

Exhibit B: Test Report
Raven Industries
RGL 600 Smartbar Transmitter

Project Number: 04136-10

Prepared for:
Raven Industries
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Austin , TX 78753

By

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October 2003

CERTIFICATION
Electromagnetic Interference Test Report
Raven Industries
RGL 600 Smartbar Transmitter
(Intentional Radiator Portion)

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THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF PROFESSIONAL TESTING (EMI), INC.



Certificate of Compliance

Applicant: Raven Industries
Applicant's Address: 500 Center Ridge Dr., Ste. 600
Austin, TX 78753
Serial Number: N/A
FCC ID: RLA-0630172368
Project Number: 04136-10
Test Dates: September 2/3, 2003

I, Jeffrey A. Lenk, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measured data and this report. I believe them to be true and accurate.

The **Raven Industries, RGL 600 Smartbar Transmitter** was tested to and found to be in compliance with FCC Part 15 Subpart C for an Intentional Radiator.

The highest emissions generated by the above equipment are listed below:

	<u>Frequency (MHz)</u>	<u>Level (dBμV/m)</u>	<u>Limit (dBμV/m)</u>	<u>Margin (dB)</u>
Fundamental	418	79.7	80.28	-0.6
Spurious	836	46.5	60.28	-13.8
	<u>Frequency (KHz)</u>	<u>Limit (KHz)</u>	<u>Margin (KHz)</u>	
Occupied	9.74	1050	1040	
Bandwidth				

Jeffrey A. Lenk
President

This report has been reviewed and accepted by Raven Industries. The undersigned is responsible for ensuring that **Raven Industries, RGL 600 Smartbar Transmitter** will continue to comply with the FCC rules.

1.0 EUT Description

The Equipment under Test (EUT) is the **Raven Industries, RGL 600 Smartbar Transmitter**. The EUT is part of a system (Swath Smart Guidance System) used to guide a farm tractor to the correct swath in the field using GPS navigation data. The RGL 600 Smartbar, connected to a DGPS receiver provides guidance control and display for swathing applications. The modes of the light bar are set and controlled using a hand-held transmitter. The transmitter has three buttons and is battery operated. The EUT operates at 419 MHz and is designed for compliance with 47 CFR 15.231 of the FCC rules. The EUT stops transmitting within one second of button release. Specific test requirements for this device include the following:

47 CFR 15.209 & 15.231	Fundamental Transmit Power
47 CFR 15.231 & 15.205	Spurious Radiated Power
47 CFR 15.231	Occupied Bandwidth
47 CFR 15.203	Antenna Requirement

The system tested consisted of the following:

<u>Manufacturer & Model</u>	<u>Serial #</u>	<u>FCC ID #</u>	<u>Description</u>
Raven Industries, RGL 600 Smartbar Transmitter	None	RLA-0630172368	Transmitter

Remote Equipment

None

System Peripherals

None

1.1 EUT Operation

The **Raven Industries RGL 600 Smartbar Transmitter** was tested in an atypical mode. One of the three operator buttons was shorted to enable continuous transmission.

2.0 Electromagnetic Emissions Testing

Professional Testing (EMI), Inc. (PTI), follows the guidelines of NIST for all uncertainty calculations, estimates and expressions thereof for EMC testing.

2.1 Radiated Emissions Measurements

Radiated emission measurements were made of the Fundamental and Spurious Emission levels for the **Raven Industries RGL 600 Smartbar Transmitter**. Measurements of the occupied bandwidth were also made for the Transmitter.

Measurements of the maximum emission levels for the fundamental and the spurious/harmonic emissions of the **Raven Industries RGL 600 Smartbar Transmitter** were made at the Professional Testing "Open Field" Site 3, located in Round Rock, Texas to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

Tests of the fundamental for the device were performed to determine the worst case polarization of the device.

2.1.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable which allows 360 degree rotation. For measurements of the fundamental signal, a measurement antenna was positioned at a distance of 3 meters as measured from the closest point of the EUT. For harmonic measurements above 1 GHz, the measurement antenna was placed 1 meter from the EUT. The radiated emissions were maximized by rotating the EUT.

A Spectrum Analyzer with average detection was used to find the maximums of the radiated emissions during the variability testing. A drawing showing the test setup is given as Figure 1.

2.1.2 Test Criteria

The table below shows FCC Part 15.231 radiated limits for an intentional radiator operating at 419 MHz band. FCC Part 15.231 allows the use of its spurious limit which is higher than the 15.209 limit normally associated with the restricted bands outlined in 15.205. Measurements of the harmonic were performed to the 10th harmonic of the fundamental. The reference distance for each limit is also shown in this table.

<u>Signal Type</u>	<u>Test Distance (Meters)</u>	<u>Field Strength</u>	
		<u>(μV/m)</u>	<u>(dBμV/m)</u>
Fundamental 419 MHz	3	10351	80.3
Harmonics (through 10th)	3	1035	60.3

Note: Radiated emissions above 1000 MHz were measured at 1 meter and the limit was increased by 9.5 dB.

2.1.3 Test Results

The radiated test data for the fundamental is included in Appendix A. Average detection was used during the test. The emissions were maximized at each frequency and the highest emissions identified were measured using peak detection. The radiated emissions generated by the **Raven Industries RGL 600 Smartbar Transmitter** are below the FCC Part 15.231 maximum emission criteria.

3 Occupied Bandwidth Measurements

Measurements of the occupied bandwidth for the fundamental signals of the FCC Part 15.231 were made at the Professional Testing's Round Rock, Texas site. All measurements were made in a controlled indoor environment in a configuration which did not present measurement distortion or ambient interference.

3.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor. The table was rotated to an angle which presented the highest signal level. The occupied bandwidth was measured on the device. The occupied bandwidth was based on a 20 dB criteria (20 dB down either side of the emission from the peak emission).

3.2 Test Criteria

According to FCC Part 15.231, the bandwidth of the emission shall not be wider than 0.25 % of the center frequency for the devices operating above 70 MHz and below 900 MHz. The limit is 1.045 MHz for a transmitter working at 419 MHz.

Measurement of the occupied bandwidth was performed to verify that the emission bandwidth from the EUT did not exceed 1.045 MHz. The typical occupied bandwidth for the module is 10 kHz.

FCC Part 15.231 deals with frequency bands. No occupied bandwidth criteria is set forth.

3.3 Test Results

The occupied bandwidth test data is included in Appendix B. The occupied bandwidth for the fundamental frequency of the **RGL 600 Smartbar Transmitter** was found to be 150 KHz. This figure is typical for a 419 MHz transmitter. This occupied bandwidth complies with the FCC Part 15.231 requirement.

4.0 Antenna Requirement

An analysis of the **Raven Industries RGL 600 Smartbar Transmitter** was performed to determine compliance with Section 15.203 of the Rules. This section requires specific handling and control of antennas used for devices subject to regulations under the Intentional Radiator portions of Part 15.

4.1 Evaluation Procedure

The structure and application of the **Raven Industries RGL 600 Smartbar Transmitter** were analyzed with respect to the rules.

The EUT has an internal antenna permanently attached to the EUT. The antenna is in a module that is soldered to the circuit board. The antenna is not accessible to the user. No auxiliary antenna port is present.

4.2 Evaluation Criteria

Section 15.203 of the rules states that the subject device must meet at least one of the following criteria:

- (a) Antenna be permanently attached to the unit.
- (b) Antenna must use a unique type of connector to attach to the EUT.
- (c) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

4.3 Evaluation Results

The **RGL 600 Smartbar Transmitter** meets the criteria of this rule by virtue of having an internal antenna permanently attached to the unit and not accessible to the user. The EUT is therefore compliant with §15.203.

5.0 Modifications to Equipment

The following modifications were made on the **RGL 600 Smartbar Transmitter** during the performance of the test program in order to meet the FCC criteria.

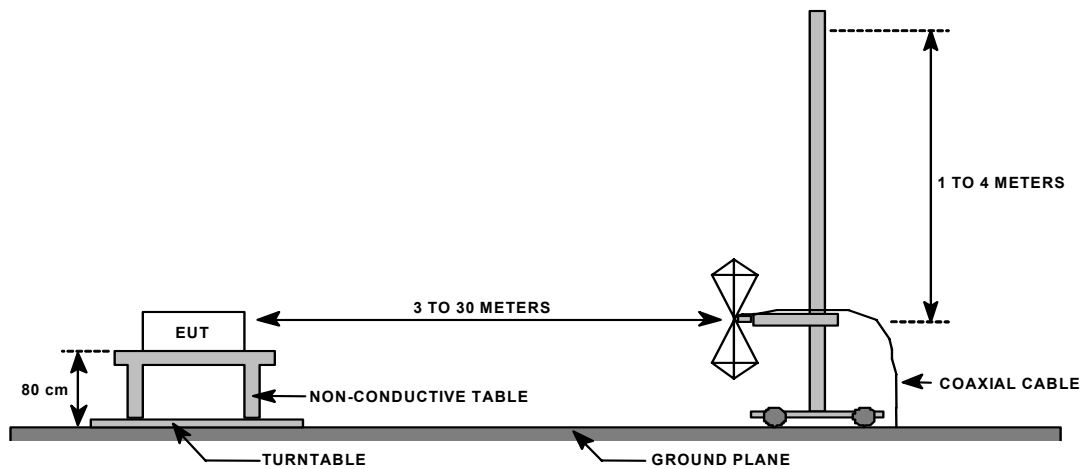
- A 750 Ohm resistor was soldered onto Pin 4 of U1 of the transmitter to make it transmit at a lower level.
- A short was soldered across one of the button circuits to make the EUT transmit continuously.

6.0 List of Test Equipment

A list of the test equipment utilized to perform the testing is given below. The date of calibration is given for each.

<u>Device</u>	<u>Description</u>	<u>Calibration Due</u>
<u>Electromagnetic Emissions</u> <u>Test Equipment</u>		
EMCO 3146	Log Periodic Antenna	November 2003
HP 85662A	Display unit	November 2003
HP 8447D	Preamplifier	November 2003
HP 85650A	Quasi-Peak Adapter	November 2003
HP 8566B	Spectrum Analyzer	November 2003
EMCO 3115	Ridge Guide Antenna	June 2004
Compliance Design B-100	Biconical Antenna	October 2003
Tektronix 2706	RF Preselctor	December 2003
MITEQ	18GHz 20dB Preamplifier	December 2003
Armored Microwave Cable		June 2004

FIGURE 1: Radiated Emissions Test Setup



**Radiated Data Sheet
Fundamental and Spurious
RGL 600 Smartbar Transmitter
Transmitter**

DATE: September 2, 2003
PROJECT: 04136-10

MEASUREMENT DISTANCE (m): 3
DETECTOR FUNCTION: Average

Antenna Polarization: Horizontal

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
418	180	1	80.3	27.1	18.7	7.8	79.6	80.28	-0.6
836	200	1	37.2	26.1	24.4	10.9	46.5	60.28	-13.8

Antenna Polarization: Vertical

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
418	10	1	67.63	27.1	18.7	7.8	67.0	80.28	-13.3
836	noise	floor	29.5	26.1	24.4	10.9	38.8	60.28	-21.5

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

TEST ENGINEER: Mike Royer

Microwave Radiated Data Sheet
Harmonics
Raven Industries
RGL 600 Smartbar Transmitter
Transmitter

DATE: July 7, 2003
PROJECT: 04136-10

MEASUREMENT DISTANCE (m): 1
DETECTOR FUNCTION: Average

Antenna Horizontal

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/M)	Cable Loss (dB)	Corrected Level (dBuV/M)	Limit (dBuV/M)	Margin (dB)
1254	270	1	38	23.3	24.4	2.0	41.1	69.8	-28.7
1672	240	1	33.6	23.0	26.0	2.3	38.9	63.5	-24.6
2090	Noise	Floor	30.7	22.7	27.7	2.6	38.3	69.8	-31.5
2508	Noise	Floor	31.7	22.5	28.3	2.9	40.4	69.8	-29.4
2926	Noise	Floor	32.7	22.8	30.3	3.2	43.4	69.8	-26.4
3344	Noise	Floor	33.7	22.9	31.3	3.4	45.5	69.8	-24.3
3762	Noise	Floor	34.7	22.9	32.5	3.7	48.0	69.8	-21.8
4180	Noise	Floor	35.7	23.0	33.4	4.0	50.0	63.5	-13.5

Antenna Vertical

Freq. (MHz)	EUT Dir (Deg.)	Antenna Elevation (Meters)	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/M)	Cable Loss (dB)	Corrected Level (dBuV/M)	Limit (dBuV/M)	Margin (dB)
1254	270	1	38	23.3	24.4	2.0	41.1	69.8	-28.7
1672	170	1	37	23.0	26.0	2.3	42.3	63.5	-21.2
2090	170	1	37.7	22.7	27.7	2.6	45.3	69.8	-24.5
2508	noise	floor	30.8	22.5	28.3	2.9	39.5	69.8	-30.3
2926	noise	floor	30.8	22.8	30.3	3.2	41.5	69.8	-28.3
3344	noise	floor	30.8	22.9	31.3	3.4	42.6	69.8	-27.2
3762	noise	floor	30.8	22.9	32.5	3.7	44.1	69.8	-25.7
4180	noise	floor	30.8	23.0	33.4	4.0	45.1	63.5	-18.4

Corrected Level = Recorded Level - Amplifier Gain + Antenna Factor + Cable Loss

TEST ENGINEER: Mike Royer

Appendix B Occupied Bandwidth Data Sheets

Occupied Bandwidth Datasheet
Raven Industries
RGL 600 Smartbar Transmitter

418 MHz Trasmmitter

