

TECHNICAL PAPER

Card Edge Connectors for Lighting Applications

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Abstract

For more than 50 years, the PCB edge connected circuit card has been a mainstay in both desktop and server computers. The traditional arrangement of backplanes and motherboards with numerous card edge slots allowed for configurability and expansion in a rapidly advancing industry. The natural result was an evolution of edge card connector technology focused on higher contact densities and improved electrical performance to try and maximize speed and throughput.



CARD EDGE CONNECTORS FOR LIGHTING APPLICATIONS

A NEW ERA FOR EDGE CONNECTORS

For more than 50 years, the PCB edge connected circuit card has been a mainstay in both desktop and server computers. The traditional arrangement of backplanes and motherboards with numerous card edge slots allowed for configurability and expansion in a rapidly advancing industry. The natural result was an evolution of edge card connector technology focused on higher contact densities and improved electrical performance to try and maximize speed and throughput.

More recently, card edge connectors have taken on a new role in the world of solid state lighting (SSL) as the LED has become the dominant source of efficient illumination. LED lighting can be split into two broad categories: traditional bulb replacements and variable length strips. The LEDs themselves are often mounted on specialized PCBs designed for heat dissipation (typically aluminum clad). Control and power supply electronics on a

traditional fiberglass PCB are mated to the LED section to form the completed luminaire. One of the most economical and reliable methods for mating these two boards turns out to be card edge connectors.

To meet the requirements of this new application space, KYOCERA AVX has developed new lines of edge card connectors with optimized contact solutions specifically tailored for LED lighting PCBs. These contacts use beryllium copper (BeCu) materials and are often stamped and formed to create the final contact geometry. BeCu has proven to be the best contact material on the market in stamped contacts, providing high spring force without yielding to elevated temperatures, a large contact deflection range, substantial insertion force tolerance, and long-term reliability.

PERPENDICULAR APPLICATIONS AND LED SOLUTIONS

When designing LED solutions for traditional bulb replacements, a complex power supply is often needed to handle AC to DC conversion and dimming. To easily conform to the shape of a standard light bulb, it is preferable to mount this power supply hardware perpendicular to the LED lighting module. This maximizes volumetric efficiency while eliminating any sources of shadow from the illumination PCB.

To meet this demand, KYOCERA AVX offers the 00-9159 Series single piece inverted through-board card edge connector, shown below. These connectors mate perpendicular PCBs to a top-mounted fiberglass or metal core PCB from the bottom side, and they are available in two to six positions. They also offer added design functionality, such as color selection or custom control lines.

The 9159 family features a gold-to-gold active contact mating interface to maximize the mechanical and environmental performance of the connector system. This series of connectors

provide a minimum of 10 mating cycles while supporting a UL rating of 2A per contact and 300V. Advantages that stamped and formed BeCu card edge connectors like these provide over conventional SMT card edge solutions include multiple position offerings, up to twice the position density and current capacity, higher voltage ratings, compatibility with several PCB thicknesses, higher



Figure 1: Vertical card edge 00-9159 family

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PERPENDICULAR APPLICATIONS AND LED SOLUTIONS

maximum operating temperatures, and improved electrical characteristics. Certain varieties also offer integrated safety caps to achieve up to 33

percent height reduction, making them less likely to interfere with light output, a primary concern in SSL designs.

COPLANAR APPLICATIONS

The advantages of LED lighting become increasingly prominent when the traditional bulb formfactor is abandoned. Freeform and strip based solutions have opened up entirely new markets for unique, highly effective luminaires. Many of these solutions still rely on modular LED boards, often connected to each other or to power supplies and controllers using edge contacts.

KYOCERA AVX's 9159 Board-to-Board interconnect system was designed specifically for this application, and it allows two PCBs to be mated end-to-end (also known as co-planar) creating strips of LED lighting. The 1-Piece Card Edge shown below provides a reliable, low cost, and simple means of connecting multiple PCBs together. The single-stamped contact has dual beams to guarantee a high contact force on standard 1.6mm PCBs. These connectors are available in 2 through 5 positions and on 2.0mm pitch centers to provide a 3-amp continuous rating.



Figure 2: 9159 single piece card edge connector

KYOCERA AVX was challenged with increasing the pin count density as well as minimizing the size of the existing coplanar BTB card edge connector for linear strip lighting. The current product is a 2.0mm and the two sides of the PCB sit or stand

to make electrical contact. By simply changing the contacts to a double-sided configuration (separate contacts for both the top and bottom of the PCB), KYOCERA AVX was able to double the pin count in the same 2.0mm pitch with minimal to no impact on the electrical performance of the connector.

Reducing the size of the connector required a completely new design as the target was a 4p connector with a total length of 4.0mm. To achieve this, KYOCERA AVX removed the end walls and added a center support/keying rib to pre-align the PCB during mating. This rib also holds the PCB in the proper functional location.

This new family of connectors shown below is available with contact sizes of 4, 6, 8 and 10 positions, doubling the current product range. The current rating is 3A for the 4p and 6p versions and 2.5A for the 8p and 10p connector. The connector supports the standard 1.6mm PCB thickness and provides the highest density to reliably connect two in-line PCBs together in the most cost-effective assembled solution. More importantly, the increased pin count allows for more flexibility in mixing and matching power and signal lines.

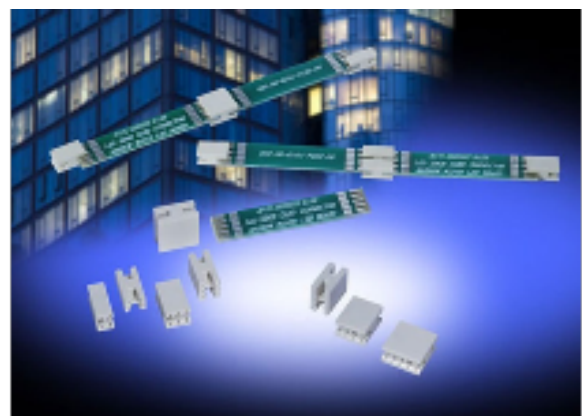


Figure 3: KYOCERA AVX's new high density card edge connector

CARD EDGE CONNECTORS FOR LIGHTING APPLICATIONS

LOWER COST LED SOLUTIONS

When cost is a primary concern for SSL applications, KYOCERA AVX offers a line of phosphor bronze contact materials that trade off a smaller deflection range. These contacts tend to use edge-stamped contact technologies instead of traditional cantilever beam technologies and do not require any secondary forming. Much more rigid than cantilever beam contacts, phosphor bronze edge-stamped contacts exhibit a high spring force with a lower spring deflection range, which requires tighter tolerance mating PCBs. In addition, due to their high force, the number of mating cycles for edge-stamped contacts is typically reduced to somewhere around five, or roughly half that of stamped and formed BeCu contacts.

Phosphor bronze contacts and edge-stamped technology are not new to the interconnect industry. Phosphor bronze is widely used in myriad applications, and edge-stamped technology has long been used in FFC/FPC and other card edge configurations. Due to the high/rigid force that these contacts provide, tin plating is often used as a lower cost alternative to the gold plating used for BeCu contacts. The key consideration in any tin-to-tin contact interface is the amount of force required to wipe the contact surface clean during the mating process and to maintain that force throughout the life of the product, which is

roughly three to 10 times the force required of a gold interface.

One example of card edge connectors that incorporate phosphor bronze contacts and edge-stamped technology is KYOCERA AVX's 70-9159 series of coplanar contacts, which are extensively employed in end-to-end strip lighting applications and shown below. The UL current ratings for this series ranges from 2.5 to 3A per contact and 300V depending on the density and pin count of the chosen connector.

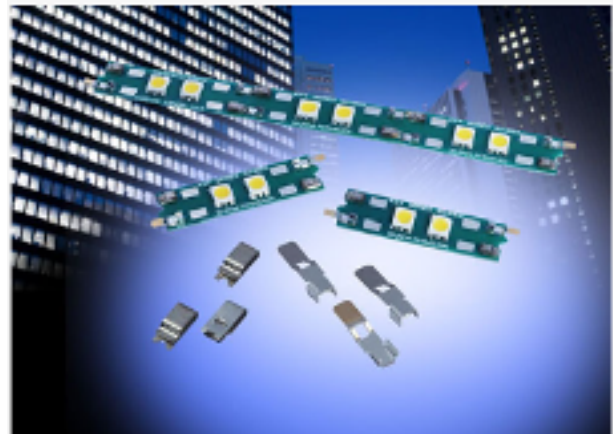


Figure 3: Phosphor bronze board edge connectors for lower cost

KYOCERA AVX: PROVIDING SIMPLE, RELIABLE, AFFORDABLE SOLUTIONS IN LED DESIGN

Although card edge connectors are one of the more historic connector technologies, their proven simplicity, reliability, and cost effectiveness has encouraged engineers to continually adopt them in modern electronics. Now broadly employed in SSL applications to connect the power and ground signals of LED-to-LED or driver-to-LED boards, a host of proven, reliable, and robust low pin count card edge connectors from a variety of manufacturers are readily available on the market. Standard product sizes typically range from 2p to 6p, and expanded sizes up to 10p, which are ideal for linear lighting applications, are also available from several manufacturers.

Further, card edge connectors suited for both

metal core and FR4 PCBs, which are growing in SSL popularity since newer LEDs consume less power and generate less heat for the same light output than they did even just a few years ago and are widely available as well. To learn more, visit: <https://www.kyocera-avx.com/products/connectors/board-to-board/>



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