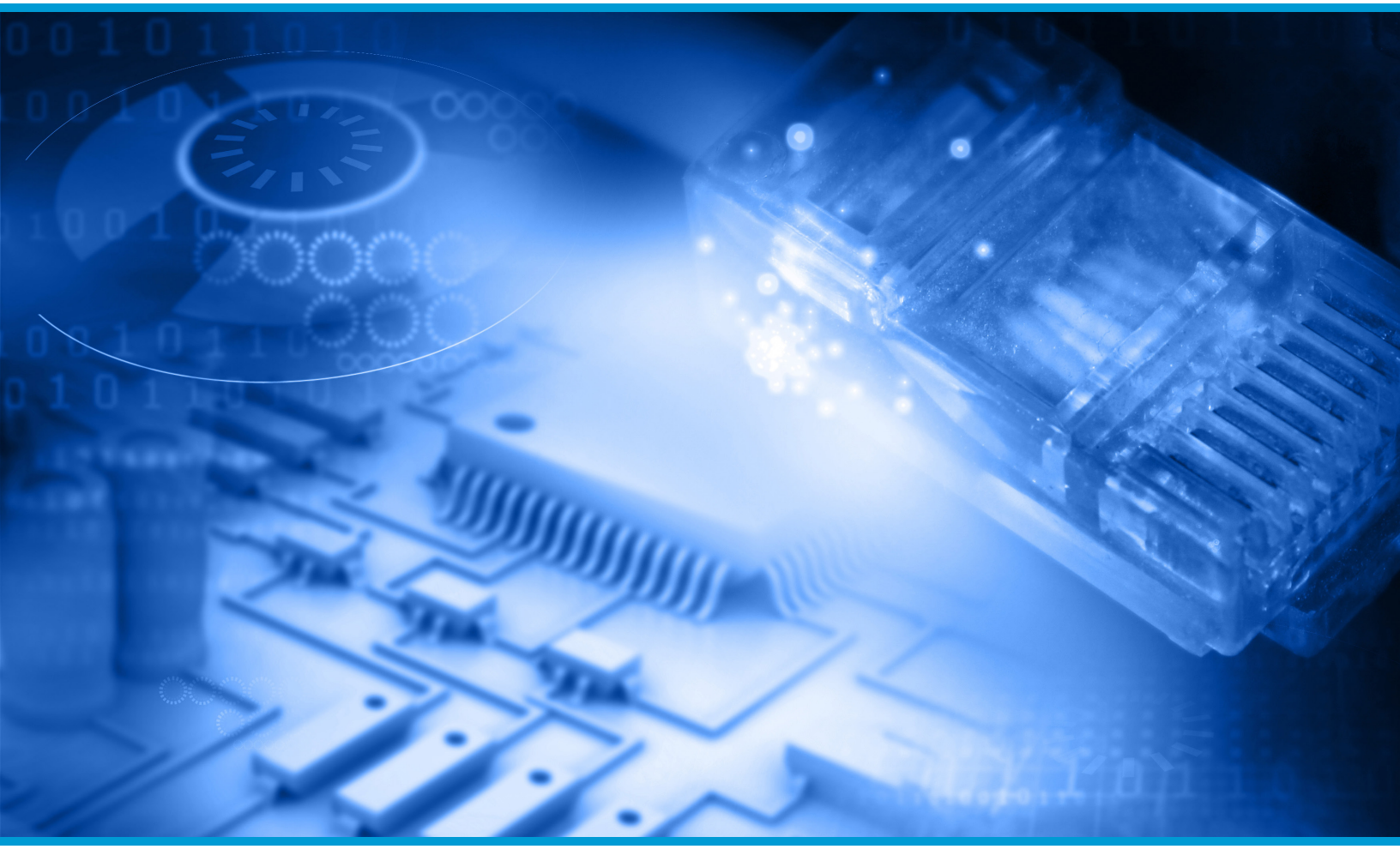
Whitepaper



Optimizing Reliability of Secured Magnet Wire in Ethernet ICMs

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OPTIMIZING RELIABILITY OF SECURED MAGNET WIRE IN ETHERNET ICMs

Issue

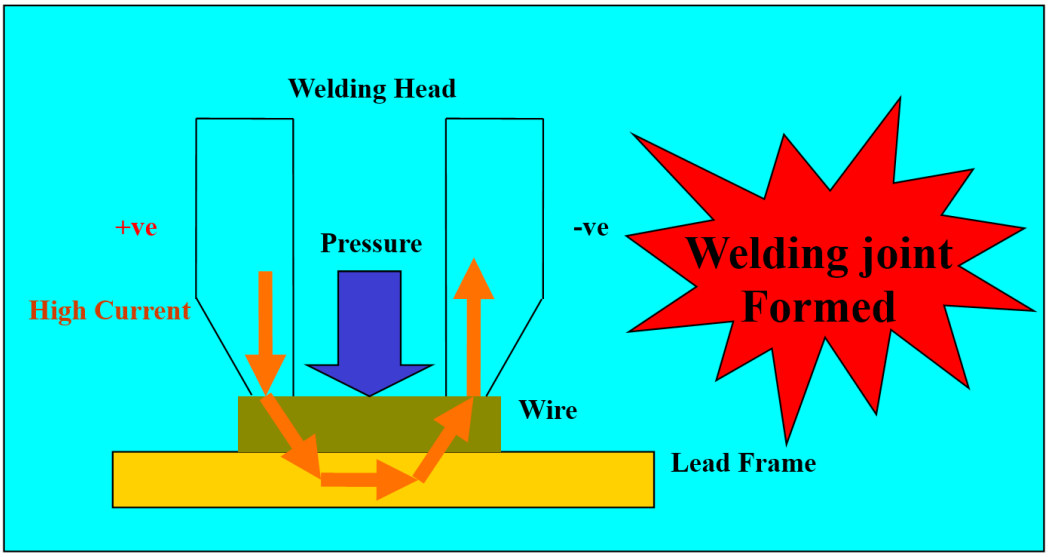
In manufacturing Ethernet Integrated Connector Modules (ICM), the securing of magnet wire to copper-based terminals is a process step that has proven difficult to ensure reliability. ICMs are used primarily in network switches, servers and storage products. Thus, the reliability of each electrical connection within an ICM is of the utmost importance.

Background

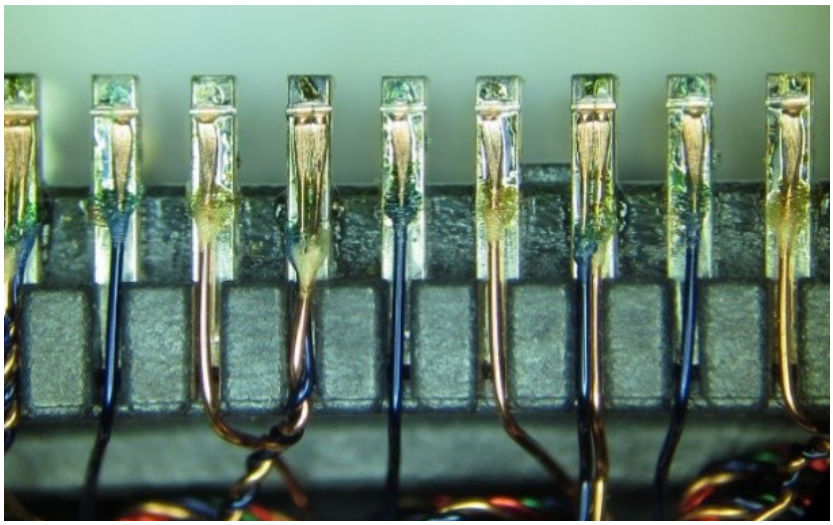
An ICM is made up of an RJ45 connector, PCB assemblies and a magnetics module. Magnetics provide isolation and signal conditioning in support of IEEE 802.3 Ethernet standards. The module consists of toroidal cores, magnet wire, silicone potting and a molded case with terminals. The gauge of the magnet wire varies by application but can be as fine as 40 AWG. The wire must be secured to the case terminals to allow completion of the required electrical connection. The standard approach is to wrap the wire around the terminal and dip solder. The wrapping and soldering processes must be well-controlled to avoid potential defects such as solder bridging, cold solder joints, excess copper dissolution and broken wires, post processing. Controlling this process effectively requires regular process maintenance and well-trained operators. While managing the required maintenance and training is certainly feasible, and is successfully done by several manufacturers, TRP Connector has developed a spot-welding process that eliminates many of the potential defects that result from a wrap and solder process.

Solution

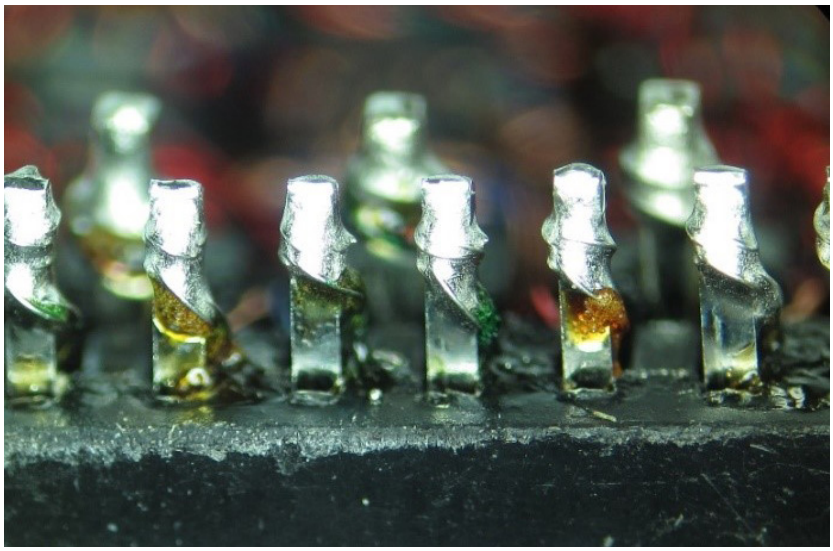
As illustrated below, magnet wire can be secured to a metal terminal using standard welding technology, where the heat produced via a high current, while pressure is applied to wire, produces a strong, reliable weld joint.



There is none of the stress or strain placed on the wire that one might experience with a standard wrap and solder process. Additionally, there is no flux residue present. See comparison photos below.



Spot Welding



Solder dipping

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Further benefits of welding include:

- Compatibility with a wider range of wire gauges. Wire that is too heavy will be difficult to solder, while fine wire will be more susceptible to breakage when wrapped and soldered. As a result, solder processes must be fine-tuned much more so than welding processes, based on the wire gauge used.
- Less consumable material results in lower overall cost, as solder and flux are no longer required.
- Elimination of flux and solder waste is in line with industry goal of becoming more environmentally friendly.
- Welding is deemed a generally safer process for operators, eliminating having to work with molten solder.
- A fully automated welding process is realizable, while solder dipping is limited to being semi-automated. High speed auto-welding equipment, as pictured below, has been developed by TRP Connector to quickly and efficiently secure the wires to the metal terminal. While solder dipping is typically done via machine, the wire wrapping, and inspection processes must be done manually.

Conclusion

As Ethernet bandwidth and power demands continue to rise, ICM designers will have fewer degrees of freedom. Thus, process capability and the resulting DFM guidelines, will increase in importance. Having an effective spot welding process, will provide designers the confidence to specify the unique winding designs required to support next generation technology (2.5G, 5G, 10G, 100W Power over Ethernet), without having reliability concerns.

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