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# Components of PV systems

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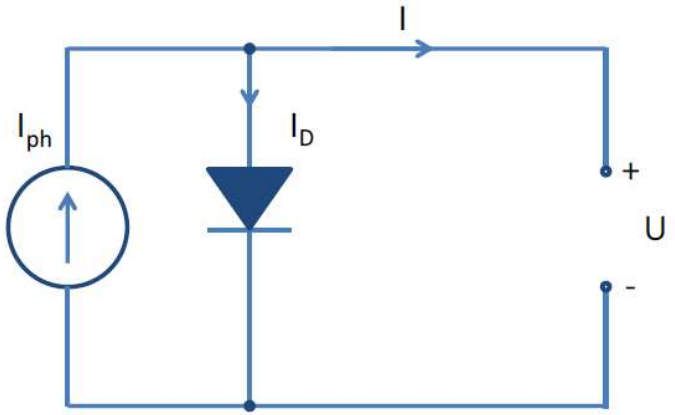
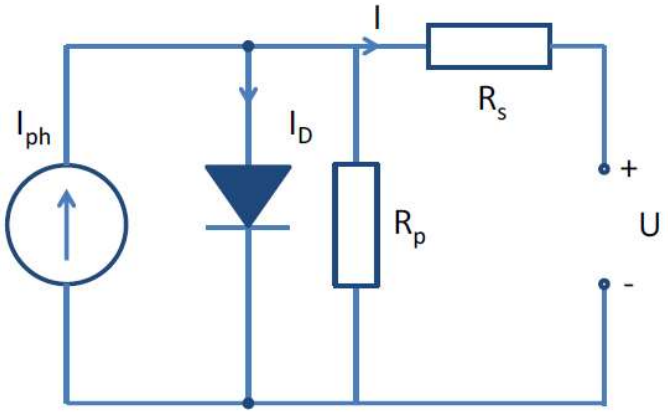
# Electric model of PV cell




Ideal PV cell




Real PV cell

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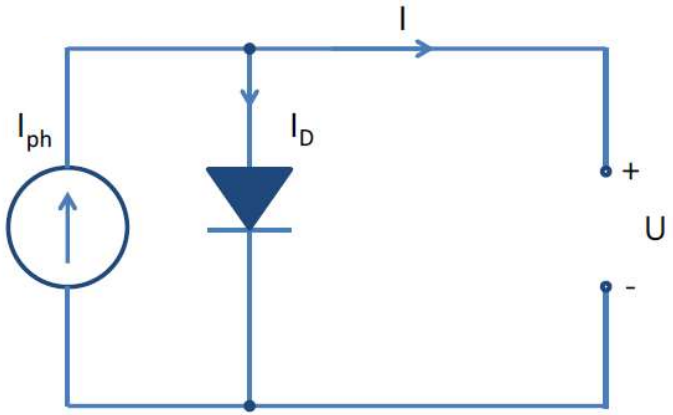
# Electric model of PV cell




The electric model of ideal PV cell contains:

- Current generator $I_{ph}$
- Diode $I_D$

Current I is flowing and on the end of the conductors we got voltage U

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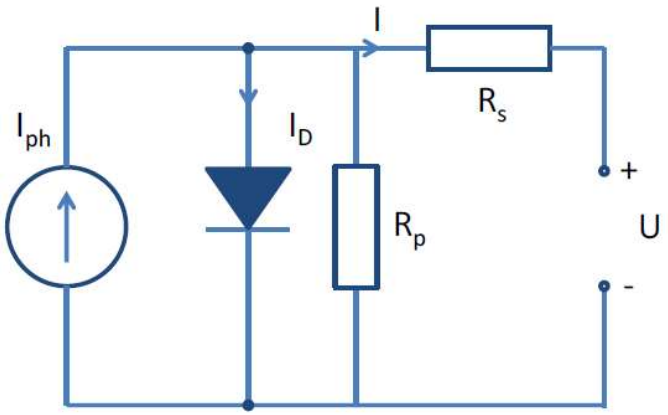
# Electric model of PV cell

The electric model of real PV cell contains:

- Current generator $I_{ph}$
- Diode $I_D$
- Serial resistor $R_s$
- Parallel resistor $R_p$

Current I is flowing, on the end of the conductors we got voltage U, while some losses are given thru the resistors $R_s$ and $R_p$



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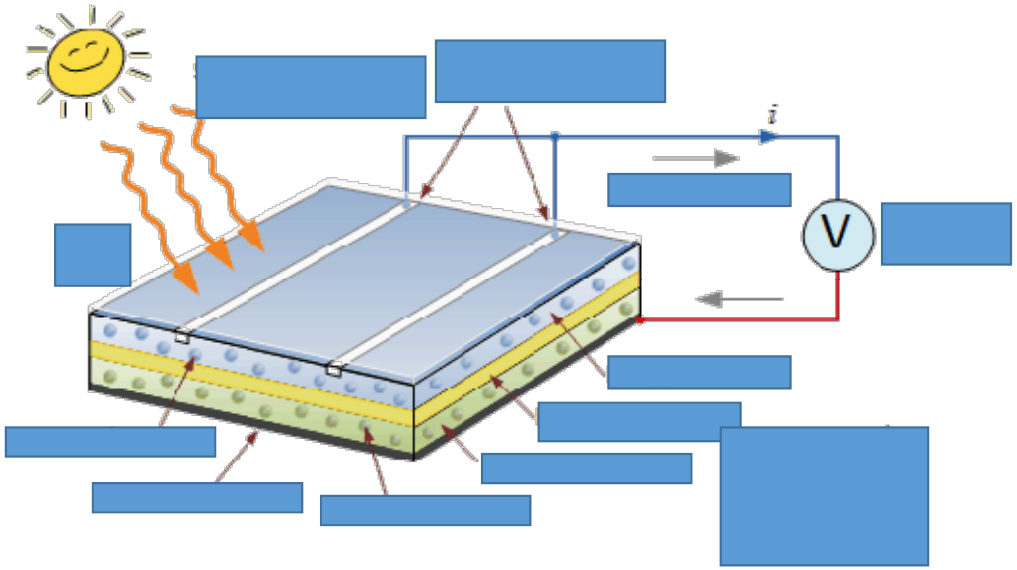
# PV cell



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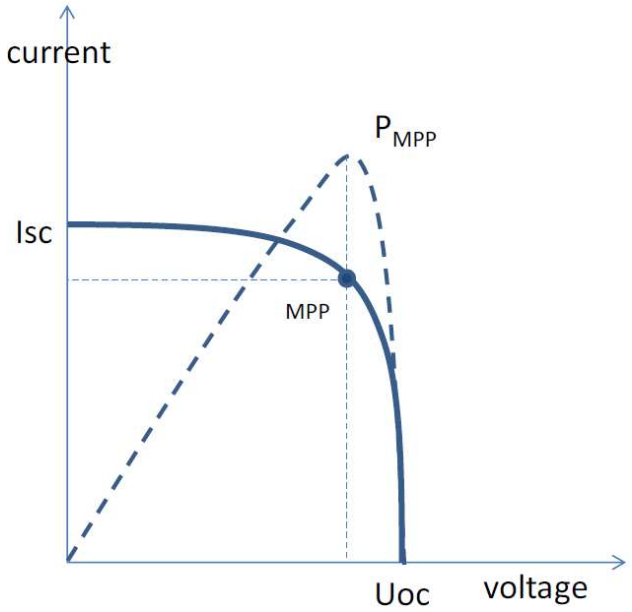
# UI diagram and Maximal Power Point




The UI diagram is representing the curve of the dependence between current I and voltage U

$I_{sc}$ is short circuit current when U=0
$U_{oc}$ in open circuit voltage when I=0

MPP is Maximal Power Point
$P_{MPP}$ is the power at MPP

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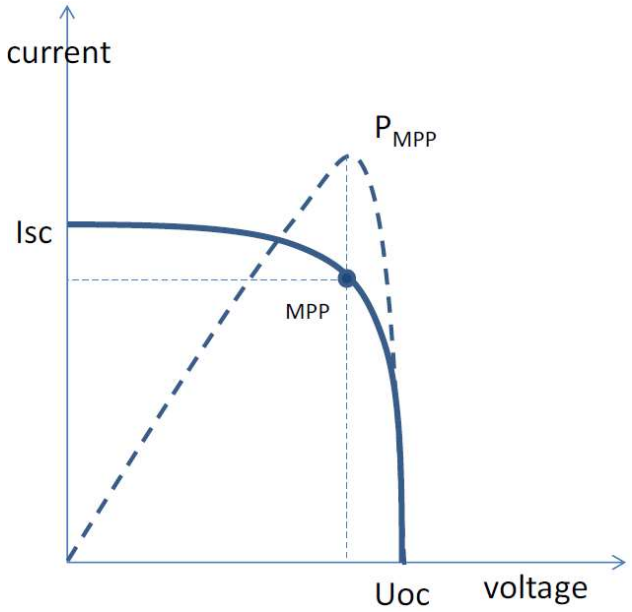
# UI diagram and Maximal Power Point




$$P = I \cdot U$$

$$P_{MPP} = I_{MPP} \cdot U_{MPP}$$

$$FF = \frac{I_{MPP} \cdot U_{MPP}}{I_{SC} \cdot U_{OC}}$$

$$FF \rightarrow 1$$

The Fill Factor FF is the available power at MPP divided by the short circuit current $I_{sc}$ and the open circuit voltage $U_{oc}$

The Fill Factor FF is a measure of quality of a solar cell and it allways should tend to 1

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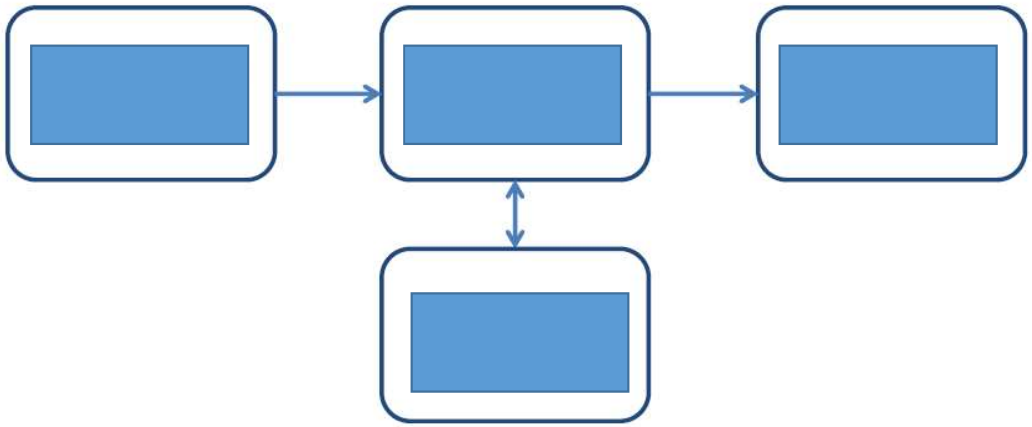
# Working principal of PV system



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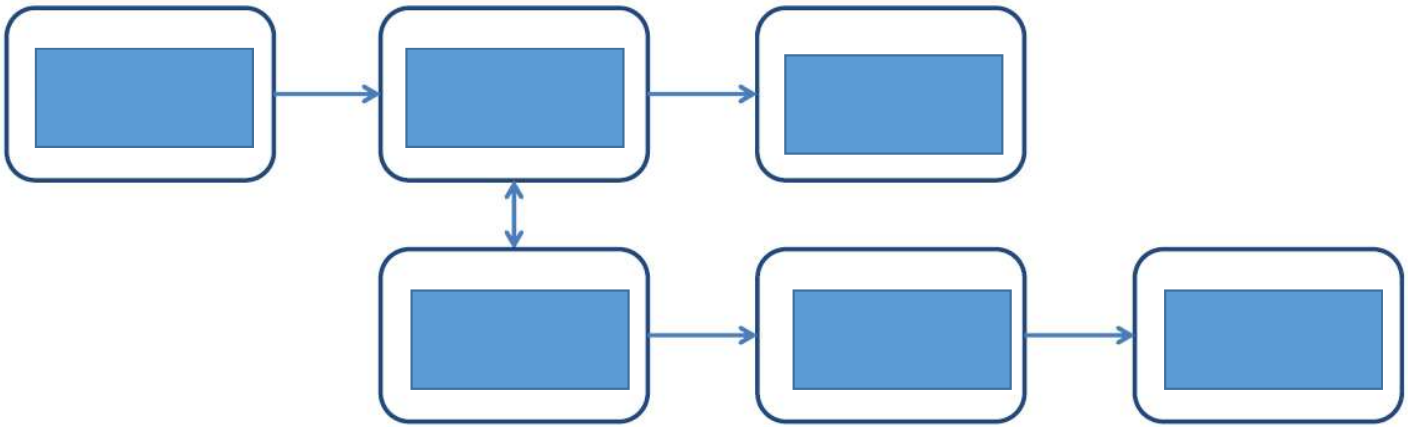
# Off-grid PV system



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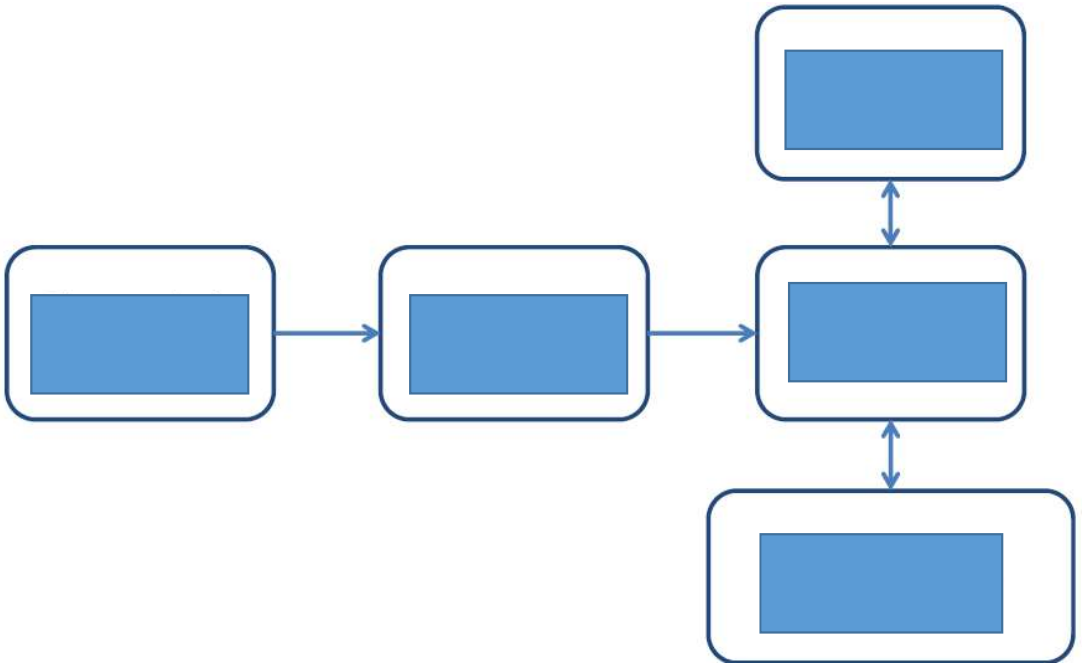
# On-grid PV system



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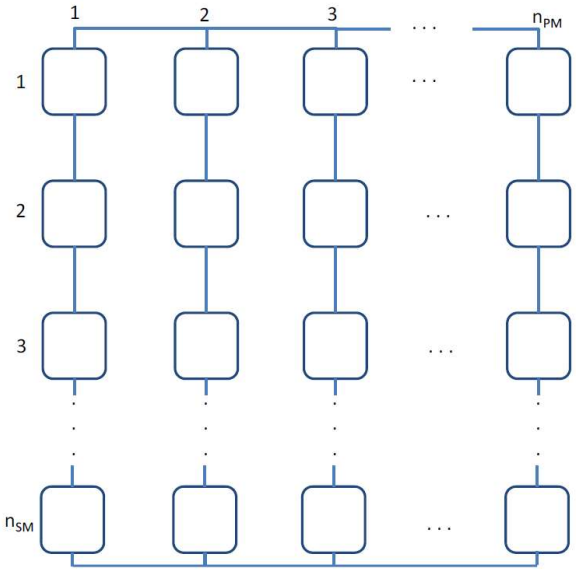
# PV modules




PV module is a collection of PV cells connected in series and in parallel.

Typical PV module contains 36, 48 or 72 PV cells

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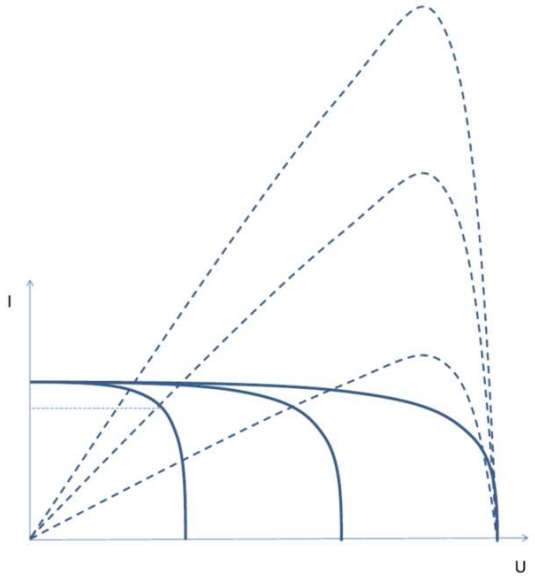
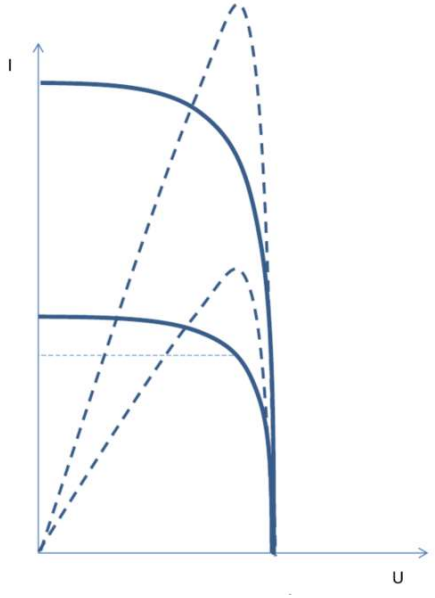
# PV modules




Serial connection




Parallel connection

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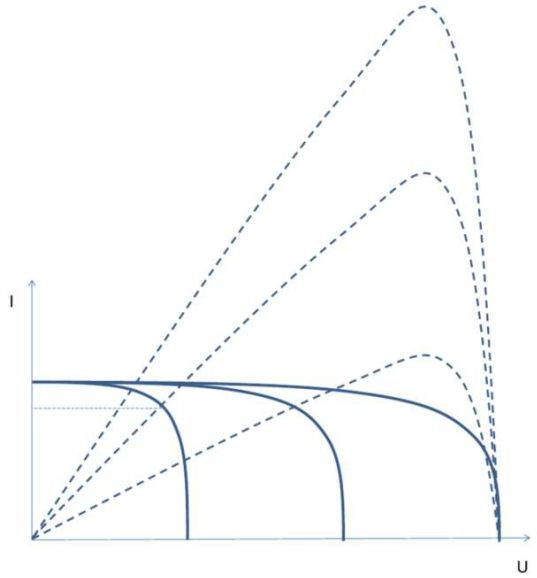
# PV modules




Serial connection

The serial connection of PV cells is summing up the voltage of every PV cell, while the current is constant

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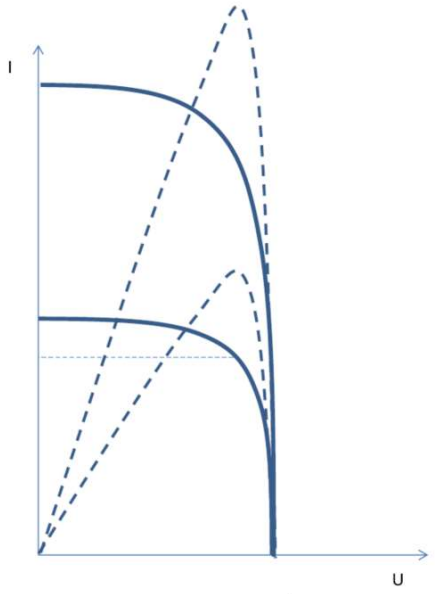
# PV modules

The parallel connection of PV cells is summing up the currents of every PV cell, while the voltage is constant




Parallel connection

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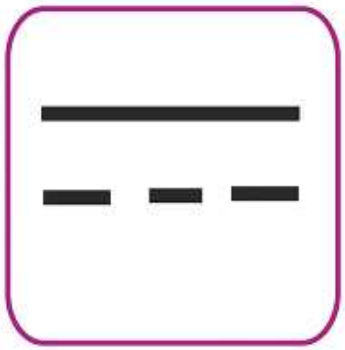
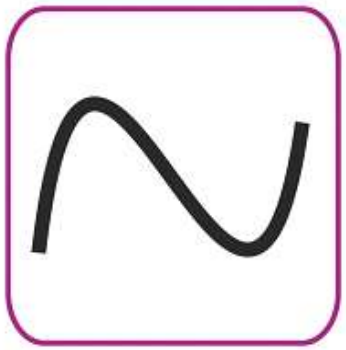
# Invertors



DC



AC

PV module produce DC current.

In order the power be used for every day use, a invertor is used to transform the DC current to AC current

Invertors can be single phase or three phase

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# Types of invertors

1. Central invertors
2. String invertors
3. Micro invertors

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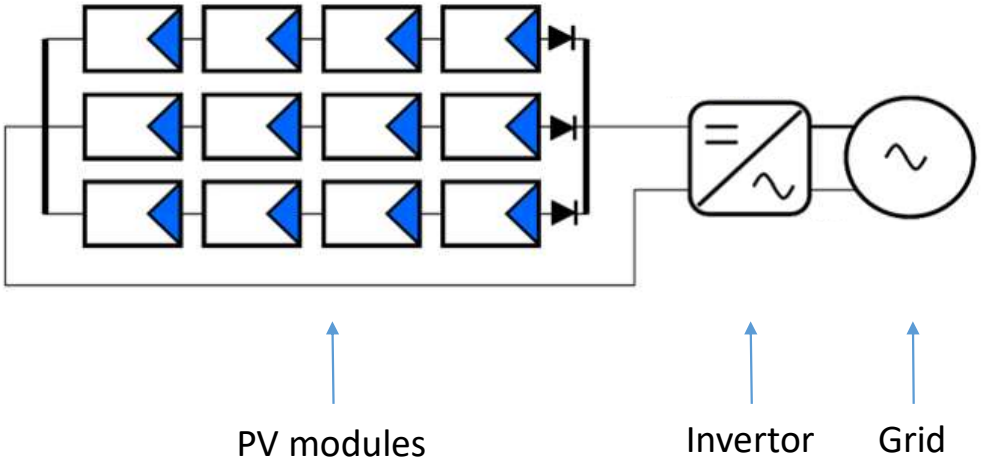
# Central invertor




In PV systems with central invertors only one invertor is used for the whole system

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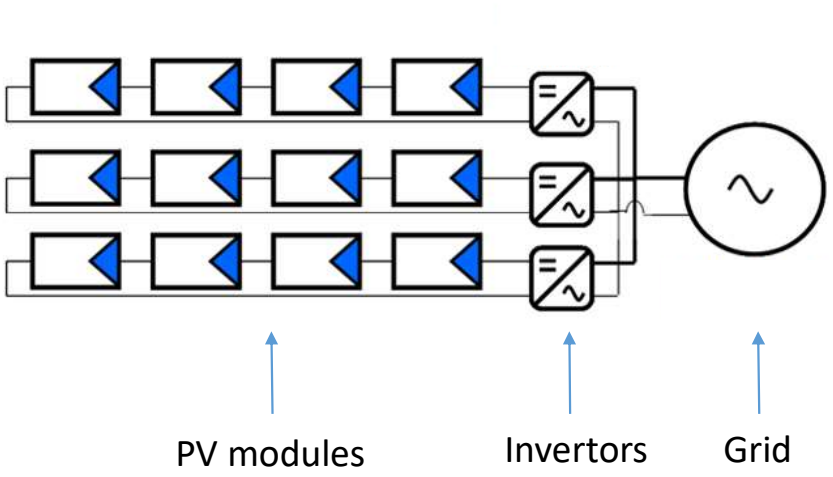
# String invertor




In PV systems with string invertors multiple invertors are used, one on every string of the system

The number of string invertors depends of the number of strings in the system

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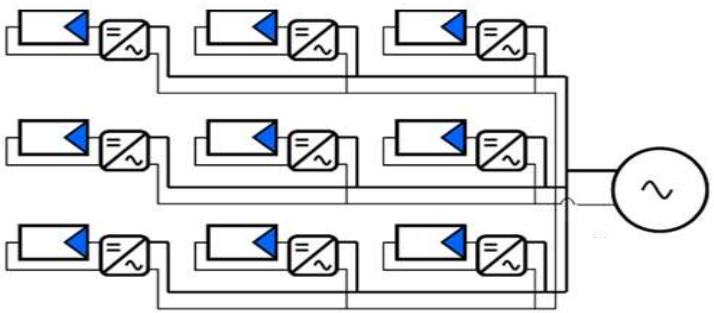
# Micro invertor




In PV systems with micro invertors multiple invertors are used, one on every PV module in the system

The number of micro invertors depends of the number of PV in the system

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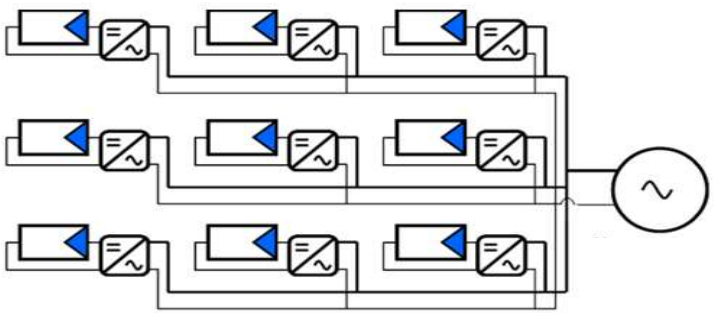
# Micro invertor




Advantages:
- More efficient
- Increased reliability of the PV system

Disadvantages:
- More expensive
- More difficult to install than other types

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# Thank you
# for the attention

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