Interplex

Press Fit Tech Bulletin

Press-Fit Current Carrying Capacity Part 1: Application Requirements

This is the first in a series of three Tech Bulletins that will focus on the current carrying capacity for Press-Fit applications. The specific three topics in this series are:

- Application requirements for higher current capabilities
- Current capability testing and results
- Special design considerations for power module applications

This Tech Bulletin addresses the first of these areas: Application Requirements

Driven by the explosive growth of automotive electrical systems and many other industries using inverter and converter based power modules, press-fit technologies have become the preferred alternative for delivering highly reliable, solderless interconnect solutions.

Automotive Applications

Press-fit components have already been qualified for use in a wide range of automotive applications across the full spectrum of operating conditions, from under-hood, engine-mounted deployments to inside the passenger cab. Driven by the industry's accelerating movement toward "electrification" of virtually all automotive applications, the use of press-fit interconnects is also ramping up rapidly.

Systems such as regenerative braking, electrical-assisted braking, power-pumps and servo-driven steering assistance are just a few examples of areas where press-fit interconnect technology is already playing a key role. As the industry continues to evolve and gas engines are replaced by hybrid systems, electric engines and battery arrays, these various electrical sub-systems throughout the car will ultimately be integrated within the overall plug-in electrical vehicle.

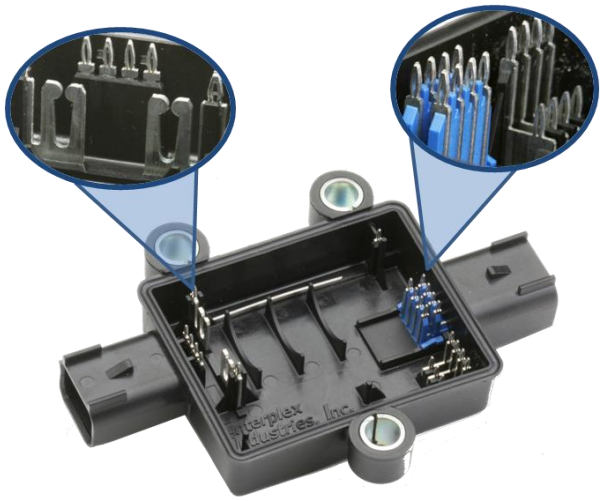

Figure 1 – Automotive Module with Press-Fit Interconnects

The on-going electrification of automobile systems requires higher current levels and the successful vehicle-wide integration of these advanced applications requires efficient voltage and current conversion mechanisms to support various subsystems. In addition, the need for sustained reliability across a broad range of operating temperatures and environmental conditions means that interconnects in automotive applications must meet very rigorous specifications.

For example, on a cold winter day, going from engine start-up to standard running temperatures could potentially require an under-hood engine-mounted electrical sub-system to go from 0º C to 150º C in less than ten minutes. A complex electrical sub-system consisting of diverse components, FR4 PCBs, metal or plastic mounting frames, heat-sinks, and enclosures typically involves a wide range of thermal coefficient of expansion (CTE) characteristics, which can be especially problematic because these systems must endure hundreds or even thousands of repeated thermal cycling during normal usage over the life of the vehicle. Conventional solder connections can add risk as a primary point-of-failure because the repeated stresses from CTE mismatches eventually cause cracks or breakage at the solder joint. Press-fit technology with its residual spring solderless connection provides an inherently reliable interface that flexes during thermal cycling without degrading the current carrying capabilities or incurring any long-term damage.

Driving the Evolution of Hybrid and Electrical based Power Systems

The electrification of automobiles is evolving in stages. The first stage has entailed many of the subsystems, including brakes, steering, etc., followed by the main systems such as batteries, inverters, controllers, etc. In most cases, large temporary power storage devices such as capacitors and conditioning components such as toroids need to interface with inverters, converters and the associated connectors in complex control circuits.

These complex control circuits typically contain many SMT components and are assembled on SMT production lines. As these control circuits are combined with the larger power components and connectors within an environmentally sealed package, designing to accommodate thermal dissipation and CTE mismatches often presents significant challenges. Creating press-fit solderless interfaces with higher current capacity for use with the larger components makes final assembly easier and also improves reliability. By using press-fit solderless interconnects, these devices can be picked and inserted along with other odd-form components without requiring any special processes or necessitating a subsequent soldering step. This avoids exposing the components on the populated assembly to an additional heating step and also eliminates the challenges of secondary soldering of a module that typically includes a large heat sink.

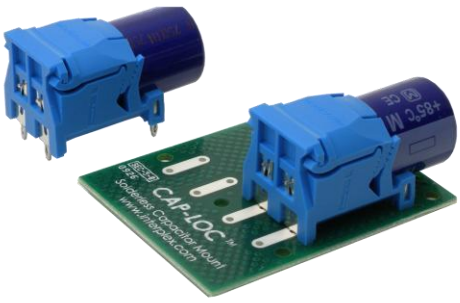

Figure 2 – Capacitor with press-fit interface for solderless mounting

As an outgrowth of responding to automotive industry requirements, power module manufacturers are also leveraging the evolution of these new modules with various solderless press-fit interconnect designs to introduce next-generation DC/AC inverters and DC/DC converters with high-reliability, plug-and-play capabilities for other market segments, such as communications, utilities, solar & wind power systems, automation/industrial computing, military systems, etc.

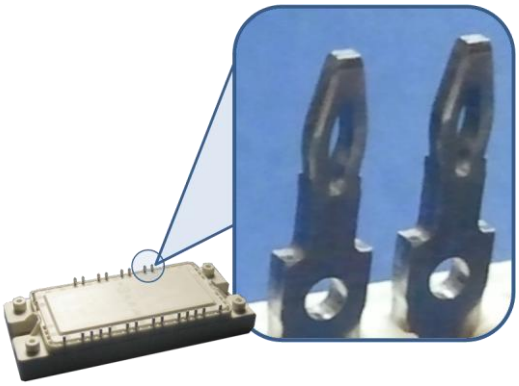

Figure 3 –Press-fit in a Power Module

Press-Fit Provides High-current Carrying Capabilities and Solderless Assembly

To support the explosive growth in the automotive industry, along with new applications in the power device and module industry, solderless press-fit interconnects are being designed and tested to carry much higher current levels than was typically considered feasible in the past.

Whereas the previous current carrying assumptions for press-fit devices was usually considered to be in the 3 to 4 amp range for 0.64mm pins and 8 to 12 amp range for 0.80mm pins, further design refinement and testing has demonstrated reliable high-current capacities of 20 to 30 amps and more.

The next Interplex Press-Fit Technology Bulletin (part 2 in this series) provides details on high-current testing set-up and methods, along with specific test results for a range of press-fit designs using a variety of alloys and PCB specifications.

These results demonstrate the capability of press-fit interconnects to provide high conductivity and current carrying capacities of 30 amps or more through a single press-fit eye, as well as the ability to maintain reliable and predicable current carrying performance curves across a range of operating temperatures including 125ºC to 150ºC and above.

More information regarding Press-Fit technologies and products can be found on the web by visiting www.interplex.com/pressfit or by calling (718) 961-6212.