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

COMPLIANCE TESTING OF:

ALERTx Transceiver Module
AX7910

PREPARED FOR:

Abenex Mfg., a division of Actall Corporation

TEST REPORT NUMBER:

303420

TEST DATE(S):

October through November, 2003

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1. L. S. Compliance In Review

Brief Review of
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:

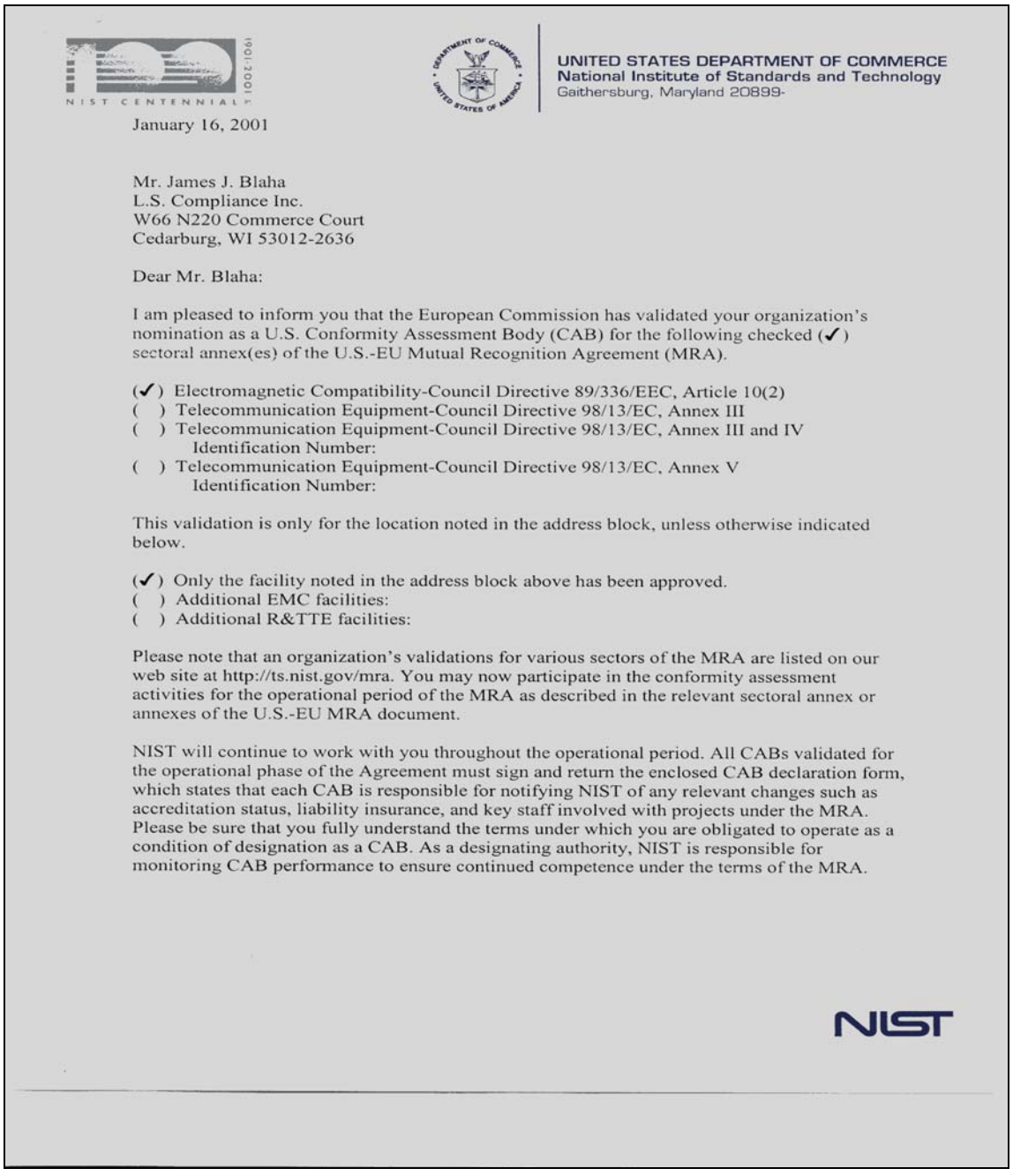
Test	Test Method(s)
Emissions	
Conducted	
Continuous/Discontinuous	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; EN: 55011, 55022, 50081-1, 50081-2; CISPR: 11, 12, 14-1, 22; CNS 13438
Radiated	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; 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.

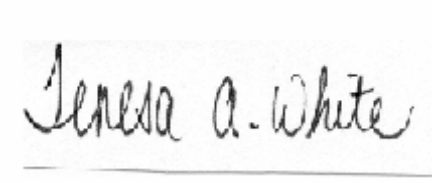
(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

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.

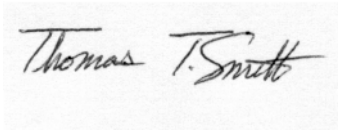
NIST

5. Signature Page



Prepared By: **December 16, 2003**

Teresa A. White, Document Coordinator **Date**



Tested By: **December 16, 2003**

Thomas T. Smith, EMC Engineer **Date**

Tested By: **December 16, 2003**

Abtin Spantman, EMC Engineer **Date**

Tested and Approved By: **December 16, 2003**

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:	Abenex Mfg., a division of Actall Corporation
Model No.:	AX7910
Serial No.:	Pre-Production
Description:	ALERTx transceiver module, 900 MHz F.H.S.S.

7. Product Description

The AX7910 Transceiver is a compact Frequency Hopping Spread Spectrum 900 MHz transceiver. It features low power consumption in receive or standby modes, 0.5 watt of RF output power, simple serial interface and is low cost. It is based on the XEMICS XE1203 transceiver chipset, and the T.I. MSP430 microprocessor. The transceiver is operated with 2 styles of a ¼ wave monopole antenna.

8. Test Requirements

The above mentioned tests were performed in order to determine the compliance of the ALERTx module 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	

All radiated emissions tests were performed to measure the emissions in the frequency bands described by the above sections, and to determine whether said emissions are below the limits established by the above sections. These tests were performed in accordance with the procedure 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 reference for the EMI receiver specification was the International Special Committee on Radio Interference (CISPR) Number 16-1 (2002). Measurement technique guidelines found in FCC Public Notice DA 00-705 were also consulted.

9. Summary of Test Report

DECLARATION OF CONFORMITY

The ALERTx 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 for a Frequency Hopping Spread Spectrum Transmitter.

10. Introduction

During October and November of 2003, a series of Radiated Emission tests were performed on one sample of the ALERTx 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, Thomas T. Smith, EMC Engineer and Abtin Spantman, EMC Engineer of L.S. Compliance, Inc.

11. Purpose

All Radiated and Conducted Emission tests upon the ALERTx module 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.

12. 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. Two antenna types, both quarter wave monopoles, were tested. The applicable limits apply at a 3 meter distance, and are found in Page 12. Measurements above 1 GHz were performed at a 1.0 meter separation distance, and the calculation can also be found in Page 12. The calculations to determine these limits are detailed in the following pages. 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 (45) and high (89) to comply with FCC Part 15.35.

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 24,000 MHz was pre-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 1 meter or 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 an EMCO Horn Antenna were used.

Test Results

The EUT was found to MEET the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.109 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 general limits for an intentional 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.

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, Subpart C (Industry Canada RSS-210) for an intentional radiator.

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.

Measurement of Electromagnetic Radiated Emissions
Within the 3 Meter FCC Listed Chamber

Frequency Range Inspected: 30 MHz - 10,000 MHz

Manufacturer: Abenex Mfg. , a division of Actall Corporation
Date(s) of Test: October through November, 2003
Model No.: AX7910
Serial No.: Pre-Production
Test Requirements: 15.205

Distance: 3 Meters. 1.0 meters	**Frequency Range Inspected:** 30 to 9,300 MHz
Configuration: Continuous Data Transmit; test message; fixed hop channel	

Test Equipment Used:

EMI Receiver: HP 8546A	Biconical Antenna: EMCO 3110
Double-Ridged Wave Guide/Horn Antenna: EMCO 3115	Log Periodic Antenna: EMCO 43146A
Standard Gain Horn: EMCO 3160-09	PreAmp: Advanced Microwave WLA612

Detector(s) Used:	√	Peak	√	Quasi-Peak		Average

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

Frequency (MHz)	Antenna Polarity	Channel (Antenna)	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBμV/m)	Duty Correction	EMI Meter Corrected Reading	15.205 Limit (dBμV/m)	Margin (dB)
966.2	V	89(a)	1.15	105	*44.2	--	44.2	54.0	9.8
2708	H	1(a)	1.0	115	68.9	5.7	63.2	63.5	0.3
2745	H	45(a)	1.0	230	66.7	5.7	61.0	63.5	2.5
2782	V	89(a)	1.0	120	67.1	5.7	61.4	63.5	2.1
3611	H	1(a)	1.25	130	59.6	5.7	53.9	63.5	9.6
3660	H	45(a)	1.0	190	64.4	5.7	58.7	63.5	4.8
3709	H	89(a)	1.20	135	67.9	5.7	62.2	63.5	1.3
4514	H	1(a)	1.05	150	67.1	5.7	61.4	63.5	2.1
4575	H	45(a)	1.0	135	63.9	5.7	58.2	63.5	5.3
4636	H	89(a)	1.0	135	60.6	5.7	54.9	63.5	8.6
5416.7	H	1(a)	1.0	160	62.1	5.7	56.4	63.5	7.1
7320.0	H	45(a)	1.0	160	66.5	5.7	60.8	63.5	2.7
7417.6	V	89(a)	1.0	260	65.1	5.7	59.4	63.5	4.1
8124.8	H	1(a)	1.0	230	60.3	5.7	54.6	63.5	8.9
8233.4	H	45(a)	1.0	170	59.0	5.7	53.3	63.5	10.2
8345.2	H	89(a)	1.0	190	60.7	5.7	55.0	63.5	8.5
2781	V	89(b)	1.0	170	67.2	5.7	61.5	63.5	2.0
3708	V	89(b)	1.0	45	66.0	5.7	60.3	63.5	3.2
4636	H	89(b)	1.0	115	68.5	5.7	62.8	63.5	0.7
5490	H	45(b)	1.0	115	66.1	5.7	60.4	63.5	3.1
7230	V	1(b)	1.0	180	68.4	5.7	62.7	63.5	0.8
8235	V	1(b)	1.0	40	63.6	5.7	57.9	63.5	5.6

Notes: A Quasi-Peak Detector (3 meter measurement distance) (*) was used in measurements below 1 GHz; a Peak Detector was used in measurements above 1 GHz. The peak readings were corrected with a duty cycle factor, which accounts for the packet transmit on-time, and the resultant average reading is compared to the limit. All measurements above 1 GHz were conducted at 1 meter separation, in order to obtain maximum dynamic range of the instrumentation during the peak measurements in the 1 megahertz bandwidth.

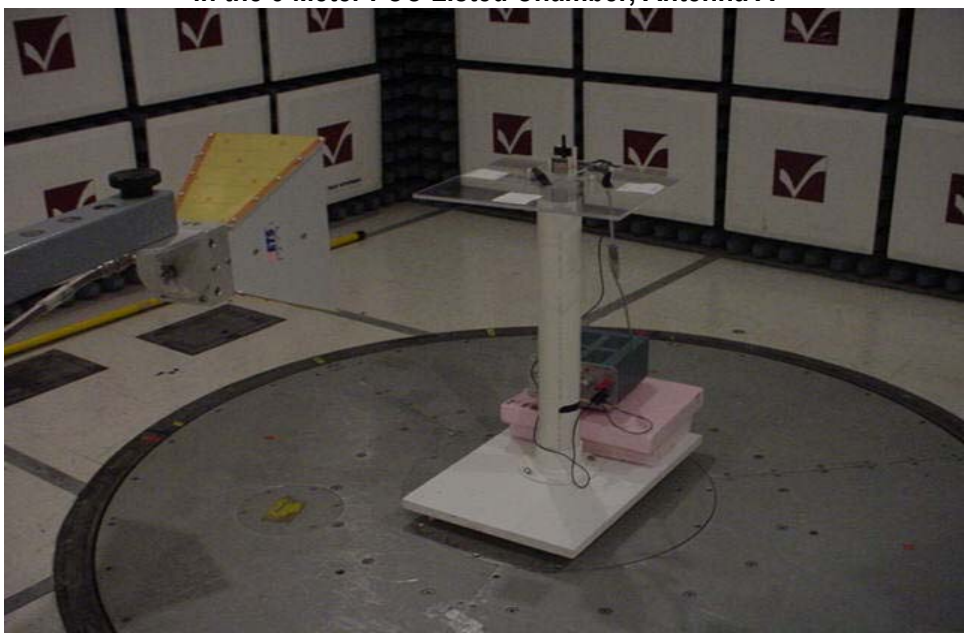
Antenna Case (a): Small ¼ wavelength monopole
Antenna Case (b): 3.5" wire vertical antenna

All other emissions seen were greater than 10 dB below the limits.

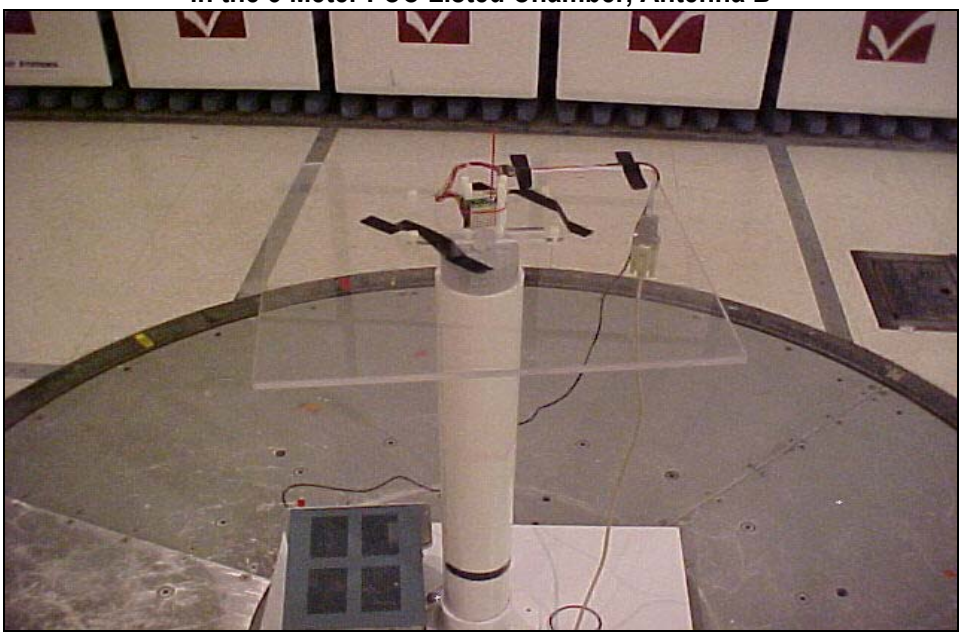
Photos Taken During Radiated Emission Testing

Setup for the Radiated Emissions Test

View of the EUT during Radiated Emission Testing in the 3 Meter FCC Listed Chamber, Antenna A

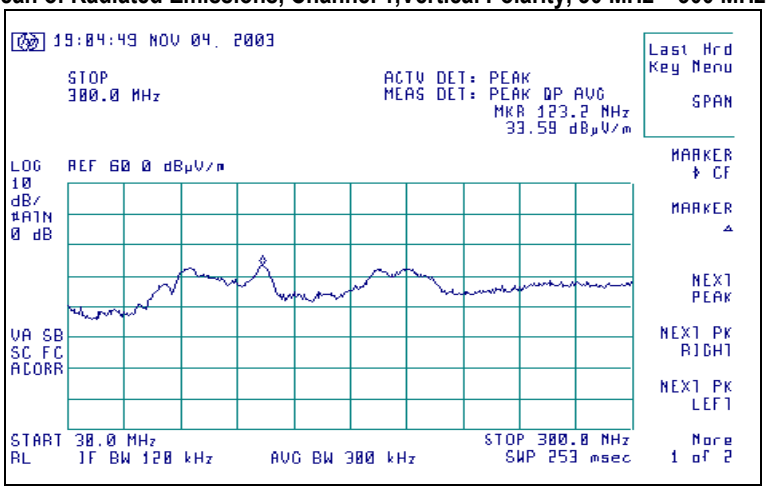


View of the EUT during Radiated Emission Testing in the 3 Meter FCC Listed Chamber, Antenna B

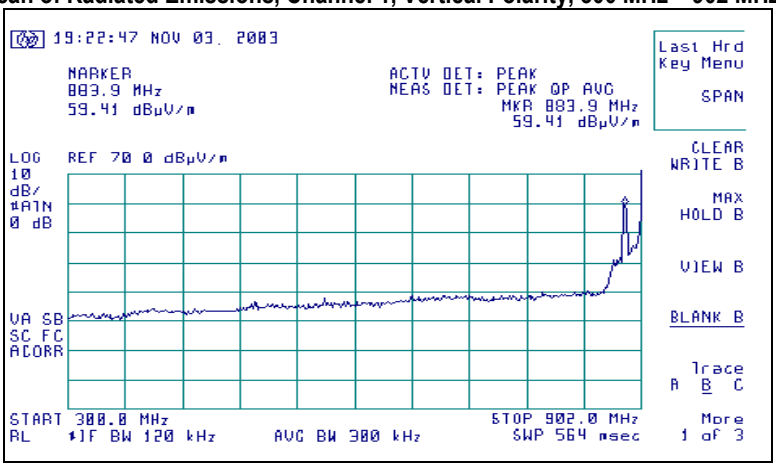


Graphs made during Radiated Emission Testing

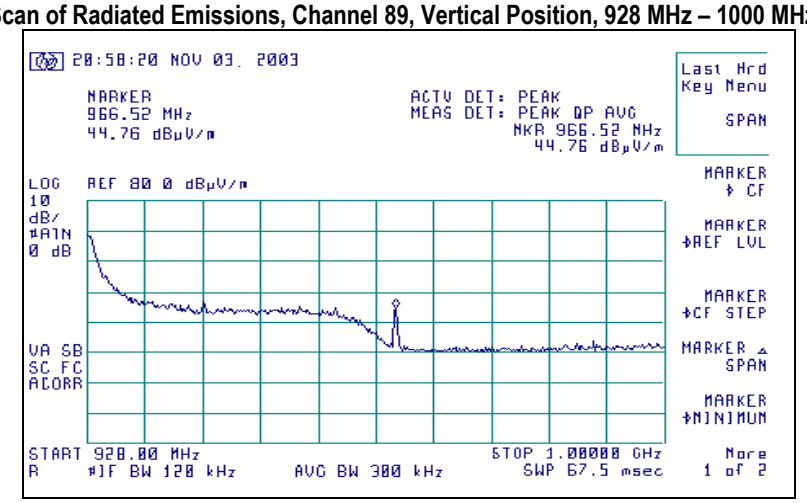
Signature Scan of Radiated Emissions, Channel 1,Vertical Polarity, 30 MHz – 300 MHz, Antenna A



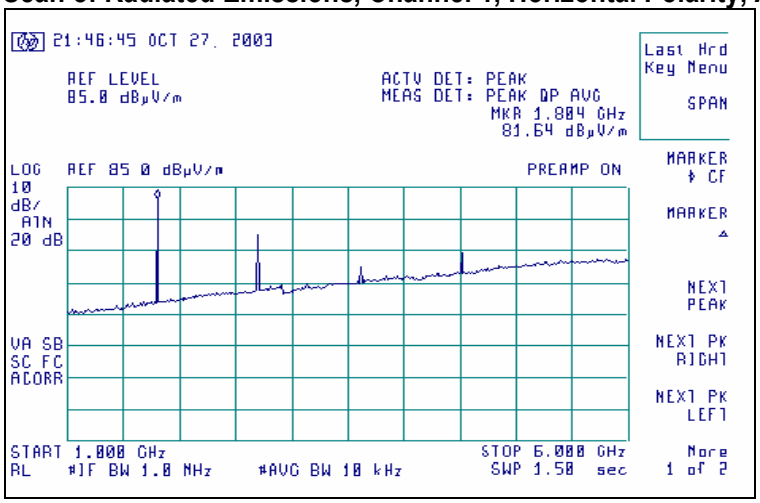
Signature Scan of Radiated Emissions, Channel 1, Vertical Polarity, 300 MHz – 902 MHz, Antenna A



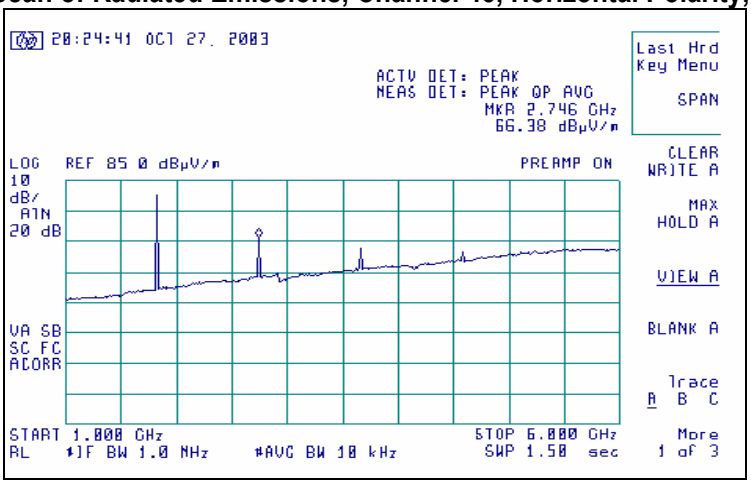
Signature Scan of Radiated Emissions, Channel 89, Vertical Position, 928 MHz – 1000 MHz, Antenna A



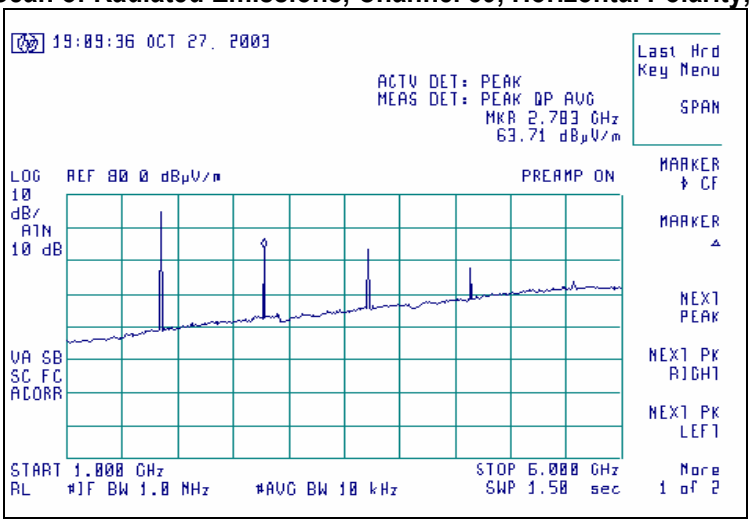
Signature Scan of Radiated Emissions, Channel 1, Horizontal Polarity, Antenna A



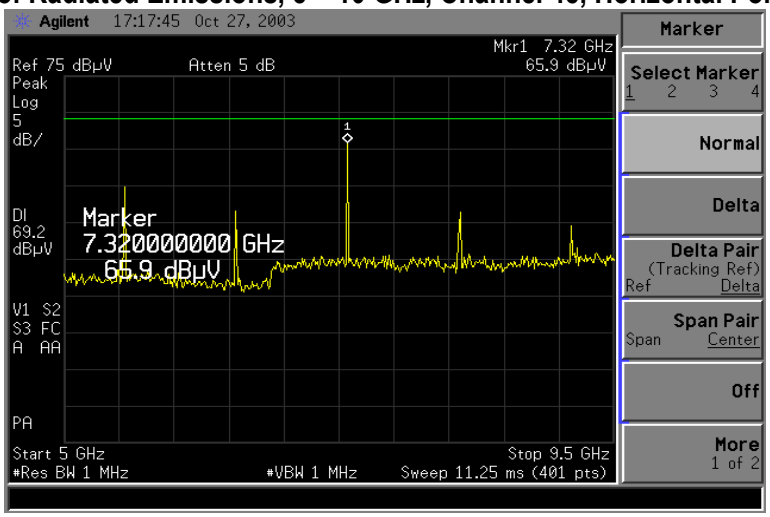
Signature Scan of Radiated Emissions, Channel 45, Horizontal Polarity, Antenna A



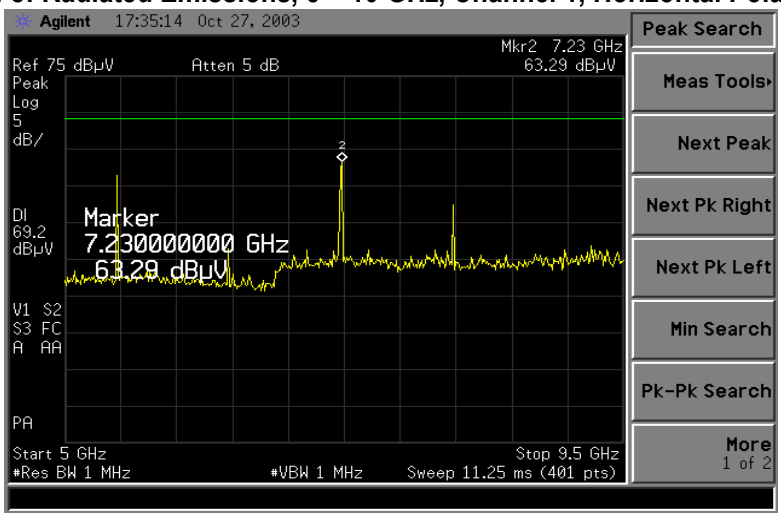
Signature Scan of Radiated Emissions, Channel 89, Horizontal Polarity, Antenna A



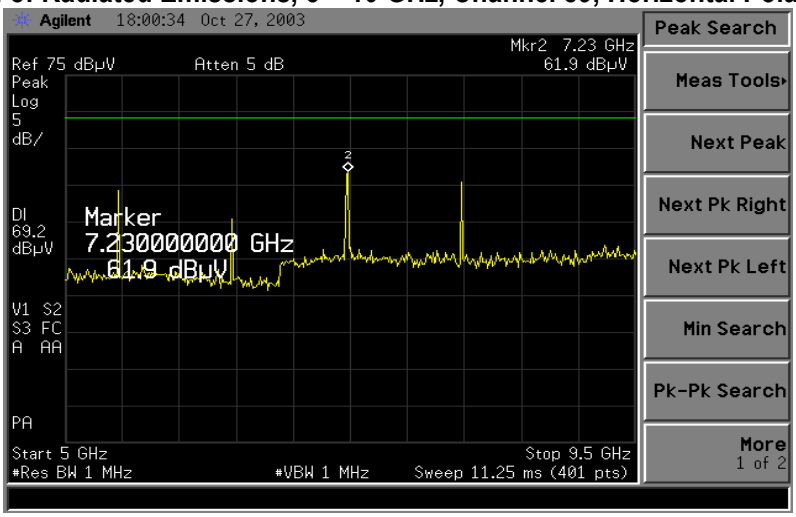
Signature Scan of Radiated Emissions, 5 – 10 GHz, Channel 45, Horizontal Polarity, Antenna A



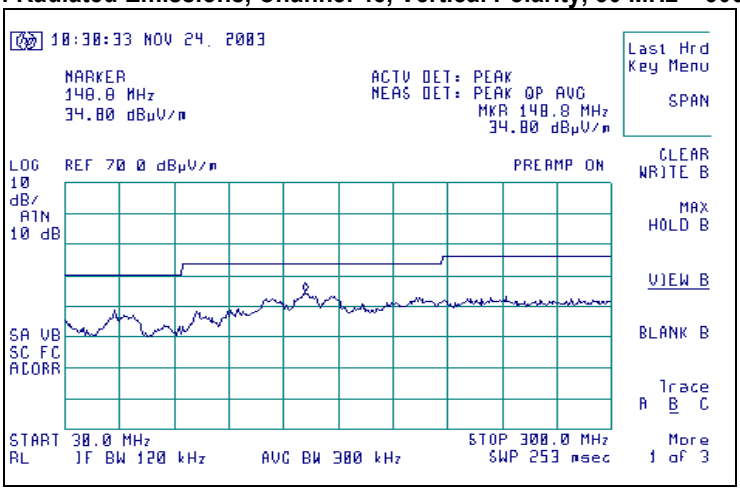
Signature Scan of Radiated Emissions, 5 – 10 GHz, Channel 1, Horizontal Polarity, Antenna A



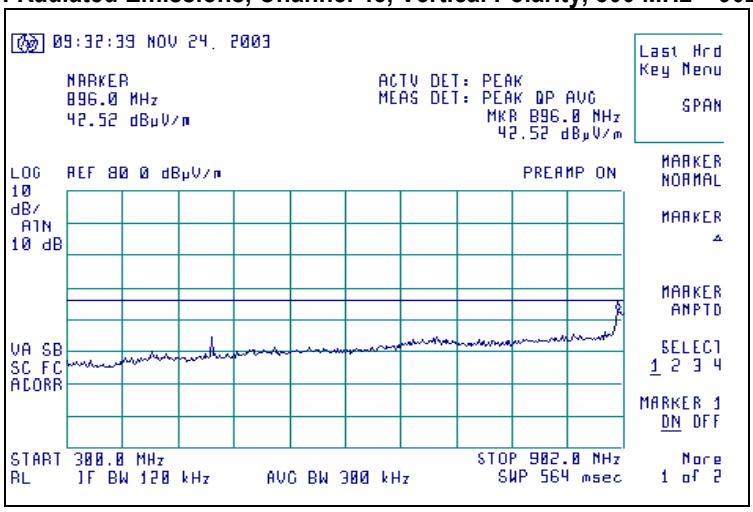
Signature Scan of Radiated Emissions, 5 – 10 GHz, Channel 89, Horizontal Polarity, Antenna A



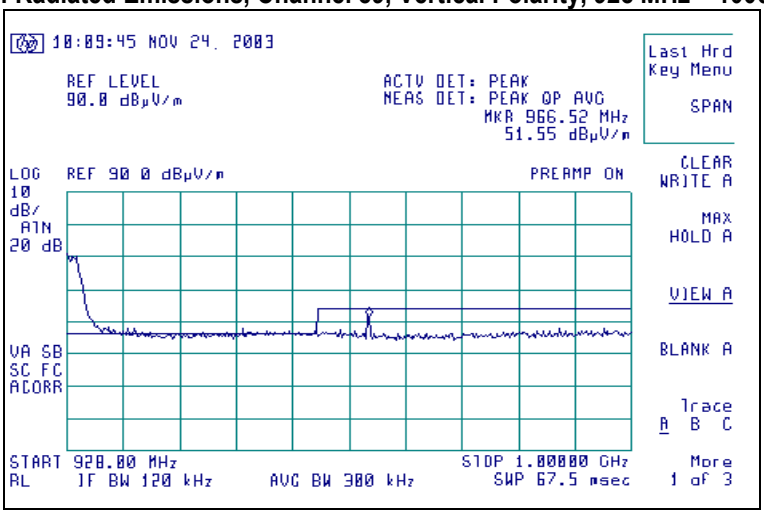
Signature Scan of Radiated Emissions, Channel 45, Vertical Polarity, 30 MHz – 300 MHz, Antenna B



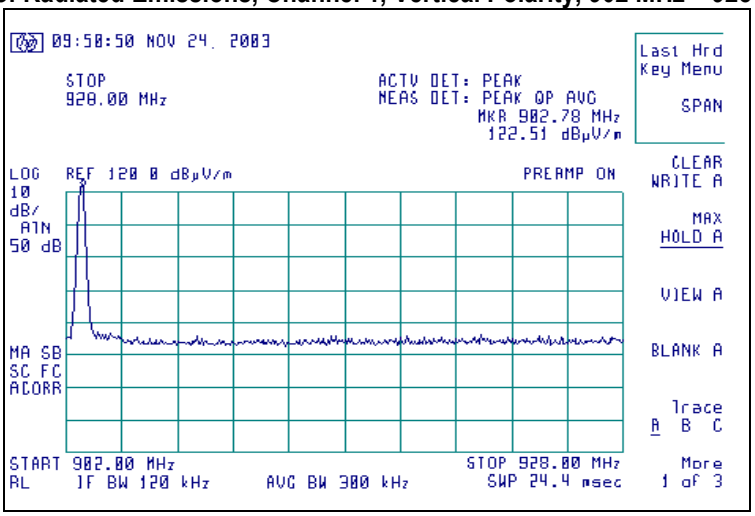
Signature Scan of Radiated Emissions, Channel 45, Vertical Polarity, 300 MHz – 902 MHz, Antenna B



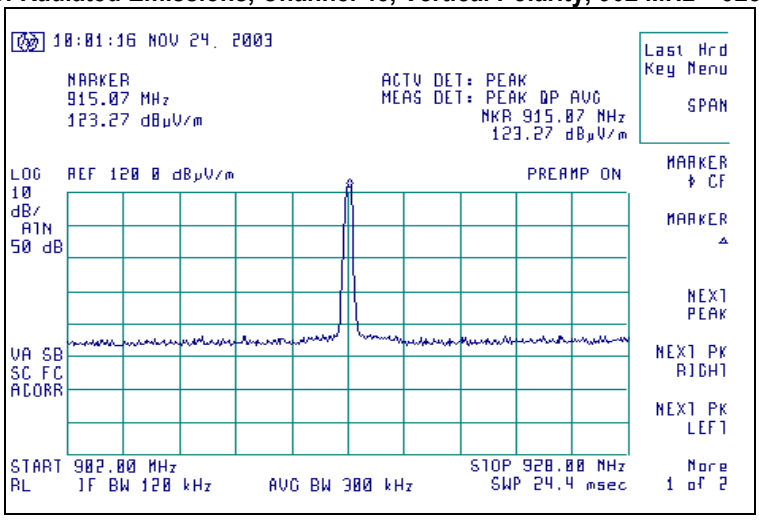
Signature Scan of Radiated Emissions, Channel 89, Vertical Polarity, 928 MHz – 1000 MHz, Antenna B



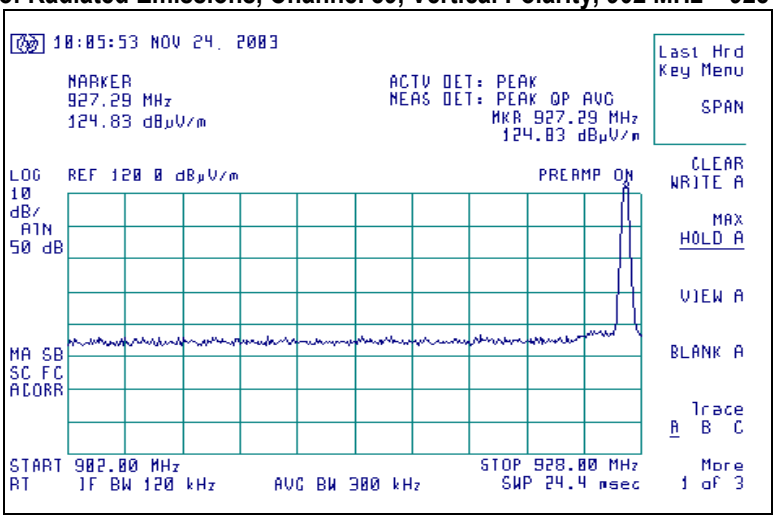
Signature Scan of Radiated Emissions, Channel 1, Vertical Polarity, 902 MHz – 928 MHz, Antenna B



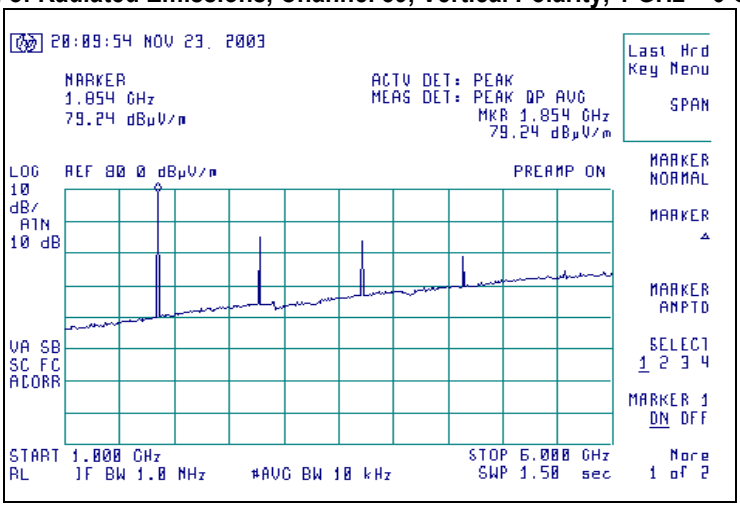
Signature Scan of Radiated Emissions, Channel 45, Vertical Polarity, 902 MHz – 928 MHz, Antenna B



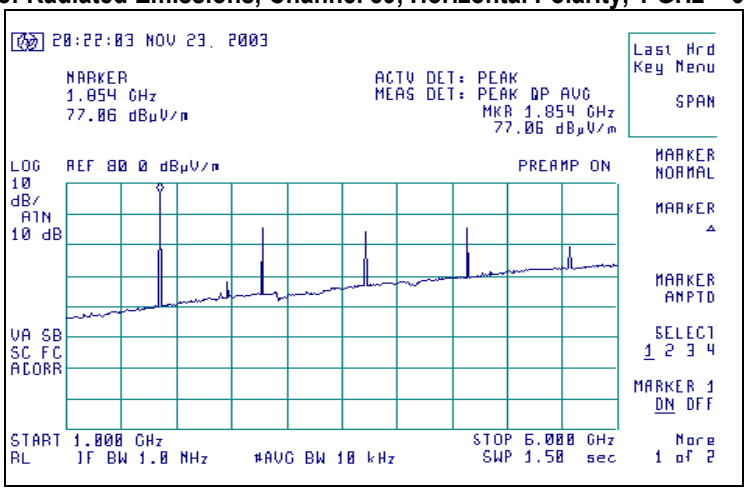
Signature Scan of Radiated Emissions, Channel 89, Vertical Polarity, 902 MHz – 928 MHz, Antenna B



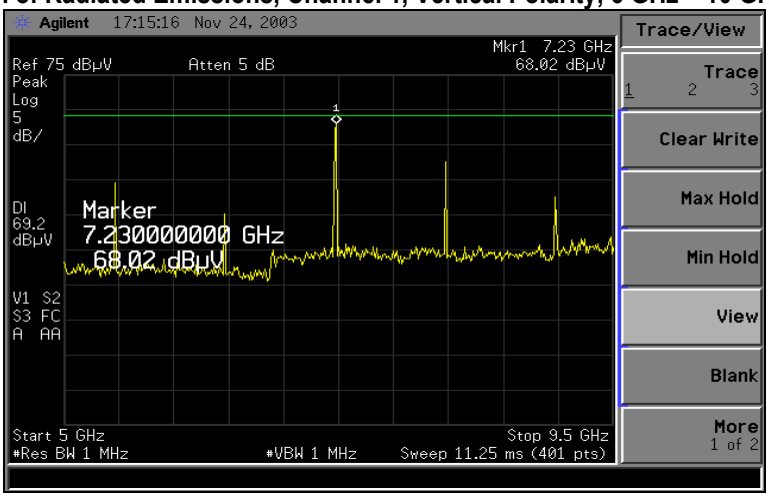
Signature Scan of Radiated Emissions, Channel 89, Vertical Polarity, 1 GHz – 6 GHz, Antenna B



Signature Scan of Radiated Emissions, Channel 89, Horizontal Polarity, 1 GHz – 6 GHz, Antenna B



Signature Scan of Radiated Emissions, Channel 1, Vertical Polarity, 6 GHz – 10 GHz, Antenna B



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	8/12/03	8/12/04
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	2/03/03	2/03/04
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
EE960047	Adv. Microwave	WLA612	0123101	Pre-amplifier	Note 1 *	Note 1 *
N/A	LSC	Cable	0011	3 Meter ½" Armored Cable	6/07/03	6/07/04
N/A	LSC	Cable	0038	1 Meter RG 214 Cable	6/07/03	6/07/04
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	6/07/03	6/07/04
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	4.80 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 Meter Chamber, 3 Volts/Meter	1.128 Volts/Meter
Conducted Immunity	3 Volt level	1.0 V