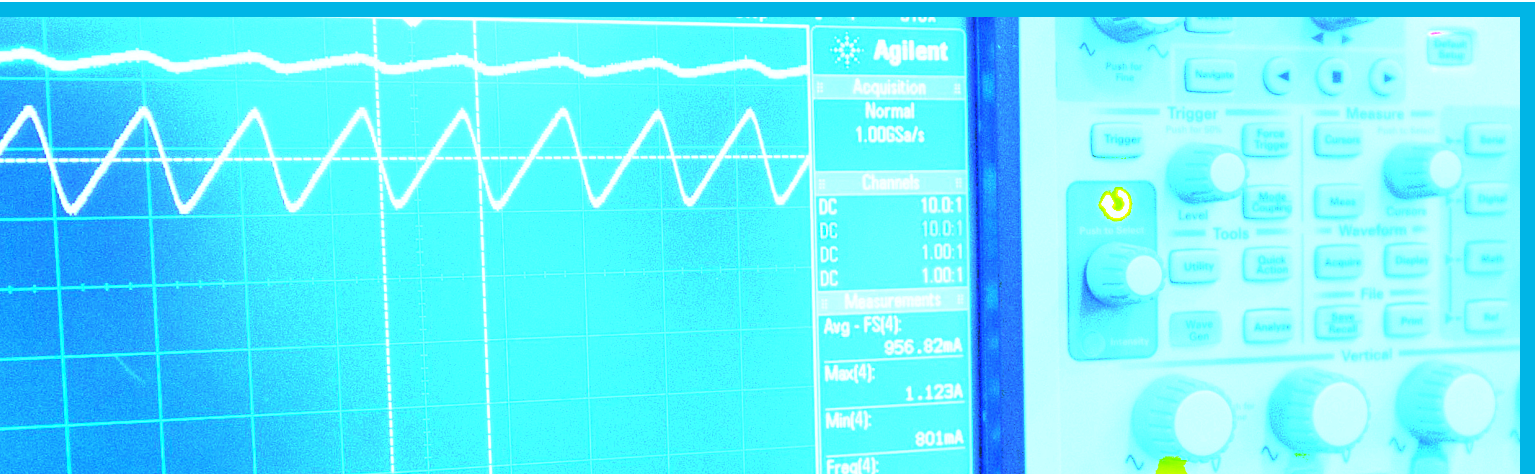


Pathway Lighting Products and Flicker — A Short White Paper



Pathway lighting fixtures use state-of-the-art constant current drivers to control the illumination of their LED lighting products. That being said, all constant current drivers have a certain level of current variation that can cause flicker. Depending on the level of dimming required, two mechanisms of current control are used; 1) constant current reduction (CCR) and 2) pulse width modulation (PWM). Products that dim to 10% typically use the CCR method, while products that dim to 1% and below typically use the PWM method. For either case, the drivers we specify have been thoroughly tested to ensure that flicker is undetectable.

Pathway characterizes flicker by using the % flicker metric defined by:

$$\% \text{ Flicker} = (\text{Max L} - \text{Min L}) / (\text{Max L} + \text{Min L}) \times 100\%$$

Where: **Max L** = Maximum light intensity
Min L = Minimum light intensity

Since the light intensity is directly proportional to the current driving the LED, the flicker equation can be rewritten in terms of drive current as follows:

$$\% \text{ Flicker} = (\text{Max Current} - \text{Min Current}) / (\text{Max Current} + \text{Min Current}) \times 100\%$$

Pathway accurately measures the maximum and minimum currents with a digital storage oscilloscope and precision AC/DC current probe to determine the max and min current levels.

The level of flicker perception varies from person to person, but a general industry rule of thumb is that using a CCR drive method, a flicker percentage of less than 50% at a frequency of 120 Hz or more will not be visible to the average observer. Even if flicker is not quite visible, it has been shown that flicker can cause health related issues such as fatigue, headaches, eye strain and even seizures.

To ensure our lighting products are truly free from flicker related issues, the CCR drivers we use are characterized such that the flicker percentage is less than 22%, more than twice as good as the generally accepted rule of thumb. This 22% limit is achieved by ensuring that the peak-to-peak ripple current measured on the constant current supplied to the LED is no more than 35% of the peak current value. Due to the design of the constant current driver, the frequency is always 120 Hz or greater and thus in the acceptable range.

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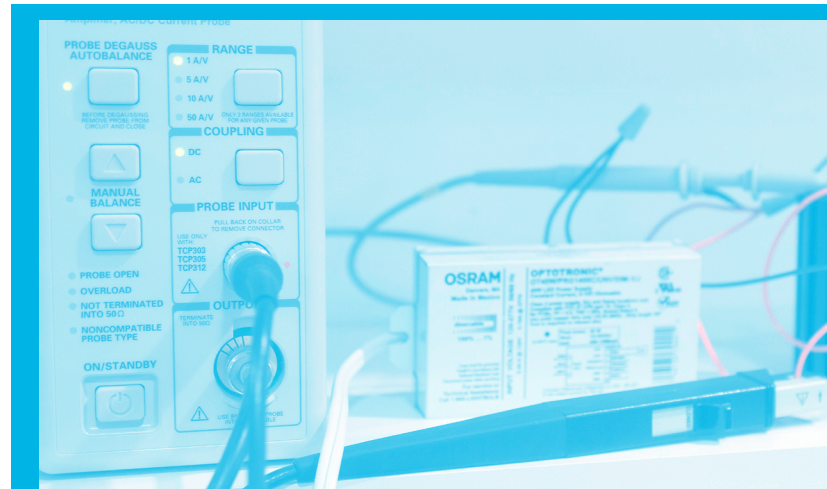
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For the PWM drive method, the rule of thumb is that a refresh frequency of greater than 200 Hz is required to make flicker not visible to the average observer. The flicker percentage metric cannot be used with the PWM drive method because the flicker % will always be 100%. However, even though the LED actually turns on and off with the PWM technique the frequency at which this turn on/turn off occurs is faster than the human eye can detect. **Once again, to ensure that there will be no flicker related issues, Pathway products using the PWM technique use refresh frequencies greater than 260 Hz at all times.** The only time the refresh frequency is as low as 260 Hz is when dimming levels are at the 1% and sub 1% levels. At dimming levels above 3% the refresh frequency is above 500 HZ and at typical brightness levels the refresh frequency is between 1000 to 3000 Hz.

In summary, for lighting products using either the CCR or PWM drive methods, flicker related issues will be non-existent with Pathway lighting products. Through a rigorous in-house testing program, great care is taken to ensure that all Pathway products meet or exceed our performance specifications. □

About the Author

Russ Budzilek : Electrical Engineer : Russ comes to Pathway with 32 years of experience in R&D of LED display systems and Led lighting. Russ is an avid boater, scuba diver and audiophile. Russ is also an Adjunct professor at Bridgeport University, College of Engineering.



About Pathway

Founded in 1990 by Fred Stark, Pathway Lighting is an innovative designer and manufacturer of specification-grade LED- and incumbent source-based luminaires, from downlights to wall washers, adjustable accents to decorative pendants, and emergency to egress fixtures, for the commercial and institutional markets in North America. Our wide range of products can support the lighting requirements of a single space or the entire project. We vet brand-name LED sources and components to guarantee system compatibility and reliability. This industry-leading, open platform approach to LED product development simplifies specification and gives our customers choice, more time to focus on lighting design, and peace of mind that only a trusted source for quality products can offer.

For nearly 25 years, Old Saybrook, CT-based Pathway Lighting has been using advanced product design software, best practices in manufacturing and fabrication, and state-of-the-art testing equipment to ensure that our products meet our customers' expectations. As an independently owned lighting manufacturer, we are able to provide responsive technical support, and we welcome our customers' requests for fixture modifications and custom products.