



RADIATION SCIENCES INC.

**TEST REPORT NO. RSI-5230E
ELECTROMAGNETIC INTERFERENCE (EMI)
OF THE
LUTRON ELECTRONICS
MODEL # RBMC-15T
FCC PART 15, SUBPART C §15.231
NOVEMBER 1999**

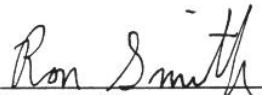
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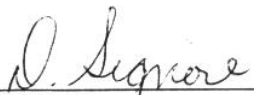
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**TABLE OF CONTENTS**

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
	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	6
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	5
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: **RBMC-15T**

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
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Lutron Electronics

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SUMMARY OF TEST RESULTS

The Model # **RBMC-15T**, 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 # RBMC-15T** 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 **RBMC-15T** is a Table-top dimmer with attached Power cord. The **RBMC-15T** 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 **RBMC-15T** 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 **RBMC-15T** 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.



RADIATION SCIENCES INC.

3.0 TEST INSTRUMENTATION

<u>RSI INV #</u>	<u>DESCRIPTION</u>	<u>MANUFACTURER</u>	<u>MODEL #</u>	<u>SERIAL #</u>	<u>LAST CAL DATE</u>	<u>CAL DUE DATE</u>	<u>C Y C L E</u>	<u>T Y P E</u>
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.	Tektronics	492BP	3020105	10/12/99	10/12/00		



4.0 TEST RESULTS

4.1 Conducted Power Line Measurements, Paragraphs §15.107

Conducted power line measurements were recorded for the **Model RBMC-15T**. 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.



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

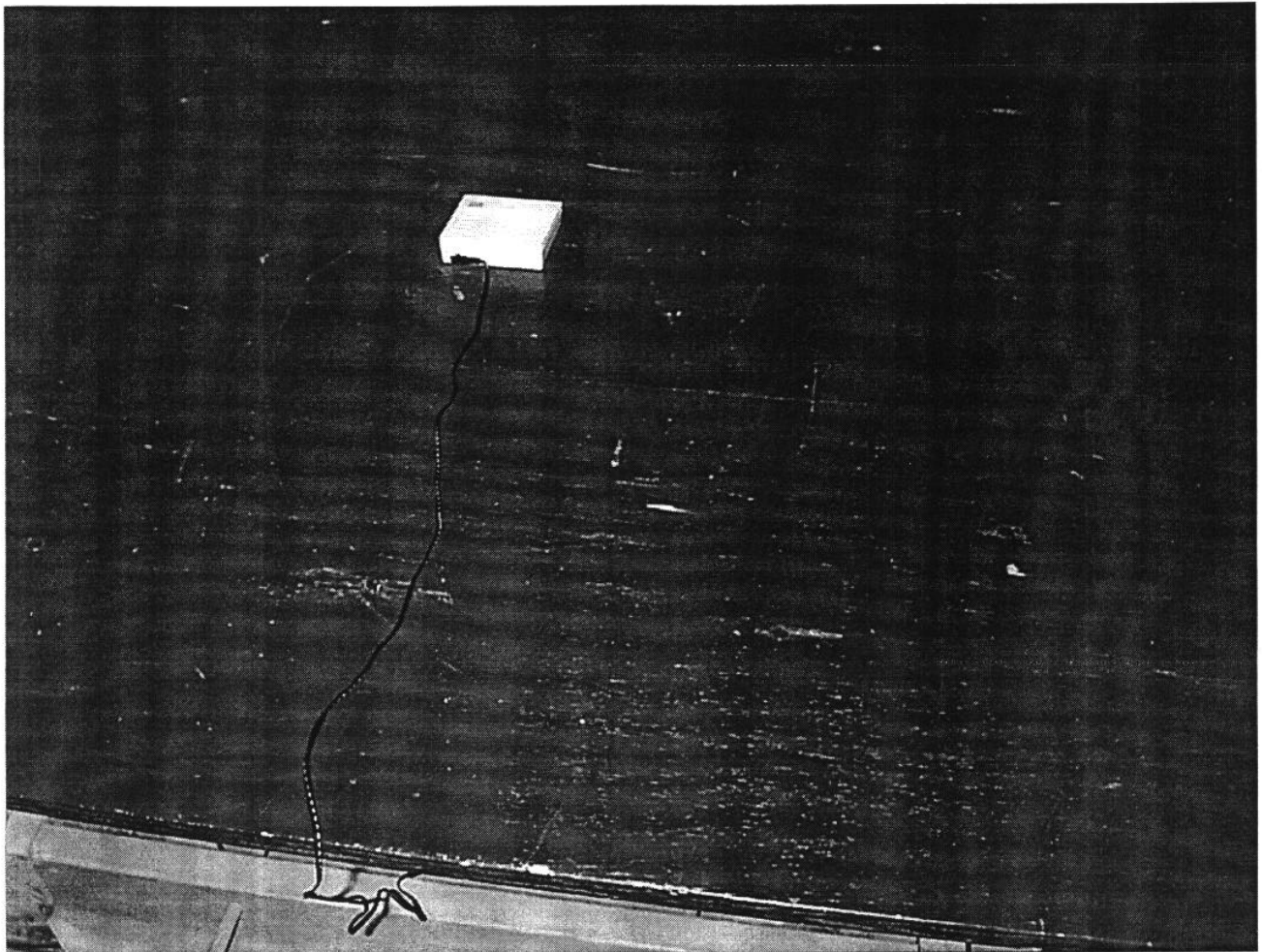
See Figure 2 for a test setup photograph and Figure 3 for a photograph of the fundamental frequency bandwidth. Radiated emission measurements were recorded for the test sample at a distance of 3 meters, unless otherwise stated. The results of field strength measurements are illustrated on Figures 6 for 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.

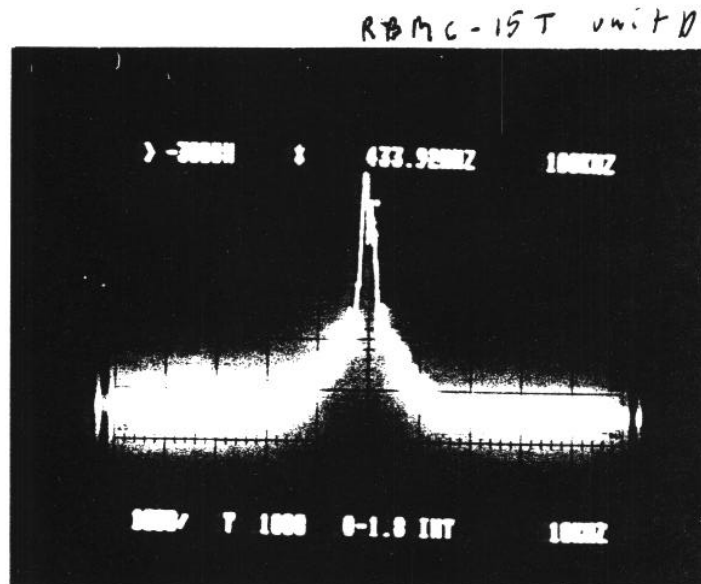
ALL LEVELS COMPLY WITH APPLICABLE LIMITS.



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Dimensions: 1152 x 864 pixels

RADIATED TEST SETUP PHOTOGRAPH

FIGURE 2



PHOTOGRAPH OF FUNDAMENTAL FREQUENCY BANDWIDTH

FIGURE 3



5.0 CONCLUSIONS

The evaluation of the **Model # RBMC-15T**, 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 37.3dB under the limit.
2. The EUT meets the radiated emission limits for unintentional radiators set forth in §15.109. The closest measurement was 8dB 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 2dB 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



RADIATION SCIENCES INC.

Company: Lutron Electronics
Model # RBMC-15T
Unit # D

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

Conducted Emission (Phase)

Frequency (MHz)	Line	Final Level (dBuV)	Conducted Limit (dBuV)	Final Level (uV)	Conducted Limit (uV)	Margin (dB)	Remarks
.450	Phase	10.1	48.0	3	250	-37.9	
.600	Phase	10.3	48.0	3	250	-37.7	
.900	Phase	2.0	48.0	1	250	-46.0	
3.0	Phase	1.0	48.0	1	250	-47.0	
5.0	Phase	2.0	48.0	1	250	-46.0	
10.6	Phase	5.0	48.0	2	250	-43.0	
15.0	Phase	2.3	48.0	1	250	-45.7	
19.0	Phase	3.5	48.0	1	250	-44.5	
25.0	Phase	1.0	48.0	1	250	-47.0	
30.0	Phase	2.0	48.0	1	250	-46.0	

FIGURE 4



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

Conducted Emission (Neutral)

Frequency (MHz)	Line	Final Level (dBuV)	Conducted Limit (dBuV)	Final Level (uV)	Conducted Limit (uV)	Margin (dB)	Remarks
.450	Neutral	9.5	48.0	3	250	-38.5	
.600	Neutral	10.7	48.0	3	250	-37.3	
.900	Neutral	2.0	48.0	1	250	-46.0	
3.0	Neutral	1.0	48.0	1	250	-47.0	
5.0	Neutral	2.0	48.0	1	250	-46.0	
10.6	Neutral	2.9	48.0	1	250	-45.1	
15.0	Neutral	2.4	48.0	1	250	-45.6	
19.0	Neutral	5.3	48.0	2	250	-42.7	
25.0	Neutral	2.0	48.0	1	250	-46.0	
30.0	Neutral	9.9	48.0	3	250	-38.1	

FIGURE 5

Company: Lutron Electronics
 Model # RBMC-15T
 Serial # None

Test Personnel: Ron Smith
 Date: 11/8/99
 Frequency Range Tested: 30 MHz - 2000MHz

Radiated Emission for Unintentional Radiators

Frequency (MHz)	Polarity	Antenna Height (Meters)	Antenna 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	50	7.3	12.1	0.9	20.3	40.0	10	100	-19.7	
140	Vert	1.00	65	2.9	12.3	1.3	16.5	43.5	7	150	-27.0	
330	Vert	1.00	150	2.8	16.1	2.4	21.3	46.0	12	200	-24.7	
423.20	Vert	1.32	298	14.8	16.8	3.0	34.6	46.0	54	200	-11.4	
846.54	Vert	1.00	229	9.0	21.9	4.1	35.0	46.0	56	200	-11.0	
1000	Vert	1.00	60	6.1	25.0	4.4	35.5	54.0	60	500	-18.5	
30	Horiz	1.00	15	5.5	12.1	0.9	18.5	40.0	8	100	-21.5	
140	Horiz	1.00	25	4.0	12.3	1.3	17.6	43.5	8	150	-25.9	
330	Horiz	1.00	20	1.9	16.1	2.4	20.4	46.0	10	200	-25.6	
423.20	Horiz	2.17	44	18.2	16.8	3.0	38.0	46.0	79	200	-8.0	
846.54	Horiz	1.02	163	10.3	22.7	4.1	37.1	46.0	72	200	-8.9	
1000	Horiz	1.00	50	5.3	24.6	4.4	34.3	54.0	52	500	-19.7	

FIGURE 6

Company: Lutron Electronics
 Model # RBmc-15T
 Unit # D

Test Personnel: Ron Smith
 Date: 11/8/99

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)
433.92	Vert	1.25	229	75.0	17.0	0.0	2.9	-20.0	74.9	80.3	5559	10332	-5.4
867.83	Vert	1.11	231	24.6	22.8	0.0	4.2	-20.0	31.6	61.9	38	1250	-30.3
1310	Vert	1.00	360	34.0	24.3	-9.5	0.8	-20.0	29.6	61.9	30	1250	-32.3
1733.2	Vert	1.00	0	0.0	27.0	-9.5	0.8	-20.0	-1.7	54.0	1	500	-55.7
2156.4	Vert	1.00	0	0.0	27.4	-9.5	0.8	-20.0	-1.3	61.9	1	1250	-63.2
2579.6	Vert	1.00	0	0.0	28.2	-9.5	0.9	-20.0	-0.4	61.9	1	1250	-62.3
3002.8	Vert	1.00	0	0.0	30.1	-9.5	0.9	-20.0	1.5	61.9	1	1250	-60.4
3426	Vert	1.00	0	0.0	31.4	-9.5	0.9	-20.0	2.8	54.0	1	500	-51.2
3849.2	Vert	1.00	0	0.0	32.7	-9.5	0.9	-20.0	4.1	54.0	2	500	-49.9
4272.4	Vert	1.00	0	0.0	32.5	-9.5	1.0	-20.0	4.0	54.0	2	500	-50.0
433.92	Horiz	1.25	229	78.4	17.0	0.0	2.9	-20.0	78.3	80.3	8222	10332	-2.0
867.83	Horiz	1.00	202	31.2	22.4	0.0	4.2	-20.0	37.8	61.9	78	1250	-24.1
1310	Horiz	1.00	162	36.4	24.3	-9.5	0.8	-20.0	32.0	61.9	40	1250	-29.9
1733.2	Horiz	1.00	0	0.0	27.0	-9.5	0.8	-20.0	-1.7	54.0	1	500	-55.7
2156.4	Horiz	1.00	0	0.0	27.4	-9.5	0.8	-20.0	-1.3	61.9	1	1250	-63.2
2579.6	Horiz	1.00	0	0.0	28.2	-9.5	0.9	-20.0	-0.4	61.9	1	1250	-62.3
3002.8	Horiz	1.00	0	0.0	30.1	-9.5	0.9	-20.0	1.5	61.9	1	1250	-60.4
3426	Horiz	1.00	0	0.0	31.4	-9.5	0.9	-20.0	2.8	54.0	1	500	-51.2
3849.2	Horiz	1.00	0	0.0	32.7	-9.5	0.9	-20.0	4.1	54.0	2	500	-49.9
4272.4	Horiz	1.00	0	0.0	32.5	-9.5	1.0	-20.0	4.0	54.0	2	500	-50.0

FIGURE 7



RADIATION SCIENCES INC.

RSI-5230E

Company: Lutron Electronics
Model # RBMC-15T
Unit # D

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

Bandwidth of Fundamental Frequency

Center Frequency	Frequency (MHz)	Measurement (dBuV/m)
	433.92	78.4

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