

Test of Zebra Technologies Corporation WhereTag IV  
Module

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

Test Report Serial No.: GBCC04-U1 Rev A



# TEST REPORT

FROM



**Test of:** Zebra Technologies Corporation WhereTag IV Module

**To:** FCC 47 CFR Part 15, SubPart 15.247 and RSS-210 Annex 8

**Test Report Serial No.:** GCBB04-U1 Rev A

This report supersedes: NONE

**Applicant:** Zebra Technologies Corporation  
2940 N. First Street  
San Jose, CA 95134  
USA

**Product Function:** Remote Telemetry Module

**Copy No:** pdf

**Issue Date:** 7th July 2012

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

**MiCOM Labs, Inc.**

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TESTING CERTIFICATE #2381.01

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



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## 1 ACCREDITATION, LISTINGS & RECOGNITION

### 1.1 ACCREDITATION

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



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### *Accredited Laboratory*

A2LA has accredited

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*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 27<sup>th</sup> day of March 2012.



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

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

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## 1.2 LISTINGS

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

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	Listing #: 4143A
Japan	MIC	CAB	APEC MRA 2	210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

\*\*APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.

Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase I - recognition for product testing

Phase II – recognition for both product testing and certification

N/A – Not Applicable

\*\*EU MRA – European Union Mutual Recognition Agreement.

Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

\*\*NB – Notified Body

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### 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](http://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>



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"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.

Presented this 27<sup>th</sup> day of March 2012.



President & CEO  
For the Accreditation Council  
Certificate Number 2381.02  
Valid to November 30, 2013

*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

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## 2 DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	7th July 2012	Initial release This report uses test results previously reported in MiCOM Labs report ETSD21-U1 Rev A published on 2 <sup>nd</sup> August 2010 with the addition of results for "Client mode" testing. Section 6.1 describes this new mode and how it functions

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### 3 TEST RESULT CERTIFICATE

Applicant:	Zebra Technologies Corporation 2940 N. First Street San Jose CA , 95134, USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
Product:	WhereTag IV Module	Telephone:	+1 925 462 0304
Model No.:	TFF-2005	Fax:	+1 925 462 0306
S/No's:	0033555155		
Date(s) Tested:	29 <sup>th</sup> – 31 <sup>st</sup> May 2012	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15, SubPart 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:**

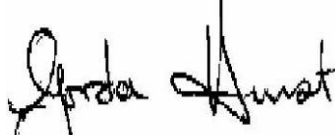
1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

**Approved & Released for MiCOM Labs, Inc. by:**



TESTING CERTIFICATE #2381.01

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

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

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## 4 REFERENCES AND MEASUREMENT UNCERTAINTY

### 4.1 Normative References

REF.	PUBLICATION	YEAR	TITLE
i.	FCC 47 CFR Part 15, Subpart C	2012	Title 47: Telecommunication PART 15—RADIO FREQUENCY DEVICES Subpart C—Intentional Radiators
ii.	RSS-210 Annex 8	2010	Radio Standards Specification 210, Issue 8, Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment
iii.	FCC OET KDB 662911	4 <sup>th</sup> April 2011	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
iv.	RSS-GEN	2010	Radio Standards Specification-Gen, Issue 3, General Requirements and Information for the Certification of Radiocommunication Equipment
v.	FCC 47 CFR Part 15, Subpart B	2012	47 CFR Part 15, SubPart B; Unintentional Radiators
vi.	ICES-003	2004	Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard Digital Apparatus; Issue 4
vii.	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
viii.	CISPR 22/ EN 55022	2008 2006+A1: 2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
ix.	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
x.	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
xi.	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
xii.	A2LA	July 2012	Rules for Making Reference to A2LA Accredited Status – A2LA Advertising Policy

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## **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 15.247

Standard Section(s)	Test Description	Condition	Result	Test Report Section
(a)(2)	6 dB Occupied Bandwidth	Conducted	Compliant	7.1
(b)(3), (b)(4)	Peak Output Power	Conducted	Compliant	7.2
(e)	Peak Power Spectral Density	Conducted	Compliant	7.3
(i)	Maximum Permissible Exposure	Calculation	Compliant	7.4
(d)	Spurious Emissions	Conducted	Compliant	7.5
(d), 15.205, 15.209	Transmitter Radiated Spurious Emissions Above 1 GHz	Radiated	Compliant	7.6 / 7.7*
(d), 15.205, 15.209	Radiated Band-Edge	Radiated	Compliant	7.6 / 7.7*
4.10, 6	Receiver Emissions	Radiated	Compliant	7.6 / 7.7*
(d), 15.205, 15.209	Radiated Transmitter Spurious emissions below 1 GHz	Radiated	Compliant	7.8
15.207	AC Wireline Emissions 0.15 – 30 MHz	Conducted	N/A	7.9

\* Section 7.6 results are for antenna ZES 10370

\* Section 7.7 results are for antenna Taoglas FXP73.07.0100A

**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

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## 6 PRODUCT DETAILS AND TEST CONFIGURATIONS

### 6.1 Test Program Scope

The scope of the test program was to test the Zebra Technologies Corporation WhereTag IV Module model TFF-2005 in Client Modes b and g for compliance against FCC 47 CFR Part 15, SubPart 15.247

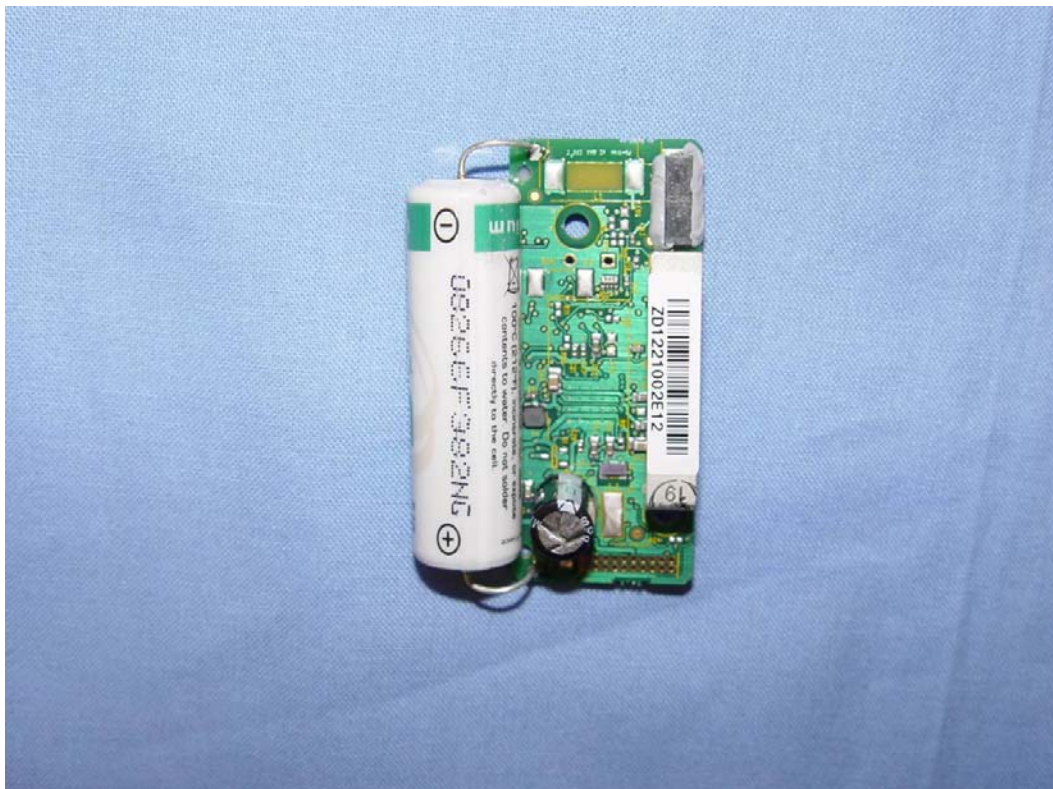
This report uses test results previously reported in MiCOM Labs report ETSD21-U1 Rev A published on 2<sup>nd</sup> August 2010 with the addition of results for client mode testing.

#### Description of new 802.11b/g Client Mode:

- Client Mode uses both the transmitter and receiver of the 802.11 radio to communication with access points, while Beacon mode (Mode 1 and 2) only uses the transmitter and turns off the receiver. Beacon mode transmits short data packets at low duty cycle, while Client Mode can transmit and receive longer data packets at higher duty cycle. Another name for Beacon Mode is "CISCO CCX Mode".

**Applicant:** Zebra Technologies Corporation

**Product:** WhereTag IV Module Model TFF-2005



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**Applicant:** Zebra Technologies Corporation

**Product:** WhereTag IV Module Model TFF-2005



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## 6.2 EUT Details

Detail	Description
Purpose:	Test of the Zebra Technologies Corporation WhereTag IV Module Remote Telemetry Module for compliance against FCC 47 CFR Part 15, SubPart 15.247 and RSS-210 Annex 8
Applicant:	Zebra Technologies Corporation 2940 N. First Street San Jose CA , 95134, USA
Manufacturer:	As Applicant
Test Laboratory:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	GBCC04-U1
Date EUT received:	29 <sup>th</sup> May 2012
Dates of test (from - to):	29 <sup>th</sup> 31 <sup>st</sup> May 2012
No of Units Tested:	1
Product Name:	WhereTag IV module
Model No.:	TFF-2005
Equipment Primary Function:	Remote Telemetry Module
Equipment Secondary Function(s):	N/A
Type of Technology:	802.11/ ISO24730
Installation type:	Mobile
Construction/Location for Use:	Indoor/Outdoor
Software/Firmware Release:	Beta 4.0.0
Hardware Release:	Beta
Test Software Release:	CertGUI Version 8-26-11
Transmit/Receive Operation:	Simplex
Output Power Type:	Stepped 1 dB
Automatic Transmit Power Control Available:	No
Remote Frequency Control Available:	No
Rated Input Voltage and Current AC:	Battery operation only
Operating Frequency:	2400 to 2483 MHz
Rated Input Voltage and Current DC:	Nominal: 3.3V, Max: 3.7V, Min: 3.0V Current: 0.2 (A)
Operating Temperature Range °C:	Min: -30 Max: 70
ITU Emission Designator(s):	802.11b: 17M7W7D 802.11g: 24M5D1D ISO 24730 DSSS: 44M4W7D ISO 24730 OOK: 10M1W7D
Long Term Frequency Stability:	1 PPM/year (+/-25PPM / 7 years)
Equipment Dimensions:	6.6x4.4x2.1cm
Weight:	51 gram

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

No External A.C./D.C. Power adaptor utilized during this test program

### 6.4 Operational Power Range

Declared O/P Power Range	Mode 1		Mode 2		Mode 3		Mode 4	
	Max	Min	Max	Min	Max	Min	Max	Min
EUT	10	0	10	0	15	0	2	-2

### 6.5 Types of Modulation Supported

Modes	Modulation / Mode	Type
Mode 1	802.11b	BPSK,QPSK, CCK
Mode 2	802.11g	OFDM
Mode 3	ISO24730 DSSS	BPSK
Mode 4	ISO24730 OOK	ASK
Mode 5 - Client Mode	ISO24730 802.11 b	BPSK,QPSK, CCK
Mode 6 - Client Mode	ISO24730 802.11 g	OFDM

### 6.6 Antenna Details

The following is a description of the EUT antennas.

Antenna Type:	Manufacturer	Model	Gain (dBi)	Frequency Range (MHz)
Inverted-F	ZES	10370	2 max	2400-2483.5
Flexible	Taoglas	FXP73.07.0100A	2.5	2400-2483.5
Mono-pole plate antenna assembly (1 center/ 3 outer)	WhereNet	22810	4 (center) 7 (outer)	2400-2483.5
Whip, 69 inches, Colinear	Valco	22944	0 (with cable)	2400-2483.5

**Description of Dome antenna assembly;** Inside the Dome, there is a Mono-Pole Plate Antenna Assembly. Dome and Mono-pole plate are the same antenna.



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## 6.7 Cabling and I/O Ports

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

Type of I/O Ports	Description	Screened (y/n)	Description	Qty	Tested
Serial Programming	20-pin header	N/A	< 1m	1	N/A

## 6.8 EUT Configurations

Band (GHz)	Mode	Freq Band (MHz)	Freq Range (MHz)	Low ch	Mid ch	High ch	# Ch	Channel Spacing (MHz)	Channel BW (MHz)
2.4	802.11 b	2400 - 2483.5	2412 - 2462	2412	2437	2462	11	5	20
2.4	802.11 g	2400 - 2483.5	2412 - 2462	2412	2437	2462	11	5	20
2.4	ISO24730 DSSS	2400 - 2483.5	2412 - 2462	--	2441.75	--	1	--	67
2.4	ISO24730 OOK	2400 - 2483.5	2412 - 2462	--	2446.519	--	1	--	10
2.4	Client Mode 802.11 b	2400 - 2483.5	2412 - 2462	2412	2437	2462	11	5	20
2.4	Client Mode 802.11 g	2400 - 2483.5	2412 - 2462	2412	2437	2462	11	5	20

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## 6.9 Equipment Details

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

Type (EUT/Support)	Equipment Description	Manufacturer	Model No.	Part No (s).
EUT	Remote Telemetry Module (w/ Antenna ZES10370) s/n 33560876	Zebra Technologies Corporation	TFF-2015	TFF-2005-00AA
EUT	Remote Telemetry Module (w/ Antenna FXP73.07.0100A) s/n 33560868	Zebra Technologies Corporation	TFF-2005	TFF-2005-00AA
Support	Laptop PC	Dell	PPX	72MUF A02
Support	Laptop PC	Dell	PPL	9172P
Support	Location Sensor	Zebra Technologies Corporation.	LOS-4100	01AC

## 6.10 Test Configurations

Operational Mode(s)	Data Rate Tested	Duty Cycle
b	1 MBit/s	100
g	6 MBit/s	100
ISO24730 DSSS	59.7 kbps	100
ISO24730 OOK	19.833 kbps	100
ISO24730 Client Mode b	1 MBit/s	100
ISO24730 Client Mode g	6 MBit/s	100

## 6.11 Equipment Modifications

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

- No modifications required.

## 6.12 Deviations from the Test Standard

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

- No deviations required.

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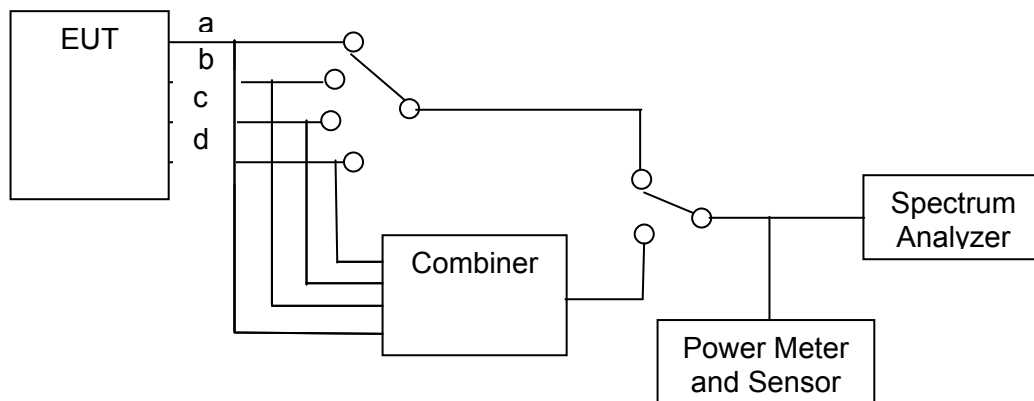
## 7 TEST RESULTS

### 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.

#### Test Configuration



Test configuration for 6 dB & 99% Bandwidth

#### Specification

##### Limits

§15.247 (a)(2)  
 The minimum 6 dB bandwidth shall be at least 500 kHz.

##### Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0252, 0313, 0314, 0116, 0117, 0287, 0363

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**7.1.1 802.11 b**

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11 b	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi
<b>Applied Voltage:</b>	3.6V Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

**6 dB Bandwidth**

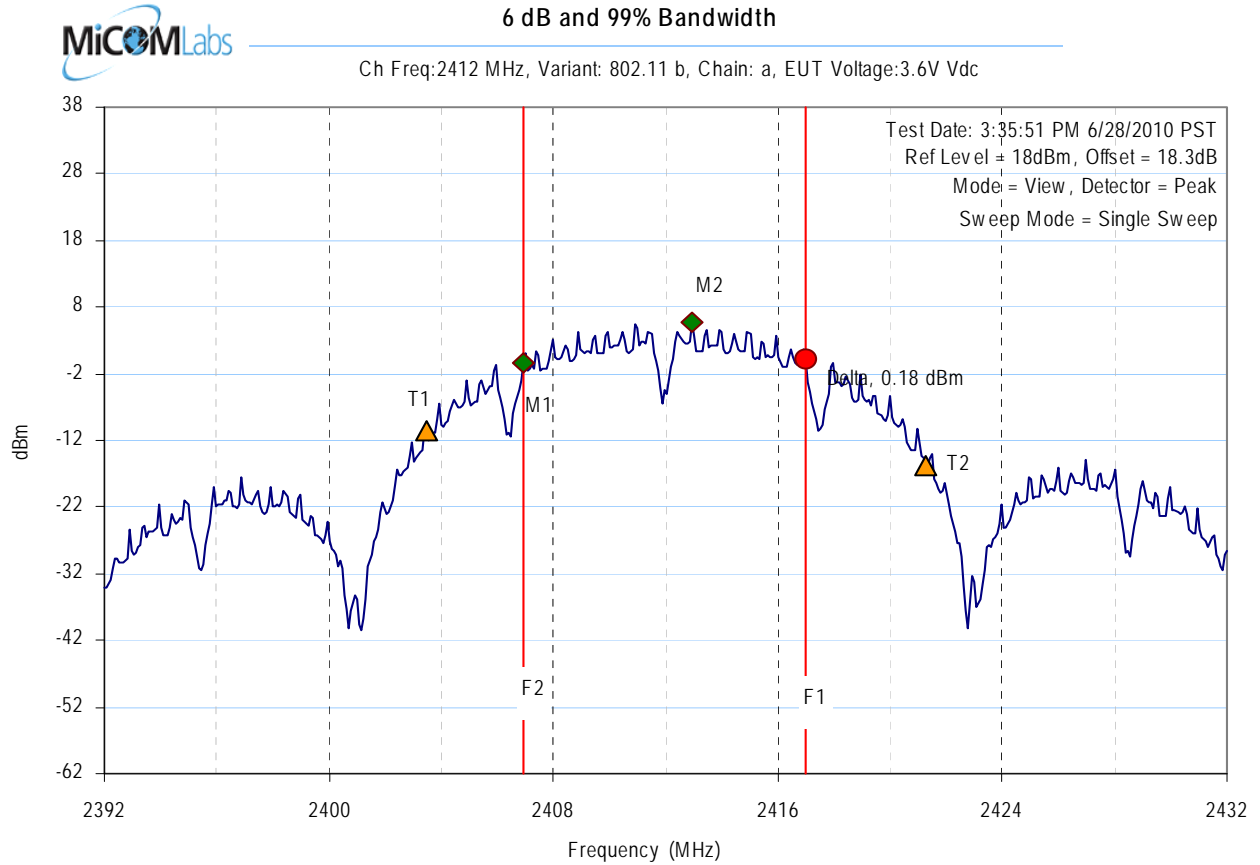
Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz				kHz	MHz	
MHz	a	b	c	d			
2412	10.100000	--	--	--	500	0.5	-9.600000
2437	10.100000	--	--	--			-9.600000
2462	10.180000	--	--	--			-9.680000

**99% Bandwidth**

Test Frequency	99 % Bandwidth						
	MHz						
MHz	a	b	c	d			
2412	17.876000	--	--	--			
2437	16.513000	--	--	--			
2462	17.715000	--	--	--			

<b>Measurement uncertainty:</b>	±2.81 dB
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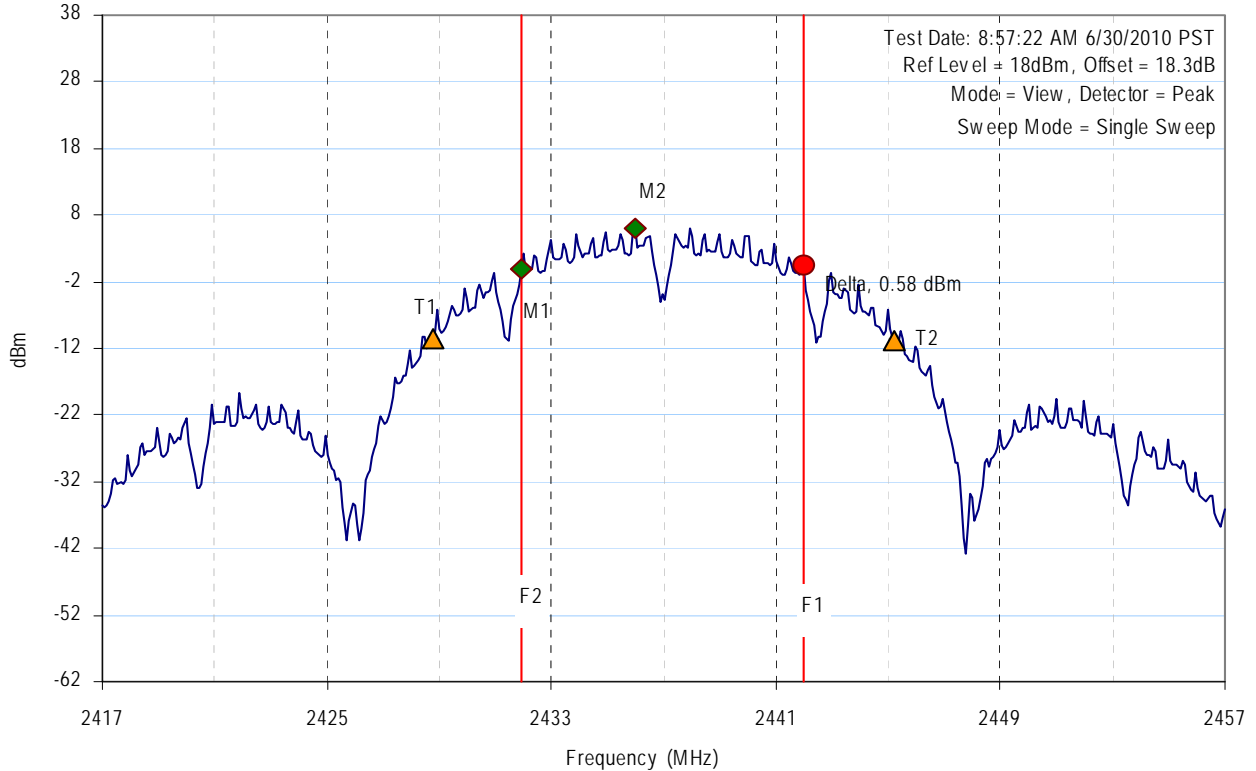
Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2406.909820MHz : -3.53dBm	Center frequency = 2412MHz
VBW = 300.00KHz	M2 : 2412.921844MHz : 5.765dBm	6dB BW(Delta-M1) = 10.100200MHz
Sweep time(s) = 20	Delta : 2417.010020MHz : .184dBm	99% OBW(T2-T1) = 17.875752MHz
RF Atten (dB) = 10	T1 : 2403.462926MHz : -10.493dBm	
Span = 40.00MHz	T2 : 2421.258517MHz : -15.815dBm	

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### 6 dB and 99% Bandwidth

Ch Freq:2437 MHz, Variant: 802.11 b, Chain: a, EUT Voltage:3.6V Vdc



#### Analyser Setup

RBW = 100.00KHz  
VBW = 300.00KHz  
Sweep time(s) = 20  
RF Atten (dB) = 10  
Span = 40.00MHz

#### Marker : Frequency : Amplitude

M1 : 2431.909820MHz : -22.6dBm  
M2 : 2435.997996MHz : 6.147dBm  
Delta : 2442.010020MHz : .577dBm  
T1 : 2428.783567MHz : -10.586dBm  
T2 : 2445.216433MHz : -10.773dBm

#### Test Results

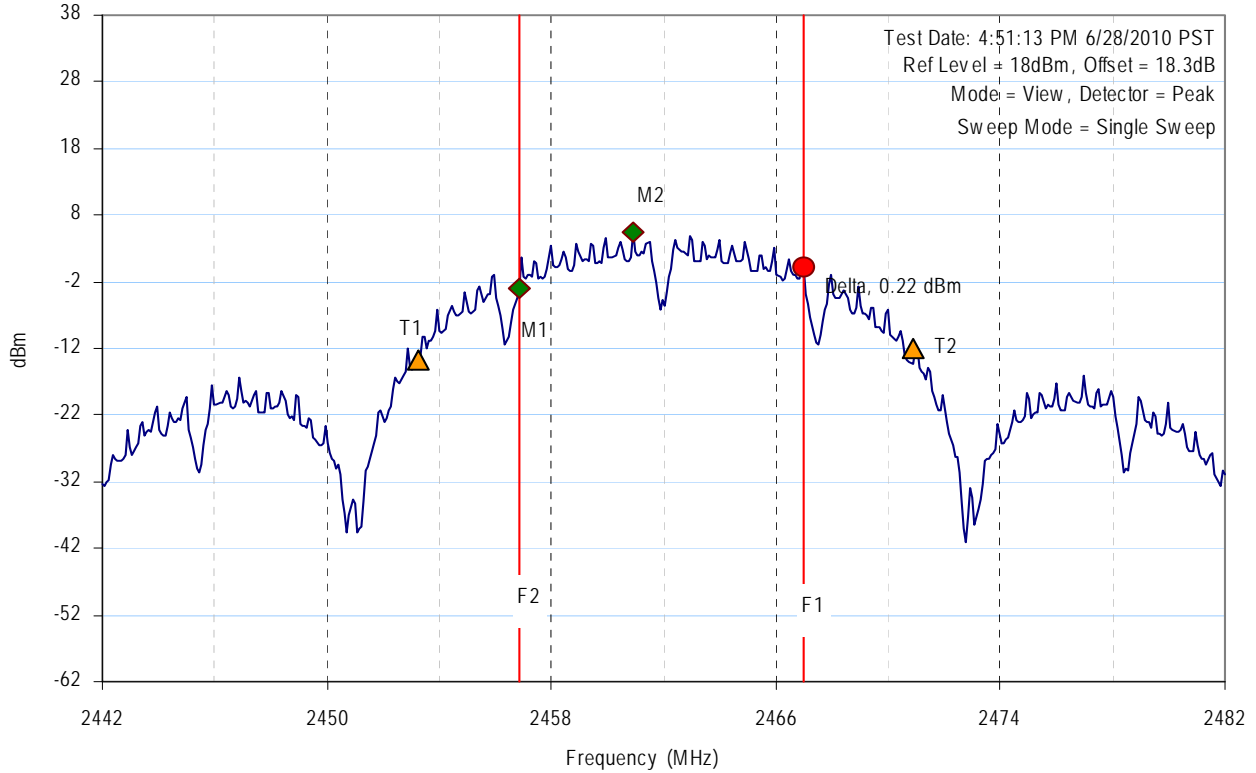
Center frequency = 2437MHz  
6dB BW(Delta-M1) = 10.100200MHz  
99% OBW(T2-T1) = 16.513026MHz

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### 6 dB and 99% Bandwidth

Ch Freq:2462 MHz, Variant: 802.11 b, Chain: a, EUT Voltage:3.6V Vdc



#### Analyser Setup

RBW = 100.00KHz  
VBW = 300.00KHz  
Sweep time(s) = 20  
RF Atten (dB) = 10  
Span = 40.00MHz

#### Marker : Frequency : Amplitude

M1 : 2456.829659MHz : -2.880dBm  
M2 : 2460.917836MHz : 5.322dBm  
Delta : 2467.010020MHz : .221dBm  
T1 : 2453.222445MHz : -13.676dBm  
T2 : 2470.857715MHz : -12.073dBm

#### Test Results

Center frequency = 2462MHz  
6dB BW(Delta-M1) = 10.180361MHz  
99% OBW(T2-T1) = 17.715431MHz

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**7.1.2 802.11 g**

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11 g	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi
<b>Applied Voltage:</b>	3.6V Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

**6 dB Bandwidth**

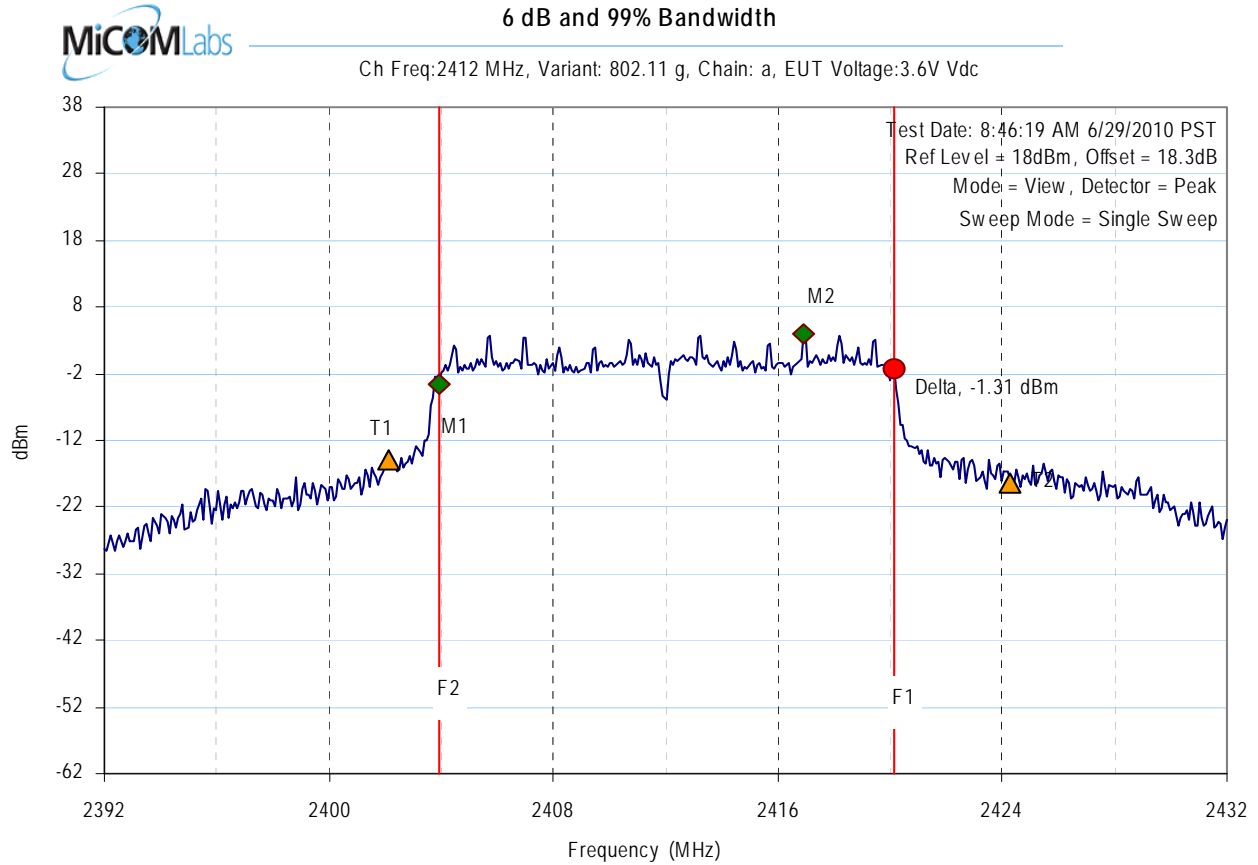
Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz				kHz	MHz	
MHz	a	b	c	d			
2412	16.192000	--	--	--	500	0.5	-15.692000
2437	16.112000	--	--	--			-15.612000
2462	16.353000	--	--	--			-15.853000

**99% Bandwidth**

Test Frequency	99 % Bandwidth						
	MHz						
MHz	a	b	c	d			
2412	22.285000	--	--	--			
2437	24.529000	--	--	--			
2462	22.926000	--	--	--			

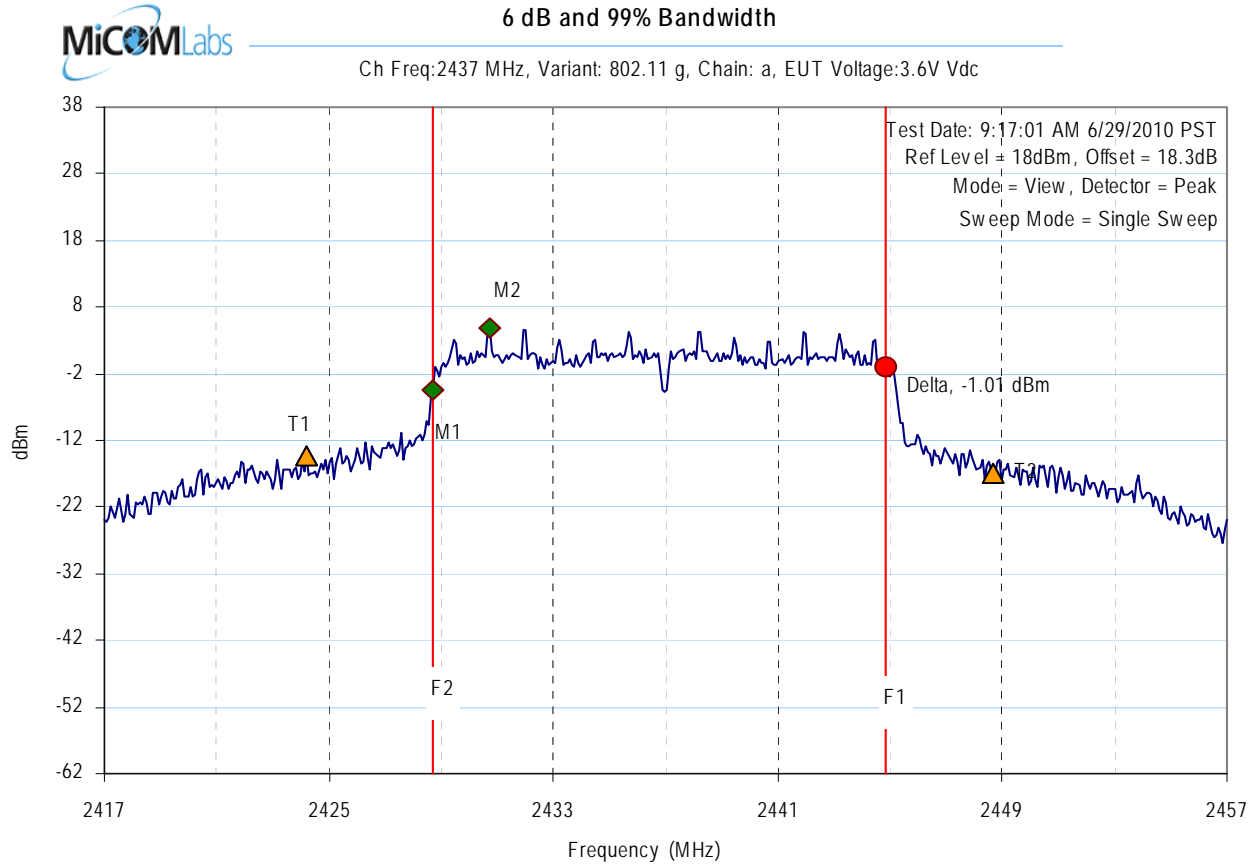
<b>Measurement uncertainty:</b>	±2.81 dB
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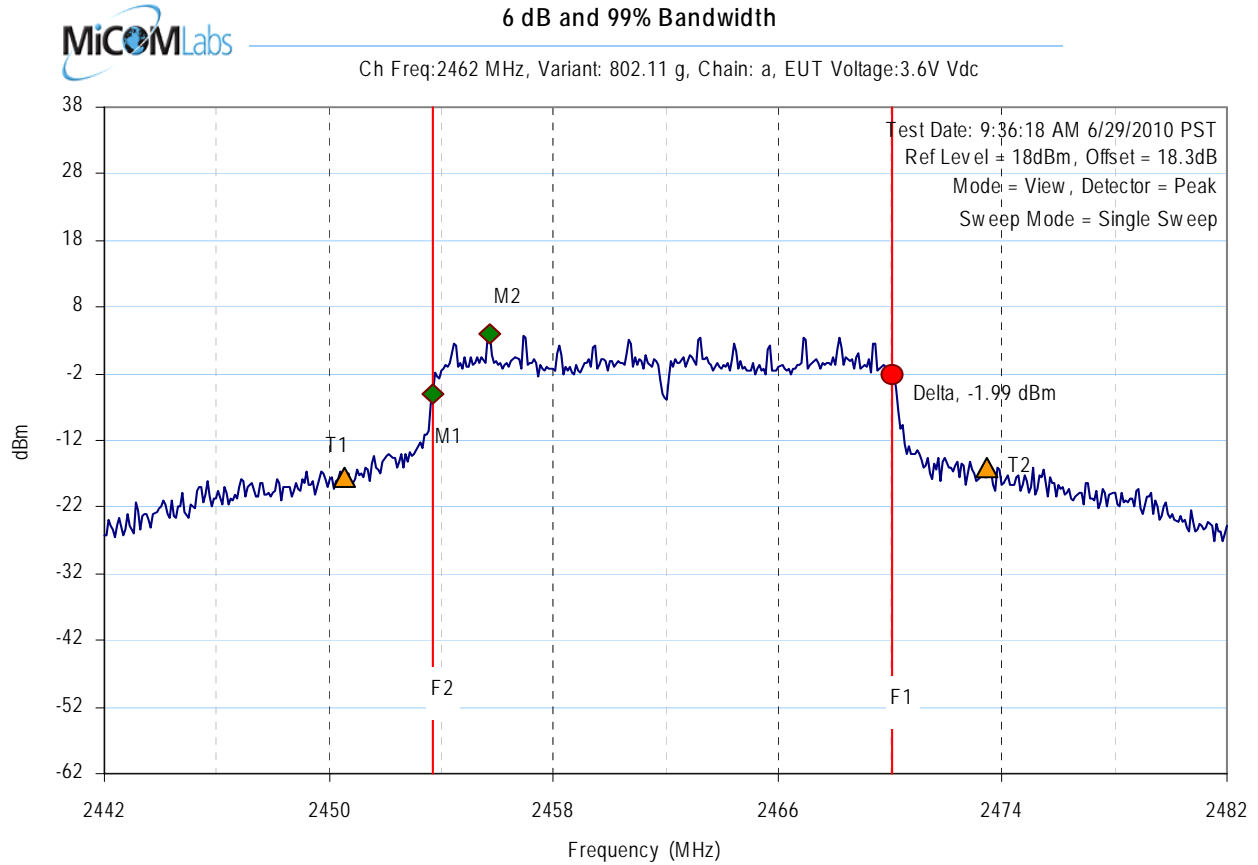
Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2403.943888MHz : -3.613dBm	Center frequency = 2412MHz
VBW = 300.00KHz	M2 : 2416.929860MHz : 3.870dBm	6dB BW(Delta-M1) = 16.192385MHz
Sweep time(s) = 20	Delta : 2420.136273MHz : -1.310dBm	99% OBW(T2-T1) = 22.284569MHz
RF Atten (dB) = 10	T1 : 2402.100200MHz : -14.957dBm	
Span = 40.00MHz	T2 : 2424.304609MHz : -18.274dBm	

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Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2428.703407MHz : -4.410dBm	Center frequency = 2437MHz
VBW = 300.00KHz	M2 : 2430.707415MHz : 4.901dBm	6dB BW(Delta-M1) = 16.112224MHz
Sweep time(s) = 20	Delta : 2444.815631MHz : -1.011dBm	99% OBW(T2-T1) = 24.529058MHz
RF Atten (dB) = 10	T1 : 2424.214429MHz : -14.221dBm	
Span = 40.00MHz	T2 : 2448.663327MHz : -16.938dBm	

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Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2453.703407MHz : -5.044dBm	Center frequency = 2462MHz
VBW = 300.00KHz	M2 : 2455.707415MHz : 3.985dBm	6dB BW(Delta-M1) = 16.352705MHz
Sweep time(s) = 20	Delta : 2470.056112MHz : -1.986dBm	99% OBW(T2-T1) = 22.925852MHz
RF Atten (dB) = 10	T1 : 2450.577154MHz : -17.554dBm	
Span = 40.00MHz	T2 : 2473.422846MHz : -16.106dBm	

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### 7.1.3 DSSS

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	DSSS	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	N/A	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi
<b>Applied Voltage:</b>	3.6V Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

#### 6 dB Bandwidth

Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz				kHz	MHz	
MHz	a	b	c	d			MHz
2441.75	22.557114	-	-	-	500	0.5	-22.057114

#### 99% Bandwidth

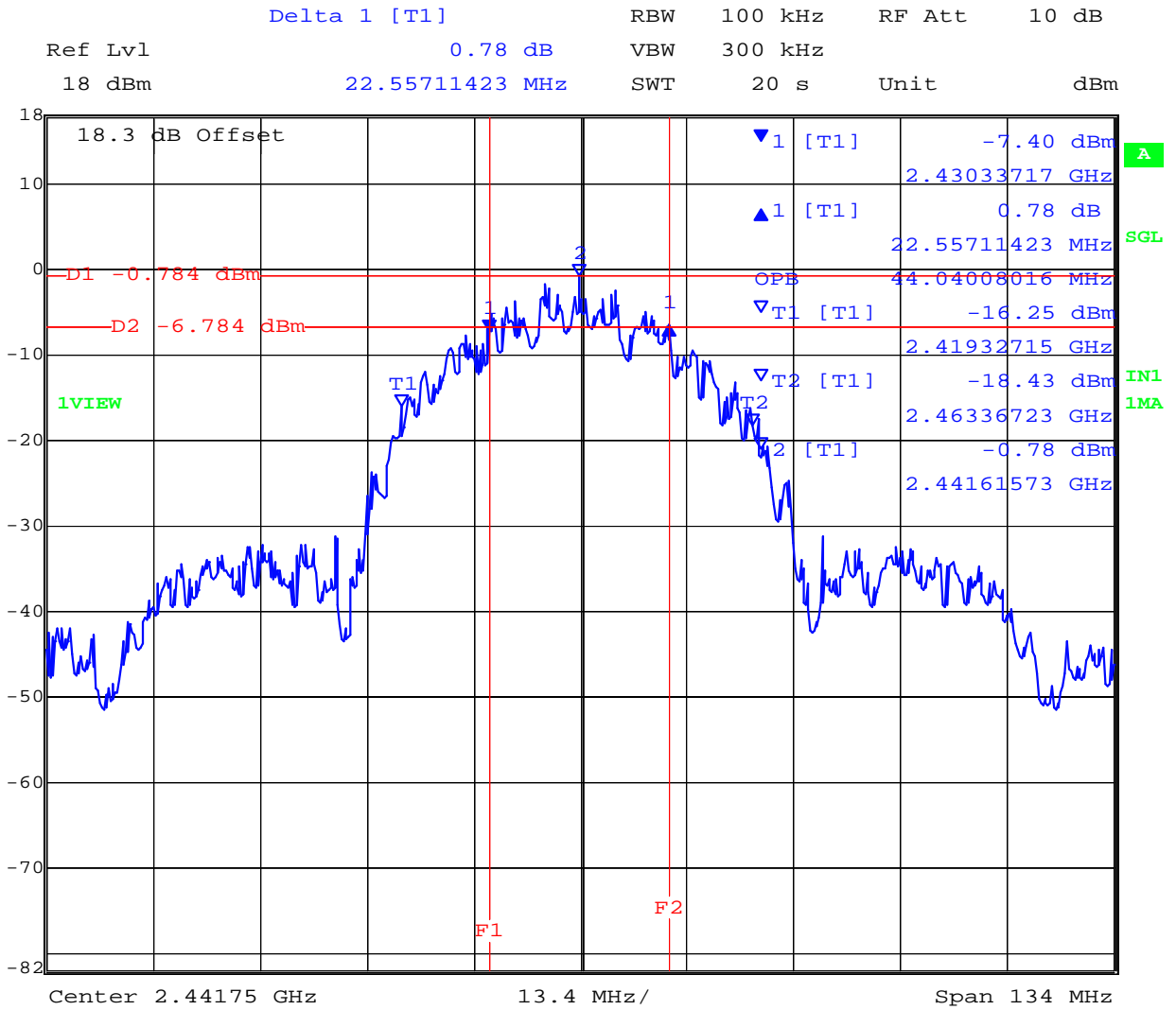
Test Frequency	99 % Bandwidth						
	MHz						
MHz	a	b	c	d			
2441.75	44.040000	-	-	-			

<b>Measurement uncertainty:</b>	±2.81 dB
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Date: 29.JUN.2010 10:45:40

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#### 7.1.4 OOK

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	OOK	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	N/A	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi
<b>Applied Voltage:</b>	3.6V Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

#### 6 dB Bandwidth

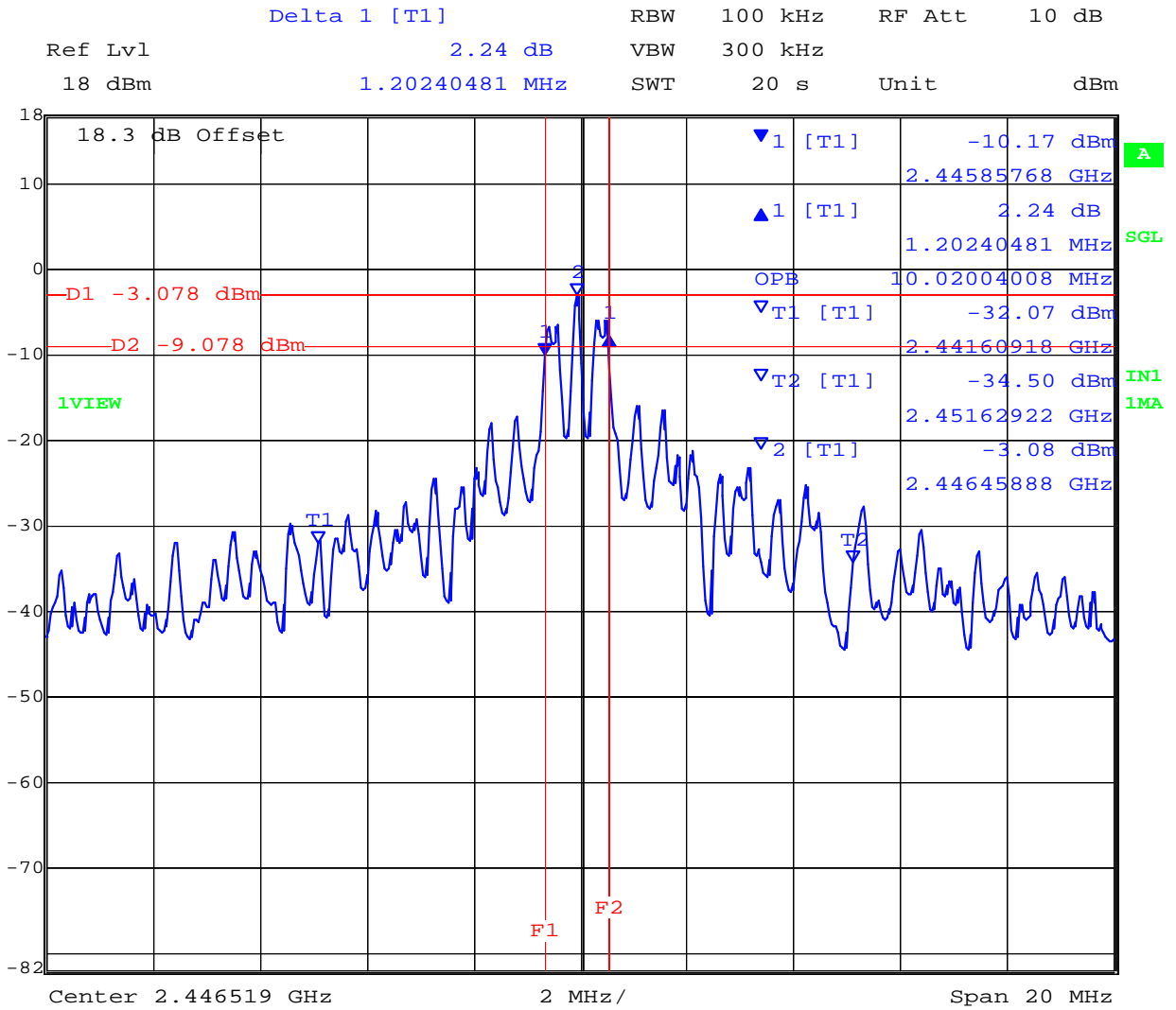
Test Frequency MHz	6 dB Bandwidth MHz				Minimum 6dB Bandwidth Limit		Margin MHz
	a	b	c	d	kHz	MHz	
2446.519	1.202405	--	--	--	500	0.5	-0.702405

#### 99% Bandwidth

Test Frequency MHz	99 % Bandwidth MHz						
	a	b	c	d			
2446.519	10.020040	--	--	--			

<b>Measurement uncertainty:</b>	±2.81 dB
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**7.1.5 Client Mode – b Mode**

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11b	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi
<b>Applied Voltage:</b>	3.60 Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

**6 dB Bandwidth**

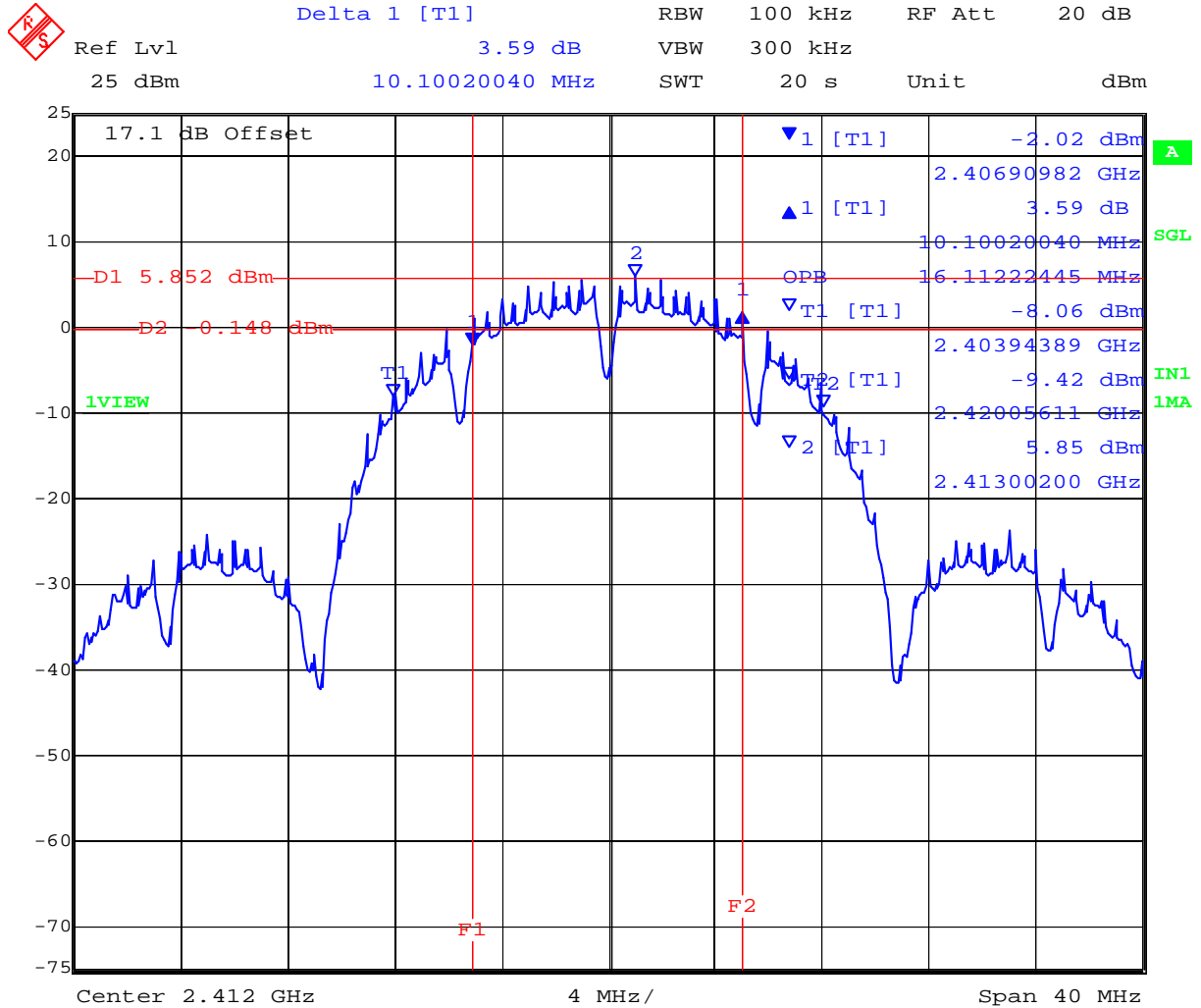
Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz				kHz	MHz	
MHz	a	b	c	d			
2412.000	10.100000	--	--	--	500	0.5	-9.600000
2437.000	10.100000	--	--	--			-9.600000
2462.000	10.100000	--	--	--			-9.600000

**99% Bandwidth**

Test Frequency	99 % Bandwidth						
	MHz						
MHz	a	b	c	d			
2412.000	16.112000	--	--	--			
2437.000	16.192000	--	--	--			
2462.000	16.192000	--	--	--			

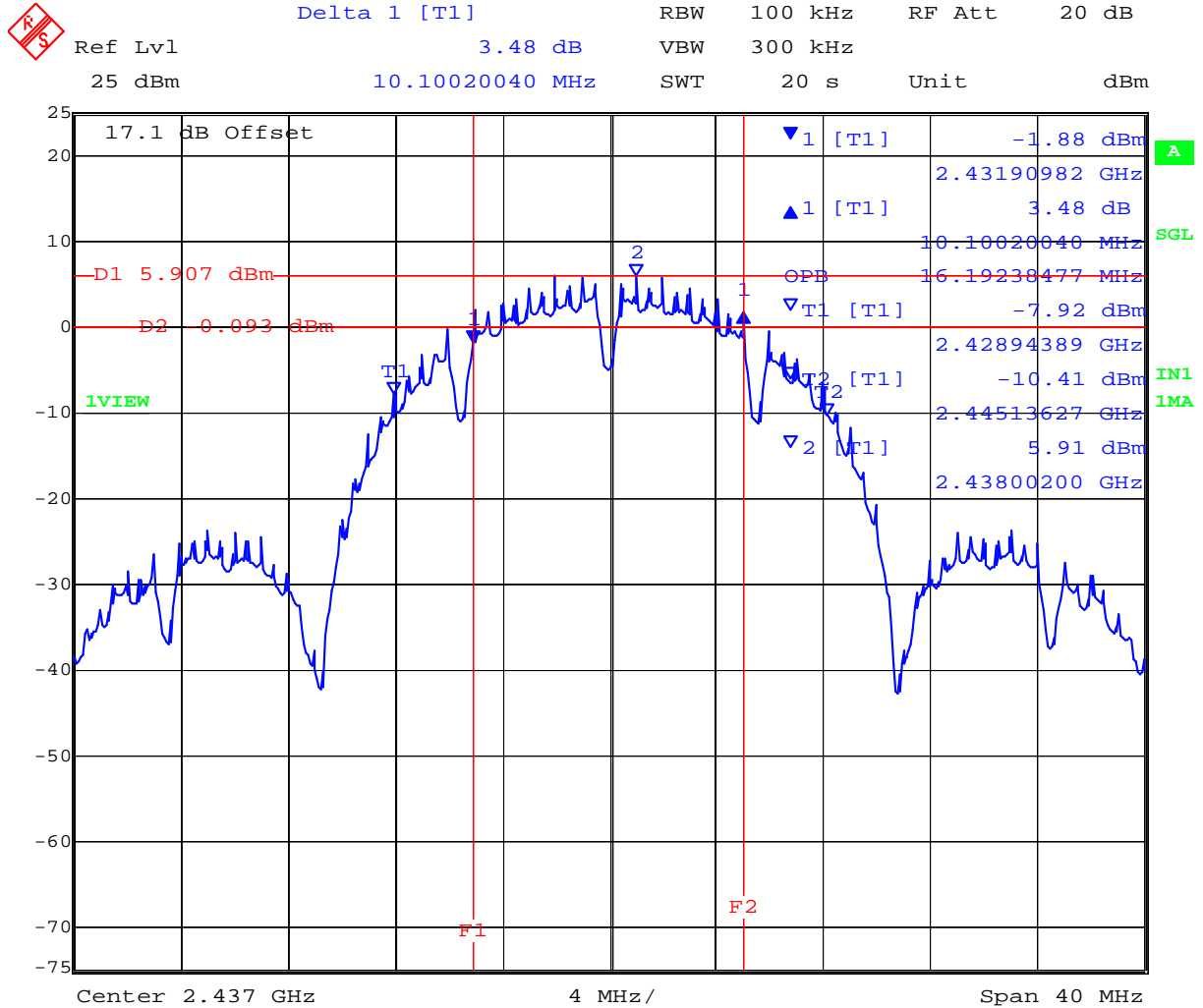
<b>Measurement uncertainty:</b>	±2.81 dB
---------------------------------	----------

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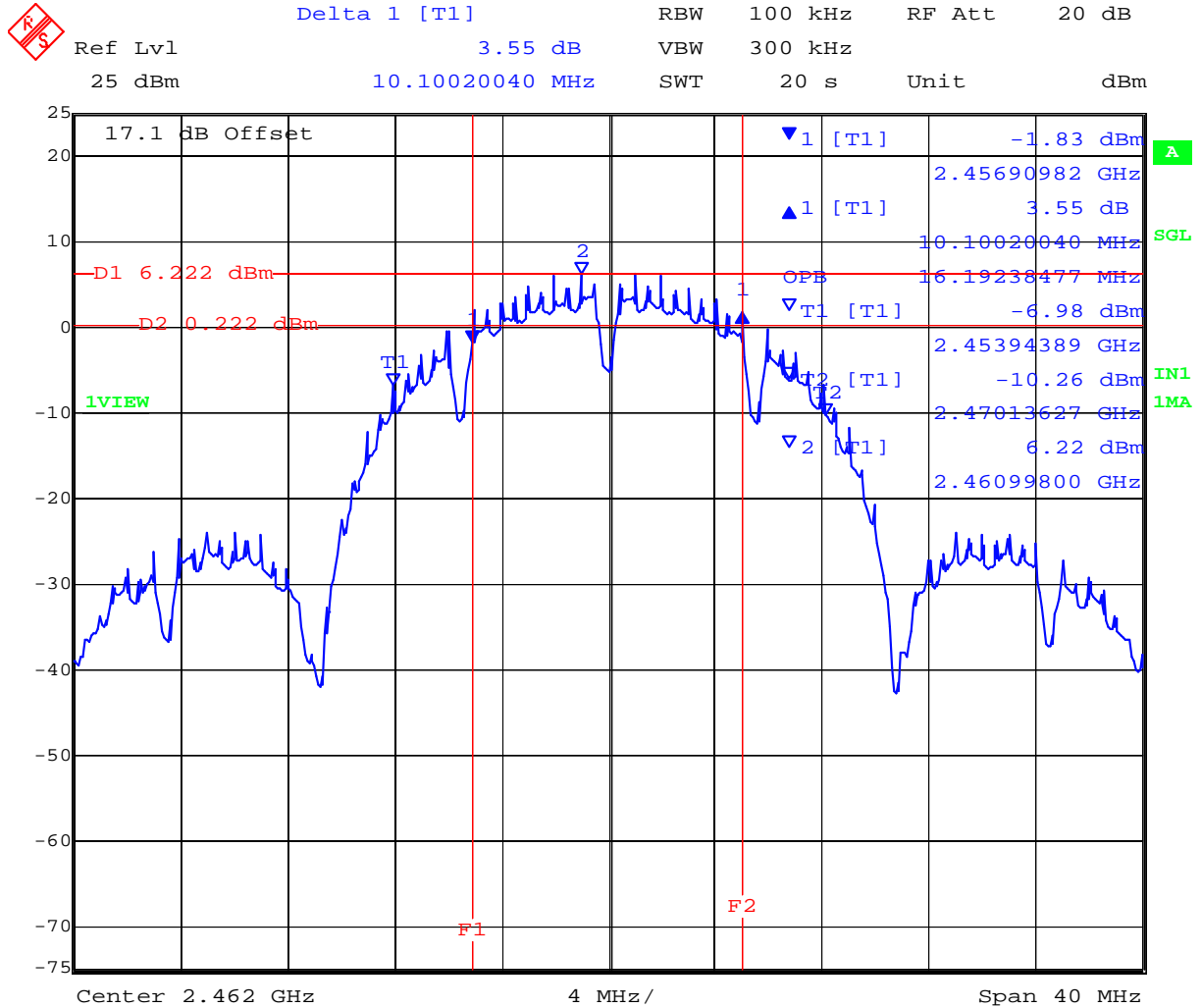
Date: 29.MAY.2012 09:57:41

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Date: 29.MAY.2012 10:43:24

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Date: 29.MAY.2012 10:56:24

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### 7.1.6 Client Mode – g Mode

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11g	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi
<b>Applied Voltage:</b>	3.60 Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

#### 6 dB Bandwidth

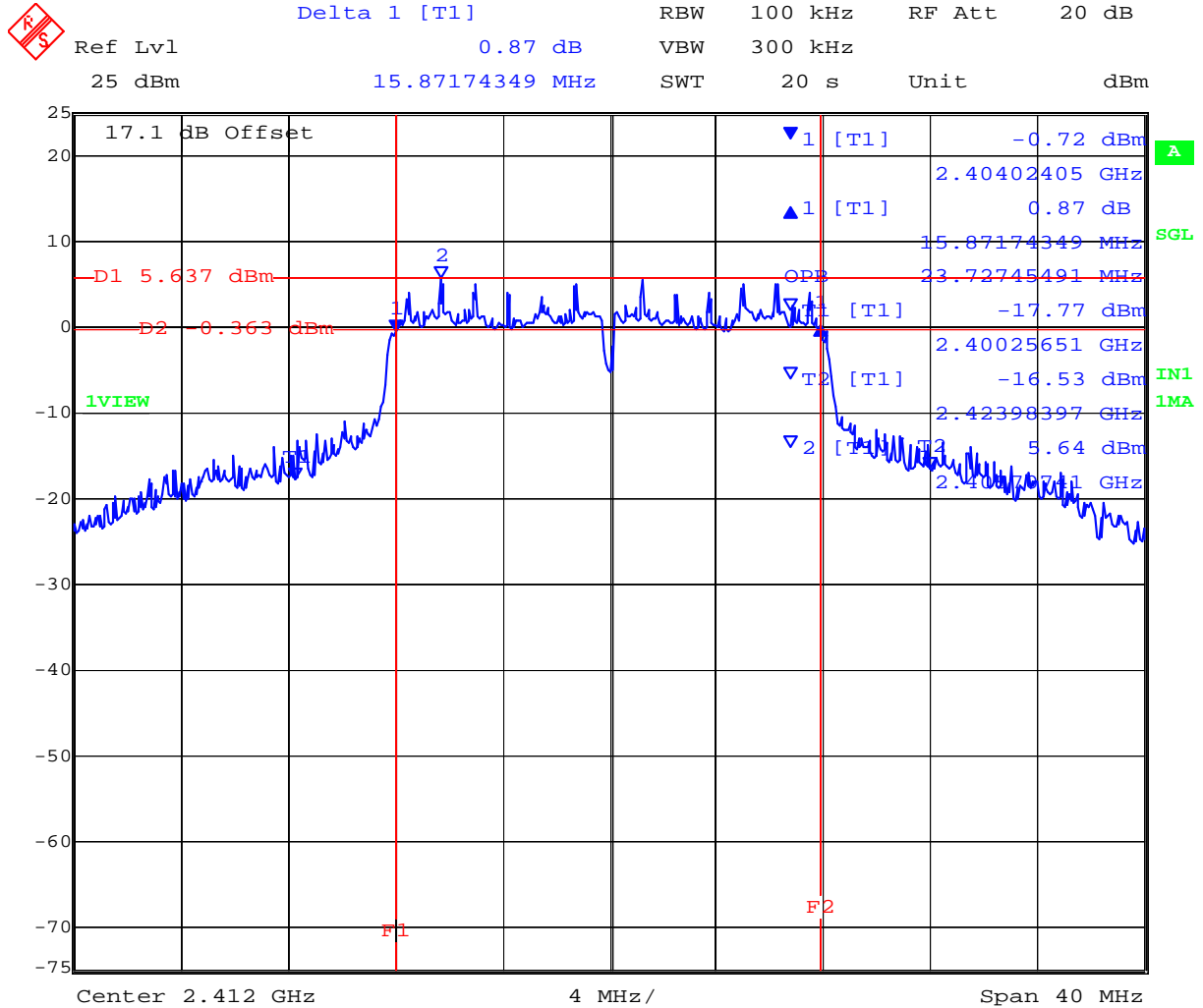
Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz				kHz	MHz	
MHz	a	b	c	d			
2412.000	15.872000	--	--	--	500	0.5	-15.372000
2437.000	15.872000	--	--	--			-15.372000
2462.000	16.353000	--	--	--			-15.853000

#### 99% Bandwidth

Test Frequency	99 % Bandwidth					
	MHz					
MHz	a	b	c	d		
2412.000	23.727000	--	--	--		
2437.000	23.808000	--	--	--		
2462.000	24.289000	--	--	--		

<b>Measurement uncertainty:</b>	±2.81 dB
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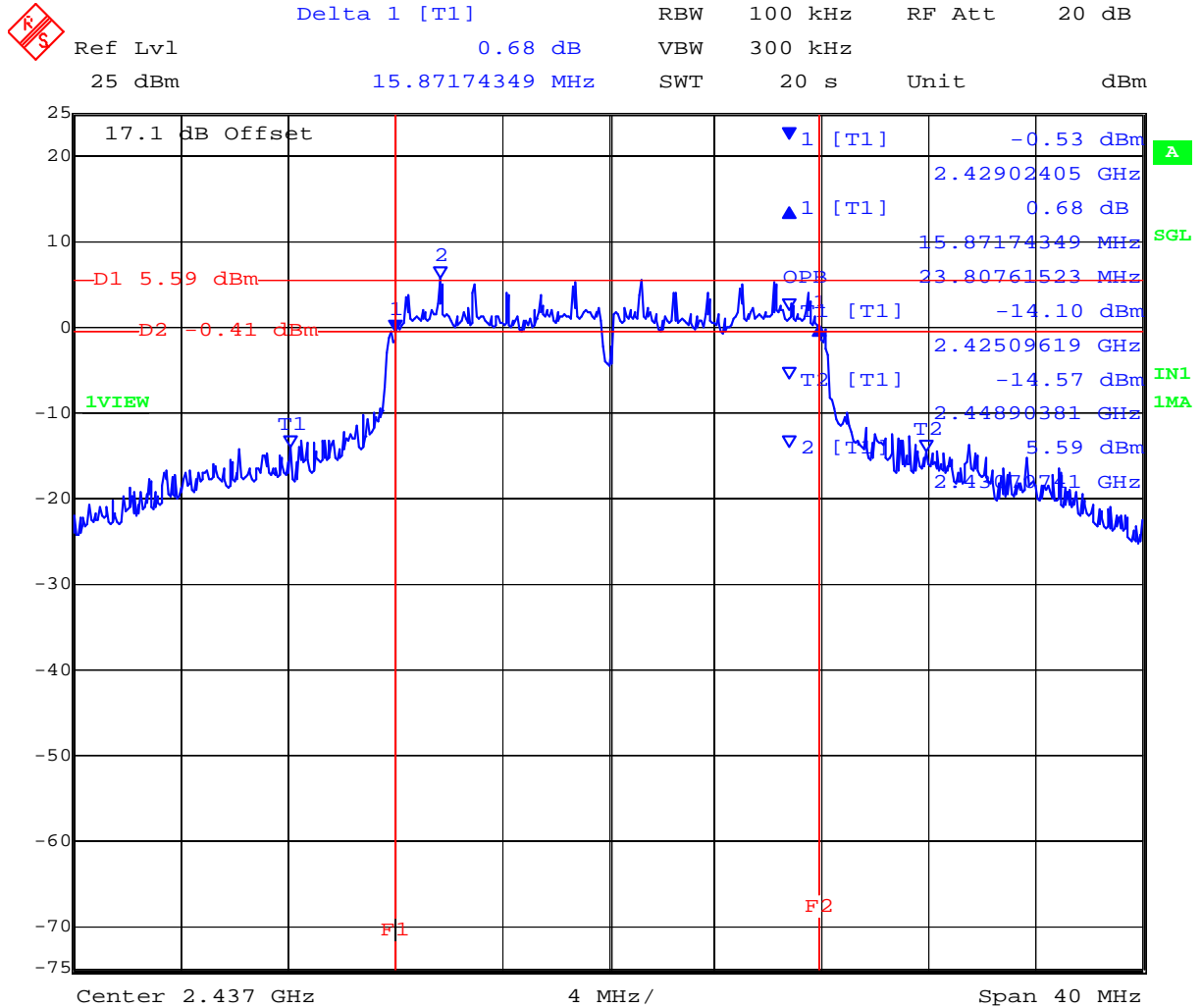


Date: 29.MAY.2012 11:14:22

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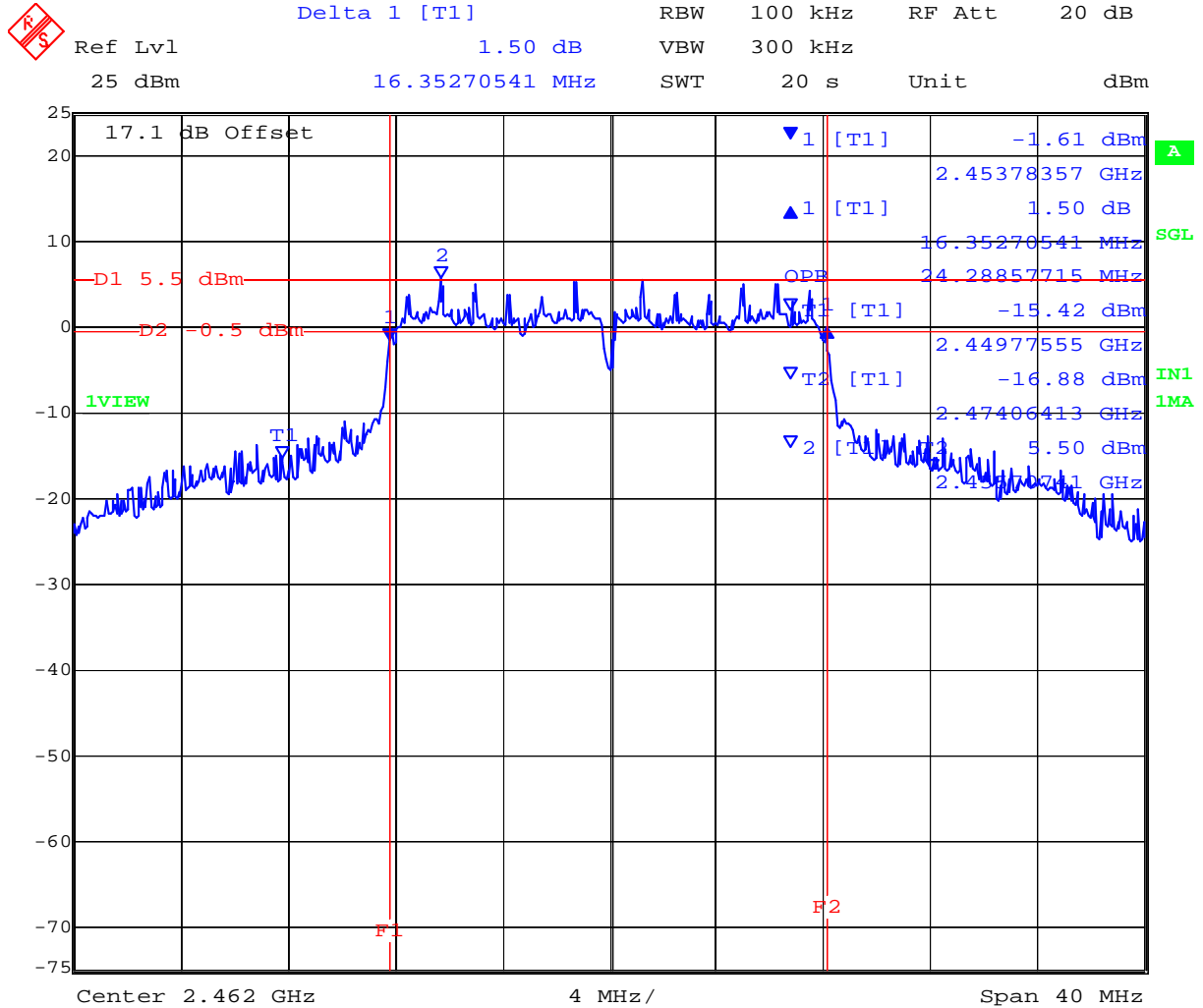


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Date: 29.MAY.2012 11:30:42

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Date: 29.MAY.2012 11:43:33

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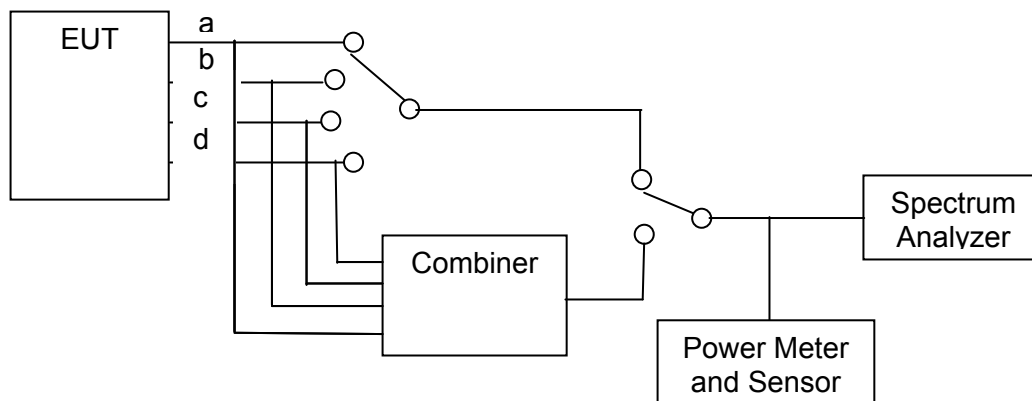
## 7.2 Peak Output Power

### 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 set-up for Peak Output Power

$$\text{Total Power} = A + G + Y + 10 \log (1/x) \text{ dBm}$$

A = Total Power  $[10 \log_{10} (10a/10 + 10b/10 + 10c/10 + 10d/10)]$ , G = Antenna Gain,

Y = Beam Forming Gain, x = Duty Cycle



## Specification

### Limits

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

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

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

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

(1) Fixed point-to-point operation:

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

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

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

### 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



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**7.2.1 802.11 b**

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11 b	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi
<b>Applied Voltage:</b>	3.6V Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

Test Frequency MHz	Measured Peak Power RF Port (dBm)				Total Power (dBm)		Limit	Margin
	a	b	c	d	Combined	Calculated	dBm	dB
2412	14.00	--	--	--		14.00	30.00	-16.00
2437	16.21	--	--	--		16.21	30.00	-13.79
2462	16.00	--	--	--		16.00	30.00	-14.00

<b>Measurement uncertainty:</b>	±1.33 dB
---------------------------------	----------

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**Title:** Zebra Technologies Corporation  
WhereTag IV Module

**To:** FCC 47 CFR Part 15, SubPart 15.247

**Serial #:** GBCC04-U1 Rev A

**Issue Date:** 7th July 2012

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**7.2.2 802.11 g**

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11 g	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi		
<b>Applied Voltage:</b>	3.6V Vdc				
<b>Notes 1:</b>					
<b>Notes 2:</b>					

Test Frequency	Measured Peak Power				Total Power (dBm)		Limit dBm	Margin dB
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d				
2412	15.19	--	--	--	15.19	15.19	30.00	-14.81
2437	15.99	--	--	--	16.00	15.99	30.00	-14.00
2462	15.13	--	--	--	15.13	15.13	30.00	-14.87

<b>Measurement uncertainty:</b>	±1.33 dB
---------------------------------	----------

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### 7.2.3 DSSS

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35	to	42			
<b>Variant:</b>	ISO 24730 DSSS	<b>Ambient Temp. (°C):</b>	19	to	22			
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003			
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100					
<b>Beam Forming Gain</b>	N/A dB	<b>Antenna Gain:</b>	2		dBi			
<b>Applied Voltage:</b>	3.6V Vdc							
<b>Notes 1:</b>								
<b>Notes 2:</b>								
Test Frequency	Measured Peak Power				Total Power (dBm)		Limit	Margin
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d				
2442	14.91	--	--	--		14.91	30.00	-15.09
<b>Measurement uncertainty:</b>						±1.33 dB		

### 7.2.4 OOK

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35	to	42			
<b>Variant:</b>	ISO 24730 OOK	<b>Ambient Temp. (°C):</b>	19	to	22			
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003			
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100					
<b>Beam Forming Gain</b>	N/A dB	<b>Antenna Gain:</b>	2		dBi			
<b>Applied Voltage:</b>	3.6V Vdc							
<b>Notes 1:</b>								
<b>Notes 2:</b>								
Test Frequency	Measured Peak Power				Total Power (dBm)		Limit	Margin
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d				
2442	1.27	--	--	--		1.27	30.00	-28.73
<b>Measurement uncertainty:</b>						±1.33 dB		

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### 7.2.5 Client Mode – b Mode

#### Average Power

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11b	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain (Y):</b>	N/A	<b>Antenna Gain:</b>	2.5 dBi		
<b>Applied Voltage:</b>	3.48	Vdc			
<b>Notes 1:</b>					
<b>Notes 2:</b>					

Test Frequency	Measured Peak Power				Total Power (dBm)		Limit	Margin
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d				
2412	9.77	--	--	--	N/A	9.77	30.00	-20.23
2437	9.81	--	--	--	N/A	9.81	30.00	-20.19
2462	9.90	--	--	--	N/A	9.90	30.00	-20.10

<b>Measurement uncertainty:</b>	±1.33 dB
---------------------------------	----------

#### Peak Power

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11b	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain (Y):</b>	N/A	<b>Antenna Gain:</b>	2.5 dBi		
<b>Applied Voltage:</b>	3.60	Vdc			
<b>Notes 1:</b>					
<b>Notes 2:</b>					

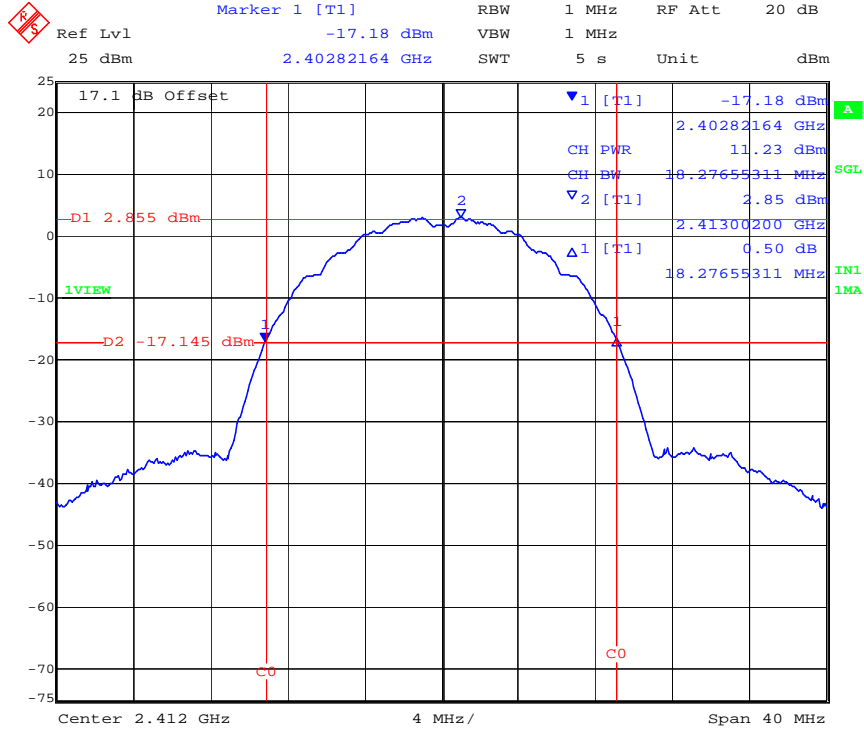
Test Frequency	Measured Peak Power				Total Power (dBm)		Limit	Margin
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d				
2412	11.23	--	--	--	N/A	11.23	30.00	-18.77
2437	11.74	--	--	--	N/A	11.74	30.00	-18.26
2462	11.56	--	--	--	N/A	11.56	30.00	-18.44

<b>Measurement uncertainty:</b>	±1.33 dB
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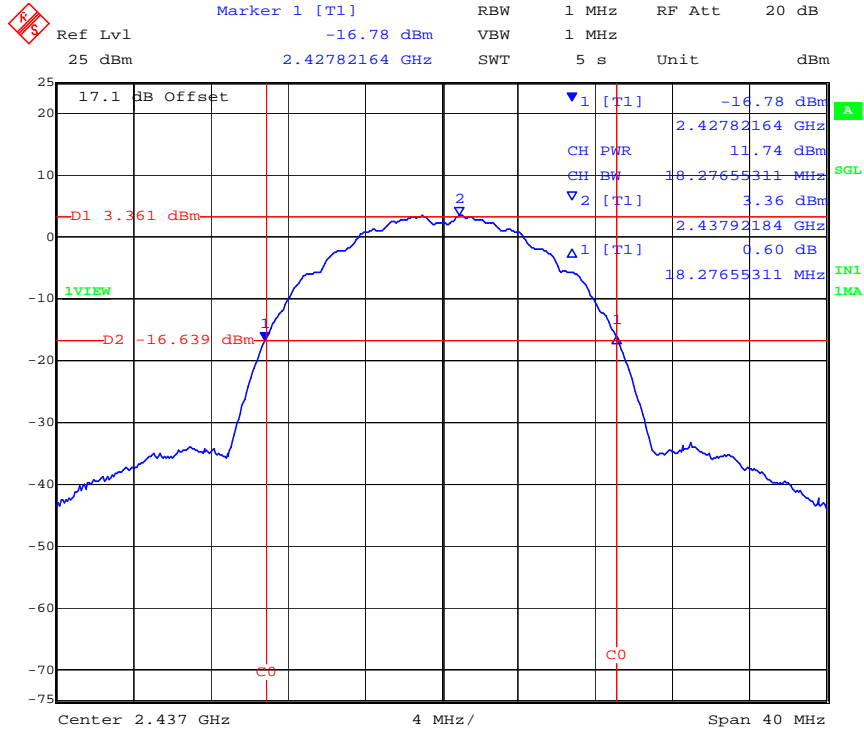


11b mode = peak power 2412 MHz



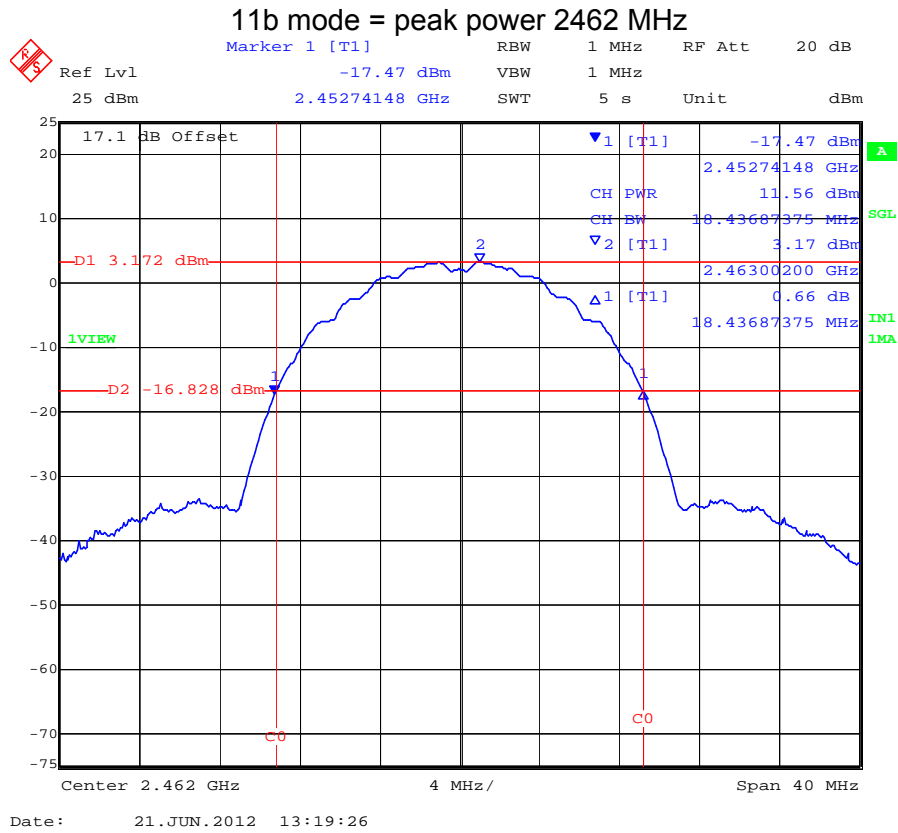
Date: 21.JUN.2012 13:15:16

11b mode = peak power 2437 MHz



Date: 21.JUN.2012 13:17:19

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### 7.2.6 Client Mode – g Mode

#### Average Power

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11g	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain (Y):</b>	N/A	<b>Antenna Gain:</b>	2.5 dBi		
<b>Applied Voltage:</b>	3.48	Vdc			
<b>Notes 1:</b>					
<b>Notes 2:</b>					

Test Frequency	Measured Peak Power				Total Power (dBm)		Limit	Margin
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d				
2412	10.50	--	--	--	N/A	10.50	30.00	-19.50
2437	11.00	--	--	--	N/A	11.00	30.00	-19.00
2462	11.03	--	--	--	N/A	11.03	30.00	-18.97

<b>Measurement uncertainty:</b>	±1.33 dB
---------------------------------	----------

#### Peak Power

<b>Test Conditions:</b>	15.247 (b)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11g	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain (Y):</b>	N/A	<b>Antenna Gain:</b>	2.5 dBi		
<b>Applied Voltage:</b>	3.60	Vdc			
<b>Notes 1:</b>					
<b>Notes 2:</b>					

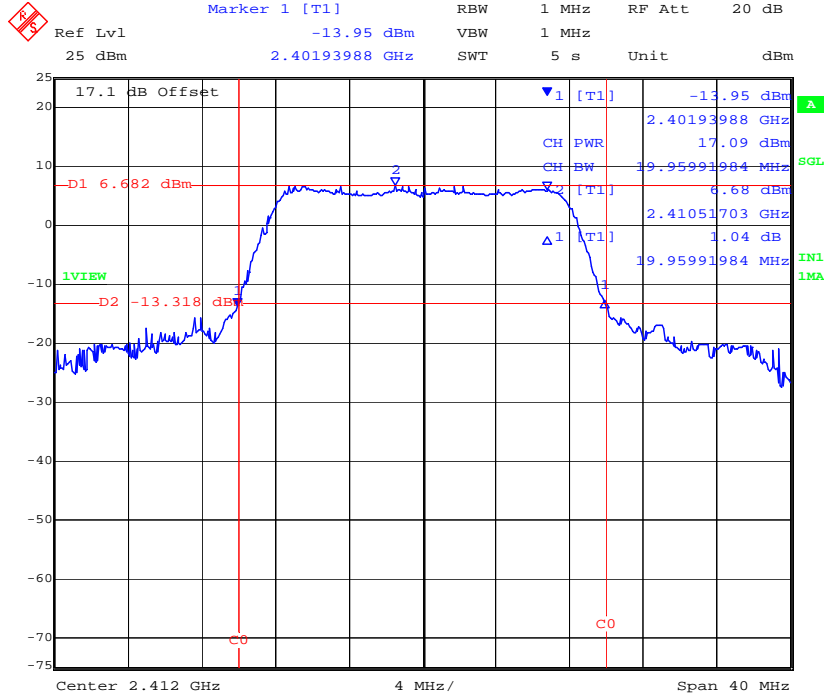
Test Frequency	Measured Peak Power				Total Power (dBm)		Limit	Margin
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d				
2412	17.09	--	--	--	N/A	17.09	30.00	-12.91
2437	17.09	--	--	--	N/A	17.09	30.00	-12.91
2462	17.27	--	--	--	N/A	17.27	30.00	-12.73

<b>Measurement uncertainty:</b>	±1.33 dB
---------------------------------	----------

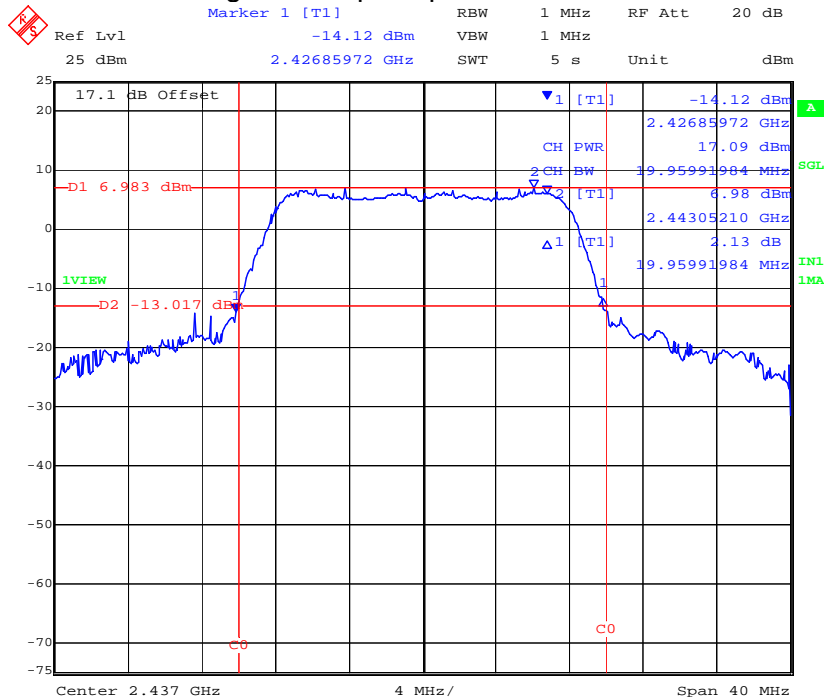
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11g mode = peak power 2412 MHz



11g mode = peak power 2437 MHz



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### 7.3 Peak Power Spectral Density

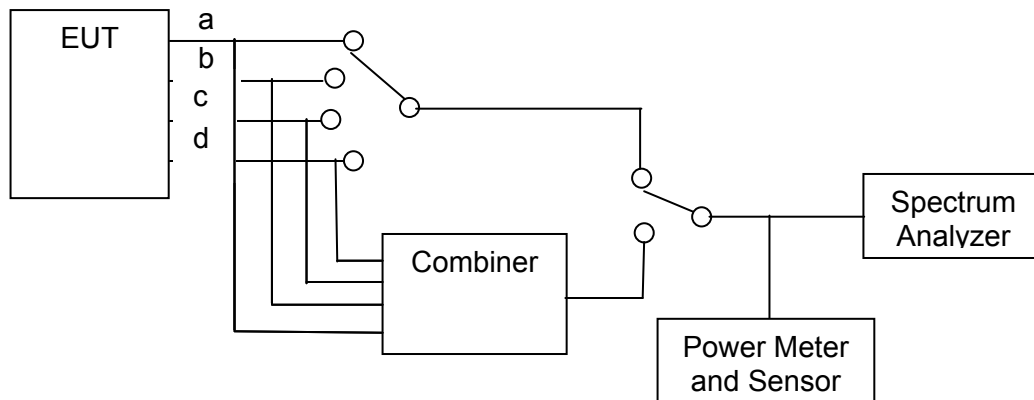
#### Test Procedure

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 set-up for Peak Power Spectral Density

#### Specification

##### Peak Power Spectral Density Limits

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

#### 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



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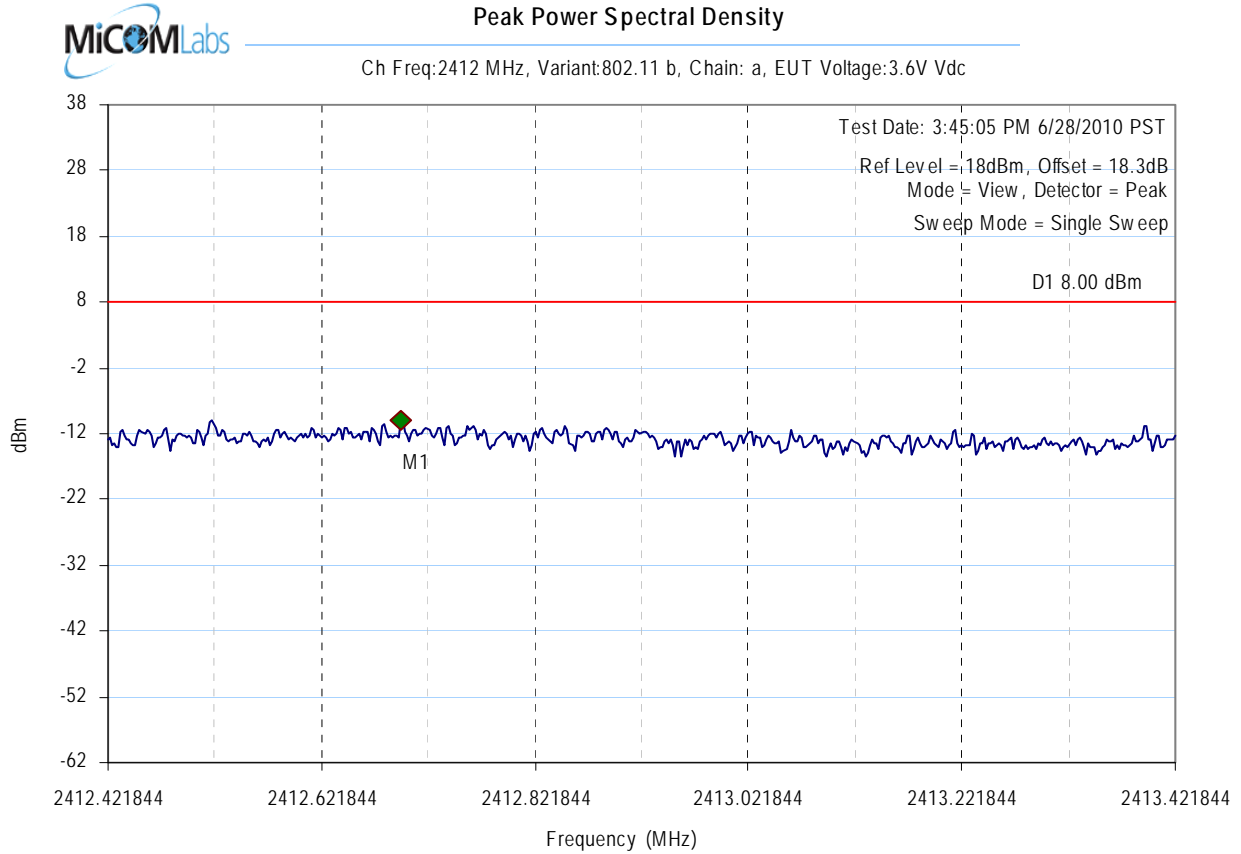
7.3.1 802.11 b

<b>Test Conditions:</b>	15.247 (e)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11 b	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming Gain</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi
<b>Applied Voltage:</b>	3.6V Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

Test Frequency	Measured Power Density				Total Peak Power Spectral Density (dBm)		Limit dBm	Margin dB
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d				
2412	-9.87	--	--	--		-9.87	8.00	-17.87
2437	-7.95	--	--	--		-7.95	8.00	-15.95
2462	-10.12	--	--	--		-10.12	8.00	-18.12

<b>Measurement uncertainty:</b>	± 1.33 dB
---------------------------------	-----------

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**Analyser Setup**

RBW = 3.00 KHz  
VBW = 10.00 KHz  
Sweep time(s) = 350  
RF Atten (dB) = 20  
Span = 1.00 MHz

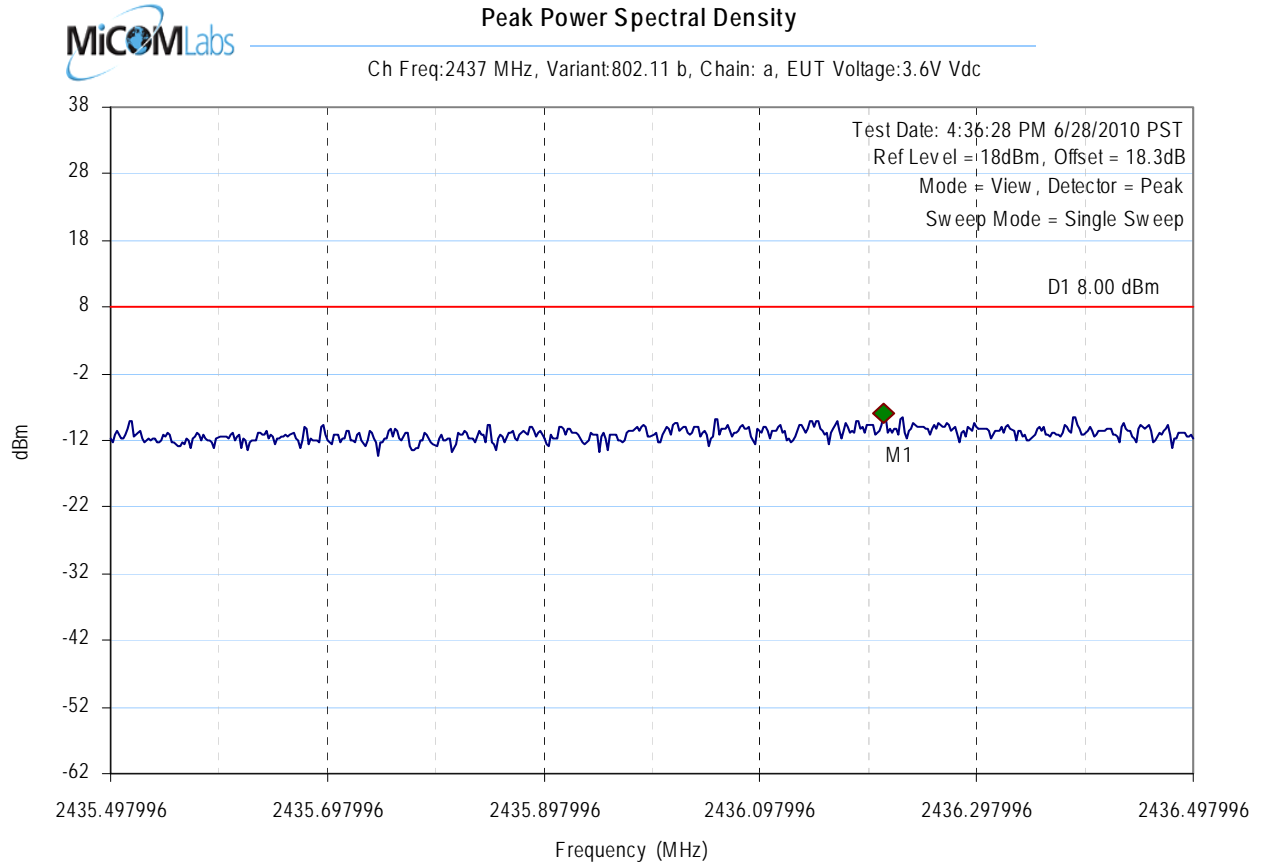
**Marker : Frequency : Amplitude**

M1 : 2412.696393 MHz : -9.87 dBm

**Test Results**

Center frequency = 2412 MHz

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**Analyser Setup**

RBW = 3.00KHz  
VBW = 10.00KHz  
Sweep time(s) = 350  
RF Atten (dB) = 20  
Span = 1.00MHz

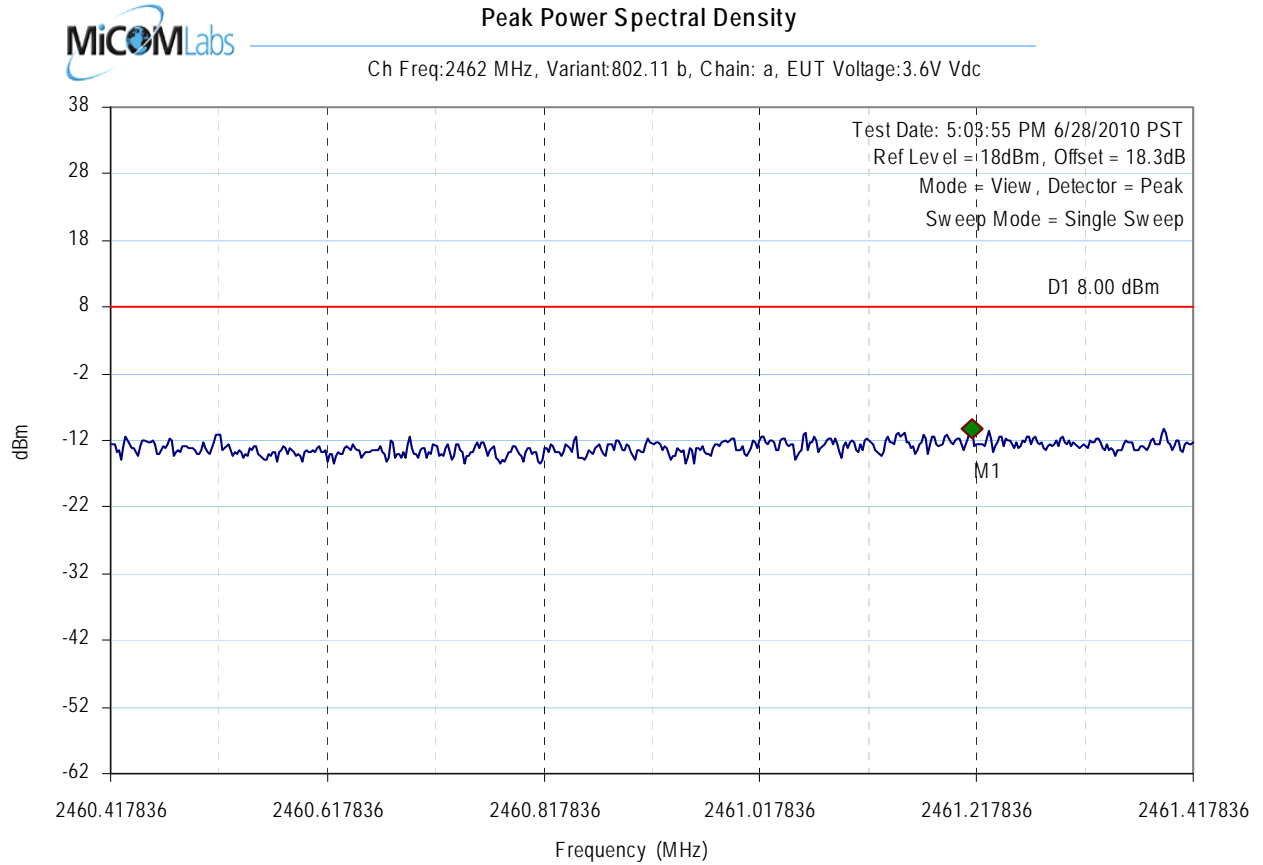
**Marker : Frequency : Amplitude**

M1 : 2436.211423MHz : -7.949dBm

**Test Results**

Center frequency = 2437MHz

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**Analyser Setup**

RBW = 3.00KHz  
VBW = 10.00KHz  
Sweep time(s) = 350  
RF Atten (dB) = 20  
Span = 1.00MHz

**Marker : Frequency : Amplitude**

M1 : 2461.213427MHz : -10.119dBm

**Test Results**

Center frequency = 2462MHz

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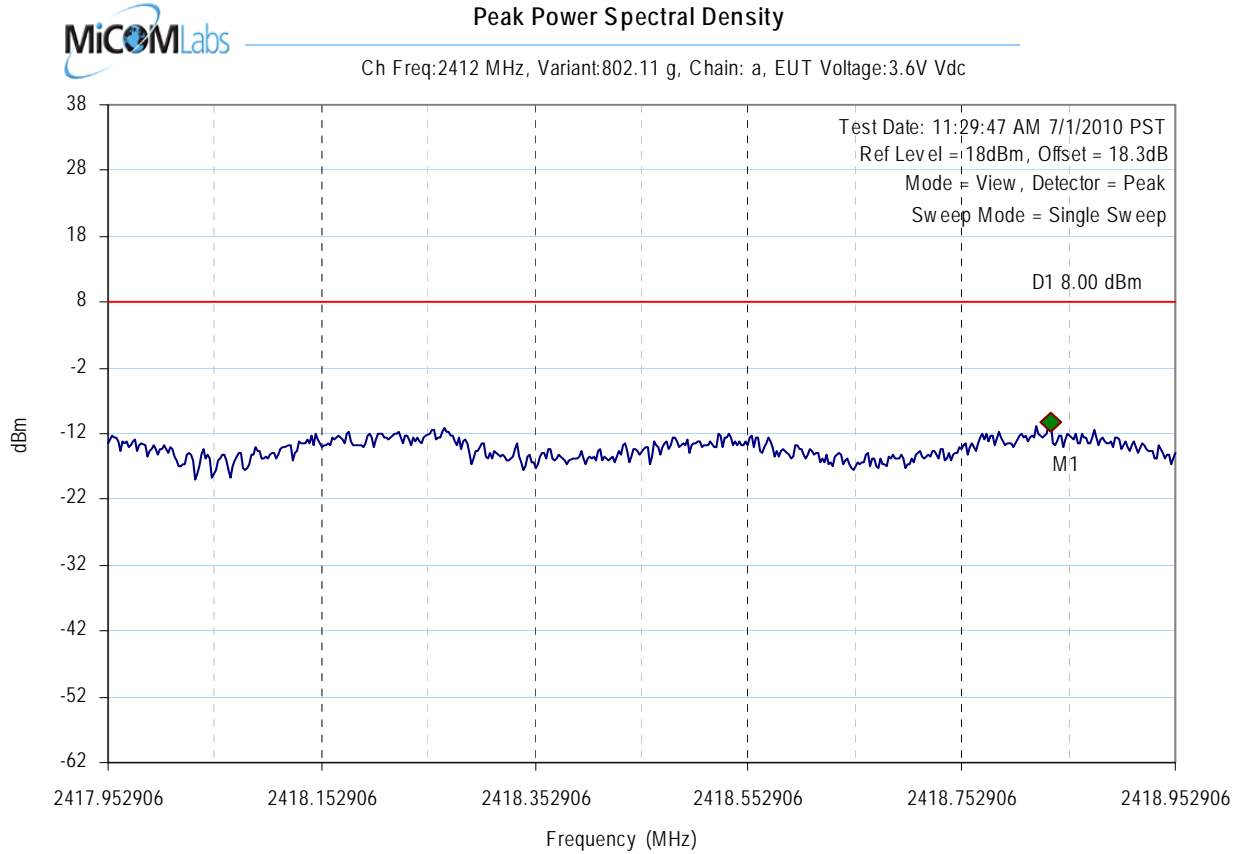
7.3.2 802.11 g

<b>Test Conditions:</b>	15.247 (e)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11 g	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming</b>	N/A dB	<b>Antenna Gain:</b>	2		dBi
<b>Applied Voltage:</b>	3.6V Vdc				
<b>Notes 1:</b>					
<b>Notes 2:</b>					

Test Frequency	Measured Power Density				Total Peak Power Spectral Density (dBm)		Limit dBm	Margin dB
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d				
2412	-10.36	--	--	--		-10.36	8.00	-18.36
2437	-9.32	--	--	--		-9.32	8.00	-17.32
2462	-9.98	--	--	--		-9.98	8.00	-17.98

<b>Measurement uncertainty:</b>	± 1.33 dB
---------------------------------	-----------

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**Analyser Setup**

RBW = 3.00 KHz  
VBW = 10.00 KHz  
Sweep time(s) = 350  
RF Atten (dB) = 20  
Span = 1.00 MHz

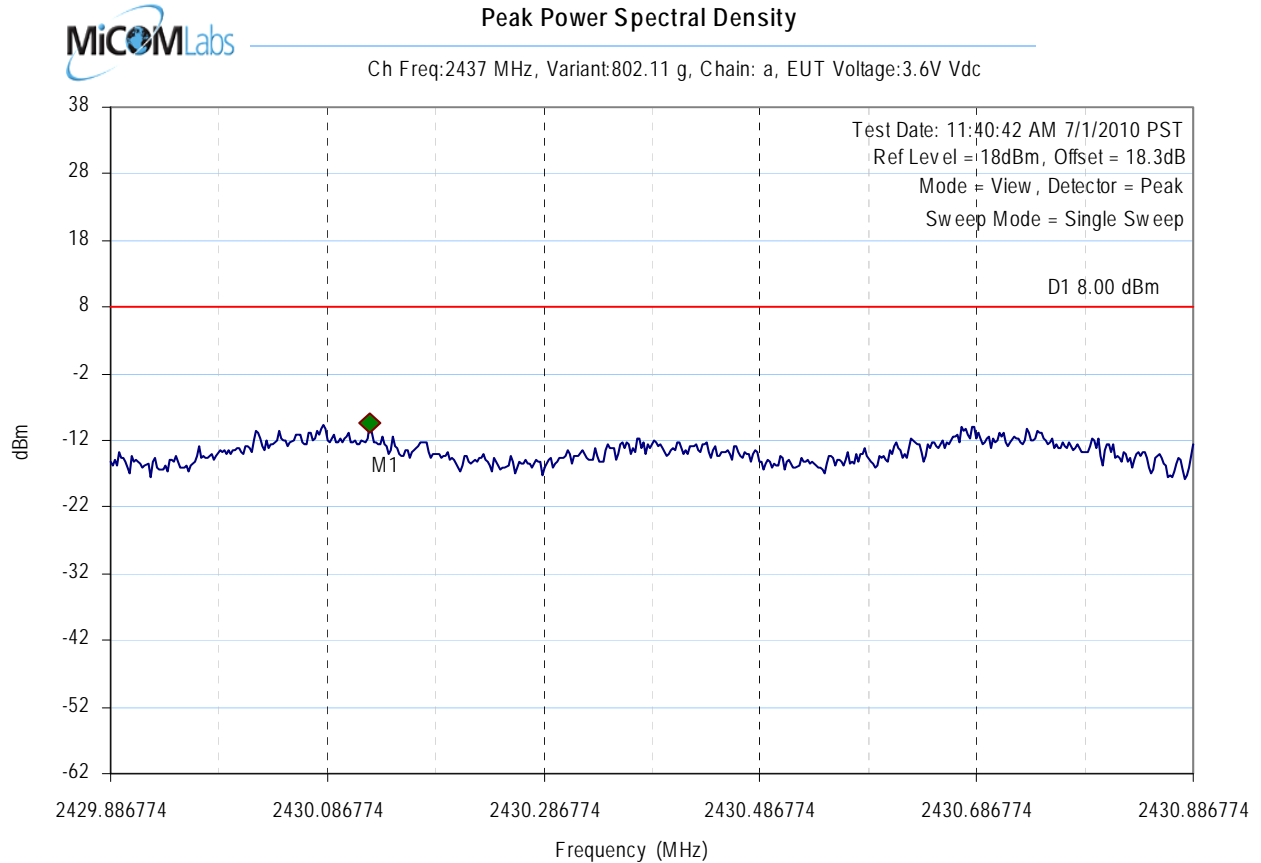
**Marker : Frequency : Amplitude**

M1 : 2418.836673 MHz : -10.359 dBm

**Test Results**

Center frequency = 2412 MHz

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**Analyser Setup**

RBW = 3.00KHz  
VBW = 10.00KHz  
Sweep time(s) = 350  
RF Atten (dB) = 20  
Span = 1.00MHz

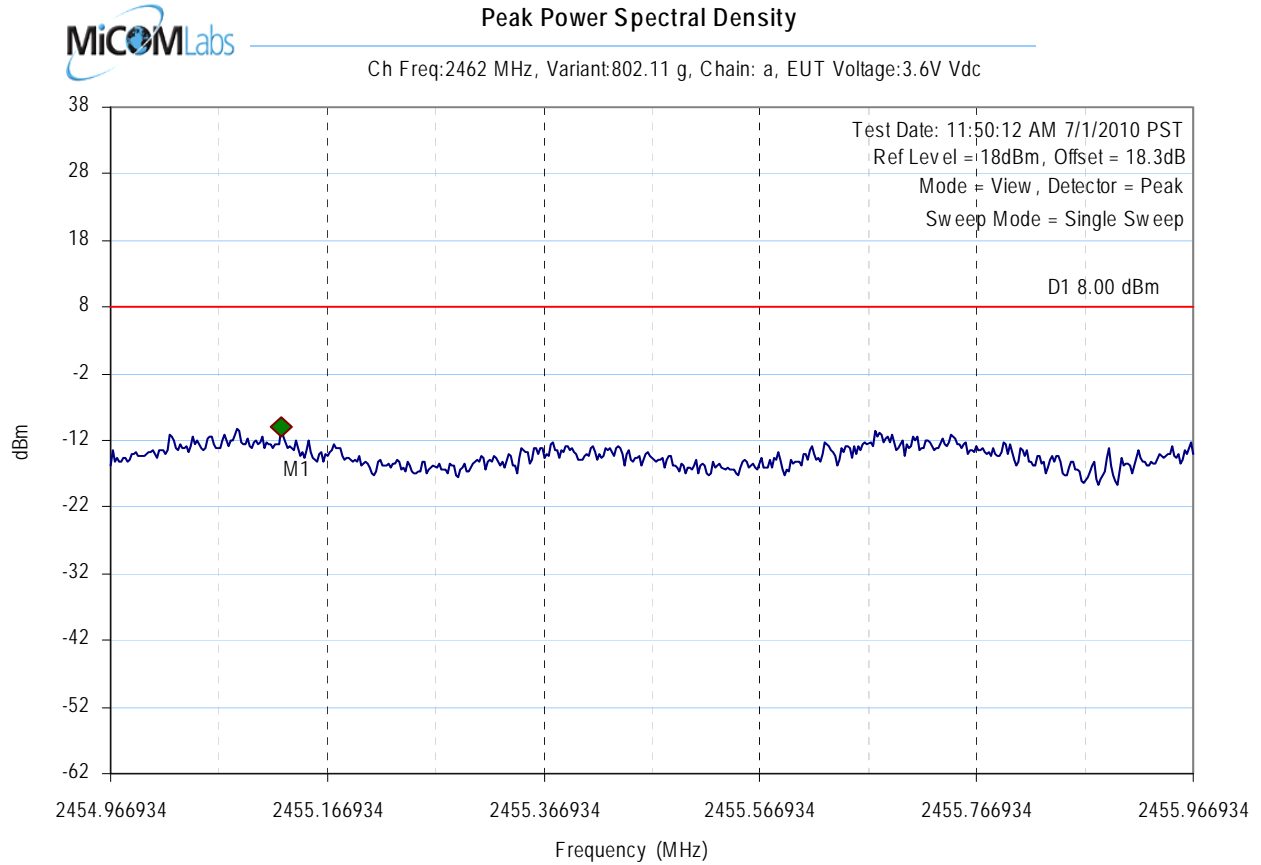
**Marker : Frequency : Amplitude**

M1 : 2430.125251MHz : -9.317dBm

**Test Results**

Center frequency = 2437MHz

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**Analyser Setup**

RBW = 3.00KHz  
VBW = 10.00KHz  
Sweep time(s) = 350  
RF Atten (dB) = 20  
Span = 1.00MHz

**Marker : Frequency : Amplitude**

M1 : 2455.125251MHz : -9.982dBm

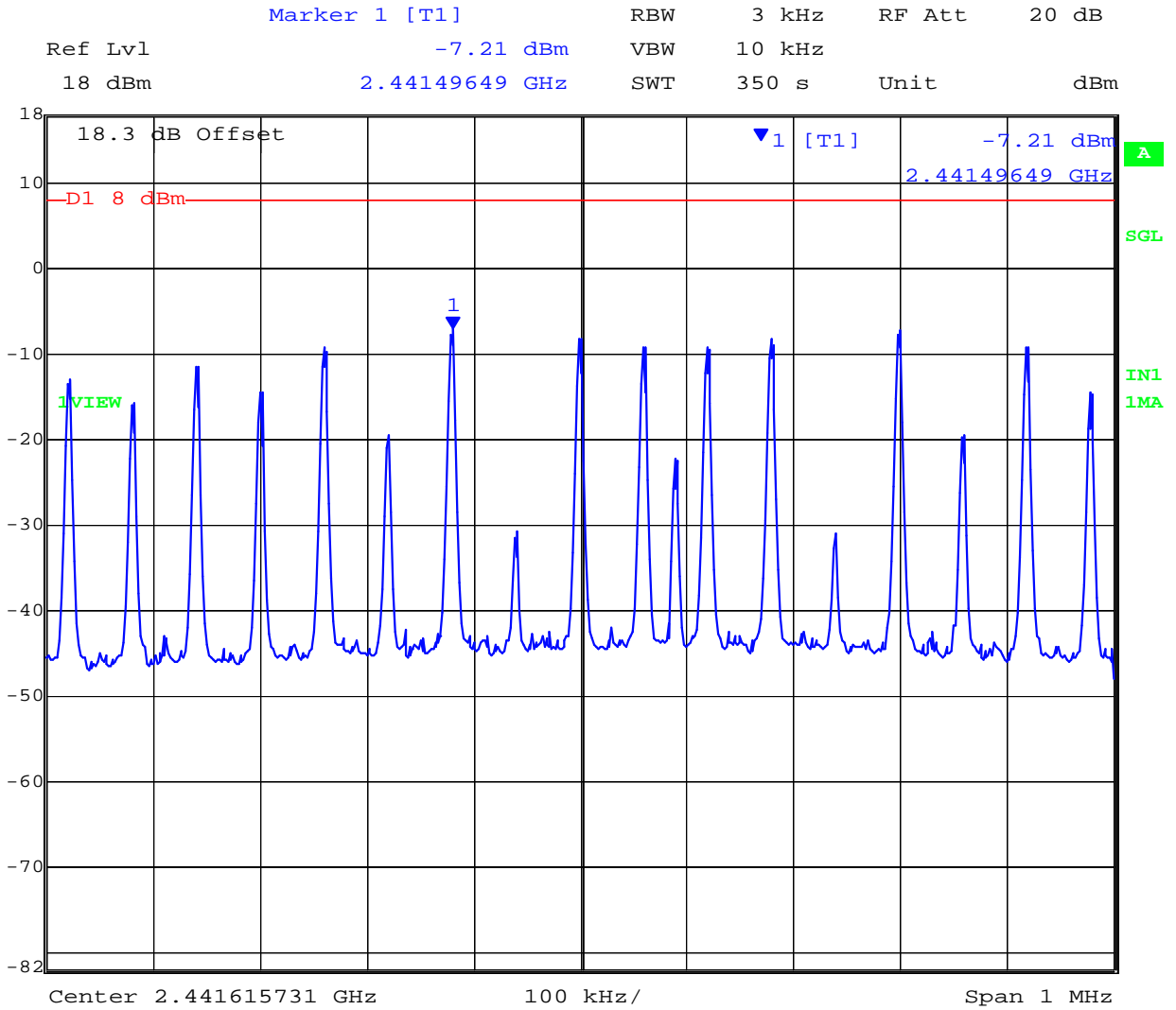
**Test Results**

Center frequency = 2462MHz

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### 7.3.3 DSSS

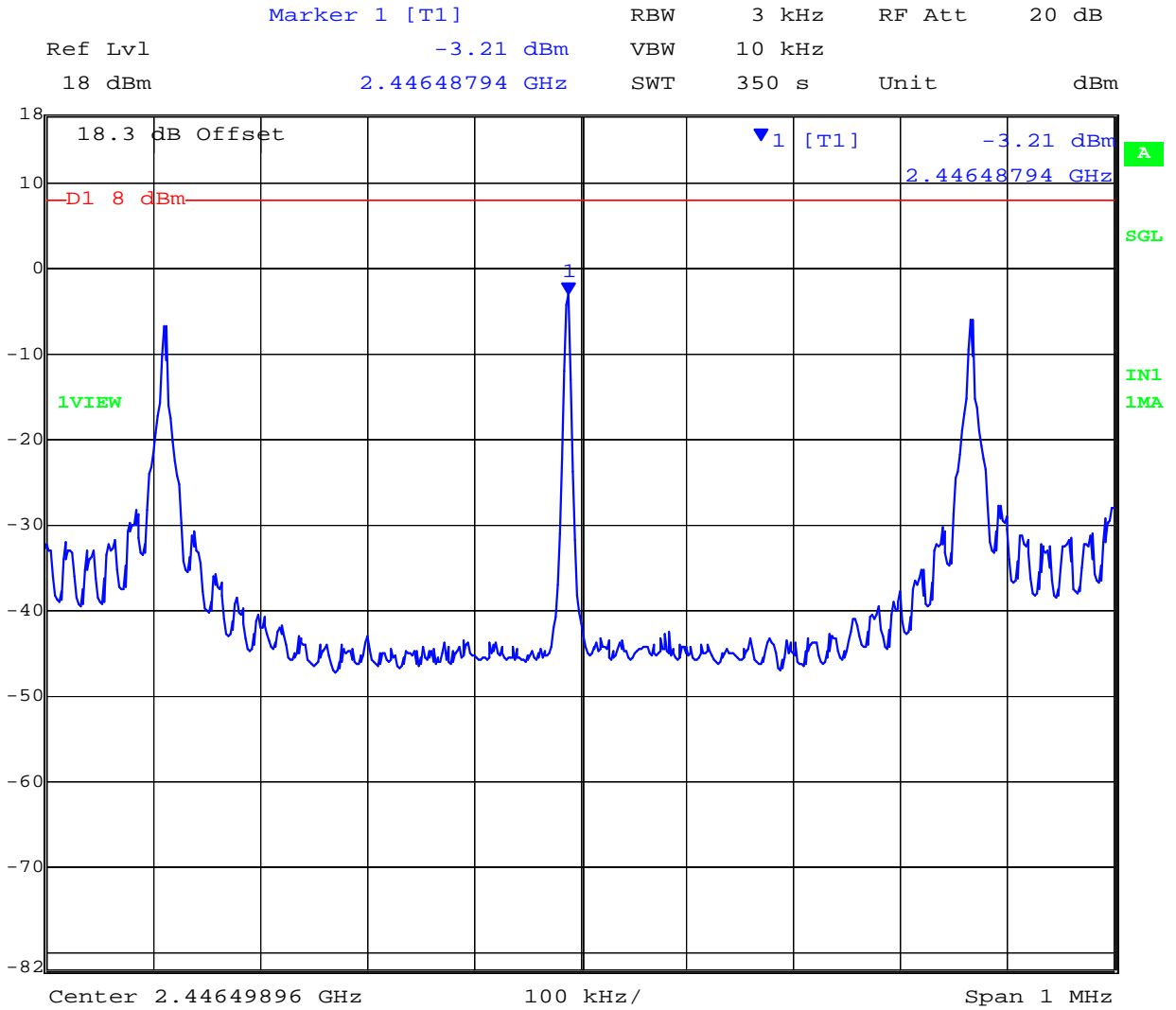


Date: 29.JUN.2010 10:53:39

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### 7.3.4 OOK



Date: 29.JUN.2010 11:18:02

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**7.3.5 Client Mode 802.11 b**

<b>Test Conditions:</b>	15.247 (e)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11b	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi		
<b>Applied Voltage:</b>	3.60 Vdc	<b>Antenna Ports (N):</b>	1		
<b>Notes 1:</b>					
<b>Notes 2:</b>					

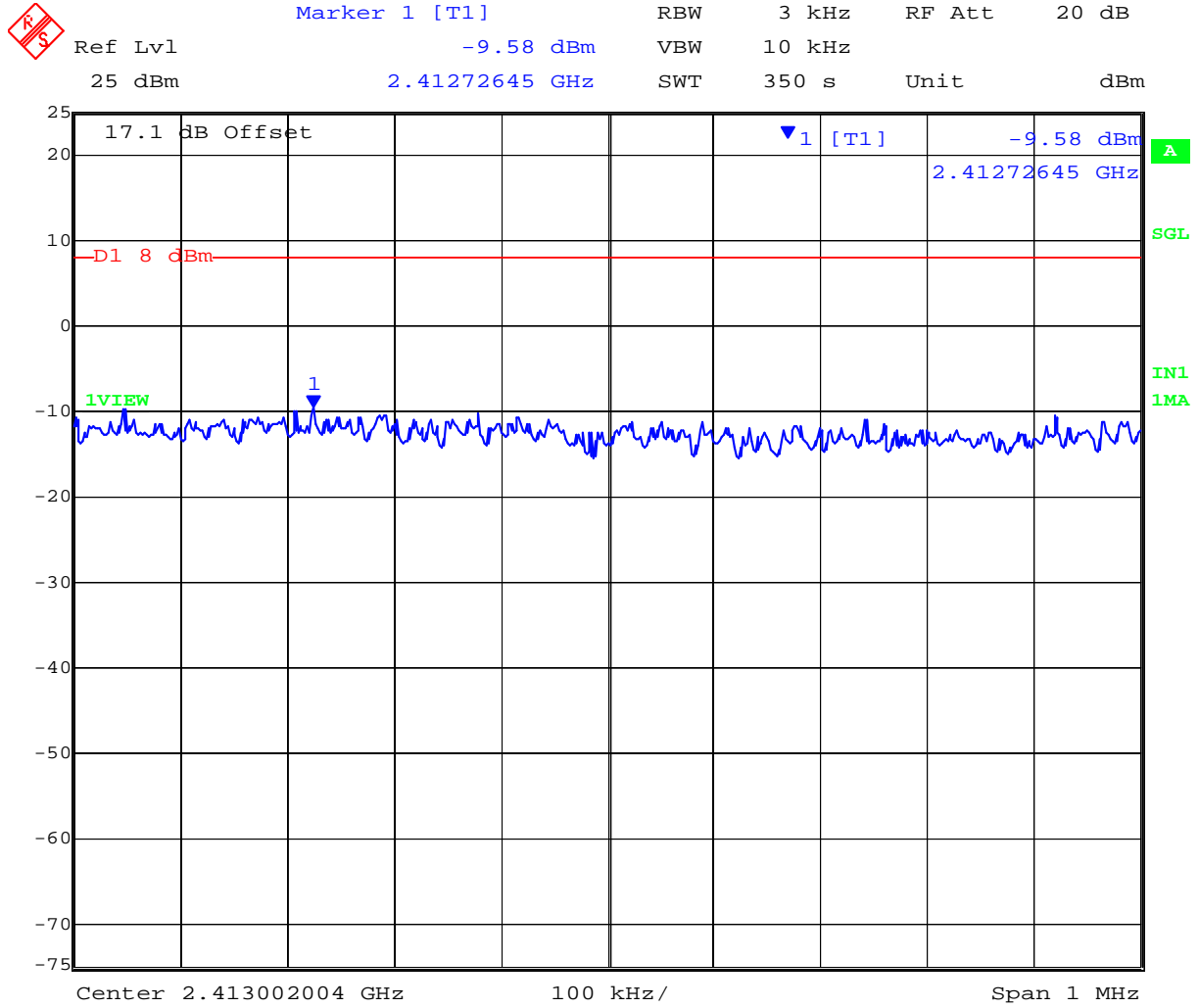
Test Frequency	Measured Power Density				Correction factor	Peak Power Spectral Density	Limit	Margin
	RF Port (dBm)							
MHz	a	b	c	d	10Log(N)	dBm	dBm	dB
2412.000	-9.58	--	--	--		-9.58	8.00	-17.58
2437.000	-9.59	--	--	--		-9.59	8.00	-17.59
2462.000	-9.69	--	--	--		-9.69	8.00	-17.69

<b>Measurement uncertainty:</b>	± 1.33 dB
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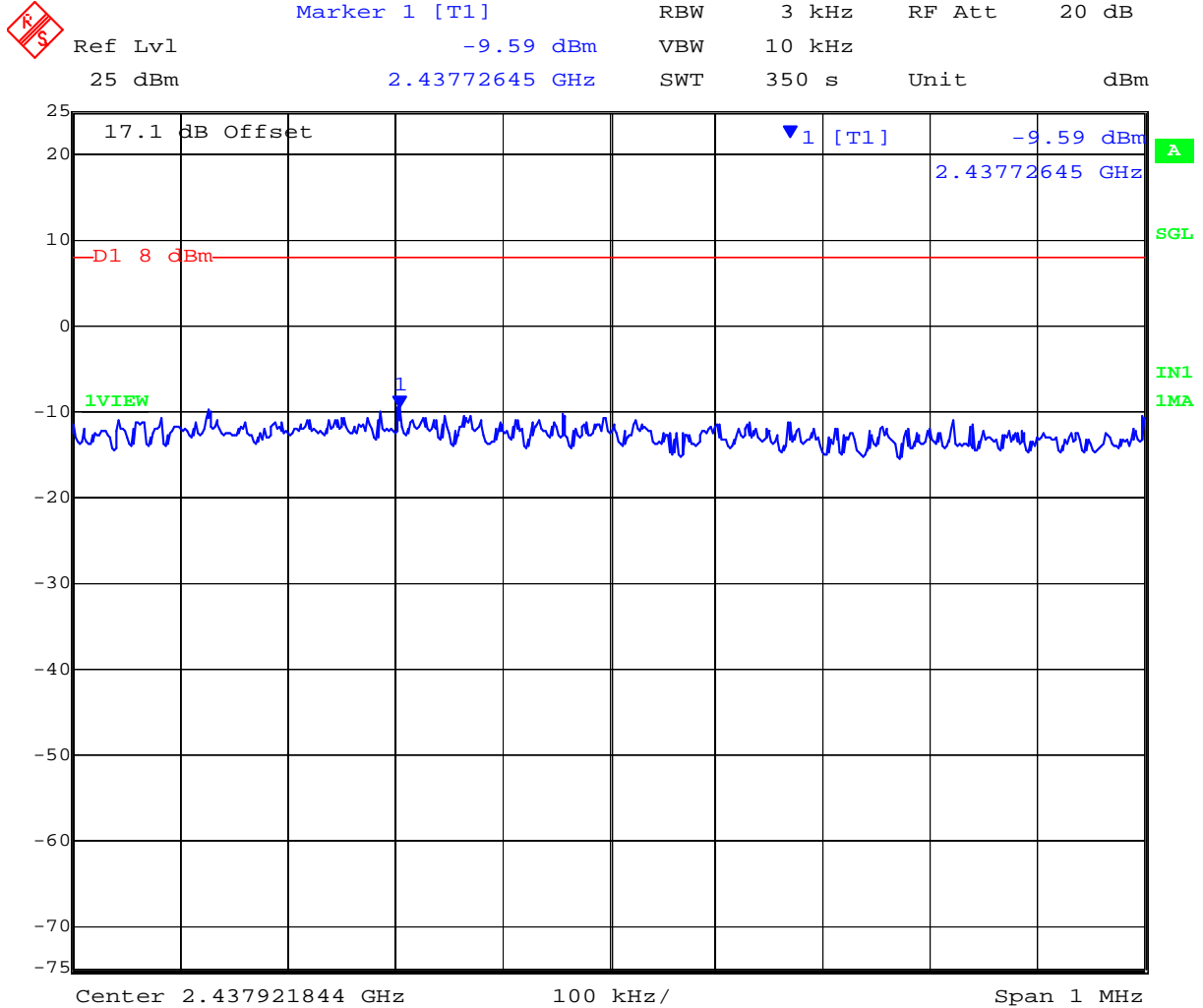
**Title:** Zebra Technologies Corporation  
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Date: 29.MAY.2012 10:05:52

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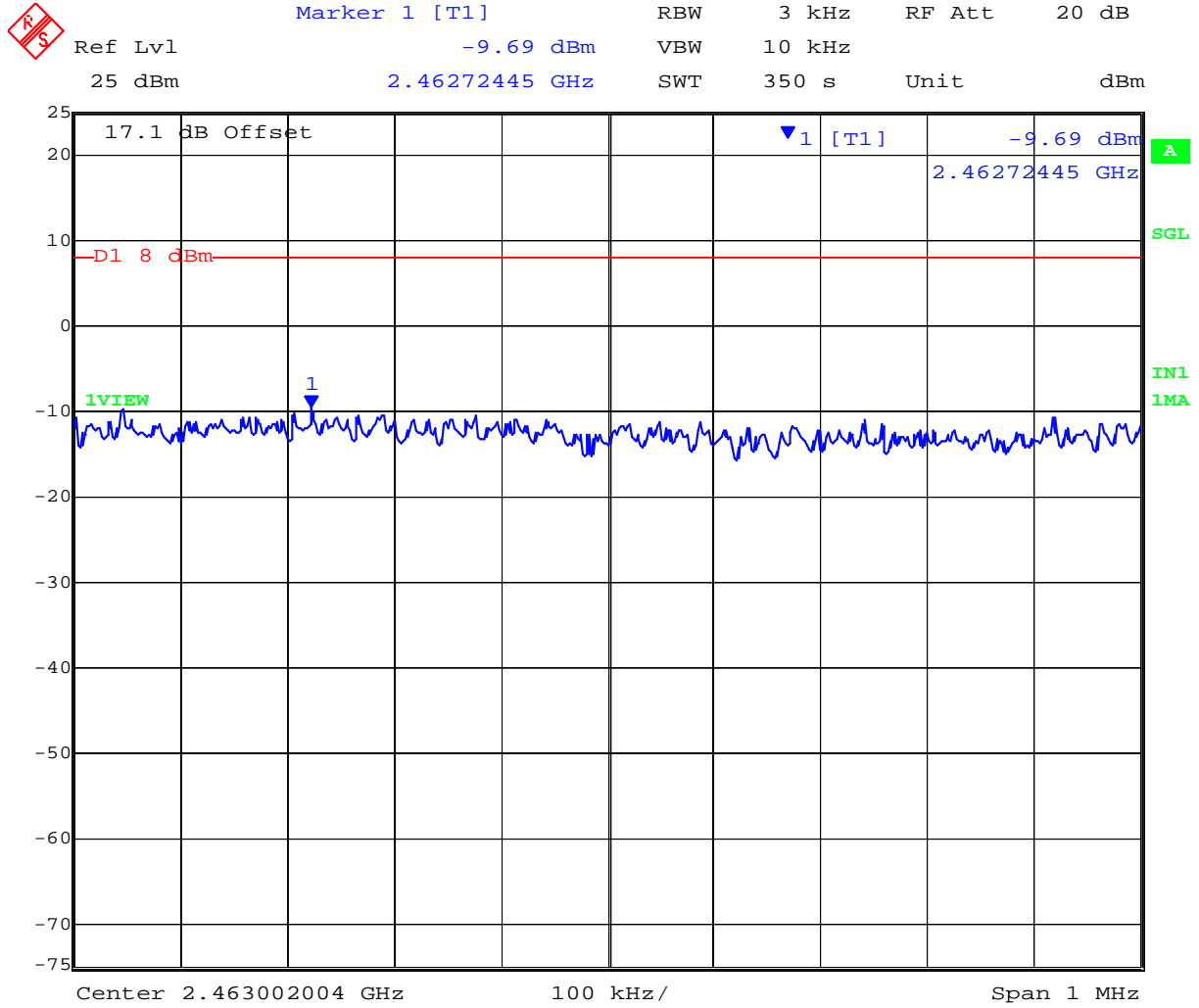


Date: 29.MAY.2012 10:51:31

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Date: 29.MAY.2012 11:04:40

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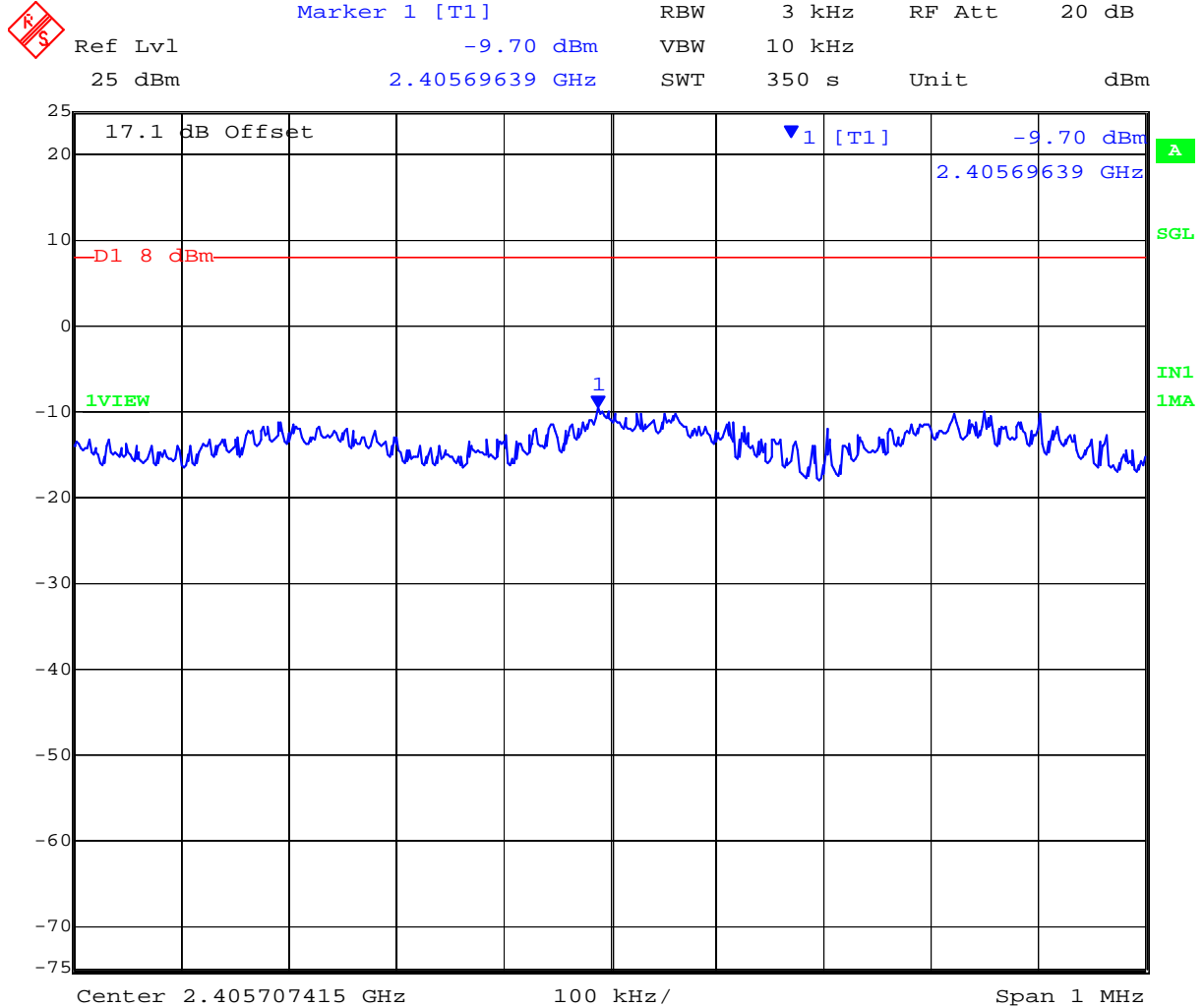
**7.3.6 Client Mode 802.11 g**

<b>Test Conditions:</b>	15.247 (e)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11g	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain (Y):</b>	N/A dB	<b>Antenna Gain:</b>	2 dBi		
<b>Applied Voltage:</b>	3.60 Vdc	<b>Antenna Ports (N):</b>	1		
<b>Notes 1:</b>					
<b>Notes 2:</b>					

Test Frequency	Measured Power Density				Correction factor	Peak Power Spectral Density	Limit	Margin
	RF Port (dBm)							
MHz	a	b	c	d	10Log(N)	dBm	dBm	dB
2412.000	-9.70	--	--	--	0.00	-9.70	8.00	-17.70
2437.000	-9.57	--	--	--	0.00	-9.57	8.00	-17.57
2462.000	-9.32	--	--	--	0.00	-9.32	8.00	-17.32

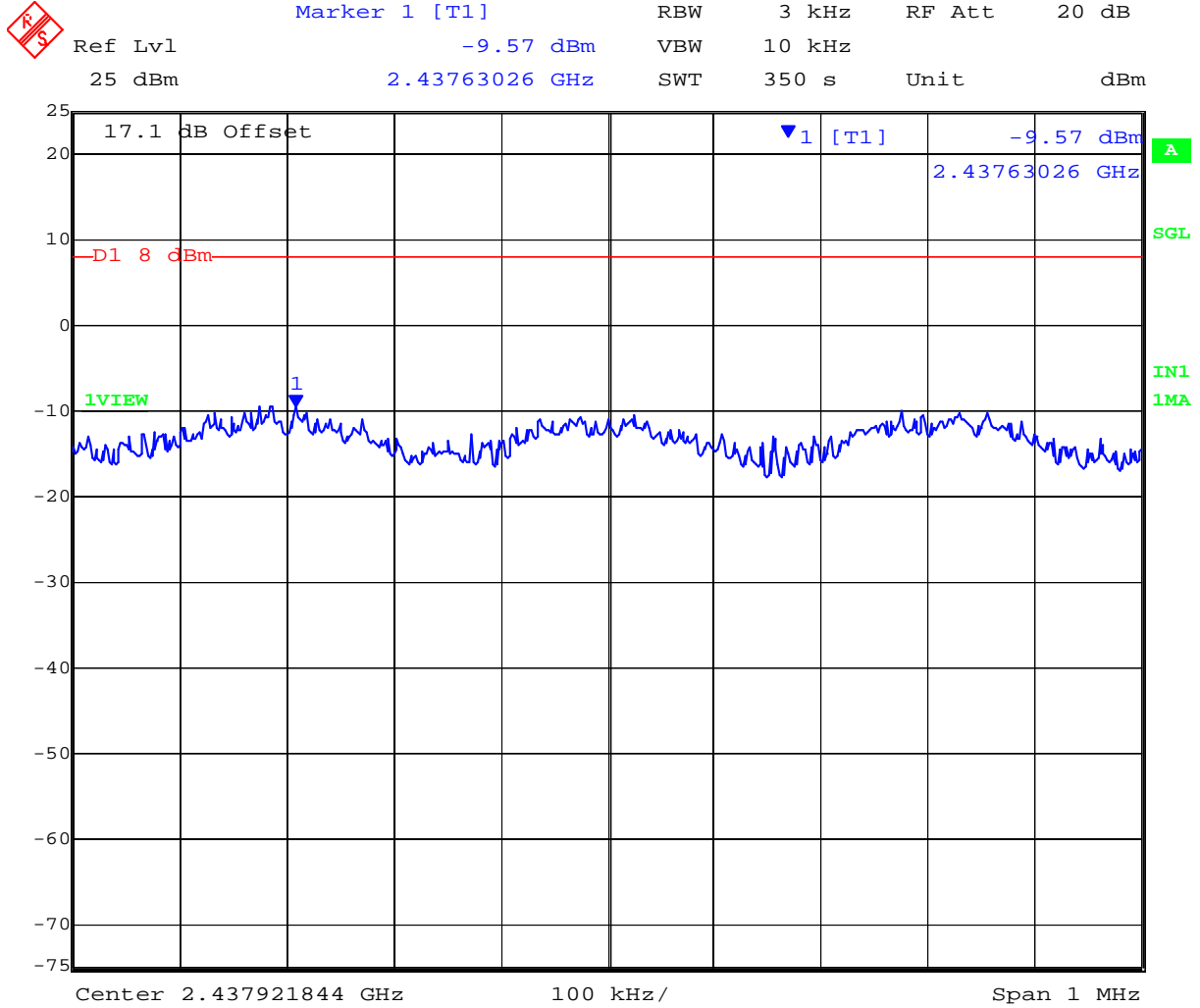
<b>Measurement uncertainty:</b>	± 1.33 dB
---------------------------------	-----------

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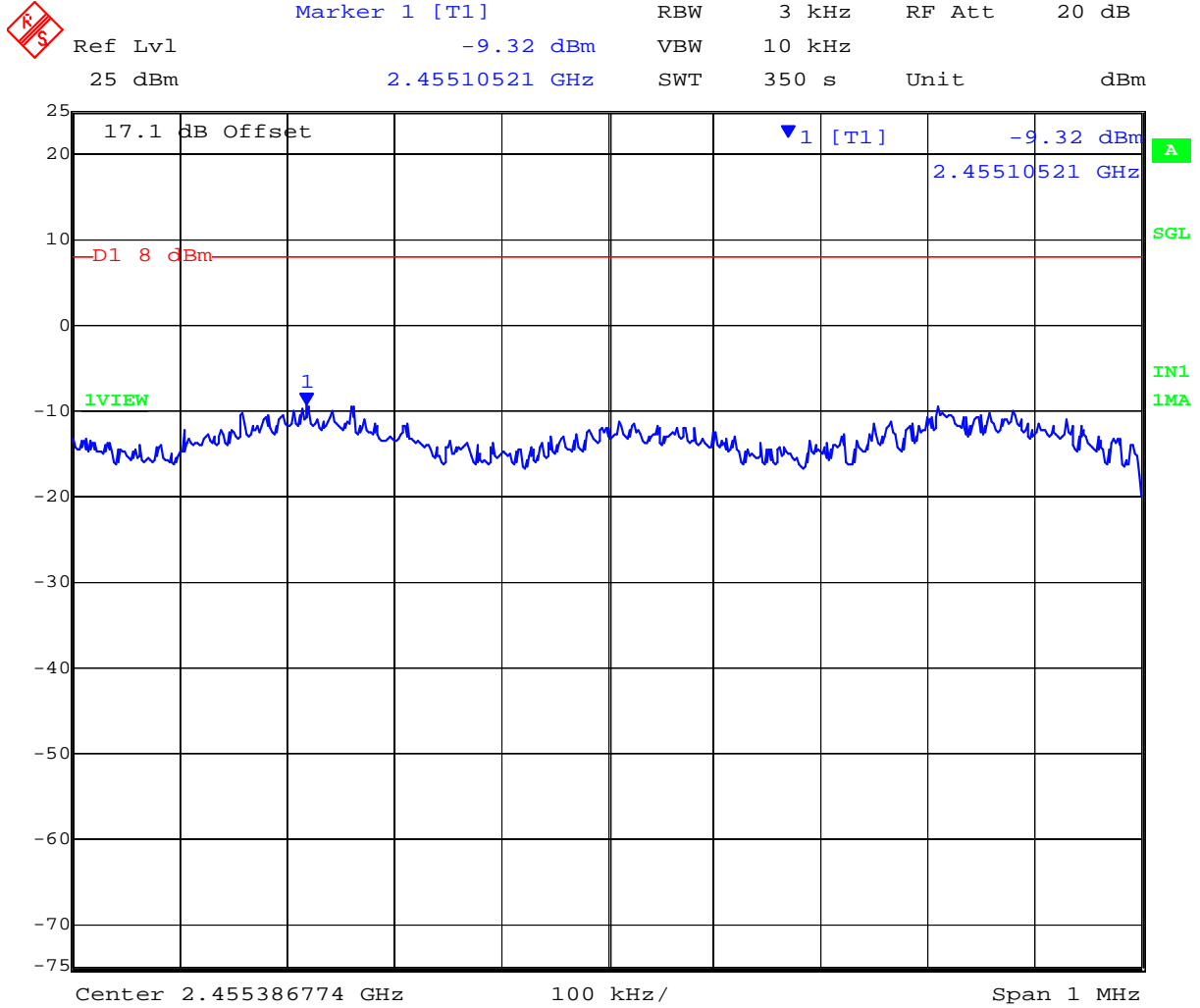
Date: 29.MAY.2012 11:22:32

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Date: 29.MAY.2012 11:37:25

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Date: 29.MAY.2012 11:51:49

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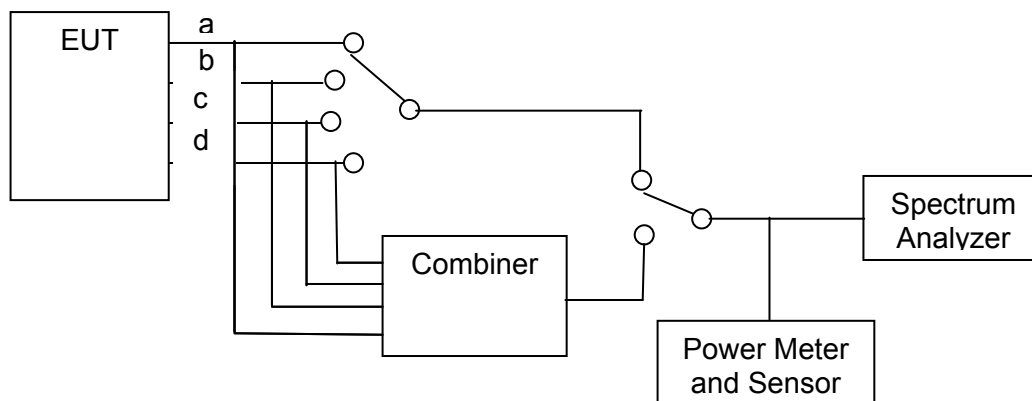
## 7.4 Conducted Spurious Emissions

### 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 Measurement Set Up



Conducted Spurious Emission measurement test configuration



**Title:** Zebra Technologies Corporation  
WhereTag IV Module  
**To:** FCC 47 CFR Part 15, SubPart 15.247  
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## Specification

### Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired power
2,400 MHz	2,483.5 MHz	≥ 20 dB
5725 MHz	5850 MHz	

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

#### §15.247(d)

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

## Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0158, 0252, 0313, 0314, 0223, 0116, 0117, 0287, 0363.

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**Title:** Zebra Technologies Corporation  
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**7.4.1 802.11 b**

<b>Test</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11 b	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming</b>	N/A dB	<b>Antenna Gain:</b>	N/A dBi
<b>Applied</b>	3.6V Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

**Conducted Spurious Measurement**

<b>Test Frequency</b>	<b>Start Frequency</b>	<b>Stop Frequency</b>	<b>Maximum Observed Emission</b>	<b>Limit (20 dB below peak of)</b>
<b>MHz</b>	<b>MHz</b>	<b>MHz</b>	<b>dBm</b>	<b>dBm</b>
2412	30.00	26000.00	-24.98	-15.27
2437	30.00	26000.00	-30.17	-14.56
2462	30.00	26000.00	-26.39	-15.23

**Band-edge Measurement**

<b>Test Frequency</b>	<b>Band-edge Frequency</b>	<b>Emission Amplitude @ Band-edge</b>	<b>Limit (20 dB below peak of)</b>	<b>Margin</b>
<b>MHz</b>	<b>MHz</b>	<b>dBm</b>	<b>dBm</b>	<b>dB</b>
2412	2400.00	-27.76	-13.79	-13.98
2462	2483.50	-46.68	-14.31	-32.37

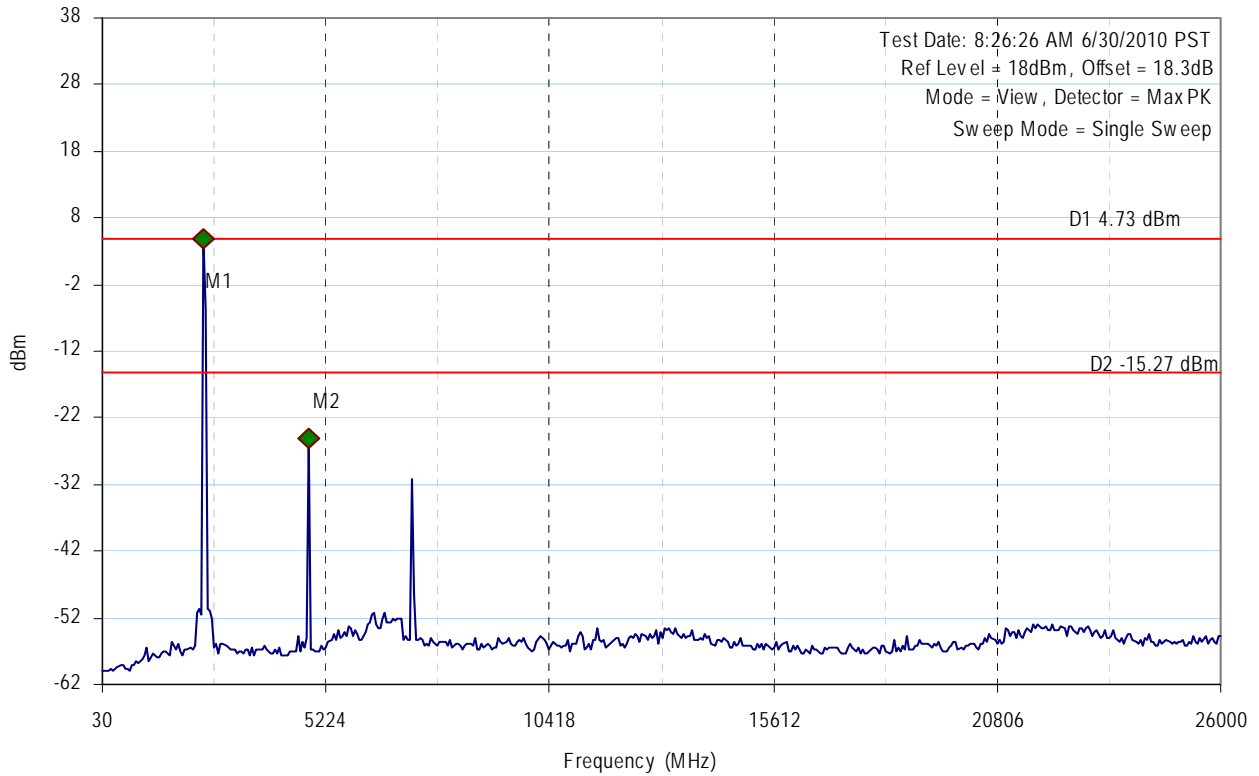
<b>Measurement uncertainty:</b>	±2.81 dB
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### Conducted Spurious Emissions

Ch Freq:2412 MHz, Variant: 802.11 b, EUT Temp:N/A, EUT Voltage:3.6V Vdc



#### Analyser Setup

RBW = 100.00KHz  
VBW = 300.00KHz  
Sweep time(s) = 60  
RF Atten (dB) = 10  
Span = 25.97GHz

#### Marker : Frequency : Amplitude

M1 : 2371.983968MHz : 4.728dBm  
M2 : 4818.056112MHz : -24.983dBm

#### Test Results

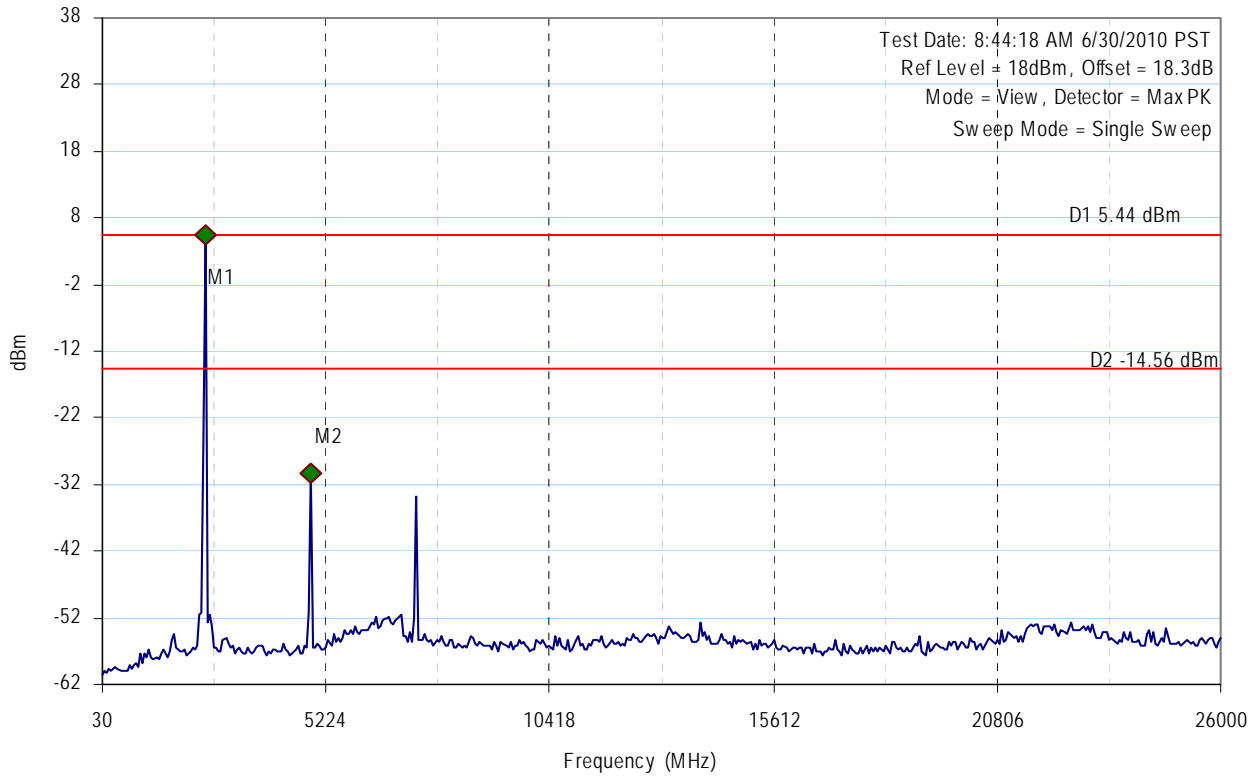
Center frequency = 2412MHz

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### Conducted Spurious Emissions

Ch Freq:2437 MHz, Variant: 802.11 b, EUT Temp:N/A, EUT Voltage:3.6V Vdc



#### Analyser Setup

RBW = 100.00KHz  
VBW = 300.00KHz  
Sweep time(s) = 60  
RF Atten (dB) = 10  
Span = 25.97GHz

#### Marker : Frequency : Amplitude

M1 : 2424.028056MHz : 5.444dBm  
M2 : 4870.100200MHz : -30.171dBm

#### Test Results

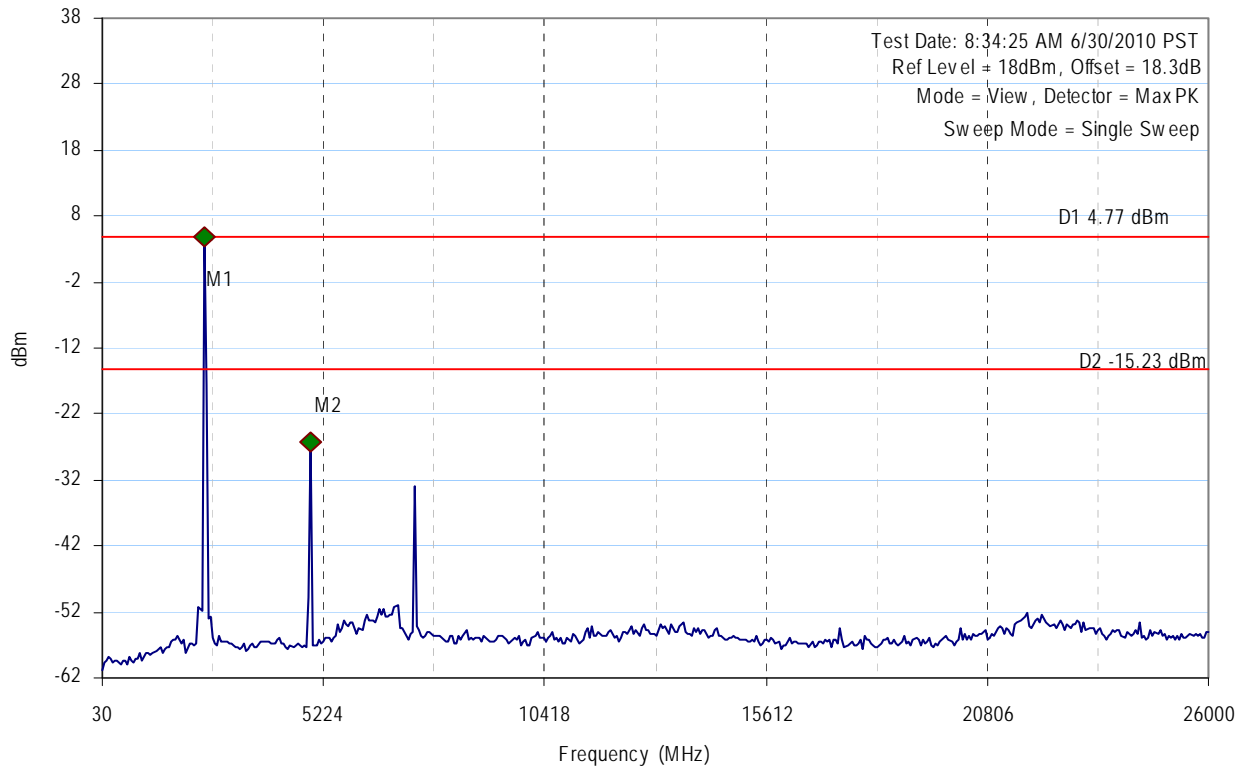
Center frequency = 2437MHz

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### Conducted Spurious Emissions

Ch Freq:2462 MHz, Variant: 802.11 b, EUT Temp:N/A, EUT Voltage:3.6V Vdc



Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2424.028056MHz : 4.775dBm	Center frequency = 2462MHz
VBW = 300.00KHz	M2 : 4922.144289MHz : -26.387dBm	
Sweep time(s) = 60		
RF Atten (dB) = 10		
Span = 25.97GHz		

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### Band-edge Measurement

Ch Freq:2412 MHz, Variant: 802.11 b, EUT Temp:N/A, EUT Voltage:3.6V Vdc



Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2400.000000MHz : -27.763dBm	Center frequency = 2412MHz
VBW = 300.00KHz	M2 : 2402.809619MHz : -16.718dBm	
Sweep time(s) = 20	M3 : 2413.054108MHz : 6.214dBm	
RF Atten (dB) = 10		
Span = 72.00MHz		

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### Band-edge Measurement

Ch Freq:2462 MHz, Variant: 802.11 b, EUT Temp:N/A, EUT Voltage:3.6V Vdc



Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2460.945892MHz : 5.694dBm	Center frequency = 2462MHz
VBW = 300.00KHz	M2 : 2471.046092MHz : -15.484dBm	
Sweep time(s) = 20	M3 : 2483.500000MHz : -46.675dBm	
RF Atten (dB) = 10		
Span = 72.00MHz		

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**Title:** Zebra Technologies Corporation  
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#### 7.4.2 802.11 g

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35 to 42
<b>Variant:</b>	802.11 g	<b>Ambient Temp. (°C):</b>	19 to 22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998 to 1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100
<b>Beam Forming</b>	N/A dB	<b>Antenna Gain:</b>	N/A dBi
<b>Applied Voltage:</b>	3.6V Vdc		
<b>Notes 1:</b>			
<b>Notes 2:</b>			

#### *Conducted Spurious Measurement*

Test Frequency	Start Frequency	Stop Frequency	Maximum Observed Emission	Limit (20 dB below peak of fundamental)
MHz	MHz	MHz	dBm	dBm
2412	30.00	26000.00	-33.42	-16.80
2437	30.00	26000.00	-26.87	-18.70
2462	30.00	26000.00	-34.13	-18.80

#### *Band-edge Measurement*

Test Frequency	Band-edge Frequency	Emission Amplitude @ Band-edge	Limit (20 dB below peak of)	Margin
MHz	MHz	dBm	dBm	dB
2412	2400.00	-18.64	-16.17	-2.47
2462	2483.50	-26.97	-16.16	-10.82

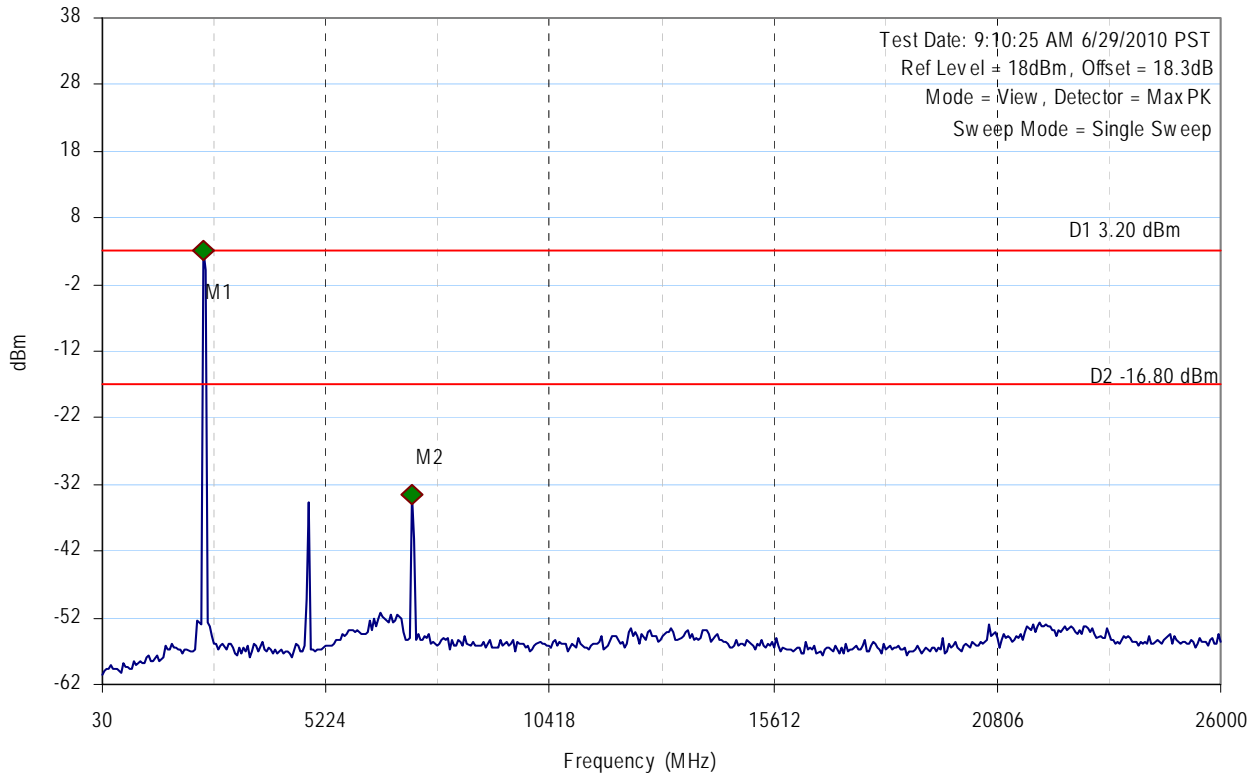
<b>Measurement uncertainty:</b>	±2.81 dB
---------------------------------	----------

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### Conducted Spurious Emissions

Ch Freq:2412 MHz, Variant: 802.11 g, EUT Temp:N/A, EUT Voltage:3.6V Vdc



#### Analyser Setup

RBW = 100.00KHz  
VBW = 300.00KHz  
Sweep time(s) = 60  
RF Atten (dB) = 10  
Span = 25.97GHz

#### Marker : Frequency : Amplitude

M1 : 2371.983968MHz : 3.198dBm  
M2 : 7212.084168MHz : -33.415dBm

#### Test Results

Center frequency = 2412MHz

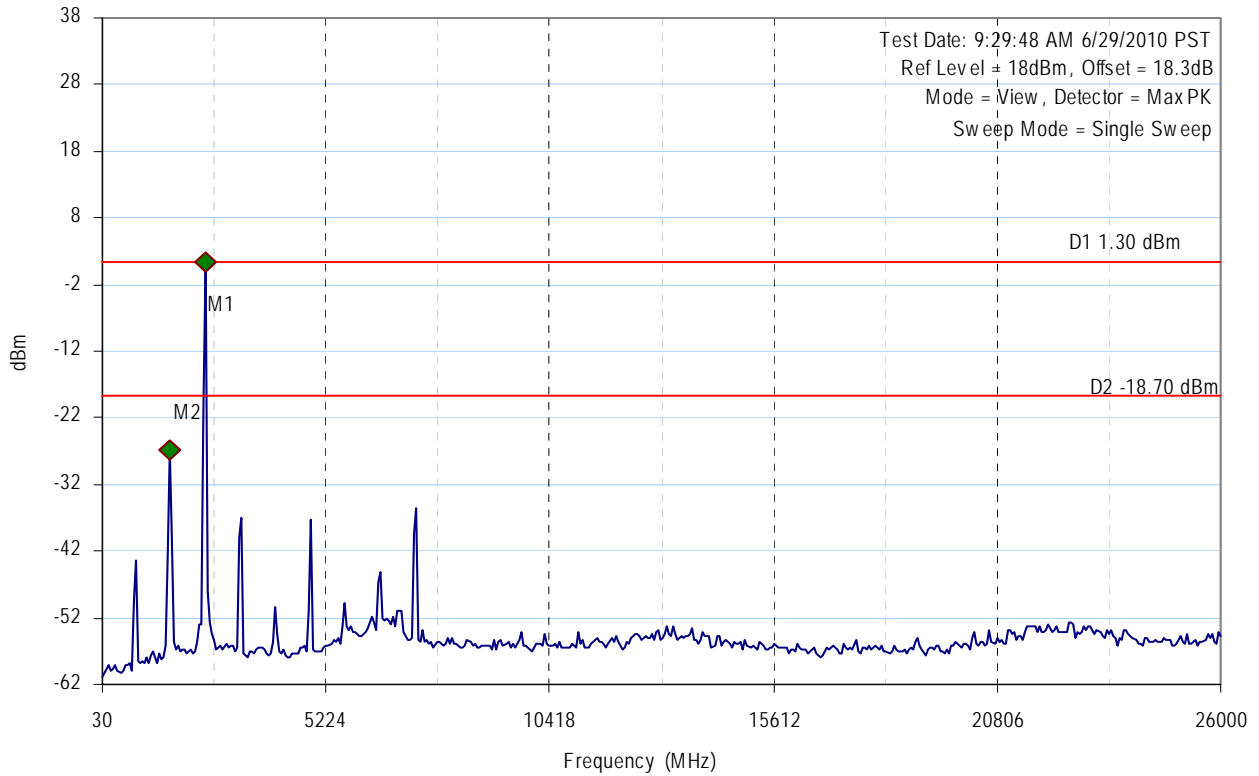
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### Conducted Spurious Emissions

Ch Freq:2437 MHz, Variant: 802.11 g, EUT Temp:N/A, EUT Voltage:3.6V Vdc



#### Analyser Setup

RBW = 100.00KHz  
VBW = 300.00KHz  
Sweep time(s) = 60  
RF Atten (dB) = 10  
Span = 25.97GHz

#### Marker : Frequency : Amplitude

M1 : 2424.028056MHz : 1.303dBm  
M2 : 1591.322645MHz : -26.866dBm

#### Test Results

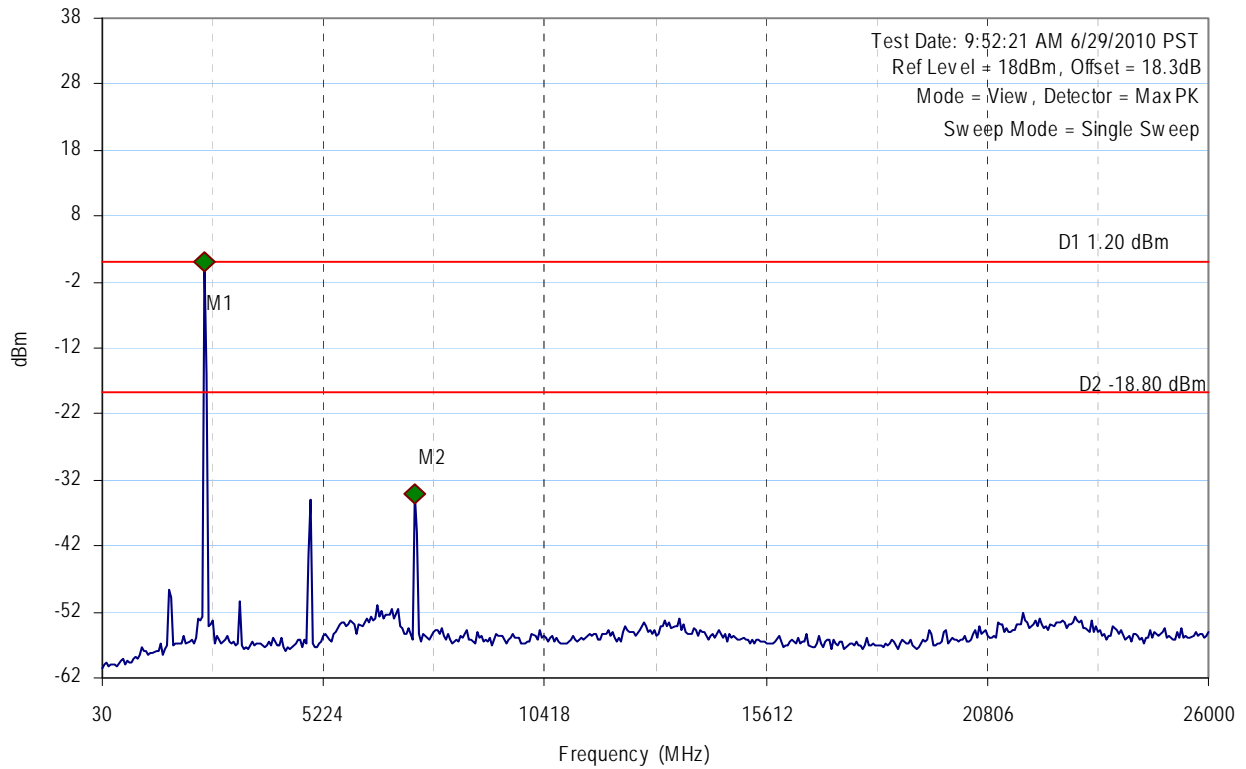
Center frequency = 2437MHz

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### Conducted Spurious Emissions

Ch Freq:2462 MHz, Variant: 802.11 g, EUT Temp:N/A, EUT Voltage:3.6V Vdc



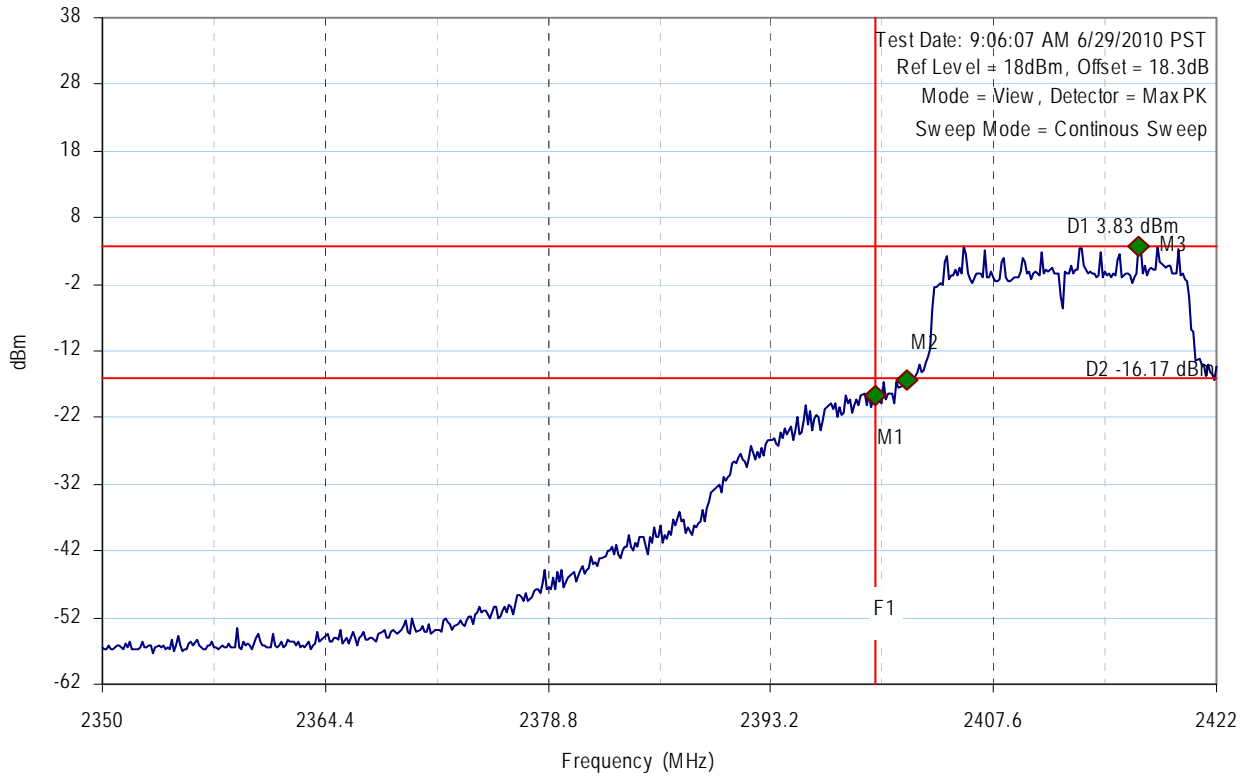
Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2424.028056MHz : 1.197dBm	Center frequency = 2462MHz
VBW = 300.00KHz	M2 : 7368.216433MHz : -34.133dBm	
Sweep time(s) = 60		
RF Atten (dB) = 10		
Span = 25.97GHz		

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### Band-edge Measurement

Ch Freq:2412 MHz, Variant: 802.11 g, EUT Temp:N/A, EUT Voltage:3.6V Vdc



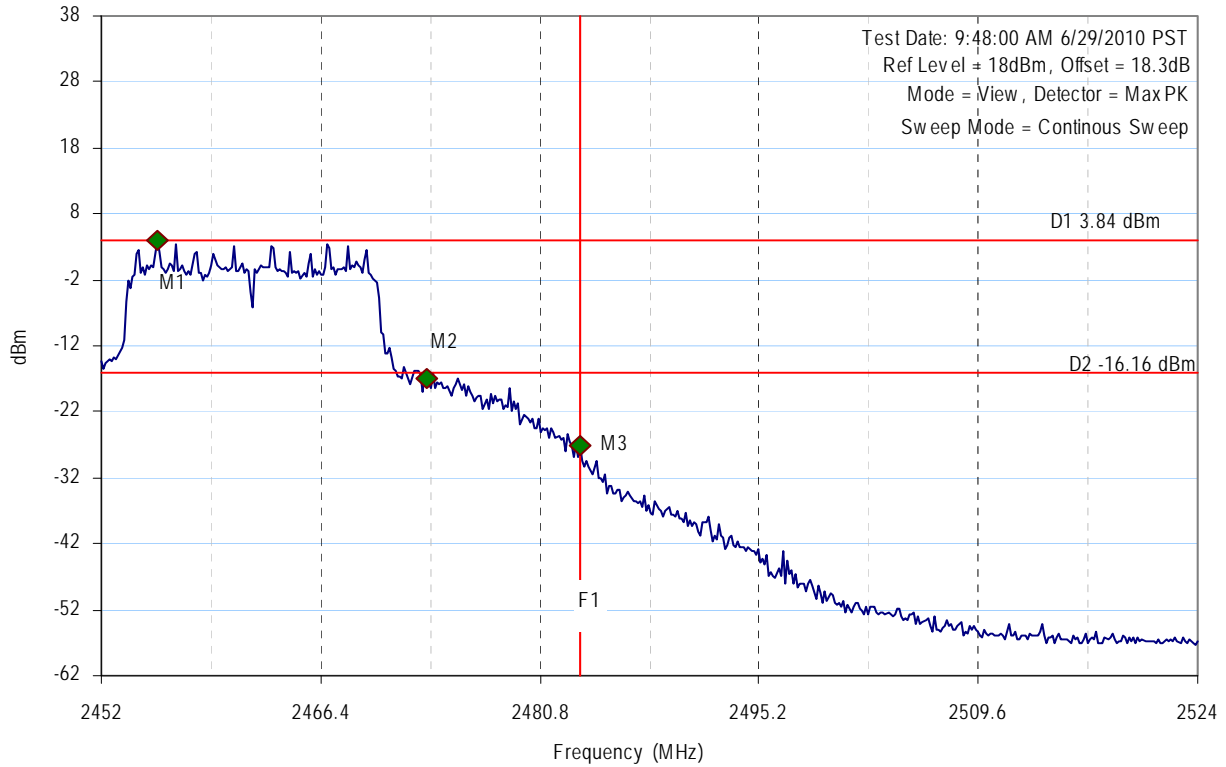
Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2400.000000MHz : -18.640dBm	Center frequency = 2412MHz
VBW = 300.00KHz	M2 : 2401.943888MHz : -16.338dBm	
Sweep time(s) = 20	M3 : 2416.949900MHz : 3.831dBm	
RF Atten (dB) = 10		
Span = 72.00MHz		

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### Band-edge Measurement

Ch Freq:2462 MHz, Variant: 802.11 g, EUT Temp:N/A, EUT Voltage:3.6V Vdc

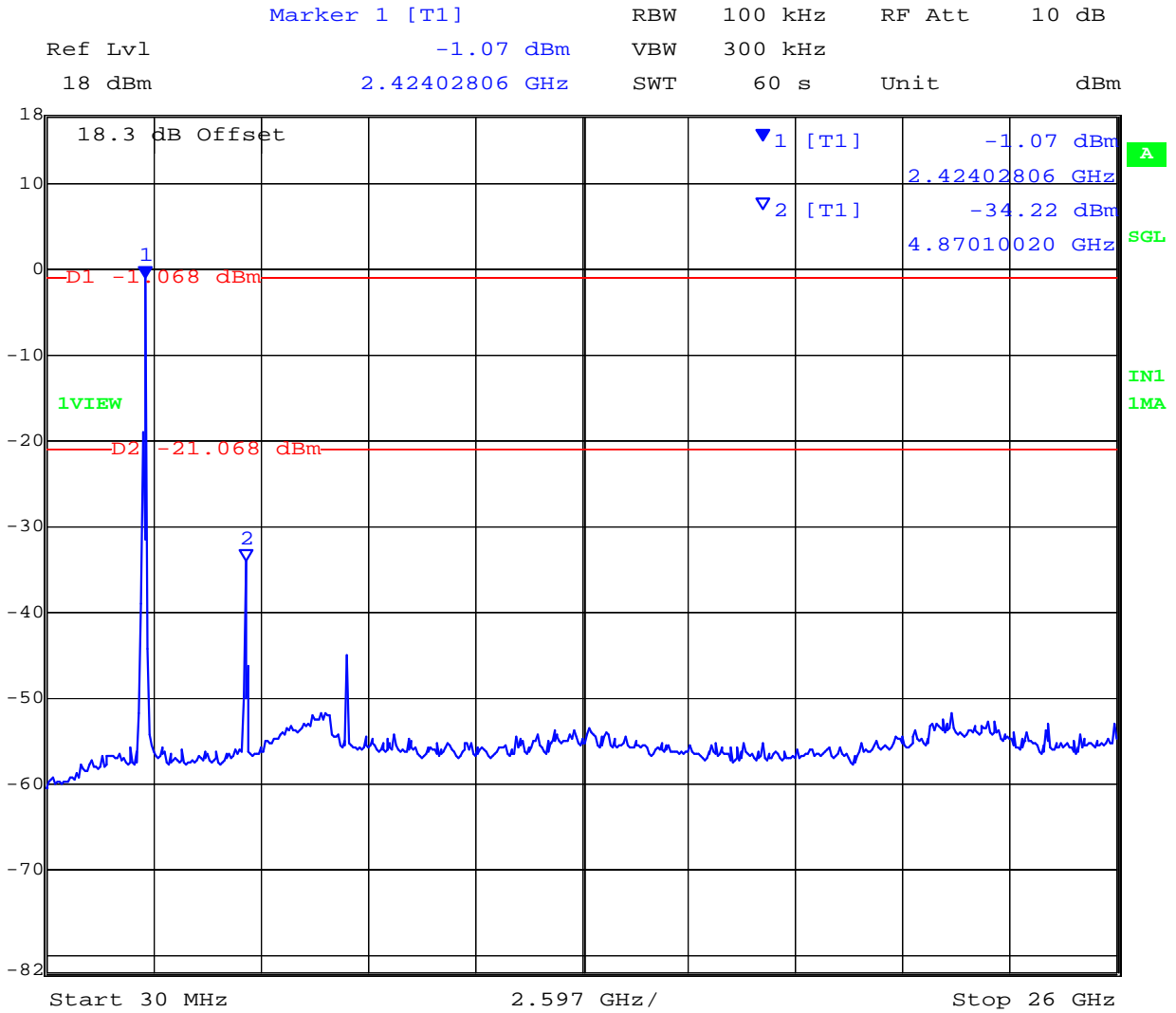


Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2455.607214MHz : 3.843dBm	Center frequency = 2462MHz
VBW = 300.00KHz	M2 : 2473.354709MHz : -17.005dBm	
Sweep time(s) = 20	M3 : 2483.500000MHz : -26.974dBm	
RF Atten (dB) = 10		
Span = 72.00MHz		

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### 7.4.3 DSSS

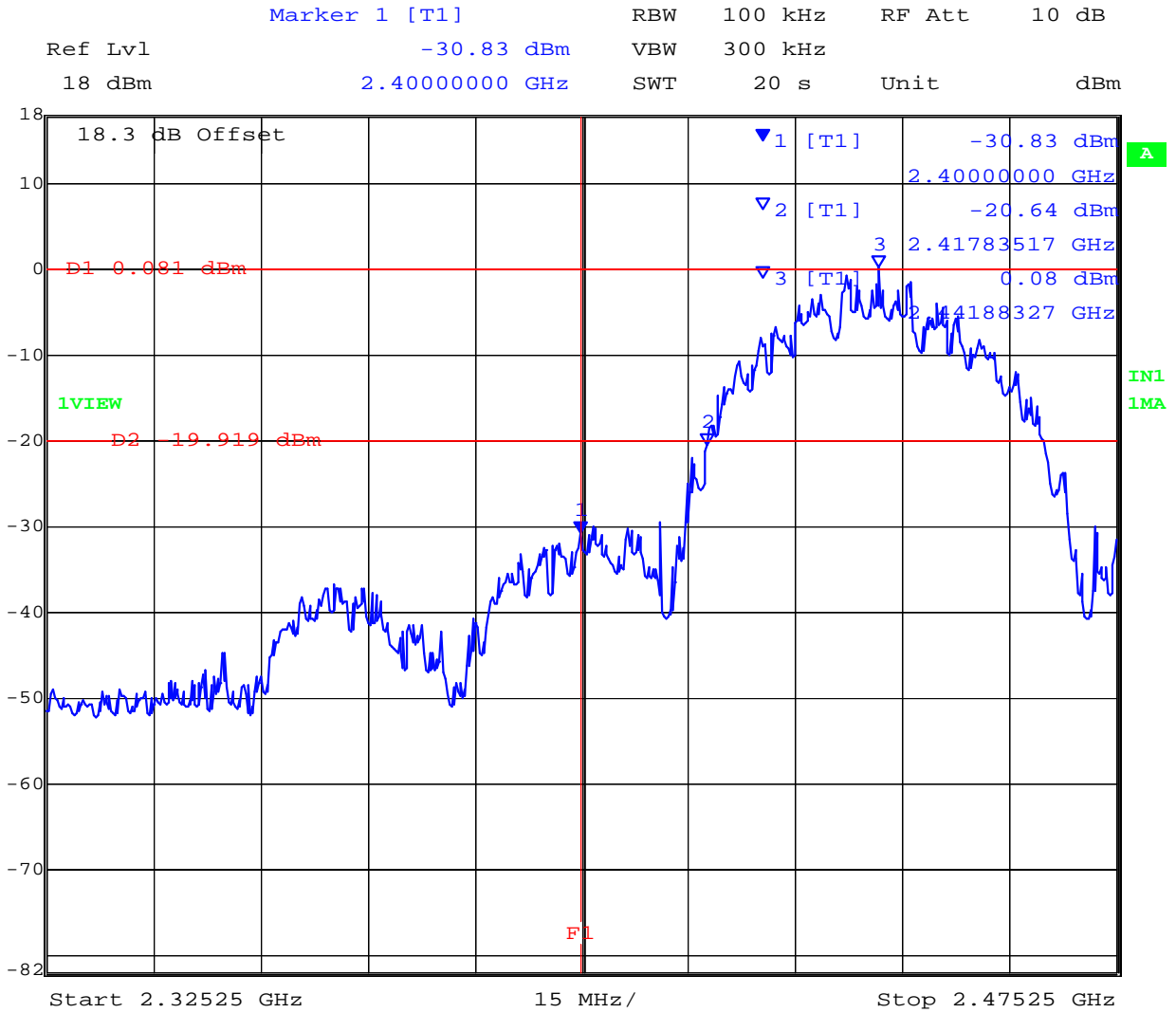


Date: 29.JUN.2010 11:01:10

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Band Edge Ambient 2442MHz 3.60V 14.91dBm 100% Duty Cycle

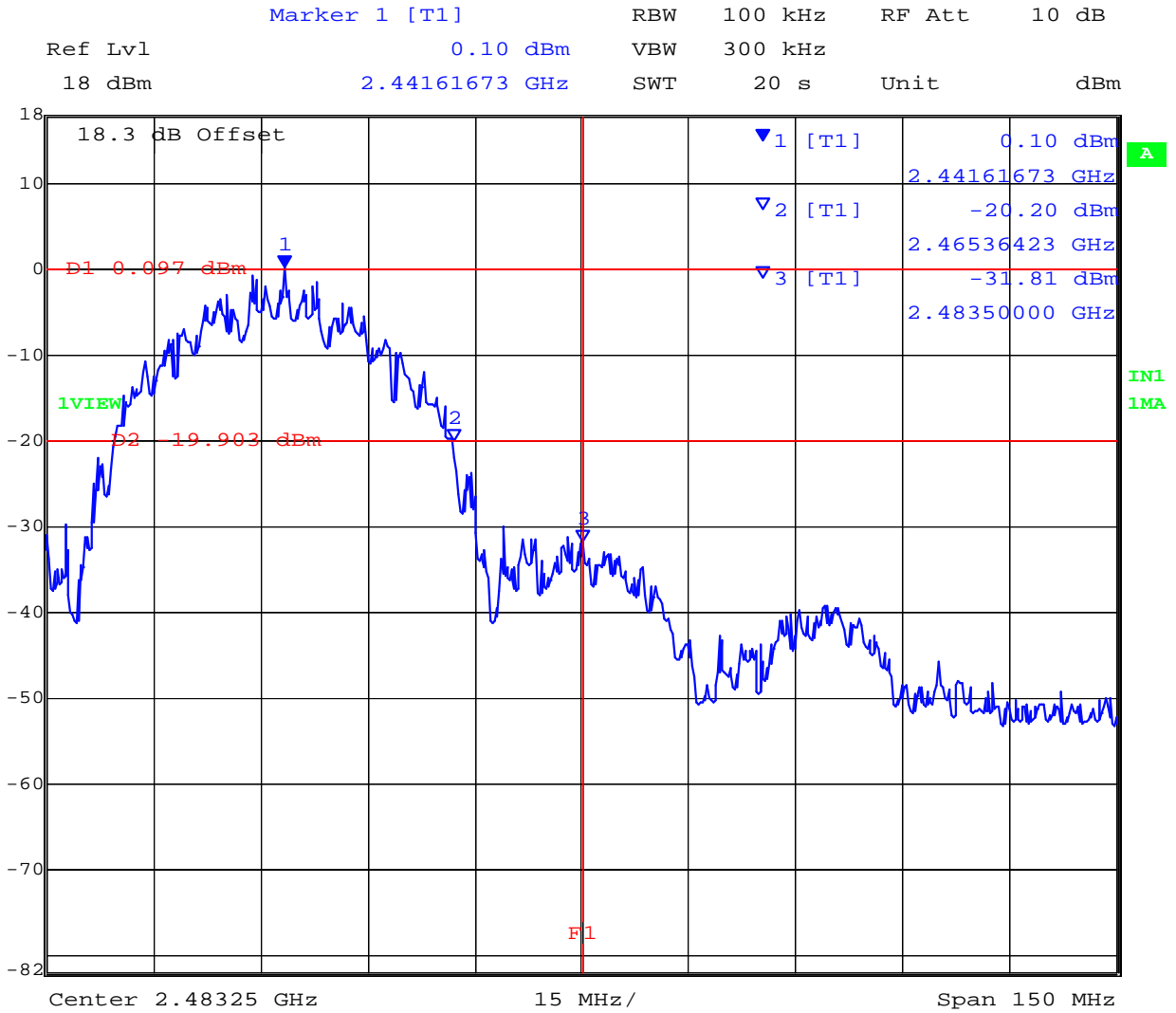


Date: 30.JUN.2010 09:05:54

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Band Edge Ambient 2442MHz 3.60V 14.90dBm 100% Duty Cycle

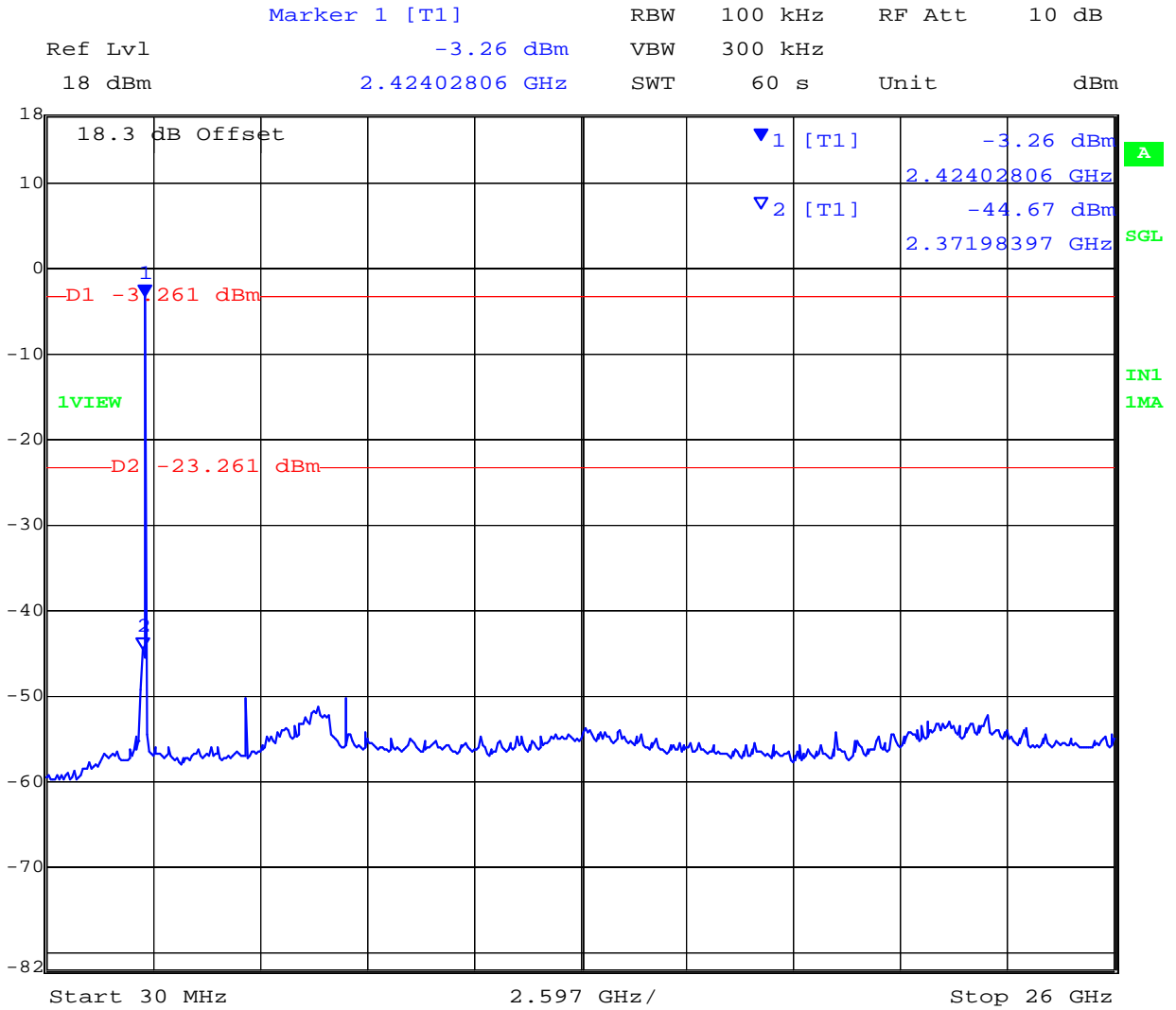


Date: 30.JUN.2010 09:11:02

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### 7.4.4 OOK



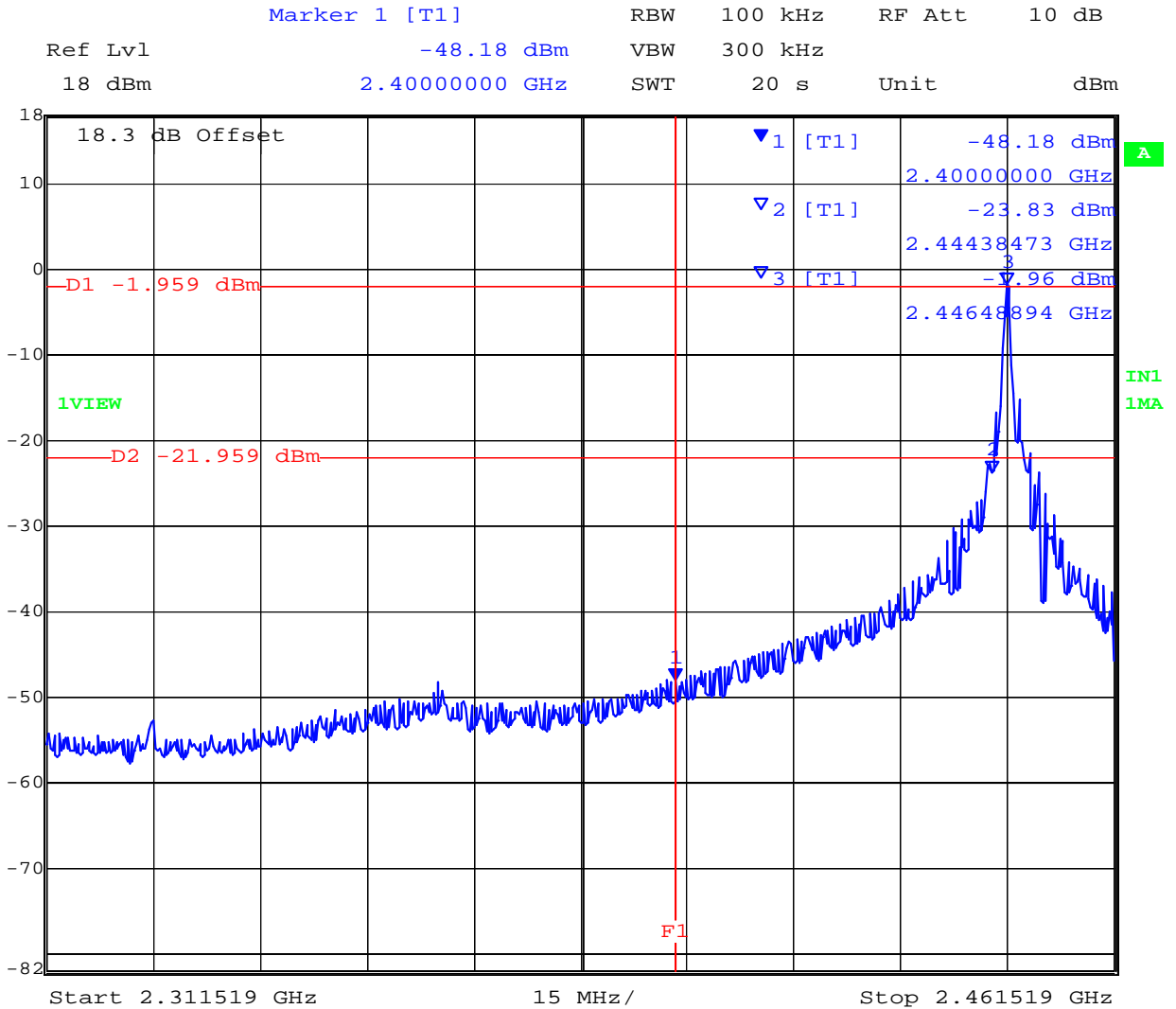
Date: 29.JUN.2010 11:23:20

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Band Edge Ambient 2447MHz 3.60V 1.23dBm 100% Duty Cycle

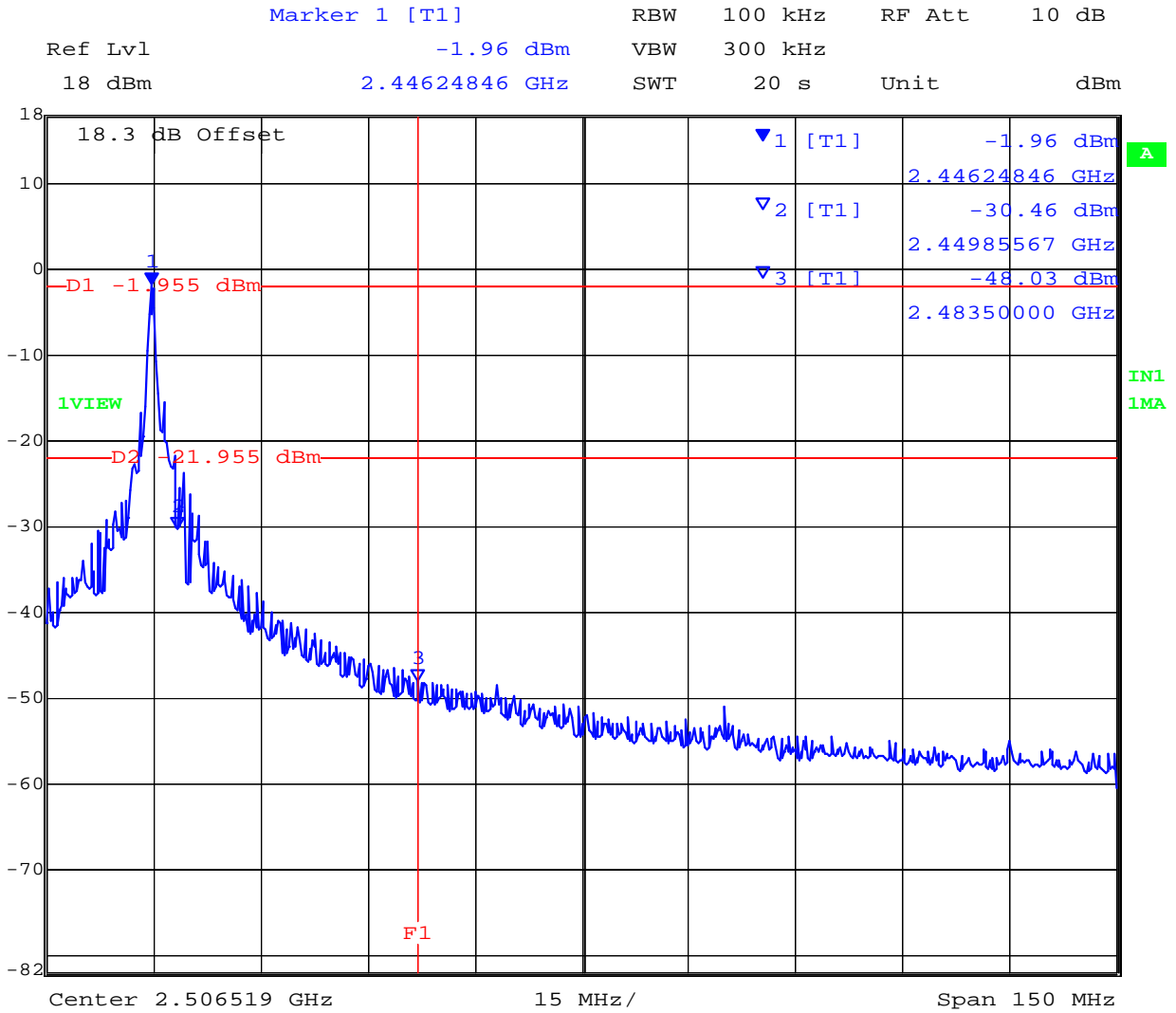


Date: 30.JUN.2010 09:21:00

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Band Edge Ambient 2447MHz 3.60V 1.27dBm 100% Duty Cycle



Date: 30.JUN.2010 09:24:47

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**7.4.5 Client Mode 802.11b**

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11b	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain</b>	N/A dB	<b>Antenna Gain:</b>	N/A dBi		
<b>Applied Voltage:</b>	3.60 Vdc	<b>Antenna Ports (N):</b>			
<b>Notes 1:</b>					
<b>Notes 2:</b>					

**Conducted Spurious Measurement**

Test Freq.	Start Freq.	Stop Freq.	Port A		Port B		Port C		Port D	
			SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm
2412.000	30.00	26000.00	-34.58	-15.35						
2437.000	30.00	26000.00	-34.26	-15.57						
2462.000	30.00	26000.00	-35.14	-16.04						

SE: Maximum spurious emission found

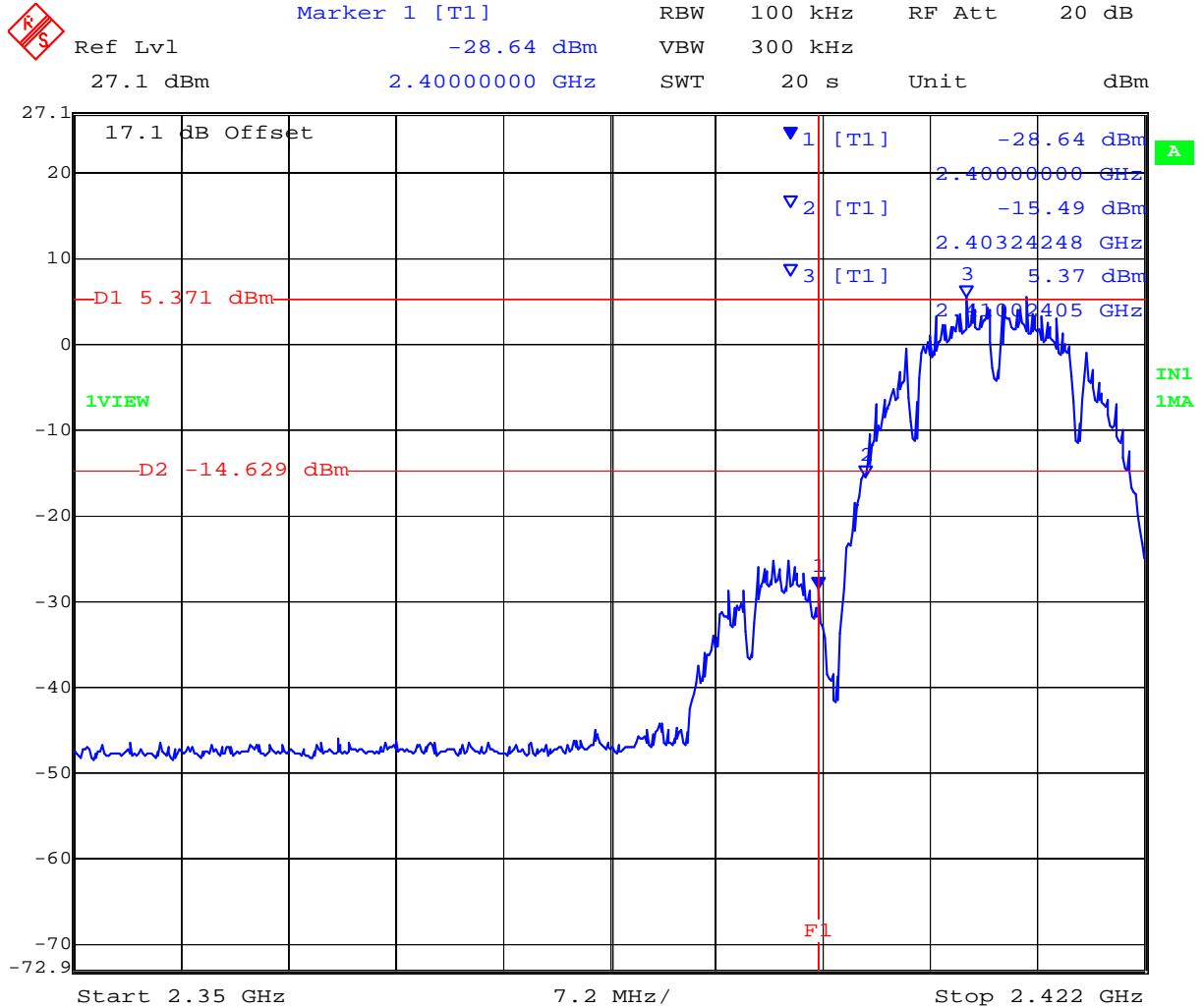
**Band-edge Measurement**

Test Freq.	Band-edge freq.	Port A		Port B		Port C		Port D	
		BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm
2412.000	2400.00	-28.65	-14.63						
2462.000	2483.50	-45.67	-14.00						

BE: Maximum Band edge emission found

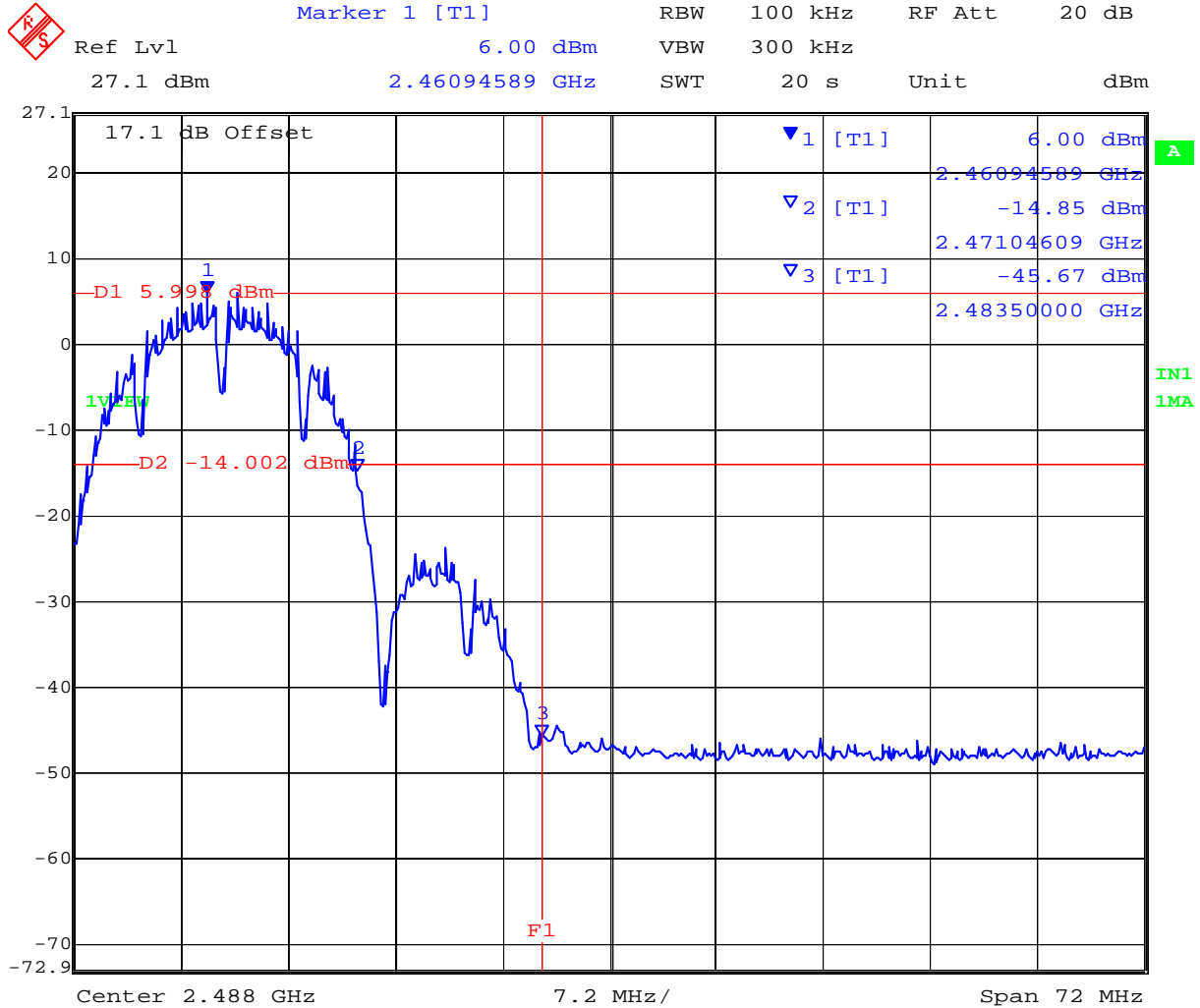
<b>Measurement uncertainty:</b>	±2.81 dB
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Note: Limit is based on 20dB down from fundamental emission



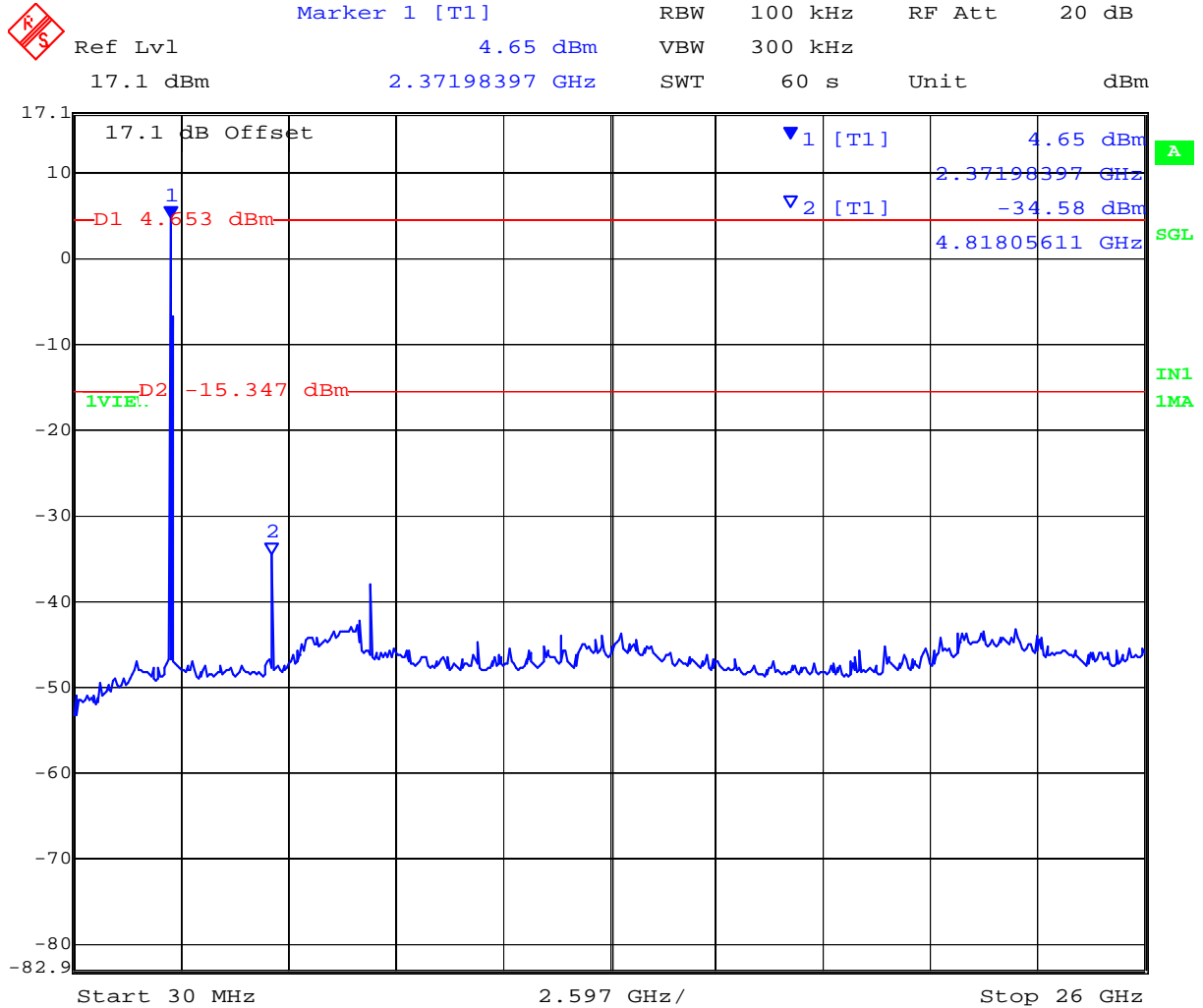
Date: 29.MAY.2012 09:59:12

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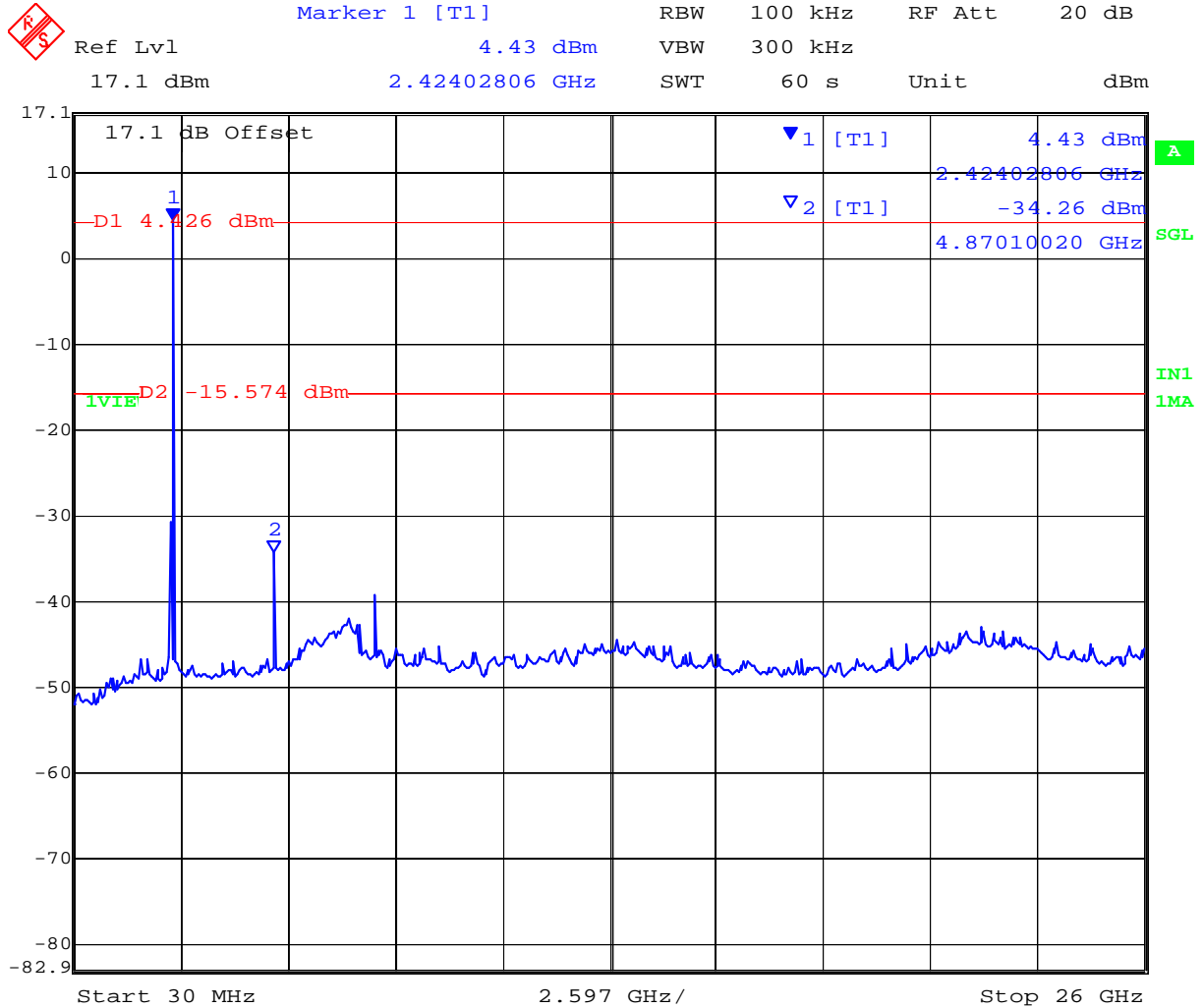
Date: 29.MAY.2012 10:57:58

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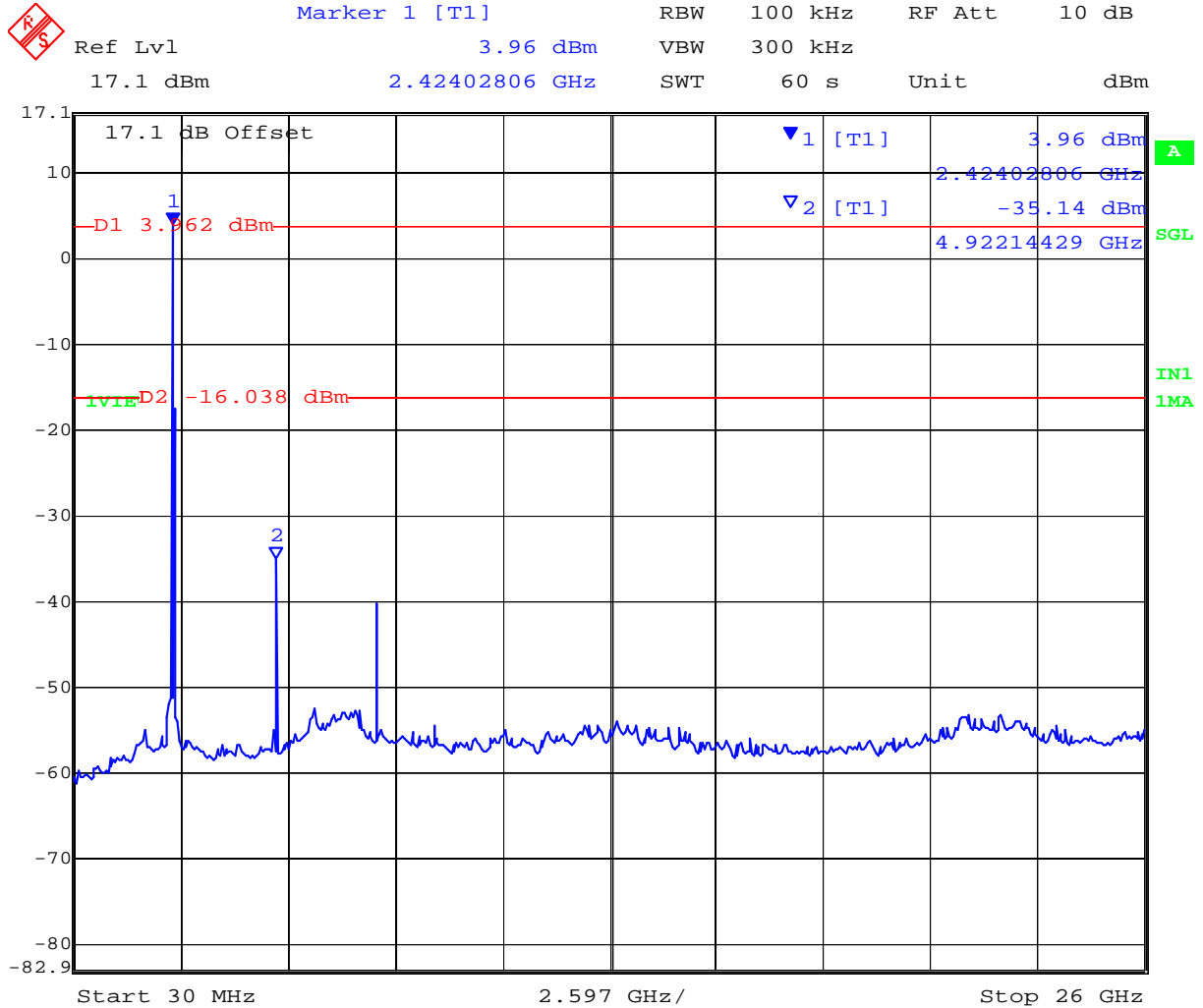
Date: 29.MAY.2012 10:08:42

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Date: 29.MAY.2012 10:54:26

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Date: 29.MAY.2012 11:07:37

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**7.4.6 Client Mode 802.11g**

<b>Test Conditions:</b>	15.247 (a)(2)	<b>Rel. Humidity (%):</b>	35	to	42
<b>Variant:</b>	802.11g	<b>Ambient Temp. (°C):</b>	19	to	22
<b>TPC:</b>	HIGH	<b>Pressure (mBars):</b>	998	to	1003
<b>Modulation:</b>	ON	<b>Duty Cycle (%):</b>	100		
<b>Beam Forming Gain</b>	N/A dB	<b>Antenna Gain:</b>	N/A dBi		
<b>Applied Voltage:</b>	3.60 Vdc	<b>Antenna Ports (N):</b>			
<b>Notes 1:</b>					
<b>Notes 2:</b>					

**Conducted Spurious Measurement**

Test Freq.	Start Freq.	Stop Freq.	Port A		Port B		Port C		Port D	
			SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm	SE dBm	Limit dBm
2412.000	30.00	26000.00	-23.09	-16.43						
2437.000	30.00	26000.00	-22.67	-16.16						
2462.000	30.00	26000.00	-22.11	-16.64						

SE: Maximum spurious emission found

**Band-edge Measurement**

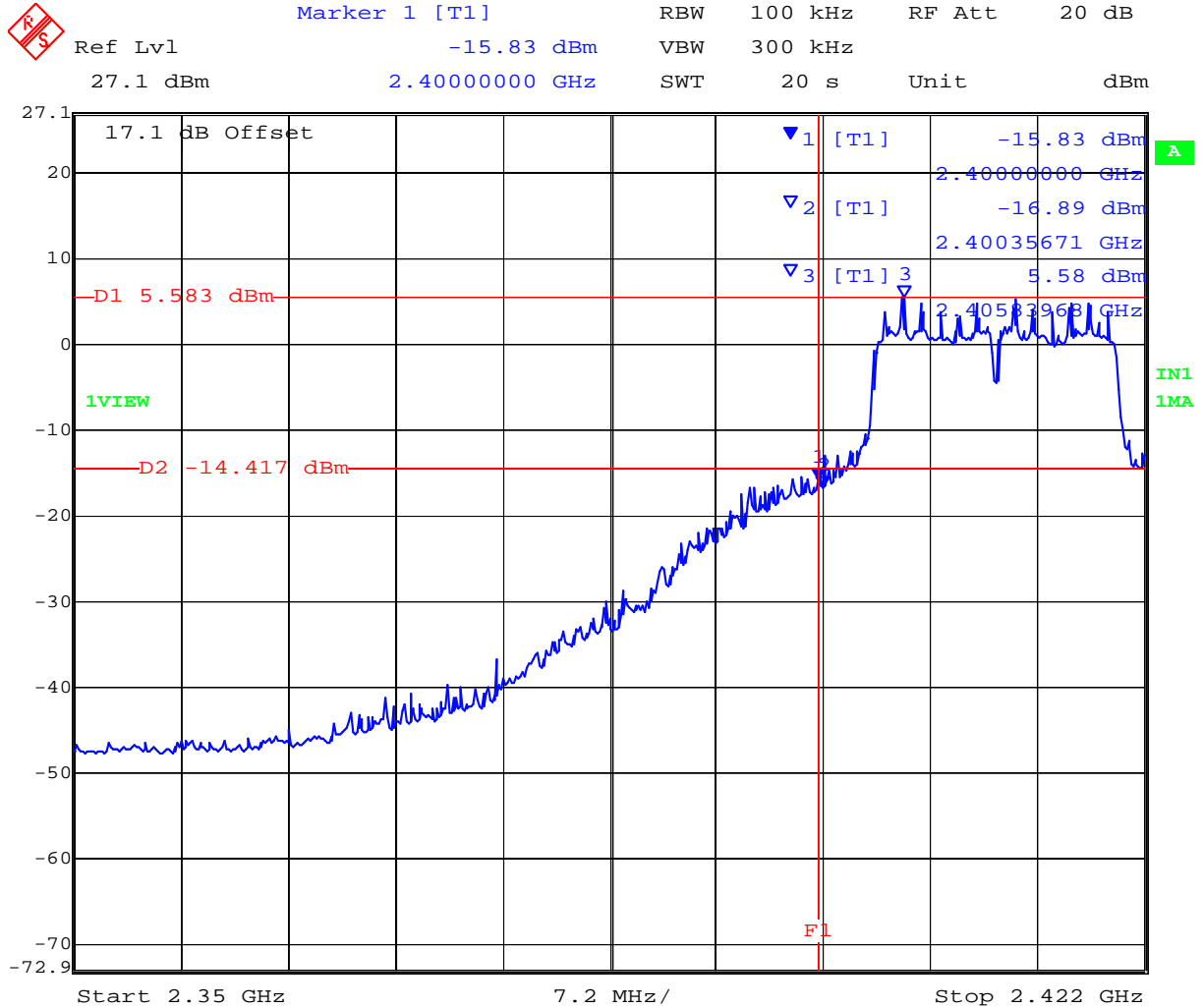
Test Freq.	Band-edge freq.	Port A		Port B		Port C		Port D	
		BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm	BE dBm	Limit dBm
2412.000	2400.00	-15.83	-14.42						
2462.000	2483.50	-25.24	-14.38						

BE: Maximum Band edge emission found

<b>Measurement uncertainty:</b>	±2.81 dB
---------------------------------	----------

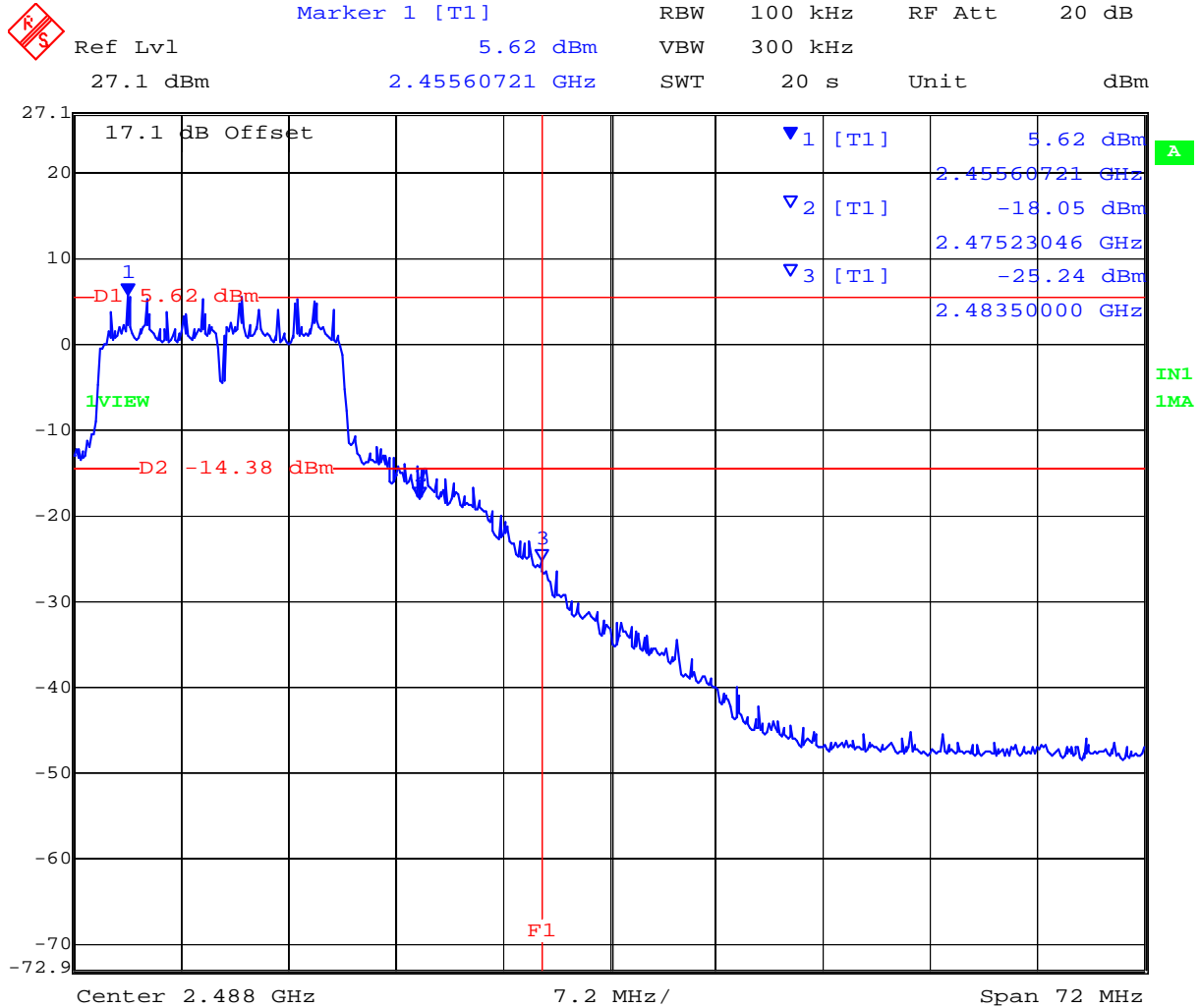
Note: Limit is based on 20dB down from fundamental emission

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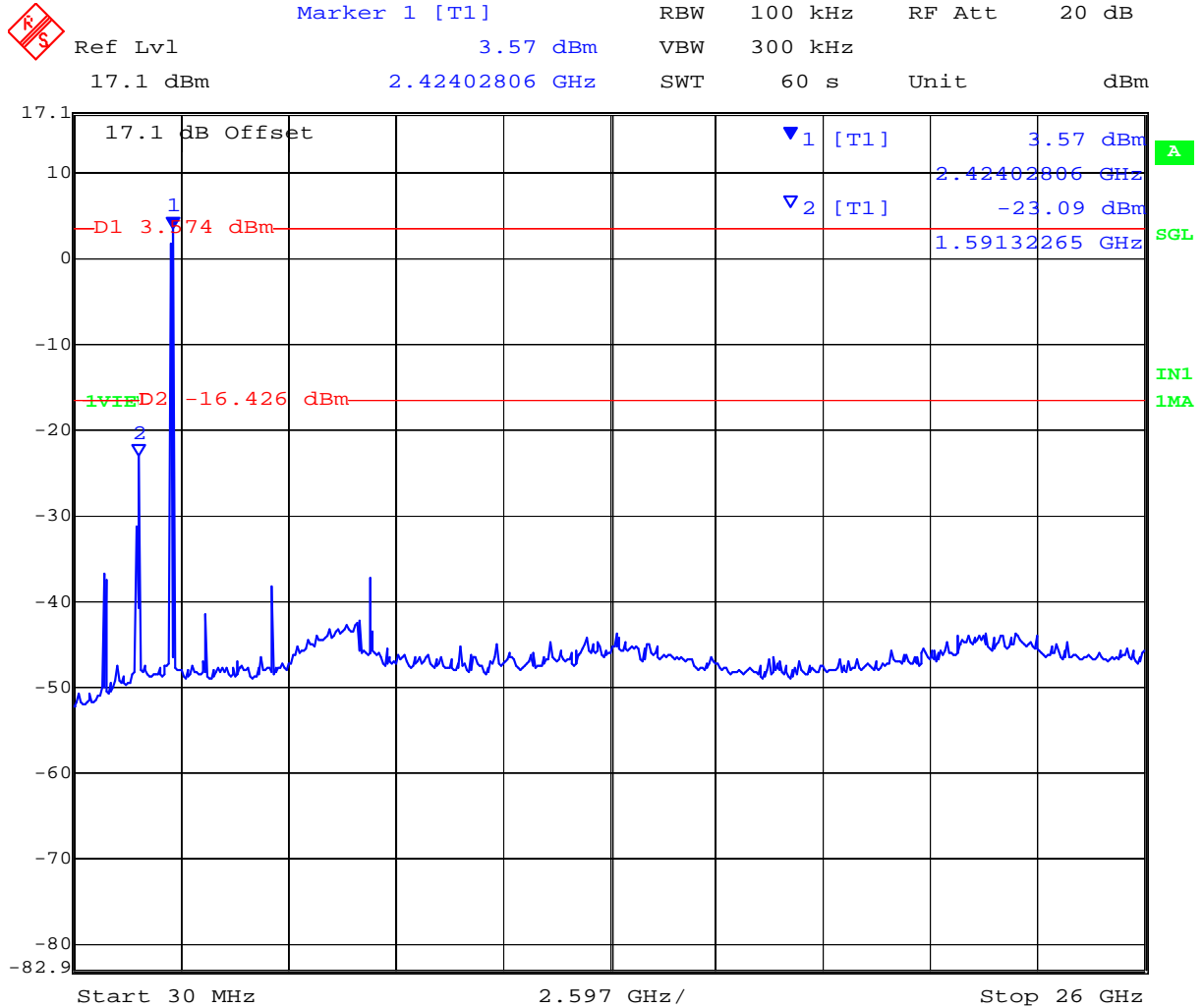
Date: 29.MAY.2012 11:15:52

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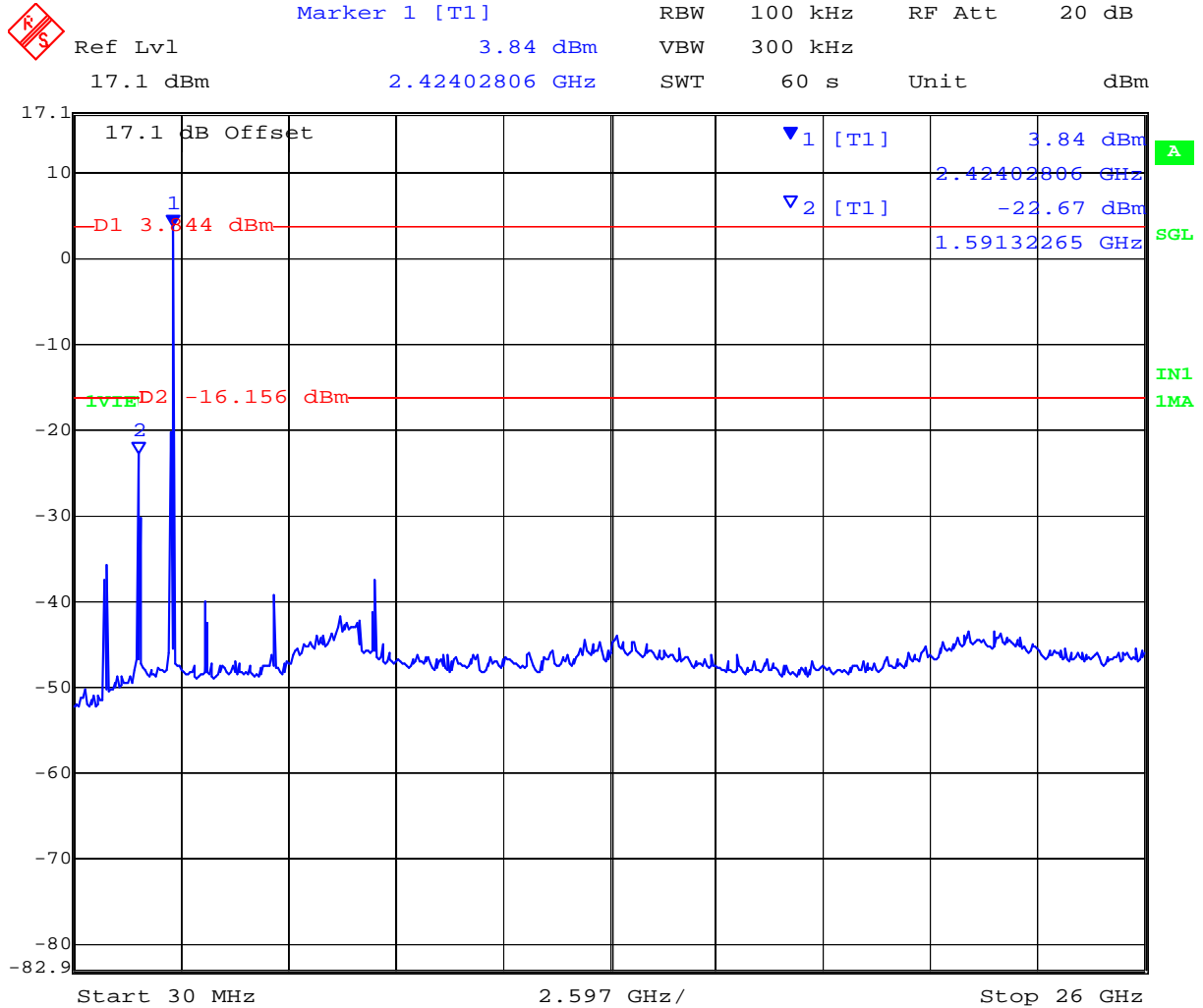
Date: 29.MAY.2012 11:45:05

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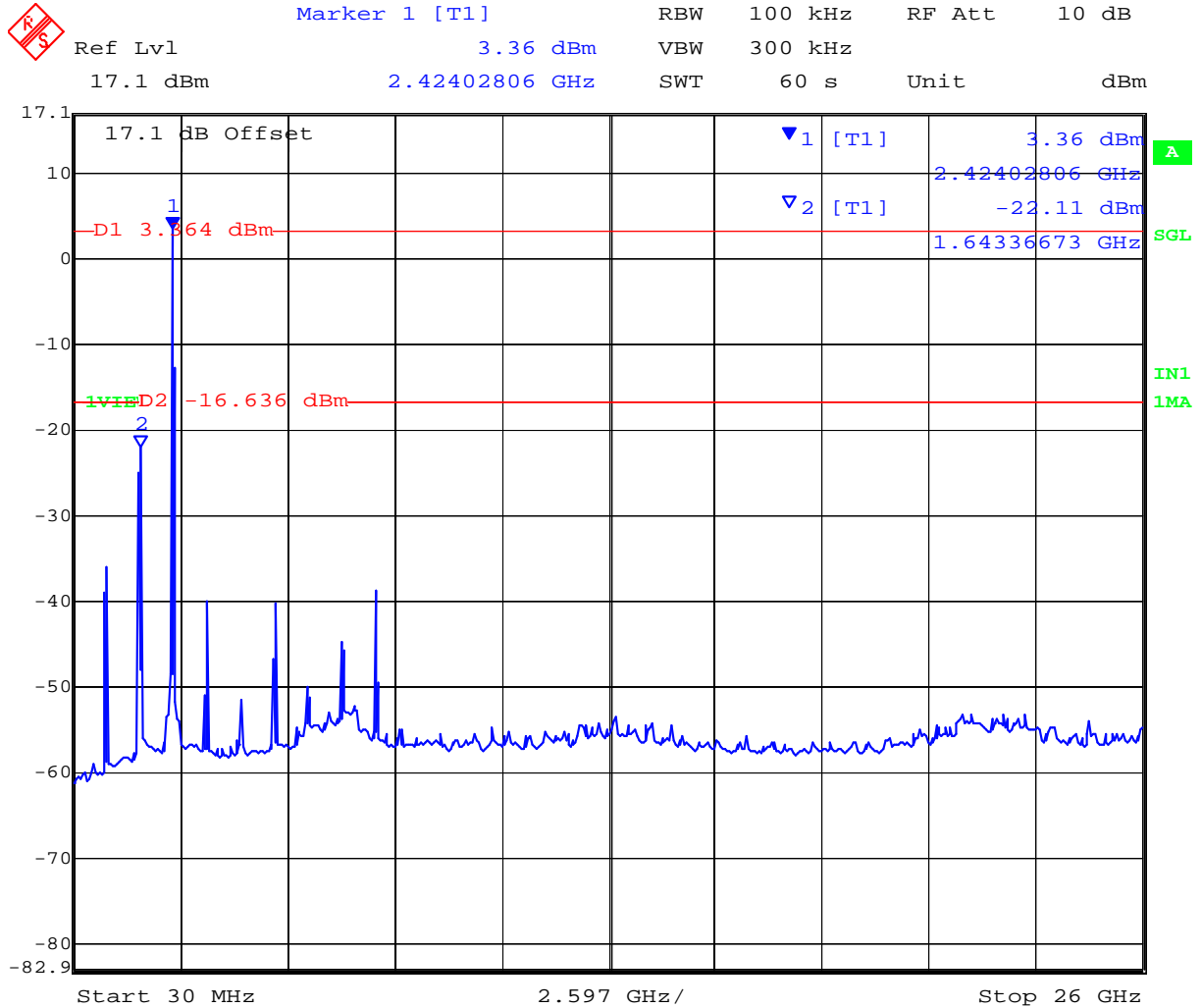
Date: 29.MAY.2012 11:25:25

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Date: 29.MAY.2012 11:40:20

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Date: 29.MAY.2012 11:54:45

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## **7.5 Radiated Spurious Emissions Above 1 GHz - Antenna ZES**

### **Test Procedure**

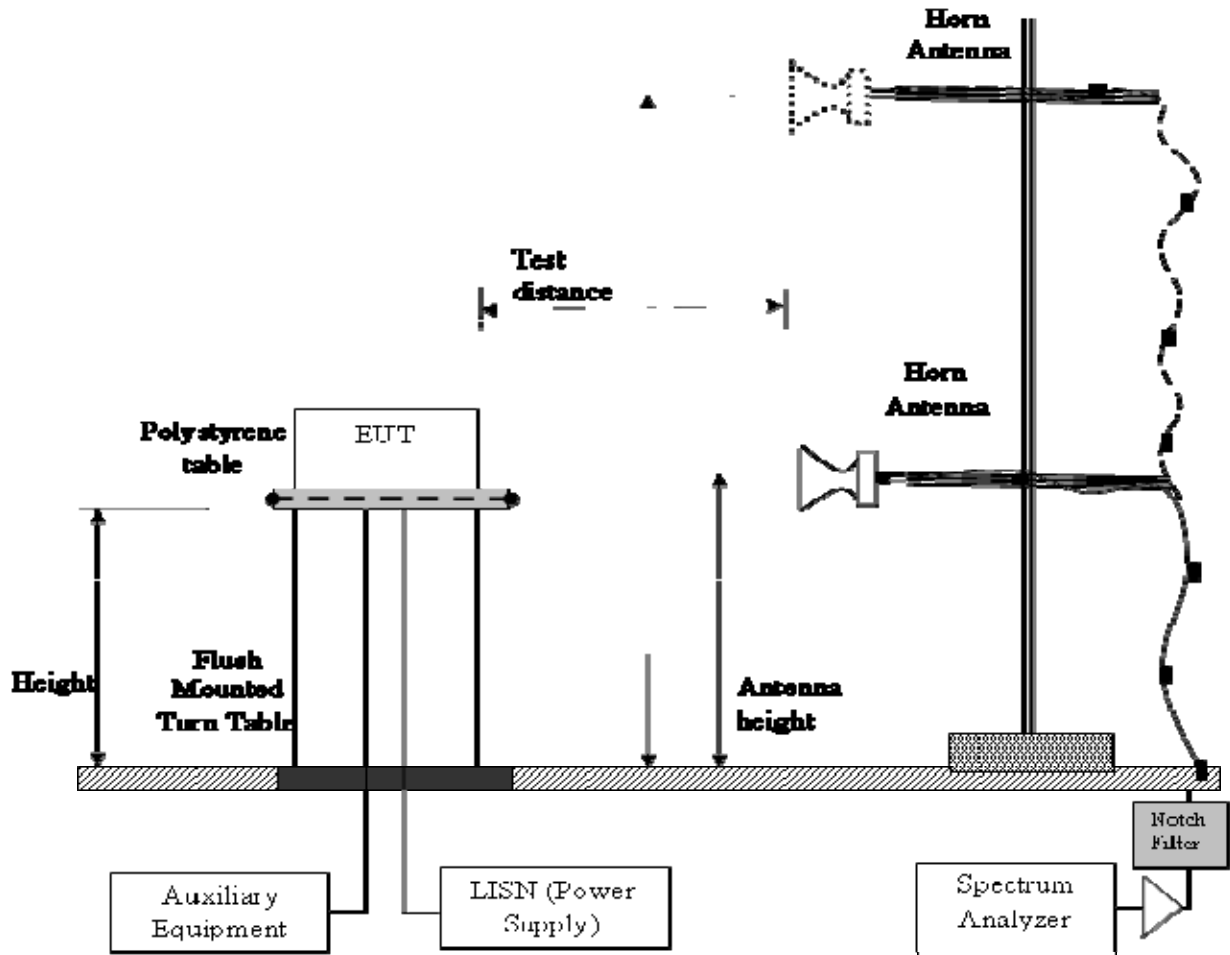
Testing was performed in a 3-meter anechoic chamber. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. Preliminary emissions were recorded with in Spectrum Analyzer mode, using a maximum peak detector while in peak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

---

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### Test Measurement Set Up



Radiated Emission Measurement Setup – Above 1 GHz





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## 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

$$CORR = \text{Correction Factor} = CL - AG + NFL$$

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

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

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

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

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

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

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## Specification

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.

---

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**Table 1: FCC 15.209 Spurious Emissions Limits**

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

**Laboratory Measurement Uncertainty for Spectrum Measurement**

Measurement Uncertainty	+5.6/ -4.5 dB
-------------------------	---------------

**Traceability:**

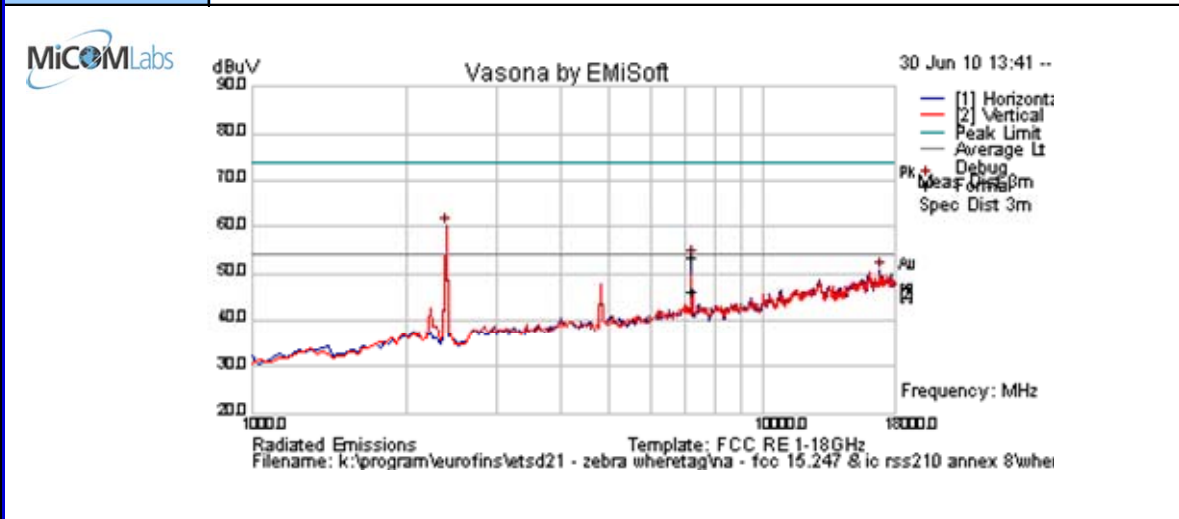
Method	Test Equipment Used
Work instruction WI-03	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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### 7.5.1 802.11b Radiated Spurious Emissions

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	GMH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	3.6 %
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2396.793	68.2	3.0	-11.2	60.0	Peak [Scan]	H	100	--	--	--	N/A	FUND
7234.909	53.3	5.4	-5.2	53.5	Peak Max	H	101	233	74.0	-20.5	Pass	RB
7234.909	45.8	5.4	-5.2	46.0	Average Max	H	101	233	54	-8.0	Pass	RB

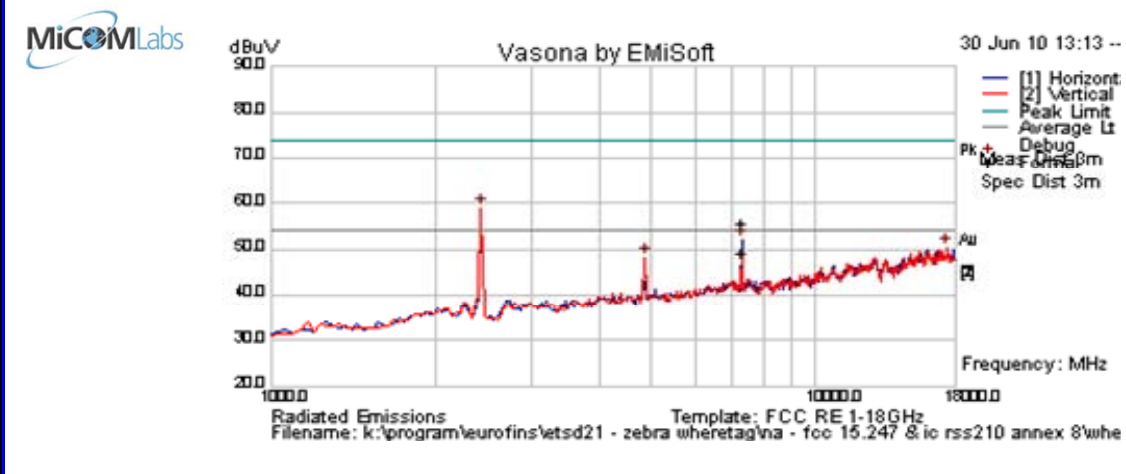
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	GMH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	3.6 %
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2438.0	67.0	3.0	-11.1	59.0	Peak [Scan]	V	100	--	--	--	N/A	FUND
7309.379	55.0	5.4	-4.9	55.5	Peak Max	H	103	193	74.0	-18.5	Pass	RB
7309.379	48.5	5.4	-4.9	49.0	Average Max	H	103	193	54.0	-5.0	Pass	RB
4873.988	53.1	4.5	-9.3	48.3	Peak [Scan]	V	100	0	54	-5.8	Pass	RB

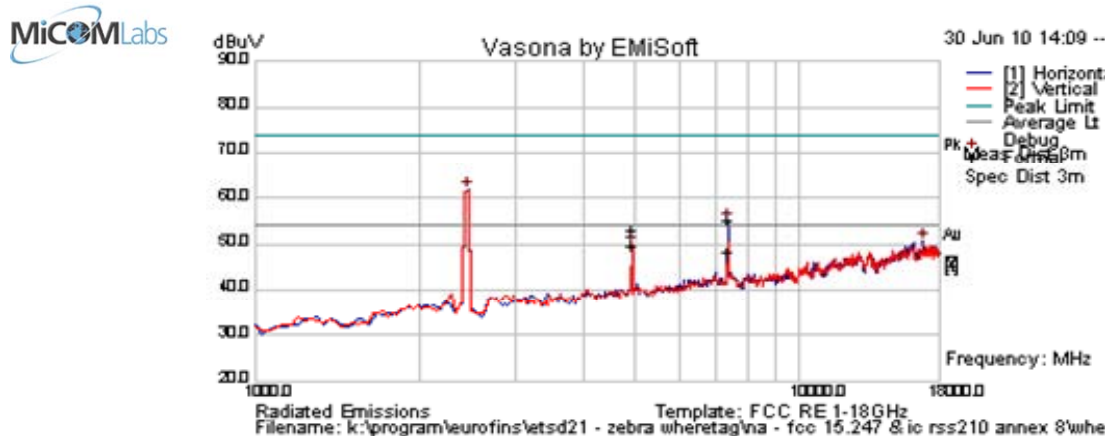
Legend: TX = Transmitter Emissions; DG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	GMH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	3.6 %
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2464.930	69.8	2.980	-11.1	61.720	Peak [Scan]	H	100	--	--	--	N/A	FUND
7384.890	54.5	5.5	-4.8	55.1	Peak Max	H	99	250	74.0	-18.9	Pass	RB
4923.942	57.5	4.6	-9.1	52.9	Peak Max	V	138	205	74.0	-21.1	Pass	RB
7384.890	47.8	5.5	-4.8	48.4	Average Max	H	99	250	54	-5.6	Pass	RB
4923.942	54.2	4.6	-9.1	49.7	Average Max	V	138	205	54	-4.3	Pass	RB

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

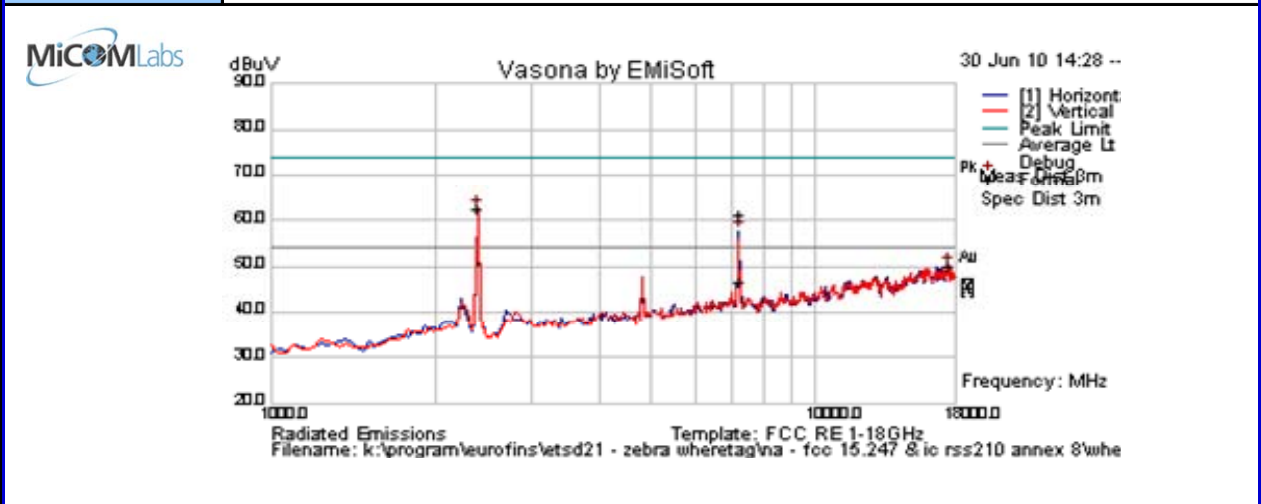
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### 7.5.2 802.11g Radiated Spurious Emissions

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	0.72%
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2396.794	70.9	3.0	-11.2	62.7	Peak [Scan]	V	100	--	--	--	N/A	FUND
7237.610	60.8	5.4	-5.1	61.1	Peak Max	H	139	39	74.0	-12.9	Pass	RB
7237.61	46.4	5.4	-5.1	46.7	Average Max	H	139	39	54.0	-7.3	Pass	RB

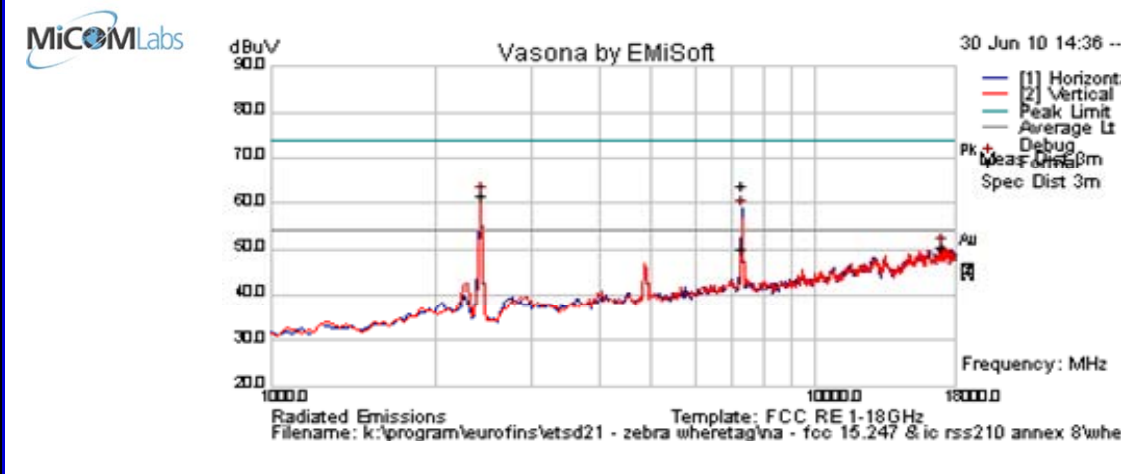
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	0.72%
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2430.862	69.9	3.0	-11.1	61.7	Peak [Scan]	H	100	--	--	--	N/A	FUND
7307.976	63.2	5.4	-4.9	63.7	Peak Max	H	115	208	74.0	-10.3	Pass	RB
7307.976	49.4	5.4	-4.9	49.9	Average Max	H	115	208	54.0	-4.1	Pass	RB
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												

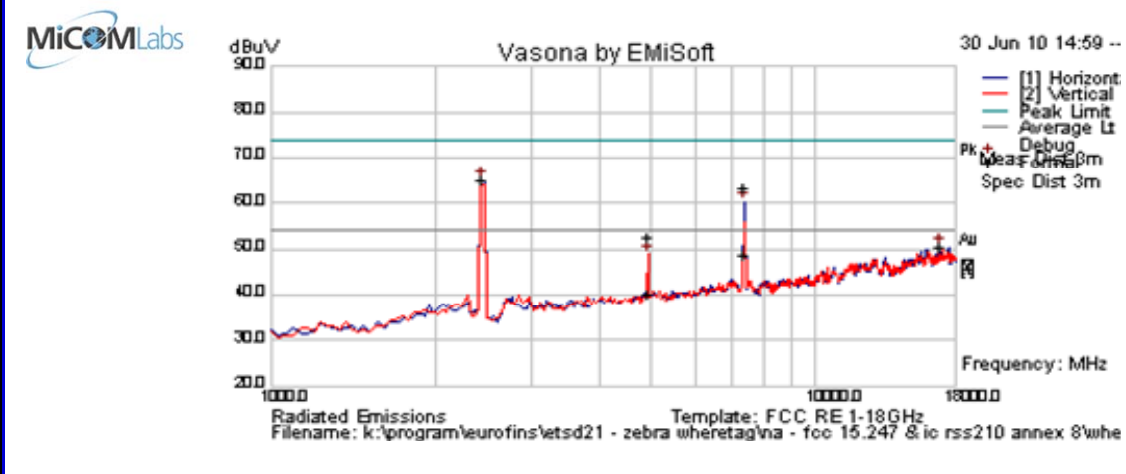
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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	0.72%
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2430.862	73.0	3.0	-11.1	64.9	Peak [Scan]	H	100	--	--	--	N/A	FUND
7386.433	62.8	5.5	-4.8	63.4	Peak Max	H	101	83	74.0	-10.6	Pass	RB
4923.873	57.0	4.6	-9.1	52.4	Peak Max	H	181	88	74.0	-21.6	Pass	RB
7386.433	48.1	5.5	-4.8	48.8	Average Max	H	101	83	54	-5.2	Pass	RB
4923.873	44.6	4.6	-9.1	40.1	Average Max	H	181	88	54	-14.0	Pass	RB

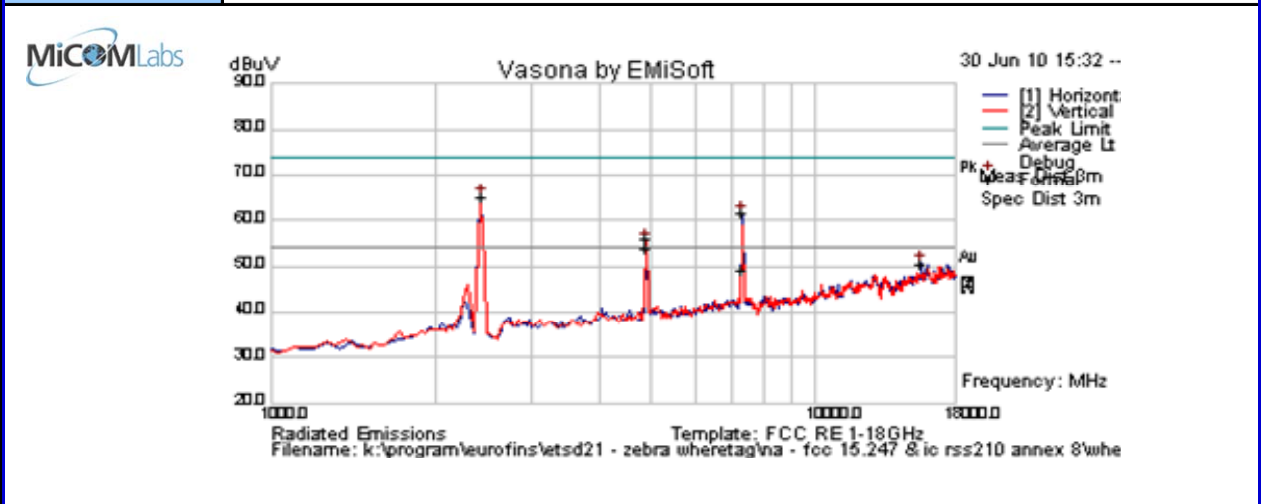
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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### 7.5.3 DSSS Radiated Spurious Emissions

<b>Test Freq.</b>	2441.75 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	DSSS	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	15 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	2.55 %
<b>Test Notes 1</b>	EUT was tested at 100% duty cycle.		
<b>Test Notes 2</b>	Fundamental attenuated by band-stop filter		



#### 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	73.3	3.0	-11.1	65.2	Peak [Scan]	H	100	--	--	--	N/A	FUND
7325.109	61.2	5.5	-5.1	61.6	Peak Max	H	101	218	74.0	-12.4	Pass	RB
4883.404	60.7	4.5	-9.3	55.9	Peak Max	V	120	184	74.0	-18.1	Pass	RB
7325.109	49.0	5.5	-5.1	49.3	Average Max	H	101	218	54	-4.7	Pass	RB
4883.404	58.5	4.5	-9.3	53.7	Average Max	V	120	184	54	-0.3	N/A	RB
4883.404	Corrected Value =			21.8	dBuV				54.0	-32.2	Pass	RB

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

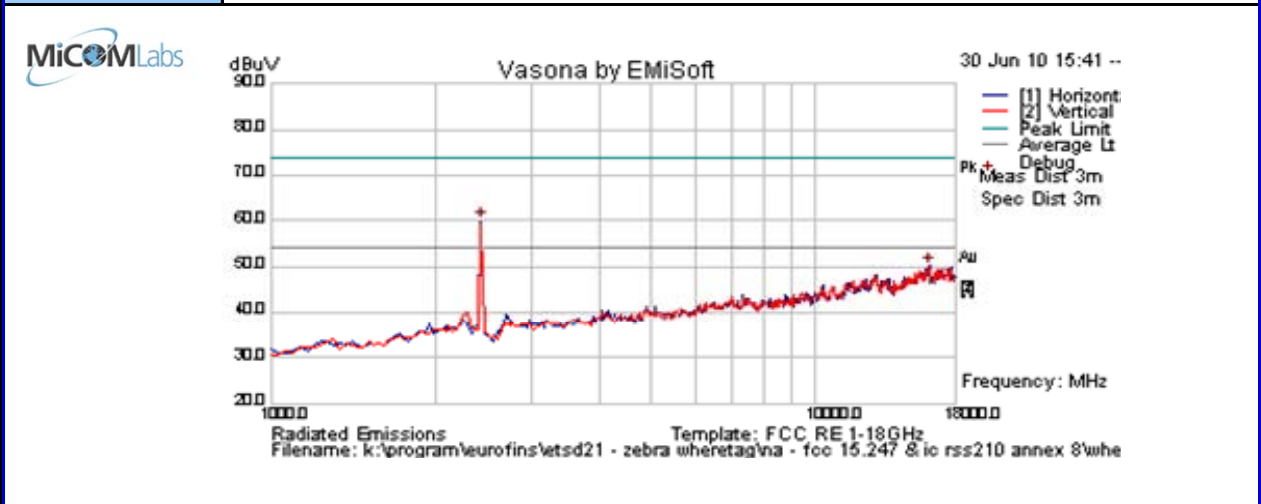
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### 7.5.4 OOK Radiated Spurious Emissions

<b>Test Freq.</b>	2446.519 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	OOK	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	15 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	13 %
<b>Test Notes 1</b>	EUT was tested at 100% duty cycle.		
<b>Test Notes 2</b>	Fundamental attenuated by band-stop filter		



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2430.862	68.0	3.0	-11.1	59.9	Peak [Scan]	H	100	--	--	--	N/A	FUND

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

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### 7.5.5 802.11b Radiated Band Edge Emissions

Duty cycle correction factor was applied to spurious emissions in the restricted bands closest to the fundamental transmission.

EUT Operational Duty Cycle: 3.6%  
Correction Factor =  $20 * \text{LOG} (3.6 / 100)$   
Correction Factor = -28.87dB  
Corrected Value = Measured Value (dB) - 28.87 (dB)

Frequency (MHz)	Measured Value (dBuV/m)	Measurement Type	Corrected Value	Margin (dB)	Pass / Fail
2327.93587	59.75	Peak	30.88	-43.12	Pass
2328.31663	51.95	Average	23.08	-30.92	Pass
2487.93086	73.06	Peak	44.19	-29.81	Pass
2487.69940	69.69	Average	40.82	-13.18	Pass

---

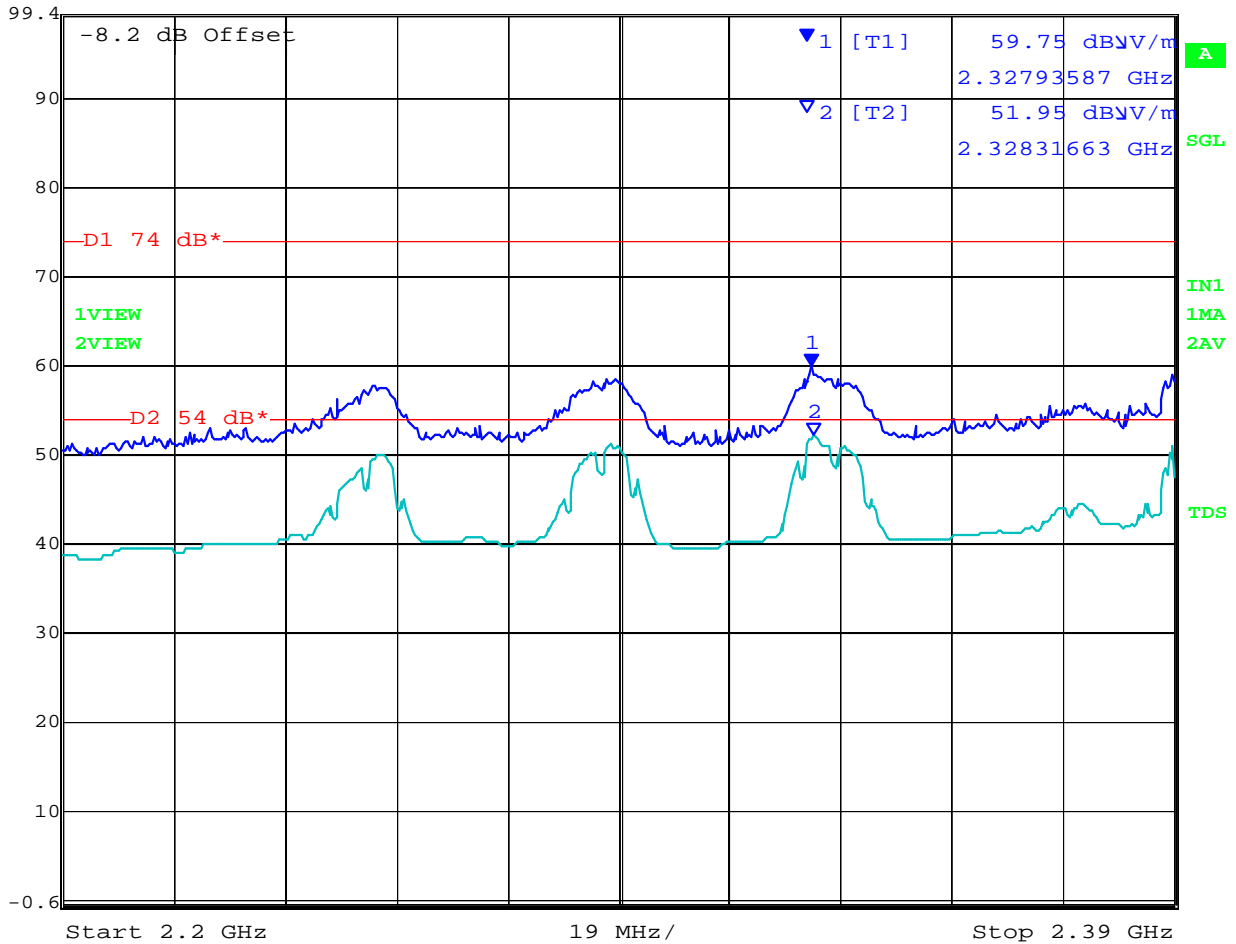
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Ref Lvl	59.75 dB $\mu$ V/m	RBW	1 MHz	RF Att	20 dB
99.4 dB*	2.32793587 GHz	VBW	1 MHz	Unit	dB $\mu$ V/m
		SWT	60 s		

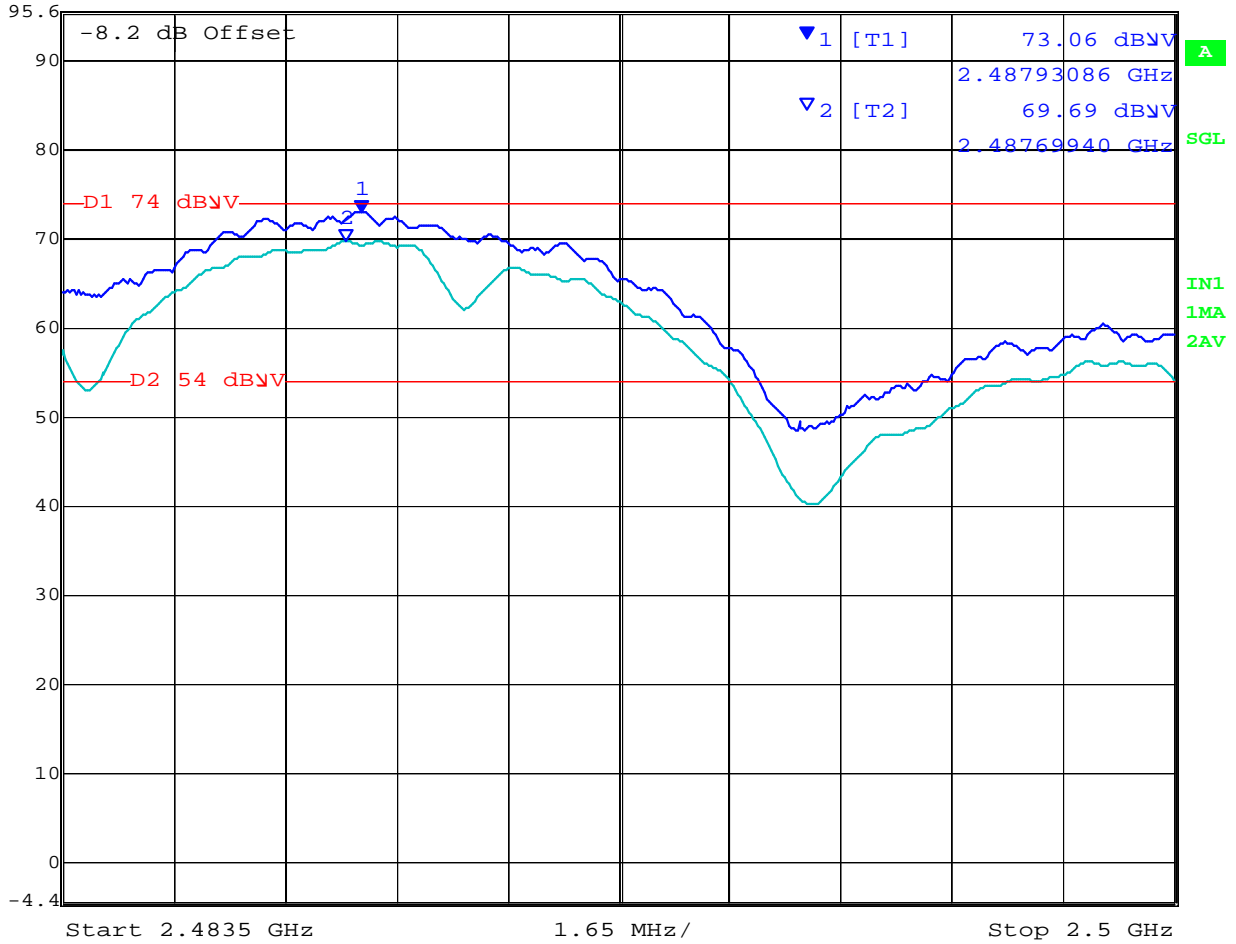


Date: 1.JUL.2010 17:50:56

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Marker 1 [T1] RBW 1 MHz RF Att 20 dB  
Ref Lvl 73.06 dBV VBW 1 MHz  
95.6 dBV 2.48793086 GHz SWT 60 s Unit dBV



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### **7.5.6 802.11g Radiated Band Edge Emissions**

Duty cycle correction factor was applied to spurious emissions in the restricted bands closest to the fundamental transmission.

EUT Operational Duty Cycle: 0.72%

Correction Factor =  $20 * \text{LOG} (0.72 / 100)$

Correction Factor = -42.85dB

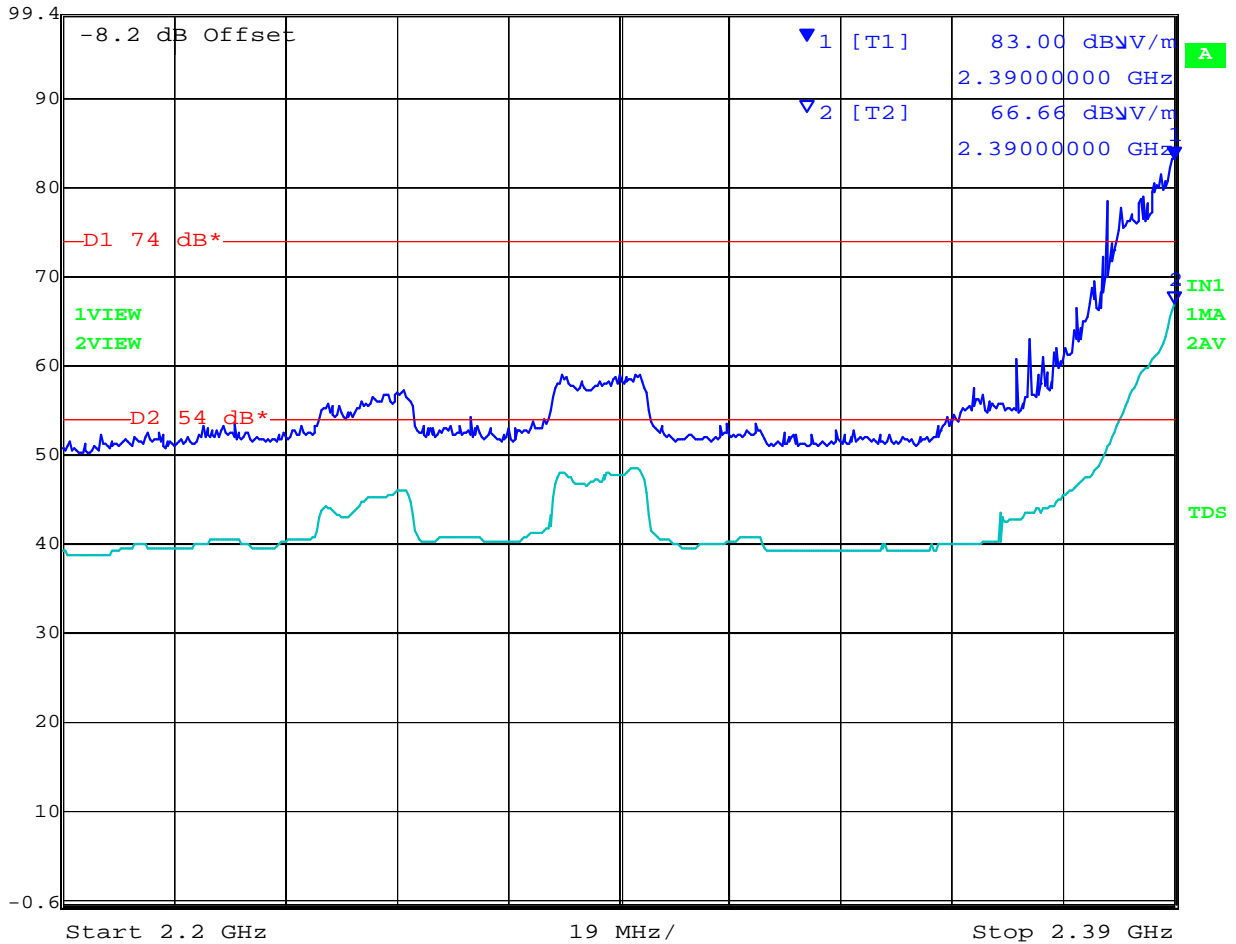
Corrected Value = Measured Value (dB) - 42.85 (dB)

Frequency (MHz)	Measured Value (dBuV/m)	Measurement Type	Corrected Value	Margin (dB)	Pass / Fail
2390.00000	83.00	Peak	40.15	-33.85	Pass
2390.00000	66.66	Average	23.81	-30.19	Pass
2483.63226	82.55	Peak	39.70	-34.30	Pass
2483.50000	64.49	Average	21.64	-32.36	Pass

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Marker 1 [T1] RBW 1 MHz RF Att 20 dB  
Ref Lvl 83.00 dB $\mu$ V/m VBW 1 MHz  
99.4 dB\* 2.3900000 GHz SWT 60 s Unit dB $\mu$ V/m



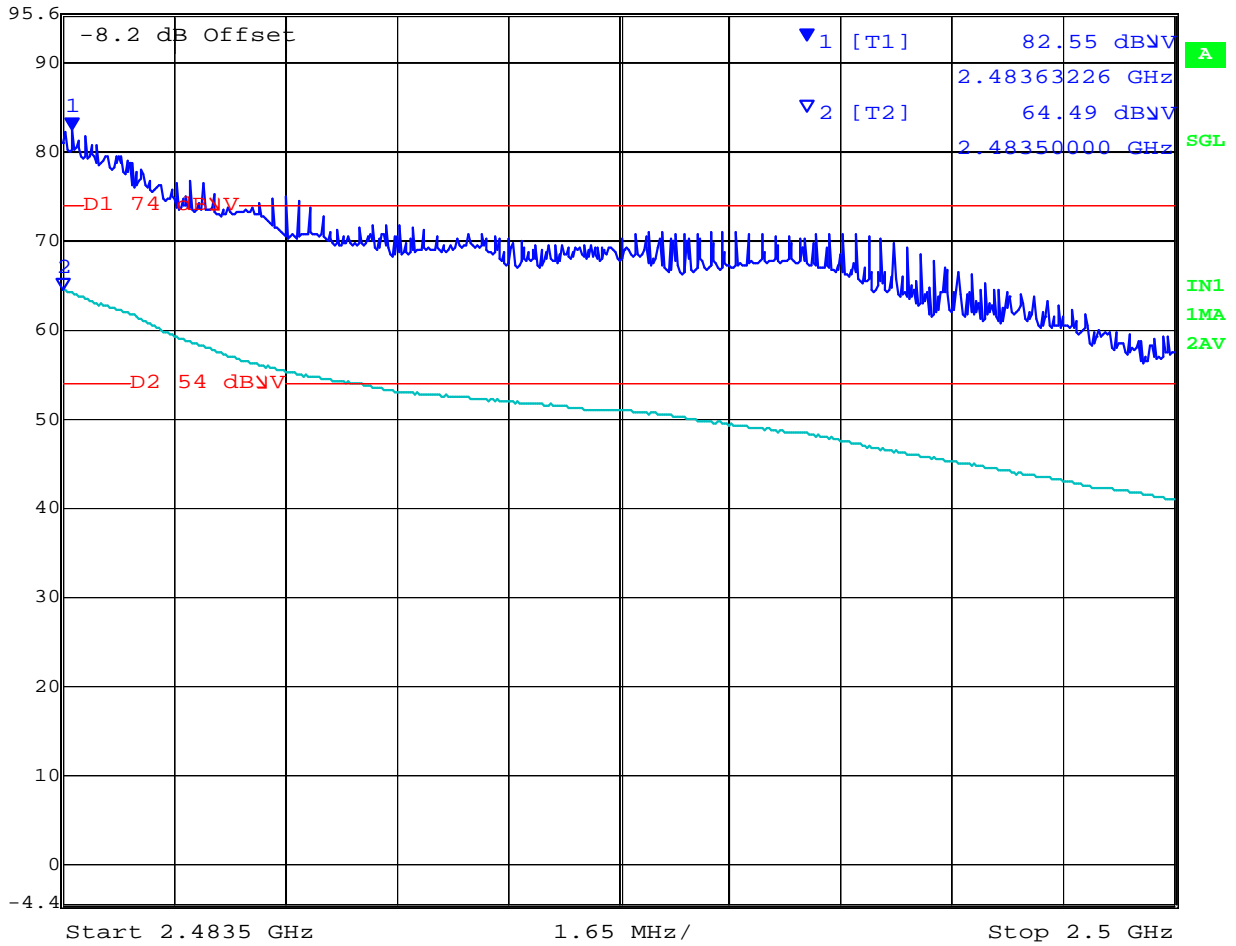
Date: 1.JUL.2010 18:04:12

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Marker 1 [T1] RBW 1 MHz RF Att 20 dB  
Ref Lvl 82.55 dBV VBW 1 MHz  
95.6 dBV 2.48363226 GHz SWT 60 s Unit dBV



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### 7.5.7 DSSS Radiated Band Edge Emissions

Duty cycle correction factor was applied to spurious emissions in the restricted bands closest to the fundamental transmission.

EUT Operational Duty Cycle: 2.55%

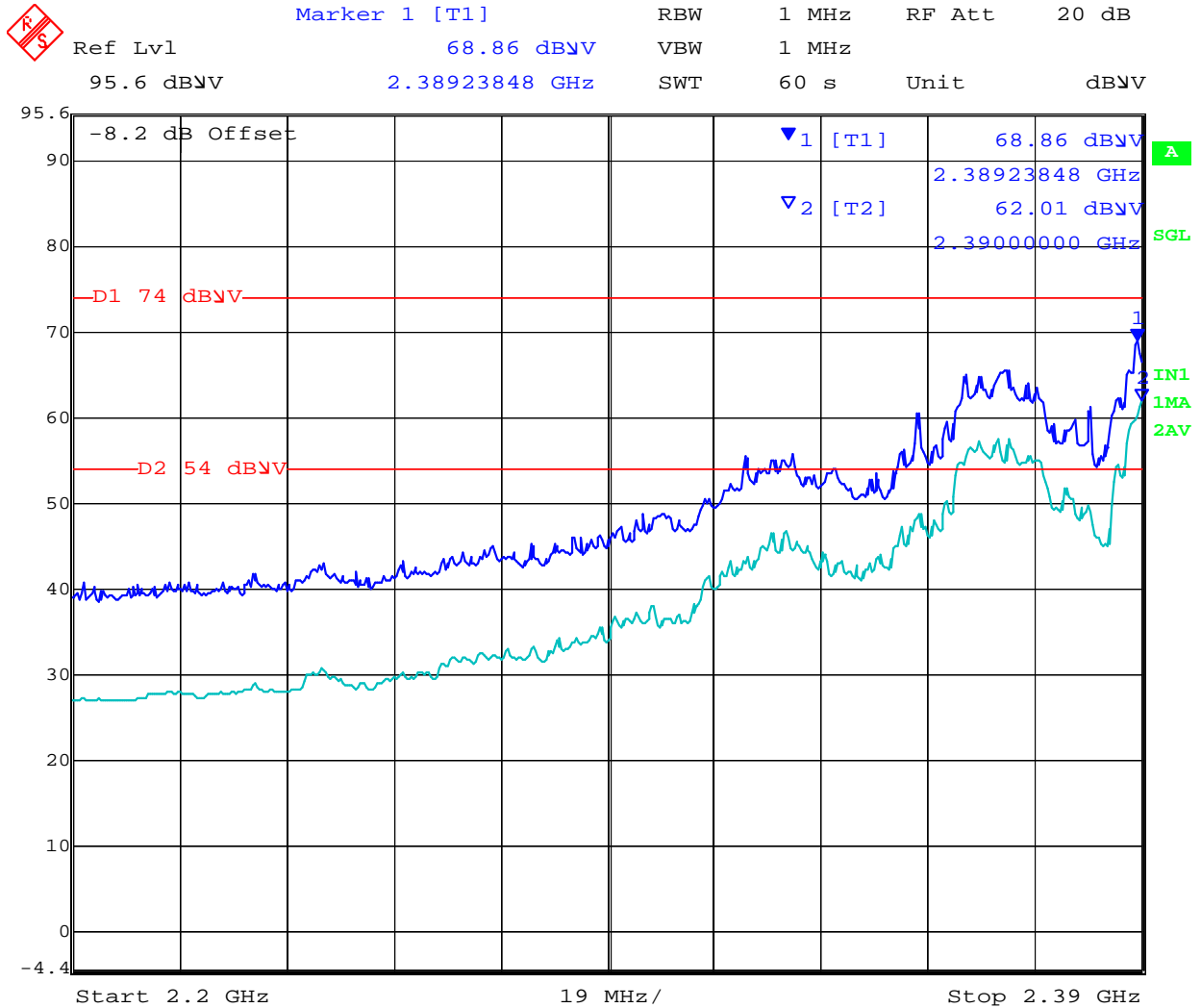
Correction Factor =  $20 * \text{LOG} (2.55 / 100)$

Correction Factor = -31.87 dB

Corrected Value = Measured Value (dB) - 31.87 (dB)

Frequency (MHz)	Measured Value (dBuV/m)	Measurement Type	Corrected Value	Margin (dB)	Pass / Fail
2389.23848	68.86	Peak	36.99	-37.01	Pass
2390.00000	62.01	Average	30.14	-23.86	Pass
2483.50000	75.12	Peak	43.25	-30.75	Pass
2483.50000	66.89	Average	35.02	-18.98	Pass

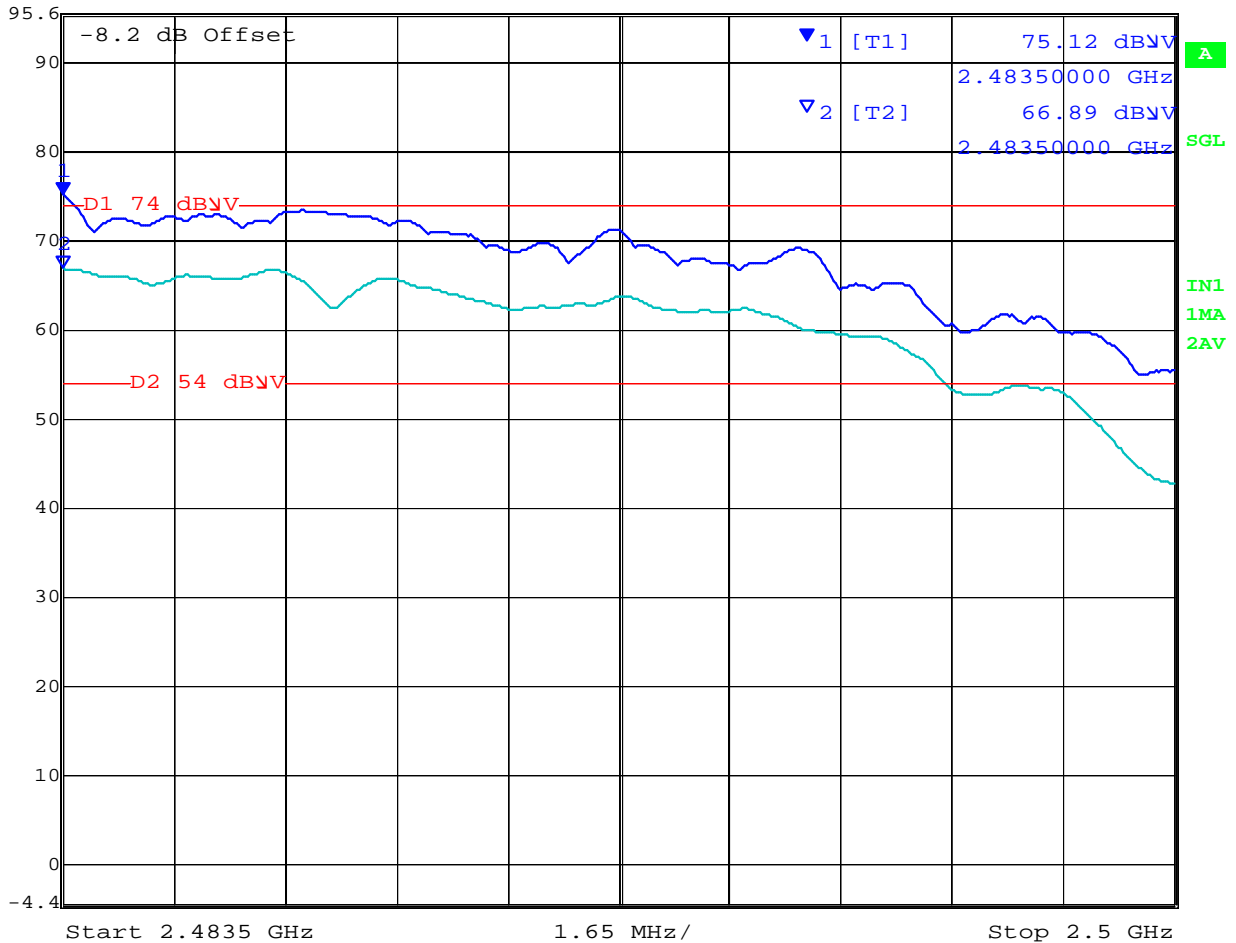
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Marker 1 [T1] RBW 1 MHz RF Att 20 dB  
Ref Lvl 75.12 dBV VBW 1 MHz  
95.6 dBV 2.48350000 GHz SWT 60 s Unit dBV

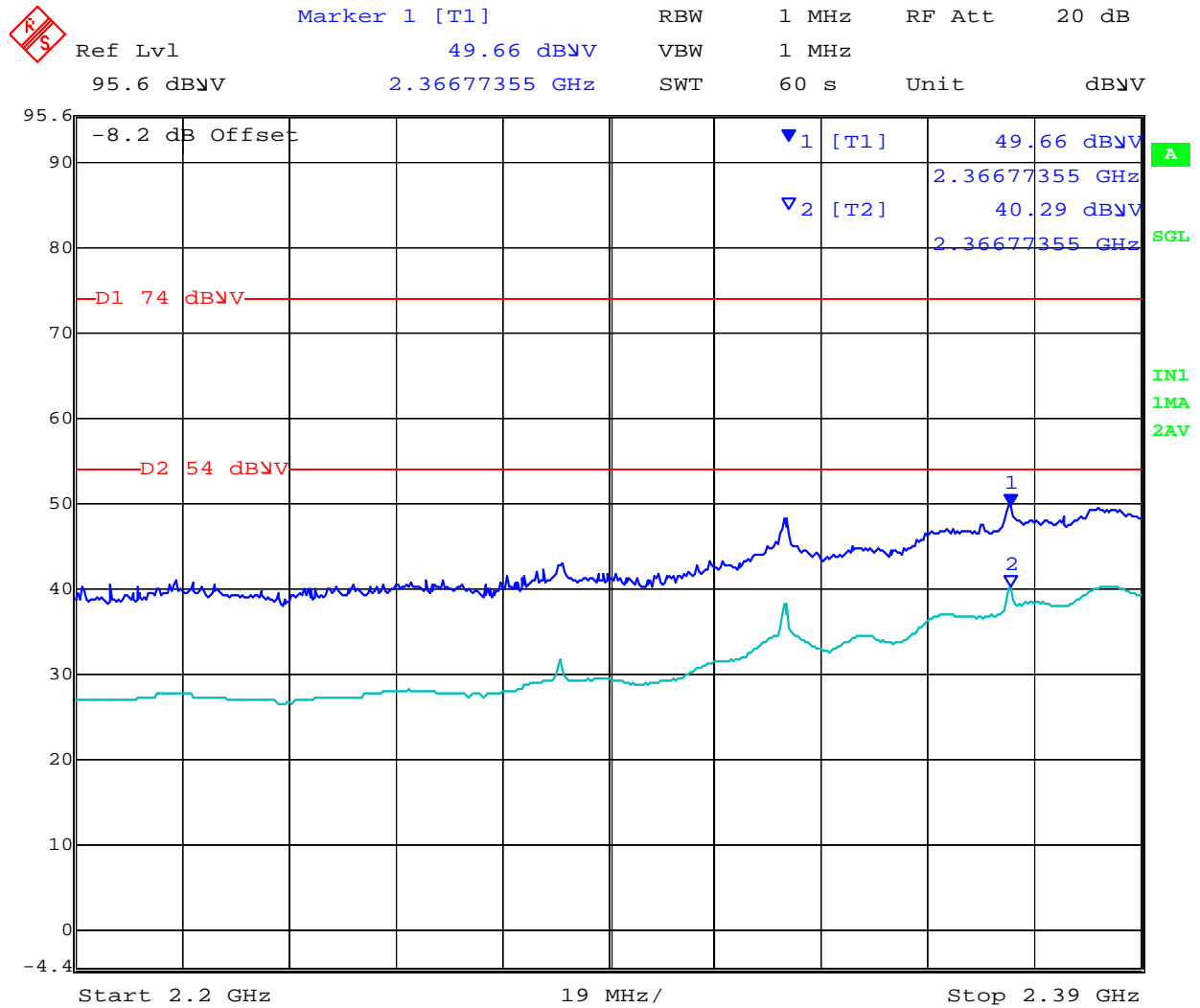


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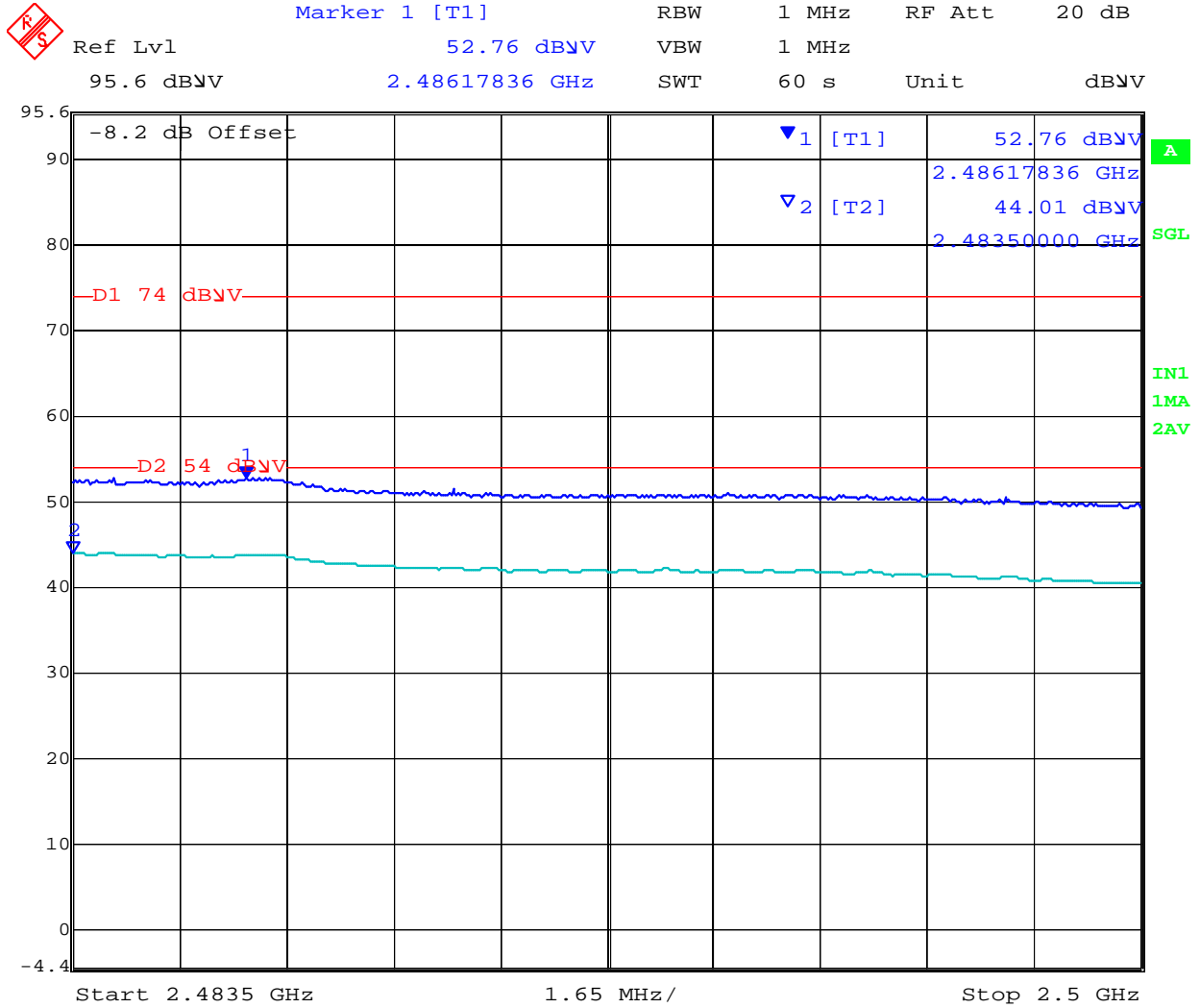


### 7.5.8 OOK Radiated Band Edge Emissions

All emissions below FCC limits when tested at 100% duty cycle. No duty cycle correction factor required to comply with FCC limits.



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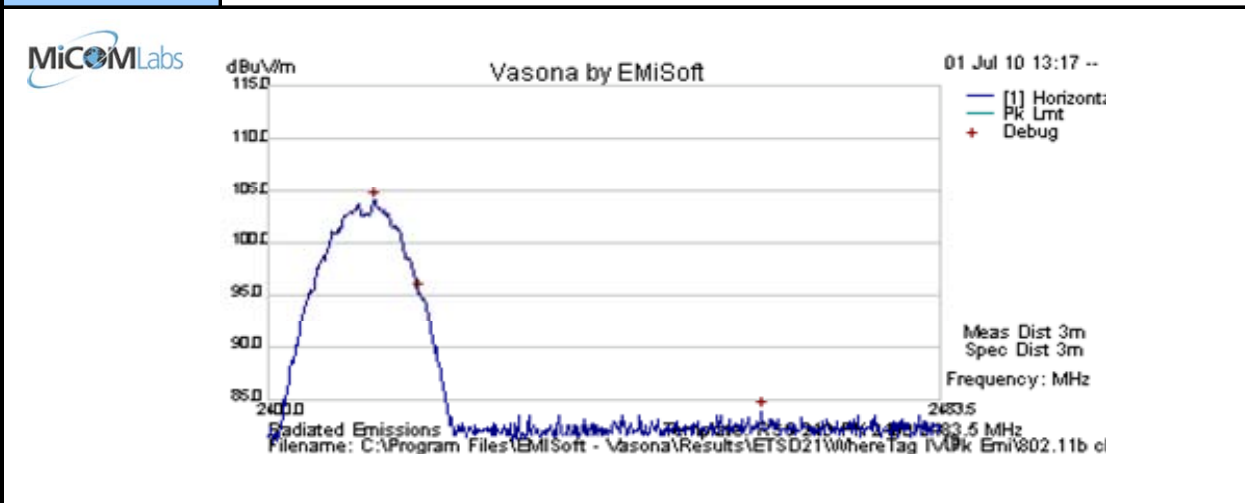
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### 7.5.9 802.11b RSS-210 Radiated Peak Emissions

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



#### Formally measured emission peaks

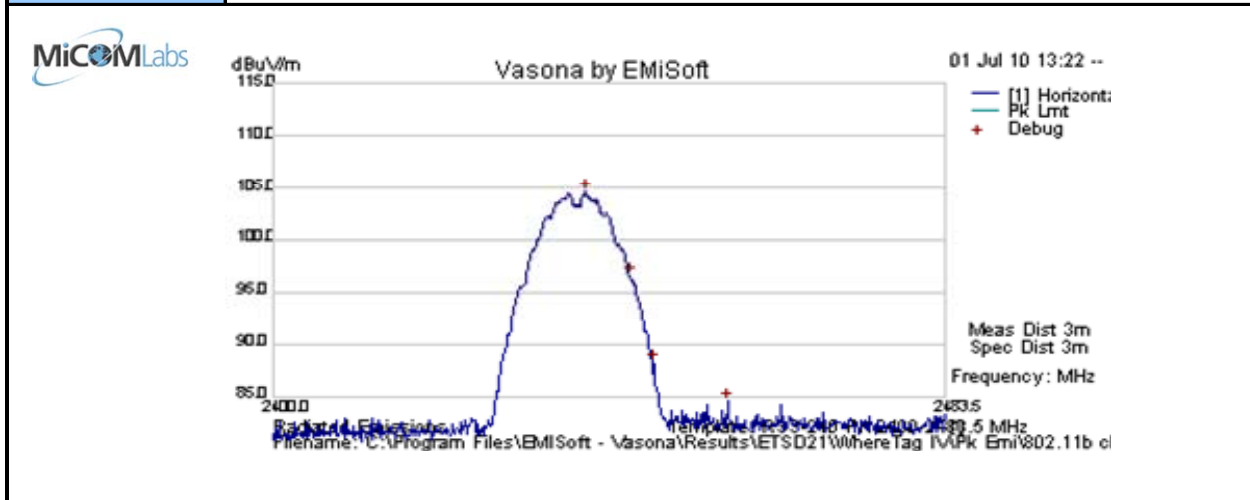
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2413.221	66.5	7.1	30.4	104.1	Peak [Scan]	V						
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission PK = Peak emissions of Fundamental												

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



**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
2438.549	67.0	7.1	30.5	104.7	Peak [Scan]	V						

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

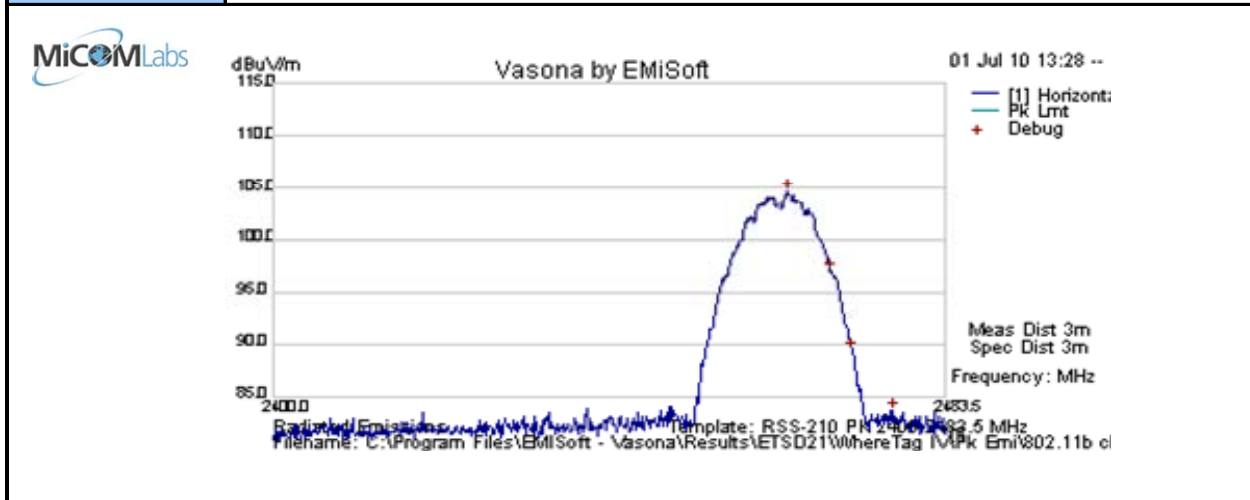
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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



**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
2463.738	66.9	7.2	30.6	104.6	Peak [Scan]	V						

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

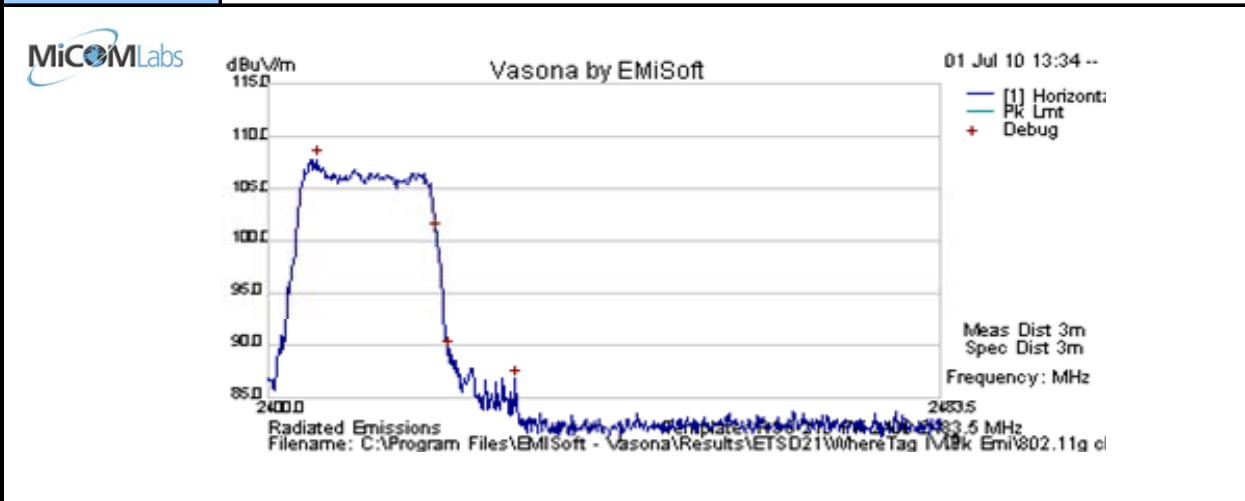
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**7.5.10 802.11g RSS-210 Radiated Peak Emissions**

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



**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
2406.123	70.4	7.1	30.4	107.9	Peak [Scan]	V						

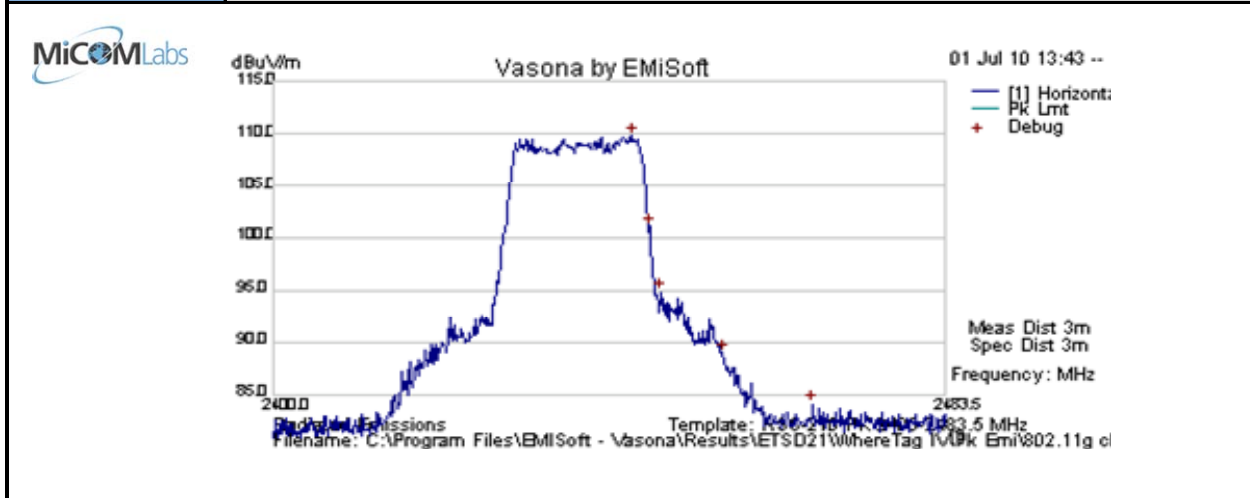
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



**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
2444.255	72.2	7.2	30.5	109.9	Peak [Scan]	V						

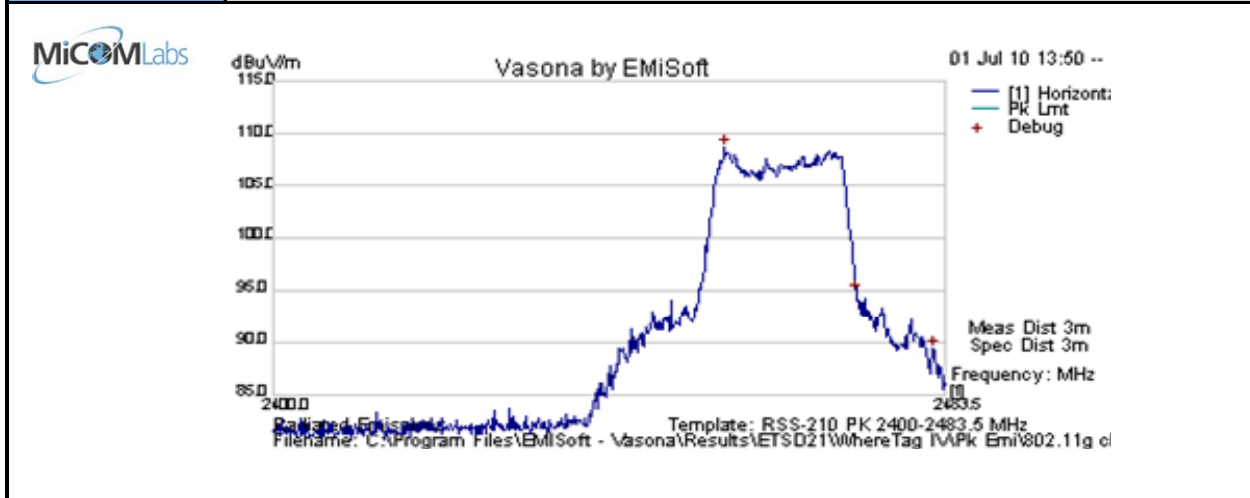
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	SB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=ZES10370	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



**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
2455.806	71.0	7.2	30.6	108.7	Peak [Scan]	V						

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

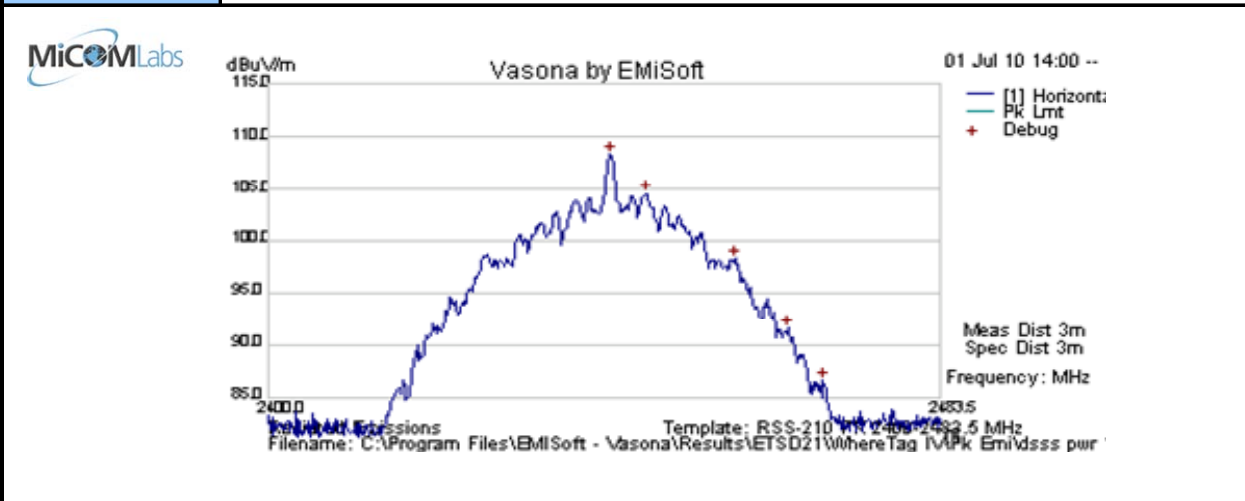
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### 7.5.11 DSSS RSS-210 Radiated Peak Emissions

Test Freq.	2441.75 MHz	Engineer	SB
Variant	DSSS	Temp (°C)	28
Freq. Range	2400 - 2483.5 MHz	Rel. Hum.(%)	36
Power Setting	14 in test utility software	Press. (mBars)	1001
Antenna	ANT=ZES10370	Duty Cycle (%)	100
Test Notes 1			
Test Notes 2			



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2442.168	70.7	7.2	30.5	108.4	Peak [Scan]	V						PK
Legend:		TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission										
		PK = Peak emissions of Fundamental										

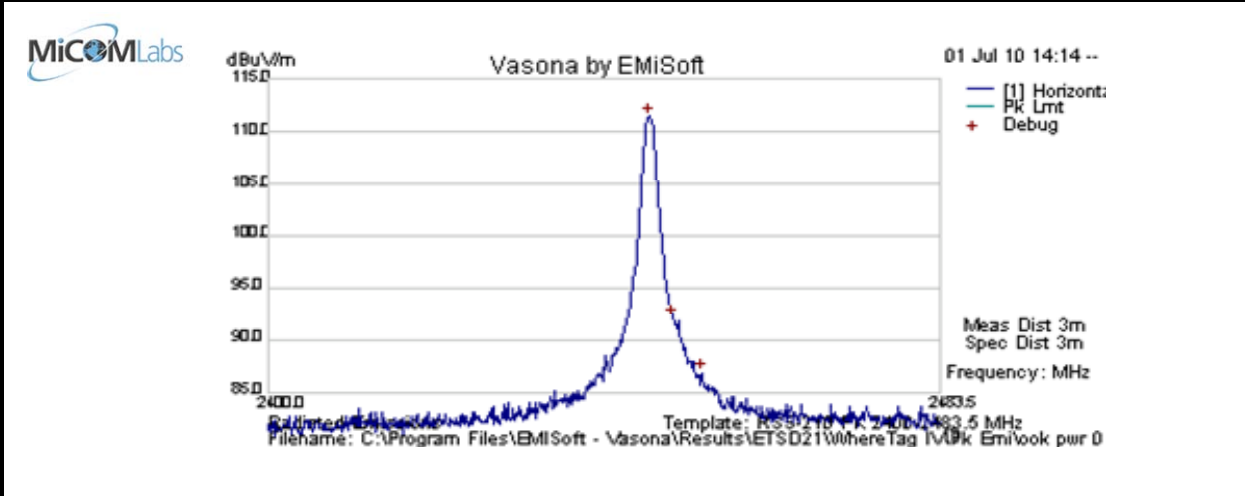
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### 7.5.12 OOK RSS-210 Radiated Peak Emissions

Test Freq.	2446.519 MHz	Engineer	SB
Variant	OOK	Temp (°C)	28
Freq. Range	2400 - 2483.5 MHz	Rel. Hum.(%)	36
Power Setting	Maximum	Press. (mBars)	1001
Antenna	ANT=ZES10370	Duty Cycle (%)	100
Test Notes 1			
Test Notes 2			



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2447.038	73.9	7.2	30.5	111.5	Peak [Scan]	V						PK

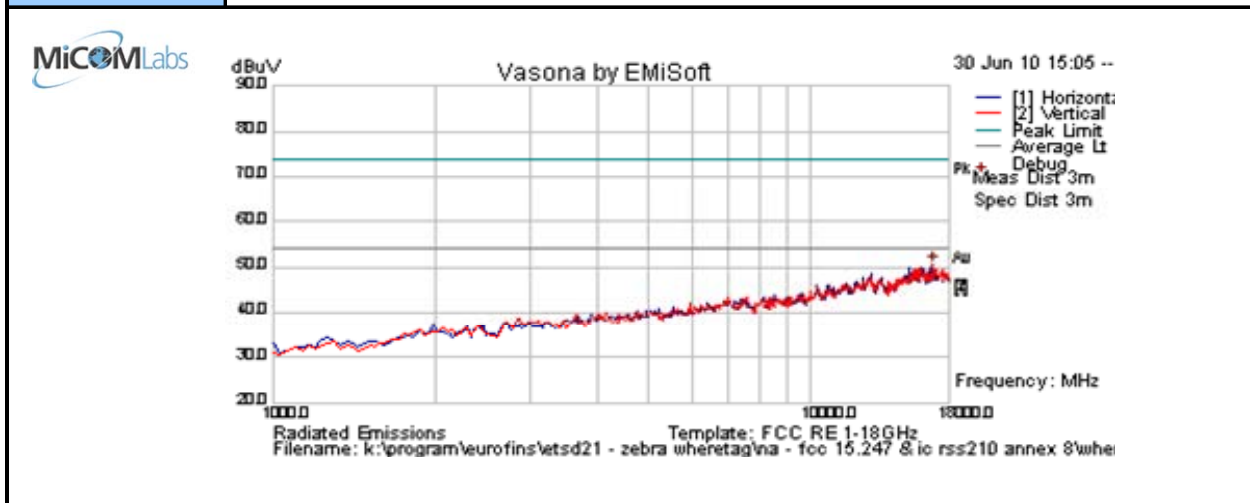
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

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### 7.5.13 RSS-210 Receiver Radiated Emissions

<b>Test Freq.</b>	2446.519 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	OOK	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	Not Applicable in Receive Mode	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370		
<b>Test Notes 1</b>	EUT was tested at 100% duty cycle.		
<b>Test Notes 2</b>			



#### 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
No Receiver Emissions within 6dB of limit.												
16841.683	40.2	8.6	1.8	50.5	Peak [Scan]	V	100	0	54.0	-3.5	Pass	Noise
<b>Legend:</b>	TRANS = Transient Emission; RB = Restricted Band; NRB = Non-Restricted Band; BE = Emission in Restricted Band Nearest Transmission Band Edge; FUND = Fundamental Freq.											

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## **7.6 Radiated Spurious Emissions above 1 GHz - Antenna Taoglas**

### **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.

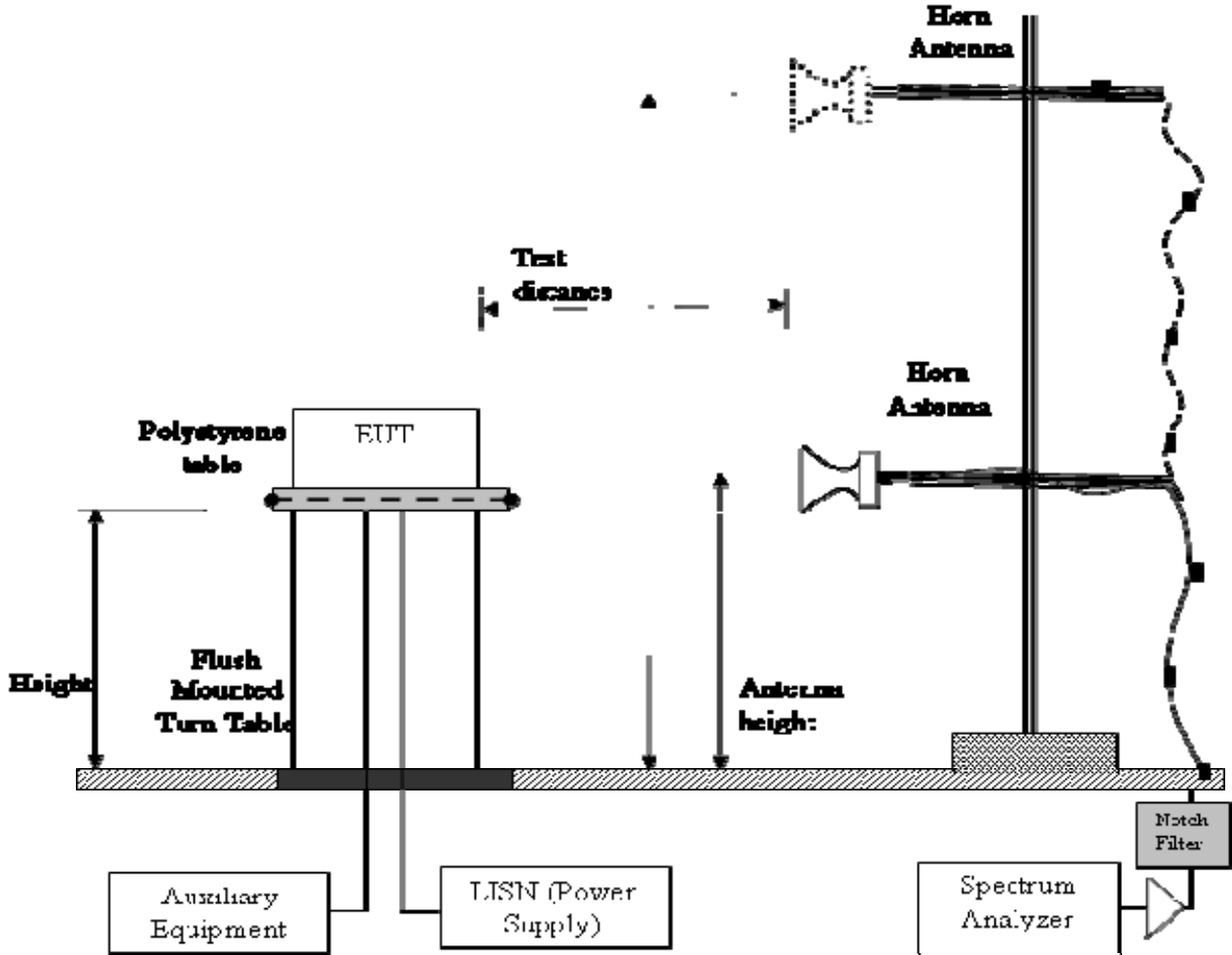
Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions above 1000 MHz are measured utilizing a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Emissions from 30 MHz – 1000 MHz are measured utilizing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

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### Test Measurement Set Up



Radiated Emission Measurement Setup – Above 1 GHz



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### 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

$$CORR = \text{Correction Factor} = CL - AG + NFL$$

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

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

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

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

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

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

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## Specification

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.

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**Table 1: FCC 15.209 Spurious Emissions Limits**

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

**Laboratory Measurement Uncertainty for Spectrum Measurement**

Measurement Uncertainty	+5.6/ -4.5 dB
-------------------------	---------------

**Traceability:**

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

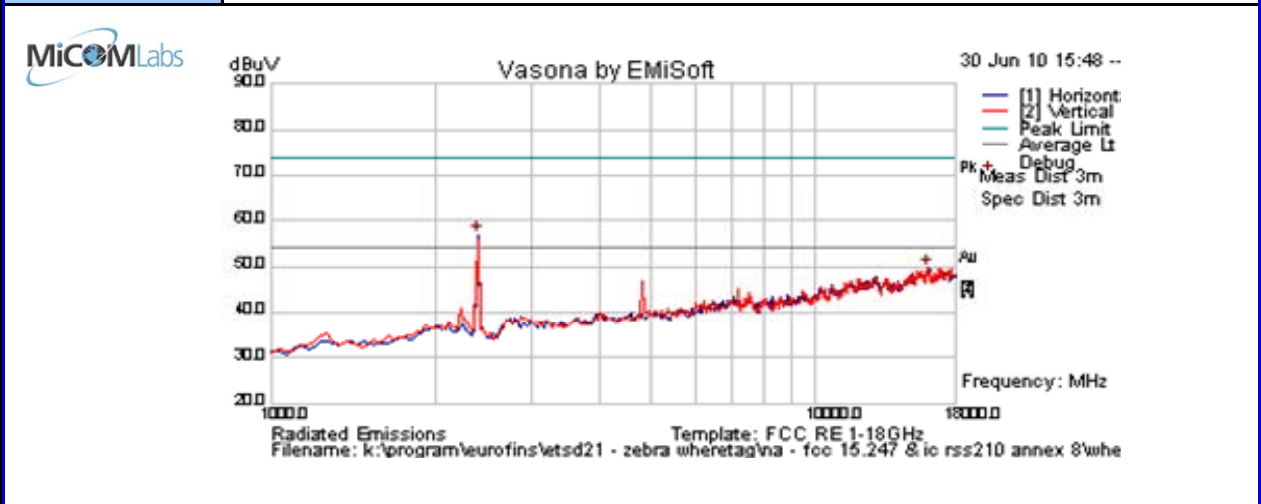
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### 7.6.1 802.11b Radiated Spurious Emissions

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	GMH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	3.6 %
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2396.794	65.0	3.0	-11.2	56.8	Peak [Scan]	H	100	--	--	--	N/A	FUND

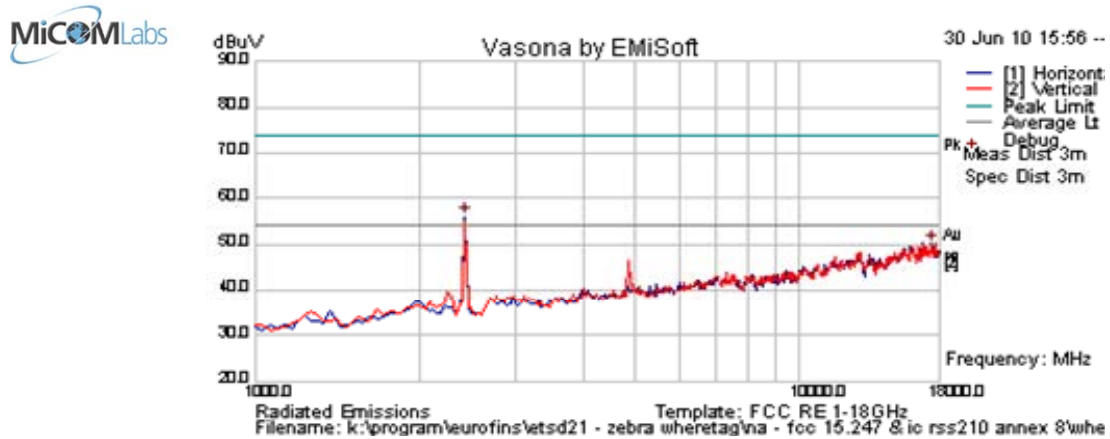
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	GMH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	3.6 %
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2430.862	64.1	3.0	-11.1	55.9	Peak [Scan]	H	100	--	--	--	N/A	FUND

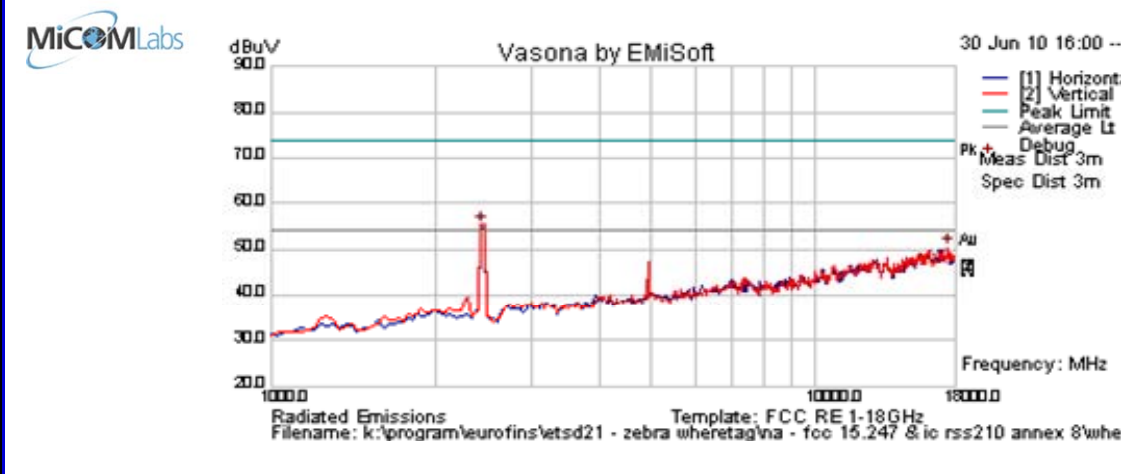
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	GMH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	3.6 %
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2430.862	63.4	3.0	-11.1	55.3	Peak [Scan]	V	100	--	--	--	N/A	Fund

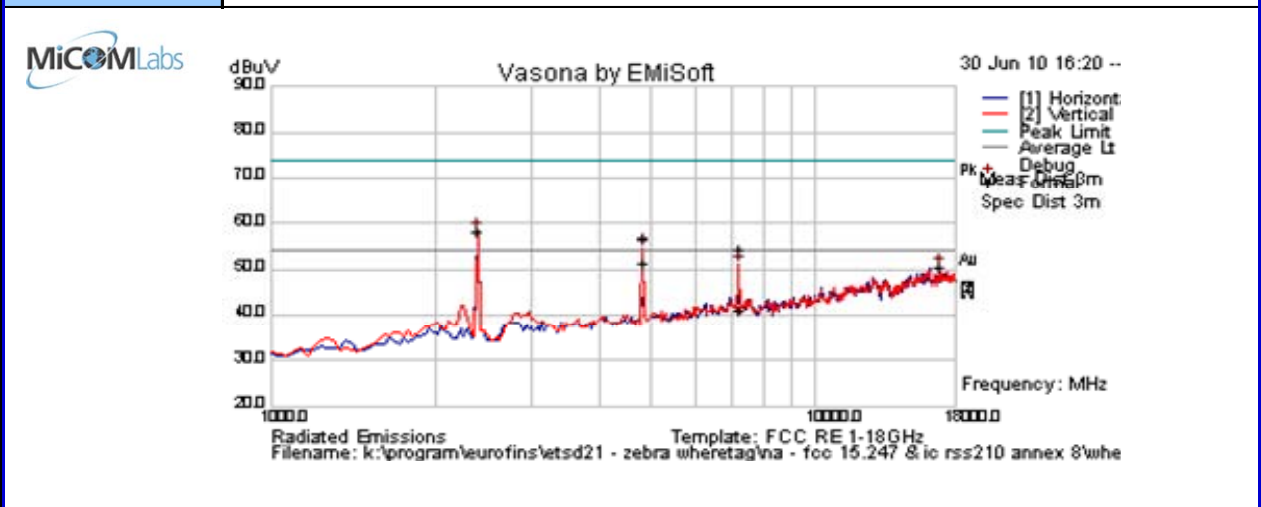
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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### 7.6.2 802.11g Radiated Spurious Emissions

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	GMH
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	0.72
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2396.794	66.4	3.0	-11.2	58.2	Peak [Scan]	H	100	--	--	--	N/A	FUND
4823.983	61.9	4.5	-9.4	57.0	Peak Max	V	137	222	74.0	-17.1	Pass	RB
7235.07	53.9	5.4	-5.2	54.2	Peak Max	V	98	300	74.0	-19.9	Pass	RB
4823.983	56.4	4.5	-9.4	51.5	Average Max	V	137	222	54	-2.5	Pass	RB
7235.070	41.0	5.4	-5.2	41.2	Average Max	V	98	300	54	-12.8	Pass	RB

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

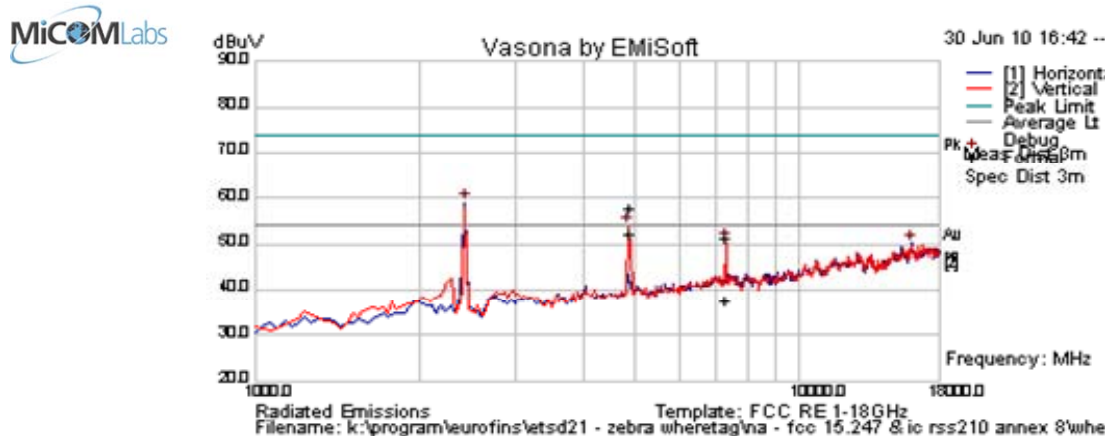
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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	GMH
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	0.72
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2430.862	67.1	3.0	-11.1	59.0	Peak [Scan]	H	100	--	--	--	N/A	FUND
4873.952	62.8	4.5	-9.3	57.9	Peak Max	V	148	326	74.0	-16.1	Pass	RB
7310.371	51.0	5.4	-4.9	51.5	Peak Max	V	99	282	74.0	-22.5	Pass	RB
4873.952	57.2	4.5	-9.3	52.4	Average Max	V	148	326	54	-1.7	Pass	RB
7310.371	37.0	5.4	-4.9	37.6	Average Max	V	99	282	54	-16.4	Pass	RB

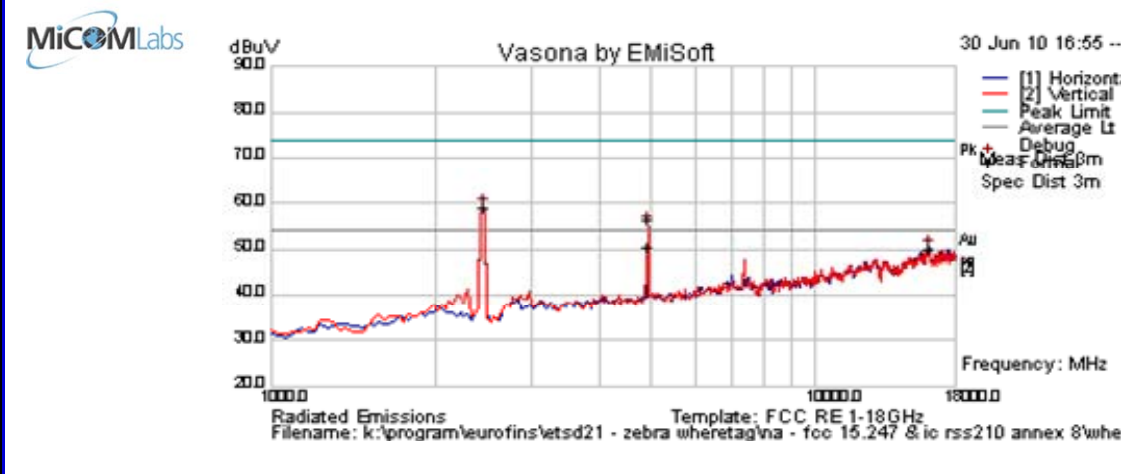
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	GMH
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	10 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	0.72
<b>Test Notes 1</b>	Fundamental attenuated by band-stop filter		
<b>Test Notes 2</b>	EUT tested at 100% duty cycle		



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2464.930	67.1	3.0	-11.1	59.0	Peak [Scan]	V	100	--	--	--	N/A	FUND
4923.925	61.0	4.6	-9.1	56.4	Peak Max	V	101	132	74.0	-17.6	Pass	RB
4923.925	55.0	4.6	-9.1	50.5	Average Max	V	101	132	54.0	-3.5	Pass	RB

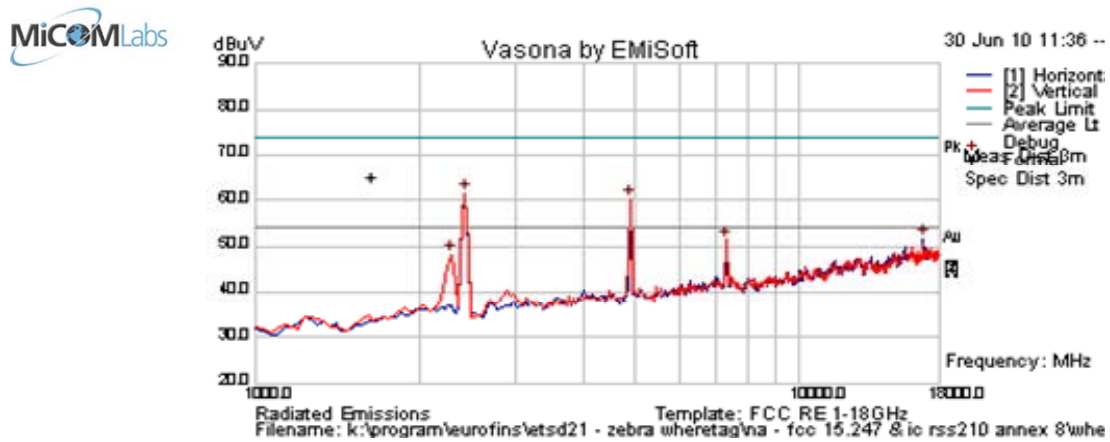
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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### 7.6.3 DSSS Radiated Spurious Emissions

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11n; HT-20; 6.5 MCS	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	15 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	2.55 %
<b>Test Notes 1</b>	EUT was tested at 100% duty cycle. Correction factor added to peak measurements.		
<b>Test Notes 2</b>	Fundamental attenuated by band-stop filter		



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2441.733	69.6	3.0	-11.0	61.5	Peak [Scan]	V	100	--	--	--	N/A	FUND
4883.437	65.1	4.5	-9.3	60.3	Peak [Scan]	V	100	0	54	6.3	N/A	RB
4883.437	Corrected Value =			28.4					54.0	-25.6	Pass	RB
7325.130	51.0	5.5	-5.1	51.4	Peak [Scan]	V	100	0	54	-2.6	Pass	RB
7325.130	Corrected Value =			19.5					54.0	-34.5	Pass	RB

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

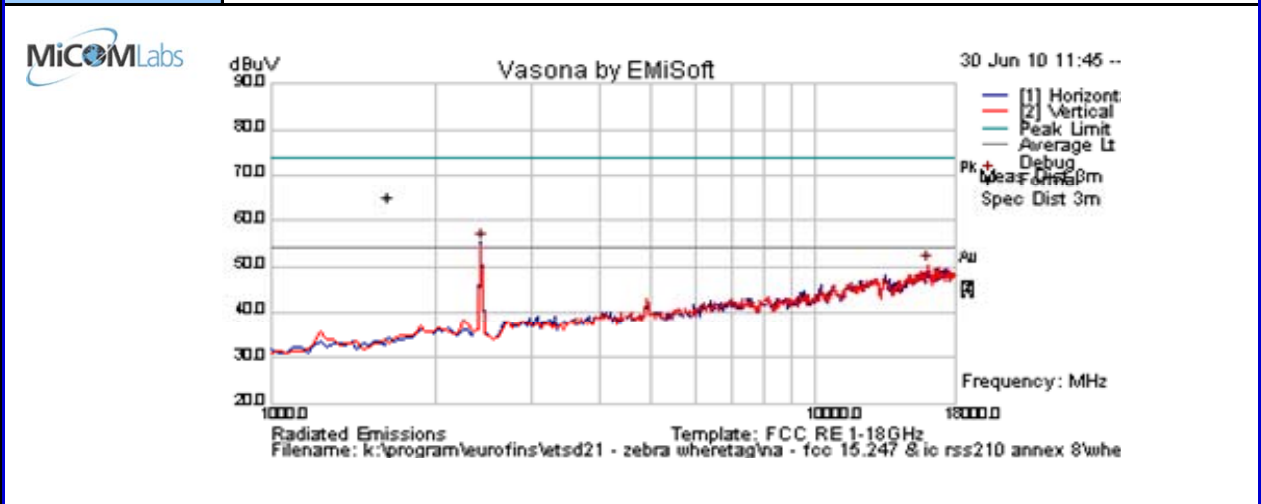
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### 7.6.4 OOK Radiated Spurious Emissions

<b>Test Freq.</b>	2446.519 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	OOK	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	15 in test utility	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	13 %
<b>Test Notes 1</b>	EUT was tested at 100% duty cycle. Correction factor added to peak measurements.		
<b>Test Notes 2</b>	Fundamental attenuated by band-stop filter		



#### Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2446.373	63.4	3.0	-11.0	55.4	Peak [Scan]	H	100	--	--	--	N/A	FUND

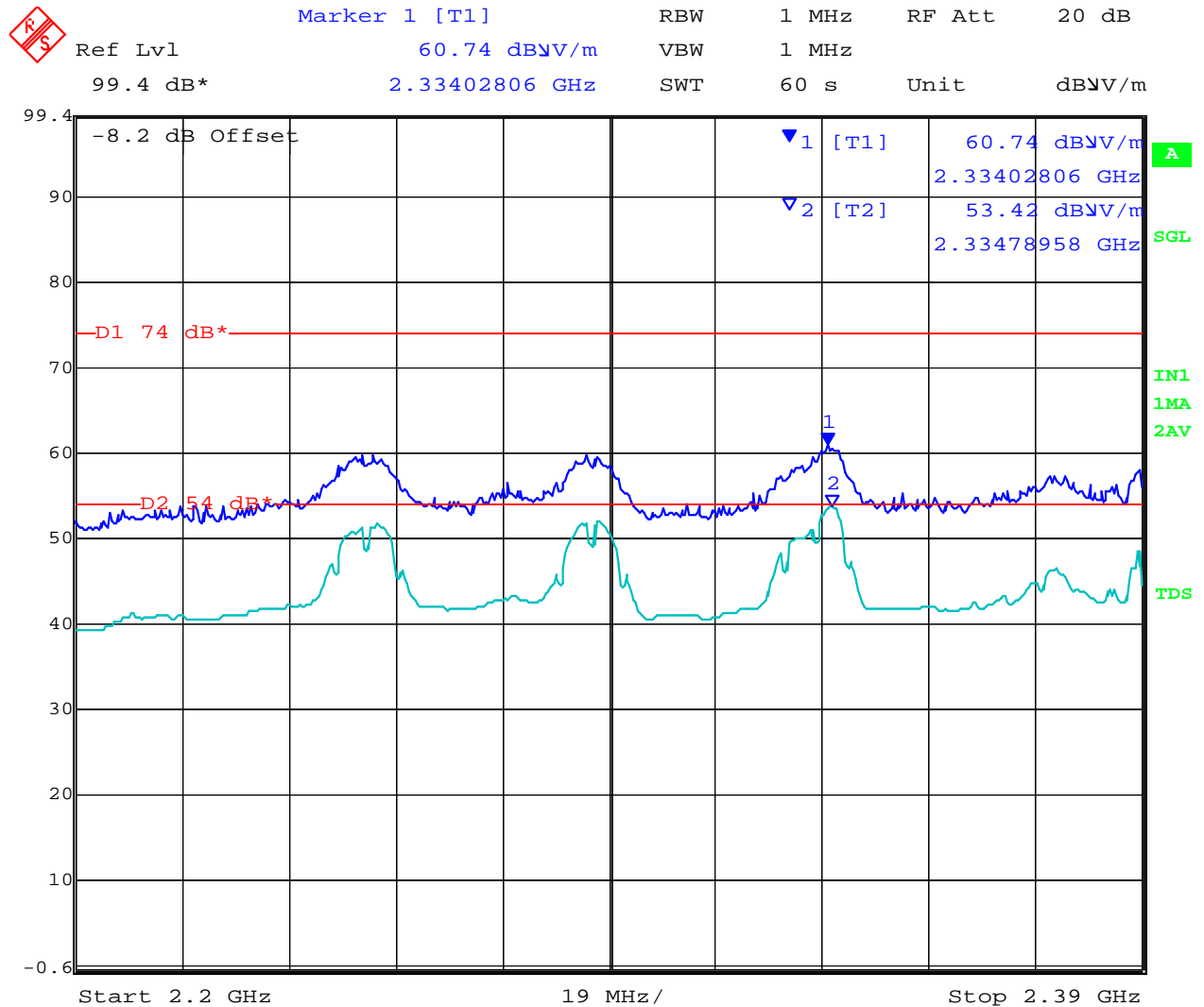
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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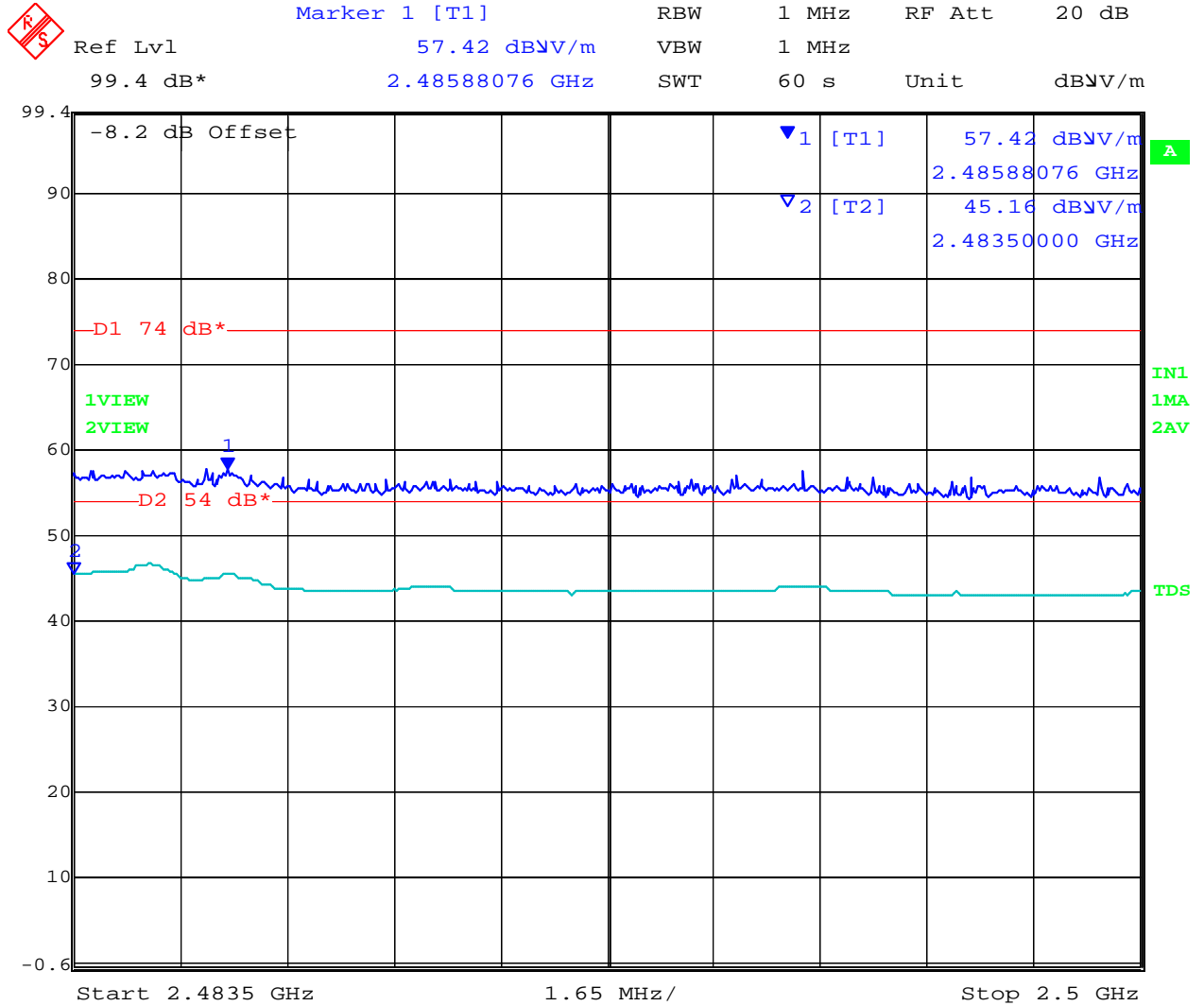
### 7.6.5 802.11b Radiated Band Edge Emissions

All emissions below FCC limits when tested at 100% duty cycle. No duty cycle correction factor required to comply with FCC limits.



Date: 1.JUL.2010 17:32:45

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Date: 1.JUL.2010 18:18:32

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### **7.6.6 802.11g Radiated Band Edge Emissions**

Duty cycle correction factor was applied to spurious emissions in the restricted bands closest to the fundamental transmission.

EUT Operational Duty Cycle: 0.72%

Correction Factor =  $20 * \text{LOG} (0.72 / 100)$

Correction Factor = -42.85dB

Corrected Value = Measured Value (dB) - 42.85 (dB)

Frequency (MHz)	Measured Value (dBuV/m)	Measurement Type	Corrected Value	Margin (dB)	Pass / Fail
2390	84.04	Peak	41.1866	-32.8134	Pass
2390	65.28	Average	22.4266	-31.5734	Pass
2483.632	83.51	Peak	40.6566	-33.3434	Pass
2483.5	63.98	Average	21.1266	-32.8734	Pass

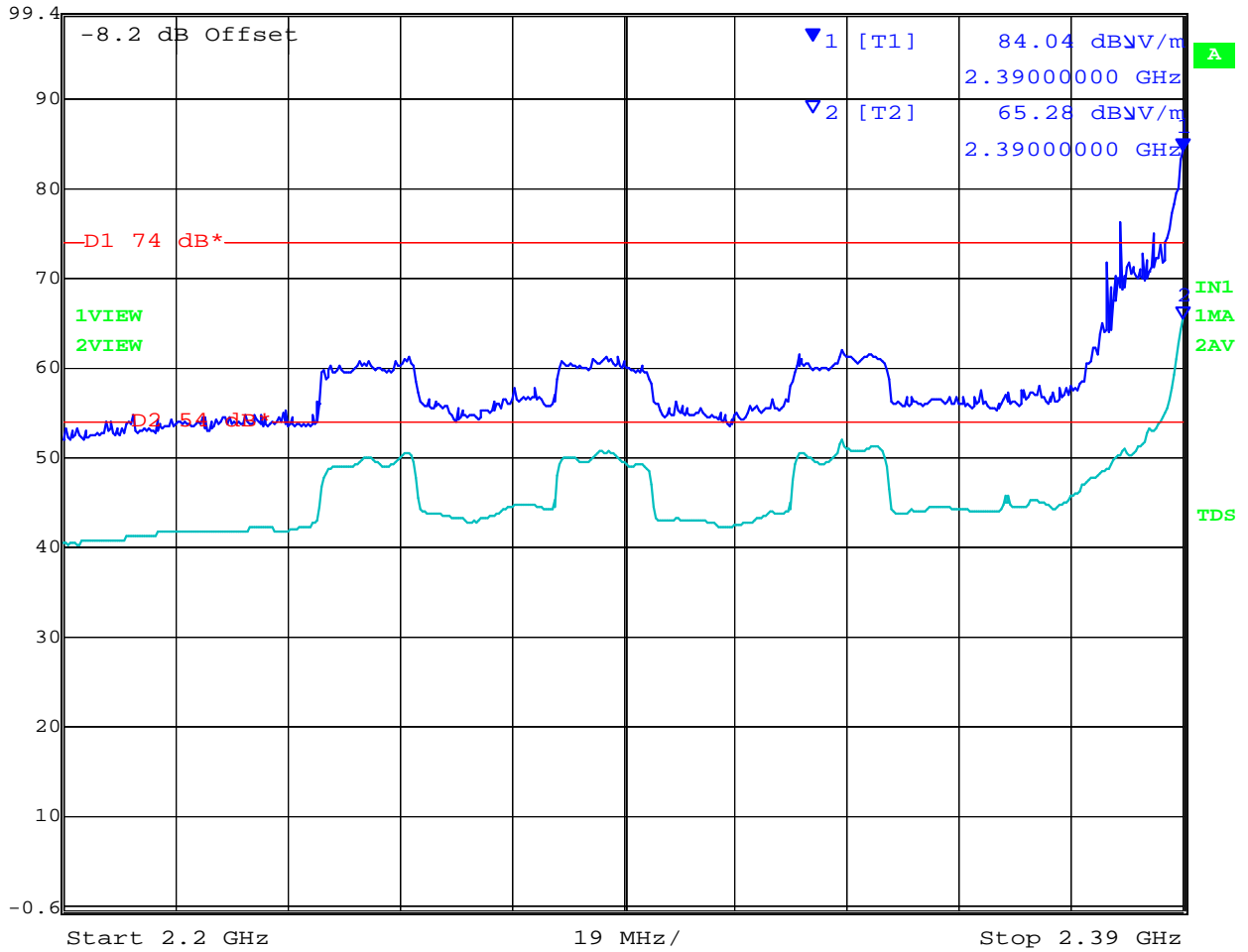
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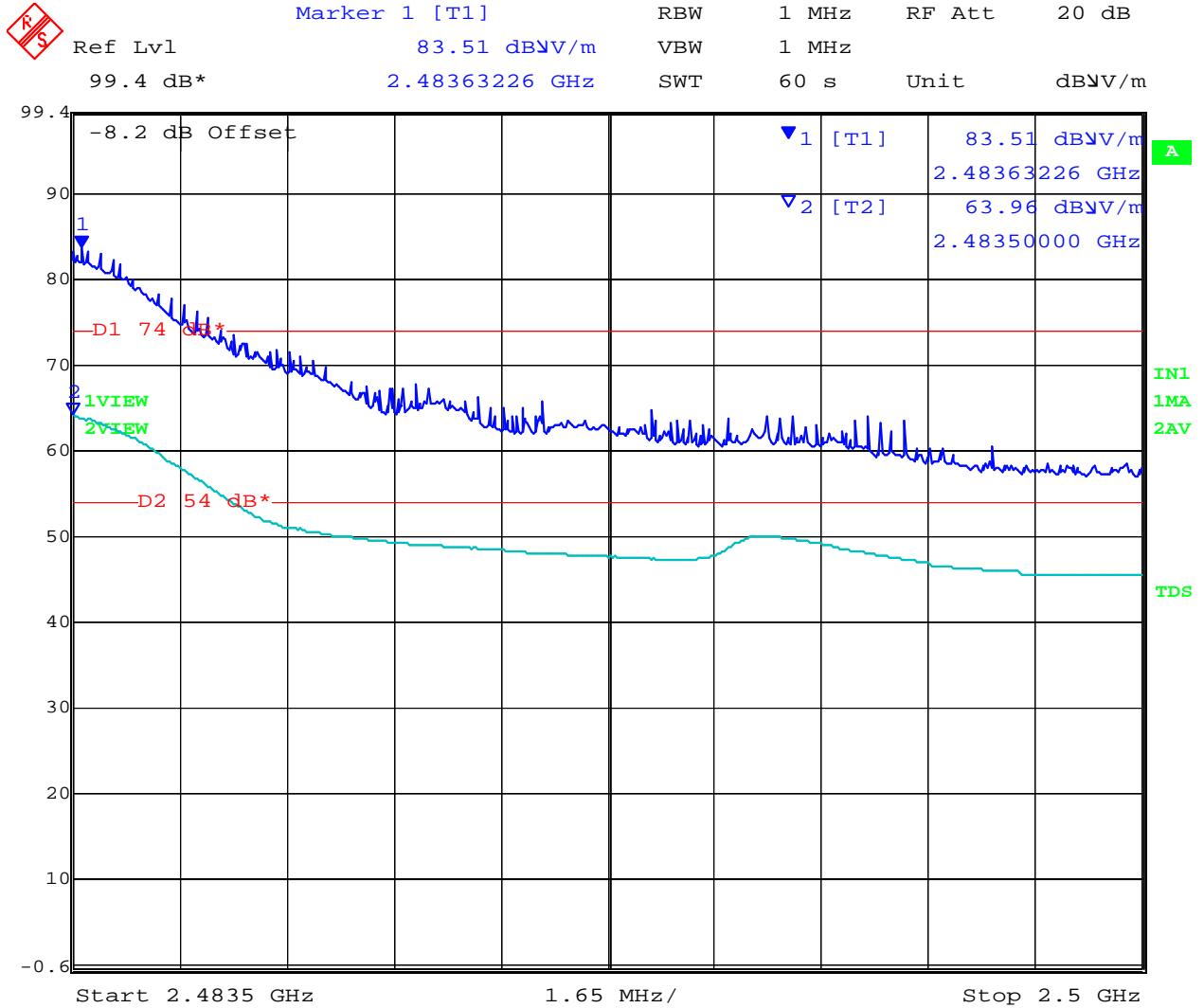
Marker 1 [T1] RBW 1 MHz RF Att 20 dB  
Ref Lvl 84.04 dB $\mu$ V/m VBW 1 MHz  
99.4 dB\* 2.3900000 GHz SWT 60 s Unit dB $\mu$ V/m



Date: 1.JUL.2010 17:41:28

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Date: 1.JUL.2010 18:13:48

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### **7.6.7 DSSS Radiated Band Edge Emissions**

Duty cycle correction factor was applied to spurious emissions in the restricted bands closest to the fundamental transmission.

EUT Operational Duty Cycle: 2.55%

Correction Factor =  $20 * \text{LOG} (2.55 / 100)$

Correction Factor = -31.87 dB

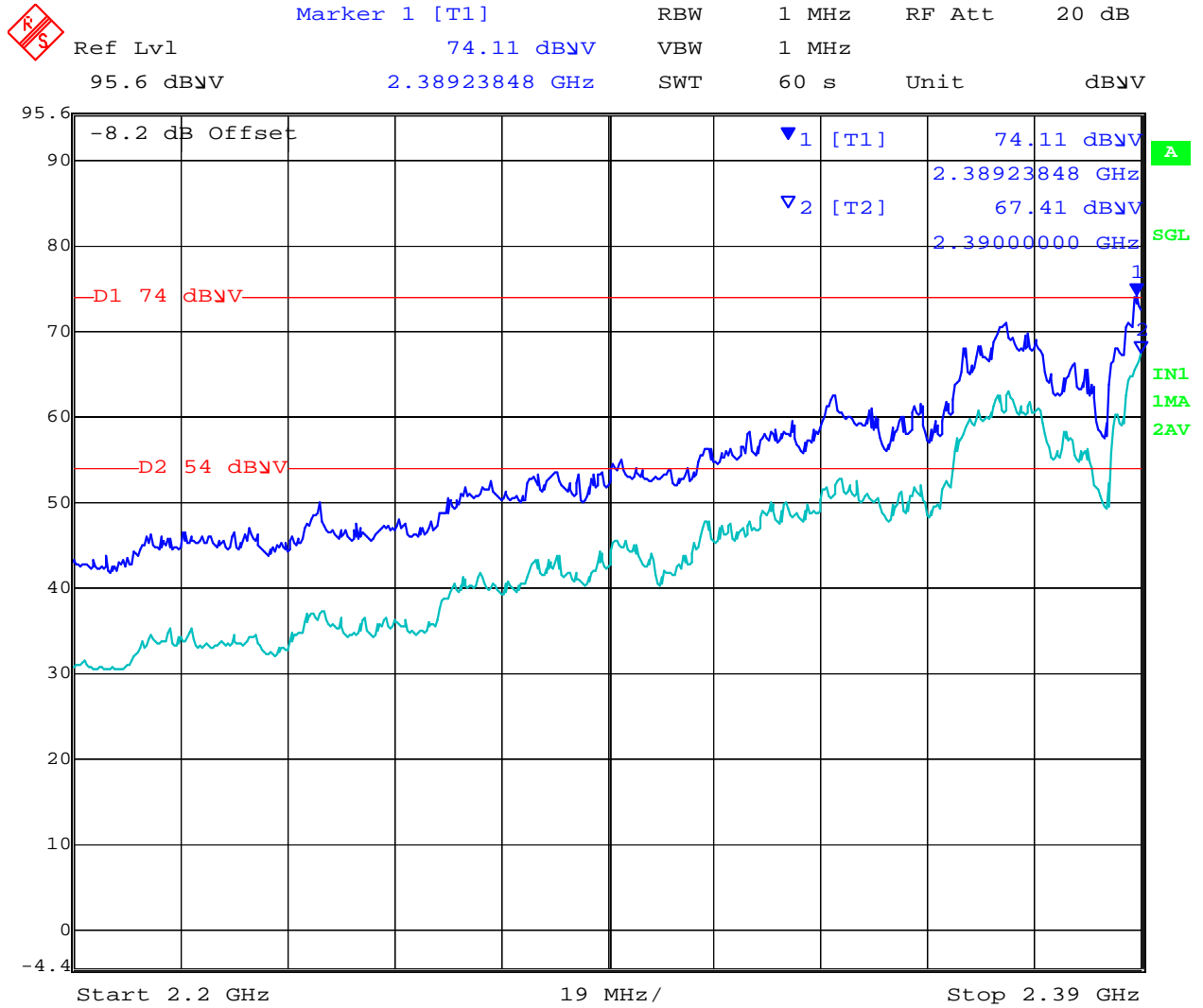
Corrected Value = Measured Value (dB) - 31.87 (dB)

Frequency (MHz)	Measured Value (dBuV/m)	Measurement Type	Corrected Value	Margin (dB)	Pass / Fail
2389.238	74.11	Peak	42.24	-31.76	Pass
2390	67.41	Average	35.54	-18.46	Pass
2483.5	75.78	Peak	43.91	-30.09	Pass
2486.641	67.99	Average	36.12	-17.88	Pass

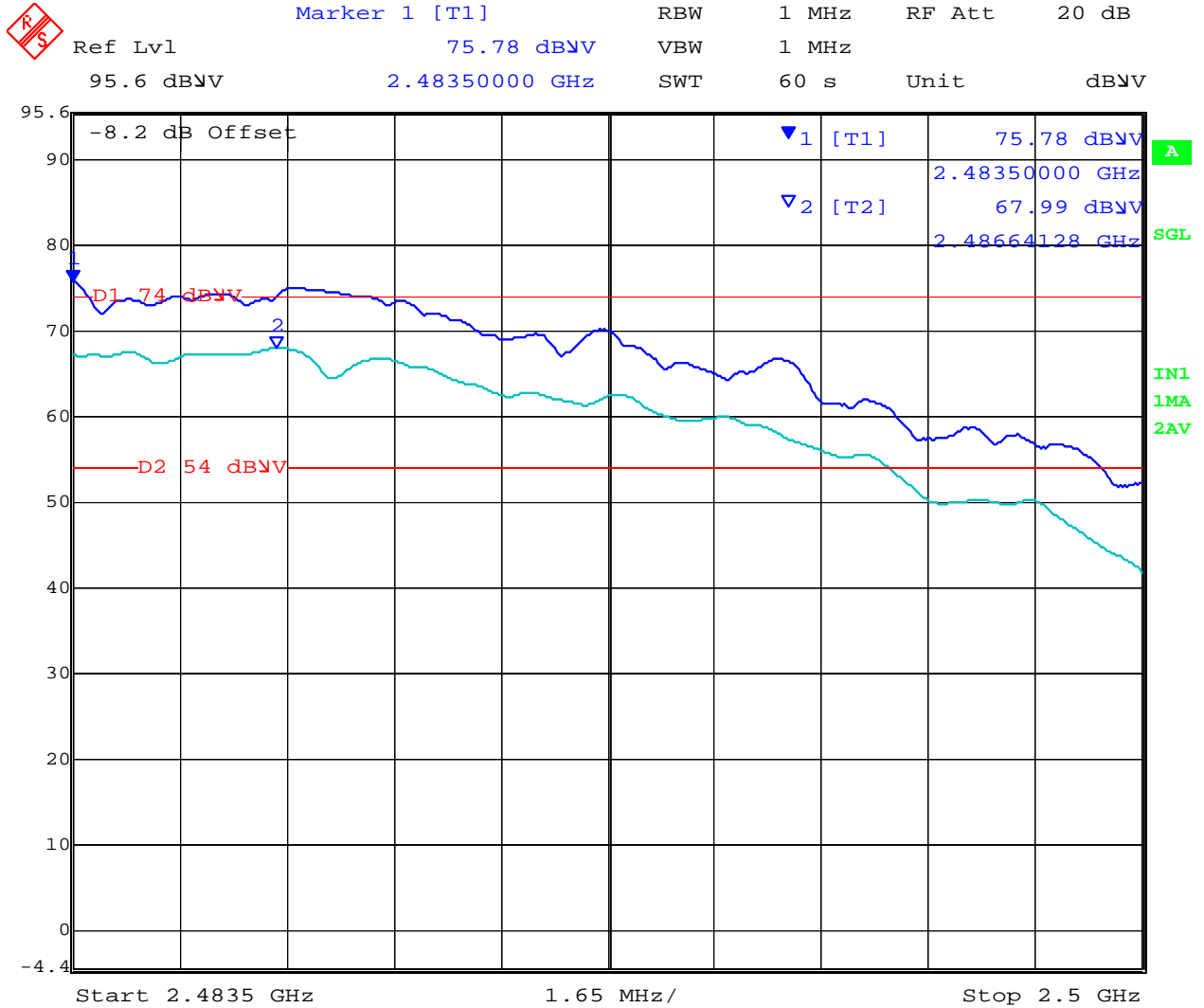
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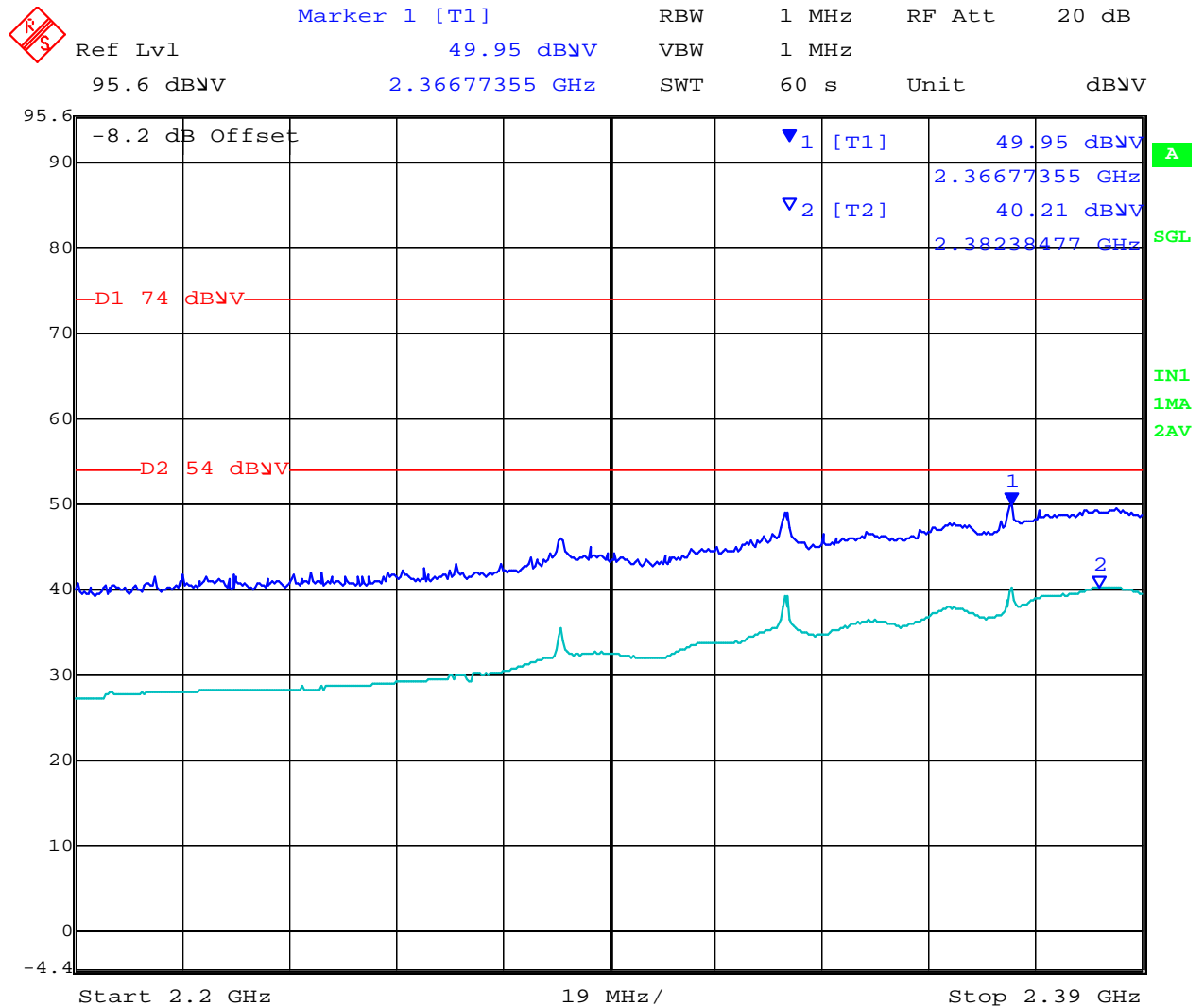


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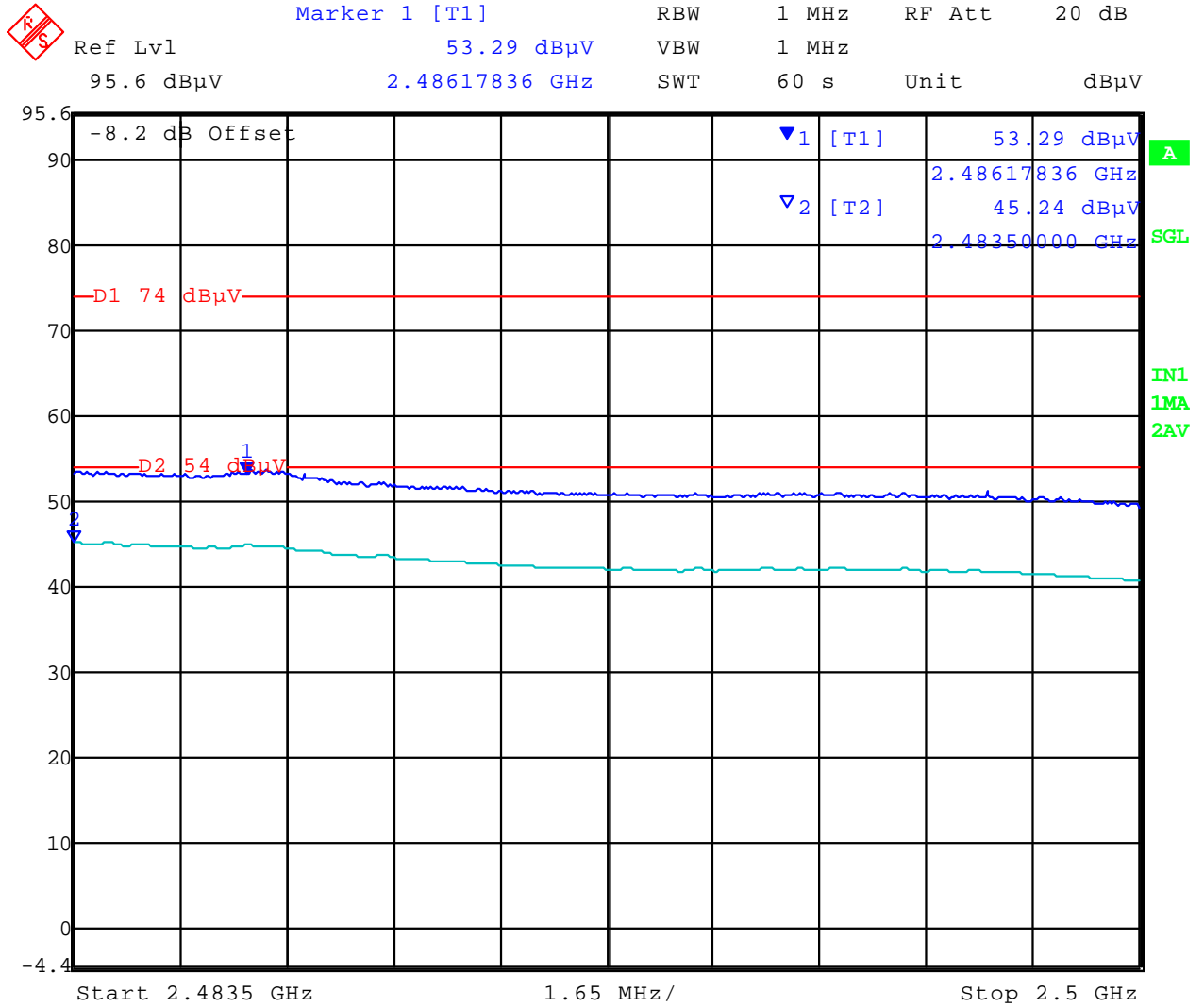


### 7.6.8 OOK Radiated Band Edge Emissions

All emissions below FCC limits when tested at 100% duty cycle. No duty cycle correction factor required to comply with FCC limits.



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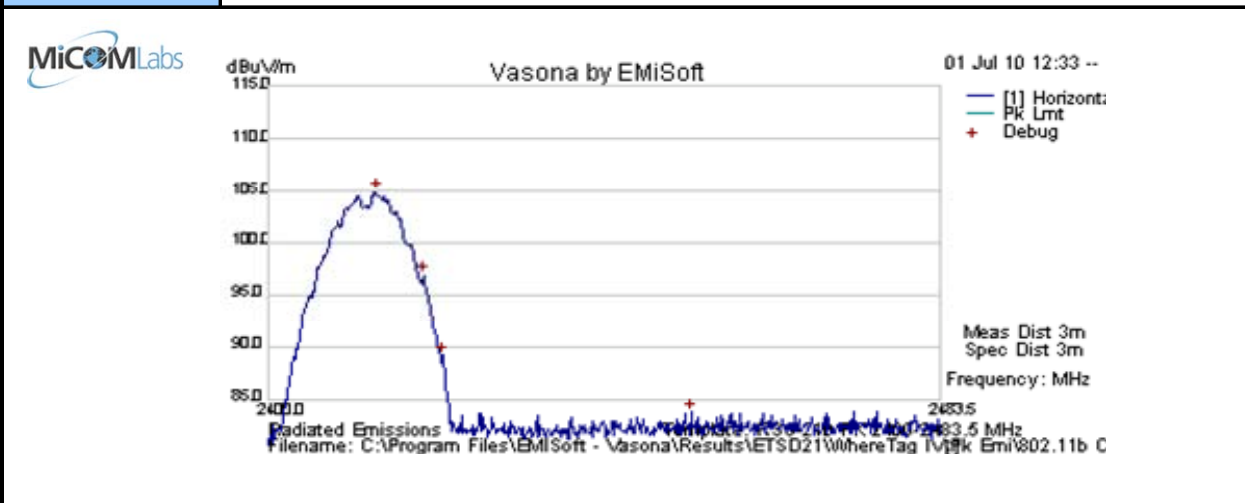
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### 7.6.9 802.11b Radiated Peak Emissions

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



#### Formally measured emission peaks

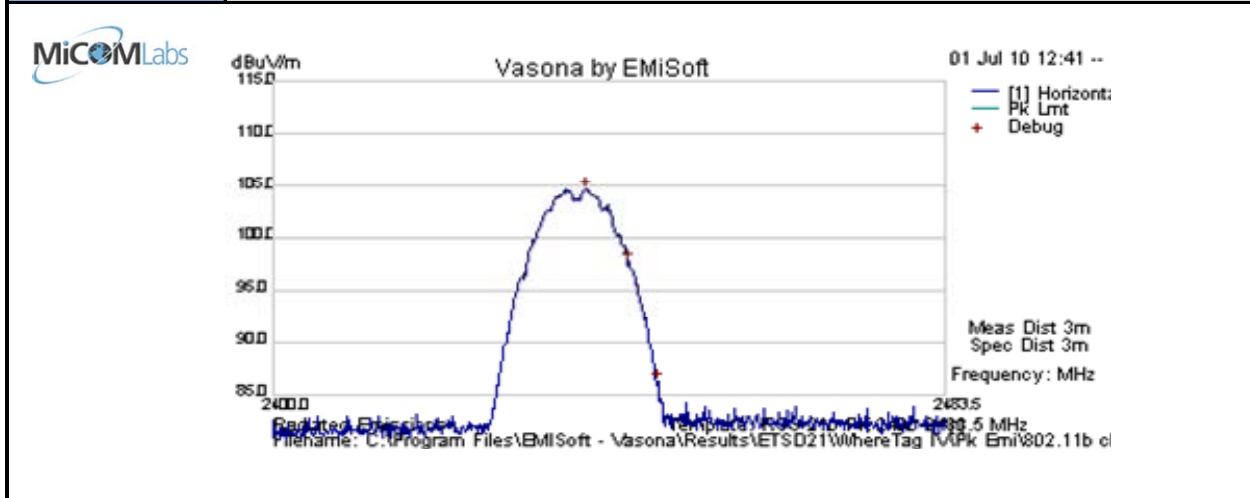
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2413.360	67.4	7.1	30.4	104.9	Peak [Scan]	V						PK
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission PK = Peak emissions of Fundamental												

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



**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
2438.688	67.0	7.1	30.5	104.7	Peak [Scan]	V						PK

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

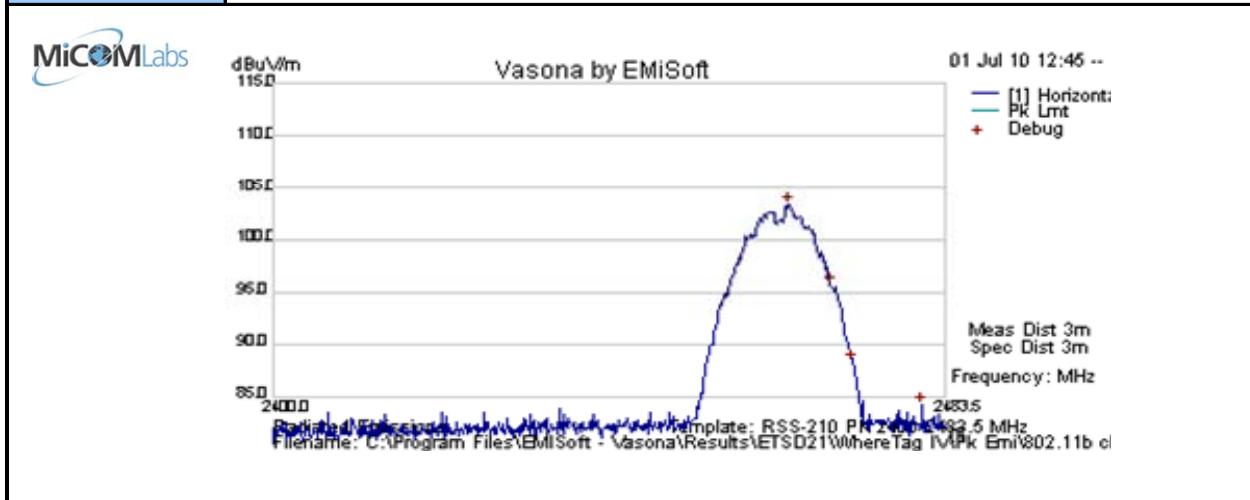
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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



**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
2463.878	65.5	7.2	30.6	103.3	Peak [Scan]	V						PK

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

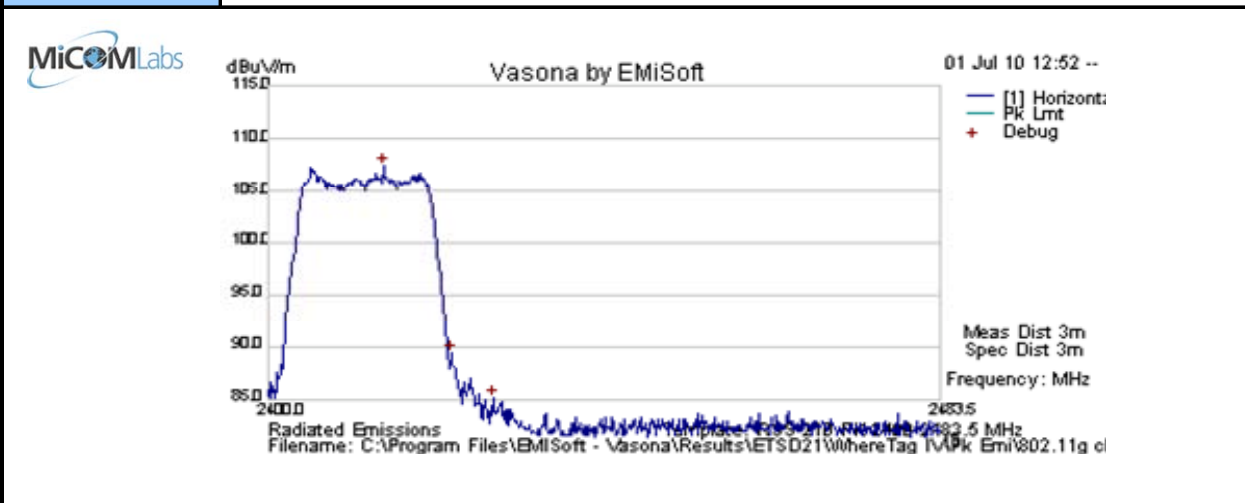
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### 7.6.10 802.11g Radiated Peak Emissions

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



#### 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
2414.195	69.9	7.1	30.4	107.4	Peak [Scan]	V						PK

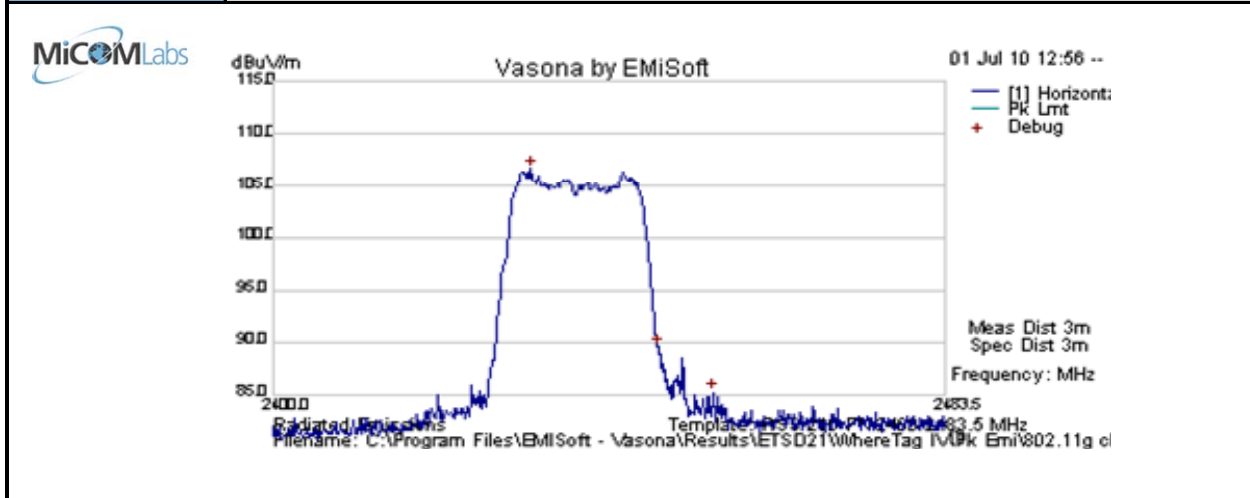
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



**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
2431.730	69.0	7.1	30.5	106.6	Peak [Scan]	V						PK

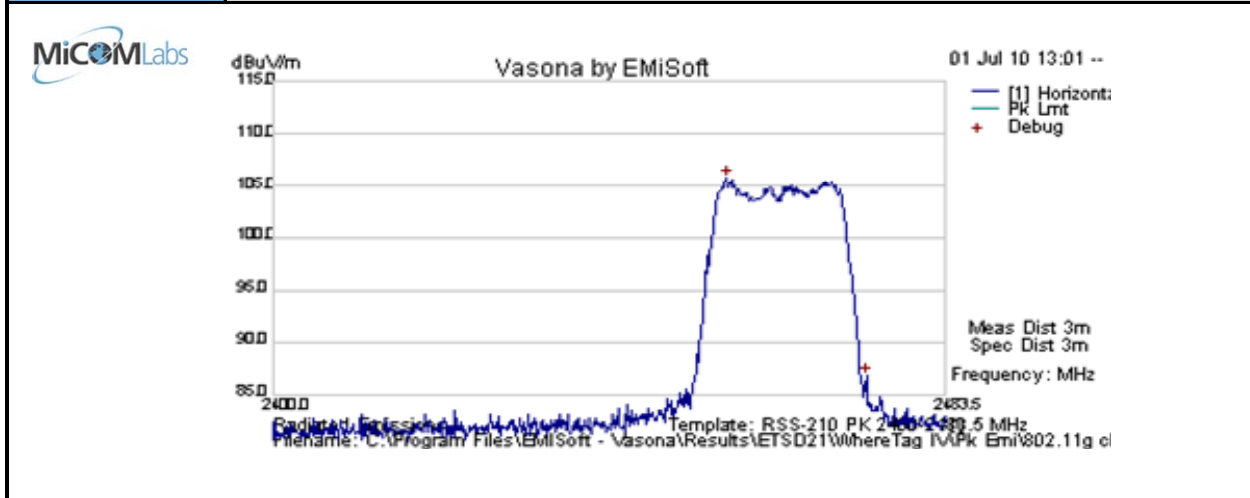
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	10 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



**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
2456.084	68.0	7.2	30.6	105.7	Peak [Scan]	V						PK

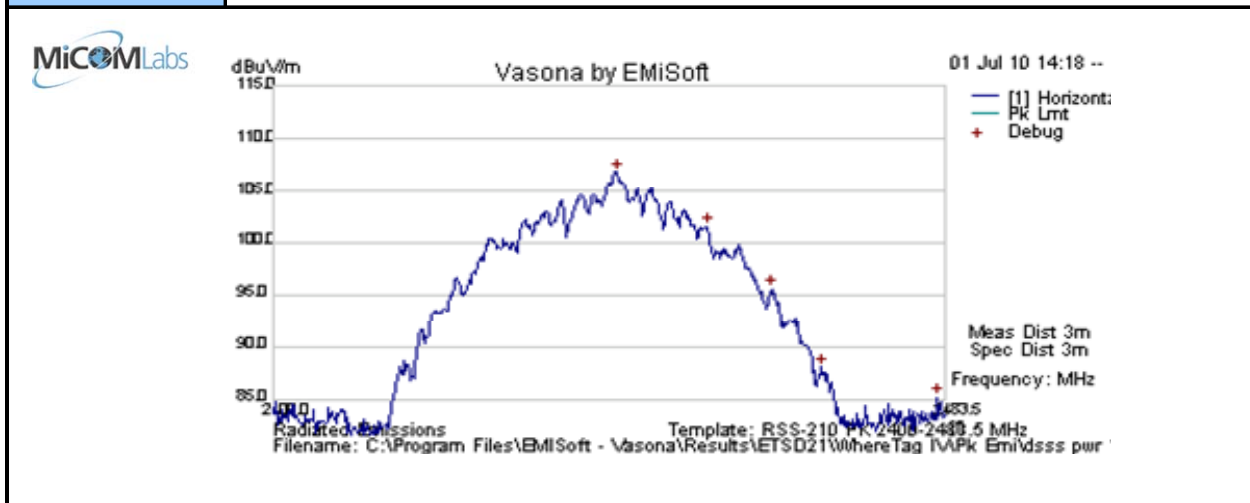
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 PK = Peak emissions of Fundamental

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### 7.6.11 DSSS Radiated Peak Emissions

<b>Test Freq.</b>	2441.75 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	DSSS	<b>Temp (°C)</b>	28
<b>Freq. Range</b>	2400 - 2483.5 MHz	<b>Rel. Hum.(%)</b>	36
<b>Power Setting</b>	14 in test utility software	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	ANT=Taoglas	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>			
<b>Test Notes 2</b>			



#### 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
2442.446	69.2	7.2	30.5	106.9	Peak [Scan]	V						PK
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission PK = Peak emissions of Fundamental												

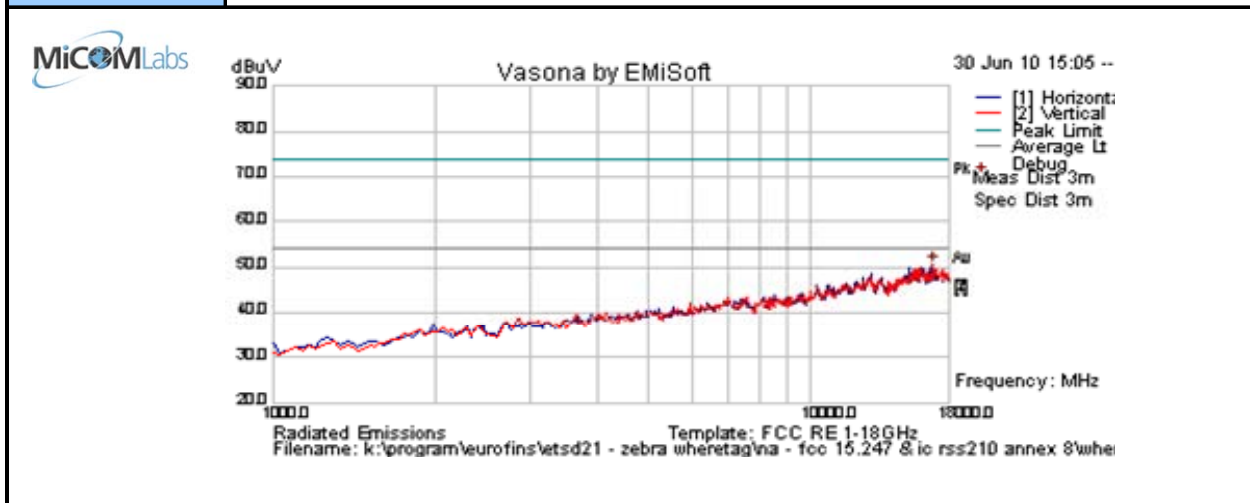
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**7.6.13 Receiver Radiated Emissions**

<b>Test Freq.</b>	2446.519 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	OOK	<b>Temp (°C)</b>	27.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	32
<b>Power Setting</b>	Not Applicable in Receive Mode	<b>Press. (mBars)</b>	1003
<b>Antenna</b>	ANT=ZES10370		
<b>Test Notes 1</b>	EUT was tested at 100% duty cycle.		
<b>Test Notes 2</b>			



**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
No Receiver Emissions within 6dB of limit.												
16841.683	40.2	8.6	1.8	50.5	Peak [Scan]	V	100	0	54.0	-3.5	Pass	Noise

Legend:	TRANS = Transient Emission; RB = Restricted Band; NRB = Non-Restricted Band;
	BE = Emission in Restricted Band Nearest Transmission Band Edge; FUND = Fundamental Freq.

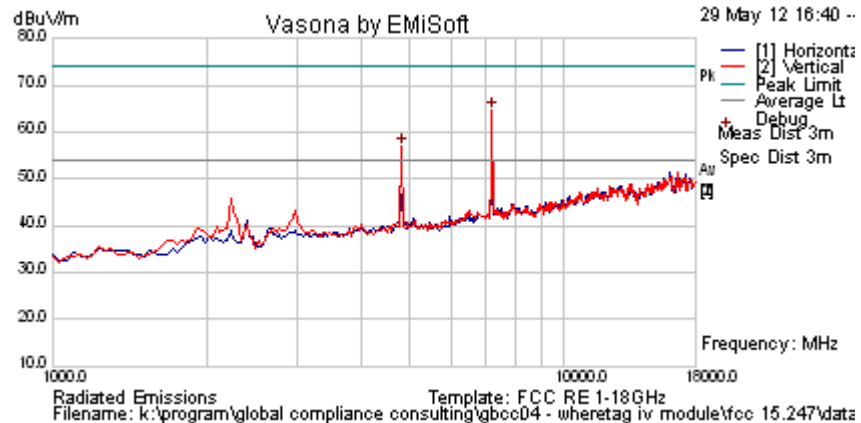
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## 7.7 Client Mode - Radiated Spurious Emissions above 1 GHz

### 7.7.1 Dome Antenna - Client Mode: 802.11b

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	26.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	35
<b>Power Setting</b>	Reduced PWR to 10	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	7 dbi Dome	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V		
<b>Test Notes 2</b>			



#### 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
7235.070	57.5	5.4	-5.8	57.1	Peak Max	V	98	15	74.0	-16.9	Pass	PWR 10
4823.988	56.9	4.5	-9.7	51.7	Peak Max	V	202	280	74.0	-22.3	Pass	PWR 10
7235.070	51.6	5.4	-5.8	51.2	Average Max	V	98	15	54	-2.8	Pass	PWR 10
4823.988	53.3	4.5	-9.7	48.1	Average Max	V	202	280	54	-5.9	Pass	PWR 10

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

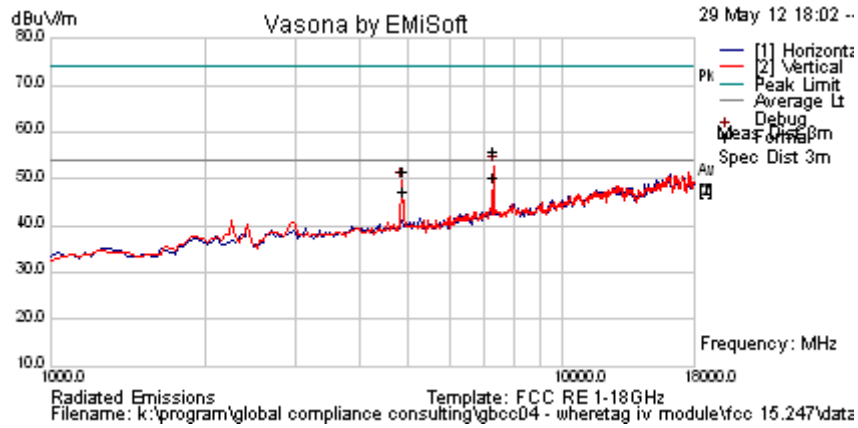
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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	26.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	35
<b>Power Setting</b>	Reduced PWR to 10	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	7 dbi Dome	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V		
<b>Test Notes 2</b>			



**Formally measured emission peaks**

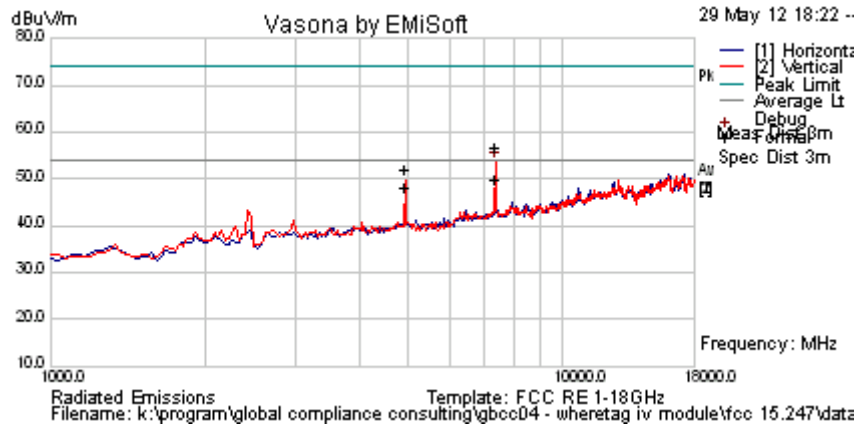
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7309.599	56.2	5.4	-5.7	56.0	Peak Max	V	98	12	74.0	-18.0	Pass	
4873.908	56.6	4.5	-9.7	51.4	Peak Max	V	193	332	74.0	-22.6	Pass	
7309.599	50.4	5.4	-5.7	50.2	Average Max	V	98	12	54	-3.8	Pass	
4873.908	52.4	4.5	-9.7	47.2	Average Max	V	193	332	54	-6.8	Pass	
<b>Legend:</b> 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												

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	26.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	35
<b>Power Setting</b>	Reduced PWR to 10	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	7 dbi Dome	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V		
<b>Test Notes 2</b>			



### Formally measured emission peaks

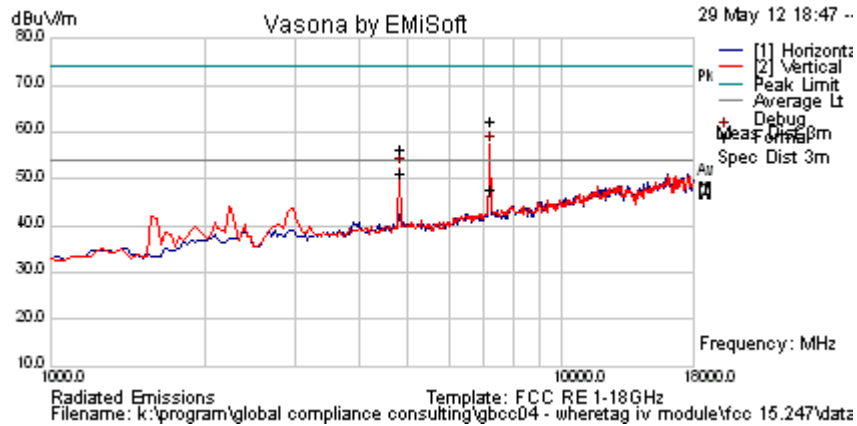
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7386.777	56.8	5.5	-5.5	56.8	Peak Max	V	98	12	74.0	-17.3	Pass	
4923.97606	57.4	4.6	-9.8	52.2	Peak Max	V	136	53	74.0	-21.8	Pass	
7386.777	50.0	5.5	-5.5	50.0	Average Max	V	98	12	54	-4.0	Pass	
4923.976	53.6	4.6	-9.8	48.4	Average Max	V	136	53	54	-5.7	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												

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**7.7.2 Dome Antenna - Client Mode: 802.11g**

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	26.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	35
<b>Power Setting</b>	PWR Reduced to 8	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	7 dbi Dome	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V, Client Mode		
<b>Test Notes 2</b>			



**Formally measured emission peaks**

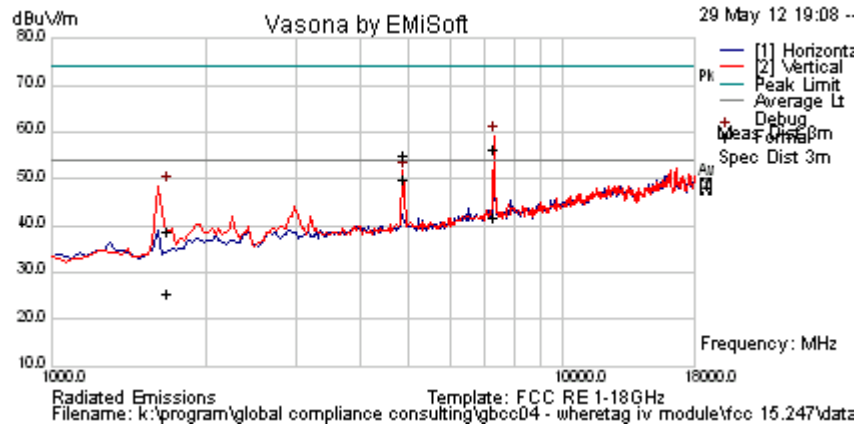
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7231.423	62.8	5.4	-5.8	62.4	Peak Max	V	98	12	74.0	-11.6	Pass	
4824.008	61.5	4.5	-9.7	56.3	Peak Max	V	157	53	74.0	-17.8	Pass	
7231.423	48.4	5.4	-5.8	48.0	Average Max	V	98	12	54	-6.1	Pass	
4824.008	56.2	4.5	-9.7	51.0	Average Max	V	157	53	54	-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

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	26.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	35
<b>Power Setting</b>	PWR Reduced to 8	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	7 dbi Dome	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V, Client Mode		
<b>Test Notes 2</b>			



### Formally measured emission peaks

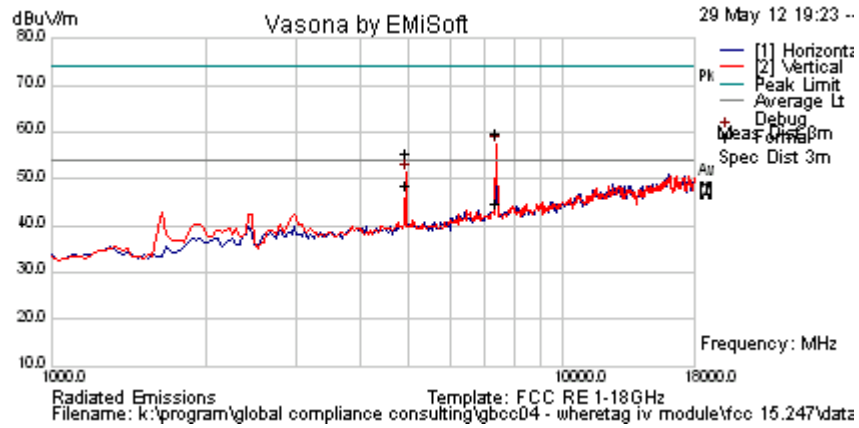
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7310.541	56.7	5.4	-5.7	56.5	Peak Max	V	139	9	74.0	-17.5	Pass	
4873.988	60.4	4.5	-9.7	55.2	Peak Max	V	193	331	74.0	-18.8	Pass	
1686.653	50.2	2.5	-14.1	38.7	Peak Max	V	140	141	74	-35.3	Pass	
7310.541	42.2	5.4	-5.7	41.9	Average Max	V	139	9	54	-12.1	Pass	
4873.988	54.9	4.5	-9.7	49.7	Average Max	V	193	331	54	-4.3	Pass	
1686.653	36.8	2.5	-14.1	25.3	Average Max	V	140	141	54	-28.7	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

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	26.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	35
<b>Power Setting</b>	PWR Reduced to 8	<b>Press. (mBars)</b>	1001
<b>Antenna</b>	7 dbi Dome	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V, Client Mode		
<b>Test Notes 2</b>			



**Formally measured emission peaks**

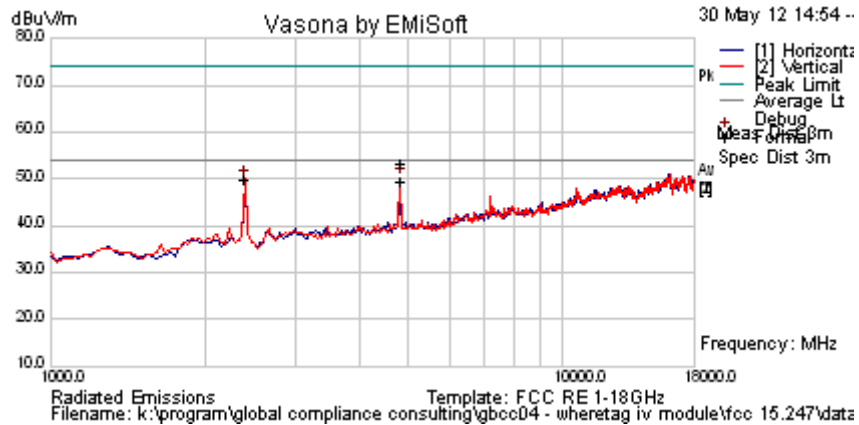
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
7387.495	59.8	5.5	-5.5	59.8	Peak Max	V	112	12	74.0	-14.2	Pass	
4924.048	60.7	4.6	-9.8	55.4	Peak Max	V	135	52	74.0	-18.6	Pass	
7387.495	44.8	5.5	-5.5	44.8	Average Max	V	112	12	54	-9.2	Pass	
4924.048	53.8	4.6	-9.8	48.5	Average Max	V	135	52	54	-5.5	Pass	
<b>Legend:</b> 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												

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**7.7.3 Whip Antenna - Client Mode: 802.11b**

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	36.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	33
<b>Power Setting</b>	PWR 11	<b>Press. (mBars)</b>	1005
<b>Antenna</b>	Whip Antenna 3 dBi	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V, Client		
<b>Test Notes 2</b>			



**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
4824.008	58.4	4.5	-9.7	53.2	Peak Max	V	133	81	74.0	-20.8	Pass	
4824.008	54.7	4.5	-9.7	49.5	Average Max	V	133	81	54.0	-4.5	Pass	
2396.794	58.7	3.0	-11.7	50.0	Peak [Scan]	V						Fundamental

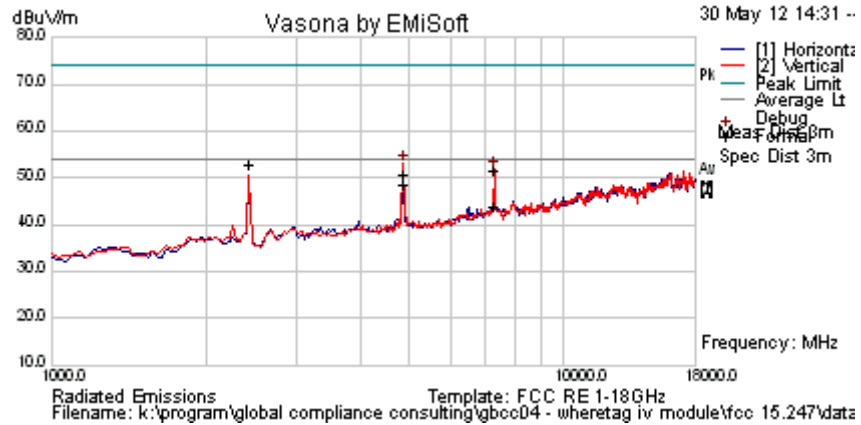
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	JH
<b>Variants</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	36.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	33
<b>Power Setting</b>	PWR 11	<b>Press. (mBars)</b>	1005
<b>Antenna</b>	Whip Antenna 3 dBi	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V, Client		
<b>Test Notes 2</b>			



**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
4873.988	55.8	4.5	-9.7	50.6	Peak Max	V	115	271	74.0	-23.4	Pass	
7310.301	51.9	5.4	-5.7	51.6	Peak Max	V	98	105	74.0	-22.4	Pass	
2435.230	61.6	3.0	-11.6	53.0	Peak Max	V						Fundamental
4873.988	53.9	4.5	-9.7	48.7	Average Max	V	115	271	54	-5.3	Pass	
7310.301	44.3	5.4	-5.7	44.1	Average Max	V	98	105	54	-9.9	Pass	

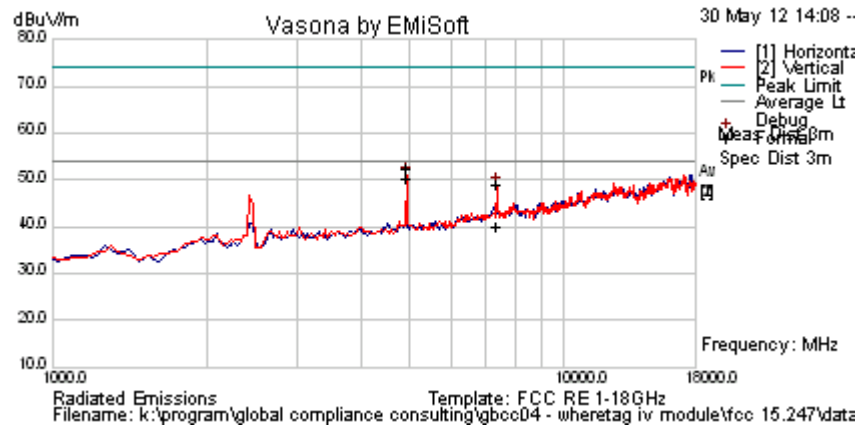
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11b; 1 Mbs	<b>Temp (°C)</b>	36.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	33
<b>Power Setting</b>	PWR 11	<b>Press. (mBars)</b>	1005
<b>Antenna</b>	Whip Antenna 3 dBi	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V, Client		
<b>Test Notes 2</b>			



**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
4923.968	57.8	4.6	-9.8	52.6	Peak Max	V	100	214	74.0	-21.4	Pass	PWR=11
7387.23412	49.2	5.5	-5.5	49.2	Peak Max	V	98	110	74.0	-24.8	Pass	
4923.968	55.6	4.6	-9.8	50.4	Average Max	V	100	214	54	-3.6	Pass	
7387.234	40.1	5.5	-5.5	40.1	Average Max	V	98	110	54	-14.0	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

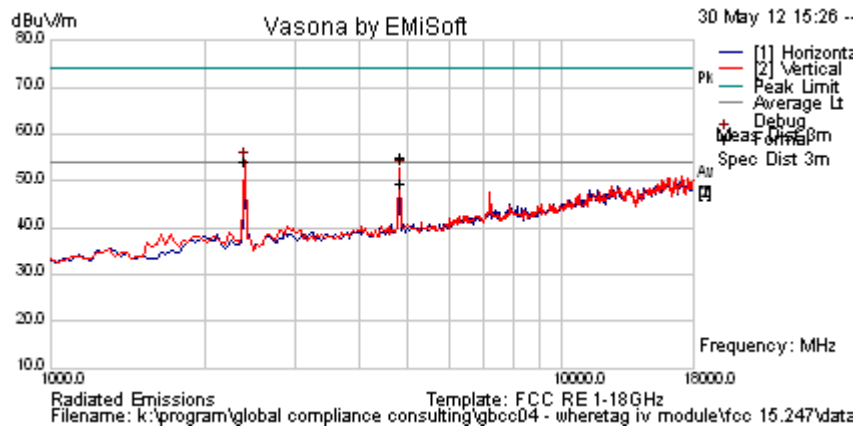
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**7.7.4 Whip Antenna - Client Mode: 802.11g**

<b>Test Freq.</b>	2412 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	36.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	33
<b>Power Setting</b>	PWR 8	<b>Press. (mBars)</b>	1005
<b>Antenna</b>	Whip Antenna 3 dBi	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V, Client		
<b>Test Notes 2</b>			



**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	63.0	3.0	-11.7	54.3	Peak [Scan]	V						Fundamental
4823.848	60.3	4.5	-9.7	55.1	Peak Max	V	106	75	74.0	-18.9	Pass	
4823.848	54.5	4.5	-9.7	49.3	Average Max	V	106	75	54	-4.7	Pass	

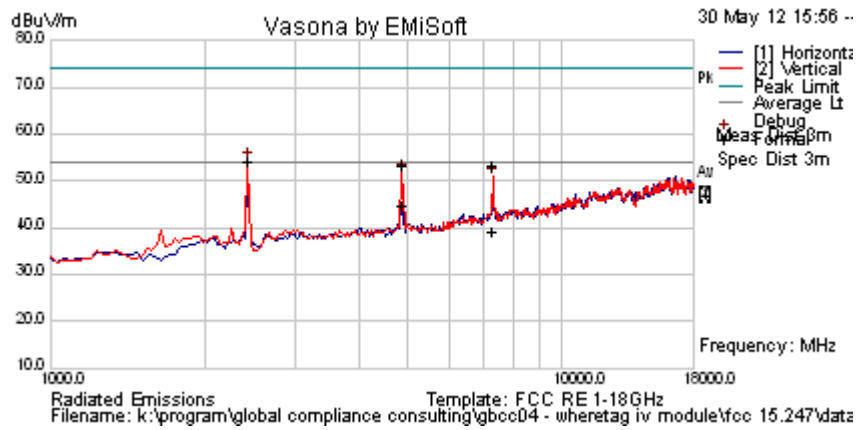
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2437 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	36.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	33
<b>Power Setting</b>	PWR 8	<b>Press. (mBars)</b>	1005
<b>Antenna</b>	Whip Antenna 3 dBi	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V, Client		
<b>Test Notes 2</b>			



### 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
4874.228	58.5	4.5	-9.7	53.3	Peak Max	V	121	352	74.0	-20.7	Pass	
7305.972	53.8	5.4	-5.7	53.5	Peak Max	V	192	318	74.0	-20.5	Pass	
4874.228	50.1	4.5	-9.7	44.9	Average Max	V	121	352	54	-9.1	Pass	
7305.972	39.4	5.4	-5.7	39.1	Average Max	V	192	318	54	-14.9	Pass	
2430.862	62.6	3.0	-11.6	54.1	Peak [Scan]	V						Fundamental

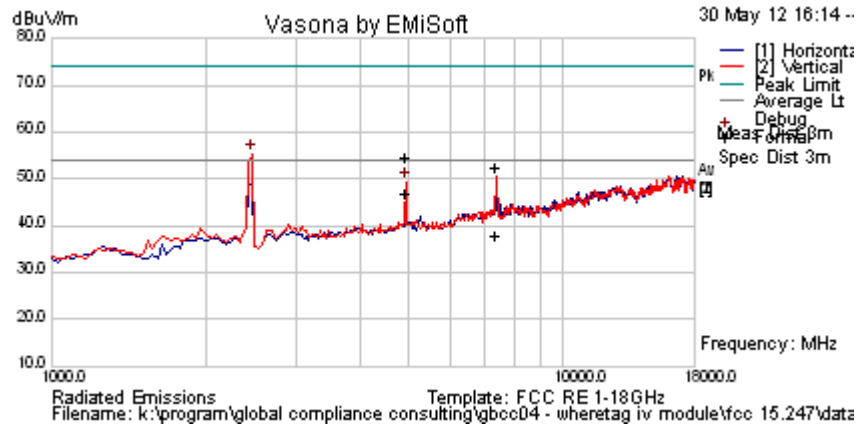
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission  
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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<b>Test Freq.</b>	2462 MHz	<b>Engineer</b>	JH
<b>Variant</b>	802.11g; 6 Mbs	<b>Temp (°C)</b>	36.5
<b>Freq. Range</b>	1000 MHz - 18000 MHz	<b>Rel. Hum.(%)</b>	33
<b>Power Setting</b>	PWR 8	<b>Press. (mBars)</b>	1005
<b>Antenna</b>	Whip Antenna 3 dBi	<b>Duty Cycle (%)</b>	100
<b>Test Notes 1</b>	DC Power @ 3.6V, Client		
<b>Test Notes 2</b>			



### 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
7389.178	52.3	5.5	-5.5	52.3	Peak Max	V	168	90	74.0	-21.7	Pass	
4923.968	59.7	4.6	-9.8	54.5	Peak Max	V	130	23	74.0	-19.5	Pass	
7389.178	38.0	5.5	-5.5	38.0	Average Max	V	168	90	54	-16.0	Pass	
4923.968	52.0	4.6	-9.8	46.8	Average Max	V	130	23	54	-7.2	Pass	
2464.930	63.9	3.0	-11.5	55.3	Peak [Scan]	V						Fundamental
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												

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## **7.8 Radiated Spurious Emissions – Below 1 GHz**

### **Test Procedure**

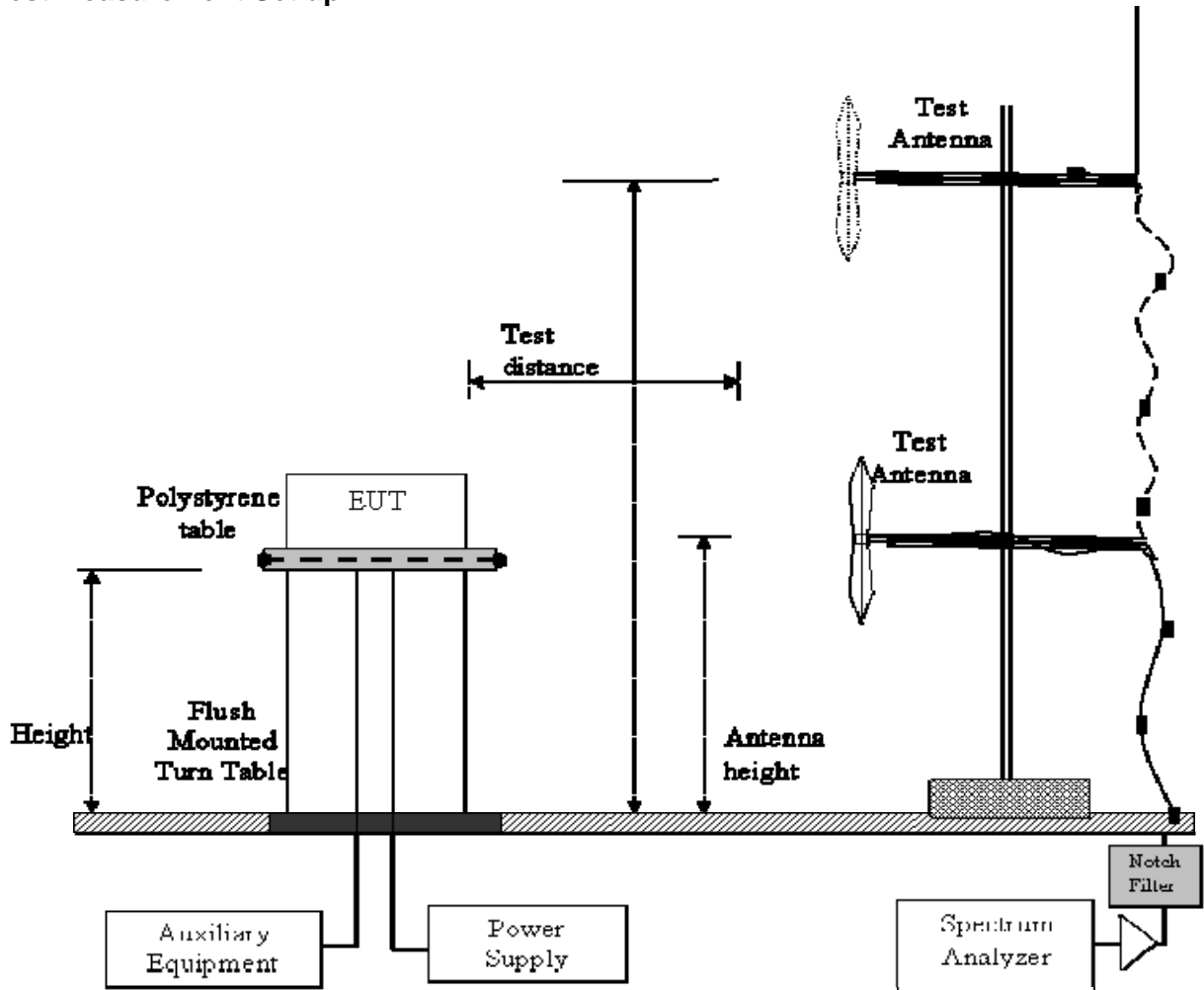
Testing was performed in a 3-meter anechoic chamber. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. Preliminary emissions were recorded with in Spectrum Analyzer mode, using a maximum peak detector while in peak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

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions 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 a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Only the highest emissions relative to the limit are listed.

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### Test Measurement Set up



Measurement set up for Radiated Emission Test



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## 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

$$CORR = \text{Correction Factor} = CL - AG + NFL$$

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

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

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

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

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

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

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## Specification

### 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.

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**Table 1: FCC 15.209 Spurious Emissions Limits**

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

**Laboratory Measurement Uncertainty for Spectrum Measurement**

<b>Measurement Uncertainty</b>	+5.6/ -4.5 dB
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**Traceability:**

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

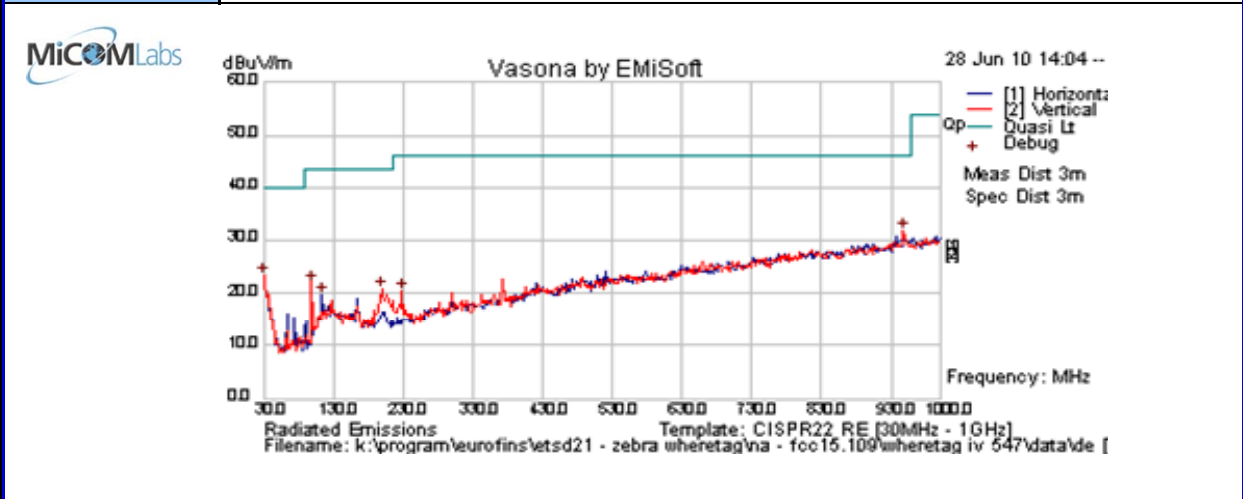
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**7.8.1 Measurement Results for Radiated Spurious Emissions Below 1 GHz - Antenna ZES**

<b>Test Freq.</b>	2441.75 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	Digital Emissions	<b>Temp (°C)</b>	29
<b>Freq. Range</b>	30 MHz - 1000 MHz	<b>Rel. Hum. (%)</b>	37
<b>Power Setting</b>	Max Power DSSS Mode	<b>Press. (mBars)</b>	997
<b>Antenna</b>	ANT=ZES10370		
<b>Test Notes 1</b>	EUT was operated in DSSS mode at maximum power for worst case operation		
<b>Test Notes 2</b>			



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
30.000	29.2	3.4	-9.2	23.4	Peak [Scan]	V	98	360	40	-16.6	Pass	DIG
98.377	39.1	4.1	-21.5	21.8	Peak [Scan]	V	98	360	43.5	-21.7	Pass	Amb
113.681	33.2	4.3	-17.9	19.6	Peak [Scan]	H	98	360	43.5	-23.9	Pass	DIG
198.784	33.7	4.7	-18.0	20.5	Peak [Scan]	V	98	360	43.5	-23.0	Pass	DIG
228.223	34.5	4.9	-19.1	20.2	Peak [Scan]	V	98	360	46	-25.8	Pass	DIG
947.369	30.7	7.5	-6.7	31.5	Peak [Scan]	V	98	360	46	-14.5	Pass	DIG

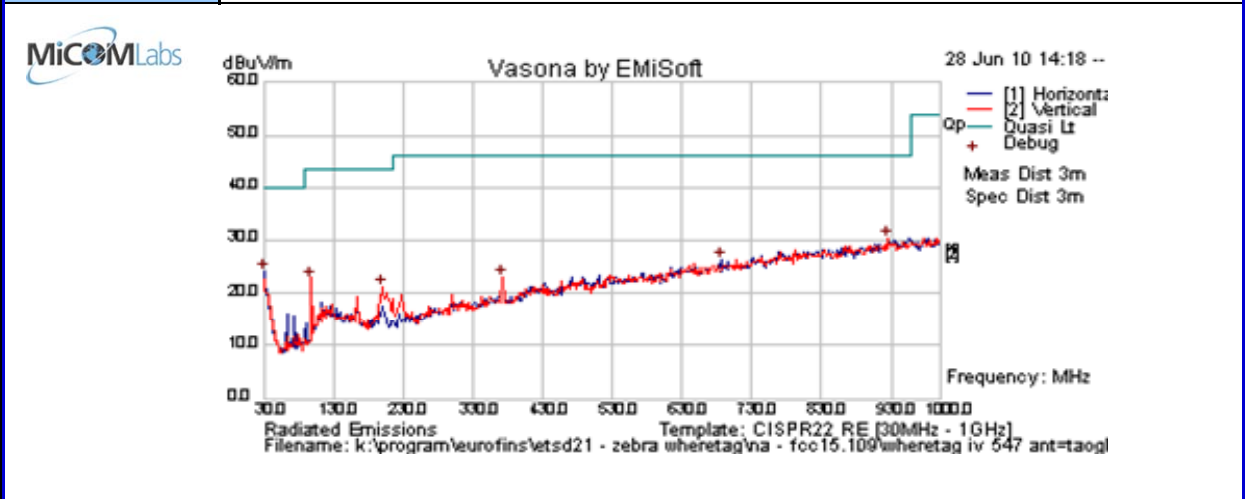
Legend: DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency  
 NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

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**7.8.2 Measurement Results for Radiated Spurious Emissions Below 1 GHz - Antenna Taoglas**

<b>Test Freq.</b>	2441.75 MHz	<b>Engineer</b>	CSB
<b>Variant</b>	Digital Emissions	<b>Temp (°C)</b>	29.5
<b>Freq. Range</b>	30 MHz - 1000 MHz	<b>Rel. Hum. (%)</b>	37
<b>Power Setting</b>	DSSS Mode - Maximum Power	<b>Press. (mBars)</b>	997
<b>Antenna</b>	WhereTag IV 547 ANT=Taoglas		
<b>Test Notes 1</b>	EUT was operated in DSSS mode at maximum power for worst case operation		
<b>Test Notes 2</b>			



**Formally measured emission peaks**

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	P o l	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
30.000	29.9	3.4	-9.2	24.1	Peak [Scan]	H	98	360	40	-15.9	Pass	DIG
97.985	40.0	4.1	-21.6	22.6	Peak [Scan]	V	98	360	43.5	-20.9	Pass	Amb
199.240	34.2	4.8	-17.9	21.1	Peak [Scan]	V	98	360	43.5	-22.4	Pass	DIG
372.013	32.5	5.6	-15.2	22.8	Peak [Scan]	V	98	360	46	-23.2	Pass	DIG
685.287	29.6	6.6	-10.0	26.2	Peak [Scan]	H	98	360	46	-19.8	Pass	DIG
924.210	30.1	7.4	-7.2	30.3	Peak [Scan]	V	98	360	46	-15.7	Pass	DIG

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

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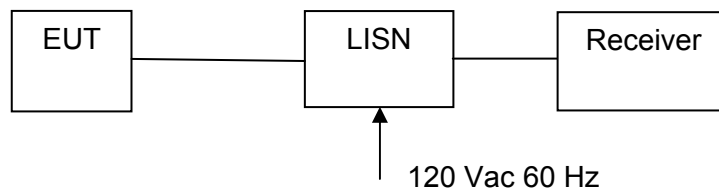
## 7.9 AC Mains Power Input/Output Port Emissions

No testing performed. EUT does not connect to AC Mains.

### Test Procedure

The measurement frequency range extends from 150 kHz to 30 MHz. 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 Setup



Measurement set up for Conducted Emissions Test

### Specification

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



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### Limits

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

\* Decreases with the logarithm of the frequency

### Traceability

All conducted emission measurements are traceable to national standards. The uncertainty of measurement at a confidence level of not less than 95 %, with a coverage factor of k=2, in the range 9 kHz – 30 MHz (Average & Quasi-peak) is  $\pm 2.64$  dB.

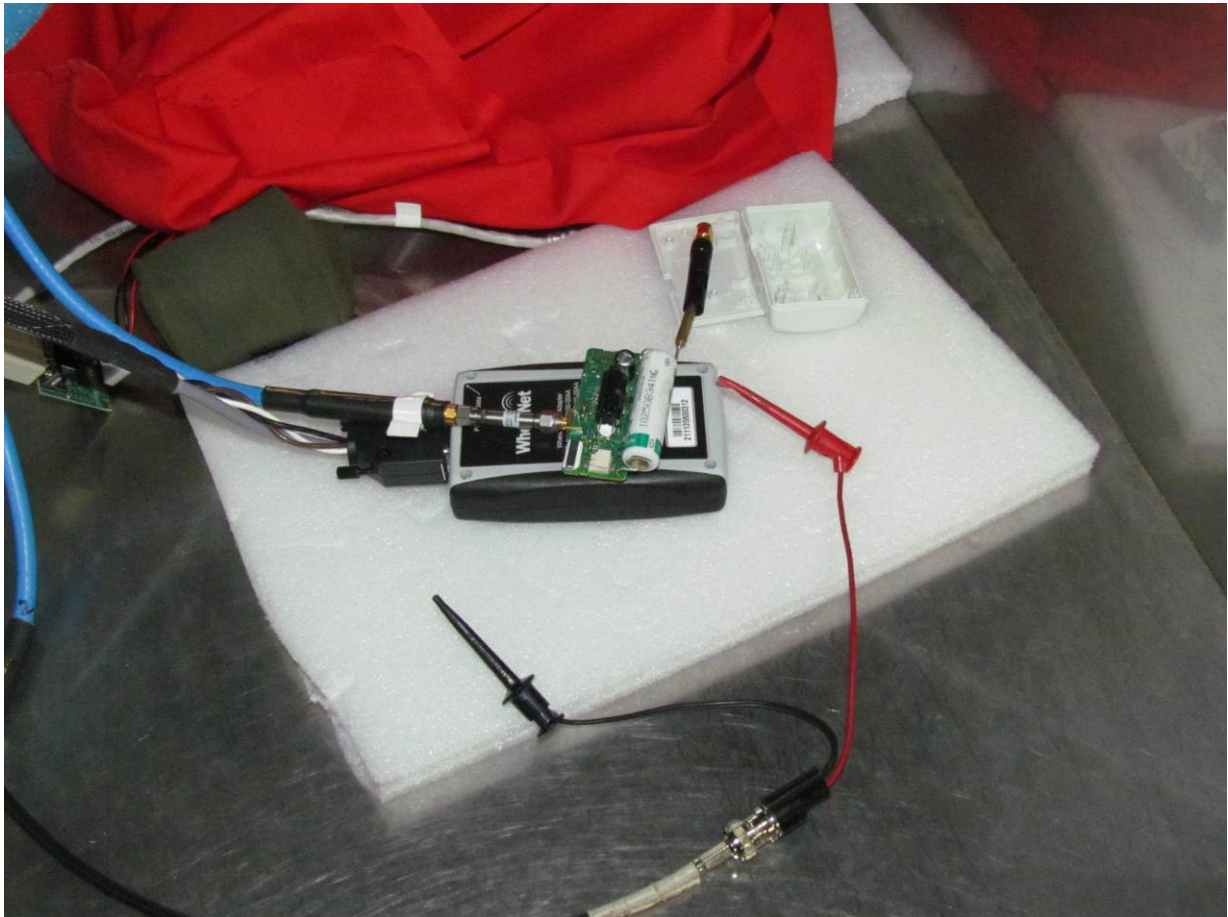
Laboratory Measurement Uncertainty	
Measurement uncertainty	$\pm 2.64$ dB

Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307, 156, 193, 190

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## 8 PHOTOGRAPHS

### 8.1 Conducted RF Measurement Set Up



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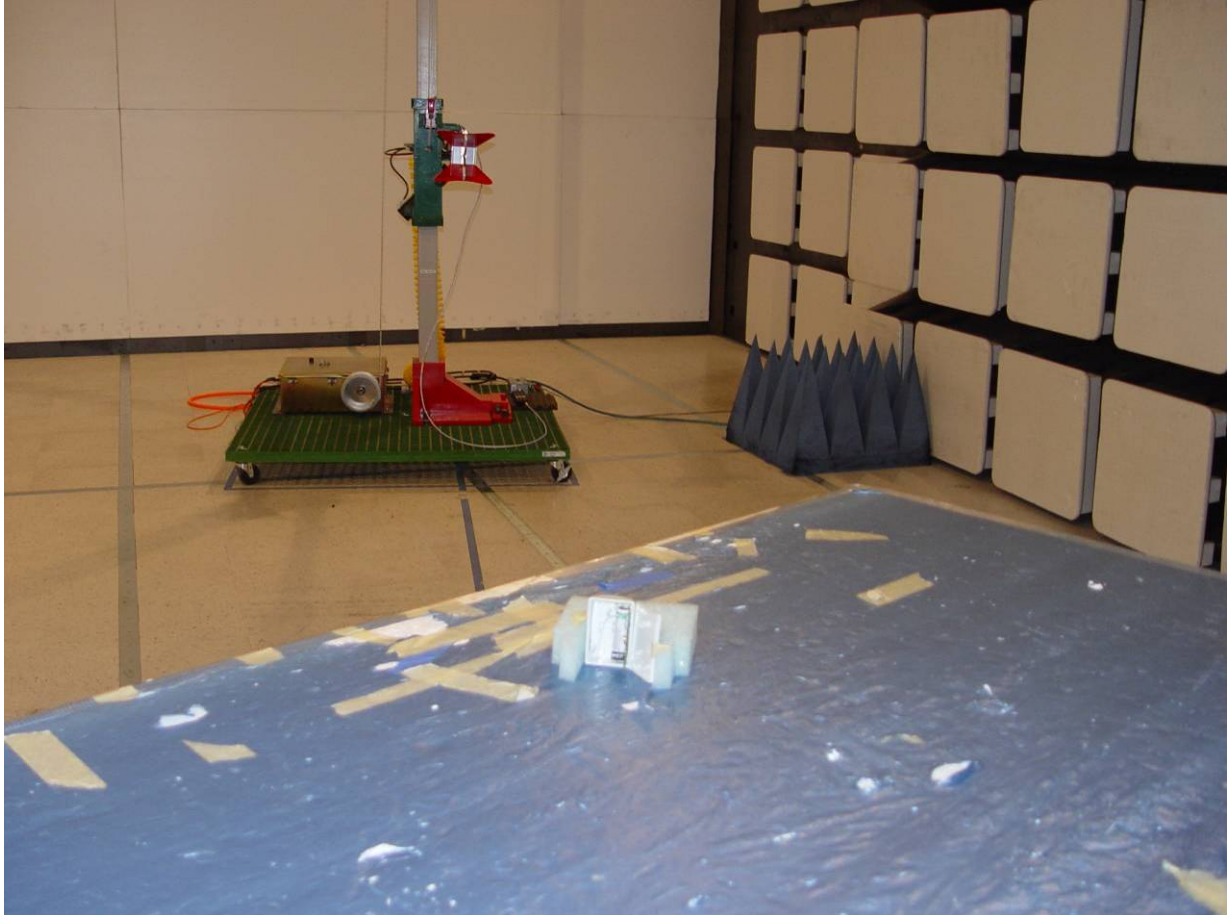
## 8.2 Radiated Spurious Emissions Above 1 GHz - ZES Antenna



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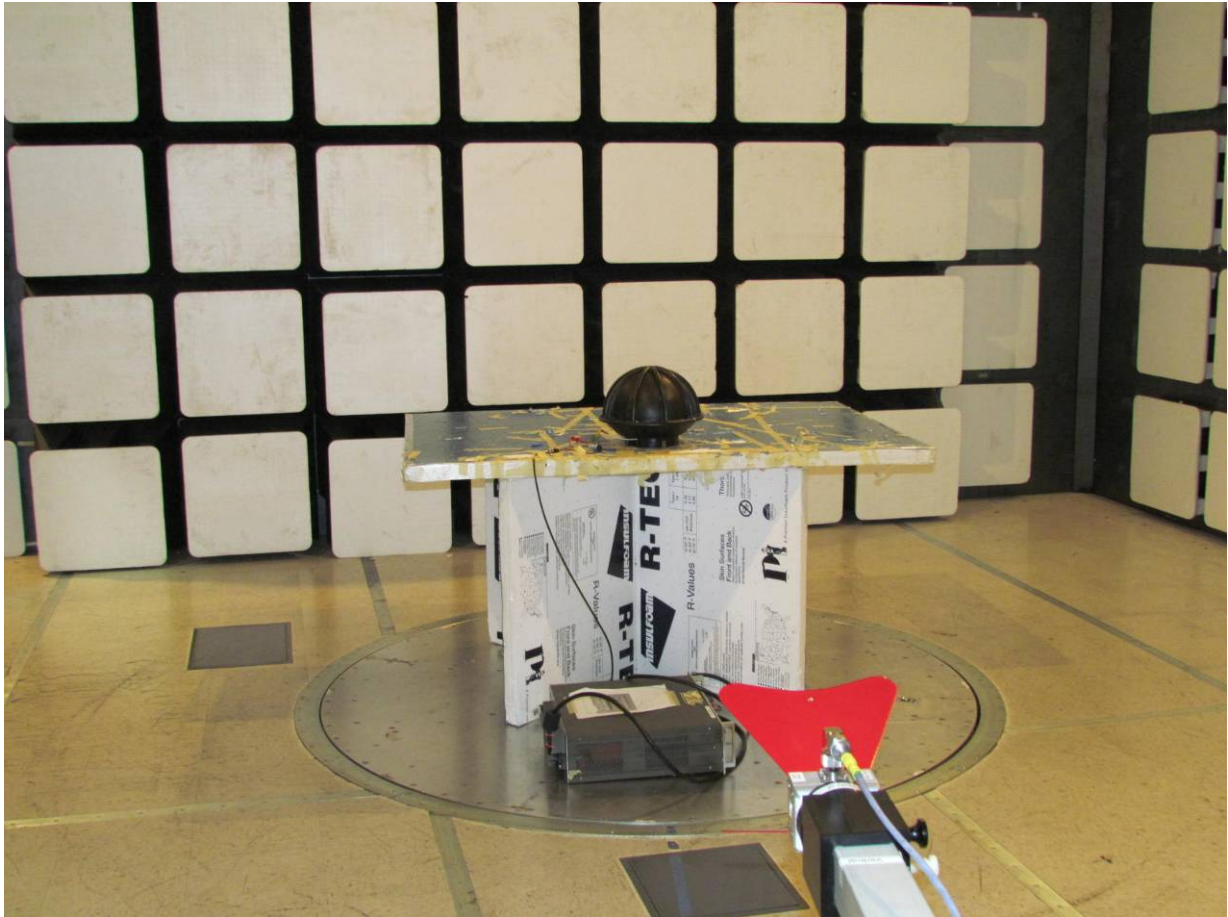
### 8.3 Radiated Spurious Emissions Above 1 GHz - Taoglas Flexible Antenna



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#### 8.4 Radiated Spurious Emissions Above 1 GHz – Dome Antenna

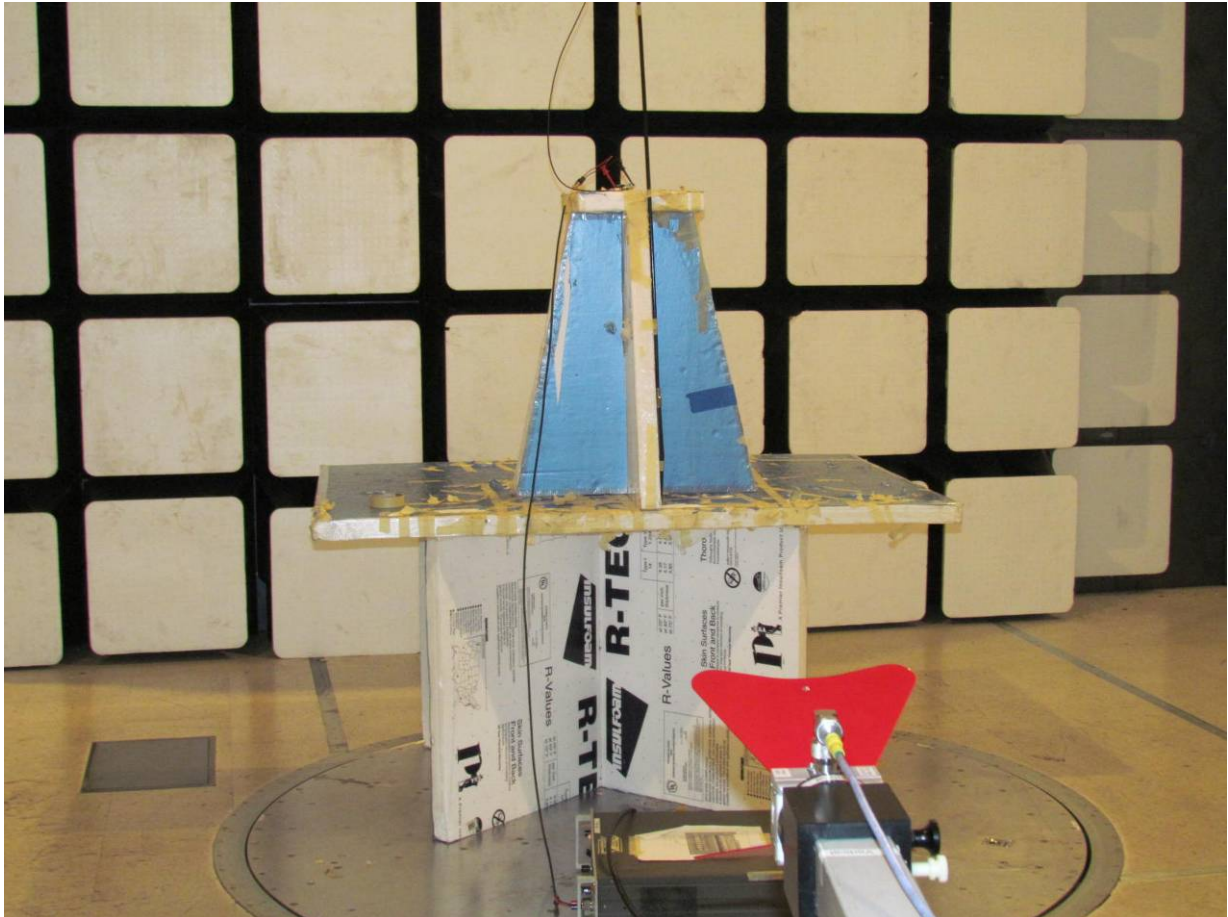


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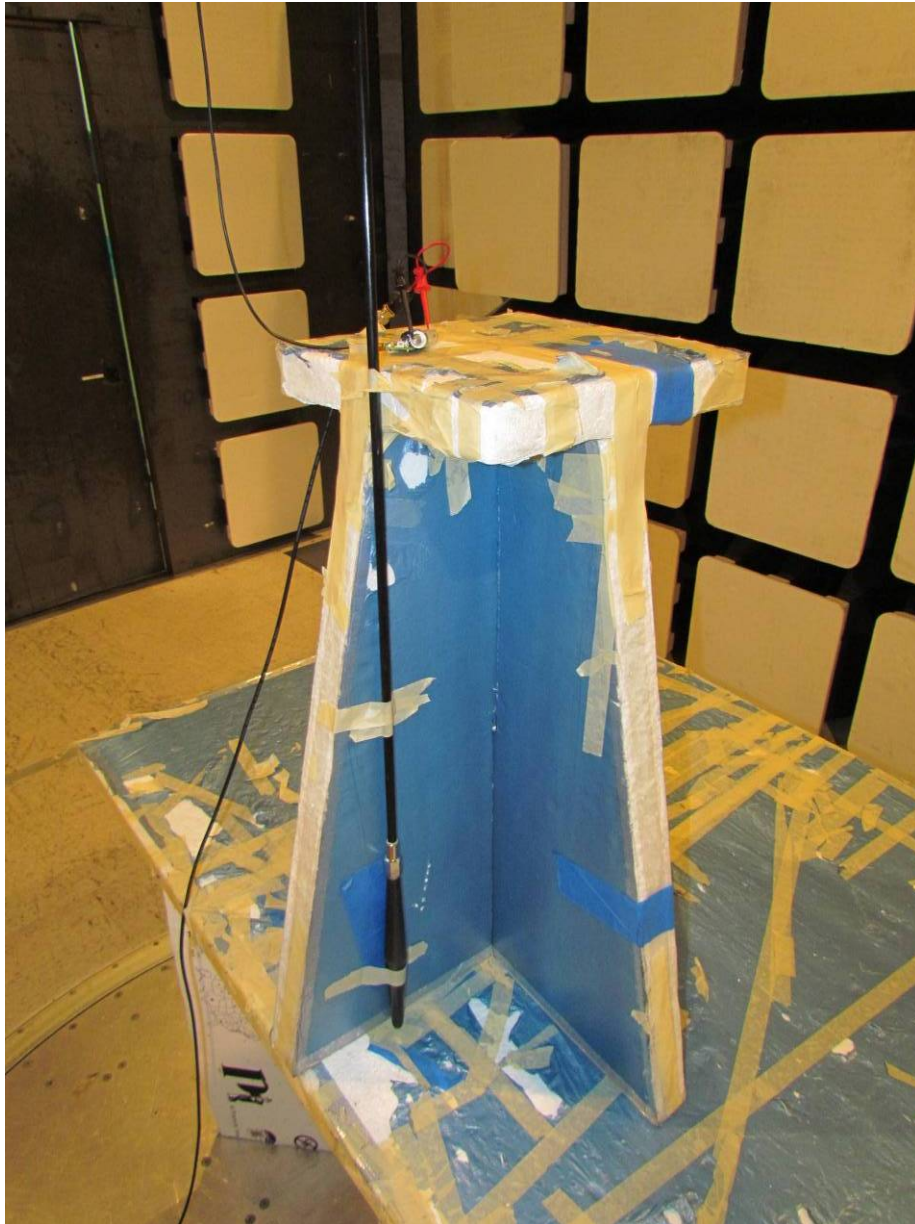


## 8.5 Radiated Spurious Emissions Above 1 GHz – Whip Antenna

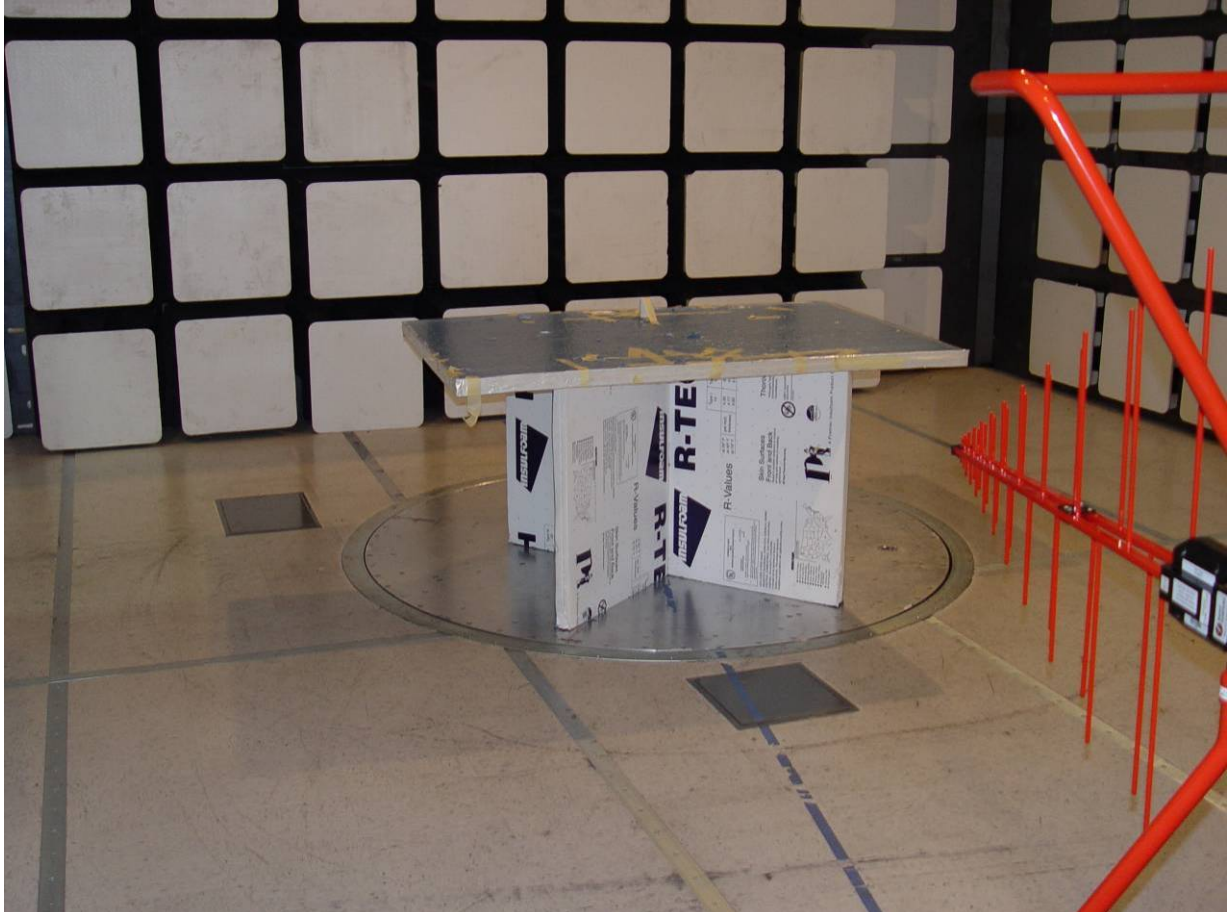


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## 8.6 Radiated Spurious Emissions Below 1 GHz



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## 9 TEST EQUIPMENT DETAILS

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

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