

Test of Zebra Enterprise Solutions Corp WhereTag IV
Module

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

Test Report Serial No.: ETSD21-U1 Rev A



TEST REPORT

FROM



Test of: Zebra Enterprise Solutions Corp WhereTag IV Module

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

Test Report Serial No.: ETSD21-U1 Rev A

This report supersedes: NONE

Applicant: Zebra Enterprise Solutions Corp
2940 N. First Street
San Jose, CA 95134
USA

Product Function: Remote Telemetry Module

Copy No: pdf

Issue Date: 2nd August 2010

This Test Report is Issued Under the Authority of;

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MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



CERTIFICATE #2381.01



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WhereTag IV Module
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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 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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1.2 LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

United States of America
Federal Communications Commission (FCC) Listing #: 102167

Canada

Industry Canada (IC) Listing #: 4143A

Japan Registration

VCCI Membership Number: 2959

- Radiated 3 meter site; Registration No. R-2881
- Line Conducted, Registration Nos. C-3181 & T-1470
- Emissions; Registration Nos. C-3180 & T-1469

1.3 RECOGNITION

APEC MRA (Asia-Pacific Economic Community Mutual Recognition Agreement)

Conformity Assessment Body (CAB) – MiCOM Labs

Test data generated by MiCOM Labs is accepted in the following countries under the APEC MRA.

Country	Recognition Body	Phase	CAB Identification No.
Australia	Australian Communications and Media Authority (ACMA)	I	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	I	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	I	
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	I	
Vietnam	Ministry of Information and Communications	I	

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2 DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	2 nd August 2010	Initial Release

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3 TEST RESULT CERTIFICATE

Applicant:	Zebra Enterprise Solutions Corp 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:	33560876 / 33560868		
Date(s) Tested:	6/28/2010	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.

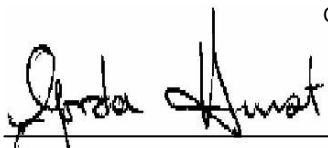
Approved & Released for MiCOM Labs, Inc. by:



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.	47 CFR Part 15, SubPart 15.247	2007	For Digitally Modulated Intentional Radiators
ii.	Industry Canada RSS-210	Issue 7 June 2007	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands): Category 1 Equipment
iii.	Industry Canada RSS-Gen	Issue 2 June 2007	General Requirements and Information for the Certification of Radiocommunication Equipment
iv.	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
v.	CISPR 22/ EN 55022	2005	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
vi.	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
vii.	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
viii.	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
ix.	A2LA	14 th September 2005	Reference to A2LA Accreditation 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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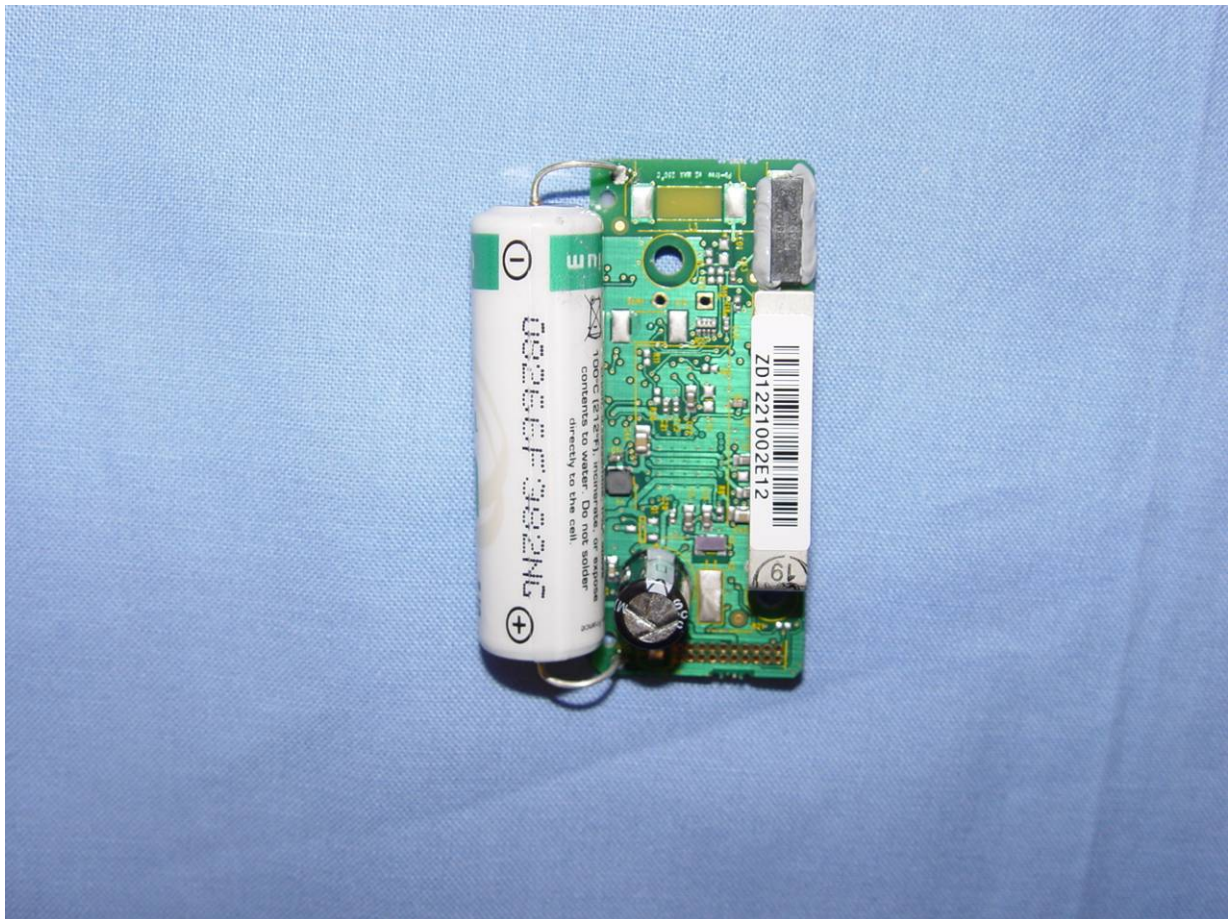
6 PRODUCT DETAILS AND TEST CONFIGURATIONS

6.1 Test Program Scope

The scope of the test program was to test the Zebra Enterprise Solutions Corp WhereTag IV MODULE Remote Telemetry Module for compliance against FCC 47 CFR Part 15, SubPart 15.247

Applicant: Zebra Enterprise Solutions Corp

Product: WhereTag IV Module



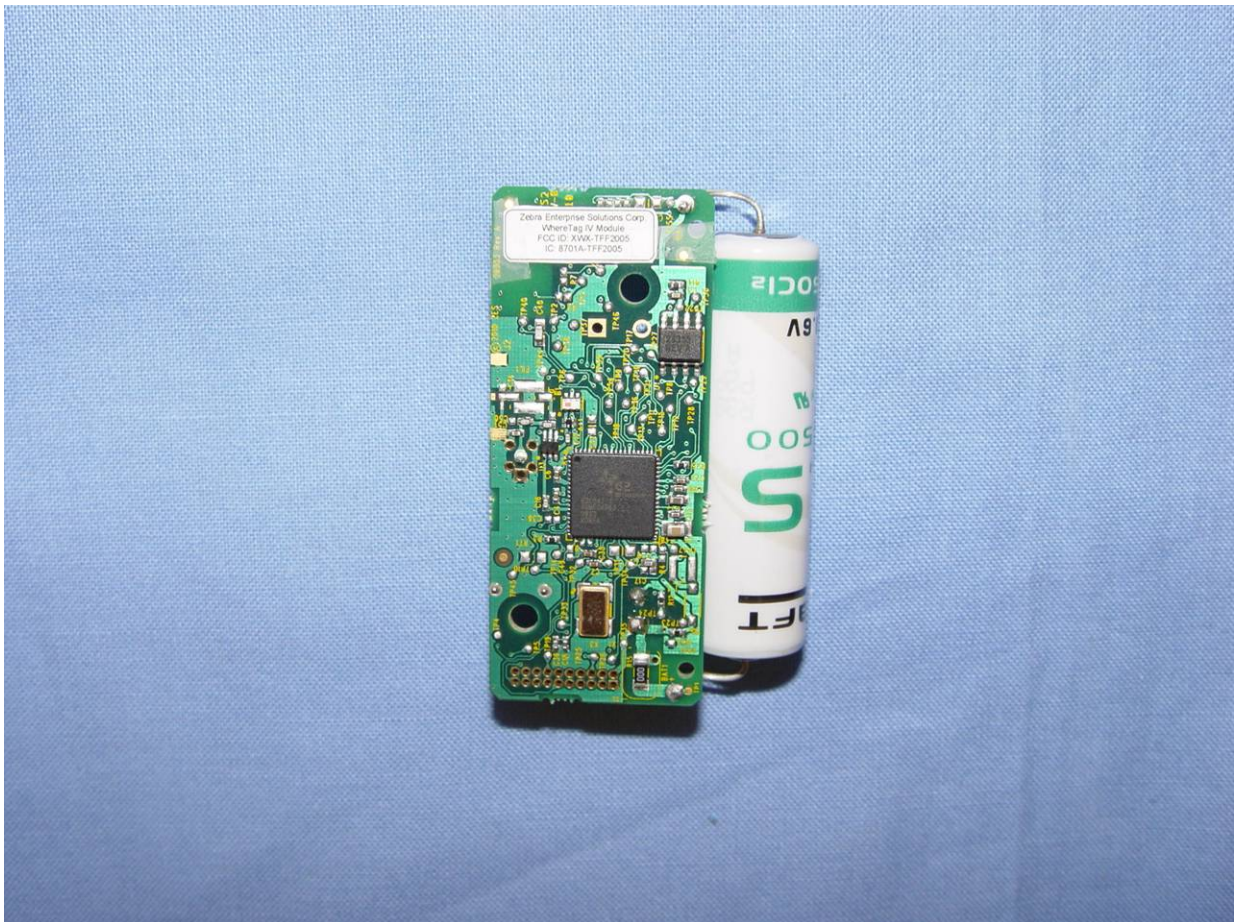
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Applicant: Zebra Enterprise Solutions Corp

Product: WhereTag IV Module



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6.2 EUT Details

Detail	Description
Purpose:	Test of the Zebra Enterprise Solutions Corp WhereTag IV Module Remote Telemetry Module for compliance against FCC 47 CFR Part 15, SubPart 15.247 and RSS-210 Annex 8
Applicant:	Zebra Enterprise Solutions Corp 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:	ETSD21
Date EUT received:	6/28/2010
Dates of test (from - to):	6/28/2010
No of Units Tested:	1
Product Name:	WhereTag IV Module
Manufacturers Trade 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:	Prod 3.1.2(0)
Hardware Release:	Rev 01
Test Software Release:	Test 3.1.2(2)
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

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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

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

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

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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

LEGACY

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

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 Enterprise Solutions Corp	TFF-2005	TFF-2005-00AA
EUT	Remote Telemetry Module (w/ Antenna FXP73.07.0100A) s/n 33560868	Zebra Enterprise Solutions Corp	TFF-2005	TFF-2005-00AA
Support	Laptop PC	Dell	PPX	72MUF A02
Support	Laptop PC	Dell	PPL	9172P
Support	Location Sensor	Zebra Enterprise Solutions Corp.	LOS-4100	01AC

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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

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.

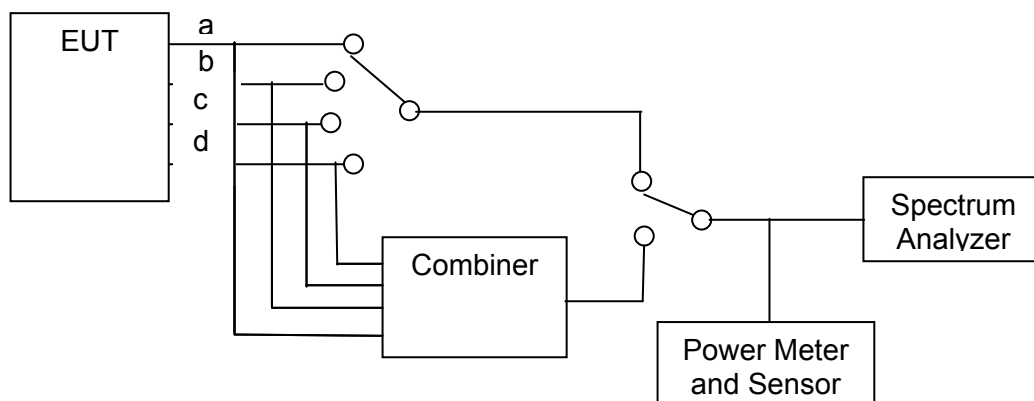
7 TEST RESULTS

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 6 dB and 99% Bandwidth Results: 802.11 b

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

6 dB Bandwidth

Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz				kHz	MHz	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

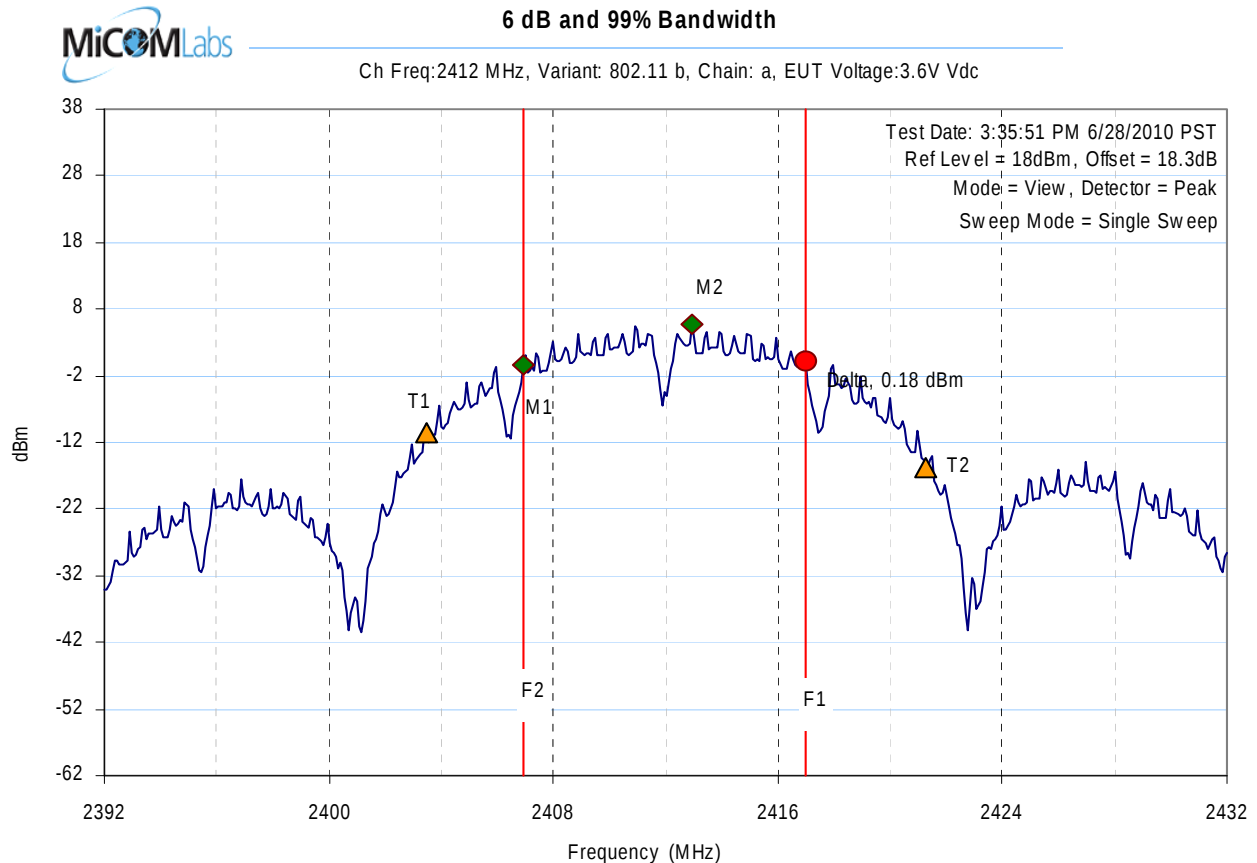
Test Frequency	99 % Bandwidth						
	MHz						
MHz	a	b	c	d			
2412	17.876000	--	--	--			
2437	16.513000	--	--	--			
2462	17.715000	--	--	--			

Measurement uncertainty:	±2.81 dB
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Analyser Setup

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

Marker : Frequency : Amplitude

M1 : 2406.909820MHz : -3.53dBm
M2 : 2412.921844MHz : 5.765dBm
Delta : 2417.010020MHz : .184dBm
T1 : 2403.462926MHz : -10.493dBm
T2 : 2421.258517MHz : -15.815dBm

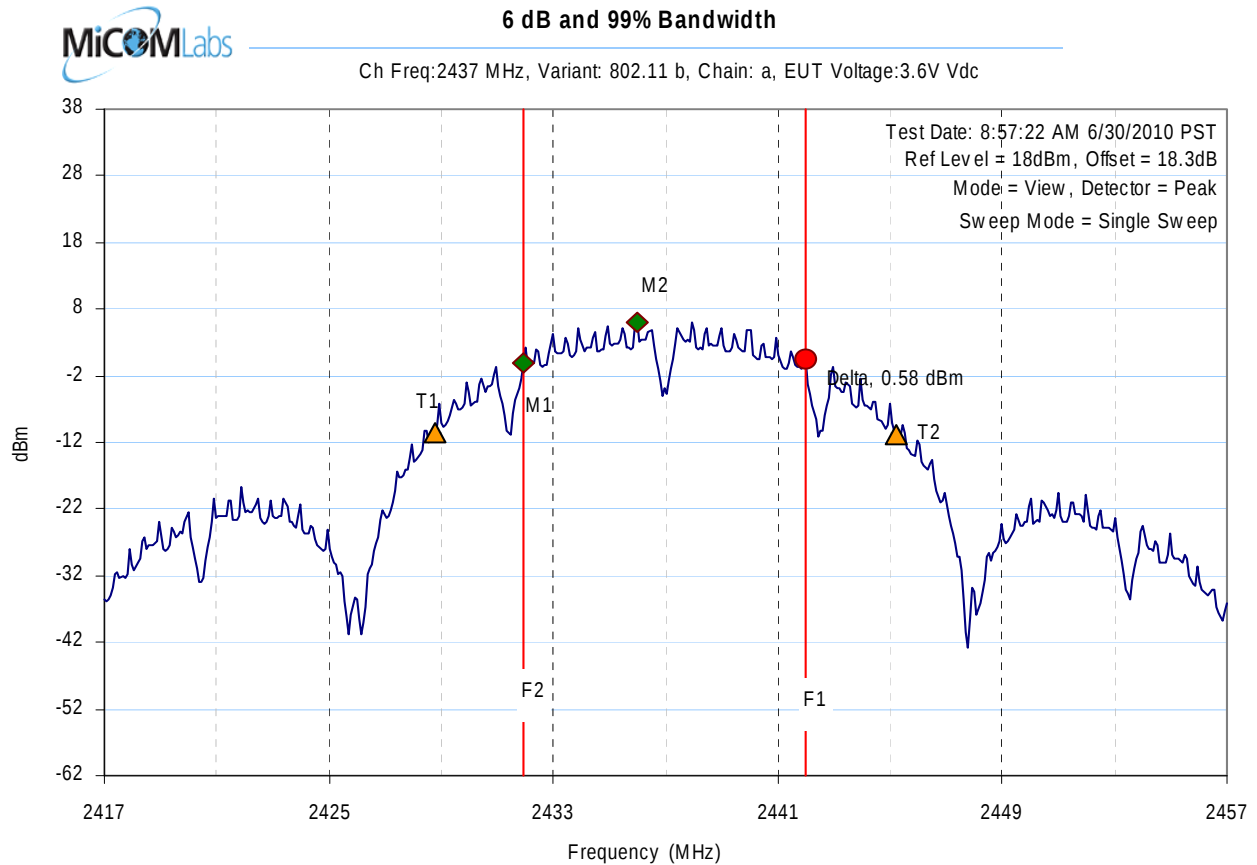
Test Results

Center frequency = 2412MHz
6dB BW(Delta-M1) = 10.100200MHz
99% OBW(T2-T1) = 17.875752MHz

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**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

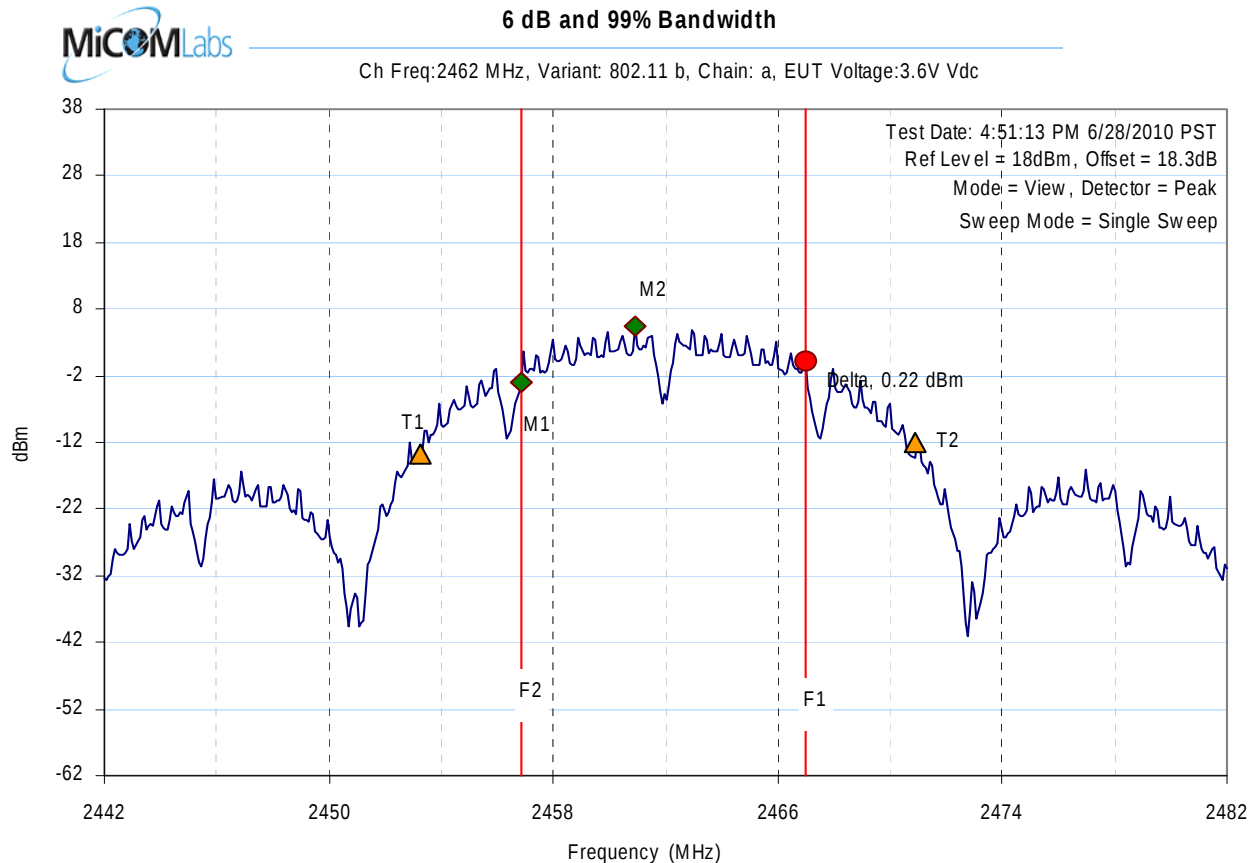
Test Results

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

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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 6 dB and 99% Bandwidth Results: 802.11 g

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

6 dB Bandwidth

Test Frequency	6 dB Bandwidth				Minimum 6dB Bandwidth Limit		Margin
	MHz				kHz	MHz	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

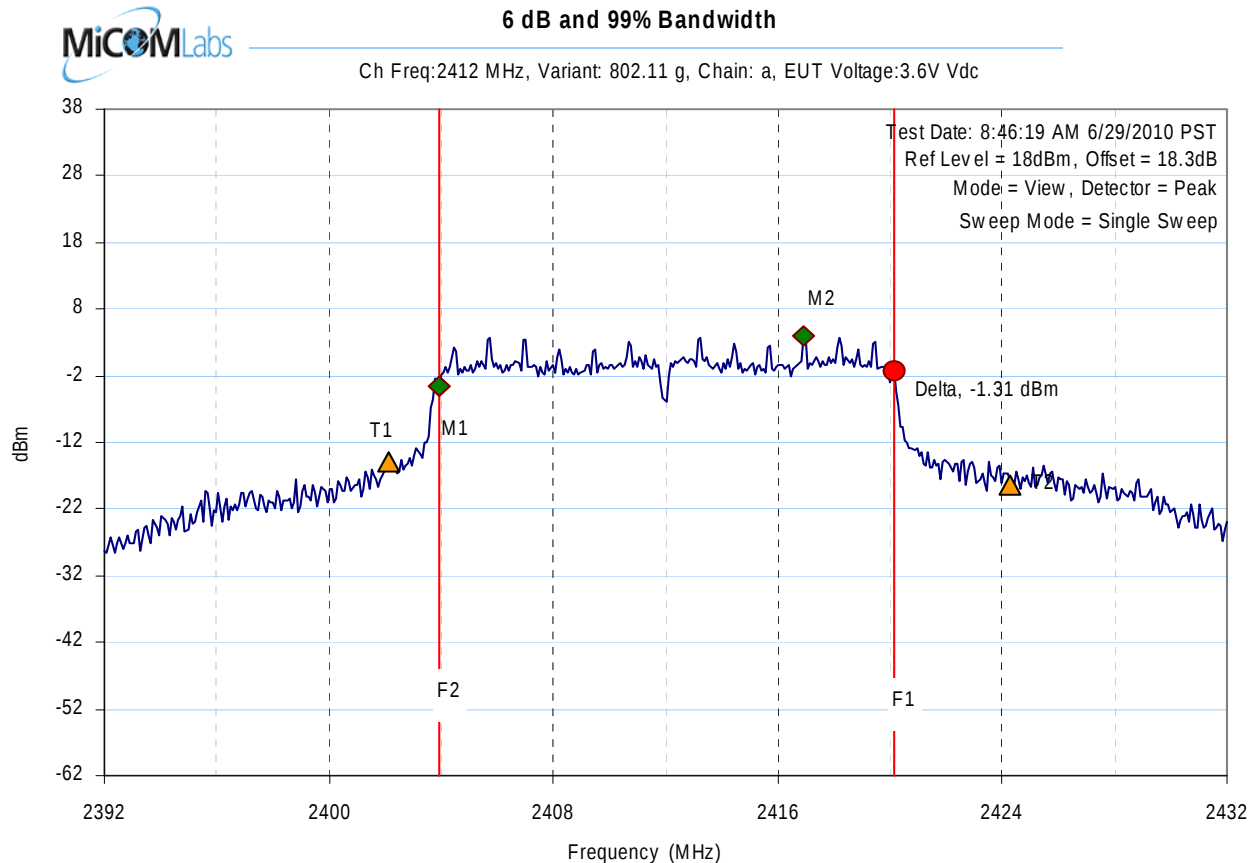
Test Frequency	99 % Bandwidth						
	MHz						
MHz	a	b	c	d			
2412	22.285000	--	--	--			
2437	24.529000	--	--	--			
2462	22.926000	--	--	--			

Measurement uncertainty:	±2.81 dB
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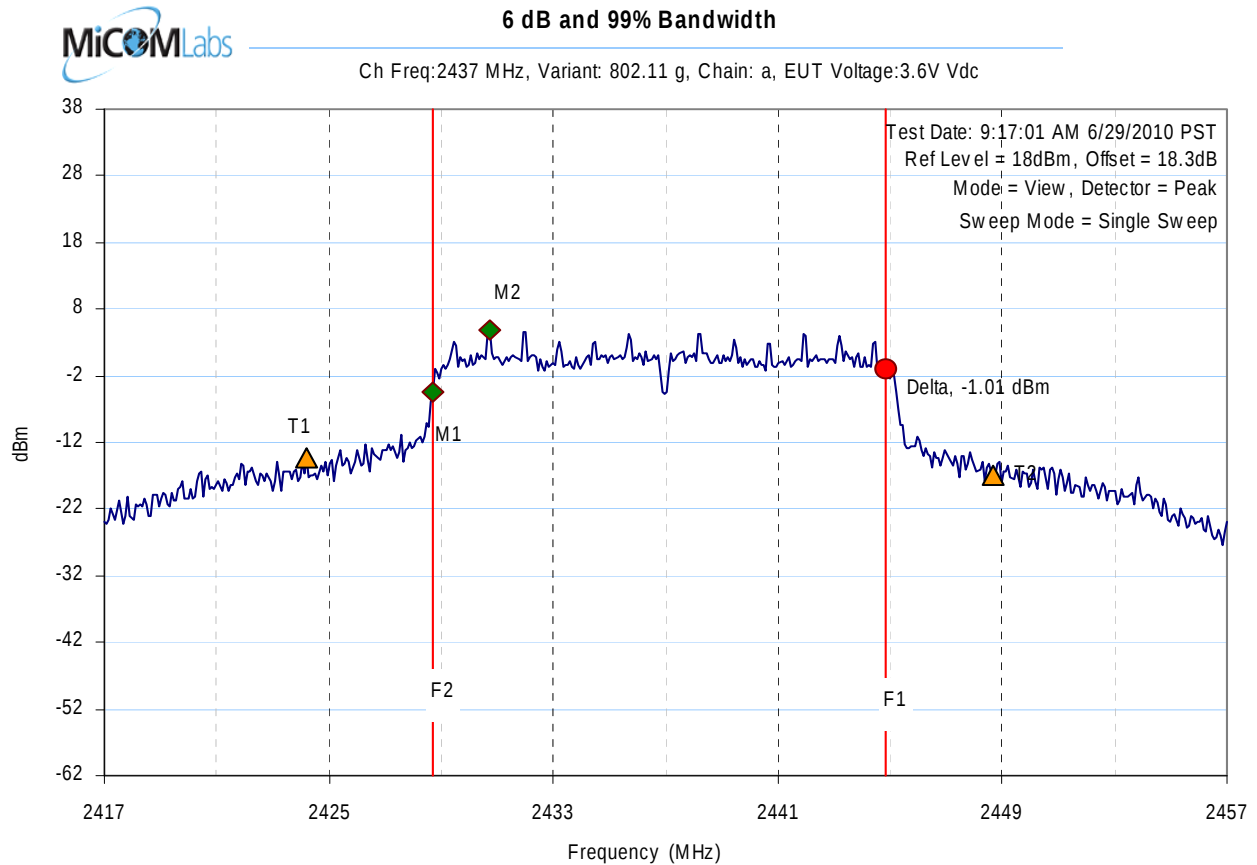


Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2403.943888MHz : -3.613dBm	Center frequency = 2412MHz
VBW = 300.00KHz	M2 : 2416.929860MHz : 3.870dBm	6dB BW(Delta-M1) = 16.192385MHz
Sweep time(s) = 20	Delta : 2420.136273MHz : -1.310dBm	99% OBW(T2-T1) = 22.284569MHz
RF Atten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

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**Analyser Setup**

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

Marker : Frequency : Amplitude

M1 : 2428.703407MHz : -4.410dBm
M2 : 2430.707415MHz : 4.901dBm
Delta : 2444.815631MHz : -1.011dBm
T1 : 2424.214429MHz : -14.221dBm
T2 : 2448.663327MHz : -16.938dBm

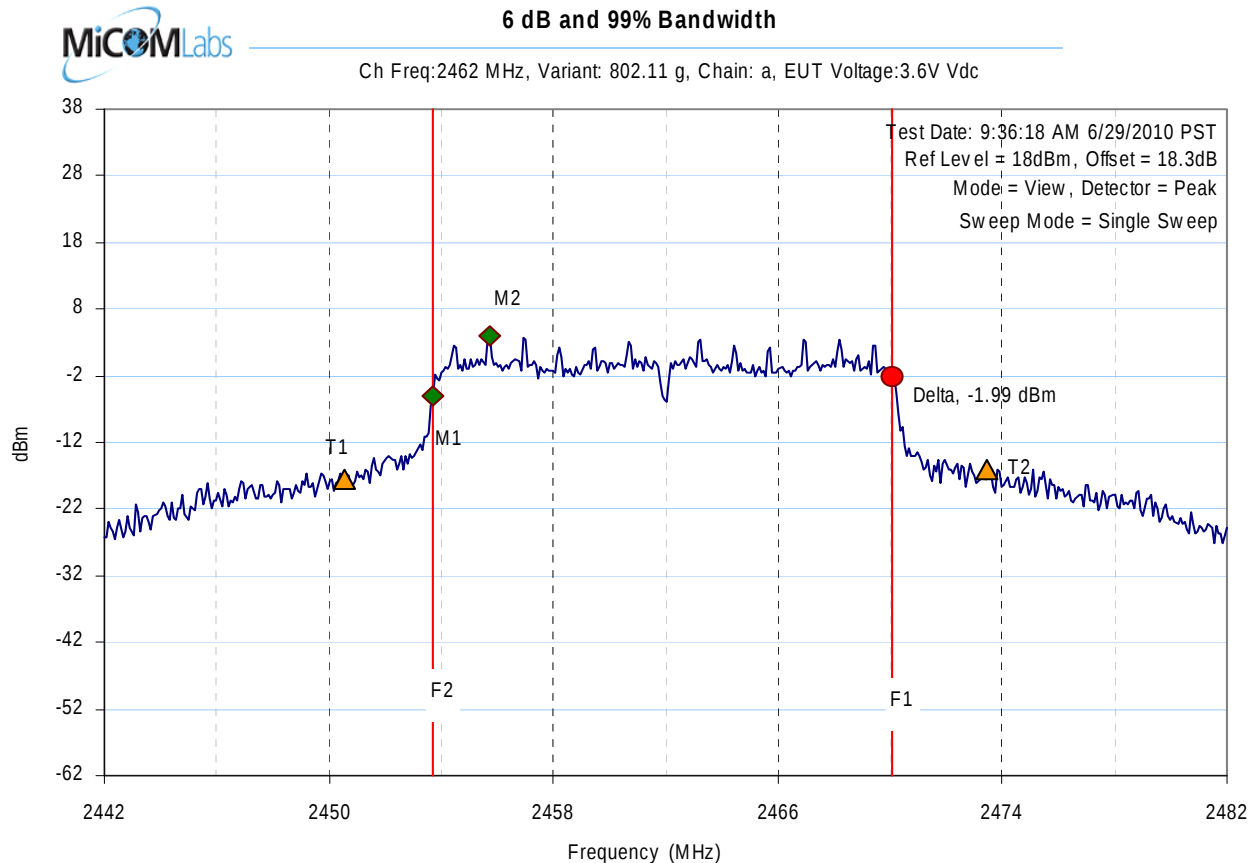
Test Results

Center frequency = 2437MHz
6dB BW(Delta-M1) = 16.112224MHz
99% OBW(T2-T1) = 24.529058MHz

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Analyser Setup

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

Marker : Frequency : Amplitude

M1 : 2453.703407MHz : -5.044dBm
M2 : 2455.707415MHz : 3.985dBm
Delta : 2470.056112MHz : -1.986dBm
T1 : 2450.577154MHz : -17.554dBm
T2 : 2473.422846MHz : -16.106dBm

Test Results

Center frequency = 2462MHz
6dB BW(Delta-M1) = 16.352705MHz
99% OBW(T2-T1) = 22.925852MHz

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7.1.3 6 dB and 99% Bandwidth Results: DSSS

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

6 dB Bandwidth

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

99% Bandwidth

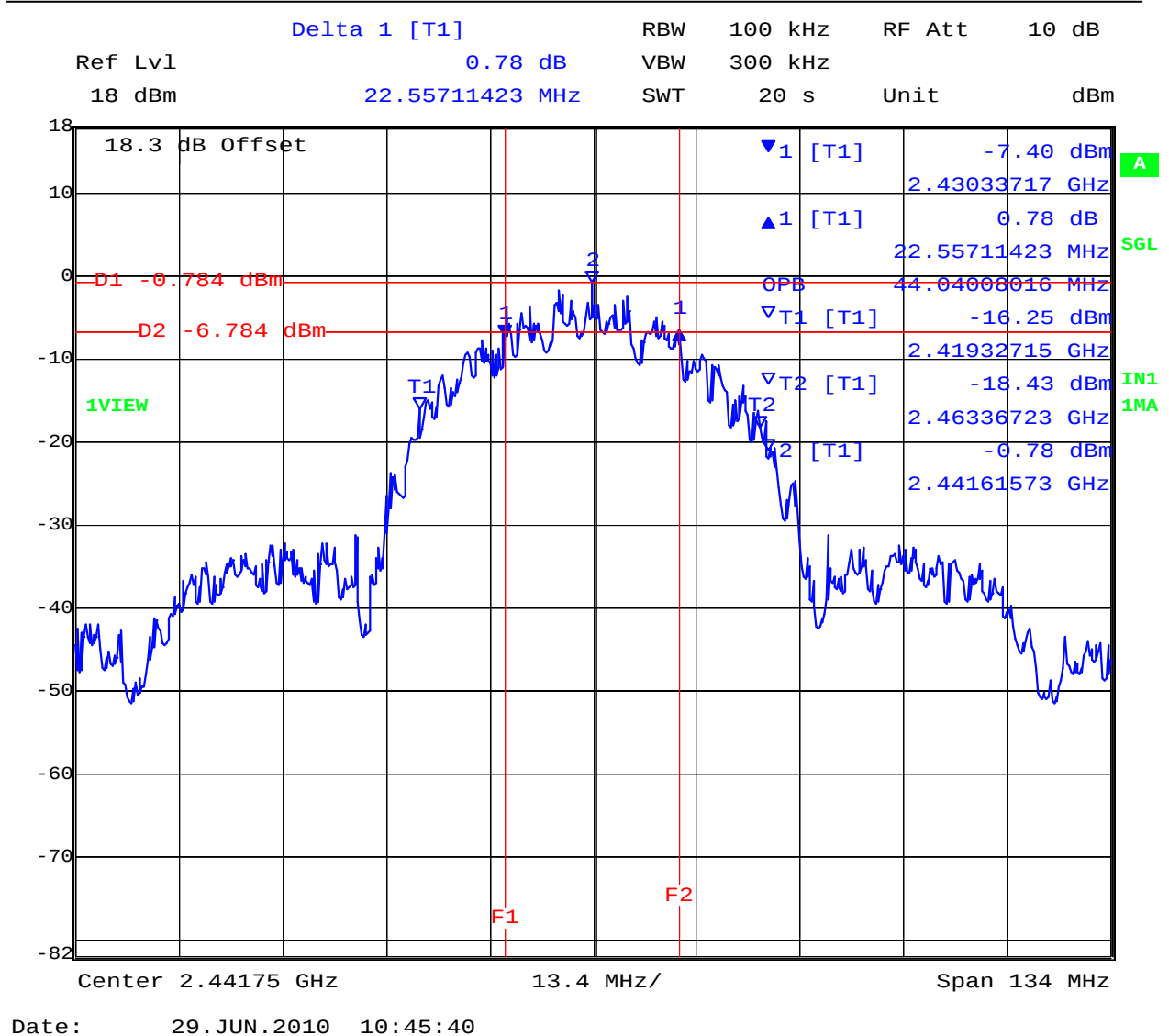
Test Frequency	99 % Bandwidth						
	MHz						
MHz	a	b	c	d			
2441.75	44.040000	—	—	—			

Measurement uncertainty:	±2.81 dB
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7.1.4 6 dB and 99% Bandwidth Results: OOK

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

6 dB Bandwidth

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

99% Bandwidth

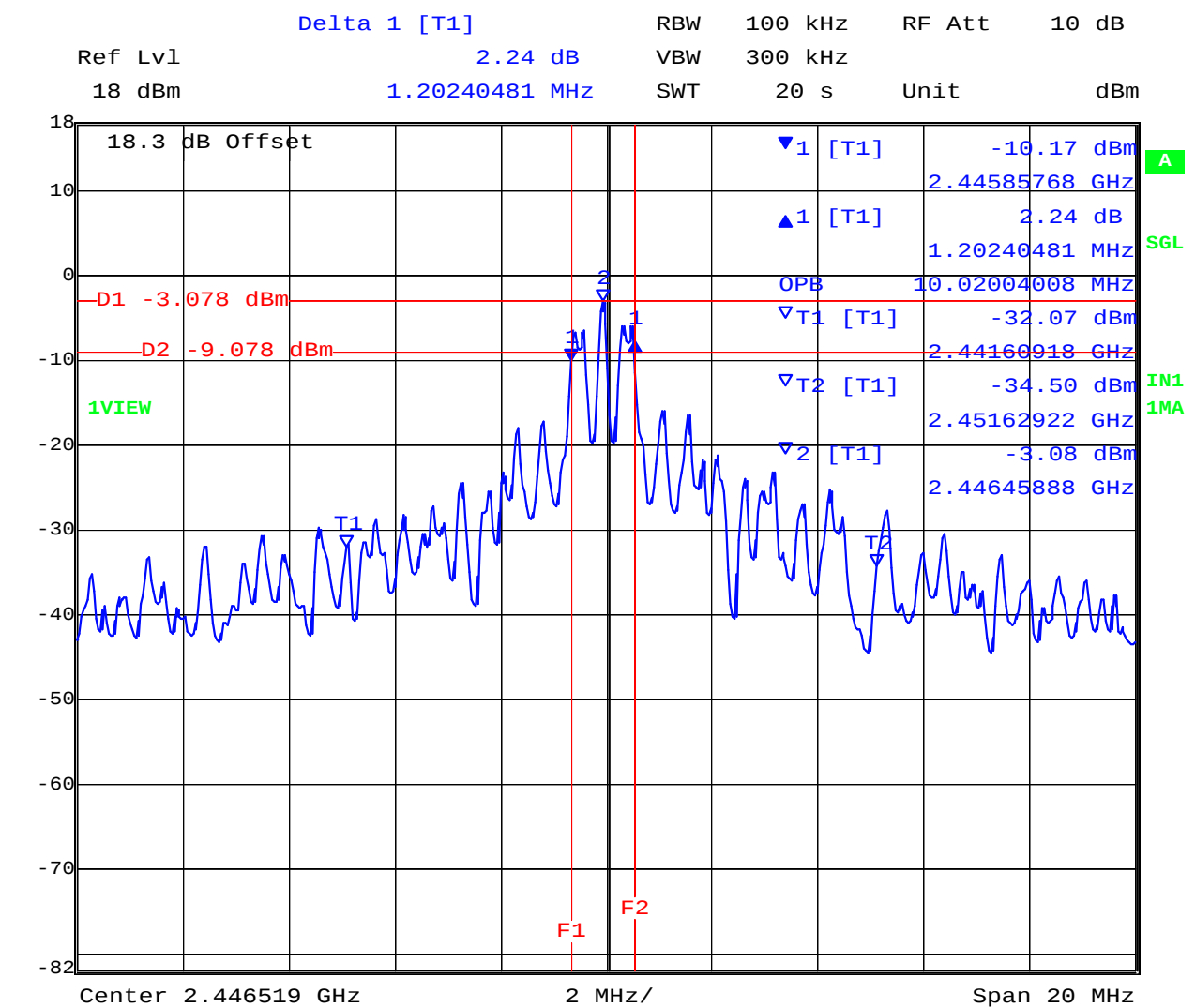
Test Frequency	99 % Bandwidth						
	MHz						
MHz	a	b	c	d			
2446.519	10.020040	--	--	--			

Measurement uncertainty:	±2.81 dB
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Date: 29.JUN.2010 11:10:03

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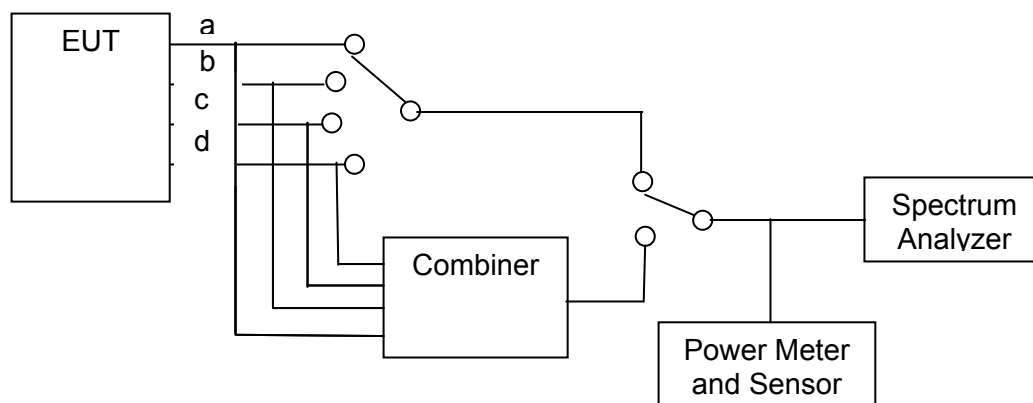
7.2 Peak Output Power

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

Total Power = A + G + Y + 10 log (1/x) dBm

A = Total Power [10 Log10 (10a/10 + 10b/10 + 10c/10 + 10d/10)], G = Antenna Gain,

Y = Beam Forming Gain, x = Duty Cycle



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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 Measurement Results: 802.11 b

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

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

Measurement uncertainty:	±1.33 dB
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7.2.2 Measurement Results: 802.11 g

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

Test Frequency	Measured Peak Power				Total Power (dBm)		Limit	Margin
	RF Port (dBm)				Combined	Calculated	dBm	dB
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

Measurement uncertainty:	±1.33 dB
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7.2.3 Measurement Results: DSSS

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

7.2.4 Measurement Results: OOK

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

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7.3 Peak Power Spectral Density

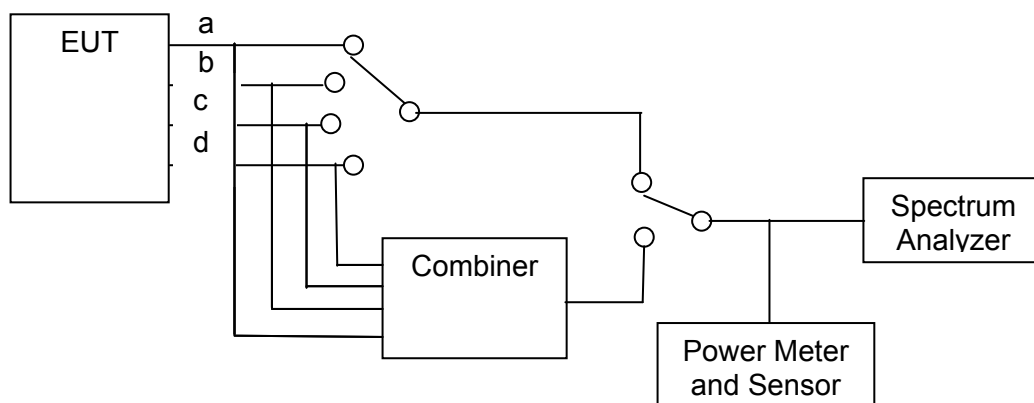
Test Procedure

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 Measurement results for 802.11 b

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

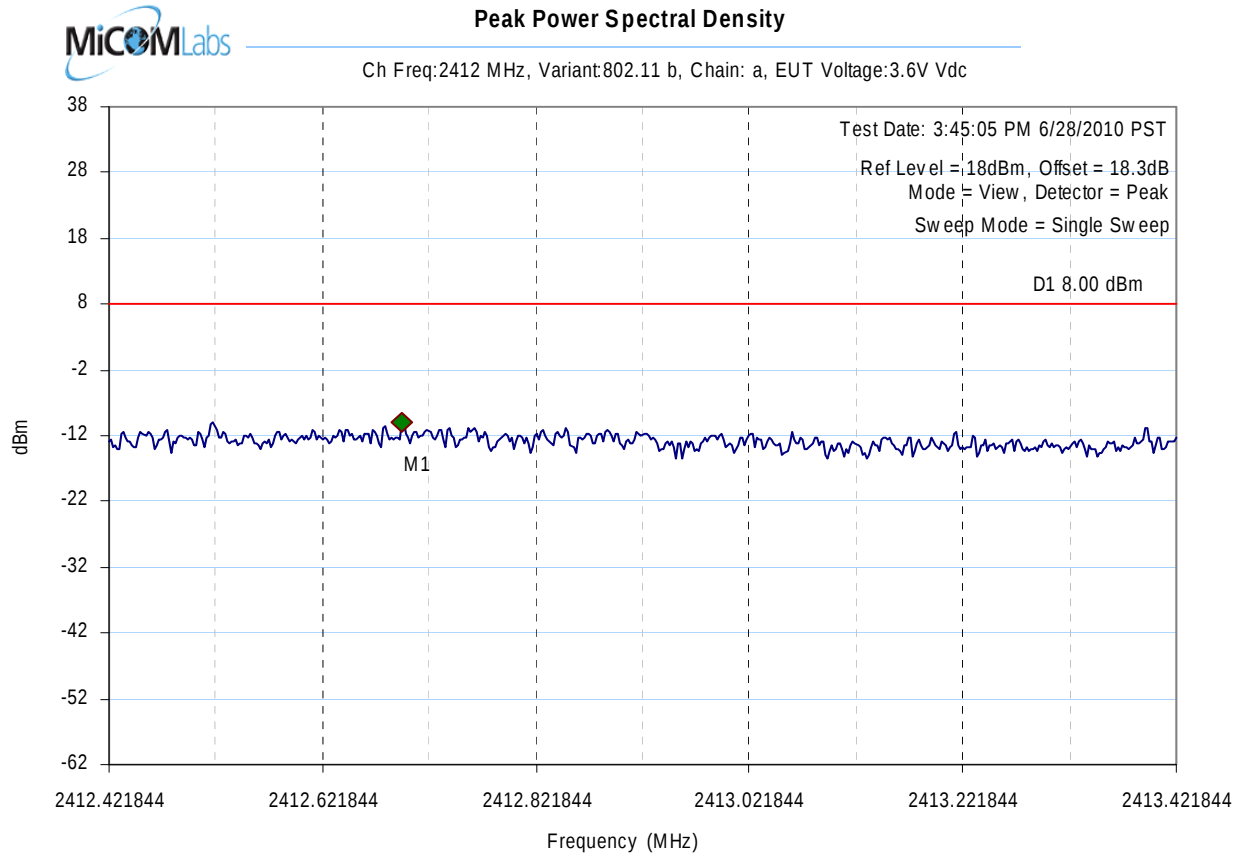
Test Frequency	Measured Power Density				Total Peak Power Spectral Density (dBm)		Limit	Margin
	RF Port (dBm)				Combined	Calculated	dBm	dB
MHz	a	b	c	d				
2412	-9.87	--	--	--		-9.87	8.00	-17.87
2437	-7.95	--	--	--		-7.95	8.00	-15.95
2462	-10.12	--	--	--		-10.12	8.00	-18.12

Measurement uncertainty:	± 1.33 dB
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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 : 2412.696393MHz : -9.870dBm

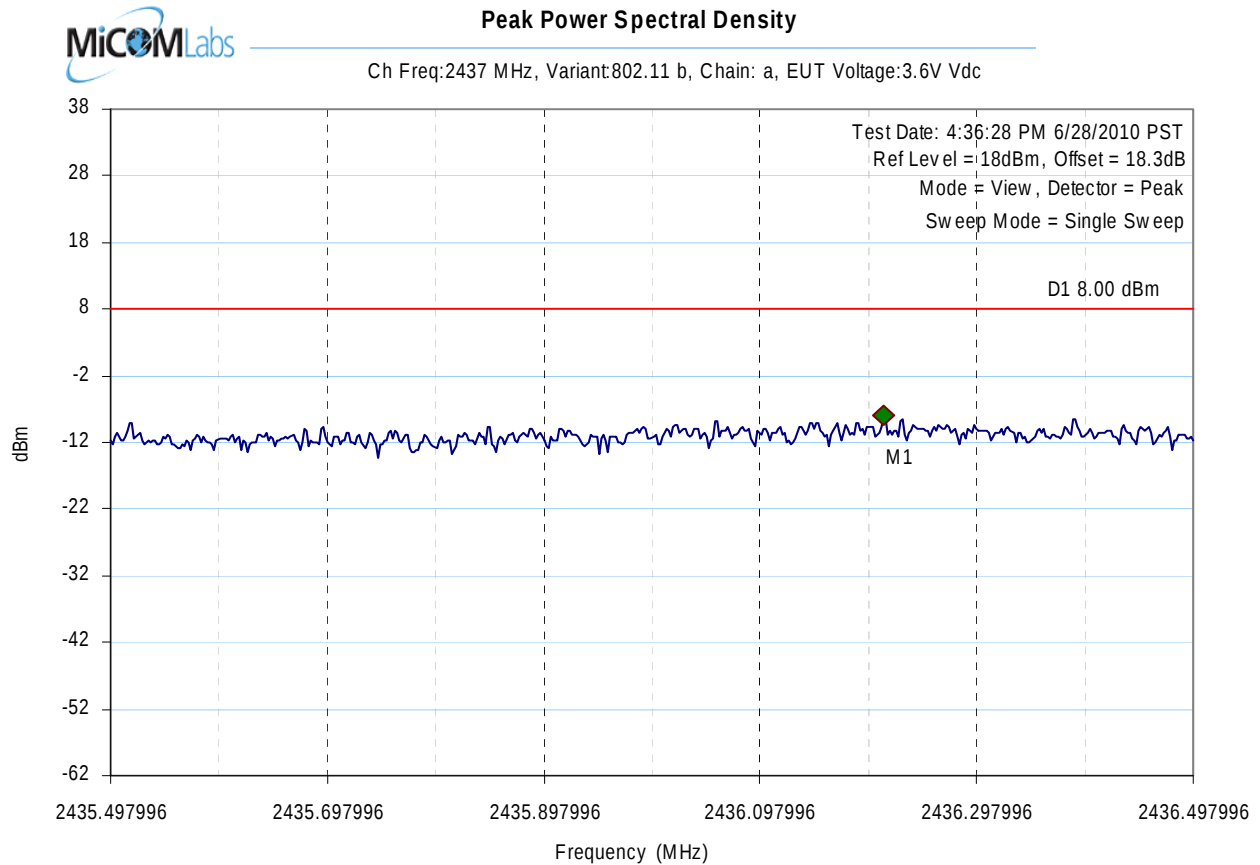
Test Results

Center frequency = 2412MHz

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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

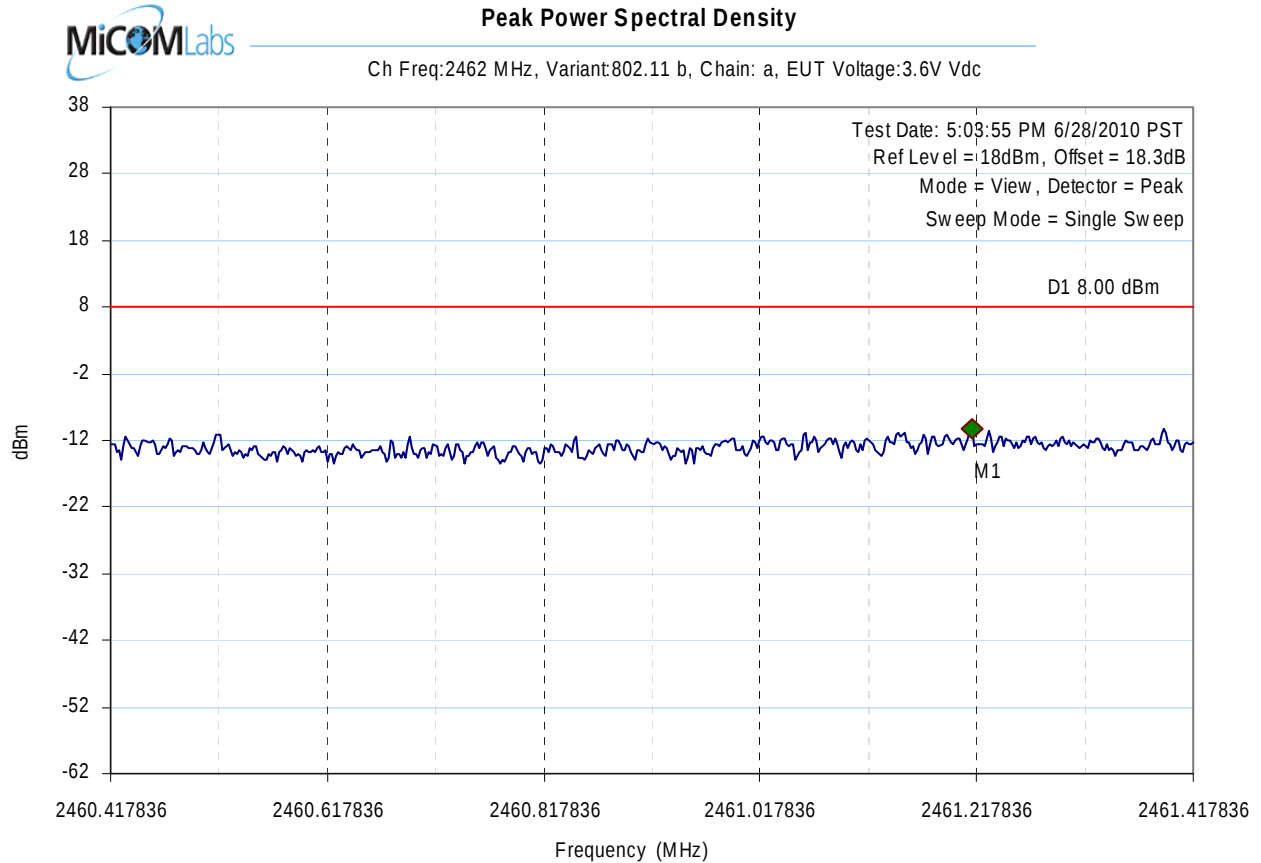
Test Results

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 Measurement results for 802.11 g

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

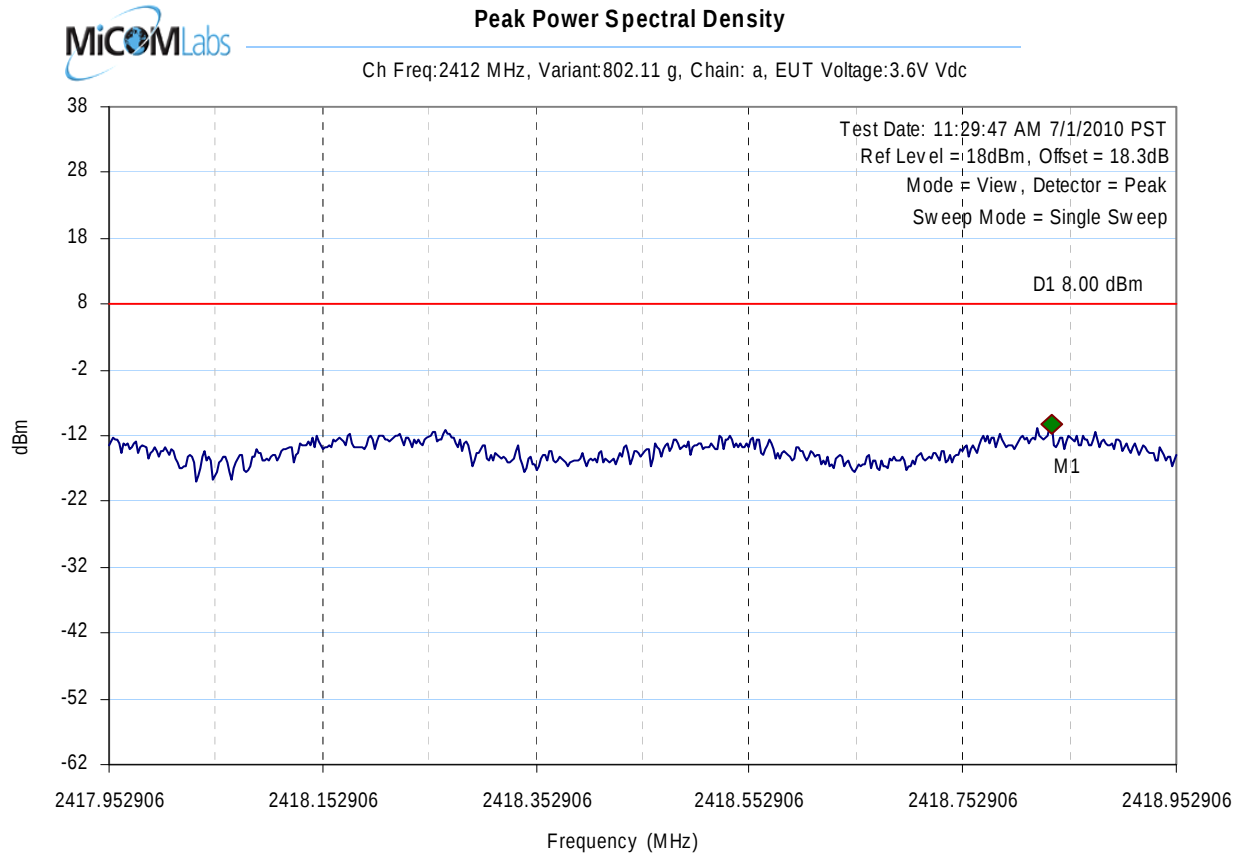
Test Frequency	Measured Power Density				Total Peak Power Spectral Density (dBm)		Limit	Margin
	RF Port (dBm)				Combined	Calculated		
MHz	a	b	c	d			dBm	dB
2412	-10.36	--	--	--		-10.36	8.00	-18.36
2437	-9.32	--	--	--		-9.32	8.00	-17.32
2462	-9.98	--	--	--		-9.98	8.00	-17.98

Measurement uncertainty:	± 1.33 dB
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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 : 2418.836673MHz : -10.359dBm

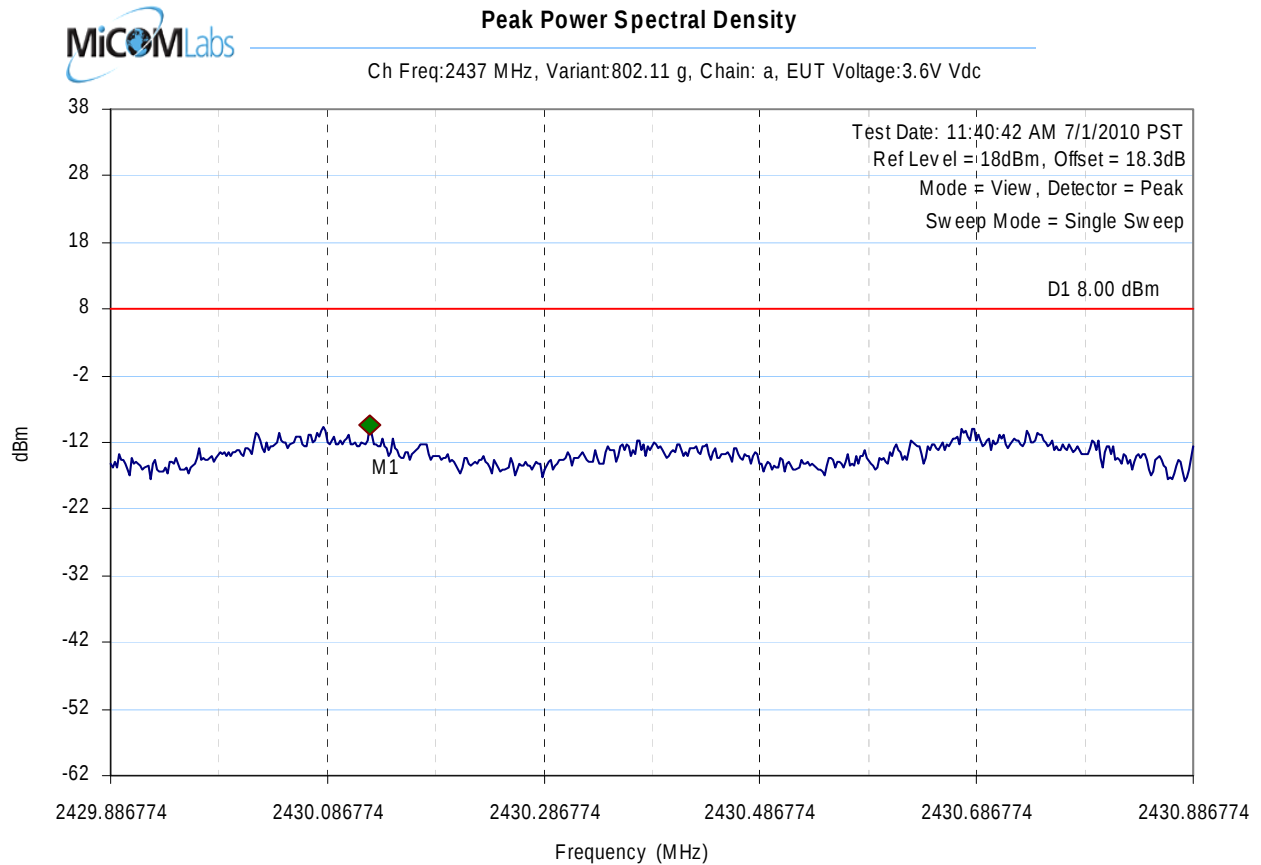
Test Results

Center frequency = 2412MHz

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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

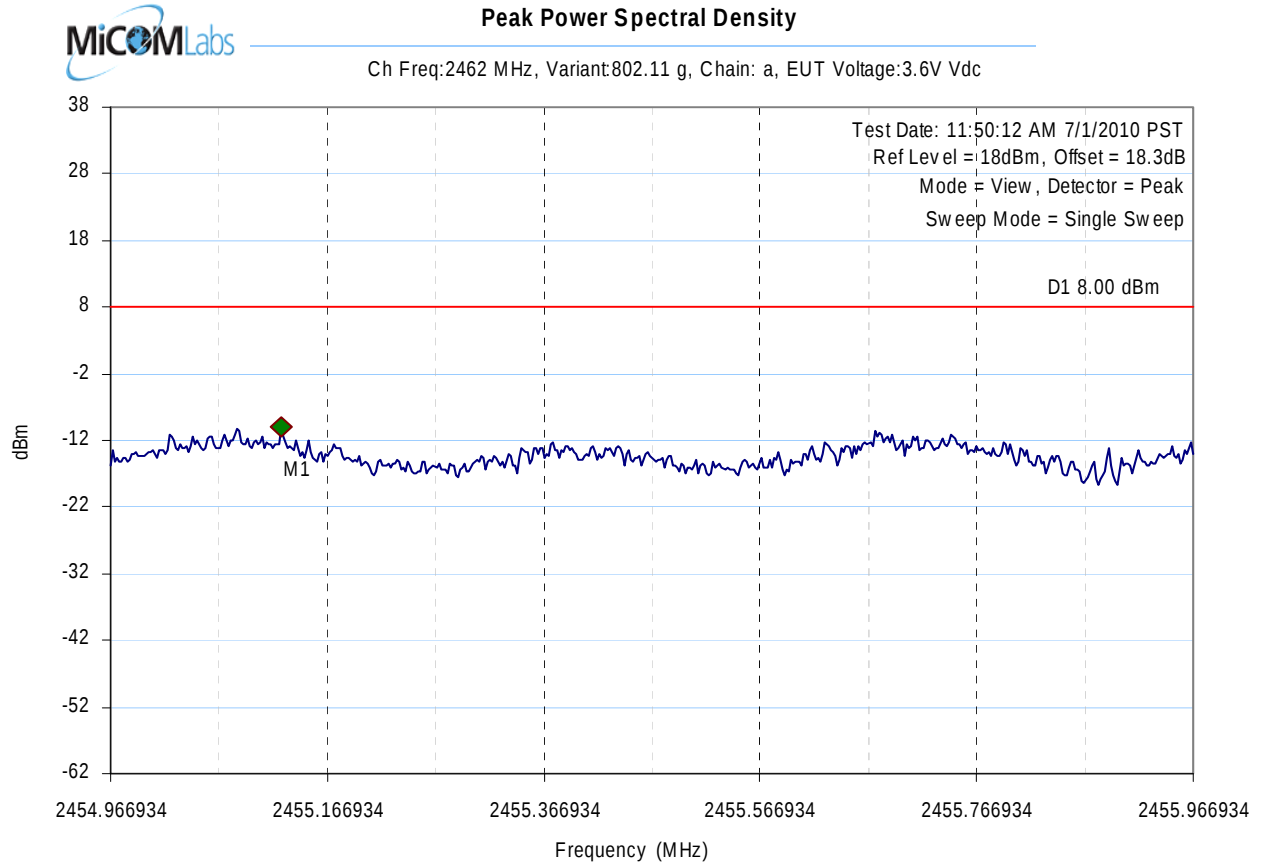
Test Results

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

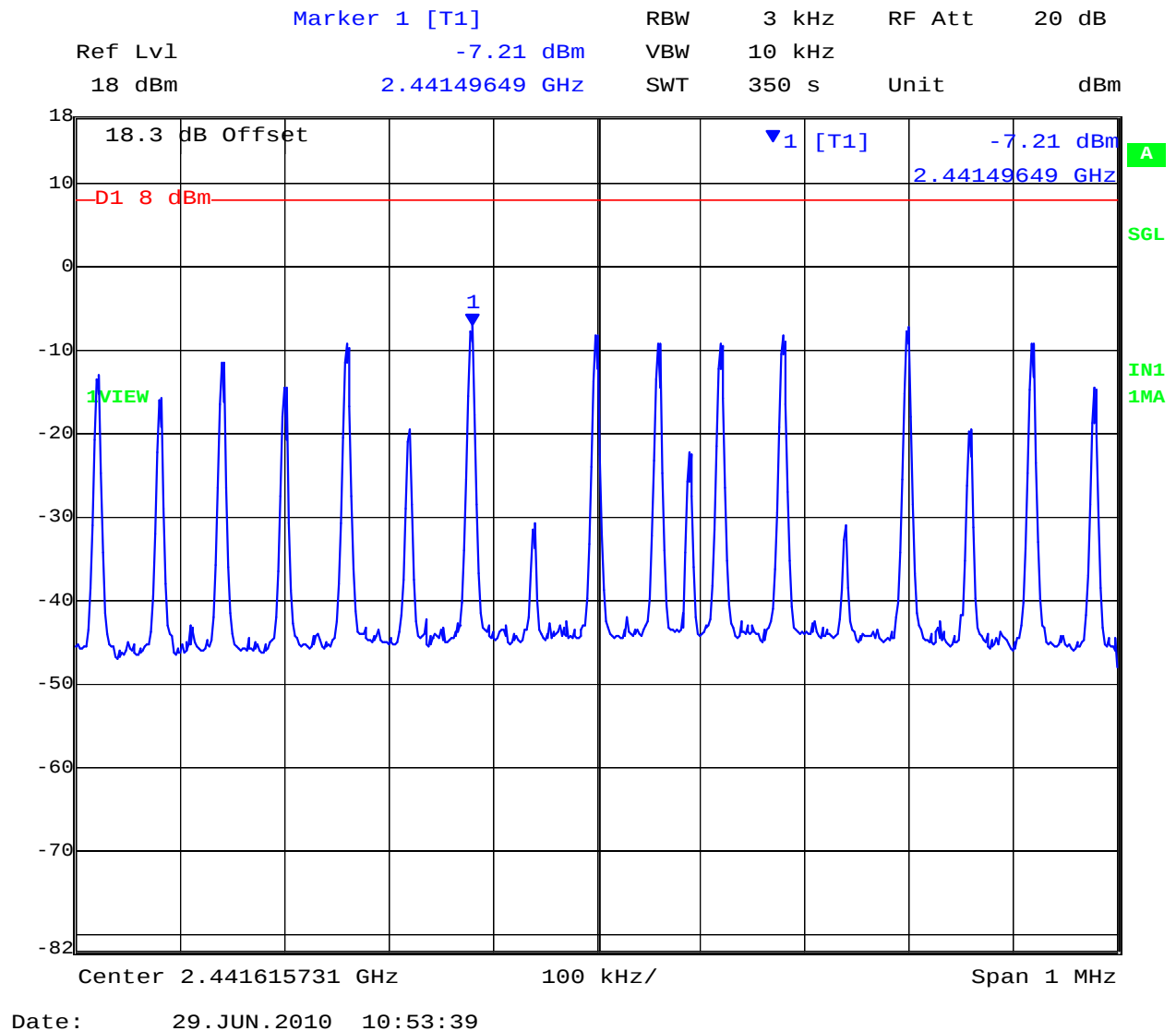
Center frequency = 2462MHz

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7.3.3 Measurement Results: DSSS

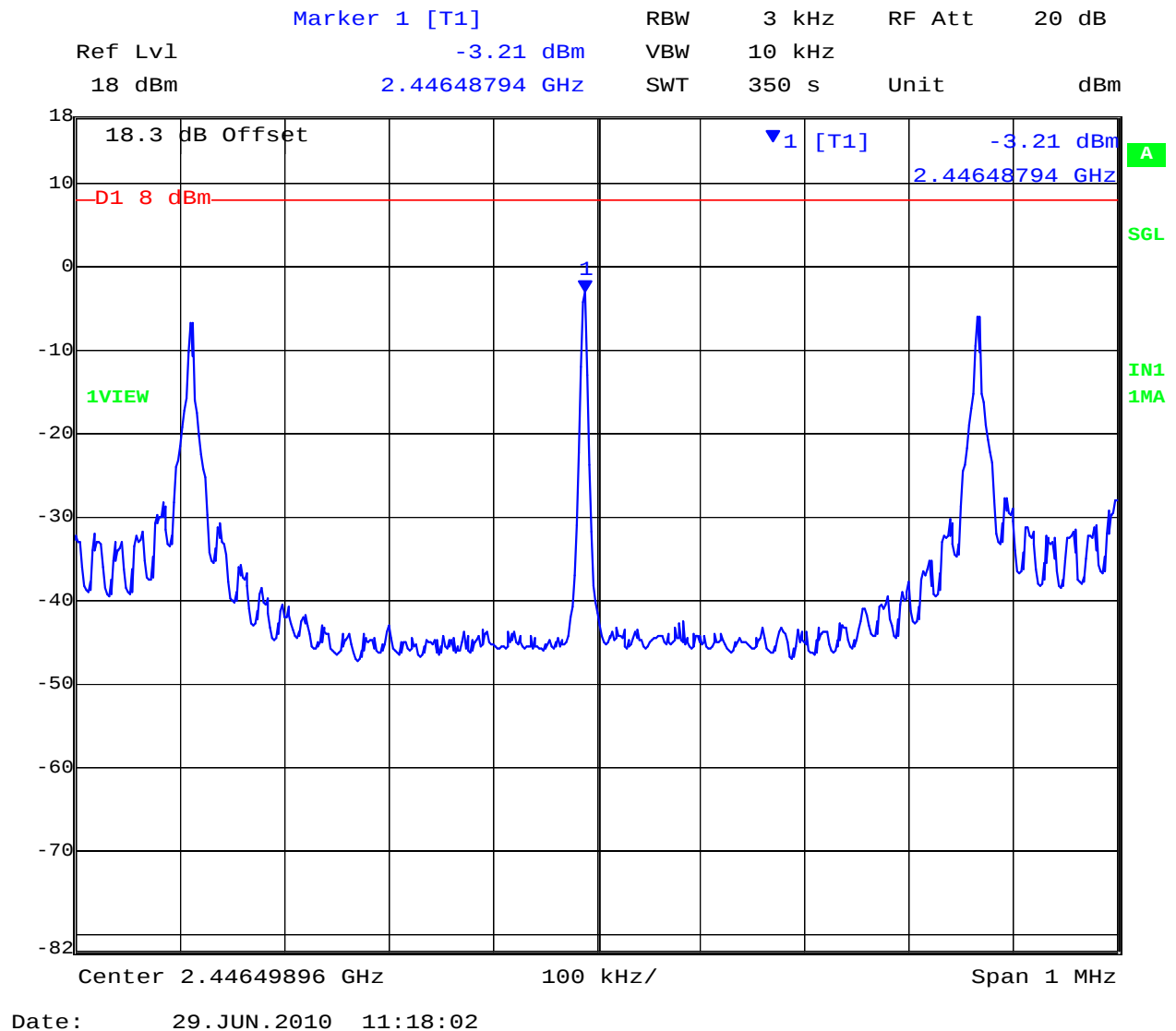


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7.3.4 Measurement Results: OOK



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7.4 Maximum Permissible Exposure

NOT APPLICABLE TO EUT

Calculations for Maximum Permissible Exposure Levels

$$\text{Power Density} = P_d (\text{mW/cm}^2) = \text{EIRP} / (4\pi d^2)$$

$$\text{EIRP} = P * G$$

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

$$\text{Numeric Gain} = 10^{(G (\text{dBi})/10)}$$

The peak power in the table below is calculated by assuming a worst case scenario where all of the EUT transmitters are operating simultaneously in the same band. The Peak Power in mW is the highest transmitter power measured and summed across all transmitters.

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm²

Freq. Band (GHz)	Antenna Gain (dBi)	Peak Power (dBm)	Antenna Gain (numeric)	EIRP (mW)	Distance @ 1mW/cm ² Limit(cm)	Minimum Separation Distance (cm)
2.4 - 2.5						20

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

Specification

Maximum Permissible Exposure Limits

§15.247(i) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines.

FCC §1.1310 Limit = 1mW / cm² from 1.310 Table 1

RSS-Gen §5.5 Before equipment certification is granted, the application requirements of RSS-102 shall be met.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB
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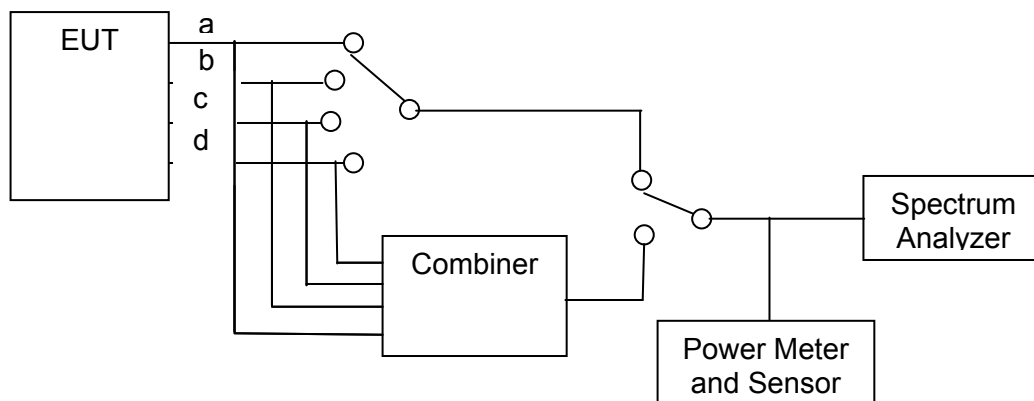
7.5 Conducted Spurious Emissions

Test Procedure

Conducted emissions were measured at a limit of 20 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Emissions at the band edge were measured and recorded. Measurements were made while EUT was operating in transmit mode of operation at the appropriate center frequency.

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

Test Measurement Set Up



Conducted Spurious Emission measurement test configuration



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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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7.5.1 Measurement Results for 802.11 b

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

Conducted Spurious Measurement

Test Frequency	Start Frequency	Stop Frequency	Maximum Observed Emission	Limit (20 dB below peak of
MHz	MHz	MHz	dBm	dBm
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

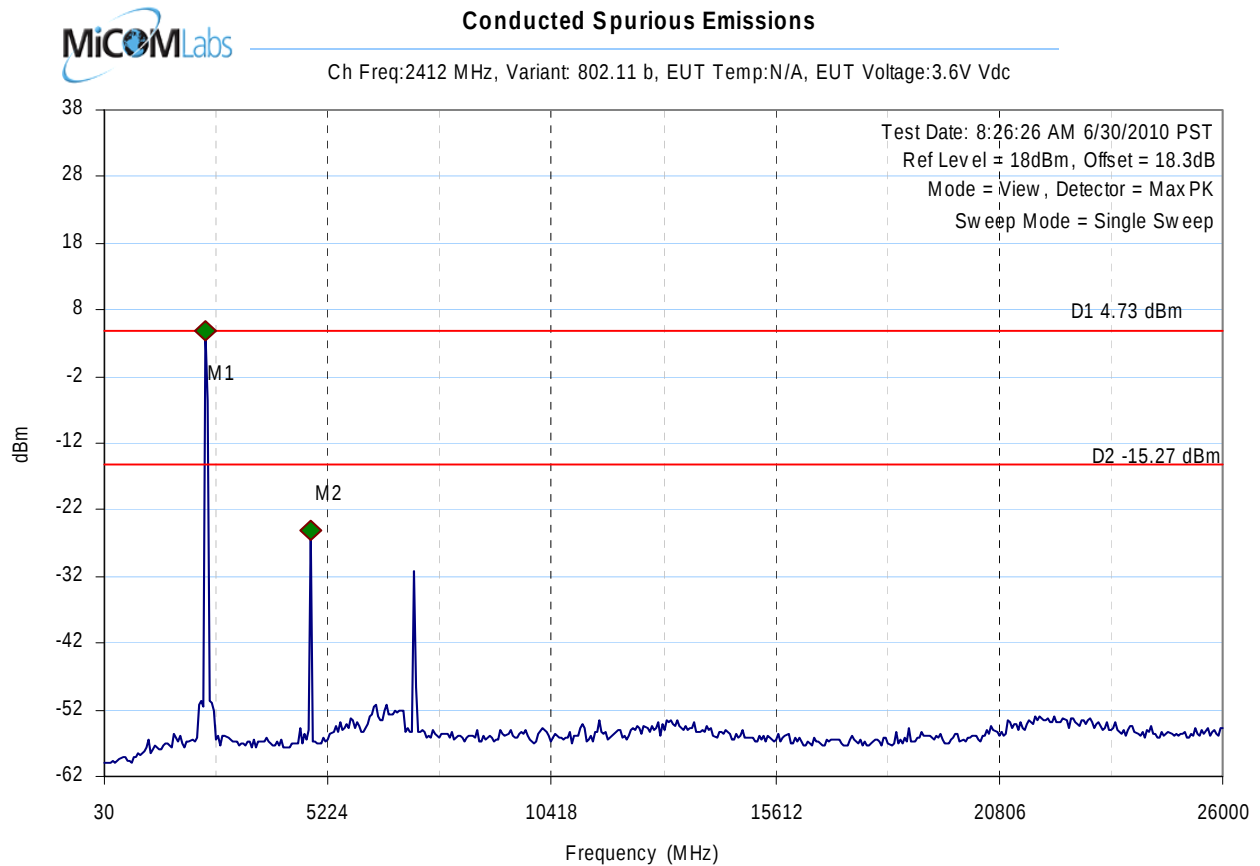
Test Frequency	Band-edge Frequency	Emission Amplitude @ Band-edge	Limit (20 dB below peak of	Margin
MHz	MHz	dBm	dBm	dB
2412	2400.00	-27.76	-13.79	-13.98
2462	2483.50	-46.68	-14.31	-32.37

Measurement uncertainty:	±2.81 dB
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**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

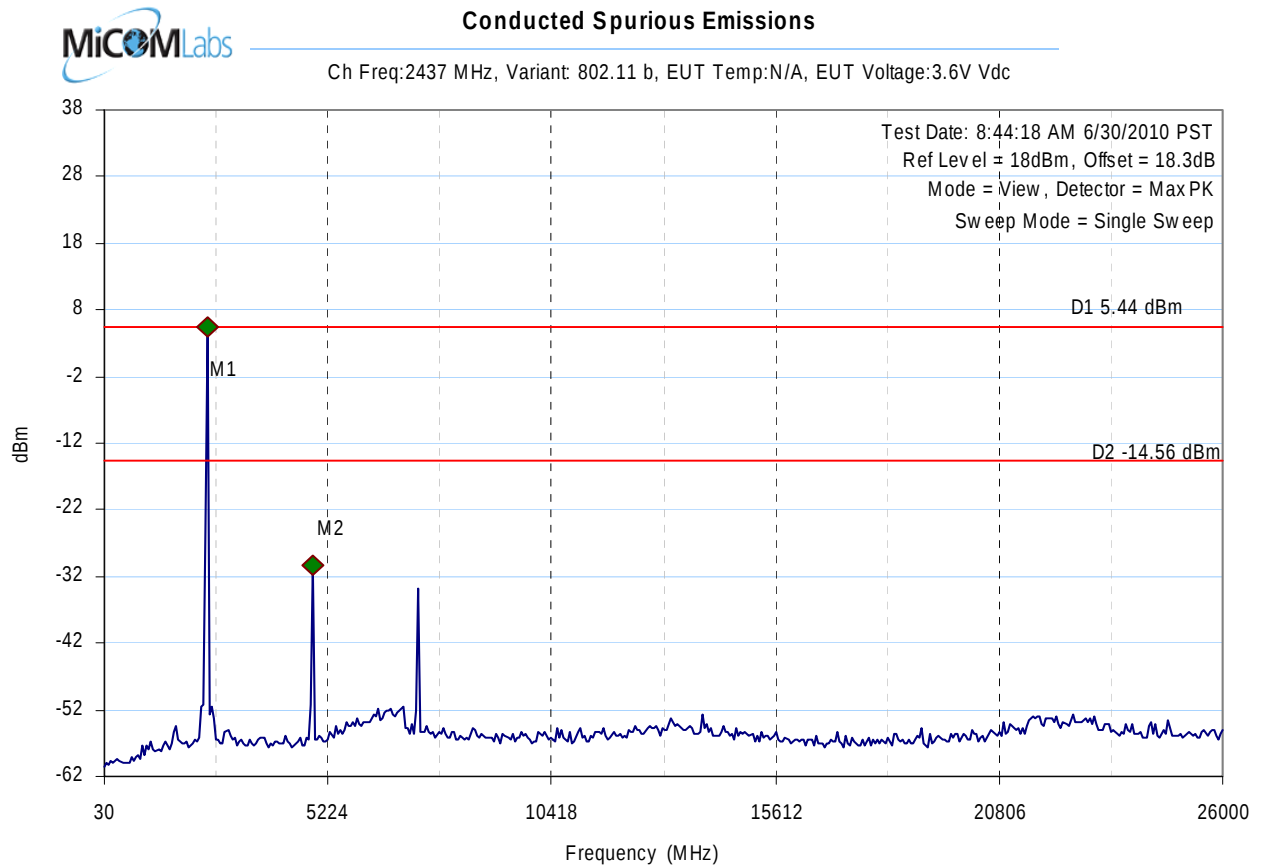
Test Results

Center frequency = 2412MHz

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**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

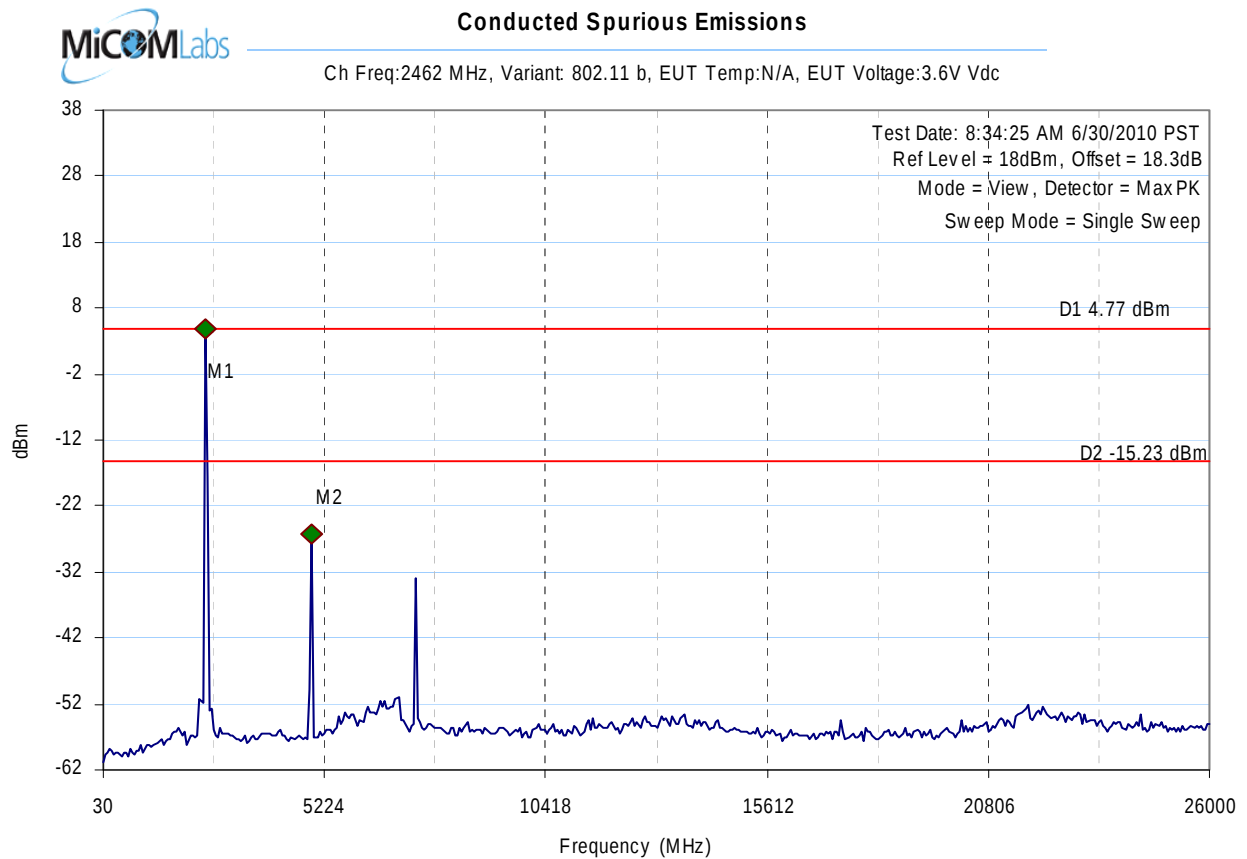
Test Results

Center frequency = 2437MHz

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**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 : 4.775dBm
M2 : 4922.144289MHz : -26.387dBm

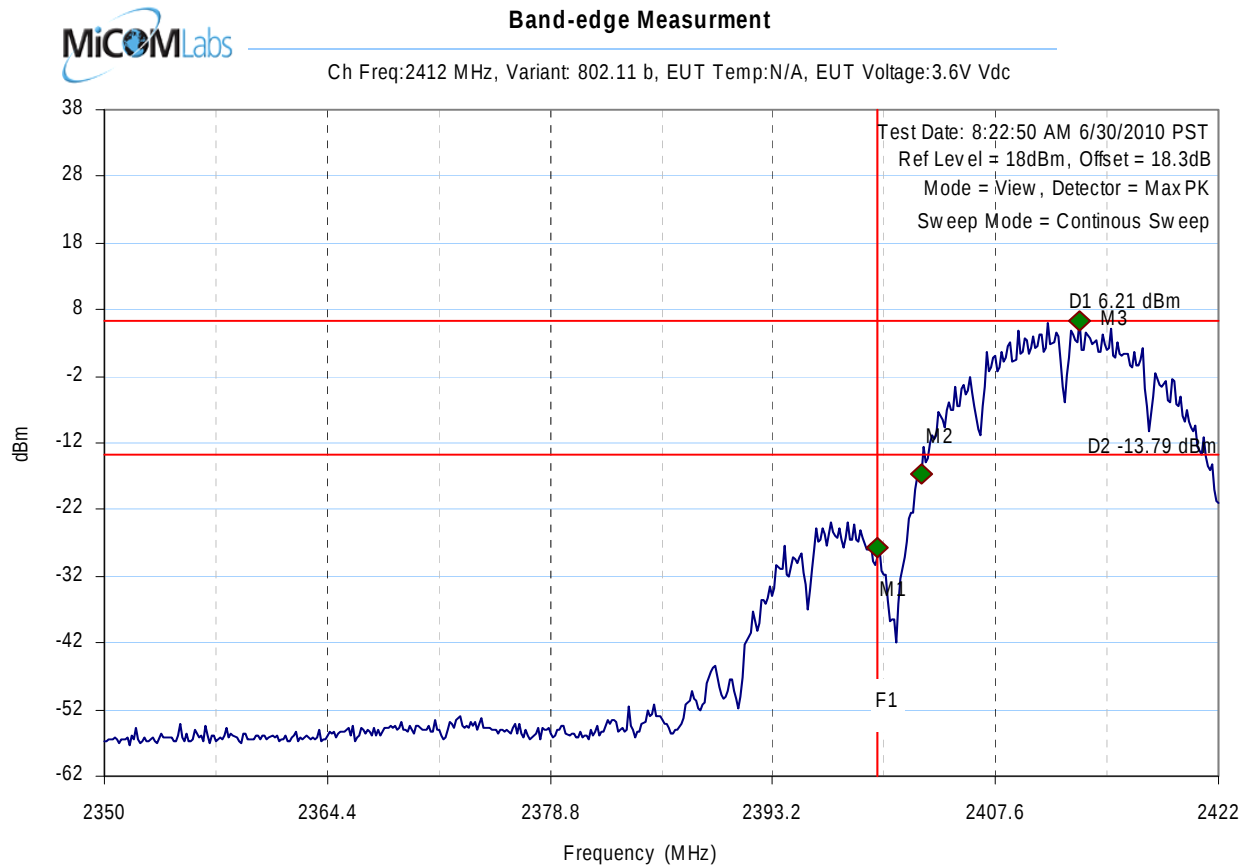
Test Results

Center frequency = 2462MHz

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**Analyser Setup**

RBW = 100.00KHz
VBW = 300.00KHz
Sweep time(s) = 20
RF Atten (dB) = 10
Span = 72.00MHz

Marker : Frequency : Amplitude

M1 : 2400.000000MHz : -27.763dBm
M2 : 2402.809619MHz : -16.718dBm
M3 : 2413.054108MHz : 6.214dBm

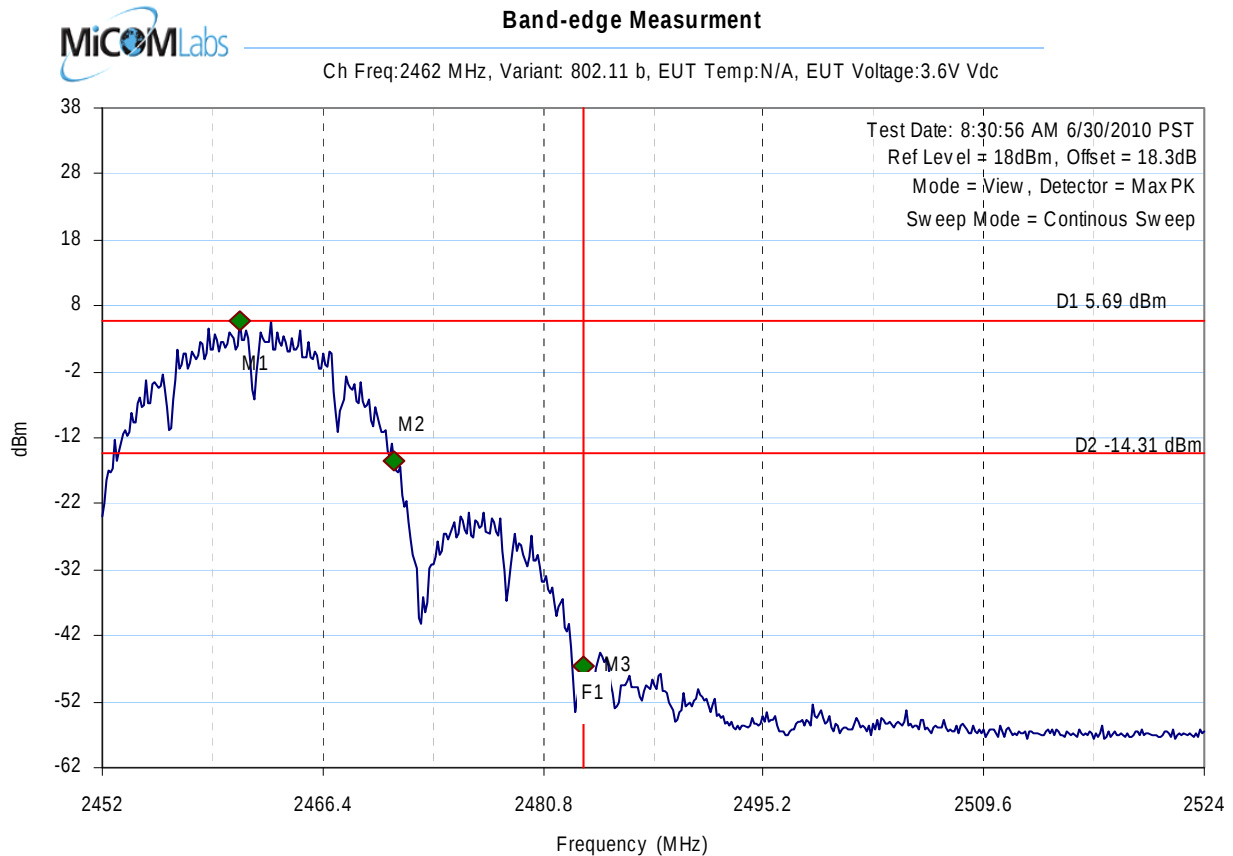
Test Results

Center frequency = 2412MHz

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Analyser Setup

RBW = 100.00KHz
VBW = 300.00KHz
Sweep time(s) = 20
RF Atten (dB) = 10
Span = 72.00MHz

Marker : Frequency : Amplitude

M1 : 2460.945892MHz : 5.694dBm
M2 : 2471.046092MHz : -15.484dBm
M3 : 2483.500000MHz : -46.675dBm

Test Results

Center frequency = 2462MHz

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7.5.2 Measurement Results for 802.11 g

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

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

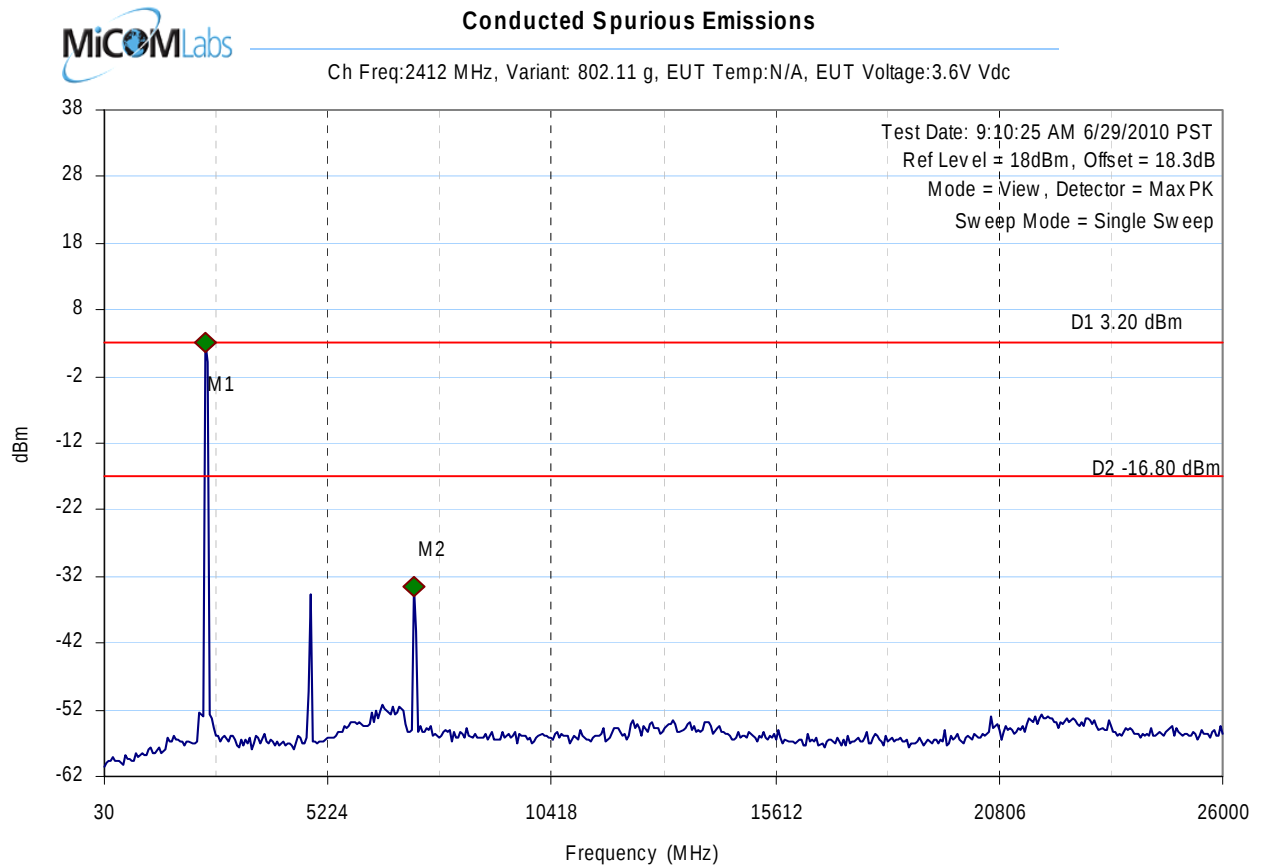
Test Frequency	Band-edge Frequency	Emission Amplitude @ Band-edge	Limit (20 dB below peak of	Margin
MHz	MHz	dBm	dBm	dB
2412	2400.00	-18.64	-16.17	-2.47
2462	2483.50	-26.97	-16.16	-10.82

Measurement uncertainty:	± 2.81 dB
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**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

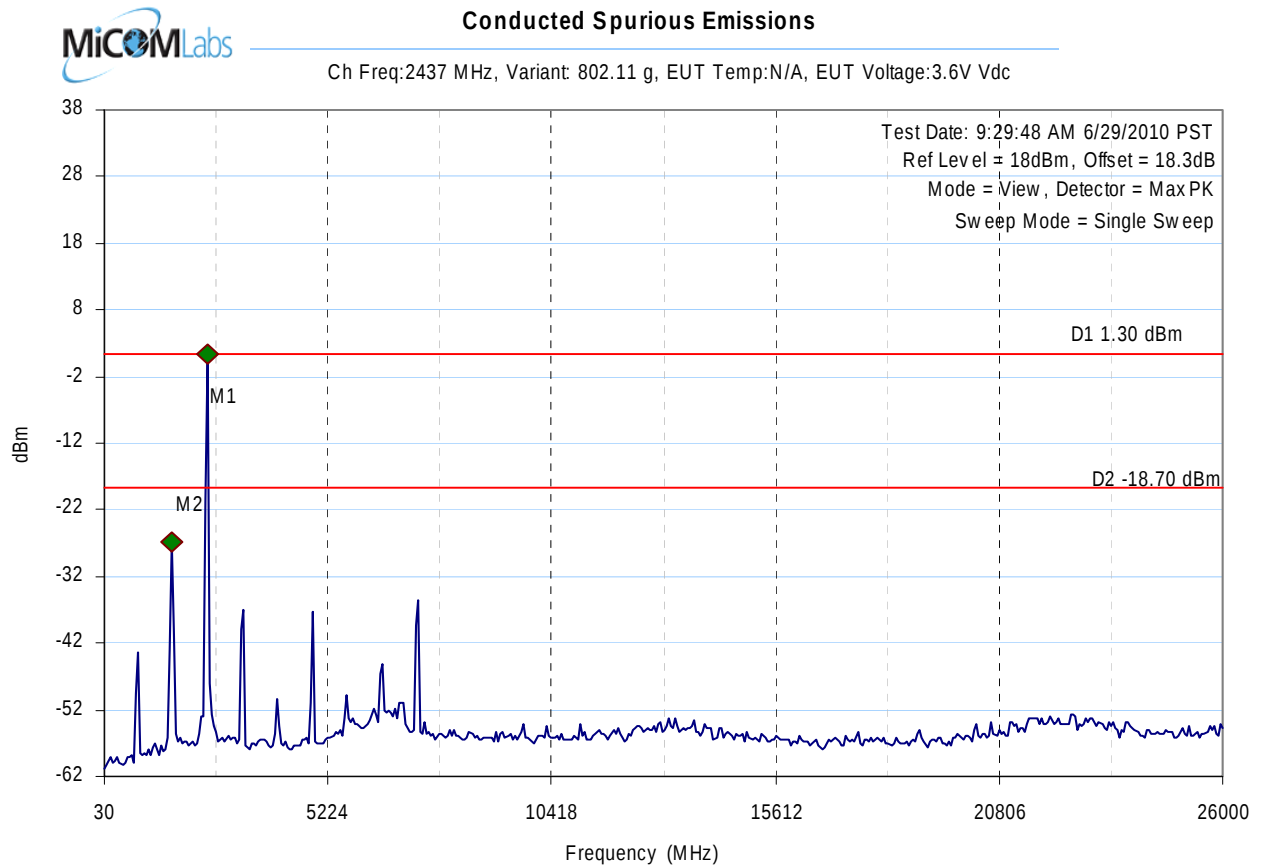
Test Results

Center frequency = 2412MHz

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**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

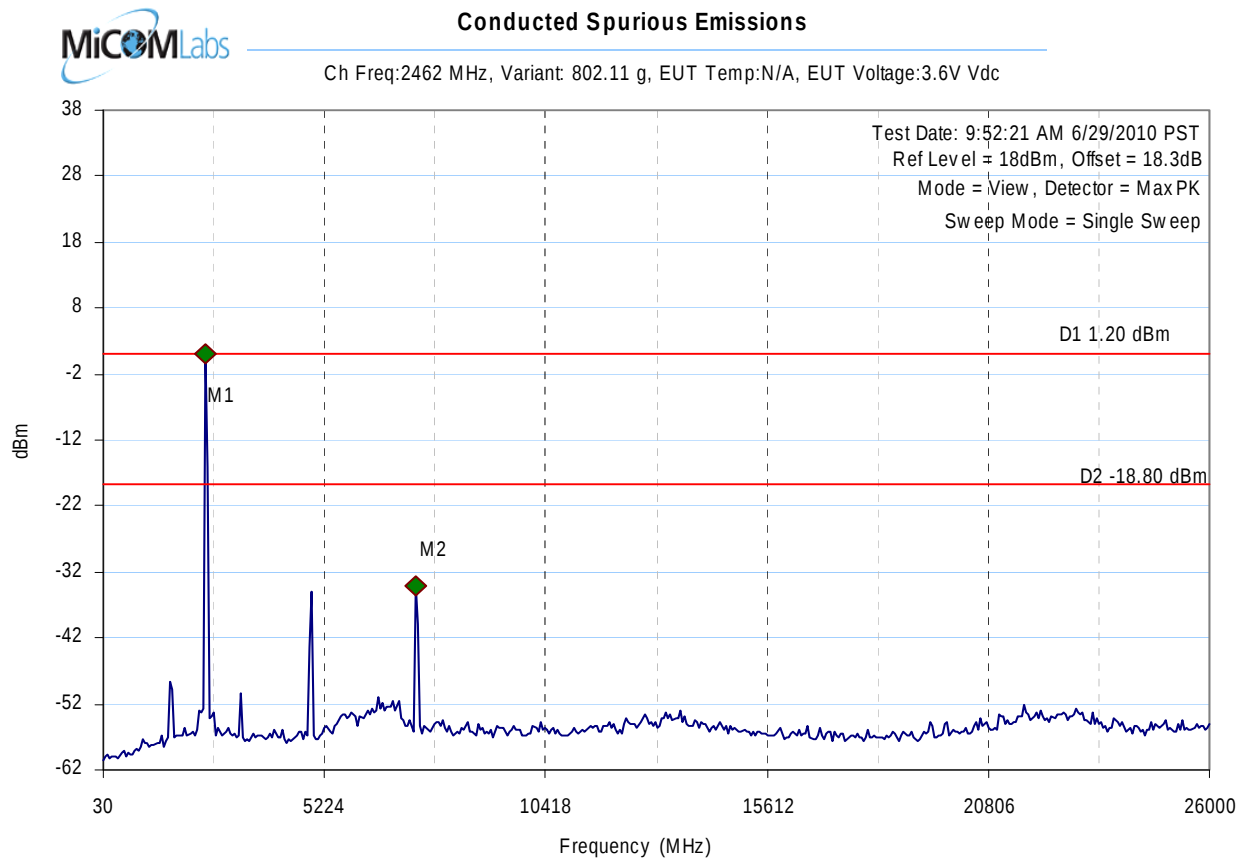
Test Results

Center frequency = 2437MHz

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**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 : 1.197dBm
M2 : 7368.216433MHz : -34.133dBm

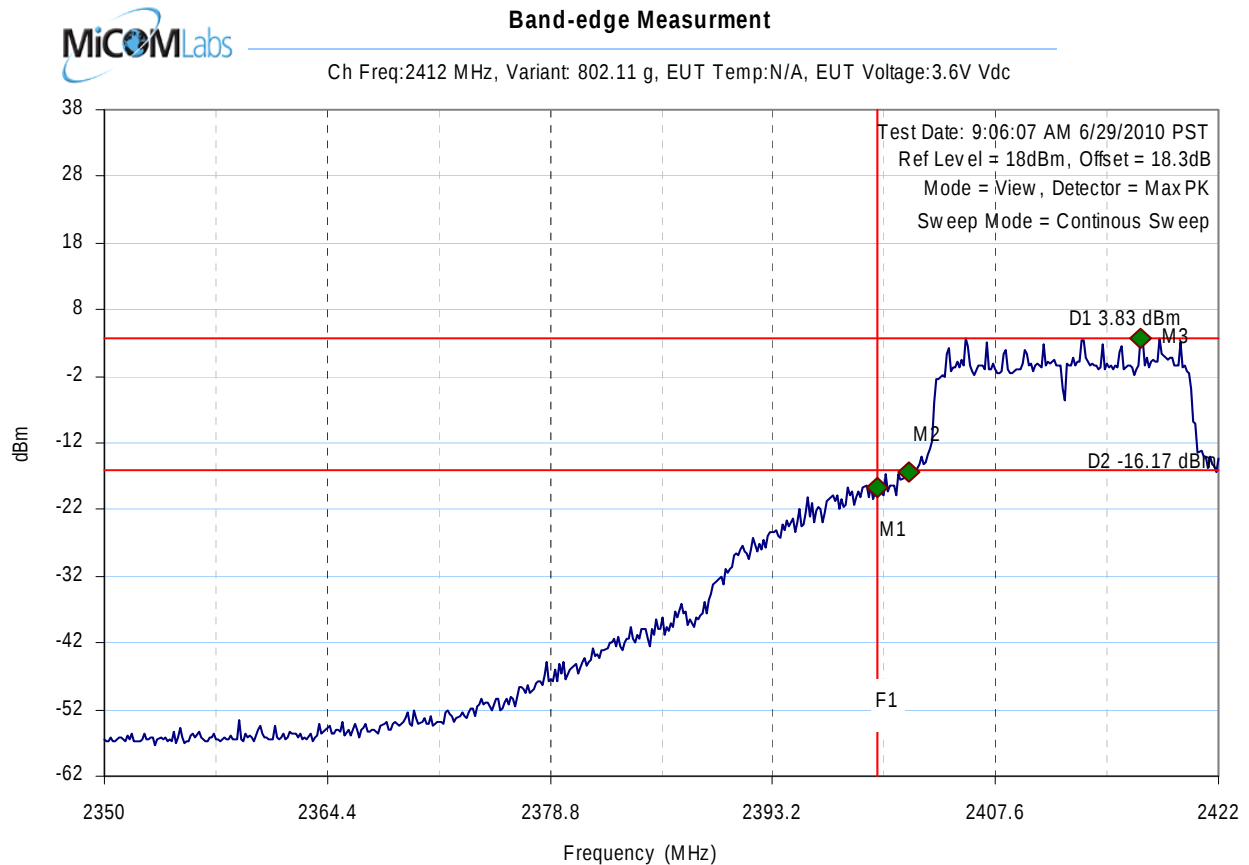
Test Results

Center frequency = 2462MHz

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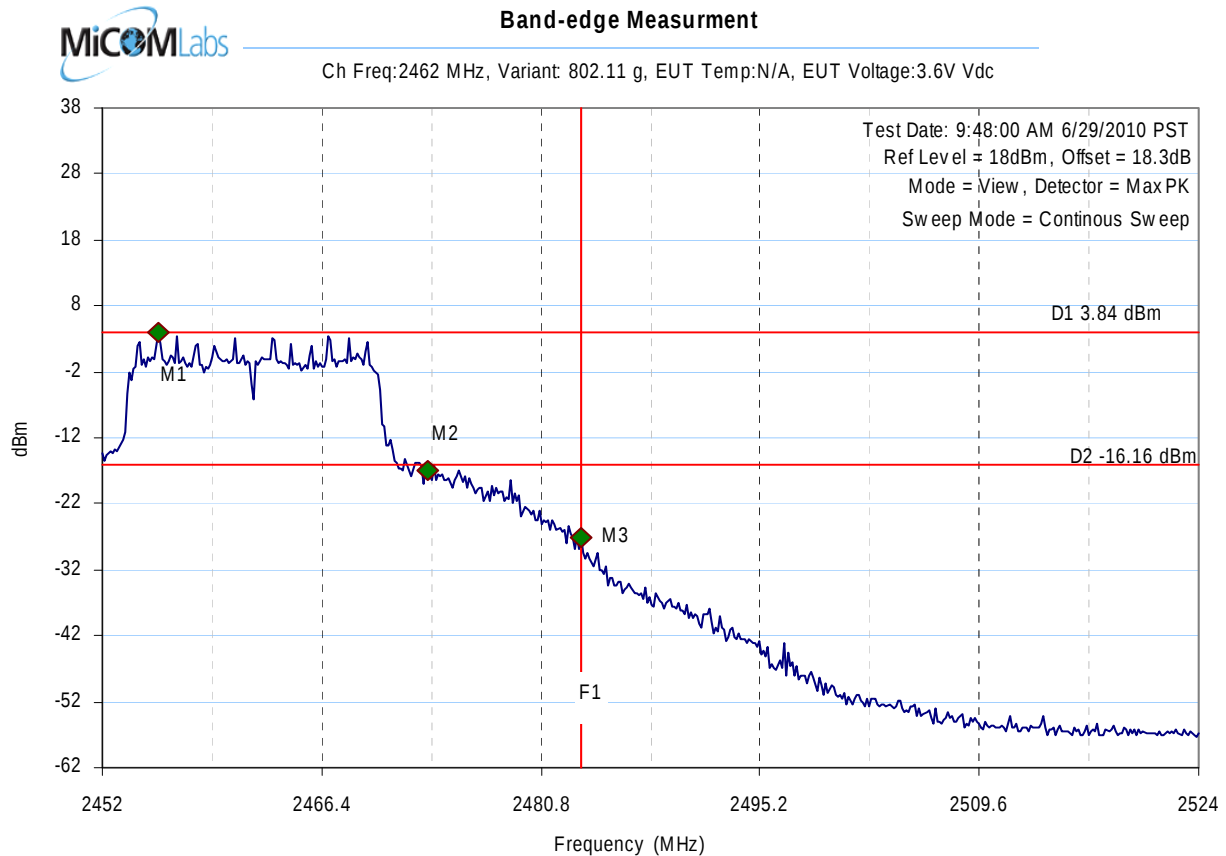


Analyser Setup	Marker : Frequency : Amplitude	Test Results
RBW = 100.00KHz	M1 : 2400.000000MHz : -18.640dBm	Center frequency = 2412MHz
VBW = 300.00KHz	M2 : 2401.943888MHz : -16.338dBm	
Sweep time(s) = 20	M3 : 2416.949900MHz : 3.831dBm	
RF Atten (dB) = 10		
Span = 72.00MHz		

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**Analyser Setup**

RBW = 100.00KHz
VBW = 300.00KHz
Sweep time(s) = 20
RF Atten (dB) = 10
Span = 72.00MHz

Marker : Frequency : Amplitude

M1 : 2455.607214MHz : 3.843dBm
M2 : 2473.354709MHz : -17.005dBm
M3 : 2483.500000MHz : -26.974dBm

Test Results

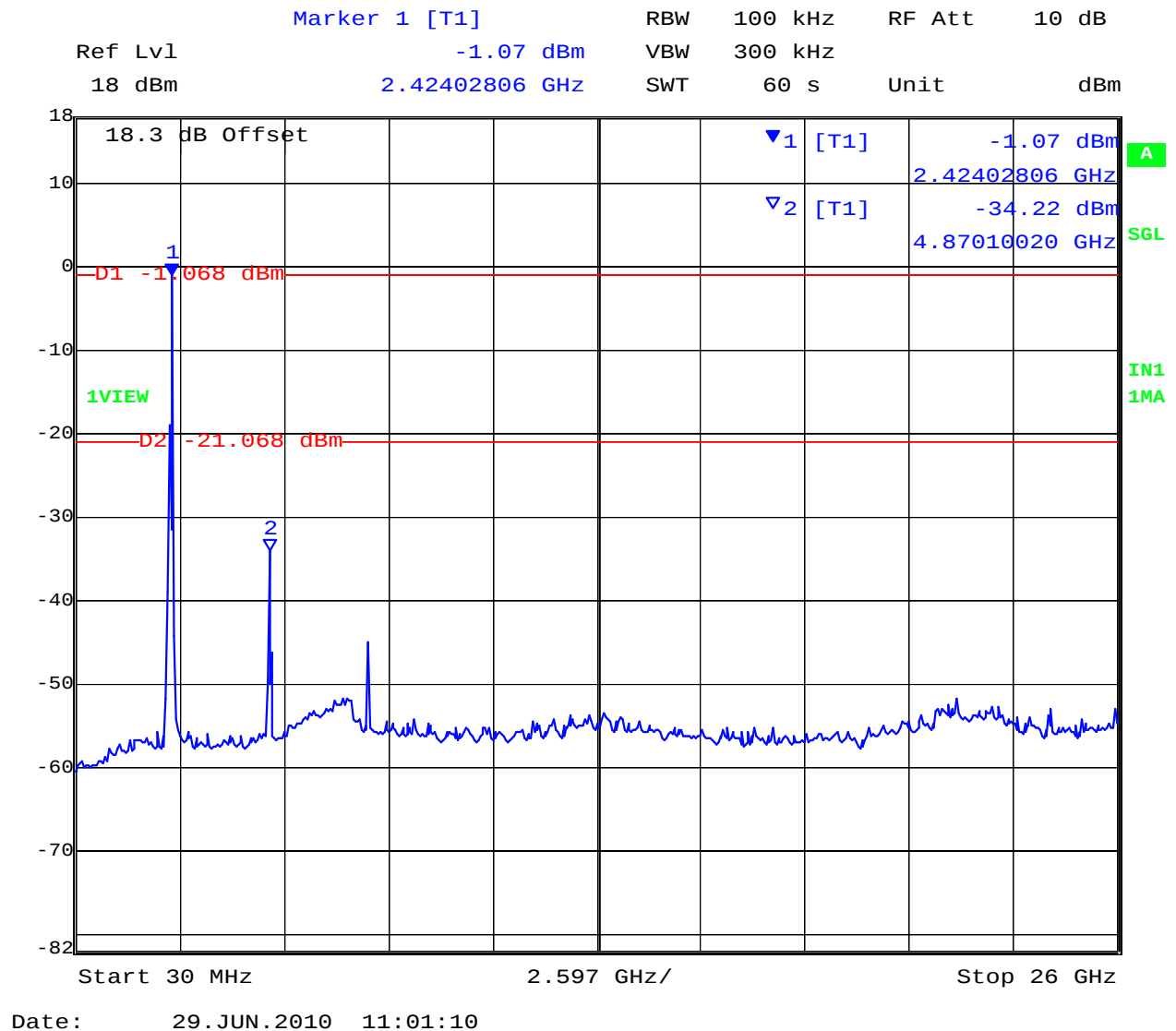
Center frequency = 2462MHz

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7.5.3 Measurement Results: DSSS



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



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

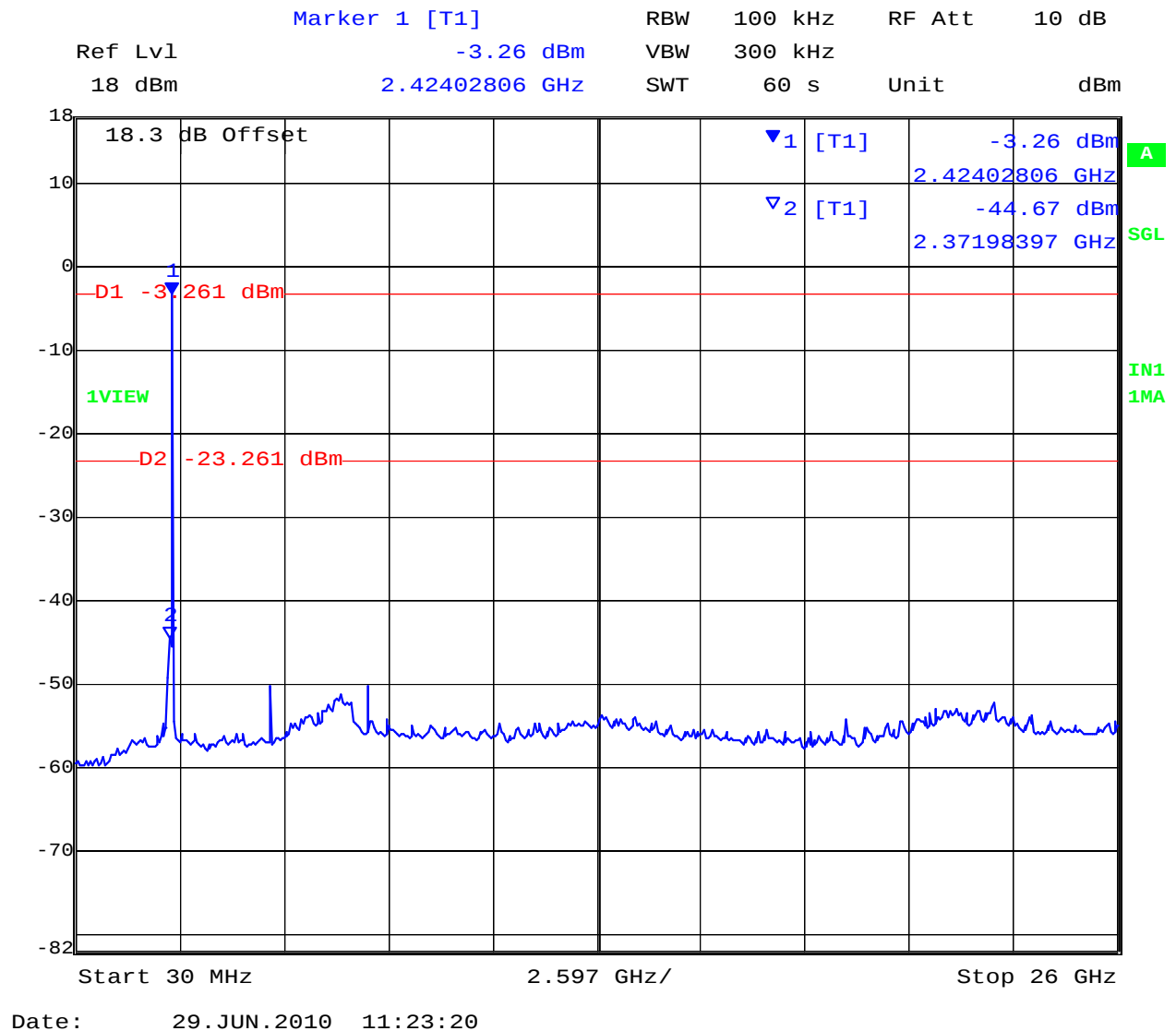


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7.5.4 Measurement Results: OOK

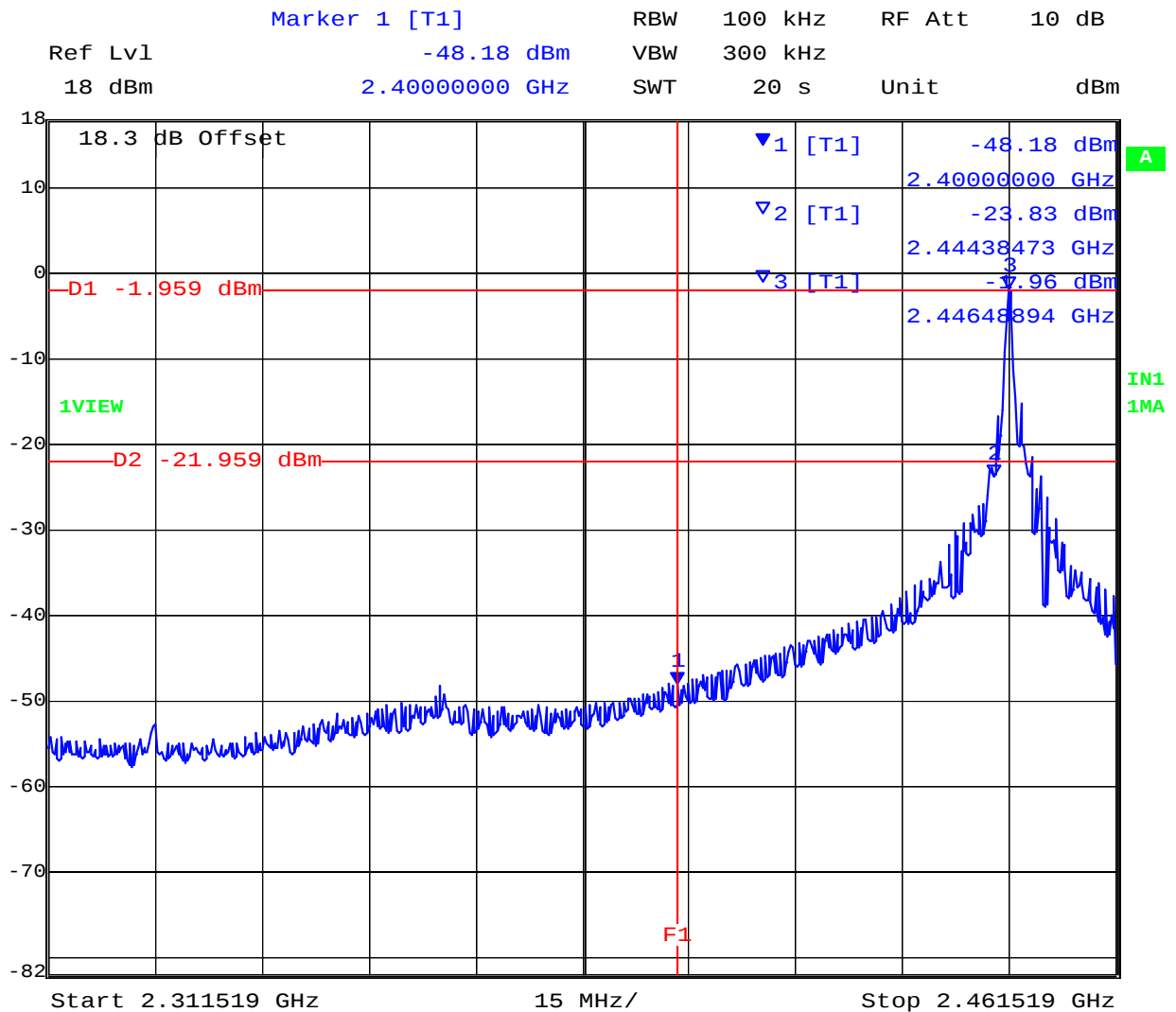


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Band Edge Ambient 2447MHz 3.60V 1.23dBm 100% Duty Cycle



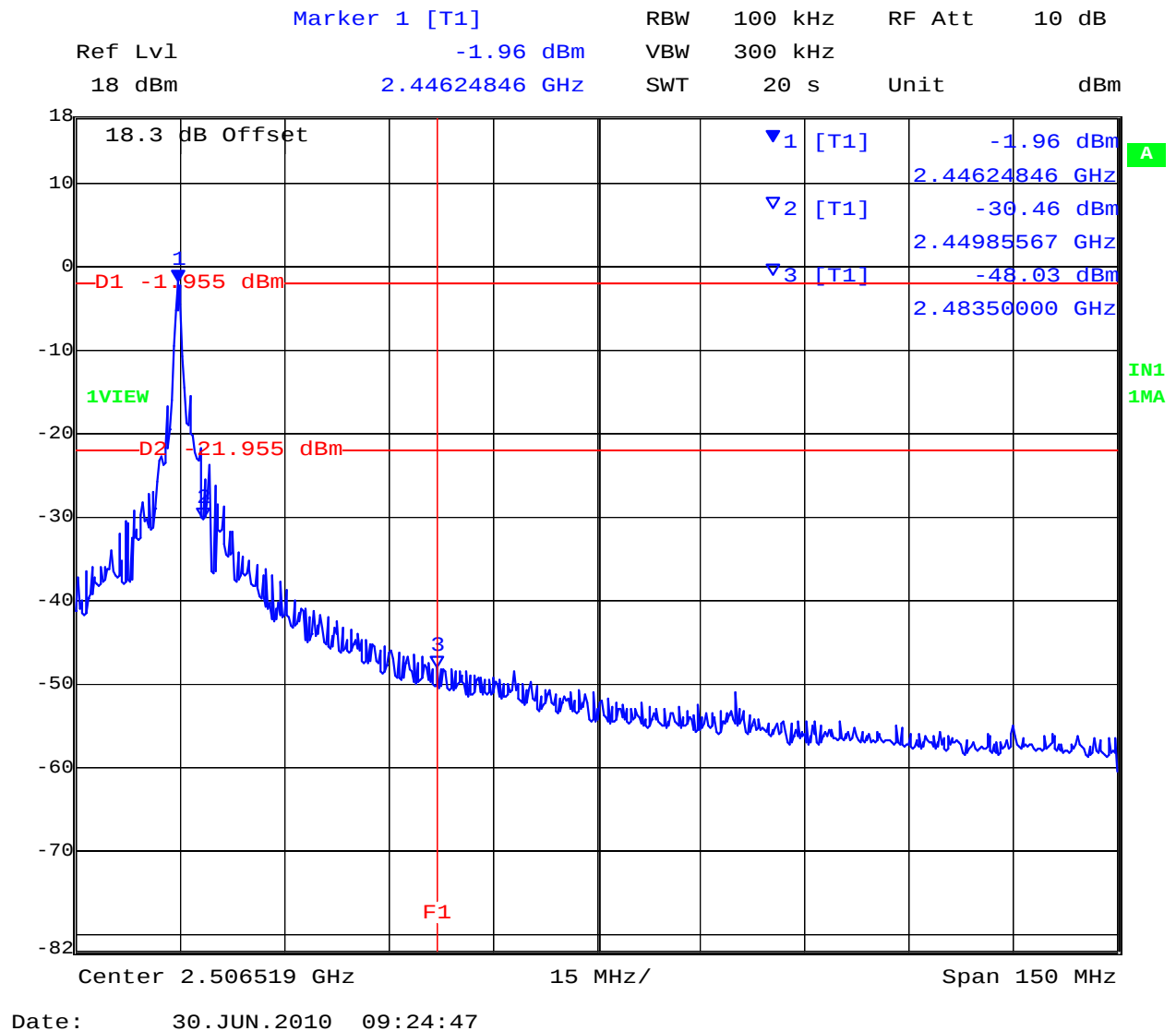
Date: 30.JUN.2010 09:21:00

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



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7.6 Radiated Spurious Emissions Above 1 GHz - Antenna ZES

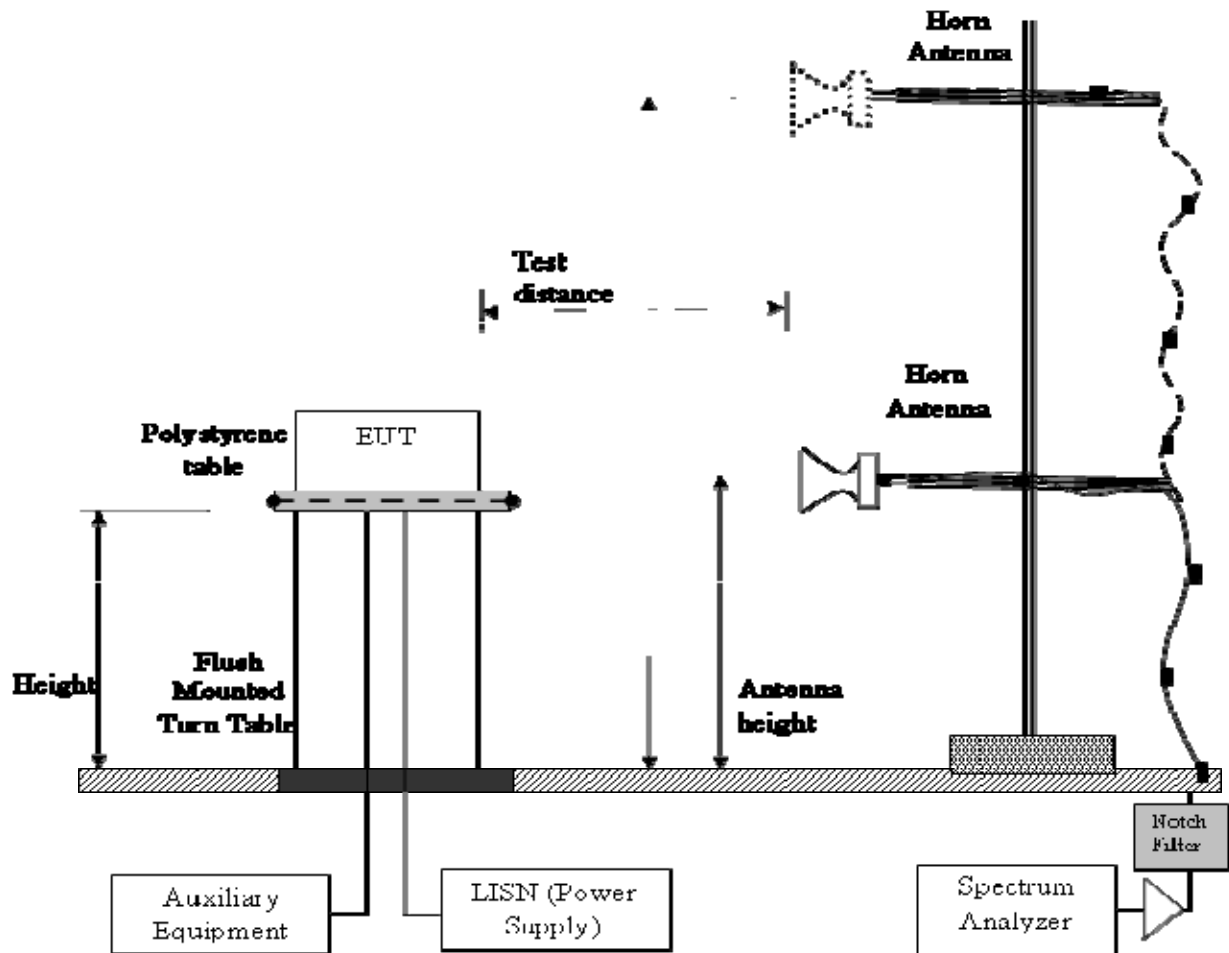
Test Procedure

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



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 μ 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 μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

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

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

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



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

Laboratory Measurement Uncertainty for Spectrum Measurement

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

Traceability:

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

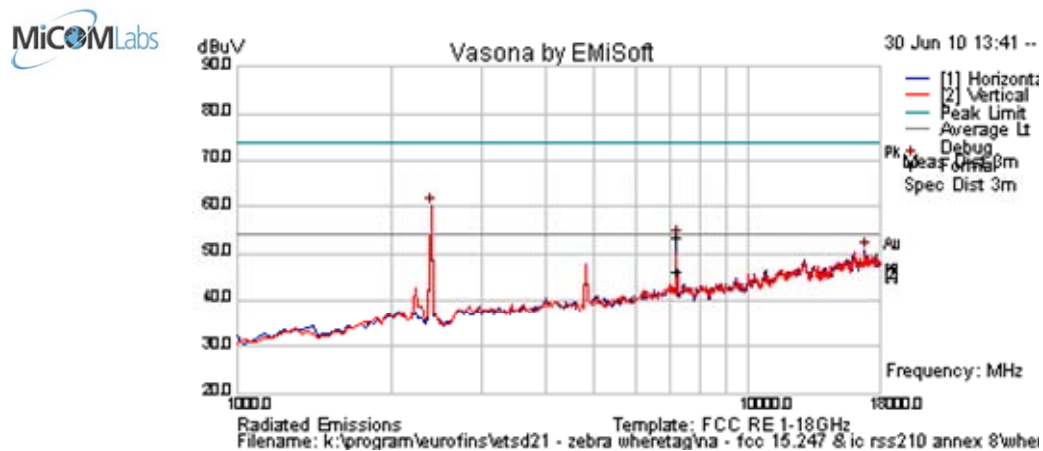
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7.6.1 802.11b Radiated Spurious Emissions

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

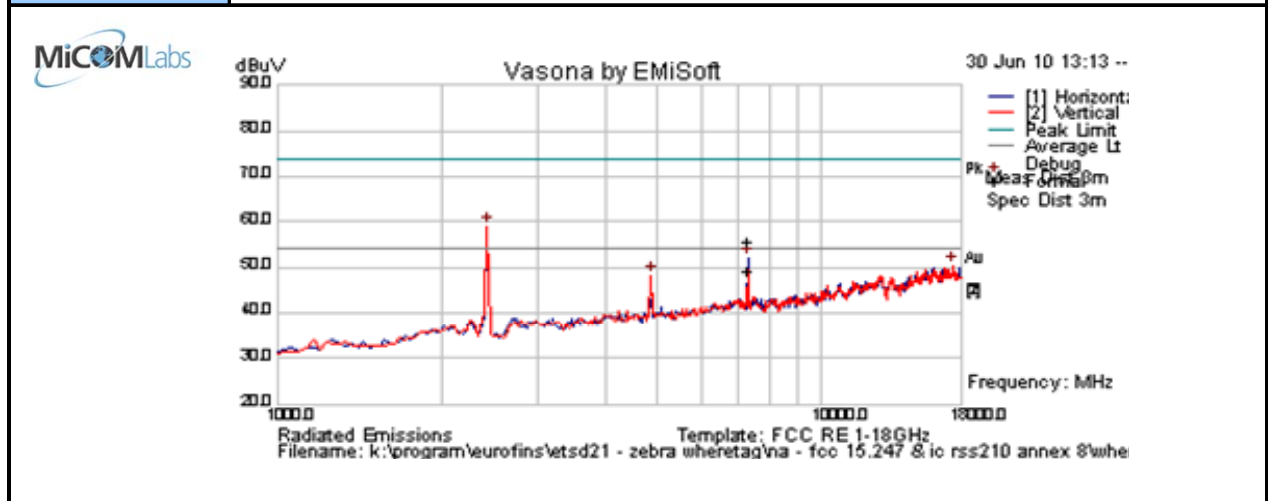
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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

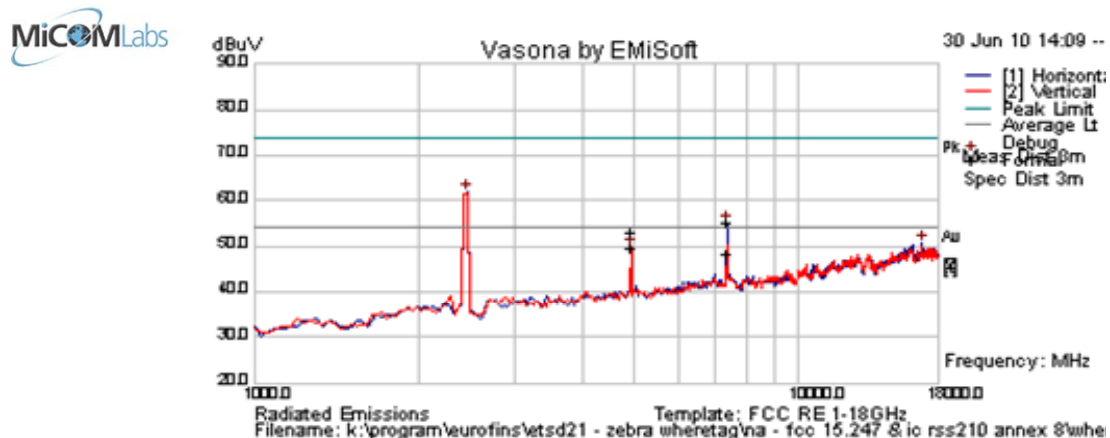


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Test Freq.	2462 MHz	Engineer	GMH
Variant	802.11b; 1 Mbs	Temp (°C)	27.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum.(%)	32
Power Setting	10 in test utility	Press. (mBars)	1003
Antenna	ANT=ZES10370	Duty Cycle (%)	3.6 %
Test Notes 1	Fundamental attenuated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

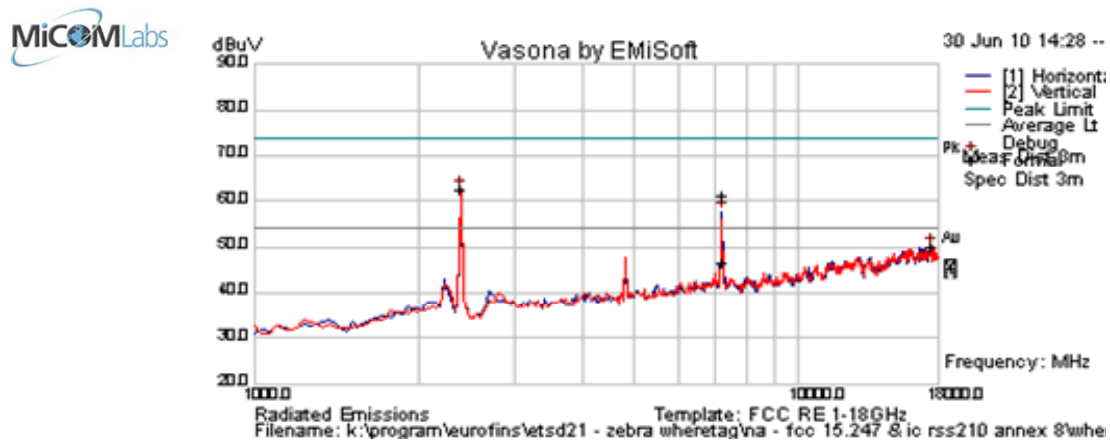
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7.6.2 802.11g Radiated Spurious Emissions

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



Formally measured emission peaks

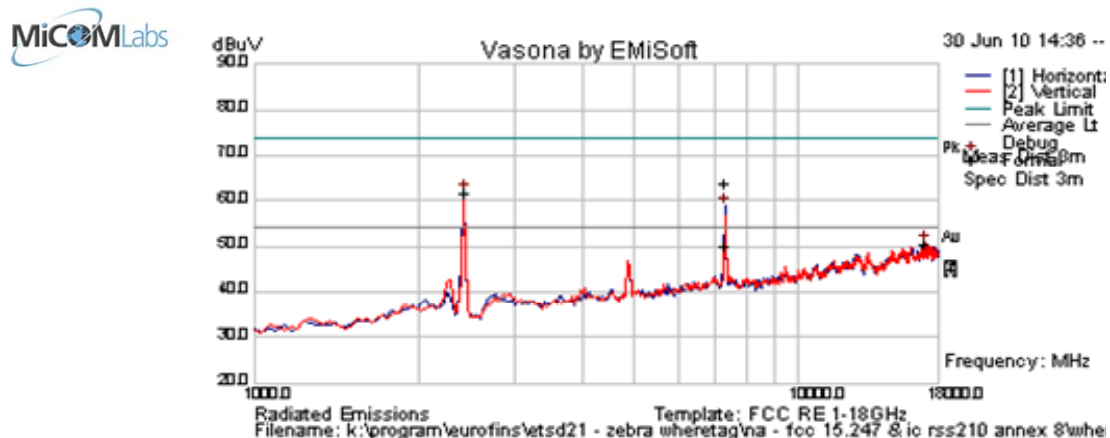
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2396.794	70.9	3.0	-11.2	62.7	Peak [Scan]	V	100	--	--	--	N/A	FUND
7237.610	60.8	5.4	-5.1	61.1	Peak Max	H	139	39	74.0	-12.9	Pass	RB
7237.61	46.4	5.4	-5.1	46.7	Average Max	H	139	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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Test Freq.	2437 MHz	Engineer	CSB
Variant	802.11g; 6 Mbs	Temp (°C)	27.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum.(%)	32
Power Setting	10 in test utility	Press. (mBars)	1003
Antenna	ANT=ZES10370	Duty Cycle (%)	0.72%
Test Notes 1	Fundamental attenuated by band-stop filter		
Test Notes 2	EUT tested at 100% duty cycle		



Formally measured emission peaks

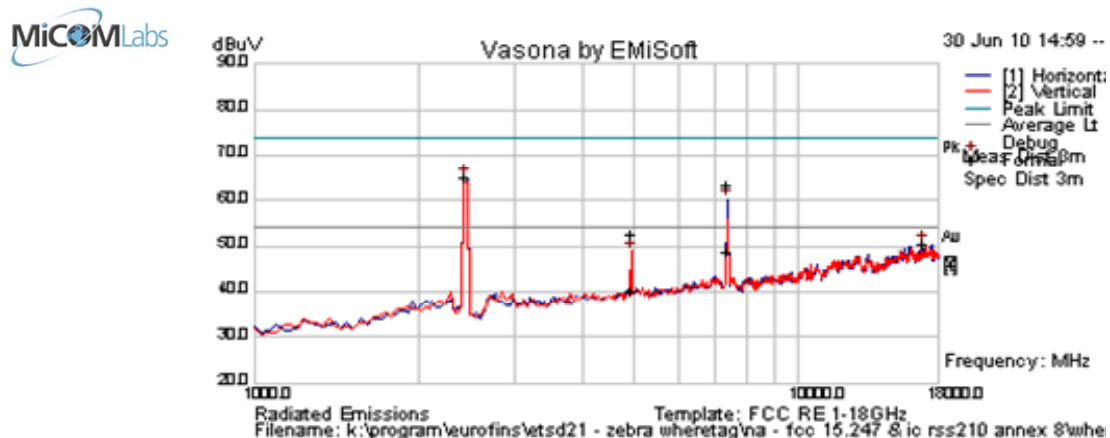
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2430.862	69.9	3.0	-11.1	61.7	Peak [Scan]	H	100	--	--	--	N/A	FUND
7307.976	63.2	5.4	-4.9	63.7	Peak Max	H	115	208	74.0	-10.3	Pass	RB
7307.976	49.4	5.4	-4.9	49.9	Average Max	H	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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Test Freq.	2462 MHz	Engineer	CSB
Variant	802.11g; 6 Mbs	Temp (°C)	27.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum.(%)	32
Power Setting	10 in test utility	Press. (mBars)	1003
Antenna	ANT=ZES10370	Duty Cycle (%)	0.72%
Test Notes 1	Fundamental attenuated by band-stop filter		
Test Notes 2	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												

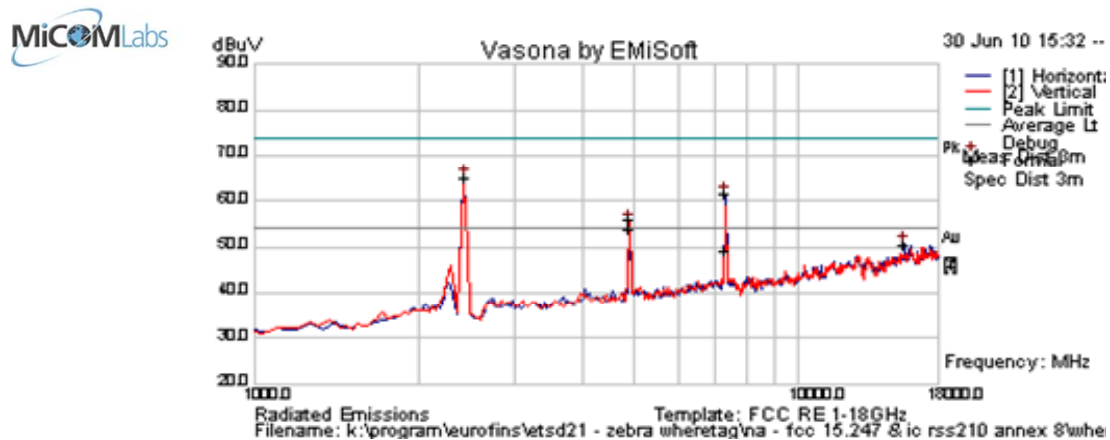
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7.6.3 DSSS Radiated Spurious Emissions

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

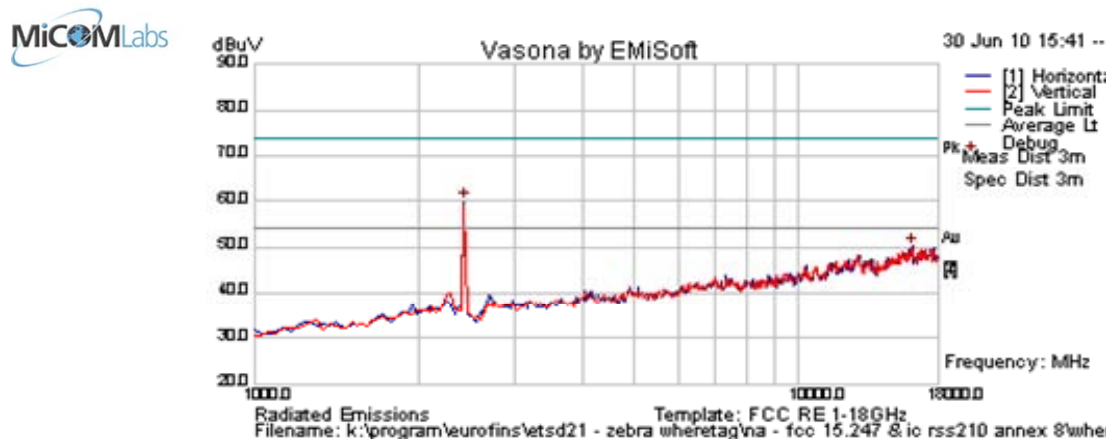
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7.6.4 OOK Radiated Spurious Emissions

Test Freq.	2446.519 MHz	Engineer	CSB
Variant	OOK	Temp (°C)	27.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum.(%)	32
Power Setting	15 in test utility	Press. (mBars)	1003
Antenna	ANT=ZES10370	Duty Cycle (%)	13 %
Test Notes 1	EUT was tested at 100% duty cycle.		
Test Notes 2	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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7.6.5 802.11b Radiated Band Edge Emissions

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

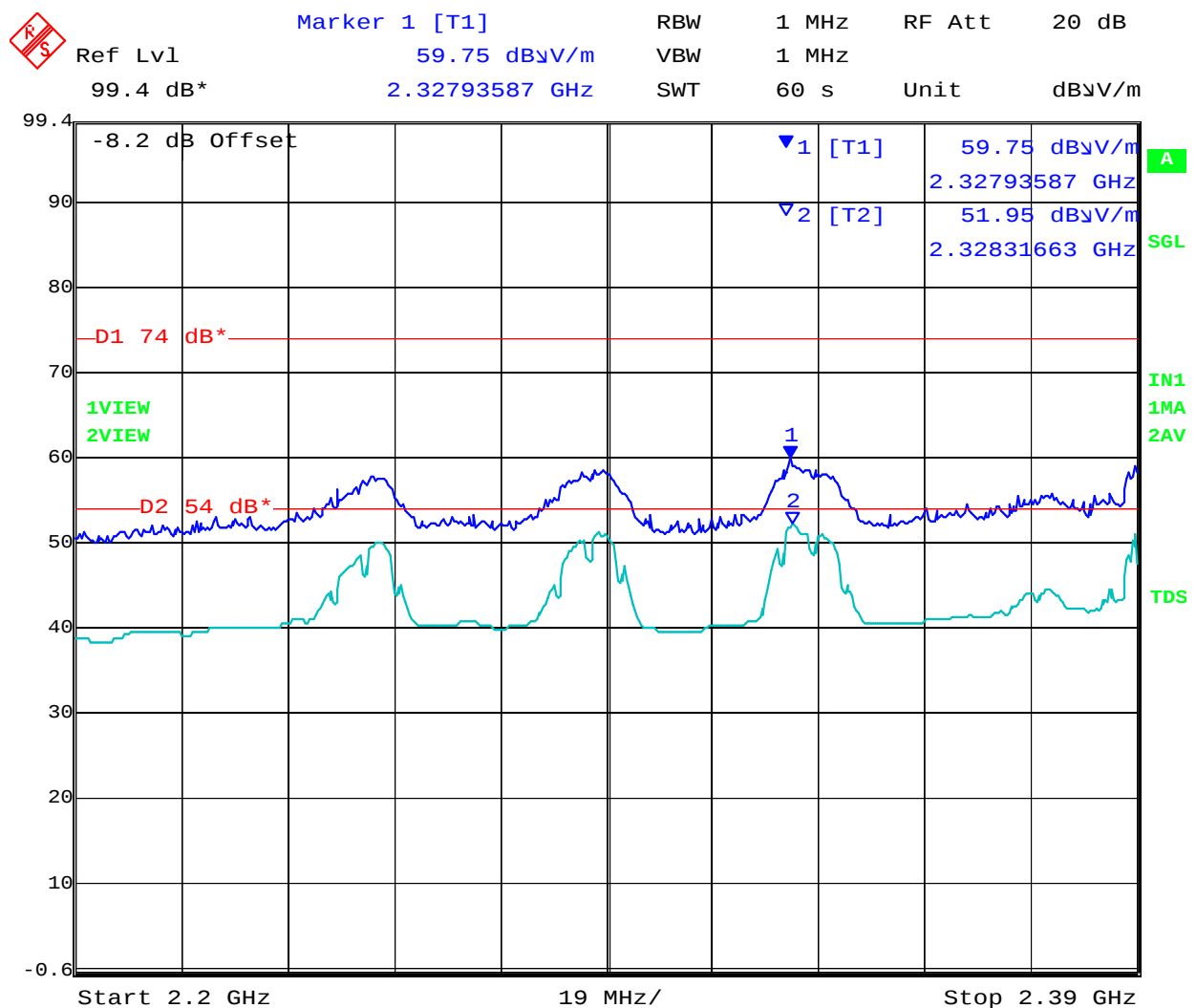
EUT Operational Duty Cycle: 3.6%
Correction Factor = $20 * \text{LOG} (3.6 / 100)$
Correction Factor = -28.87dB
Corrected Value = Measured Value (dB) - 28.87 (dB)

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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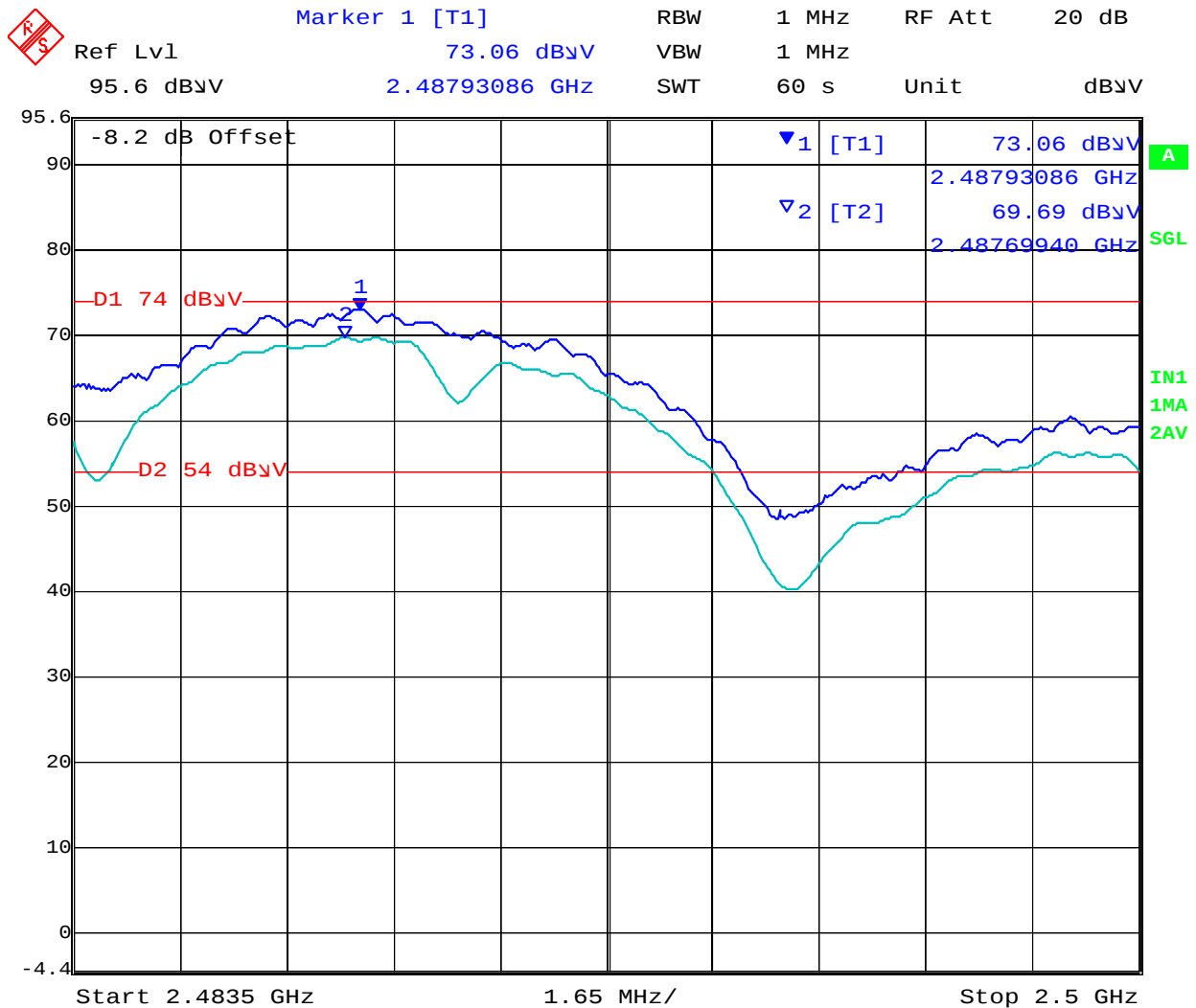


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7.6.6 802.11g Radiated Band Edge Emissions

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

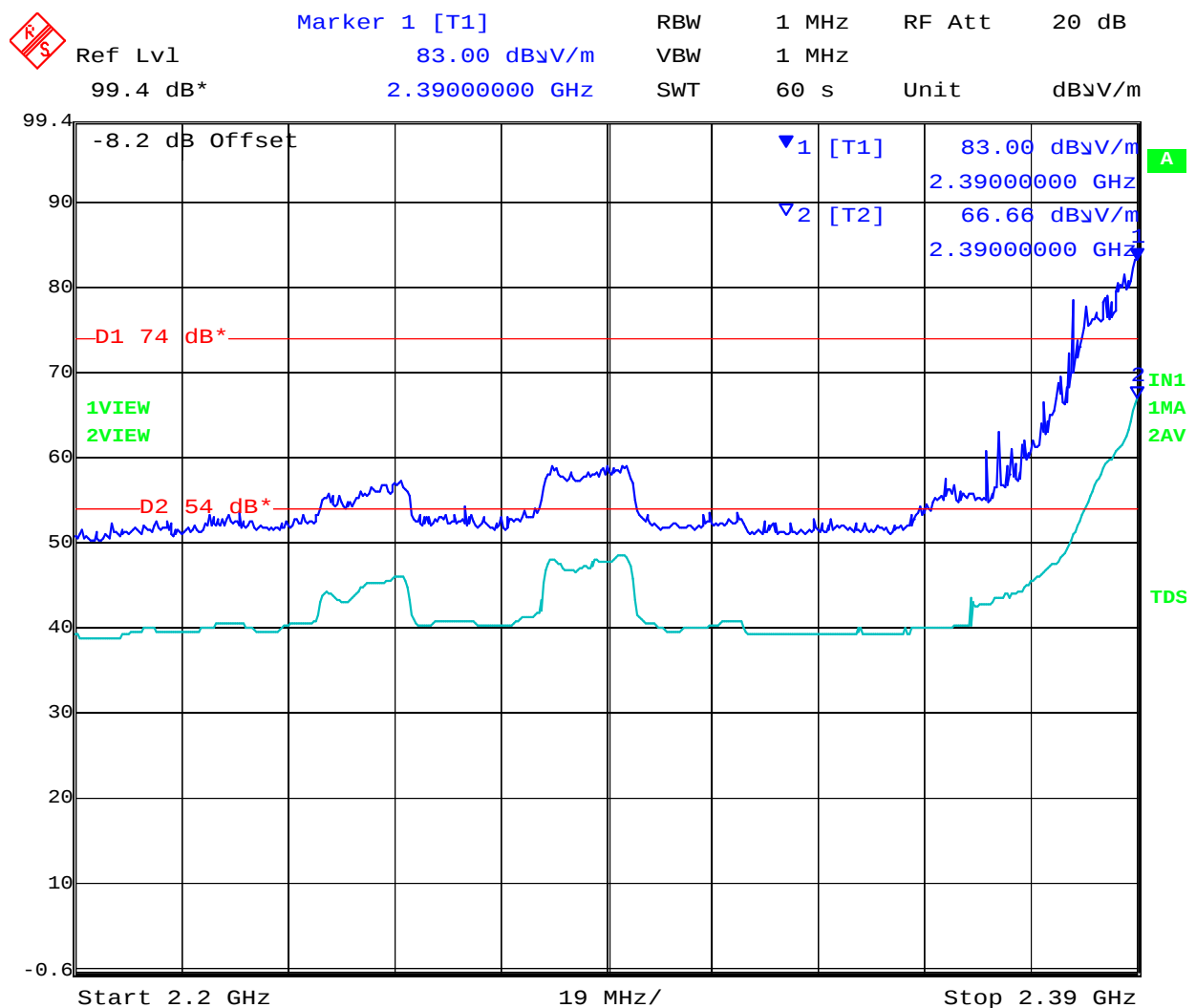
EUT Operational Duty Cycle: 0.72%
Correction Factor = $20 * \text{LOG} (0.72 / 100)$
Correction Factor = -42.85dB
Corrected Value = Measured Value (dB) - 42.85 (dB)

Frequency (MHz)	Measured Value (dBuV/m)	Measurement Type	Corrected Value	Margin (dB)	Pass / Fail
2390.00000	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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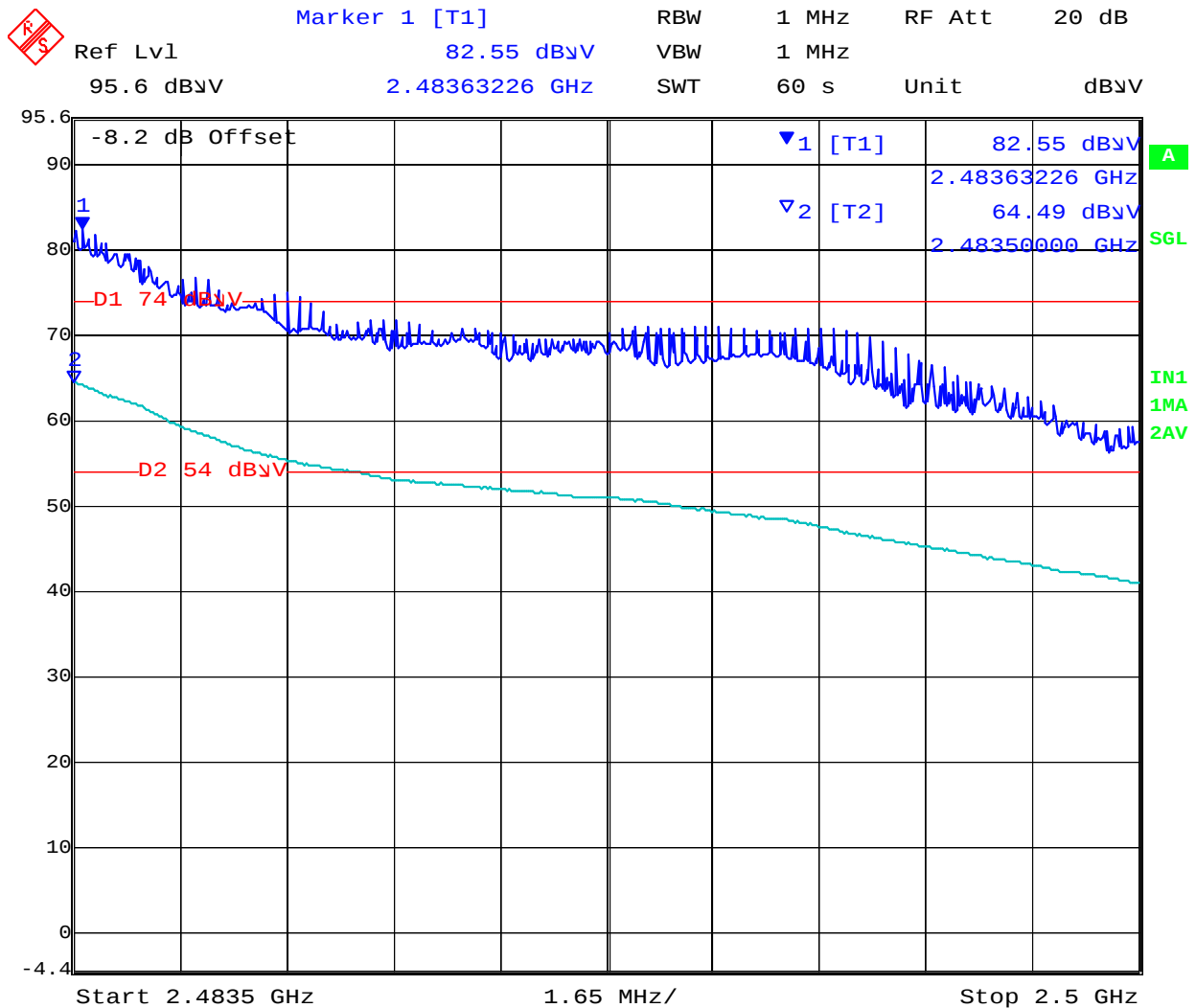


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7.6.7 DSSS Radiated Band Edge Emissions

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
2389.23848	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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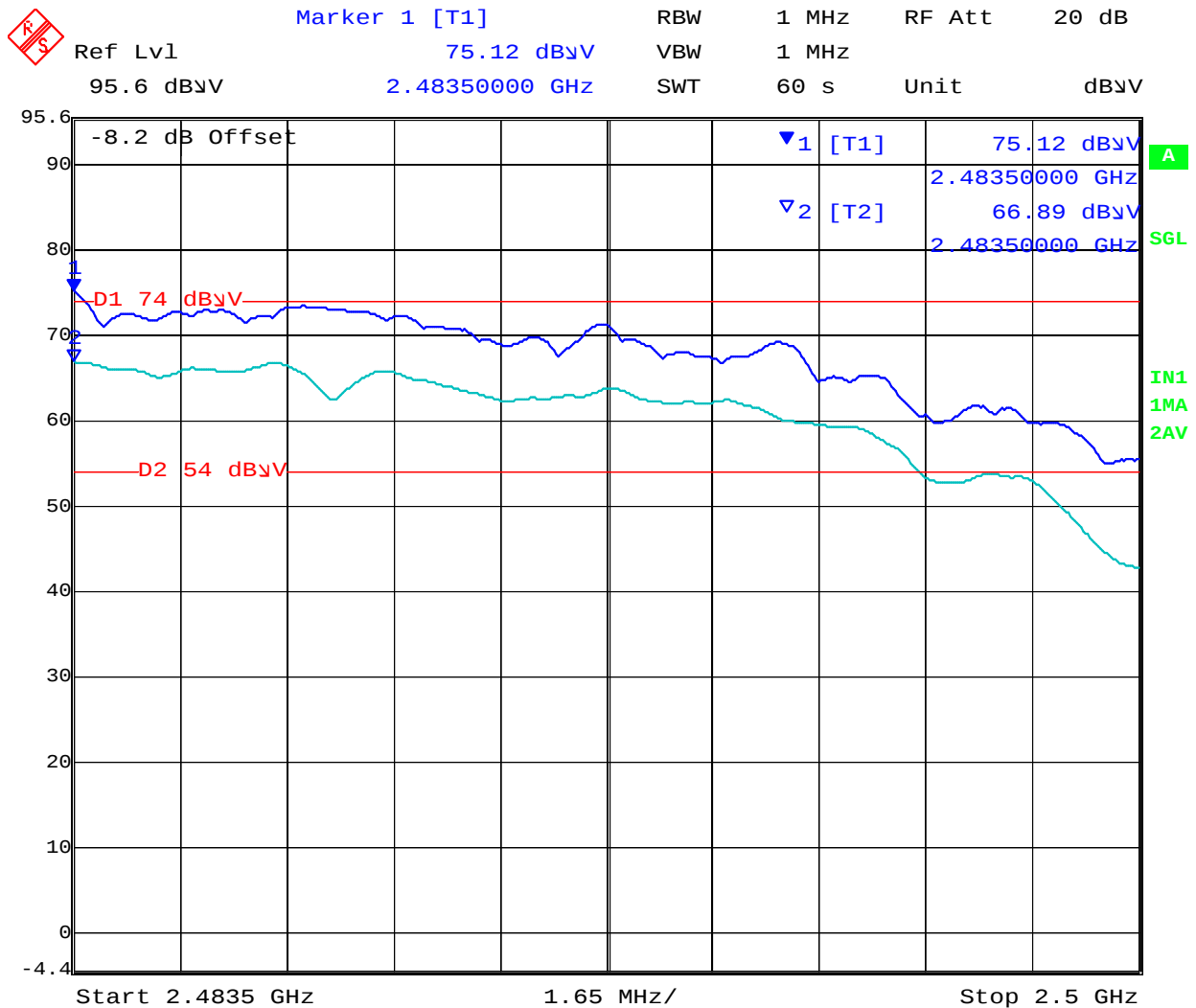
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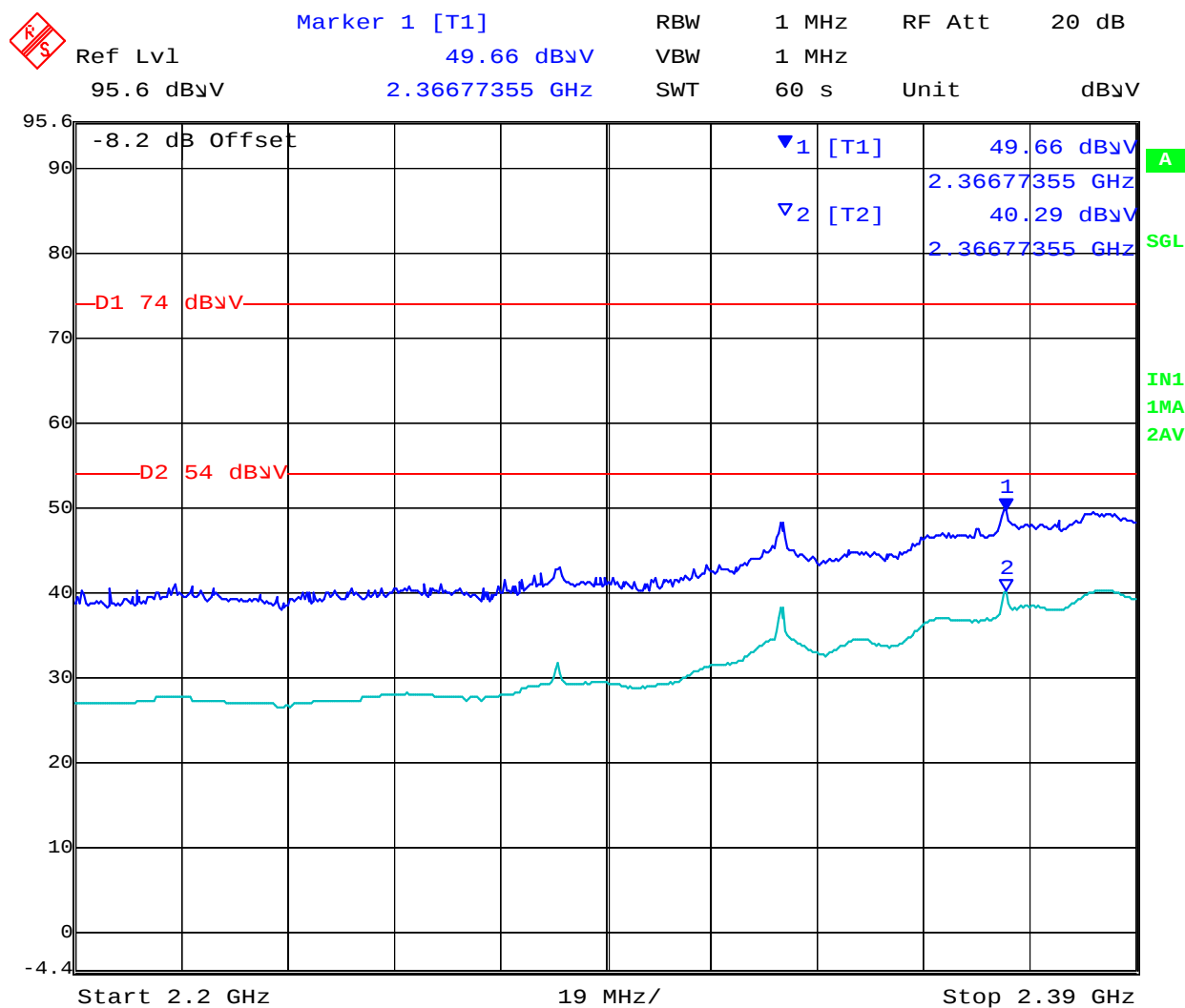


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7.6.8 OOK Radiated Band Edge Emissions

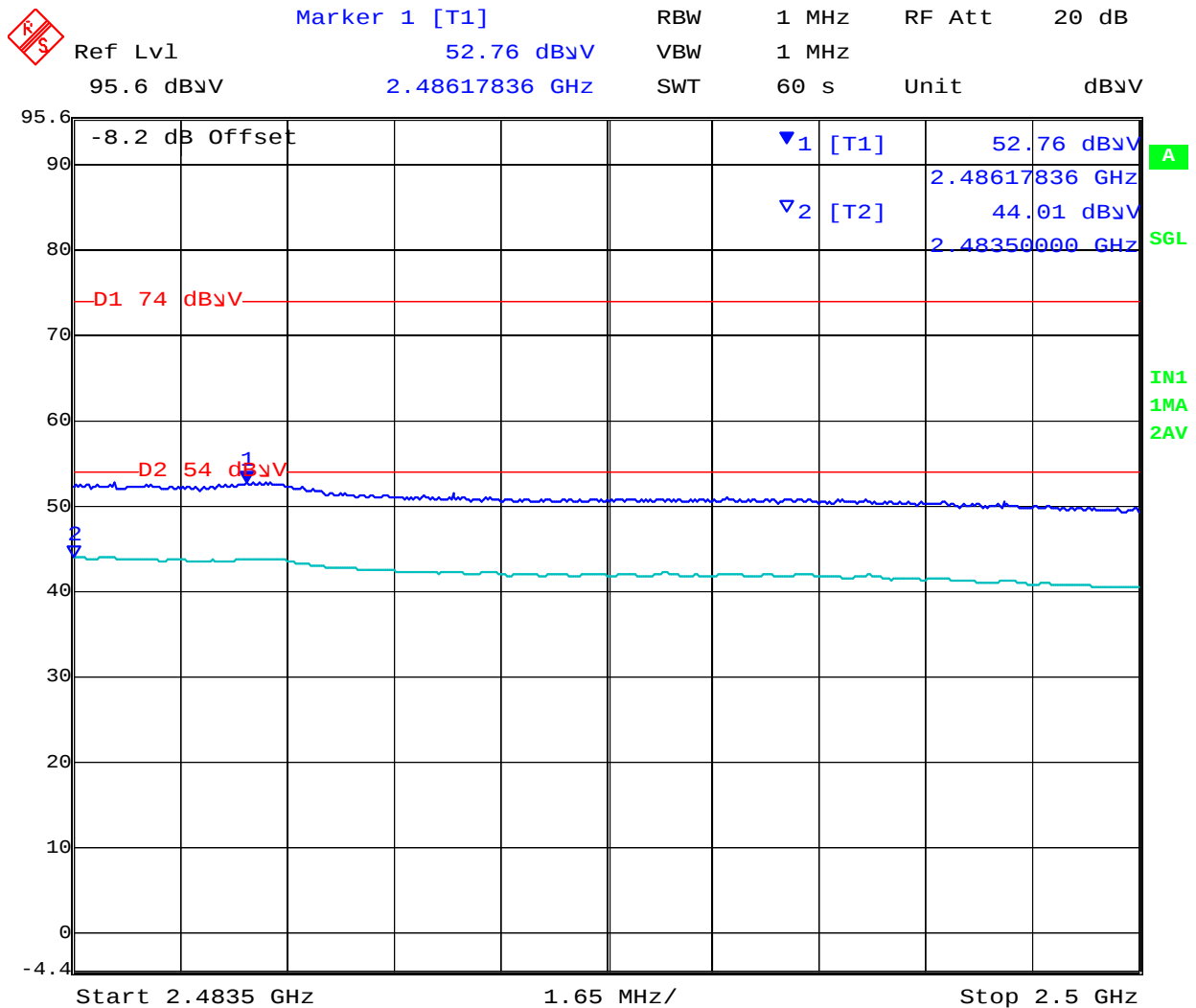
All emissions below FCC limits when tested at 100% duty cycle. No duty cycle correction factor required to comply with FCC limits.



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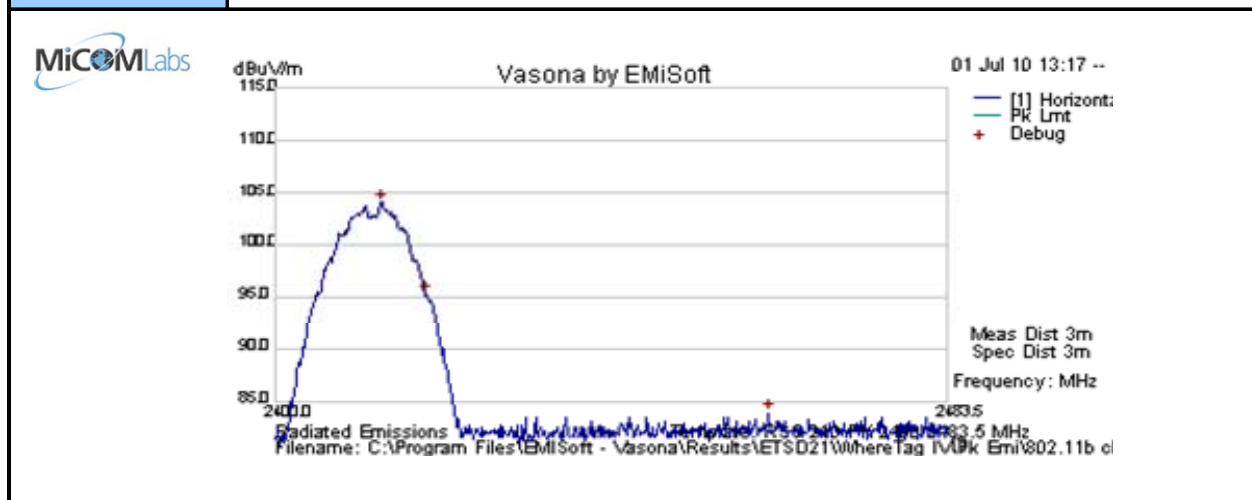
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7.6.9 802.11b RSS-210 Radiated Peak Emissions

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



Formally measured emission peaks

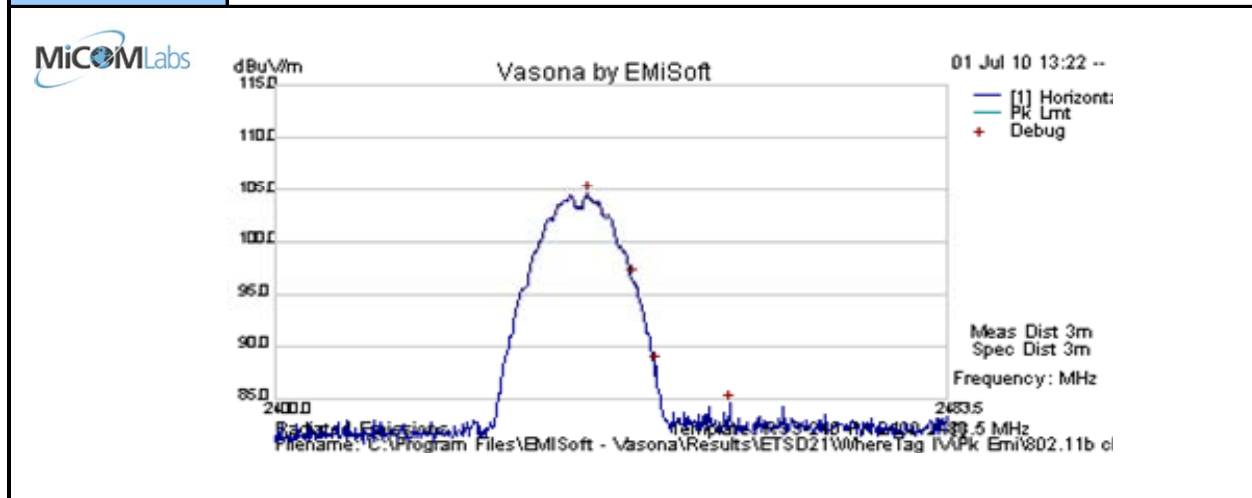
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2413.221	66.5	7.1	30.4	104.1	Peak [Scan]	V						
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission PK = Peak emissions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

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



Formally measured emission peaks

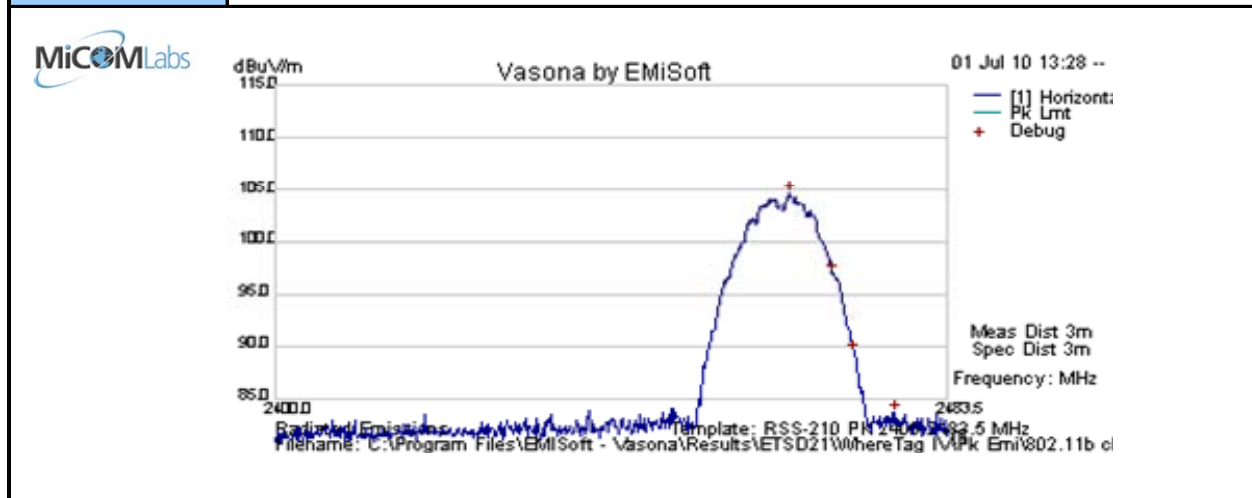
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2438.549	67.0	7.1	30.5	104.7	Peak [Scan]	V						
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission PK = Peak emissions of Fundamental												

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Test Freq.	2462 MHz	Engineer	SB
Variant	802.11b; 1 Mbs	Temp (°C)	28
Freq. Range	2400 - 2483.5 MHz	Rel. Hum.(%)	36
Power Setting	10 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
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												

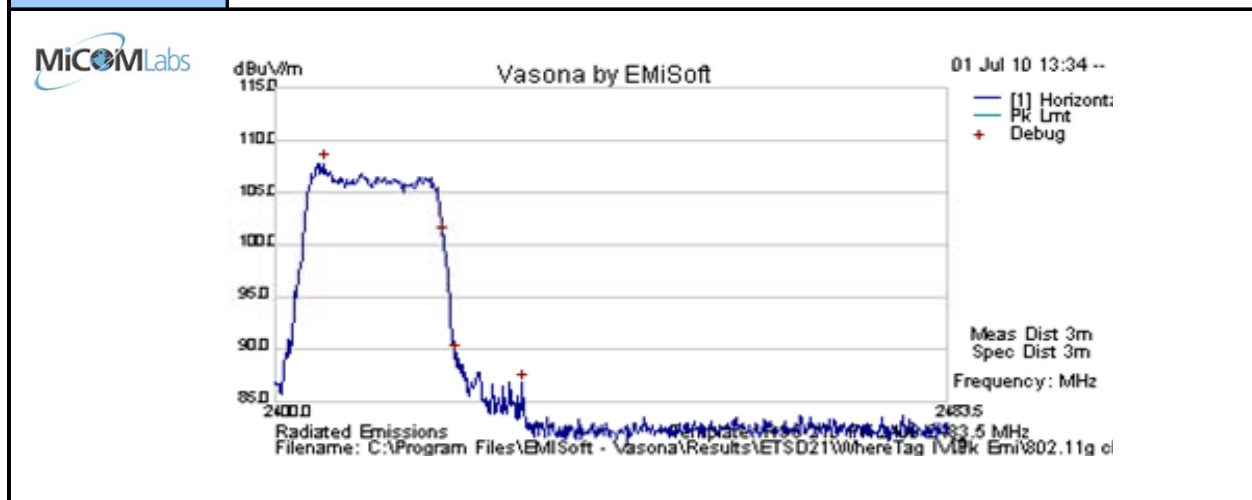
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7.6.10 802.11g RSS-210 Radiated Peak Emissions

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



Formally measured emission peaks

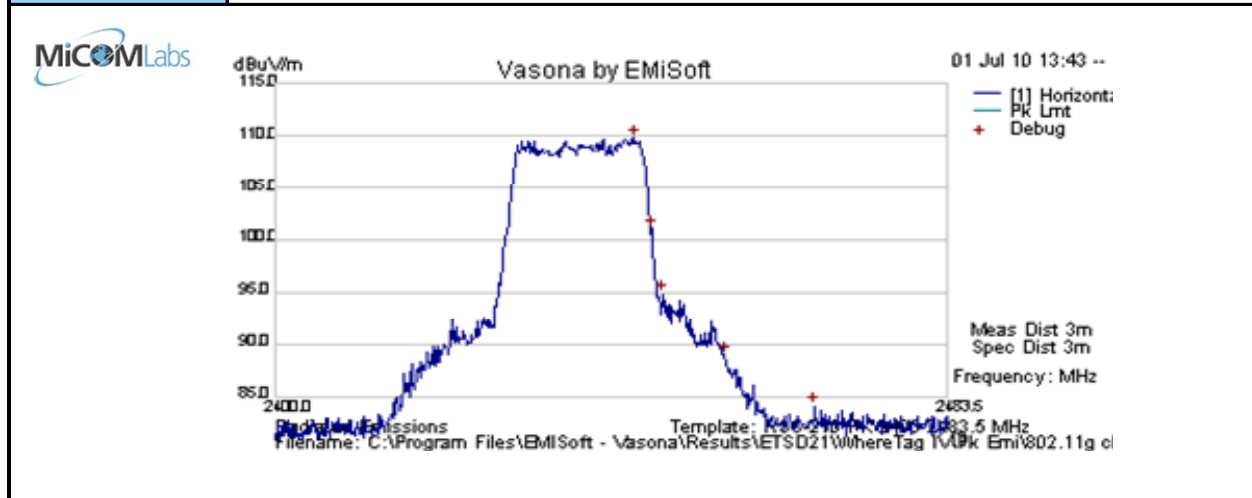
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2406.123	70.4	7.1	30.4	107.9	Peak [Scan]	V						
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission PK = Peak emissions of Fundamental												

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



Formally measured emission peaks

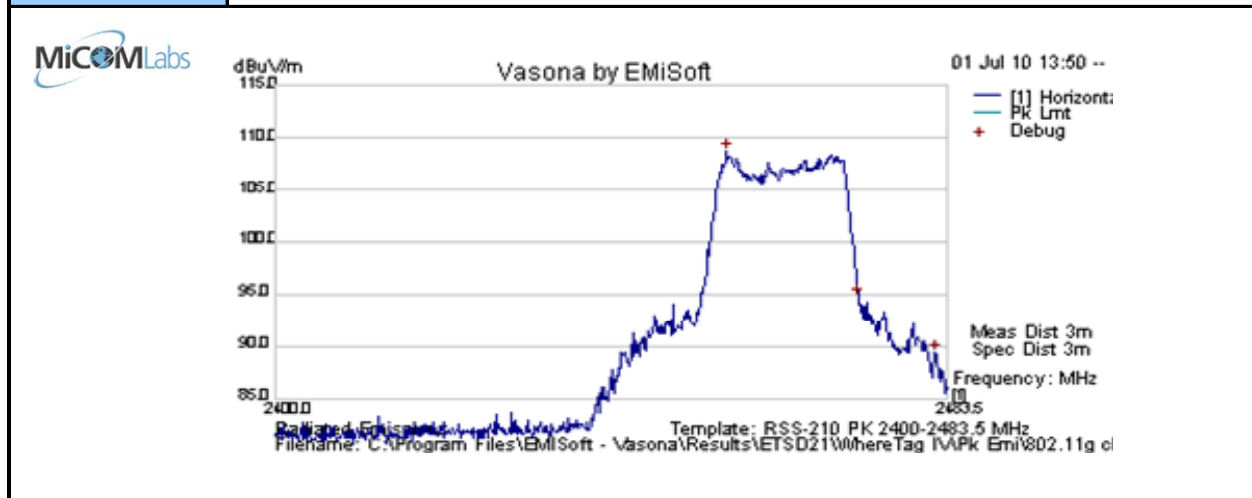
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2444.255	72.2	7.2	30.5	109.9	Peak [Scan]	V						
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission PK = Peak emissions of Fundamental												

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Test Freq.	2462 MHz	Engineer	SB
Variant	802.11g; 6 Mbs	Temp (°C)	28
Freq. Range	2400 - 2483.5 MHz	Rel. Hum.(%)	36
Power Setting	10 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
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												

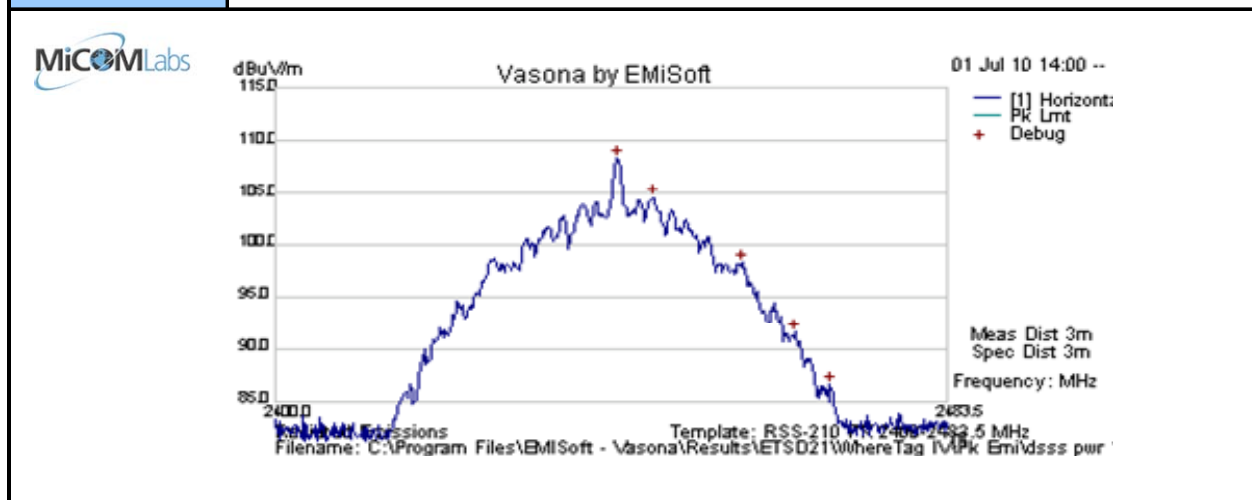
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7.6.11 DSSS RSS-210 Radiated Peak Emissions

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												

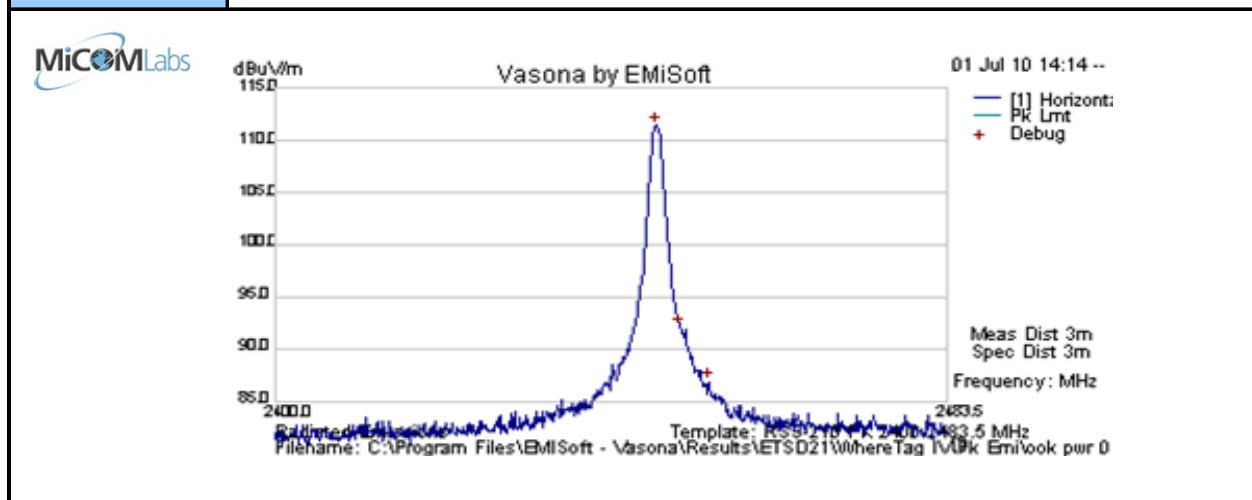
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7.6.12 OOK RSS-210 Radiated Peak Emissions

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												

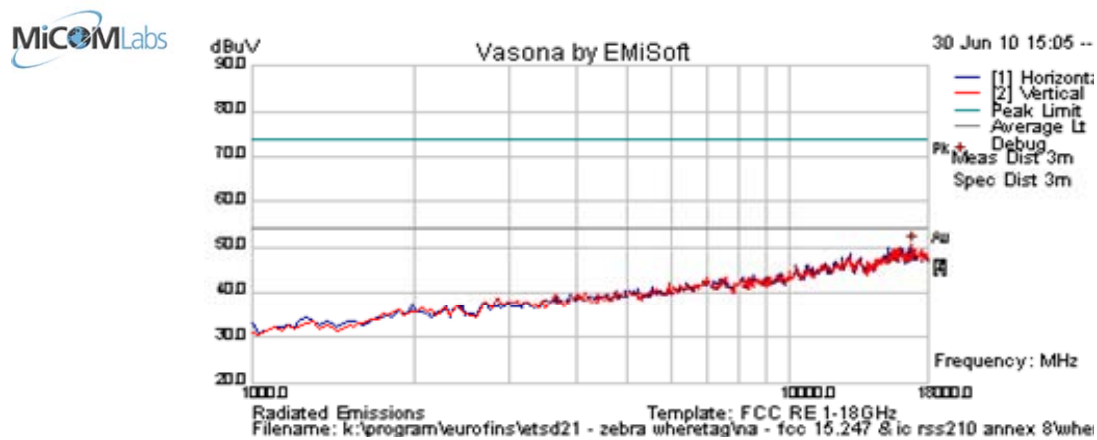
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7.6.13 RSS-210 Receiver Radiated Emissions

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

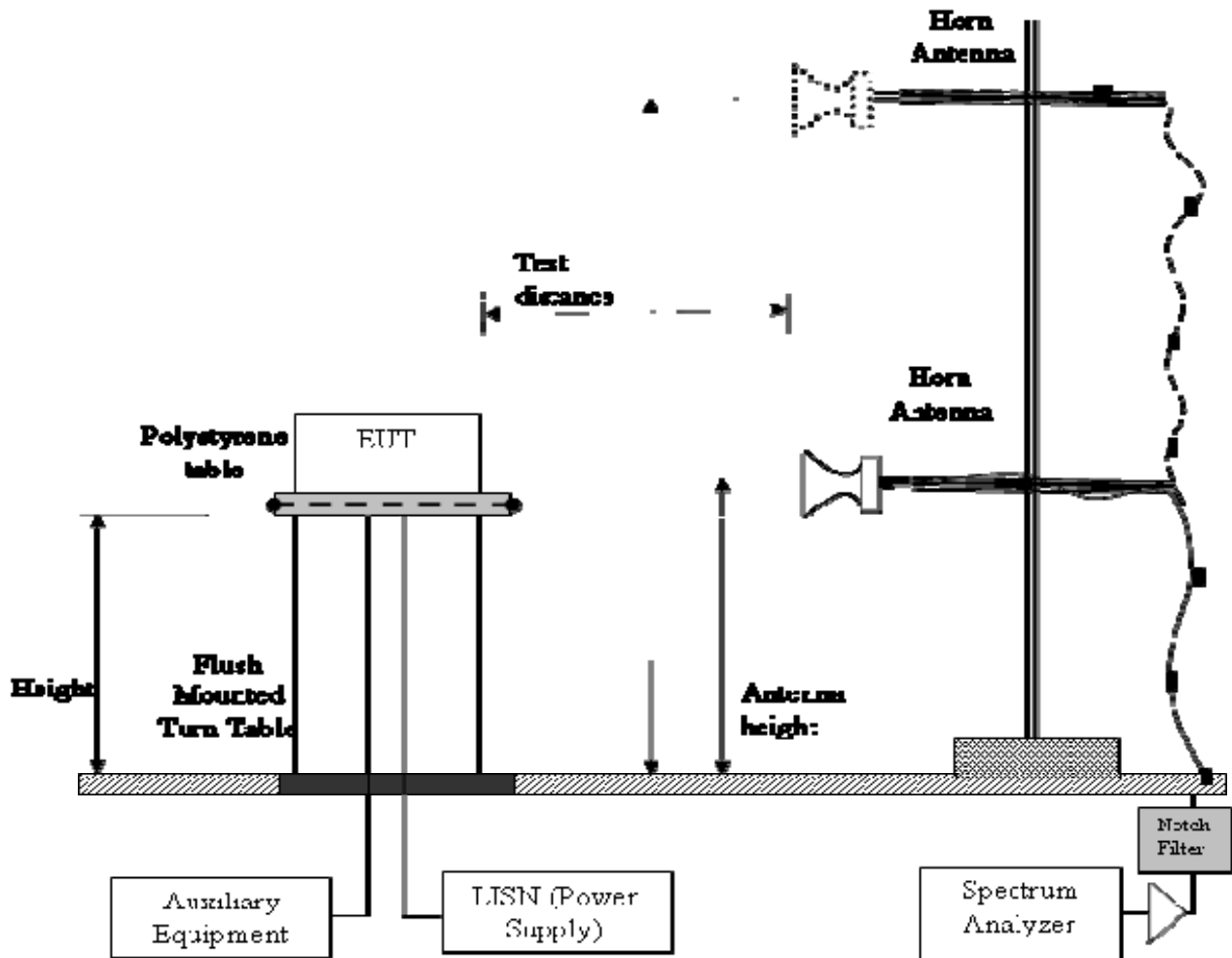
Test Procedure

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 μ 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 μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

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

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

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

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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

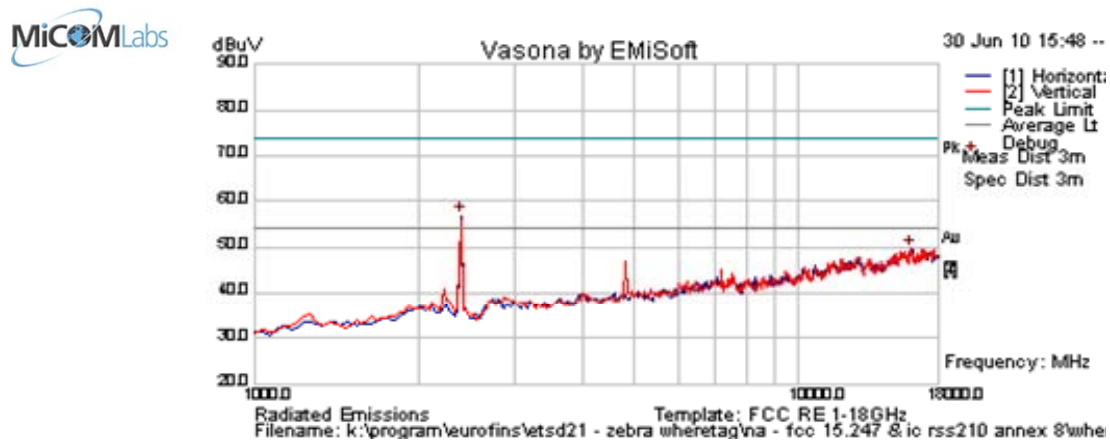
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7.7.1 802.11b Radiated Spurious Emissions

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



Formally measured emission peaks

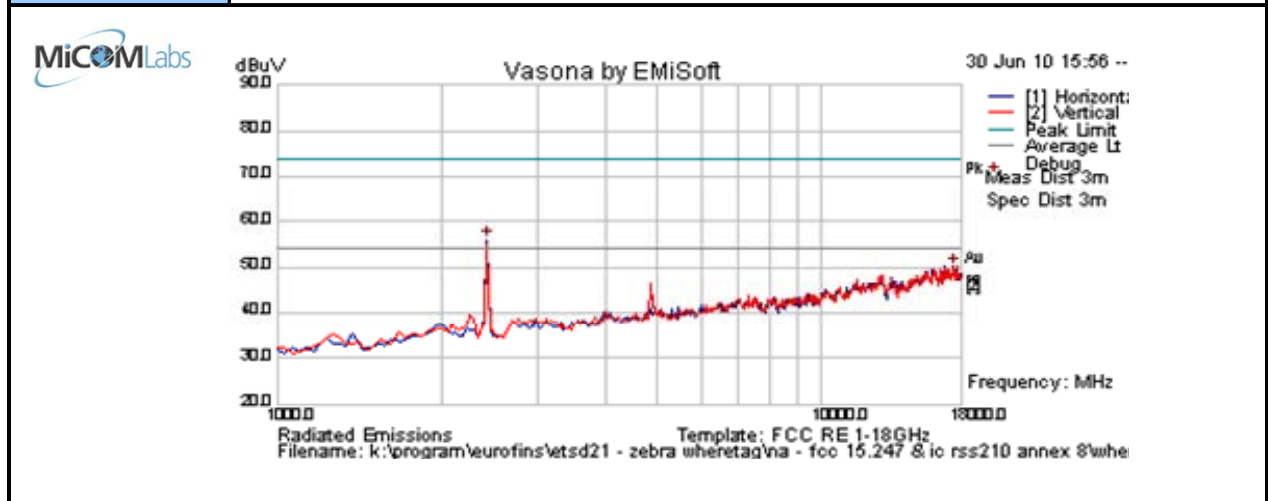
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2396.794	65.0	3.0	-11.2	56.8	Peak [Scan]	H	100	--	--	--	N/A	FUND
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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

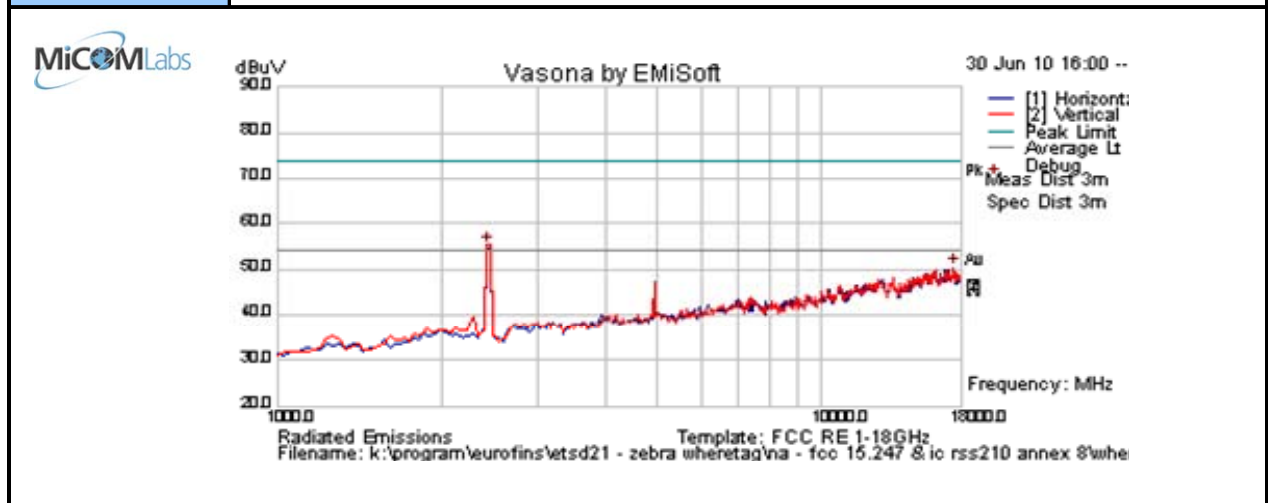
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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

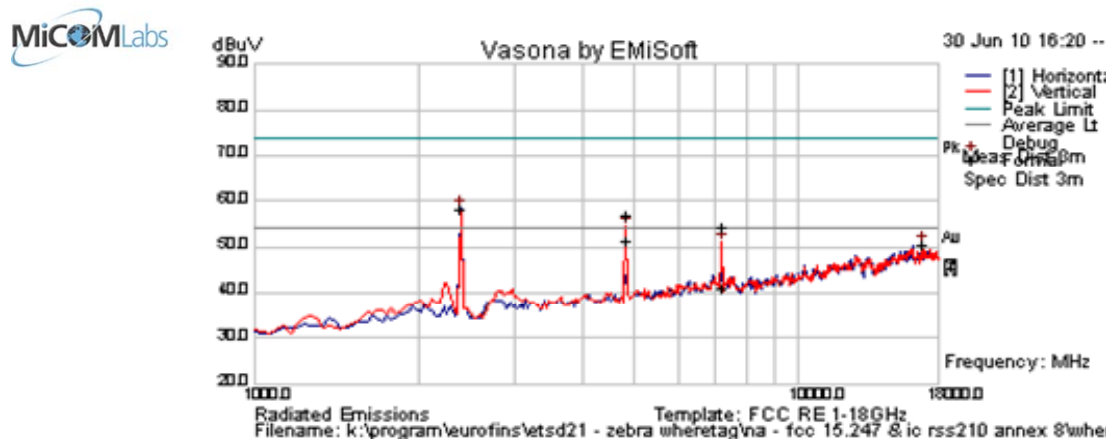
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7.7.2 802.11g Radiated Spurious Emissions

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



Formally measured emission peaks

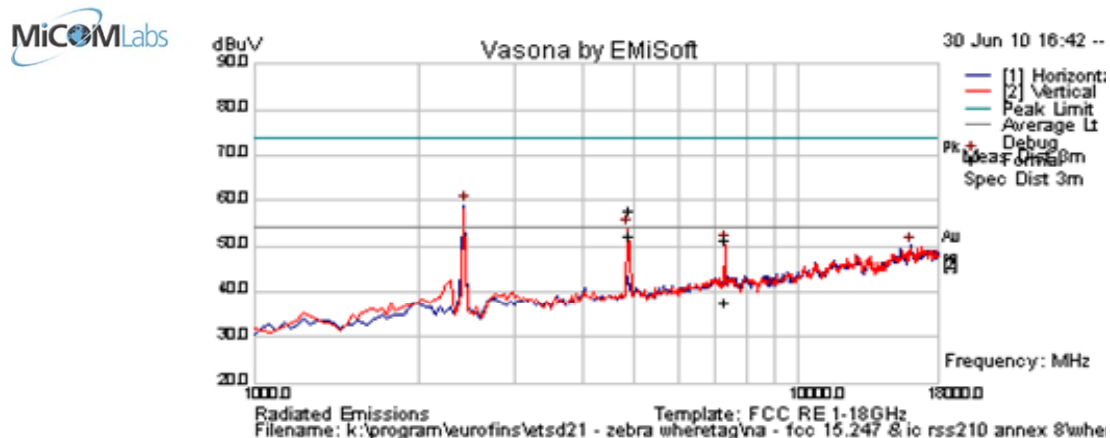
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2396.794	66.4	3.0	-11.2	58.2	Peak [Scan]	H	100	--	--	--	N/A	FUND
4823.983	61.9	4.5	-9.4	57.0	Peak Max	V	137	222	74.0	-17.1	Pass	RB
7235.07	53.9	5.4	-5.2	54.2	Peak Max	V	98	300	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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Test Freq.	2437 MHz	Engineer	GMH
Variant	802.11g; 6 Mbs	Temp (°C)	27.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum.(%)	32
Power Setting	10 in test utility	Press. (mBars)	1003
Antenna	ANT=Taoglas	Duty Cycle (%)	0.72
Test Notes 1	Fundamental attenuated by band-stop filter		
Test Notes 2	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

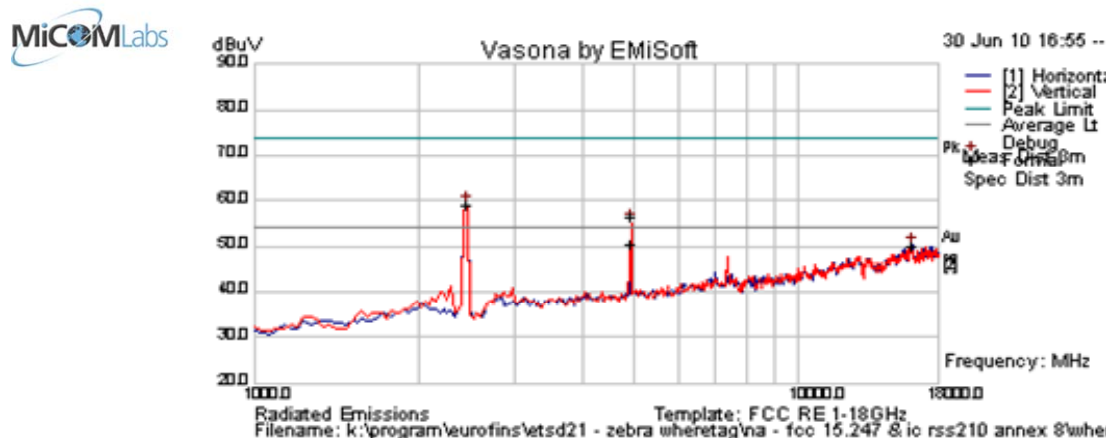
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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

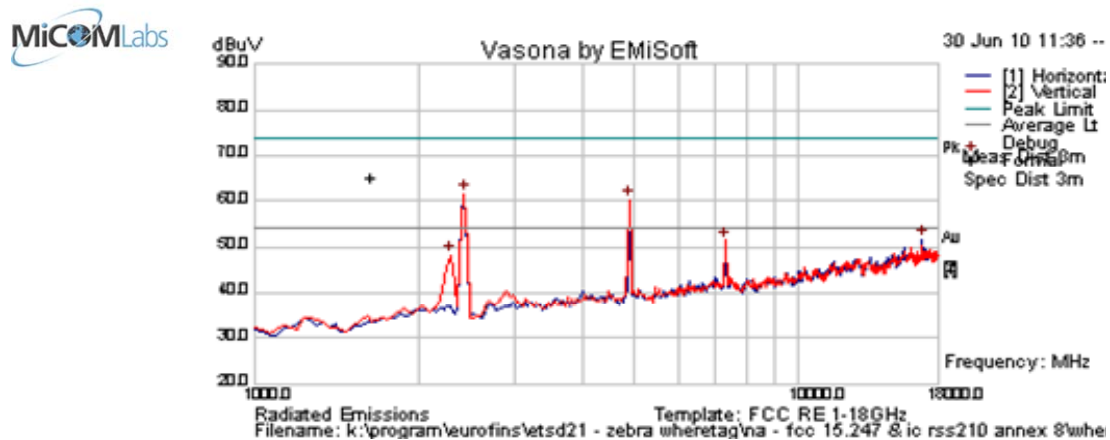
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7.7.3 DSSS Radiated Spurious Emissions

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

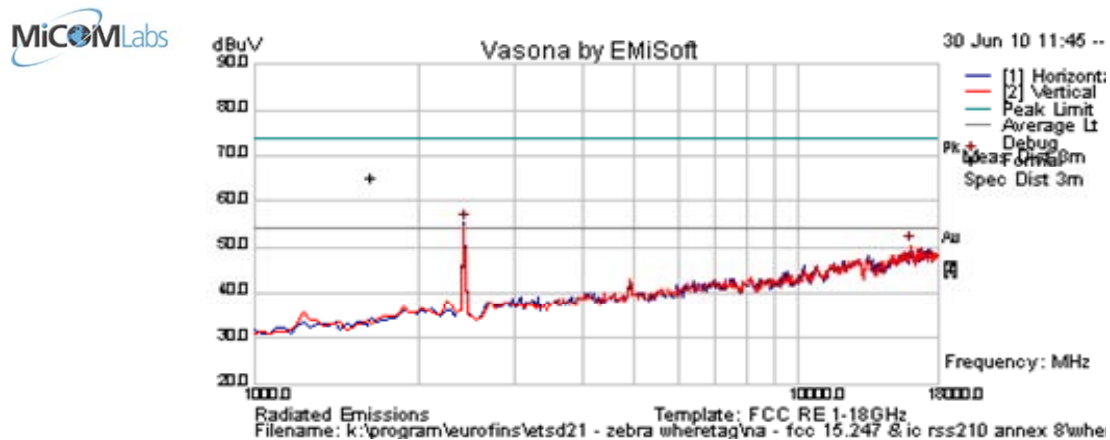
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7.7.4 OOK Radiated Spurious Emissions

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

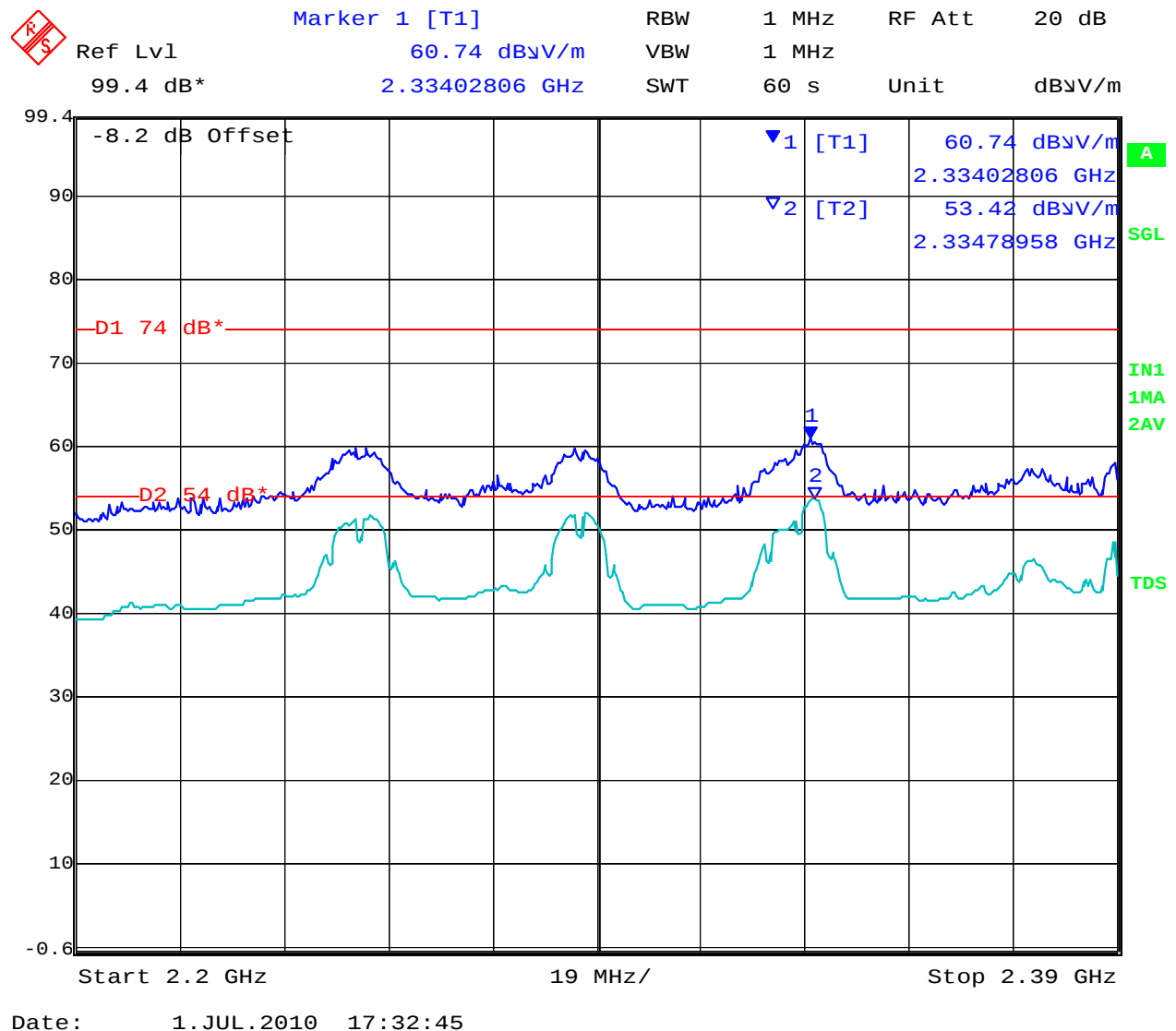
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7.7.5 802.11b Radiated Band Edge Emissions

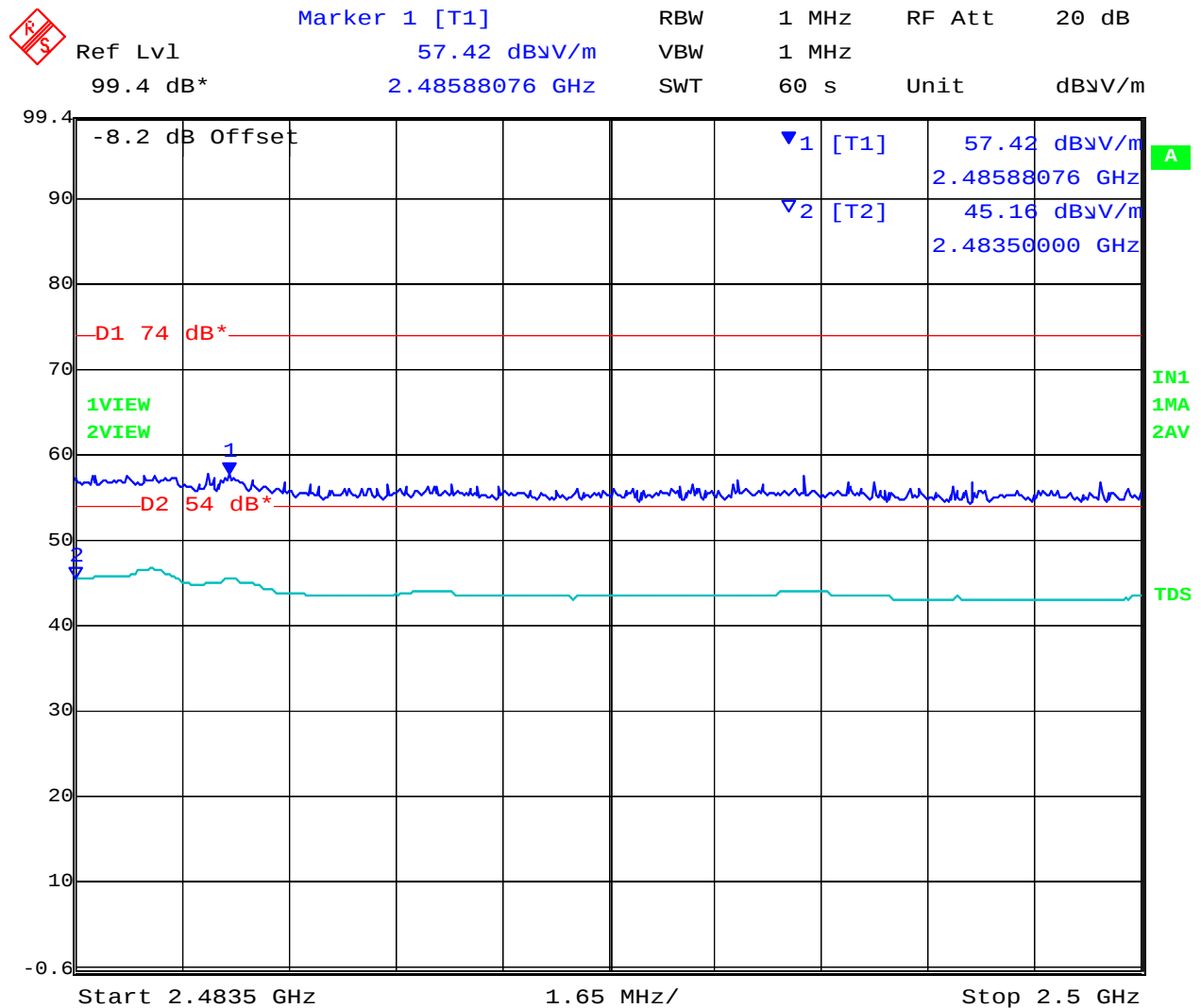
All emissions below FCC limits when tested at 100% duty cycle. No duty cycle correction factor required to comply with FCC limits.



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

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7.7.6 802.11g Radiated Band Edge Emissions

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

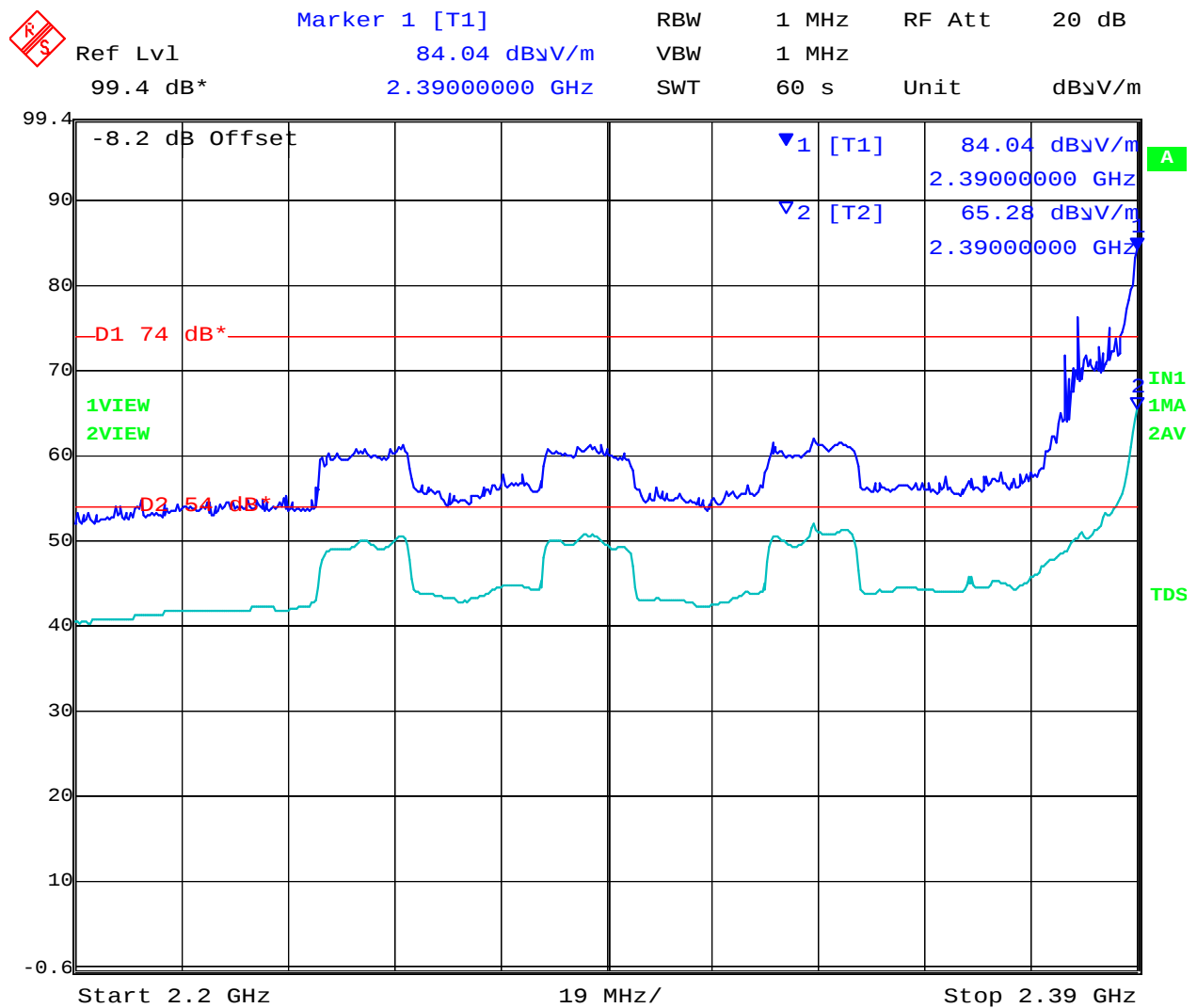
EUT Operational Duty Cycle: 0.72%
Correction Factor = $20 * \text{LOG} (0.72 / 100)$
Correction Factor = -42.85dB
Corrected Value = Measured Value (dB) - 42.85 (dB)

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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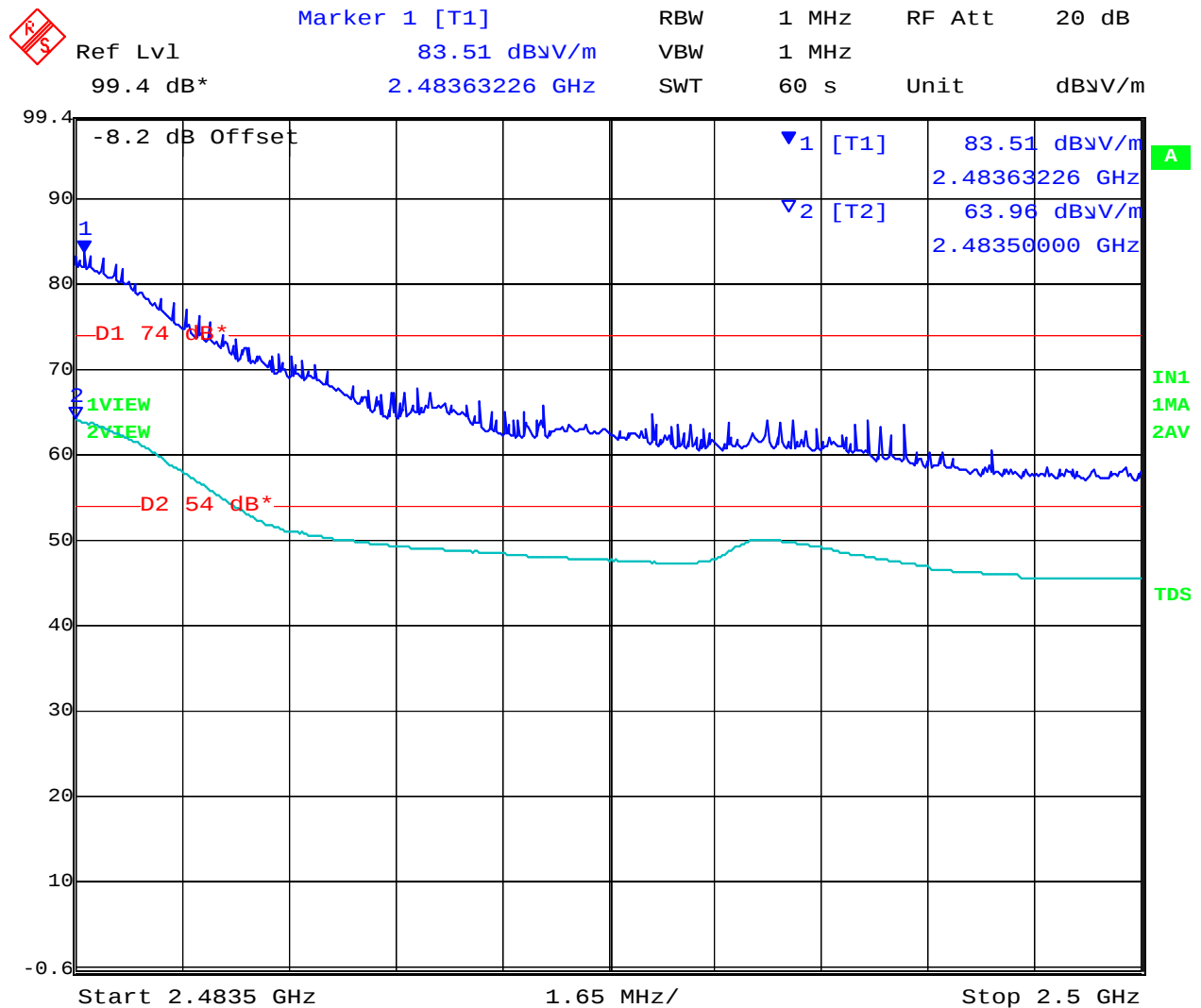


Date: 1.JUL.2010 17:41:28

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7.7.7 DSSS Radiated Band Edge Emissions

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

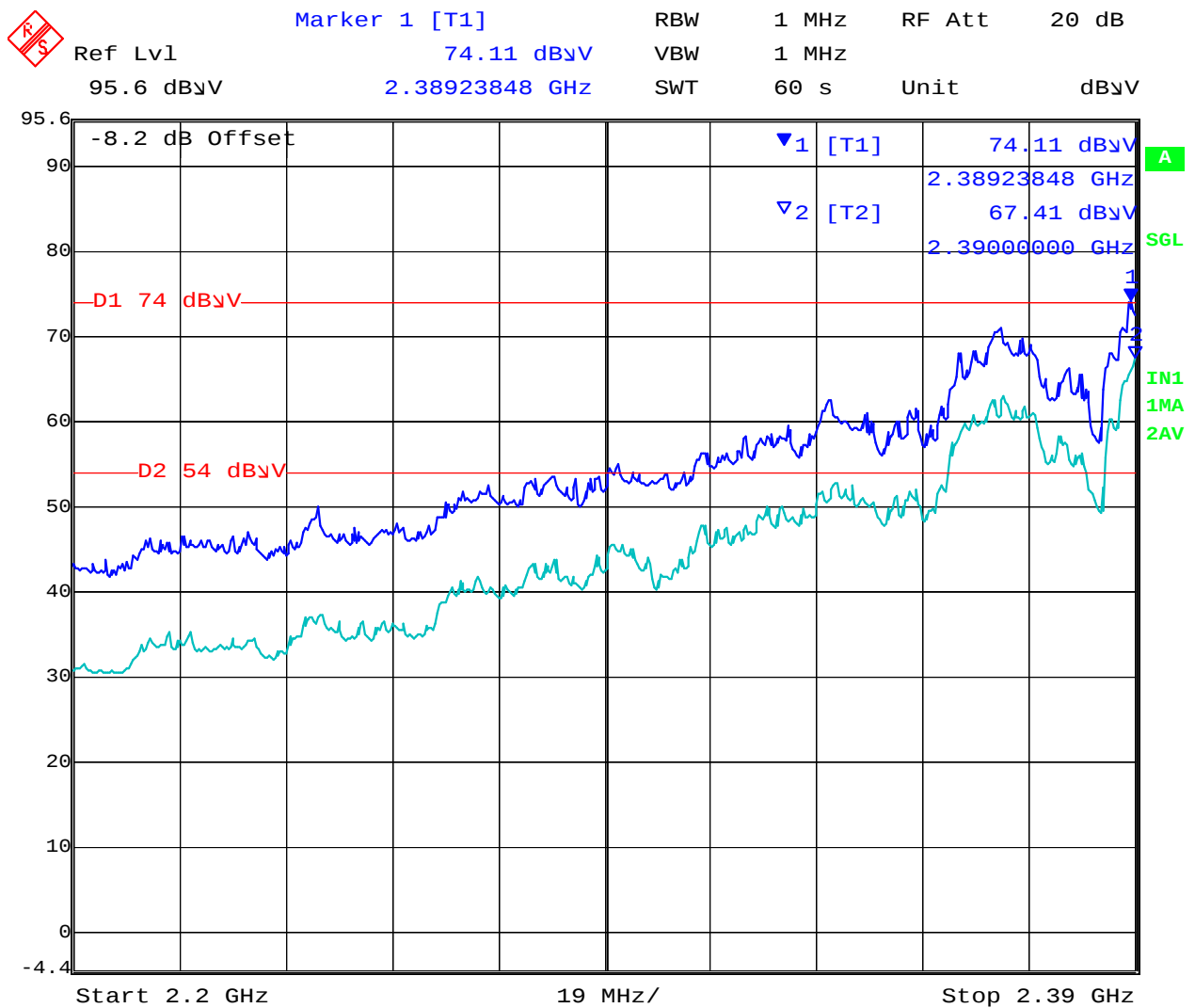
EUT Operational Duty Cycle: 2.55%
Correction Factor = $20 * \text{LOG} (2.55 / 100)$
Correction Factor = -31.87 dB
Corrected Value = Measured Value (dB) - 31.87 (dB)

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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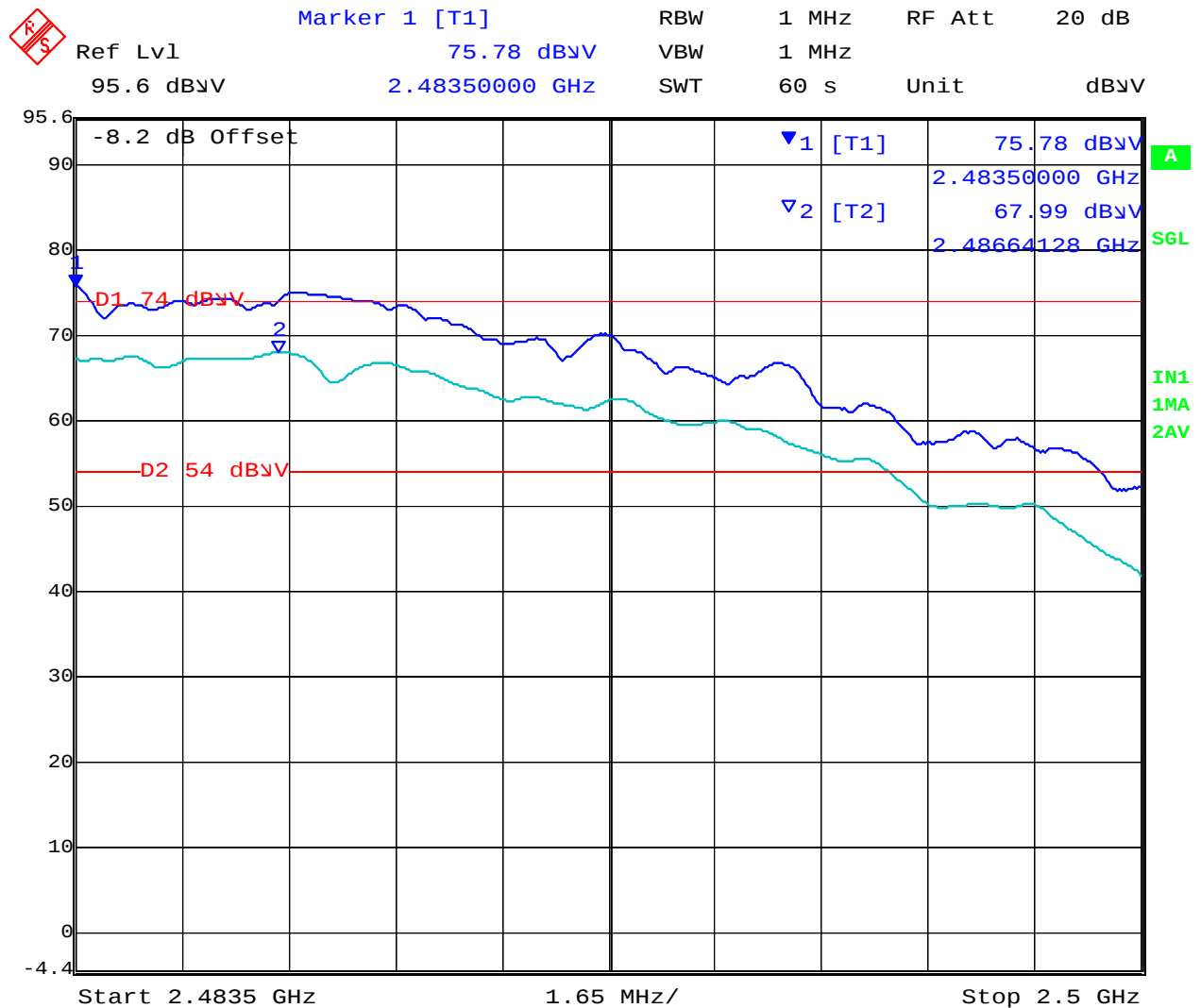
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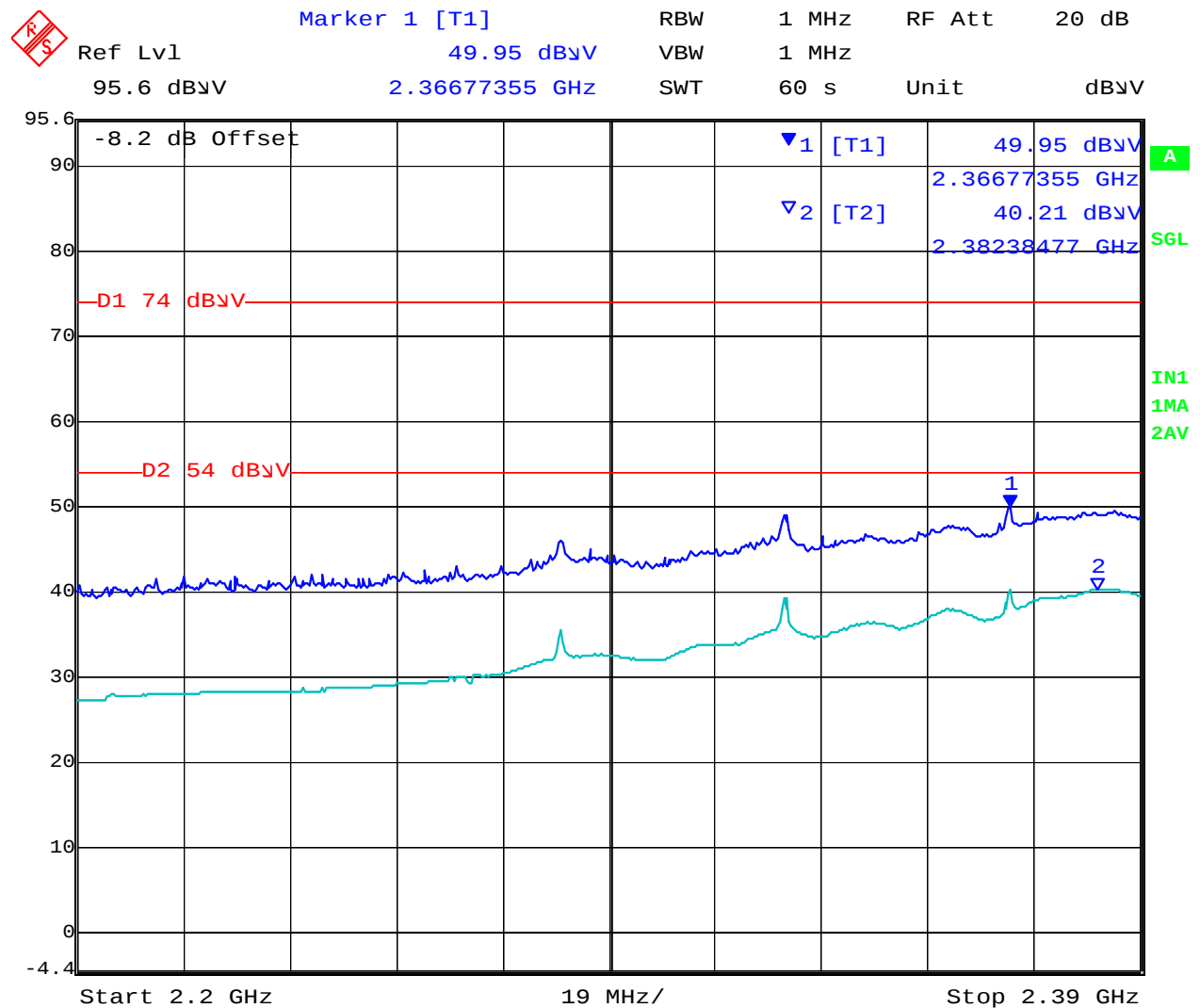


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7.7.8 OOK Radiated Band Edge Emissions

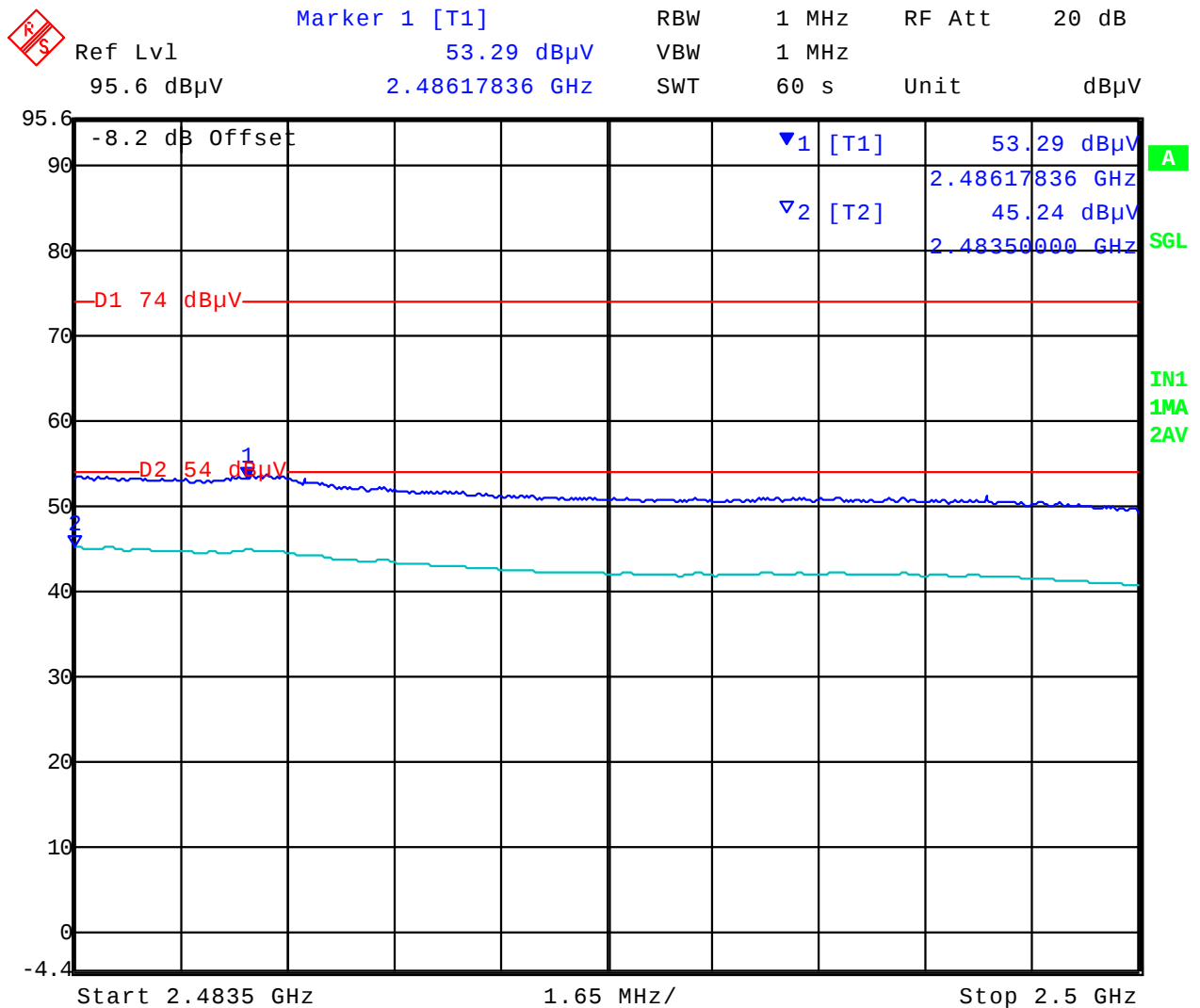
All emissions below FCC limits when tested at 100% duty cycle. No duty cycle correction factor required to comply with FCC limits.



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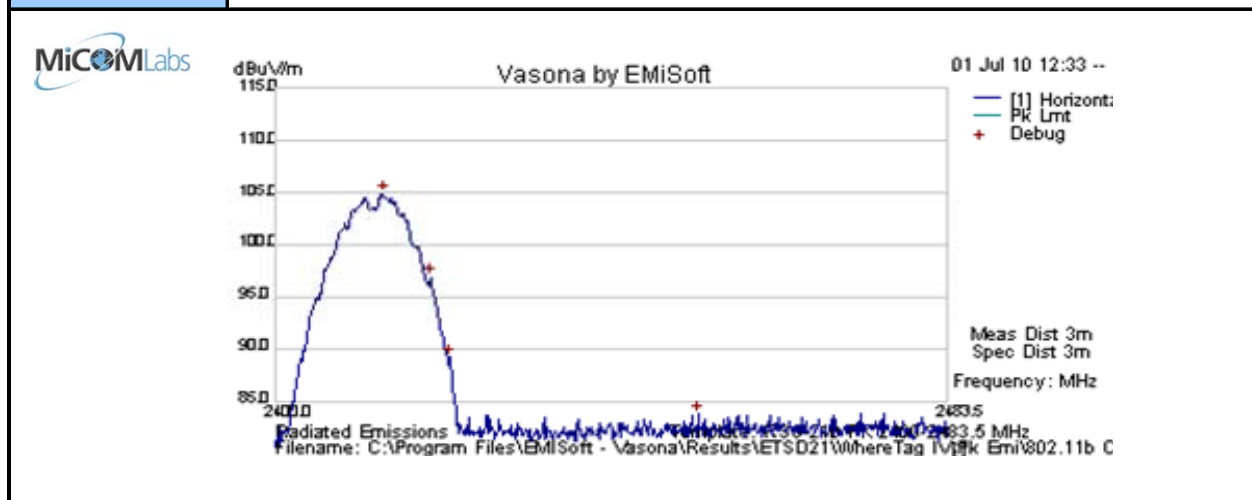
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7.7.9 802.11b Radiated Peak Emissions

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



Formally measured emission peaks

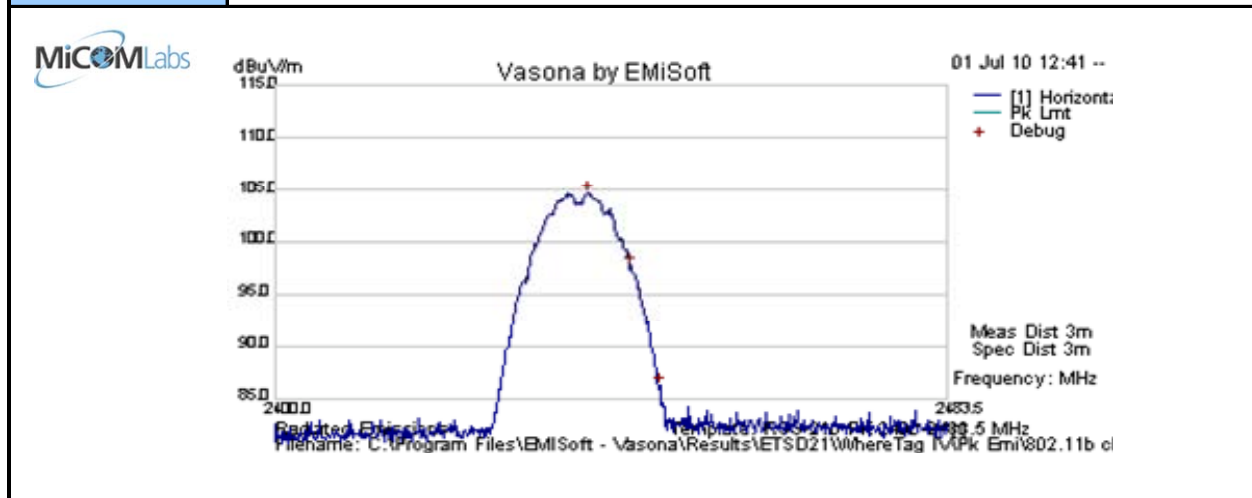
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2413.360	67.4	7.1	30.4	104.9	Peak [Scan]	V						PK
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission												
PK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

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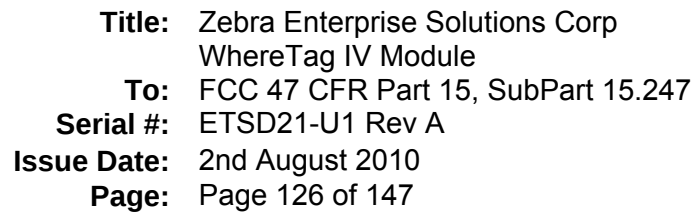
Test Freq.	2437 MHz	Engineer	CSB
Variant	802.11b; 1 Mbs	Temp (°C)	28
Freq. Range	2400 - 2483.5 MHz	Rel. Hum.(%)	36
Power Setting	10 in test utility software	Press. (mBars)	1001
Antenna	ANT=Taoglas	Duty Cycle (%)	100
Test Notes 1			
Test Notes 2			



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
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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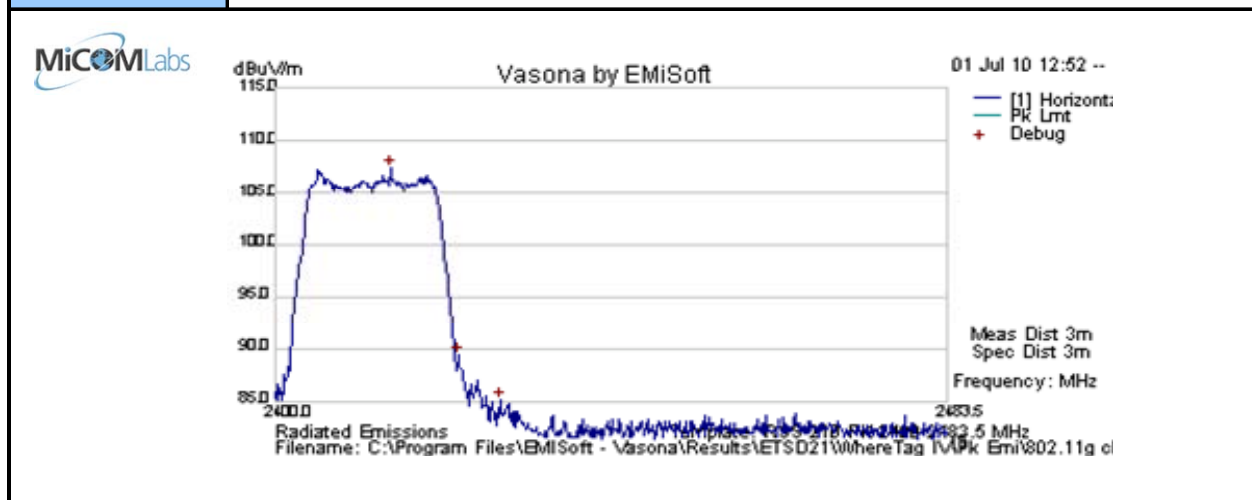
Formally measured emission peaks												
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2463.878	65.5	7.2	30.6	103.3	Peak [Scan]	V						PK
Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission PK = Peak emissions of Fundamental											



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7.7.10 802.11g Radiated Peak Emissions

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



Formally measured emission peaks

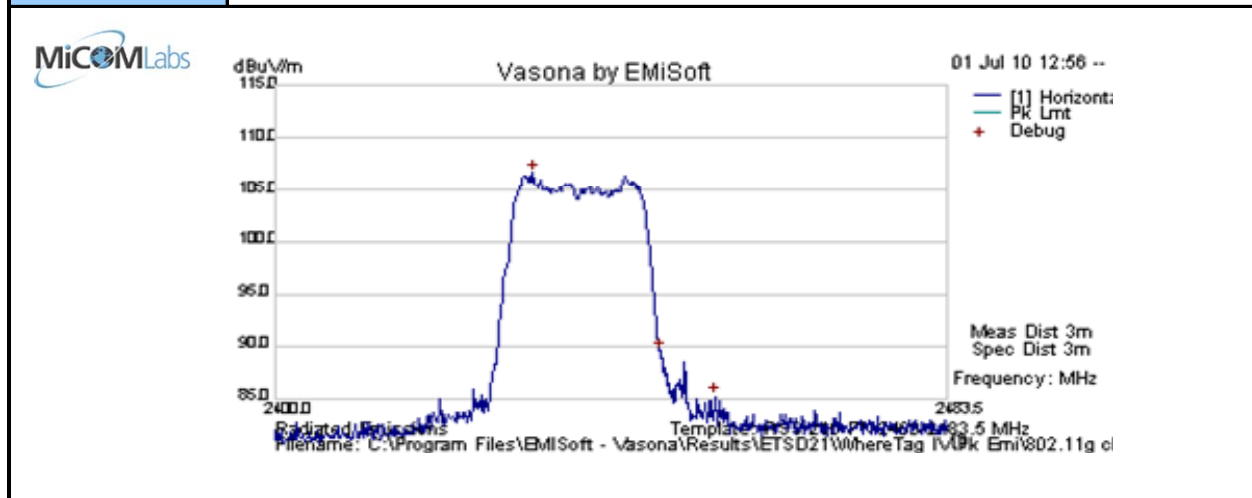
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2414.195	69.9	7.1	30.4	107.4	Peak [Scan]	V						PK
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission												
PK = Peak emissions of Fundamental												

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



Formally measured emission peaks

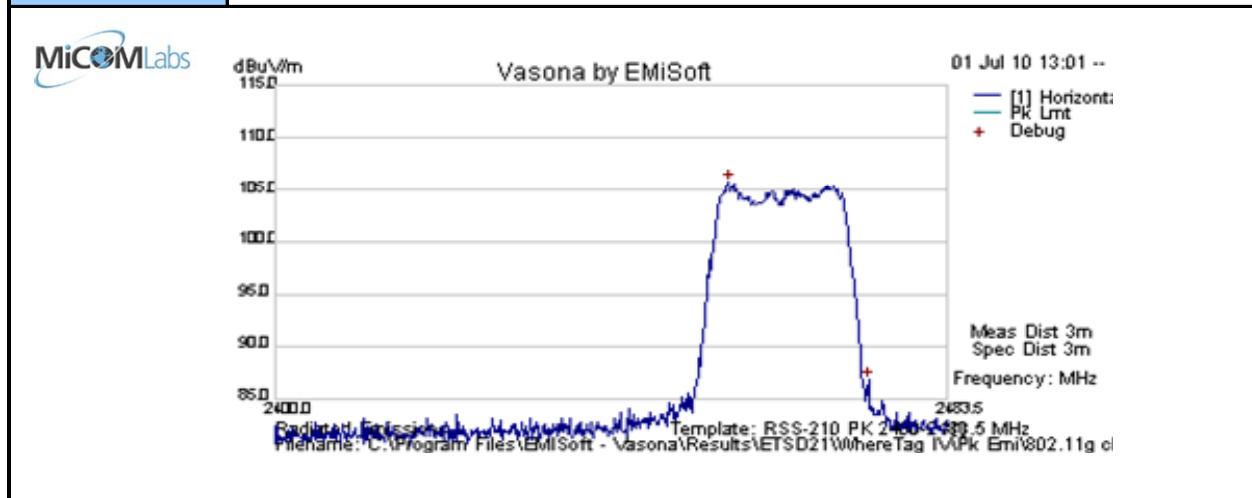
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
2431.730	69.0	7.1	30.5	106.6	Peak [Scan]	V						PK
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission PK = Peak emissions of Fundamental												

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

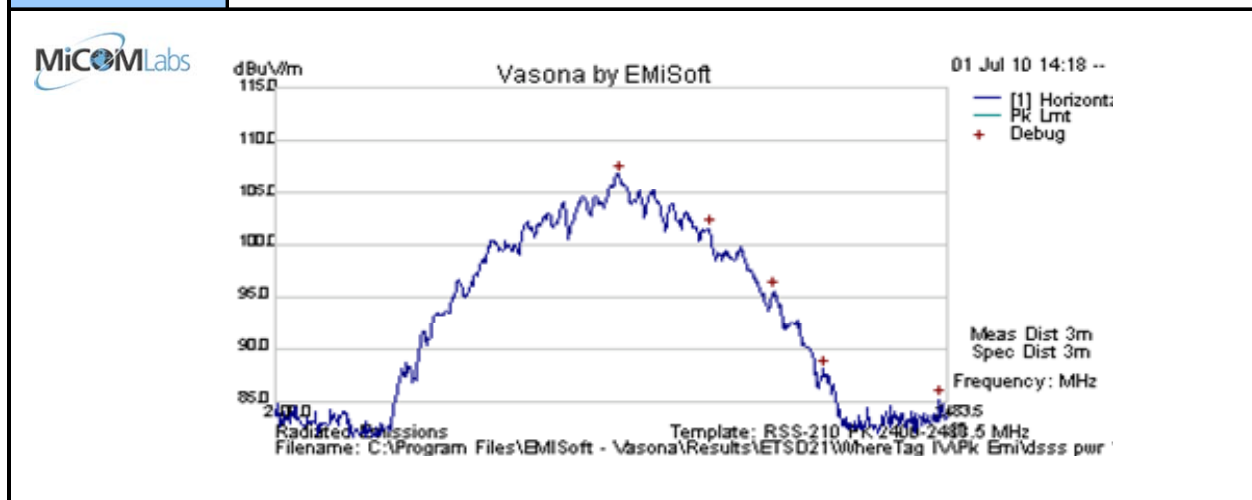
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7.7.11 DSSS Radiated Peak Emissions

Test Freq.	2441.75 MHz	Engineer	CSB
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=Taoglas	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
2442.446	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												

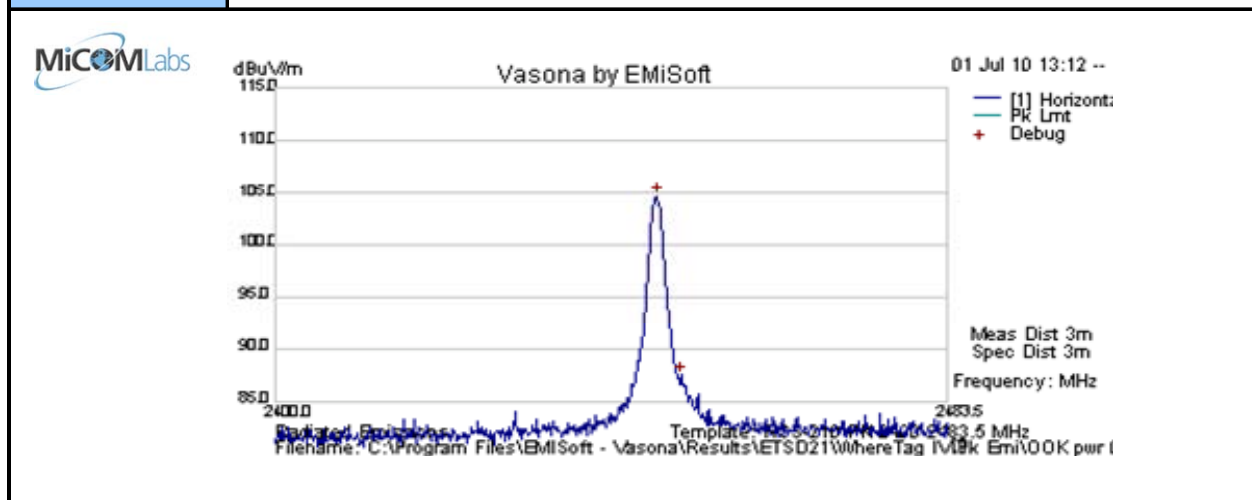
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7.7.12 OOK Radiated Peak Emissions

Test Freq.	2446.519	Engineer	CSB
Variant	OOK	Temp (°C)	28
Freq. Range	2400 - 2483.5 MHz	Rel. Hum.(%)	36
Power Setting	Maximum	Press. (mBars)	1001
Antenna	ANT=Taoglas	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
2447.178	67.0	7.2	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												

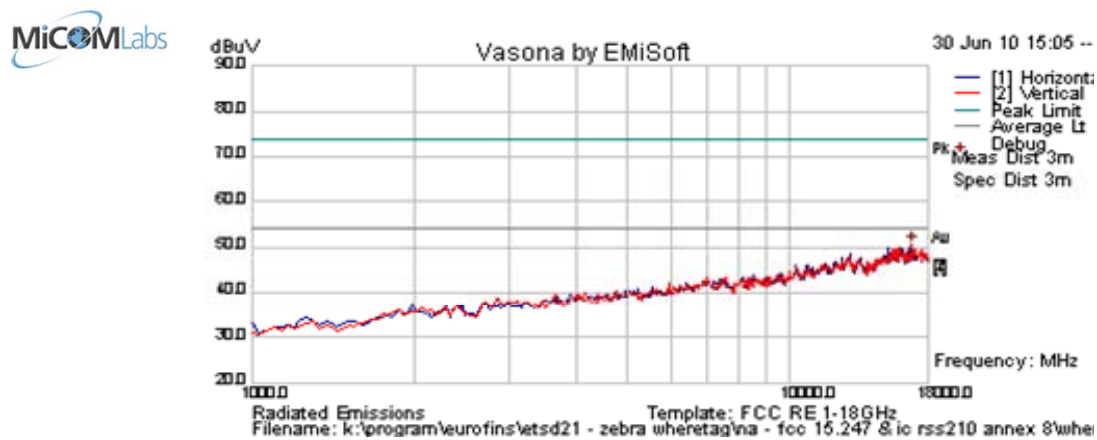
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7.7.13 Receiver Radiated Emissions

Test Freq.	2446.519 MHz	Engineer	CSB
Variant	OOK	Temp (°C)	27.5
Freq. Range	1000 MHz - 18000 MHz	Rel. Hum.(%)	32
Power Setting	Not Applicable in Receive Mode	Press. (mBars)	1003
Antenna	ANT=ZES10370		
Test Notes 1	EUT was tested at 100% duty cycle.		
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
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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7.8 Radiated Spurious Emissions – Below 1 GHz

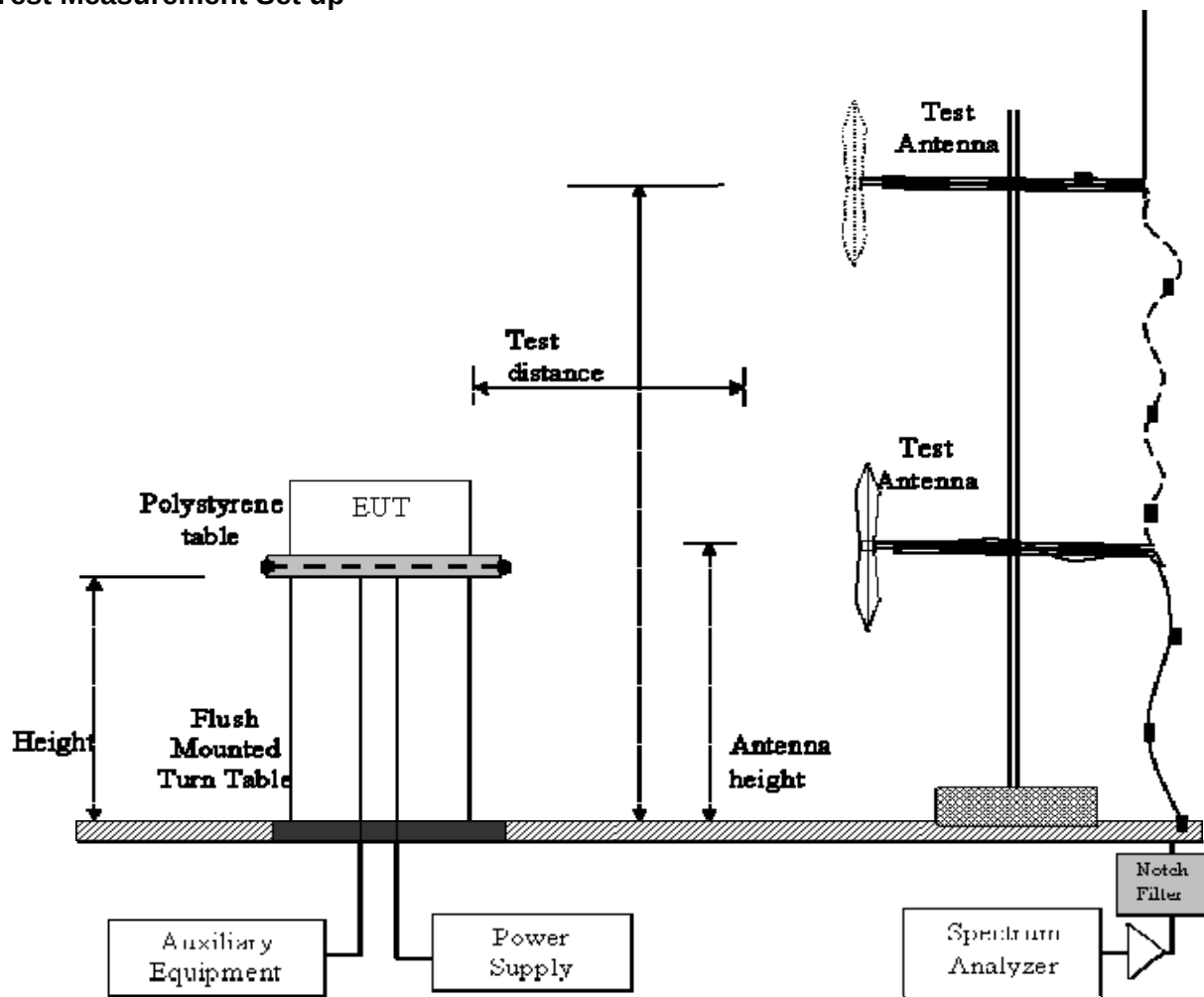
Test Procedure

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 μ 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 μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

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

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

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

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WhereTag IV Module
To: FCC 47 CFR Part 15, SubPart 15.247
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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 (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
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Traceability:

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

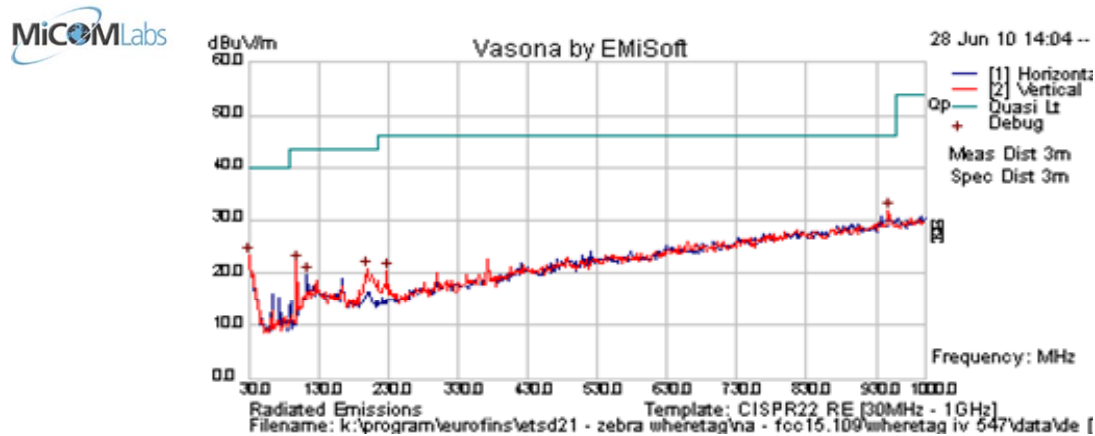
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7.8.1 Measurement Results for Radiated Spurious Emissions Below 1 GHz - Antenna ZES

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



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
30.000	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

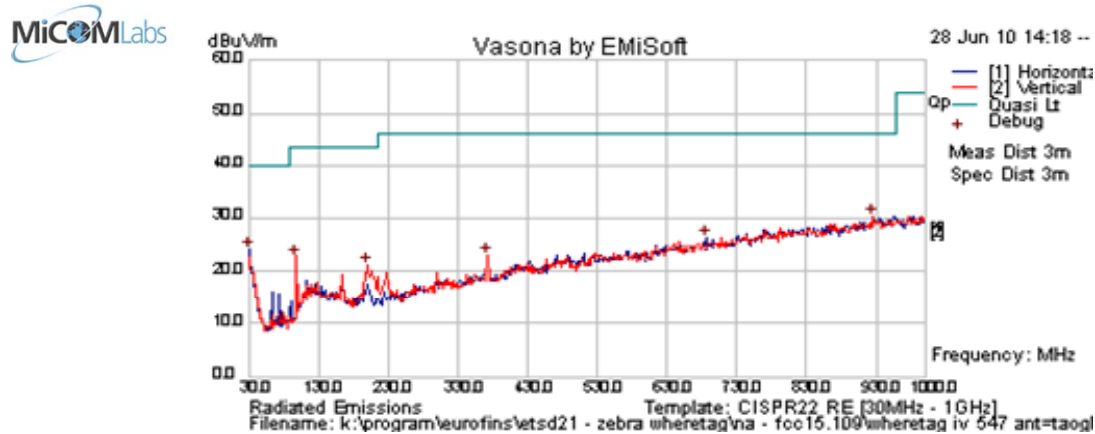
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7.8.2 Measurement Results for Radiated Spurious Emissions Below 1 GHz - Antenna Taoglas

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



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
30.000	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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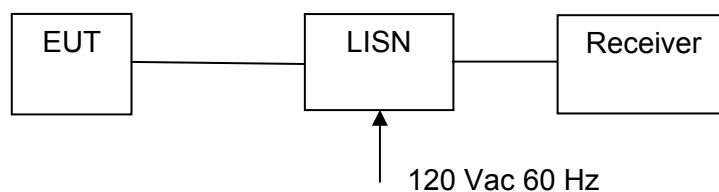
7.9 AC Mains Power Input/Output Port Emissions

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 μ 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 ± 2.64 dB.

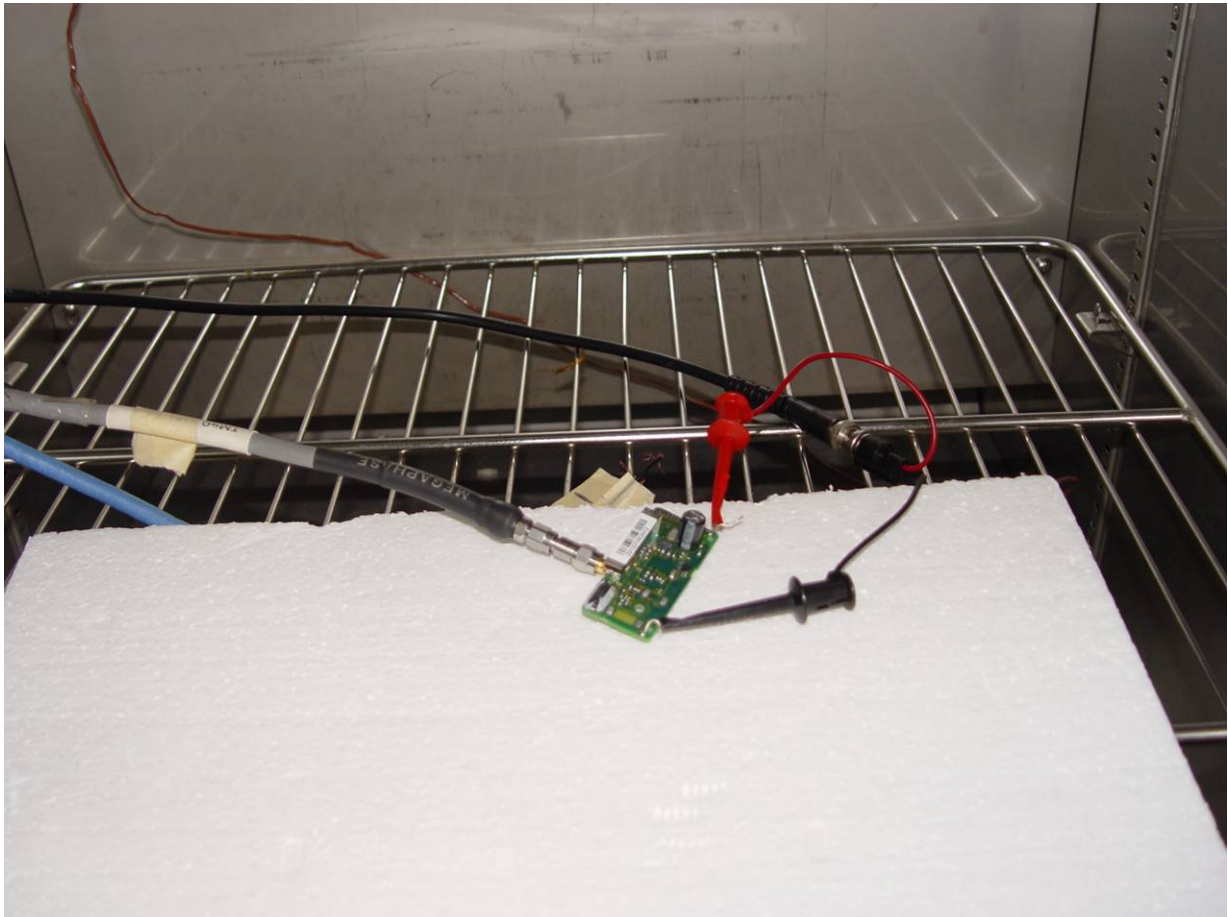
Laboratory Measurement Uncertainty	
Measurement uncertainty	± 2.64 dB

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

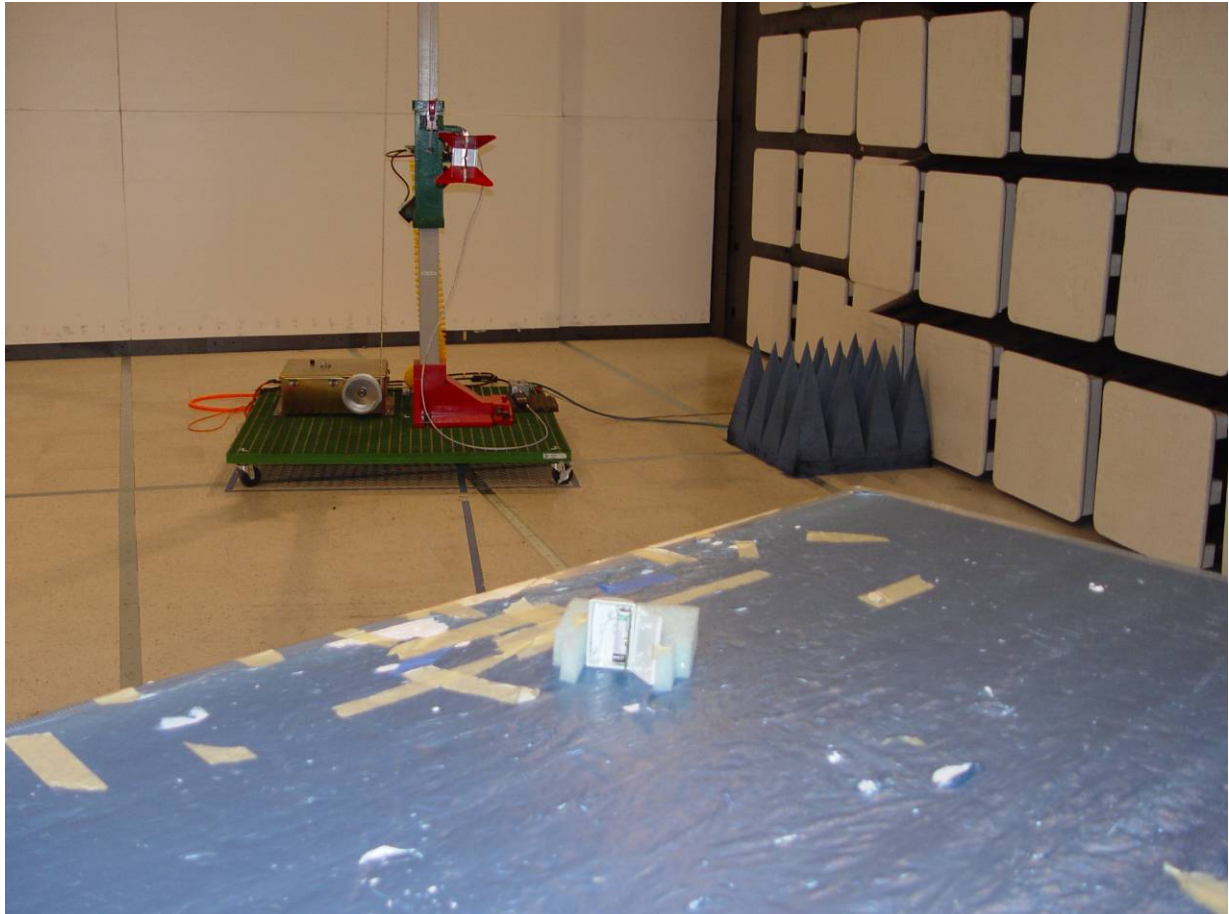
8.1 Conducted RF Measurement Set Up



8.2 Radiated Spurious Emissions Above 1 GHz - ZES Antenna



8.3 Radiated Spurious Emissions Above 1 GHz - Taoglas Flexible Antenna



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9 TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0075	Environmental Chamber	Thermatron	SE-300-2-2	27946
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0287	EMI Receiver	Rhode & Schwartz	ESIB 40	100201
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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