TA.TEC Engineering Insights #002

More Wires or Larger Wire Diameter?

Which Bond Wire Design Survives Longer Power Cycling?

Experimental results and coupled thermo-mechanical FEM analyses provide the answer.

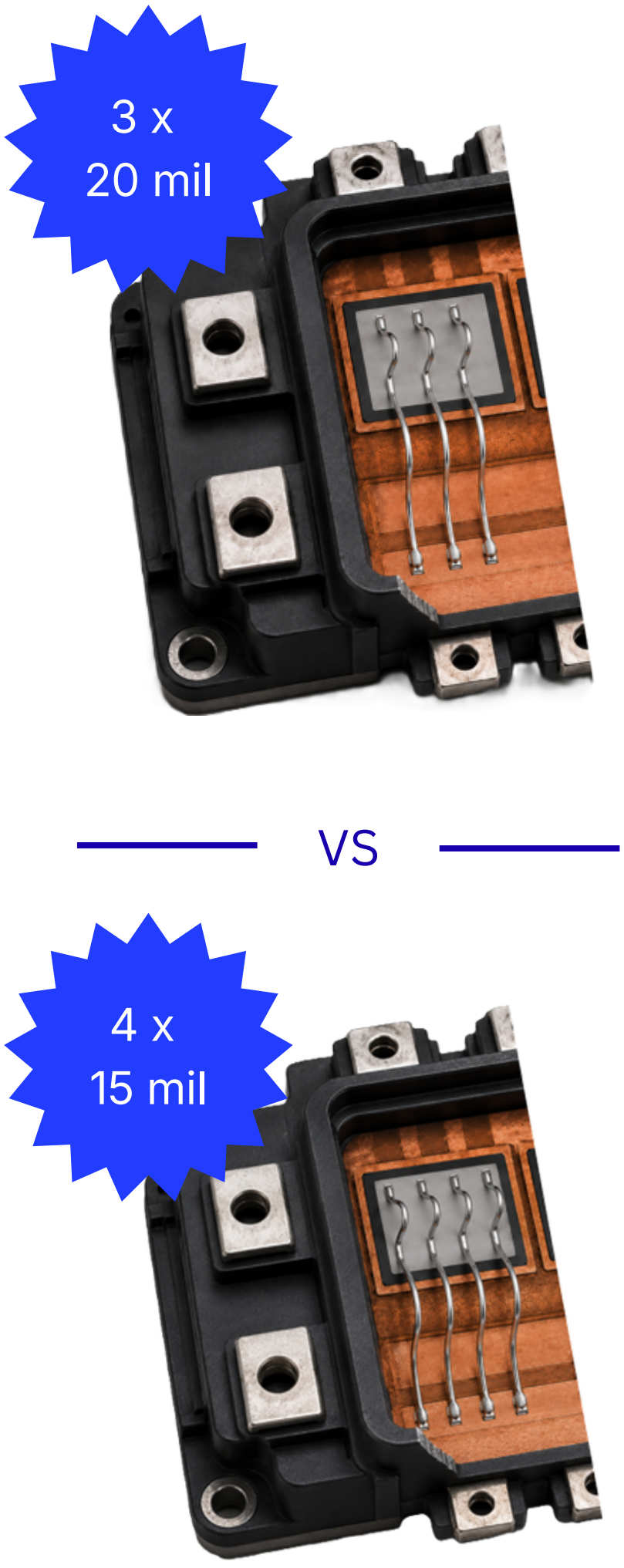


fig. Illustrative visualization of wire bonds

Thermal Performance
Lower Temperature is better

Mechanical Reliability
Lower Strain is better

What Was Investigated?

Two wire bond layouts with identical current capability

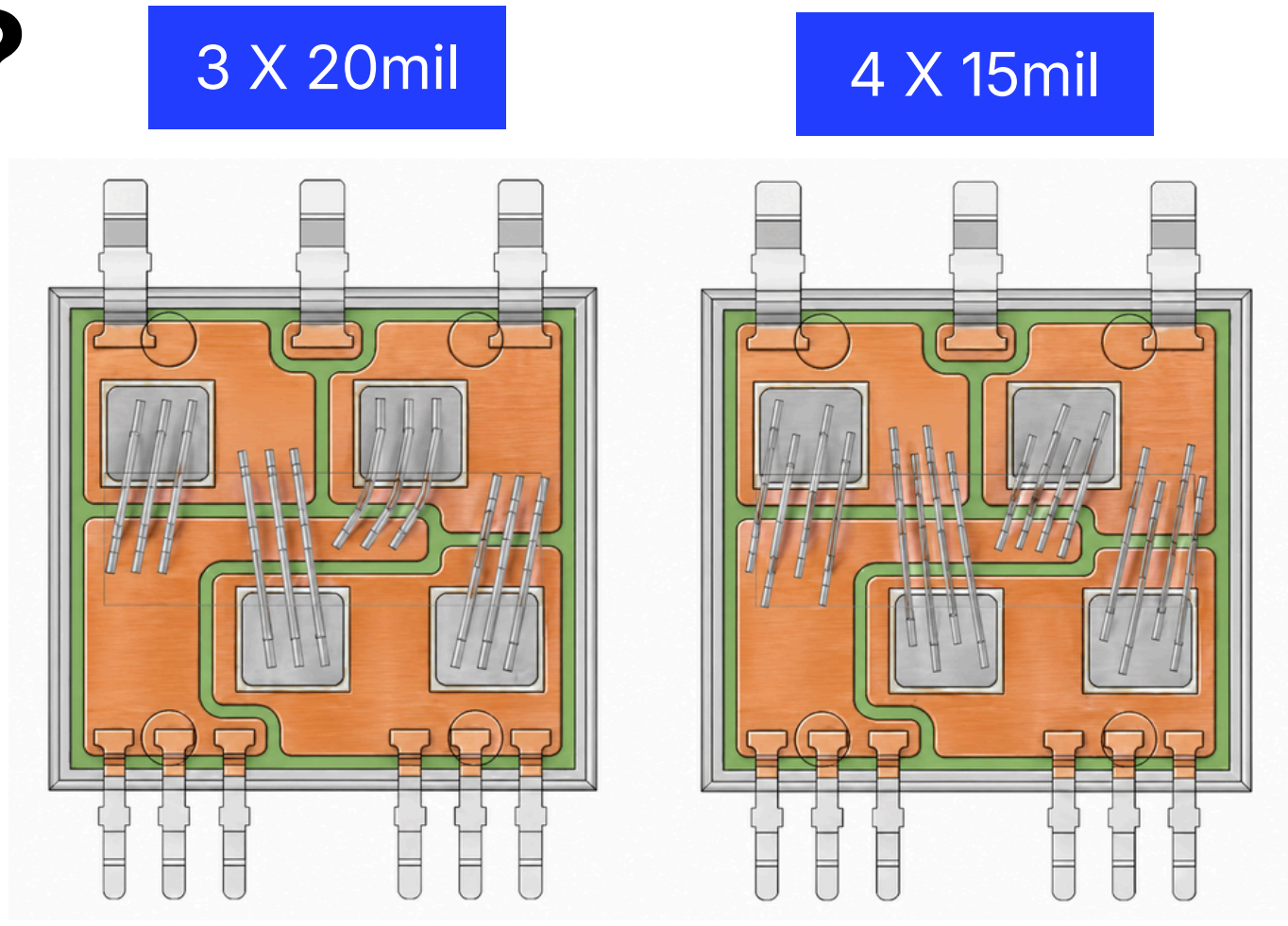


fig. Illustrative visualization of bond layout

Methods

Power cycling

Failure analysis

coupled thermo-mechanical FEM

Objectives

Determine which bond wire configuration provides higher thermomechanical reliability under the investigated test conditions.

Both configurations were designed to provide **identical current capability**.

Experimental Results

Power Cycling Results

The experimental results clearly show a significant difference in lifetime between the two configurations.

3 X 20mil

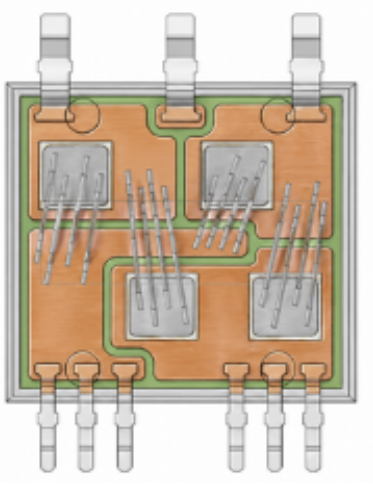


Wire Lift-offs observed
before 5,000 cycles

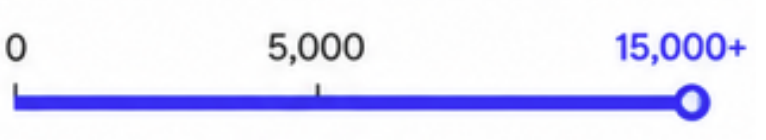


VS

4 X 15mil



Wire Lift-offs observed
after 15,000+ cycles

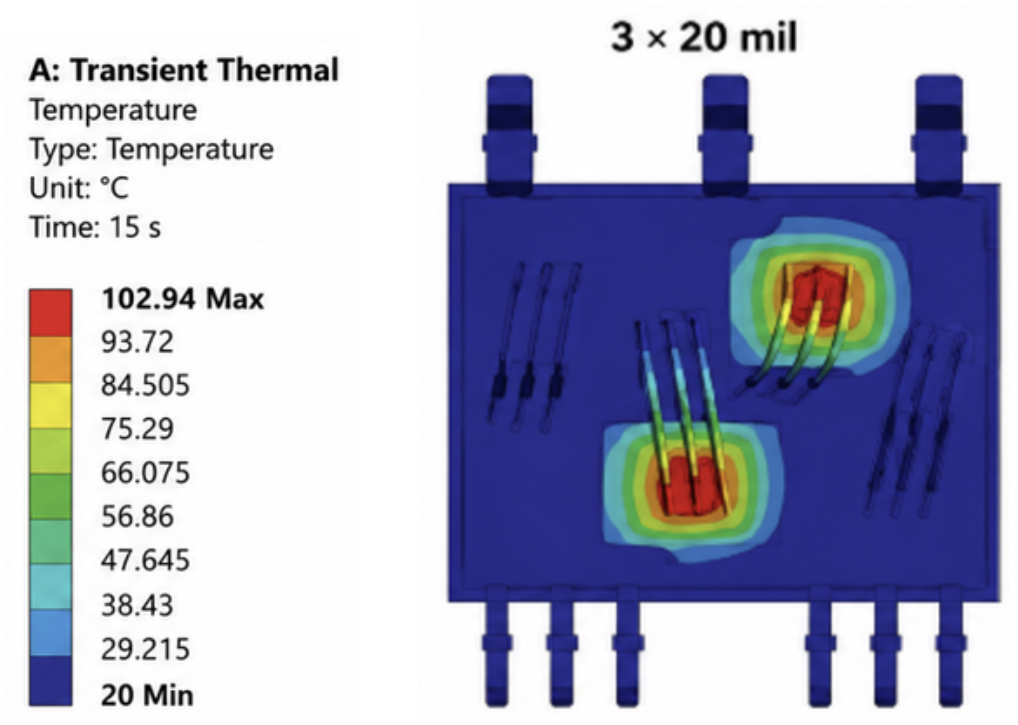


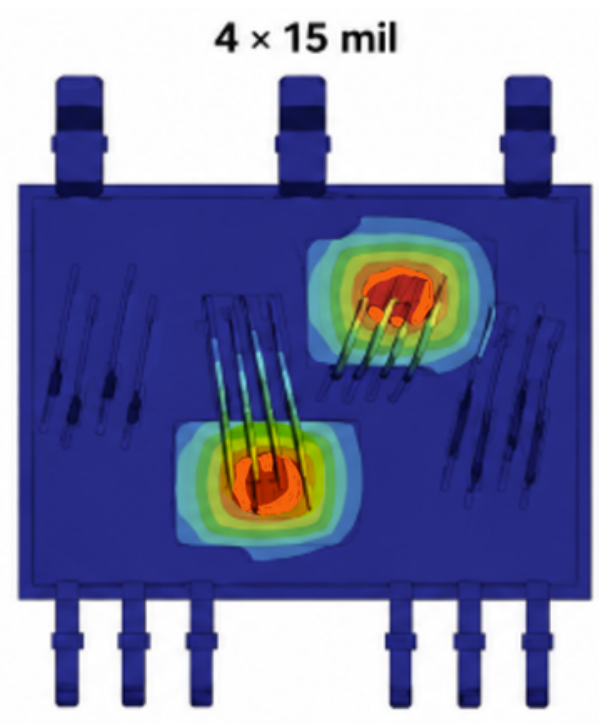
Takeaway

Under the investigated test conditions, the **4 × 15 mil configuration** achieved a **substantially longer** power cycling lifetime.

Why?

FEM Explained the Difference





Simulation metric

Accumlated
Equivalent plastic strain

Simulation showed

- **Lower** accumlated plastic strain
- **Lower** strain concentration

for the 4 X 15 mil configuration

fig. Illustrative visualization based on the simulation results reported in the study.

Takeaway

The 4 × 15 mil configuration exhibited lower accumlated plastic strain, consistent with its longer experimental power cycling lifetime.

Engineering Insight

What can we learn?

Based on the experimental results and FEM simulations presented in the study

Increasing the number of bond wires reduced accumulated equivalent plastic strain.

Lower accumulated equivalent plastic strain corresponded to longer power cycling lifetime.

These findings apply to
the investigated module design and test conditions presented in this study.

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Research Behind This Engineering Insight

Boutaleb, M., Roqueta, F., Moreau, F., Brenet, Y., & Barreau, L.

Thermomechanical Reliability of Bond Wires in Power Modules subjected to Power Cycling

Proceedings of EuroSimE 2025 (IEEE)

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