



Univerza v Mariboru



Fakulteta za elektrotehniko,
računalništvo in informatiko

Reactive power generation in micro inverters for photovoltaic systems

Primož Sukič

Dušan Drevenšek

Ernest Belič

Katarina Dežan

Gorazd Štumberger

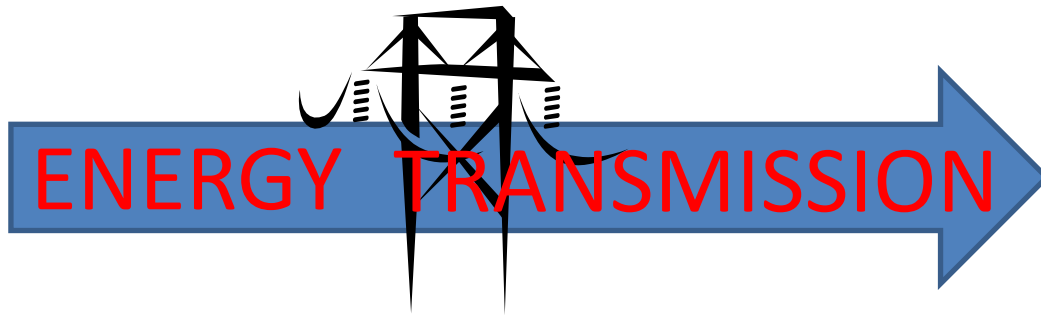
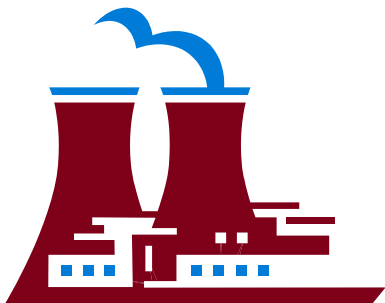
Laboratorij za energetiko

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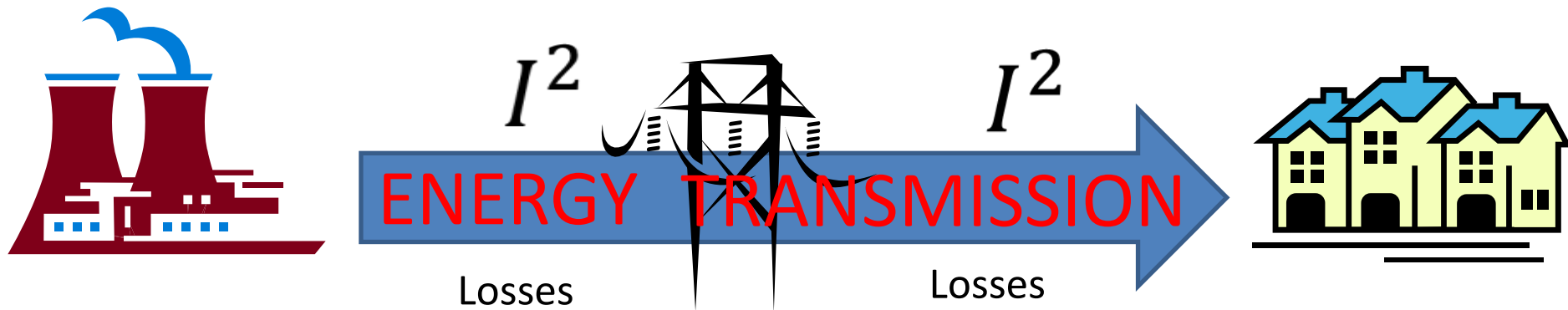
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- SOLAR INVERTER LIMITS
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GENERATION IN MICRO INVERTERS
- CONCLUSION

INTRODUCTION

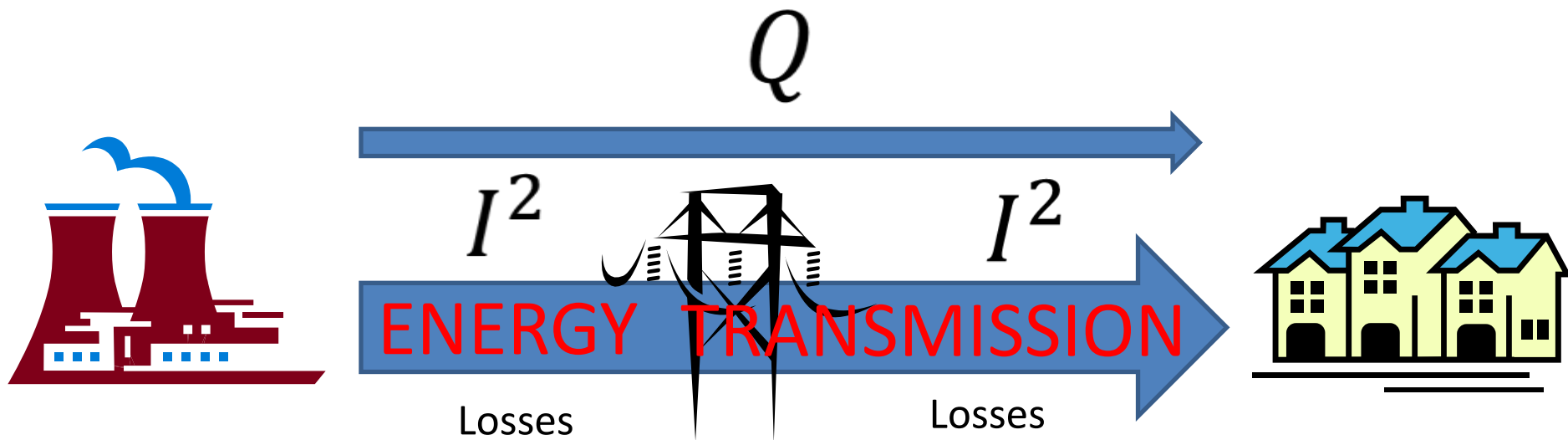
INTRODUCTION



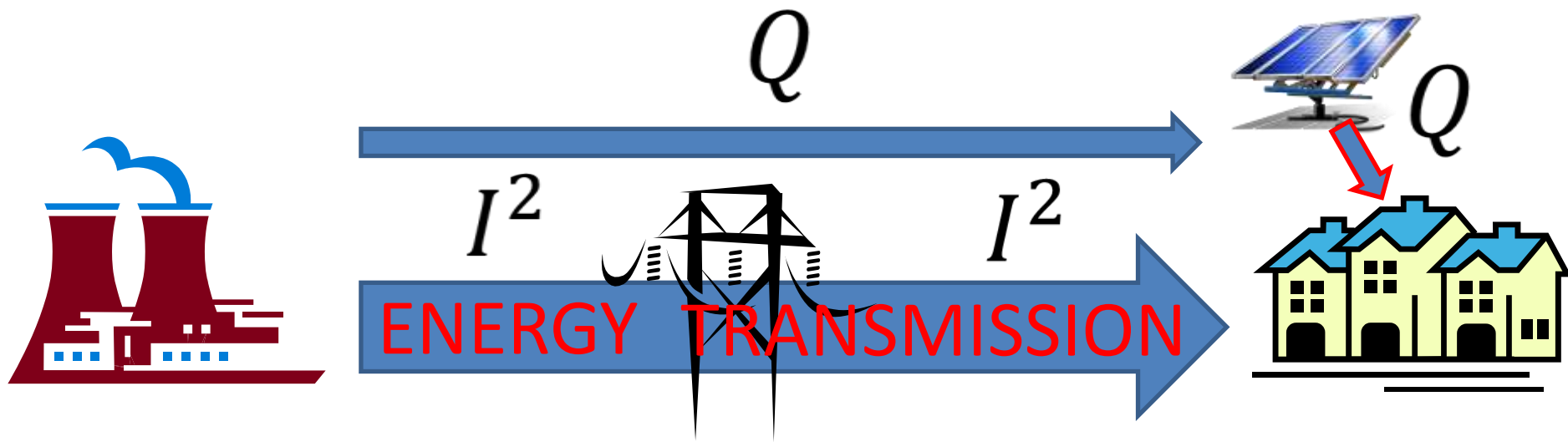
INTRODUCTION

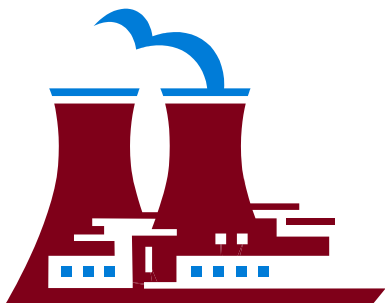


INTRODUCTION

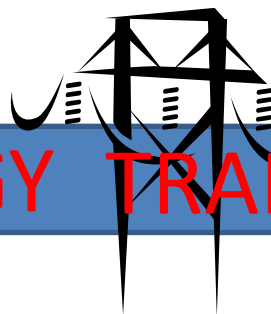


INTRODUCTION





I^2



I^2

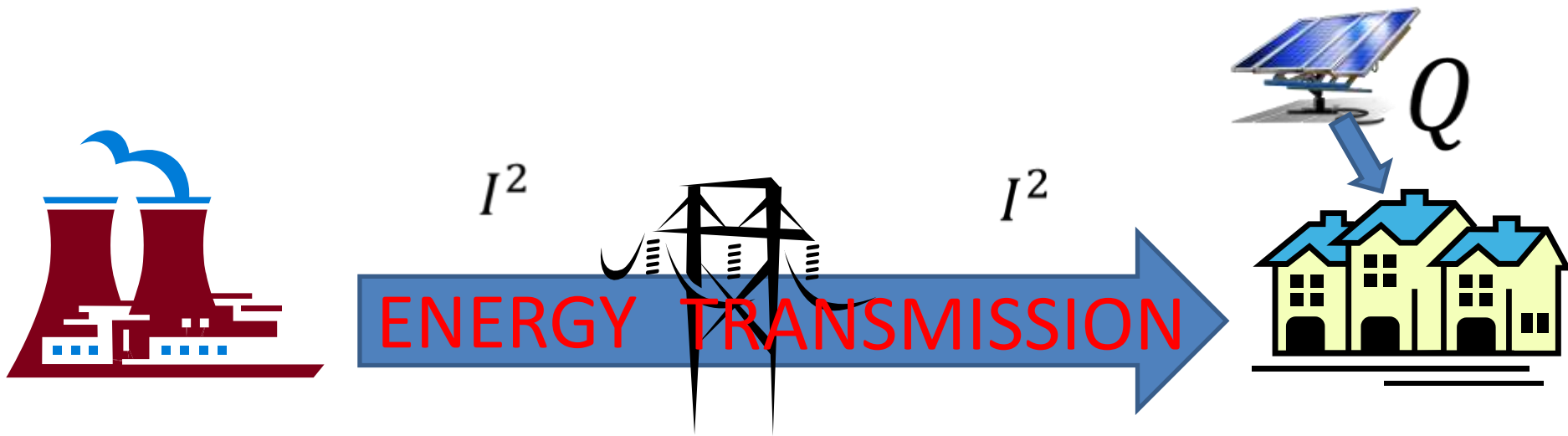
ENERGY TRANSMISSION



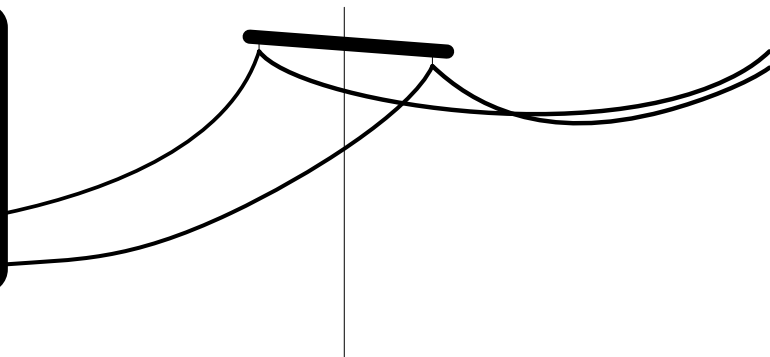
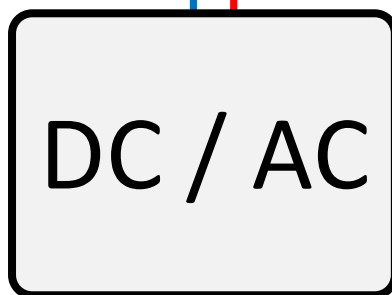
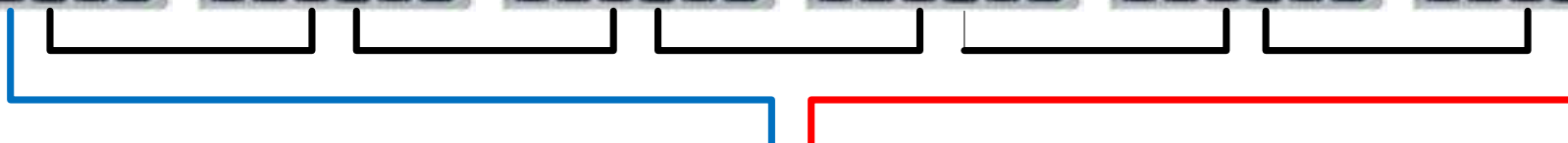
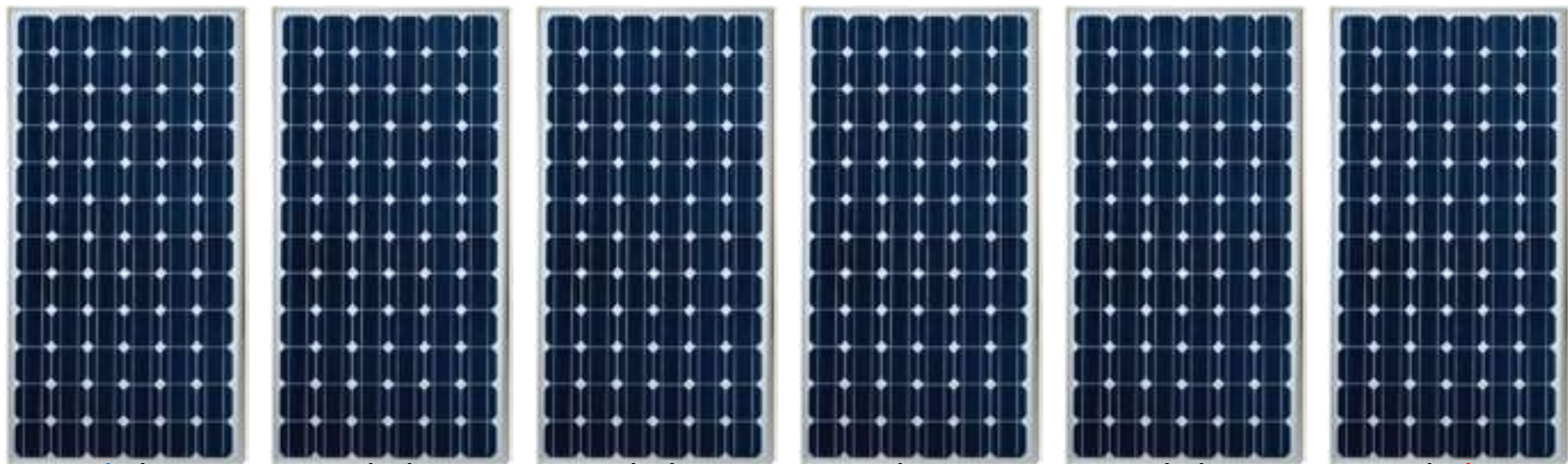
Q

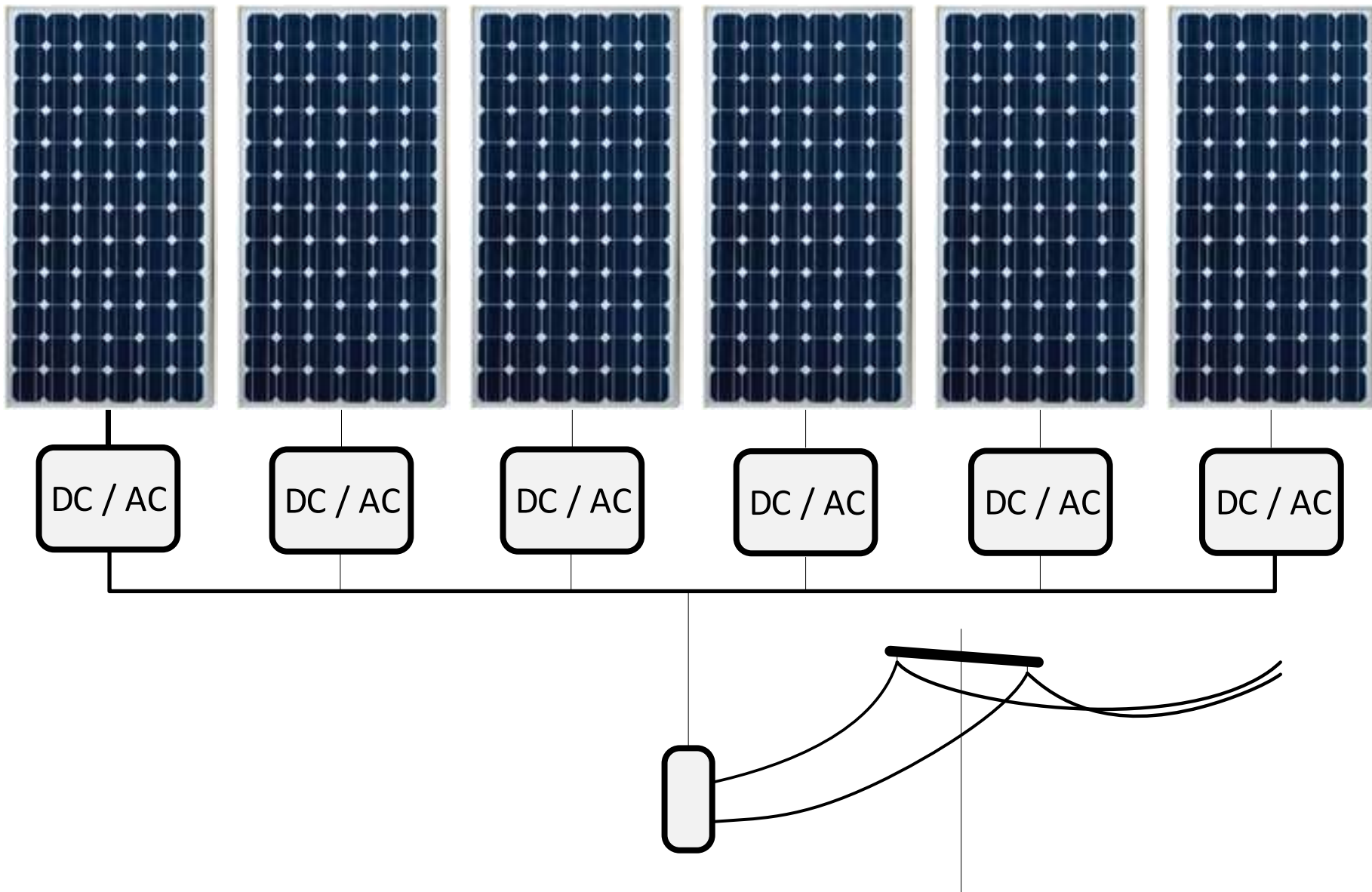


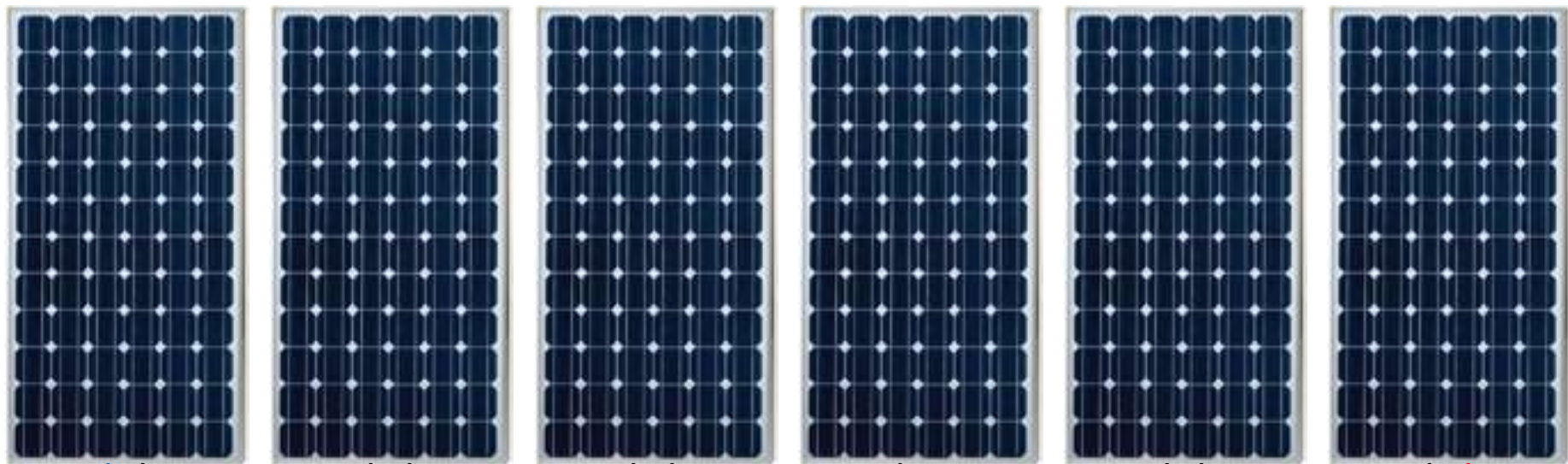
INTRODUCTION



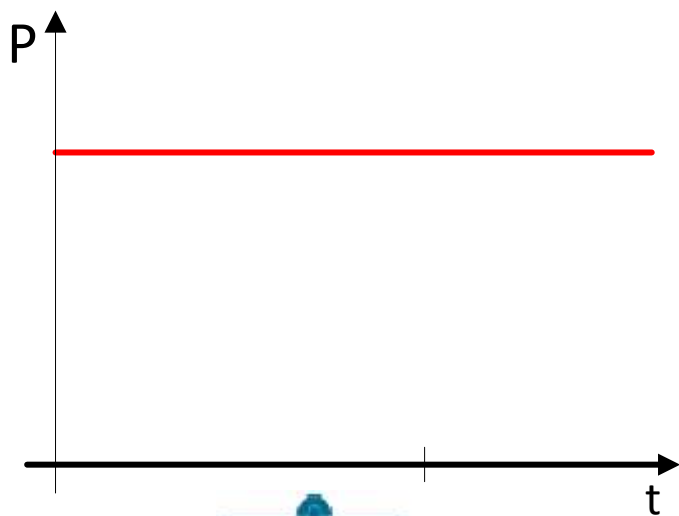
SOLAR INVERTERS

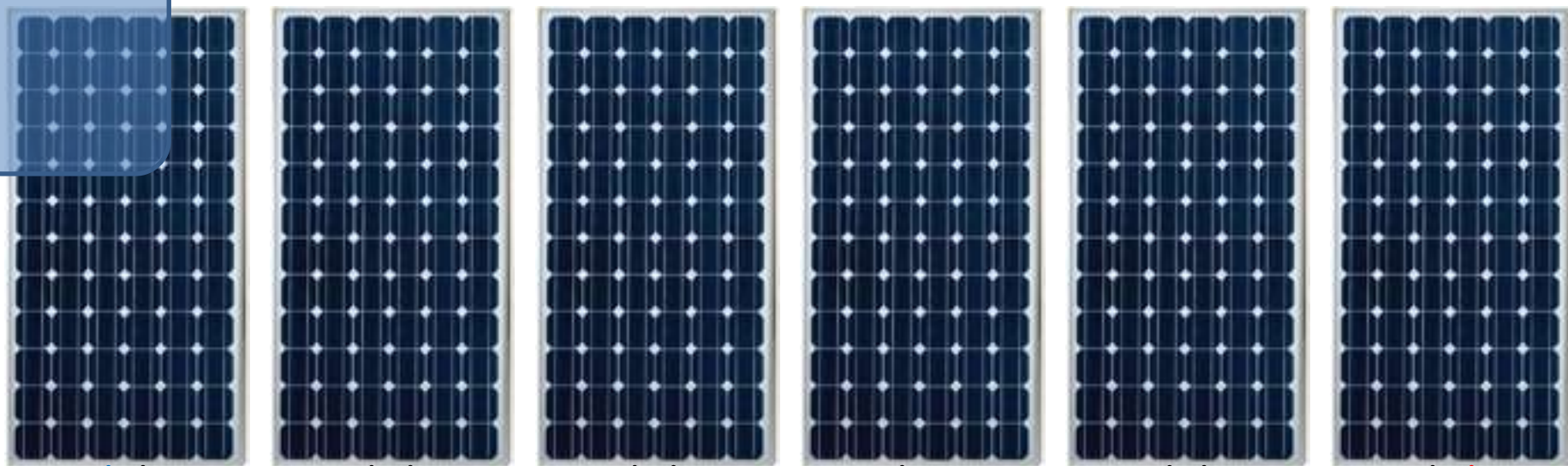
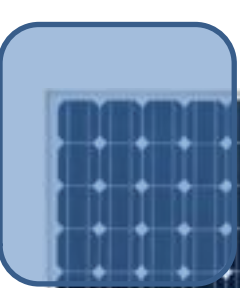




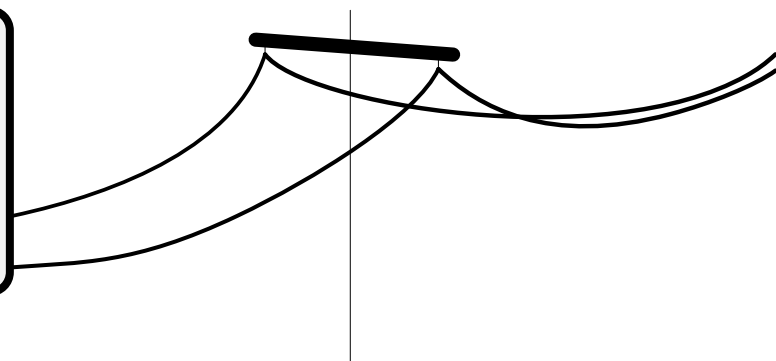
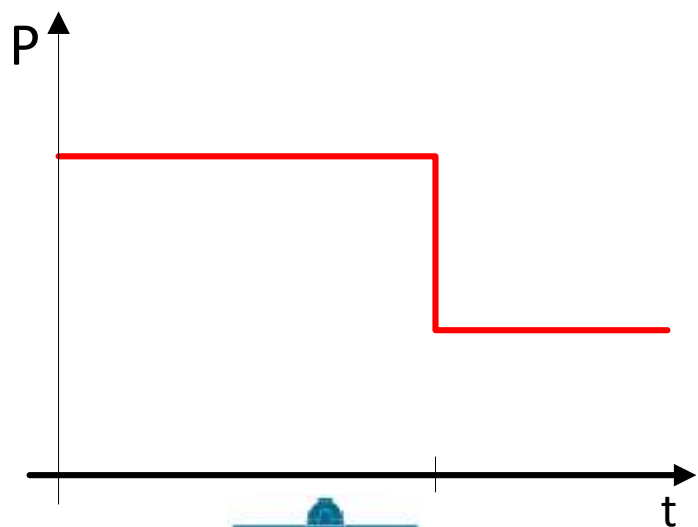


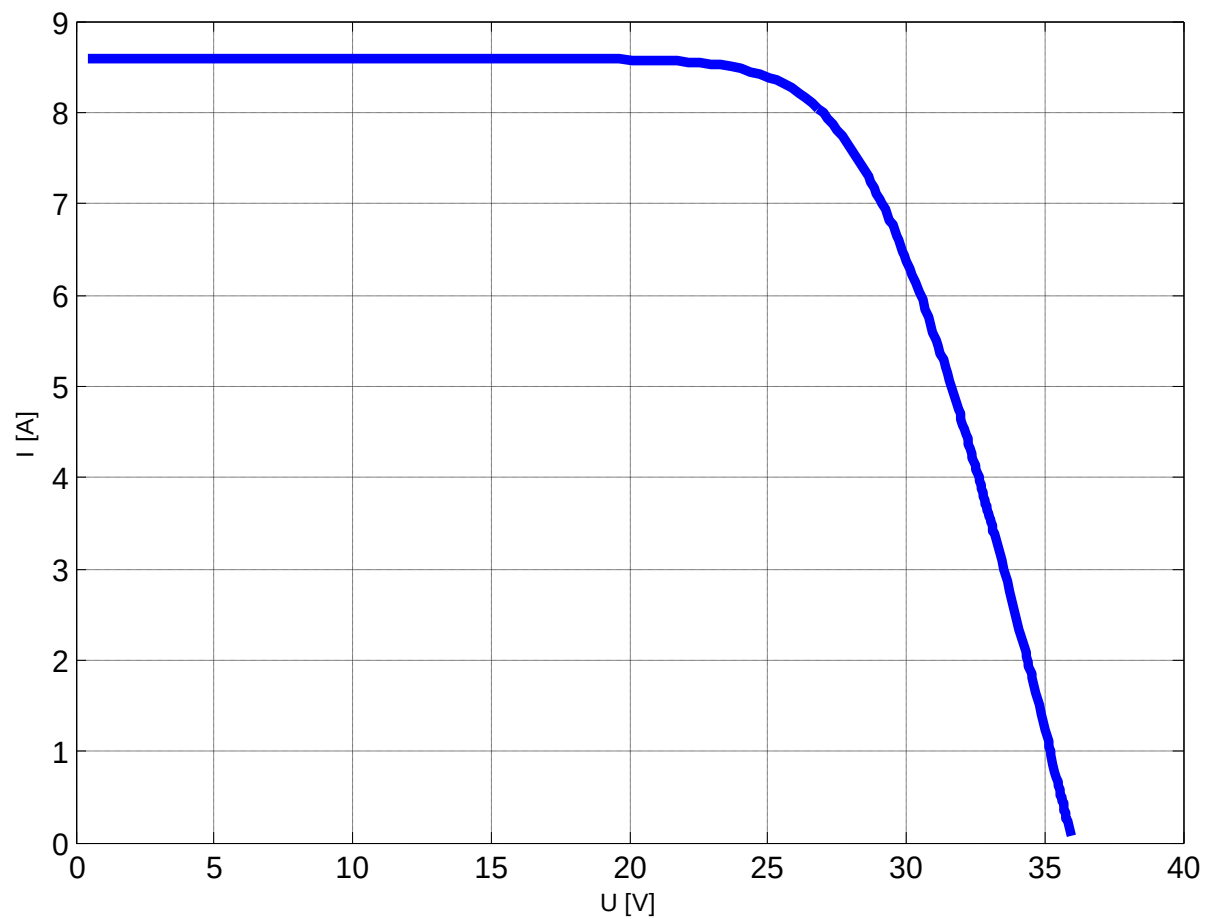
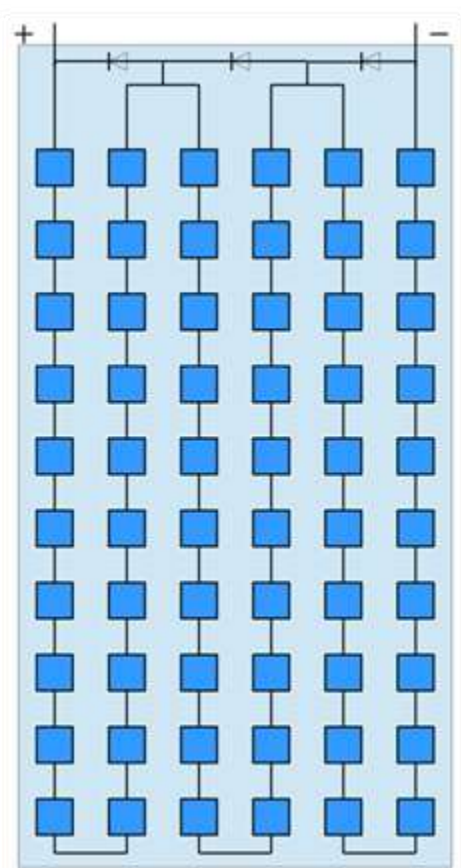
DC / AC

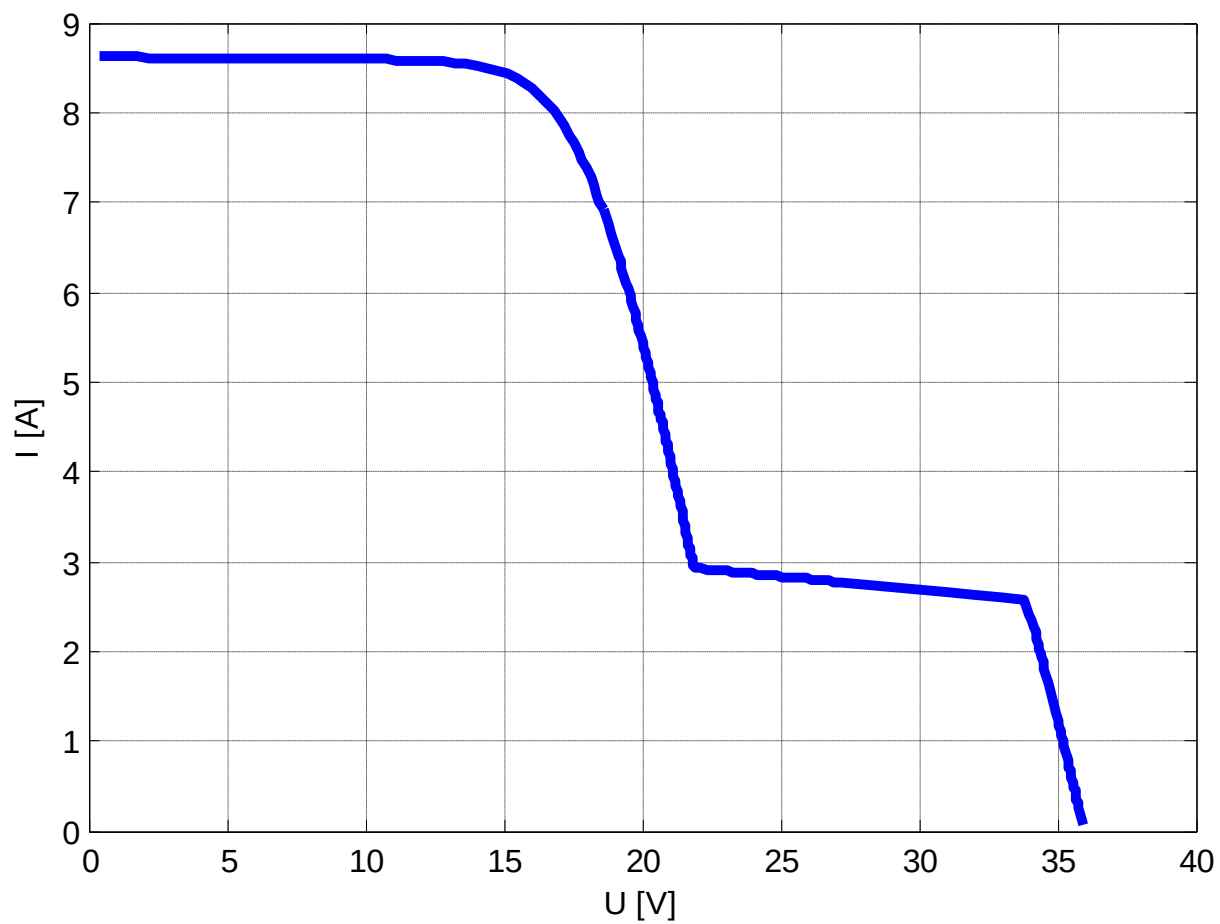
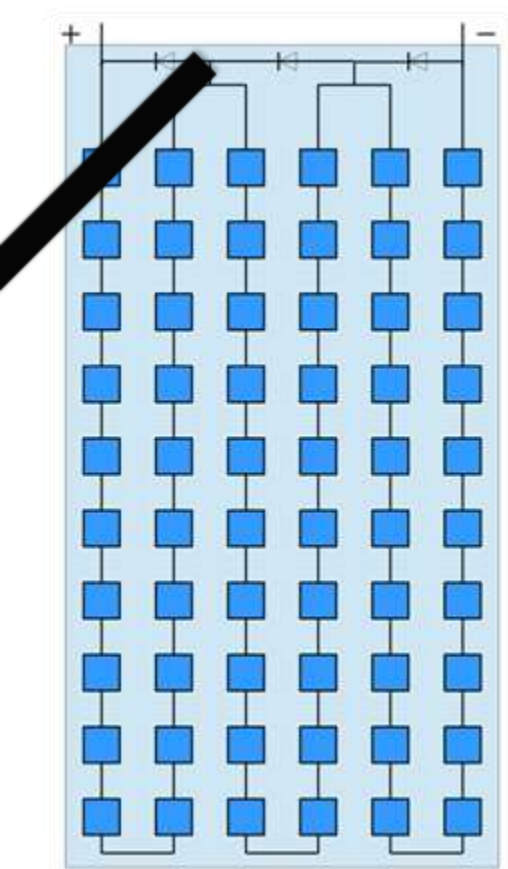


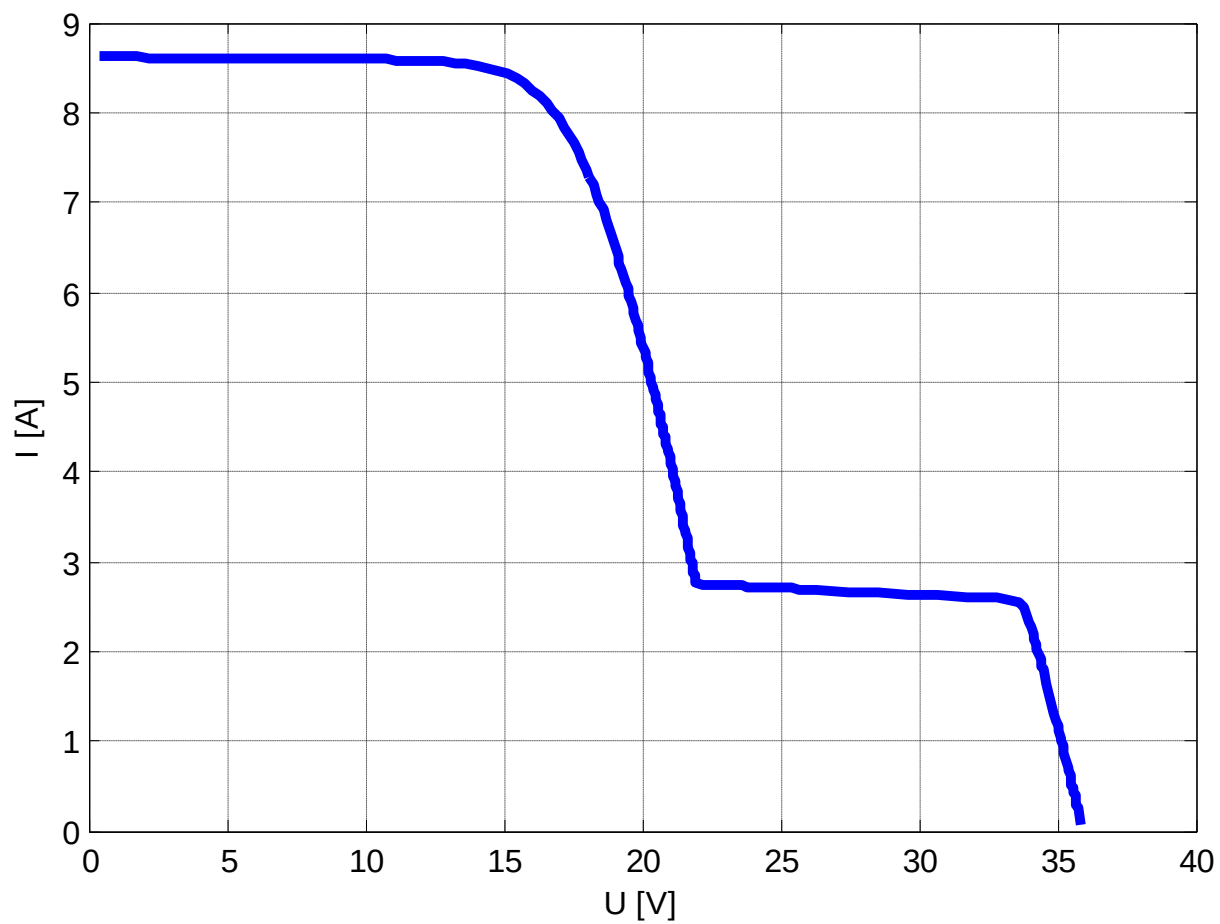
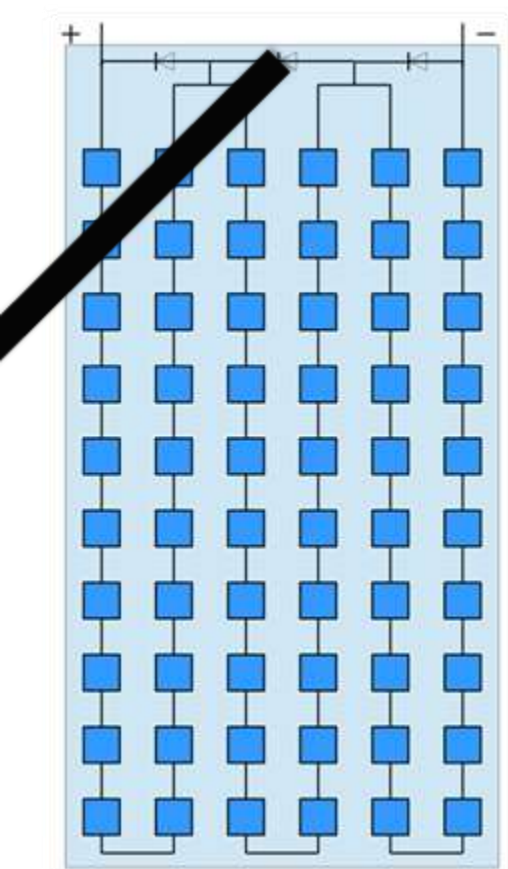


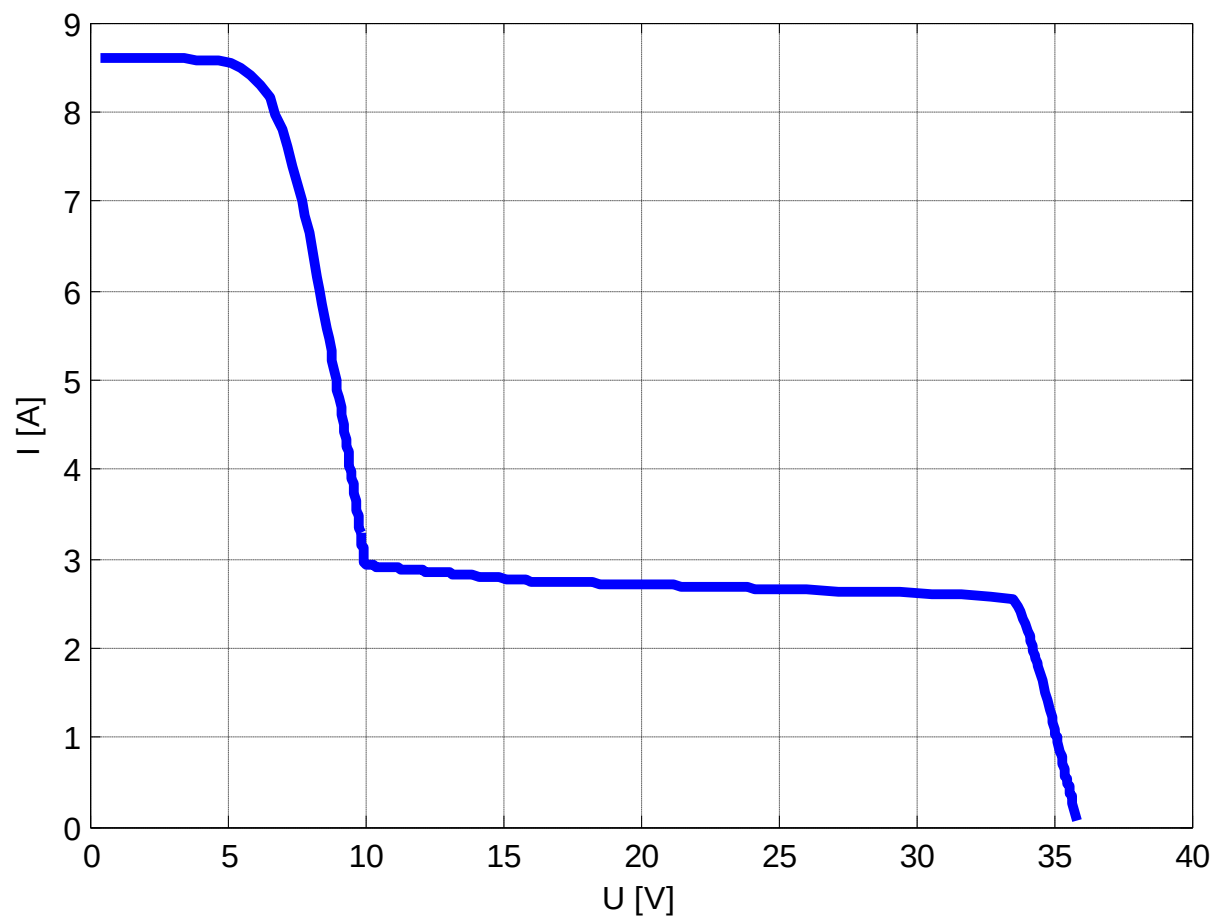
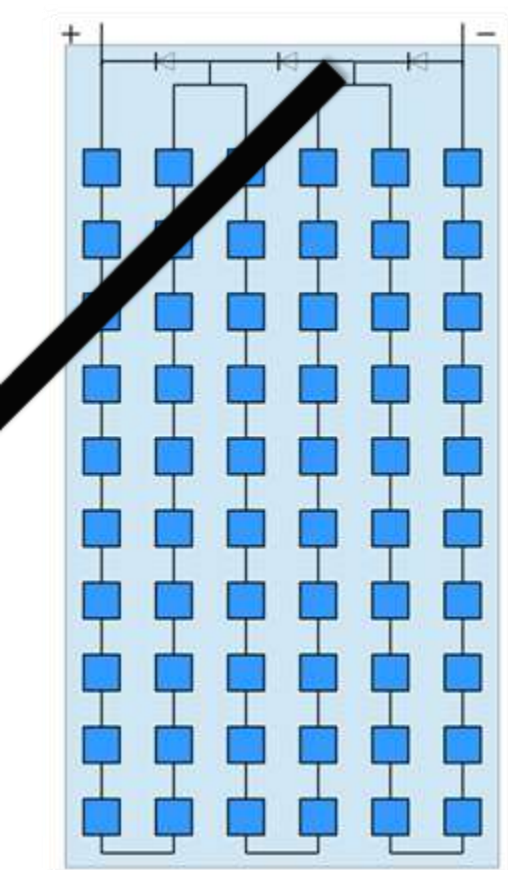
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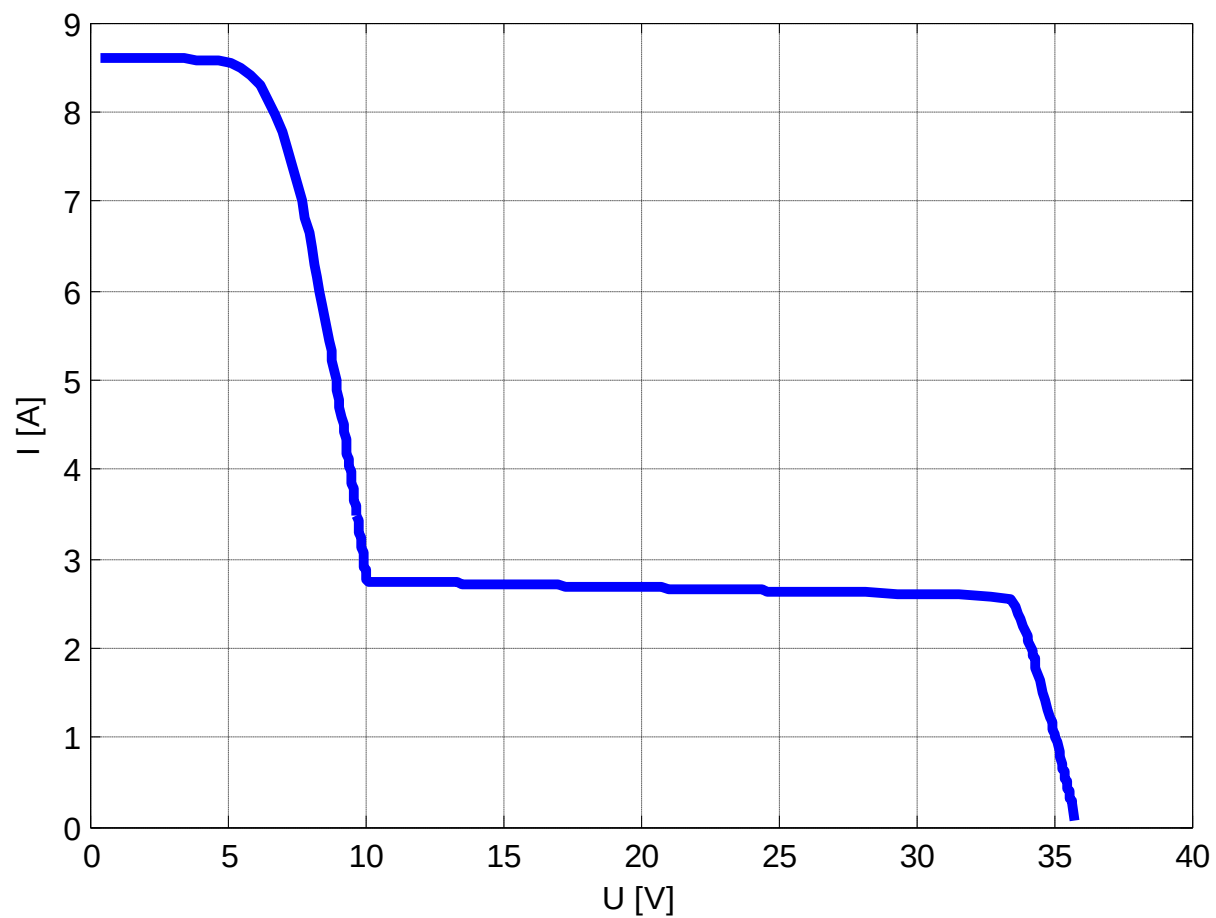
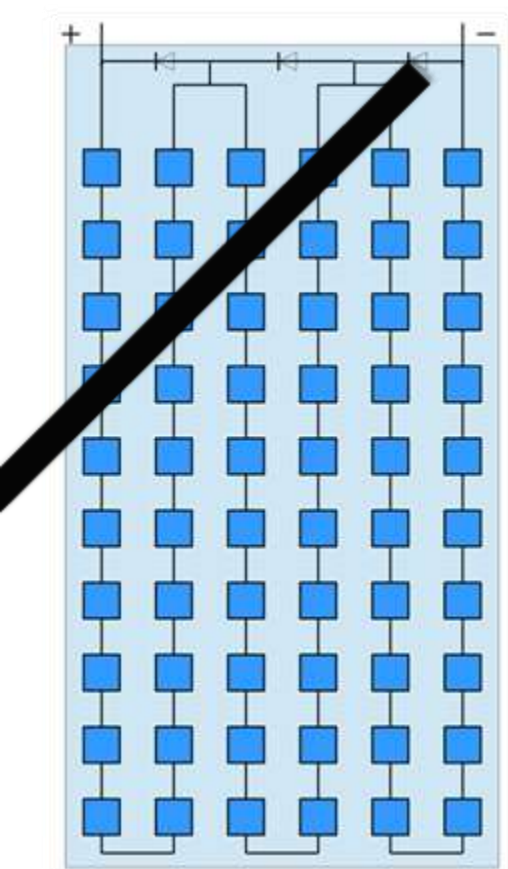


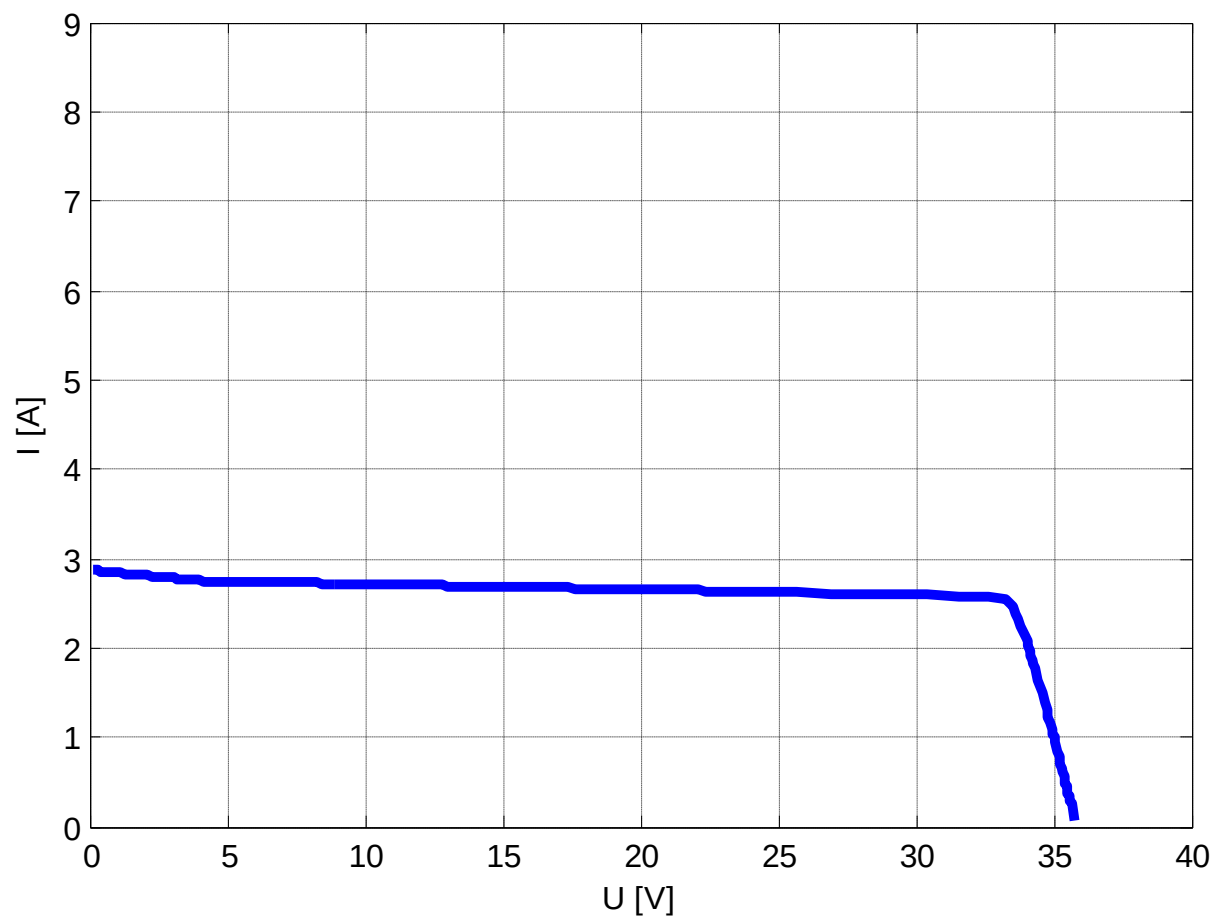
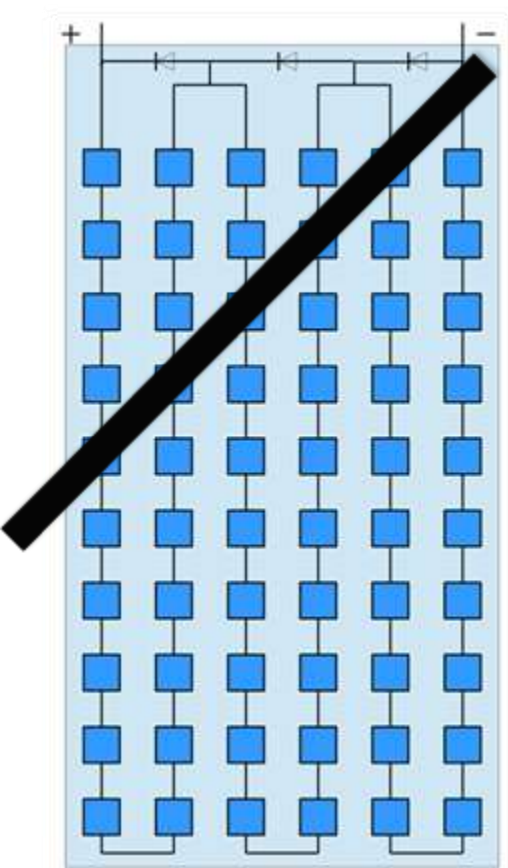


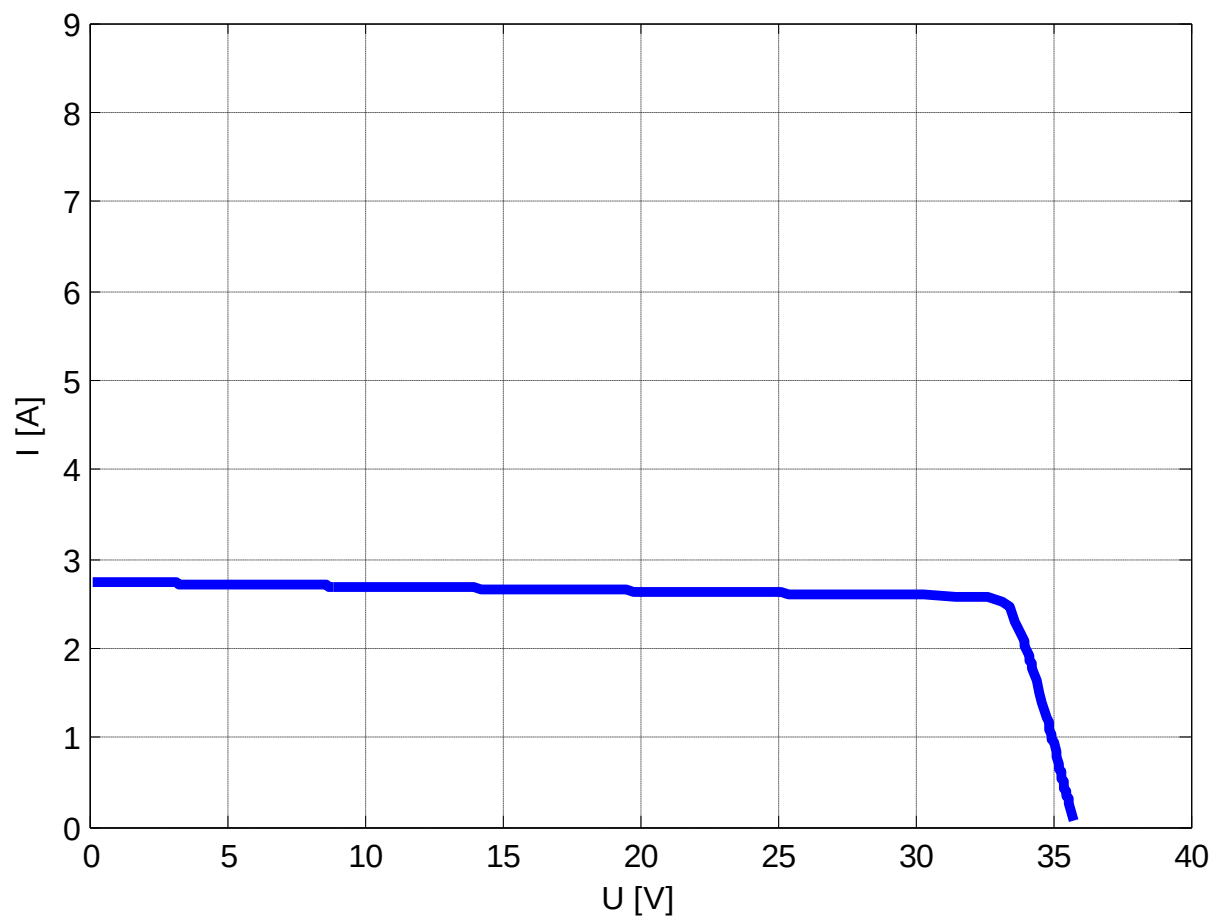
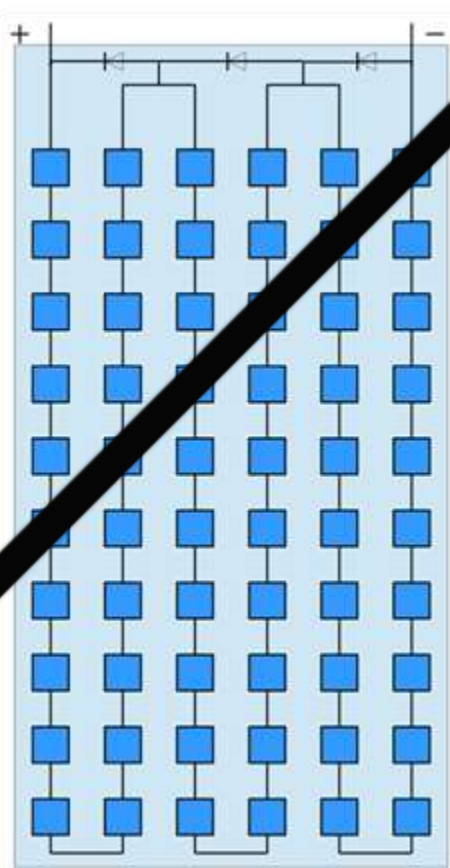


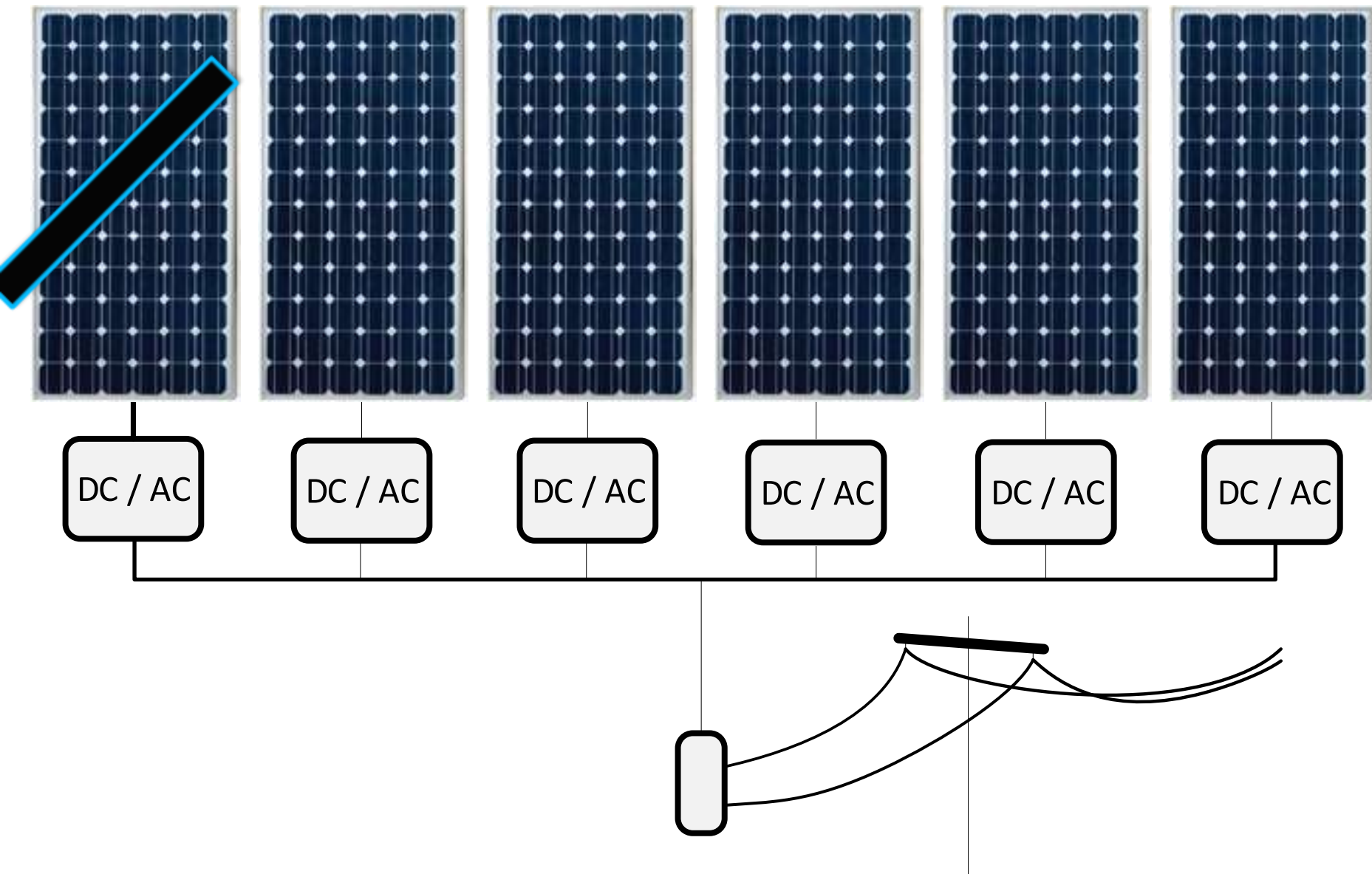


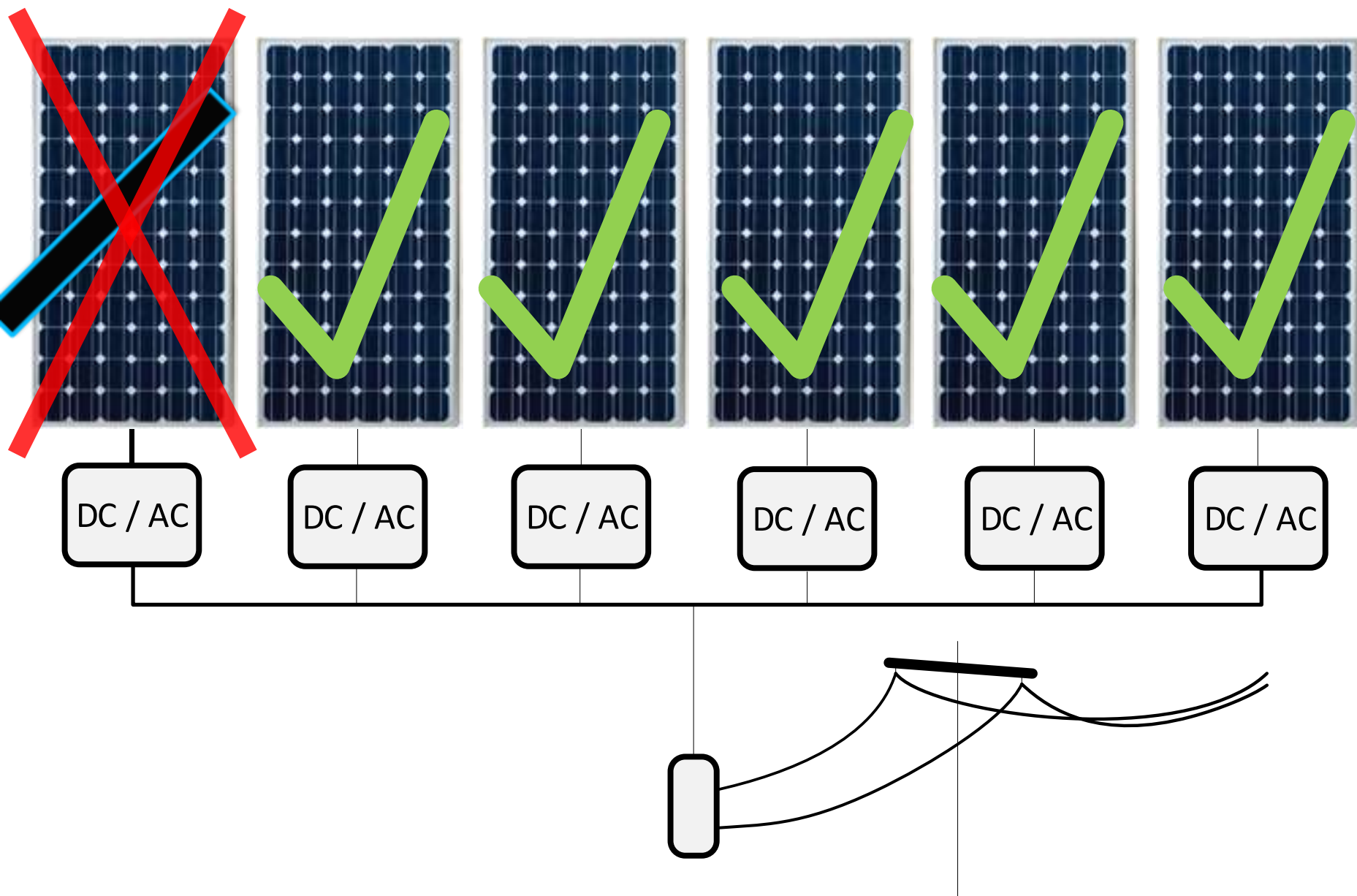














DC / AC

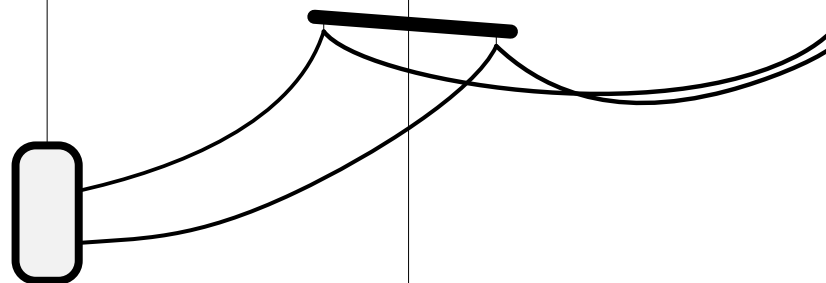
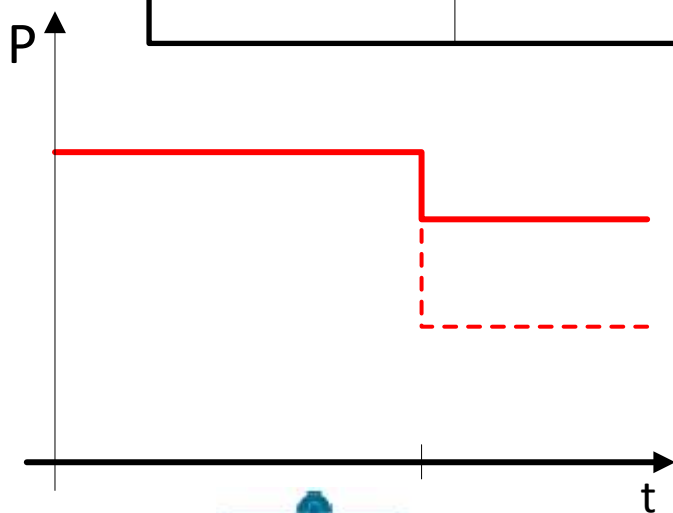
DC / AC

DC / AC

DC / AC

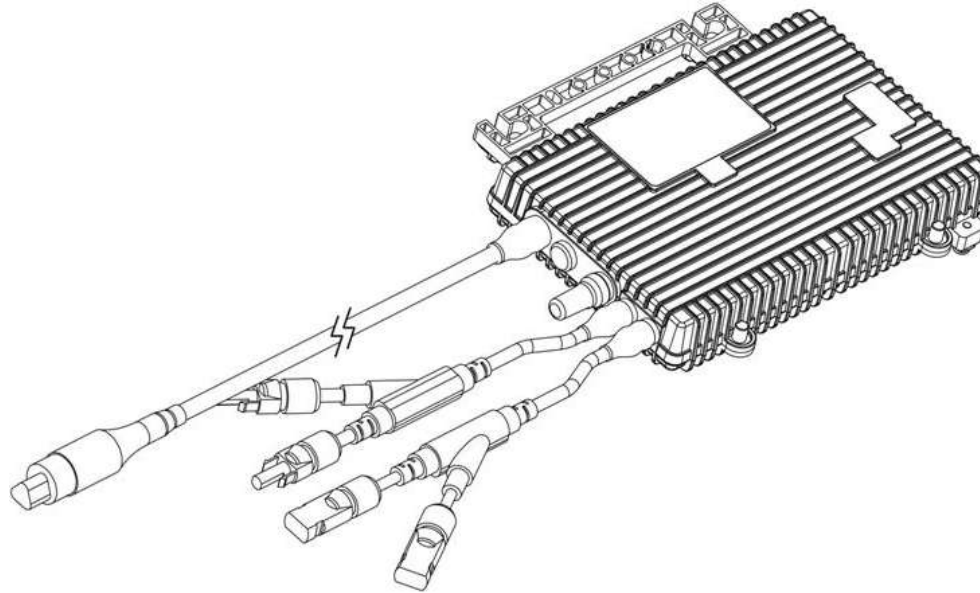
DC / AC

DC / AC



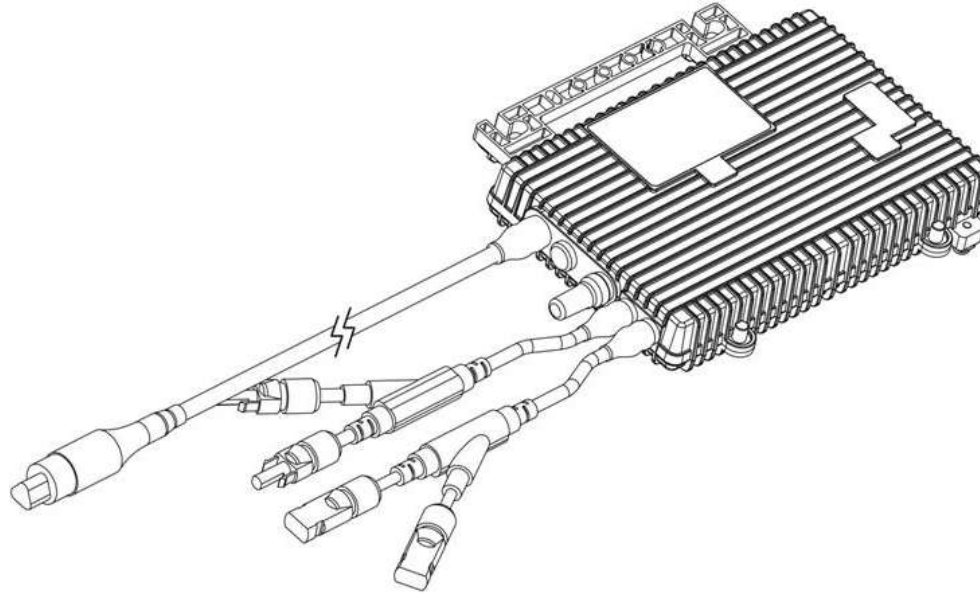
INVERTER LIMITS

INVERTER LIMITS



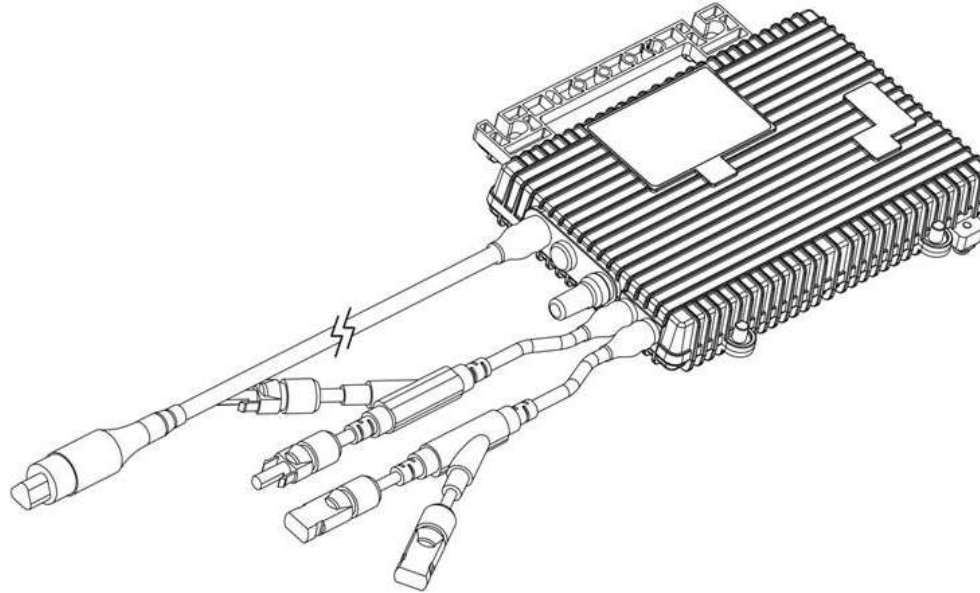
$I_{\max}$

INVERTER LIMITS



$$S_{\max} = U_{\text{ef}} \cdot I_{\max}$$

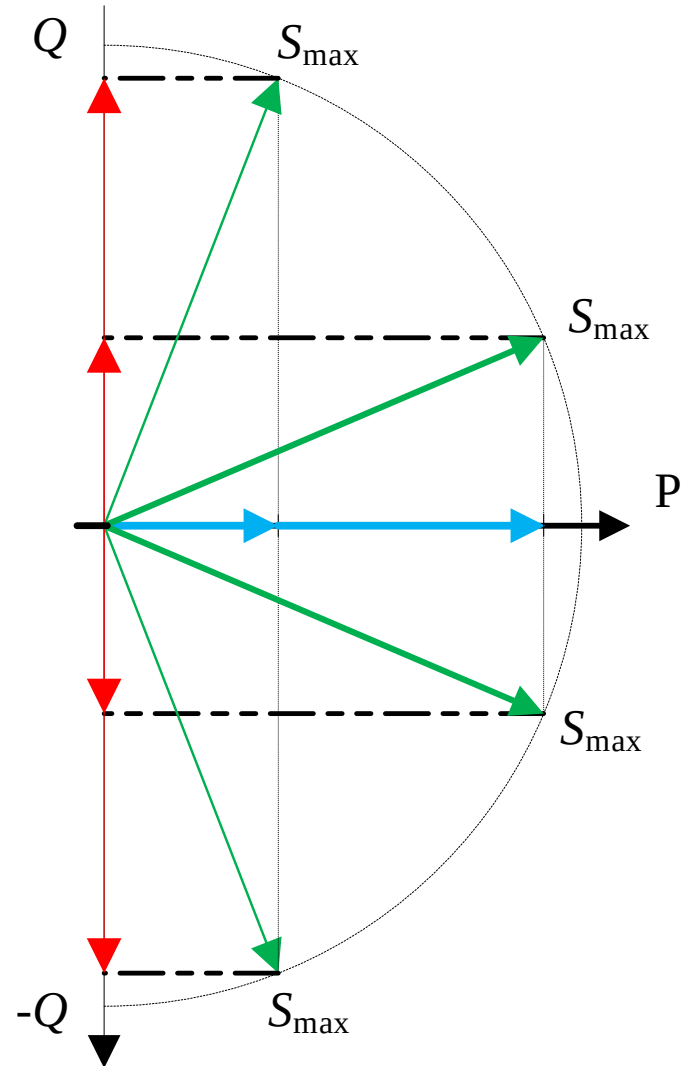
INVERTER LIMITS



$$Q_{max} = \sqrt{S_{max}^2 - P^2}$$

INVERTER LIMITS

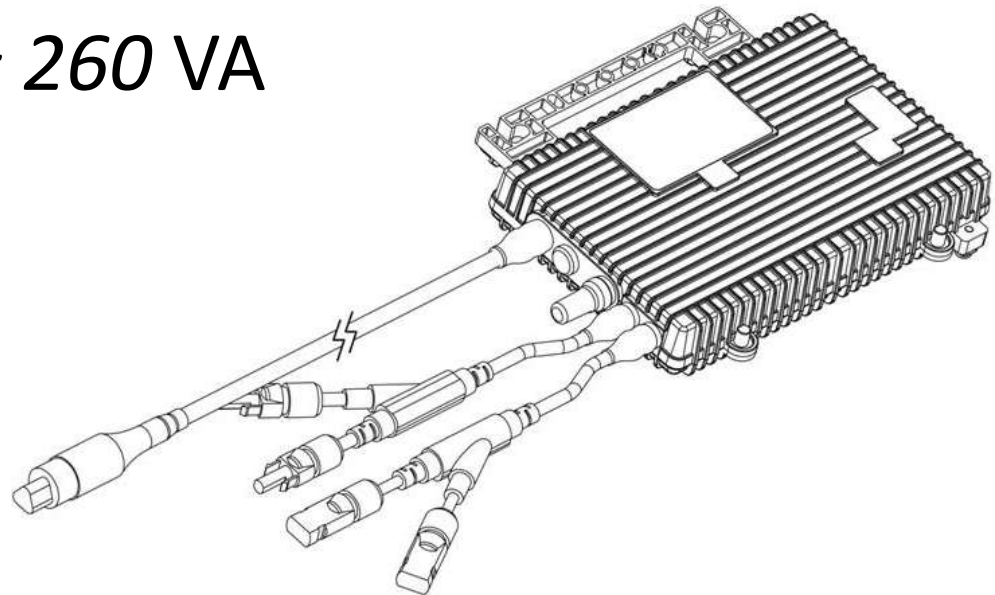
$$Q_{\max} = \sqrt{S_{\max}^2 - P^2}$$



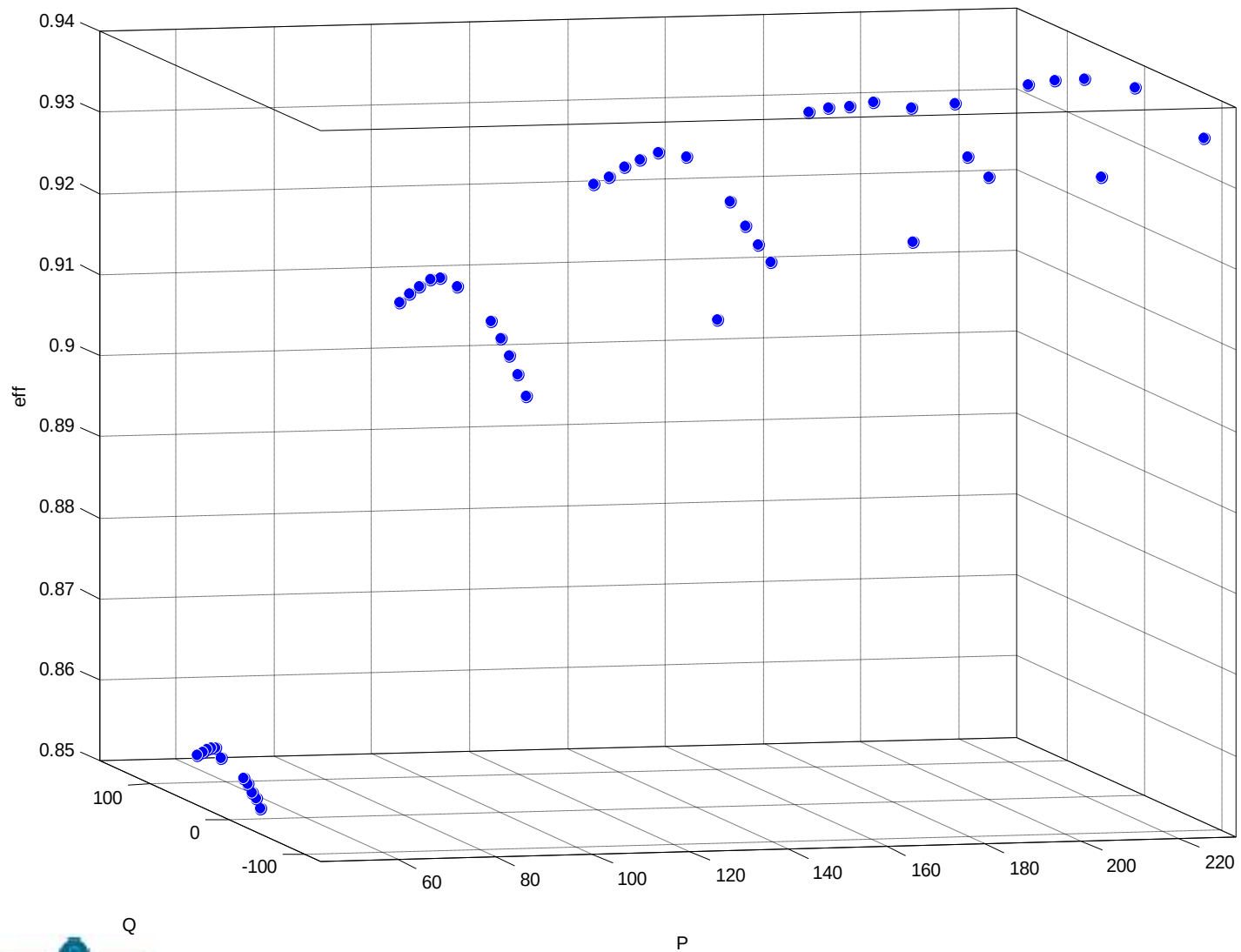
INVERTER MEASUREMENTS

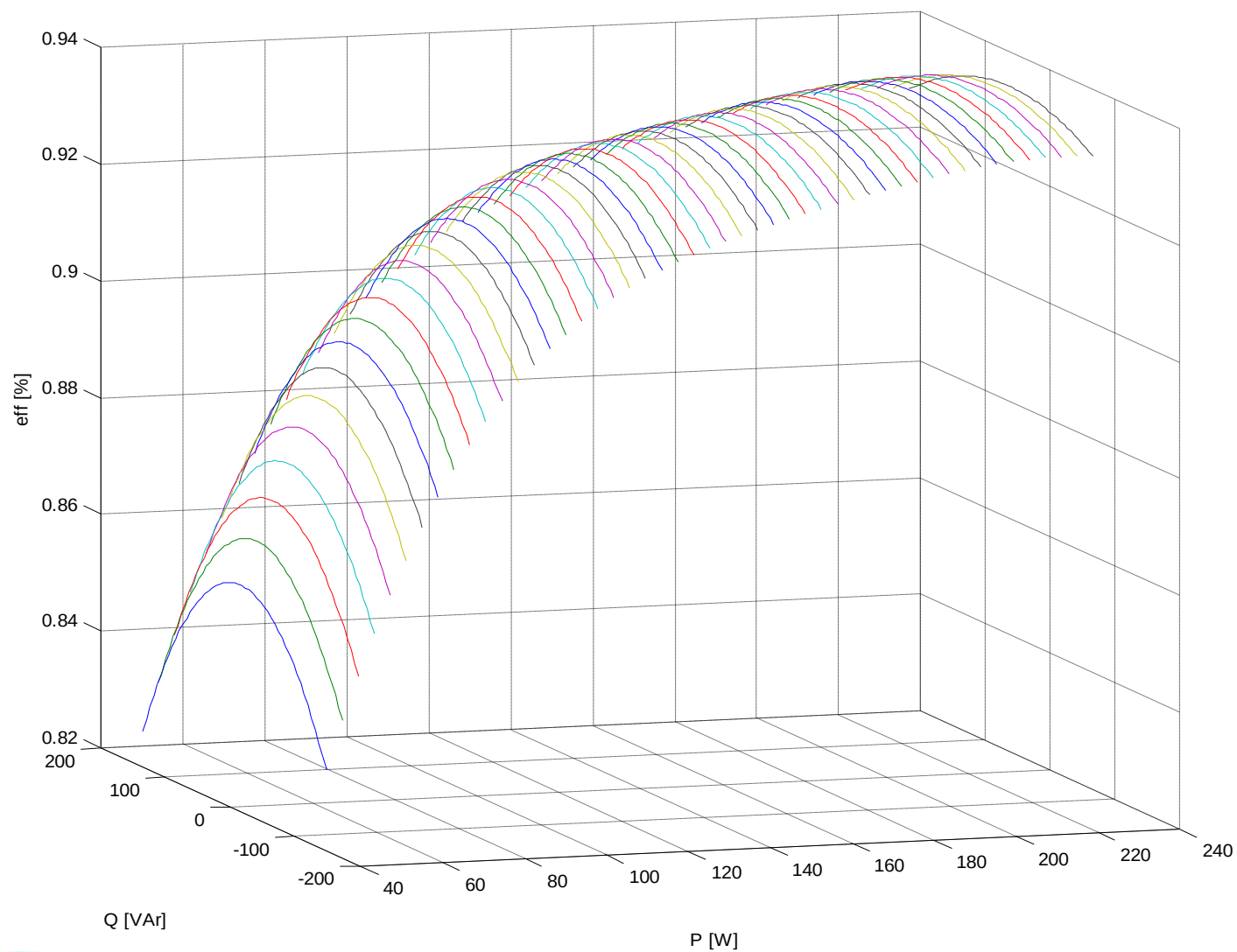
INVERTER MEASUREMENT

- Micro inverter
- Main power $S = 260 \text{ VA}$

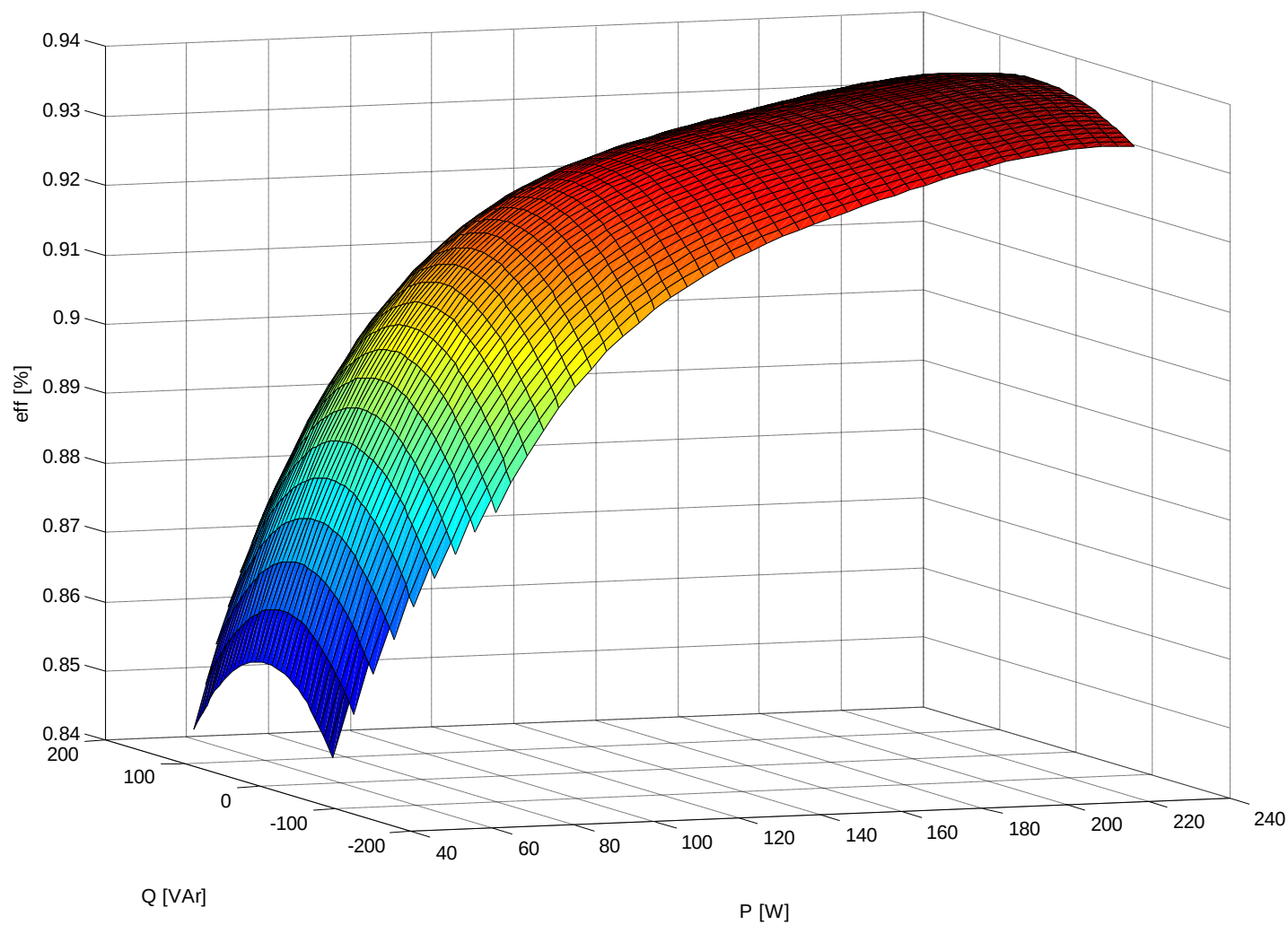


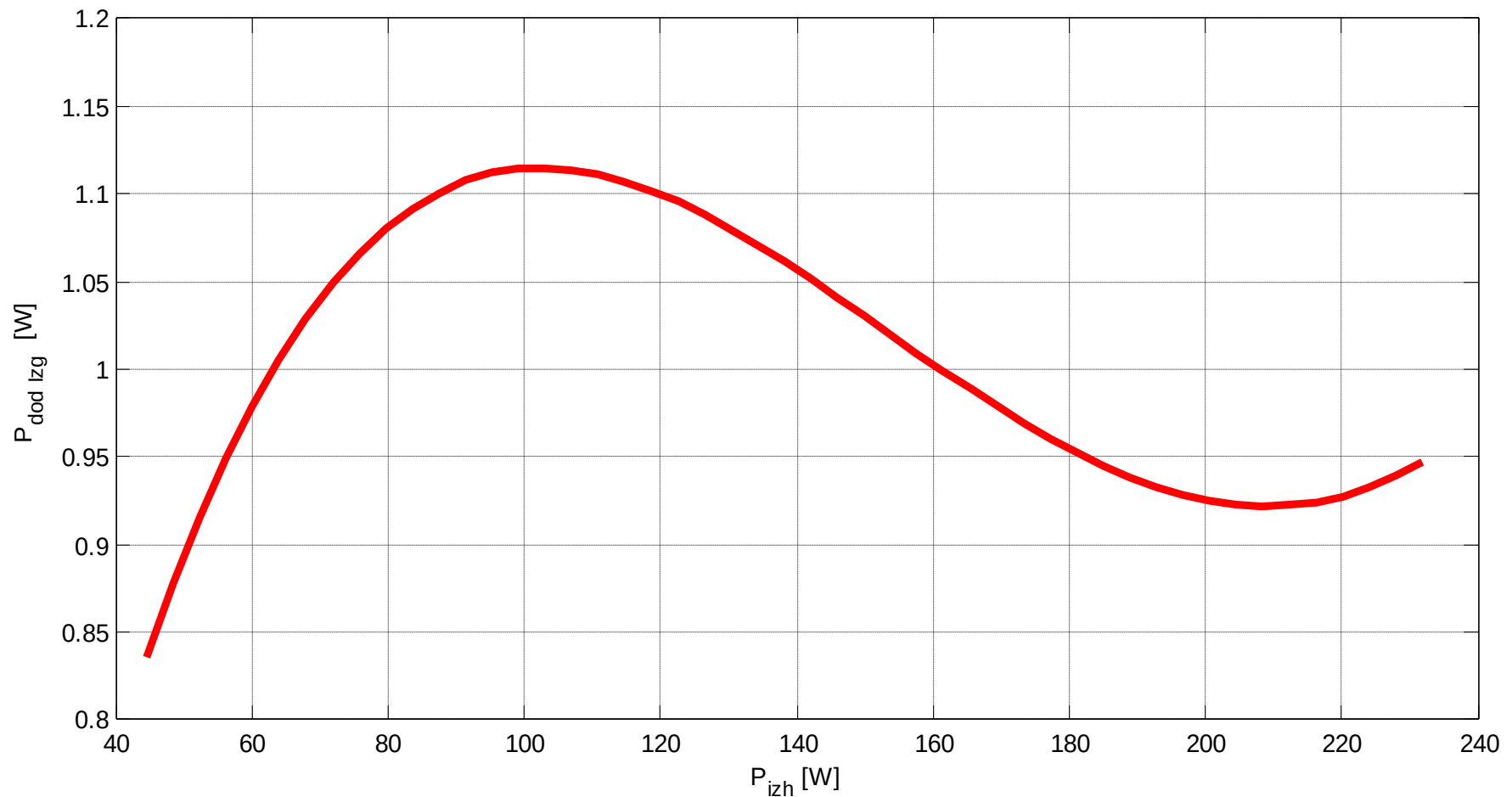
INVERTER MEASUREMENT





Surface approximation





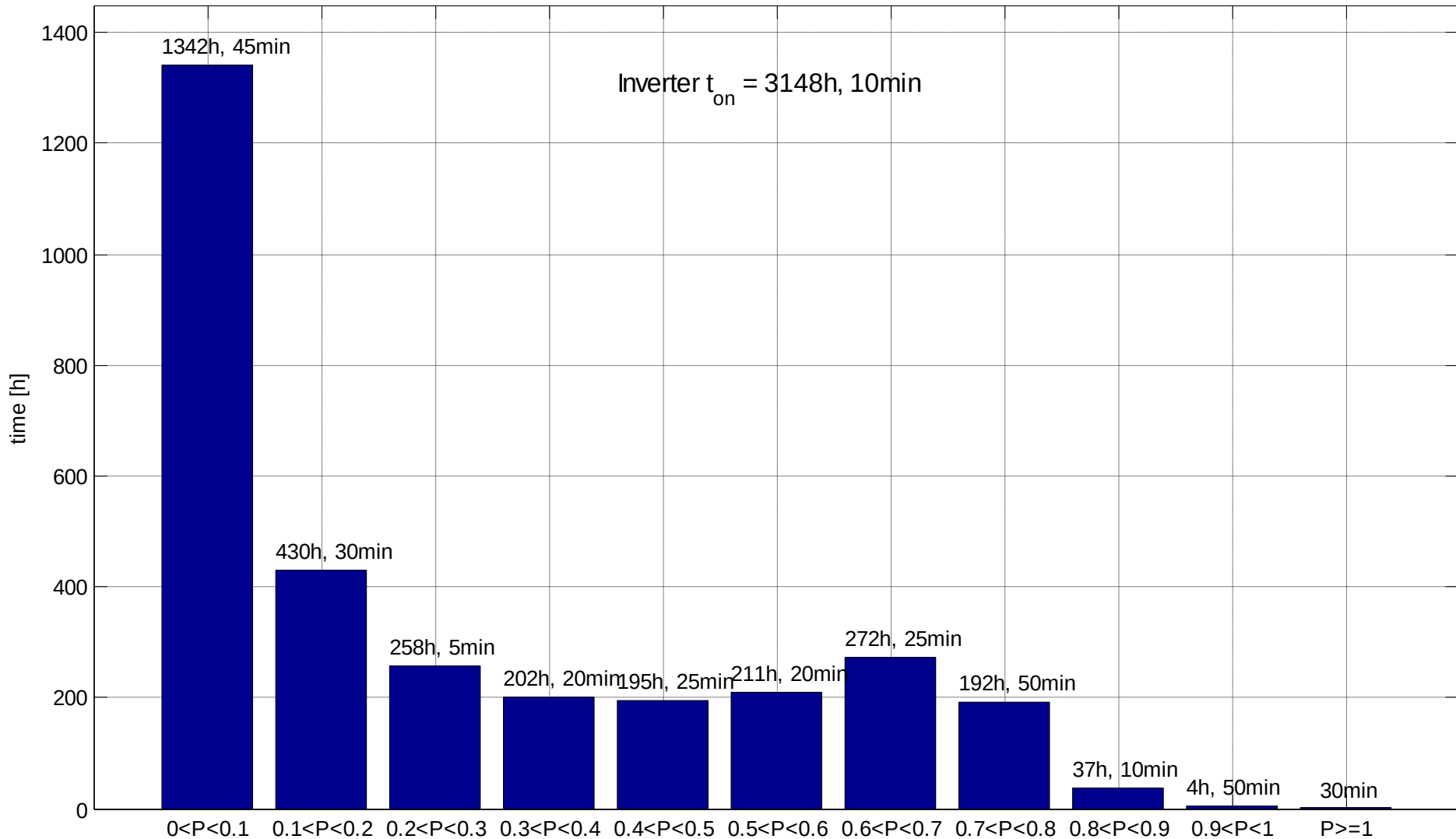
- Additional losses $P_{\text{dod izg}}$ [W]
- Fixed value of reactive power generating $Q = 100 \text{ VAr}$
- Variable active power P_{izh} [W]

Inverter capability to generate reactive power Q

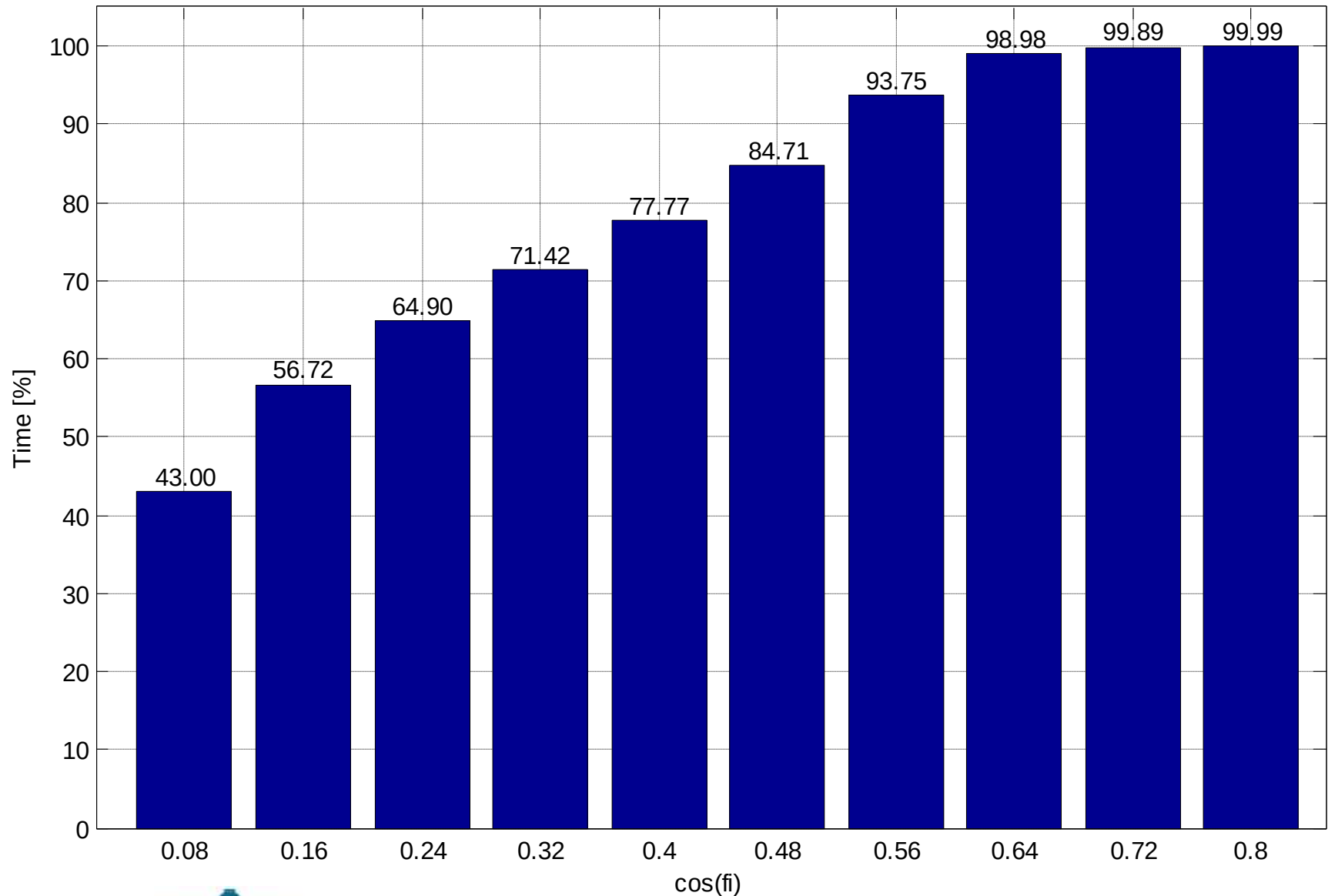
Micro solar plant UM FERl



Micro solar plant UM FERI 2013



Inverter capability to generate reactive power



Conclusion

- Inverters have big potential for generating reactive power
- Low additional losses for generating reactive power (less than 2%)
- With inverter surface characteristic could be determinate losses