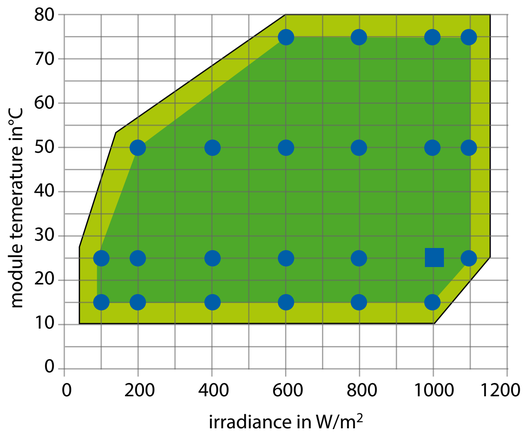
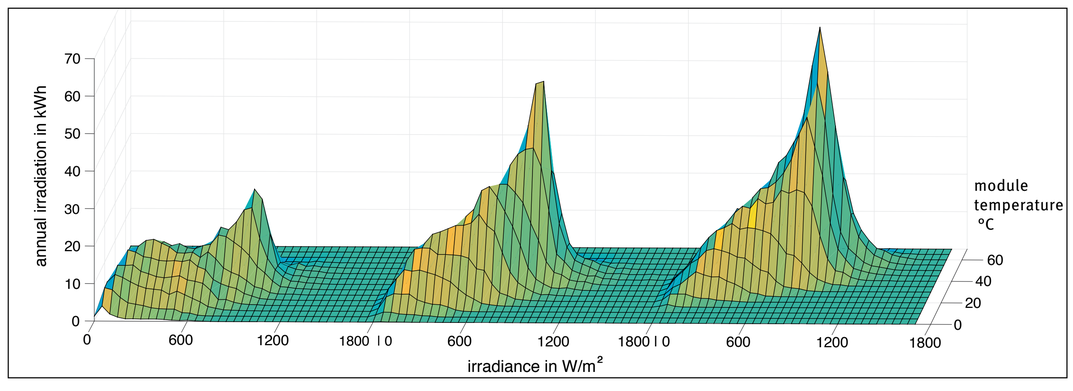
PV*SOL® | Modelling PV modules based on IEC 61853 data

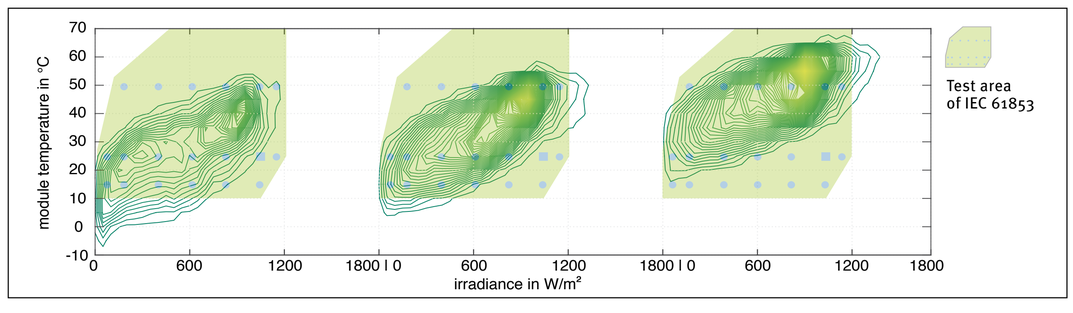
We present a model for the dynamic simulation of PV modules that is based on measurement data according to the IEC 61853. The operational scope of the test matrix is verified with the help of three locations (i.e. Berlin, Rome and Dubai). The procedure for calculating the electrical behavior for arbitrary operation conditions via inter- and extrapolation is presented. The resulting characteristics are discussed for various cell types.

Test matrix IEC 61853

The short circuit current (SC), the open circuit voltage (OC) and the maximum power point (MPP) are measured in every test point, for 23 points in total. These points define an operational scope that is compared to the irradiation/temperature conditions resulting from simulations. For the locations of Berlin, Rome and Dubai up to 90/98/98% of the annual irradiation lie within the scope of the test matrix (light green area).



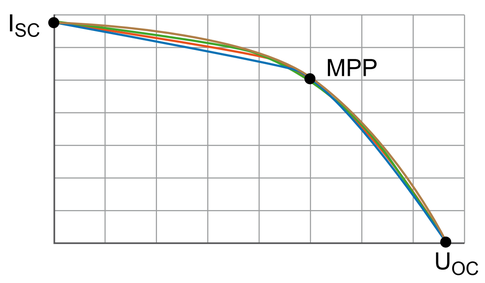


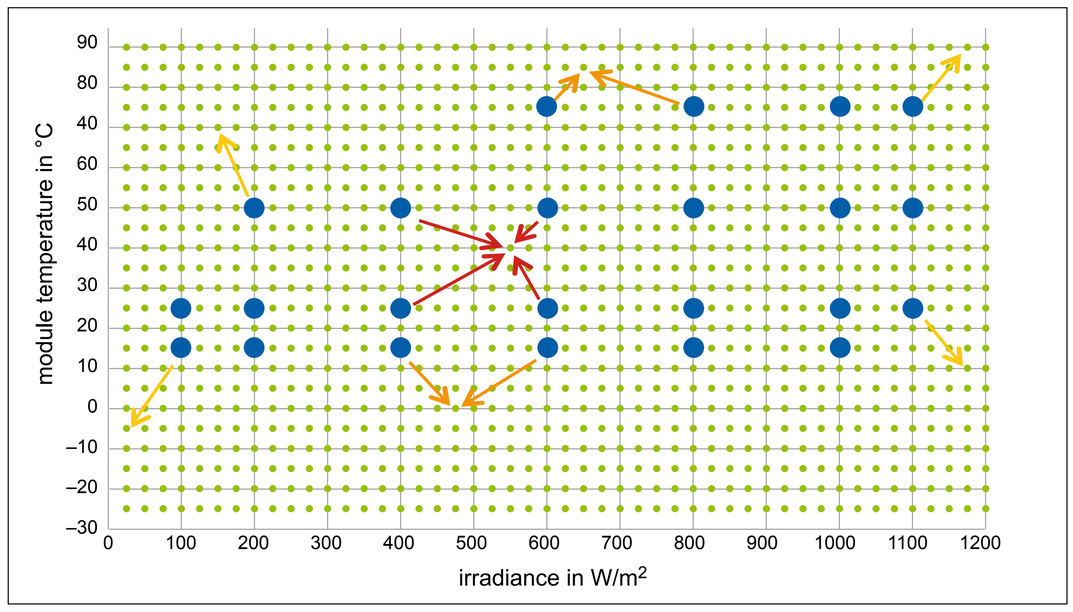


Inter- and extrapolation

Using the one-diode model, the I-V characteristics are generally extracted out of the measurement data from the Standard Test Conditions (STC). In the approach presented here, we develop complete one-diode models in each of the 23 test points. By superposition of these models we can determine the I-V characteristics for arbitrary operation conditions (red/yellow arrows, fine grid).

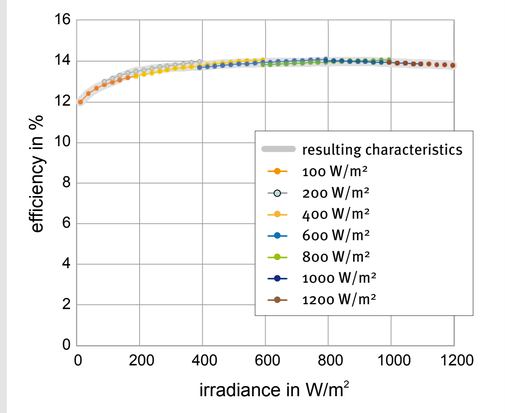
The diode factor is set to a typical value for the corresponding cell type, but can also be used to customize the shape of the characteristics.

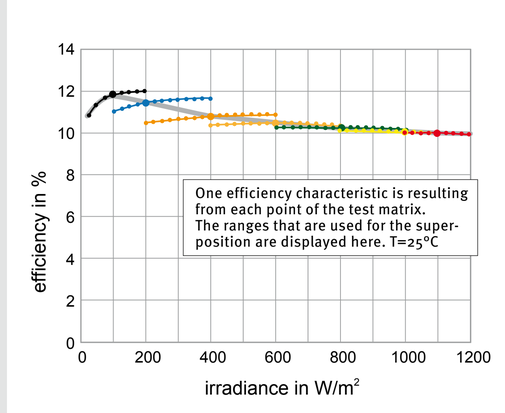




Results

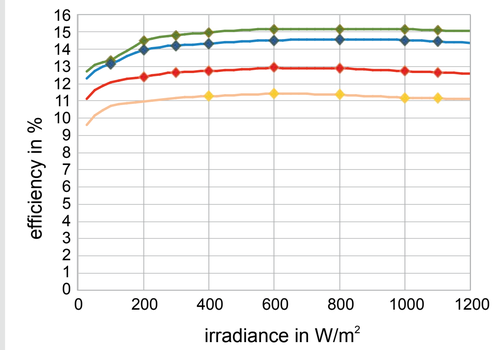
Crystalline modules are well described by the one-diode model, so that the characteristics derived from the test points (colored) differ only minimally from the characteristic generated by superposition (grey).





For thin film modules with an efficiency elevation in low light conditions the one-diode model is considered insufficiently precise. This can be confirmed by the clearly shifted characteristics based on the test points. The superposition of the single characteristics, however, leads to smooth total characteristics.

Distinctive features of the test measurements remain. The interpolation between those points using typical behavior leads to module-specific characteristics, even if there are less measurement points than defined in the test standard.



Conclusion

With the presented procedure it is possible to generate detailed I-V characteristics for every operation state that occurs during simulation, based on measurement data according to IEC 61853. In particular, it is possible to simulate more precisely those modules that were only insufficiently described by the one-diode model. Uncertainties of yield predictions based on models of PV modules can thus be significantly reduced.

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