NATIONAL LIGHTING PRODUCT INFORMATION PROGRAM

Guide to Specifying High-Frequency Electronic Ballasts

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Overview

Lighting specifiers should consider six criteria when specifying high-frequency (20–60 kHz) electronic ballasts for linear fluorescent lamps: starting method, ballast factor, power factor and total harmonic distortion, lamp-ballast compatibility, inrush current, and ballast reliability. The National Lighting Product Information Program (NLPIP) prepared this *Guide to Specifying High-Frequency Electronic Ballasts*, including a sample specification form, to help lighting specifiers understand and use manufacturer-supplied data to select appropriate high-frequency electronic ballasts.

More detailed information on electronic ballasts, including manufacturer-specific performance data, is available in NLPIP's *Specifier Reports: Electronic Ballasts.*

Issues

Starting Method

There are two major starting methods for electronic ballasts for linear fluorescent lamps: rapid-start and instant-start.

Rapid-start ballasts heat the electrodes of fluorescent lamps before applying the voltage necessary to start the lamps, causing a brief delay in starting. Electrode heating, which usually continues even after starting, results in a power loss of 3–4 watts.

Instant-start ballasts do not heat the lamp electrodes during either starting or operation and so usually operate at lower power than a comparable rapid-start ballast. Instant-start ballasts provide high initial starting voltage, which will reduce lamp life relative to rapid-start operation. This reduction in lamp life is greatest when lamps are turned on and off frequently, which sometimes occurs in applications where occupancy sensors are used.

Ballast Factor

Ballast factor (BF) is the ratio of the light output of a lamp operated by a given ballast to the light output of the same lamp when operated by a reference ballast. For example, lamps operated by a ballast with BF of 0.90 will provide 90% of their rated light output (lumens). Different types of lamps operated by the same ballast may produce different BFs. BFs between 0.85 and 1.0 are the most common.

A lamp-ballast system with high BF, which NLPIP defines as greater than 1.0, will produce high light output so that fewer lamps may be necessary in a particular application. However, the high lamp current associated with high BF may reduce lamp life and add to the energy required to operate the lamps. That associated current may also accelerate lamp lumen depreciation, which is a progressive decrease in light output.

Low BF (<0.85) systems produce low light output, and can save energy because of their low system power compared to high BF systems. However, low BF systems may reduce lamp life, due to reduced electrode temperatures.

Power Factor and Total Harmonic Distortion

Power factor (PF) is defined as the ratio of active power (watts) to the apparent power (volt-amps). PF is reduced when there is a phase shift between current and voltage or a distortion of the sinusoidal wave shapes. Low PFs result in unusable power capacity in the electrical distribution system and may result in penalty fees from the electric utility company. The American National Standards Institute (ANSI) classifies ballasts with PF greater than 0.90 as "high power factor."

Total harmonic distortion (THD) is a measure of the deviation from a sinusoidal waveform. High THD reduces power factor and may cause interference with the operation of electronic equipment, improper operation of power grid protective devices (fuses, circuit breakers, and relays), interference with nearby communications circuits, and overheating of motors, transformers, capacitors, and neutral conductors.

ANSI requires that electronic ballasts have current THD less than 32%. Most of the electronic ballasts on the US market have THDs of less than 20%. Ballasts with THD as low as 5% are available, but are usually more expensive than other ballasts, and may have higher inrush current.

Lamp-Ballast Compatibility

Fluorescent lamps have specific ballast requirements to ensure optimal operating characteristics and lamp life. Incompatible lamp-ballast systems may cause unreliable starting, end darkening, and reduced life. ANSI has established standards for many of the compatibility factors; these standards were summarized in the NLPIP publication *Guide to Fluorescent Lamp-Ballast Compatibility.*

The Certified Ballast Manufacturers Association (CBM) labels ballasts that meet ANSI standards. Not all ballast manufacturers participate in CBM, and some ballast manufacturers choose to produce ballasts that do not comply with ANSI standards. A specifier who chooses to use a ballast without a CBM label should also resolve the question of who will warrant the lamp and ballast, since lamp manufacturers generally warrant their lamps only for operation with ballasts that meet ANSI standards.

Inrush Current

Inrush current is a momentary surge in current that can occur when an electrical device, such as a motor or an electronic ballast, starts. The duration of inrush current is very brief, typically less than 3 milliseconds. High inrush current (>20A) can trip circuit breakers, blow fuses, or overload relays. ANSI does not presently set limits for inrush current; however, some manufacturers incorporate devices to limit inrush current.

Inrush current for an electronic ballast should meet the inrush specifications for relays, circuit breakers, or fuses that may be included in the circuit, including those used in control devices such as occupancy sensors and photosensors. The specifications for these other devices can be used to determine the maximum current and duration for the ballast specification. The rated inrush current for the ballast must not exceed the rated inrush current for any other device in the circuit.

Ballast Reliability

Manufacturers of electronic ballasts usually provide three- to five-year warranties for their products. Because ballast life depends on input voltage and ambient temperature, specifiers should determine the acceptable ranges for input voltage and temperature for the warranty to be valid, and ensure that conditions in the intended application will be within these ranges. Furthermore, NLPIP recommends that specifiers determine whether the manufacturer's warranty includes labor costs for replacement of defective ballasts.

The reliability of electronic ballasts can also depend on their ability to withstand voltage surges and electrical transients, and to withstand operation for conditions outside of those for which the ballasts were designed. Some manufacturers conduct special stress testing for their ballasts to determine their reliability in these conditions. NLPIP developed the list of questions below for specifiers to use in discussions with manufacturers on ballast reliability.

Sample Specification

Ballasts shall operate lamps at high frequency (>20 kHz), and shall be of the _______ [rapid-start or instant-start] type with ballast factor of ________ [>1.0, 0.85–1.0, or <0.85]. Ballasts shall have power factor >0.90 and current THD of _______ [<32%, <20%, <10%, or <5%], and shall have maximum inrush current of _______ A for a maximum duration of _______ ms. Ballasts shall meet all ANSI requirements*.

**If the ballast does not meet ANSI requirements, explain which parameter(s) does not meet ANSI and estimate the consequences in system performance, in terms of energy use, lamp life, light output, and other measures.*

Ballast Reliability Questions

- Is the ballast protected from voltage surges and electrical transients?
- Will the ballast be affected by any of the following "faulty" operating conditions?
  - using fewer lamps than rated?
  - using non-compatible lamps?
  - operating with a failed lamp(s) in the circuit?
  - operating with open-circuit or short-circuit conditions
  - operating in extreme temperatures?
- Has the manufacturer conducted stress testing to determine reliability? (Stress testing can include rapid-cycle testing, testing under extreme temperature and voltage variations, or testing under faulty operating conditions.)

More Information

To obtain information on other publications from the National Lighting Product Information Program, please contact the Lighting Research Center, Rensselaer Polytechnic Institute, 110 8th Street, Troy NY 12180-3590, phone (518)276-8716, fax (518)276-2999, e-mail lrc@rpi.edu, World Wide Web http://www.lrc.rpi.edu/.

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