were observed. The result is compliant.

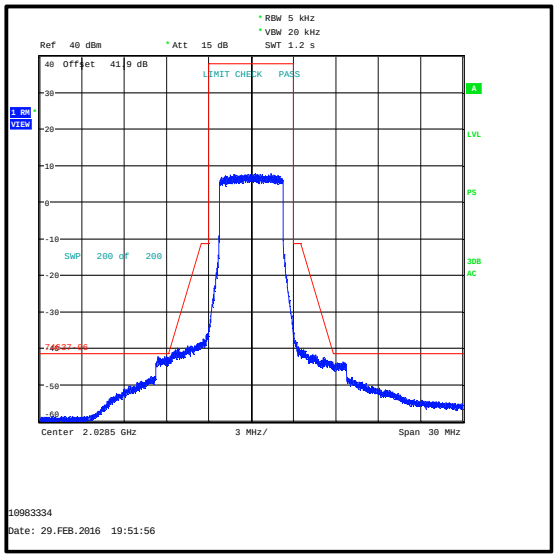
Transmitter Conducted Emission Mask (continued)

Test setup:

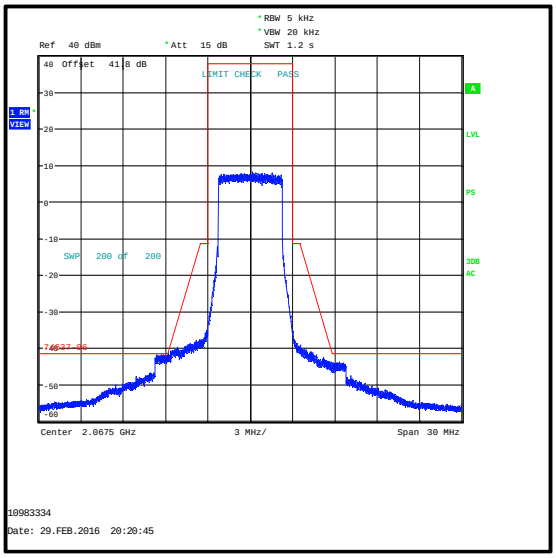


Transmitter Conducted Emission Mask (continued)

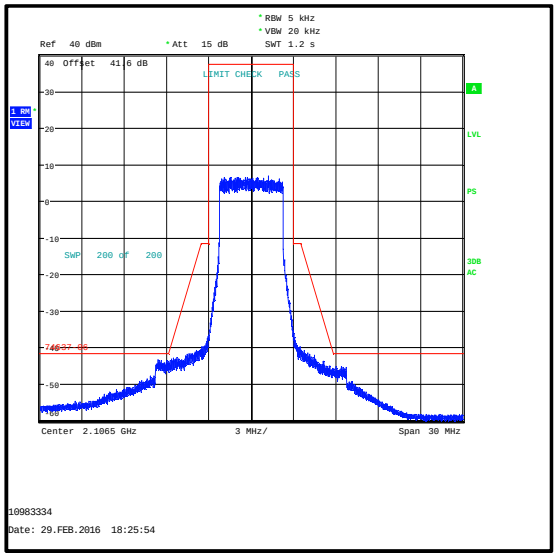
Results: 5 MHz Channel Bandwidth / QPSK



Bottom Channel



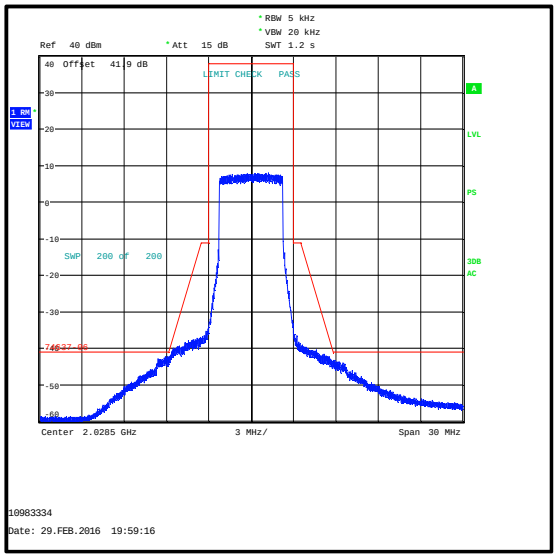
Middle Channel



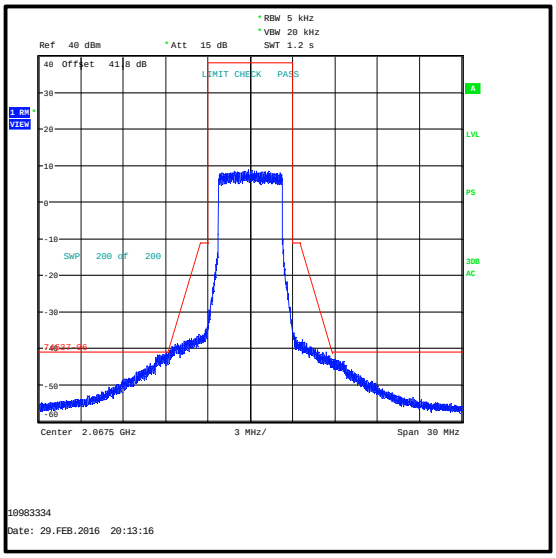
Top Channel

Transmitter Conducted Emission Mask (continued)

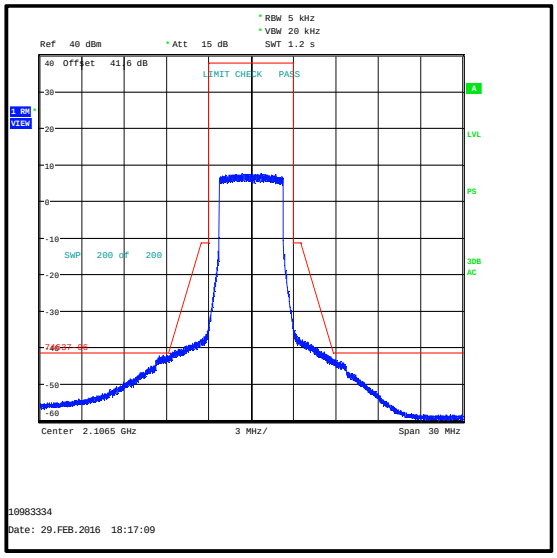
Results: 5 MHz Channel Bandwidth / 16QAM



Bottom Channel



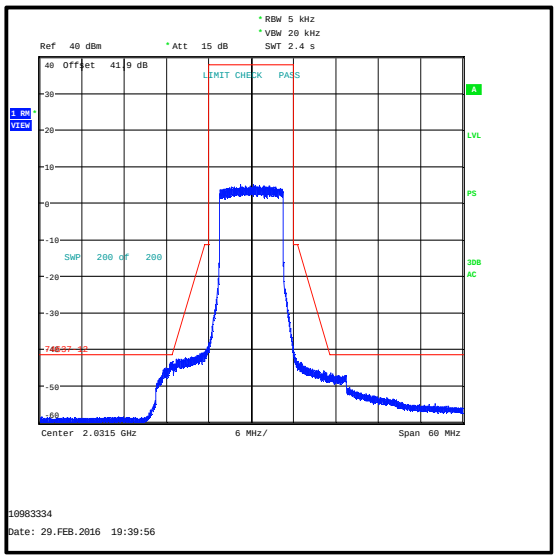
Middle Channel



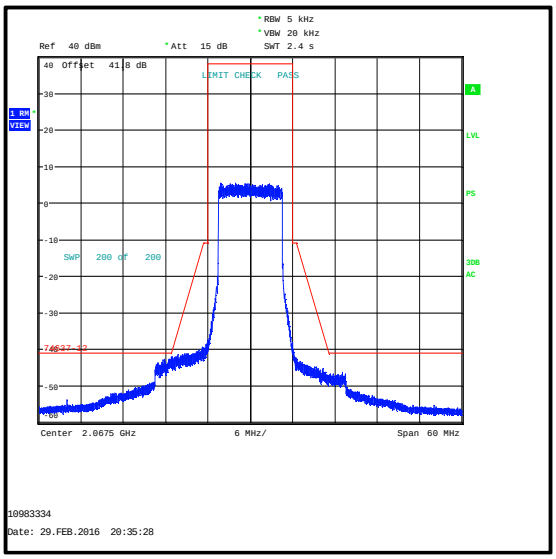
Top Channel

Transmitter Conducted Emission Mask (continued)

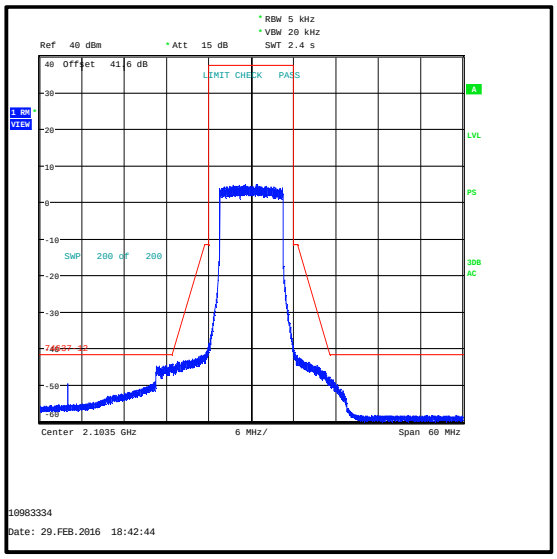
Results: 10 MHz Channel Bandwidth / QPSK



Bottom Channel



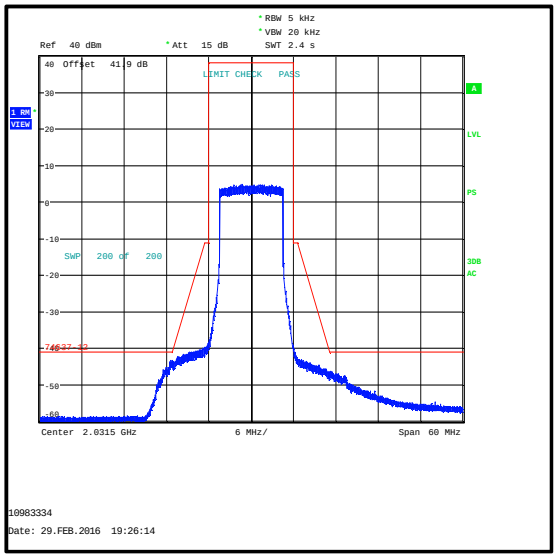
Middle Channel



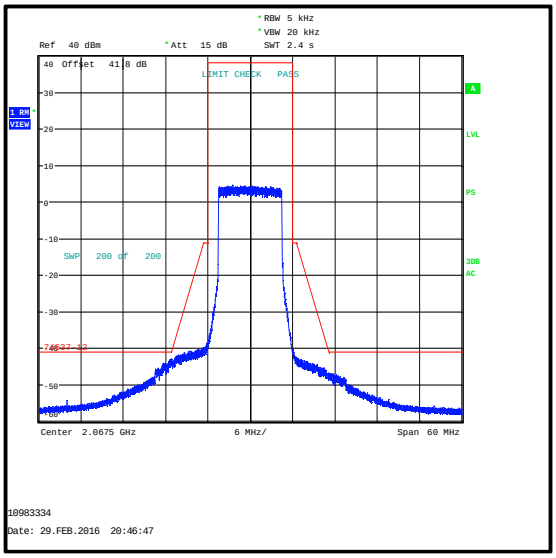
Top Channel

Transmitter Conducted Emission Mask (continued)

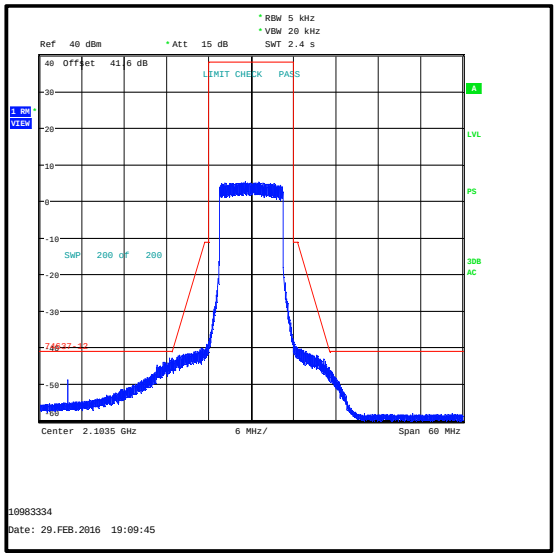
Results: 10 MHz Channel Bandwidth / 16QAM



Bottom Channel



Middle Channel



Top Channel

Transmitter Conducted Emission Mask (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	23 Apr 2016	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	12 Jun 2016	12
A296	Attenuator	Narda	766-20	167	Calibrated before use	-
A1397	Attenuator	Weinschel Associates	WA46-20	A128	Calibrated before use	-
A2534	Directional Coupler	AtlanTecRF	CDC-003060-20	14041701718	Calibrated before use	-
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	18 Jul 2016	36
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	08 Apr 2016	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	23 Apr 2016	24

5.2.5. Transmitter Conducted Emissions

Test Summary:

Test Engineer:	Keith Tucker	**Test Dates:**	23 February 2016 & 24 February 2016
Test Sample Serial Number:	BBRBG010042A		

FCC Reference:	Parts 74.637(a)(2)(iii), 74.637(c)(3) and 2.1051
Test Method Used:	KDB 971168 D01 Section 6.0 & 8.0
Frequency Range:	9 kHz to 22 GHz

Environmental Conditions:

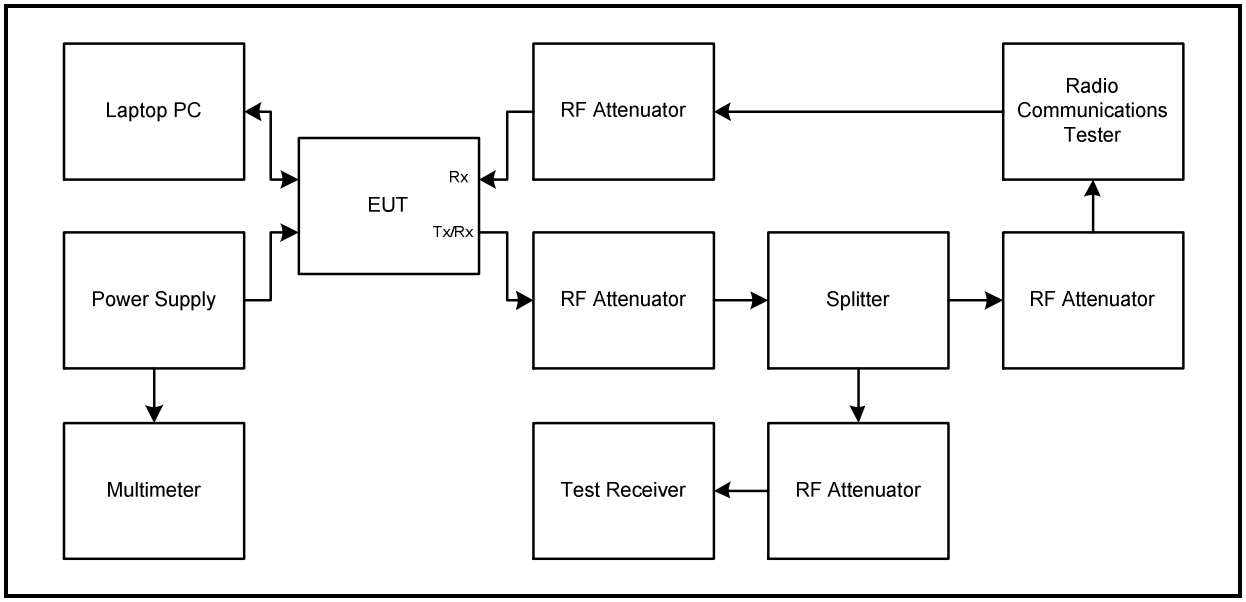
Temperature (°C):	25
Relative Humidity (%):	28 to 32

Note(s):

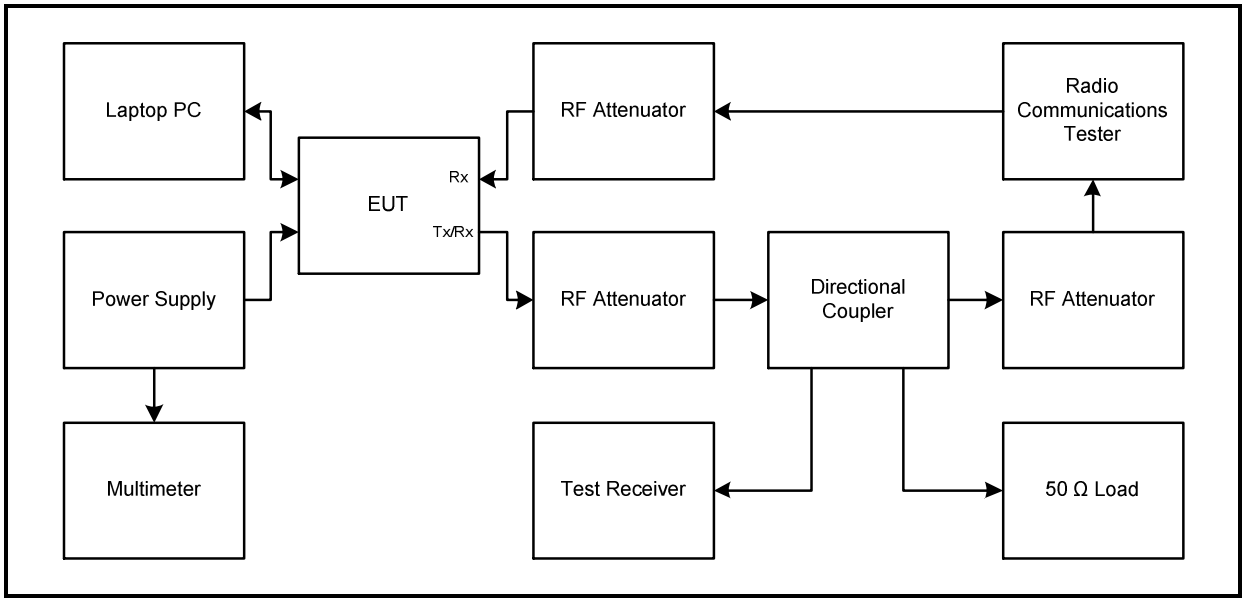
1. Pre-scans were performed with the EUT transmitting at maximum power with 10 MHz Channel Bandwidth using QPSK modulation scheme, as this was found to produce the highest output level and therefore deemed worst case.
2. Testing was performed to 22 GHz, as this was equal to at least the tenth harmonic of the highest fundamental frequency (2106.5 MHz).
3. The frequency range 2037.5 to 2097.5 MHz is less than or equal to ±250% of the authorised bandwidth for the test signal (2067.5 MHz) used, therefore the emission requirement of Part 74.637(c)(3) for this range is tested separately in Section 5.2.5 of this test report.
4. Emission levels measured in the plots below require a compensation factor: Clause 74.637(a)(2)(iii) defines the required emission attenuation level when measured in a 4 kHz reference bandwidth $B_{REF.}$ Part 74.637(c)(3) defines the resolution bandwidth B_{RES} of the measuring instrument but, where B_{RES} and B_{REF} are not equal, requires a correction of $10 \times log_{10}[(B_{REF} \text{ in megahertz})/(B_{RES} \text{ in megahertz})]$ decibels.
5. The signal analyser's number of sweep points was set to greater than twice the span divided by the RBW
6. All emissions were >20 dB below the applicable limit or below the level of the noise floor of the measuring receiver, therefore the highest emission level in each measurement range has been recorded in the table below.

Transmitter Conducted Emissions (continued)

Test setup 9 kHz to 1 GHz:



Test setup 1 GHz to 22 GHz:



Transmitter Conducted Emissions (continued)

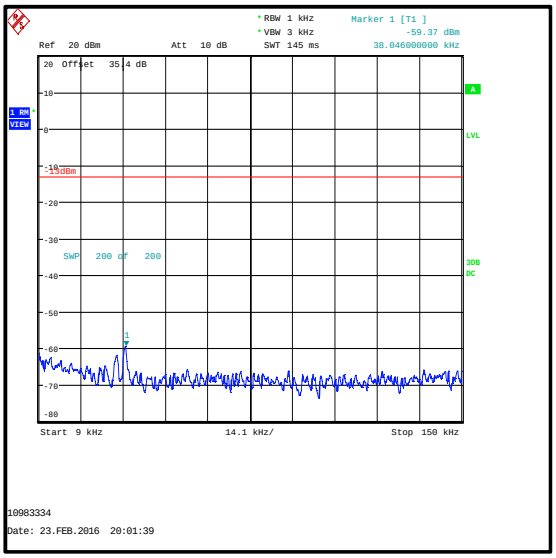
Results: 10 MHz Channel Bandwidth / Middle Channel / QPSK

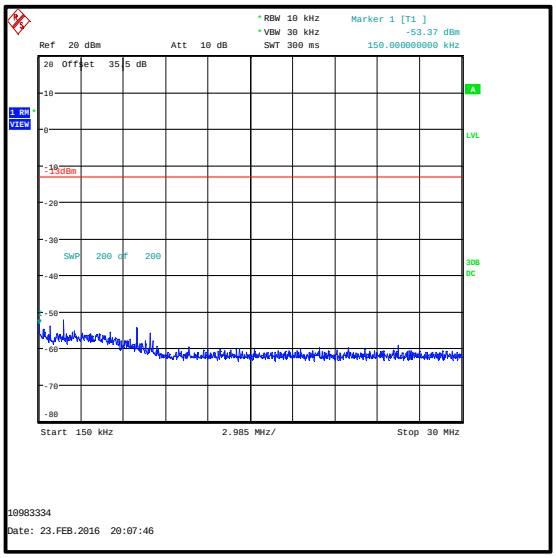
Measurement Range (MHz)	Measured Peak Emission Level (dBm)	Resolution Bandwidth B_{RES} (kHz)	Correction factor (dB) for B_{REF} = 4 kHz	Corrected Peak Emission Level (dBm)
0.009 to 0.15	-59.4	1	6.0	-53.4
0.15 to 30	-53.4	10	-4.0	-57.4
30 to 1000	-56.3	100	-14.0	-70.3
1000 to 22000	-35.8	1000	-24.0	-59.8

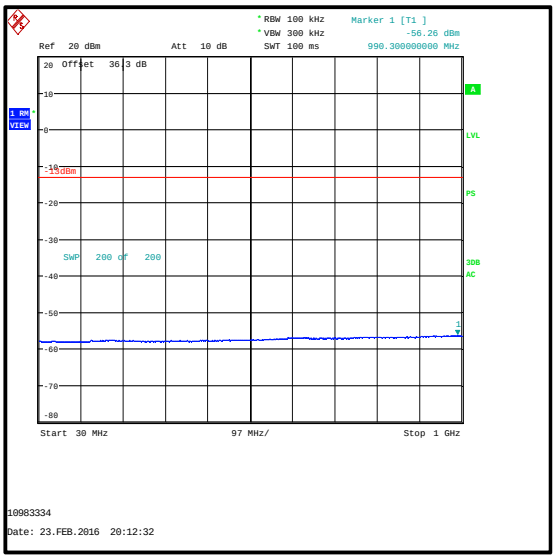
Results: Highest level emission

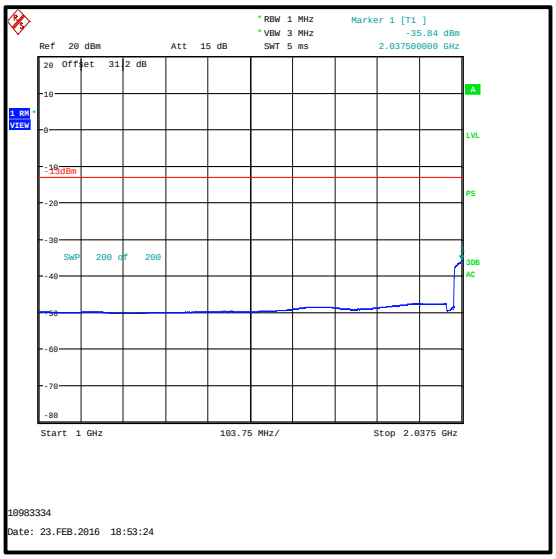
Peak Emission Frequency (kHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
38.046	-53.4	-13.0	40.4	Complied

Transmitter Conducted Emissions (continued)



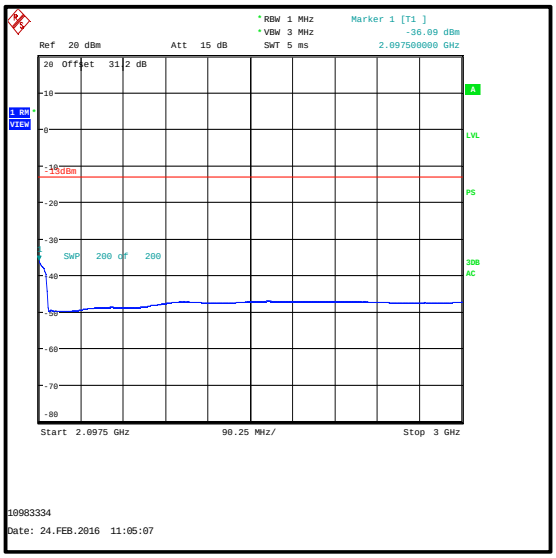


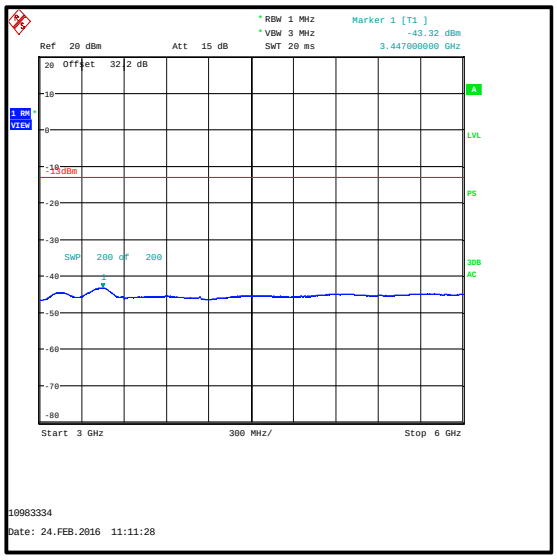


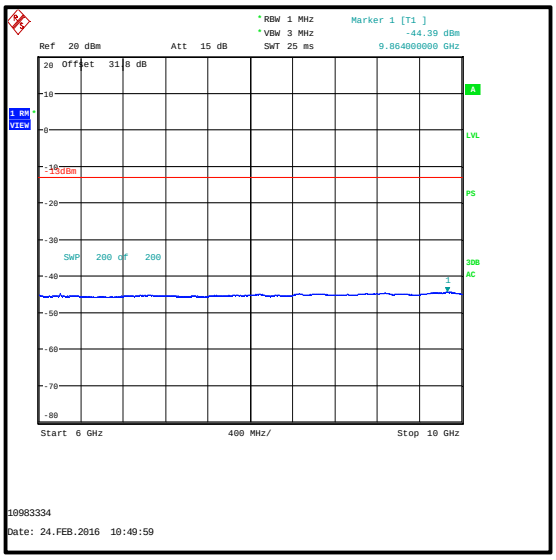


Transmitter Conducted Emissions (continued)

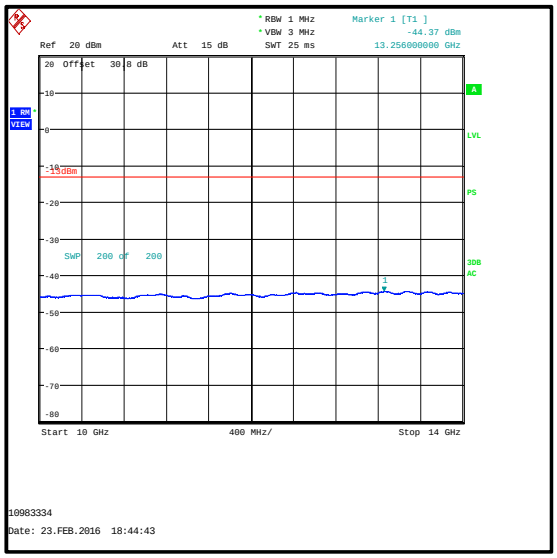
2037.5 MHz to 2097.5 MHz
Refer to Transmitter Conducted Emission Mask section of this test report

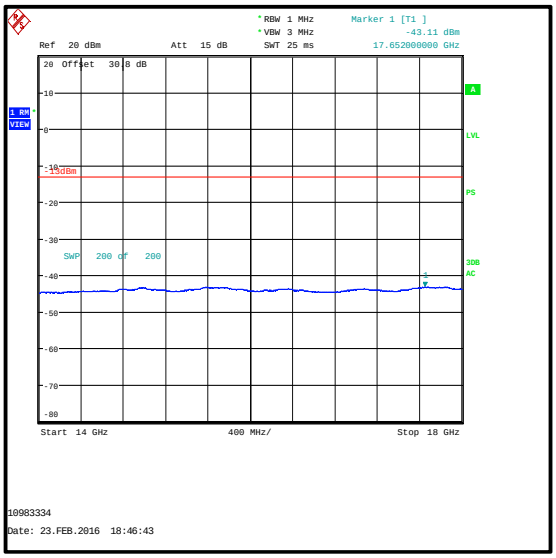


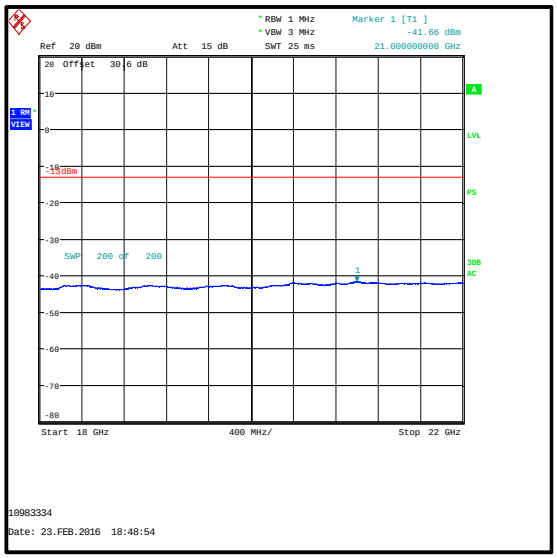




Transmitter Conducted Emissions (continued)







Transmitter Conducted Emissions (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1785	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	23 Apr 2016	12
M1590	Spectrum Analyser	Rohde & Schwarz	ESU26	100239	10 Feb 2017	12
A2140	Attenuator	AtlanTecRF	AN18-10	090918-14	14 May 2016	12
A1397	Attenuator	Weinschel Associates	WA46-20	A128	Calibrated before use	-
A1271	Power Splitter	Mini Circuits	ZFRSC-42	001	Calibrated before use	-
A1100	Directional Coupler	Hewlett Packard	HP87300C	3239A01058	Calibrated before use	-
A1975	High Pass Filter	AtlanTecRF	AFH-03000	83640A	17 Apr 2016	12
G047	Signal Generator	Rohde & Schwarz	SMY01	843 215/015	24 Jul 2016	12
M1252	Signal Generator	Hewlett Packard	83640A	3119A00489	26 Oct 2017	24
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	18 Jul 2016	36
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	08 Apr 2016	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	23 Apr 2016	24

5.2.6. Transmitter Radiated Spurious Emissions

Test Summary:

Test Engineer:	Nick Steele	**Test Dates:**	25 February 2016 & 26 February 2016
Test Sample Serial Number:	BBRBG010042A		

FCC Reference:	Parts 74.637(a)(2)(iii), 74.637(c)(3), 2.1053 and notes below
Test Method Used:	KDB 971168 D01 Section 6.1
Frequency Range:	30 MHz to 22 GHz

Environmental Conditions:

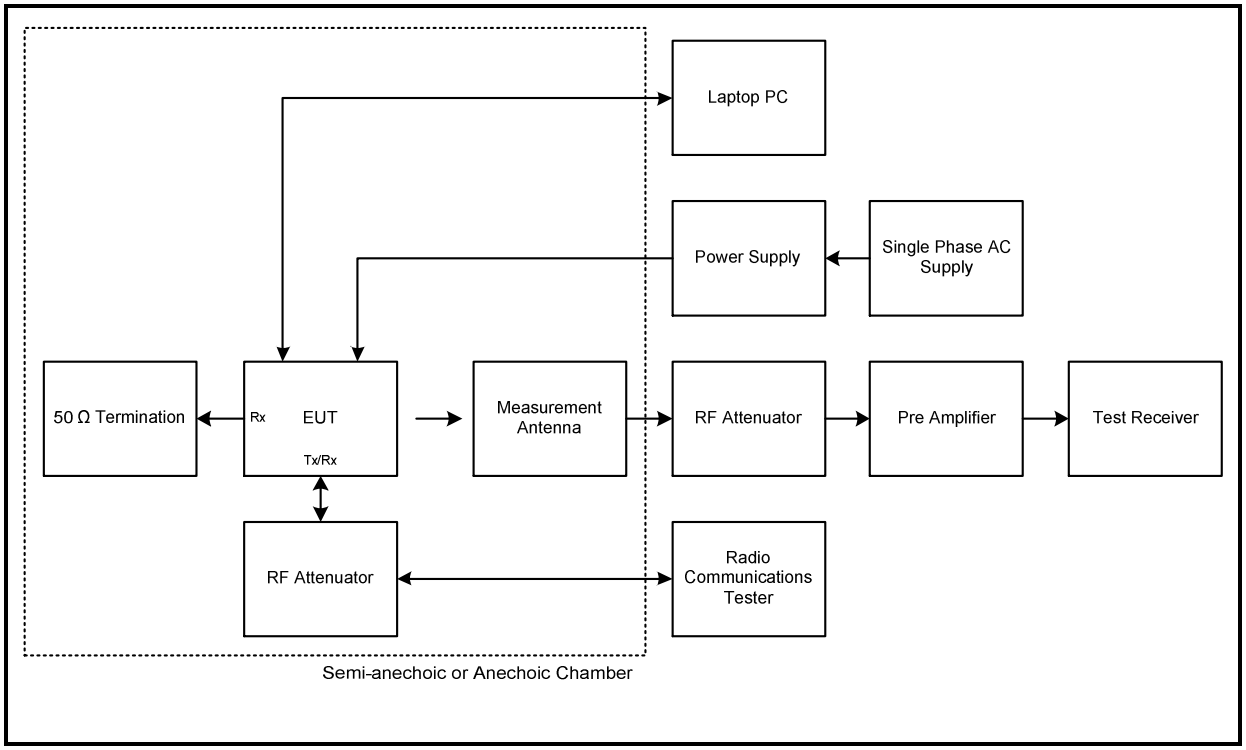
Temperature (°C):	22 to 24
Relative Humidity (%):	30

Note(s):

1. Pre scans were performed with the EUT was set to transmit with a 10 MHz channel bandwidth with QPSK modulation and full Resource Blocks, as this was found to have the highest output power.
2. The emission seen on the 1 GHz to 4 GHz plot at approximately 2067.5 MHz is the EUT carrier.
3. 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.
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.

Transmitter Radiated Spurious Emissions (continued)

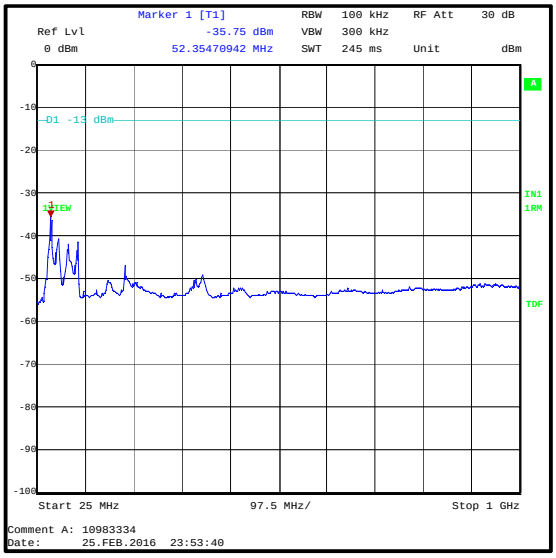
Test setup:

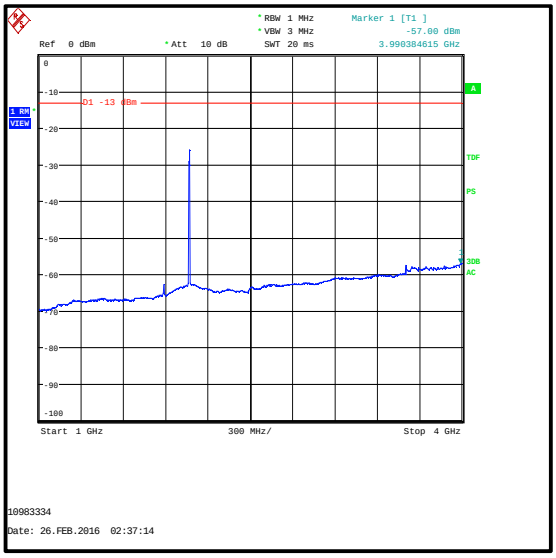


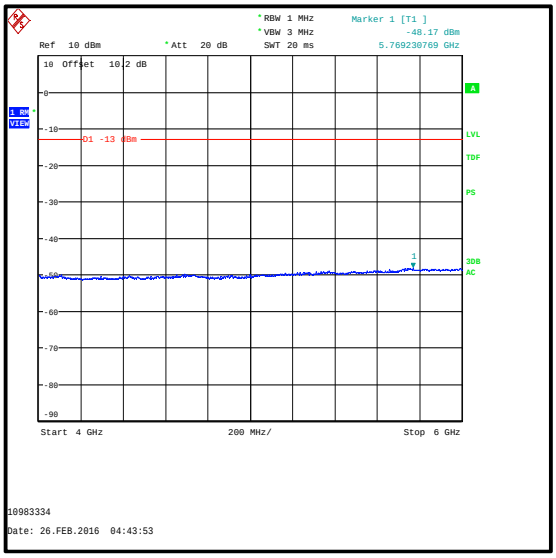
Transmitter Radiated Spurious Emissions (continued)

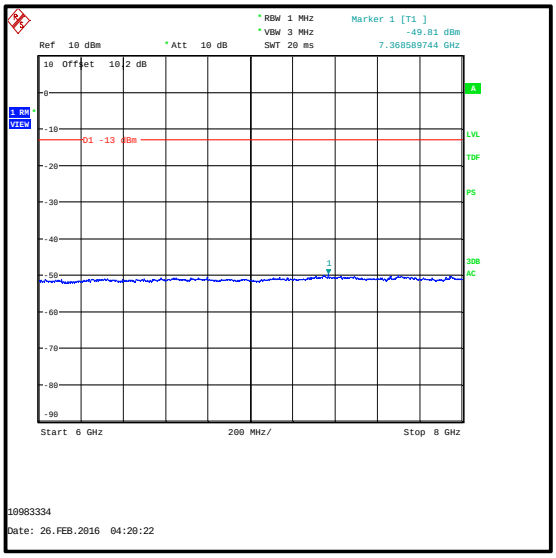
Results:

Frequency (MHz)	Antenna Polarity	Level (dBm)	Limit (dBm)	Margin (dB)	Result
18000.000	Vertical	-36.3	-13.0	23.3	Complied

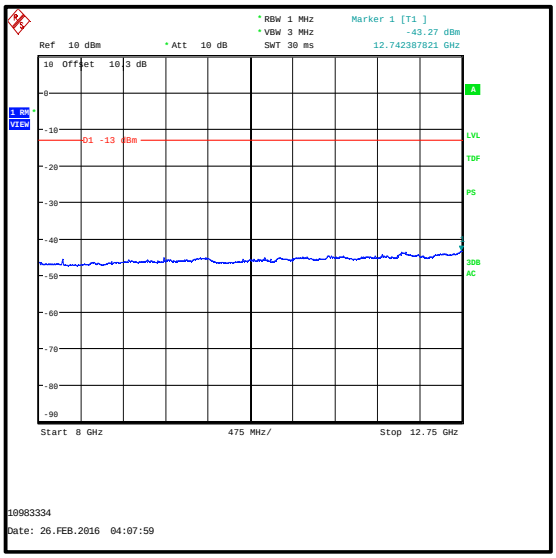


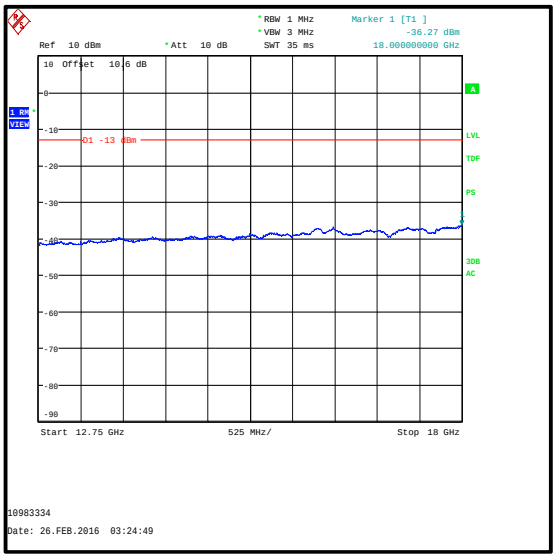


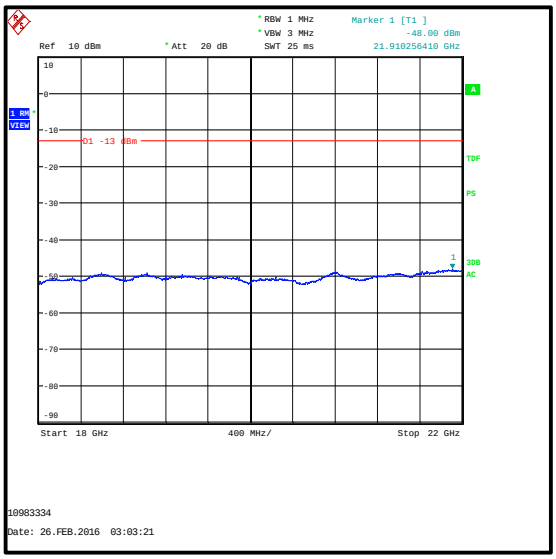




Transmitter Radiated Spurious Emissions (continued)







Transmitter Radiated Spurious Emissions (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1623	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	11 Jan 2017	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	12 Jan 2017	12
A259	Antenna	Chase	CBL6111A	1513	09 Apr 2016	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	19 Mar 2016	12
G0543	Amplifier	Sonoma	310N	230801	29 May 2016	3
A1834	Attenuator	Hewlett Packard	8491B	10444	05 Mar 2016	12
M1656	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	23 Apr 2016	12
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 May 2016	12
M1886	Test Receiver	Rohde & Schwarz	ESU26	100554	21 May 2016	12
A1534	Pre Amplifier	Hewlett Packard	8449B	3008A00405	19 Dec 2016	12
A1396	Attenuator	Huber & Suhner	6810.17.B	757987	05 May 2016	12
A1818	Antenna	EMCO	3115	00075692	17 Dec 2016	12
A253	Antenna	Flann Microwave	12240-20	128	17 Dec 2016	12
A254	Antenna	Flann Microwave	14240-20	139	17 Dec 2016	12
A255	Antenna	Flann Microwave	16240-20	519	17 Dec 2016	12
A256	Antenna	Flann Microwave	18240-20	400	17 Dec 2016	12
A436	Antenna	Flann Microwave	20240-20	330	19 Dec 2016	12

5.2.7. Transmitter Frequency Stability (Temperature Variation)

Test Summary:

Test Engineer:	Keith Tucker	**Test Dates:**	24 February 2016 & 25 February 2016
Test Sample Serial Number:	BBRBG010042A		

FCC Reference:	Parts 74.661 and 2.1055
Test Method Used:	KDB 971168 D01 Section 9.0 referencing FCC CFR Part 2.1055 and notes below

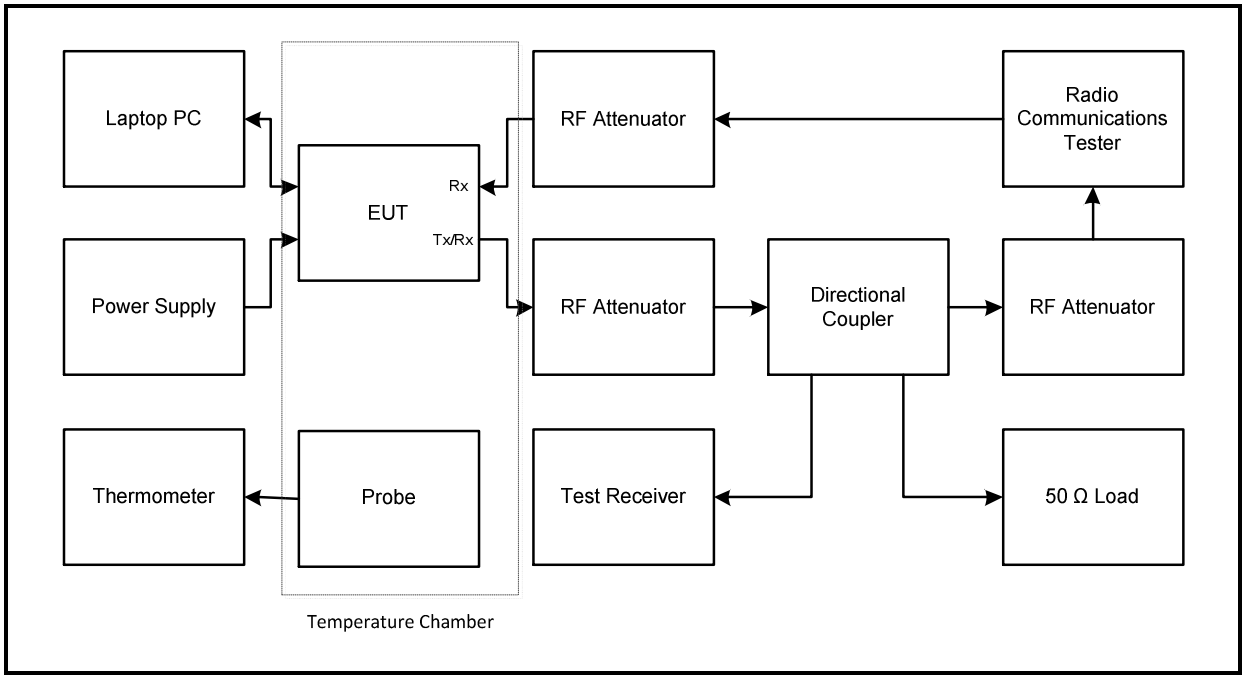
Environmental Conditions:

Ambient Temperature (°C):	27 to 28
Ambient Relative Humidity (%):	28 to 29

Note(s):

1. The EUT could not be configured to operate in an unmodulated mode, therefore the mean of the upper and lower 10 dBc modulated envelope frequencies was calculated in order to determine the carrier frequency.
2. The envelope frequencies were measured with a test receiver using a 1 kHz RBW and more than one sweep point per kHz of span.
3. The frequency reference of the test receiver was used as a common frequency reference for the test system.
4. Temperature was monitored throughout the test with a calibrated digital thermometer.

Test setup:



Transmitter Frequency Stability (Temperature Variation) (continued)

Results: Bottom Channel (2028.5 MHz)

Temperature (°C)	Lower Frequency (MHz)	Upper Frequency (MHz)	Mean Frequency (MHz)	Frequency Error (%)	Limit (%)	Margin (%)	Result
-30	2026.243590	2030.759615	2028.501603	0.000079	0.005	0.004921	Complied
-20	2026.243590	2030.756410	2028.500000	0.000000	0.005	0.005000	Complied
-10	2026.243590	2030.756410	2028.500000	0.000000	0.005	0.005000	Complied
0	2026.237179	2030.756410	2028.496795	0.000158	0.005	0.004842	Complied
10	2026.241590	2030.767282	2028.504436	0.000219	0.005	0.004781	Complied
20	2026.240385	2030.759615	2028.500000	0.000000	0.005	0.005000	Complied
30	2026.240385	2030.759615	2028.500000	0.000000	0.005	0.005000	Complied
40	2026.240308	2030.756410	2028.498359	0.000081	0.005	0.004919	Complied
50	2026.240308	2030.756410	2028.498359	0.000081	0.005	0.004919	Complied

Results: Top Channel (2106.5 MHz)

Temperature (°C)	Lower Frequency (MHz)	Upper Frequency (MHz)	Mean Frequency (MHz)	Frequency Error (%)	Limit (%)	Margin (%)	Result
-30	2104.243590	2108.756410	2106.500000	0.000000	0.005	0.005000	Complied
-20	2104.243590	2108.756410	2106.500000	0.000000	0.005	0.005000	Complied
-10	2104.243590	2108.756410	2106.500000	0.000000	0.005	0.005000	Complied
0	2104.243590	2108.756410	2106.500000	0.000000	0.005	0.005000	Complied
10	2104.240385	2108.759077	2106.499731	0.000013	0.005	0.004987	Complied
20	2104.243590	2108.759077	2106.501334	0.000063	0.005	0.004937	Complied
30	2104.240385	2108.759615	2106.500000	0.000000	0.005	0.005000	Complied
40	2104.243590	2108.759615	2106.501603	0.000076	0.005	0.004924	Complied
50	2104.240385	2108.760154	2106.500270	0.000013	0.005	0.004987	Complied

Transmitter Frequency Stability (Temperature Variation) (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	23 Apr 2016	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	12 Jun 2016	12
E0513	Environmental Chamber	TAS	LT600 Series 3	23900506	Calibrated before use	-
M1249	Thermometer	Fluke	52II	88800049	27 May 2016	12
A1397	Attenuator	Weinschel Associates	WA46-20	A128	Calibrated before use	-
A2534	Directional Coupler	AtlanTecRF	CDC-003060-20	14041701718	Calibrated before use	-
G088	Power Supply	Thurlby Thandar	CPX200	100700	Calibrated before use	-
S021	Power Supply	Thurlby Thandar	CPX200	061034	Calibrated before use	-
M1251	Multimeter	Fluke	175	89170179	26 May 2016	12
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	18 Jul 2016	36
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	08 Apr 2016	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	23 Apr 2016	24

5.2.8. Transmitter Frequency Stability (Voltage Variation)

Test Summary:

Test Engineer:	Keith Tucker	**Test Date:**	25 February 2016
Test Sample Serial Number:	BBRBG010042A		

FCC Reference:	Parts 74.661 and 2.1055
Test Method Used:	KDB 971168 D01 Section 9.0 referencing FCC CFR Part 2.1055 and notes below

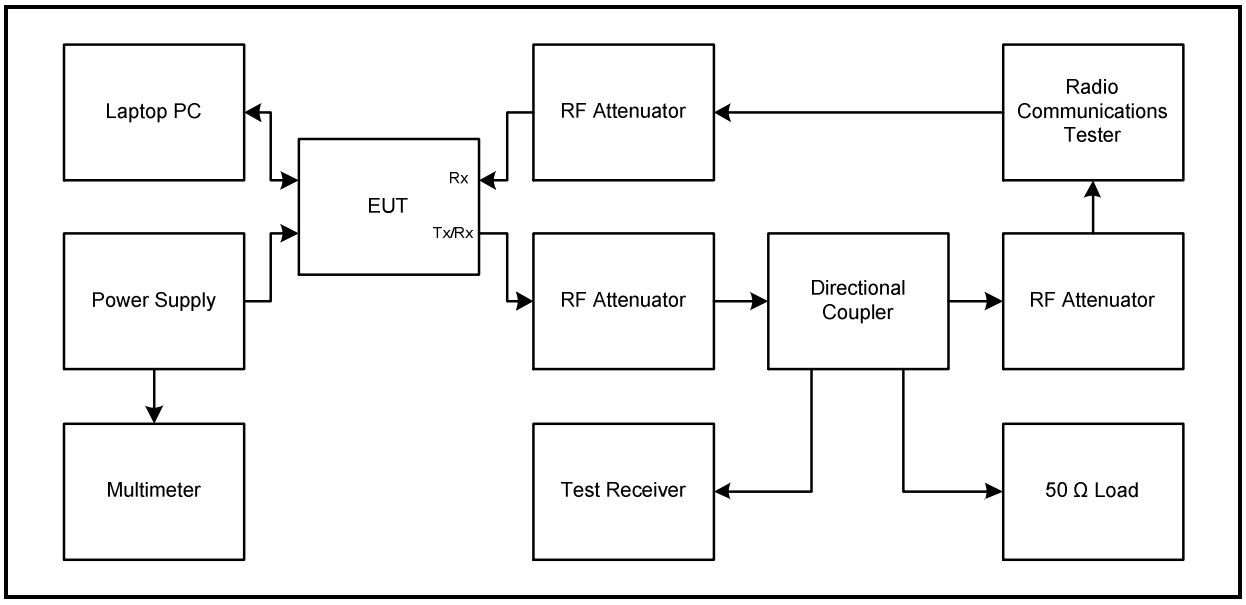
Environmental Conditions:

Temperature (°C):	28
Relative Humidity (%):	28

Note(s):

1. Voltage at the EUT was monitored throughout the test with a calibrated digital voltmeter.
2. The EUT could not be configured to operate in an unmodulated mode, therefore the mean of the upper and lower 10 dBc modulated envelope frequencies was calculated in order to determine the carrier frequency.
3. The envelope frequencies were measured with a test receiver using a 1 kHz RBW and more than one sweep point per kHz of span.
4. The frequency reference of the test receiver was used as a common reference for the test system.

Test setup:



Transmitter Frequency Stability (Voltage Variation) (continued)

Results: Bottom Channel (2028.5 MHz)

Supply Voltage (V)	Lower Frequency (MHz)	Upper Frequency (MHz)	Mean Frequency (MHz)	Frequency Error (%)	Limit (%)	Margin (%)	Result
23.8	2026.243590	2030.796150	2028.519870	0.000980	0.005	0.004020	Complied
32.2	2026.237179	2030.756410	2028.496795	0.000158	0.005	0.004842	Complied

Results: Top Channel (2106.5 MHz)

Supply Voltage (V)	Lower Frequency (MHz)	Upper Frequency (MHz)	Mean Frequency (MHz)	Frequency Error (%)	Limit (%)	Margin (%)	Result
23.8	2104.243590	2108.756410	2106.500000	0.000000	0.005	0.005000	Complied
32.2	2104.243590	2108.756410	2106.500000	0.000000	0.005	0.005000	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	23 Apr 2016	12
M1874	Test Receiver	Rohde & Schwarz	ESU26	100553	12 Jun 2016	12
A1397	Attenuator	Weinschel Associates	WA46-20	A128	Calibrated before use	-
A2534	Directional Coupler	AtlanTecRF	CDC-003060-20	14041701718	Calibrated before use	-
G088	Power Supply	Thurlby Thandar	CPX200	100700	Calibrated before use	-
S021	Power Supply	Thurlby Thandar	CPX200	061034	Calibrated before use	-
M1251	Multimeter	Fluke	175	89170179	26 May 2016	12
G0607	Signal Generator	Rohde & Schwarz	SMU200A	100943	18 Jul 2016	36
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	08 Apr 2016	24
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	23 Apr 2016	24

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
99% Occupied Bandwidth	2025 MHz to 2110 MHz	95%	±3.92 %
Conducted Carrier Output Power	2025 MHz to 2110 MHz	95%	±1.13 dB
Duty Cycle with Spectrum Analyser	2025 MHz to 2110 MHz	95%	±1.14 %
Conducted Spurious Emissions	9 kHz to 22 GHz	95%	±2.62 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Spurious Emissions	1 GHz to 22 GHz	95%	±2.94 dB
Frequency Stability	2025 MHz to 2110 MHz	95%	±0.92 ppm

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

7. Report Revision History

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

--- END OF REPORT ---