Removing LED Flicker from Priceless Family Memories

Author: *Scott Brown, EE*
VP Marketing
iWatt Inc.

Abstract

For more than 50 years families have recorded holiday celebrations and special occasions with home video, from super 8mm to modern HD digital video cameras recording directly to integrated flash memory. The biggest complication up until now was trying to capture the kids just in the moment when they did something spontaneous or cute. With the increasing use of alternative lighting a new problem has arisen. New LED lighting technology driven from the AC line voltage can cause a flicker that when recorded onto digital video becomes visible. A well-designed LED circuit can remove this flicker and guarantee that you will capture those properly lit memories for all time.

Most commercial LED lighting that has gained acceptance up to this point has been in the decorative area, whether lighting strips to adorn home furniture or product stands in department stores. Now, LED-based replacements for incandescent bulbs have reached the tipping point for cost efficiency and are gaining momentum in the home. These new drivers must work with existing light switches and dimming circuits so that they can directly replace incandescent bulbs without any modifications needed to the existing infrastructure.

Many off-line LED drivers used to convert the AC line voltage to a usable DC voltage and current carry a low frequency component that is two times the standard line voltage frequency, either 100Hz or 120Hz. The AC component of the low frequency LED current applied to the LEDs causes flicker, or the pulsing of the LEDs at the applied frequency. Pulsing light at frequencies above 70Hz may not be visible to the naked eye because a characteristic called persistence makes flickering light at frequencies above 70Hz appear to be continuous point sources. But, when recorded and displayed on TVs that have refresh rates operating at similar frequencies, the LED-based lighting will flicker, making the video difficult to watch or even unbearable, ruining a cherished family memory.

Most digital video technology uses interlaced video where lines of video are output to the television in an alternating fashion. On analog CRT-based televisions, historically the refresh rate was 50Hz or 60Hz depending on the region, which was perceivable by the eye when looking at sharply contrasted images, i.e. white text on a black background. The text lacked definition and sharpness, and even seemed to “dance” due to the flickering of the image at 50Hz/60Hz.

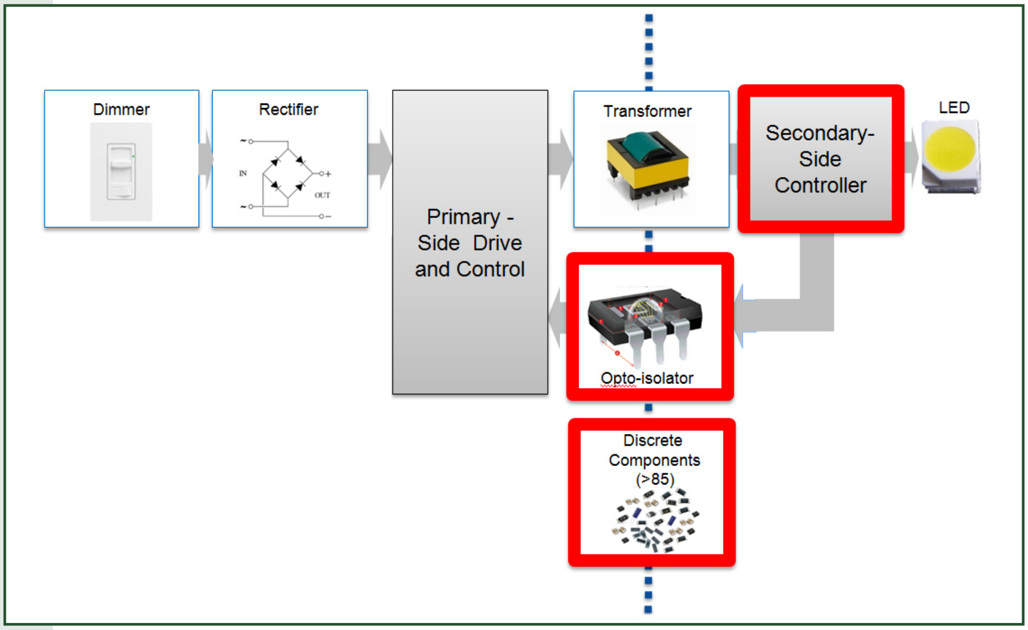
Prior to the flat-screen, LCD era, the tube-TV manufacturers moved to 100Hz/120Hz refresh rates in order to improve the stability of the image, since 100Hz/120Hz was beyond the visible range of the eye. Most HDTVs use a minimum of 100Hz refresh rate, with the highest performing HDTVs using a refresh rate of 600Hz.

While we can easily point at the TV as the guilty party, modern video cameras can take their fair share of blame as well. Most use shutter speeds that are low enough that they also “beat” with the 100Hz-120Hz ripple that cause the LED flicker. The camera captures that flicker and it will appear on the final video, even on TVs with high enough refresh rates where the beat frequency can be seen. At best the flicker can be reduced by adjusting the shutter speed, but not removed without using a Hollywood caliber video camera, beyond the budget of the average family.

Issues with Single Stage Analog Solutions

As stated earlier, solutions for LED driving from the 110VAC-220VAC line voltages exist, but these approaches are often single-stage, analog solutions similar to what is used on the bulk of off-line power supplies today. Single-stage solutions (figure 1) take an AC-rectified line voltage and that voltage is stepped down through a flyback transformer, filtered and applied to the LEDs. The problem is that the rectified voltage contains ripple at two times the line frequency (either 100Hz or 120Hz depending upon the line frequency in the region). The frequency component also gets transformed and appears on the output of the LEDs as an alternating current on the LEDs, which can cause the aforementioned flicker.

Figure 1. Single-Stage Approach



Two Stage Approach

iWatt's digital controllers incorporate a two-stage approach (figure 2), adding digital control for a chopping circuit (figure 3), a simple circuit that takes the rectified AC-voltage and does exactly as it sounds, it chops that voltage and converts it, accomplishing two important tasks. First, it converts the low frequency, AC voltage to another voltage, and in the process removes the low frequency component from the line voltage. And secondly the chopping circuit handles the power factor correction (PFC) component by ensuring that the current through the chopping circuit is closely in phase with the input voltage, generating an inherently high power factor. By removing the low frequency that comes from the AC-rectified input, the chopping circuit eliminates flicker from all LED lighting fixtures, guaranteeing smooth video capture of family memories lit by LEDs powered by iWatt technology.

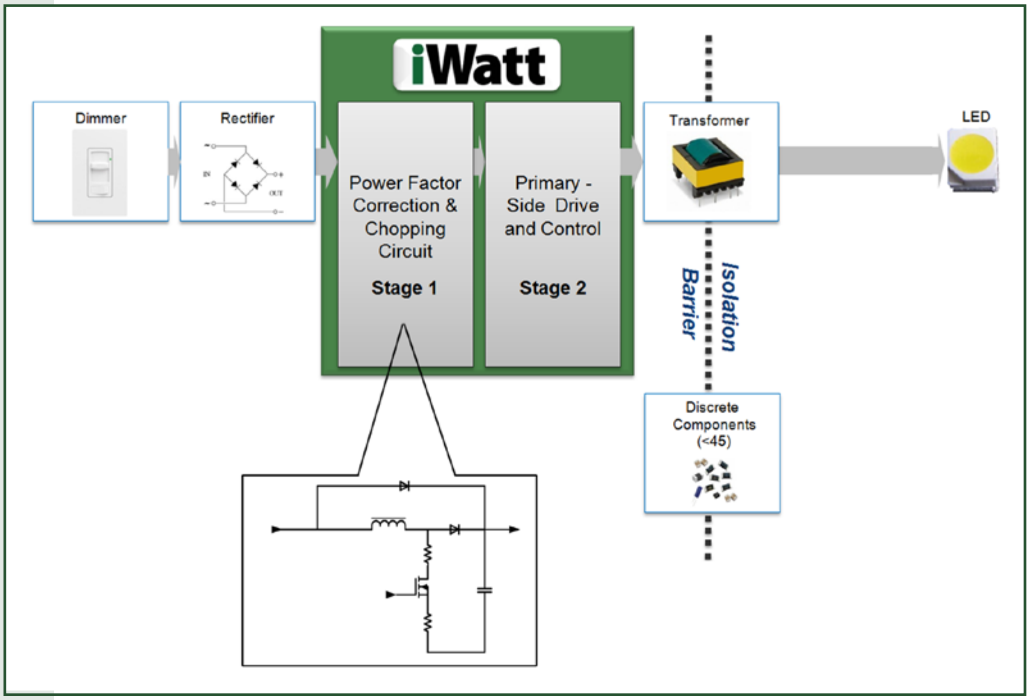


Figure 2. Two-Stage Digital Control Architecture in iWatt's FlickerLess™ SSL LED Drivers

Figure 3. Chopper Circuit – Removes AC Line Frequency

Conclusion

While upgrading home lighting to a more efficient, cost-effective alternative such as LED lighting is appealing for obvious reasons, a poorly designed bulb can end up being costly in the long run. Moments come and go, but some should be saved for posterity and enjoyed over and over again. With the wrong choice in off-line driver technology, a precious memory risks being lost because of nasty flicker effects. iWatt's innovative digital technology removes potential flicker problems and guarantees that these memories are captured in time for ever.

References

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Reference 2
US Patent (Pending) 12/503,063 "*Adaptive Dimmer Detection and Control for LED Lamp*"
Inventors: Liang Yan, Xiaoyan Wang, Jun Zheng, Junjie Zheng, and Clarita Poon
Assignee: iWatt Inc.

About iWatt

iWatt, Inc.

675 Campbell Technology Pkwy.
Suite 150, Campbell CA 95008
USA
Tel: 408.374.4200

Privately-held iWatt, Inc. is a leader in "green" power conversion technology, recognized in the semiconductor industry for enabling energy-saving electrical devices. The company's proprietary PrimAccurate™ digital control technology simplifies power management, and enables compact, low-component-count, energy-efficient power supplies for SSL LED lighting, LED-backlit LCDTVs, and power adapters for consumer devices. iWatt provides its power supply control ICs to leading manufacturers of these products worldwide. The company is headquartered in Campbell, CA with additional offices in Taipei, Seoul, Tokyo, Shenzhen, and Hong Kong.