Expanding Ultrasonic Applications In EV's

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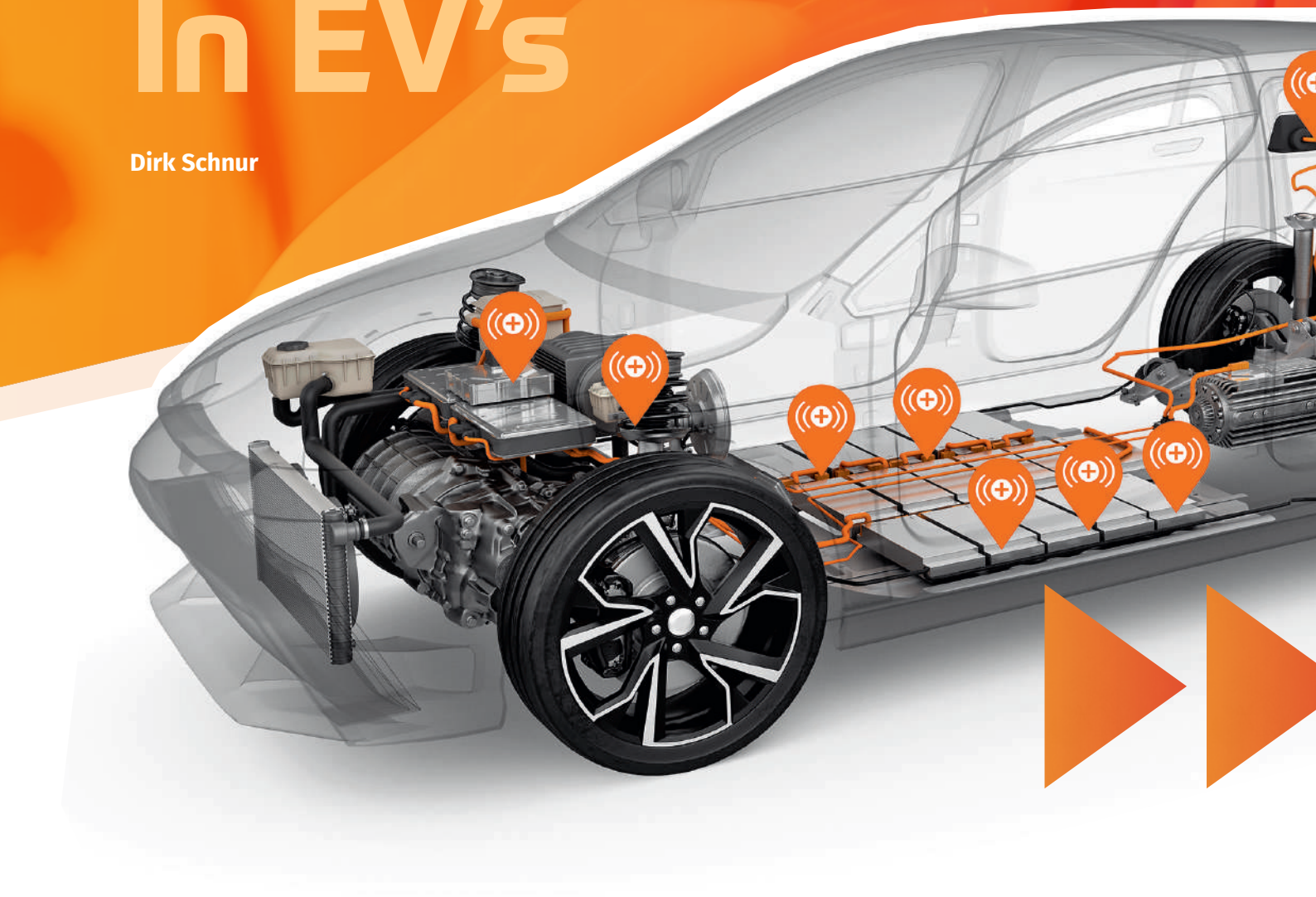


Electromobility is now regarded as the key to climate-friendly driving practices due to the fact that electric vehicles generate significantly less carbon dioxide per kilometre than vehicles with conventional combustion engines – especially in combination with electricity generated from renewable sources. At the same time, the energy storage systems used by electric vehicles can compensate for fluctuations in the electricity grid by means of wind and solar power, thereby supporting the expansion and market integration of these energy sources.

This presents new challenges for the automotive industry and need to be addressed in an innovative manner. This also applies to the manufacturing technologies that are required for all aspects of electromobility, from lightweight body construction to the electrical and electronic components and battery production. Processes that use ultrasonics open interesting possibilities relating to quality and also from an economic and ecological point of view. Ultrasonic- based processes and electric vehicles have much in common: Efficiency, performance capability, reliability, connectivity, and eco-friendliness are among the essential characteristics that they both share.

The objective of this article is to introduce some of the breakthroughs in automotive wire harness and battery manufacturing for both internal combustion engine vehicles and EV's. The TELSOCAR image defines challenging applications with solutions that have now been implemented in manufacturing of high voltage terminations and batteries. We highlight metal welding applications of Telsonic's PowerWheel® and SONIQTWIST® technology in this article as a general introduction, with more joining applications to be introduced later in future articles.

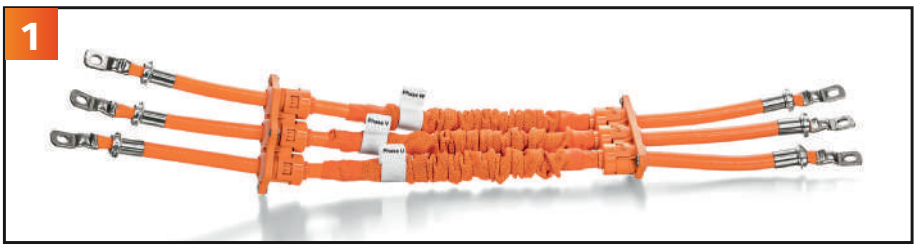
Ultrasonic welding technology is a proven joining process that is increasingly being specified by carmakers for use in EV for cable to terminal connections, bus bars, battery manufacturing and power electronics. The automotive wire harness manufacturing industry has traditionally been the single largest user of ultrasonic welding, mostly splicing of wires, since the late 1980's. Linear welding is the more common technique, known and used by all equipment manufacturers, and a standard process for splicing of wires. However, like many other joining processes, there are limitations in size, welding in smaller areas, geometrical shapes, orientation of welding, and vibration effects on peripheral components.

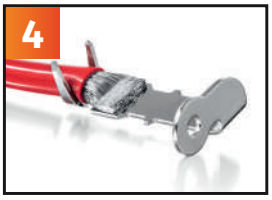
Torsional Metal Welding Technologies

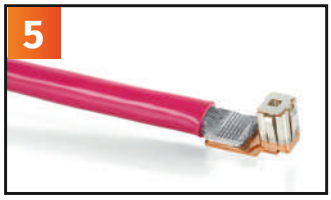
Telsonic Torsional PowerWheel and SONIQTWIST technology have created innovative solutions for EV joining applications, that were otherwise impossible. Torsional technology allows larger weld sizes, produces gentle vibrations, and makes it possible to perform welds in difficult to reach areas. These characteristics have significantly expanded the spectrum of ultrasonic applications. These innovative techniques allow many joining applications that were previously impossible using Linear welding as we know it. These torsional technologies opened the door to new designs of components as well as new manufacturing methods, never possible in the past. In fact, this technology is sometimes found to be the only solution for electric car battery manufacturers, and in the termination of high-voltage cables. Other examples where torsional ultrasonic welding proves to be the superior method are bus bars, 3D terminals and integrated gate bipolar transistors (IGBT).

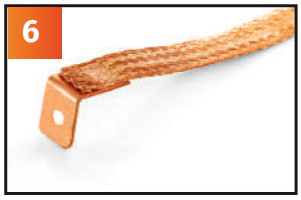
PowerWheel welding technology application overview for stranded wire on terminals

Illustrated here are some specific applications and challenges for ultrasonic welding of stranded wires on terminals:









1. High voltage cable set with tubular cable lugs - Welding is proven to work using PowerWheel.

2. Shielded cables - Larger cables up to 200 mm² in a smaller weld area is possible when there are restrictions on surface area of the connector.

3. Short cables welded on both sides - Welding both ends of a short cable using Linear welding could potentially allow the vibration from the second weld to break the first weld. Torsional welding has a much-reduced vibration affect and therefore, making welding of cables as short as 4 Inches possible.

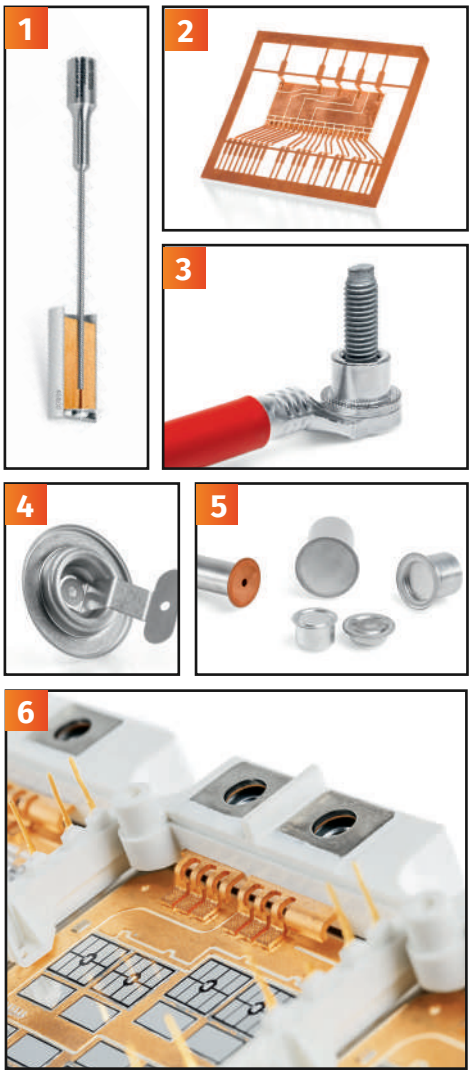
4. 3D terminal – in this situation, PowerWheel offers the advantage of better access to the weld area.

5. High power lock box terminals with Al cable - The Royal Power Solutions terminal, SQ4, in this case is about 17 mm high. PowerWheel® is the method used to access the weld area.

6. Terminal to stranded braided cord - Braided wires have very fine strands which could be damaged were it not for the gentle vibrations from the Torsional process. IGBTs (insulated gate bipolar transistors) are designed for high voltage switching applications. Due to their high efficiency and reliability, they are the perfect match for (plug-in) hybrid vehicles and electric cars.

SONIQTWIST welding technology application overview for metal components

We have also detailed here some specific applications and challenges for ultrasonic welding of electrical components:



1. Ultrasonic welding pole - The application requires welding to take place at the bottom of the cylindrical cell through the jelly roll, so the ultrasonic welding tool has to have a long reach.

2. Stator welding of magnet wires - Reaching inside this IGBT* is much easier with TSP equipment. The gentle vibration allows more consistent welds without damaging the ceramics.

3. Connection bolt on current conductor - This is a 360° weld around the bolt that requires a recess on the ultrasonic tool. Connecting the bolt on the connector conductor made it possible to realise a significant manufacturing cost reduction.

4. Battery cap welding - The space is limited as the film-style electrical conductor must be welded into an embossed channel in the battery cap.

5. Hermetic seals on cylindrical cans - Hermetic seal in the circular shape for applications such as airbag sensors.

6. Electrical connection on IGBT - The Cu-plated ceramic printed assembly board in IGBT modules for welding the conductor. The gentle vibrations allow more consistent welds without damaging the ceramics. The process is also very forgiving on the fine wire bonds on the DBC.

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