At Fraunhofer CSP’s Module Technology Centre a complete production line for full scale PV module processing is available. Our team is a competent partner for application-oriented research projects for PV module manufacturing.

We are a partner for cooperation with equipment suppliers, PV-manufacturers and material distributors to develop machine design strategies for next generation solar cell layouts as well as alternative module technologies. The aim is to reduce PV levelized cost of electricity (LCOE) by lowering production cost and increasing the efficiency of solar modules.

**Research Area**

**Topics**

- Evaluation and optimization of PV production
- Full scale process development for new module materials
- Assembly of standard 60- or 72-cell modules
- Development and use of testing methods for process control
- Cell interconnection processes for new cell technologies: bifacial cells, back contact cells
- Special module applications:
  - BiPV & lightweight
  - Colored modules as design elements
  - Reference modules for flasher calibration for thin film modules
  - High efficiency modules, etc.

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## Equipment

- Module production line (Module size 0.7 x 1.2 m² up to 2.2 x 2.6 m²)
- Glass washing machine – GTA
- Variable cell string layup – USK
- Industry scale cell stringing equipment (2-SBB, full/half cell) – ATN & XA X3.
- Lab and large scale module laminator – MSS
- 3D laminator for complex module stacks – SM INNOTECH 3-in-1
- Manual framing and junction box assembly

- Module flasher for performance testing – BERGER
- Electroluminescence tester for cell strings and modules, incl. Automated defect classification – PI4
- Precision testing machines for cell interconnection and module packaging characterization
- RTP oven and screen printer for special cell processing
- Various testing equipment (non-destructive / destructive) for module quality characterization and material diagnostics

## Publications

- Hanifi, H., Pfau, C., Dassler, D., Schindler, S., Schneider, J., Turek, M., Bagdahn, J.; Investigation of cell-to-module (CTM) ratios of PV modules by analysis of loss and gain mechanisms; Photovoltaics International; May 2016; 32nd Edition
- Schindler, S., Fraunhofer CSP, Halle, & Volk, M., SCHMID Group, Freudenstadt; Multi-busbar technology: Increased module power and higher reliability at lower cost; Photovoltaics International; March 2014; 23rd Edition
- Schneider, J.; Leers, C.; Raise your glass, PV Magazine 10/2013, page 100

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3. EL measurement image with automated failure detection and classification for cell strings and modules.

4. Module production and charity support for school project in Africa.