Interplex

Press Fit Tech Bulletin

Enabling Next-Gen Power Applications With Improved Packaging Efficiency

Electrification and Power Conversion Requirements for Automotive, Transportation and Green-Power Markets Are Driving New Approaches to Power Interconnects and Packaging

Growth in the electrification of automobiles, transportation systems and green-power applications has given rise to a whole new set of challenges in the design and packaging of power conversion and power management devices.

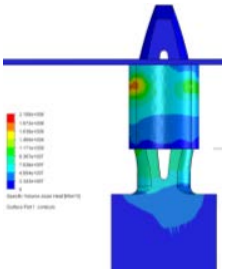
This Tech Bulletin focuses on how high force solder-free technology can provide an effective method for interconnecting power stack assemblies, which helps improve efficiency and streamlines assembly.

Wire Bond to Press-fit Power Module

Topics addressed in this Tech Bulletin include:

- Overview of High-Force Solder-free Technology
- Past Approaches to Power Module Interconnects and Packaging
- Trends toward eliminating solder and simplifying interconnect methods
- Application benefits of using High-Force Press-Fit Interconnects

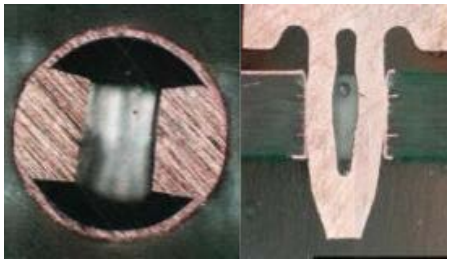
Overview of High-Force Solder-Free Technology



Joule Heating in PCB hole Current Simulation

High-Force compliant press-fit technology is a proven solution for creating high power reliable electro-mechanical interconnects without using solder. Performance testing has demonstrated that press-fit pins satisfy stringent operational requirements as defined by IEC, EIA and SAE specifications and they have been qualified to 150° C temperatures. Depending on the pin configuration, these solder-free interconnects can provide retention force up to just over to 22lbs.
Key advantages include:

- More efficient than solder in power connections
- Ability to conduct high current
- Direct connect to PCB hole allows for effective heat and current transfer
- Remains compliant to compensate for CTE mismatch between subassemblies
- Solder free and pluggable no heat needed for assembly
- Compatible with controlled and automated assembly methods



Direct Connect to PCB hole (no solder voids)

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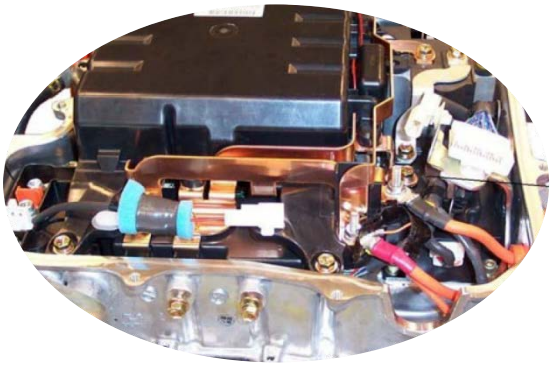
Past Approaches to Power Module Interconnects and Packaging
The basic functionality of power conversion from battery (DC) sources to AC output has been around for many years. However, until recently, traditional power module designs have not been constrained by stringent demands to reduce size and weight while simultaneously improving efficiency.

Therefore, conventional designs have focused less on tightly integrating functionality, with most design approaches consisting of multiple discrete assemblies such as:

- Power DBC
- Capacitor Module
- Control PCB
- Multiple Bus Assemblies

These were connected by a variety of methods including:

- Numerous wire-bonds
- Bolts
- Bus structures
- Harnesses
- Connectors
- Solder-joints

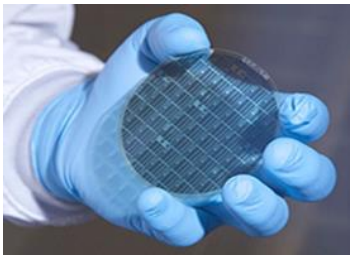


Power Inverter Assembly
2004 Prius

The result was typically large, bulky and heavy power devices that exhibited high inductance and relatively low efficiency – all at a fairly high cost.

Driving Forces for Simplifying Interconnects and Eliminating Solder
With exponential growth of new electrification applications and expanding range of demands, the old approaches to power conversion and power management are no longer adequate to keep pace. *Reducing size and improving power efficiency have now become critical factors for success.*

At the chip level, advances such as the move from silicon to GaN and SiC are increasing overall power densities and enabling faster switching speeds. These chip advancements provide increased efficiencies in power conversation but those efficiency gains can be degraded without careful attention and upgrades to the interconnects and packaging.



RFMD GaN 3" wafer

New-generation high power chips require more efficient connections to the surrounding subsystems with the shortest possible current paths and the smallest number of interconnections to optimize overall efficiencies.

In essence, power module design is becoming more of a systems integration challenge, with the need to efficiently interconnect multiple discrete power units together. This means that engineering the electrical connections and packaging has become critical for achieving optimal results.

New-generation power device design is moving toward an increased emphasis on tight integration from the chip level all the way up through subassemblies and the module level. The ideal approach is to leverage interconnect methods that enable subassemblies at each level to become seamlessly pluggable and integral elements of the overall assembly.

In effect, this allows designers to downsize the traditionally inefficient interconnect methods into a more integrated foundation for the overall module. This literally changes the approach from a bolt-on cumbersome attachment of interconnects to making them an embedded part of the core design.

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Application Benefits from High-Force Solder-Free Technology
To support this transition toward more efficient and adaptable interconnect technologies for power module implementation, the industry is turning to high-force, functionally compliant technology.

Some of the key reasons include:

- Direct connect from power circuit to busbar, eliminating some bolt and nut assemblies
- Shorter current paths - Lower overall inductance
- Reduced assembly size, stack heights and interconnect spacing
- Easy integration of power and control circuits, busbars & boards and power capacitors
- Proven, reliable solder-free assembly with controlled monitoring assembly methods
- Low contact resistance interconnects that are repeatable, consistent, strong and reliable
- No high current hot spots due to low quality solder joints, fillers and voids
- High normal force interconnect = good electrical and thermal transfer
- Flexible interconnect - allowing for movement to cyclical CTE mismatch

In addition to eliminating conventional cabling, bolts and specialty connectors, this evolution of power interconnects is effectively eliminating the need for solder joints and the inherent problems of soldering..

Getting rid of solder not only has the advantage of streamlining assembly and integration of subsystems; it also eliminates a common point of failure for power products with inherently high temperatures and CTE mismatch characteristics.

In addition, the configurability of press-fit technology enables interconnect to be implemented directly as part of other elements in the design, such as lead-frames, bus-bars, module housings, etc. Designers thus gain much more flexibility for making interconnects a fundamental part of their overall power module architecture.

Summary
This Tech Bulletin has offered an overview of how high-force, high-current, functionally compliant, press-fit technology can enable new-generation power module implementations.

Other tech bulletins in this series focus on specific implementation scenarios, including:

- Methods for termination off DBC utilizing high force pluggable Press-fit technology
  - Wire Bond off DBC to press-fit Interconnect
  - Flexible surface mount to DBC with press-fit interconnect (Flex-Fit)
  - Direct lead bond to DBC with press-fit termination to bus structure
- Using high force press-fit for direct termination to copper bus bars
- Integrating a shunt current sensor to bus with press-fit terminations
- Using Press-fit termination on Capacitors to create pluggable capacitor bus assemblies
- Using press-fit in combination with IDC for power applications
- Assuring high-current carrying capacity with press-fit power interconnects

More information regarding new and emerging power management technologies and products can be found on the web by visiting www.interplex.com or by calling (718) 961-6212.

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