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

Compliance Testing:

Key Chain Transmitter
Model # TV-001-1

Prepared For:

Boomerang Tracking Corporation
Attn.: Andre Boulay
9280 Boulevard De L'Acadie
Montreal, Quebec H4N 3C5
Canada

Test Report Number:

302382

Test Dates:

January 6th, 10th and 30th, 2003

Table of Contents

1. L.S. Compliance in Review

L. S. Compliance, Inc. is located in Cedarburg, Wisconsin – United States.

We may be contacted by:

Mail: L. S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, Wisconsin 53102

Phone: 262-375-4400
Fax: 262-375-4248
E-Mail: eng@lsr.com

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: 2001
With electrical (EMC) Scope of Accreditation
A2LA Certificate Number: **1255.01**

U.S. Conformity Assessment Body (CAB) Validation
Validated by the European Commission as a U.S. conformity assessment Body operating under the U.S./EU, Mutual Recognition Agreement (MRA) operating under the European Union EMC Directive 89/336/EEC, Article 10.2
Date of Validation: **January 16, 2001**

Federal Communications Commission (FCC) – USA
Listing of 3 Meter Semi-Anechoic Chamber based on 47CFR 2.948
FCC Registration Number: **90756**

Listing of 3 and 10 Meter OATS based on 47CFR 2.948
FCC Registration Number: **90757**

Industry Canada
On-file, 3 Meter Semi-Anechoic Chamber based on 47CFR 2.948
File Number: **IC 3088**

On-file 3 and 10 meter OATS based on RSS-210
File Number: **IC 3088-A**

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 (EMC) Testing

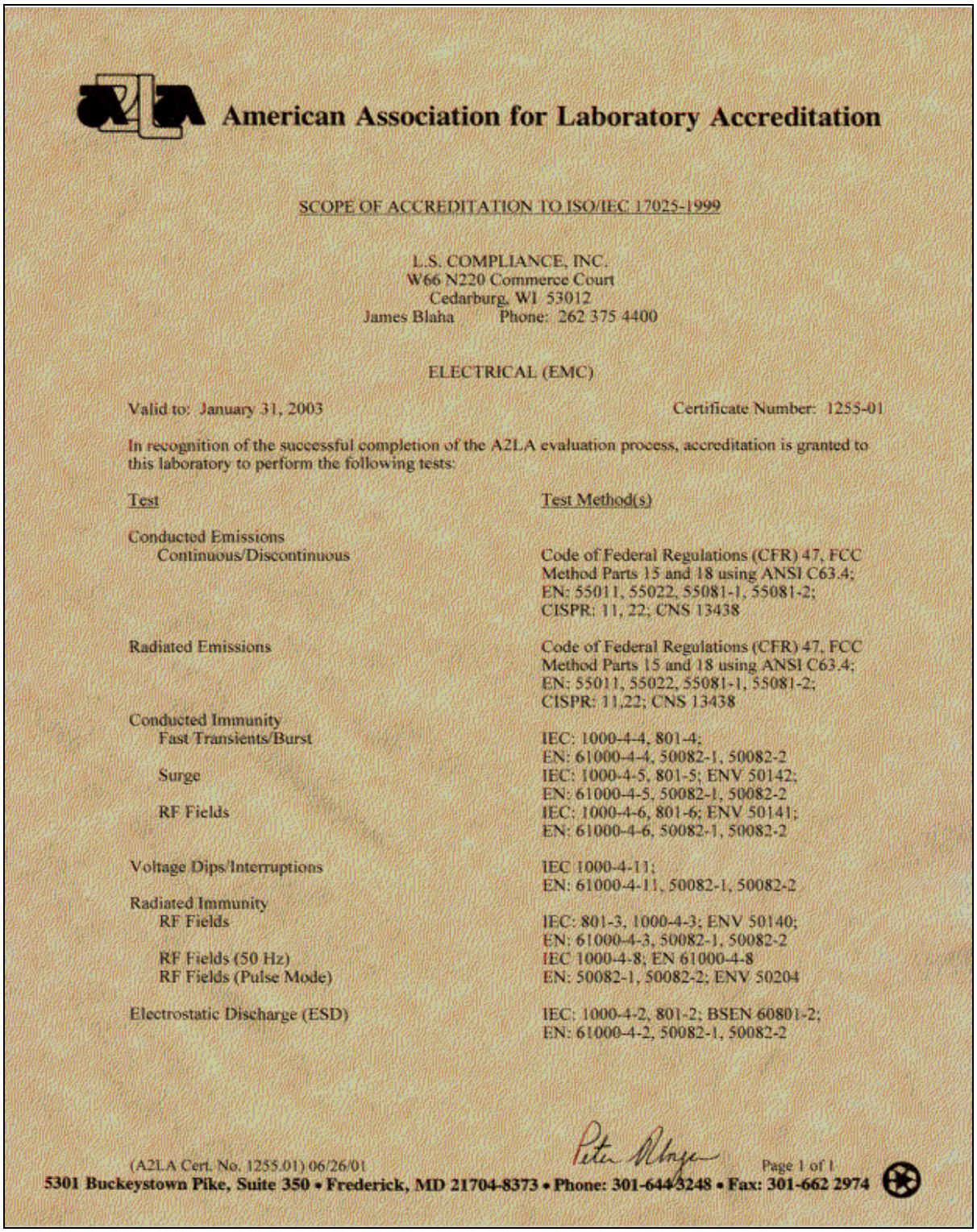
The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified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

Presented this 26th day of June, 2001.

President
For the Accreditation Council
Certificate Number 1255.01
Valid to January 31, 2003

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical (EMC) 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, 2003 Certificate Number: 1255-01

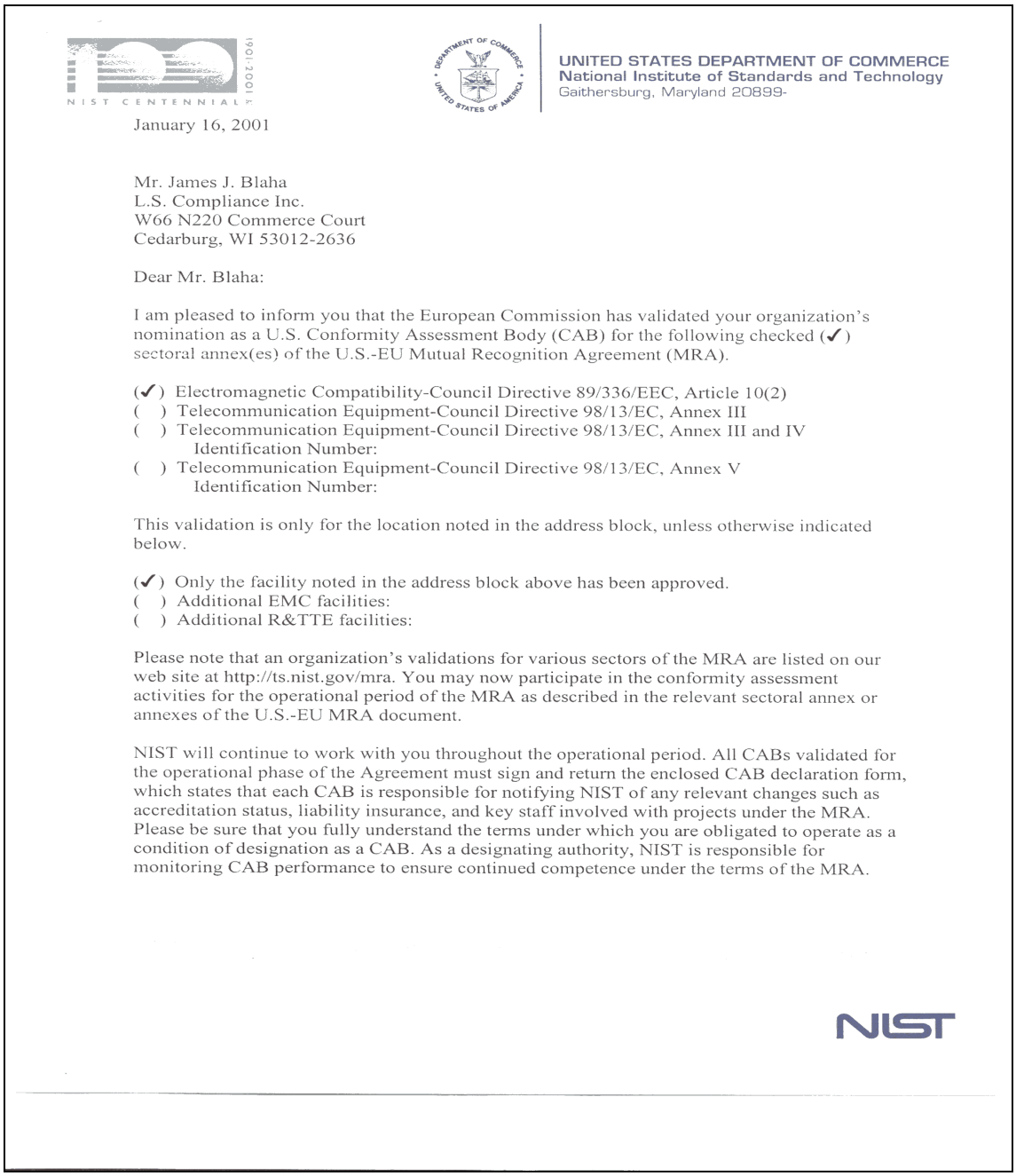
In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

Test	Test Method(s)
Conducted Emissions Continuous/Discontinuous	Code of Federal Regulations (CFR) 47, FCC Method Parts 15 and 18 using ANSI C63.4; EN: 55011, 55022, 55081-1, 55081-2; CISPR: 11, 22; CNS 13438
Radiated Emissions	Code of Federal Regulations (CFR) 47, FCC Method Parts 15 and 18 using ANSI C63.4; EN: 55011, 55022, 55081-1, 55081-2; CISPR: 11,22; CNS 13438
Conducted Immunity Fast Transients/Burst	IEC: 1000-4-4, 801-4; EN: 61000-4-4, 50082-1, 50082-2
Surge	IEC: 1000-4-5, 801-5; ENV 50142; EN: 61000-4-5, 50082-1, 50082-2
RF Fields	IEC: 1000-4-6, 801-6; ENV 50141; EN: 61000-4-6, 50082-1, 50082-2
Voltage Dips/Interruptions	IEC 1000-4-11; EN: 61000-4-11, 50082-1, 50082-2
Radiated Immunity RF Fields	IEC: 801-3, 1000-4-3; ENV 50140; EN: 61000-4-3, 50082-1, 50082-2
RF Fields (50 Hz)	IEC 1000-4-8; EN 61000-4-8
RF Fields (Pulse Mode)	EN: 50082-1, 50082-2; ENV 50204
Electrostatic Discharge (ESD)	IEC: 1000-4-2, 801-2; BSEN 60801-2; EN: 61000-4-2, 50082-1, 50082-2

(A2LA Cert. No. 1255.01) 06/26/01 Page 1 of 1

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



NIST CENTENNIAL 1901-2001

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.

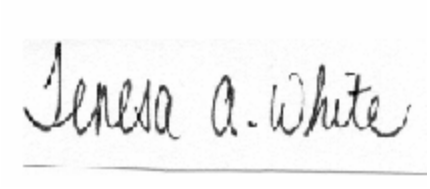
(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

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



March 17, 2003

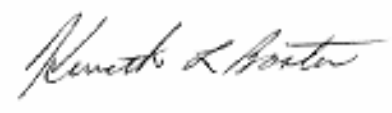
Prepared By: _____

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

March 17, 2003

Tested By: _____

Abtin Spantman, EMC Engineer **Date**



March 17, 2003

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:	Boomerang Tracking Corporation
Model Number:	Boomerang Key Chain Transmitter #TV-001-1
Serial Number:	TX-01
Test Voltage:	3.0 VDC Battery

Environmental Conditions in the Test Lab:

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

7. Introduction

On January 6th, 10th, and 30th, 2003 a series of Radiated Emissions tests were performed on one sample of the Boomerang Key Chain Transmitter, Model TV-000-1, Serial Number TX-01 here forth referred to as the "*Equipment Under Test*" or "*EUT*". This product operates by means of periodically transmitting bursts of data at 303.7 MHz. The unit does not have any buttons or other user interface features, and operates from an internal 3 volt battery.

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 above-mentioned tests were performed in order to determine the compliance of the Equipment Under Test (EUT), with limits contained in various provisions of Title 47CFR, FCC Part 15, including: 15.205, 15.209, 15.231(a), 15.231(c), 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

The Boomerang Key Chain Transmitter is a remote control hand-held transmitter, used to de-activate the alarm functions of a vehicle recovery system, or an alarm system. It is programmed to transmit a short I.D. data packet automatically at timed intervals, with no requirement of the user to activate the key chain transmitter manually. The transmitter has a "saw" stabilized oscillator, and operates on 3.0 VDC as provided by a CR 2354, Coin-Cell type battery.

10. Test Requirements

The EUT was to be tested for radiated emissions, and compliance with the limits set forth by 47 CFR, FCC Parts 15.205, 15.209, 15.231(a), 15.231(c), and 15.231(e), for 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 EUT was found to **MEET** the requirements as described within the specifications of Title 47 CFR, 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 EUT was operated in continuous transmit CW mode for the radiated emissions measurements, and in normal mode for all other measurements.

The EUT was configured to run in a continuous transmit CW mode during the FCC Parts 15.231(a) and 15.231(e) measurements.

12b. Test Procedure

The fundamental and spurious (harmonic) emissions of the transmitter were tested for compliance to Title 47CFR, FCC Parts 15.231(a), and 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 Bi-conical 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 modified to produce a continuous CW signal. 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. The battery, type CR2354 3.0 VDC Lithium, was check periodically during the test, and was replaced as necessary.

12c. Test Results

No significant emissions were found aside from the transmitter fundamental and harmonics. The units were scanned for emissions, over the range of 30 MHz to 3100 MHz to establish compliance with FCC Parts 15.231 and 15.205 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 20dB 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 Analyzer that 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 observed bandwidth was seen to be 47.5 kHz.

The sample was activated to transmit in normal 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 Analyzer, where the fundamental frequency was displayed, and a plot of the occupied bandwidth was produced. Results can be seen in the following plots, and in Appendix A. Plots derived via an oscilloscope placed on the EMI output can be found in Section H. The plots support the duty cycle calculations, and show compliance with the timing requirements found in 15.231(e).

12e. Test Equipment Utilized

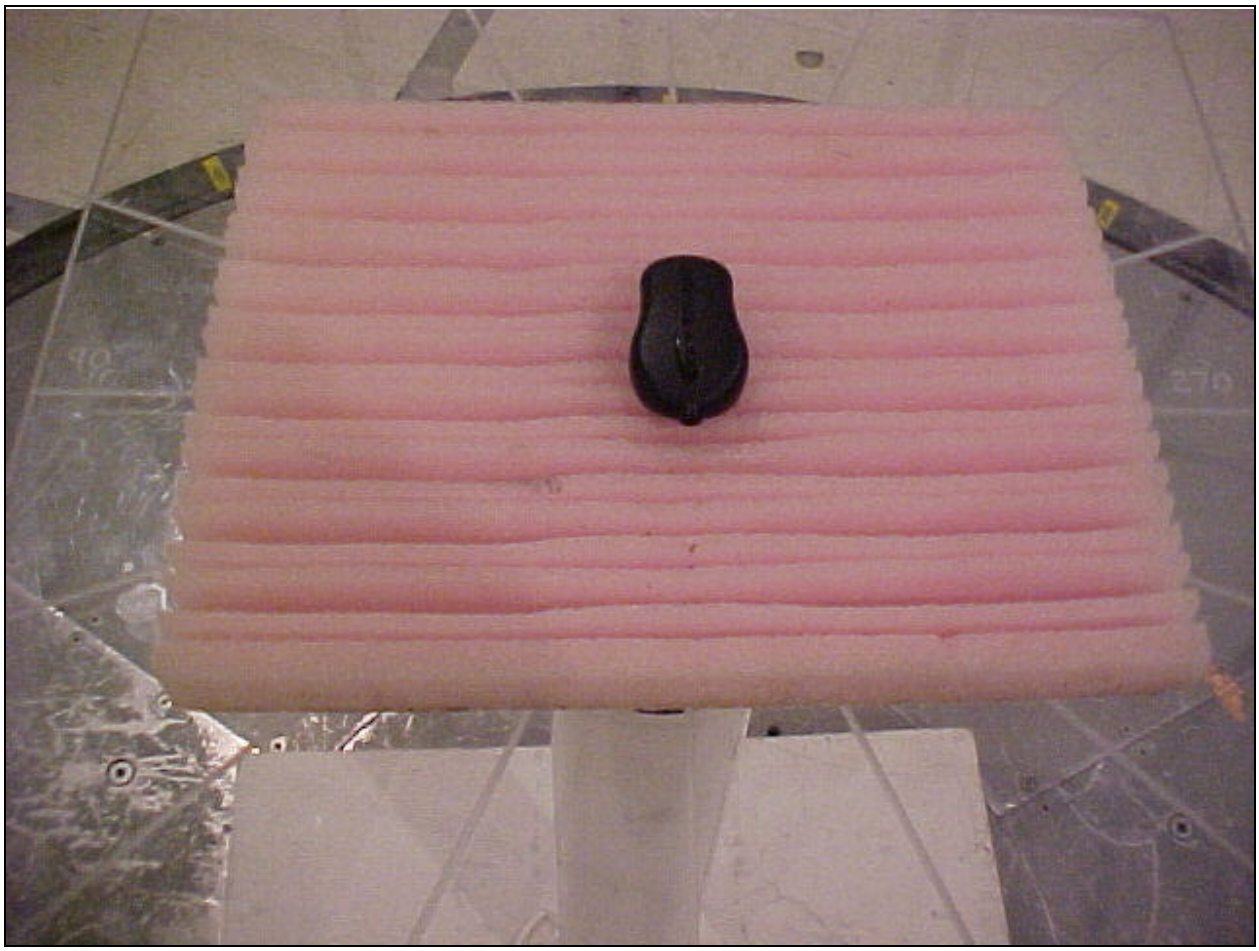
A list of the test equipment used for the tests can be found in Appendix B. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All antenna calibrations were performed at a N.I.S.T. traceable site, and the resultant correction factors were entered into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

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 compared to the appropriate limit in order to determine compliance. 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.

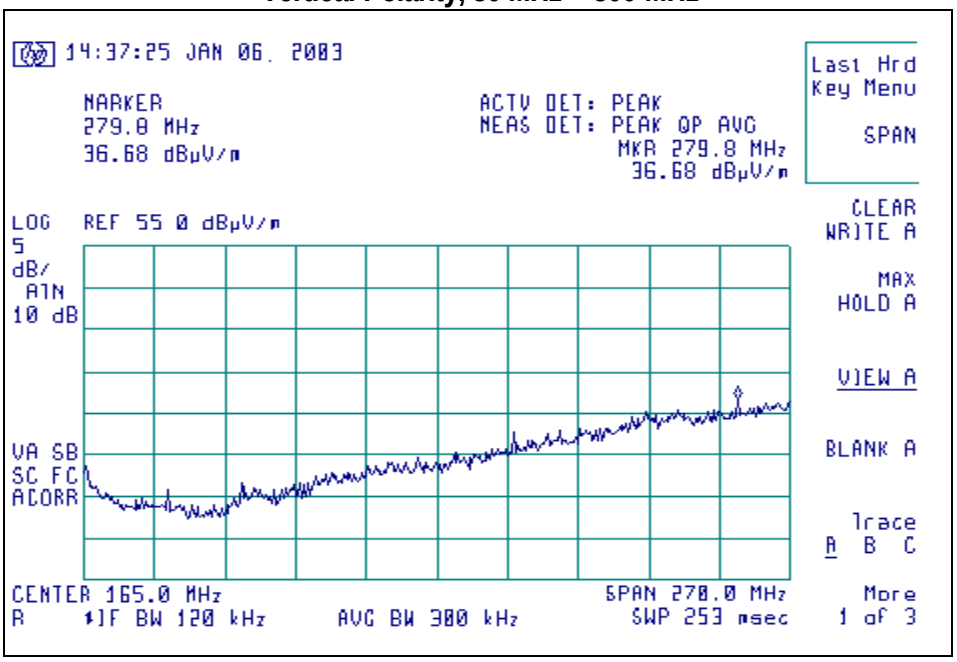
The Peak, Quasi-Peak and Average Detector functions were all used.

12f. Photo of Setup for Radiated Emissions Test

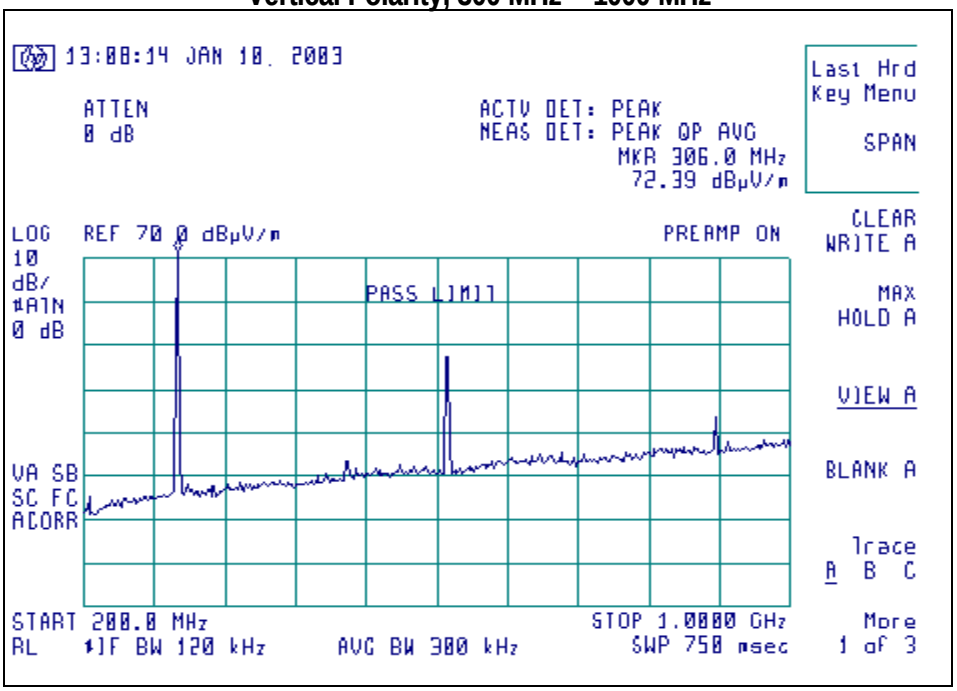


12g. Signature Scans – Radiated Emissions

Vertical Polarity, 30 MHz – 300 MHz

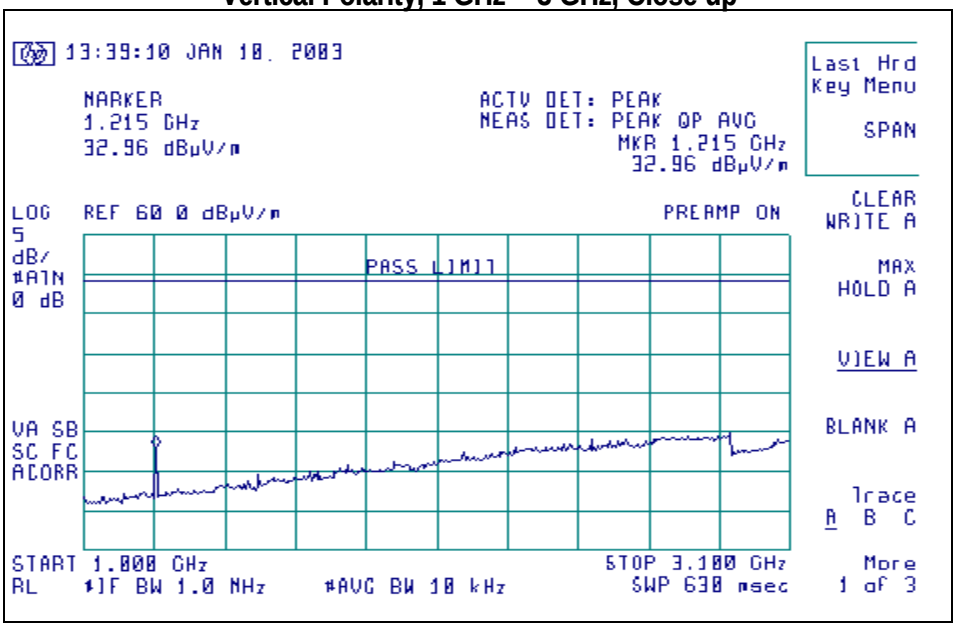


Vertical Polarity, 300 MHz – 1000 MHz

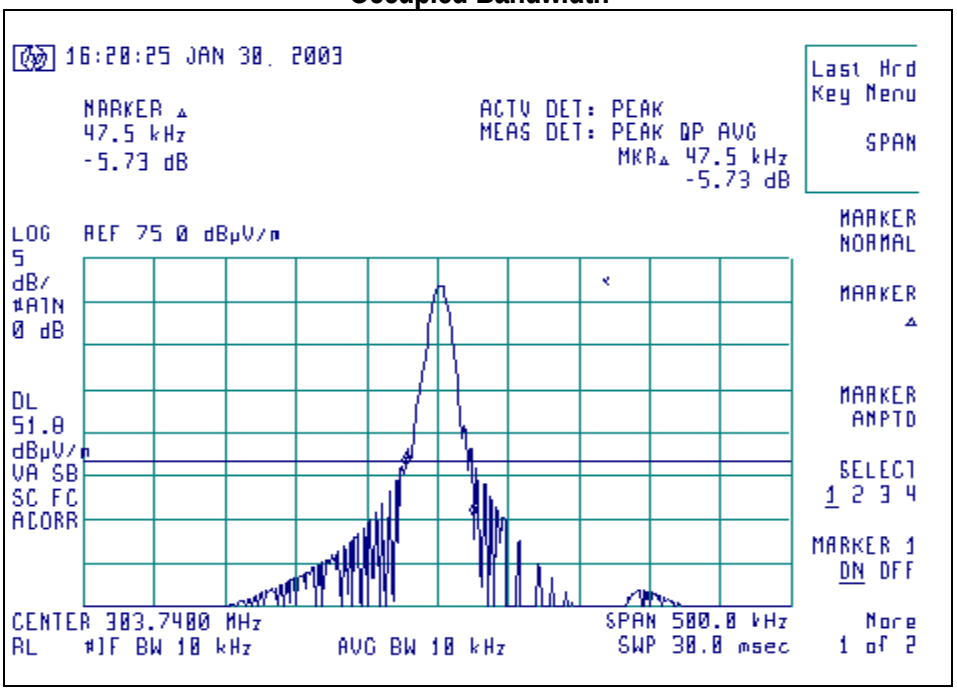


Signature Scans – Radiated Emissions

Vertical Polarity, 1 GHz – 3 GHz, Close up

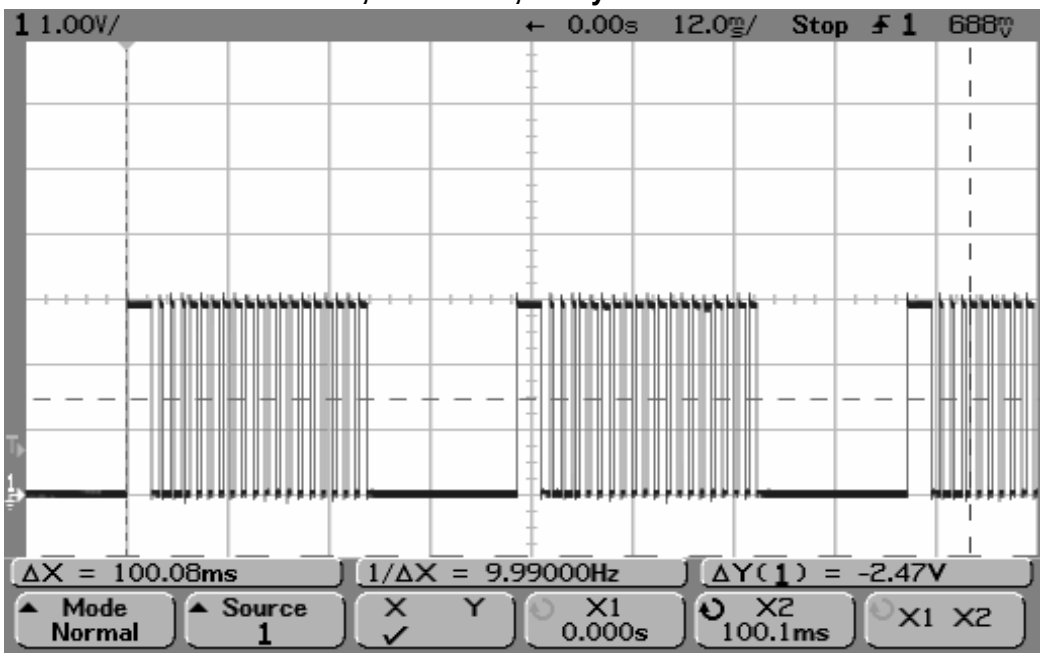


Occupied Bandwidth

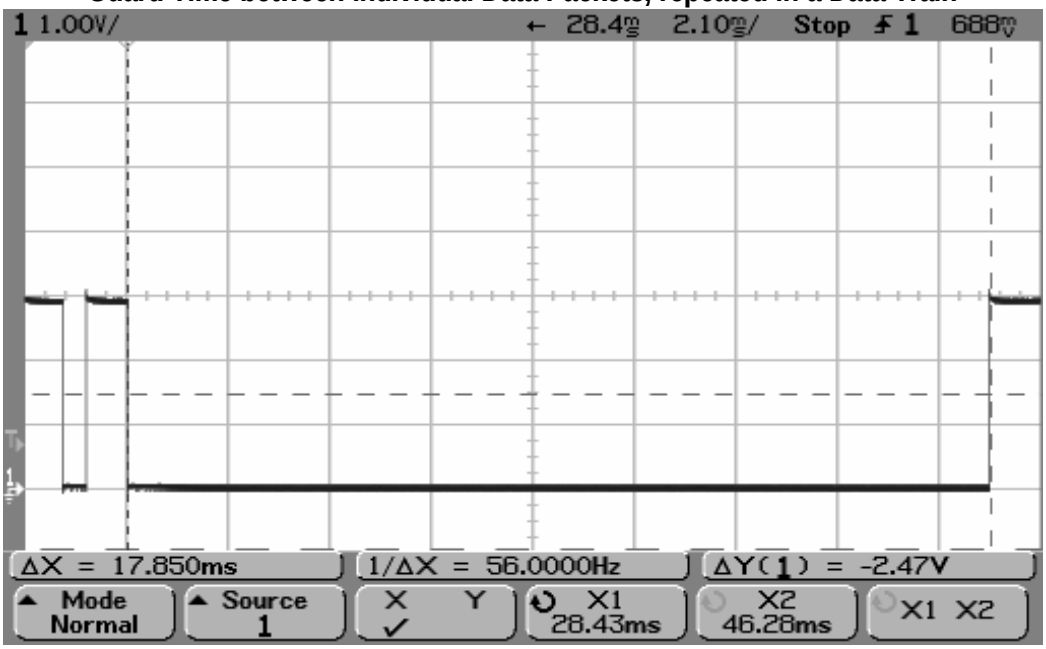


12h. Data Packet Detail – Radiated Emissions

Data Packet Detail, worst-case, in any 100 Millisecond window

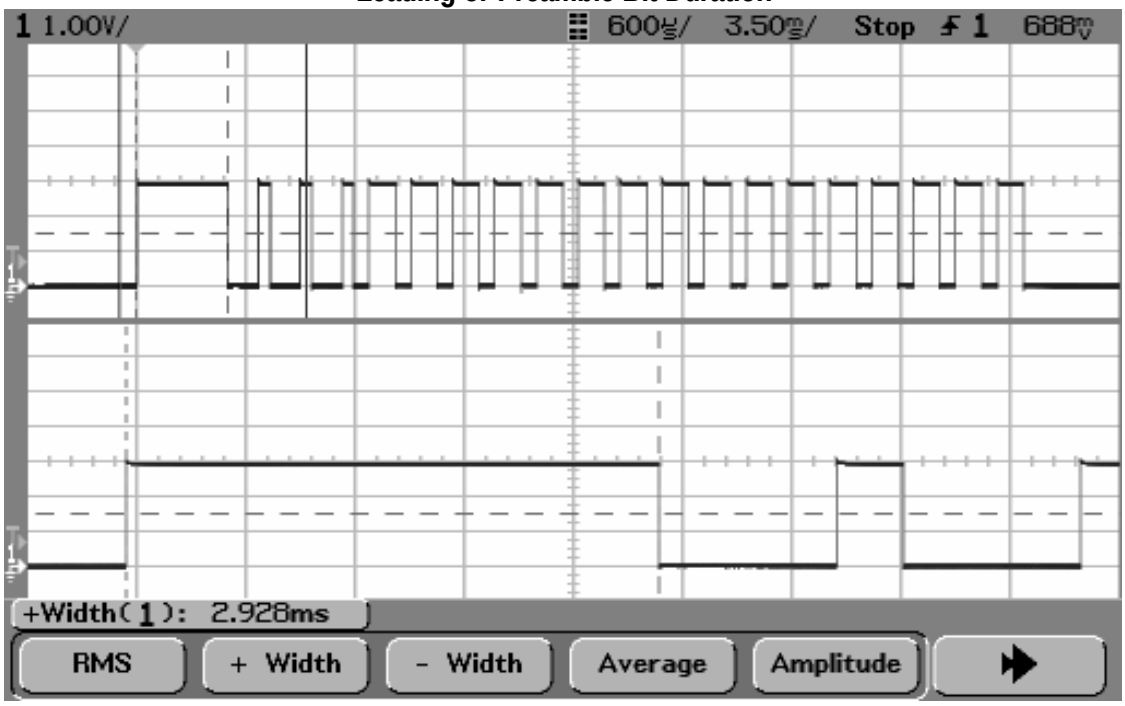


Guard Time between individual Data Packets, repeated in a Data Train

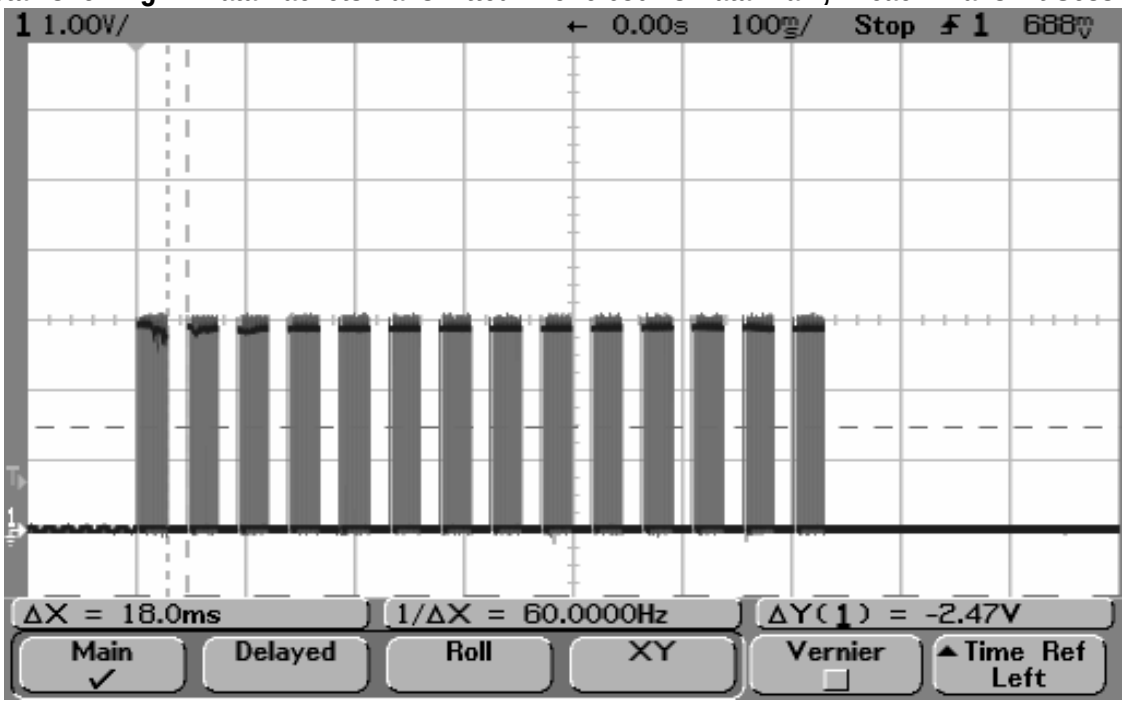


Data Packet Detail – Radiated Emissions

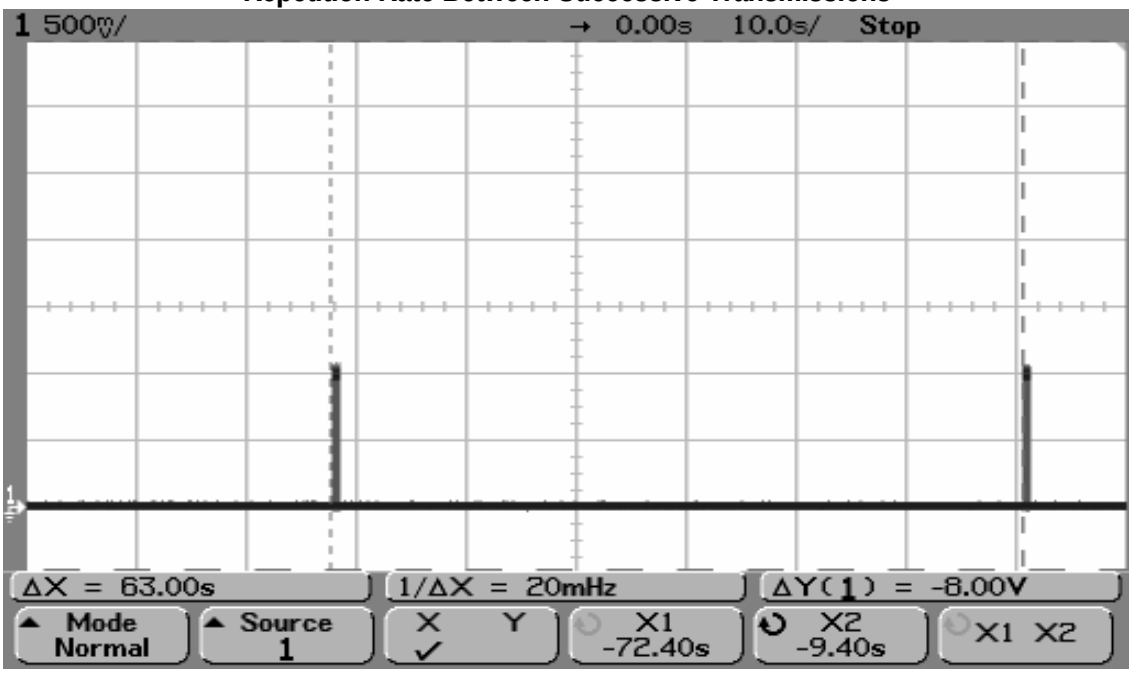
Leading or Preamble Bit Duration



Detail showing 14 Data Packets transmitted in one 630ms Data Train, in each Transmit Session



Repetition Rate Between Successive Transmissions



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

Manufacturer:	Boomerang Tracking Corporation
Date of Test:	January 6th, 10th and 30th, 2003
Model:	Boomerang Key Chain Transmitter #TV-001-1
Serial:	TX-01
Test Specifications:	**FCC Parts 15.205, 15.209, 15.231(a), 15.231(b), and 15.231(e).**

Distance: 3 Meters				**Frequency Range Inspected:** 30 MHz to 6000 MHz		
Configuration: Normal and CW modes						
Detector(s) Used:	v	Peak		Quasi-Peak		Average

Test Equipment Used:

EMI Receiver: HP 8546A	Log Periodic Antenna: EMCO 93146
Double-Ridged Horn Antenna: EMCO 3115	Biconical Antenna: EMCO 93110B

The following tables depict the level of significant fundamental and harmonic emissions found.

EUT in flat position, lettering upward; cell voltage: 3.1 volts

Frequency (MHz)	Antenna Polarity	Height (Meters)	Azimuth (0°-360°)	EMI Meter Reading (dBµV/m)	Duty Cycle Correction (dB)	Corrected Reading (dBµV/m)	15.231b Limit (dBµV/m)	Margin (dB)
303.7	H	1.0	90	73.0	7.1	65.9	67.0	1.1
607.4	H	1.3	270	49.1	7.1	42.0	47.0	5.0
911.1	H	1.5	270	35.2	7.1	28.1	47.0	18.9
1215	V	1.0	155	40.4	7.1	33.3	54.0	20.7
1520	V	-	-	29.6 *	7.1		54.0	>20.0
1823	V	-	-	30.5 *	7.1		54.0	>20.0
2127	V	-	-	32.3 *	7.1		54.0	>20.0
2431	V	-	-	33.3 *	7.1		54.0	>20.0
2732	V	-	-	33.9 *	7.1		54.0	>20.0
3046	V	-	-	33.5 *	7.1		54.0	>20.0

Note: A Peak Detector was used in all measurements.

*** = Noise Floor**

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 3100 MHz to establish compliance with FCC Parts 15.205, 15.209, 15.231(a), 15.231(c), 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 20dB of the limits.

APPENDIX A

Calculations

Manufacturer: Boomerang Tracking Corporation
Model: Boomerang Key Chain Transmitter #TV-001-1
Serial: TX-01

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= f_o=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= f_o=470 MHz,
can be found by: 150 + 1.1667(f_o – 260), where f_o is in MHz.

Above 470 MHz, the limit on the spurious and harmonic emissions is 5,000 µV/m @ 3m.

At fundamental frequency f_o = 303.8 MHz

Fundamental Limit:	1500 + 16.6667 (303.8-260)	= 2,230 µV/m @ 3m
Harmonic Limit:	150 + 1.1667 (303.8-260)	= 223.0 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)
303.8	2,230	223	67.0	47.0

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.

Average (Relaxation) Factor

Average Factor = 20 * Log_{10} (Worst Case EUT On-time over 100 ms time window)
In this particular case, the sum of two (2) and the start of a 3rd packet can be used to calculate the relaxation factor.

Worst Case data for one packet gives:

One long burst	=	2.928ms x 1	= 2.928ms
3 logic zeros	=	0.366ms x 3	= 1.098ms
19 logic ones	=	0.852ms x 19	= 16.188ms
			19.116ms

2 packets = 2 x 19.116 = 38.232ms
added to this is the start of a 3rd packet, or 2.928ms + 3x (.852ms) = 5.484ms
total on five equals 38.232ms + 5.484 = 43.716ms

Average Factor = 20 * Log_{10} (43.716 ms / 100 ms) = -7.187dB
A relaxation factor of 7.1 dB would be a conservative round-off for this product.

OCCUPIED BANDWIDTH CALCULATIONS

FCC Part 15.231(c) states that the bandwidth of a manually operated device shall be no wider than 0.25% of the center frequency for devices operating between 70 MHz and 900 MHz. For a transmitter operating at 303.8 MHz, maximum bandwidth is 760 kHz.

Said bandwidth is determined at the -20 dB reference to peak carrier points.

Refer to the set of screen captures in Section 12g, showing the actual occupied bandwidth of the transmitter to be 47.5 kHz.

APPENDIX B

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Calibration Information	
					Date	Due Date
AA960007	EMCO	3115	9311-4138	Horn Antenna	08-23-01	08-23-02
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization	09-19-02	09-19-03
AA960014	Fischer	FCC-801-M3-25	148	Coupler-De-Coupler Network	09-20-02	09-20-03
AA960054	Giga-Tronics	80301A	1830164	Power Sensor	05-02-02	05-02-03
AA960074	Fischer	F2031-32mm	361	EM Injection Clamp	06-22-01	11-29-02
AA960076	Fischer	F201-32mm	347	Absorbing Clamp	08-29-02	08-29-03
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	09-19-02	09-19-03
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	09-19-02	09-19-03
AA960081	EMCO	3115	6907	Double Ridged Horn Antenna	10-30-02	10-30-03
CC00181C	HP	33120A	US36013549	Signal Generator	09-20-02	09-20-03
CC00221C	Agilent	E4407B	US39160256	Spectrum analyzer	10-28-02	10-28-03
EE960003	Amplifier Research	100W 1000M1A	19821	100 Watts Amp	06-19-01	Note 1*
EE960005	Giga-Tronics	8542C	1831450	Dual Channel Power Meter	09-19-02	09-19-03
EE960013	HP	8546A	3617A00320	Receiver RF Section	09-20-02	09-20-03
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	09-20-02	09-20-03
EE960015	HP	6843A	3531A-00145	AC Power Source/Analyzer	10-22-00	N/A
EE960016	Marconi	2024	112120/044	Signal Generator	09-19-02	09-19-03
EE960055	Amplifier Research	75A250	21952	75 Watt Amp	06-22-01	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