LETID AND THE FUTURE OF MODULE DEGRADATION TESTING

A Comparison of Test Methods on Module Level

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TestLab PV Modules

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TestLab PV Modules
Failure Research and Testing Service

PV Module Certification in close Cooperation with VDE since 2005.

VDE

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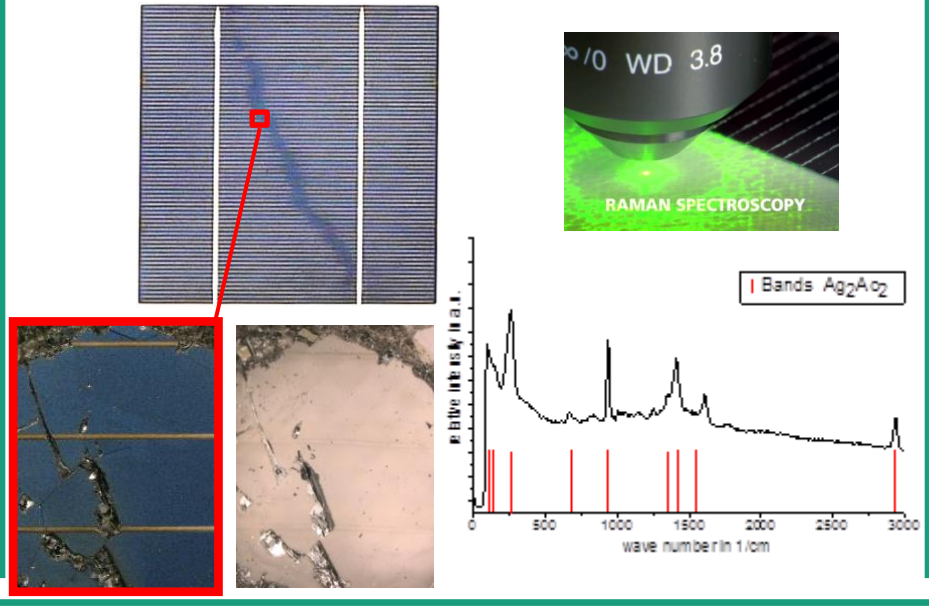
IECEE

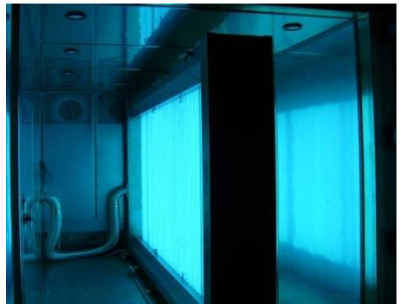
IEC

DAkkS Deutsche Akkreditierungsstelle D-PL-11140-03-02

- **Failure analysis**
  - Identification of root causes and relevant stress factors
  - Failure prevention



- **Testing beyond standards**
  - Combined stress tests, e.g. UV + humidity
  - Test development



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LeTID Module Testing
Challenges for EPCs, investors and testing laboratories

- „Black box“ PV module
  - LeTID behavior is influenced by various factors, such as firing profiles [1,2], wafer thickness [3], BO-stabilization procedures [4]
  - This information is usually not available
- Long timescales
  - ~years until max. degradation is reached in the field [5]
  - Not detected by IEC 61215-2:2016 MQT 19
- Superposition of more than one process at the same time

- Demands for LeTID module tests
  - Risk estimation
  - Acceptance criterion?
  - Comparability of results
  - Acceptable testing time
- Standardization
  - Discussed for IEC test specification:

    75 °C, MPP mode, CID

[1] C. Chan et al., *IEEE J. Photovoltaics* 2016;6:1473–9; [2] R. Eberle et al., *Energy Procedia* 2017;124:712–7 ; [3] D. Bredemeier et al., *Sol. RRL* 2018;2:1700159; [4] F. Fertig et al. *Energy Procedia* 2017;124:338–45; [5] F. Kersten et al., Energy Procedia 124 (2017) pp. 540–546

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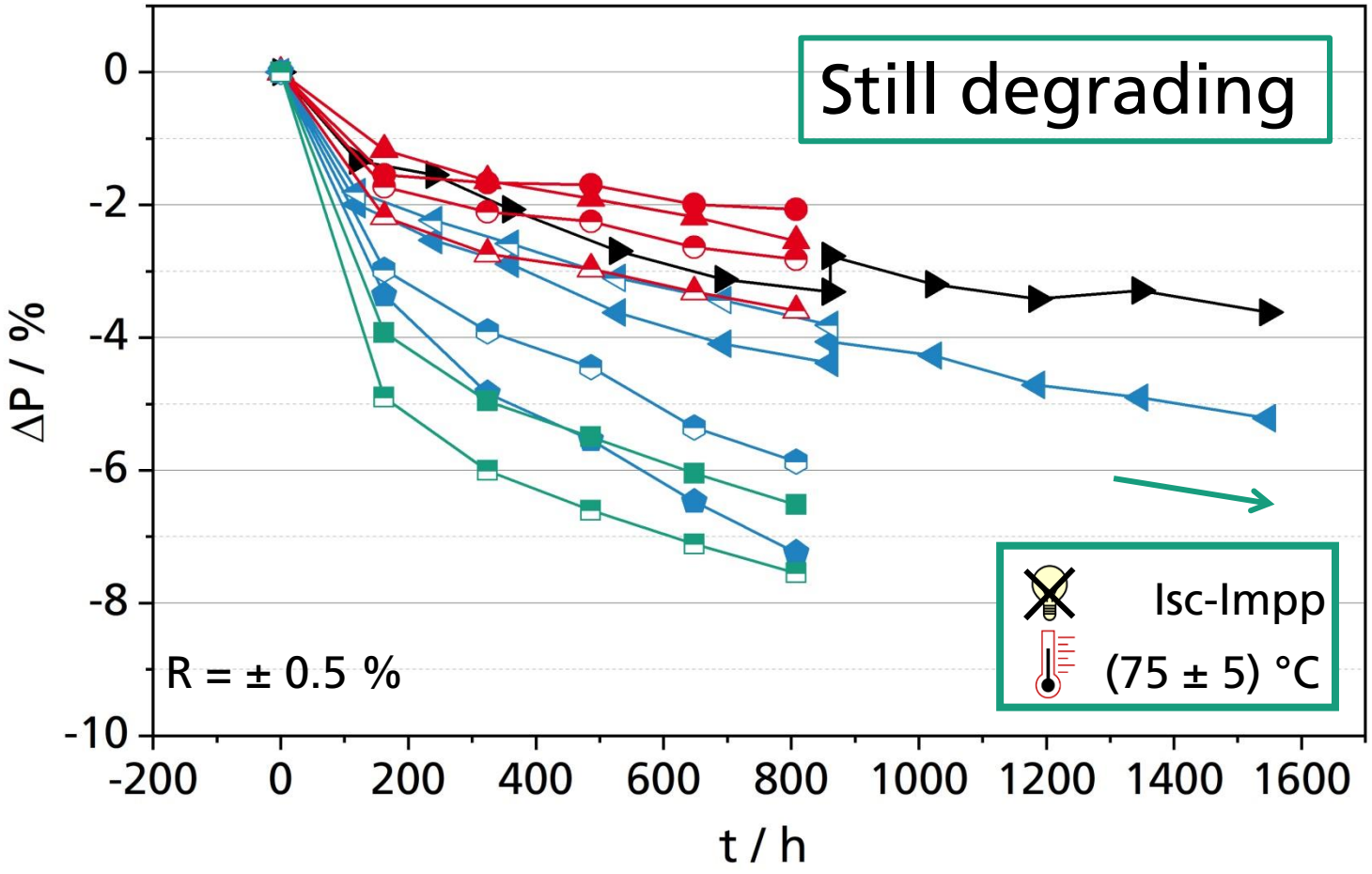
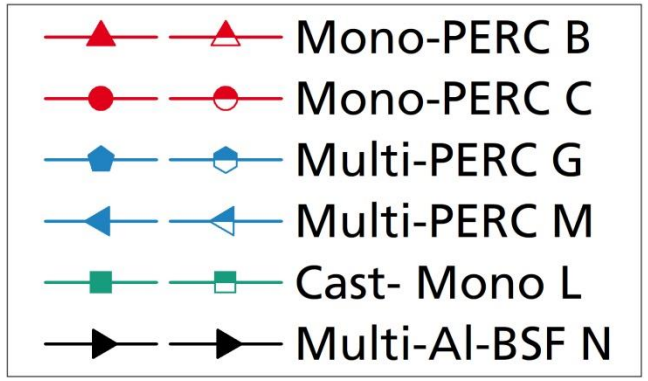
Further Testing





Testing until maximum degradation is too time consuming for module quality testing

→ Stop Criterion?

→ Further acceleration?

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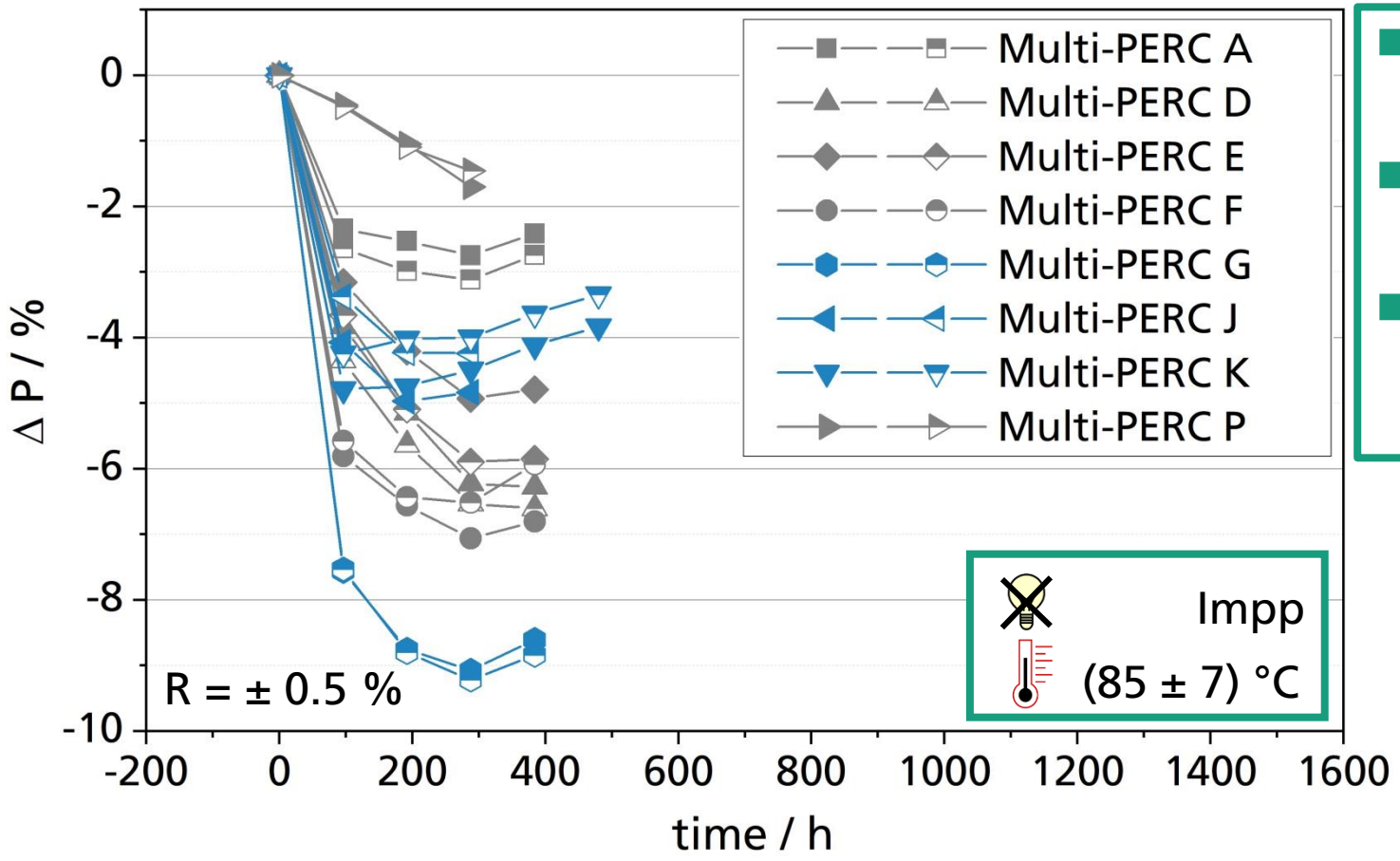
Multi-PERC

What if we accelerate further?



- Start of the regeneration phase within 300h
- Wide range of sensitivity (ΔP ≈ -1.5 % … -9 %)
- Is the maximum detected degradation comparable to slow LeTID test results?

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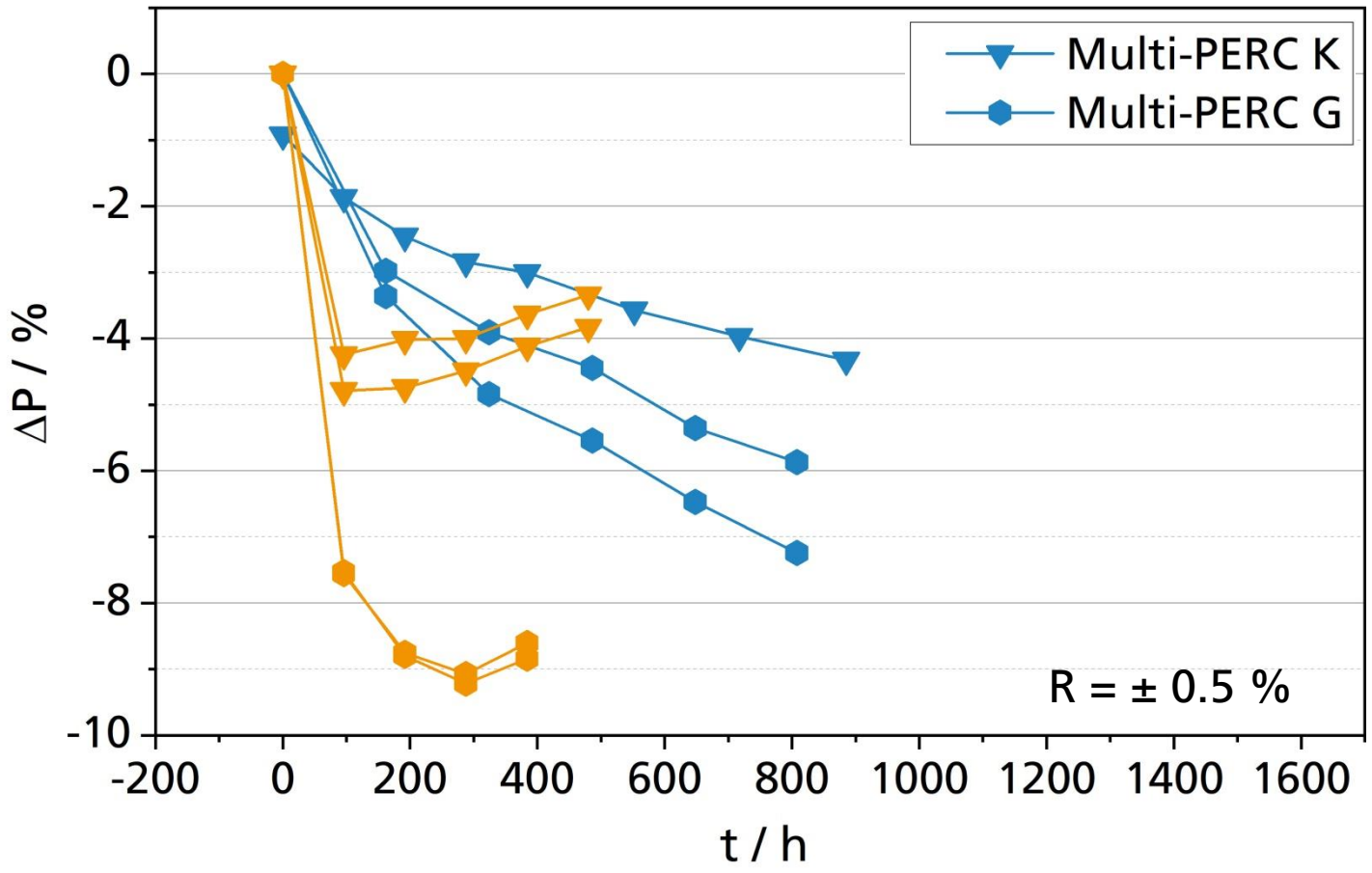
Multi-PERC Comparison

Are the results comparable?



- Direct comparison for two module types (Multi-PERC)
- Comparable performance losses for Multi-PERC K (within the testing time)
- Higher losses in fast test for Multi-PERC G, reason: degradation still ongoing in slow test

Isc-Impp
(75 ± 5) °C

Impp
(85 ± 7) °C

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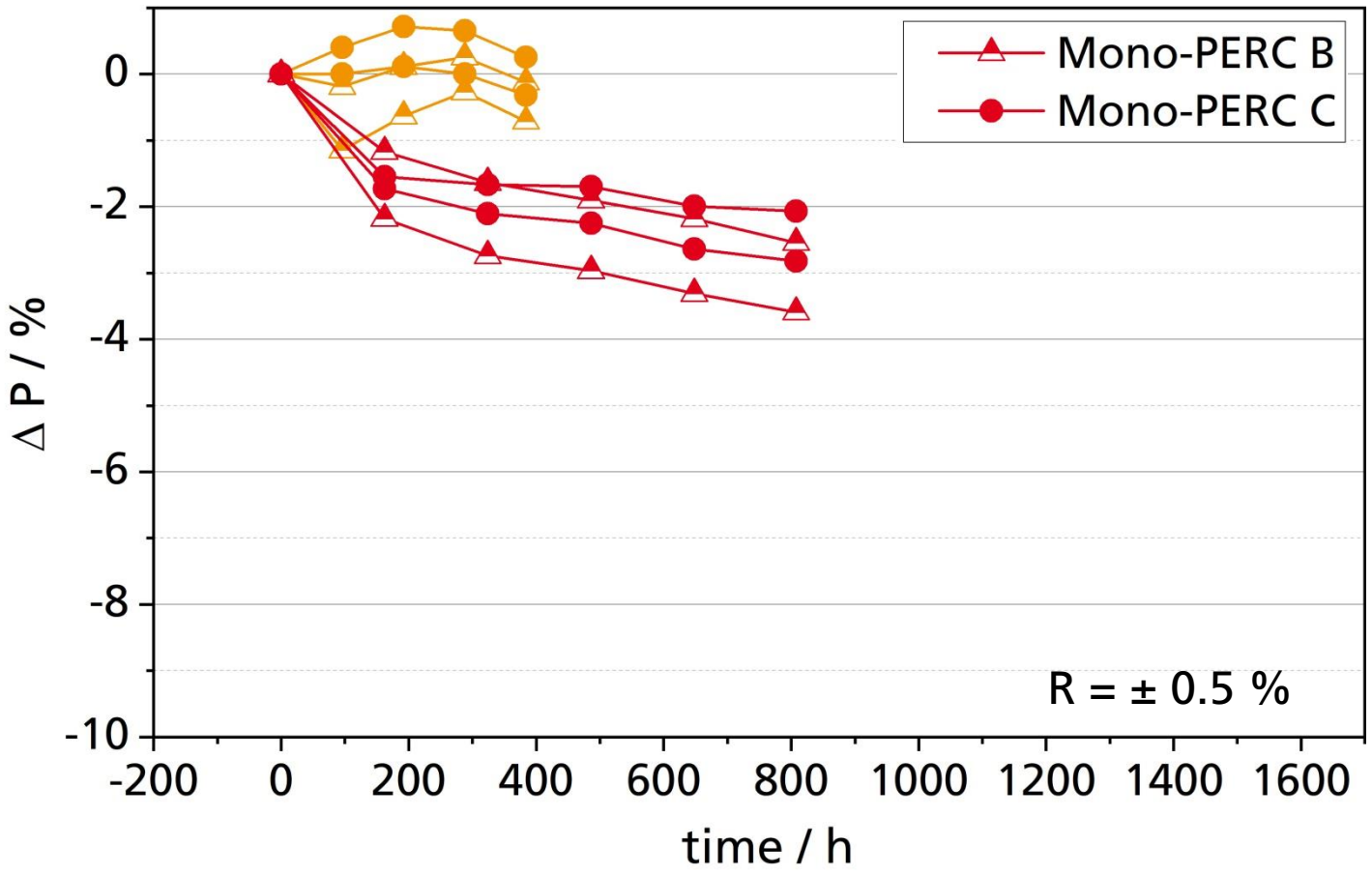
Mono-PERC

Are the results comparable?



- Direct comparison for two module types (Mono-PERC)
- Almost no degradation in fast test
- Possible reason: high acceleration of regeneration process → field relevant degradation not detected

Isc-Impp
(75 ± 3) °C

Impp
(85 ± 7) °C

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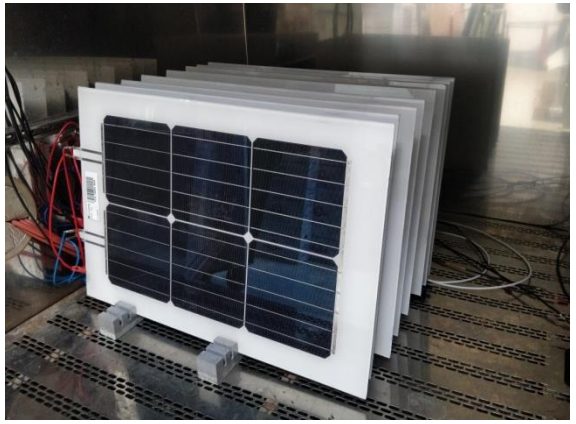
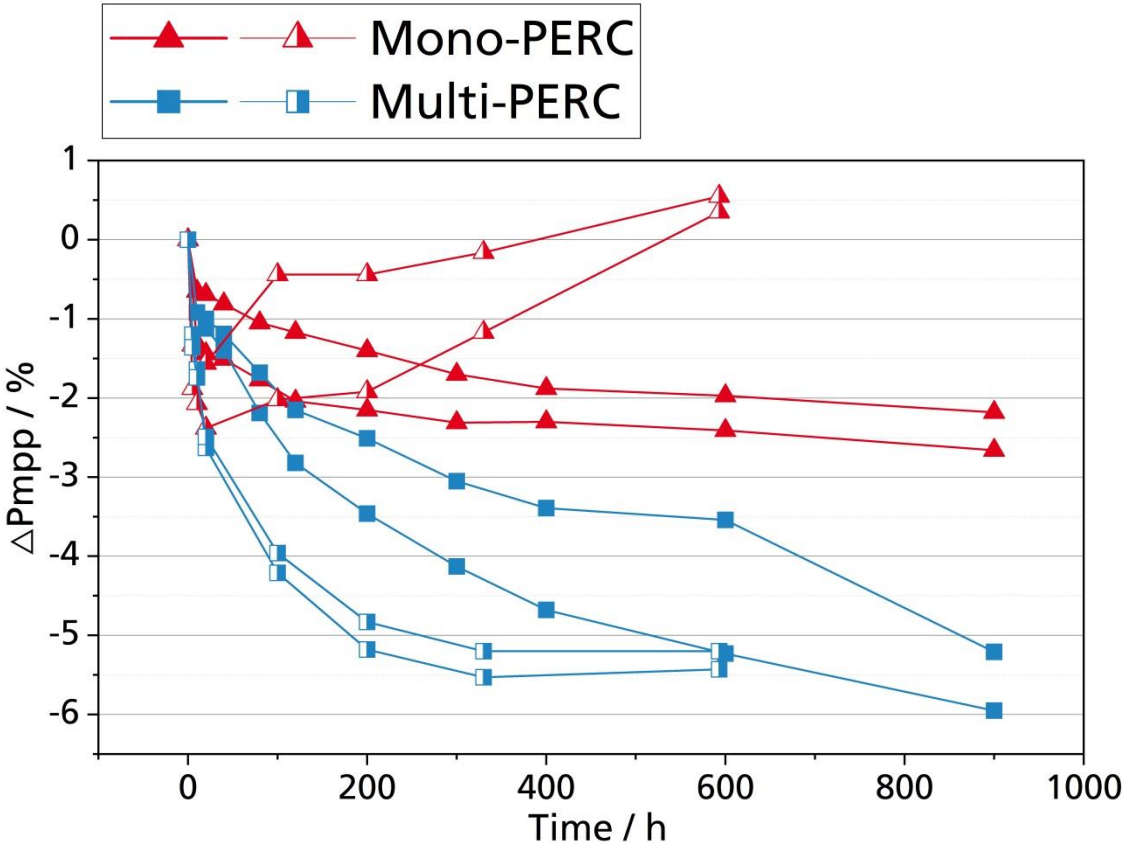
6-Cell-Laminates
LID 85°C vs. CID 75°C

*To be verified

Isc-Impp
(75 ± 3) °C

1 sun, MPP*
(85 ± 7) °C





- Test Equipment LID
  - Climatic Chamber
  - Integrated AAA Solar Simulator (IEC 60904-9)

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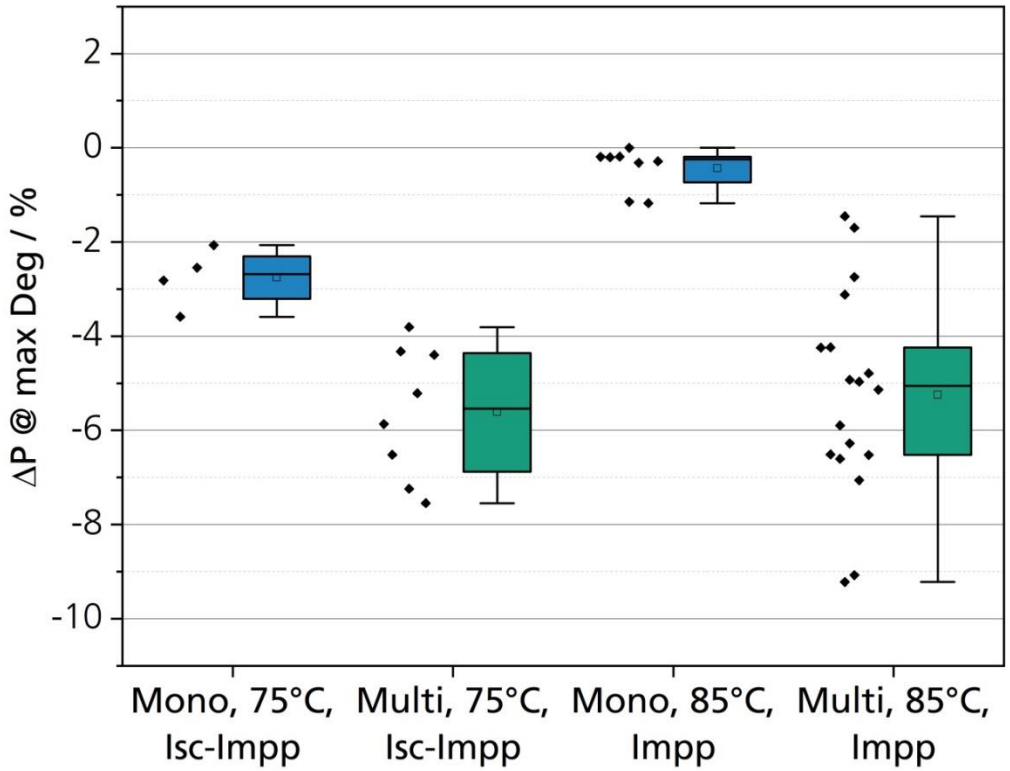
Conclusions

- LeTID test experience at TestLab PV Modules



- LeTID can be suppressed by some manufacturers
- Discussed for IEC test specification: CID, 75 °C, Isc-Impp,
  - Reliable method for LeTID detection, but long testing times
- Accelerated test: CID, 85 °C, Impp
  - Acceptable testing times
  - Risk of underestimation in case of mono-Si
- Promising solution: only increasing temperature, e.g. 85 °C, MPP mode

  → will be further investigated

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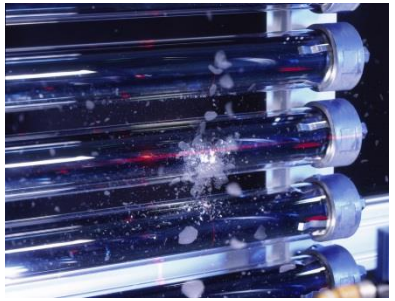
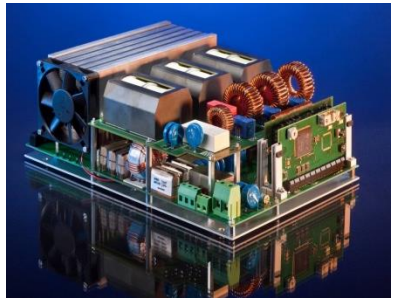
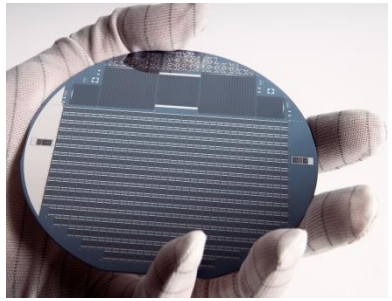
Thank you for your Attention!

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