



**RADIATION SCIENCES INC.**

**TEST REPORT NO. RSI-5225E**  
**ELECTROMAGNETIC INTERFERENCE (EMI)**  
**OF THE**  
**LUTRON ELECTRONICS**  
**MODEL # RB-REP**  
**FCC PART 15, SUBPART C §15.231**  
**NOVEMBER 1999**

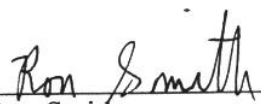
**PREPARED FOR:**

**Lutron Electronics**  
7200 Suter Road  
Coopersburg, PA 18036

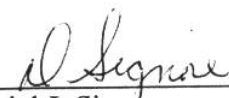
**SUBMITTED BY:**

**Radiation Sciences Inc.**  
3131 Detwiler Road  
Harleysville, PA 19438

**PREPARED BY:**

  
\_\_\_\_\_  
Ron Smith  
Test Technician  
**Radiation Sciences Inc.**

**REVIEWED BY:**

  
\_\_\_\_\_  
Daniel J. Signore  
President  
**Radiation Sciences Inc.**



**TABLE OF CONTENTS**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>	<b><u>PAGE</u></b>
	Table of Contents	i
	List of Figures	i
	Administrative Data	ii
	Summary of Test Results	iii
1.0	INTRODUCTION	1
2.0	DESCRIPTION OF THE TEST SAMPLE	2
3.0	TEST INSTRUMENTATION	3
4.0	TEST RESULTS	4
4.1	Conducted Power Line Measurements	4
4.2	Radiated Emission Measurements	5
5.0	CONCLUSIONS	9
APPENDIX A	DATA SHEETS	10-15
APPENDIX B	RSI's TEST PROCEDURES 4963E	---
APPENDIX C	RSI CERTIFICATIONS	---

**LIST OF FIGURES**

FIGURE 1	Conducted Test Setup Photograph	6
2	Radiated Test Setup Photograph	7
3	Photograph of Fundamental Frequency Bandwidth	8
4	Conducted Emission Data Sheet (Phase)	11
5	Conducted Emission Data Sheet (Neutral)	12
6	RE for Unintentional Radiators Data Sheet	13
7	RE for Intentional Radiators Data Sheet	14
8	Bandwidth of Fundamental Frequency Data Sheet	15



**ADMINISTRATIVE DATA**

**TEST PERFORMED:**

Measurements of radiated RF and conducted emissions.

**PURPOSE OF TEST:**

To evaluate the ElectroMagnetic Interference (EMI) characteristics of the Equipment Under Test with respect to Subpart B and C of Part 15 of the Federal Communications Commission (FCC) Rules for intentional and unintentional radiators.

**EQUIPMENT UNDER TEST (EUT):**

Model Number: **RB-REP**

**CONTRACT:**

Purchase Order Number: NP-990513

**TEST PERIOD:**

8-11 November 1999

**TEST FACILITY:**

**Radiation Sciences Incorporated (RSI)**, EMI/EMC Test Laboratory, located at: 651 North Cannon Avenue, Lansdale, PA 19446.

**TEST PERSONNEL AND COORDINATORS:**

**Radiation Sciences Inc.**

Ron Smith  
D. Signore  
C. Kosiorek

**Lutron Electronics**

Mark Clouser  
Steve Thompson



**SUMMARY OF TEST RESULTS**

The Model # RB-REP, configured as described herein, **FULLY COMPLIES WITH THE REQUIREMENTS SET FORTH IN SUBPART B AND C OF PART 15 OF THE FEDERAL COMMUNICATIONS COMMISSION (FCC) RULES FOR INTENTIONAL AND UNINTENTIONAL RADIATORS.**



## 1.0 INTRODUCTION

This document is a report of tests to determine the ElectroMagnetic Interference (EMI) characteristics of the **Model # RB-REP** presented by **Lutron Electronics** of Coopersburg, Pennsylvania.

The purpose of the testing was to evaluate the EMI characteristics of the test sample with respect to Subpart B and C of Part 15 of the FCC Rules for intentional and unintentional radiators.

Test setups and procedures are described in **RSI's Test Procedures 4963E** (see Appendix B) and test results are summarized herein on graphs.

All test procedures used meet the requirements of the American National Standards Institute Procedure C63.4: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz", dated 17 July 1992.



## 2.0 DESCRIPTION OF THE TEST SAMPLE:

The **RB-REP** is a tabletop mounted dimmer with attached power cord. The **RB-REP** contains a super-heterodyne receiver, a transmitter, and an antenna. It is used to control table lamps as part of an integrated lighting control system.

The receiver down converts a 433.9MHz carrier frequency using a 423.2MHz local oscillator producing a 10.7MHz IF signal. The signal is further processed to decode data. The transmitter uses a SAW oscillator and power amplifier, which is keyed ON/OFF to produce the modulated carrier. Each **RB-REP** contains a micro controller running at 4MHz to ensure that all transmissions stop within 5 seconds of the button release or within 5 seconds on the beginning of the transmission or a transmission actuated automatically shall cease transmission within 5 seconds after activation. Modulation is AM specifically ON/OFF Keyed (OOK) or sometimes called Amplitude Shift Keyed (ASK) data at 15.625kbps. The antenna cannot be modified or easily replaced by the user.

The **RB-REP** derives power from the AC power line through the attached power cord. It utilizes a Fullwave Bridge Rectifier Power Supply and linear Voltage regulator to produce a 5V DC output.

**3.0 TEST INSTRUMENTATION**

<b>RSI INV #</b>	<b>DESCRIPTION</b>	<b>MANUFACTURER</b>	<b>MODEL #</b>	<b>SERIAL #</b>	<b>LAST CAL DATE</b>	<b>CAL DUE DATE</b>	<b>C Y C L E</b>	<b>T Y P E</b>
75	ANTENNA	TENSOR	4108	204	1/6/1999	1/6/2000	12	C
80	ANTENNA	AMP.RES.ASSOC.	AT1000	4094-025	1/6/1999	1/6/2000	12	C
91	ANTENNA	EMCO	3115	2023	5/22/1999	5/22/2000	12	C
245	LISN	SOLAR	8028-50-TS-24-BNC	830525	5/18/1998	5/18/1999	12	C
260	LISN	SOLAR	8028-50-TS-24-BNC	974629	12/21/1998	12/21/1999	12	C
390	RECEIVER	R & S	ESH 3	861742/012	3/30/1999	3/30/2000	12	C
391	RECEIVER	R & S	ESVP	861744/015	3/30/1999	3/30/2000	12	C
	Spec. Anal.	Tektronix	492BP	3020105	10/12/99	10/12/99		



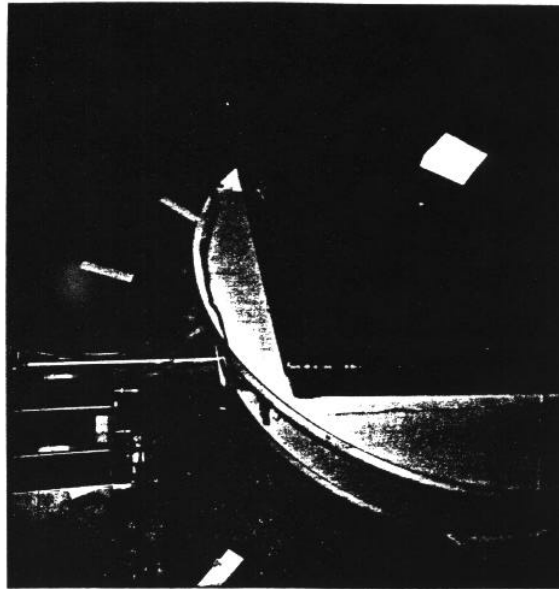
#### **4.0 TEST RESULTS**

##### **4.1 Conducted Power Line Measurements, Paragraphs § 15.107**

Conducted power line measurements were recorded for the **Model RB-REP**. A test setup photograph is shown in Figure 1. The results of the line-to-ground radio noise voltage measurements are shown in Figures 4 and 5. Measurements were conducted on both the phase and neutral lines.

**ALL LEVELS ARE BELOW THE APPLICABLE LIMITS.**





**CONDUCTED TEST SETUP PHOTOGRAPH**

**FIGURE 1**



**4.2 Radiated Emission Measurements, Paragraphs §15.33, §15.35, §15.109, §15.205, §15.209 and §15.231**

See Figure 2 for a test setup photograph and Figure 3 for a photograph of the fundamental frequency bandwidth. Radiated emission measurements were recorded for the test sample at a distance of 3 meters, unless otherwise stated. The results of field strength measurements are illustrated on Figures 6 for unintentional radiators and Figures 7 and 8 for intentional radiators. Radiated emissions were measured with the antenna in both the horizontal and vertical polarizations. The antenna was raised 1 to 4 meters in height and the equipment under test (EUT) was rotated 360° to maximize the emission.

For unintentional radiators, the emissions from the EUT were scanned from 30MHz to 2000MHz since its local oscillator is 423.2MHz.

For intentional radiators the field strength of emissions of the EUT were measured out to the tenth harmonic of the carrier frequency. The carrier frequency is 433.9MHz. The bandwidth of the emission shall be no wider than .25% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier.

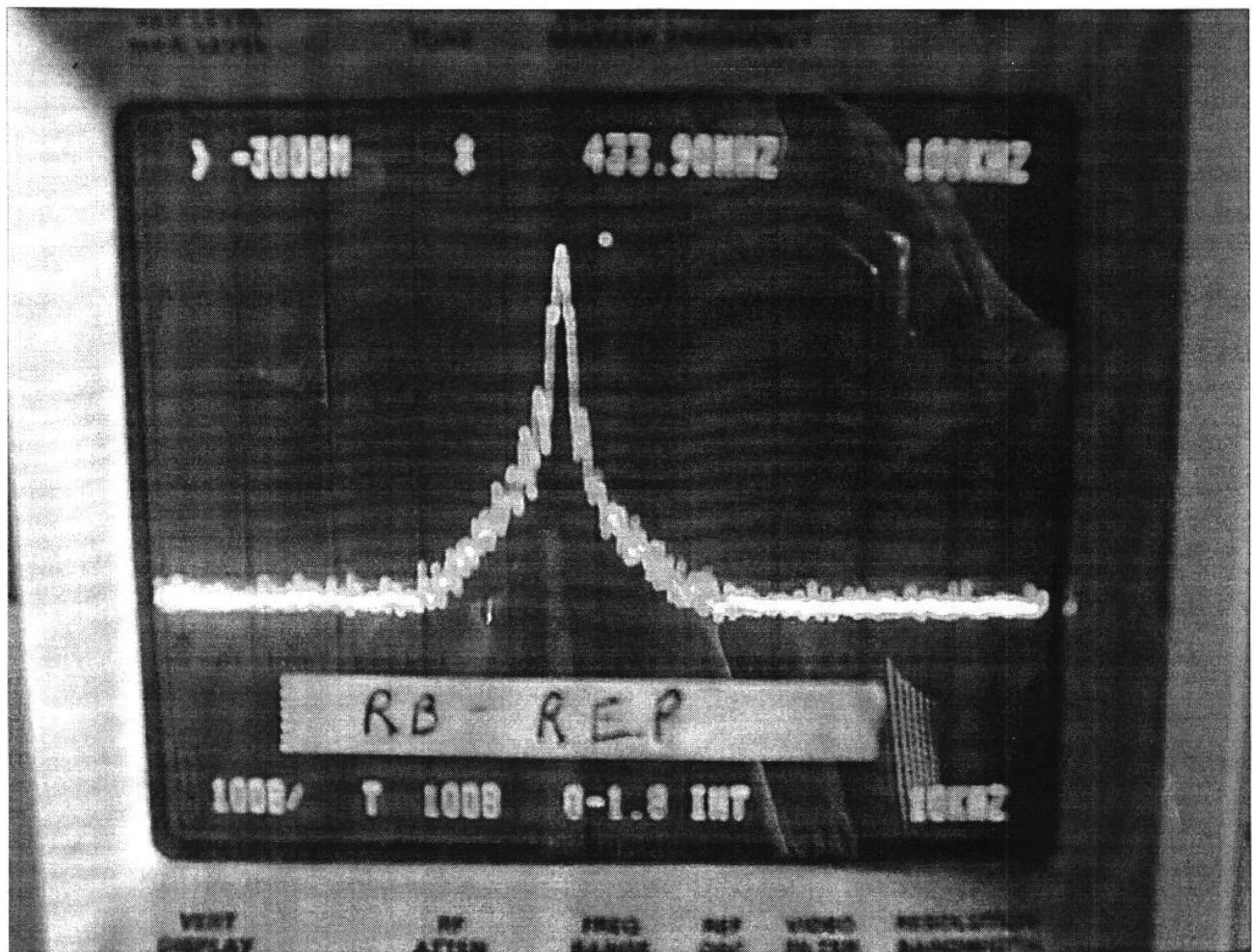
An average factor of 20dB was applied to the level of the fundamental emission when compared to the FCC limit.

**ALL LEVELS COMPLY WITH APPLICABLE LIMITS.**



RADIATED TEST SETUP PHOTOGRAPH

FIGURE 2



Name: DCP00990.JPG  
Dimensions: 1152 x 864 pixels

PHOTOGRAPH OF FUNDAMENTAL FREQUENCY BANDWIDTH

FIGURE 3



## **5.0 CONCLUSIONS**

The evaluation of the **Model # RB-REP**, configured as described herein, indicated that the unit complies with the requirements set forth in Subpart B and C of Part 15 of the **FCC Rules** for unintentional and intentional radiators.

1. The EUT meets the conducted emission limits set forth in § 15.107. The closest measurement was 36dB under the limit.
2. The EUT meets the radiated emission limits for unintentional radiators set forth in §15.109. The closest measurement was 3.6dB under the limit.
3. The EUT meets the radiated emission limits for intentional radiators set forth in §15.205, §15.209 and §15.231. The closest measurement was 1.6dB under the limit.
4. The EUT meets the bandwidth requirements set forth in §15.231 (c).

Certification by the Federal Communications Commission (**FCC**) is required. This report, **RSI's Test Procedure 4963E** and **FCC Form 731** must be submitted to the **FCC** for approval.



**APPENDIX A**

**DATA SHEETS**

Test Personnel: Ron Smith  
Date: 11/11/99  
Frequency Range Tested: 450 kHz - 30 MHz

[illegible]

**FIGURE 4**



Test Personnel: Ron Smith  
Date: 11/11/99  
Frequency Range Tested: 450 kHz - 30 MHz

## Conducted Emission (Neutral)

[illegible]

**FIGURE 5**





Company: Lutron Electronics  
Model # RB-REP  
Serial # None

Test Personnel: Ron Smith  
Date: 11/9/99  
Frequency Range Tested: 30 MHz - 2000MHz

### Radiated Emission for Unintentional Radiators

Frequency (MHz)	Polarity	Antenna Height (Meters)	Azimuth (Degrees)	Indicated Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Field Strength @ 3m (dBuV/m)	Limits @ 3m (dBuV/m)	Field Strength @ 3m (uV/m)	Limits @ 3m (uV/m)	Margin (dB)	Remarks
30	Vert	1.00	0	7.5	12.1	0.9	20.5	40.0	11	100	-19.5	
140	Vert	1.00	0	2.6	12.3	1.3	16.2	43.5	6	150	-27.3	
330	Vert	1.00	0	2.3	16.1	2.4	20.8	46.0	11	200	-25.2	
423.22	Vert	1.20	232	22.6	16.8	3.0	42.4	46.0	132	200	-3.6	
846.46	Vert	1.03	304	6.8	21.9	4.1	32.8	46.0	44	200	-13.2	
1000	Vert	1.00	0	5.9	25.0	4.4	35.3	54.0	58	500	-18.7	
30	Horiz	1.00	0	5.2	12.1	0.9	18.2	40.0	8	100	-21.8	
140	Horiz	1.00	0	3.8	12.3	1.3	17.4	43.5	7	150	-26.1	
330	Horiz	1.00	0	1.6	16.1	2.4	20.1	46.0	10	200	-25.9	
423.22	Horiz	1.01	129	21.7	16.8	3.0	41.5	46.0	119	200	-4.5	
846.46	Horiz	1.02	92	4.9	22.7	4.1	31.7	46.0	38	200	-14.3	
1000	Horiz	1.00	47	5.1	24.6	4.4	34.1	54.0	51	500	-19.9	

**FIGURE 6**



Company: Lutron Electronics  
Model # RB-REP  
Unit # None

Test Personnel: Ron Smith  
Date: 11/9/99

## Radiated Emission for Intentional Radiators

Frequency (MHz)	Polarity	Antenna Height (Meters)	Antenna Azimuth (Degrees)	Indicated Level (dBuV)	Antenna Factor (dB)	Distance Factor 1m to 3m (dB)	Cable Loss (dB)	Averaging Factor (dB)	Field Strength @ 3m (dBuV/m)	Limits @ 3m (dBuV/m)	Field Strength @ 3m (uV/m)	Limits @ 3m (uV/m)	Margin (dB)
433.86	Vert	1.39	246	78.8	17.0	0.0	2.9	-20.0	78.7	80.3	8610	10332	-1.6
867.73	Vert	1.23	174	38.2	22.8	0.0	4.2	-20.0	45.2	61.9	182	1250	-16.7
1300	Vert	1.00	180	43.6	24.3	-9.5	0.8	-20.0	39.2	61.9	91	1250	-22.7
1735	Vert	1.00	45	28.4	27.0	-9.5	0.8	-20.0	26.7	54.0	22	500	-27.3
2169	Vert	1.00	0	0.0	27.4	-9.5	0.8	-20.0	-1.3	61.9	1	1250	-63.2
2603	Vert	1.00	345	41.6	28.2	-9.5	0.9	-20.0	41.2	61.9	115	1250	-20.7
3037	Vert	1.00	0	0.0	30.1	-9.5	0.9	-20.0	1.5	61.9	1	1250	-60.4
3471	Vert	1.00	0	0.0	31.4	-9.5	0.9	-20.0	2.8	54.0	1	500	-51.2
3905	Vert	1.00	0	0.0	32.7	-9.5	0.9	-20.0	4.1	54.0	2	500	-49.9
4328	Vert	1.00	0	0.0	32.5	-9.5	1.0	-20.0	4.0	54.0	2	500	-50.0
433.86	Horiz	1.02	247	75.8	17.0	0.0	2.9	-20.0	75.7	80.3	6095	10332	-4.6
867.73	Horiz	1.00	190	38.1	22.4	0.0	4.2	-20.0	44.7	61.9	172	1250	-17.2
1300	Horiz	1.00	340	46.3	24.3	-9.5	0.8	-20.0	41.9	61.9	124	1250	-20.0
1735	Horiz	1.00	180	28.8	27.0	-9.5	0.8	-20.0	27.1	54.0	23	500	-26.9
2169	Horiz	1.00	0	0.0	27.4	-9.5	0.8	-20.0	-1.3	61.9	1	1250	-63.2
2603	Horiz	1.00	345	28.0	28.2	-9.5	0.9	-20.0	27.6	61.9	24	1250	-34.3
3037	Horiz	1.00	0	0.0	30.1	-9.5	0.9	-20.0	1.5	61.9	1	1250	-60.4
3471	Horiz	1.00	0	0.0	31.4	-9.5	0.9	-20.0	2.8	54.0	1	500	-51.2
3905	Horiz	1.00	0	0.0	32.7	-9.5	0.9	-20.0	4.1	54.0	2	500	-49.9
4328	Horiz	1.00	0	0.0	32.5	-9.5	1.0	-20.0	4.0	54.0	2	500	-50.0

FIGURE 7



Company: Lutron Electronics  
 Model # RB-REP  
 Unit # None

Test Personnel: Ron Smith  
 Date: 11/11/99

### Bandwidth of Fundamental Frequency

Center Frequency	Frequency (MHz)	Measurement (dBuV/m)
	433.86	78.8

The bandwidth is less than 100 KHz as observed on Tektronics model #492 BP spectrum analyzer  
 Reference figure #3

**FIGURE 8**