

PROGRESS TO SUCCESS

UC 3.1a Prognostics for Industrial Drives

Lead: ABB, Partners: AALTO, AIT, BME, IFAG, NANOJ, SAL, TUDD



Objectives:

Demonstration of **predictive health management** (PHM) and **pre-warning** algorithms to determine 1) **thermomechanical** and 2) **electrochemical** migration induced failure mechanisms:

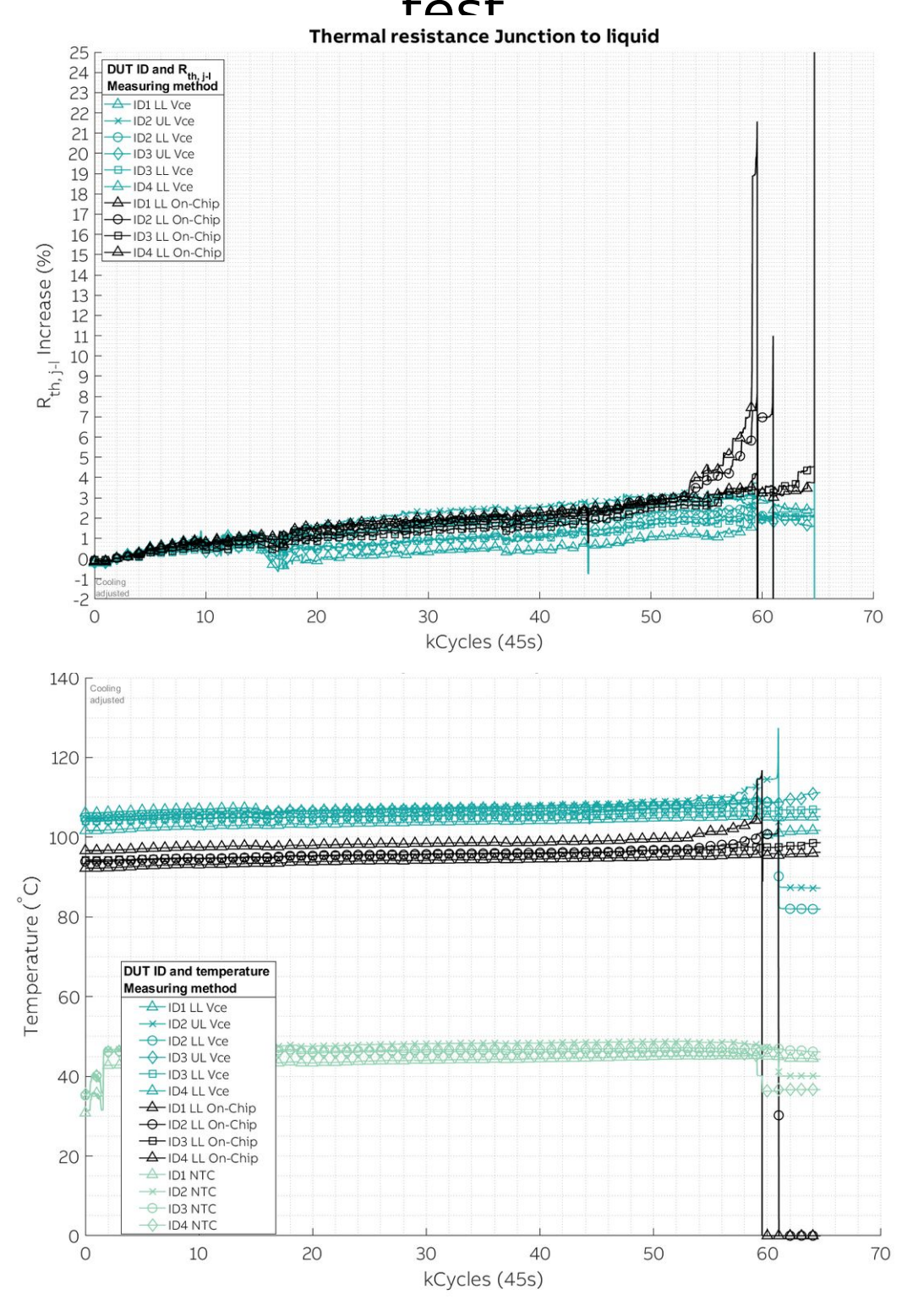
1) Demonstrate beyond state-of-the-art component-level in-situ self-learning algorithm PHM demonstrated in industrial drive (e.g. ACS880 R7iLC TRL6) with a separation of different failure mechanisms (e.g., bond-wire lift-off, die attach, system solder, and thermal interface material degradation) using **in-situ sensors (e.g. on-chip Tj or acoustic emissions)** with (RUL) model to separate failure mechanisms using AI accelerator circuit or conventional approach.

2) Demonstration of novel interconnect materials (Cu sintering front- and back side), large area Ag sintering, SLID bonding in a combined power and thermal cycling test.

KPIs:

- Improved accuracy of the junction temperature estimation by 50% compared to a state-of-the-art module with NTC-Element
- Improved RUL estimation accuracy of 80 %.
- Separation of the failure mechanism in at least 90 % of the cases (either with the conventional method or with AI)

Fast-track demonstration from BiCycle



Motivation:

- Power electronics, reliability, CM, IoT, and AI.

Relevance:

- Cost-effective maintenance, smart techniques, and sensors.

Market Demand:

- Growing adoption, Industry 4.0, safety, and cost-effectiveness.

Novel Interconnect

This section features a collage of images and graphs. On the left, there are images of Si and IMC substrates with Cu sintering. In the center, there is a graph showing the demonstration of on-chip Tj measurement at transient (200A) with a temperature curve. Below this is a block diagram of the IFD: Prognostics Demonstrator Block Diagram, showing the integration of a Power Converter, Your Controller, and an Analytics Stack. On the right, there is an image of a TUDD in-situ temperature measurement unit and a graph showing the detailed 3D numerical thermal model for investigating die attach layer degradation scenarios, plotting C_{th} (W/K) and R_{th} (K/W) against time.



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