PSD EUROPE

June 2020

Special Report: Lighting + Illumination (pg 25)

PSD EUROPE

WWW.POWERSYSTEMSDESIGN.COM

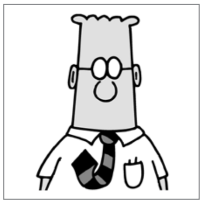
Visit us online for exclusive content; Industry News, Products, Reviews, and full PSD archives and back issues

COVER STORY

Automotive Exterior Lighting Solutions (pg 9)

Highlighted Products News, Industry News and more web-only content, to:

www.powersystemsdesign.com



EUROPE
Information to Power Your Designs

Power Systems Corporation
146 Charles Street
Annapolis, MD 21401 USA
Tel: +410.295.0177
Fax: +510.217.3608
www.powersystemsdesign.com

Registration of copyright: January 2004
ISSN number: 1613-6365

Volume 16, Issue 5

Lighting the Way

Welcome to the June edition of PSD. This month our special feature is on LEDs and lighting. Up until fairly recently, this is an industry hasn't seemed to evolve an awful lot in the 150 or so years since the incandescent bulb was first invented. Even though light bulbs were patently inefficient, which could easily be felt as they gave off almost as much waste heat as they did light, as long as there was power to spare then things seemed to be fine. As populations have grown and living standards have improved across the globe, the amount of energy required for lighting grew correspondingly. By some estimates, Lighting had risen to around 20% of the energy generated globally. With energy grids being put under pressure, decreasing the power demand from lighting would help greatly. When the dangers of climate change became more apparent, the demand to cut all types of energy use increased dramatically.

LEDs had often been suggested as a better form of lighting. They were more energy efficient and had longer working lifetimes. On the other hand, white light was not easy to generate, the devices couldn't be plugged directly into the mains, LED lighting didn't disperse light as evenly as ordinary light bulbs and cutting power wouldn't dim light as it does for incandescent bulbs. These problems have been overcome and LED lighting has now been adopted widely, while incandescent bulbs are being phased out. Dimming and powering LEDs took a specialised circuit, which could easy be adapted for other control functions, such as sensor integration and colour change. As in many other applications, each manufacturer initially developed its own system of powering and controlling LEDs for lighting, making interoperability difficult. This problem was addressed by the DALI (Digital Addressable Lighting Interface) standard.

DALI provided a robust, scalable and flexible way to install LED lighting networks by providing a bi-directional link between lighting-control products. A single pair of wires was used to both control the devices and to power them. The utility of LEDs since then has grown and they are a much more integral part of the home ecosystem. To ensure that designers can take advantage of newer features and maximise interoperability, the DALI protocol is getting a revamp itself. Inside the issue, Tim Whitaker from the Digital Illumination Interface Alliance (DiiA) will give us more details on the capabilities of the new standard.

When LED lighting was first introduced, one of the first applications that LEDs gained real traction was in the automotive industry. Manufacturers saw the advantage of a light, long-lasting alternative to incandescent bulbs. But the industry has moved on and more flexible features are in demand. In our second special focus article, Stefan Drouzas from ROHM Semiconductor tells us how the company's vertical focus, from power components to the LEDs themselves, has allowed it to create a new type of LED control for the automotive industry that adds features while cutting costs and power consumption.

As well as our special focus, we have a range of features and article on general topics of interest to those creating power designs. I hope you enjoy the magazine.

Best Regards,

Ally Winning
European Editor, PSD
Ally@powersystemsdesign.com

Automotive Exterior Lighting Solutions

An automotive lighting solution that combines the LED driver ICs req. for LED lighting control along with compact high reliability LEDs

By: Stefan Drouzas, Senior Application Marketing Manager, ROHM Semiconductor GmbH

Changing exterior lamps from bulbs to LEDs makes it possible to achieve smaller, thinner light sources, allowing more manufacturers to improve lamp design. To improve design, it is necessary to increase LED output while reducing the power consumption of the LED drive control circuit along with size. At the same time, longer life is needed. Unlike bulbs that break after a certain period and require replacement, LEDs are often integrated with the control circuit, making replacement difficult. Since LEDs are not expected to break, the tendency is to require high reliability at the component level. The demand to reduce costs cannot be ignored. For example, 2-wheeled vehicles are sold at very reasonable prices in India and ASEAN, where they are the mainstream mode of transportation.

The difference between resistor and driver IC circuits

Until recently, resistor circuits were typically used to control LED current due to cost advantages. A resistance circuit can light LEDs using a simple circuit similar to those used with conventional bulbs, making it possible to achieve lower costs. However, disadvantages include lower efficiency due to circuit heat loss and the inability to detect LED failures.

In contrast, circuits using LED driver ICs (LED driver IC circuits) that have been attracting attention in recent years provide a number of advantages, including lower power consumption while ensuring high reliability by incorporating protection circuits that can detect LED failures. However, at the same time, these circuits also increase the cost of components.

The differences are:

1) Power Consumption

Resistance and LED driver circuits utilize very different methods of controlling LED current when the battery voltage (that is, the

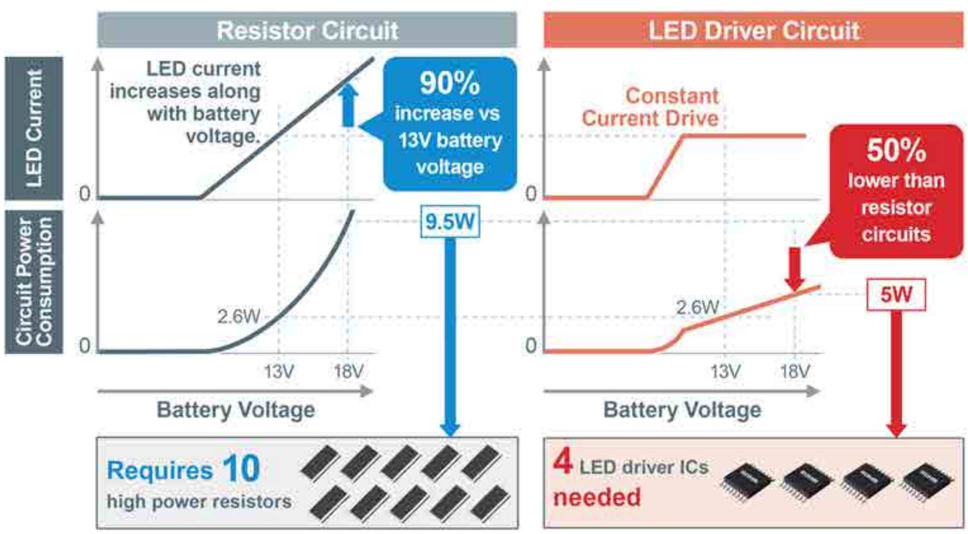


Figure 1: Power Consumption Characteristics Comparison

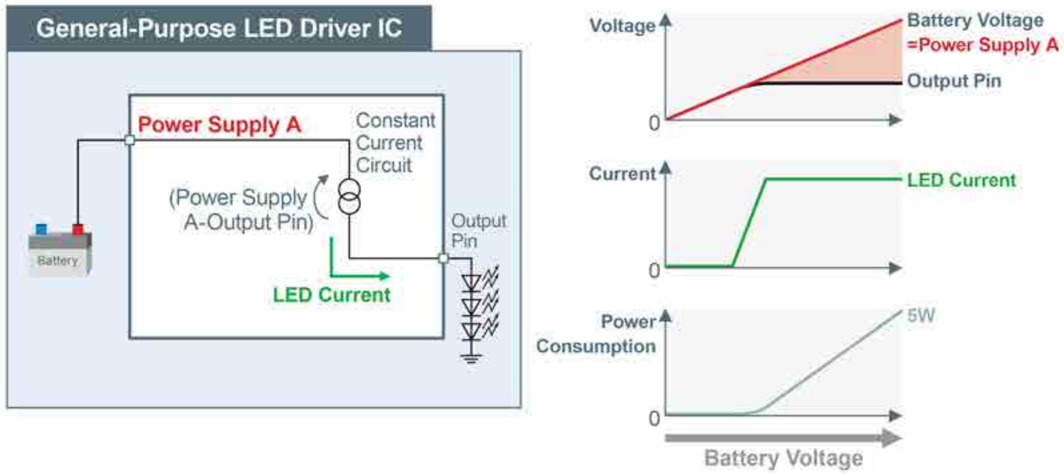


Figure 2: General LED Driver IC and Its Characteristics

supply input of the drive circuit) rises. In the case of a resistor circuit, the LED current increases along with the battery voltage. But with LED drive circuits, constant current drive is possible at a preset value even if the battery voltage increases.

2) Reliability
LED driver IC circuits are also beneficial in terms of reliability. This is because the number of mounted parts is small, reducing the likelihood of component failure on the control board. In addition, LED driver ICs can detect errors such as LED open/short failures and provide external notification.

3) Cost
Resistor circuits are generally more cost efficient. For example, as shown in Fig. 1, in the case of driving 9 LEDs, a typical resistor circuit requires at least 10 1W resistors, while an LED driver IC circuit needs just 4 ICs, depending on the package. So while it seems that the more components used in resistor circuits should result in higher costs, it is possible to significantly reduce costs by adopting multiple high power resistors, which are much cheaper than ICs. Conversely, LED driver ICs require more ICs as the number of LEDs increases, leading to higher costs compared with resistor circuits.

New LED Driver IC
In response to the recent market demands, ROHM developed the BD183x7EFVM series of 4ch LED driver ICs (BD18337EFV-M/BD18347EFV-M) that utilize a new control method called Energy Sharing in which power consumption is distributed from within the LED driver IC to external resistors.

Figure 2 shows a general driver IC, comprised of a constant current circuit that supplies current to the LEDs, an input that connects to the battery power supply, and an output that connects to that connects to the LEDs. When Power Supply A to which the input voltage from the battery is connected rises to some extent, the constant current circuit within the LED driver IC can output a constant LED current. So as a result, the output terminal voltage is equivalent to the forward voltage characteristics of the connected LEDs.

Since the power consumption of the LED driver IC is the product of the input-output voltage difference of the constant current circuit and LED current, the power consumption will increase as the input voltage from the battery rises. Therefore, to decrease LED driver IC power consumption it is necessary to reduce either the input-output voltage difference of the constant current circuit or LED current. However, customer requirements and other factors make it difficult to change the LED current, so ROHM developed a method for controlling the voltage between the input and output of the constant current circuit.

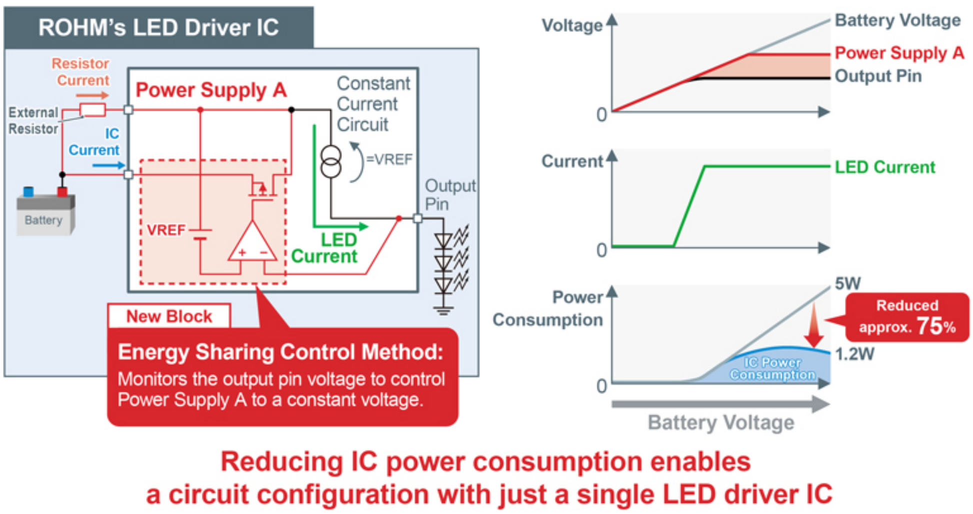


Figure 3: ROHM's LED Driver IC and Its Characteristics

Figure 3 shows ROHM's new Energy Sharing control method that achieves lower costs by reducing LED driver IC power consumption. The voltage between the input and output of the constant current circuit is controlled by passing a part of the LED current through the external resistor of the LED driver IC to suppress heat generation. At the same time, a newly added block monitors the output pin voltage to control Power Supply A to a constant voltage. The current flowing through the resistor is represented by the external resistor R and the voltage difference between the battery voltage generated at both ends of the resistor and Power Supply A voltage (Battery Voltage - Power Supply A Voltage). Power Supply A voltage is controlled to a constant value by increasing the resistance current as the battery voltage rises.

Using this control method allows most of the power previously consumed by the LED driver IC itself to be consumed by the external resistor R, reducing LED driver IC power consumption by approx. 75% vs conventional solutions. So by sharing power consumption between the LED driver and external resistor, the power achieved by 4 conventional ICs can be handled with a single IC and high power resistor.

ROHM achieves this function by adding an extra input pin to a conventional LED driver IC. And since lighting modes unique to 2-wheeled vehicles is supported, most of the necessary functions can be covered by the IC alone.

Although circuits equipped with ROHM's new LED driver IC are slightly more expensive than resistor circuits, a cost savings of around 40% can be realized over conventional LED driver circuits. As a result, in addition to lower power consumption and greater reliability, lower cost on par with resistor circuits is possible by pairing with an external resistor. In addition, ROHM makes this function available by only adding the input terminal with one pin to a conventional LED driver IC. Furthermore, most of the necessary functions can be covered with only this IC since it is able to support the specific feature for 2-wheeled vehicles, the lighting on/off mode.

LEDs Optimized for Automotive Applications

ROHM has is able to implement product development with thorough quality control utilizing a vertically integrated production system in which every process, from element fabrication to packaging, is carried out in-house. Advantages of manufacturing in-house include the ability to supply high quality products, through measures such as implementing an easy-to-manufacture chip design during the assembly process, introducing traceability for ultra-compact components, and carrying out process management for automotive-grade products.

In recent years, compact LEDs are increasingly being adopted as indicator light sources for instrument clusters. To cope with the severe

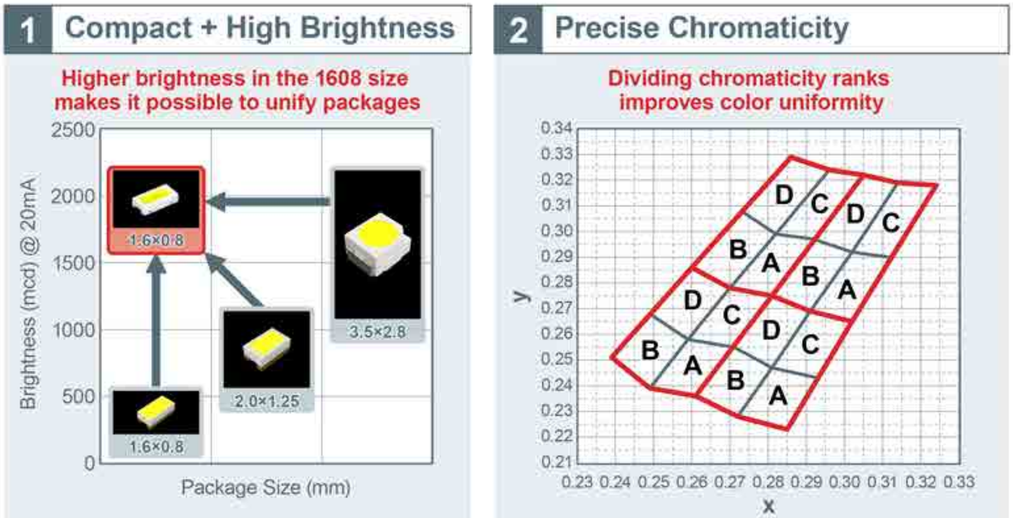


Figure 4: Trend of LEDs used for in-vehicle illumination

temperature changes that occur in automotive environments, a gap is provided between the light shield and substrate to prevent contact. But this results in light leakage from the LED to adjacent areas, which can become problematic. What's more, in applications utilizing compact LEDs, particularly automotive systems exposed to severe conditions, high reliability products that incorporate measures against aging due to environmental stress are required.

In response, ROHM developed the CSL0901/0902 series of compact, high output, surface-mount lens-type LEDs optimized for indicator light sources in vehicle instrument clusters that are expected to be exposed to harsh conditions. Raising the position of the light source to 0.49mm virtually eliminates light leakage. This enables the use of smaller LEDs – approximately 18x smaller (in volume) than conventional reflector-type LEDs, contributing to greater application space savings. In addition, ROHM developed a new molded resin that significantly reduces brightness degradation at high temperatures, even for short wavelength high brightness products. For example, in accelerated high temperature conduction testing with blue LEDs (85°C, IF= 20mA, 1,000hrs energization), ROHM succeeded in improving the residual luminosity rate by approx. 80% over conventional products.

In addition to icon display for in-vehicle systems such as instrument clusters, expanding set functionality is demanding compact LEDs for illuminating the entire panel as well (i.e. infotainment/navigation systems).

To respond to these market needs, ROHM is developing compact, high brightness LEDs by optimizing a variety of factors, including the package shape, reflector material, elements, and surface plating. Furthermore, chromaticity variations are significantly reduced by carrying out high accuracy element and phosphor adjustment, making it possible to achieve high brightness equivalent to larger conventional packages in a compact 1608 size.

For exterior vehicle lamps, from a design perspective there is an increasing demand for smaller, thinner LEDs while improving power to reduce the number of mounted components. Also, as vehicle stop lamps are often used under harsh conditions, measures against sulfuration are needed to ensure reliability. ROHM is currently developing high power LEDs that deliver superior sulfuration resistance while maintaining high brightness.

ROHM
www.rohm.com