

Emissions Testing
Performed
on the
SLI Lighting
2 Lamp-T8 Electronic Instant Start Ballast
Model: L232SI120S
To
FCC Part 18 (Consumer Equipment)

Date of Test: November 21, 2000

Job #: J20029790

Contact: Mr. Dale Reynolds

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Intertek Testing Services NA, Inc.

TO: SLI Lighting
Mr. Dale Reynolds

FROM: Kouma P. Sinn

DATE: November 21, 2000

JOB #: J20029790

RE: Emissions testing performed on the 2 Lamp-T8 Electronic Instant Start Ballast, Model:
L232SI120S

On November 21, 2000, we tested the 2 Lamp-T8 Electronic Instant Start Ballast, Model: L232SI120S, to determine if it was in compliance with the FCC Part 18 (Consumer Equipment) emissions limits. We found that the unit met the FCC Part 18 (Consumer Equipment) requirements when modified as described below.

Configuration: Initial

Radiated emissions testing was not performed as the unit operated below 1.705 MHz.

Table 1 shows the line-conducted emissions results. The worst-case line-conducted emission, when measured with a quasi-peak detector and compared with the quasi-peak limits was 5.1 dB above the FCC Part 18 (Consumer Equipment) limit at 0.456 MHz. Several other emissions exceeded or were marginal to the applicable limit.

Modifications Required for Compliance

The following modifications were installed during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by SLI Lighting prior to compliance testing):

- (1) *Replaced the "Y" capacitor with 1000 pF capacitor on both lines.*
- (2) *Covered the AC power cable with conduit and tied it to chassis of the light fixture.*

Following the modification (1) above, the worst-case line-conducted emission, when measured with a quasi-peak detector and compared with the quasi-peak limits was 0.1 dB below the FCC Part 18 (Consumer Equipment) limit at 20.86 MHz. All other line-conducted emissions were at least 2.7 dB below the applicable limits (see table 2).

Following the modification (2) above, the worst-case line-conducted emission, when measured with a quasi-peak detector and compared with the quasi-peak limits was 3.3 dB below the FCC Part 18 (Consumer Equipment) limit at 0.481 MHz. All other line-conducted emissions were at least 4.3 dB below the applicable limits (see table 2).

Conclusion:

In summary, this report verifies that the 2 Lamp-T8 Electronic Instant Start Ballast, Model: L232SI120S, is compliant with the FCC Part 18 (Consumer Equipment) requirements when modified as described in this report. Please address all questions and comments concerning this report to Candy L. Campbell, ITE Engineering Team Leader.

LABORATORY MEASUREMENTS

**Pursuant To
Part 18, Subpart C
and
FCC Procedure MP-5 (1985)**

Company Name: SLI Lighting
500 Chapman Road
Canton, Ma 02021

Attention: Mr. Dale Reynolds

Model No.: L232SI120S

Report Date: May 11, 2001

Test Site Location: INTERTEK TESTING SERVICES NA INC.
70 Codman Hill Road
Boxborough, Massachusetts 01719

Site Number: 3C

We attest to the accuracy of this report:

Signature

Signature

Testing Performed By

Reviewer

Title

Title

Introduction

This report is designed to show compliance with Part 18, Subpart C Rules, for Industrial Scientific and Medical Equipment (ISM). The various provisions of the Rules, as well as methods for determining compliance will be discussed below.

Technical Requirements Of Part 18, Subpart C

The Rules require that the category of Industrial, Scientific and Medical Equipment meet emission limits which differ from other apparatus. Particular frequency bands are allocated for use by ISM equipment. These ISM frequency bands are shown in Table 1. There are no RF power limits for these particular frequency bands, but field strength limits outside of the band are shown in Table 2. Maximum deviation from ISM frequencies (as a result of different loading, running modes, configuration, etc.) are recorded in order to ensure that the tolerances shown below are not violated in the worst case situation. Table 3 shows the ranges of frequency measurement required, based upon the lowest frequency generated in the device being tested.

The maximum permissible field strength limits for RF lighting devices differ from those shown in Table 2 and are given below in Table 4.

Operation of ISM equipment is prohibited within the frequency bands listed below, which are allocated to safety, search and rescue operation:

990 to 510 kHz
2170 to 2194 kHz
8354 to 8374 kHz
121.4 to 121.6 MHz
156.7 to 156.9 MHz
242.8 to 243.2 MHz

Table 1

ISM frequency bands

ISM Frequency	Tolerance
6.78 MHz	+ 15.0 kHz
13.56 MHz	± 7.0 kHz
27.12 MHz	± 63.0 kHz
40.68 MHz	±20.0 kHz
915.00 MHz	±13.0 MHz
2,450.00 MHz	±50.0 MHz
5,800.00 MHz	±75.0 MHz
24,125.00 MHz	±125.0 MHz
61.25 GHz	±250.0 MHz
122.50 GHz	±500.0 MHz
245.00 GHz	±1.0 GHz

Table 2
Radiated emission limits for ISM equipment

Equipment	Operating Frequency	RF Power Generated By Equipment (Watts)	Field Strength Limit ($\mu\text{V}/\text{m}$)	Distance (Meters)
Any type unless Otherwise specified (misc.)	Any ISM Frequency	Below 500	25	300
		500 or more	$25/\text{power}/500$	300
	Any non-ISM Frequency	Below 500	15	300
		500 or more	$15/\text{power}/500$	300
Industrial Heaters and RF Stabilized Arc Welders	On or below 5,725 MHz	Any	10	1,600
	Above 5,725 MHz	Any	As small as possible	As small as possible
Medical Diathermy	Any ISM Frequency	Any	25	300
	Any non-ISM Frequency	Any	15	300
Ultrasonic	Below 490 kHz	Below 500	$2400/F$ (kHz)	300
		500 or more	$2400/F$ (kHz) x /power/500	300
	490 to 1,600 kHz	Any	$24,000/F$ (kHz)	30
	Above 1,600 kHz	Any	15	30
Induction Cooking Ranges	Below 90 kHz	Any	1,500	30
	On or above 90 kHz	Any	300	30

Table 3

Required range of frequency measurements for ISM equipment

Frequency Band In Which Device Operates (MHz)	Range of Frequency Measurements	
	Lowest Frequency	Highest Frequency
Below 1.705	Lowest frequency generated in the device or 9 kHz, whichever is lower	30 MHz
1.705 to 30	Lowest frequency generated in the device or 9 kHz, whichever is lower	400 MHz
30 to 500	Lowest frequency generated in the device or 25 MHz, whichever is lower	tenth harmonic or 1000 MHz, whichever is higher
500 to 1000	Lowest frequency generated In the device or 100 MHz	tenth harmonic
above 1000	do	tenth harmonic or highest detectable emission

Table 4

Radiated emission limits for RF lighting devices

Frequency (MHz)	Field Strength Limit at 30 meters ($\mu\text{V}/\text{m}$)
Non-Consumer Equipment:	
30-88	30
88-216	50
216-1000	70
Consumer Equipment:	
30-88	10
88-216	15
216-1000	20

(Note that three sets of units are commonly used for EMI measurements, decibels below one milliwatt (-dBm), decibels above a microvolt (dB μV) and microvolts (μV). To convert between them, use the following formulas:

$$20 \log_{10} (\mu\text{V}) = \text{dB}\mu\text{V}$$
$$-\text{dBm} = \text{dB}\mu\text{V} - 107$$

For the purposes of this report, we will use -dBm or μV units exclusively.

Line conducted emission limits are also imposed for ultrasonic equipment, induction cooking ranges and RF lighting devices. Different line impedance stabilization networks (LISNs) are used in each case.

Table 5

Line conducted emission limits for ultrasonic equipment

Frequency (MHz)	Maximum RF Line Voltage Measured with a 5 μ H/50 Ω LISN (μ V)
0.010-0.49	1000
0.49-30	200

Table 6

Line conducted emission limits for induction cooking ranges

Frequency (MHz)	Maximum RF Line Voltage Measured with a 5 μ H/50 Ω LISN (μ V)
0.010-0.1	10-1 (linear interpolation)
0.1-0.5	1
0.5-30	0.25

Table 7

Line conducted emission limits for RF lighting devices

Frequency (MHz)	Maximum RF Line Voltage Measured with a 50 μ H/50 Ω LISN (μ V)
Non-Consumer Equipment	
0.45-1.6	1000
1.6-30	3000
Consumer Equipment	
0.45-30	250

**Test Procedure Used:
FCC Measurement Standard MP-5(1985)**

The procedure used for the measurements specified in this report is the procedure described in FCC Document MP-5 (1985).

**General Test Conditions
Test Site**

SITE 3C - At this time, three weather-sheltered open field test sites are in use. Site 3 is surrounded by a wire mesh groundplane extension of 25m x 37m to permit 30m operation, and a turntable capacity is increased to 12,000 lbs.

Each site is comprised of a 33' x 57' continuous metal sheet groundplane, sheltered by an arched, flexible plastic cover supported by semicircular fiberglass ribs. Maximum interior height is 16'. The groundplane is earthed at 3' intervals around its periphery by grounding straps outside of the foundation. Access to the site is provided by both a personnel door and a 10' x 10' operable flap in the plastic cover.

Each site has a 12' diameter flush-mounted motorized turntable and remote-controlled mast for antenna height and polarization. A half-basement provides access below the turntable for support equipment and mains power selection.

The operation and test equipment are located below the groundplane at a mezzanine level, permitting observation of the EUT without affecting the measurement of radiated emissions.

For 30m antenna distances in Site 3, the antenna mast is located outside of the plastic shelter, on the wire mesh extension of the groundplane.

All unnecessary equipment is removed from the site following the shipping and storing procedures of the Standard Operating Procedures. Any packaging material is moved to a corner of the site. Packing material is generally non-conductive. Any metal shipping containers are removed entirely from the site, and, if necessary due to inclement weather, either sheltered in plastic or removed to another location.

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Conducted emissions tests are performed in the same facilities used for radiated tests. Here, a portable LISN, designed in accordance with MP-5 has been electrically bonded to the site ground plane and is placed at the base of the EUT, which in turn is mounted on the same table as used for radiated emissions, and emissions readings are taken on the spectrum analyzer.

Conducted emissions testing (for ISM devices) is only necessary for the following equipment:

- a. Ultrasonic equipment.
- b. Induction cooking ranges manufactured after February 1, 1980.
- c. RF lighting devices.

Where tests have been required to be performed at sites other than those described above, the facilities used will be described elsewhere in this report.

Frequency Range Scanned and Reporting Format

Table 3 shows the frequency range to be scanned when testing for radiated emissions. For conducted power line measurements, the frequency range specified in FCC Part 18, Subpart C is scanned.

General Configuration of EUT

The EUT was set-up in such a way as to maximize emissions in a typical configuration. Power and signal distribution, grounding, interconnecting cables and placement of the equipment simulated a typical application in so far as was practicable.

The EUT was operated at the specified load conditions. Loads were either actual or simulated as described in the individual equipment requirements. The power output was correlated with the appropriate limits (see table of limits).

The equipment is generally connected to at least one of each types of accessory provided by the manufacturer.

Excess length of cables were bundled so that they did not exceed 40 centimeters. If this was impractical for any reason, disposition of these cables was left to the discretion of the test engineer.

EUT Grounding

The unit was grounded as normally used.

Test Environment

If ambient levels of emissions exceed the appropriate limit, the following steps were taken to assure compliance. First, the measurement bandwidth was reduced, if this did not affect the peak readings. Such a reduction can allow much closer examination of emissions close to local ambient signals. Second, the antenna could be brought closer to the EUT. Finally, in severe cases, testing was re-performed at night or other times when the offending signal was off the air.

The measurements were made at nominal room temperature ($25^{\circ}\text{C} \pm 10^{\circ}\text{C}$)

Test Platform

Tests were made on either a one meter high, one meter wide non-conductive platform, or for larger equipment, an 8 foot diameter metal turntable connected to the ground plane around its periphery. In some cases, large equipment on its own casters is tested without a platform.

Ground Screen

Each site used employed a ground screen.

Conducted Emissions

Conducted emissions readings (if applicable) were taken using the same test platform used for radiated emissions. The LISN used was placed on the floor at the base of the test platform and electrically bonded directly to the ground plane. The line cord was bundled so that a straight, rigid length of cord was produced and unlike other cables attached to the EUT, its orientation was not changed.

The LISN has impedance characteristics which match those specified in MP-5, Figure 3c (50 Ω /50 μ H) for RF lighting devices or Figure 3a or 3b (5 μ H/50 Ω) for ultrasonic equipment and induction cooking ranges. All unused ports on the LISN were terminated with 50 Ω . The LISN's impedance is measured once a year.

Configuration Information

Equipment Under Test: 2 Lamp-T8 Electronic Instant Start Ballast

Model: L232SI120S

Serial Number: 112000

FCC Identifier: Not Applicable

Support Equipment:

Cables:

QTY	Description	Shield Description	Hood Description	Length (m)
1	AC Power Cord	none	Plastic	1

**Configuration Photographs –Worst-Case Line-Conducted Emissions
With conduit**



**Configuration Photographs –Worst-Case Line-Conducted Emissions
Without conduit**



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Test Equipment

The following equipment settings were used to make measurements for emissions testing:

Description	Manufacturer	Model	Serial #	Cal Due
RECEIVER	HEWLETT PACKARD	85422E	3520A00125	11/21/2001
LISN	SOLAR ELECTRONICS	9252-50-R-24-BNC	955107	03/20/2001

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Test Data Radiated and Conducted Emissions

I. Instrumentation

A. Spectrum Analyzer or Receiver

- HP8542E with Quasi-Peak and Average Measurement Detectors
- HP8558B with 182T or 853A Mainframe
- HP8591E with Quasi-Peak and Average Measurement Detectors
- HP8593A with Quasi-Peak and Average Measurement Detectors
- Other _____

II. Client Information

- A. **Name and Address:** SLI Lighting
500 Chapman Road
Canton, Ma 02021
- Attention:** Mr. Dale Reynolds
- B. **Model:** L232SI120S
- C. **Date(s) of Test:** November 21, 2000

Conducted Emissions / Interference

Table: 1

Company: SLI Lighting
Model: L232SI120s
Serial: 112000 (Issued by ITS)
Job No.: J20029790
Date: 11/21/00
Standard: Part 18 (Consumer Equipment)
Class: None Group: None
Notes:

Tested by: Kouma Sinn
Location: Site 3C
Site condition: 15.5°C, 34%
Detector: HP 8542E
Cable(s): 3C-10m 3-1-00
Limiter: no

System Loss: Includes the Cable and LISN loss.
220VAC, 50 Hz

Frequency MHz	Reading Side A dB	Reading Side B dB	Attenuator Factor dB	System Loss dB	Quasi-Peak		
					Net dB(uV)	Limit dB(uV)	Margin dB
23.130	0.0	23.9	20.0	0.1	44.0	48.0	-4.0
0.456	0.0	32.2	20.0	0.9	53.1	48.0	+5.1
0.525	0.0	29.6	20.0	0.9	50.5	48.0	+2.5

Conducted Emissions / Interference

Table: 2

Company: SLI Lighting	Tested by: Kouma Sinn
Model: L232SI120s	Location: Site 3C
Serial: 112000 (Issued by ITS)	Site condition: 15.5°C, 34%
Job No.: J20029790	Detector: HP 8542E
Date: 11/21/00	Cable(s): 3C-10m 3-1-00
Standard: Part 18 (Consumer Equipment)	Limiter: no
Class: None Group: None	
Notes:	

System Loss: Includes the Cable and LISN loss.

Frequency MHz	Reading Side A dB	Reading Side B dB	Attenuator Factor dB	System Loss dB	Quasi-Peak		
					Net dB(uV)	Limit dB(uV)	Margin dB
Replaced the Y-capacitor with 1000 pF on both lines.							
20.860	25.2	27.8	20.0	0.1	47.9	48.0	-0.1
18.620	24.2	24.9	20.0	0.4	45.3	48.0	-2.7
15.290	23.7	21.0	20.0	0.4	44.1	48.0	-3.9
Covered the AC power cable with conduit.							
20.600	23.6	20.7	20.0	0.1	43.7	48.0	-4.3
12.370	19.0	19.3	20.0	0.4	39.7	48.0	-8.3
0.481	22.8	23.8	20.0	0.9	44.7	48.0	-3.3