

Test of Axxcelera ABMAX-APD567xx Access  
Point

To: FCC 47 CFR Part 15.407 & IC RSS-210

Test Report Serial No.: AXXC04-A3 Rev B





Test of Axxcelera ABMAX-APD567xx Access Point  
to  
To: FCC 47 CFR Part 15.407 & IC RSS-210

Test Report Serial No.: AXXC04-A3 Rev B

Note: this report only contains data with regard to the 5,470 to 5,725 MHz operational modes of the  
Axxcelera ABMAX-APD567xx Access Point

This report supersedes AXXC04-A3 Rev A

**Applicant:** Axxcelera Broadband Wireless, Inc  
1600 E. Parham Road  
Richmond  
Virginia 23228 USA

**Product Function:** 802.16 Wireless Access Point

**Copy No:** pdf    **Issue Date:** 27th October 2008

**This Test Report is Issued Under the Authority of:**

**MiCOM Labs, Inc.**  
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CERTIFICATE #2381.01

**MiCOM Labs is an ISO 17025 Accredited Testing Laboratory**



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 3 of 121

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 4 of 121

## TABLE OF CONTENTS

<b>ACCREDITATION &amp; LISTINGS.....</b>	<b>6</b>
<b>1. TEST RESULT CERTIFICATE .....</b>	<b>9</b>
<b>2. REFERENCES AND MEASUREMENT UNCERTAINTY .....</b>	<b>10</b>
2.1. Normative References .....	10
2.2. Test and Uncertainty Procedures .....	11
<b>3. PRODUCT DETAILS AND TEST CONFIGURATIONS .....</b>	<b>12</b>
3.1. Technical Details .....	12
3.2. Scope of Test Program.....	13
3.3. Equipment Model(s) and Serial Number(s) .....	15
3.4. Antenna Details .....	15
3.5. Cabling and I/O Ports .....	15
3.6. Test Configurations.....	16
3.7. Equipment Modifications.....	16
3.8. Deviations from the Test Standard .....	16
<b>4. TEST SUMMARY .....</b>	<b>17</b>
<b>5. TEST RESULTS .....</b>	<b>20</b>
5.1. Device Characteristics .....	20
5.1.1. 26 dB and 99 % Bandwidth .....	20
5.1.2. Transmit Output Power.....	31
5.1.3. Peak Power Spectral Density .....	35
5.1.4. Peak Excursion Ratio .....	46
5.1.5. Frequency Stability.....	57
5.1.6. Maximum Permissible Exposure .....	58
5.1.7. Radiated Emissions.....	59
5.1.8. AC Wireline Conducted Emissions (150 kHz – 30 MHz).....	74
<b>6. Dynamic Frequency Selection (DFS).....</b>	<b>77</b>
6.1. Test Procedure and Setup.....	77
6.1.1. Interference Threshold values, Master or Client incorporating In-Service Monitoring.....	77
6.1.2. DFS Response requirement values.....	77
6.1.3. Radar Test Waveforms.....	78
6.1.4. Frequency Hopping Radar Test Waveform .....	81
6.1.5. Radar Waveform Calibration .....	81
6.1.6. Radar Waveform Calibration Plots .....	82
6.1.7. Test Set Up:.....	88
6.2. Dynamic Frequency Selection (DFS) Test Results .....	90
6.2.1. UNII Detection Bandwidth: .....	90
6.2.2. Initial Channel Availability Check Time.....	94
6.2.3. Radar Burst at the Beginning of the Channel Availability Check Time: .....	96
6.2.4. Radar Burst at the End of the Channel Availability Check Time: .....	98
6.2.5. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period .....	100
6.2.6. Statistical Performance Check .....	108

This test report may be reproduced in full only. The document may only be updated by MiCOM Labs personnel. Any changes will be noted in the Document History section of the report.



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 5 of 121

---

<b>7. PHOTOGRAPHS.....</b>	<b>113</b>
7.1. Radiated Spurious Emissions < 1 GHz (Front).....	113
7.2. Radiated Spurious Emissions < 1 GHz (Rear) .....	114
7.3. Conducted Emissions (150 kHz - 30 MHz) .....	115
7.4. General Measurement Test Set-Up .....	116
7.5. General Measurement Test Set-Up (Test Equipment) .....	117
7.6. Dynamic Frequency Selection Test Set-Up .....	118
<b>8. TEST EQUIPMENT DETAILS.....</b>	<b>120</b>

---

This test report may be reproduced in full only. The document may only be updated by MiCOM Labs personnel. Any changes will be noted in the Document History section of the report.



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 6 of 121

## **ACCREDITATION & LISTINGS**

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) [www.a2la.org](http://www.a2la.org) test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 7 of 121

---

## LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

### North America

#### **United States of America**

Federal Communications Commission (FCC) Listing #: 102167

#### **Canada**

Industry Canada: 4143A

## RECOGNITION

### **APEC MRA (Asia-Pacific Economic Community Mutual Recognition Agreement)**

#### **Conformity Assessment Body (CAB) – MiCOM Labs**

Test data generated by MiCOM Labs is accepted in the following countries under the APEC MRA.

Country	Recognition Body	Phase	CAB Identification No.
Australia	Australian Communications and Media Authority (ACMA)	I	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	I	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	I	
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	Directorate General of Telecommunications (DGT) Bureau of Standards, Metrology and Inspection (BSMI)	I	

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 8 of 121

---

## DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	29 <sup>th</sup> September 2008	Initial release.
Rev B	27 <sup>th</sup> October 2008	Updated the following DFS Sections to include 5 and 10 MHz channel bandwidth results;  6.2.1 UNII Detection Bandwidth  6.2.6 Statistical Performance Check

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 9 of 121

## 1. TEST RESULT CERTIFICATE

Manufacturer:	Axxcelera Broadband Wireless, Inc 1600 E. Parham Road Richmond Virginia 23228 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	Wireless Access Point	Telephone:	+1 925 462 0304
Model:	ABMAX-APD567xx	Fax:	+1 925 462 0306
S/N:	SJ0838001		
Test Date(s):	2nd to 27th October 2008	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.407 & IC RSS-210	EQUIPMENT COMPLIES

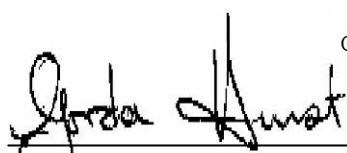
MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

### Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:

  
\_\_\_\_\_  
Graeme Grieve  
Quality Manager MiCOM Labs,

  
\_\_\_\_\_  
Gordon Hurst  
President & CEO MiCOM Labs, Inc.



CERTIFICATE #2381.01

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## 2. REFERENCES AND MEASUREMENT UNCERTAINTY

### 2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.407	2007	Code of Federal Regulations
(ii)	FCC 06-96	June 2006	Memorandum Opinion and Order
(iii)	Industry Canada RSS-210	Issue 7 June 2007	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands): Category 1 Equipment
(iv)	Industry Canada RSS-Gen	Issue 2 June 2007	General Requirements and Information for the Certification of Radiocommunication Equipment
(v)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(vi)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vii)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(viii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(ix)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(x)	A2LA	14 <sup>th</sup> September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy
(xi)	FCC Public Notice – DA 02-2138	2002	Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 11 of 121

---

## **2.2. Test and Uncertainty Procedures**

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor  $k = 2$ , providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 12 of 121

### 3. PRODUCT DETAILS AND TEST CONFIGURATIONS

#### 3.1. Technical Details

Details	Description
Purpose:	Test of the Axxcelera ABMAX-APD567xx Access Point in the frequency range 5470 to 5,725 MHz to FCC Part 15.407 and Industry Canada RSS-210 regulations.
Applicant:	As Manufacturer
Manufacturer:	Axxcelera Broadband Wireless, Inc 1600 E. Parham Road Richmond Virginia 23228 USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	AXXC04-A3 Rev B
Date EUT received:	8 <sup>TH</sup> September 2008
Standard(s) applied:	FCC 47 CFR Part 15.407 & IC RSS-210
Dates of test (from - to):	2nd to 27th October 2008
No of Units Tested:	1
Software Revision:	3.3.0.3
Test Code Revision:	3.1.1.3 T&M
Type of Equipment:	Point to Point or Point to Multipoint with GPS Wireless Access Point.
Manufacturers Trade Name:	AB-MAX Access Point
Model:	ABMAX-APD567xx
Location for use:	Outdoor
Declared Frequency Range(s):	5,470 to 5,725 MHz
Declared Nominal Output Power: (Average Power)	5,470 - 5,725 MHz: +17 dBm
Type of Modulation:	BPSK, QPSK, 16QAM, 64QAM
EUT Modes of Operation:	Bandwidths: 5, 10 & 15 MHz
Transmit/Receive Operation:	Time Division Duplex
Rated Input Voltage and Current:	48 Vdc, 625 mA
Operating Temperature Range:	Declared range -40 to +55°C
ITU Emission Designator:	5 MHz BW – 4M6W7D 10 MHz BW – 9M1W7D 15 MHz BW – 13M6W7D
Clock/Oscillator(s):	5725MHz, 25KHz
Frequency Stability (long term):	±6 ppm/year
Equipment Dimensions:	Integrated antenna (20.5" X 10" X 3") External antenna (10" X 10" X 3")
Weight:	3 lbs
Primary function of equipment:	ABMAX provides a Point to Multipoint or Point to Point Wireless Access Point (Ethernet Network).

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 13 of 121

---

### **3.2. Scope of Test Program**

#### **RF Testing**

The scope of the test program was to test the Axxcelera ABMAX-APD567XX wireless Access Point in the frequency range 5470 – 5725 MHz for compliance against FCC 47 CFR Part 15.407, Industry Canada RSS-210 specifications including Dynamic Frequency Selection (DFS) requirements.

The Access Point covers channels 5,482.5 – 5712.5 MHz

#### **Dynamic Frequency Selection**

The scope of the test program was to test the Axxcelera ABMAX-APD567XX wireless Access Point in the frequency range 5,470 to 5,725 MHz as a Master device for compliance against DFS requirements of FCC 47 CFR Part 15.407 and the FCC specification Memorandum Opinion and Order FCC 06-96.

One frequency was chosen (5,500 MHz) from the operating channels of the UUT within the 5,470 – 5,725 MHz band for DFS testing per the requirements of FCC specification “Memorandum Opinion and Order FCC 06-96”, Section 7.8 “DFS Conformance Test Procedures”.

U-NII devices operating in the 5,470 - 5,725 MHz band shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems.

The Axxcelera ABMAX-APD567XX product operates as a Master device with full radar detection and Dynamic Frequency Selection (DFS) capability.

The Master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels.

**Axxcelera ABMAX-APD567XX  
Wireless Access Point**



The photograph of the ABMAX-D567 identifies the access point used for conducted test purposes.





**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 15 of 121

---

### 3.3. Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	Wireless AP	Axxcelera	ABMAX-APD567xx	SJ08380001
EUT	Power Supply	Cincon Electronics Co, Ltd	TR36A-POE-480	36480- 007281
Support	Laptop PC	Dell	Inspiron	None

### 3.4. Antenna Details

1. Maximum Antenna Gain = +16.0 dBi

Patch array, European Antennas, 60deg Az, Switchable Polarization

Model Number: SA17-55VH-ABL/602

### 3.5. Cabling and I/O Ports

Number and type of I/O ports

1. POE 10/100 Ethernet (max length 30 meters)
2. GPS (max length 15 meters)

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 16 of 121

---

### **3.6. Test Configurations**

Testing was performed to determine the worst case test scenario. It was found through exercising each modulation with each bandwidth that there was no difference. Test data is available and held on file by the laboratory identifying cross checks performed.

Matrix of test configurations

Operational Mode	Frequencies (5 MHz Channel Spacing)	Frequencies (10 MHz Channel Spacing)	Frequencies (15 MHz Channel Spacing)
802.16	5482.5	5485.0	5487.5
	5597.5	5597.5	5597.5
	5712.5	5710	5707.5

### **3.7. Equipment Modifications**

The following modifications were required to bring the equipment into compliance:

1. NONE

### **3.8. Deviations from the Test Standard**

The following deviations from the test standard were required in order to complete the test program:

1. NONE





**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 17 of 121

#### 4. TEST SUMMARY

##### List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.407** and **Industry Canada RSS-210** and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.407(a) A9.2(2) 4.4	26dB and 99% Emission BW	Emission bandwidth measurement	Conducted	Complies	5.1.1
15.407(a) A9.2(2) 4.6	Transmit Output Power	Power Measurement	Conducted	Complies	5.1.2
15.407(a) A9.2(2)	Peak Power Spectral Density	PPSD	Conducted	Complies	5.1.3
15.407(a)(6)	Peak Excursion Ratio	<13dB in any 1MHz bandwidth	Conducted	Complies	5.1.4
15.407(g) 15.31 2.1 4.5	Frequency Stability	Limits: contained within band of operation at all times.	Manufacturer declaration	Complies	5.1.5
15.407(f) 5.5	Radio Frequency Radiation Exposure	Exposure to radio frequency energy levels, Maximum Permissible Exposure (MPE)	SAR testing performed	Complies	5.1.6

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 18 of 121

### List of Measurements (continued)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.407** and **Industry Canada RSS-210** and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.407(b)(2) 15.205(a) 15.209(a) 2.2 2.6 A9.3(2) 4.7	Radiated Emissions		Radiated		5.1.7
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	5.1.7.1
	Radiated Band Edge	Band edge results		Complies	5.1.7.2
RSS-GEN 6	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	5.1.7.3
15.407(b)(6) 15.205(a) 15.209(a) 2.2	Radiated Emissions	Emissions <1 GHz (30M-1 GHz)		Complies	5.1.7.4
15.407(b)(6) 15.207 7.2.2	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies	5.1.8

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 19 of 121

## List of Measurements (cont'd)

### Dynamic Frequency Selection (DFS)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.407(h)(2)** and **FCC Memorandum Opinion and Order FCC 06-96 (Compliance Measurement procedures for unlicensed national information infrastructure devices operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating dynamic frequency selection)**.

### Tests performed on Master Device

Section	Test Items	Description	Condition	Result	Test Report Section
7.8.1	Detection Bandwidth	UNII Detection Bandwidth	Conducted	Complies	6.2.1
7.8.2.1	Performance Requirements Check	Initial Channel Availability Check Time	Conducted	Complies	6.2.2
7.8.2.2		Radar Burst at the Beginning of the Channel Availability Check Time	Conducted	Complies	6.2.3
7.8.2.3		Radar Burst at the End of the Channel Availability Check Time	Conducted	Complies	6.2.4
7.8.3	In-Service Monitoring	In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period	Conducted	Complies	6.2.5
7.8.4	Radar Detection	Statistical Performance Check	Conducted	Complies	6.2.6

**Note 1:** Test results reported in this document relate only to the items tested

**Note 2:** The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria

**Note 3:** Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

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## 5. TEST RESULTS

### 5.1. Device Characteristics

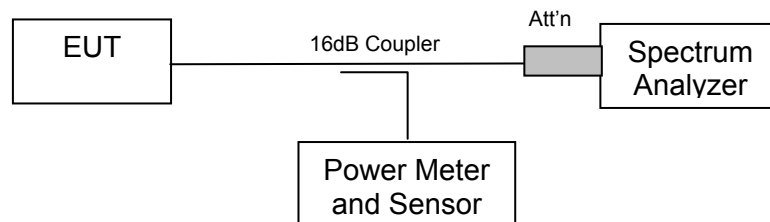
#### 5.1.1. 26 dB and 99 % Bandwidth

**FCC, Part 15 Subpart C §15.407(a)**  
**Industry Canada RSS-210 § A9.2(2)**  
**Industry Canada RSS-Gen 4.4**

#### Test Procedure

The bandwidth at 26 dB and 99 % is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

#### Test Measurement Set up



Measurement set up for 26 dB and 99 % bandwidth test



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 21 of 121

### Measurement Results for 26 dB and 99 % Operational Bandwidth(s)

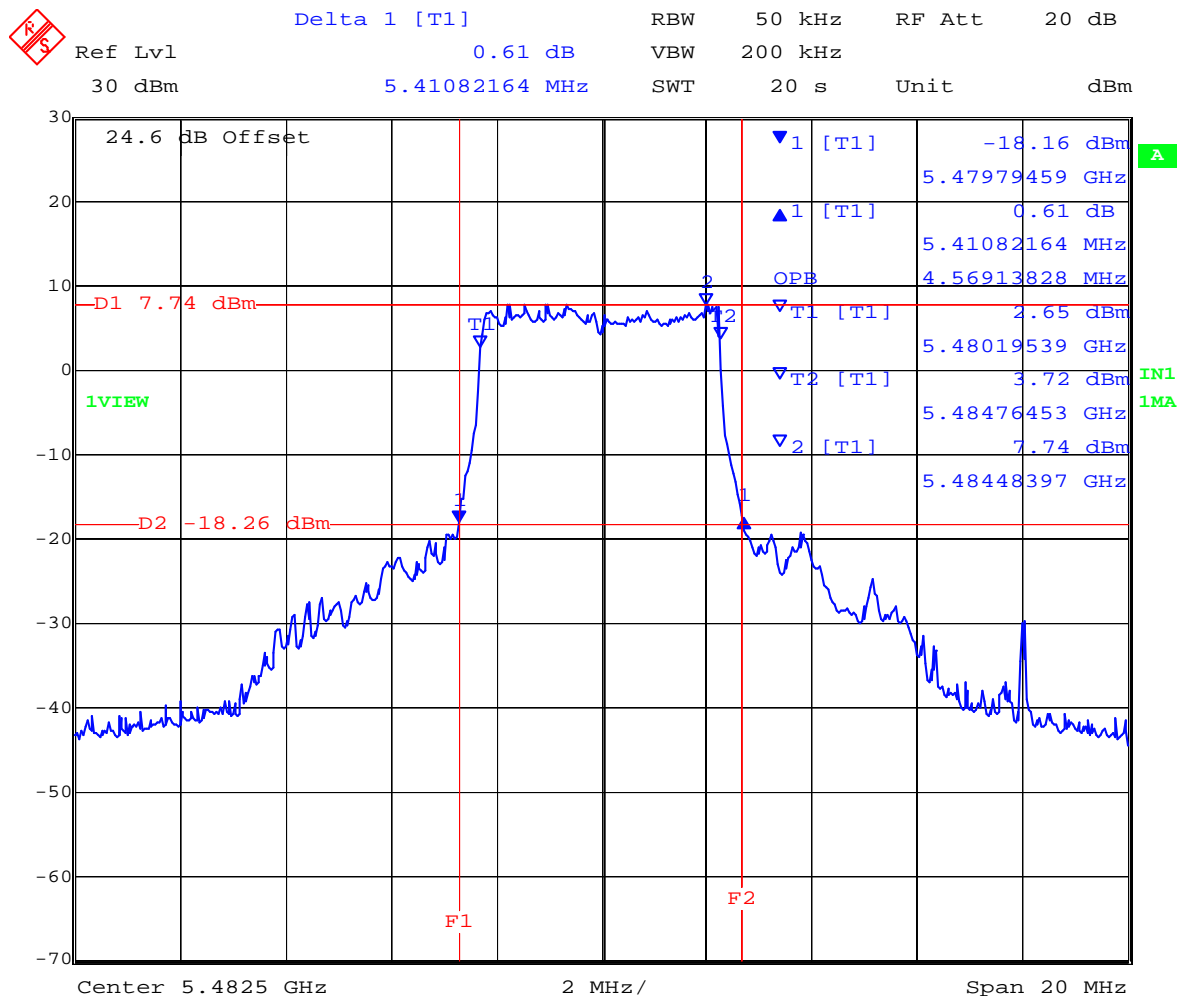
Ambient conditions.

Temperature: 17 to 23 °C      Relative humidity: 31 to 57 %      Pressure: 999 to 1012 mbar

#### TABLE OF RESULTS –64 QAM 5 MHz BW

Center Frequency (MHz)	26 dB Bandwidth (MHz)	99 % BW (MHz)
5,482.5	5.41082164	4.56913828
5,597.5	6.01202405	4.56913828
5,712.5	5.49098196	4.56913828

#### 5,482.5 MHz 64 QAM 5 MHz 26 dB and 99 % Bandwidth



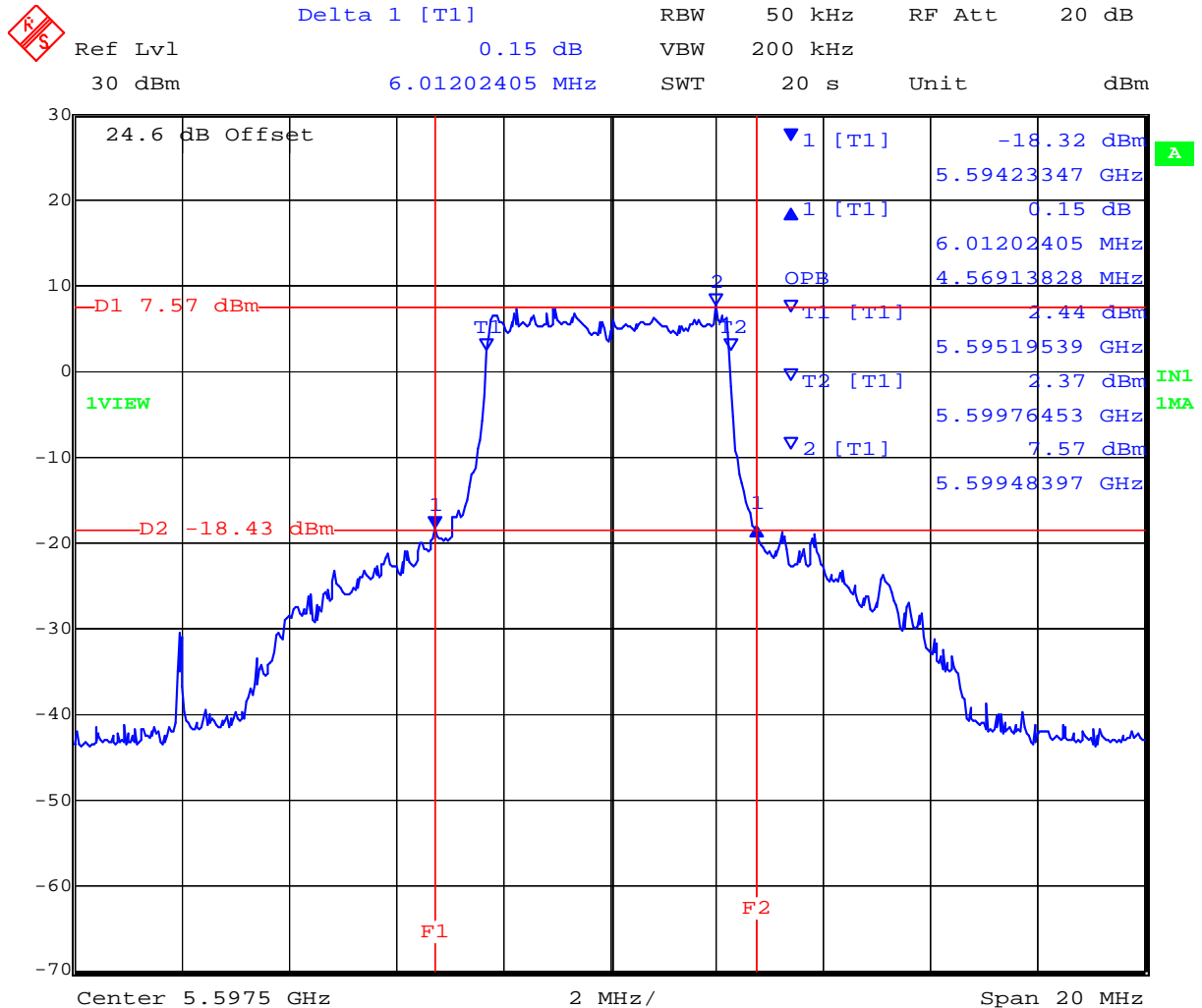
Date: 18.SEP.2008 12:15:17

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 22 of 121

### 5,597.5 MHz 64 QAM 5 MHz 26 dB and 99 % Bandwidth



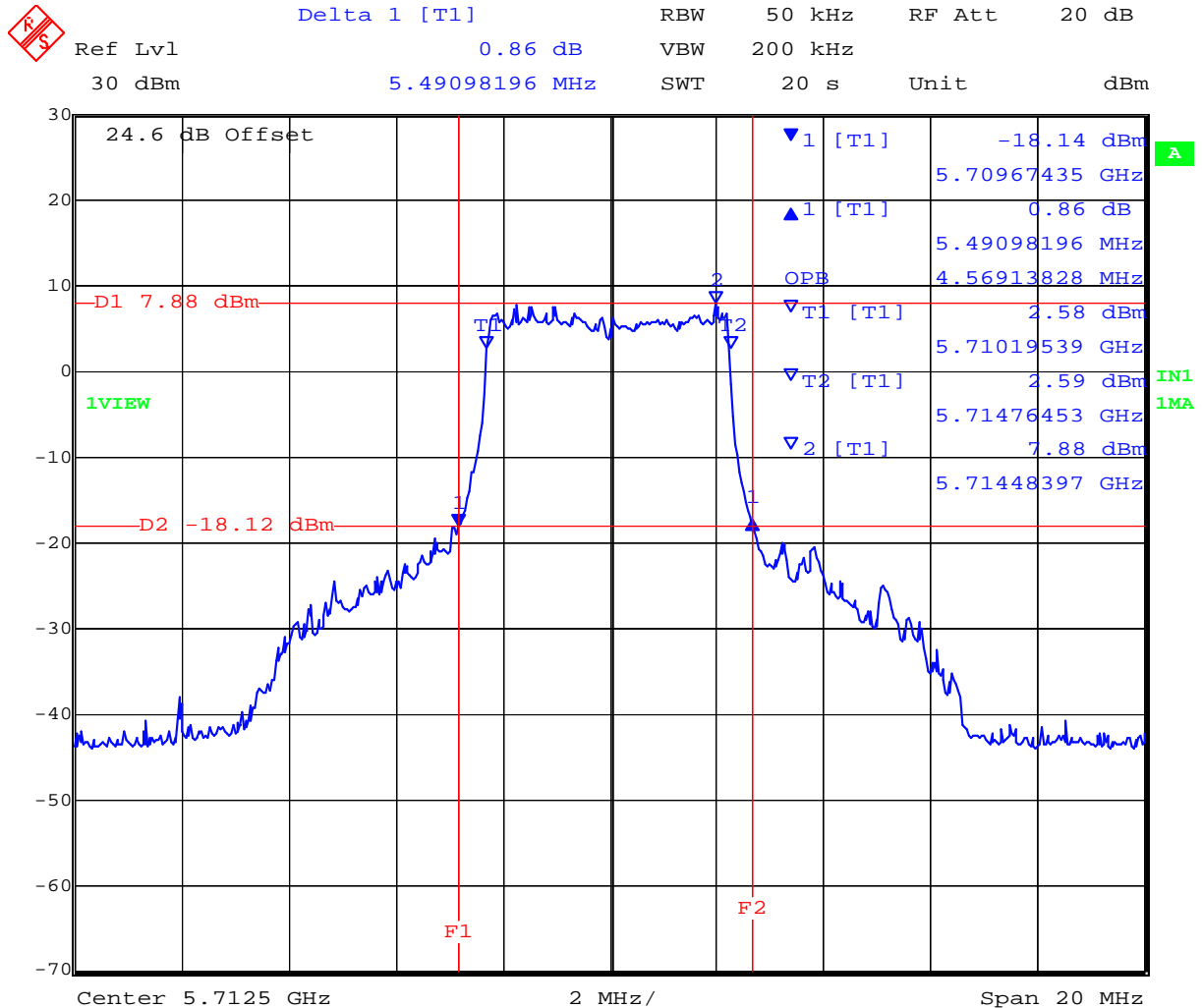
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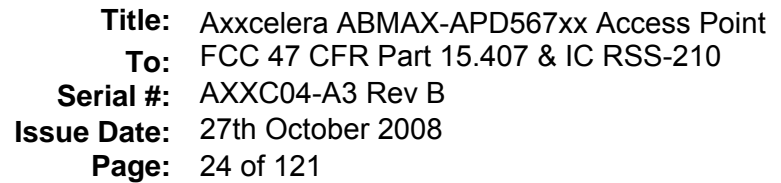
Title: Axxcelera ABMAX-APD567xx Access Point  
To: FCC 47 CFR Part 15.407 & IC RSS-210  
Serial #: AXXC04-A3 Rev B  
Issue Date: 27th October 2008  
Page: 23 of 121

### 5,712.5 MHz 64 QAM 5 MHz 26 dB and 99 % Bandwidth



Date: 18.SEP.2008 12:34:49

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Center Frequency (MHz)	26 dB Bandwidth (MHz)	99 % BW (MHz)
5,485	10.68136273	9.05811623
5,597.5	10.98127655	9.13827655
5,710	10.34068136	9.05811623

Ref Lvl 30 dBm Delta 1 [T1] 0.88 dB RBW 100 kHz RF Att 20 dB

30 dBm 10.68136273 MHz VBW 200 kHz Unit dBm

24.6 dB Offset

1VIEW

D1 8.21 dBm

D2 -17.79 dBm

▼1 [T1] -19.22 dBm 5.47950902 GHz

▲1 [T1] 0.88 dB 10.68136273 MHz

OPB 9.05811623 MHz

▼T1 [T1] 3.15 dBm 5.48047094 GHz

▼T2 [T1] 3.28 dBm 5.48952906 GHz

▼2 [T1] 8.21 dBm 5.48904810 GHz

F1 F2

Center 5.485 GHz 4 MHz/ Span 40 MHz

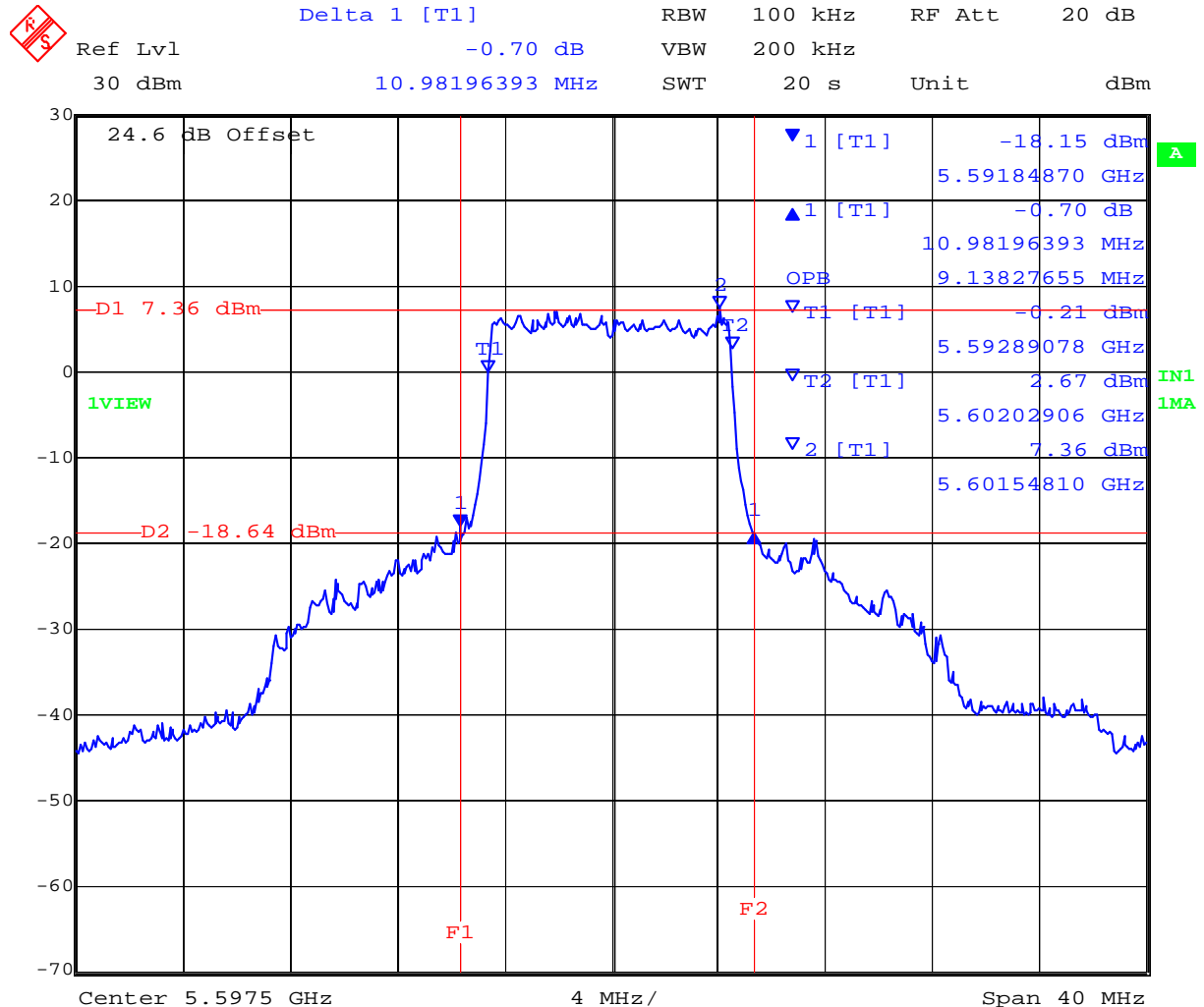
MiCOM Labs, 440 Boulder Court, Suite 200, Pleasanton, CA 94566 USA, Phone: 925.462.0304, Fax: 925.462.0306, [www.micomlabs.com](http://www.micomlabs.com)





Title: Axxcelera ABMAX-APD567xx Access Point  
To: FCC 47 CFR Part 15.407 & IC RSS-210  
Serial #: AXXC04-A3 Rev B  
Issue Date: 27th October 2008  
Page: 25 of 121

### 5,597.5 MHz 64 QAM 10 MHz 26 dB & 99% Bandwidth



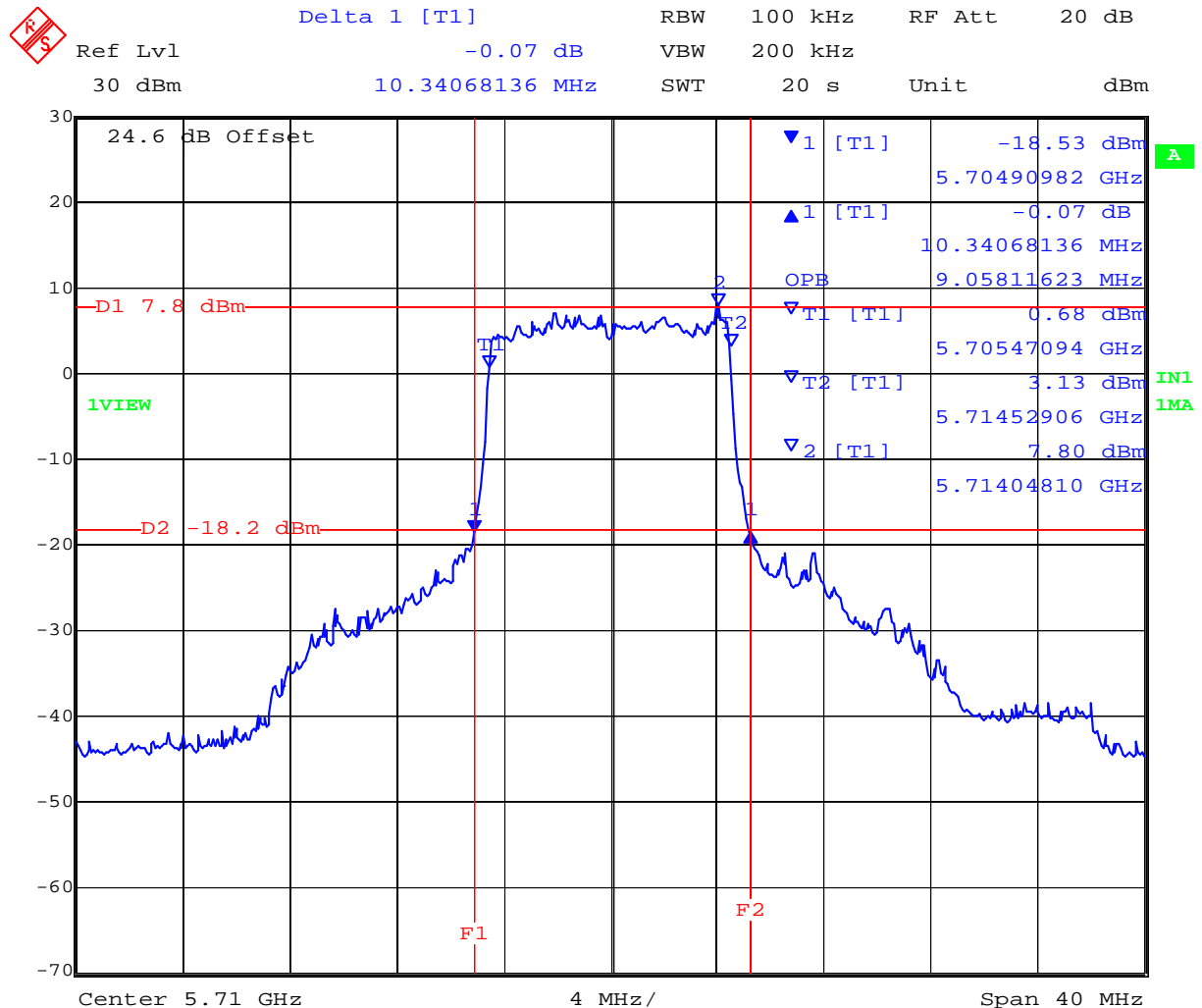
Date: 18.SEP.2008 12:49:29

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 26 of 121

### 5,710 MHz 64 QAM 10 MHz 26 dB & 99% Bandwidth



Date: 18.SEP.2008 12:53:22

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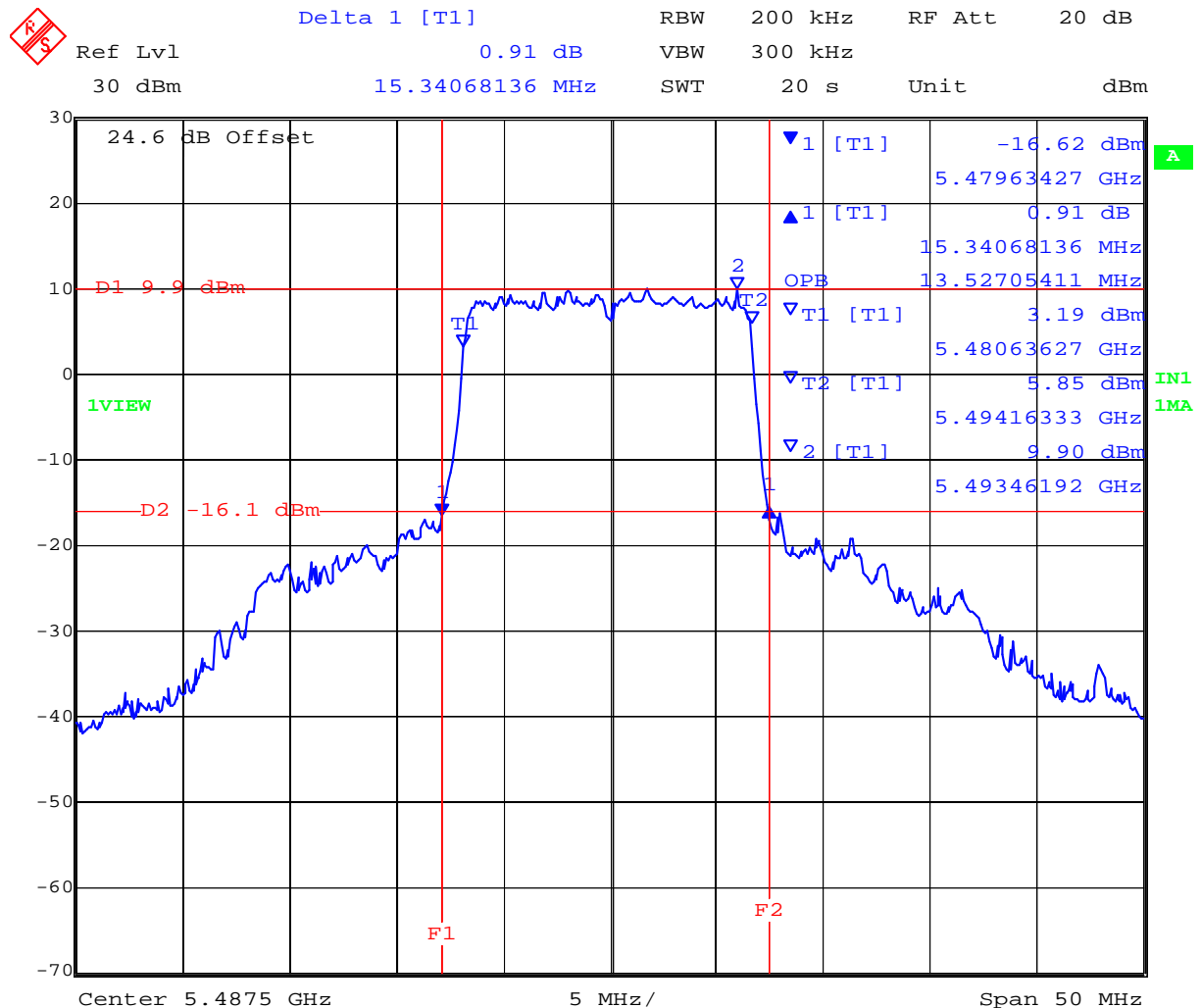


**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 27 of 121

TABLE OF RESULTS – 64 QAM 15 MHz BW

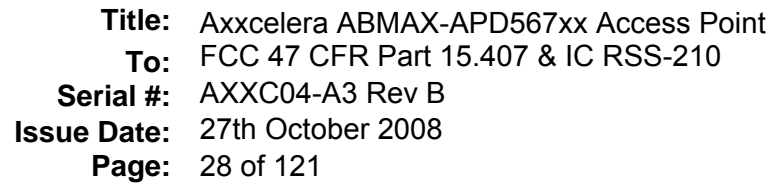
Center Frequency (MHz)	26 dB Bandwidth (MHz)	99 % BW (MHz)
5,487.5	15.34068136	13.52705411
5,597.5	16.53306613	13.62725451
5,707.5	16.33266533	13.52705411

**5,487.5 MHz 64 QAM 15 MHz 26 dB & 99% Bandwidth**



Date: 18.SEP.2008 13:06:57

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Ref Lvl 30 dBm Delta 1 [T1] 0.64 dB RBW 300 kHz RF Att 20 dB

30 dBm 16.53306613 MHz SWT 20 s Unit dBm

24.6 dB Offset

D1 8.87 dBm

1VIEW

D2 -17.13 dBm

T1

T2

F1

F2

Center 5.5975 GHz 5 MHz/ Span 50 MHz

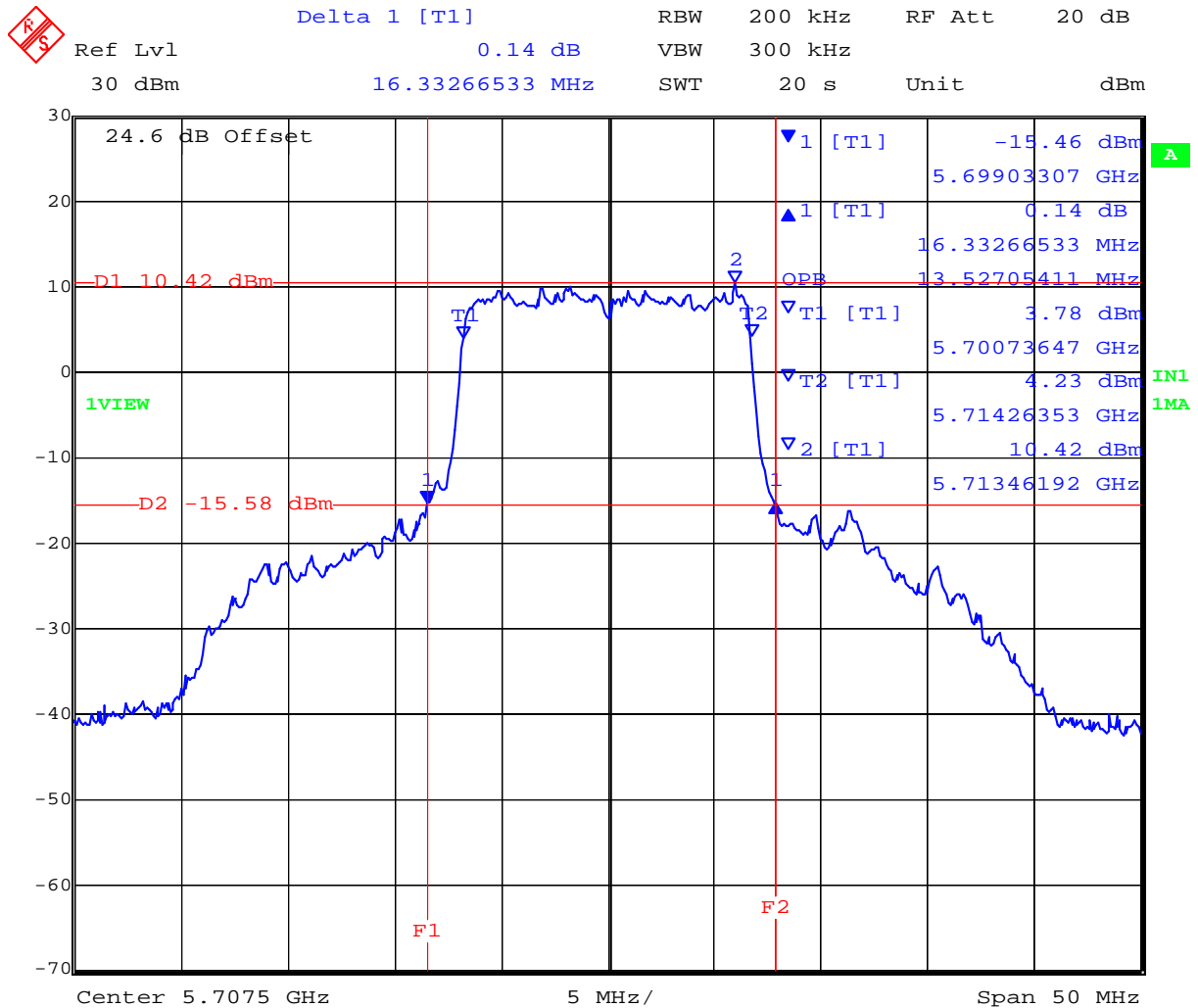
Label	Value
[T1]	-17.43 dBm
5.5883267 GHz	
1 [T1]	0.64 dB
16.53306613 MHz	
OPB	13.62725451 MHz
T1 [T1]	2.07 dBm
5.59063627 GHz	
T2 [T1]	2.60 dBm
5.60426353 GHz	
2 [T1]	8.87 dBm
5.60346192 GHz	

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 29 of 121

### 5,707.5 MHz 64 QAM 15 MHz 26 dB & 99% Bandwidth



Date: 18.SEP.2008 13:13:21

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 30 of 121

## Specification

### Limits

#### **FCC, Part 15 §15.407 (a)(1), (a)(2) and Industry Canada RSS-210 § A9.2(2)**

**(a)(1)** For the band 5.15-5.25 GHz the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or +4 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed +4 dBm in any 1 megahertz band.

**(a)(2)** For the 5.25-5.35 GHz band the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or +11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed +11 dBm in any 1 megahertz band.

#### **Industry Canada RSS-Gen 4.4**

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

## Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB
-------------------------	----------

## Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 31 of 121

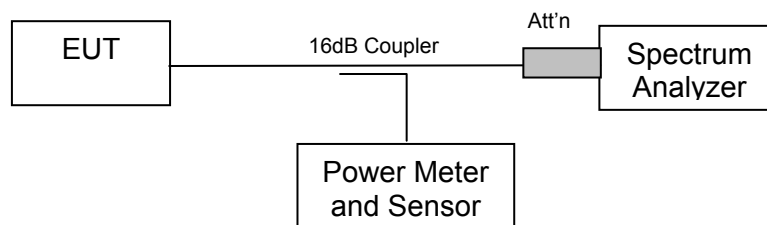
### 5.1.2. Transmit Output Power

**FCC, Part 15 Subpart C §15.407(a)**  
**Industry Canada RSS-210 §9.9(2)**  
**Industry Canada RSS-Gen 4.6**

#### **Test Procedure**

The transmitter terminal of EUT was connected to the input of the average power meter and the spectrum analyzer. Method #2 as outlined in the FCC's Public Notice (DA 02-2138, August 30, 2002) was used to make all measurements. The results reported include all offsets due to attenuators, cable losses etc.

#### **Test Measurement Set up**



Measurement set up for Transmitter Output Power

#### **Maximum Transmit Power, FCC Limits**

Limit 5470 – 5725 MHz band; Lesser of 250 mW (+24dBm) or  $11 + 10 \log(B)$  dBm

BW (MHz)	Frequency Range (MHz)	Maximum 26 dB Bandwidth (MHz)	$11 + 10 \log(B)$	Limit (dBm)
5	5470 - 5725	6.01	+18.78	+18.78
10	5470 – 5725	10.98	+21.41	+21.41
15	5470 - 5725	16.53	+23.18	+23.18

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 32 of 121

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### Industry Canada Limits

#### Maximum Transmit Power Industry Canada Limits

Limit 5470 – 5725; Lesser of 250 mW (+24dBm) or  $11 + 10 \log(B)$  dBm

BW (MHz)	Frequency Range (MHz)	Maximum 99% Bandwidth (MHz)	$11 + 10 \log(B)$	Limit (dBm)
5	5470 - 5725	4.57	+17.60	+17.60
10	5470 – 5725	9.61	+20.83	+20.83
15	5470 - 5725	13.63	+22.34	+22.34

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 33 of 121

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### Measurement Results for Transmit Output Power

Ambient conditions.

Temperature: 17 to 23 °C      Relative humidity: 31 to 57 %      Pressure: 999 to 1012 mbar

TABLE OF RESULTS – - 64 QAM 5 MHz BW

Center Frequency (MHz)	Maximum Conducted Power (dBm)
5,482.5	+17.58
5,597.5	+16.75
5,712.5	+17.14

TABLE OF RESULTS – - 64 QAM 10 MHz BW

Center Frequency (MHz)	Maximum Conducted Power (dBm)
5,485	+16.65
5,597.5	+16.47
5,710	+16.95

TABLE OF RESULTS – - 64 QAM 15 MHz BW

Center Frequency (MHz)	Maximum Conducted Power (dBm)
5,487.5	+17.36
5,597.5	+17.09
5,707.5	+17.44

---

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 34 of 121

## Specification

### Limits

#### **FCC, Part 15 §15.407 (a)(1), (a)(2) and Industry Canada RSS-210 § A9.2(2)**

**(a)(1)** For the band 5.15-5.25 GHz the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or  $+4 \text{ dBm} + 10 \log B$ , where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed +4 dBm in any 1 megahertz band.

**(a)(2)** For the 5.25-5.35 GHz band the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or  $+11 \text{ dBm} + 10 \log B$ , where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed +11 dBm in any 1 megahertz band.

#### **Industry Canada RSS-210 §A9.2(2)**

For the band 5150-5250 MHz, the maximum equivalent isotropically radiated power (e.i.r.p.) shall not exceed 200 mW or  $10 + 10 \log_{10} B$ , dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

For the band 5250-5350 MHz and 5470-5725 MHz, the maximum conducted output power shall not exceed 250 mW or  $11 + 10 \log_{10} B$ , dBm, whichever power is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 1.0 W or  $17 + 10 \log_{10} B$ , dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

#### **Industry Canada RSS-Gen 4.4**

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

## Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	$\pm 1.33 \text{ dB}$
-------------------------	-----------------------

## Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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### 5.1.3. Peak Power Spectral Density

**FCC, Part 15 Subpart C §15.407(a)**  
**Industry Canada RSS-210 § A9.2(2)**

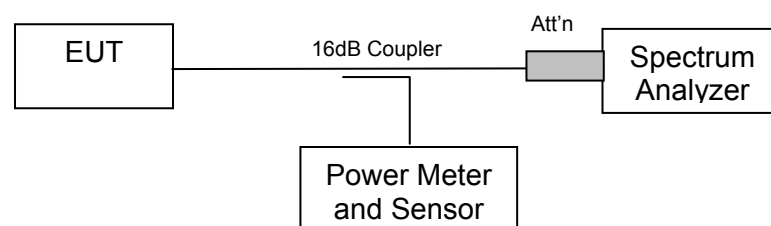
#### **Test Procedure**

The transmitter output was connected to a spectrum analyzer and the peak power spectral density measured. Method 2 Sample Detection and power averaging, specified in FCC document DA 02-2138 (Normative Reference (x) in Section 2.1 'References and Measurement Uncertainty';

“Measurement Procedure Updated for Peak Transmit Power in the Unlicensed National Information Infrastructure (U-NII) Bands.”

was used to determine the peak power spectral density of the emission. The Peak Power Spectral Density is the highest level found across the emission in a 1 MHz resolution bandwidth.

#### **Test Measurement Set up**



Measurement set up for Peak Power Spectral Density

#### **Measurement Results for Peak Power Spectral Density**

Ambient conditions.

Temperature: 17 to 23 °C      Relative humidity: 31 to 57 %      Pressure: 999 to 1012 mbar

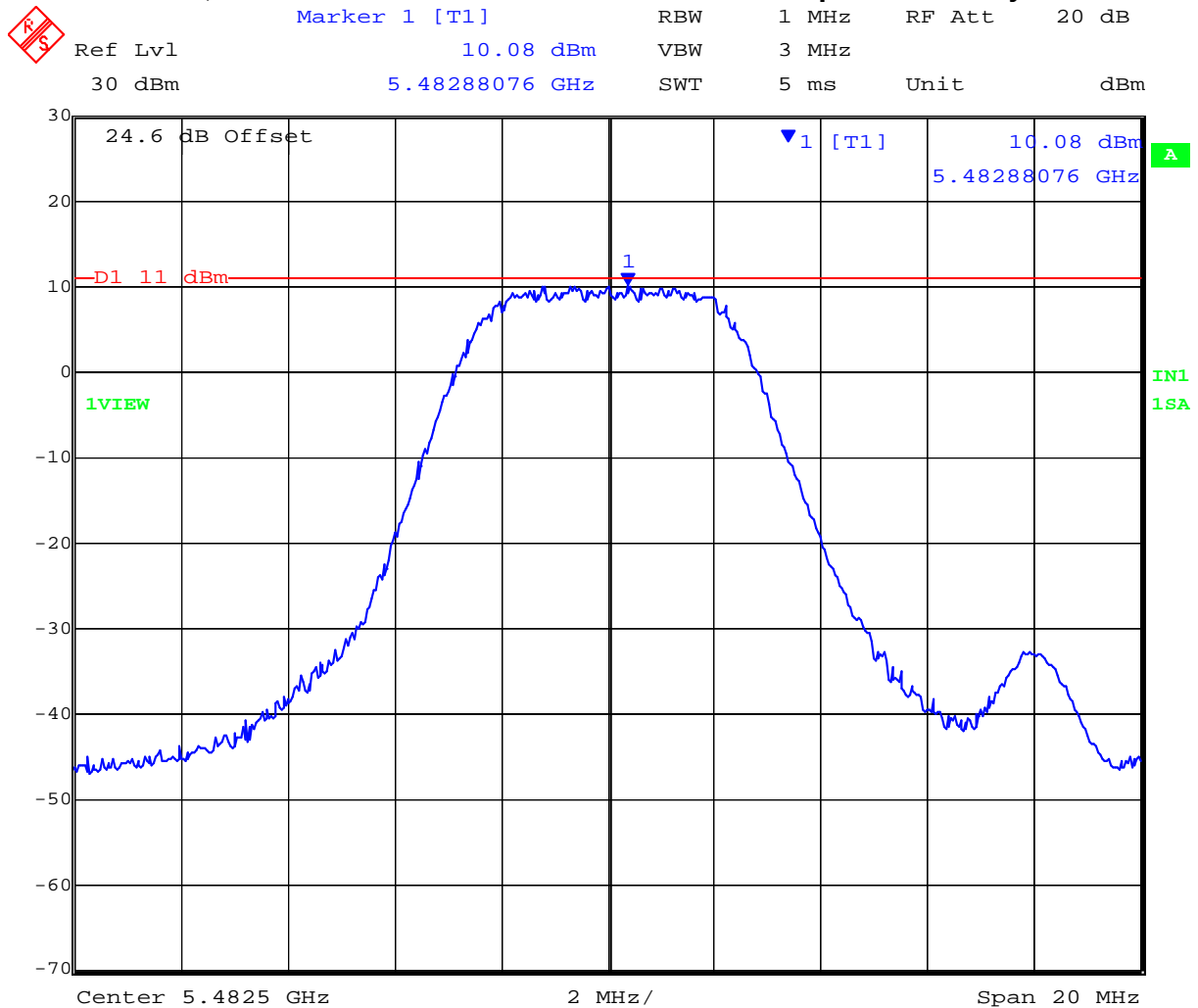


Title: Axxcelera ABMAX-APD567xx Access Point  
To: FCC 47 CFR Part 15.407 & IC RSS-210  
Serial #: AXXC04-A3 Rev B  
Issue Date: 27th October 2008  
Page: 36 of 121

TABLE OF RESULTS – 64 QAM 5 MHz BW

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)
5,482.5	5,482.88076	+10.08	+11
5,597.5	5,596.39780	+8.60	+11
5,712.5	5,713.08116	+9.56	+11

5,482.5 MHz 64 QAM 5 MHz BW Peak Power Spectral Density



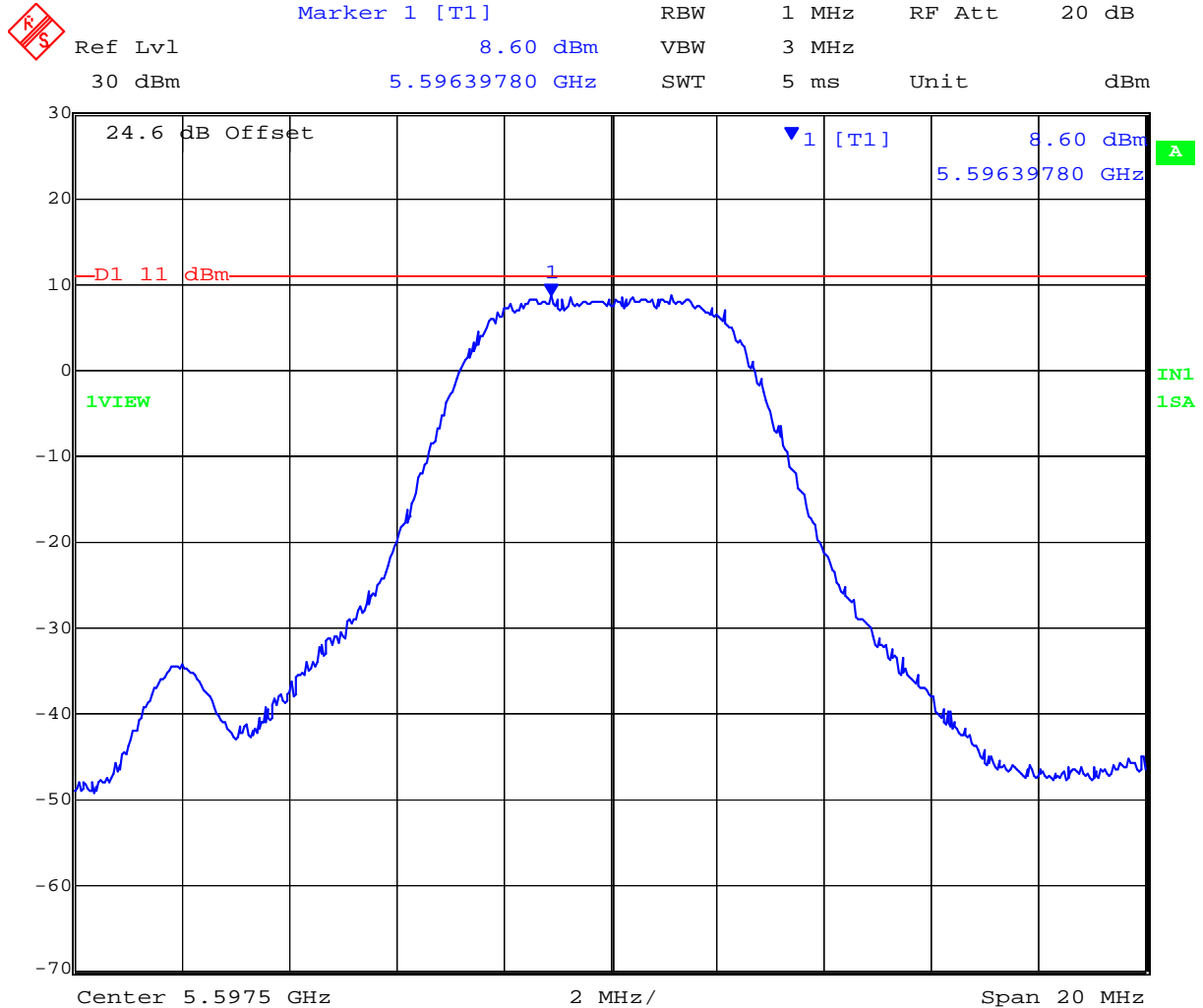
Date: 18.SEP.2008 15:49:42

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 37 of 121

### 5,597.5 MHz - 64 QAM 5 MHz BW Peak Power Spectral Density



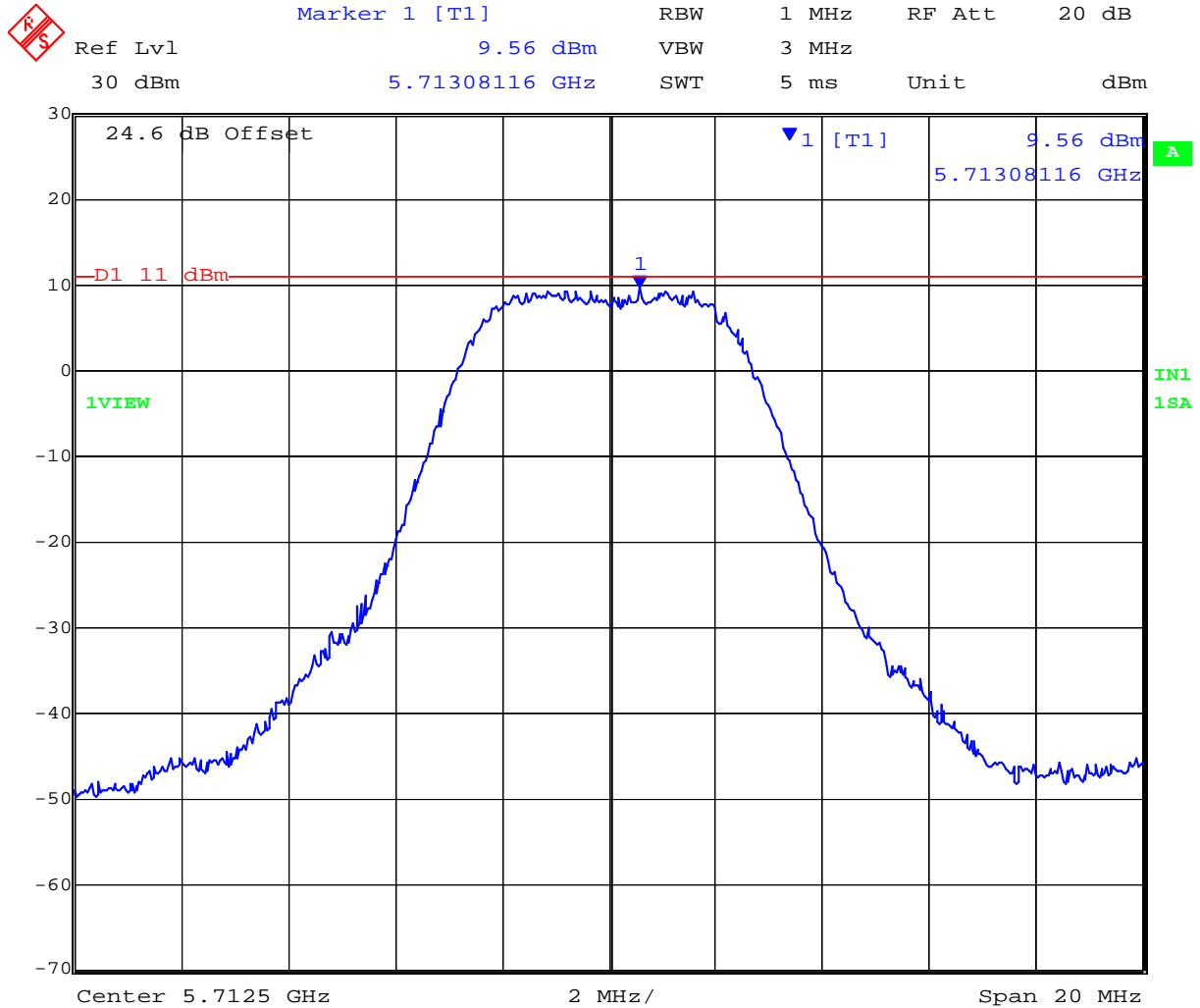
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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 38 of 121

### 5,712.5 MHz 64 QAM 5 MHz BW Peak Power Spectral Density



Date: 18.SEP.2008 15:57:07

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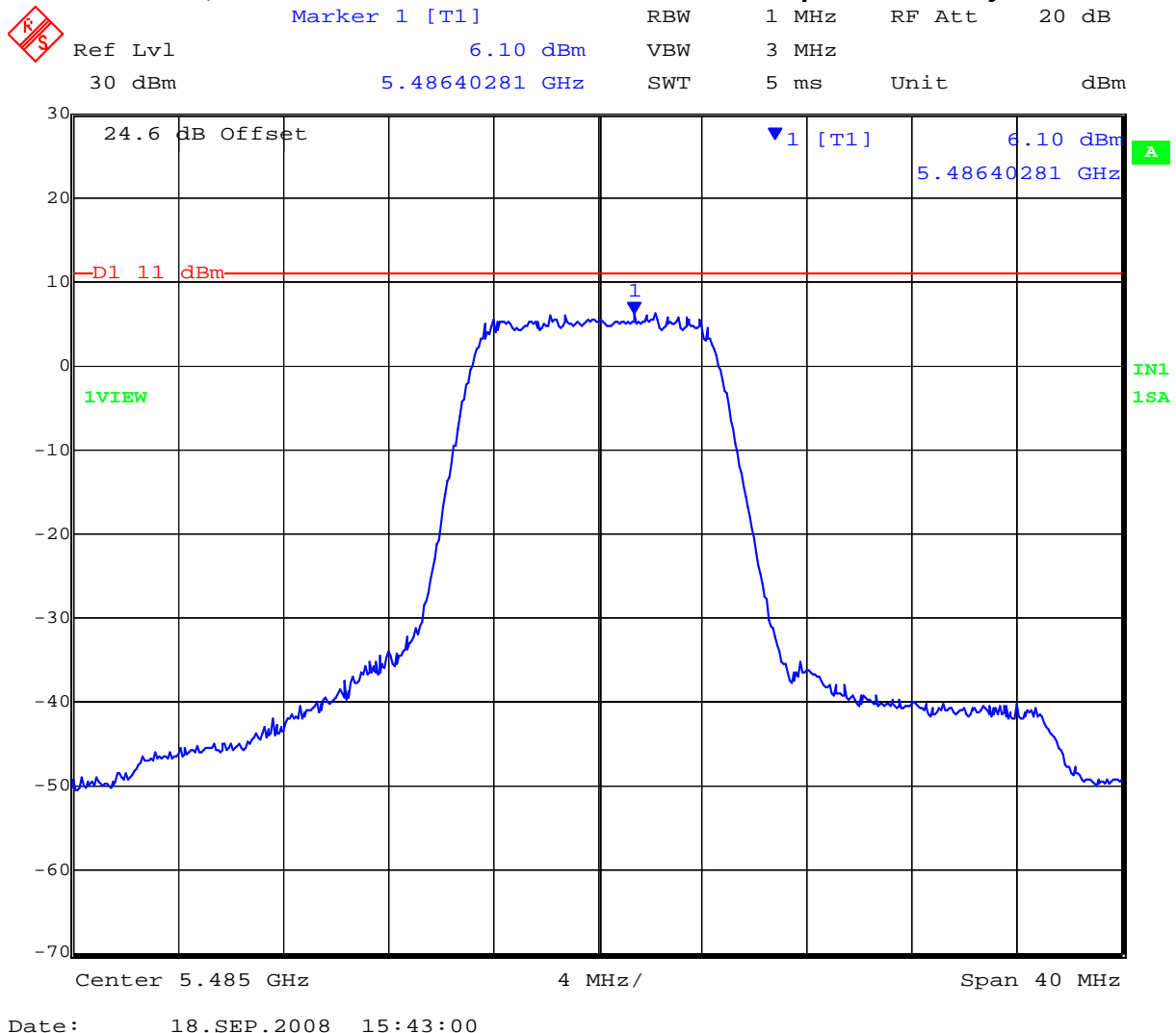


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To: FCC 47 CFR Part 15.407 & IC RSS-210  
Serial #: AXXC04-A3 Rev B  
Issue Date: 27th October 2008  
Page: 39 of 121

TABLE OF RESULTS – - 64 QAM 10 MHz BW

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)
5,485	5486.40281	+6.10	+11
5,597.5	5,598.50200	+5.60	+11
5,710	5,711.48297	+6.67	+11

5,485 MHz 64 QAM 10 MHz BW Peak Power Spectral Density

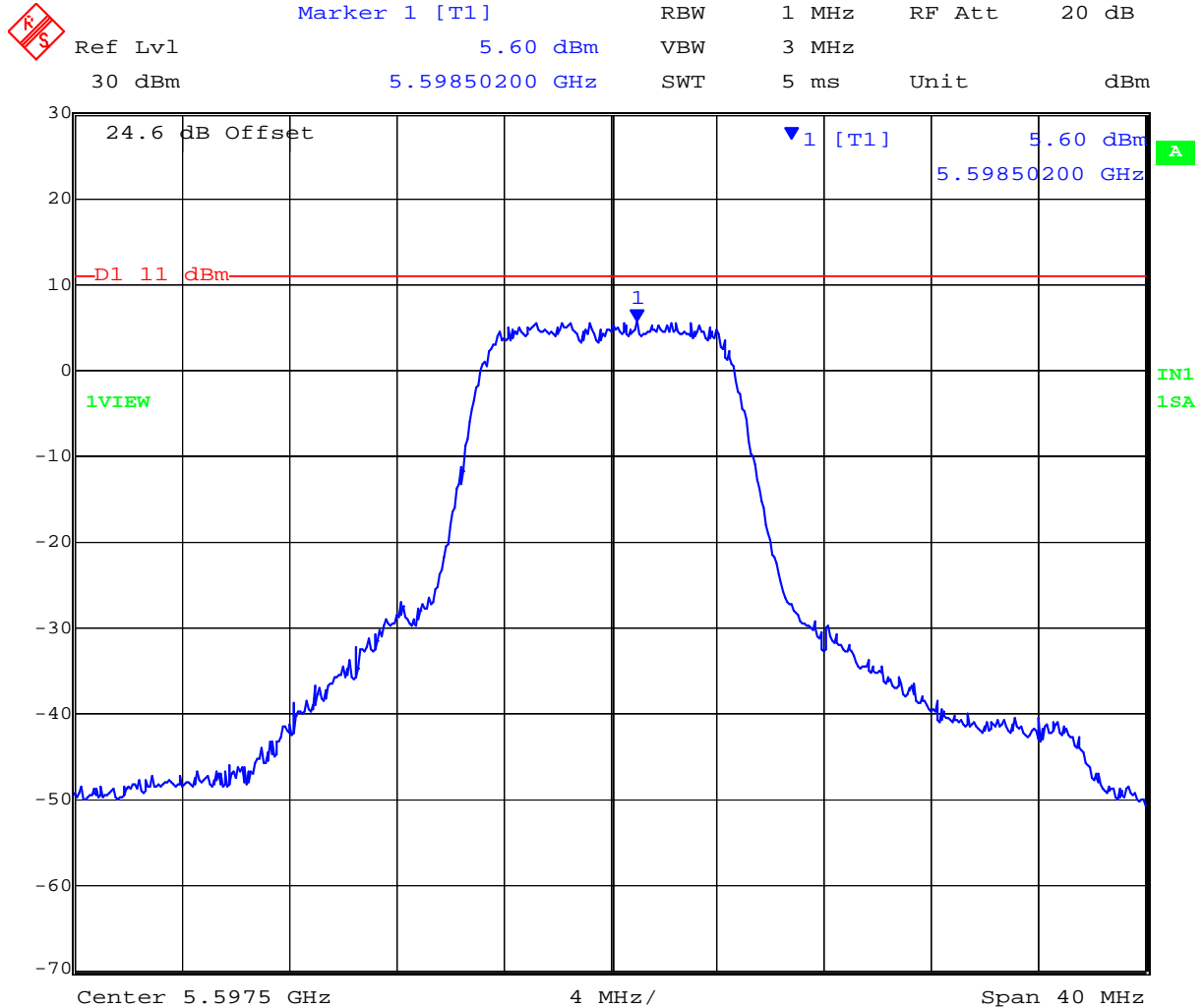


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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 40 of 121

### 5,597.5 MHz - 64 QAM 10 MHz BW Peak Power Spectral Density

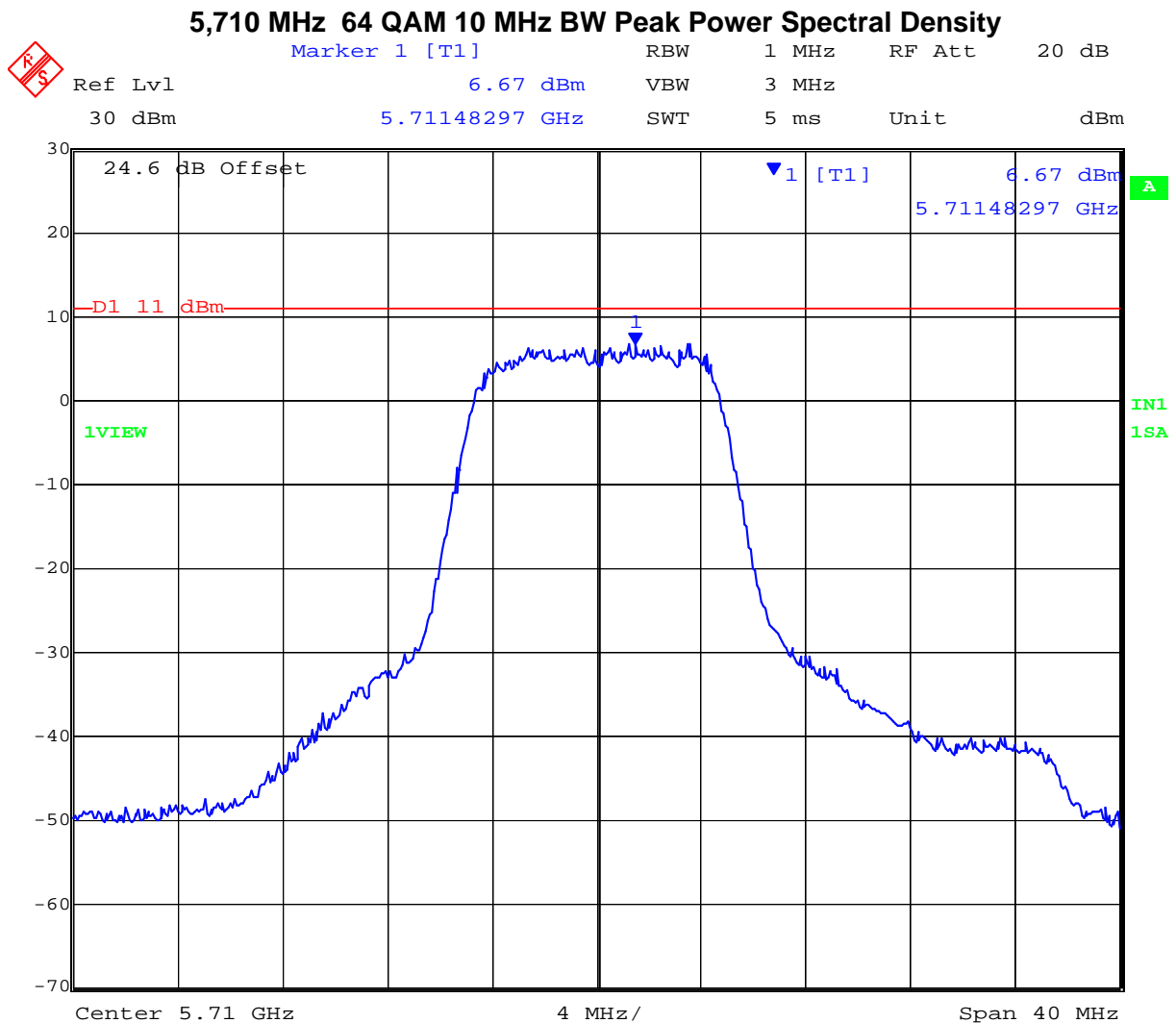


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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 41 of 121



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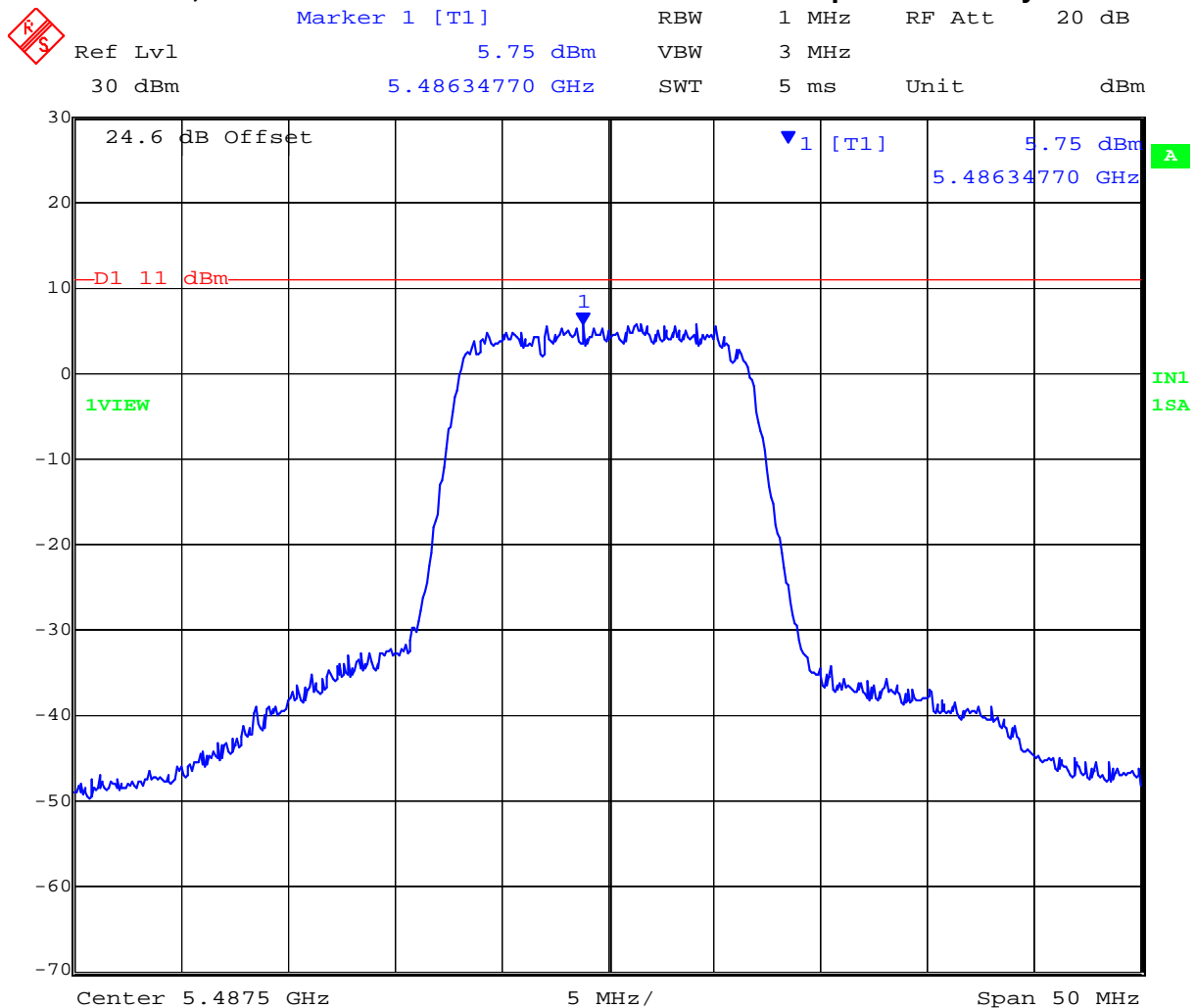


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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 42 of 121

TABLE OF RESULTS -- 64 QAM 15 MHz BW

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)
5,487.5	5,486.34770	+5.75	+11
5,597.5	5,598.65230	+5.03	+11
5,707.5	5,709.05311	+5.63	+11

5,487.5 MHz - 64 QAM 15 MHz BW Peak Power Spectral Density



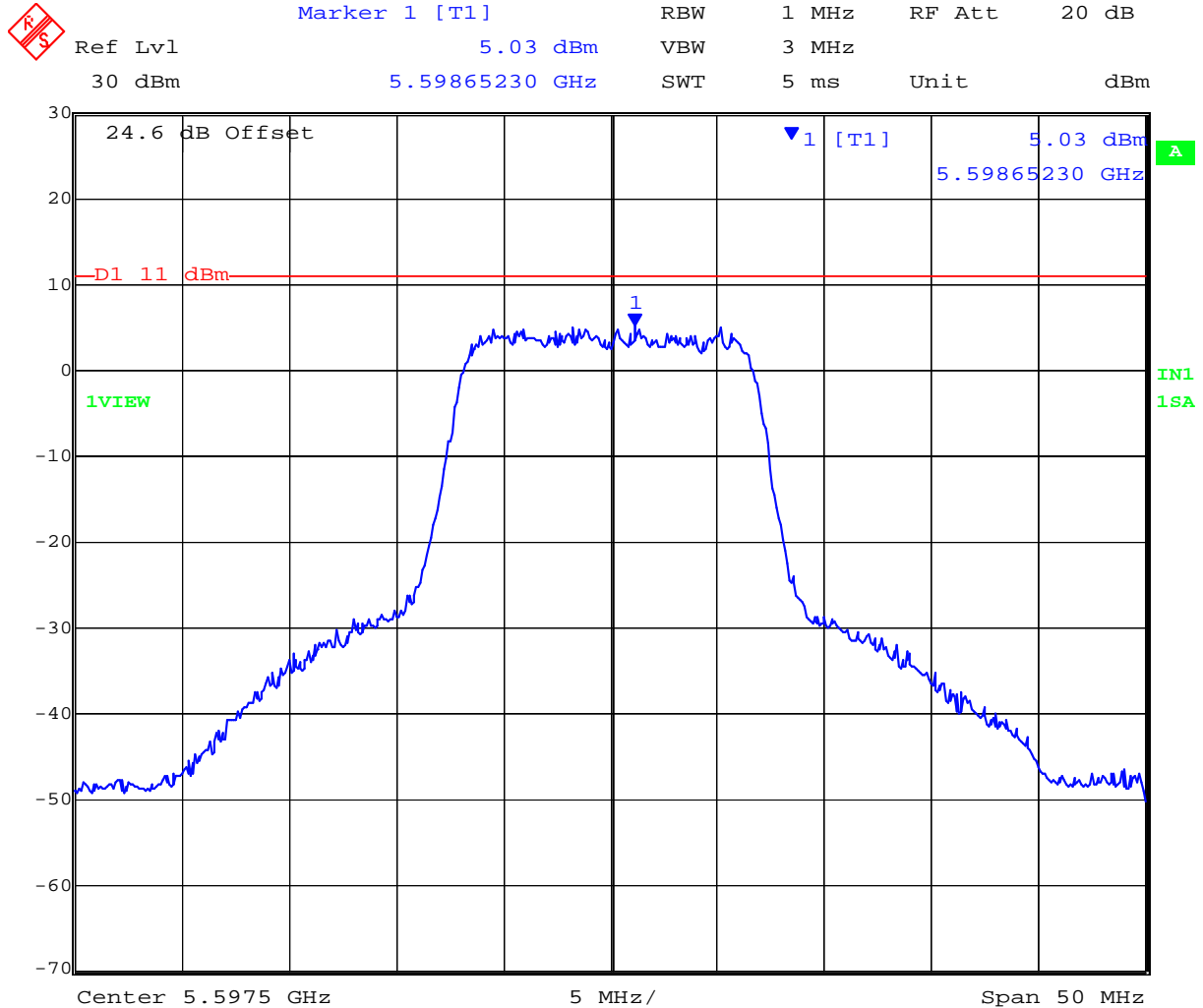
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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 43 of 121

### 5,597.5 MHz - 64 QAM 15 MHz BW Peak Power Spectral Density



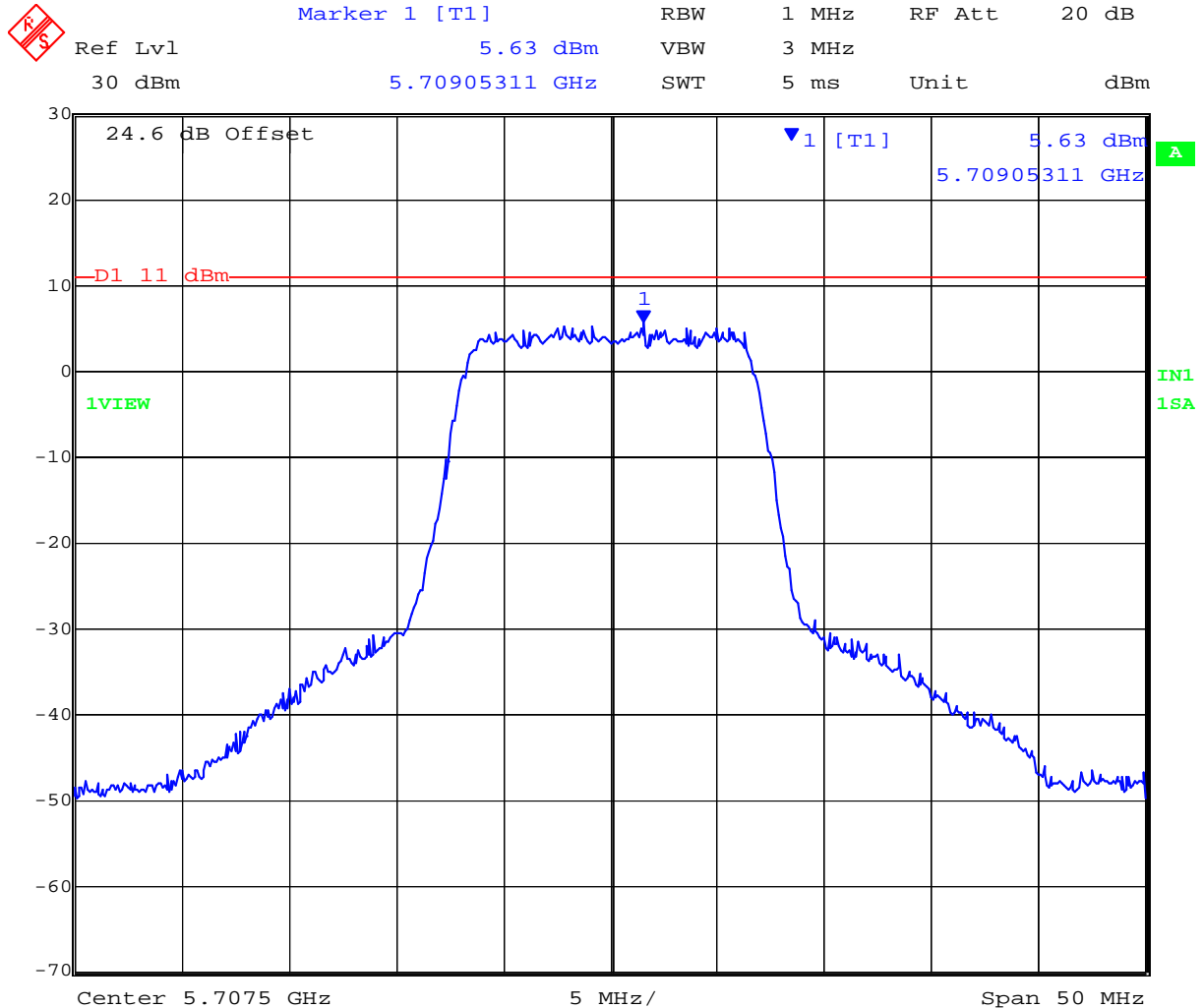
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**Serial #:** AXXC04-A3 Rev B  
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**Page:** 44 of 121

### 5,707.5 MHz 64 QAM 15 MHz BW Peak Power Spectral Density



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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 45 of 121

## Specification

### **FCC, Part 15 §15.407 (a)(1), (a)(2)**

**(a)(1)** The peak power spectral density shall not exceed +4 dBm in any 1 megahertz band.

**(a)(2)** The peak power spectral density shall not exceed +11 dBm in any 1 megahertz band.

### **Industry Canada RSS-210 § A9.2(1), A9.2(2)**

§ **A9.2(1)** The eirp spectral density shall not exceed +10 dBm in any 1 MHz band

§ **A9.2(2)** The power spectral density shall not exceed +11 dBm in any 1 MHz band

## Laboratory Measurement Uncertainty for Spectral Density

Measurement uncertainty	±1.33 dB
-------------------------	----------

## Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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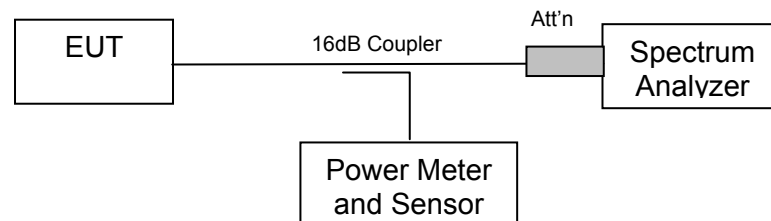
#### 5.1.4. Peak Excursion Ratio

##### **FCC, Part 15 Subpart C §15.407(a)(6)**

#### **Test Procedure**

Normative Reference (xi) Section 2.1 Measurement Procedure DA 02-2138 “Measurement Procedure Updated for Peak Transmit Power in the UNII Bands” was implemented to determine the Peak Excursion Ratio. This is a conducted measurement using a spectrum analyzer. The Peak Excursion Ratio is the difference in amplitude (dB) between the two traces.

#### **Test Measurement Set up**



Measurement set up for Peak Excursion Ratio

#### **Measurement Results for Peak Excursion Ratio**

Ambient conditions.

Temperature: 17 to 23 °C    Relative humidity: 31 to 57%    Pressure: 999 to 1012 mbar

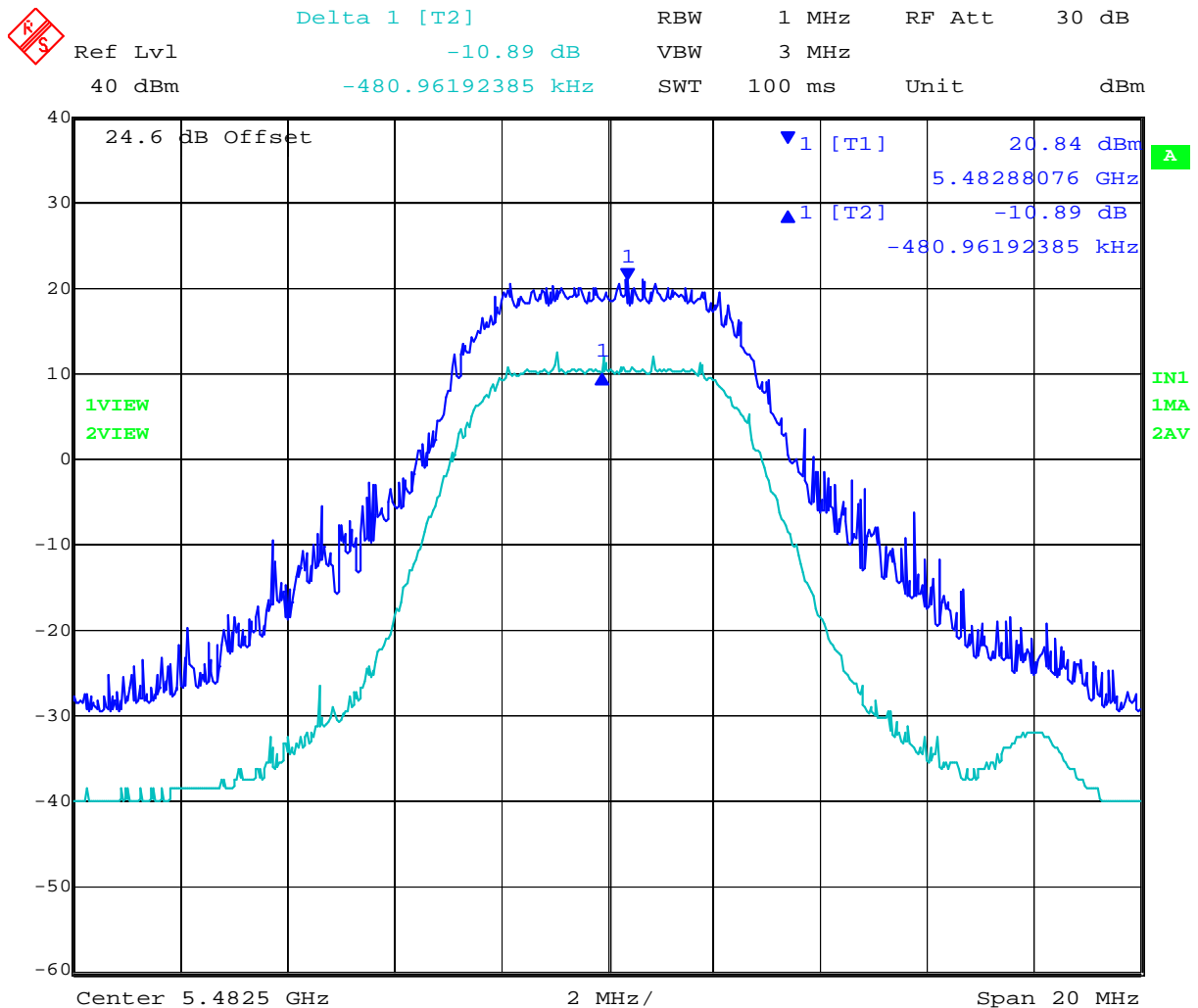


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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 47 of 121

**TABLE OF RESULTS – - 64 QAM 5 MHz BW**

Centre Frequency (MHz)	Peak Excursion Ratio (dB)	Limit (dB)
5,482.5	10.89	13.0
5,597.5	10.91	13.0
5,712.5	11.11	13.0

**5,482.5 MHz - 64 QAM 5 MHz BW Peak Excursion Ratio**



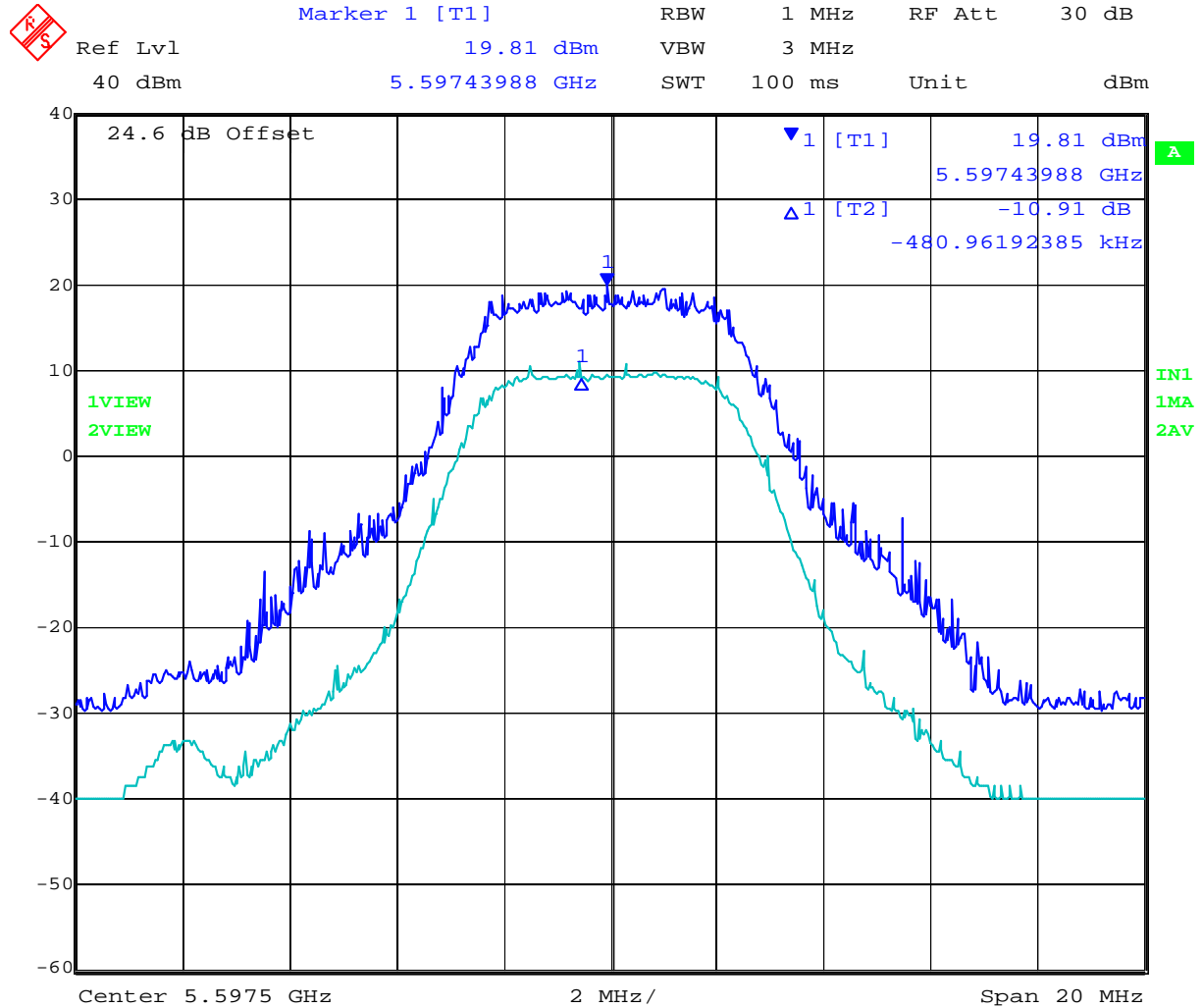
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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 48 of 121

### 5,597.5 MHz - 64 QAM 5 MHz BW Peak Excursion Ratio



Date: 18.SEP.2008 16:14:39

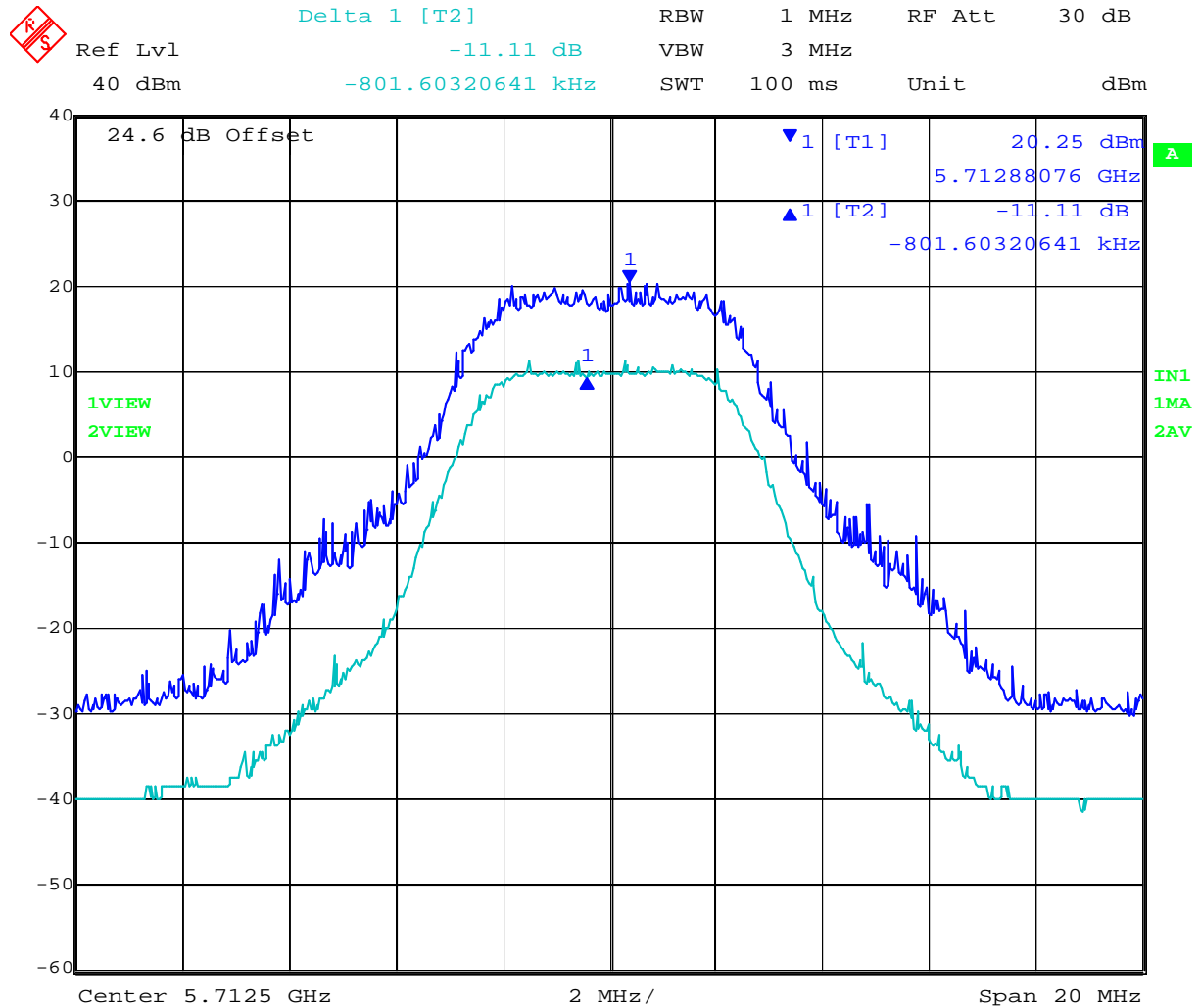
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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 49 of 121

### 5,712.5 MHz - 64 QAM 5 MHz BW Peak Excursion Ratio



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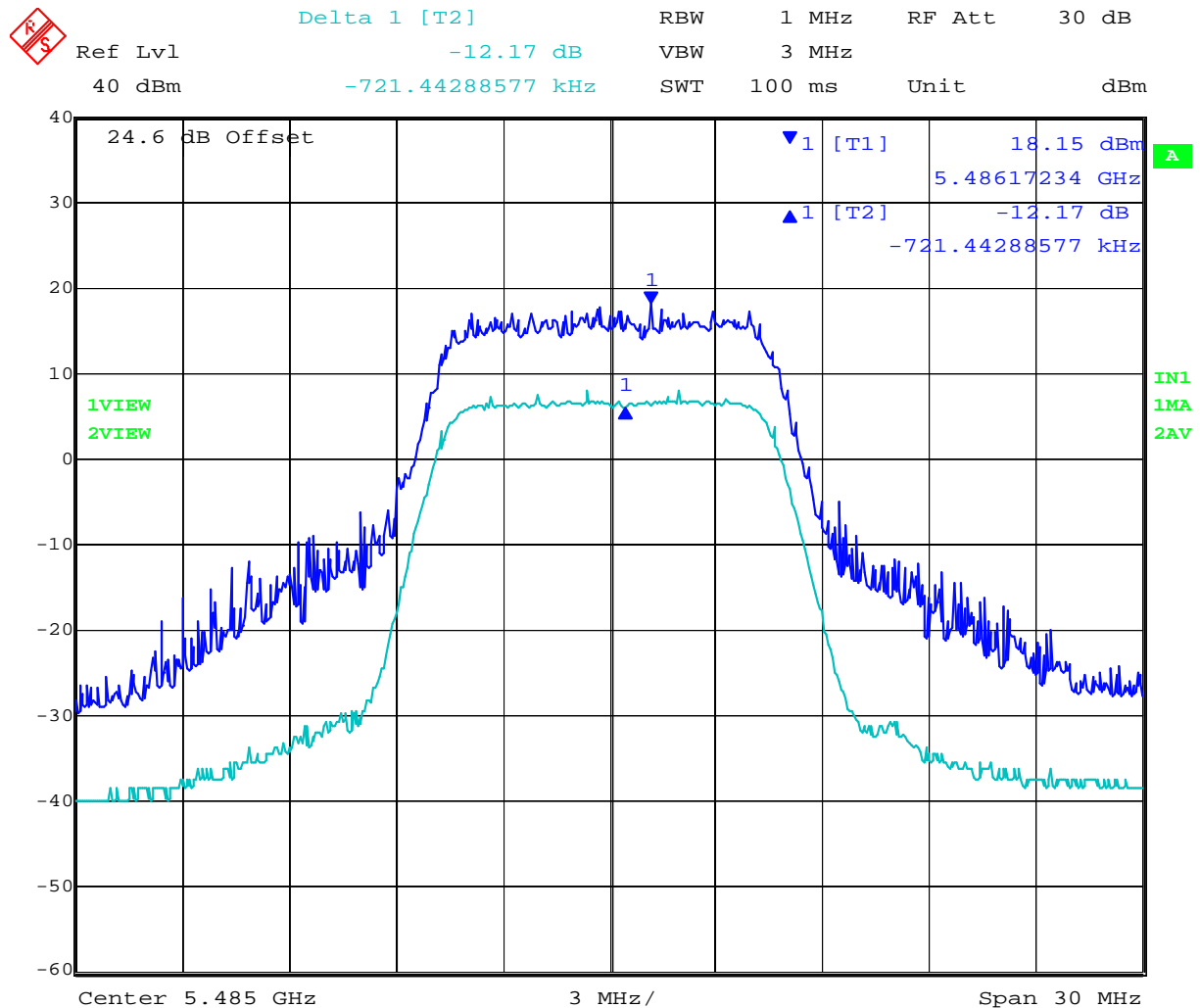


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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 50 of 121

# TABLE OF RESULTS – 64 QAM 10 MHz BW

Centre Frequency (MHz)	Peak Excursion Ratio (dB)	Limit (dB)
5,485	12.17	13.0
5,597.5	10.91	13.0
5,710	12.32	13.0

## 5,485 MHz - 64 QAM 10 MHz BW Peak Excursion Ratio



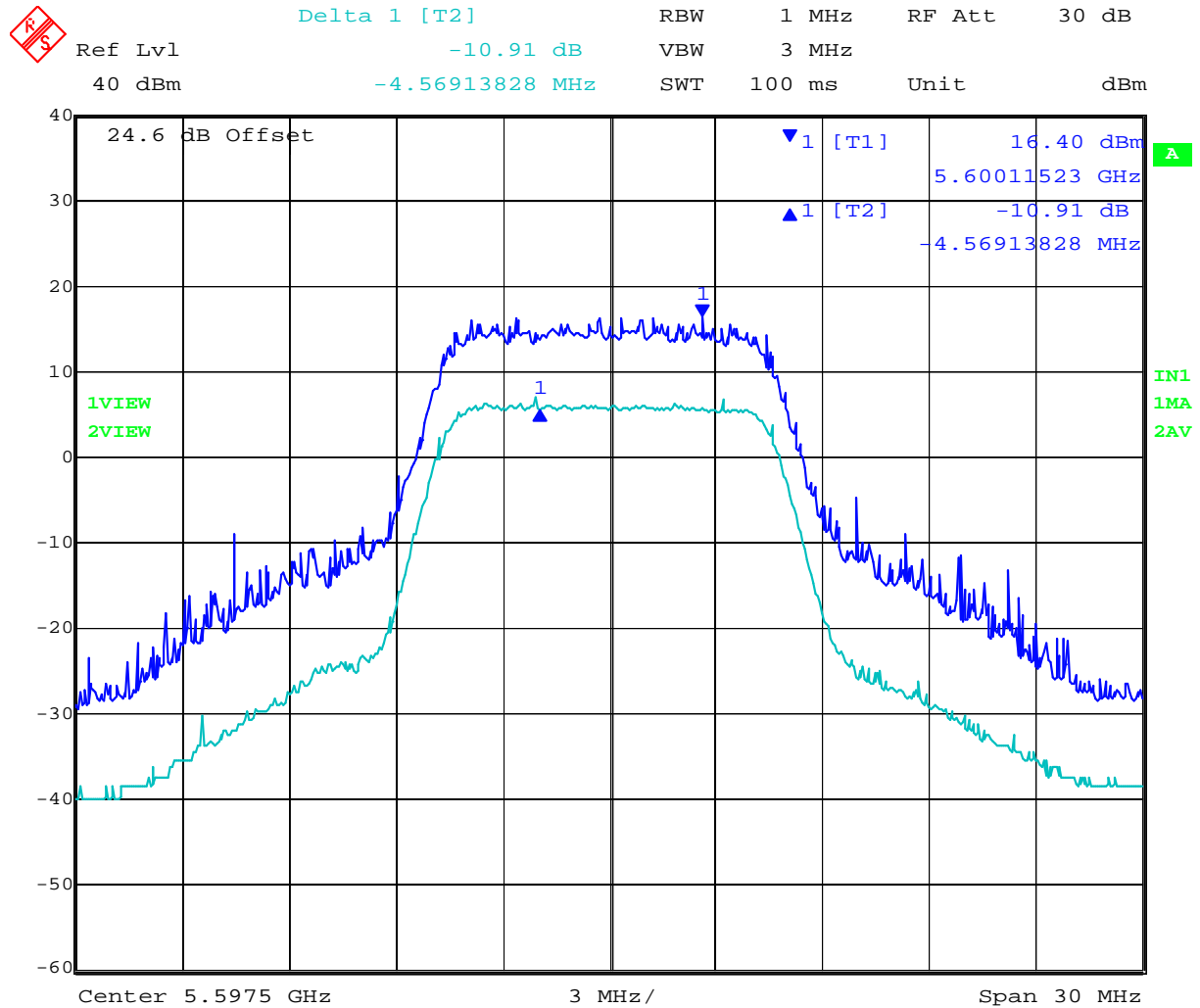
Date: 18.SEP.2008 18:57:37

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Title: Axxcelera ABMAX-APD567xx Access Point  
To: FCC 47 CFR Part 15.407 & IC RSS-210  
Serial #: AXXC04-A3 Rev B  
Issue Date: 27th October 2008  
Page: 51 of 121

### 5,597.5 MHz - 64 QAM 10 MHz BW Peak Excursion Ratio



Date: 18.SEP.2008 19:00:05

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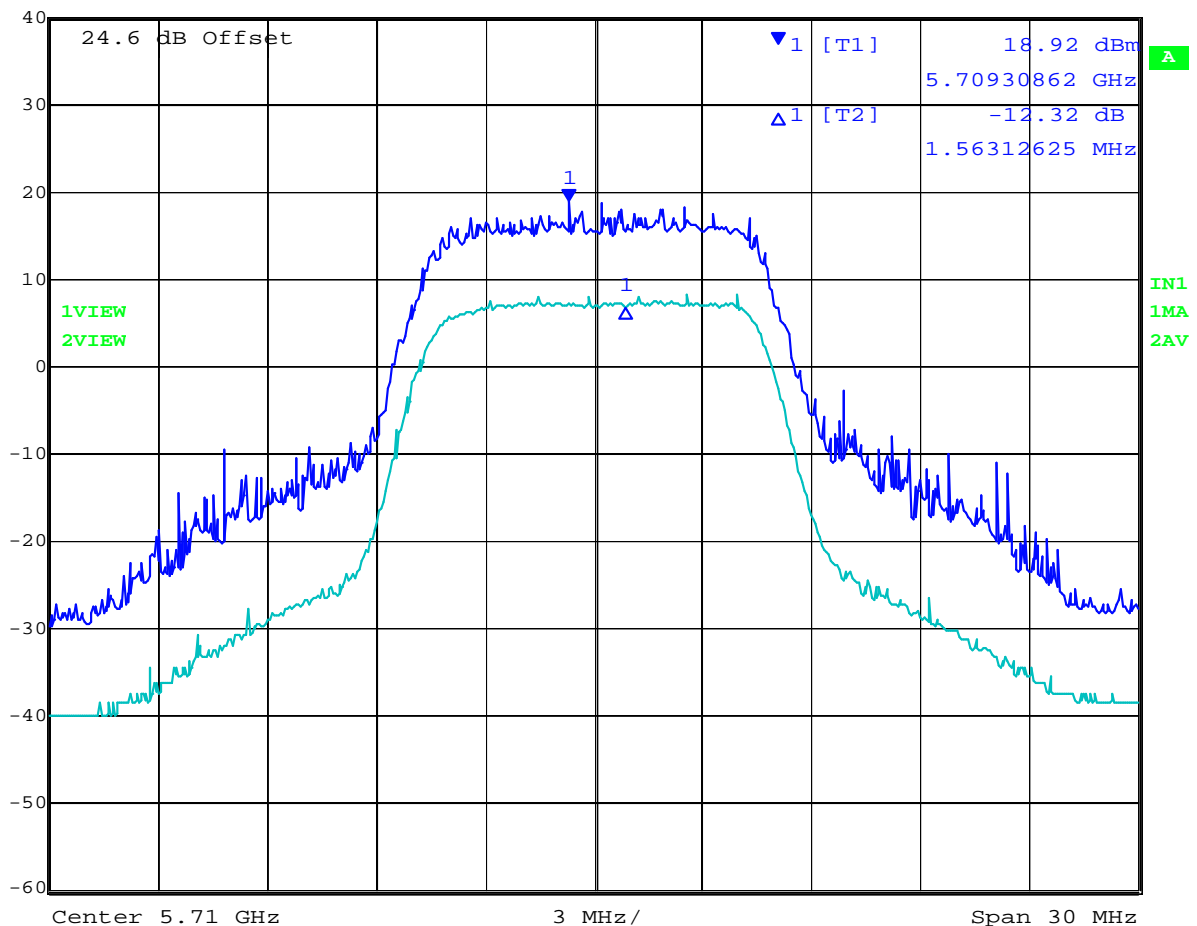


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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 52 of 121

### 5,710 MHz - 64 QAM 10 MHz BW Peak Excursion Ratio



Marker 1 [T1] RBW 1 MHz RF Att 30 dB  
Ref Lvl 18.92 dBm VBW 3 MHz  
40 dBm 5.70930862 GHz SWT 100 ms Unit dBm



Date: 18.SEP.2008 19:01:53

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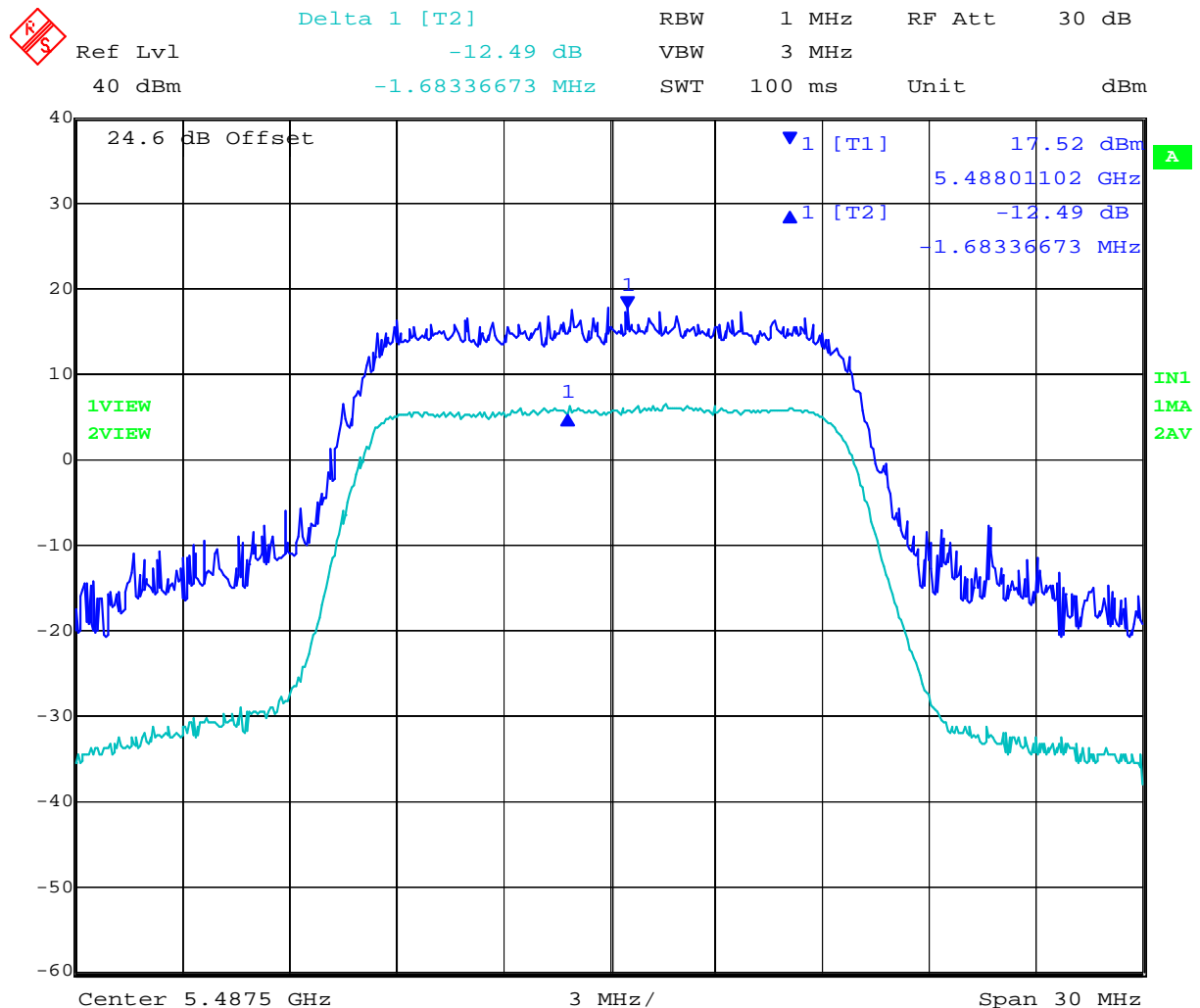


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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 53 of 121

TABLE OF RESULTS – - 64 QAM 15 MHz BW

Centre Frequency (MHz)	Peak Excursion Ratio (dB)	Limit (dB)
5,487.5	12.49	13.0
5,597.5	12.20	13.0
5,707.5	12.38	13.0

5,487.5 MHz - 64 QAM 15 MHz BW Peak Excursion Ratio



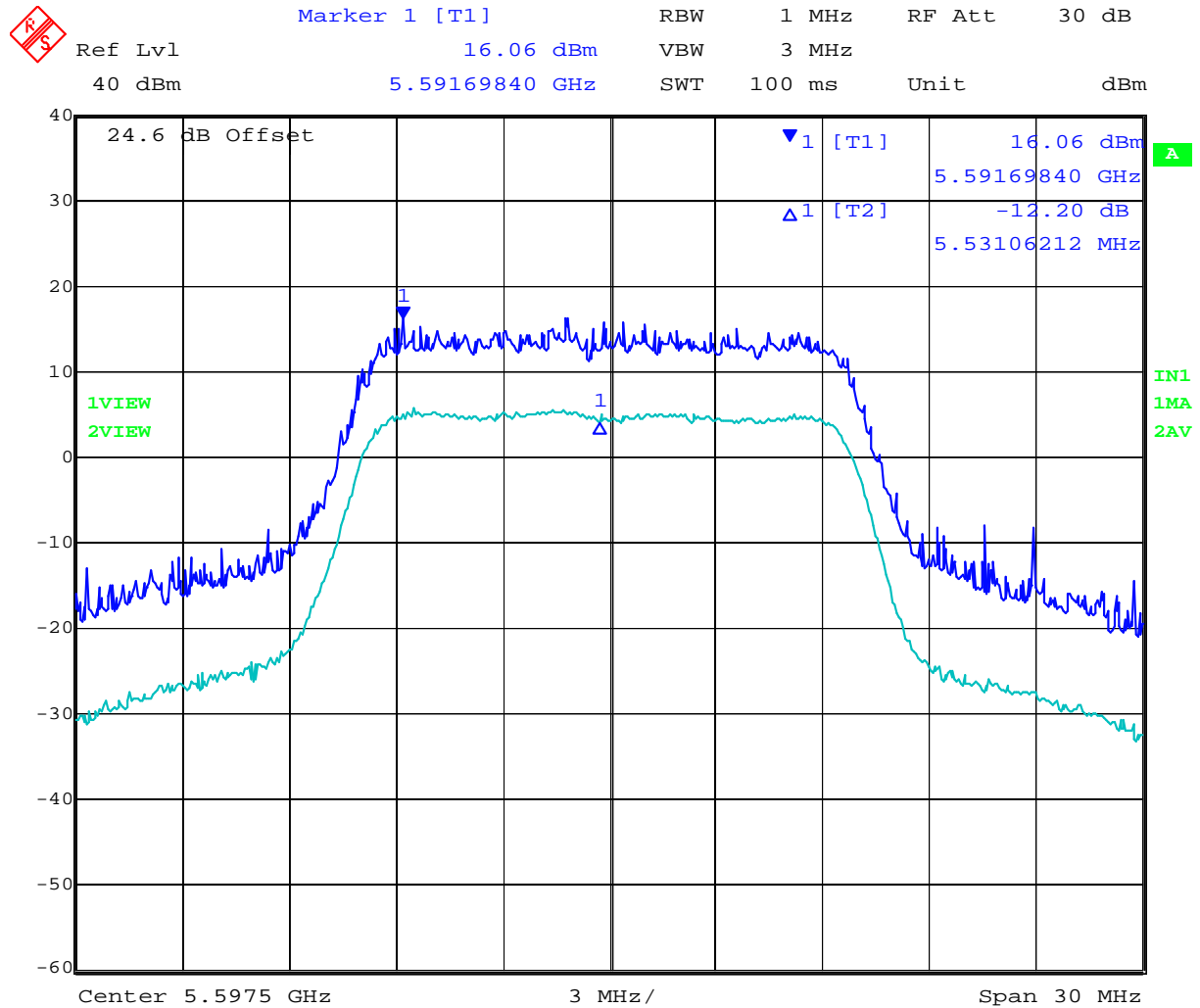
Date: 18.SEP.2008 19:04:08

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 54 of 121

### 5,597.5 MHz - 64 QAM 15 MHz BW Peak Excursion Ratio



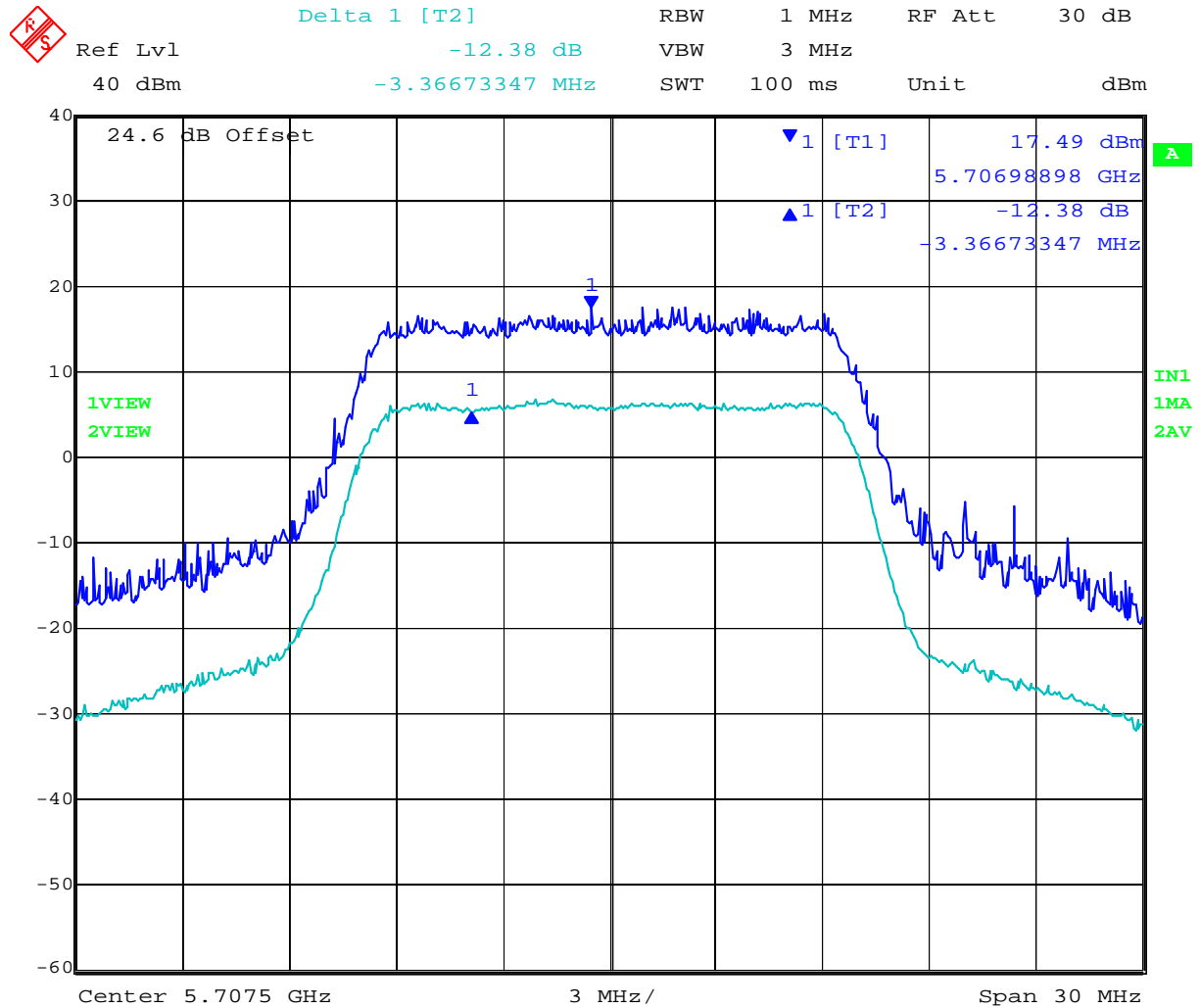
Date: 18.SEP.2008 19:06:29

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 55 of 121

### 5,707.5 MHz - 64 QAM 15 MHz BW Peak Excursion Ratio



Date: 18.SEP.2008 19:08:15

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 56 of 121

## Specification

### Limits

**§15.407 (a)(6)** The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified in this paragraph) shall not exceed 13dB across any 1MHz bandwidth or the emission bandwidth whichever is less

## Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	$\pm 2.81\text{dB}$
-------------------------	---------------------

## Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 57 of 121

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#### **5.1.5. Frequency Stability**

**FCC, Part 15 Subpart C §15.407(g)**  
**Industry Canada RSS-210 §2.1**

#### **Test Procedure**

The manufacturer of the equipment is responsible for ensuring that the frequency stability is such that emissions are always maintained within the band of operation under all conditions.

#### **Manufacturer Declaration**

The frequency stability of the reference oscillator sets the frequency stability of the RF transceiver signals. Therefore all of the RF signals should have  $\pm 20$ ppm stability.

This stability accounts for room temp tolerance of the crystal oscillator circuit, frequency variation across temperature, and crystal ageing.

$\pm 20$ ppm at 5.5 GHz translates to a maximum frequency shift of  $\pm 110$  KHz. As the edge of the channels is at least one MHz from either of the band edges,  $\pm 110$  KHz is more than sufficient to guarantee that the intentional emission will remain in the band over the entire operating range of the EUT.

#### **Specification**

#### **Limits**

**§15.407 (g)** Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 58 of 121

#### 5.1.6. Maximum Permissible Exposure

**FCC, Part 15 Subpart C §15.407(f)**  
**Industry Canada RSS-Gen §5.5**

#### Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm<sup>2</sup>) = EIRP/(4πd<sup>2</sup>)

EIRP = P \* G

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

Numeric Gain = 10 ^ (G (dBi)/10)

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm<sup>2</sup>

Freq. Band (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 1mW/cm <sup>2</sup> Limit(cm)	Minimum Separation Distance (cm)
5.6	16.0	39.81	+17.58	57.28	13.47	20

**Note:** for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

#### Specification Maximum Permissible Exposure Limits

**FCC §1.1310** Limit = 1mW / cm<sup>2</sup> from 1.310 Table 1

**RSS-Gen §5.5** Before equipment certification is granted, the application requirements of RSS-102 shall be met.

#### Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty

±1.33 dB

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### 5.1.7. Radiated Emissions

#### 5.1.7.1. Transmitter Radiated Spurious Emissions (above 1 GHz)

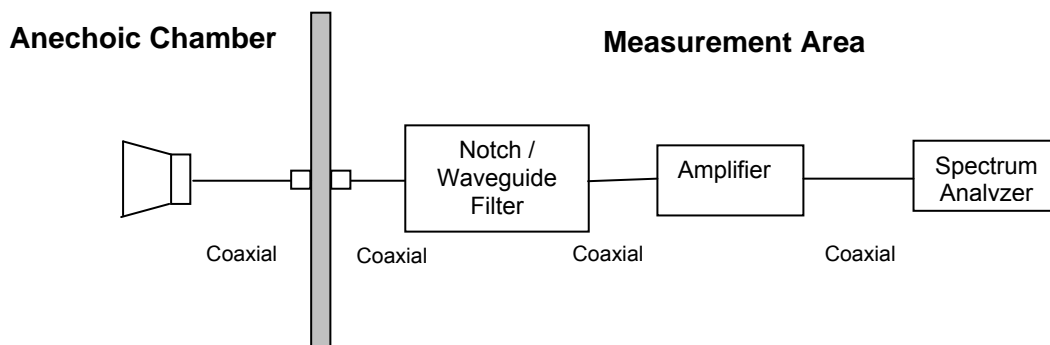
**FCC, Part 15 Subpart C §15.407(b)(2), §15.205(a)/15.209(a)**  
**Industry Canada RSS-210 §A9.3(2); §2.2; §2.6; RSS-Gen §4.7**

#### Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

#### Test Measurement Set up



Measurement set up for Radiated Emission Test

#### Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where: FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 60 of 121

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For example:

Given receiver input reading of 51.5 dB $\mu$ V; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dB}\mu\text{V/m}$$

Conversion between dB $\mu$ V/m (or dB $\mu$ V) and  $\mu$ V/m (or  $\mu$ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log (level (}\mu\text{V/m))}$$

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength;

$$E = 1000000 \times \sqrt{30P} / 3 \mu\text{V/m, where P is the EIRP in Watts}$$

Therefore: -27 dBm/MHz = 68.23 dB $\mu$ V/m

**Note(s):**

- 1).. The data in this Section along with the data in sections 5.1.7 (Conducted Spurious Emissions) and Section 5.1.8.2 (Radiated Band Edge - Restricted Bands) identifies that the EUT is in compliance with the -27dBm/MHz EIRP limit for out of band emissions.
  
- 2).. EUT was grounded to the turntable during radiated emission testing at all times



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 61 of 121

### Measurement Results Transmitter Radiated Spurious Emissions above 1 GHz

Ambient conditions.

Temperature: 17 to 23°C

Relative humidity: 31 to 57 %

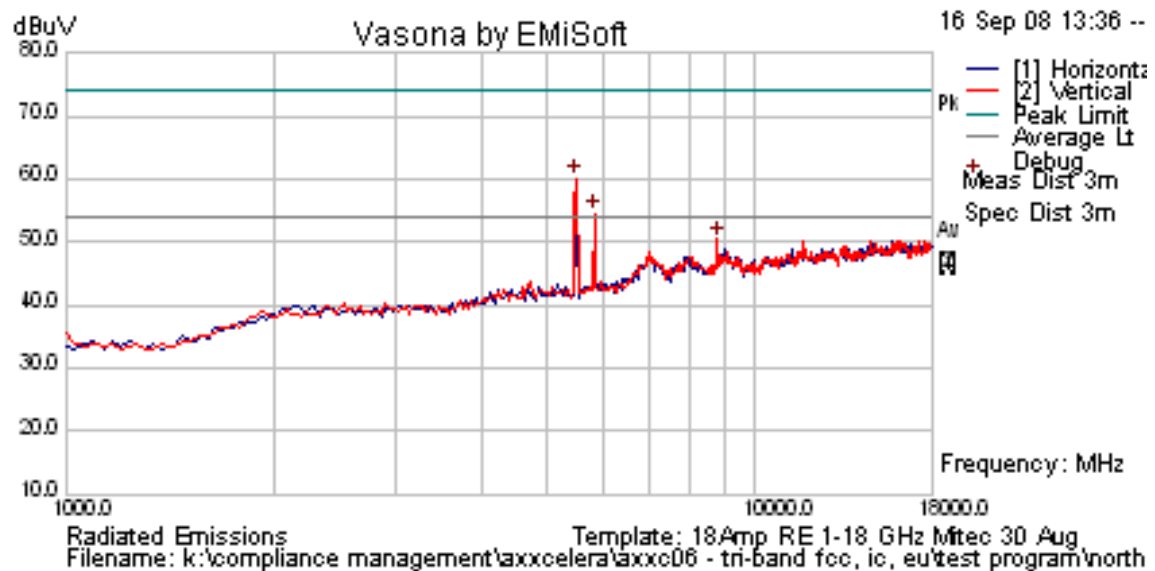
Pressure: 999 to 1012 mbar

#### TABLE OF RESULTS – 5,487.5 MHz 64 QAM 15 MHz BW

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5486.537	75.52	10.75	35.1	121.37	Peak [Scan]	V	100	0	N/A	N/A	N/A	Pk Emission
5460	Power Setting = Max			61.02	Peak Max	V			74	-12.98	Pass	Band-edge
5460				47.94	Average Max	V			54	-6.06	Pass	Band-edge
8801.707	43.89	6.09	-1.38	48.59	Peak Max	V	133	223	74	-25.41	Pass	RB
8801.707	30.13	6.09	-1.38	34.84	Average Max	V	133	223	54	-19.16	Pass	RB
5837.675	57.56	4.8	-7.81	54.55	Peak Max	V	100	0	68.23	-13.68	Pass	NRB

Pk Emission – Peak Emission  
Band-edge – Restricted Bands  
RB – Restricted Band  
NRB – Non-Restricted Band

#### Radiated Emissions for 5,487.5 MHz 64 QAM 15 MHz BW



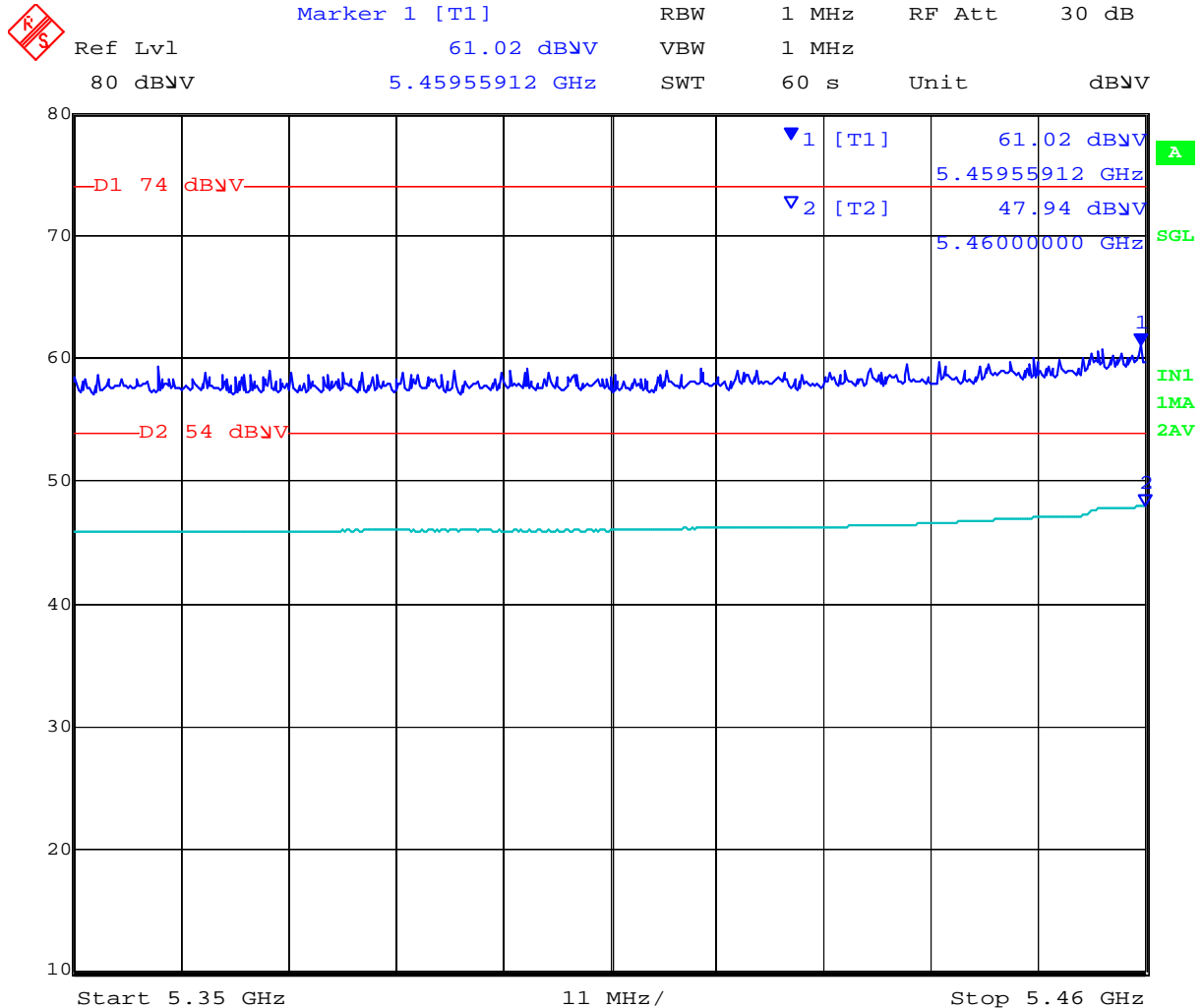
The above plot depicts peak emissions only

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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 62 of 121

### Band-edge Emissions for 5,487.5 MHz 64 QAM 15 MHz BW



Date: 16.SEP.2008 16:39:19

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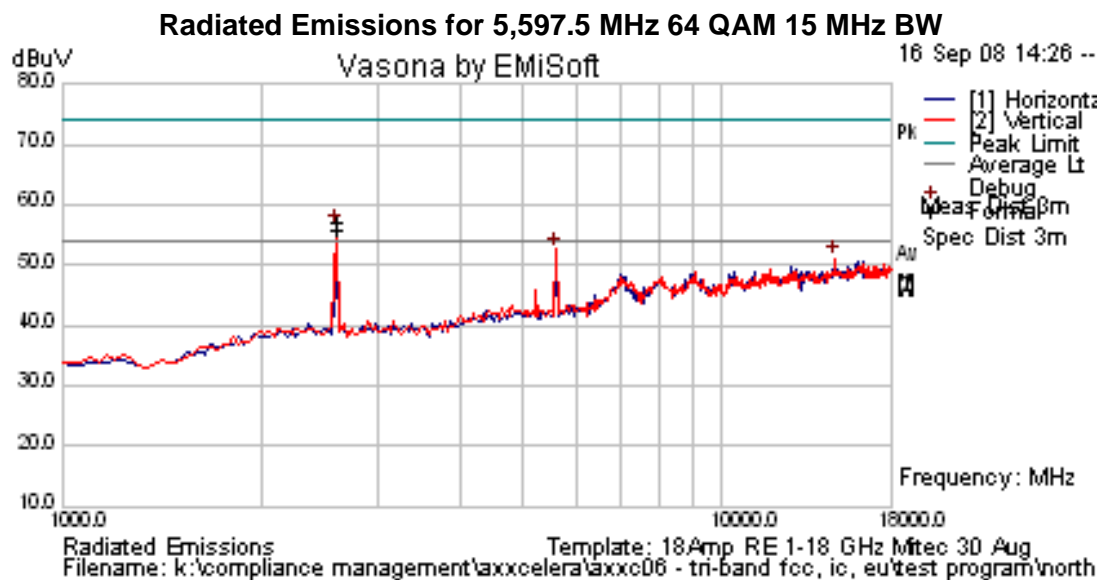


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**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 63 of 121

#### TABLE OF RESULTS – 5,597.5 MHz 64 QAM 15 MHz BW

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5599.198	75.52	10.75	35.1	121.37	Peak [Scan]	V	100	0	N/A	N/A	N/A	Pk Emission
2601.202	63.92	3.08	-10.81	56.19	Peak Max	V	100	0	68.23	-25.41	Pass	NRB
14797.595	44.17	8.17	-1.27	51.07	Peak Max	V	100	0	68.23	-17.16	Pass	Noise Floor

Pk Emission – Peak Emission  
Band-edge – Restricted Bands  
RB – Restricted Band  
NRB – Non-Restricted Band



The above plot depicts peak emissions only

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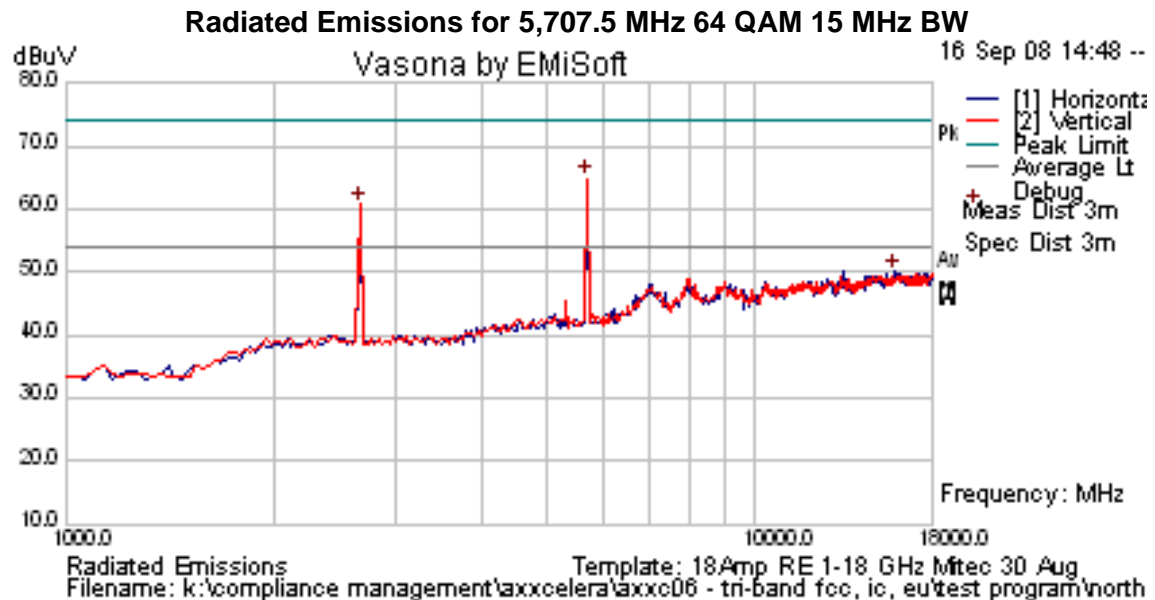


**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 64 of 121

# TABLE OF RESULTS – 5,707.5 MHz 64 QAM 15 MHz BW

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
5701.403	75.52	10.75	35.1	121.37	Peak [Scan]	V	100	0	N/A	N/A	N/A	Pk Emission
2669.339	68.52	3.14	-10.93	60.72	Peak Max	V	100	0	68.23	-7.51	Pass	NRB
15887.776	41.83	8.84	-0.53	50.14	Peak Max	V	100	0	68.23	-18.09	Pass	Noise Floor

Pk Emission – Peak Emission  
 RB – Restricted Band  
 NRB – Non-Restricted Band



The above plot depicts peak emissions only

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### 5.1.7.2. Receiver Spurious Emissions above 1 GHz

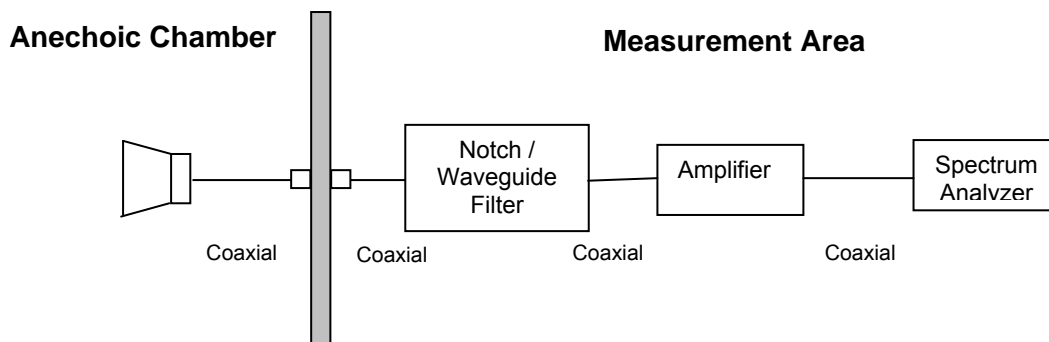
#### Industry Canada RSS-Gen §4.8, §6

#### Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

#### Test Measurement Set up



Measurement set up for Radiated Emission Test

#### Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where: FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 66 of 121

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For example:

Given receiver input reading of 51.5 dB $\mu$ V; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dB}\mu\text{V/m}$$

Conversion between dB $\mu$ V/m (or dB $\mu$ V) and  $\mu$ V/m (or  $\mu$ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log (level (\mu V/m))}$$

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 67 of 121

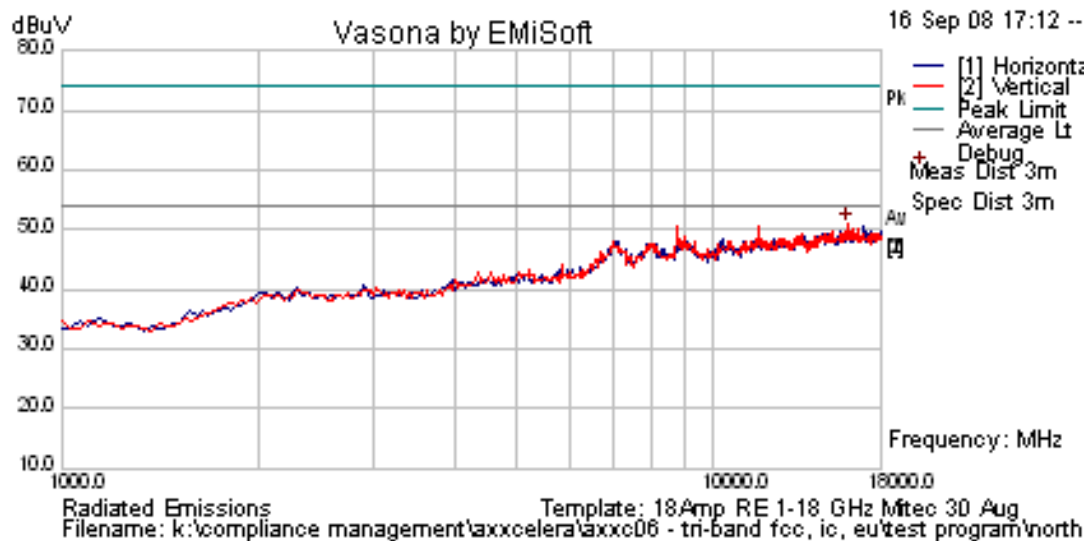
## Receiver Radiated Spurious Emissions above 1 GHz

### TABLE OF RESULTS – 64 QAM 5,597.5 MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments

No emissions within 6dB of the limit line were found

### 5,597.5 MHz 64 QAM – Receiver Radiated Emissions



The above plot depicts peak receiver spurious emissions

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## Specification

### Limits

**15.407 (b)(2).** All emissions outside of the 5,150-5,350MHz band shall not exceed an EIRP of -27dBm/MHz.

**§15.205 (a)** Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

**§15.205 (a)** Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

**§15.209 (a)** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

**RSS-210 §A9.3(2)** For transmitters operating in the 5250-5350 MHz band, all emissions outside the 5150-5350 MHz band shall not exceed -27 dBm/MHz e.i.r.p. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band shall not exceed out of band emission limit of 27 dBm/MHz e.i.r.p. in the 5150-5250 MHz band in order to operate indoor/outdoor, or alternatively shall comply with the spectral power density for operation within the 5150-5250 MHz band and shall be labeled "for indoor use only".

**RSS-Gen §4.7** The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz, whichever is the lowest frequency, to the 5<sup>th</sup> harmonic of the highest frequency generated without exceeding 40 GHz.

#### **RSS-Gen §6** Receiver Spurious Emission Standard

If a radiated measurement is made, all spurious emissions shall comply with the limits of the following Table. The resolution bandwidth of the spectrum analyzer shall be 100 kHz for spurious emission measurements below 1.0 GHz and 1.0 MHz for measurements above 1.0 GHz

Frequency (MHz)	Field Strength ( $\mu$ V/m)	Field Strength (dB $\mu$ V/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 69 of 121

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#### Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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#### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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### 5.1.7.3. Radiated Spurious Emissions (30M-1 GHz)

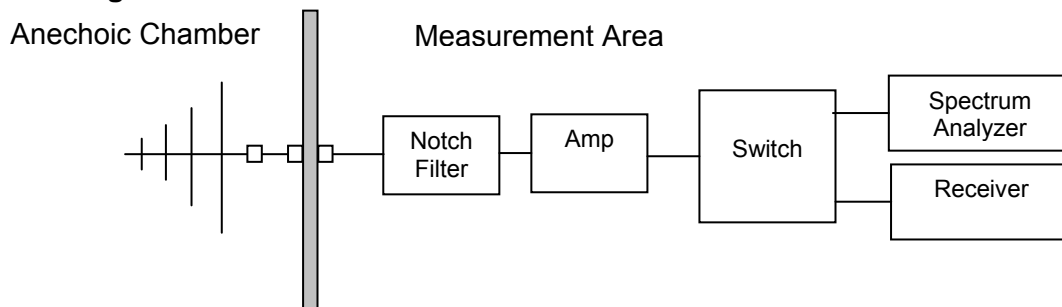
**FCC, Part 15 Subpart C §15.407(b)(6); §15.205(a); §15.209(a)**  
**Industry Canada RSS-210 §2.2**

#### Test Procedure

Preliminary radiated emissions are measured in the anechoic chamber at a 10-meter distance on every azimuth in both horizontal and vertical polarity. The emissions are recorded with a spectrum analyzer in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

#### Test Measurement Set up

#### Field Strength Calculation



The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength

R = Measured Receiver Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 71 of 121

---

For example:

Given a Receiver input reading of 51.5dB $\mu$ V; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3\text{dB}\mu\text{V/m}$$

Conversion between dB $\mu$ V/m (or dB $\mu$ V) and  $\mu$ V/m (or  $\mu$ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log (level (\mu V/m))}$$

$$40 \text{ dB}\mu\text{V/m} = 100\mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250\mu\text{V/m}$$

### Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

Ambient conditions.

Temperature: 17 to 23 °C      Relative humidity: 31 to 57 %      Pressure: 999 to 1012 mbar

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 72 of 121

#### EUT Setup

POE 48VDC

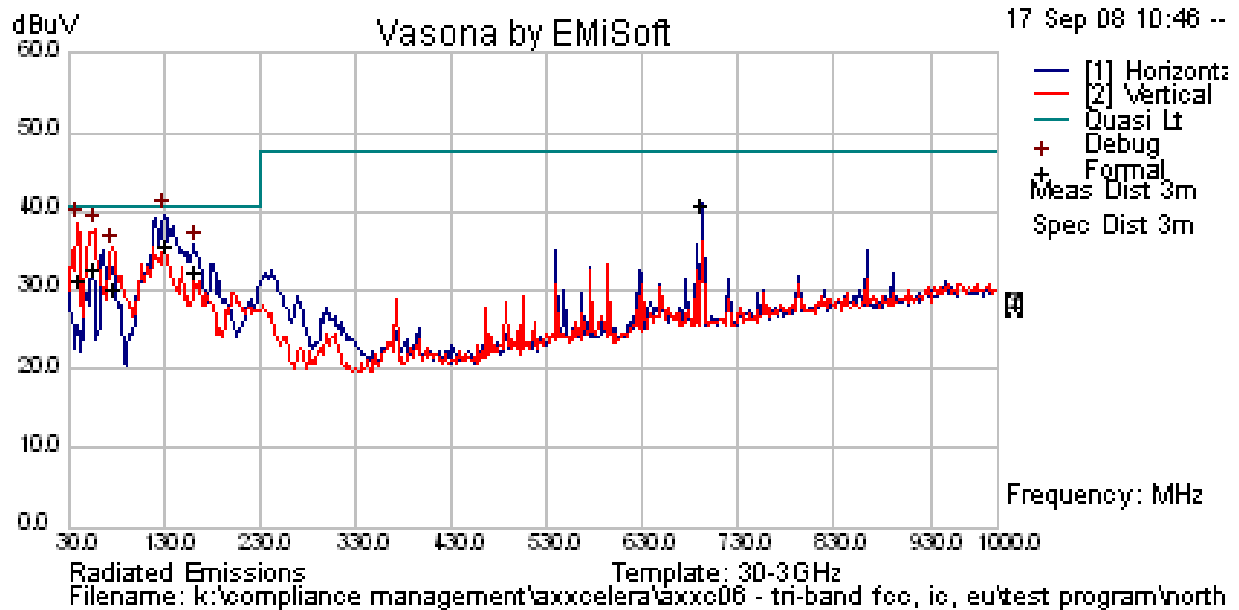
Orientation: Unit vertical on the table top

POE Axxcelera Cincon TR36A-POE-480 P/N800-18297-0001 Rev A S/N:36480-0005802

#### TABLE OF RESULTS

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Height (cm)	Polarity
131.917	39.71	35.65	40.5	-4.85	267	176	H
42.206	38.5	31.09	40.5	-9.41	100	309	V
57.199	37.74	32.88	40.5	-7.62	114	90	V
161.994	35.69	32.51	40.5	-7.99	213	311	H
78.126	35.45	30.23	40.5	-10.27	98	8	V
692.981	40.5	40.77	47.5	-6.73	100	83	H

#### Radiated Emissions 30 MHz to 1 GHz



The above plot depicts peak radiated emissions below 1 GHz

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 73 of 121

## Specification

### Limits

**§15.407(b)(6)** Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Section 15.209.

**§15.205 (a)** Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

**§15.205 (a)** Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

**§15.209 (a)** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

**RSS-210 §2.2** refers to Section 2.7 Table 2 below;-

Frequency(MHz)	Field Strength ( $\mu$ V/m)	Field Strength (dB $\mu$ V/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

### Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
-------------------------	---------------

### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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#### **5.1.8. AC Wireline Conducted Emissions (150 kHz – 30 MHz)**

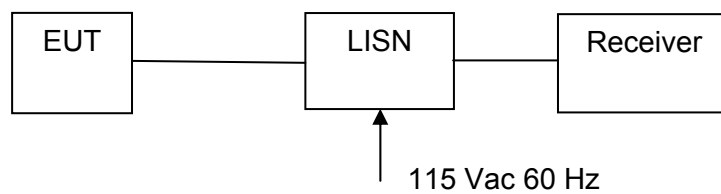
**FCC, Part 15 Subpart C §15.407(b)(6)/15.207**

**Industry Canada RSS-Gen §7.2.2**

##### **Test Procedure**

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

##### **Test Measurement Set up**



Measurement set up for AC Wireline Conducted Emissions Test

#### **Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)**

Ambient conditions.

Temperature: 17 to 23 °C      Relative humidity: 31 to 57 %      Pressure: 999 to 1012 mbar

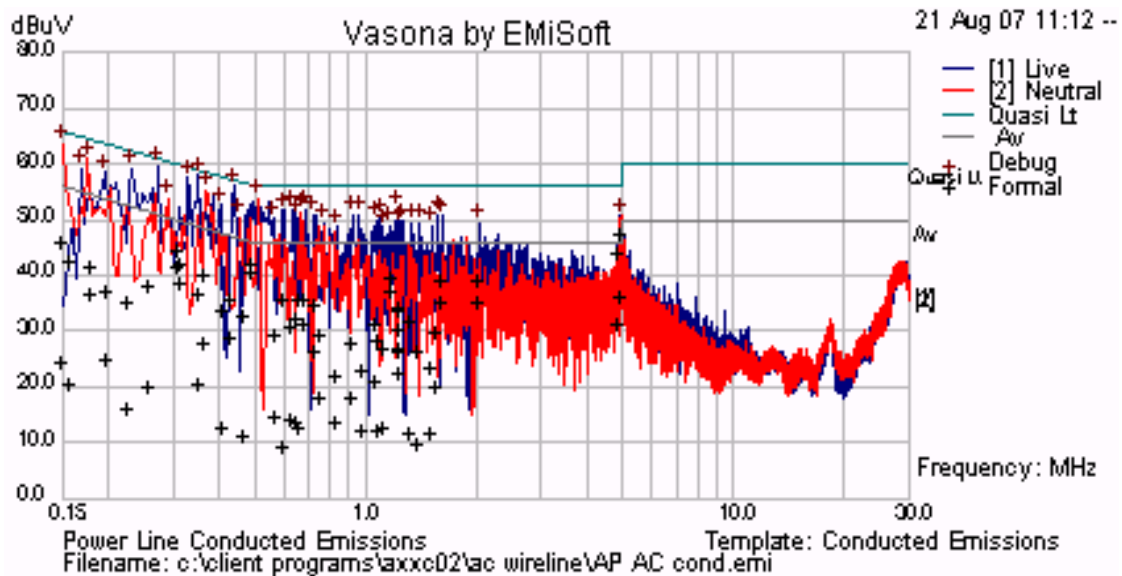


**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 75 of 121

## TABLE OF RESULTS

Freq (MHz)	Lline	Peak (dB $\mu$ V)	QP (dB $\mu$ V)	QP Limit (dB $\mu$ V)	QP Margin (dB)	Ave. (dB $\mu$ V)	Ave. Limit (dB $\mu$ V)	Ave. Margin (dB)
0.150	Neutral	63.61	43.91	66.00	-22.09	21.93	56.00	-34.07
0.176	Neutral	60.91	39.50	64.55	-25.05	34.35	54.55	-20.20
0.232	Live	59.16	32.98	62.54	-29.56	13.70	52.54	-38.85
0.273	Live	59.81	35.68	61.47	-25.79	17.71	51.47	-33.76
0.329	Live	57.62	39.98	59.88	-19.90	36.53	49.88	-13.36
0.352	Live	57.93	34.49	58.82	-24.32	18.45	48.82	-30.37
0.371	Neutral	55.37	37.89	58.62	-20.73	25.46	48.62	-23.16
0.438	Live	56.07	33.20	57.24	-24.04	26.42	47.24	-20.82
0.513	Neutral	53.90	39.69	56.07	-16.37	38.50	46.07	-7.57
0.636	Live	51.89	28.47	56.00	-27.53	11.73	46.00	-34.27
0.688	Live	51.90	33.28	56.00	-22.72	28.80	46.00	-17.20
1.219	Live	51.99	31.51	56.00	-24.49	24.81	46.00	-21.19

## AC Wireline Conducted Emissions – Live and Neutral Lines (150 kHz – 30 MHz)



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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 76 of 121

## Specification

### Limit

**§15.407 (b)(6);** Any U-NII devices using an AC power line are required to comply also with the limits set forth in Section 15.207.

**§15.207 (a)** Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu\Omega$  line impedance stabilization network (LISN), see §15.207 (a) matrix below. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

#### **RSS-Gen §7.2.2**

The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

#### **§15.207 (a)** and **RSS-Gen §7.2.2** Limit Matrix

The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency

#### **Laboratory Measurement Uncertainty for Conducted Emissions**

Measurement uncertainty	$\pm 2.64$ dB
-------------------------	---------------

#### **Traceability**

Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 77 of 121

## 6. Dynamic Frequency Selection (DFS)

### 6.1. Test Procedure and Setup

FCC, Part 15 Subpart C §15.407(h)  
FCC 06-96 Memorandum Opinion and Order  
Industry Canada RSS-210 A9.4

#### 6.1.1. Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (see note)
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna	

#### 6.1.2. DFS Response requirement values

Parameter	Value
<i>Non-occupancy period</i>	Minimum 30 minutes
<i>Channel Availability Check Time</i>	60 seconds
<i>Channel Move Time</i>	10 seconds See Note 1.
<i>Channel Closing Transmission Time</i>	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
<i>U-NII Detection Bandwidth</i>	Minimum 80% of the 99% power bandwidth See Note 3.

Note 1: The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:

- For the Short pulse radar Test Signals this instant is the end of the *Burst*.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar *Burst* generated.
- For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission.

Note 2: The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate *Channel* changes (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the *U-NII Detection Bandwidth* detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90%. Measurements are performed with no data traffic.



### 6.1.3. Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

#### Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Trials
1	1	1428	18	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

A minimum of 30 unique waveforms are required for each of the short pulse radar types 2 through 4. For short pulse radar type 1, the same waveform is used a minimum of 30 times. If more than 30 waveforms are used for short pulse radar types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. The aggregate is the average of the percentage of successful detections of short pulse radar types 1-4.

#### Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse radar test signal. If more than 30 waveforms are used for the Long Pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 79 of 121

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Each waveform is defined as follows:

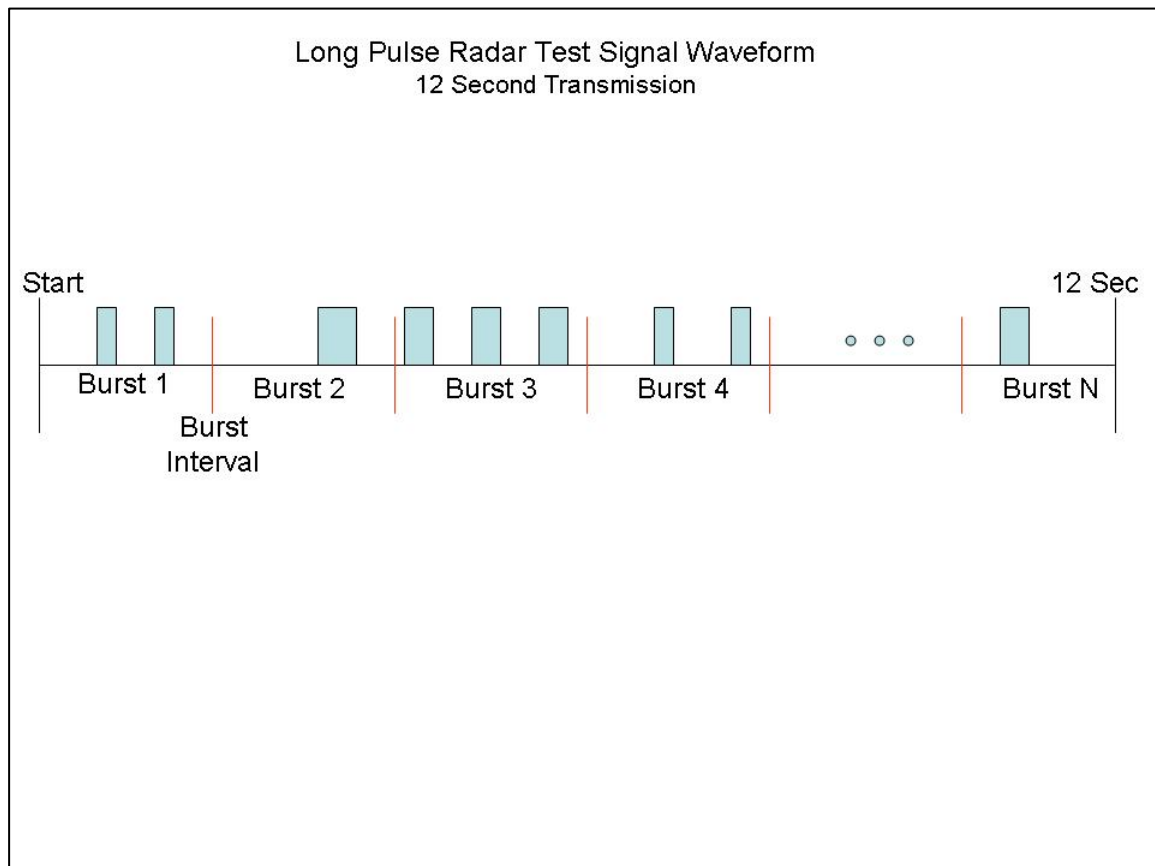
- 1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
- 2) There are a total of 8 to 20 *Bursts* in the 12 second period, with the number of *Bursts* being randomly chosen. This number is *Burst Count*.
- 3) Each *Burst* consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each *Burst* within the 12 second sequence may have a different number of pulses.
- 4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a *Burst* will have the same pulse width. Pulses in different *Bursts* may have different pulse widths.
- 5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a *Burst* will have the same chirp width. Pulses in different *Bursts* may have different chirp widths. The chirp is centered on the pulse. For example, with a radar frequency of 5,620 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
- 6) If more than one pulse is present in a *Burst*, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a *Burst*, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
- 7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to *Burst\_Count*. Each interval is of length  $(12,000,000 / \text{Burst\_Count})$  microseconds. Each interval contains one *Burst*. The start time for the *Burst*, relative to the beginning of the interval, is between 1 and  $[(12,000,000 / \text{Burst\_Count}) - (\text{Total Burst Length}) + (\text{One Random PRI Interval})]$  microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each *Burst* is chosen independently.



**A representative example of a Long Pulse radar test waveform:**

- 1) The total test signal length is 12 seconds.
- 2) 8 *Bursts* are randomly generated for the *Burst\_Count*.
- 3) *Burst* 1 has 2 randomly generated pulses.
- 4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
- 5) The PRI is randomly selected to be at 1213 microseconds.
- 6) *Bursts* 2 through 8 are generated using steps 3 – 5.
- 7) Each *Burst* is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, *Burst* 1 is randomly generated (1 to 1,500,000 minus the total *Burst* 1 length + 1 random PRI interval) at the 325,001 microsecond step. *Bursts* 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. *Burst* 2 falls in the 1,500,001 – 3,000,000 microsecond range).

**Graphical representation of the Long Pulse radar Test Waveform.**





#### 6.1.4. Frequency Hopping Radar Test Waveform

**Frequency Hopping Radar Test Waveform**

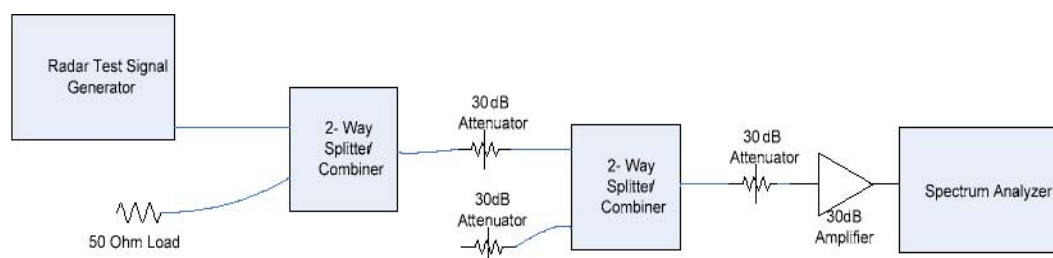
Radar Type	Pulse Width (µsec)	PRI (µsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	9	.333	300	70%	30

For the Frequency Hopping Radar Type, the same *Burst* parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence defined by the following algorithm:

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set. For selection of a random frequency, the frequencies remaining within the group are always treated as equally likely.

#### 6.1.5. Radar Waveform Calibration

The following equipment setup was used to calibrate the conducted Radar Waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3 MHz. The signal generator amplitude was set so that the power level measured at the spectrum analyzer was -61dBm (Ref Section 5.1). The 30dB amplifier gain was entered as an amplitude offset on the spectrum analyzer.



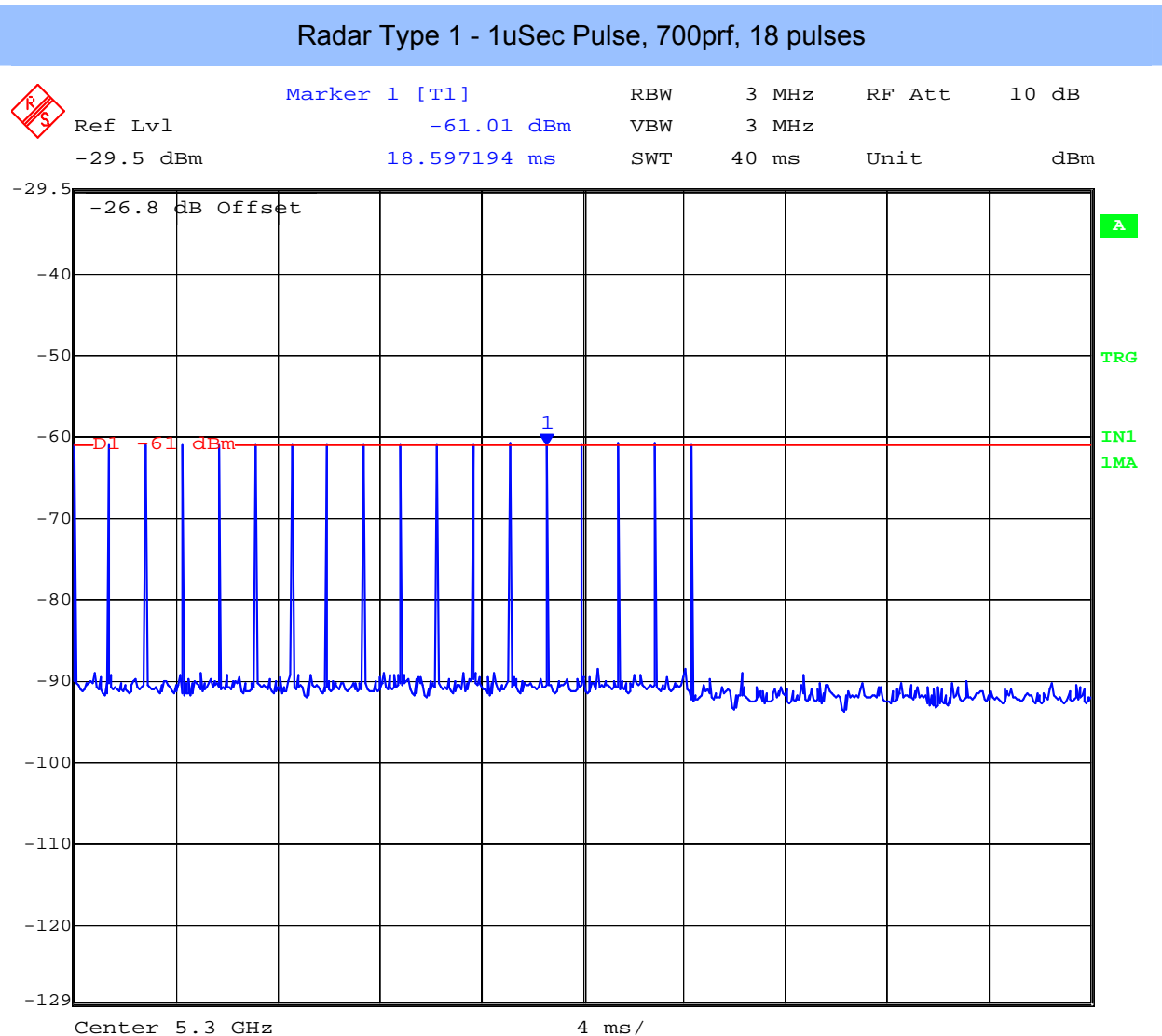
**Conducted Calibration Setup**



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 82 of 121

#### 6.1.6. Radar Waveform Calibration Plots

The following are the calibration plots for required radar waveforms

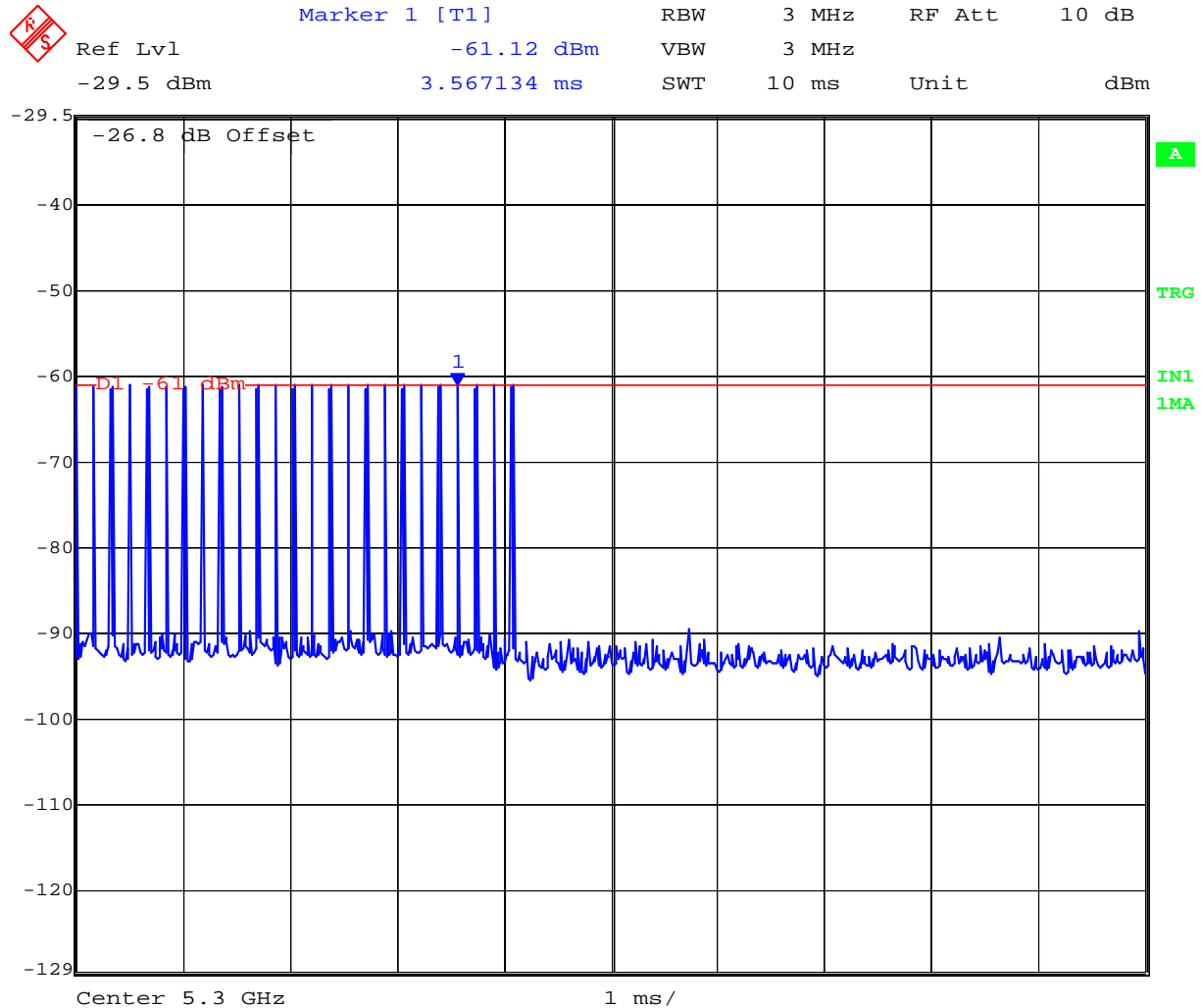


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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 83 of 121

### Radar Type 2 - 2.1uSec Pulse Width, 170prf, 25 pulses

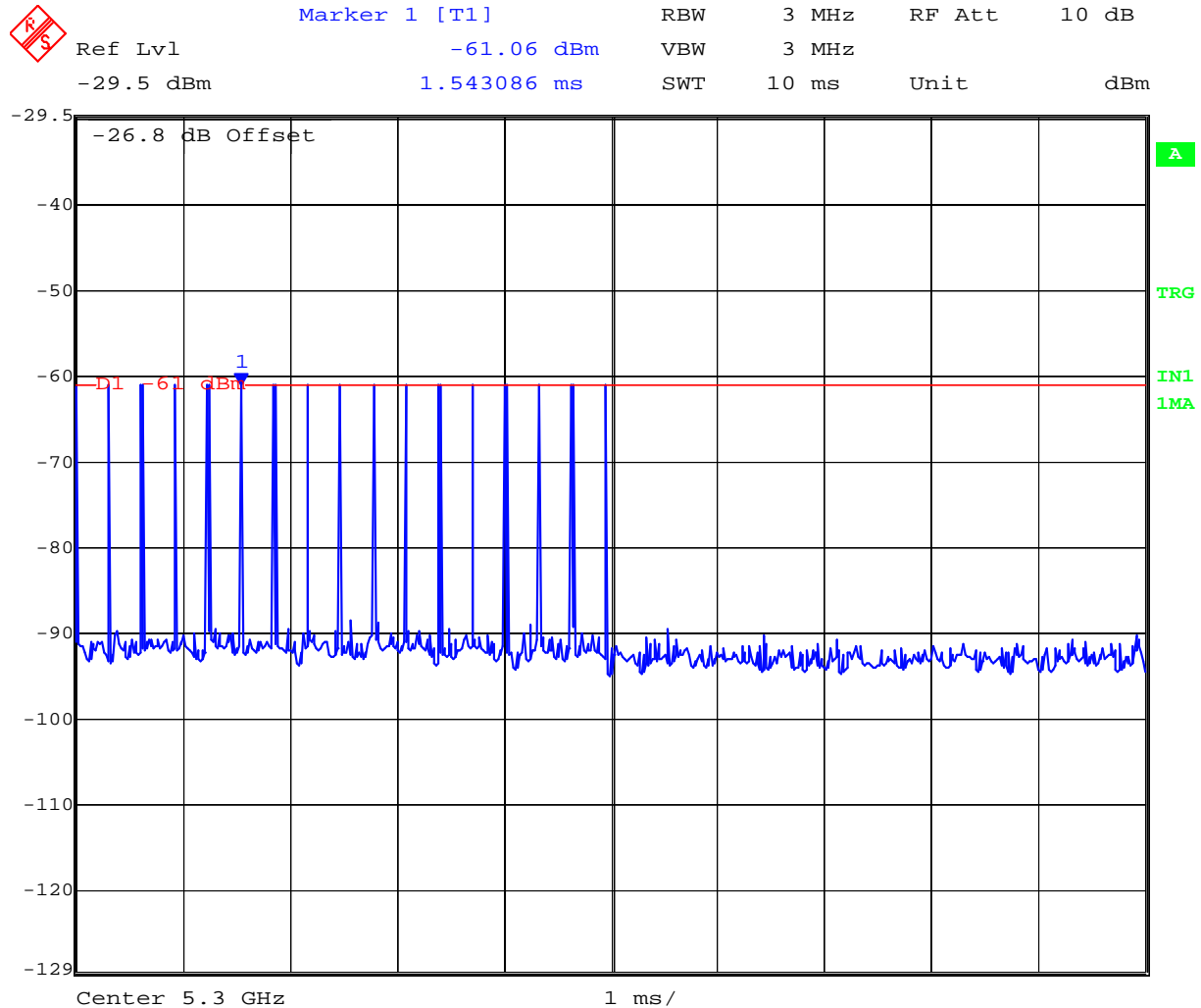


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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 84 of 121

Radar Type 3 - 7.5uSec Pulse Width, 309prf, 17 pulses

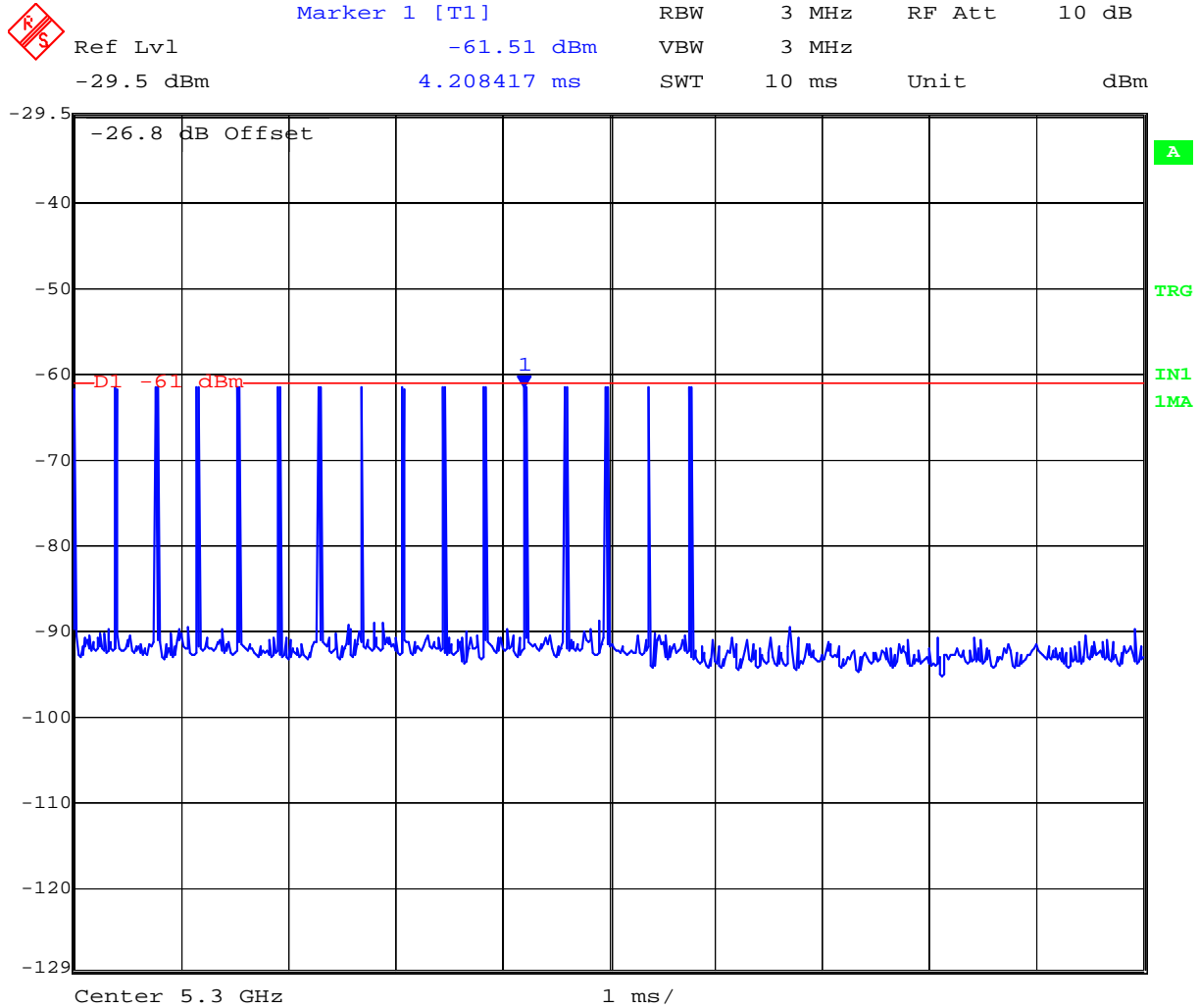


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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 85 of 121

Radar Type 4 - 17.9uSec Pulse Width, 383prf, 16 pulses

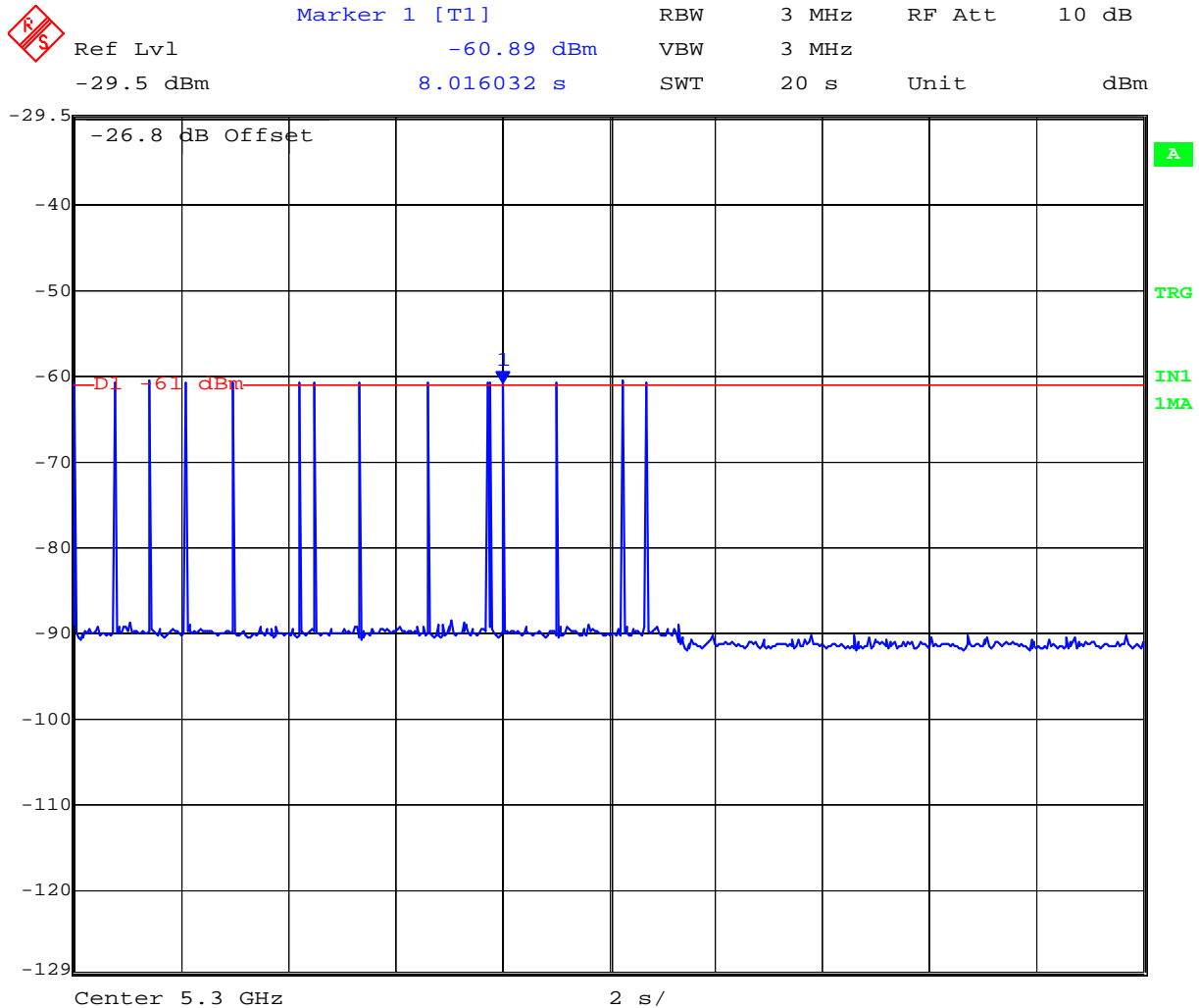


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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 86 of 121

### Radar Type 5

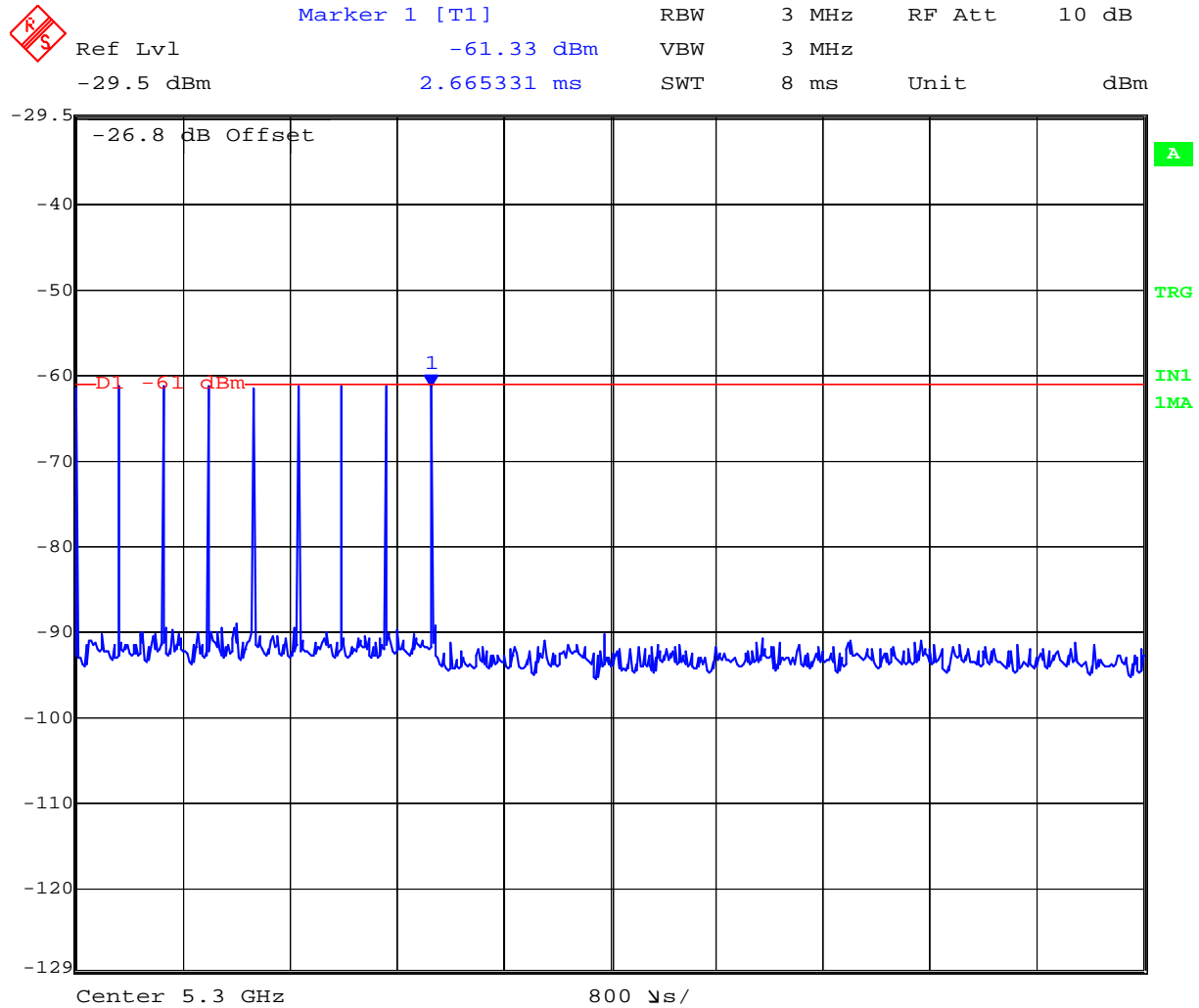


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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 87 of 121

### Radar Type 6

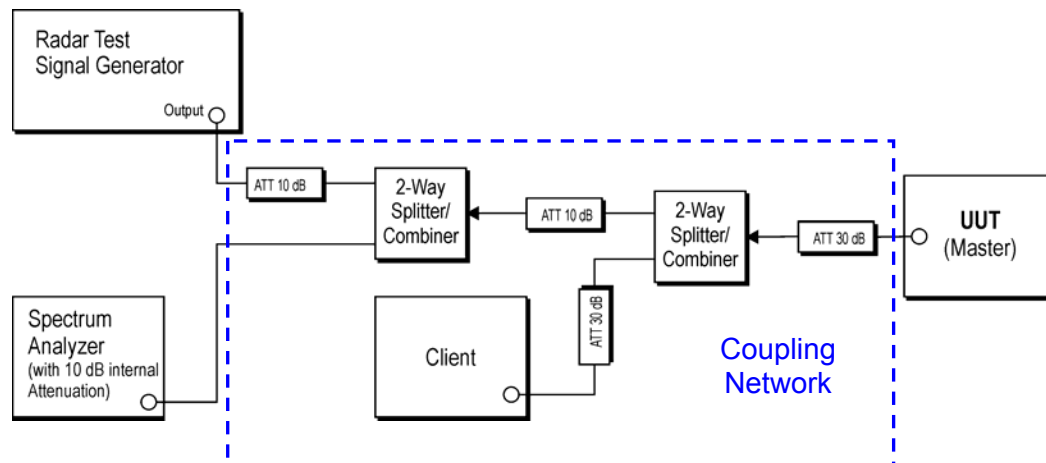


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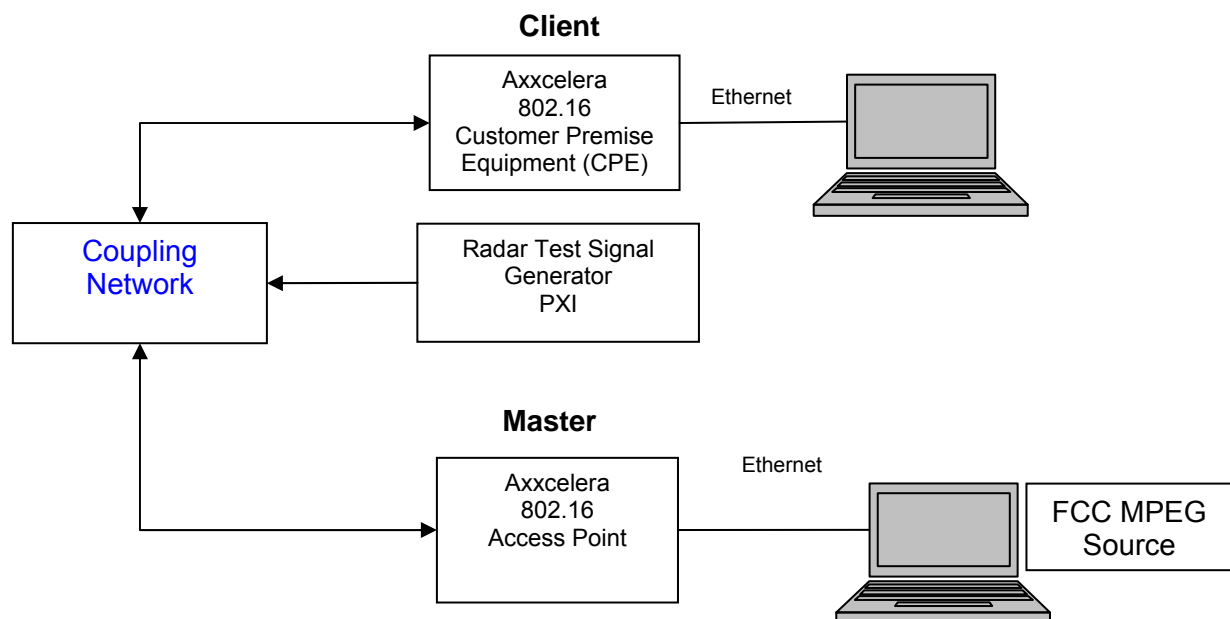
### 6.1.7. Test Set Up:

#### Block Diagram(s) of Test Setup

Setup for Conducted Measurements where the EUT is the Master with injection of Radar Test Waveforms at the Master.



#### Support Equipment Configuration







**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 89 of 121

For the frequency band 5,470 – 5,725 MHz, the Master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels.

Declared minimum antenna gain 9 dBi. ;

Radar receive signal level = -62 dBm + minimum antenna gain + 1 dB

$$= -62 + 9 + 1$$

Radar receive signal level = -52 dBm

#### Applicability of DFS requirements during normal operation

Requirement	Operational Mode		
	Master	Client Without Radar Detection	Client With Radar Detection
<i>DFS Detection Threshold</i>	Yes	Not required	Yes
<i>Channel Closing Transmission Time</i>	Yes	Yes	Yes
<i>Channel Move Time</i>	Yes	Yes	Yes
<i>U-NII Detection Bandwidth</i>	Yes	Not required	Yes

The Axxcelera ABMAX-APD567XX Access Point is a Master device.

#### Measurement Results - Dynamic Frequency Selection (DFS)

Ambient conditions.

Temperature: 17 to 23 °C      Relative humidity: 31 to 57%      Pressure: 999 to 1012 mbar

Radio parameters.

Test methodology: Conducted

Device Type: Master

Transmit Power: Maximum

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 90 of 121

---

## **6.2. Dynamic Frequency Selection (DFS) Test Results**

### **6.2.1. UNII Detection Bandwidth:**

All UNII channels for this device have identical channel bandwidths and DFS testing was completed on channel 5,500 MHz.

The generating equipment is configured as shown in the Conducted Test Setup above. A single Burst of the short pulse radar Type 1 through 6 was produced at 5,500 MHz at a level of -52 dBm. The EUT is set up as a standalone device (not associated Client and no traffic).

A single radar Burst is generated for a minimum of 10 trials, and the response of the EUT is noted. The EUT must detect the Radar Waveform 90% or more of the time.

The radar frequency is increased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The highest frequency at which detection is greater than or equal to 90% is denoted as  $F_H$ .

The radar frequency is decreased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The lowest frequency at which detection is greater than or equal to 90% is denoted as  $F_L$ .

The U-NII Detection Bandwidth is calculated as follows:

$$\text{U-NII Detection Bandwidth} = F_H - F_L$$

The U-NII Detection Bandwidth must be at least 80% of the EUT transmitter 99% power, otherwise, the EUT does not comply with DFS requirements.



### 15 MHz Operation

EUT Frequency = 5,500MHz											
Radar Frequency (MHz)	DFS Detection Trials (1=Detection, Blank= No Detection)										Detection Rate (%)
	1	2	3	4	5	6	7	8	9	10	
5493 (F <sub>L</sub> )	1	1	0	0	1	1	1	1	1	1	80%
5494	1	1	1	1	0	1	1	1	1	1	90%
5495	1	1	1	1	1	1	1	1	0	1	90%
5496	1	1	1	1	1	1	0	1	1	1	90%
5497	1	1	1	1	1	1	1	1	1	1	100%
5498	1	1	1	0	1	1	1	1	1	1	90%
5499	1	1	0	1	1	1	1	1	1	1	90%
5500	1	1	1	1	1	1	0	1	1	1	90%
5501	1	1	1	1	1	1	1	1	1	0	90%
5502	1	1	1	0	1	1	1	1	1	1	90%
5503	1	1	1	1	0	1	1	1	1	1	90%
5504	1	1	1	0	1	1	1	1	1	1	90%
5505	1	1	1	1	0	1	1	1	1	1	90%
5506 (F <sub>H</sub> )	1	1	1	1	1	1	1	0	1	0	80%
5507	1	1	1	1	1	0	0	1	1	0	70%
Detection Bandwidth = F <sub>H</sub> -F <sub>L</sub> = 5506-5493 = 13 MHz											
EUT 99% Bandwidth @ 15 MHz Bandwidth = 13.63 MHz											
13.67 MHz *80% = 10.9 MHz											

Equipment complies with the receiver detection bandwidth requirements

For each frequency step the minimum percentage detection is 90%



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 92 of 121

### 10 MHz Operation

EUT Frequency = 5,500MHz											
Radar Frequency (MHz)	DFS Detection Trials (1=Detection, Blank= No Detection)										Detection Rate (%)
	1	2	3	4	5	6	7	8	9	10	
5496 (F <sub>L</sub> )	1	1	1	1	1	1	1	1	1	1	100%
5497	1	1	1	1	1	1	1	0	1	1	90%
5498	1	1	1	1	1	1	1	1	1	0	90%
5499	1	1	1	1	0	1	1	1	1	1	90%
5500	1	1	1	1	1	1	1	1	1	1	100%
5501	1	0	1	1	1	1	1	1	1	1	90%
5502	1	1	0	1	1	1	1	1	1	1	90%
5503	1	1	1	1	1	1	1	1	1	0	90%
5504 (F <sub>H</sub> )	1	1	1	0	1	1	1	1	1	1	90%
Detection Bandwidth = F <sub>H</sub> -F <sub>L</sub> = 5504-5496 = 8 MHz											
EUT 99% Bandwidth @ 10 MHz Bandwidth = 9.14 MHz											
9.14 MHz *80% = 7.31 MHz											

Equipment complies with the receiver detection bandwidth requirements

For each frequency step the minimum percentage detection is 90%

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## 5 MHz Operation

EUT Frequency = 5,500MHz												
Radar Frequency (MHz)	DFS Detection Trials (1=Detection, Blank= No Detection)										Detection Rate (%)	
	1	2	3	4	5	6	7	8	9	10		
5497.25	1	0	0	1	0	0	0	1	0	0		30%
5497.5 (F <sub>L</sub> )	1	1	1	1	1	1	1	1	1	1		90%
5498	1	1	1	1	1	1	1	1	1	1		100%
5499	1	1	1	1	1	1	1	1	1	1		100%
5500	1	1	1	1	1	1	1	1	1	1		100%
5501	1	1	1	1	1	1	1	1	1	0		90%
5502	1	0	1	1	1	1	1	1	1	1		90%
5502.25 (F <sub>H</sub> )	1	1	1	1	1	1	1	1	1	1		100%
5502.5	1	0	0	1	1	1	1	1	1	1		80%
Detection Bandwidth = F <sub>H</sub> -F <sub>L</sub> = 5502.25-5497.5 = 4.75 MHz												
EUT 99% Bandwidth @ 5 MHz Bandwidth = 4.57 MHz												
4.57 MHz *80% = 3.8 MHz												

Equipment complies with the receiver detection bandwidth requirements

For each frequency step the minimum percentage detection is 90%



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 94 of 121

---

### **6.2.2. Initial Channel Availability Check Time**

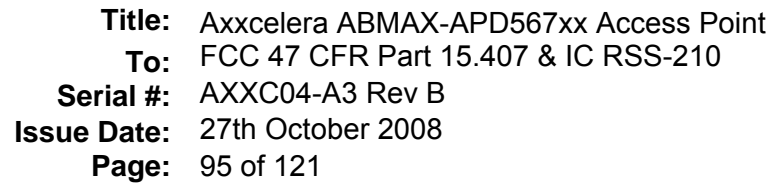
This test verifies that the EUT does not emit pulse, control, or data signals on the test channel until the power-up sequence has been completed and the U-NII device checks for Radar Waveforms for one minute on the test channel. This test does not use any Radar Waveforms.

The U-NII device is powered on and be instructed to operate at 5,500 MHz. At the same time the EUT is powered on, the spectrum analyzer is set for zero span with a 1 MHz resolution bandwidth at 5,500 MHz with a 250 second sweep time. The analyzer's sweep will be started the same time power is applied to the U-NII device.

The EUT should not transmit any pulse or data transmissions until at least 1 minute after the completion of the power-on cycle.

The red frequency line denotes  $T_0$  the instant when the EUT has completed its power-up sequence. This is denoted by the analyzer's first vertical red time line (T1) on the following plot. The Channel Availability Check Time commences at instant  $T_0$  and will end no sooner than  $T_0 + 60$  seconds.

The Master requires 82.16 seconds to complete its power-on cycle.



Ref Lvl -40 dBm

Marker 1 [T1] -100.66 dBm

RBW 1 MHz

VBW 1 MHz

SWT 250 s

Unit dBm

Center 5.5 GHz

25 s/

Marker	Value
1	-100.66 dBm
2	-100.45 dBm
3	-101.18 dBm
4	-83.71 dBm

MiCOM Labs, 440 Boulder Court, Suite 200, Pleasanton, CA 94566 USA, Phone: 925.462.0304, Fax: 925.462.0306, [www.micomlabs.com](http://www.micomlabs.com)



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 96 of 121

---

### **6.2.3. Radar Burst at the Beginning of the Channel Availability Check Time:**

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold occurs at the beginning of the Channel Availability Check Time.

A single Burst of short pulse of radar Type 1 will commence within a 6 second window starting at T1.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5,500MHz will continue for 2.5 minutes after the radar burst has been generated.

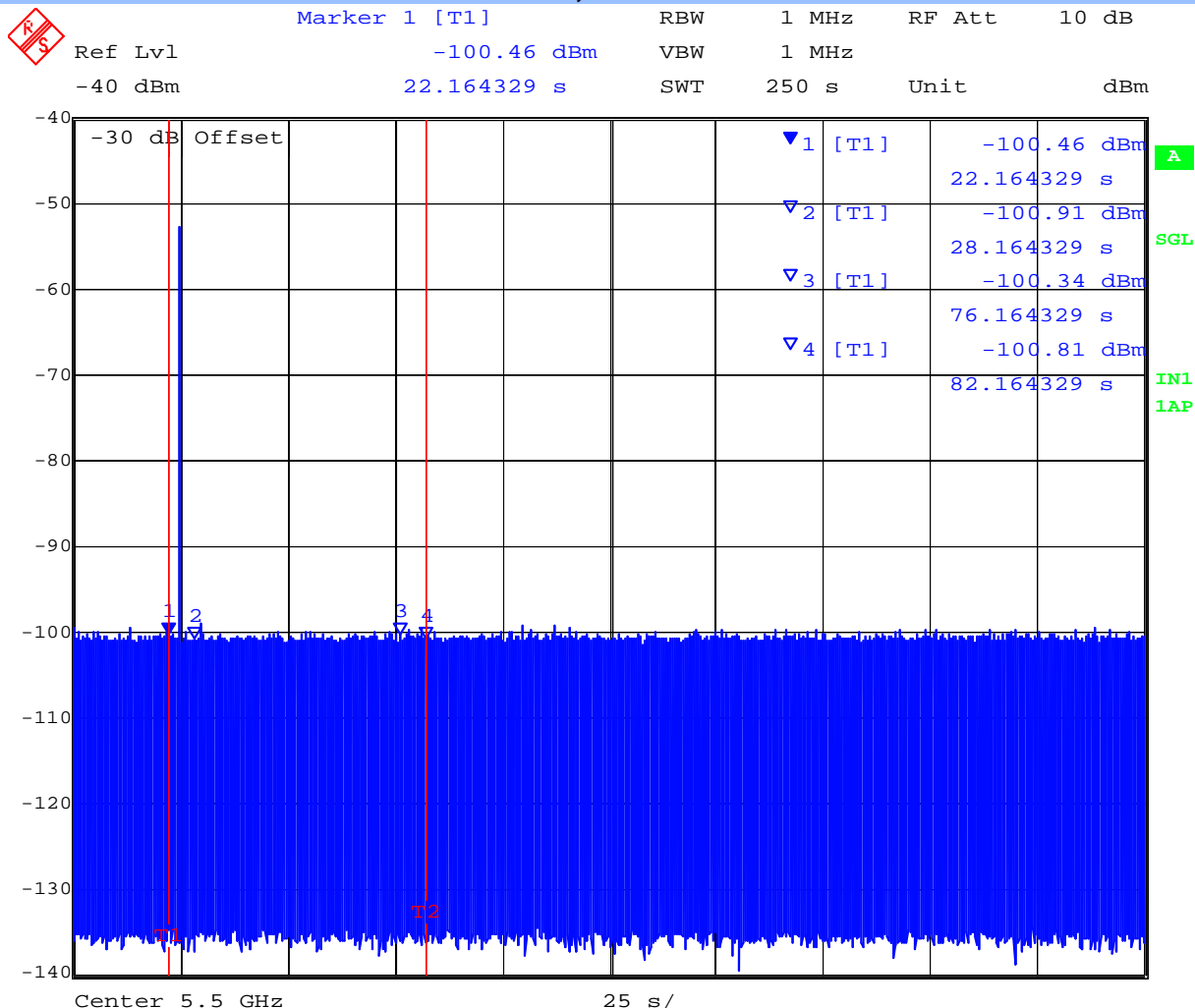
Verify that during the 2.5 minute measurement window no EUT transmissions have occurred on frequency 5,500MHz.





**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 97 of 121

**Channel Availability Check Time at the start of the 60 second Check Time**  
**Ch 5,500 MHz**



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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 98 of 121

---

#### **6.2.4. Radar Burst at the End of the Channel Availability Check Time:**

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold occurs at the end of the Channel Availability Check Time.

A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at  $T_0 + 54$  seconds.

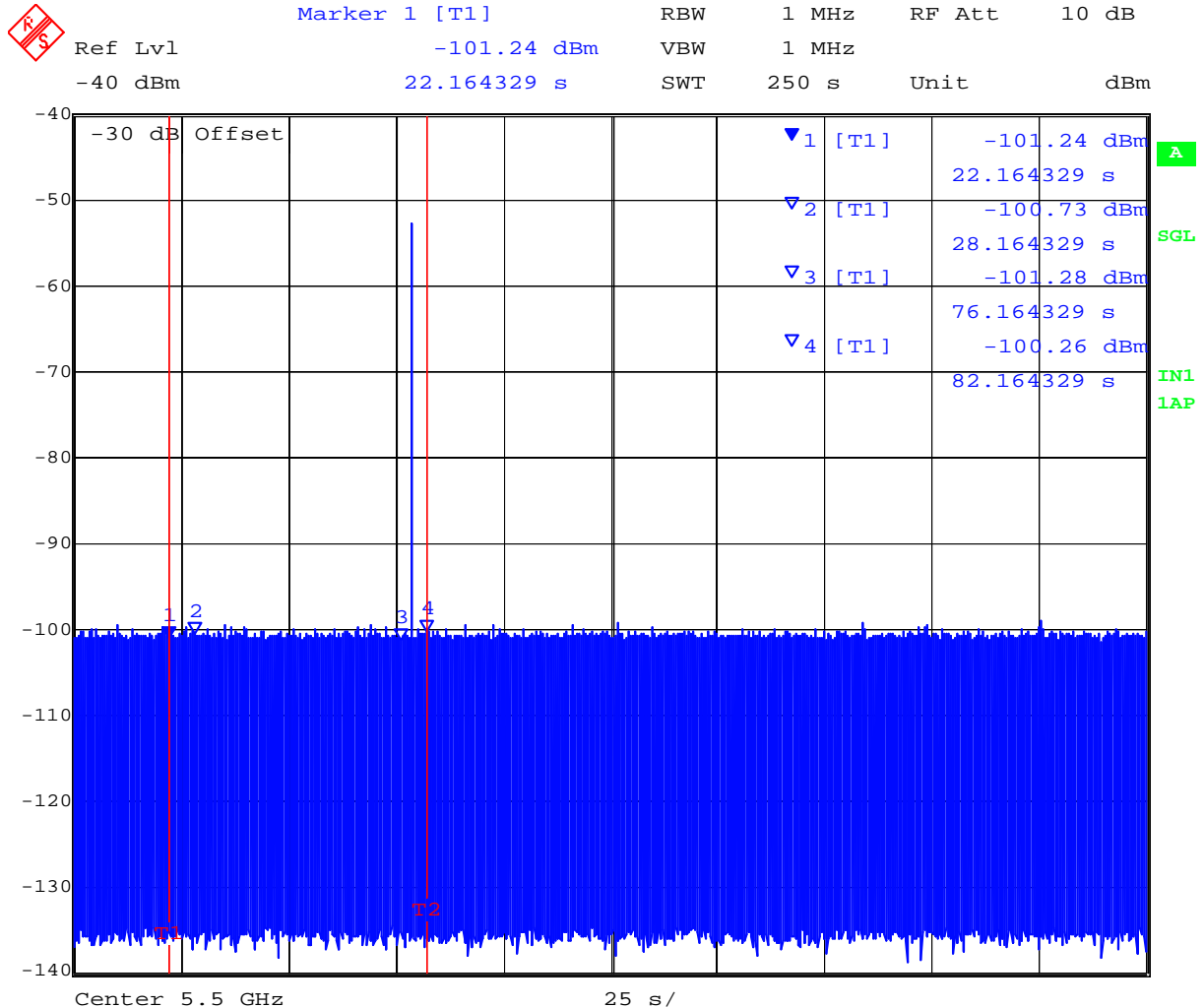
Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5,500MHz will continue for 2.5 minutes after the radar burst has been generated.

Verify that during the 2.5 minute measurement window no EUT transmissions occurred on 5,500MHz.



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 99 of 121

**Channel Availability Check Time at the end of the 60 second Check Time**  
**Ch 5,500 MHz**



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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 100 of 121

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**6.2.5. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period**  
**FCC §15.407(h)(2)(iii)**

The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the EUT (Master). The requisite MPEG video file ("TestFile.mpg" available on the NTIA website at the following link <http://ntiacsd.ntia.doc.gov/dfs/>) is streamed from the master device (AP) to the client.

**Channel Closing Transmission Time - Measurement**

A Type 1 waveform was introduced to the EUT, from which a 12 second transmission record was digitally captured, collecting nearly 250M samples of data, which included in excess of 600 ms of pre-trigger data. This Type 1 waveform had an integral marker built into its construction, marking the start of the radar waveform play, which directly triggered the PXI digitizer's data capture via the PXI backplane trigger bus.

The test system was set-up to capture all transmission data for access point events above a threshold level of -50 dBm. The test equipment time stamps all captured events with respect to  $T_0$  (zero time indicating the start of the measurements sequence) starting the 612.1 ms pre-trigger period followed by the radar type 1 burst period.

Radar (Type 1) Pre-trigger period      612.1 ms

Type 1 burst period                      25.705 ms

(The period of the 18 pulse burst includes [18 pulses \* 1.428mS PRI] = 25.704 ms. Then add 1  $\mu$ s pulse width for the final pulse.)

Channel Closing Transmission Time starts immediately after the last radar pulse is transmitted i.e. 637.8 ms after the start of the trace capture period.

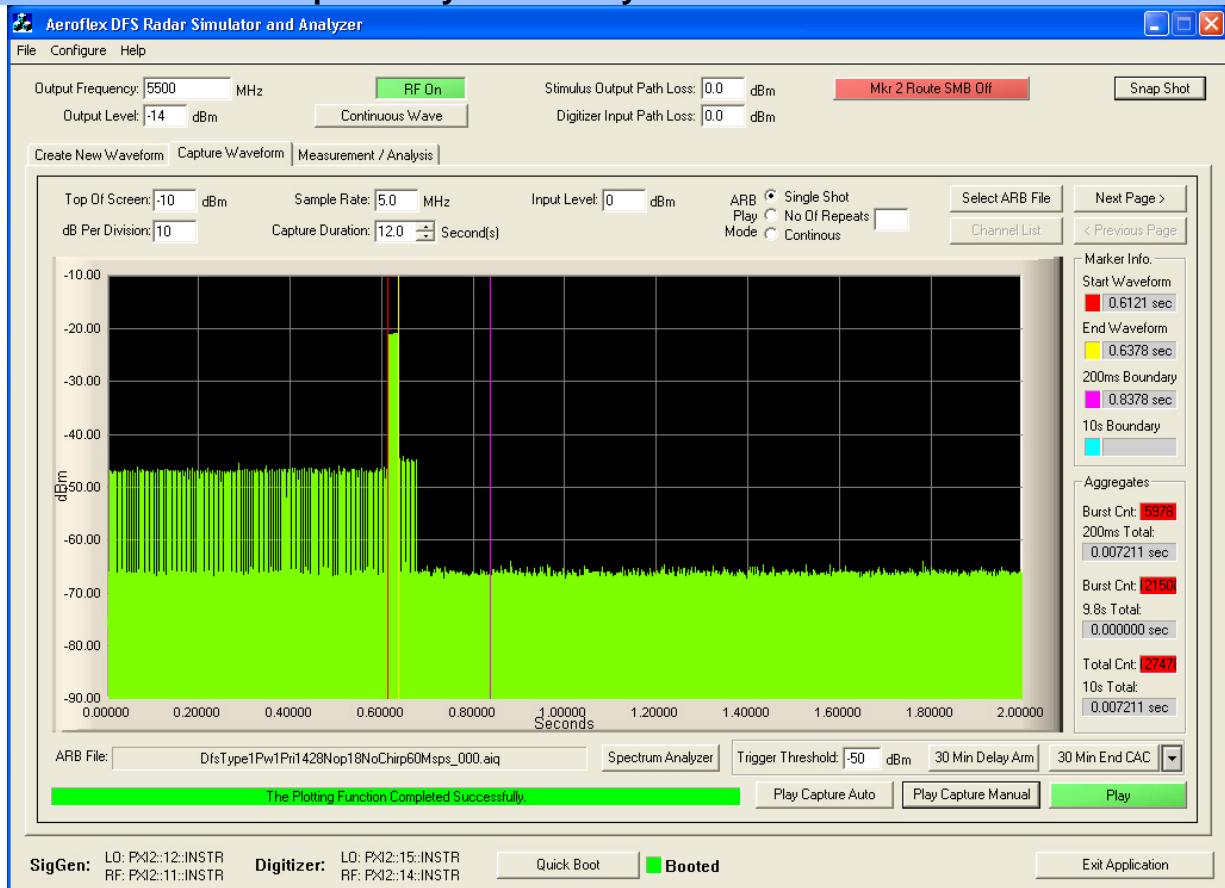


**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 101 of 121

Therefore, pulses seen after this 637.8 ms boundary are identified and totaled to provide an aggregate total of transmissions in order to determine whether the EUT is compliant with the Channel Closing Transmission Time requirements as described in MO&O FCC 06-96. In this case, it was found that an aggregate total of 7.211 ms of transmission time accrued. This value is found at the right hand side at the foot of the following plot (10s Total).

**Channel Closing Transmission Time = 7.211 mSecs (limit 260 mSecs)**

**Master Device - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar  
Captured by the Test System - 0 to 2 seconds**



From the plot above it can be seen that the transmission activity within the 200 mS window is 7.211 mS (see 200 mS Total). From the following plots which shows all additional activity within the remainder of the 10 sec measurement window it can be determined that the aggregate transmission is 0.0 mS which is less than the 60 mS limit.

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 102 of 121

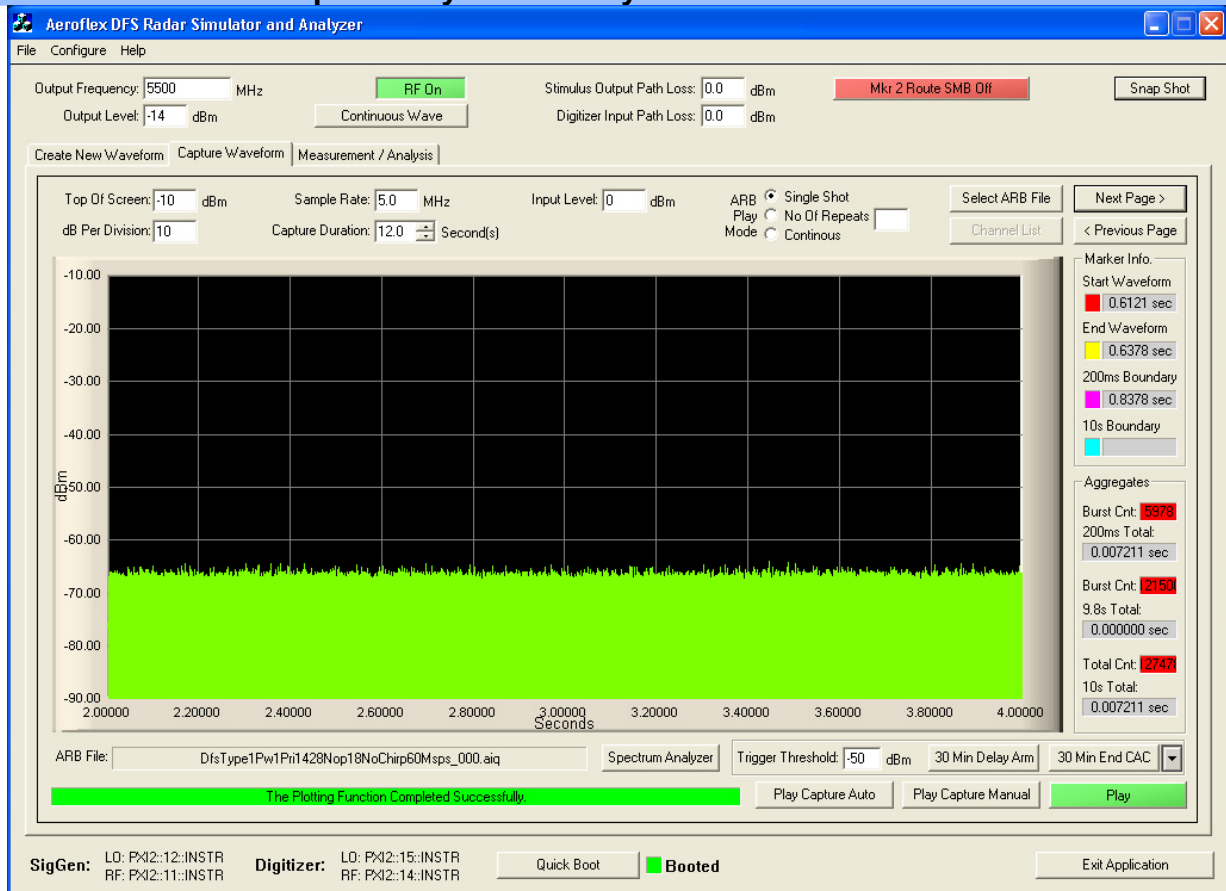
Last Transmitter Activity = 0.6691 Seconds

Last Radar Activity = 0.6378 Seconds

Channel Move Time = Last Transmitter Activity – Last Radar Activity = 0.6691 – 0.6378

**Channel Move Time = 31.3 msec (Limit 10 secs)**

**Master Device - Channel Move Time, Channel Closing Transmission Time for Type 1 Radar  
Captured by the Test System - 2 to 4 seconds**

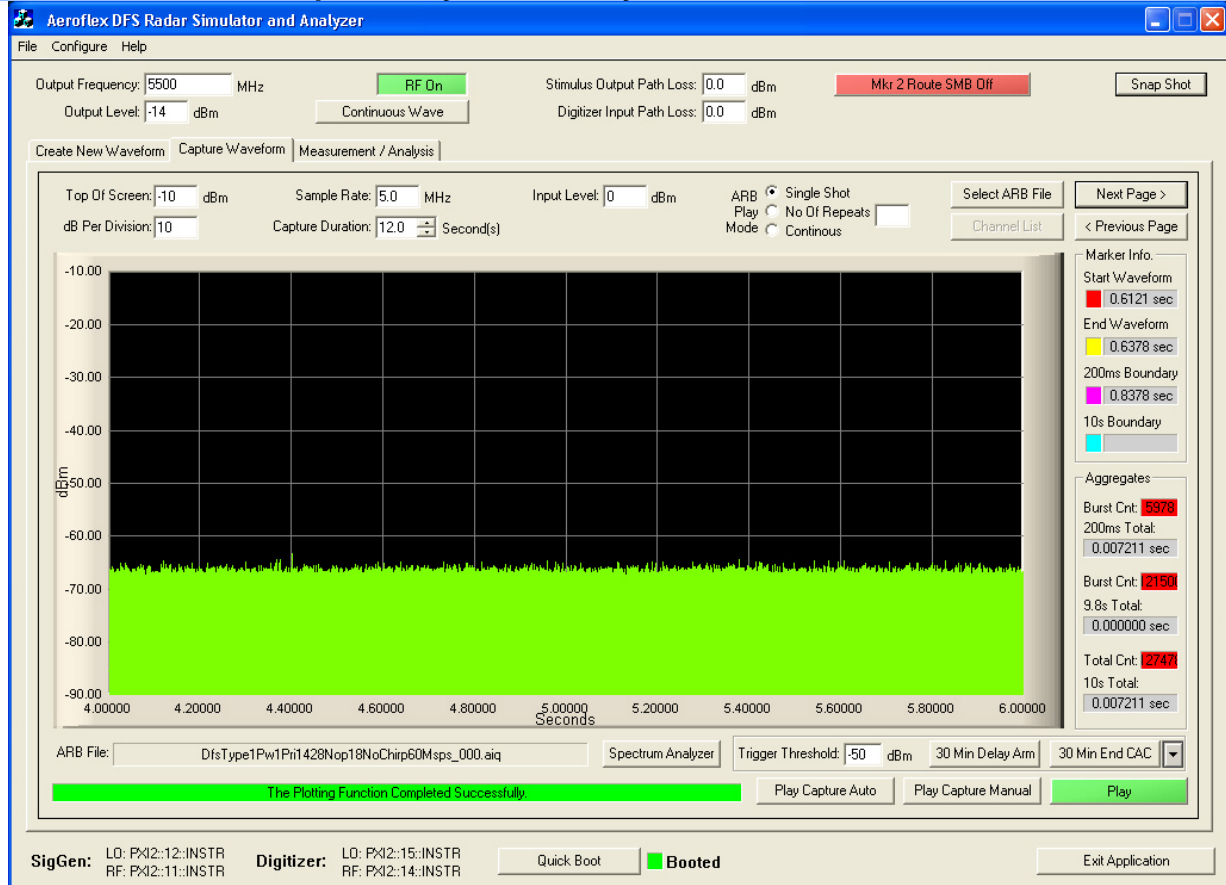


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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 103 of 121

**Master Device - Channel Move Time, Channel Closing Transmission Time for  
Type 1 Radar  
Captured by the Test System - 4 to 6 seconds**



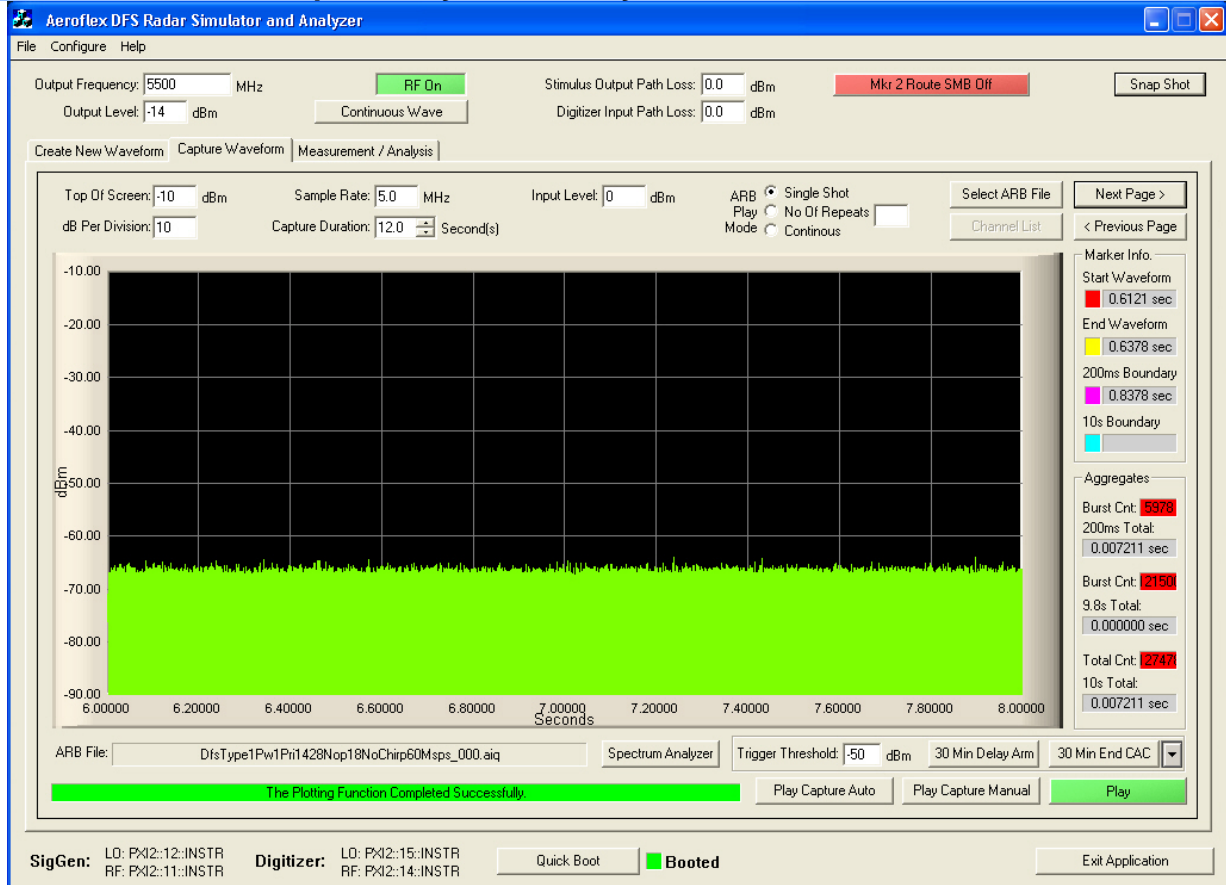
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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 104 of 121

**Master Device - Channel Move Time, Channel Closing Transmission Time for  
Type 1 Radar  
Captured by the Test System - 6 to 8 seconds**



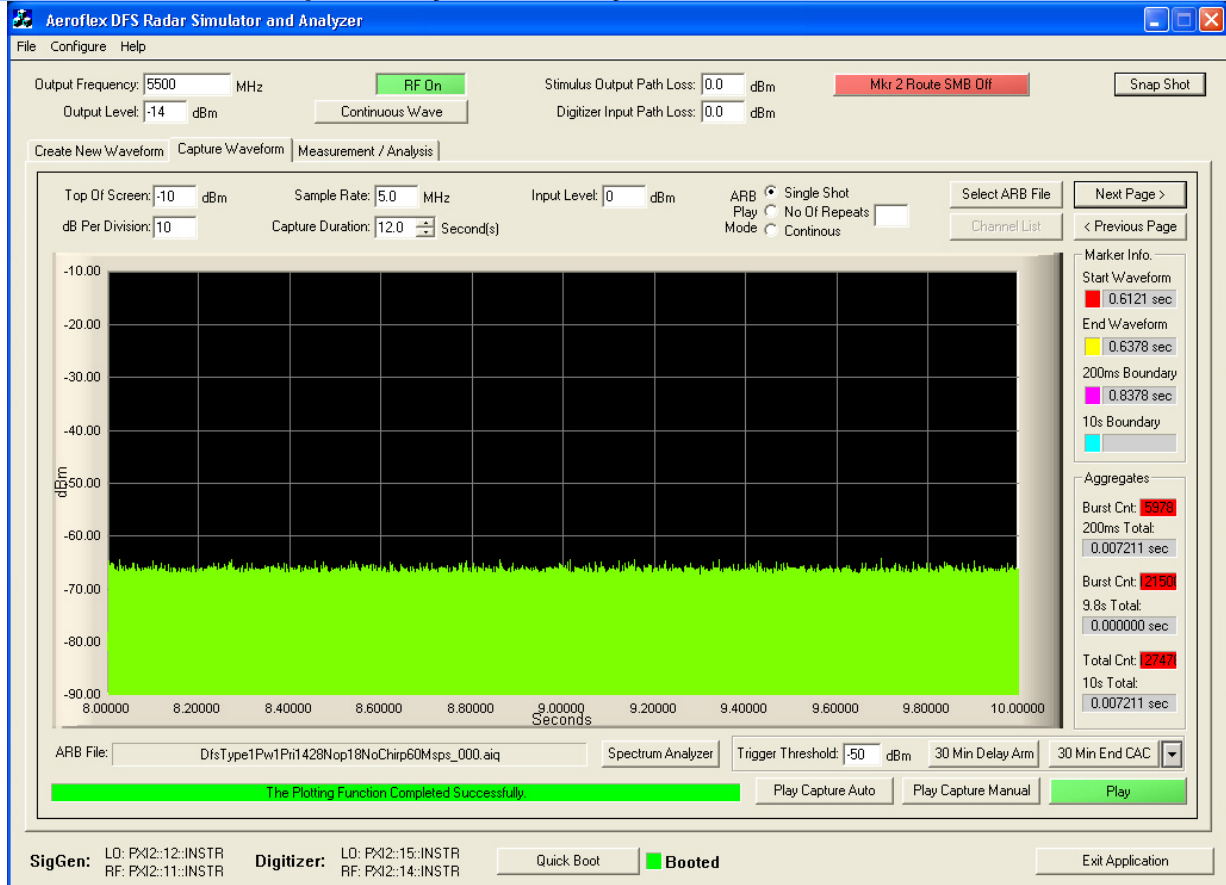
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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 105 of 121

**Master Device - Channel Move Time, Channel Closing Transmission Time for  
Type 1 Radar  
Captured by the Test System - 8 to 10 seconds**

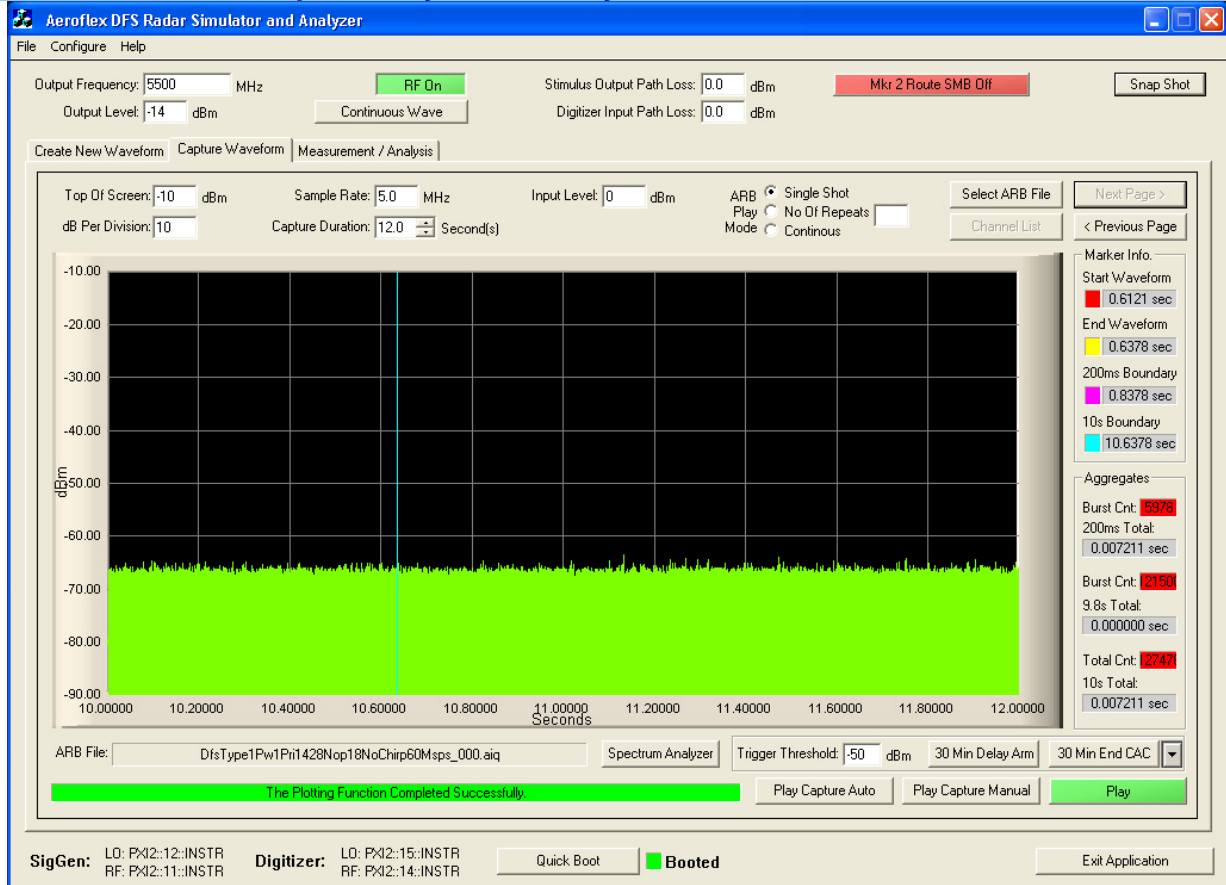


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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 106 of 121

**Master Device - Channel Move Time, Channel Closing Transmission Time for  
Type 1 Radar  
Captured by the Test System - 10 to 12 seconds**



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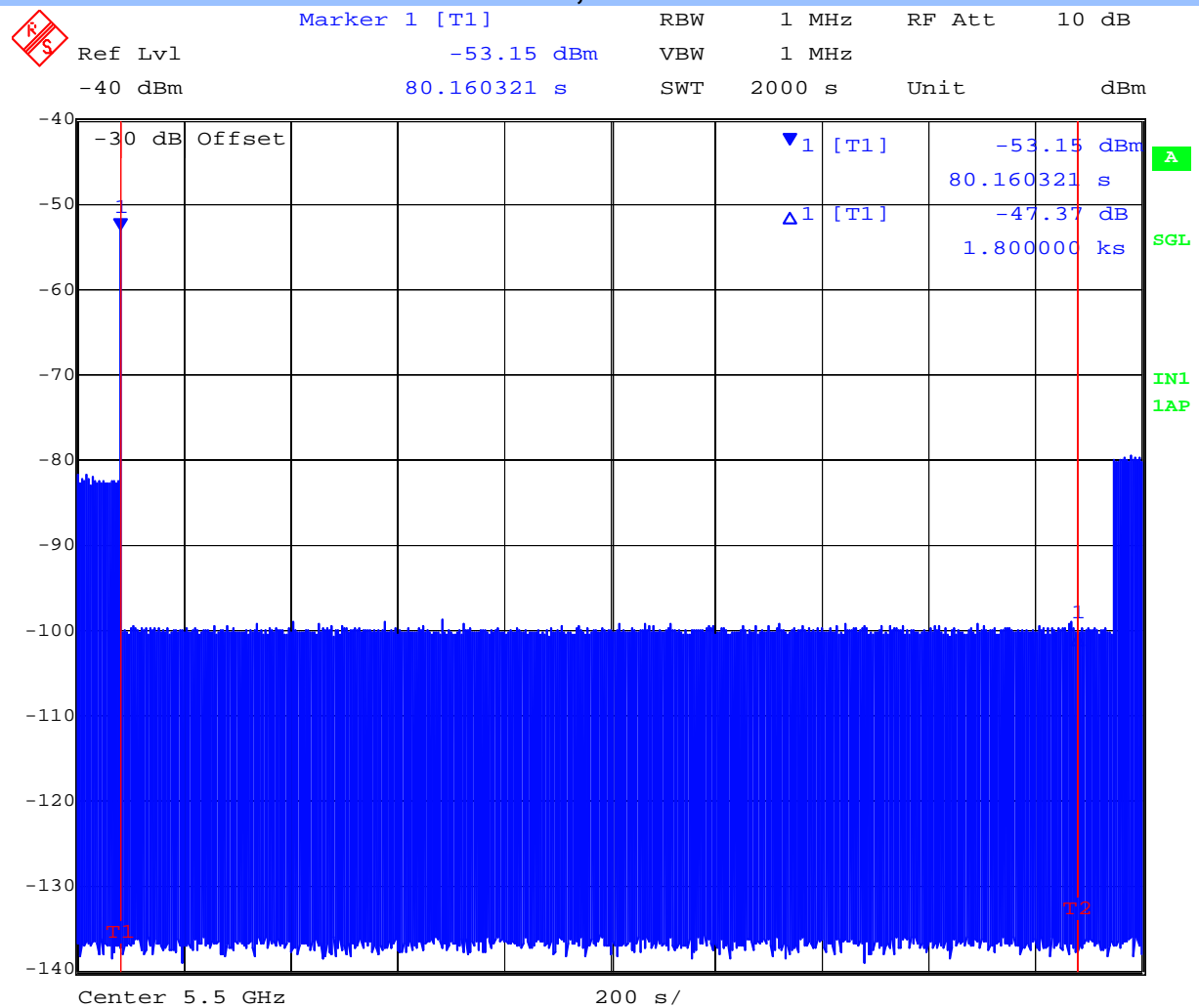


Title: Axxcelera ABMAX-APD567xx Access Point  
To: FCC 47 CFR Part 15.407 & IC RSS-210  
Serial #: AXXC04-A3 Rev B  
Issue Date: 27th October 2008  
Page: 107 of 121

### 30 Minute Non-Occupancy Period

The EUT is monitored for more than 30 minutes following the channel close/move time to verify no transmissions resume on this Channel.

#### 30 Minute Non-Occupancy Period Type 1 Radar Ch 5,500 MHz



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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 108 of 121

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#### **6.2.6. Statistical Performance Check**

The steps below define the procedure to determine the minimum percentage of detection when a radar burst with a level equal to the DFS Detection Threshold is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at 5,500 MHz. Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test.

The Radar Waveform generator sends the individual waveform for each of the radar types 1-6. Statistical data will be gathered to determine the ability of the device to detect the radar test waveforms. The device can utilize a test mode to demonstrate when detection occurs to prevent the need to reset the device between trial runs. The percentage of successful detection is calculated by:

$$\text{Total \# of detections} \div \text{Total \# of Trials} \times 100 = \text{Probability of Detection}$$

The Minimum number of trails, minimum percentage of successful detection and the average minimum percentage of successful detection are found in the Radar Test Waveforms section.



**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 109 of 121

**Verification of Detection 15 MHz Channel Spacing (Injection @ -5 MHz offset i.e. 5495 MHz)**

Trial #	Detection = √, No Detection = 0					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
1	√	√	√	√	√	√
2	√	√	√	√	√	√
3	0	√	√	0	0	√
4	√	√	√	√	√	√
5	√	√	0	√	√	0
6	0	√	√	√	√	√
7	√	0	√	0	√	√
8	√	√	√	√	√	√
9	0	√	√	0	√	√
10	√	√	√	√	√	√
11	√	√	√	√	√	√
12	√	0	√	√	√	√
13	0	√	0	√	√	0
14	√	√	√	√	√	√
15	0	√	√	√	√	√
16	√	√	√	√	√	√
17	√	0	√	√	√	√
18	√	√	√	√	√	√
19	√	√	0	√	√	√
20	√	√	√	√	√	√
21	√	0	√	√	√	√
22	√	√	√	√	√	0
23	√	√	√	0	√	√
24	√	0	√	0	√	0
25	√	√	√	√	√	√
26	√	√	√	0	0	√
27	√	√	√	√	0	√
28	√	√	√	0	√	0
29	√	√	√	√	√	√
30	√	√	√	√	√	√
<b>Detection Percentage</b>	<b>83% (&gt;60%)</b>	<b>83% (&gt;60%)</b>	<b>90% (&gt;60%)</b>	<b>76% (&gt;60%)</b>	<b>90% (&gt;80%)</b>	<b>83.3% (&gt;80%)</b>

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;

$$(P_{d1} + P_{d2} + P_{d3} + P_{d4}) / 4 = (83\% + 83\% + 90\% + 76\%) / 4 = 83.0\% (> 80\%)$$

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 110 of 121

**Verification of Detection 10 MHz Channel Spacing (Injection @ -2 MHz offset i.e. 5498 MHz)**

Trial #	Detection = √, No Detection = 0					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
1	√	√	√	√	√	√
2	0	√	√	√	√	√
3	√	0	0	0	√	√
4	√	0	0	0	√	0
5	0	√	√	√	√	√
6	√	√	√	√	√	√
7	√	√	0	0	√	√
8	√	√	√	√	√	√
9	√	0	√	√	0	√
10	√	√	√	√	√	√
11	√	√	√	√	√	√
12	√	√	√	√	√	√
13	0	0	√	√	0	√
14	√	√	√	√	√	√
15	√	√	√	√	√	0
16	√	√	√	√	√	0
17	√	√	√	√	√	0
18	√	0	√	√	√	√
19	0	√	0	√	0	√
20	√	√	√	√	√	√
21	√	√	√	0	√	√
22	√	√	√	√	√	√
23	0	√	√	√	√	√
24	√	0	√	√	√	√
25	√	√	√	0	√	√
26	0	√	√	0	√	√
27	0	√	0	√	√	√
28	√	√	√	√	√	√
29	√	√	√	0	0	√
30	√	√	√	√	√	0
31	√	√	√	√	--	--
32	√	√	√	√	--	--
33	√	√	√	√	--	--
34	√	√	√	√	--	--
35	√	√	√	√	--	--
<b>Detection Percentage</b>	80% (>60%)	82% (>60%)	85% (>60%)	80% (>60%)	86% (>80%)	83% (>80%)

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;

$$(P_{d1} + P_{d2} + P_{d3} + P_{d4}) / 4 = (80\% + 82\% + 85\% + 80\%) / 4 = 81.75\% (> 80\%)$$

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 111 of 121

**Verification of Detection 5 MHz Channel Spacing (Injection @ -2 MHz offset i.e. 5498 MHz)**

Trial #	Detection = √, No Detection = 0					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
1	0	√	√	√	0	0
2	√	√	0	√	√	√
3	√	0	0	√	√	√
4	√	√	√	√	√	√
5	√	0	√	0	0	0
6	√	√	√	0	√	0
7	0	√	√	0	√	√
8	√	√	0	0	√	√
9	√	√	√	√	√	√
10	√	0	0	√	√	√
11	√	√	√	√	√	√
12	√	√	√	√	√	√
13	0	√	√	√	√	√
14	0	√	√	√	√	0
15	√	√	√	√	√	√
16	√	0	√	√	√	√
17	√	√	√	0	√	√
18	0	√	√	√	√	√
19	√	√	√	√	0	√
20	0	√	√	√	√	√
21	√	0	√	√	0	√
22	√	√	√	√	0	√
23	√	√	√	0	√	0
24	√	√	√	√	√	√
25	√	√	√	0	√	√
26	√	0	√	√	√	√
27	√	√	0	√	√	√
28	0	√	√	√	√	0
29	√	0	0	√	√	√
30	√	√	√	√	0	√
31	√	√	√	√	--	--
32	√	√	√	√	--	--
33	√	√	√	√	--	--
34	√	√	√	√	--	--
35	√	√	0	√	--	--
<b>Detection Percentage</b>	80% (>60%)	80% (>60%)	80% (>60%)	80% (>60%)	80% (>80%)	80% (>80%)

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;

$$(P_{d1} + P_{d2} + P_{d3} + P_{d4}) / 4 = (80\% + 80\% + 80\% + 80\%) / 4 = 80.0\% (> 80\%)$$

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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 112 of 121

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**Measurement Uncertainty Time/Power**

Measurement uncertainty	
- Time	4%
- Power	1.33dB

**Traceability**

Test Equipment Used
0072, 0083, 0098, 0116, 0132, 0158, 0313, 0314, 0193, 0223, 0252, 0253, 0251, 0256, 0328, 0329

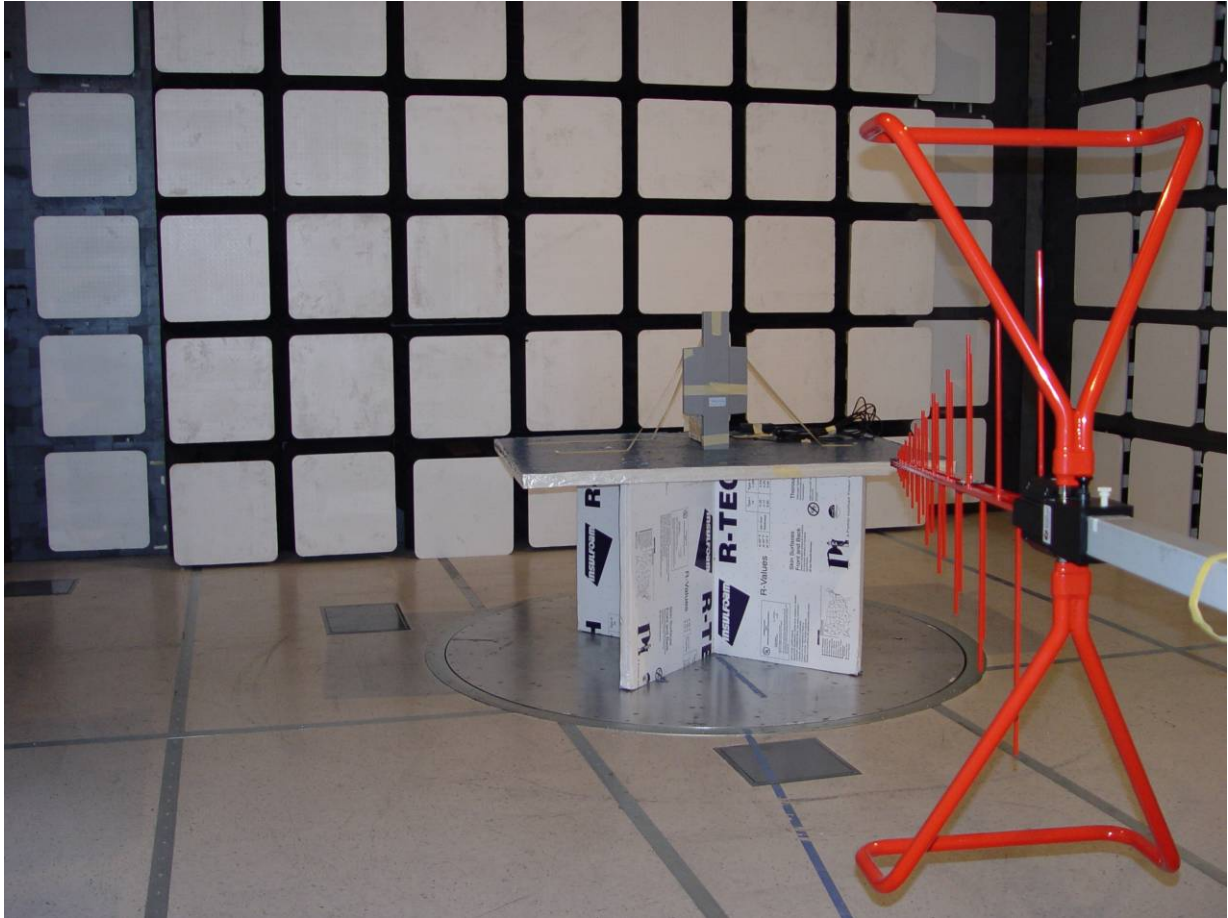
---

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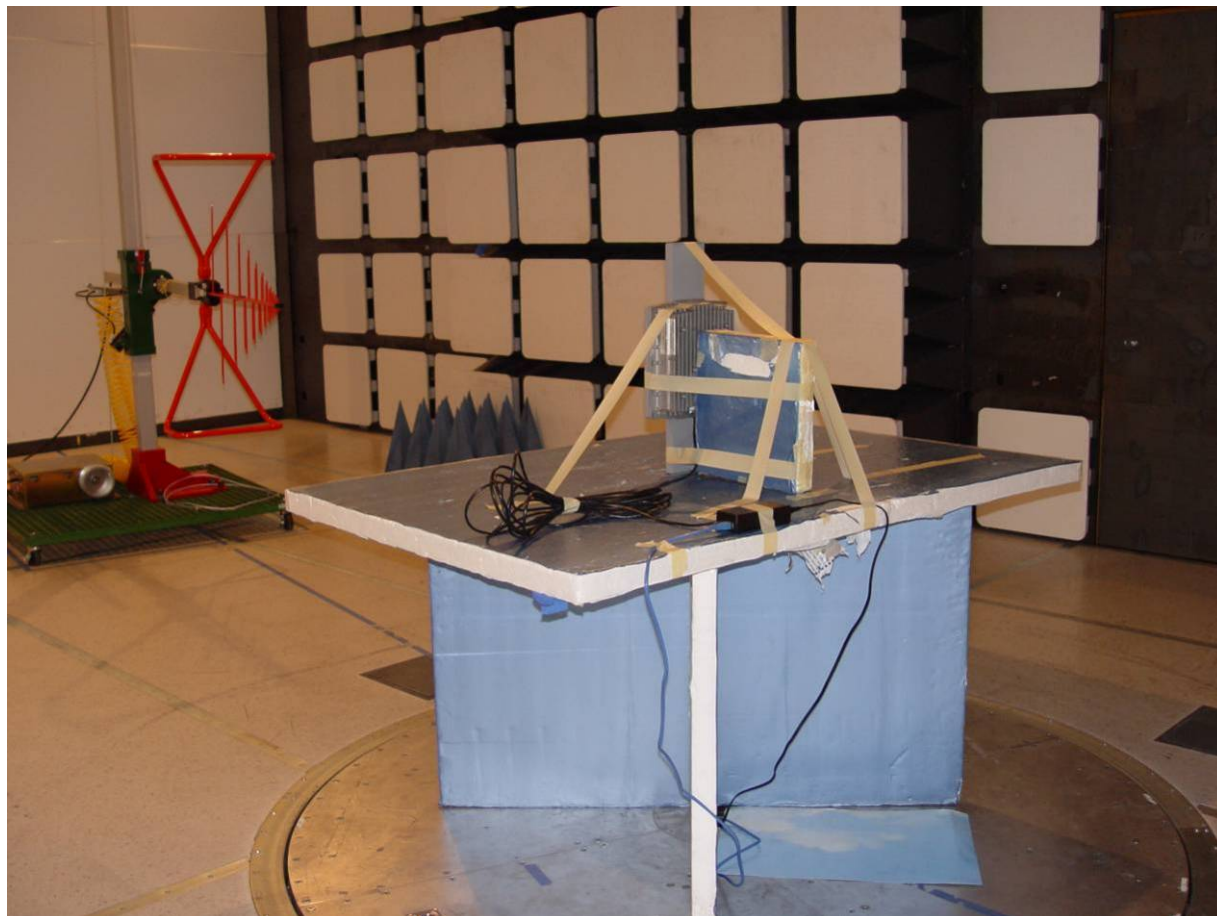


## 7. PHOTOGRAPHS

### 7.1. Radiated Spurious Emissions < 1 GHz (Front)



## 7.2. Radiated Spurious Emissions < 1 GHz (Rear)



### 7.3. Conducted Emissions (150 kHz - 30 MHz)



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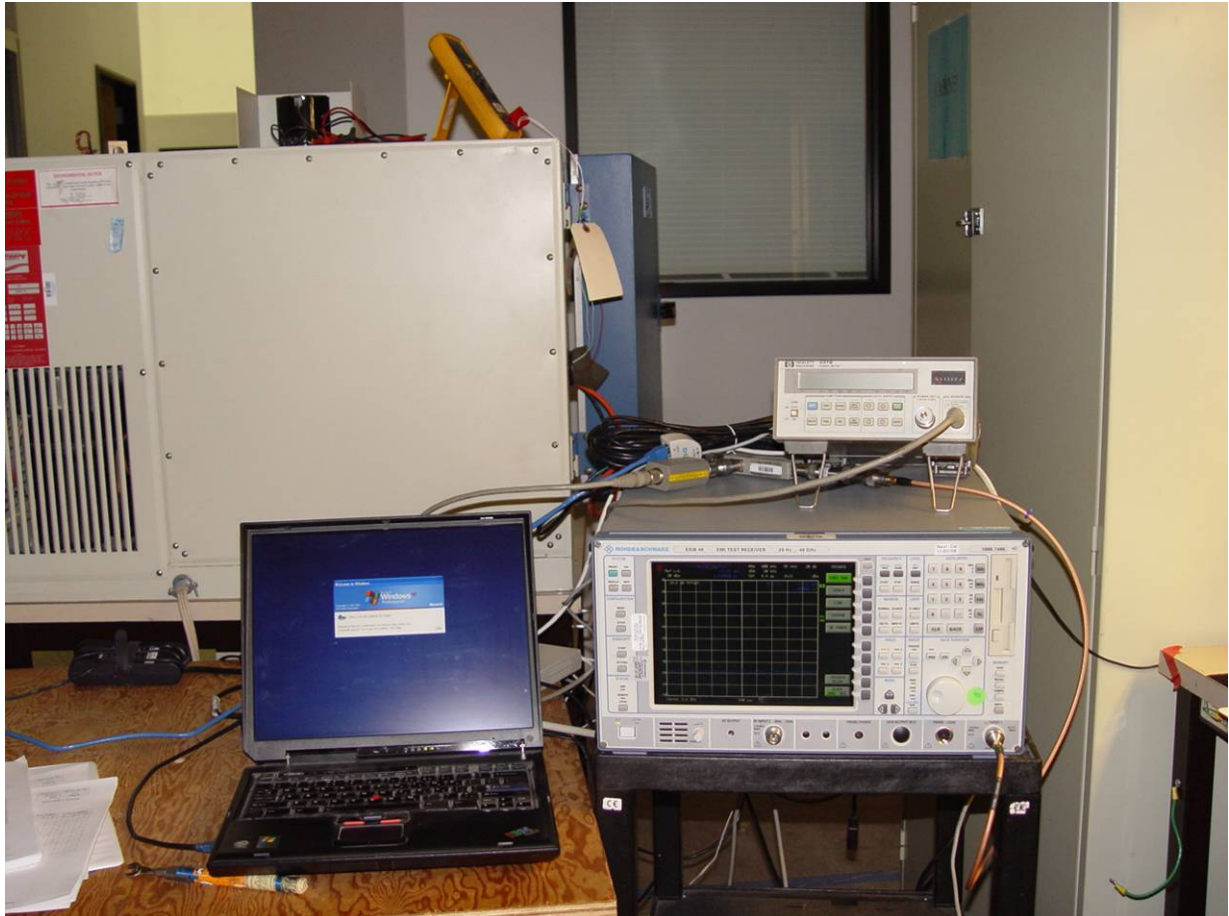
#### 7.4. General Measurement Test Set-Up



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## 7.5. General Measurement Test Set-Up (Test Equipment)



## 7.6. Dynamic Frequency Selection Test Set-Up

**General DFS Test Setup**

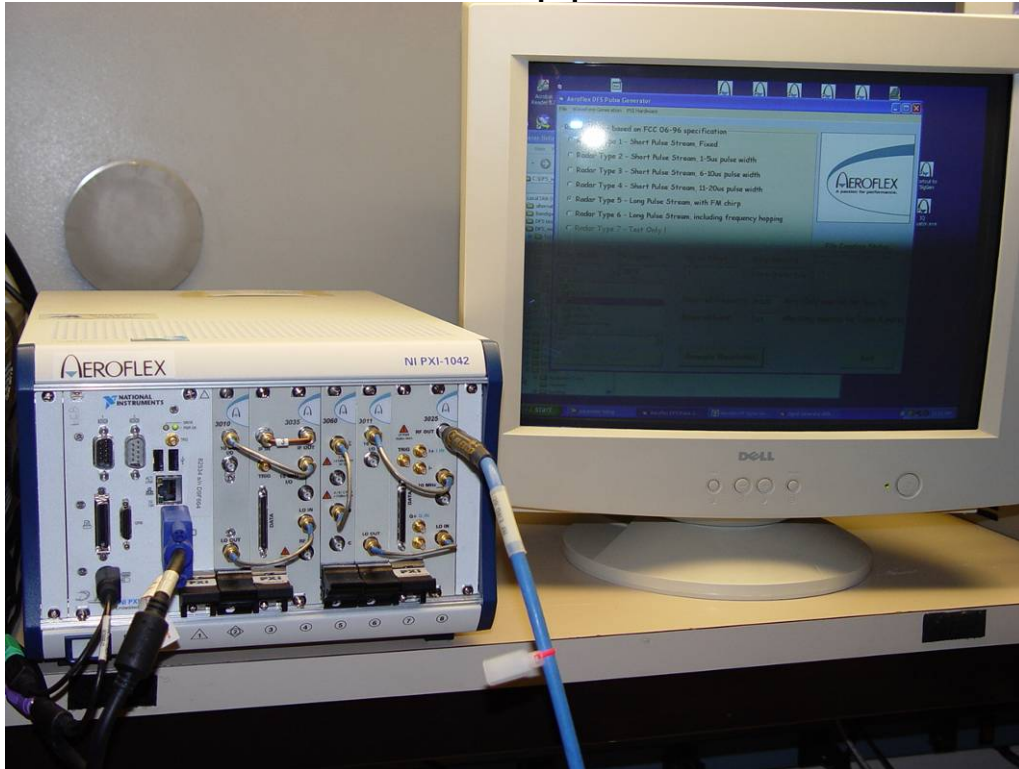


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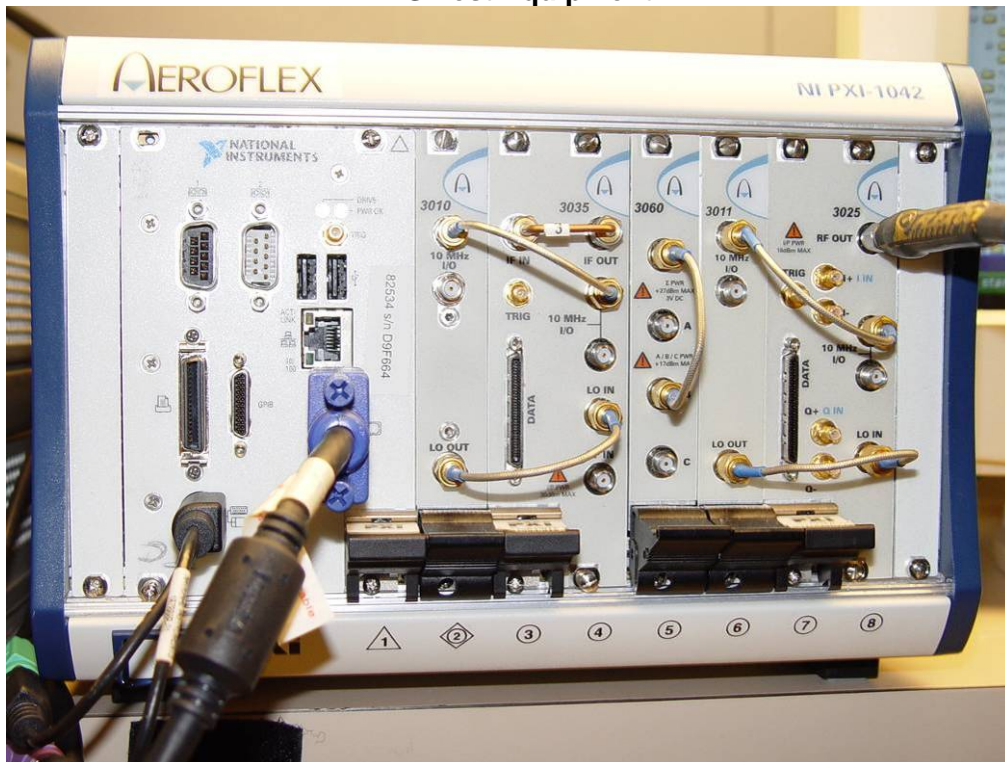
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## DFS Test Equipment



## DFS Test Equipment



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**Title:** Axxcelera ABMAX-APD567xx Access Point  
**To:** FCC 47 CFR Part 15.407 & IC RSS-210  
**Serial #:** AXXC04-A3 Rev B  
**Issue Date:** 27th October 2008  
**Page:** 120 of 121

## 8. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787- 3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181- 3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907
	Radar Signal Generator	Aeroflex	3025, 3010, 3010/11 Opt 1	
	Analyzer	Aeroflex	3035, 3011, 3010/11 Opt 1	
	PXI Chassis	Aeroflex	82536	

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