IMM2024 – PV Optimizer

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Driving decarbonization and digitalization. Together.

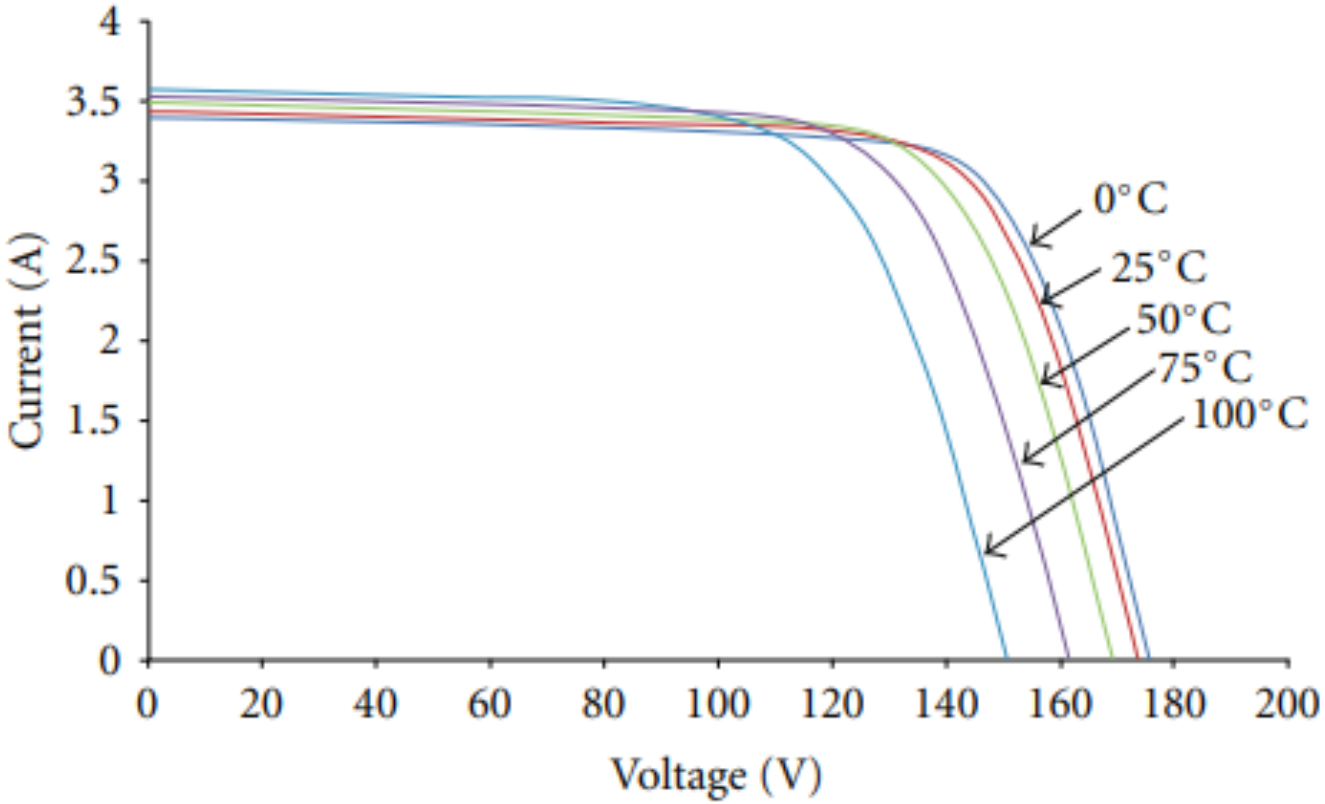
Semiconductors are crucial to solve the energy challenges of our time and shape the digital transformation.

This is why Infineon is committed to actively driving decarbonization and digitalization.

As a global semiconductor leader in power systems and IoT, we enable game-changing solutions for green and efficient energy, clean and safe mobility, as well as smart and secure IoT.

We make life easier, safer, and greener. Together with our customers and partners.
For a better tomorrow.

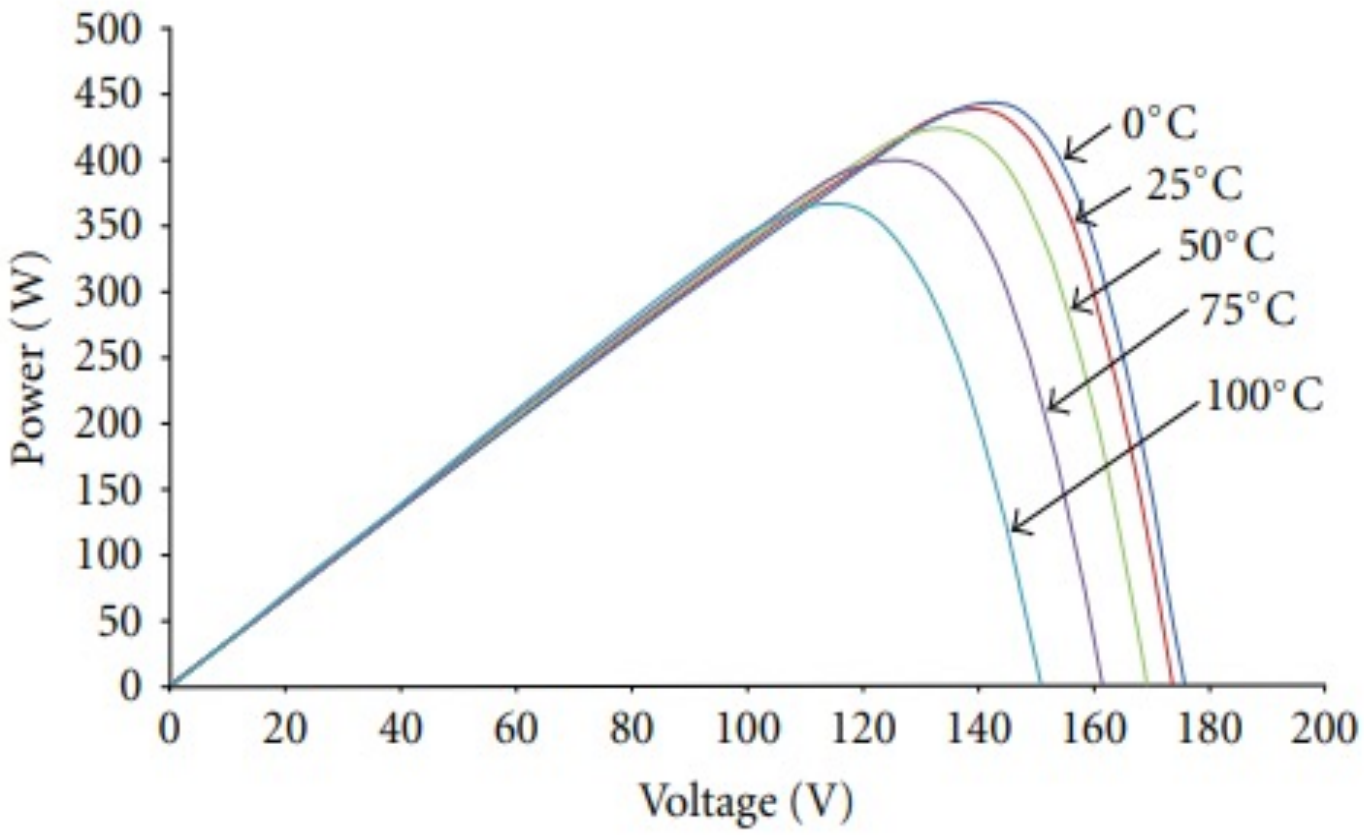
Why do we want a solar optimizer?



- Solar panels operate in the environment under ever changing conditions.
- Enviromental factors such as cloud shadows and other obstacles can lead to a difference in sunlight intensity reaching the solar panel and the ambient temperature of the solar panel which changes the characteristic of solar cells.
- Therefor I-V curves of PV systems under certain conditions have distinct shapes to PV systems under different operating conditions.

Current–voltage characteristic

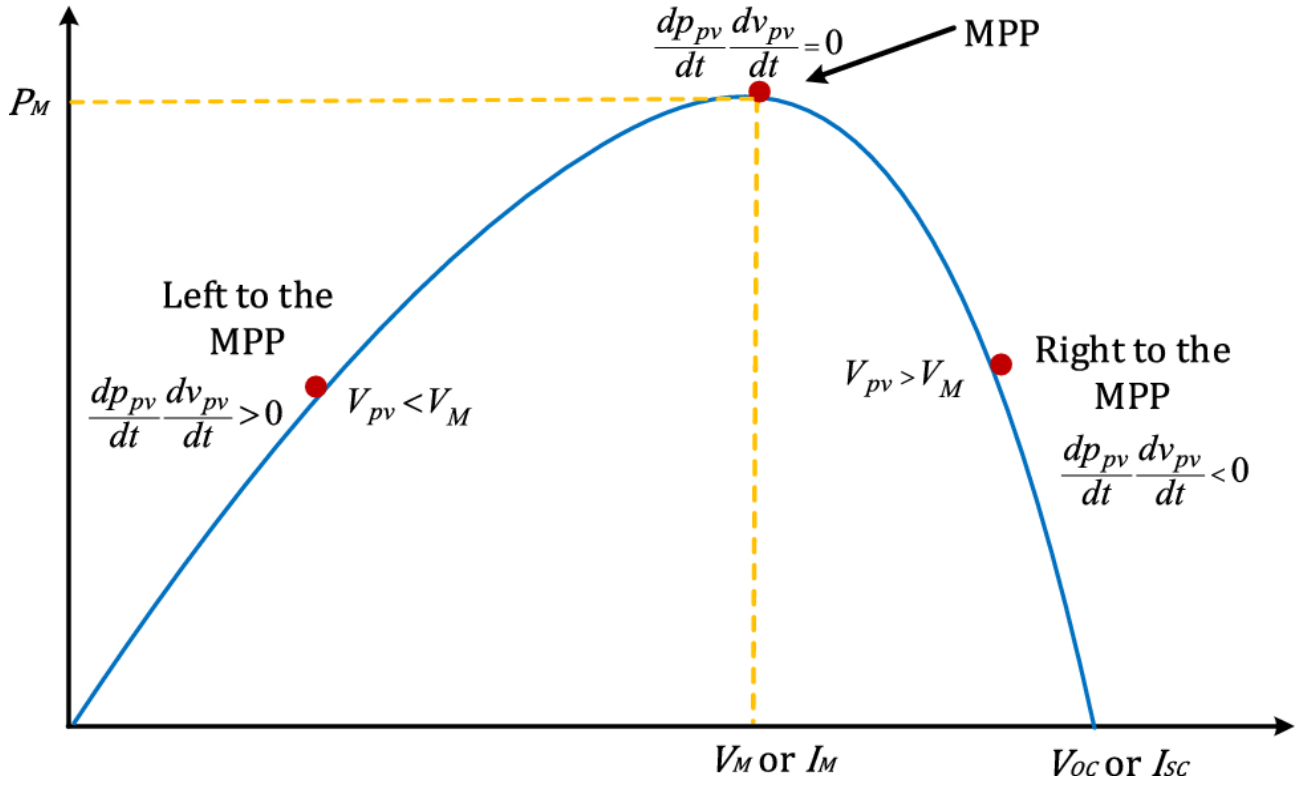
- The Current-voltage characteristic changes depending on the temperature
- The changed Current-voltage characteristic leads to a changed Power-Voltage characteristic.
- There you can see, the higher the temperature the lower the voltage and the lower the power output.
- For a higher power output under varying conditions we can us a solar optimizer



Solar Optimizer

- A solar optimizer is a device that is designed to maximize the performance of a solar panel, especially when individual panels are connected in a series or parallel configuration.
- For a single solar cell, a solar optimizer can help improve the efficiency of the cell by ensuring that it is operating at its maximum power point (MPP).
- The MPP is the point at which the cell generates the most power for a given amount of sunlight.

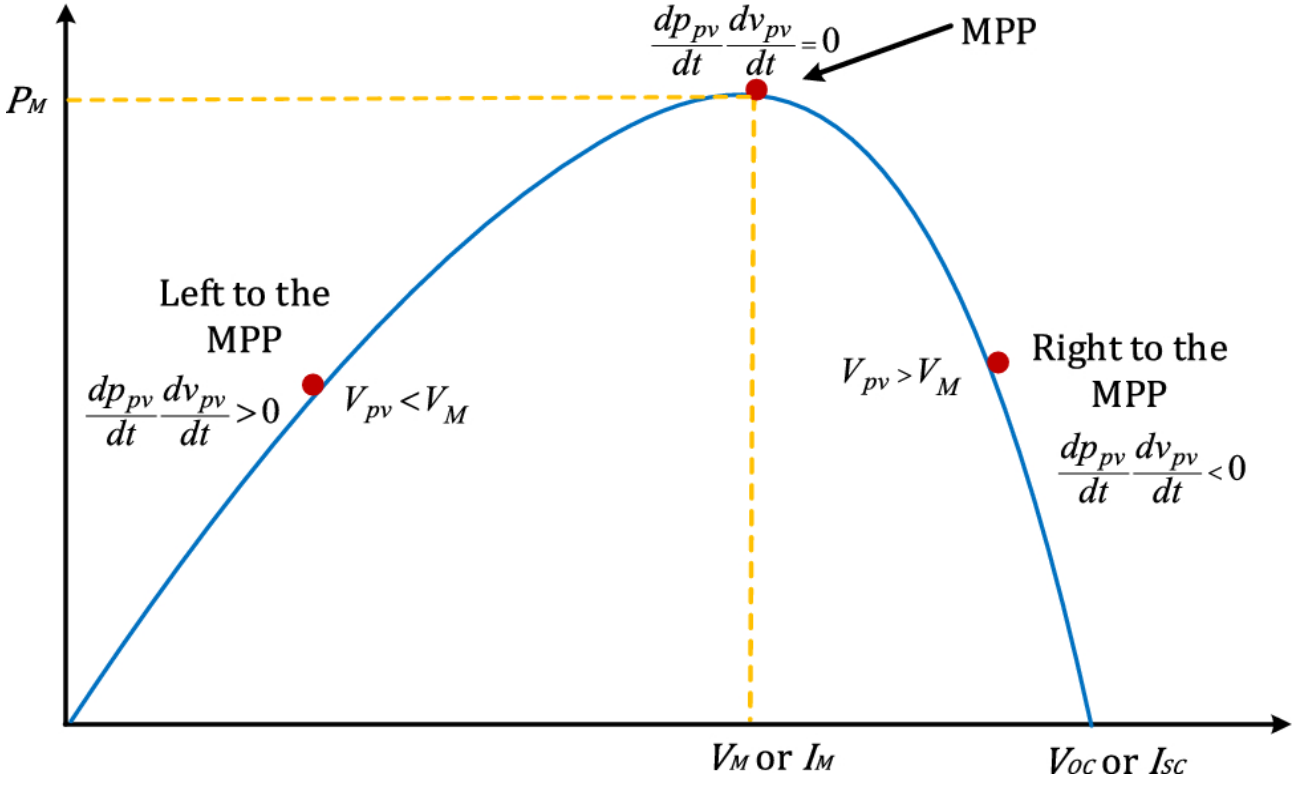
PV panel output characteristics



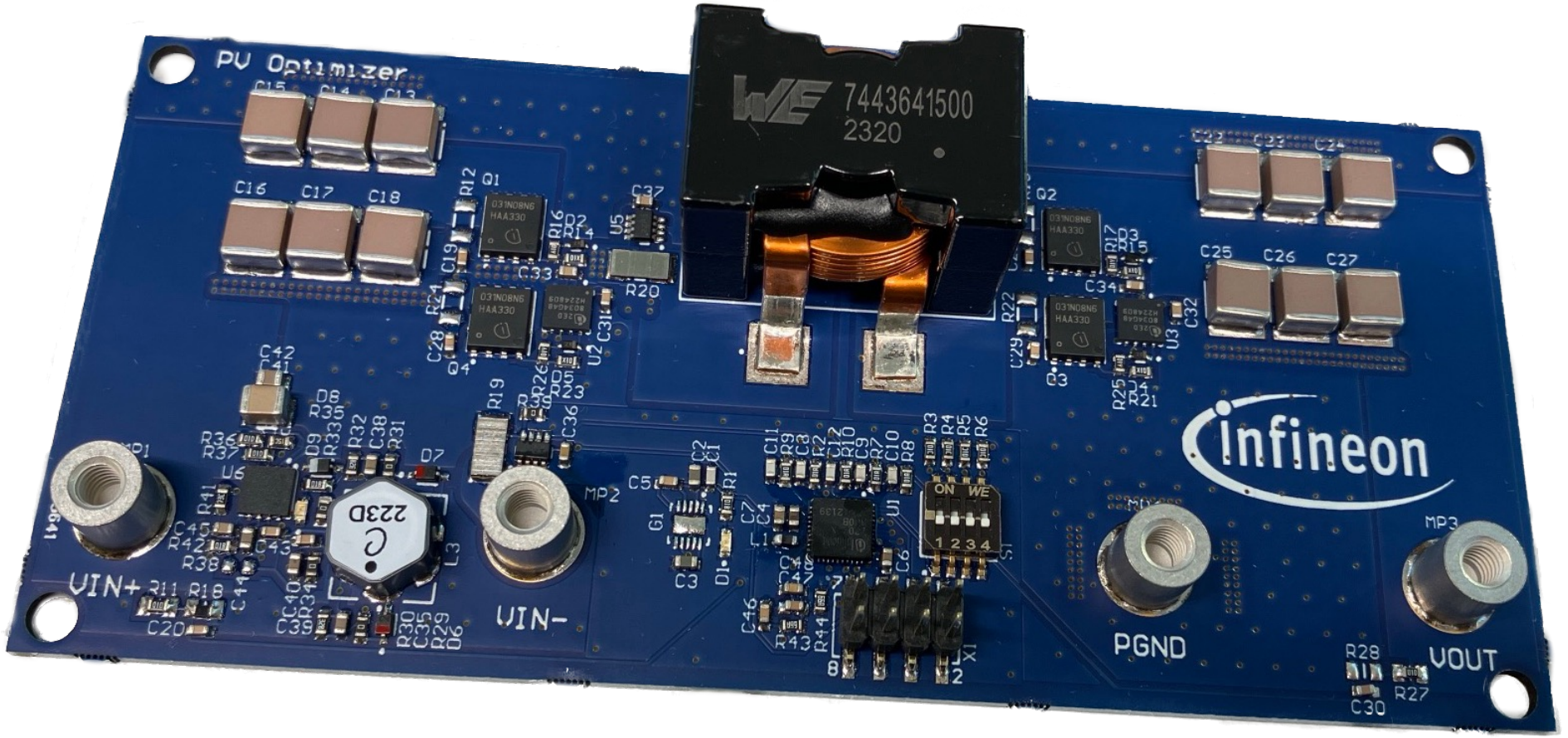
Solar Optimizer

- A solar optimizer typically uses advanced algorithms to track the voltage and current of the solar cell and adjusts the voltage to ensure that the cell is operating at its MPP.
- This can be especially important in situations where the solar cell is exposed to varying levels of sunlight, such as during cloudy or partially shaded conditions.
- By optimizing the performance of the solar cell, a solar optimizer can help improve the overall efficiency and output of a solar system, reducing energy costs and improving environmental sustainability.

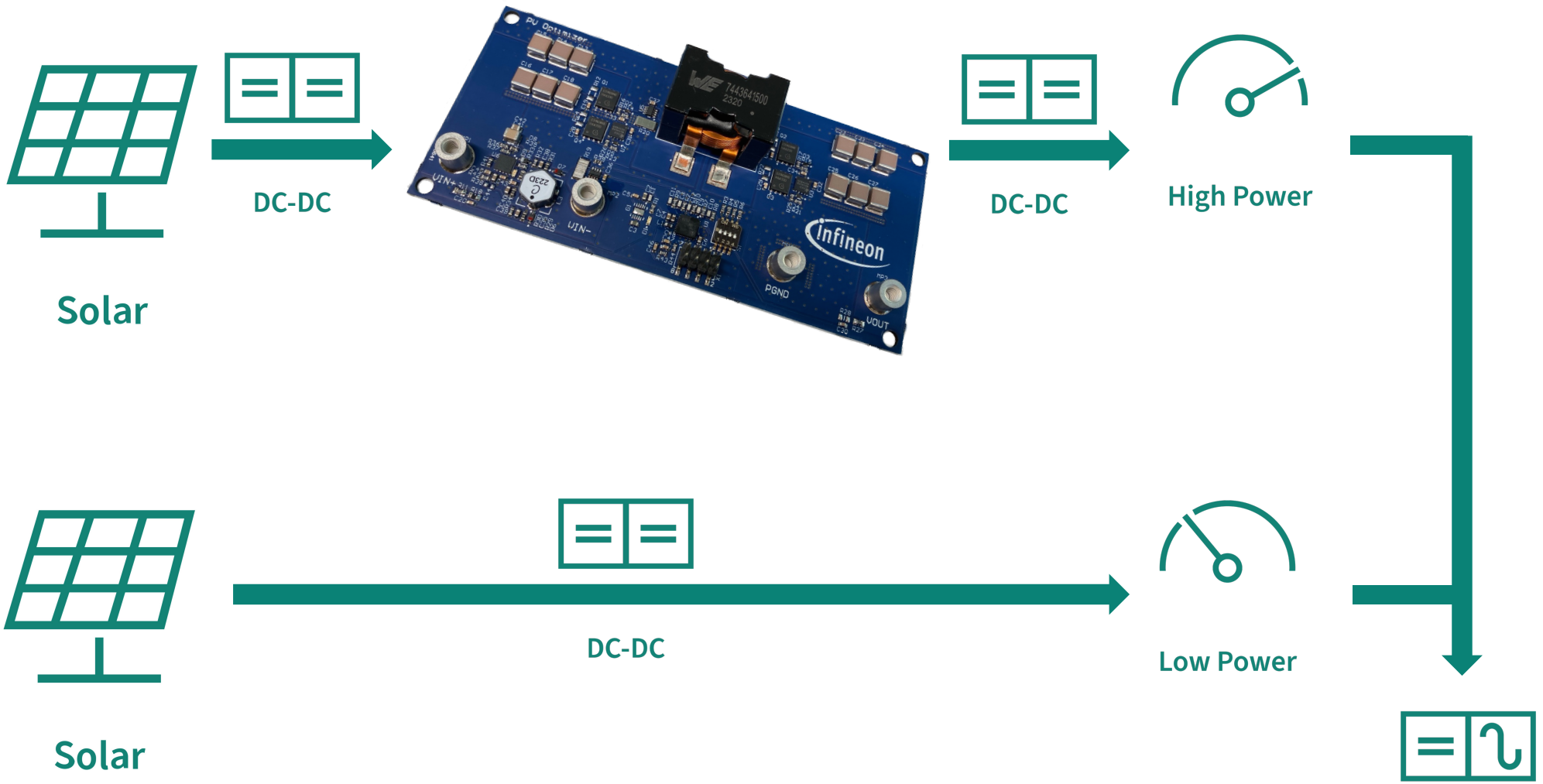
PV panel output characteristics



PV Optimizer 200W



PV Optimizer 200W



PV Optimizer 200W Schematics

Power profil data:

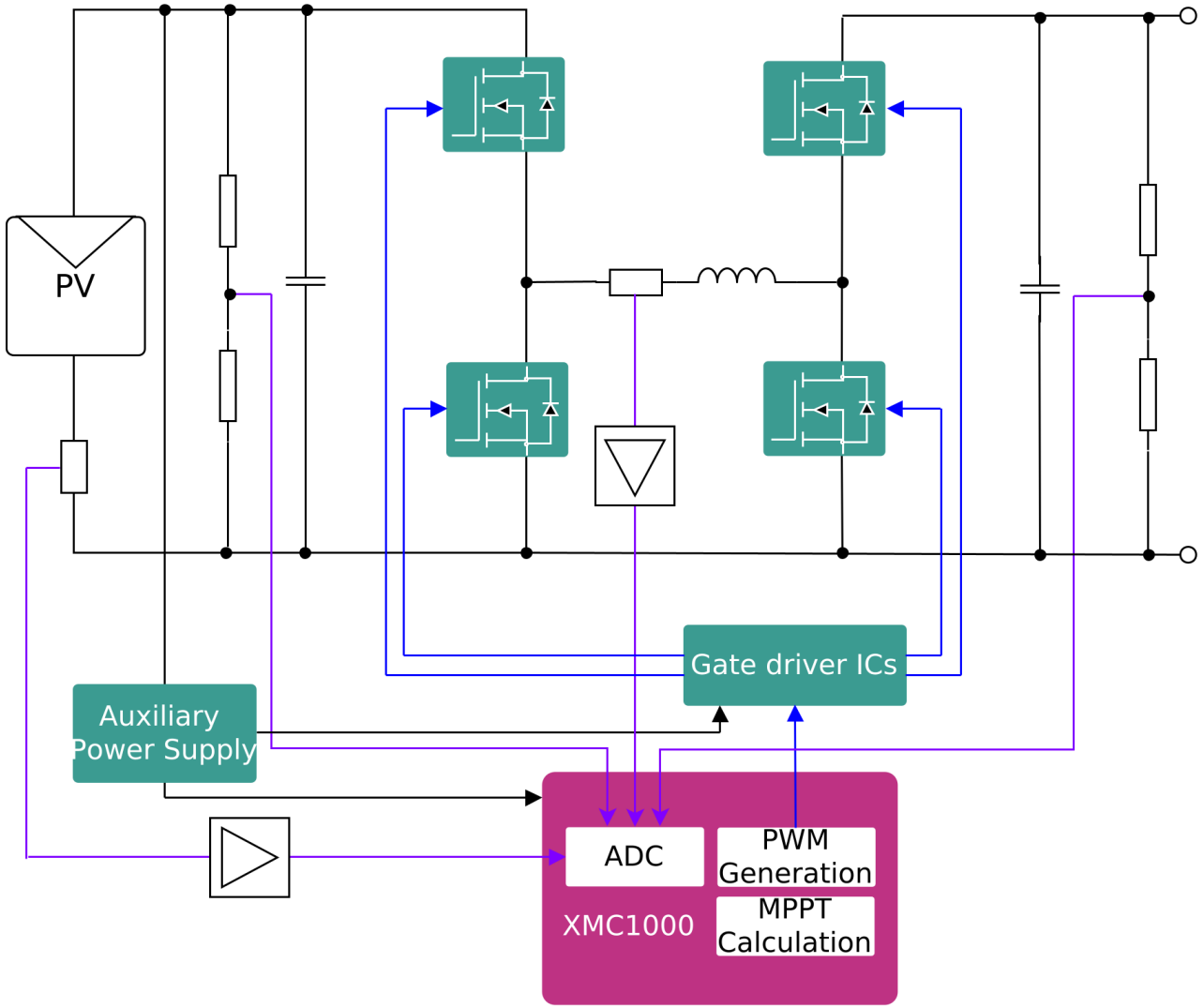
- Vin= 15-60V
- Vout= 0-60V
- Pout= 200W
- fsw = 200kHz

Microcontroller:

- XMC1302-Q40 mit 200k flash

Abbreviations:

- ADC: Analog to Digital Converter
- PWM Generation: Puls Width Modulation is a method of controlling the average power or amplitude delivered by an electrical signal.
- MPPT Calculation: Maximum Power Point Tracking calculation



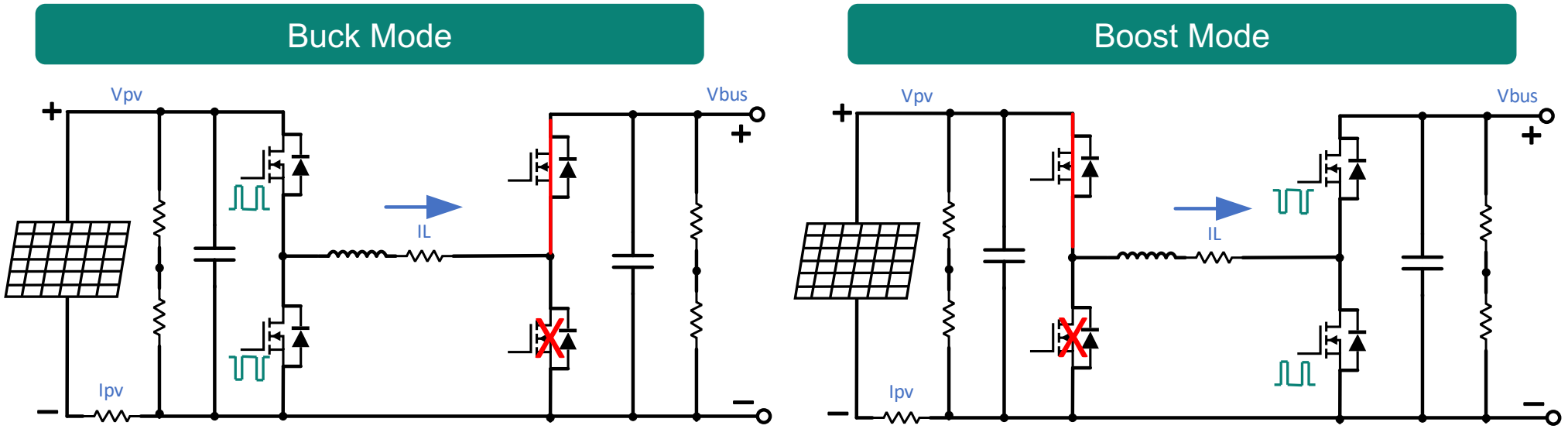
The XMC1302-Q40 mit 200k flash

The XMC1302-Q040X0200 AB is a 32-bit Microcontroller with ARM® Cortex®-M0 with focus on low-cost embedded control applications.

- 200KB Flash, 16KB RAM
- Supply voltage range: 1.8 - 5.5V
- MATH co-processor for CORDIC & HW Divide
- 8 x 16-bit special purpose timers, dead time generation
- Hall Sensor & Encoder I/F
- LED brightness & color control module (BCCU)
- 12 channel 12-bit ADC, 2 x parallel sampling
- 3 x Comparators
- 2 channel USIC (configurable to SPI, UART, IIC, IIS)
- Peripherals Clock: 64 [MHZ]
- Temperature Sensor
- Pseudo Random Number Gererator
- Real Time Clock
- Watch Dog Timer
- PG-VQFN-40
- Temperature range: -40 - 105°C
- Analog comparators with only 3 mv input offset voltage and a propagation delay of 30 ns

PV Optimizer: Four-switch buck-boost converter

– The four-switch buck-boost converter is a type of DC-DC converter that can step up or step down the input voltage. It uses four switches to control the flow of current through the inductor and capacitor, which allows it to convert the voltage in either direction.



Content of the challenge

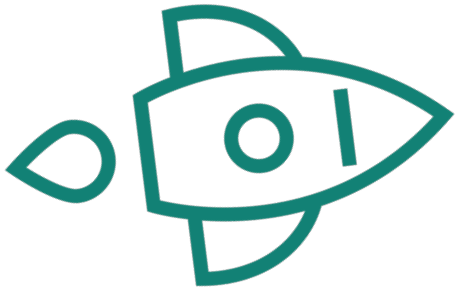
Develop Maximum Power Point Tracking (MPPT) Algorithm to optimize the power output

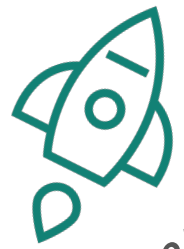
You will get:
- Hardware Board
- Microcontroller Software framework, written in C (GIT Hub: https://github.com/Infineon/IMM2024)
- Microcontroller Development environment

Your Task:
- Create a Maximum Power Point Tracking (MPPT) Algorithm
- Developement of MPPT control structure, to be integrated into the existing SW framework
  - Firmware implementation
  - Testing
  - Documentation
- **Optional: use boost circuit to keep highside constant on to lower the materials count**

You are fitting best to the challenge, if you are:
- startup or service company in the area of embedded software development, interested in or with experience on solar power
- university teams of interested students and professors with microcontroller programming skills
- Makers with microcontroller focus and programming experience

Timeline





14.03.2024 IMM Kickoff + Deep Dive

29.03.2024 Final admission

05.04.2024 Hardware distribution

19.04.2024 Present concept and Q&A

06.05.2024 Q&A

27.05.2024 Q&A

24.06.2024 Futuretech Bootcamp(optional)

27.06.2024 Final presentation

March **April** **May** **June**

Application

Please, send the applications to
industrymeetsmakers@infineon.com

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