PV Module Efficiency, Fill Factor and Area per kWp

Fill factor and efficiency of a PV module from its data-sheet voltages, currents, power and area, with power per square metre and area per kWp.

Method: PV module figures of merit

Input parameters

Unit system: SI

Parameter	Value	Unit
Open-circuit voltage	49.500	V
Short-circuit current	10.200	A
Maximum-power voltage	41.500	V
Maximum-power current	9.6400	A
Module area	2.0000	m²

Calculated results

Parameter	Value	Unit
Maximum power V_mp I_mp	0.40006	kW
Fill factor	79.235	%
Efficiency at 1,000 W/m²	20.003	%
Power per m²	200.03	W/m²
Area per kWp	4.9993	m²

Notes for this case

• FF = V_mpI_mp/(V_ocI_sc); efficiency at standard test conditions (1,000 W/m², 25 °C). Crystalline modules have fill factors of about 0.75–0.82; low fill factors indicate high series resistance or shunts.

Formula and method

$$FF = \frac{V_{mp} I_{mp}}{V_{oc} I_{sc}}, \quad \eta = \frac{V_{mp} I_{mp}}{1000 A}$$

Variables

V_{oc}	Open-circuit voltage	V
I_{sc}	Short-circuit current	A
V_{mp}	Maximum-power voltage	V
I_{mp}	Maximum-power current	A
A	Module area	m²
P_{mp}	Maximum power V_mp I_mp	W
FF	Fill factor	-
η	Efficiency at 1,000 W/m²	-
P/A	Power per m²	W/m²
A/kWp	Area per kWp	m²

Method and standards

Module figures of merit.

Assumptions and limits

- Standard test conditions.

References

PV module figures of merit

Report details

Report reference	FCC-VFWF-5FSJ (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/solar-pv/pv-module-efficiency-fill-factor

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.