Test of Bright Star Engineering Inc. MicroPod
MPOD2-C

To: FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: BSTR39-U3 Rev B

TEST REPORT

FROM

Test of Bright Star Engineering Inc. MicroPod MPOD2-C

to

To FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: BSTR39-U3 Rev B

This report supersedes: BSTR39-U3 Rev A

Applicant: Bright Star Engineering Inc
299 Ballardvale Street, Suite 5
Wilmington, MA 01887
USA

Product Function: Wireless Automobile OBDII Monitoring System

Copy No: pdf Issue Date: 1st October 2012

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
Fax: +1 (925) 462-0306
www.micomlabs.com

ACCREDITED

TEST CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

This page has been left intentionally blank

TABLE OF CONTENTS

ACCREDITATION, LISTINGS & RECOGNITION

TESTING ACCREDITATION

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

ilac-MRA

A2LA World Class Accreditation

The American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 27th day of March 2012.

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2013

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical 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	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2
Japan	MIC	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
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 September 2012	Initial release.
Rev B	1st October 2012	Revised Section 3.1 “location for use” to outdoor. Clarification of test methodologies used during power spectral density and radiated emissions testing.

1. TEST RESULT CERTIFICATE

Manufacturer:	Bright Star Engineering Inc 299 Ballardvale Street, Suite 5 Wilmington, MA 01887 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	802.11a/b/g/n Wireless Automobile OBDII Monitoring System	Telephone:	+1 925 462 0304
Model:	MicroPod MPOD2-C	Fax:	+1 925 462 0306
S/N's:	WCP-01084, WCP-01043		
Test Date(s):	1st June 2012 to 14th August '2012	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.247 & 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
TEST 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, Subpart C	2012	Title 47: Telecommunication PART 15 — Radio Frequency Devices Subpart C—Intentional Radiators
ii.	RSS-210 Annex 8	2010	Radio Standards Specification 210, Issue 8, Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment
iii.	FCC OET KDB 662911	4th April 2011	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
iv.	DA 00-705	2000	FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems" released March 30, 2000
v.	RSS-GEN	2010	Radio Standards Specification-Gen, Issue 3, General Requirements and Information for the Certification of Radiocommunication Equipment
vi.	FCC 47 CFR Part 15, Subpart B	2010	47 CFR Part 15, SubPart B; Unintentional Radiators
vii.	ICES-003	2004	Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard Digital Apparatus; Issue 4
viii.	ANSI C63.4	2009	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
ix.	CISPR 22/ EN 55022	2008 2006 +A1:2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
x.	M 3003	Edition 2 Jan. 2007	Expression of Uncertainty and Confidence in Measurements
xi.	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
xii.	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
xiii.	A2LA	July 2012	Reference to A2LA Accreditation Status – A2LA Advertising Policy

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 Bright Star Engineering Inc. MicroPod MPOD2-C to FCC Part 15.247 and Industry Canada RSS-210 regulations.
Applicant:	Bright Star Engineering Inc 299 Ballardvale Street, Suite 5 Wilmington, MA 01887 USA
Manufacturer:	As applicant.
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	BSTR39-U3 Rev B
Date EUT received:	21st May 2012
Standard(s) applied:	FCC 47 CFR Part 15.247 & IC RSS-210
Dates of test (from - to):	1st June 2012 to 14th August '2012
No of Units Tested:	One
Type of Equipment:	802.11a/b/g/n Wireless Access Point, 3x3 Spatial Multiplexing MIMO configuration
Manufacturers Trade Name:	BrightStar
Model(s):	wiTECH microPOD II
Location for use:	Outdoor
Declared Frequency Range(s):	2400 - 2483.5 MHz;
Software Release	0.11
Type of Modulation:	Per 802.11 –CCK, BPSK, QPSK, DSSS, OFDM
EUT Modes of Operation:	802.11b/g/n , 802.15 (Bluetooth)
Transmit/Receive Operation:	Simplex
Output Power Type:	Fixed, not variable
Rated Input Voltage and Current:	12 Vdc 200 mA
Operating Temperature Range:	Declared range -40° to +85ºC
ITU Emission Designator:	2400 – 2483.5 MHz 802.11b 14M0G1D 2400 – 2483.5 MHz 802.11g 16M6D1D 2400 – 2483.5 MHz 802.11n 17M6D1D
Equipment Dimensions:	7.2 cm x 2.2 cm x 4.3 cm
Weight:	6 oz
Primary function of equipment:	Wireless Data Communication
Equipment Secondary Function(s):	Automotive Diagnostics

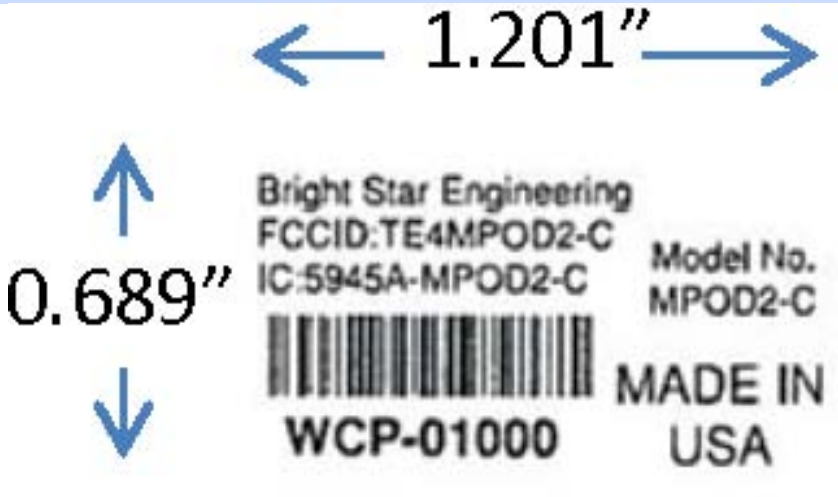
3.2. Scope of Test Program

Bright Star Engineering Inc. MicroPod MPOD2-C
The scope of this program was to test the Bright Star Engineering Inc. MicroPod MPOD2-C 802.11 b/g/n HT-20 configurations in the frequency ranges 2400 - 2483.5 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications.

The MicroPod MPOD2-C connects to an automobile OBDII port monitoring automobile performance and diagnostics.

MicroPod MPOD2-C 802.11 b/g/n Wireless

MicroPod MPOD2-C 802.11 b/g/n Wireless



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

Equipment Type	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	802.11 b/g WLAN	Brightstar Engineering Inc	MicroPod MPOD2-C	WCP-01084, WCP-01043
Support	Laptop PC	IBM	Thinkpad	None

3.4. Antenna Details

Antenna Type	Manufacturer	Model Number	Antenna Gain (dBi
			2.4 GHz
Rufa 2.4 GHz SMD	Antenova	A5887	Peak Gain 2.1

3.5. Cabling and I/O Ports

The following is a description of the cable and input, output ports available on the EUT.

Type of I/O Ports	Description	Screened (y/n)	Description	Qty
Vehicle	K-line, J1850, Can	N	--	1
USB	Mini USB @ EUT	Yes	2 meters	1

3.6. EUT Configurations

Band (GHz)	Mode	Freq Band (MHz)	Freq Range (MHz)	Low ch	Mid ch	High ch
2.4	802.11b	2400 - 2483.5	2412 - 2462	2412	2437	2462
2.4	802.11g	2400 - 2483.5	2412 - 2462	2412	2437	2462
2.4	802.11n HT-20	2400 - 2483.5	2412 - 2462	2412	2437	2462

3.7. 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.

Operational Mode(s) (802.11a/b/g/n)	Variant	Data Rate with Highest Power	Frequencies (MHz)
b	Legacy	1 MBit/s	2,412 2,437 2,462
g	Legacy	6 MBit/s	
n	Legacy	54 MBit/s	

Legacy – data rates for 802.11bg products

Results for the above configurations are provided in this report.

3.8. Equipment Details

The following is a description of EUT and supporting equipment used during the test program.

Type (EUT/Support)	Equipment Description	Manufacturer	Model No.	Serial No (s).
EUT (Radiated)	802.11b/g/n; 802.15 Data Collection Module	Bright Star	WiTECH micorPOD II	WMP-00268

Antenna Test Configurations for Radiated Emissions

Results for the following configurations are provided in this report.

2,400 – 2483.5 MHz

15.247	
802.11b	b SE 2412
	b SE 2437
	b SE 2462
	BE b 2390
	BE b 2483.5
802.11g	g SE 2412
	g SE 2437
	g SE 2462
	BE g 2390
	BE g 2483.5
802.11n HT-20	g SE 2412
	g SE 2437
	g SE 2462
	BE g 2390
	BE g 2483.5

KEY;-

SE – Spurious Emission
BE – Band-Edge

3.9. Equipment Modifications

The following modifications were required to bring the equipment into compliance

No modifications required

3.10. Deviations from the Test Standard

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

1. NONE

4. TESTING EQUIPMENT CONFIGURATION(S)

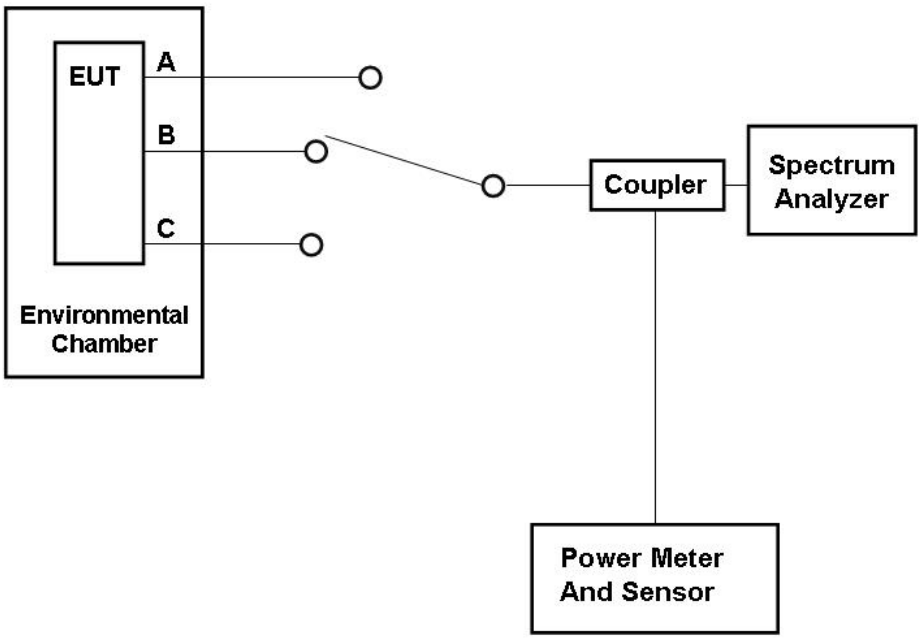
4.1. Conducted RF Emission Test Set-up

The following tests were performed using the conducted test set-up shown in the diagram below.

1. Section 6.1.1.1. 6 dB and 99% Bandwidth
2. Section 6.1.1.2. Peak Output Power
3. Section 6.1.1.3. Power Spectral Density
4. Section 6.1.1.4. Conducted Spurious Emissions

Conducted Test Set-Up Pictorial Representation

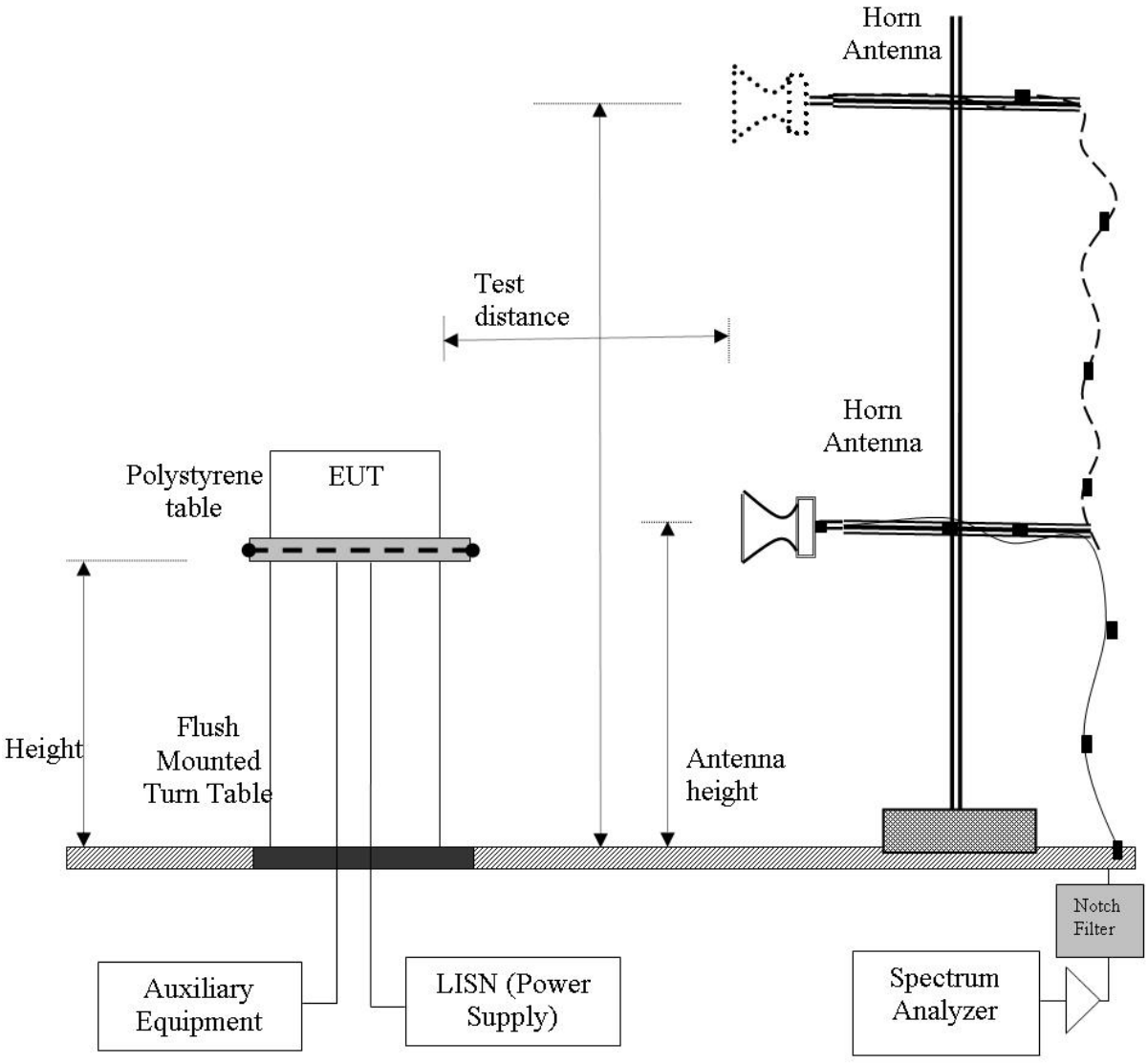
3 - Port Test Configuration



4.2. Radiated Spurious Emission Test Set-up > 1 GHz

The following tests were performed using the radiated test set-up shown in the diagram below.

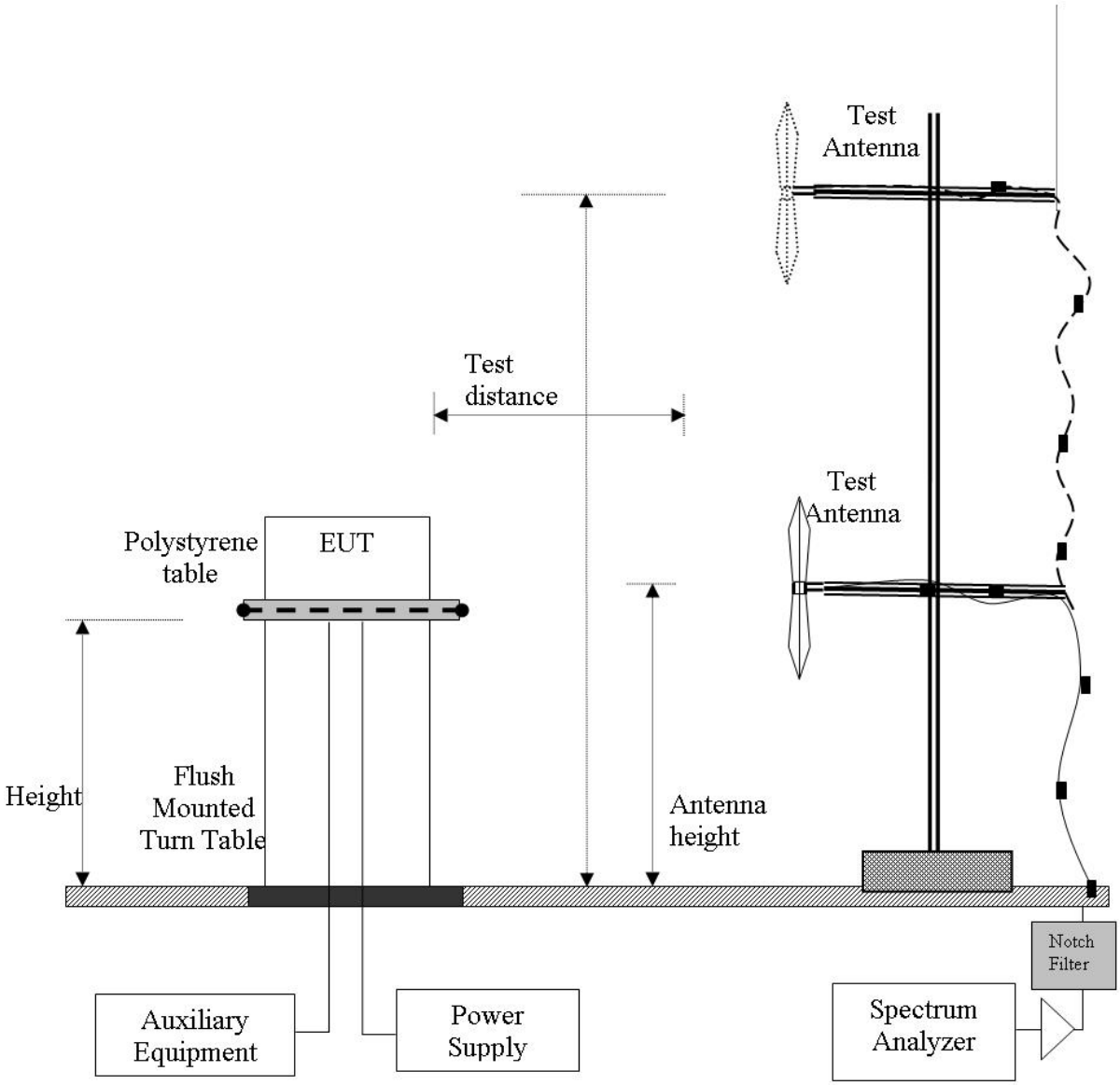
Radiated Emission Measurement Setup – Above 1 GHz



4.3. Digital Emissions Test Set-up (0.03 – 1 GHz)

The following tests were performed using the radiated test set-up shown in the diagram below.

Digital Emission Measurement Setup – Below 1 GHz



5. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247** and **Industry Canada RSS-210** and **Industry Canada RSS-Gen.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2) **A8.2(1)** **4.4**	6 dB and 99 % Bandwidths	≥500 kHz	Conducted	Complies	6.1.1.1
15.247(b)(3) **15.31(e)** **A8.4(4)**	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	6.1.1.2
15.247(e) **A8.2**	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	6.1.1.3
15.247(i) **5.5**	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	6.1.1.4
15.247(d) **15.205 /** **15.209** **A8.5** **2.2** **4.7**	Spurious Emissions (30MHz - 26 GHz b/g and 30 MHz – 40 GHz a)	The radiated emission in any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density	Conducted	Complies	6.1.1.5

List of Measurements (continued)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247, Industry Canada RSS-210,** and **Industry Canada RSS-Gen.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(d) **15.205 /** **15.209** **A8.5** **2.2** **2.6** **4.7**	Radiated Emissions	Restricted Bands	Radiated	Complies	6.1.2
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*6.1.2.1*
	Radiated Band Edge	Band-edge results Peak Emissions		Complies	
15.205 / **15.209** **2.2**	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	*6.1.2.2*
15.207 **7.2.2**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	N/A EUT is POE powered - not shipped with equipment	*6.1.3*

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*

6. TEST RESULTS

6.1. Device Characteristics

6.1.1. Conducted Testing

6.1.1.1. 6 dB and 99 % Bandwidth

Conducted Test Conditions for 6 dB and 99% Bandwidth			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	6 dB and 99 % Bandwidth	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(2)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	KDB 558074 - D01 DTS Measurement Guidance v01: Section 5.1 Emission Bandwidth		

Test Procedure for 6 dB and 99% Bandwidth Measurement

The bandwidth at 6 dB and 99 % was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate centre frequency.

Equipment Configuration for 6 dB and 99% Bandwidth			
Variant:	802.11b	**Duty Cycle (%):**	100
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	CCK	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz) Port(s)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
MHz	a	b	c	d	Highest	Lowest	MHz	MHz
2412.0	9.138	--	--	--	9.138	9.138	0.5	-8.64
2437.0	9.138	--	--	--	9.138	9.138	0.5	-8.64
2462.0	9.138	--	--	--	9.138	9.138	0.5	-8.64

Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)
MHz	a	b	c	d	
2412.0	13.868	--	--	--	13.868
2437.0	13.948	--	--	--	13.948
2462.0	13.948	--	--	--	13.948

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring Spectrum Mask
Measurement Uncertainty:	±2.81 dB

Note: click the link in the above results matrix to view the plot

Equipment Configuration for 6 dB and 99% Bandwidth			
Variant:	802.11g	**Duty Cycle (%):**	100
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	OFDM	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz) Port(s)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
MHz	**a**	**b**	**c**	**d**	**Highest**	**Lowest**	**MHz**	**MHz**
2412.0	15.872	--	--	--	15.872	15.872	0.5	-15.37
2437.0	15.872	--	--	--	15.872	15.872	0.5	-15.37
2462.0	15.872	--	--	--	15.872	15.872	0.5	-15.37

Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)
MHz	**a**	**b**	**c**	**d**	
2412.0	16.513	--	--	--	16.513
2437.0	16.513	--	--	--	16.513
2462.0	16.593	--	--	--	16.593

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring Spectrum Mask
Measurement Uncertainty:	±2.81 dB

Note: click the link in the above results matrix to view the plot

Equipment Configuration for 6 dB and 99% Bandwidth			
Variant:	802.11n HT-20	**Duty Cycle (%):**	100
Data Rate:	6.5 MBit/s (MCS0)	**Antenna Gain (dBi):**	N/A
Modulation:	OFDM	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz) Port(s)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
MHz	a	b	c	d	Highest	Lowest	MHz	MHz
2412.0	16.994	--	--	--	16.994	16.994	0.5	-16.49
2437.0	16.994	--	--	--	16.994	16.994	0.5	-16.49
2462.0	16.994	--	--	--	16.994	16.994	0.5	-16.49

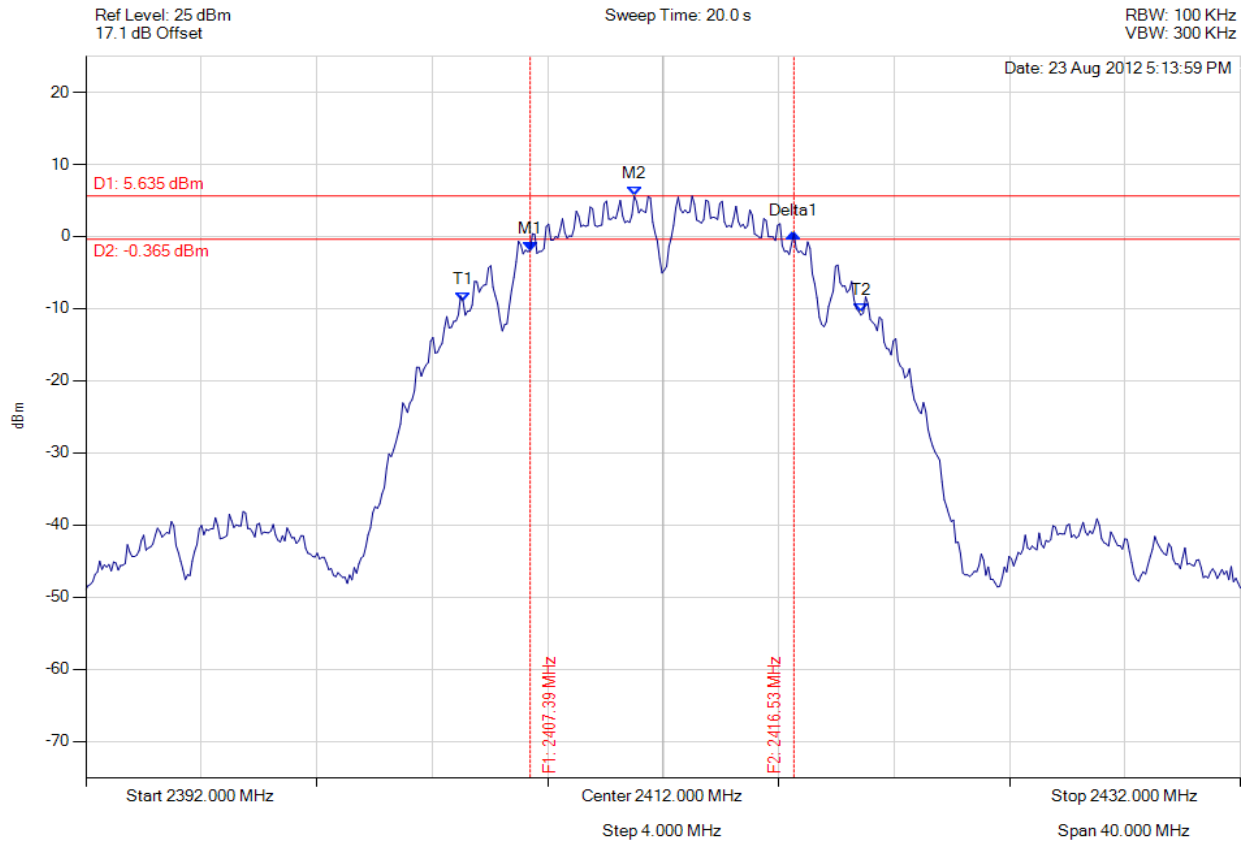
Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)
MHz	a	b	c	d	
2412.0	17.555	--	--	--	17.555
2437.0	17.555	--	--	--	17.555
2462.0	17.555	--	--	--	17.555

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring Spectrum Mask
Measurement Uncertainty:	±2.81 dB

Note: click the link in the above results matrix to view the plot

6 dB and 99% Bandwidth

Variant: 802.11b, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

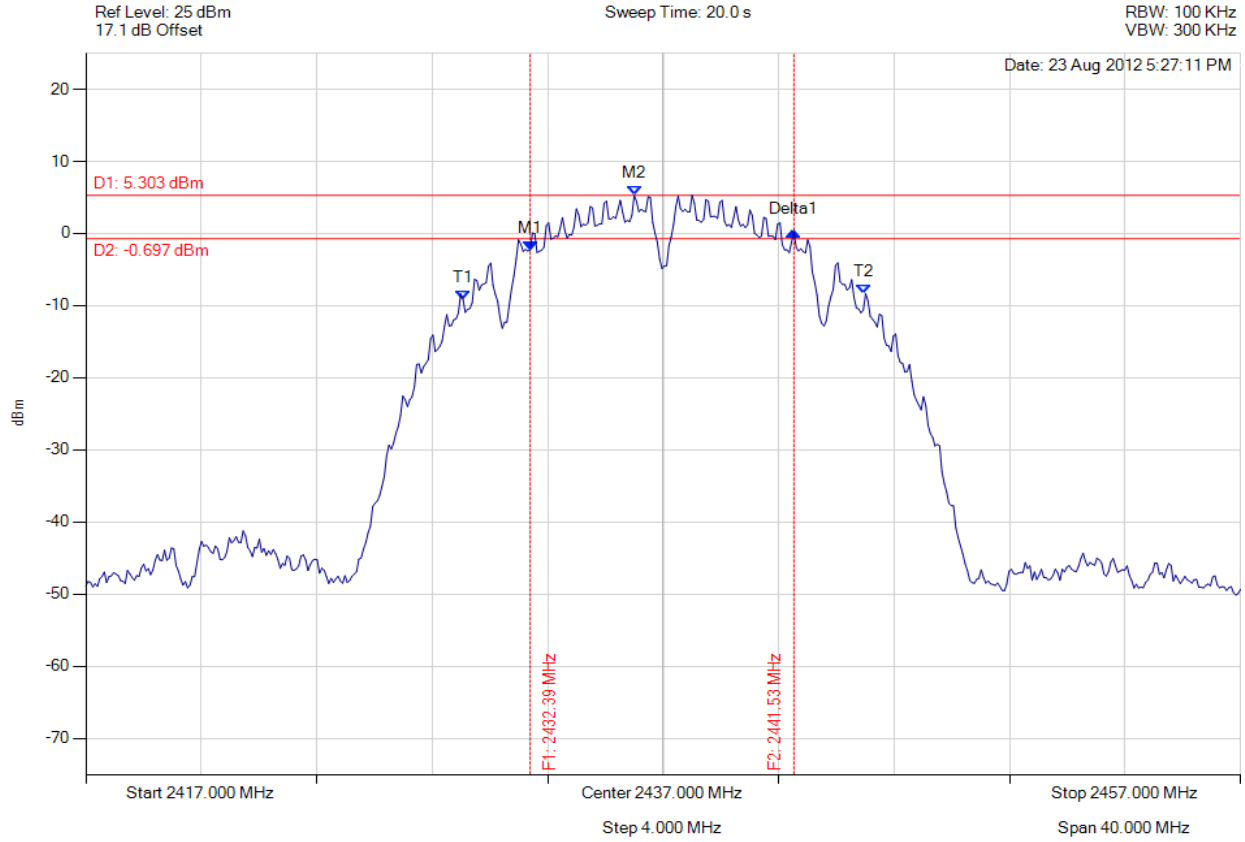


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2407.391 MHz : -1.996 dBm M2 : 2410.998 MHz : 5.635 dBm Delta1 : 9.138 MHz : 2.410 dB T1 : 2405.066 MHz : -8.966 dBm T2 : 2418.854 MHz : -10.609 dBm OBW : 13.868 MHz	Measured 6 dB Bandwidth: 9.138 MHz Limit: 0.5 MHz Margin: -8.64 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11b, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

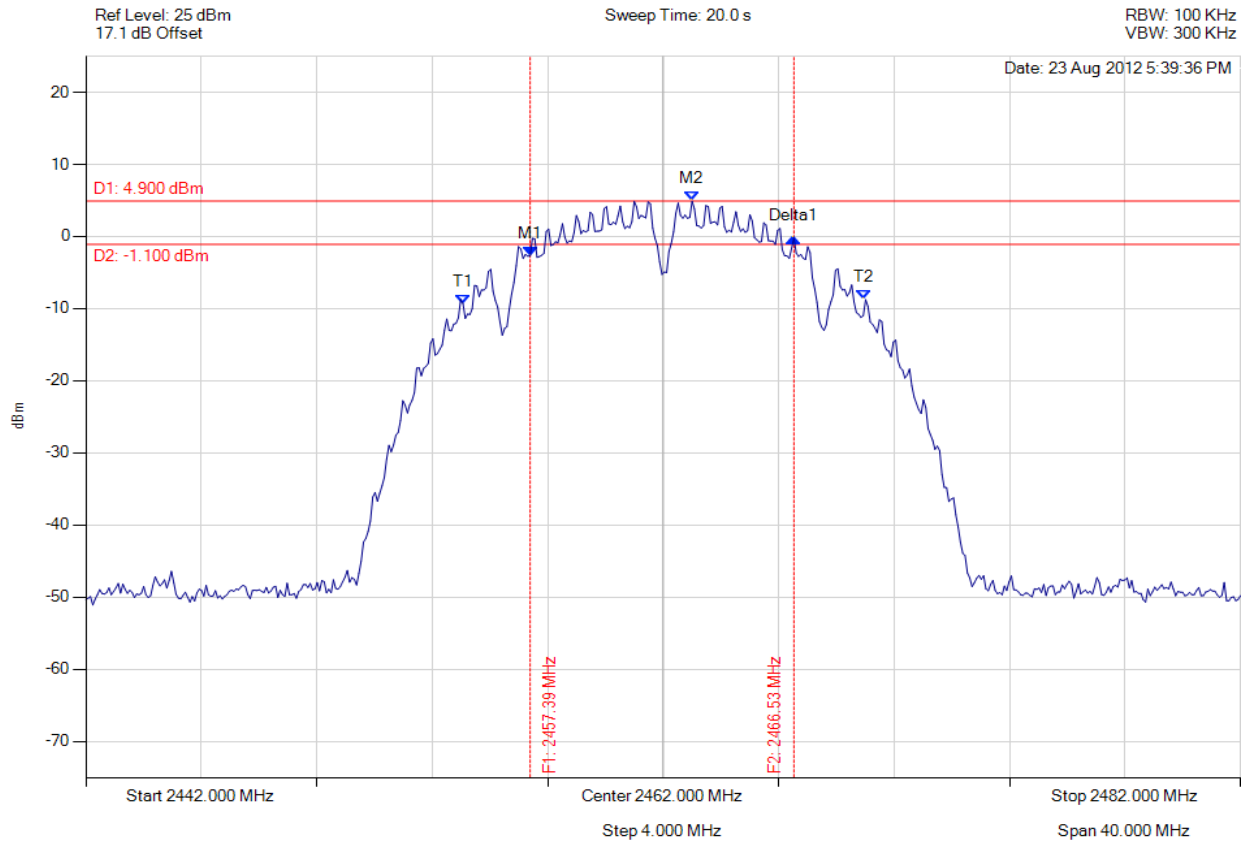


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2432.391 MHz : -2.329 dBm M2 : 2435.998 MHz : 5.303 dBm Delta1 : 9.138 MHz : 2.556 dB T1 : 2430.066 MHz : -9.134 dBm T2 : 2443.934 MHz : -8.333 dBm OBW : 13.948 MHz	Measured 6 dB Bandwidth: 9.138 MHz Limit: 0.5 MHz Margin: -8.64 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11b, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

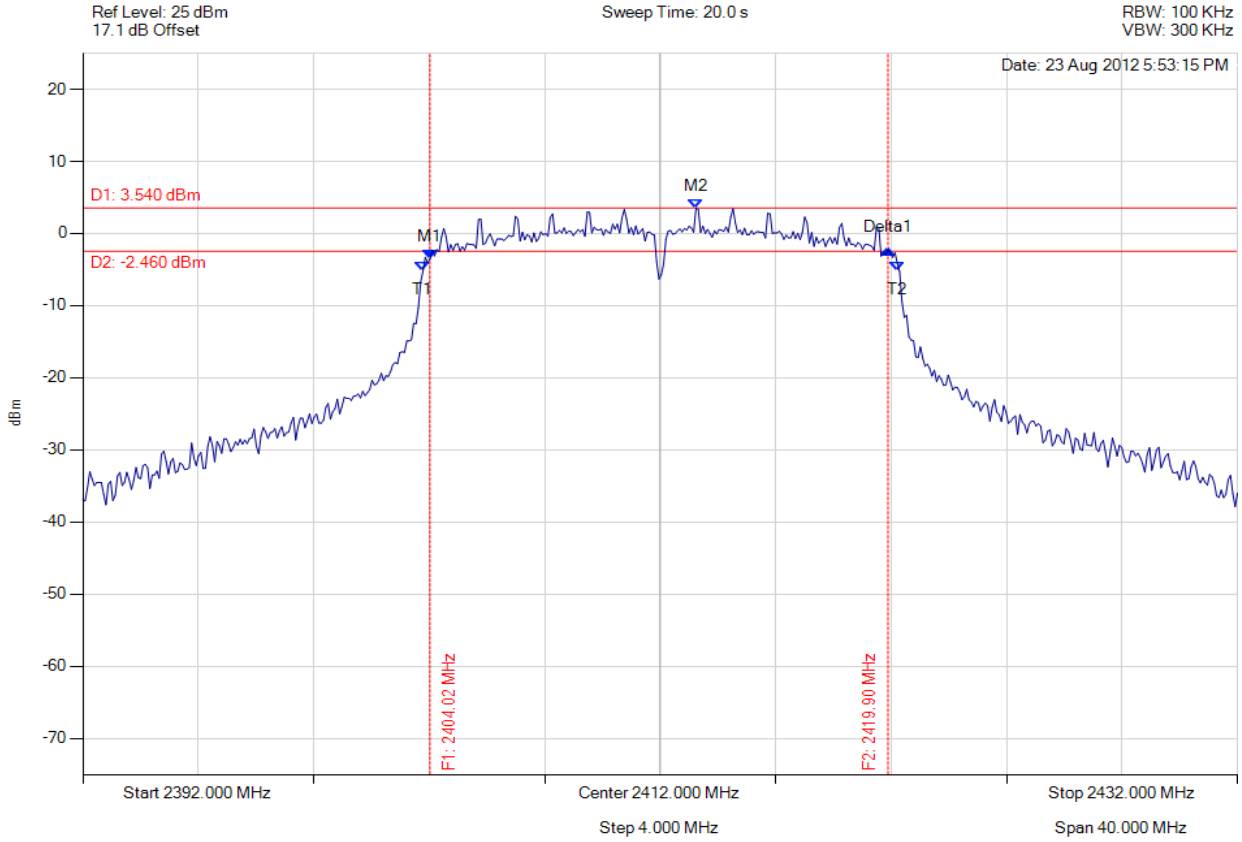


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2457.391 MHz : -2.722 dBm M2 : 2463.002 MHz : 4.900 dBm Delta1 : 9.138 MHz : 2.491 dB T1 : 2455.066 MHz : -9.346 dBm T2 : 2468.934 MHz : -8.754 dBm OBW : 13.948 MHz	Measured 6 dB Bandwidth: 9.138 MHz Limit: 0.5 MHz Margin: -8.64 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11g, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

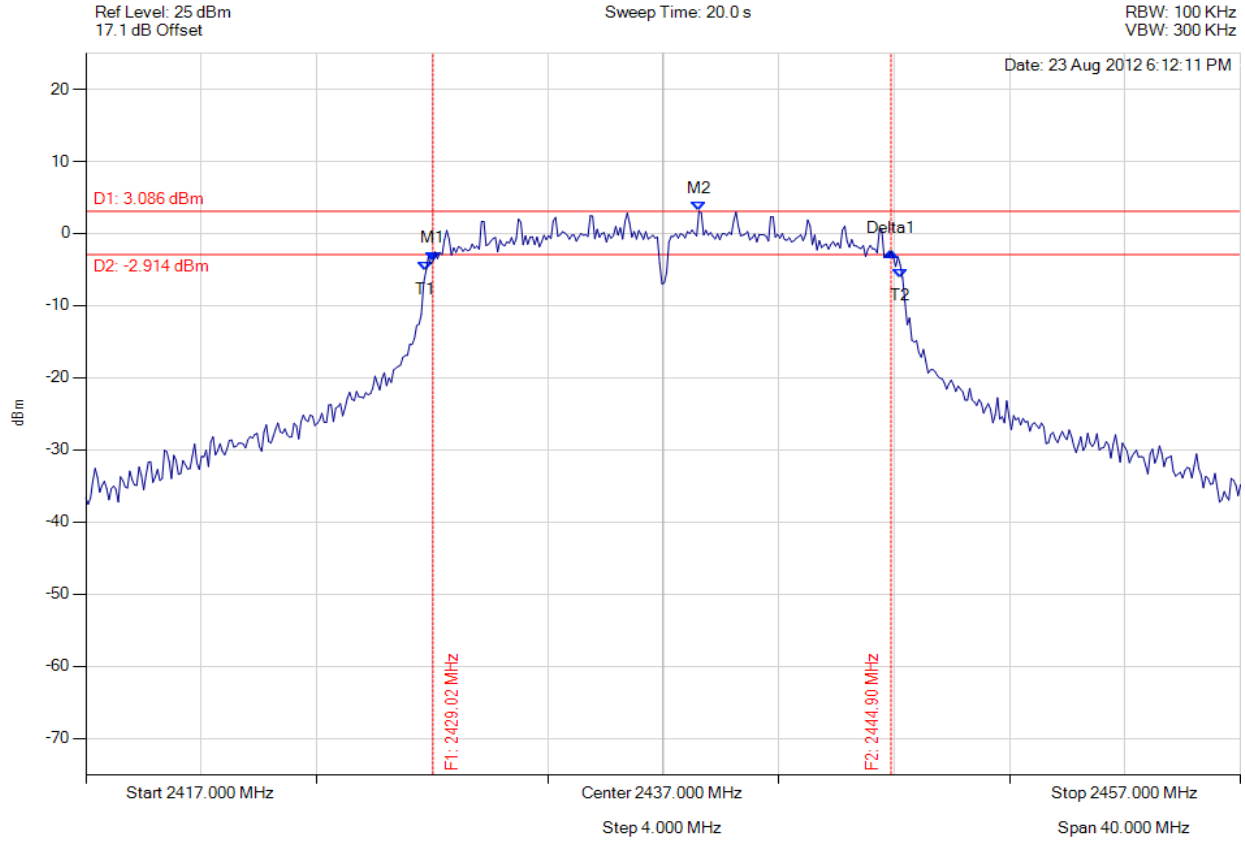


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2404.024 MHz : -3.556 dBm M2 : 2413.242 MHz : 3.540 dBm Delta1 : 15.872 MHz : 1.342 dB T1 : 2403.784 MHz : -5.242 dBm T2 : 2420.216 MHz : -5.252 dBm OBW : 16.513 MHz	Measured 6 dB Bandwidth: 15.872 MHz Limit: 0.5 MHz Margin: -15.37 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11g, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

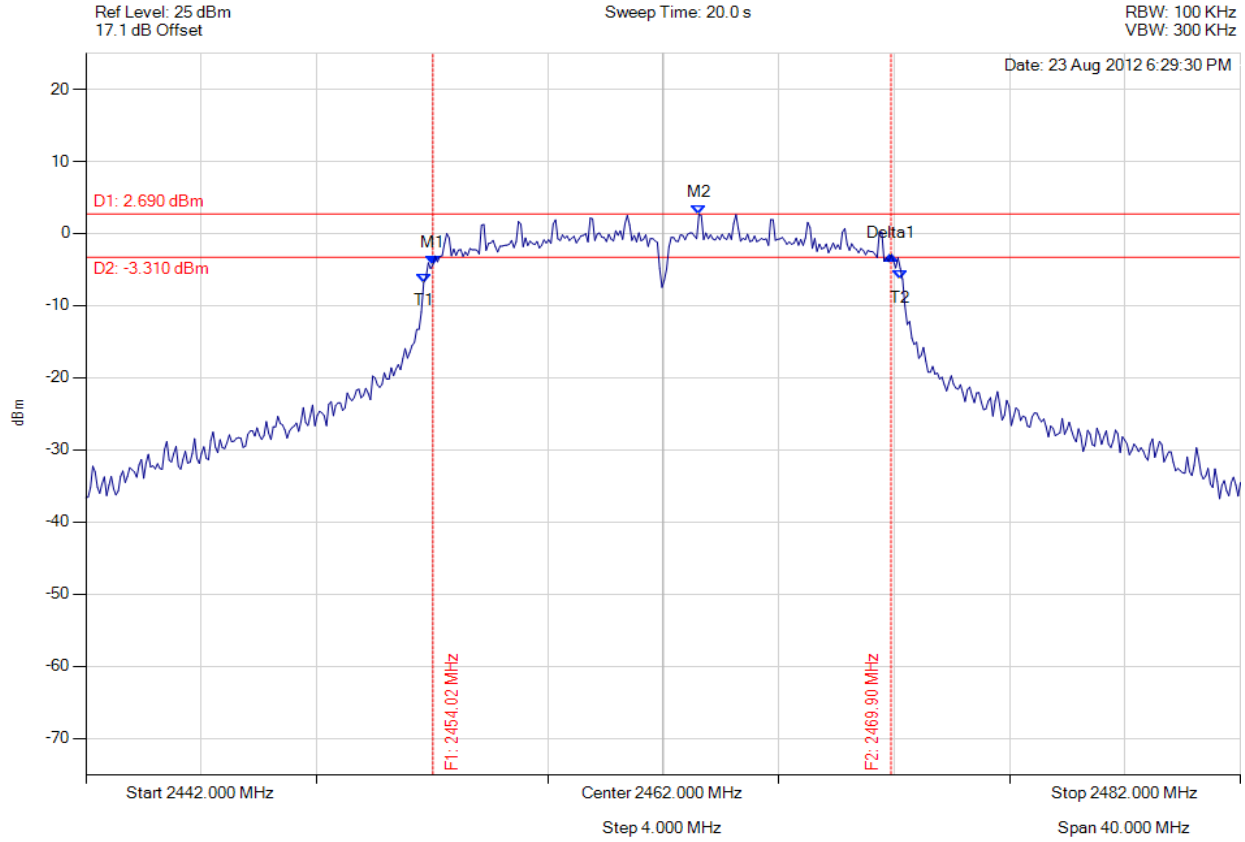


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2429.024 MHz : -3.782 dBm M2 : 2438.242 MHz : 3.086 dBm Delta1 : 15.872 MHz : 1.334 dB T1 : 2428.784 MHz : -5.226 dBm T2 : 2445.216 MHz : -6.167 dBm OBW : 16.513 MHz	Measured 6 dB Bandwidth: 15.872 MHz Limit: 0.5 MHz Margin: -15.37 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11g, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

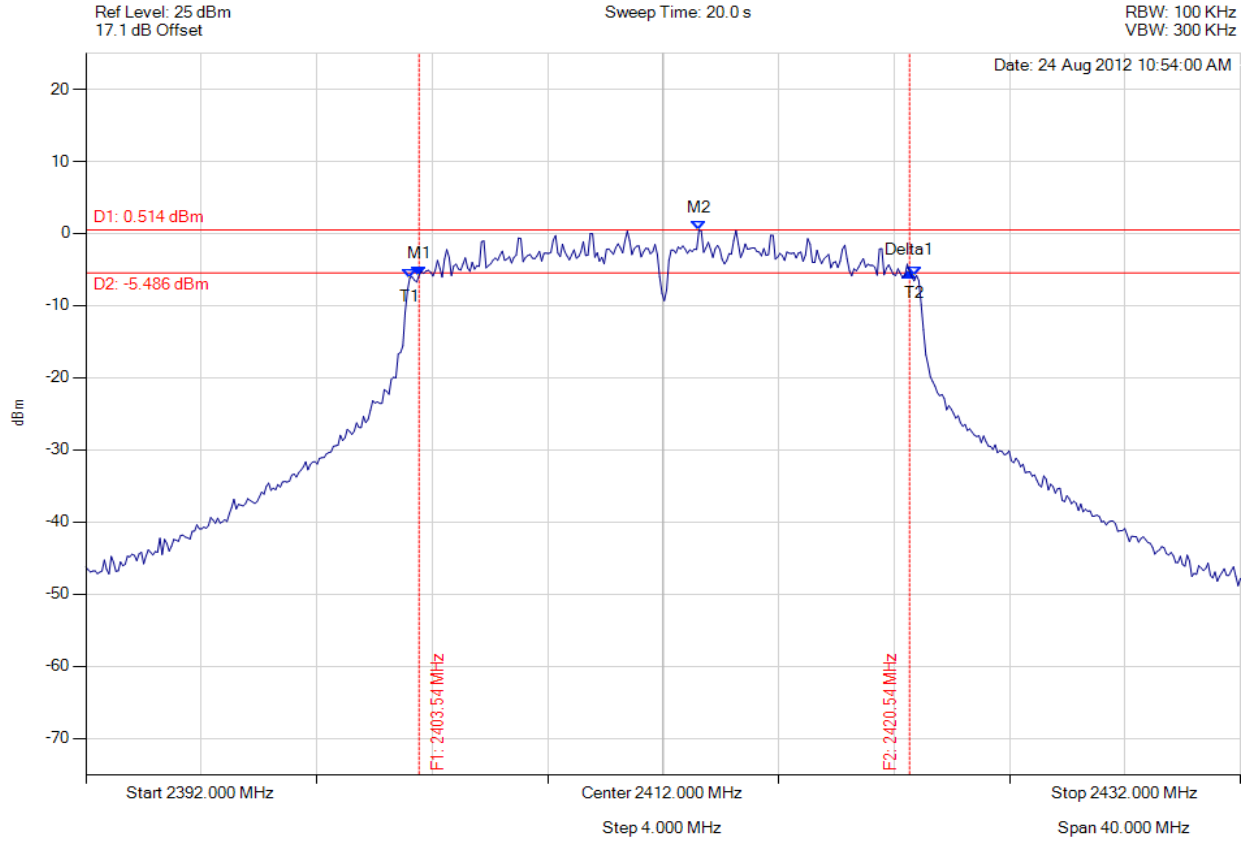


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2454.024 MHz : -4.298 dBm M2 : 2463.242 MHz : 2.690 dBm Delta1 : 15.872 MHz : 1.324 dB T1 : 2453.703 MHz : -6.822 dBm T2 : 2470.216 MHz : -6.385 dBm OBW : 16.593 MHz	Measured 6 dB Bandwidth: 15.872 MHz Limit: 0.5 MHz Margin: -15.37 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11n HT-20, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

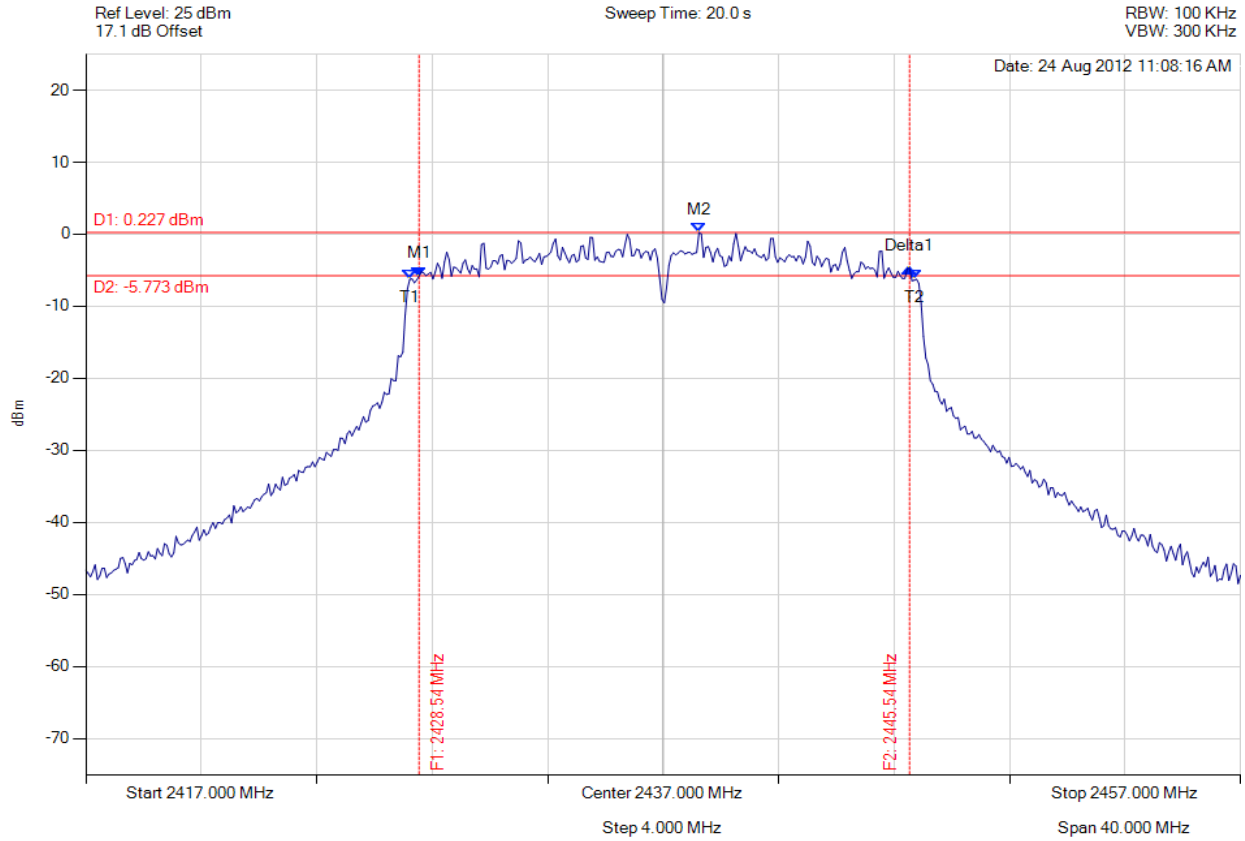


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2403.543 MHz : -5.797 dBm M2 : 2413.242 MHz : 0.514 dBm Delta1 : 16.994 MHz : 0.500 dB T1 : 2403.222 MHz : -6.177 dBm T2 : 2420.697 MHz : -5.803 dBm OBW : 17.555 MHz	Measured 6 dB Bandwidth: 16.994 MHz Limit: 0.5 MHz Margin: -16.49 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11n HT-20, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

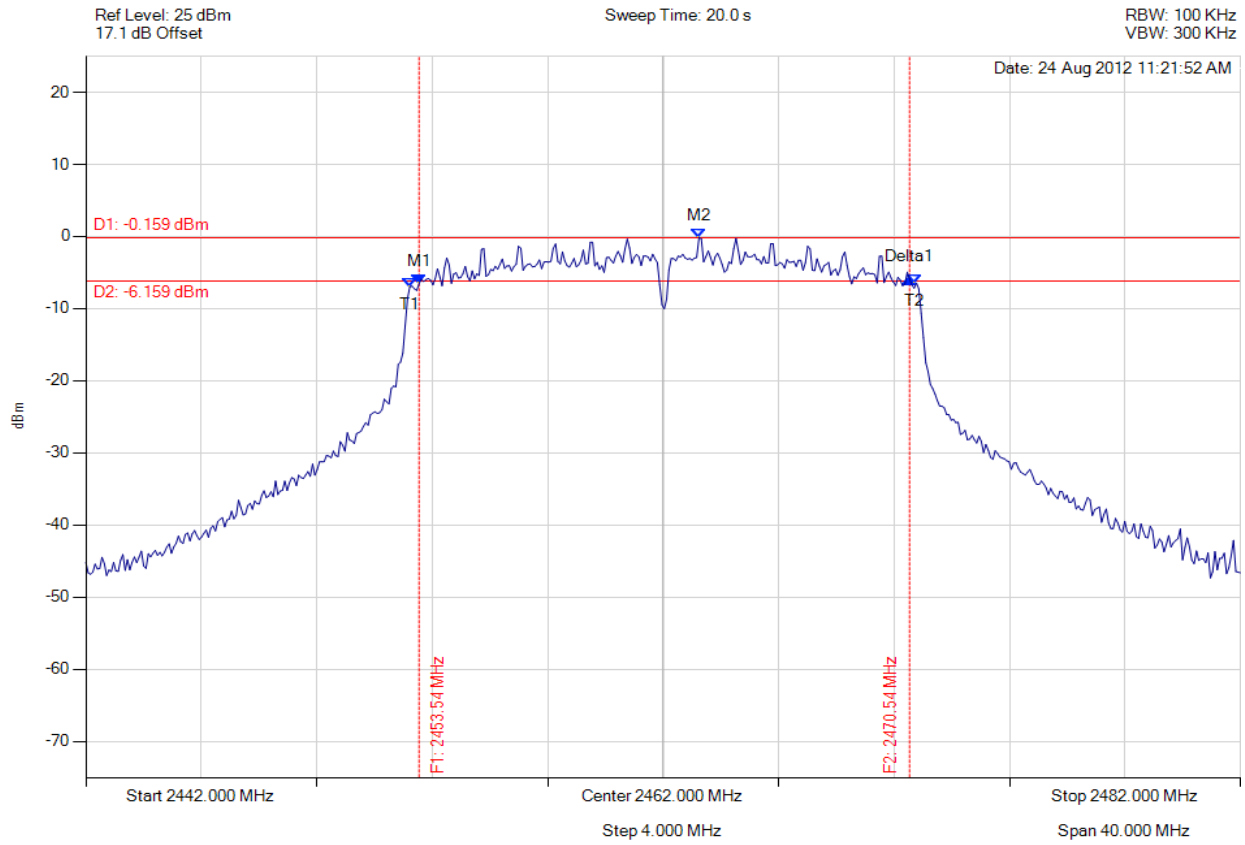


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2428.543 MHz : -5.795 dBm M2 : 2438.242 MHz : 0.227 dBm Delta1 : 16.994 MHz : 1.051 dB T1 : 2428.222 MHz : -6.259 dBm T2 : 2445.697 MHz : -6.255 dBm OBW : 17.555 MHz	Measured 6 dB Bandwidth: 16.994 MHz Limit: 0.5 MHz Margin: -16.49 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11n HT-20, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2453.543 MHz : -6.560 dBm M2 : 2463.242 MHz : -0.159 dBm Delta1 : 16.994 MHz : 0.714 dB T1 : 2453.222 MHz : -6.973 dBm T2 : 2470.697 MHz : -6.460 dBm OBW : 17.555 MHz	Measured 6 dB Bandwidth: 16.994 MHz Limit: 0.5 MHz Margin: -16.49 MHz

Back to the Matrix

Specification

Limits

§15.247 (a)(2) & RSS-210 §A8.2(1)
The minimum 6 dB bandwidth shall be at least 500 kHz.

§ IC RSS-Gen 4.4.1 Occupied Bandwidth 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.

§ IC RSS-Gen 4.4.2 6 dB Bandwidth Where indicated, the 6 dB bandwidth is measured at the points when the spectral density of the signal is 6 dB down from the in –band spectral density of the modulated signal, with the transmitter modulated by a representative signal.

Traceability

Test Equipment Used
0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117

6.1.1.2. Peak Output Power

Conducted Test Conditions for Fundamental Emission Output Power			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Emission Output Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(2)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	KDB 558074 - D01 DTS Measurement Guidance v01: Section 5.2 Fundamental Emission Output Power		

Test Procedure for Fundamental Emission Output Power Measurement
The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure peak power. The resolution filter bandwidth was set to 6 dB, peak detector selected and the analyzer built-in power function was used to integrate peak power over the 20 dB bandwidth.

Supporting Information
Calculated Power = A + G + 10 log (1/x) dBm
A = Total Power [10 Log10 ($10^{a/10}$ + $10^{b/10}$ + $10^{c/10}$ + $10^{d/10}$)], G = Antenna Gain,
x = Duty Cycle

Equipment Configuration for Peak Output Power			
Variant:	802.11b	**Duty Cycle (%):**	100
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	CCK	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm) Port(s)				Calculated Total Power (dBm)	Limit	Margin	EUT Power Setting
MHz	a	b	c	d	Σ Port(s)	dBm	dBm	
2412.0	17.42	--	--	--	17.42	30.00	-12.58	20
2437.0	17.11	--	--	--	17.11	30.00	-12.89	20
2462.0	16.75	--	--	--	16.75	30.00	-13.25	20

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 Measuring RF Output Power
Measurement Uncertainty:	±1.33 dB

Note: click the link in the above results matrix to view the plot

Equipment Configuration for Peak Output Power			
Variant:	802.11g	**Duty Cycle (%):**	100
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	OFDM	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm) Port(s)				Calculated Total Power (dBm)	Limit	Margin	EUT Power Setting
MHz	a	b	c	d	Σ Port(s)	dBm	dBm	
2412.0	21.49	--	--	--	21.49	30.00	-8.51	20
2437.0	21.15	--	--	--	21.15	30.00	-8.85	20
2462.0	20.64	--	--	--	20.64	30.00	-9.36	20

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 Measuring RF Output Power
Measurement Uncertainty:	±1.33 dB

Note: click the link in the above results matrix to view the plot

Equipment Configuration for Peak Output Power			
Variant:	802.11n HT-20	**Duty Cycle (%):**	100
Data Rate:	6.5 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	OFDM	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

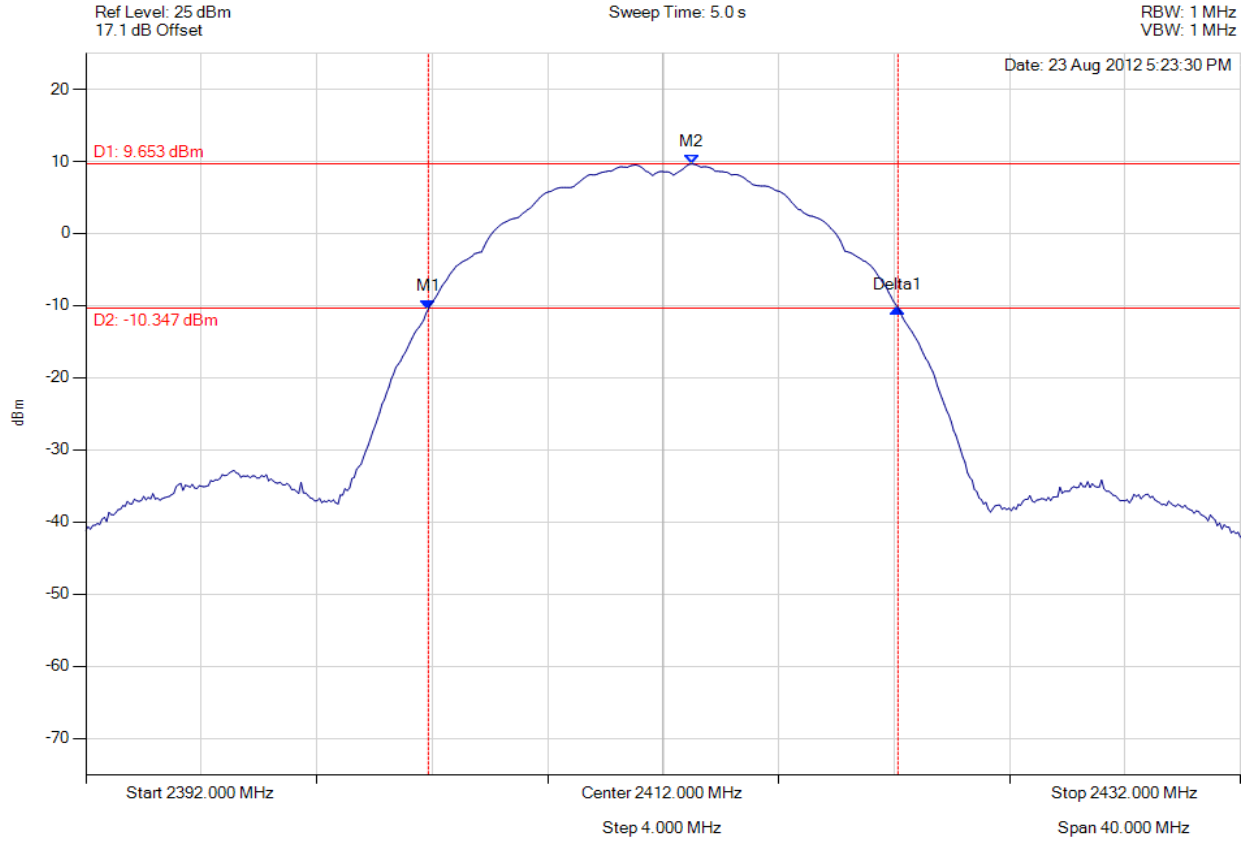
Test Frequency	Measured Output Power (dBm) Port(s)				Calculated Total Power (dBm)	Limit	Margin	EUT Power Setting
MHz	a	b	c	d	Σ Port(s)	dBm	dBm	
2412.0	18.81	--	--	--	18.81	30.00	-11.19	20
2437.0	18.49	--	--	--	18.49	30.00	-11.51	20
2462.0	18.12	--	--	--	18.12	30.00	-11.88	20

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 Measuring RF Output Power
Measurement Uncertainty:	±1.33 dB

Note: click the link in the above results matrix to view the plot

Peak Output Power

Variant: 802.11b, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

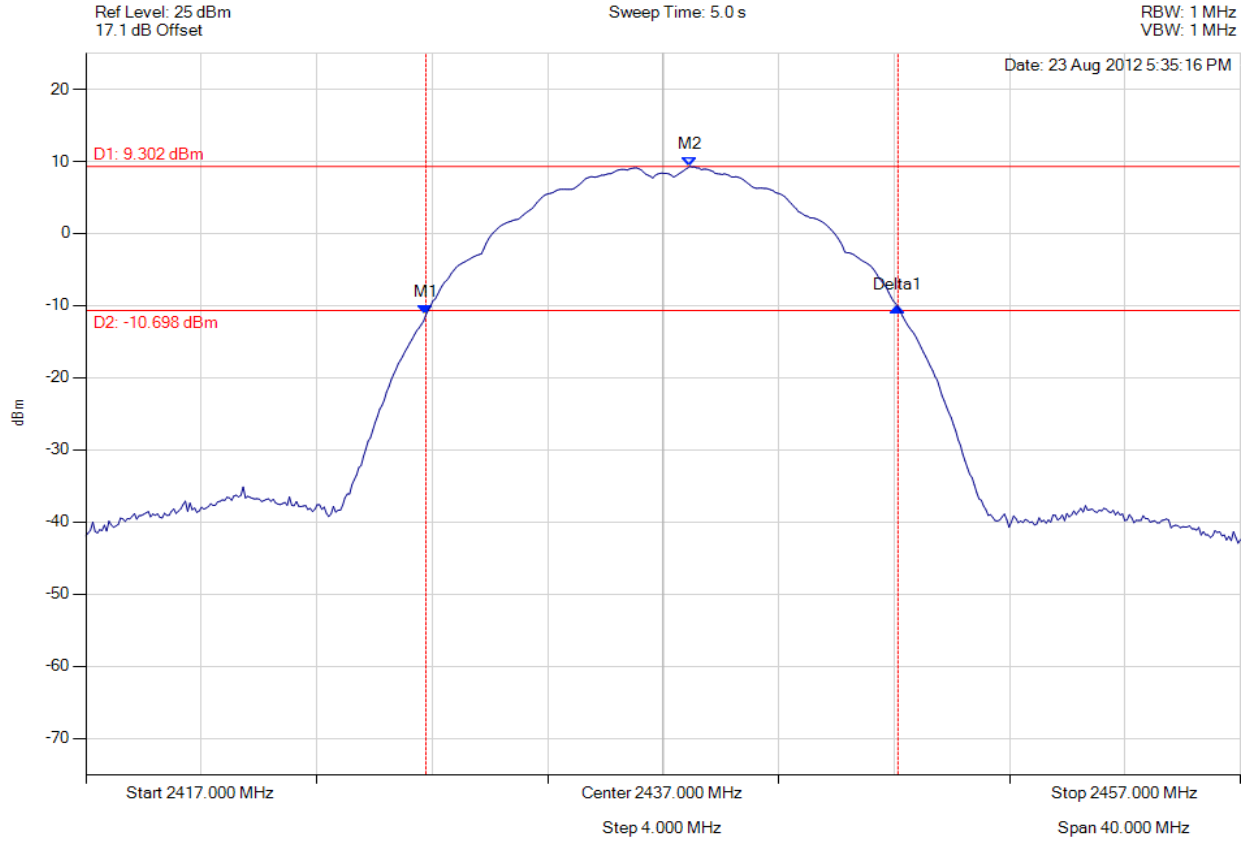


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2403.864 MHz : -10.464 dBm M2 : 2413.002 MHz : 9.653 dBm Delta1 : 16.273 MHz : 0.167 dB	Channel Power: 17.42 dBm Limit: 30.00 dBm Margin: -12.58 dB

Back to the Matrix

Peak Output Power

Variant: 802.11b, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

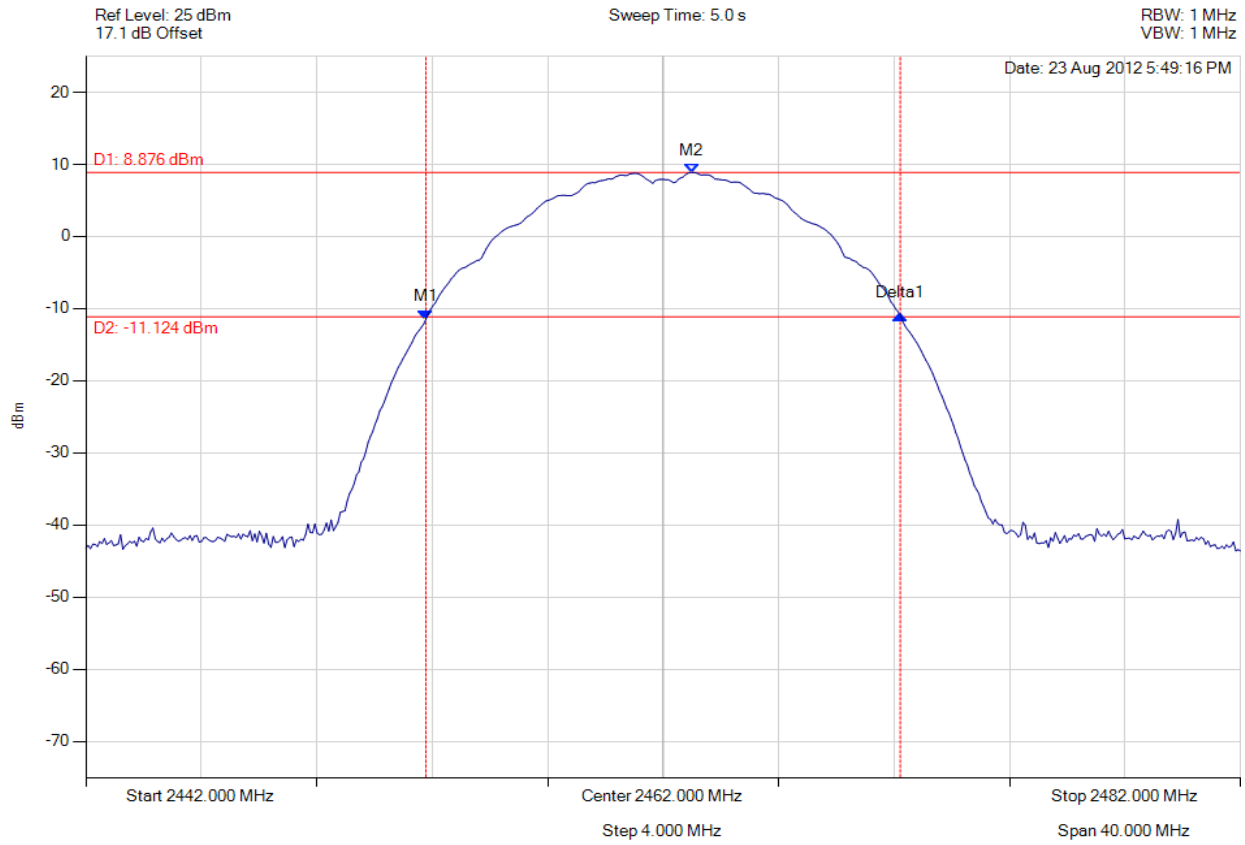


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2428.784 MHz : -11.262 dBm M2 : 2437.922 MHz : 9.302 dBm Delta1 : 16.353 MHz : 1.056 dB	Channel Power: 17.11 dBm Limit: 30.00 dBm Margin: -12.89 dB

Back to the Matrix

Peak Output Power

Variant: 802.11b, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

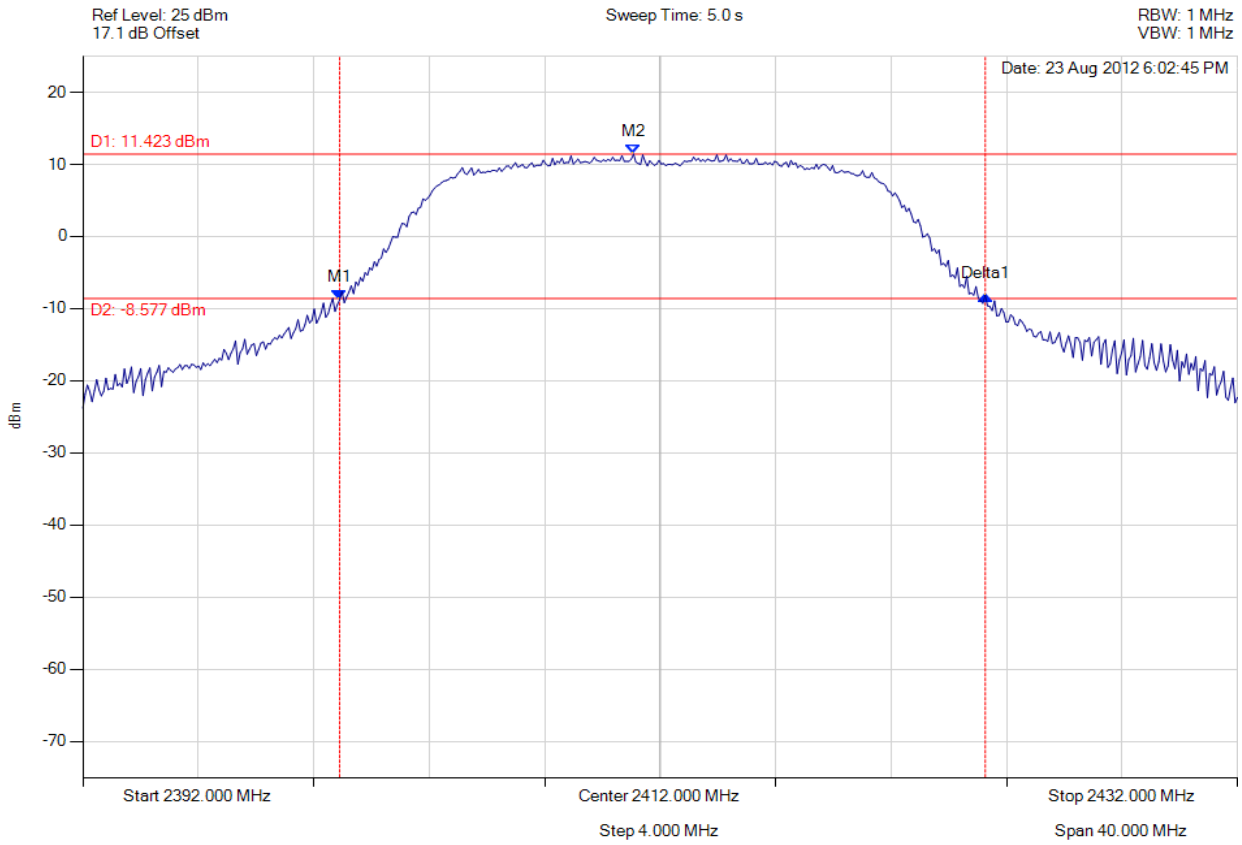


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2453.784 MHz : -11.459 dBm M2 : 2463.002 MHz : 8.876 dBm Delta1 : 16.433 MHz : 0.576 dB	Channel Power: 16.75 dBm Limit: 30.00 dBm Margin: -13.25 dB

Back to the Matrix

Peak Output Power

Variant: 802.11g, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

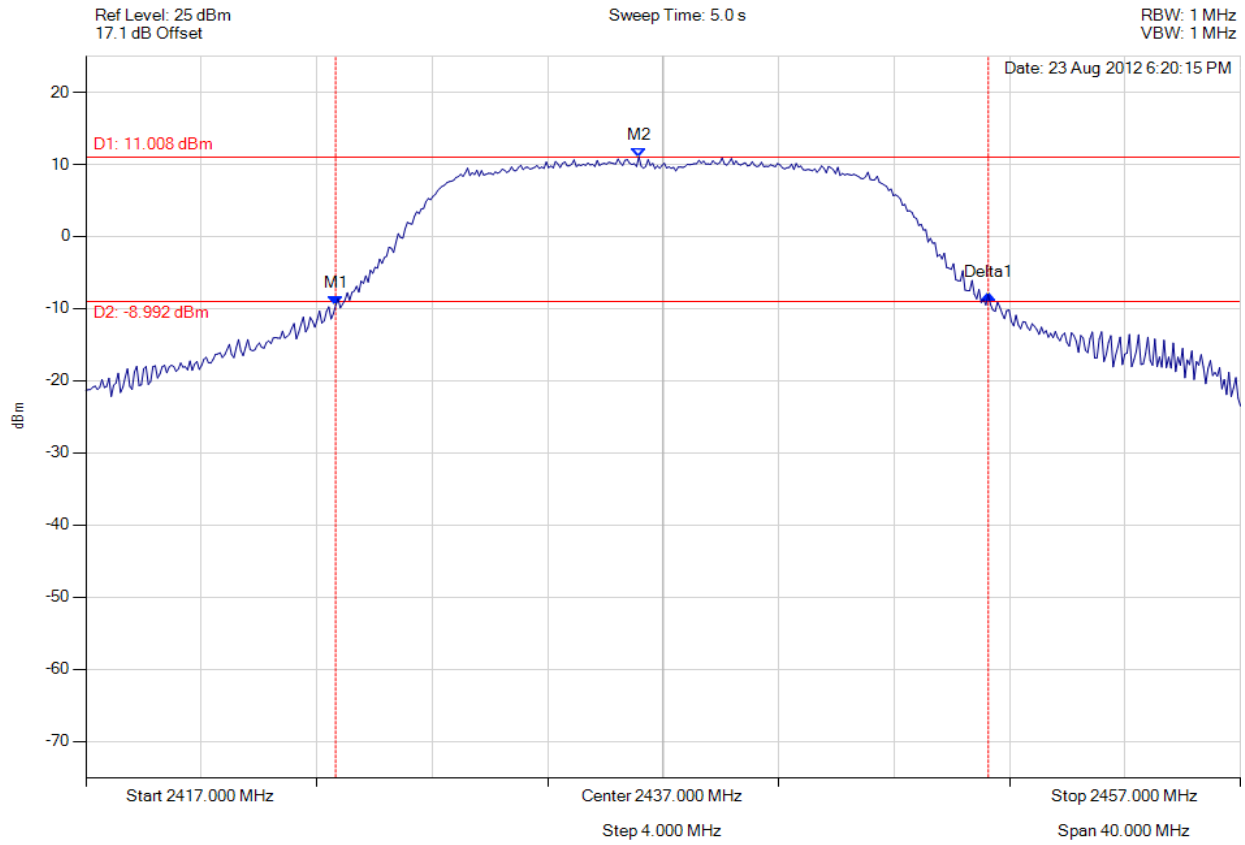


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.898 MHz : -8.766 dBm M2 : 2411.078 MHz : 11.423 dBm Delta1 : 22.365 MHz : 0.614 dB	Channel Power: 21.49 dBm Limit: 30.00 dBm Margin: -8.51 dB

Back to the Matrix

Peak Output Power

Variant: 802.11g, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

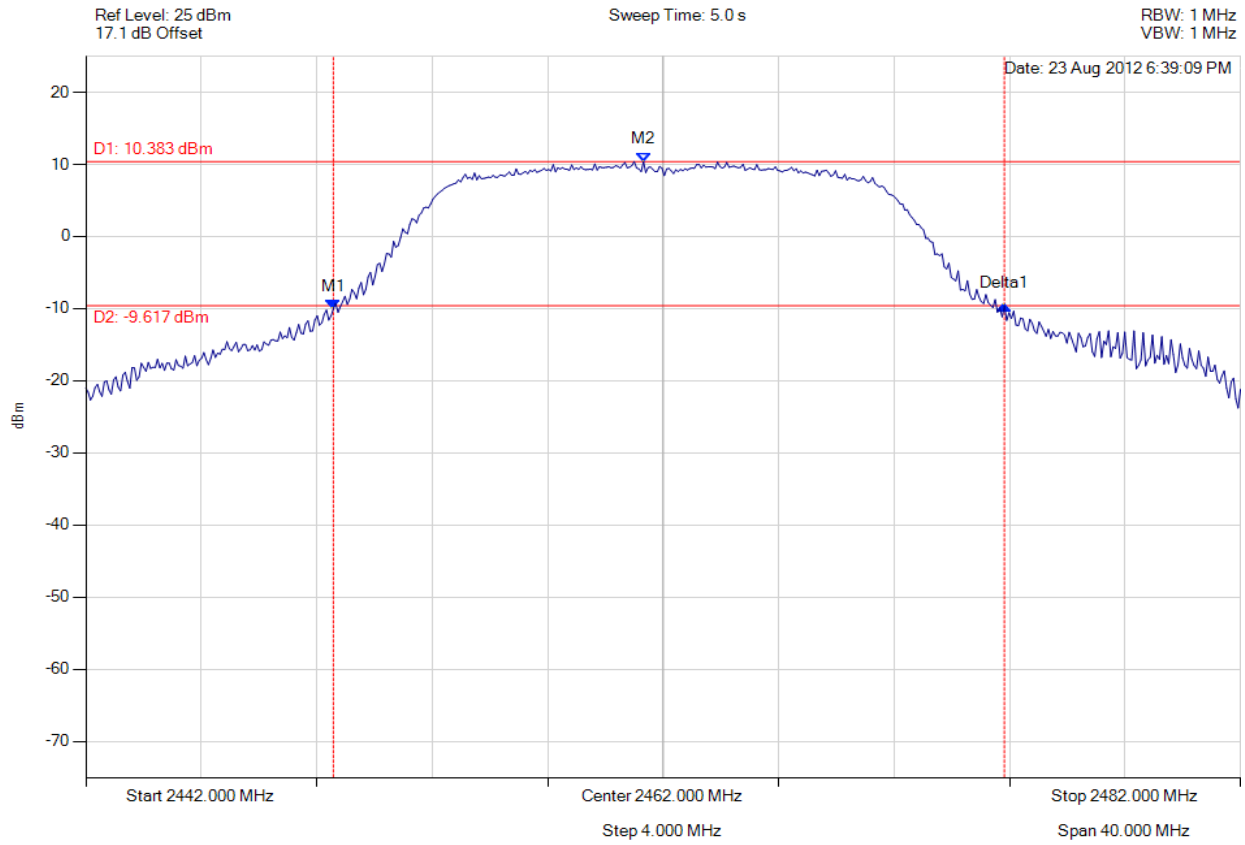


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2425.657 MHz : -9.539 dBm M2 : 2436.158 MHz : 11.008 dBm Delta1 : 22.605 MHz : 1.479 dB	Channel Power: 21.15 dBm Limit: 30.00 dBm Margin: -8.85 dB

Back to the Matrix

Peak Output Power

Variant: 802.11g, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

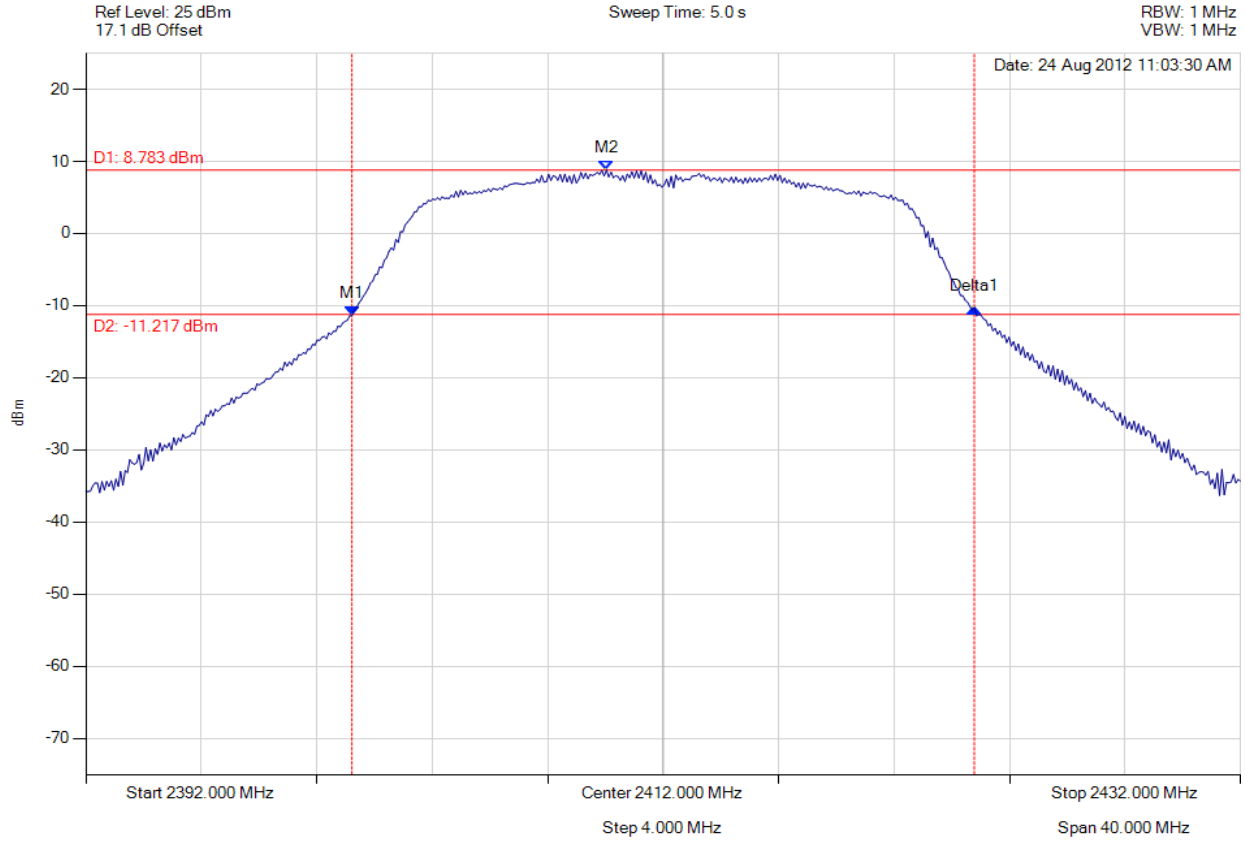


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2450.577 MHz : -9.999 dBm M2 : 2461.319 MHz : 10.383 dBm Delta1 : 23.246 MHz : 0.393 dB	Channel Power: 20.64 dBm Limit: 30.00 dBm Margin: -9.36 dB

Back to the Matrix

Peak Output Power

Variant: 802.11n HT-20, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

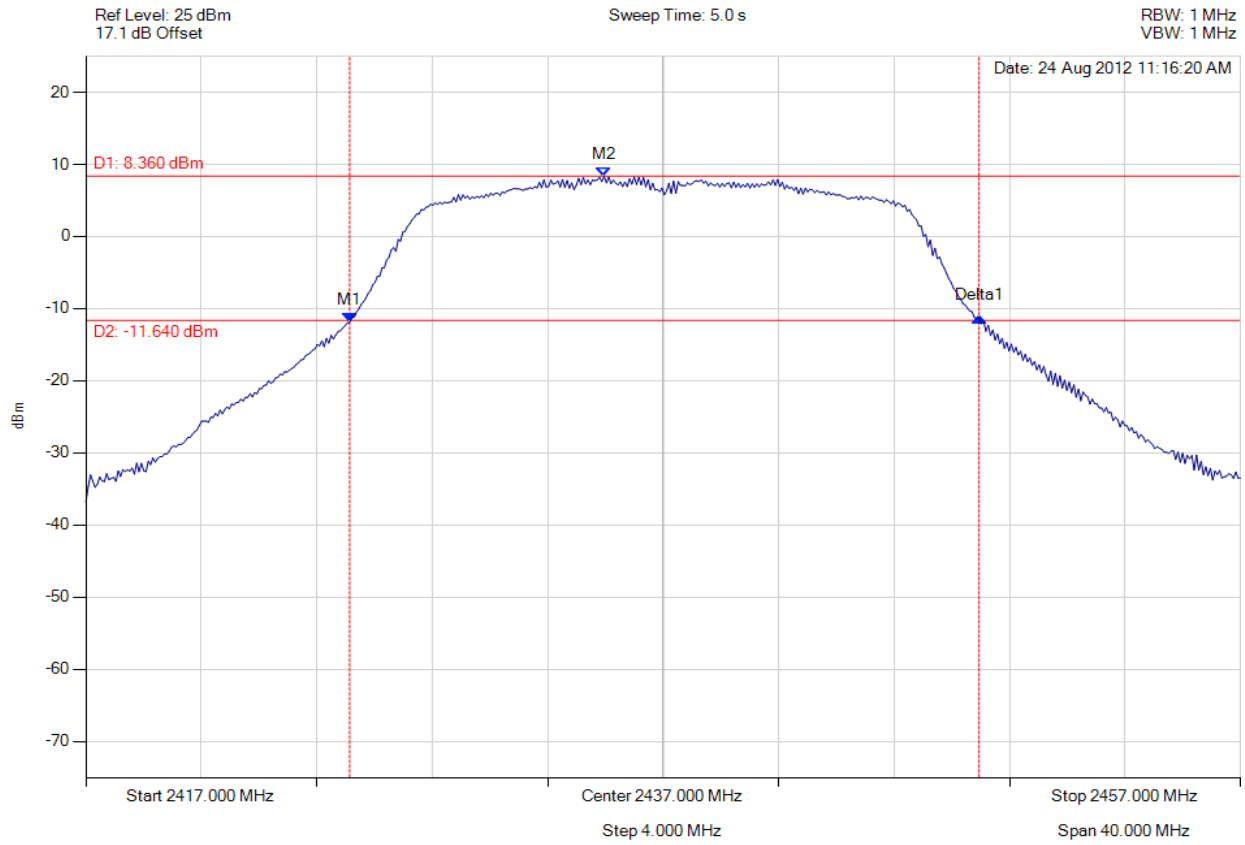


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2401.218 MHz : -11.337 dBm M2 : 2410.036 MHz : 8.783 dBm Delta1 : 21.563 MHz : 1.021 dB	Channel Power: 18.81 dBm Limit: 30.00 dBm Margin: -11.19 dB

Back to the Matrix

Peak Output Power

Variant: 802.11n HT-20, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

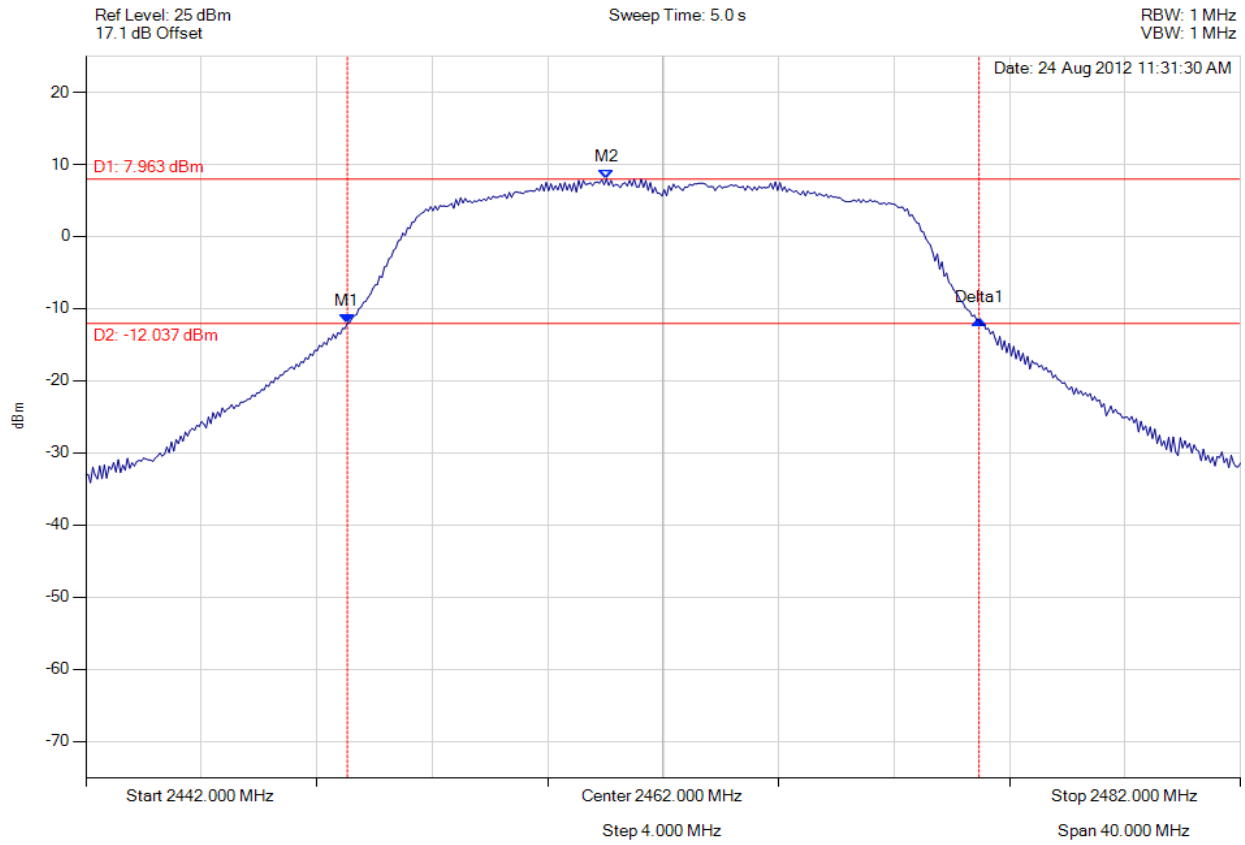


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2426.138 MHz : -11.912 dBm M2 : 2434.956 MHz : 8.360 dBm Delta1 : 21.804 MHz : 0.718 dB	Channel Power: 18.49 dBm Limit: 30.00 dBm Margin: -11.51 dB

Back to the Matrix

Peak Output Power

Variant: 802.11n HT-20, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2451.058 MHz : -12.055 dBm M2 : 2460.036 MHz : 7.963 dBm Delta1 : 21.884 MHz : 0.551 dB	Channel Power: 18.12 dBm Limit: 30.00 dBm Margin: -11.88 dB

Back to the Matrix

Specification

Limits

§15.247 (b) The maximum peak output power of the intentional radiator shall not exceed the following:

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1.0 watt.

15.247 (b) (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

15.247 (c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

§15.31 (e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

§ RSS-210 A8.4(4) For systems employing digital modulation techniques operating in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands the maximum peak conducted power shall not exceed 1 watt.

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

6.1.1.3. Power Spectral Density

Conducted Test Conditions for Power Spectral Density			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Power Spectral Density	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (e)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	KDB 558074 - D01 DTS Measurement Guidance v01: Section 5.3 Maximum Power Spectral Density Level in the Emission Bandwidth		

Test Procedure for Power Spectral Density
The transmitter output was connected to a spectrum analyzer. With the analyzer span set to 5 - 30 % greater than the emission band width (EBW) the peak emission was found over the full emission bandwidth and centered on the analyzer, the frequency span was subsequently reduced to obtain enhanced resolution. Sweep time ≥ span / 3 kHz with video averaging turned off. The Power Spectral Density is the highest level found across the emission in a 3 kHz resolution bandwidth.

Supporting Information
Calculated Power = A + 10 log (1/x) dBm
A = Total Power Spectral Density [10 Log10 (10a/10 + 10 b/10 + 10c/10 + 10d/10)]
x = Duty Cycle
Limit Line: KDB 662911 was implemented for In-band power spectral density (PSD) measurements - Option (2) measure and subtract 10 log (N) dB from the limit for devices with multiple RF ports

Equipment Configuration for Power Spectral Density			
Variant:	802.11b	**Duty Cycle (%):**	100
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	CCK	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Power Spectral Density (dBm)				Calculated Total Power Spectral Density (dBm)		Limit	Margin
	Port(s)							
MHz	a	b	c	d	Σ Port(s)	Conversion to 3 kHz RBW	dBm	dB
2412.0	-8.744	--	--	--	-8.744	N/A	8.0	-16.74
2437.0	-8.992	--	--	--	-8.992	N/A	8.0	-16.99
2462.0	-9.246	--	--	--	-9.246	N/A	8.0	-17.25

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring Spectrum Mask
Measurement Uncertainty:	±2.81 dB

Note: click the link in the above results matrix to view the plot

Equipment Configuration for Power Spectral Density			
Variant:	802.11g	**Duty Cycle (%):**	100
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	OFDM	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Power Spectral Density (dBm)				Calculated Total Power Spectral Density (dBm)		Limit	Margin
	Port(s)							
MHz	a	b	c	d	Σ Port(s)	Conversion to 3 kHz RBW	dBm	dB
2412.0	-11.369	--	--	--	-11.369	N/A	8.0	-19.37
2437.0	-11.341	--	--	--	-11.341	N/A	8.0	-19.34
2462.0	-11.441	--	--	--	-11.441	N/A	8.0	-19.44

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring Spectrum Mask
Measurement Uncertainty:	±2.81 dB

Note: click the link in the above results matrix to view the plot

Equipment Configuration for Power Spectral Density			
Variant:	802.11n HT-20	**Duty Cycle (%):**	100
Data Rate:	6.5 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	OFDM	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

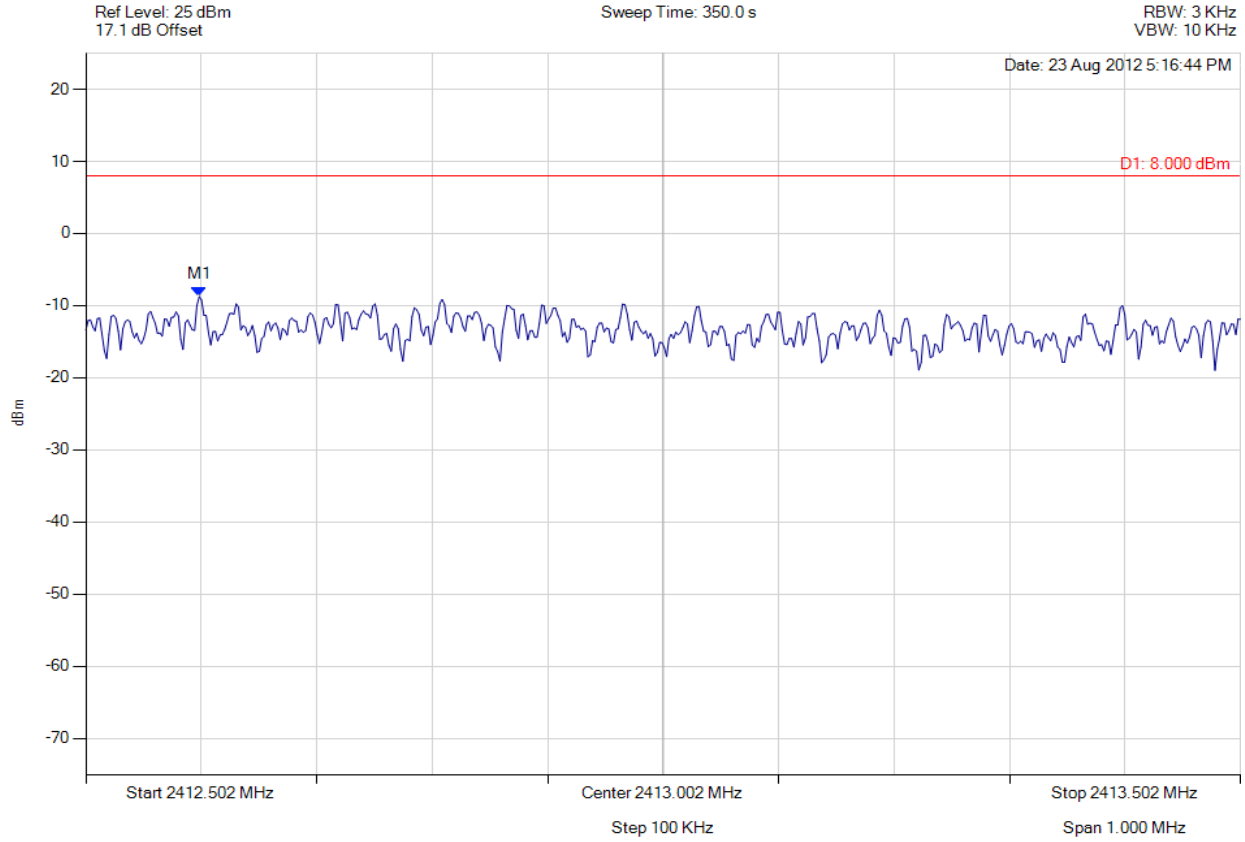
Test Frequency	Measured Power Spectral Density (dBm)				Calculated Total Power Spectral Density (dBm)		Limit	Margin
	Port(s)							
MHz	a	b	c	d	Σ Port(s)	Conversion to 3 kHz RBW	dBm	dB
2412.0	-17.021	--	--	--	-17.021	N/A	8.0	-25.02
2437.0	-17.448	--	--	--	-17.448	N/A	8.0	-25.45
2462.0	-17.821	--	--	--	-17.821	N/A	8.0	-25.82

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring Spectrum Mask
Measurement Uncertainty:	±2.81 dB

Note: click the link in the above results matrix to view the plot

Power Spectral Density

Variant: 802.11b, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

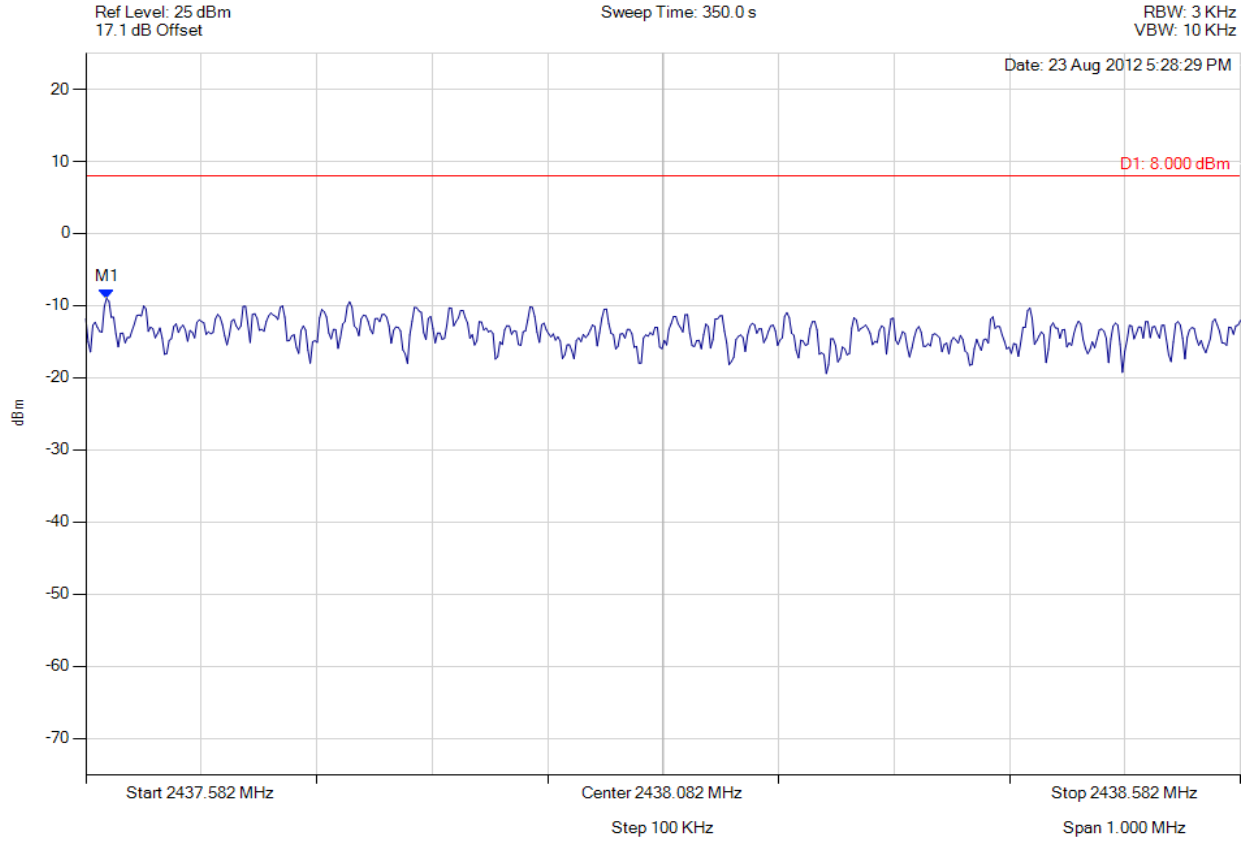


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2412.600 MHz : -8.744 dBm	Limit: 8.000 dBm Margin: -16.74 dB

Back to the Matrix

Power Spectral Density

Variant: 802.11b, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

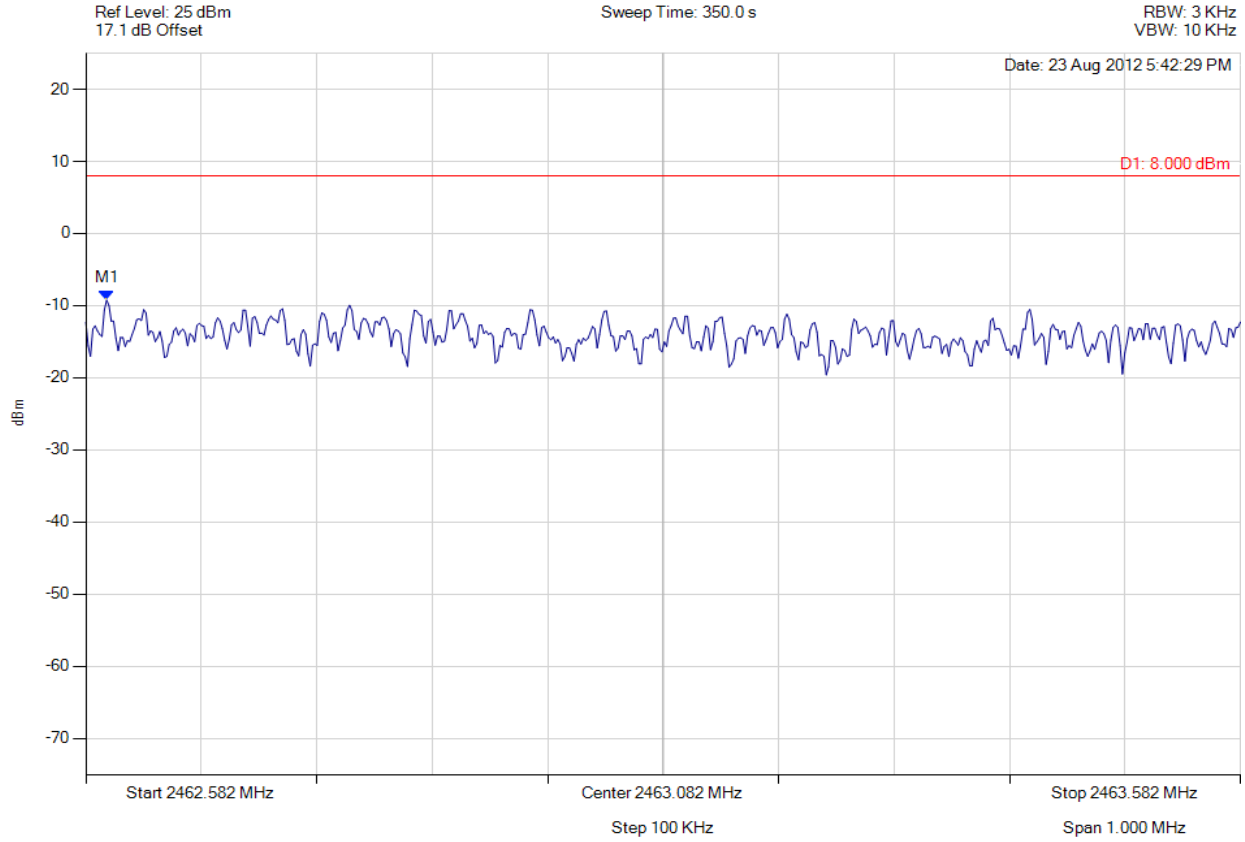


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2437.600 MHz : -8.992 dBm	Limit: 8.000 dBm Margin: -16.99 dB

Back to the Matrix

Power Spectral Density

Variant: 802.11b, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

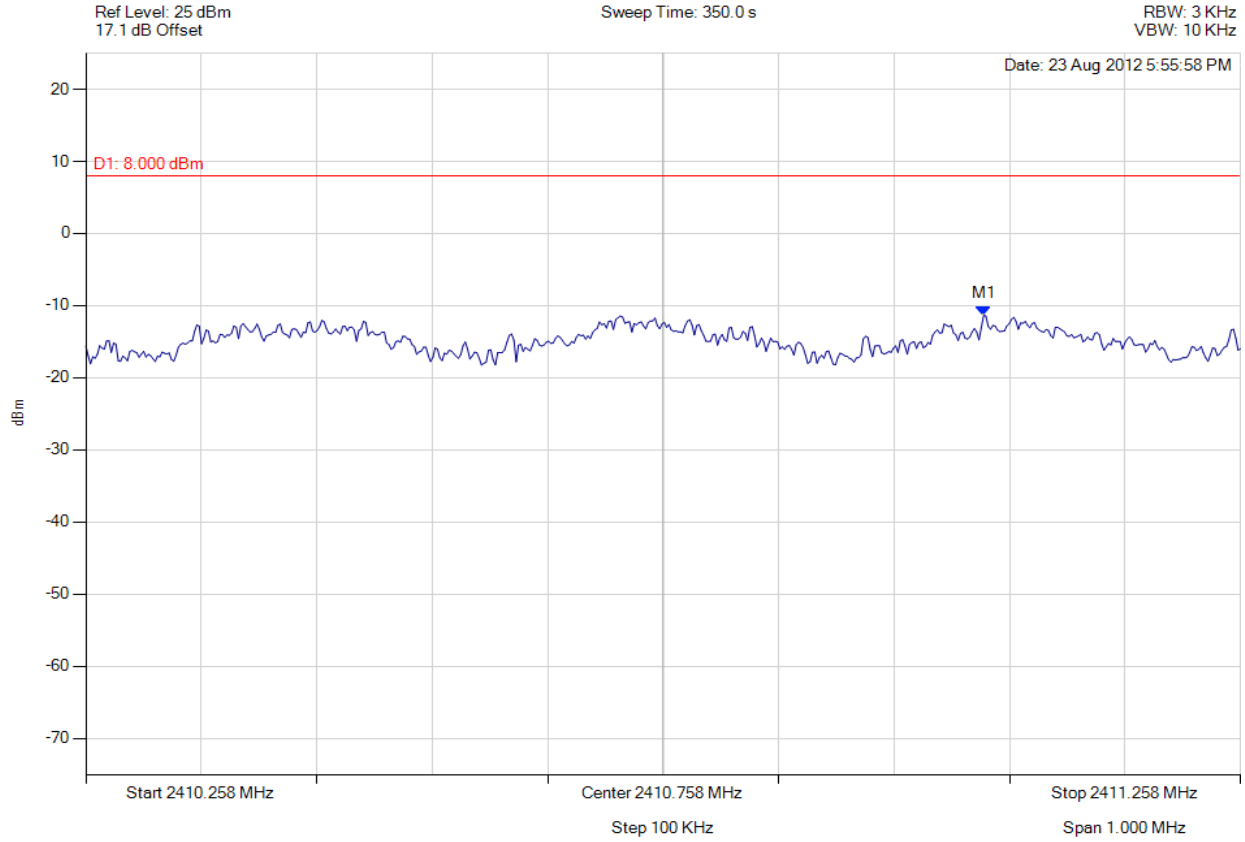


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2462.600 MHz : -9.246 dBm	Limit: 8.000 dBm Margin: -17.25 dB

Back to the Matrix

Power Spectral Density

Variant: 802.11g, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

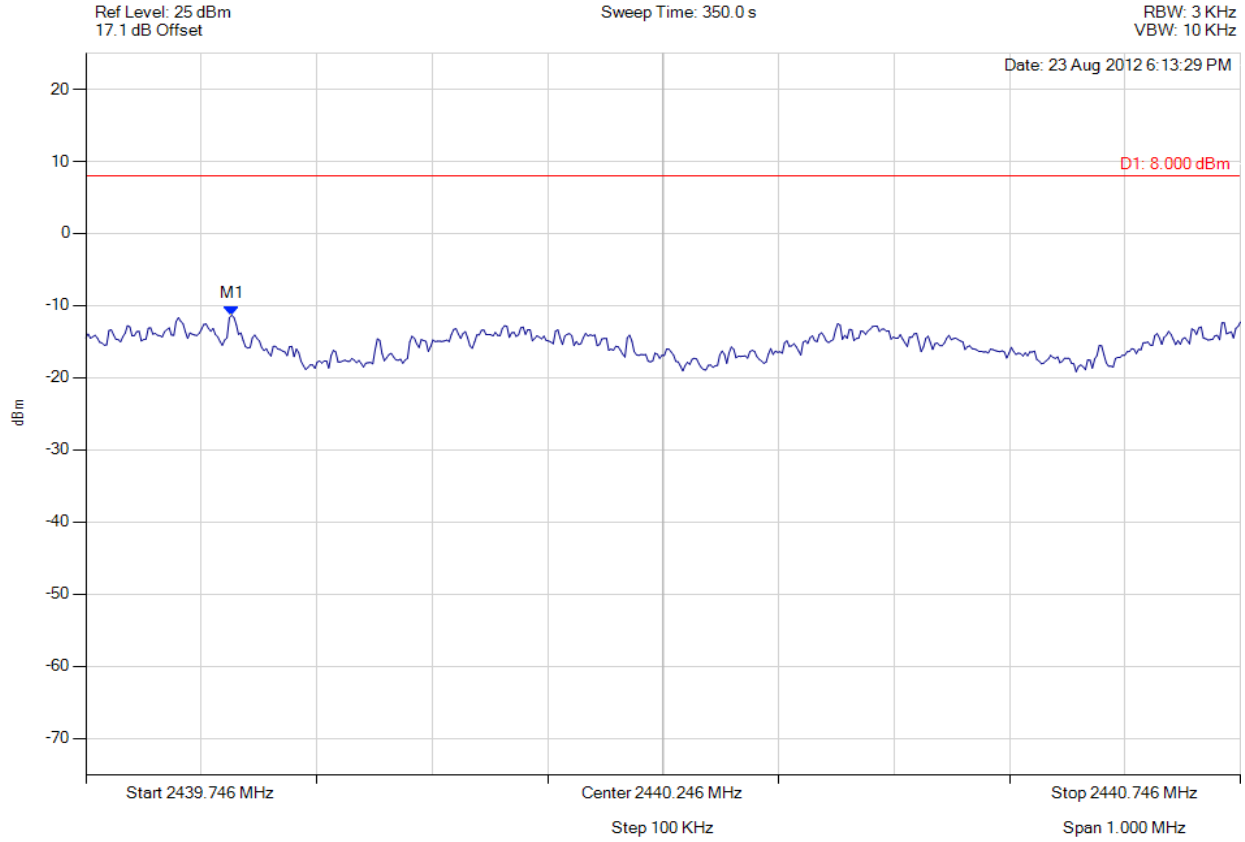


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2411.035 MHz : -11.369 dBm	Limit: 8.000 dBm Margin: -19.37 dB

Back to the Matrix

Power Spectral Density

Variant: 802.11g, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

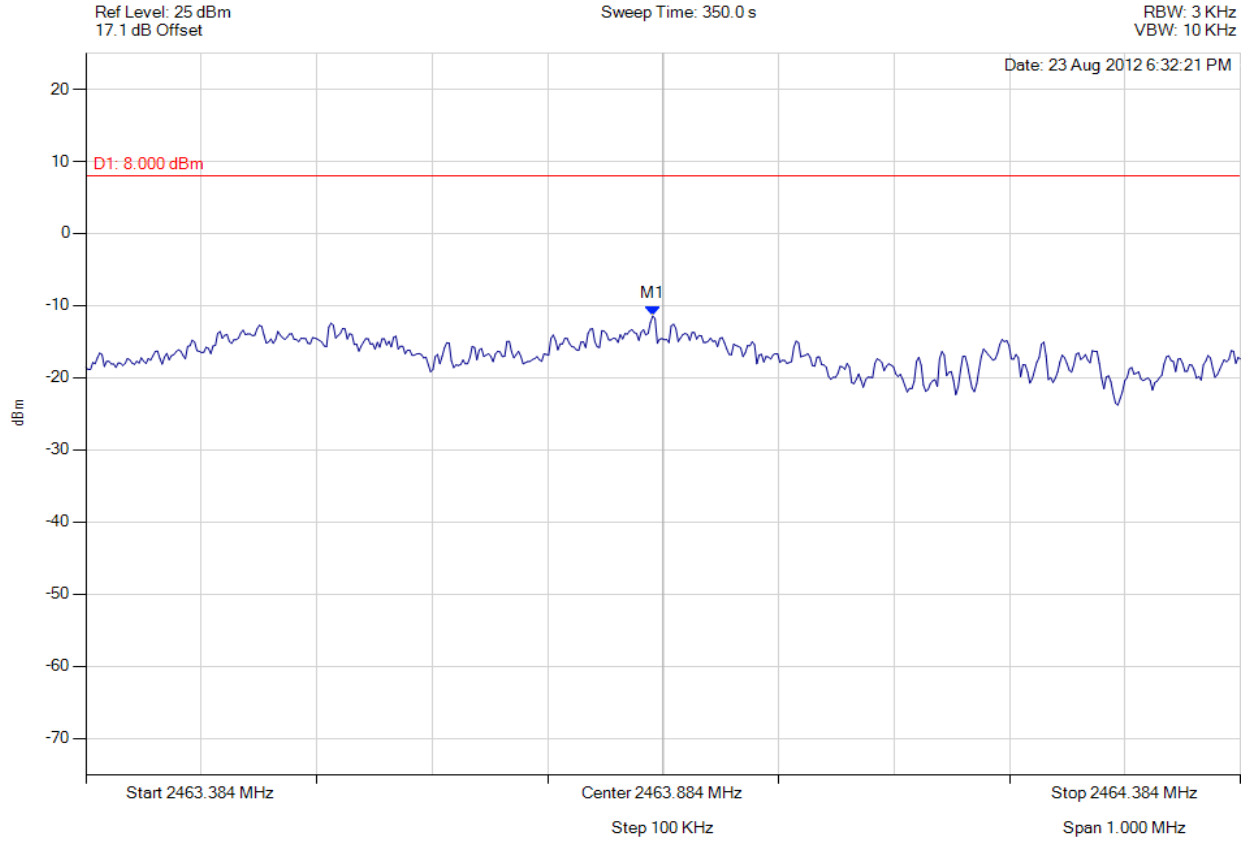


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2439.873 MHz : -11.341 dBm	Limit: 8.000 dBm Margin: -19.34 dB

Back to the Matrix

Power Spectral Density

Variant: 802.11g, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

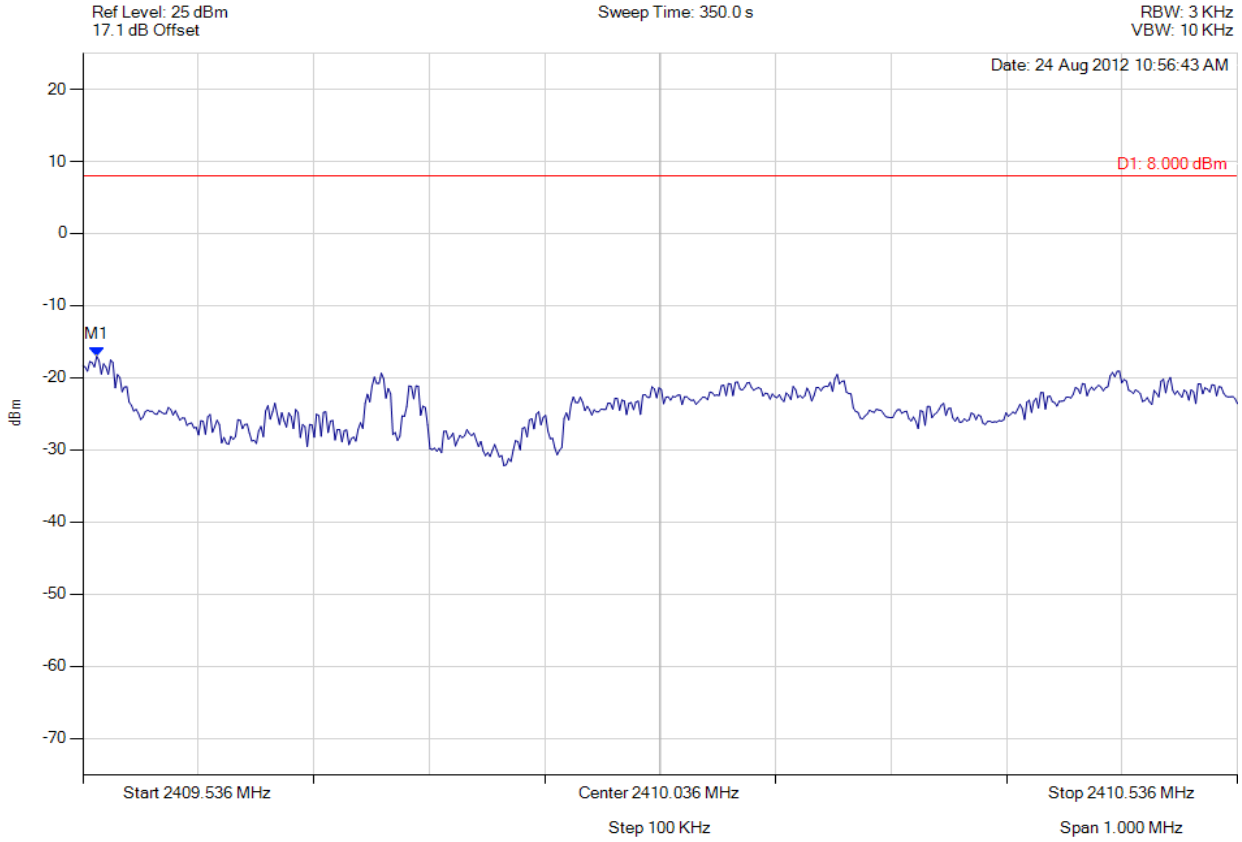


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2463.875 MHz : -11.441 dBm	Limit: 8.000 dBm Margin: -19.44 dB

Back to the Matrix

Power Spectral Density

Variant: 802.11n HT-20, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

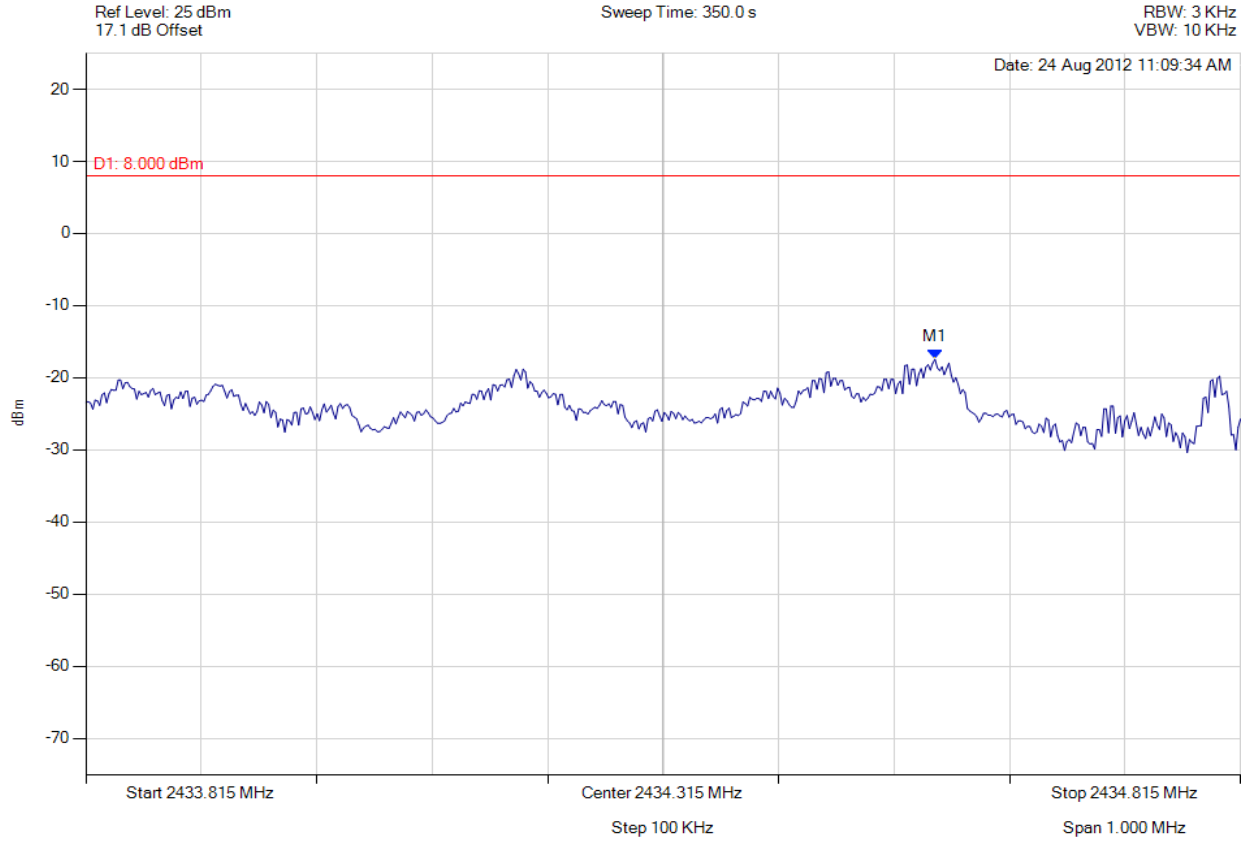


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2409.548 MHz : -17.021 dBm	Limit: 8.000 dBm Margin: -25.02 dB

Back to the Matrix

Power Spectral Density

Variant: 802.11n HT-20, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

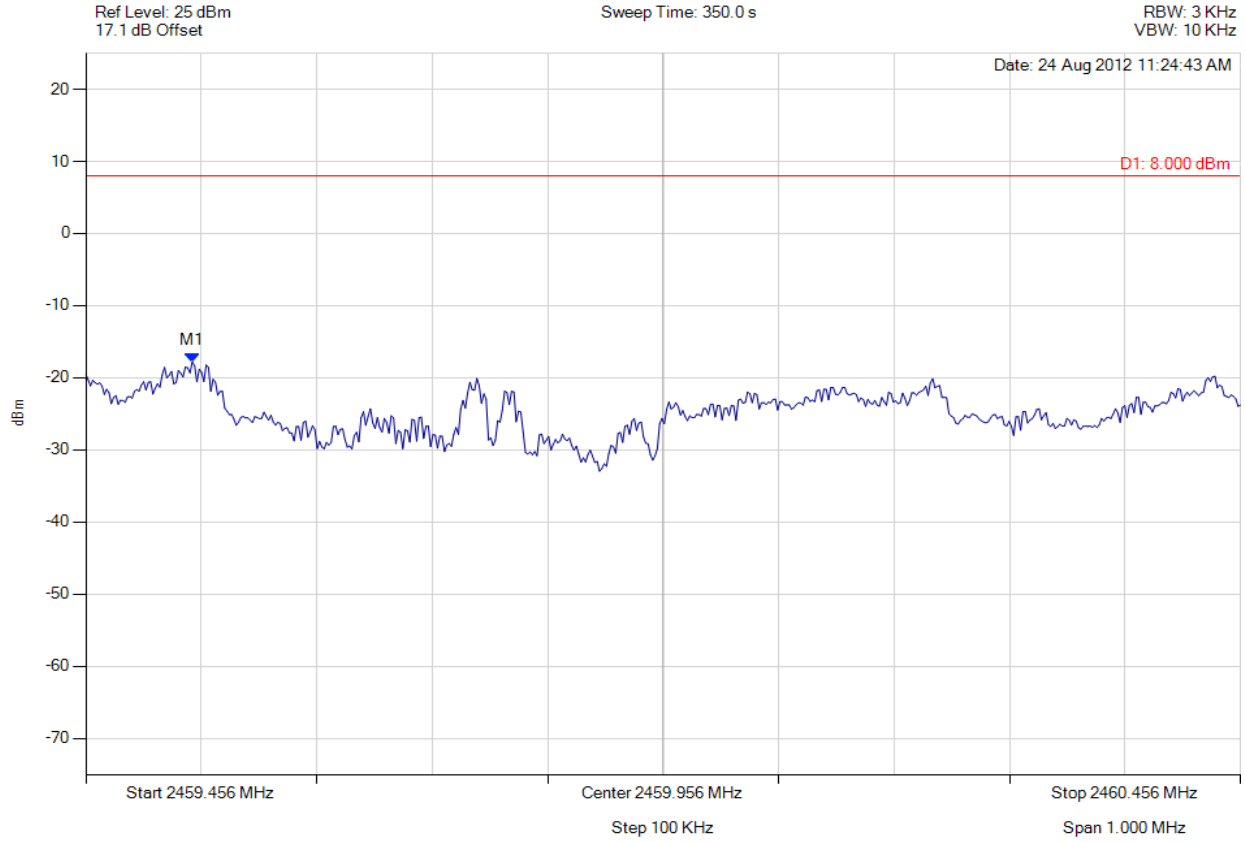


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2434.550 MHz : -17.448 dBm	Limit: 8.000 dBm Margin: -25.45 dB

Back to the Matrix

Power Spectral Density

Variant: 802.11n HT-20, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2459.548 MHz : -17.821 dBm	Limit: 8.000 dBm Margin: -25.82 dB

Back to the Matrix

Specification
Peak Power Spectral Density Limits

§15.247(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission

RSS-210 §**A8.2(2)** The transmitter power spectral density (into the antenna) shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.

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

6.1.1.4. Conducted Spurious Emissions

Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Max Unwanted Emission Levels	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (d)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	KDB 558074 - D01 DTS Measurement Guidance v01: Section 5.4 Maximum Unwanted Emission Levels		

Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement

Transmitter Conducted Spurious and Band-Edge emissions were measured at a limit of 20 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Measurements were made while EUT was operating in transmit mode of operation at the appropriate centre frequency closest to the band-edge. Emissions were maximized during the measurement and limits derived from the peak spectral power and drawn on each plot.

Equipment Configuration for Transmitter Conducted Spurious and Band-Edge Emissions			
Variant:	802.11b	**Duty Cycle (%):**	100
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	CCK	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Transmitter Conducted Spurious Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
2412.0	30.0 - 26000.0	-44.478	-14.90	--	--	--	--	--	--
2437.0	30.0 - 26000.0	-44.459	-15.96	--	--	--	--	--	--
2462.0	30.0 - 26000.0	-48.572	-15.31	--	--	--	--	--	--

SE - Maximum spurious emission found

Test Frequency	Band-Edge Frequency	Transmitter Conducted Band-Edge Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	BE	Limit	BE	Limit	BE	Limit	BE	Limit
2412.0	2400.0	-44.040	-14.37	--	--	--	--	--	--
2462.0	2483.5	-49.694	-15.25	--	--	--	--	--	--

BE - Maximum band-edge emission found

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring Spectrum Mask
Measurement Uncertainty:	±2.81 dB

Note: click the link in the above results matrix to view the plot

Equipment Configuration for Transmitter Conducted Spurious and Band-Edge Emissions			
Variant:	802.11g	**Duty Cycle (%):**	100
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	N/A
Modulation:	OFDM	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Transmitter Conducted Spurious Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
2412.0	30.0 - 26000.0	-43.949	-17.03	--	--	--	--	--	--
2437.0	30.0 - 26000.0	-44.311	-16.82	--	--	--	--	--	--
2462.0	30.0 - 26000.0	-48.464	-17.71	--	--	--	--	--	--

SE - Maximum spurious emission found

Test Frequency	Band-Edge Frequency	Transmitter Conducted Band-Edge Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	BE	Limit	BE	Limit	BE	Limit	BE	Limit
2412.0	2400.0	-25.885	-16.41	--	--	--	--	--	--
2462.0	2483.5	-39.426	-17.32	--	--	--	--	--	--

BE - Maximum band-edge emission found

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring Spectrum Mask
Measurement Uncertainty:	±2.81 dB

Note: click the link in the above results matrix to view the plot

Equipment Configuration for Transmitter Conducted Spurious and Band-Edge Emissions			
Variant:	802.11n HT-20	**Duty Cycle (%):**	100
Data Rate:	6.5 MBit/s (MCS0)	**Antenna Gain (dBi):**	N/A
Modulation:	OFDM	**Beam Forming Gain (Y):**	N/A
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Transmitter Conducted Spurious Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
2412.0	30.0 - 26000.0	-43.345	-19.64	--	--	--	--	--	--
2437.0	30.0 - 26000.0	-43.973	-20.03	--	--	--	--	--	--
2462.0	30.0 - 26000.0	-52.546	-20.49	--	--	--	--	--	--

SE - Maximum spurious emission found

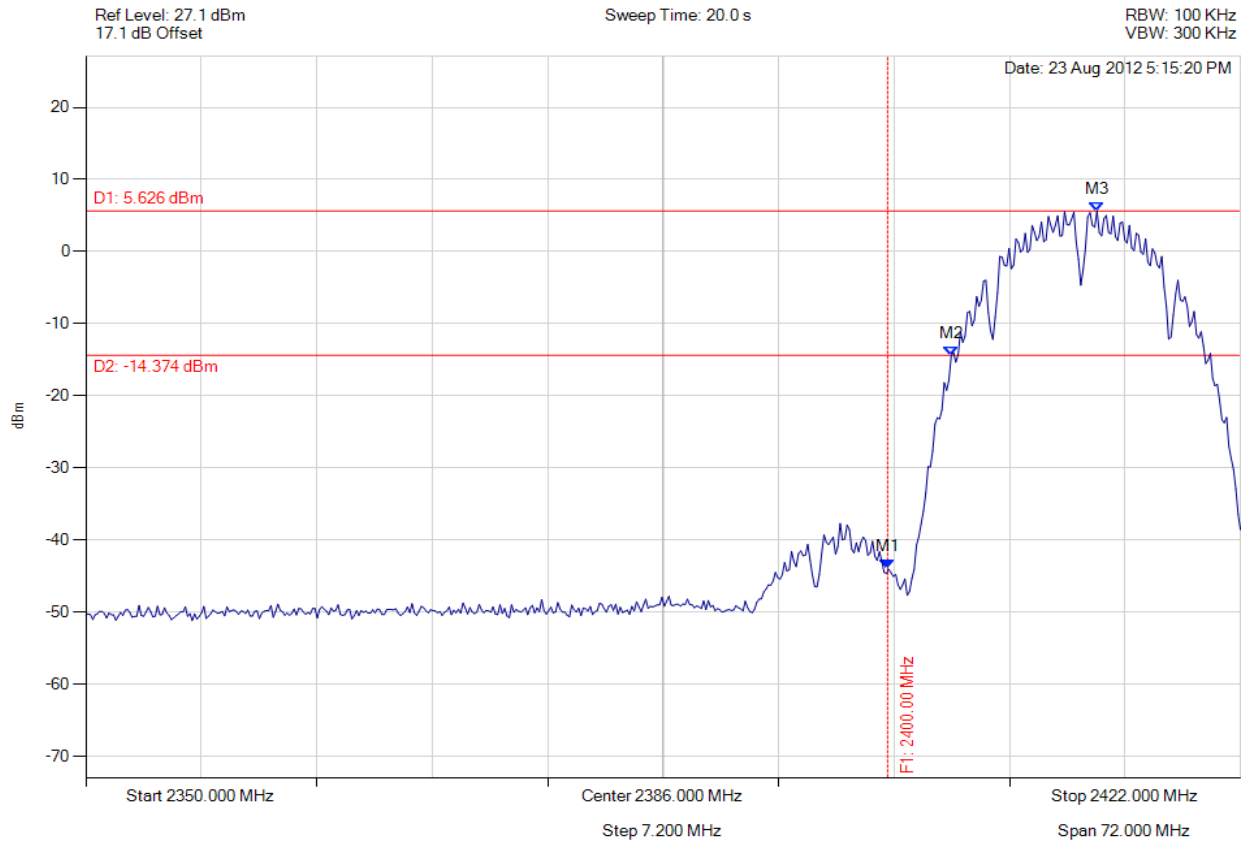
Test Frequency	Band-Edge Frequency	Transmitter Conducted Band-Edge Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	BE	Limit	BE	Limit	BE	Limit	BE	Limit
2412.0	2400.0	-31.323	-19.58	--	--	--	--	--	--
2462.0	2483.5	-48.566	-20.25	--	--	--	--	--	--

BE - Maximum band-edge emission found

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring Spectrum Mask
Measurement Uncertainty:	±2.81 dB

Conducted Band-Edge Emissions

Variant: 802.11b, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

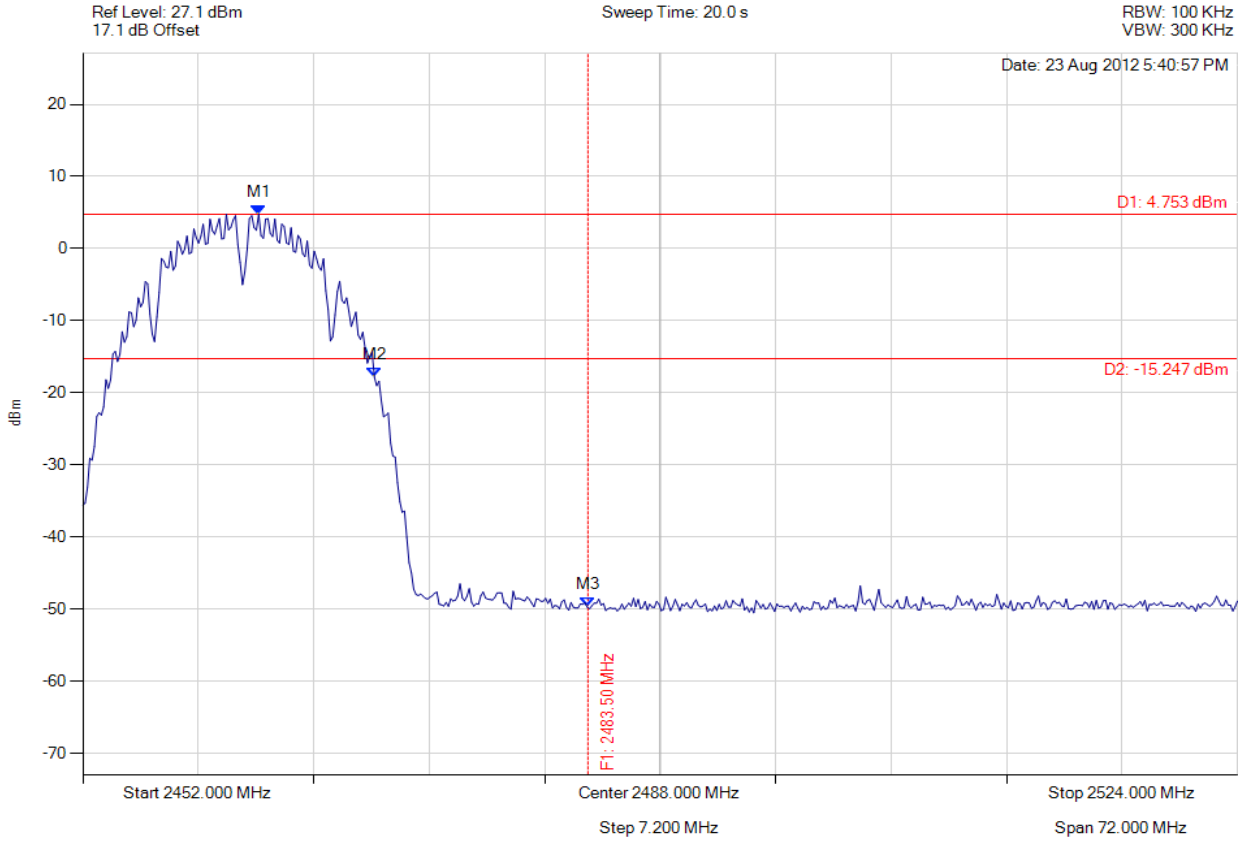


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.000 MHz : -44.040 dBm M2 : 2403.964 MHz : -14.405 dBm M3 : 2413.054 MHz : 5.626 dBm	Limit: -14.37 dBm Margin: -29.67 dB

Back to the Matrix

Conducted Band-Edge Emissions

Variant: 802.11b, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

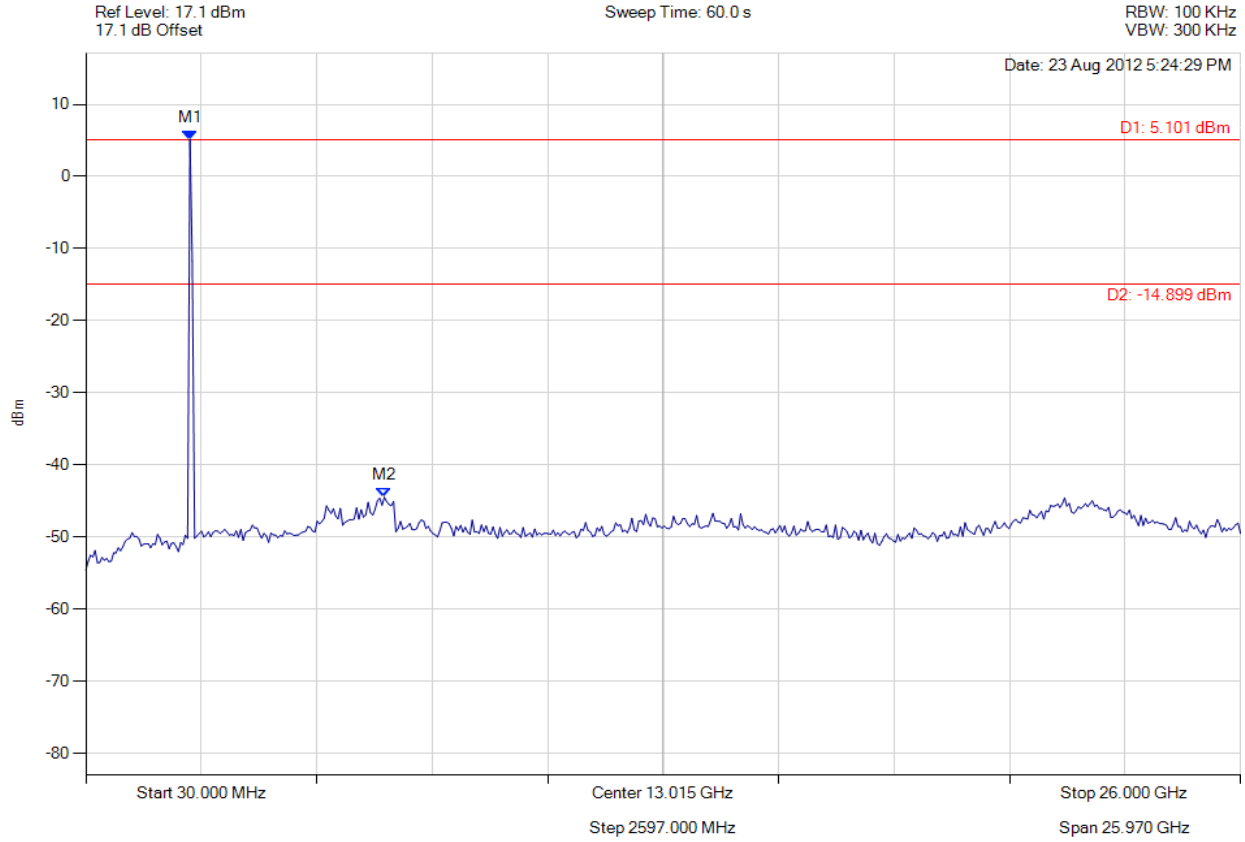


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2462.966 MHz : 4.753 dBm M2 : 2470.180 MHz : -17.817 dBm M3 : 2483.500 MHz : -49.694 dBm	Limit: -15.25 dBm Margin: -34.44 dB

Back to the Matrix

Conducted Spurious Emissions

Variant: 802.11b, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

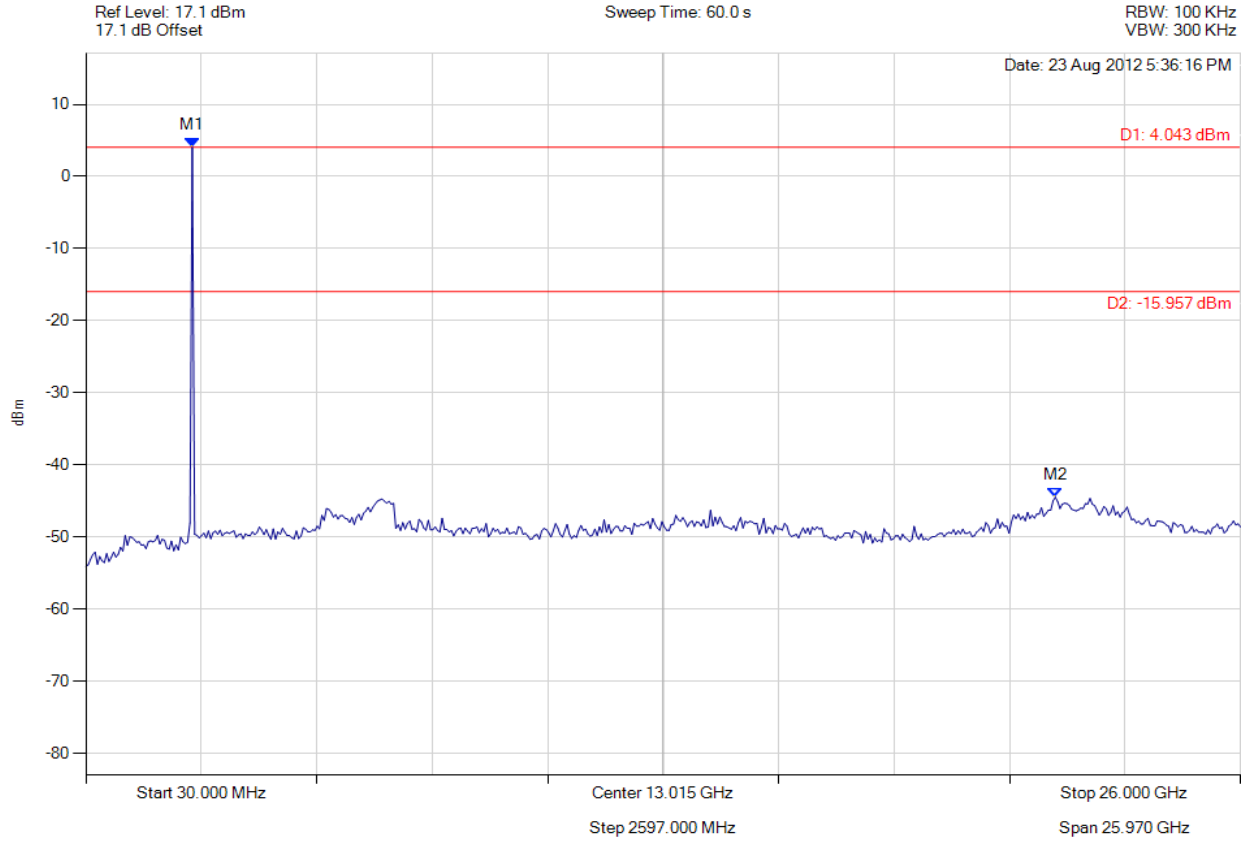


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2371.984 MHz : 5.101 dBm M2 : 6743.687 MHz : -44.478 dBm	Limit: -14.90 dBm Margin: -29.58 dB

Back to the Matrix

Conducted Spurious Emissions

Variant: 802.11b, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

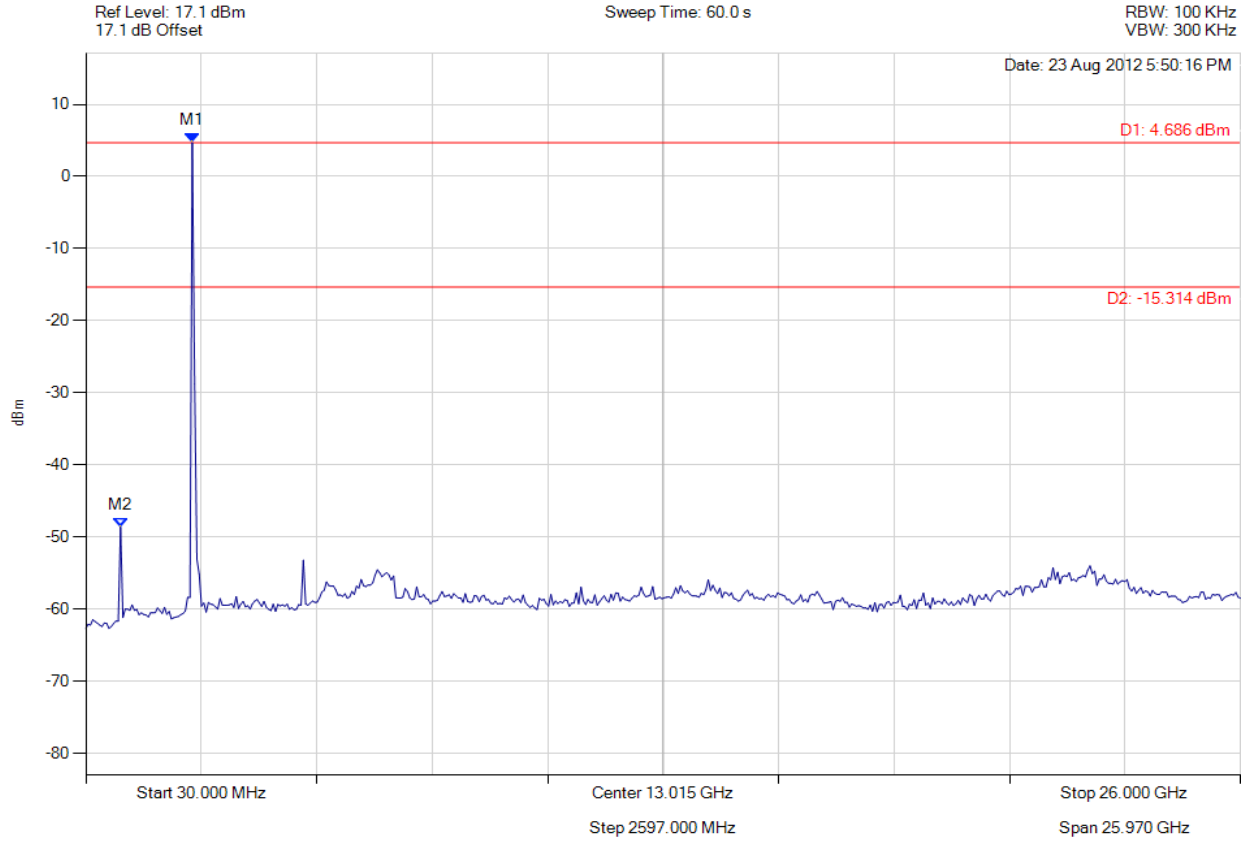


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2424.028 MHz : 4.043 dBm M2 : 21.836 GHz : -44.459 dBm	Limit: -15.96 dBm Margin: -28.50 dB

Back to the Matrix

Conducted Spurious Emissions

Variant: 802.11b, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

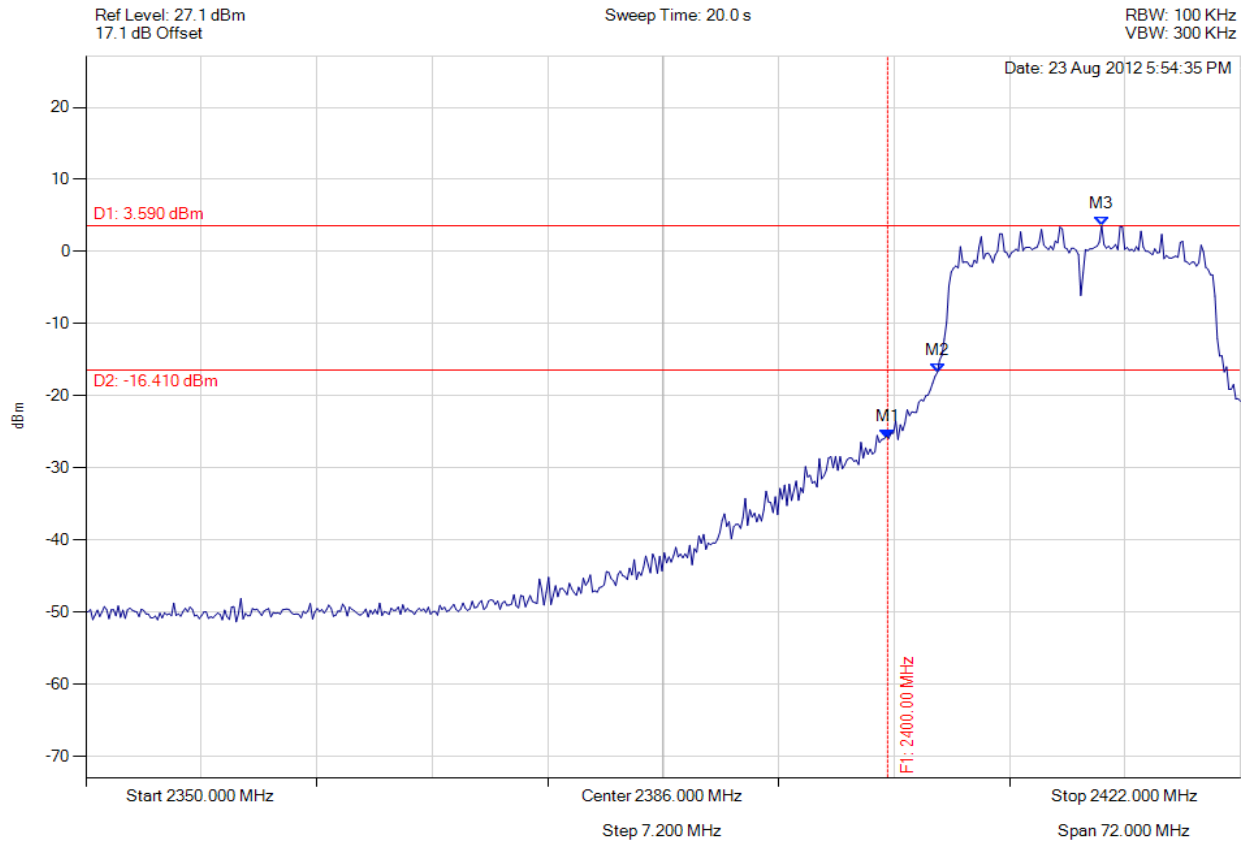


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2424.028 MHz : 4.686 dBm M2 : 810.661 MHz : -48.572 dBm	Limit: -15.31 dBm Margin: -33.26 dB

Back to the Matrix

Conducted Band-Edge Emissions

Variant: 802.11g, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

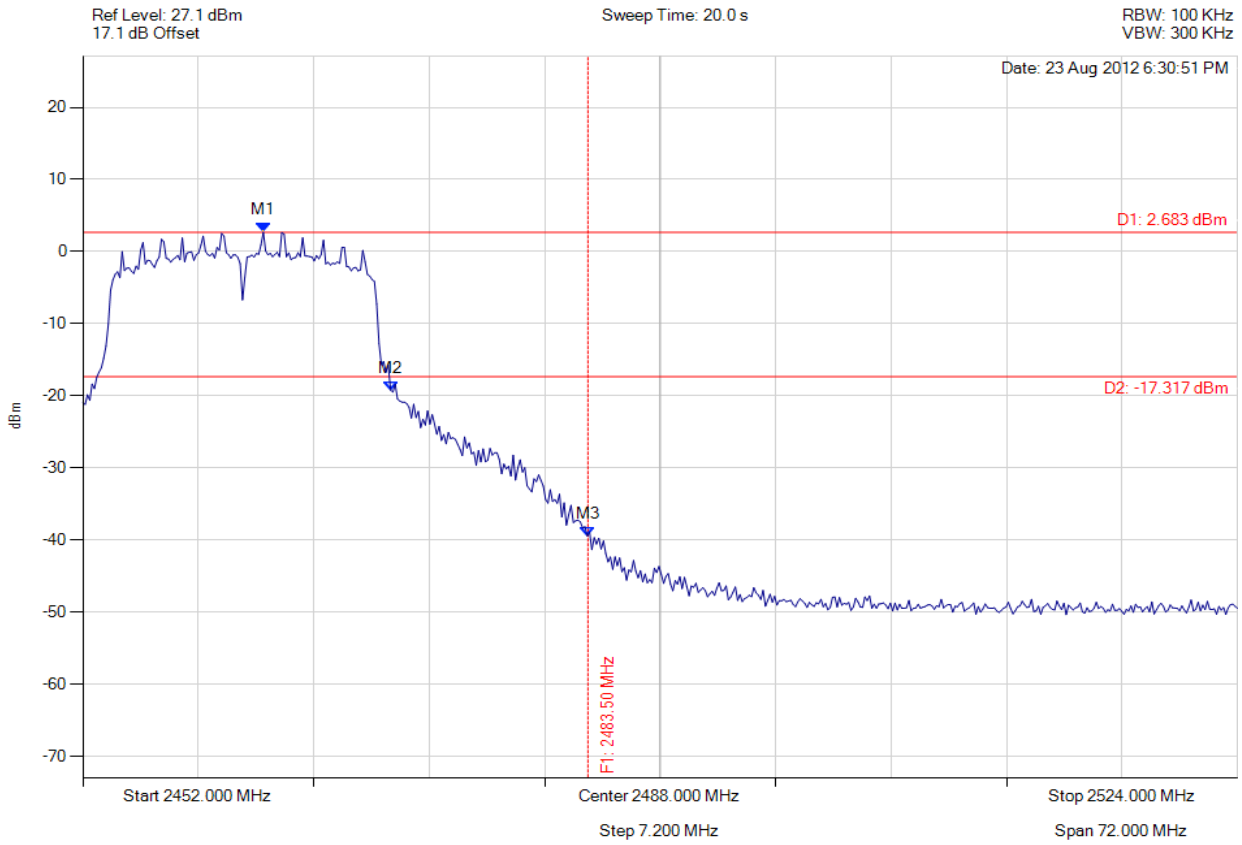


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.000 MHz : -25.885 dBm M2 : 2403.098 MHz : -16.758 dBm M3 : 2413.343 MHz : 3.590 dBm	Limit: -16.41 dBm Margin: -9.48 dB

Back to the Matrix

Conducted Band-Edge Emissions

Variant: 802.11g, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

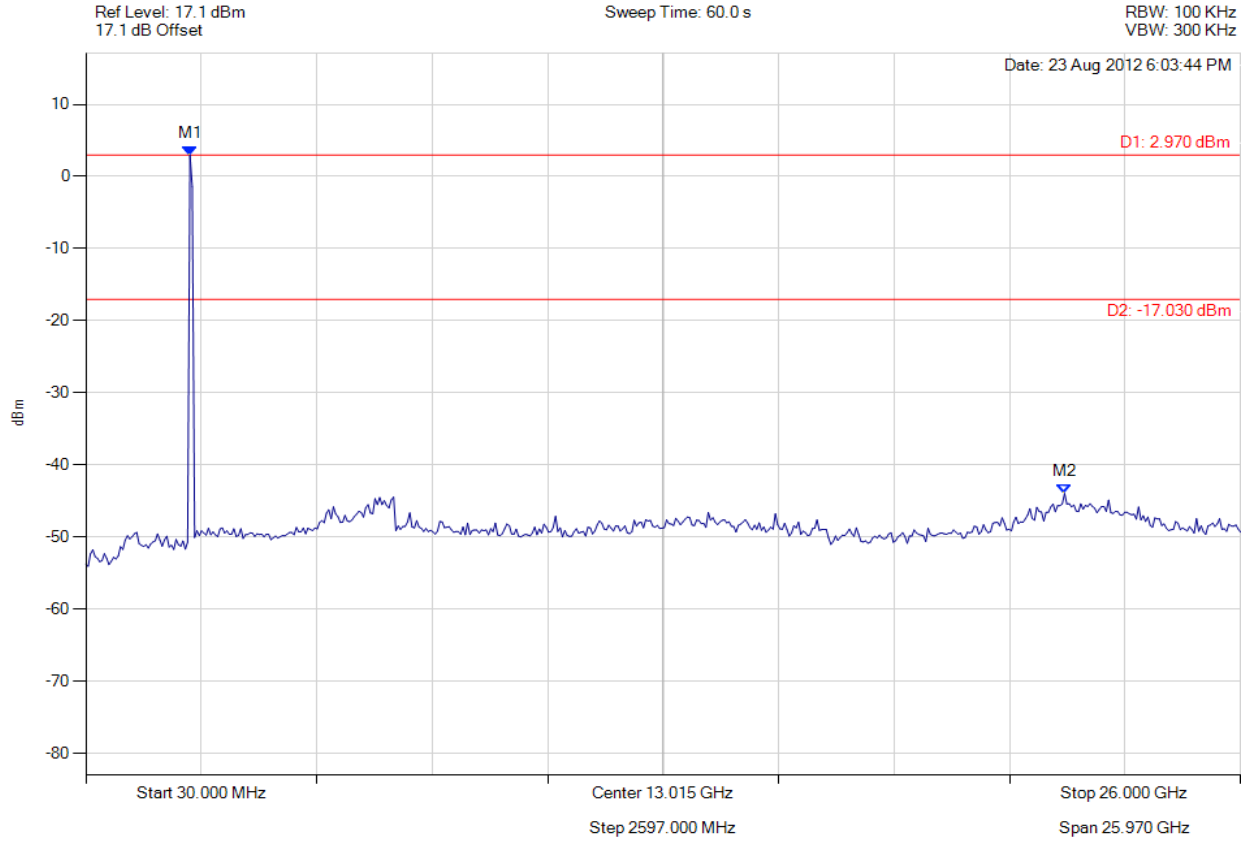


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2463.255 MHz : 2.683 dBm M2 : 2471.190 MHz : -19.210 dBm M3 : 2483.500 MHz : -39.426 dBm	Limit: -17.32 dBm Margin: -22.11 dB

Back to the Matrix

Conducted Spurious Emissions

Variant: 802.11g, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

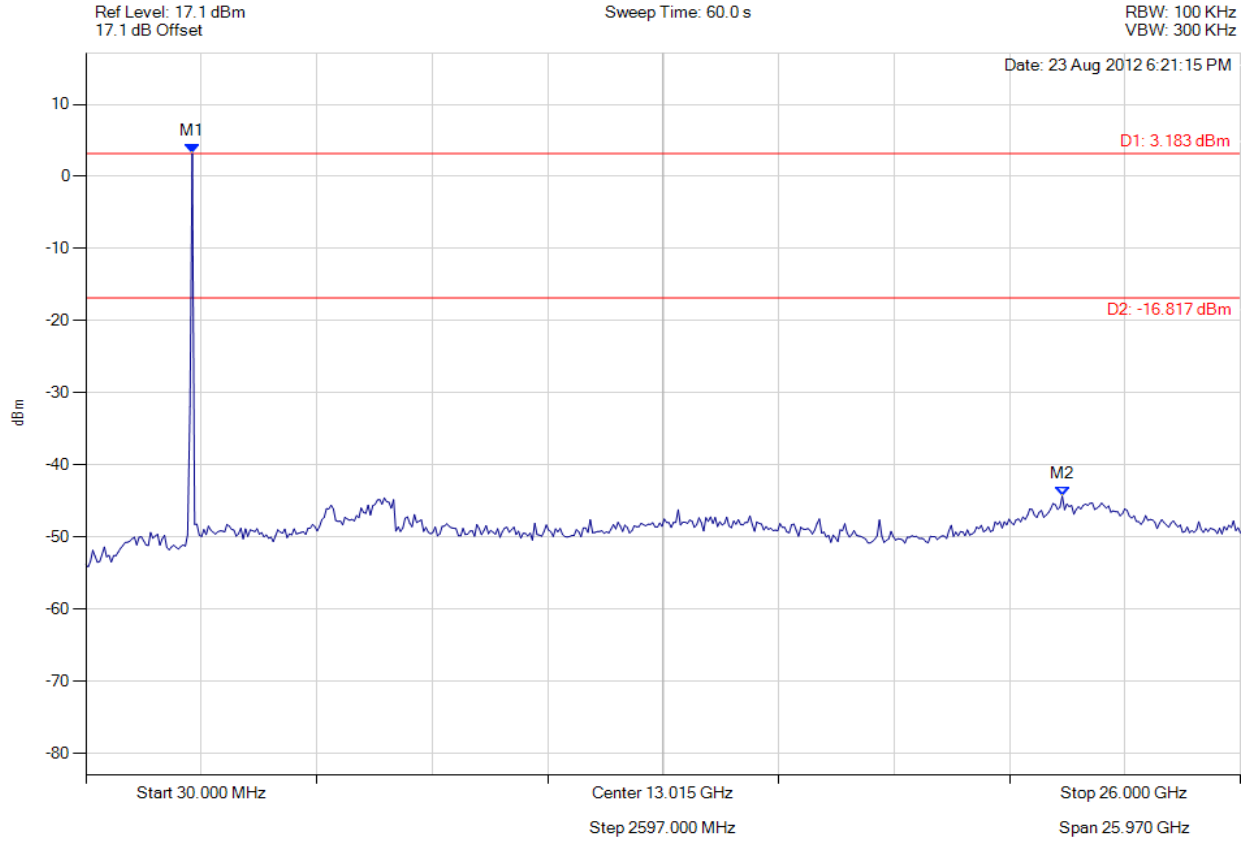


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2371.984 MHz : 2.970 dBm M2 : 22.045 GHz : -43.949 dBm	Limit: -17.03 dBm Margin: -26.92 dB

Back to the Matrix

Conducted Spurious Emissions

Variant: 802.11g, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

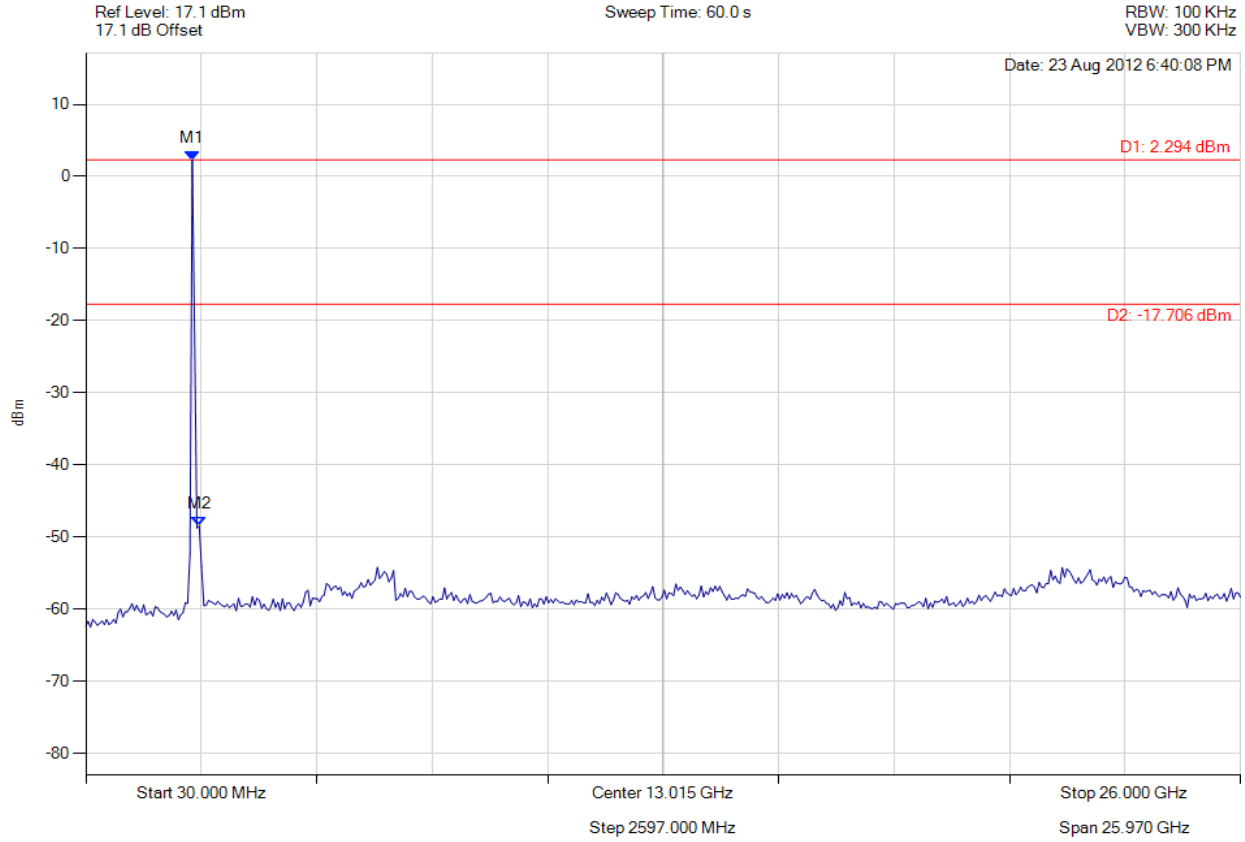


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2424.028 MHz : 3.183 dBm M2 : 21.993 GHz : -44.311 dBm	Limit: -16.82 dBm Margin: -27.49 dB

Back to the Matrix

Conducted Spurious Emissions

Variant: 802.11g, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

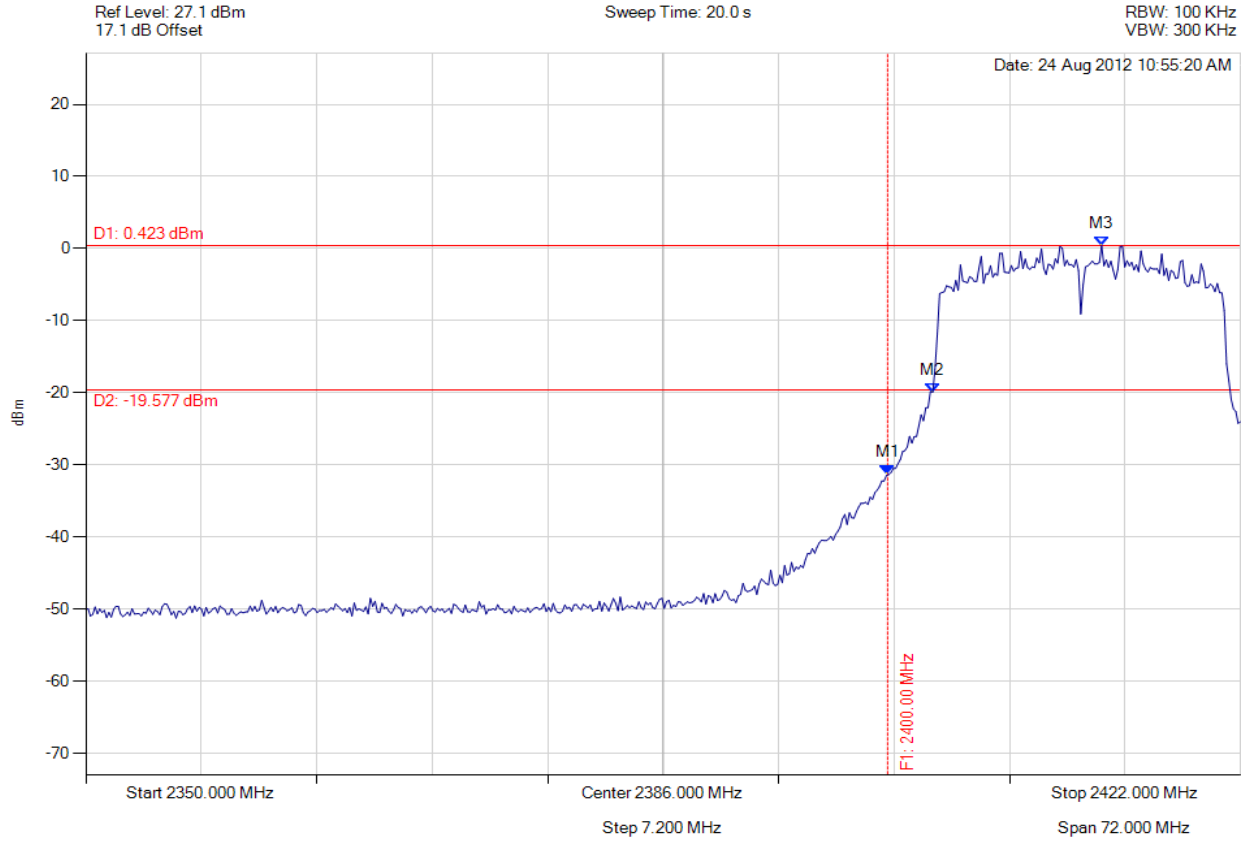


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2424.028 MHz : 2.294 dBm M2 : 2580.160 MHz : -48.464 dBm	Limit: -17.71 dBm Margin: -30.75 dB

Back to the Matrix

Conducted Band-Edge Emissions

Variant: 802.11n HT-20, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

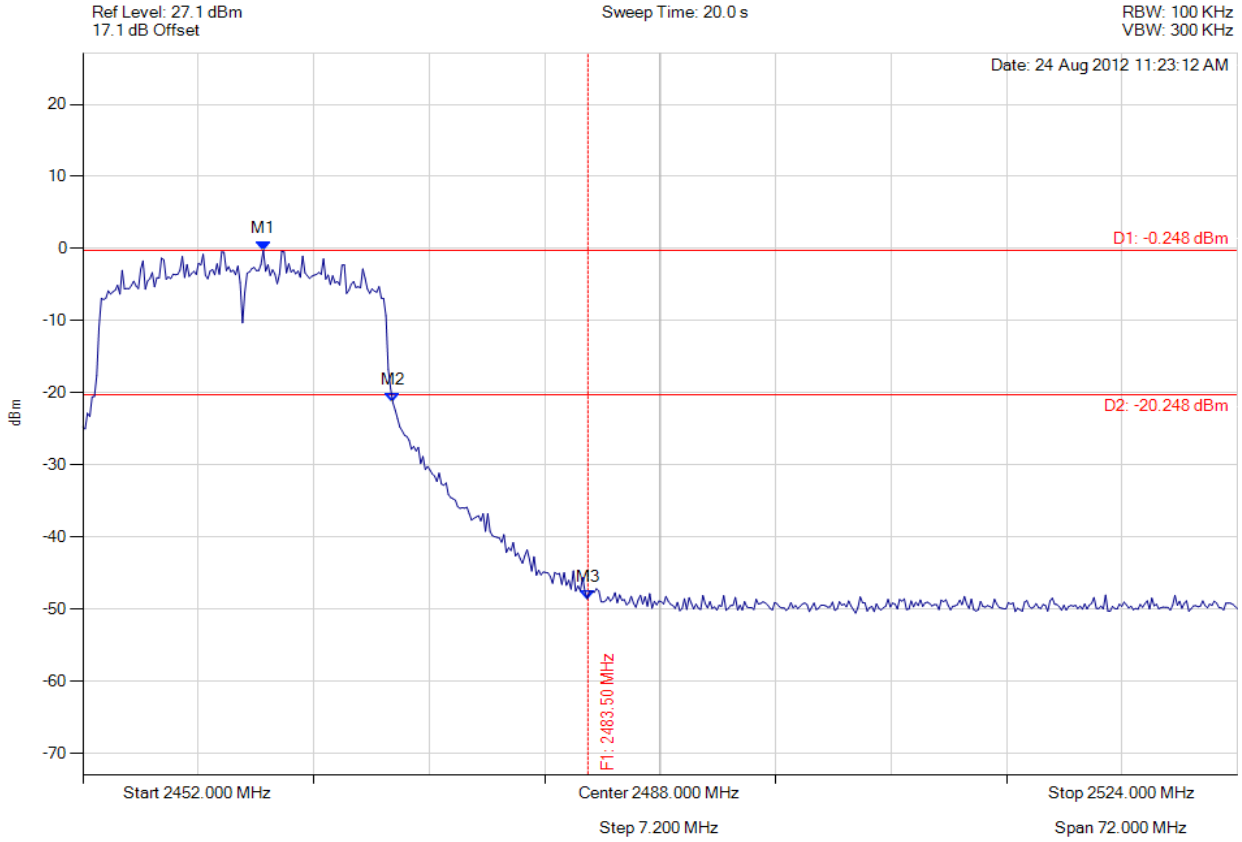


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.000 MHz : -31.323 dBm M2 : 2402.810 MHz : -19.888 dBm M3 : 2413.343 MHz : 0.423 dBm	Limit: -19.58 dBm Margin: -11.74 dB

Back to the Matrix

Conducted Band-Edge Emissions

Variant: 802.11n HT-20, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

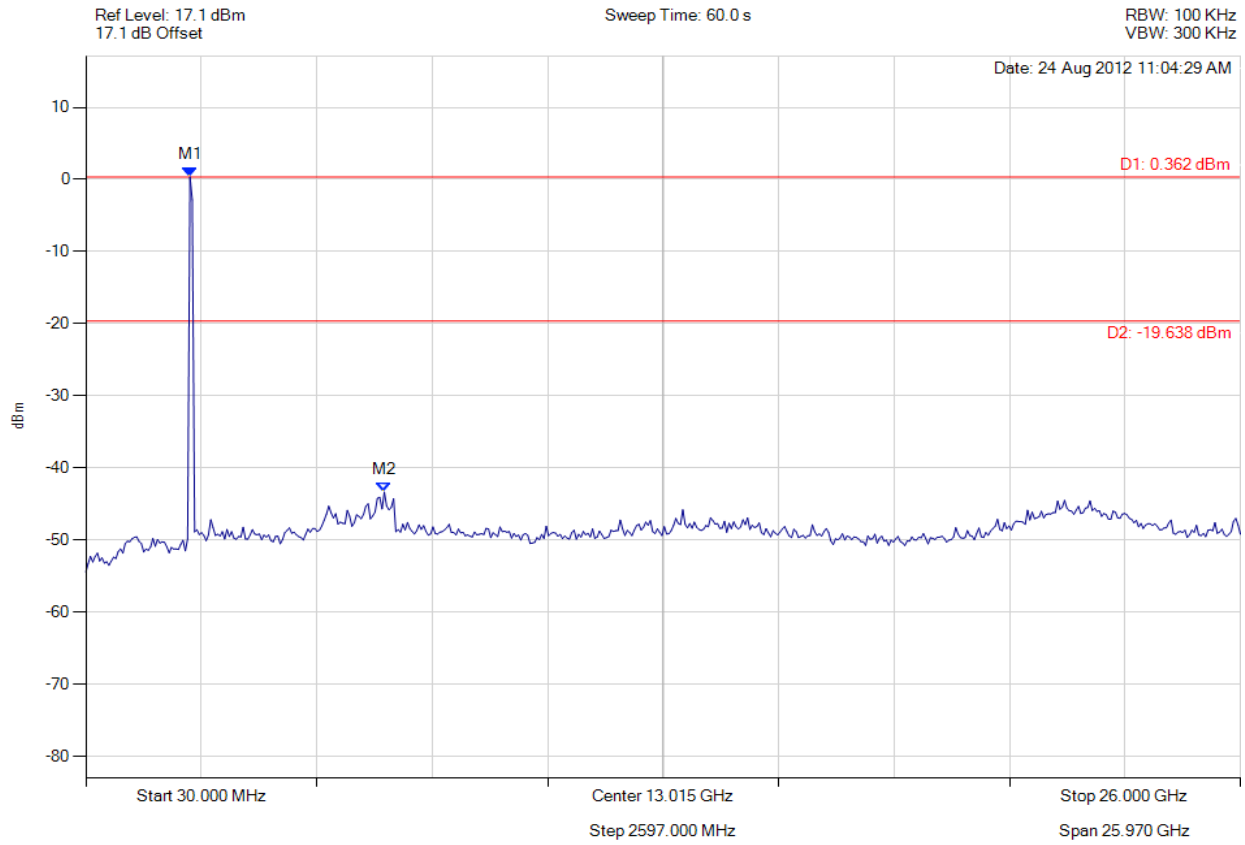


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2463.255 MHz : -0.248 dBm M2 : 2471.335 MHz : -21.358 dBm M3 : 2483.500 MHz : -48.566 dBm	Limit: -20.25 dBm Margin: -28.32 dB

Back to the Matrix

Conducted Spurious Emissions

Variant: 802.11n HT-20, Channel: 2412.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

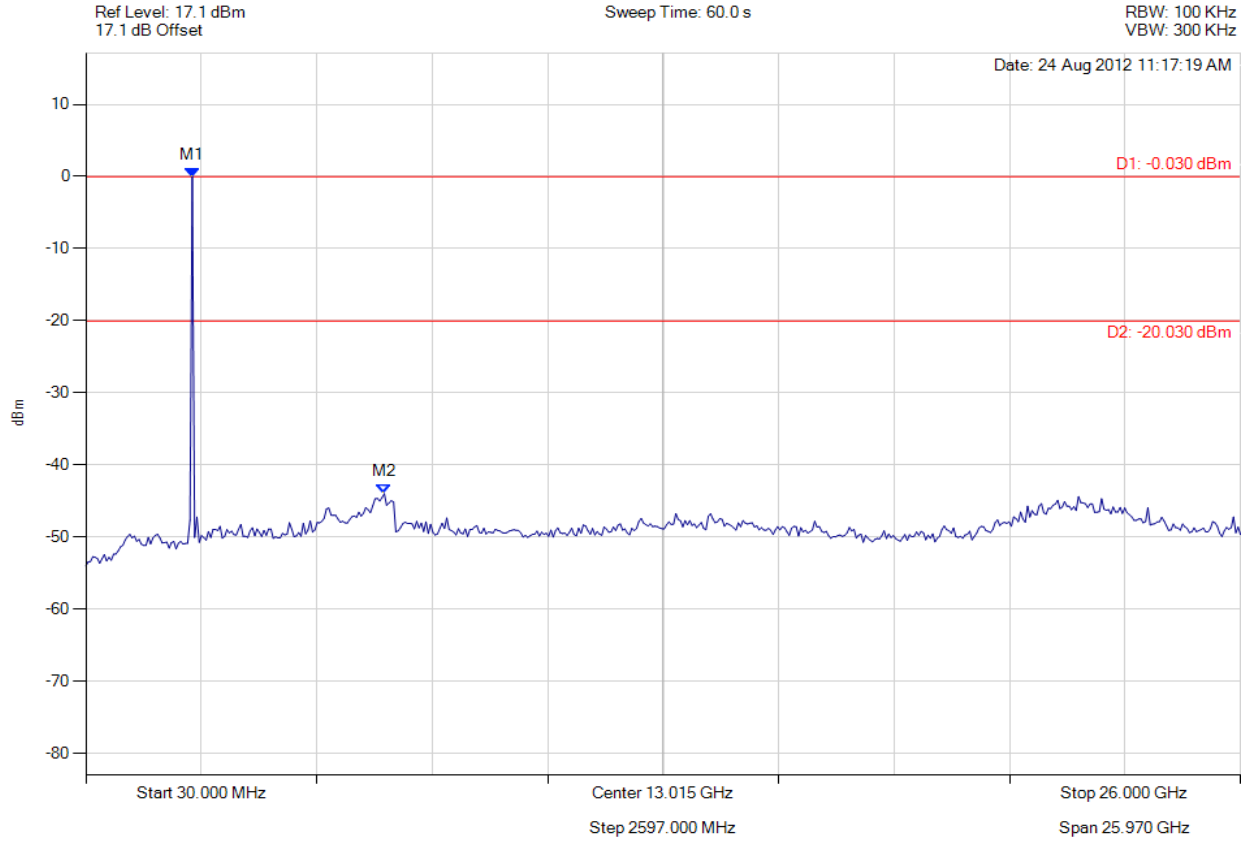


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2371.984 MHz : 0.362 dBm M2 : 6743.687 MHz : -43.345 dBm	Limit: -19.64 dBm Margin: -23.70 dB

Back to the Matrix

Conducted Spurious Emissions

Variant: 802.11n HT-20, Channel: 2437.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc

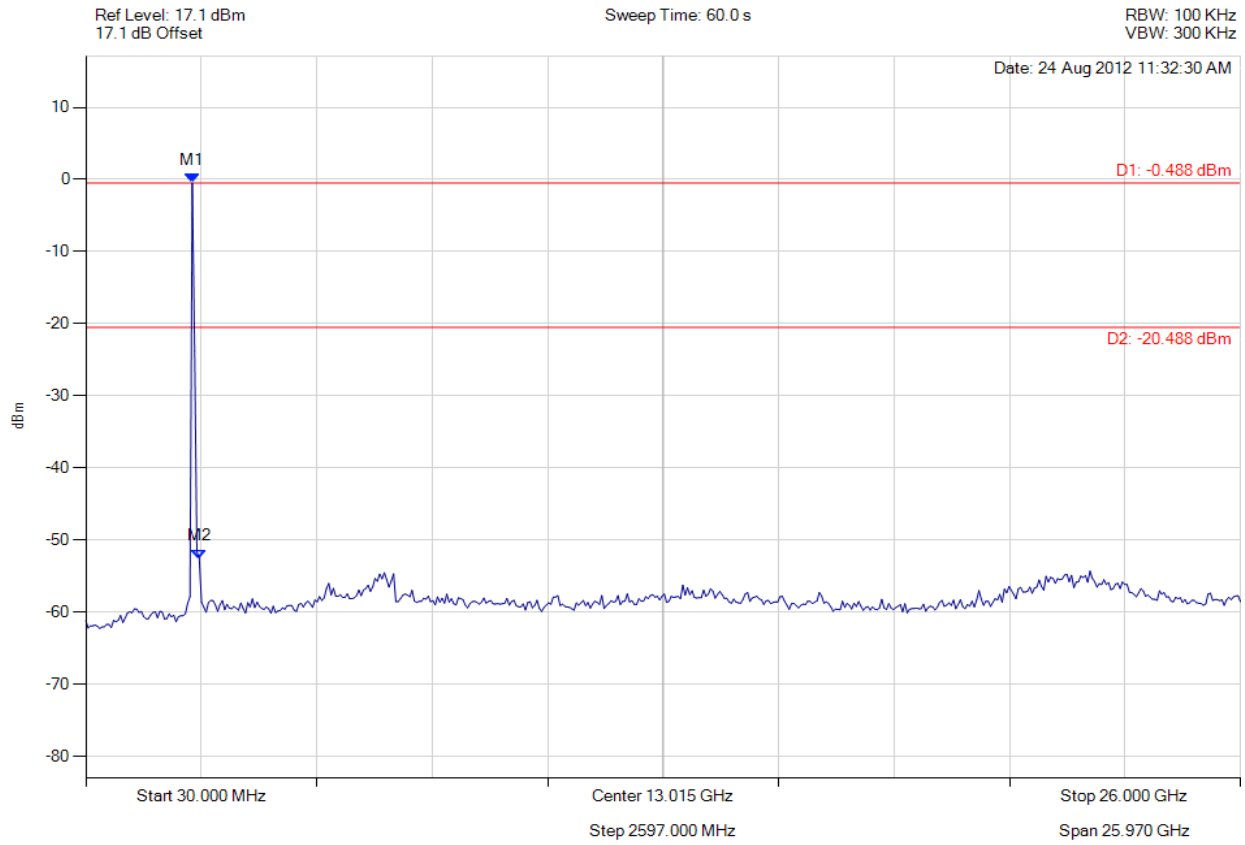


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2424.028 MHz : -0.030 dBm M2 : 6743.687 MHz : -43.973 dBm	Limit: -20.03 dBm Margin: -23.94 dB

Back to the Matrix

Conducted Spurious Emissions

Variant: 802.11n HT-20, Channel: 2462.00 MHz, Chain A, Temp: Ambient, Voltage: 5.00 Vdc



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2424.028 MHz : -0.488 dBm M2 : 2580.160 MHz : -52.546 dBm	Limit: -20.49 dBm Margin: -32.06 dB

Back to the Matrix

Specification

Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired power
2,400 MHz	2,483.5 MHz	≥ 20 dB

§15.247(d) and RSS-210 §A8.5 In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

§15.247(d)
If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

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.

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0088, 0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117.

6.1.2. Radiated Emission Testing

Transmitter Radiated Spurious Emissions (above 1 GHz); Peak Field Strength Measurements; and Radiated Band Edge Measurements – Restricted Bands

FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2, §2.6
Industry Canada 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.

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

For 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))

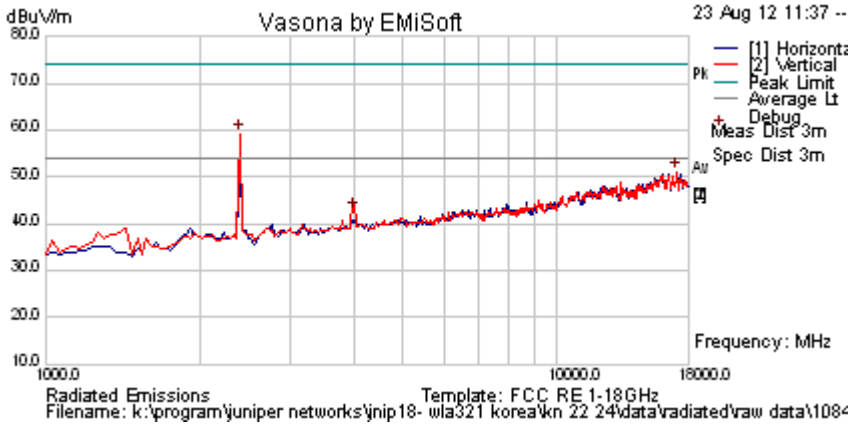
40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

6.1.2.1. Transmitter Radiated Spurious Emissions (>1 GHz)

The EUT was evaluated to determine orientation where maximum emissions were observed (i.e. horizontal or vertical). The EUT was positioned vertically on the test table during radiated emissions testing and was tested with the receive antenna positioned both horizontally and vertically such that testing was performed in three orthogonal axis.

802.11b mode

Test Freq.	2412 MHz	**Engineer**	JMH
Variant	802.11b; 1 Mbs	**Temp (ºC)**	27
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting		**Press. (mBars)**	998
Antenna		**Duty Cycle (%)**	100
Test Notes 1	EUT Serial Number 1043		
Test Notes 2			

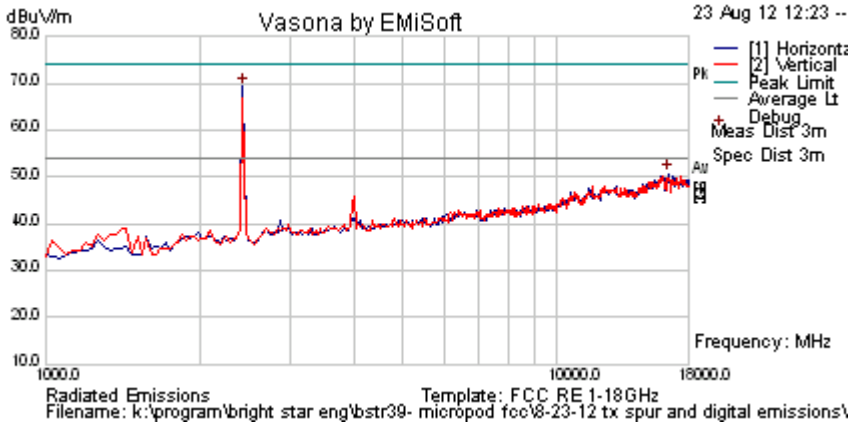


Formally measured emission peaks

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
2410.501	67.9	3.0	-11.6	59.2	Peak [Scan]	V	100					Fund
17080.16	42.3	8.5	0.4	51.2	Peak [Scan]	V	200	0	54.0	-2.8	Pass	RB
4010.130	49.4	3.9	-10.5	42.8	Peak [Scan]	V	98	0	54	-11.2	Pass	Noise

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2437 MHz	**Engineer**	JMH
Variant	802.11b; 1 Mbs	**Temp (ºC)**	27
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	20	**Press. (mBars)**	998
Antenna		**Duty Cycle (%)**	100
Test Notes 1	EUT Serial Number 1043		
Test Notes 2			

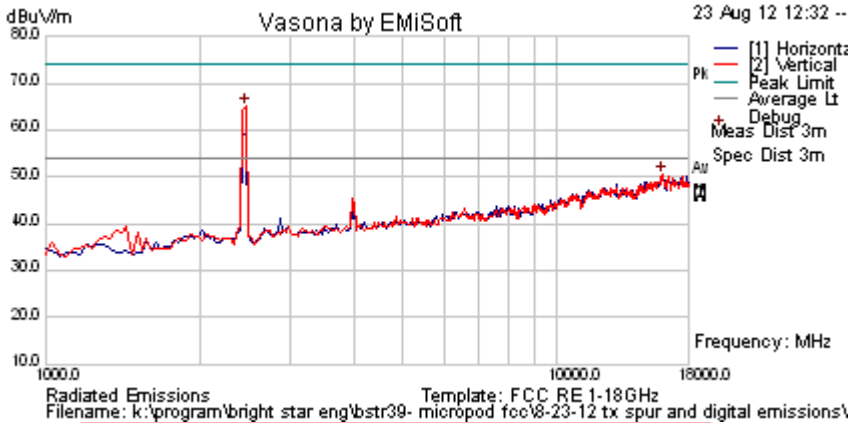


Formally measured emission peaks

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
2430.862	77.9	3.0	-11.6	69.3	Peak [Scan]	H	100					Fund
16466.934	41.7	8.8	0.3	50.8	Peak [Scan]	H	200	0	54.0	-3.2	Pass	Noise

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2462 MHz	**Engineer**	JMH
Variant	802.11b; 1 Mbs	**Temp (ºC)**	27
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	20	**Press. (mBars)**	998
Antenna		**Duty Cycle (%)**	100
Test Notes 1	EUT Serial Number 1043		
Test Notes 2			



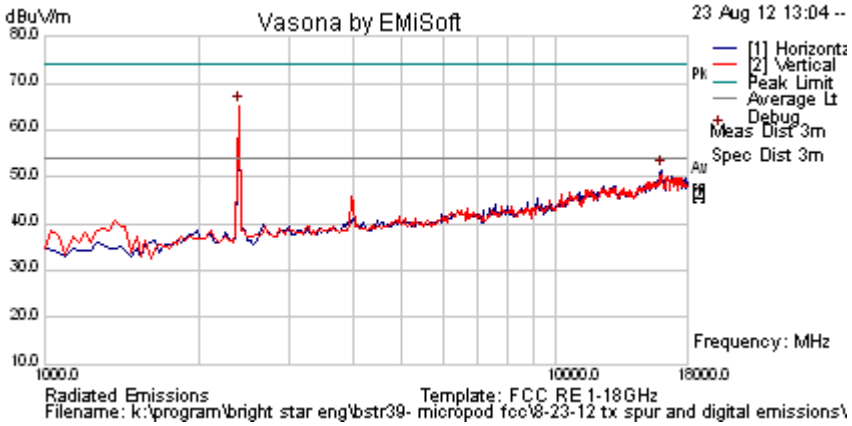
Formally measured emission peaks

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
2464.930	73.5	3.0	-11.5	64.9	Peak [Scan]	V	150					Fund
15989.98	41.5	9.0	0.1	50.6	Peak [Scan]	H	100	0	54.0	-3.4	Pass	Noise

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

802.11g mode

Test Freq.	2412 MHz	**Engineer**	JMH
Variant	802.11g; 6 Mbs	**Temp (ºC)**	27
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	20	**Press. (mBars)**	998
Antenna		**Duty Cycle (%)**	100
Test Notes 1			
Test Notes 2			

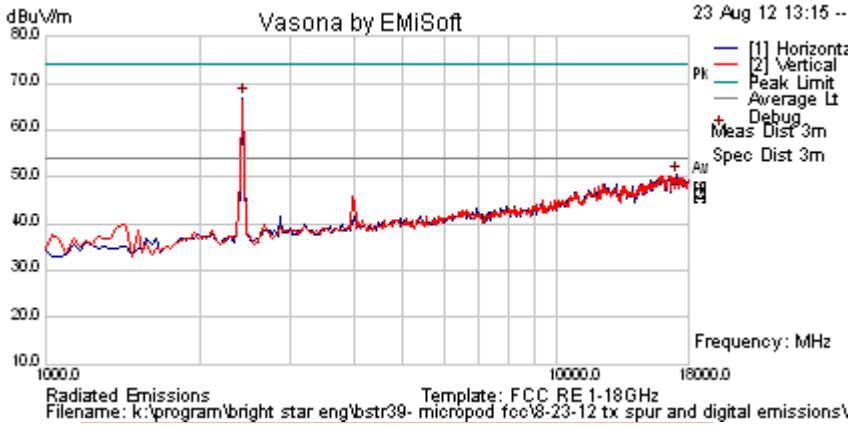


Formally measured emission peaks

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
2396.794	73.9	3.0	-11.7	65.2	Peak [Scan]	V	150					Fund
15989.98	42.3	9.0	0.1	51.5	Peak [Scan]	H	200	0	54.0	-2.5	Pass	Noise

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2437 MHz	**Engineer**	JMH
Variant	802.11g; 6 Mbs	**Temp (ºC)**	27
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	20	**Press. (mBars)**	998
Antenna		**Duty Cycle (%)**	100
Test Notes 1			
Test Notes 2			

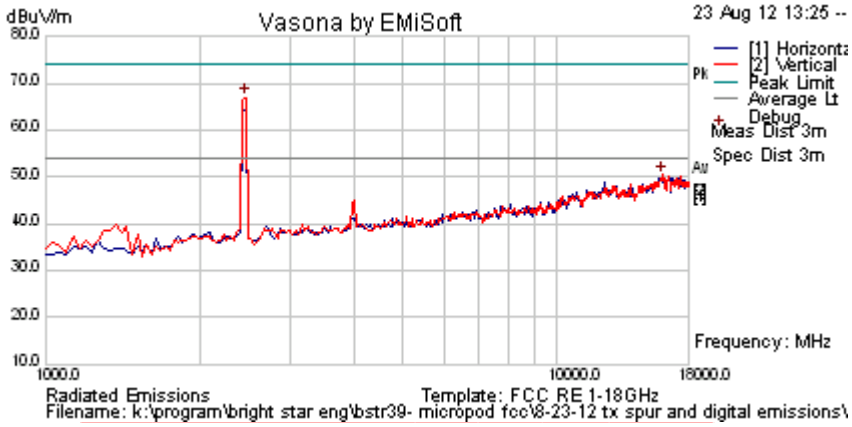


Formally measured emission peaks

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
2430.862	75.5	3.0	-11.6	66.9	Peak [Scan]	H	150					Fund
17114.228	41.5	8.5	0.5	50.4	Peak [Scan]	H	150	0	54.0	-3.6	Pass	Noise

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2462 MHz	**Engineer**	JMH
Variant	802.11g; 6 Mbs	**Temp (ºC)**	27
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	20	**Press. (mBars)**	998
Antenna		**Duty Cycle (%)**	100
Test Notes 1			
Test Notes 2			



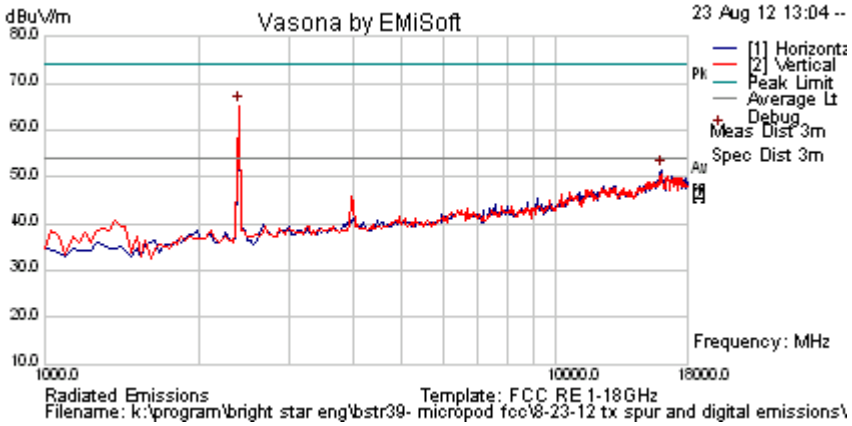
Formally measured emission peaks

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
2464.930	75.4	3.0	-11.5	66.9	Peak [Scan]	V	150					Fund
15989.98	41.4	9.0	0.1	50.5	Peak [Scan]	V	200	0	54.0	-3.5	Pass	Noise

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

802.11n HT20 mode

Test Freq.	2412 MHz	**Engineer**	JMH
Variant	802.11n HT20; 6.5 Mbs	**Temp (ºC)**	27
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	20	**Press. (mBars)**	998
Antenna		**Duty Cycle (%)**	100
Test Notes 1			
Test Notes 2			

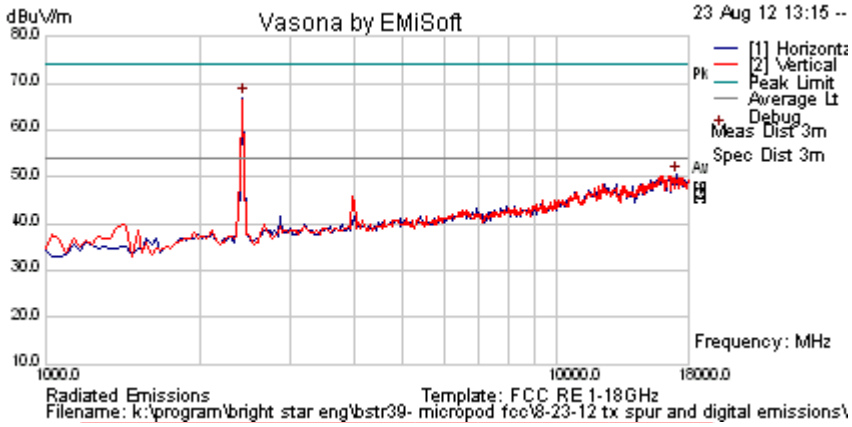


Formally measured emission peaks

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
2396.794	73.9	3.0	-11.7	65.2	Peak [Scan]	V	150					Fund
15989.98	42.3	9.0	0.1	51.5	Peak [Scan]	H	200	0	54.0	-2.5	Pass	Noise

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2437 MHz	**Engineer**	JMH
Variant	802.11n HT20; 6.5 Mbs	**Temp (ºC)**	27
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	20	**Press. (mBars)**	998
Antenna		**Duty Cycle (%)**	100
Test Notes 1			
Test Notes 2			

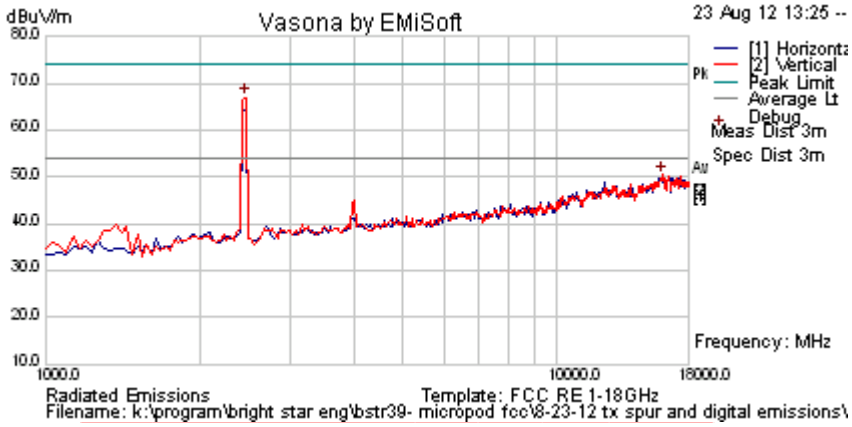


Formally measured emission peaks

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
2430.862	75.5	3.0	-11.6	66.9	Peak [Scan]	H	150					Fund
17114.228	41.5	8.5	0.5	50.4	Peak [Scan]	H	150	0	54.0	-3.6	Pass	Noise

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Test Freq.	2462 MHz	**Engineer**	JMH
Variant	802.11n HT20; 6.5 Mbs	**Temp (ºC)**	27
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	20	**Press. (mBars)**	998
Antenna		**Duty Cycle (%)**	100
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
2464.930	75.4	3.0	-11.5	66.9	Peak [Scan]	V	150					Fund
15989.98	41.4	9.0	0.1	50.5	Peak [Scan]	V	200	0	54.0	-3.5	Pass	Noise

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Specification Limits

FCC §15.247(d) and RSS-210 §A8.5 In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

FCC §15.247(d)
If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

IC RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

IC 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.

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.

§15.209 (a) Limit Matrix

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

6.1.2.2. Digital Emissions (0.03-1 GHz)

FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-210 §2.2

Test Procedure

Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver 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.

The EUT had two methods of powering on ac/dc converter and Power over Ethernet (POE). Both modes were tested for emissions below 1GHz.

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

For example:
Given a Receiver input reading of 51.5dBμV; 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:

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

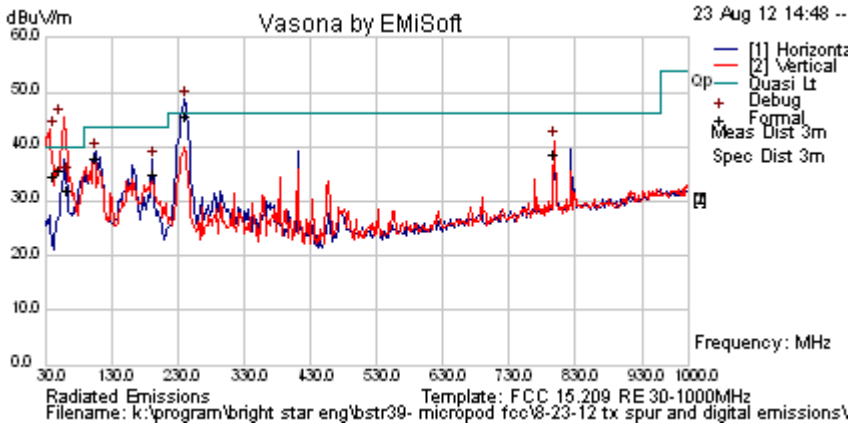
Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

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

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

The EUT was evaluated to determine orientation where maximum emissions were observed (i.e. horizontal or vertical). The EUT was positioned vertically on the test table during radiated emissions testing and was tested with the receive antenna positioned both horizontally and vertically such that testing was performed in three orthogonal axis.

Test Freq.	2437 MHz	**Engineer**	SB
Variant	Digital Emissions	**Temp (ºC)**	24.2
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	33
Power Setting		**Press. (mBars)**	1008
Antenna			
Test Notes 1			



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
52.677	56.0	3.7	-23.8	35.9	Quasi Max	V	112	174	40	-4.2	Pass	
41.267	49.5	3.6	-18.4	34.7	Quasi Max	V	108	135	40	-5.4	Pass	
242.421	59.8	4.8	-19.0	45.7	Quasi Max	H	122	50	46	-0.4	Pass	
105.812	53.4	4.1	-19.7	37.8	Quasi Max	H	158	21	43.5	-5.7	Pass	
798.148	40.7	6.8	-8.9	38.6	Quasi Max	V	99	78	46	-7.4	Pass	
62.429	52.1	3.8	-23.8	32.0	Quasi Max	V	103	102	40	-8.0	Pass	
191.986	49.7	4.6	-19.4	34.9	Quasi Max	V	99	337	43.5	-8.6	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

Specification

Limits

§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.

§15.209 (a) and **RSS-Gen §2.2** Limit Matrix

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

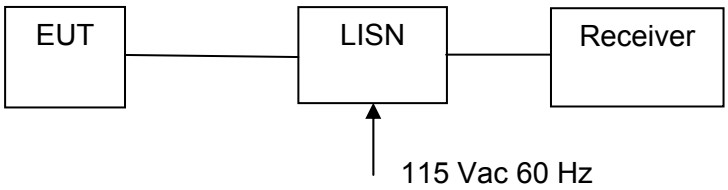
6.1.3. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

FCC, Part 15 Subpart C §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

Not required - EUT is power by DC only.

Specification

Limit

§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

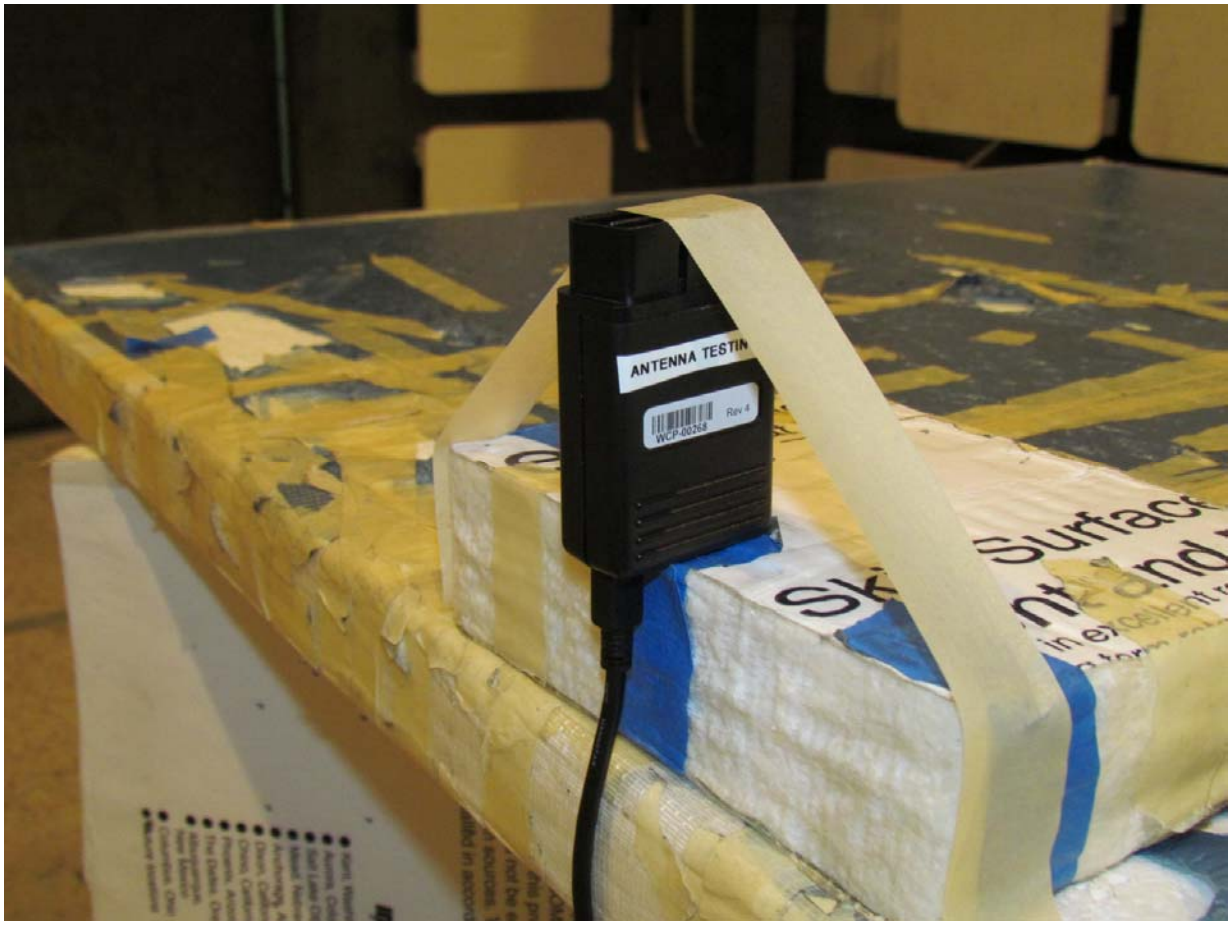
Measurement uncertainty	±2.64 dB

Traceability

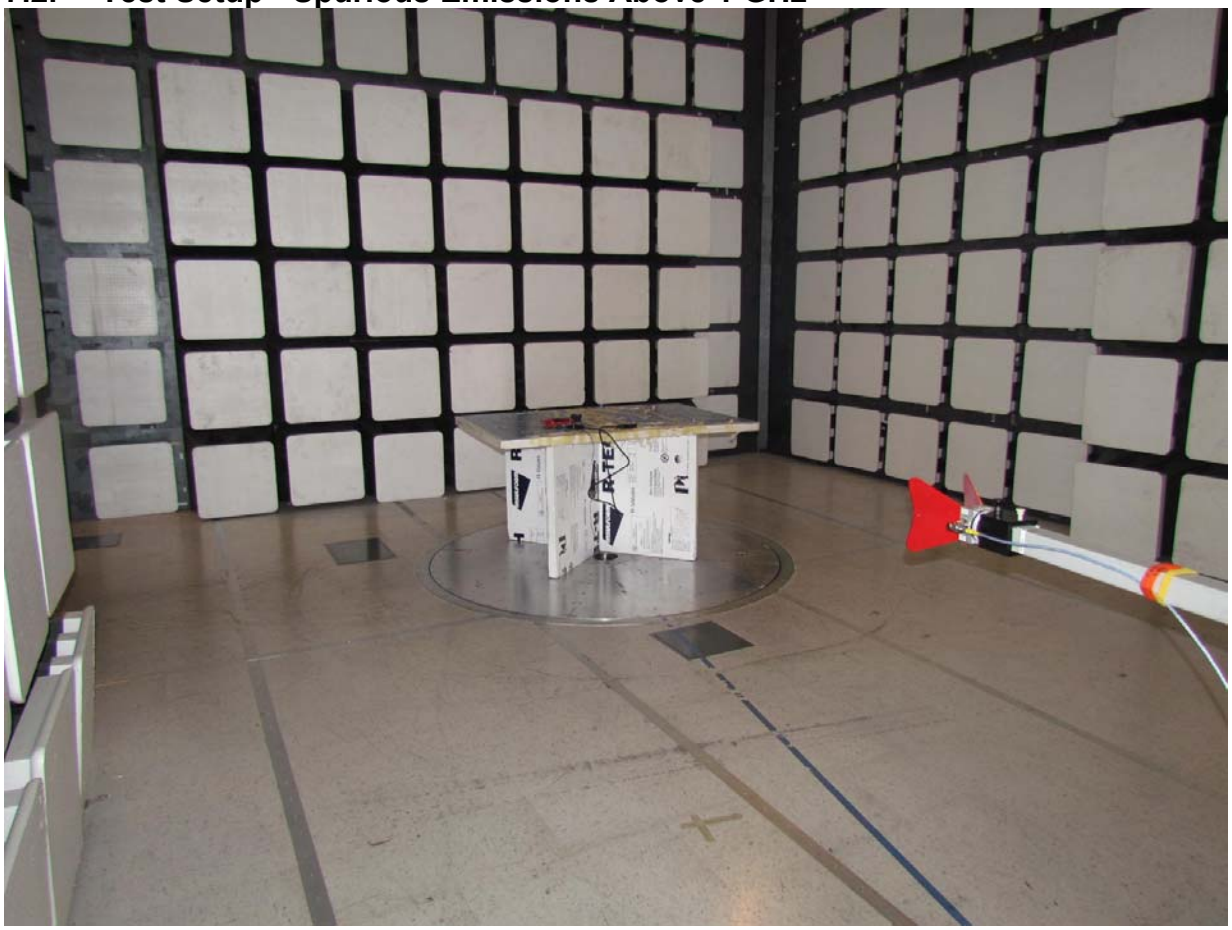
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0287, 0190, 0293, 0307

7. PHOTOGRAPHS

7.1. Test Setup - Digital Emissions below 1 GHz



7.2. Test Setup - Spurious Emissions Above 1 GHz



8. TEST EQUIPMENT

Asset #	Instrument	Manufacturer	Part #	Serial #	Calibration Due Date
0070	Power Meter	Hewlett Packard	437B	3125U11552	28th Nov 12
0117	Power Sensor	Hewlett Packard	8487D	3318A00371	15th Nov 12
0223	Power Meter	Hewlett Packard	EPM-442A	US37480256	15th Nov 12
0374	Power Sensor	Hewlett Packard	8485A	3318A19694	29th Nov 12
0158	Barometer /Thermometer	Control Co.	4196	E2846	8th Dec 12
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007	2nd Dec 12
0287	EMI Receiver	Rhode & Schwartz	ESIB40	100201	16th Nov 12
0338	30 - 3000 MHz Antenna	Sunol	JB3	A052907	8th Nov 12
0335	1-18 GHz Horn Antenna	EMCO	3117	00066580	7th Nov 12
0252	SMA Cable	Megaphase	Sucoflex 104	None	N/A
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001	N/A
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002	N/A
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001	N/A
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001	N/A
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623	N/A
	EMC Test Software	EMISoft	Vasona	5.0051	N/A
	RF Conducted Test Software	National Instruments	Labview	Version 8.2	N/A
	RF Conducted Test Software	MiCOM Labs ATS		Version 1.4	N/A

440 Boulder Court, Suite 200
Pleasanton, CA 94566, USA
Tel: 1.925.462.0304
Fax: 1.925.462.0306
www.micomlabs.com