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;**

**MiCOM Labs, Inc.**
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
www.micomlabs.com


CERTIFICATE #2381.01

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

# TABLE OF CONTENTS

# 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

## 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)<br>Bureau of Standards, Metrology and Inspection (BSMI) | I<br>I | |
| Vietnam | Ministry of Information and Communications | I | |

# 2 DOCUMENT HISTORY

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

# 3 TEST RESULT CERTIFICATE

| | | | |
|---|---|---|---|
| Applicant: | Zebra Enterprise Solutions Corp<br>2940 N. First Street<br>San Jose<br>CA , 95134, USA | Tested By: | MiCOM Labs, Inc.<br>440 Boulder Court<br>Suite 200<br>Pleasanton<br>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.

ACCREDITED
CERTIFICATE #2381.01

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

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

# 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<br>Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics |
| **ix.** | A2LA | 14th September 2005 | Reference to A2LA Accreditation Status – A2LA Advertising Policy |

## 4.2 Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

# 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*

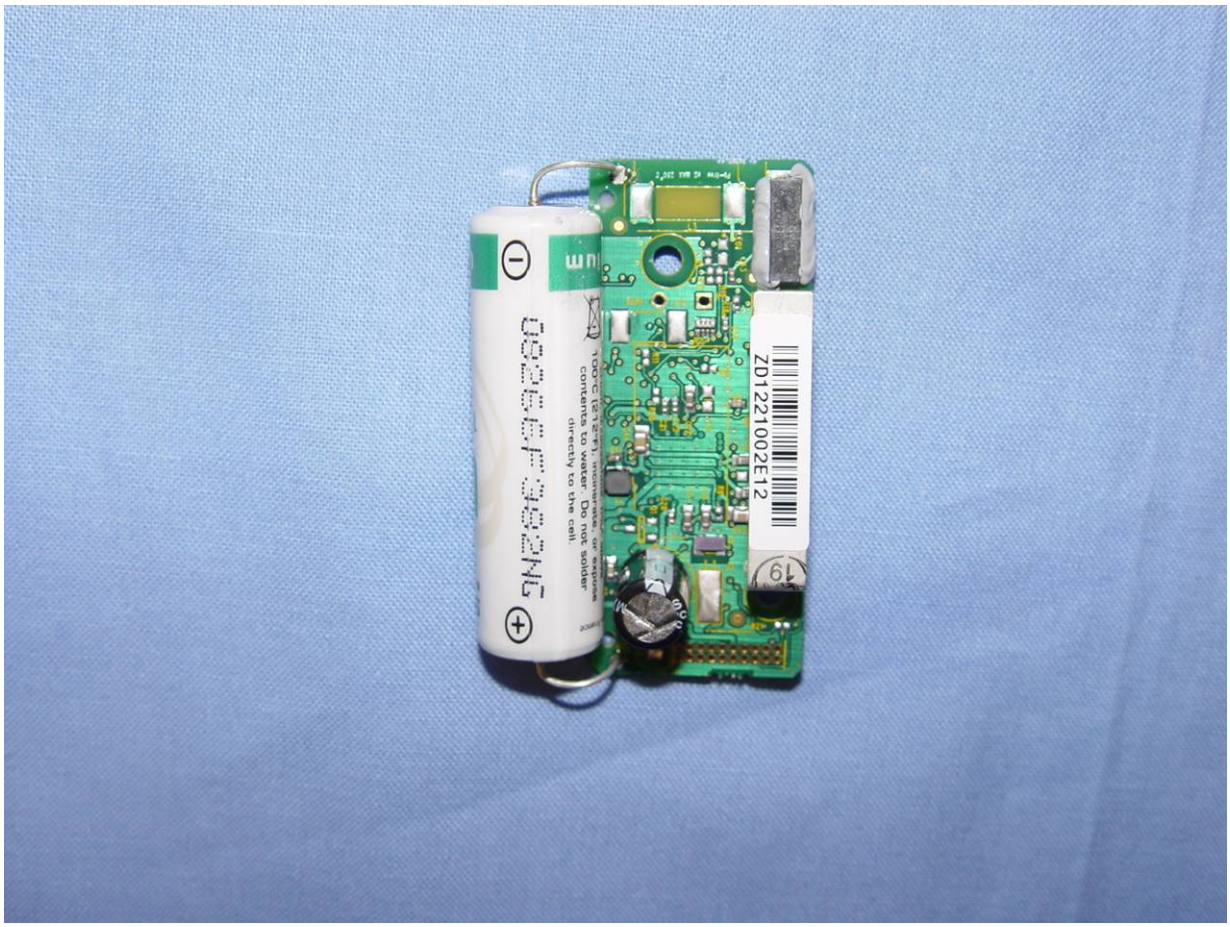
# 6 PRODUCT DETAILS AND TEST CONFIGURATIONS

## 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

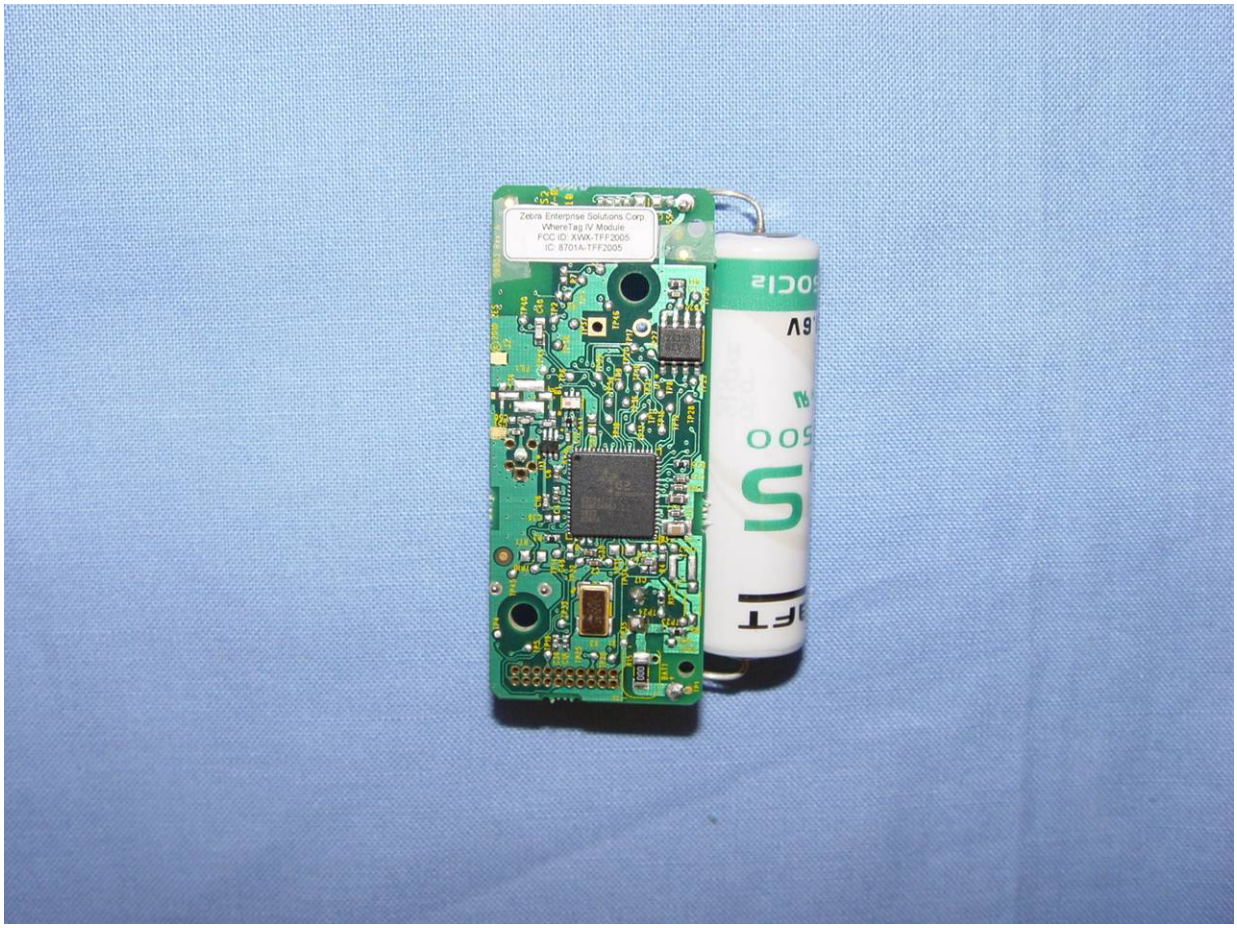
**Applicant:** Zebra Enterprise Solutions Corp

**Product:** WhereTag IV Module



**Applicant:** Zebra Enterprise Solutions Corp

**Product:** WhereTag IV Module



## 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<br>2940 N. First Street<br>San Jose<br>CA , 95134, USA |
| Manufacturer: | As Applicant |
| Test Laboratory: | MiCOM Labs, Inc.<br>440 Boulder Court, Suite 200<br>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 |
| AutomaticTransmit 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<br>Max: 3.7V<br>Min: 3.0V<br>Current: 0.2 (A) |
| Operating Temperature Range ºC: | Min: -30 Max: 70 |

| | |
|---|---|
| ITU Emission Designator(s): | 802.11b: 17M7W7D<br>802.11g: 24M5D1D<br>ISO 24730 DSSS: 44M4W7D<br>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 |

## 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 |

## 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:

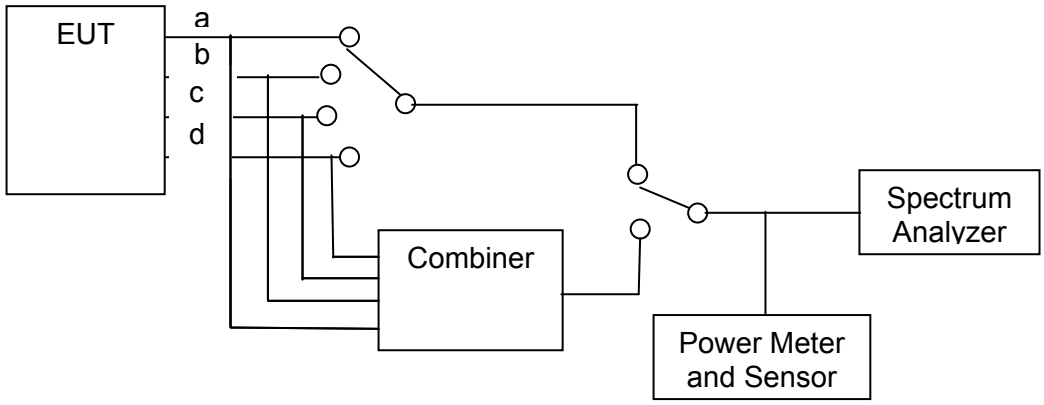
- No deviations required.

# 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)<br>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 |

### 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. (ºC):** | 19 to 22 | |
| **TPC:** | HIGH | | **Pressure (mBars):** | 998 to 1003 | |
| **Modulation:** | ON | | **Duty Cycle (%):** | 100 | |
| **Beam Forming Gain (Y):** | N/A | dB | **Antenna Gain:** | 2 | dBi |
| **Applied Voltage:** | 3.6V | Vdc | | | |
| **Notes 1:** | | | | | |
| **Notes 2:** | | | | | |

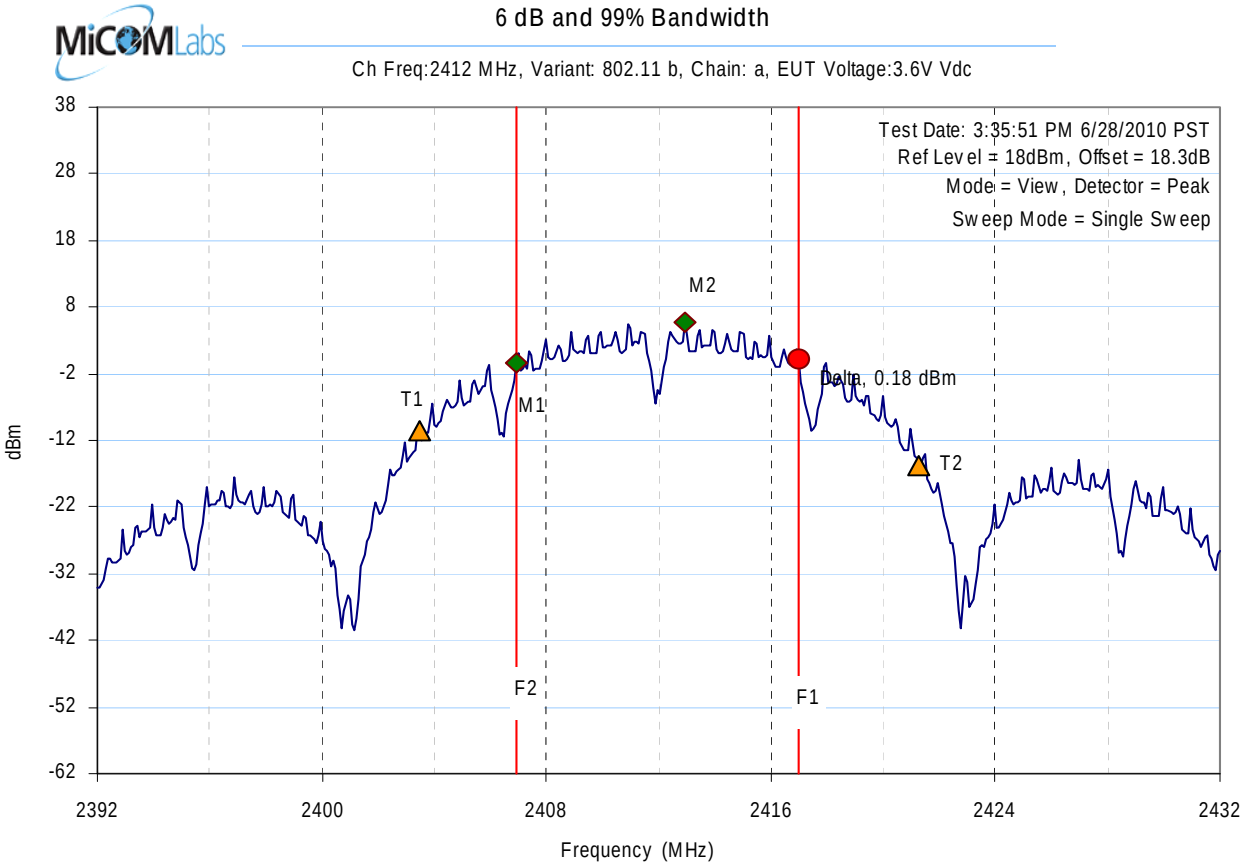
***6 dB Bandwidth***

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

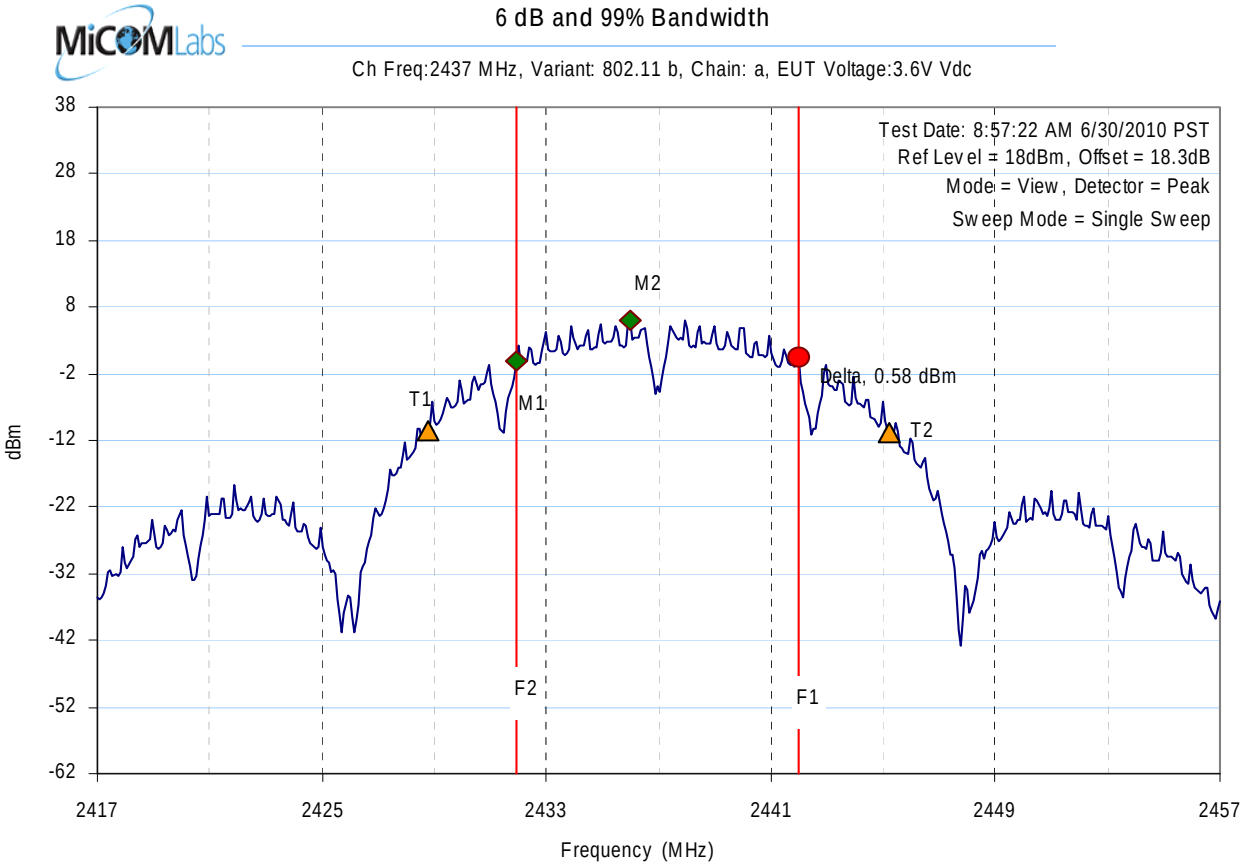
***99% Bandwidth***

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

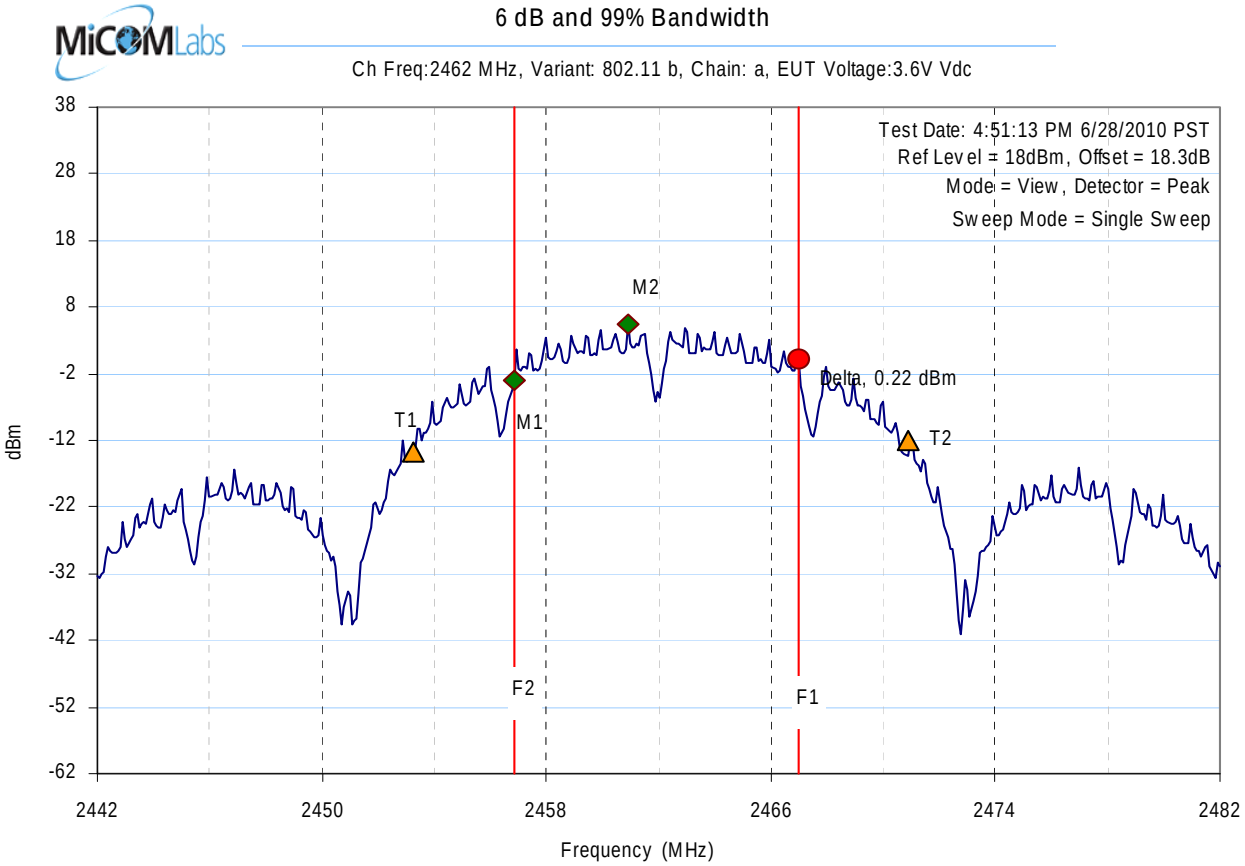
| | |
|---|---|
| **Measurement uncertainty:** | ±2.81 dB |




| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 100.00KHz | M1 : 2406.909820MHz : -.353dBm | Center frequency = 2412MHz |
| VBW = 300.00KHz | M2 : 2412.921844MHz : 5.765dBm | 6dB BW(Delta-M1) = 10.100200MHz |
| Sweep time(s) = 20 | Delta : 2417.010020MHz : .184dBm | 99% OBW(T2-T1) = 17.875752MHz |
| RF Atten (dB) = 10 | T1 : 2403.462926MHz : -10.493dBm | |
| Span = 40.00MHz | T2 : 2421.258517MHz : -15.815dBm | |




| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 100.00KHz | M1 : 2431.909820MHz : -.226dBm | Center frequency = 2437MHz |
| VBW = 300.00KHz | M2 : 2435.997996MHz : 6.147dBm | 6dB BW(Delta-M1) = 10.100200MHz |
| Sweep time(s) = 20 | Delta : 2442.010020MHz : .577dBm | 99% OBW(T2-T1) = 16.513026MHz |
| RF Atten (dB) = 10 | T1 : 2428.783567MHz : -10.586dBm | |
| Span = 40.00MHz | T2 : 2445.216433MHz : -10.773dBm | |




| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 100.00KHz | M1 : 2456.829659MHz : -2.880dBm | Center frequency = 2462MHz |
| VBW = 300.00KHz | M2 : 2460.917836MHz : 5.322dBm | 6dB BW(Delta-M1) = 10.180361MHz |
| Sweep time(s) = 20 | Delta : 2467.010020MHz : .221dBm | 99% OBW(T2-T1) = 17.715431MHz |
| RF Atten (dB) = 10 | T1 : 2453.222445MHz : -13.676dBm | |
| Span = 40.00MHz | T2 : 2470.857715MHz : -12.073dBm | |

### 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. (ºC):** | 19 to 22 | |
| **TPC:** | HIGH | | **Pressure (mBars):** | 998 to 1003 | |
| **Modulation:** | ON | | **Duty Cycle (%):** | 100 | |
| **Beam Forming Gain (Y):** | N/A | dB | **Antenna Gain:** | 2 | dBi |
| **Applied Voltage:** | 3.6V | Vdc | | | |
| **Notes 1:** | | | | | |
| **Notes 2:** | | | | | |

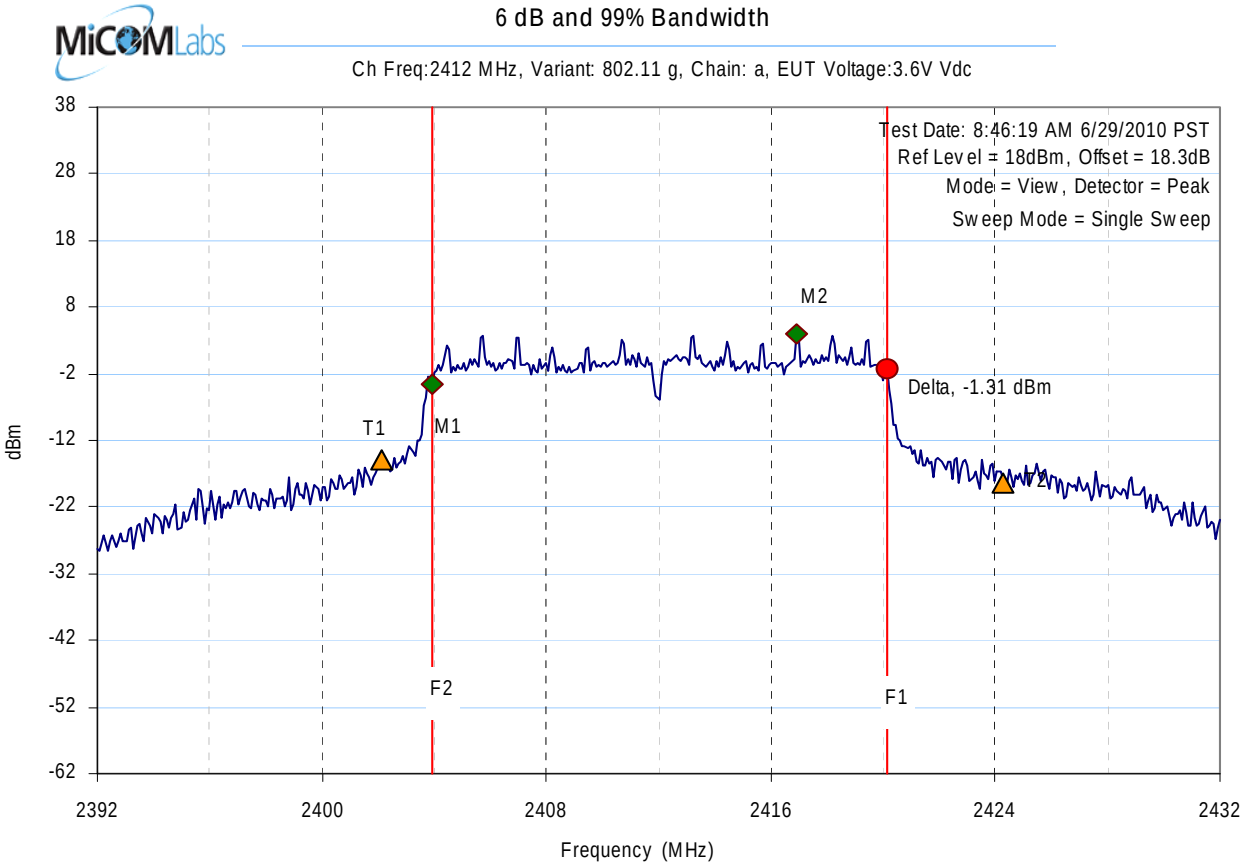
***6 dB Bandwidth***

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

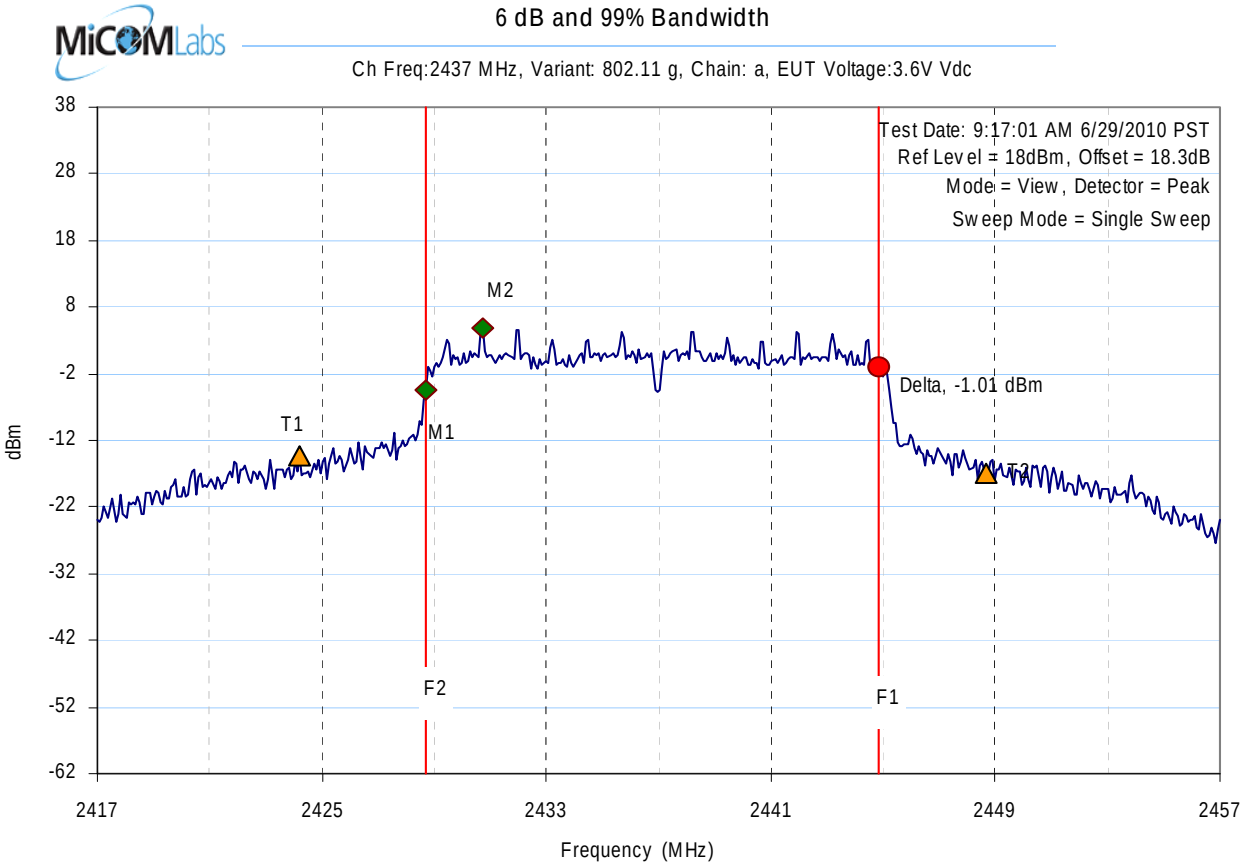
***99% Bandwidth***

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

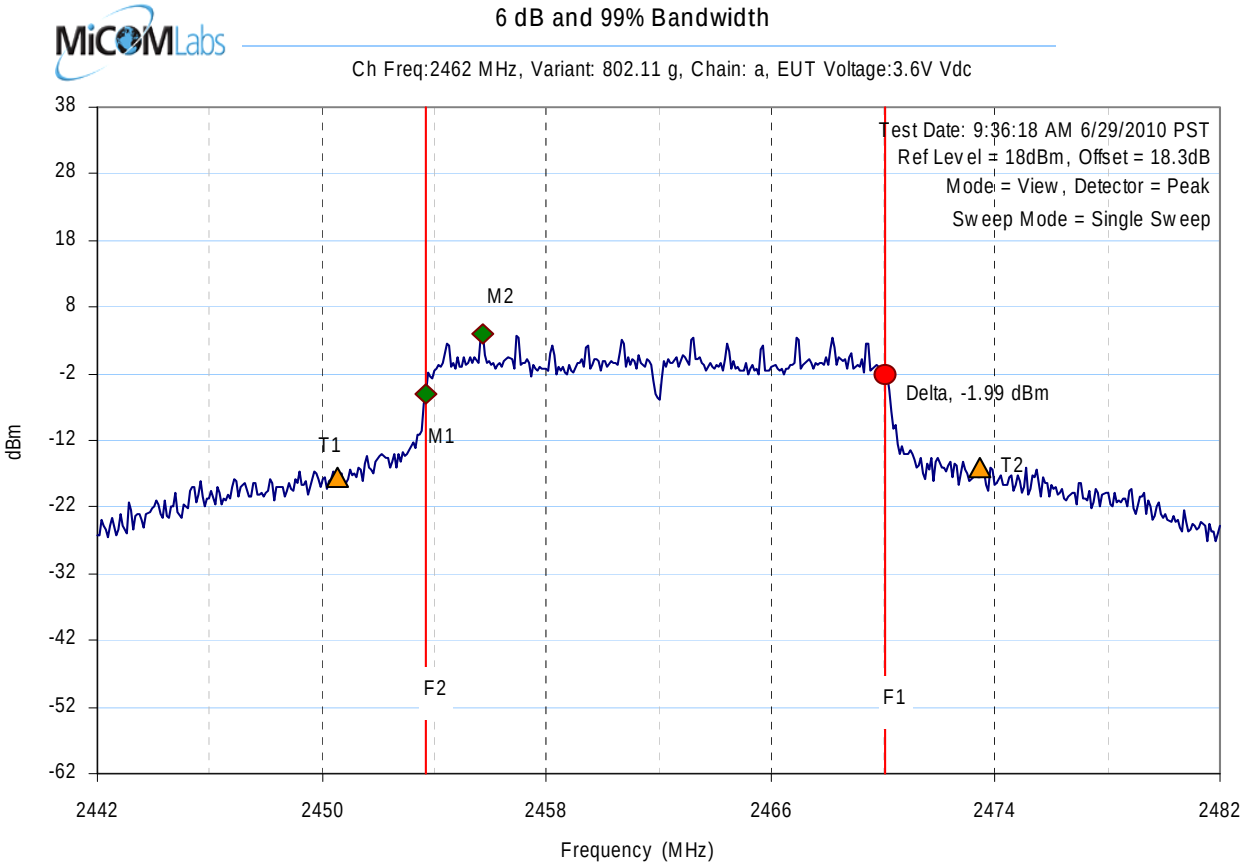
| | |
|---|---|
| **Measurement uncertainty:** | ±2.81 dB |




| 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 | |




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




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

### 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 | |
| **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 | | | | | | |
| **MHz** | **a** | **b** | **c** | **d** | **kHz** | **MHz** | **MHz** |
| 2441.75 | 22.557114 | – | – | – | 500 | 0.5 | -22.057114 |

***99% Bandwidth***

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

| | |
|---|---|
| **Measurement uncertainty:** | ±2.81 dB |

### 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:** | | | | | |

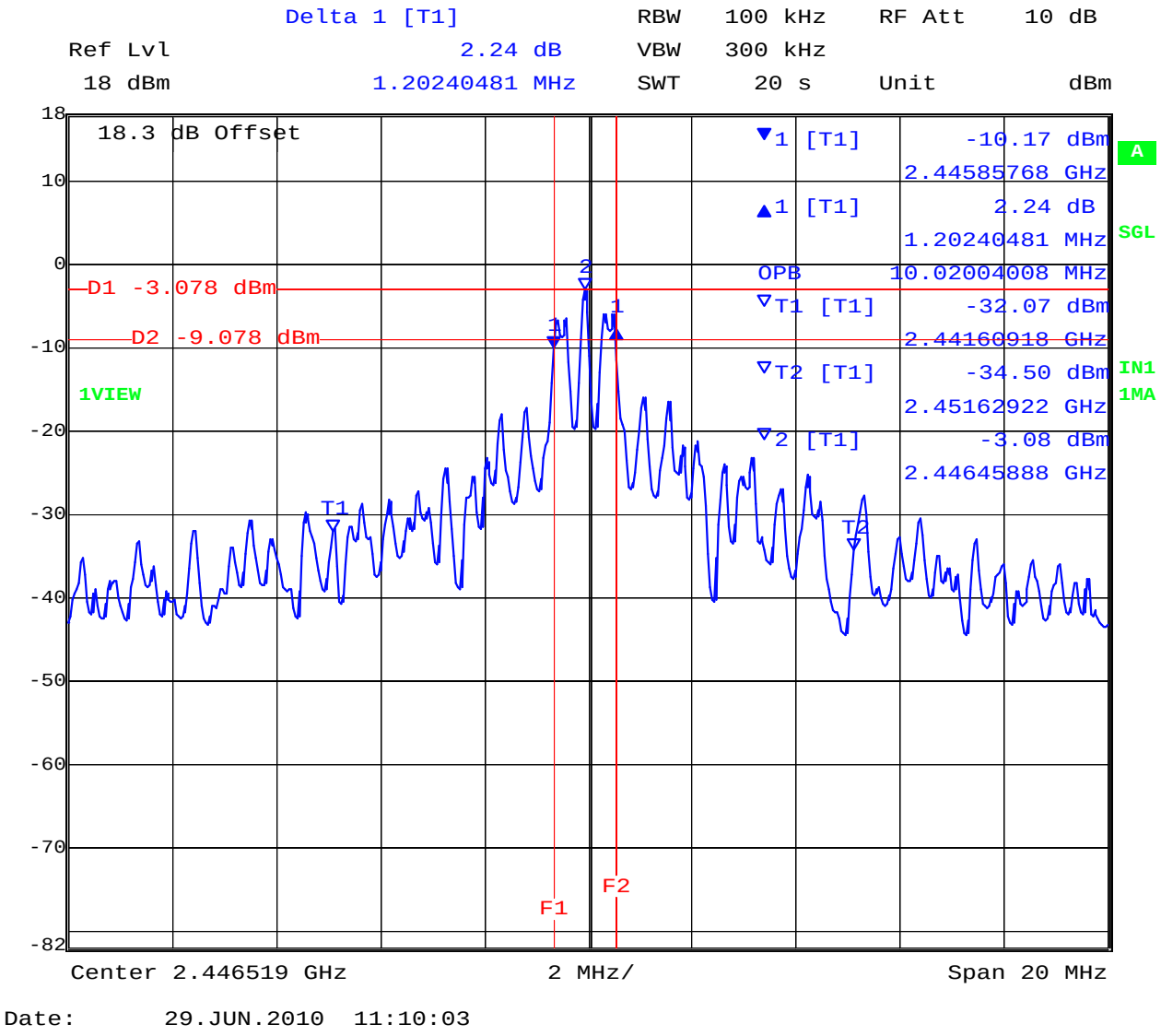
***6 dB Bandwidth***

| Test Frequency | 6 dB Bandwidth MHz | | | | Minimum 6dB Bandwidth Limit | | Margin |
|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **kHz** | **MHz** | **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 |




Date: 29.JUN.2010 11:10:03

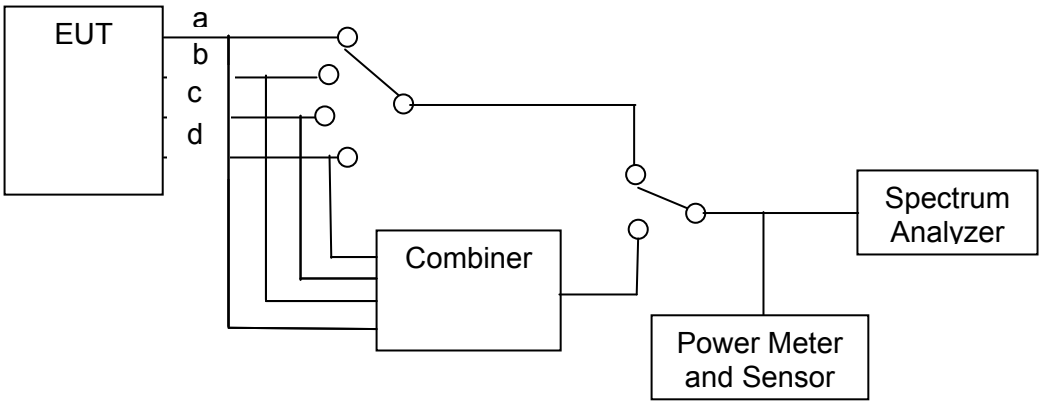
## 7.2 Peak Output Power

**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

## 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 |

### 7.2.1 Measurement Results: 802.11 b

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

| Test Frequency | Measured Peak Power RF Port (dBm) | | | | Total Power (dBm) | | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | Combined | Calculated | dBm | dB |
| 2412 | 14.00 | -- | -- | -- | | 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 |
|---|---|

### 7.2.2 Measurement Results: 802.11 g

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

| Test Frequency | Measured Peak Power RF Port (dBm) | | | | Total Power (dBm) | | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | Combined | Calculated | dBm | dB |
| 2412 | 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 |
|---|---|

### 7.2.3 Measurement Results: DSSS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Test Conditions:** | 15.247 (b) | | | | **Rel. Humidity (%):** | 35 | to | 42 | |
| **Variant:** | ISO 24730 DSSS | | | | **Ambient Temp. (ºC):** | 19 | to | 22 | |
| **TPC:** | HIGH | | | | **Pressure (mBars):** | 998 | to | 1003 | |
| **Modulation:** | ON | | | | **Duty Cycle (%):** | 100 | | | |
| **Beam Forming Gain** | N/A | dB | | | **Antenna Gain:** | 2 | dBi | | |
| **Applied Voltage:** | 3.6V | Vdc | | | | | | | |
| **Notes 1:** | | | | | | | | | |
| **Notes 2:** | | | | | | | | | |

| **Test Frequency** | **Measured Peak Power RF Port (dBm)** | | | | **Total Power (dBm)** | | **Limit** | **Margin** |
|---|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **Combined** | **Calculated** | **dBm** | **dB** |
| 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. (ºC):** | 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 RF Port (dBm)** | | | | **Total Power (dBm)** | | **Limit** | **Margin** |
|---|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **Combined** | **Calculated** | **dBm** | **dB** |
| 2442 | 1.27 | -- | -- | -- | | 1.27 | 30.00 | -28.73 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

## 7.3 Peak Power Spectral Density

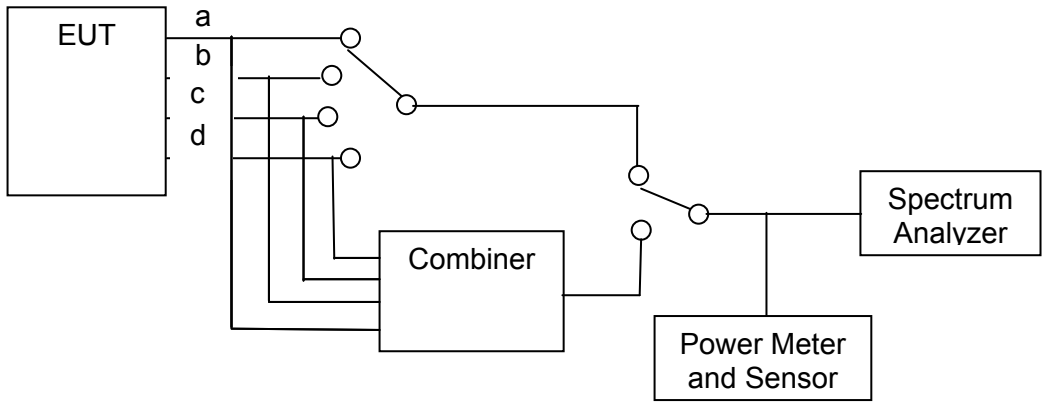
**Test Procedure**

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**

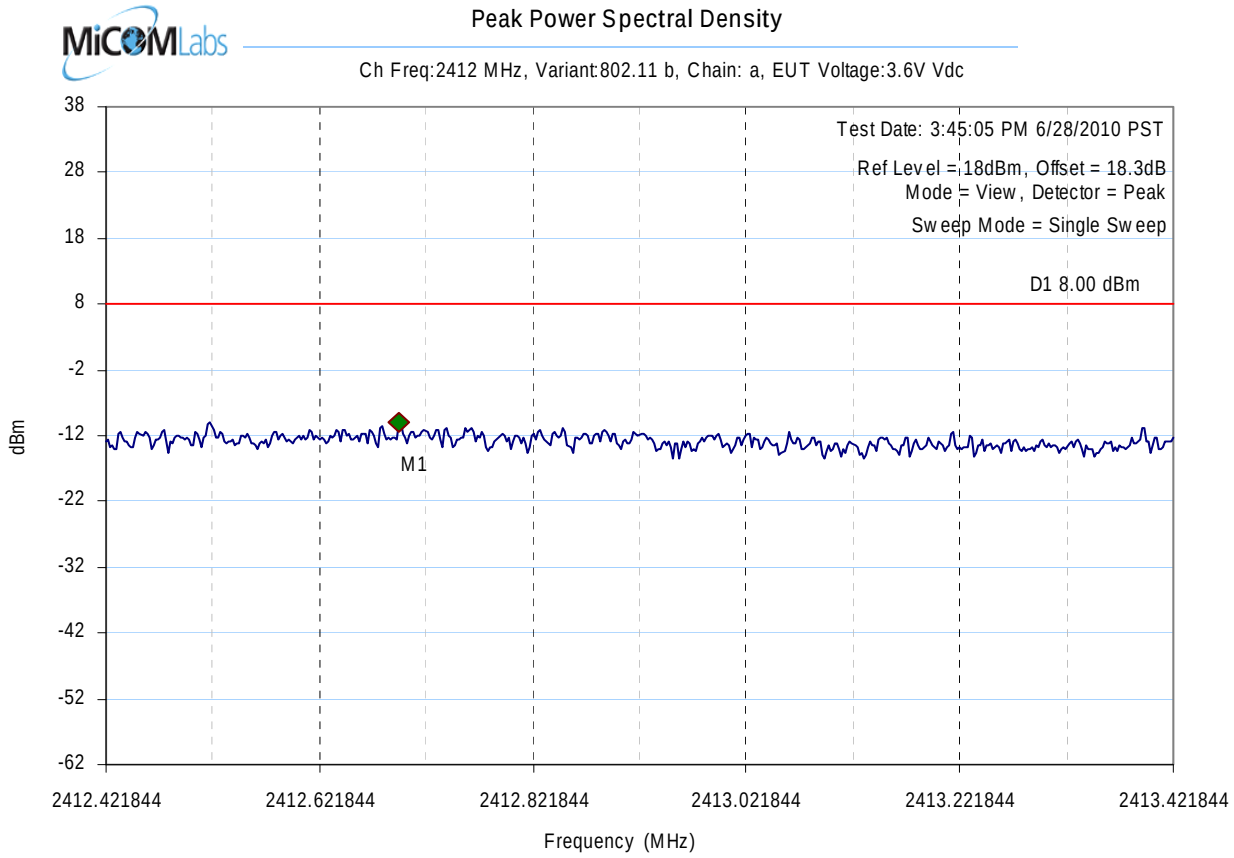
| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-01 'Measuring RF Output Power' | 0158, 0252, 0313, 0314, 0223, 0116, 0117, 0287, 0363 |

### 7.3.1 Measurement results for 802.11 b

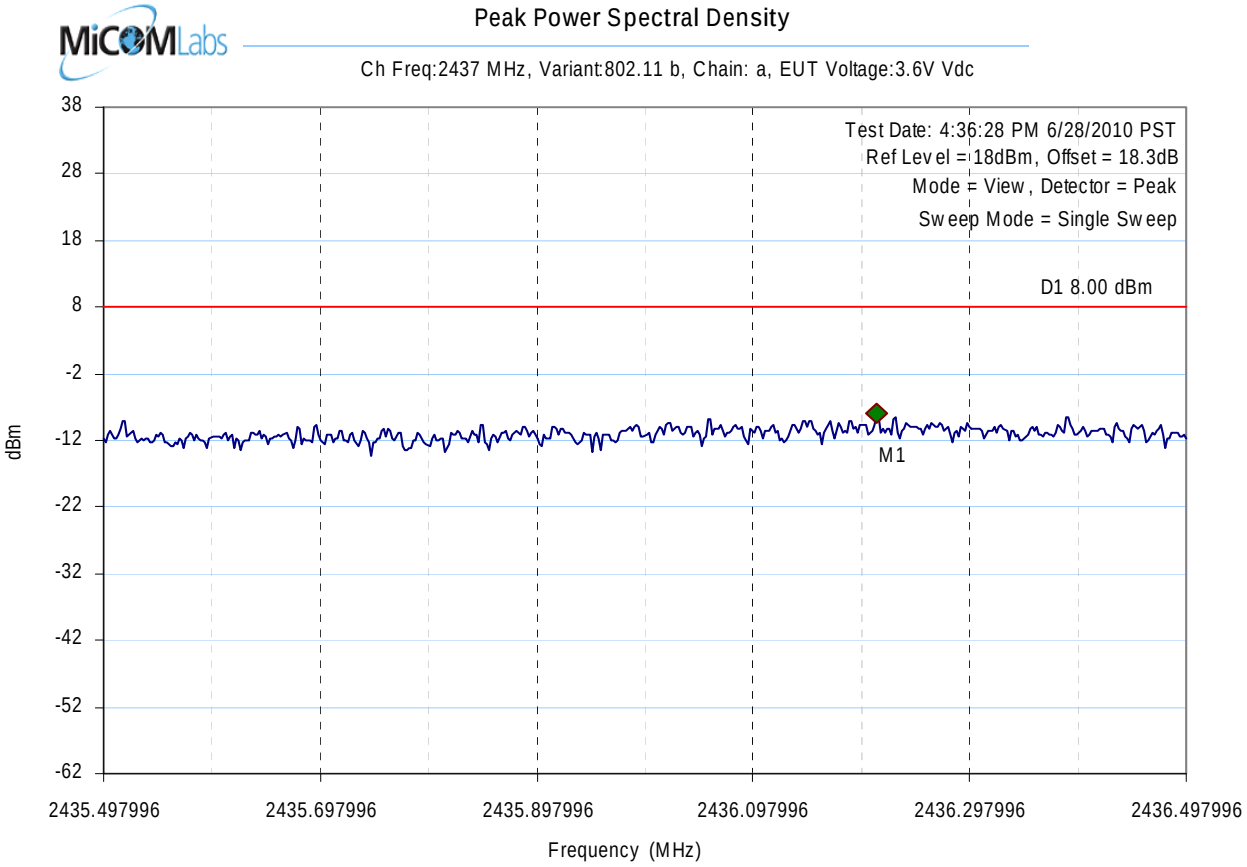
| | | | | | |
|---|---|---|---|---|---|
| **Test Conditions:** | 15.247 (e) | | **Rel. Humidity (%):** | 35 to 42 | |
| **Variant:** | 802.11 b | | **Ambient Temp. (ºC):** | 19 to 22 | |
| **TPC:** | HIGH | | **Pressure (mBars):** | 998 to 1003 | |
| **Modulation:** | ON | | **Duty Cycle (%):** | 100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

| Test Frequency | Measured Power Density RF Port (dBm) | | | | Total Peak Power Spectral Density (dBm) | | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **Combined** | **Calculated** | **dBm** | **dB** |
| 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 |

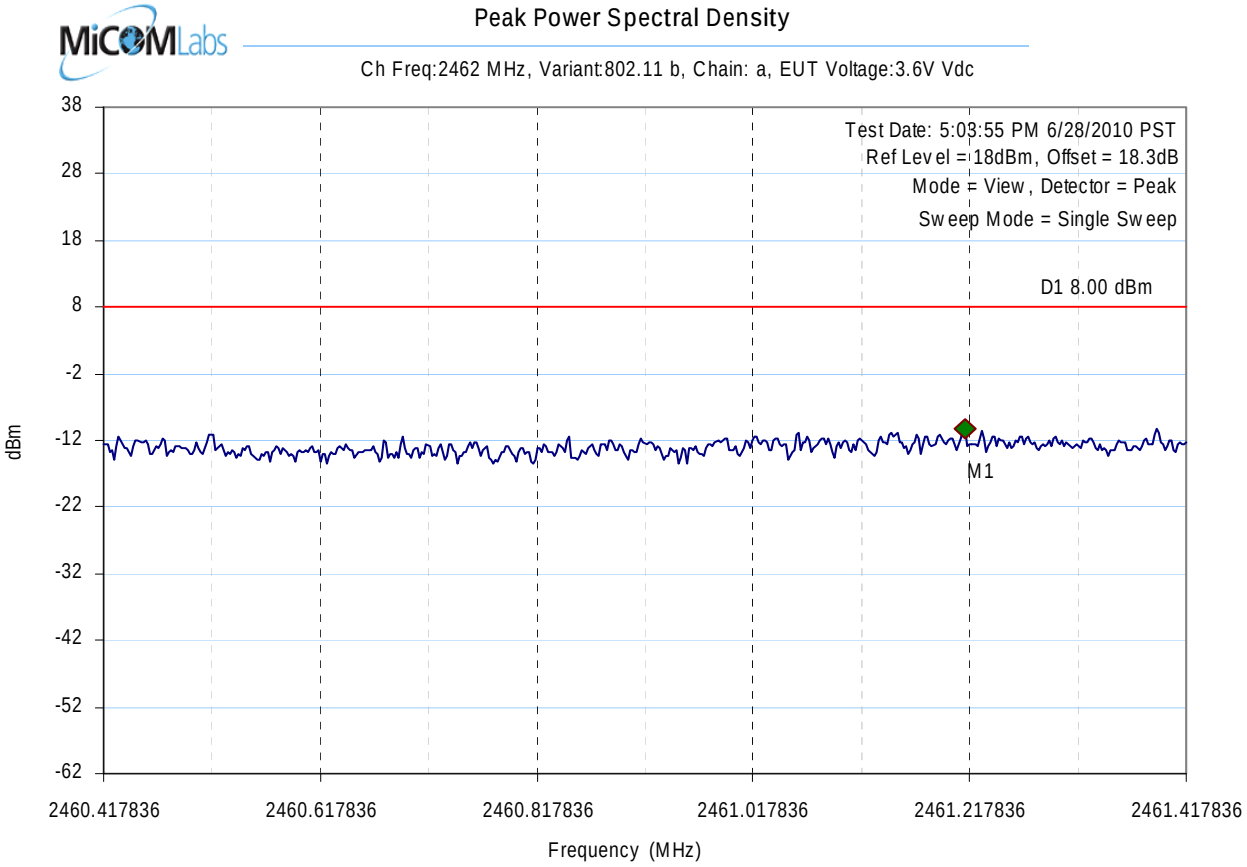
| **Measurement uncertainty:** | ± 1.33 dB |
|---|---|




| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 3.00KHz | M1 : 2412.696393MHz : -9.870dBm | Center frequency = 2412MHz |
| VBW = 10.00KHz | | |
| Sweep time(s) = 350 | | |
| RF Atten (dB) = 20 | | |
| Span = 1.00MHz | | |




| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 3.00KHz | M1 : 2436.211423MHz : -7.949dBm | Center frequency = 2437MHz |
| VBW = 10.00KHz | | |
| Sweep time(s) = 350 | | |
| RF Atten (dB) = 20 | | |
| Span = 1.00MHz | | |



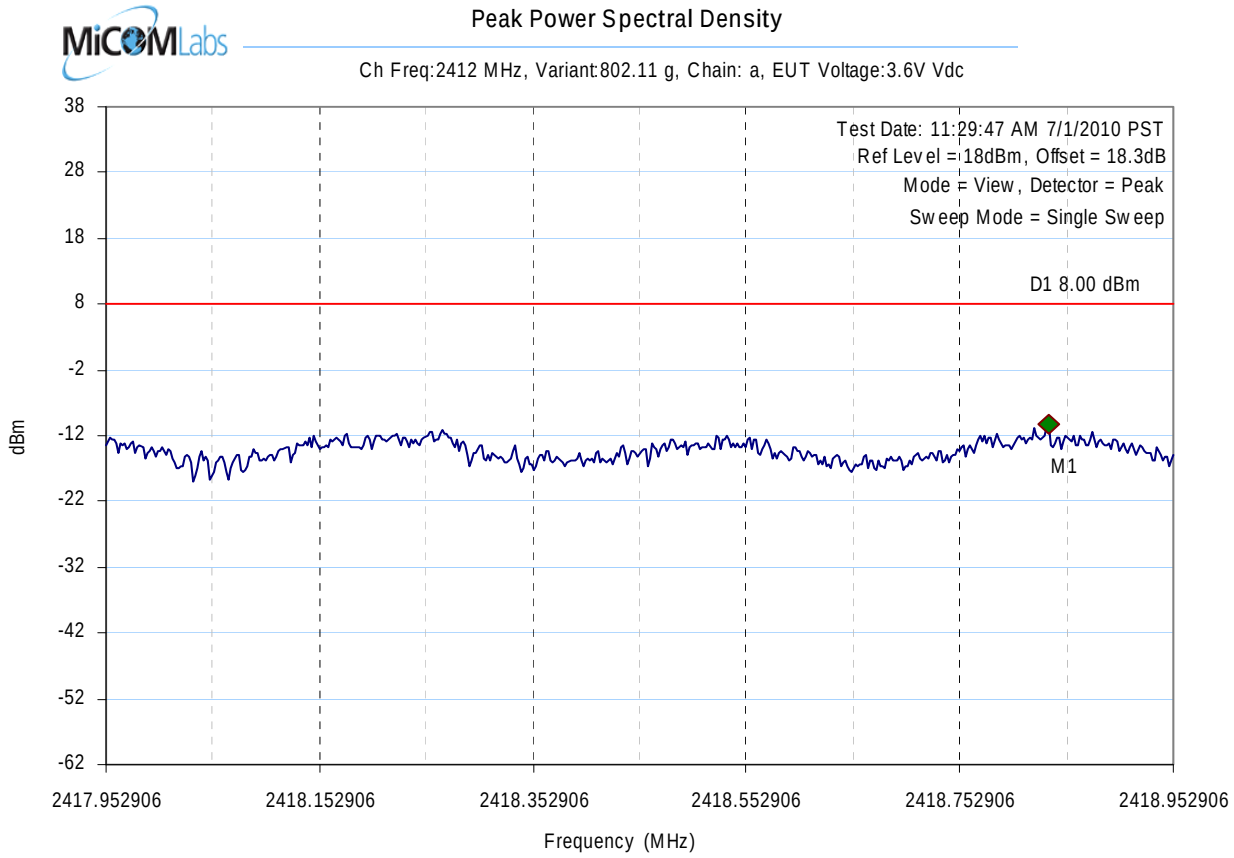

| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 3.00KHz | M1 : 2461.213427MHz : -10.119dBm | Center frequency = 2462MHz |
| VBW = 10.00KHz | | |
| Sweep time(s) = 350 | | |
| RF Atten (dB) = 20 | | |
| Span = 1.00MHz | | |

### 7.3.2 Measurement results for 802.11 g

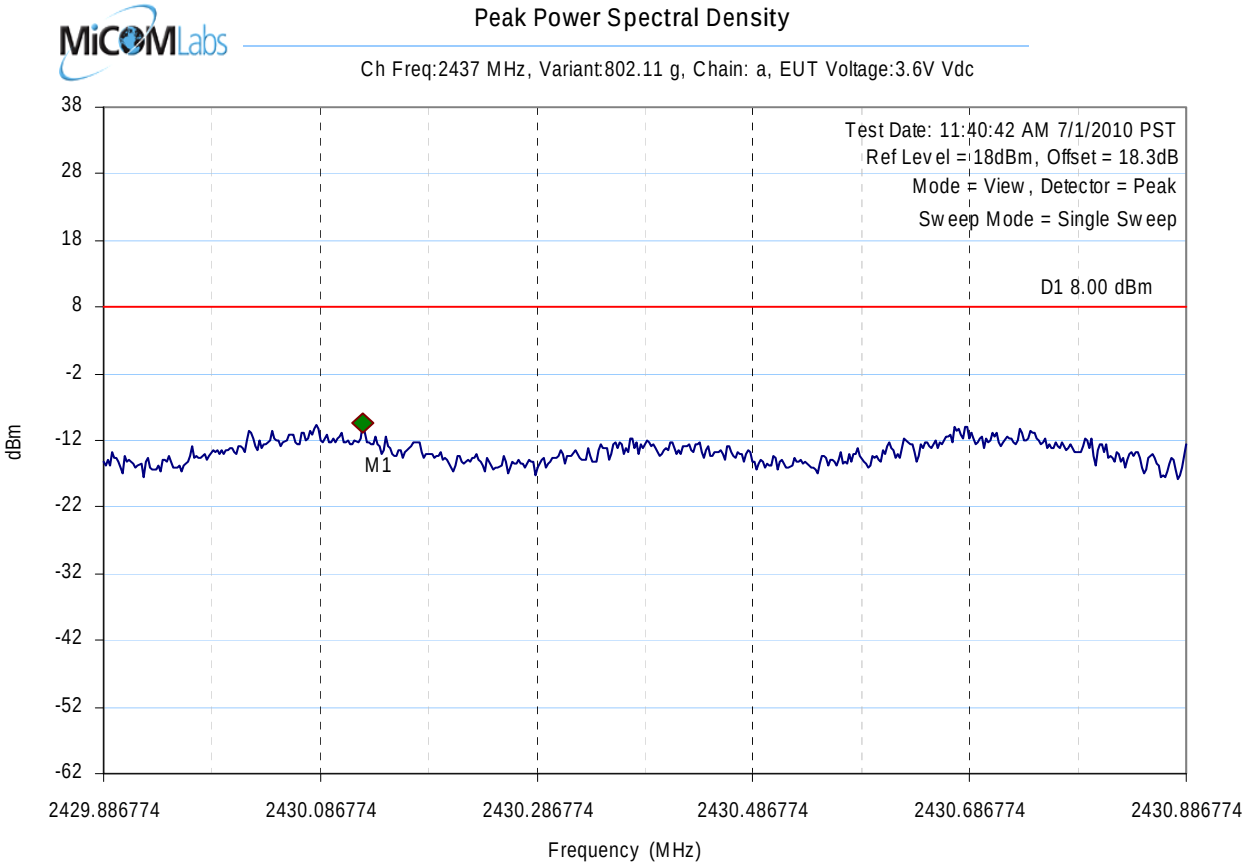
| | | | | | |
|---|---|---|---|---|---|
| **Test Conditions:** | 15.247 (e) | | **Rel. Humidity (%):** | 35 to 42 | |
| **Variant:** | 802.11 g | | **Ambient Temp. (ºC):** | 19 to 22 | |
| **TPC:** | HIGH | | **Pressure (mBars):** | 998 to 1003 | |
| **Modulation:** | ON | | **Duty Cycle (%):** | 100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

| Test Frequency | Measured Power Density RF Port (dBm) | | | | Total Peak Power Spectral Density (dBm) | | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **Combined** | **Calculated** | **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 |

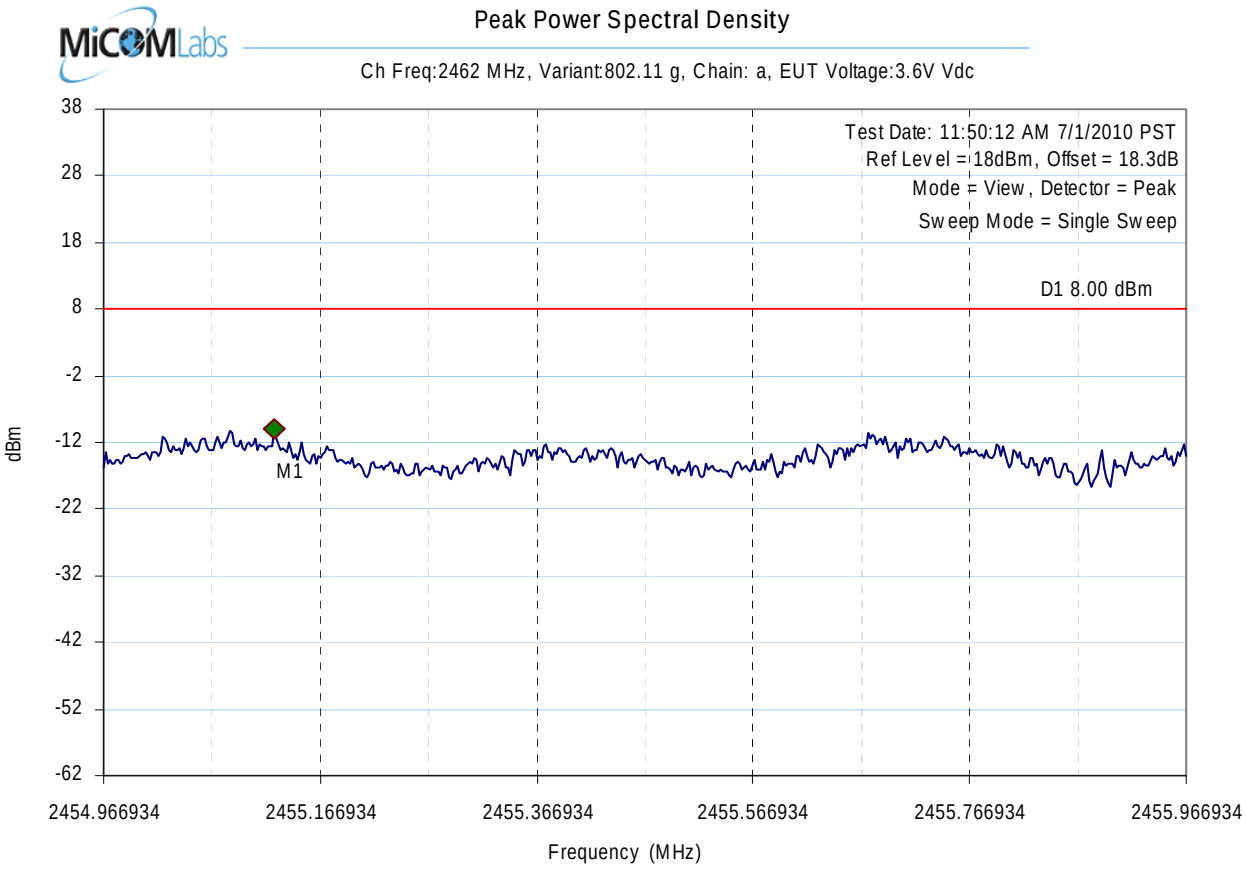
| | |
|---|---|
| **Measurement uncertainty:** | ± 1.33 dB |




| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 3.00KHz | M1 : 2418.836673MHz : -10.359dBm | Center frequency = 2412MHz |
| VBW = 10.00KHz | | |
| Sweep time(s) = 350 | | |
| RF Atten (dB) = 20 | | |
| Span = 1.00MHz | | |

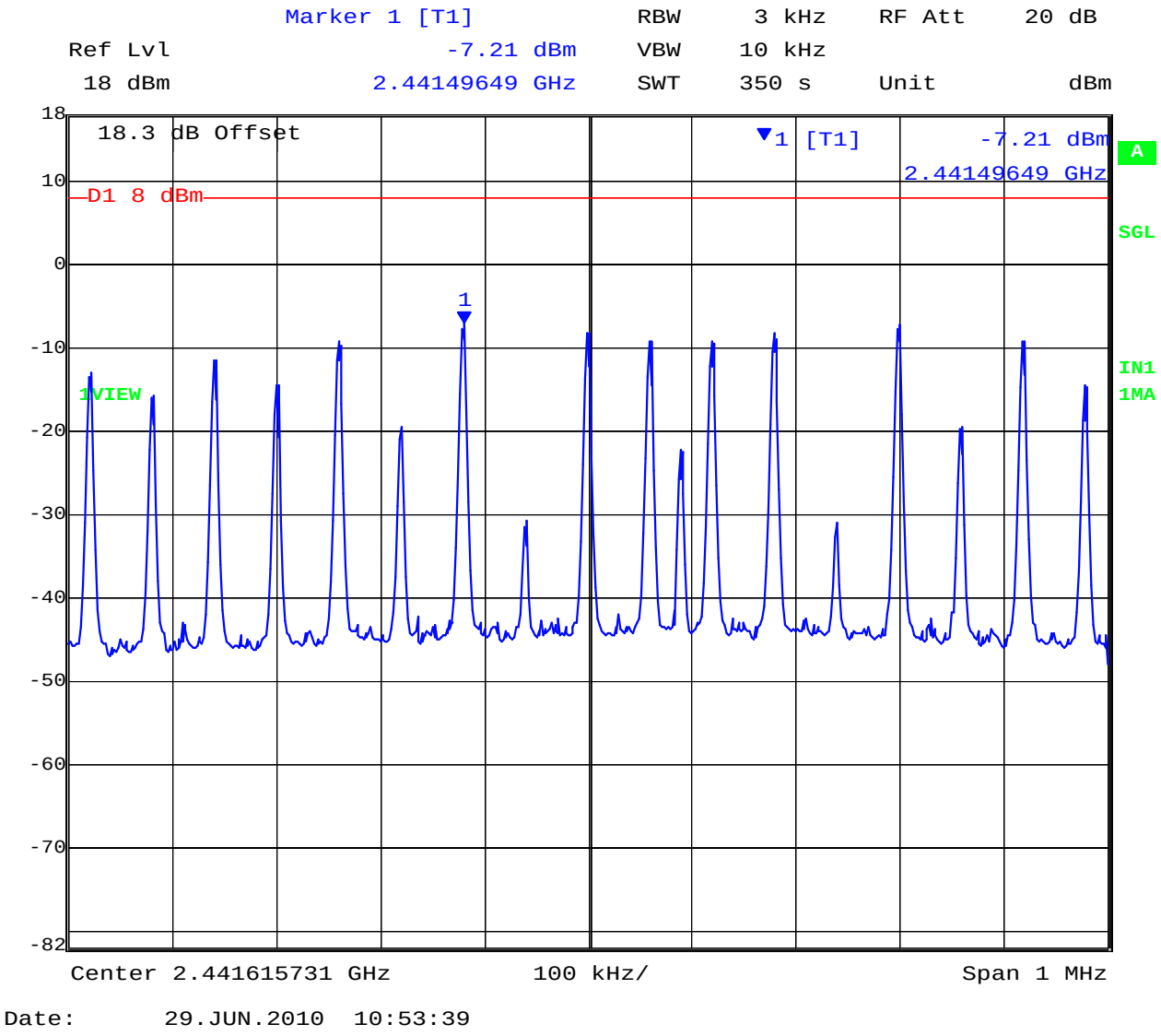



| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 3.00KHz | M1 : 2430.125251MHz : -9.317dBm | Center frequency = 2437MHz |
| VBW = 10.00KHz | | |
| Sweep time(s) = 350 | | |
| RF Atten (dB) = 20 | | |
| Span = 1.00MHz | | |

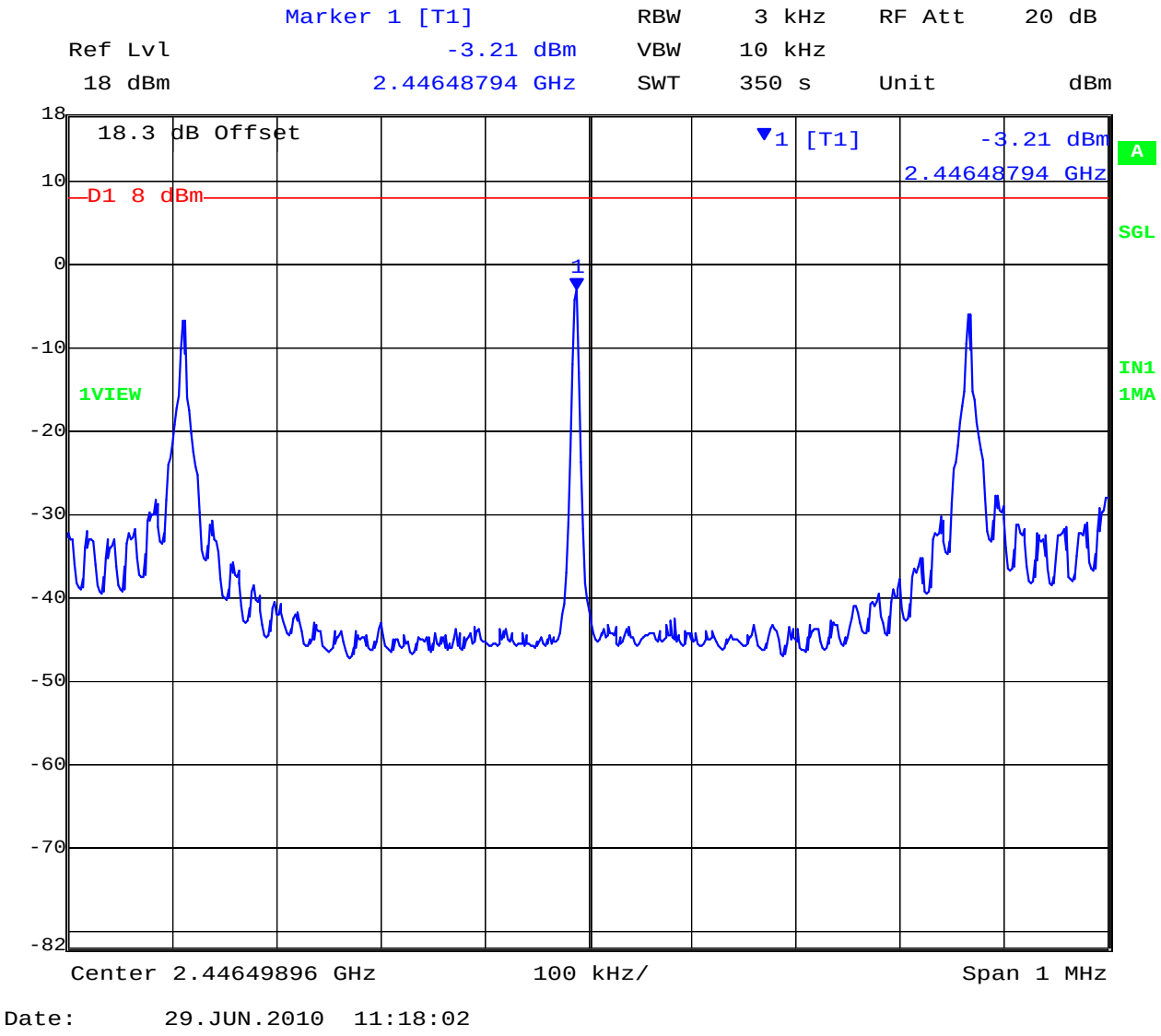



| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 3.00KHz | M1 : 2455.125251MHz : -9.982dBm | Center frequency = 2462MHz |
| VBW = 10.00KHz | | |
| Sweep time(s) = 350 | | |
| RF Atten (dB) = 20 | | |
| Span = 1.00MHz | | |

### 7.3.3 Measurement Results: DSSS



### 7.3.4 Measurement Results: OOK



## 7.4 Maximum Permissible Exposure

**NOT APPLICABLE TO EUT**

Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm2) = EIRP/(4πd2)
EIRP = P * G
P = Peak output power (mW)
G = Antenna numeric gain (numeric)
d = Separation distance (cm)
Numeric Gain = 10 ^ (G (dBi)/10)

The peak power in 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/cm2 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 |

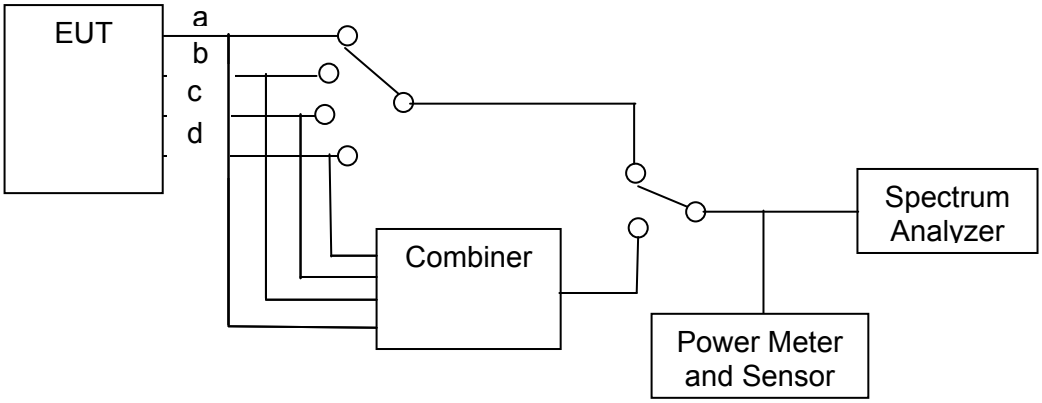
## 7.5 Conducted Spurious Emissions

**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

**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. |

### 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. (ºC):** | 19 | to | 22 |
| **TPC:** | HIGH | | **Pressure (mBars):** | 998 | to | 1003 |
| **Modulation:** | ON | | **Duty Cycle (%):** | 100 | | |
| **Beam Forming** | N/A | dB | **Antenna Gain:** | N/A | dBi | |
| **Applied** | 3.6V | Vdc | | | | |
| **Notes 1:** | | | | | | |
| **Notes 2:** | | | | | | |

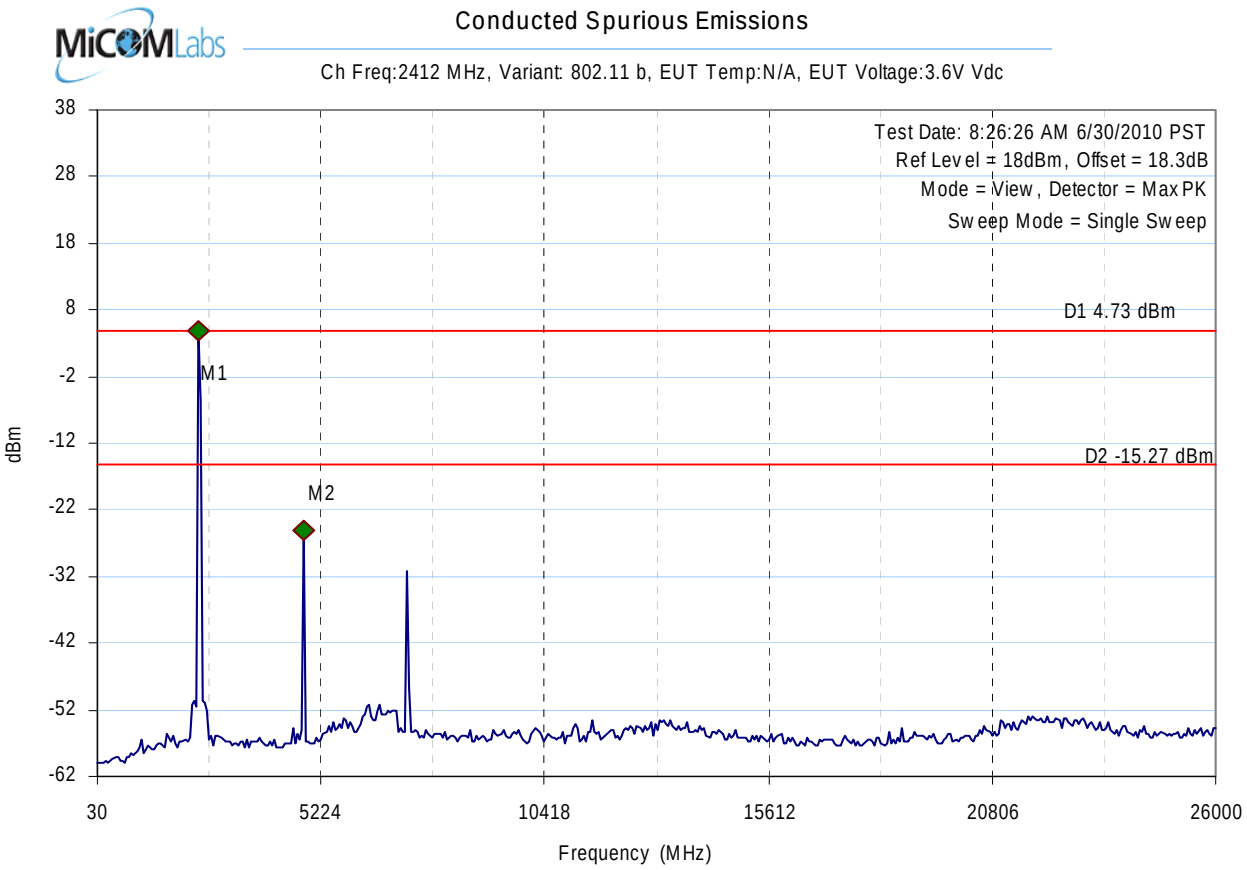
***Conducted Spurious Measurment***

| 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 |

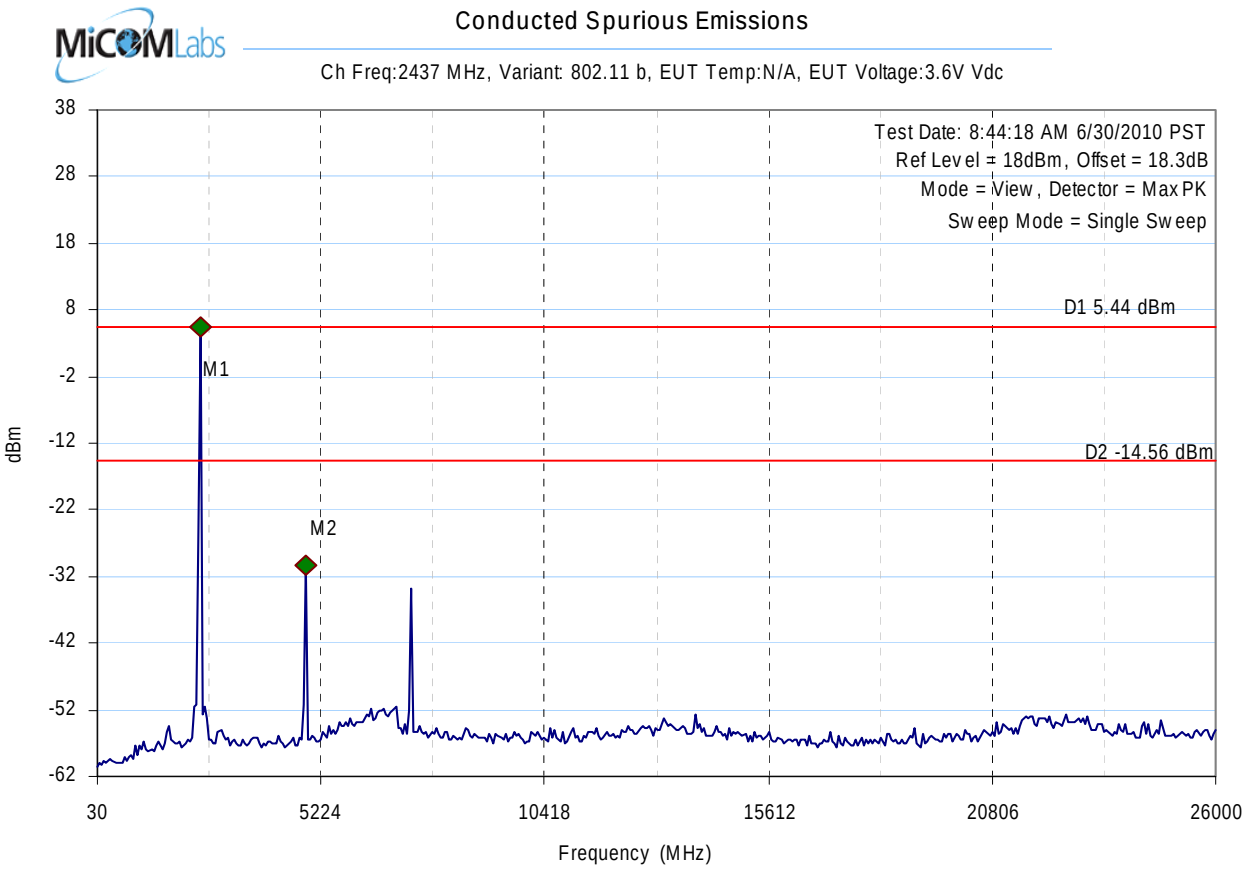
***Band-edge Measurment***

| 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 |

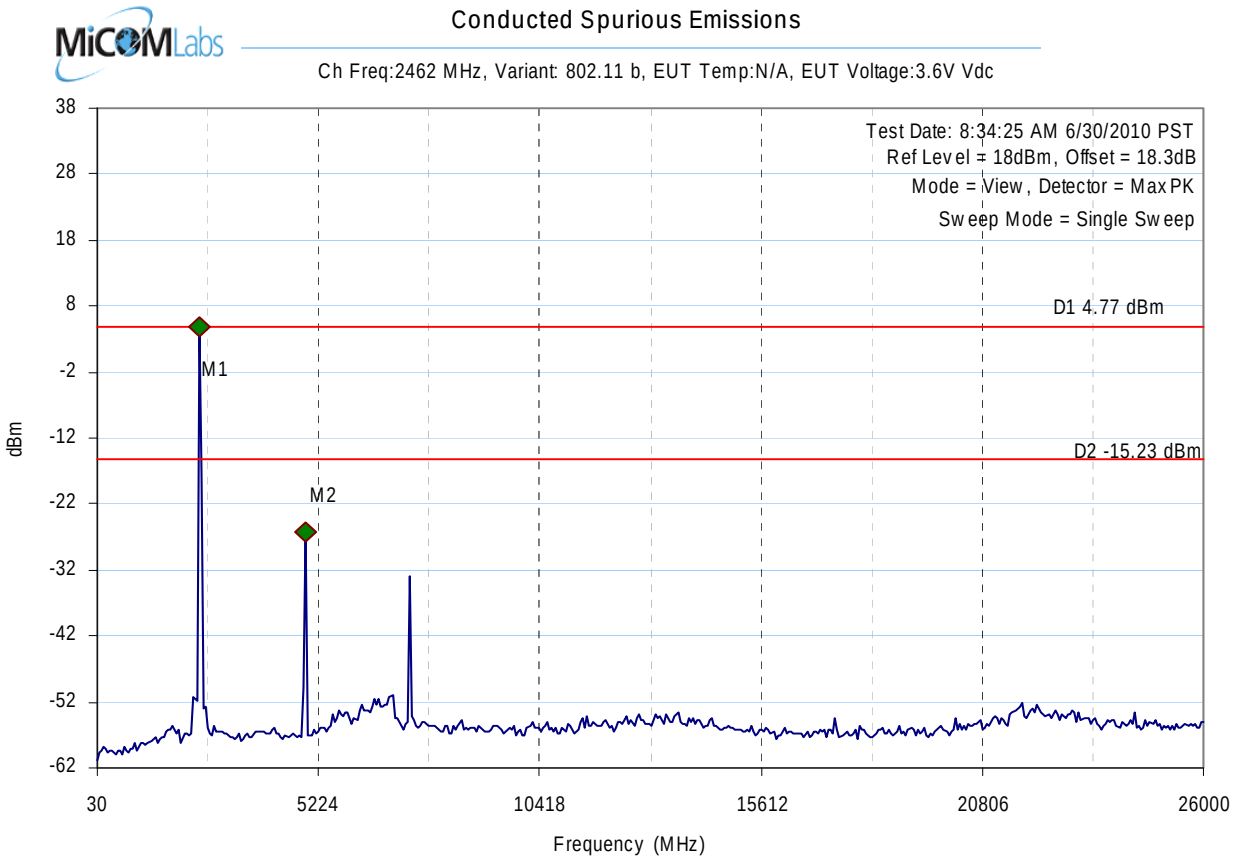
| | |
|---|---|
| **Measurement uncertainty:** | ±2.81 dB |



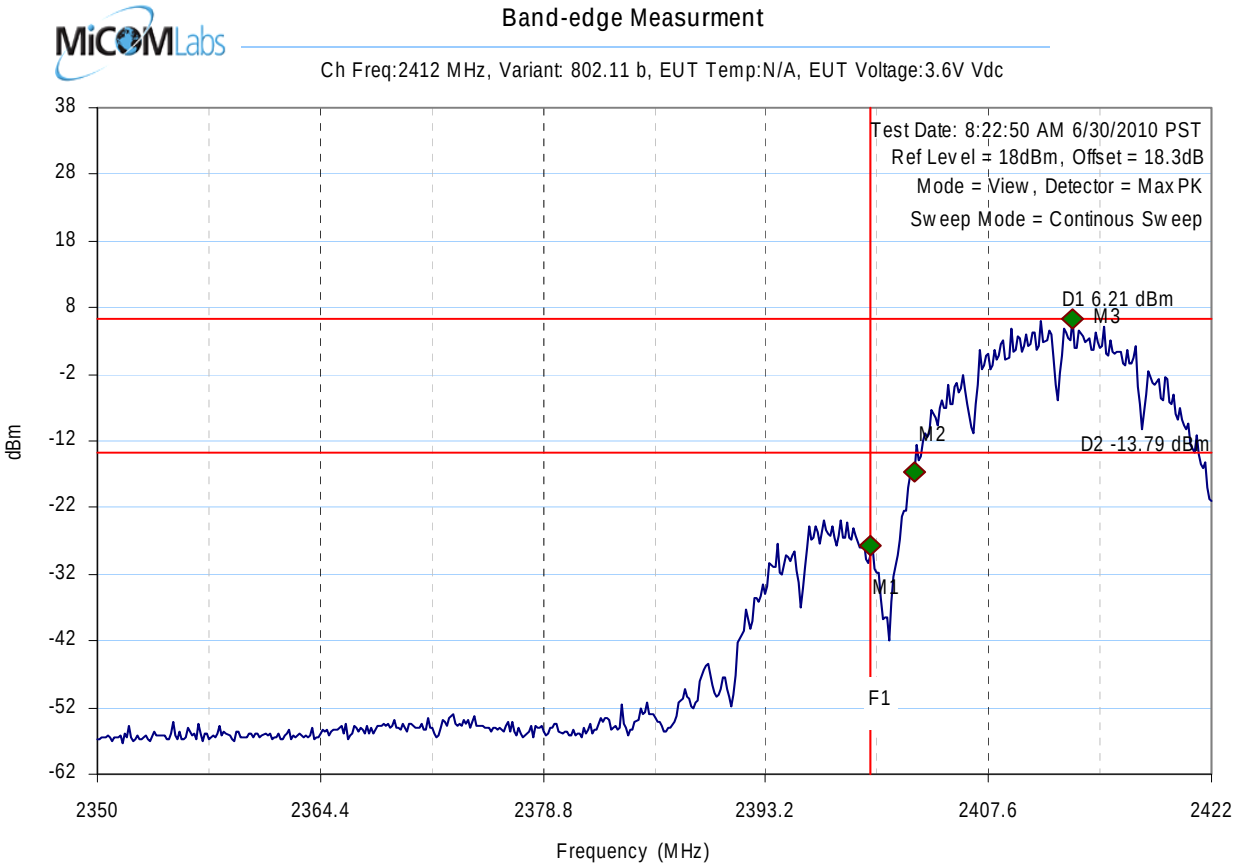

| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 100.00KHz | M1 : 2371.983968MHz : 4.728dBm | Center frequency = 2412MHz |
| VBW = 300.00KHz | M2 : 4818.056112MHz : -24.983dBm | |
| Sweep time(s) = 60 | | |
| RF Atten (dB) = 10 | | |
| Span = 25.97GHz | | |



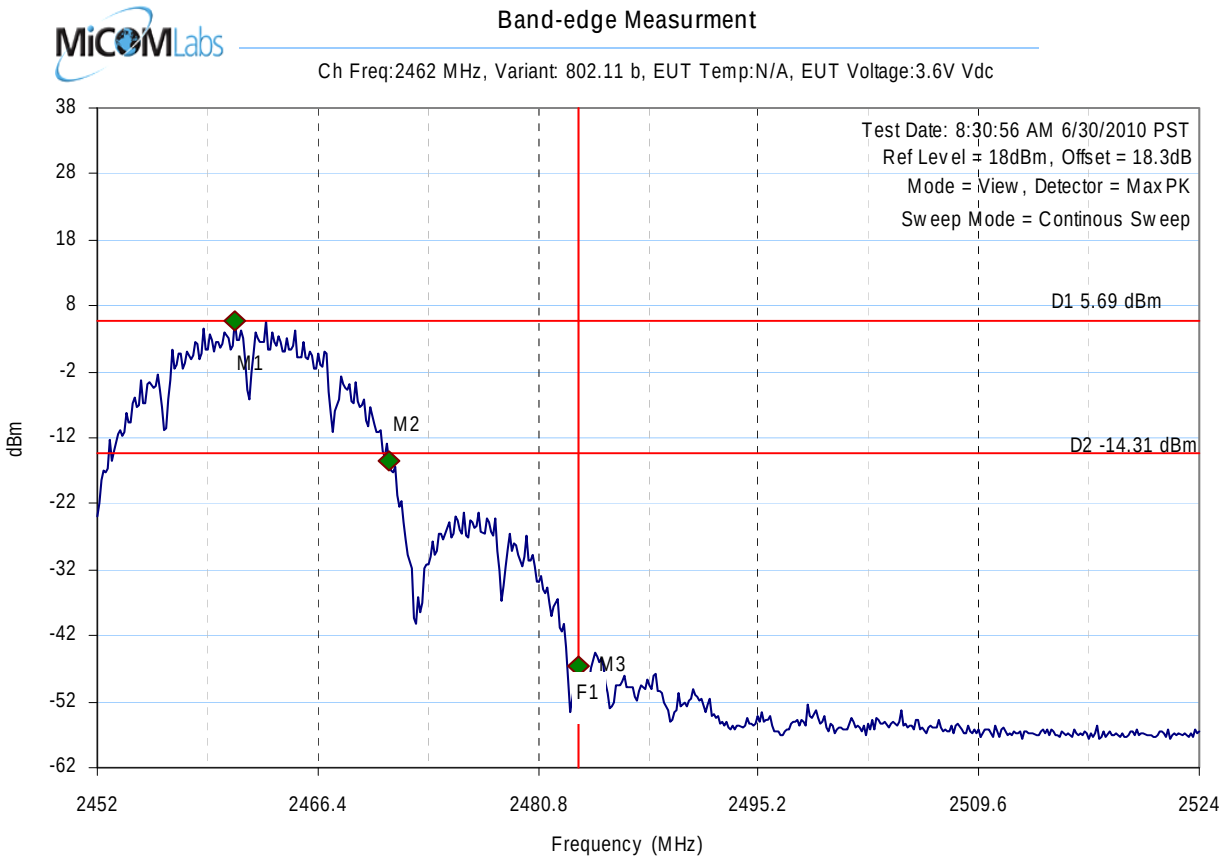

| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 100.00KHz | M1 : 2424.028056MHz : 5.444dBm | Center frequency = 2437MHz |
| VBW = 300.00KHz | M2 : 4870.100200MHz : -30.171dBm | |
| Sweep time(s) = 60 | | |
| RF Atten (dB) = 10 | | |
| Span = 25.97GHz | | |




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




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




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

### 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. (ºC):** | 19 to 22 | |
| **TPC:** | HIGH | | **Pressure (mBars):** | 998 to 1003 | |
| **Modulation:** | ON | | **Duty Cycle (%):** | 100 | |
| **Beam Forming** | N/A | dB | **Antenna Gain:** | N/A | dBi |
| **Applied Voltage:** | 3.6V | Vdc | | | |
| **Notes 1:** | | | | | |
| **Notes 2:** | | | | | |

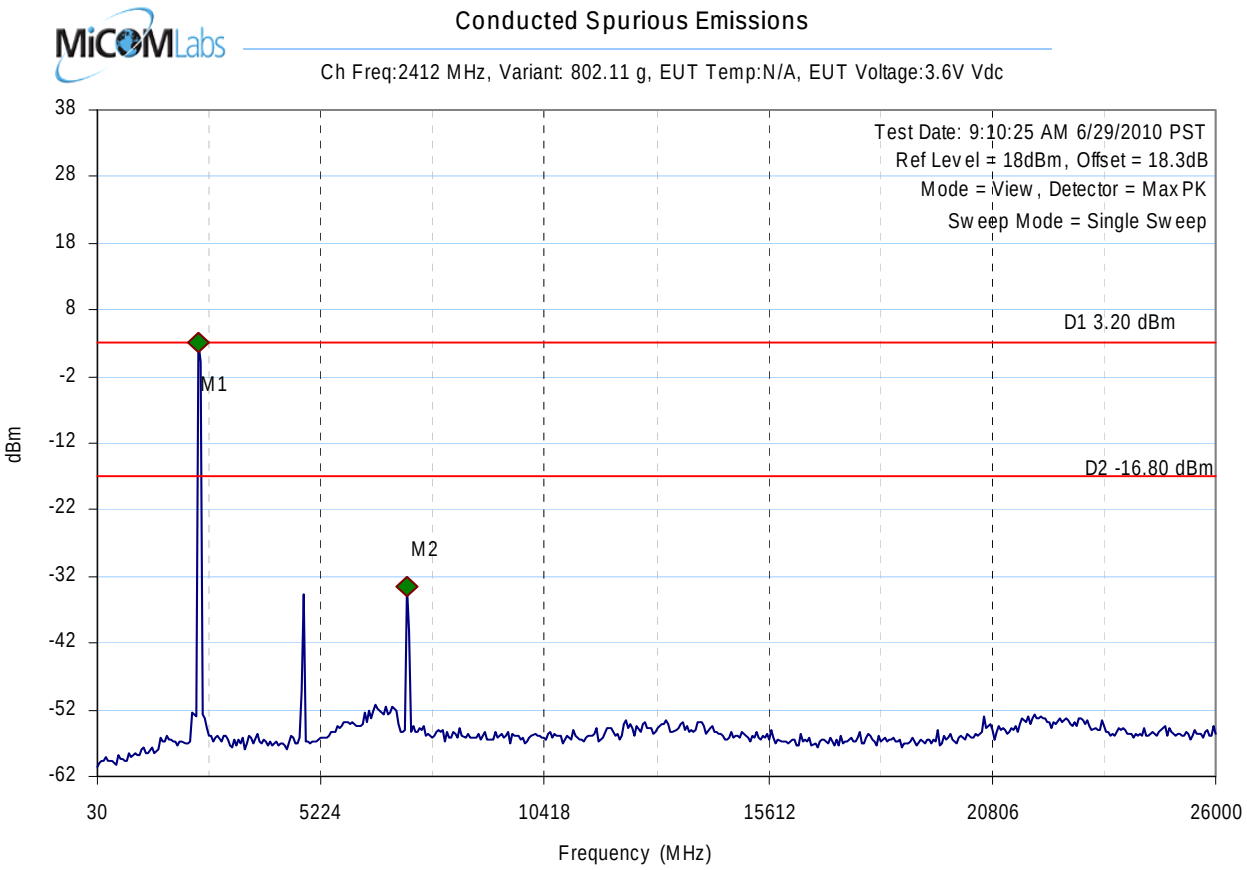
***Conducted Spurious Measurment***

| 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 |

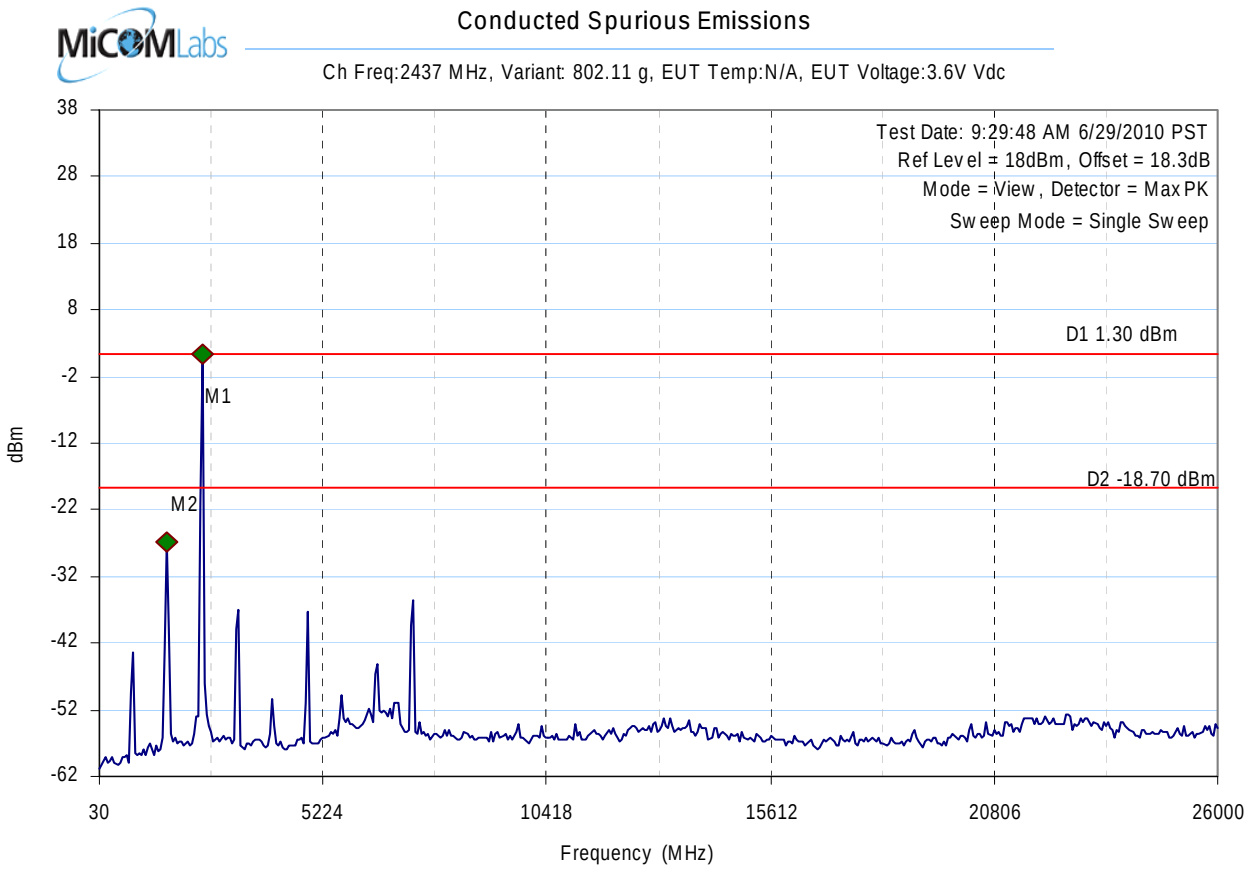
***Band-edge Measurment***

| 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 |

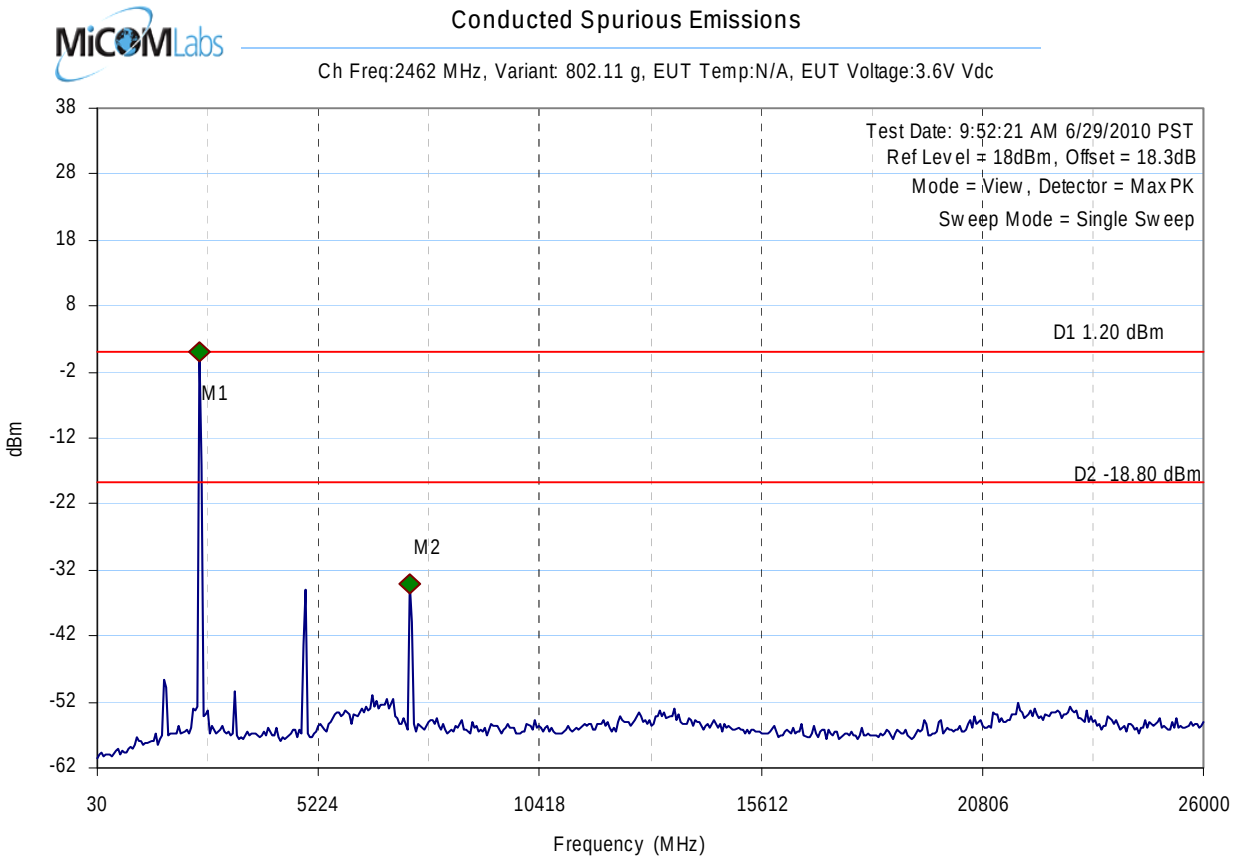
| | |
|---|---|
| **Measurement uncertainty:** | ±2.81 dB |



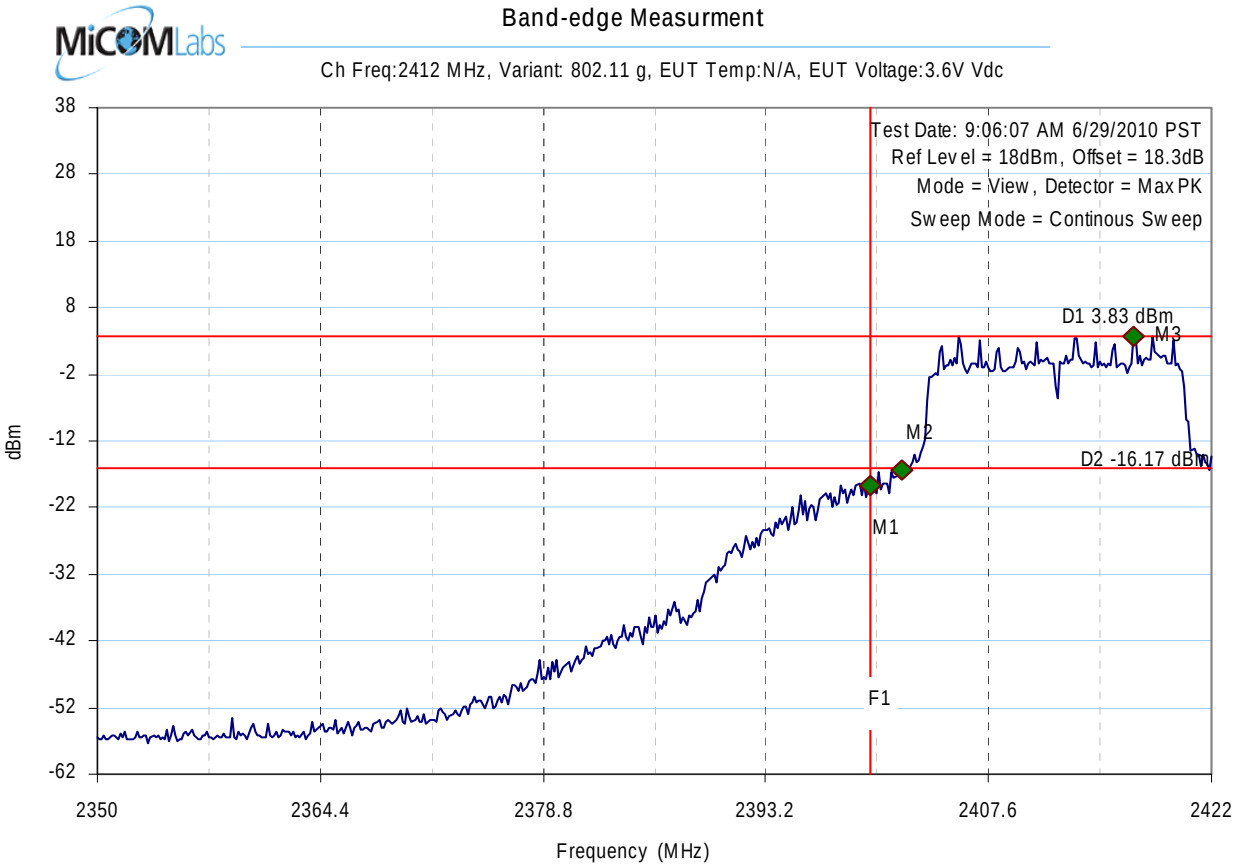

| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 100.00KHz | M1 : 2371.983968MHz : 3.198dBm | Center frequency = 2412MHz |
| VBW = 300.00KHz | M2 : 7212.084168MHz : -33.415dBm | |
| Sweep time(s) = 60 | | |
| RF Atten (dB) = 10 | | |
| Span = 25.97GHz | | |



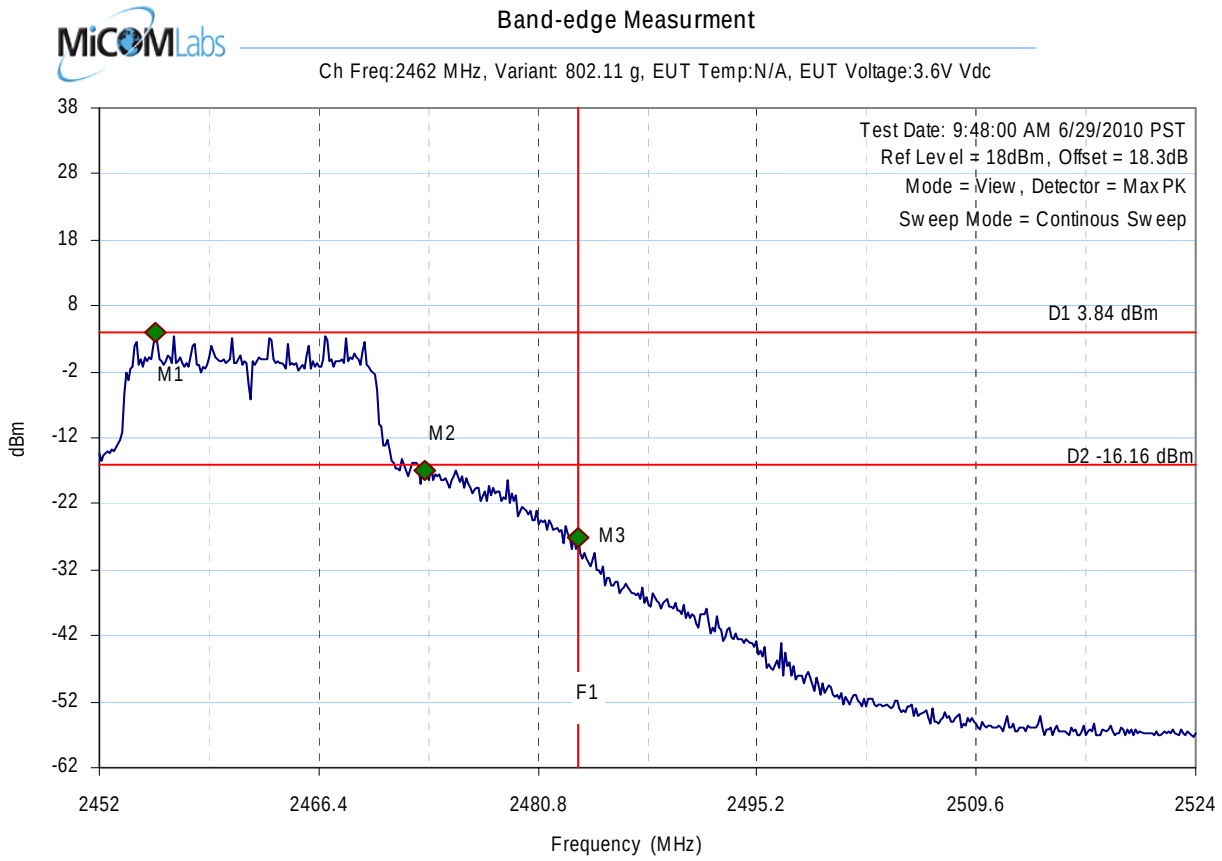

| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 100.00KHz | M1 : 2424.028056MHz : 1.303dBm | Center frequency = 2437MHz |
| VBW = 300.00KHz | M2 : 1591.322645MHz : -26.866dBm | |
| Sweep time(s) = 60 | | |
| RF Atten (dB) = 10 | | |
| Span = 25.97GHz | | |




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

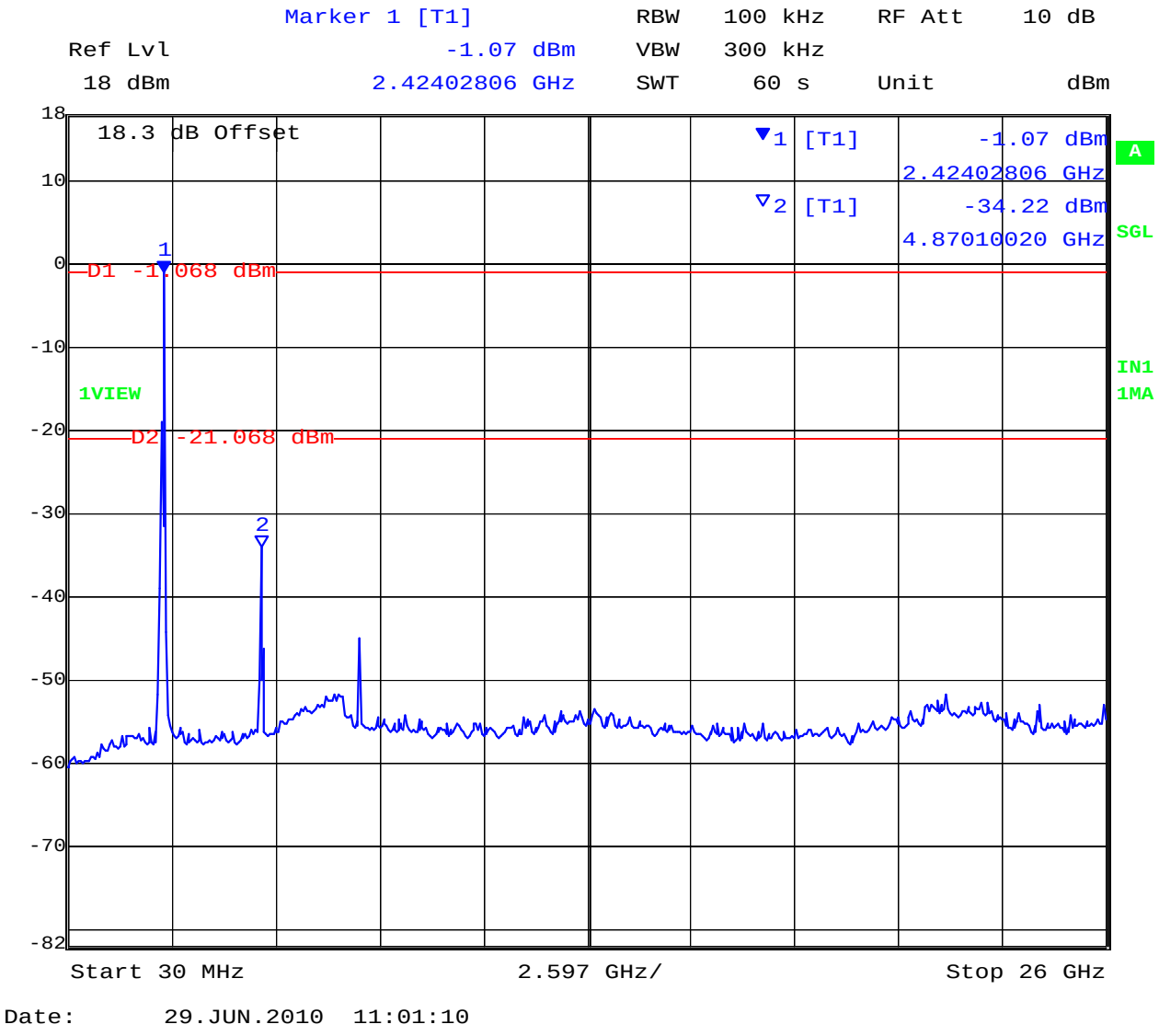



| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 100.00KHz | M1 : 2400.000000MHz : -18.640dBm | Center frequency = 2412MHz |
| VBW = 300.00KHz | M2 : 2401.943888MHz : -16.338dBm | |
| Sweep time(s) = 20 | M3 : 2416.949900MHz : 3.831dBm | |
| RF Atten (dB) = 10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

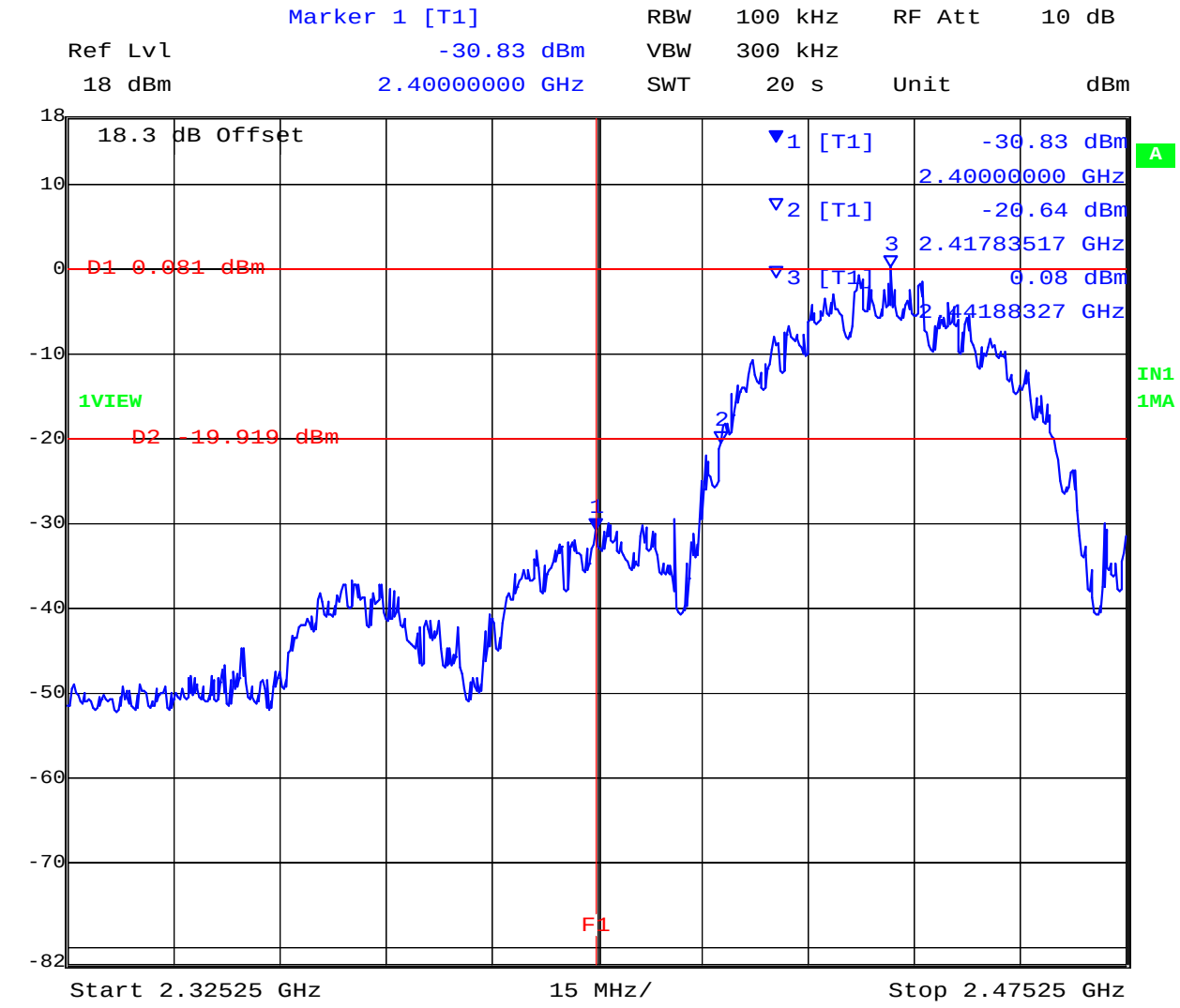



| Analyser Setup | Marker : Frequency : Amplitude | Test Results |
|---|---|---|
| RBW = 100.00KHz | M1 : 2455.607214MHz : 3.843dBm | Center frequency = 2462MHz |
| VBW = 300.00KHz | M2 : 2473.354709MHz : -17.005dBm | |
| Sweep time(s) = 20 | M3 : 2483.500000MHz : -26.974dBm | |
| RF Atten (dB) = 10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

### 7.5.3 Measurement Results: DSSS

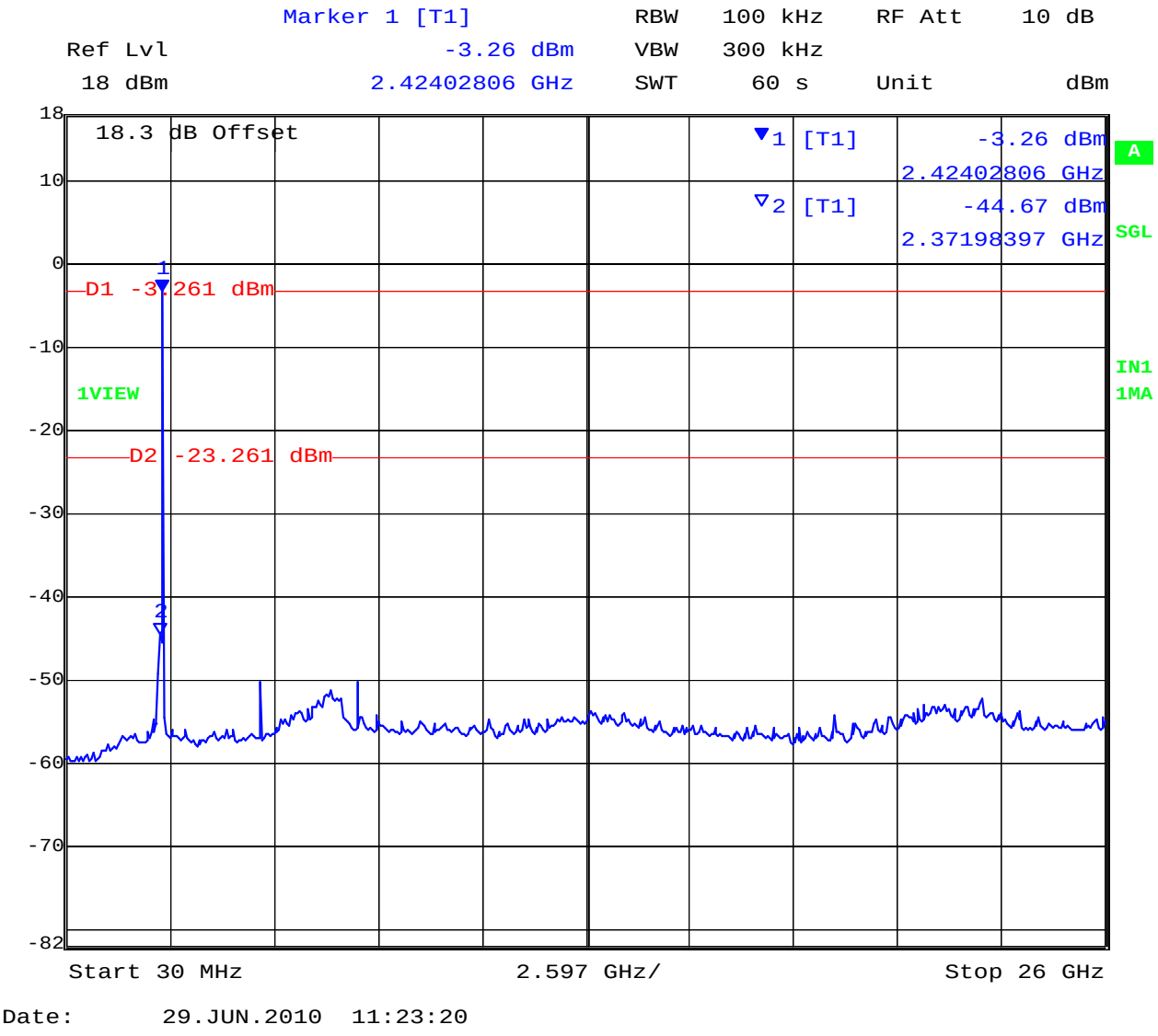


Band Edge Ambient 2442MHz 3.60V 14.91dBm 100% Duty Cycle

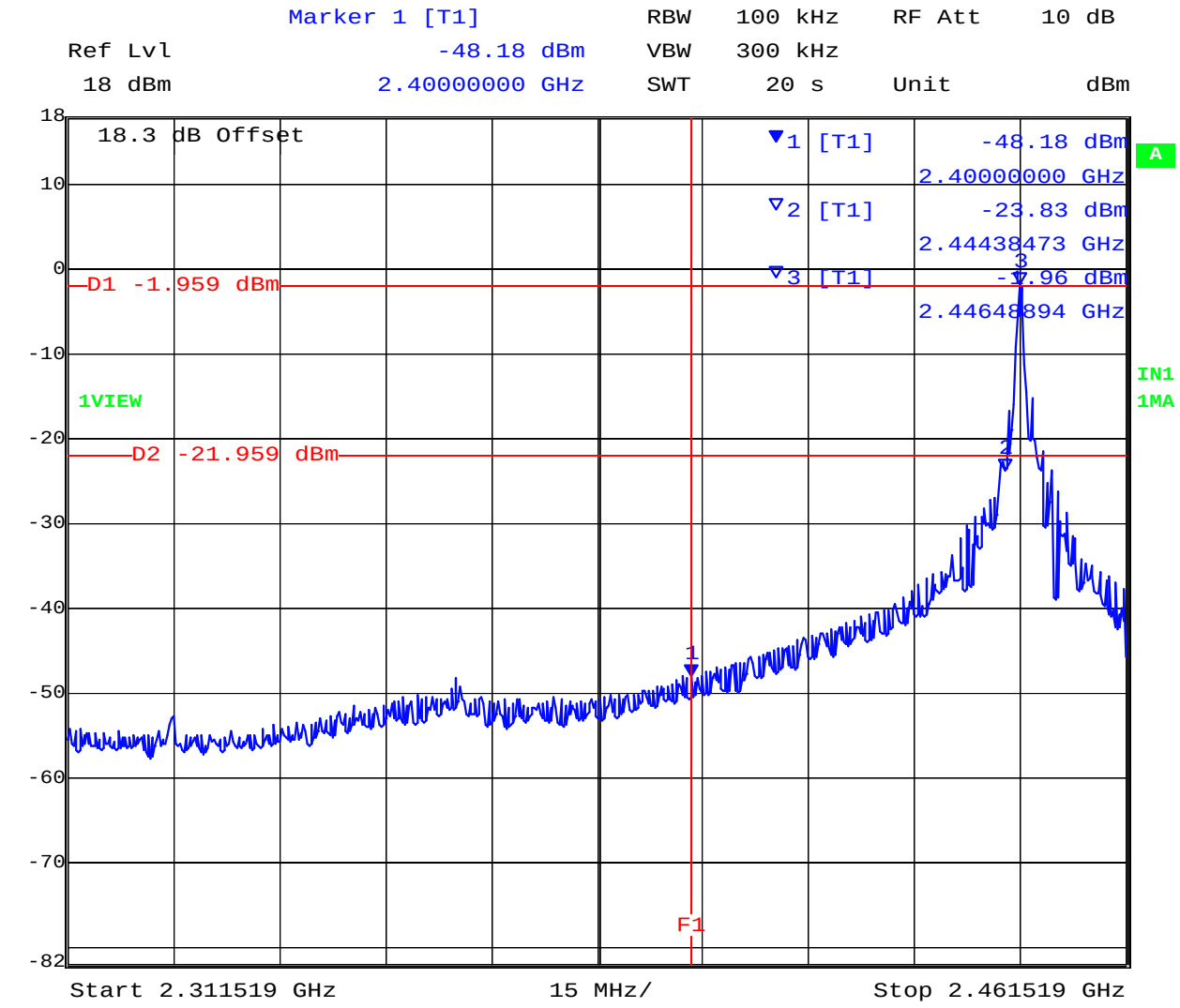


Band Edge Ambient 2442MHz 3.60V 14.90dBm 100% Duty Cycle

### 7.5.4 Measurement Results: OOK

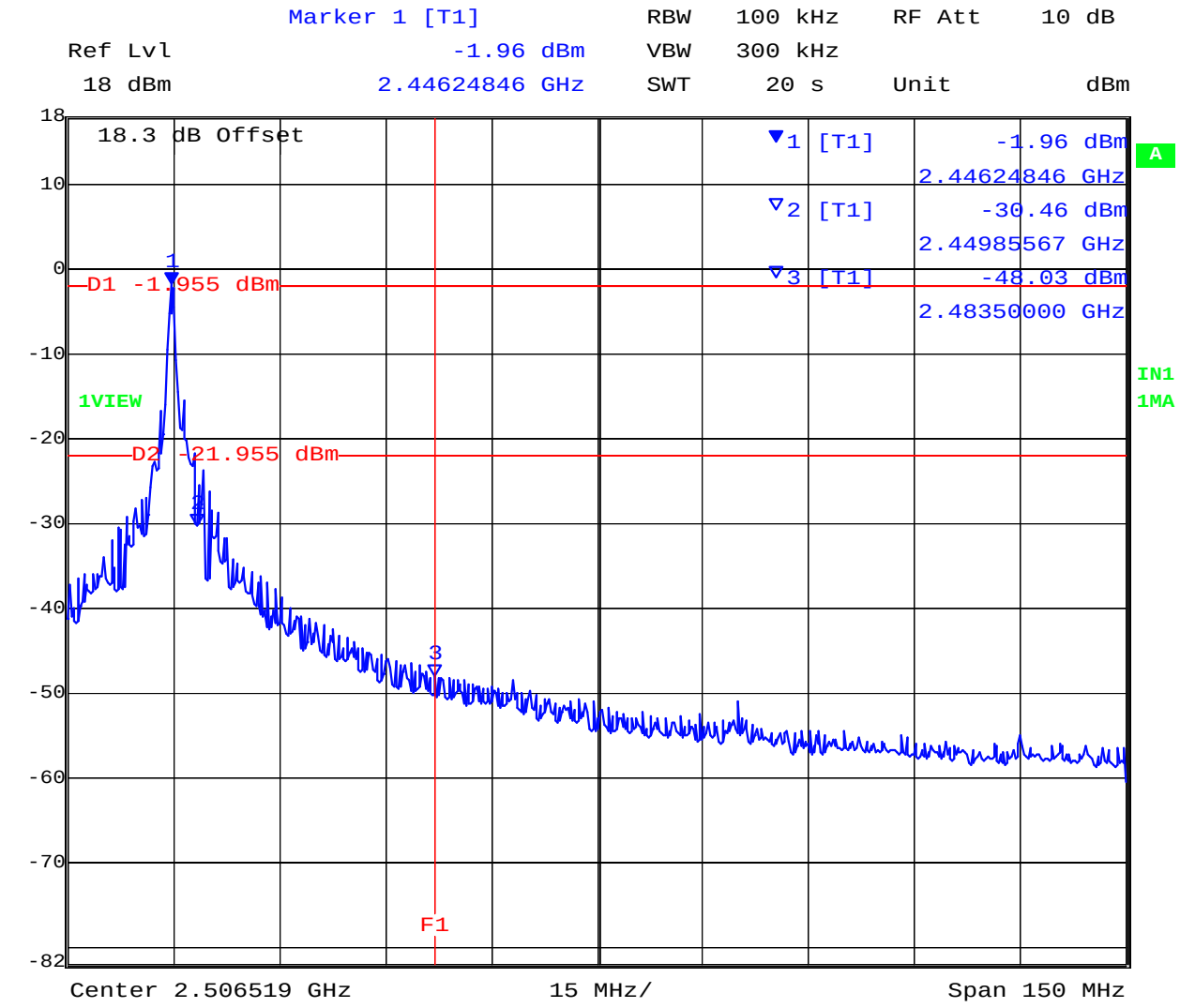


Band Edge Ambient 2447MHz 3.60V 1.23dBm 100% Duty Cycle




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

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



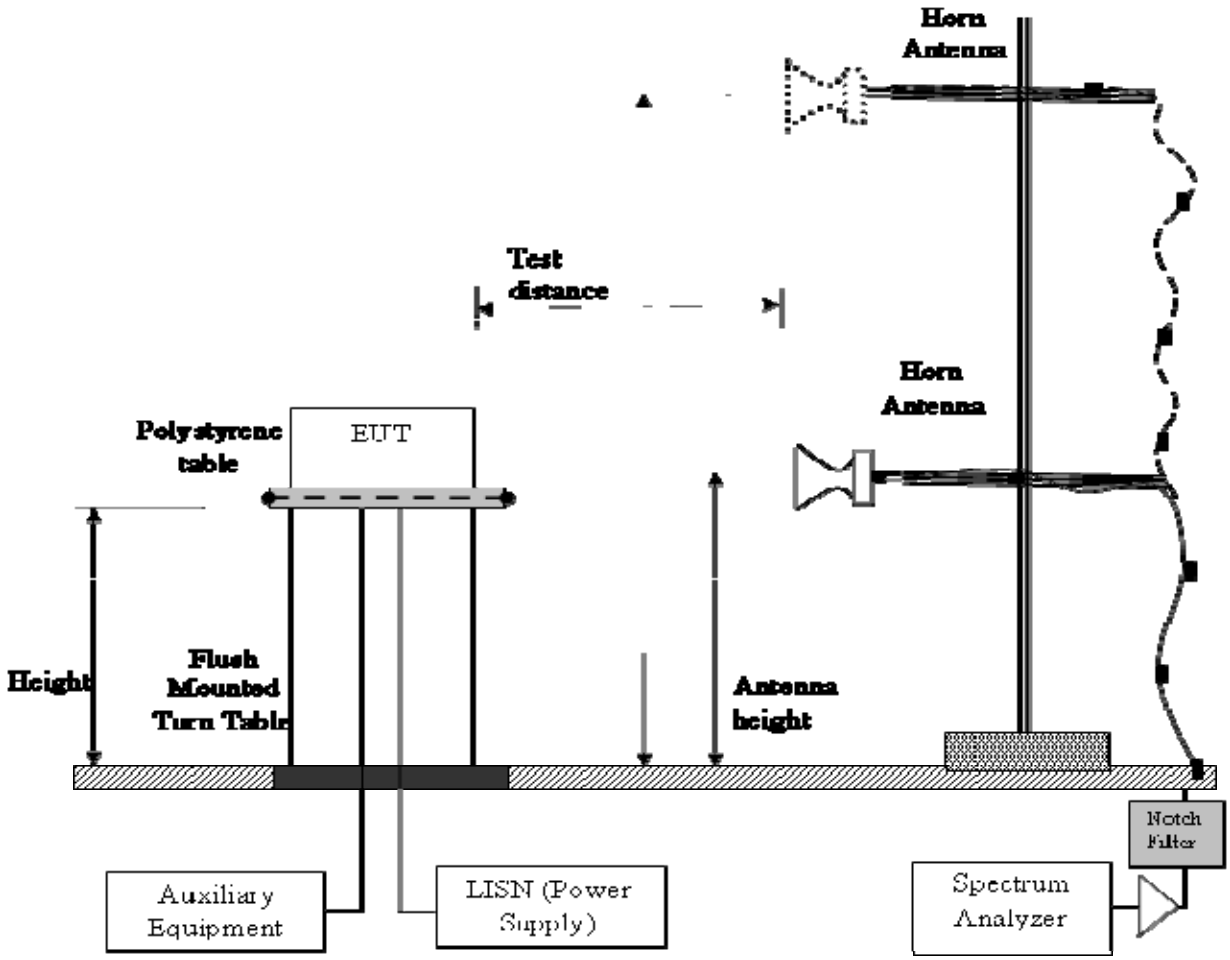
## 7.6 Radiated Spurious Emissions Above 1 GHz - Antenna ZES

**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.

**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 = Correction Factor = CL – AG + NFL**

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

Field Strength Calculation Example:

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

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

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

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

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

**Specification**

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

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

FCC §15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

FCC §15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC §15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

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

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

**Laboratory Measurement Uncertainty for Spectrum Measurement**

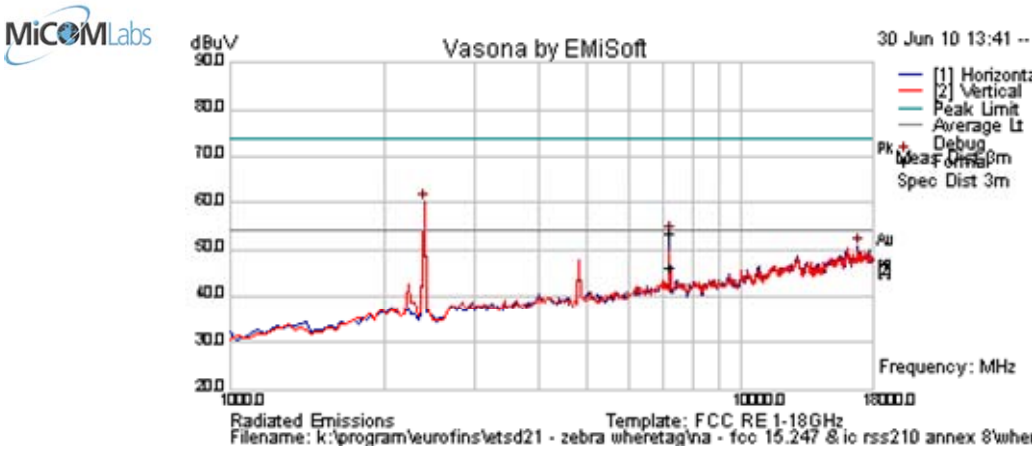
| | |
|---|---|
| Measurement Uncertainty | +5.6/ -4.5 dB |

**Traceability:**

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

### 7.6.1 802.11b Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2412 MHz | **Engineer** | GMH |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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 | | |

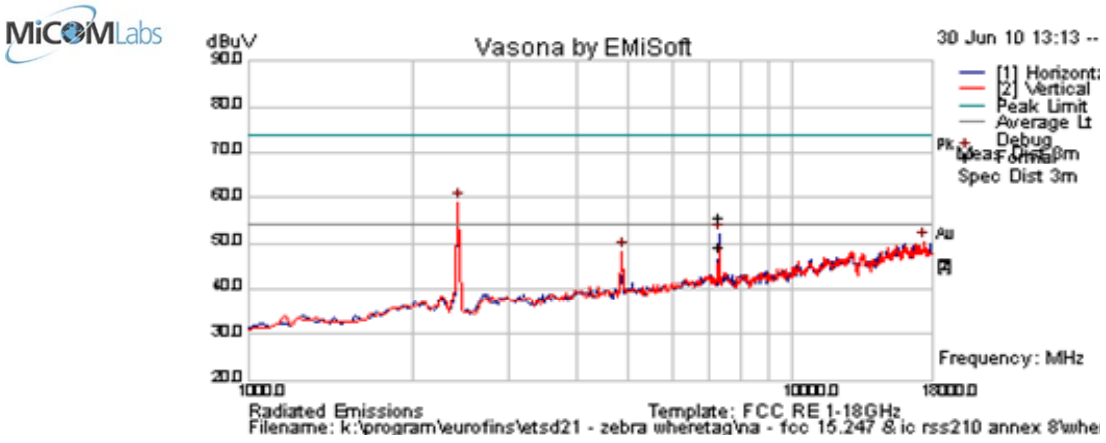



**Formally measured emission peaks**

| 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 | -- | -- | -- | N/A | FUND |
| 7234.909 | 53.3 | 5.4 | -5.2 | 53.5 | Peak Max | H | 101 | 233 | 74.0 | -20.5 | Pass | RB |
| 7234.909 | 45.8 | 5.4 | -5.2 | 46.0 | Average Max | H | 101 | 233 | 54 | -8.0 | Pass | RB |

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

| | | | |
|---|---|---|---|
| **Test Freq.** | 2437 MHz | **Engineer** | GMH |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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 | | |

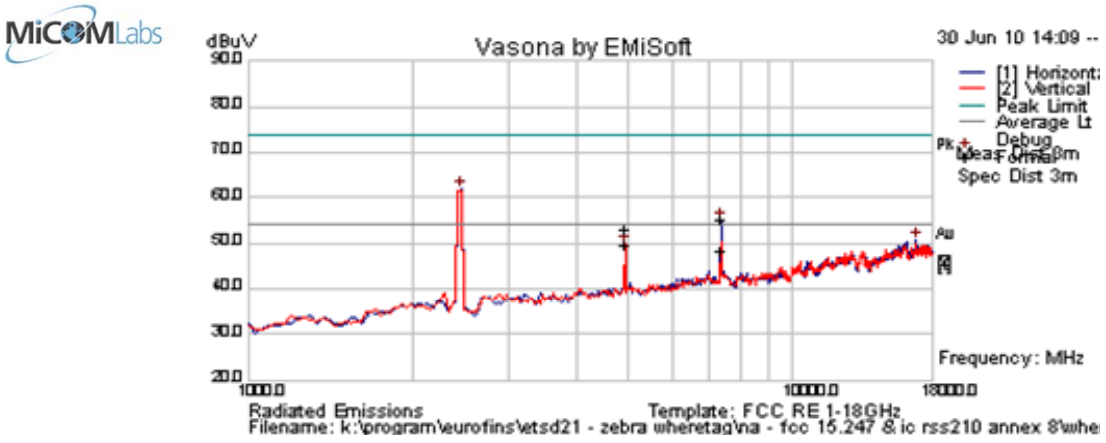



## Formally measured emission peaks

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

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

| | | | |
|---|---|---|---|
| **Test Freq.** | 2462 MHz | **Engineer** | GMH |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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 | | |



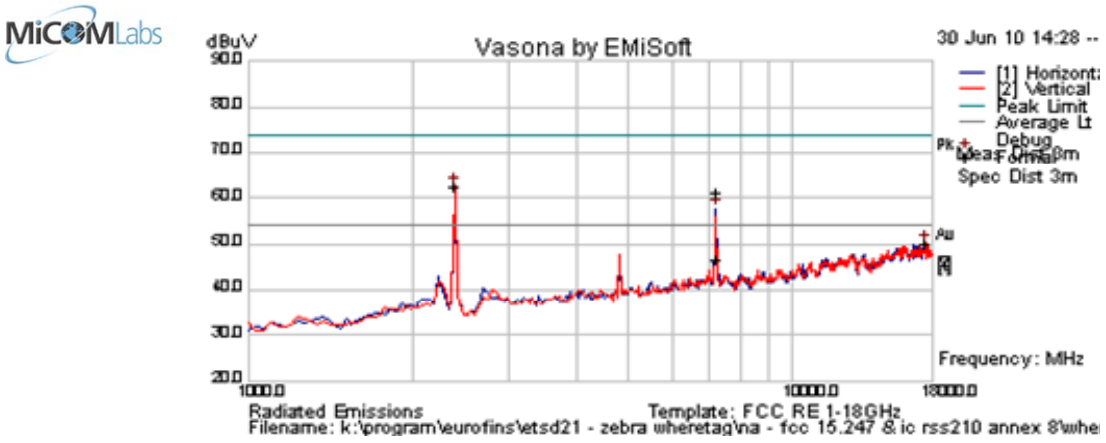

## Formally measured emission peaks

| 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 |

## 7.6.2 802.11g Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2412 MHz | **Engineer** | CSB |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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 | | |

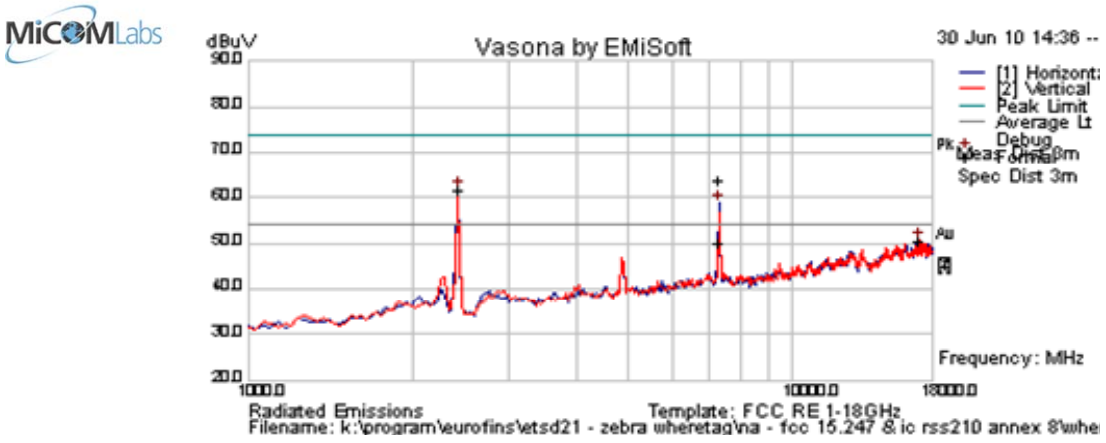



### Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2437 MHz | **Engineer** | CSB |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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 | | |

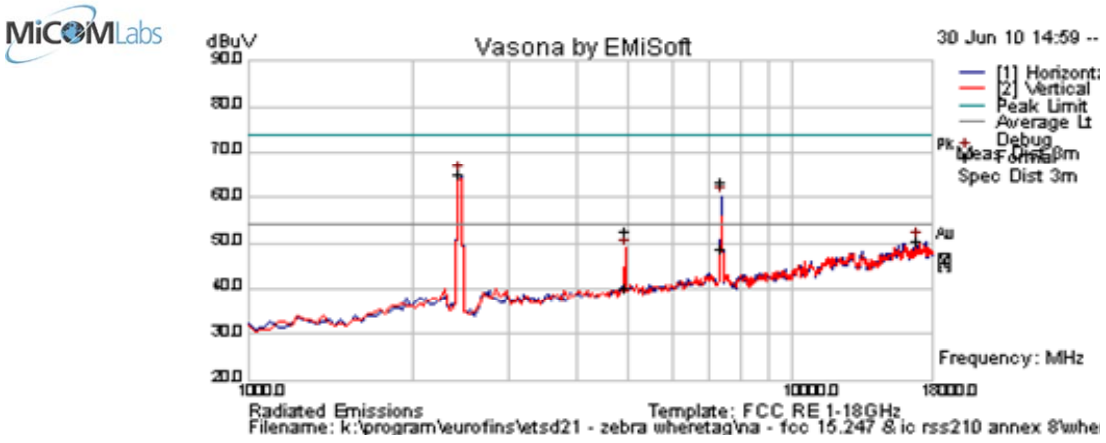



## Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2462 MHz | **Engineer** | CSB |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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 | | |



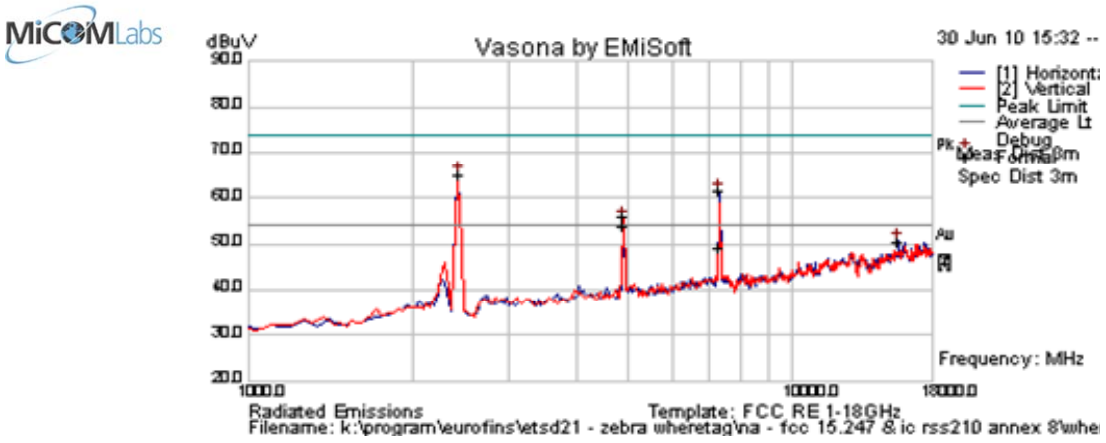

## Formally measured emission peaks

| 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 |

### 7.6.3 DSSS Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2441.75 MHz | **Engineer** | CSB |
| **Variant** | DSSS | **Temp (ºC)** | 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 | | |



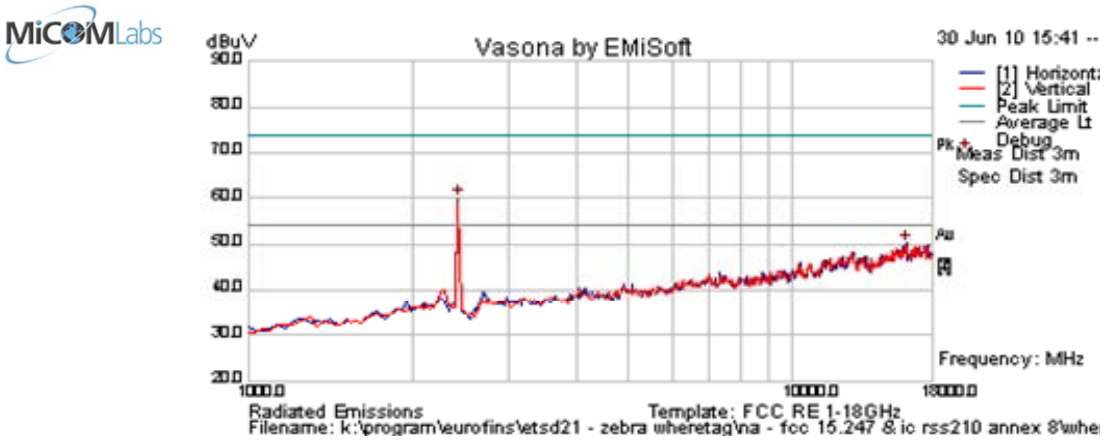

## Formally measured emission peaks

| 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 |

### 7.6.4 OOK Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2446.519 MHz | **Engineer** | CSB |
| **Variant** | OOK | **Temp (ºC)** | 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 |

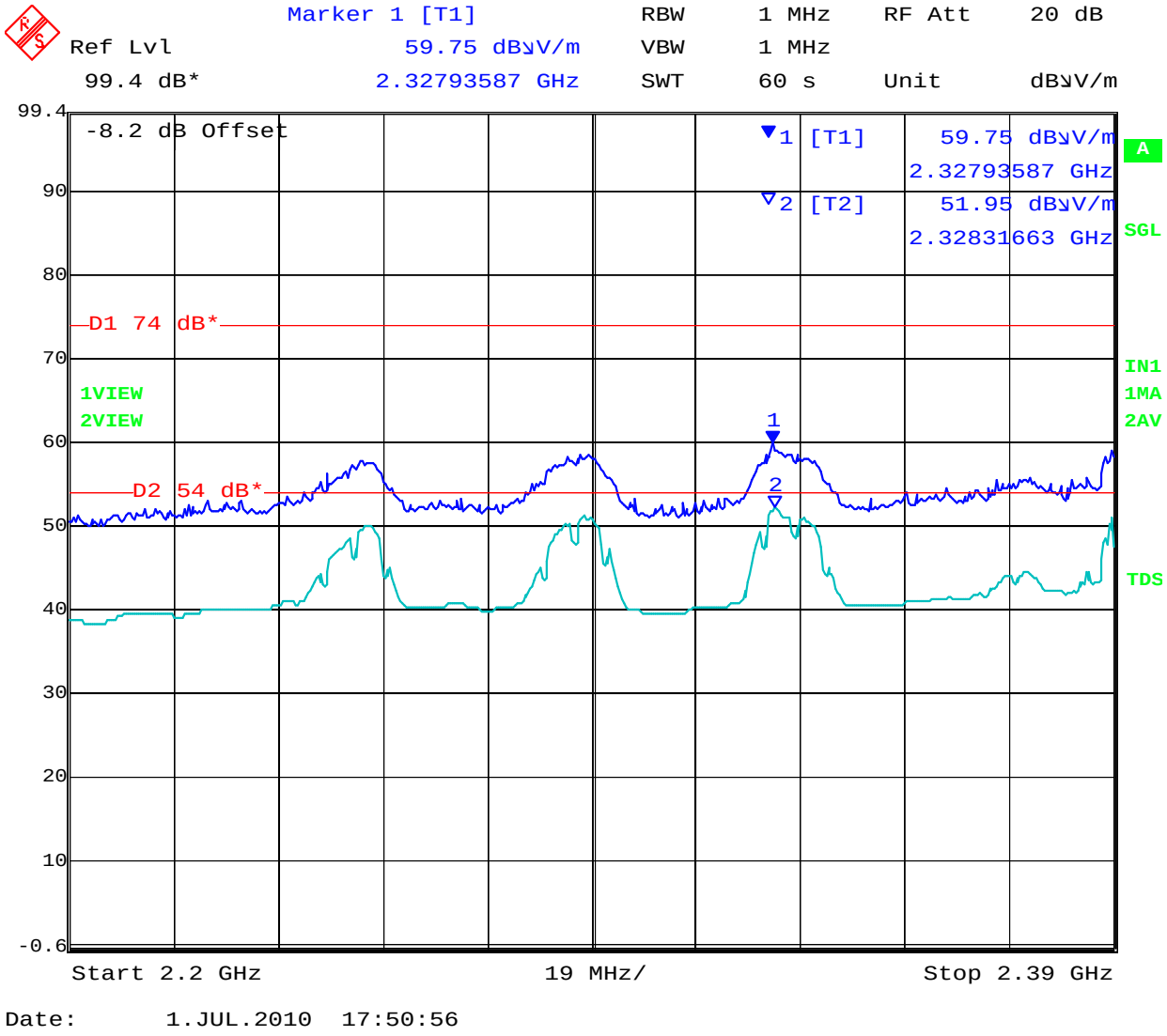
| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

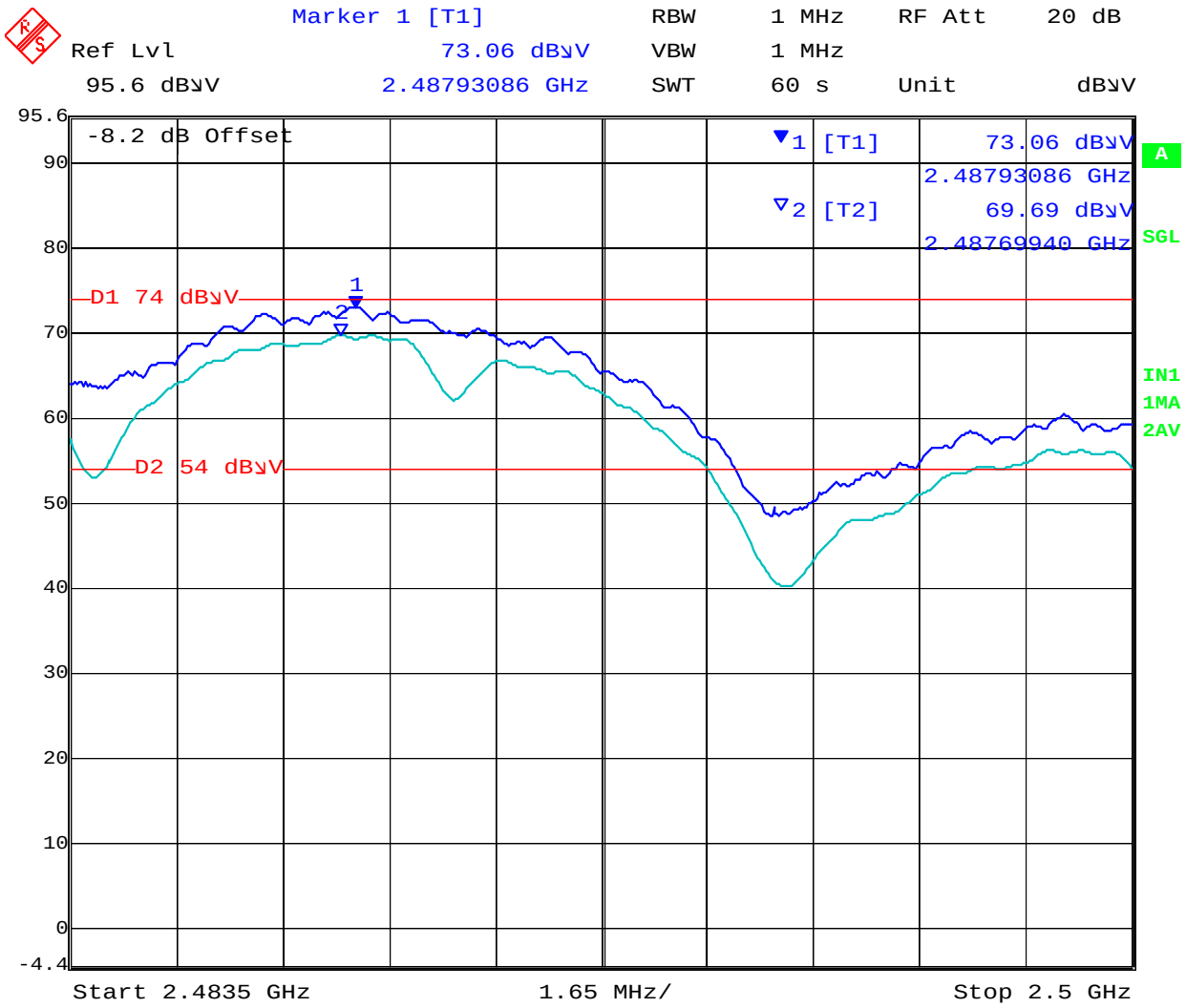
### 7.6.5 802.11b Radiated Band Edge Emissions

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 * 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 |



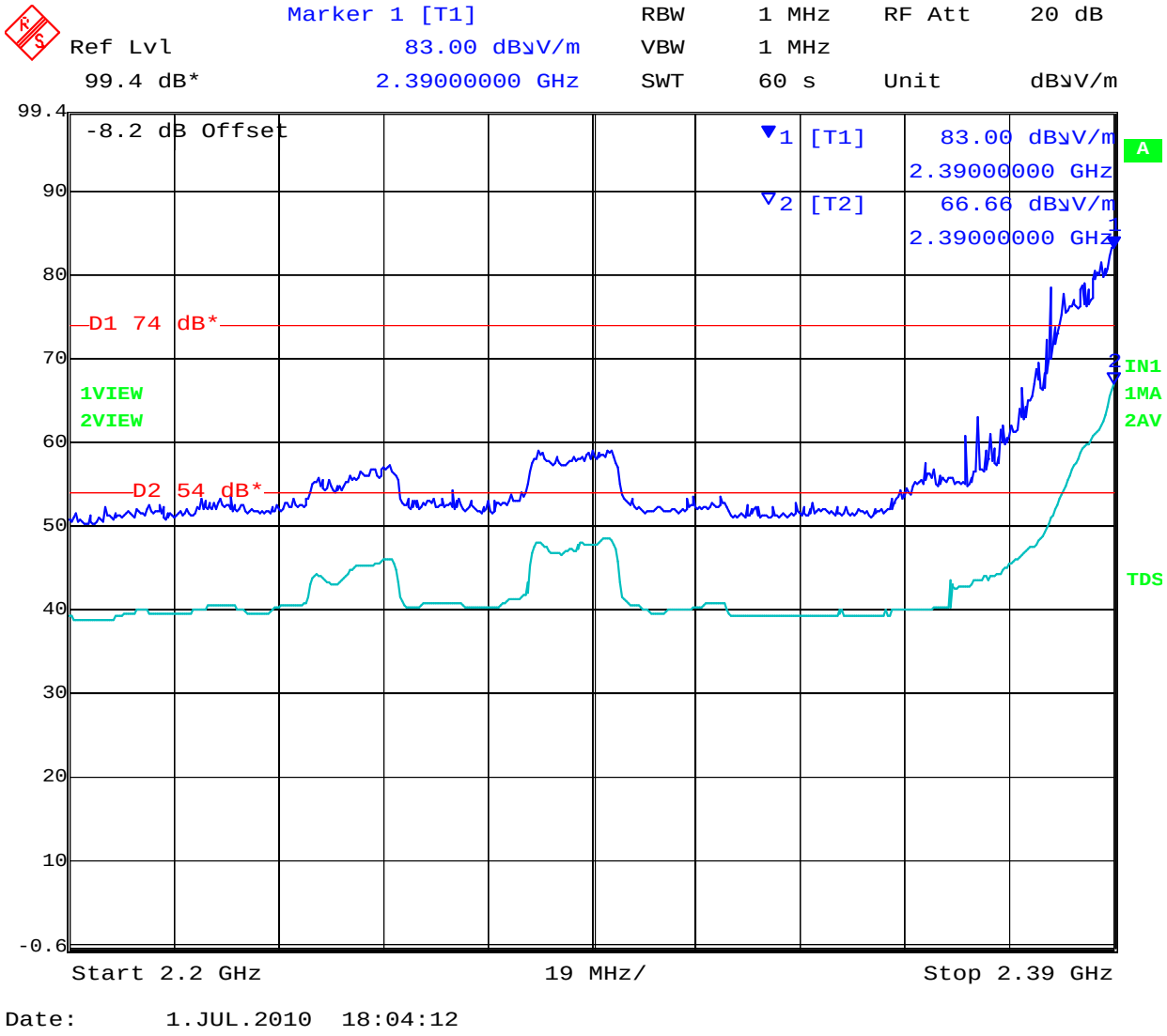


### 7.6.6 802.11g Radiated Band Edge Emissions

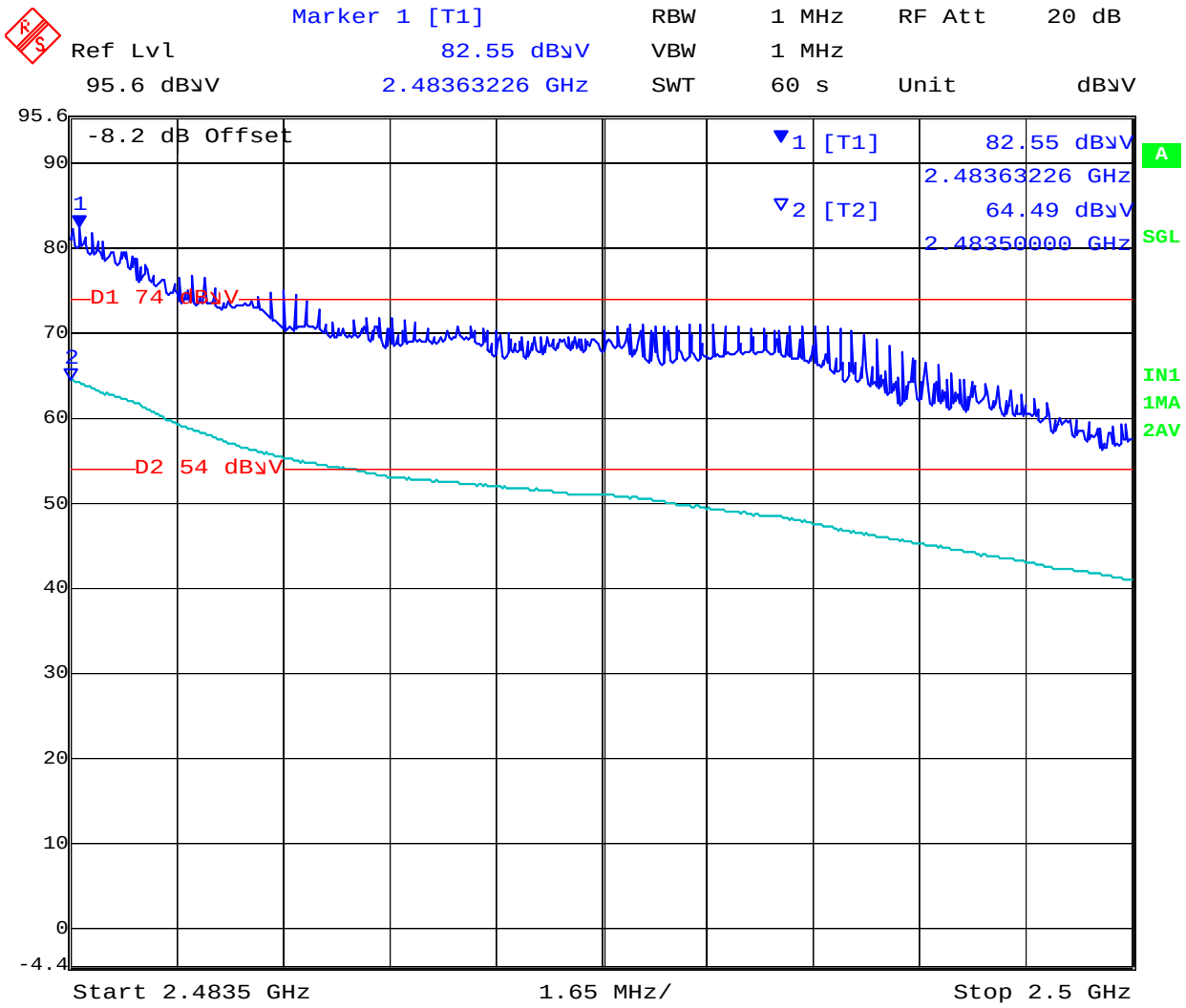
Duty cycle correction factor was applied to spurious emissions in the restricted bands closest to the fundamental transmission.

EUT Operational Duty Cycle: 0.72%
Correction Factor = 20 * 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 |




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

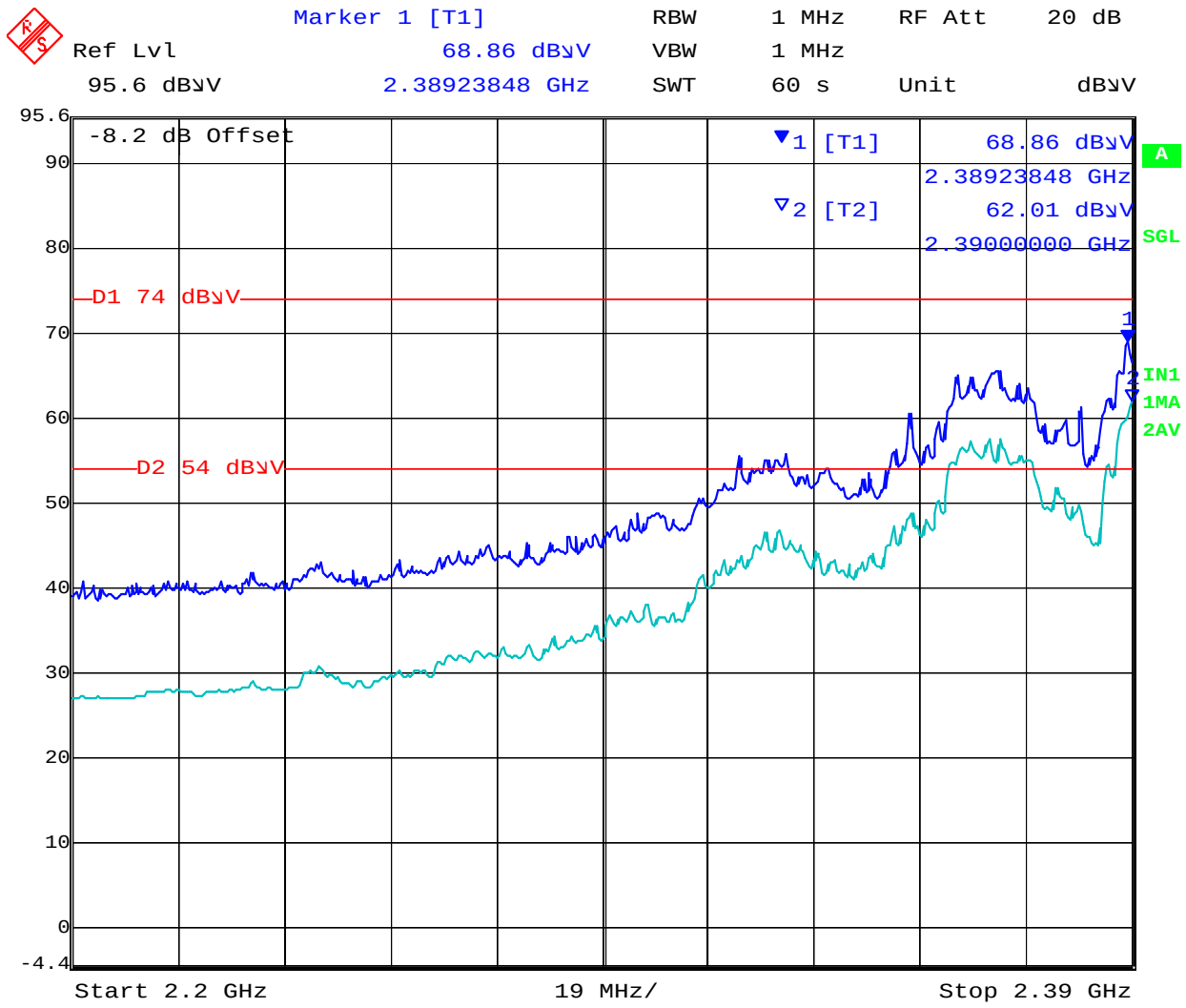


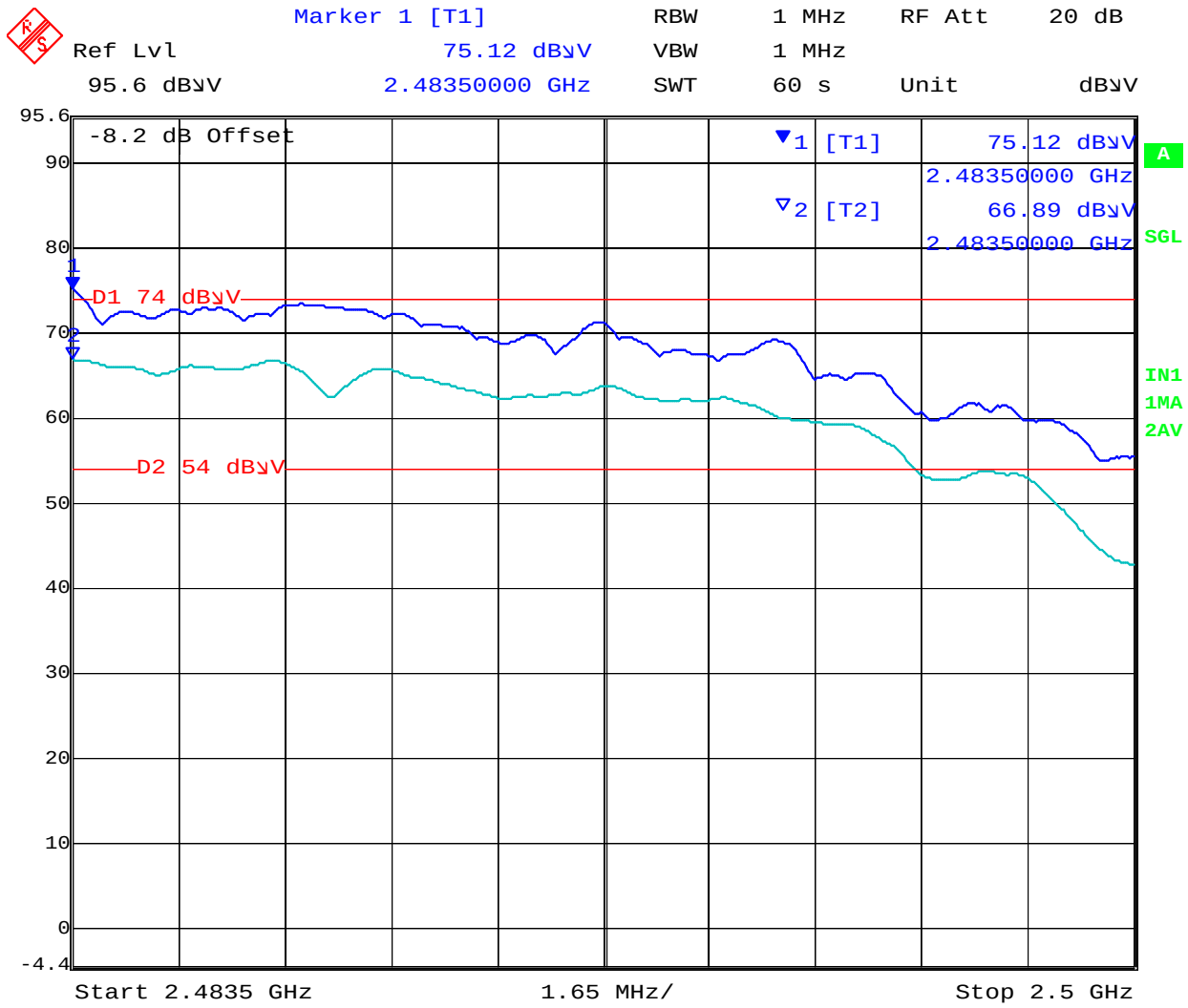
### 7.6.7 DSSS Radiated Band Edge Emissions

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 * LOG (2.55 / 100)
Correction Factor = -31.87 dB
Corrected Value = Measured Value (dB) - 31.87 (dB)

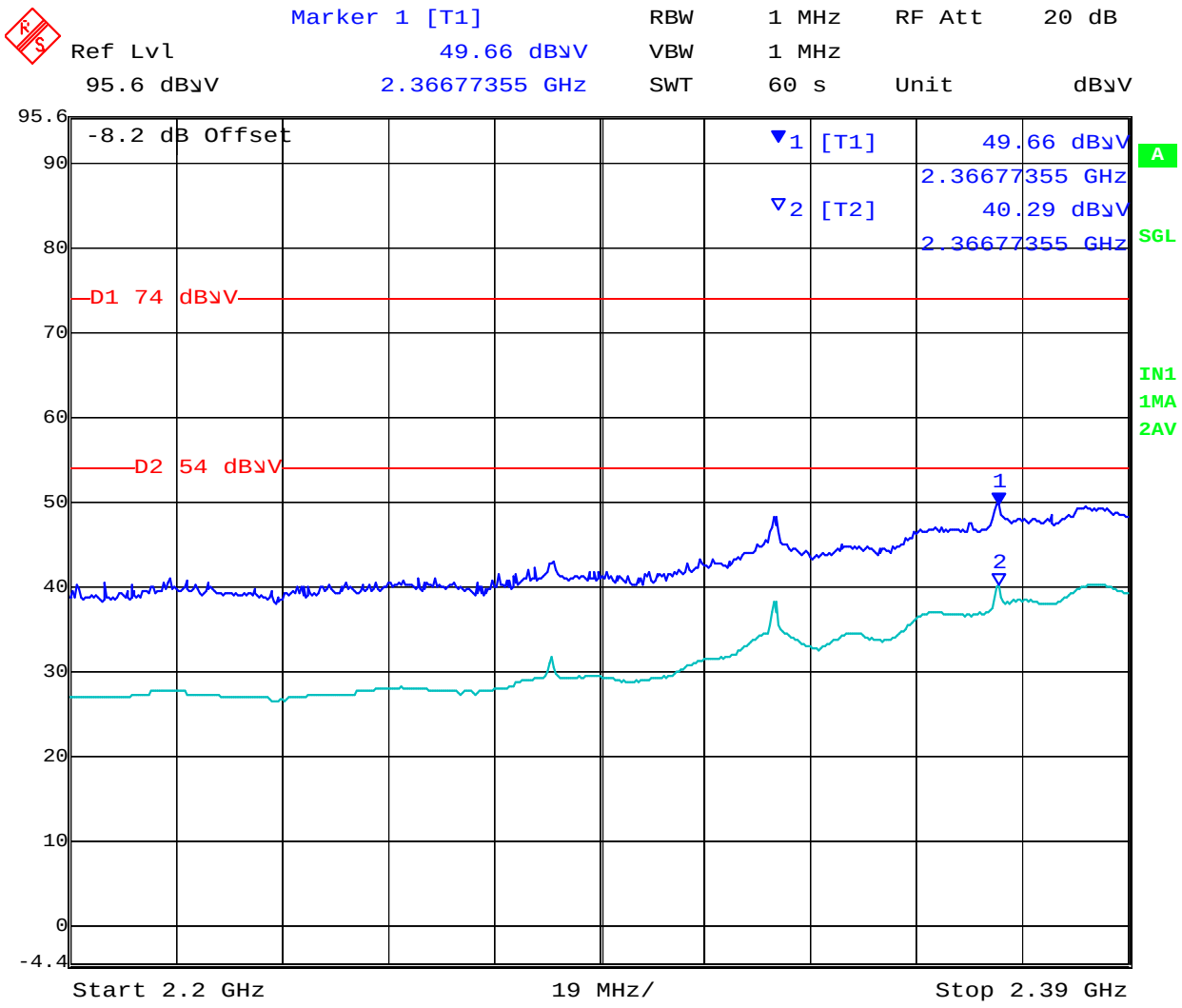
| Frequency (MHz) | Measured Value (dBuV/m) | Measurement Type | Corrected Value | Margin (dB) | Pass / Fail |
|---|---|---|---|---|---|
| 2389.23848 | 68.86 | Peak | 36.99 | -37.01 | Pass |
| 2390.00000 | 62.01 | Average | 30.14 | -23.86 | Pass |
| 2483.50000 | 75.12 | Peak | 43.25 | -30.75 | Pass |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

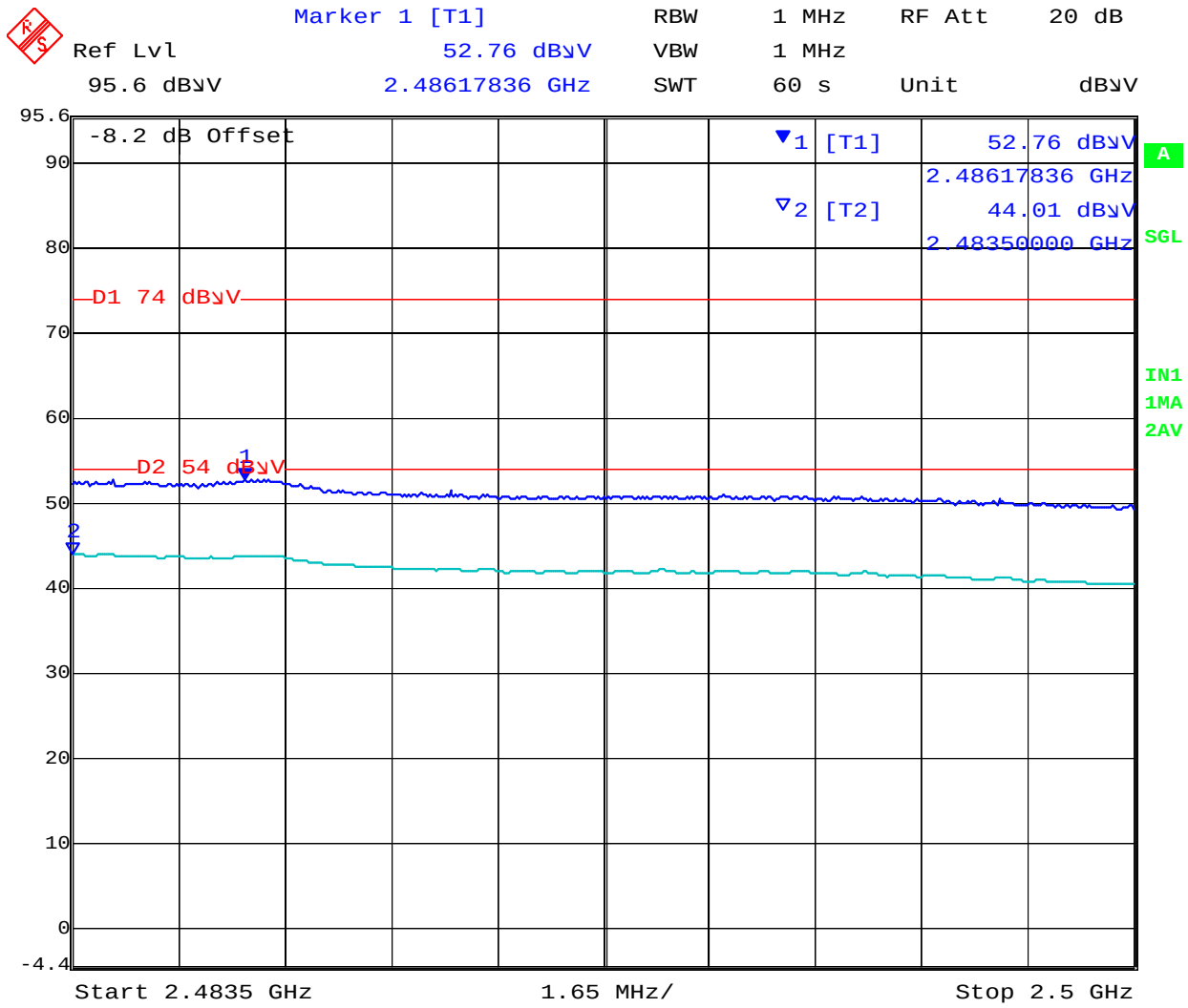




### 7.6.8 OOK Radiated Band Edge Emissions

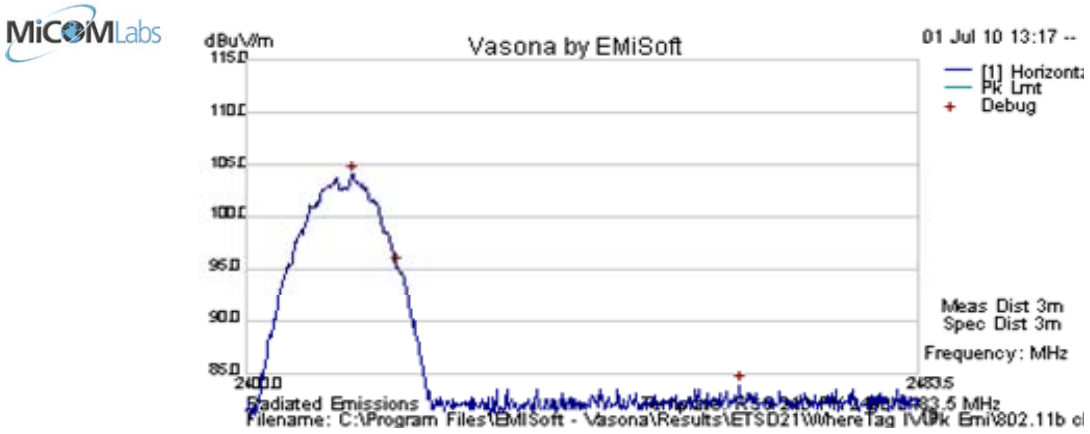
All emissions below FCC limits when tested at 100% duty cycle. No duty cycle correction factor required to comply with FCC limits.





### 7.6.9 802.11b RSS-210 Radiated Peak Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2412 MHz | **Engineer** | SB |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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** | | | |

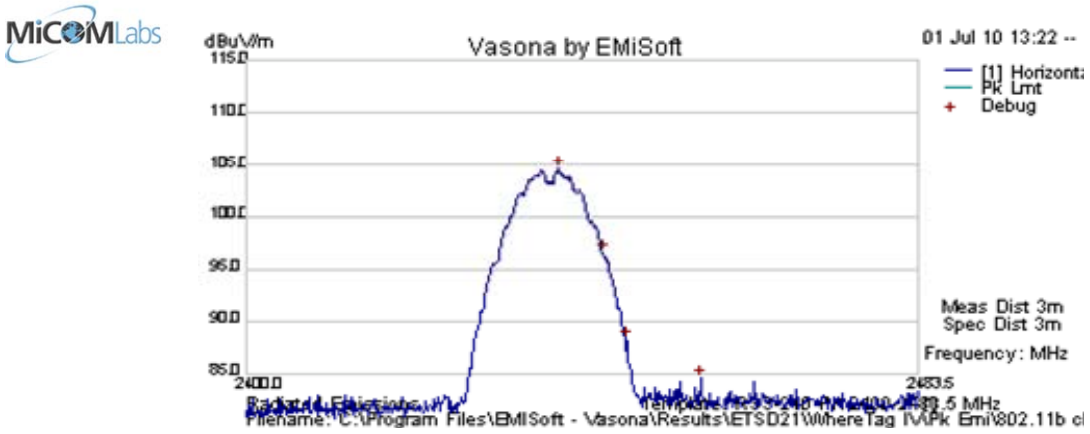



**Formally measured emission peaks**

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2437 MHz | **Engineer** | SB |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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** | | | |

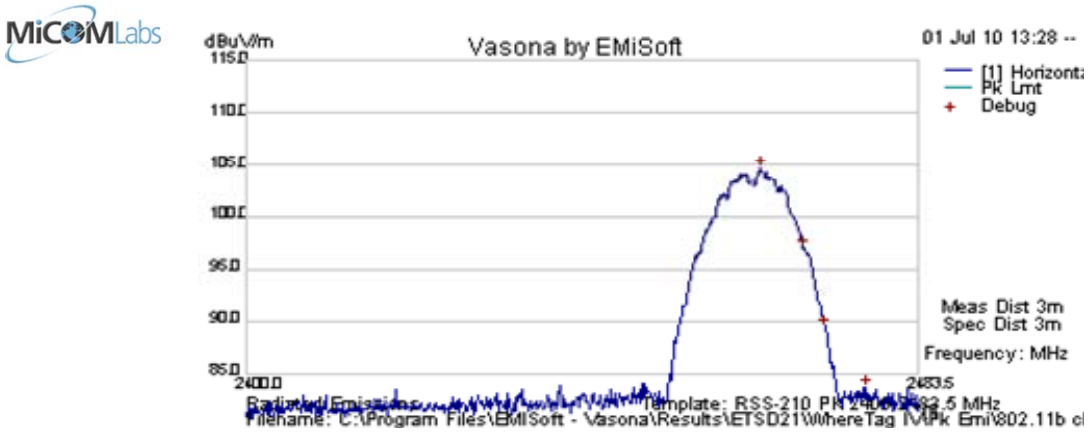



## Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2462 MHz | **Engineer** | SB |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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** | | | |



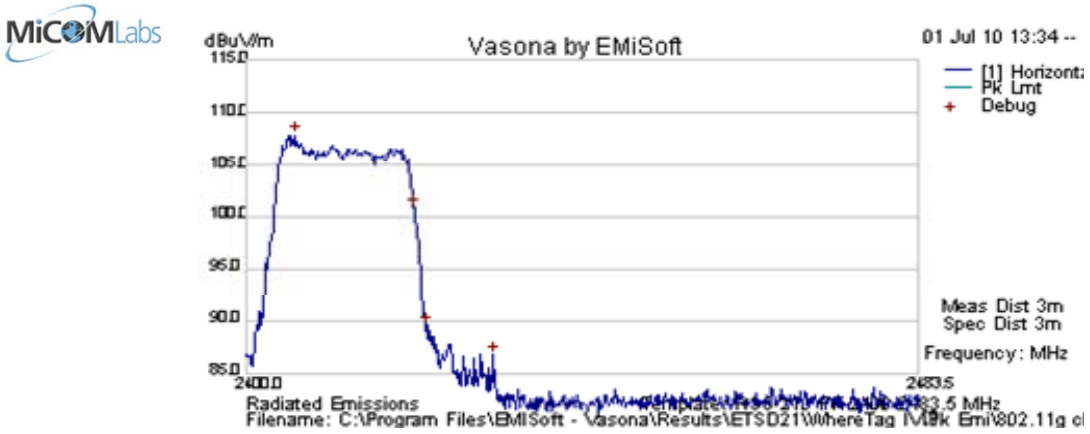

## Formally measured emission peaks

| 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 |

## 7.6.10 802.11g RSS-210 Radiated Peak Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2412 MHz | **Engineer** | SB |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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** | | | |

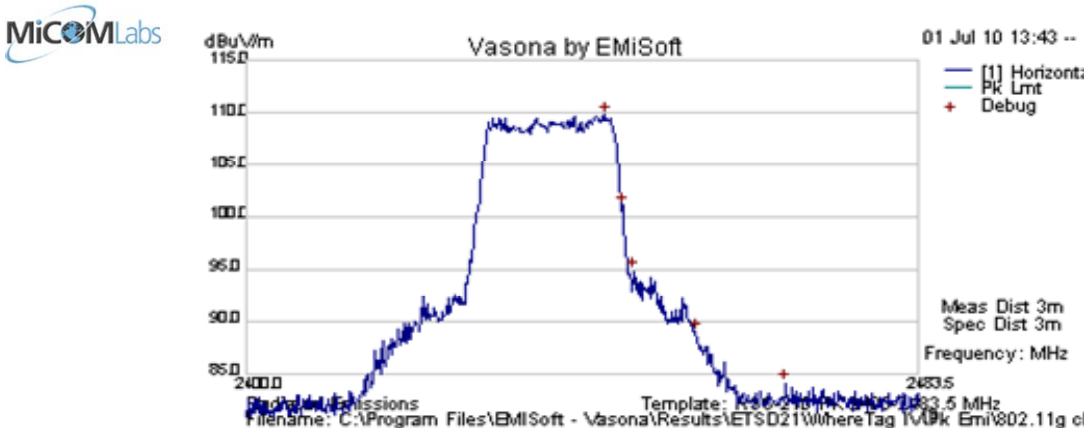



### Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2437 MHz | **Engineer** | SB |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2462 MHz | **Engineer** | SB |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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 |

## 7.6.11 DSSS RSS-210 Radiated Peak Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2441.75 MHz | **Engineer** | SB |
| **Variant** | DSSS | **Temp (ºC)** | 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** | | | |

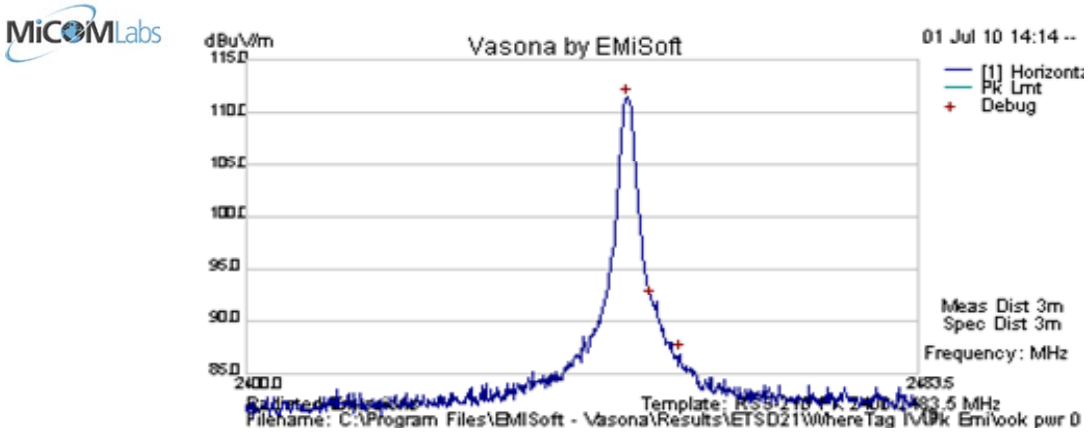

### Formally measured emission peaks

| 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 |

## 7.6.12 OOK RSS-210 Radiated Peak Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2446.519 MHz | **Engineer** | SB |
| **Variant** | OOK | **Temp (ºC)** | 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** | | | |



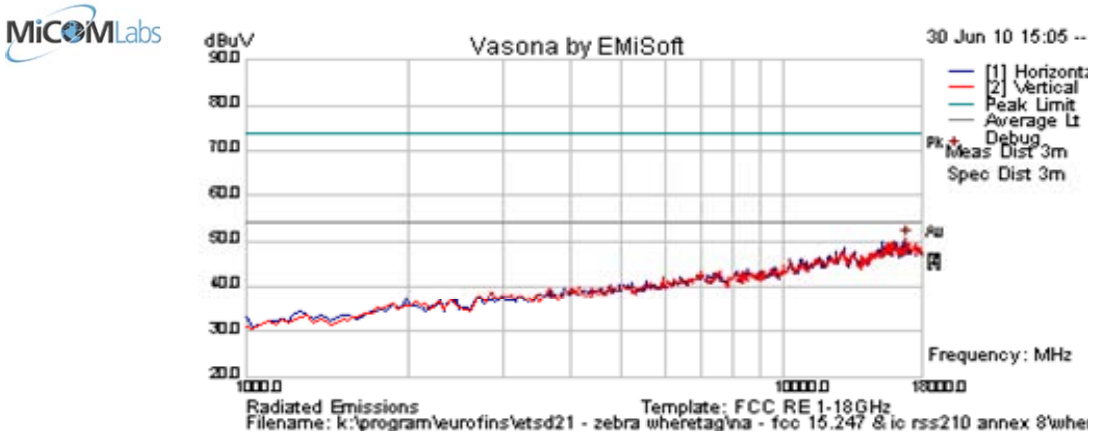

### Formally measured emission peaks

| 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 |

## 7.6.13 RSS-210 Receiver Radiated Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2446.519 MHz | **Engineer** | CSB |
| **Variant** | OOK | **Temp (ºC)** | 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. |

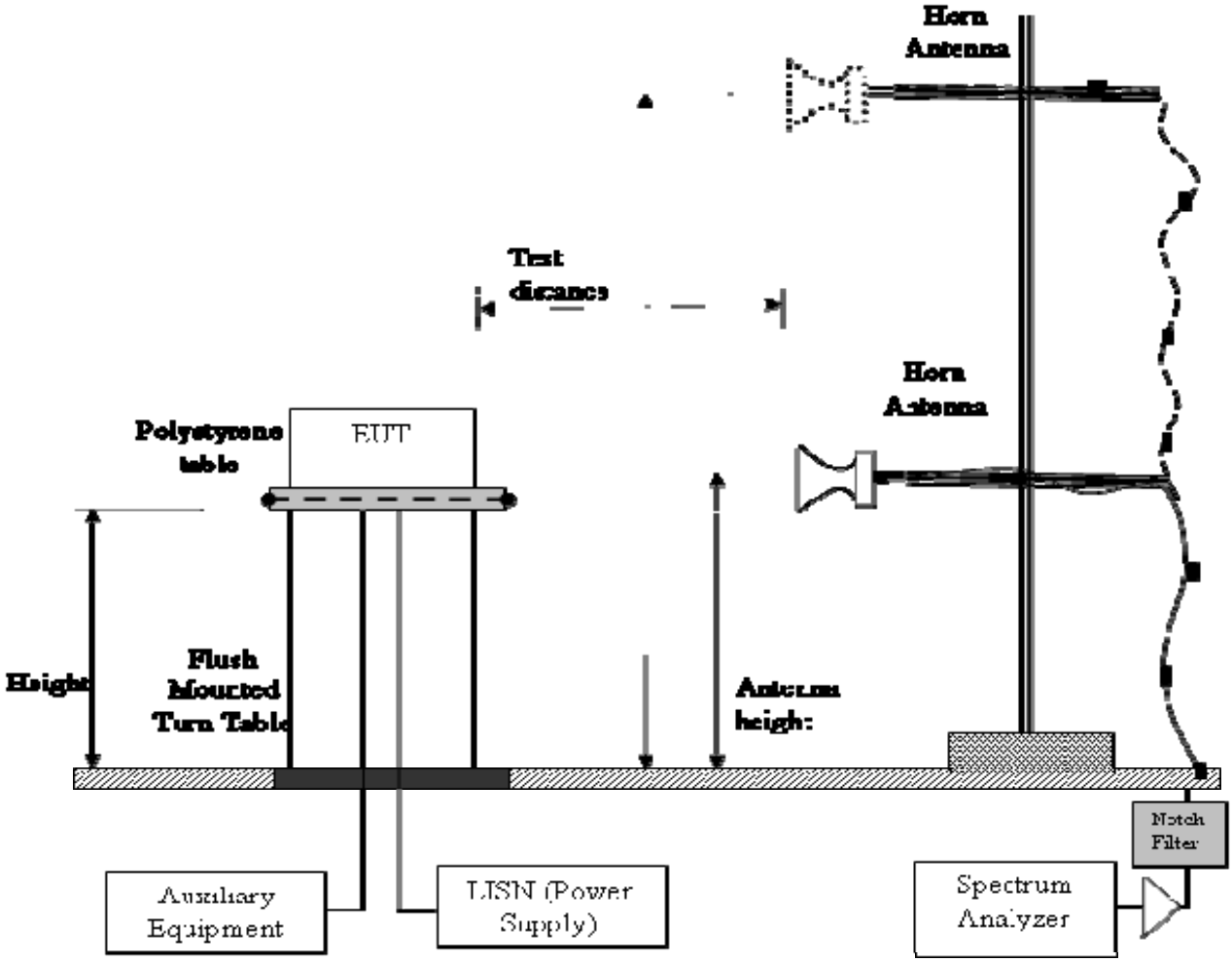
## 7.7 Radiated Spurious Emissions above 1 GHz - Antenna Taoglas

**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.

**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 = Correction Factor = CL – AG + NFL**

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

Field Strength Calculation Example:

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

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

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

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

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

**Specification**

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

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

FCC §15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

FCC §15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC §15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

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

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

**Laboratory Measurement Uncertainty for Spectrum Measurement**

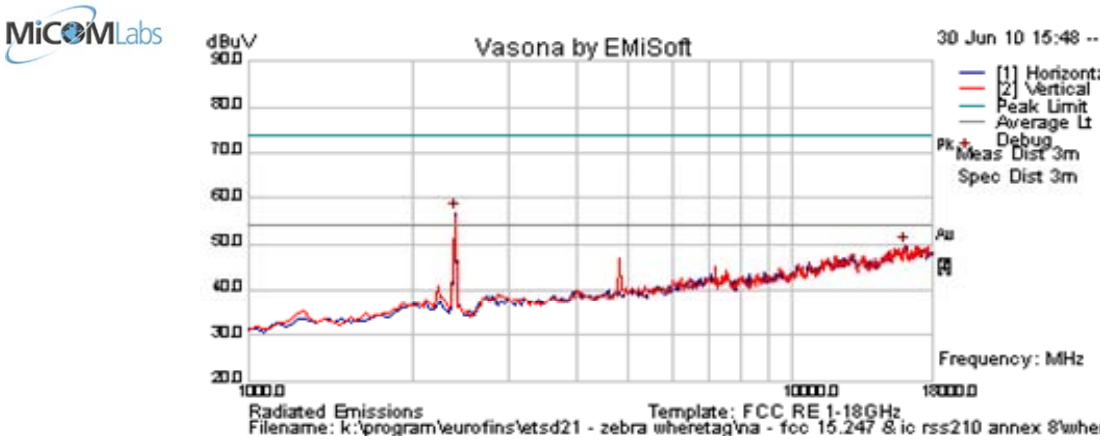
| | |
|---|---|
| Measurement Uncertainty | +5.6/ -4.5 dB |

**Traceability:**

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

### 7.7.1 802.11b Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2412 MHz | **Engineer** | GMH |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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 | | |

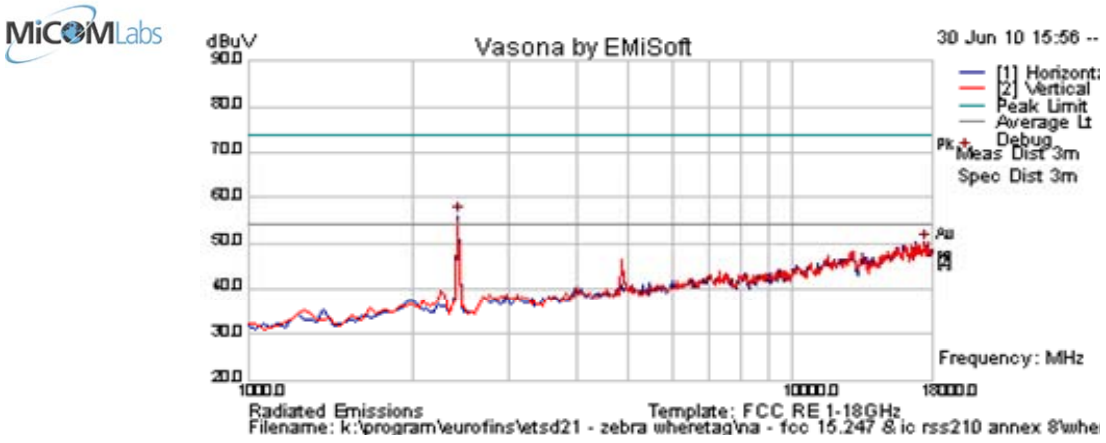



**Formally measured emission peaks**

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2437 MHz | **Engineer** | GMH |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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 | | |

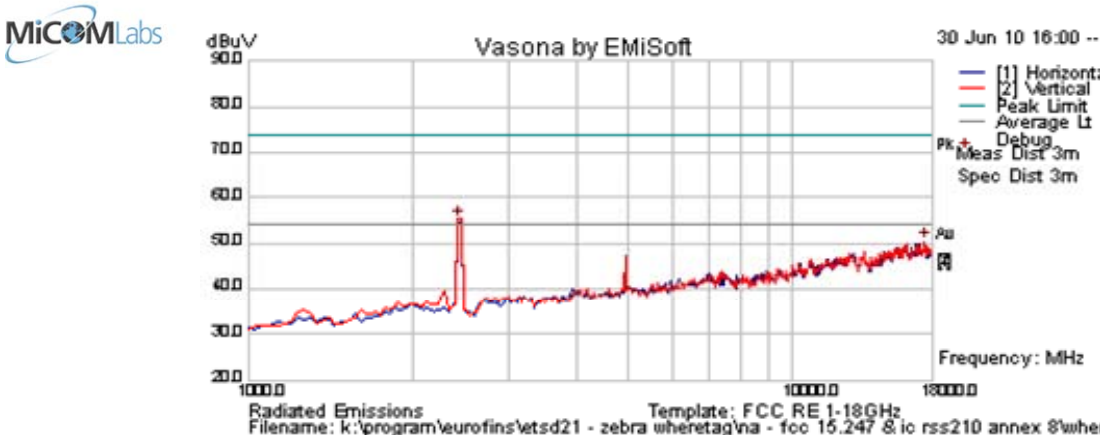



## Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2462 MHz | **Engineer** | GMH |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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 | | |



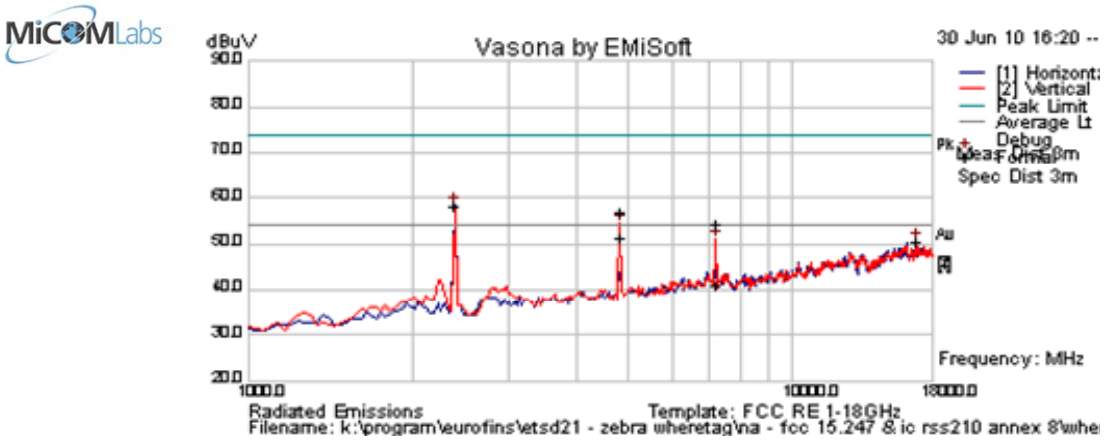

## Formally measured emission peaks

| 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 |

## 7.7.2 802.11g Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2412 MHz | **Engineer** | GMH |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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 | | |

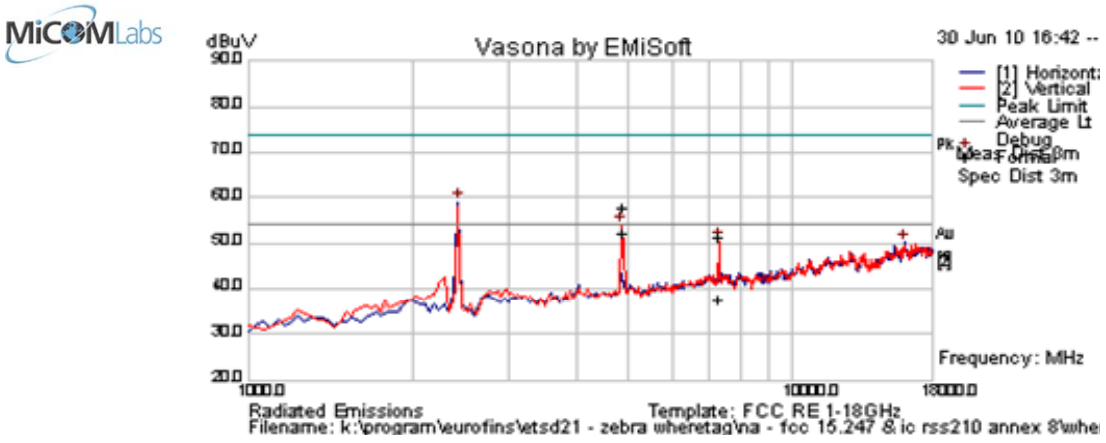



### Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2437 MHz | **Engineer** | GMH |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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 | | |

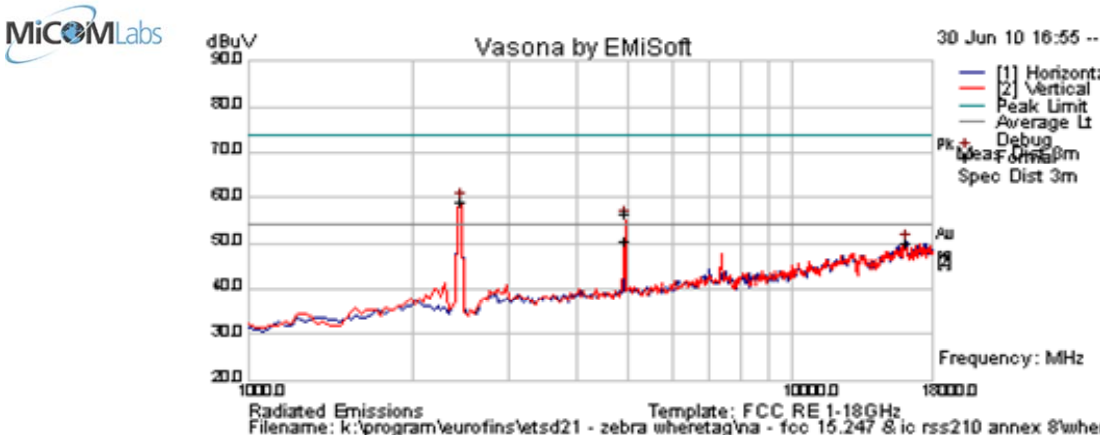



## Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2462 MHz | **Engineer** | GMH |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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 | | |



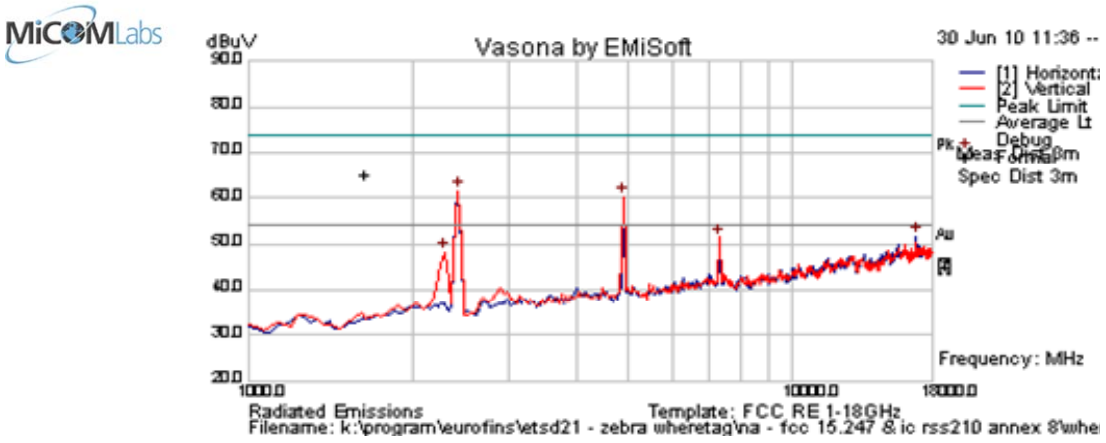

## Formally measured emission peaks

| 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 |

### 7.7.3 DSSS Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2412 MHz | **Engineer** | CSB |
| **Variant** | 802.11n; HT-20; 6.5 MCS | **Temp (ºC)** | 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 | | |



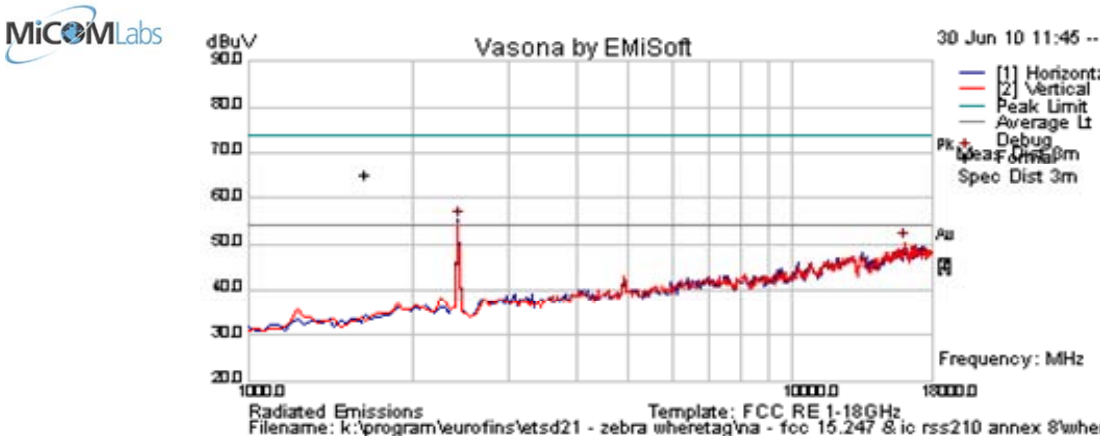

**Formally measured emission peaks**

| 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 |

## 7.7.4 OOK Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2446.519 MHz | **Engineer** | CSB |
| **Variant** | OOK | **Temp (ºC)** | 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 | | |



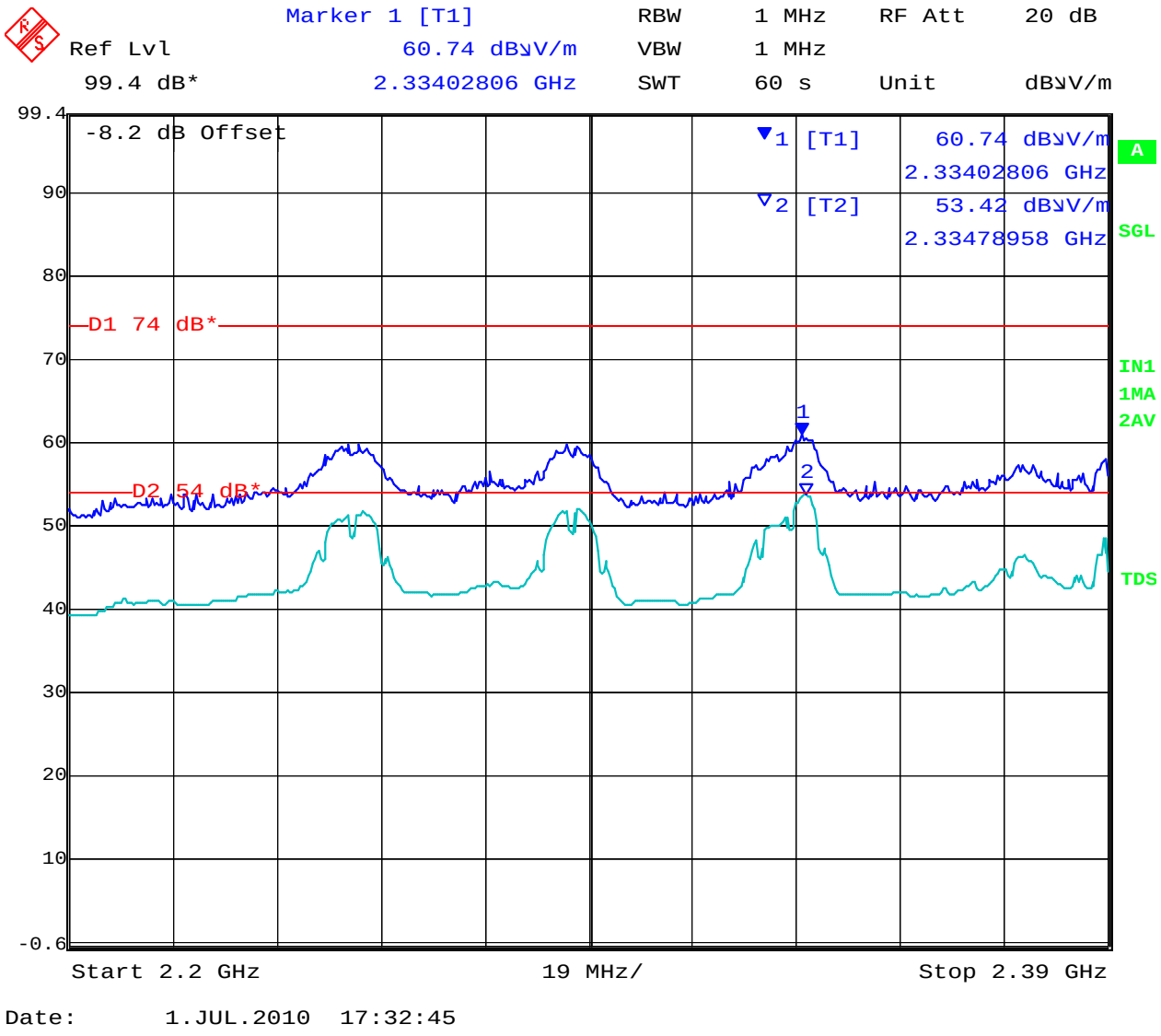

### Formally measured emission peaks

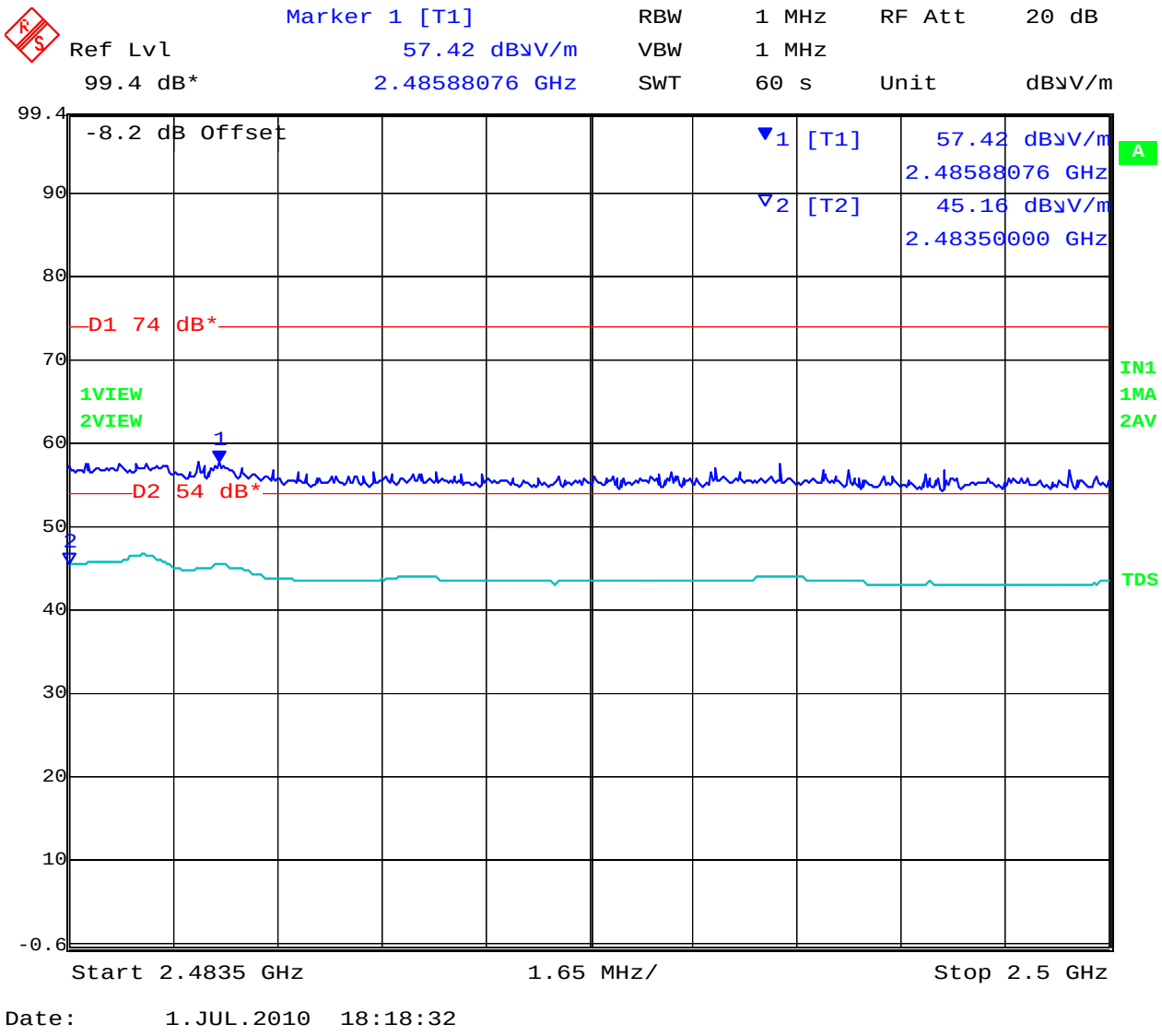
| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2446.373 | 63.4 | 3.0 | -11.0 | 55.4 | Peak [Scan] | H | 100 | -- | -- | -- | N/A | FUND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

| | |
|---|---|
| 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 |

### 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.



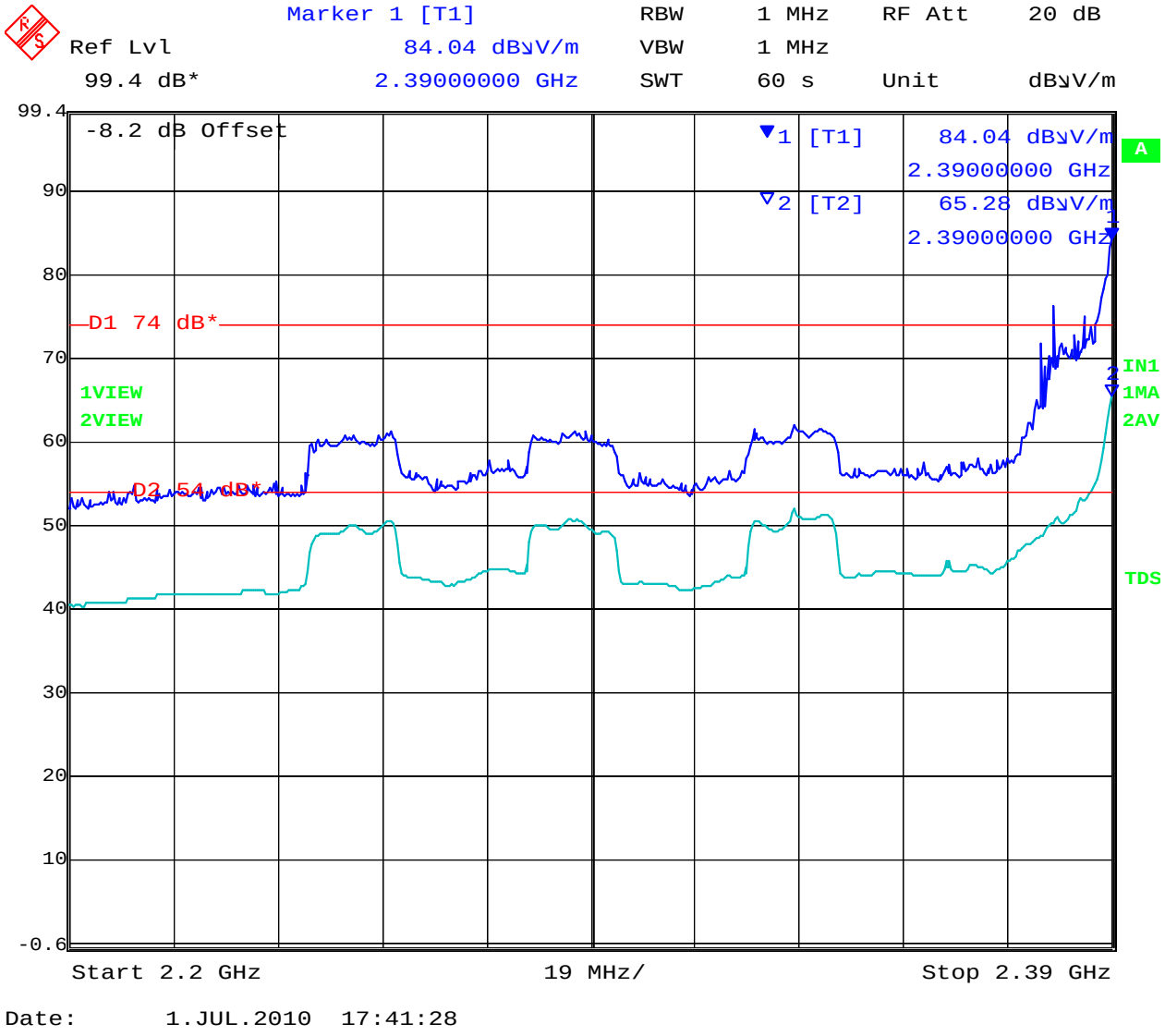


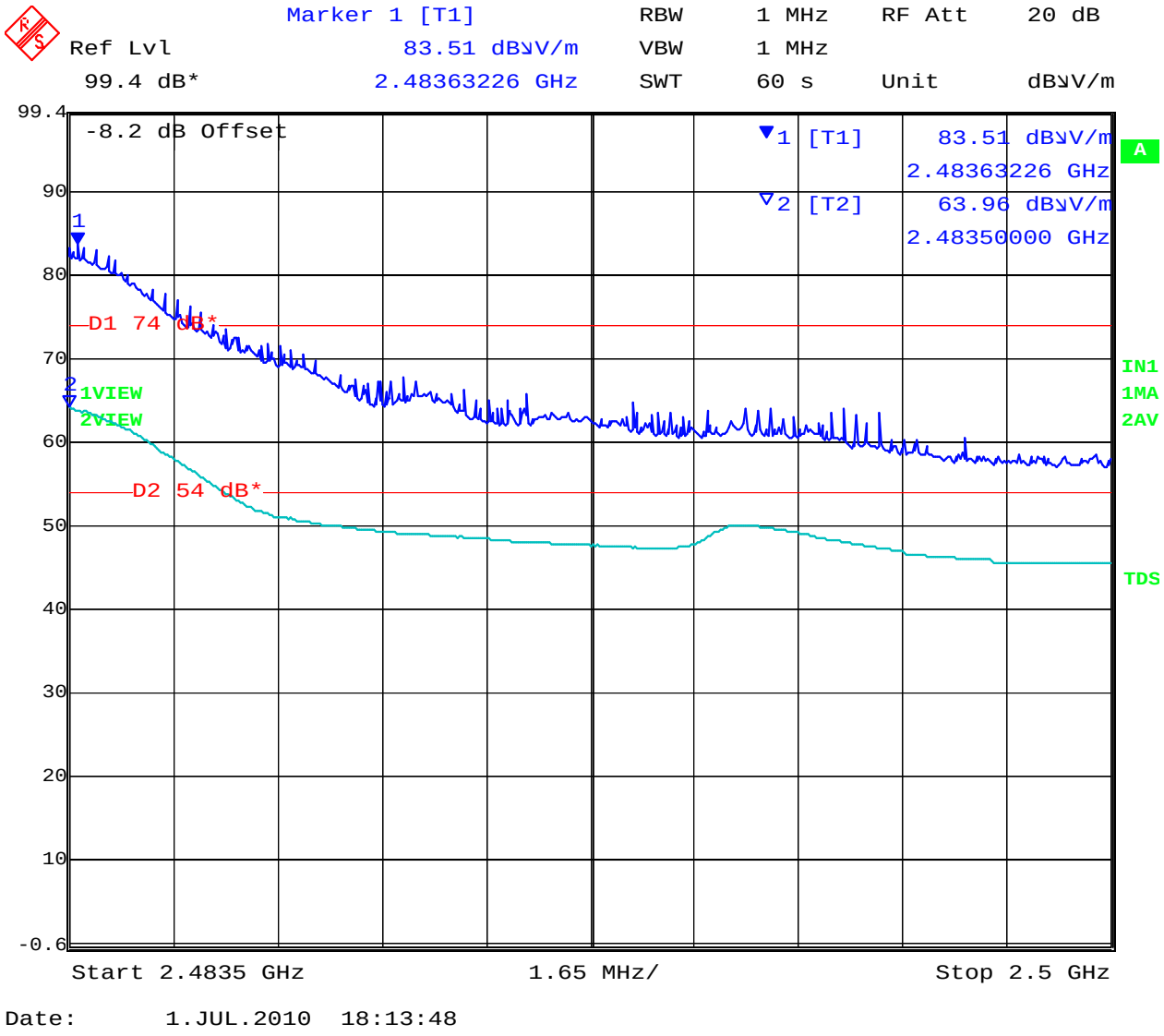
### 7.7.6 802.11g Radiated Band Edge Emissions

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 * 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 |



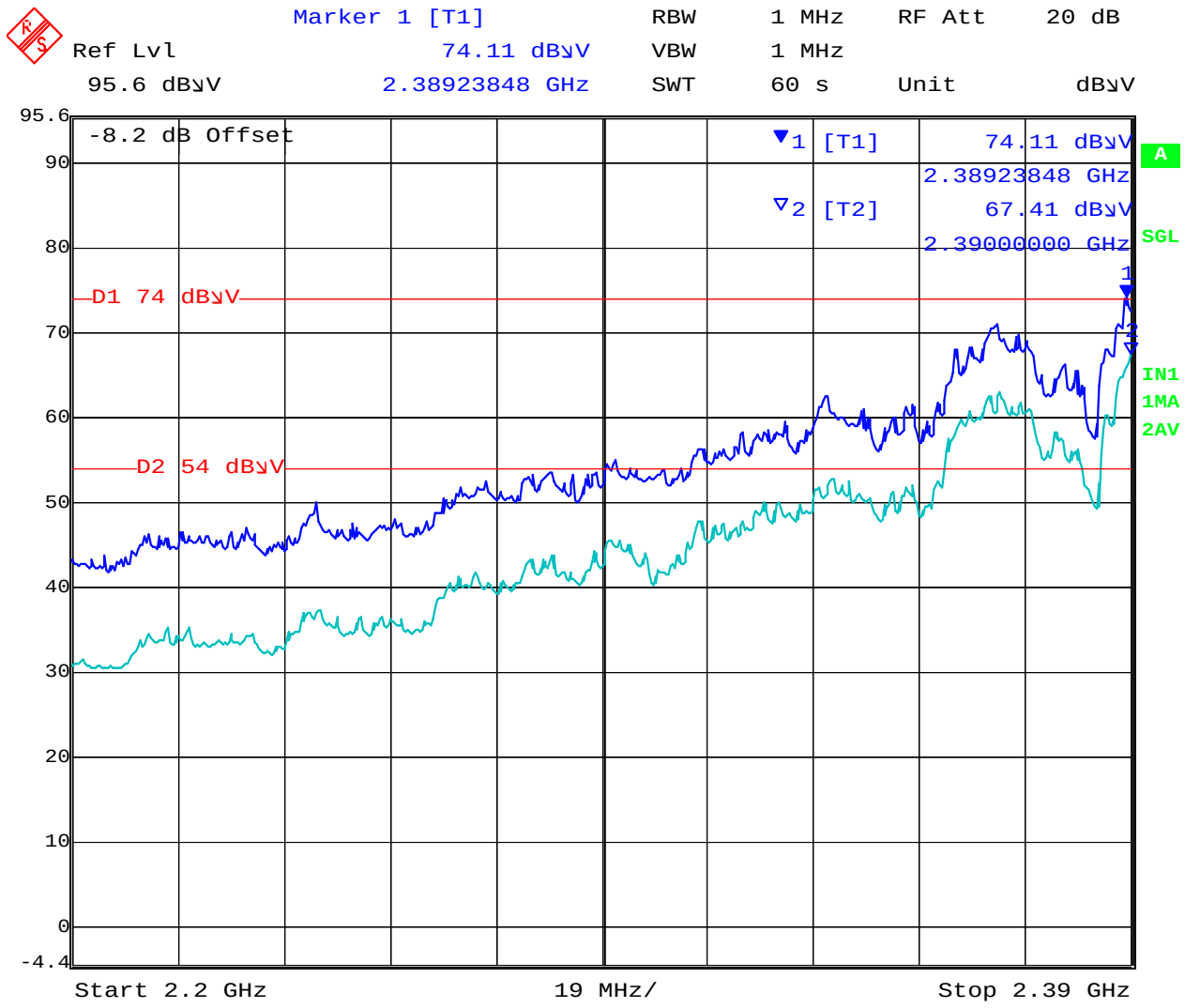


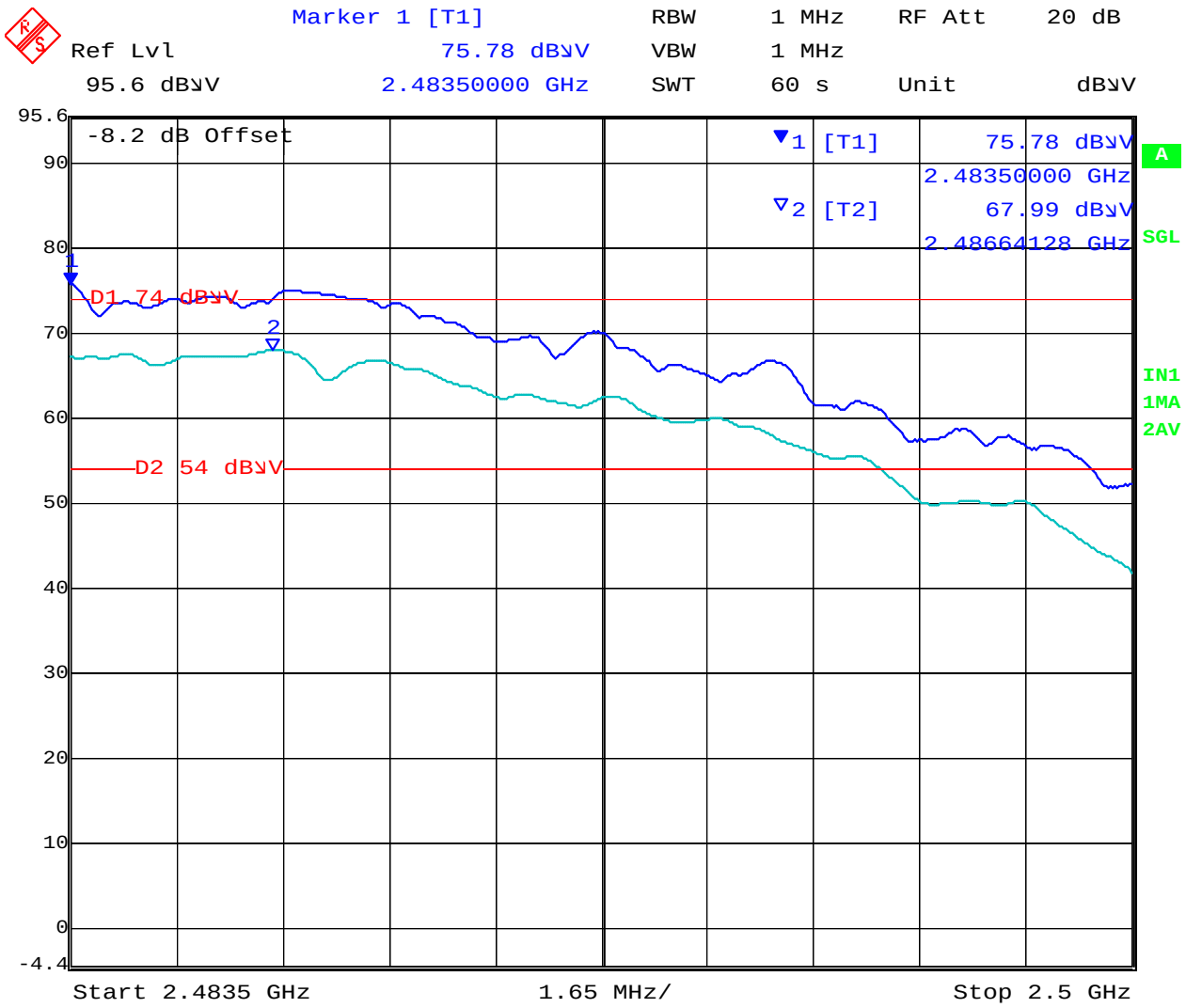
### 7.7.7 DSSS Radiated Band Edge Emissions

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 * LOG (2.55 / 100)
Correction Factor = -31.87 dB
Corrected Value = Measured Value (dB) - 31.87 (dB)

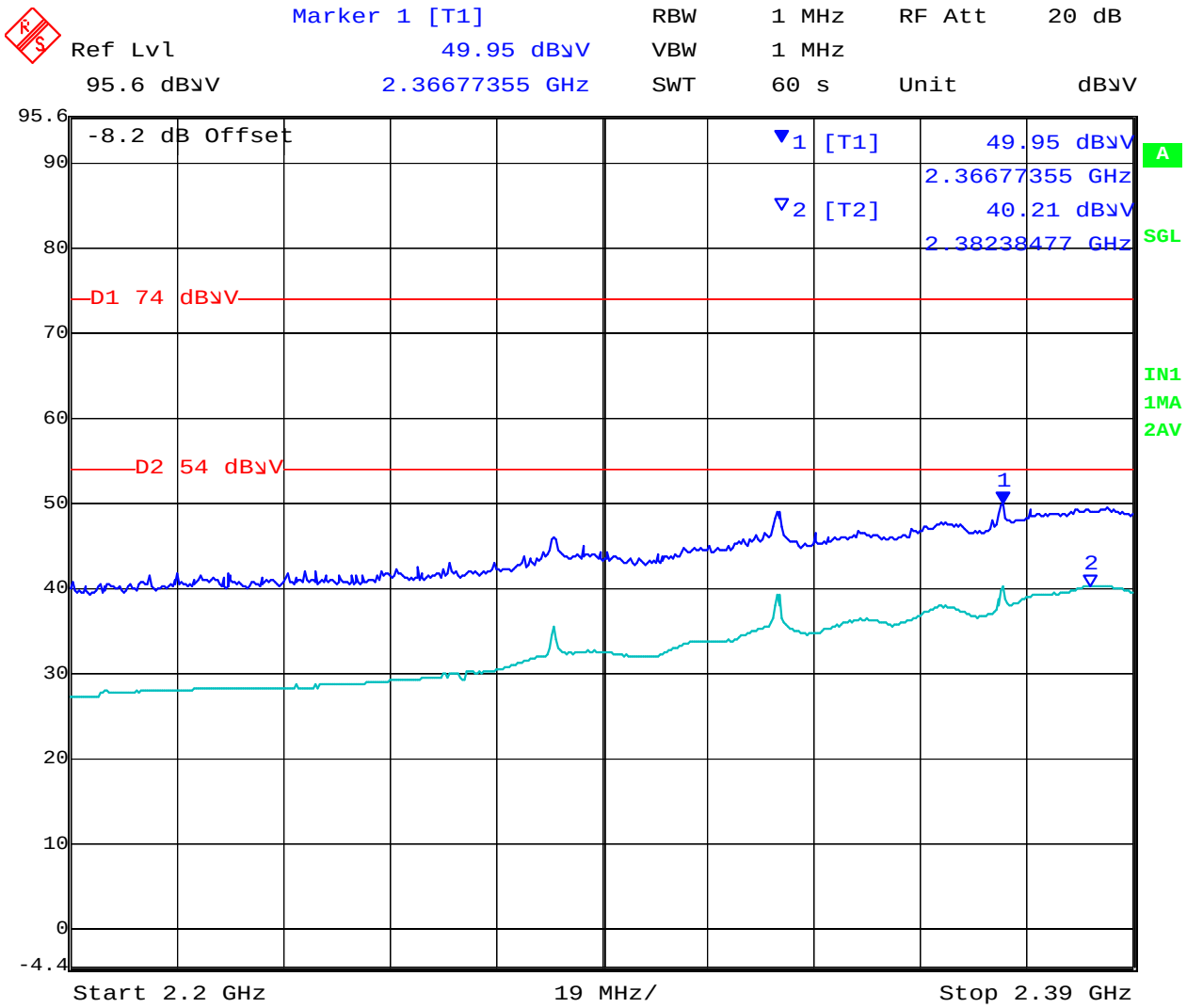
| Frequency (MHz) | Measured Value (dBuV/m) | Measurement Type | Corrected Value | Margin (dB) | Pass / Fail |
|---|---|---|---|---|---|
| 2389.238 | 74.11 | Peak | 42.24 | -31.76 | Pass |
| 2390 | 67.41 | Average | 35.54 | -18.46 | Pass |
| 2483.5 | 75.78 | Peak | 43.91 | -30.09 | Pass |
| 2486.641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

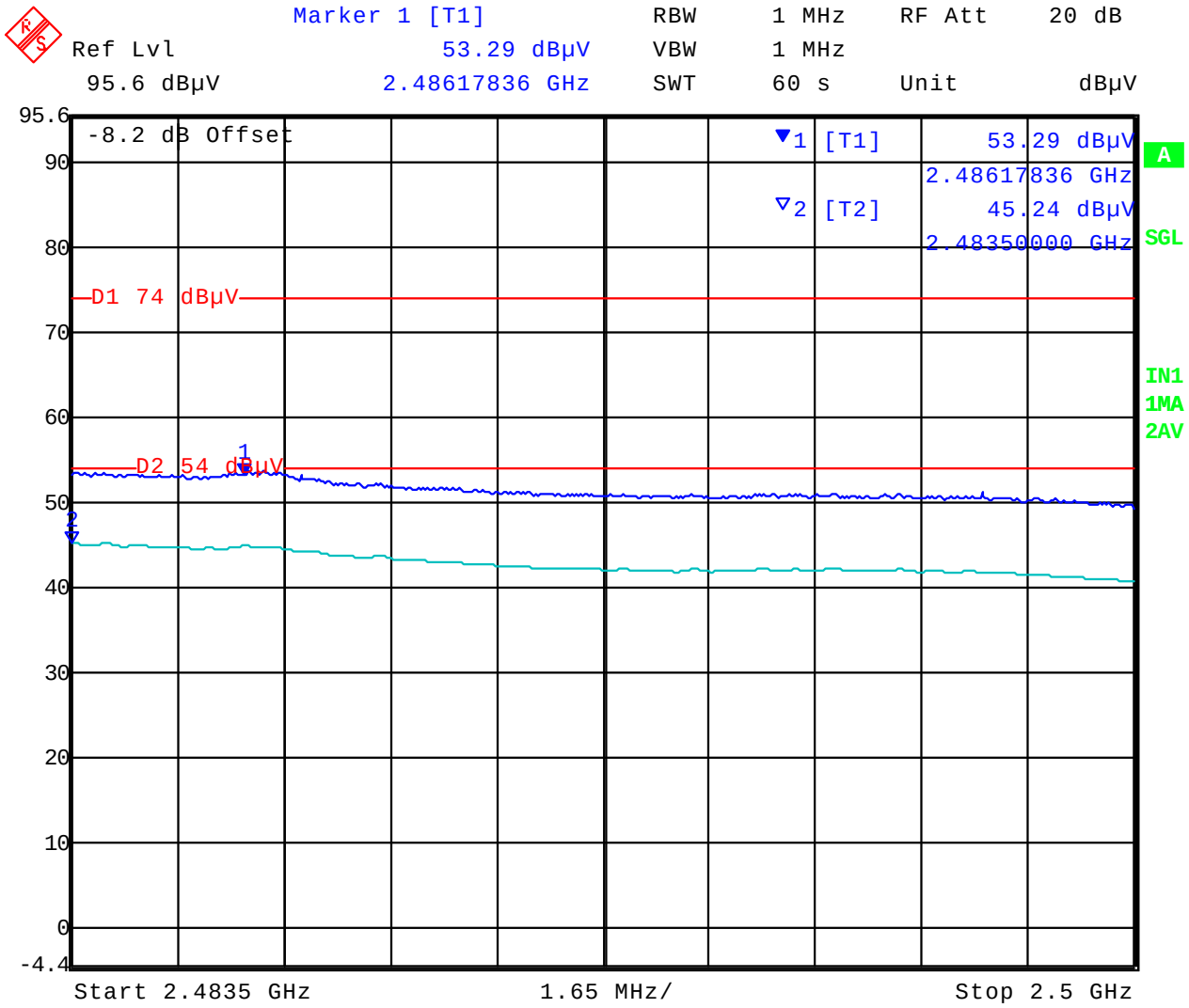




### 7.7.8 OOK Radiated Band Edge Emissions

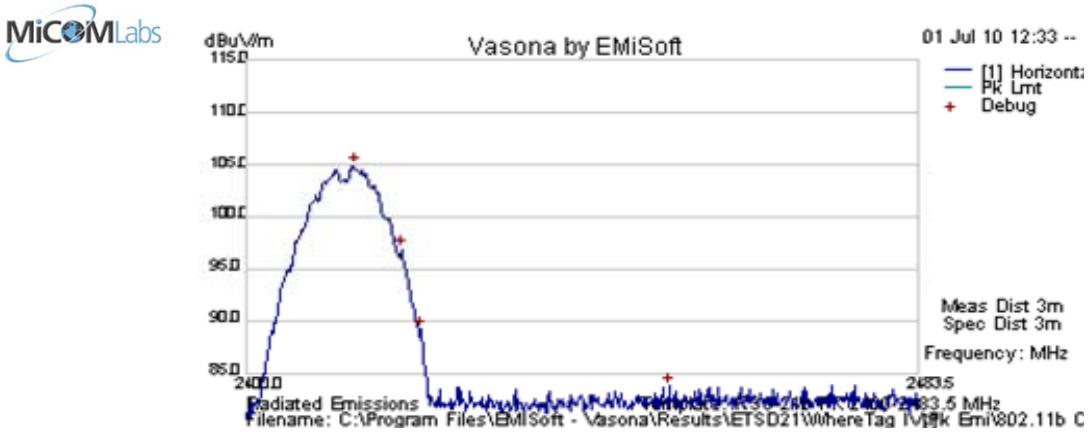
All emissions below FCC limits when tested at 100% duty cycle. No duty cycle correction factor required to comply with FCC limits.





### 7.7.9 802.11b Radiated Peak Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2412 MHz | **Engineer** | CSB |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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** | | | |

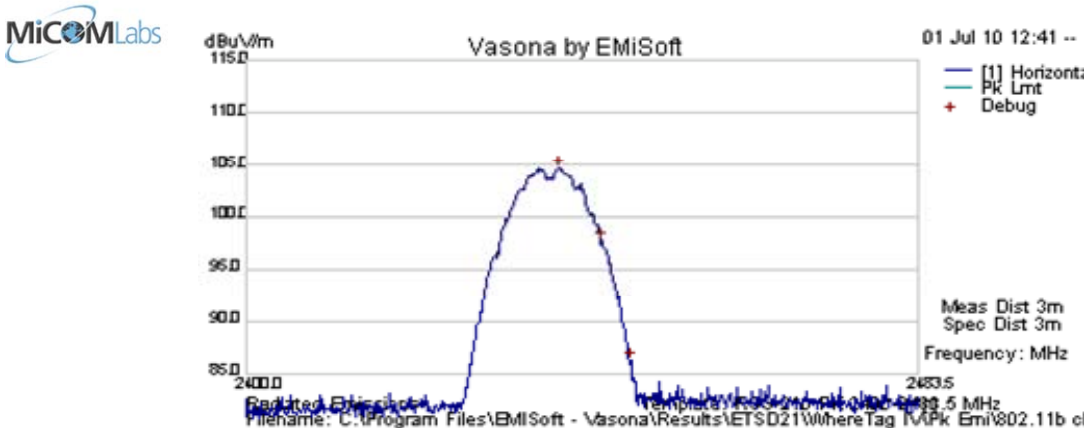



**Formally measured emission peaks**

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2437 MHz | **Engineer** | CSB |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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** | | | |

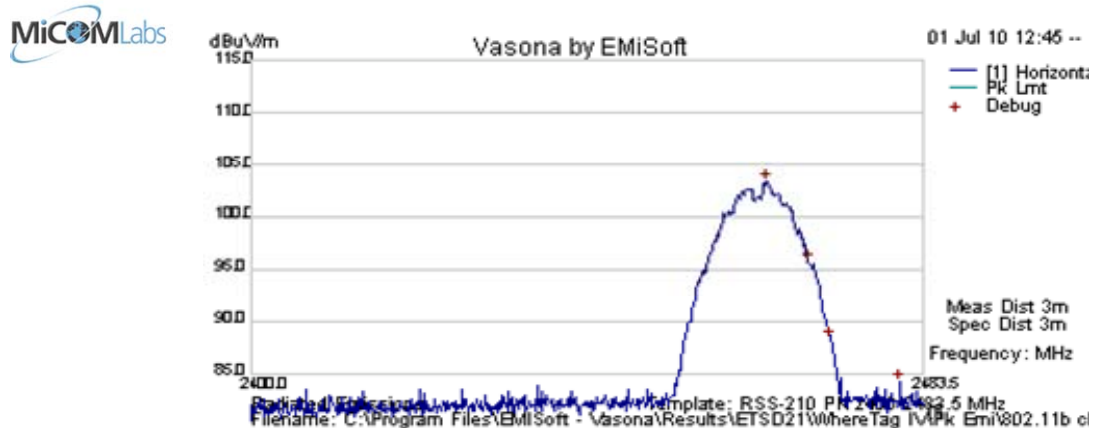



## Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2462 MHz | **Engineer** | CSB |
| **Variant** | 802.11b; 1 Mbs | **Temp (ºC)** | 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** | | | |



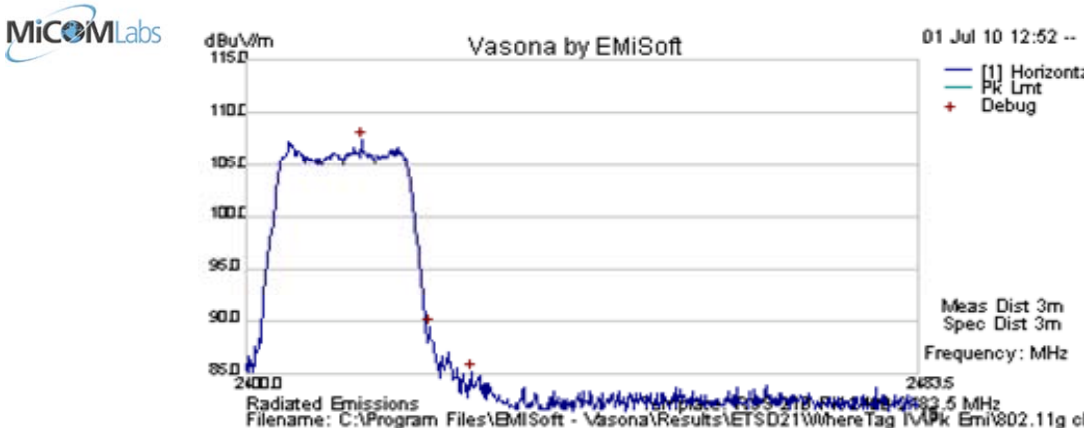

## Formally measured emission peaks

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |

## 7.7.10 802.11g Radiated Peak Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2412 MHz | **Engineer** | CSB |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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** | | | |

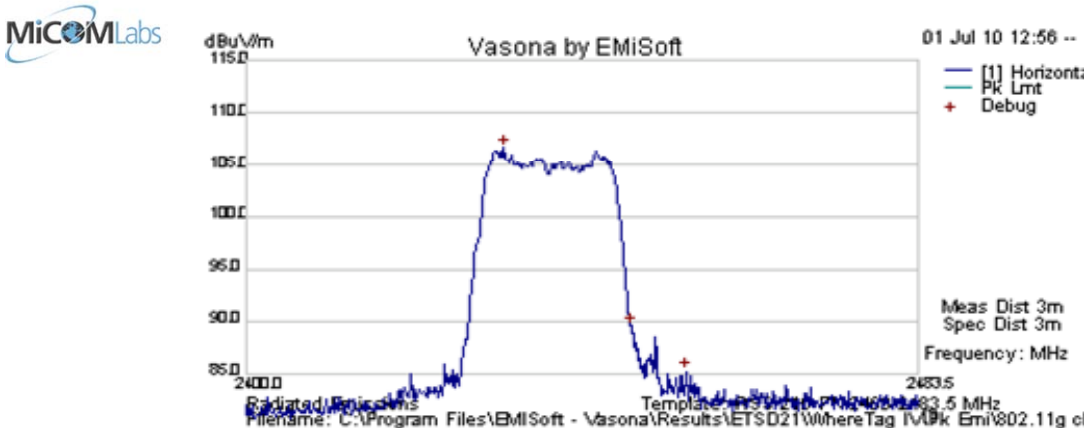



### Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2437 MHz | **Engineer** | CSB |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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** | | | |

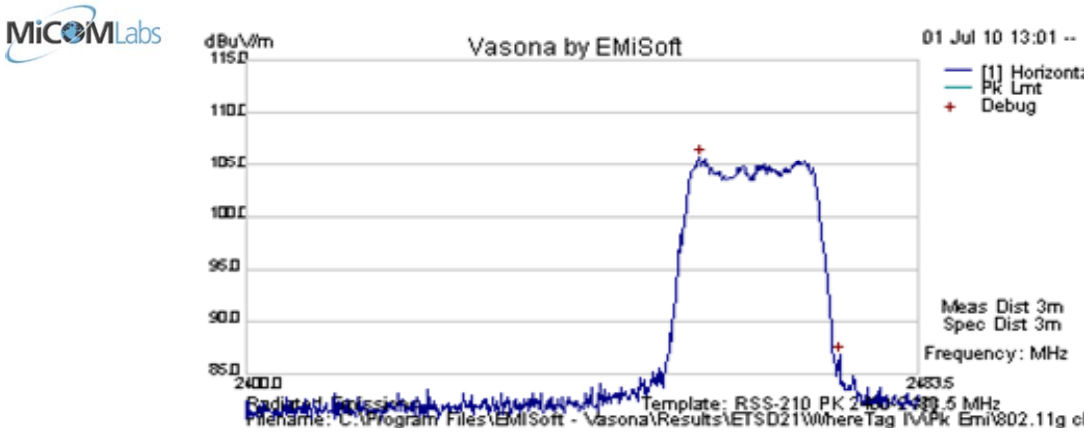



## Formally measured emission peaks

| 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 |

| | | | |
|---|---|---|---|
| **Test Freq.** | 2462 MHz | **Engineer** | CSB |
| **Variant** | 802.11g; 6 Mbs | **Temp (ºC)** | 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 |

## 7.7.11 DSSS Radiated Peak Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2441.75 MHz | **Engineer** | CSB |
| **Variant** | DSSS | **Temp (ºC)** | 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** | | | |

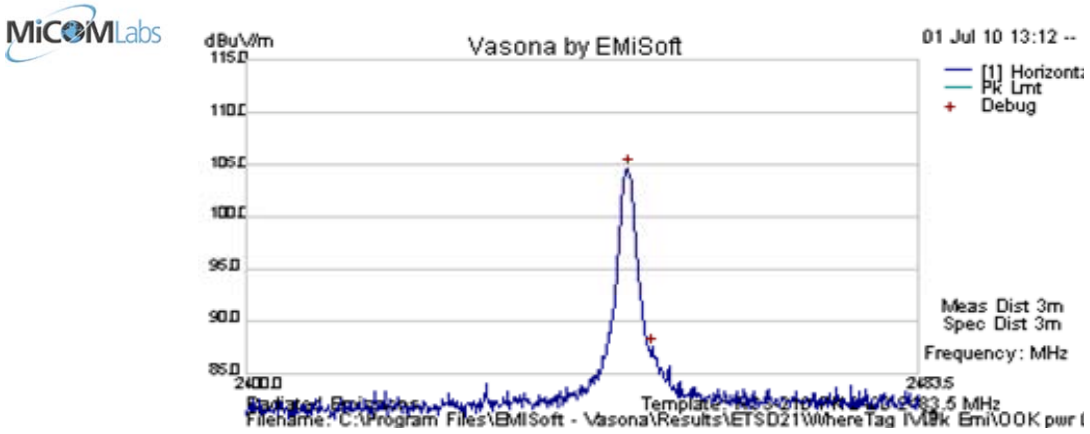

### Formally measured emission peaks

| 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 |

## 7.7.12 OOK Radiated Peak Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2446.519 | **Engineer** | CSB |
| **Variant** | OOK | **Temp (ºC)** | 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** | | | |



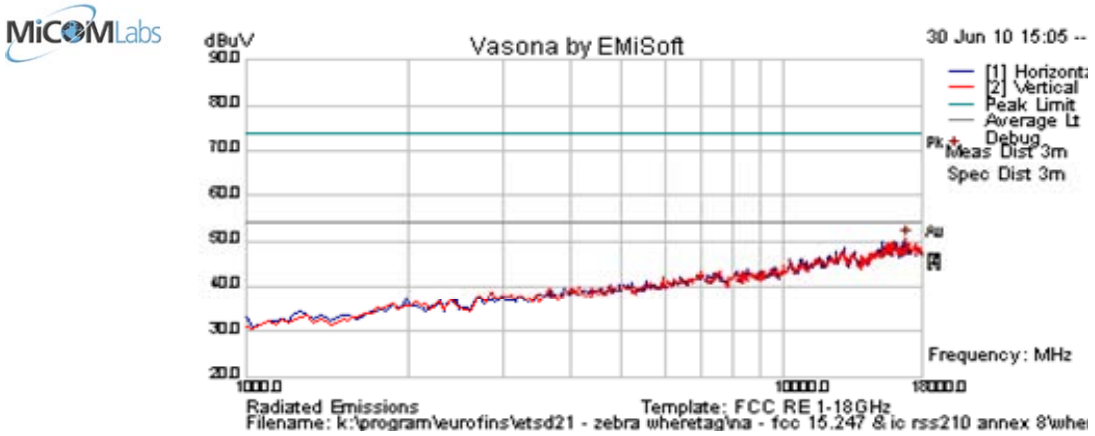

### Formally measured emission peaks

| 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 |

## 7.7.13 Receiver Radiated Emissions

| | | | |
|---|---|---|---|
| **Test Freq.** | 2446.519 MHz | **Engineer** | CSB |
| **Variant** | OOK | **Temp (ºC)** | 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. |

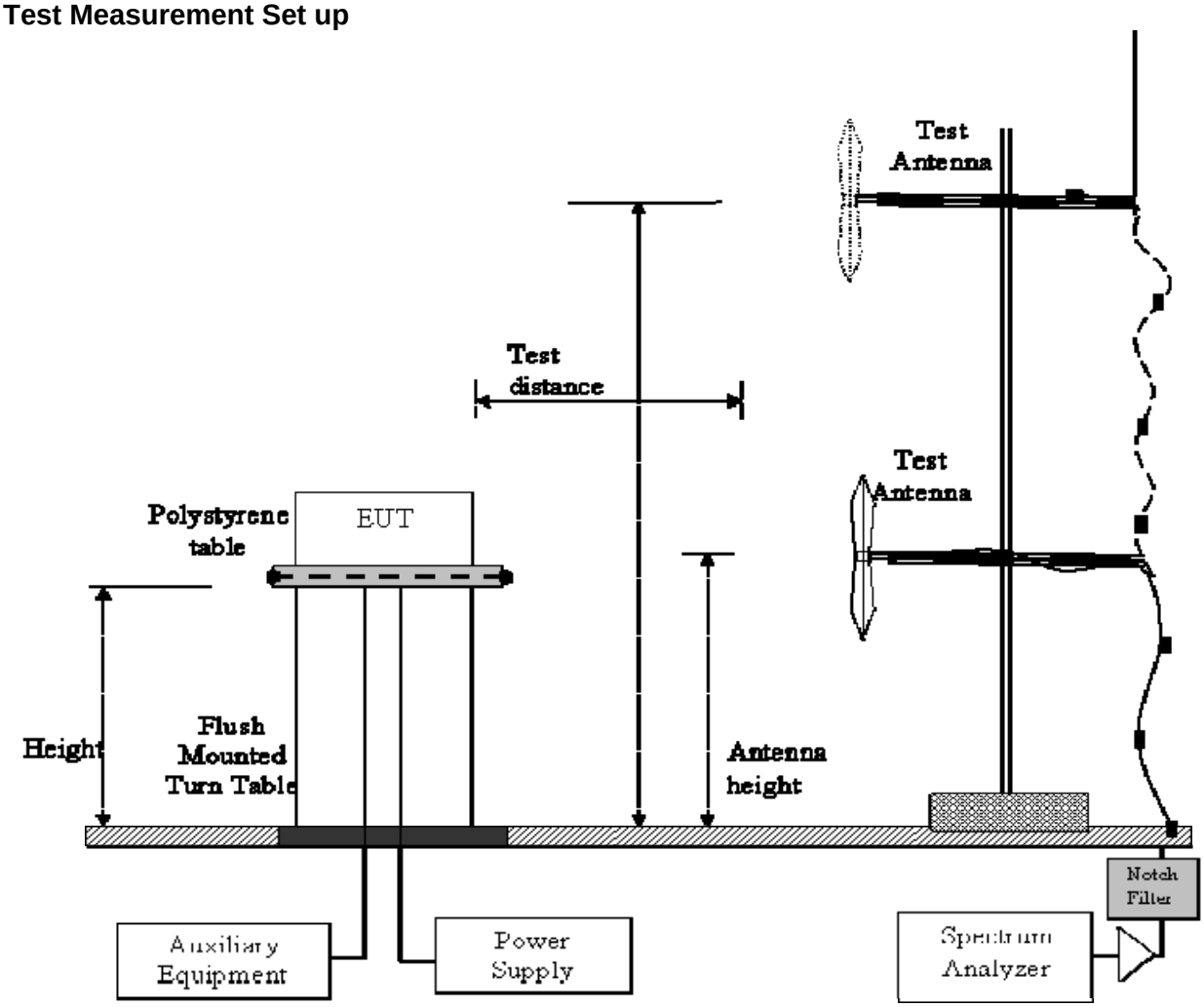
## 7.8 Radiated Spurious Emissions – Below 1 GHz

### 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.

**Test Measurement Set up**




Measurement set up for Radiated Emission Test

**Field Strength Calculation**

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

**FS = R + AF + CORR – FO**

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

**CORR = Correction Factor = CL – AG + NFL**

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

Field Strength Calculation Example:

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

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

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

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

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

**Specification**

**Radiated Spurious Emissions**

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

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

**FCC §15.205 (a)** Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

**FCC §15.205 (a)** Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

**FCC §15.209 (a)** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

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

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

**Laboratory Measurement Uncertainty for Spectrum Measurement**

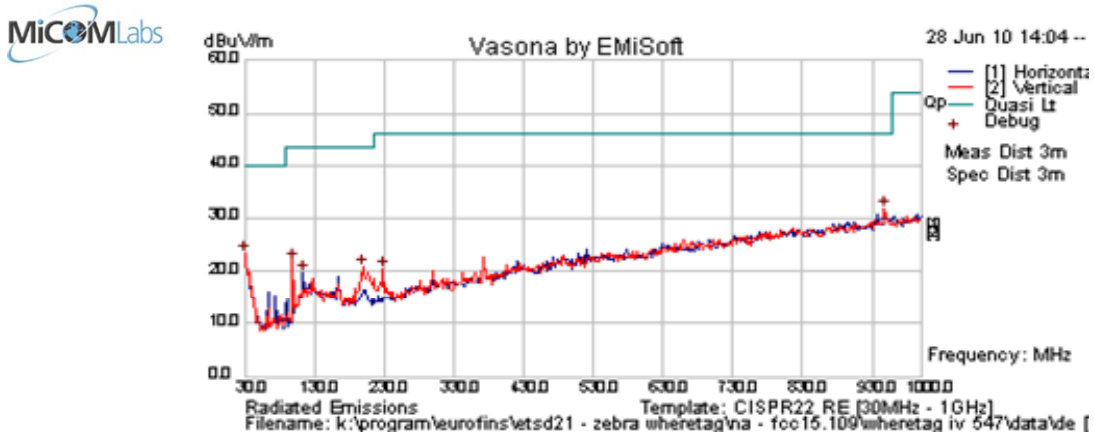
| | |
|---|---|
| **Measurement Uncertainty** | +5.6/ -4.5 dB |

**Traceability:**

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

### 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** | | | |



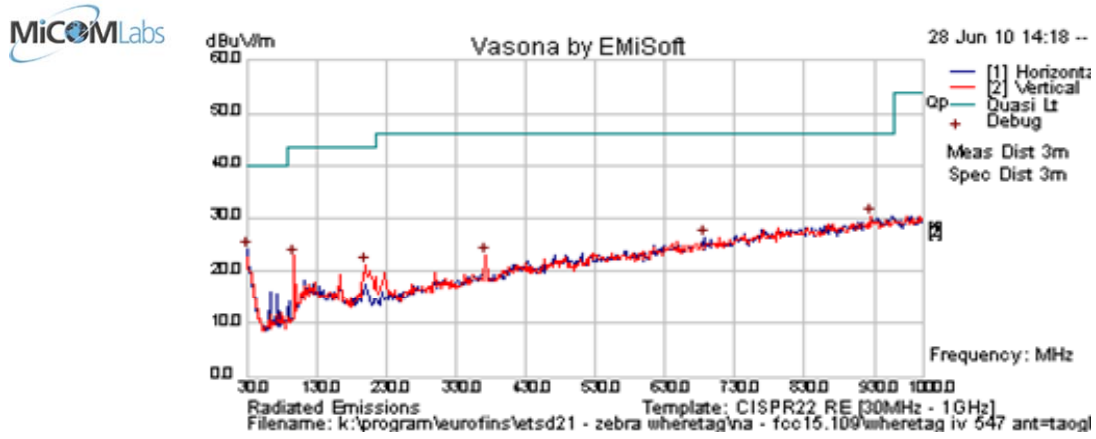

**Formally measured emission peaks**

| 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 |

## 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 |

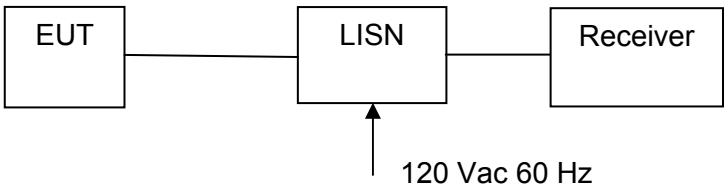
## 7.9 AC Mains Power Input/Output Port Emissions

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 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

**Limits**

| Frequency of Emission (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency

**Traceability**

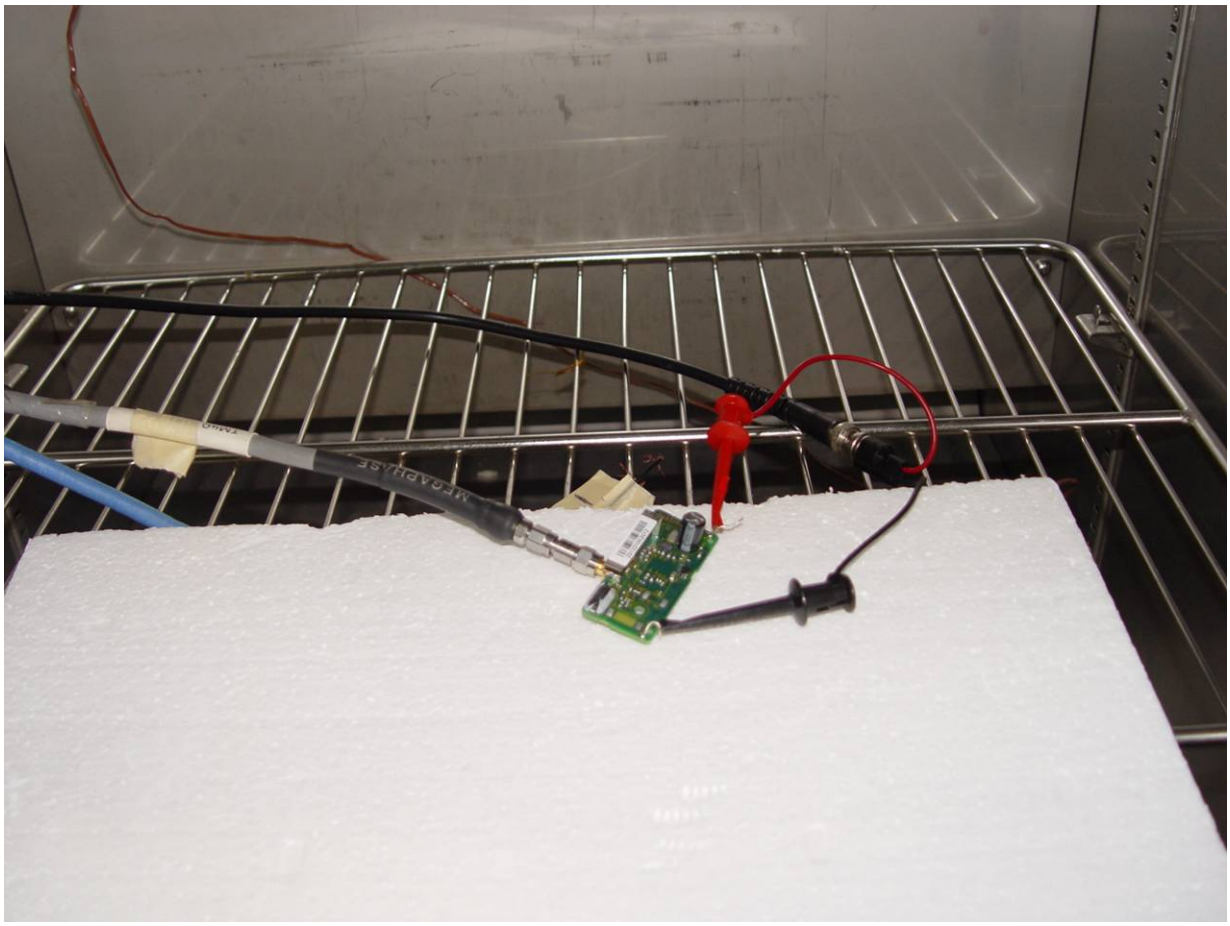
All conducted emission measurements are traceable to national standards. The uncertainty of measurement at a confidence level of not less than 95 %, with a coverage factor of k=2, in the range 9 kHz – 30 MHz (Average & Quasi-peak) is ±2.64 dB.

| 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 |

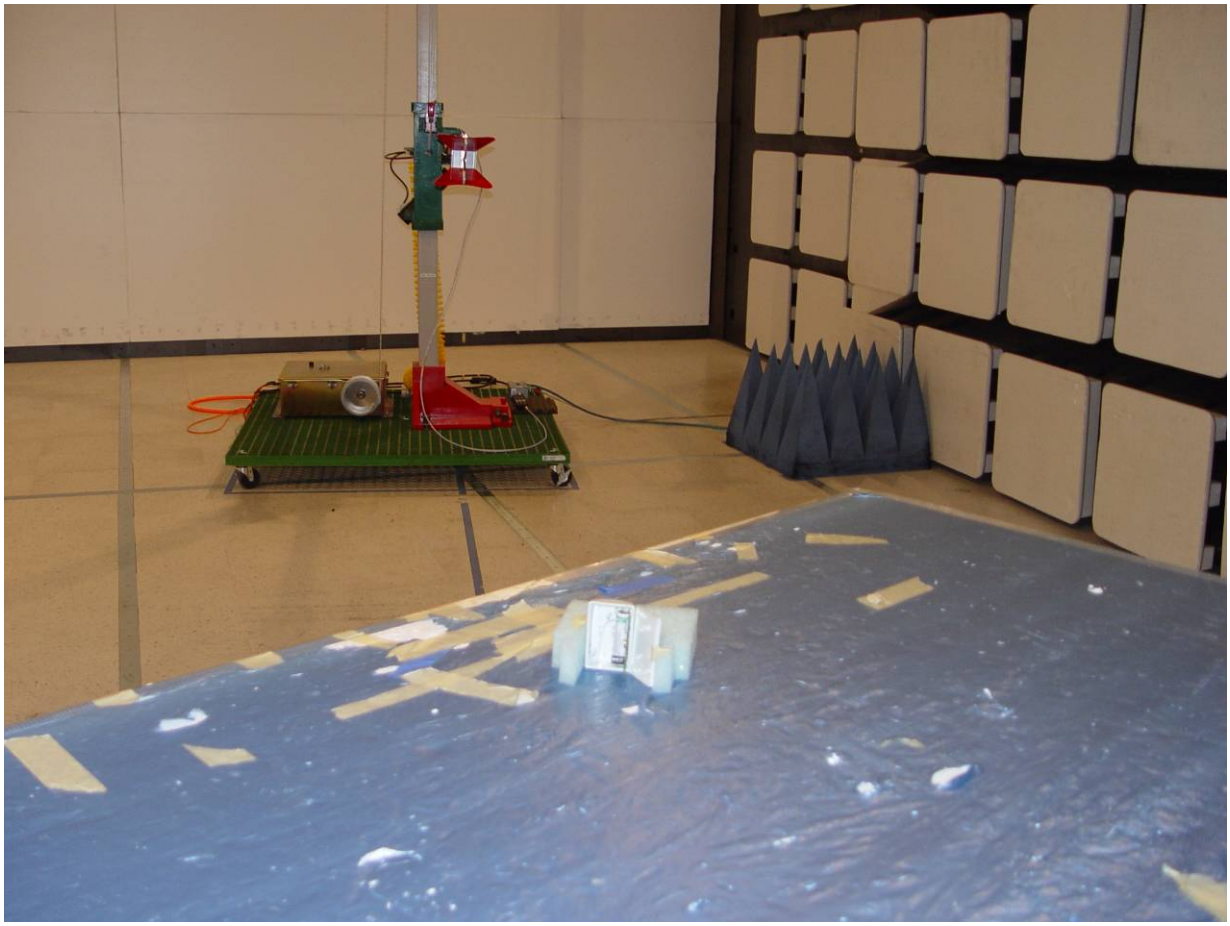
# 8 PHOTOGRAPHS

## 8.1 Conducted RF Measurement Set Up

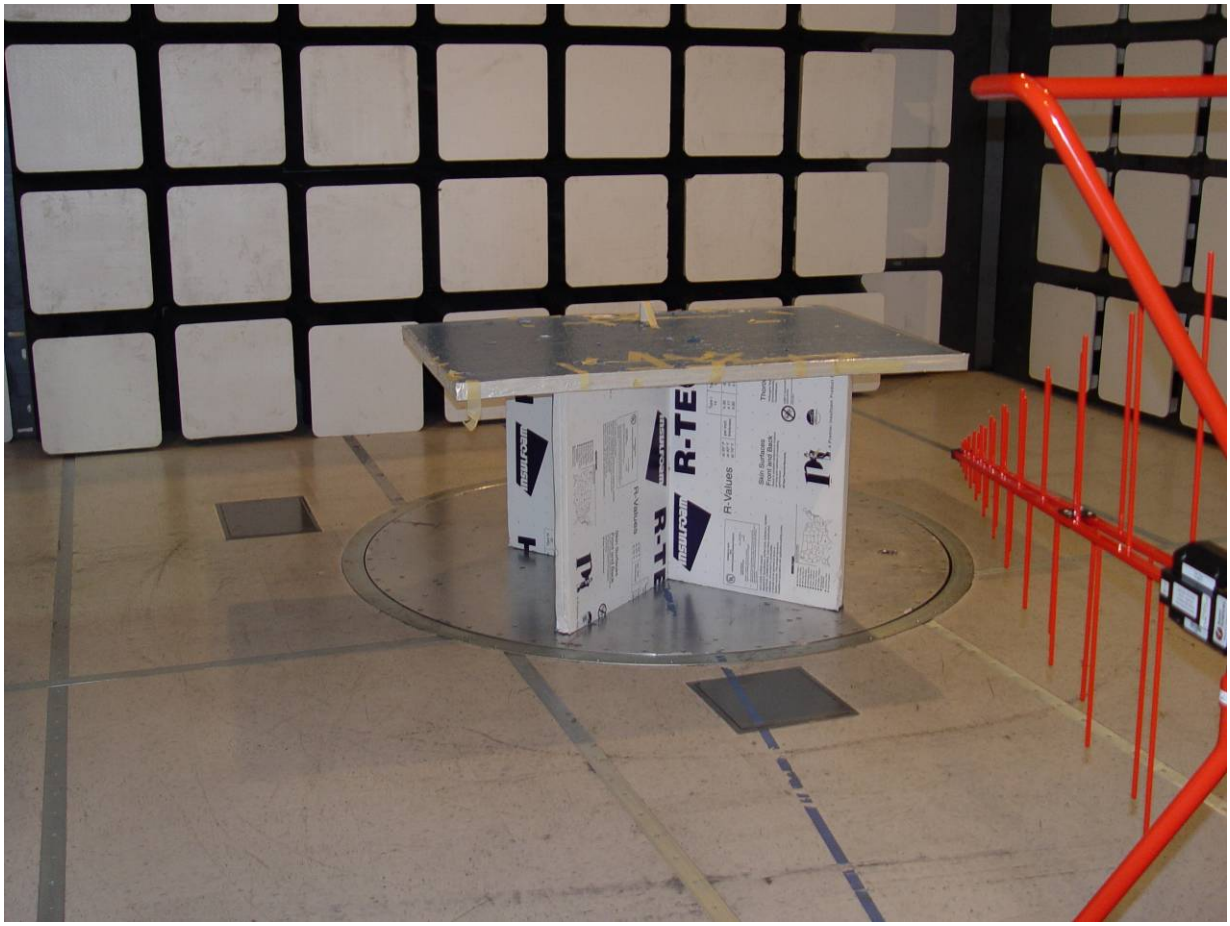


## 8.2 Radiated Spurious Emissions Above 1 GHz - ZES Antenna

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



## 8.4 Radiated Spurious Emissions Below 1 GHz



# 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 |


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