LS Research, LLC
Cert. # 1255.01
W66 N220 Commerce Court ● Cedarburg, WI 53012 ● USA
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www.lsr.com

COMPLIANCE TESTING OF:
USB Transmitter Key

PREPARED FOR:
Mortara Instrument
Attn: Brian Sueppel
7865 North 86th Street
Milwaukee, WI 53224

TEST REPORT NUMBER:
309054
LSR Job #: C-542

TEST DATE(S):
February 20-26; April 27, & May 18, 2009

Table of Contents

1. LS Research, LLC In Review

LS Research, LLC - Accreditations and Listing's

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025 : 2005
with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01

Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948
FCC Registration Number: 90756

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1
File Number: IC 3088-A

On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1
File Number: IC 3088

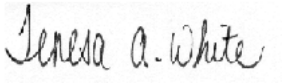
U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2)
Date of Validation: January 16, 2001

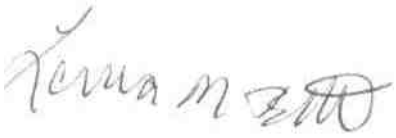
Validated by the European Commission as a U.S. Notified Body operating under the U.S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.

Date of Validation: November 20, 2002
Notified Body Identification Number: 1243

2. Signature Page

Reviewed By:  May 6, 2009

Teresa A. White, Quality Manager Date



Tested By: May 6, 2009

Laura Bott, EMC Engineer Date

Approved By: **May 6, 2009**

Ryan Urness, EMC Lab Manager **Date**

3. Product and General Information

Manufacturer:	Mortara Instrument					
Date(s) of Test:	February 20-26, April 27, & May 18, 2009					
Test Engineer(s):	√	Laura Bott		Ryan Urness		Ken Boston
Model #:	UTK					
Serial #:	Engineering Proto #25					
Voltage:	5 VDC					
Operation Mode:	Normal, continuous transmit					

4. Introduction

On February 20-26, and April 27, 2009 a series of Radiated and Conducted Emission tests were performed on one sample of the USB Transmitter Key, Model Number UTK, Serial Number Engineering Proto #25, here forth referred to as the "*Equipment Under Test*" or "*EUT*". These tests were performed using the procedures outlined in ANSI C63.4-2003 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.249 (Industry Canada RSS-210, Issue 7, 2007) for a low power transmitter. These tests were performed by Laura Bott, EMC Engineer of LS Research, LLC.

All Radiated and Conducted Emission tests were performed upon the EUT to measure the emissions in the frequency bands described in FCC Title 47 CFR Part 15, including 15.35, 15.209, 15.249 and Industry Canada RSS-210, Issue 7, 2007 to determine whether these emissions are below the limits expressed within the standards. These tests were performed in accordance with the procedures described in the American National Standard for methods of measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003). Another document used as a reference for the EMI Receiver specification was the Comite International Special Des Perturbations Radioelelectriques (CISPR) Number 16-1, 2003.

5. Product Description

The Mortara USB Transceiver Key (UTK) is a compact radio transceiver designed to be interoperable with the Mortara Wireless Acquisition Module. The UTK is compatible with the USB ports of PC's and Mortara ECG devices and enables these devices to receive, display, and store ECG data from patients with a wireless connection.

The UTK contains an integrated radio and microprocessor. The microprocessor directs the radio and formats the received ECG data into USB packets communicated to the host. The UTK is the master of the RF protocol by selecting the optimum operating frequency and initiating each frame with a beacon.

The UTK transceiver operates in the 2.4 GHz ISM band and is designed to meet FCC rules Part 15.249. The modulation of the carrier is done with simple Minimum Shift Keying (MSK). Antennas are integrated internally and are not removable or replaceable. The UTK has a single printed circuit board with shield.

The UTK is powered via a USB port on the host and has no other external connectors. The overall dimensions of the UTK are 6x3x1 cm.

6. EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

Frequency Range (in MHz)	2403.38-2479.45 MHz
RF Power in Watts	0.000631 W Note 1
Conducted Output Power (in dBm)	-2 dBm Note 2
EIRP (in mW)	0.2443 mW
Field Strength (and at what distance)	89.11 dBµV/m @ 3 meters (2403 MHz)
Occupied Bandwidth (99% BW)	1383 kHz (CH 16: 2441 MHz)
Type of Modulation	MSK
Emission Designator	1M38F1D
Transmitter Spurious (worst case)	55.14 dBµV/m @1m (4806.76 MHz) 45.64 dBµV/m @3m
Receiver Spurious (worst case)	59.51 dBµV/m at 1 meter (1793 MHz) 50.01 dBµV/m at 3 meter
Receiver Bandwidth	800 kHz
Receiver Sensitivity	-82 dBm
Microprocessor Model # (if applicable)	TI CC2511
EUT will be operated under FCC Rule Part(s)	CFR 47 §15.249 and IC: RSS-GEN 2007 and RSS-210, Issue 7, 2007
Antenna Information:	
a) Antenna Type	PCB inverted F
b) Detachable/Non-Detachable	Non-Detachable
c) Antenna Gain (in dBi)	-4.12 dBi
Modular Filing	☐ Yes ☒ No
Portable/Mobile	☒ Portable ☐ Mobile

Notes
1. The RF power was calculated using the formula: Power (mW) = 10^power(dBm)/10
2. The Conducted Output power was supplied by Mortara Instrument, Inc.

RF Technical Information:

Type of Evaluation (check one)		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	√	RF Evaluation

If RF Evaluation checked above, test engineer to complete the following:

- Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
- Duty Cycle used in evaluation: 100 %
- Standard used for evaluation: OET 65
- Measurement Distance: 3 m
- RF Value: 0.0285 ☒ V/m ☐ A/m ☐ W/m^2
  ☒ Measured ☐ Computed ☐ Calculated

7. Test Requirements

The above mentioned tests were performed in order to determine the compliance of the Wireless Patient Cable with limits contained in various provisions of Title 47 CFR, FCC Part 15, including:

15.31	15.205
15.33	15.207
15.35	15.209
15.37	15.249

8. Summary of Test Report

DECLARATION OF CONFORMITY

The Wireless Patient Cable was found to meet the requirements as described within the specification of Title 47 CFR FCC, Part 15.249, Subpart (a); and Industry Canada RSS-210, Issue 7, 2007 Section 6.2 for a *'Non-Momentarily Operated Transmitting Device'*.

The enclosed test results pertain to the sample(s) of the test item listed, and only for the tests performed on the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.

9. Radiated Emissions Test

Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15 and ANSI C63.4-2003.

Measurements at frequencies 30 MHz – 4 GHz where taken when the EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. Because the radiated emissions limits for unintentional radiators, denoted in FCC §15.109 and 15.249 apply at a 3 meter distance, the measurement antenna was placed 3 meters from the EUT radiating element.

Measurements above 4 GHz were performed at a 1.0 meter separation distance in a semi-anechoic mini chamber. The calculations to determine the limits at the 1.0 meter separation distance are detailed in the following pages.

The EUT was tested in continuous modulated transmit mode. Power was supplied to the EUT by the USB port on the host computer. The unit has the capability to operate on 16 channels, controllable via firmware loaded on the host computer.

The test sample was operated on one of three (3) standard channels: low (2403 MHz), middle (2441 MHz) and high (2479 MHz) to comply with FCC § 15.31(m).

Please refer to Appendix A for a complete list of test equipment.

Test Procedure

Radiated Emissions measurements were taken from 30-25000 MHz. Measurements from 30 - 4000 MHz were performed a 3 meter Semi-Anechoic, FCC listed Chamber. Measurements from 4000-18000 MHz were taken at a 1 meter separation distance, and 1800-25000 MHz at a separation distance of 30 cm in a semi-anechoic mini chamber. The radiated RF emission levels were manually noted at discrete turntable azimuths and measurement antenna heights, corresponding to peak emission levels at various frequencies.

A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz, and an EMCO standard gain horn antenna was used for measurements from 18 to 25 GHz. The maximum radiated RF emissions were found by rotating the EUT 360°, and raising and lowering the antenna between 1 and 4 meters, using both horizontal and vertical antenna polarities.

The EUT was tested in both vertical and horizontal USB slots during the investigations to find the highest emission levels.

Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at a N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading.

For measurements 30 MHz – 4 GHz, the HP 8546A EMI receiver was used, and an Agilent E4446A Spectrum Analyzer was utilized for measurements 4 GHz – 25 GHz. An EMCO horn antenna was used for measurements between 1 GHz and 18 GHz (accompanied by a preamp for measurements over 4 GHz), and a standard gain horn with preamp were used for measurements 18-25 GHz.

Test Results

The EUT was found to meet the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.249 for a transmitter (Canada RSS-210). The frequencies with significant signals were recorded and plotted as shown in the Data Charts and Graphs.

CALCULATION OF RADIATED EMISSIONS LIMITS:

Field Strength of Fundamental Frequencies:

The fundamental emissions for an intentional radiator in the 2400-2483.5 MHz band, operating under FCC part 15.249 limits, must have electric field strength of no greater than 50 mV/m, for the fundamental frequency, when measured at 3 meters, and harmonic field strength of no greater than 500 μV/m, when measured at 3 meters. Spurious emissions outside the 2400-2483.5 MHz band shall be attenuated by at least 50 dB below the level of the fundamental, or meet the limits expressed in FCC part 15.209 under general emission limits.

Field Strength of Fundamental Frequencies is Limited to 50,000 μV/m, or 94 dBμV/m.

Field Strength of Harmonic and Spurious Frequencies is Limited by FCC 15.249 (c)

The harmonic limit of –50 dBc with respect to the fundamental limit would be:

94 dBμV/m – 50 dB = 44 dBμV/m,

with the exception of where FCC 15.209 allows for a higher limit to be used.

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)
2480-2483.5	50,000	94.0
30-88 ; 88-216	159	44.0
216-902 ; 928-960	500	46.0*
960-40,000	500	54.0*

The following table depicts the general radiated emission limits obtained from Title 47 CFR, part 15.209a, for radiated emissions measurements, including restricted band limits as expressed in 47 CFR, part 15.205.

Frequency (MHz)	3 m Limit (μV/m)	3 m Limit (dBμV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-40,000	500	54.0

Sample conversion from field strength μV/m to dBμV/m:

$dB\mu V/m = 20 \log_{10}$ (3m limit)

from 30 - 88 MHz for example: $dB\mu V/m = 20 \log_{10} (100)$

$40.0\ dB\mu V/m = 20 \log_{10} (100)$

For measurements made at 1 meter, a 9.5 dB correction may be been invoked.

960 MHz to 40,000 MHz

500 μV/m or 54.0 dBμV/m at 3 meters

54.0 + 9.5 = 63.5 dBμV/m at 1 meter

Note: Limits are conservatively rounded to the nearest tenth of a whole number.

Summary of Results and Conclusions

Based on the procedures outlined in this report, and the test results, it can be determined that the EUT does meet the emission requirements of Title 47 CFR, FCC Part 15.249, for a frequency modulated transmitter.

The enclosed test results pertain to the samples of the test item listed, and only for the tests performed per the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.

Radiated Emissions Data Chart

3 Meter Measurements of Electromagnetic Radiated Emissions

Test Standard: Title 47 CFR 15.249 and RSS-210 Issue 7

Frequency Range Inspected: 30 MHz to 25000 MHz

Manufacturer:	Mortara Instrument					
Date(s) of Test:	February 20-26, 2009					
Test Engineer(s):	√	Laura Bott		Ryan Urness		Ken Boston
Model #:	25025-092-03 Rev A1					
Serial #:	Engineering Proto #25					
Voltage:	5 VDC					
Operation Mode:	Normal , Continuous Data Modulation					
EUT Power:		Single Phase ___VAC		3 Phase ___VAC		
	√	Battery		Other:		
EUT Placement:	√	80cm non-conductive table		10cm Spacers		
EUT Test Location:	√	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	√	Final
Detectors Used:	√	Peak	√	Quasi-Peak	√	Average

Environmental Conditions in the Lab:
Temperature: 20 – 25°C
Relative Humidity: 30 – 60 %

Test Equipment Used:
EMI Measurement Instrument: HP8546A and Agilent E4407B
Log Periodic Antenna: EMCO #93146
Horn Antenna: EMCO #3115
Biconical Antenna: EMCO 93110
Pre-Amp: Advanced Microwave WHA6224
Standard Gain Horn: EMCO 3160-09

The following table depicts the level of significant radiated emissions found on the fundamental frequencies:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
2403.38	1.07	348	90.43	89.11	94.00	4.89	Vertical	Flat-soc
2441.35	1.12	295	88.69	86.74	94.00	7.26	Vertical	Flat-soc
2479.45	1.05	351	88.46	86.70	94.00	7.30	Vertical	Flat-soc

Note: For EUT orientation: Flat-soc = Flat Side of Computer, Vertical boc = Vertical Back of Computer

The following table depicts the level of significant radiated emissions found on the low channel (2403 MHz):

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4806.76	1.00	25	57.67	55.14	63.50	8.36	Vertical	Vertical-boc
7210.14	1.06	327	52.77	46.30	63.50	17.20	Horizontal	Vertical-boc
9613.52	1.00	341	53.63	45.00	63.50	18.50	Horizontal	Vertical-boc
12016.9	1.00	127	52.72	42.44	63.50	21.06	Vertical	Flat-soc
14420.28	1.13	349	51.94	39.81	63.50	23.69	Horizontal	Flat-soc
16823.66	1.08	150	51.91	39.91	63.50	23.59	Vertical	Vertical-boc
19227.04	1.05	330	56.44	43.94	74.00	30.06	Vertical	Vertical-boc
21630.42	1.39	357	56.87	44.29	74.00	29.71	Horizontal	Flat-soc
24033.8	1.31	313	59.55	47.11	74.00	26.89	Vertical	Flat-soc

The following table depicts the level of significant radiated emissions found on the middle channel (2441 MHz):

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4882.7	1.00	358	55.19	51.78	63.50	11.72	Vertical	Vertical-boc
7324.05	1.04	332	53.76	47.38	63.50	16.12	Horizontal	Vertical-boc
9765.4	1.05	337	56.53	49.03	63.50	14.47	Horizontal	Vertical-boc
12206.75	1.00	1	52.00	41.27	63.50	22.23	Vertical	Vertical-boc
14648.1	1.04	214	51.31	39.84	63.50	23.66	Horizontal	Flat-soc
17089.45	1.29	212	55.40	43.13	63.50	20.37	Vertical	Flat-soc
19530.8	1.24	254	55.40	43.54	74.00	30.46	Horizontal	Flat-soc
21972.15	1.34	356	56.24	44.63	74.00	29.37	Horizontal	Vertical-boc
24413.5	1.49	236	58.48	45.64	74.00	28.36	Horizontal	Vertical-boc

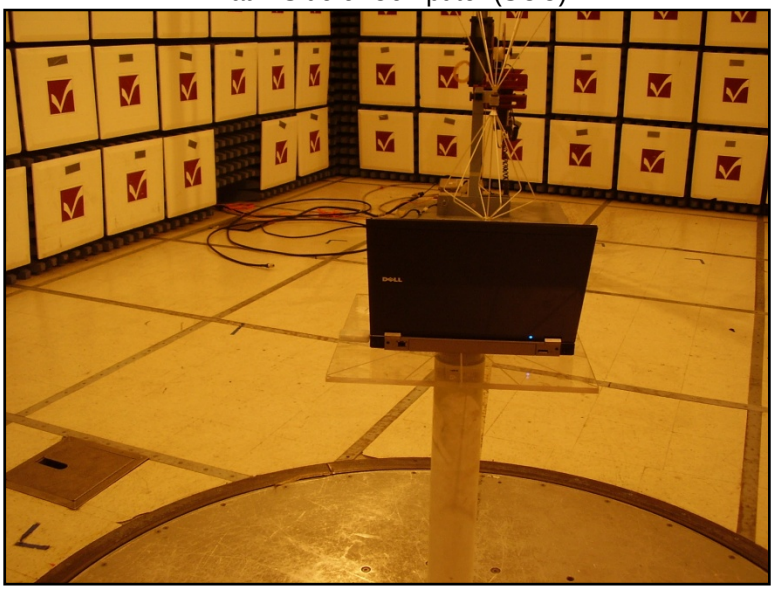
The following table depicts the level of significant radiated emissions found on the high channel (2479 MHz):

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4958.9	1.10	320	54.90	51.25	63.50	12.25	Horizontal	Vertical-boc
7438.35	1.02	277	51.29	43.02	63.50	20.48	Vertical	Vertical-boc
9917.8	1.05	331	59.39	52.50	63.50	11.00	Horizontal	Vertical-boc
12397.25	1.00	330	51.95	41.19	63.50	22.31	Horizontal	Vertical-boc
14876.7	1.13	352	50.88	38.96	63.50	24.54	Vertical	Vertical-boc
17356.15	1.66	335	55.72	44.10	63.50	19.40	Vertical	Vertical-boc
19835.6	1.13	290	55.53	43.36	74.00	30.64	Horizontal	Vertical-boc
22315.05	1.05	291	56.61	44.42	74.00	29.58	Vertical	Vertical-boc
24794.5	1.18	346	60.52	48.22	74.00	25.78	Vertical	Flat-soc

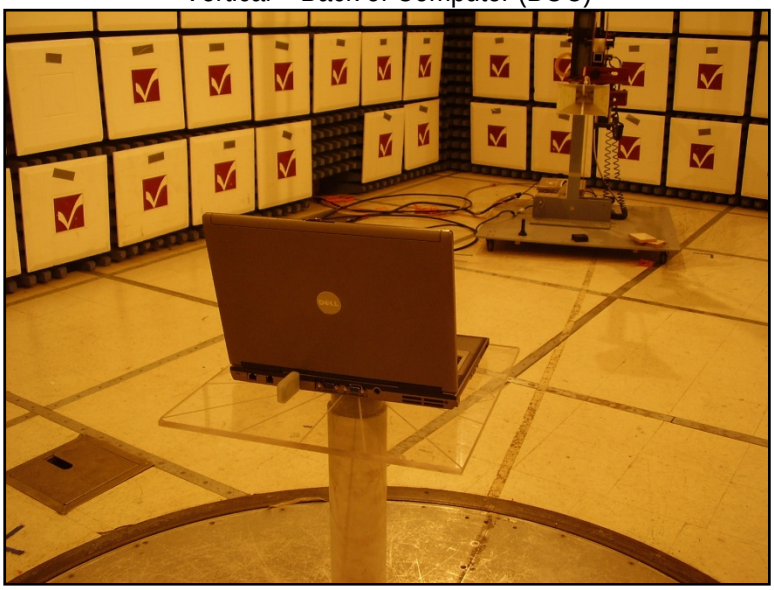
Notes: A Quasi-Peak Detector was used in measurements below 1 GHz, and 10 Hz video averaged signal was used to obtain average measurements above 1 GHz.

Setup for the Radiated Emissions Test

Flat – Side of Computer (SOC)



Vertical – Back of Computer (BOC)

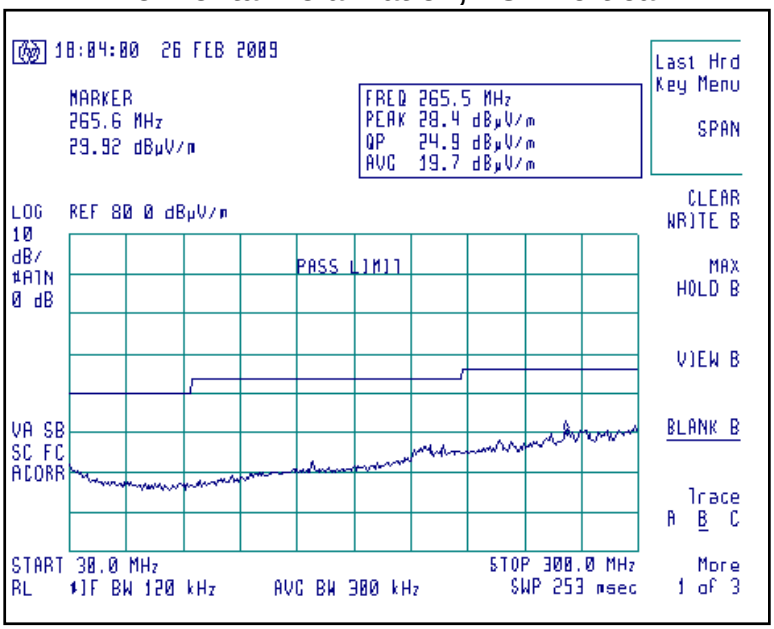


GRAPHS

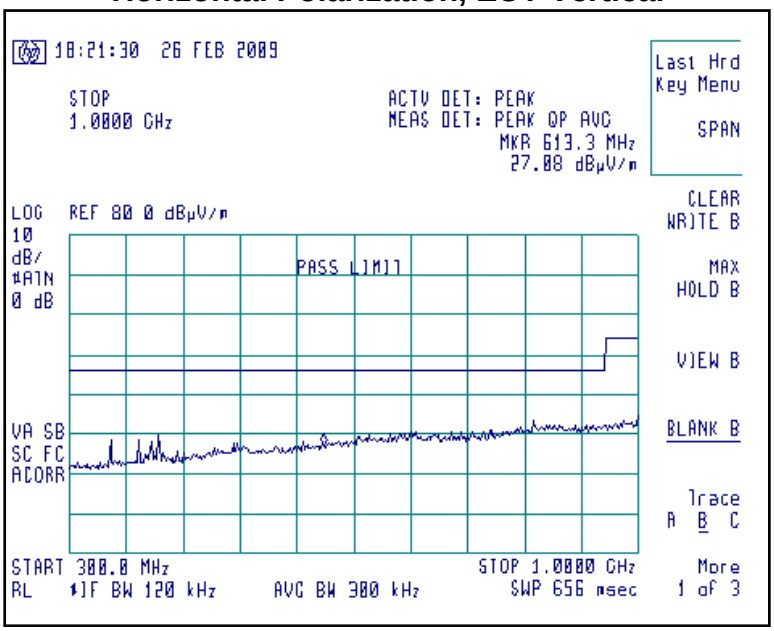
Screen Captures of Radiated RF Emissions:

Please note these screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and an Average detector function is utilized when measuring frequencies above 1 GHz. The signature scans shown here are from worst-case emissions, as measured on channels 2403, 2441, or 2479 with the sense and EUT antennas both in vertical polarity for worst case presentations.

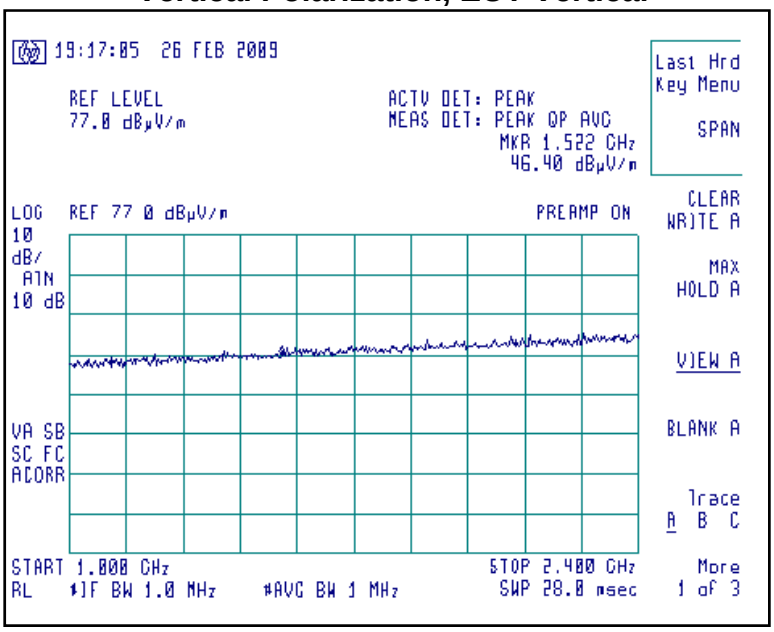
Signature Scan of Peak Radiated Emissions 30-300 MHz, Horizontal Polarization, EUT Vertical



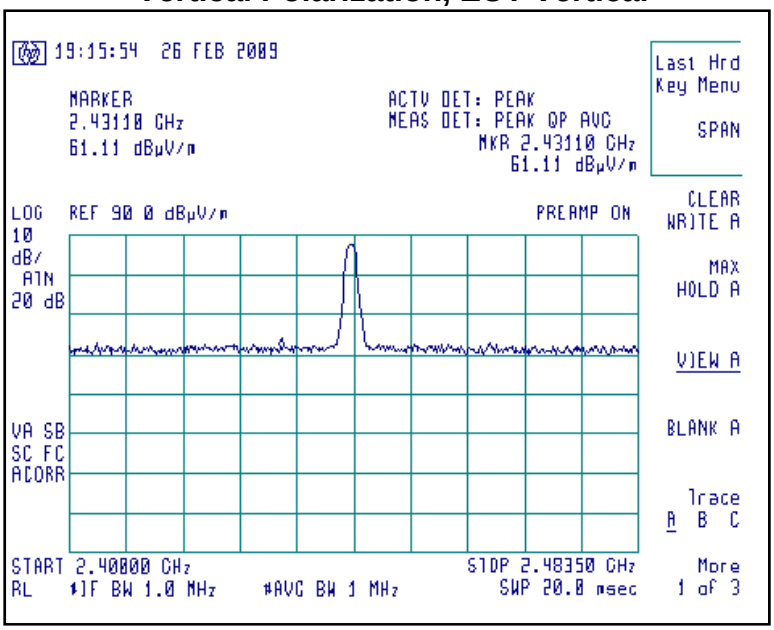
Signature Scan of Peak Radiated Emissions 300-1000 MHz, Horizontal Polarization, EUT Vertical



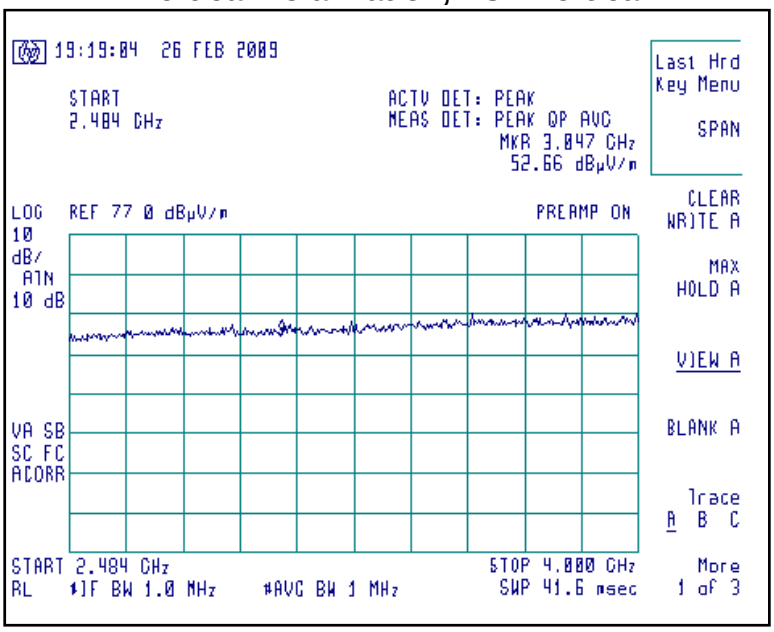
Signature Scan of Peak Radiated Emissions 1000-2400 MHz, Vertical Polarization, EUT Vertical



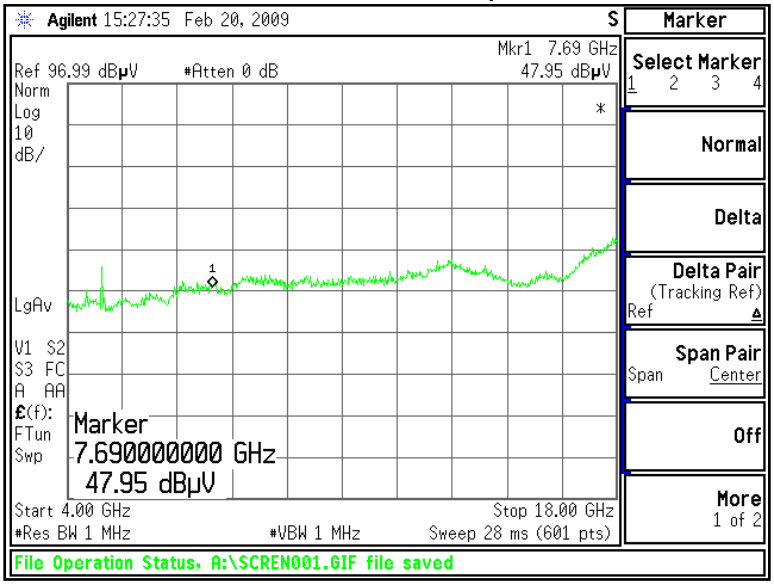
Signature Scan of Peak Radiated Emissions 2400-2483.5 MHz, Vertical Polarization, EUT Vertical



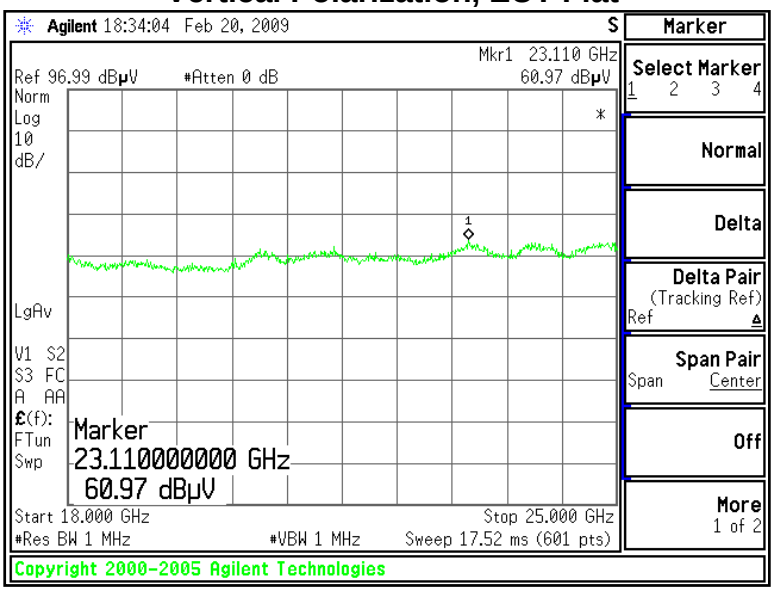
Signature Scan of Peak Radiated Emissions 2484-4000 MHz, Vertical Polarization, EUT Vertical



Signature Scan of Peak Radiated Emissions 4000-18000 MHz, Horizontal Polarization, EUT Flat



Signature Scan of Peak Radiated Emissions 18000-25000 MHz, Vertical Polarization, EUT Flat



Receive Mode:

The test setup was assembled in accordance with RSS GEN and ANSI C63.4-2003 The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in receive mode and was powered by the 5V from the USB port. The unit has the capability to operate on 3 channels, controllable via firmware loaded on the EUT.

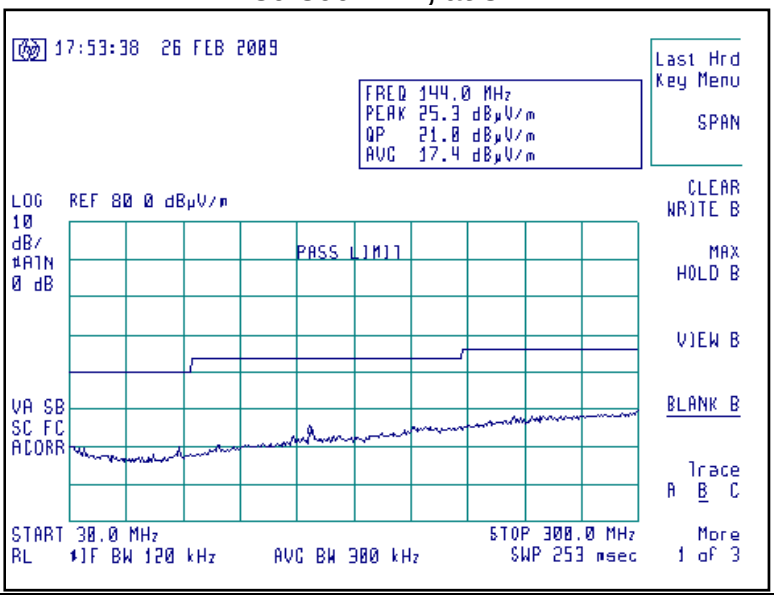
The following table depicts the level of significant spurious radiated RF emissions found:

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
144.0	1.00	0	21.0	43.5	22.5	Vertical	Flat
265.5	1.00	0	24.9	46.0	21.1	Horizontal	Flat
349.9	1.00	294	20.0	46.0	26.0	Horizontal	Flat
348.5	1.60	155	19.5	46.0	26.5	Vertical	Flat

Frequency (MHz)	Height (m)	Azimuth (degree)	Average Reading (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
2538.0	1.00	0	44.23	54.00	9.77	Vertical	Vertical
2984.0	1.00	0	48.86	54.00	5.14	Horizontal	Flat

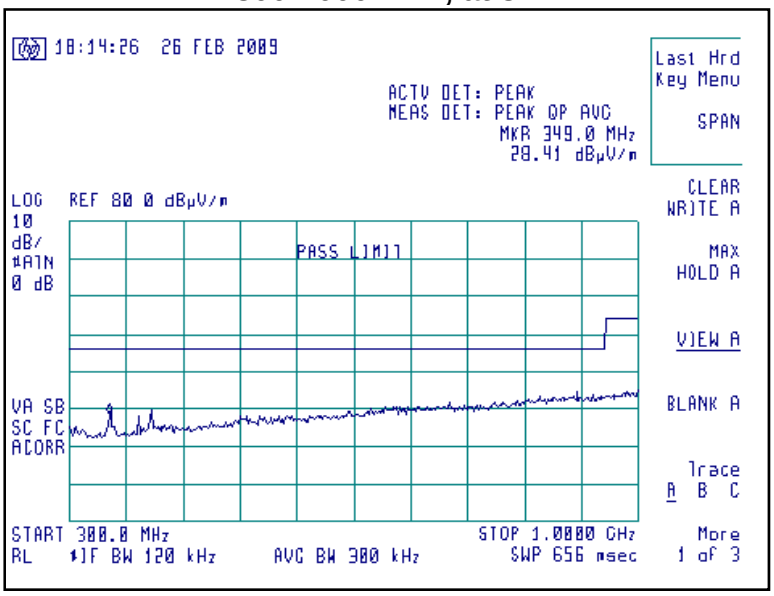
Radiated Emissions Graphs:

Channel 16, Antenna Vertically Polarized, EUT on Side of Computer
30-300 MHz, at 3m

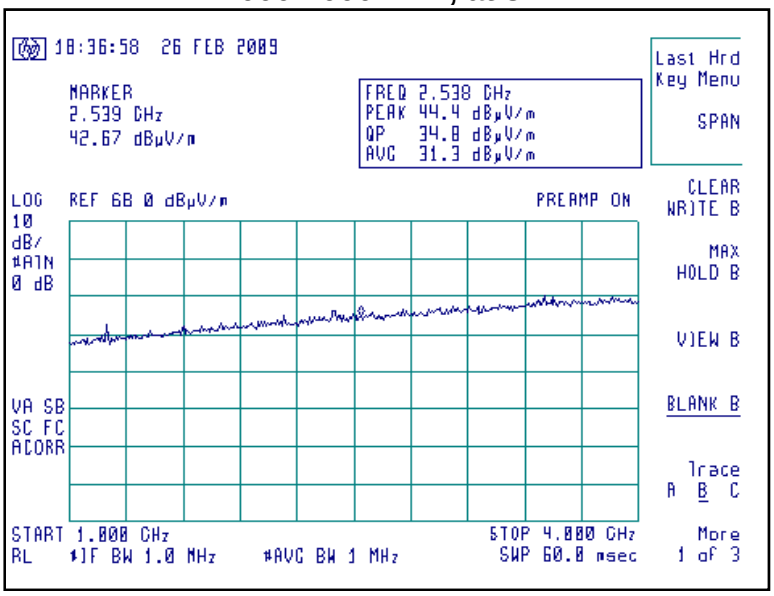


Screen Captures - Radiated Emissions Testing *(continued)*

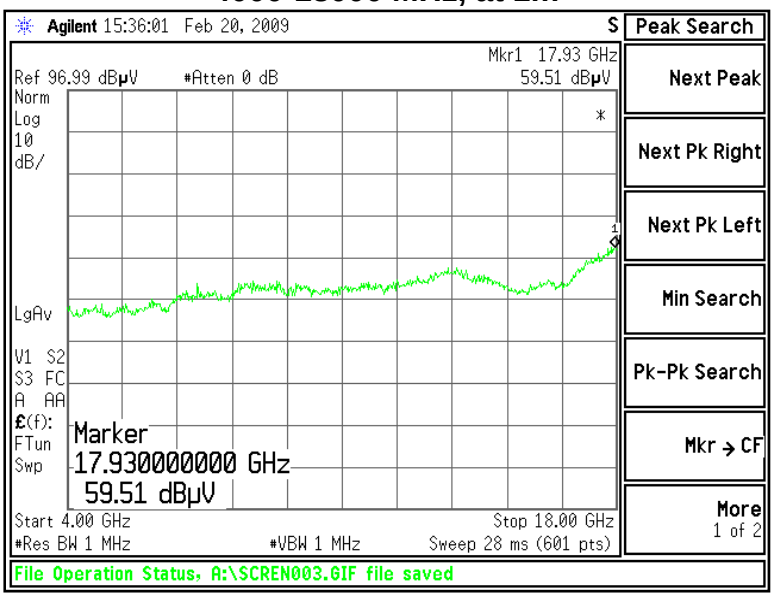
Channel 16, Antenna Vertically Polarized, EUT on Side of Computer
300-1000 MHz, at 3m



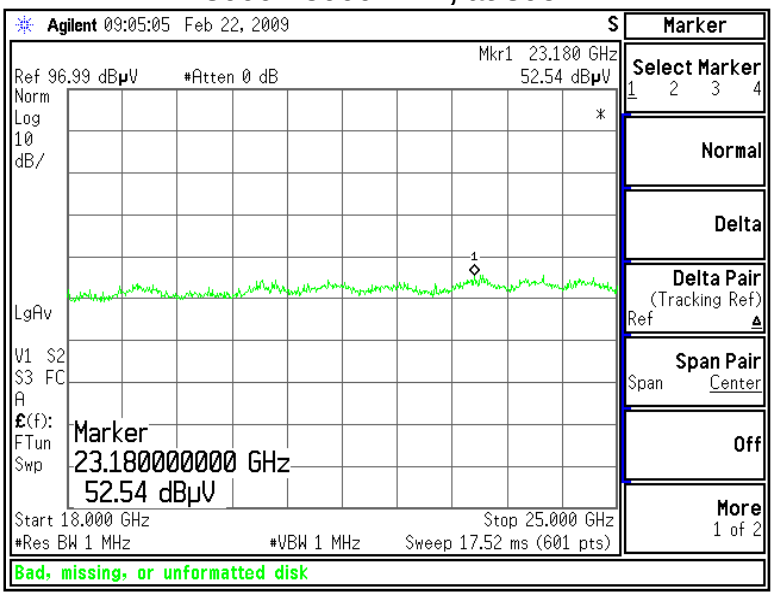
Channel 16, Antenna Vertically Polarized, EUT on Back of Computer
1000-4000 MHz, at 3m



Channel 16, Antenna Vertically Polarized, EUT on Back of Computer 4000-18000 MHz, at 1m



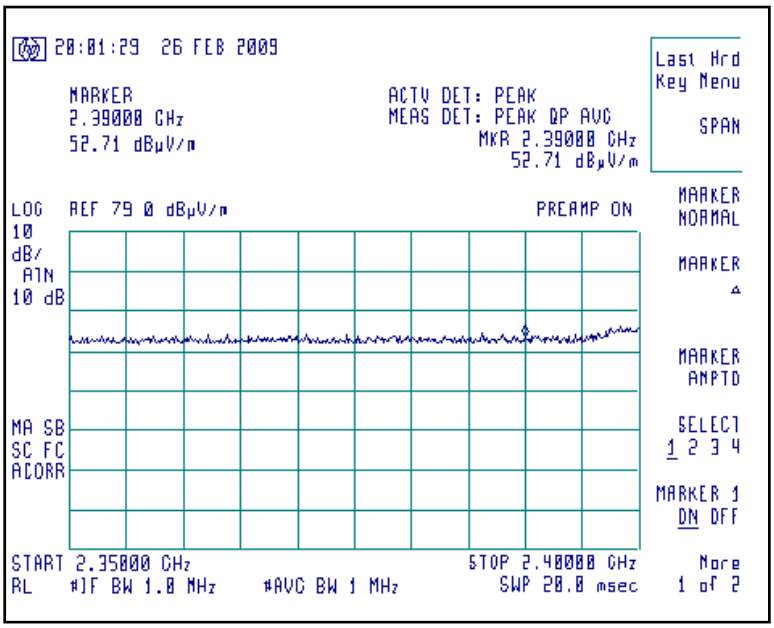
Channel 16, Antenna Vertically Polarized, EUT on Back of Computer 18000-25000 MHz, at 30cm

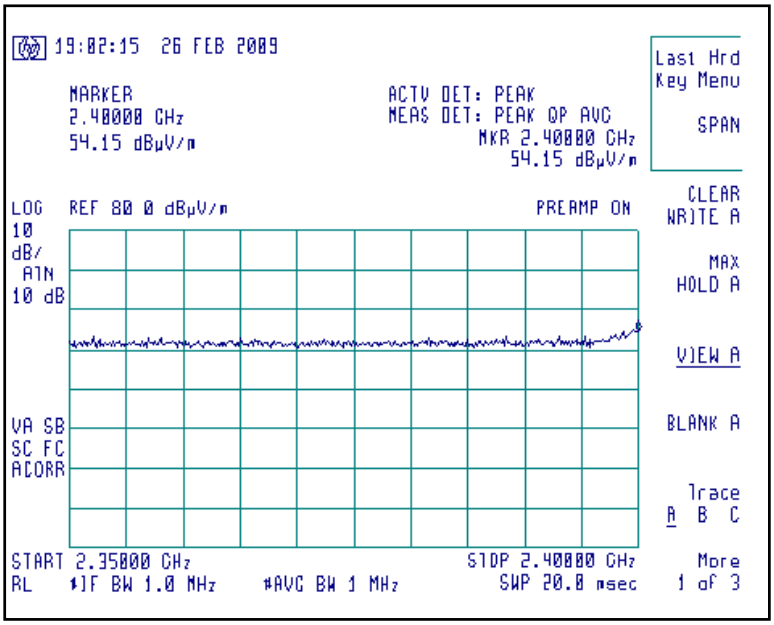


10. Band-Edge Measurements

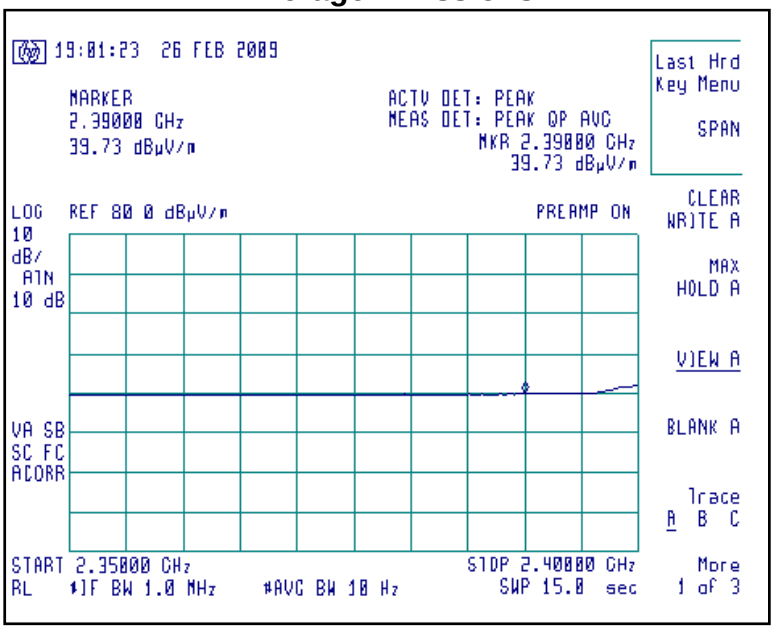
FCC 15.209(b) and 15.249(d) require a measurement of spurious emission levels, in particular at the band-edges where the intentional radiator operates. The following screen captures demonstrate compliance of the intentional radiator at the 2400-2483.5 MHz band-edges. The EUT was operated at the lowest channel, with continuous modulation, for the investigation of the lower band-edge, and at the highest channel for the investigation of the higher band-edge.

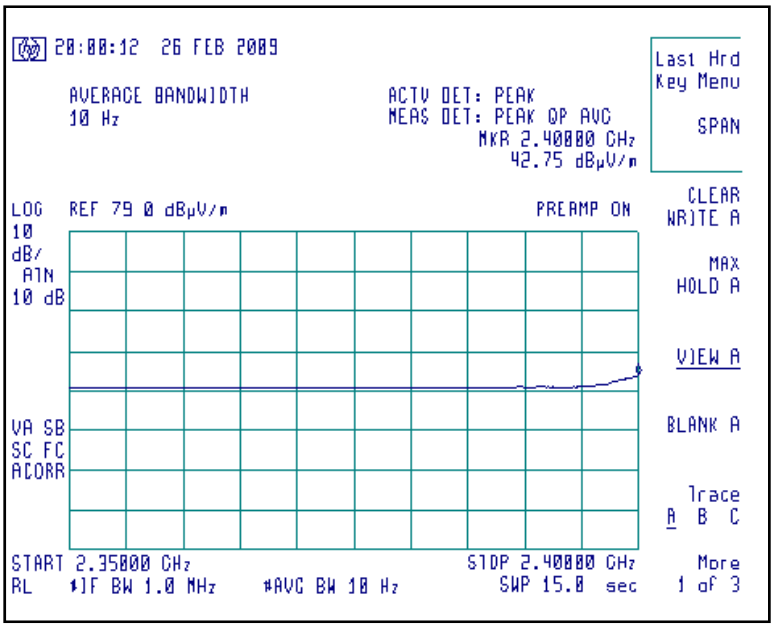
Screen Capture demonstrating compliance at the Lower Band-Edge
Peak Emissions



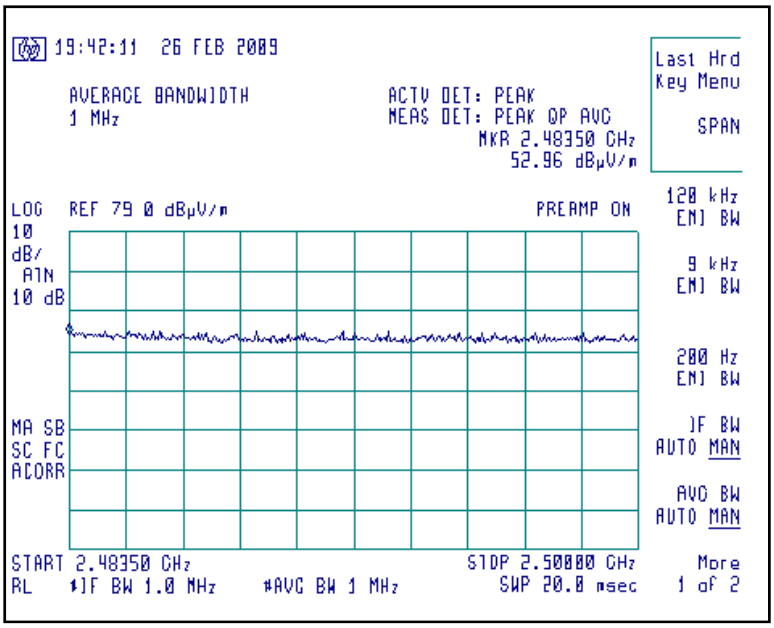


Screen Capture demonstrating compliance at the Lower Band-Edge Average Emissions

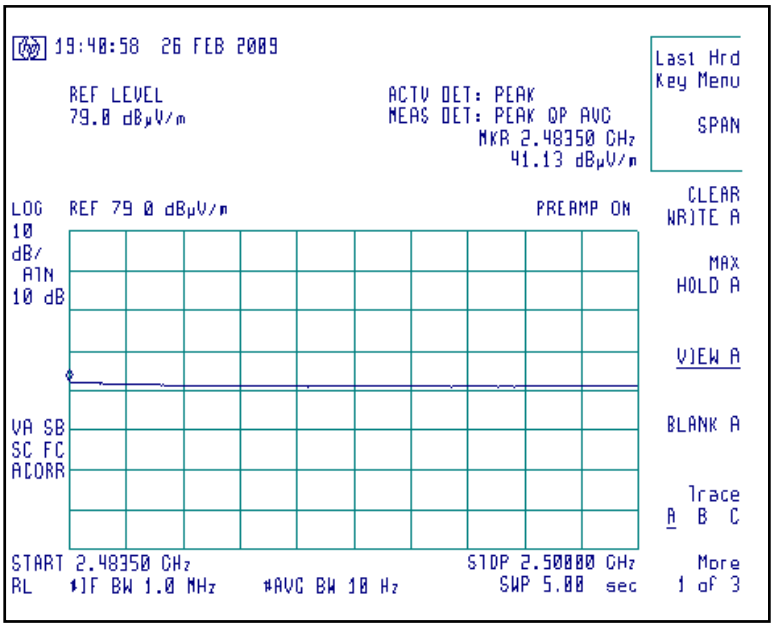




Screen Capture demonstrating compliance at the Higher Band-Edge Peak Emissions



Screen Capture demonstrating compliance at the Higher Band-Edge Average Emissions



11. Occupied Bandwidth: RSS GEN 4.6.1

11.1 Method of Measurements

Refer to ANSI C63.4 and RSS GEN 4.6.1 for test procedures.

Because there is no access to the antenna port of the EUT, a radiated measurement in the near field was made. The bandwidth of the fundamental frequency was measured with the Spectrum Analyzer using 100 kHz RBW and VBW=100 kHz.

For this portion of the tests, the EUT was placed on a flat, non conductive surface close to an antenna which was attached to the front end of a HP E4446A spectrum analyzer.

The EUT was configured to run in a continuous transmit, modulated mode. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

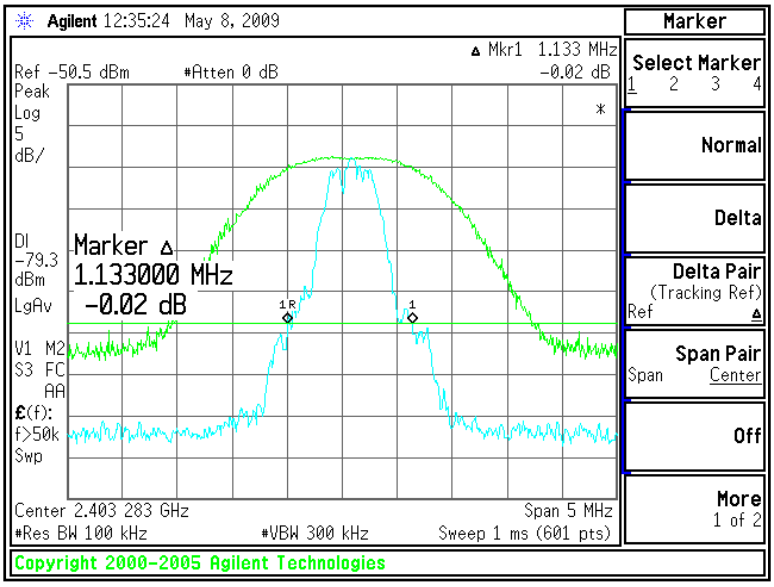
11.2 Test Data

Channel	Center Frequency (MHz)	Measured -20 dBc Occupied Bandwidth (kHz)
1	2403	1133
16	2441	1383
32	2479	1167

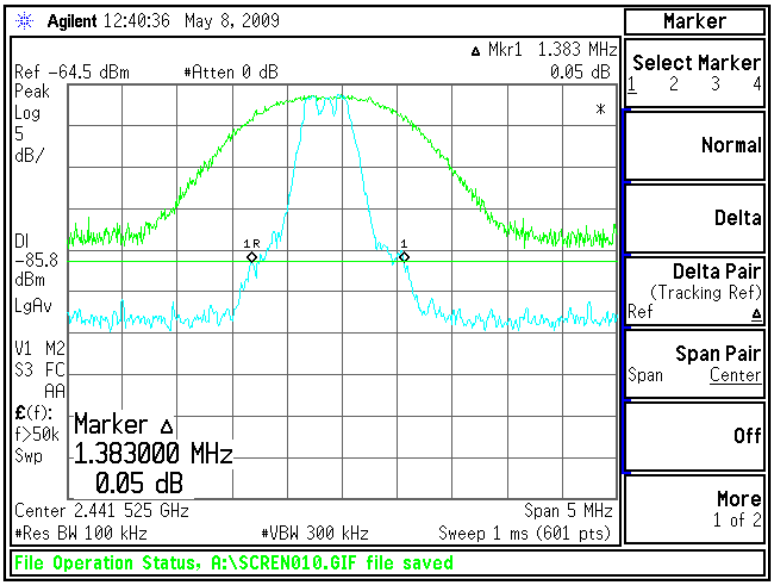
11.3 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
Spectrum Analyzer	Agilent	E4446A	US45300564

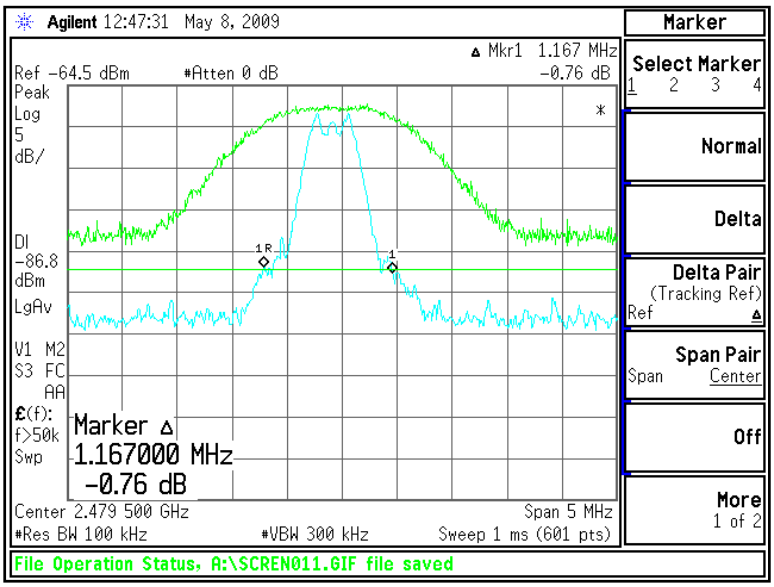
Channel 1: -20 dBc OBW



Channel 16: -20 dBc OBW



Channel 32: -20 dBc OBW



12. Conducted Emissions Test, AC Power Line: FCC 15.207 and RSS-Gen 7.2.2

12.1 Test Setup

The test area and setup are in accordance with ANSI C63.4-2003, and with Title 47 CFR, FCC Part 15 (Industry Canada RSS-Gen 7.2.2 and RSS-210, Issue 6). The EUT was placed on a non-conductive wooden table, 80 cm above the reference ground plane. Because the EUT will operate off power from a USB port, the UTK was plugged into the USB port of a DELL Latutude 0630 Laptop, whose power cord was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 110V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the HP 8546A EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

12.2 Test Procedure

The EUT was investigated in continuous modulated transmit mode for this portion of the testing. Measurements were made from 150 kHz-30MHz. The Intermediate Frequency Bandwidth was set to 9.0 kHz and the Average Bandwidth to 30 kHz, per CISPR 16-1 (2003), Section 1, Table 1. Plots of peak values were captured and are shown below. Quasi-peak and average signal strength values were measured at discrete frequencies; these are denoted in the table in Section 6.5 of this report.

12.3 Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter are traceable to N.I.S.T. All cables are calibrated and checked periodically for conformance. The emissions are measured on the HP 8546A EMI Receiver, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

12.4 Test Equipment List

Test Equipment	Manufacturer	Model No.	Serial No.
EMI Receiver	HP	8546A	3617A00320
Spectrum Analyzer	Agilent	E4446A	US45300564
LISN	EMCO	3816/2NM	9701-1057
Transient Limiter	HP	119474A	3107A01708

Test Results

The EUT was found to meet the Conducted Emission requirements of FCC Part 15.207 and RSS-Gen 7.2.2 Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

12.5 FCC and RSS-Gen Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBµV)		Measuring Bandwidth
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

Calculation of Conducted Emissions Limits

The following table describes the Class B limits for an unintentional radiator. These limits are obtained from CISPR 22 (2003) Table 2, for Limits for conducted disturbance at the mains ports of "Class B" ITE products..

Frequency (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)
0.15 – 0.5	66 – 56 *	56 - 46
0.5 – 5.0	56	46
5.0 – 30.0	60	50

* Decreases with the logarithm of the frequency.

Sample calculation for the limits in the 0.15 to 0.5 MHz:

$$\text{Limit} = -19.12\ (\text{Log}_{10}\ (F\ [\text{MHz}] / 0.15\ [\text{MHz}])) + 66.0\ \text{dB}\mu\text{V}$$

For a frequency of 200 kHz for example:

$$\text{Quasi-Peak Limit } (F = 200\ \text{kHz}) = -19.12\ (\text{Log}_{10}\ (0.2[\text{MHz}] / 0.15\ [\text{MHz}])) + 66.0\ \text{dB}\mu\text{V}$$

$$\text{Quasi-Peak Limit } (F = 200\ \text{kHz}) = 63.6\ \text{dB}\mu\text{V}$$

$$\text{Average Limit } (F=200\ \text{kHz}) = -19.12\ (\text{Log}_{10}\ (0.2[\text{MHz}]/0.15[\text{MHz}])) + 56.0\ \text{dB}\mu\text{V}$$

$$\text{Average Limit } (F = 200\ \text{kHz}) = 53.6\ \text{dB}\mu\text{V}$$

Measurement of Electromagnetic Conducted Emissions

Frequency Range inspected: 150 KHz to 30 MHz

Test Standard: CISPR 22, Class B

Manufacturer:	*Mortatra Instrument, Inc*					
Date(s) of Test:	*May 18, 2009*					
Test Engineer:	√	*Laura Bott*		*Ryan Urness*		*Ken Boston*
Model #:	*25025-092-03 Rev A1*					
Serial #:	*Engineering Proto #25*					
Voltage:	*5.0 VDC*					
Operation Mode:	*Normal, continuous transmit*					
Test Location:	√	*Shielded Area*				*Chamber*
EUT Placed On:		*40cm from Vertical Ground Plane*				*10cm Spacers*
	√	*80cm above Ground Plane*				*Other:*
Measurements:		Pre-Compliance		Preliminary	√	Final
Detectors Used:	√	Peak	√	Quasi-Peak	√	Average

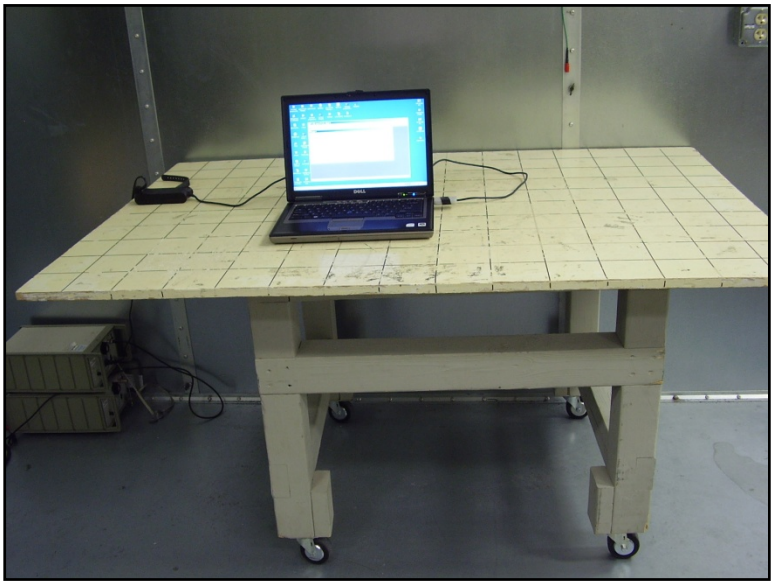
Environmental Conditions in the Lab:
Temperature: 20 – 25° C
Atmospheric Pressure: 86 kPa – 106 kPa
Relative Humidity: 30 – 60%

Test Equipment Utilized:
EMI Receiver: HP 8546A
LISN: EMCO 3816/2NM
Transient Limiter: HP 119474A

Frequency (MHz)	Line	Q-Peak Reading	Q-Peak Limit	Margin	Average Reading	Average Limit	Margin
0.170	1	50.20	64.95	14.75	36.00	54.95	18.95
0.225	1	43.60	62.63	19.03	29.20	52.63	23.43
0.282	1	37.20	60.77	23.57	29.90	50.77	20.87
1.981	1	36.90	56.00	19.10	32.00	46.00	14.00
3.513	1	39.90	56.00	16.10	28.60	46.00	17.40
10.590	1	32.30	60.00	27.70	25.80	50.00	24.20
0.151	2	50.60	65.97	15.37	35.30	55.97	20.67
0.153	2	49.70	65.81	16.11	29.10	55.81	26.71
0.196	2	41.40	63.77	22.37	25.90	53.77	27.87
3.739	2	33.50	56.00	22.50	21.30	46.00	24.70
10.720	2	30.30	60.00	29.70	21.80	50.00	28.20

Notes:
1) All other emissions were better than 20 dB below the limits.
2) The EUT exhibited similar emissions in transmit and receive modes, and across the Low, Middle and High channels tested..

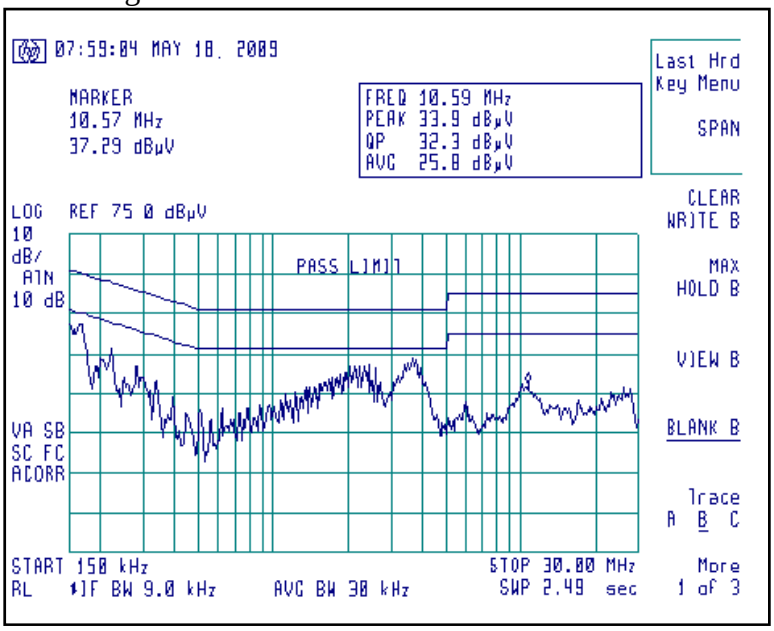
General test setup during RF emissions tests onto AC Mains



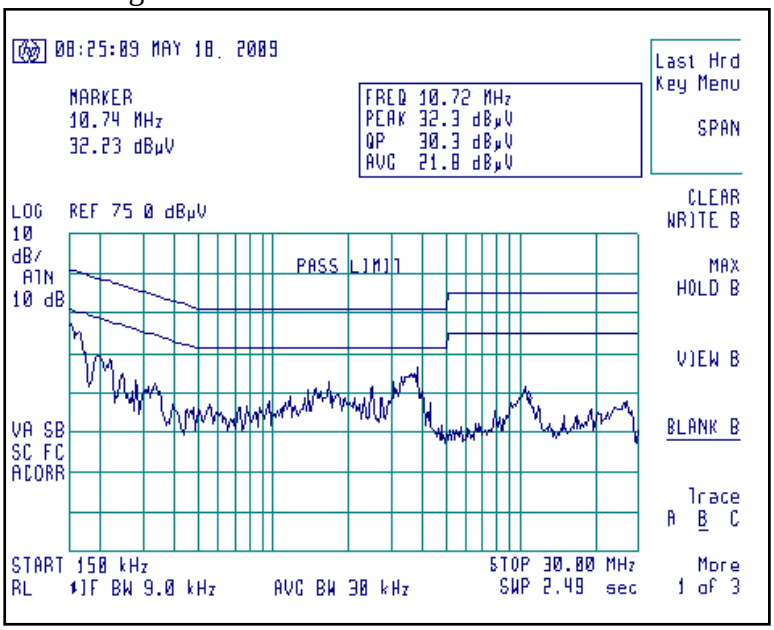
Screen Captures of Conducted AC Mains Emissions:

Please note these screen captures represent Peak Emissions. For conducted emission measurements, we utilize both a Quasi-Peak detector function as well as the Average detector function for measurements. The emissions must meet both the Quasi-peak limit and the Average limit as described in CISPR 22.
The signature scans shown here are from channel 18, chosen as being a good representative of all channels.

Channel 16, Line 1
Emission signatures were similar in transmit and receive modes,



Channel 16, Line 2
Emission signatures were similar in transmit and receive modes



APPENDIX A

Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 5-Mar-2009 Type Test : Radiated Emissions Job # : C-542

Prepared By: L Bott Customer : Mortara Instrument, Inc. Quote #: 309054

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960004	Log Periodic Antenna	EMCO	93146	9512-4276	8/28/2008	8/28/2009	Active Calibration
2	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	6/17/2008	6/17/2009	Active Calibration
3	AA 960063	Pyramidal Horn Antenna	EMCO	3160-09	9809-1120	6/17/2008	6/17/2009	Active Calibration
4	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	9/26/2008	9/26/2009	Active Calibration
5	AA 960142	Phaseflex	Gore	EMOCJOCJO36	4943263	10/15/2008	10/15/2009	Active Calibration
6	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	9/23/2008	9/23/2009	Active Calibration
7	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	9/23/2008	9/23/2009	Active Calibration
8	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	9/26/2008	9/26/2009	Active Calibration

Note 1 - Equipment calibrated within a traceable system.

APPENDIX B
TEST STANDARDS – CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2003		
CISPR 11	2003-03	2004-05	2006-06
CISPR 14-1	2005-11		
CISPR 14-2	2001-11	2001-11	2008-05
CISPR 16-1-1 Note 1	2006-03	2006-09	2007-07
CISPR 16-1-2 Note 1	2003	2004-04	2006-07
CISPR 22	2005	2005-07	2006-01
CISPR 24	1997-09	2001-07	2002-10
EN 55011	2007-05		
EN 55014-1	2006		
EN 55014-2	1997		
EN 55022	2006		
EN 60601-1-2	2007		
EN 61000-3-2	2006-05		
EN 61000-3-3	1994	1995	
EN 61000-4-2	2001	1998	2001
EN 61000-4-3	2006-07	2008-05	
EN 61000-4-4	2004		
EN 61000-4-5	2006-12		
EN 61000-4-6	2007-08		
EN 61000-4-8	1993	1994-01	
EN 61000-4-11	2004-10		
EN 61000-6-1	2007-02		
EN 61000-6-2	2005-12		
EN 61000-6-3	2007-02		
EN 61000-6-4	2007-02		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2007		
FCC Public Notice DA 00-1407	2000		
FCC ET Docket # 99-231	2002		
FCC Procedures	2007		
ICES 001	2006-06		
ICES 002	2007-02		
ICES 003	2004-02		
IEC 60601-1-2 Note 1	2007-03		
IEC 61000-3-2	2005	2008-03	
IEC 61000-3-3	2008-06		
IEC 61000-4-2	2001-04	1998	2000
IEC 61000-4-3	2006-02	incl in 2006	
IEC 61000-4-4	2004-07		

STANDARD #	DATE	Am. 1	Am. 2
IEC 61000-4-5	2005-11		
IEC 61000-4-6	2008-07		
IEC 61000-4-8	2001-03	2000	
IEC 61000-4-11	2004-03		
IEC 61326-1	2005-12		
ISO 14082	1998-07		
MIL Std. 461E	1999-08		
RSS GEN	2007-06		
RSS 119	2007-06		
RSS 123	1999-11		
RSS 125	2000-03		
RSS 131	2003-07		
RSS 136	2002-10		
RSS 137	1999-09		
RSS 210	2007-06		
RSS 213	2005-12		
RSS 243	2005-11		
RSS 310	2007-06		

Note 1: Test not on LSR Scope of Accreditation.

APPENDIX C
Uncertainty Statement

This uncertainty represents an expanded uncertainty
expressed at approximately the 95% confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V