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FCC and Industry Canada Certification Test Report
For the
KEE Action Sports
Hatred Marq/Protègè Board

FCC ID: W7BKEE58701
IC: 8265A-58701

WLL JOB# **10793**
June 8, 2009

Prepared for:

KEE Action Sports
570 Mantua Avenue
Sewell, NJ 08080

Prepared By:

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

ACCREDITED
Testing Certificate 2675.01

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Prepared by:

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Reviewed by:

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 Hatred Marq/Protègè 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 Hatred Marq/Protègè Board complies with the limits for an Intentional Radiator device under FCC Part 15.249 and RSS-210 of Industry Canada.

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The KEE Action Sports Hatred Marq/Protègè 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 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):	4/27/09 – 5/6/09

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell
Client Representative	Louis Spicer

1.6 Abbreviations

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

2 Equipment Under Test

2.1 EUT Identification & Description

The KEE Action Sports Hatred Marq/Protègè Board is an after market device that installs in a paintball marker and allows the marker to be synchronized with the attached loader.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	KEE Action Sports
FCC ID:	FCC ID: W7BKEE58701
IC:	IC: 8265A-58701
Model:	Hatred Marq/Protègè Board
FCC Rule Parts:	§15.249
Frequency Range:	903.3MHz
Maximum Field Strength:	6159.3 uV/m (75.8 dBuV/m)
Modulation:	GFSK
Occupied Bandwidth:	731.67kHz
Keying:	Automatic, Manual
Type of Information:	Data
Number of Channels:	1
Power Output Level	Fixed
Antenna Connector	Strip line
Antenna Type	None – part of PCB
Interface Cables:	none
Power Source & Voltage:	9V Battery

2.2 Test Configuration

The Hatred Marq/Protègè Board was configured with the radio outside the marker in a standalone configuration.

2.3 Testing Algorithm

The Hatred Marq/Protègè Board was operated in rapid fire mode to continuously transmit on its designated frequency of 903.3MHz.

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 ±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:	**Radiated Emissions**	Test Date:	**04/27/2009**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
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
- duty cycle = on time/100 milliseconds

The following Figures show the plots of the modulated carrier. The spectrum analyzer was set to Zero Span and the video triggered to collect the pulse train of the modulation. Calculations of the duty cycle correction factor were obtained from time data provided by the plots.

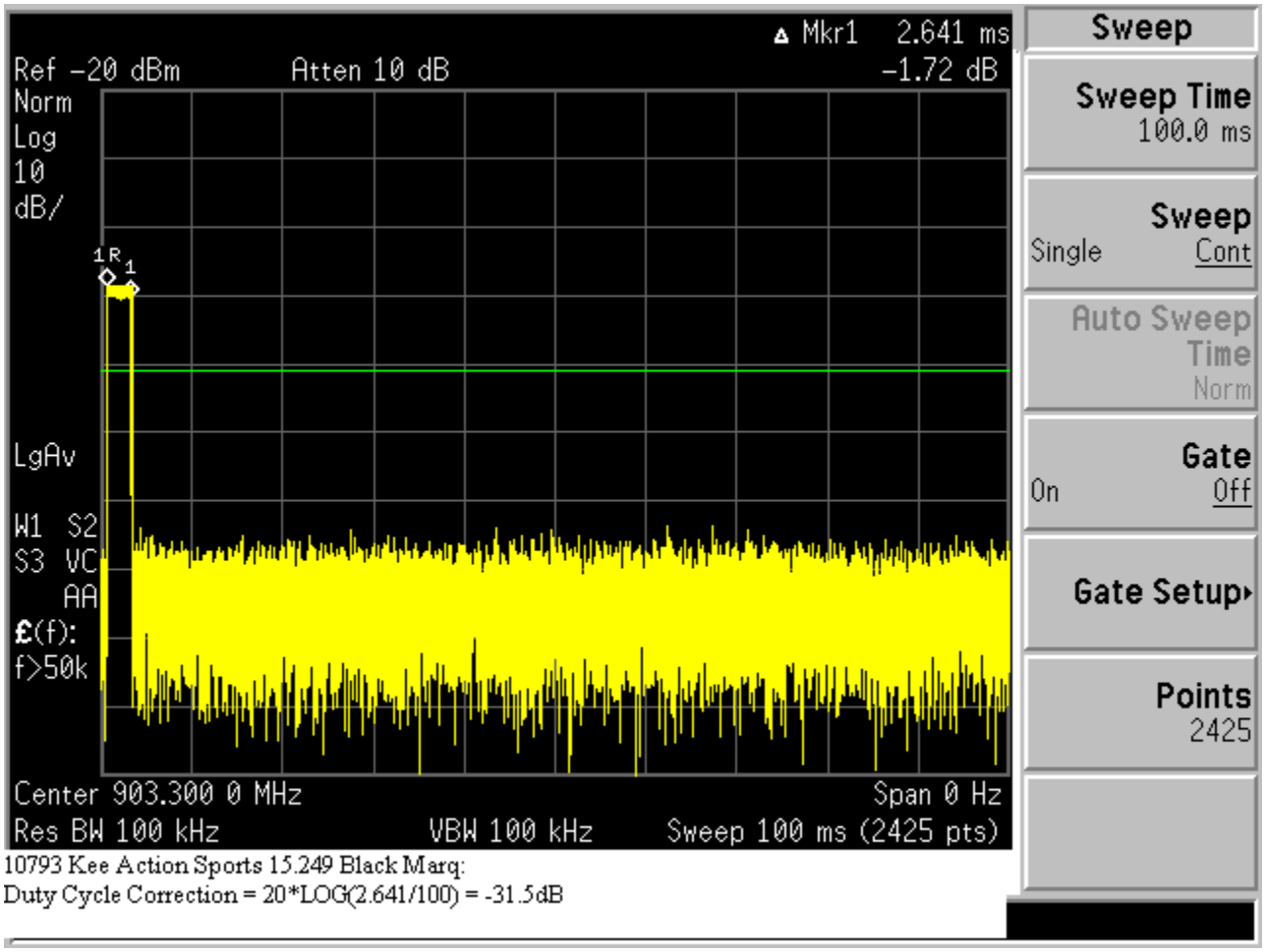

Figure 4-1. Duty Cycle Plot – Worst Case 100ms and Pulse Train

From the data in Figure 4-1, the following calculations are made.

On Time Per 100ms (worst case): 2.61ms

Duty cycle calculation:

20* LOG (2.61/100) = -31.5dB

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:

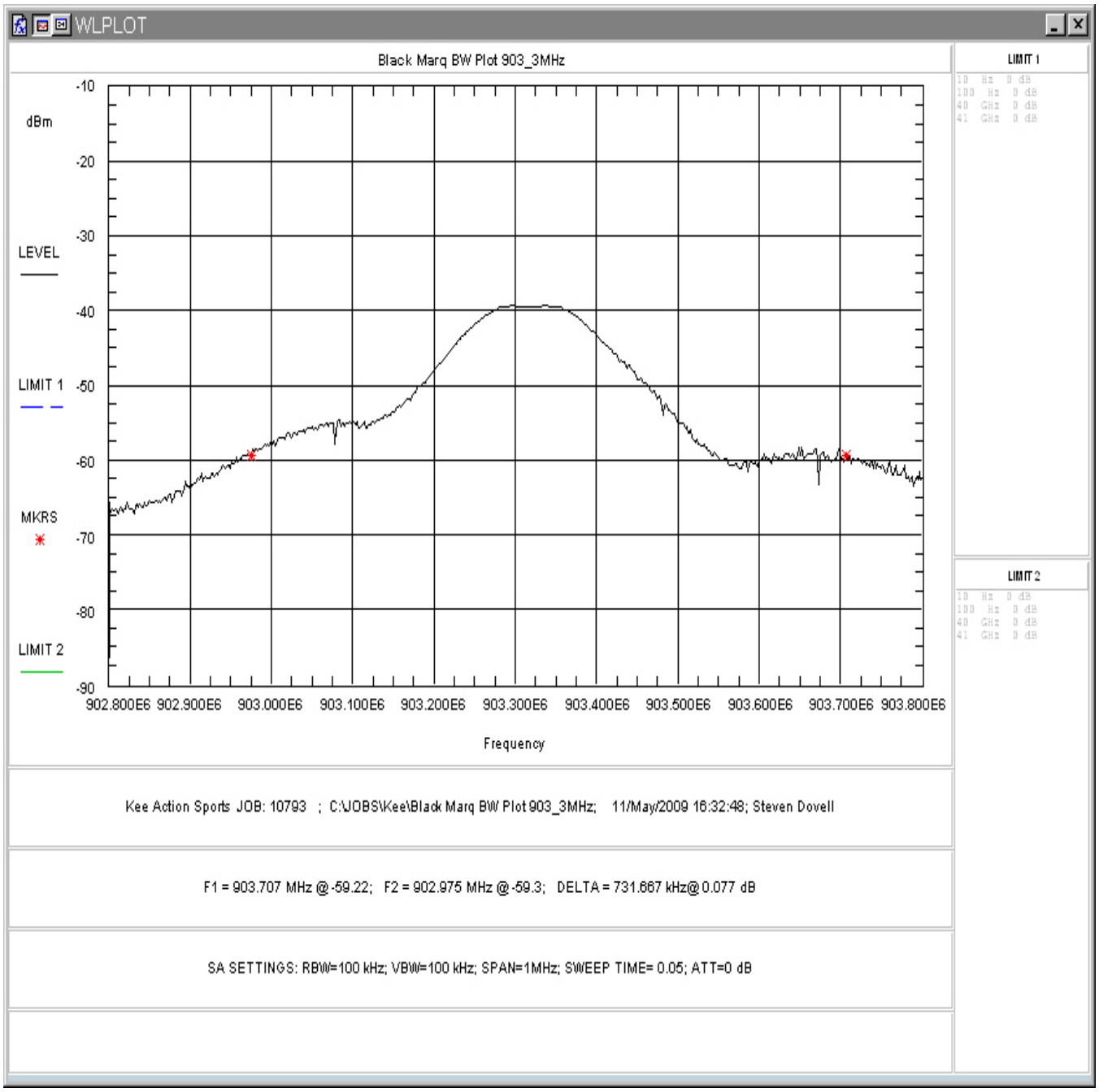

Figure 4-2. Occupied Bandwidth

Table 3 provides a summary of the Occupied Bandwidth Results.

Table 3. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
903.3MHz	731.657kHz	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

Fundamental Frequency	Field Strength of Fundamental (µV/m)	Field Strength of Harmonics (µV/m)
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:

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

Emissions were measured to the 10^{th} 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.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level):	V dBµV
Antenna Factor (Ant Corr):	AFdB/m
Cable Loss Correction (Cable Corr):	CCdB
Duty Cycle Correction (Average)	DCCdB
Amplifier Gain:	GdB
Corr factors:	CCFdB = AFdB/m + CCdB + DCCdB - GdB
Electric Field (Corr Level):	EdBµV/m = 10^((VdBµV + CCFdB)/20))

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
903.31	V	190.00	1.00	37.30	35.5	4360.5	50000.0	-21.2	Fund
429.05	V	180.00	1.59	8.70	26.2	55.3	200.0	-11.2	Ambient
160.00	V	270.00	1.00	0.40	18.6	8.9	150.0	-24.5	Ambient
193.23	V	270.00	2.40	1.20	18.2	9.3	150.0	-24.1	Ambient
219.28	V	0.00	2.50	7.70	18.7	21.0	200.0	-19.6	Ambient
505.33	V	90.00	1.27	4.80	28.1	44.2	200.0	-13.1	Ambient
735.23	V	180.00	1.60	0.90	32.8	48.2	200.0	-12.4	Ambient
1806.60	V	125.00	2.57	54.00	-37.7	6.5	500.0	-37.7	Avg
2709.90	V	180.00	2.57	56.30	-34.3	12.6	500.0	-31.9	Avg
3613.20	V	220.00	2.63	47.20	-32.0	5.7	500.0	-38.8	Avg
4516.50	V	220.00	2.63	42.80	-30.3	4.2	500.0	-41.5	Avg
5419.80	V	270.00	2.65	48.70	-27.7	11.2	500.0	-33.0	Avg
6323.10	V	90.00	2.64	42.00	-25.9	6.4	500.0	-37.9	Avg
1806.60	V	125.00	2.60	54.00	-6.2	244.3	5000.0	-26.2	Peak
2709.90	V	180.00	2.60	56.30	-2.8	475.4	5000.0	-20.4	Peak
3613.20	V	220.00	2.70	47.20	-0.5	215.8	5000.0	-27.3	Peak
4516.50	V	220.00	2.70	42.80	1.2	158.8	5000.0	-30.0	Peak
5419.80	V	270.00	2.65	48.70	3.8	419.8	5000.0	-21.5	Peak
6323.10	V	90.00	2.67	42.00	5.6	239.2	5000.0	-26.4	Peak
903.31	H	190.00	1.00	40.30	35.5	6159.3	50000.0	-18.2	Fund
64.00	H	90.00	1.40	4.20	11.1	5.8	100.0	-24.7	Ambient
160.00	H	90.00	1.00	1.50	18.6	10.1	150.0	-23.4	Ambient
193.23	H	180.00	2.38	6.60	18.2	17.3	150.0	-18.7	Ambient
219.28	H	180.00	2.50	4.70	18.7	14.8	200.0	-22.6	Ambient
505.33	H	90.00	1.00	2.20	28.1	32.8	200.0	-15.7	Ambient
735.23	H	90.00	1.80	3.60	32.8	65.8	200.0	-9.7	Ambient
1806.60	H	350.00	2.10	57.00	-37.7	9.2	500.0	-34.7	Avg
2709.95	H	180.00	2.10	57.30	-34.3	14.2	500.0	-30.9	Avg
3613.27	H	220.00	2.10	44.00	-32.0	4.0	500.0	-42.0	Avg
4516.50	H	270.00	2.00	45.50	-30.3	5.8	500.0	-38.8	Avg
5419.73	H	270.00	2.00	43.50	-27.7	6.1	500.0	-38.2	Avg
6323.10	H	90.00	2.00	37.80	-25.9	3.9	500.0	-42.1	Avg Ambient
1806.60	H	350.00	2.10	57.00	-6.2	345.1	5000.0	-23.2	Peak
2709.95	H	180.00	2.10	57.30	-2.8	533.4	5000.0	-19.4	Peak
3613.27	H	220.00	2.10	44.00	-0.5	149.3	5000.0	-30.5	Peak
4516.50	H	270.00	2.00	45.50	1.2	216.7	5000.0	-27.3	Peak
5419.73	H	270.00	2.00	43.50	3.8	230.7	5000.0	-26.7	Peak
6323.10	H	90.00	2.00	37.80	5.6	147.5	5000.0	-30.6	Peak

Table 6: Radiated Emission Test Data – RX only

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
429.05	V	180.00	1.59	8.70	21.1	31.0	200.0	-16.2	Ambient
160.00	V	270.00	1.00	0.40	14.2	5.4	150.0	-28.9	Ambient
193.23	V	270.00	2.40	1.20	13.7	5.5	150.0	-28.7	Ambient
219.28	V	0.00	2.50	7.70	14.1	12.4	200.0	-24.2	Ambient
505.33	V	90.00	1.27	4.80	23.0	24.5	200.0	-18.2	Ambient
735.23	V	180.00	1.60	0.90	27.4	26.0	200.0	-17.7	Ambient
64.00	H	90.00	1.40	4.20	8.0	4.1	100.0	-27.8	Ambient
160.00	H	90.00	1.00	1.50	14.2	6.1	150.0	-27.8	Ambient
193.23	H	180.00	2.38	6.60	13.7	10.3	150.0	-23.3	Ambient
219.28	H	180.00	2.50	4.70	14.1	8.8	200.0	-27.2	Ambient
505.33	H	90.00	1.00	2.20	23.0	18.1	200.0	-20.8	Ambient
735.23	H	90.00	1.80	3.60	27.4	35.4	200.0	-15.0	Ambient

