PV Module Driving a Resistive Load: Operating Point

Operating voltage, current and power of a PV module connected directly to a resistive load, from an ideal single-diode I-V curve, compared with its maximum power.

Method: Ideal single-diode PV characteristic and load line

Input parameters

Unit system: SI

Parameter	Value	Unit
Short-circuit current	9.5000	A
Open-circuit voltage	44.000	V
Cells in series	72.000	
Diode ideality factor	1.2000	
Cell temperature	45.000	°C
Load resistance	3.0000	Ω

Calculated results

Parameter	Value	Unit
Operating voltage	28.460	V
Operating current	9.4866	A
Power delivered	0.26998	kW
Maximum power of the curve	0.33341	kW
Utilisation of available power	80.977	%
Load resistance for maximum power	4.1781	Ω

Notes for this case

• Ideal single-diode curve I = I_sc − I₀(e^(V/N_s nV_t) − 1) with I₀ from V_oc; operating point where the curve meets I = V/R. Series and shunt resistance are neglected, so the fill factor is slightly optimistic. A maximum power point tracker keeps the load at R_mp as irradiance changes.

Formula and method

$$I = I_{sc} - I_0\left(e^{V/(N_s n V_t)} - 1\right), \quad I_0 = \frac{I_{sc}}{e^{V_{oc}/(N_s n V_t)} - 1}, \quad I = \frac{V}{R}$$

Variables

I_{sc}	Short-circuit current	A
V_{oc}	Open-circuit voltage	V
N_s	Cells in series	-
n	Diode ideality factor	-
T_c	Cell temperature	K
R	Load resistance	Ω
V	Operating voltage	V
I	Operating current	A
P	Power delivered	W
P_{mp}	Maximum power of the curve	W
P/P_{mp}	Utilisation of available power	-
R_{mp}	Load resistance for maximum power	Ω

Method and standards

PV and load matching.

Assumptions and limits

- Ideal diode; uniform irradiance; no series or shunt resistance.

References

Ideal single-diode PV characteristic and load line

Report details

Report reference	FCC-SCWN-YFSM (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-resistive-load-operating-point

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.