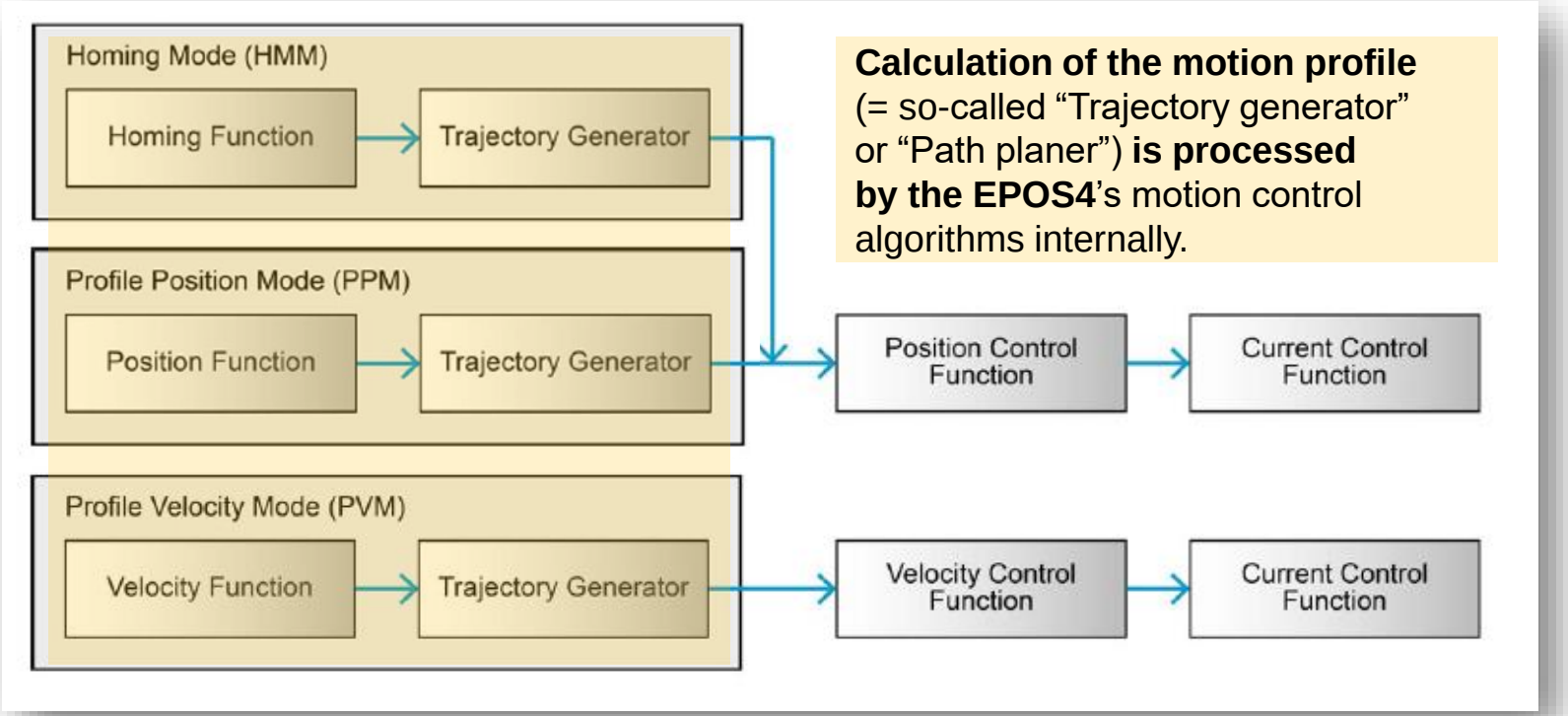
EPOS4 / CiA 402*1: Profile operating modes

EPOS4's profile based operating modes



EPOS4's "Trajectory generator" calculates updated "Position demand value" (PPM -> object: 0x6062) or "Velocity demand value" (PVM -> object: 0x606B) at each control cycle and **commands the "Position control" resp. "Velocity control" function internally**.

The internally calculated demand values are based on the configured "Profile acceleration" (0x6083), "Profile deceleration" (0x6084), "Profile velocity" (0x6081), and the final "Target position" (0x607A) in case of PPM = Profile Position Mode.

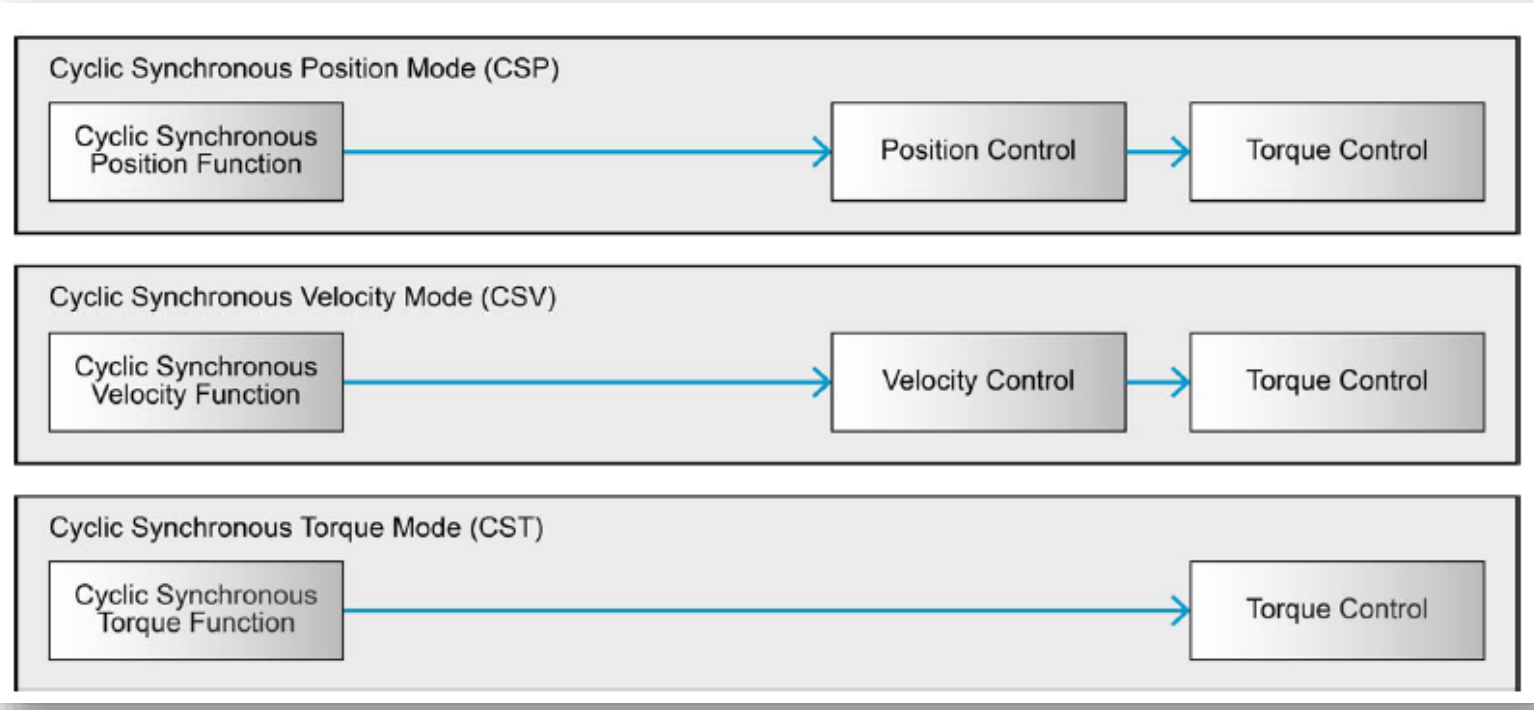
maxon | zub

*Reference *1: CiA 402 CANopen device profile for drives and motion control, www.can-cia.org*

EPOS4 / CiA 402*1: Cyclic Synchronous operating modes

EPOS4'S cyclic synchronous operating modes

The "Trajectory Generator" or even add-on control functions are processed "externally" by a supervisor controller so-called "**Real time Master**".



The master commands the EPOS4's cyclic synchronous operating modes (CSP, CSV, CST) with the "Target position" (0x607A), "Target velocity" (0x60FF), or "Target torque" (0x6071) at a quite fast and very precise cyclic period of typically 1 … 4 ms. The master also receives required "Position actual", "Velocity actual", "Current actual" values, and "Statusword" information by the EPOS4 at the same cyclic bus rate too.

Important: There is a so-called **real time master** (e.g. PLC or zub's MasterMACS) and CANopen or EtherCAT required to provide the required performance for a fast, predictable, cyclic data exchange and processing of all data.

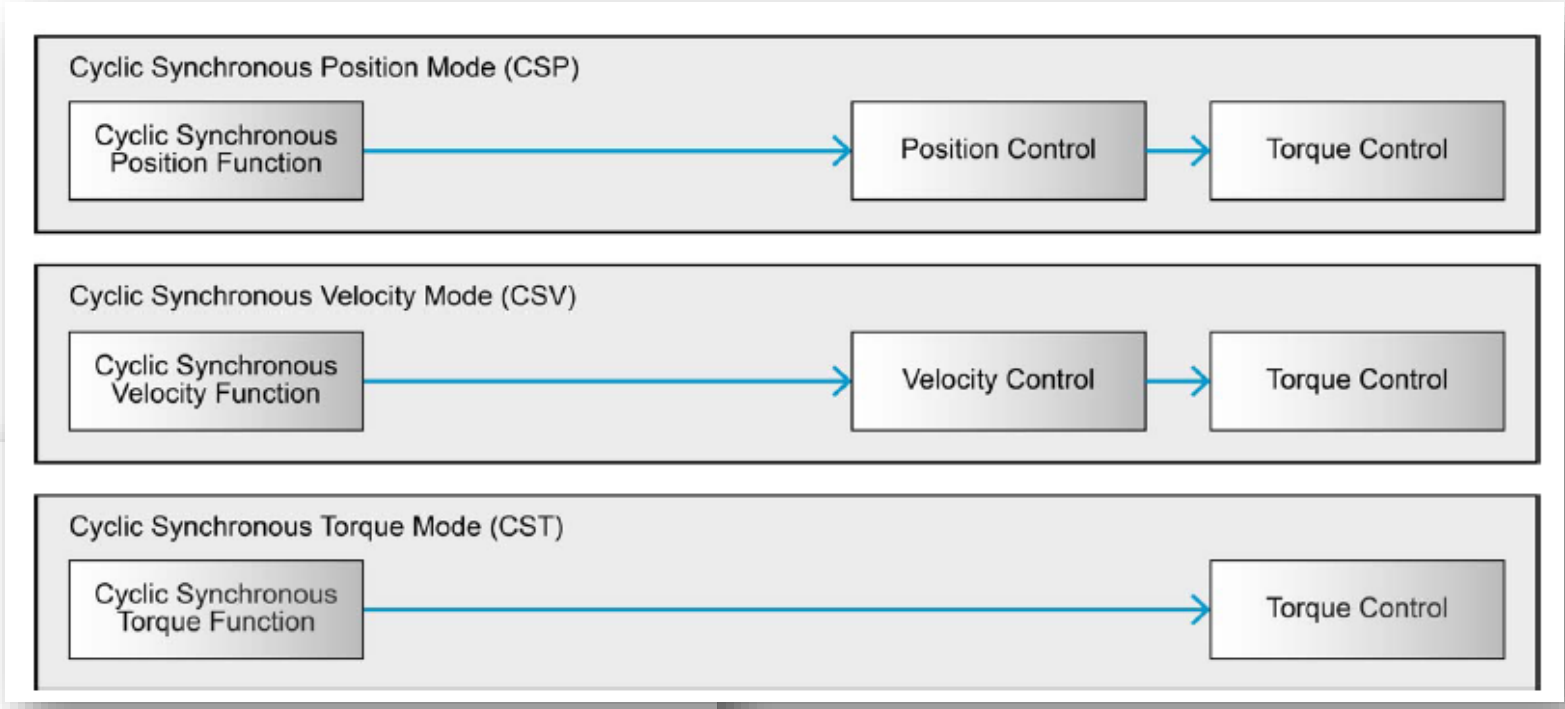
maxon | zub

*Reference *1: CiA 402 CANopen device profile for drives and motion control, www.can-cia.org*

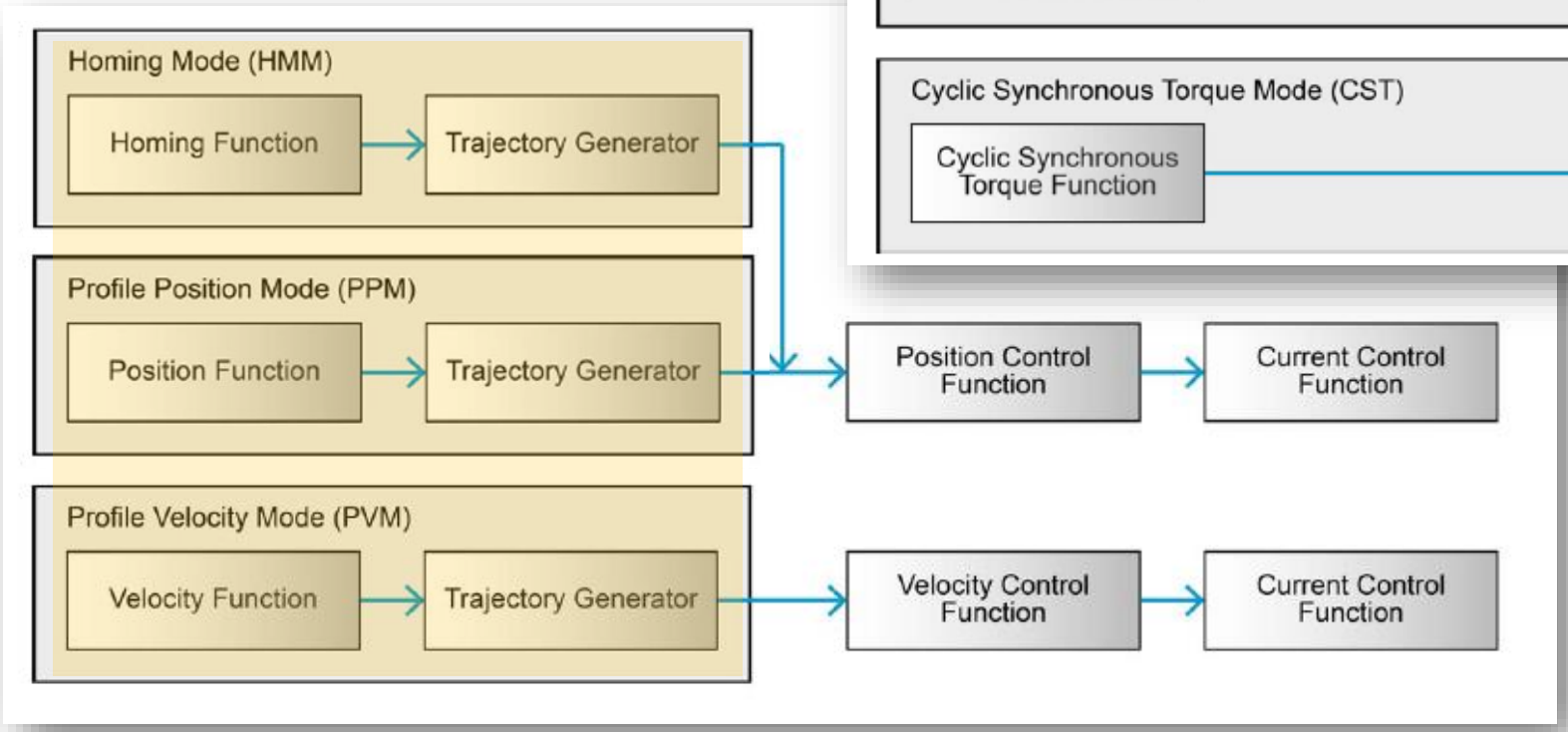
Operating modes: Profile versus Cyclic Synchronous modes

Cyclic synchronous

Trajectory generated
by the master



Profile based



Trajectory generated
by the EPOS4 internally.

maxon | zub

Comparison: PPM mode versus CSP mode

PPM - Profile Position Mode

- EPOS4 in charge of motion profile
  - Motion profile is based on motion data (acceleration, deceleration, velocity, target) which is setup before the motion starts or just updated sometimes sporadically during motion.
  - No or less interaction in between different axes during motion required.
- Typical applications:
  - Predefined point-to-point motion.
  - Independent acting multi-axes drives.
- System environment:
  - Microcontroller, PC, PLC
- Bus interfaces:
  - CANopen
  - USB, RS232

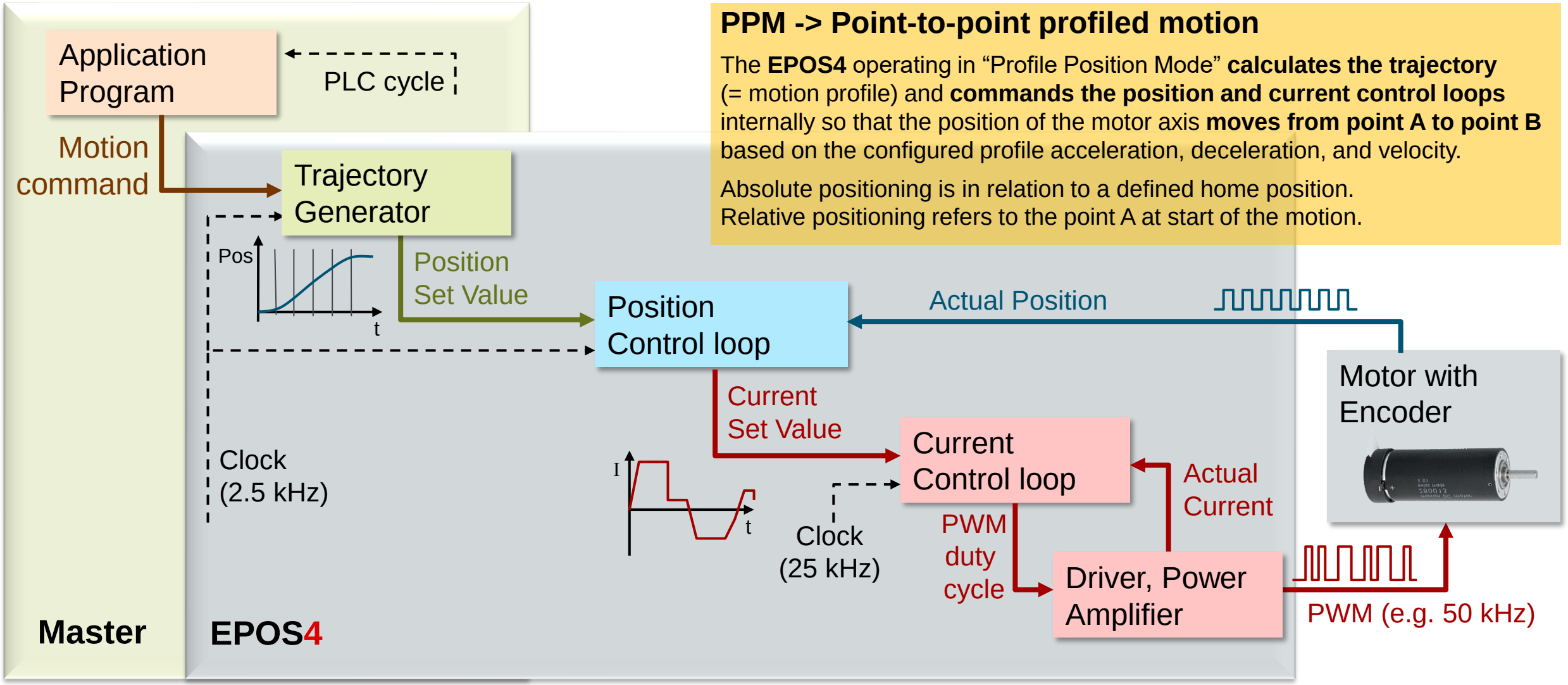
CSP – Cyclic Synchronous Position

- Master in charge of motion profile
  - Master calculates the motion profile and takes care of acceleration, deceleration, and speed profiles.
  - Master takes care of motion or synchronization of several drives.
- Typical applications:
  - Multi-axes drive systems
- System environment:
  - Real time master mandatory,
    typically: PLC
    or: PC / microcontroller with a real time operating system
- Bus interface:
  - Real time bus interface mandatory!

    CANopen EtherCAT

    No(!) USB, no(!) RS232

PPM: Profile Position Mode

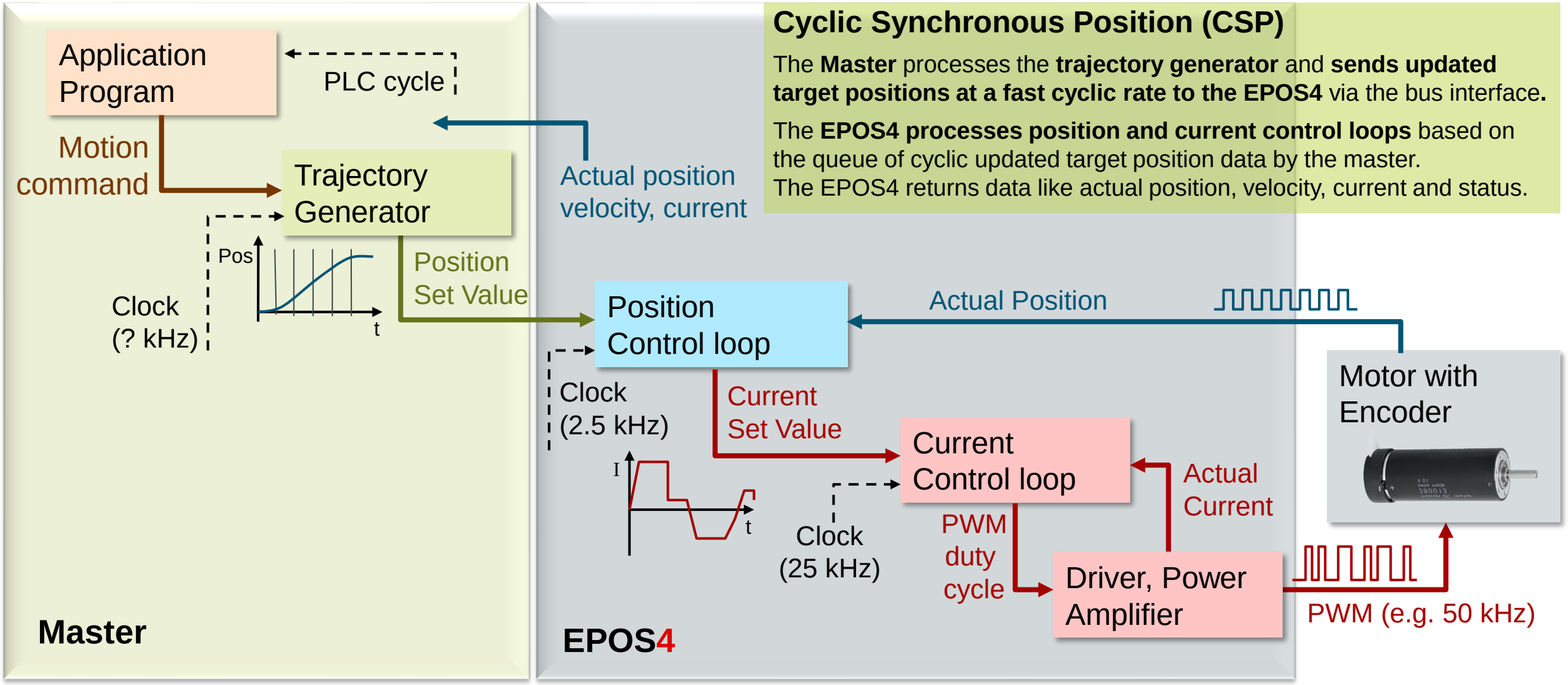


PPM -> Point-to-point profiled motion

The **EPOS4** operating in “Profile Position Mode” **calculates the trajectory** (= motion profile) and **commands the position and current control loops** internally so that the position of the motor axis **moves from point A to point B** based on the configured profile acceleration, deceleration, and velocity.

Absolute positioning is in relation to a defined home position.
Relative positioning refers to the point A at start of the motion.

CSP: Cyclic Synchronous Position mode



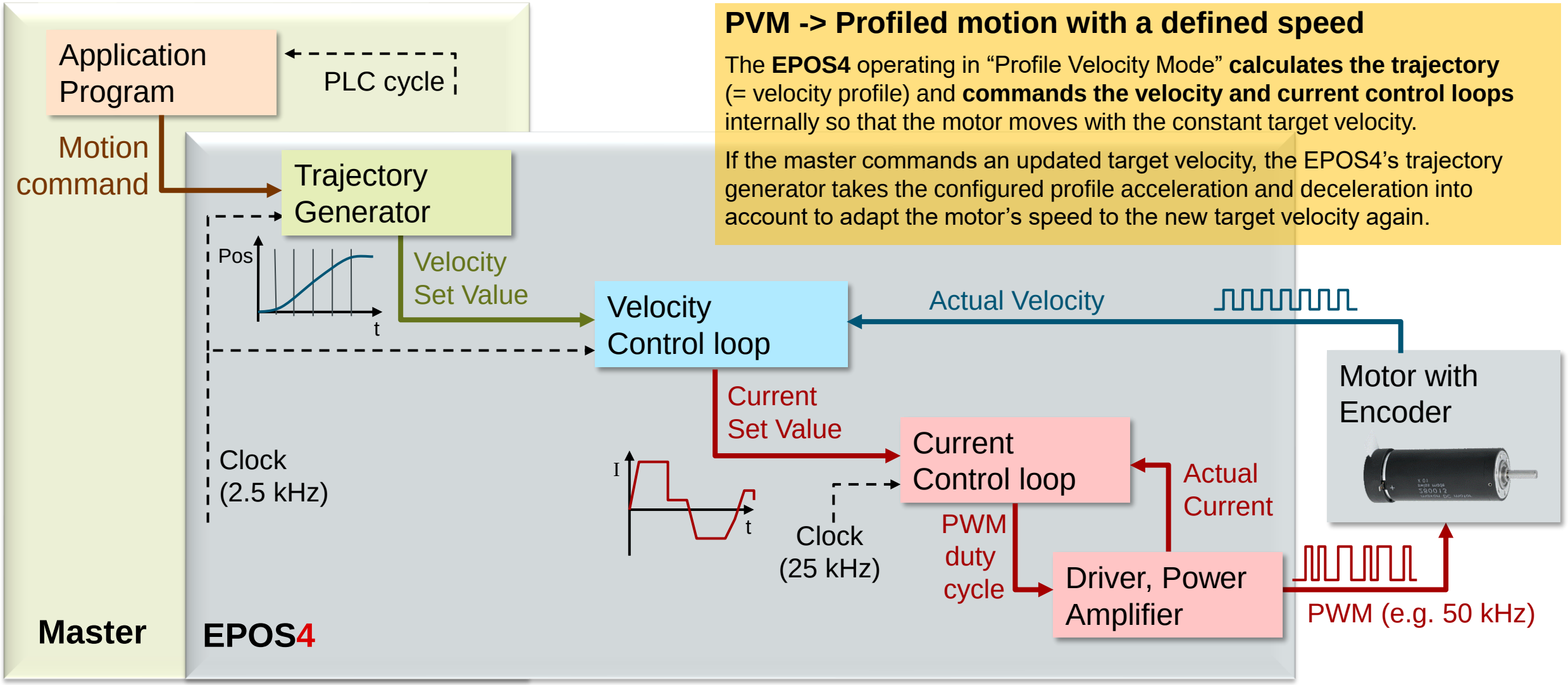
Cyclic Synchronous Position (CSP)

The **Master** processes the **trajectory generator** and **sends updated target positions at a fast cyclic rate to the EPOS4** via the bus interface**.**

The **EPOS4 processes position and current control loops** based on the queue of cyclic updated target position data by the master.
The EPOS4 returns data like actual position, velocity, current and status.

maxon | zub

PVM: Profile Velocity Mode



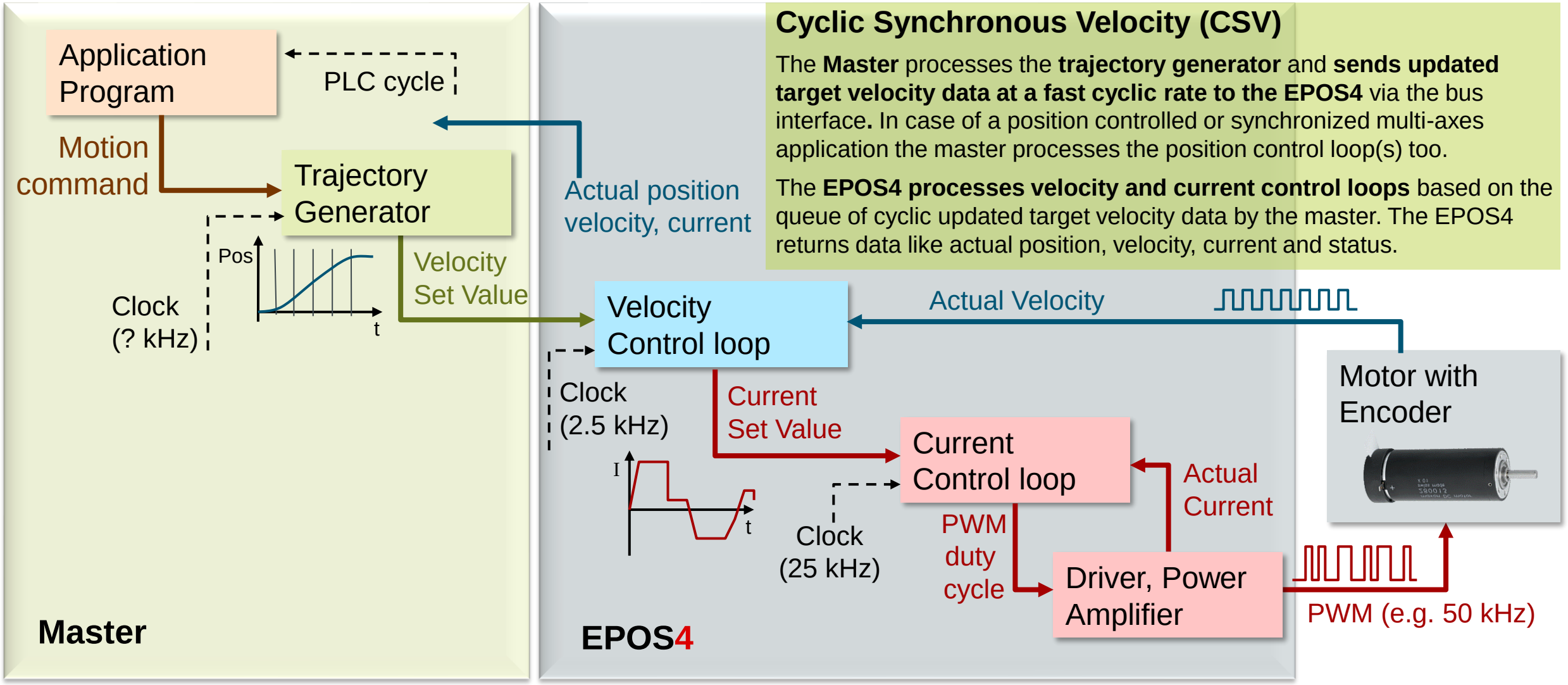
PVM -> Profiled motion with a defined speed

The **EPOS4** operating in “Profile Velocity Mode” **calculates the trajectory** (= velocity profile) and **commands the velocity and current control loops** internally so that the motor moves with the constant target velocity.

If the master commands an updated target velocity, the EPOS4’s trajectory generator takes the configured profile acceleration and deceleration into account to adapt the motor’s speed to the new target velocity again.

maxon | zub

CSV: Cyclic Synchronous Velocity mode



Cyclic Synchronous Velocity (CSV)

The **Master** processes the **trajectory generator** and **sends updated target velocity data at a fast cyclic rate to the EPOS4** via the bus interface**.** In case of a position controlled or synchronized multi-axes application the master processes the position control loop(s) too.

The **EPOS4 processes velocity and current control loops** based on the queue of cyclic updated target velocity data by the master. The EPOS4 returns data like actual position, velocity, current and status.

maxon | zub

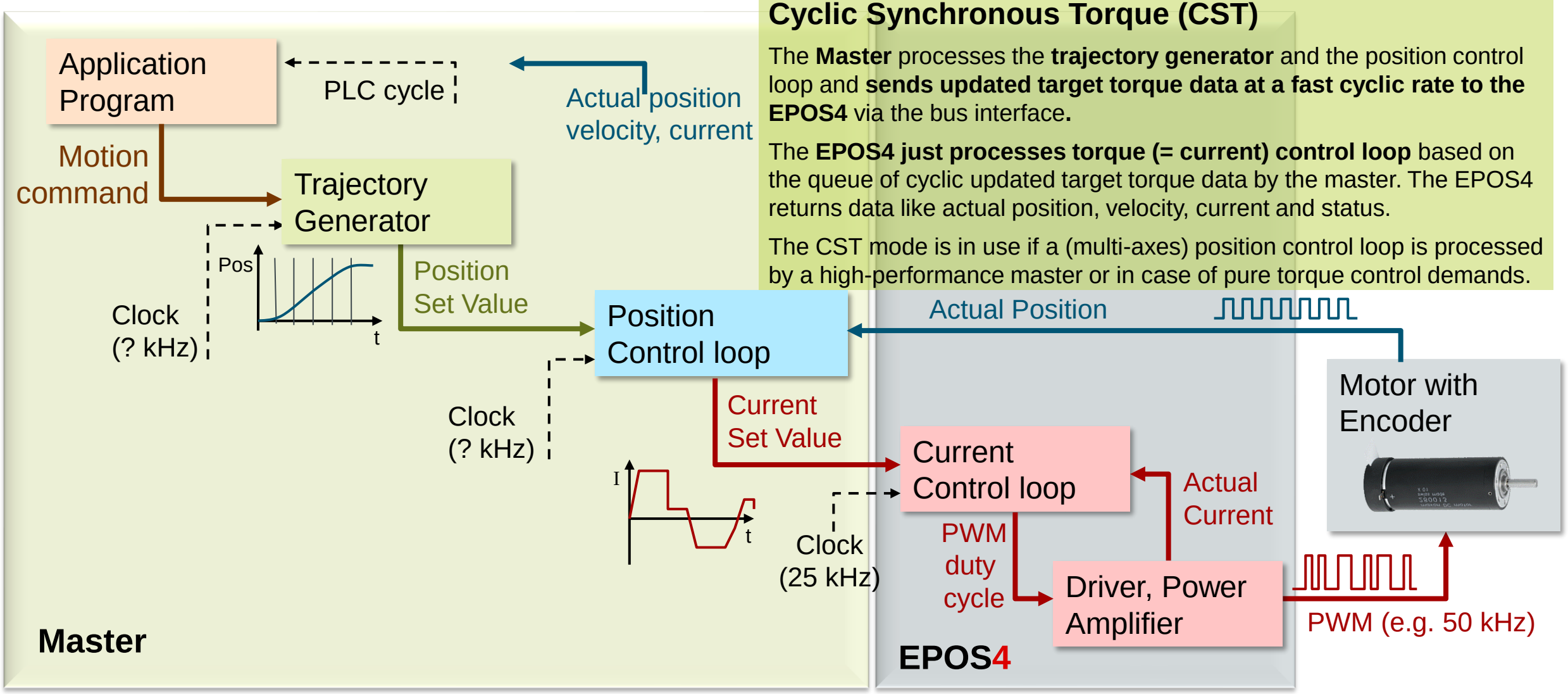
CST: Cyclic Synchronous Torque mode

Cyclic Synchronous Torque (CST)

The **Master** processes the **trajectory generator** and the position control loop and **sends updated target torque data at a fast cyclic rate to the EPOS4** via the bus interface**.**

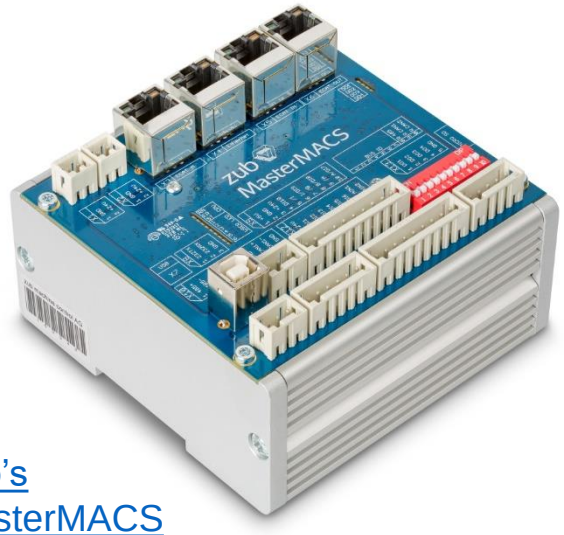
The **EPOS4 just processes torque (= current) control loop** based on the queue of cyclic updated target torque data by the master. The EPOS4 returns data like actual position, velocity, current and status.

The CST mode is in use if a (multi-axes) position control loop is processed by a high-performance master or in case of pure torque control demands.



maxon’s master & CiA 402 motion controllers

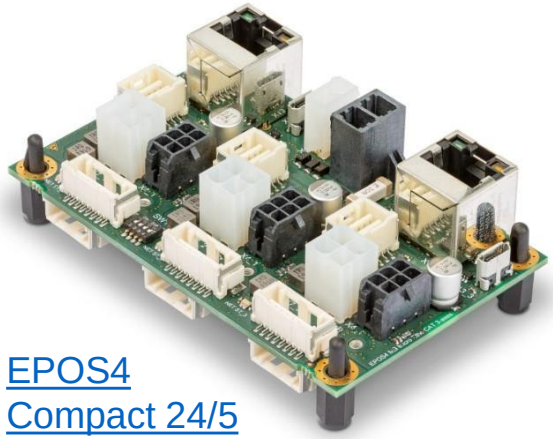
Master controller:
MasterMACS



zub’s
MasterMACS
(PN: 001725)

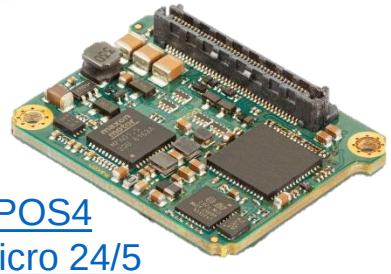
www.maxongroup.com/maxon/view/content/zub-machine-control

CiA 402 motion controller:
EPOS4 product line



EPOS4
Compact 24/5
EtherCAT 3-axes
(PN: 684519)

EPOS4 50/5
(PN: 546047)



EPOS4
Micro 24/5
EtherCAT
(PN: 654731)

http://epos.maxongroup.com

maxon | zub