Test of Vardr Hawkeye Wireless Security Camera

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

Test Report Serial No.: VARD03-U1 Rev A

TEST REPORT

FROM

Test of Vardr Hawkeye Wireless Security Camera

to

To FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: VARD03-U1 Rev A

This report supersedes: NONE

Applicant: Hive Labs Inc
3901 Lakeplace Lane
Austin
Texas 78746, USA

Product Function: Wireless Security Camera

Copy No: pdf Issue Date: 30th November 2012

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
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Pleasanton, CA 94566 USA
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ACCREDITED
TEST CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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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

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 (Ministry of Internal Affairs and Communication)	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	30th November 2012	Initial release.

1. TEST RESULT CERTIFICATE

Applicant:	Hive Labs Inc 3901 Lakeplace Lane Austin Texas 78746, USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	802.11b/g Wireless Security Camera	Telephone:	+1 925 462 0304
Model:	Hawkeye	Fax:	+1 925 462 0306
S/N's:	808488 Conducted & Radiated 8084D8 Emissions below 1 GHz		
Test Date(s):	16th October 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	2010	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 1 Dec. 1997	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 Vardr Hawkeye Wireless Security Camera to FCC Part 15.247 and Industry Canada RSS-210 regulations.
Applicant:	Hive Labs Inc 3901 Lakeplace Lane Austin Texas 78746, USA
Manufacturer:	Vardr 7 Clunies Ross Court Brisbane Technology Park Eight Mile Plains, Brisbaine OLD 4113, Australia
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	VARD03-U1 Rev A
Date EUT received:	16th October 2012
Standard(s) applied:	FCC 47 CFR Part 15.247 & IC RSS-210
Dates of test (from - to):	16th October 2012
No of Units Tested:	Two
Type of Equipment:	802.11b/g Wireless Client
Manufacturers Trade Name:	Wireless Client
Model(s):	Hawkeye Wireless Security Camera
Location for use:	Indoors, home and office
Declared Frequency Range(s):	2400 - 2483.5 MHz
Hardware Rev	4v4
Test Software Rev	Unknown
Type of Modulation:	Per 802.11 –CCK, OFDM
Declared Nominal Average Output Power:	802.11b: +10 dBm 802.11g:Leg. +10dBm
EUT Modes of Operation:	Legacy 802.11b/g
Transmit/Receive Operation:	Time Division Duplex
System Beam Forming:	Device has no capability for antenna beam forming
Rated Input Voltage and Current:	3 Vdc Battery
Operating Temperature Range:	Declared range 0° to +50ºC
ITU Emission Designator:	2400 – 2483.5 MHz 802.11b 17M0G1D 2400 – 2483.5 MHz 802.11g 23M2D1D
Equipment Dimensions:	65mm diameter sphere, 74.6mm high including base
Weight:	154 g (including batteries)
Primary function of equipment:	Wireless client for transmitting captured security camera data

3.2. Scope of Test Program

Vardr 2.4 GHz Wireless Client

The scope of the test program was to test the Vardr Hawkeye Wireless Security Camera, configurations in the frequency range 2400 - 2483.5 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications.

Vardr Hawkeye Wireless Security Camera

Vardr Hawkeye Wireless Security Camera

Vardr Hawkeye Wireless Security Camera
Product Label

Model: Hawkeye 4v5
Serial #: <device id>

FCC ID: XXX-YYYYYY
IC: WWWW-YYYYYY

Designed by Vardr in Australia
Assembled by Staci in China

<Staci Build Date Code>

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

Equipment Type	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	802.11b/g Wireless Client	Vardr	Hawkeye	808488 Conducted & Radiated (external dc powered)
EUT	802.11b/g Wireless Client	Vardr	Hawkeye	8084D8 Emissions below 1 GHz (battery powered)
Support	Laptop	Apple	MacBook Pro	C02F5MRCDH2H

3.4. Antenna Details

Antenna Type	Manufacturer	Model Number	Antenna Gain (dBi	
			2.4 GHz	5 GHz
Integral	pcb	N/A	0.0	N/A

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. No external cables or connectors available

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.

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	

Legacy – data rates for 802.11bg products

Results for the above configurations are provided in this report.

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

KEY;-

SE – Spurious Emission
BE – Band-Edge

3.7. Equipment Modifications

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

1. Band-Edge Power Reduction

   All conducted and radiated spurious emission testing was performed with the device set for maximum power at all times. During radiated band-edge emission testing the output power was reduced in order to comply with the Restricted Band limit criteria. At 2.4 GHz restricted bands are 2,310 – 2,390 MHz and 2,483.5 – 2,500 MHz.

   Initial power setting for all channels was 12.

		Channel (MHz)	Maximum Power Level
2.4 GHz	b	2412	10
		2437	10
		2462	10
	g	2412	10
		2437	10
		2462	10

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

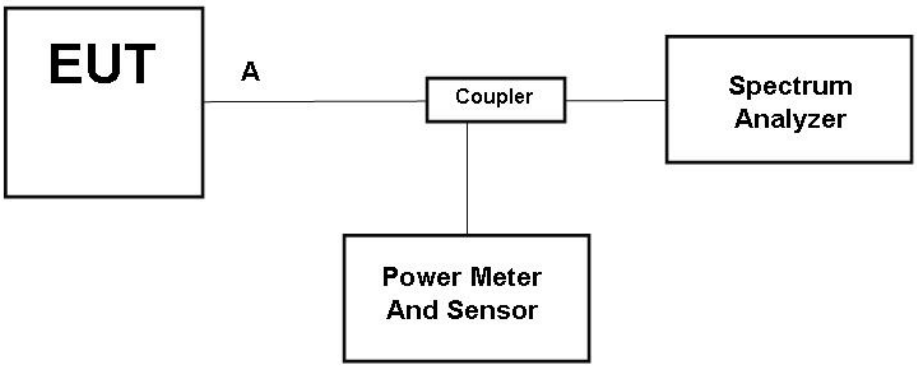
4. TEST EQUIPMENT CONFIGURATION(S)

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 (Non-Restricted Band(s))

Conducted Test Set-Up Pictorial Representation

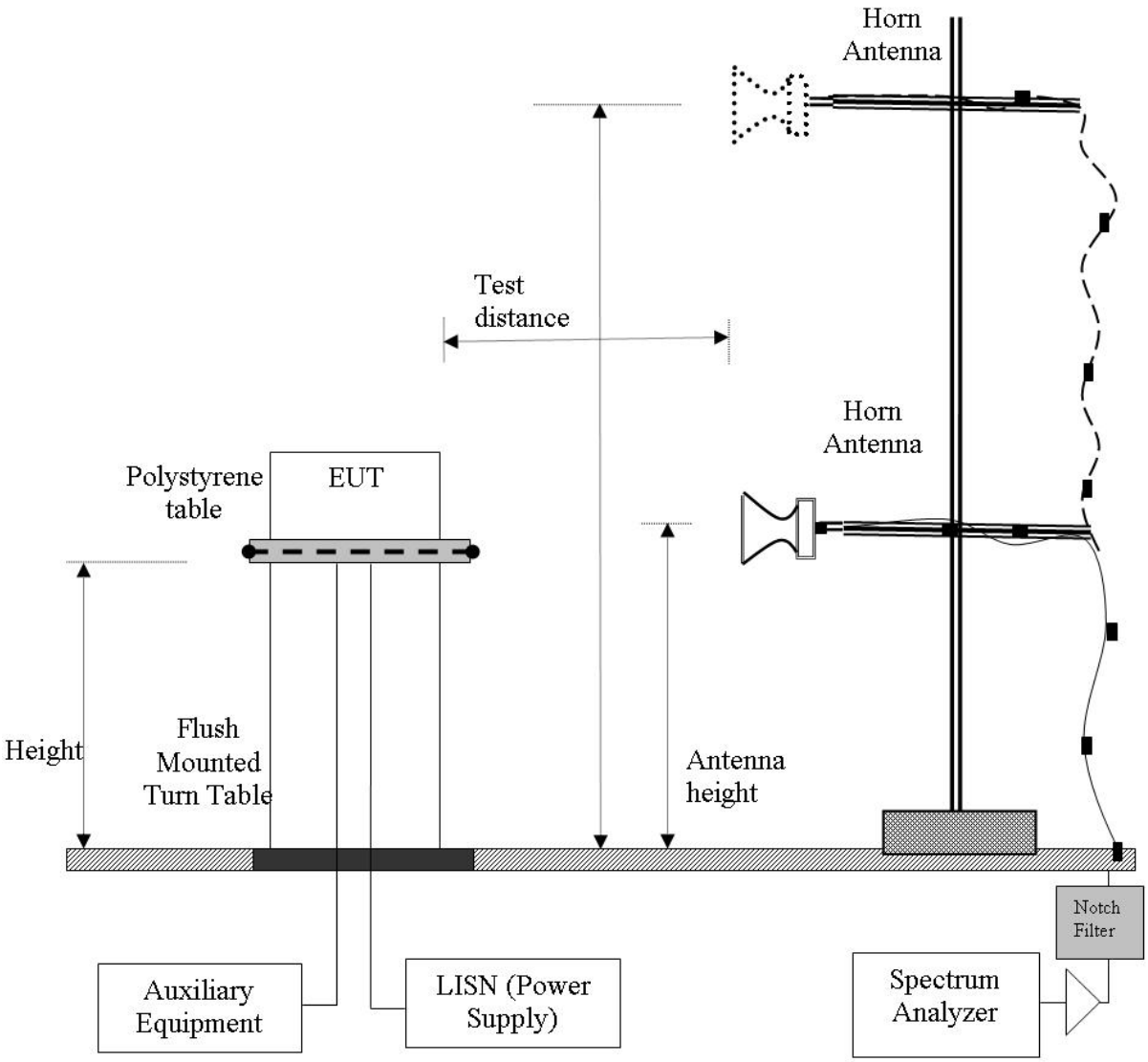


4.2. Radiated Spurious Emission Test Set-up > 1 GHz

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

1. Section 6.1.2.1

Radiated Emission Measurement Setup – Above 1 GHz

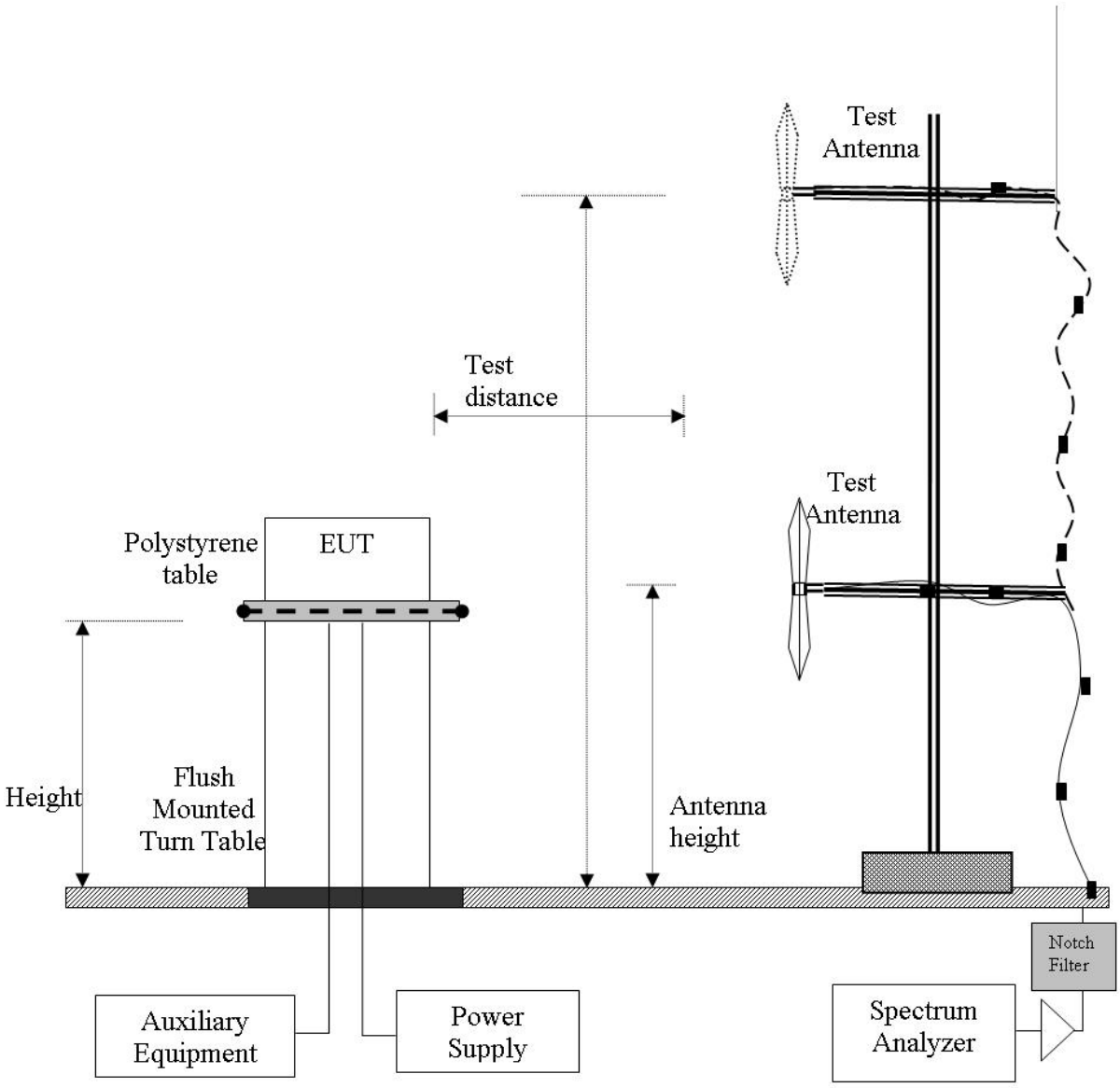


4.3. Digital Emissions Test Set-up (0.03 – 1 GHz)

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

1. Section 6.1.2.2.

Digital Emission Measurement Setup – Below 1 GHz



4.4. ac Wireline Emission Test Set-up

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

1. Section 6.1.3 Not Applicable device battery powered

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(d) **15.205 /** **15.209** **A8.5** **2.2** **4.7**	Spurious Emissions (Non-Restricted band) (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	6.1.1.4

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	6.1.2.1
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	6.1.2.1
	Radiated Band Edge	Band-edge results Peak Emissions		Complies	6.1.2.1
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 battery powered	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 (%):**	99
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	CCK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	TPC Here		
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	10.180	--	--	--	10.180	10.180	≥ 0.5	-9.68
2437.0	10.180	--	--	--	10.180	10.180	≥ 0.5	-9.68
2462.0	10.180	--	--	--	10.180	10.180	≥ 0.5	-9.68

Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)
MHz	a	b	c	d	
2412.0	16.834	--	--	--	16.834
2437.0	16.994	--	--	--	16.994
2462.0	16.994	--	--	--	16.994

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 Measuring RF 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 99% Bandwidth			
Variant:	802.11g	**Duty Cycle (%):**	99
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
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	16.353	--	--	--	16.353	16.353	≥ 0.5	-15.85
2437.0	16.353	--	--	--	16.353	16.353	≥ 0.5	-15.85
2462.0	16.353	--	--	--	16.353	16.353	≥ 0.5	-15.85

Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)
MHz	a	b	c	d	
2412.0	21.242	--	--	--	21.242
2437.0	22.525	--	--	--	22.525
2462.0	23.246	--	--	--	23.246

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

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

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 KDB 662911 was implemented for In-band power measurements. The measure and sum technique was implemented in all cases.		

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.

15.247 (c) Operation with directional antenna gains greater than 6 dBi.
If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Device antenna was a pcb type with gain 0.0 dBi therefore no reduction in power was necessary

The following Peak Power Matrix(s) was tested using the system maximum power setting NART = 10, see Section 3.7 Equipment Modifications

Equipment Configuration for Peak Output Power			
Variant:	802.11b	**Duty Cycle (%):**	99
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	CCK	**Beam Forming Gain (Y):**	Not Applicable
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	11.99	--	--	--	11.99	30.00	-18.01	10
2437.0	12.05	--	--	--	12.05	30.00	-17.95	10
2462.0	11.82	--	--	--	11.82	30.00	-18.18	10

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

Equipment Configuration for peak output power			
Variant:	802.11g	**Duty Cycle (%):**	99
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
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	15.79	--	--	--	15.79	30.00	-14.21	10
2437.0	15.64	--	--	--	15.64	30.00	-14.36	10
2462.0	15.34	--	--	--	15.34	30.00	-14.66	10

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	
Measurement Uncertainty:	

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

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

Test Equipment Used
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 and the maximum level in a 3 kHz bandwidth was measured. A peak value was found over the full emission bandwidth and the frequency span reduced to obtain enhanced resolution. Sweep time ≥ span / 3 kHz with video averaging turned off. The Peak Power Spectral Density is the highest level found across the emission in a 3 kHz resolution bandwidth.

Equipment Configuration for Power Density			
Variant:	802.11b	**Duty Cycle (%):**	99
Data Rate:	1 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	Modulation Here	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Power Spectral Density (dBm) Port(s)				Calculated Total Power Spectral Density dBm		Limit	Margin
MHz	a	b	c	d	Σ Port(s)	Conversion to 3 kHz RBW	dBm	dB
2412.0	-12.185	--	--	--	-12.185	N/A	≤8.0	-20.19
2437.0	-11.799	--	--	--	-11.799	N/A	≤8.0	-19.80
2462.0	-10.900	--	--	--	-10.900	N/A	≤8.0	-18.90

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

Equipment Configuration for Power Density			
Variant:	802.11g	**Duty Cycle (%):**	99
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Maximum Power		
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Power Spectral Density (dBm) Port(s)				Calculated Total Power Spectral Density dBm		Limit	Margin
MHz	a	b	c	d	Σ Port(s)	Conversion to 3 kHz RBW	dBm	dB
2412.0	-15.882	--	--	--	-15.882	N/A	≤8.0	-23.88
2437.0	-15.919	--	--	--	-15.919	N/A	≤8.0	-23.92
2462.0	-15.954	--	--	--	-15.954	N/A	≤8.0	-23.95

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

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

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

Test Equipment Used
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):**	Not Applicable
Modulation:	CCK	**Beam Forming Gain (Y):**	Not Applicable
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	-42.043	-21.21	--	--	--	--	--	--
2437.0	30.0 - 26000.0	-41.986	-20.48	--	--	--	--	--	--
2462.0	30.0 - 26000.0	-52.363	-20.16	--	--	--	--	--	--

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	-29.359	-19.79	--	--	--	--	--	--
2462.0	2483.5	-48.004	-19.82	--	--	--	--	--	--

BE - Maximum band-edge emission found

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 Measurement of Spurious Emissions
Measurement Uncertainty:	≤ 40 GHz ±2.37 dB > 40 GHz ±4.6 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 (%):**	99
Data Rate:	6 MBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OFDM	**Beam Forming Gain (Y):**	Not Applicable
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	-37.268	-22.48	--	--	--	--	--	--
2437.0	30.0 - 26000.0	-33.148	-22.83	--	--	--	--	--	--
2462.0	30.0 - 26000.0	-31.966	-23.07	--	--	--	--	--	--

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	-22.861	-22.16	--	--	--	--	--	--
2462.0	2483.5	-33.414	-22.57	--	--	--	--	--	--

BE - Maximum band-edge emission found

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 Measurement of Spurious Emissions
Measurement Uncertainty:	≤ 40 GHz ±2.37 dB > 40 GHz ±4.6 dB

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

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
5725 MHz	5850 MHz	

§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

Test Equipment Used
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

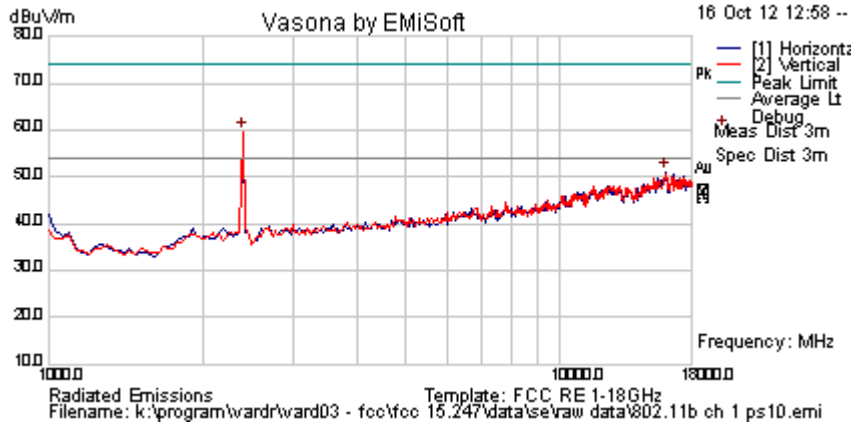
Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

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

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

6.1.2.1. Integral Antenna

Test Freq.	2412 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	26
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	10	**Press. (mBars)**	1008
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	3VDC;		
Test Notes 2			



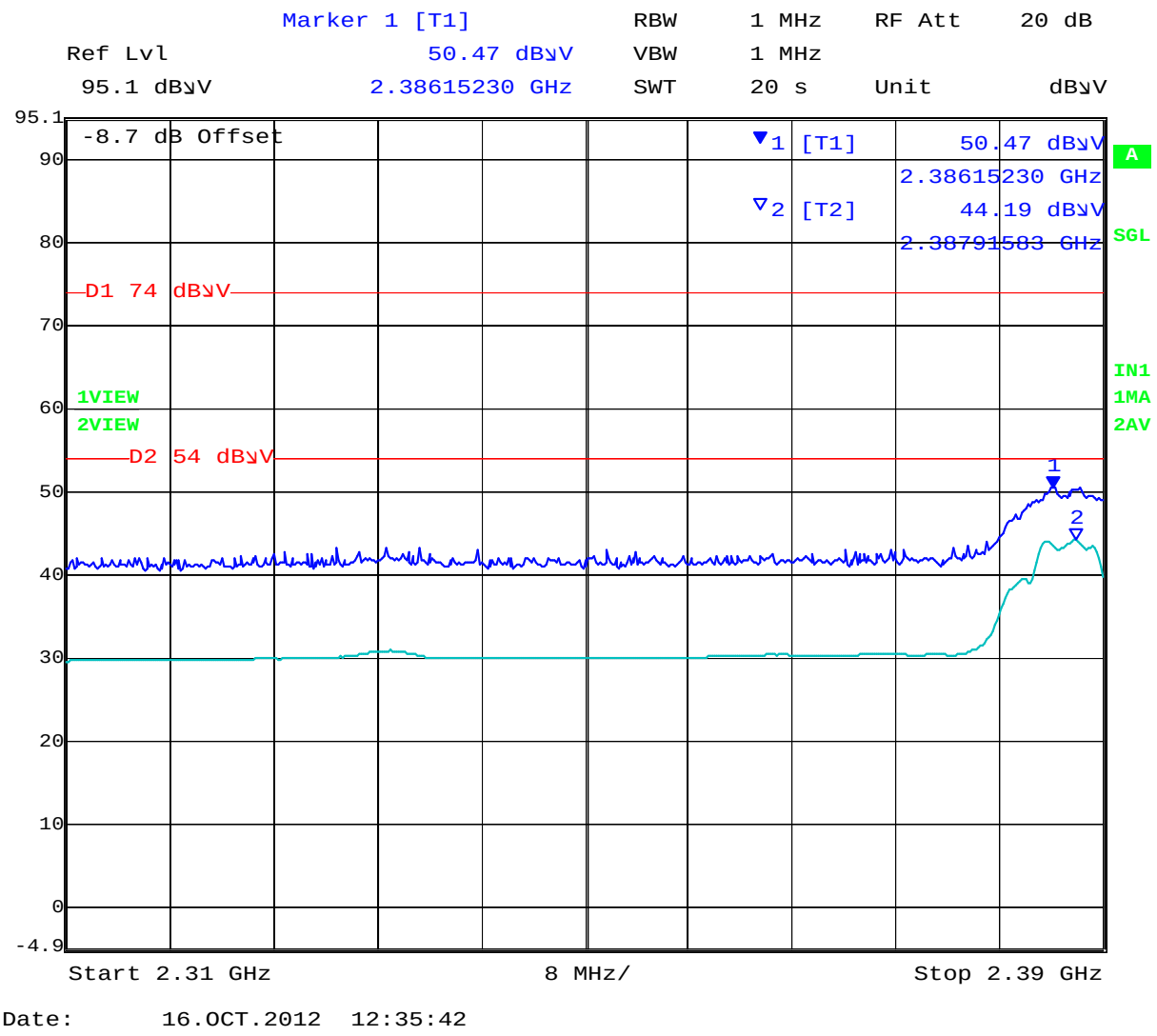
Formally measured emission peaks

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	68.4	3.0	-11.7	59.7	Peak [Scan]	V						FUND

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

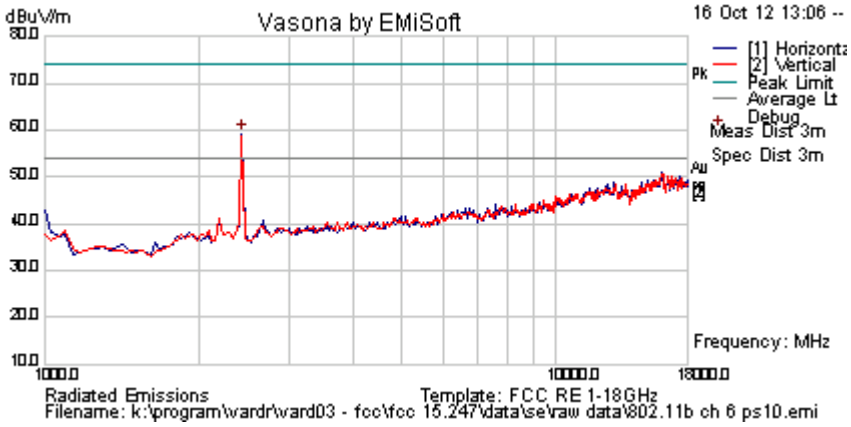
No emissions found within 6 dB of the limit. The emission breaking the limit line is the fundamental frequency

Band Edge



Power reduction required in order to bring unit into compliance Power Setting = 10

Test Freq.	2437 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	26
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	10	**Press. (mBars)**	1008
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	3VDC;		
Test Notes 2			



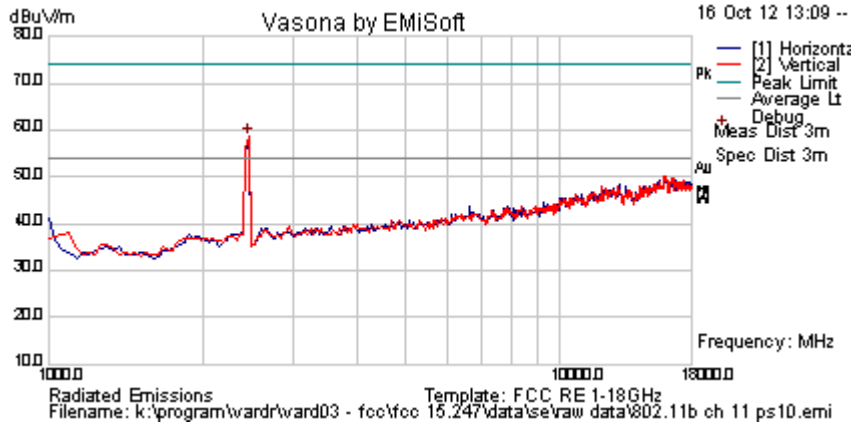
Formally measured emission peaks

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	67.9	3.0	-11.6	59.3	Peak [Scan]	H						FUND

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

No emissions found within 6 dB of the limit. The emission breaking the limit line is the fundamental frequency

Test Freq.	2462 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	26
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	10	**Press. (mBars)**	1008
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	3VDC;		
Test Notes 2			



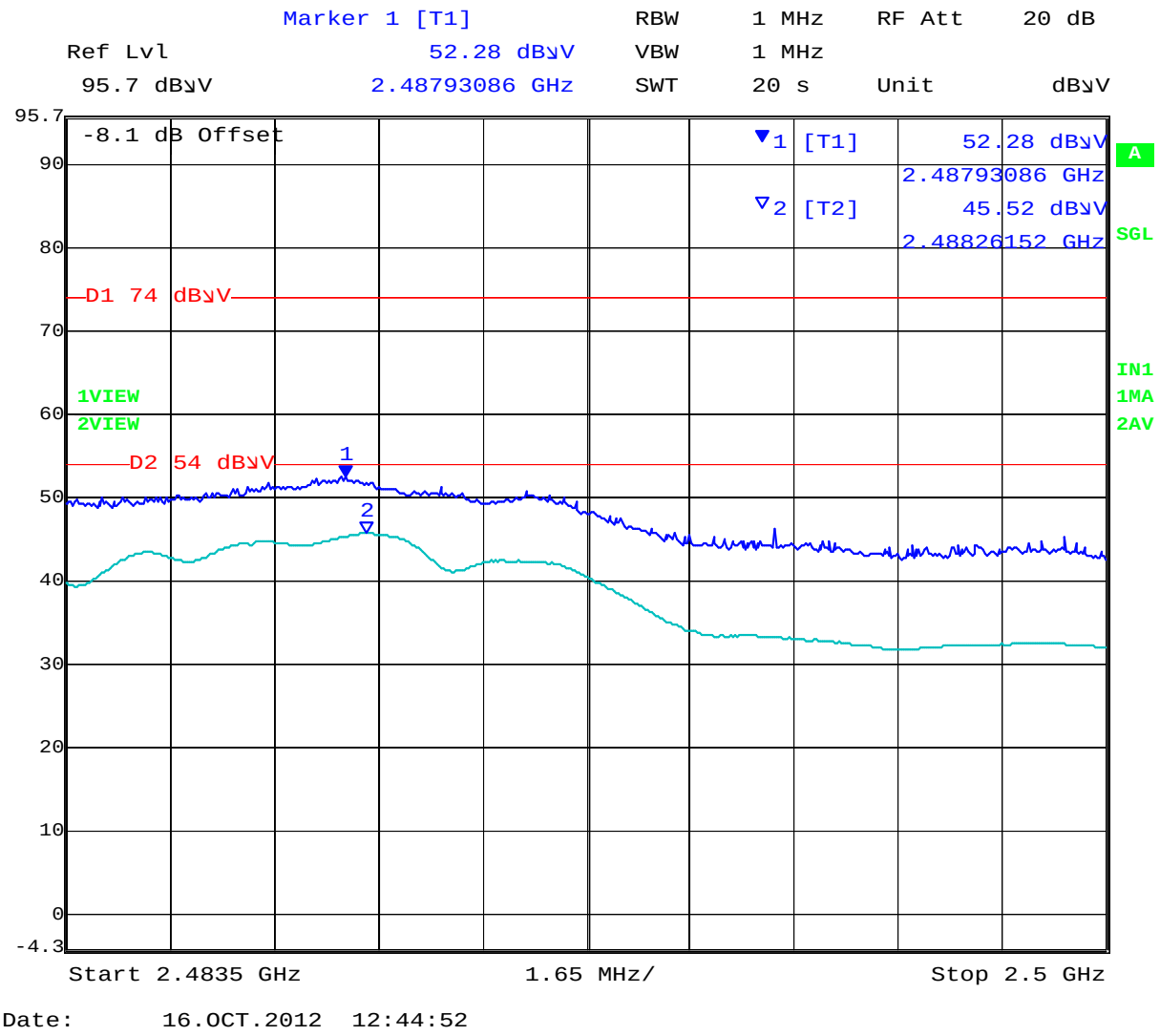
Formally measured emission peaks

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	67.2	3.0	-11.5	58.6	Peak [Scan]	V						FUND

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

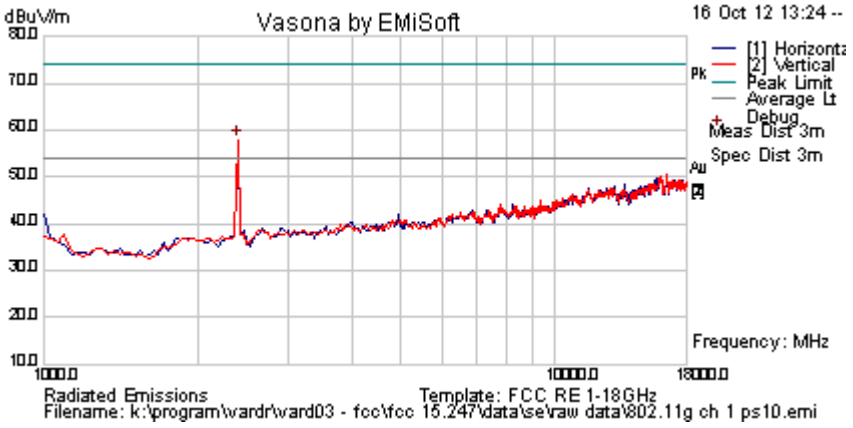
No emissions found within 6 dB of the limit. The emission breaking the limit line is the fundamental frequency

Band Edge



Power reduction required in order to bring unit into compliance Power Setting = 10

Test Freq.	2412 MHz	**Engineer**	SB
Variant	802.11g; 6 Mbs	**Temp (ºC)**	26
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	10	**Press. (mBars)**	1008
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	3VDC;		
Test Notes 2			



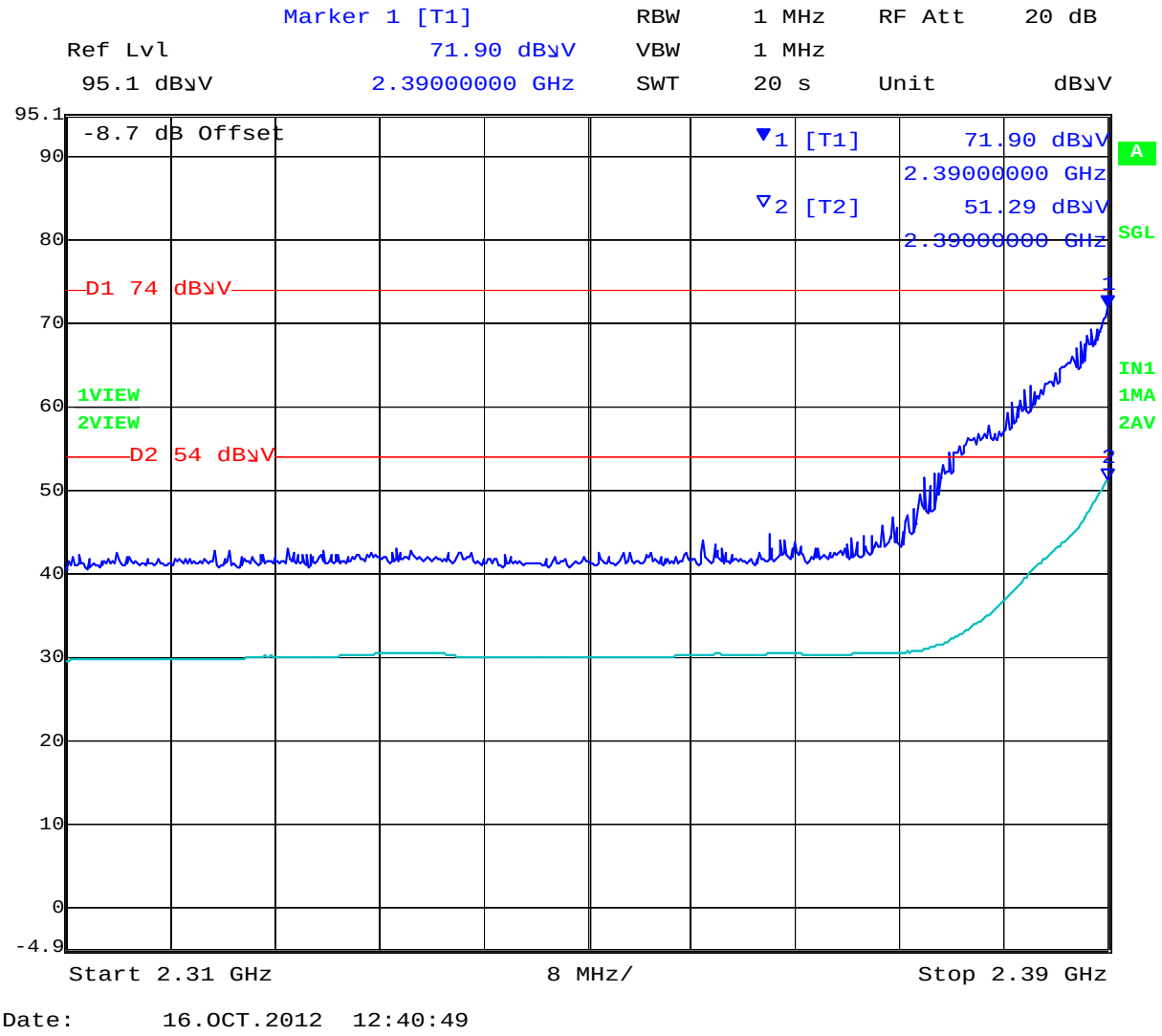
Formally measured emission peaks

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	66.6	3.0	-11.7	57.9	Peak [Scan]	V						FUND

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

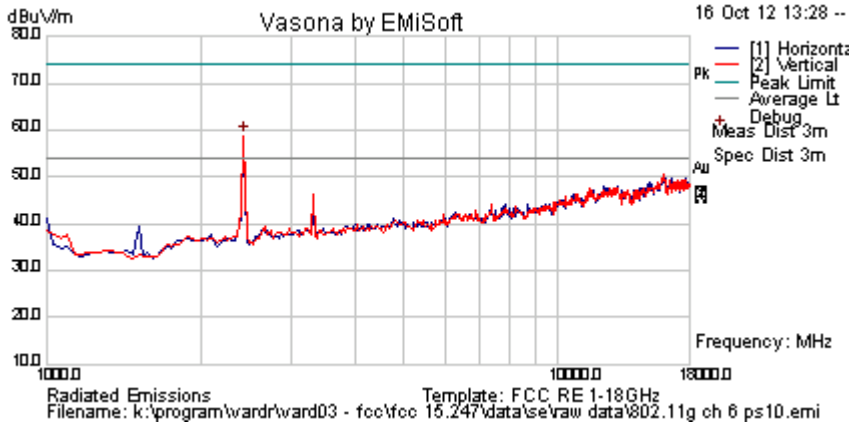
No emissions found within 6 dB of the limit. The emission breaking the limit line is the fundamental frequency

Band Edge



Power reduction required in order to bring unit into compliance Power Setting = 10

Test Freq.	2437 MHz	**Engineer**	SB
Variant	802.11g; 6 Mbs	**Temp (ºC)**	26
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	10	**Press. (mBars)**	1008
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	3VDC;		
Test Notes 2			



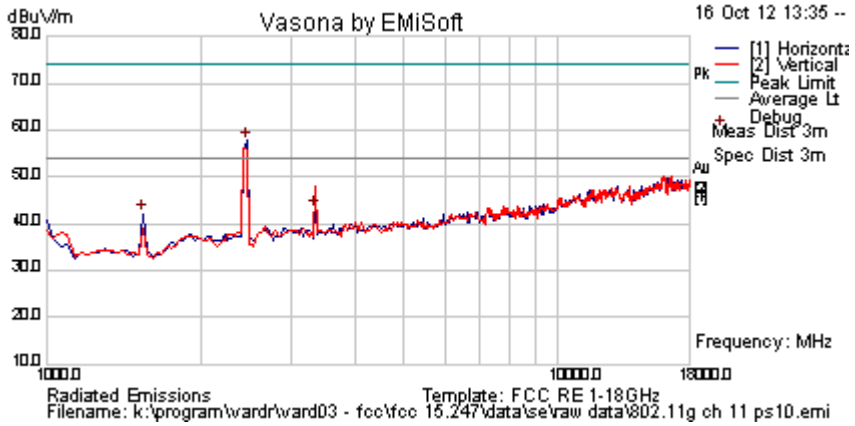
Formally measured emission peaks

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	67.4	3.0	-11.6	58.8	Peak [Scan]	V						FUND

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

No emissions found within 6 dB of the limit. The emission breaking the limit line is the fundamental frequency

Test Freq.	2462 MHz	**Engineer**	SB
Variant	802.11g; 6 Mbs	**Temp (ºC)**	26
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	10	**Press. (mBars)**	1008
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	3VDC;		
Test Notes 2			



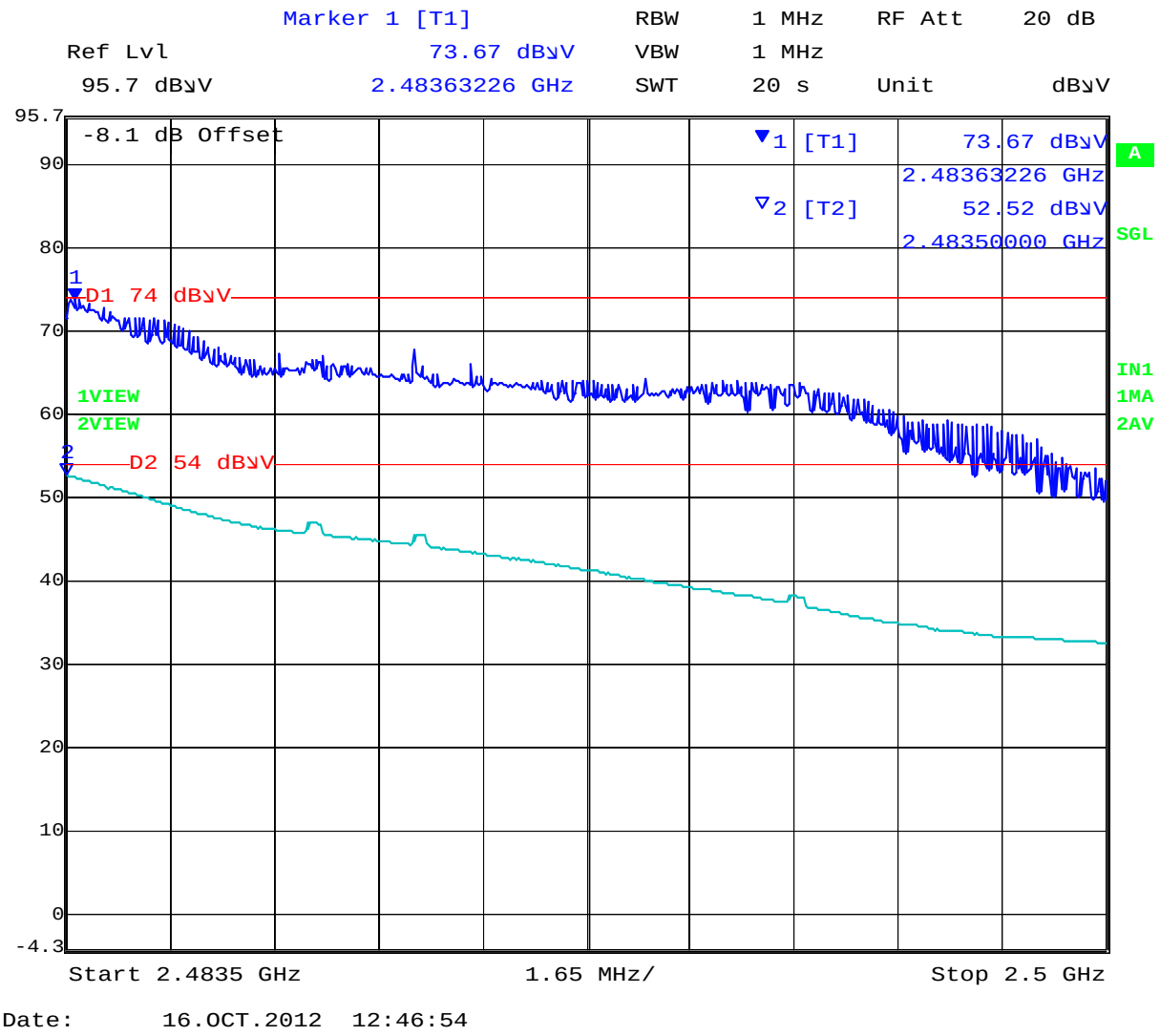
Formally measured emission peaks

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	66.2	3.0	-11.5	57.7	Peak [Scan]	H						FUND
1544.965	54.8	2.4	-15.1	42.1	Peak [Scan]	V	98	0	54.0	-11.9	Pass	
3352.213	51.2	3.5	-11.8	42.9	Peak [Scan]	V	98	0	54	-11.1	Pass	

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

No emissions found within 6 dB of the limit. The emission breaking the limit line is the fundamental frequency

Band Edge



Power reduction required in order to bring unit into compliance Power Setting = 10

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:

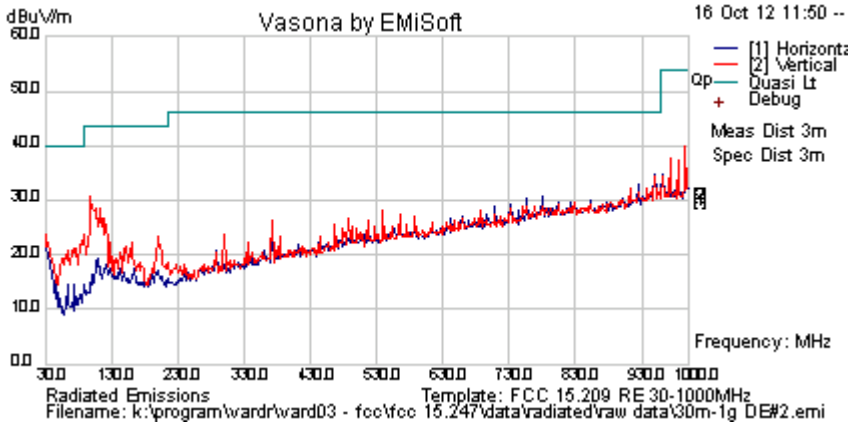
$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 dB\mu V/m$$

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

Test Freq.	2437 MHz	**Engineer**	SB
Variant	Digital Emissions	**Temp (ºC)**	24
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	33
Power Setting	N/A	**Press. (mBars)**	1008
Antenna	Integral		
Test Notes 1	3V Battery; Sound Loop/Video Loop Operational		
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
996.011	38.5	7.4	-6.5	39.5	Peak [Scan]	V	98	0	54	-14.6	Pass	
100.325	45.6	4.1	-21.1	28.5	Peak [Scan]	V	98	0	43.5	-15.0	Pass	
372.410	35.0	5.4	-15.3	25.1	Peak [Scan]	V	98	0	46	-20.9	Pass	
203.145	36.0	4.7	-19.1	21.6	Peak [Scan]	V	98	0	43.5	-21.9	Pass	
160.950	35.6	4.4	-18.8	21.2	Peak [Scan]	V	98	0	43.5	-22.3	Pass	
299.660	34.2	5.1	-17.2	22.1	Peak [Scan]	V	98	0	46	-23.9	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

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

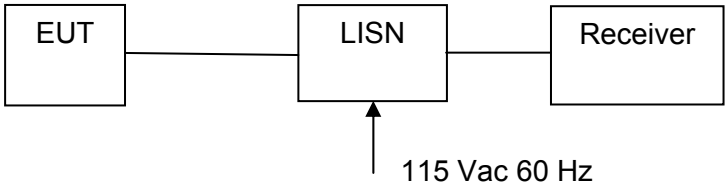
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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 battery powered

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

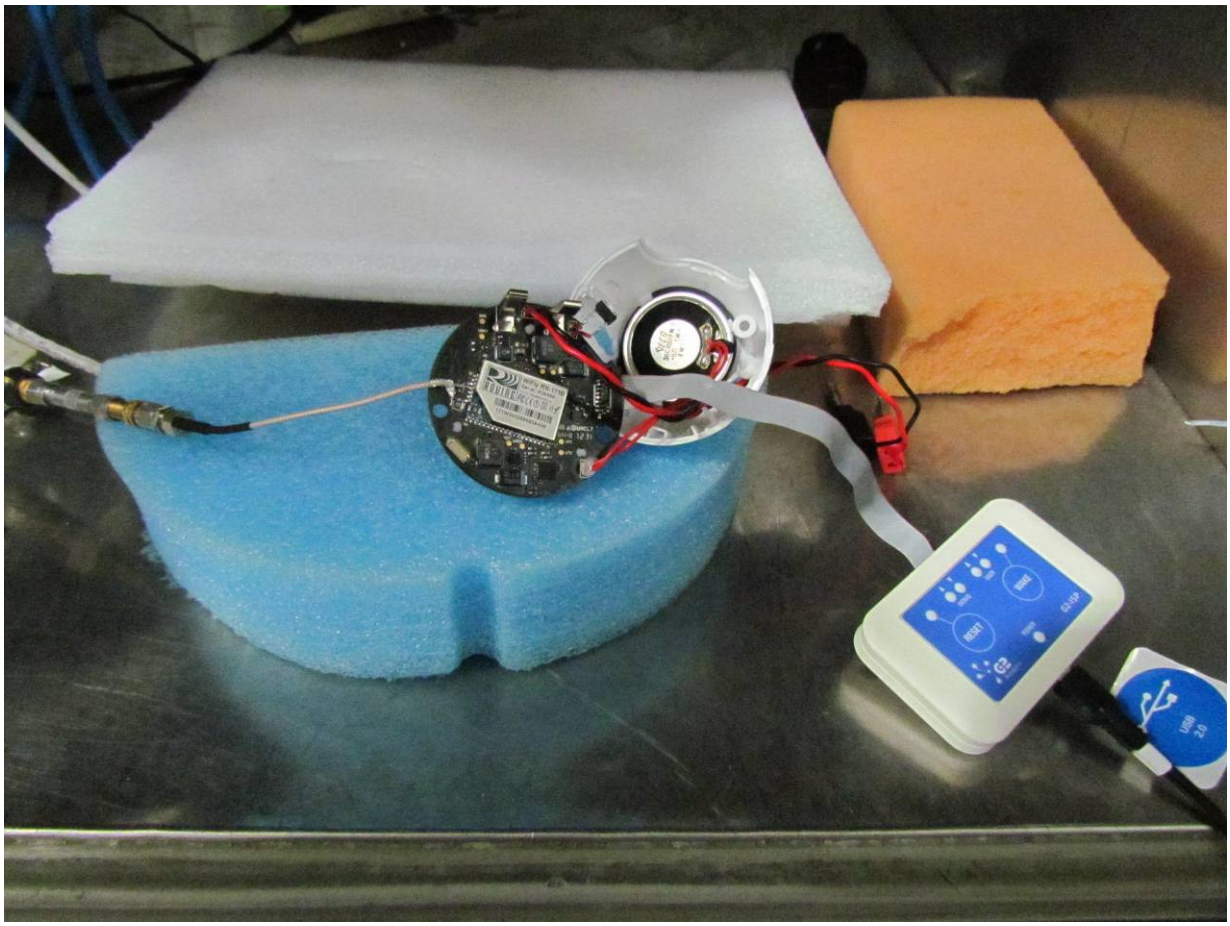
Measurement uncertainty	±2.64 dB

Traceability

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

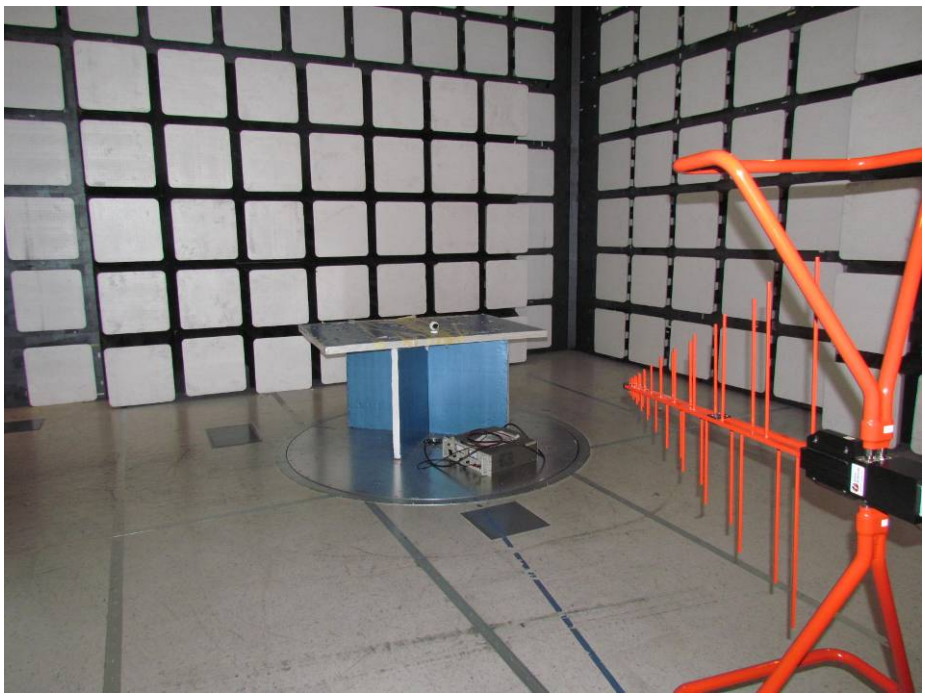
7. PHOTOGRAPHS

7.1. Conducted Test Setup



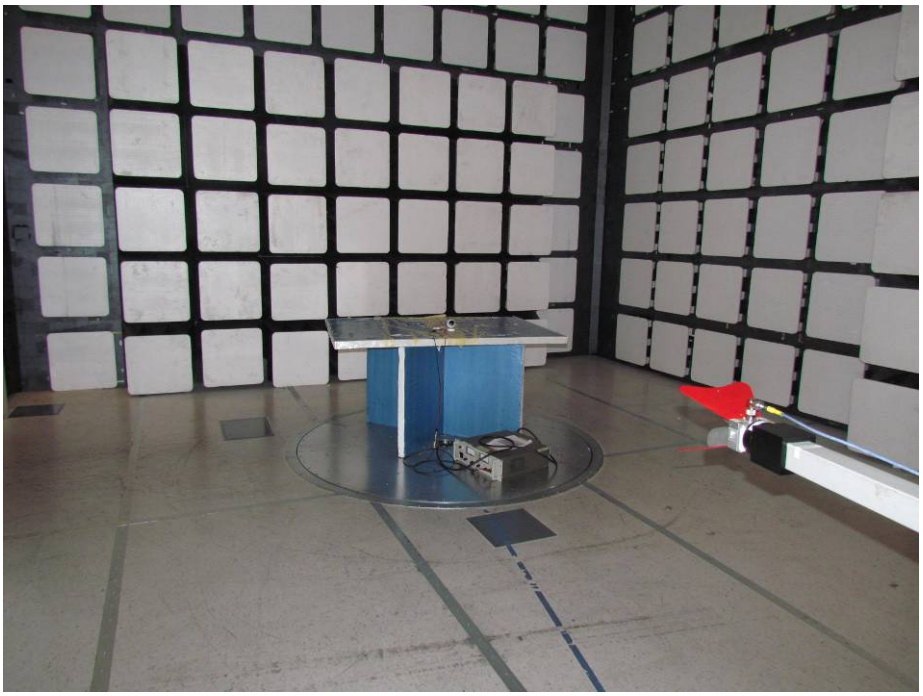
EUT power 3.0 Vdc was derived from the USB interface

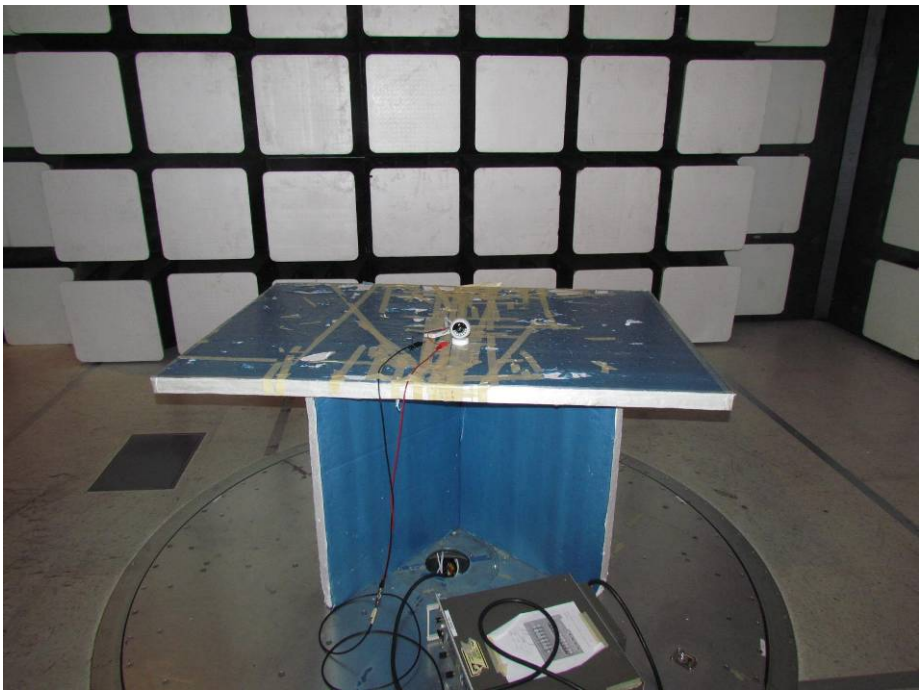
7.2. Test Setup - Digital Emissions below 1 GHz



Device was tested using its own internal batteries for emissions below 1 GHz

7.3. Radiated Emissions Test Setup >1 GHz





EUT was provided an external power source for emission testing above 1 GHz

8. TEST EQUIPMENT

Asset #	Instrument	Manufacturer	Part #	Serial #	Calibration Due Date
0070	Power Meter	Hewlett Packard	437B	3125U11552	28th Nov 12
0374	Power Sensor	Hewlett Packard	8485A	3318A19694	29th Nov 12
0158	Barometer /Thermometer	Control Co.	4196	E2846	8th Dec 12
0287	EMI Receiver	Rhode & Schwartz	ESIB40	100201	16th Nov 13
0338	30 - 3000 MHz Antenna	Sunol	JB3	A052907	8th Nov 13
0335	1-18 GHz Horn Antenna	EMCO	3117	00066580	7th Nov 13
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

APPENDIX

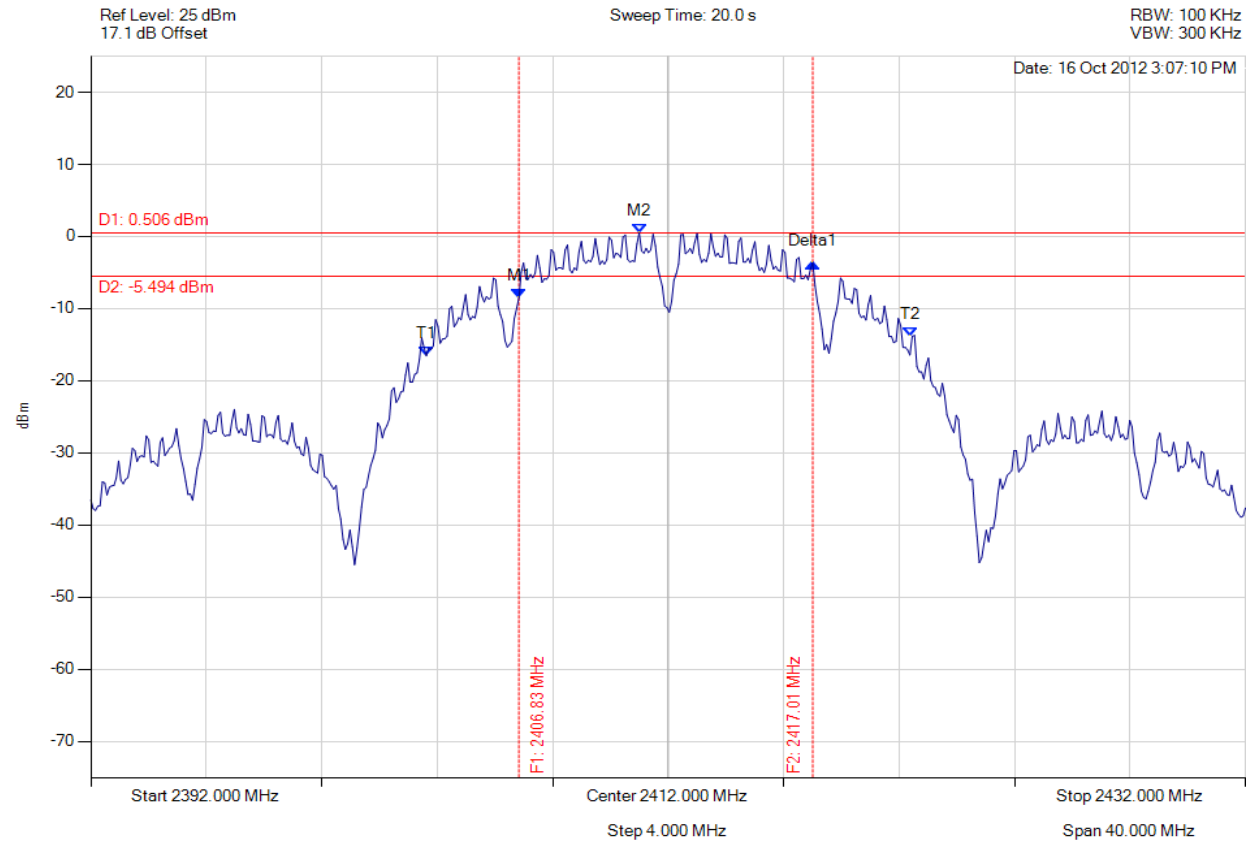
A. SUPPORTING INFORMATION

A.1. CONDUCTED TEST PLOTS

A.1.1. 6 dB & 99% Bandwidth

6 dB and 99% Bandwidth

Variant: 802.11b, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

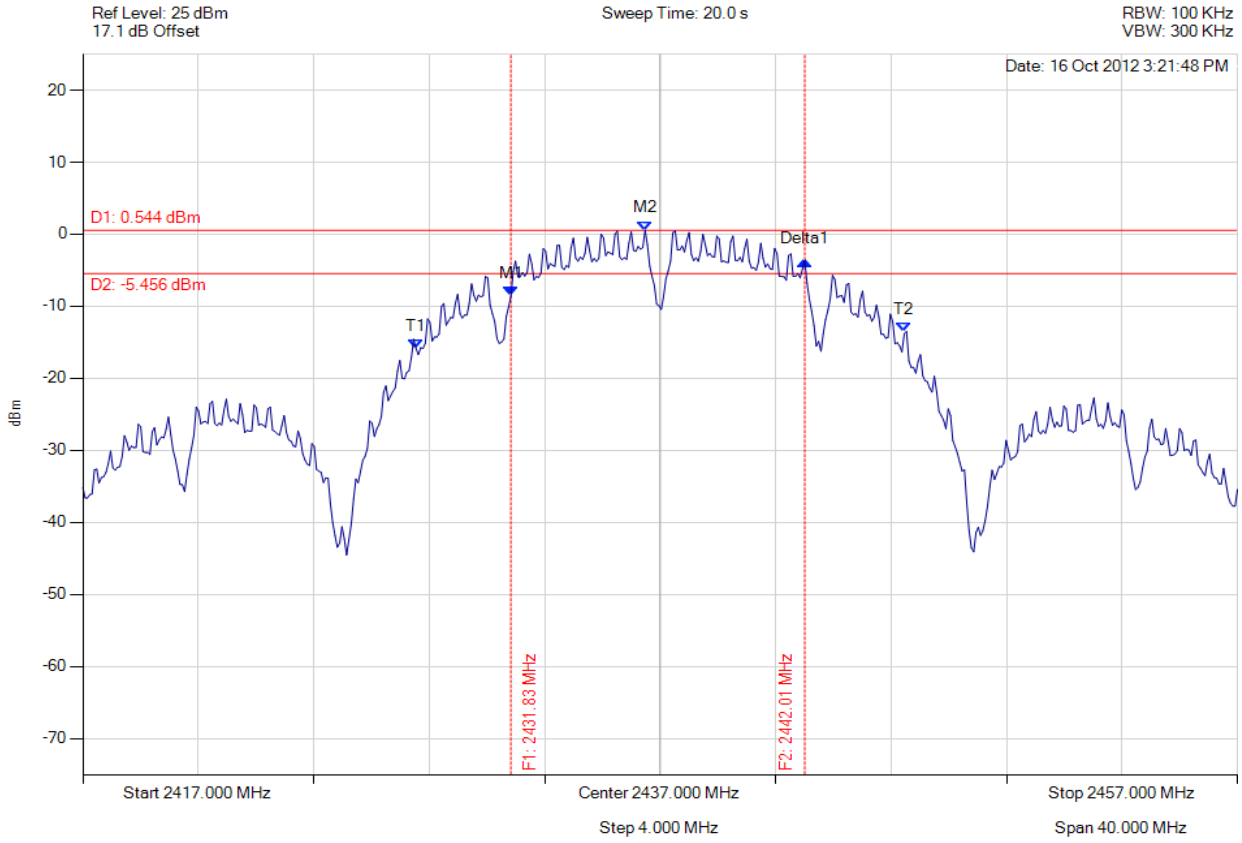


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2406.830 MHz : -8.500 dBm M2 : 2410.998 MHz : 0.506 dBm Delta1 : 10.180 MHz : 4.808 dB T1 : 2403.623 MHz : -16.551 dBm T2 : 2420.377 MHz : -13.824 dBm OBW : 16.834 MHz	Measured 6 dB Bandwidth: 10.180 MHz Limit: ≥ 0.5 MHz Margin: -9.68 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11b, Channel: 2437.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

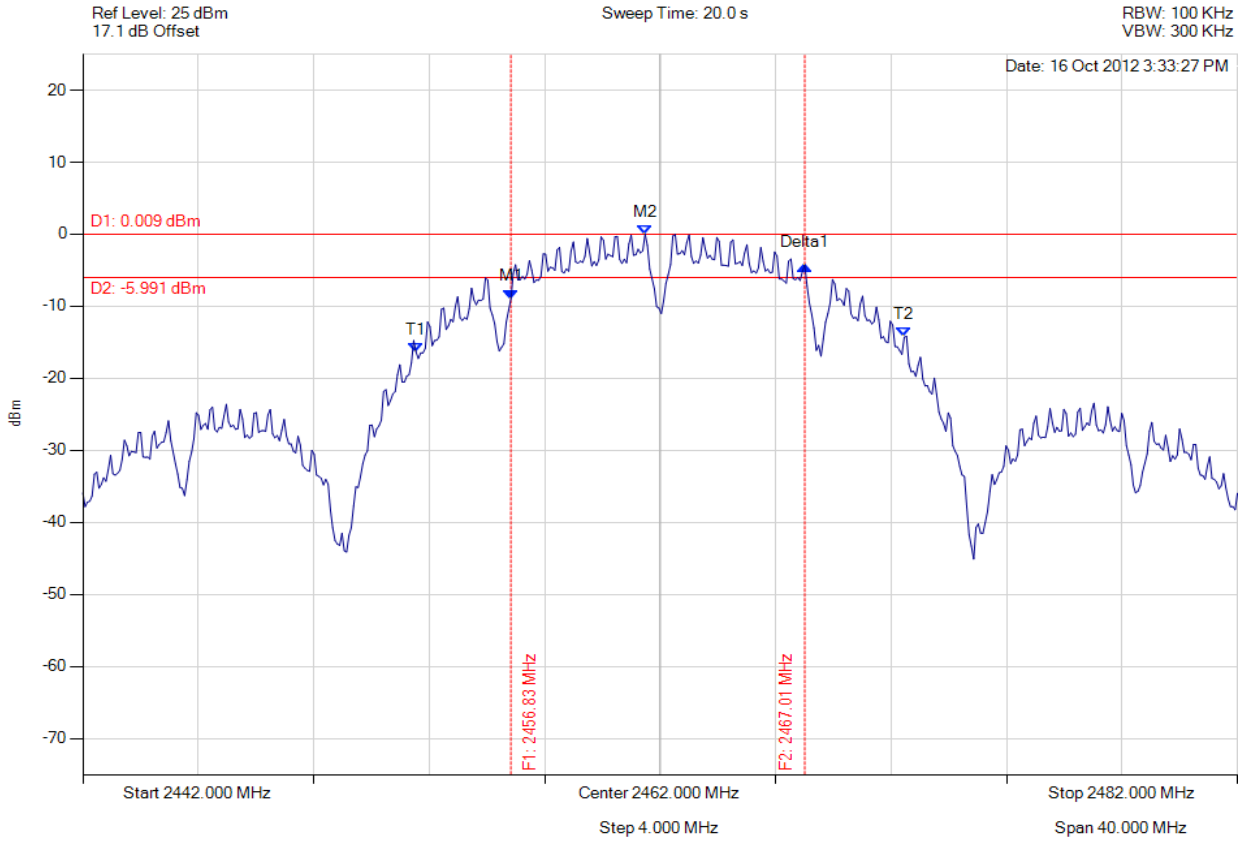


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2431.830 MHz : -8.575 dBm M2 : 2436.479 MHz : 0.544 dBm Delta1 : 10.180 MHz : 4.924 dB T1 : 2428.543 MHz : -15.897 dBm T2 : 2445.457 MHz : -13.481 dBm OBW : 16.994 MHz	Measured 6 dB Bandwidth: 10.180 MHz Limit: ≥ 0.5 MHz Margin: -9.68 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11b, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

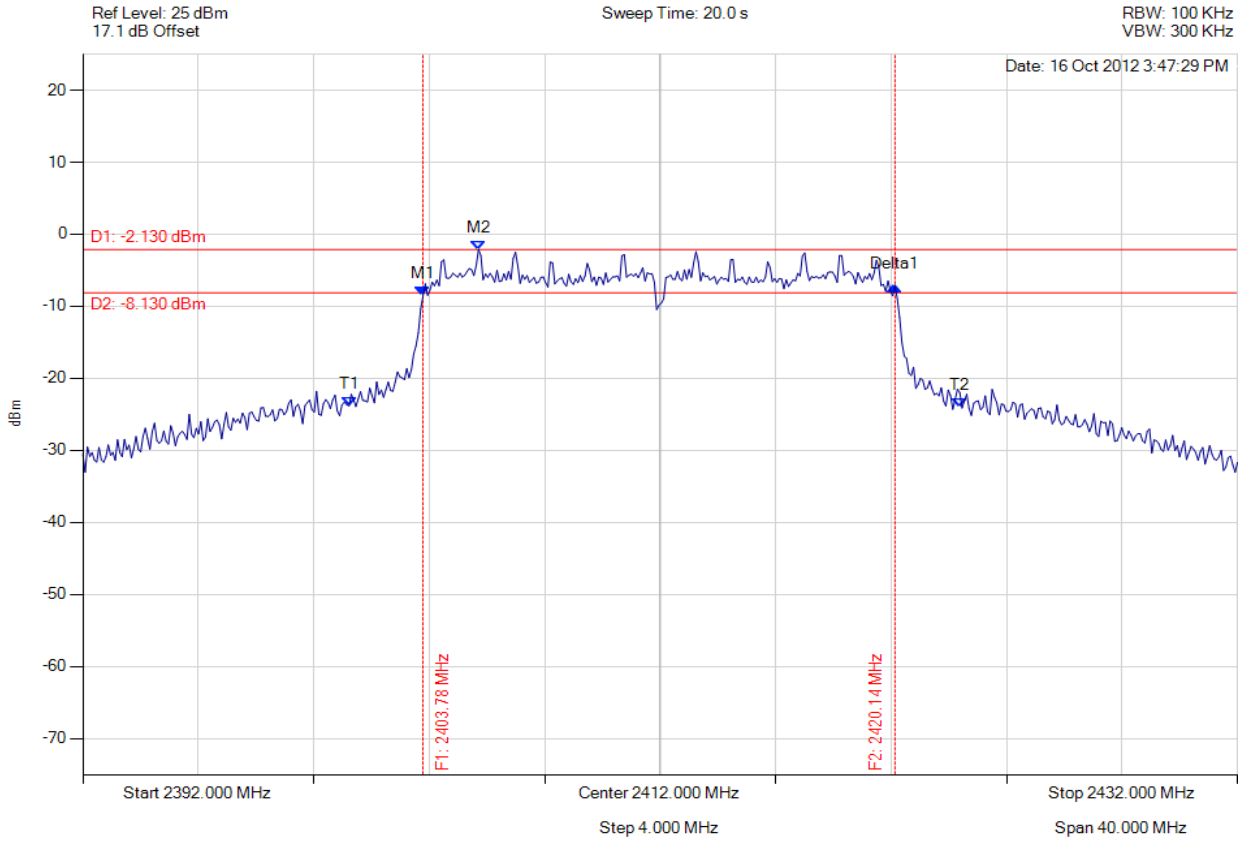


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2456.830 MHz : -8.962 dBm M2 : 2461.479 MHz : 0.009 dBm Delta1 : 10.180 MHz : 4.669 dB T1 : 2453.543 MHz : -16.366 dBm T2 : 2470.457 MHz : -14.154 dBm OBW : 16.994 MHz	Measured 6 dB Bandwidth: 10.180 MHz Limit: ≥ 0.5 MHz Margin: -9.68 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11g, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

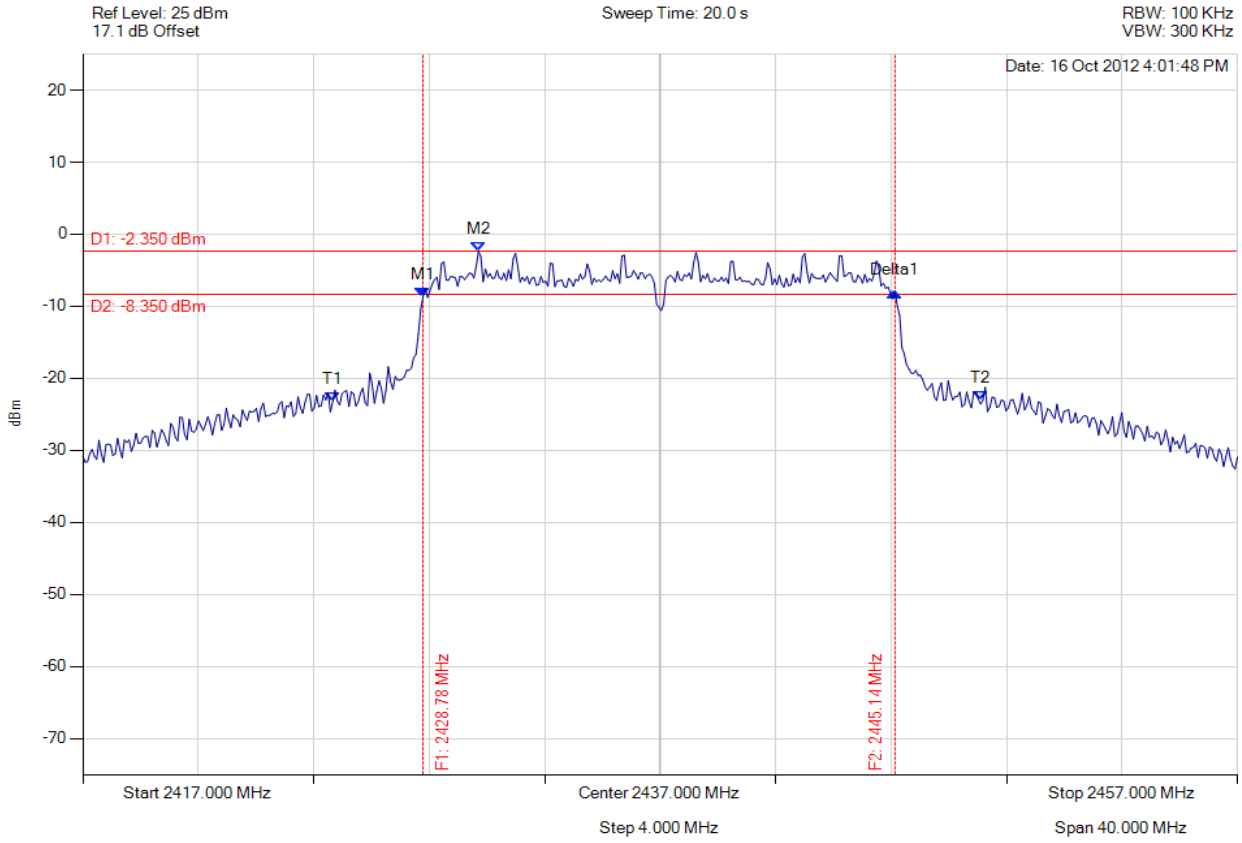


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2403.784 MHz : -8.616 dBm M2 : 2405.707 MHz : -2.130 dBm Delta1 : 16.353 MHz : 1.436 dB T1 : 2401.218 MHz : -23.836 dBm T2 : 2422.381 MHz : -24.119 dBm OBW : 21.242 MHz	Measured 6 dB Bandwidth: 16.353 MHz Limit: ≥ 0.5 MHz Margin: -15.85 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11g, Channel: 2437.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

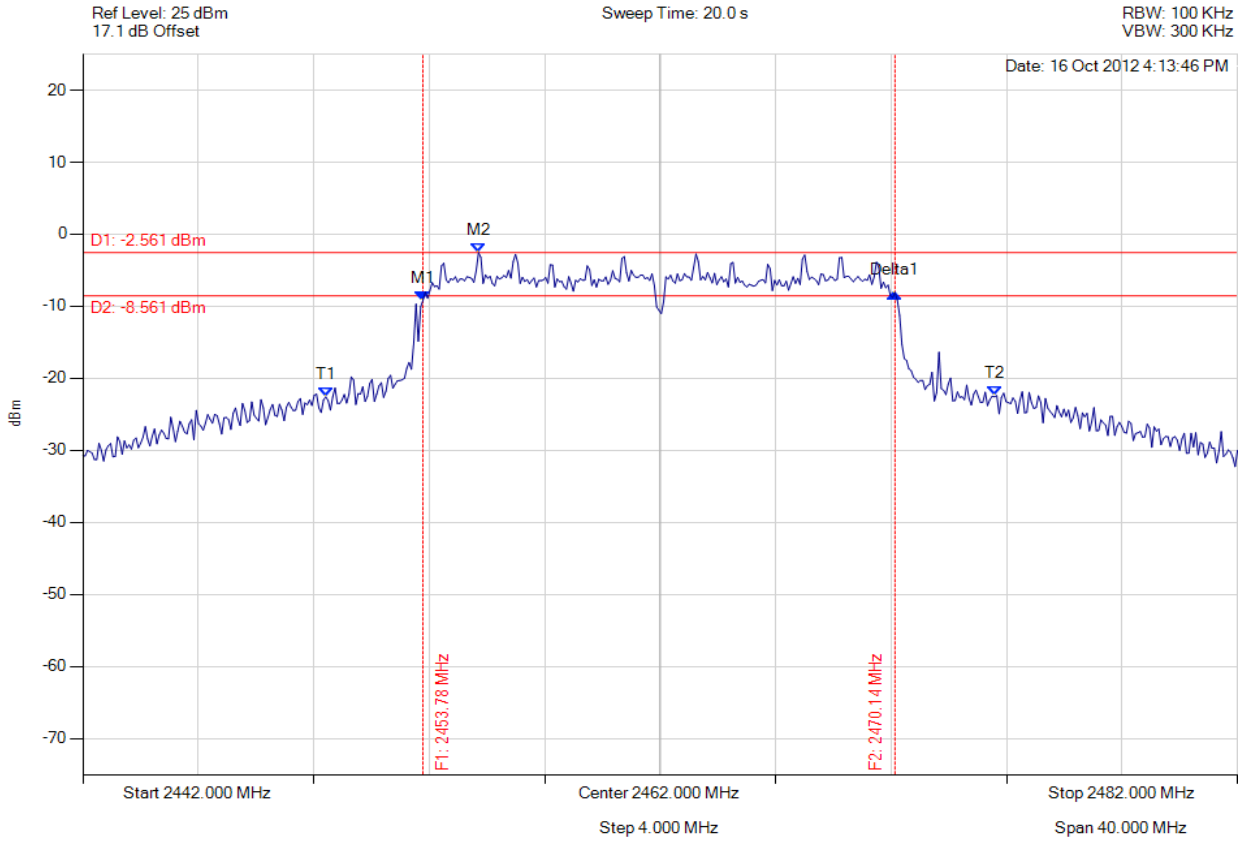


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2428.784 MHz : -8.707 dBm M2 : 2430.707 MHz : -2.350 dBm Delta1 : 16.353 MHz : 0.673 dB T1 : 2425.657 MHz : -23.236 dBm T2 : 2448.102 MHz : -23.066 dBm OBW : 22.525 MHz	Measured 6 dB Bandwidth: 16.353 MHz Limit: ≥ 0.5 MHz Margin: -15.85 MHz

Back to the Matrix

6 dB and 99% Bandwidth

Variant: 802.11g, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



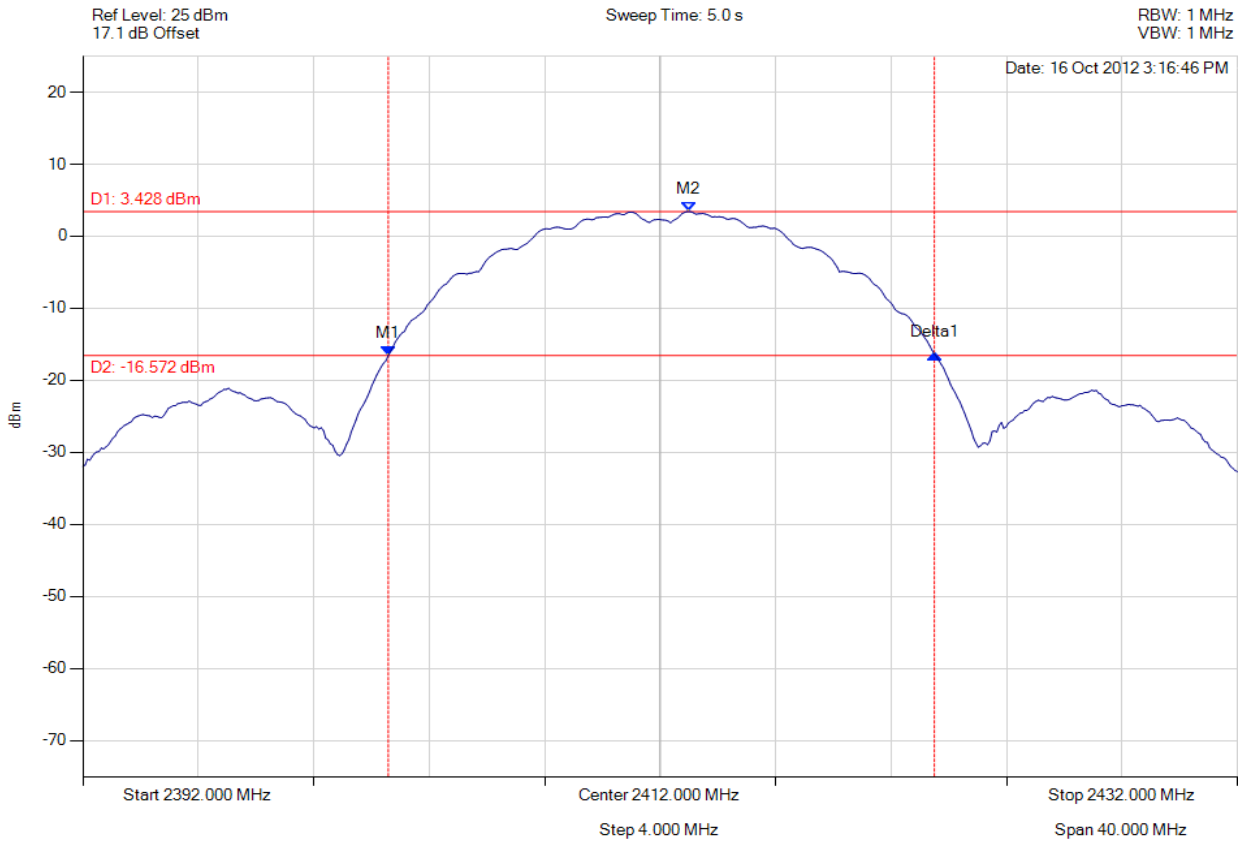
Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2453.784 MHz : -9.177 dBm M2 : 2455.707 MHz : -2.561 dBm Delta1 : 16.353 MHz : 1.056 dB T1 : 2450.417 MHz : -22.579 dBm T2 : 2473.583 MHz : -22.398 dBm OBW : 23.246 MHz	Measured 6 dB Bandwidth: 16.353 MHz Limit: ≥ 0.5 MHz Margin: -15.85 MHz

Back to the Matrix

A.1.2. Peak Output Power

Peak Output Power

Variant: 802.11b, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

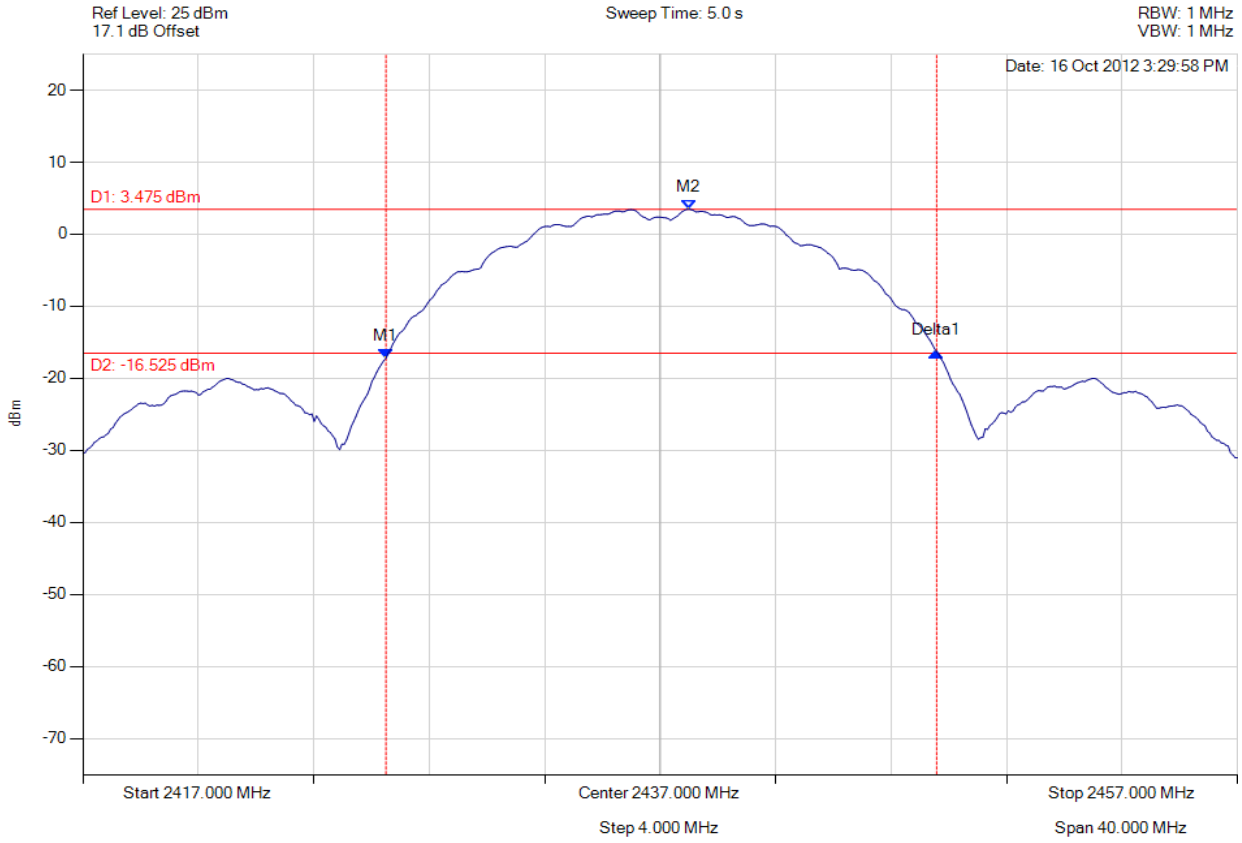


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2402.581 MHz : -16.584 dBm M2 : 2413.002 MHz : 3.428 dBm Delta1 : 18.918 MHz : 0.240 dB	Channel Power: 11.99 dBm Limit: 30.00 dBm Margin: -18.01 dB

Back to the Matrix

Peak Output Power

Variant: 802.11b, Channel: 2437.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

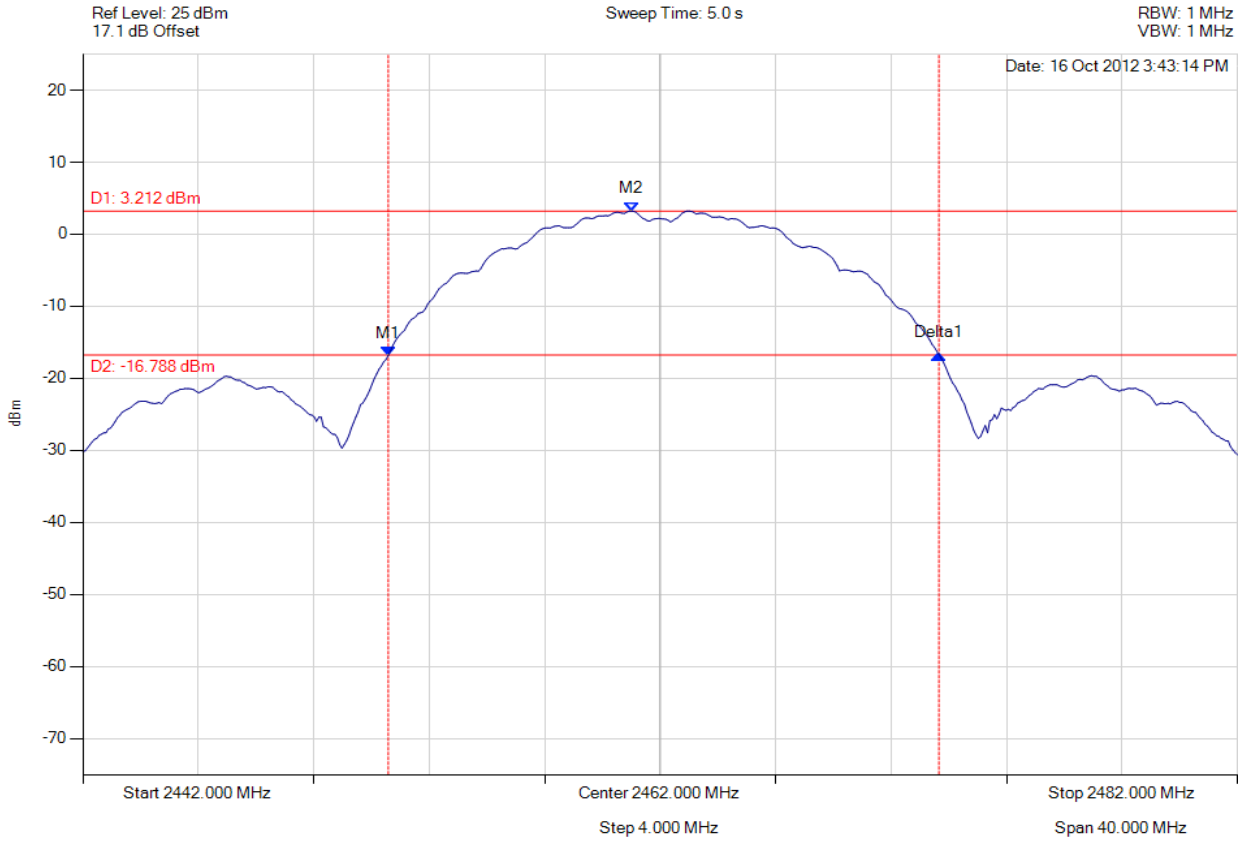


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2427.501 MHz : -17.237 dBm M2 : 2438.002 MHz : 3.475 dBm Delta1 : 19.078 MHz : 0.913 dB	Channel Power: 12.05 dBm Limit: 30.00 dBm Margin: -17.95 dB

Back to the Matrix

Peak Output Power

Variant: 802.11b, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2452.581 MHz : -16.806 dBm M2 : 2460.998 MHz : 3.212 dBm Delta1 : 19.078 MHz : 0.106 dB	Channel Power: 11.82 dBm Limit: 30.00 dBm Margin: -18.18 dB

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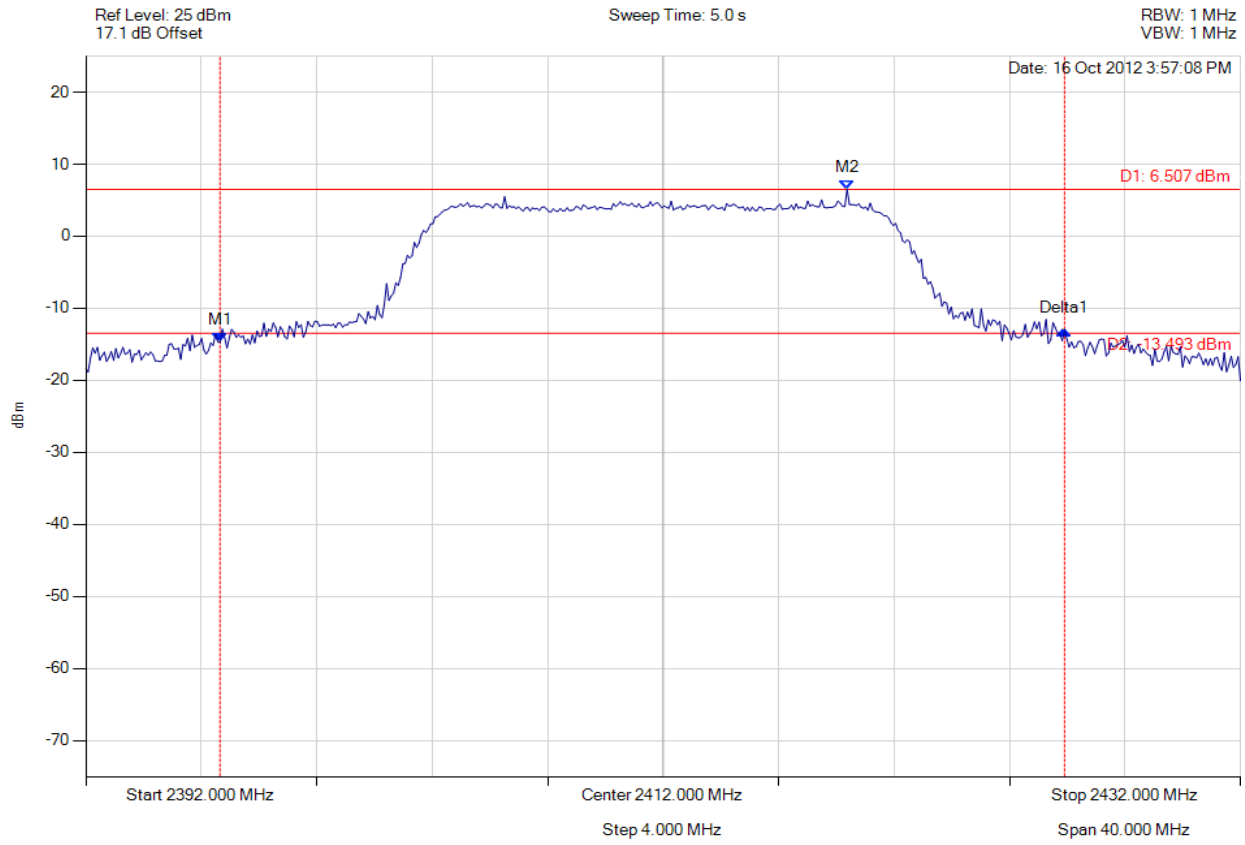
peak output power

Variant: 802.11g, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2396.649 MHz : -14.748 dBm M2 : 2418.373 MHz : 6.507 dBm Delta1 : 29.259 MHz : 1.682 dB	Channel Power: 15.79 dBm Limit: 30.00 dBm Margin: -14.21 dB

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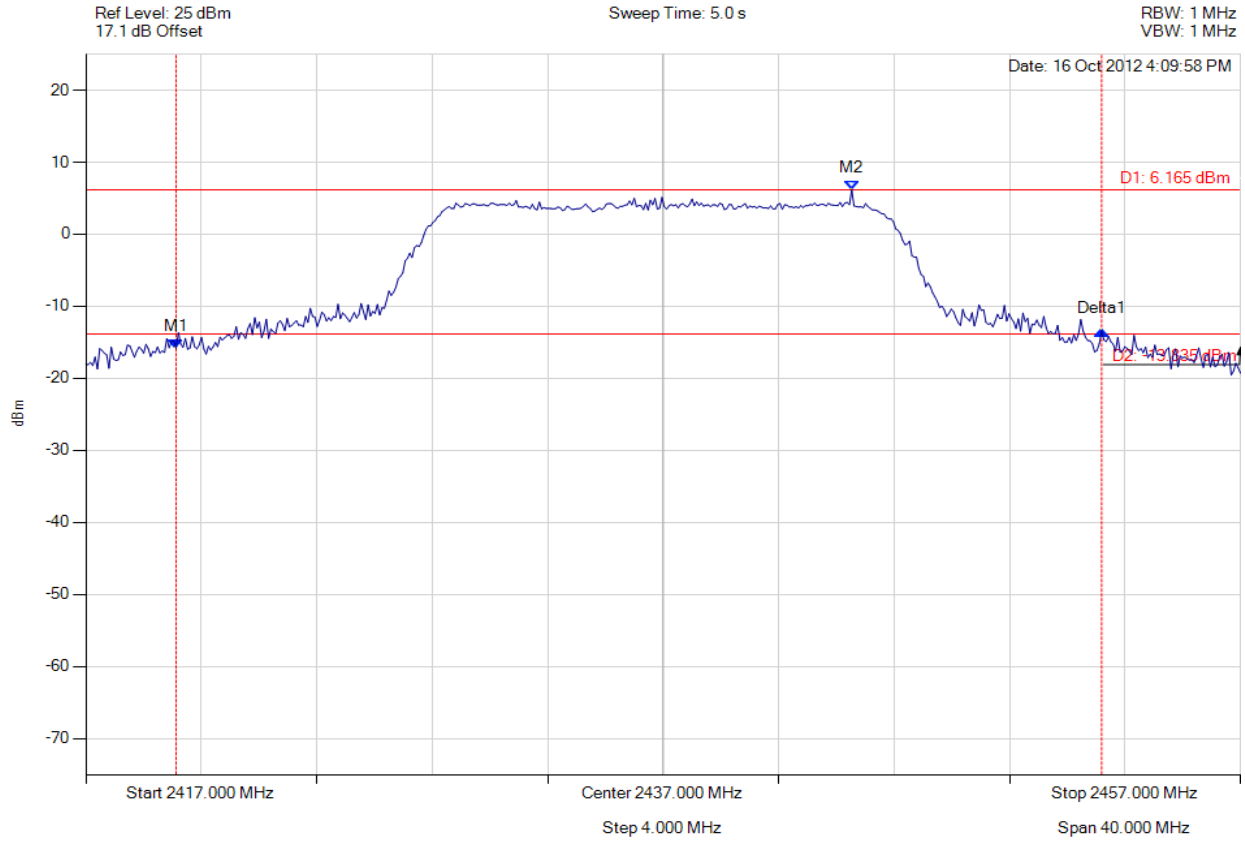
peak output power

Variant: 802.11g, Channel: 2437.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2420.126 MHz : -15.836 dBm M2 : 2443.533 MHz : 6.165 dBm Delta1 : 32.064 MHz : 2.392 dB	Channel Power: 15.64 dBm Limit: 30.00 dBm Margin: -14.36 dB

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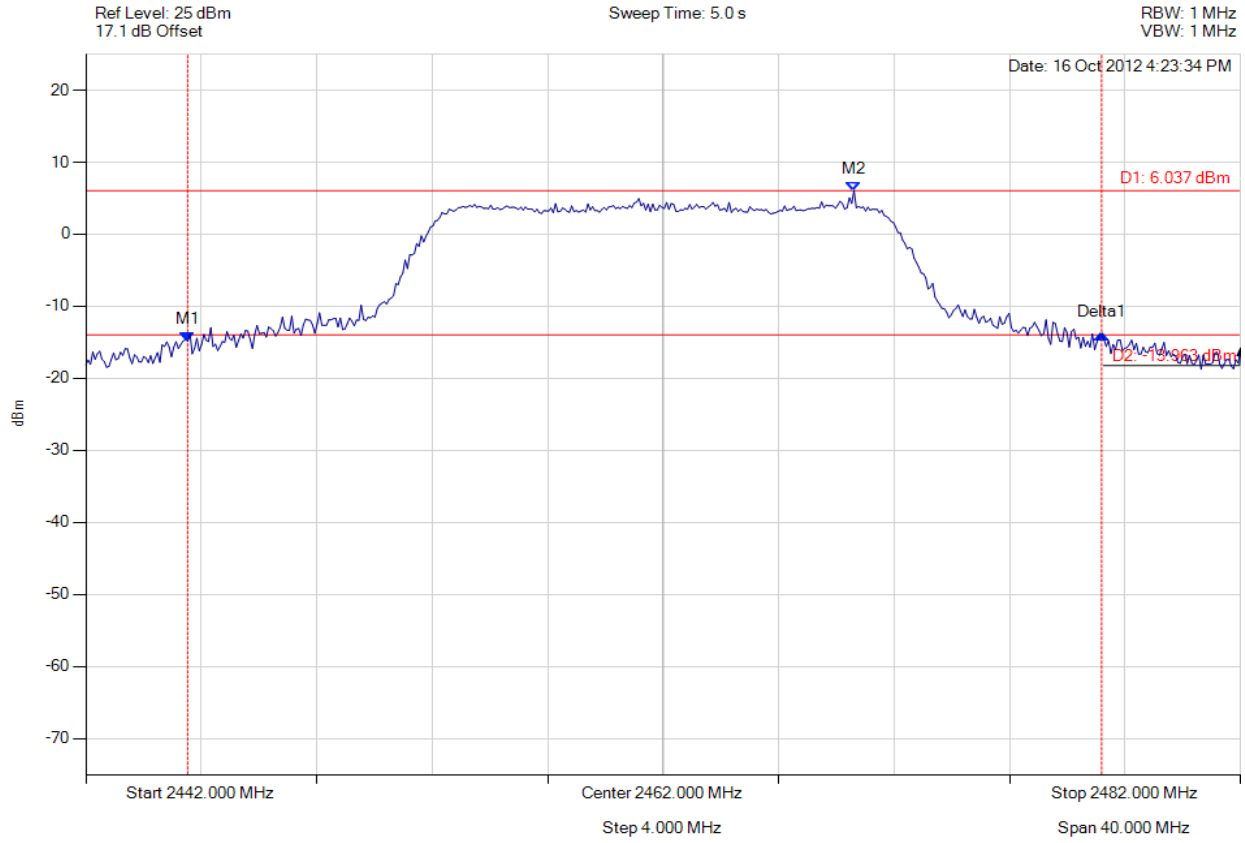
peak output power

Variant: 802.11g, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2445.527 MHz : -14.853 dBm M2 : 2468.613 MHz : 6.037 dBm Delta1 : 31.663 MHz : 1.027 dB	Channel Power: 15.34 dBm Limit: 30.00 dBm Margin: -14.66 dB

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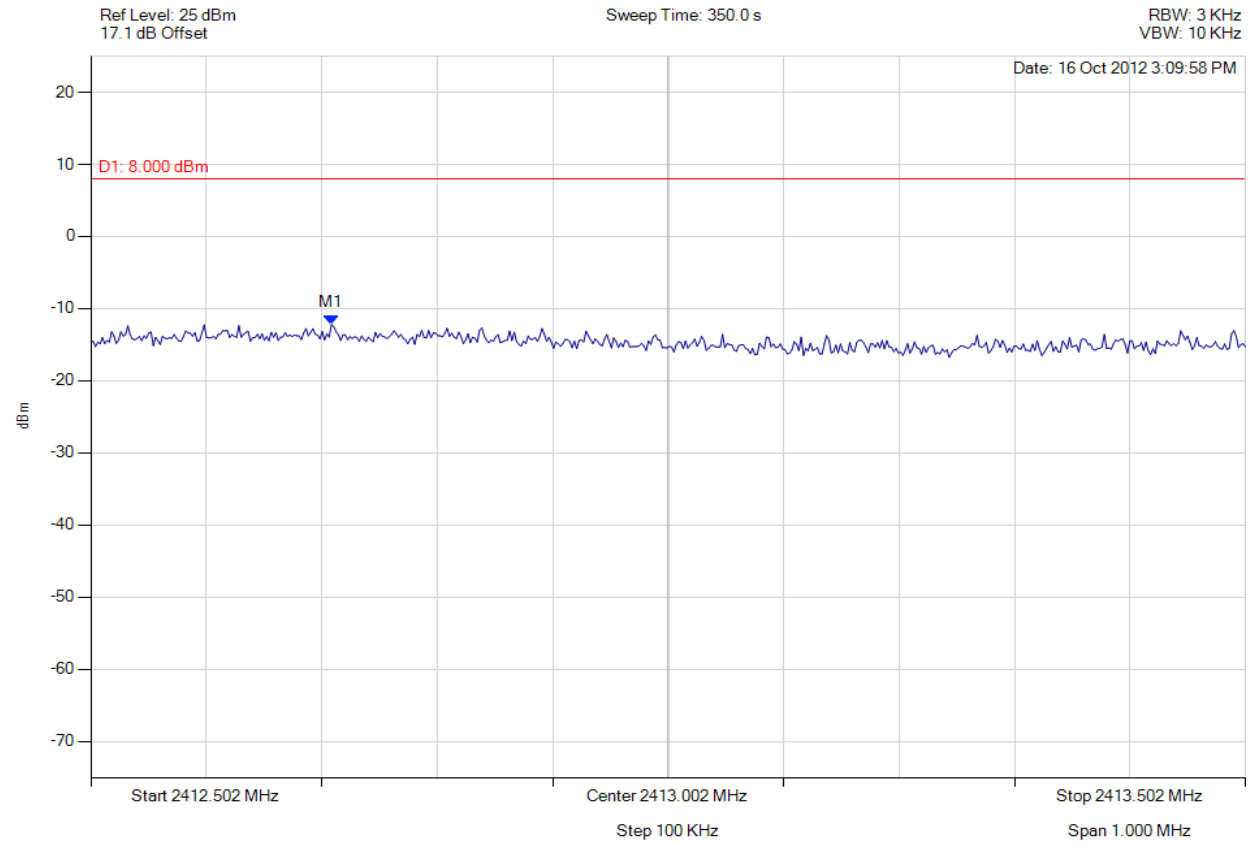
A.1.3. Power Spectral Density

Power Density

Variant: 802.11b, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

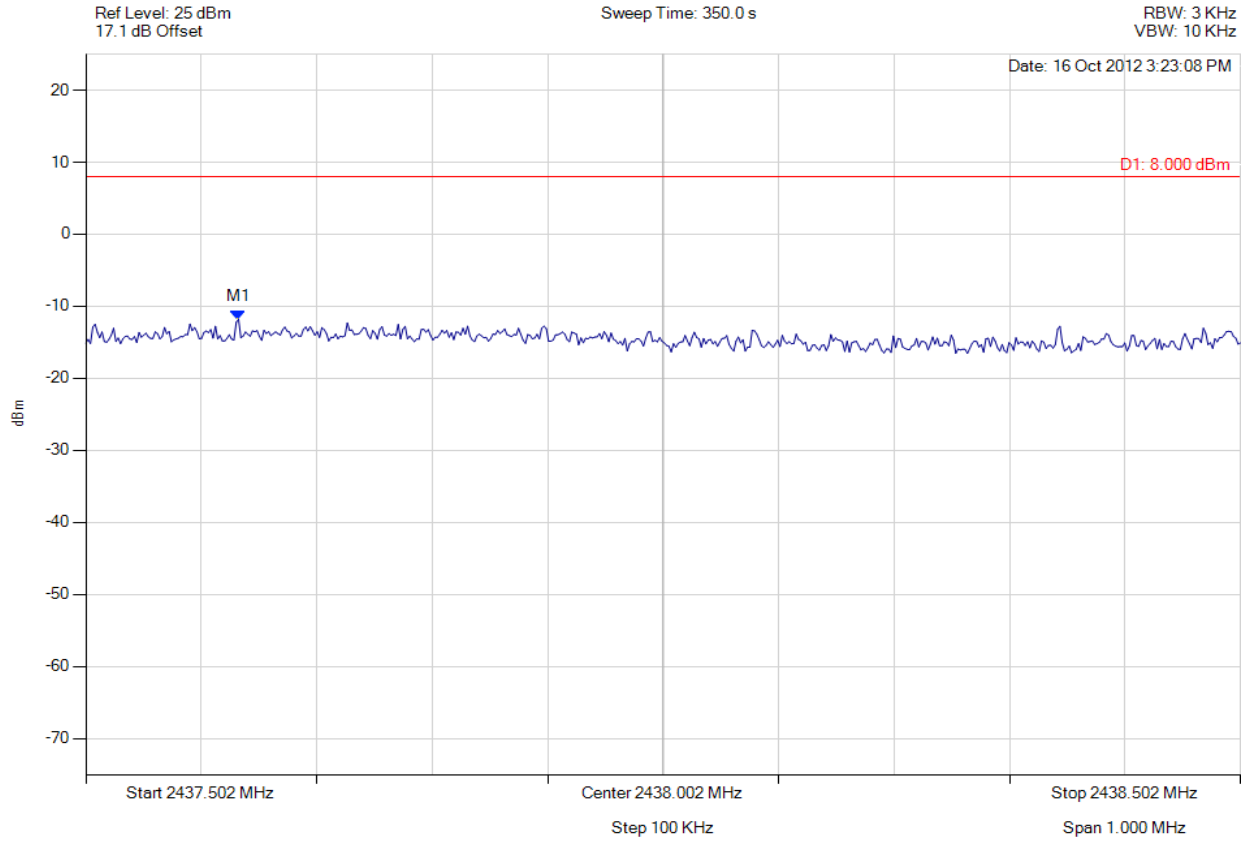


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2412.710 MHz : -12.185 dBm	Limit: ≤8.00 dBm Margin: -20.19 dB

Back to the Matrix

Power Density

Variant: 802.11b, Channel: 2437.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

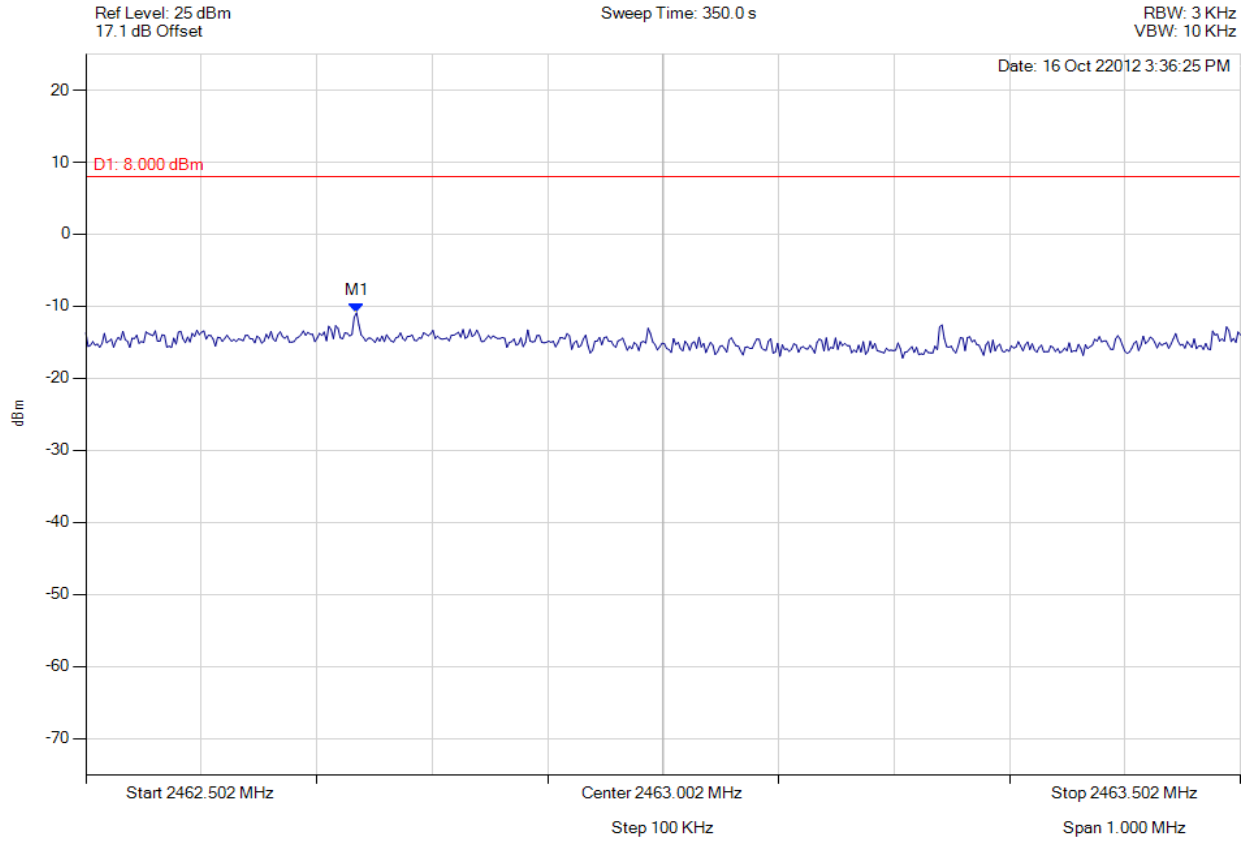


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2437.634 MHz : -11.799 dBm	Limit: ≤8.00 dBm Margin: -19.80 dB

Back to the Matrix

Power Density

Variant: 802.11b, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

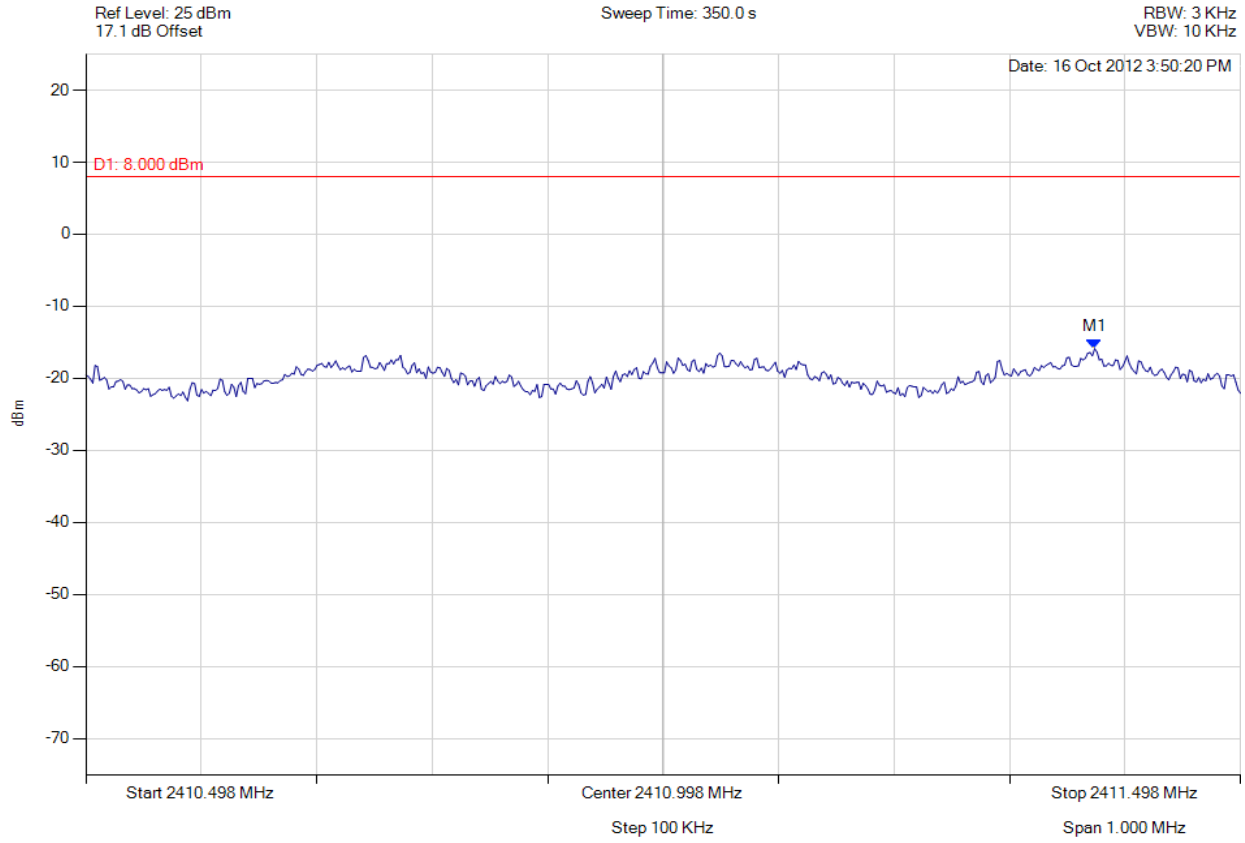


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2462.736 MHz : -10.900 dBm	Limit: ≤8.00 dBm Margin: -18.90 dB

Back to the Matrix

Power Density

Variant: 802.11g, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

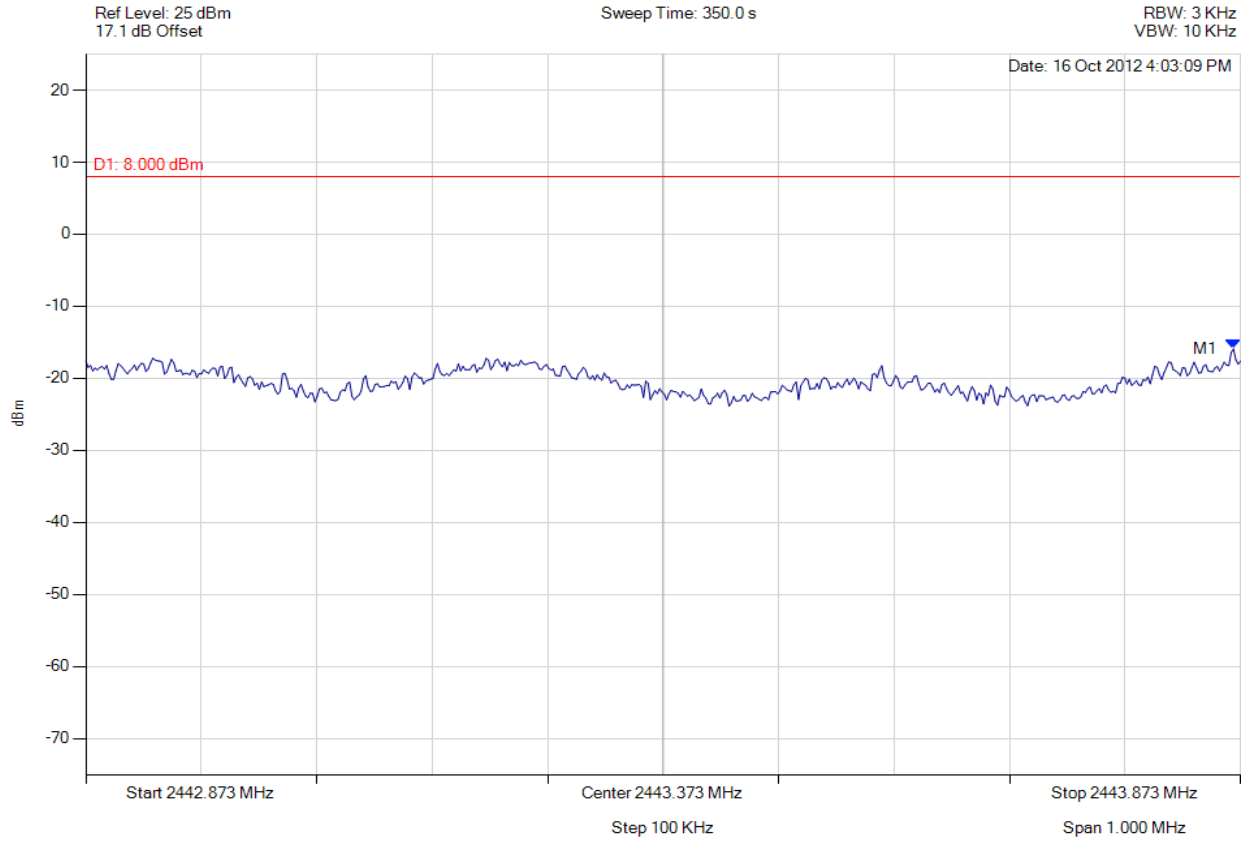


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2411.372 MHz : -15.882 dBm	Limit: ≤8.00 dBm Margin: -23.88 dB

Back to the Matrix

Power Density

Variant: 802.11g, Channel: 2437.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

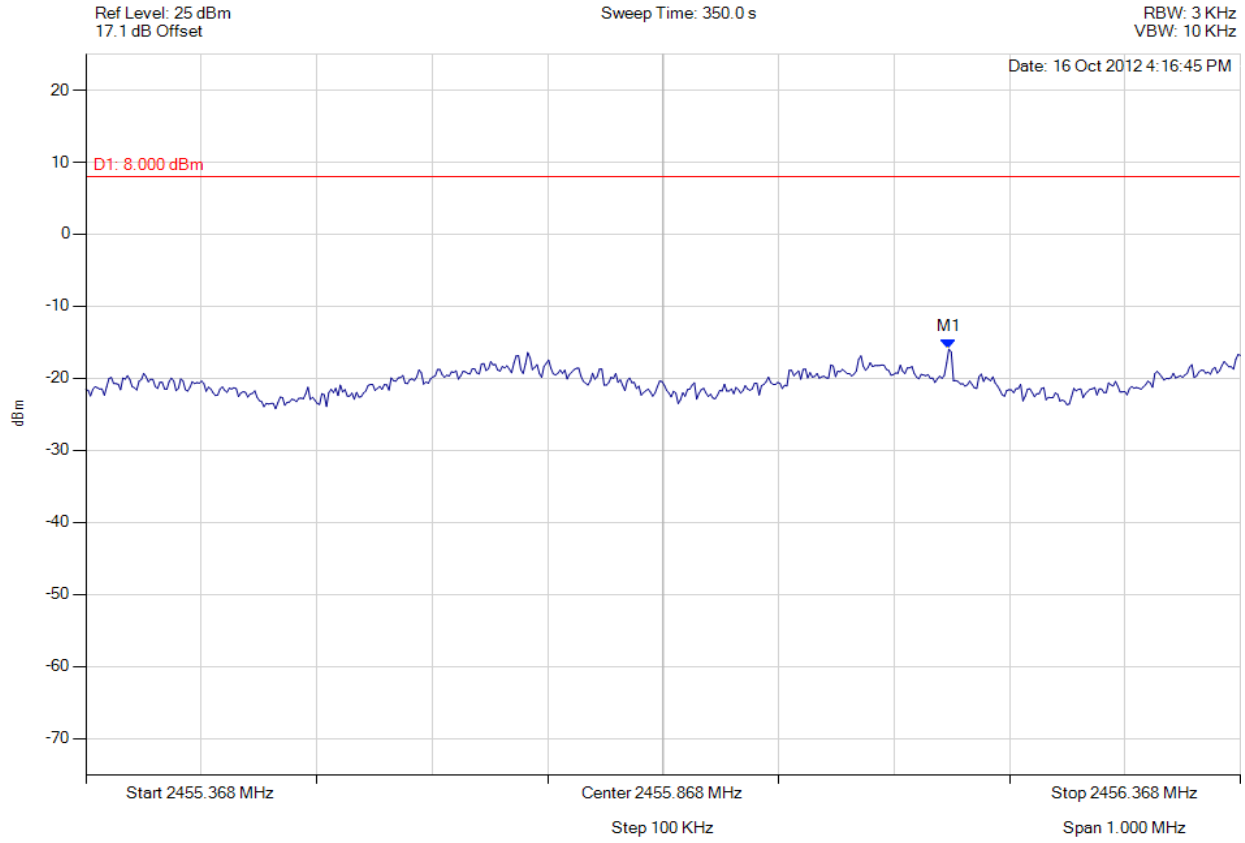


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2443.867 MHz : -15.919 dBm	Limit: ≤8.00 dBm Margin: -23.92 dB

Back to the Matrix

Power Density

Variant: 802.11g, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2456.115 MHz : -15.954 dBm	Limit: ≤8.00 dBm Margin: -23.95 dB

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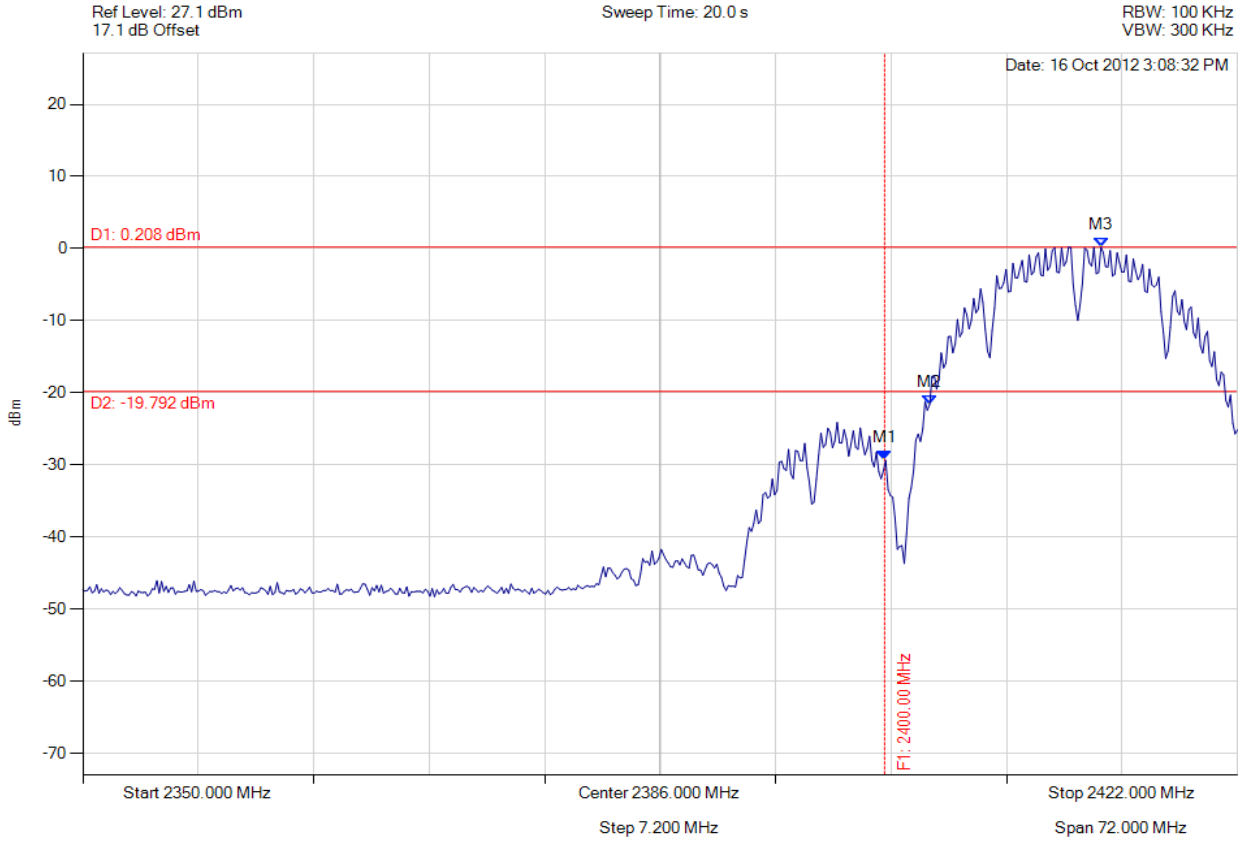
A.1.4. Conducted Spurious Emissions

Conducted Band-Edge Emissions

Variant: 802.11b, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

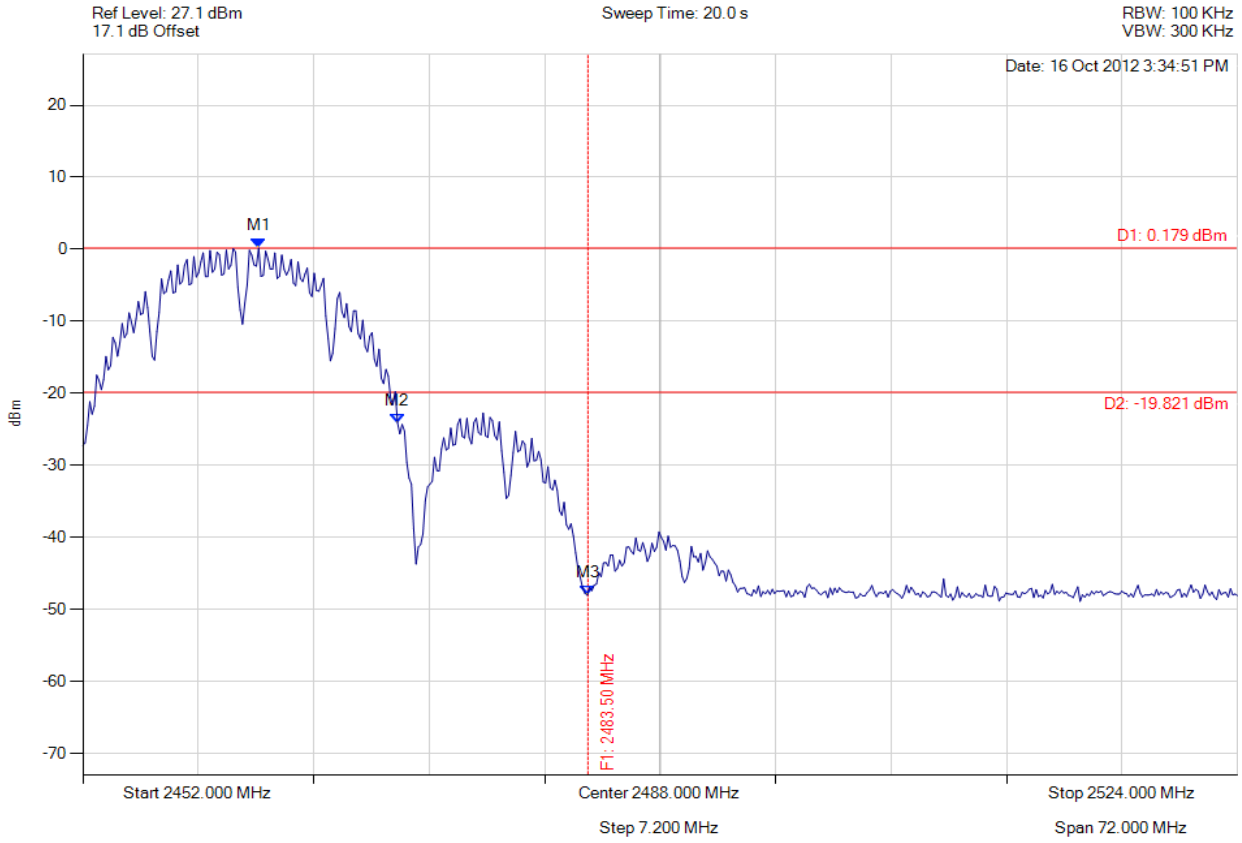


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.000 MHz : -29.359 dBm M2 : 2402.810 MHz : -21.600 dBm M3 : 2413.487 MHz : 0.208 dBm	Limit: -19.79 dBm Margin: -9.57 dB

Back to the Matrix

Conducted Band-Edge Emissions

Variant: 802.11b, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

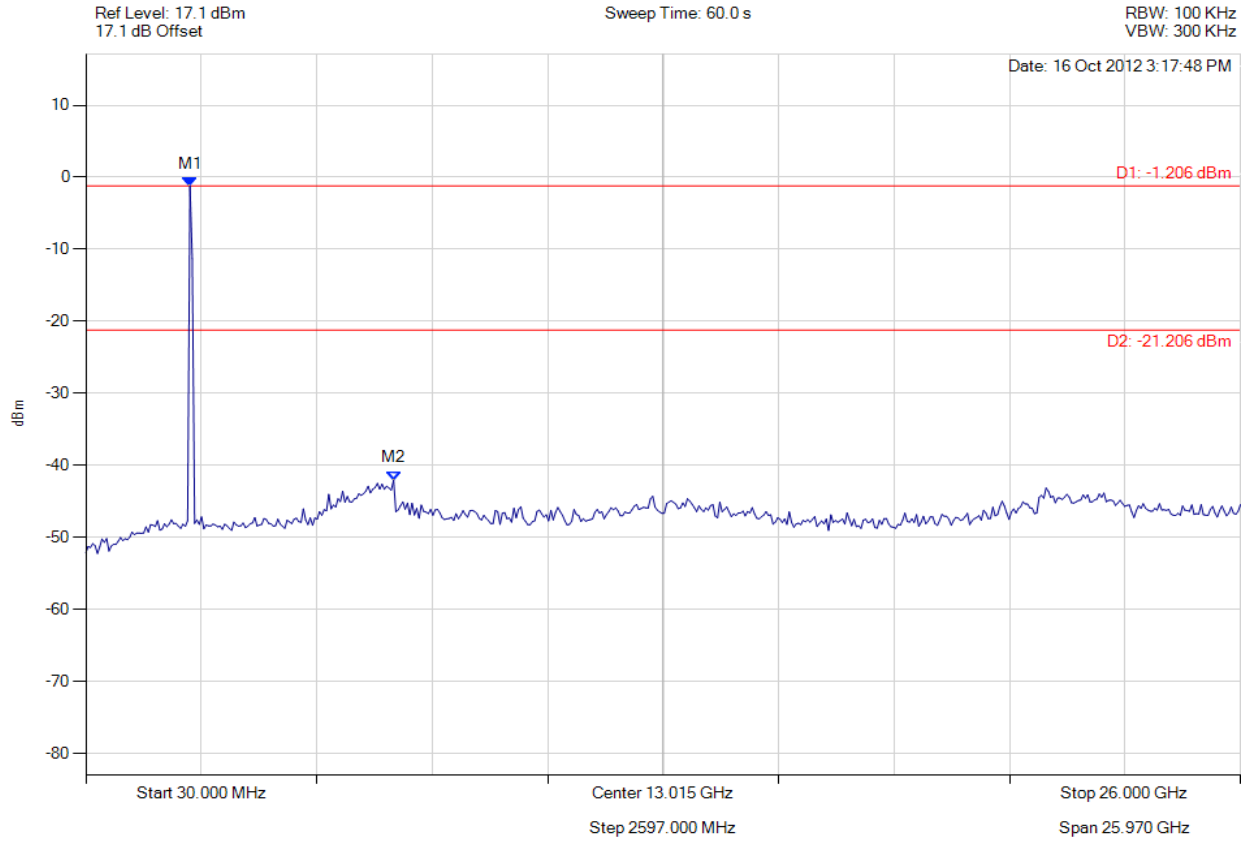


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2462.966 MHz : 0.179 dBm M2 : 2471.623 MHz : -24.067 dBm M3 : 2483.500 MHz : -48.004 dBm	Limit: -19.82 dBm Margin: 20.00 dB

Back to the Matrix

Conducted Transmitter Spurious Emissions

Variant: 802.11b, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

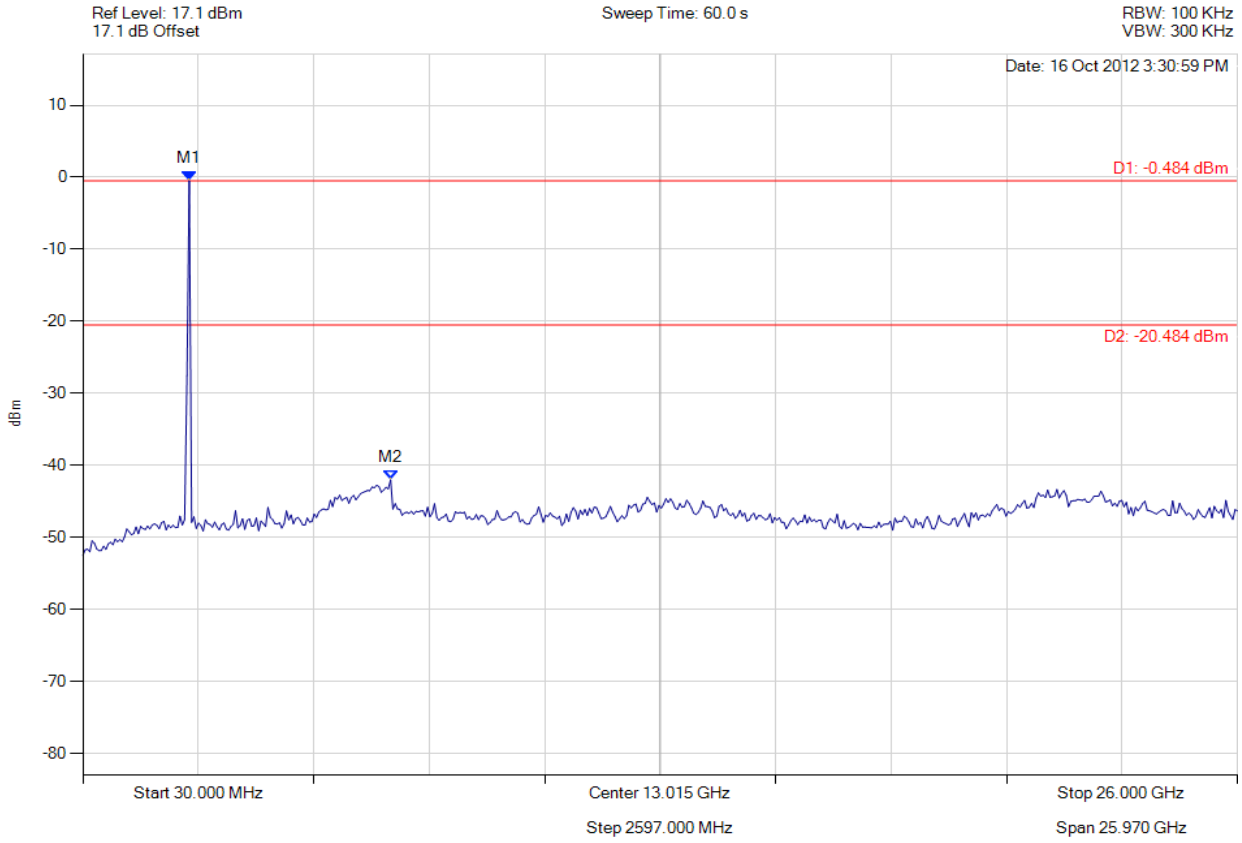


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2371.984 MHz : -1.206 dBm M2 : 6951.864 MHz : -42.043 dBm	Limit: -21.21 dBm Margin: -20.83 dB

Back to the Matrix

Conducted Transmitter Spurious Emissions

Variant: 802.11b, Channel: 2437.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

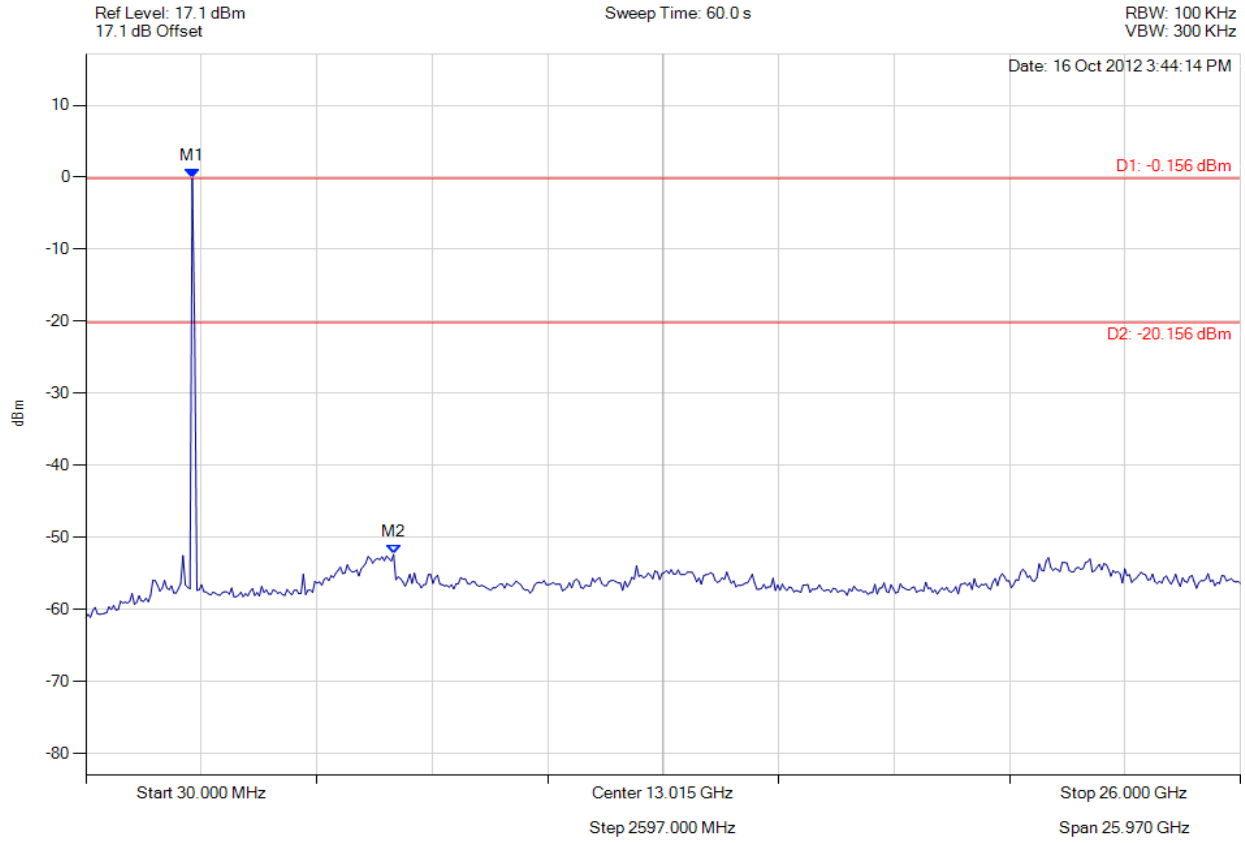


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2424.028 MHz : -0.484 dBm M2 : 6951.864 MHz : -41.986 dBm	Limit: -20.48 dBm Margin: -21.51 dB

Back to the Matrix

Conducted Transmitter Spurious Emissions

Variant: 802.11b, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V

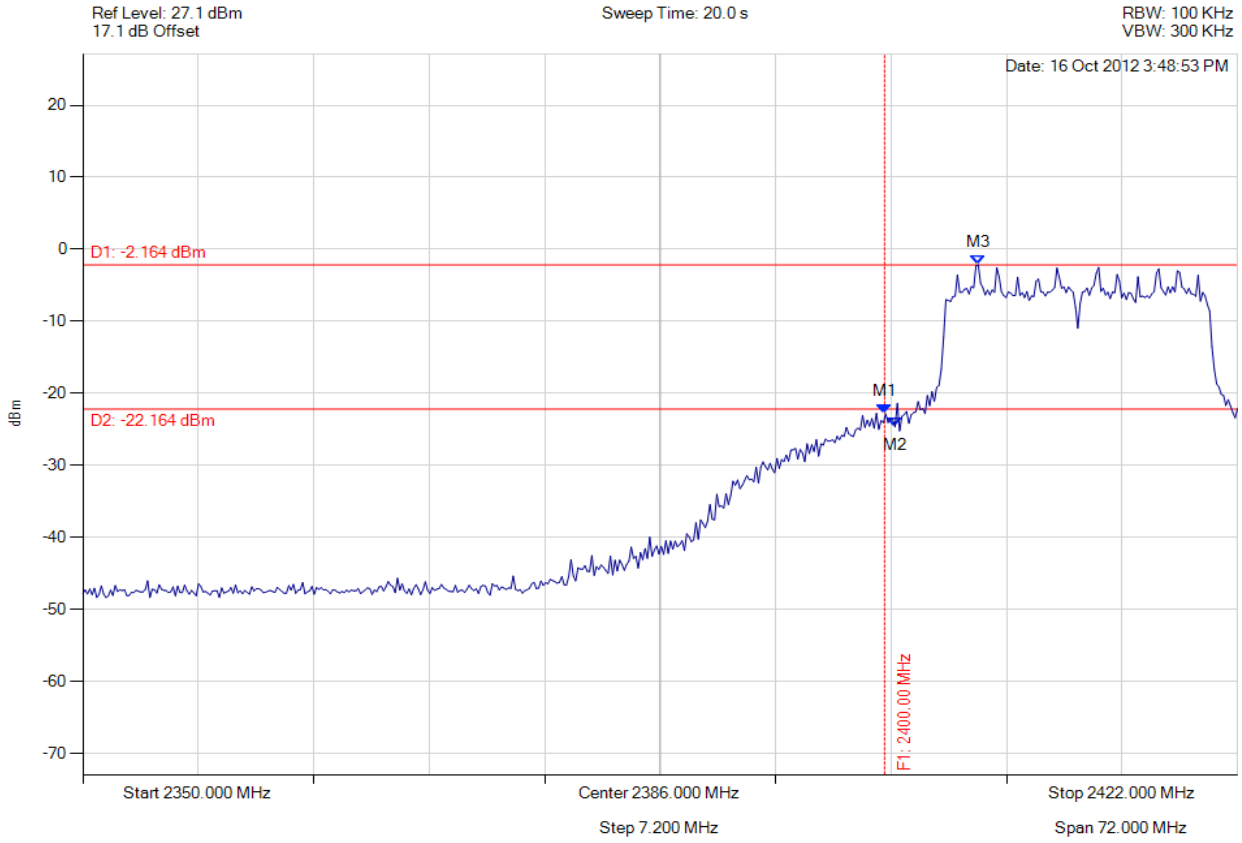


Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2424.028 MHz : -0.156 dBm M2 : 6951.864 MHz : -52.363 dBm	Limit: -20.16 dBm Margin: -32.20 dB

Back to the Matrix

Conducted Band-Edge Emissions

Variant: 802.11g, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.000 MHz : -22.861 dBm M2 : 2400.645 MHz : -24.638 dBm M3 : 2405.840 MHz : -2.164 dBm	Limit: -22.16 dBm Margin: -0.70 dB

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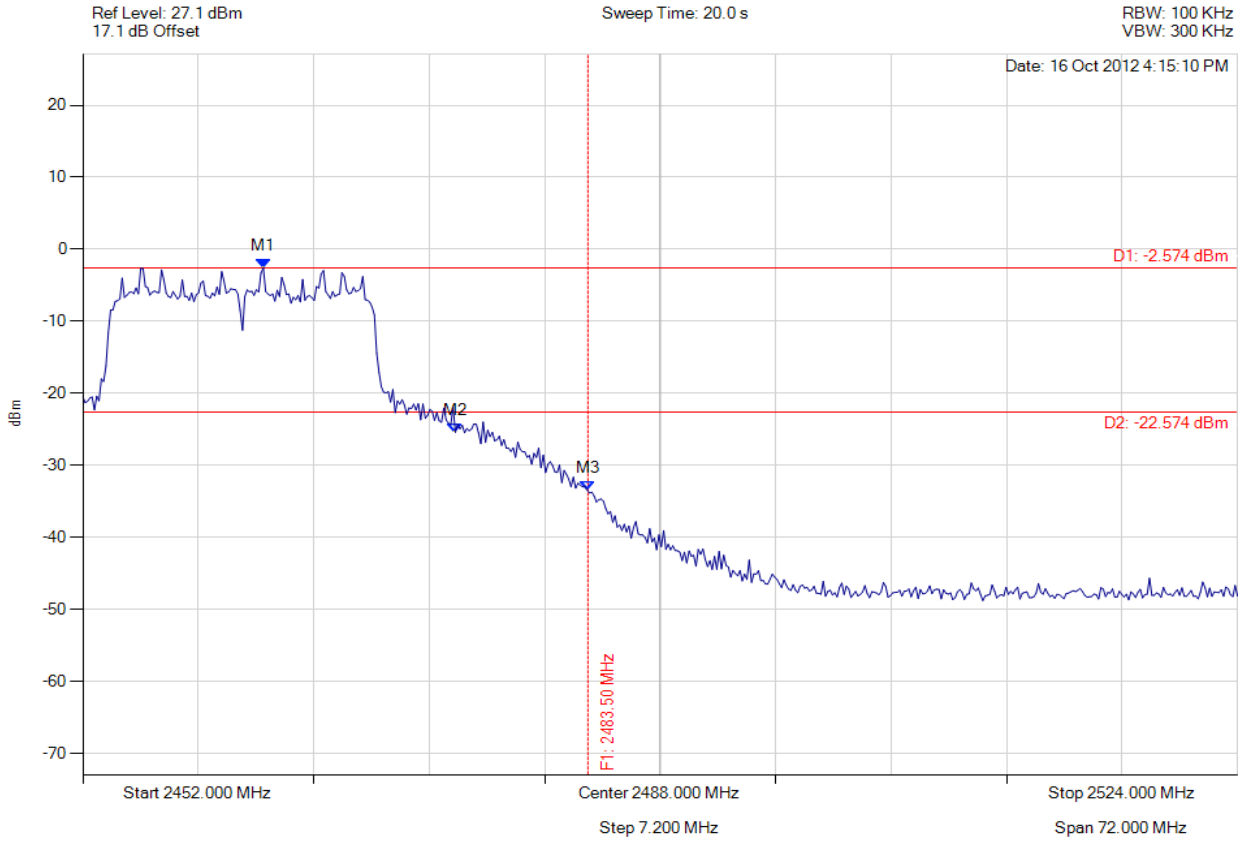
Conducted Band-Edge Emissions

Variant: 802.11g, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2463.255 MHz : -2.574 dBm M2 : 2475.230 MHz : -25.393 dBm M3 : 2483.500 MHz : -33.414 dBm	Limit: -22.57 dBm Margin: 20.00 dB

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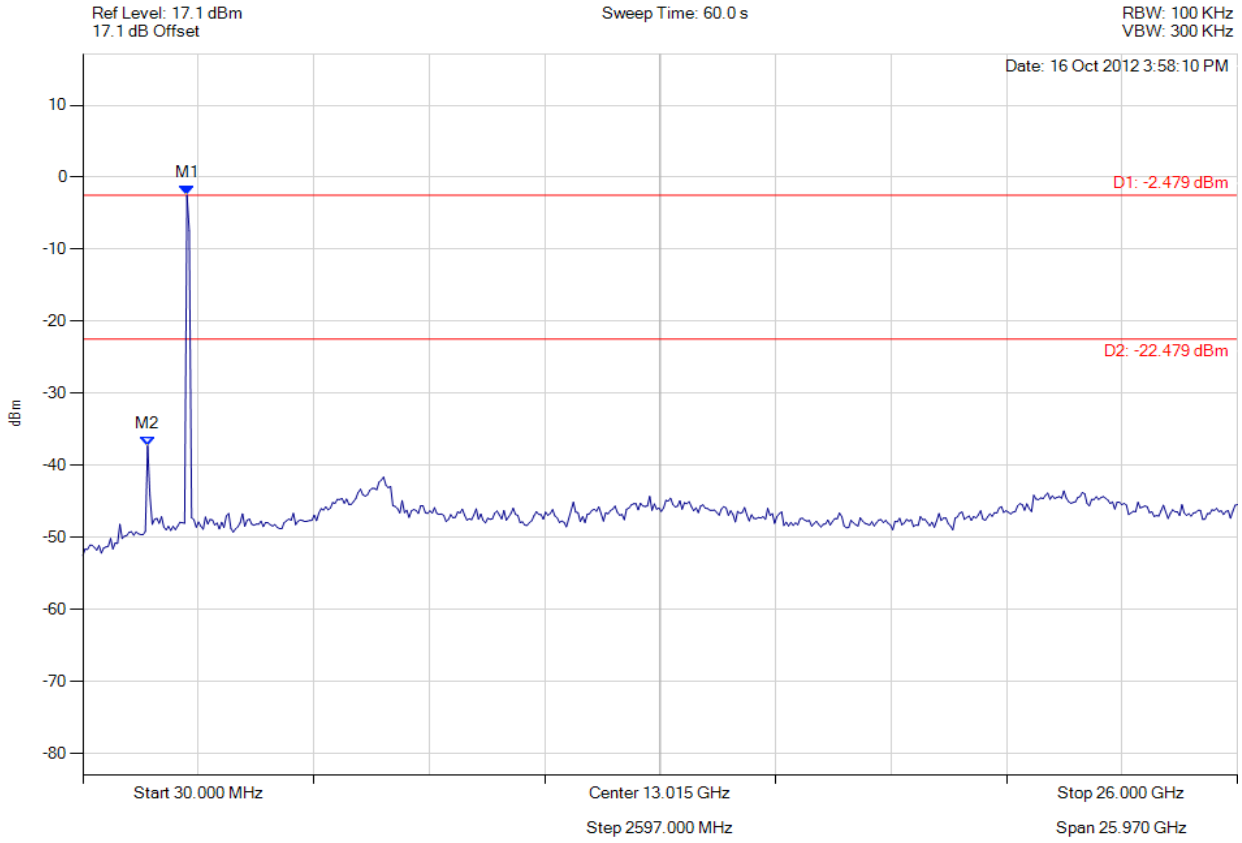
Conducted Transmitter Spurious Emissions

Variant: 802.11g, Channel: 2412.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2371.984 MHz : -2.479 dBm M2 : 1487.234 MHz : -37.268 dBm	Limit: -22.48 dBm Margin: -14.79 dB

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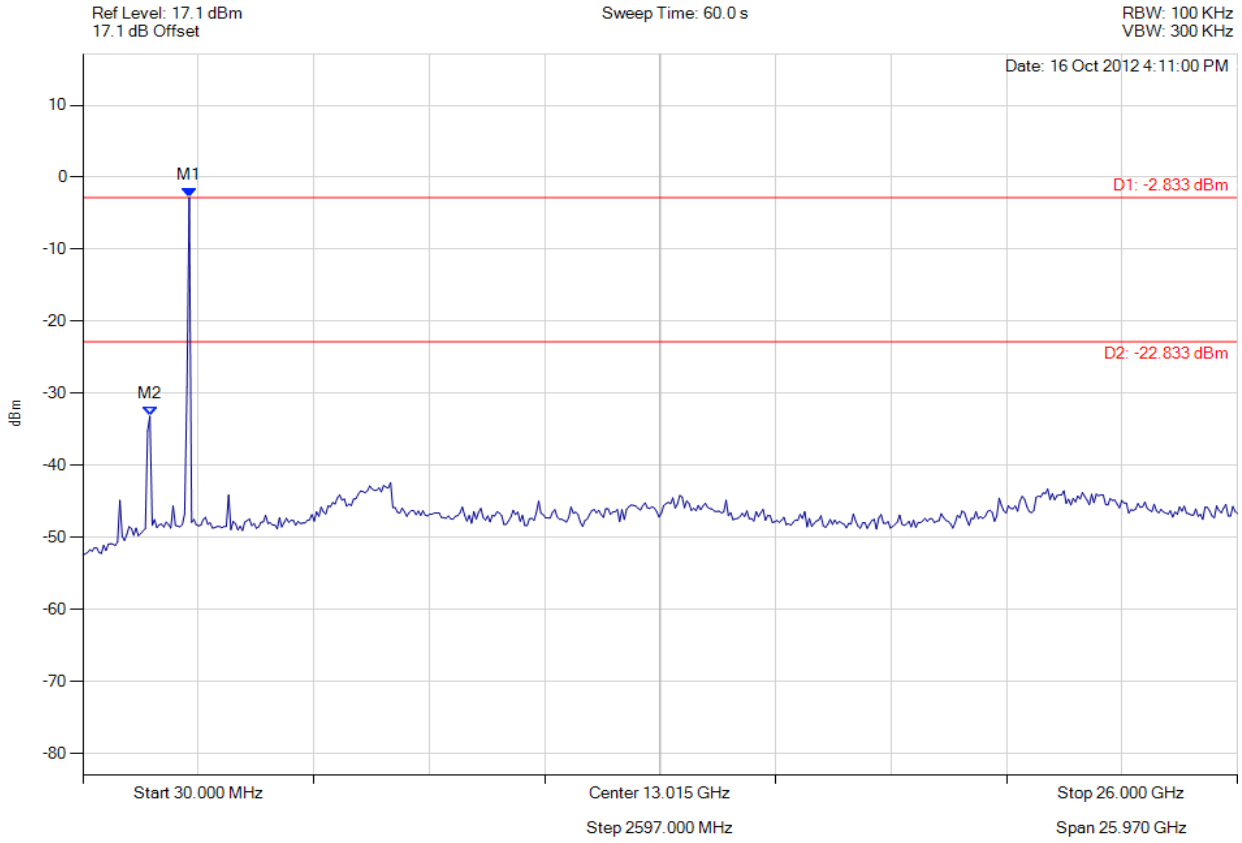
Conducted Transmitter Spurious Emissions

Variant: 802.11g, Channel: 2437.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2424.028 MHz : -2.833 dBm M2 : 1539.279 MHz : -33.148 dBm	Limit: -22.83 dBm Margin: -10.32 dB

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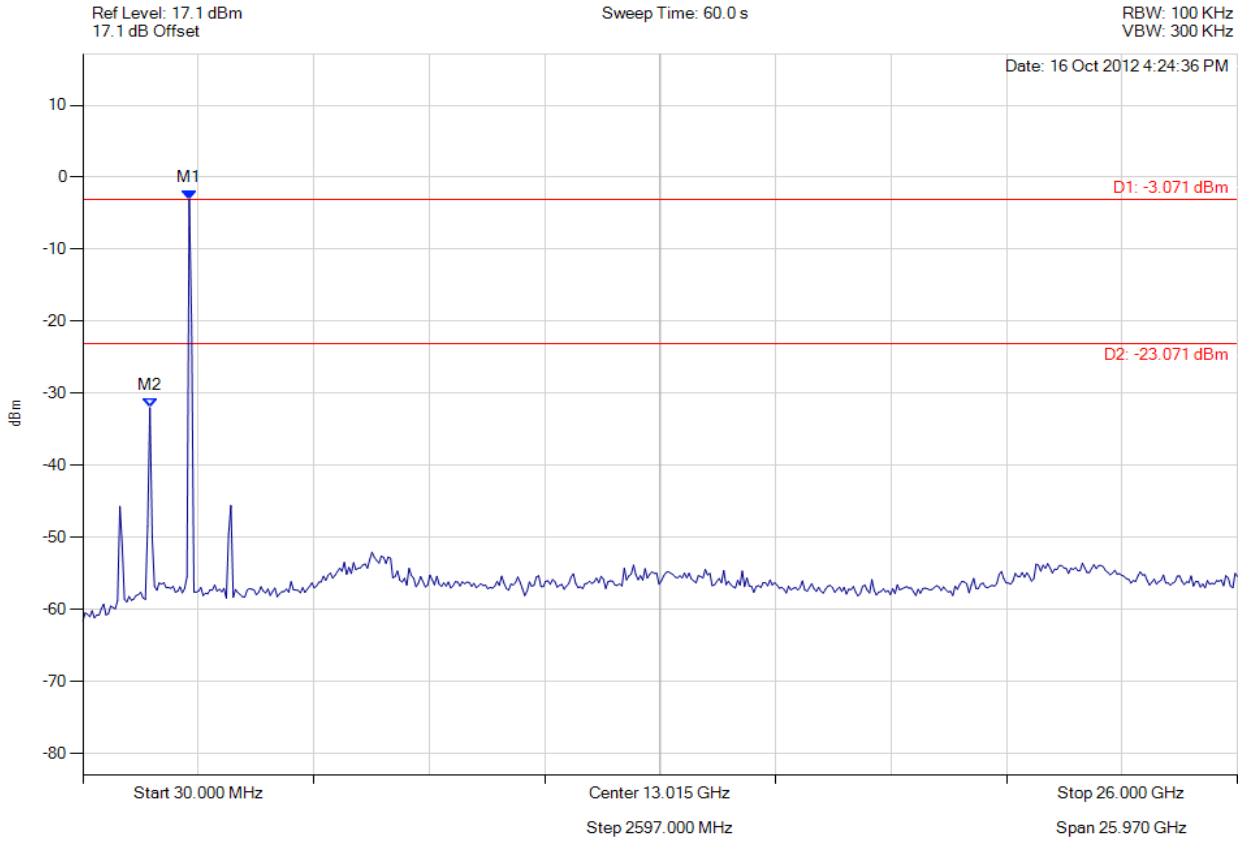
Conducted Transmitter Spurious Emissions

Variant: 802.11g, Channel: 2462.00 MHz, Chain a, Temp: Ambient, Voltage: 3.00V



Analyser Setup	Marker : Frequency : Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2424.028 MHz : -3.071 dBm M2 : 1539.279 MHz : -31.966 dBm	Limit: -23.07 dBm Margin: -8.90 dB

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