Electromagnetic Compatibility Test Report

Prepared in accordance with

FCC Part 15C, RSS-210 Issue 8 and ANSI C63.10-2009

ANSI C63.10:2009

On

WI-FI Transceiver

Ithaca 9800

TransAct Technologies Inc.

20 Bomax Drive

Ithaca, New York 14850

Prepared by:

TUV Rheinland of North America, Inc.

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Client:	TransAct Technologies Inc. 20 Bomax Drive Ithaca, New York 14850	Contact: Tel: Fax: e-mail	Jim Del Signore 607-257-8901 607-257-3893 jdelsignore@transact-tech.com
Identification:	WI-FI Transceiver	***Serial No.:***	TS-1
Test item:	Ithaca 9800	***Date Test Completed:***	July 25, 2014
Testing location:	TUV Rheinland of North America 710 Resende Road, Building 199 Webster NY 14580 U.S.A.	Tel: (585) 645-0125	
Test specification:	Emissions: Radiated Emissions Std FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 A8.5 and RSS-GEN 7.2.1 RSS-210 Issue 8 Conducted Emissions Std FCC 15.209, RSS-210		
Test Result:	**The above product was found to be Compliant to the above test standard(s)**		

tested by: Randall Masline	***reviewed by:*** Cecil Gittens
31 March 2015 Randall E Masline *Date* *Name* *Signature*	31 March 2015 Cecil Gittens *Date* *Name* *Signature*
Other Aspects:	**None**

Abbreviations: OK, Pass, Compliant, Complies = passed
Fail, Not Compliant, Does Not Comply = failed
N/A = not applicable

		Industry Canada	**VCCI**	**BSMI**
US5253	**Testing Cert.# 3331.08**	**482B-1**	**A-0203**	**SL2-IN-E-050R**

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Revisions

Date mm/dd/yy	Name	Page Number of Change	Describe Change

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the FCC Part 15.247 and RSS-210 Annex 8 based on the results of testing performed on July 25, 2014 on the WI-FI Transceiver, Model Number. Ithaca 9800, manufactured by TransAct Technologies Inc.. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

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1.3 Certification

The purpose of this testing is to ensure that the Murata LBEE5ZSTNC, used inside Transact's Ithaca 9800 remains Compliant with the present certification.

The original certification uses a Mono-pole type antenna and Transact is using the Taoglass

Part No. PC11.07.0100A listed below.

TheStripe™ PCB Dual-band 2.4 / 5.2 GHz antenna Features

High Efficiency Dual Band for Wi-Fi /Bluetooth/Zigbee Applications

IPEX MHF Connector (U.FL compatible)

Frequency	2.4 ~ 2.5GHz,	4.9 ~ 5.9GHz
Peak Gain (free space)	3dBi	4.5dBi
Average Gain (on plastic)	-0.6dBi	-0.5dBI

NOTE: Transact will not be utilizing the Bluetooth Feature, only 802.11

- **Murata Module Features**
- Murata LBEE5ZSTNC module integrates WLAN and Bluetooth functions.
- WLAN: IEEE 802.11 b, g, n compliant.
- Typical WLAN Transmit Power (typical):

+20.0dBm at 11Mbps, CCK (11b)
+15.0dBm at 54Mbps, OFDM (11g)
+14.5dBm at 65Mbps, OFDM (11n)

- Typical WLAN Sensitivity (typical):

-88.0dBm at 8% PER, 11Mbps
-73.0dBm at 10% PER, 54Mbps
-70.0dBm at 10% PER, 65Mbps

- Module size: 17.0x10.0mm typical.
- Module height: 2.2mm max.
- FCC (USA) and IC (Canada) Certification with mono-pole type antenna.

U.FL connector for external antenna connection is selectable but additional certification tests are required.

FCC ID: VPYLBTN, IC ID: 772C-LBTN

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1.4 *Summary of Test Results*

Applicant	TransAct Technologies Inc. 20 Bomax Drive Ithaca, New York 14850	**Tel**	607-257-8901	**Contact**	Jim Del Signore
		Fax	607-257-3893	**e-mail**	jdelsignore@transact-tech.com

Description	WI-FI Transceiver	**Model Number**	Ithaca 9800
Serial Number	TS-1	**Test Voltage/Freq.**	120VAC/60Hz
Test Date Completed:	July 25, 2014	**Test Engineer**	Randall Masline

Standards	Description	Severity Level or Limit	Criteria	Test Result
FCC Part 15, Subpart C Standard	Radio Frequency Devices-Subpart C: Intentional Radiators	See called out parts below	See Below	**Complies**
RSS-210 Issue 8 Standard	Low-Power Licence-exempt Radiocommunication Devices Category I Equipment	See called out parts below	See Below	**Complies**
FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 A8.5 and RSS-GEN 7.2.1	Out-of-Band Spurious and Harmonic Emissions (EUT in Transmit Mode)	Below the applicable limits	Below Limit	Complies
FCC Parts 15.247(i) and RSS-102, Issue 4	RF Exposure	SAR or MPE Requirements	Below Limit	Complies (without testing)

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2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at, 710 Resende Road, Building 199, Webster, NY 14580 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90575). The laboratory scope of accreditation includes: Title 47 CFR Part 15, and 18. The accreditation is updated every 3 years.

2.1.2 ILAC/A2LA

This is a program which is administered under the auspices of A2LA. The laboratory has been assessed and accredited in accordance with ISO Standard 17025:2005 (Certificate Number: 3331.08). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 VCCI

VCCI Accredited test lab. Registration numbers A-0203.

2.1.4 Industry Canada

(Registration No.: 482B-1) The 10M SEMI-ANECHOIC CHAMBER has been accepted by Industry Canada to perform testing to 3 and to 10m, based on the test procedures described in ANSI C63.4-2009.

2.1.5 BSMI

Registration No.: SL2-IN-E-050R. The BSMI accreditation was obtained by NIST MRA with the BSMI.

2.1.6 Korea

Recognized by Radio Research Agency as an accredited Conformity Assessment Body (CAB) under the terms of Phase I of the APEC TEL.

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2.1.7 Test Software

- Agilent MXE Receiver A.10.04

  (The installed EMC software in the MXE has p/n N6141A-2FP and version 1.3.50510.18099)
- CIGUI 32 Version 1.4 for California Instruments AC power source
- HP software E7415A Version A.01.45
- National Instruments “Measurement & Automation Employer” Version 4.6.2f1
- Rohde & Schwarz EMI Measurement software ES-K1 V1.71 ServicePack2
- Schaffner NSG 2025 Win 2025 Version 5.0
- Schaffner NSG 2050 Win 2050 Version 6.0
- TILE version 3.4.K.28
- Voltech PM 6000 Firmware 1.22.07RC6, Software IEC61000-3 for PM6000 Release 1.24.12

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2.1.8 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBµV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBµV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBµV/m)

25 dBµV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBµV/m

2.2 Measurement Uncertainty Emissions

Per CISPR 16-4-2	**Ulab**	**Ucispr**
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	4.57 dB	5.2 dB
Radiated Disturbance @ 3m		
1.0 GHz – 6.0 GHz	5.08 dB	5.2 dB
6.0 GHz – 18.0 GHz	5.16 dB	5.5 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	2.62 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.88 dB	4.5 dB

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Measurement Uncertainty Immunity

The estimated combined standard uncertainty for ESD immunity measurements is ± 2.98%.	Per EN61000-4-2
The estimated combined standard uncertainty for radiated immunity measurements is ± 2.0dB.	Per EN61000-4-3
The estimated combined standard uncertainty for EFT fast transient immunity measurements is ± 5.0%.	Per EN61000-4-6
The estimated combined standard uncertainty for surge immunity measurements is ± 5.0%.	Per EN61000-4-5
The estimated combined standard uncertainty for conducted immunity measurements is ± 2.0dB.	Per EN61000-4-6
The estimated combined standard uncertainty for power frequency magnetic field immunity measurements is ± 2.57%.	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for voltage variation and interruption measurements is ± 2.48%.	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for radiated emissions measurements is ± 4.57 dB	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for radiated emissions measurements from 1 GHz to 6 GHz is ± 4.57dB	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for radiated emissions measurements from 6 GHz to 18 GHz is ± 4.57dB	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for conducted emissions measurements is ± 2.62dB.	Per CISPR16-4-2 Method
The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 11.15%.	Per CISPR16-4-2 Method

Expanded measurement uncertainty numbers are shown in the tables above. Compliance criteria are not based on measurement uncertainty.

2.3 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

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2.4 Measurement Equipment Used

Equipment	Manufacturer	Model #	Ref.	Serial #	Last Cal dd/mm/yy	Next Cal dd/mm/yy	Test
Radiated Emissions							
Horn	ETS/Lindgren	3117		00109306	06-Jan 14	06-Jan-16	RE
BiLog	Chase	CBL6111	C041	1170	12-Sept-12	12-Sept-14	RE
Receiver (20Hz-40GHz)	Rohde & Schwarz	ESI(B) 40	C320	839283/005	16-Jan-14	16-Jan-15	RE
Multimeter	Fluke	83	C437	48162892	06-Aug-14	06-Aug-15	RE
BiLog	Chase	CBL6111B	C448	2081	22-Aug-13	22-Aug-15	RE
Horn(18-26.5 GHz)	EMCO	3160-09	C447	C447	8-Mar-13	8-Mar-15	RE

Note: CE = Conducted Emissions, CI= Conducted Immunity, DP=Disturbance Power, EFT=Electrical Fast Transients, ESD = Electrostatic Discharge, FLI=Flicker, HAR=Harmonics, MF=Magnetic Field Immunity, RE=Radiated Emissions, RI=Radiated Immunity, SI=Surge Immunity, VDSI=Voltage Dips and Short Interruptions

3 Product Information

3.1 Equipment Modifications

No modifications were needed to bring product into compliance.

3.2 Test Plan

The EUT product information, test configuration, mode of operation, test types, test procedures, test levels, pass/failure criteria, in this report were carried out per the product test plan located in appendix A of this report

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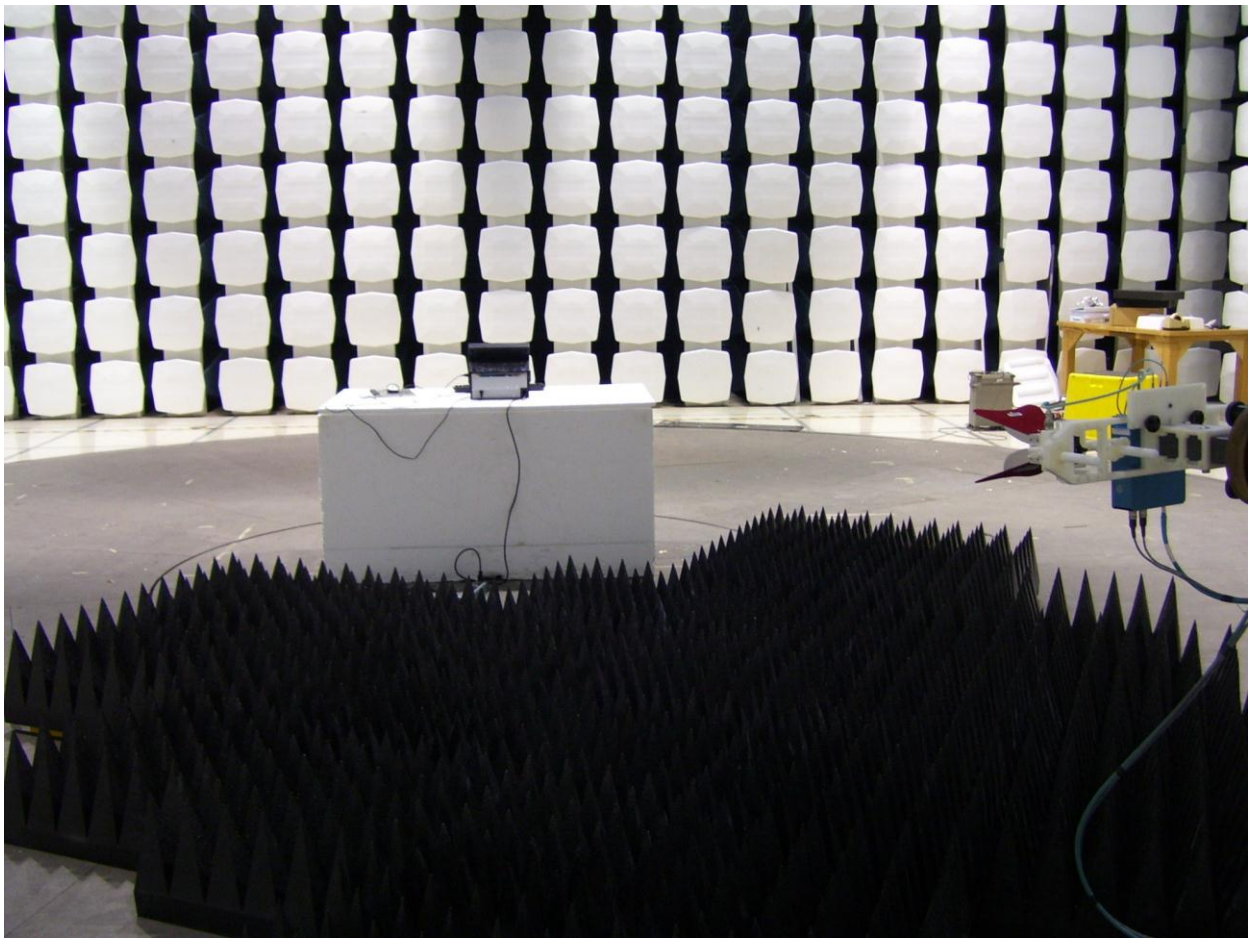

Figure 1 –External Photo of EUT

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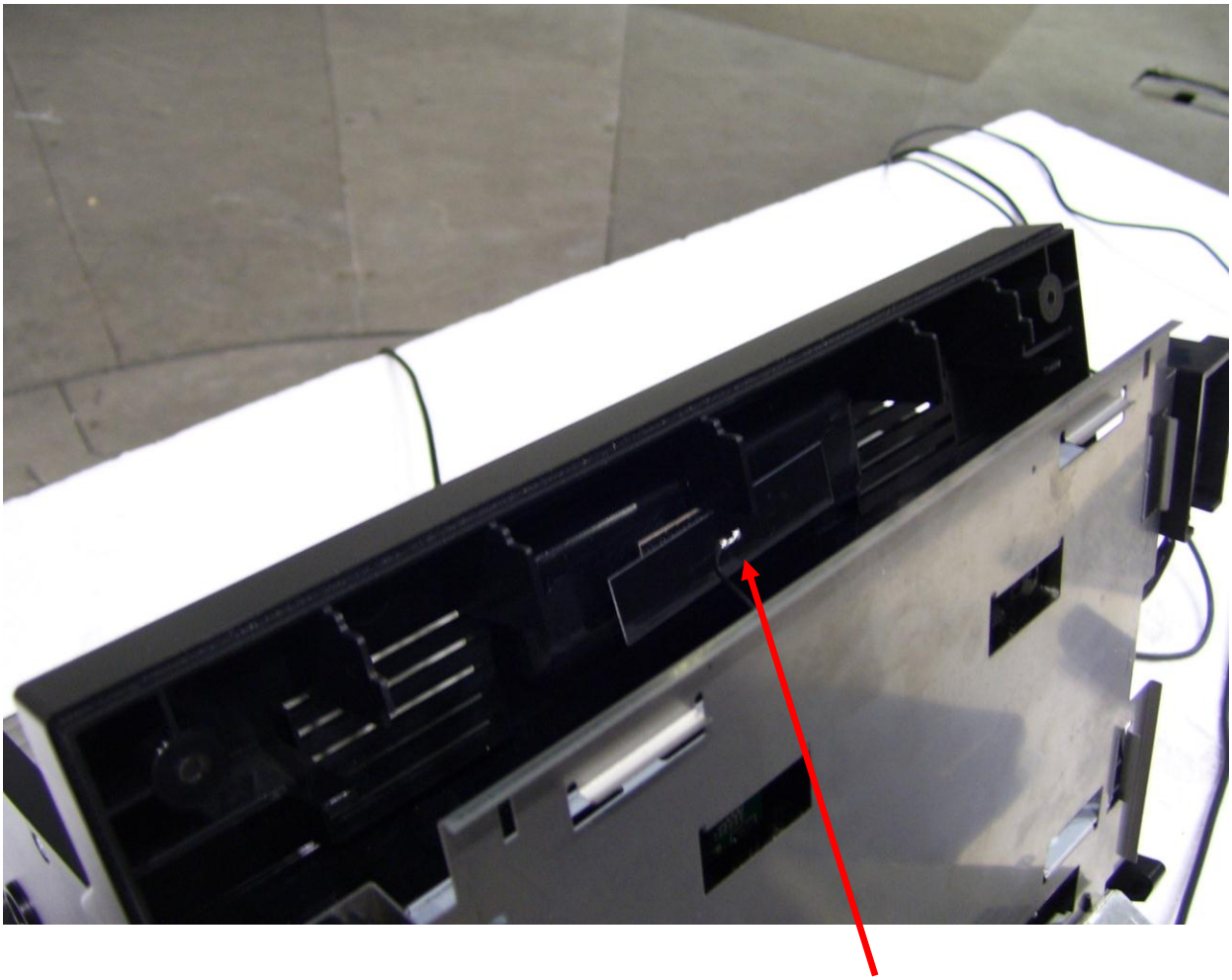

Figure 2 –External Photo of EUT - Antenna

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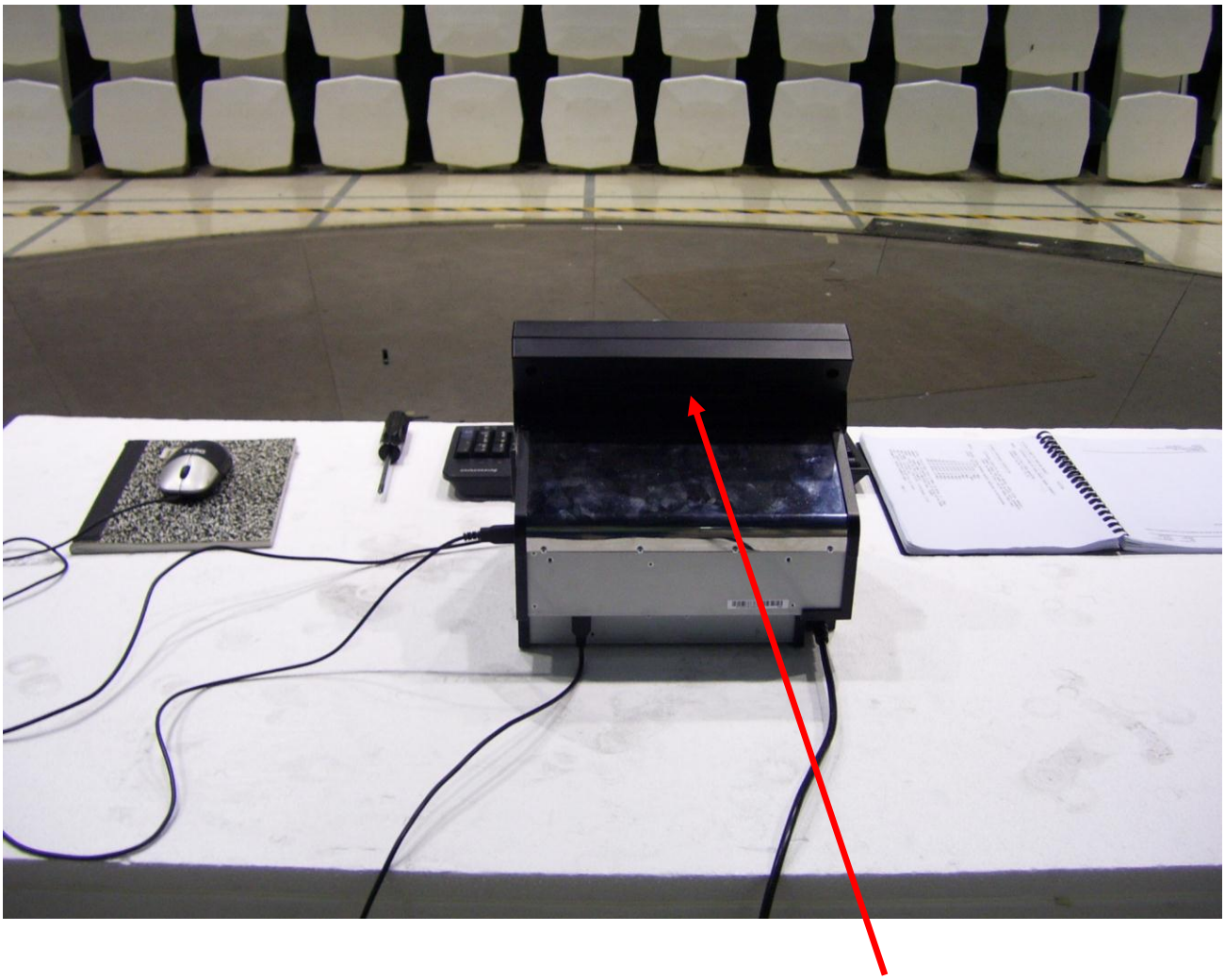

Figure 3 –External Photo of EUT – Antenna Placement, behind this cover

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4 Emissions

5 Radiated Emissions

5.1 Spurious Emissions Outside the band - FCC 15.247(d), RSS-210 A8.5

In any 100kHz 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 desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided below to show that the EUT meets these requirements at the band edges.

5.1.1 Over View of Test

Results	**Complies** (as tested per this report)				**Date**	7/25/2014	
Standard	FCC Parts 15.205, 15.209, 15.215(c), 15.247(d), RSS-210 A8.5, and RSS-GEN 7.2.1						
Product Model	Ithaca 9800			**Serial#**	TS-1		
Test Set-up	Tested in a 10m Anechoic chamber, placed on a non-conductive table 80cm above the ground plane on a turn-table. See test plans for details						
EUT Powered By	120VAC/60Hz	**Temp**	76 ºF	**Humidity**	36%	**Pressure**	1007 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Randall Masline		

5.1.2 Test Procedure

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSS-GEN Issue 2. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

5.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the radiated emission test.

5.1.4 Final Test

All final radiated spurious emissions measurements were below (in compliance) the limits.

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5.1.4.1 Emissions Outside the Frequency Band

In any 100kHz 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 desired power, based on either RF conducted or radiated measurements. Conducted antenna port measurements are provided below to show that the EUT meets these requirements at the band edges.

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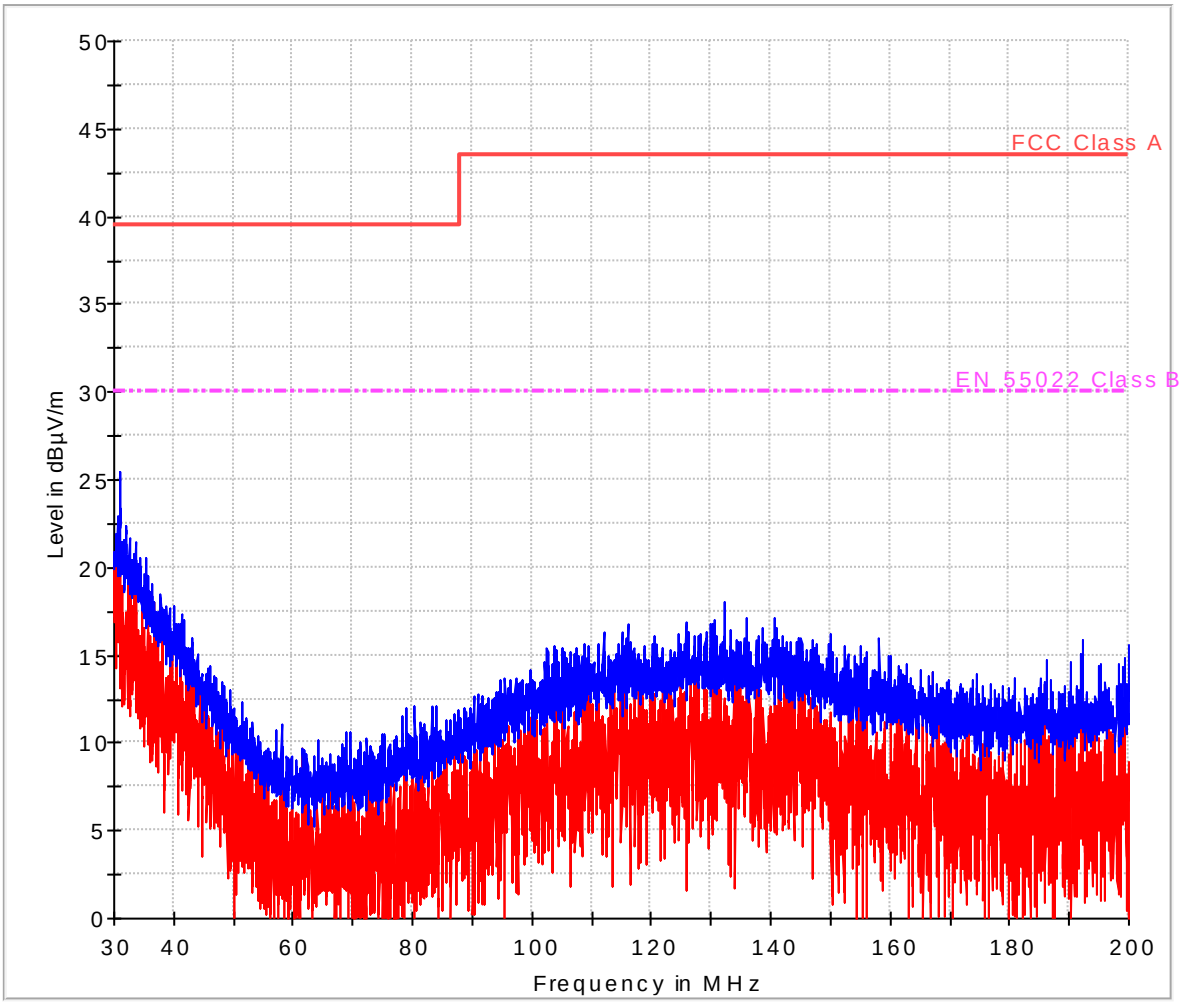
Worst-Case Radiated Emissions 30 MHz to 200 MHz
Horizontal Transmitting 802.11 b



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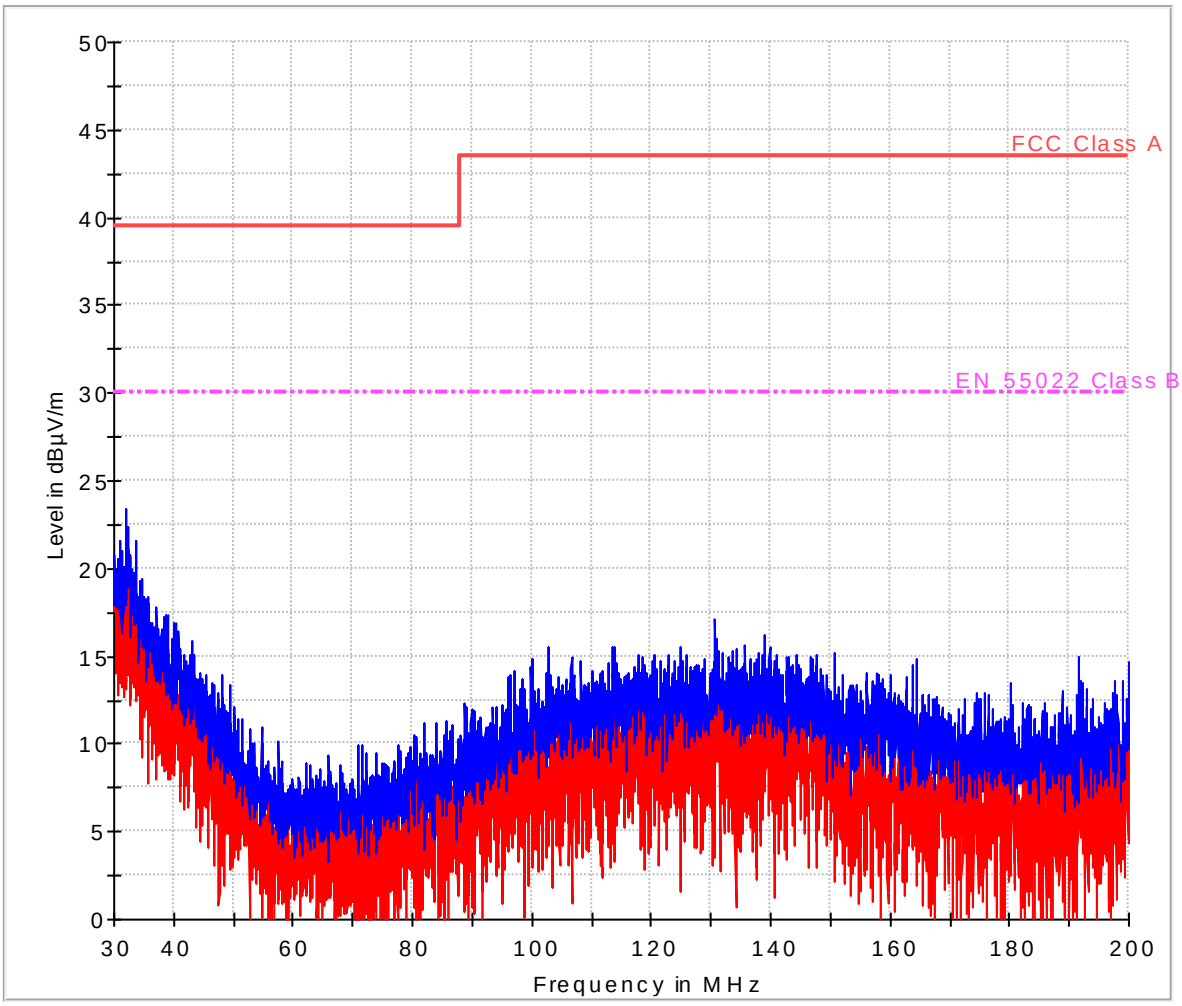
Worst-Case Radiated Emissions 30 MHz to 200 MHz
Vertical Transmitting 802.11 b



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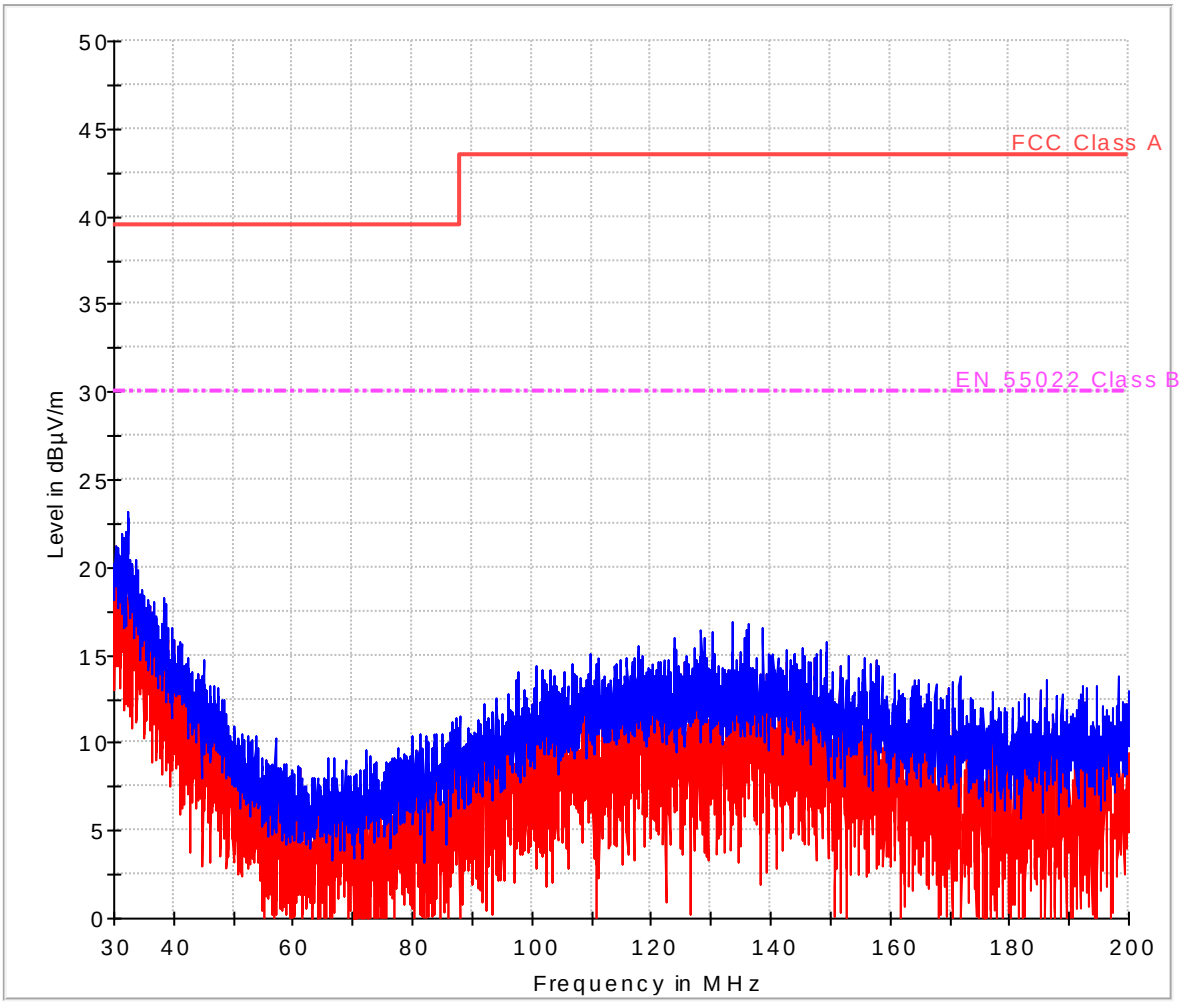
Worst-Case Radiated Emissions 30 MHz to 200 MHz
Horizontal Transmitting 802.11 g



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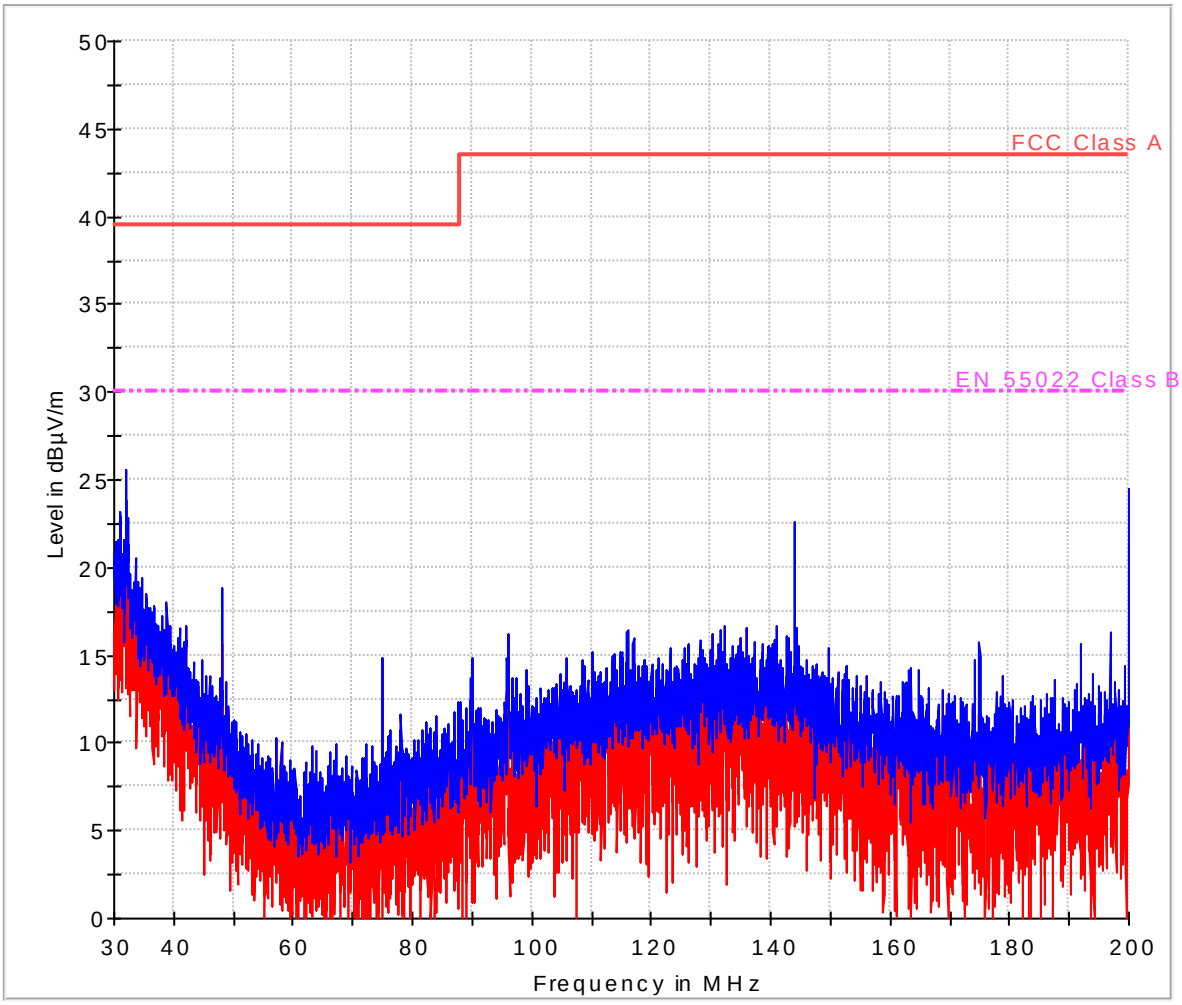
Worst-Case Radiated Emissions 30 MHz to 200 MHz
Vertical



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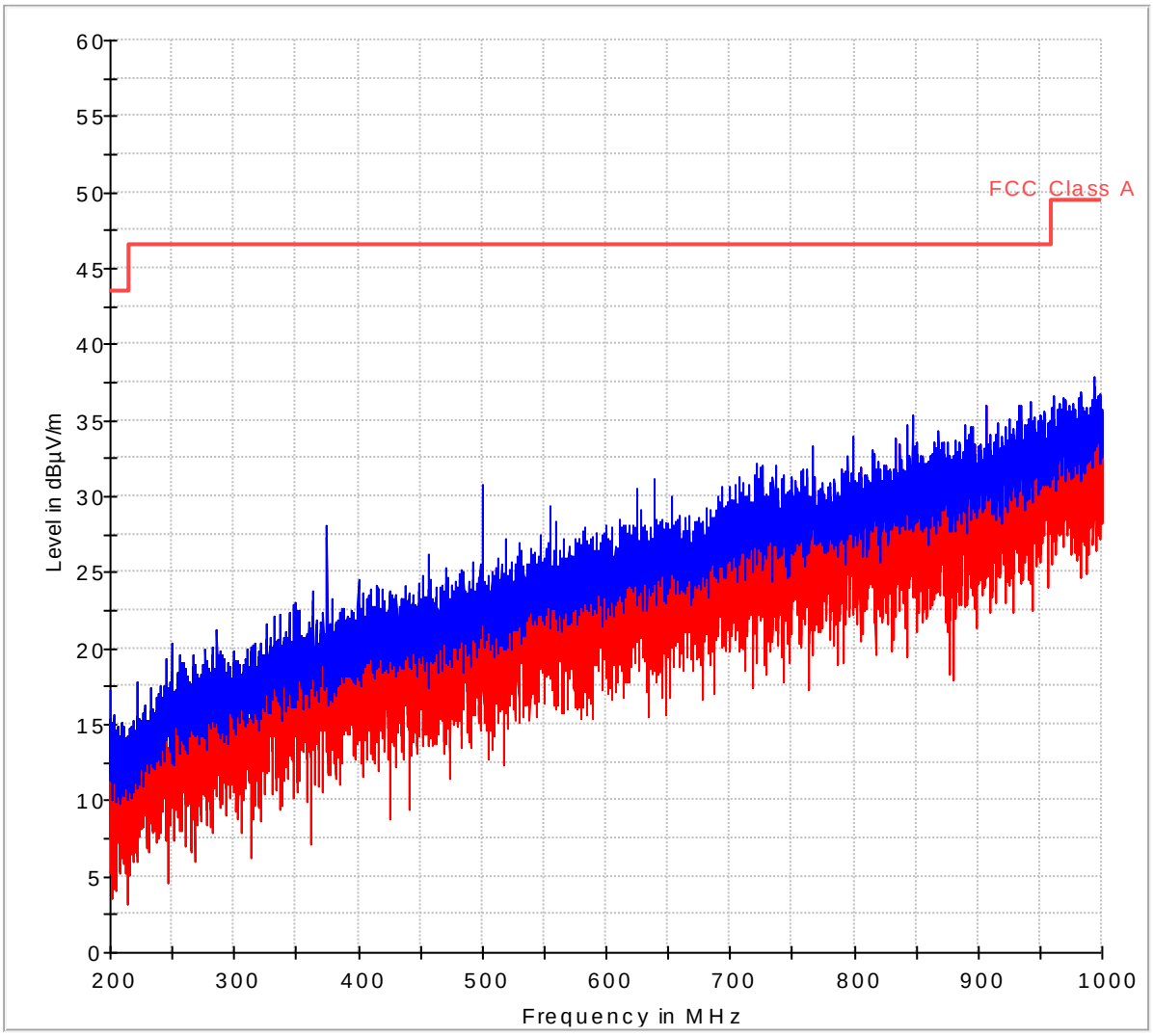
Worst-Case Radiated Emissions 200MHz to 1000MHz

Horizontal transmitting 802.11 b



Frequency MHz	QuasiPeak dBµV/m	Meas. Time ms	Bandwidth kHz	Height cm	Polarization	Azimuth deg	Corr. dB
---	---	---	---	---		---	---
375.040000	27.6	100.0	120.000	100.0	H	-3.0	2.2
500.000000	30.2	100.0	120.000	100.0	H	-3.0	5.0
500.000000	30.2	100.0	120.000	100.0	H	-3.0	5.0

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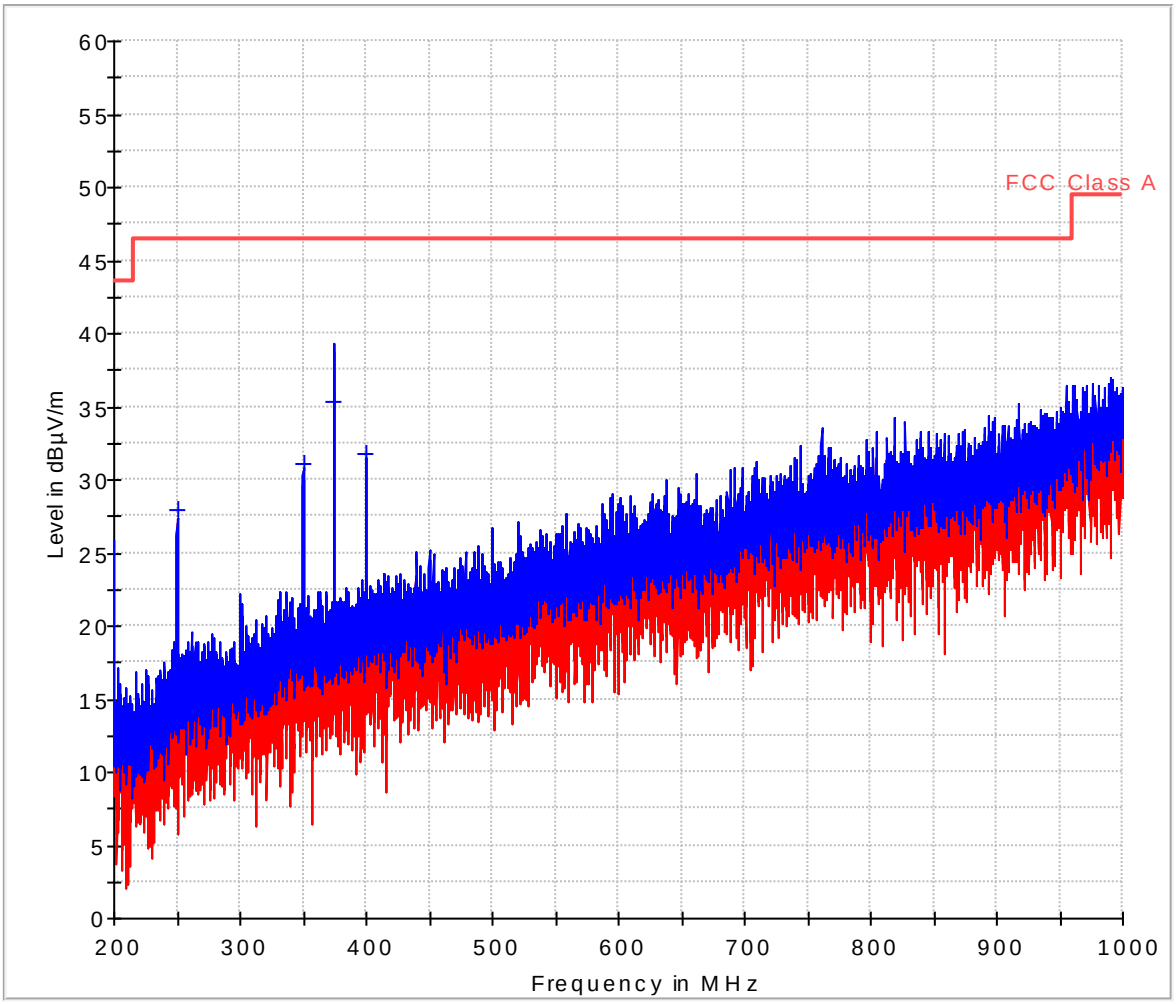
Worst-Case Radiated Emissions 200MHz to 1000MHz

Vertical Transmitting 802.11 b



Frequency MHz	QuasiPeak dBµV/m	Meas. Time ms	Bandwidth kHz	Height cm	Polarization	Azimuth deg	Corr. dB
250.000000	28.0	100.0	120.000	100.0	V	-3.0	-2.0
350.000000	31.1	100.0	120.000	100.0	V	-3.0	1.6
374.960000	35.3	100.0	120.000	100.0	V	-3.0	2.2
400.000000	31.8	100.0	120.000	100.0	V	-3.0	3.0
400.000000	31.8	100.0	120.000	100.0	V	-3.0	3.0

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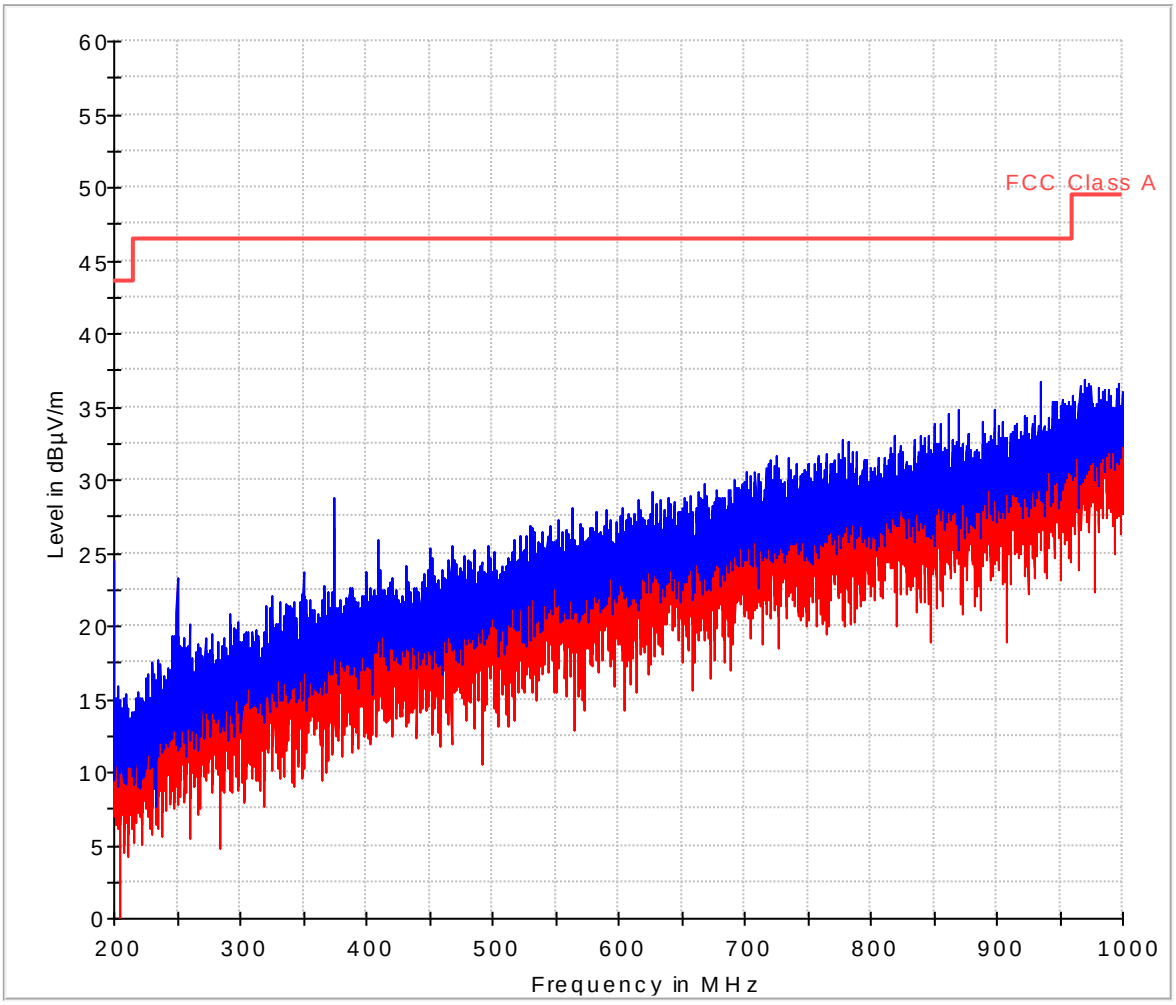
Worst-Case Radiated Emissions 200MHz to 1000MHz
Horizontal Transmitting 802.11 g



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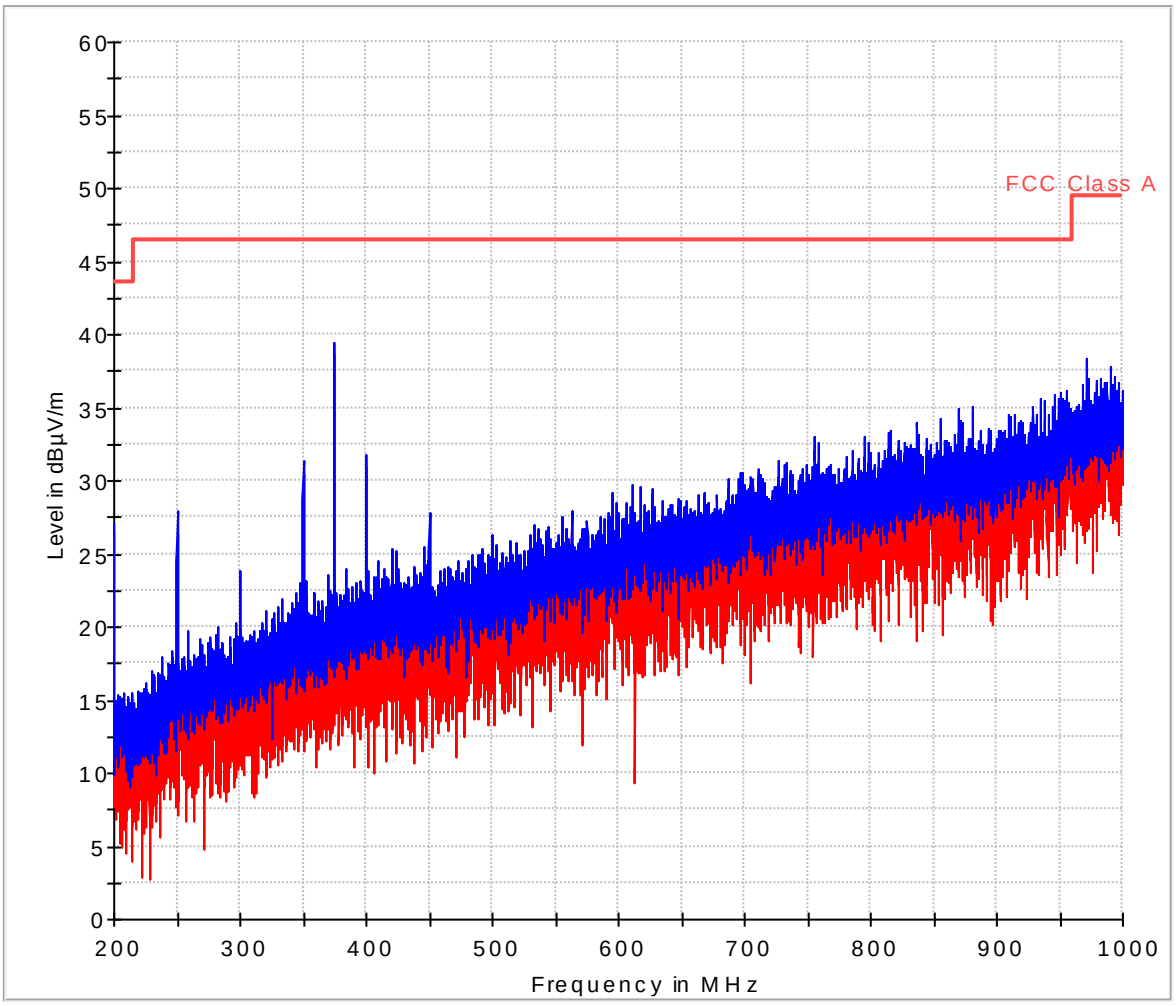
Worst-Case Radiated Emissions 200MHz to 1000MHz

Vertical Transmitting 802.11 g



Frequency MHz	QuasiPeak dBµV/m	Meas. Time ms	Bandwidth kHz	Height cm	Polarization	Azimuth deg	Corr. dB
350.000000	31.1	100.0	120.000	100.0	V	-3.0	1.6
250.000000	28.0	100.0	120.000	100.0	V	-3.0	-2.0
374.960000	35.4	100.0	120.000	100.0	V	-3.0	2.2
400.000000	31.9	100.0	120.000	100.0	V	-3.0	3.0
400.000000	31.9	100.0	120.000	100.0	V	-3.0	3.0

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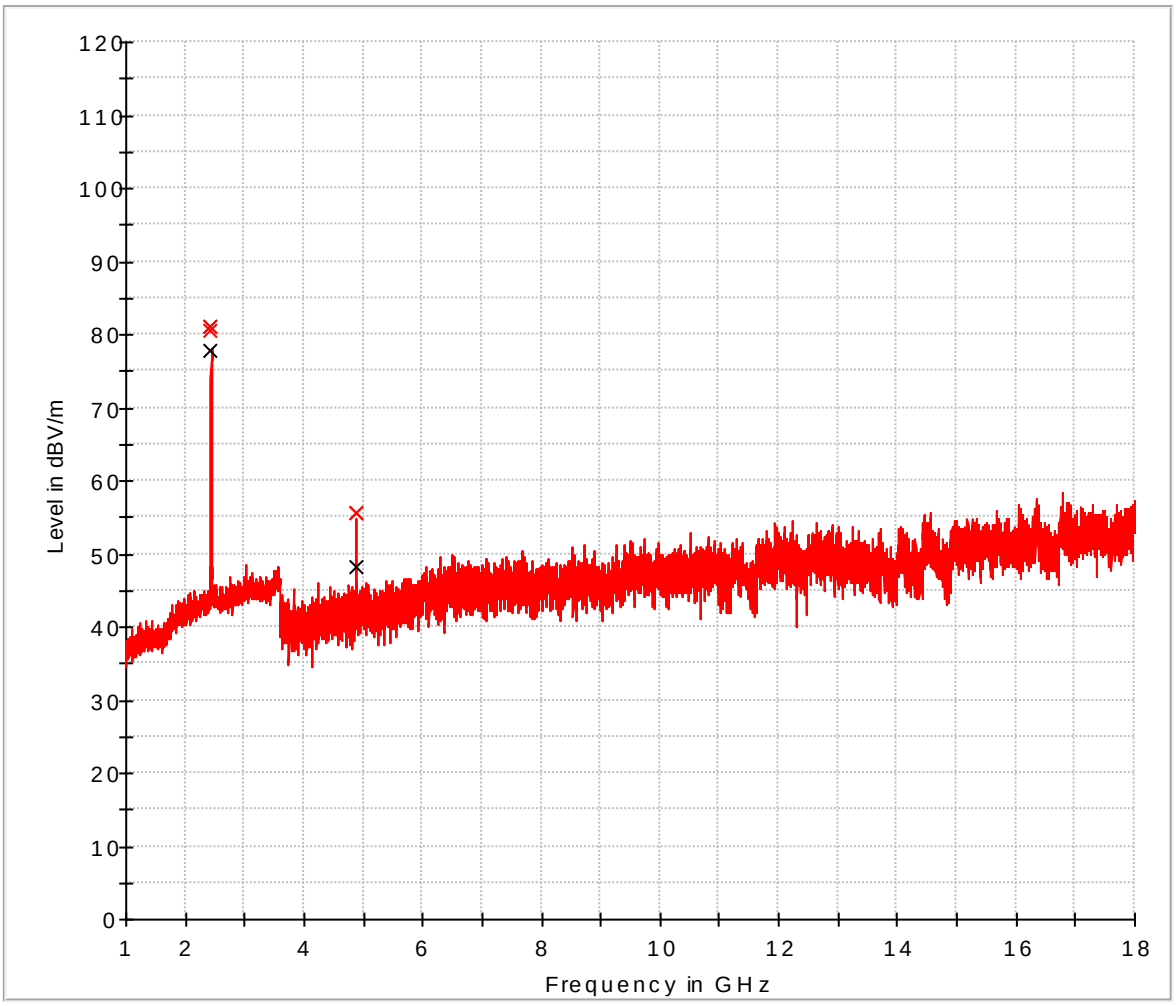
Worst-Case Radiated Emissions 1GHz to 18GHz

Horizontal Transmitting 802.11 b 1mb Channel 7



Frequency MHz	MaxPeak dBV/m	CAverage dBV/m	Meas. Time ms	Bandwidth kHz	Height cm	Polarization	Azimuth deg	Corr. dB
2409.250000	81.2	77.8	2.0	1000.000	0.0	H	-2.0	-1.4
4882.750000	56.6	48.9	2.0	1000.000	0.0	H	-2.0	2.7

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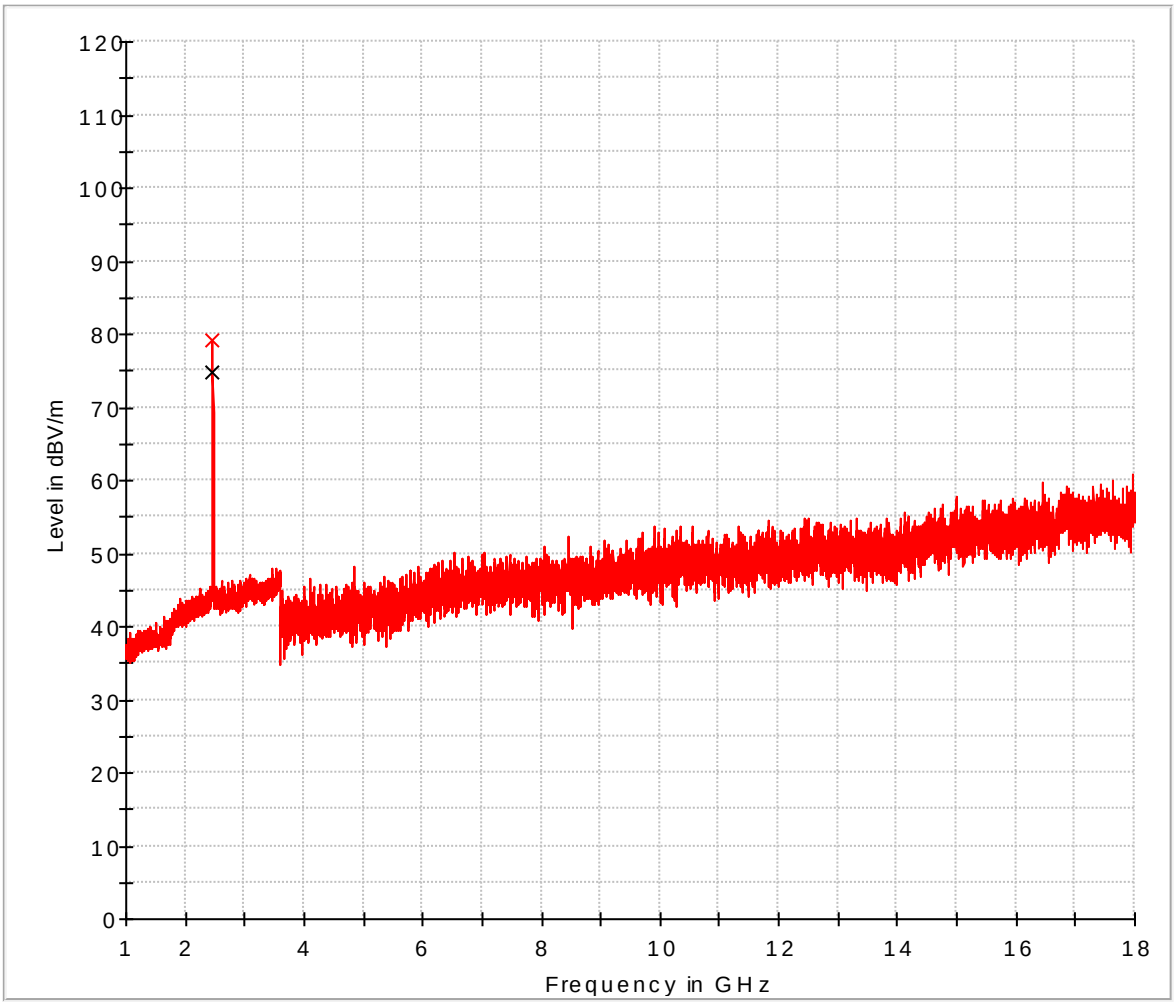
Worst-Case Radiated Emissions 1GHz to 18GHz
Horizontal Transmitting 802.11 b 1Mb channel 11



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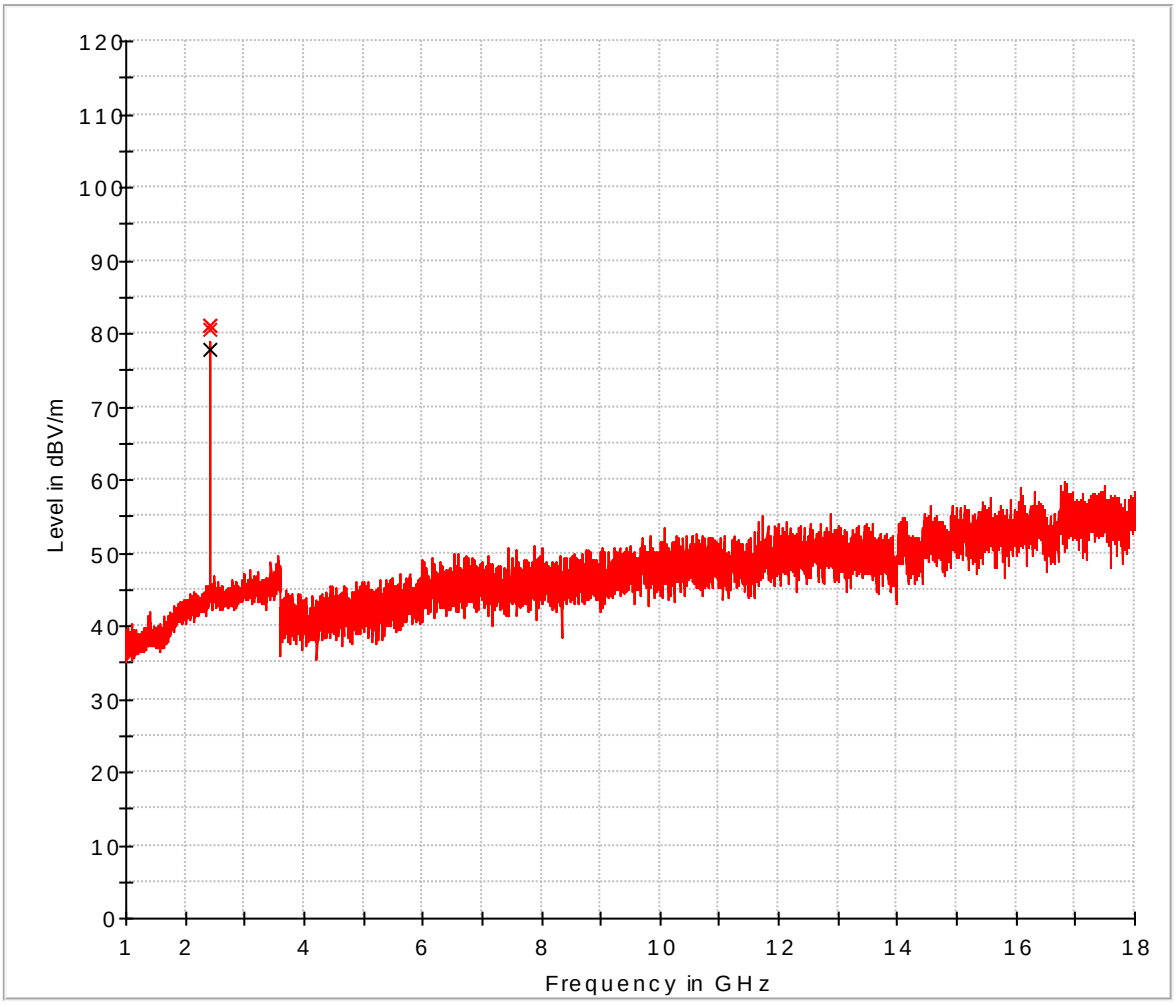
Worst-Case Radiated Emissions 1GHz to 18GHz

Horizontal Transmitting 802.11 b 11Mb Channel 1



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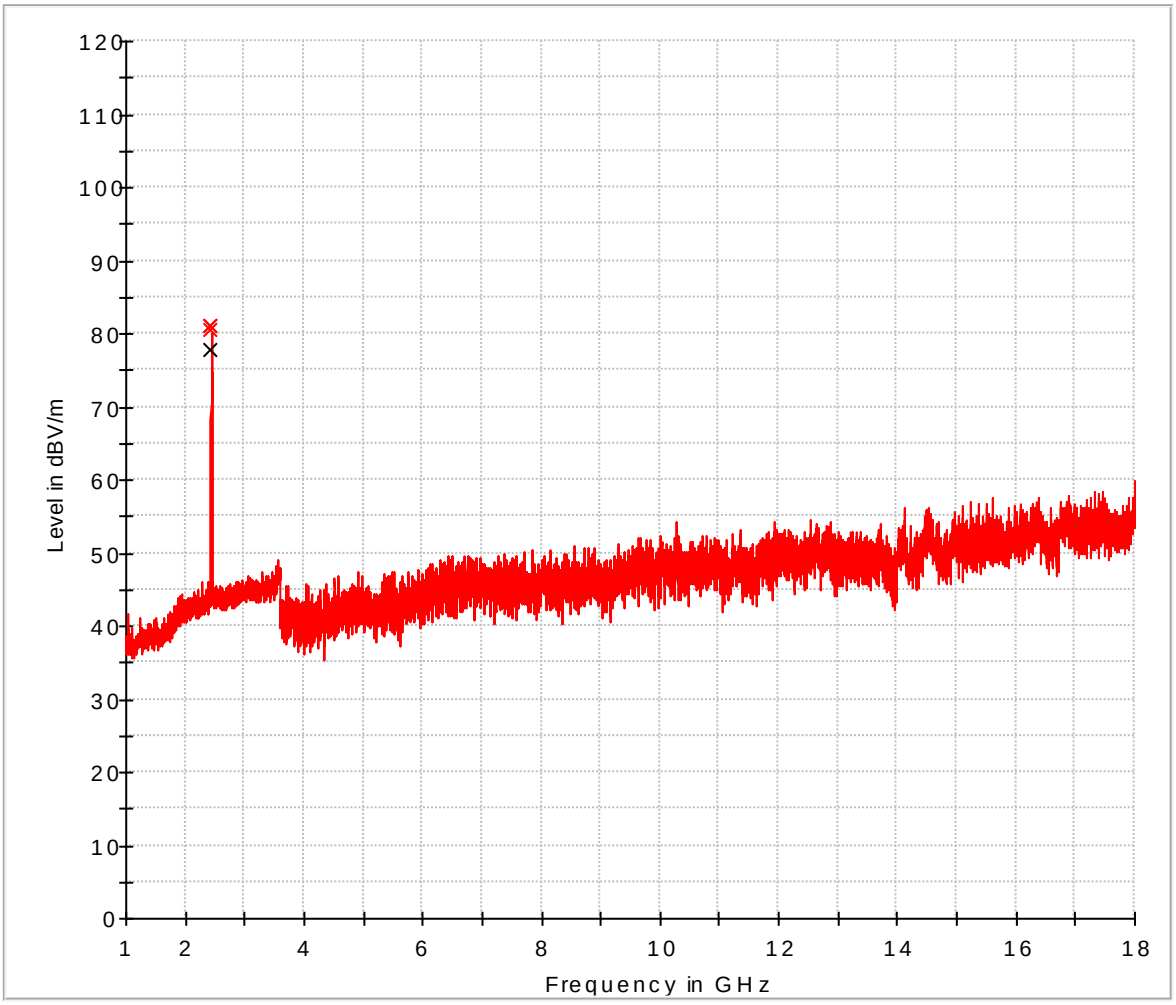
Worst-Case Radiated Emissions 1GHz to 18GHz
Vertical Transmitting 802.11 b 11 Mb channel 1



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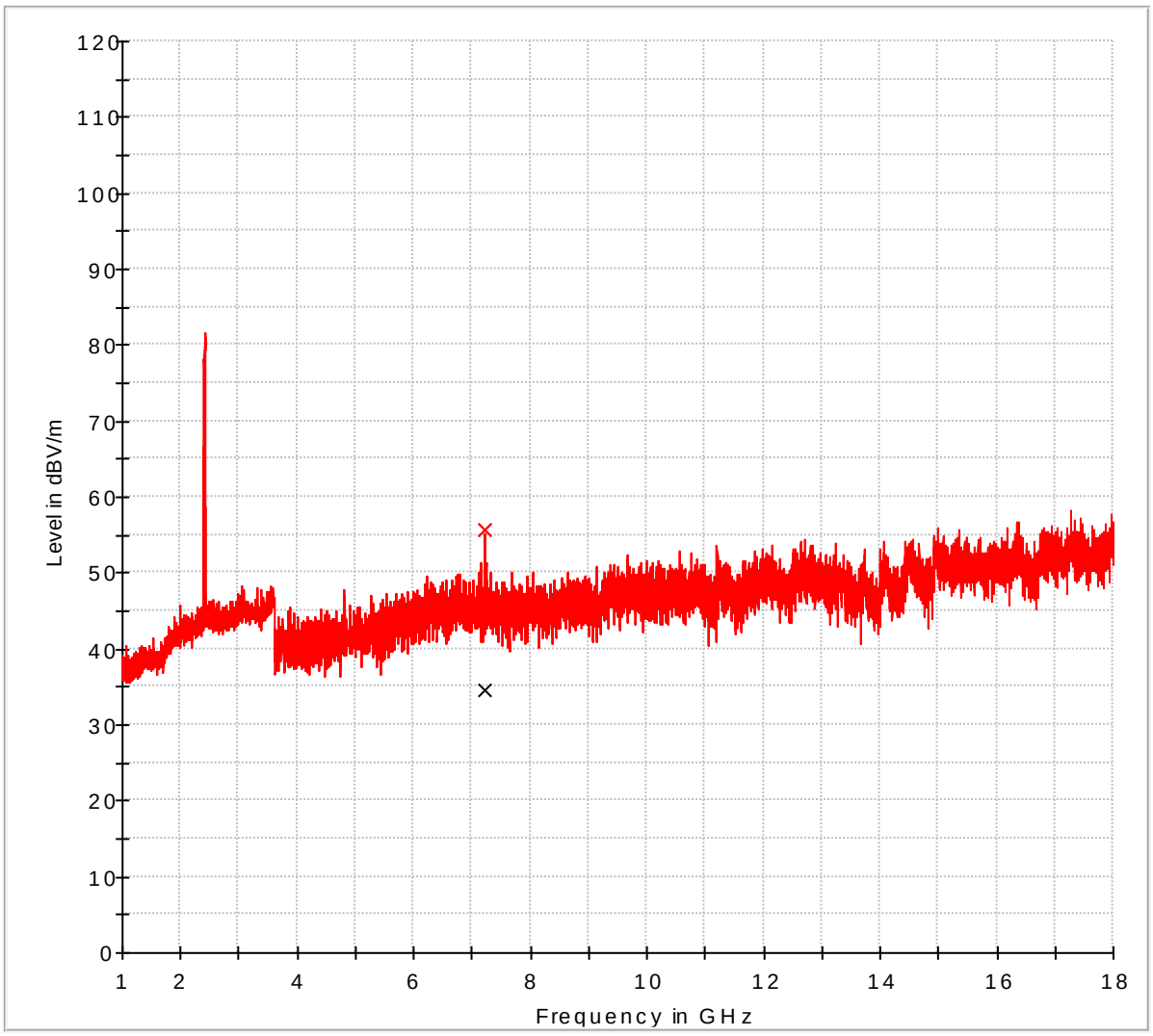
Worst-Case Radiated Emissions 1GHz to 18GHz

Vertical Transmitting 802.11 g 54Mb channel 1



Frequency MHz	MaxPeak dBV/m	CAverage dBV/m	Meas. Time ms	Bandwidth kHz	Height cm	Polarization	Azimuth deg	Corr. dB
---	---	---	---	---	---		---	---
7230.500000	55.6	34.6	2.0	1000.000	1.0	H	-2.0	6.6
7230.500000	56.3	34.6	2.0	1000.000	1.0	H	-2.0	6.6

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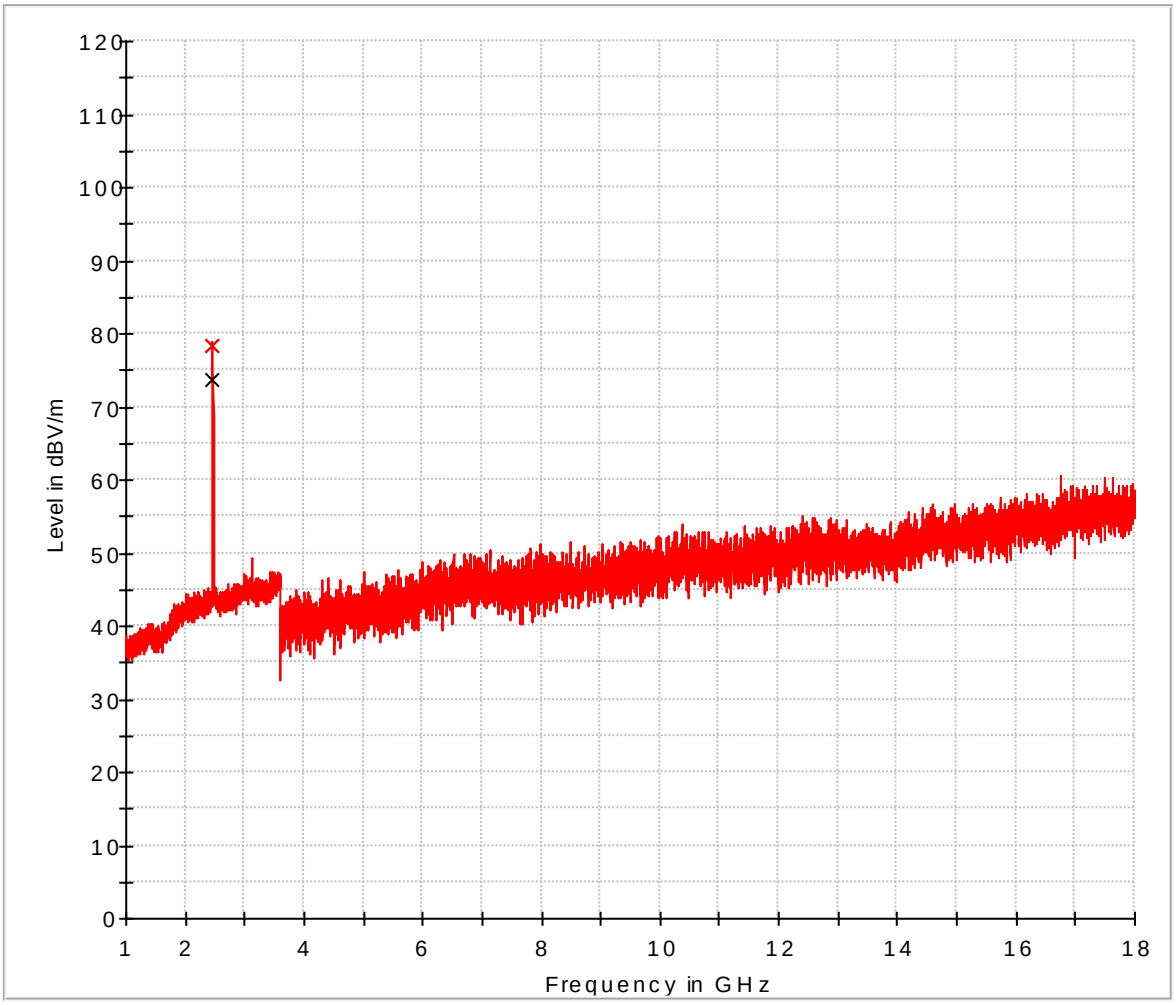
Worst-Case Radiated Emissions 1GHz to 18GHz
Horizontal Transmitting 802.11 g 54Mb Channel 11



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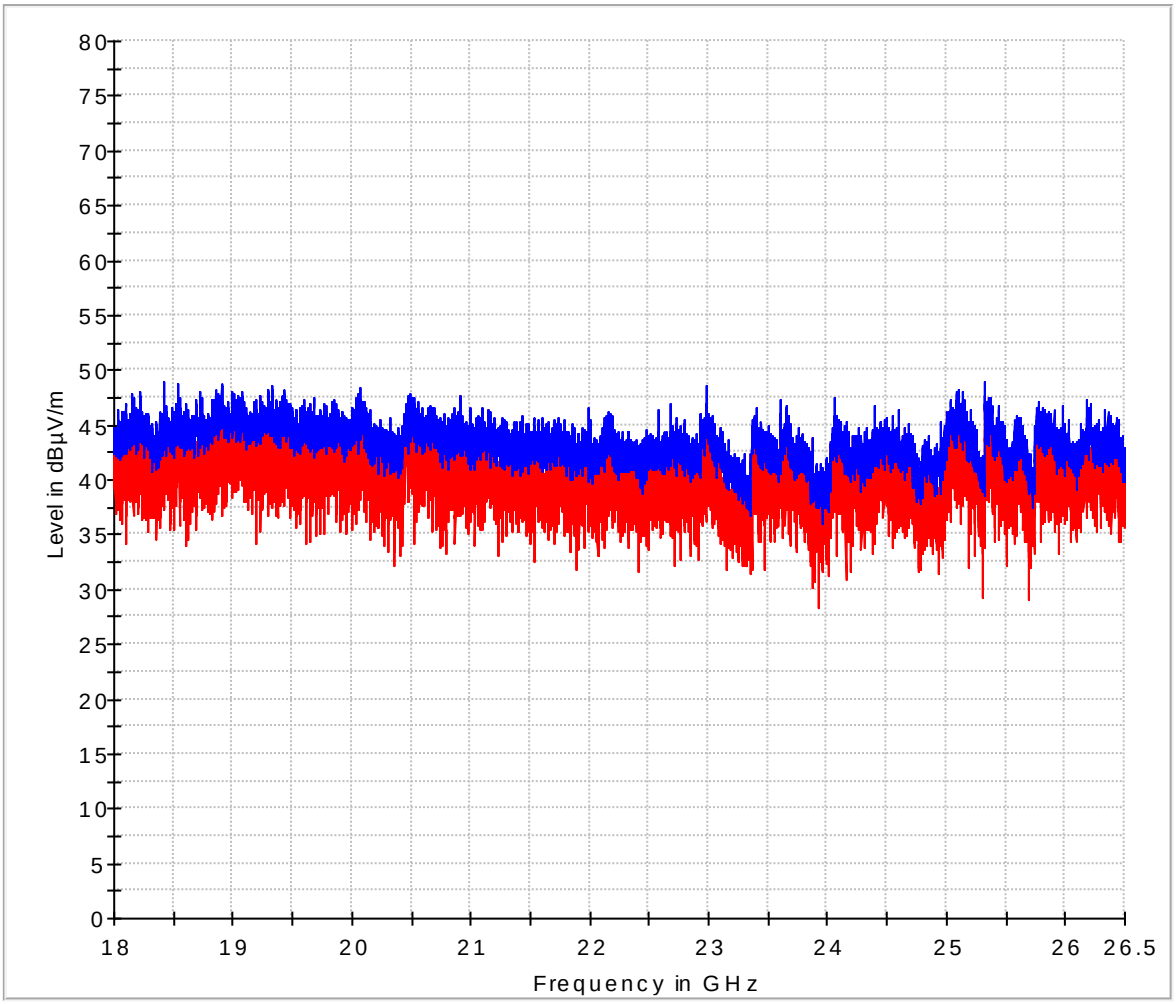
Worst-Case Radiated Emissions 18GHz to 26.5GHz

Vertical transmitting 802.11 b 1Mb Channel 1



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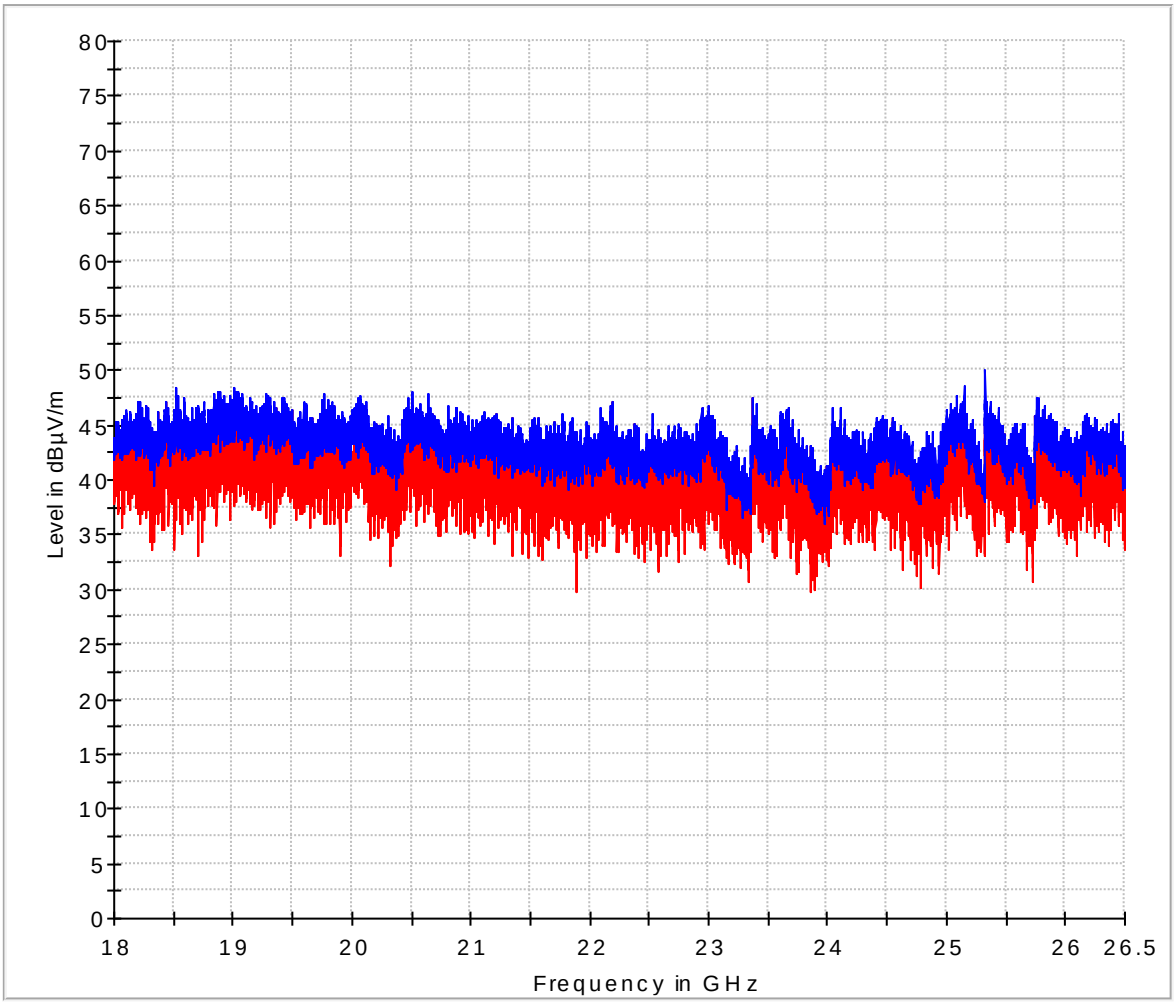
Worst-Case Radiated Emissions 18GHz to 26.5GHz

Horizontal Transmitting 802.11 b 1Mb Channel 1



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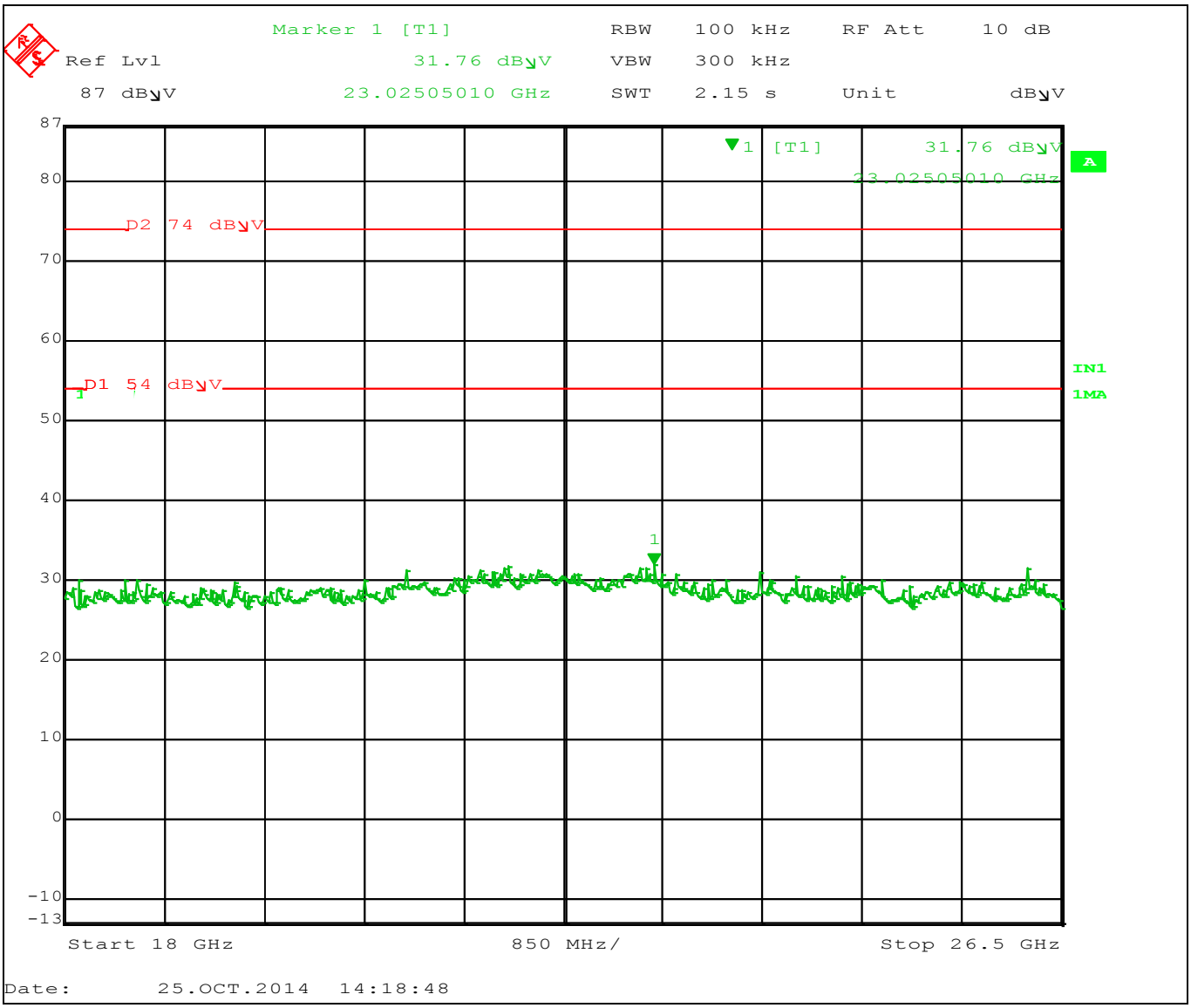
Worst-Case Radiated Emissions 18GHz to 26.5GHz

Vertical Transmitting 802.11 b 1Mb Channel 11



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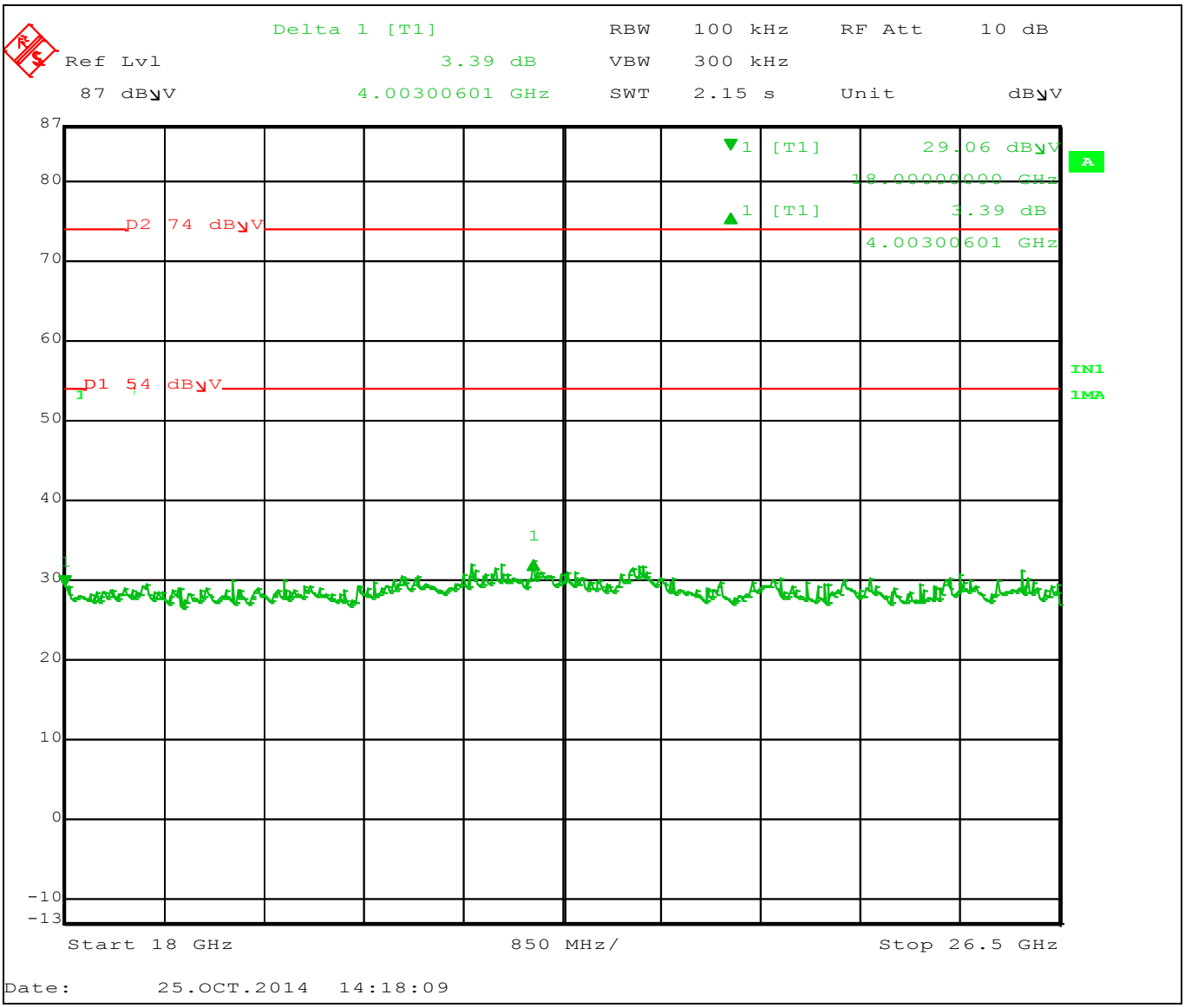
Worst-Case Radiated Emissions 18GHz to 26.5GHz

Horizontal Transmitting 802.11 b 11Mb Channel 11



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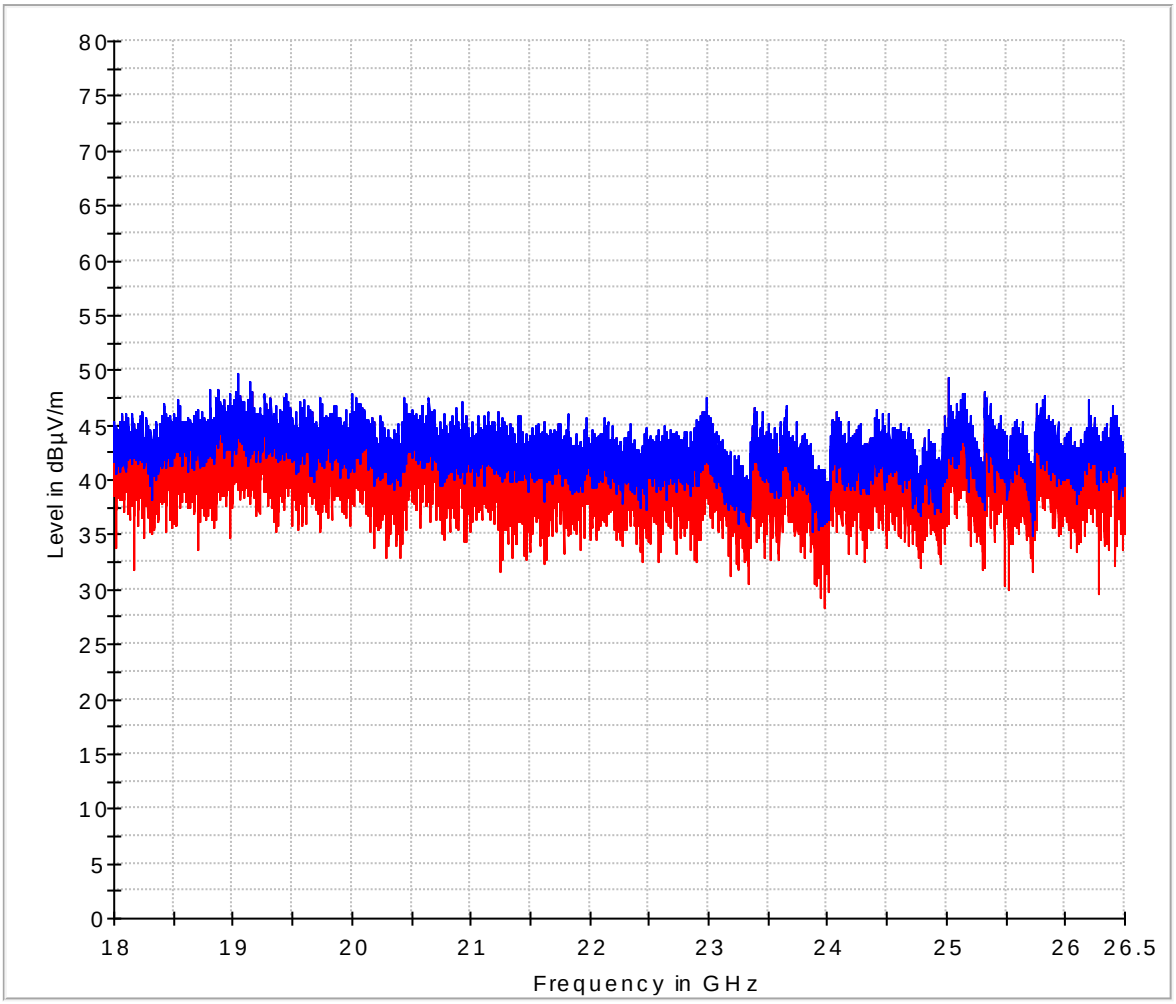
Worst-Case Radiated Emissions 18GHz to 26.5GHz

Vertical Transmitting 802.11 g 6Mb Channel 1



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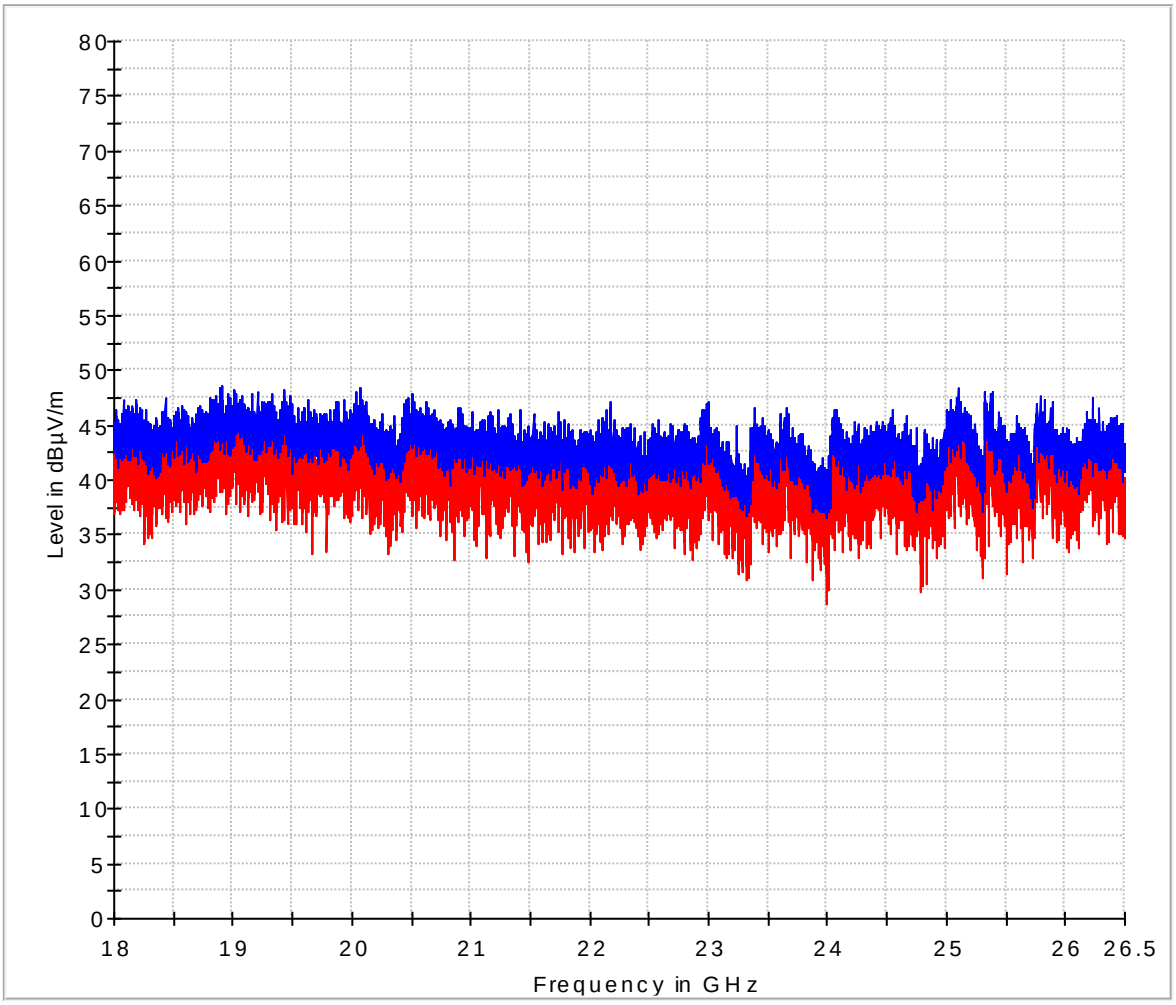
Worst-Case Radiated Emissions 18GHz to 26.5GHz
Horizontal Transmitting 802.11 g 54 Mb Channel 1



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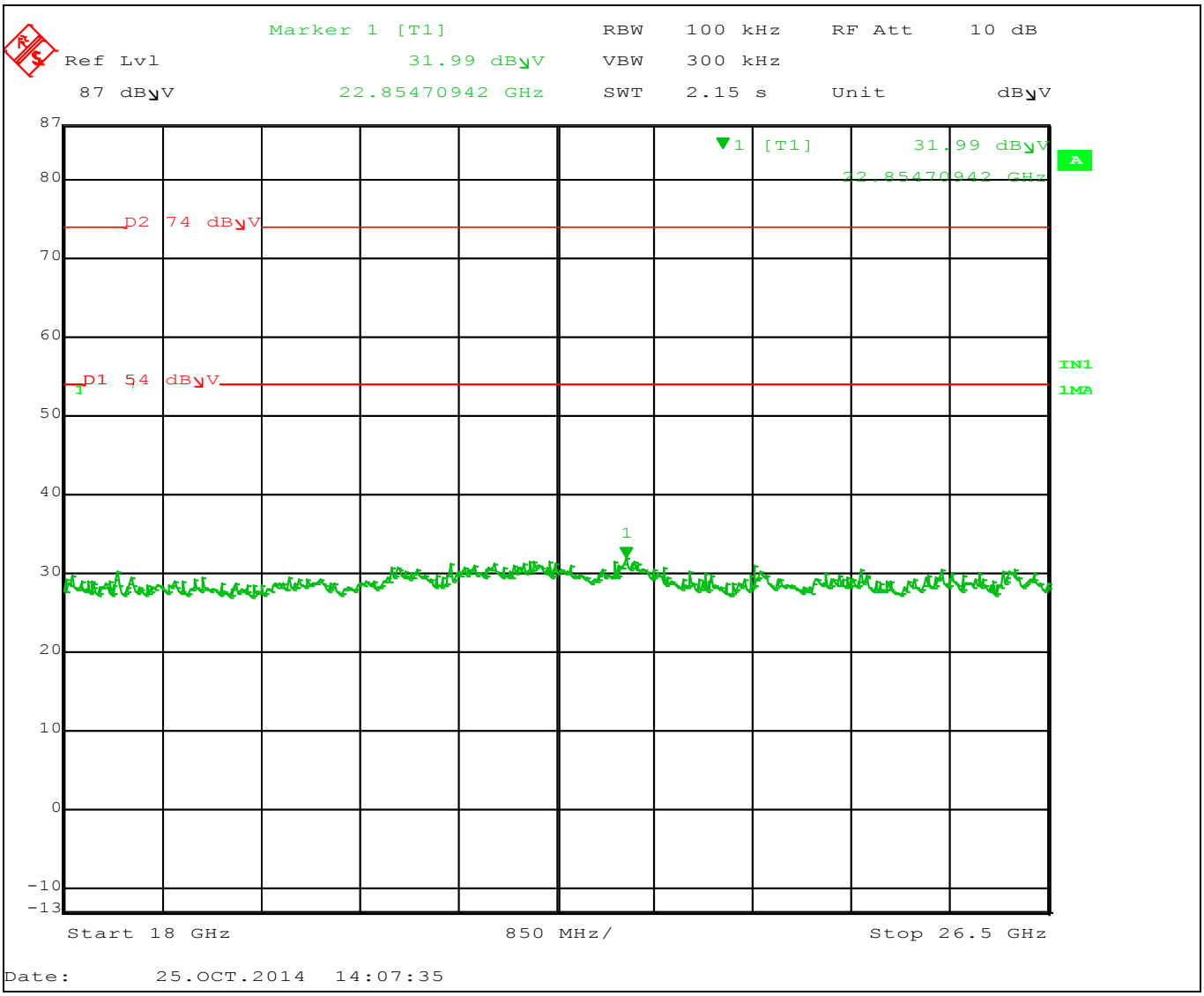
Worst-Case Radiated Emissions 18GHz to 26.5GHz

Vertical Transmitting 802.11 g 6Mb Channel 11



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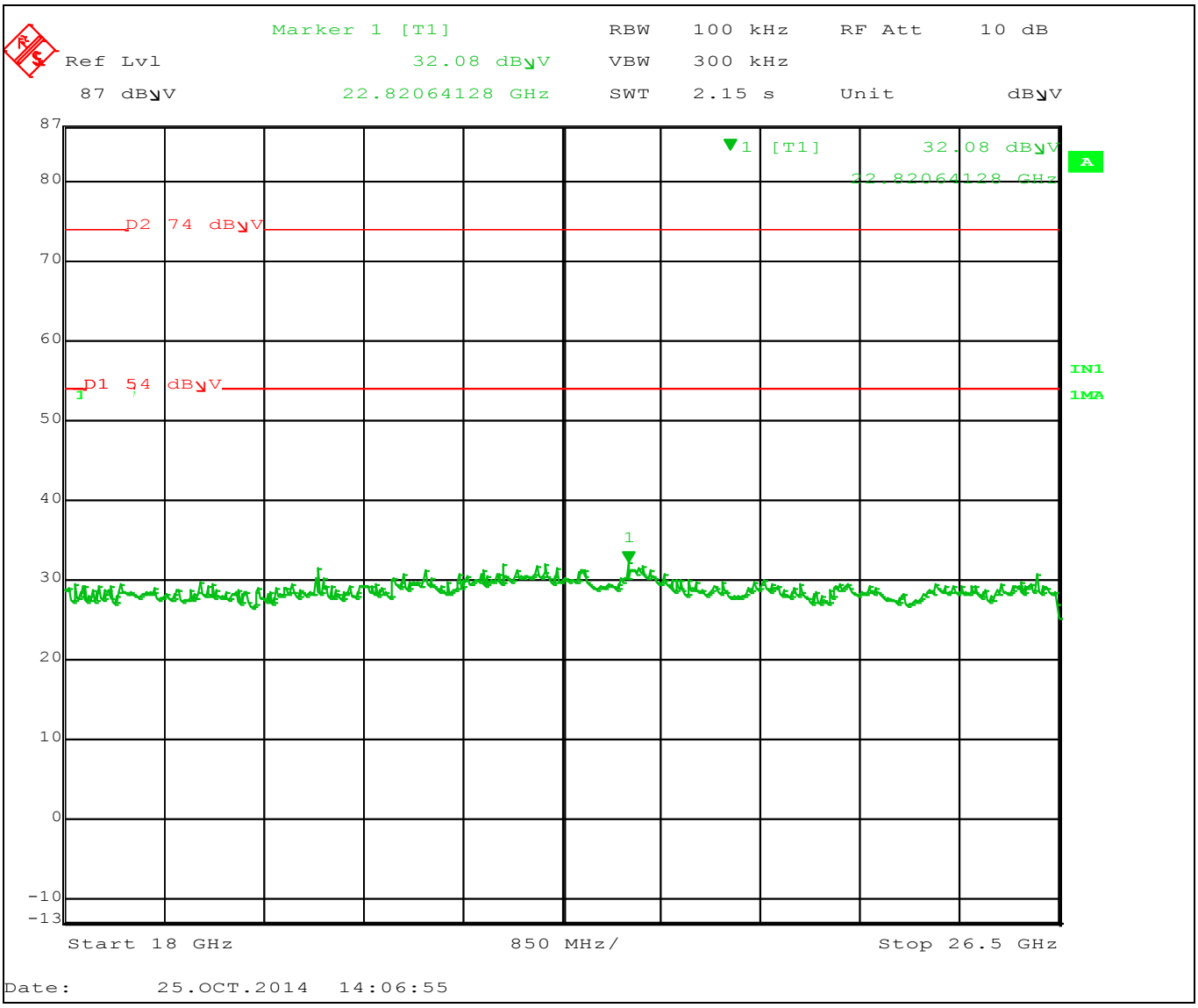
Worst-Case Radiated Emissions 18GHz to 26GHz

Horizontal Transmitting 802.11 g 54 Mb Channel 11



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5.2 Band Edge Measurements

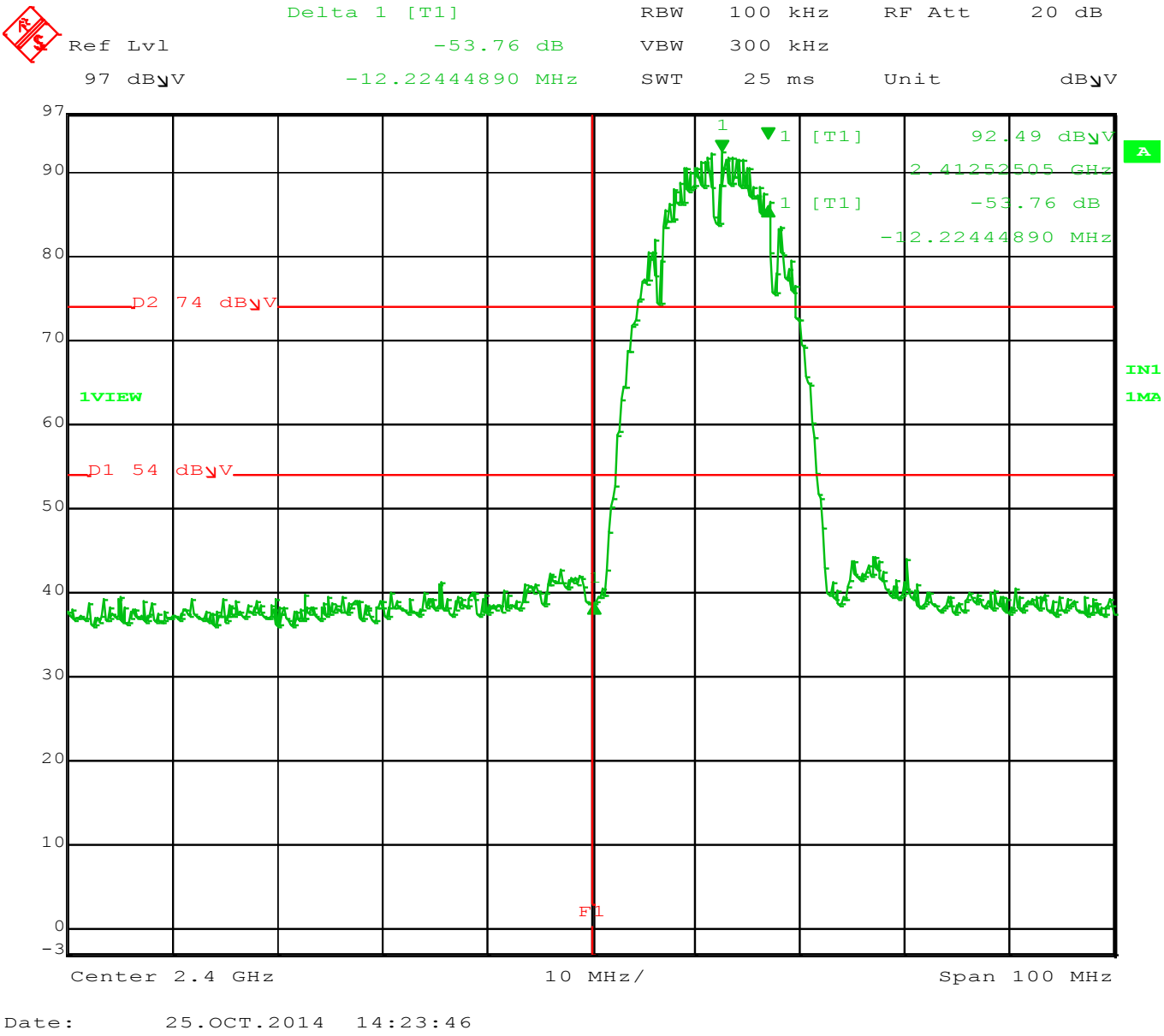

Figure 4 – Channel 1 Lower Band Edge DSSS

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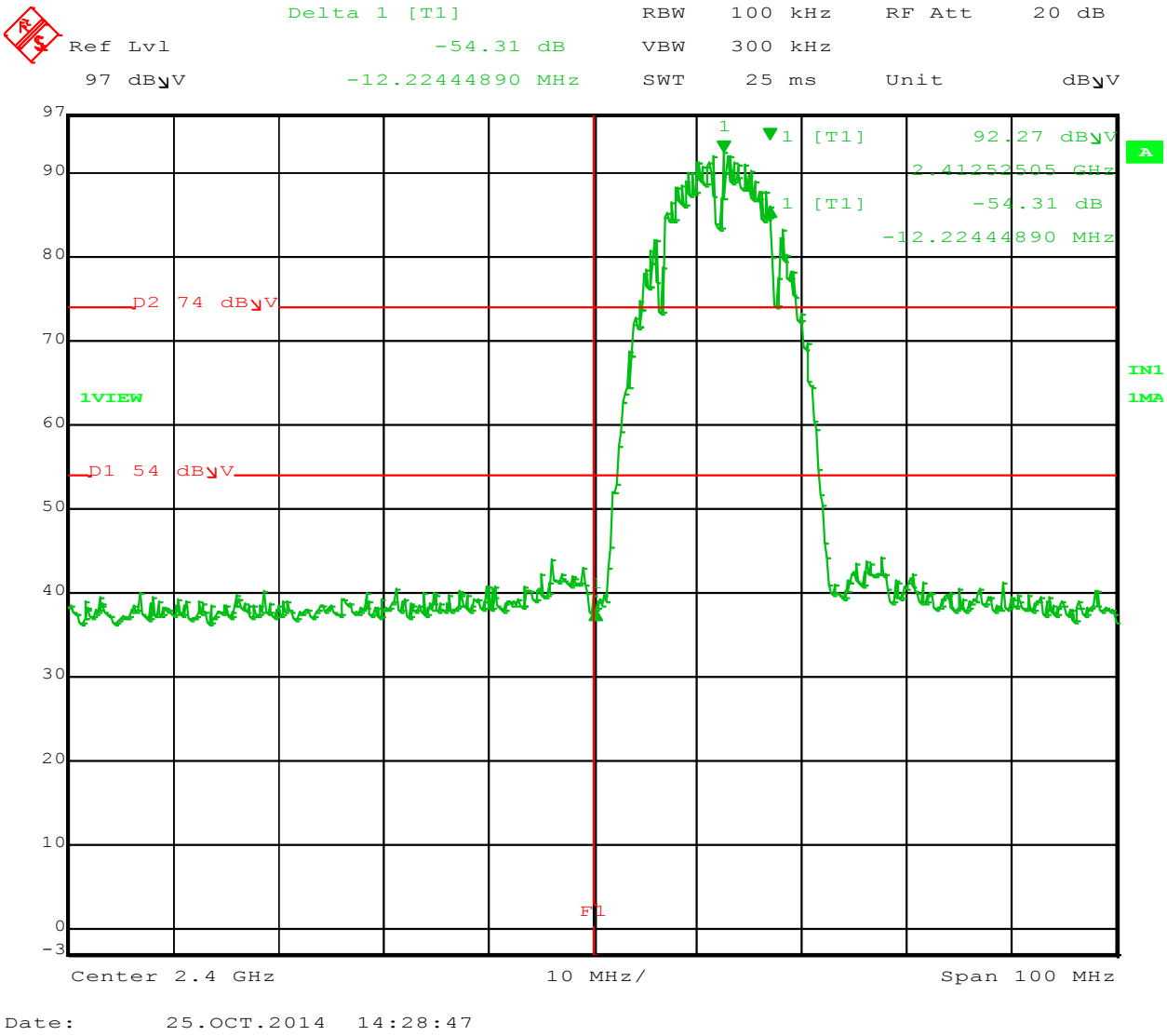

Figure 5 – Channel 1 Lower Band Edge OFDM

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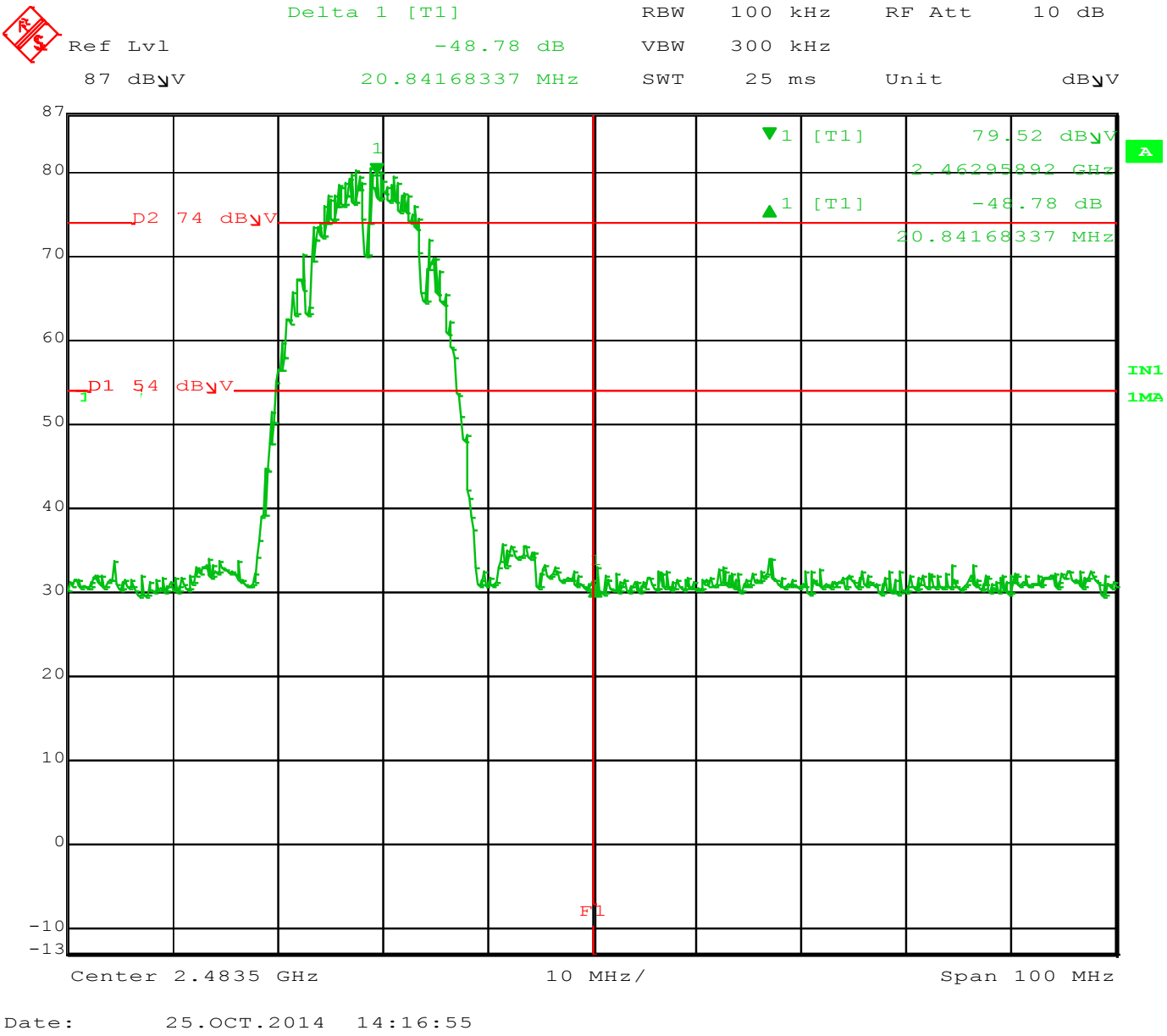

Figure 6 – Channel 11 Upper Band Edge DSSS

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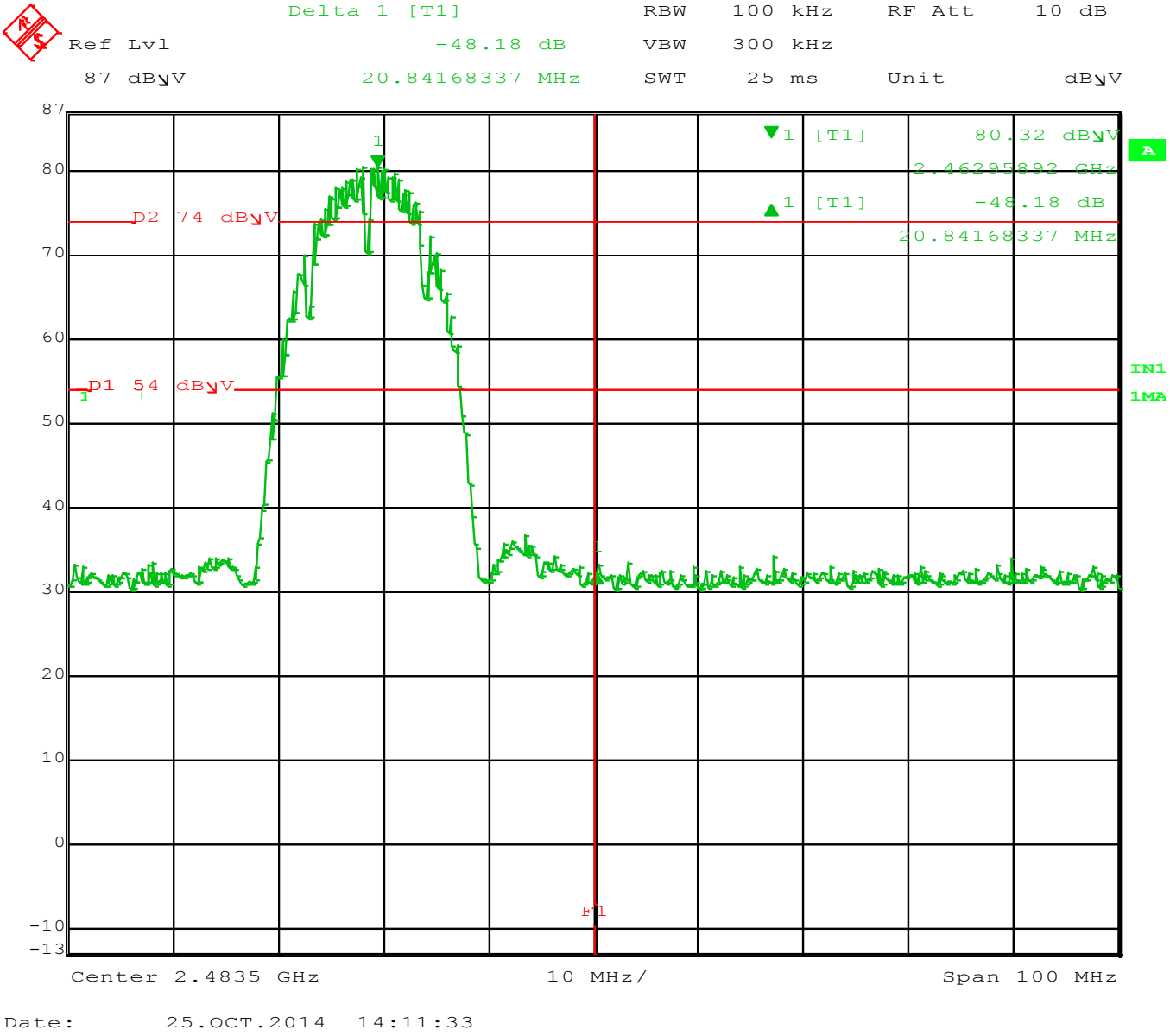

Figure 7 – Channel 11 Upper Band Edge OFDM

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6 RF Exposure

6.1.1 Classification

The antenna of the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in users manual. Therefore, this device is classified as a **Mobile Device**.

6.1.2 Test Results

6.1.2.1 Antenna Gain

The maximum Gain measured in Semi-Anechoic Chamber is

3 dBi peak or 2.0 (numeric).

6.1.2.2 Output Power into Antenna & RF Exposure value at distance 20cm:

Calculations for this report are based on highest power measurement and the highest gain of the antenna. Limit for MPE (from FCC part 1.1310 table 1) is 1.0 mW/cm^2 for 2400MHz.

The highest Pout was taken from the original certification report under FCC ID: VPYLBTN

Highest Pout is 264.24mW, highest antenna gain (in linear scale) is 2.0, and R is 20cm.

		FCC:						
		Controlled Exposures - Limit (mW/cm^2) =	5					
		Uncontrolled Exposures - Limit (mW/cm^2) =	1					
		Pd =	0.0930529	mW/cm^2		Pd = (Pout*G) / (4*π*R^2)		
		Controlled Margin to Limit =	4.9069	mW/cm^2				
		Uncontrolled Margin to Limit =	0.9069	mW/cm^2				

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Evaluation for Industry Canada

From RSS-102 Issue 5, Table 4;

		IC:						
		Uncontrolled Exposures						
		Limit (W/m^2) = $0.02619\ f^{0.6834}$ =	5.35	W/m^2				
		Pd =	0.931	W/m^2		Pd = (Pout*G) / (4*π*R^2)		
		Uncontrolled Margin to Limit =	4.417	W/m^2				

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

6.1.3 Sample Calculation

The Friis transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in W/m^2
Pout = output power to antenna in W
G = gain of antenna in linear scale

$\pi \approx 3.1416$

R = distance between observation point and center of the radiator in m

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

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