Test of Hewlett Packard, SDG0B-1291

To: FCC 47 CFR Part 15, SubPart C 15.247 & RSS-210 Annex 8

Test Report Serial No.: MARS03-U1 Rev A

MiCOM Labs

opening wireless markets

TEST REPORT

From

Test of: Hewlett Packard, SDG0B-1291

To: FCC 47 CFR Part 15, SubPart C 15.247 & RSS-210 Annex 8

Test Report Serial No.: MARS03-U1 Rev A

This report supersedes: NONE

Applicant: Hewlett Packard Company
3000 Hanover Street
Palo Alto, California 94304
USA

Product Function: Wireless Client

Copy No: pdf **Issue Date:** 26th January 2012

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
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ACCREDITED

TESTING CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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1 ACCREDITATION, LISTINGS & RECOGNITION

1.1 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

The American Association for Laboratory Accreditation

World Class 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 14th day of April 2010.

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION CORPORATE SEAL 1978 DISTRICT OF COLUMBIA A2LA

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to January 31, 2012
Revised September 2, 2011

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

1.2 RECOGNITION

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

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

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.
Phase I - recognition for product testing
Phase II – recognition for both product testing and certification
N/A – Not Applicable

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

**NB – Notified Body

1.3 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

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited Product Certification Body

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence as a

Product Certification Body

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

Presented this 24th day of June 2010.

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

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

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

2 DOCUMENT HISTORY

Document History		
Revision	**Date**	**Comments**
Draft		
Rev A	26th January 2012	Initial Release

3 TEST RESULT CERTIFICATE

Applicant:	Hewlett Packard Company 3000 Hanover Street Palo Alto California 94304 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
Product:	2.4 GHz WiFi Client	Telephone:	+1 925 462 0304
Model No.:	SDG0B-1291	Fax:	+1 925 462 0306
S/No's:	00 50 43 21 3E 4E		
Date(s) Tested:	16th – 17th November 2011	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15, SubPart C 15.247 & RSS-210 Annex 8	EQUIPMENT COMPLIES

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

Notes:

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

Approved & Released for MiCOM Labs, Inc. by:

ACCREDITED

TESTING CERTIFICATE #2381.01

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

4 REFERENCES AND MEASUREMENT UNCERTAINTY

4.1 Normative References

Ref.	Publication	Year	Title
i.	FCC 47 CFR Part 15, SubPart C 15.247	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.	RSS-GEN	2010	Radio Standards Specification-Gen, Issue 3, General Requirements and Information for the Certification of Radiocommunication Equipment,
iv.	47 CFR Part 15, SubPart B	2010	47 CFR Part 15, SubPart B; Unintentional Radiators
v.	ICES-003	2004	Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard Digital Apparatus; Issue 4
vi.	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
vii.	CISPR 22/ EN 55022	2008 2006+A1:2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
viii.	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
ix.	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
x.	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
xi.	A2LA	9th June 2010	Reference to A2LA Accreditation Status – A2LA Advertising Policy

4.2 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.

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5 TEST SUMMARY

List of Measurements: The following table represents the list of measurements required under FCC 47 CFR Part 15, SubPart C 15.247 & industry Canada RSS-210 Annex 8.

Standard Section(s)	Test Description	Condition	Result	Notes	Test Report Section
15.247 (a)(2)	6 dB Occupied Bandwidth	Conducted	PASS	Note 1,2,3	7.1
15.247 (b)(3), 15.247 (b)(4)	Peak Output Power	Conducted	PASS	Note 1,2,3	7.2
15.247 (i)	Maximum Permissible Exposure	Calculation	PASS	Note 1,2,3	7.3
15.247 (e)	Peak Power Spectral Density	Conducted	PASS	Note 1,2,3	7.4
15.247 (d)	Spurious Emissions	Conducted	PASS	Note 1,2,3	7.5
15.247 (d), 15.205, 15.209	Transmitter Radiated Spurious Emissions	Radiated	PASS	Note 1,2,3	7.6.1
15.247 (d), 15.205, 15.209	Radiated Band-Edge	Radiated	PASS	Note 1,2,3	7.6.2
RSS-GEN	Radiated Peak Emissions	Radiated	PASS	Note 1,2,3	7.6.3
RSS-GEN	Radiated Receiver Emissions	Radiated	PASS	Note 1,2,3	7.6.4
15.207	AC Wireline Emissions 0.15 – 30 MHz	Conducted		Not Tested – EUT Module Battery Powered	7.7

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 6.11 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

6 PRODUCT DETAILS AND TEST CONFIGURATIONS

6.1 Test Program Scope

The scope of the test program was to test the 802.11b/g/n Wi-Fi Client for compliance against FCC 47 CFR Part 15, SubPart C 15.247 & RSS-210 Annex 8.

Brand	Product Name	Model #	Part #	Description
HP	802.11 b/g/n WLAN Module	SDGOB-1291	1150-7958	USB right angle, top mount
HP	802.11 b/g/n WLAN Module	SDGOB-1291	1150-7959	USB straight, bottom mount

The 2 parts identified above have the same radio module and antenna; the only difference is the digital input interface and the way they are mounted.

Both Main and Aux Antenna of the EUT were investigated for output power and radiated emissions (harmonics and bandedge), it was determined that the main antenna on Part # 1150-7959 is the worst case of the 2 parts in the above table. Therefore, final testing was done on the main antenna on Part # 1150-7959.

APPLICANT: Hewlett-Packard **PRODUCT:** 2.4 GHz Wi-Fi Client

6.2 EUT Details

Detail	Description
Purpose:	Test of the Hewlett-Packard 2.4 GHz Wi-Fi Client SDG0B-1291 for compliance against FCC 47 CFR Part 15, SubPart C 15.247 & RSS-210 Annex 8
Applicant:	Hewlett Packard Company 3000 Hanover Street Palo Alto California 94304 USA
Manufacturer:	As Applicant
Test Laboratory:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	MARS03-U1
Date EUT received:	16th November 2011
Dates of test (from - to):	16th – 17th November 2011
No of Units Tested:	1
Product Name:	802.11 b/g/n WLAN Module
Manufacturers Trade Name:	Hewlett Packard Company
Model No.:	SDGOB-1291
Part numbers:	1150-7958 and 1150-7959
Equipment Primary Function:	Wi-Fi client for use in printers
Equipment Secondary Function(s):	Not provided
Type of Technology:	802.11b/g/n
Installation type:	Fixed
Construction/Location for Use:	Indoor only
Hardware Release:	2
Software/Firmware Release:	Linux supported with drivers based on Fedora Core 13
Rated Input Voltage and Current DC:	Powered by Host Nominal:3.3 Vdc; Extremes: 2.97 – 3.63 Vdc
Operating Temperature Range ºC:	Min: 0 °C Max: +55 °C
Equipment Dimensions:	44.5x40x1 mm
Weight:	4 grams
ITU Emission Designator:	2400 – 2483.5 MHz 802.11b - 13M8G1D 2400 – 2483.5 MHz 802.11g - 16M5D1D 2400 – 2483.5 MHz 802.11n HT-20 - 17M7D1D 2400 – 2483.5 MHz 802.11n HT-40 - 36M4D1D
Transmit/Receive Operation:	Full Duplex
Output Power Type	Fixed

6.3 External A.C. / D.C. Power Adaptor

1. NONE – EUT battery powered

Model	Description

6.4 Operational Power Range

Fundamental Frequency (MHz)	Utility Setting Used During Tests	Measured Output Power (dBm)	TX SPR: Utility Setting Used During Test	Band Edge: Utility Setting Used During Test	Compliant Test Utility Setting	Compliant Output Power (dBm)
802.11b	Conducted RF Emissions		Radiated RF Emissions		Final Results	
2412	Max	11.26	Max	Max	Max	16.90
2437	Max	12.03	Max		Max	17.68
2462	Max	11.68	Max	Max	Max	17.48
802.11g	Conducted RF Emissions		Radiated RF Emissions		Final Results	
2412	Max	10.19	Max	Max	Max	14.97
2437	Max	10.60	Max		Max	15.50
2462	Reduction	10.80	Max	Reduction	Max	14.51
802.11n HT-20	Conducted RF Emissions		Radiated RF Emissions		Final Results	
2412	Max	10.19	Max	Max	Max	14.06
2437	Max	10.60	Max		Max	14.49
2462	Reduction	10.80	Max	Reduction	Max	13.16
802.11n HT-40	Conducted RF Emissions		Radiated RF Emissions		Final Results	
2412	Max	10.19	Max	Max	Max	11.97
2437	Max	10.60	Max		Max	12.33
2462	Reduction	10.80	Max	Reduction	Max	10.6

Power reduction required as a result of radiated band-edge issues. In each case the power setting was reduced by a value of "1".

6.5 Types of Modulation Supported

Modulation / Mode	BW 1
802.11b	DSSS/CCK
802.11g	OFDM
802.11n HT-20	OFDM
802.11n HT-40	OFDM

6.6 Antenna Details

The following is a description of the EUT antennas.

Antenna Type	Manufacturer	Model	Gain (dBi)	Frequency Range
PCB Embedded	Hewlett-Packard	1	2.5	2400-2500

6.7 Cabling and I/O Ports

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

1. NONE – module had no external cabling or I/O ports

Type of I/O Ports	Description	Screened (Y/N)	Length	Qty	Tested (Y/N)

6.8 EUT Configurations

Channel plan and spacing

Band (GHz)	Mode	Freq Band (MHz)	Freq Range (MHz)	Low Ch	Mid Ch	High Ch	# Ch	Ch Spacing (MHz)
2.4	802.11b	2400-2483.5	2412 - 2462	2412	2437	2462	11	5
2.4	802.11g	2400-2483.5	2412 - 2462	2412	2437	2462	11	5
2.4	802.11HT-20	2400-2483.5	2412 - 2462	2412	2437	2462	11	5
2.4	802.11HT-40	2400-2483.5	2422 - 2452	2422	2437	2452	7	5

6.9 Equipment Details

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

Equipment	Equipment Description	Manufacturer	Model No.	Serial No (s).	Tested
Computer	Laptop	IBM			

6.10 Test Configurations

Operational Mode(s)	Data Rate Tested	Duty Cycle
b	1 MBit/s	100 %
g	6 MBit/s	100 %
n Ht-20	6.5 MBit/s	100 %
n Ht-40	13.5 MBit/s	100 %

6.11 Equipment Modifications

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

1. NONE

6.12 Deviations from the Test Standard

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

1. NONE

7 TEST RESULTS

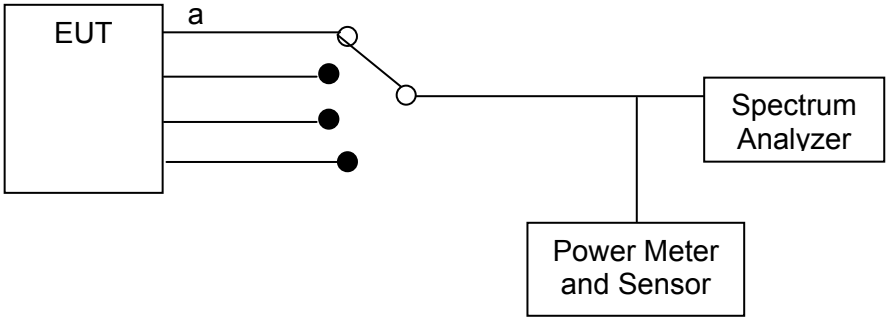
7.1 6 dB and 99% Bandwidth

Test Procedure

The test methodology and conditions utilized for each measurement is referenced in the following test results matrix. 6 dB and 99% bandwidth were measured per the Test Configuration identified below.

Testing was restricted to a single port.

Test Configuration



Test setup for 6 dB & 99% Bandwidth

Specification for 6dB Bandwidth Limits

FCC §15.247 (a)(2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

Industry Canada RSS-210 §A8.2 (a)

These include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to all three bands:

(a) The minimum -6 dB bandwidth shall be at least 500 kHz.

Traceability

Method	Test Equipment Used
WI-03	0158, 0252, 0313, 0314, 0116, 0117, 0287, 0363

7.1.1 6 dB and 99% Bandwidth Results: 802.11b

Test Conditions:	15.247 (a)(2)		**Rel. Humidity (%):**	35 to 42	
Variant:	802.11b		**Ambient Temp. (ºC):**	19 to 22	
TPC:	HIGH		**Pressure (mBars):**	998 to 1003	
Modulation:	ON		**Duty Cycle (%):**	100	
Beam Forming Gain (Y):	N/A	dB	**Antenna Gain:**	2.5 dBi	
Applied Voltage:	3.30	Vdc			
Notes 1:					
Notes 2:					

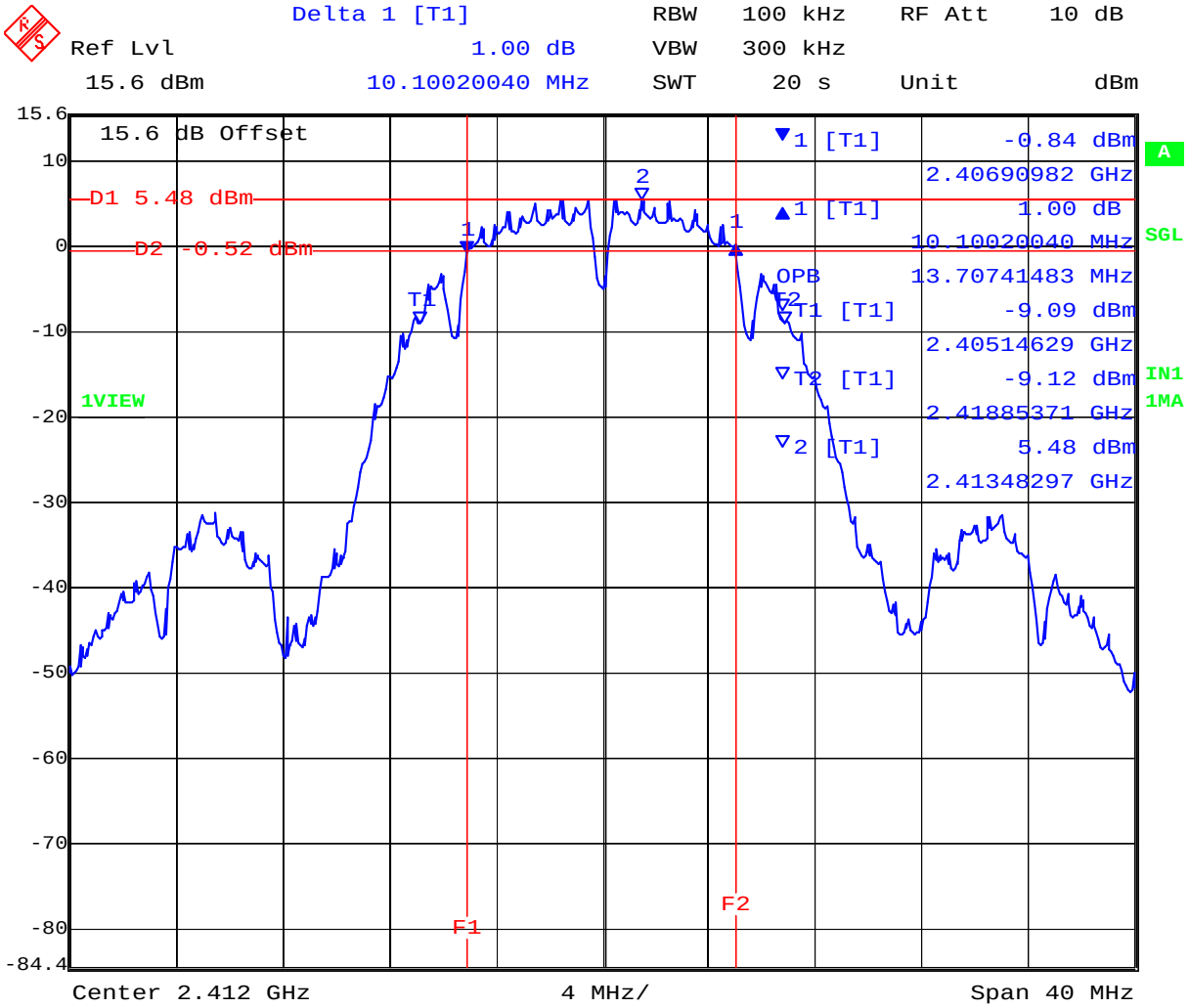
6 dB Bandwidth

Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz						
MHz	**a**	**b**	**c**	**d**	**kHz**	**MHz**	**MHz**
2412.000	10.100000	--	--	--	500	0.5	-9.600000
2437.000	10.100000	--	--	--			-9.600000
2462.000	10.100000	--	--	--			-9.600000

99% Bandwidth

Test Frequency	99 % Bandwidth						
	MHz						
MHz	**a**	**b**	**c**	**d**			
2412.000	13.707000	--	--	--			
2437.000	13.788000	--	--	--			
2462.000	13.788000	--	--	--			

Measurement uncertainty:	±2.81 dB



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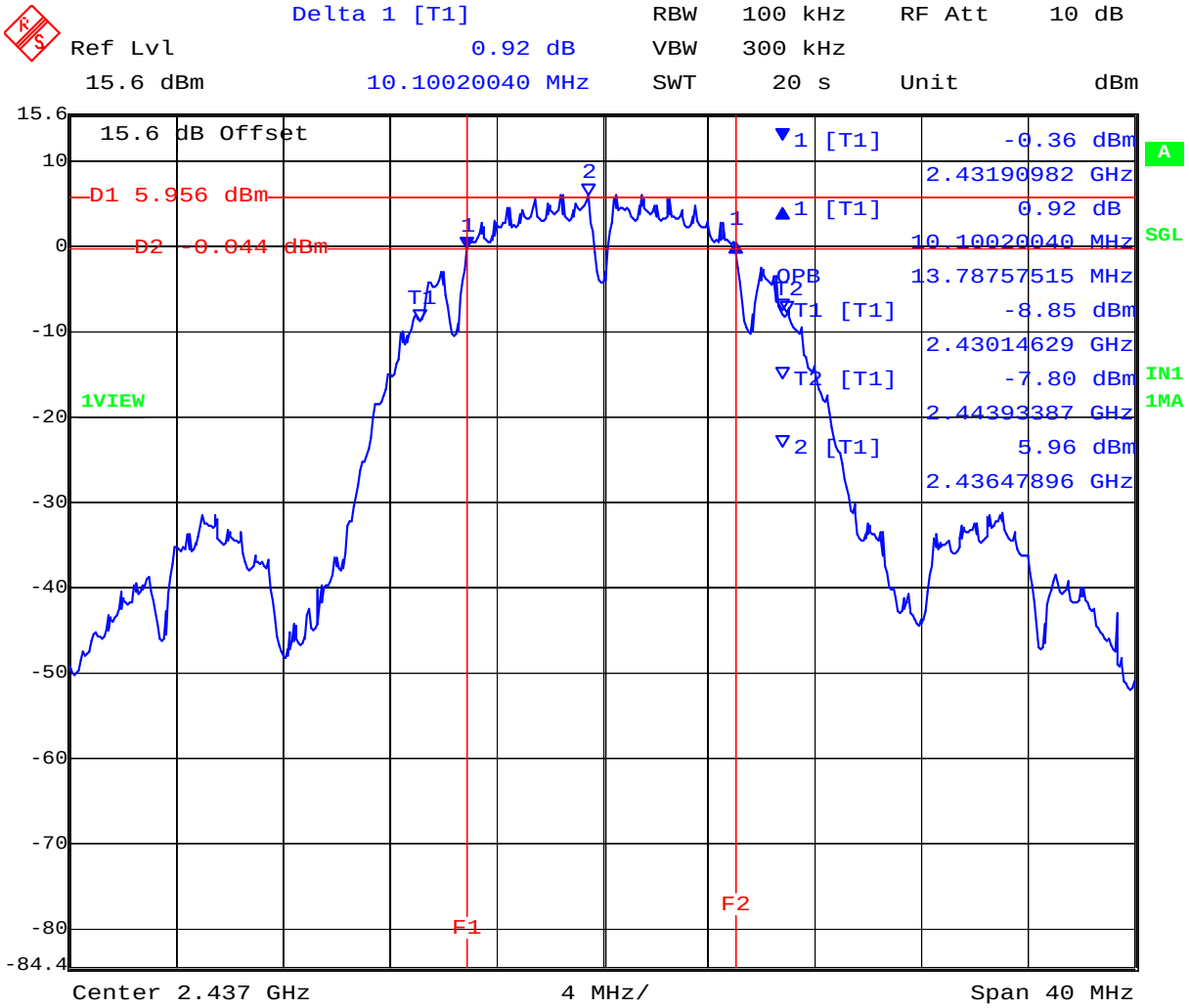

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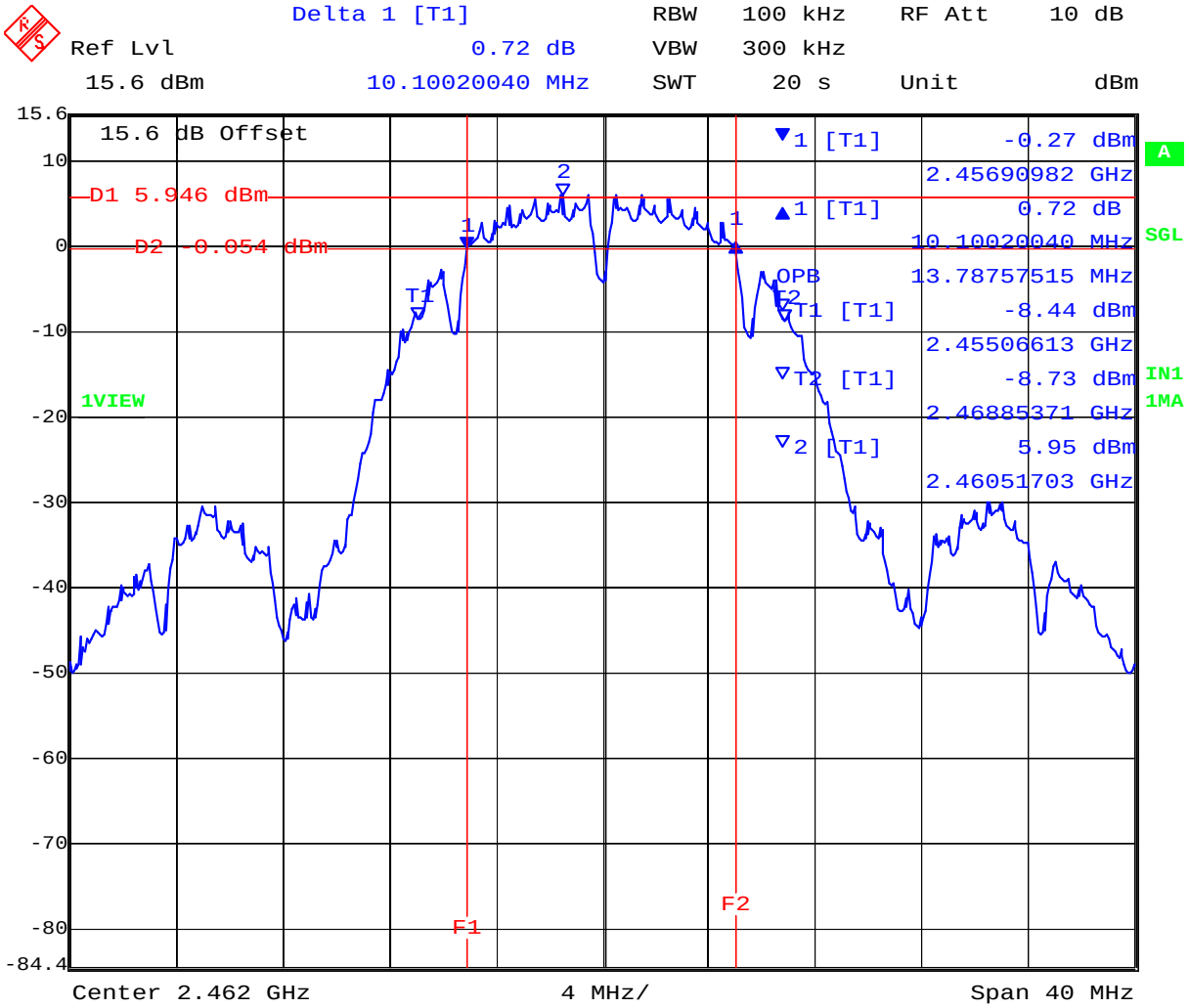

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7.1.2 6 dB and 99% Bandwidth Results: 802.11g

Test Conditions:	15.247 (a)(2)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11g	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	2.5 dBi
Applied Voltage:	3.30 Vdc		
Notes 1:			
Notes 2:			

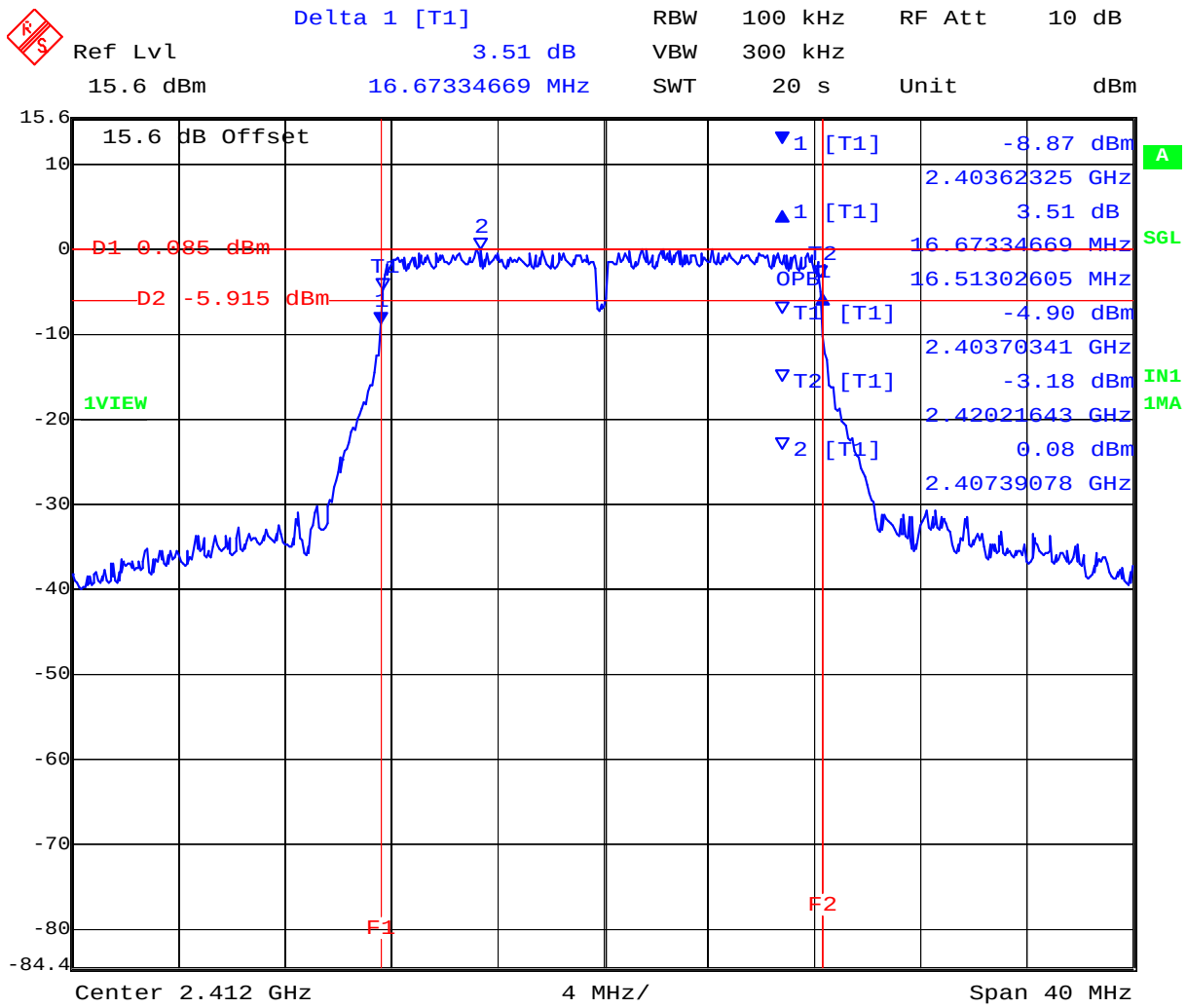
6 dB Bandwidth

Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz						
MHz	**a**	**b**	**c**	**d**	**kHz**	**MHz**	**MHz**
2412.000	16.673000	--	--	--	500	0.5	-16.173000
2437.000	16.513000	--	--	--			-16.013000
2462.000	16.593000	--	--	--			-16.093000

99% Bandwidth

Test Frequency	99 % Bandwidth						
	MHz						
MHz	**a**	**b**	**c**	**d**			
2412.000	16.513000	--	--	--			
2437.000	16.433000	--	--	--			
2462.000	16.513000	--	--	--			

Measurement uncertainty:	±2.81 dB



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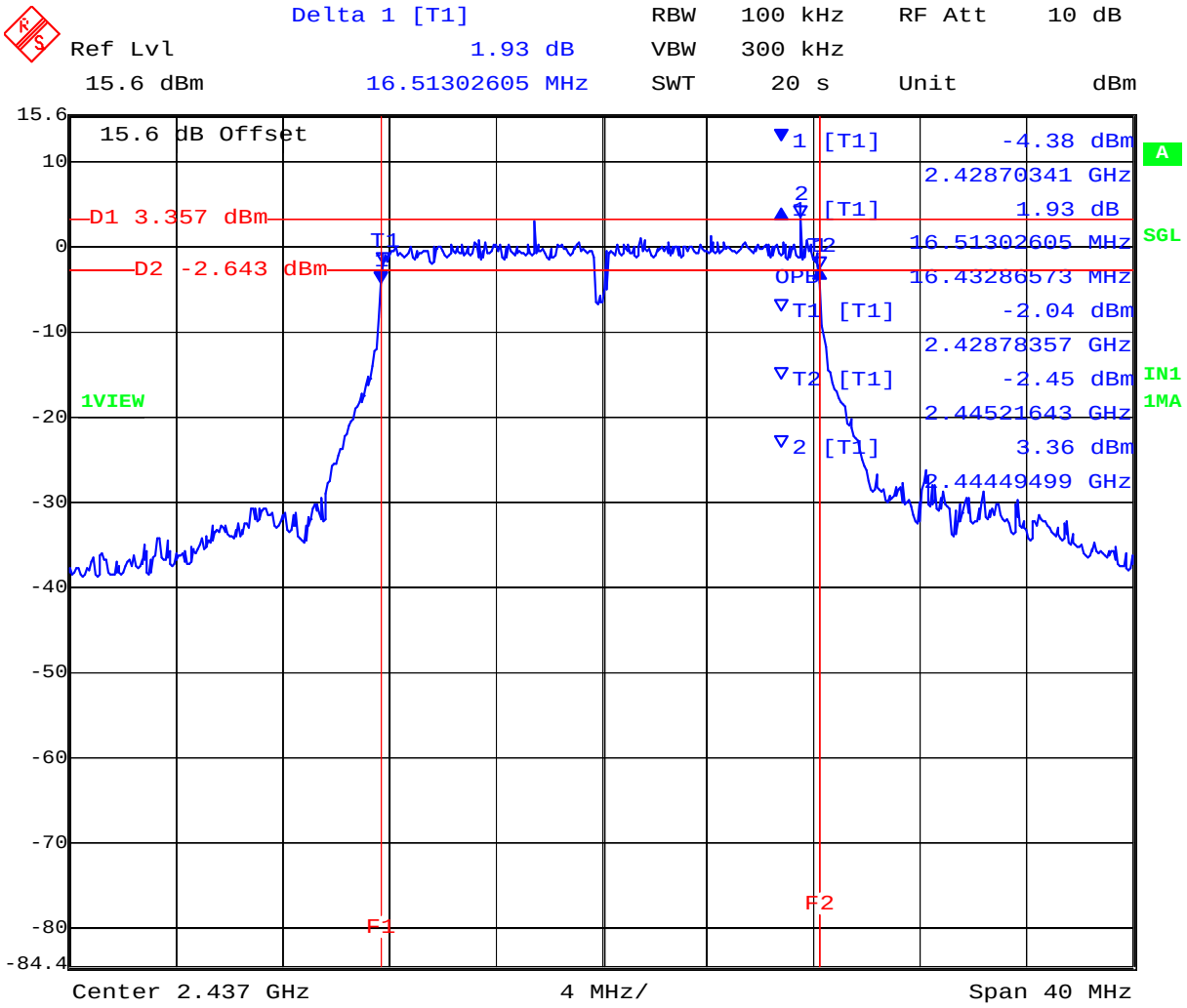

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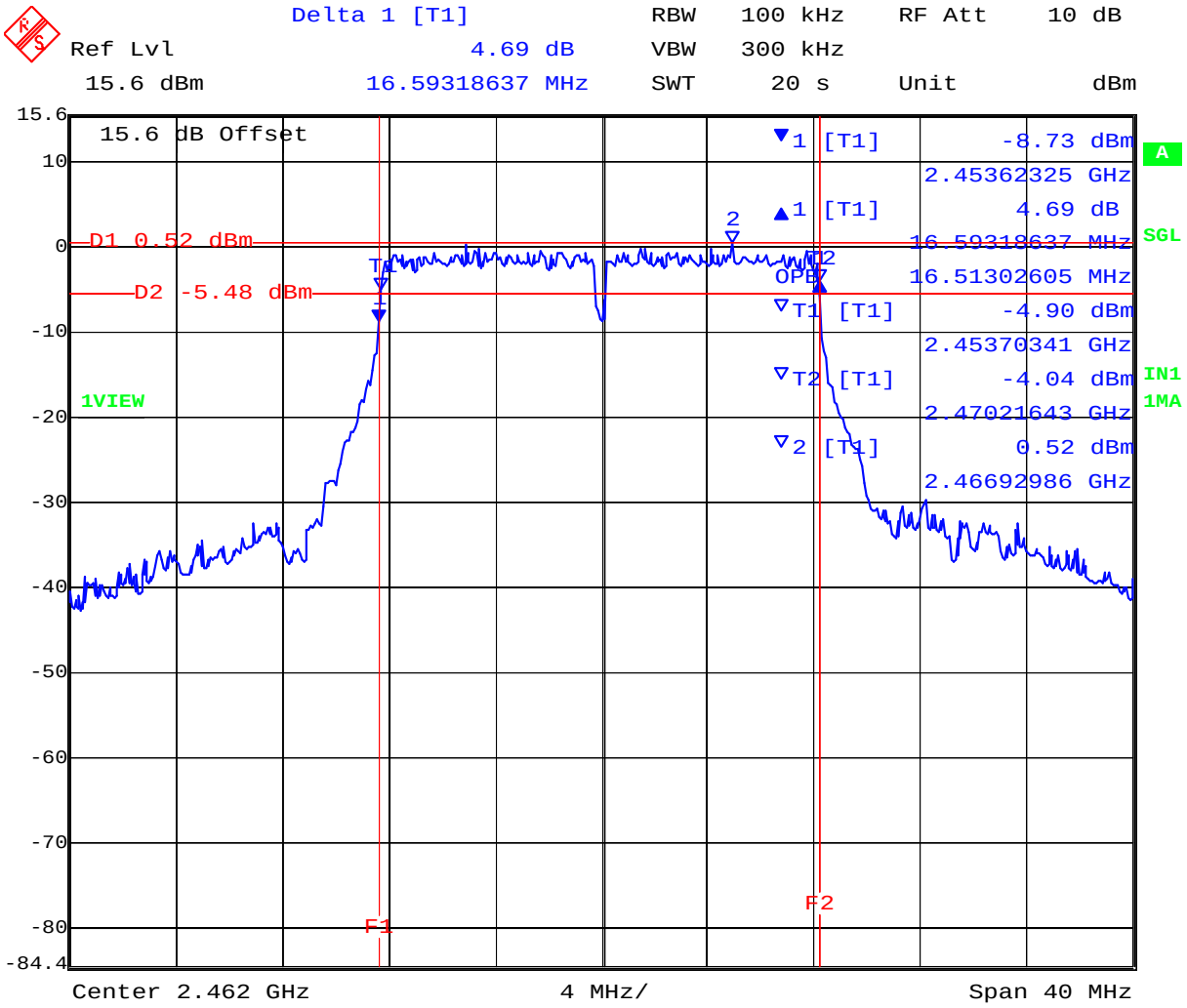

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7.1.3 6 dB and 99% Bandwidth Results: 802.11n HT-20

Test Conditions:	15.247 (a)(2)		**Rel. Humidity (%):**	35 to 42	
Variant:	802.11n HT-20		**Ambient Temp. (ºC):**	19 to 22	
TPC:	HIGH		**Pressure (mBars):**	998 to 1003	
Modulation:	ON		**Duty Cycle (%):**	100	
Beam Forming Gain (Y):	N/A	dB	**Antenna Gain:**	2.5 dBi	
Applied Voltage:	3.30	Vdc			
Notes 1:					
Notes 2:					

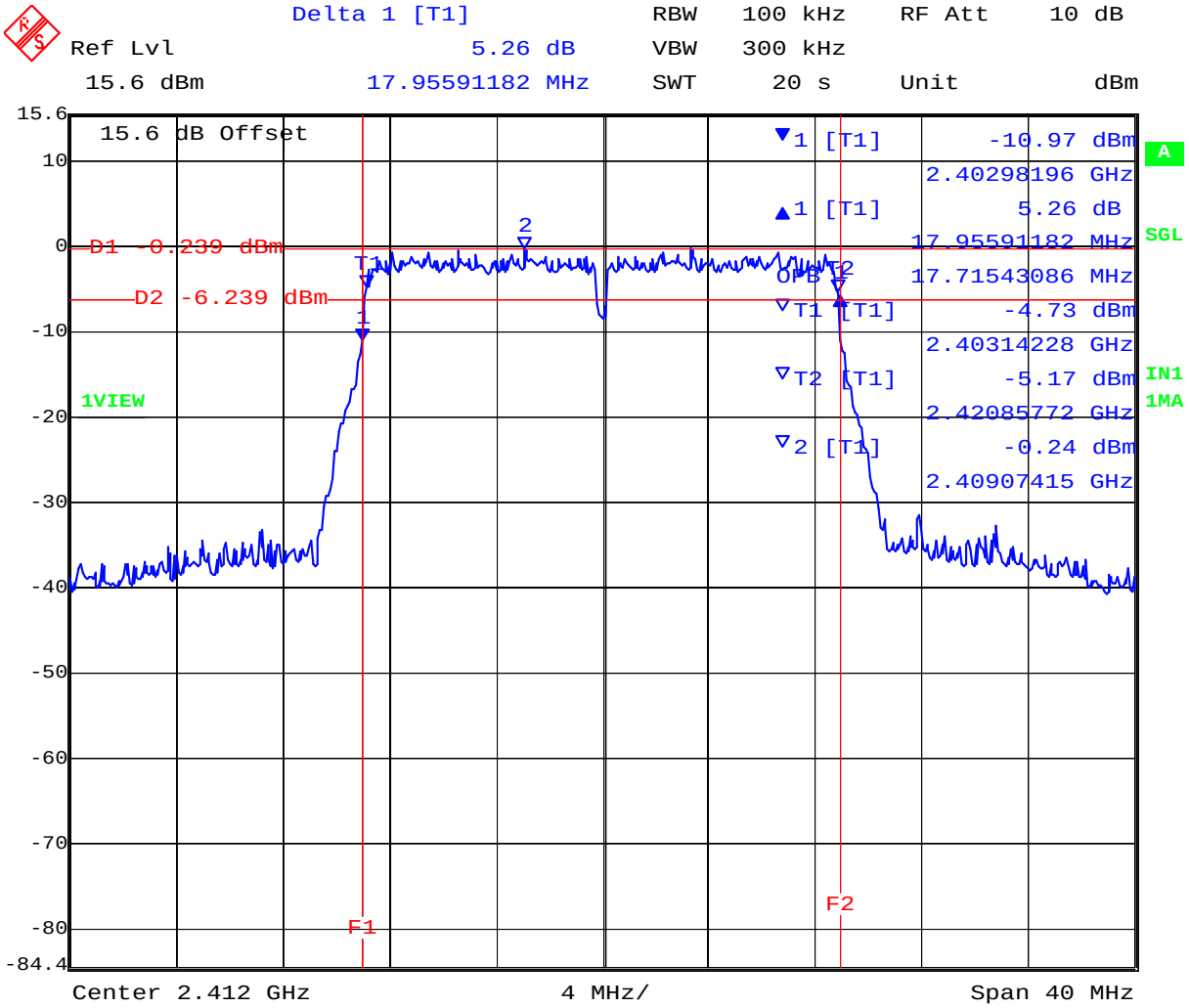
6 dB Bandwidth

Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz						
MHz	**a**	**b**	**c**	**d**	**kHz**	**MHz**	**MHz**
2412.000	17.956000	--	--	--	500	0.5	-17.456000
2437.000	17.635000	--	--	--			-17.135000
2462.000	17.635000	--	--	--			-17.135000

99% Bandwidth

Test Frequency	99 % Bandwidth						
	MHz						
MHz	**a**	**b**	**c**	**d**			
2412.000	17.715000	--	--	--			
2437.000	17.715000	--	--	--			
2462.000	17.715000	--	--	--			

Measurement uncertainty:	±2.81 dB



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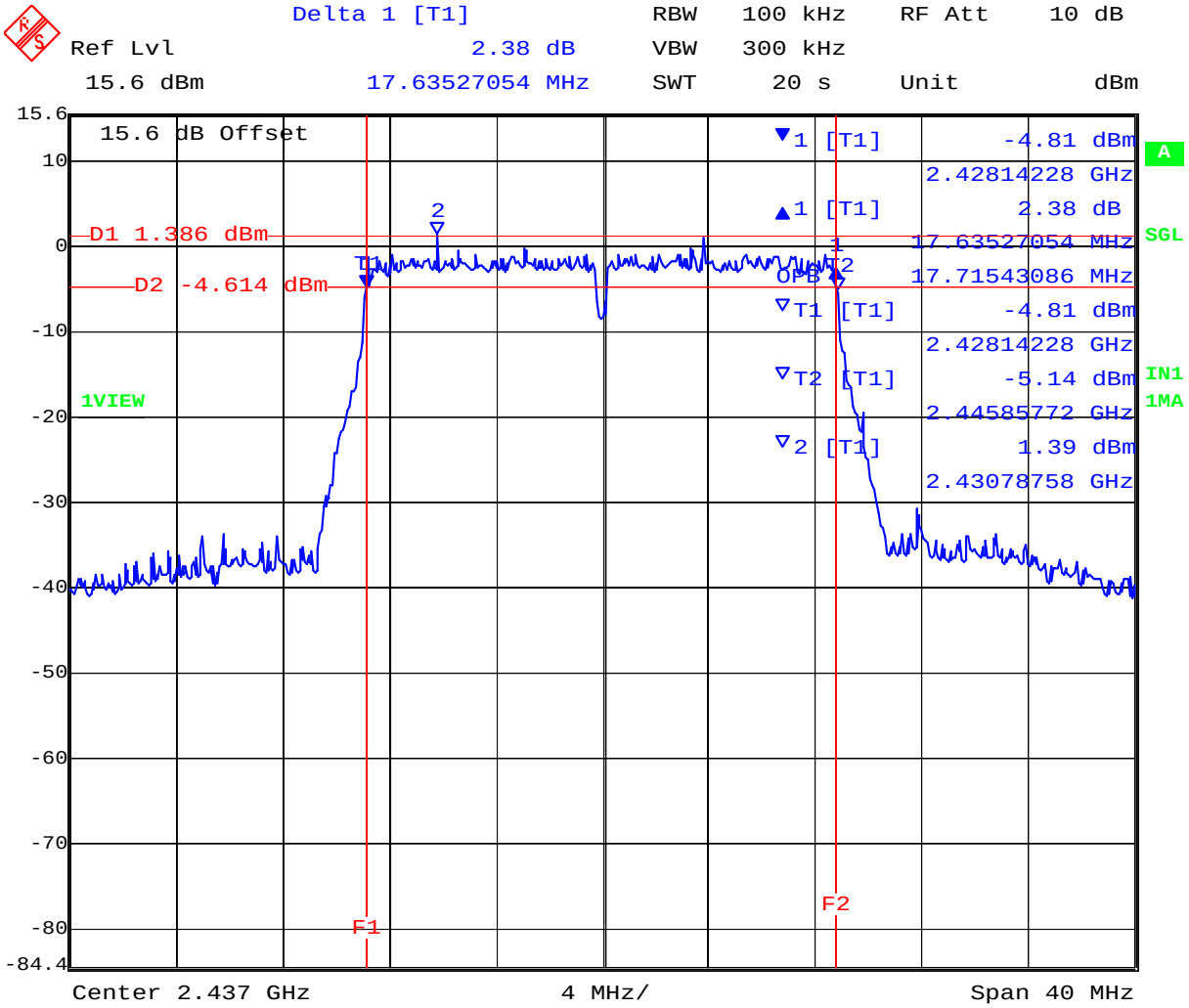
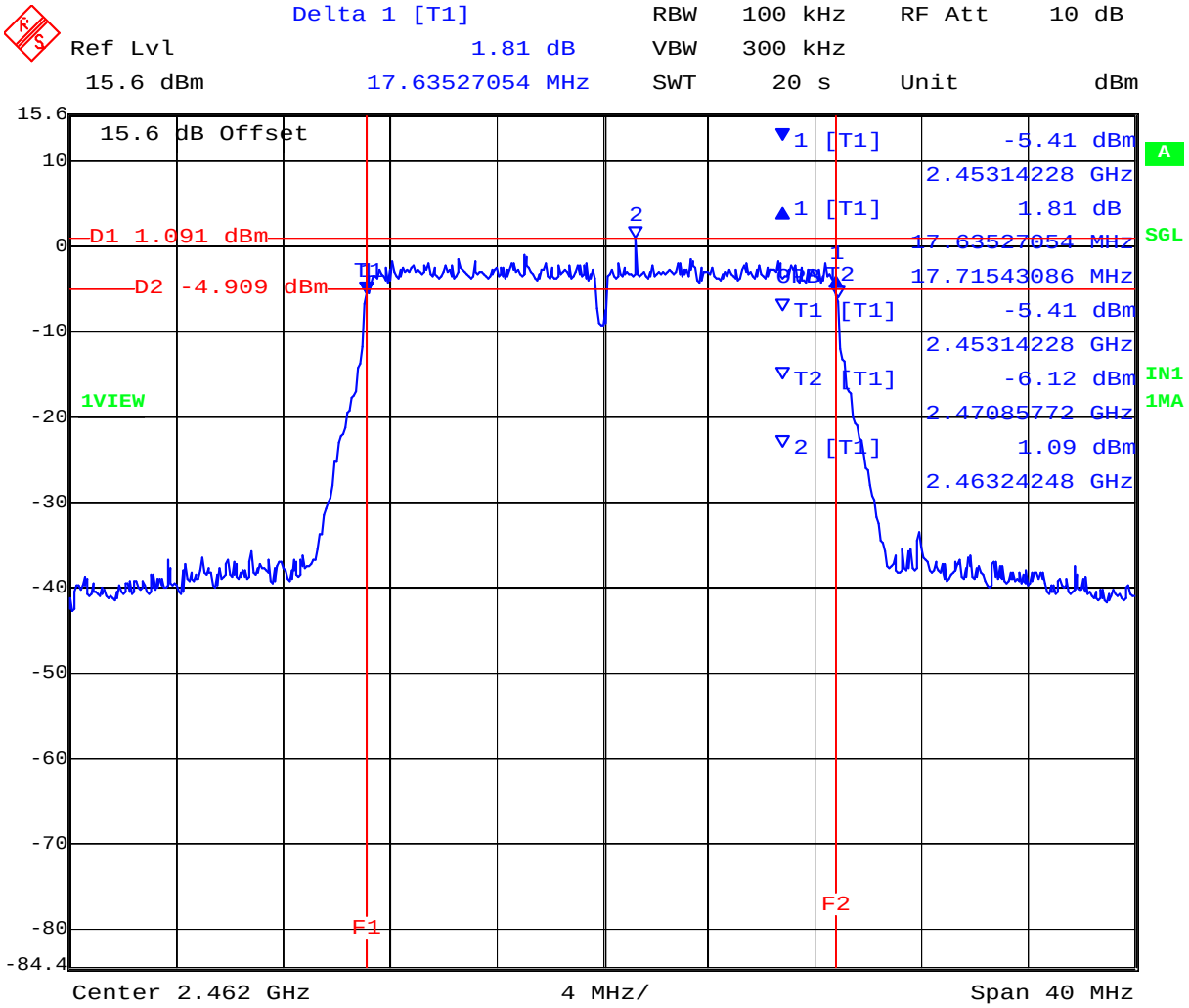

Delta 1 [T1]
RBW 100 kHz
RF Att 10 dB
Ref Lvl
2.38 dB
VBW 300 kHz
15.6 dBm
17.63527054 MHz
SWT 20 s
Unit dBm
15.6 dB Offset
1 [T1] -4.81 dBm
2.42814228 GHz
1 [T1] 2.38 dB
17.63527054 MHz
17.71543086 MHz
T1 [T1] -4.81 dBm
2.42814228 GHz
T2 [T1] -5.14 dBm
2.44585772 GHz
2 [T1] 1.39 dBm
2.43078758 GHz
D1 1.386 dBm
D2 -4.614 dBm
1VIEW
A
SGL
IN1
1MA
F1
F2
Center 2.437 GHz
4 MHz/
Span 40 MHz
Date: 17.NOV.2011 15:48:46



Date: 17.NOV.2011 15:59:11

7.1.4 6 dB and 99% Bandwidth Results: 802.11n HT-40

Test Conditions:	15.247 (a)(2)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11n HT-40	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	2.5 dBi
Applied Voltage:	3.30 Vdc		
Notes 1:			
Notes 2:			

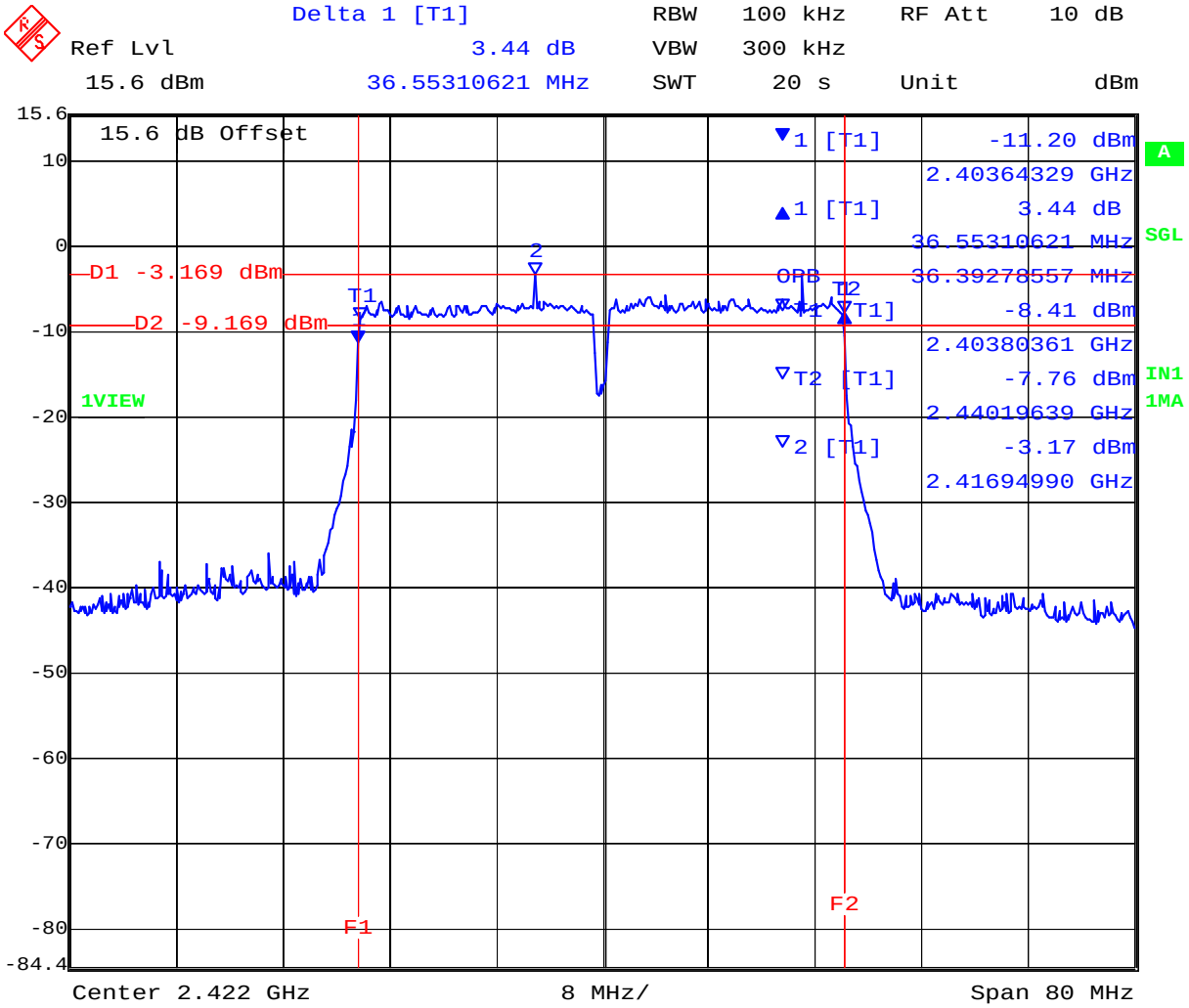
6 dB Bandwidth

Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz						
MHz	**a**	**b**	**c**	**d**	**kHz**	**MHz**	**MHz**
2422.000	36.553000	--	--	--	500	0.5	-36.053000
2437.000	36.874000	--	--	--			-36.374000
2452.000	36.553000	--	--	--			-36.053000

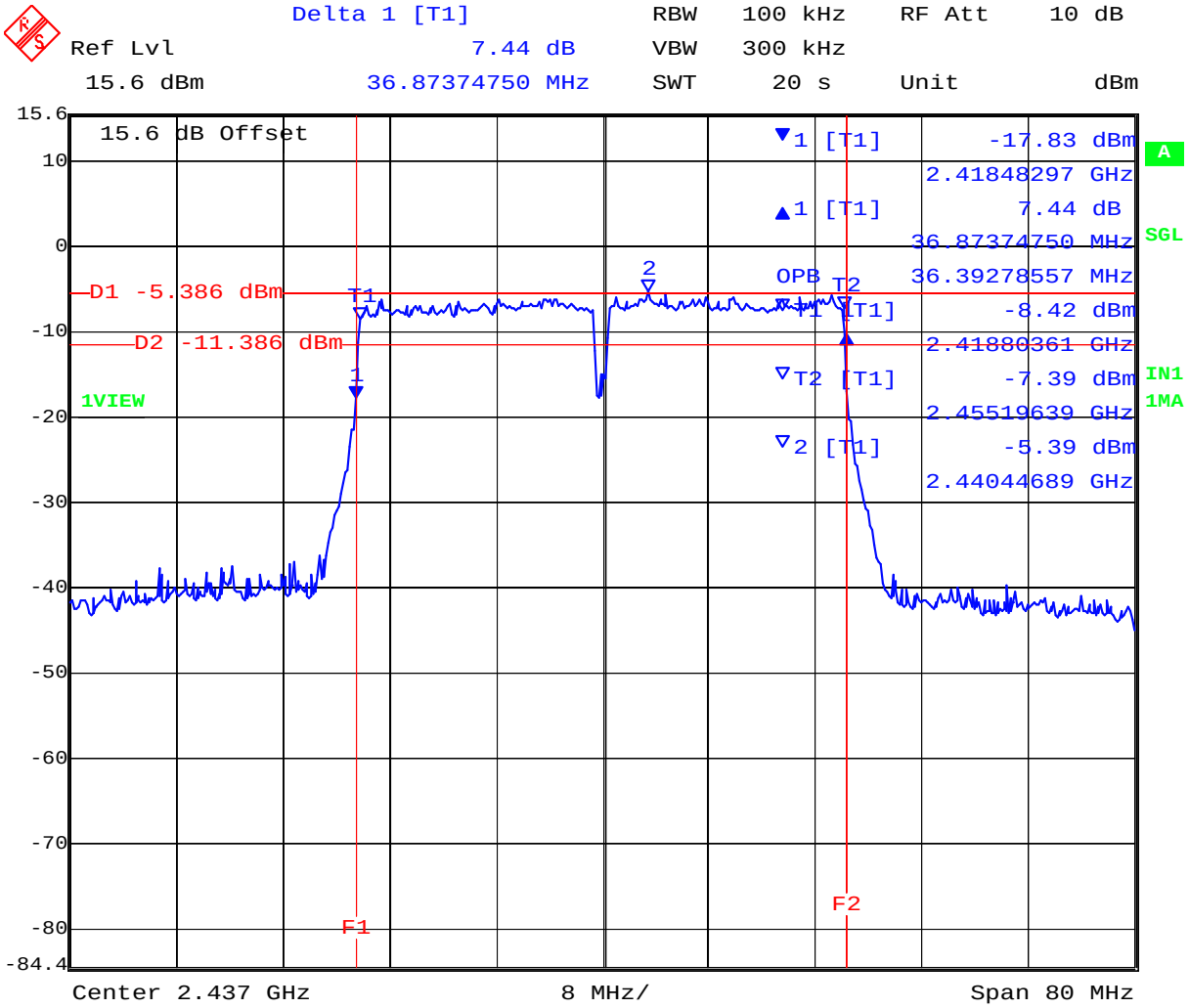
99% Bandwidth

Test Frequency	99 % Bandwidth						
	MHz						
MHz	**a**	**b**	**c**	**d**			
2422.000	36.393000	--	--	--			
2437.000	36.393000	--	--	--			
2452.000	36.393000	--	--	--			

Measurement uncertainty:	±2.81 dB



Date: 17.NOV.2011 16:11:37



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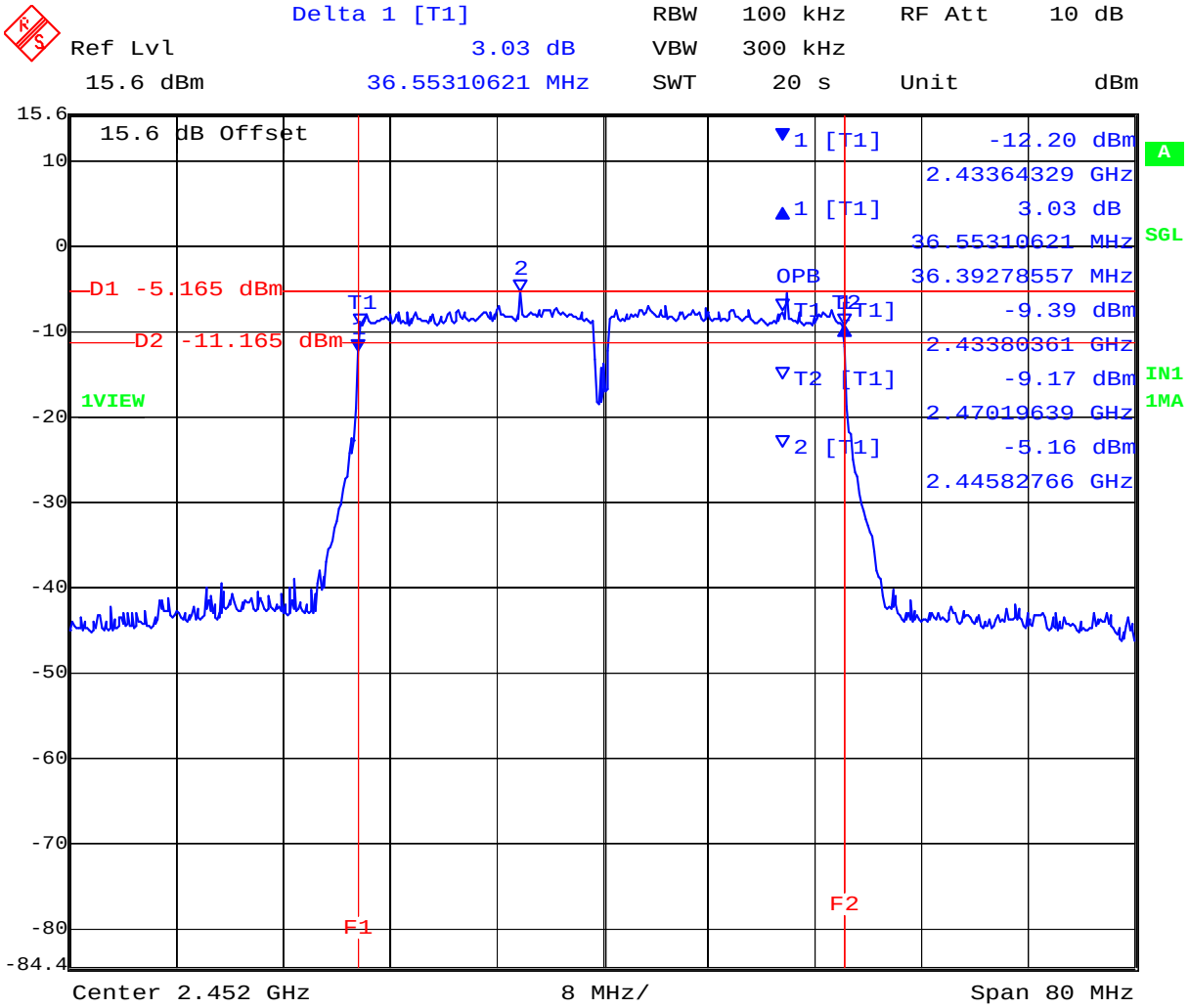

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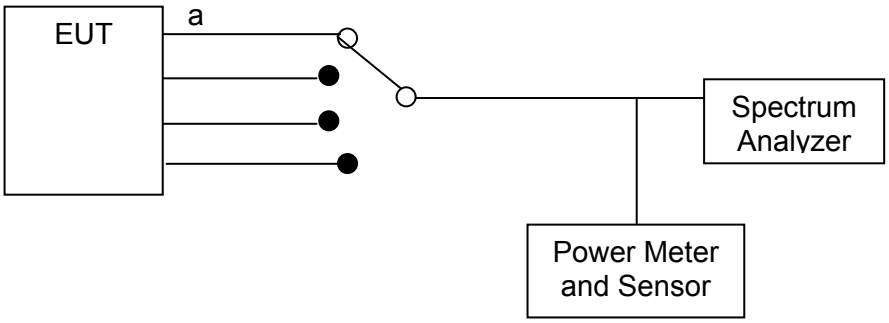
7.2 Peak Output Power

Test Procedure

The test methodology and conditions utilized for each measurement is referenced in the test results matrix. The average output power was measured per the test configuration identified below. Per the standard measurements were taken at ambient conditions, nominal voltage.

Test Configuration



Measurement setup for Peak Output Power

Specification for Peak Output Power 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.

Specification for Peak Output Power Limits (continued)

Industry Canada RSS-210 §A8.4 (4)

(4) For systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz, the maximum peak conducted output power shall not exceed 1 W. Except as provided in Section A8.4 (5), the e.i.r.p. shall not exceed 4 W.

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

(5) Point-to-point systems in the bands 2400-2483.5 MHz and 5725-5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems, omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding 4 W e.i.r.p. However, remote stations of point-to-multipoint systems shall be allowed to operate at greater than 4 W e.i.r.p. under the same conditions as for point-to-point systems.

Note: "Fixed point-to-point operation" excludes point-to-multipoint systems, omnidirectional applications and multiple co-located transmitters transmitting the same information.

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0252, 0313, 0314, 0223, 0116, 0117, 0287, 0363

7.2.1 Measurement results for 802.11b

Test Conditions:	15.247 (b)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11b	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	2.5 dBi
Applied Voltage:	3.30 Vdc		
Notes 1:			
Notes 2:			

Test Frequency	Measured Peak Power RF Port (dBm)				Total Power (dBm)		Limit	Margin
MHz	**a**	**b**	**c**	**d**	**Combined**	**Calculated**	**dBm**	**dB**
2412	16.90	--	--	--	N/A	16.90	30.00	-13.10
2437	17.68	--	--	--	N/A	17.68	30.00	-12.32
2462	17.48	--	--	--	N/A	17.48	30.00	-12.52

Measurement uncertainty:	±1.33 dB

7.2.2 Measurement results for 802.11g

Test Conditions:	15.247 (b)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11g	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	2.5 dBi
Applied Voltage:	3.30 Vdc		
Notes 1:			
Notes 2:			

Test Frequency	Measured Peak Power RF Port (dBm)				Total Power (dBm)		Limit	Margin
MHz	**a**	**b**	**c**	**d**	**Combined**	**Calculated**	**dBm**	**dB**
2412	14.97	--	--	--	N/A	14.97	30.00	-15.03
2437	15.50	--	--	--	N/A	15.50	30.00	-14.50
2462	14.51	--	--	--	N/A	14.51	30.00	-15.49

Measurement uncertainty:	±1.33 dB

7.2.3 Measurement results for 802.11n HT-20

Test Conditions:	15.247 (b)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11n HT-20	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	2.5 dBi
Applied Voltage:	3.30 Vdc		
Notes 1:			
Notes 2:			

Test Frequency	Measured Peak Power RF Port (dBm)				Total Power (dBm)		Limit	Margin
MHz	**a**	**b**	**c**	**d**	**Combined**	**Calculated**	**dBm**	**dB**
2412	14.06	--	--	--	N/A	14.06	30.00	-15.94
2437	14.49	--	--	--	N/A	14.49	30.00	-15.51
2462	13.16	--	--	--	N/A	13.16	30.00	-16.84

Measurement uncertainty:	±1.33 dB

7.2.4 Measurement results for 802.11n HT-40

Test Conditions:	15.247 (b)	**Rel. Humidity (%):**	35 to 42
Variant:	802.11n HT-40	**Ambient Temp. (ºC):**	19 to 22
TPC:	HIGH	**Pressure (mBars):**	998 to 1003
Modulation:	ON	**Duty Cycle (%):**	100
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	2.5 dBi
Applied Voltage:	3.30 Vdc		
Notes 1:			
Notes 2:			

Test Frequency	Measured Peak Power RF Port (dBm)				Total Power (dBm)		Limit	Margin
MHz	**a**	**b**	**c**	**d**	**Combined**	**Calculated**	**dBm**	**dB**
2422	11.97	--	--	--	N/A	11.97	30.00	-18.03
2437	12.33	--	--	--	N/A	12.33	30.00	-17.67
2452	10.6	--	--	--	N/A	10.60	30.00	-19.40

Measurement uncertainty:	±1.33 dB

7.3 Maximum Permissible Exposure

Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm2) = EIRP/($4\pi d^2$)
EIRP = P * G
P = Peak output power (mW)
G = Antenna numeric gain (numeric)
d = Separation distance (cm)
Numeric Gain = 10 ^ (G (dBi)/10)

The Peak Power in mW is the highest transmitter power measured and summed across all transmitters. Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm2

Freq. Band (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Peak Output Power (dBm)	EIRP (mW)	Distance @ 1mW/cm2 Limit(cm)	Minimum Separation Distance (cm)
2.4 - 4.835	2.5	1.8	+17.68	58.6	2.9	20

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

Specification

Maximum Permissible Exposure Limits

FCC §1.1310

Limit = 1mW / cm^2 from 1.310 Table 1

RSS-Gen §5.6

Exposure of Humans to RF Fields: Category I and Category II equipment shall comply with the applicable requirements of RSS-102.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

7.4 Peak Power Spectral Density

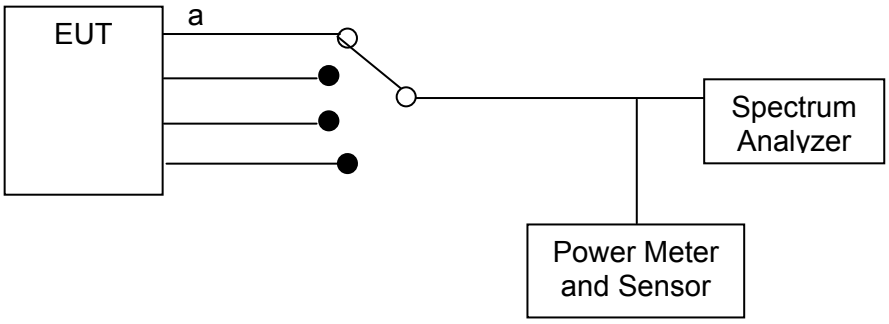
Test Procedure

The test methodology and conditions utilized for each measurement is referenced in the following test results matrix. RF output power, transmit power control and power density were measured per the Test Configuration identified below.

Testing was performed on the highest and lowest power settings of the equipment.

Per the standard measurements were taken at ambient and extreme temperature conditions at nominal and extreme voltage levels.

Test Configuration



Measurement setup for Peak Power Spectral Density

Specification for Peak Power Spectral Density Limits

FCC §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

Industry Canada RSS-210 §A8.2 (b)

These include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to all three bands:

(a) The minimum -6 dB bandwidth shall be at least 500 kHz.

(b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section A8.4 (4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Traceability

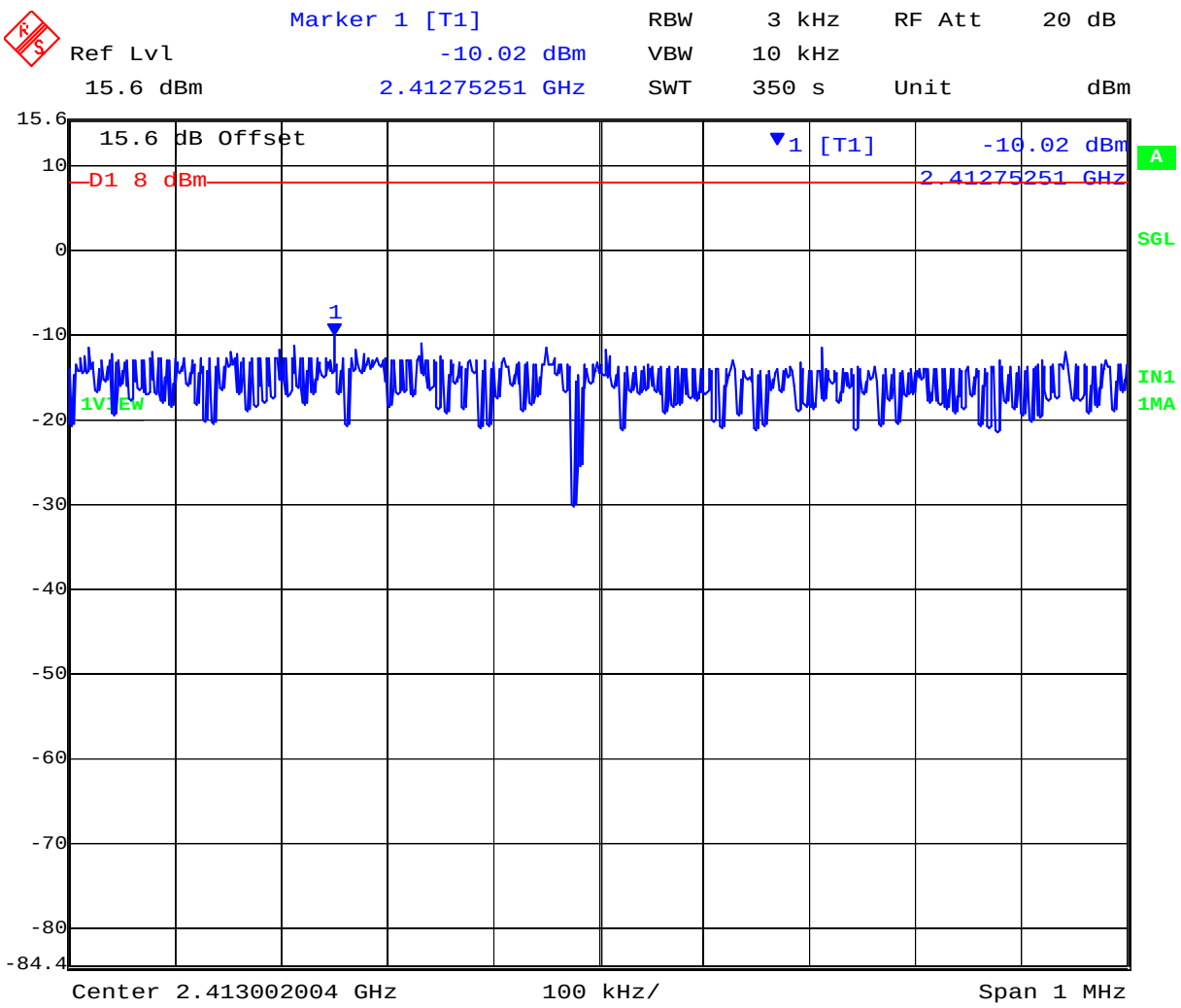
Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0252, 0313, 0314, 0223, 0116, 0117, 0287, 0363

7.4.1 Measurement results for 802.11b

Test Conditions:	15.247 (e)		**Rel. Humidity (%):**	35 to 42	
Variant:	802.11b		**Ambient Temp. (ºC):**	19 to 22	
TPC:	HIGH		**Pressure (mBars):**	998 to 1003	
Modulation:	ON		**Duty Cycle (%):**	100	
Beam Forming Gain (Y):	N/A	dB	**Antenna Gain:**	2.5 dBi	
Applied Voltage:	3.30	Vdc	**Antenna Ports (N):**	1	
Notes 1:					
Notes 2:					

Test Frequency	Measured Power Density RF Port (dBm)				Correction factor	Peak Power Spectral Density	Limit	Margin
MHz	**a**	**b**	**c**	**d**	**10Log(N)**	**dBm**	**dBm**	**dB**
2412.000	-10.02	--	--	--	0.00	-10.02	8.00	-18.02
2437.000	-9.76	--	--	--	0.00	-9.76	8.00	-17.76
2462.000	-9.89	--	--	--	0.00	-9.89	8.00	-17.89

Measurement uncertainty:	± 1.33 dB



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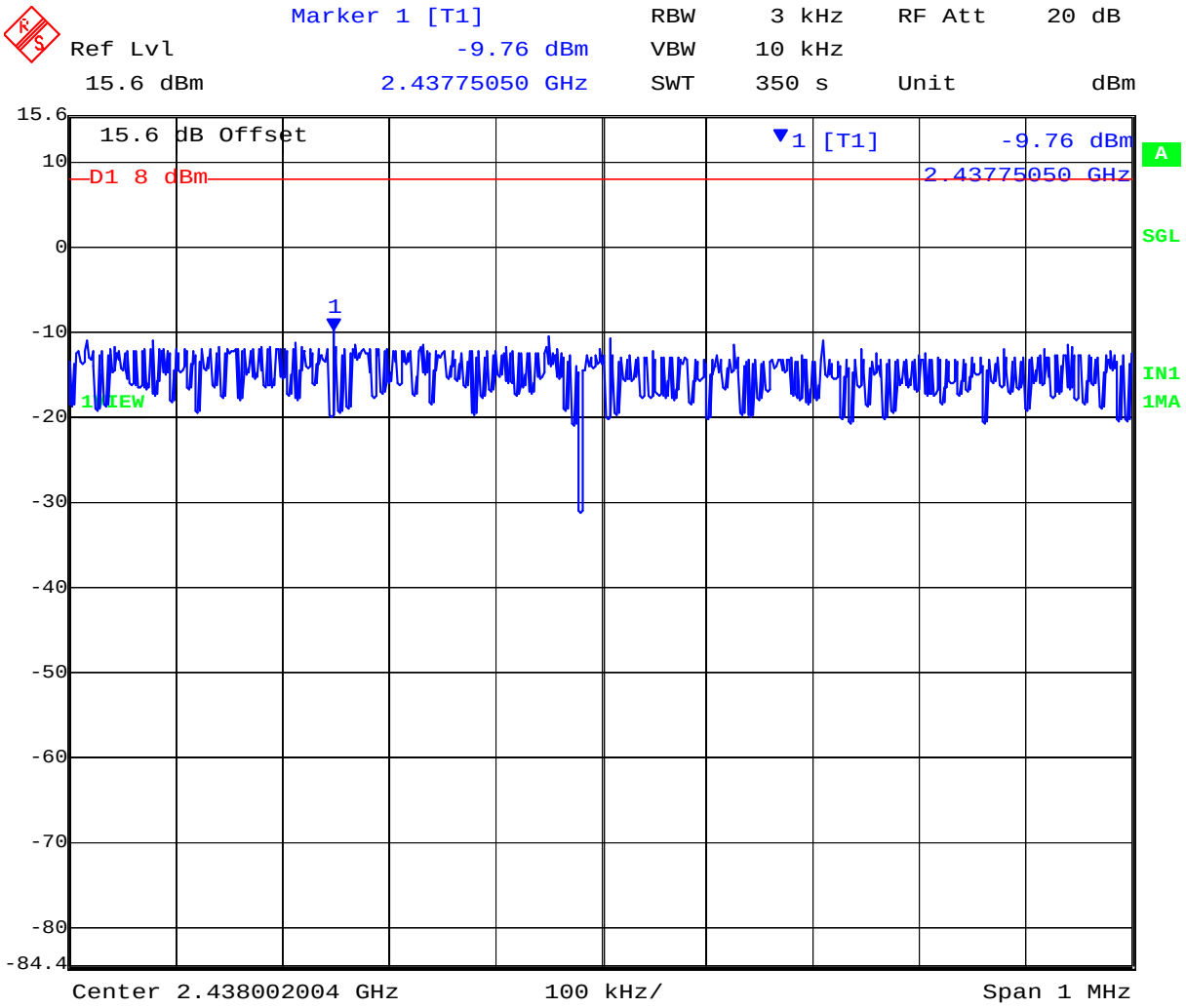

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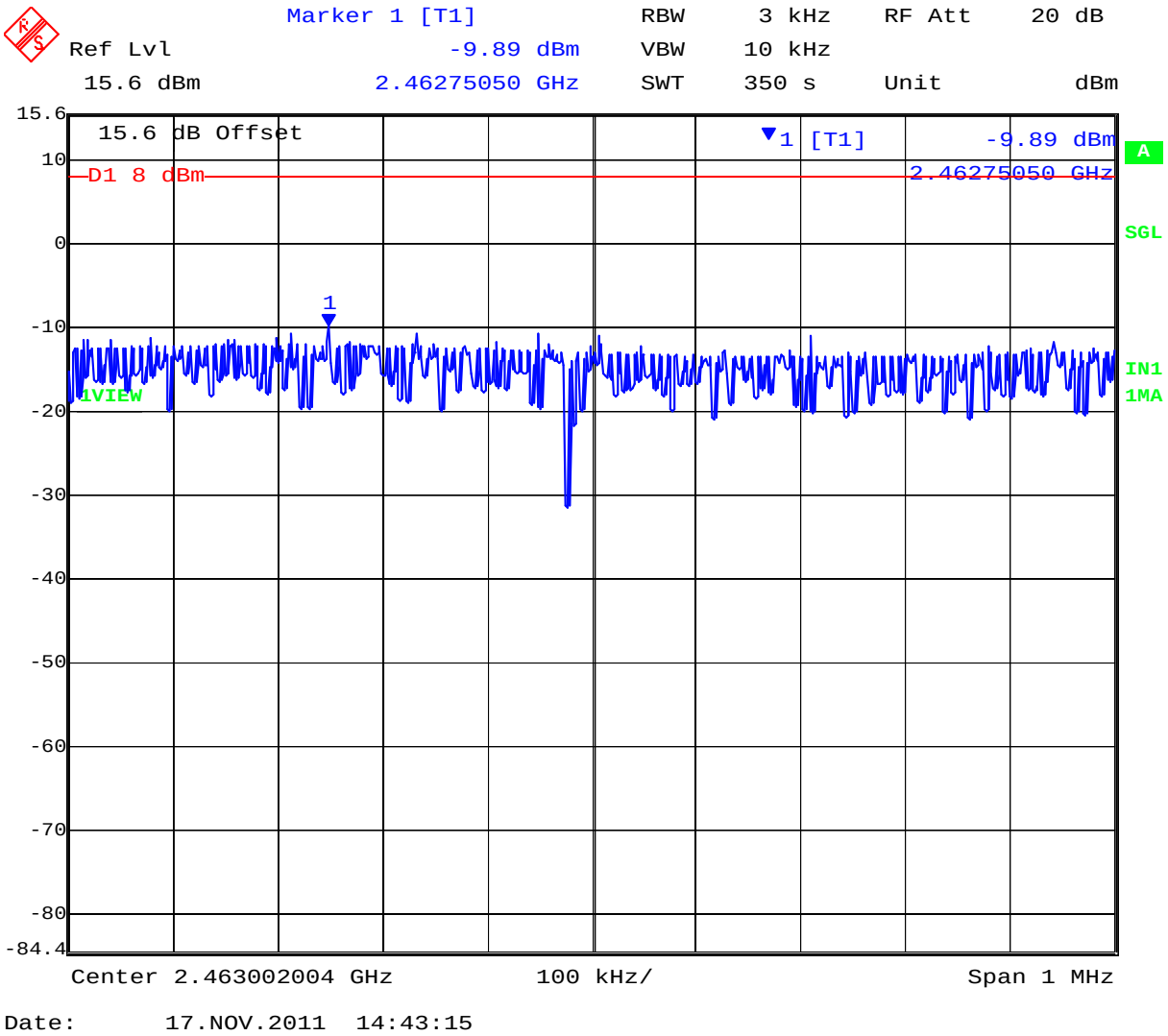
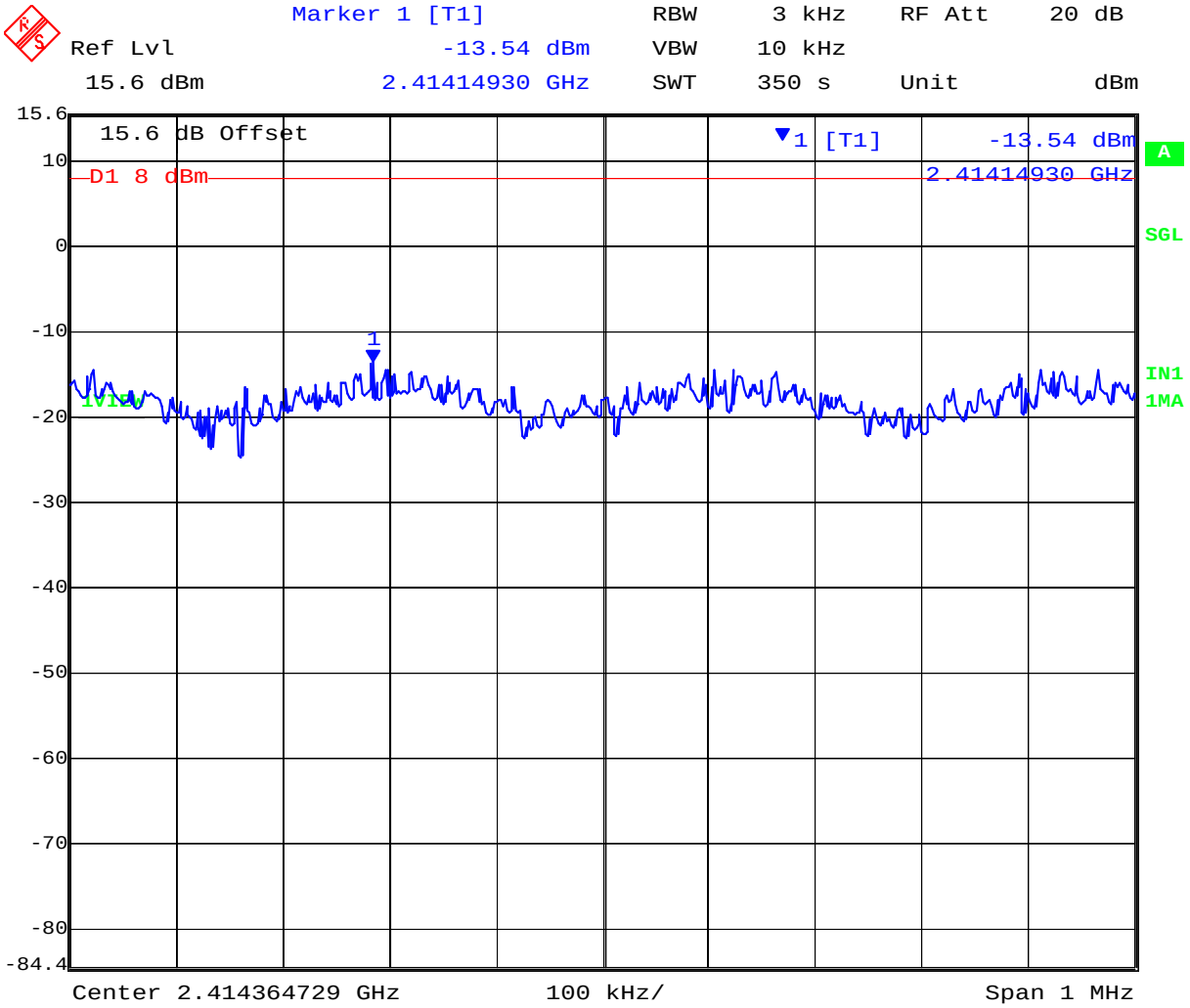

Marker 1 [T1]
RBW 3 kHz
RF Att 20 dB
Ref Lvl
-9.89 dBm
VBW 10 kHz
15.6 dBm
2.46275050 GHz
SWT 350 s
Unit dBm
15.6 dB Offset
1 [T1] -9.89 dBm
2.46275050 GHz
D1 8 dBm
A
SGL
IN1
1MA
1VIEW
15.6
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-84.4
Center 2.463002004 GHz
100 kHz/
Span 1 MHz
Date: 17.NOV.2011 14:43:15

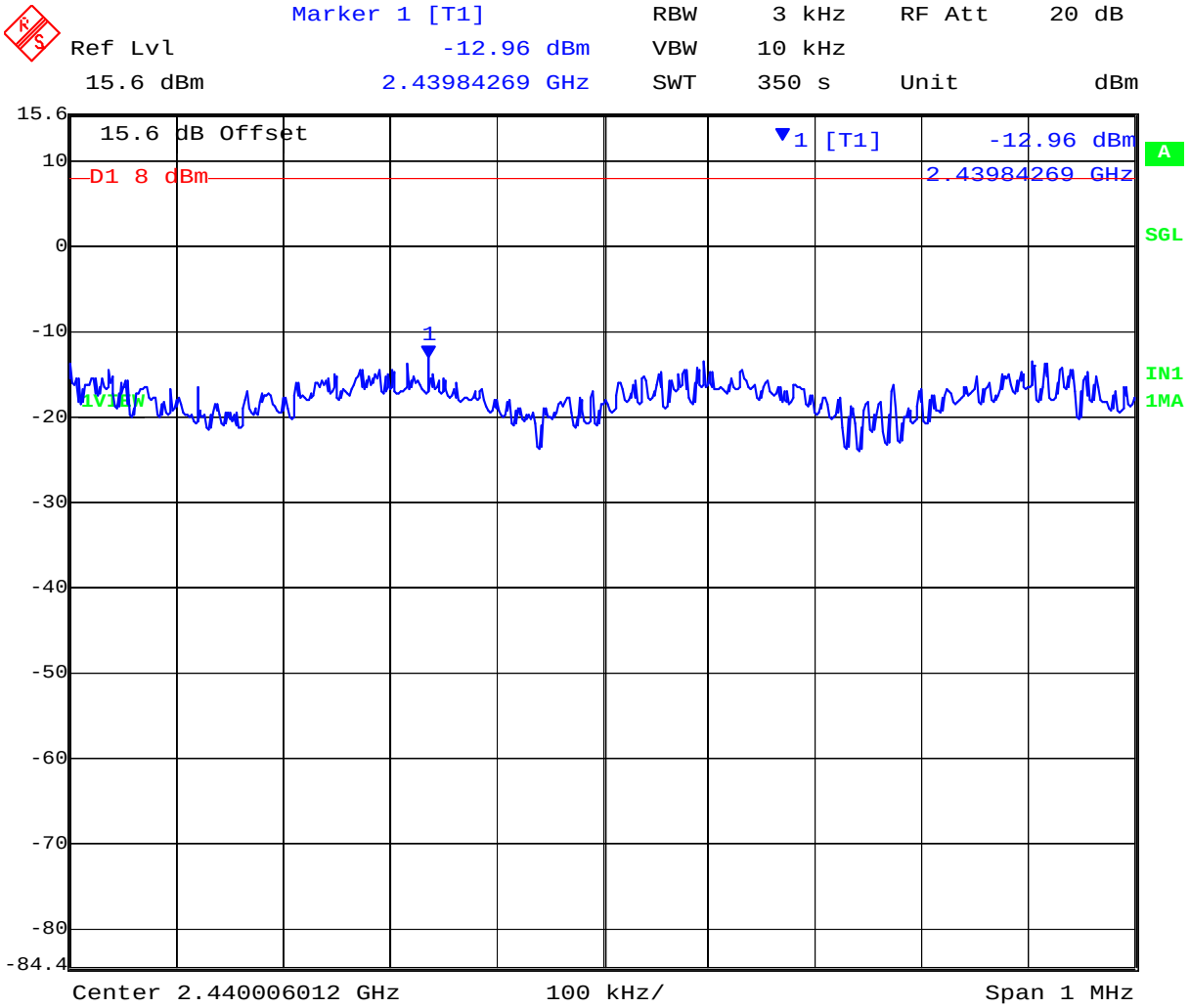
7.4.2 Measurement results for 802.11g

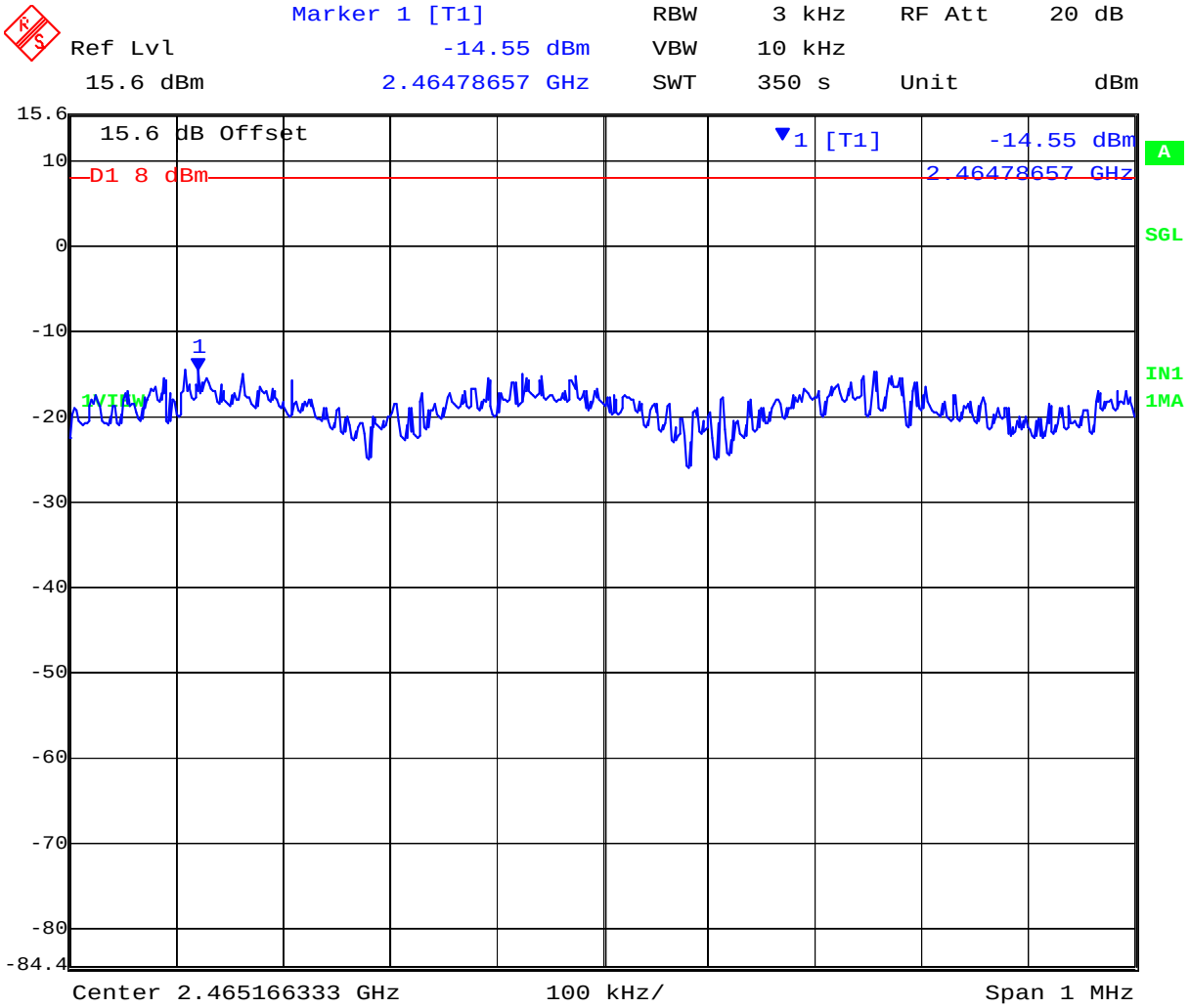
Test Conditions:	15.247 (e)	**Rel. Humidity (%):**	35	to	42
Variant:	802.11g	**Ambient Temp. (ºC):**	19	to	22
TPC:	HIGH	**Pressure (mBars):**	998	to	1003
Modulation:	ON	**Duty Cycle (%):**	100		
Beam Forming Gain (Y):	N/A dB	**Antenna Gain:**	2.5 dBi		
Applied Voltage:	3.30 Vdc	**Antenna Ports (N):**	1		
Notes 1:					
Notes 2:					

Test Frequency	Measured Power Density RF Port (dBm)				Correction factor	Peak Power Spectral Density	Limit	Margin
MHz	a	b	c	d	10Log(N)	dBm	dBm	dB
2412.000	-13.54	--	--	--	0.00	-13.54	8.00	-21.54
2437.000	-12.96	--	--	--	0.00	-12.96	8.00	-20.96
2462.000	-14.55	--	--	--	0.00	-14.55	8.00	-22.55

Measurement uncertainty:	± 1.33 dB


Marker 1 [T1]
RBW 3 kHz
RF Att 20 dB
Ref Lvl
-13.54 dBm
VBW 10 kHz
15.6 dBm
2.41414930 GHz
SWT 350 s
Unit dBm
15.6 dB Offset
1 [T1] -13.54 dBm
D1 8 dBm
2.41414930 GHz
A
SGL
IN1
1MA
15.6
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-84.4
Center 2.414364729 GHz
100 kHz/
Span 1 MHz
Date: 17.NOV.2011 14:59:47


Marker 1 [T1]
RBW 3 kHz
RF Att 20 dB
Ref Lvl
-12.96 dBm
VBW 10 kHz
15.6 dBm
2.43984269 GHz
SWT 350 s
Unit dBm
15.6 dB Offset
1 [T1] -12.96 dBm
D1 8 dBm
2.43984269 GHz
A
SGL
IN1
1MA
1VBW
15.6
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-84.4
Center 2.440006012 GHz
100 kHz/
Span 1 MHz
Date: 17.NOV.2011 15:09:54

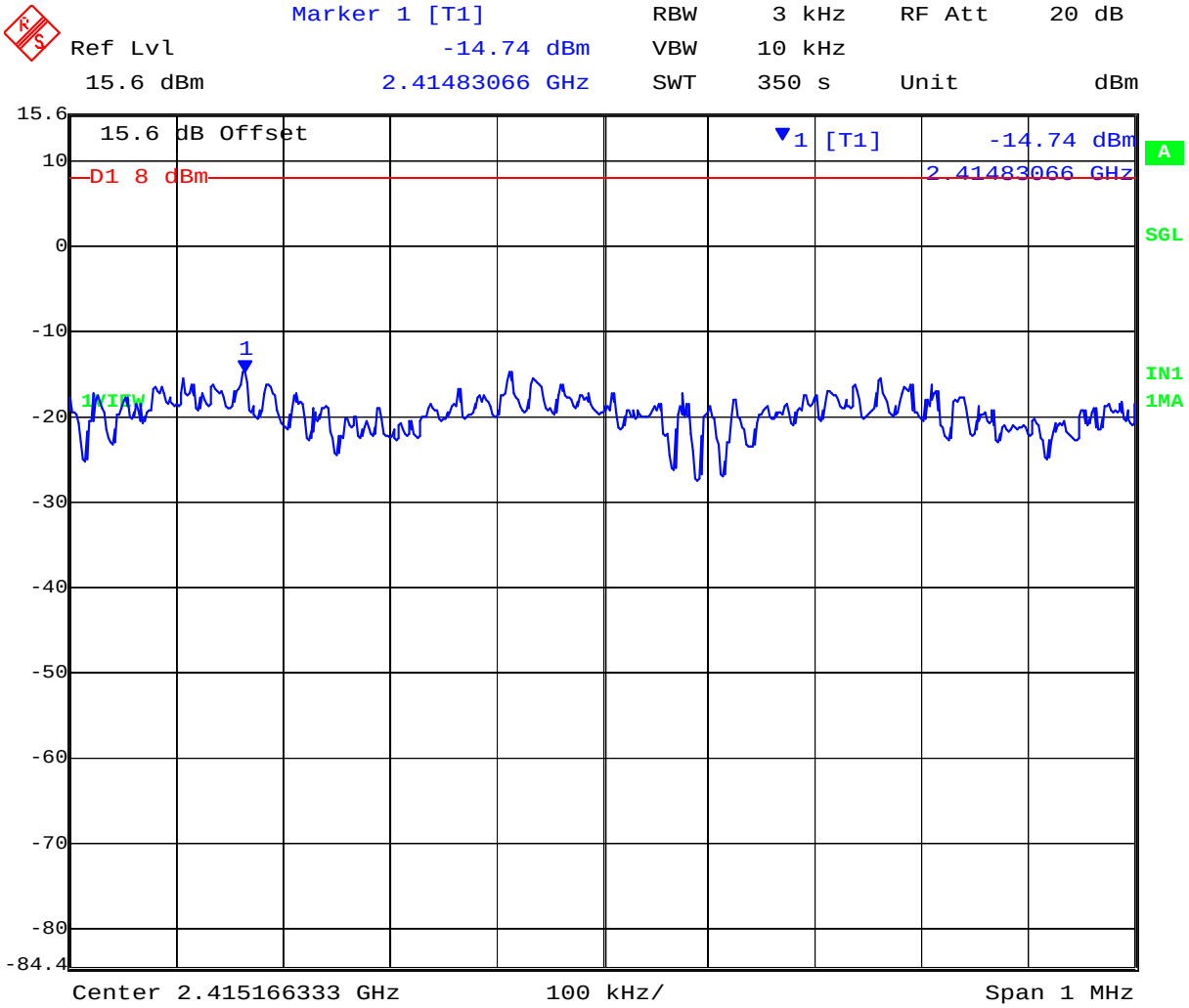

Marker 1 [T1]
RBW 3 kHz
RF Att 20 dB
Ref Lvl
-14.55 dBm
VBW 10 kHz
15.6 dBm
2.46478657 GHz
SWT 350 s
Unit dBm
15.6 dB Offset
1 [T1] -14.55 dBm
2.46478657 GHz
D1 8 dBm
A
SGL
IN1
1MA
15.6
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-84.4
Center 2.465166333 GHz
100 kHz/
Span 1 MHz
Date: 17.NOV.2011 15:21:25

7.4.3 Measurement results for 802.11n HT-20

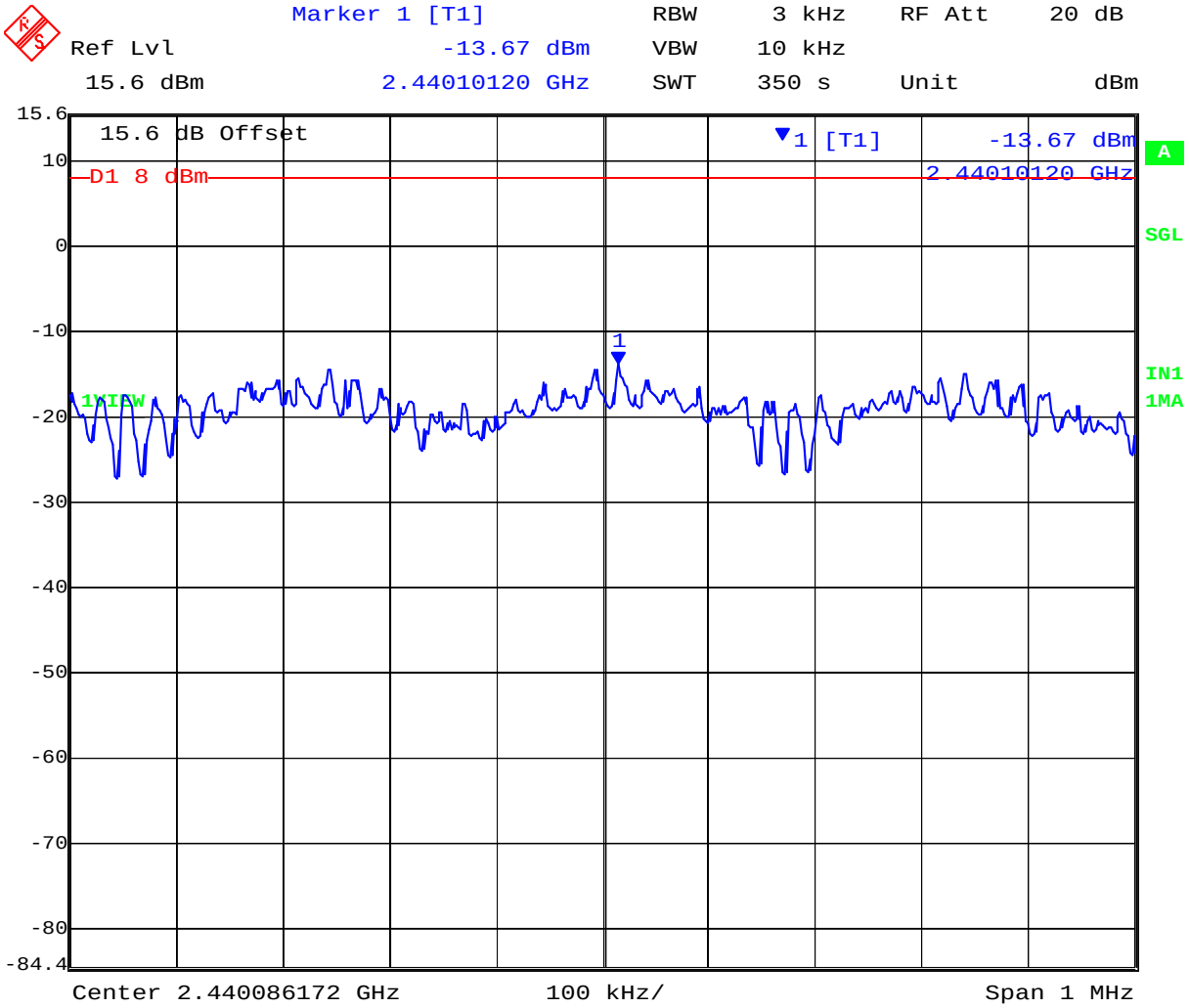
Test Conditions:	15.247 (e)		**Rel. Humidity (%):**	35 to 42	
Variant:	802.11n HT-20		**Ambient Temp. (ºC):**	19 to 22	
TPC:	HIGH		**Pressure (mBars):**	998 to 1003	
Modulation:	ON		**Duty Cycle (%):**	100	
Beam Forming Gain (Y):	N/A	dB	**Antenna Gain:**	2.5 dBi	
Applied Voltage:	3.30	Vdc	**Antenna Ports (N):**	1	
Notes 1:					
Notes 2:					

Test Frequency	Measured Power Density RF Port (dBm)				Correction factor	Peak Power Spectral Density	Limit	Margin
MHz	**a**	**b**	**c**	**d**	**10Log(N)**	**dBm**	**dBm**	**dB**
2412.000	-14.74	--	--	--	0.00	-14.74	8.00	-22.74
2437.000	-13.67	--	--	--	0.00	-13.67	8.00	-21.67
2462.000	-15.73	--	--	--	0.00	-15.73	8.00	-23.73

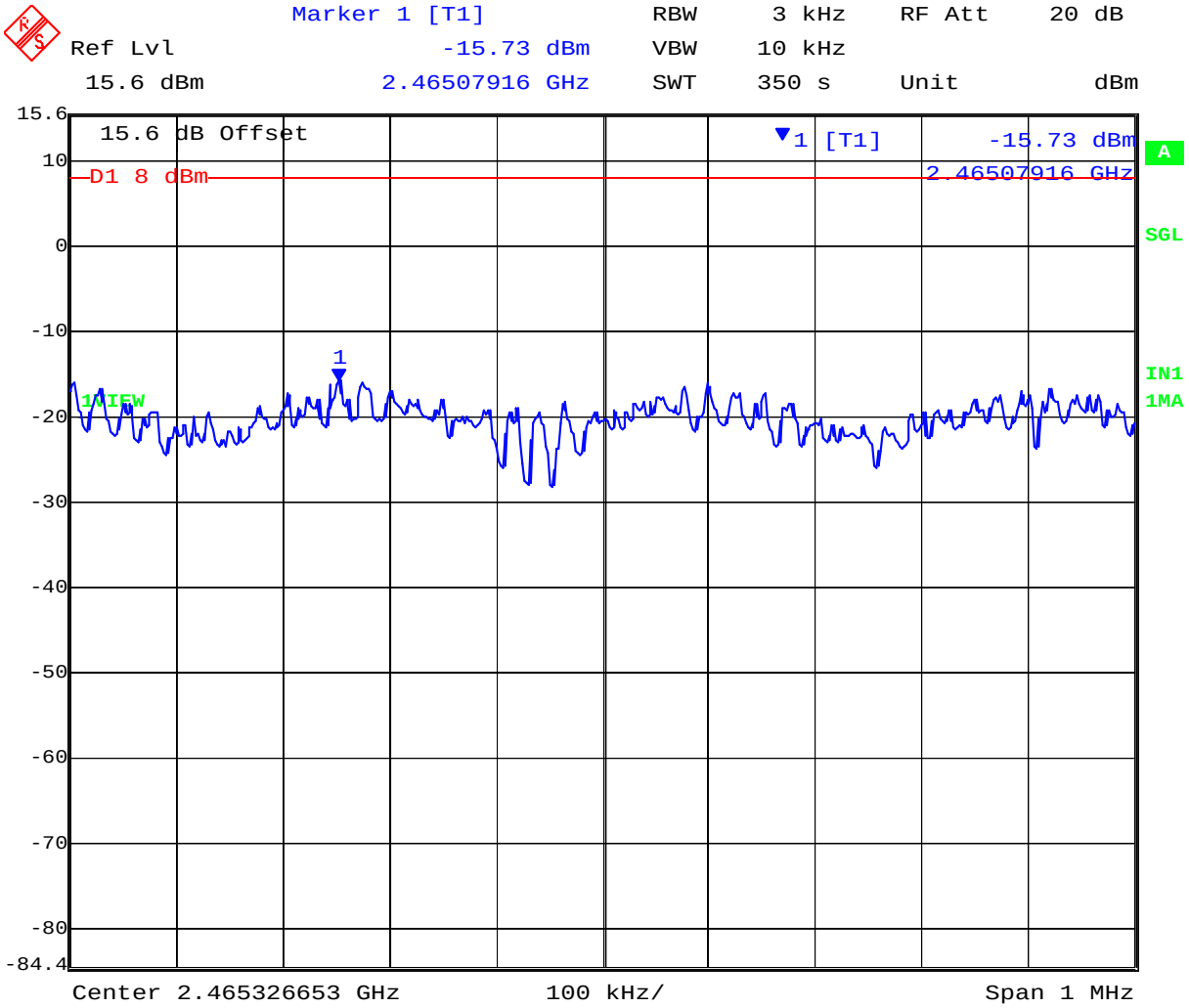
Measurement uncertainty:	± 1.33 dB



Date: 17.NOV.2011 15:45:15



Date: 17.NOV.2011 15:55:20

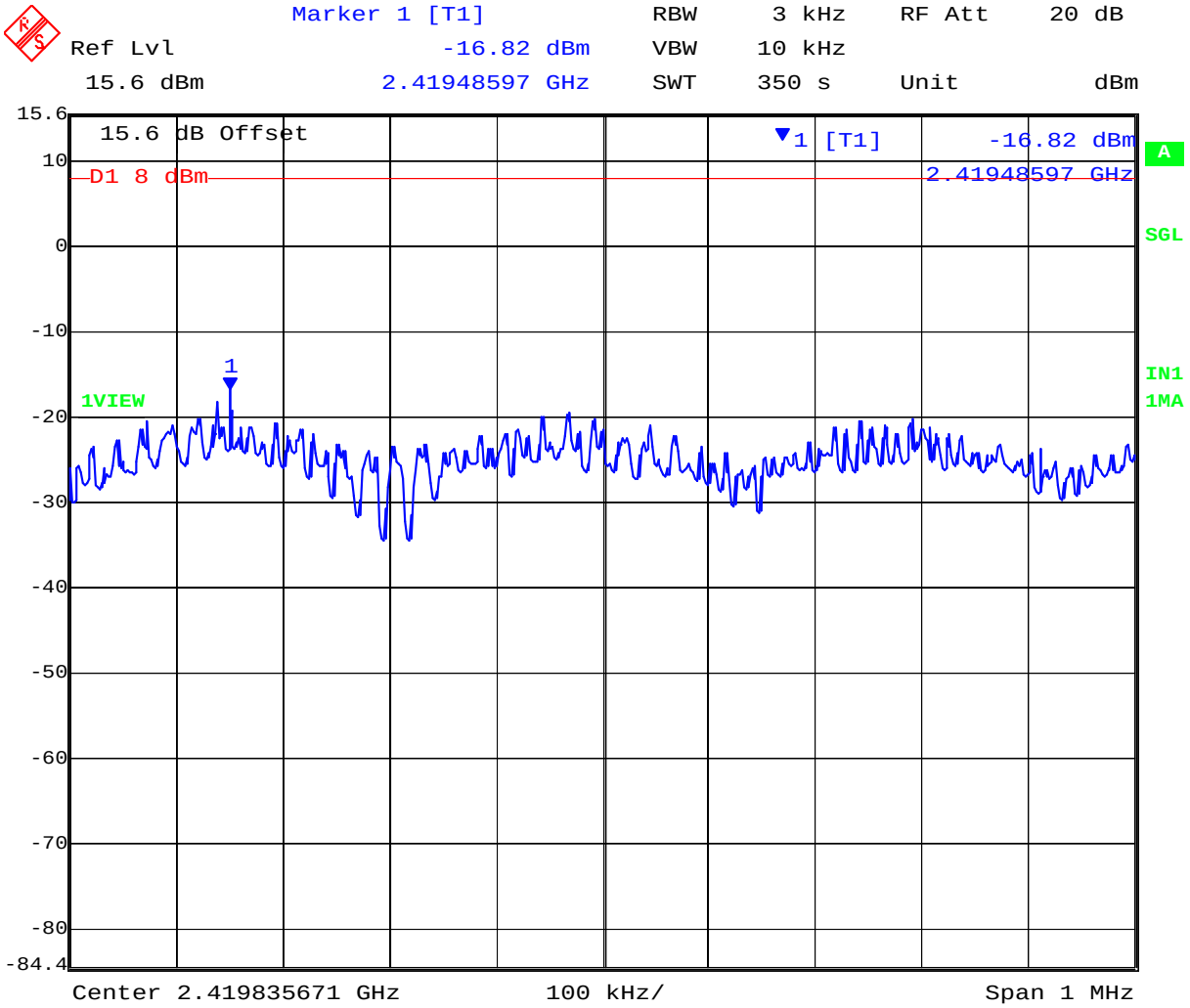

Marker 1 [T1]
RBW 3 kHz
RF Att 20 dB
Ref Lvl
-15.73 dBm
VBW 10 kHz
15.6 dBm
2.46507916 GHz
SWT 350 s
Unit dBm
15.6 dB Offset
1 [T1] -15.73 dBm
D1 8 dBm
2.46507916 GHz
A
SGL
IN1
1MA
1IFW
15.6
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-84.4
Center 2.465326653 GHz
100 kHz/
Span 1 MHz
Date: 17.NOV.2011 16:07:10

7.4.4 Measurement results for 802.11n HT-40

Test Conditions:	15.247 (e)		**Rel. Humidity (%):**	35 to 42	
Variant:	802.11n HT-40		**Ambient Temp. (ºC):**	19 to 22	
TPC:	HIGH		**Pressure (mBars):**	998 to 1003	
Modulation:	ON		**Duty Cycle (%):**	100	
Beam Forming Gain (Y):	N/A	dB	**Antenna Gain:**	2.5 dBi	
Applied Voltage:	3.30	Vdc	**Antenna Ports (N):**	1	
Notes 1:					
Notes 2:					

Test Frequency	Measured Power Density RF Port (dBm)				Correction factor	Peak Power Spectral Density	Limit	Margin
MHz	**a**	**b**	**c**	**d**	**10Log(N)**	**dBm**	**dBm**	**dB**
2422.000	-16.82	--	--	--	0.00	-16.82	8.00	-24.82
2437.000	-19.41	--	--	--	0.00	-19.41	8.00	-27.41
2452.000	-18.64	--	--	--	0.00	-18.64	8.00	-26.64

Measurement uncertainty:	± 1.33 dB



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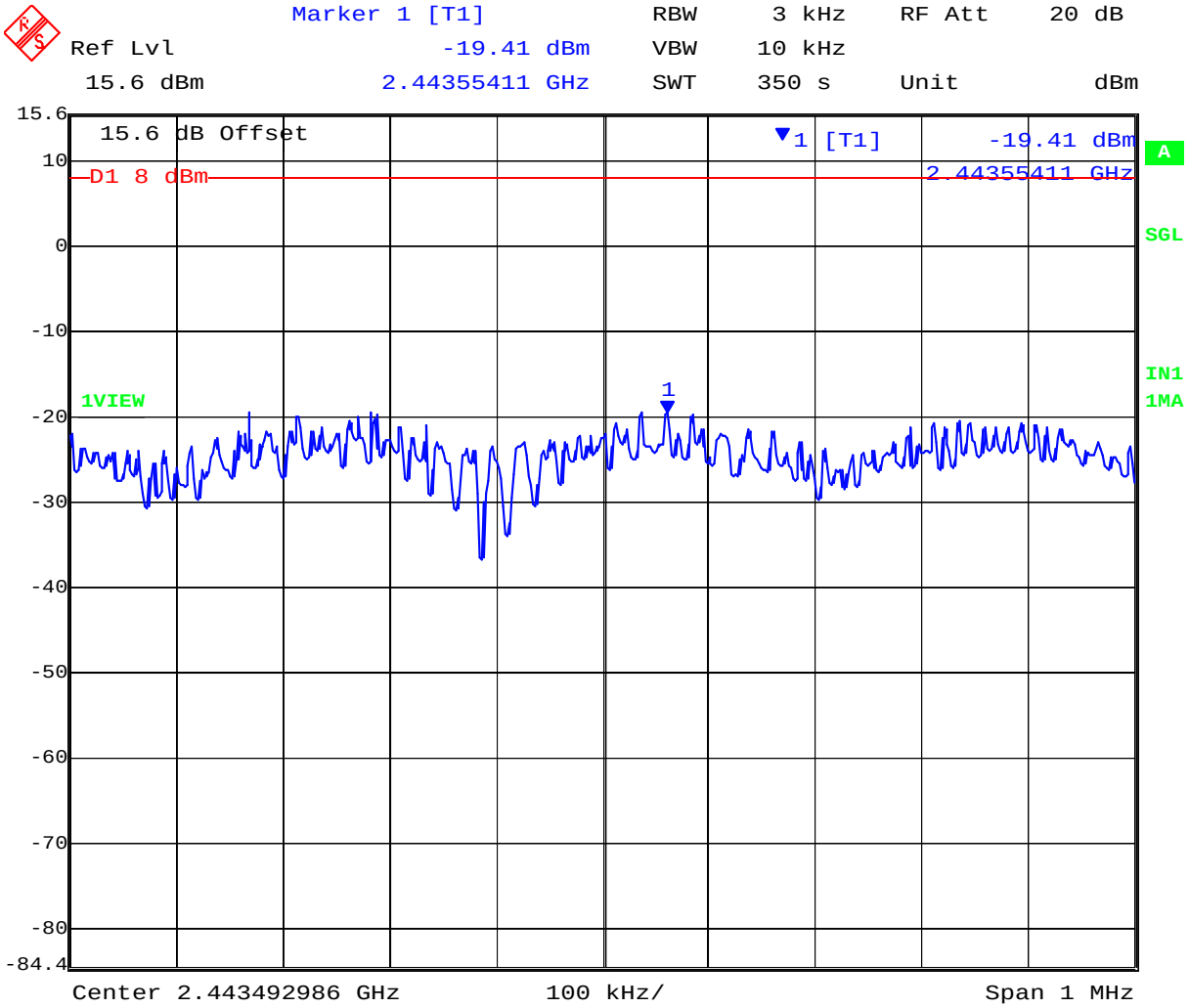

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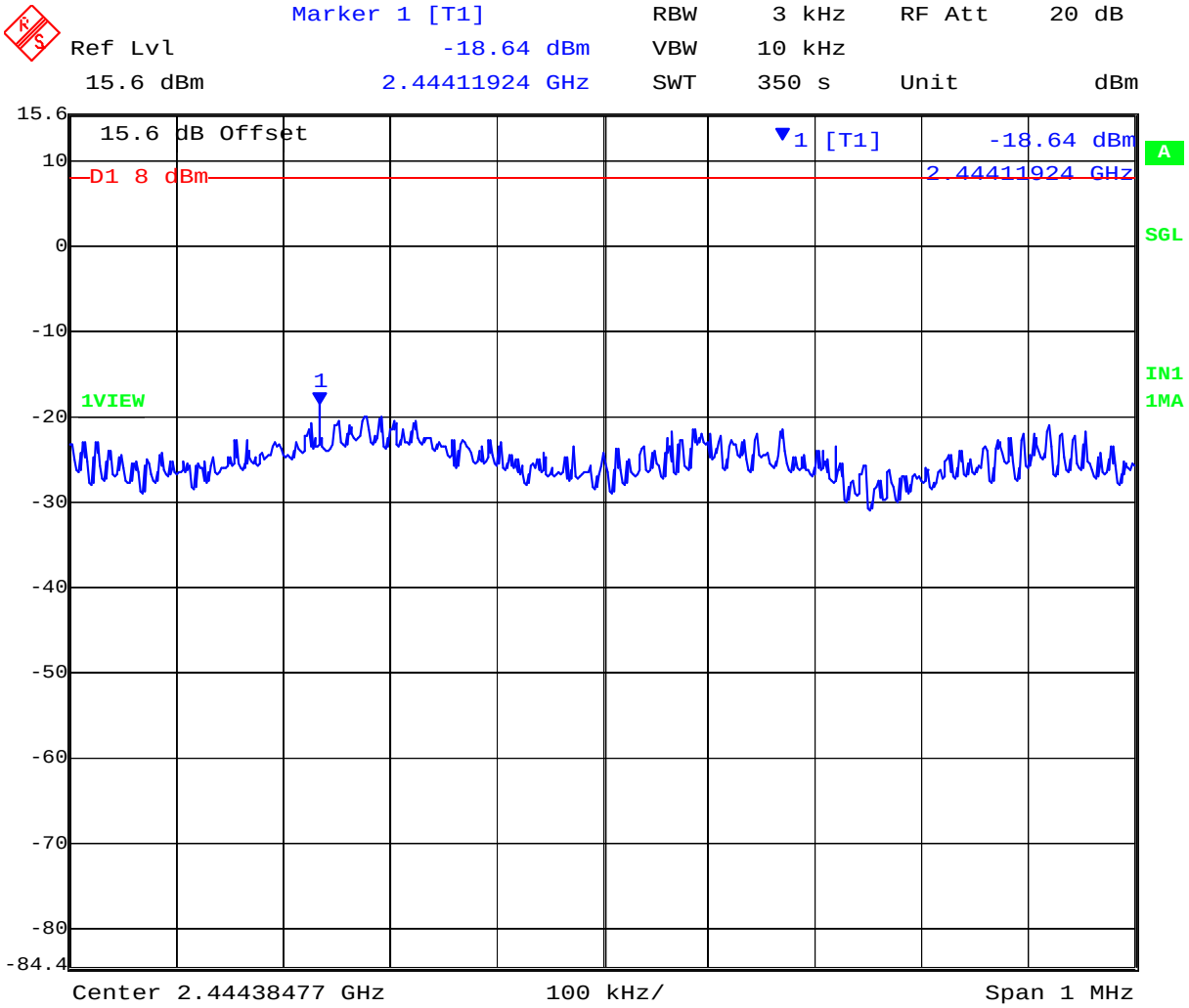


Date: 17.NOV.2011 16:41:42

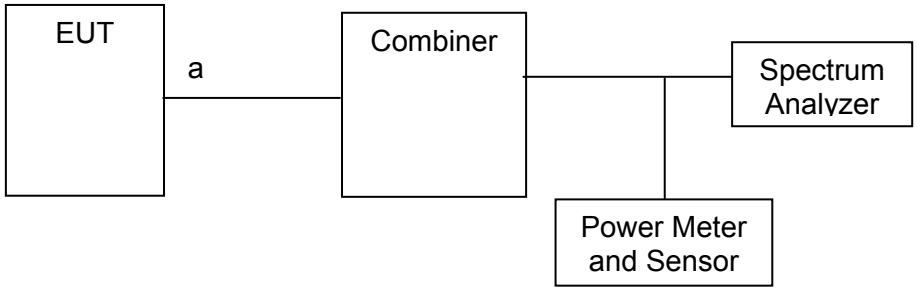
7.5 Conducted Spurious Emissions

Test Procedure

Conducted 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. Emissions at the band edge were measured and recorded. Measurements were made while EUT was operating in transmit mode of operation at the appropriate center frequency.

Measurements were made using a combiner with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement. Limits which were derived from the peak emission.

Test Configuration



Measurement setup for Conducted Spurious Emission

Specification for Band Edge Limits

FCC §15.247(d)

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)).

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	

Industry Canada RSS-210 §A8.5

Out-of-band Emissions: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square 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 field strength limits specified in RSS-Gen is not required.

RSS-GEN 6.2

If the receiver has a detachable antenna of known impedance, antenna conducted spurious emissions measurement is permitted as an alternative to radiated measurement. However, the radiated method of Section 6.1 is recommended:

The antenna conducted test shall be performed with the antenna disconnected and the receiver antenna terminals connected to a measuring instrument having equal impedance to that specified for the antenna

The receiver spurious emissions measured at the antenna terminals by the antenna conducted method shall then comply with the following limits:

Receiver spurious emissions at any discrete frequency shall not exceed 2 nanowatts in the band 30-1000 MHz, and 5 nanowatts above 1000 MHz.

Traceability

Method	Test Equipment Used
WI-05	0158, 0252, 0313, 0314, 0223, 0116, 0117, 0287, 0363.

7.5.1 Measurement Results for 802.11b

Test Conditions:	15.247 (a)(2)		**Rel. Humidity (%):**	35 to 42	
Variant:	802.11b		**Ambient Temp. (ºC):**	19 to 22	
TPC:	HIGH		**Pressure (mBars):**	998 to 1003	
Modulation:	ON		**Duty Cycle (%):**	100	
Beam Forming Gain	N/A	dB	**Antenna Gain:**	N/A	dBi
Applied Voltage:	3.30	Vdc	**Antenna Ports (N):**		
Notes 1:					
Notes 2:					

Conducted Spurious Measurement

Test Freq.	Start Freq.	Stop Freq.	Port A		Port B		Port C		Port D	
MHz	MHz	MHz	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm
2412.000	30.00	26000.00	-52.08	-14.24						
2437.000	30.00	26000.00	-52.45	-13.74						
2462.000	30.00	26000.00	-53.26	-14.31						

SE: Maximum spurious emsission found

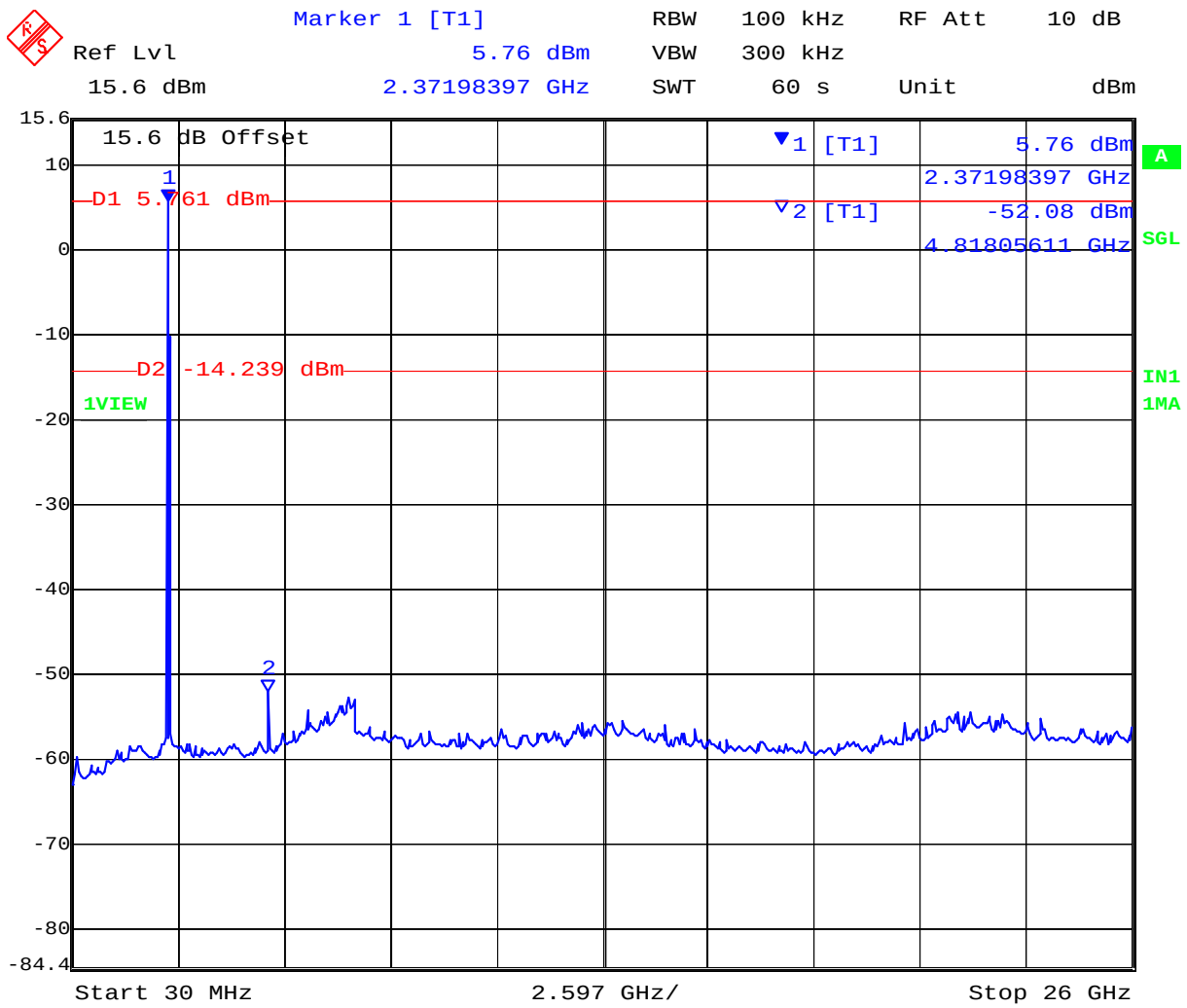
Band-edge Measurement

Test Freq.	Band-edge freq.	Port A		Port B		Port C		Port D	
MHz	MHz	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm
2412.000	2400.00	-47.42	-14.52						
2462.000	2483.50	-49.93	-14.09						

BE: Maximum Band edge emssion found

Measurement uncertainty:	±2.81 dB

Note: Limit is based on 20dB down from fundamental emissions



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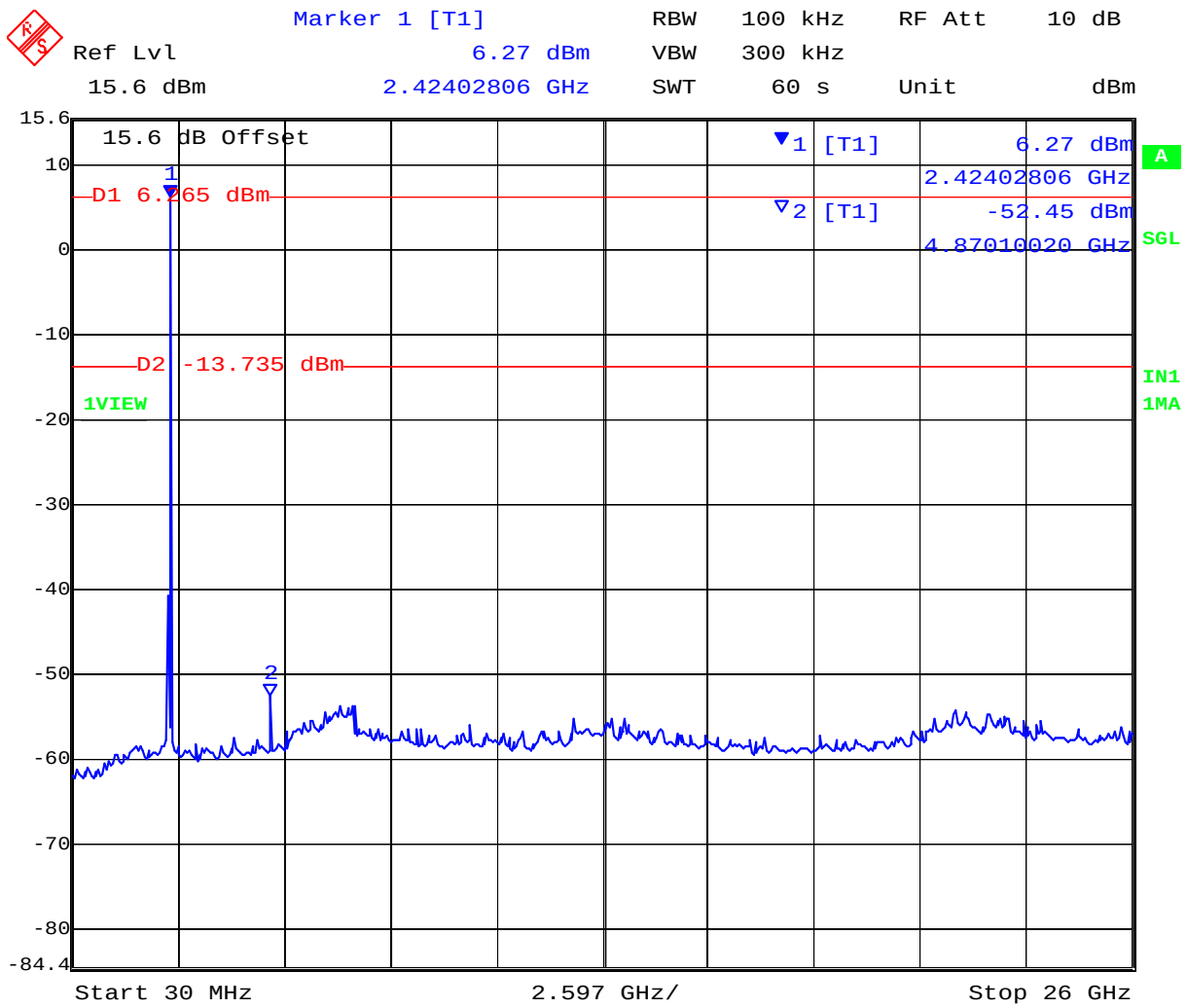

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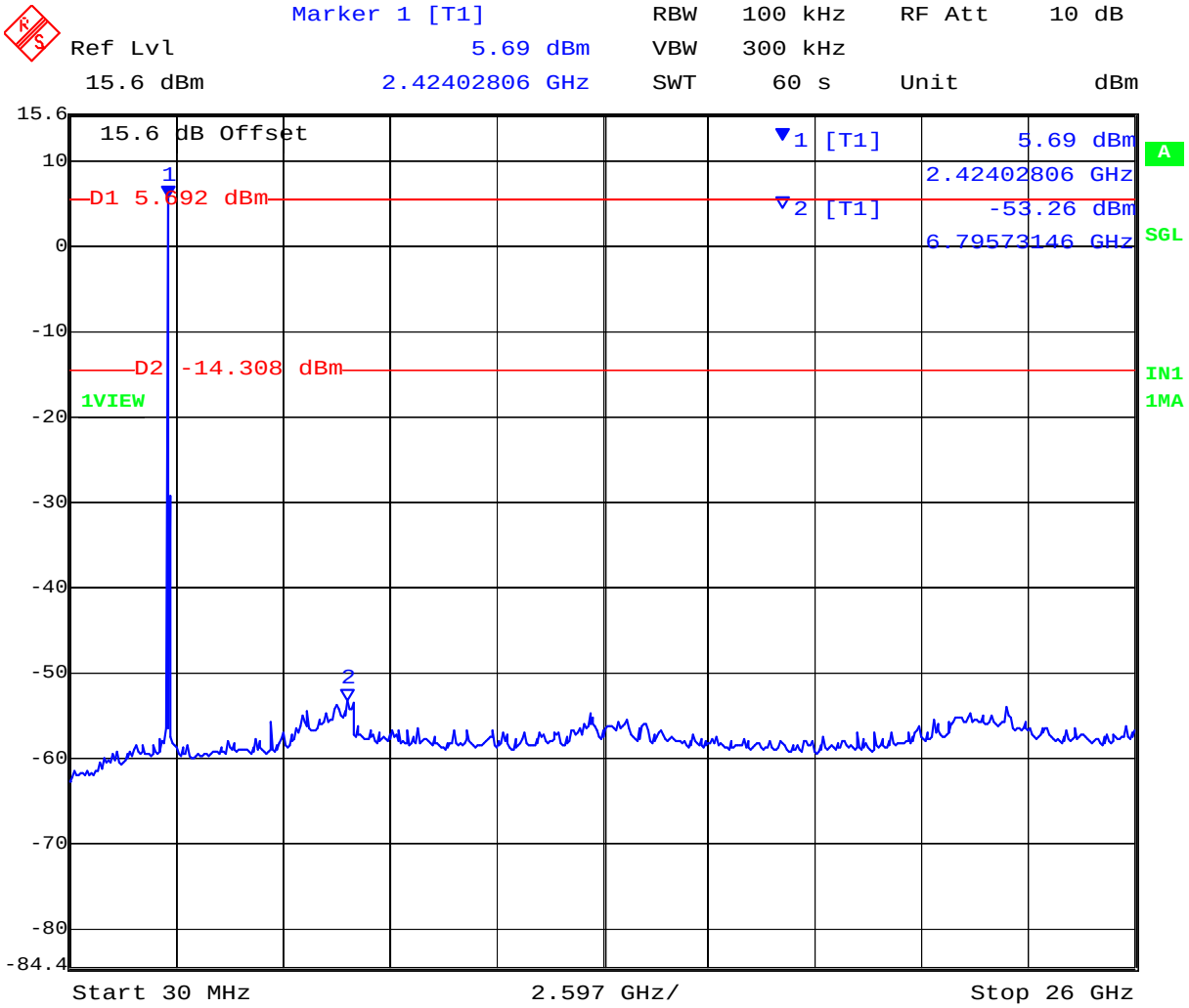

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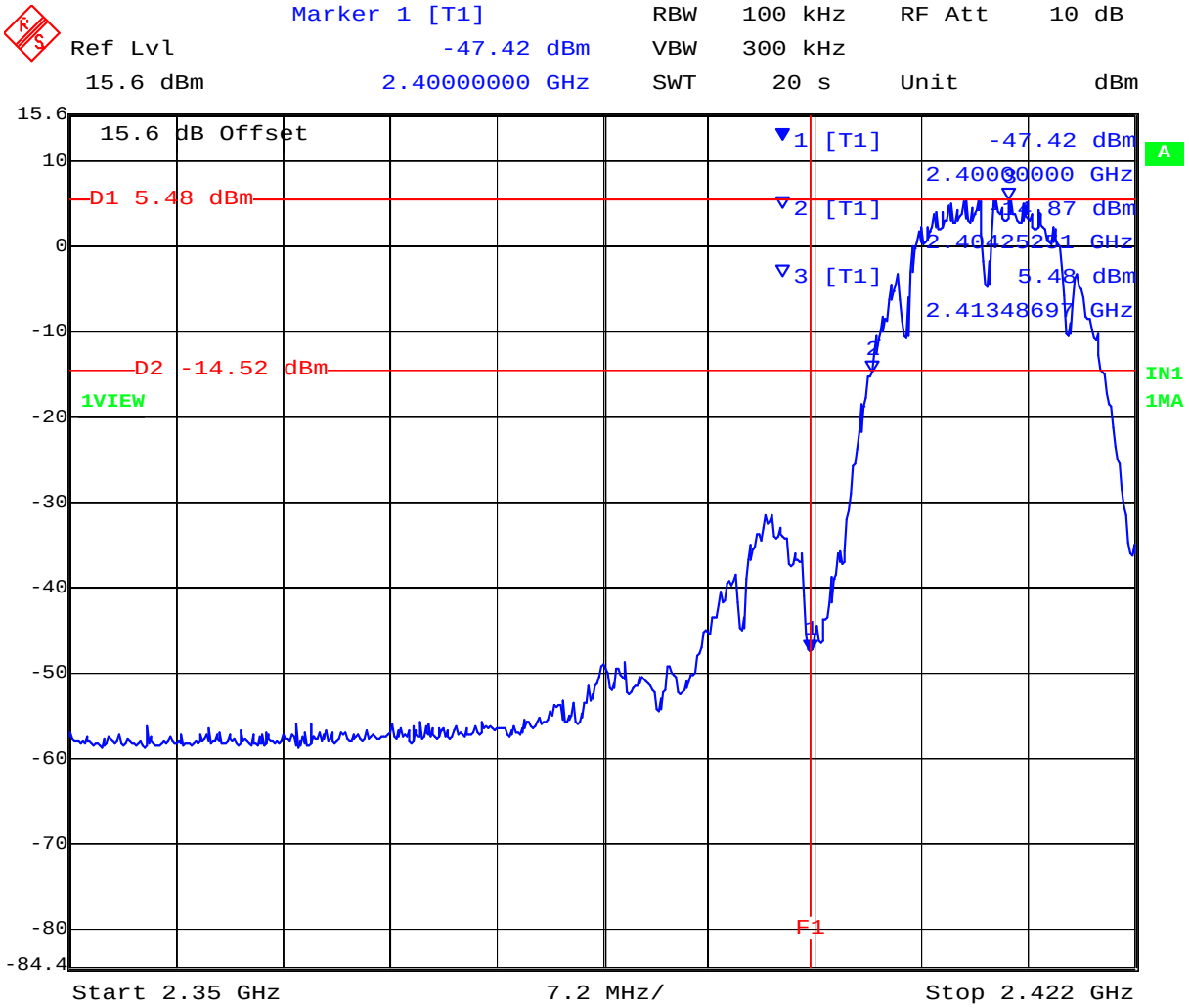

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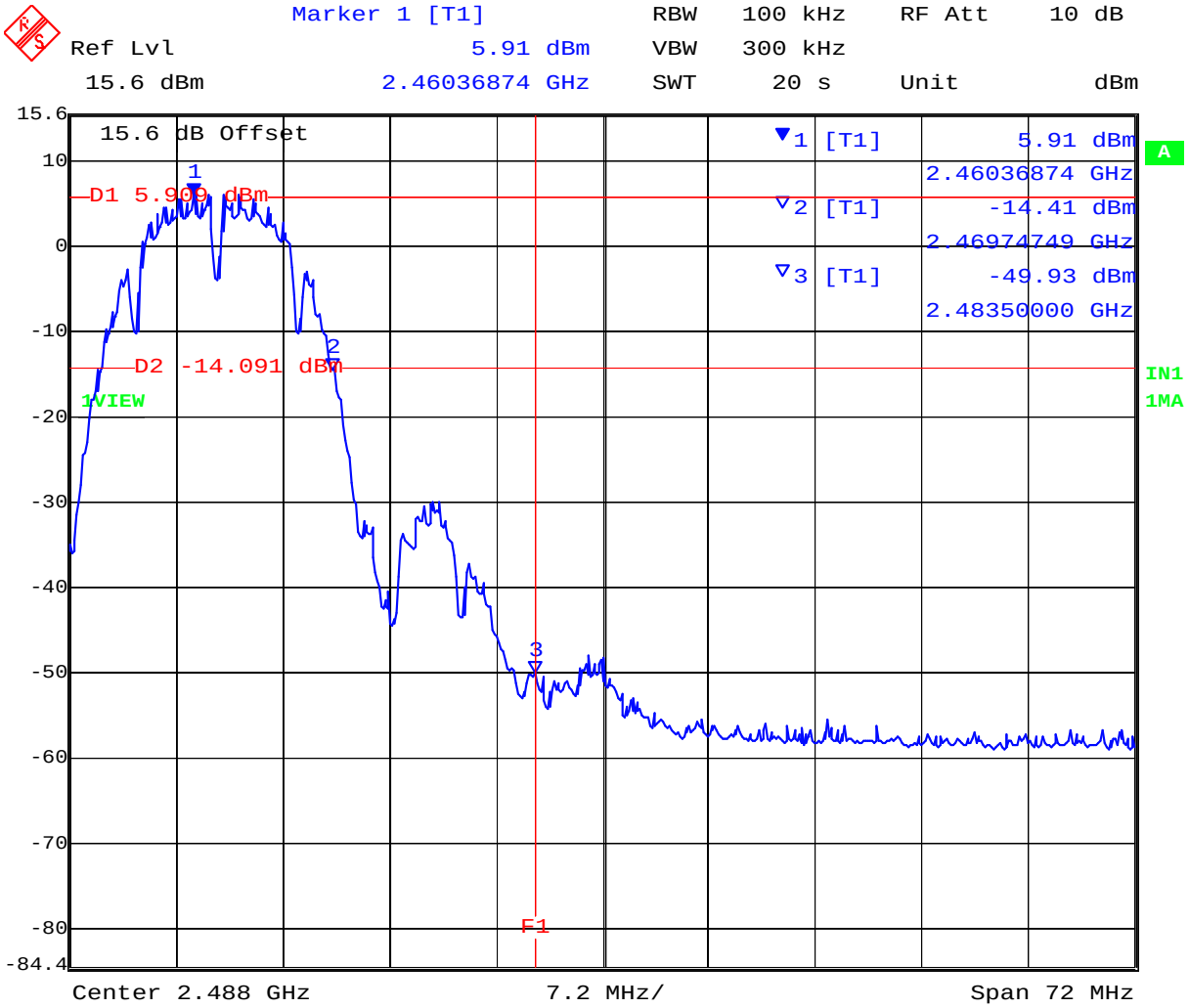


Date: 17.NOV.2011 14:36:41

7.5.2 Measurement Results for 802.11g

Test Conditions:	15.247 (a)(2)		**Rel. Humidity (%):**	35	to	42
Variant:	802.11g		**Ambient Temp. (ºC):**	19	to	22
TPC:	HIGH		**Pressure (mBars):**	998	to	1003
Modulation:	ON		**Duty Cycle (%):**	100		
Beam Forming Gain	N/A	dB	**Antenna Gain:**	N/A	dBi	
Applied Voltage:	3.30	Vdc	**Antenna Ports (N):**			
Notes 1:						
Notes 2:						

Conducted Spurious Measurement

Test Freq.	Start Freq.	Stop Freq.	Port A		Port B		Port C		Port D	
MHz	MHz	MHz	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm
2412.000	30.00	26000.00	-53.30	-20.06						
2437.000	30.00	26000.00	-52.66	-19.06						
2462.000	30.00	26000.00	-53.82	-20.92						

SE: Maximum spurious emsission found

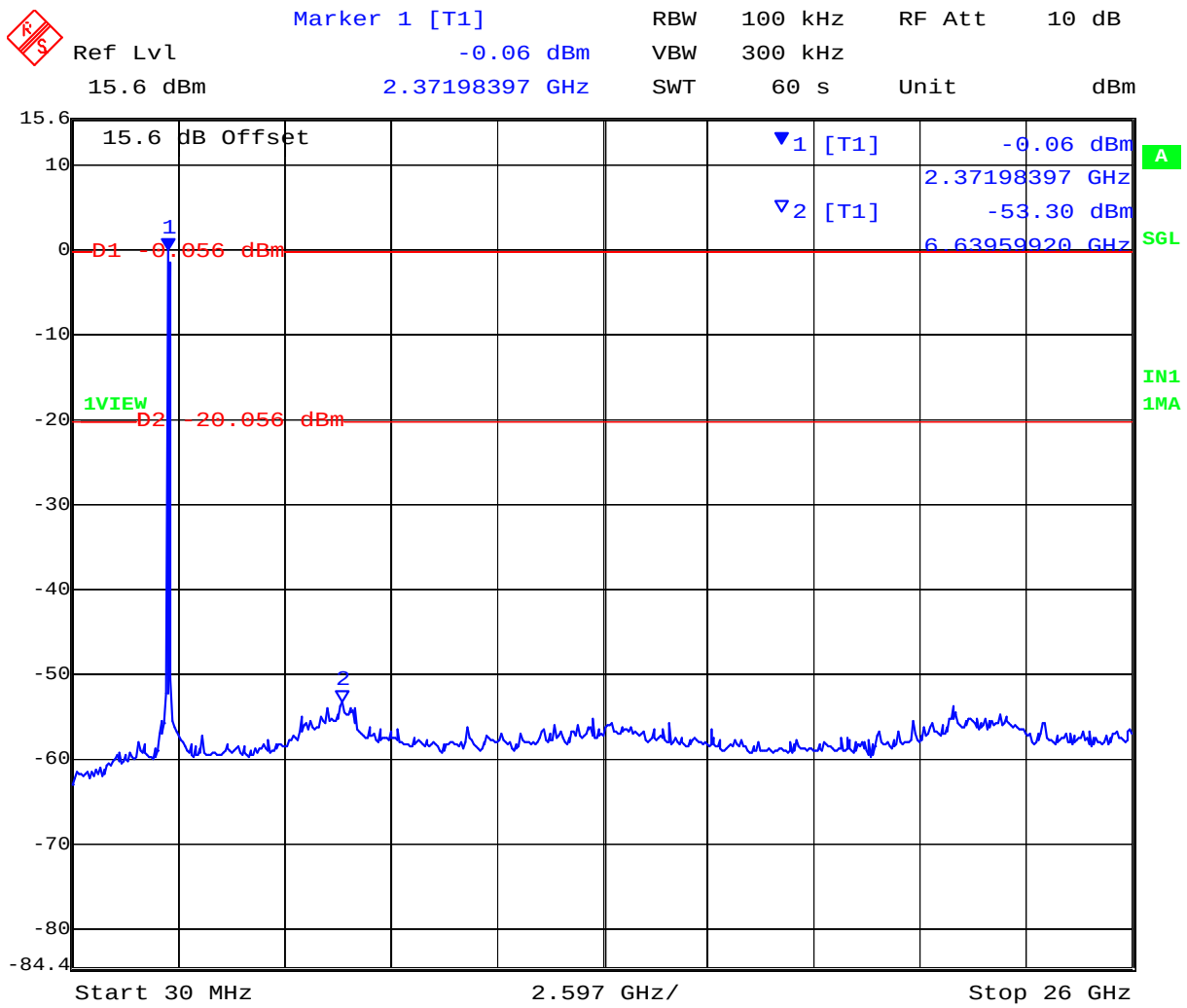
Band-edge Measurement

Test Freq.	Band-edge freq.	Port A		Port B		Port C		Port D	
MHz	MHz	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm
2412.000	2400.00	-31.62	-17.91						
2462.000	2483.50	-42.76	-17.66						

BE: Maximum Band edge emssion found

Measurement uncertainty:	±2.81 dB

Note: Limit is based on 20dB down from fundamental emissions



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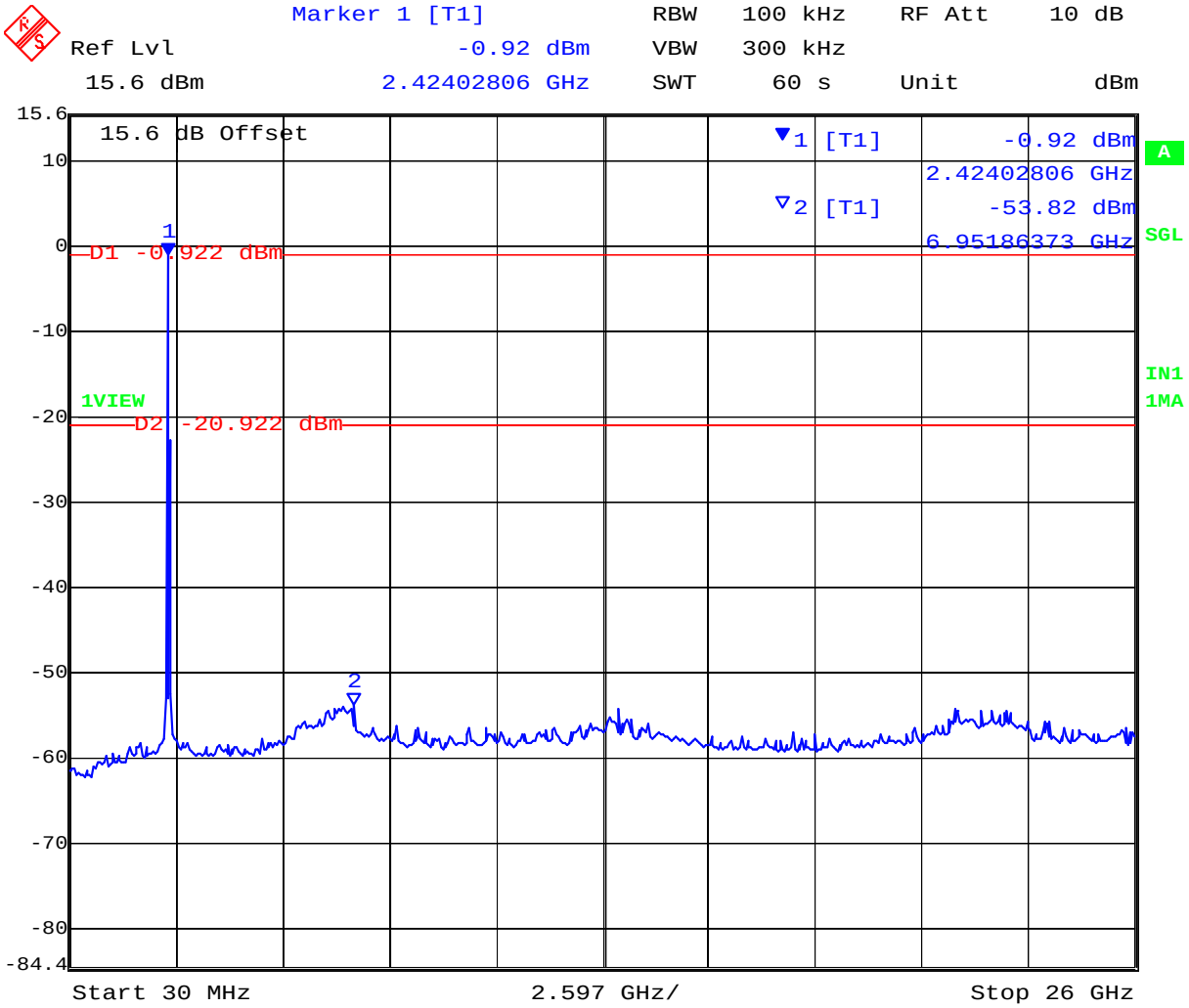

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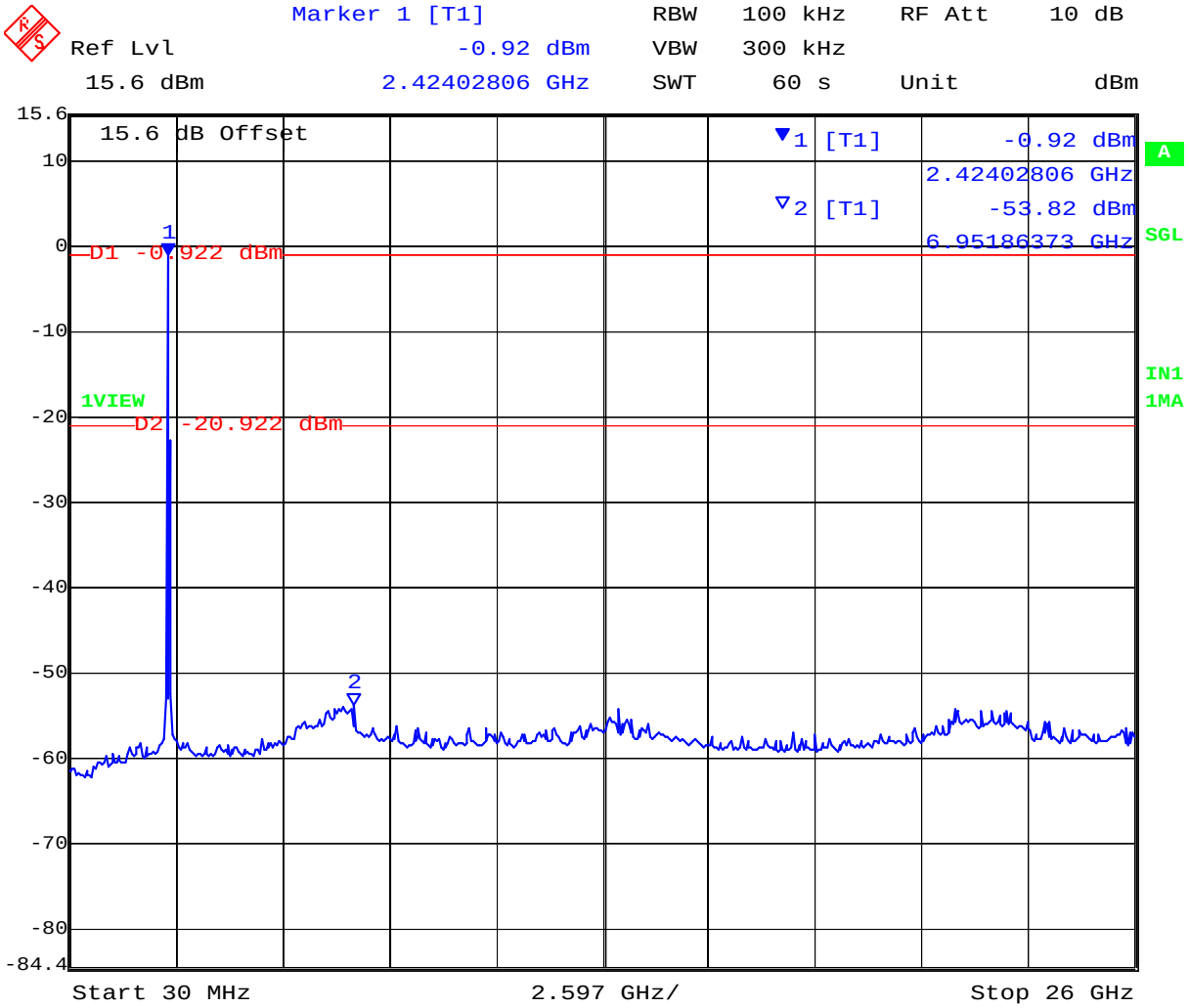

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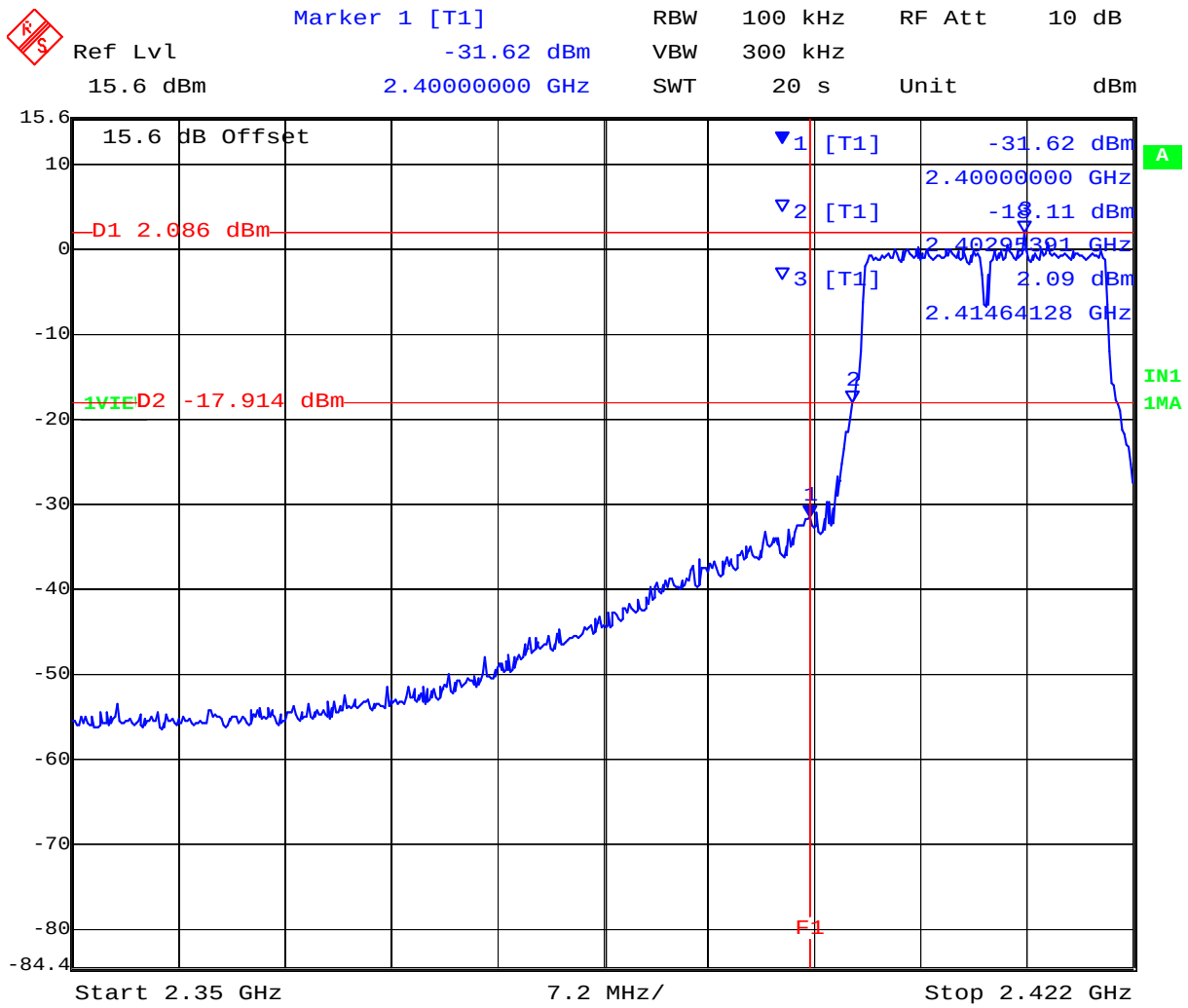

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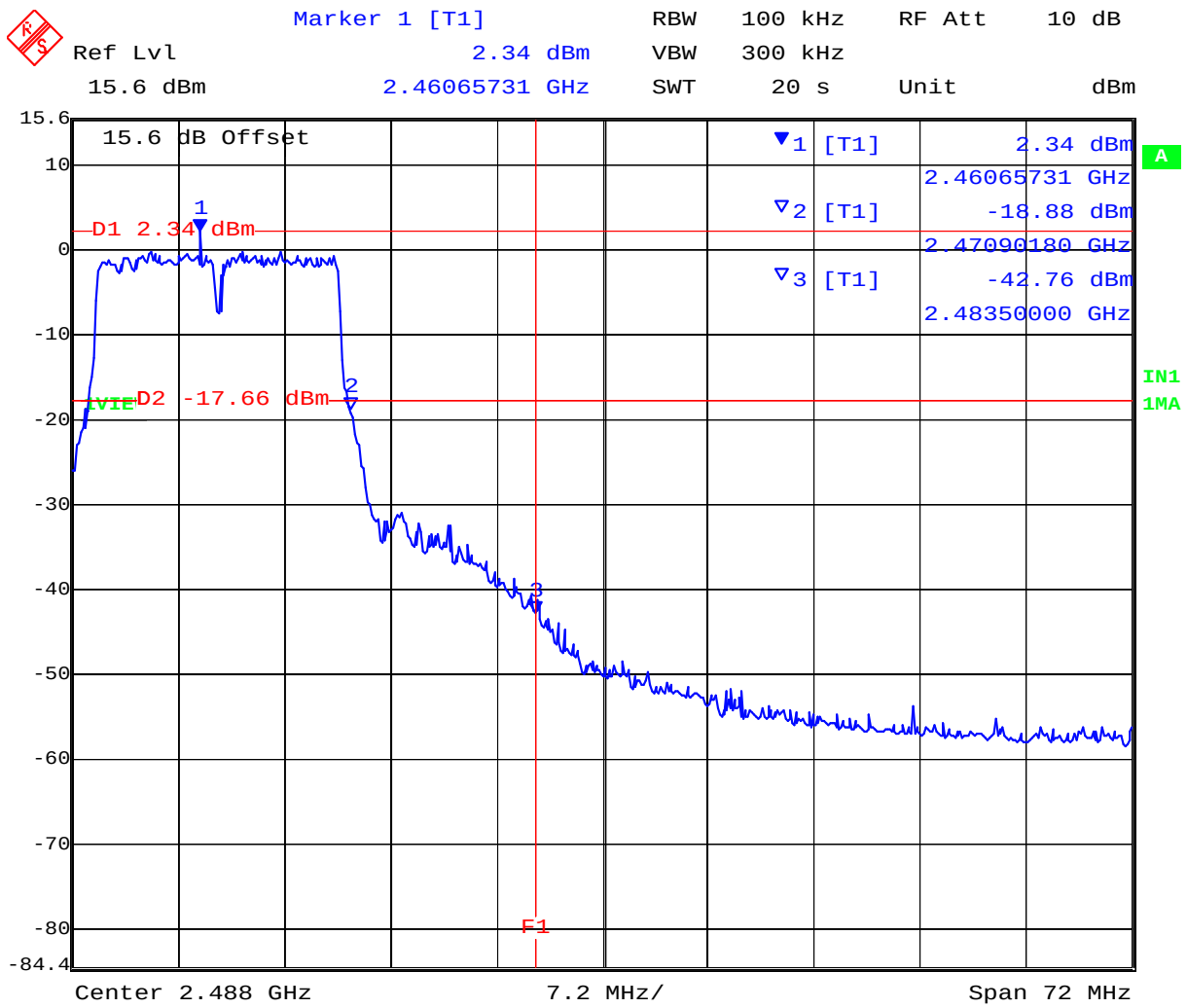


Date: 17.NOV.2011 15:14:51

7.5.3 Measurement Results for 802.11n HT-20

Test Conditions:	15.247 (a)(2)		**Rel. Humidity (%):**	35 to 42	
Variant:	802.11n HT-20		**Ambient Temp. (ºC):**	19 to 22	
TPC:	HIGH		**Pressure (mBars):**	998 to 1003	
Modulation:	ON		**Duty Cycle (%):**	100	
Beam Forming Gain	N/A	dB	**Antenna Gain:**	N/A	dBi
Applied Voltage:	3.30	Vdc	**Antenna Ports (N):**		
Notes 1:					
Notes 2:					

Conducted Spurious Measurement

Test Freq.	Start Freq.	Stop Freq.	Port A		Port B		Port C		Port D	
MHz	MHz	MHz	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm
2412.000	30.00	26000.00	-54.02	-20.61						
2437.000	30.00	26000.00	-52.99	-20.71						
2462.000	30.00	26000.00	-52.37	-21.83						

SE: Maximum spurious emsission found

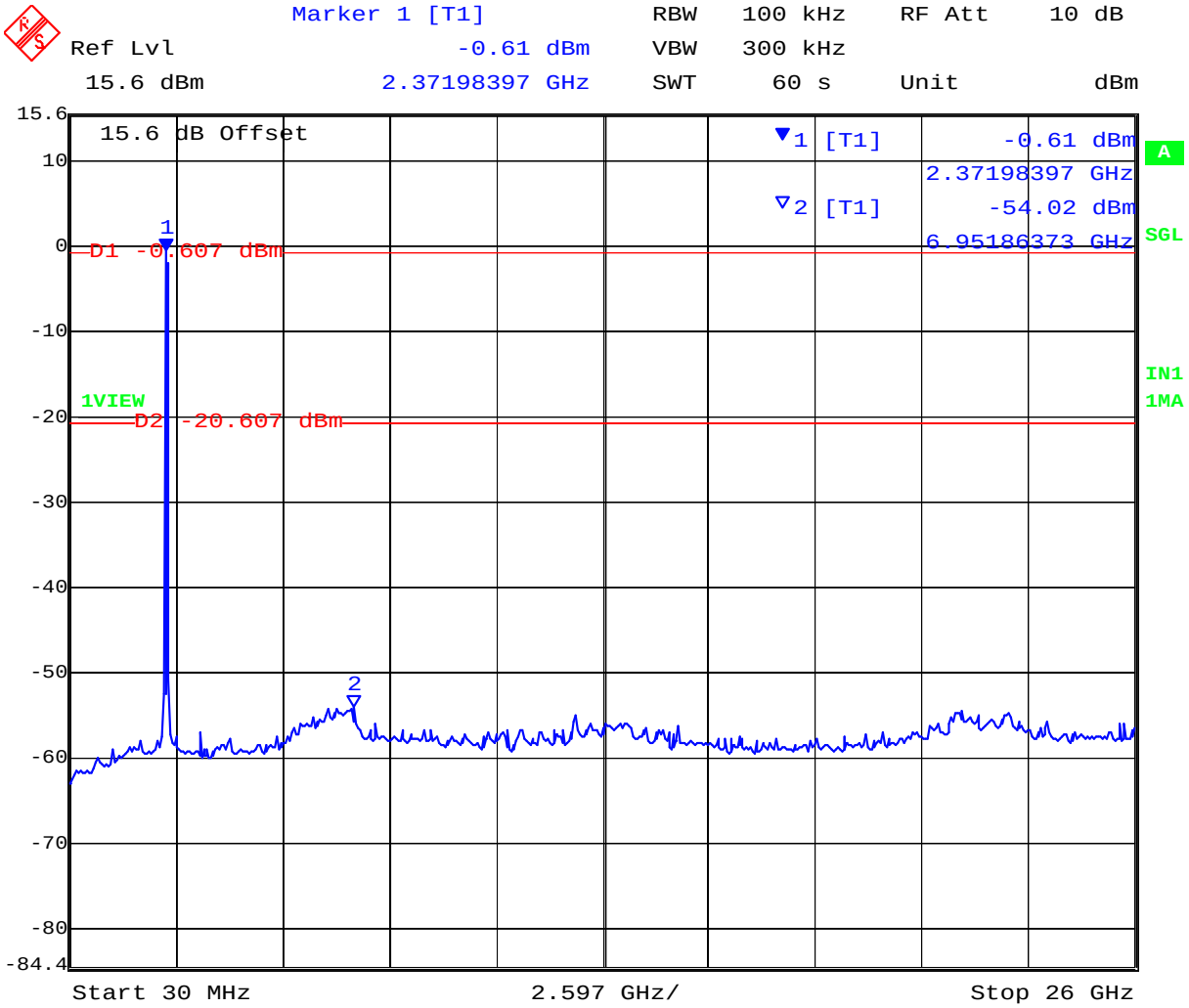
Band-edge Measurement

Test Freq.	Band-edge freq.	Port A		Port B		Port C		Port D	
MHz	MHz	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm
2412.000	2400.00	-35.93	-20.40						
2462.000	2483.50	-41.98	-21.38						

BE: Maximum Band edge emssion found

Measurement uncertainty:	±2.81 dB

Note: Limit is based on 20dB down from fundamental emissions



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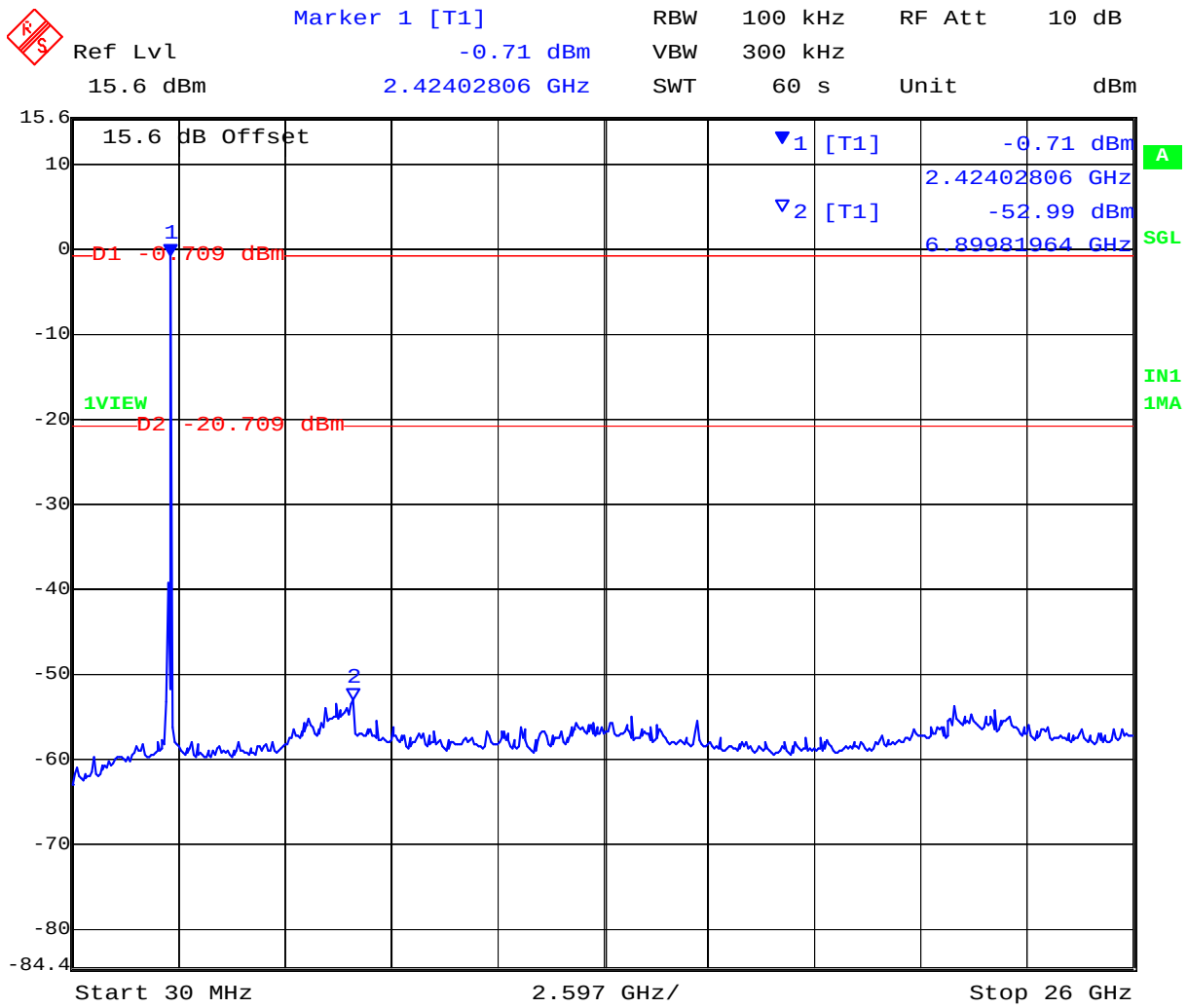

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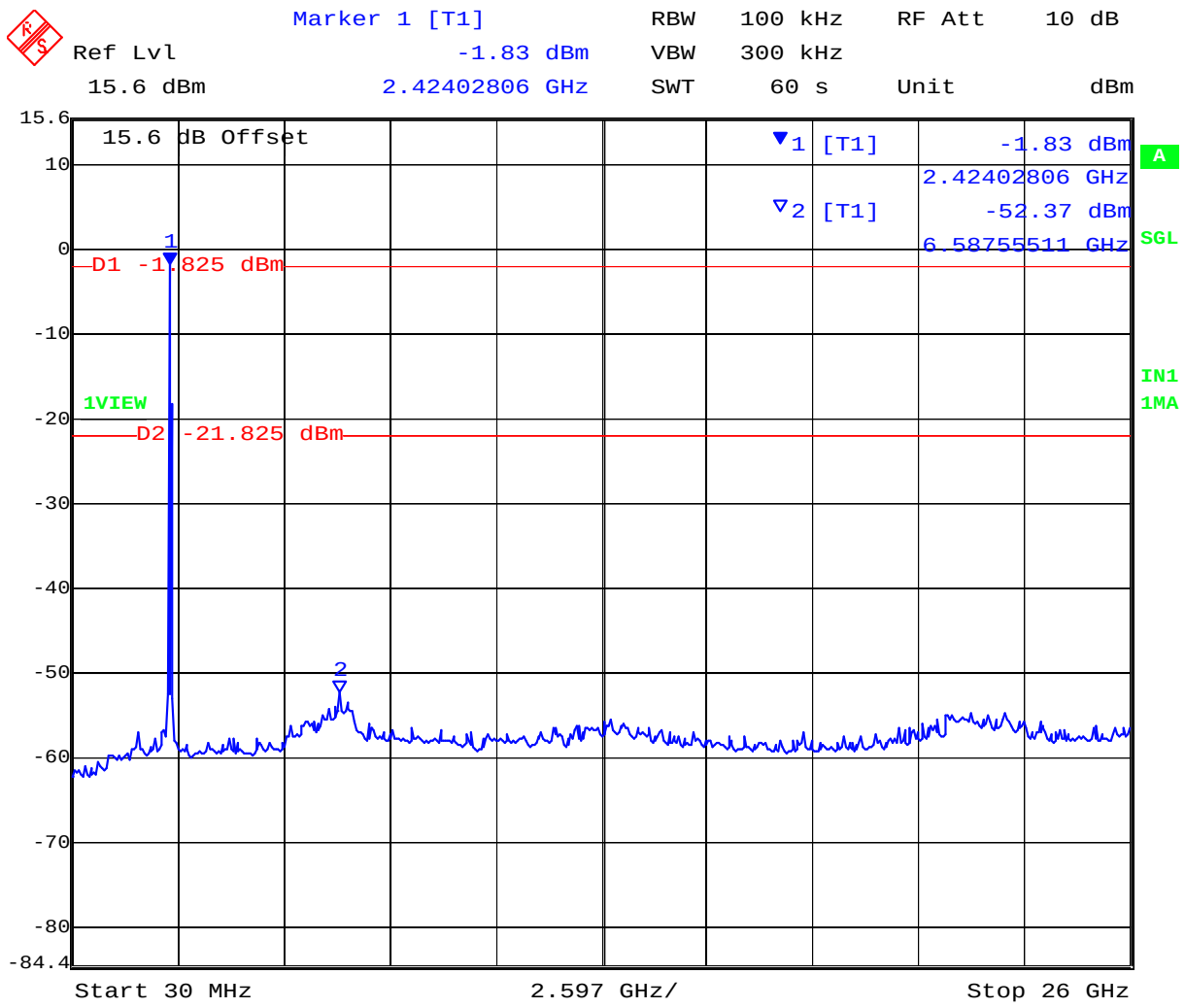

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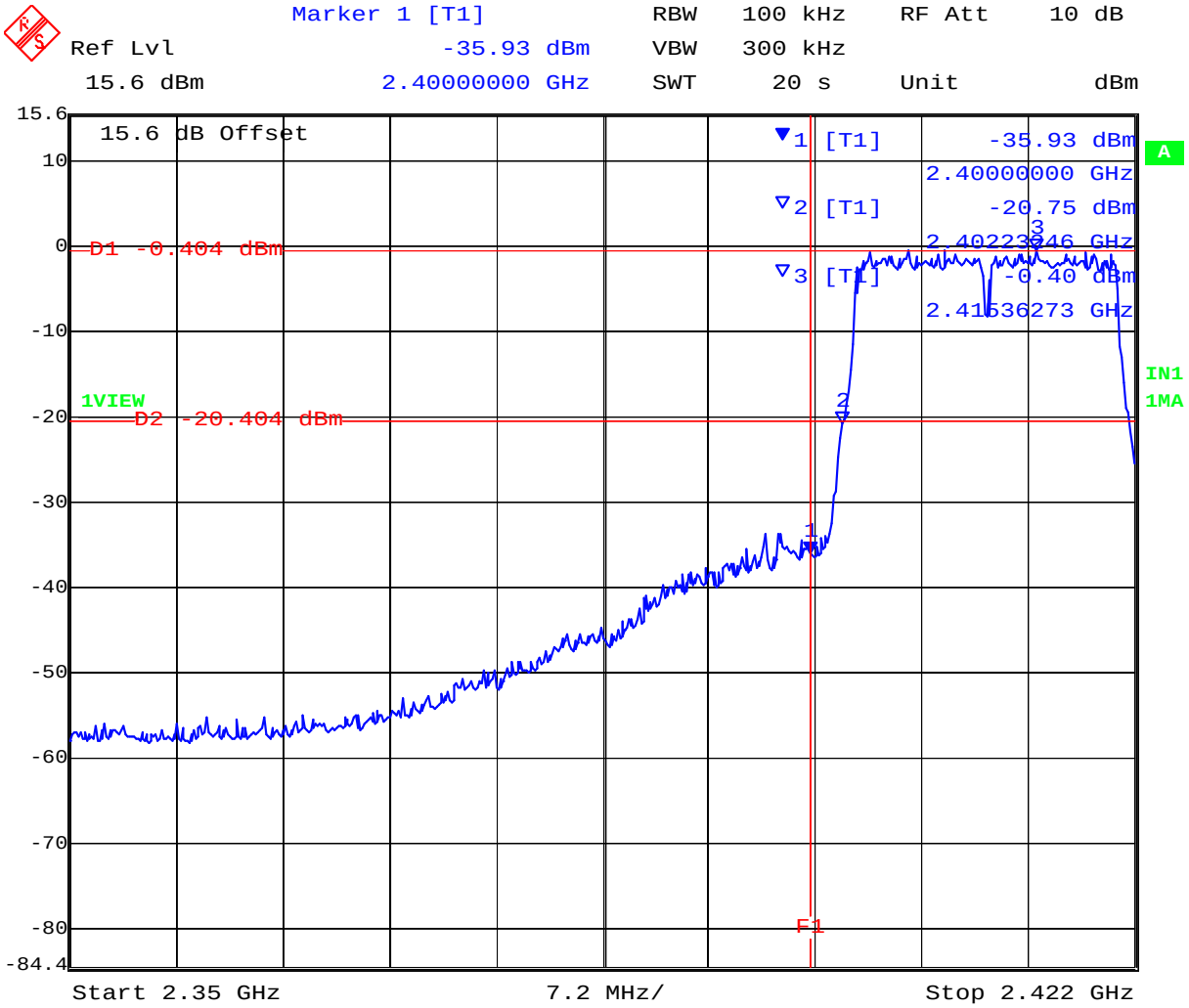

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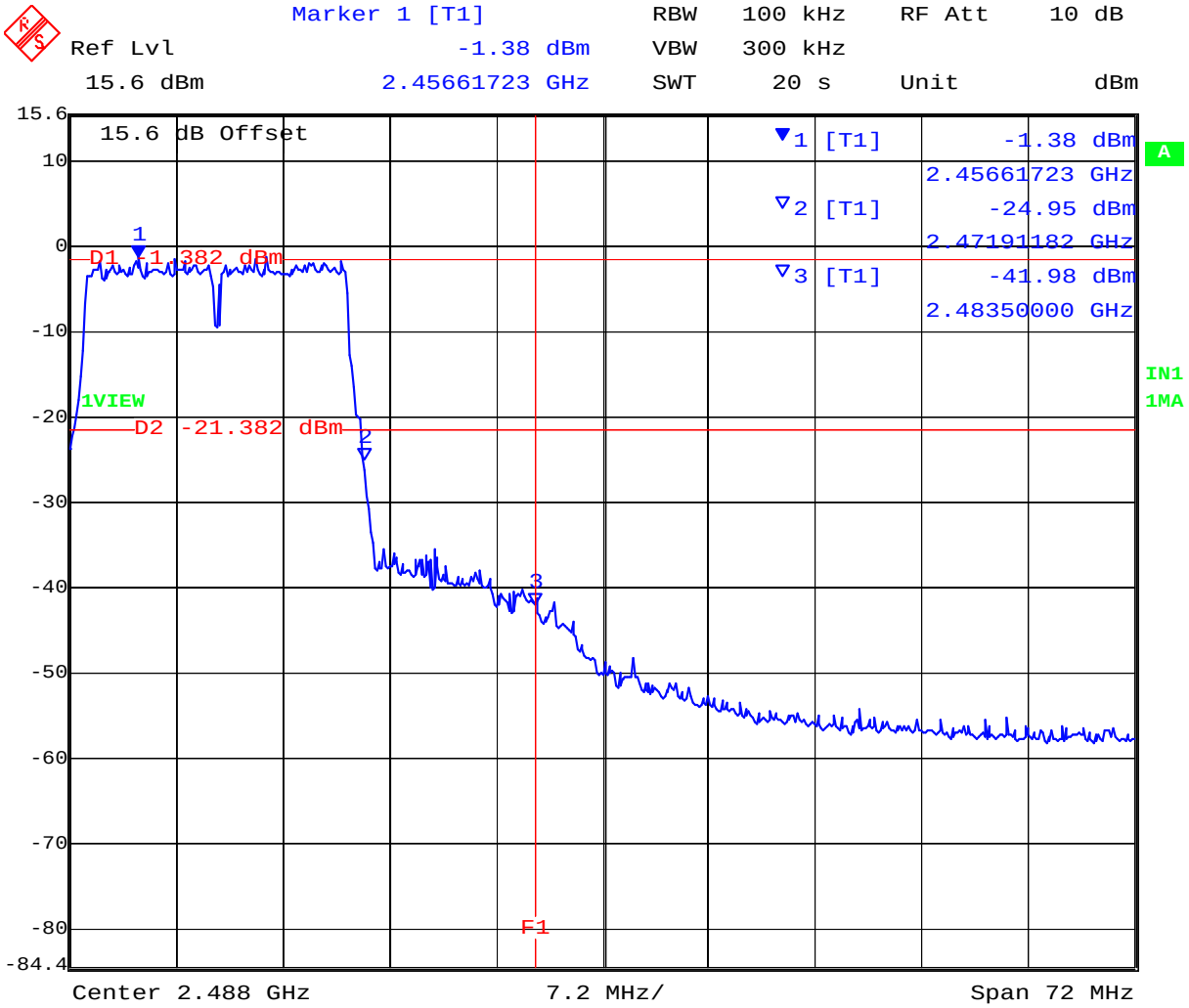


Date: 17.NOV.2011 16:00:35

7.5.4 Measurement Results for 802.11n HT-40

Test Conditions:	15.247 (a)(2)		**Rel. Humidity (%):**	35 to 42	
Variant:	802.11n HT-40		**Ambient Temp. (ºC):**	19 to 22	
TPC:	HIGH		**Pressure (mBars):**	998 to 1003	
Modulation:	ON		**Duty Cycle (%):**	100	
Beam Forming Gain	N/A	dB	**Antenna Gain:**	N/A	dBi
Applied Voltage:	3.30	Vdc	**Antenna Ports (N):**		
Notes 1:					
Notes 2:					

Conducted Spurious Measurement

Test Freq.	Start Freq.	Stop Freq.	Port A		Port B		Port C		Port D	
MHz	MHz	MHz	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm
2422.000	30.00	26000.00	-53.31	-25.73						
2437.000	30.00	26000.00	-53.88	-25.90						
2452.000	30.00	26000.00	-52.92	-26.97						

SE: Maximum spurious emsission found

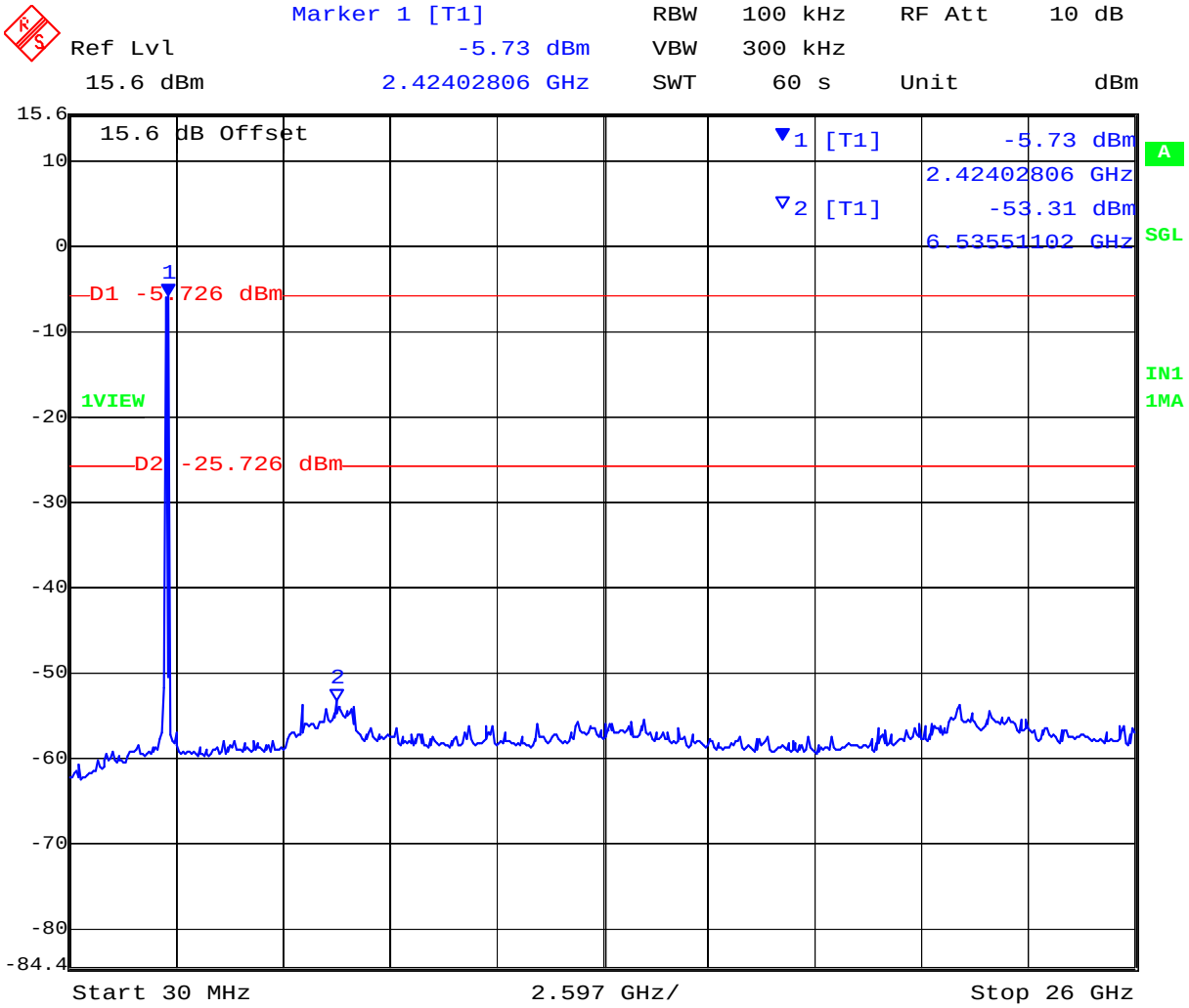
Band-edge Measurement

Test Freq.	Band-edge freq.	Port A		Port B		Port C		Port D	
MHz	MHz	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm
2422.000	2400.00	-39.28	-25.70						
2452.000	2483.50	-44.33	-25.47						

BE: Maximum Band edge emssion found

Measurement uncertainty:	±2.81 dB

Note: Limit is based on 20dB down from fundamental emissions



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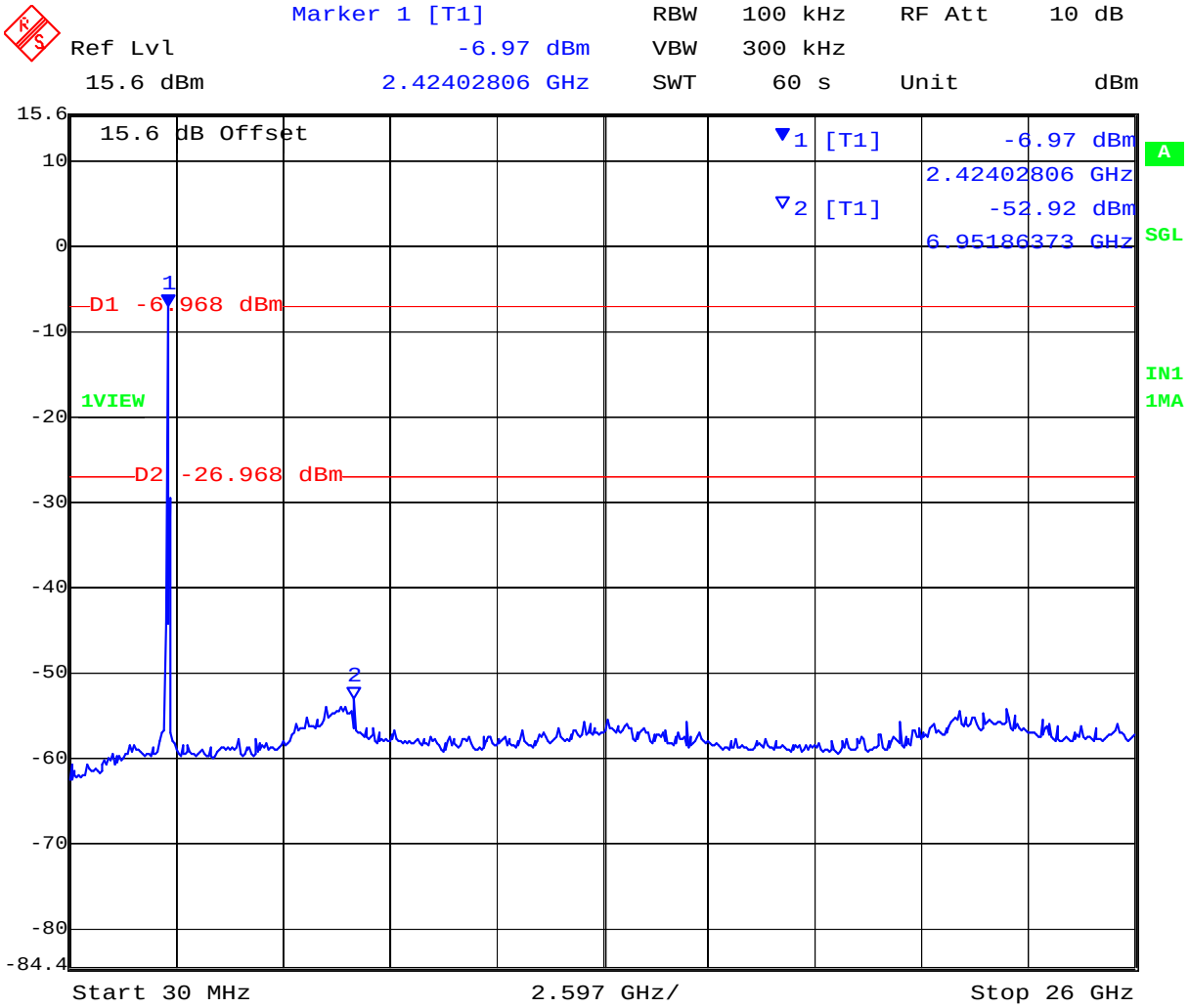

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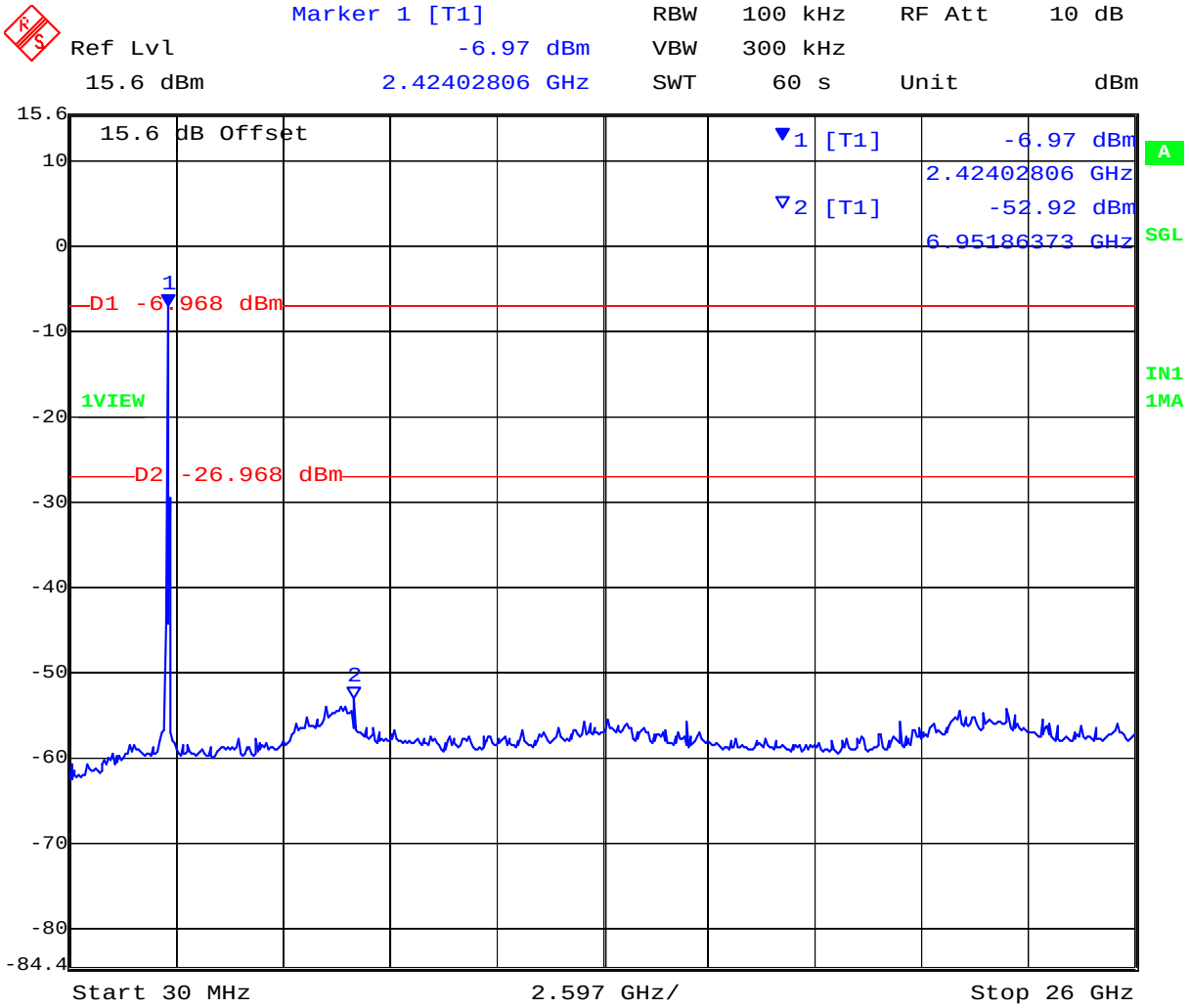

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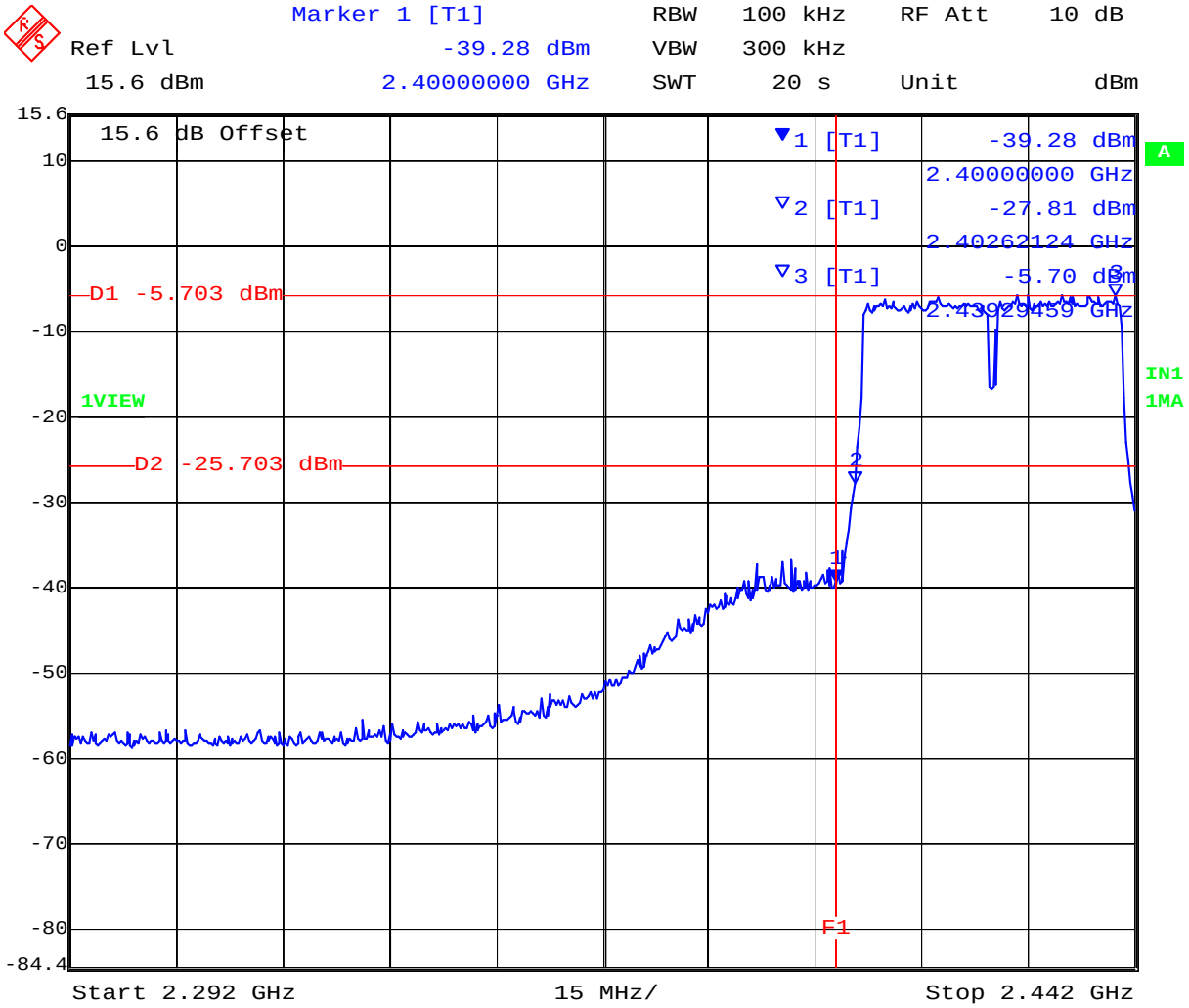

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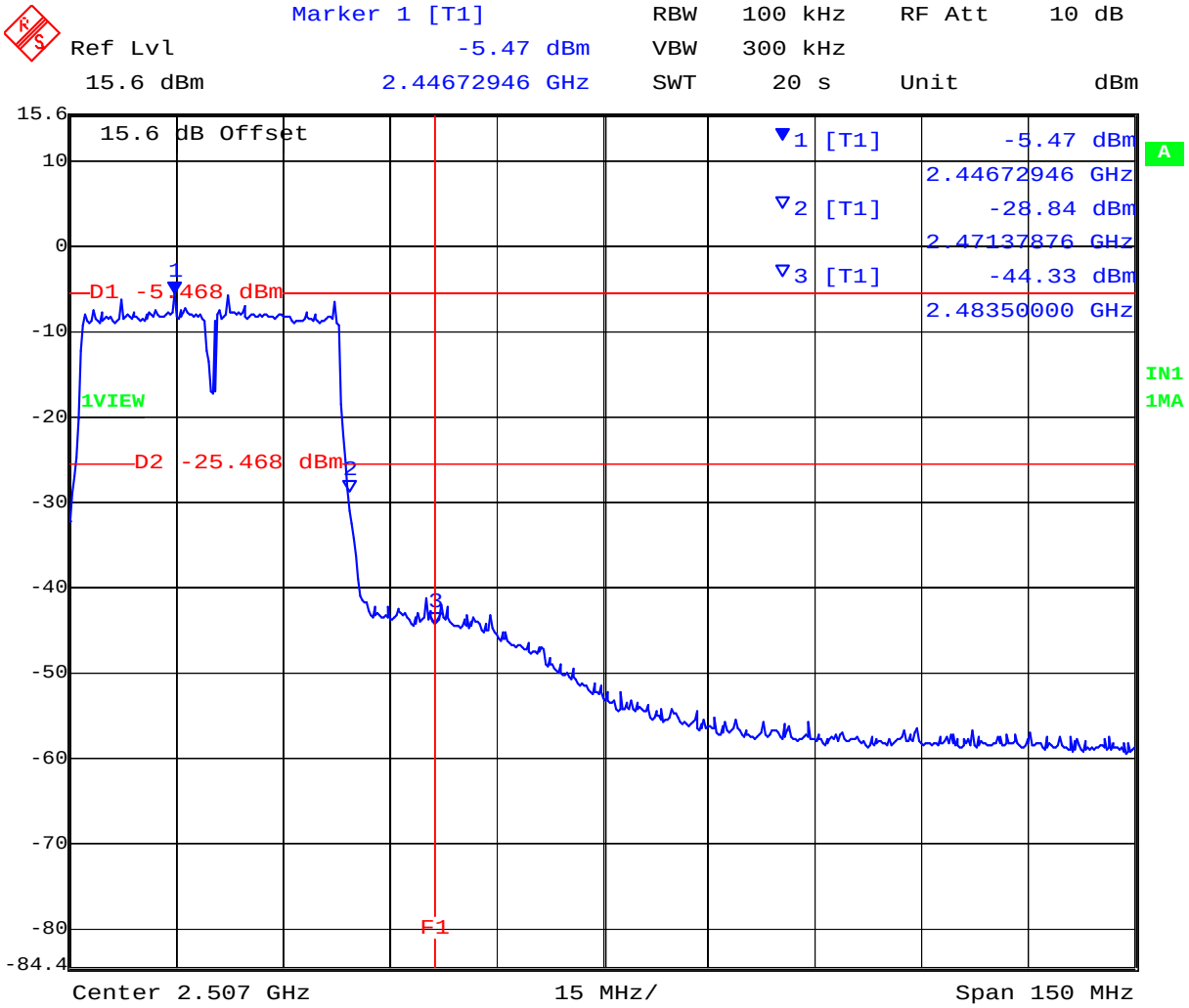


Date: 17.NOV.2011 16:35:07

7.6 Radiated Spurious Emissions

Test Procedure

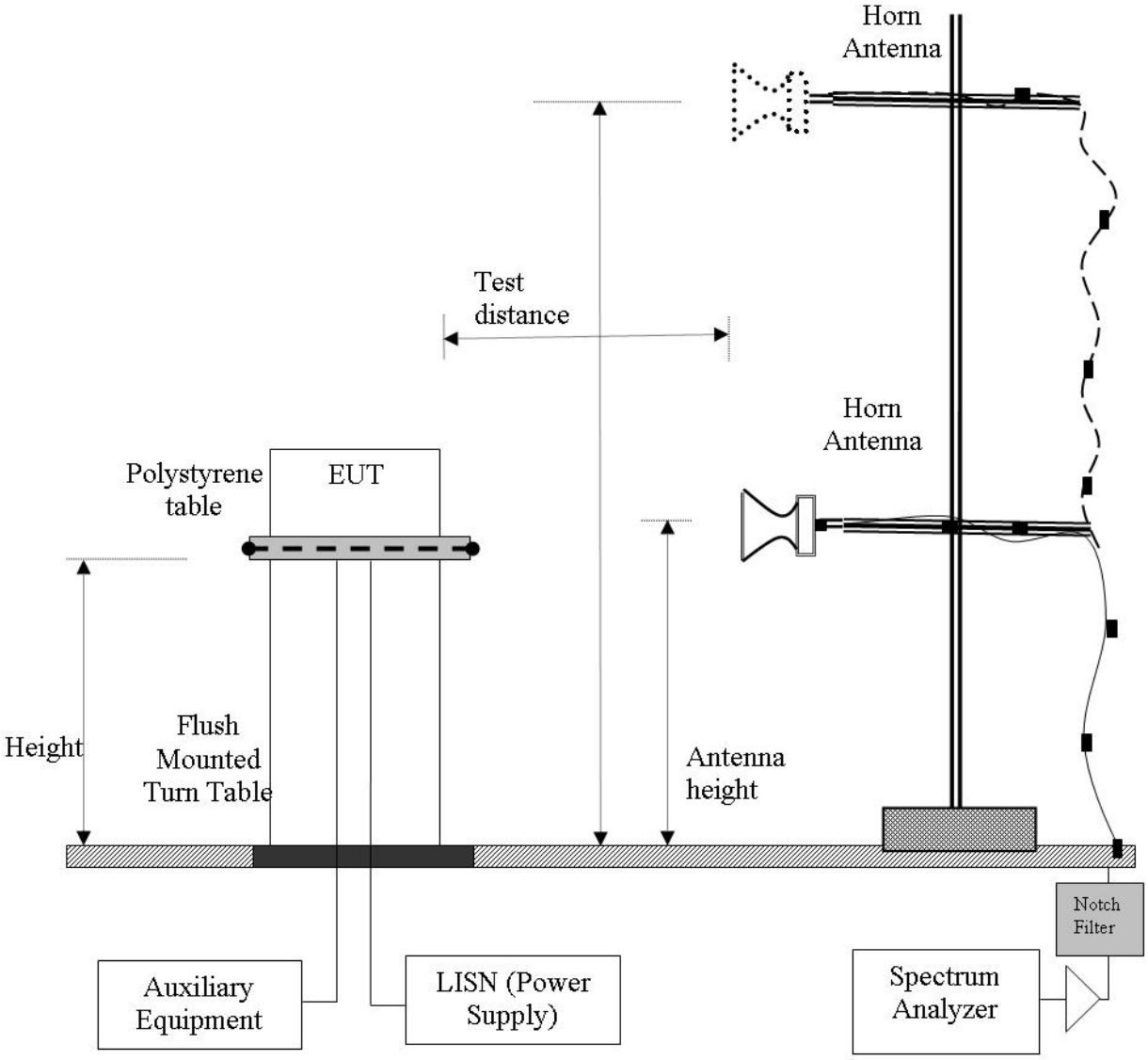
Testing was performed in a 3-meter anechoic chamber. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. Preliminary emissions were recorded with in Spectrum Analyzer mode, using a maximum peak detector while in peak hold mode.

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

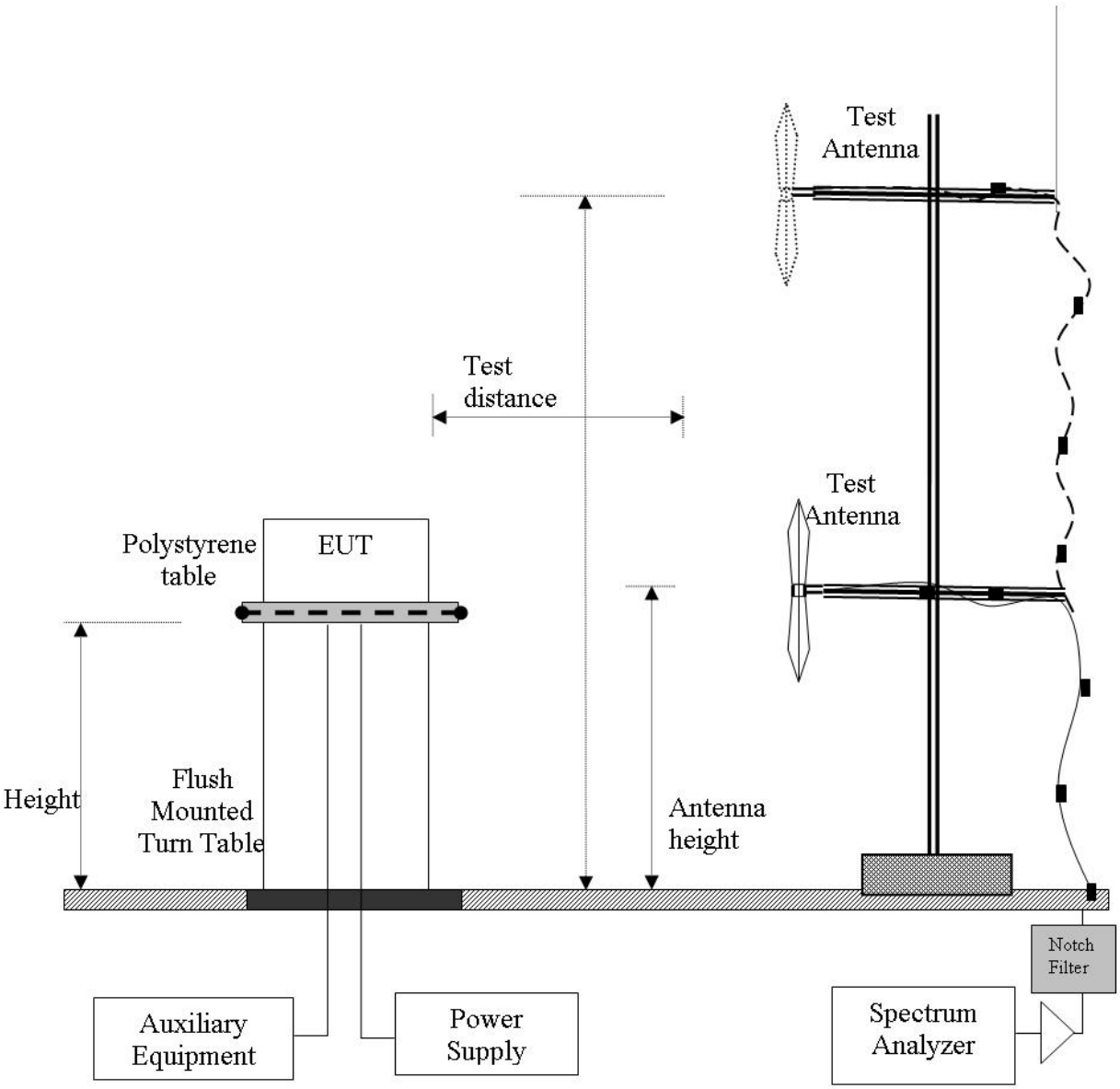
Only the highest emissions relative to the limit are listed.

To find out which was the worst case EUT position the EUT was placed horizontal and vertical on the test table top. Worst case was found to be vertical placement on the table top. The horizontal plot emissions are kept on file by the lab.

Radiated Emission Measurement Setup – Above 1 GHz



Radiated Emission Measurement Setup – Below 1 GHz



Field Strength Calculation

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

FS = R + AF + CORR – FO

FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

Field Strength Calculation Example:

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

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

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

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

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

Specification for FCC Part 15 Radiated Spurious Emissions

FCC §15.247(d) 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.

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)).

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.

Table 1: FCC 15.209 Spurious Emissions Limits

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Specification for Industry Canada RSS-210 Radiated Spurious Emissions

RSS-210 §2.1 RSS-Gen Compliance
In addition to RSS-210, the requirements in RSS-Gen, General Requirements and Information for the Certification of Radio Apparatus, must be met.

RSS-210 §2.2 Emissions Falling Within Restricted Frequency Bands
Category I license-exempt equipment is required to comply with the provisions in RSS-Gen with respect to emissions falling within restricted frequency bands. These restricted frequency bands are listed in RSS-Gen.

RSS-210 §2.3 Receivers
Category I equipment receivers for use with transmitters subject to RSS-210 must comply with the applicable requirements set out in RSS-Gen and be certified under RSS-210. Category II equipment receivers for use with transmitters subject to RSS-210 are exempt from certification, but are subject to compliance with RSS-Gen and RSS-310.

RSS-210 §2.5 General Field Strength Limits
RSS-Gen includes the general field strength limits of unwanted emissions, where applicable, for transmitters and receivers operating in accordance with the provisions specified in this standard.

Unwanted emissions of transmitters and receivers are permitted to fall within the restricted bands listed in RSS-Gen, and including the TV bands, but fundamental emissions are prohibited in the restricted bands.

Specification for Industry Canada RSS-Gen Radiated Transmitter Spurious Emissions

RSS-Gen §7.2.5 Transmitter Spurious Emissions Limits
Spurious emissions from license-exempt transmitters shall comply with the field strength limits shown below. Additionally, the level of any transmitter spurious emission shall not exceed the level of the transmitter's fundamental emission.

Table 1: RSS-Gen §7.2.5 Radiated Transmitter Spurious Emissions Lim its

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

Specification for Industry Canada RSS-Gen Radiated Receiver Spurious Emissions

RSS-Gen §6.1 Receiver Spurious Emissions Limits
Radiated spurious emission measurements shall be performed with the receiver antenna connected to the receiver antenna terminals.

Spurious emissions from receivers shall not exceed the radiated limits shown in the table below.

Table 1: RSS-Gen §6.1 Radiated Receiver Spurious Emissions Limits

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement Uncertainty	+5.6/ -4.5 dB

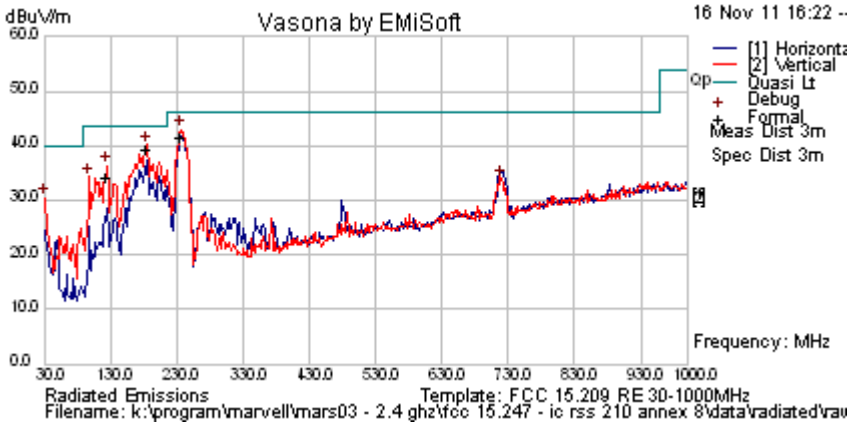
Traceability:

Method	Test Equipment Used
Work instruction WI-03	0287, 0193, 0342, 0158, 0303, 0304, 0134, 0310, 0312

7.6.1 Transmitter Radiated Spurious Emissions

All frequencies and modes were checked per 15.247 for radio emissions below 1GHz.

Test Freq.	N/A	**Engineer**	GMH
Variant	Digital Emissions	**Temp (ºC)**	24
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	32
Power Setting	N/A	**Press. (mBars)**	1007
Antenna	integral		
Test Notes 1			
Test Notes 2	Rx: Ch.		



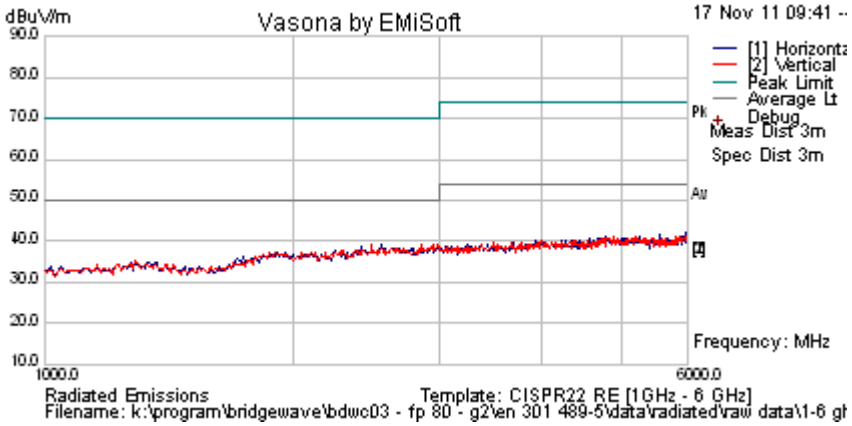
Formally measured emission peaks

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
236.132	55.4	4.9	-18.7	41.7	Quasi Max	V	98	115	46	-4.4	Pass	
184.556	54.3	4.7	-19.4	39.5	Quasi Max	V	104	99	43.5	-4.0	Pass	
123.900	46.9	4.3	-16.9	34.4	Quasi Max	V	98	76	43.5	-9.1	Pass	
30.121	36.3	3.4	-9.3	30.4	Peak [Scan]	H	98	0	40.0	-9.6	Pass	
720.431	36.6	6.8	-9.4	33.9	Peak [Scan]	V	98	0	46.0	-12.1	Pass	
98.072	51.6	4.1	-21.4	34.4	Peak [Scan]	H	98	0	43.5	-9.1	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

The above plot implements a peak detector showing both polarities.

Test Freq.	N/A	**Engineer**	GMH
Variant	Digital Emissions	**Temp (ºC)**	23
Freq. Range	1000 MHz - 6000 MHz	**Rel. Hum.(%)**	33
Power Setting	N/A	**Press. (mBars)**	1007
Antenna	integral		
Test Notes 1			
Test Notes 2			



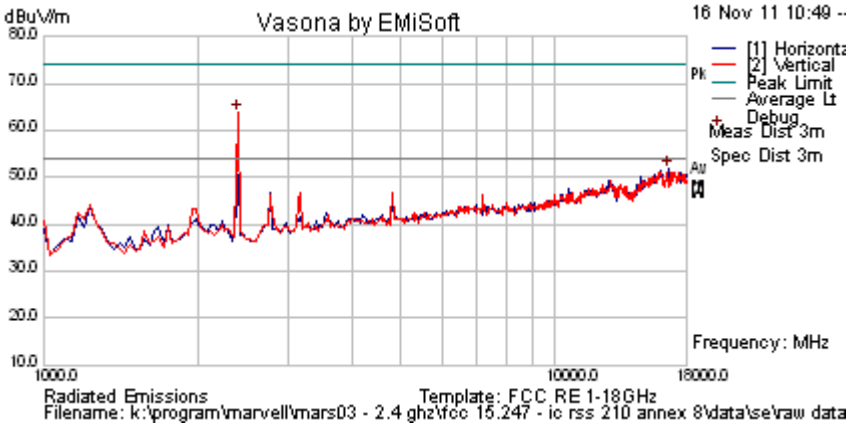
Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
0.000	0.0	0.0	0.0	0.0	Peak [Scan]		0	0	0.0	0.0	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

No emissions were found within 6 dB of the limit

Test Freq.	2412 MHz	**Engineer**	GMH
Variant	802.11b; 1 Mbs	**Temp (ºC)**	20.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	18	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



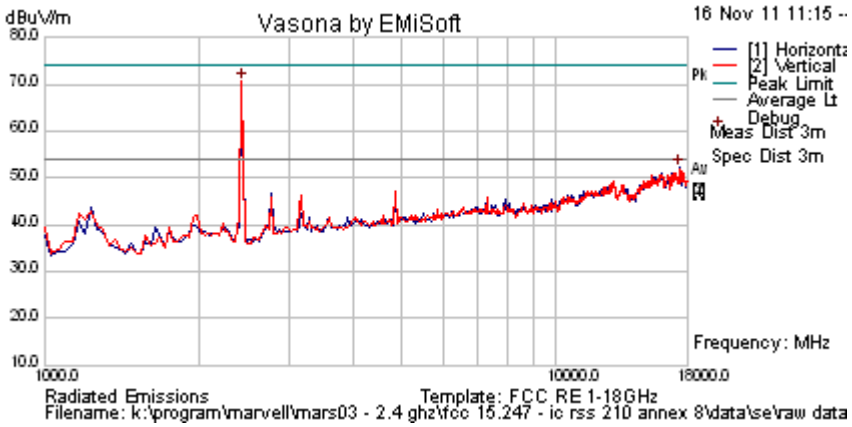
Formally measured emission peaks

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	72.5	3.0	-11.6	63.8	Peak [Scan]	V						FUND
16569.138	42.5	8.8	0.4	51.7	Peak [Scan]	H	150	0	54.0	-2.3	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

The above plot implements a peak detector showing both polarities. The emission breaking the limit line is the fundamental frequency.

Test Freq.	2437 MHz	**Engineer**	GMH
Variant	802.11b; 1 Mbs	**Temp (ºC)**	20.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	18	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



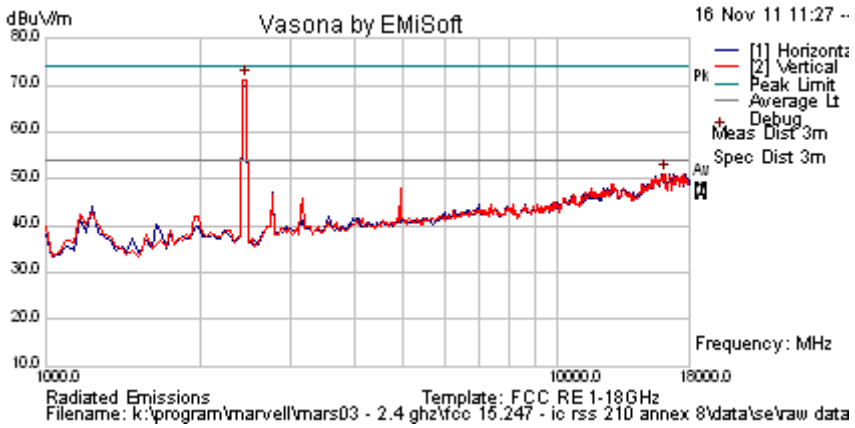
Formally measured emission peaks

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	79.3	3.0	-11.6	70.7	Peak [Scan]	V						FUND
17386.774	41.7	8.7	1.7	52.1	Peak [Scan]	H	100	0	54.0	-1.9	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

The above plot implements a peak detector showing both polarities. The emission closest to the limit line is the fundamental frequency.

Test Freq.	2462 MHz	**Engineer**	GMH
Variant	802.11b; 1 Mbs	**Temp (ºC)**	20.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	18	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



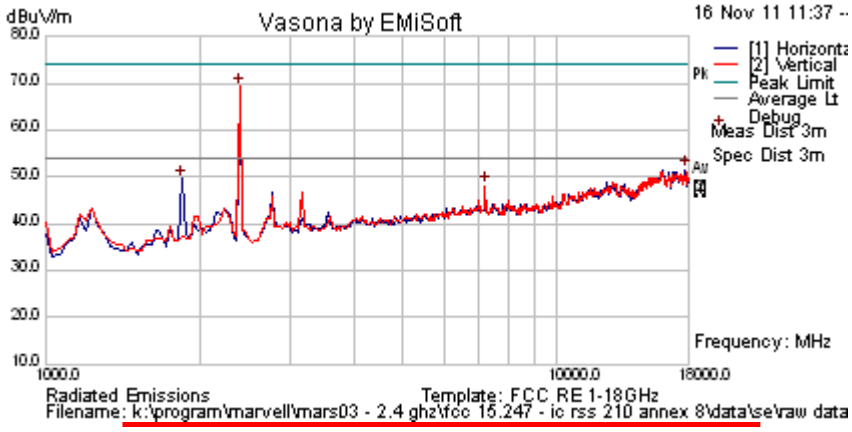
Formally measured emission peaks

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	79.9	3.0	-11.6	71.4	Peak [Scan]	V						FUND
16126.253	41.8	9.0	0.3	51.0	Peak [Scan]	V	150	0	54.0	-3.0	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

The above plot implements a peak detector showing both polarities. The emission closest to the limit line is the fundamental frequency.

Test Freq.	2412 MHz	**Engineer**	GMH
Variant	802.11g; 6 Mbs	**Temp (ºC)**	20.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	16	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



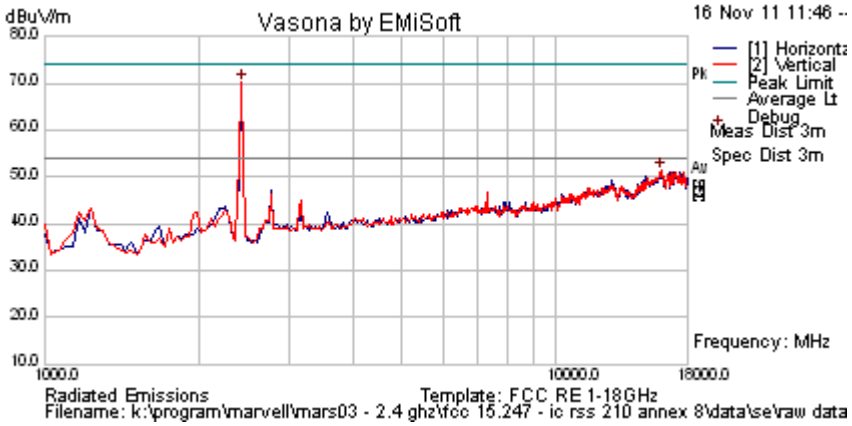
Formally measured emission peaks

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	77.9	3.0	-11.6	69.3	Peak [Scan]	V						FUND
17761.523	42.4	8.8	0.4	51.5	Peak [Scan]	H	200	0	54.0	-2.5	Pass	
1851.703	59.7	2.7	-12.8	49.5	Peak [Scan]	H	200	0	54	-4.5	Pass	
7234.469	48.3	5.4	-5.6	48.1	Peak [Scan]	V	100	0	54	-5.9	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

The above plot implements a peak detector showing both polarities. The emission closest to the limit line is the fundamental frequency.

Test Freq.	2437 MHz	**Engineer**	GMH
Variant	802.11g; 6 Mbs	**Temp (ºC)**	20.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	16	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



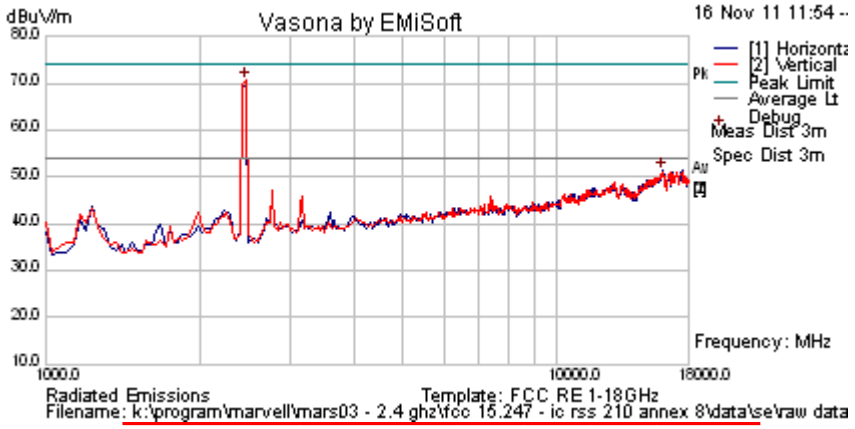
Formally measured emission peaks

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	78.7	3.0	-11.6	70.1	Peak [Scan]	V						FUND
15989.98	42.2	9.0	0.2	51.4	Peak [Scan]	V	100	0	54.0	-2.6	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

The above plot implements a peak detector showing both polarities. The emission breaking the limit line is the fundamental frequency.

Test Freq.	2462 MHz	**Engineer**	GMH
Variant	802.11g; 6 Mbs	**Temp (ºC)**	20.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	16	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



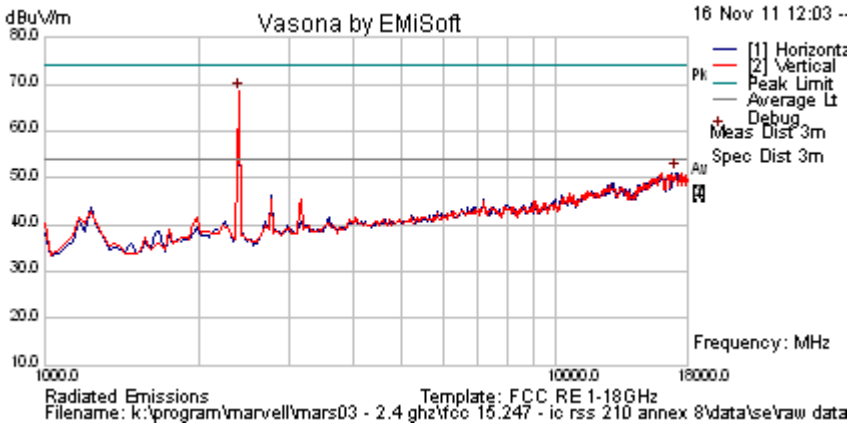
Formally measured emission peaks

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	79.1	3.0	-11.6	70.5	Peak [Scan]	V						FUND
16024.048	41.9	9.0	0.4	51.3	Peak [Scan]	H	150	0	54.0	-2.7	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

The above plot implements a peak detector showing both polarities. The emission breaking the limit line is the fundamental frequency.

Test Freq.	2412 MHz	**Engineer**	GMH
Variant	802.11n; HT-20; 6.5 MCS	**Temp (ºC)**	21
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	15	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



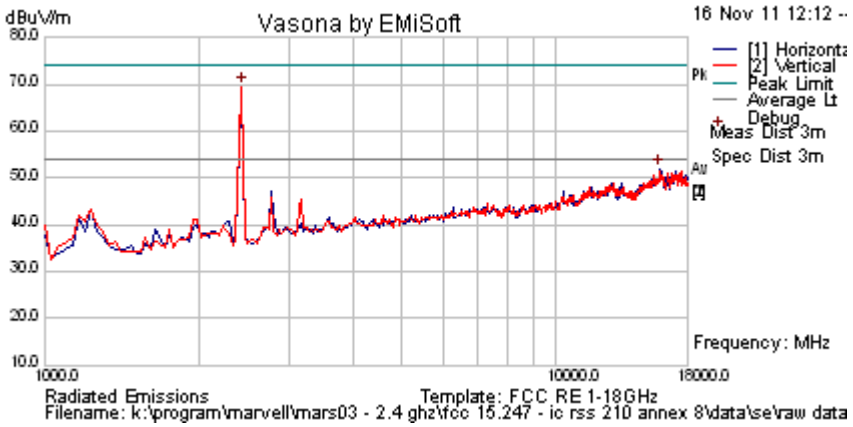
Formally measured emission peaks

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	77.2	3.0	-11.6	68.6	Peak [Scan]	V						FUND
17080.16	42.1	8.5	0.4	51.0	Peak [Scan]	H	200	0	54.0	-3.0	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

The above plot implements a peak detector showing both polarities. The emission breaking the limit line is the fundamental frequency.

Test Freq.	2437 MHz	**Engineer**	GMH
Variant	802.11n; HT-20; 6.5 MCS	**Temp (ºC)**	21
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	15	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



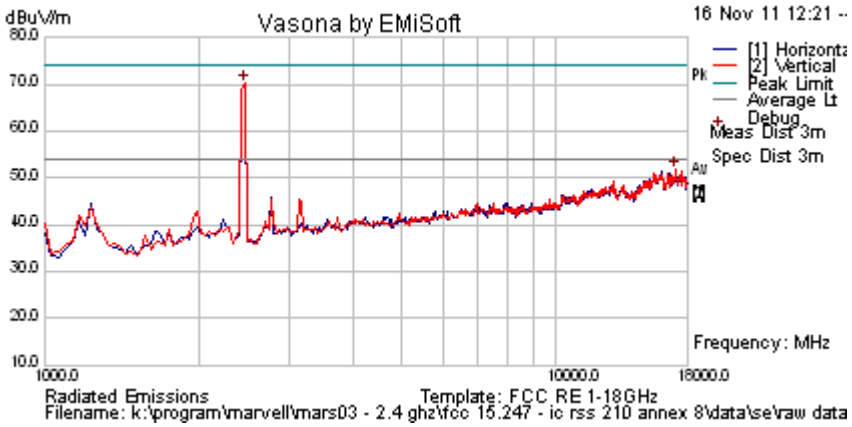
Formally measured emission peaks

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	78.2	3.0	-11.6	69.5	Peak [Scan]	V						FUND
15921.844	43.1	8.9	-0.1	52.0	Peak [Scan]	H	100	0	54.0	-2.0	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

The above plot implements a peak detector showing both polarities. The emission breaking the limit line is the fundamental frequency.

Test Freq.	2462 MHz	**Engineer**	GMH
Variant	802.11n; HT-20; 6.5 MCS	**Temp (ºC)**	21
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	15	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



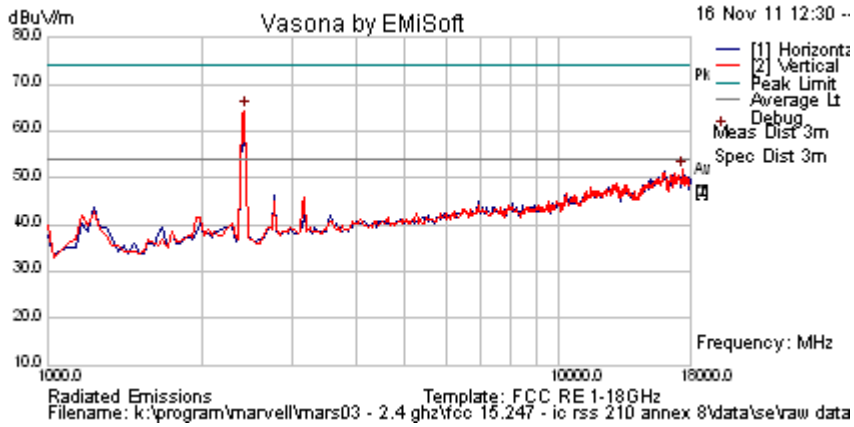
Formally measured emission peaks

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	78.8	3.0	-11.6	70.2	Peak [Scan]	V						FUND
17080.16	42.9	8.5	0.4	51.8	Peak [Scan]	V	150	0	54.0	-2.2	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

The above plot implements a peak detector showing both polarities. The emission breaking the limit line is the fundamental frequency.

Test Freq.	2422 MHz	**Engineer**	GMH
Variant	802.11n; HT-40; 13.5 MCS	**Temp (ºC)**	21
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	13	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



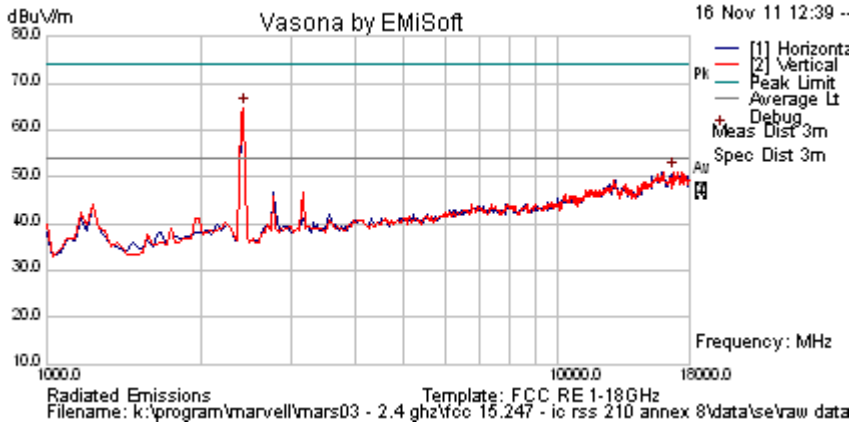
Formally measured emission peaks

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	73.0	3.0	-11.6	64.4	Peak [Scan]	V						FUND
17420.842	41.4	8.7	1.5	51.6	Peak [Scan]	V	200	0	54.0	-2.4	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

The above plot implements a peak detector showing both polarities. The emission breaking the limit line is the fundamental frequency.

Test Freq.	2437 MHz	**Engineer**	GMH
Variant	802.11n; HT-40; 13.5 MCS	**Temp (ºC)**	21
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	13	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



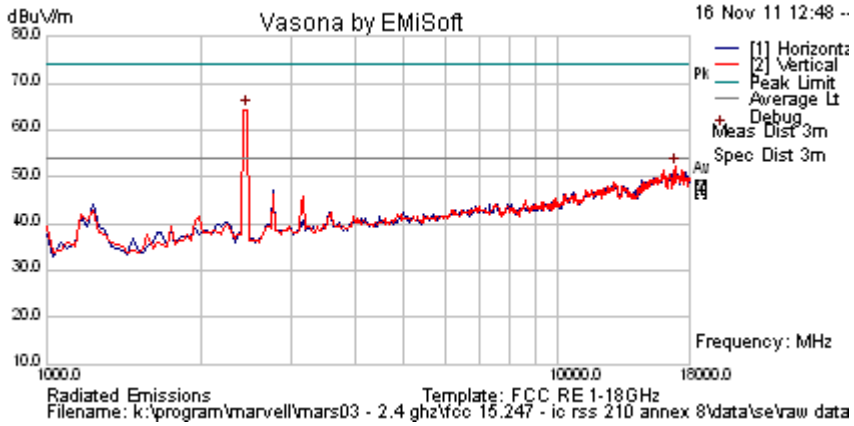
Formally measured emission peaks

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	73.5	3.0	-11.6	64.9	Peak [Scan]	V						FUND
16807.615	41.4	8.6	1.1	51.2	Peak [Scan]	V	100	0	54.0	-2.8	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

The above plot implements a peak detector showing both polarities. The emission breaking the limit line is the fundamental frequency.

Test Freq.	2452 MHz	**Engineer**	GMH
Variant	802.11n; HT-40; 13.5 MCS	**Temp (ºC)**	21
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	13	**Press. (mBars)**	1010
Antenna	Main ANT	**Duty Cycle (%)**	100
Test Notes 1	Straight Connecter;MAC: E9;		
Test Notes 2			



Formally measured emission peaks

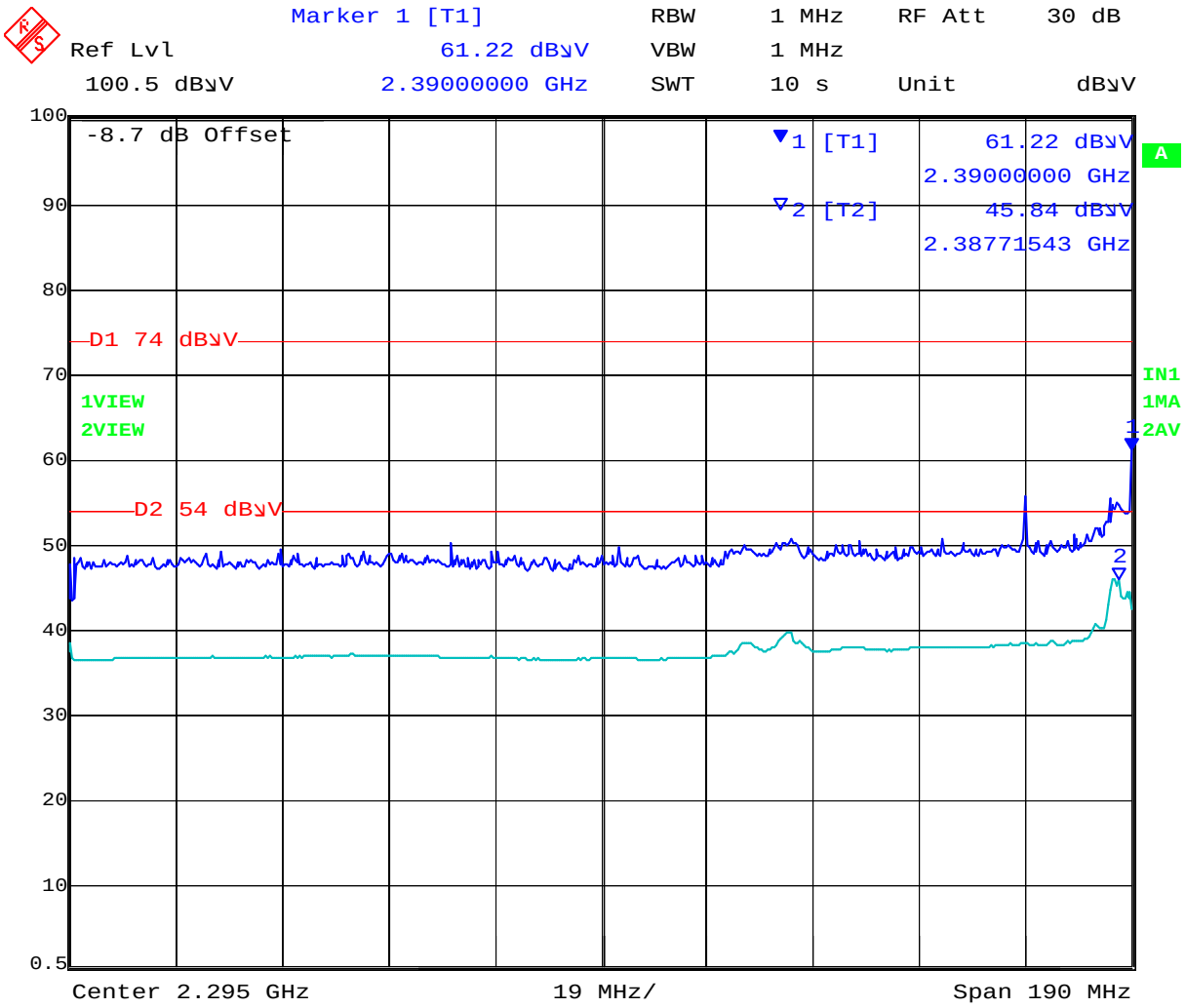
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2464.930	73.0	3.0	-11.6	64.4	Peak [Scan]	H						FUND
16875.752	42.8	8.6	0.9	52.3	Peak [Scan]	V	200	0	54.0	-1.7	Pass	

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

The above plot implements a peak detector showing both polarities. The emission breaking the limit line is the fundamental frequency.

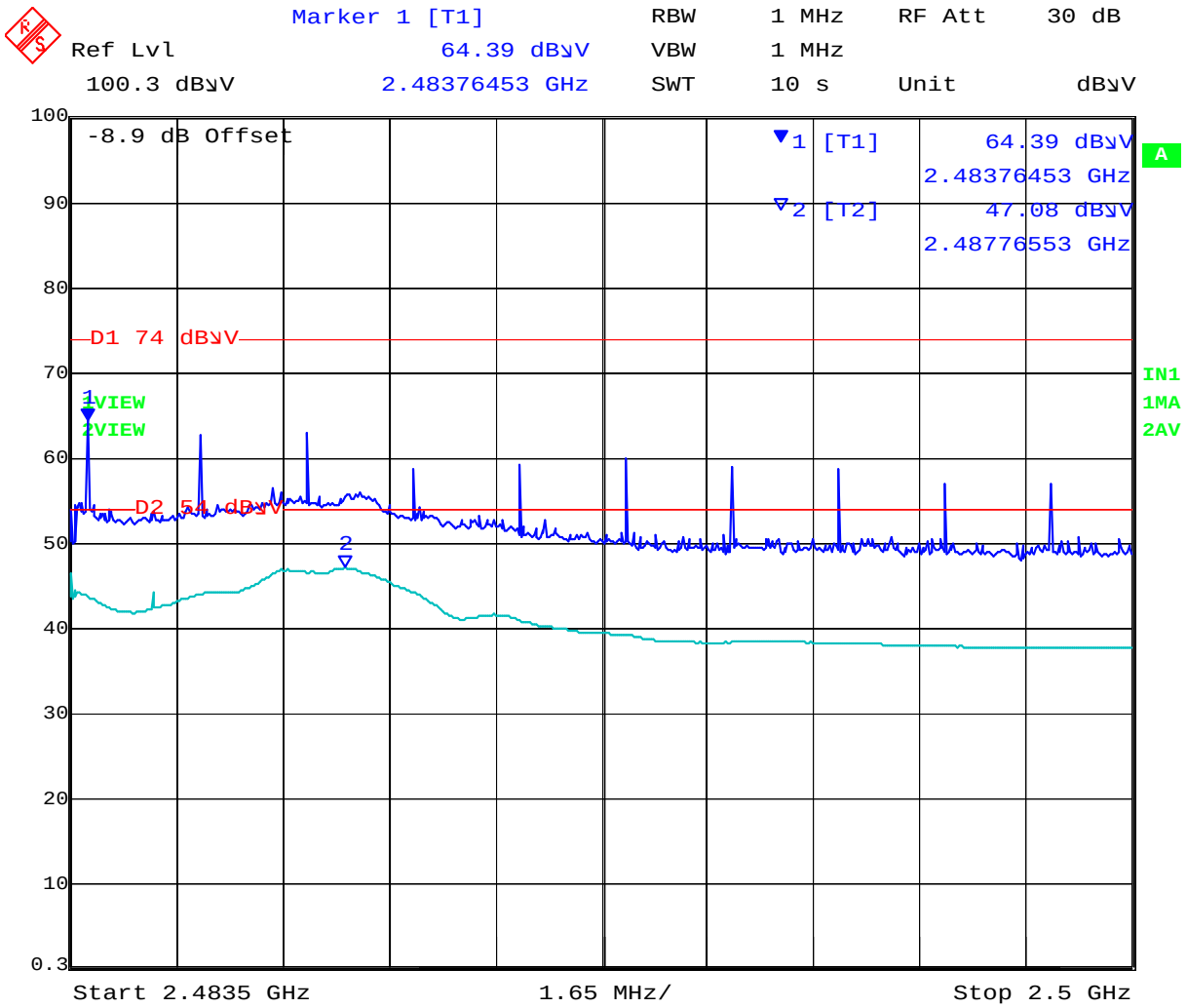
7.6.2 Band-Edge Measurements

Band-Edge 2412MHz; 802.11b 2310-2390 MHz



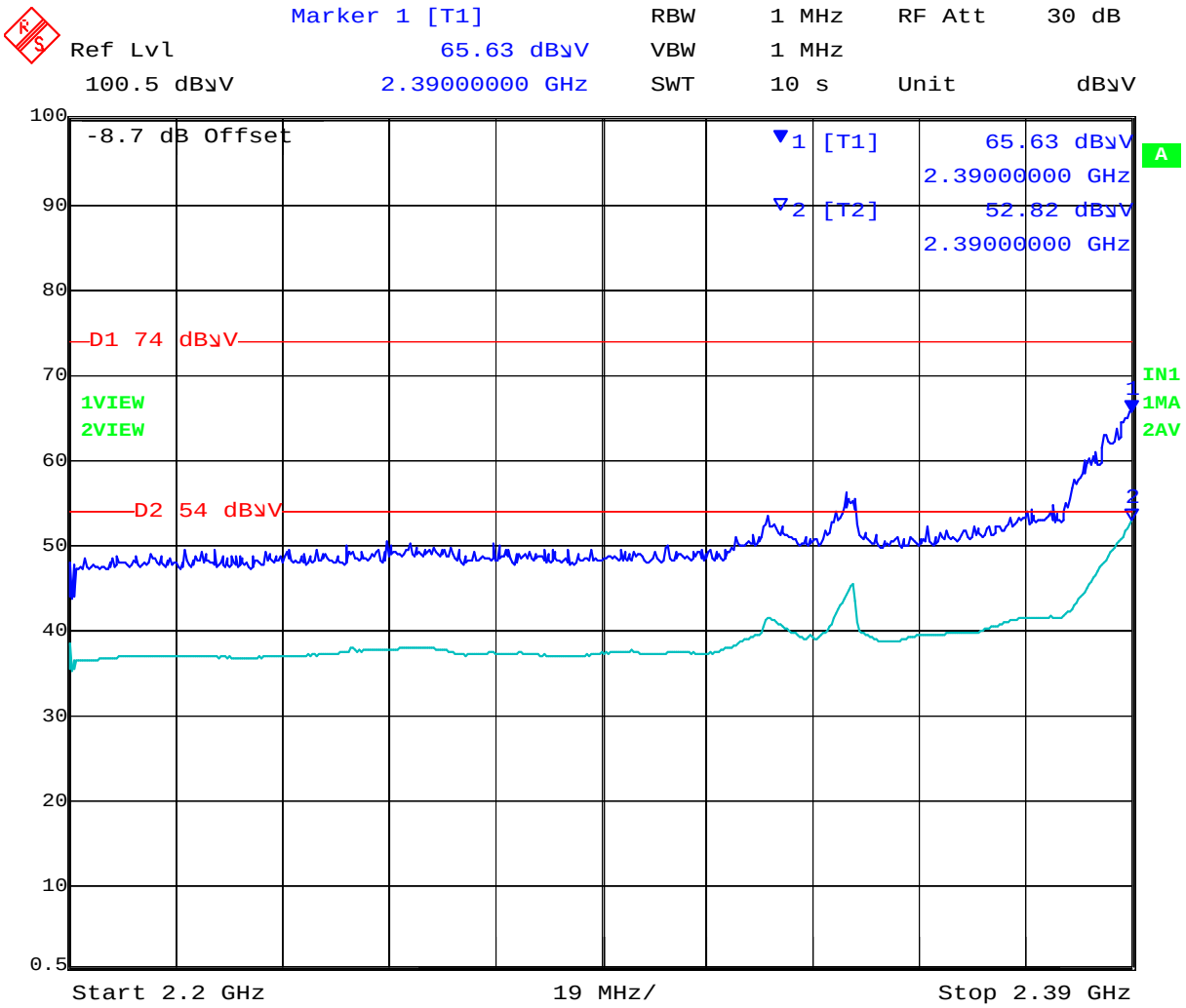
Date: 16.NOV.2011 14:33:20

Band-Edge 2462MHz; 802.11b 2483.5 - 2500 MHz



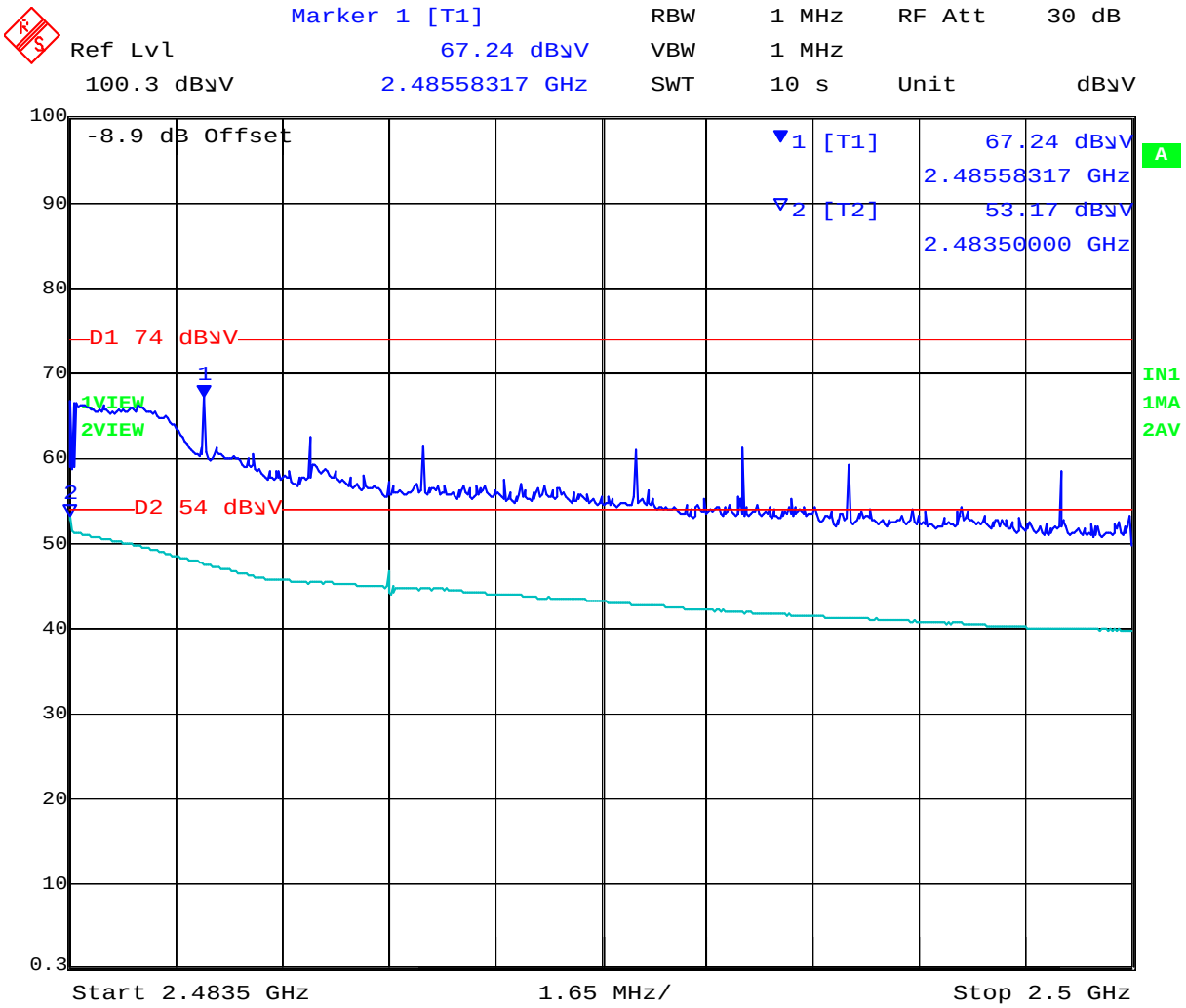
Date: 16.NOV.2011 14:50:30

Band-Edge 2412MHz; 802.11g 2310-2390 MHz



Date: 16.NOV.2011 14:37:42

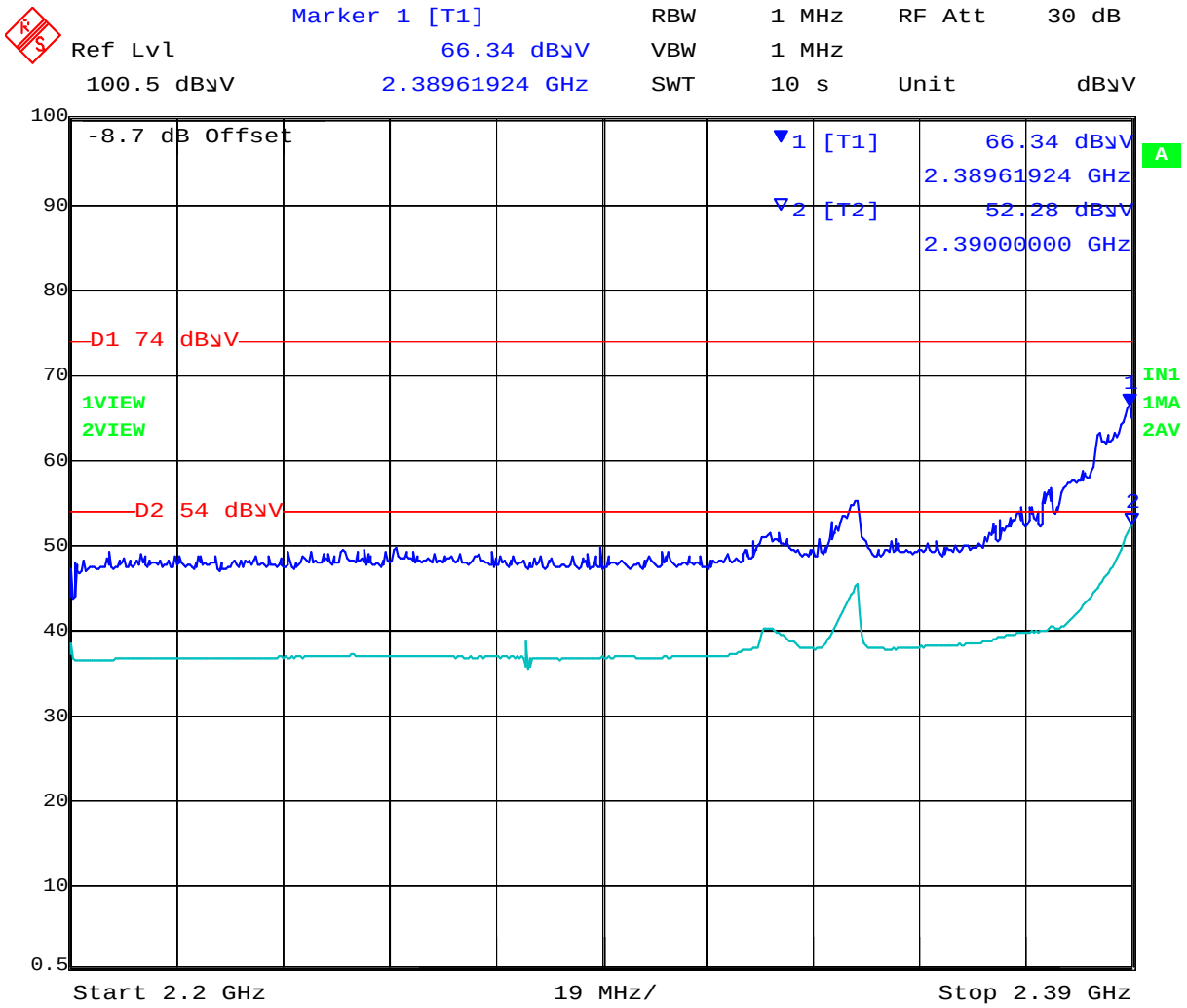
Band-Edge 2462MHz; 802.11g 2483.5 - 2500 MHz



Date: 16.NOV.2011 14:52:26

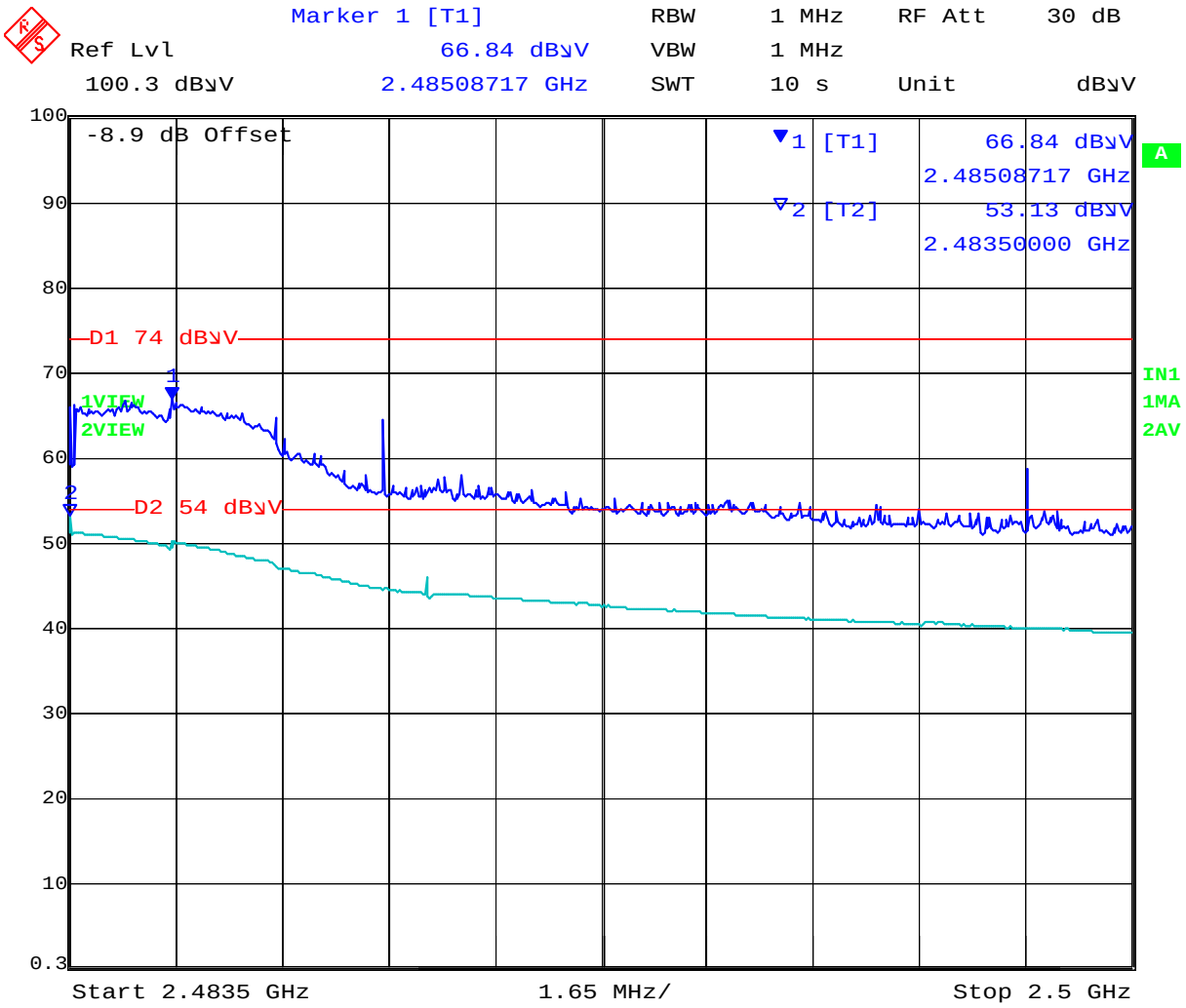
Power reduction of "1" required in order to comply with band-edge requirements

Band-Edge 2412MHz; 802.11n HT-20 2310-2390 MHz



Date: 16.NOV.2011 14:40:05

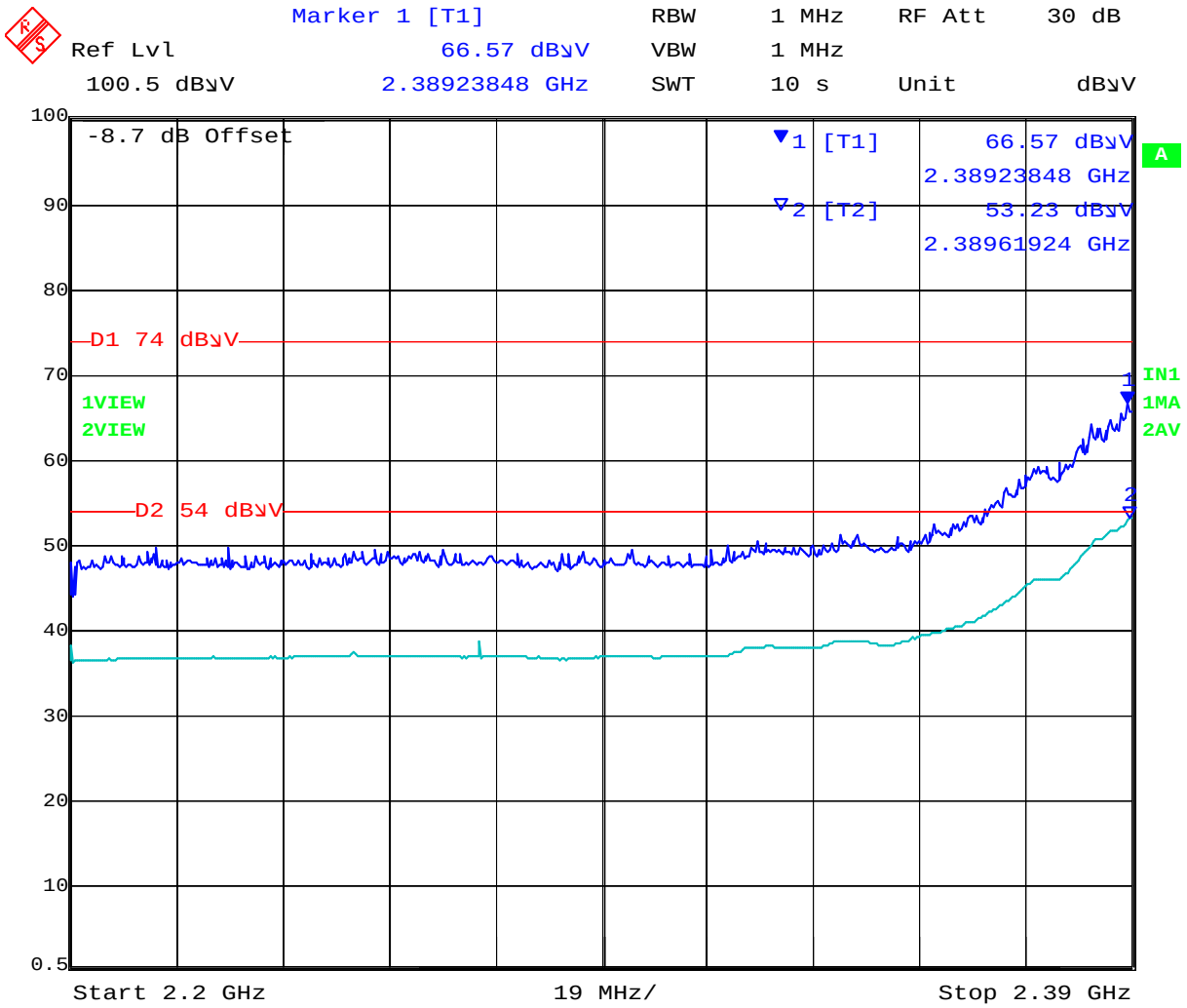
Band-Edge 2462MHz; 802.11n HT-20 2483.5 - 2500 MHz



Date: 16.NOV.2011 14:54:23

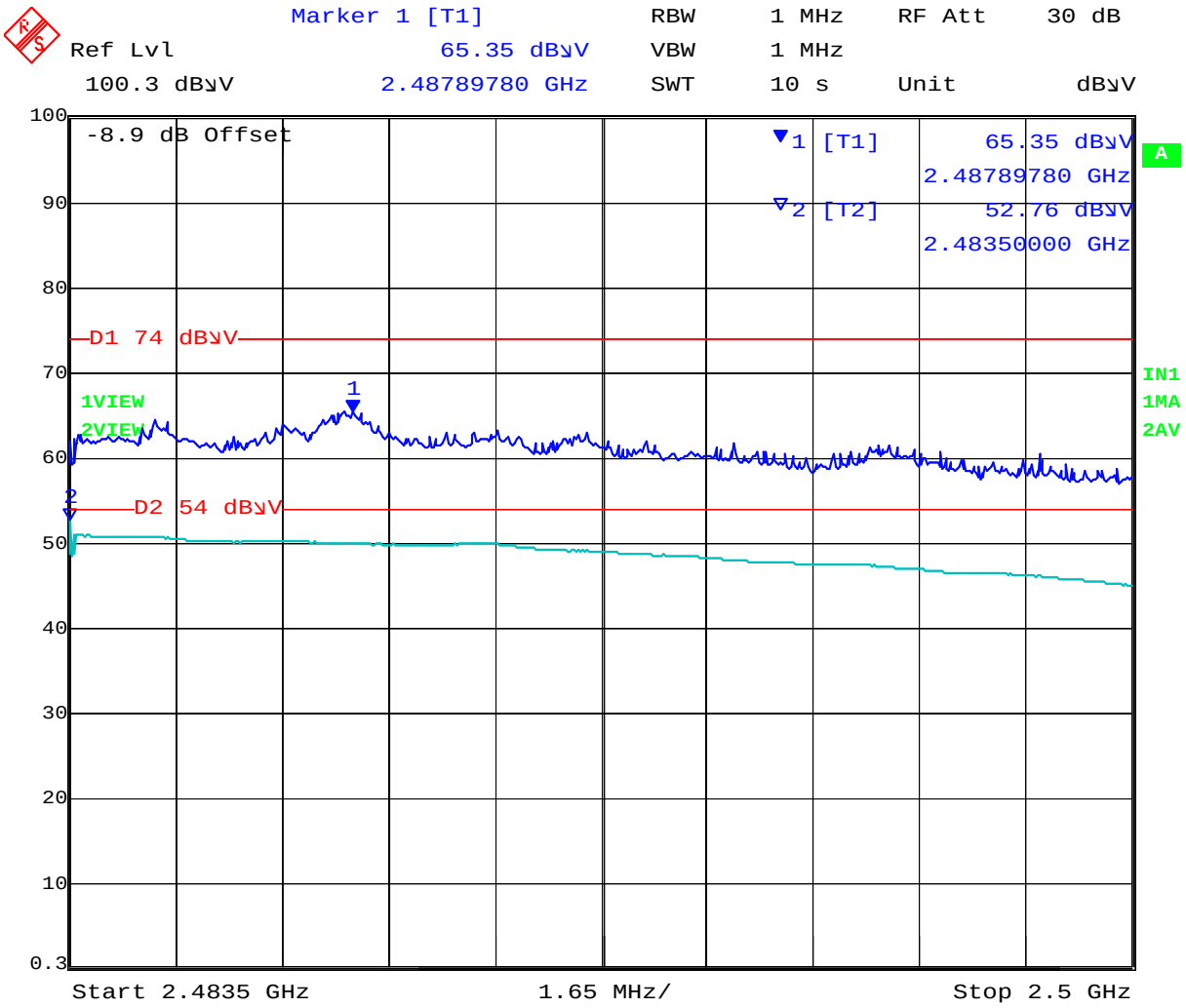
Power reduction of "1" required in order to comply with band-edge requirements

Band-Edge 2422MHz; 802.11n HT-40 2310-2390 MHz



Date: 16.NOV.2011 14:43:32

Band-Edge 2452MHz; 802.11n HT-40 2483.5 - 2500 MHz

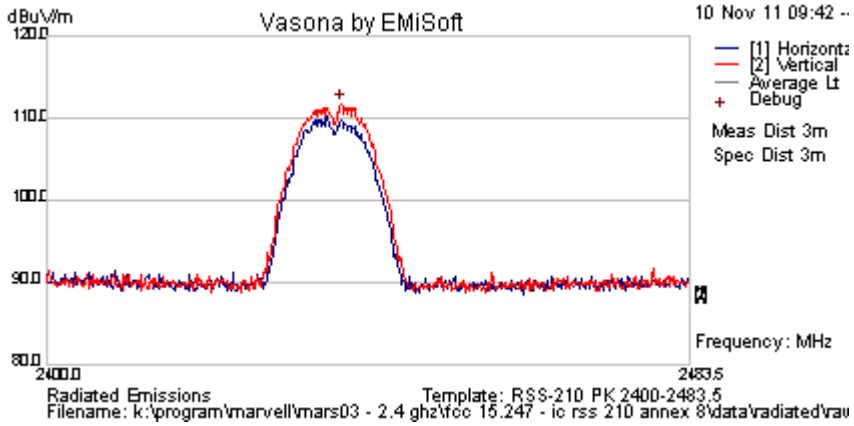


Date: 16.NOV.2011 14:57:22

Power reduction of "1" required in order to comply with band-edge requirements

7.6.3 Peak Emission

Test Freq.	2437 MHz	**Engineer**	SB
Variant	802.11b; 1 Mbs	**Temp (ºC)**	19
Freq. Range	2400-2483.5MHz	**Rel. Hum.(%)**	32
Power Setting	18 dBm	**Press. (mBars)**	1007
Antenna	Main Ant	**Duty Cycle (%)**	100
Test Notes 1	MAC:E9;		
Test Notes 2	Right Angle Connecter; Vertical Position (Y);		



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
2437.985	66.6	13.0	32.2	111.8	Peak [Scan]	V	100					

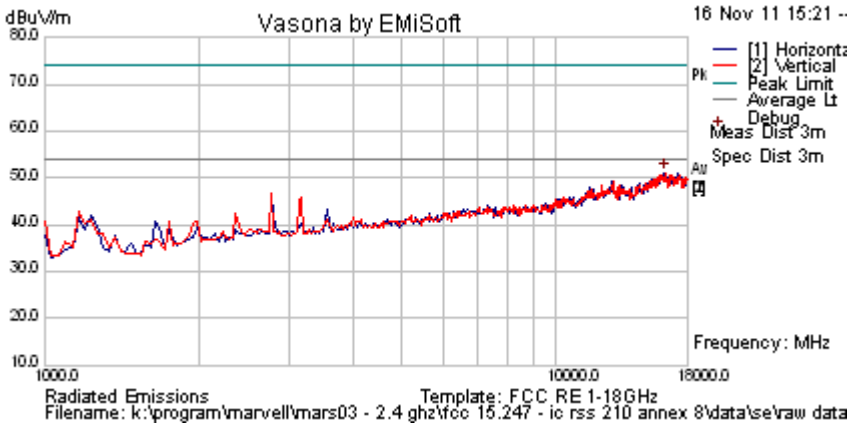
Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

Maximum peak emission observed

7.6.4 Receiver Radiated Emissions

Measurement Results for Radiated Spurious Emissions – Receiver

Test Freq.	2437 MHz	**Engineer**	GMH
Variant	All modes	**Temp (ºC)**	23.5
Freq. Range	1000 MHz - 18000 MHz	**Rel. Hum.(%)**	33
Power Setting	N/A	**Press. (mBars)**	1007
Antenna	Main ANT	**Duty Cycle (%)**	N/A
Test Notes 1	Straight Connecter;MAC: E9;		
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
16330.661	42.0	8.9	0.3	51.1	Peak [Scan]	H	200	0	54.0	-2.9	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

7.7 Conducted Disturbance at Mains Terminal (150 kHz – 30 MHz)

NOTE: Test not applicable EUT is a battery powered module

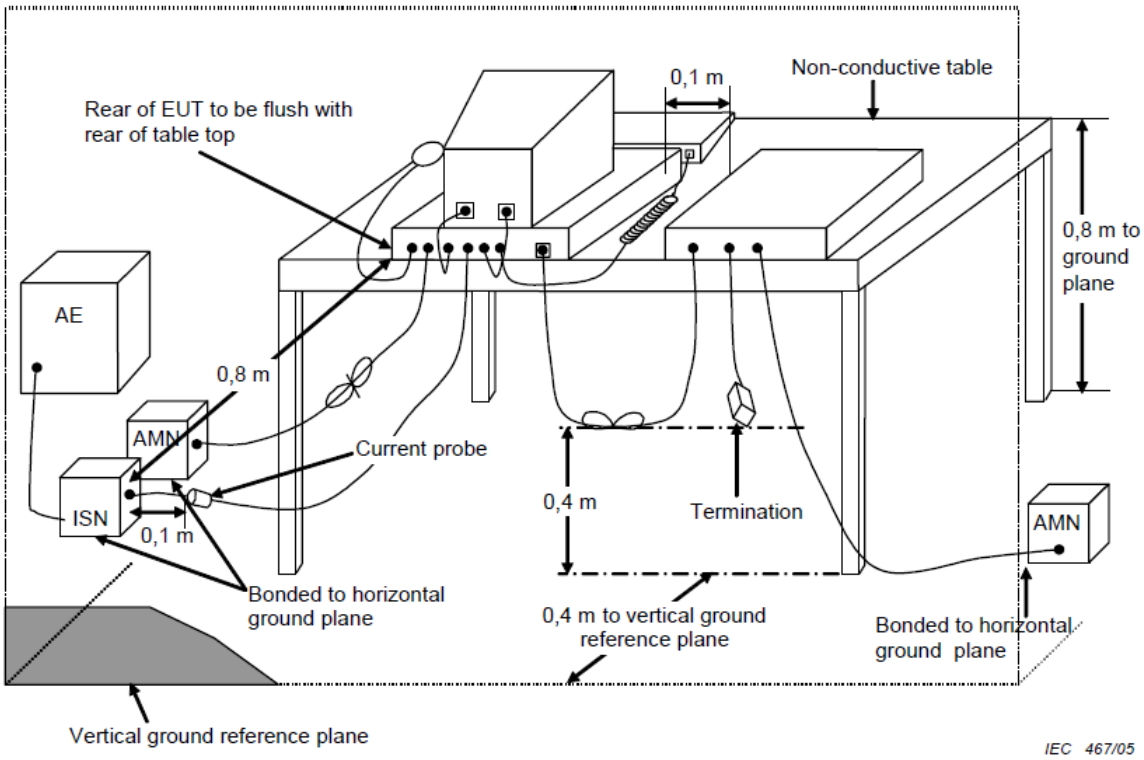
Test Procedure

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.

If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

Test Measurement Setup



Measurement setup for Conducted Disturbance at Mains Terminals

Specification for Conducted Disturbance at Mains Terminal – Digital Apparatus

FCC §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 §7.2.4

AC Power Line Conducted Emissions Limits: Except when the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply, either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto 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 more stringent limit applies at the frequency range boundaries.

The conducted emissions shall be measured with a 50 ohm/50 microhenry line impedance stabilization network (LISN).

Limits

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

Traceability

Laboratory Measurement Uncertainty for Conducted Emissions

Measurement uncertainty	±2.64 dB

Traceability

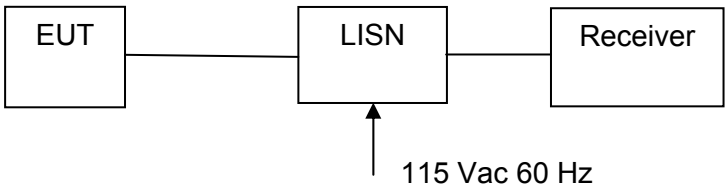
Method	Test Equipment Used
Work instruction WI-EMC-01	0158, 0184, 0193, 0190, 0293, 0307

7.7.1 Conducted Disturbance at Mains Terminal (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

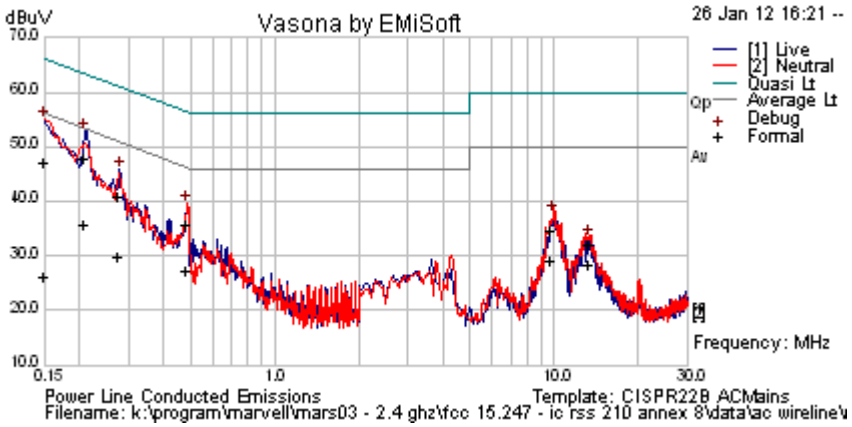


Measurement set up for AC Wireline Conducted Emissions Test

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

Ambient conditions.
Temperature: **Error! Reference source not found.** °C
Relative humidity: **Error! Reference source not found.** %
Pressure: **Error! Reference source not found.** mbar

Test Freq.	N/A	**Engineer**	GMH
Variant	AC Line Emissions	**Temp (ºC)**	18.5
Freq. Range	0.150 MHz - 30 MHz	**Rel. Hum.(%)**	43
Power Setting	Maximum	**Press. (mBars)**	1015
Antenna	Integral		
Test Notes 1	Unit pinging access point		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.279	30.9	9.9	0.1	40.9	Quasi Peak	Live	60.85	-20.0	Pass	
0.210	37.9	9.9	0.1	47.8	Quasi Peak	Live	63.2	-15.4	Pass	
0.487	25.7	9.9	0.1	35.7	Quasi Peak	Neutral	56.22	-20.6	Pass	
0.150	37.2	9.9	0.1	47.2	Quasi Peak	Neutral	66	-18.8	Pass	
9.827	24.0	10.3	0.4	34.7	Quasi Peak	Neutral	60	-25.3	Pass	
13.362	21.2	10.4	0.6	32.1	Quasi Peak	Neutral	60	-27.9	Pass	
0.279	19.8	9.9	0.1	29.7	Average	Live	50.85	-21.1	Pass	
0.210	25.7	9.9	0.1	35.7	Average	Live	53.2	-17.5	Pass	
0.487	17.3	9.9	0.1	27.3	Average	Neutral	46.22	-18.9	Pass	
0.150	16.1	9.9	0.1	26.1	Average	Neutral	56	-29.9	Pass	
9.827	18.4	10.3	0.4	29.0	Average	Neutral	50	-21.0	Pass	
13.362	17.5	10.4	0.6	28.4	Average	Neutral	50	-21.6	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

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

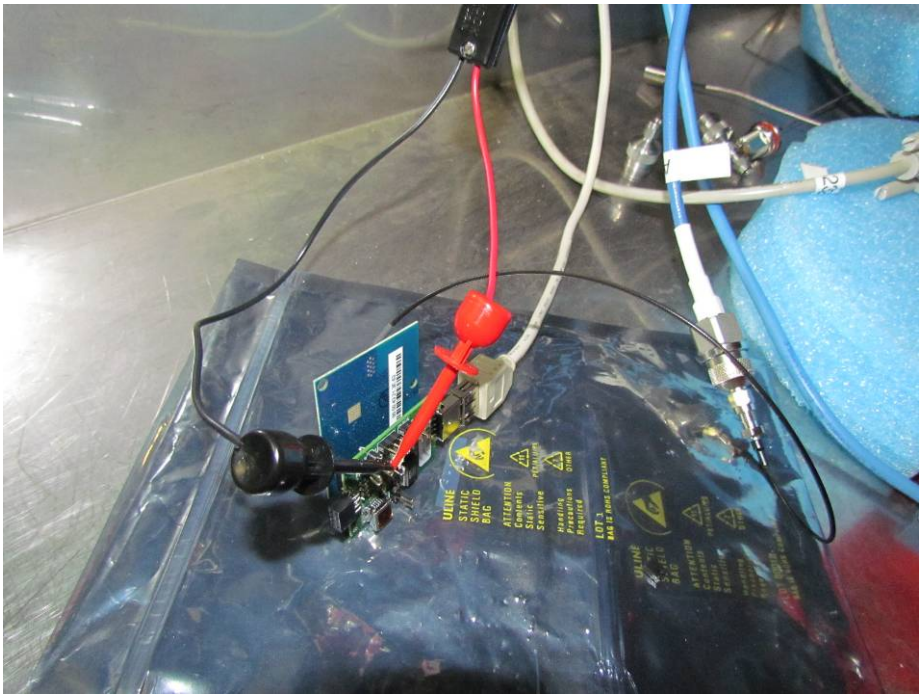
Measurement uncertainty	±2.64 dB

Traceability

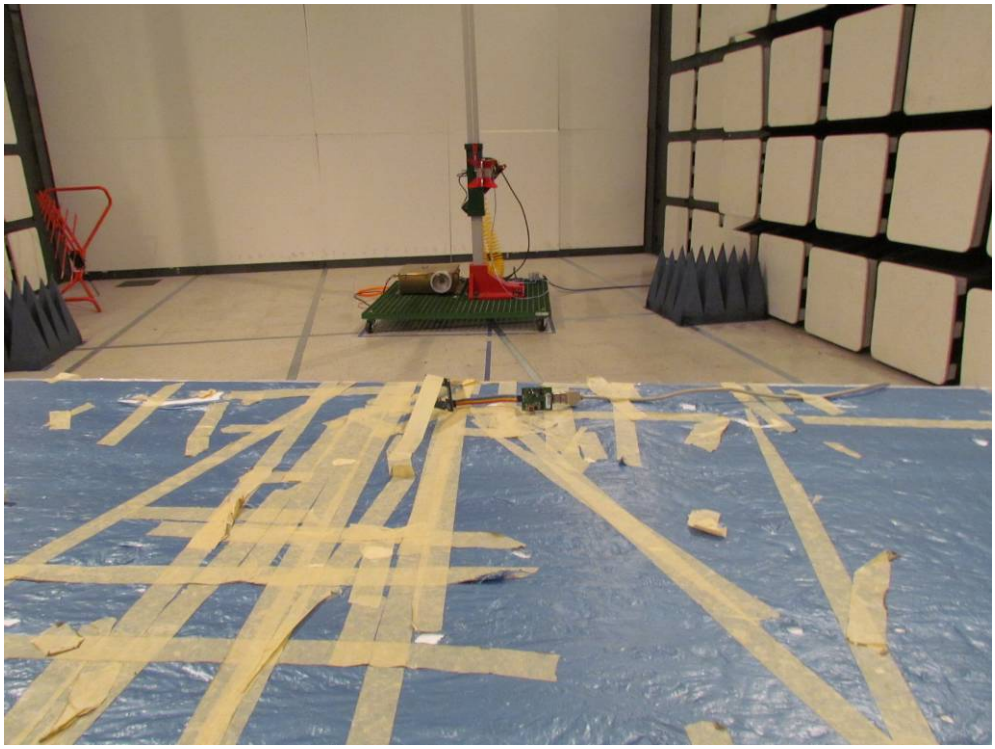
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0287, 0190, 0293, 0307

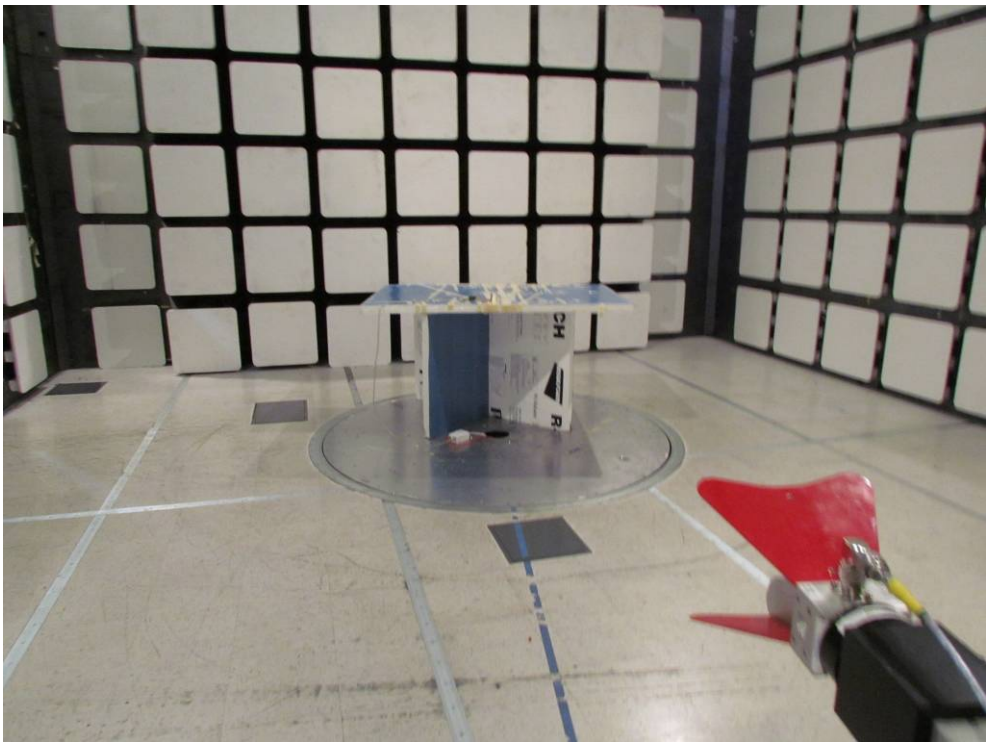
8 Photographs

8.1 Conducted RF Emissions - EUT

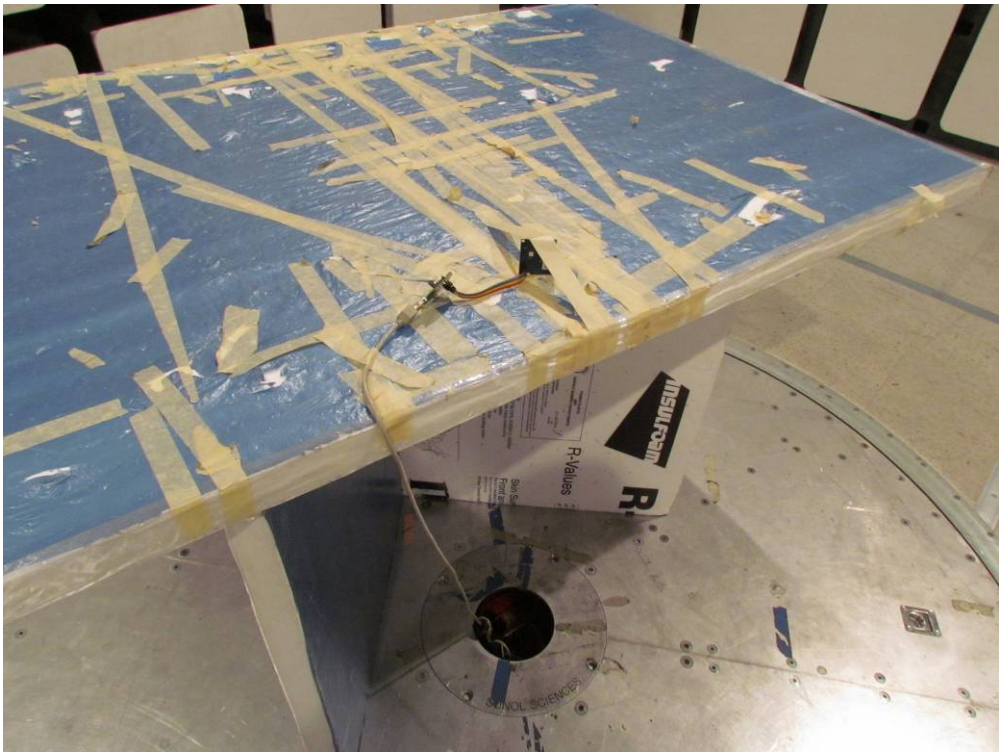


8.2 Transmitter Radiated Spurious Emission above 1 GHz

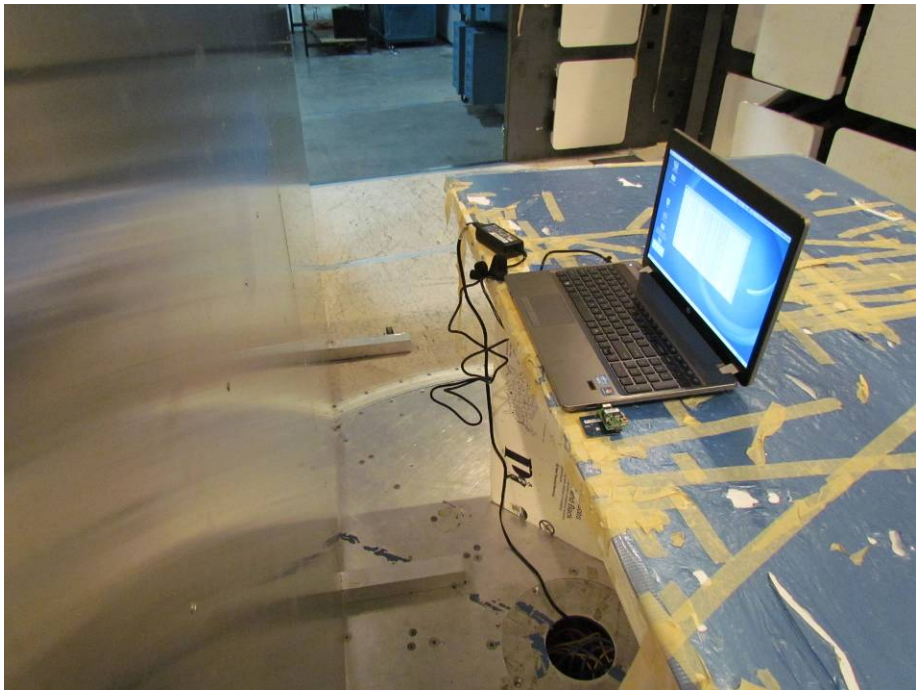


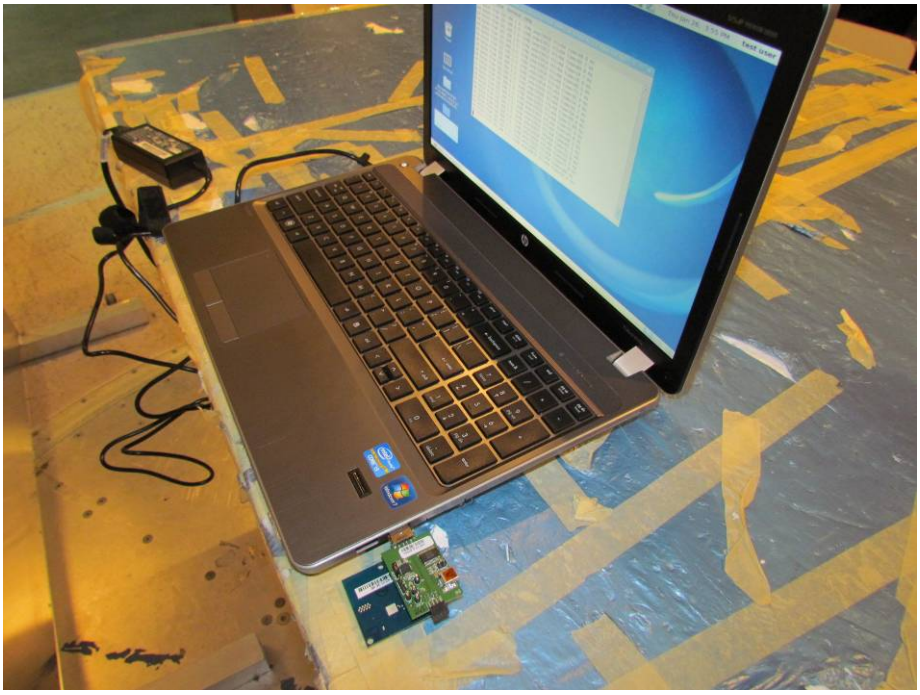


8.3 Transmitter Radiated Spurious Emission below 1 GHz



8.4 AC Wireline Emissions





9 TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0287	EMI Receiver	Rhode & Schwartz	ESIB 40	100201
0193	EMI Receiver	Rhode & Schwartz	ESIB 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907
0342	2.4 GHz Notch Filter	EWT	EWT-14-0203	H1

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