

Advances in Discrete Wire-to-Board Technology

Although numerous, wire-to-board (WTB) connectors are still basic and can fail to meet cross-market demand for smaller, lighter, more versatile, and more affordable solutions. By Tom Anderson, AVX

Many new connectors today lack the innovation needed to meet the needs of design engineers. In 2012, a team of experts at a leading global connector manufacturer collaborated to design and build a WTB connector system that could satisfy the size, cost, and configuration requirements faced by today's electronic design engineers. Markedly different from existing products, the innovative solution is, technically speaking, not even a connector.

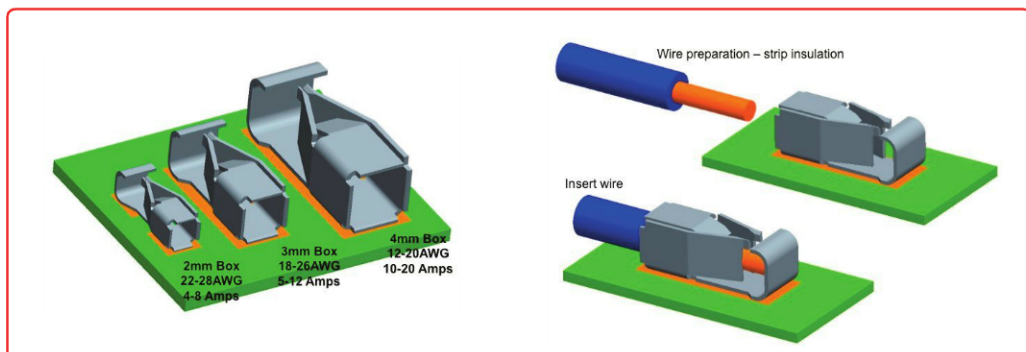
Existing connectors are comprised of two components: a contact system and an insulator. The contact system is the heart of a connector; the insulator, a plastic component that provides protection and support — but it also adds cost.

The insulator provided the team with a perfect opportunity to significantly reduce the size and cost of the connector without compromising electrical or mechanical performance. All they had to do was create a contact capable of satisfying all of the performance requirements of standard

connectors with regard to robustness, reliability, simplicity, and ease of use in an unprotected, insulator-less environment.

To create a contact capable of robust, reliable performance in an unprotected environment, the team examined traditional discrete wire-to-board applications, identified the design considerations and concerns that could be solved with this new technology, and determined that individual contacts could offer three primary benefits. They could replace the hard soldering of wires to a PCB, which, although cost-effective, requires additional labor costs and is not a repeatable manufacturing process. They could replace traditional two-piece connector systems, enabling reductions in both cost and component count. And, they could also replace traditional terminal block style connectors, enabling: mix-and-match contact selection and placement based on AWG, current, and voltage specifications; pick-and-place SMT automated processing; and increased ease of use, insertion, and removal.

Wire termination for AVX's novel 9296 Series contacts is as simple as stripping the insulation and inserting into the contact



Three critical design parameters needed to be met in order to achieve a cost-effective contact capable of unprotected performance in harsh environment WTB applications: function, size, and manufacturability. First and foremost, the new contact must provide simple, robust, and reliable termination of either stranded or solid wires to a PCB. Second, the size of the contact had to remain minimal to enable widespread application. Third, the contact must be able to be manufactured economically so that the cost savings realised by the redesign could be passed onto the consumer.

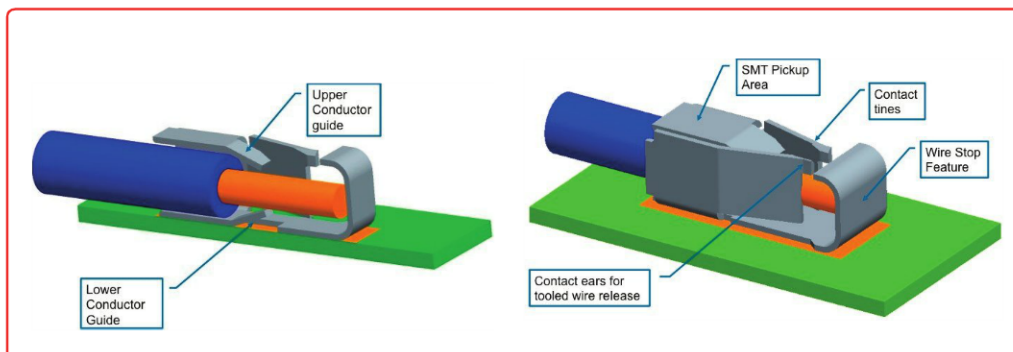
To be practical, the new contact had to accommodate wire sizes ranging from 12AWG down to 28AWG, which was accomplished by designing three analogous contacts with distinct sizes and mechanical limits. To achieve the required electrical performance and meet the mechanical targets for strength of termination, each contact has to connect with and securely constrain the wire, so the range of AWG for each contact is dictated by the mechanical capabilities of each contact. To further expand the functionality of each of the three contacts, the design team deliberately overlapped the wire sizes between contacts as much as possible.

The primary considerations for materials selection are performance and price. Beryllium Copper (BeCu) materials provide superior strength and long lasting fatigue performance, but are

relatively expensive. Instead, the team selected a high performance copper alloy material, which doesn't provide quite the same level of performance as BeCu, but nevertheless exhibits both robust performance and long term reliability while addressing the critical cost issue.

The closed box contact design provides a guided, four-sided aperture for the wire to be inserted into and takes up the smallest area possible on the PCB. The top and bottom tines guide the wire into the centre target zone of the right and left contact beams; the lower box section provides a suitable flat area for soldering, ensuring maximum mechanical attachment to the PCB; and the top side features a vacuum nozzle pick up area, allowing contacts to be pulled out of the tape and reel packaging during an automated placement process.

By reimagining physical attributes and performance characteristics, a team of connector experts succeeded in developing an innovative contact technology capable of satisfying the cross-market demands for smaller, lighter, more versatile, and more affordable end products. This new, insulator-less contact system is robust, reliable, and easy-to-use; provides simple wire insertion and removal across a broad wire range spectrum; can survive harsh environments unprotected; and has markedly redefined WTB connectors. ❖



The integral contact tines of the 9296 Series guide the wire directly into the middle of the contact zone