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**FCC and Industry Canada Certification Test Report**  
**For the**  
**KEE Action Sports**  
**Empire RF Transmitter Board**

**FCC ID: W7BKEE38491**

**IC ID: 8265A-38491**

**WLL JOB# 10794**  
**June, 2009**

Prepared for:

**KEE Action Sports**  
**570 Mantua Avenue**  
**Sewell, NJ 08080**

Prepared By:

**Washington Laboratories, Ltd.**  
**7560 Lindbergh Drive**  
**Gaithersburg, Maryland 20879**



Testing Certificate 2675.01

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Prepared by:  
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Steven D. Koster  
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## **Abstract**

This report has been prepared on behalf of KEE Action Sports to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.249 (7/2008) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 of Industry Canada. This Certification Test Report documents the test configuration and test results for a KEE Action Sports Empire RF Transmitter Board.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 as an independent FCC test laboratory.

The KEE Action Sports Empire RF Transmitter Board complies with the limits for an Intentional Radiator device under FCC Part 15.249 and RSS-210 of Industry Canada.

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## **1 Introduction**

### **1.1 Compliance Statement**

The KEE Action Sports Empire RF Transmitter Board complies with the limits for an Intentional Radiator device under FCC Part 15.249 (7/2008) and Industry Canada RSS-210 with a Limited Modular Approval. The reason for the LMA is to show that the unit, which is to be sold as an after market addition for paintball markers, will comply with the requirements when installed by the end user. The transmitter board was exposed from the marker and not depending on the host for any of the shielding.

### **1.2 Test Scope**

Tests for radiated and conducted emissions were performed. All measurements were performed in accordance with FCC Public Notice DA 00-705 and the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

### **1.3 Contract Information**

Customer:	KEE Action Sports 570 Mantua Avenue Sewell, NJ 08080
Purchase Order Number:	N/A
Quotation Number:	64728

### **1.4 Test Dates**

Testing was performed on the following date(s):	2/20/09 & 4/27/09
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### **1.5 Test and Support Personnel**

Washington Laboratories, LTD	Steven Dovell, Elmer Rodriguez
Client Representative	Louis Spicer

## 1.6 Abbreviations

<b>A</b>	<b>A</b> mpere
<b>ac</b>	<b>a</b> lternating current
<b>AM</b>	<b>A</b> mplitude Modulation
<b>Amps</b>	<b>A</b> mperes
<b>b/s</b>	<b>b</b> its per second
<b>BW</b>	<b>B</b> and <b>W</b> idth
<b>CE</b>	<b>C</b> onducted <b>E</b> mission
<b>cm</b>	<b>c</b> entim <b>e</b> ter
<b>CW</b>	<b>C</b> ontinuous <b>W</b> ave
<b>dB</b>	<b>d</b> eci <b>B</b> el
<b>dc</b>	<b>d</b> irect current
<b>EMI</b>	<b>E</b> lectrom <b>a</b> gnetic <b>I</b> nterference
<b>EUT</b>	<b>E</b> quipment <b>U</b> nder <b>T</b> est
<b>FM</b>	<b>F</b> requency <b>M</b> odulation
<b>G</b>	<b>g</b> iga - prefix for $10^9$ multiplier
<b>Hz</b>	<b>H</b> ertz
<b>IF</b>	<b>I</b> ntermediate <b>F</b> requency
<b>k</b>	<b>k</b> ilo - prefix for $10^3$ multiplier
<b>LISN</b>	<b>L</b> ine <b>I</b> mpedance <b>S</b> tabilization <b>N</b> etwork
<b>M</b>	<b>M</b> ega - prefix for $10^6$ multiplier
<b>m</b>	<b>m</b> eter
<b>μ</b>	<b>m</b> icro - prefix for $10^{-6}$ multiplier
<b>NB</b>	<b>N</b> arrow <b>b</b> and
<b>QP</b>	<b>Q</b> uasi- <b>P</b> eak
<b>RE</b>	<b>R</b> adiated <b>E</b> missions
<b>RF</b>	<b>R</b> adio <b>F</b> requency
<b>rms</b>	<b>r</b> oot- <b>m</b> ean- <b>s</b> quare
<b>SN</b>	<b>S</b> erial <b>N</b> umber
<b>S/A</b>	<b>S</b> pectrum <b>A</b> nalyzer
<b>V</b>	<b>V</b> olt

## 2 Equipment Under Test

### 2.1 EUT Identification & Description

The KEE Action Sports Empire RF Transmitter Board RF is a Transmitter module, which can be attached to a paintball marker and is used to transmit a signal to an automatic loader that is attached to the marker.

**Table 1. Device Summary**

ITEM	DESCRIPTION
Manufacturer:	KEE Action Sports
FCC ID:	W7BKEE38491
IC ID:	8265A-38491
Model:	Empire RF Transmitter Board
FCC Rule Parts:	§15.249
Frequency Range:	2402MHz
Maximum Output Power:	20,090 $\mu$ V @ 3 meters
Modulation:	GFSK
Occupied Bandwidth:	875kHz
Keying:	Manual
Type of Information:	Data
Number of Channels:	1
Power Output Level	Fixed
Antenna Connector	none
Antenna Type	Wire
Interface Cables:	3 pin header
Power Source & Voltage:	9V Battery
TX Spurious	298.8 $\mu$ V/m @ 3 meters
RX Spurious	N/A

### 2.2 Test Configuration

The Empire RF Transmitter Board was configured with the radio outside the marker in a standalone configuration.

### 2.3 Testing Algorithm

The Empire RF Transmitter Board was operated in rapid fire mode to continuously transmit on its designated frequency of 2402MHz.

Worst case emission levels are provided in the test results data.

### 2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 as an independent FCC test laboratory.

## 2.5 Measurements

### 2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 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

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603C)

## 2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is  $\pm 2.3$  dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty =  $0.5 (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$  dB.



### 3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

**Table 2: Test Equipment List**

Test Name: <b>Radiated Emissions</b>		Test Date: <b>04/27/2009</b>	
<b>Asset #</b>	<b>Manufacturer/Model</b>	<b>Description</b>	<b>Cal. Due</b>
644	Sunol Science JB1	BiConalog Antenna	12/29/2009
69	HP, 85650A	Adapter, QP	07/09/2009
73	HP, 8568B	Analyzer, Spectrum	07/08/2009
71	HP, 85685A	Preselector, RF	07/09/2009
4	ARA, DRG-118/A	Antenna, DRG, 1-18GHz	02/06/2011
618	HP 8563A	Analyzer, Spectrum	04/10/2010
522	HP, 8449B	Pre-Amplifier, 1-26.5GHz	07/15/2009

## 4 Test Results

### 4.1 Duty Cycle Correction

Measurements may be adjusted where pulsed RF is utilized to find the average level associated with a quantity. This calculation is applied to limits for pulsed licensed and unlicensed devices.

- For Unlicensed Intentional Radiators under 47CFR Part 15, all duty cycle measurements compared to a 100 millisecond period
- $\text{duty cycle} = \text{on time} / 100 \text{ milliseconds}$

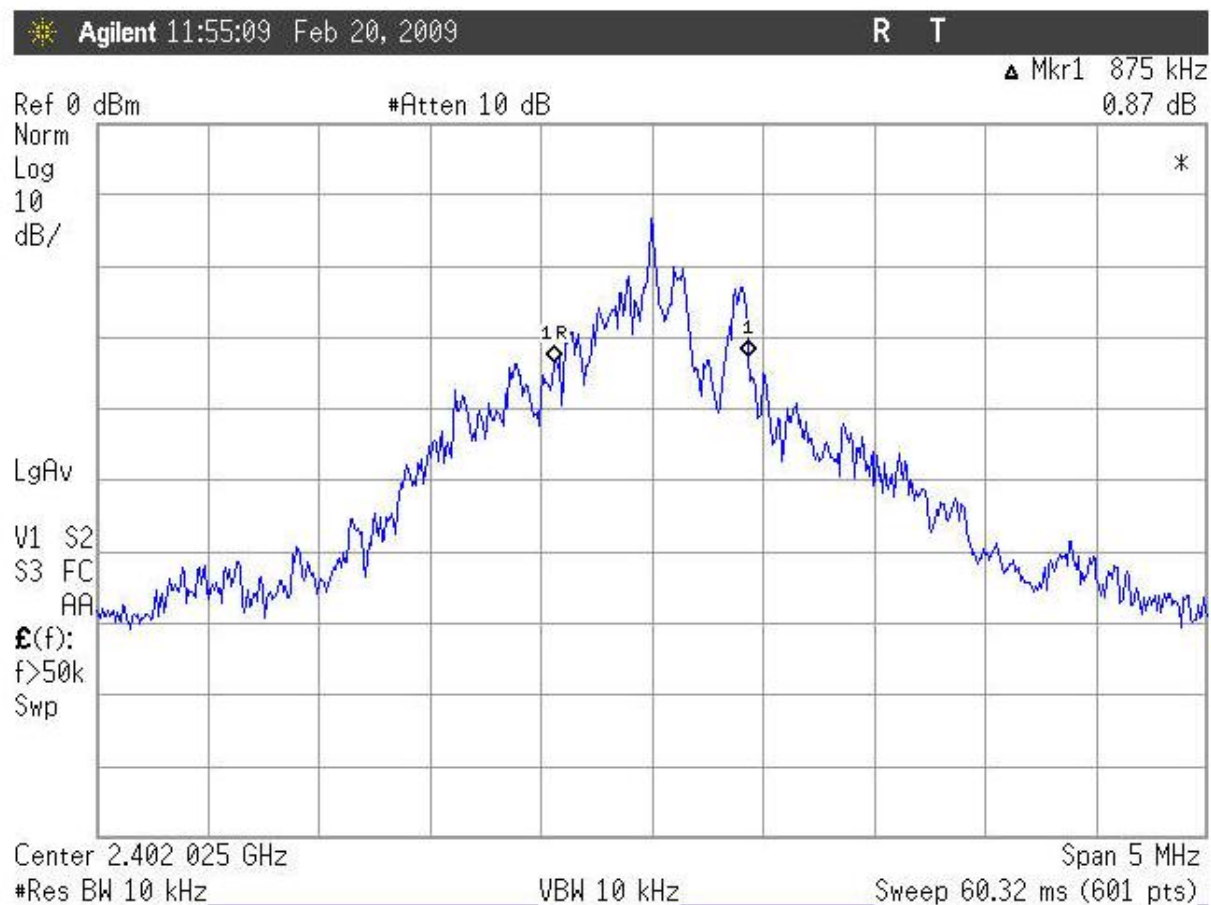
Duty Cycle Correction was not required for this device

### 4.2 Occupied Bandwidth: (FCC Part §2.1049 and RSS-210 A1.1.3)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

At full modulation, the occupied bandwidth was measured as shown:

KEE Action Sports 10793 Green Mini Invert FCC 15.249 20dB BW plot



**Figure 4-1. Occupied Bandwidth**

Table 3 provides a summary of the Occupied Bandwidth Results.

**Table 3. Occupied Bandwidth Results**

Frequency	Bandwidth	Limit	Pass/Fail
Channel: 2402MHz	875kHz	1 MHz	Pass

#### 4.3 Radiated Emissions: (FCC Part §2.1053, RSS210 A2.9)

The EUT must comply with the radiated emission limits of 15.249(a) & RSS210 A2.9. The limits are as shown in the following table.

**Table 4. Radiated Emissions Limits**

<b>Fundamental Frequency</b>	<b>Field Strength of Fundamental (<math>\mu\text{V/m}</math>)</b>	<b>Field Strength of Harmonics (<math>\mu\text{V/m}</math>)</b>
902 – 928 MHz	50,000	500
2400 – 2483.5 MHz	50,000	500
5725 – 5875 MHz	50,000	500
24.00 – 24.25 GHz	250,000	2500

##### 4.3.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The EUT was measured in three orthogonals. Worst case emissions are reported in Table 5.

The emissions were measured using the following resolution bandwidths:

<b>Frequency Range</b>	<b>Resolution Bandwidth</b>	<b>Video Bandwidth</b>
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	<30 Hz (Avg.) 1MHz (Peak)

Emissions were measured to the 10<sup>th</sup> harmonic of the transmit frequency. Worst case emission levels are reported.

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits. The duty cycle correction was added to the correction factor column as part of the over all correction factor for those measurements labeled AVG.

**Table 5: Radiated Emission Test Data**

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
48.00	V	0.0	1.4	9.8	9.9	9.7	100.0	-20.3	Ambient
64.00	V	45.0	1.0	5.5	8.0	4.8	100.0	-26.5	Ambient
160.00	V	90.0	1.4	-1.3	14.2	4.4	150.0	-30.6	Ambient
255.53	V	180.0	1.5	2.8	15.1	7.9	200.0	-28.1	Ambient
577.74	V	90.0	1.6	4.8	24.7	29.8	200.0	-16.5	
669.70	V	45.0	1.0	0.5	26.1	21.3	200.0	-19.4	Ambient
2401.82	V	90.00	2.70	81.00	-3.6	7379.3	50000.0	-16.6	Fundamental Peak
4804.06	V	265.00	2.40	41.30	2.0	146.3	500.0	-10.7	`
7206.83	V	0.00	2.40	34.20	8.6	138.3	500.0	-11.2	Ambient
9609.96	V	0.00	2.40	33.70	10.7	165.8	500.0	-9.6	Ambient
12011.12	V	0.00	2.40	32.80	10.9	152.3	500.0	-10.3	Ambient
48.00	H	0.0	0.0	0.0	9.9	3.1	100.0	-30.1	Ambient
64.00	H	45.0	3.9	3.5	8.0	3.8	100.0	-28.5	Ambient
160.00	H	90.0	3.3	2.5	14.2	6.9	150.0	-26.8	Ambient
255.53	H	180.0	3.9	5.7	15.1	11.0	200.0	-25.2	Ambient
577.74	H	90.0	2.0	7.6	24.7	41.2	200.0	-13.7	
669.78	H	0.0	3.9	0.7	26.1	21.8	200.0	-19.2	Ambient
729.80	H	270.0	3.9	-1.9	27.2	18.3	200.0	-20.8	Ambient
2401.82	H	180.00	1.26	89.70	-3.6	20091.7	50000.0	-7.9	Fundamental Peak
4804.06	H	160.00	1.20	47.50	2.0	298.8	500.0	-4.5	
7206.83	H	0.00	1.20	33.70	8.6	130.6	500.0	-11.7	Ambient
9609.96	H	0.00	1.20	34.50	10.7	181.8	500.0	-8.8	Ambient
12011.12	H	0.00	1.20	33.30	10.9	161.3	500.0	-9.8	Ambient