



**RADIATION SCIENCES INC.**

**TEST REPORT NO. RSI-5132E**  
**ELECTROMAGNETIC EMISSION EVALUATION**  
**OF THE**  
**LUTRON ELECTRONICS**  
**MODEL # RAX-300TL**  
**FCC PART 15, SUBPART C §15.231**  
**APRIL 1999**

**PREPARED FOR:**

**Lutron Electronics**  
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**SUBMITTED BY:**

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## **ADMINISTRATIVE DATA**

### **TEST PERFORMED:**

Measurements of radiated RF and conducted emissions..

### **PURPOSE OF TEST:**

To evaluate the ElectroMagnetic Emission (EME) 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: **RAX-300TL**

Unit Numbers: 18 and 21

### **CONTRACT:**

Purchase Order Number: NP-987661

### **TEST PERIOD:**

01 April 1999

### **TEST FACILITY:**

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

### **TEST PERSONNEL AND COORDINATORS:**

#### **Radiation Sciences Inc.**

Thomas Koester  
D. Signore

#### **Lutron Electronics**

Richard Black  
Chris Rogan

## **SUMMARY OF TEST RESULTS**

The **Model # RAX-300TL**, 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 EME characteristics of the **Model # RAX-300TL** presented by **Lutron Electronics** of Coopersburg, Pennsylvania.

The purpose of the testing was to evaluate the EMC 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:**

**Device Function:** The RAX-300TL is a table top mounted dimmer with attached power cord. The RAX-300TL 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 purpose of the RF communication is to transmit and receive command signals. Received command signals allow the RAX-300TL to turn ON or OFF in response to commands from the Lutron RAMC-XX master control keypads and the Lutron RA-REP. Transmitted command signals acknowledge the state of the RAX-300TL to the rest of the RadioRA system in response to manual button presses on a master control keypad.

**RF Function:** The receiver down converts a 418MHz carrier frequency using a 407.3MHz 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 RAX-300TL 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.

**Analog Function:** The RAX-300TL derives power from the AC power line through the attached power cord. The device power supply and linear voltage regulator produce a 5V DC output which is used to power all analog and micro controller activities.

### 3.0 TEST INSTRUMENTATION

RSI INV	#	DESCRIPTION	MANUFACTURER	MODEL #	SERIAL #	CAL DUE DATE	C Y C L E	T Y P E
	31	SPEC ANALYZER	ADVANTEST	R3271	J003583	4/10/1999	12	C
	75	ANTENNA	TENSOR	4108	204	1/6/2000	12	C
	80	ANTENNA	AMP.RES.Assoc.	AT1000	4094-025	1/6/2000	12	C
	91	ANTENNA	EMCO	3115	2023	6/18/1999	6	V
	245	LISN	SOLAR	8028-50-TS-24-BNC	830525	5/18/1999	12	C
	260	LISN	SOLAR	8028-50-TS-24-BNC	974629	12/21/1999	12	C
	390	RECEIVER	Rohde & Schwarz	ESH 3	861742/012	3/30/2000	12	C
	391	RECEIVER	Rohde & Schwarz	ESVP	861744/015	3/30/2000	12	C

#### **4.0 TEST RESULTS**

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

Conducted power line measurements were recorded for the **Model RAX-300TL**. 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**

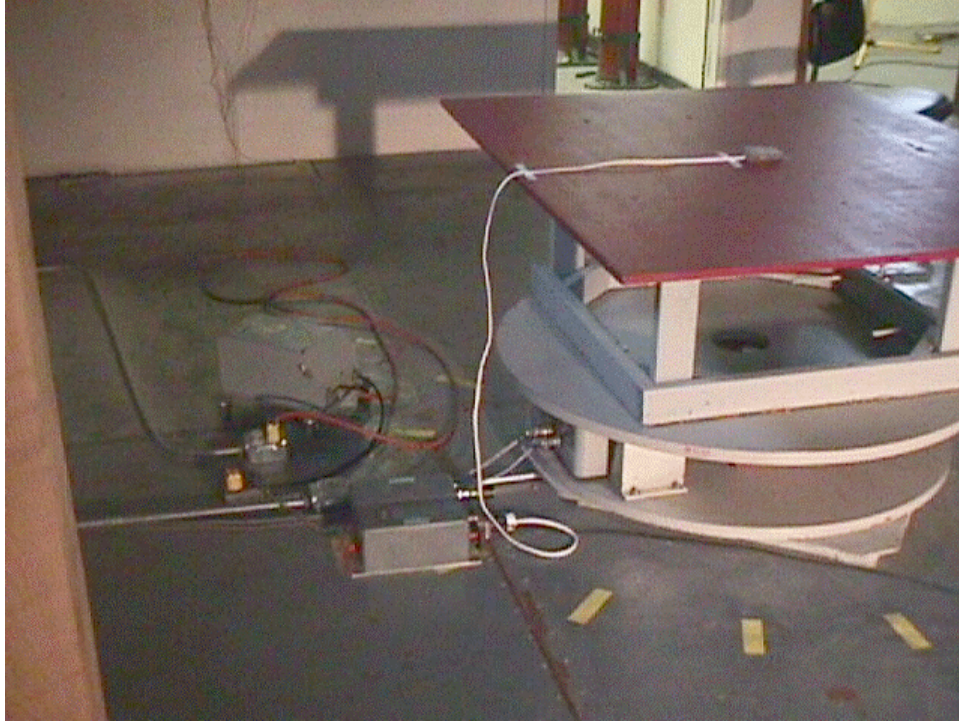
See Figure 2 for a test setup photograph and Figure 3 for a photograph of the fundamental frequency bandwidth. Radiated emission measurements were recorded for the test sample at a distance of 3 meters, unless otherwise stated. The results of field strength measurements are illustrated on Figures 6 for 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 407.3MHz.

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 418MHz. 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.**



**CONDUCTED TEST SETUP PHOTOGRAPH**

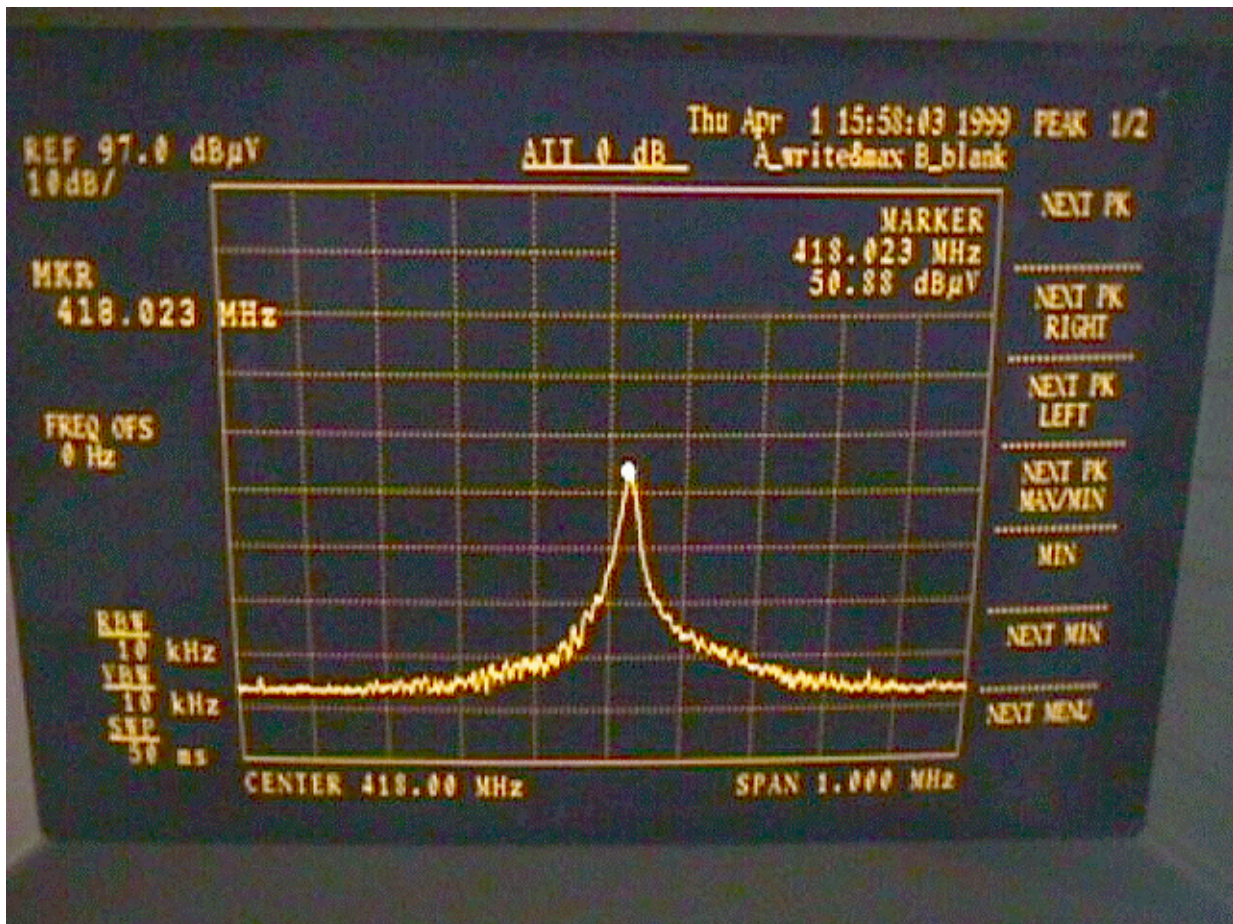
**FIGURE 1**





**RADIATED TEST SETUP PHOTOGRAPH**

**FIGURE 2**



PHOTOGRAPH OF FUNDAMENTAL FREQUENCY BANDWIDTH

FIGURE 3



## **5.0 CONCLUSIONS**

The evaluation of the **Model # RAX-300TL**, 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 10dB under the limit.
2. The EUT meets the radiated emission limits for unintentional radiators set forth in §15.109. The closest measurement was .5dB 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 1.8dB 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**

Company: Lutron Electronics  
 Model # RAX-300TL  
 Unit # 21

Test Personnel: Thomas Koester  
 Date: 4/1/99  
 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	38.0	48.0	79	250	-10.0	
.600	Phase	29.0	48.0	28	250	-19.0	
.900	Phase	13.0	48.0	4	250	-35.0	
1.50	Phase	1.0	48.0	1	250	-47.0	
3.00	Phase	1.0	48.0	1	250	-47.0	
5.00	Phase	1.0	48.0	1	250	-47.0	
8.00	Phase	1.0	48.0	1	250	-47.0	
11.0	Phase	1.0	48.0	1	250	-47.0	
12.97	Phase	8.0	48.0	3	250	-40.0	
15.0	Phase	17.0	48.0	7	250	-31.0	
18.0	Phase	1.0	48.0	1	250	-47.0	
21.0	Phase	1.0	48.0	1	250	-47.0	
24.0	Phase	5.0	48.0	2	250	-43.0	
27.0	Phase	1.0	48.0	1	250	-47.0	
30.0	Phase	2.0	48.0	1	250	-46.0	

**FIGURE 4**

Company: Lutron Electronics  
 Model # RAX-300TL  
 Unit # 21

Test Personnel: Thomas Koester  
 Date: 4/1/99  
 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	38.0	48.0	79	250	-10.0	
.600	Neutral	29.0	48.0	28	250	-19.0	
.900	Neutral	14.0	48.0	5	250	-34.0	
1.50	Neutral	1.0	48.0	1	250	-47.0	
3.00	Neutral	1.0	48.0	1	250	-47.0	
5.00	Neutral	1.0	48.0	1	250	-47.0	
8.00	Neutral	1.0	48.0	1	250	-47.0	
11.0	Neutral	1.0	48.0	1	250	-47.0	
12.97	Neutral	11.0	48.0	4	250	-37.0	
15.0	Neutral	19.0	48.0	9	250	-29.0	
18.0	Neutral	1.0	48.0	1	250	-47.0	
21.0	Neutral	1.0	48.0	1	250	-47.0	
24.0	Neutral	1.0	48.0	1	250	-47.0	
27.0	Neutral	1.0	48.0	1	250	-47.0	
30.0	Neutral	2.0	48.0	1	250	-46.0	

**FIGURE 5**



Company: Lutron Electronics  
 Model # RAX-300LT  
 Unit # 18

Test Personnel: Thomas Koester  
 Date: 4/1/99  
 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
32	Vert	1.00	162	9.2	11.7	0.9	21.8	40.0	12	100	-18.2	
396.53	Vert	1.00	0	1.7	15.4	2.7	19.8	43.5	10	150	-23.7	
407.37	Vert	1.00	149	23.6	16.2	2.9	42.7	46.0	136	200	-3.3	
428.63	Vert	1.00	0	2.1	16.9	3.0	22.0	46.0	13	200	-24.0	
814.73	Vert	1.00	297	9.2	22.7	4.1	36.0	46.0	63	200	-10.0	
846.6	Vert	1.00	0	5.0	21.9	4.2	31.1	54.0	36	500	-22.9	
32	Horiz	1.00	96	9.6	13.1	0.9	23.6	40.0	15	100	-16.4	
396.53	Horiz	1.00	0	2.3	15.6	2.7	20.6	43.5	11	150	-22.9	
407.37	Horiz	1.25	333	26.7	15.9	2.9	45.5	46.0	188	200	-0.5	
428.63	Horiz	1.25	0	2.6	17.3	3.0	22.9	46.0	14	200	-23.1	
814.73	Horiz	1.00	210	9.6	23.2	4.1	36.9	46.0	70	200	-9.1	
846.6	Horiz	1.00	0	5.0	22.7	4.2	31.9	54.0	39	500	-22.1	

**FIGURE 6**

Company: Lutron Electronics  
 Model # RAX-300TL  
 Unit # 21

Test Personnel: Thomas Koester  
 Date: 4/1/99

### Radiated Emission for Intentional Radiators

Frequency (MHz)	Polarity	Antenna Height (Meters)	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)
418.0	Vert	1.30	261	72.8	16.7	0.0	2.9	-20.0	72.4	80.3	4169	10332	-7.9
836.0	Vert	1.03	181	25.5	22.7	0.0	4.2	-20.0	32.4	61.9	42	1250	-29.5
1254	Vert	1.00	225	33.3	25.0	-9.5	0.8	-20.0	29.6	61.9	30	1250	-32.3
1672	Vert	1.00	340	33.9	26.5	-9.5	0.8	-20.0	31.7	54.0	38	500	-22.3
2090	Vert	1.00	130	29.5	28.0	-9.5	0.8	-20.0	28.8	61.9	28	1250	-33.1
2508	Vert	1.00	140	29.7	29.2	-9.5	0.9	-20.0	30.3	61.9	33	1250	-31.6
2926	Vert	1.00	40	31.6	30.5	-9.5	0.9	-20.0	33.5	61.9	47	1250	-28.4
3344	Vert	1.00	0	30.0	31.5	-9.5	0.9	-20.0	32.9	54.0	44	500	-21.1
3762	Vert	1.00	350	28.4	32.2	-9.5	0.9	-20.0	32.0	54.0	40	500	-22.0
4180	Vert	1.00	150	27.5	33.2	-9.5	1.0	-20.0	32.2	54.0	41	500	-21.8
418.0	Horiz	1.00	131	79.2	16.4	0.0	2.9	-20.0	78.5	80.3	8414	10332	-1.8
836.0	Horiz	1.00	143	25.2	23.0	0.0	4.2	-20.0	32.4	61.9	42	1250	-29.5
1254	Horiz	1.00	145	32.1	25.0	-9.5	0.8	-20.0	28.4	61.9	26	1250	-33.5
1672	Horiz	1.00	160	33.8	26.5	-9.5	0.8	-20.0	31.6	54.0	38	500	-22.4
2090	Horiz	1.00	150	28.9	28.0	-9.5	0.8	-20.0	28.2	61.9	26	1250	-33.7
2508	Horiz	1.00	200	30.4	29.2	-9.5	0.9	-20.0	31.0	61.9	35	1250	-30.9
2926	Horiz	1.00	150	31.0	30.5	-9.5	0.9	-20.0	32.9	61.9	44	1250	-29.0
3344	Horiz	1.00	0	28.9	31.5	-9.5	0.9	-20.0	31.8	54.0	39	500	-22.2
3762	Horiz	1.00	145	28.1	32.2	-9.5	0.9	-20.0	31.7	54.0	38	500	-22.3
4180	Horiz	1.00	140	27.5	33.2	-9.5	1.0	-20.0	32.2	54.0	41	500	-21.8

**FIGURE 7**

Company: Lutron Electronics  
Model # RAX-300TL  
Unit # 21

Test Personnel: Thomas Koester  
Date: 4/1/99

### Bandwidth of Fundamental Frequency

	Frequency (MHz)	Measurement (dBuV/m)
Center Frequency	418.027	53.00
20 dB down	417.994	30.84
20 dB down	418.053	32.63

The bandwidth is 59 KHz

**FIGURE 8**