New Products: R2A20134 LED Driver IC

Advanced LED Driver IC Removes Obstacles to the Widespread Commercial and Residential Adoption of Environmentally-friendly LED Light Bulbs

New chip delivers features for reducing the cost of AC-powered LED light bulbs and increasing the bulbs' energy efficiency—design advantages that lighting manufacturers can use to open up vast mass markets

The market for LED light bulbs is expanding rapidly, driven primarily by the global trend toward a low-carbon society and stronger interest in methods to protect the global ecology. Also, energy-saving efforts favoring LED lighting are being demanded for their economic benefits. Governmental regulations are giving this movement added momentum, too. For example, the Japanese legislature is calling for a cessation in the production of incandescent light bulbs by the end of 2012 because that venerable illumination technology is extremely inefficient. And in the USA, new efficiency standards on fluorescent and incandescent lighting are under consideration. For these and other reasons, a very rapid expansion of the LED light bulb market seems certain in the near future. In fact, sales of LED lighting products, which a few years ago had been forecasted to reach $1 billion last year, now are expected to grow to $8.3 billion by 2014, according to a new research report by Strategies Unlimited: "LED Luminaires Market Analysis and Forecast, Second Edition, 2011". Commenting on this prognostication, the research company said that several conditions contributed to their optimistic forecast, including "improvements in (the) performance and price of commercially available high-brightness LED packages, heightened concerns regarding energy efficiency, and the phasing-out of incandescent bulbs."

At present though, general household adoption of LED light bulbs—by far the biggest market for these devices—is growing quite slowly. The greatest barrier to popular adoption remains the issue of price. Many consumers are reluctant to buy LED light bulbs because the solid-state illuminators are relatively expensive compared to incandescent light bulbs and bulb-type fluorescent lights. Therefore, the key to unlocking the huge mass market for LED light bulbs is to make them available at sufficiently low prices.

Another factor that would accelerate market growth is better promotion of the energy-efficiency advantages of LED light bulbs, a feature that will generate substantial cost savings over the bulbs' very long lifetimes.

Reducing the BOM cost so LED bulbs can be priced more competitively

Recognizing this market situation as both a technology challenge and a business opportunity, Renesas has developed a key component for high-intensity AC-powered LED lighting products; the R2A20134 single-stage LED driver IC. This device delivers two critically important benefits. It is designed to reduce a bulb's BOM (Bill of Materials) cost, thereby allowing bulb manufacturers to price their products at lower, more competitive levels that encourage consumer adoption. The chip also helps increase the efficiency of new bulbs that save electricity, reduce lighting costs, and benefit the planet's ecology.

There are three primary design characteristics of this important new device:

- The inclusion of a proprietary step-down method of operation to boost efficiency
- A power-factor improvement control function
- Compatibility with all types of LED bulb circuits to serve global markets.

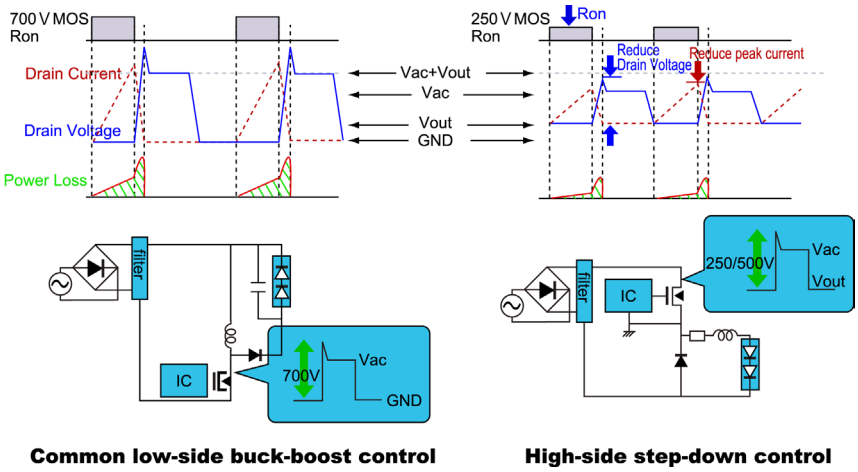
The attributes of this driver IC make it ideal for use in the class of LED light bulbs intended to replace 40- to 60-Watt incandescent light bulbs. And due to the chip's advantages and the extremely dynamic nature of this market at present, numerous lighting manufacturers have already decided to adopt the R2A20134 device. As a result, Renesas plans to mass-produce 3 million chips per month starting in March 2011, and we stand ready to ramp up the manufacturing lines to higher volumes as required.

Applying high-side step-down control so low-cost MOSFETs can be used

The new LED driver IC is particularly effective when used in circuits that apply the high-side step-down control method Renesas has developed. This proprietary approach enables lower costs and greater efficiency than can be obtained with the traditional low-side buck-boost control method.

LEDs are direct-current (DC) devices. Therefore, to operate an LED light bulb the internal electronics has to convert the alternating-current (AC) power in the light socket to DC. A common method for doing this today is the low-side buck-boost control scheme diagrammed in the left side of Figure 1. To perform the power conversion from a 100 VAC line using this method, the MOSFET switch that drives the LED must be able to withstand a maximum voltage of 700 volts. This necessity creates two design problems. MOSFETs with this high level of withstand voltage are relatively expensive due to the manufacturing processes they require. Additionally, such high-voltage MOSFETs inherently have relatively high levels of internal capacitance. That capacitance slows down the circuit's switching action, degrading its maximum achievable power efficiency.

Major design benefits are obtained when the R2A20134 LED driver IC is used in a circuit that employs the Renesas-proprietary high-side step-down control method shown in the right side of Figure 1. Chief among them is that when the input again is a 100 VAC line for instance, this control approach allows the use of a MOSFET that has to withstand only 250 volts. Such a device is significantly less costly than a 700-volt one, and the light bulb's BOM decreases accordingly.



Common low-side buck-boost control **High-side step-down control**

Figure 1: Advantages of high-side step-down control.

Delivering power-conversion efficiencies as high as 92 percent

Another benefit of the R2A20134 device is that it enables the highest power-conversion efficiency obtainable by any LED driver IC now available: our engineering teams have recorded power efficiencies up to 92%. One reason for this outstanding performance is that the smaller input capacitance of the lower-voltage MOSFET reduces the circuit's switching loss. Another reason is that the step-down control method has a critical-mode feature that activates the switching function precisely when there is no current running through the coil. The chip implements zero-current switching at turn-on and switches the MOSFET in a low drain-source voltage state.

To enable customers to implement the high-side step-down control method easily and effectively, Renesas has developed a MOSFET for optimized driving LED light bulbs that is an excellent companion for the R2A20134 driver IC. The features and performance that this combination of components delivers when used in this control approach are demonstrated by an available evaluation board.

Achieving a truly environmentally-friendly power factor of 0.9 or more

The R2A20134 chip incorporates a power-factor improvement control function. This function, in addition to a critical-conduction mode, allows PFC (power factor correction) control using only a few external components. With PFC control the chip can deliver a power factor of 0.9 or more—the highest of

any LED driver IC. This achievement minimizes the waste—in the form of apparent power—that is lost in the power supplied from the electric utility company. The LED light bulbs for which the R2A20134 chip is optimized are in the 7-Watt class, well below the 25-Watt threshold at which existing power-factor regulations for lighting products typically begin to apply. Nevertheless, in the future, power factor rules that are more environmentally friendly may be introduced to regulate lower-wattage bulbs. If that happens, products built with R2A20134 driver ICs are likely to already be compliant.

Accommodating various types of control circuits to provide design flexibility

As previously mentioned, the R2A20134 LED driver IC is compatible with other control schemes beside the high-side step-down type. It also supports the low-side buck-boost and flyback techniques shown in Figure 2, as well as the peak-current, average-current, low-side step-down, high-side buck-boost, and constant-input-power control approaches, among others.

This generous circuit-design flexibility is beneficial because it allows an LED light bulb manufacturer to reduce its parts inventory by using the same driver IC in different LED light bulbs tailored for diverse markets.

Key electrical specifications of the R2A20134SP LED driver IC are as follows. Its maximum power supply voltage is 24 V, its operating junction temperature range is −40 to +150°C, the operation start voltage is 12.0 V ±0.8 V, and the operation stop voltage is 9.2 V ±0.7 V. Packaged in a small SOP-8 package, the device provides overcurrent-limit, zero-current detection, and power-factor improvement functions. This new LED driver IC clearly demonstrates Renesas' continuing commitment to the production of a broad range of products and solutions that contribute to the realization of a worldwide ecology society.

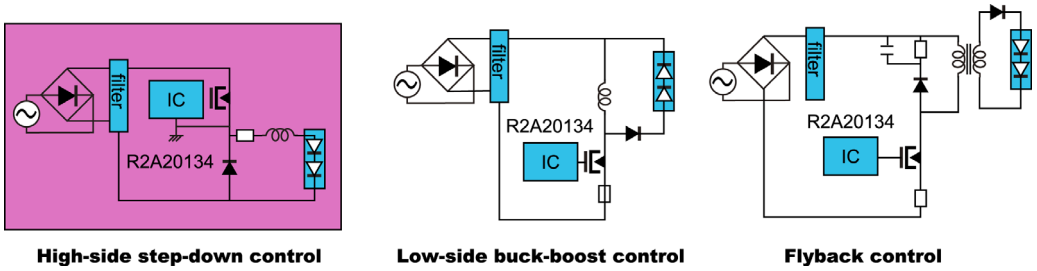


Figure 2: Example applications of the R2A20134 LED driver IC.

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