



**ROGERS LABS, INC.**

4405 West 259<sup>th</sup> Terrace  
Louisburg, KS 66053  
Phone / Fax (913) 837-3214

**ENGINEERING TEST REPORT  
FOR  
APPLICATION of  
GRANT of CERTIFICATION**

FOR  
**CFR 47, PART 15C - INTENTIONAL RADIATORS  
Paragraph 15.231  
Radiated emission limits; general requirements**

For  
**SAVANT TECHNOLOGY GROUP, INC.**  
7011 Koll Center Parkway, Suite 150  
Pleasanton, CA 94566  
Stephen D. Ricketts,

**CLASSROOM WIRELESS LEARNING REMOTE**  
Model: 2207  
Frequency 433 MHz  
FCC ID#: SA7 2207

Test Date: December 3, 2004

Certifying Engineer: *Scot D Rogers*  
Scot D. Rogers  
ROGERS LABS, INC.  
4405 West 259<sup>th</sup> Terrace  
Louisburg, KS 66053  
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**FORWARD:**

The following is submitted for consideration in obtaining a Grant of Certification for intentional radiators operating under CFR Paragraph 15.231.

Name of Applicant:

SAVANT TECHNOLOGY GROUP, INC.  
7011 Koll Center Parkway, Suite 150  
Pleasanton, CA 94566

Model: 2207.

FCC I.D.: SA7 2207.

Frequency Range: 433 MHz.

Operating Power: 34.4E-6 W (3 meter effective radiated measurement).

$$\begin{aligned} E(v/m) &= 10^{(FSM ((dB\mu V)-120)/20)} &= 10^{(80.6-120)/20} &= 10.715E-3 \text{ v/m} \\ ERP \text{ (Watts)} &= (Ed)^2/30 &= (10.715E-3)^2/30 &= 34.4E-6 \text{ Watts} \end{aligned}$$

**1) Applicable Standards & Test Procedures**

a) In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2003, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.231 the following is submitted:

b) Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI 63.4, FCC documents DA00-1407 and DA00-705 and/or TIA/EIA 603-1.

**2.1033(b) Application for Certification**

- (1) Manufacturer: SAVANT TECHNOLOGY GROUP, INC.  
7011 Koll Center Parkway, Suite 150  
Pleasanton, CA 94566
- (2) Identification: Model: 2207  
FCC ID.: SA7 2207
- (3) Instruction Book:  
  
Refer to Exhibit for Instruction Manual.
- (4) Description of Circuit Functions:  
  
Refer to Exhibit of Operational Description.
- (5) Block Diagram with Frequencies:  
  
Refer to Exhibit of Operational Description.
- (6) Report of Measurements:  
  
Report of measurements follows in this Report.
- (7) Photographs: Construction, Component Placement, etc.:  
  
Refer to Exhibit for photographs of equipment.
- (8) Peripheral Equipment: No peripheral equipment required.
- (9) Transition Provisions of 15.37 are not being requested.
- (10) Scanning receiver:  
  
Not applicable, the unit is not a scanning receiver.
- (11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.

## 2) Equipment Tested

<u>Equipment</u>	<u>Model</u>	<u>FCC ID.#</u>
EUT	2207	SA7 2207

Test results in this report relate only to the items tested.

## 3) Equipment Function and Testing Procedures

The EUT is a 433 MHz radio transmitter used with a receiver unit connected to a computer to register student responses to a presented question. The system enables an instructor to present questions and register responses from many participants using the remote control keypads. The unit operates at 433 MHz and sends and receives wireless code to and from the remote receiver. The unit transmits participant responses to the receiver for registration on the computer system and receives an acknowledgment signal from the receiver when the response has been received and registered. The device utilizes a permanently connected tuned antenna system on the printed circuit board of the transmitter with no provision for user replacement. The unit has no provision to connect to external auxiliary equipment and operates solely from the battery cells internal to the unit. It has no provision to connect to the utility power system.

#### 4) Equipment and Cable Configurations

##### ***Conducted Emission Test Procedure***

The unit operates from the power supplied from the replaceable batteries internal to the unit and has no provision to connect to utility power. Therefore no AC line conducted emissions test was performed.

##### ***Radiated Emission Test Procedure:***

The EUT was placed on a rotating 1 x 1.5-meter wooden platform, 0.8 meters above the ground plane at a distance 3 meters from the FSM antenna. EMI energy was maximized by equipment placement, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken using a spectrum analyzer. The antenna substitution method was used to measure the radiated power required to reproduce the measured emission of the intentional radiator. Refer to photographs in the exhibits for EUT placement.

#### 5) List of Test Equipment

A Hewlett Packard 8591EM Spectrum Analyzer was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Hewlett Packard 8562A Spectrum Analyzer was used as the measuring device for testing the emissions at frequencies above 1 GHz. The analyzer settings used are described in the following table. Refer to the appendix for a complete list of test equipment.

HP 8591 EM ANALYZER SETTINGS		
CONDUCTED EMISSIONS:		
RBW	AVG. BW	DETECTOR FUNCTION
9 kHz	30 kHz	Peak / Quasi Peak
RADIATED EMISSIONS:(Below 30 MHz)		
RBW	AVG. BW	DETECTOR FUNCTION
9 kHz	30 kHz	Peak / Average
RADIATED EMISSIONS:(Above 30 MHz)		
RBW	AVG. BW	DETECTOR FUNCTION
120 kHz	300 kHz	Peak / Quasi Peak
HP 8562A ANALYZER SETTINGS		
RBW	VIDEO BW	DETECTOR FUNCTION
100 kHz	100 kHz	PEAK
1 MHz	1 MHz	Peak / Average

<u>EQUIPMENT MFG.</u>	<u>MODEL</u>	<u>CAL. DATES</u>	<u>DUE.</u>
LISN Comp. Design	FCC-LISN-2-MOD.CD	10/04	10/05
Antenna ARA	BCD-235-B	10/04	10/05
Antenna EMCO	3147	10/04	10/05
Antenna EMCO	3143	5/04	5/05
AnalyzerHP	8591EM	5/04	5/05
AnalyzerHP	8562A	2/04	2/05

## 6) Units of Measurements

Conducted EMI: Data is in dB $\mu$ V; dB referenced to one microvolt.

Radiated EMI: Data is in dB $\mu$ V/m; dB/m referenced to one microvolt per meter.

## 7) Test Site Locations

**Conducted EMI:** The AC power line conducted emissions tests were performed in a shielded screen room located at Rogers Labs, Inc., 4405 W. 259<sup>th</sup> Terrace, Louisburg, KS.

**Radiated EMI:** The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 W. 259<sup>th</sup> Terrace, Louisburg, KS.

**Site Approval:** Refer to Appendix for FCC Site Approval Letter, Reference # 90910.

**NVLAP Accredited:** Lab Code 200087-0.

## 8) **SUBPART B – UNINTENTIONAL RADIATORS**

### ***Conducted EMI***

The unit operates from the power supplied from the replaceable batteries internal to the unit and has no provision to connect to utility power. Therefore no AC line conducted emissions test was performed.

### ***Radiated EMI***

The EUT was arranged in a typical equipment configuration and operated through all of its various modes. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies, which produced the highest emissions. Plots were made of the frequency spectrum from 30 MHz to 5,000 MHz for the preliminary testing. Refer to figures one through four for plots of the radiated emissions spectrum taken in a screen room at one meter distance. The highest radiated emission was then re-maximized at the OATS location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the OATS at a distance of 3 meters between the EUT



and the receiving antenna to demonstrate compliance with the general radiated emissions limits. The frequency spectrum from 30 MHz to 5,000 MHz was searched for radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna position between horizontal and vertical polarization. Antennas used were Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 1000 MHz, Log Periodic from 200 MHz to 5 GHz and or, pyramidal horns and mixers from 4 GHz to 10 GHz, notch filters and appropriate amplifiers were utilized.

#### Sample Calculations:

$$\begin{aligned} \text{RFS} &= \text{Radiated Field Strength} \\ \text{dB}\mu\text{V/m @ 3m} &= \text{dB}\mu\text{V} + \text{A.F.} - \text{Amplifier Gain} \\ \text{dB}\mu\text{V/m @ 3m} &= 43.2 + 6.0 - 30 \\ &= 19.2 \end{aligned}$$

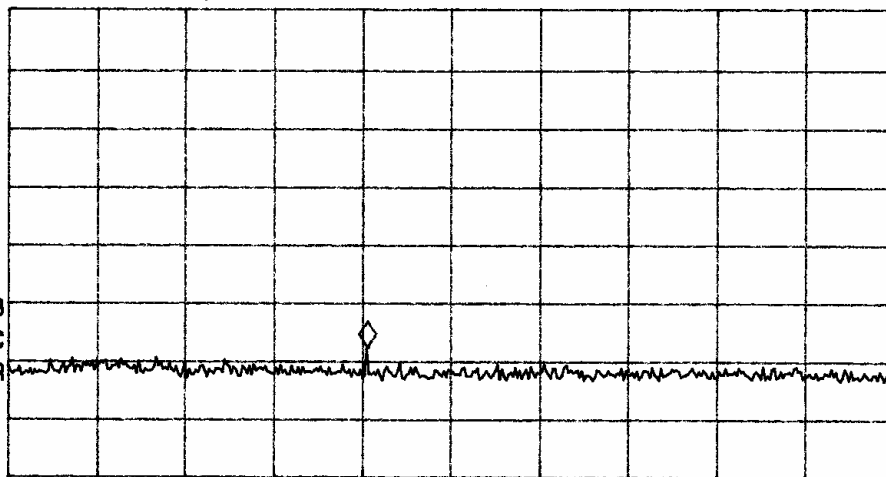
MARKER  
111.0 MHz  
22.31 dB $\mu$ V

ACTV DET: PEAK  
MEAS DET: PEAK QP  
MKR 111.0 MHz  
22.31 dB $\mu$ V

LOG REF 80.0 dB $\mu$ V

10  
dB/  
#ATN  
0 dB

MA SB  
SC FC  
CORR



START 30.0 MHz

#IF BW 120 kHz

AVG BW 300 kHz

STOP 230.0 MHz

SWP 41.7 msec

Figure one Radiated Emissions taken at 1 meter in screen room.

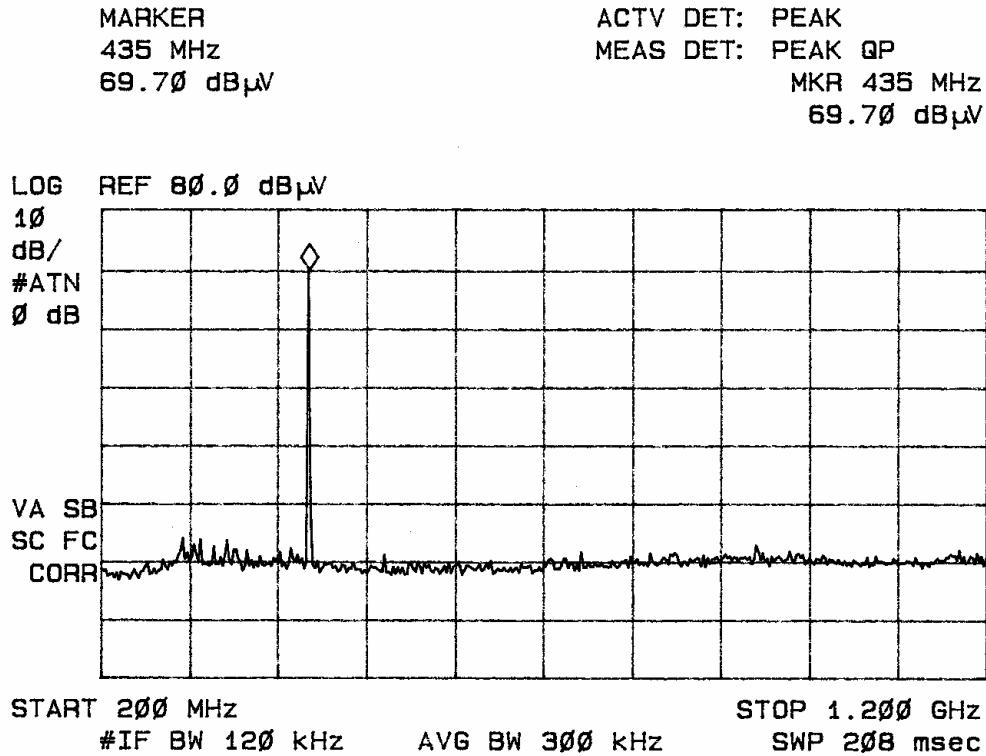


Figure two Radiated Emissions taken at 1 meter in screen room.

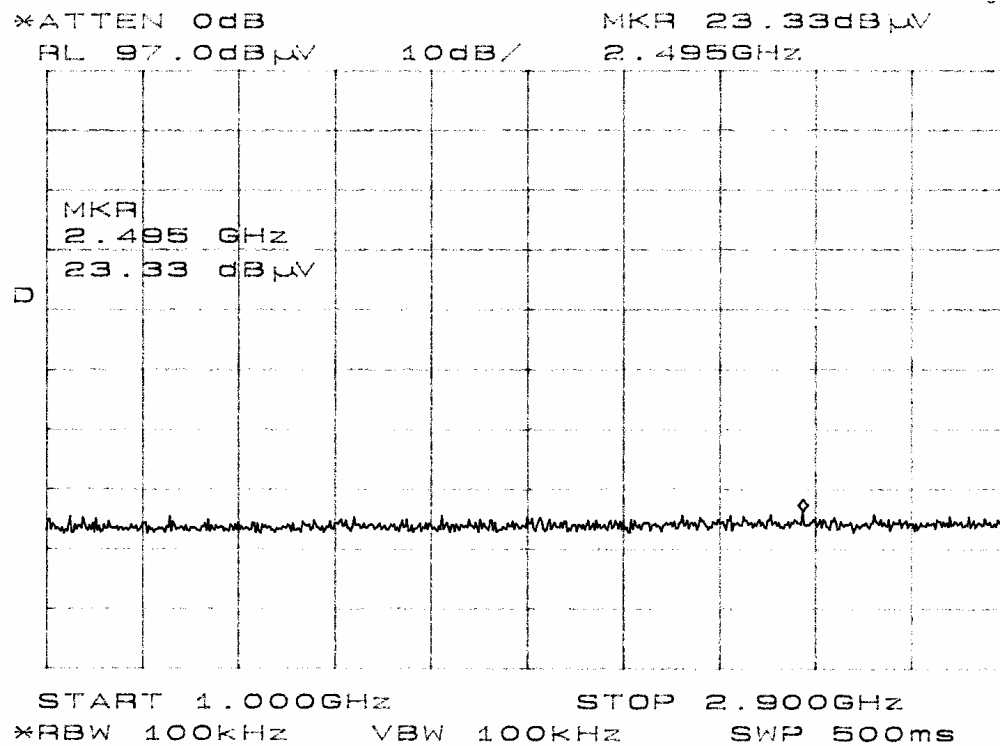


Figure three Radiated Emissions taken at 1 meter in screen room.

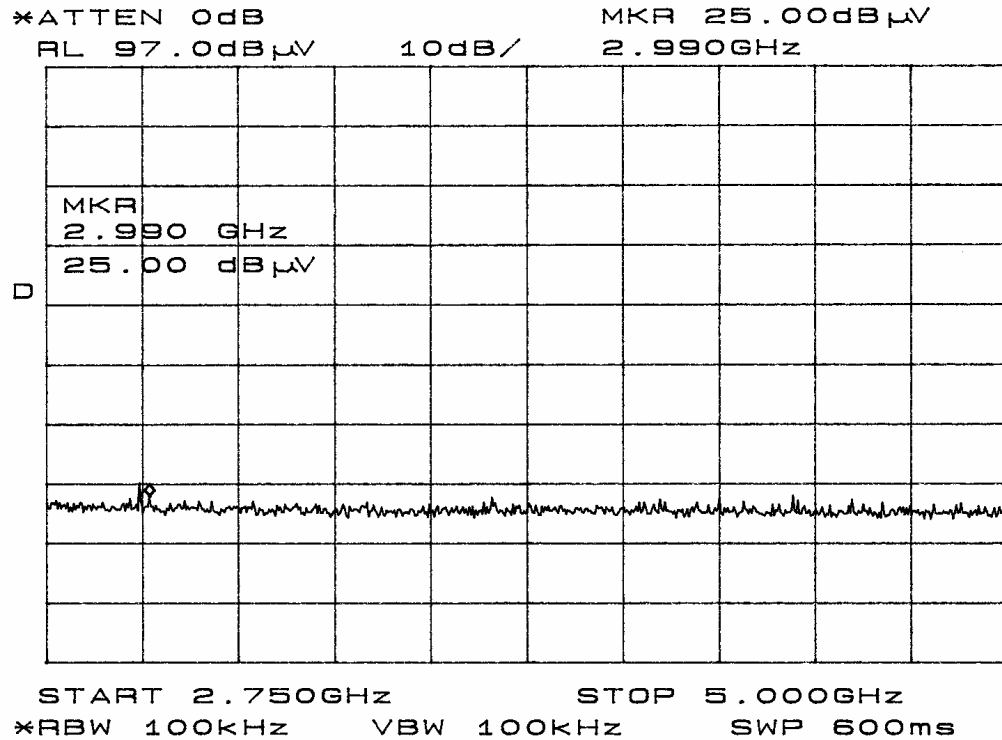


Figure four Radiated Emissions taken at 1 meter in screen room.

### Conducted (Highest Emissions)

Frequency band (MHz)	L1 Level (dB $\mu$ V)			L2 Level (dB $\mu$ V)			CISPR 22 Q.P./AVE Limit (dB $\mu$ V)
	Peak	Q.P.	AVE	Peak	Q.P.	AVE	
0.15 - 0.5							66 / 56
0.5 - 5							56 / 46
5 - 10							60 / 50
10 - 15							60 / 50
15 - 20							60 / 50
20 - 25							60 / 50
25 - 30							60 / 50

Other emissions present had amplitudes at least 10 dB below the limit.

**Data: General Radiated Emissions from test system (Highest Emissions)**

Frequency in MHz	FSM Horz. (dB $\mu$ V)	FSM Vert. (dB $\mu$ V)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dB $\mu$ V/m)	RFS Vert. @ 3m (dB $\mu$ V/m)	FCC Class B Limit @ 3m (dB $\mu$ V/m)
64.0	43.2	41.4	6.0	30	19.2	17.4	40.0
116.0	35.4	42.5	6.8	30	12.2	19.3	43.5

Other emissions present had amplitudes at least 10 dB below the limit.

**Summary of Results for Test System Conducted Emissions**

The unit operates from power supplied from replaceable batteries internal to the unit and has no provision to connect to utility power. Therefore no AC line conducted emissions testing was performed. The conducted emissions for the EUT meet the requirements for CISPR 22 and FCC Part 15B CLASS B Digital Devices.

**Summary of Results for Test System Radiated Emissions**

The radiated emissions for the EUT meet the requirements for CISPR 22 and FCC Part 15B CLASS B Digital Devices. The EUT had a 20.8 dB minimum margin below the quasi-peak limit. Other emissions were present with amplitudes at least 20 dB below the limit.

**Statement of Modifications and Deviations**

No modifications to the EUT were required for the unit to meet the CISPR 22 or FCC Part 15B CLASS B emissions standards. There were no deviations or exceptions to the specifications.

## 9) Subpart C - Intentional Radiators

As per CFR Part 15, Subpart C, paragraph 15.201 the following information is submitted.

### **15.203 Antenna Requirements**

The unit is produced with a permanently attached antenna and has no provision for user service, replacement, or antenna modification. The requirements of 15.203 are fulfilled and there are no deviations or exceptions to the specification.

### **15.205 Restricted Bands of Operation**

Spurious emissions falling in the restricted frequency bands of operation were measured at a distance of three meters at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were checked at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. No other significant emission was observed which fell into the restricted bands of operation.

Sample Calculations:

$$\begin{aligned} \text{RFS (dB}\mu\text{V/m @ 3m)} &= \text{FSM(dB}\mu\text{V)} + \text{A.F.(dB)} - \text{Gain(dB)} \\ &= 43.2 + 6.0 - 30 \\ &= 19.2 \end{aligned}$$

### **Data: Emissions in Restricted Bands**

Frequency in MHz	FSM Horz. (dB $\mu$ V)	FSM Vert. (dB $\mu$ V)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dB $\mu$ V/m)	RFS Vert. @ 3m (dB $\mu$ V/m)	FCC Class B Limit @ 3m (dB $\mu$ V/m)
116.0	43.2	41.4	6.0	30	19.2	17.4	43.5

***Summary of Results for Radiated Emissions in Restricted Bands:***

The radiated emissions for the EUT meet the requirements for FCC Part 15C Intentional Radiators. The EUT had a 20.8 dB minimum margin below the limits. Average, Quasi-peak, and peak amplitudes were checked for compliance with the regulations. No other emissions were found in the restricted frequency bands. Other emissions were present with amplitudes at least 20 dB below the FCC Limits.

***15.209 Radiated Emissions Limits; General Requirements*****Radiated EMI**

The EUT was arranged in a typical equipment configuration and operated through all of its various modes. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies, which produced the highest emissions. Emissions were checked in the screen room from 30 to 5,000 MHz and plots were made of the frequency spectrum from 30 MHz to 5,000 MHz for the preliminary testing. Refer to figures three through six displaying plots made of emissions taken in the screen room. The highest radiated emission was then re-maximized at the OATS location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the open area test site at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 30 MHz to 5,000 MHz was searched for radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna polarization between horizontal and vertical.

Antennas used were Broadband Biconical from 30 MHz to 200 MHz, Biconilog from 30 MHz to 1000 MHz, Log Periodic from 200 MHz to 5 GHz, and/or Pyramidal Horns from 4 GHz to 10 GHz.

Sample Calculations:

RFS = Radiated Field Strength

$\text{dB}\mu\text{V/m @ 3m} = \text{dB}\mu\text{V} + \text{A.F.} - \text{Amplifier Gain}$

$\text{dB}\mu\text{V/m @ 3m} = 43.2 + 6.0 - 30$   
 $= 19.2$

**Data: General Radiated Emissions from EUT ( Highest Emissions)**

Frequency in MHz	FSM Horz. (dB $\mu$ V)	FSM Vert. (dB $\mu$ V)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dB $\mu$ V/m)	RFS Vert. @ 3m (dB $\mu$ V/m)	FCC Class B Limit @ 3m (dB $\mu$ V/m)
64.0	43.2	41.4	6.0	30	19.2	17.4	40.0
116.0	35.4	42.5	6.8	30	12.2	19.3	43.5

Other emissions present had amplitudes at least 10 dB below the limit.

***Summary of Results for Radiated Emissions:***

The radiated emissions for the EUT meet the requirements for FCC Part 15C Intentional Radiators. The EUT had a 20.8 dB minimum margin below the limits. Other emissions were present with amplitudes at least 20 dB below the FCC Limits.

***Radiated Emissions of Intentional Radiator in the Band 431 MHz***

The power output was measured on an open field test site @ 3 meters. Data was taken per Paragraph 2.1046(a) and 15.231.

(a) The EUT was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the FSM antenna. The amplitude of the carrier frequency was measured using a spectrum analyzer. The amplitude of the emission was then recorded from

the analyzer display. The EUT was replaced by a dipole antenna driven by a frequency

generator. The generator output was increased until the received emission level was equal to the level take from the EUT. The antenna was removed and the output amplitude of the generator was measured and recorded from the spectrum analyzer.

(b) The EUT was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the FSM antenna. The amplitude of the harmonic frequencies was measured using a spectrum analyzer. The amplitude of the emission was then recorded from the analyzer display. The EUT was replaced by a dipole antenna driven by a frequency generator. The generator output was increased until the received emission level was equal to the level take from the EUT. The antenna was removed and the output amplitude of the generator was measured and recorded from the spectrum analyzer. Refer to figure five showing compliance with occupied bandwidth.

The radiated emissions for the EUT were measured at a distance of 3 meters.

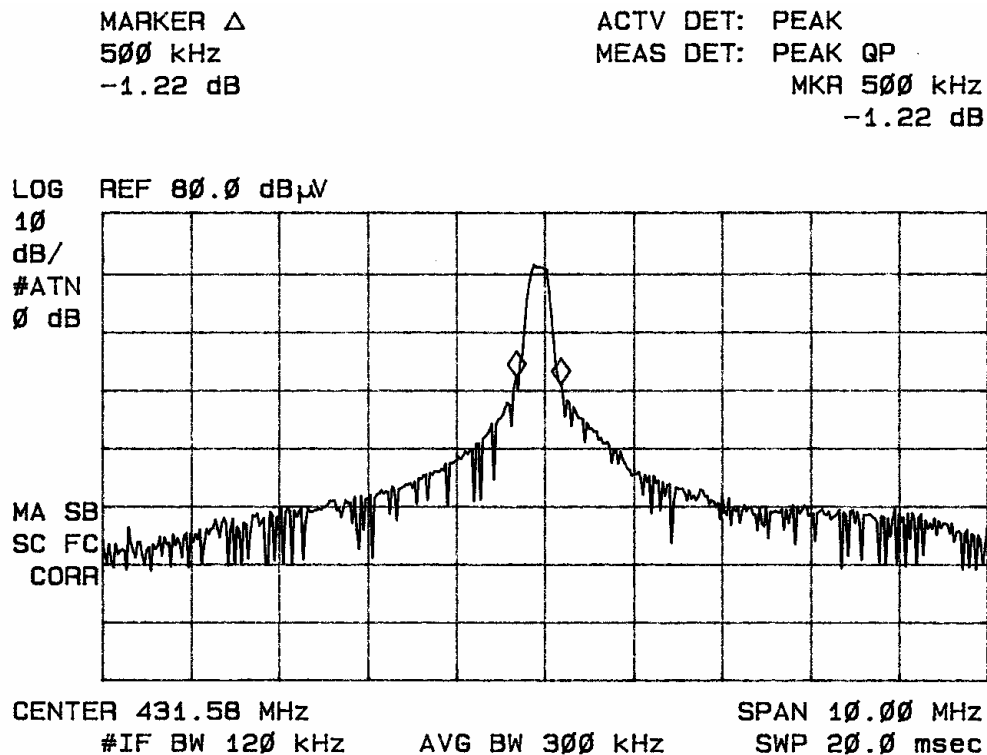


Figure five occupied bandwidth emissions taken at 1 meter in screen room.



**Data: Radiated Emissions data from EUT taken at three meter distance.**

Emission Frequency (kHz)	FSM (dBμV) Horizontal	FSM (dBμV) Vertical	Antenna Factor (dB)	Amplifier Gain (dB)	Calculated Field Strength @ 3m (dBμV/m)	Calculated Field Strength @ 3m (dBμV/m)
431.5	63.8	63.0	16.8	0	80.6	79.8
863.0	18.5	17.0	22.3	25	15.8	14.3
1294.5	25.5	20.8	22.8	25	23.3	18.6
1726.0	20.1	20.5	29.0	25	24.1	24.5
2157.5	21.8	21.7	31.2	25	28.0	27.9
2589.0	20.0	20.2	35.2	25	30.2	30.4
3020.5	19.8	21.1	36.9	25	31.7	33.0
3452.0	21.0	21.3	39.5	25	35.5	35.8
3883.5	20.5	21.7	39.8	25	35.3	36.5

The calculated limit for the fundamental at a three meter distance was 80.6 dBμV/m, and harmonic limits were 54.0 dBμV/m.

**Data: Antenna Substitution Method.**

Frequency of Emission (MHz)	Amplitude of EUT Spurious emission		Signal level to substitution antenna required to reproduce		Emission level below carrier		Limit
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
	dBm	dBm	dBm	dBm	dBc	dBc	dBc
431.5	-43.4	-44.0	-7.0	-10.0	--	--	--
863.0	-88.4	-89.5	-50.5	-56.9	-43.5	-46.9	
1294.5	-80.5	-86.5	-48.6	-55.0	-41.6	-45.0	

***Summary of Results for Radiated Emissions of Intentional Radiator***

The EUT had the highest emission level of 80.6 dBmV/m at a 3 meter distance for the fundamental frequency of operation. This is below the limit of 80.6 dBμV/m required by 15.231. The harmonic emissions were also measured and compared to the specifications of 15.209 and found to be below the limits. There are no measurable emissions in the restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the FCC Limits. The specifications of 15.231 were met; there are no deviations or exceptions to the requirements.

***Statement of Modifications and Deviations***

No modifications to the EUT were required for the unit to meet the FCC Part 15C emissions standards. There were no deviations to the specifications.

## **APPENDIX**

### Model: 2207 CLASSROOM WIRELESS LEARNING RECEIVER

1. Test Equipment List
2. Rogers Qualifications
3. FCC Site Approval Letter

**TEST EQUIPMENT LIST FOR ROGERS LABS, INC.**

The test equipment used is maintained in calibration and good operating condition. Use of this calibrated equipment ensures measurements are traceable to national standards.

**List of Test Equipment:****Calibration Date:**

Scope: Tektronix 2230	2/04
Wattmeter: Bird 43 with Load Bird 8085	2/04
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/04
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/04
R.F. Generator: HP 606A	2/04
R.F. Generator: HP 8614A	2/04
R.F. Generator: HP 8640B	2/04
Spectrum Analyzer: HP 8562A,	2/04
Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	
HP Adapters: 11518, 11519, 11520	
Spectrum Analyzer: HP 8591 EM	5/04
Frequency Counter: Leader LDC 825	2/04
Antenna: EMCO Biconilog Model: 3143	5/04
Antenna: EMCO Log Periodic Model: 3147	10/04
Antenna: Antenna Research Biconical Model: BCD 235	10/04
Antenna: EMCO Dipole Set 3121C	2/04
Antenna: C.D. B-101	2/04
Antenna: Solar 9229-1 & 9230-1	2/04
Antenna: EMCO 6509	2/04
Audio Oscillator: H.P. 201CD	2/04
R.F. Power Amp 65W Model: 470-A-1010	2/04
R.F. Power Amp 50W M185- 10-501	2/04
R.F. PreAmp CPPA-102	2/04
LISN 50 $\mu$ Hy/50 ohm/0.1 $\mu$ f	10/04
LISN Compliance Eng. 240/20	2/04
Peavey Power Amp Model: IPS 801	2/04
Power Amp A.R. Model: 10W 1010M7	2/04
Power Amp EIN Model: A301	2/04
ELGAR Model: 1751	2/04
ELGAR Model: TG 704A-3D	2/04
ESD Test Set 2010i	2/04
Fast Transient Burst Generator Model: EFT/B-101	2/04
Current Probe: Singer CP-105	2/04
Current Probe: Solar 9108-1N	2/04
Field Intensity Meter: EFM-018	2/04
KEYTEK Ecat Surge Generator	2/04
Shielded Room 5 M x 3 M x 3.0 M (101 dB Integrity)	

10/1/2004

**QUALIFICATIONS**

Of

**SCOT D. ROGERS, ENGINEER****ROGERS LABS, INC.**

Mr. Rogers has approximately 16 years experience in the field of electronics. Six years working in the automated controls industry and 6 years working with the design, development and testing of radio communications and electronic equipment.

**POSITIONS HELD:**

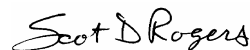
Systems Engineer: A/C Controls Mfg. Co., Inc.  
6 Years

Electrical Engineer: Rogers Consulting Labs, Inc.  
5 Years

Electrical Engineer: Rogers Labs, Inc.  
Current

**EDUCATIONAL BACKGROUND:**

- 1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.
- 2) Bachelor of Science Degree in Business Administration Kansas State University.
- 3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.



Scot D. Rogers

December 3, 2004

Date

1/11/03

**FEDERAL COMMUNICATIONS COMMISSION**

**Laboratory Division  
7435 Oakland Mills Road  
Columbia, MD 21046**

August 15, 2003

Registration Number: 90910

Rogers Labs, Inc.  
4405 West 259th Terrace  
Louisburg, KS 66053

Attention: Scot Rogers


Re: Measurement facility located at Louisburg  
3 & 10 meter site  
Date of Renewal: August 15, 2003

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website [www.fcc.gov](http://www.fcc.gov) under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,



Ms. Phyllis Parrish  
Information Technician