Emissions Test Report

EUT Name:	2.4 GHz Communications Option Board
EUT Model:	ZOB
FCC ID:	G8J ZGB1
IC:	4557C-ZGB1

FCC Title 47, Part 15, Subpart C, RSS-210 Issue 7

Prepared for:

John Casaer
Elster Integrated Solutions, LLC
208 South Rogers Lane
Raleigh, NC 27610
Tel: 919-250-5440
Fax: 919-250-5439

Prepared by:

TUV Rheinland
762 Park Avenue
Youngsville, NC 27596
Tel: (919) 554-0901
Fax: (919) 556-2043
http://www.tuv.com/

Report/Issue Date: 15 October, 2007
Report Number: 30863354.001

Statement of Compliance

Manufacturer:	Elster Integrated Solutions, LLC 208 South Rogers Lane Raleigh, NC 27610 919-250-5440
Requester / Applicant:	John Casaer
Name of Equipment:	2.4 GHz Communications Option Board
Operation Frequency Range	2405 MHz to 2465 MHz
Type of Equipment:	Intentional Radiator
Application of Regulations:	FCC Title 47, Part 15, Subpart C, RSS-210 Issue 7
Test Dates:	20 November, 2008 to 4 December, 2008

Guidance Documents:

Emissions: FCC 47 CFR Part 15C, RSS-210 Issue 7

FCC 47 CFR Part 15B, ICES-003 Issue 4

Test Methods:

Emissions: ANSI C63.4:2003

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that a sample of one, of the equipment described above, has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. This report contains data that are not covered by NVLAP accreditation. This report shall not be reproduced except in full, without the written authorization of the laboratory.

Mark Ryan — 4 December 2008

NVLAP Signatory — Date

NVLAP	FCC	Industry Canada
200094-0	90552 and 100881	IC: 3755A

Table of Contents

1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the FCC Title 47, Part 15, Subpart C, RSS-210 Issue 7 based on the results of testing performed on *20 November,* 2008 through *4 December, 2008* on the *2.4 GHz Communications Option Board* Model No. *ZOB* manufactured by Elster Integrated Solutions, LLC. 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 in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 Summary of Test Results

Table 1 - Summary of Test Results

Test	Test Method(s)	Test Parameters	Result
Antenna Requirement	FCC Part 15.203	Unique	**compliant**
Restricted Bands for intentional operation	FCC 15.205 RSS-210	15.209 Table 1	**compliant**
Power Line Conducted Emissions	FCC 15.207	Per test method	**compliant**
Spurious Radiated Emissions	FCC Part 15.209 RSS-210	Per test method Table 2	**compliant**
Occupied Bandwidth	FCC Part 15.247(a)(2) RSS-210, A8.2 (a)	6 dB Bandwidth & 99% Bandwidth	**compliant**
Maximum Output Power	FCC Part 15.247(b)(3) RSS-210, A8.4 (4)	< 1 Watt	**compliant**
Antenna Gain	FCC Part 15.247(b)(4) RSS-210, A8.5(5)	< 6 dBi	**compliant**
Antenna Conducted spurious	FCC Part 15.247(d) RSS-210, A8.5	< 20 dBc	**compliant**
Spectral Density	FCC Part 15.247(e) RSS-210, A8.2(b)	< 8dBm (3 kHz BW)	**compliant**
Maximum Permissible Exposure	FCC 15.247(i) IC Safety code 6	>20 cm separation	**compliant**
Power Line Conducted Emissions in receive mode	FCC Part 15.107(a)	Class B	**compliant**
Radiated Emissions in receive mode	FCC Part 15.109(a)	Class B	**compliant**

Overall Results: **PASS**

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

No modifications were found to be necessary in order to achieve compliance.

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address 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 90552 and 100881). The laboratory scope of accreditation includes: Title 47 CFR Part 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP

TUV Rheinland is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 25 and ISO 9002 (Lab code 200094-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada – Industry Canada

Registration No. IC 3755

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration No. R-1174 and C-1236).

2.1.5 Acceptance By Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address test results and test reports within the scope of the laboratory NIST / NVLAP accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 762 Park Ave., Youngsville, North Carolina 27596, USA.

2.2.1 Emission Test Facility

The Open Area Test Site and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2005, at a test distance of 3 and 10 meters. This site has been described in reports dated May 12, 1997, submitted to the FCC, and accepted by letter dated June 25, 1997 (31040/SIT 1300F2). The site is listed with the FCC and accredited by NVLAP (code 200094-0). The 5m semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2005, at a test distance of 3 meters. A report detailing this site can be obtained from TUV Rheinland.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7m x 3.7m x 3.175mm thick aluminum floor connected to PE ground. For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6m x 0.8m x 0.8m high non-conductive table with a 3.175mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50cm x 50cm x 3.175mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. For each of the other tests, the HCP is removed.

RF Field Immunity testing is performed in a 7.3m x 3.7m x 3.2m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.9m x 3.7m x 3.175mm thick aluminum ground plane which is connected to one end of the anechoic chamber.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1^{st} addition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities. The term standard uncertainty is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. The fraction may be viewed as the coverage probability or level of confidence of the interval.

The test system for conducted emissions is defined as the LISN, spectrum analyzer, coaxial cables, and pads. The test system for radiated emissions is defined as the antenna, spectrum analyzer, pre-amplifier, coaxial cables, and pads. The conducted test system has a combined standard uncertainty of ± 1.2 dB. The radiated test system has a combined standard uncertainty of ± 1.6 dB. The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 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 Guide 25.

2.5 Product Information

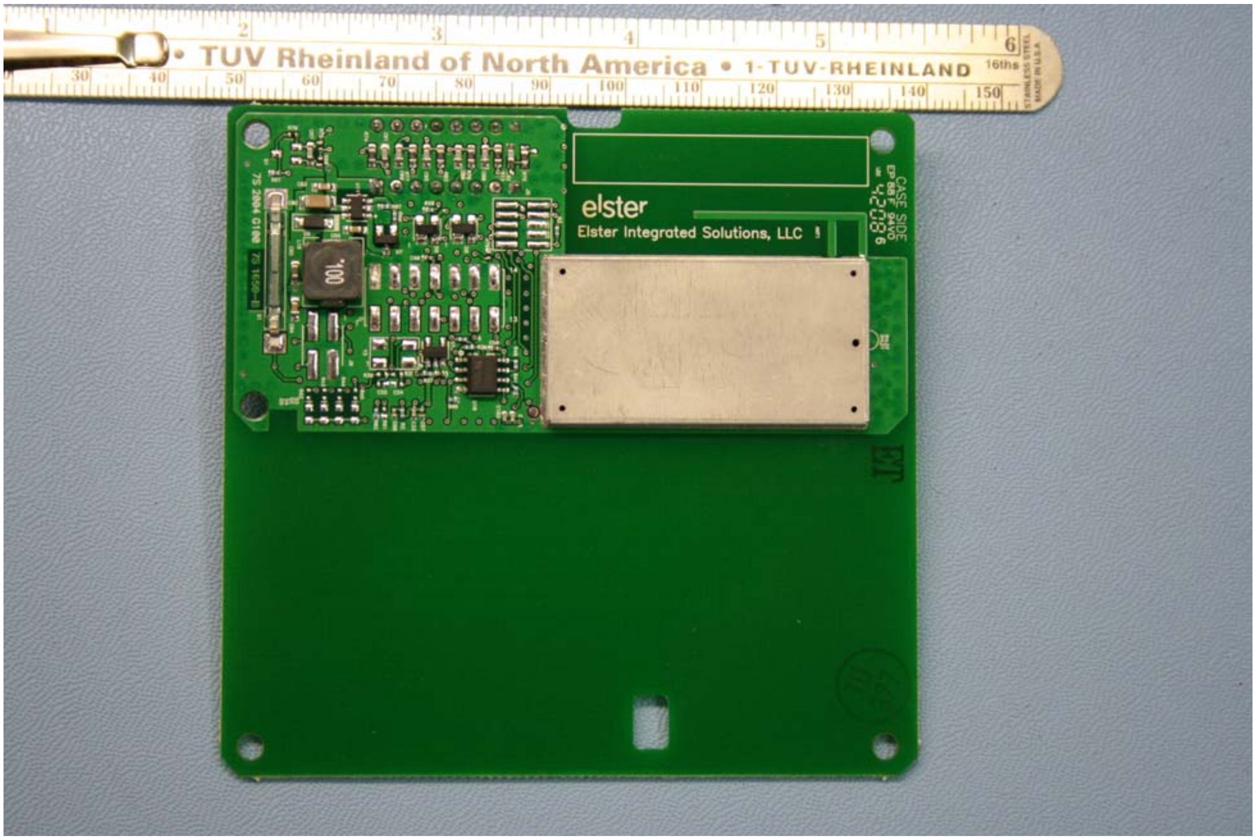


Figure 1: Photo of EUT

2.6 Product Description

The EUT is a 2.4 GHz Communications Option Board that contains a 2.4 GHz ISM Band Transceiver. A more detailed description of the EUT can be found in document; G8J ZGB1_Description for FCC.doc.

The serial number of the EUT submitted for testing was 0003.

2.7 Configuration

A representative of Elster Integrated Systems was on site for all testing. Two samples were supplied for testing; one was a standard production-line model for Radiated measurements. The second one was modified with a coax connector mounted to the RF power output, bypassing the internal antenna. A interface module and computer with software for setting channels and modulation was provided and operated by the representative.

For conducted emissions, the EUT was installed in a “REX2” power meter as a typical installation for this option board.

Since the representative was on site, no test plan was included in this test report.

3 Justifications, Descriptions, or Deviations

The following justifications for tests not performed or deviations from the above listed specification apply:

- The Antenna requirement specified in FCC part 15.203 (RSS-210 section 5.5), the EUT uses a PCB trace antenna with a gain of 0dBi, there is no user provision to change or modify this antenna.
- The EUT is designed to operate only in the 2400-2483.5 MHz band.
- The antenna gain used by the EUT, as stated above is 0 dBi.
- For Maximum permissible exposure, this device operates at less then 1 Watt in the 2400-2483.5 MHz band and is designed to operate greater than 20 cm from personnel during normal operation. No testing is required, however worst case calculated exposure compliance follows later in this test report.

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.4:2003, RSS-210 Issue 7. 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.

4 INTENTIONAL RADIATOR EMISSIONS

4.1 Restricted band measurements 15.205

Radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see 15.205(c)). In addition, where an average detector is used for determining compliance with the limits in 15.209(a), there is a corresponding peak limit 20 dB above the specified average limit according to 15.35(b)

Measurements demonstrating compliance with these parts are provided in the sections below.

4.1.1 Test Results

All spurious and harmonic emissions outside the band are below the limits of part 15.209(a). Refer to the Radiated Emissions section of this test report.

The EUT is compliant with the rules.

4.2 Power Line Conducted Emissions, FCC 15.207, RSS-210 section 2.6

Testing was performed in accordance with FCC part 15.207 and RSS-210-section 2.6.

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.

The EUT was installed in a "REX2" power meter as a typical installation for this option board.

4.2.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. For each frequency sub-range, each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50μH / 50Ω LISNs.

Testing is either performed in the anechoic chamber or on PLC Site 2. The setup photographs clearly identify which site was used. The vertical ground plane used in the anechoic chamber is a 2m x 2m wooden frame that is covered with ¼ inch hardware cloth and is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN. Floor-standing equipment is placed directly on the ground plane.

4.2.1.1 Deviations

There were no deviations from this test methodology.

4.2.2 Test Results

Section 4.2.2.1 lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

Plots of the EUT's AC Line Conducted emissions are contained in the following sections. The plots show peak and/or average emissions and the corresponding peak and/or average limits. If the peak emissions are below the average limit, then the EUT is considered to pass and no average measurements are made. If the peak emissions are below the quasi-peak limit and the average emissions are below the average limit, then the EUT is considered to pass and no further measurements are made. Otherwise, individual frequencies are measured and compared to the corresponding limit for the detector used (quasi-peak or average).

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

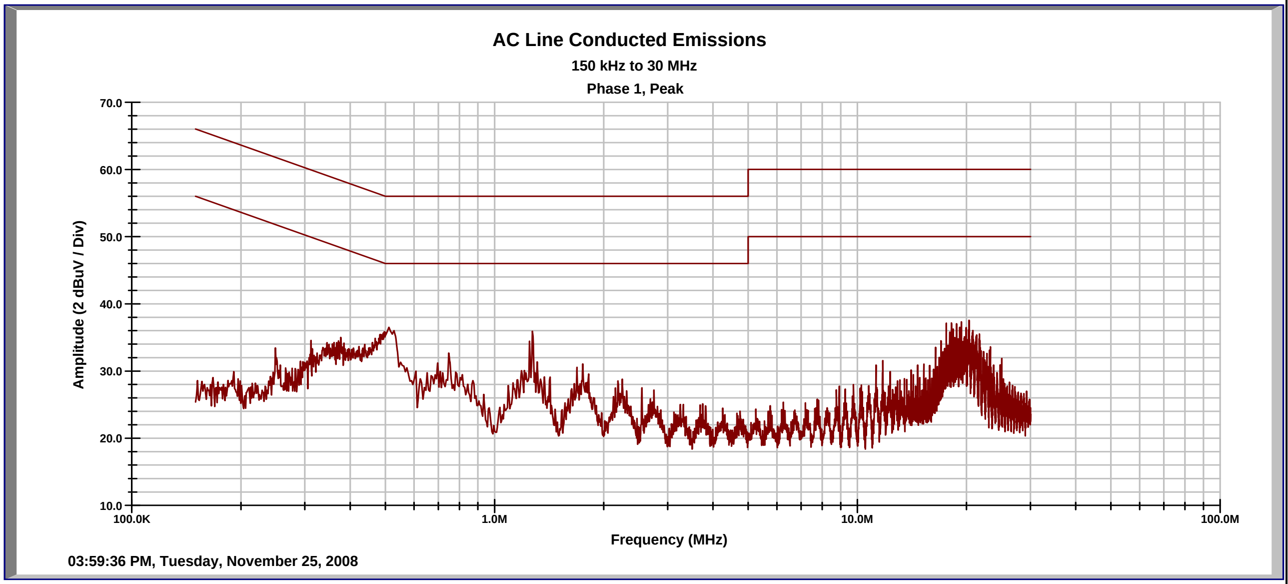
4.2.2.1 Final Data

The data recorded in this section contains the final results under the worst-case conditions and with any modifications or special accessories implemented as the manufacturer intends.

SOP 2 Conducted Emissions

Tracking # 30863354.001 Page 1 of 2

EUT Name	2.4 GHz Communications Option Board	**Date**	25 November 2008
EUT Model	ZOB	**Temperature**	74° F
EUT Serial	0003	**Humidity**	28% rH
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC /Freq**	240VAC / 60Hz
LISNs Used	18	**Performed by**	Mark Ryan
Configuration	Continuous operation on 2440MHz		



Emission Freq (MHz)	Line ID (1,2,3,N)	FIM Quasi (dBuV)	FIM Ave (dBuV)	Cable Loss (dB)	LISN + T Limiter (dB)	Quasi Limit (dBuV)	Ave Limit (dBuV)	Quasi Spec Margin (dB)	Ave Spec Margin (dB)
0.52	1	18.48	2.16	0.07	10.00	56.00	46.00	-27.46	-33.78
0.74	1	18.03	11.95	0.12	10.00	56.00	46.00	-27.84	-23.92
1.27	1	25.02	23.52	0.12	10.03	56.00	46.00	-20.83	-12.33
1.75	1	16.94	10.90	0.13	10.06	56.00	46.00	-28.87	-24.91
8.90	1	12.82	10.74	0.13	10.51	60.00	50.00	-36.54	-28.62
20.32	1	23.23	18.05	0.21	11.02	60.00	50.00	-25.54	-20.72

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF – Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF – Ave Limit ± Uncertainty

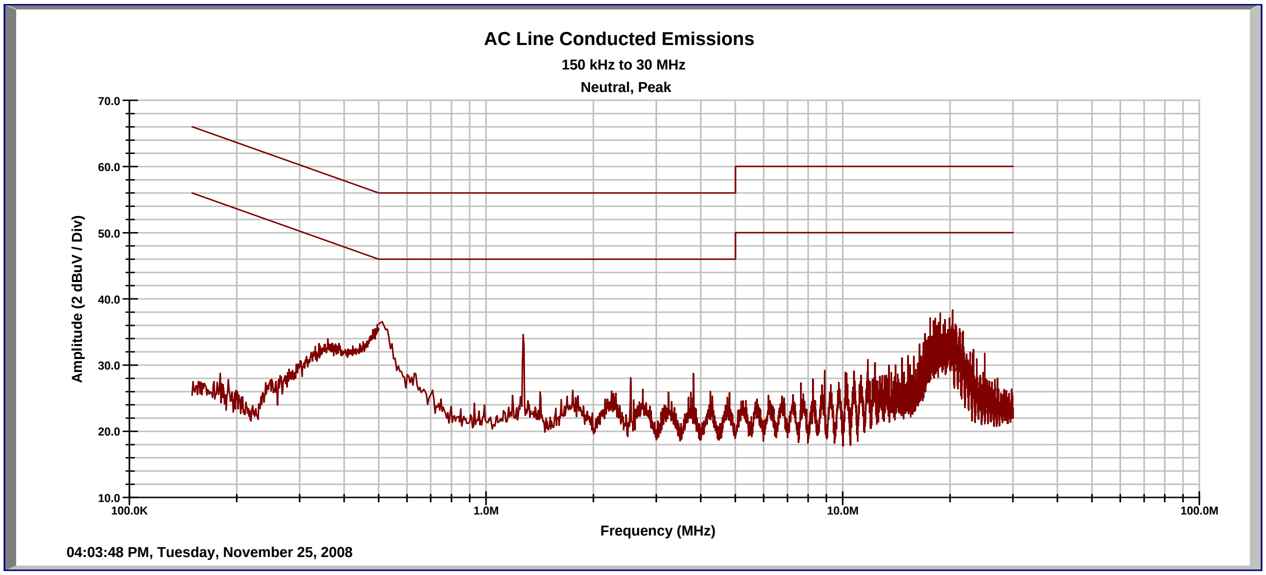
Combined Standard Uncertainty $u_c(y) = \pm 1.2$dB Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence

Notes:

SOP 2 Conducted Emissions

Tracking # 30863354.001 Page 2 of 2

EUT Name	2.4 GHz Communications Option Board	**Date**	25 November 2008
EUT Model	ZOB	**Temperature**	74° F
EUT Serial	0003	**Humidity**	28% rH
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC /Freq**	240VAC / 60Hz
LISNs Used	17	**Performed by**	Mark Ryan
Configuration	Continuous operation on 2440MHz		



Emission Freq (MHz)	Line ID (1,2,3,N)	FIM Quasi (dBuV)	FIM Ave (dBuV)	Cable Loss (dB)	LISN + T Limiter (dB)	Quasi Limit (dBuV)	Ave Limit (dBuV)	Quasi Spec Margin (dB)	Ave Spec Margin (dB)
0.51	N	18.47	2.01	0.06	9.99	56.00	46.00	-27.47	-33.93
0.74	N	6.72	0.30	0.12	10.00	56.00	46.00	-39.16	-35.58
1.27	N	23.26	22.35	0.12	10.02	56.00	46.00	-22.61	-13.52.
1.75	N	12.02	5.89	0.13	10.03	56.00	46.00	-33.82	-29.95
8.90	N	15.67	14.23	0.13	10.27	60.00	50.00	-33.94	-25.38
20.32	N	23.05	18.12	0.21	10.45	60.00	50.00	-26.29	-21.22

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF – Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF – Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y) = \pm 1.2$dB Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence

Notes:

4.3 Radiated Emissions FCC Part 15.209, RSS-210 section 2.6

4.3.1 Test Methodology

Testing was performed in accordance with FCC part 15.209 and RSS-210-section 2.6. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT in transmit mode, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.3.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 300 kHz and provide a reading at each frequency for each 6° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.3.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

4.3.1.3 Deviations

There were no deviations from this test methodology.

4.3.2 Test Results

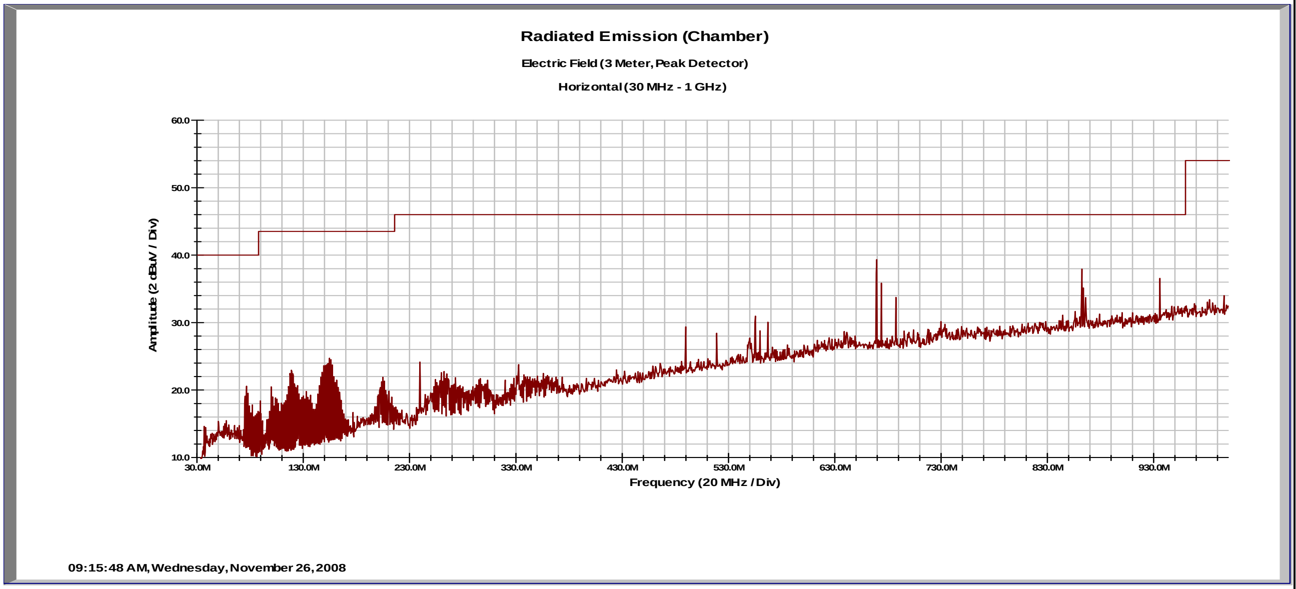
All Spurious and harmonic emissions are below the limits of part 15.209(a).

Since all harmonic and spurious emissions outside the frequency band were below the part 15.209 limits, the data for parts the restricted bands of part 15.205 and 15.247(d) (excluding the band edge measurements shown in section 4.7 of this report) are also included in the tables below

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

SOP 1 Radiated Emissions   Tracking # 30863354.001 Page 1 of 8

EUT Name	2.4 GHz Communications Option Board	**Date**	26 November 2008
EUT Model	ZOB	**Temp / Hum in**	71°F / 25% rH
EUT Serial	0003	**Temp / Hum out**	NA
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC / Freq.**	120V / 60Hz
Deg/sweep	12	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / 6140	**Performed by**	Mark Ryan
Configuration	30 MHz to 1 GHz – 15.209 limits – 2440 MHz Fundamental		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
118.80	H	1.9	287	16.48	0.00	1.19	7.33	25.00	43.50	-18.50
154.28	H	1.9	270	14.77	0.00	1.36	8.16	24.29	43.50	-19.21
240.00	H	1	267	9.40	0.00	1.71	11.60	22.71	46.00	-23.29
669.28	H	1.5	61	20.03	0.00	2.89	20.20	43.12	46.00	-2.88
856.04	H	1.5	331	9.98	0.00	3.31	22.12	35.41	46.00	-10.59
935.76	H	1.6	322	6.45	0.00	3.42	22.93	32.80	46.00	-13.20

Spec Margin = E-Field Value – Limit, E-Field Value = FIM Value – Amp Gain + Cable Loss + ANT Factor ± Uncertainty

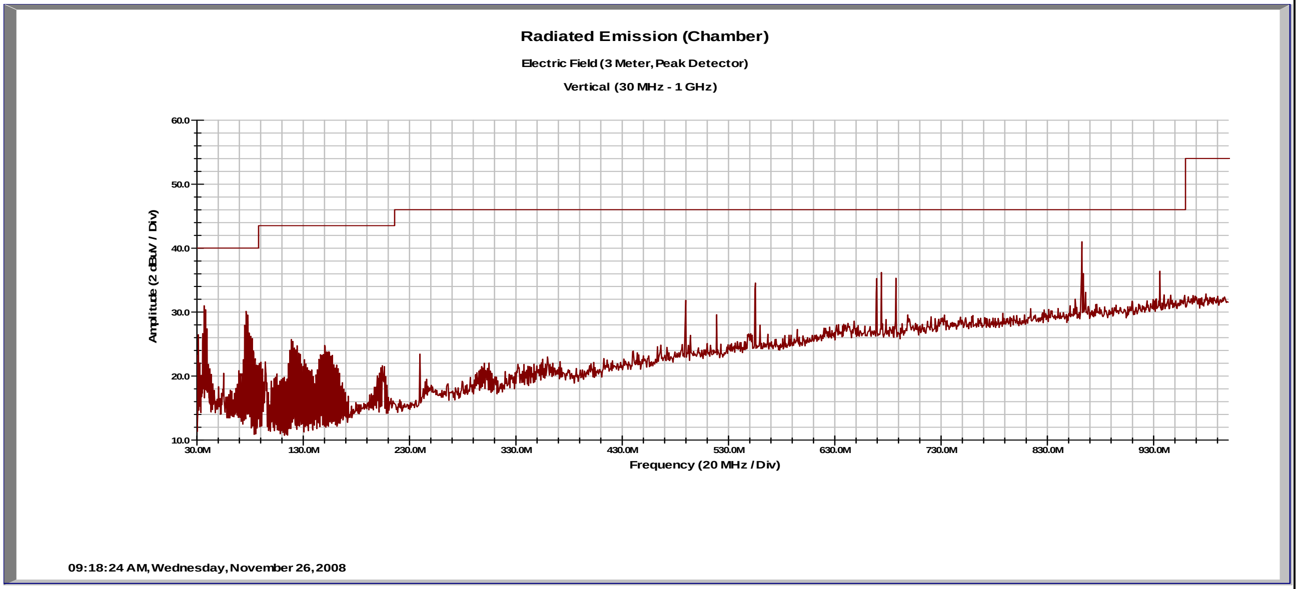
Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Using a 2.4 to 2.5 GHz notch filter on the fundamental

All emissions are using the Quasi-Peak Detector.

SOP 1 Radiated Emissions Tracking # 30863354.001 Page 2 of 8

EUT Name	2.4 GHz Communications Option Board	**Date**	26 November 2008
EUT Model	ZOB	**Temp / Hum in**	71°F / 25% rH
EUT Serial	0003	**Temp / Hum out**	NA
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC / Freq.**	120V / 60Hz
Deg/sweep	12	**RBW / VBW**	120 kHz / 300 kMHz
Dist/Ant Used	3m / 6140	**Performed by**	Mark Ryan
Configuration	30 MHz to 1 GHz – 15.209 limits - Mid band 2440 MHz Fundamental		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
36.84	V	1	131	21.54	0.00	0.65	7.82	30.01	40.00	-9.99
76.40	V	1	308	20.24	0.00	0.97	6.64	27.85	40.00	-12.15
519.24	V	1.2	277	8.01	0.00	2.50	17.27	27.78	46.00	-18.22
673.76	V	1.3	100	10.86	0.00	2.91	20.08	33.85	46.00	-12.15
862.44	V	1	10	13.29	0.00	3.33	21.80	38.42	46.00	-7.58
935.80	V	2	313	11.42	0.00	3.42	22.83	37.67	46.00	-8.33

Spec Margin = E-Field Value – Limit, E-Field Value = FIM Value – Amp Gain + Cable Loss + ANT Factor ± Uncertainty

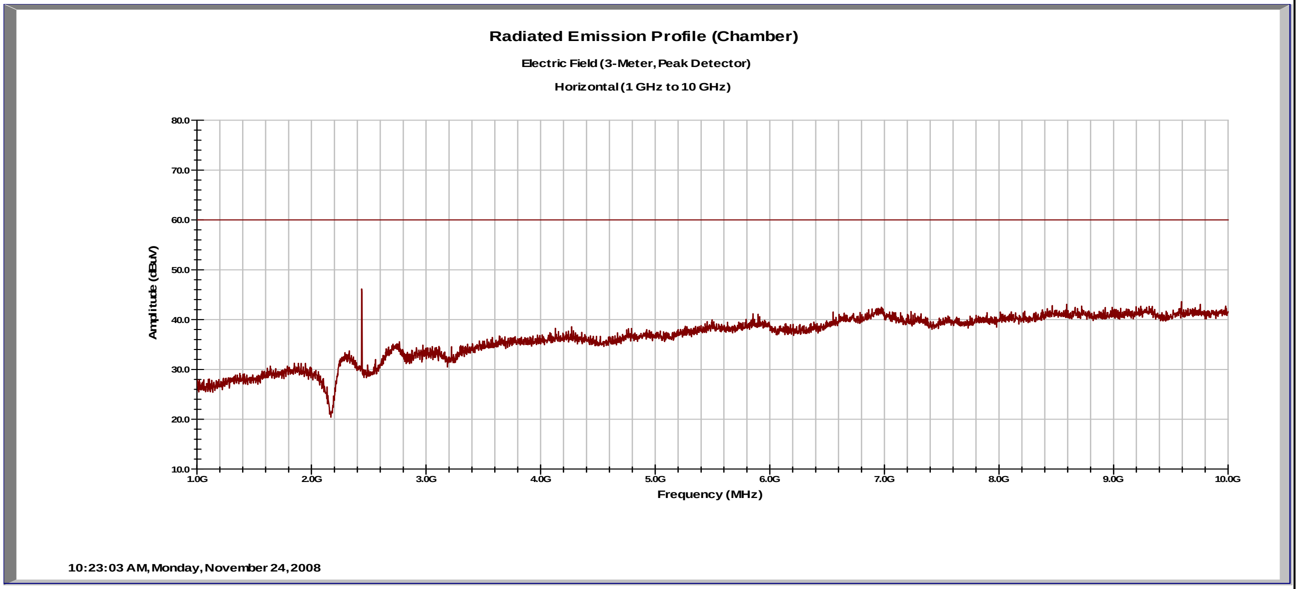
Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Using a 2.4 to 2.5 GHz notch filter on the fundamental

All emissions are using the Quasi-Peak Detector.

SOP 1 Radiated Emissions Tracking # 30863354.001 Page 3 of 8

EUT Name	2.4 GHz Communications Option Board	**Date**	24 November 2008
EUT Model	ZOB	**Temp / Hum in**	73°F / 24% rH
EUT Serial	0003	**Temp / Hum out**	NA
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC / Freq.**	120V / 60Hz
Deg/sweep	6	**RBW / VBW**	1MHz / 3 MHz
Dist/Ant Used	3m / 3115-2236	**Performed by**	Mark Ryan
Configuration	1-10GHz Horizontal – 15.209 limits - Mid band 2440 MHz Fundamental		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Spec Margin = E-Field Value – Limit, E-Field Value = FIM Value – Amp Gain + Cable Loss + ANT Factor ± Uncertainty

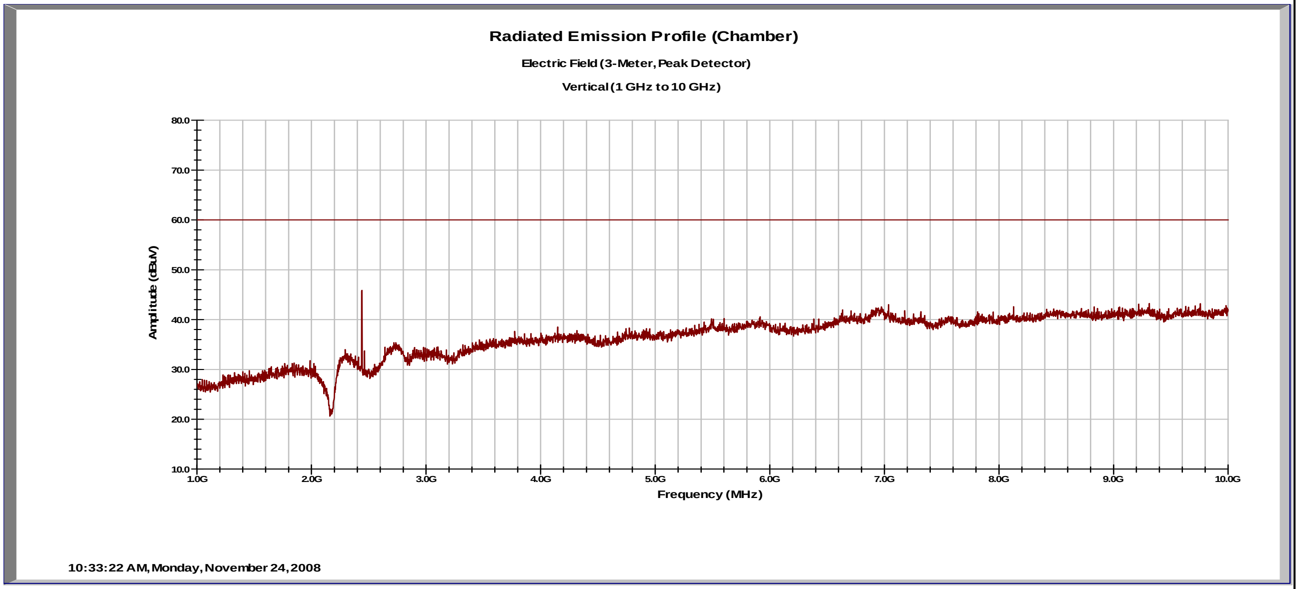
Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: The peak is the fundamental frequency attenuated by use of a 2.4-2.5 GHz notch filter on the input to the preamp

All emissions other were indistinguishable from the noise floor of the EMI Test Receiver.

SOP 1 Radiated Emissions — Tracking # 30863354.001 Page 4 of 8

EUT Name	2.4 GHz Communications Option Board	**Date**	24 November 2008
EUT Model	ZOB	**Temp / Hum in**	73°F / 24% rH
EUT Serial	0003	**Temp / Hum out**	NA
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC / Freq.**	120V / 60Hz
Deg/sweep	6	**RBW / VBW**	1MHz / 3 MHz
Dist/Ant Used	3m / 3115-2236	**Performed by**	Mark Ryan
Configuration	1-10GHz Vertical – 15.209 limits - Mid band 2440 MHz Fundamental		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Spec Margin = E-Field Value – Limit, E-Field Value = FIM Value – Amp Gain + Cable Loss + ANT Factor ± Uncertainty

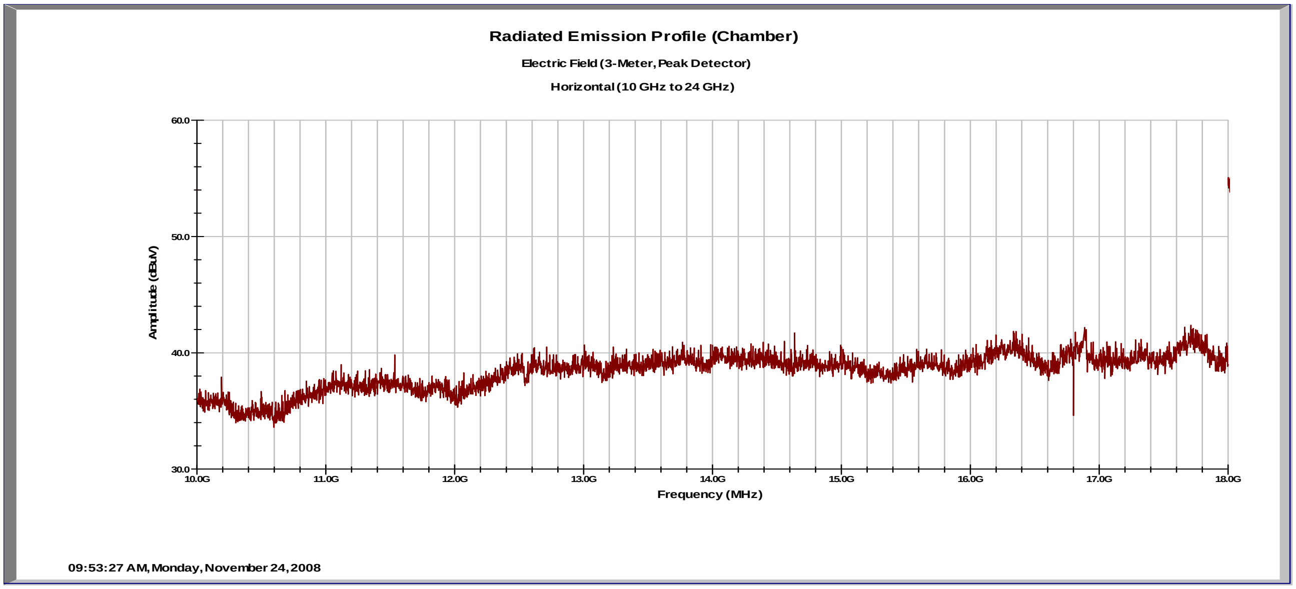
Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: The peak is the fundamental frequency attenuated by use of a 2.4-2.5 GHz notch filter on the input to the preamp

All emissions other were indistinguishable from the noise floor of the EMI Test Receiver.

SOP 1 Radiated Emissions — Tracking # 30863354.001 Page 5 of 8

EUT Name	2.4 GHz Communications Option Board	**Date**	24 November 2008
EUT Model	ZOB	**Temp / Hum in**	73°F / 24% rH
EUT Serial	0003	**Temp / Hum out**	NA
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC / Freq.**	120V / 60Hz
Deg/sweep	6	**RBW / VBW**	1MHz / 3 MHz
Dist/Ant Used	3m / 3115-2236	**Performed by**	Mark Ryan
Configuration	10-18GHz Horizontal – 15.209 limits - Mid band 2440 MHz Fundamental		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

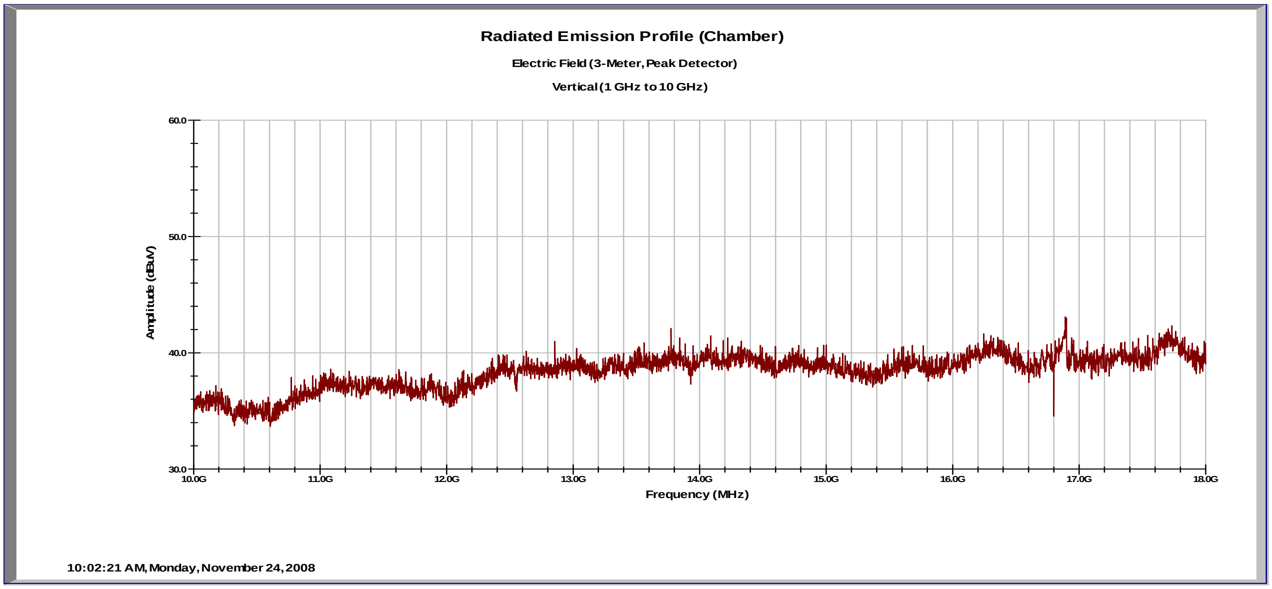
Spec Margin = E-Field Value – Limit, E-Field Value = FIM Value – Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions were indistinguishable from the noise floor of the EMI Test Receiver.

SOP 1 Radiated Emissions — Tracking # 30863354.001 Page 6 of 8

EUT Name	2.4 GHz Communications Option Board	**Date**	24 November 2008
EUT Model	ZOB	**Temp / Hum in**	73°F / 24% rH
EUT Serial	0003	**Temp / Hum out**	NA
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC / Freq.**	120V / 60Hz
Deg/sweep	6	**RBW / VBW**	1MHz / 3 MHz
Dist/Ant Used	3m / 3115-2236	**Performed by**	Mark Ryan
Configuration	10-18GHz Vertical – 15.209 limits - Mid band 2440 MHz Fundamental		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

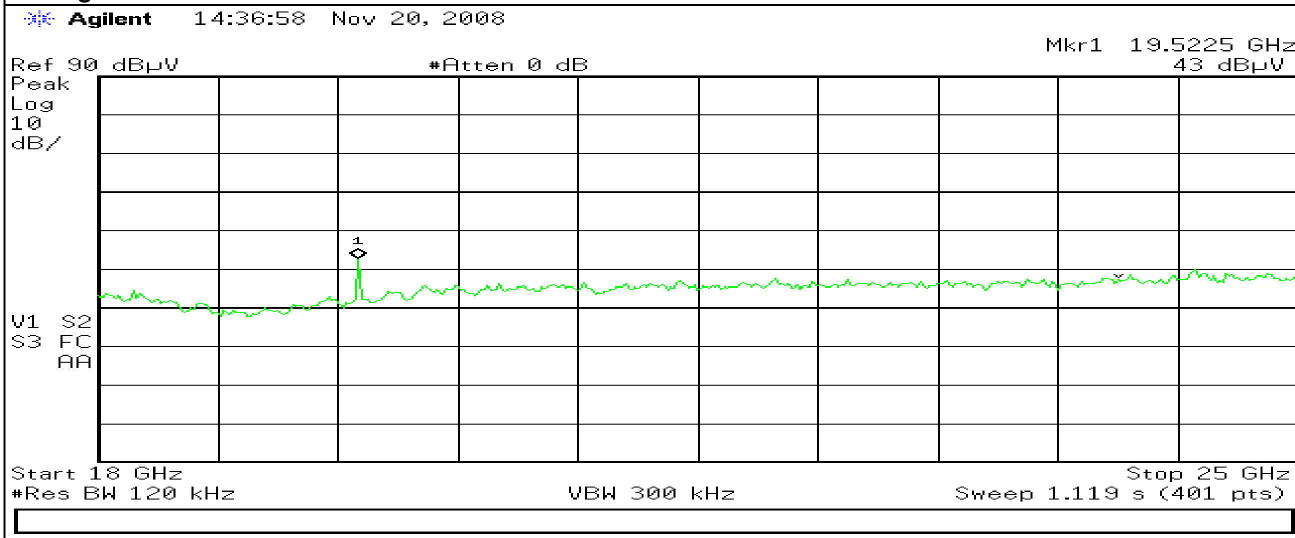
Spec Margin = E-Field Value – Limit, E-Field Value = FIM Value – Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions were indistinguishable from the noise floor of the EMI Test Receiver.

SOP 1 Radiated Emissions   Tracking # 30863354.001 Page 7 of 8

EUT Name	2.4 GHz Communications Option Board	**Date**	20 November 2008
EUT Model	ZOB	**Temp / Hum in**	73°F / 24% rH
EUT Serial	0003	**Temp / Hum out**	NA
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC / Freq.**	120V / 60Hz
Deg/sweep	6	**RBW / VBW**	1MHz / 3 MHz
Dist/Ant Used	1m / MA86552	**Performed by**	Mark Ryan
Configuration	18 – 25 GHz Horizontal – 15.209 limits - Mid band 2440 MHz Fundamental		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain + Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Spec Margin = E-Field Value – Limit, E-Field Value = FIM Value – Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y) = \pm 1.6$dB Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence

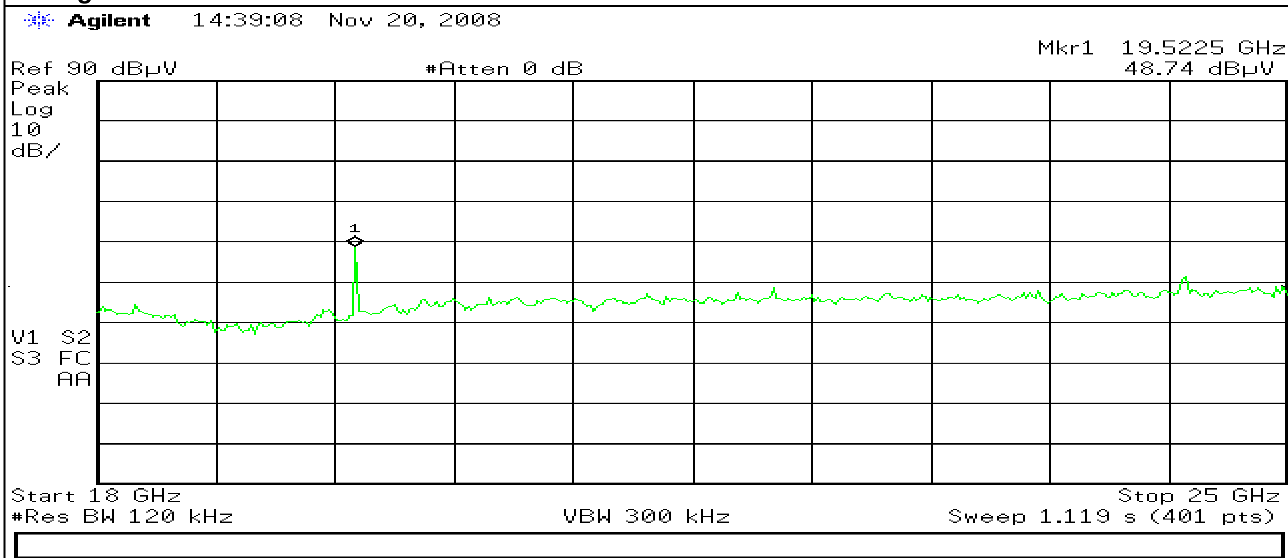
Notes: Plot shown without correction factors applied.

See Vertical Emission (below) for worst case emission.

All other emissions were indistinguishable from the noise floor of the EMI Test Receiver.

SOP 1 Radiated Emissions   Tracking # 30863354.001 Page 8 of 8

EUT Name	2.4 GHz Communications Option Board	**Date**	20 November 2008
EUT Model	ZOB	**Temp / Hum in**	73°F / 24% rH
EUT Serial	0003	**Temp / Hum out**	NA
Standard	FCC 47 CFR Part 15C, RSS-210 Issue 7	**Line AC / Freq.**	120V / 60Hz
Deg/sweep	6	**RBW / VBW**	1MHz / 3 MHz
Dist/Ant Used	1m / MA86552	**Performed by**	Mark Ryan
Configuration	18 – 25 GHz Vertical – 15.209 limits - Mid band 2440 MHz Fundamental		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain + Cable loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
19523.42	V	1	350	43.02	27.4	40.11	59.73	64.00	-4.27
19523.42	V	1	350	50.88	27.4	40.11	67.59	84.00	-16.41

Spec Margin = E-Field Value – Limit, E-Field Value = FIM Value – Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Plot shown without correction factors applied.

The limits have been increased +10dB to compensate for the 1m measuring antenna distance.

Emissions shown in BLUE are using the Average detector and emissions shown in GREEN are using the Peak Detector.

All other emissions were indistinguishable from the noise floor of the EMI Test Receiver.

4.4 6 dB Bandwidth of Digitally Modulated Systems FCC Part 15.247(a)(2)

Systems using digital modulation techniques may operate in the 2400-2483.5 MHz band.
The minimum 6 dB bandwidth shall be at least 500 kHz.

4.4.1 Test Results

BW = 1.6 MHz which is greater than the minimum 500 kHz 6 dB Bandwidth

The EUT is compliant with the rules.

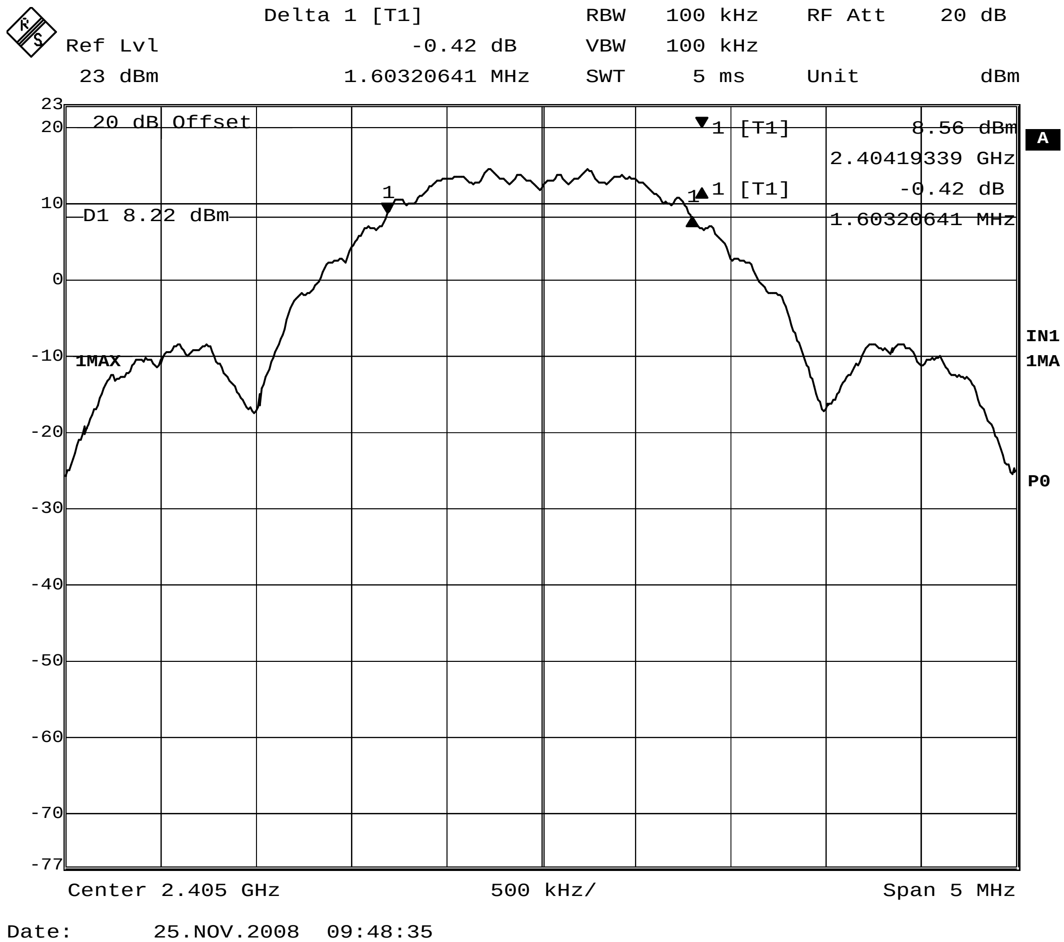


Figure 2: 2405 MHz 6 dB Bandwidth

Note: The above plot is the worst case. The other 6 dB bandwidth plots are on file at TUV Rheinland

Spectrum Analyzer Parameters:
RBW=100 kHz
Span=5 MHz
VBW= 100 kHz
LOG dB/div.= 10dB
Sweep = Auto
Detector = peak detector, max hold

4.5 Bandwidth RSS-210 Section A1.1.3

For the purpose of Section A1.1, the 99% bandwidth shall be no wider than .25% of the center frequency for devices operating between 70-900MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

Using the procedures of RSS-GEN section 4.6.1, the resolution bandwidth is 1% of the 5 MHz span.

The limit of the bandwidth would be 0. 5% of 2405 MHz, or 12.03 MHz. The measured 99% bandwidth is 2.425 MHz.

4.5.1 Test Results

The EUT is compliant to the requirements of RSS-210 A1.1.3

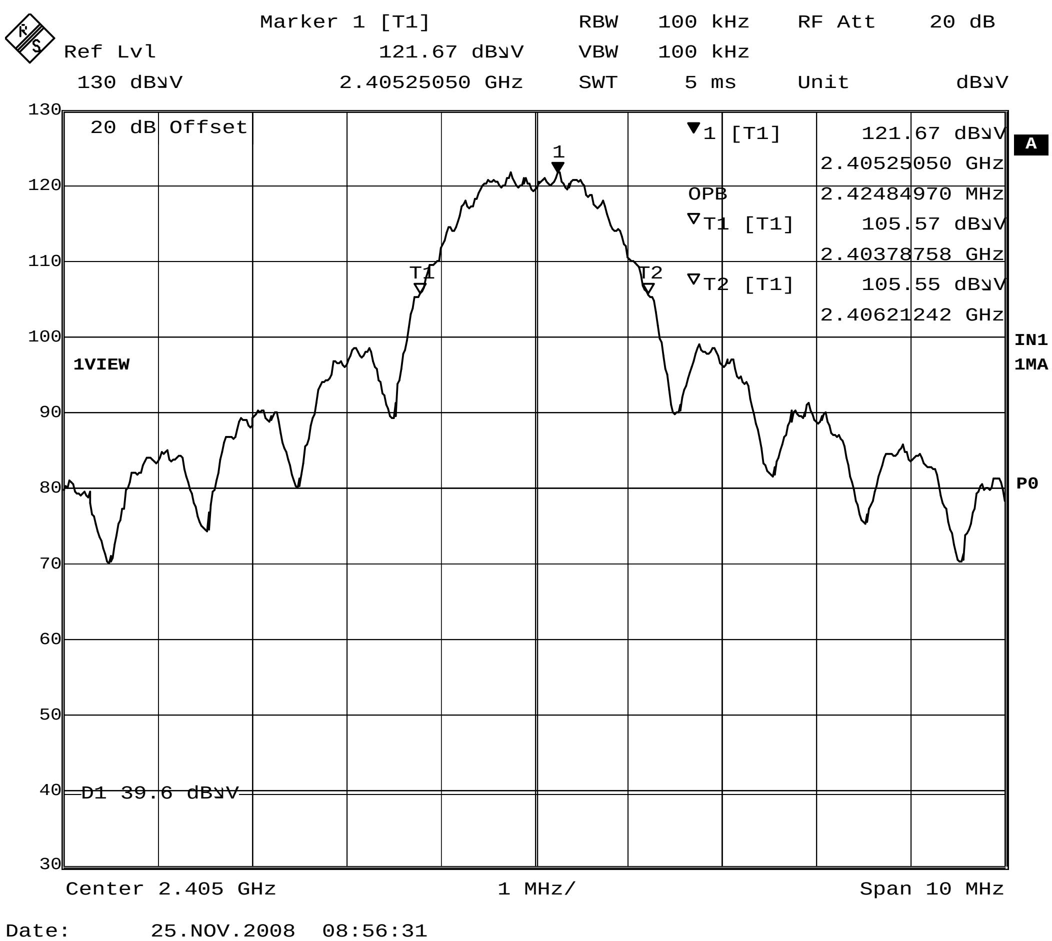


Figure 3 – 99% Bandwidth

Spectrum Analyzer Parameters:
RBW=100 kHz
Span=10 MHz
VBW= 100 kHz
LOG dB/div.= 10dB
Sweep = Auto
Detector = peak detector, max hold

4.6 Peak Output Power FCC Part 15.247(b)(3)

For systems using digital modulation in the 2400-2483.5 MHz band: 1 Watt.
As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

The EUT was set to transmit an un-modulated carrier for peak power measurements

Test Setup

Measured Peak Power Output

Lowest Channel; CH 11: 2405 MHz = 17.9 dBm = 61.7 mW

Mid Channel; CH 18: 2440 MHz = 18.74 dBm = 74.8 mW

Highest Channel; CH 23: 2465 MHz = 18.27 dBm = 66.7 mW

4.6.1 Results

The Maximum power output of the EUT is 74.8mW, which is .925 Watts below the 1 Watt limit

The EUT is compliant with the rules.

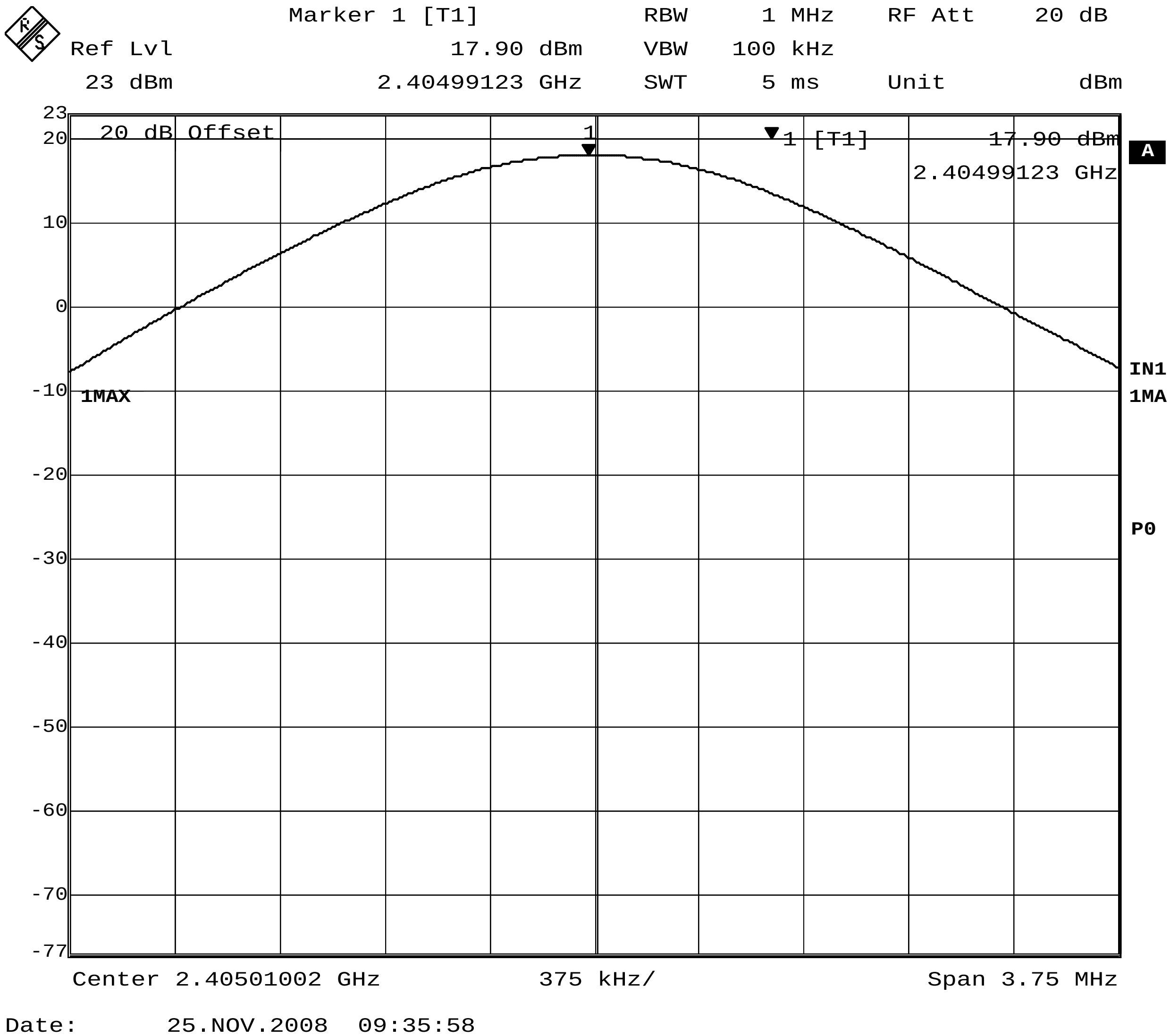


Figure 4: CH 1 (2405 MHz) Peak Output Power

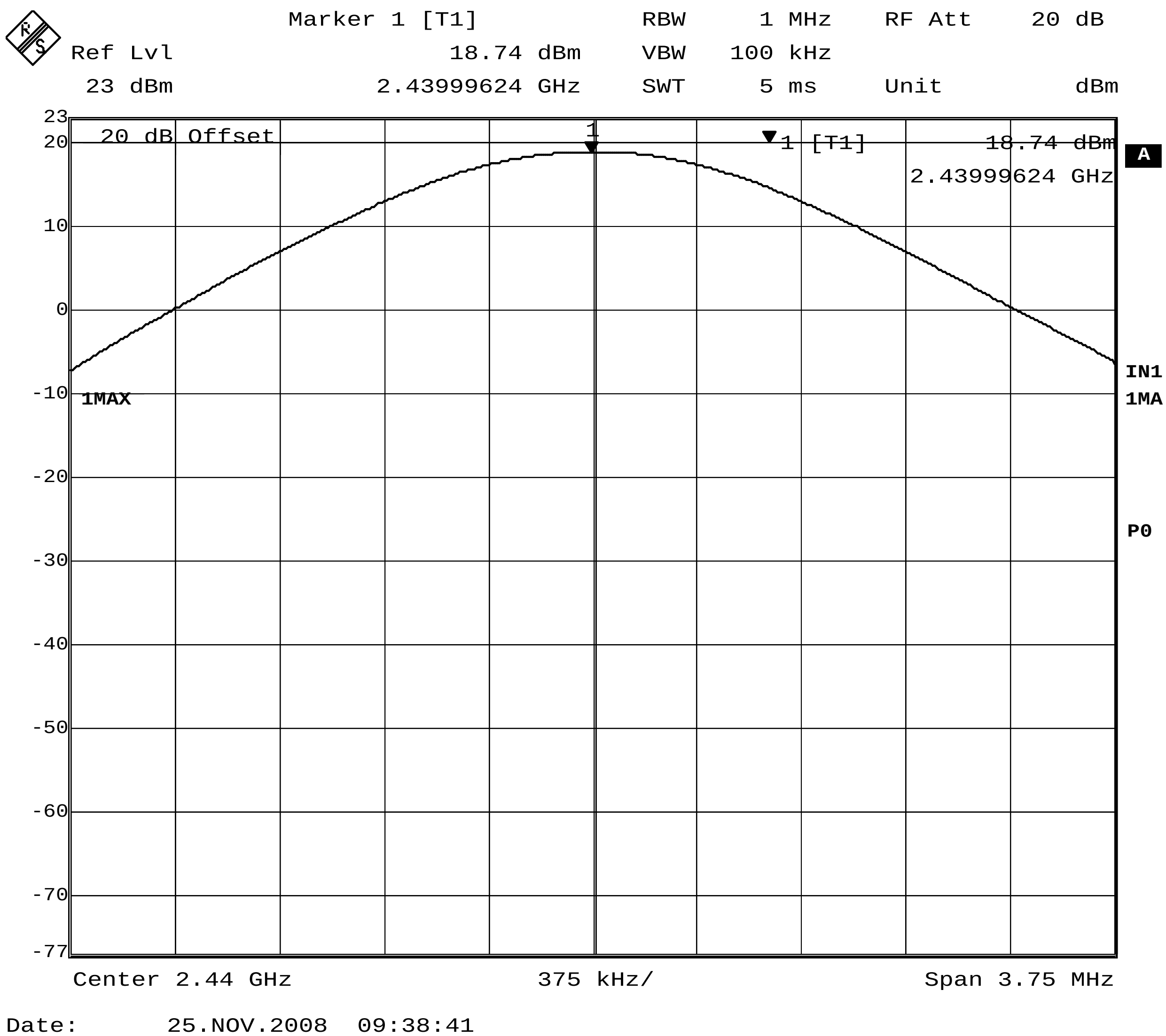


Figure 5: CH 31 (2440 MHz) Peak Output Power

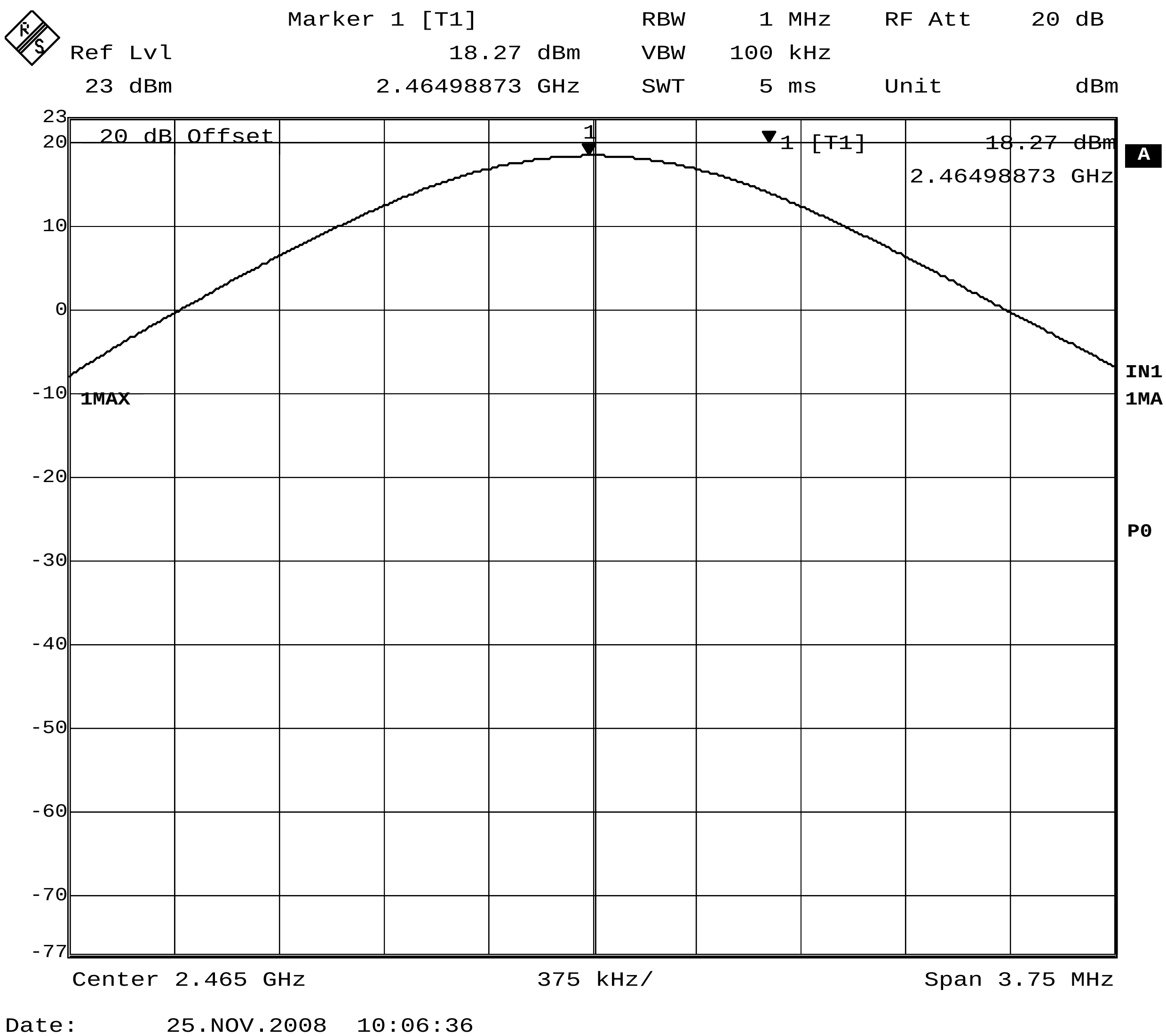


Figure 6: CH 48 (2465 MHz) Peak Output Power

4.6.2 Antenna Gain

As noted in Section 3 of this report the Antenna requirement specified in FCC part 15.203 (RSS-210 section 5.5), the EUT uses a PCB trace antenna with a gain of 0 dBi, there is no user provision to change or modify this antenna.

4.6.2.1 Results

Antenna is 0 dBi gain.

4.7 Band Edge FCC Part 15.247(d)

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.

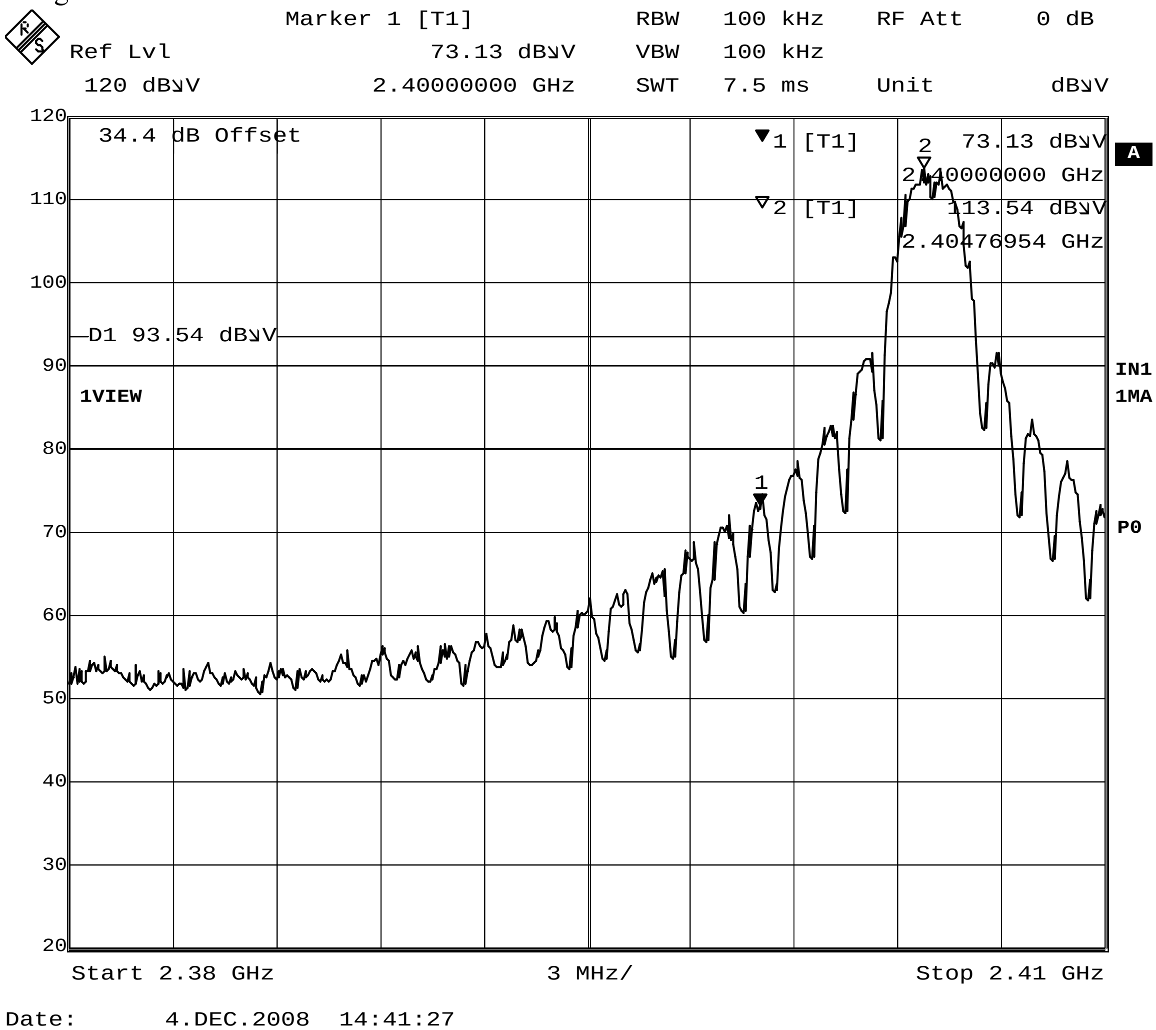


Figure 7: Lower Band Edge Measurement Using Peak Detector (Display line is 20 dB below carrier)

Note: Marker 2 is highest peak power, Marker 1 is the 2400MHz band edge.

The EUT lowest operating frequency is 20.4 dB below the 20 dB band edge limit.

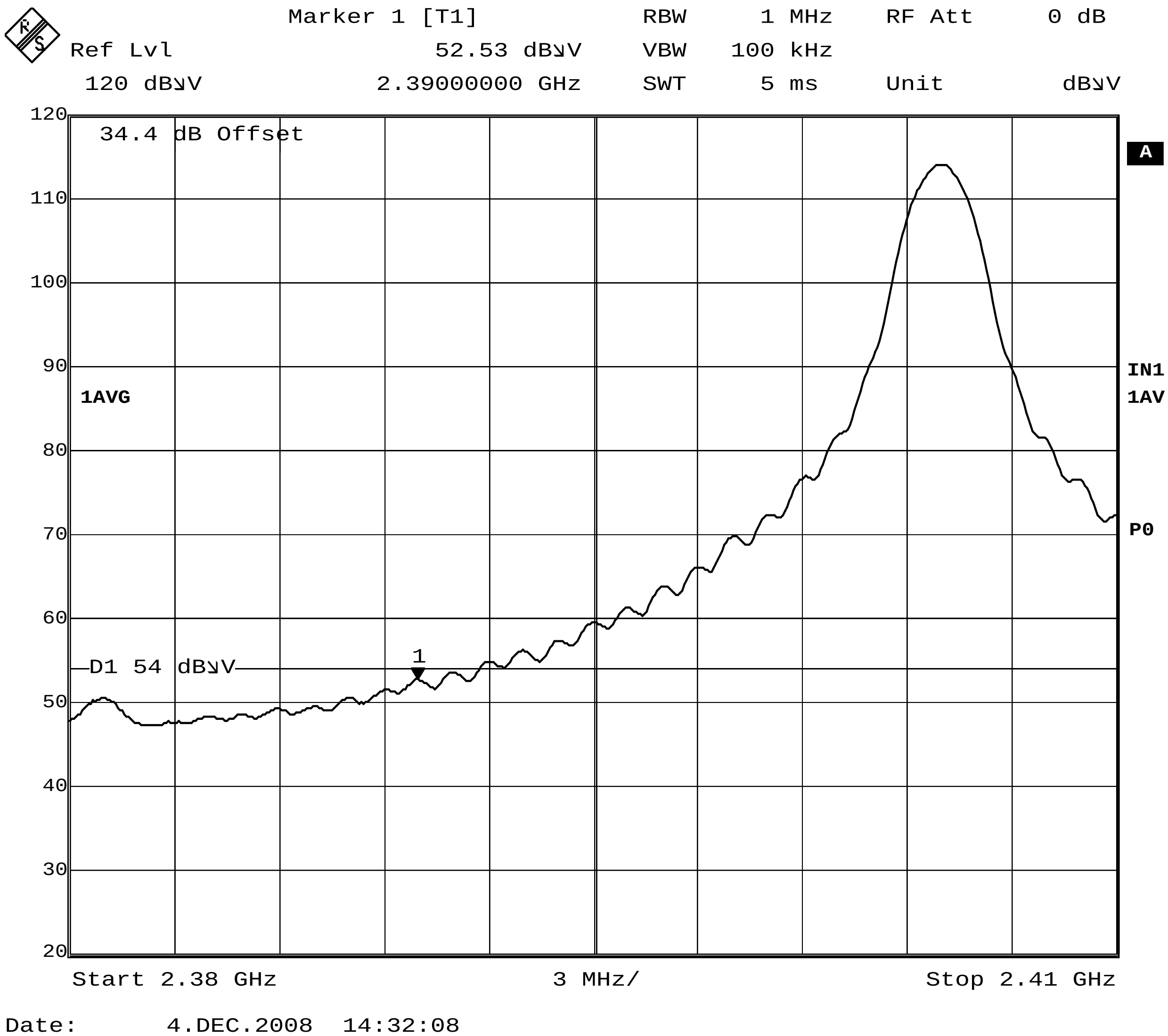


Figure 8: Lower Band Edge Measurement Using Average Detector (54 dBµV = 500 µV)

Note: Marker 1 the edge of the restricted band at 2390 MHz. .

The EUT lowest operating frequency is 1.5 dB below the average limit at the restricted band.

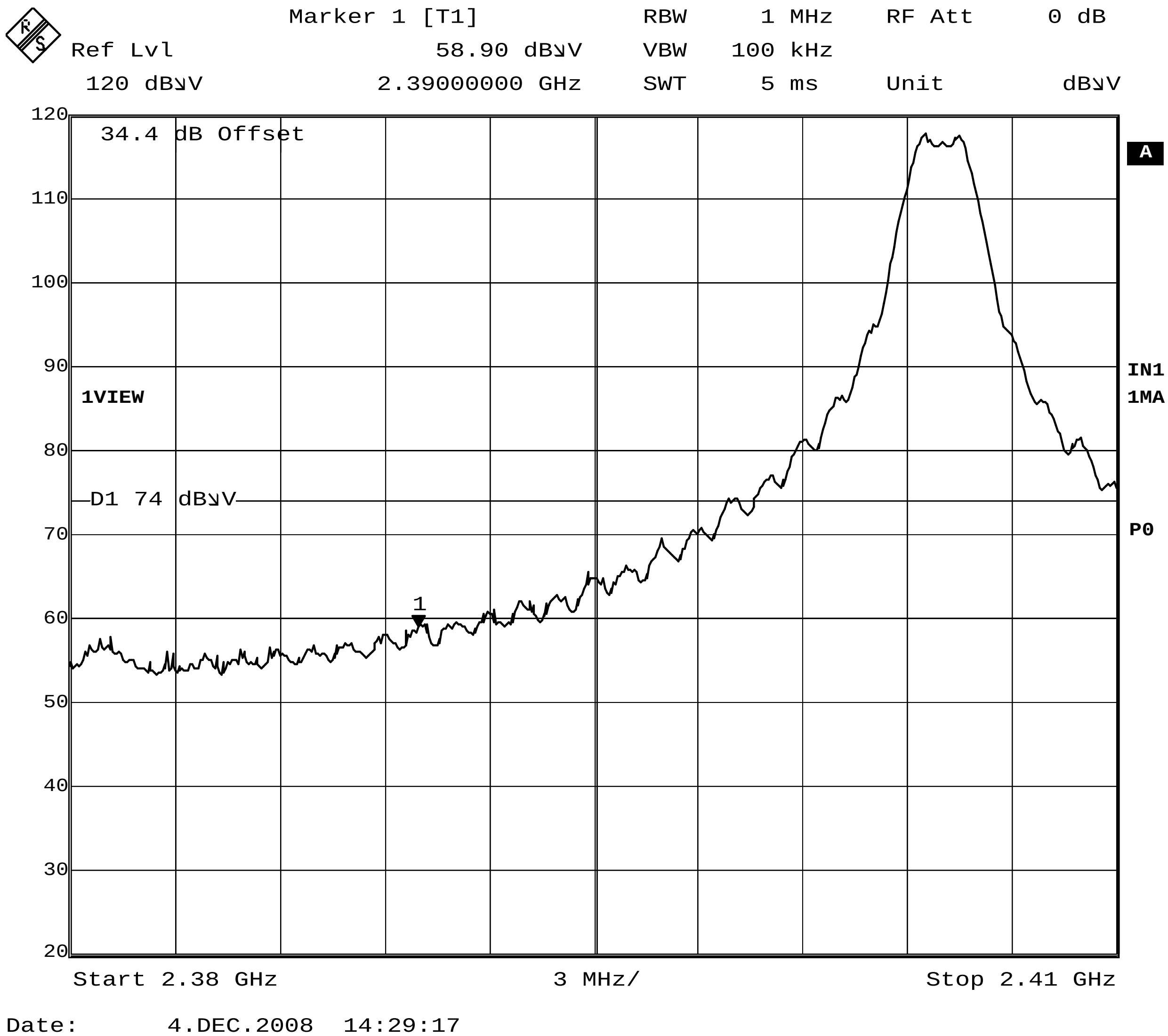


Figure 9: Lower Band Edge Measurement Using Peak Detector

Note: Marker 1 is the edge of the restricted band at 2390 MHz.

The EUT lowest operating frequency is 15.1 dB below the peak limit at the restricted band.

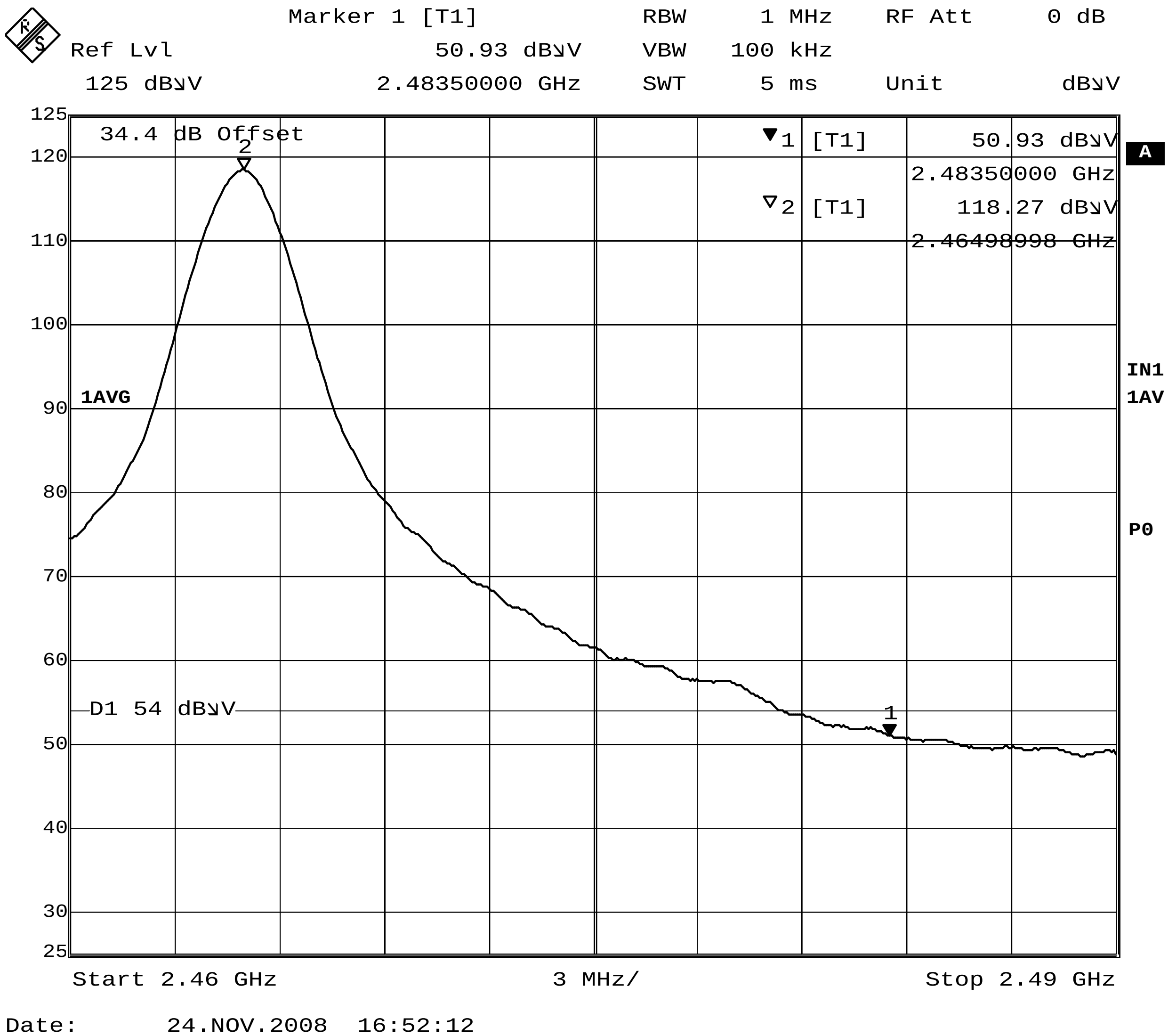


Figure 10: High Band Edge Measurement Using Average Detector (54 dBμV = 500 μV)

Note: Marker 1 is highest average power, Marker 2 the 2423.5MHz band edge, which is also the start of a restricted band.

The EUT’s highest operating frequency is 3 dB below the limit at the restricted band.

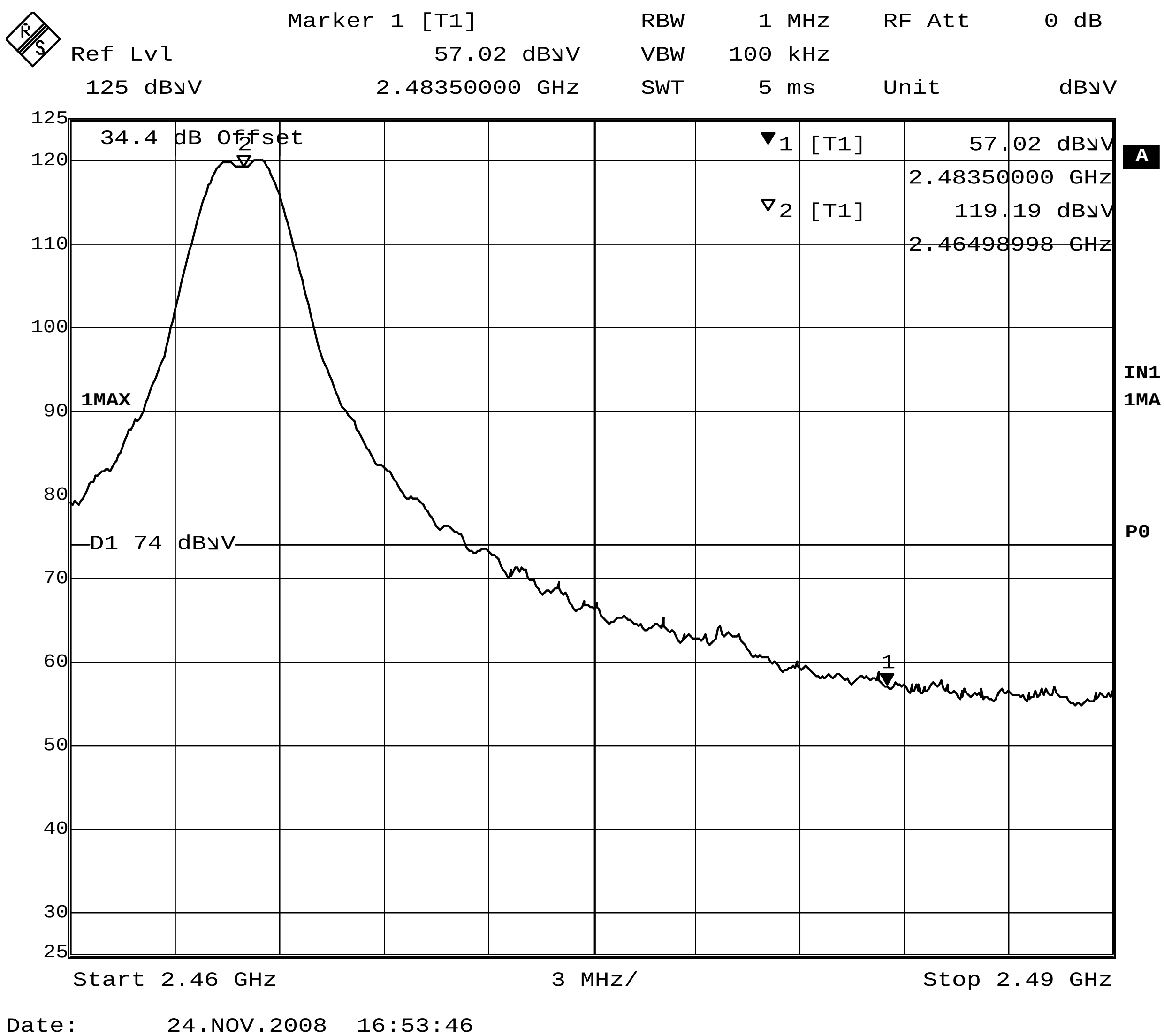


Figure 11: High Band Edge Measurement Using Average Detector (74 dBµV = 5000 µV)

Note: Marker 1 the 2423.5MHz band edge, which is also the start of a restricted band. .
The EUT's highest operating frequency is 17 dB below the limit at the restricted band.

4.7.1 Test Results

The EUT is compliant with the rules.

4.8 Power Spectral Density FCC Part 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. The same method of determining the conducted output power shall be used to determine the power spectral density.

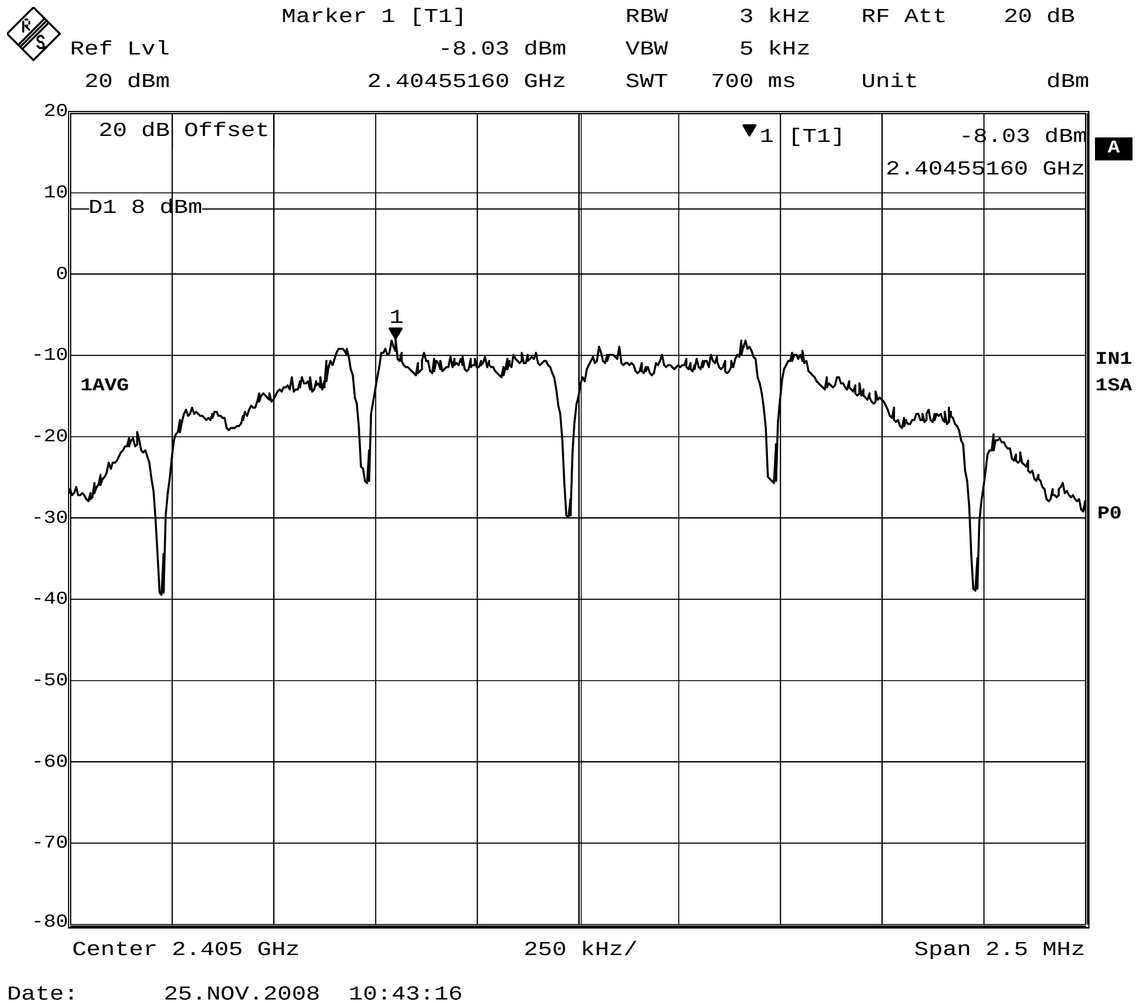


Figure 12: Low channel (2405MHz) PPSD = -8.03 dBm which is 16 dB below the 8 dBm limit

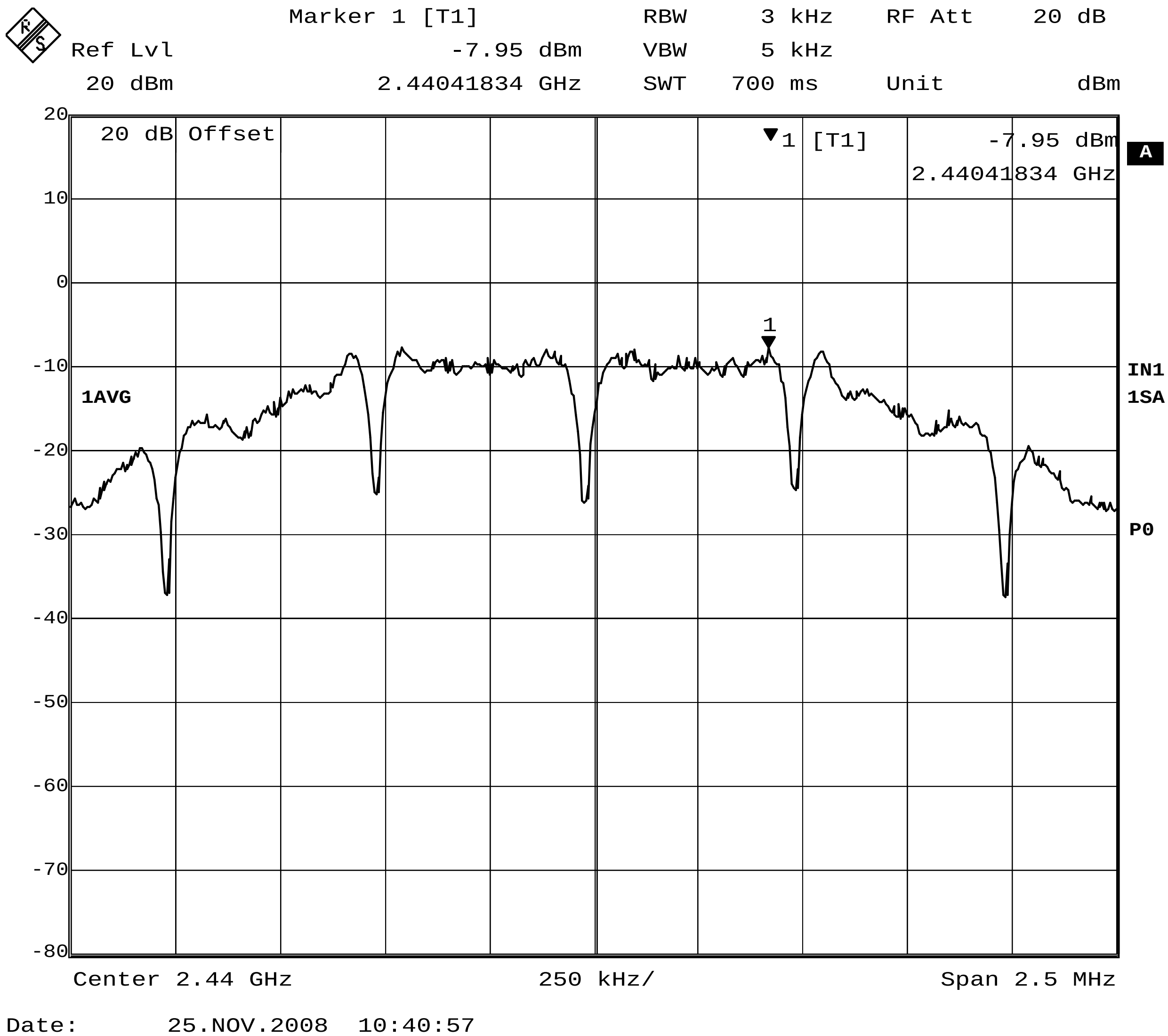


Figure 13: Mid channel (2444 MHz) PPSD = -7.99 dBm which is 16 dB below the +8 dBm limit

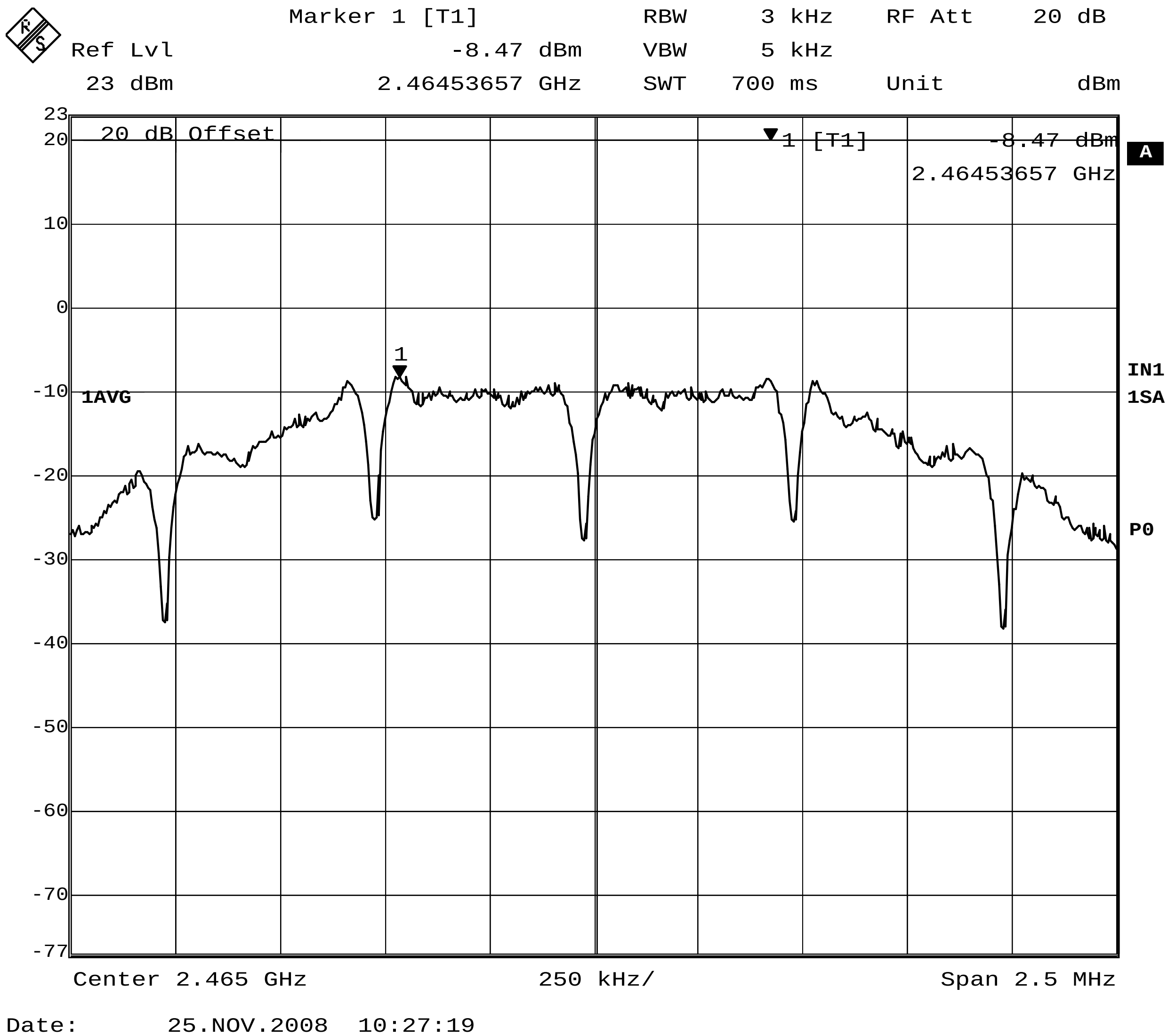


Figure 14: High channel (2465MHz) PPSD = -8.47 dBm which is 16.5 dB below the +8 dBm limit

Spectrum Analyzer Parameters:
RBW=3 kHz
Span=2.5 MHz
VBW= 5 kHz
LOG dB/div.= 10dB
Sweep = Auto
Detector = sample detector, 100 sample average

4.8.1 Test Results

The EUT is compliant with the rules.

4.9 Maximum Permissible Exposure FCC Part 15.247(i), IC Safety code 6

4.9.1 Test Methodology

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Semi-Anechoic Chamber, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

4.9.2 RF Exposure Limit

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
300-1500	…	…	F/300	6
1500-100,000	…	…	5	6
(B)Limits For General Population / Uncontrolled Exposure				
300-1500	…	…	F/1500	6
1500-100,000	…	…	1.0	30

F = Frequency in MHz

4.9.3 EUT Operating Condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

4.9.4 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.

4.9.5 Calculation Results

4.9.5.1 Antenna Gain

The stated, Antenna Gain is 0 dBi or a numeric gain of 1.

4.9.5.2 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 mW/cm^2

Highest P_{out} is 74.8 mW, highest antenna gain (in linear scale) is 1, and R is 20cm.

$Pd = (74.8 * 1) / (4 * 20^2 * \pi) =$ **0.015 mW/cm^2**, which is 4.985 mW/cm^2 below to the limit.

4.9.6 Sample Calculation

The Friis transmission formula: $Pd = (P_{out} * G) / (4 * R^2 * \pi)$

Where;

Pd = power density in mW/cm2
P_{out} = output power to antenna in mW
G = gain of antenna in linear scale
$\pi \approx 3.1416$
R = distance between observation point and center of the radiator in cm

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

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

5 UNINTENTIONAL RADIATOR EMISSIONS

5.1 Power Line Conducted Emissions, FCC part 15.107, ICES-003

Testing was performed in accordance with 47 CFR 15B, ICES-003. These test methods are listed under the laboratory's NVLAP Scope of Accreditation.

This test measures the levels emanating from the EUT in receive mode, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

5.1.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. For each frequency sub-range, each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50µH / 50Ω LISNs.

Testing is either performed in the anechoic chamber or on PLC Site 2. The setup photographs clearly identify which site was used. The vertical ground plane used in the anechoic chamber is a 2m x 2m wooden frame that is covered with ¼ inch hardware cloth and is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN. Floor-standing equipment is placed directly on the ground plane.

5.1.1.1 Deviations

There were no deviations from this test methodology.

5.1.2 Test Results

This Section lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Plots of the EUT's AC Line Conducted emissions are contained in the following sections. The plots show peak and/or average emissions and the corresponding peak and/or average limits. If the peak emissions are below the average limit, then the EUT is considered to pass and no average measurements are made. If the peak emissions are below the quasi-peak limit and the average emissions are below the average limit, then the EUT is considered to pass and no further measurements are made. Otherwise, individual frequencies are measured and compared to the corresponding limit for the detector used (quasi-peak or average).

5.1.2.1 Final Data

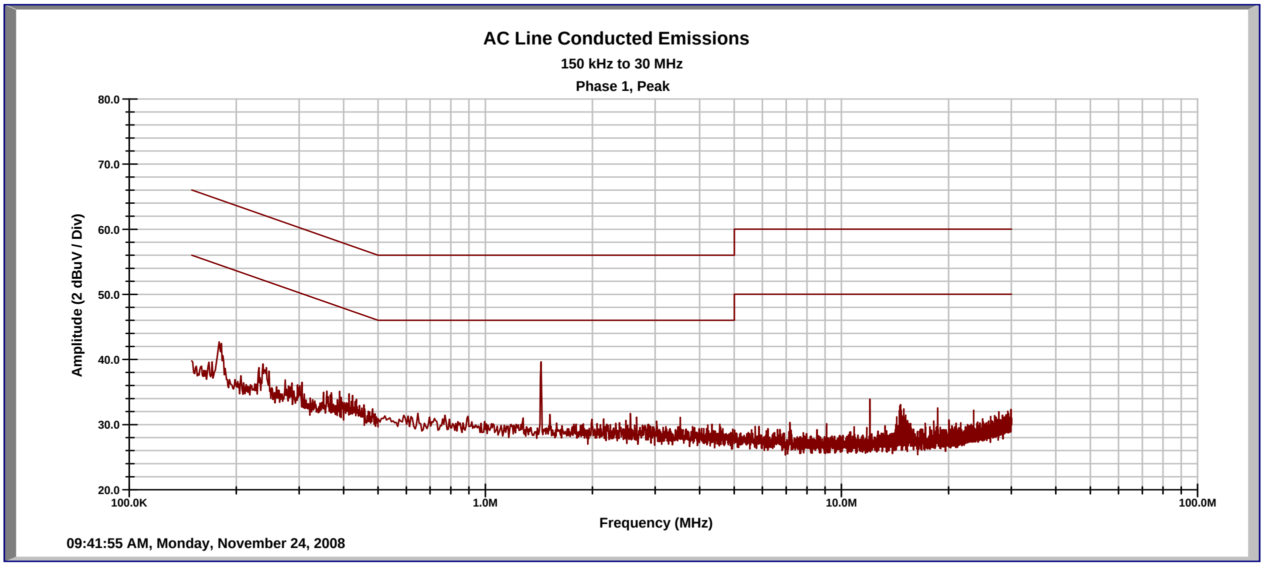
The data recorded in this section contains the final results under the worst-case conditions and with any modifications or special accessories implemented as the manufacturer intends.

SOP 2 Conducted Emissions

Tracking # 30863354.001 Page 1 of 2

EUT Name	2.4 GHz Communications Option Board	**Date**	24-Nov 2008
EUT Model	ZOB	**Temperature**	74° F
EUT Serial	0003	**Humidity**	27% rH
Standard	FCC 47 CFR Part 15B, ICES-003 Issue 4	**Line AC / Freq**	120VAC / 60 Hz
LISNs Used	18	**Performed by**	Michael Moranha

Configuration EUT installed in a typical application (REX2 power meter), in Receive Mode



Emission Freq (MHz)	Line ID (1,2,3,N)	FIM Quasi (dBuV)	FIM Ave (dBuV)	Cable Loss (dB)	LISN + T Limiter (dB)	Quasi Limit (dBuV)	Ave Limit (dBuV)	Quasi Spec Margin (dB)	Ave Spec Margin (dB)
0.18	1	29.87	23.75	0.00	9.99	64.44	54.44	-24.58	-20.70
0.24	1	27.44	22.86	0.12	9.99	62.03	52.03	-24.47	-19.05
12.00	1	19.18	11.43	0.13	10.80	60.00	50.00	-29.89	-27.64

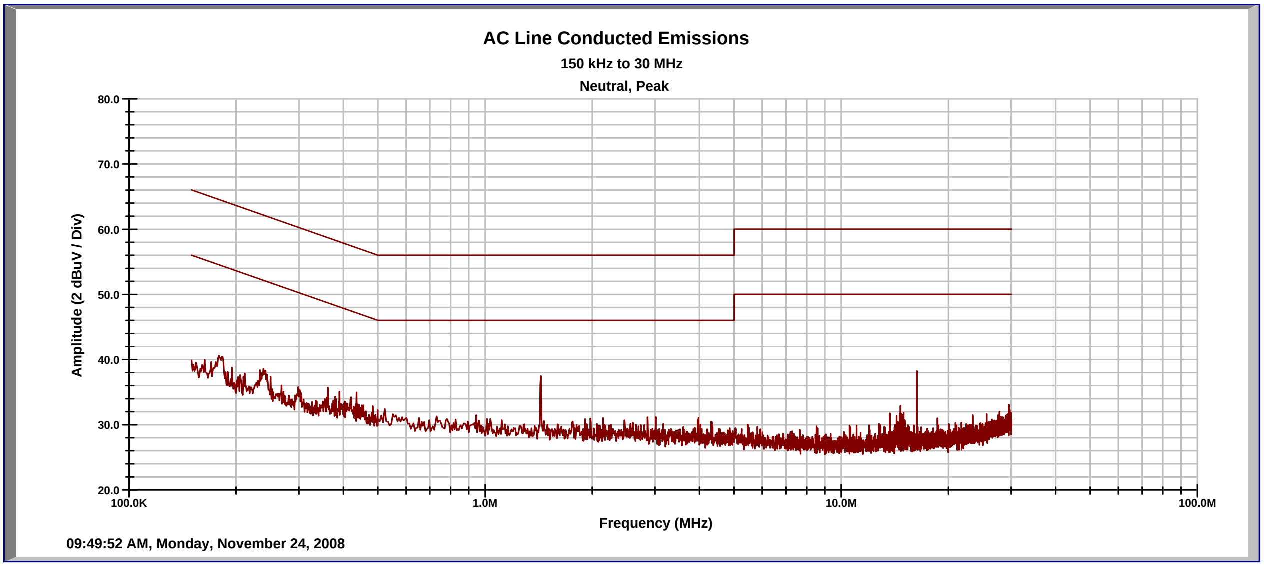
Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y) = \pm 1.2$dB Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence

Notes: 1.433 Mhz is ambient emission.

SOP 2 Conducted Emissions — Tracking # 30863354.001 Page 2 of 2

EUT Name	2.4 GHz Communications Option Board	**Date**	24-Nov 2008
EUT Model	ZOB	**Temperature**	74° F /
EUT Serial	0003	**Humidity**	27% rH
Standard	FCC 47 CFR Part 15B, ICES-003 Issue 4	**Line AC /Freq**	120VAC / 60 Hz
LISNs Used	17	**Performed by**	Michael Moranha
Configuration	EUT installed in a typical application (REX2 power meter), in Receive Mode		



Emission Freq (MHz)	Line ID (1,2,3,N)	FIM Quasi (dBuV)	FIM Ave (dBuV)	Cable Loss (dB)	LISN + T Limiter (dB)	Quasi Limit (dBuV)	Ave Limit (dBuV)	Quasi Spec Margin (dB)	Ave Spec Margin (dB)
0.18	N	27.90	23.50	0.00	9.99	64.44	54.44	-26.55	-20.95
14.65	N	20.50	15.10	0.20	10.34	60.00	50.00	-28.96	-24.36
16.28	N	18.99	12.04	0.19	10.35	60.00	50.00	-30.46	-27.41

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y) = \pm 1.2$dB   Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence

Notes: 1.433 Mhz is ambient emission.

5.1.3 Sample Calculation

The signal strength is calculated by adding the LISN Correction Factor and Cable Loss to the measured reading. The basic equation is as follows:

$$\text{Field Strength } (dB\mu V/m) = FIM + CBL + LCF$$

Where: FIM = Field Intensity Meter (dBμV)
CBL = Cable Loss (dB)
LCF = LISN Loss (dB)

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

5.2 Radiated Emissions, FCC part 15.109, ICES-003

Testing was performed in accordance with 47 CFR 15B, ICES-003. 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.

5.2.1 Test Methodology

5.2.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 300 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

5.2.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

5.2.1.3 Deviations

There were no deviations from this test methodology.

5.2.2 Test Results

Section 6 contains preliminary test data as well as any engineering data used to determine any modifications or special accessories. Section 5.2.2.1 lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

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

5.2.2.1 Final Data

The data recorded in this section contains the final results under the worst-case conditions and with any modifications or special accessories implemented as the manufacturer intends.

5.2.3 Sample Calculation

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) = FIM - AMP + CBL + ACF

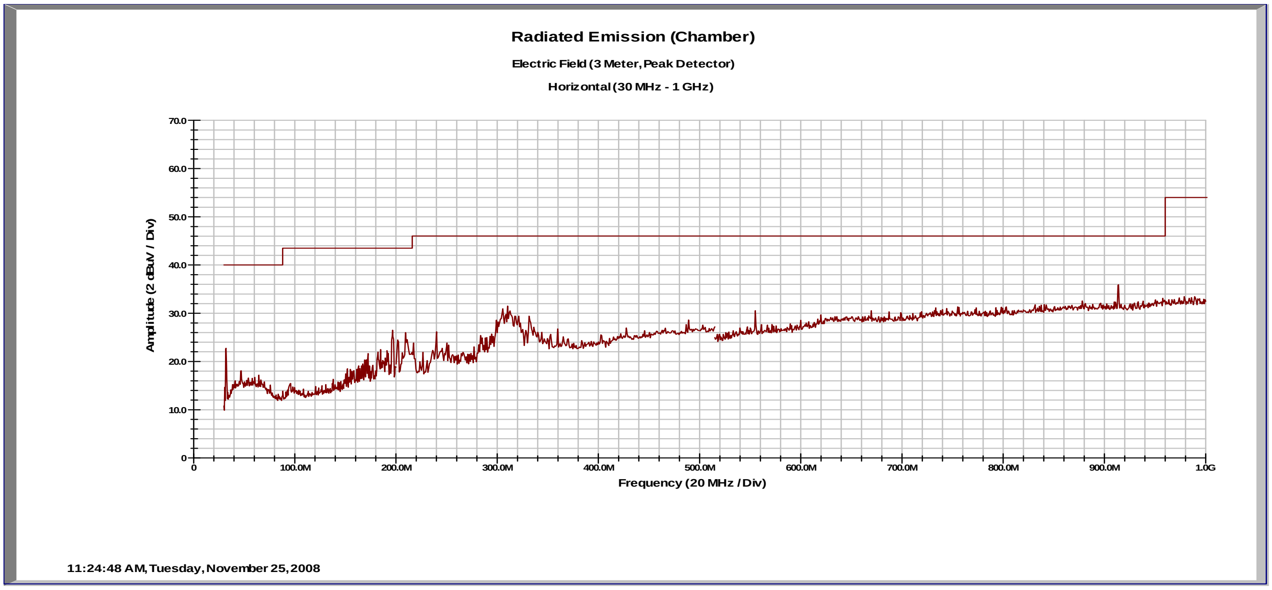
Where: FIM = Field Intensity Meter (dBμV)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

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

SOP 1 Radiated Emissions

Tracking # 30863354.001 Page 1 of 2

EUT Name	2.4 GHz Communications Option Board	**Date**	25-Nov-2008
EUT Model	ZOB	**Temp / Hum in**	74° F / 27% rH
EUT Serial	0003	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15B, ICES-003 Issue 4	**Line AC / Freq.**	120V / 60 Hz
Deg/sweep	12	**RBW / VBW**	
Dist/Ant Used	3m / 6140	**Performed by**	Michael Moranha
Configuration	EUT installed in a typical application (REX2 power meter), in Receive Mode		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
210.23	H	1.00	8	9.81	0.00	1.60	10.60	22.01	43.50	-21.49
302.57	H	1.00	3	13.66	0.00	1.93	13.00	28.59	46.00	-17.41
907.73	H	1.00	0	7.64	0.00	3.38	22.55	33.58	46.00	-12.42

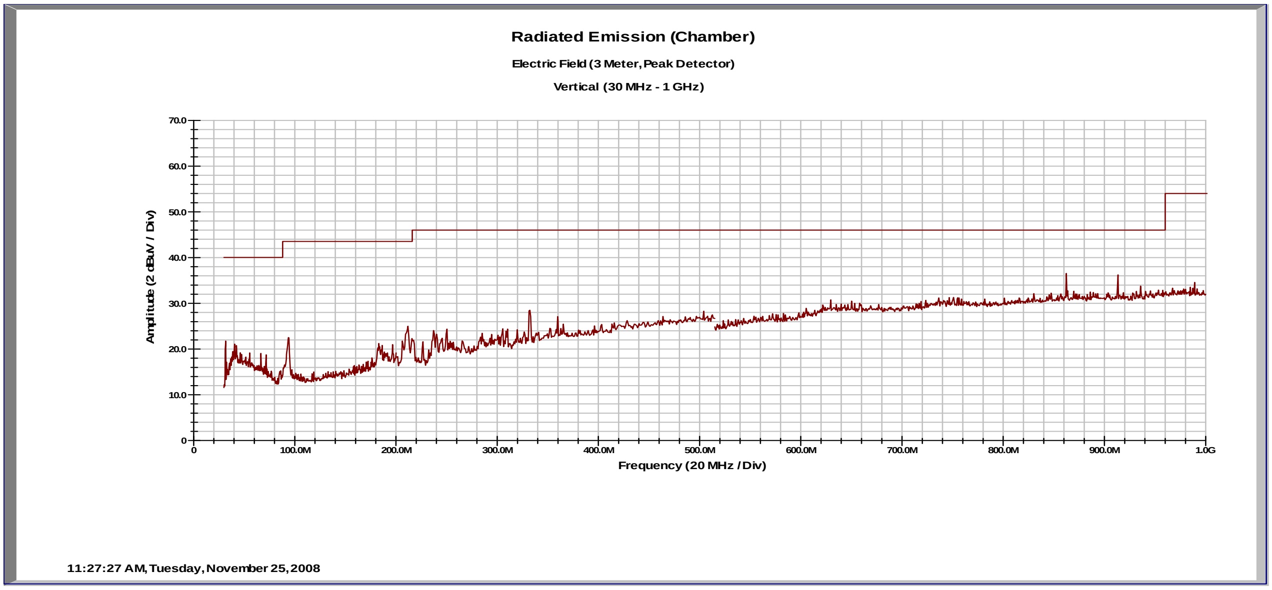
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

SOP 1 Radiated Emissions — Tracking # 30863354.001 Page 2 of 2

EUT Name	2.4 GHz Communications Option Board	**Date**	25-Nov-2008
EUT Model	ZOB	**Temp / Hum in**	74° F / 27% rH
EUT Serial	0003	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15B, ICES-003 Issue 4	**Line AC / Freq.**	240V / 60 Hz
Deg/sweep	12	**RBW / VBW**	
Dist/Ant Used	3m / 6140	**Performed by**	Michael Moranha
Configuration	EUT installed in a typical application (REX2 power meter), in Receive Mode		



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
69.52	V	1.00	0	10.55	0.00	0.92	7.24	18.72	40.00	-21.28
862.40	V	1.00	10	8.89	0.00	3.33	21.80	34.02	46.00	-11.98
912.20	V	1.00	5	9.72	0.00	3.40	22.30	35.42	46.00	-10.58

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

6 Test Equipment Use List

6.1 Test Equipment use list

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
SOP 1 – Radiated and Antenna Port Conducted Emissions (5 Meter Chamber)					
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	30-Jan-08	30-Jan-09
Antenna Horn 1-18GHz	EMCO	3115	5770	16-Jun-08	16-Jun-10
Antenna Horn 18-26GHz	Advanced Receiver Research	MA86552	8426	7-Jan-08	7-Jan-10
Ant. BiconiLog	Chase	CBL6140A	1108	13-Jun-08	13-Jun-10
Receiver, EMI [1]	Rohde & Schwarz	ESIB40	100043	9-Jun-08	9-Jun-09
Cable, Coax	Andrew	FSJ1-50A	003	25-Jan-08	25-Jan-09
Cable, Coax	Andrew	FSJ1-50A	030	30-Jan-08	30-Jan-09
Cable, Coax	Andrew	FSJ1-50A	045	30-Jan-08	30-Jan-09
SOP 2 - Conducted Emissions (AC/DC)					
LISN 15-18 (NSLK 8126)	Schwarzbeck Mess-Electronik	NSLK 8126	003885	11-Jan-08	11-Jan-09
Spectrum Analyzer	Agilent Tec.	E7405A	US39440161	7-Aug-08	7-Aug-09
Cable, Coax	Belden	RG-213	004	25-Jan-08	25-Jan-09

- Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly.

1) This equipment was also used for antenna port conducted measurements.

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