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

Assigned Engineer: Tom Smith

Compliance Testing of:

Mother/Baby Transmitter

Prepared For:

RF Technologies, Inc.
Attn.: Mr. John LaBorde
3125 N. 126th Street
Brookfield, WI 53005

Test Report Number:

303443 TX Rev. 1

Test Date(s):

November 20th, 2003

All results of this report relate only to the items that were tested. This report may not be reproduced, except in full, without written approval of L.S. Compliance, Inc.

Table of Contents

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:

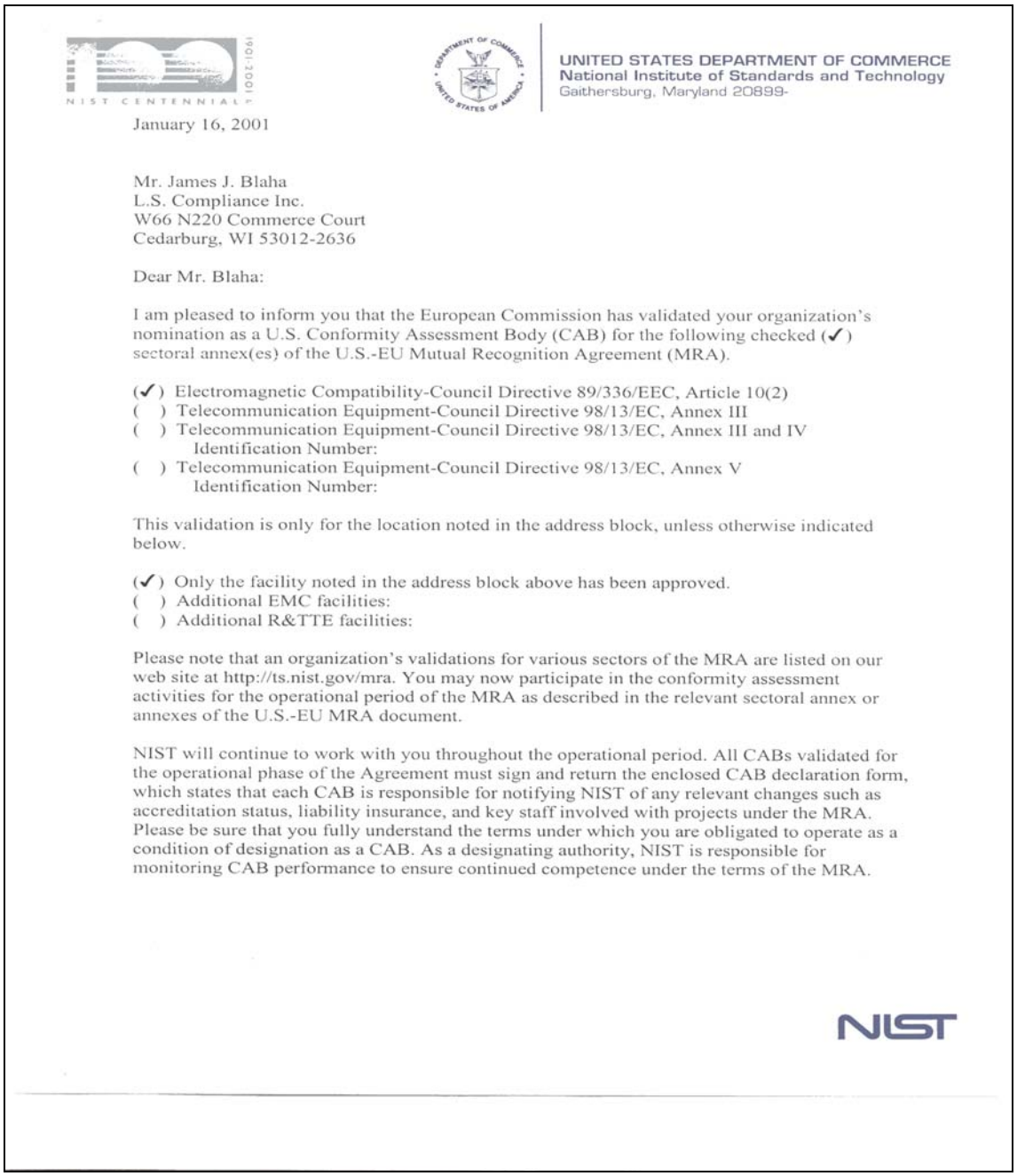
Test	Test Method(s)
Emissions	
Conducted	
Continuous/Discontinuous	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; EN: 55011, 55022, 50081-1, 50081-2; CISPR: 11, 12, 14-1, 22; CNS 13438
Radiated	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4;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

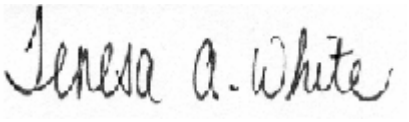
(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

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



January 21, 2004

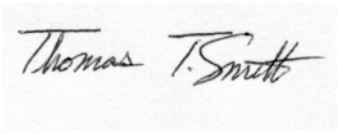
Prepared By: _____

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

January 21, 2004

Tested By: _____

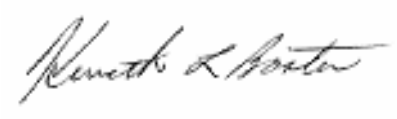
Abtin Spantman, EMC Engineer **Date**



January 21, 2004

Tested By: _____

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



January 21, 2004

Approved By: _____

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:	RF Technologies, Inc.
Model Number:	9450-3000
Serial Number:	Engineering Unit

Environmental Conditions in the Test Lab:

Temperature: 20-25◦ C
Atmospheric Pressure: 86kPa-106kPa
Humidity: 30-60%

7. Introduction

On November 20, 2003, a series of Radiated Emissions tests were performed on one sample of the Mother/Baby Transmitter, Model Number 9450-3000, Serial Number Engineering Unit, here forth referred to as the "*Equipment Under Test*" or "*EUT*". This product operates upon a single channel of a frequency at 318.1 MHz.

These tests were performed using the test procedure outlined in ANSI C63.4, 2001 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.231, for a periodic operation of a low power transmitter.

8. Purpose

The tests were performed in order to determine the compliance of the EUT, with limits contained in various provisions of Title 47CFR, FCC Part 15, including: 15.205, 15.209 and 15.231(e).

All radiated emission tests were performed to measure the emissions in the frequency bands described in Section 12i of this report, and to determine whether said emissions are below the limits established by the aforementioned standards.

These tests were performed in accordance with the procedures described in the American National Standard for methods of measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4, 2001).

Also used as a reference for the EMI Receiver specification is the International Special Committee on Radio Interference – CISPR 16-1, 2002.

9. Product Description

This product is used in maternity wards where staff needs to ensure that when an infant is returned to the mother, there is a match between the two. This is done by linking via a low frequency transmission from a transmitter worn by the infant to a transmitter/receiver worn by the mother. On the transmitter/receiver worn by the mother a match between the two results in the illumination of a green LED and a mismatch results in the illumination of a red LED accompanied by a succession of beeps from a piezo buzzer. The results of the match are sent via a 318.1 MHz transmission from the transmitter/receiver worn by the mother back to a central collection device to maintain reports on the frequency of matches vs. mismatches.

10. Test Requirements

The EUT was tested for Radiated Emissions, and for compliance with the limits set forth by Title 47 CFR, FCC Parts 15.205, 15.209 and 15.231(e) for automatically operated periodic transmitters, as well as for compliance with Industry Canada, RSS-210, for low power license-exempt radio-communication devices.

11. Summary of Test Report

The Equipment Under Test (EUT) was found to **MEET** the requirements as described within the specifications of Title 47 CFR, FCC Part 15.231 and RSS-210, Section 6.1 for a low power transmitter.

12. Radiated Emission Test

12a. Test Setup

The EUT was operated within the 3 Meter FCC listed Semi-Anechoic Chamber, located at L.S. Compliance, Inc., Cedarburg, Wisconsin. The EUT was placed on an 80cm high non-conductive pedestal, which was centered on the flush-mounted 2m diameter metal turntable. The test sample was operated in continuous transmit mode for the radiated emissions measurements, and in normal mode for all other measurements.

The EUT was configured to run in a continuous transmit mode during the 15.231(e) measurements. The EUT was then returned to normal operation for testing of the data packet length and occupied bandwidth.

12b. Test Procedure

The fundamental and spurious (harmonic) emissions of the transmitter were tested for compliance to Title 47CFR, FCC Parts 15.231(e) limits for periodic devices.

The EUT was tested from the lowest frequency generated by the transmitter (without going below 9kHz) to the 10th harmonic of the fundamental frequency generated by the device. The appropriate limits were also observed when the fundamental or spurious signals were located within any of the restricted bands as described in FCC Part 15.205(a).

The EUT was placed on an 80 cm high non-conductive pedestal, with the Antenna Mast placed 3 m from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz, and a Double Ridged Waveguide Horn Antenna was used to measure emissions above 1 GHz.

The EUT was programmed to operate in a continuous transmit mode. The resultant signals from the fundamental harmonics, and spurious signals were maximized by rotating the turntable 360 degrees, and by raising and lowering the Antenna between 1 and 4 meters. The EUT was also given different orientations to determine the maximum signal levels, using both horizontal and vertical antenna polarities.

12c. Test Results

No significant emissions were found aside from the transmitter fundamental and harmonics. The unit was scanned for emissions, over the range of 30 MHz to 3500 MHz to establish compliance with FCC Parts 15.231 and 15.205 while in a continuous transmit mode. At frequencies below the fundamental, no spurious signals, other than the noise floor of the system could be found within 20 dB of the limits. A numeric list of measured emissions appears in Section 12i of this report.

12d. Occupied Bandwidth

In addition to measuring the levels of radiated emissions, the occupied bandwidth of the transmitter was measured. In accordance with FCC Part 15.231(c), the 20dB bandwidth of the transmitted signal should be within a window of 0.25% of the center carrier frequency. The resolution bandwidth was set to the closest available filter setting on the HP 8546A EMI Receiver than corresponded to 5% of the allowable bandwidth determined in the calculation mentioned above, without going below the resolution bandwidth of 10 kHz, as dictated in ANSI C63.4-2001 Section 13.1.7.

The sample was activated to transmit in a continuous mode and was placed on the aforementioned test configuration within the 3 Meter Chamber. The transmitted signal was received on a Log Periodic Antenna and fed to the HP 8546A EMI Receiver, where the fundamental frequency was displayed, and a plot of the occupied bandwidth was produced. Results can be seen in the plots and in Appendix A.

12e. Test Equipment Utilized, Radiated Emissions

A list of the test equipment used for the tests can be found in Appendix B. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All antenna calibrations were performed at a N.I.S.T. traceable site, and the resultant correction factors were entered into the HP 8546A EMI Receiver software database.

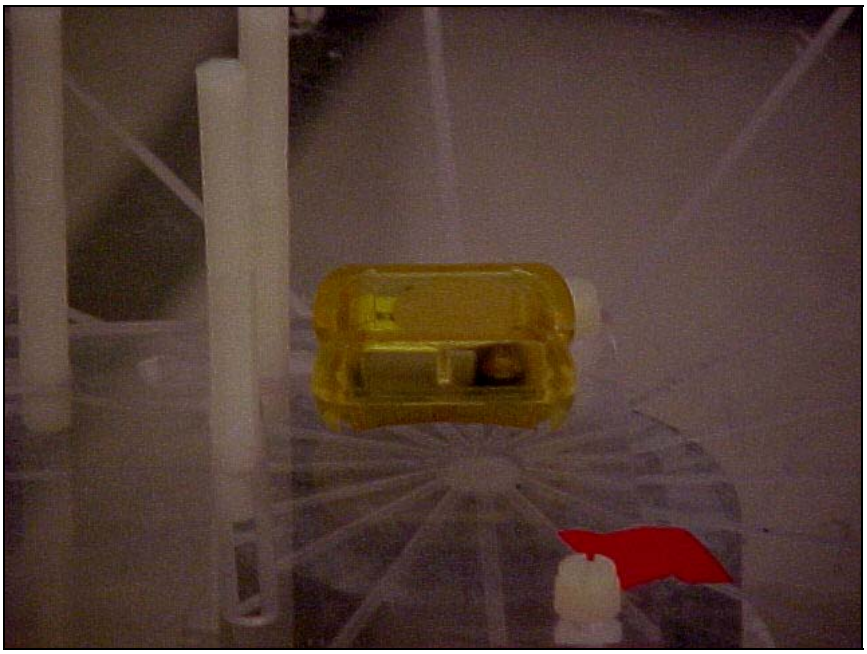
The connecting cables used were also measured for loss using a calibrated Signal Generator and the HP 8546A EMI Receiver. The resulting loss factors were entered into the HP 8546A EMI Receiver database. This allowed for automatic change in the antenna correction factor. The resulting data taken from the HP 8546A EMI Receiver is an actual reading and can be entered into the database as a corrected meter reading.

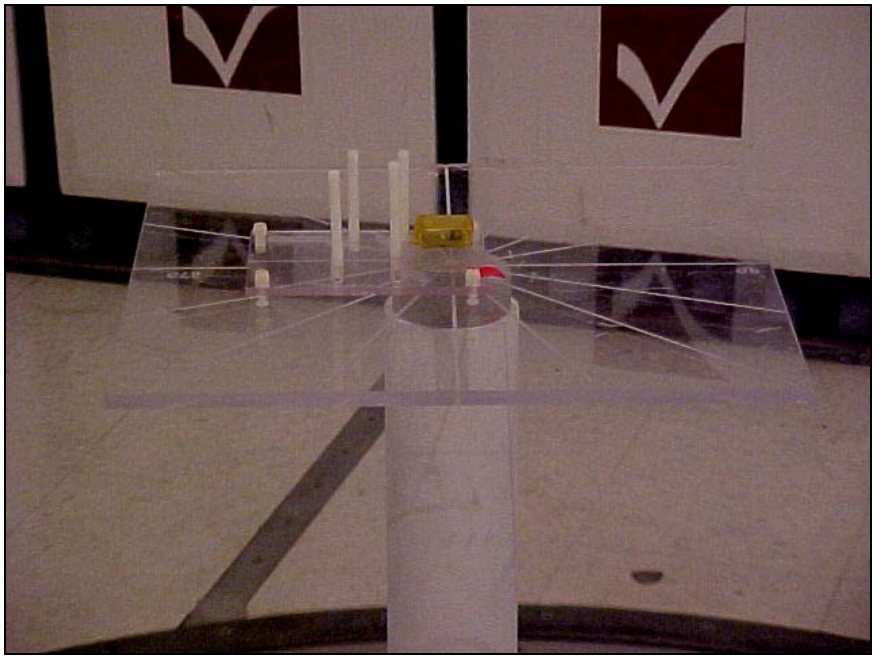
When a reading is taken using the Peak Detector, a duty cycle correction factor can be applied for conversion to an average reading. This operation can be used when measuring short-duration bursts of data transmission, under FCC Part 15.231.

The resulting average reading can then be compared to the appropriate limit in order to determine compliance with the limits. The HP 8546A EMI Receiver was operated with a bandwidth of 120 kHz when receiving signals below 1 GHz, and with a bandwidth of 1 MHz when receiving signals above 1 GHz, in accordance with CISPR 16.

The Peak, Quasi-Peak and Average Detector functions were all used.

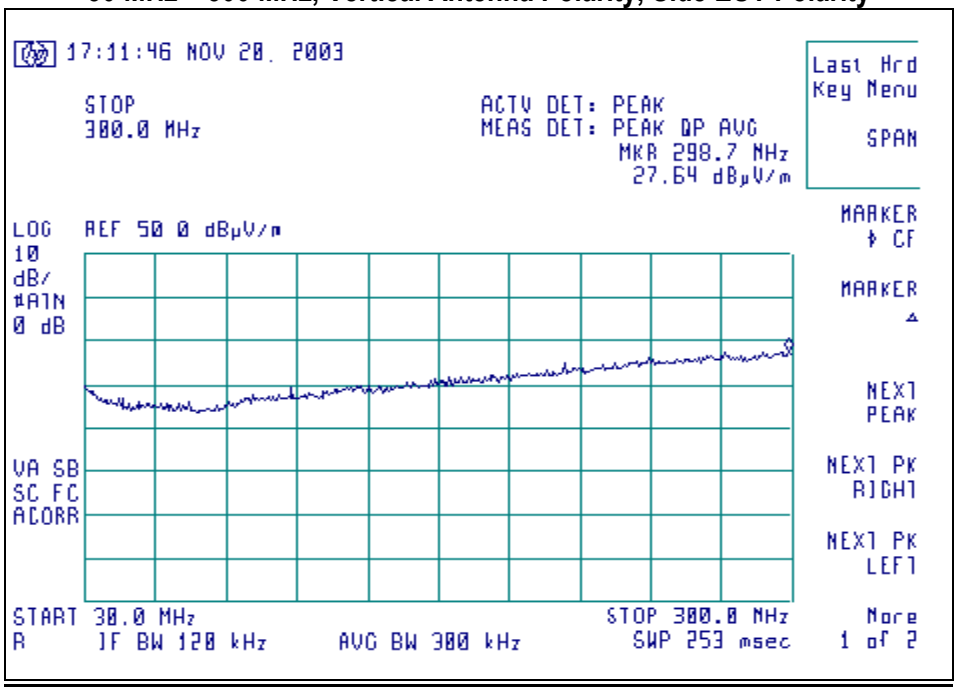
12f. Photos of Setup for Radiated Emissions Test



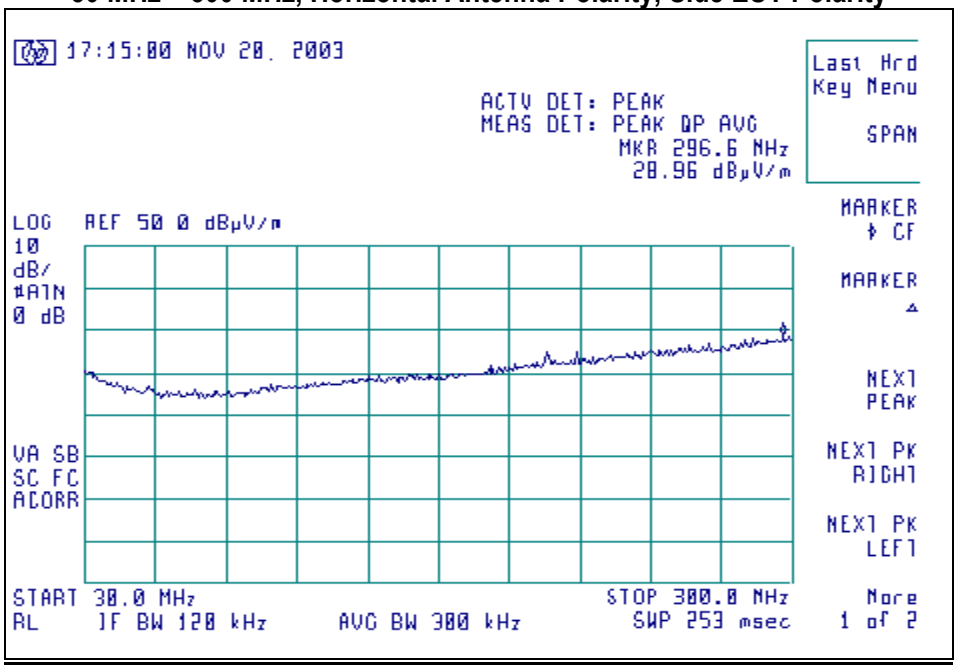


12g. Signature Scans – Radiated Emissions

Signature Scan of Radiated Emissions
30 MHz – 300 MHz, Vertical Antenna Polarity, Side EUT Polarity

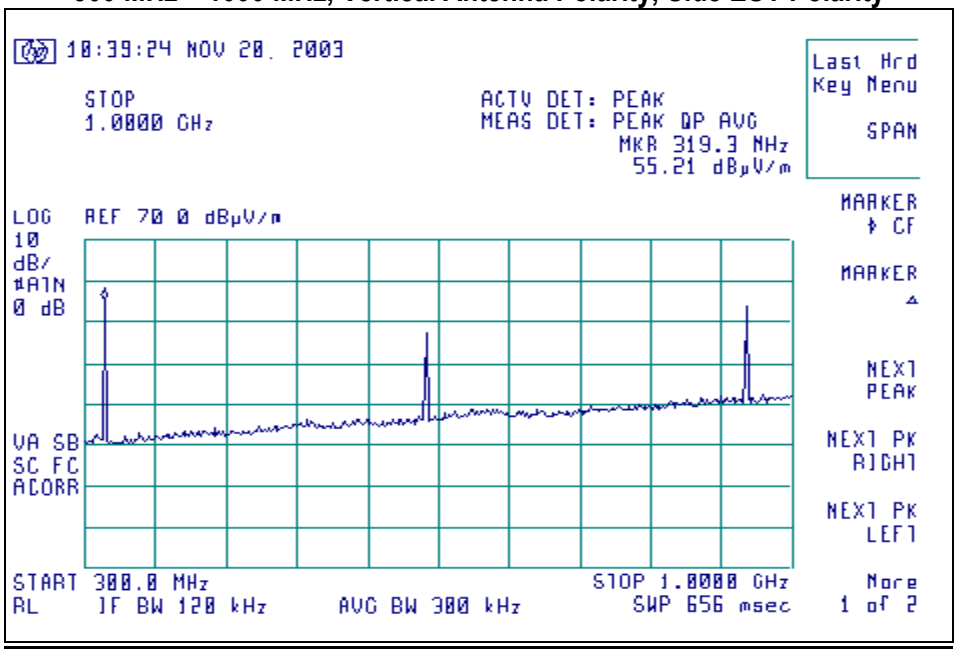


Signature Scan of Radiated Emissions
30 MHz – 300 MHz, Horizontal Antenna Polarity, Side EUT Polarity

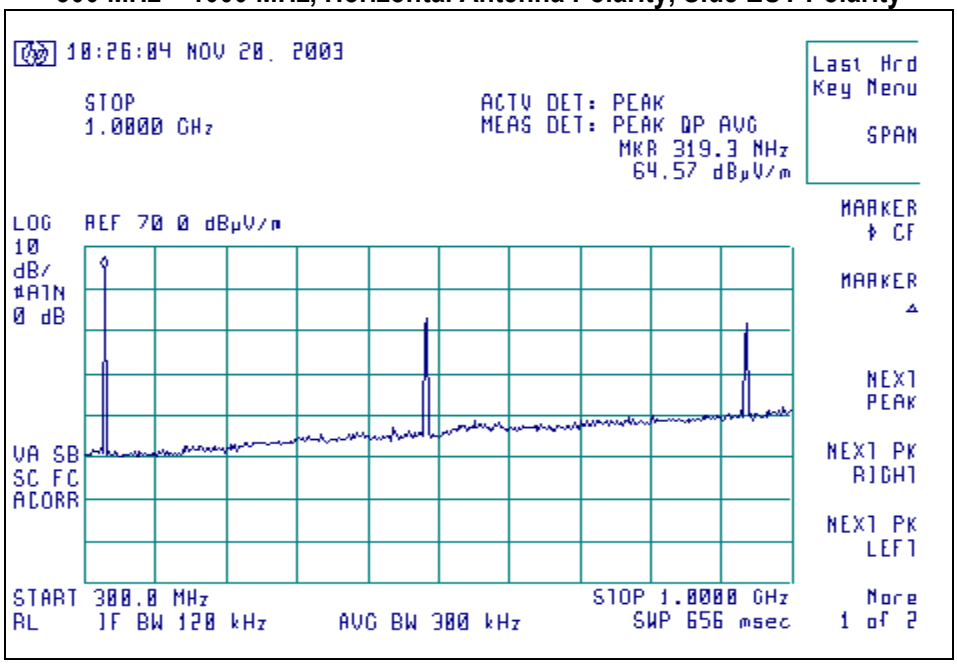


12g. Signature Scans – Radiated Emissions (continued)

Signature Scan of Radiated Emissions
300 MHz – 1000 MHz, Vertical Antenna Polarity, Side EUT Polarity

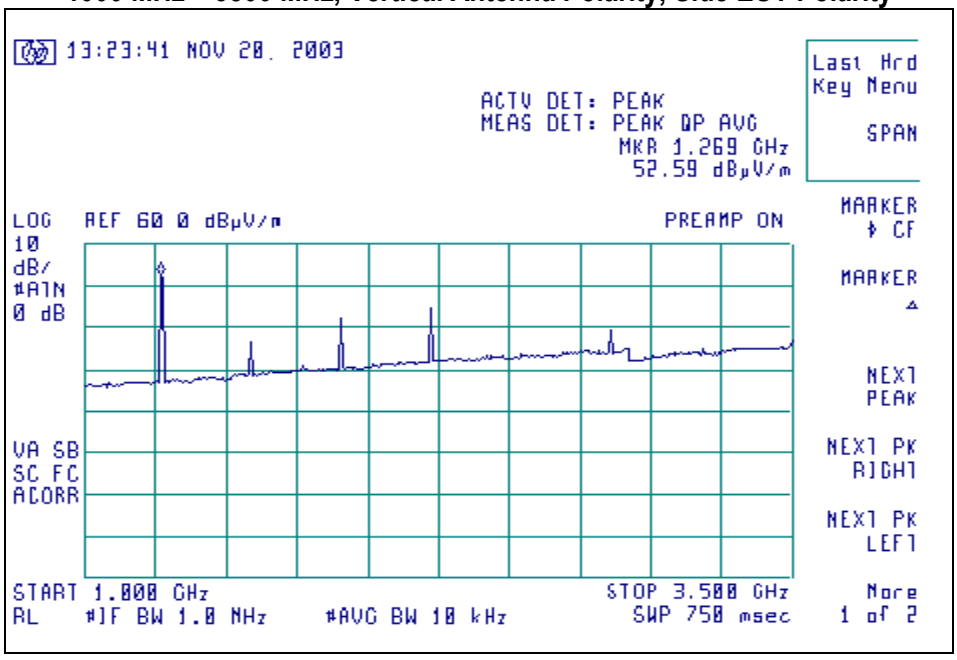


Signature Scan of Radiated Emissions
300 MHz – 1000 MHz, Horizontal Antenna Polarity, Side EUT Polarity

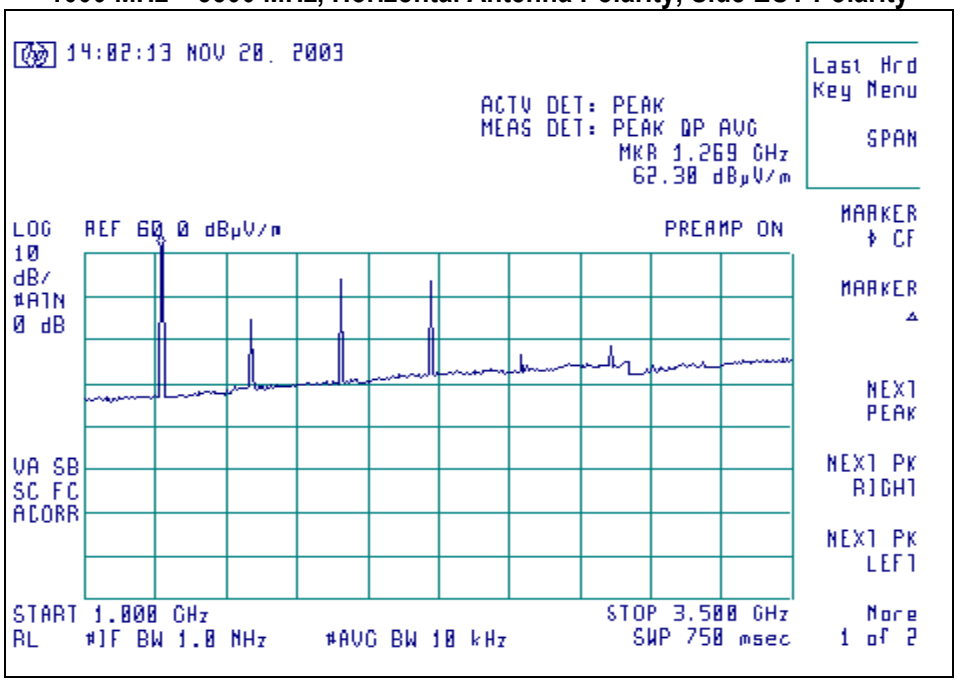


12g. Signature Scans – Radiated Emissions (continued)

Signature Scan of Radiated Emissions
1000 MHz – 3500 MHz, Vertical Antenna Polarity, Side EUT Polarity

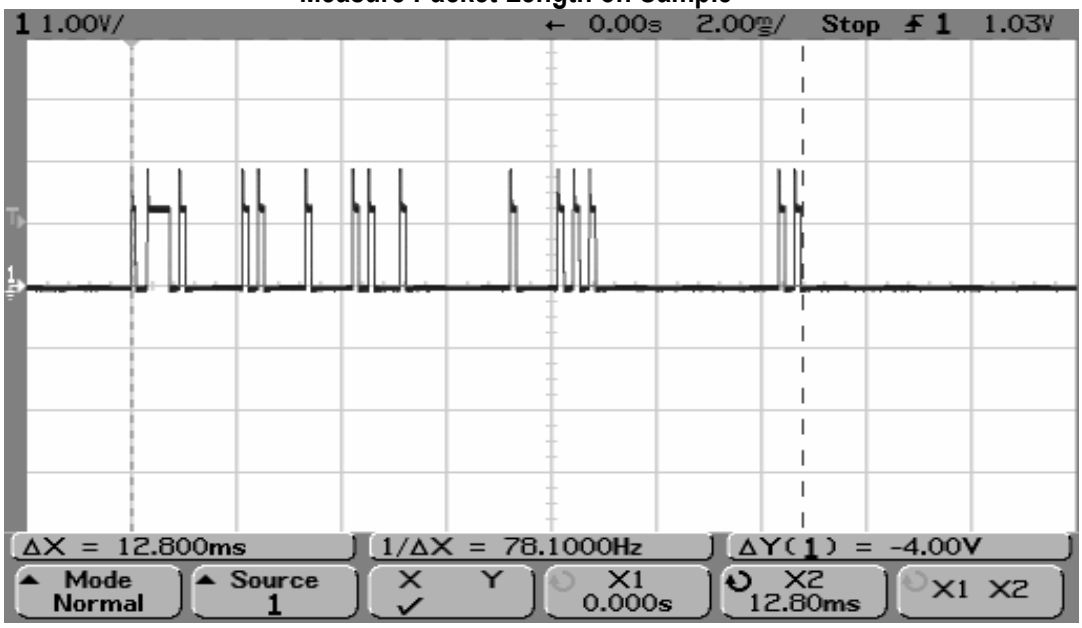


Signature Scan of Radiated Emissions
1000 MHz – 3500 MHz, Horizontal Antenna Polarity, Side EUT Polarity

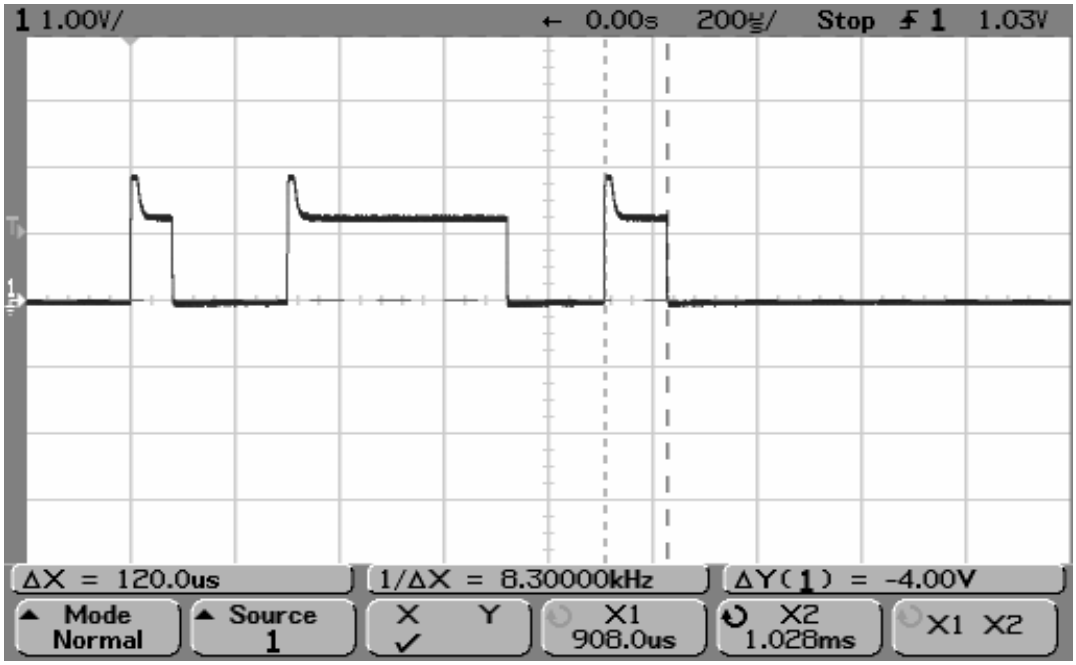


12h. Data Packet Detail – Radiated Emissions

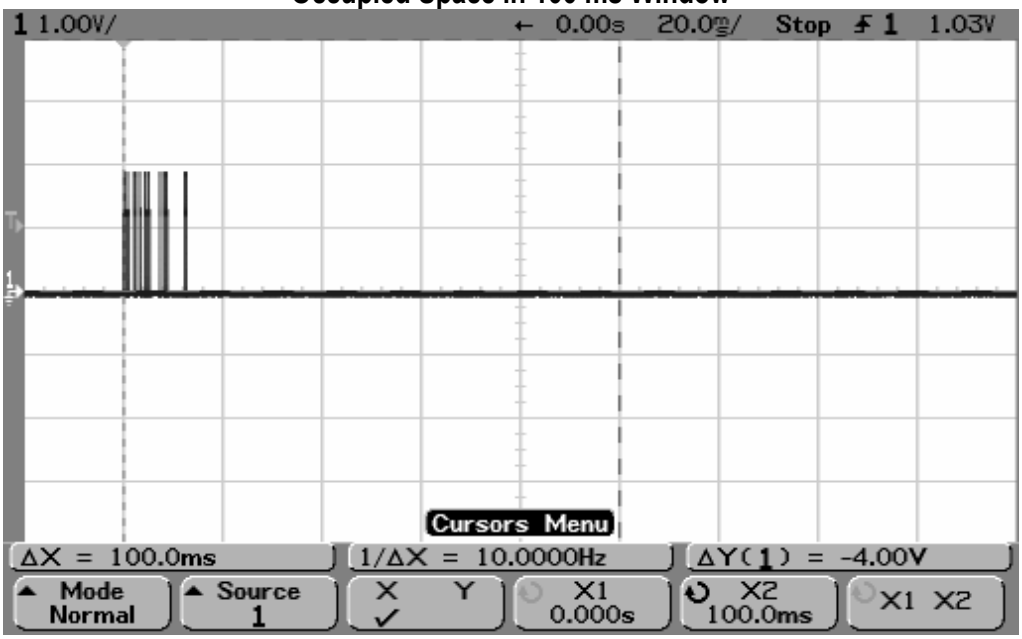
Measure Packet Length on Sample



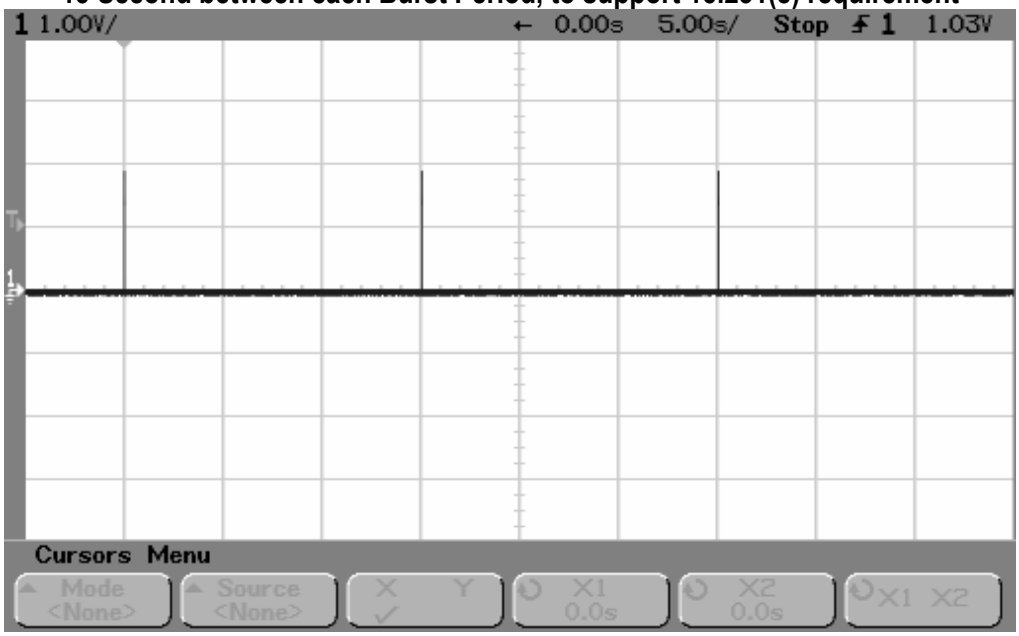
120 us Bit Period



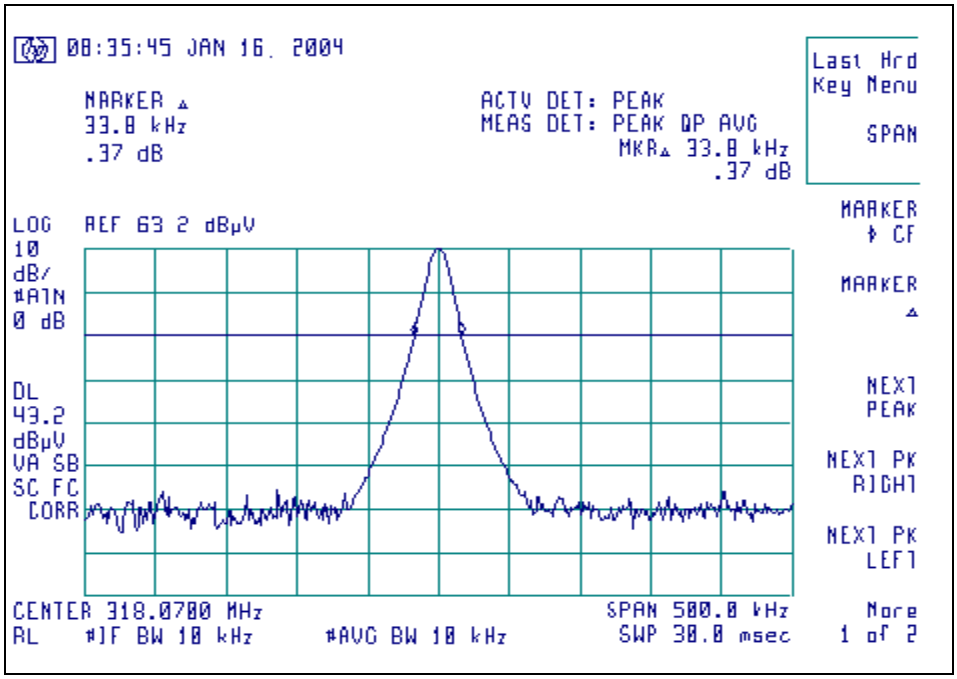
Occupied Space in 100 ms Window



15 Second between each Burst Period, to support 15.231(e) requirement



Plot of Occupied Bandwidth



12i. Measurement of Electromagnetic Radiated Emission Within the 3 Meter Semi-Anechoic FCC Listed Chamber

Manufacturer:	RF Technologies, Inc.
Date of Test:	November 20, 2003
Model:	9450-3000
Serial:	Engineering Unit
Test Specifications:	**FCC Parts 15.231(e) and 15.209**

Distance: 3 Meters				**Frequency Range Inspected:** 30 MHz to 3500 MHz		
Configuration: Continuous Data Transmit						
Detector(s) Used:	√	Peak		Quasi-Peak		Average

Test Equipment Used:

EMI Receiver: HP 8546A	Log Periodic Antenna: EMCO 93146
Dipole Set Antenna: EMCO 3121C	Biconical Antenna: EMCO 3110B
Double-Ridged Wave Guide/Horn Antenna: EMCO 3115	

The following table depicts the level of significant radiated fundamental and harmonic emissions found.

Frequency (MHz)	Antenna Polarity	Height (Meters)	Azimuth (0◦-360◦)	EMI Meter Reading (dBµV/m)	Duty Cycle Correction (dB)	Corrected Reading (dBµV/m)	15.231e Limit (dBµV/m)	Margin (dB)
318.1	H	1.0	85	65.3	20	45.3	67.8	22.5
636.1	H	1.35	270	54.0	20	34.0	47.8	13.8
954.2	V	1.1	259	56.8	20	36.8	47.8	11.0
1.272	H	1.18	0	63.1	20	43.1	54.0	10.9
1.590	H	1.31	310	48.1	20	28.1	54.0	25.9
1.908	H	1.1	346	56.0	20	36.0	54.0	18.0
2.226	H	1.23	322	56.0	20	36.0	54.0	18.0
2.544	H	1.0	300	45.3	20	25.3	54.0	28.7
2.863	V	1.0	310	47.6	20	27.6	54.0	26.4
3.181	H	1.0	312	46.4	20	26.4	54.0	27.6

Note: A Peak Detector was used for all measurements.

12j. Test Results

No significant emissions were found aside from the transmitter fundamental and several harmonics. The unit was scanned for emissions, over the range of 30 MHz to 3500 MHz to establish compliance with FCC Parts 15.205, 15.209 and 15.231(e) while in continuous transmit mode. At frequencies below the fundamental, no spurious signals, other than the noise floor of the system could be found within 20 dB of the limits.

APPENDIX A

Calculations

Manufacturer: RF Technologies, Inc.
Model: 9450-3000

CALCULATION OF RADIATED EMISSIONS LIMITS
FOR FCC PARTS 15.209, and 15.231(e) (260-470 MHz)

FIELD STRENGTH OF FUNDAMENTAL FREQUENCIES:
The calculation involves a linear interpolation of 1500 to 5000 µV/m over 260-470 MHz, where field strength of the fundamental frequency (f_o) when $260 \leq f_o \leq 470$ MHz,
can be found by: $1500 + 16.6667(f_o - 260)$, where f_o is in MHz.

FIELD STRENGTH OF SPURIOUS/HARMONIC FREQUENCIES:
The spurious and harmonic emissions are subject to the limits expressed in FCC Parts 15.205, and 15.209, if within the restricted bands, and dictated by the following calculation elsewhere.

The calculation involves a linear interpolation of 150 to 500 µV/m over 260 to 470 MHz, where field strength of the harmonic frequencies ($2f_o$, $3f_o$...), when $260 \leq f_o \leq 470$ MHz,
can be found by: $150 + 1.667(f_o - 260)$, where f_o is in MHz.

Above 470 MHz, the limit on the spurious and harmonic emissions is 500 µV/m @ 3m.

At fundamental frequency f_o = 318.1 MHz

Fundamental Limit:	1500 + 16.6667 (318.1-260)	= 2,468.33 µV/m @ 3m
Harmonic Limit:	150 + 1.6667 (318.1-260)	= 246.83 µV/m @ 3m

Frequency (MHz)	Fundamental Limit (µV/m @ 3m)	Fundamental Limit (dBµV/m @ 3m)	Harmonic Limit (µV/m @ 3m)	Harmonic Limit (dBµV/m @ 3m)
318.1	2468.33	67.8	246.83	47.8

DUTY CYCLE CORRECTION FACTOR CALCULATION

For a graphical presentation of the data packets from the transmitter, refer to Section 12h. These images were captured on an oscilloscope, while probing the data line, feeding into the transmitter. The transmitter was functioning in normal operating mode, and activated by pressing one of the transmit buttons.

Average (Relaxation) Factor

Average Factor = 20 * Log_{10} (Worst Case EUT On-time over 100 ms time window)
In this particular case, the transmit packet envelope can be used to calculate the relaxation factor.

The transmit packet occupies 5.42 ms of time, within any 100 ms window. Therefore, the relaxation factor allowance is calculated as:

Average Factor = 20 * Log_{10} (5.42 ms / 100 ms) = -25.3

A relaxation factor of -25.3 dB is calculated. However the maximum allowed relaxation is 20dB, thus by default the relaxation factor for this device is 20dB.

The Long Format (NEW WORST CASE, based on pages 10 and 11 in RF Tech document)

PS L TTTT m pppp pppp m CMILEF m OX ff m qqqq qqqq cccccc
111x xxxx 1 xxxx xxxx 1 x1xxxx 1 xxxx 1 xxxx xxxx xxxxxx
1111 1111 1 1111 1111 1 111111 1 1111 1 1111 1111 111111

Except for the Preamble and Start bit, Each bit =300microseconds in length, Logic 0 = 300 microseconds of low, Logic 1 = 120 microsecond high, 180 microseconds low.
Preamble P = 80 microsecond high, 220 microseconds low.
Start Bit S = 420 microsecond high, 180 microseconds low. (shown as a 2-bit wide character)

Worst case 'On time' = 80us + 420us + (120us x 41 bits) = 5.42 ms

15.231(e) Timing Consideration

FCC Part 15.231(e) states that devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Refer to the set of screen captures in Section 12h, showing the duration between the transmissions.

OCCUPIED BANDWIDTH CALCULATIONS

FCC Part 15.231(c) gives the maximum 20 dB bandwidth allowed as 0.25% of the center frequency:

.0025 x 318.1 = 0.795 MHz

A screen capture is included in Section 12h; demonstrating compliance with this requirement.

APPENDIX B – 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	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
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	4.8 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