Electromagnetic Compatibility Test Report

Prepared in accordance with

CFR Title 47, Part 15 C

On

Mobile Telemetry (MT) System

WCEM SENSOR

FCC ID: YCVBRSA01

BIOMEDICAL SYSTEMS
77 Progress Parkway, Bldg One
Maryland Heights, MO 63043

Prepared by:

TUV Rheinland of North America, Inc.

Client:	BIOMEDICAL SYSTEMS 77 Progress Parkway, Bldg One Maryland Heights, MO 63043	Eric Baumann 858-780-2746 / 858-366-4993 eric@ebauma.net	
Identification:	Mobile Telemetry (MT) System	***Serial No.:***	Production Prototype
Test item:	WCEM SENSOR	***Date tested:***	05 November 2009
Testing location:	TUV Rheinland of North America 762 Park Avenue Youngsville, NC 27596-9470 U.S.A.	Tel: (919) 554-3668 Fax: (919) 554-3542	
Test specification:	Emissions: FCC Part 15.109(a) FCC Parts: 15.205, 15.209, 15.279(a), 15.249(c), 15.249(d) and 15.249(f)		
Test Result	**The above product was found to be Compliant to the above test standard(s)**		

tested by: Mark Ryan	***reviewed by:*** Michael Moranha
22 April 2010 ***Date*** ***Signature***	Michael Moranha 2010.04.22 13:09:36 -04'00' 22 April 2010 ***Date*** ***Signature***
Other Aspects:	**None**

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

FC	NVLAP	**Industry Canada**
90552 and 100881	**NVLAP Lab Code (200094-0)**	**IC-2932H**

TABLE OF CONTENTS

1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR Title 47, Part 15 C based on the results of testing performed on 05 November 2009 on the Mobile Telemetry (MT) System, Model No. WCEM SENSOR, manufactured by BIOMEDICAL SYSTEMS. 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.

1.3 *Summary of Test Results*

Applicant	**BIOMEDICAL SYSTEMS** **77 Progress Parkway, Bldg One** **Maryland Heights, MO 63043**	**Tel**	858-780-2746	**Contact**	Eric Baumann
		Fax	858-366-4993	**e-mail**	eric@ebauma.net

Description	Mobile Telemetry (MT) System	**Model Number**	WCEM SENSOR
Serial Number	Production Prototype	**Test Voltage/Freq.**	1.5 VDC Battery
Test Date Completed:	05 November 2009	**Test Engineer**	Mark Ryan

Standards	Description	Severity Level or Limit	Worst Case Measurement	Test Result
CFR Title 47, Part 15 Subpart C	Radio Frequeny Devices - Intentional Radiators	See called out basic standards below	See Below	**Complies**
FCC Part 15.207(c)	Conducted Emissions	N/A - Apparatus is battery operated	N/A	**compliant** (without testing)
FCC Parts 15.249(a), and 15.249(c)	Peak Output Power	50 mV/m (94 dBµV/m)	41.8 mV/m (92.42 dBµV/m) @ 3 meters (Av)	**compliant**
FCC Parts 15.249(c), 15.249(d) and 15.249(e)	Spurious Emissions	500µV /m (54 dBµV/m)	177.0 µV /m (44.96 dBµV /m) @ 3 meters (Av)	**compliant**
FCC Part 15.109(a)	Radiated Emissions (when not transmitting)	Class B, 30 - 1000 MHz	-	**Complies**

2 Laboratory Information

2.1 Accreditations and Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at 762 Park Avenue, Youngsville, NC 27596-9470 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, and 18. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP

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 Standard 17025:2005 (Lab code: 200094-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Industry Canada

Registration No.: IC-2932H The OATS has been accepted by Industry Canada to perform testing to 3 and to 10m, based on the test procedures described in ANSI C63.4-2003.

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, R-1679, C-1790 and C-1791).

2.1.5 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 (dBuV/m)

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

2.2 Measurement Uncertainty Emissions

	U_{lab}	U_{cispr}
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	3.3 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.18 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.88 dB	4.5 dB

Measurement Uncertainty Immunity

The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 2.5 %
The estimated combined standard uncertainty for ESD immunity measurements is 4.10 %
The estimated combined standard uncertainty for radiated immunity measurements is ± 2.05 dB
The estimated combined standard uncertainty for EFT fast transient immunity measurements is ± 2.92 %
The estimated combined standard uncertainty for surge immunity measurements is ± 2.92 %
The estimated combined standard uncertainty for conducted immunity measurements is ± 1.83
The estimated combined standard uncertainty for power frequency magnetic field immunity measurements is ± 5.8 %
The estimated combined standard uncertainty for voltage variation and interruption measurements is ± 1.74 %

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.

2.3 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.

2.4 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Radiated Emissions (5 Meter Chamber)					
Ant. BiconiLog 30-1000 MHz	Chase	CBL6140A	1108	13-Jun-08	13-Jun-10
Antenna Horn 1-18GHz	EMCO	3115	5770	16-Jun-08	16-Jun-10
Antenna Horn 18 – 25GHz	ATM	42-442-6/CAL	G181104-01	29-Oct-08	29-Oct-10
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	23-Jan-09	23-Jan-10
Receiver, EMI	Rohde & Schwarz	ESIB40	100043	29-Jun-09	29-Jun-10
Spectrum Analyzer	Agilent Tec.	E7405A	US39440161	26-May-09	26-May-10
Cable, Coax	Andrew	FSJ1-50A	003	22-Jan-09	22-Jan-10
Cable, Coax	Andrew	FSJ1-50A	030	22-Jan-09	22-Jan-10
Cable, Coax	Andrew	FSJ1-50A	045	22-Jan-09	22-Jan-10
Notch Filter	Micro-Tronics	BRM50702	049	26-Jan-09	26-Jan-10
General Laboratory Equipment					
Meter, Multi	Fluke	179	90580752	02-Dec-08	02-Dec-09
Meter, Temp/Humid/Barom	Fisher	02-400	01	04-Mar-09	04-Mar-10

3 Product Information

3.1 Product Description

Refer to Manual.

3.2 Equipment Modifications

No modifications were needed to bring product into compliance.

4 Radiated RF Emissions

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.4:2009 and ANSI C63.10-2009. 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.

4.1 Peak Output Power FCC Part 15.249(a)

The EUT is not a fixed, point-to-point device therefore FCC part 15.249(b) is not applicable to this apparatus.

The EUT uses an internal chip antenna with no external antenna connector. The chip antenna is rated at 0dBi gain.

The field strength of emissions from intentional radiators operated within the frequency band of 2400 – 2483.5 MHz shall comply with the following limits:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
2400-2483.5 MHz	50	500

Note: 50 mV/m is equivalent to 94 dBµV/m [20* (log 50000µV/m)]

500 µV/m is equivalent to 54 dBµV/m [20* (log 500µV/m)]

Peak Power Output:

Low Channel: 2402.0 MHz = 92.42 dBµV/m = **41.8 mV/m** (Worst Case emission)

Mid Channel: 2440.8 MHz = 91.88 dBµV/m = 39.3 mV/m

High Channel: 2448.0 MHz = 91.56 dBµV/m = 37.8 mV/m

Notes: Measurements were made using the Average and Peak functions of a CISPR 16 compliant EMC Receiver.

Per FCC Part 15.249(c), all field strengths were measured at a distance of 3m.

The worst case was investigated by observing the emissions of the EUT in three orthogonal orientations. The worst case orientation was used for all the measurements (see test setup photos). The data from this investigation is on file at the TUV Rheinland.

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Type Detector Used	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2402.00	H	1.1	9	58.30	AV	5.82	28.30	92.42	94.00	-1.58
2404.00	H	1.1	9	61.37	PK	5.83	28.31	95.51	114.00	-18.49
2440.80	H	1.6	49	57.50	AV	6.00	28.38	91.88	94.00	-2.12
2440.80	H	1.6	49	61.51	PK	6.00	28.38	95.89	114.00	-18.11
2448.00	H	1.3	218	57.13	AV	6.04	28.40	91.56	94.00	-2.44
2448.00	H	1.3	218	60.28	PK	6.04	28.40	94.71	114.00	-19.21

Notes: Measurement in Red is the Lowest frequency used and is the worst case emission.
Measurement in Blue is the Mid frequency
Measurement in Green is Highest frequency used

Per FCC Part 15.35(b), the average and peak detectors are used.
The limit, using the peak detector, is 20 dB above the average limit.

EMC Receiver settings used:

RBW = 1 MHz

4.2 Emissions Outside the band - FCC Parts 15.249(a), 15.249(d) and 15.249(e)

4.2.1 Test Methodology

4.2.1.1 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 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.

4.2.1.2 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.

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.

4.2.1.3 Deviations

There were no deviations from this test methodology.

4.2.2 Test Results

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

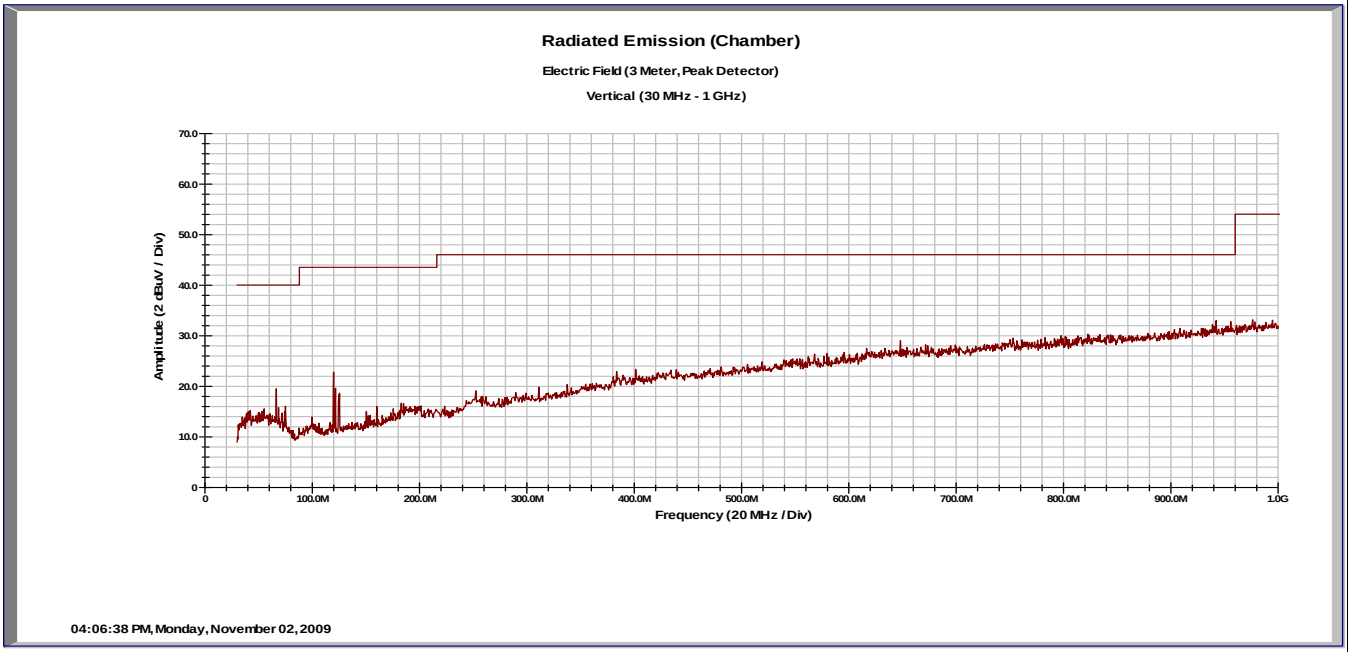
4.2.2.1 Emissions Outside the Frequency Band

Per FCC part 15.249(d): Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Sec. 15.209, whichever is the lesser attenuation.

Per FCC part 15.249(e): As shown in Sec. 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section is based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Note: only the worst-case emissions are shown in this report, all others are on file at TUV Rheinland.

30 MHz - 1 GHz Radiated Emissions – at Low frequency
Vertical

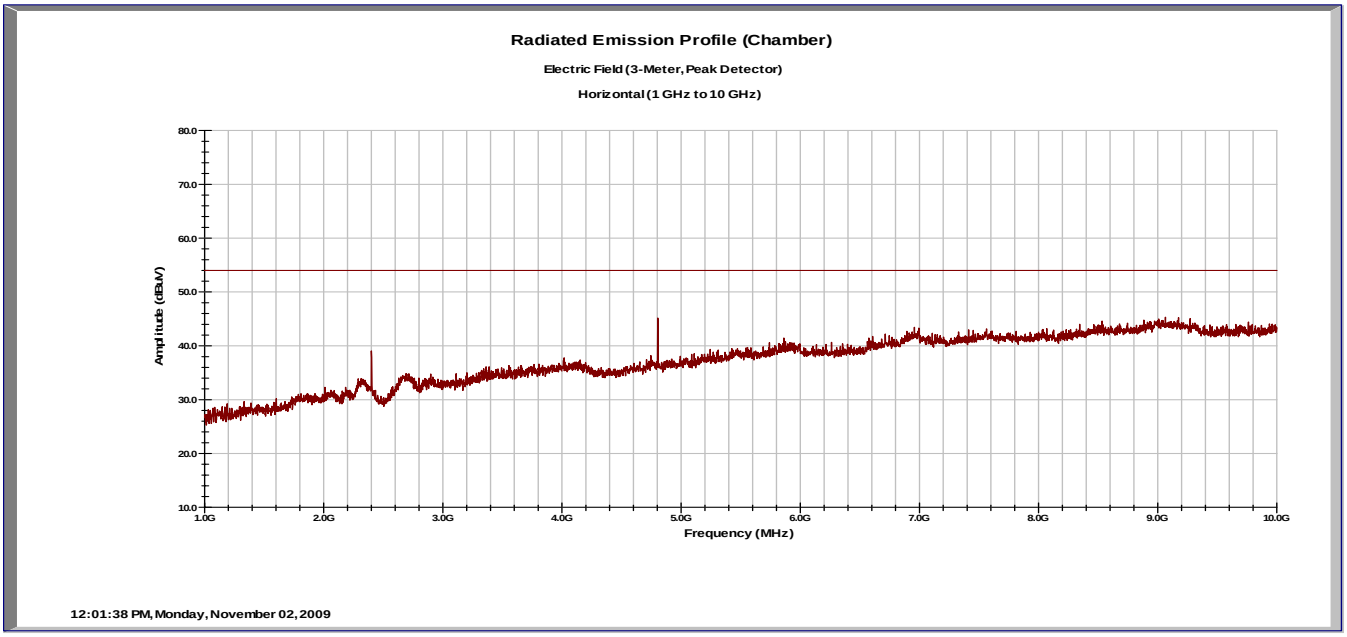


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Notes: All peak signals are more than 20 dB below the limit or below the noise floor of the receiver

1-10GHz Radiated Emissions – at Low frequency

Horizontal



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)
4804.00	H	1	207	33.36	35.53	11.07	32.81	41.71	54.00	-12.29
4804.00	H	1	207	41.11	35.53	11.07	32.81	49.46	74.00	-24.54

Notes: The emission shown in **Green** is using the average detector
The emission shown in **Blue** is using the peak detector. Respective limits are shown.

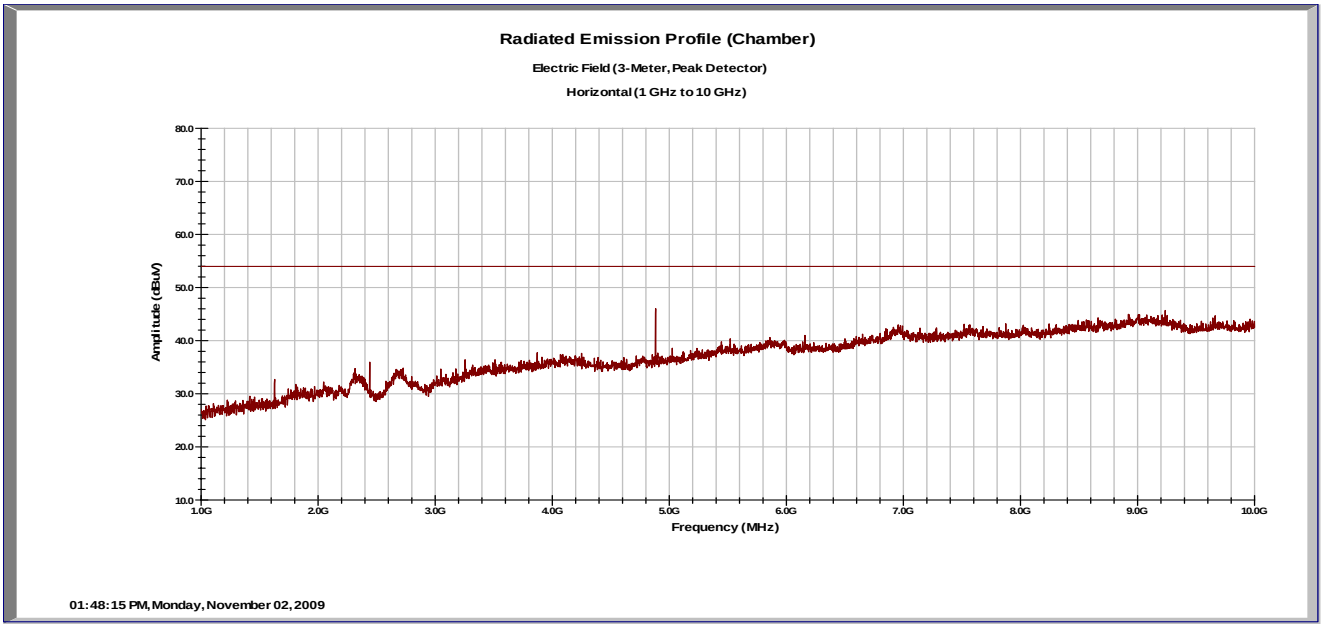
A notch filter was used at the fundamental frequency.

All peak emissions, including the harmonics, are well below the restricted band (Parts 15.205 and 15.209) limits.

All other signals are below the noise floor of the receiver

1-10GHz Radiated Emissions – at Mid frequency

Horizontal



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)
4880.00	H	1	205	34.15	35.49	11.11	32.96	42.73	54.00	-11.27
4882.00	H	1	205	42.91	35.49	11.11	32.96	51.50	74.00	-22.50

Notes: The emission shown in **Green** is using the average detector
The emission shown in **Blue** is using the peak detector. Respective limits are shown.

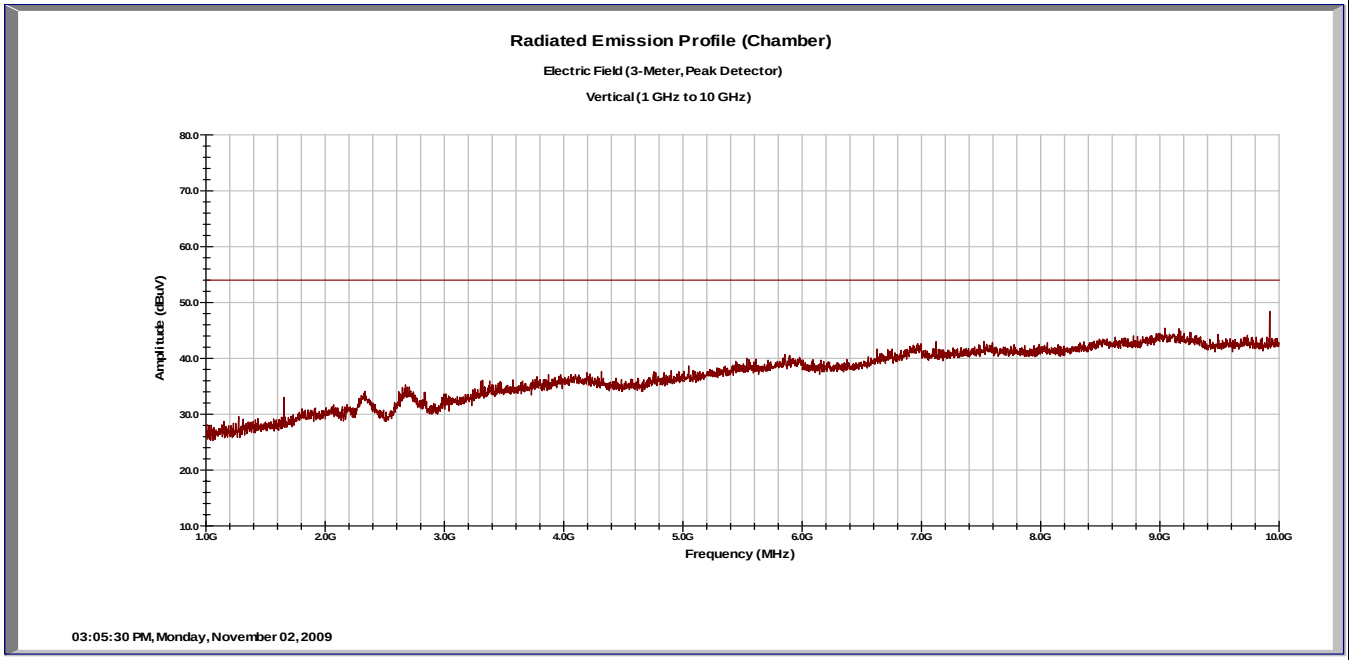
A notch filter was used at the fundamental frequency.

All peak emissions, including the harmonics, are well below the restricted band (Parts 15.205 and 15.209) limits.

All other signals are below the noise floor of the receiver

1-10GHz Radiated Emissions – at High frequency

Vertical



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)
1653.60	V	1	12	30.41	35.83	6.02	25.88	26.47	54.00	-27.53
1653.60	V	1	12	42.18	35.83	6.02	25.88	38.24	74.00	-35.76
9919.60	V	1	32	26.07	36.09	16.51	38.48	44.96	54.00	-9.04
9919.60	V	1	32	37.30	36.09	16.51	38.48	56.19	74.00	-17.81

Notes: The emission shown in **Green** is using the average detector
The emission shown in **Blue** is using the peak detector. Respective limits are shown.

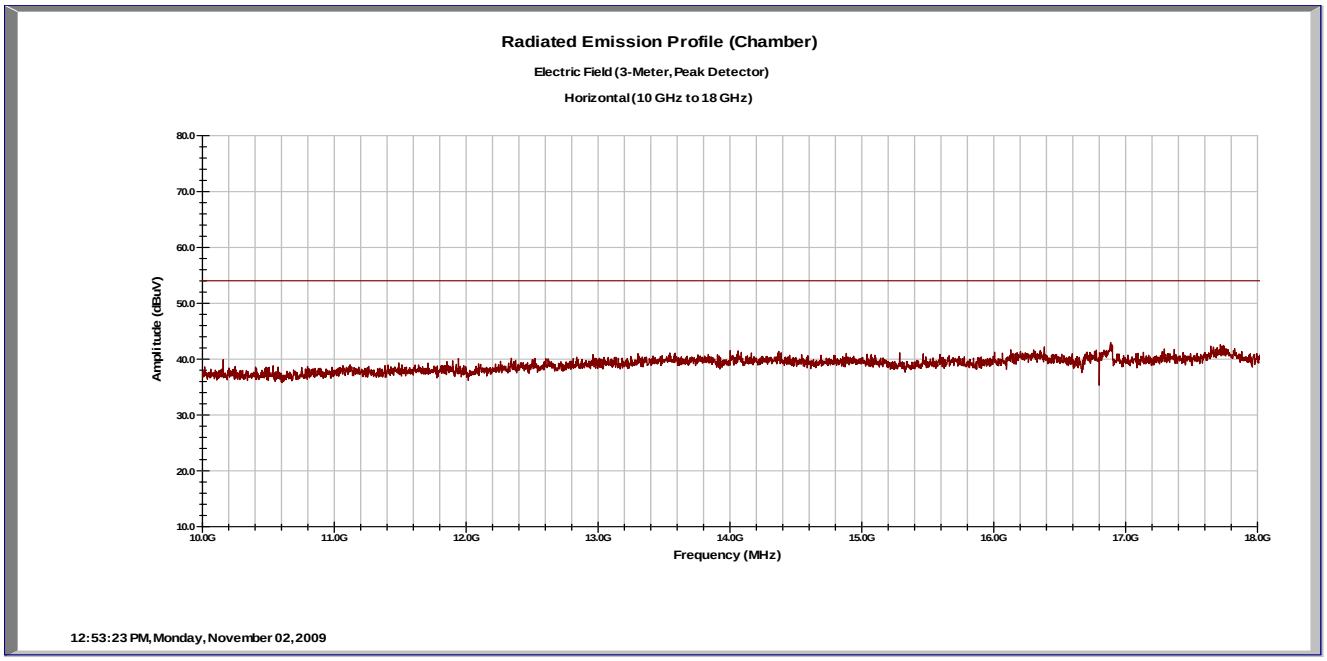
A notch filter was used at the fundamental frequency.

All peak emissions, including the harmonics, are well below the restricted band (Parts 15.205 and 15.209) limits.

All other signals are below the noise floor of the receiver

10 -18 GHz Radiated Emissions – at Low frequency

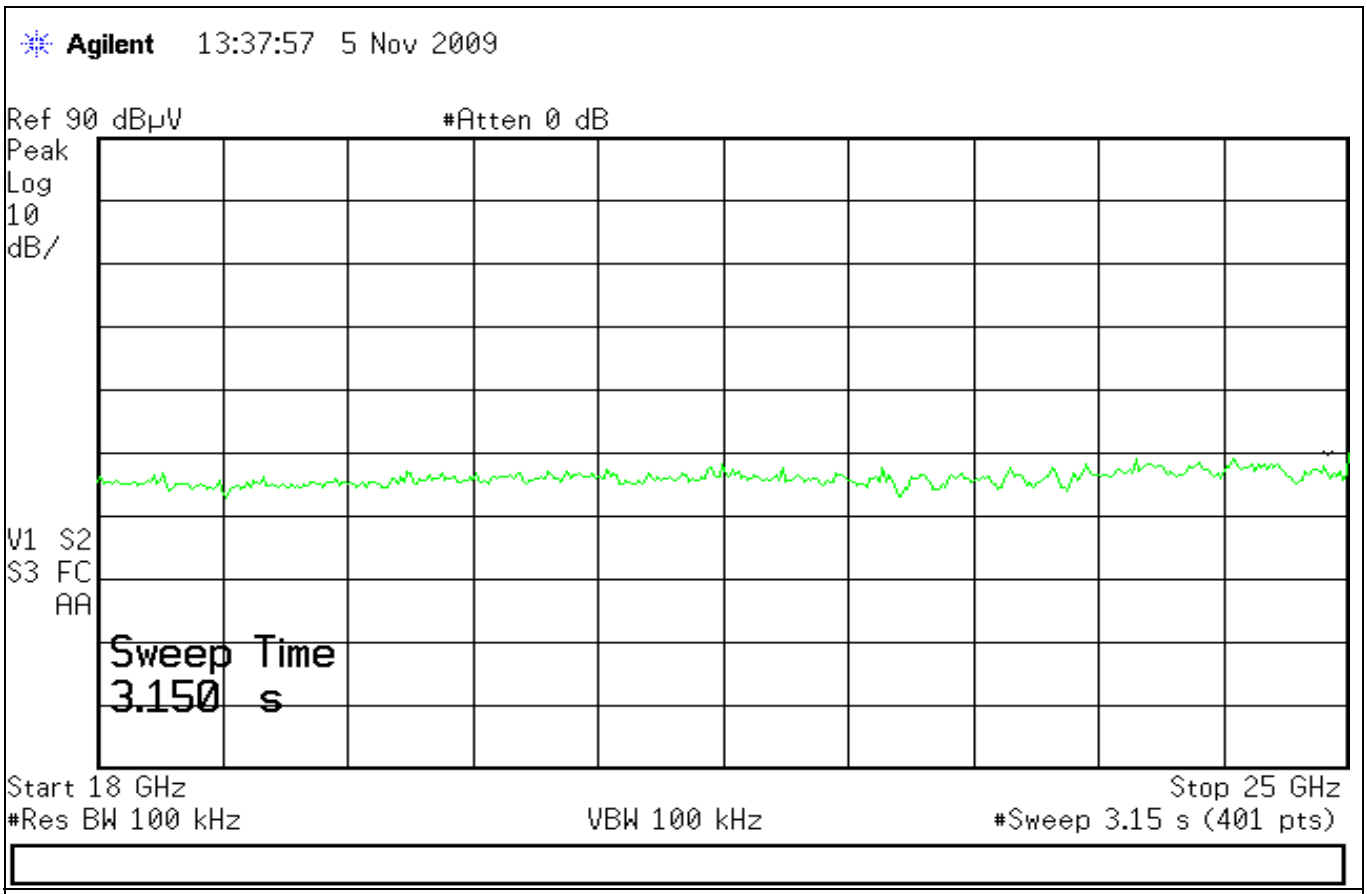
Horizontal



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)

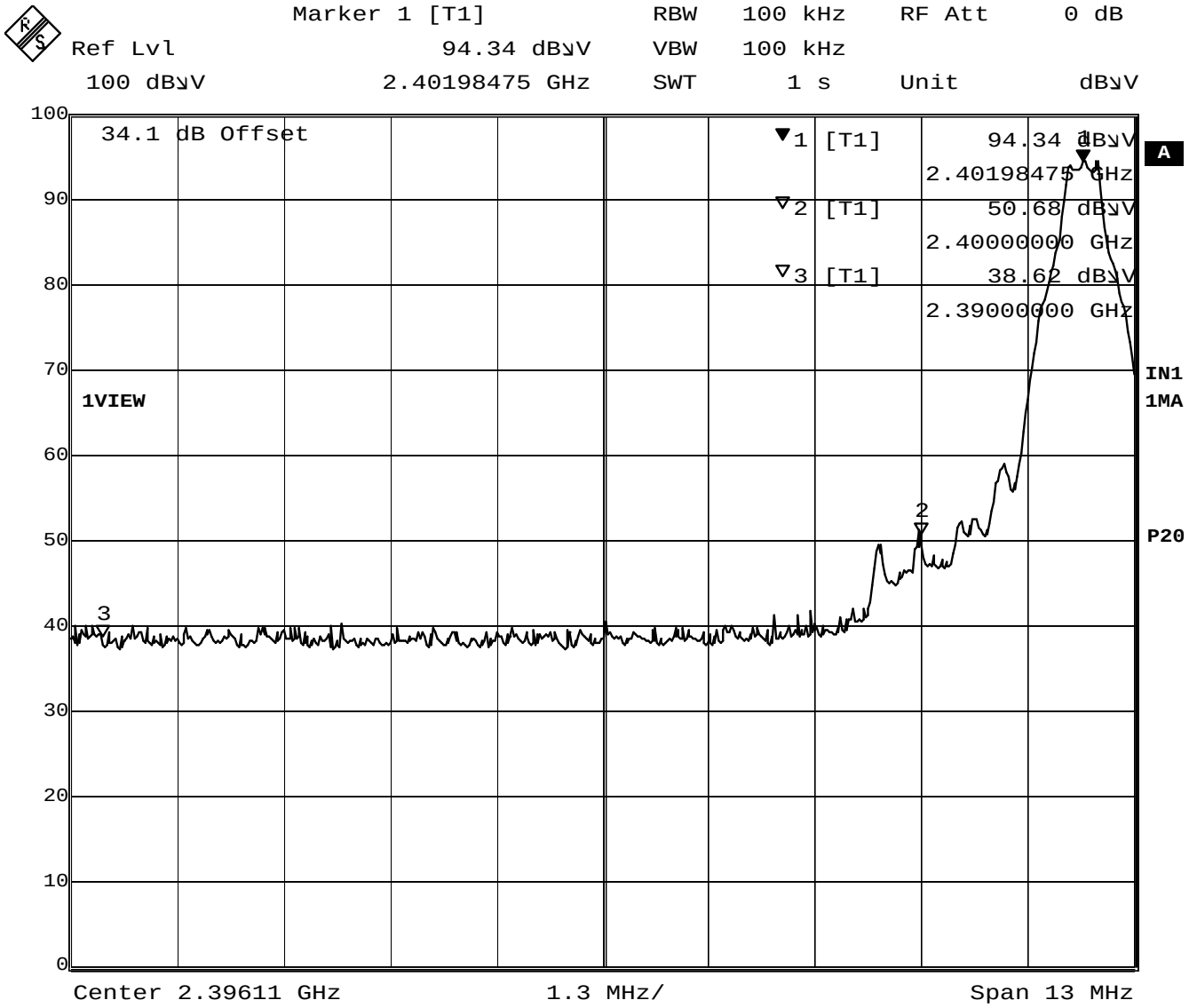
Notes: All signals are below the noise floor of the receiver

10 -18 GHz Radiated Emissions – at Low frequency
Horizontal



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)

Notes: No correction factors were used in this sweep. No signals were detected.



Date: 2.NOV.2009 11:38:26

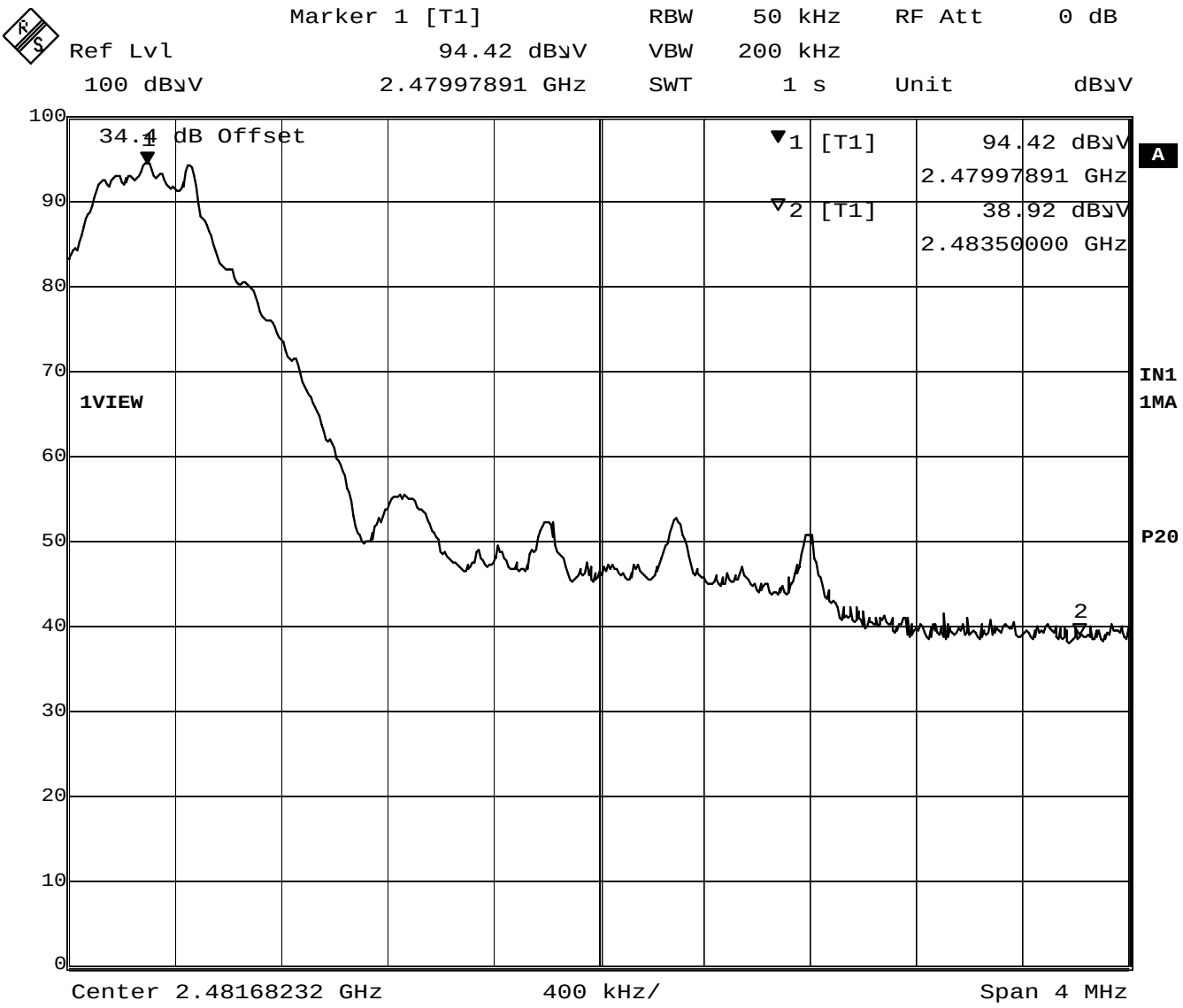
Note: Measurements made using the procedures of ANSI C63.10-2009

All measurements are using the peak detector and correction factors have been applied.

Marker 1: is the peak reading of the lowest Channel used.

Marker 2: at the band edge (2400 MHz)
The peak signal is 3.32 dB below the average limits of part 15.209

Marker 3: at the restricted band edge (2390 MHz)
The peak signal is 15.38 dB below the average limits of part 15.209



Date: 2.NOV.2009 10:54:05

Note: Measurements made using the procedures of ANSI C63.10-2009

All measurements are using the peak detector and correction factors have been applied.

Marker 1: is the peak reading of the highest Channel used.

Marker 2: at the band edge. This is also the start of a restricted band at 2483.5 MHz.
The peak signal is 15.08 dB below the average limits of part 15.209.

4.1 Radiated Emissions – FCC Part 15.109(a)

This test measures the electromagnetic levels of spurious signals generated by the EUT that radiated from the EUT when it is not transmitting and may affect the performance of other nearby electronic equipment.

4.1.1 Over View of Test

Results	**Complies** (as tested per this report)					**Date**	2 November 2009
Standard	FCC Part 15.109(a)						
Product Model	Model (Name\Number)			**Serial#**	S/N		
Configuration	See test plan for details						
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table. See test plans for details						
EUT Powered By	Battery Operated	**Temp**	74ºF	**Humidity**	49%	**Pressure**	1010 mbar
Frequency Range	30 - 1000 MHz @ 3m						
Perf. Criteria	Class B. (Below Limit)			**Perf. Verification**	Readings Under Limit		
Mod. to EUT	None			**Test Performed By**	Mark Ryan		

4.1.2 Test Procedure

Radiated and FCC emissions tests were performed using the procedures of ANSI C63.4 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The EUT's highest frequency clock (not including the intentional radiator) is less then 108MHz, therefore the frequency range from 30 - 1000 MHz was investigated for radiated emissions.

Radiated emission testing was performed at a distance of 3 meters in a 5 meter semi-anechoic chamber.

4.1.3 Deviations

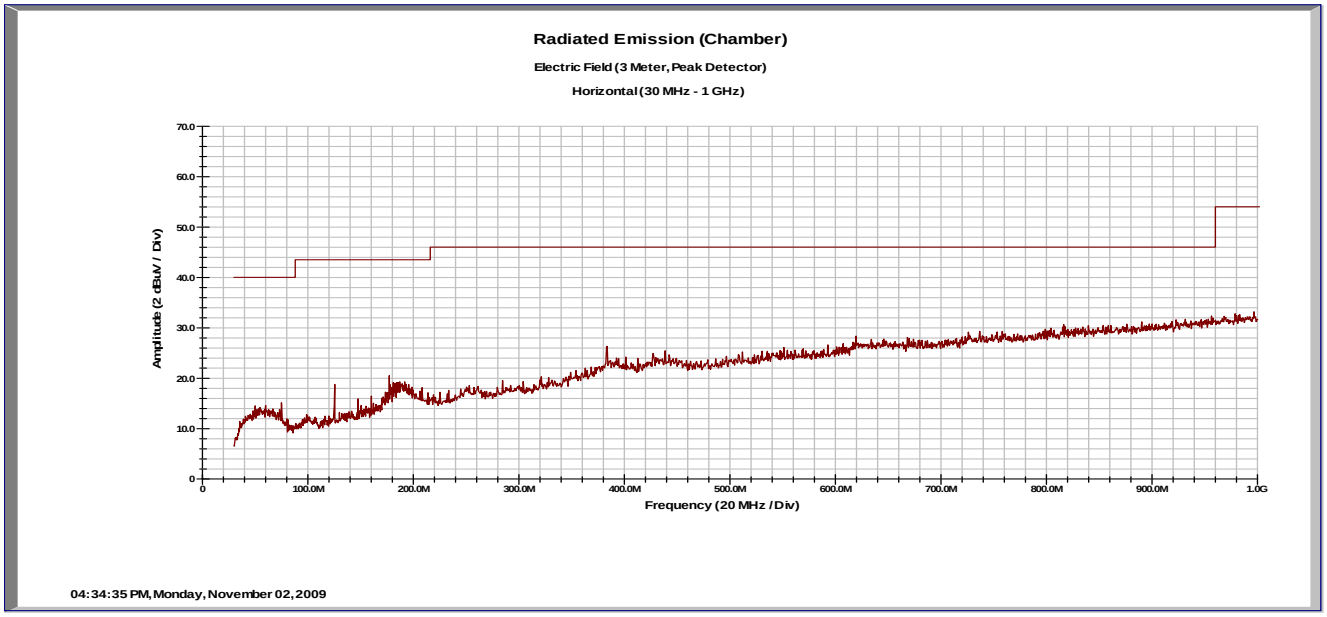
There were no deviations from the test methodology listed in the test plan for the radiated emission test.

4.1.4 Final Test

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

4.1.5 Final Graphs and Tabulated Data

Radiated Emissions
Horizontal

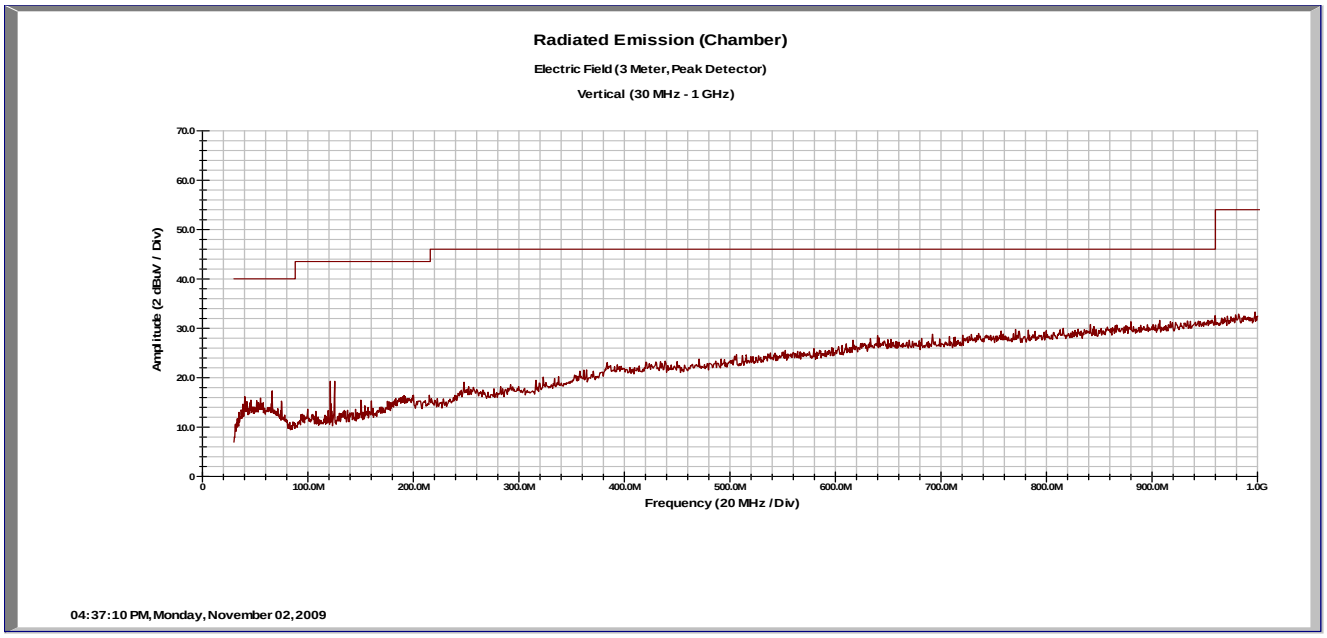


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Notes: All peak emissions are more than 20dB below the QP limits of Part 15.109(a).

Radiated Emissions

Vertical



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)

Notes: All peak emissions are more than 20dB below the QP limits of Part 15.109(a).

5 Conducted Emissions FCC Parts 15.107(d) and 15.207(c)

The EUT is battery operated. Therefore, in accordance with FCC Part 15.207(c) and FCC Part 15.107(d), testing is not required.

6 SAR Evaluation

Section 2) a) of FCC publication 447498 D01 Mobile Portable RF Exposure v04 ; SAR testing is not required if the power output of the mobile/portable device is less than $60/f_{(GHz)}$ mW.

Power at which SAR testing is required = $60/2.4_{(GHz)}$ = 25 mW.

The EiRP of the EUT is far below this limit. The EUT has a max power of 42 mV/m at 3m. which is equivalent to 0.035 mV/m at 3m

SAR testing is not required for this apparatus.