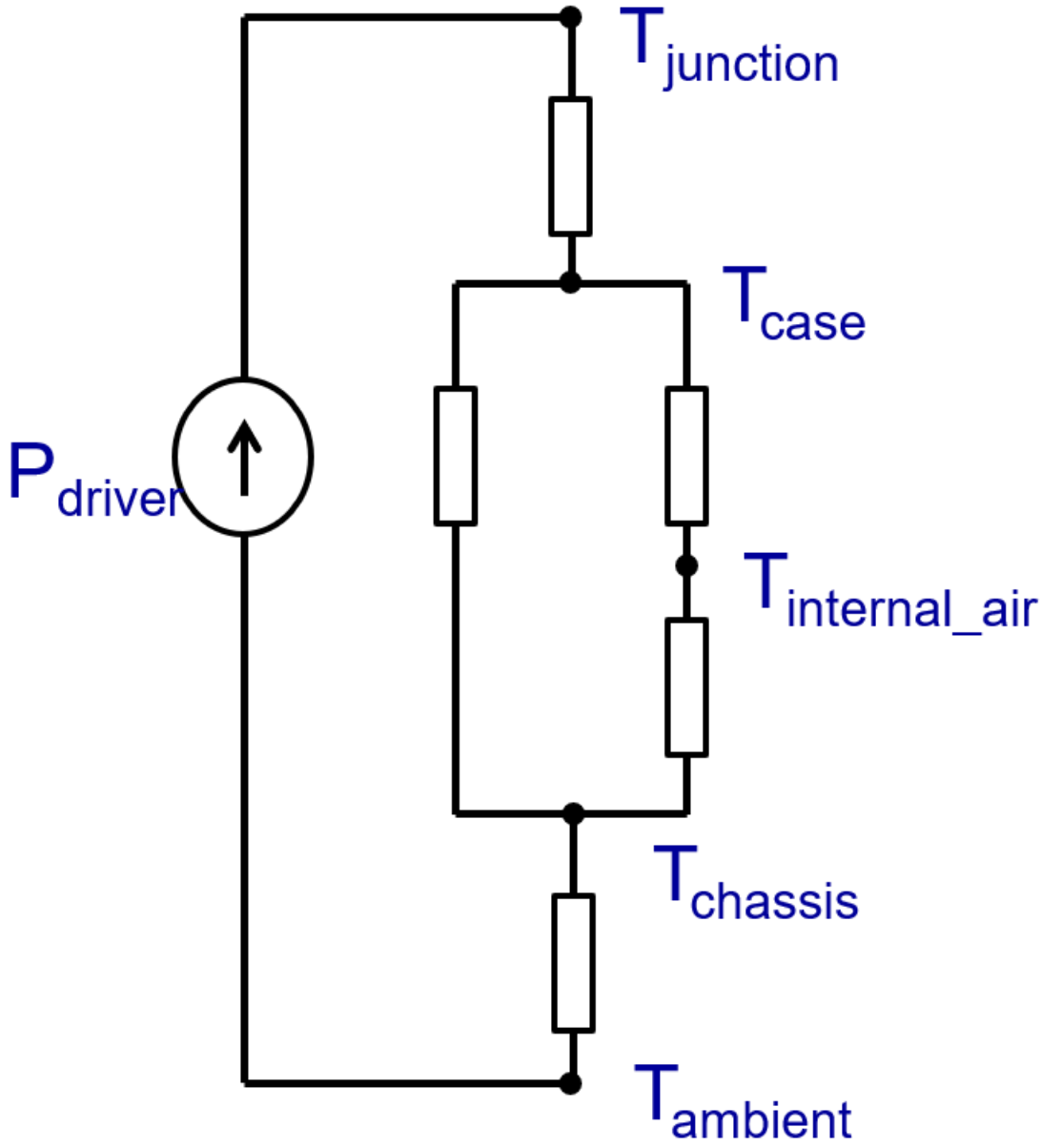

Thermal Management

Design Considerations for an Optimized System

INVENTRONICS

Why is Thermal Management Important?

Poor thermal management is one of the most significant issues seen in luminaire design. Many designs do not take into consideration both the driver thermal design and the luminaire thermal design which leads to poor performance for the system. Heat is ultimately what causes a driver to fail, in particular, the heating of electrolytic capacitors.

With proper thermal management, you can conduct dissipated heat outside the driver and transfer it to the luminaire case. This can enhance the lifetime and reliability of the entire system. In this white paper we will outline the different methods of removing heat, best installation practices and what Inventronics is doing to help address the problem.

How is Heat Removed?

Heat can be removed from the driver in three different ways: Convection, Radiation and Conduction. Convection is when air or liquid is heated and carries the thermal energy away from the source.

Radiation is generated from the emission of electromagnetic waves that carry the energy away from the source emitting the heat. Conduction transfers heat via direct molecular collision and is the most common form of heat transfer. See Figure 1 which demonstrates these different methods with an LED driver.

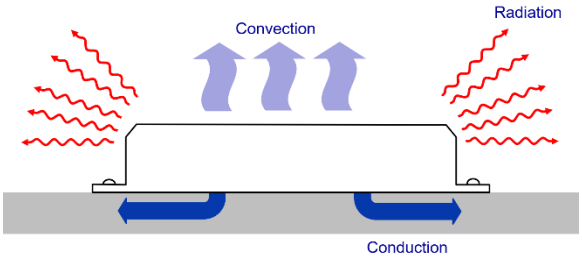

Figure 1: Examples of different methods of heat removal from the LED driver.

While convection, radiation and conduction all play a role in cooling the driver, in most applications, conduction is the primary form of cooling. This is due to the fact that the driver is typically enclosed inside a luminaire or housing where internal temperatures can be significantly higher than outside ambient temperatures.

Optimizing Driver Thermal Design:

Drivers that utilize a good, high grade potting compound will have a thermal conductivity 25-35 times better than air and 10-30% better than water.

Proper location of components and heat spreaders can also help to pull heat away from the junction of heat dissipating components.

Aluminum housing is also more effective than steel at conducting heat and helps to spread the heat more evenly over the entire surface of the driver.

A luminaire with great thermal design can support higher max ambient temperatures, whereas a luminaire using the same driver with poor thermal design will have a much lower max ambient temperature. Therefore, when comparing various drivers, it is important to measure the case temperature in the application.

Two drivers can both have a life of 50,000 hours at a Tcase of 60C° and yet yield very different results in the application due to efficiency and thermal design. A difference of 10C° can double the life of the product. See Figure 2 showing a thermal test conducted on two 150W drivers. The only difference is that the Inventronics driver is equipped with an aluminum enclosure, fins and a high-grade potting compound.

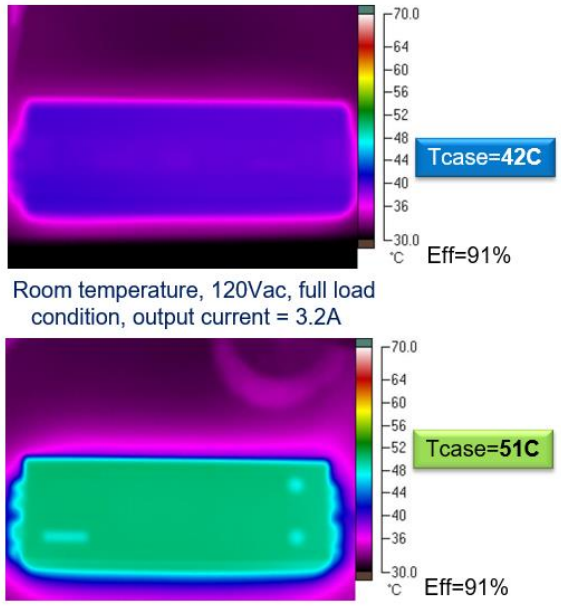

Figure 2: Thermal testing results between two 150W drivers with the same power dissipation.

Driver Installation Also Plays a Big Role:

There are many aspects to consider when developing a good thermal design. It is important to understand these aspects in both the driver and the fixture design to create an optimal thermal performance for a long-lasting product. A good driver case design can greatly reduce the thermal impedance from the case to the surrounding air and/or fixture chassis.

It is critical to have a thermally conductive path from the driver case to the fixture chassis to the outside ambient air. An optimized driver design can be easily negated by poor fixture design or installation. Standoffs are a prime example of how not to install the driver. By using standoffs, they replace a good thermal conduction path with dead air is trapped inside the luminaire housing. See Figure 3 which shows a 2mm gap leads to a 5.7 C° rise over ambient where a 10mm gap leads to a 13.33 C° rise over ambient.

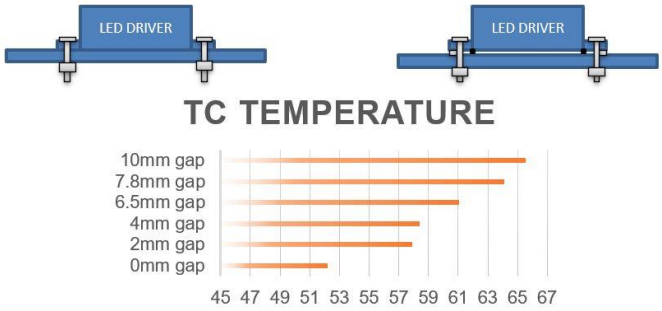

Figure 3: Results of a Standoff Test with 200 x 200 2mm thick aluminum plate at Ta 24 C°

The ultimate objective when installing the driver is to reduce the amount of heat the components are exposed to, enhancing the lifetime and reliability of the system. See Figure 4 showing a thermal design that conducts dissipated heat outside through the chassis to the outside air for optimal thermal performance.

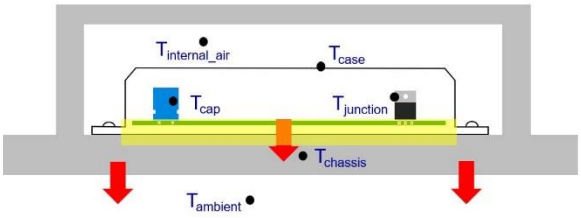

Figure 4: Conducting Dissipated Heat Outside the Fixture

The most ideal driver installation would include using thermal pads or grease to fill

any coplanar irregularities between the luminaire housing and driver body. The driver should be mounted flush with the luminaire to provide adequate heat sinking while also ensuring other sources of heat (usually the LEDs) are isolated from the driver. This prevents the driver from serving as the heat sink for the LEDs. Figure 5 illustrates these two mounting methods.

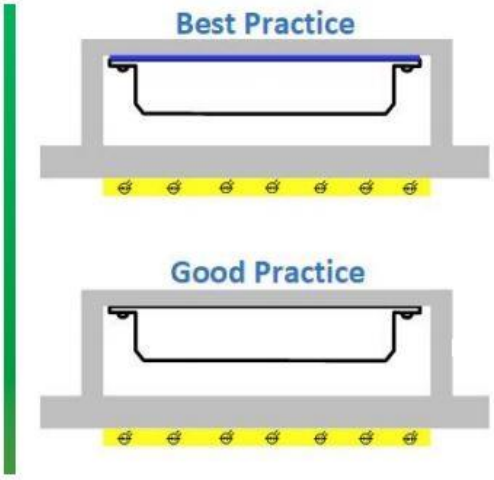

Figure 5: Recommended Driver Installation for Optimal Thermal Performance

To learn more on installation guidelines, please read our Installation Guidelines-Thermal Design User Instructions.

Thermal Design Summary:

Proper thermal management is critical to the luminaire design and greatly impacts driver success in the field. Inventronics designs our drivers for high efficiency which means there is less heat to move. We also reduce component exposure to dissipated heat through careful PCB layout so there is less heat building up in single, critical points.

Our aluminum metal housing and proprietary potting process allow us to move the heat effectively from inside the driver through to the outside world through good thermally conductive paths to provide optimal thermal performance.

However, having a driver with a good thermal design is not enough. Both the driver design and luminaire design should be considered to ensure the system runs smoothly and leads to longer lifetimes.

The luminaire's ability, or inability, to pull heat away from the driver will ultimately determine the life of the system. The fixture should be designed in a way that it is providing an effective cooling method to reduce the temperature inside the driver.

To learn more about thermal management and Inventronics drivers, please reach out to your local technical support or sales representative.

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Bobbie Grider is the marketing communications manager for Inventronics and is responsible for developing the company's marketing, advertising and public relations strategies for their broad portfolio of LED drivers and lighting accessories. Based in Oklahoma City, OK Grider manages the branding and messaging for Inventronics, a leading manufacturer of LED drivers for the solid-state lighting market. She has a bachelor's degree in journalism and business marketing. She has five years' experience in the power and lighting industry.

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