Test of Aruba AP-93H 802.11a/b/g/n Wireless AP

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

Test Report Serial No.: ARUB74-U2 Rev A

TEST REPORT

FROM

Test of Aruba Networks, Inc AP-93H 802.11a/b/g/n Wireless AP
to

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

Test Report Serial No.: ARUB74-U2 Rev A

Note: this report contains data with regard to the 5,150 to 5,250 MHz band for the Aruba Networks, Inc AP-93H Wireless LAN Access Point. 2.4 and 5.8 GHz test data are reported in MiCOM Labs test report ARUB74-U1.

This report supersedes None

Applicant: Aruba Networks, Inc
1344 Crossman Avenue
Sunnyvale
CA 94089, USA

Product Function: Wireless LAN Access Point

Copy No: pdf Issue Date: 21st December 2011

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
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ACCREDITED
CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS & RECOGNITION

ACCREDITATION - TESTING

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) 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

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Product Certification Body

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence as a

Product Certification Body

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC Guide 65:1996 *General requirements for bodies operating product certification systems*. This accreditation demonstrates technical competence for a defined scope and the operation of a quality management system for a Telecommunications Certification Body (TCB) meeting FCC (U.S.), Japan (MIC), and IC (Canada) requirements.

Presented this 24th day of June 2010.

President & CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to January 31, 2012
Revised September 2, 2011

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA** countries. Our test reports are widely accepted for global type approvals.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	Listing #: 4143A
Japan	MIC	CAB	APEC MRA 2	210
	VCCI	--	--	No. 2959
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

- Phase I - recognition for product testing
- Phase II – recognition for both product testing and certification
- N/A – Not Applicable

**EU MRA – European Union Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

**NB – Notified Body

PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC Guide 65. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf

United States of America – Telecommunication Certification Body (TCB)
TCB Identifier – US0159

Industry Canada – Certification Body
CAB Identifier – US0159

Europe – Notified Body
Notified Body Identifier - 2280

Japan – Recognized Certification Body (RCB)
RCB Identifier - 210

DOCUMENT HISTORY

Document History		
Revision	**Date**	**Comments**
Draft		
Rev A	21st December 2011	Initial Release

1. TEST RESULT CERTIFICATE

Applicant:	Aruba Networks, Inc 1344 Crossman Avenue Sunnyvale CA 94089, USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	802.11a/b/g/n Wireless Access Point	Tel:	+1 925 462 0304
Model:	AP-93H	Fax:	+1 925 462 0306
S/N:	AN0000049 (Conducted) AN0000064 (Radiated)		
Test Date(s):	3rd to 28th April 2010 & 8th Oct to 5th Dec 2011	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.

ACCREDITED
CERTIFICATE #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.407	2009	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	14th 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

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.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the Aruba AP-93H 802.11a/b/g/n Wireless AP in the frequency ranges 5150 to 5250 MHz to FCC Part 15.407 and Industry Canada RSS-210 regulations.
Applicant:	Aruba Networks, Inc 1344 Crossman Avenue Sunnyvale CA 94089, USA
Manufacturer:	As applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	ARUB74-U2 Rev A
Date EUT received:	3rd April 2010
Standard(s) applied:	FCC 47 CFR Part 15.407 & IC RSS-210
Dates of test (from - to):	3rd to 28th April 2010 & 8th Oct to 5th Dec 2011
No of Units Tested:	Three (separate units for conducted and radiated)
Type of Equipment:	802.11a/b/g/n Wireless Access Point, 2x2 Spatial Multiplexing MIMO configuration
Applicants Trade Name:	Aruba Networks, Inc
Model(s):	AP-92 (external antenna), AP-93 (integral antenna)
Software Release	5.0.1.0 ART v0_9-b16ALL
Location for use:	Indoor
Declared Frequency Range(s):	5,150 to 5,250 MHz
Type of Modulation:	Per 802.11 –CCK, BPSK, QPSK, DSSS, OFDM
Declared Nominal Output Power: (Average Power)	802.11a: Legacy +17 dBm 802.11n: HT-20 +17 dBm 802.11n: HT-40 +17 dBm
EUT Modes of Operation:	Legacy 802.11a/b/g, 802.11n HT-20, HT-40
Transmit/Receive Operation:	Time Division Duplex
Rated Input Voltage and Current:	DC: Nominal: 12V DC Current: 1.25 A ENET: Nominal: 48 V DC Current: 0.350 A
Operating Temperature Range:	Nominal: 20 ºC Max: 50 ºC Min: 0 ºC
ITU Emission Designator:	5150 – 5250 MHz 802.11a 18M5D1D 5150 – 5250 MHz 802.11n HT-20 19M5D1D 5150 – 5250 MHz 802.11n HT-40 39M9D1D
Frequency Stability:	±20 ppm
Equipment Dimensions:	12.0 cm x 12.7 cm x 3.2 cm
Weight:	375 grams
Primary function of equipment:	Wireless Access Point for transmitting data and voice

3.2. Scope of Test Program

Testing

Per manufactures declaration: The AP-93H contains an AP-93 Access Point with the addition of 4 Ethernet port LAN switch functionality to the main board (digital portion modification only). The RF part of the device is not modified.

The scope of the compliance program was to test the Aruba AP-93H wireless LAN access point, 2x2 Spatial Multiplexing MIMO configurations in the frequency ranges 2400 – 2483.5 MHz and 5725-5850 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications. This report contains data previous reported in MiCOM Labs test report ARUB51-U1 Rev A Aruba AP-92_93 FCC Part 15.247

Aruba AP-92, AP-93 Access Point

The AP-93 is a high-speed, affordable, and reliable 802.11n access points for indoor environments. Designed for both ceiling and wall mounting, the compact AP-92 and AP-93 deliver wire-like performance at data rates up to 300Mbps. The AP-92 and AP-93 are built to deliver years of trouble-free operation and are backed by Aruba's limited lifetime warranty program.

Working in conjunction with Aruba's line of centralized Mobility Controllers, the AP-93H delivers high-speed, secure network services that let users finally move to a "wireless where possible, wired where necessary" network access model. The network can then be right sized, with unnecessary ports eliminated to lower operating costs. The key to rightsizing is Aruba's unique Adaptive Radio Management technology, which manages channel, power, and wireless client behavior to deliver wire-like performance and reliability. By rightsizing network infrastructure, organizations significantly enhance user mobility and efficiency while lowering total cost of ownership.

The multifunction AP-93H can be configured through the controller to provide wireless LAN access, air monitoring, remote networking, secure enterprise mesh, and wireless intrusion detection and prevention over the 2.4GHz and 5GHz RF spectrum. The AP-93H feature a 100/1000Base-T Ethernet interface and operate from either standard 802.3af Power over Ethernet (PoE) sources or a 12VDC power supply.

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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	802.11a/b/g/n Wireless Access Point	Aruba Networks , Inc	AP-93H	AN0000049 (Conducted) AN0000064 (Radiated)
Support	Laptop PC	IBM	Thinkpad	None

3.4. Antenna Details

Antenna Type	Manufacturer	Model	Gain (dBi / dBd)	Frequency Range (MHz)
Integral	Aruba Networks, Inc	Integral Antenna	5.8	4900 - 5875

3.5. Cabling and I/O Ports

Number and type of I/O ports

Description	Type	Length	Additional Information
ENET	RJ-45 Ethernet Port	Greater than 10m	Ethernet connection; Only non-shielded CAT-5 cable was used during testing. Port not connected to public utility/telecommunication network.
CONSOLE	RJ-45 Serial Port	Greater than 10m	For EUT setup only, not connected during typical EUT operation; Only non-shielded CAT-5 cable was used during testing.
DC Power	DC Power Port	Less than 3m	AC adaptor with attached DC cable supplied with EUT
AC Power	AC Adaptor	Less than 3m	AC adaptor and mains cable supplied with EUT

3.6. Test Configurations

Testing was performed to determine the highest power level versus bit rate. The variant with the highest power was used to exercise the product.

Matrix of test configurations

Operational Mode(s) (802.11)	Variant	Data Rates with Highest Power	Frequencies (MHz)
a,n	Legacy	6 MBit/s	5,180 5,200 5,240
	HT-20	6.5 MCS	
	HT-40	13.5 MCS	5,190 5,230

Antenna Test Configurations for Radiated Emissions and Band-Edge

The following measurements were performed on all antenna configurations identified in Section 3.4 Antenna Details.

Spurious Emission and Band-Edge Test Strategy

11a	11n HT-20	11n HT-40
SE 5180	SE 5180	SE 5190
SE 5200	SE 5200	
SE 5240	SE 5240	SE 5230
BE 5150	BE 5150	BE 5150
Pk 5180	Pk 5180	Pk 5190
Pk 5200	Pk 5200	
Pk 5240	Pk 5240	Pk 5230

KEY:-

SE – Spurious Emissions

BE – Band-Edge

PK - Peak Emission

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

3.9. Subcontracted Testing or Third Party Data

1. NONE

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.	Applicant declaration	Complies	5.1.5
15.407(f) **5.5**	Radio Frequency Radiation Exposure	Exposure to radio frequency energy levels, Maximum Permissible Exposure (MPE)	Conducted	Complies	5.1.6

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	*5.1.7.1*
Industry Canada only **RSS-Gen §4.10, §6**	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.7.2*
15.407(b)(6) **15.205(a)** **15.209(a)** **2.2**	Radiated Emissions	Emissions <1 GHz (30M-1 GHz)		Complies	*5.1.7.3*
15.407(b)(6) **15.207** **7.2.2**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies	5.1.8

5. TEST RESULTS

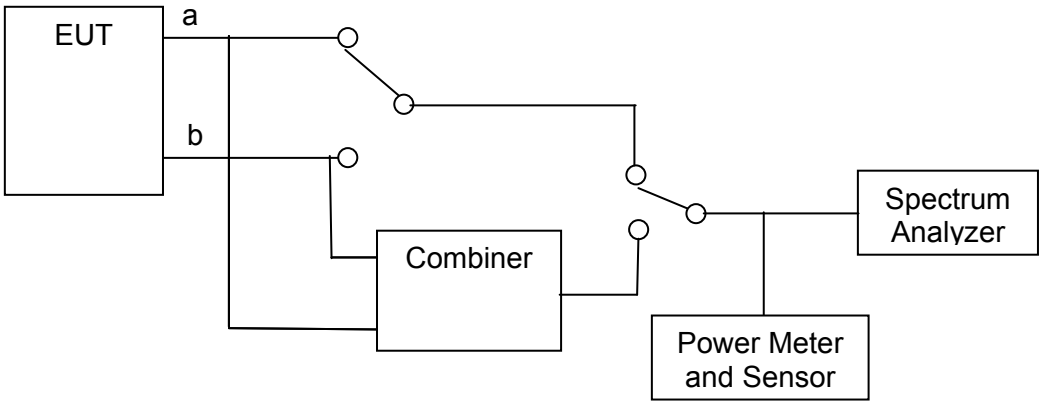
5.1. Device Characteristics

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

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum Default Power

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 – **802.11a Legacy**

Test Conditions:	15.247 (a)(2)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 a	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (x):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc		
Notes 1:			
Notes 2:			

26 dB Bandwidth

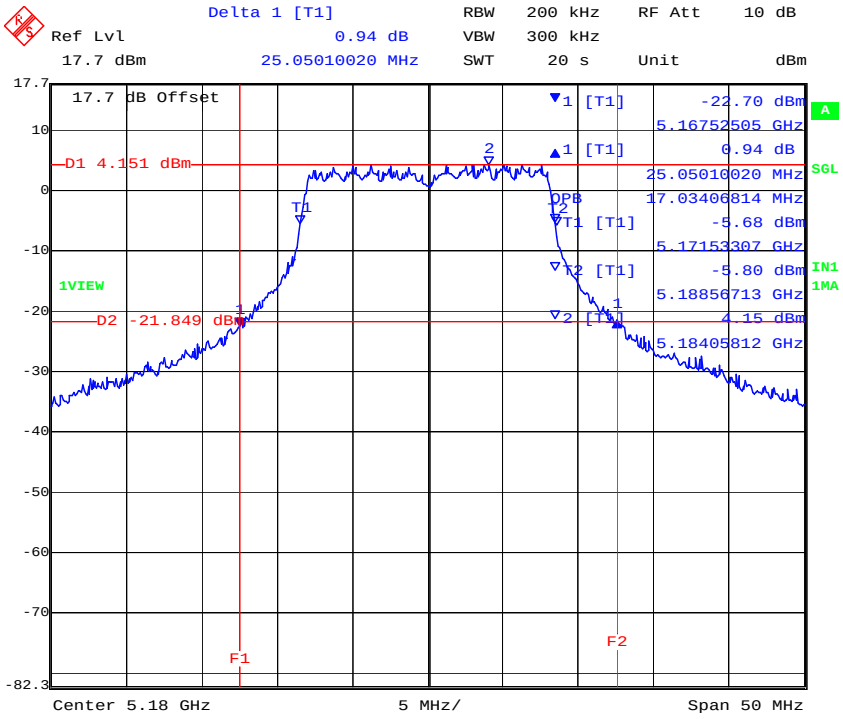
Test Frequency	26 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz						
MHz	**a**	**b**	**c**	**d**	**kHz**	**MHz**	**MHz**
5180	25.050000	25.752000	--	--	500	0.5	-24.550000
5200	25.852000	26.052000	--	--			-25.352000
5240	26.152000	26.152000	--	--			-25.652000

99% Bandwidth

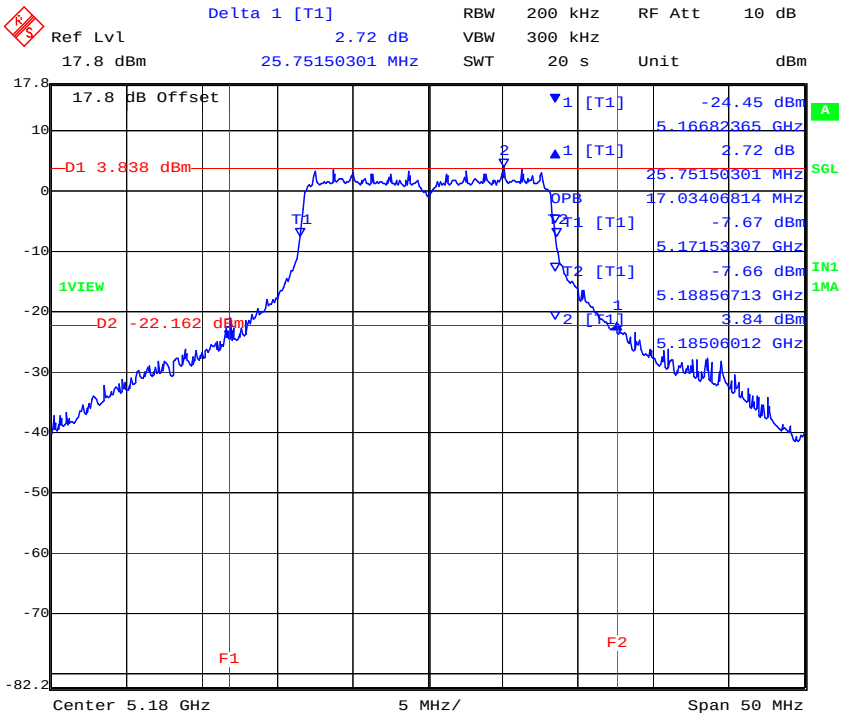
Test Frequency	99 % Bandwidth						
	MHz						
MHz	**a**	**b**	**c**	**d**			
5180	17.034000	17.034000	--	--			
5200	17.234000	17.034000	--	--			
5240	17.234000	17.034000	--	--			

Measurement uncertainty:	±2.81 dB

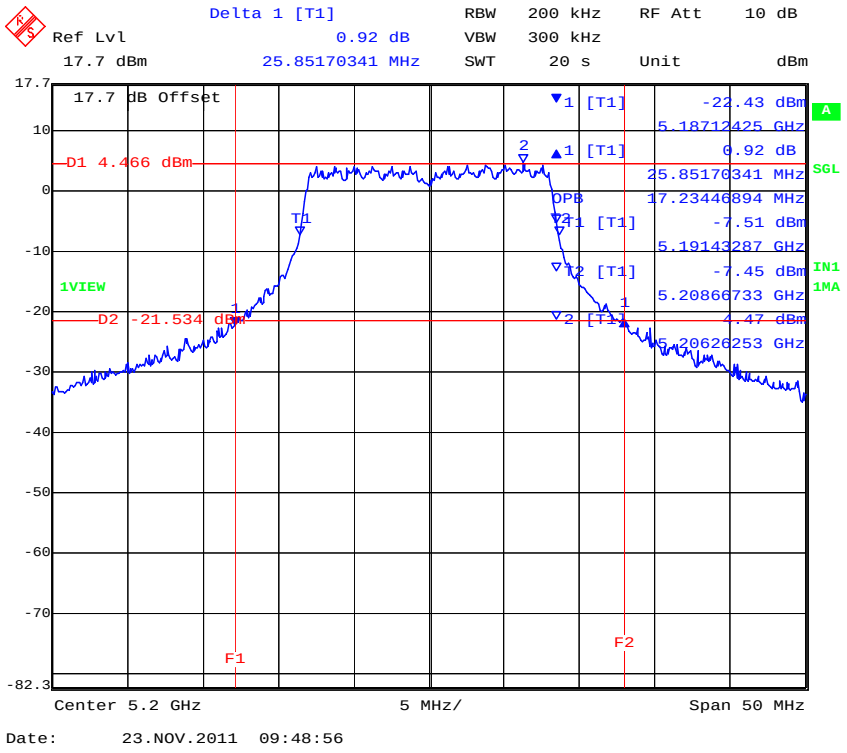
CHAIN A 5,180 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



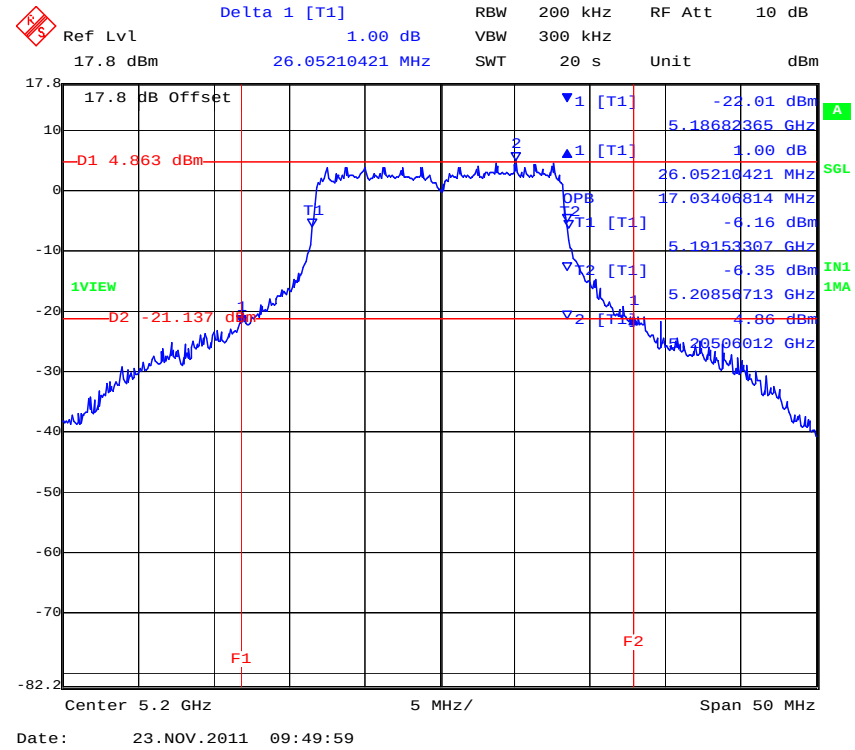
CHAIN B 5,180 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



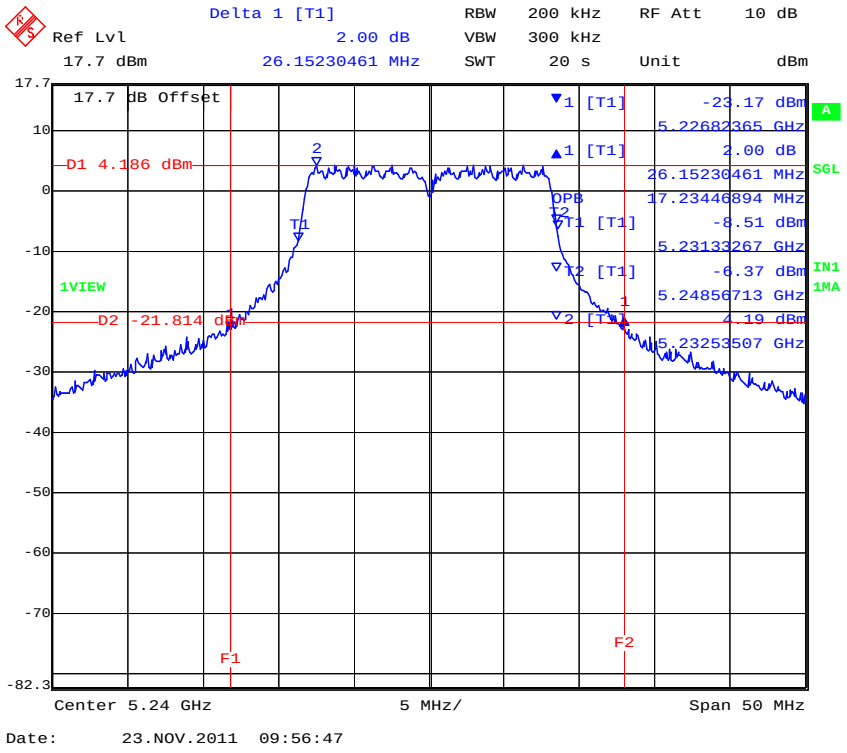
CHAIN A 5,200 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



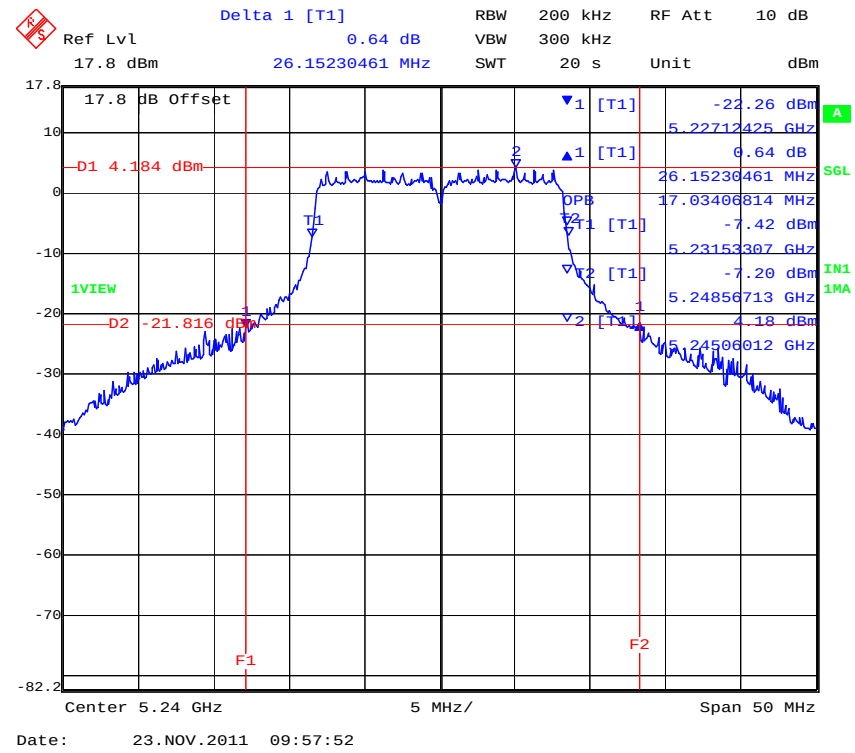
CHAIN B 5,200 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



CHAIN A 5,240 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



CHAIN B 5,240 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



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

TABLE OF RESULTS – **802.11n HT20**

Test Conditions:	15.247 (a)(2)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 n HT-20	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (x):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc		
Notes 1:			
Notes 2:			

26 dB Bandwidth

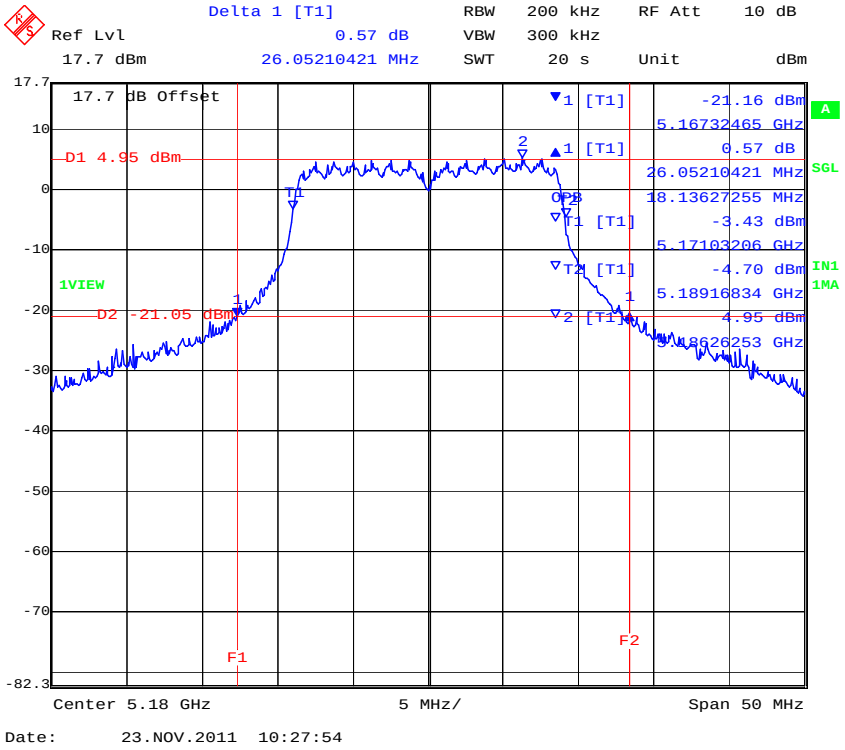
Test Frequency	26 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz						
MHz	**a**	**b**	**c**	**d**	**kHz**	**MHz**	**MHz**
5180	26.052000	25.752000	--	--	500	0.5	-25.252000
5200	25.651000	25.952000	--	--			-25.151000
5240	26.453000	25.351000	--	--			-24.851000

99% Bandwidth

Test Frequency	99 % Bandwidth						
	MHz						
MHz	**a**	**b**	**c**	**d**			
5180	18.136000	18.236000	--	--			
5200	18.236000	18.136000	--	--			
5240	18.236000	18.136000	--	--			

Measurement uncertainty:	±2.81 dB

CHAIN A 5,180 MHz 802.11n HT20 26 dB and 99 % Bandwidth



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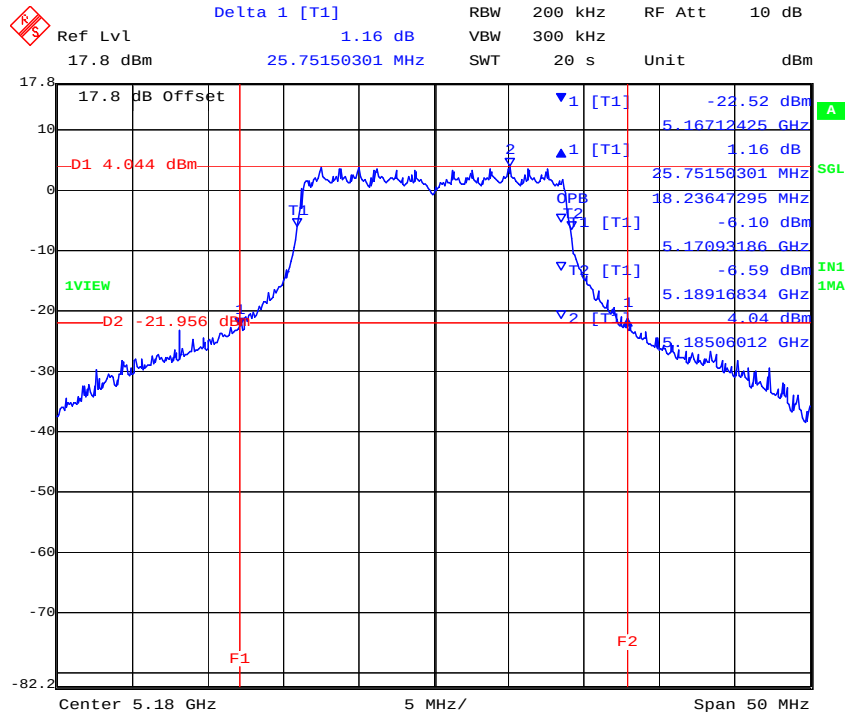
CHAIN B 5,180 MHz 802.11n HT20 26 dB and 99 % Bandwidth



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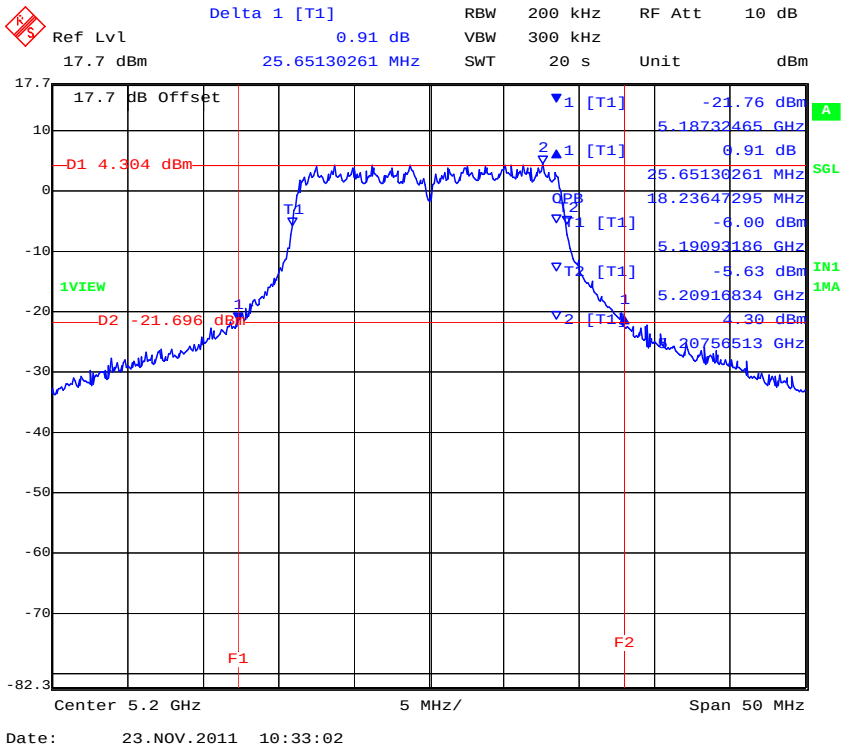
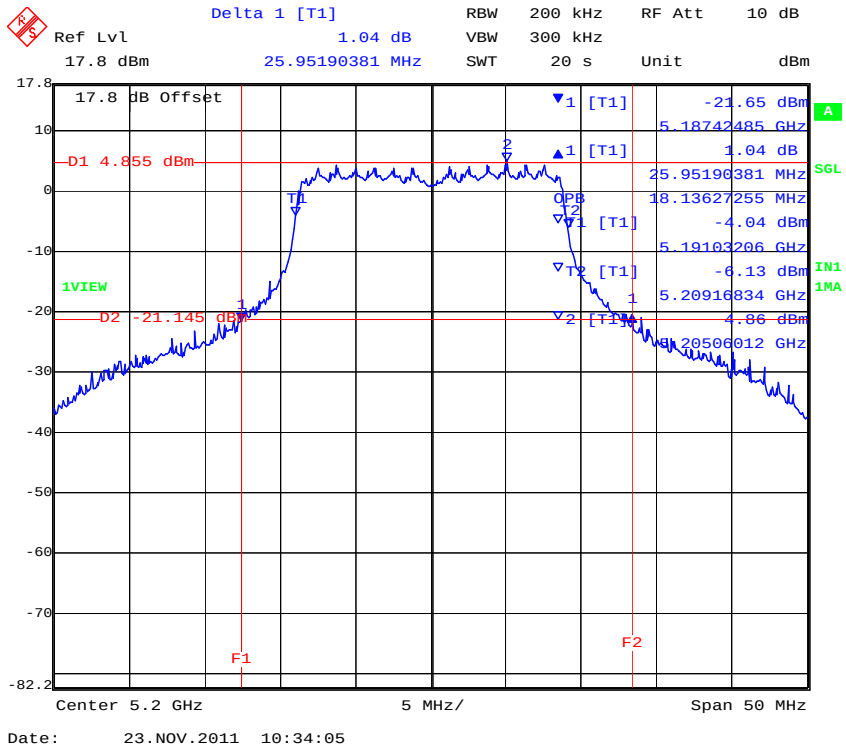
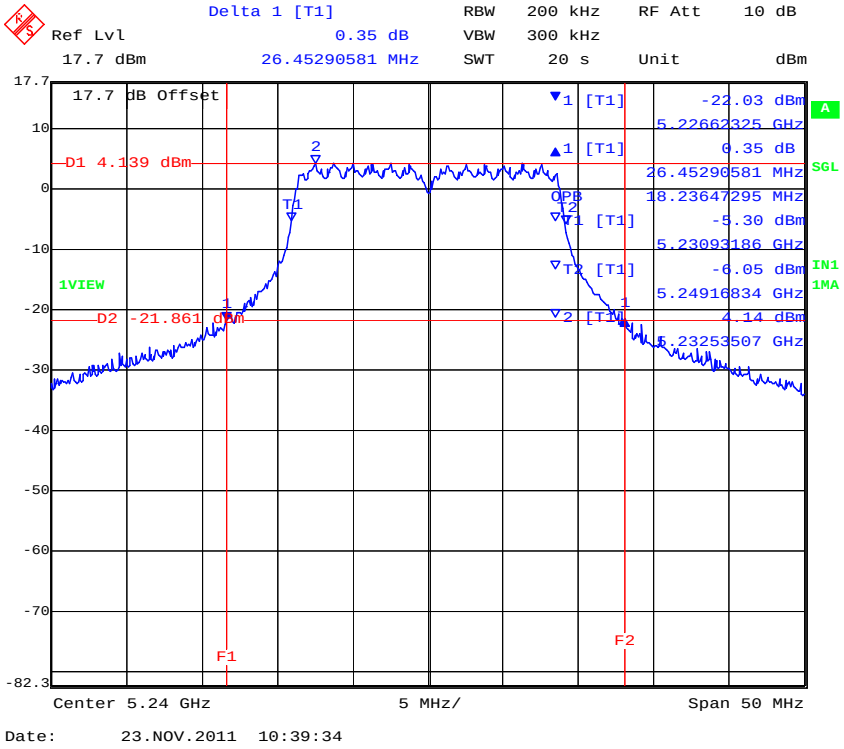
CHAIN A 5,200 MHz 802.11n HT-20 26 dB and 99 % Bandwidth



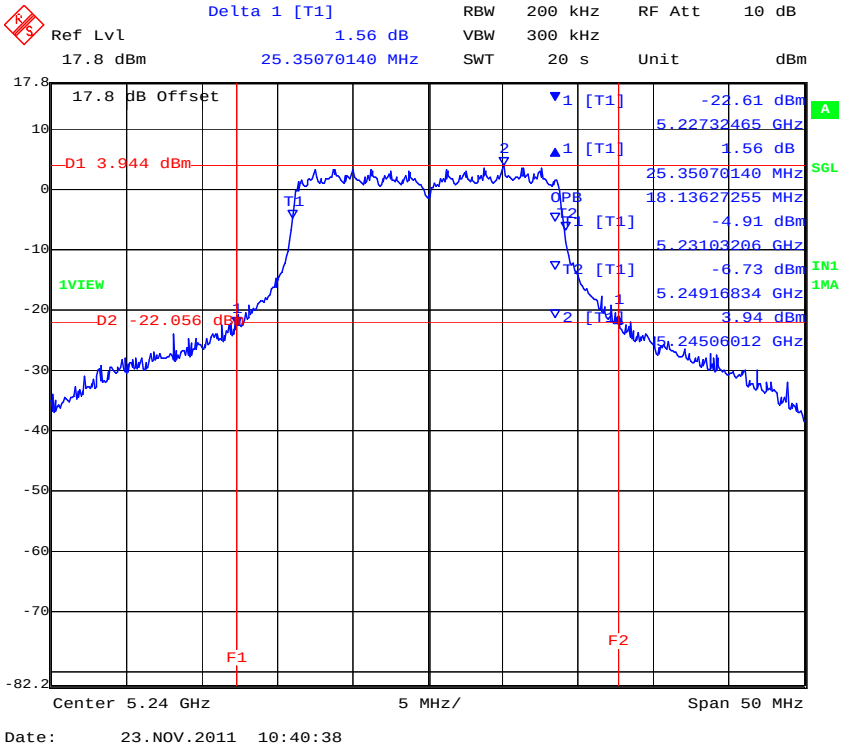
CHAIN B 5,200 MHz 802.11n HT-20 26 dB and 99 % Bandwidth



CHAIN A 5,240 MHz 802.11n HT20 26 dB and 99 % Bandwidth



CHAIN B 5,240 MHz 802.11n HT20 26 dB and 99 % Bandwidth



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

TABLE OF RESULTS – **802.11n HT40**

Test Conditions:	15.247 (a)(2)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 n HT-40	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (x):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc		
Notes 1:			
Notes 2:			

26 dB Bandwidth

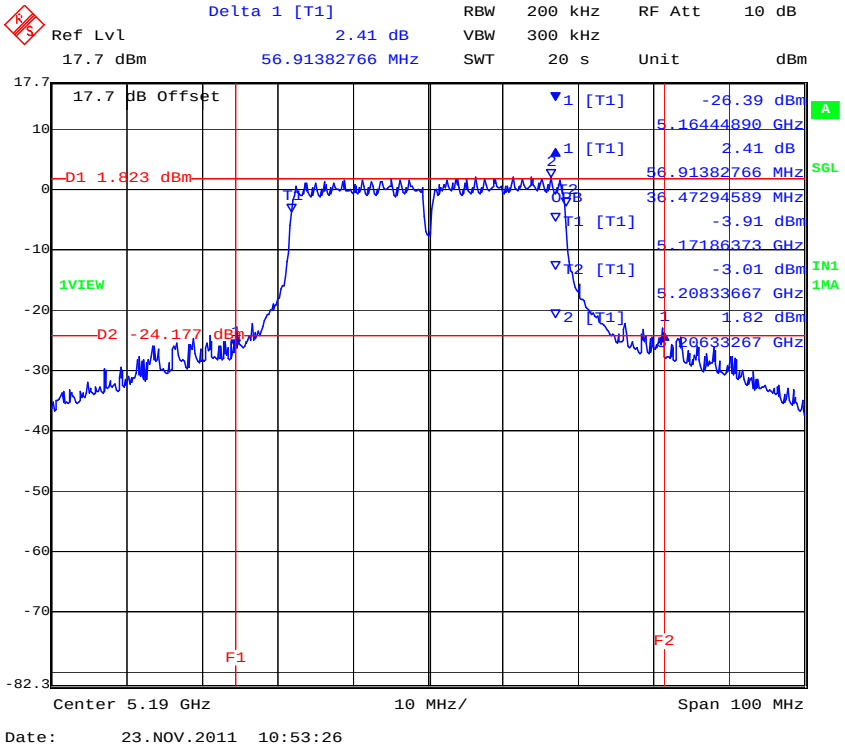
Test Frequency	26 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz						
MHz	**a**	**b**	**c**	**d**	**kHz**	**MHz**	**MHz**
5190	56.914000	60.321000	--	--	500	0.5	-56.414000
5230	49.098000	65.130000	--	--			-48.598000

99% Bandwidth

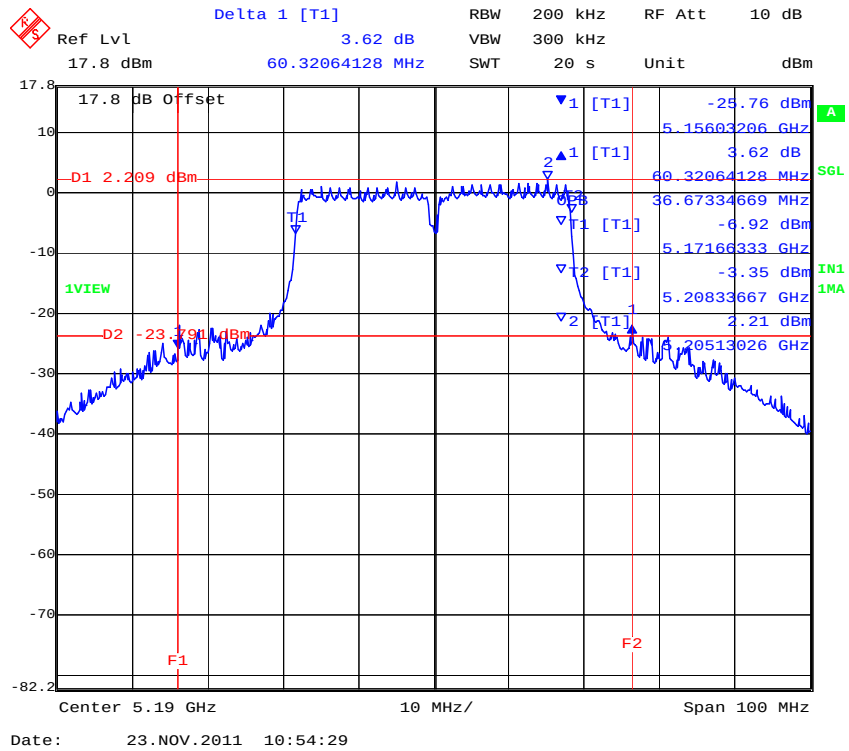
Test Frequency	99 % Bandwidth						
	MHz						
MHz	**a**	**b**	**c**	**d**			
5190	36.473000	36.673000	--	--			
5230	36.473000	36.673000	--	--			

Measurement uncertainty:	±2.81 dB

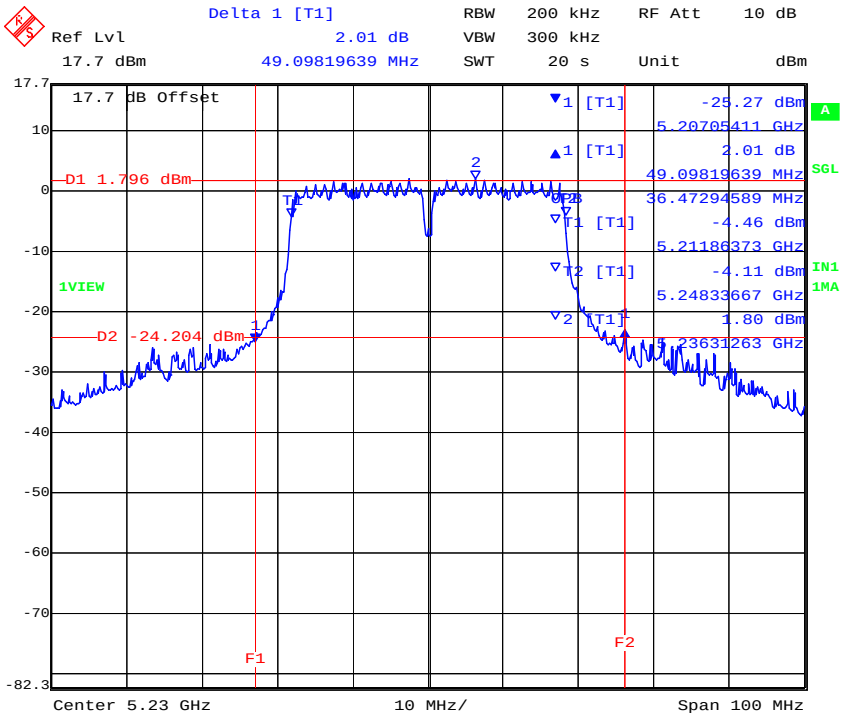
Chain A 5,190 MHz 802.11n HT40 26 dB and 99 % Bandwidth



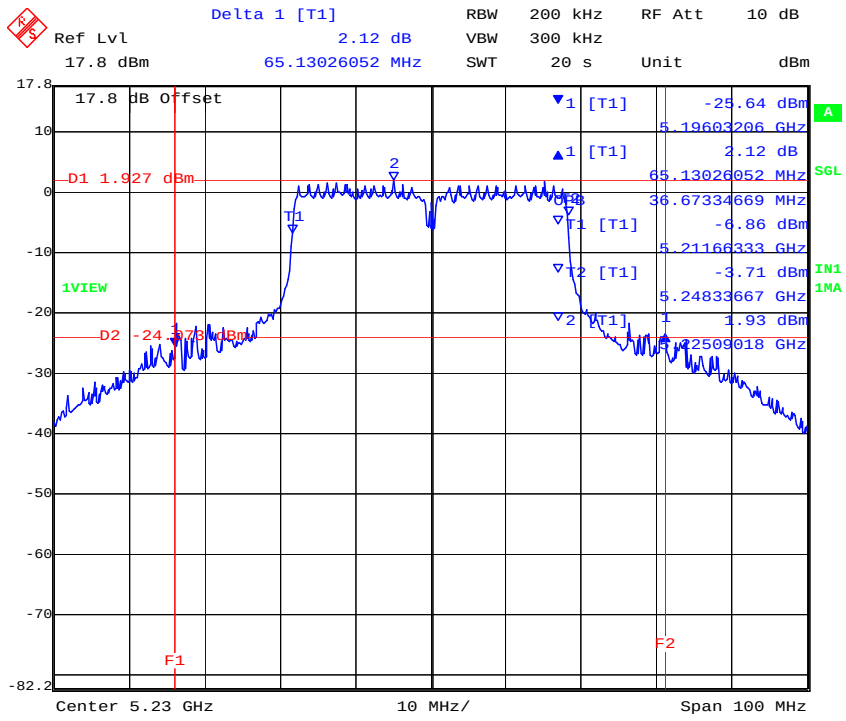
Chain B 5,190 MHz 802.11n HT40 26 dB and 99 % Bandwidth



Chain A 5,230 MHz 802.11n HT40 26 dB and 99 % Bandwidth



Chain B 5,230 MHz 802.11n HT40 26 dB and 99 % Bandwidth



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, 0287, 0252, 0313, 0314, 0070, 0116, 0117

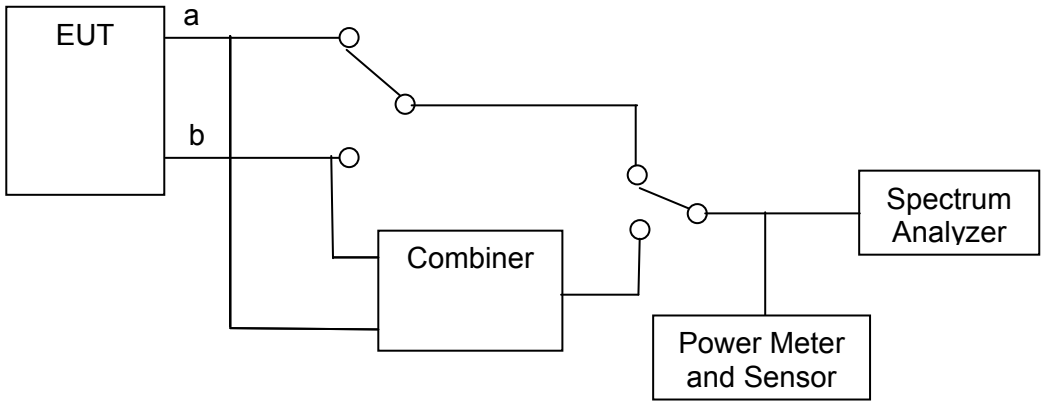
5.1.2. Transmit Output Power

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 an average power meter. Measurements were made while EUT was operating in a continuous transmission mode i.e. 100 % duty cycle at the appropriate center frequency. All cable losses and offsets were taken into consideration in the measured result.

Test Measurement Set up



Measurement set up for Transmitter Output Power

Maximum Transmit Power, FCC Limits

Limit 5150 – 5250 MHz: Lesser of 50 mW (+17dBm) or 4 + 10 Log (B) dBm

Mode	Frequency Range (MHz)	Maximum 26 dB Bandwidth (MHz)	4 + 10 Log (B) (dBm)	Limit (dBm)
a	5150 – 5250	34.569	19.39	+17.00
HT-20		35.571	19.51	+17.00
HT-40		77.555	22.90	+17.00

Maximum Conducted Power Industry Canada Limits

Limit 5150 – 5250 MHz: Lesser of 200 mW (+23 dBm) or 10 + 10 Log (B) dBm

Mode	Frequency Range (MHz)	Maximum 99% Bandwidth (MHz)	10 + 10 Log (B) (dBm)	EIRP Limit (dBm)
a	5150 – 5250	18.437	22.66	+23.00
HT-20		19.439	22.89	+23.00
HT-40		39.880	26.01	+23.00

Measurement Results for Transmit Output Power
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

EUT parameters.
Power Level: Maximum
Duty Cycle: 100%
Temperature: Ambient

TABLE OF RESULTS – **802.11a Legacy**

Test Conditions:	15.407 (a)(1)	**Rel. Humidity (%):**	35	to	42
Variant:	802.11 a	**Ambient Temp. (ºC):**	19	to	22
TPC:	HIGH	**Pressure (mBars):**	998	to	1003
Modulation:	ON	**Duty Cycle (x):**	100		
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi		
Applied Voltage:	55.0 Vdc				
Notes 1:					
Notes 2:					

Test Frequency	**Measured Peak Power RF Port (dBm)**				**Total Power (dBm)**		**Limit**	**Margin**
MHz	**a**	**b**	**c**	**d**	**Combined**	**Calculated**	**dBm**	**dB**
5180	13.47	12.53	--	--	N/A	16.04	17.00	-0.96
5200	13.50	13.56	--	--	N/A	16.54	17.00	-0.46
5240	13.73	12.61	--	--	N/A	16.22	17.00	-0.78

Measurement uncertainty:	±1.33 dB

TABLE OF RESULTS – **802.11n HT20**

Test Conditions:	15.407 (a)(1)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 n HT-20	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (x):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc		
Notes 1:			
Notes 2:			

Test Frequency	**Measured Peak Power RF Port (dBm)**				**Total Power (dBm)**		**Limit**	**Margin**
MHz	**a**	**b**	**c**	**d**	**Combined**	**Calculated**	**dBm**	**dB**
5180	14.15	12.76	--	--	N/A	16.52	17.00	-0.48
5200	13.26	13.30	--	--	N/A	16.29	17.00	-0.71
5240	13.63	12.94	--	--	N/A	16.31	17.00	-0.69

Measurement uncertainty:	±1.33 dB

TABLE OF RESULTS – **802.11n HT40**

Test Conditions:	15.407 (a)(1)		**Rel. Humidity (%):**	35 to 42	
Variant:	802.11 n HT-40		**Ambient Temp. (ºC):**	19 to 22	
TPC:	HIGH		**Pressure (mBars):**	998 to 1003	
Modulation:	ON		**Duty Cycle (x):**	100	
Beam Forming Gain (Y):	N/A	dB	**Antenna Gain:**	5.8 dBi	
Applied Voltage:	55.0	Vdc			
Notes 1:					
Notes 2:					

Test Frequency	Measured Peak Power RF Port (dBm)				Total Power (dBm)		Limit	Margin
MHz	**a**	**b**	**c**	**d**	**Combined**	**Calculated**	**dBm**	**dB**
5190	9.94	9.81	--	--	N/A	12.89	17.00	-4.11
5230	13.75	13.18	--	--	N/A	16.48	17.00	-0.52

Measurement uncertainty:	±1.33 dB

Note: Reduction in power required as a result of radiated band-edge measurements Section 5.1.7.2 Integral Antenna – Band-Edge Spurious Emissions. ART reduced from 18 to ART = 13

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 and 5470-5725 MHz 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-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 log10 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 log10 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 log10 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	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

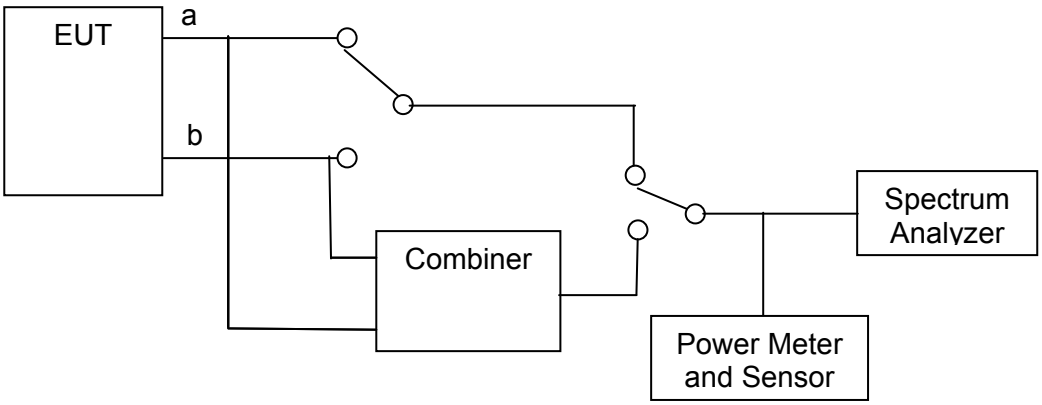
5.1.3. Peak Power Spectral Density

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 (ix) Section 2.1 "Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices") 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

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum Default Power

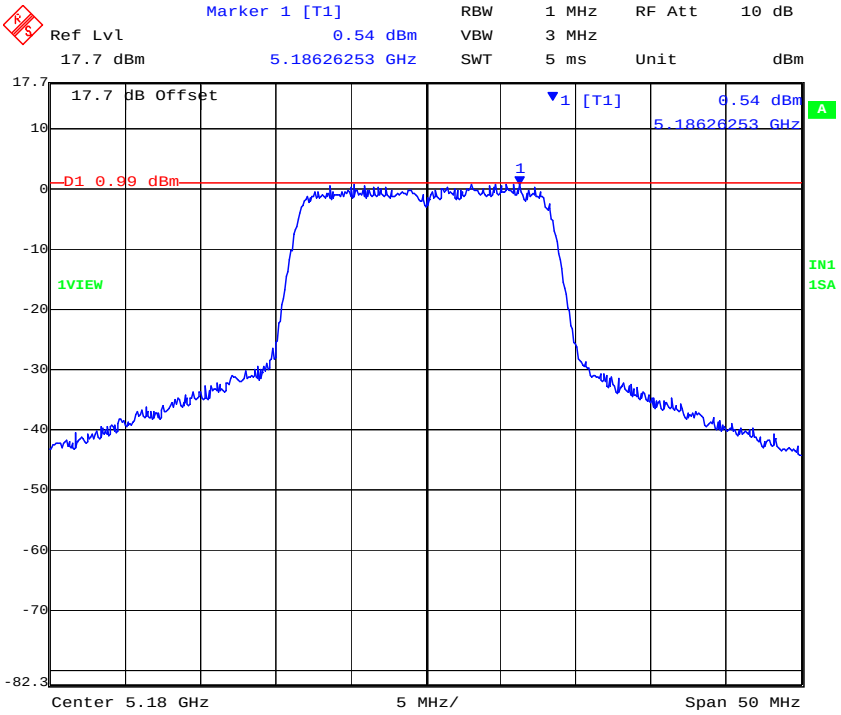
TABLE OF RESULTS – **802.11a Legacy**

Test Conditions:	15.407 (a)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 a	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc	**Antenna Ports (N):**	2
Notes 1:			
Notes 2:			

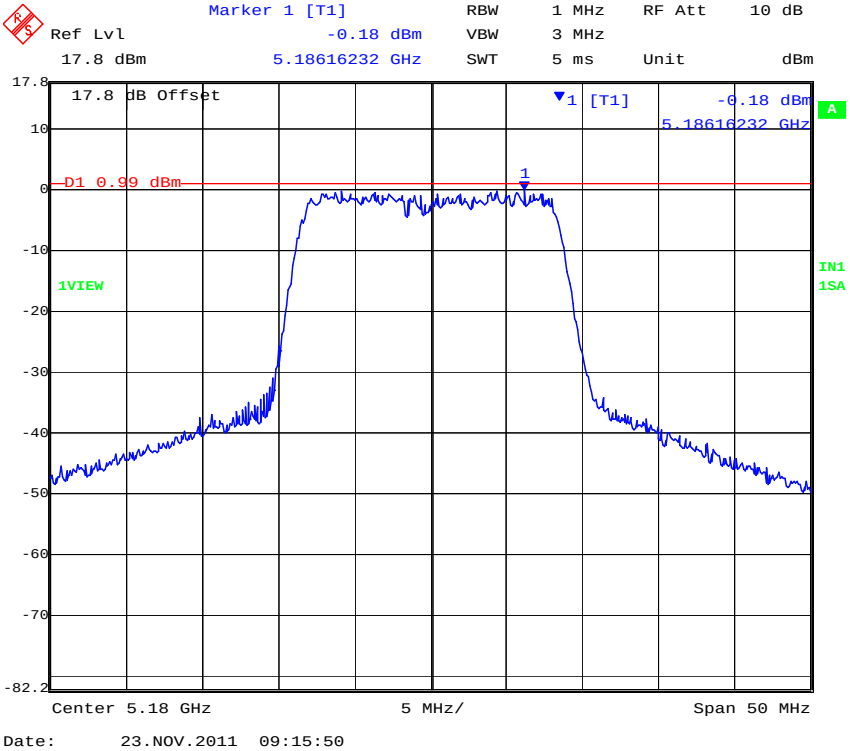
Test Frequency	Measured Peak Power RF Port (dBm)				Correction factor	Peak Power Spectral Density	Limit	Margin
MHz	**a**	**b**	**c**	**d**	**10Log(N)**	**dBm**	**dBm**	**dB**
5180	0.54	-0.18	--	--	3.01	3.55	4.00	-0.45
5200	0.71	0.97	--	--	3.01	3.98	4.00	-0.02
5240	0.58	0.02	--	--	3.01	3.59	4.00	-0.41

Measurement uncertainty:	±1.33 dB

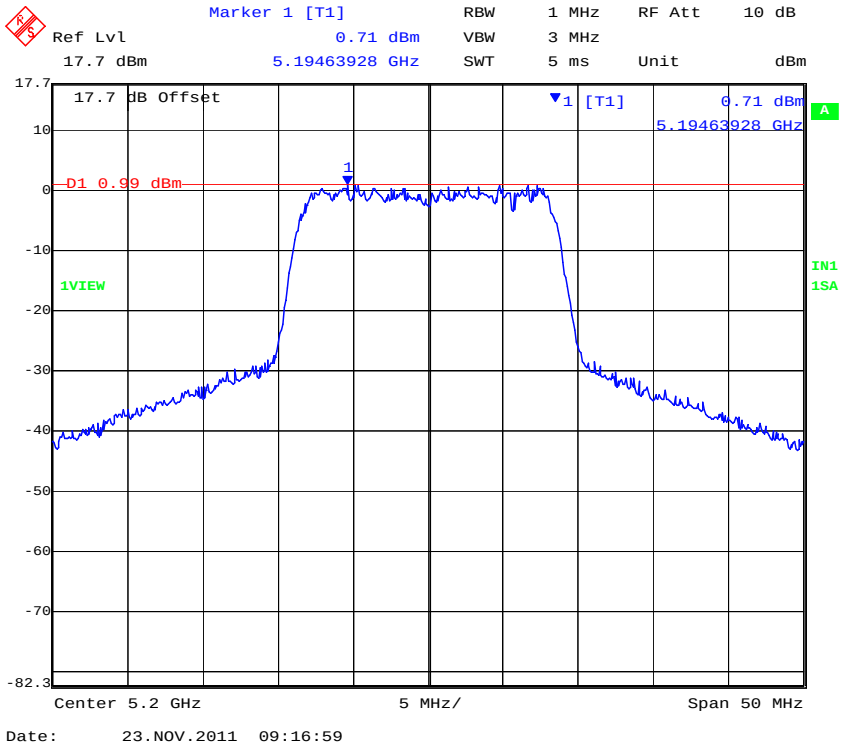
CHAIN A 5,180 MHz 802.11a Legacy Peak Power Spectral Density



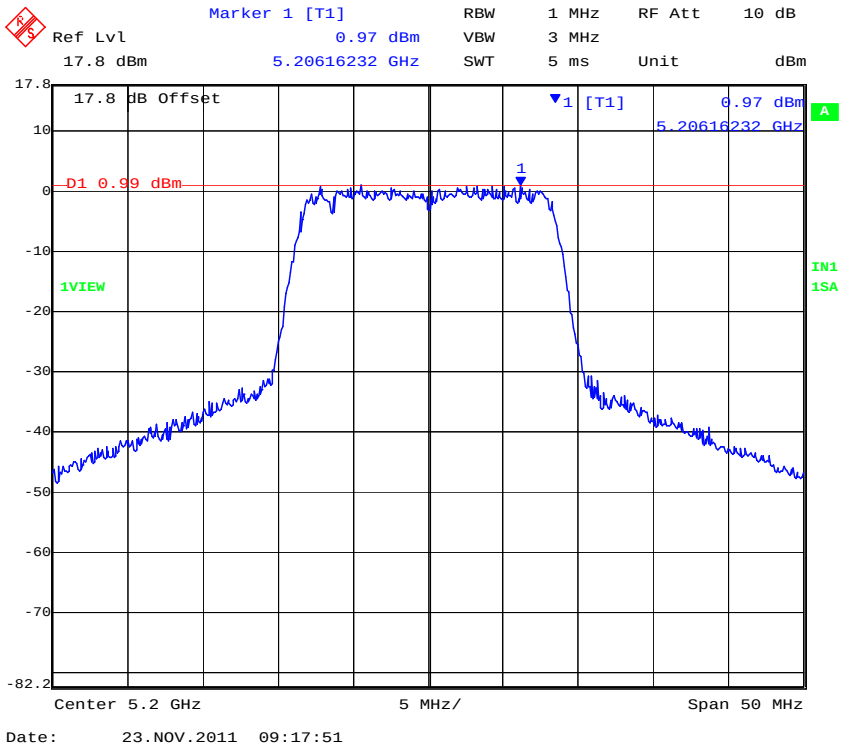
CHAIN B 5,180 MHz 802.11a Legacy Peak Power Spectral Density



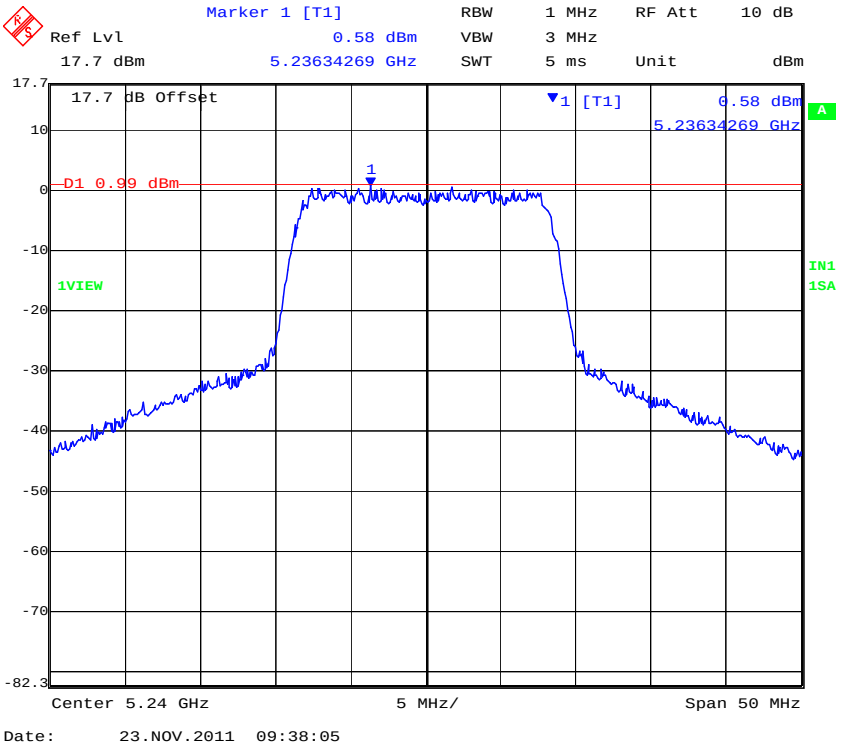
CHAIN A 5,200 MHz 802.11a Legacy Peak Power Spectral Density



CHAIN B 5,200 MHz 802.11a Legacy Peak Power Spectral Density



Chain A 5,240 MHz 802.11a Legacy Peak Power Spectral Density



Chain B 5,240 MHz 802.11a Legacy Peak Power Spectral Density

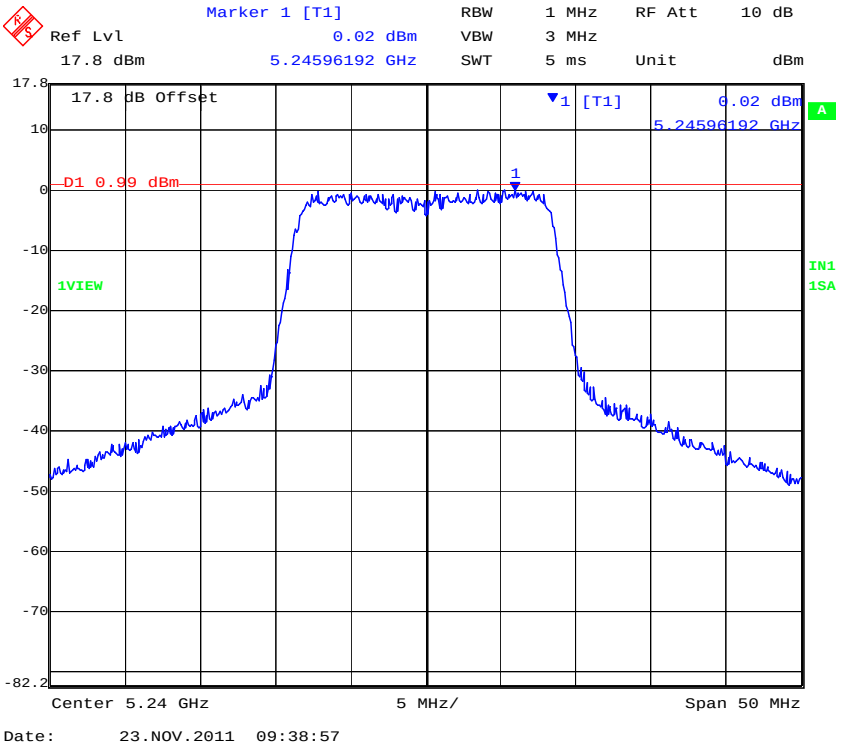


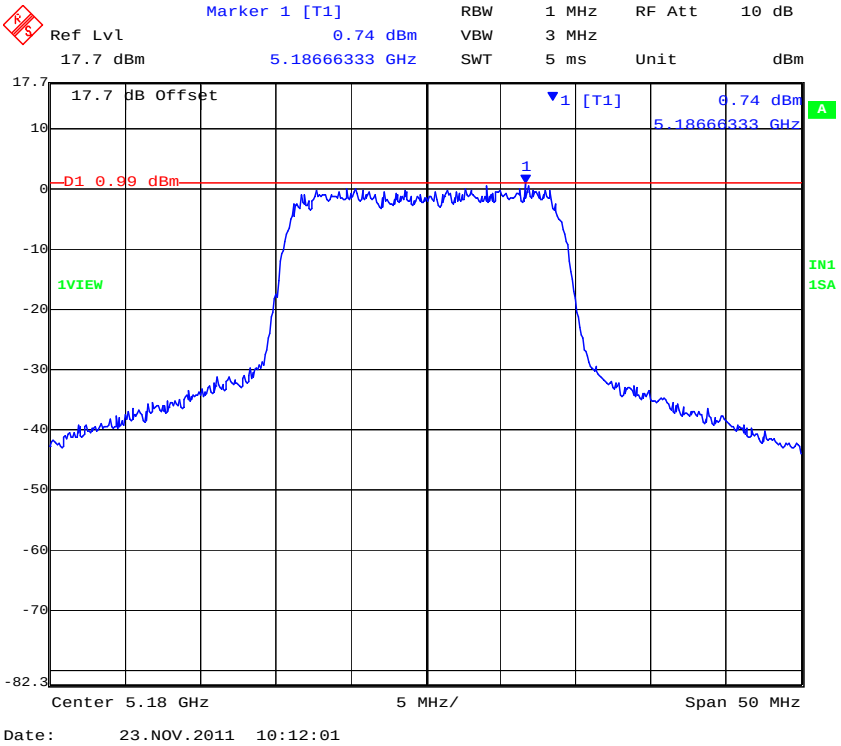
TABLE OF RESULTS – **802.11n HT20**

Test Conditions:	15.407 (a)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 n HT-20	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc	**Antenna Ports (N):**	2
Notes 1:			
Notes 2:			

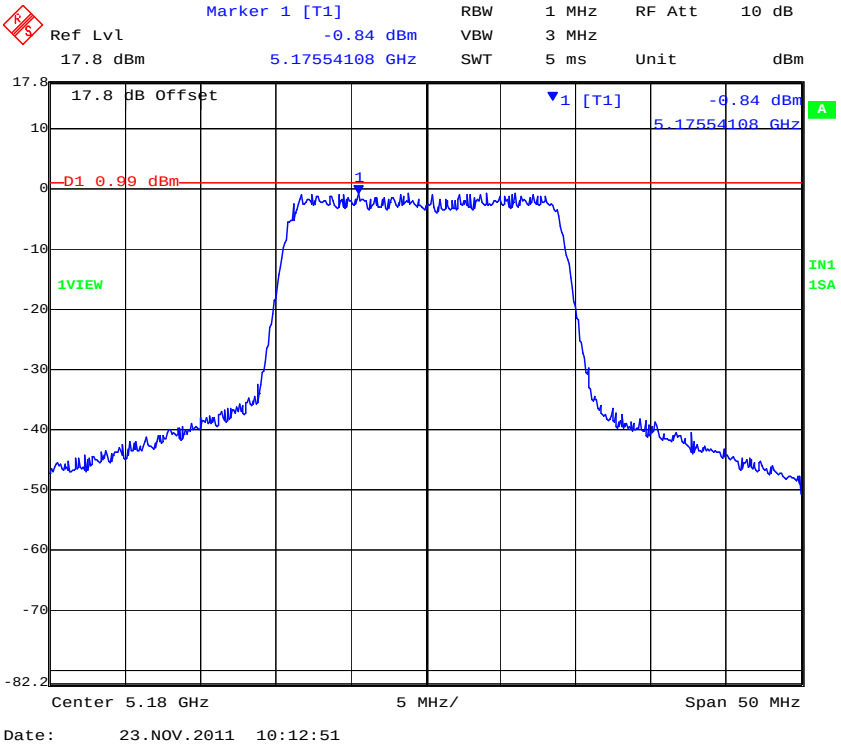
Test Frequency	Measured Peak Power RF Port (dBm)				Correction factor	Peak Power Spectral Density	Limit	Margin
MHz	**a**	**b**	**c**	**d**	**10Log(N)**	**dBm**	**dBm**	**dB**
5180	0.74	-0.84	--	--	3.01	3.75	4.00	-0.25
5200	0.28	0.54	--	--	3.01	3.55	4.00	-0.45
5240	0.66	-0.33	--	--	3.01	3.67	4.00	-0.33

Measurement uncertainty:	±1.33 dB

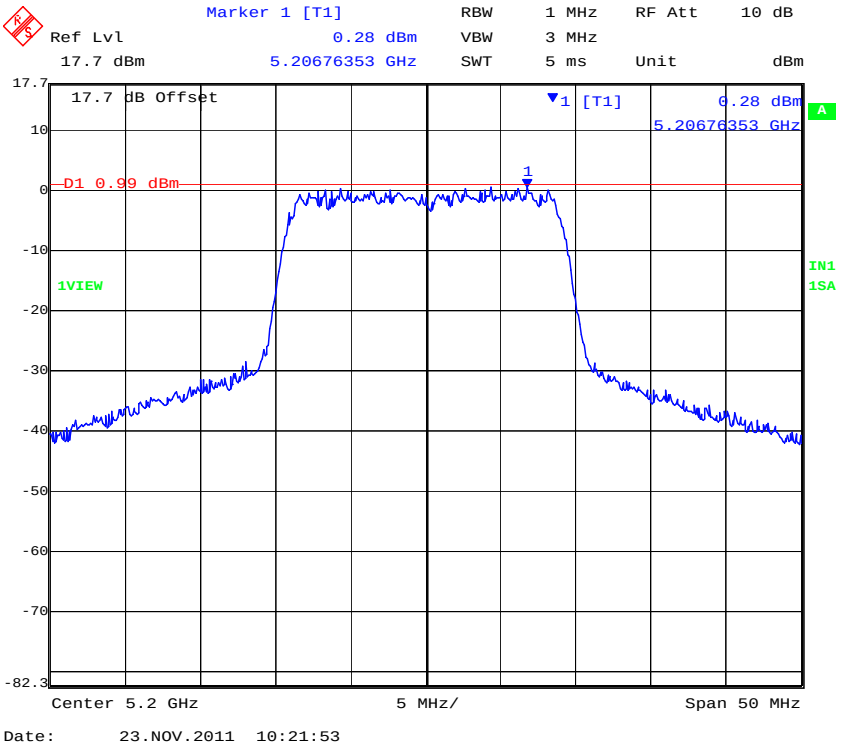
Chain A 5,180 MHz 802.11n HT20 Peak Power Spectral Density



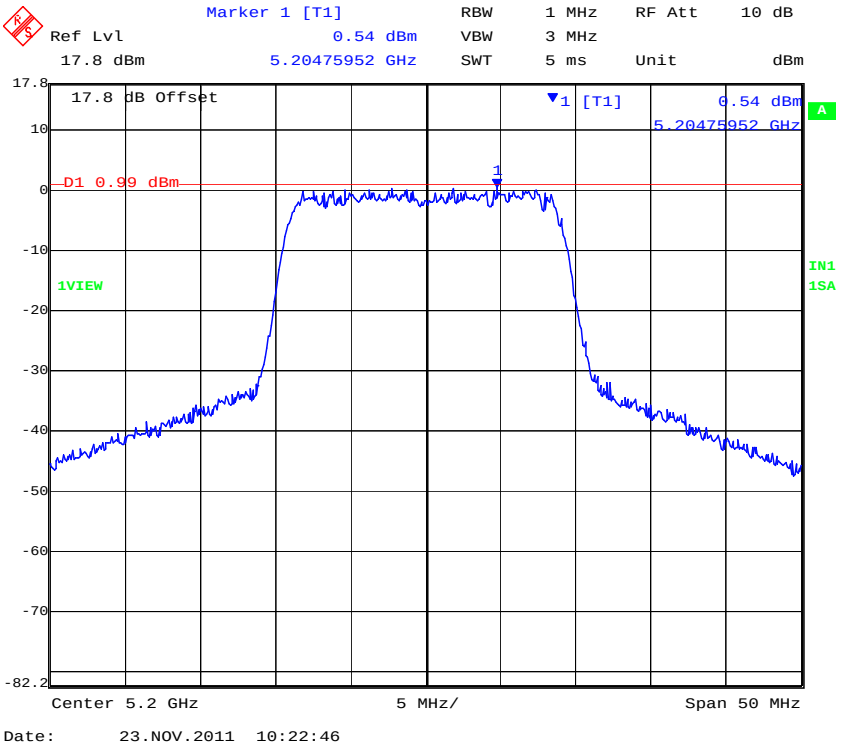
Chain B 5,180 MHz 802.11n HT20 Peak Power Spectral Density



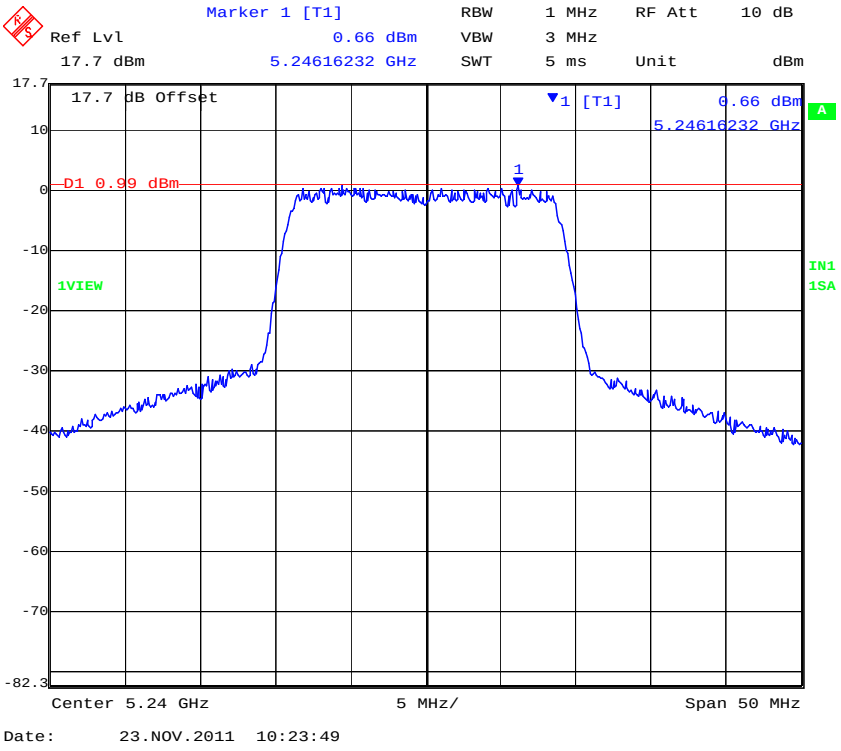
Chain A 5,200 MHz 802.11n HT20 Peak Power Spectral Density



Chain B 5,200 MHz 802.11n HT20 Peak Power Spectral Density



Chain A 5,240 MHz 802.11n HT20 Peak Power Spectral Density



Chain B 5,240 MHz 802.11n HT20 Peak Power Spectral Density

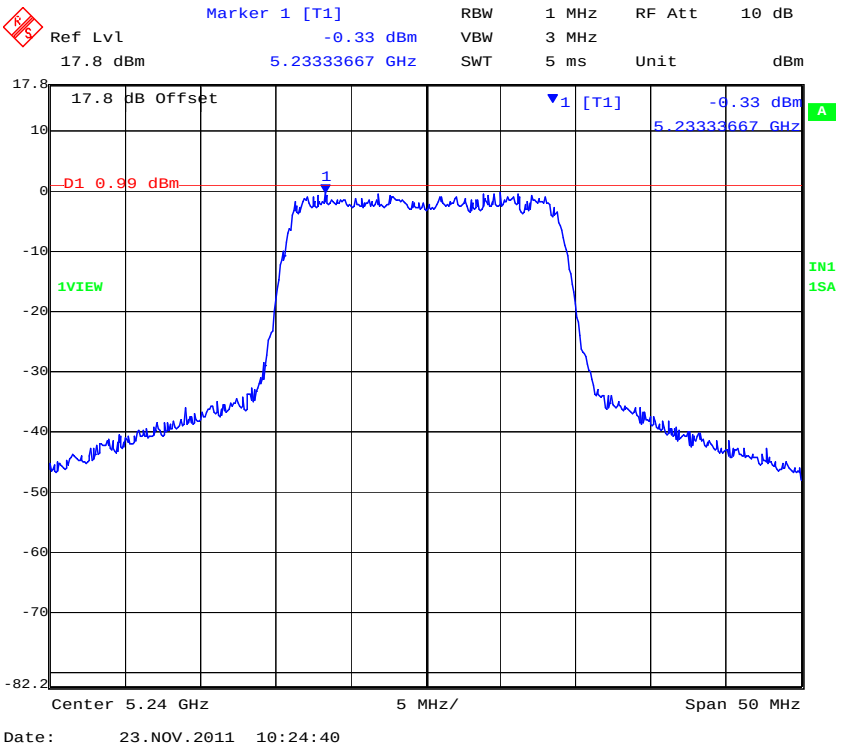


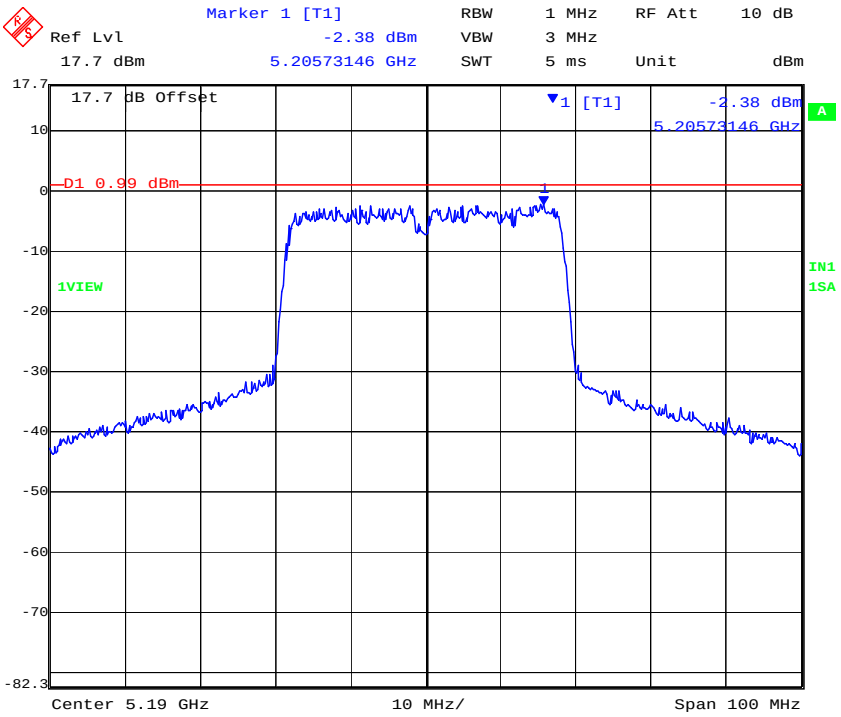
TABLE OF RESULTS – **802.11n HT40**

Test Conditions:	15.407 (a)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 n HT-40	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc	**Antenna Ports (N):**	2
Notes 1:			
Notes 2:			

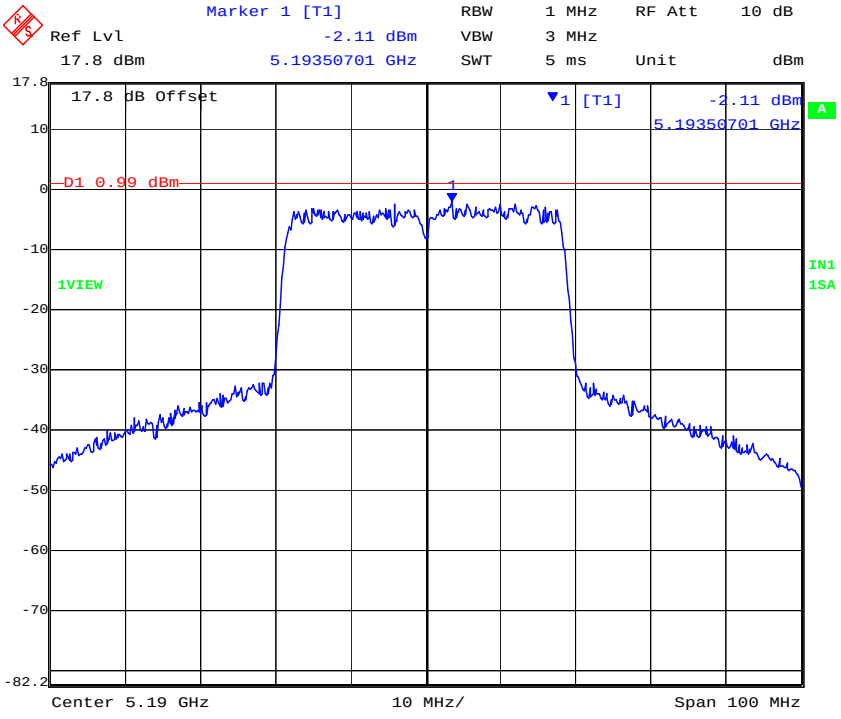
Test Frequency	**Measured Peak Power**				**Correction factor**	**Peak Power Spectral Density**	**Limit**	**Margin**
	RF Port (dBm)							
MHz	**a**	**b**	**c**	**d**	**10Log(N)**	**dBm**	**dBm**	**dB**
5190	-2.38	-2.11	--	--	3.01	0.90	4.00	-3.10
0	--	--	--	--	3.01	3.01	4.00	-0.99
5230	-2.32	-2.41	--	--	3.01	0.69	4.00	-3.31

Measurement uncertainty:	±1.33 dB

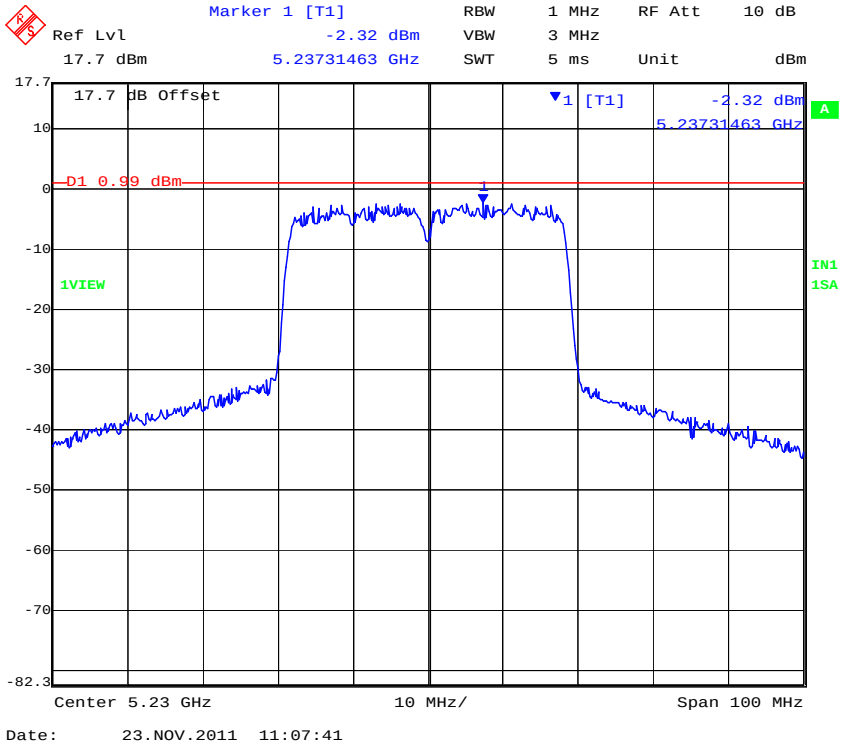
Chain A 5,190 MHz 802.11n HT40 Peak Power Spectral Density



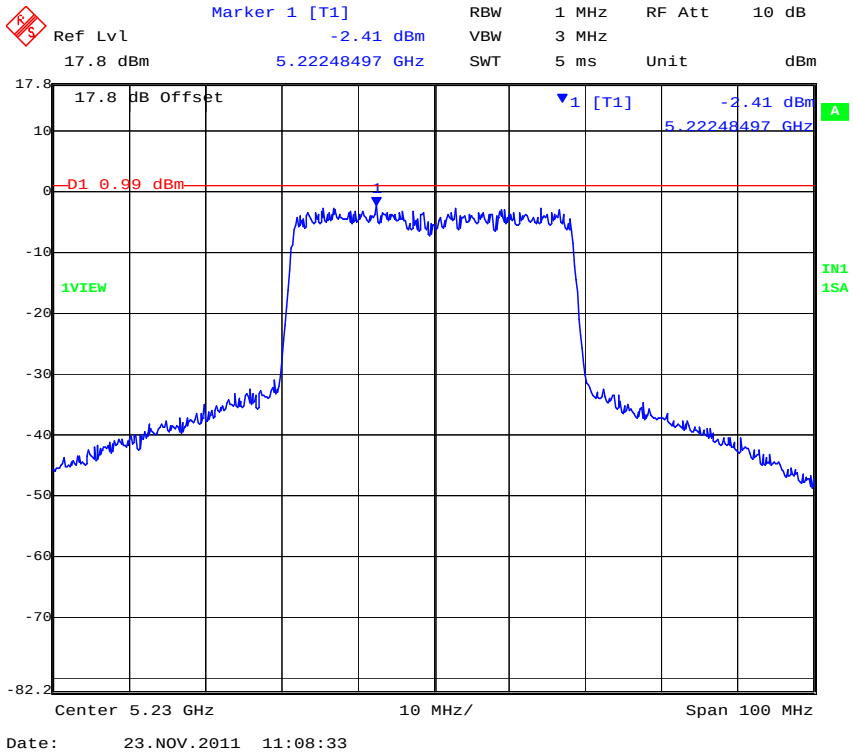
Chain B 5,190 MHz 802.11n HT40 Peak Power Spectral Density



Chain A 5,230 MHz 802.11n HT40 Peak Power Spectral Density



Chain B 5,230 MHz 802.11n HT40 Peak Power Spectral Density



Specification

FCC, Part 15 §15.407 (a)(1), (a)(2)
5150 – 5250 MHz
(a)(1) The peak power spectral density shall not exceed +4 dBm in any 1 megahertz band.

5250 – 5350 MHz & 5470 – 5725 MHz
(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)**
5150 – 5250 MHz
§ **A9.2(1)** The eirp spectral density shall not exceed +10 dBm in any 1 MHz band

5250 – 5350 MHz & 5470 – 5725 MHz
§ **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, 0287, 0252, 0313, 0314, 0070, 0116, 0117

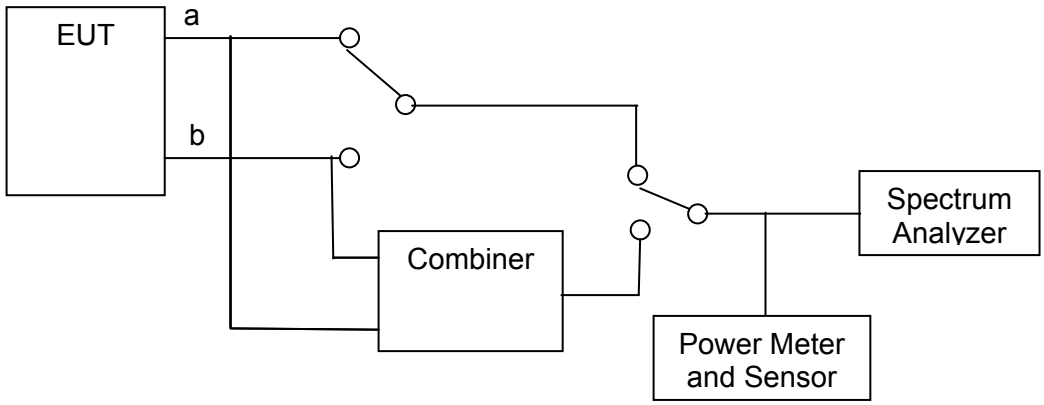
5.1.4. Peak Excursion Ratio

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

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum Default Power

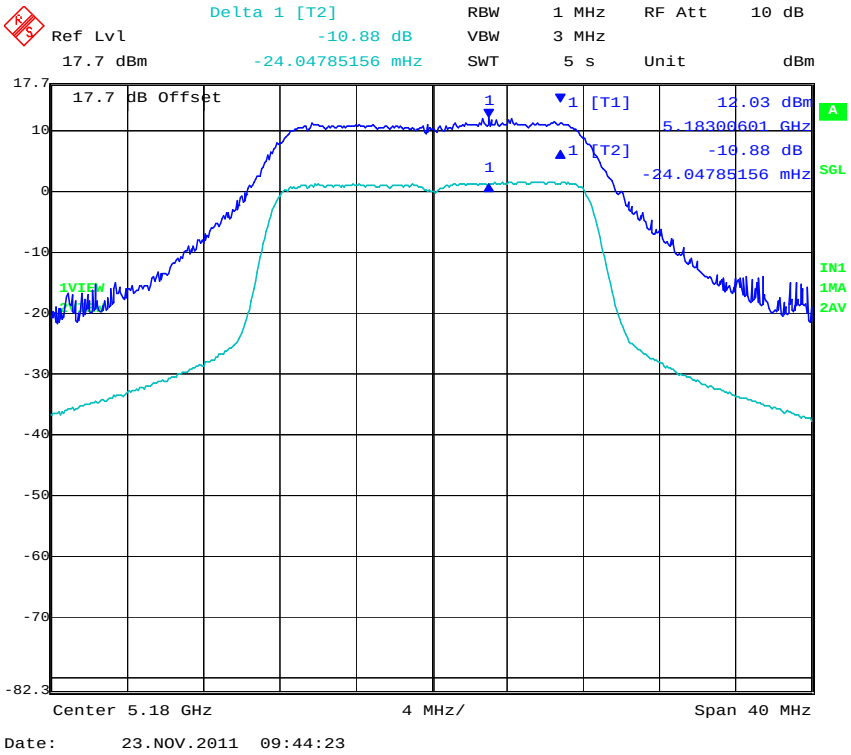
TABLE OF RESULTS – **802.11a Legacy**

Test Conditions:	15.407 (a)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 a	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc		
Notes 1:			
Notes 2:			

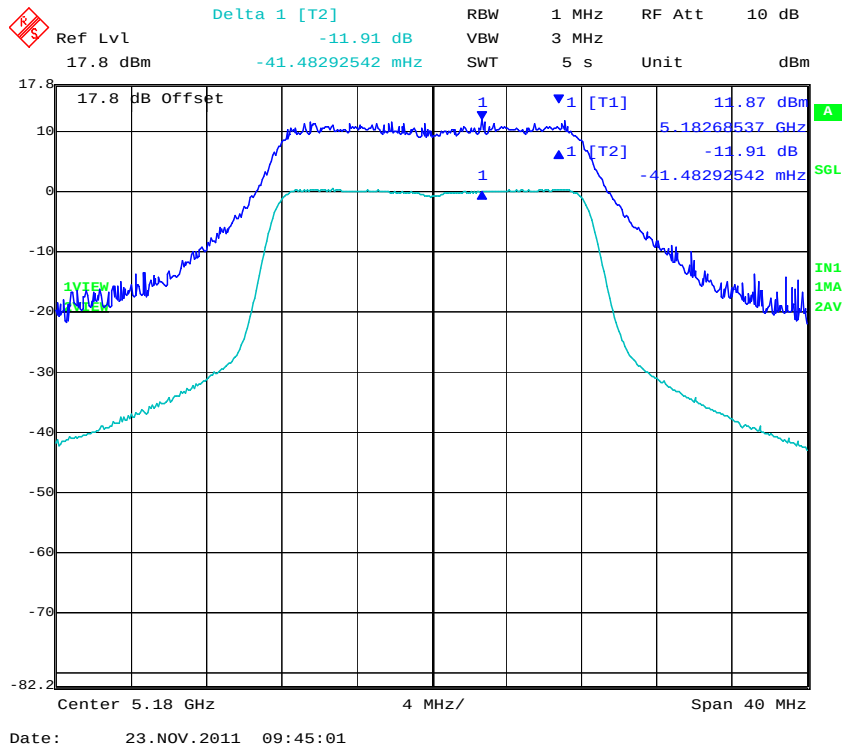
Test Frequency	Trace Δ Marker				Limit	Margin
	Port A	Port B	Port C	Port D		
MHz	dB	dB	dB	dB	dB	dB
5180	-10.88	-11.91	--	--	-13.00	-1.09
5200	-10.86	-12.13	--	--		-0.87
5240	-10.72	-11.88	--	--		-1.12

Measurement uncertainty:	±1.33 dB

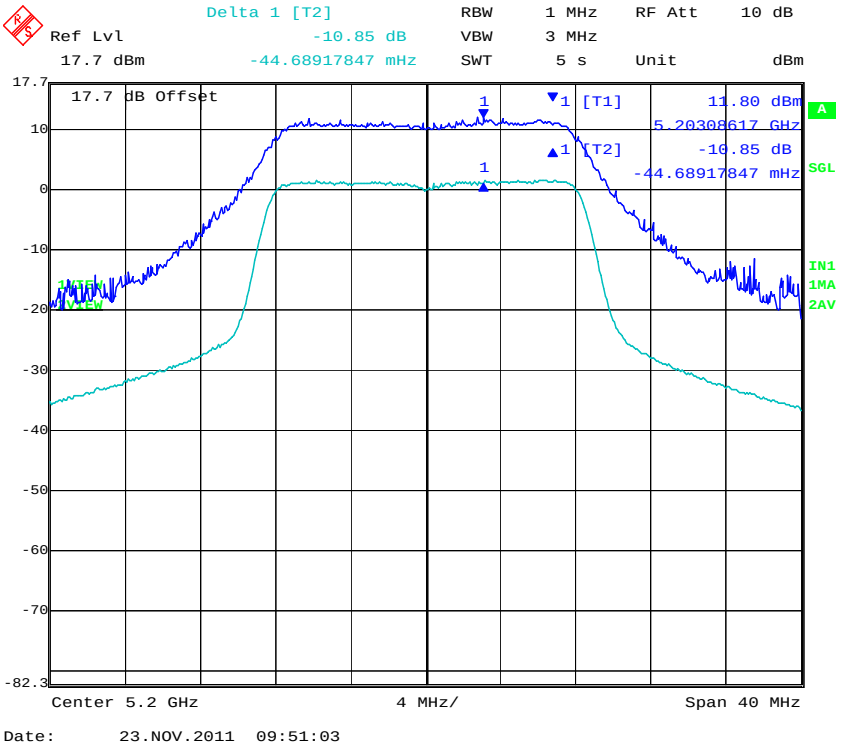
CHAIN A 5,180 MHz 802.11a Legacy - Peak Excursion Ratio



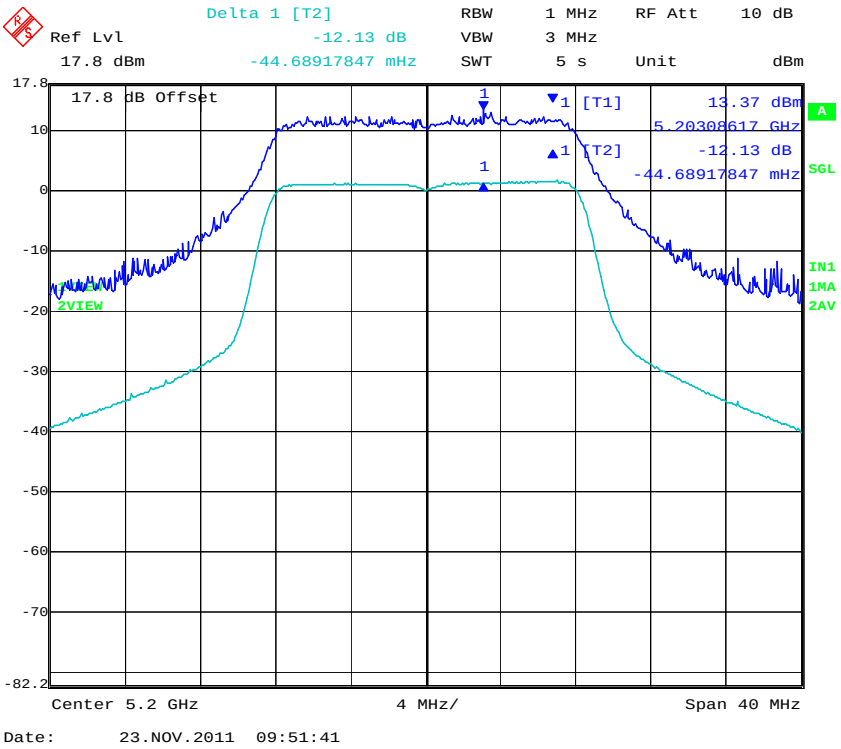
CHAIN B 5,180 MHz 802.11a Legacy - Peak Excursion Ratio



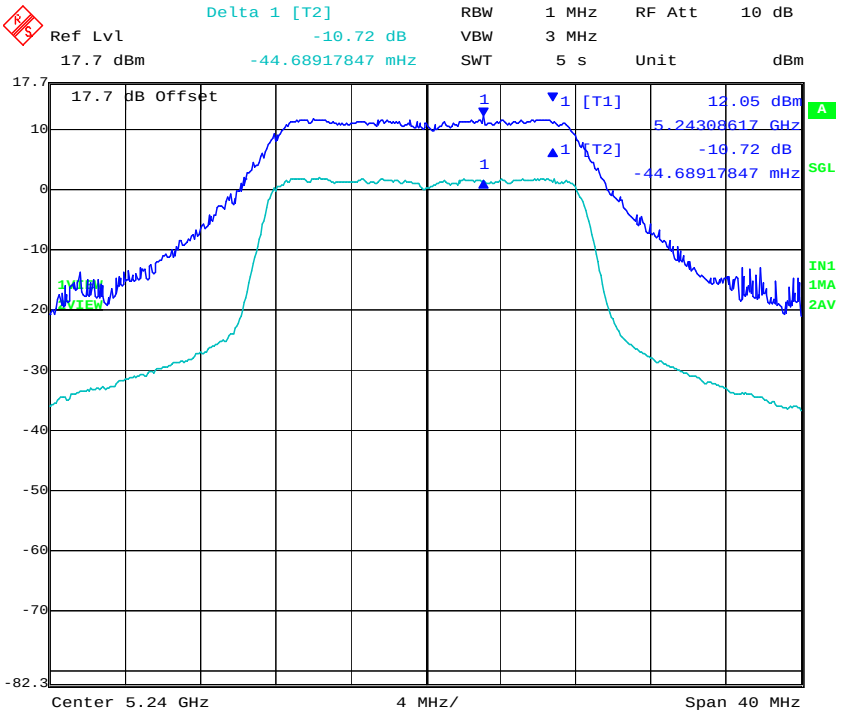
CHAIN A 5,200 MHz 802.11a Legacy - Peak Excursion Ratio



CHAIN B 5,200 MHz 802.11a Legacy - Peak Excursion Ratio

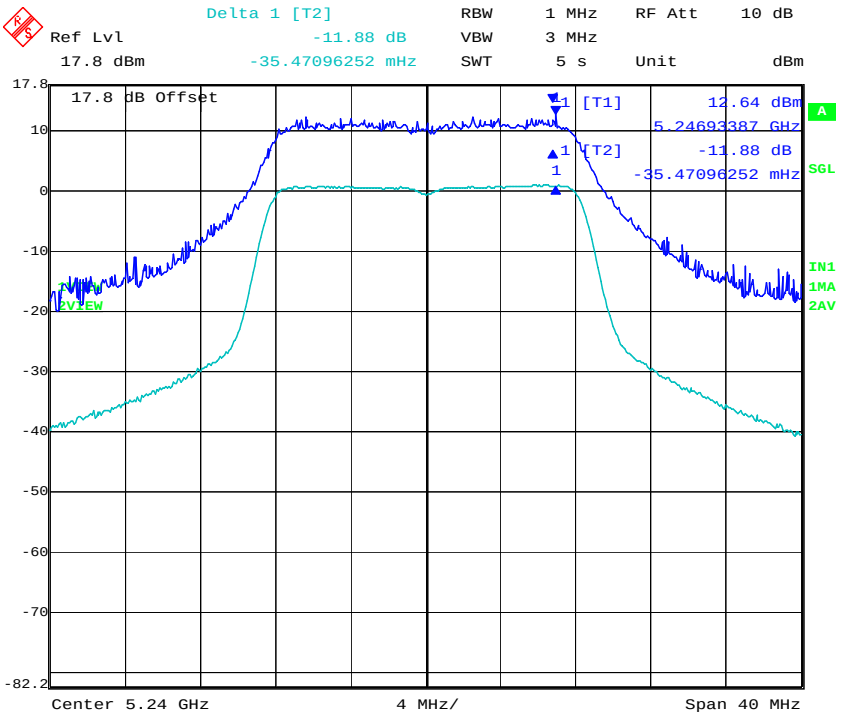


CHAIN A 5,240 MHz 802.11a Legacy - Peak Excursion Ratio



Date: 23.NOV.2011 09:58:56

CHAIN B 5,240 MHz 802.11a Legacy - Peak Excursion Ratio



Date: 23.NOV.2011 09:59:34

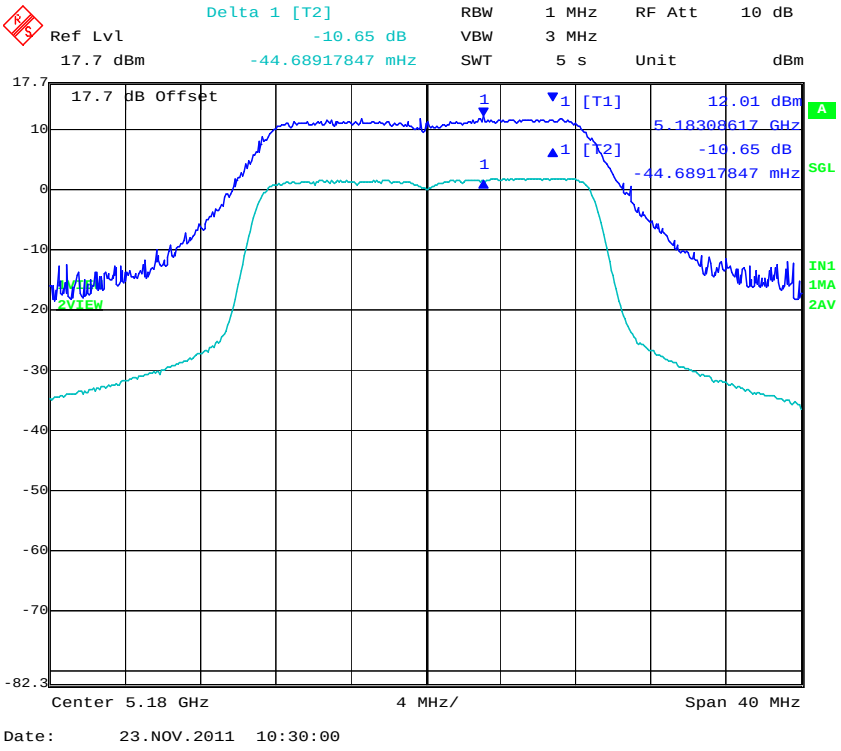
TABLE OF RESULTS – **802.11n HT20**

Test Conditions:	15.407 (a)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 n HT-20	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc		
Notes 1:			
Notes 2:			

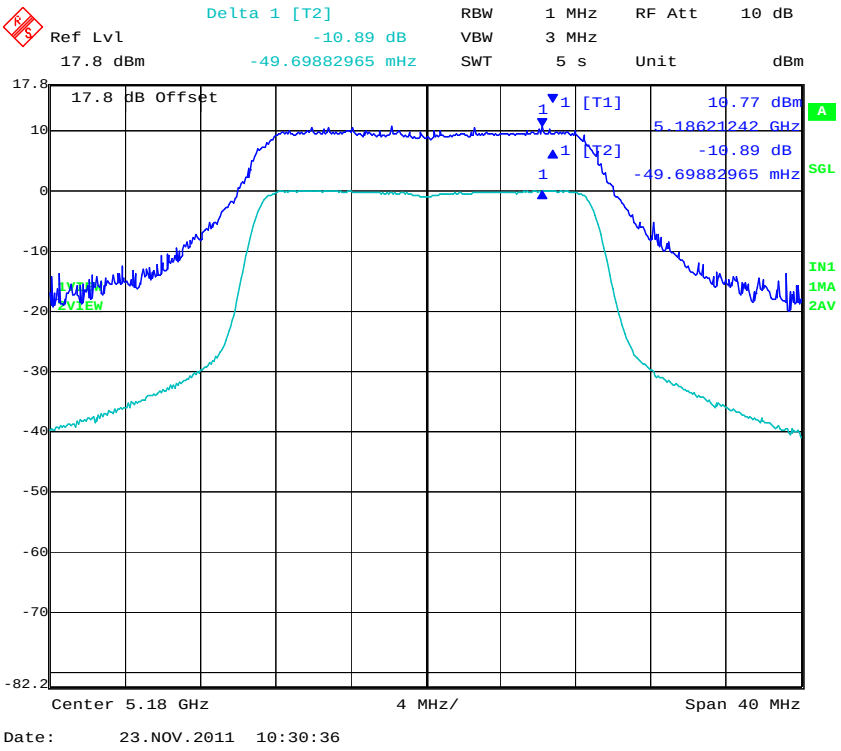
Test Frequency	Trace Δ Marker				Limit	Margin
	Port A	Port B	Port C	Port D		
MHz	dB	dB	dB	dB	dB	dB
5180	-10.65	-10.89	--	--	-13.00	-2.11
5200	-10.22	-11.17	--	--		-1.83
5240	-10.81	-11.04	--	--		-1.96

Measurement uncertainty:	±1.33 dB

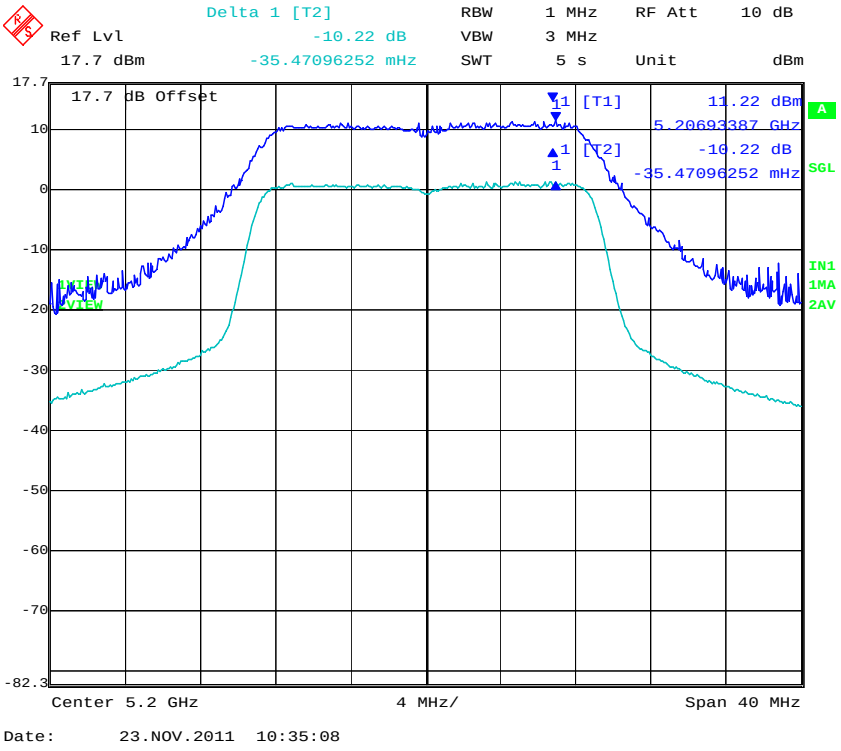
CHAIN A 5,180 MHz 802.11n HT20 - Peak Excursion Ratio



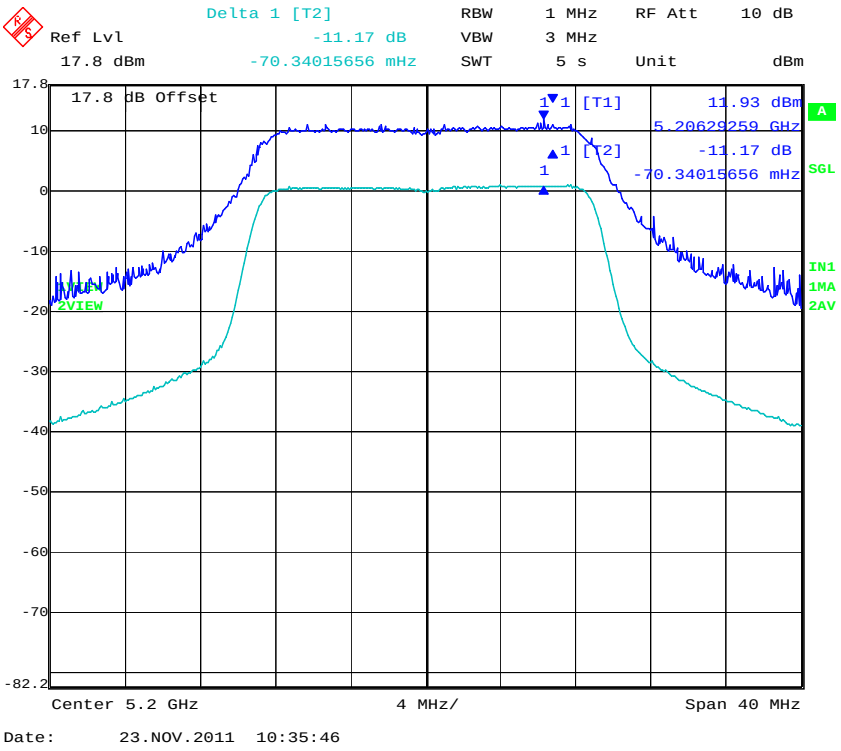
CHAIN B 5,180 MHz 802.11n HT20 - Peak Excursion Ratio



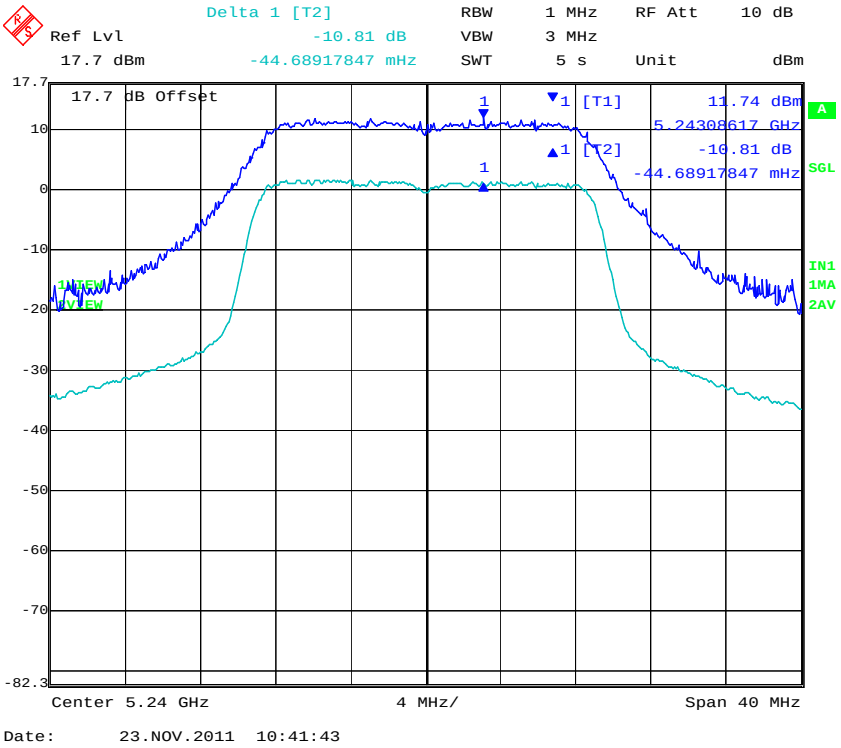
CHAIN A 5,200 MHz 802.11n HT20 - Peak Excursion Ratio



CHAIN B 5,200 MHz 802.11n HT20 - Peak Excursion Ratio



CHAIN A 5,240 MHz 802.11n HT20 - Peak Excursion Ratio



CHAIN B 5,240 MHz 802.11n HT20 - Peak Excursion Ratio

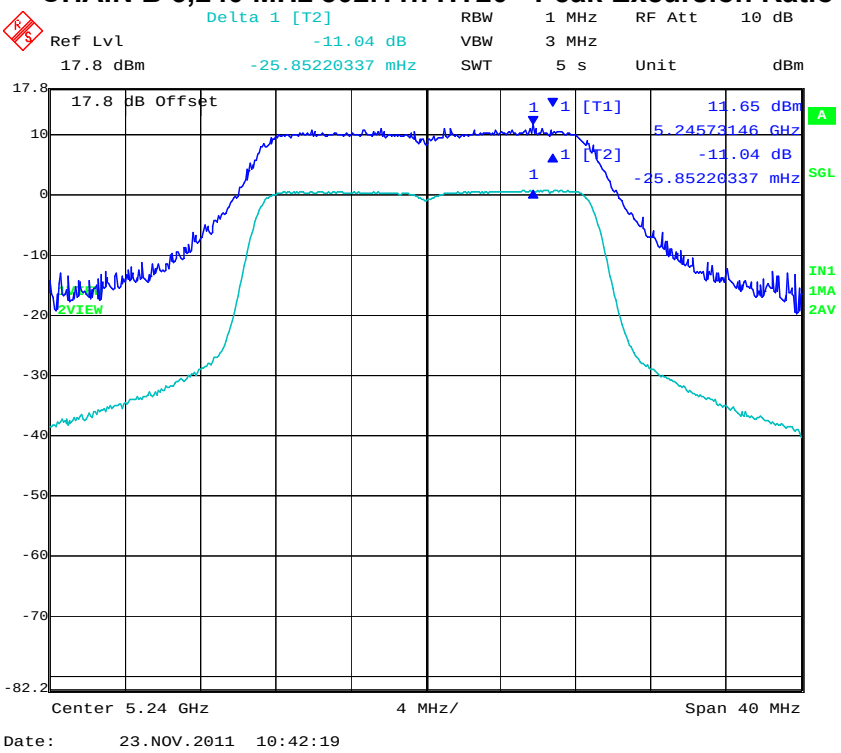


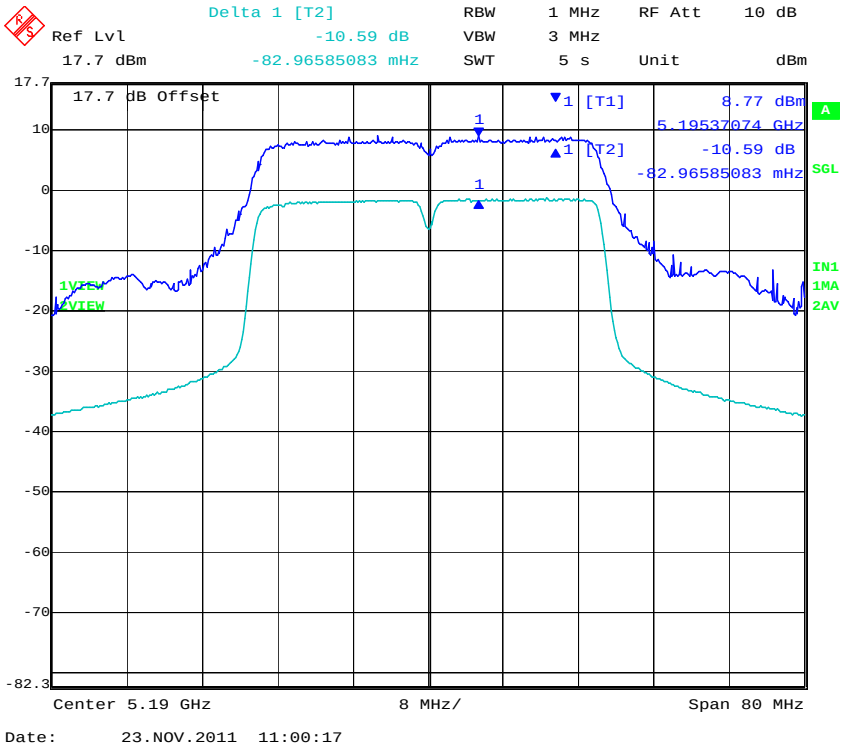
TABLE OF RESULTS – **802.11n HT40**

Test Conditions:	15.407 (a)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11 n HT-40	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	5.8 dBi
Applied Voltage:	55.0 Vdc		
Notes 1:			
Notes 2:			

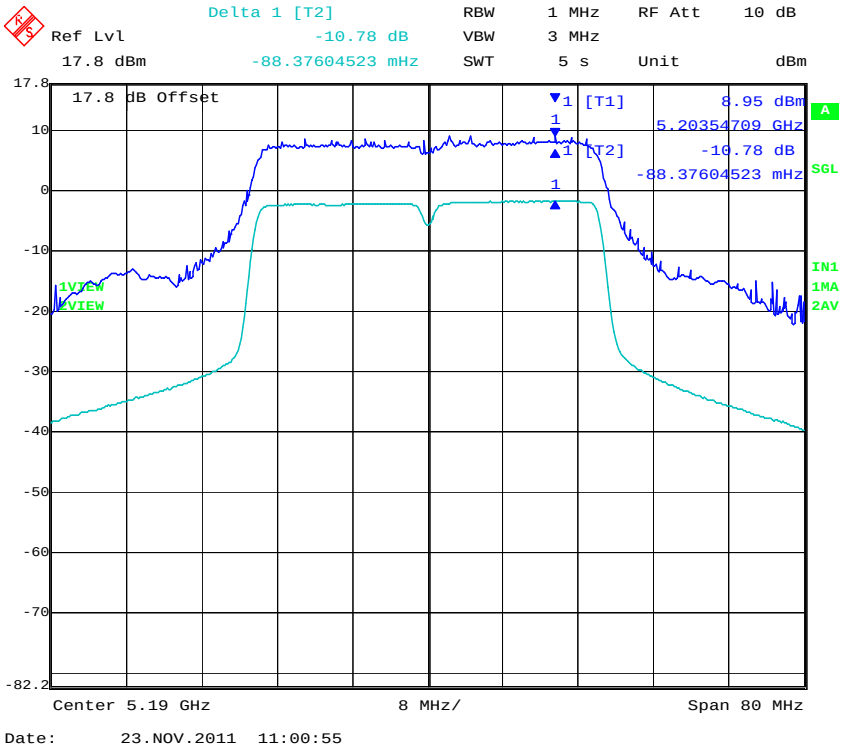
Test Frequency	Trace Δ Marker				Limit	Margin
	Port A	Port B	Port C	Port D		
MHz	dB	dB	dB	dB	dB	dB
5190	-10.59	-10.78	--	--	-13.00	-2.22
0	--	--	--	--		-13.00
5230	-10.83	-10.87	--	--		-2.13

Measurement uncertainty:	±1.33 dB

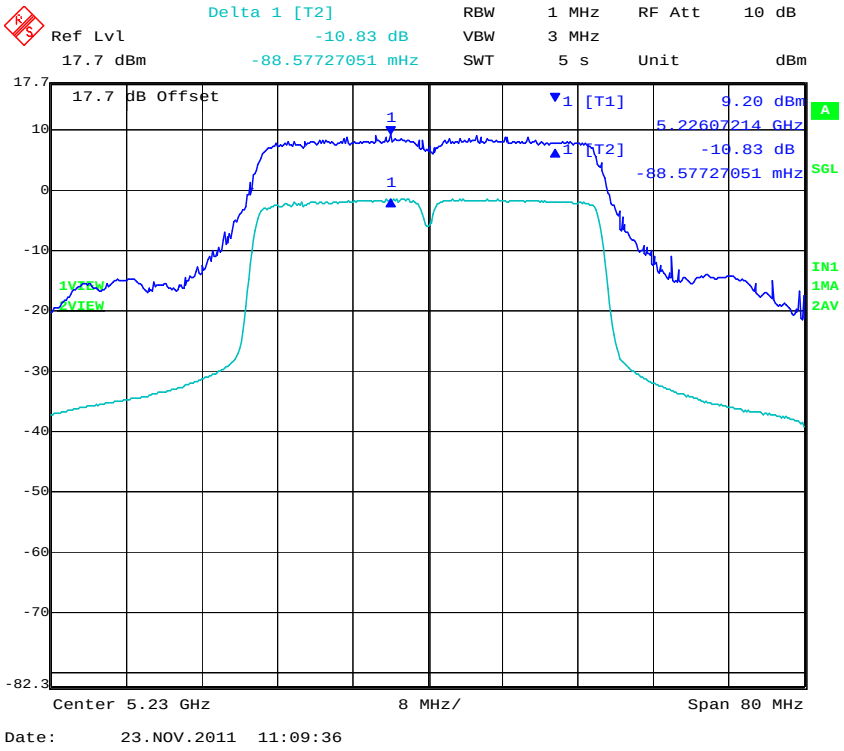
CHAIN A 5,190 MHz 802.11n HT40 - Peak Excursion Ratio



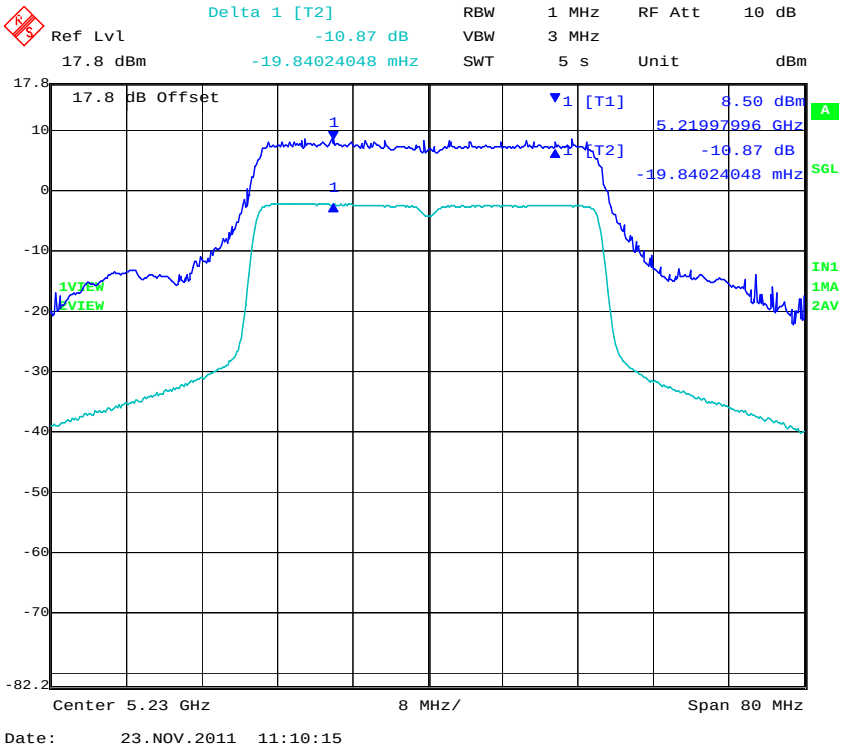
CHAIN B 5,190 MHz 802.11n HT40 - Peak Excursion Ratio



CHAIN A 5,230 MHz 802.11n HT40 - Peak Excursion Ratio



CHAIN B 5,230 MHz 802.11n HT40 - Peak Excursion Ratio



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	± 2.81dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

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 ±20ppm stability.
This stability accounts for room temp tolerance of the crystal oscillator circuit, frequency variation across temperature, and crystal ageing.

±20ppm at 5.250 GHz translates to a maximum frequency shift of ±105 KHz. As the edge of the channels is at least one MHz from either of the band edges, ±105 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.

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^2) = EIRP/(4πd^2)

EIRP = P * G * 2

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

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

The Aruba AP93 has two transmitters. The peak power in the table below is calculated by assuming a worst case scenario where the two transmitters are operating simultaneously in the same band. The Peak Power in mW is calculated by taking the maximum conducted power measured in each band and multiplying by 2.

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

Freq. Band (MHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power x 2 (mW)	Calculated Safe Distance @ 1mW/cm^2 Limit(cm)	Minimum Separation Distance (cm)
5150 - 5250	5.8	25.1	+16.89	97.7	14.00	20.00

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^2 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

5.1.7. Radiated Emissions

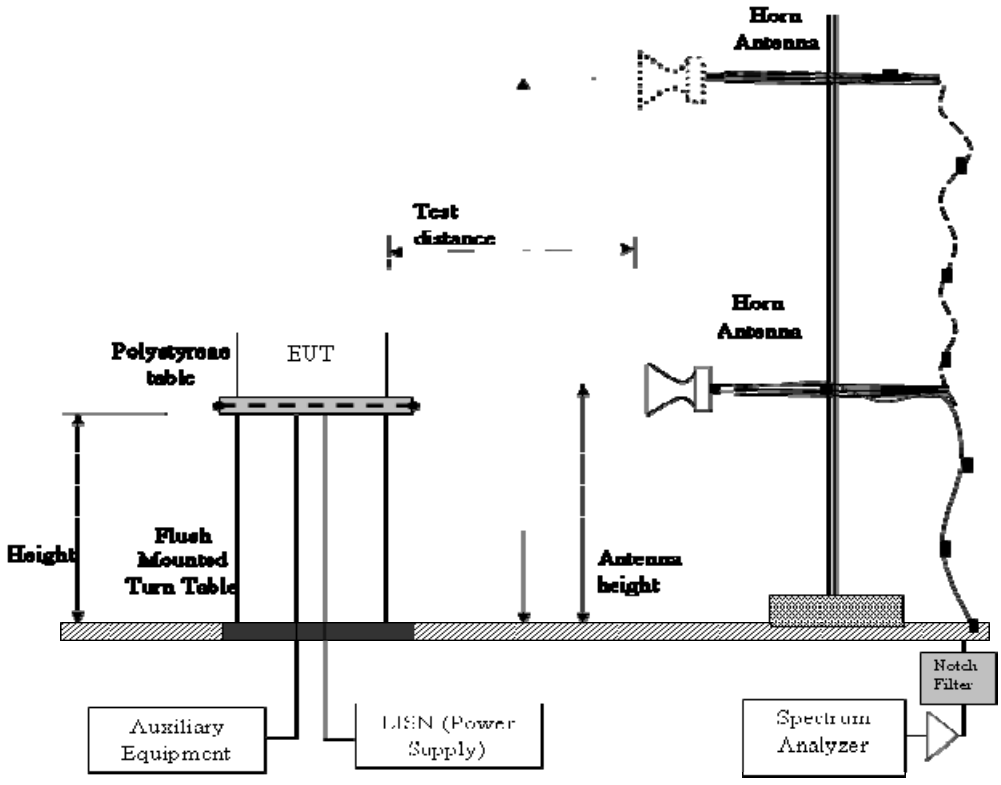
FCC, Part 15 Subpart C §15.407(b)(2), §15.205(a)/15.209(a)
Industry Canada RSS-210 §A9.3(2); §2.2; §2.6; RSS-Gen §4.7

Test Procedure

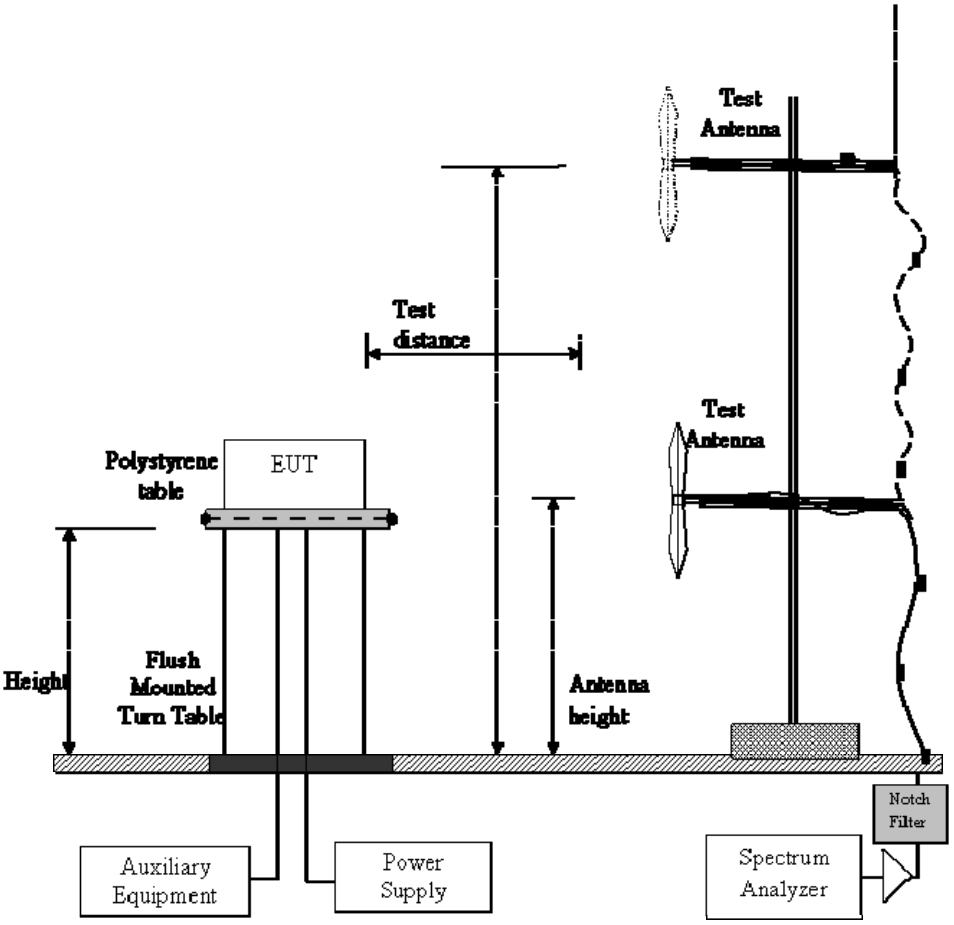
Testing was performed in a 3-meter anechoic chamber. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. Preliminary emissions were recorded with in Spectrum Analyzer mode, using a maximum peak detector while in peak hold mode. Depending on the frequency band spanned a notch filter and/or waveguide filter was used to remove the fundamental frequency.

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR compliant receiver. Emissions above 1000 MHz are measured utilizing a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Emissions from 30 MHz – 1000 MHz are measured utilizing a CISPR compliant quasi-peak detector with a tuned receiver, using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

Test Measurement Set Up



Radiated Emission Measurement Setup – Above 1 GHz



Radiated Emission Measurement Setup – Below 1 GHz

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

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

Field Strength Calculation Example:

Given receiver input reading of 51.5 dBμV; 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 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

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

$$E = 1000000 \times \sqrt{30P} / 3 \ \mu V/m$$

where P is the EIRP in Watts

Therefore: -27 dBm/MHz = 68.23 dBuV/m

Note: The data in this Section identifies that the EUT is in compliance with the -27dBm/MHz EIRP limit (68.23 dBμV/m) for out of band emissions. All out of band emissions are less than 68.23 dB μV/m.

Specification

Radiated Spurious Emissions

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

FCC §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.

FCC §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.

FCC §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 5th 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

Table 1: FCC 15.209 Spurious Emissions Limits

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/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 Spectrum Measurement

Measurement Uncertainty	+5.6/ -4.5 dB

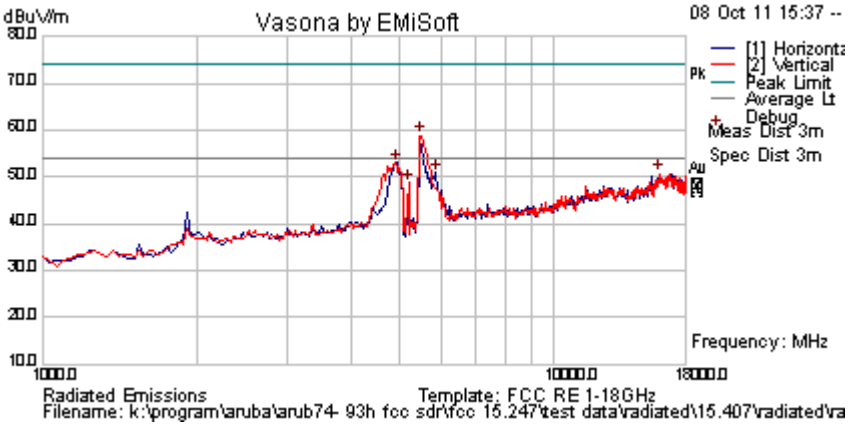
Traceability:

Method	Test Equipment Used
Work instruction WI-03	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.7.1. Integral Antenna – Radiated Spurious Emissions – Above 1 GHz

LOW BAND: 5150 – 5250 MHz: 802.11a

Test Freq.	5180 MHz	**Engineer**	GMH
Variant	802.11a; 6 Mbs	**Temp (ºC)**	29
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	999
Power Setting	18	**Press. (mBars)**	30.5
Antenna	Integral	**Duty Cycle (%)**	
Test Notes 1			
Test Notes 2			

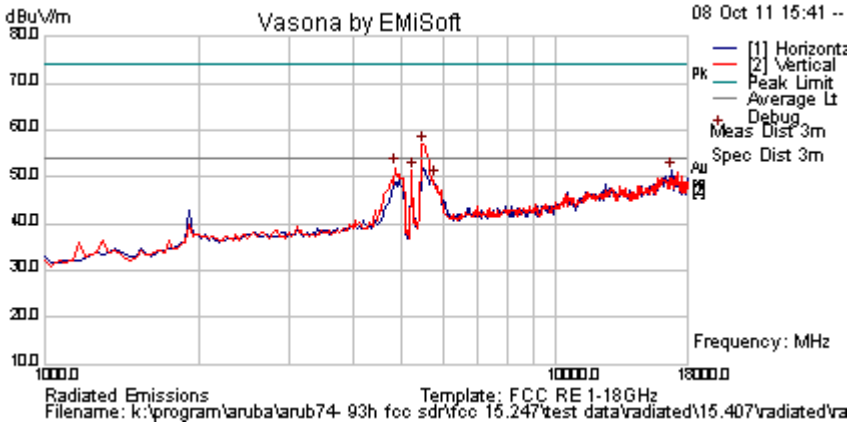


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
5462.926	63.4	4.6	-9.2	58.8	Peak [Scan]	V					Pass	BE
4917.83567	58.6	4.6	-10.0	53.2	Peak [Scan]	H	100	0	54.0	-0.8	Pass	BE
5871.743	54.8	4.8	-8.8	50.9	Peak [Scan]	H	100	0	54	-3.2	Pass	BE
16024.048	41.4	9.0	0.4	50.8	Peak [Scan]	V	100	0	54	-3.2	Pass	NOISE
5190.381	53.7	4.6	-9.6	48.7	Peak [Scan]	V						FUND

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	5200 MHz	**Engineer**	GMH
Variant	802.11a; 6 Mbs	**Temp (ºC)**	29
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	999
Power Setting	18	**Press. (mBars)**	30.5
Antenna	Integral	**Duty Cycle (%)**	
Test Notes 1			
Test Notes 2			

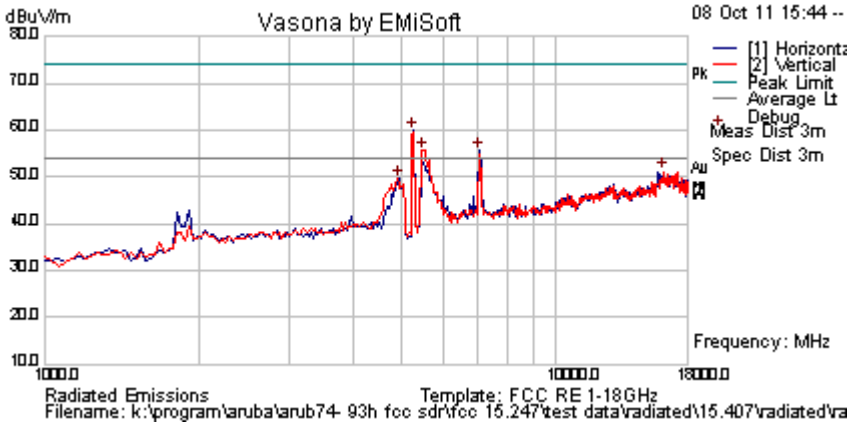


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
5496.994	61.5	4.6	-9.2	57.0	Peak [Scan]	V					Pass	BE
4849.6994	57.4	4.5	-9.9	52.0	Peak [Scan]	V	100	0	54.0	-2.0	Pass	BE
5224.449	56.4	4.6	-9.6	51.4	Peak [Scan]	V						FUND
16773.547	41.5	8.6	1.2	51.3	Peak [Scan]	H	100	0	54	-2.7	Pass	NOISE
5769.539	53.5	4.8	-8.9	49.4	Peak [Scan]	V	100	0	54	-4.6	Pass	BE

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	5240 MHz	**Engineer**	GMH
Variant	802.11a; 6 Mbs	**Temp (ºC)**	29
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	999
Power Setting	18	**Press. (mBars)**	30.5
Antenna	Integral	**Duty Cycle (%)**	
Test Notes 1			
Test Notes 2			



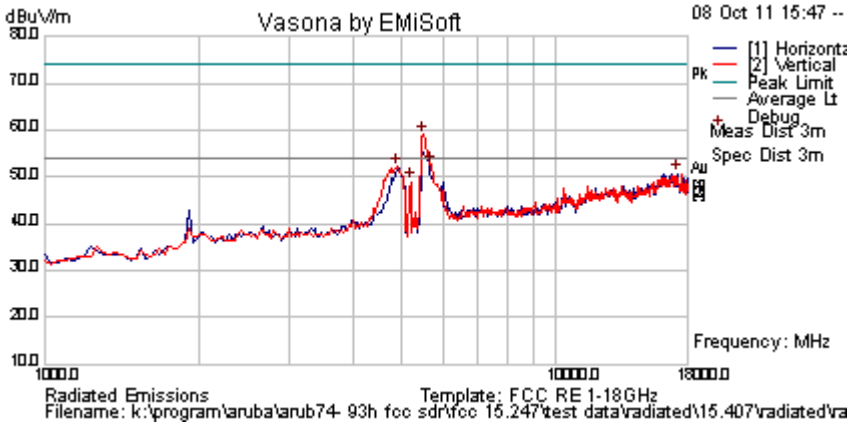
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
5258.517	64.9	4.6	-9.6	59.9	Peak [Scan]	H						FUND
5462.92585	60.3	4.6	-9.2	55.7	Peak [Scan]	V					Pass	BE
7064.128	56.1	5.4	-5.9	55.6	Peak [Scan]	H					Pass	NRB
16160.321	41.9	9.0	0.3	51.2	Peak [Scan]	V	100	0	54	-2.9	Pass	NOISE
4917.836	55.1	4.6	-10.0	49.7	Peak [Scan]	H	100	0	54	-4.3	Pass	BE

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

LOW BAND: 5150 – 5250 MHz: 802.11n HT-20

Test Freq.	5180 MHz	**Engineer**	GMH
Variant	802.11n HT-20; 6.5 MCS	**Temp (ºC)**	29
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	999
Power Setting	18	**Press. (mBars)**	30.5
Antenna	Integral	**Duty Cycle (%)**	
Test Notes 1			
Test Notes 2			

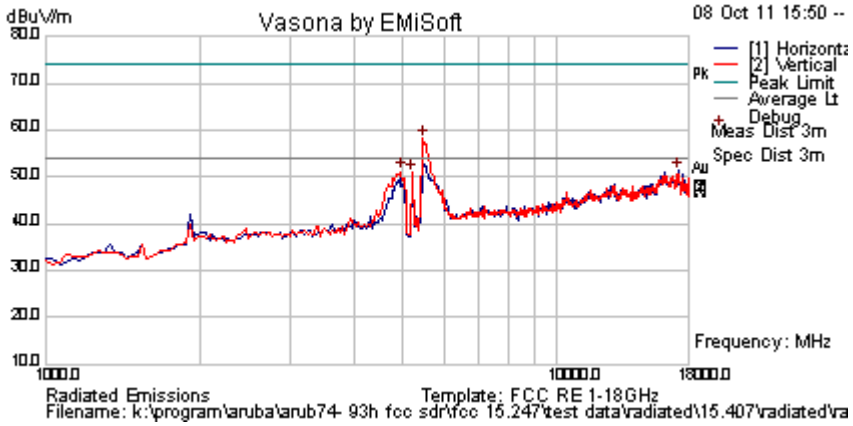


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
5496.994	63.7	4.6	-9.2	59.1	Peak [Scan]	V					Pass	BE
5701.40281	56.8	4.7	-8.9	52.7	Peak [Scan]	V	100	0	54.0	-1.3	Pass	BE
4883.768	57.5	4.5	-10.0	52.1	Peak [Scan]	V	100	0	54	-1.9	Pass	BE
17216.433	41.2	8.6	1.0	50.7	Peak [Scan]	H	100	0	54	-3.3	Pass	NOISE
5190.381	53.9	4.6	-9.6	48.9	Peak [Scan]	V						FUND

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	5200 MHz	**Engineer**	GMH
Variant	802.11n HT-20; 6.5 MCS	**Temp (ºC)**	29
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	999
Power Setting	18	**Press. (mBars)**	30.5
Antenna	Integral	**Duty Cycle (%)**	
Test Notes 1			
Test Notes 2			

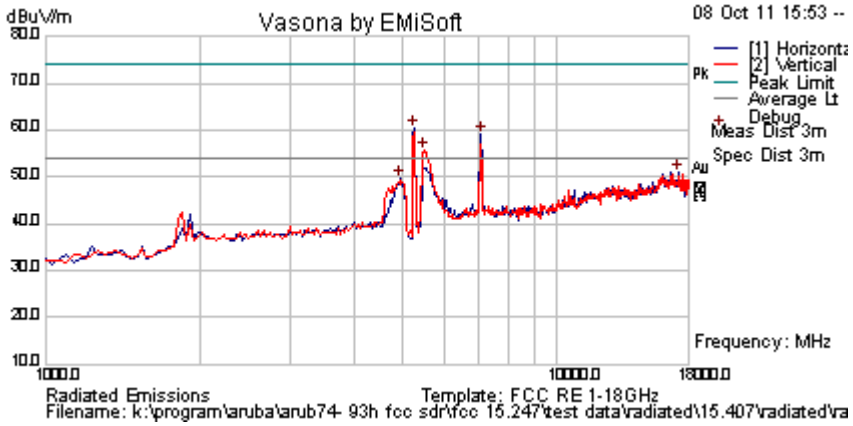


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
5462.926	62.9	4.6	-9.2	58.3	Peak [Scan]	V					Pass	BE
17216.433	41.7	8.6	1.0	51.3	Peak [Scan]	H	100	0	54.0	-2.7	Pass	NOISE
4951.904	56.5	4.6	-9.9	51.2	Peak [Scan]	V	100	0	54	-2.8	Pass	BE
5190.381	56.0	4.6	-9.6	51.0	Peak [Scan]	V						FUND

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	5240 MHz	**Engineer**	GMH
Variant	802.11n HT-20; 6.5 MCS	**Temp (ºC)**	29
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	999
Power Setting	18	**Press. (mBars)**	30.5
Antenna	Integral	**Duty Cycle (%)**	
Test Notes 1			
Test Notes 2			



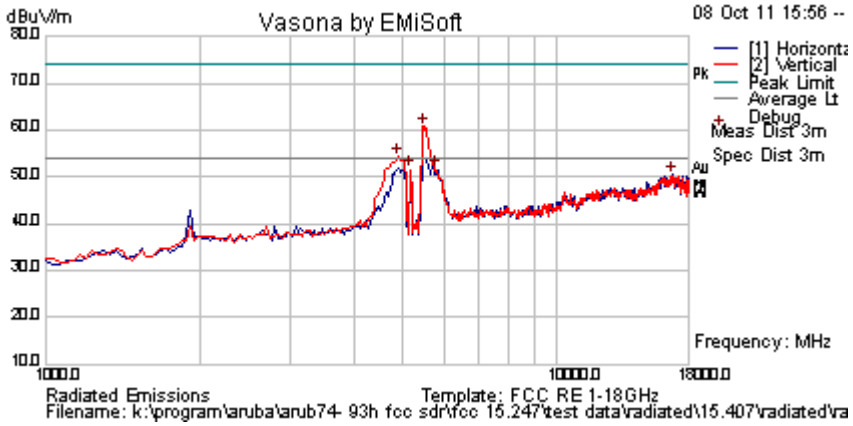
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
5258.517	65.4	4.6	-9.6	60.4	Peak [Scan]	H						FUND
7098.19639	59.4	5.4	-5.8	58.9	Peak [Scan]	H					Pass	NRB
5496.994	60.1	4.6	-9.2	55.5	Peak [Scan]	V					Pass	BE
17216.433	41.4	8.6	1.0	50.9	Peak [Scan]	H	100	0	54	-3.1	Pass	NOISE
4917.836	55.1	4.6	-10.0	49.7	Peak [Scan]	H	100	0	54	-4.3	Pass	BE

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

LOW BAND: 5150 – 5250 MHz: 802.11n HT-40

Test Freq.	5190 MHz	**Engineer**	GMH
Variant	802.11n HT-40; 13.5 MCS	**Temp (ºC)**	29
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	999
Power Setting	18	**Press. (mBars)**	30.5
Antenna	Integral	**Duty Cycle (%)**	
Test Notes 1			
Test Notes 2			

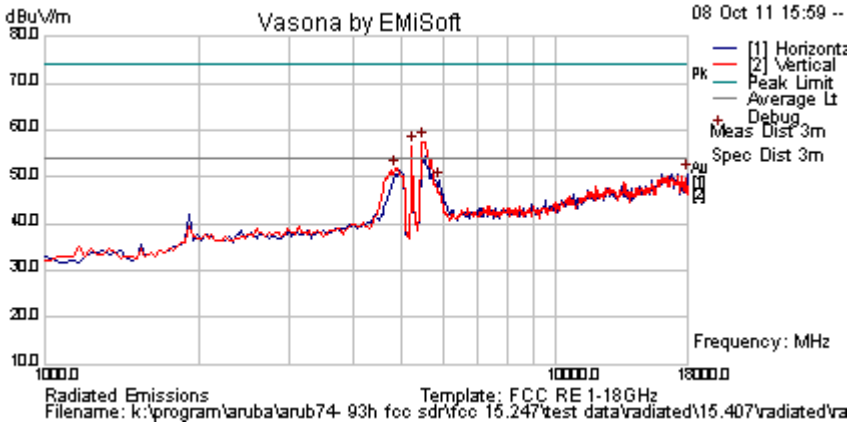


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
5462.926	65.5	4.6	-9.2	60.9	Peak [Scan]	V					Pass	BE
4883.76754	59.7	4.5	-10.0	54.3	Peak [Scan]	V					Pass	BE
5769.539	56.0	4.8	-8.9	51.8	Peak [Scan]	V	100	0	54	-2.2	Pass	BE
5156.313	56.5	4.6	-9.6	51.5	Peak [Scan]	V						FUND
16773.547	40.6	8.6	1.2	50.4	Peak [Scan]	H	100	0	54	-3.6	Pass	NOISE

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	5230 MHz	**Engineer**	GMH
Variant	802.11n HT-40; 13.5 MCS	**Temp (ºC)**	29
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	999
Power Setting	18	**Press. (mBars)**	30.5
Antenna	Integral	**Duty Cycle (%)**	
Test Notes 1			
Test Notes 2			



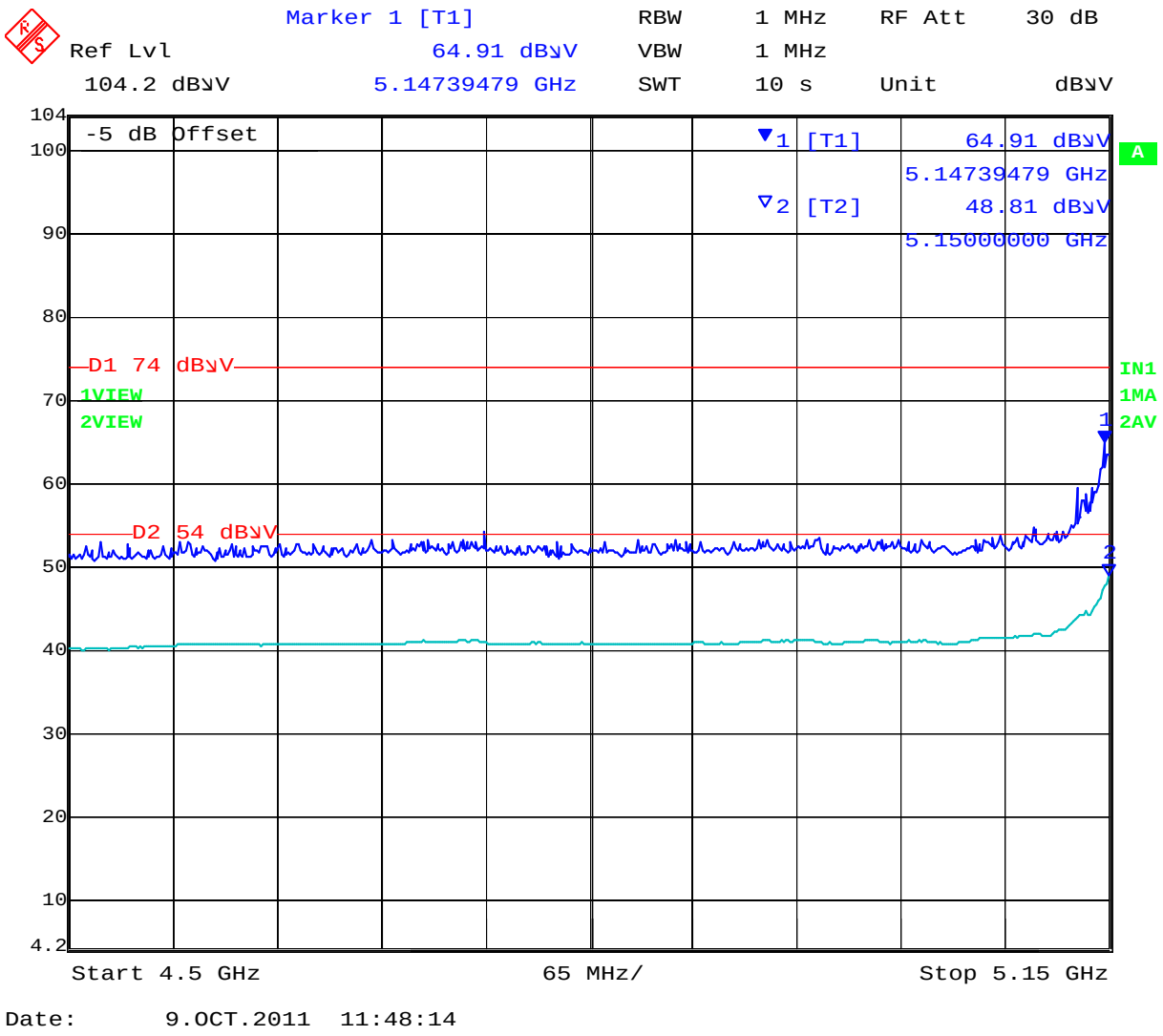
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
5496.994	62.2	4.6	-9.2	57.6	Peak [Scan]	V					Pass	BE
5224.4489	61.7	4.6	-9.6	56.7	Peak [Scan]	V						FUND
4849.699	57.2	4.5	-9.9	51.8	Peak [Scan]	V	100	0	54	-2.2	Pass	BE
18000.000	41.2	8.8	0.8	50.8	Peak [Scan]	H	100	0	54	-3.2	Pass	NOISE
5905.812	53.1	4.8	-8.7	49.3	Peak [Scan]	H	100	0	54	-4.7	Pass	BE

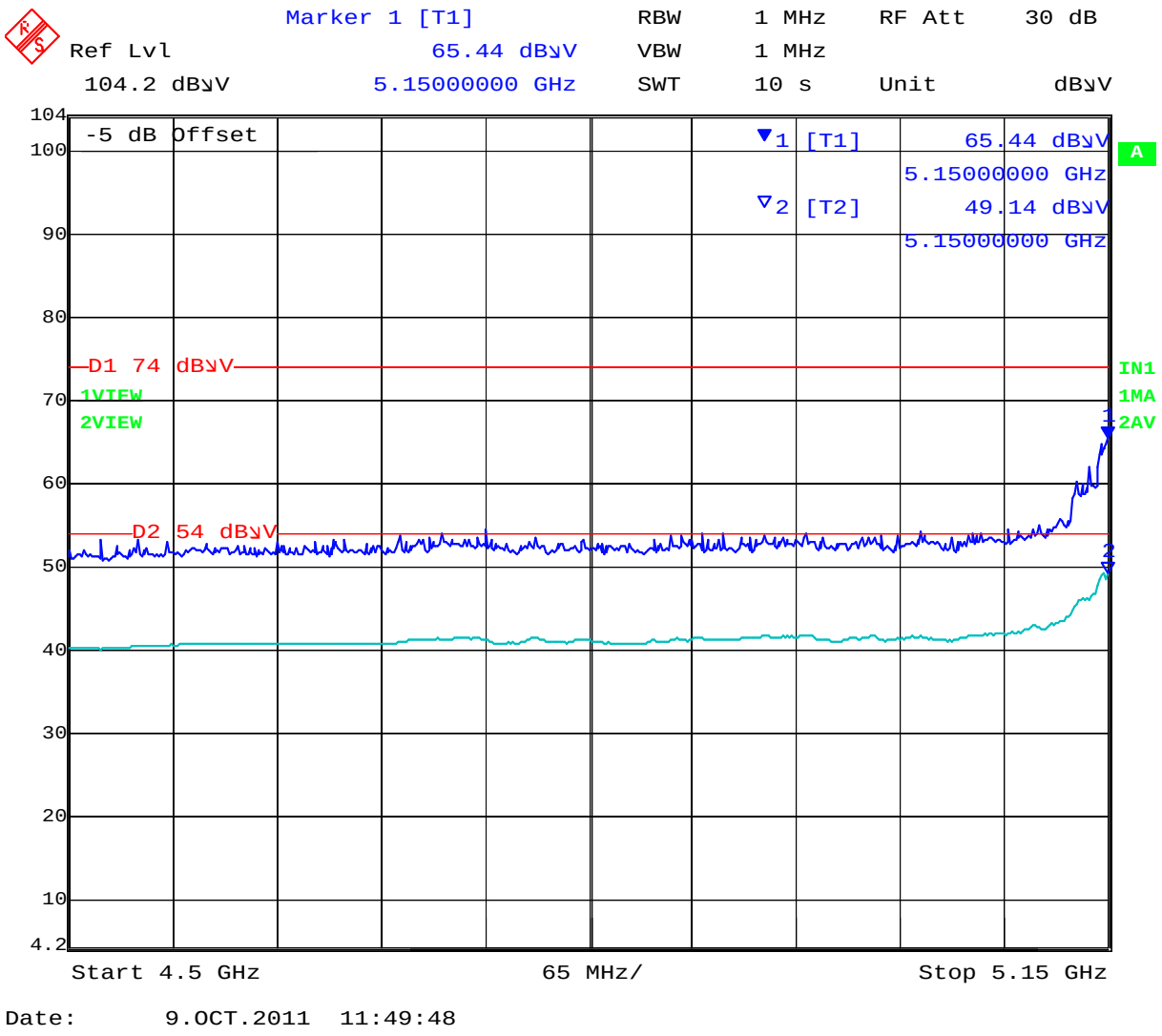
Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

5.1.7.2. Integral Antenna – Band edge spurious emissions

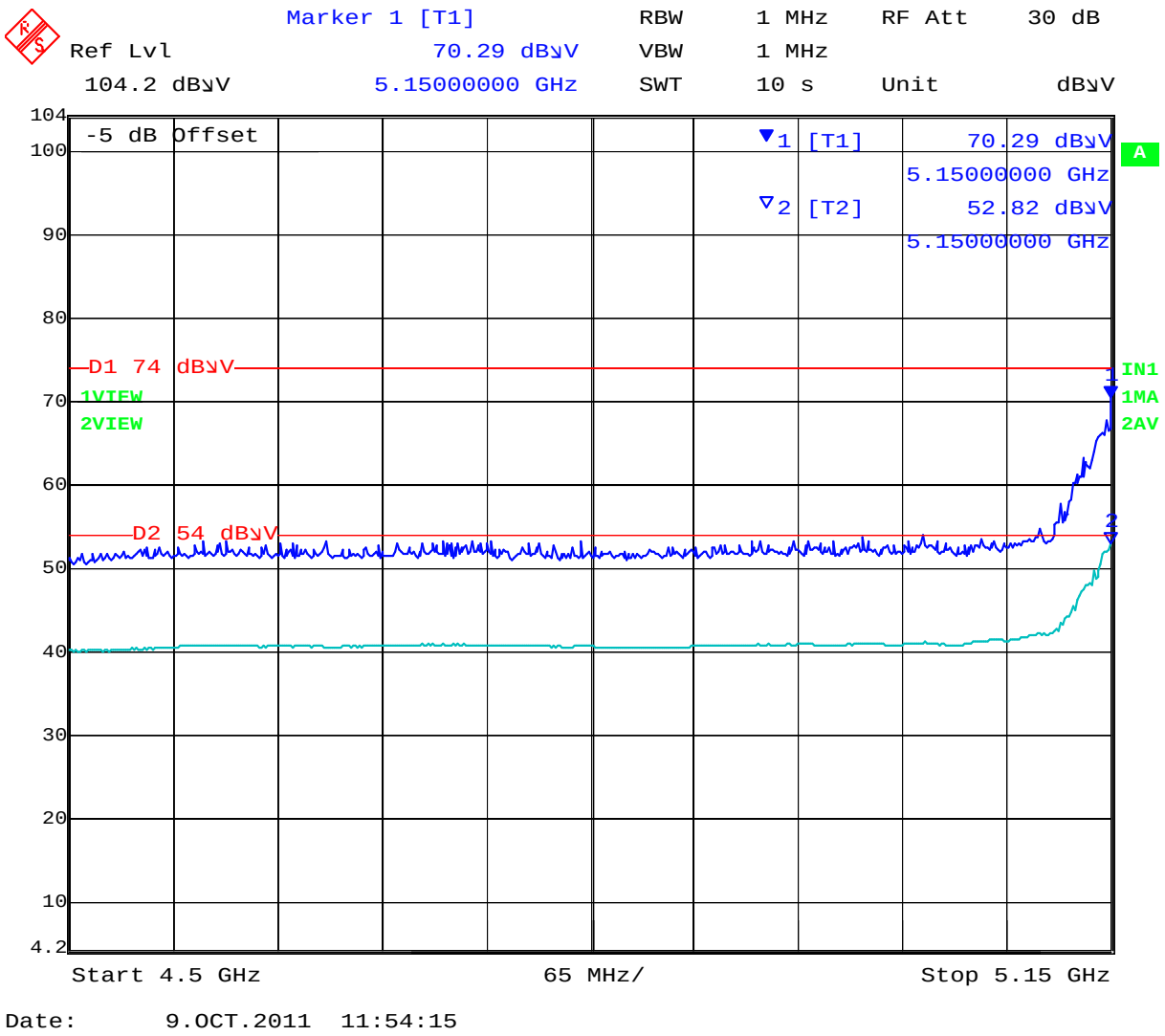
5180 MHz - 802.11a 4500-5150 MHz



5180 MHz - 802.11n HT-20 4500-5150 MHz



5190 MHz - 802.11n HT-40 4500-5150 MHz



NOTE: Power Reduction Required ART = 13

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 (μV/m)	Field Strength (dBμV/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

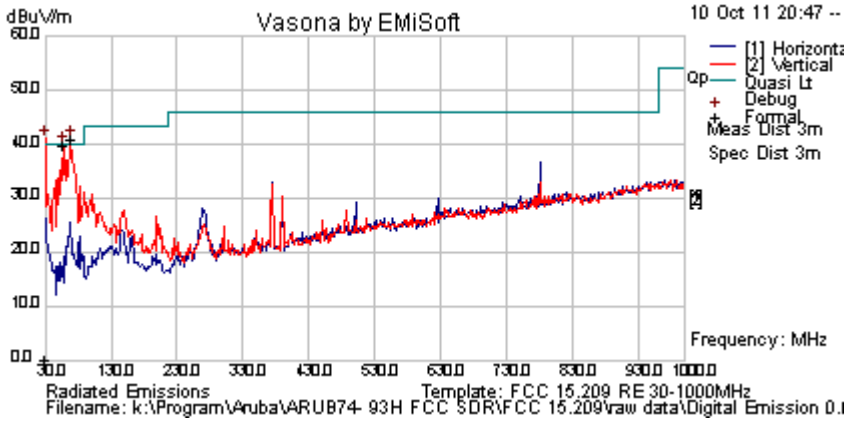
Traceability

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

5.1.7.3. Radiated Spurious Emissions – 30MHz – 1000MHz

Note: No radio emissions were present below 1 GHz. Emissions were investigated while the unit was transmitting at maximum power and in receive mode for both AC Adaptor powered and POE (Power Over Ethernet) configuration.

Test Freq.	2442 MHz	**Engineer**	GMH
Variant	Digital Emissions	**Temp (ºC)**	25
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	41
Power Setting	Max	**Press. (mBars)**	1001
Antenna	integral		
Test Notes 1			
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
30.000	41.1	3.4	-9.2	35.3	Quasi Max	V	107	297	40	-4.7	Pass	
57.214	56.1	3.8	-23.7	36.2	Quasi Max	V	98	176	40.0	-3.8	Pass	
69.184	58.2	3.9	-23.0	39.1	Quasi Max	V	130	201	40.0	-0.9	Pass	

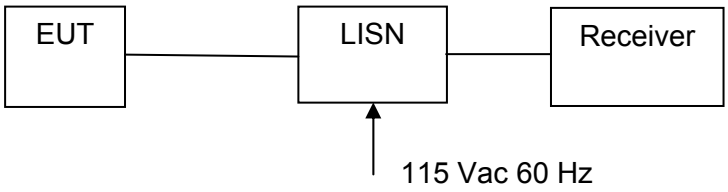
Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

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

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 μΩ 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 (dBμV)	
	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

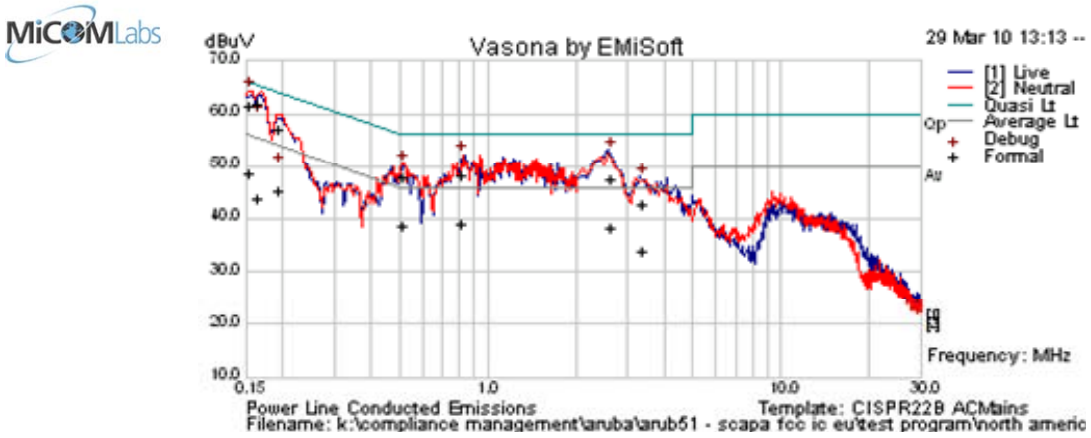
Measurement uncertainty	±2.64 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0287, 0190, 0293, 0307

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

Test Freq.	2437 - Rx Mode	**Engineer**	CSB
Variant	AC Line Emissions	**Temp (ºC)**	22
Freq. Range	0.150 MHz - 30 MHz	**Rel. Hum.(%)**	38
Power Setting	N/A	**Press. (mBars)**	1006
Antenna	Integral Antennas		
Test Notes 1	AC Powered - 120V AC 60Hz		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.155	38.8	9.9	0.1	48.8	Average	Neutral	55.73	-7.0	Pass	DIG
0.155	51.6	9.9	0.1	61.6	Quasi Peak	Neutral	65.73	-4.2	Pass	DIG
0.167	33.8	9.9	0.1	43.7	Average	Neutral	55.11	-11.4	Pass	DIG
0.167	51.7	9.9	0.1	61.7	Quasi Peak	Neutral	65.11	-3.4	Pass	DIG
0.194	35.4	9.9	0.1	45.3	Average	Neutral	53.86	-8.5	Pass	DIG
0.194	47.2	9.9	0.1	57.1	Quasi Peak	Neutral	63.86	-6.7	Pass	DIG
0.516	28.6	9.9	0.1	38.6	Average	Neutral	46	-7.4	Pass	DIG
0.516	37.8	9.9	0.1	47.9	Quasi Peak	Neutral	56	-8.2	Pass	DIG
0.828	38.4	9.9	0.1	48.4	Quasi Peak	Neutral	56	-7.6	Pass	DIG
0.828	29.1	9.9	0.1	39.1	Average	Neutral	46	-6.9	Pass	DIG
2.661	28.2	10.1	0.1	38.4	Average	Live	46	-7.6	Pass	DIG
2.661	37.3	10.1	0.1	47.6	Quasi Peak	Live	56	-8.5	Pass	DIG

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

6. 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
0287	EMI Receiver	Rhode & Schwartz	ESIB 40	100201
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

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