# Solar Charge Controller Sizing (PWM and MPPT)

Current rating of a PWM or MPPT solar charge controller from array short-circuit current or power and battery voltage, and the cold open-circuit voltage.

**Method:** Charge controller sizing from array current; power and voltage

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Module short-circuit current | 11.000 | A |
| Strings in parallel | 2.0000 | |
| Module open-circuit voltage | 49.000 | V |
| Modules in series per string | 2.0000 | |
| Array rated power | 2.1800 | kW |
| Battery bank voltage | 48.000 | V |
| Safety factor on current | 1.2500 | |
| Cold-temperature factor on V_oc | 1.1200 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| PWM controller rating | 27.500 | A |
| MPPT controller output rating | 56.771 | A |
| Maximum array open-circuit voltage (cold) | 109.76 | V |
| Array short-circuit current | 22.000 | A |

### Notes for this case

• A PWM controller connects the array directly to the battery, so it must carry the array's short-circuit current with a margin (about 1.25), and the array's maximum-power voltage should be only a little above the battery's. An MPPT controller converts the array power to battery voltage, so its output current is about P/V_battery with the same margin, and it can take a higher-voltage array. In both cases the cold-morning open-circuit voltage (V_oc raised by roughly 0.3 % per °C below 25 °C) must stay below the controller's maximum input voltage.

## Formula and method

$$I_{PWM} = k_s N_p I_{sc}, \quad I_{MPPT} = k_s \frac{P_a}{V_b}, \quad V_{max} = k_T N_s V_{oc}$$

### Variables

| | | |
|---|---|---|
| $I_{sc}$ | Module short-circuit current | A |
| $N_p$ | Strings in parallel | - |
| $V_{oc}$ | Module open-circuit voltage | V |
| $N_s$ | Modules in series per string | - |
| $P_a$ | Array rated power | W |
| $V_b$ | Battery bank voltage | V |
| $k_s$ | Safety factor on current | - |
| $k_T$ | Cold-temperature factor on V_oc | - |
| $I_{PWM}$ | PWM controller rating | A |
| $I_{MPPT}$ | MPPT controller output rating | A |

| | | |
|---|---|---|
| $V_{max}$ | Maximum array open-circuit voltage (cold) | V |
| $I_a$ | Array short-circuit current | A |

### Method and standards

Charge controller.

### Assumptions and limits

- Rated module values; margin as entered.

### References

Charge controller sizing from array current, power and voltage

## Report details

| | |
|---|---|
| Report reference | FCC-DBZE-9Z88 (the same inputs always give the same reference) |
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| Method last reviewed | 17 November 2026 |
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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/solar-charge-controller-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.