L.S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012
262-375-4400 Fax: 262-375-4248

COMPLIANCE TESTING OF:

900S500 Module (500 mW)

PREPARED FOR:

Xecom

TEST REPORT NUMBER:

304192 TX (TCB Rev. 1)

TEST DATE(S):

March 26th, 29th, 30th and April 2nd & 5th, 2004

# Table of Contents

## 1. L. S. Compliance In Review

**L.S. Compliance – 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 : 1999
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

Listing of 3 and 10 meter OATS based on Title 47CFR – Part 2.948
FCC Registration Number: 90757

**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 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. A2LA Certificate of Accreditation

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

# ACCREDITED LABORATORY

A2LA has accredited

## L.S. COMPLIANCE, INC.
**Cedarburg, WI**

for technical competence in the field of

## Electrical Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing. Testing and calibration laboratories that comply with this International Standard also operate in accordance with ISO 9001 or ISO 9002 (1994).

Presented this 26th day of March 2003.

President
For the Accreditation Council
Certificate Number 1255.01
Valid to January 31, 2005

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

## 3. A2LA Scope of Accreditation

**American Association for Laboratory Accreditation**

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999

L.S. COMPLIANCE, INC.
W66 N220 Commerce Court
Cedarburg, WI 53012
James Blaha Phone: 262 375 4400

ELECTRICAL (EMC)

Valid to: January 31, 2005 Certificate Number: 1255-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

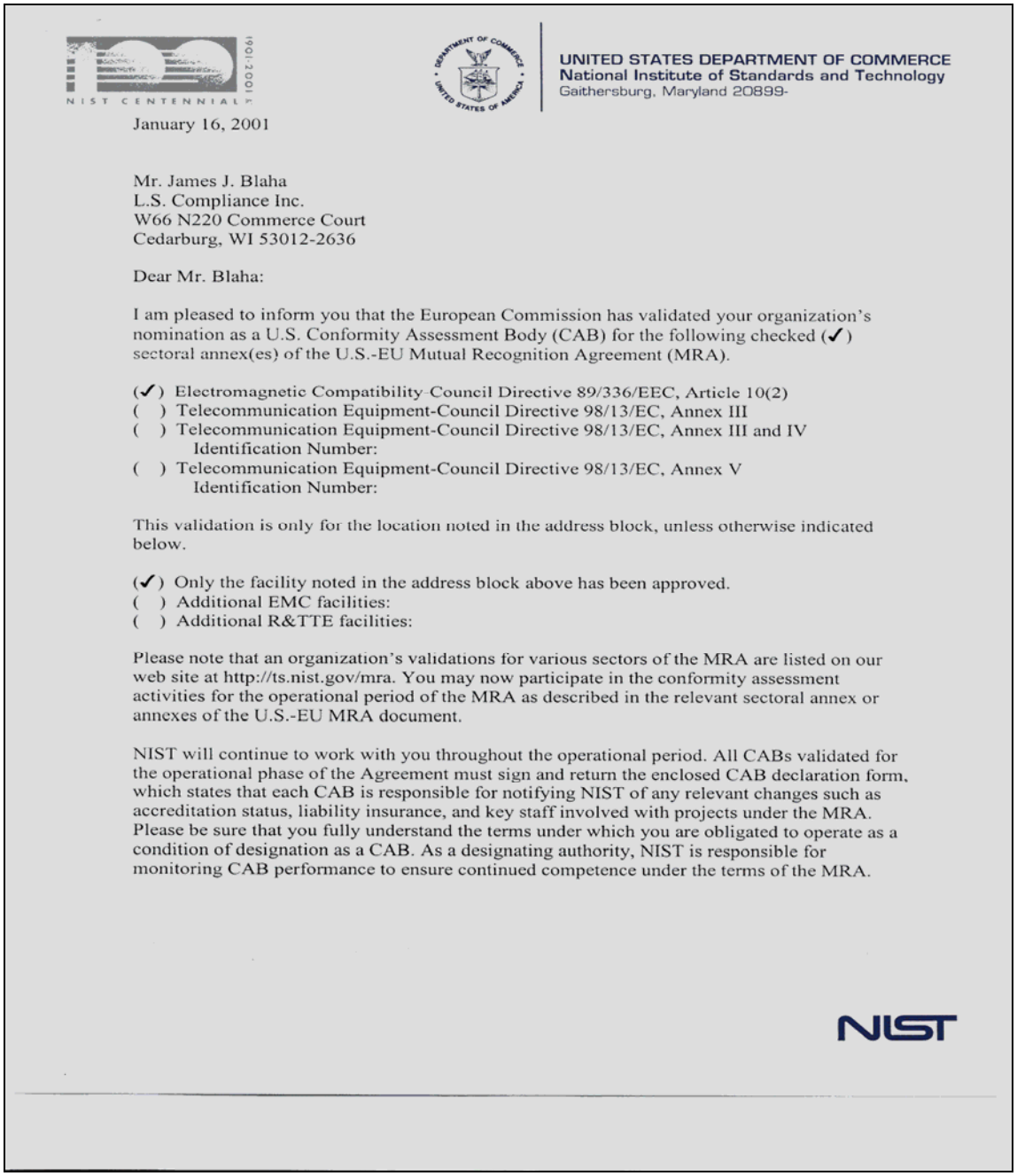
| Test | Test Method(s) |
|---|---|
| Emissions | |
| Conducted | |
| Continuous/Discontinuous | Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; EN: 55011, 55022, 50081-1, 50081-2; CISPR: 11, 12, 14-1, 22; CNS 13438 |
| Radiated | Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; EN: 55011, 55022, 50081-1, 50081-2; CISPR: 11, 12, 14-1, 22; CNS 13438 |
| Current Harmonics | IEC 61000-3-2; EN 61000-3-2 |
| Voltage Fluctuations & Flicker | IEC 61000-3-3; EN 61000-3-3 |
| Immunity | EN: 50082-1, 50082-2 EN 61000-6-2 CISPR: 14-2, 24 |
| Conducted Immunity | |
| Fast Transients/Burst | IEC 61000-4-4; EN 61000-4-4 |
| Surge | IEC: 61000-4-5; ENV 50142; EN 61000-4-5 |
| RF Fields | IEC: 61000-4-6; ENV 50141; EN 61000-4-6 |
| Voltage Dips/Interruptions | IEC 61000-4-11; EN 61000-4-11 |

Roxanne M. Robinson

(A2LA Cert. No. 1255-01) 05/13/03 Page 1 of 2

**5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644 3248 • Fax: 301-662 2974**

## 4. Validation Letter – U.S. Competent Body for EMC Directive 89/336/EEC



UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

January 16, 2001

Mr. James J. Blaha
L.S. Compliance Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012-2636

Dear Mr. Blaha:

I am pleased to inform you that the European Commission has validated your organization's nomination as a U.S. Conformity Assessment Body (CAB) for the following checked (✓) sectoral annex(es) of the U.S.-EU Mutual Recognition Agreement (MRA).

(✓) Electromagnetic Compatibility–Council Directive 89/336/EEC, Article 10(2)
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III and IV
Identification Number:
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex V
Identification Number:

This validation is only for the location noted in the address block, unless otherwise indicated below.

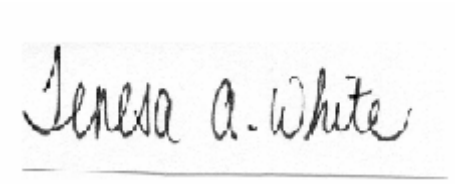
(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

Please note that an organization's validations for various sectors of the MRA are listed on our web site at http://ts.nist.gov/mra. You may now participate in the conformity assessment activities for the operational period of the MRA as described in the relevant sectoral annex or annexes of the U.S.-EU MRA document.

NIST will continue to work with you throughout the operational period. All CABs validated for the operational phase of the Agreement must sign and return the enclosed CAB declaration form, which states that each CAB is responsible for notifying NIST of any relevant changes such as accreditation status, liability insurance, and key staff involved with projects under the MRA. Please be sure that you fully understand the terms under which you are obligated to operate as a condition of designation as a CAB. As a designating authority, NIST is responsible for monitoring CAB performance to ensure continued competence under the terms of the MRA.

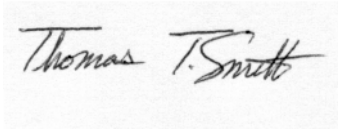
NIST

## 5. Signature Page



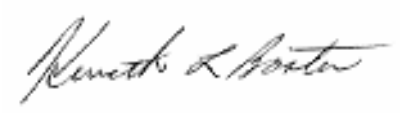
Prepared By: Sept. 1, 2004

Teresa A. White, Document Coordinator Date



Tested By: Sept. 1, 2004

Thomas T. Smith, EMC Engineer Date



Approved By: Sept. 1, 2004

Kenneth L. Boston, EMC Lab Manager Date
PE #31926 Licensed Professional Engineer
Registered in the State of Wisconsin, United States

## 6. Product and General Information

| | | | | | | |
|---|---|---|---|---|---|---|
| Manufacturer: | Xecom | | | | | |
| Date(s) of Test: | March 26th, 29th, 30th and April 2nd & 5th, 2004 | | | | | |
| Test Engineer(s): | √ | Tom Smith | | Abtin Spantman | √ | Ken Boston |
| Model #: | 900 S 500 | | | | | |
| Serial #: | Engineering Unit | | | | | |
| Voltage: | 3.0 VDC | | | | | |
| Operation Mode: | Normal | | | | | |

## 7. Introduction

On March 26th, 29th, 30th and April 2nd & 5th, 2004 a series of Radiated Emission tests were performed on one sample of the Xecom 900 S 500 Module, here forth referred to as the "*Equipment Under Test*" or "*EUT*". These tests were performed using the procedures outlined in ANSI C63.4-2001 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.247 (Industry Canada RSS-210) for a low power transmitter. These tests were performed by Kenneth L. Boston, EMC Lab Manager and Thomas T. Smith, EMC Engineer of L.S. Compliance, Inc.

All Radiated and Conducted Emission tests upon the EUT were performed to measure the emissions in the frequency bands described in Title 47 CFR, FCC Part 15, including 15.35, 15.209, 15.247 and Industry Canada RSS-210 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 C63.4-2001). Another document used as a reference for the EMI Receiver specification was the Comite International Special Des Perturbations Radioelelectriques (CISPR) Number 16-1, 2002.

## 8. Product Description

The Xecom 900 S 500 Transceiver is a compact frequency hopping spread spectrum 900 MHz transceiver. It is a low power, 500 mW output device with a simple series interface capability. It is based on the Xemics XE1203 transceiver chipset and the T.I. MSP430 microprocessor, and operates with a ¼ wave monopole antenna.

## 9. Test Requirements

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

| | | |
|---|---|---|
| 15.207 | 15.247b | 15.247e |
| 15.205 | 15.247c | 15.109 |
| 15.247a | 15.247d | |

## 10. Summary of Test Report

### DECLARATION OF CONFORMITY

The Xecom 900 S 500 Module was found to **MEET** the requirements as described within the specification of Title 47 CFR FCC, Part 15.247, Subpart C; and Industry Canada RSS-210, Section 6.2.2(o) for a Frequency Hopping Spread Spectrum Transmitter.

## 11. Radiated Emissions Test

### Test Setup

The test setup was assembled in accordance with Title 47, CRF FCC Part 15 and ANSI C63.4-2001. The EUT was placed on an 80cm high non-conductive pedestal centered on a flush mounted 2-meter diameter turntable inside the 3 Meter Semi-Anechoic, FCC listed Chamber located at L. S. Compliance, Inc., Cedarburg, Wisconsin. The EUT was operated in one of several test modes and powered via a 3 volt regulated supply. A laptop computer was used to upload a test program that allowed both fixed channel and frequency hopping operations to be examined. The applicable limits apply at a 3 meter distance, and are found on Page 11 of this test report. Measurements above 5 GHz were also performed at a 1.0 meter separation distance, and the calculation can also be found on Page 11 of this test report. The calculations to determine these limits are detailed on Page 11. Please refer to Appendix A for a list of the test equipment. The test sample was operated on one of three (3) standard channels: low (1), medium (27) and high (52) to comply with FCC Part 15.35. The sample was also inspected with the antenna placed in 3 orthogonal positions, due to the presence of a flexible antenna cable (ant.: vertical, flat, 90° flat).

### Test Procedure

Radiation measurements were performed on the EUT in the 3 Meter Semi-Anechoic, FCC listed Chamber, located at L. S. Compliance, Inc. in Cedarburg, Wisconsin. The frequency range from 30 MHz to 9,300 MHz was scanned, and levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on the non-conductive pedestal in the 3 Meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. 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 9.3 GHz. The maximum radiated emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities.

### 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 an 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. The HP 8546A EMI Receiver was operated with a bandwidth of 120 kHz for measurements below 1 GHz, and a bandwidth of 1 MHz for measurements above 1 GHz. Both the Peak and Quasi-Peak Detector functions were utilized. From 5 GHz to 9.3 GHz, an HP E4407 Spectrum Analyzer and the EMCO Horn Antenna were used.

### Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 for a FHSS 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

The following table depicts the Class B limits for an unintentional radiator. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands.

| Frequency (MHz) | μV/m | 3 m Limit (dBμV/m) | 1 m Limit (dBμV/m) |
|---|---|---|---|
| 30-88 | 100 | 40.0 | - |
| 88-216 | 150 | 43.5 | - |
| 216-960 | 200 | 46.0 | - |
| 960-24,000 | 500 | 54.0 | 63.5 |

Sample conversion from field strength μV/m to dBμV/m:
$dB\mu V/m = 20 \log_{10} (100)$
= 40 dBμV/m (from 30-88 MHz)

For measurements made at 1.0 meter, a 9.5 dB correction has been invoked.

960 MHz to 10,000 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 9.5 = 63.5 dB/μV/m at 1.0 meters

## DUTY CYCLE CORRECTION FACTOR CALCULATION

**Average (Duty Cycle) Factor**

Average Factor = 20 * $Log_{10}$ (Worst Case EUT On-time over 100 ms time window)
In this particular case, the transmit packet envelope or burst length in a single channel can be used to calculate the duty cycle factor.

The transmit burst length (see page 17 of the Conducted Emissions report) occupies 52 ms of time, within any 100 ms window. Therefore, the duty cycle factor allowance is calculated as:

Average Factor = 20 * $Log_{10}$ (52 ms / 100 ms) = -5.7
A duty cycle factor of 5.7 dB would be allowable for this product.

# Measurement of Electromagnetic Radiated Emissions
# Within the 3 Meter FCC Listed Chamber
## Frequency Range Inspected: 30 MHz to 9300 MHz
## Test Requirements: 15.205

| | | | | | | |
|---|---|---|---|---|---|---|
| Manufacturer: | Xecom | | | | | |
| Date(s) of Test: | April 2nd and 5th, 2004 | | | | | |
| Test Engineer(s): | √ | Tom Smith | | Abtin Spantman | √ | Ken Boston |
| Model #: | 900 S 500 | | | | | |
| Serial #: | Engineering Unit | | | | | |
| Voltage: | 3.0 VDC | | | | | |
| Operation Mode: | Normal; antenna vertical unless otherwise indicated by (*) | | | | | |
| EUT Power: | | Single Phase ___VAC | | 3 Phase ___VAC | | |
| | | Battery | √ | Other: 3 volt bench supply | | |
| 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 3110
Pre-Amp: Advanced Microwave WHA6224
Standard Gain Horn: EMCO 3160-09

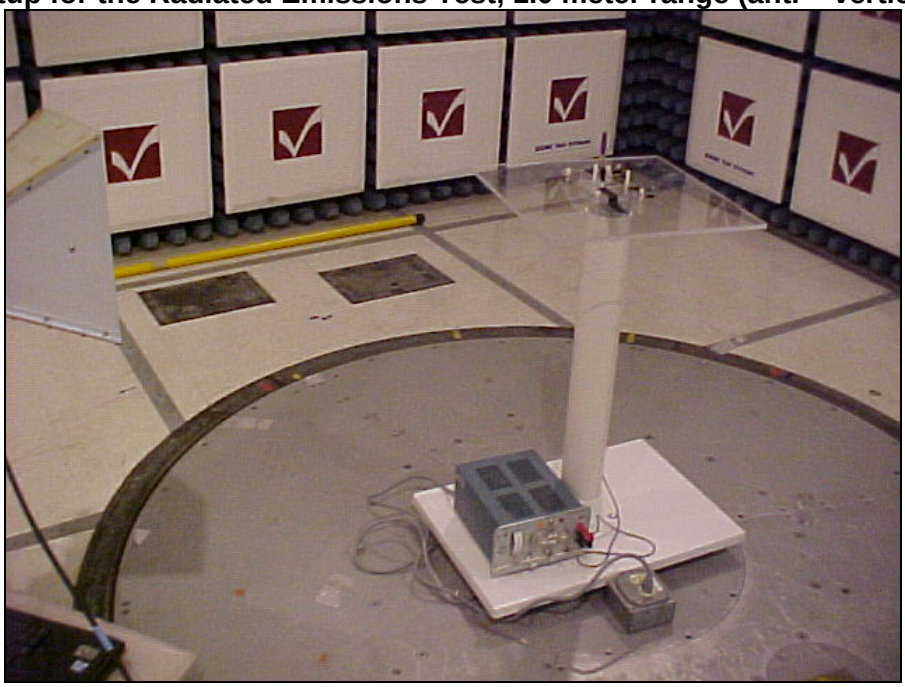
The following table depicts the level of significant radiated emissions found:

| Frequency (MHz) | Antenna Polarity | Channel | Height (meters) | Azimuth (0° - 360°) | EMI Meter Reading (dBµV/m) | | | 15.205 Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 2710 | V | 1 | 1.2 | 315 | 51.5 | 5.7 | 45.8 | 54.0 | 8.2 |
| 3613 | V | 1 * | 1.0 | 225 | 56.2 | 5.7 | 50.5 | 54.0 | 3.5 |
| 4515 | V | 1 | 1.0 | 50 | 56.3 | 5.7 | 50.6 | 54.0 | 3.4 |
| 5420 | V | 1 | 1.05 | 150 | 56.9 | 5.7 | 51.2 | 54.0 | 2.8 |
| 7226.4 | V | 1 | 1.0 | 210 | 62.9 | 5.7 | 57.2 | 63.5 | 6.3 |
| 2745 | H | 27 | 1.0 | 105 | 53.3 | 5.7 | 47.6 | 54.0 | 6.4 |
| 3661 | V | 27 | 1.05 | 350 | 57.3 | 5.7 | 51.6 | 54.0 | 2.4 |
| 4576 | V | 27 | 1.0 | 280 | 54.2 | 5.7 | 48.5 | 54.0 | 5.5 |
| 5492 | V | 27 | 1.0 | 160 | 56.2 | 5.7 | 50.5 | 54.0 | 3.5 |
| 7322 | V | 27 | 1.0 | 240 | 67.0 | 5.7 | 61.3 | 63.5 | 2.2 |
| 2782 | V | 52 | 1.05 | 270 | 52.5 | 5.7 | 46.8 | 54.0 | 7.2 |
| 3708 | V | 52 | 1.05 | 340 | 57.3 | 5.7 | 51.6 | 54.0 | 2.4 |
| 4637 | V | 52 | 1.0 | 275 | 52.3 | 5.7 | 46.6 | 54.0 | 7.4 |
| 5564 | H | 52 | 1.0 | 145 | 56.2 | 5.7 | 50.5 | 54.0 | 3.5 |
| 7412 | V | 52 | 1.0 | 240 | 68.8 | 5.7 | 63.1 | 63.5 | 0.4 |

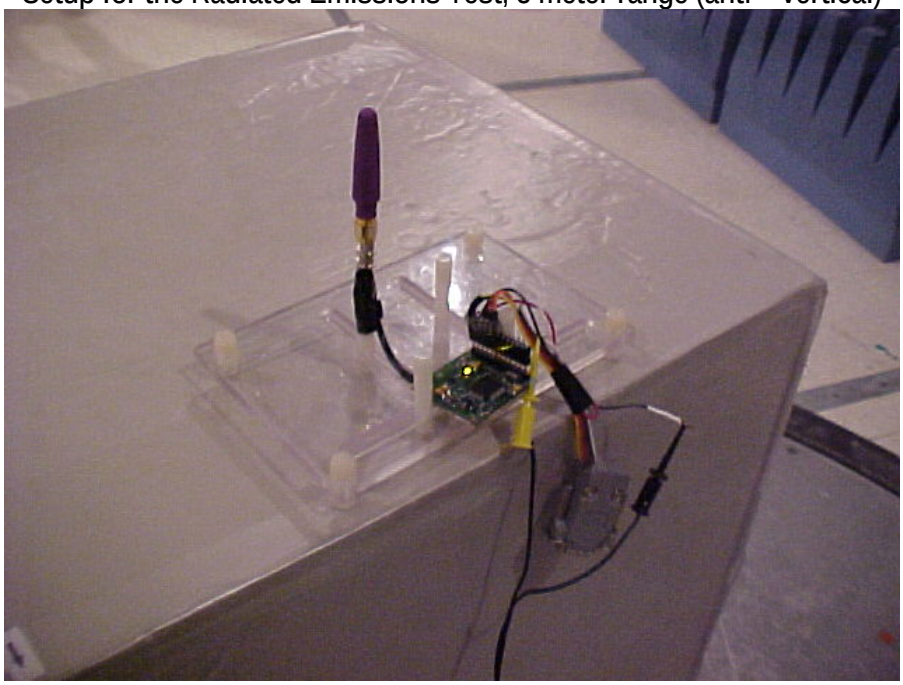
Notes: A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak Detector was used in measurements above 1 GHz.
Unit was tested with the supplied small ¼ wave stub radiator; Temple Star model 01 C-522 with OdBi gain.
(*) ant. = flat position

## Photo(s) Taken During Radiated Emission Testing

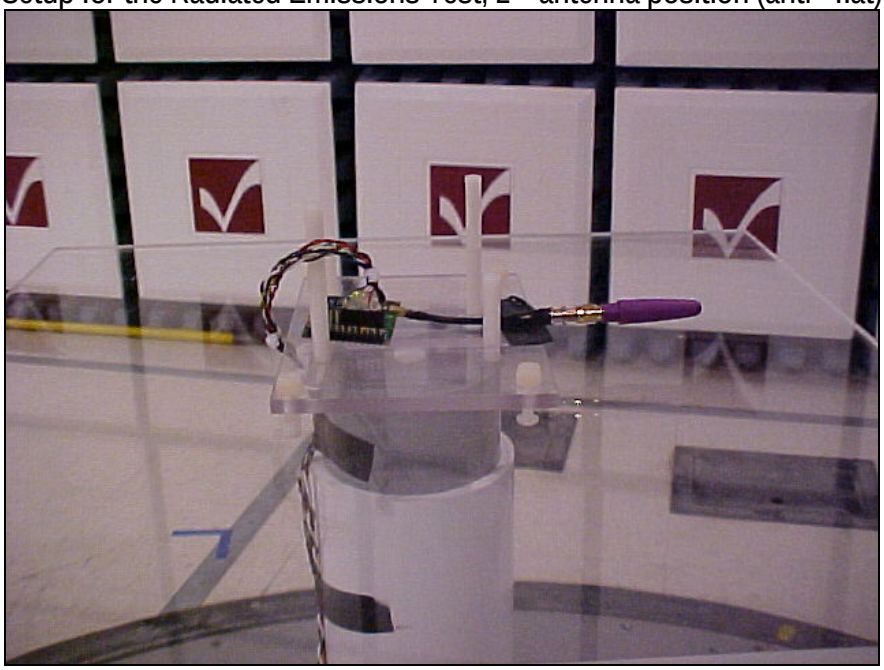
**Setup for the Radiated Emissions Test, 1.0 meter range (ant. = vertical)**



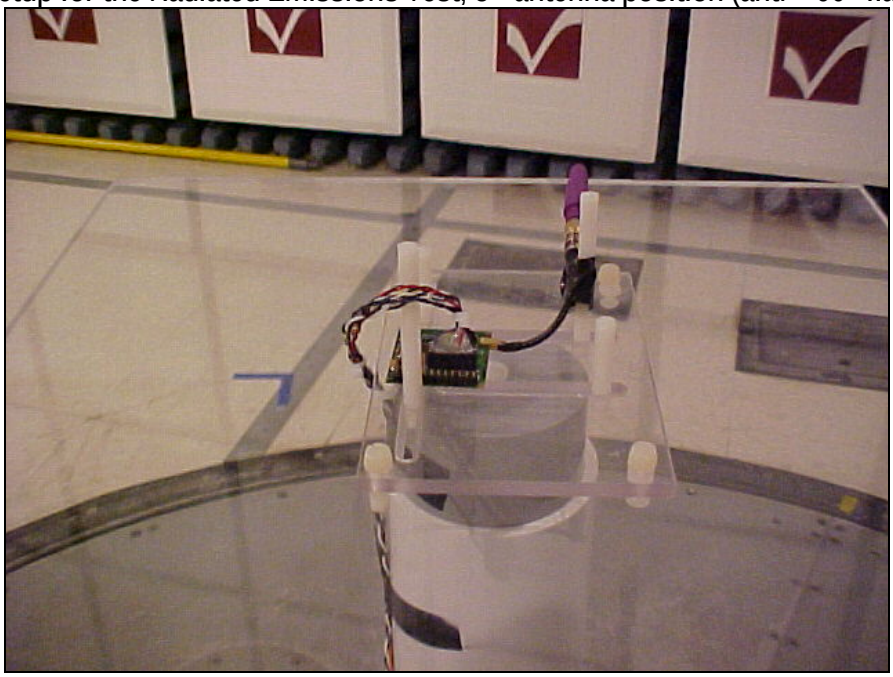
Setup for the Radiated Emissions Test, 3 meter range (ant. = vertical)



Setup for the Radiated Emissions Test, 2nd antenna position (ant.= flat)

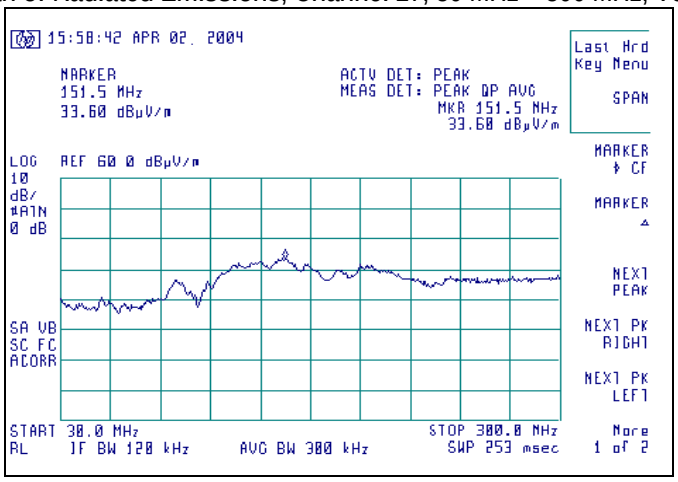


Setup for the Radiated Emissions Test, 3rd antenna position (ant. = 90° flat)

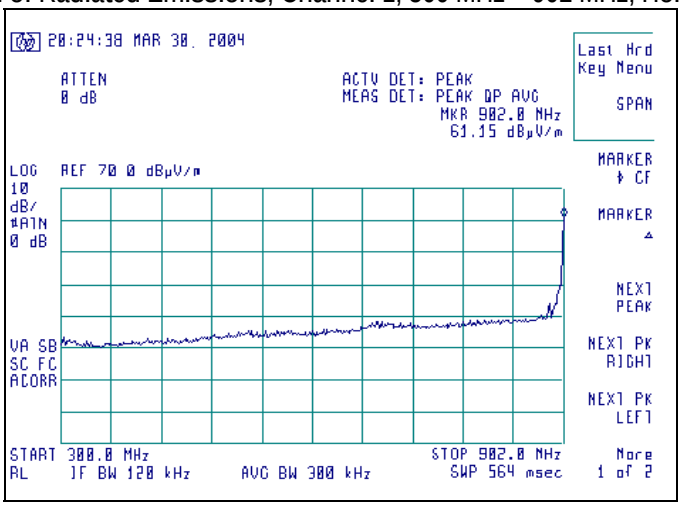


## Graphs made during Radiated Emission Testing; EUT antenna = vertical (unless noted)

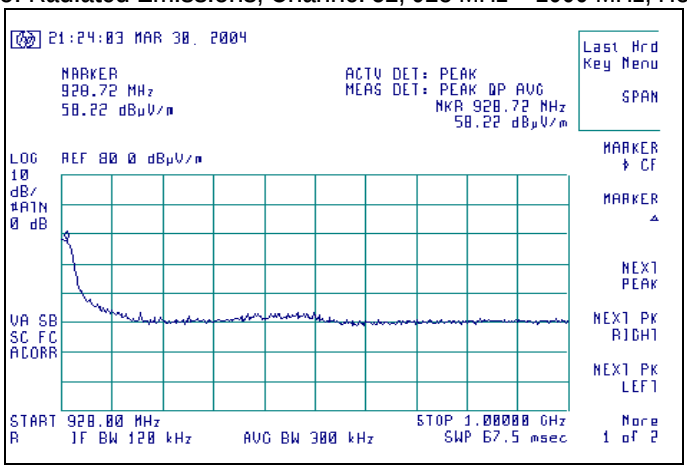
Signature Scan of Radiated Emissions, Channel 27, 30 MHz – 300 MHz, Vertical Polarity




Signature Scan of Radiated Emissions, Channel 1, 300 MHz – 902 MHz, Horizontal Polarity

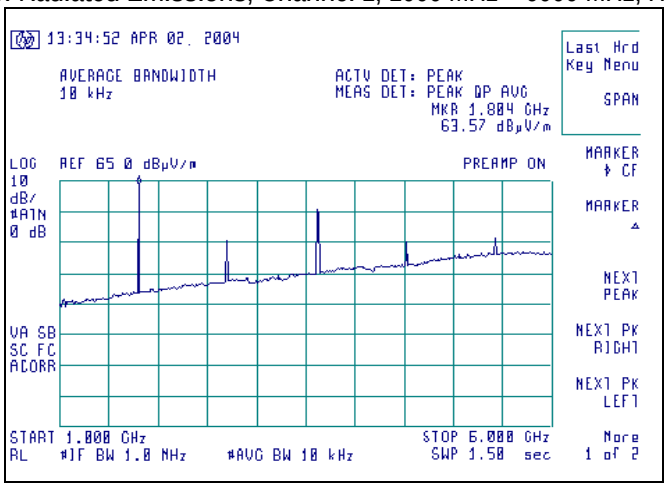



Signature Scan of Radiated Emissions, Channel 52, 928 MHz – 1000 MHz, Horizontal Polarity

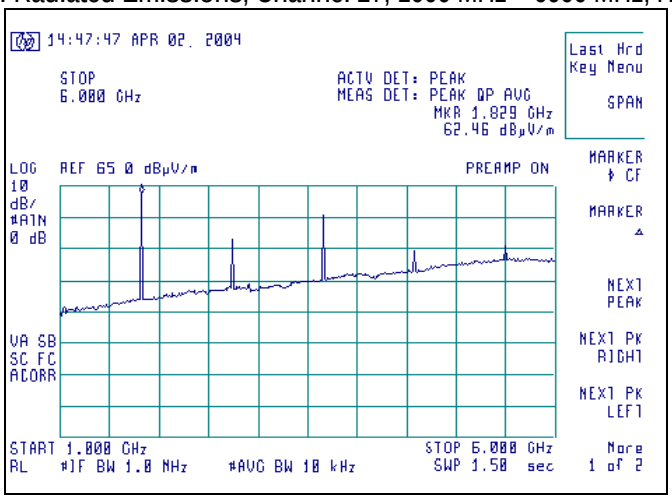


## Graphs made during Radiated Emission Testing (continued)

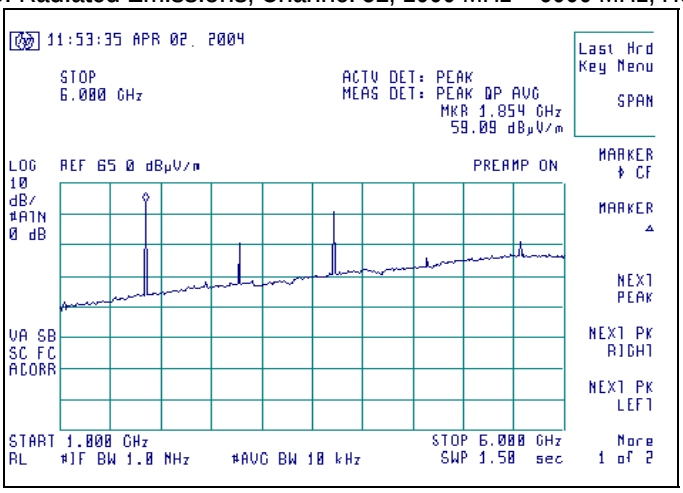
Signature Scan of Radiated Emissions, Channel 1, 1000 MHz – 6000 MHz, Horizontal Polarity




Signature Scan of Radiated Emissions, Channel 27, 1000 MHz – 6000 MHz, Horizontal Polarity

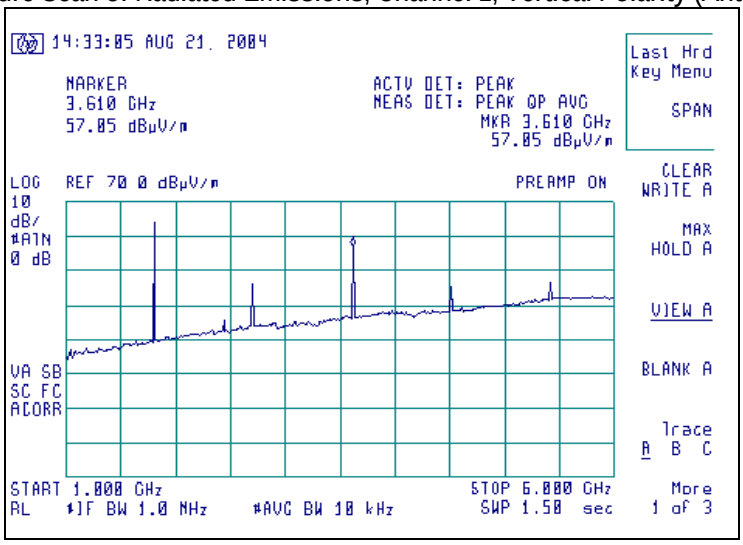



Signature Scan of Radiated Emissions, Channel 52, 1000 MHz – 6000 MHz, Horizontal Polarity

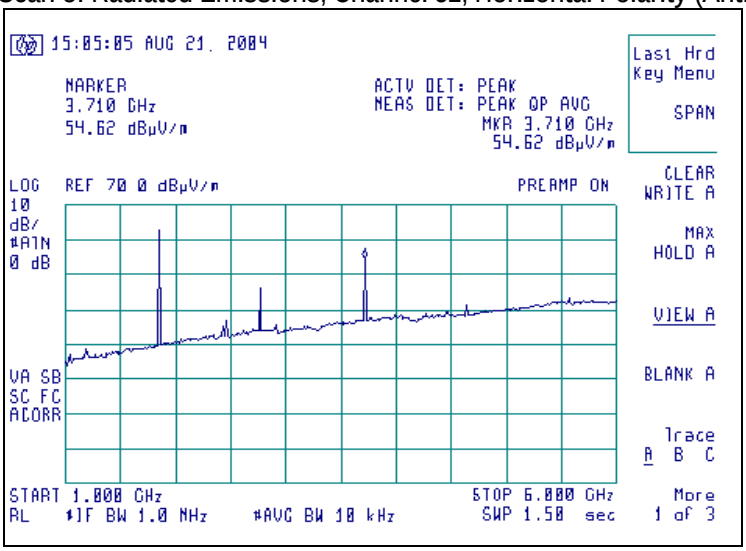


## Graphs made during Radiated Emission Testing (continued)

Signature Scan of Radiated Emissions, Channel 1, Vertical Polarity (Ant. = flat)

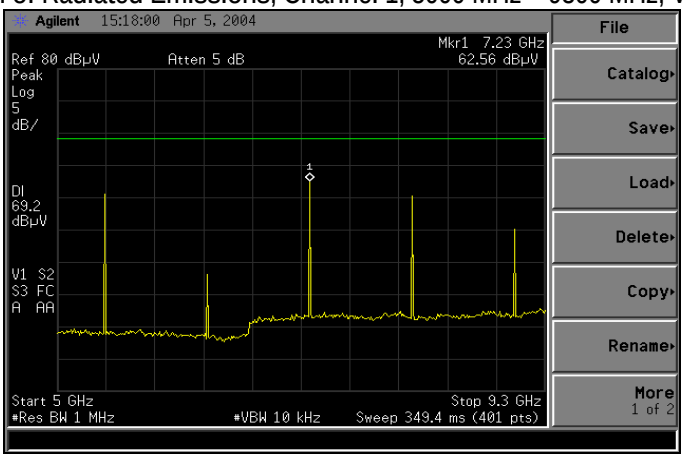



Signature Scan of Radiated Emissions, Channel 52, Horizontal Polarity (Ant. = 90° flat)

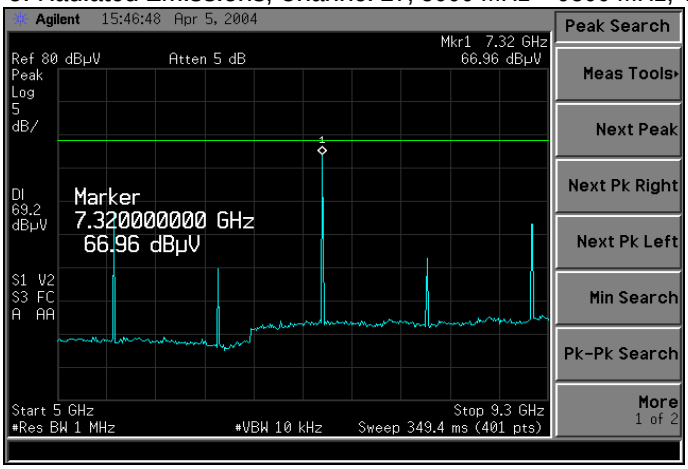


## Graphs made during Radiated Emission Testing (continued)

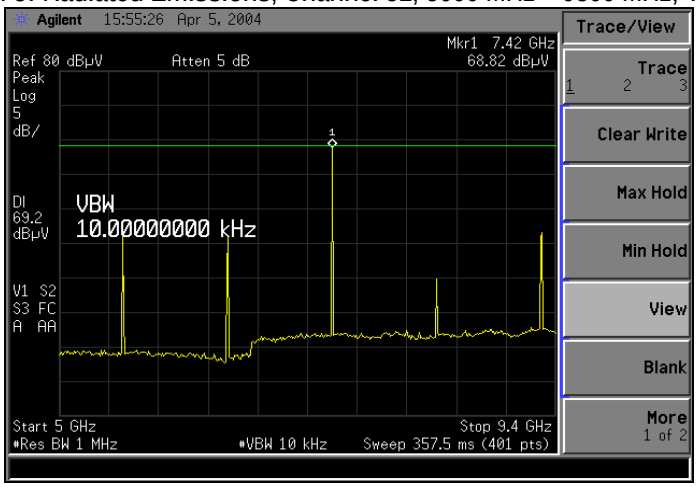
Signature Scan of Radiated Emissions, Channel 1, 5000 MHz – 9300 MHz, Vertical Polarity




Signature Scan of Radiated Emissions, Channel 27, 5000 MHz – 9300 MHz, Vertical Polarity

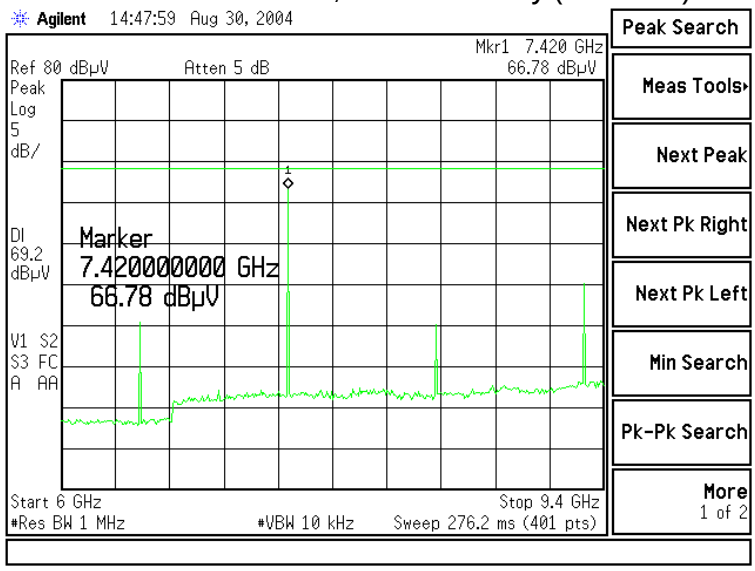



Signature Scan of Radiated Emissions, Channel 52, 5000 MHz – 9300 MHz, Vertical Polarity

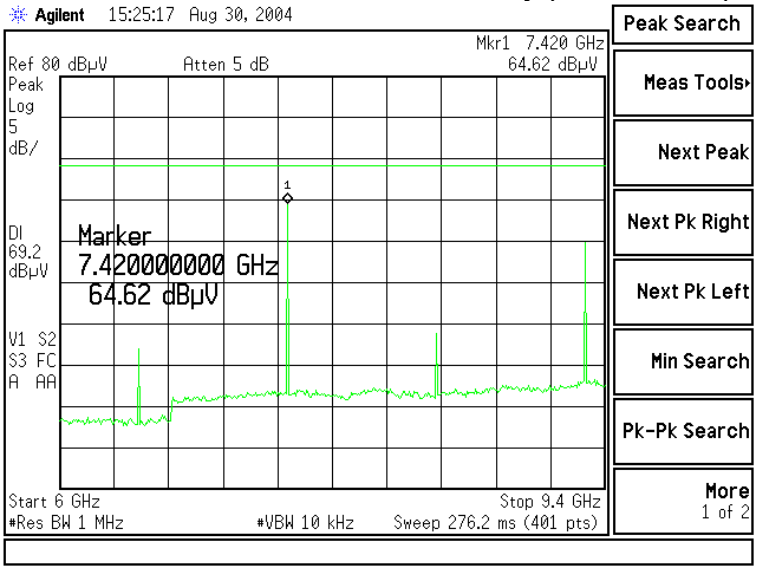


## Graphs made during Radiated Emission Testing (continued)

Signature Scan of Radiated Emissions, Channel 52
6000 MHz – 9400 MHz, Vertical Polarity (Ant. = flat)




Signature Scan of Radiated Emissions, Channel 52
6000 MHz – 9400 MHz, Horizontal Polarity (Ant. = 90° flat)



## 12. Conducted Emissions Test, AC Power Line

### Test Setup

The Conducted Emissions test was performed at L.S. Compliance, Inc. in Cedarburg, Wisconsin. The test area and setup are in accordance with ANSI C63.4-2001 and with Title 47 CFR, FCC Part 15, Subpart B (Industry Canada RSS-210). The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power supply was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was fed into the 3 Meter Semi-Anechoic Chamber 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 cabled 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).

### Test Procedure

The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1 (2002), Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30MHz. Final readings were then taken and recorded.

### Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is 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. 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.

### Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part 15, Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

# Measurement of Electromagnetic Conducted Emission
## In the Shielded Room
### Test Requirements: 15.207
### Frequency Range inspected: 150 KHz to 30 MHz

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Manufacturer: | Xecom | | | | | | | | |
| Date(s) of Test: | May 14, 2004 | | | | | | | | |
| Test Engineer: | | Tom Smith | √ | Abtin Spantman | | Ken Boston | | | |
| Model #: | 900 S 500 | | | | | | | | |
| Serial #: | Engineering Unit | | | | | | | | |
| Voltage: | 3.0 VDC; 115VAC to supply | | | | | | | | |
| Operation Mode: | Normal | | | | | | | | |
| Distance (meters): | 3 Meter Separation | | | | | | | | |
| Test Location: | √ | Shielded Room | | | | 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

Note: No emissions within 20 dB of the limits were found.

# Calculation of Conducted Emissions Limits

The following table describes the 15.207 limits for an intentional radiator. These limits are obtained from Title 47 CFR, Part 15.207 for Conducted Emissions.

| 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:

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

For a frequency of 200 kHz for example:

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

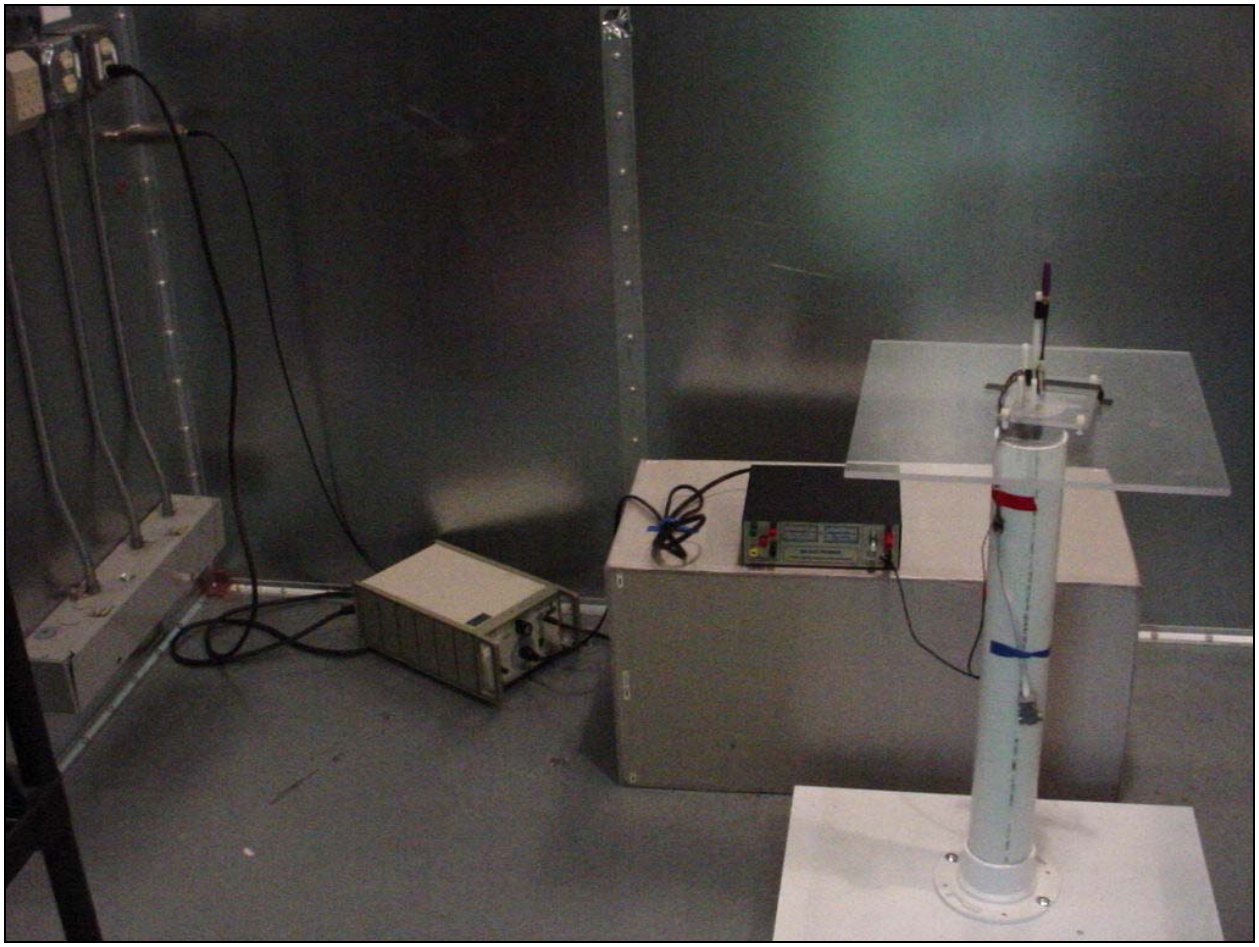
$$\text{Quasi-Peak Limit (F=200kHz)} = 63.6 \text{ dB}\mu\text{V}$$

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

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

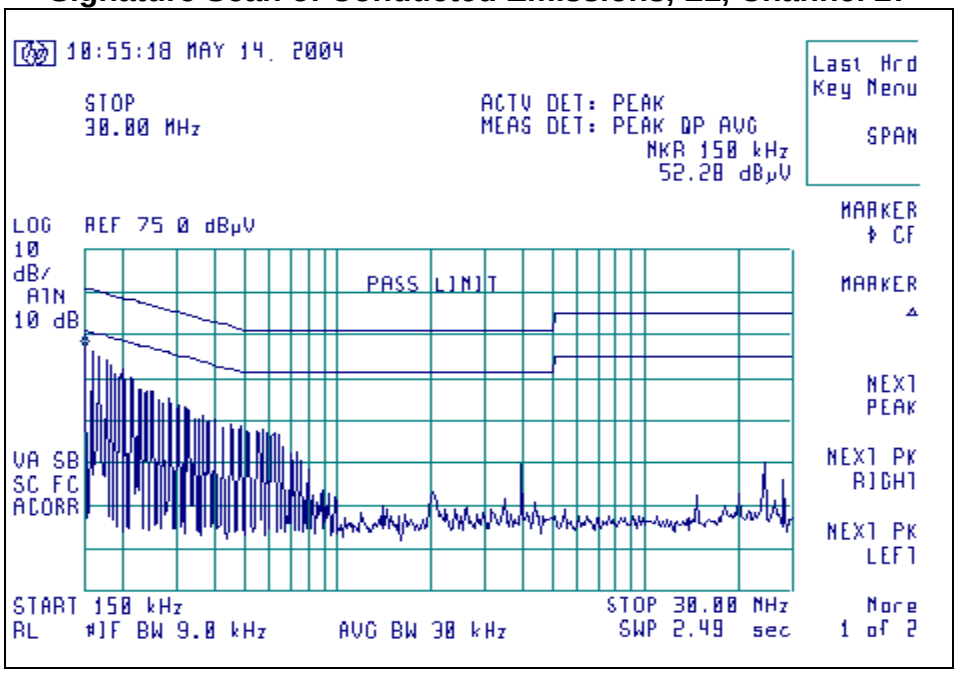
## Photo(s) Taken During Conducted Emission Testing

### Setup for the Conducted Emissions Test

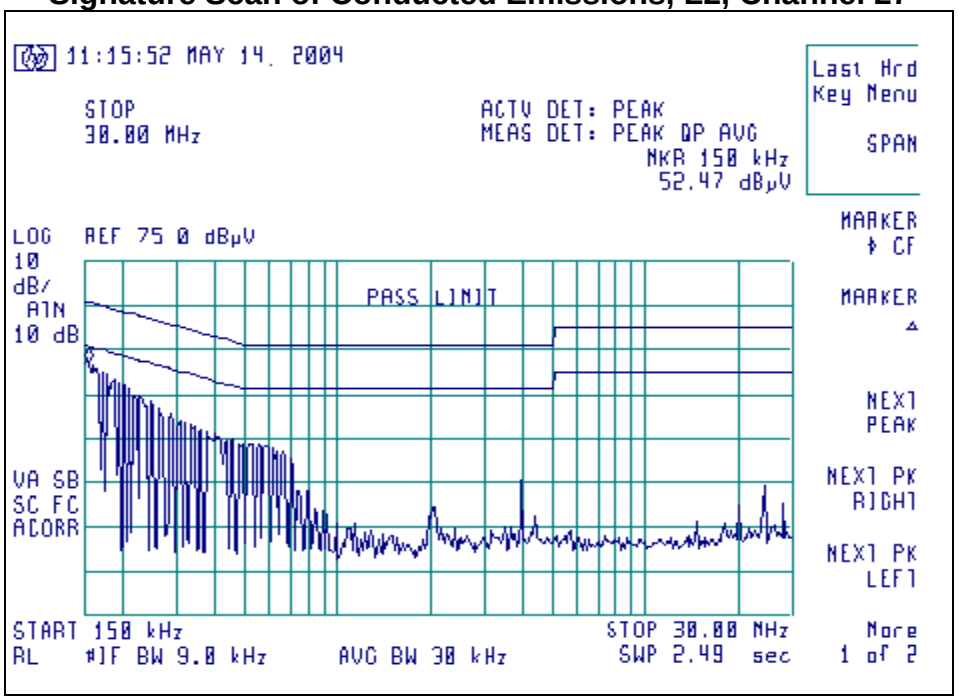


## Graphs made during Conducted Emission Testing

### Signature Scan of Conducted Emissions, L1, Channel 27




### Signature Scan of Conducted Emissions, L2, Channel 27



# Appendix A

## Test Equipment List

| Asset # | Manufacturer | Model # | Serial # | Description | Date | Due |
|---|---|---|---|---|---|---|
| AA960008 | EMCO | 3816/2NM | 9701-1057 | Line Impedance Stabilization Network | 9/03/03 | 9/03/04 |
| AA960031 | HP | 119474A | 3107A01708 | Transient Limiter | Note 1 | Note 1 |
| AA960077 | EMCO | 93110B | 9702-2918 | Biconical Antenna | 9/02/03 | 9/02/04 |
| AA960078 | EMCO | 93146 | 9701-4855 | Log-Periodic Antenna | 9/02/03 | 9/02/04 |
| AA960081 | EMCO | 3115 | 6907 | Double Ridge Horn Antenna | 11/14/03 | 11/14/04 |
| CC00221C | Agilent | E4407B | US39160256 | Spectrum Analyzer | 11/04/03 | 11/04/04 |
| EE960004 | EMCO | 2090 | 9607-1164 | Device Controller | N/A | N/A |
| EE960013 | HP | 8546A | 3617A00320 | Receiver RF Section | 9/04/03 | 9/04/04 |
| EE960014 | HP | 85460A | 3448A00296 | Receiver Pre-Selector | 9/04/03 | 9/04/04 |
| N/A | LSC | Cable | 0011 | 3 Meter ½" Armored Cable | 6/07/04 | 6/07/05 |
| N/A | LSC | Cable | 0038 | 1 Meter RG 214 Cable | 6/07/04 | 6/07/05 |
| N/A | LSC | Cable | 0050 | 10 Meter RG 214 Cable | 6/07/04 | 6/07/05 |
| N/A | Pasternack | Attenuator | N/A | 10 dB Attenuator | Note 1 | Note 1 |

*Note 1 - Equipment calibrated within a traceable system.*

*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 |