Solve Your Enclosure Challenges with Integrated LED Illumination

Introduction

Modern enclosure development is a hotbed of innovation – and challenges. Today's smart, connected devices generate significantly more information that needs to be communicated to the user. Industrial designers have moved beyond the old school putty-colored cuboids to distinctive shapes with unique contours. These trends result in more LEDs with output routed over more complex paths to more points on the enclosure body. One size no longer fits all. But one solution may fit all sizes – integrated LED illumination. This new generation of highly adaptable tools can solve challenges and make it easy for product developers to create distinctive and highly functional enclosure patterns to delight users and differentiate products in a competitive marketplace.

The New Enclosure Illumination Toolkit in Action

The key to optimizing light movement and placement in enclosures is to use an integrated design approach. Instead of waiting to squeeze in the LED subassembly at the end, consider LED requirements at the beginning. Identify and prioritize the function for each LED. Take into account physical factors, and performance metrics. Don't forget to consider some of the new integrated LED illumination options. They may simplify an existing design challenge or reveal an entirely new option. Let's take a look at a few examples.

The Problem: A Large Number of LEDs Grouped Closely Together

Grouping LEDs together on the PCB is a useful board design technique but it can complicate light pipe configuration and assembly. Light pipe arrays provide an integrated solution. Some light pipes in the array can perform standard indication, while others can backlight buttons, icons, and even logos for a highly compact, high functionality user interface. Bivar's Modular Light Pipe System (MLPS) enables product developers to specify the full parameters of the light pipe array required. The MLPS arrives preassembled in a custom bezel ready for installation, dock to stock (see Figure 1). Suddenly, incorporating sophisticated arrays in new products is fast and easy.
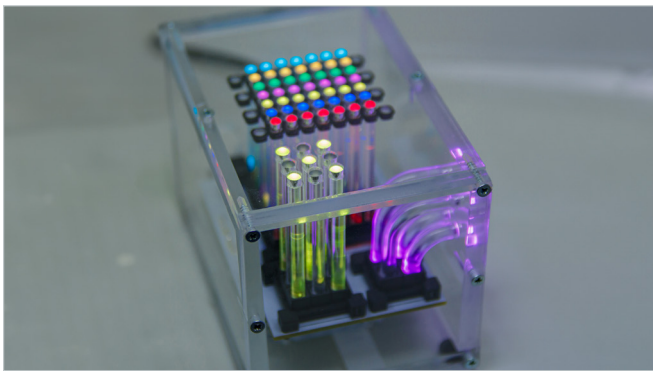

Figure 1: The MLPS modular light pipe system arrives preassembled in a positioning bezel, ready for installation.

Figure 2: Array version of ZeroLightBleed™ adapter eliminates light bleed between closely spaced SMD LEDs while minimizing footprint and assembly time.

The Problem: Color Mixing Between Closely Spaced Indication LEDs

When there is a gap between the light pipe and the LED, light can escape without coupling into the light pipe, reducing brightness at point of use and creating an unwanted glow in the enclosure. Worse, the stray light can be coupled into adjacent light pipes, particularly when they are closely spaced. This can cause false readings and blended colors. Indication points are no longer readable at a glance, just confusing. The solution is an integrated LED illumination device: Bivar's ZeroLightBleed™ adapter.

Each device consists of a surface mount LED fully enclosed by the adapter, which is tightly integrated to the light pipe. The result is brighter illumination at the user interface and elimination of stray light and color mixing. It's a particularly good solution for tightly spaced indication arrays because the ZeroLightBleed™ array version is designed to minimize footprint, as well as speed assembly (see Figure 2).

The Problem: Presenting Complex Status Data from Only a Few Indication Points

Today's sophisticated products need more than a simple on/off indication. Users expect to determine at a glance whether a device is functioning properly, whether it's connected to the network, the level of battery charge, and more. The first step is to look beyond single-color LEDs. LED arrays run by microcontroller units (MCUs) or even single-board computers can support dynamic color changing in real time to create patterns or blink at different rates and in different colors (an indication point changes from solid green to slow flash amber to fast flash red as battery charge runs down, for example).

The Problem: Highlighting a Button or Keyhole Without Hotspots

Rather than designing an assembly of multiple LEDs with a diffusing overlay, look for an integrated LED illumination solution. Bivar's integrated LED light guides represent a radical rethinking of the classic two-pin LED. They integrate an LED, a PCB with controller, and a diffusing lens in a single extended-area, low-profile device (see Figure 3).

With an annular LED light guide, adding programmable color and dynamic effects is straightforward. The integrated light guide just needs to be connected to a voltage source with a current-limiting resistor. The ring can change color and flash as programed by the user. The large area (OD of about 20 mm) eliminates the need to worry about multi-LED integration for hotspots. LED light guides are also available in rectangular and "bar graph" form factors.
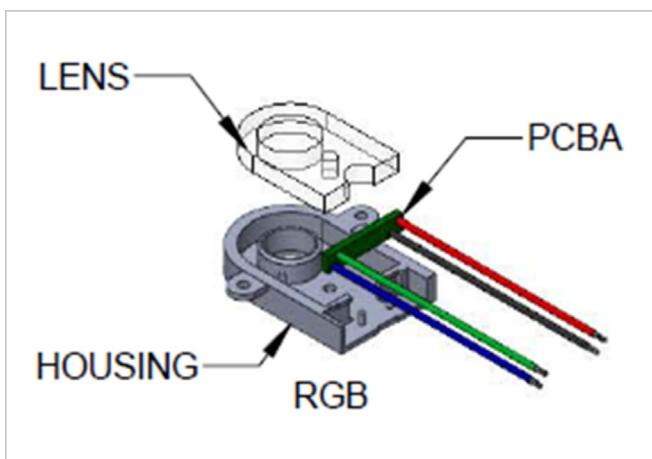

Figure 3: Bivar's LED light guides integrate the LED, lens, and PCB with microcontroller in a single housing. The large-area devices are available in multiple form factors, including annular (shown here), rectangular, and "bar graph."

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The Problem: Designing a System for a Harsh Environment

Light pipes can provide varying levels of ingress protection, all the way up to IP68. They can cushion the effects of shock and vibration, as well. Bivar offers ruggedized mounting systems with reinforced posts to resist jostling and bumping, whether that's in a vehicle or a soldier's backpack.

The Problem: An Obstacle Between the LED and the User Interface

Particularly with ultracompact mobile devices, the user interface may be on a different plane than the LED, or other components may block the path. Flexible light pipes can easily change angles or redirect around obstructions. Fiber-optic light pipes are ideal for longer distances. For shorter reaches or in spaces that require more maneuverability, Bivar's new UHF silicone light pipes offer exceptional pliability and transmissivity (see Figure 4). They are single-piece integrated designs with an IP67 rating.

Figure 4: Highly pliable silicone light pipes deliver high maneuverability for installations with circuitous paths or obstructed optical paths.

Tips for Success

The new class of integrated illumination tools can help realize distinctive visions or introduce intriguing new possibilities. Reach out to your vendors. At Bivar, for example, we have a catalog of more than 25,000 parts, many of which are highly configurable. If you need something else, our design team can develop a custom solution that is just right for your application. The key is starting early enough to make this possible. And if you start at the beginning of the design, with our integrated LED illumination tools and configurability you may discover that you can get what you want without any customization necessary.