



TEST REPORT

Test Report No. : UL-RPT-RP89056JD13E V2.0

Manufacturer : Bang & Olufsen a/s
Model No. : LBWA1ZZPDZ-385
FCC ID : TTULBWA1ZZPD
IC Certification No. : 3775B-LBWA1ZZPD
Test Standard(s) : FCC Part 15.247: 2011 & Industry Canada RSS-210 Issue 8
December 2010, RSS-Gen Issue 3 December 2010

1. This test report shall not be reproduced in full or partial, without the written approval of RFI Global Services Ltd trading as UL.
2. The results in this report apply only to the sample(s) tested.
3. This sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 2.0 supersedes all previous versions.

Date of Issue: 25 January 2013

Checked by:

Sarah Williams
WiSE Laboratory Engineer

Issued by :

op

John Newell
Group Quality Manager, WiSE
Basingstoke,
UL Verification Services



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

RFI Global Services Ltd trading as UL

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG, UK
Telephone: +44 (0)1256 312000
Facsimile: +44 (0)1256 312001

This page has been left intentionally blank.

Table of Contents

1. Customer Information.....	4
2. Summary of Testing.....	5
2.1. General Information	5
2.2. Summary of Test Results	5
2.3. Methods and Procedures	5
2.4. Deviations from the Test Specification	5
3. Equipment Under Test (EUT)	6
3.1. Identification of Equipment Under Test (EUT)	6
3.2. Description of EUT	6
3.3. Modifications Incorporated in the EUT	6
3.4. Additional Information Related to Testing	7
3.5. Support Equipment	8
3.6. Antenna	8
4. Operation and Monitoring of the EUT during Testing	9
4.1. Operating Modes	9
4.2. Configuration and Peripherals	9
5. Measurements, Examinations and Derived Results	10
5.1. General Comments	10
5.2. Test Results	11
5.2.1. Transmitter Maximum Peak Output Power	11
6. Measurement Uncertainty	33
7. Report Revision History	34

1. Customer Information




Company Name:	Bang & Olufsen a/s
Address:	Peter Bangs Vej 15 7600 Struer Denmark

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2012: Part 15 Subpart C (Intentional Radiators) - Section 15.247
Specification Reference:	RSS-Gen Issue 3 December 2010
Specification Title:	General Requirements and Information for the Certification of Radio Apparatus
Specification Reference:	RSS-210 Issue 8 December 2010
Specification Title:	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
Site Registration:	FCC: 209735; Industry Canada: 3245B-2
Location of Testing:	RFI Global Services Ltd trading as UL, Wade Road, Basingstoke, Hampshire, RG24 8AH.
Test Date:	07 January 2012

2.2. Summary of Test Results

	IC Reference	Measurement	Result
Part 15.247(b)(3)	RSS-Gen 4.8 RSS-210 A8.4(4)	Transmitter Maximum Peak Output Power	
Key to Results  = Complied  = Did not comply			

2.3. Methods and Procedures

Reference:	ANSI C63.4 (2009)
Title:	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Reference:	ANSI C63.10 (2009)
Title:	American National Standard for Testing Unlicensed Wireless Devices
Reference:	FCC KDB 558074 D01 v01 1/18/2012
Title:	Guidance for Performing Compliance Measurements on Digital Transmission System (DTS) devices operating Under §15.247
Reference:	FCC KDB 662911 D01 v01r01 10/25/2011
Title:	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

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:	Bang & Olufsen
Model Number:	Murata LBWA1ZZPDZ-385
Specification Number:	JEBMM0-0505
Firmware Version:	2.4.0.0 ,Size: 371412 bytes, date: 20110223
Serial Number:	Not marked or stated
FCC ID:	TTULBWA1ZZPD
IC Certification Number:	3775B-LBWA1ZZPD

3.2. Description of EUT

The equipment under test was an IEEE 802.11a,b,g,n WLAN module operating in the 2.4 GHz and 5 GHz bands. The module is normally incorporated into a 32" television. The EUT has three external antenna ports, two transmit chains and three receive chains, MIMO is supported. For 802.11n operation the device uses MIMO (2 transmitters and 3 receivers). Depending on the 802.11 MCS, the device transmits 1 or 2 spatial stream. The device uses spatial multiplexing and from an RF point of view the streams are uncorrelated.

The Customer supplied a Video Engine which contains the WLAN Module and is part of the television. The Video Engine contained input and output ports (serial, Ethernet, HDMI, USB and RF ports). The Video Engine was powered from 5 V and 12 VDC supplies. The Video Engine allowed conducted measurements to be performed.

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:	IEEE 802.11 / Unlicensed National Information Infrastructure Devices (U-NII)		
Type of Unit:	Transceiver		
Data rates:	802.11 a	6, 9, 12, 18, 24, 36 ,48 & 54 Mbps	
	802.11 n	13, 19.5, 26, 39, 52, 58.5, 65, 13.5, 26, 39, 52, 78, 104, 117 & 130 Mbps	
TV Power Supply Requirement(s):	Nominal	120 VAC 60 Hz	
Maximum Conducted Output Power:	21.4 dBm		
Channel Spacing:	20 MHz		
Transmit & Receive Frequency Band:	5725 MHz to 5850 MHz		
Transmit & Receive Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	149	5745
	Middle	157	5785
	Top	165	5825
Channel Spacing:	40 MHz		
Transmit & Receive Frequency Band:	5725 MHz to 5850 MHz		
Transmit & Receive Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	151	5755
	Top	159	5795

3.5. Support Equipment

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

Description:	Laptop
Brand Name:	Dell
Model Name or Number:	D610
Serial Number:	RFI Asset No. PC343NT

Description:	Internal Antenna
Brand Name:	TE Connectivity Ltd
Model Name or Number:	PUCK

Description:	Internal Antenna
Brand Name:	TE Connectivity Ltd
Model Name or Number:	UAM

Description:	Serial to Ethernet cable
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

3.6. Antenna

The table below lists the antennas used with this product:

Type	Stated Gain (dBi)	Model	Part No.
Dual-band	4.0	PUCK	1551868-1
Dual-band	3.0	UAM	1513472-7

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 with a modulated carrier at maximum power on the bottom, middle and top channels as required using the supported data rates/modulation types.

4.2. Configuration and Peripherals

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

- Transmitting in test mode with 100% duty cycle and controlled using a bespoke application on a laptop PC using Hyperterminal PC application. The application was used to enable continuous transmission and to select the test channels, data rates and modulation schemes as required. The Customer supplied instructions on how to configure the EUT for test purposes.
- Conducted measurements were performed with the EUT fitted to the Video Engine and tests made with the measurement equipment connected to antenna ports (Port 0 & Port 1). Short internal RF cables were fitted between the Video Engine and the SMA antenna ports. The Customer declared the antenna gain was 4.0 dBi in the 5725-5850 GHz band. This figure is the antenna manufacturer's stated antenna gain less the loss of the internal RF cables. DC voltage to the Video Engine (5.0 VDC and 12.0 VDC) was supplied by two bench power supplies. Voltage was monitored using two calibrated voltmeters.
- The EUT has three RF ports, two transmit/receive RF ports (labelled as Port 0 and Port 1) and an additional receive RF port (labelled as Port 2). Conducted measurements were performed on Port 0 and Port 1. RF cables and attenuators connecting the test equipment to the EUT ports were calibrated before use and the calibration data incorporated into the conducted measurement results.
- The 3 internal antennas are connected to the WLAN module ports within the television as follows:

Module Port	Antenna Type	TX	RX
ANT0	PUCK	Yes	Yes
ANT1	UAM	Yes	Yes
ANT2	PUCK	No	Yes

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 Maximum Peak Output Power

Test Summary:

Test Engineer:	Andrew Edwards	Test Date:	07 January 2012
Test Sample Serial No:	Not stated		

FCC Reference:	Part 15.247(b)(3)
Industry Canada Reference:	RSS-Gen 4.8, RSS-210 A8.4(4)
Test Method Used:	KDB 558074 Section 5.2.1.2

Environmental Conditions:

Temperature (°C):	19
Relative Humidity (%):	27

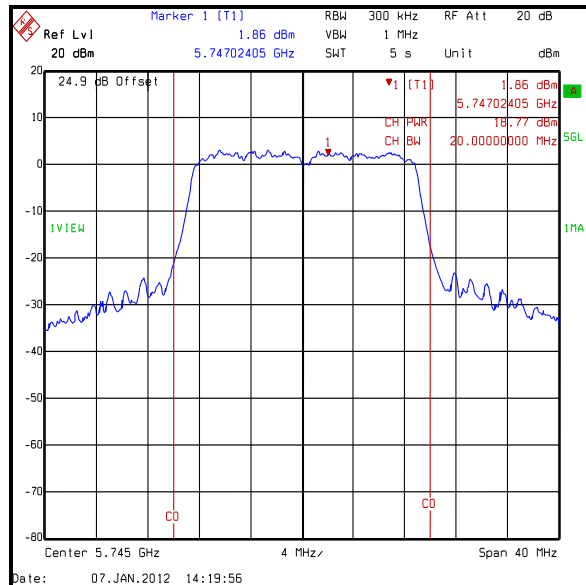
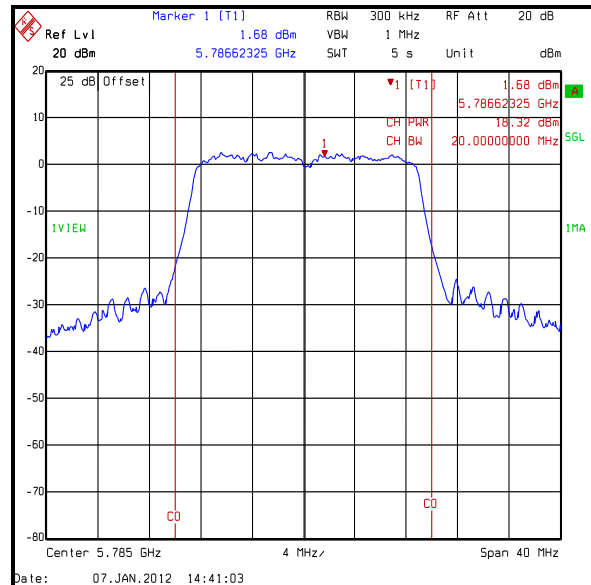
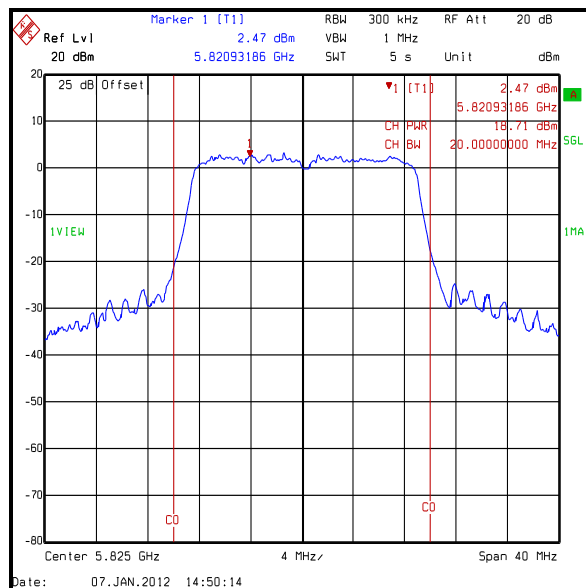
Note(s):

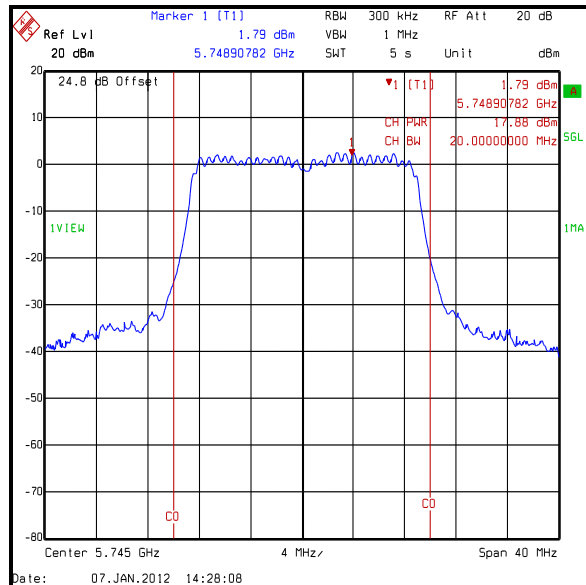
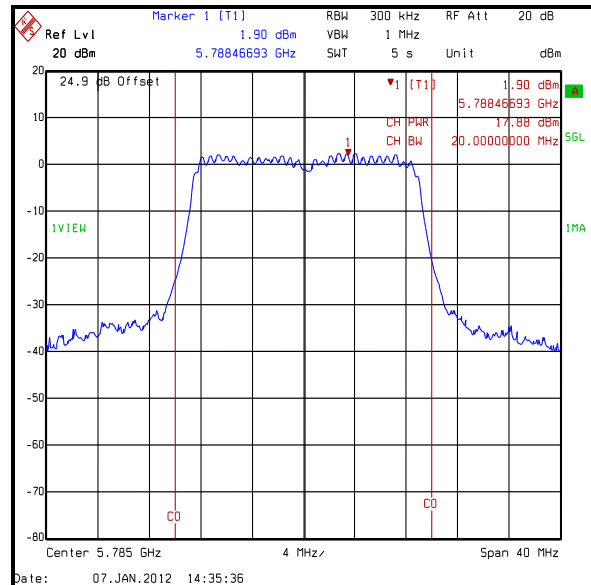
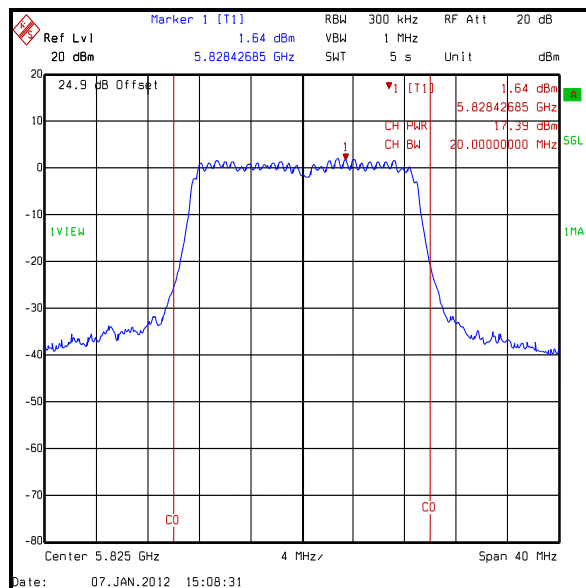
1. Conducted power tests in all bands were performed using a spectrum analyser in accordance with FCC KDB 558074 Section 5.2.1.2 Measurement Procedure PK2.
2. The EUT has two RF ports, Port 0 and Port 1. Conducted power from both ports was measured and combined using the measure-and-sum method stated in FCC KDB 662911 D01.
3. The EUT was transmitting at 100% duty cycle.
4. The EUT antenna has a declared gain of 4.0 dBi. The declared antenna gain was added to the combined conducted power in order to calculate the EIRP.
5. Measurements were performed on the highest data rates within each modulation scheme for bottom, middle and top channels on both ports and for both 20 MHz and 40 MHz channel bandwidths.

Transmitter Maximum Peak Output Power (continued)**Results: 13 Mbps / BPSK / 20 MHz**

Channel	Conducted Peak Power Port 0 (dBm)	Conducted Peak Power Port 1 (dBm)	Combined Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	18.8	17.9	21.4	30.0	8.6	Complied
Middle	18.3	17.9	21.1	30.0	8.9	Complied
Top	18.7	17.4	21.1	30.0	8.9	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	21.4	4.0	25.4	36.0	10.6	Complied
Middle	21.1	4.0	25.1	36.0	10.9	Complied
Top	21.1	4.0	25.1	36.0	10.9	Complied

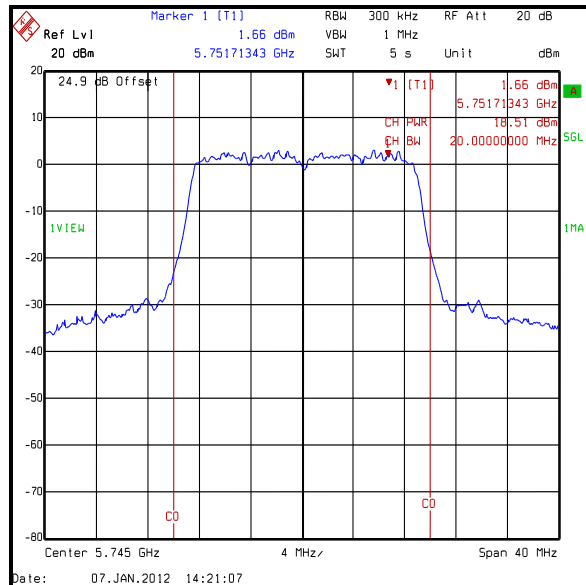
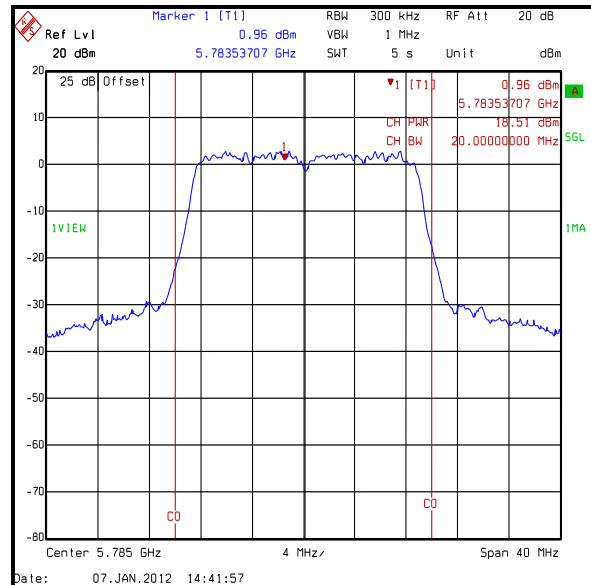
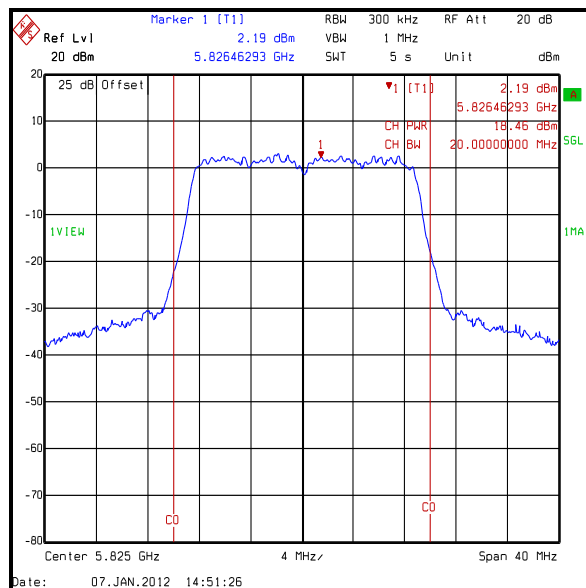
Transmitter Maximum Peak Output Power (continued)**Results: 13 Mbps / BPSK / 20 MHz / Port 0****Bottom Channel****Middle Channel****Top Channel**

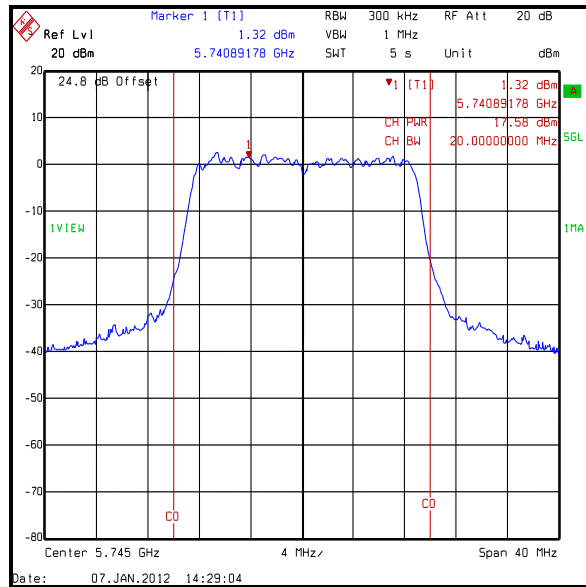
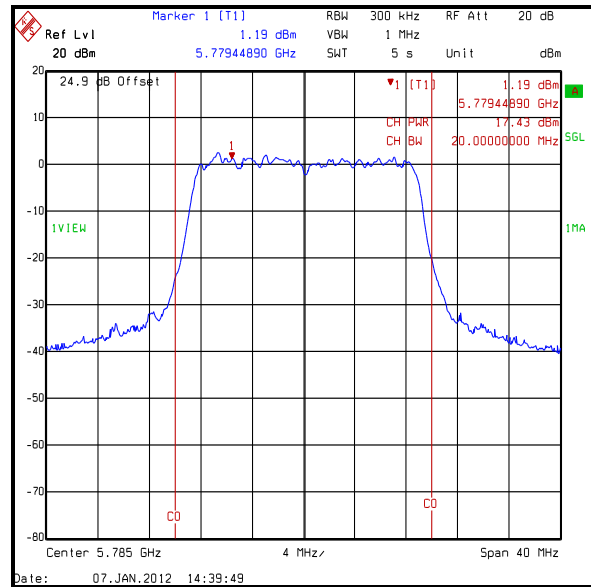
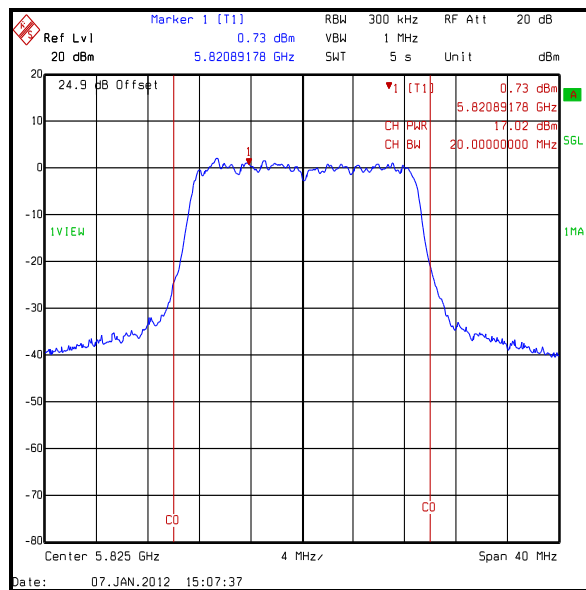
Transmitter Maximum Peak Output Power (continued)**Results: 13 Mbps / BPSK / 20 MHz / Port 1****Bottom Channel****Middle Channel****Top Channel**

Transmitter Maximum Peak Output Power (continued)**Results: 39 Mbps / QPSK / 20 MHz**

Channel	Conducted Peak Power Port 0 (dBm)	Conducted Peak Power Port 1 (dBm)	Combined Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	18.5	17.6	21.1	30.0	8.9	Complied
Middle	18.5	17.4	21.0	30.0	9.0	Complied
Top	18.5	17.0	20.8	30.0	9.2	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	21.1	4.0	25.1	36.0	10.9	Complied
Middle	21.0	4.0	25.0	36.0	11.0	Complied
Top	20.8	4.0	24.8	36.0	11.2	Complied

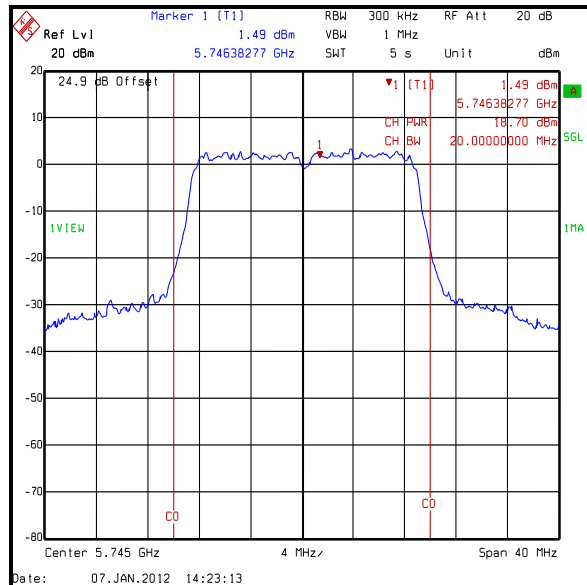
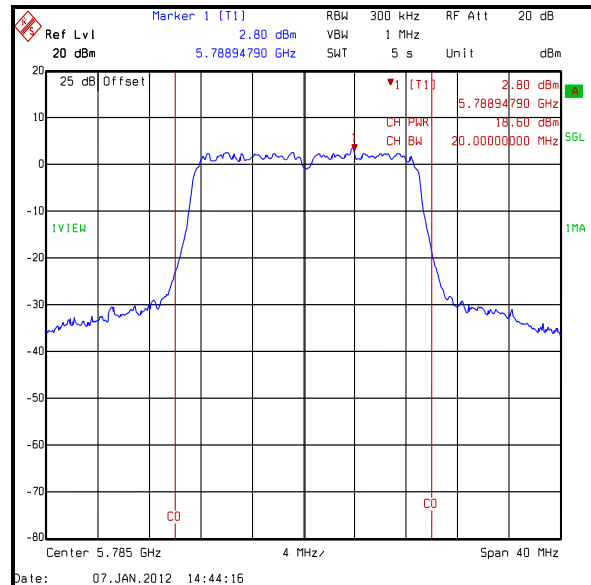
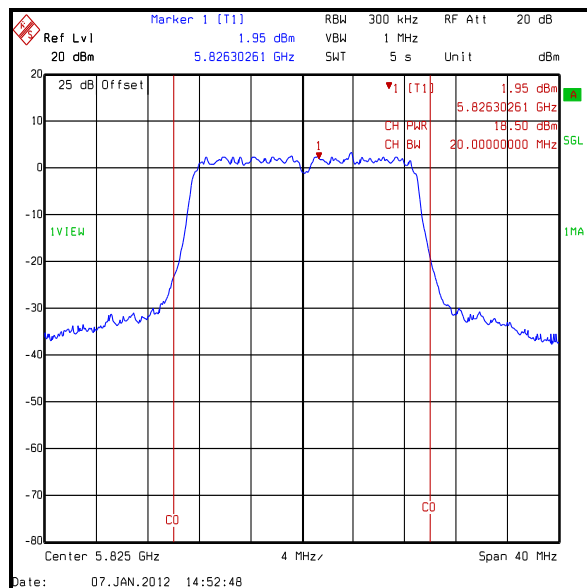
Transmitter Maximum Peak Output Power (continued)**Results: 39 Mbps / QPSK / 20 MHz / Port 0****Bottom Channel****Middle Channel****Top Channel**

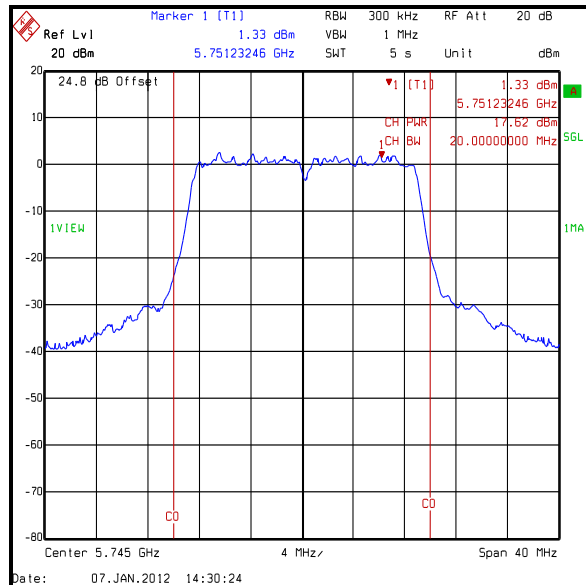
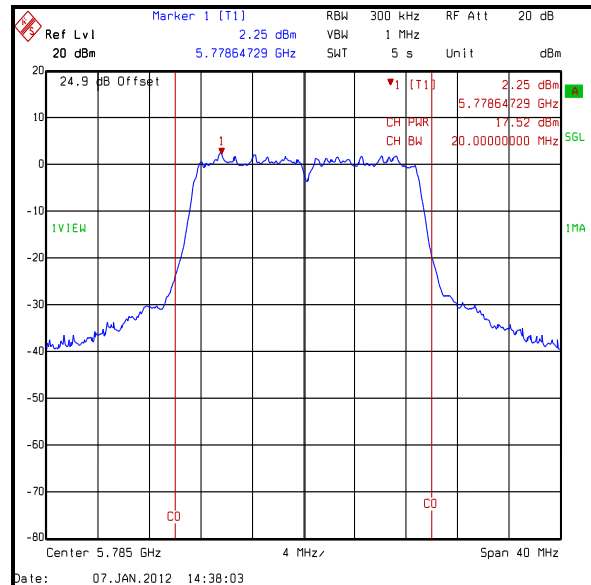
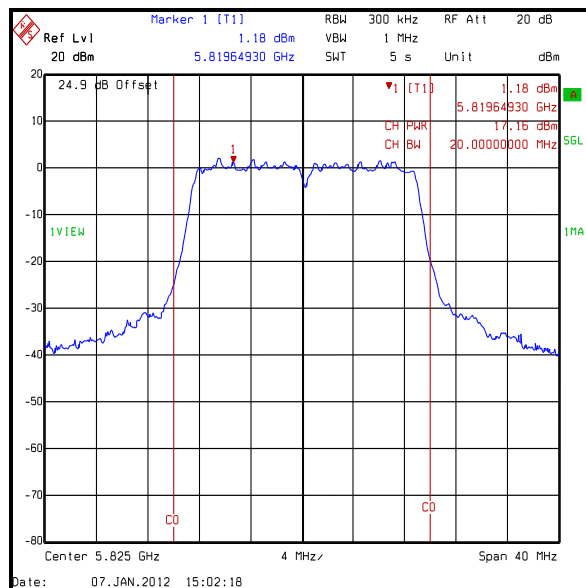
Transmitter Maximum Peak Output Power (continued)**Results: 39 Mbps / QPSK / 20 MHz / Port 1****Bottom Channel****Middle Channel****Top Channel**

Transmitter Maximum Peak Output Power (continued)**Results: 78 Mbps / 16QAM / 20 MHz**

Channel	Conducted Peak Power Port 0 (dBm)	Conducted Peak Power Port 1 (dBm)	Combined Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	18.7	17.6	21.2	30.0	8.8	Complied
Middle	18.6	17.5	21.1	30.0	8.9	Complied
Top	18.5	17.2	20.9	30.0	9.1	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	21.2	4.0	25.2	36.0	10.8	Complied
Middle	21.1	4.0	25.1	36.0	10.9	Complied
Top	20.9	4.0	24.9	36.0	11.1	Complied

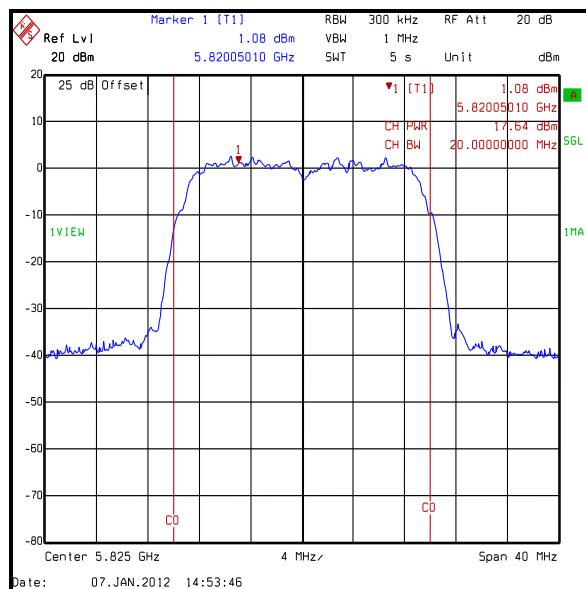
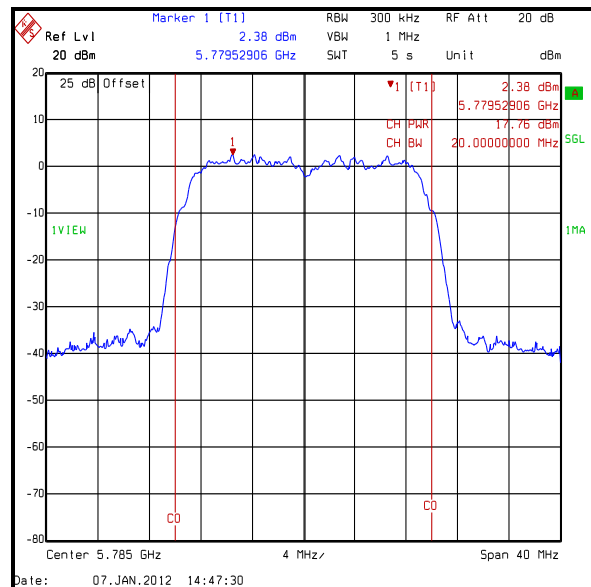
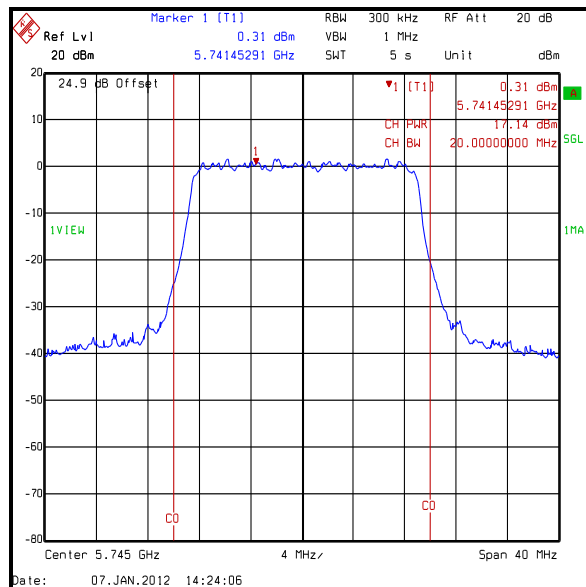
Transmitter Maximum Peak Output Power (continued)**Results: 78 Mbps / 16QAM / 20 MHz / Port 0****Bottom Channel****Middle Channel****Top Channel**

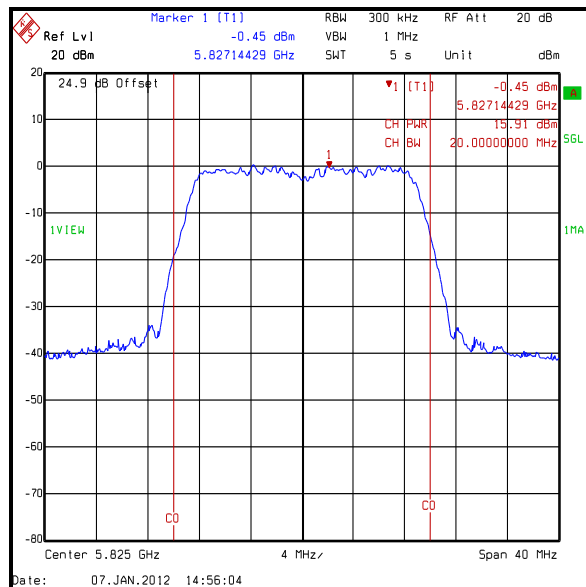
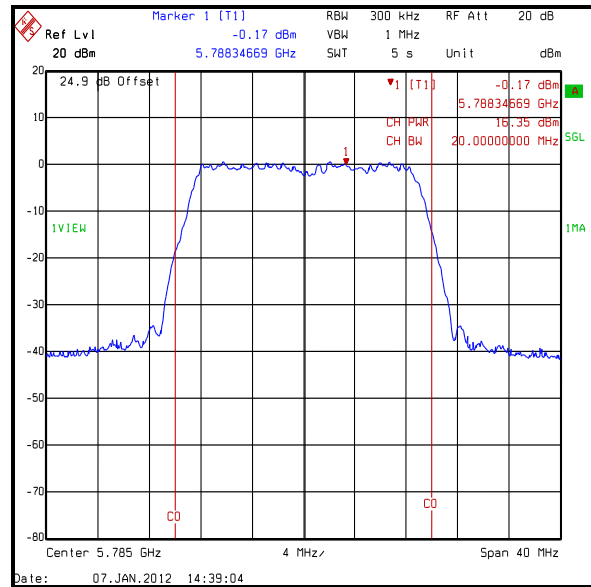
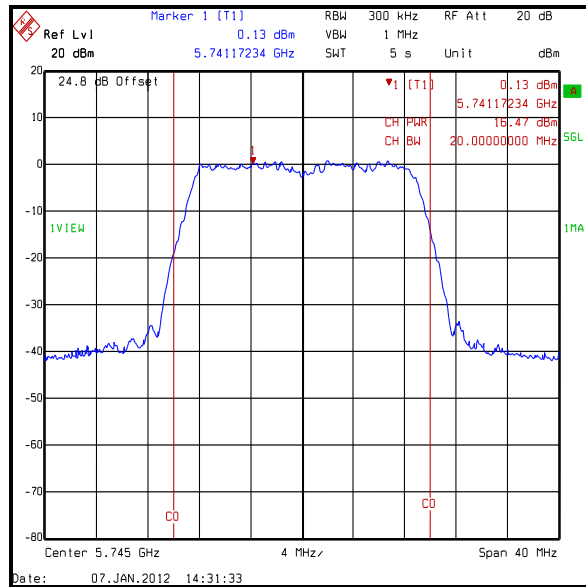
Transmitter Maximum Peak Output Power (continued)**Results: 78 Mbps / 16QAM / 20 MHz / Port 1****Bottom Channel****Middle Channel****Top Channel**

Transmitter Maximum Peak Output Power (continued)**Results: 130 Mbps / 64QAM / 20 MHz**

Channel	Conducted Peak Power Port 0 (dBm)	Conducted Peak Power Port 1 (dBm)	Combined Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	17.1	16.5	19.8	30.0	10.2	Complied
Middle	17.8	16.4	20.2	30.0	9.8	Complied
Top	17.6	15.9	19.8	30.0	10.2	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	19.8	4.0	23.8	36.0	12.2	Complied
Middle	20.2	4.0	24.2	36.0	11.8	Complied
Top	19.8	4.0	23.8	36.0	12.2	Complied

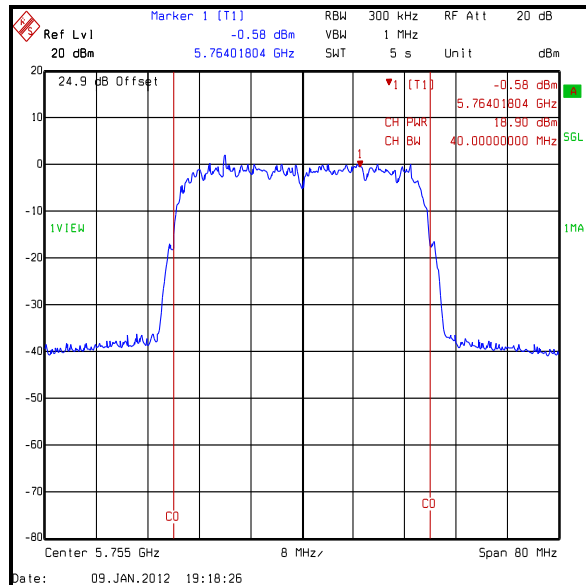
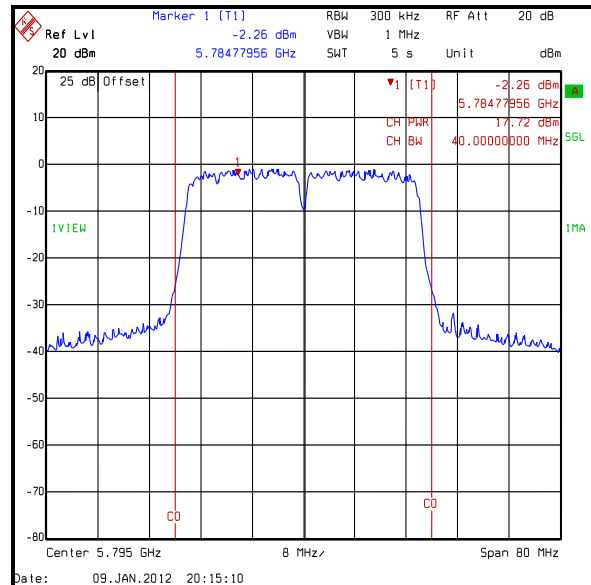
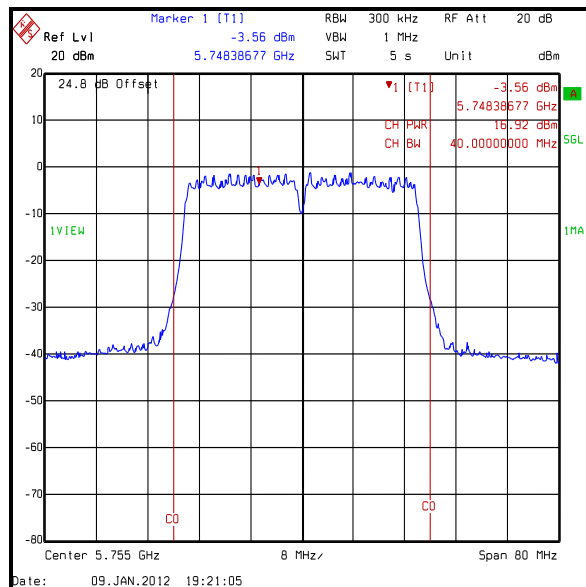
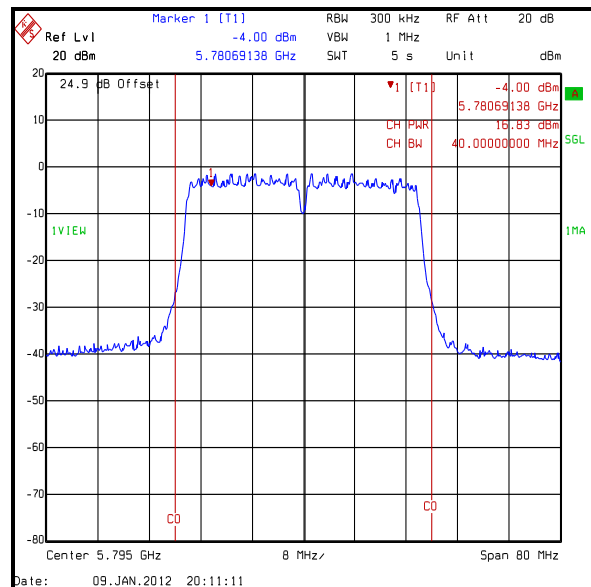
Transmitter Maximum Peak Output Power (continued)**Results: 130 Mbps / 64QAM / 20 MHz / Port 0**

Transmitter Maximum Peak Output Power (continued)**Results: 130 Mbps / 64QAM / 20 MHz / Port 1**

Transmitter Maximum Peak Output Power (continued)**Results: 13 Mbps / BPSK / 40 MHz**

Channel	Conducted Peak Power Port 0 (dBm)	Conducted Peak Power Port 1 (dBm)	Combined Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	18.9	16.9	21.0	30.0	9.0	Complied
Top	17.7	16.8	20.3	30.0	9.7	Complied

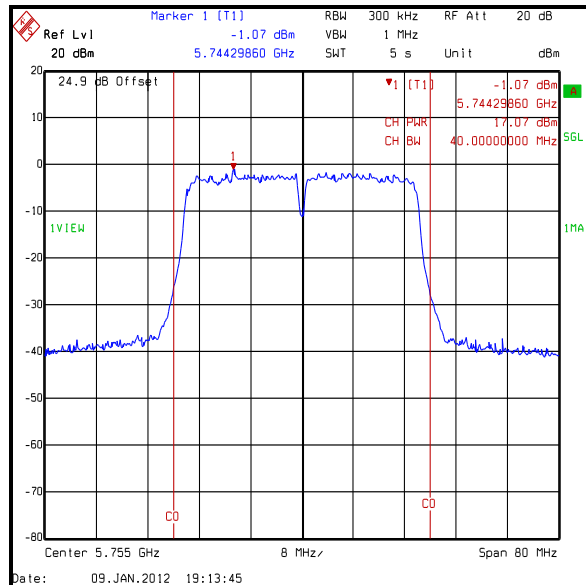
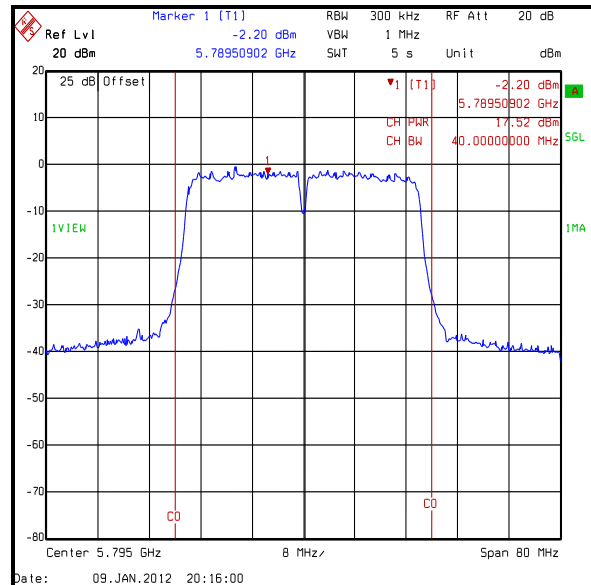
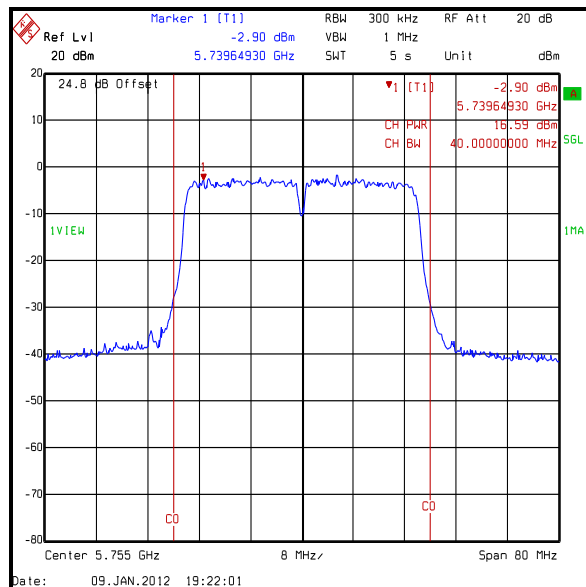
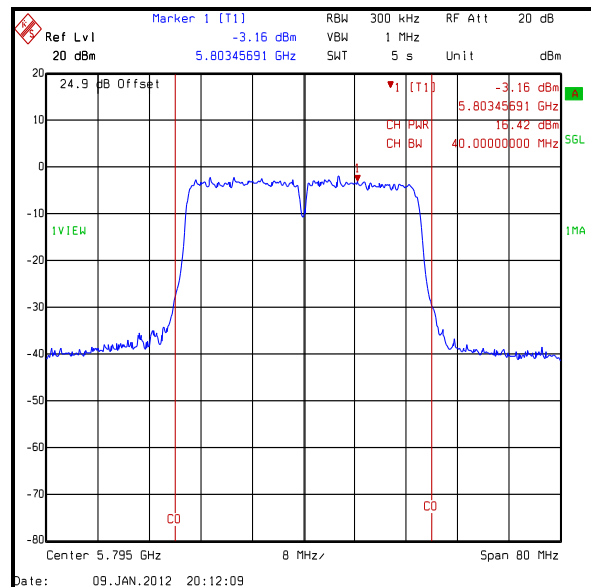
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	21.0	4.0	25.0	36.0	11.0	Complied
Top	20.3	4.0	24.3	36.0	11.7	Complied

Transmitter Maximum Peak Output Power (continued)**Results: 13 Mbps / BPSK / 40 MHz / Port 0****Bottom Channel****Top Channel****Results: 13 Mbps / BPSK / 40 MHz / Port 1****Bottom Channel****Top Channel**

Transmitter Maximum Peak Output Power (continued)**Results: 39 Mbps / QPSK / 40 MHz**

Channel	Conducted Peak Power Port 0 (dBm)	Conducted Peak Power Port 1 (dBm)	Combined Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	17.1	16.6	19.8	30.0	10.2	Complied
Top	17.5	16.4	20.0	30.0	10.0	Complied

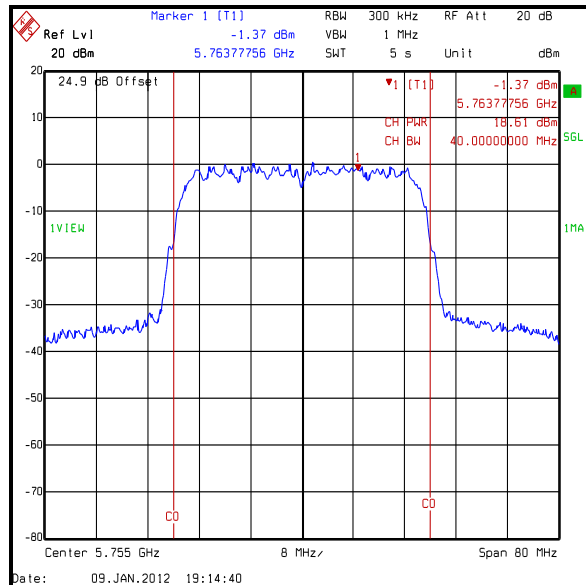
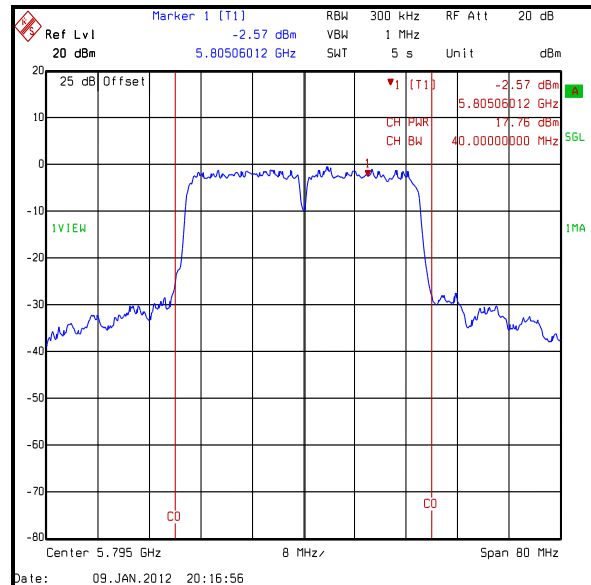
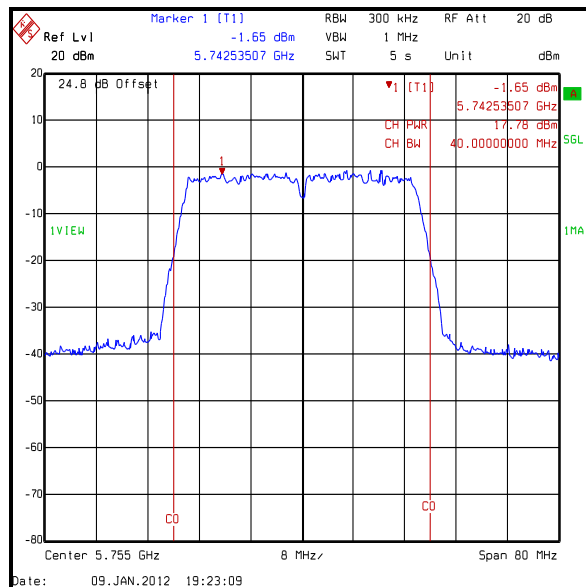
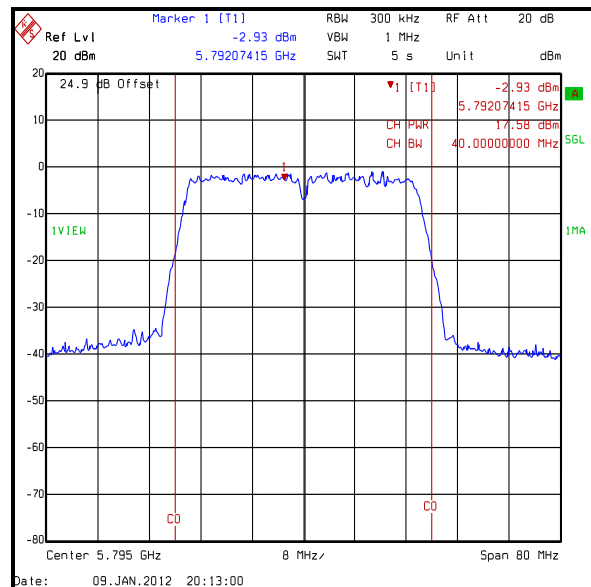
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	19.8	4.0	23.8	36.0	12.2	Complied
Top	20.0	4.0	24.0	36.0	12.0	Complied

Transmitter Maximum Peak Output Power (continued)**Results: 39 Mbps / QPSK / 40 MHz / Port 0****Bottom Channel****Top Channel****Results: 39 Mbps / QPSK / 40 MHz / Port 1****Bottom Channel****Top Channel**

Transmitter Maximum Peak Output Power (continued)**Results: 78 Mbps / 16QAM / 40 MHz**

Channel	Conducted Peak Power Port 0 (dBm)	Conducted Peak Power Port 1 (dBm)	Combined Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	18.6	17.8	21.2	30.0	8.8	Complied
Top	17.8	17.6	20.7	30.0	9.3	Complied

Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	21.2	4.0	25.2	36.0	10.8	Complied
Top	20.7	4.0	24.7	36.0	11.3	Complied

Transmitter Maximum Peak Output Power (continued)**Results: 78 Mbps / 16QAM / 40 MHz / Port 0****Bottom Channel****Top Channel****Results: 78 Mbps / 16QAM / 40 MHz / Port 1****Bottom Channel****Top Channel**

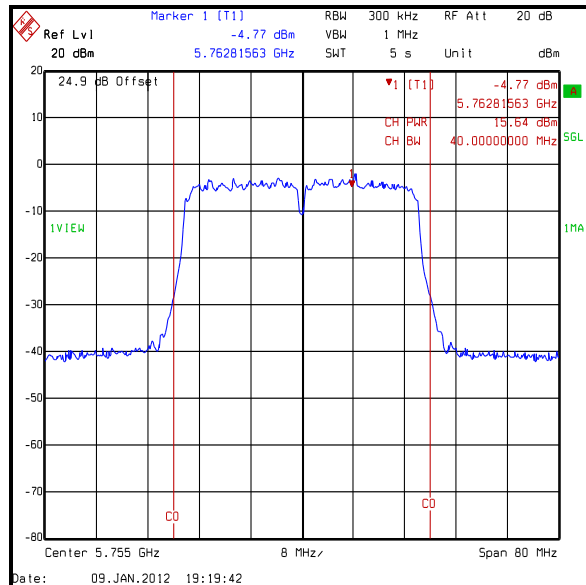
Transmitter Maximum Peak Output Power (continued)**Results: 130 Mbps / 64QAM / 40 MHz**

Channel	Conducted Peak Power Port 0 (dBm)	Conducted Peak Power Port 1 (dBm)	Combined Peak Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	15.6	16.1	18.9	30.0	11.1	Complied
Top	17.3	15.0	19.3	30.0	10.7	Complied

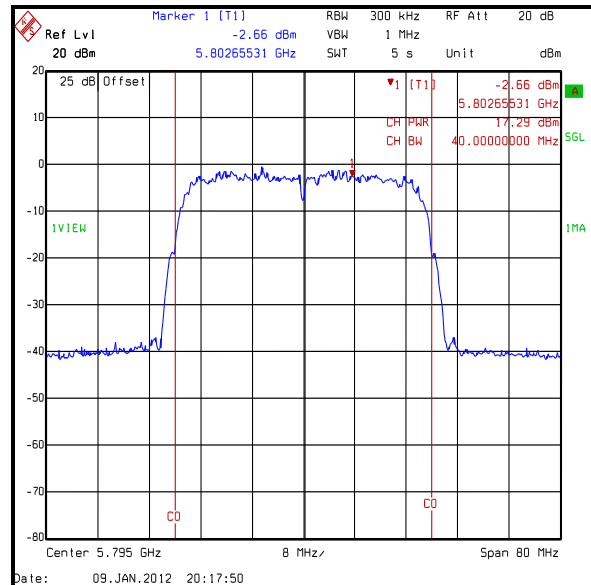
Channel	Conducted Peak Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	18.9	4.0	22.9	36.0	13.1	Complied
Top	19.3	4.0	23.3	36.0	12.7	Complied

Transmitter Maximum Peak Output Power (continued)

Results: 130 Mbps / 64QAM / 40 MHz / Port 0

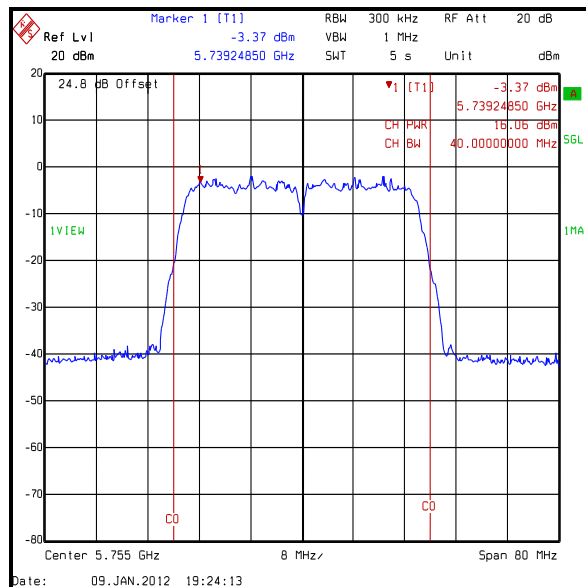


Bottom Channel

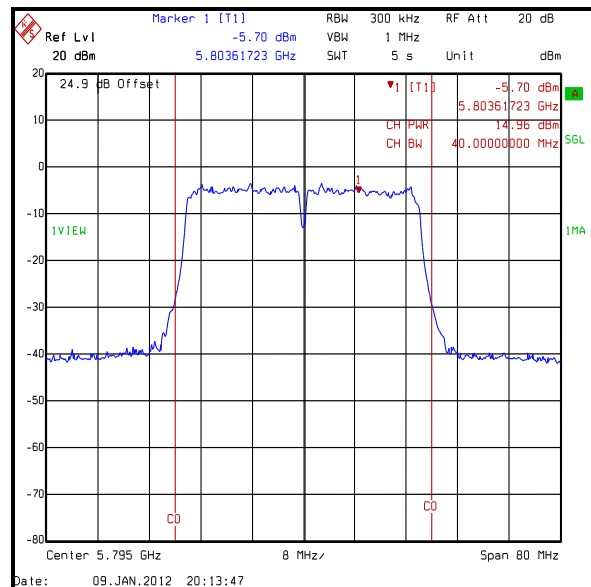


Top Channel

Results: 130 Mbps / 64QAM / 40 MHz / Port 1



Bottom Channel



Top Channel

Transmitter Maximum Peak Output Power (continued)**Test Equipment Used:**

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (months)
A1998	Attenuator	Huber & Suhner	6820.17.B	07101	09 Feb 2012	12
A1999	Attenuator	Huber & Suhner	6820.17.B	07101	18 Mar 2012	12
M1251	Multimeter	Fluke	179	87640015	21 Jun 2012	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB30	842 659/016	08 Nov 2012	12
M1269	Multimeter	Fluke	179	90250210	20 Jul 2012	12
S011	DC Power Supply Unit	INSTEK	PR-3010H	9401270	Calibrated Before Use	-
S0537	EL302D Dual Power Supply	TTI	EL302D	249928	Calibrated Before Use	-

6. Measurement Uncertainty

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

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

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

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

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Conducted Maximum Peak Output Power	5725 MHz to 5850 MHz	95%	±0.28 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	-	-	Antenna information added