A BIG PICTURE VIEW OF MINIATURIZATION IN TODAY'S DESIGNS

THE KEY TO SOLVING DESIGN CHALLENGES FOR TODAY'S CONNECTED TOOLS AND DEVICES

By: Jacky Hsu, Business Development Manager
Tom Morris, Field Application Engineer

The consumer's desire for smaller, more portable appliances and devices combined with the demand for smarter, more connected devices with enhanced functionalities leaves design engineers with complex challenges and additional needs for more innovation.

Air purifier with TE's Miniature FASTON receptacles and AMP CT connectors

Challenges include what functions to prioritize, how to design in all the components required, and how to find and choose smaller components without compromising reliability and performance. Solving this challenge requires "big picture" thinking from day one of the design process. Designers have to think about how much space they have on the PCB, as well as spacing through the design for all the required components. This is where using miniaturized components can allow greater efficiency of design without taking away performance. In addition, design engineers should consider who among their suppliers can provide reliable components as well as expertise that can help gain a technological advantage.

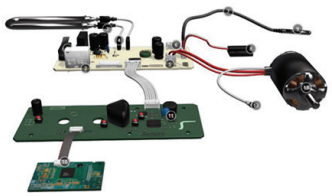
Health monitoring device with FPC connectors, spring finger contacts and heat shrink tubing

Design opportunities that stem from the miniaturization trend include adding greater functionality without using as much space on the PCB. Improvements around energy efficiency, cost-effectiveness, portability and other connected functionalities could also help increase consumer adoption.

Power tool with TE's magnet wire terminals

The Need for More Functionalities, More Components and Smaller Devices

Small, connected devices—like home security systems—require miniaturized components to be able to provide the functionality desired. Compact appliances such as robotic vacuum cleaners take time for consumers to adopt, but once they adapt, their expectations for functionality and efficiency keep growing. In addition to standard vacuum functions, robotic vacuums can have advanced features like navigation, room mapping, timed cleaning, self-emptying.



Standard PCB subsystems with miniaturized solutions from TE

More functions require more components and often higher functional density, leaving designers to fit additional components into a smaller space. Designers are typically already working in a limited space, miniature components are key to achieving a smaller design. The same principle is true in smart coffeemakers, rice cookers, lawn and garden tools, and other compact connected devices.

Even larger appliances require miniaturized components. For example, in air conditioners and refrigerators, increasing energy efficiency is important—for consumers and, in some cases, to comply with regulations. To accomplish this, heat exchangers and other major components have become bigger, while space available on the main control board is becoming smaller.

It is important to select the right components early in the design process to ensure these components will perform reliably with the other electronics in the system. With this requirement in mind, it is critical to support early involvement with choosing and prioritizing what components will be used to support the function of systems to work together as integrated solutions, and determine how much space will be available on the PCB to accommodate the entire design.

In addition to thinking about the entire design and functionality, design engineers need to consider assembly—ergonomics and ease of assembly. Thinner and more complex PCBs and cable assemblies can be difficult and slow to assemble. It is important to choose connectors and other components that require low insertion force and have anti-snag or anti-mismatch features.

Trends That are Changing Device Designs

These new trends in functionality and miniaturization are driving changes in appliance and device design and will continue to shape the way engineers design devices in the future:

- Surface Mounted Technology (SMT) and miniaturization go hand-in-hand, with smaller, lighter weight components being able to be mounted closer together on the PCB than through-hole components, saving significant space. Being mounted to the PCB also allows for automated processing and high assembly density.

- Multilayer PCBs (instead of two-layer) offer high speed and high capacity in a smaller footprint, reducing weight and simplifying design. With three or more layers of conductive material, multilayer PCBs offer a greater degree of functionality without adding to PCB thickness. Additionally,the high assembly density helps extend the life of the PCB.

- Integrated interfaces: Multiple power and signal interfaces can present challenges to the PCB design and manufacturing process. Typically, different connectors are used to send power and signal to each module. Integrated interfaces can reduce the amount of connections needed and, in the future, we may only need one or two integrated interfaces to accomplish this power and signal transfer within each module.

- Increasing functionalities: Engineers are designing more features into devices, resulting in a higher density of subsystems, such as sensing systems and touch screens.

Adding Perspective to Get The Full Picture

With today's complex connected appliances, and especially designing for future technology and consumer needs, working alone can make it difficult to optimize the design from the start. OEMs that want an advantage in technology and innovation should look to partner with some of their suppliers to overcome design challenges and innovate together.

TE's Miniaturized Components for Connected Devices

2mm Signal GRACE INERTIA Connector:

Our miniature design utilizes IDC technology to help lower applied costs

Sealed Signal Double Lock Connector:

Provides IP67 rated water and dust protection in a miniaturized space saving design

Mini MAG-MATE Magnet Wire Terminals:

Terminate some of the smallest diameters of cooper wire utilizing IDC technology to maximize manufacturing efficiency

250 Series Miniature FASTON Receptacles:

Offer a miniature and ergonomically-friend design for use in applications with limited space for electrical connections

OJT TV-8 Relay:

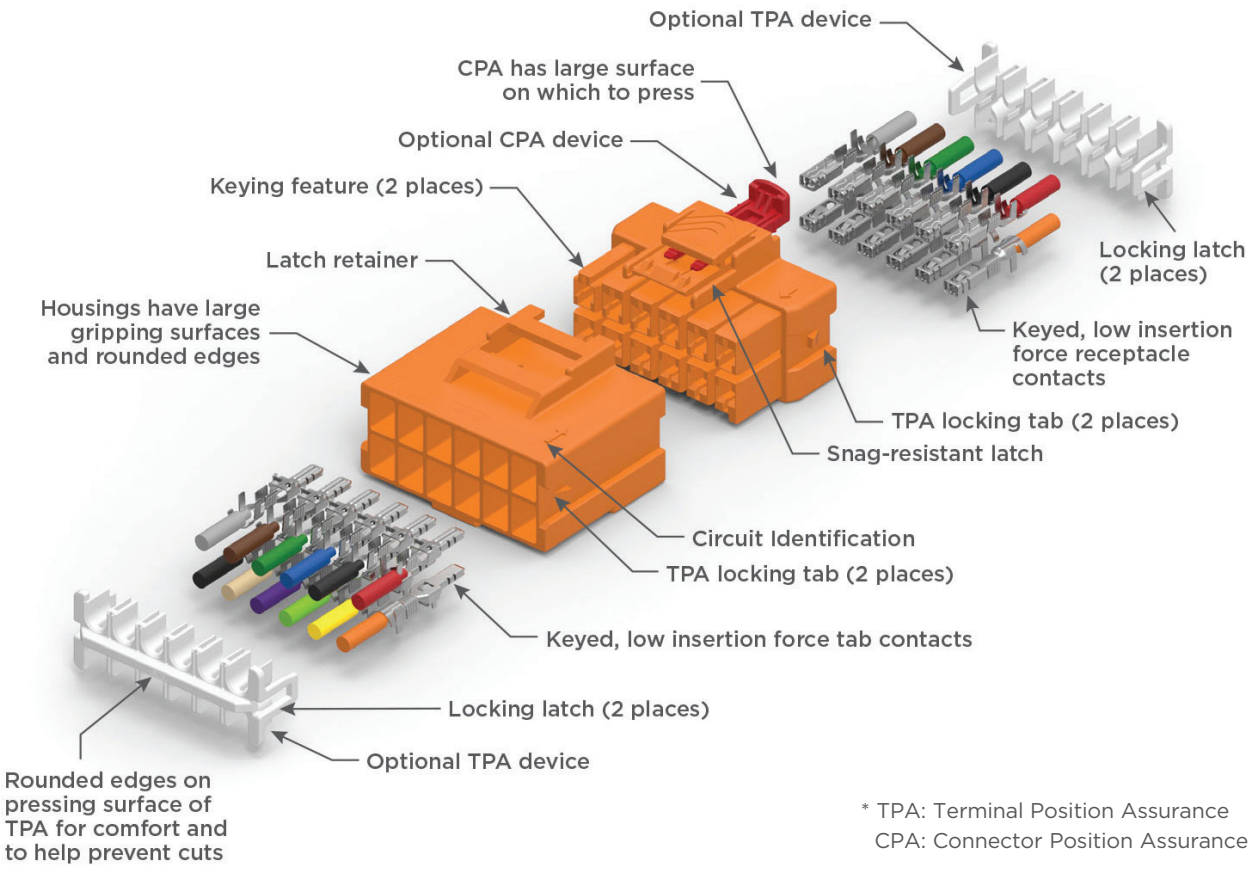
40% smaller in size compared to similarly rated relays, offering a miniature design that can withstand up to 117A of inrush current

Component manufacturers can often be more than just suppliers—partnering in design early on to streamline the PCB, maximize data power and signal while increasing energy efficiency, set up the design for easy assembly, and more. Component selection becomes easier when the experts on that component design and performance can weigh in on function and reliability, suggesting parts that work well together. For example, TE Connectivity (TE) understands the challenges and opportunities involved in connected device design because we design components and integrated solutions specifically for miniaturization trends, across industries.

Instead of searching through an online catalog of parts, reading the specs and hoping choose the ideal component for your needs, the component manufacturer can tell exactly what parts would work best for the functions desired. When the conversation is broadened to include component engineers early in your design, they can help choose the optimal part not only for that one function but for the entire design architecture. Additionally, they can give insight into how a line of parts or an integrated solution may free up available space, improve performance and reliability, and enhance your overall design.

The TE Advantage

TE is an industrial technology leader and an ideal partner for miniaturization in device design. Whether you need a power connector with a smaller footprint or ergonomic connectors that improve assembly efficiency, TE has the products you need to create more efficient and reliable appliances, tools and devices. If you are designing a smart coffeemaker or robotic vacuum cleaner, surface-mounted resistors with silver conductive edges on either end provide the same functionality as traditional axially leaded resistors but with a lower power dissipation capacity and, typically, a lower stray inductance and capacity.



* TPA: Terminal Position Assurance
CPA: Connector Position Assurance

(Image: Ergonomic features of a typical TE connector)

A Big Picture View of Miniaturization in Today's Designs

TE's portfolio is full of small pitch and low-profile products that are durable and reliable in harsh environment applications. To ease assembly, many of TE's solutions for compact designs have features such as anti-mismatching, keying, low insertion force, anti-snag design, and TPA. Our FASTON quick connects—offering speed of application, uniform reliability and low per-line cost—are an industry leader in the appliance and automotive industries. The product line now includes an expanded range of low insertion force terminals, high-temperature terminals and low-profile terminals.

TE's engineers are well-versed in application analysis and termination technology and have the benefit of extensive cross-industry experience to draw from for innovation. We are committed to meeting our customers' needs and delivering quality products, as well as identifying opportunities for more efficiencies, cost savings and innovations in design. Finding ways to solve customer design challenges while maintaining or increasing reliability and performance in harsh environments is just one of the ways TE lives up to its purpose of creating a safer, sustainable, productive and connected future.

CONNECT WITH US

We make it easy to connect with our experts and are ready to provide all the support you need. Visit **www.te.com/support** to chat with our Solutions Center.

4-1773983-4 05/20

TRENDPAPER

TE Connectivity
Appliances

te.com/Appliance

www.te.com