



SOLDERLESS MAGNET WIRE SOLUTIONS FOR ELECTRIC BICYCLE MOTORS

With increased focus on a more sustainable future, industries around the world are scaling up production of energy efficient, low carbon footprint technologies and they require electrical components that can keep pace with this growth. One bottleneck in the push for more efficient electric motor manufacturing is the limitation of magnet wire soldering and welding processes. These processes can be time-consuming, costly and difficult.

SOLDERING AND WELDING CHALLENGES

Workspace Constraints

Soldering or welding small diameter wire in tight spaces can make it difficult to avoid bridging connections or overheating sensitive components.

Insulation Removal

Removing the thin layer of enamel insulation without damaging the wire requires time-consuming precision and care.

Joint Reliability

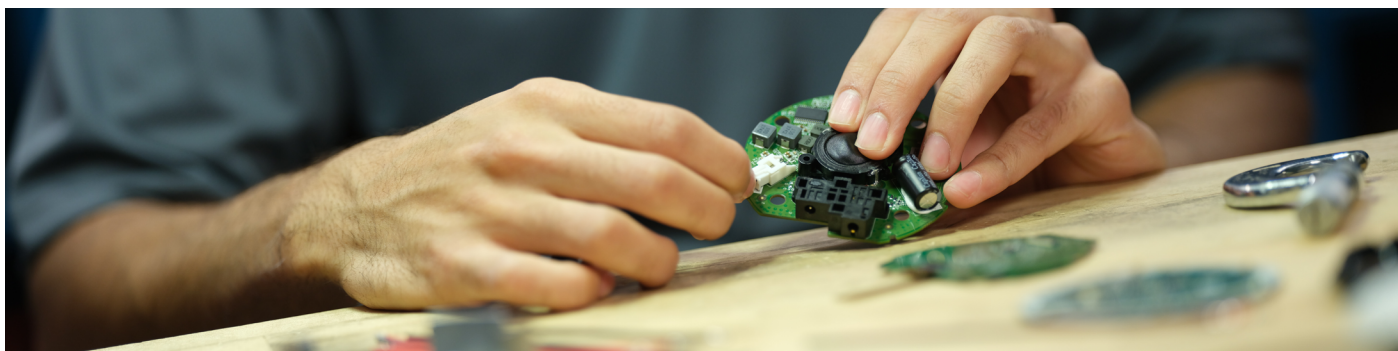
Strong and reliable joints may be challenging with thin diameter wire that has limited surface area. This can affect the reliability of motors.

Heat Sensitivity

Excessive heat may reduce insulation effectiveness near solder joints and may embrittle the copper or aluminum wire. This can reduce the life expectancy and performance of motors.

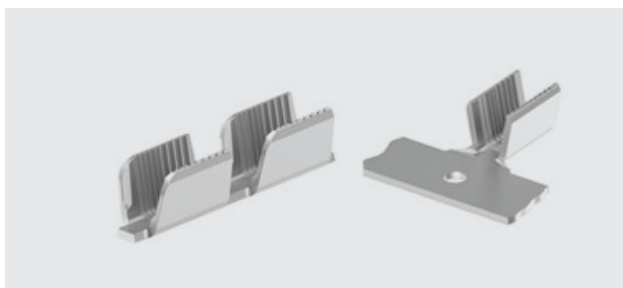
Flux Compatibility

Connection reliability challenges due to adhesion and conductivity issues may occur if flux is not properly matched with the magnet wire.



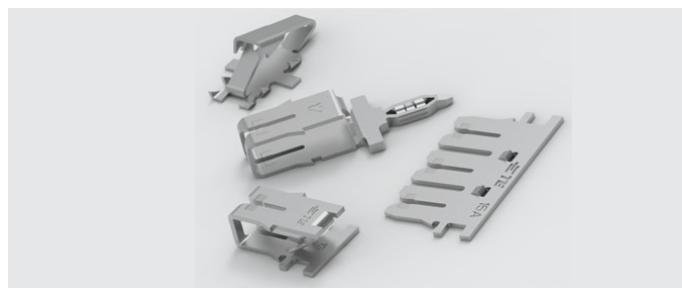
TE Solderless Solutions

For engineers working to streamline electric motor manufacturing processes, TE Connectivity (TE) offers a portfolio of solderless magnet wire solutions and low applied cost tooling options designed for copper and/or aluminum magnet wire. The products listed below are designed to help reduce cost while improving repeatability and manufacturability.



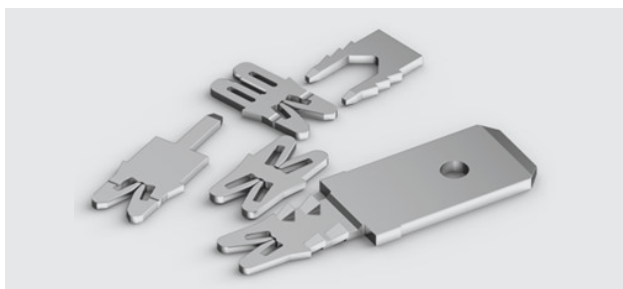
AMPLIVAR Terminals

Developed in 1953, these terminals and splices feature a serrated barrel design to pierce and displace magnet wire insulation, producing superior metal-to-metal compression crimp joints with excellent strength and reliability. With new application tooling, splices can be bussed together in virtually infinite combinations.



MAG-MATE Terminals

Introduced in 1975, these terminals feature an insulation displacement contact (IDC) that creates a gas-tight magnet wire termination. Standard MAG-MATE terminals support 34-12 AWG magnet wires and smaller versions are available for fine gauge wire. They are available in a variety of styles including poke-in, poke-in tab, splice, crimp wire barrel, solder post and others. TE provides specifications to incorporate cavities for these unique terminations into coil bodies or other custom housings.



SIAMEZE Terminals

Like MAG-MATE terminals, the versatile SIAMEZE terminal system features IDC technology to achieve a secure metal-to-metal interface without stripping magnet wire. The SIAMEZE terminal has a compact design intended for more space constrained motor systems and features an optional Lead Lok to secure lead wires with high retention force.



Solderless Solutions for Electric Bicycle (E-Bike) Motors

As electric vehicles (EVs) continue to grow in popularity, many are turning to the electric bicycle (e-bike) for local transportation. The e-bike motor is intended to help the rider when conditions or terrain make riding more difficult. Similarly, TE's solderless solutions help e-bike manufacturers reduce cost, improve reliability and increase manufacturing efficiency.

The standard solder solution for e-bike motor assembly requires soldering multiple groups of magnet wires on the common side of the windings. Figure 1 shows these splices in green. The assemblers then separately solder multiple sets of magnet wires to lead wires for the power input (shown in orange). These solder points can be time consuming to complete and may be subject to the previously discussed processing challenges. Below are several solutions incorporating solderless connections to simplify this e-bike motor assembly. These products represent just a portion of TE's broad portfolio of solutions for such electric motor applications.

AMPLIVAR Splice Solution: To eliminate the common side soldering operations and to automate the assembly process, TE recommends AMPLIVAR splice connections. Developed more than 50 years ago, this robust insulation piercing crimp system remains a popular and reliable method for splicing magnet wires. An illustration of the serrated terminations prior to crimping is shown in Figure 2. TE has updated the AMPLIVAR product terminator, shown in Figure 3, to enable bussing or ganging splices, making this terminal well suited for the e-bike common connections. Crimp bussing improves the consistency of the connections and reduces the time required to complete them.

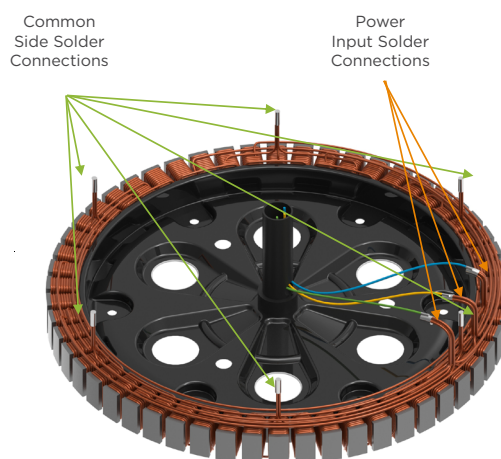


FIGURE 1: SOLDERED MAGNET WIRE SOLUTION

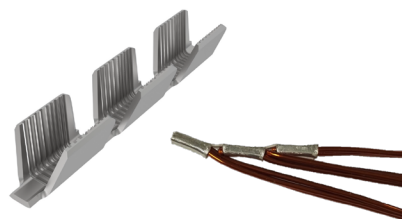


FIGURE 2: BUSSING AMPLIVAR TERMINATIONS



FIGURE 3: CRIMP BUSSING WITH THE AMPLIVAR PRODUCT TERMINATOR

Power Splice Solution: For production environments with a high quantity of terminations per year, TE's power splice terminals are a recommended replacement for the power input solder connection. These splices are designed to combine multiple lead and magnet wires into a single termination. This unique connector, shown in Figure 4, separates up to two stripped lead wires from up to six magnet wires. Like the AMPLIVAR splice, the insulation piercing serrations on the lower saddle maximize magnet wire contact area, minimizing the contact resistance. The power splice machine from TE is designed for high volume production and provides reliable splice termination of magnet wire with solid or stranded lead wire.

MAG-MATE IDC Terminal Solution: TE offers a full selection of MAG-MATE IDC magnet wire terminations (Figure 5) and provides full specifications for MAG-MATE cavities to support customized integration into product designs. Figure 6 shows a motor winding assembly for the e-bike application with a bobbin designed to accept two-slot MAG-MATE terminals. These allow up to 2 wires per slot and will therefore accommodate 3 wires at each of the common terminations.

The tri-slot MAG-MATE Terminal (Figure 7) will link up to 6 magnet wires of the same size and type. For this application, a stranded lead wire from the power input is inserted in the tri-slot terminal using a poke-in tab connection. The MAG-MATE inserter, featured in Figure 8, simultaneously cuts the terminals from the feeder strip, inserts the terminal into the cavity, along with a captured magnet wire, and pierces the magnet wire insulation at the contact areas.

With all three of these solderless solutions for the e-bike assembly, the time-consuming and potentially unreliable soldering steps are replaced with high-throughput and consistently reliable connections.

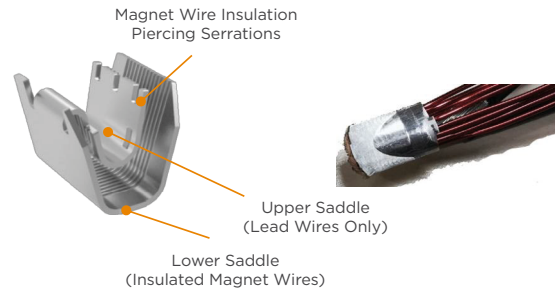


FIGURE 4: POWER SPLICE TERMINATIONS

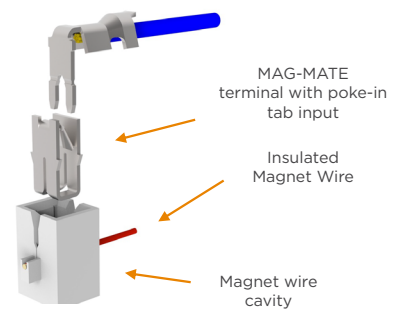


FIGURE 5: MAG-MATE TERMINAL WITH POKE-IN TAB INPUT AND CUSTOMIZED MAGNET WIRE CAVITY

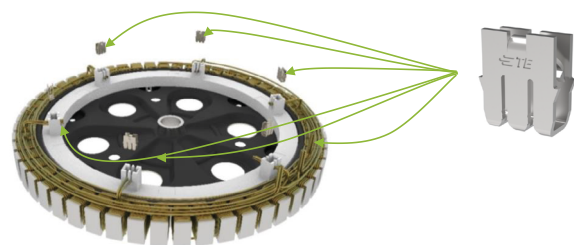


FIGURE 6 - E-BIKE MOTOR WINDNGS WITH MAG-MATE IDC TERMINALS

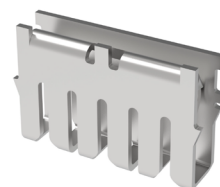


FIGURE 7 - TRI-SLOT MAG-MATE TERMINAL



FIGURE 8 - MAG-MATE INSERTER TOOL

Find Your Solderless Solution with TE Connectivity

TE Connectivity remains committed to developing and improving magnet wire solderless solutions for our manufacturing partners. Providing cost effective, sustainable connection solutions with automated assembly tools allows our customers to reduce labor costs while increasing productivity and minimizing human error. Our broad portfolio of magnet wire solutions and ability to support custom connector development let these solderless solutions fit in almost any electric motor system.

Contact our team to learn how our magnet wire solutions can help you.

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 a Product Information Specialist.



Trevis L. Benchoff
Director Engineering



Alvin Wang
Product Manager



Ugo Aime
Manager, Product Management



Tim Ding
Senior Manager
Engineering



Justin Huang
Principal Product
Development Engineer

LEADING THE

CHARGE

THE FUTURE OF HOME CHARGING

[LEARN MORE ▶](#)

te.com

TE Connectivity, TE Connectivity (logo), MAG-MATE, AMPLIVAR, TE and SIAMEZE are trademarks owned or licensed by the TE Connectivity Ltd. family of companies. All other logos, products and/or company names referred to herein might be trademarks of their respective owners.

The information given herein, including drawings, illustrations and schematics which are intended for illustration purposes only, is believed to be reliable. However, TE Connectivity makes no warranties as to its accuracy or completeness and disclaims any liability in connection with its use. TE Connectivity's obligations shall only be as set forth in TE Connectivity's Standard Terms and Conditions of Sale for this product and in no case will TE Connectivity be liable for any incidental, indirect or consequential damages arising out of the sale, resale, use or misuse of the product. Users of TE Connectivity products should make their own evaluation to determine the suitability of each such product for the specific application.

©2023 TE Connectivity. All Rights Reserved.

09/23 Original