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

Compliance Testing of the Commando Remote Unit

Prepared For:
Sports Communications, Inc.
Attn.: Mr. Tom Turkington
205 Technology Parkway
Auburn, AL 36830

Test Report Number:
303136 TX

Test Date:
February 3rd – 6th, 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: 2005
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 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

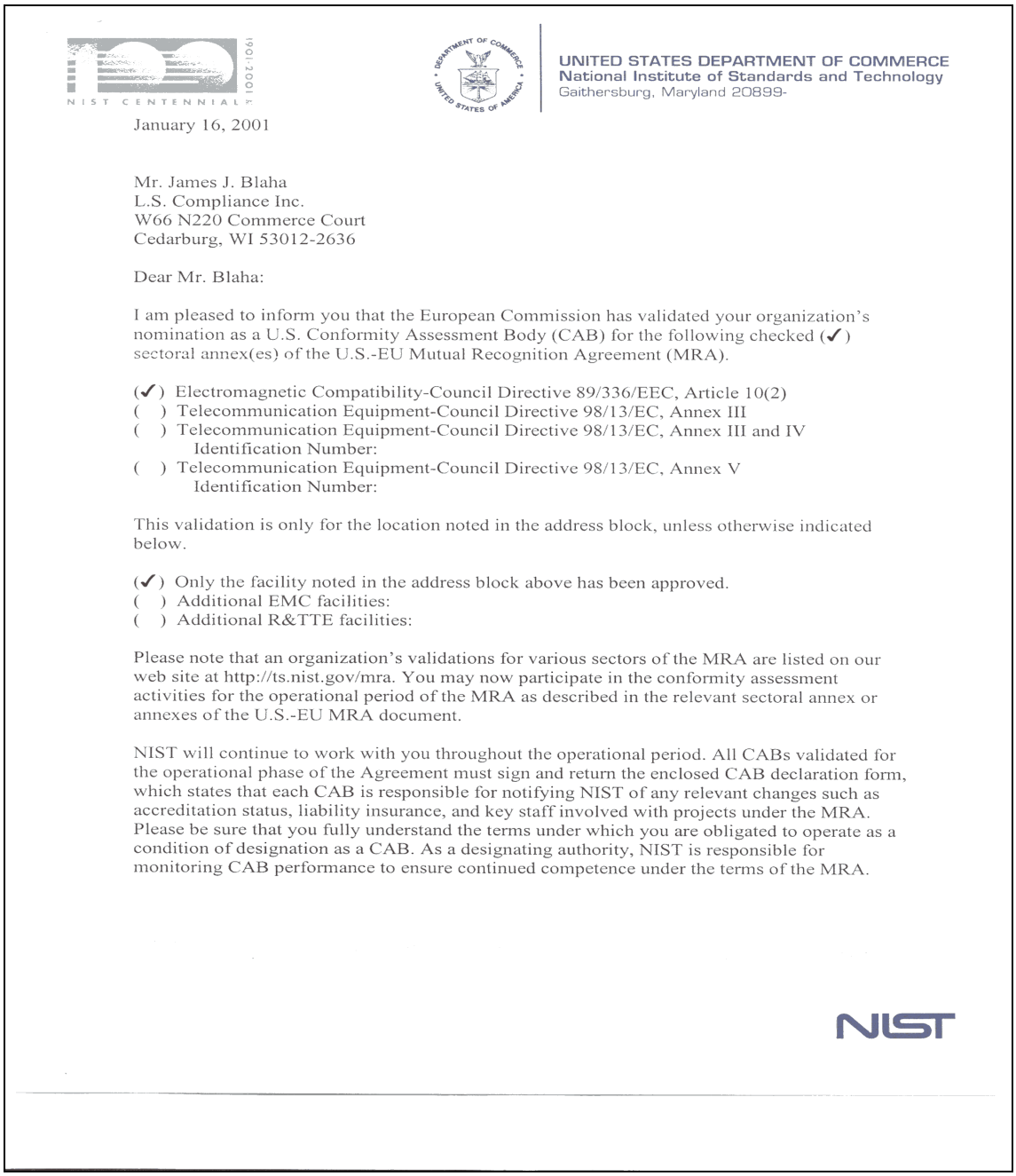
In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

Test	Test Method(s)
Emissions	
Conducted 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
Current Harmonics	EN 61000-3-2
Voltage Fluctuations & Flicker	EN 61000-3-3
Immunity	
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

Lorraine M. Robinson

(A2LA Cert. No. 1255.01) 03/26/03 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.

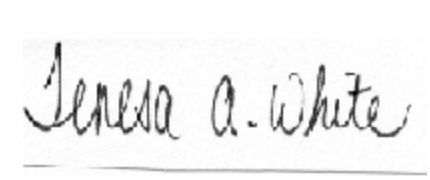
(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

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



April 29, 2003

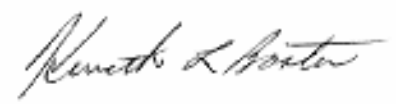
Prepared By: _____

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

April 29, 2003

Tested By: _____

Abtin Spantman, EMC Engineer **Date**



April 29, 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:	Sports Communications
Model Number:	Commando Remote
Serial Number:	Engineering Unit
Frequency Range:	902-928 MHz
Test Voltage:	3.7 VDC (average) Rechargeable Lithium Ion Battery Pack

Environmental Conditions in the Test Lab:

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

7. Introduction

During February 3rd, - 6th, 2003, a series of Radiated Emissions tests were performed on one sample of the Sports Communications Remote Unit, Transmitter Reference-Design, here forth referred to as the "*Equipment Under Test*" or "*EUT*". This product operates by means of transmitting packets of data containing embedded codes.

These tests were preformed using the test procedure outlined in ANSI C63.4, 2001 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.249, for a manually operated 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, and 15.249.

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

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 Commando Control RF Wireless Remote Transceiver is a low power device used in a remote control application. The transceiver operates in the 902-928 MHz I.S.M. band, on one of ten channels, using FSK for the modulation method. The lowest channel (1), has a fundamental frequency of 903.0 MHz, and the highest channel (10) has a fundamental frequency of 911.0 MHz.

The Commando Control RF Wireless Remote is operated in a system with the Commando Control RF Base to allow for the remote control of a video device, particularly in a sports electronics application.

10. Test Requirements

The EUT was tested for radiated emissions, and compliance with the limits set forth by 47 CFR, Parts 15.205, 15.209, and 15.249, for a low power transmitter in an Ism band. The EUT was tested on the lowest and the highest channel, in accordance with 15.33.

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, Part 15.249.

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 wooden pedestal, which was centered on the flush-mounted 2m diameter metal turntable. The test sample was operated in continuous transmit CW mode for the radiated emissions measurements, and in normal mode for all other measurements, running a simulated set of commands.

12b. Test Procedure

The fundamental and spurious (harmonic) emissions of the transmitter were tested for compliance to Title 47CFR, FCC Part 15.249 limits for a low power transmitter in the ISM bands.

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 15.205a.

The EUT was placed on an 80 cm high 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 operated with the 5 VAC rechargeable battery fully charged. Operation was also checked with the charging cable plugged into the remote and the base unit. 3 orientations of the EUT were tested; vertical, horizontal and side. The unit was tested with a fully re-charged battery pack.

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.

12c. Test Results

The Equipment Under Test (EUT) was found to **MEET** the requirements as described within the specifications of Title 47 CFR, Part 15.249 for Radiated Emissions.

12d. Occupied Bandwidth

All fundamental signals were seen to fall completely within the 902-928 MHz I.S.M. band.

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 HP8546A EMI Receiver software database.

The connecting cables used were also measured for loss using a calibrated Signal Generator and the HP8546A EMI Receiver. The resulting loss factors were entered into the HP8546A database. This allowed for automatic change in the antenna correction factor. The resulting data taken from the HP8546A EMI Receiver is an actual reading and can be entered into the database as a corrected meter reading. The resulting reading can then compared to the appropriate limit in order to determine compliance. The HP8546A 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

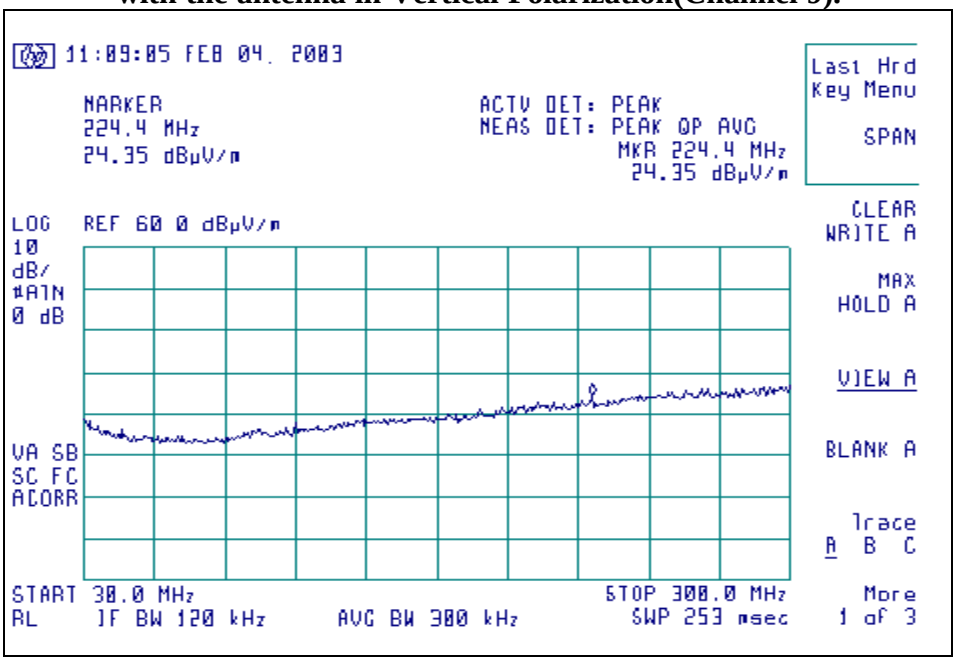
In the 3 Meter Semi-Anechoic Chamber

Horizontal Orientation

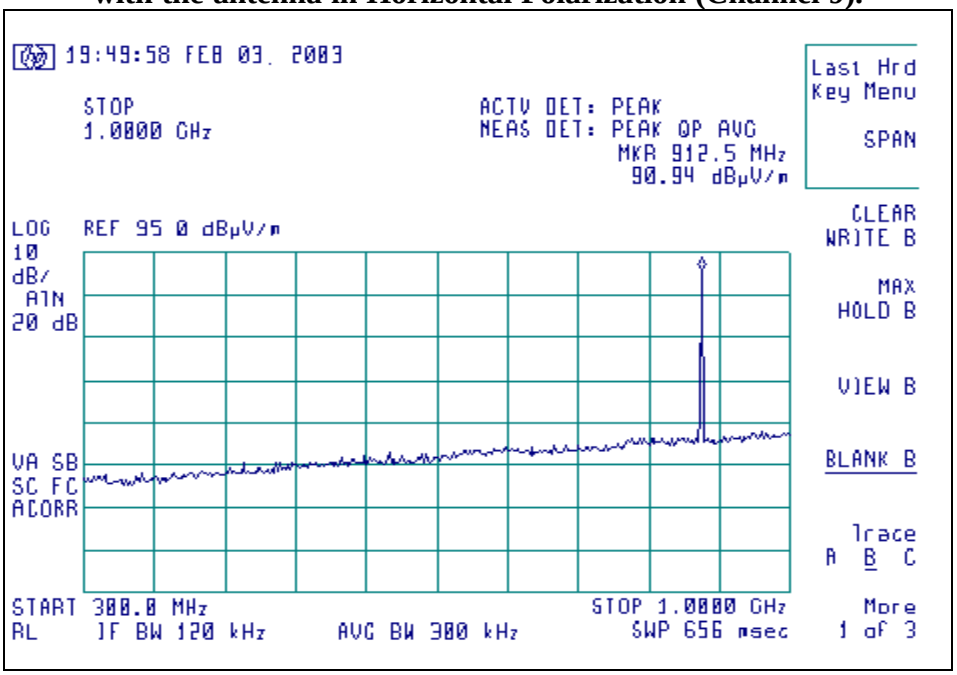
Vertical Orientation

12g. Signature Scans – Radiated Emissions

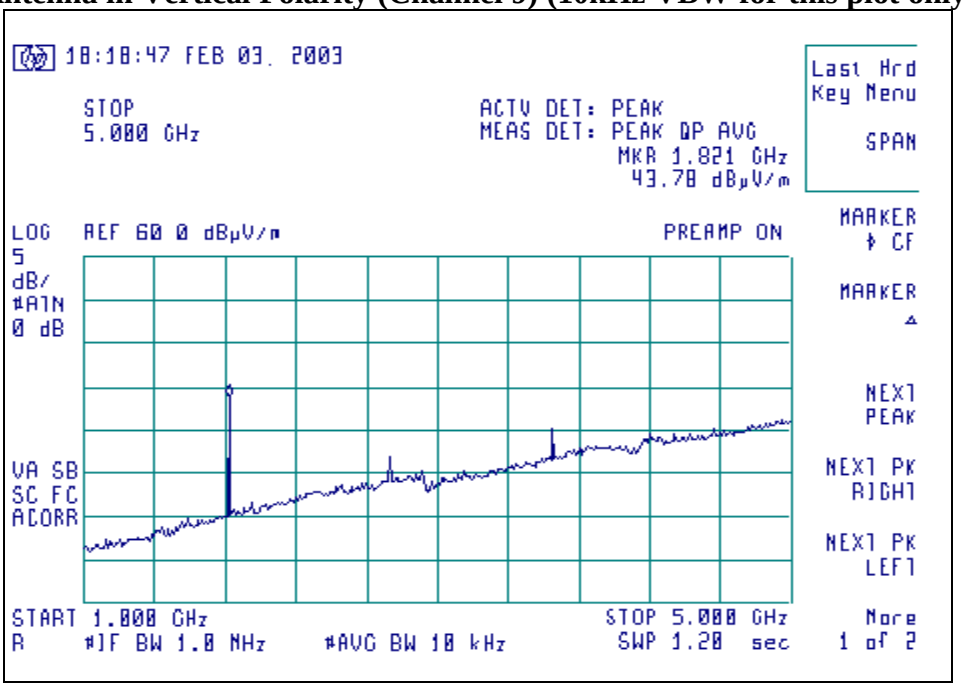
Signature Scan from 30 MHz to 300 MHz,
with the antenna in Vertical Polarization(Channel 9).



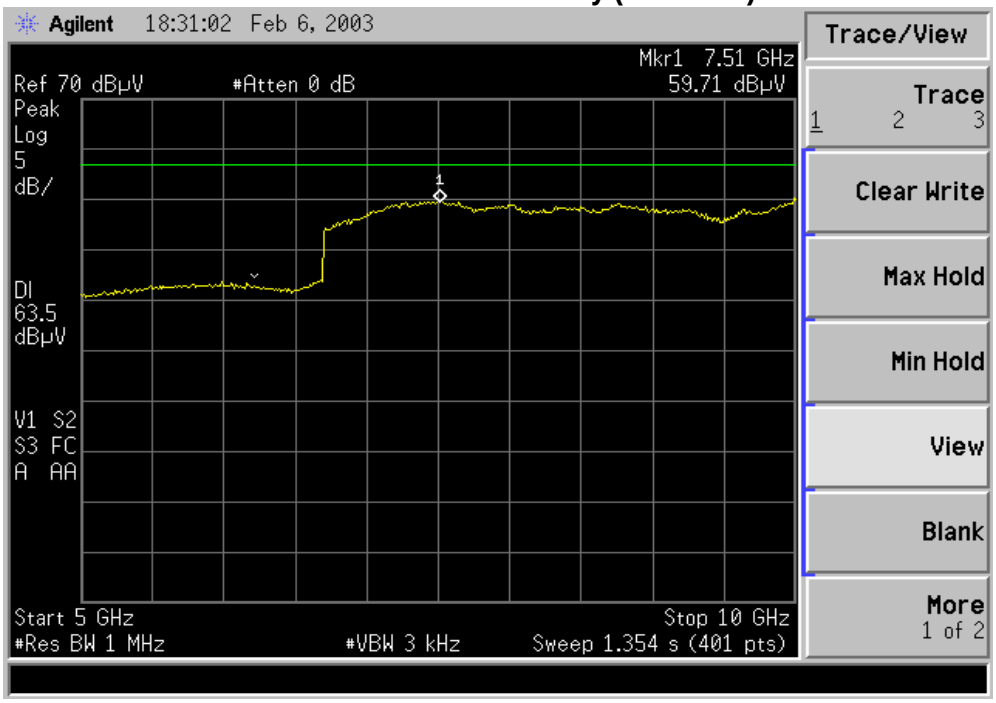
Signature Scan from 300 MHz to 1000 MHz,
with the antenna in Horizontal Polarization (Channel 9).



Signature Scan from 1000 MHz to 5000 MHz,
Antenna in Vertical Polarity (Channel 9) (10kHz VBW for this plot only)



Signature Scan from 5000 MHz to 10000 MHz,
Antenna in Horizontal Polarity (Channel 9).



Note: The above plot is performed while inspecting emissions with the device at 1 meter (or 0.3 meter to determine if the product is emitting spurious signals in this frequency range) 3 kHz VRW was used for this plot only. Highest noise floor at 7.5GHz was 58.0dBµV with 10Hz VBW.

12h. Measurement of Electromagnetic Radiated Emission

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

Manufacturer:	Sports Communications
Date of Test:	February 3rd – 6th, 2003
Model:	Commando Remote Unit
Serial:	Engineering Unit
Operating Mode:	4.2 VDC battery fully charged; continuous transmit

Test Specifications: **FCC Parts 15.205, 15.209, and 15.249.**

Distance: 3 Meters, 1 Meter (or 0.3) >5GHz			**Frequency Range Inspected:** 30 MHz to 10,000 MHz			
Configuration: Continuous Data Transmit, 3.8 VDC battery voltage measured at end of test.						
Detector(s) Used:		Peak	v	Quasi-Peak	v	Average

Test Equipment Used:

EMI Receiver: HP 8546A	Log Periodic Antenna: EMCO 93146
Double-Ridged Horn Antenna: EMCO 3115	Biconical Antenna: EMCO 93110B
Microwave Spectrum Analyzer HP E4407	

The following table depicts the level of significant fundamental and harmonic emissions found.
Higher order harmonics were found to be below the noise floor of the receiving system.

Frequency (MHz)	Channel	Antenna Polarity	Product Orientation	Height (Meters)	Azimuth (0?-360?)	EMI Meter Reading (dBµV/m)	Limits per 15.249,15.209 (dBµV/m)	Margin (dB)
903.0	**0**	**V**	**V**	**1.1**	**60**	**93.8**	**94.0**	**0.2**
910.9	**9**	**H**	**H**	**1.65**	**175**	**92.6**	**94.0**	**1.4**
1806	0	V	V	1.2	180	43.4	54.0	10.6
1822	9	V	H	1.0	265	42.9	54.0	11.1
2709	0	H	V	1.25	200	36.5	54.0	17.5
2733	9	H	H	1.0	15	37.1	54.0	16.9
3611	0	H	H	1.15	135	37.3	54.0	16.7
3644	9	V	H	1.15	200	38.9	54.0	15.1
4514	0	V	H	1.0	295	37.8	54.0	16.2
4555	9	V	H	1.0	0	39.1	54.0	14.9

Note: All measurements below 1GHz were taken with a quasi-peak detector. All measurements above 1 GHz were taken with an average detector.

Note: Peak readings were also performed above 1 GHz; all were found to be greater than 20dB below the 74 dBµV/m limit. (highest: 46.3 dBµV/m at 1806 MHz using 1 MHz/1MHz RBW/VBW

12i. Test Equipment Utilized

A list of the test equipment and antennas 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 HP8546A EMI Receiver software database.

The connecting cables used were also measured for loss using a calibrated Signal Generator and the HP8546A EMI Receiver. The resulting loss factors were entered into the HP8546A database. This allowed for automatic change in the antenna correction factor, as well as cable. The resulting data taken from the HP8546A EMI Receiver is an actual reading and can be entered into the database as a corrected meter reading.

The resulting reading was then compared to the appropriate limit in order to determine compliance. The HP8546a 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 standards. An Agilent E4407B Microwave Spectrum Analyzer was used above 6 GHz.

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

APPENDIX A

Calculations

Manufacturer: Sports Communications, Inc.
Model: Commando Remote Unit
Serial: Engineering Unit

CALCULATION OF RADIATED EMISSIONS LIMITS
FOR FCC PARTS 15.209, and 15.249 (260-470 MHz)

FIELD STRENGTH OF FUNDAMENTAL FREQUENCIES:
The fundamental emissions for a 916 MHz transmitter, operating under FCC Part 15.249 limits, must have a field strength no greater than 50mV/m at 3 meters, and a harmonic field strength no greater than 500µV/m at 3 meters.

Spurious emissions outside the 902 MHz - 928 MHz band shall be attenuated by at least 50 dB below the level of the fundamental, or meet the limits expressed in FCC Parts 15.205, and 15.209, under general emission limits.

Where f_o = 916.75 MHz

Fundamental: 20 Log (50mV / 1µV) = 93.97 dBµV/m @ 3m
Harmonic 20 Log (500µV / 1µV) = 53.97 dBµV/m @ 3m

Frequency (MHz)	Fundamental Limit (µV/m @ 3m)	Fundamental Limit (dBµV/m @ 3m)	Harmonic Limit (µV/m @ 3m)	Harmonic Limit (dBµV/m @ 3m)
916.75	50,000	93.97	500	53.97

Limits are rounded to the nearest whole number; i.e. 94.0 dBµV/m.

APPENDIX B

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Calibration Information	
					Date	Due Date
AA960007	EMCO	3115	9311-4138	Horn Antenna	12-06-02	12-06-03
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	05-02-02	05-02-03
AA960023	Werlatone	C3910	5167	Directional Coupler 40dB	06-19-01	Note 1*
AA960024	Pasternack	100 Watts	PE 7021-6	DC-1.5 GHz Attenuator	I/O	Note 1*
AA960050	Chase	BiCBL6140A	Bilog 1106	Bilog Antenna	06-19-01	Note 1*
AA960054	Giga-Tronics	80301A	1830164	Power Sensor	05-02-02	05-02-03
AA960074	Fischer	F2031-32mm	361	EM Injection Clamp	01-03-03	01-03-04
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
CC00181C	HP	33120A	US36013549	Signal Generator	09-29-00	N/A
CC00221C	Agilent	E4407B (26.5GHz)	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
EE960006	Haefely Trench	PESD 1600	H604079	ESD Gun	09-19-02	09-19-03
EE960007	Haefely Trench	P-line 1610	083732-19	Line Fluctuation Generator	09-19-02	09-19-03
EE960010	Haefely Trench	P-Surge-4	083061-08	Power Surge Generator	08-07-02	08-07-03
EE960011	Haefely Trench	PEFT 4010	083180-21	EFT/Burst Generator	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	Uc Value in Appropriate Units
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