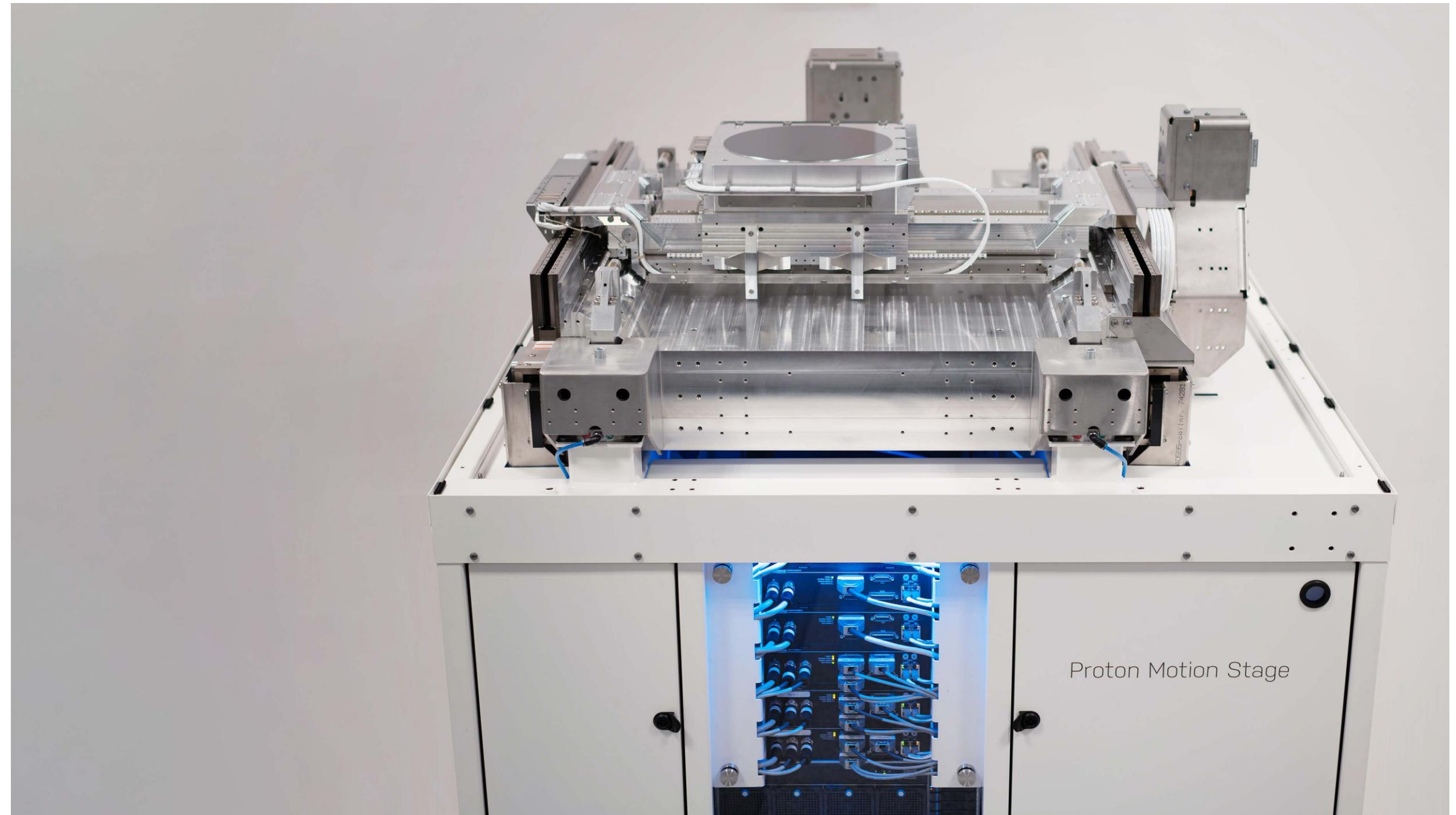




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Motion stage for wafer inspection, controlled by a Poseidon

Knowledge

Engineering excellence is the driving force behind servo drive innovation in both design and manufacturing. Prodrive has a highly skilled group of electrical, mechanical and software engineers capable of customizing drive technology towards your needs.

Quality

Quality is in the DNA of Prodrive Technologies. With a long history in electronics manufacturing, Prodrive continues in this area with the same philosophy and processes, setting a new standard within the servo drive market.

Automation

Design for manufacturing is key to reduce cost and guarantee quality. Circuit board manufacturing, testing and assembly are highly automated processes which guarantee a constant quality at minimum cost.

Time to market

Due to the agility of Prodrive Technologies' large development department, customization can be performed in a very short time, providing a short time to market for challenging mechatronic applications.



Prodrive Technologies HQ Campus, The Netherlands



Arcas

ARM-based embedded control solution for EtherCAT®¹ motion control networks with up to 12 axes at 10kHz.



Poseidon EGS

x86-based powerful control solution for EtherCAT®¹ based motion control networks with up to 28 axes at 20kHz for the base variant. Higher performance variants available on request.

Note 1: EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany

Introducing the Arcas Motion Controller — a beacon of exceptional performance seamlessly packed into a compact form factor. Designed to meet the demands of motion-intensive applications, this controller excels with precision, offering control for up to 12 axes at an impressive 10kHz.

Setting new standards, the Arcas motion controller effortlessly supports high-performance EtherCAT® drives, ensuring a seamless integration into advanced motion systems.

Built to endure, the Arcas stands out as the ideal choice for applications demanding longevity. With a robust commitment to support, it boasts an extended lifecycle of over 10 years, guaranteeing reliability and continuity for your evolving needs. Elevate your motion control experience with the unparalleled capabilities of the Arcas motion controller.

- Quad-core ARM processor @ 1.5GHz
 - Up to 12 axes @ 10kHz
 - More axes at lower update frequencies
- Connectivity
 - 1x Gigabit Ethernet host interface
 - 1x EtherCAT® MDevice bus
- I/O
 - 4x 24V digital inputs
 - 4x 24V digital outputs
 - 2x High-speed differential outputs for position based triggering
- Panel or DIN rail mounting

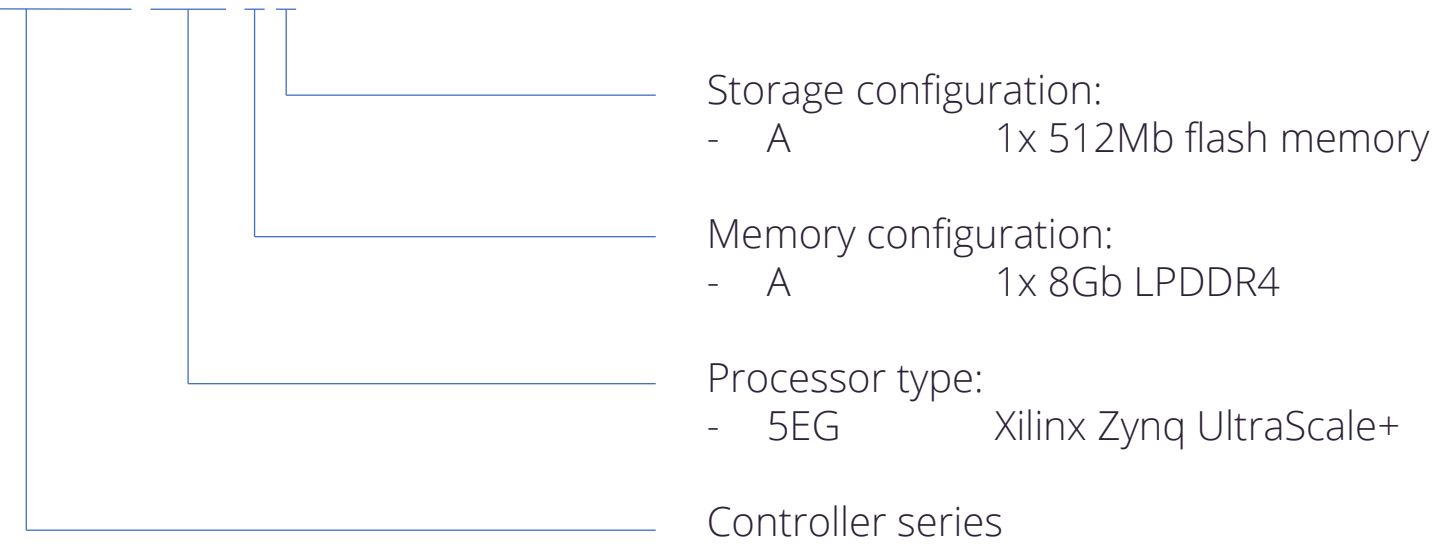


Arcas motion controller



Arcas motion controller

PMP-Arcas-5EG-AA



Configuration	Prodrive Product Number
PMP-Arcas-5EG-AA	6001-2011-2501

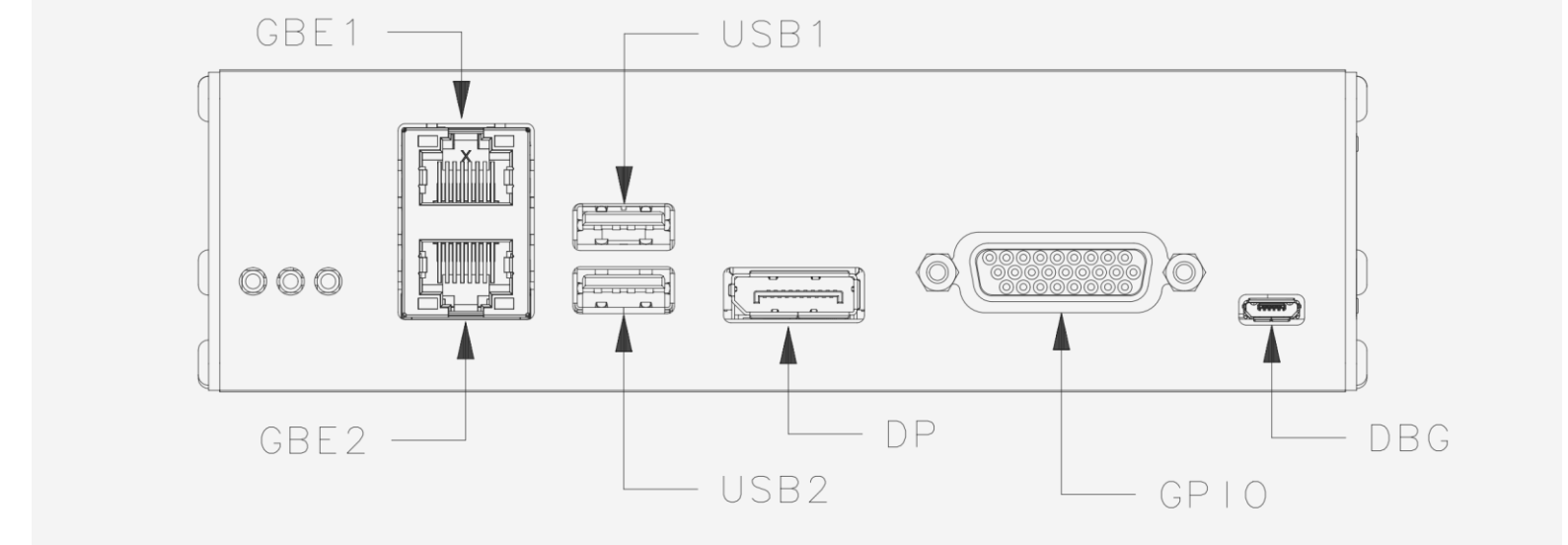
Arcas order information

ARCAS – INTERFACE SPECIFICATIONS

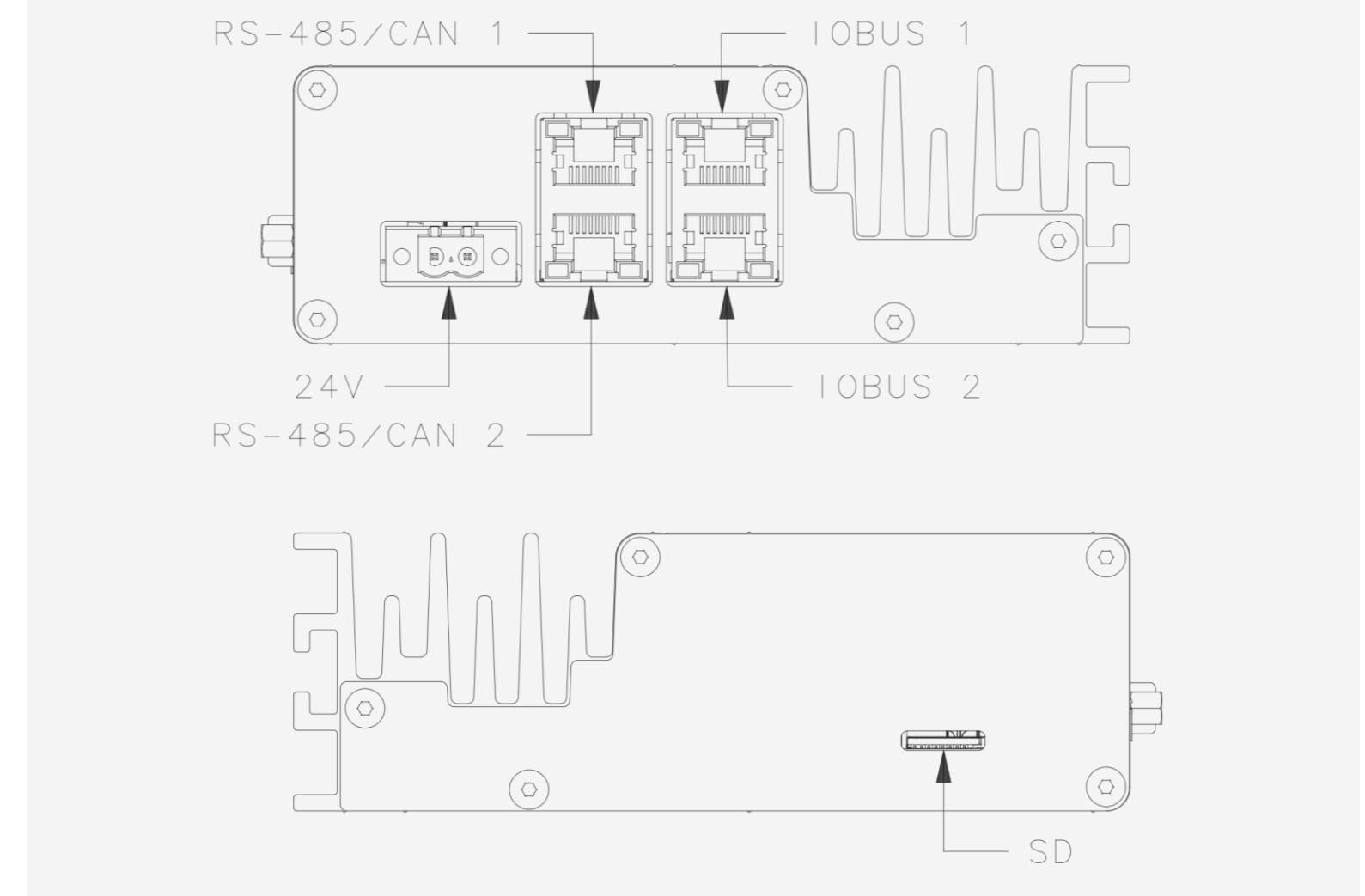
	Parameter	Symbol	Unit	Arcas 5EG	Remark
GBE1	Interface specification	-	-	Host interface	
	Speed	-	Mbps	10/100/1000	
GBE2	Type	-	-	EtherCAT® MDevice interface	
	Speed	-	Mbps	10/100/1000	Set to 100Mbps for EtherCAT® communication
USB	Number of interfaces	-	-	2	
	Type	-	-	USB 3.0	Used for mass storage devices
	Rated current	-	A	2	Combined for both USB interfaces
RS485	Number of interfaces	-	-	2	Used for position based triggering
	Interface specification	-	-	TIA/EIA-485A	
	Communication speed	-	Mbps	up to 50	
GPIO	Isolated digital inputs	-	-	4 x 24V	($V_{IH} \geq 11V$, $V_{IL} \leq 5V$, $I_{IN} < 15mA$)
	Non-isolated digital outputs	-	-	4 x 30V / 500mA	
	Electrical isolation	-	V	60	
microSD	Number of interfaces	-	-	1	High Speed mode supported
24V	Supply input voltage	V_{SUPPLY}	V	12 - 24	
	Supply input voltage, abs. max	$V_{SUPPLY_ABS_MAX}$	V	28	
	Idle power	P_{SUPPLY_IDLE}	W	7	
	Maximum input power	P_{SUPPLY_MAX}	W	35	

Note: CAN, IOBUS, DisplayPort and DBG are intended only for Prodrive Technologies proprietary usage

Arcas front view



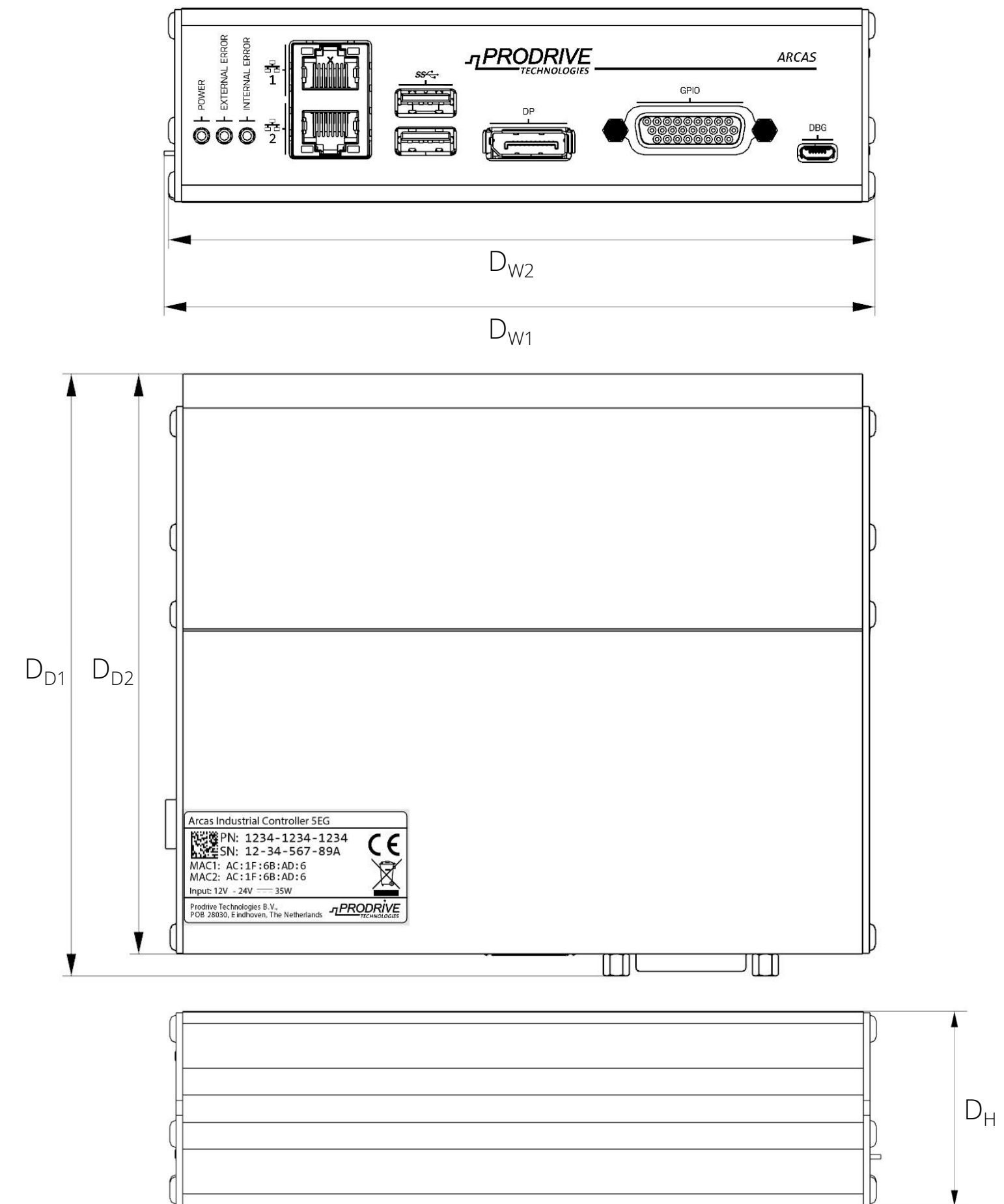
Arcas side views



ARCAS – MECHANICAL & ENVIRONMENTAL SPECIFICATIONS

	Parameter	Symbol	Unit	Arcas 5EG	Remark
Mechanical	Width	D_{W1}	mm	158.80	MicroSD card connected
		D_{W2}	mm	157.80	
	Depth	D_{D1}	mm	134.55	Including GPIO connector
		D_{D2}	mm	129.65	
	Height	D_H	mm	43.40	
Mass	mass	kg	0.83		
Environmental	Ambient temperature during operation	$T_{Ambient, operating}$	°C	0 - 45	Note 1, 2, 3
	Ambient temperature during storage	$T_{Ambient, storage}$	°C	-25 - 70	
	Relative humidity during operation	$RH_{Ambient, operating}$	%	10 - 90	Non-condensing
	Relative humidity during storage	$RH_{Ambient, storage}$	%	10 - 95	Non-condensing
	Altitude during operation	$Alt_{operating}$	m	0 - 5000	
	MTBF	MTBF	kHrs	>1000	Steady state mean time between failures
Directives	Electromagnetic Compatibility	-	-	EMC Directive 2014/30/EU	
	Low Voltage	-	-	LV Directive 2014/35/EU	
	Restriction of Hazardous Substances	-	-	RoHS Directive 2011/65/EU	
	Waste Electrical and Electronic Equipment	-	-	WEEE Directive 2012/19/EU	
	Registration, Evaluation, Authorisation and Restriction of Chemicals	-	-	REACH EC 1907/2006	
Standards	Safety	-	-	IEC 62368-1	DEKRA certified Includes national deviations for EU, US/Canada and China
	Electromagnetic Compatibility (Immunity)	-	-	IEC 60001-6-1	
	Electromagnetic Compatibility (Emissions)	-	-	EN 55011	
	Shock & Vibration	-	-	IEC 60068-2-27	

Note 1: Operating temperature derating is reduced by 1[°C]/300m above 1000m



Introducing the Poseidon EGS Motion Controller series — a peak of unparalleled performance designed to master the challenges of the most demanding motion applications.

The Poseidon EGS facilitates synchronized control across all available EtherCAT® buses, offering the flexibility to allocate individual buses for distinct sections of a single machine or to enable low-latency control of individual connected EtherCAT® devices.

Tailored to meet the stringent requirements of the medical and semiconductor industries, the Poseidon EGS Motion Controller stands out with its extended lifecycle support, ensuring reliability and continuity for applications with enduring demands. Elevate your precision control experience with the Poseidon EGS — a testament to exceptional performance and longevity.

- 4 core x86 processor @ 2.4GHz¹
 - Up to 28 axes @ 20kHz
 - Up to 70 axes @ 10kHz
 - More axes at lower update frequencies
- Connectivity
 - 1x Gigabit Ethernet host interface
 - Up to 16 synchronized EtherCAT® MDevice buses
- 19" rack mounting
- Rear connectivity



Poseidon EGS motion controller

Note 1: Higher core counts and core frequencies on request

POSEIDON EGS – CONFIGURATIONS



Poseidon EGS motion controller, 1U with rear side connectivity

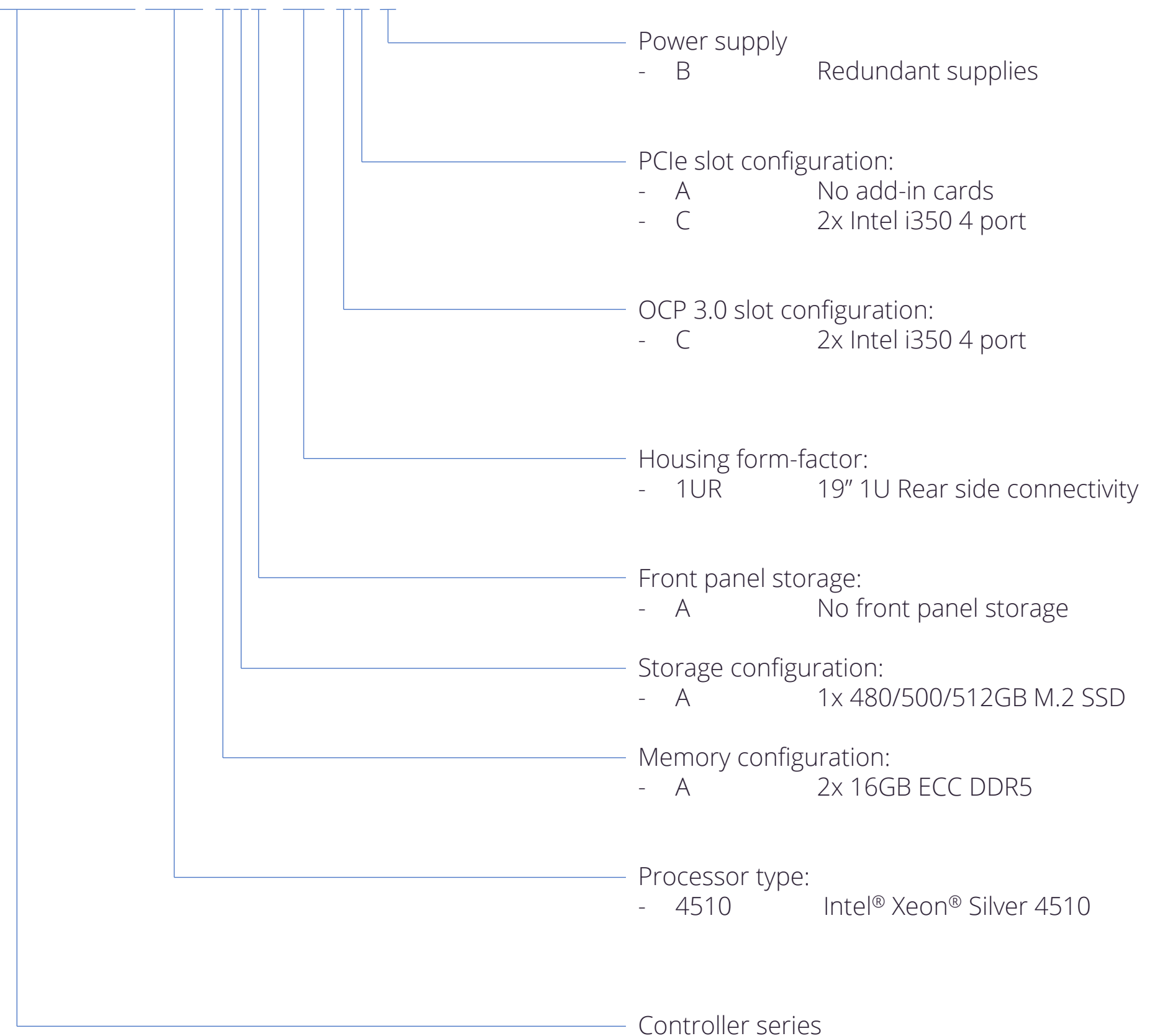
Configuration	Prodrive Product Number
PMP-Poseidon-EGS-4510-AAA-1UR-CA-B	6001-2501-5200
PMP-Poseidon-EGS-4510-AAA-1UR-CC-B	6001-2519-6400

Poseidon EGS order information for preferred configurations. Other configurations are possible with longer leadtime.

Optional/replaceable part	Prodrive Product Number
Rail kit	6001-2515-0300
Fan module (set of 5)	6001-2515-0100
Power supply	6001-2515-0200

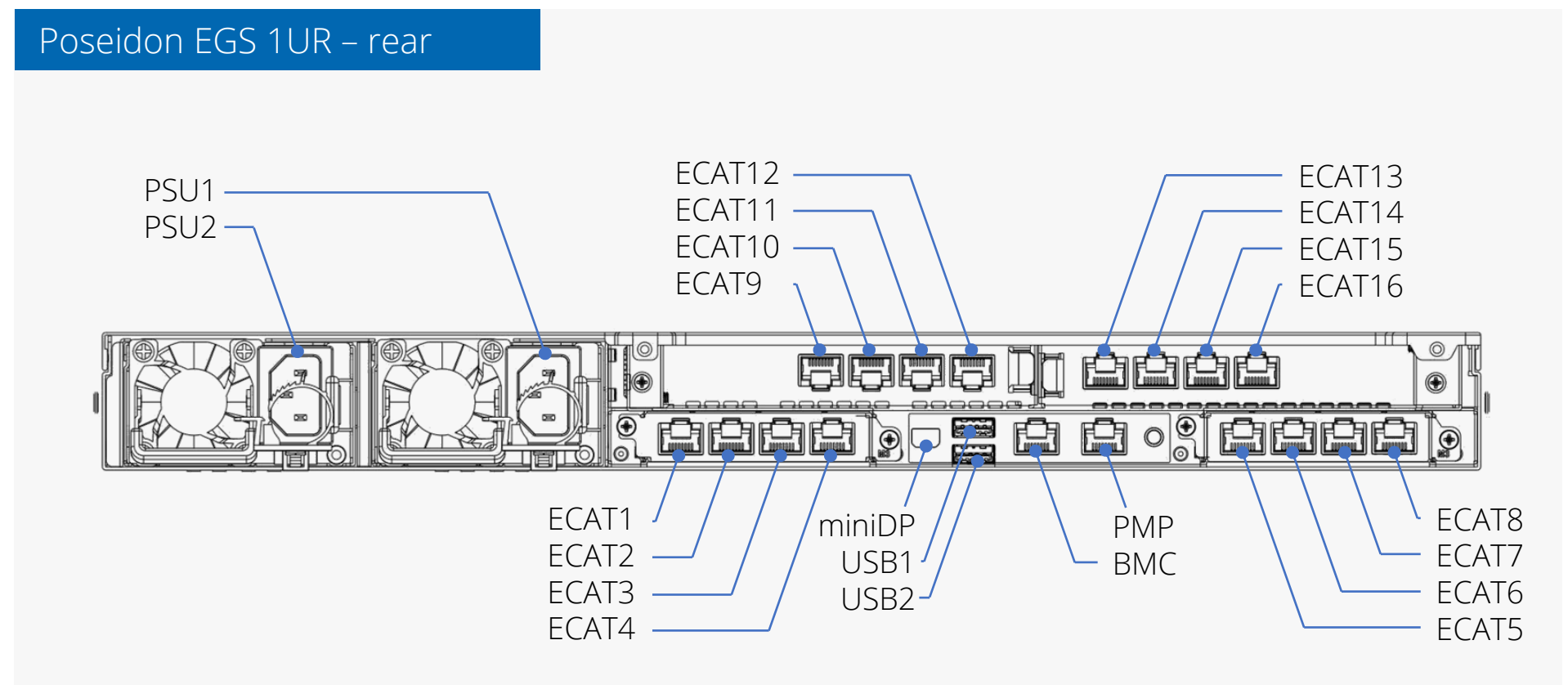
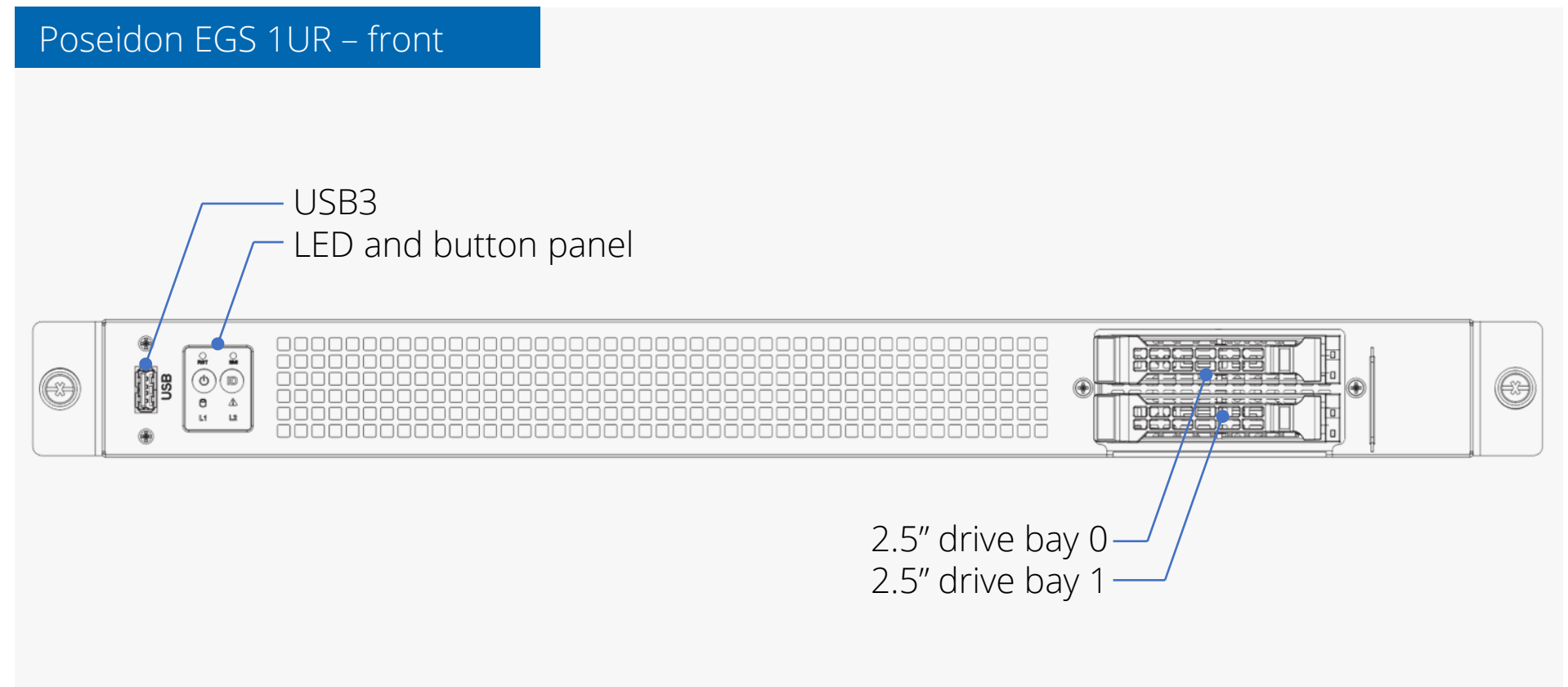
Poseidon EGS order information for optional and replaceable parts.

PMP-Poseidon-EGS-4510-AAA-1UR-CA-B



POSEIDON EGS – INTERFACES SPECIFICATIONS

	Parameter	Symbol	Unit	Poseidon EGS	Remark
PMP	Type	-	-	PMP host interface	
	Speed	-	Mbps	10/100/1000	
BMC	Type	-	-	Management interface	
	Speed	-	Mbps	10/100/1000	
ECAT	Interface 1 - 16				ECAT 9-16 only available for PCIe option C
	Type	-	-	EtherCAT® MDevice interface	
	Speed	-	Mbps	10/100/1000	
USB	Interface 1 - 2				
	Type	-	-	USB 3.2 Gen 1	Not available in PMP
	Rated current	-	A	1.8	Per 2x USB 3.2 ports
	Interface 3				
Storage	Type	-	-	USB 3.2 Gen 1	Not available in PMP
	Rated current	-	A	1.8	
	Interface 1 - 2				
miniDP	Form factor	-	-	2.5" drive bay	Not available in PMP
	Size	-	Gb	-	Can be configured on request
	Compatibility	-	-	DisplayPort 1.1a	Not available in PMP
PSU	Resolution	-	-	1920x1200	Max
	Frequency	-	Hz	60	Max
	Type	-	-	1+1 800W AC redundant	80 PLUS Platinum
	Input voltage low	V _{IN_LOW}	V	100 - 127	
	Input voltage high	V _{IN_HIGH}	V	200 - 240	
Input frequency	F _{IN}	Hz	50 - 60		
Input current low	I _{IN_LOW}	A	10	Max current for low input voltage (110V)	



PMP-Poseidon-EGS-4510-AAA-1UR-CC-B with 16 EtherCAT® ports

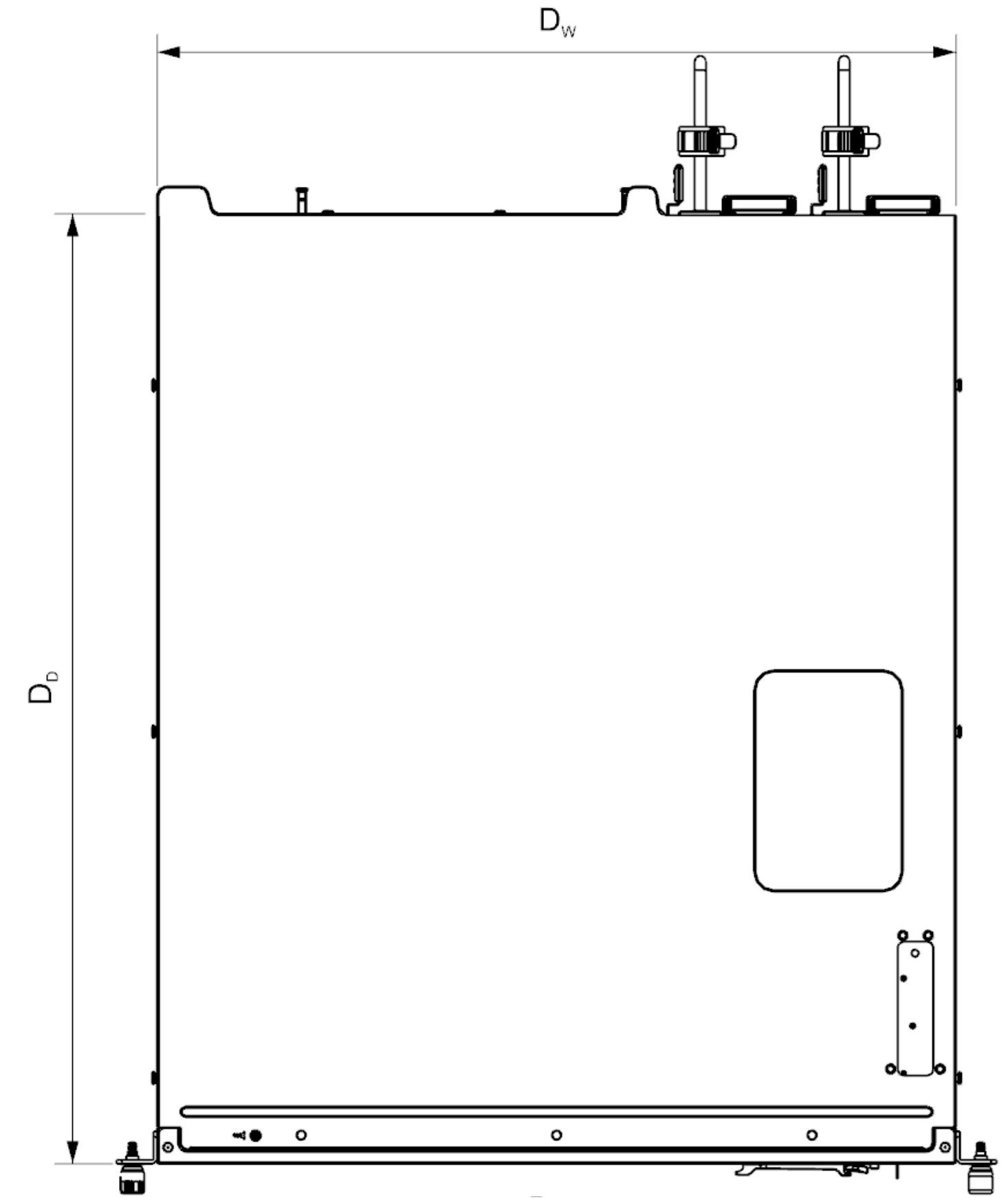
POSEIDON EGS – MECHANICAL & ENVIRONMENTAL SPECIFICATIONS

	Parameter	Symbol	Unit	Poseidon EGS	Remark
Mechanica	Height	D_H	mm	45.00	
	Front panel width	D_{FPW}	mm	482.00	
	Width	D_W	mm	438.00	
	Depth RIO	D_D	mm	538.00	
Environmental	Ambient temperature during operation	$T_{Ambient, operating}$	°C	10 - 35	Note 1
	Ambient temperature during storage	$T_{Ambient, storage}$	°C	-40 - 60	
	Relative humidity during operation	$RH_{Ambient, operating}$	%	8 - 80	Non-condensing
	Relative humidity during storage	$RH_{Ambient, storage}$	%	20 - 95	Non-condensing
	Air pressure at fan inlet	$P_{Air, inlet}$	kPa	70 - 120	
Directives	Altitude during operation	$Alt_{operating}$	m	0 - 5000	
	Electromagnetic Compatibility	-	-	EMC Directive 2014/30/EU	
	Low Voltage	-	-	LV Directive 2014/35/EU	
	Restriction of Hazardous Substances	-	-	RoHS Directive 2011/65/EU	
	Waste Electrical and Electronic Equipment	-	-	WEEE Directive 2012/19/EU	
Registration, Evaluation, Authorisation and Restriction of Chemicals	-	-	REACH EC 1907/2006		

Note 1: Operating temperature derating is reduced by 1[°C]/300m above 1000m



Poseidon EGS 1UR front view



Poseidon EGS 1UR top view

All Prodrive motion controllers operate using the powerful and versatile **Prodrive Motion software Platform (PMP)**. PMP is our real-time software, developed from years of experience in motion control across various industries and customer applications. Many players in the motion industry have recognized this platform's capabilities, using it to elevate their motion solutions.

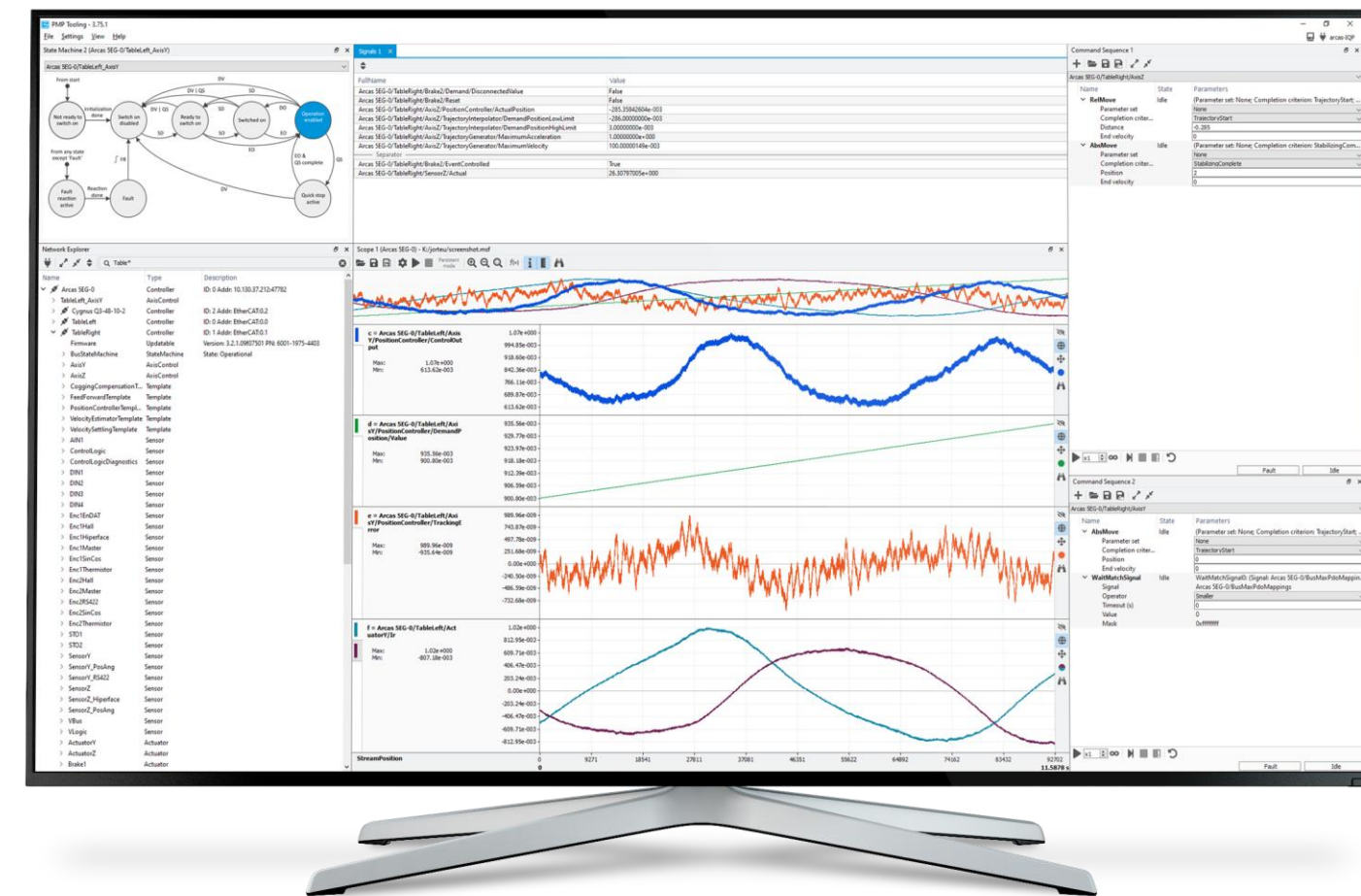
What sets PMP apart from other motion software systems is its reliable **real-time performance** for **centralized, distributed, and hybrid control** of motion systems. It features multiple parallel EtherCAT® buses with **frequencies up to 20kHz**.

We also offer extensive opportunities for **control structure optimization** and tuning. Our **MATLAB® Simulink®** code generation and C++ toolchains allow for seamless integration of custom algorithms into our controllers.

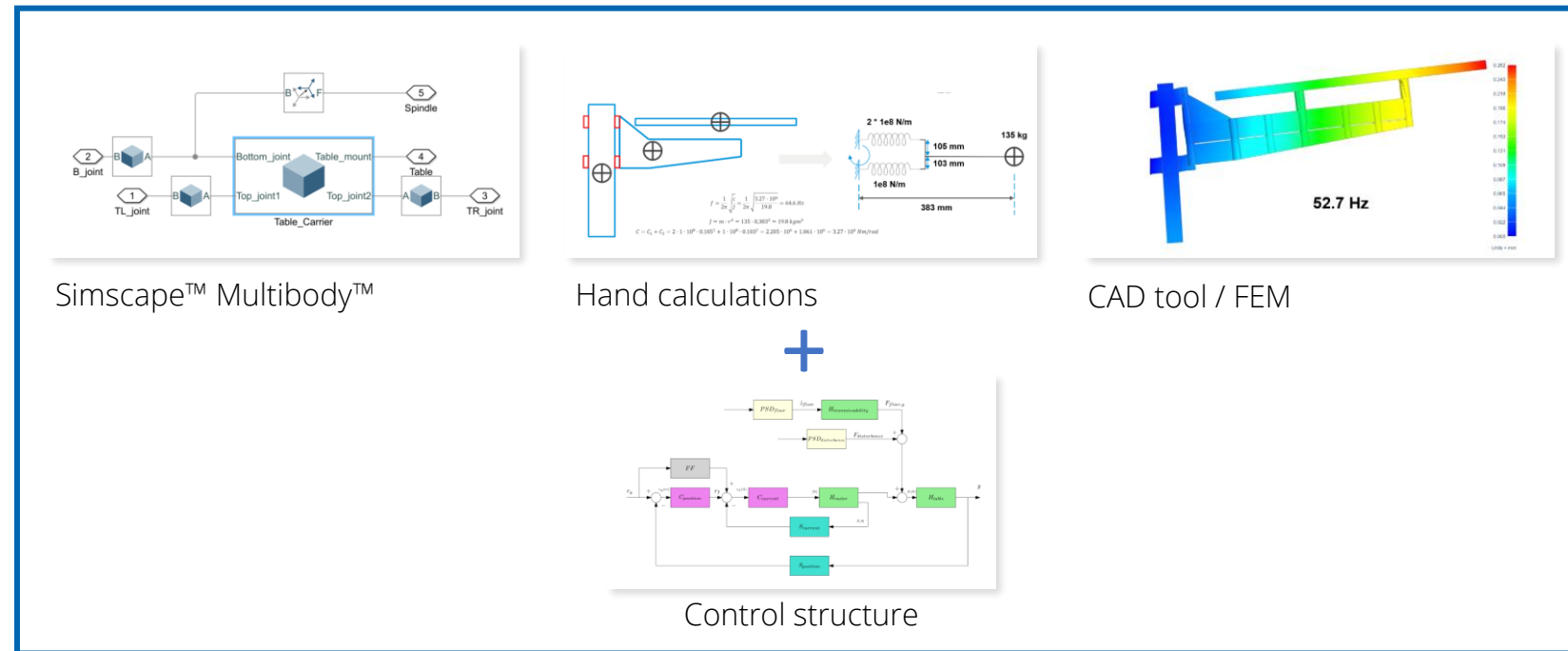
Our comprehensive API is available in **C++ and C#**. Through .NET integration, it can also be utilized in **Python.NET™ and MATLAB®**. Additionally, we provide a software simulator that runs on both **Windows® and Debian™ Linux®**, allowing users to start development without requiring physical hardware controllers.

The motion platform is completed by our **tool suite** for initial integration and debugging the system without the need to write a single line of code. This tool suite fully supports our API, from data acquisition to command queueing.

PMP Prodrive Motion Software Platform



Debug & integration tool suite



While conventional motion platforms impose fixed control structures, our PMP controllers offer a groundbreaking **blank canvas approach**. With PMP, users are not constrained by pre-defined configurations; instead, you have the freedom to **deploy any control structure you envision**.

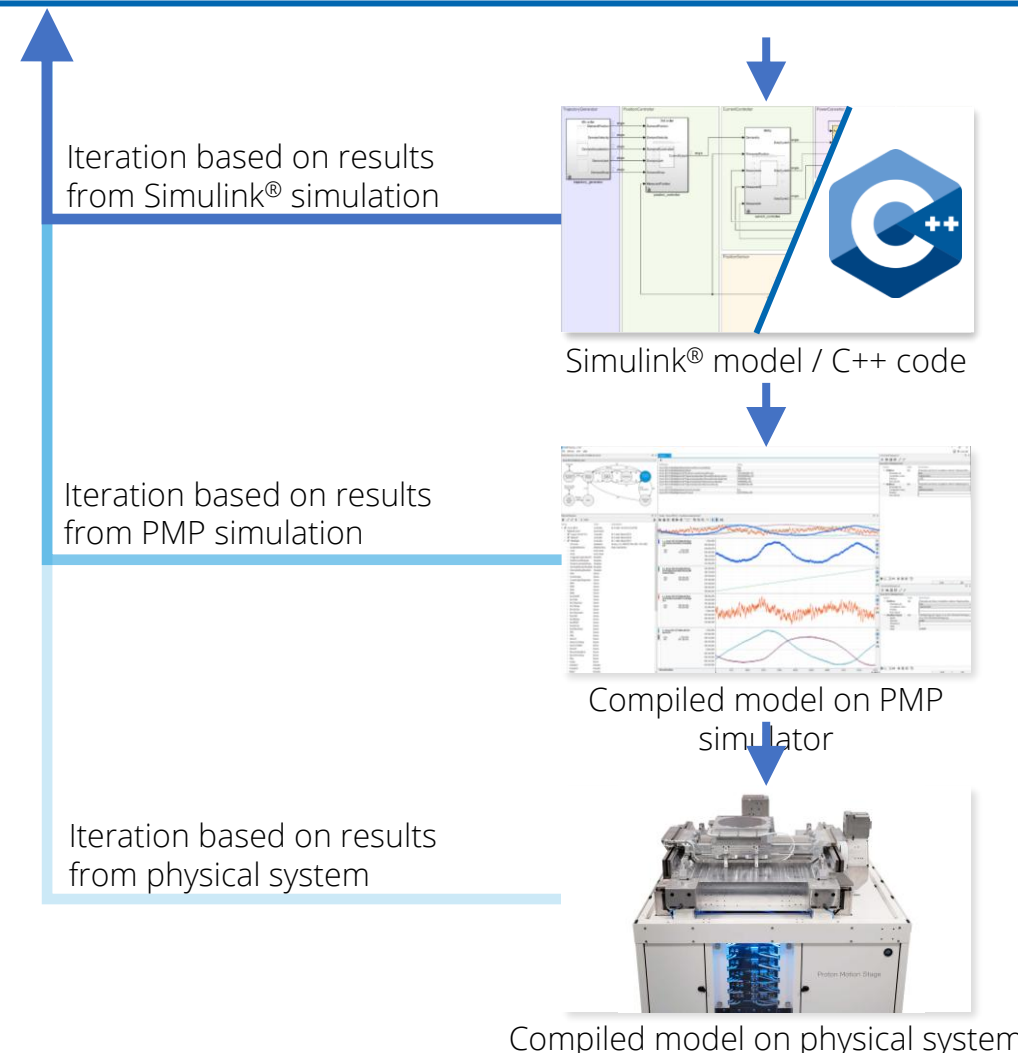
The PMP software empowers users to design and implement custom control structures using **Simulink® code generation** or handwritten **C++**. This allows people to (re)use any control IP that has been developed in the past.

Our intuitive code generation toolchain facilitates the creation of binary files directly from these Simulink® models or handwritten C++. These binaries files can be seamlessly uploaded to our controllers, or to the Windows and Debian Linux simulator, ensuring smooth integration into the workflow.

For axes that do not require special control structures, we also provide pre-configured **default control networks and processing blocks**. From feedforward to advanced feedback control systems, our comprehensive library of processing blocks supports a wide range of applications.

The generated binaries typically run synchronously within the isochronous sample loop to minimize I/O delay. However, if computationally heavy code is required, it can be run **asynchronously** at a lower frequency compared to the rest of the system.

Explore our documentation for [control loop customization](#) and [processing blocks](#) to unlock the full potential of your motion platform.



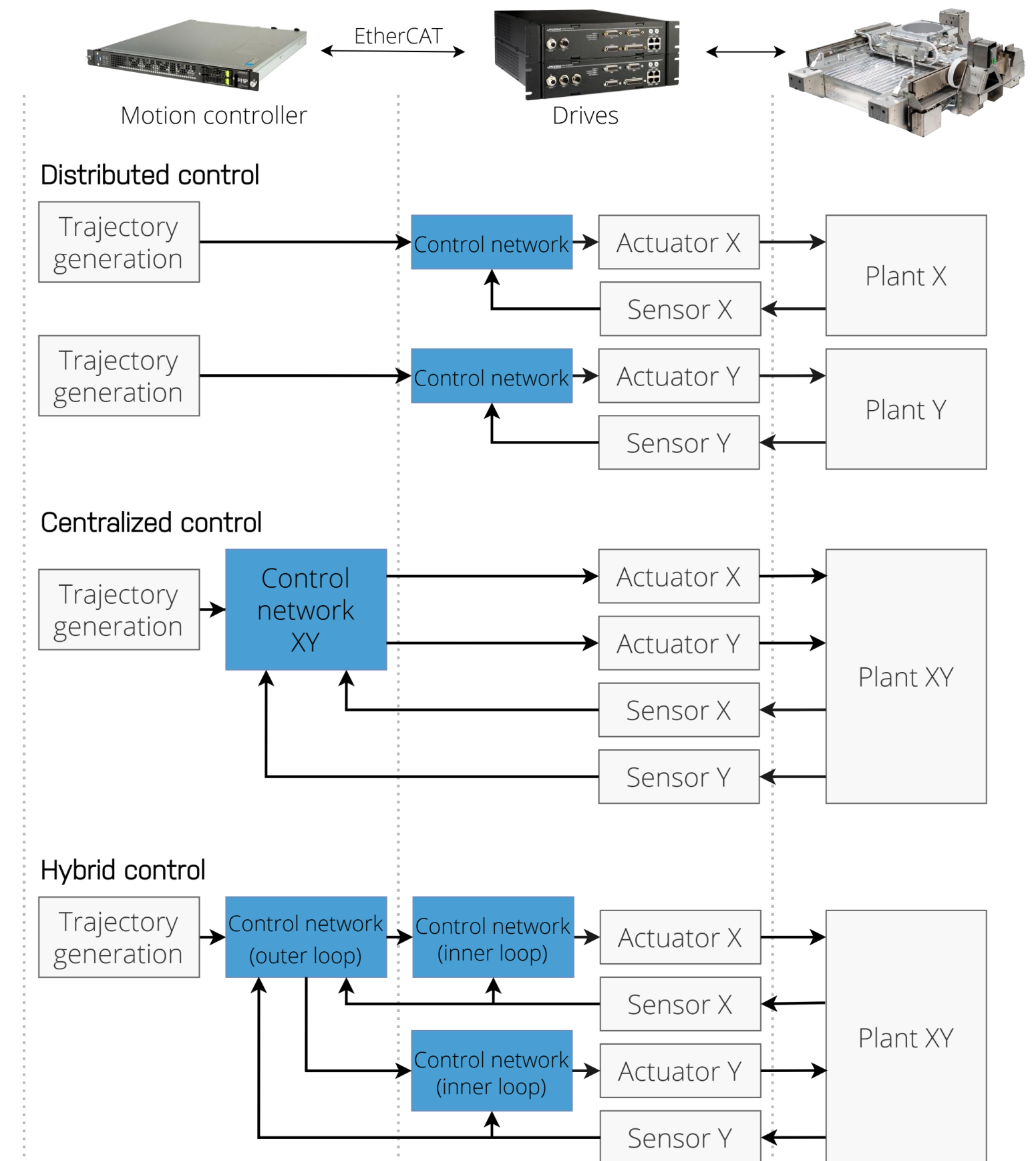
SOFTWARE – CONTROL TOPOLOGIES

We provide seamless interoperability with 3rd party EtherCAT[®] drives. For each axis of a CiA402 SubDevice, a physical axis control is automatically instantiated on our motion controller, offering a range of powerful features:

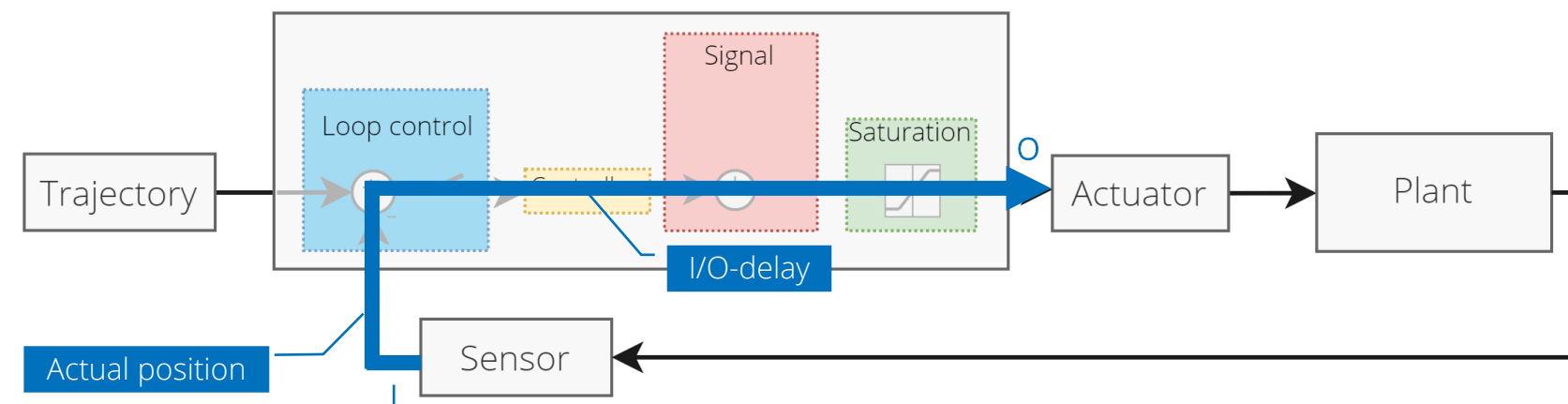
- **State machine:** Directly linked to the actuator's CiA402 state.
- **Command queue:** Enables real-time execution of commands.
- **Trajectory generator and interpolator:** Facilitates smooth and efficient motion.
- **Event responders:** Allows autonomous actions on the motion controller.
- **Advanced homing and alignment methods:** Ensures precise positioning and efficient control.

PMP offers the flexibility to choose the control strategy that best fits your application.

- **Distributed control:** The control loops are run on the SubDevices. This method achieves the highest possible sample frequency and lowest IO delay but is typically suitable only for SISO (single input single output) systems. It is commonly used for stages with positioning accuracy greater than 1 μm or for systems with axes.
- **Centralized control:** All control loops are run on the motion controller, while the SubDevices handle only IO tasks. Required to get the best performance for systems with any coupling between axes, for example when moving one axis causes vibrations in another axis. This method requires high communication bandwidth, typically has a higher I/O delay, and needs a powerful motion controller to run multiple control loops at high sample frequencies. It is typically used for stages with sub-100nm positioning accuracy, where all axes have some coupling.
- **Hybrid control:** Allows performance of distributed control for axes that are/can be fully decoupled and centralized control for axes that require it. This is typically used for cascaded control, such as a position outer loop combined with a velocity inner loop.



Distributed vs centralized vs hybrid control topology



I/O delay is the time between reading sensors and actuation

PreCalculate Calculate PostCalculate

Core	Task ID	Duration	Task ID	Duration	Task ID	Duration	Task ID	Duration	Task ID	Duration	Task ID	Duration
Core #0	d70da4ae51370545972ae31c2bbd5822ec58b63ff	39 ns	0cf9dded1abc49ad7f2395a01c1ef2f0683155t	44 ns	43 ns	26 ns	54 ns	38 ns				
Core #1	3483c7964cd853927	36 ns	3d060f6678006bfaf485913ca01	29 ns	35 ns	26 ns	79 ns	57b2af84c645e66	26 ns	15c89ac172	326 ns	

Multi core schedule overview for the calculate phase of core #0 and #1

When deploying a complex control structure, you expect nothing less than peak performance. Our controllers are built to deliver precision, offering configurable sample frequencies ranging from **200 Hz to 20 kHz**. The maximum feasible frequency depends on a few factors, such as the controller's performance, the number of connected EtherCAT® devices, PDO data, and the complexity of the control structure. Our hardware provides a range of options to match users' desired performance and budget.

However, performance is more than just numbers – it is about optimization. Our control structure deployment is engineered for maximum efficiency **and minimal I/O delay**.

How do we achieve this? Through advanced techniques such as:

- **Multi-core task scheduling:** Our controllers intelligently distribute the workload across all available real-time cores, ensuring optimal resource utilization.
- **Automatic calculation order determination:** By automatically determining the calculation order based on input connections, our controllers streamline operations and eliminate unnecessary delays.
- **Automatically PDO data determination,** optimizing system performance without compromising functionality. Based on input connections, this function streamlines operations and reduces unnecessary overhead.
- **Time-critical distinction:** We prioritize time-critical calculations, reducing I/O critical time and ensuring smooth operation, even under demanding conditions.

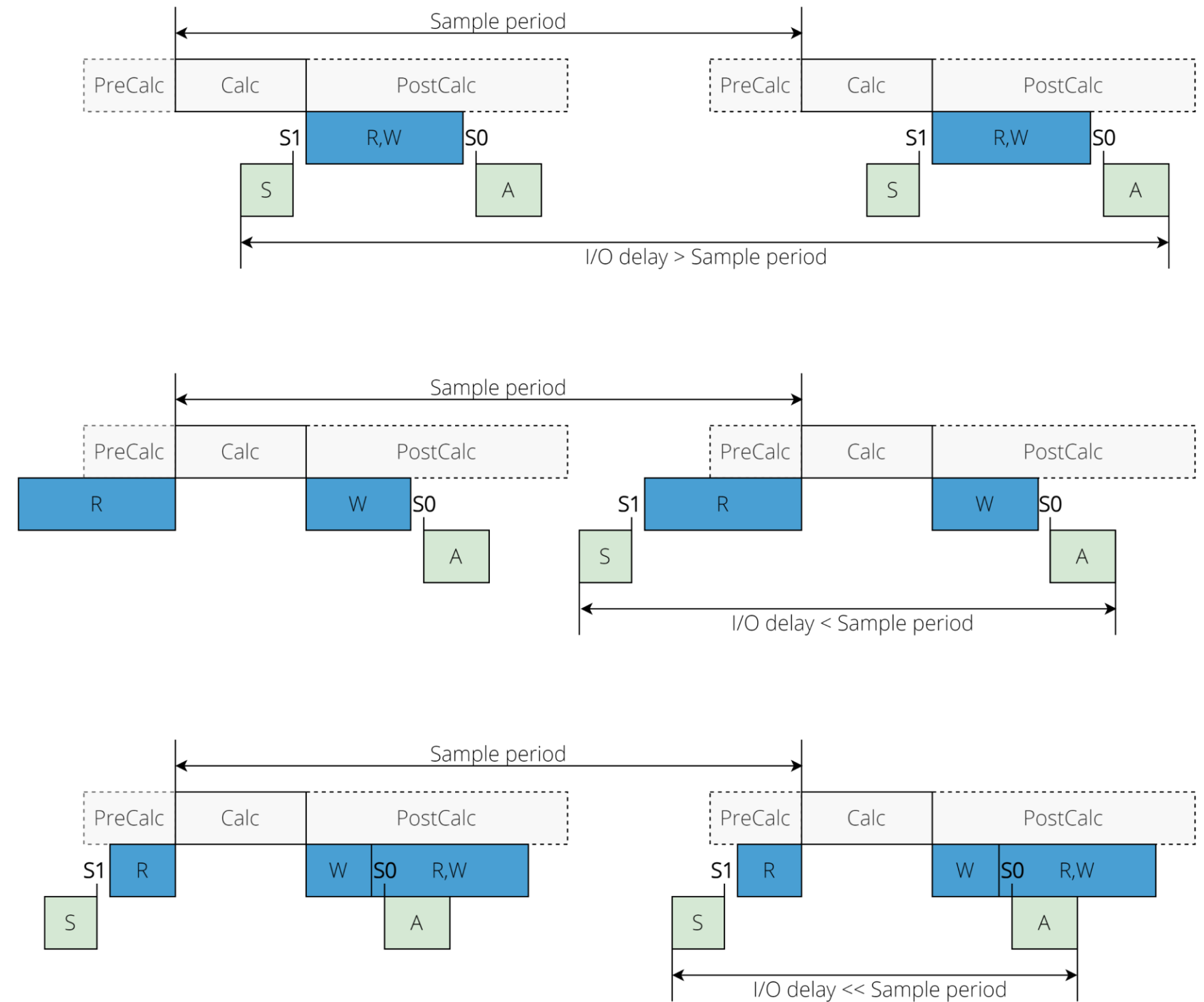
Once an optimal configuration is found, it can be downloaded and deployed on other controllers. With PMP controllers, users don't just get high performance, they get performance optimized to perfection.

SOFTWARE – ETHERCAT® MULTIPLE PACKET MODES

Minimizing I/O delay is crucial in centralized control, and that's where we excel. Our team specializes in maximizing EtherCAT® potential to deliver performance that exceeds expectations. With bus frequencies ranging from 200 Hz to 20 kHz, our motion controllers provide unparalleled speed and responsiveness, ensuring seamless operations.

To further reduce I/O delay, we offer **multiple packet modes** tailored to users' specific needs:

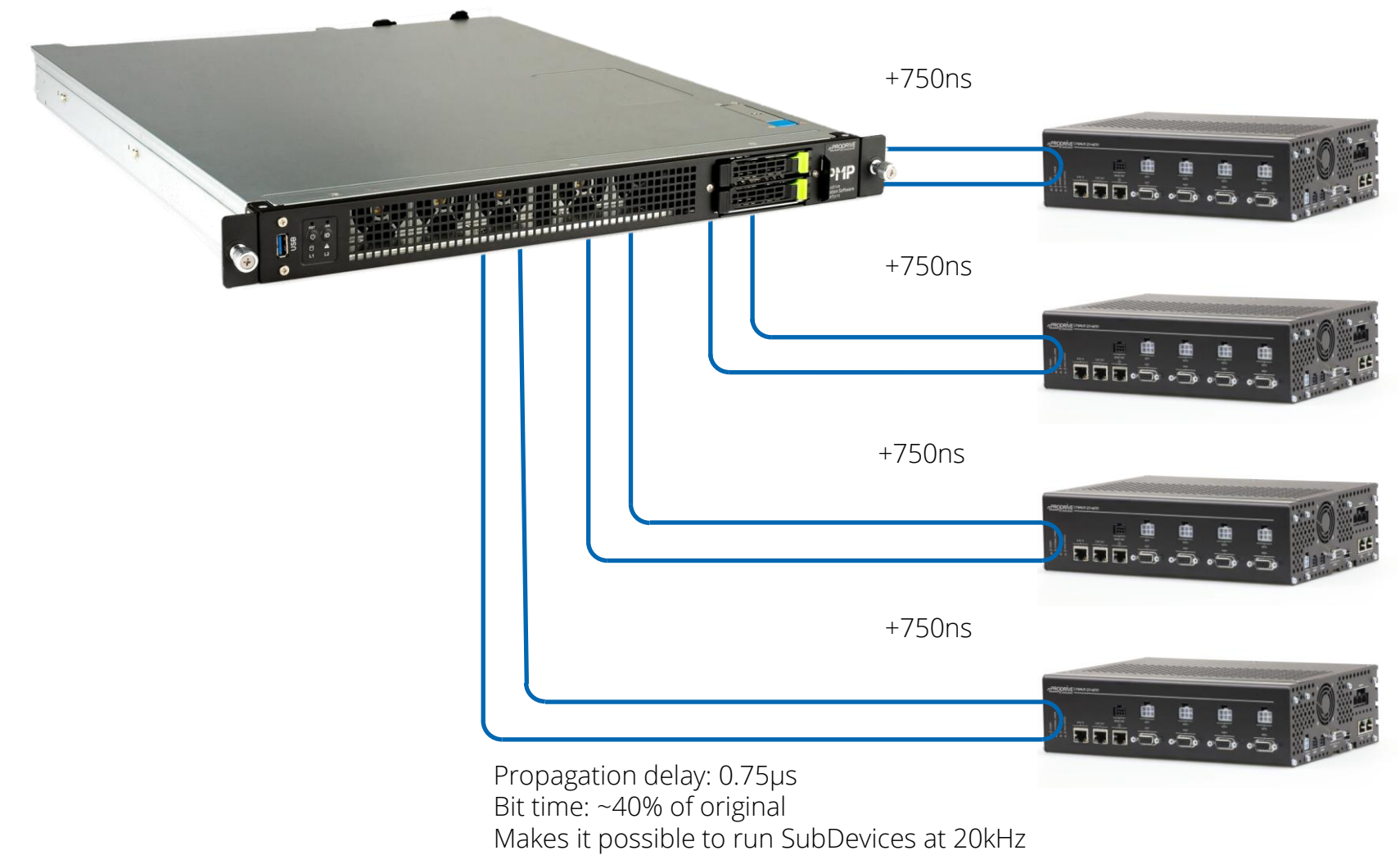
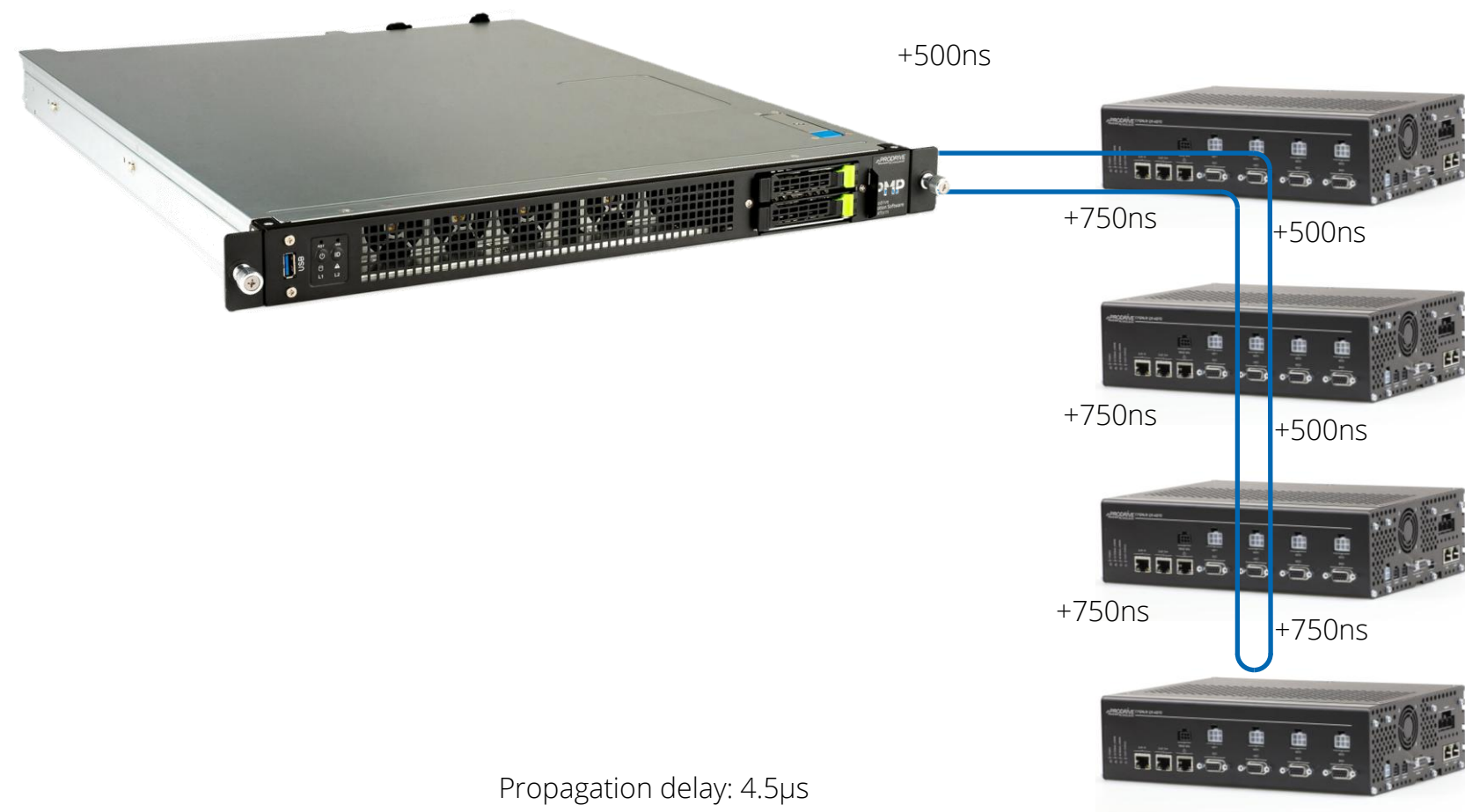
- **Standard** (1 packet): Combines read and write packets for traditional operations.
- **Read/write separated** (2 packets): Separates read and write packets to minimize I/O delay.
- **Critical I/O prioritized** (3 packets): Prioritizes critical I/O data over other data for peak performance.



Supported packet modes (top: standard, center: read/write separated, bottom: critical I/O prioritized)

SOFTWARE – PARALLEL ETHERCAT® BUSES

Another way to reduce I/O delay is by using multiple EtherCAT® buses. The Poseidon series motion controllers supports **multi-bus operation and synchronization**, allowing up to 12 parallel buses at 20 kHz. This means higher data bandwidth, reduced I/O delay, lower propagation delay per chain, and shorter bit times per chain – leading to unparalleled control performance.



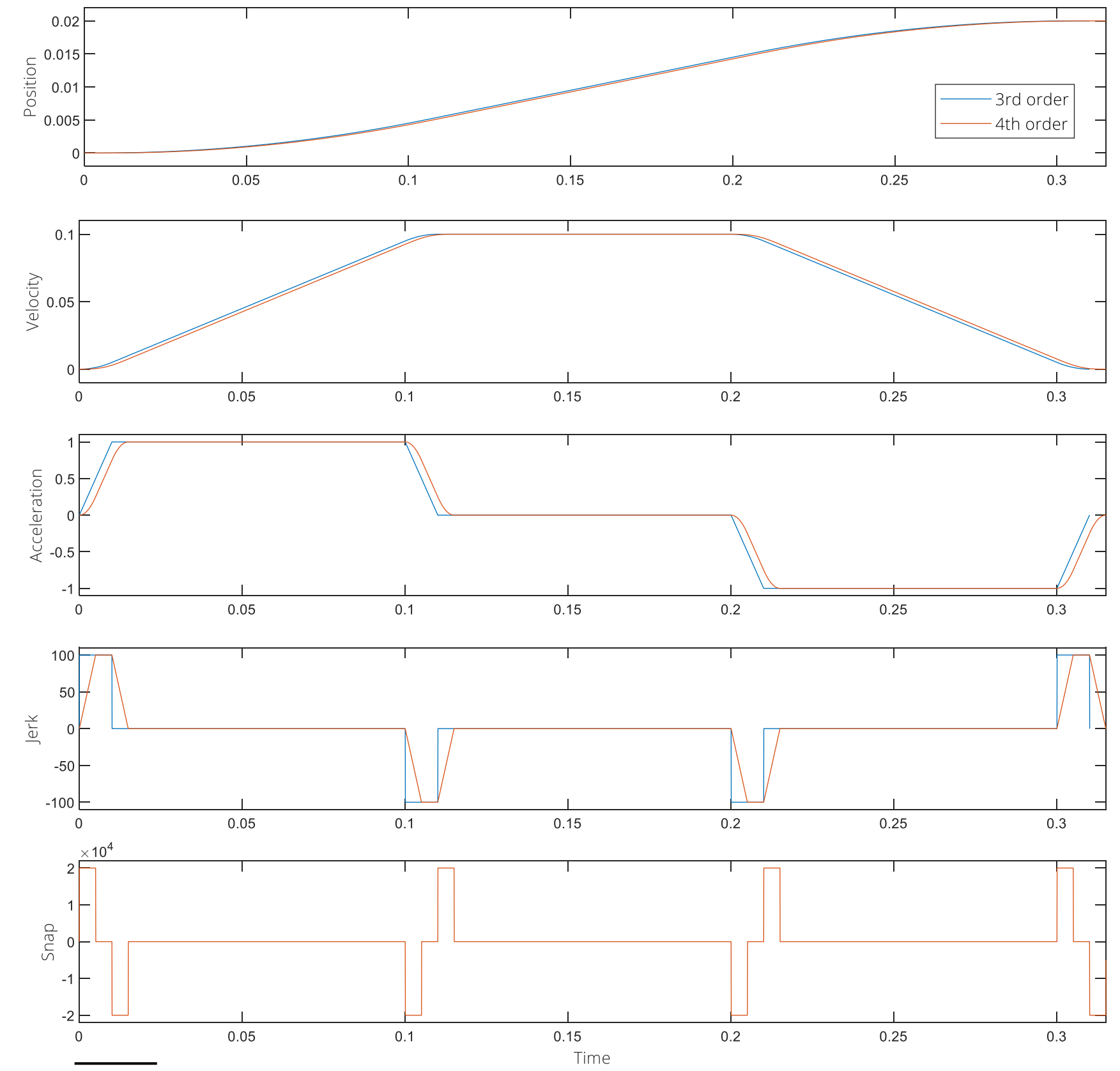
Standard connectivity vs.. multiple buses results in a lower I/O delay

SOFTWARE – TRAJECTORY GENERATION

All motion controllers come with **3rd order trajectory generators** for all axes by default. These generators create smooth trajectories suitable for most motion control applications. Maximum velocity, acceleration, and jerk can be configured, based on these parameters the generator determines the **time-optimal trajectory** to the desired end-point.

The 3rd order trajectory generator supports **point-to-point movement with or without end velocity**, jogging, and smooth stopping. We also offer the option to **lock the ratio** between velocity, acceleration, and jerk, which can **improve settling behavior** for small moves by avoiding mechanical resonances at undesired frequencies.

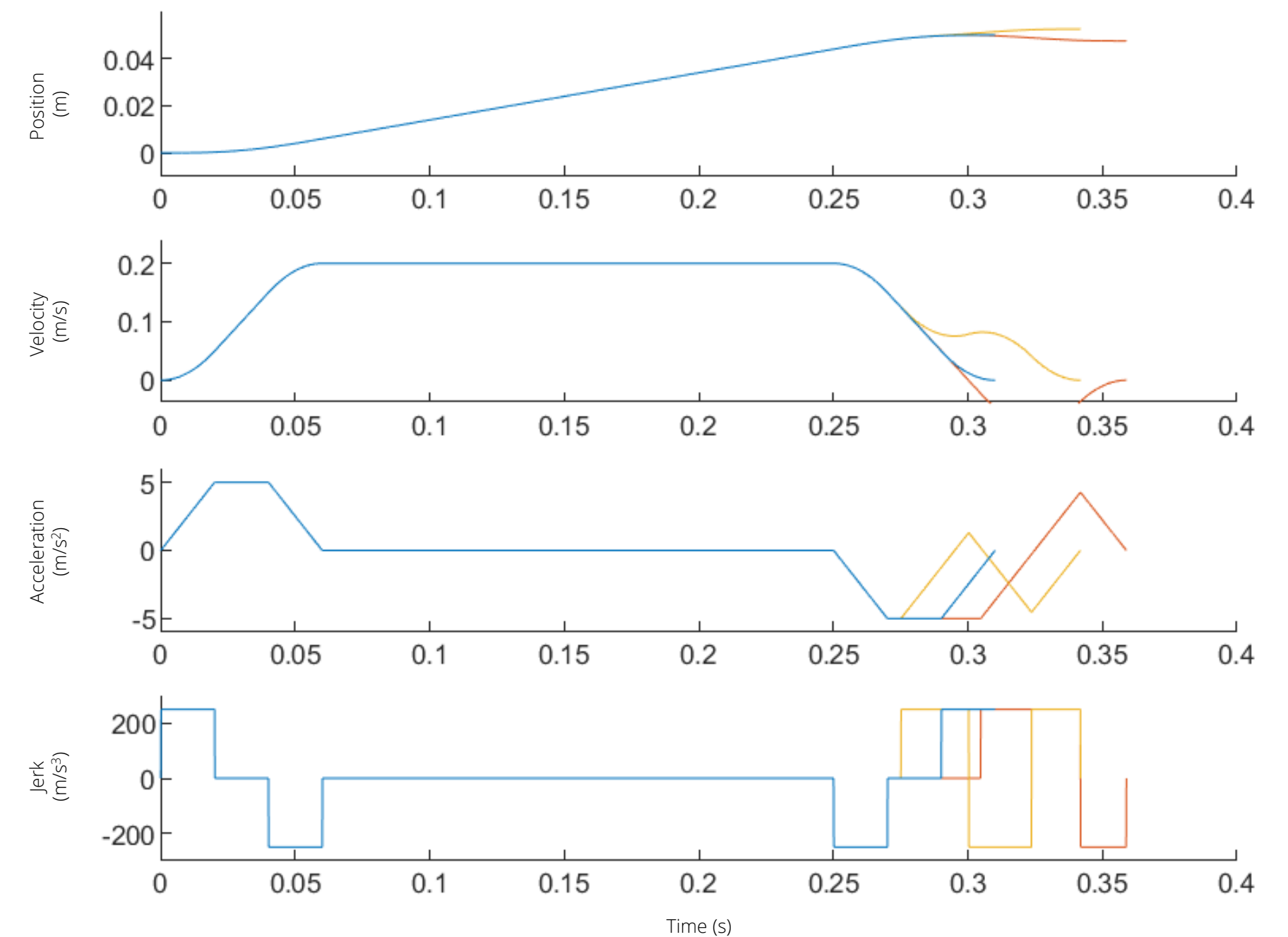
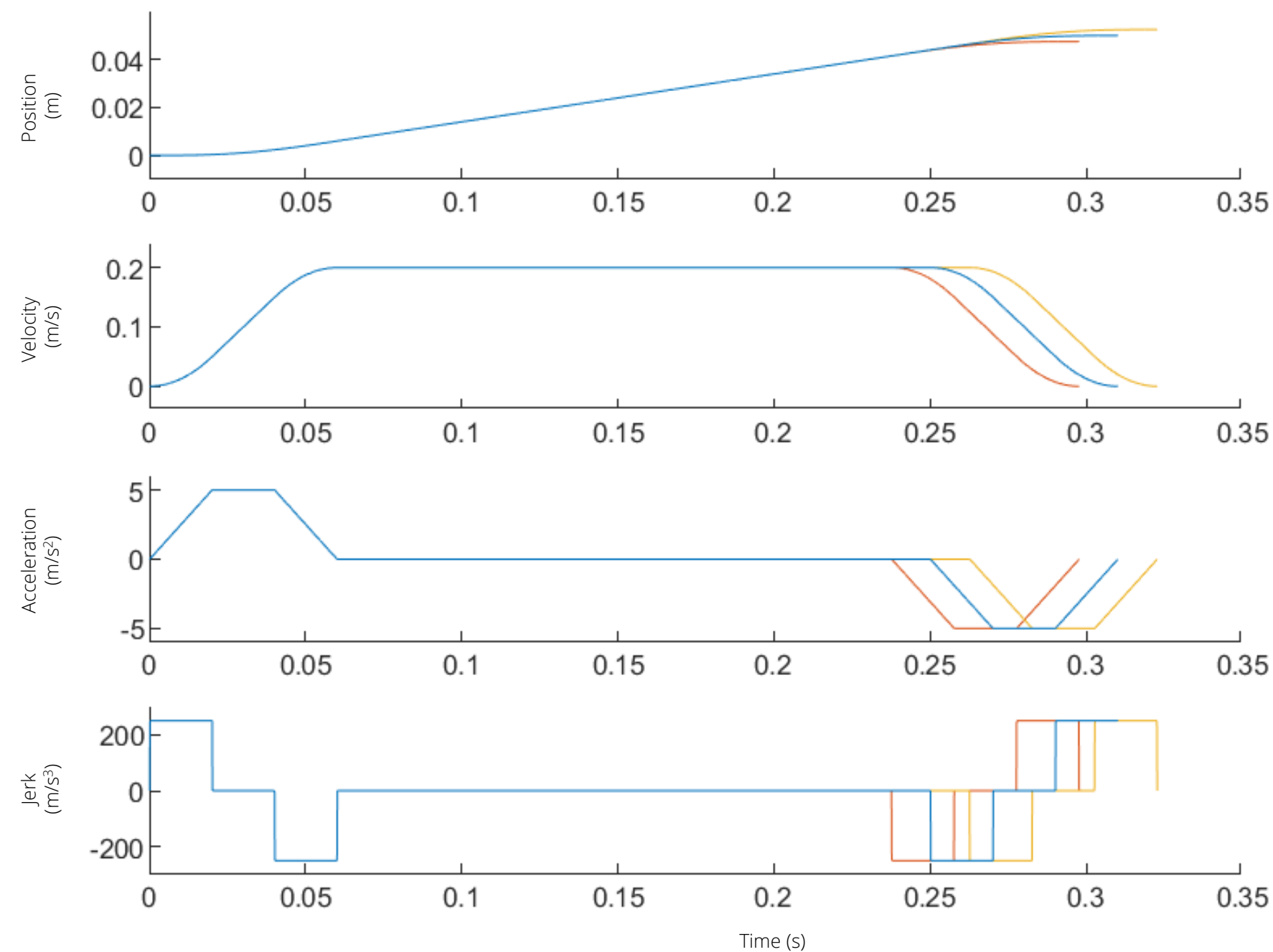
For point-to-point applications requiring reduced settling, we offer a **4th order trajectory generator** for even smoother movement with less excitation of mechanical resonances. The maximum snap can also be limited, which causes a slightly longer move time, but results in better tracking during movement and faster settling after a move or when reaching constant velocity - improving overall system efficiency and throughput.



Difference between 3rd and 4th order trajectory

SOFTWARE – TRAJECTORY END-POINT CORRECTION

Sometimes the exact end position is not known at the start of a move, for example when camera input is required to measure the exact end position. Instead of relying on multiple moves, our 3rd order trajectory generator allows updating the end position and velocity while the trajectory is being executed. This process, known as **end-point correction** or **on-the-fly move update**, helps to increase throughput where it is most critical.

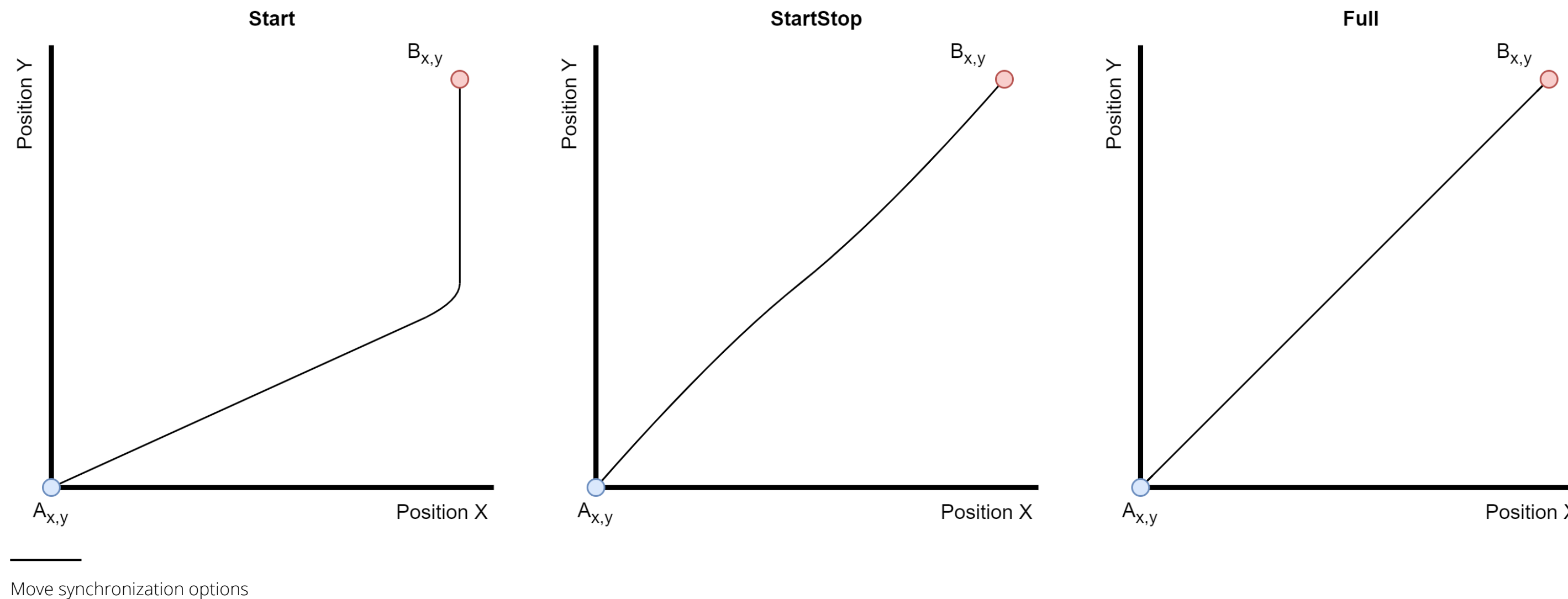


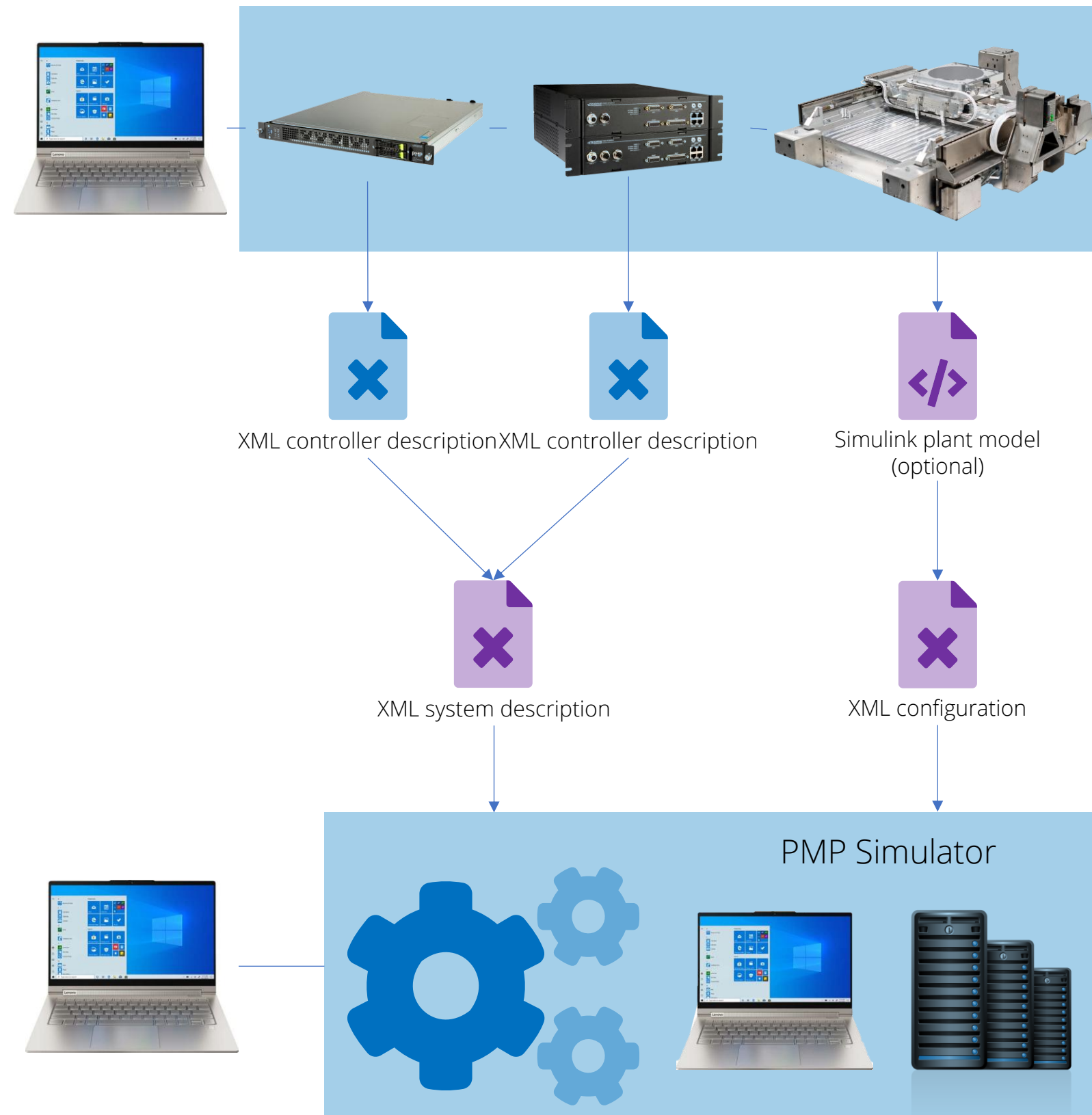
End-point correction with target position: 50mm ± 5%, Maximum VAJS: 0.2m/s, 5m/s², 250m/s³

For advanced control needs, it is possible to synchronize axes setpoints through trajectory synchronization on axis control groups. This ensures coordinated and **synchronized motion across multiple dimensions**, optimizing system performance, functionality, and safety.

The following multi-dimensional synchronization modes are supported:

- **Start**: trajectories start simultaneously
- **StartStop**: trajectories start and stop simultaneously; velocity, acceleration, and jerk (VAJ) of faster-moving axes are adjusted to match move duration
- **Full**: trajectories start and stop simultaneously; all move segments matched to achieve a perfect straight line





Simulating a system via the PMP simulator

When developing a new system, it is important to start integration as early as possible to **mitigate risks** and reduce hardware dependencies, ultimately **saving costs**. Our software simulator allows users to simulate their entire system on **Windows®** or **Debian™ Linux®**, minimizing the need for additional hardware and mechanical systems.

The simulator **covers the entire API** and simulates the logic of our motion controllers and drives. Prodrive provides the simulator executable through the PMP installer, along with XML controller descriptions for Prodrive motion controllers and drives, which include all supported functionality and interfaces. Interfaces for 3rd party devices are also supported. Simply specify the system topology using an XML system description or the API, start the simulator, and begin the development process.

With our simulator, users can run **custom C++** or **Simulink®-generated code** just as users would on our actual motion controllers. The system can be configured identically to the actual hardware via configuration files. Similarly, simulated plants can be instantiated to replicate complete system behavior based on users' design parameters, saving significant time during development and integration phase.

SOFTWARE – DEBUG & INTEGRATION TOOL SUITE

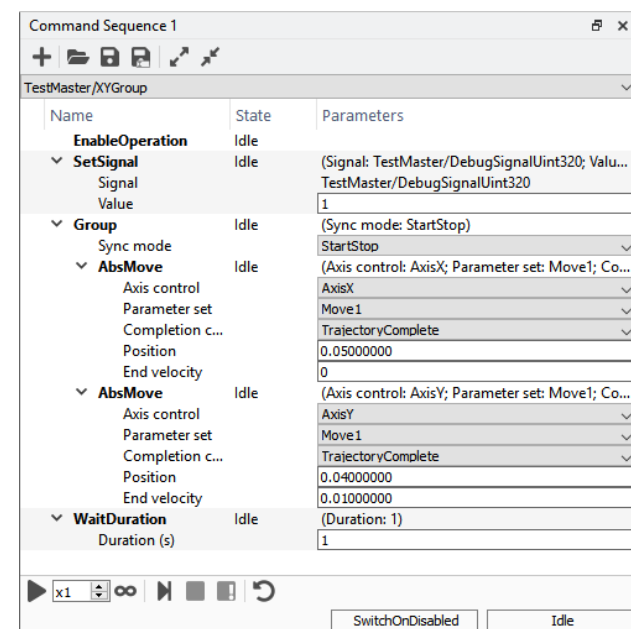


We understand that users want to start integrating as soon as they receive our motion controller. With our debug and integration tool suite, users can get started without writing a single line of code. The entire PMP API is accessible through this tool suite.

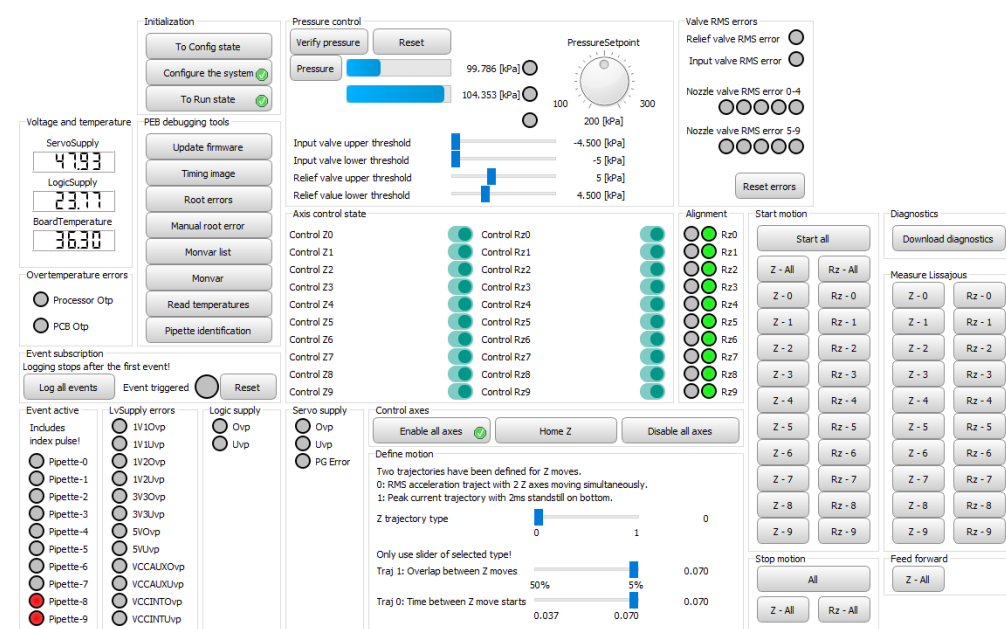
All available objects are displayed in a **tree view**, providing a clear overview of every component, including their configuration. The system can be configured manually by setting parameter values via the **signal view** or by loading **configuration files**.

All signals in the system can be read asynchronously or traced at any desired sample rate using the **powerful built-in scope view**. Use manual or **triggered acquisition** with autonomous start/stop to capture traces precisely when it is needed. **Continuous tracing** is also possible, allowing users to monitor the system behavior in real-time without waiting for acquisition completion. All traces can be saved manually or automatically in .msf¹, .csv or .png format.

Scope view with triggered acquisition settings



Command sequence view



HMI view

Axes can be enabled via a clear **state machine view**, and commands can be queued through the **command sequence view**. Users can check diagnostics using the **log and event views**. If the predefined views do not meet users' needs, users can create a custom **HMI view** tailored to the system.

SOFTWARE – PERFORMANCE COMPARISON

	Parameter	Unit	Arcas 5EG	Poseidon EGS
	Architecture	-	ARM v8a	x86
	Amount of cores	#	4	4 (up to 12 on request ^{2,3})
Axis control	Axis controls performance ¹	#	12 @ 10kHz	70 @ 10kHz, 28 @ 20kHz (more on request ^{2,3})
	Supported trajectory generators	-	Standard3rdOrder	Standard3rdOrder FixedRatios3rdOrder ² Standard4thOrder ² FixedRatios4thOrder ²
	Trajectory interpolator	-	Standard3rdOrder	Standard3rdOrder Standard4thOrder ²
	Parameter sets	#	120	250
EtherCAT	EtherCAT buses	#	1	8 (up to 16 on request ³)
	Bus frequency	Hz	200 - 10k	200 - 20k ²
	PDO modes	-	Standard (1 packet)	Standard (1 packet) Read/write separated (2 packets) ² Critical I/O prioritized (3 packets) ²
Control	Maximum number of axis control groups	#	10	10
	Maximum amount of axis controls per group	#	10	10
	Maximum commands	#	1000	10000
	Memory for processing blocks/updatables/FoE	MiB	66	1000
	Asynchronous processing blocks support	-	No	On request ²
Acquisition	Max acquisition instances	#	16	32
	Max acquisition signals	#	250	250
	Maximum super sample frequency	Hz	100k	400k
	Maximum data rate	samples/sec	500k	2M
	Acquisition buffer size	MiB	32	64

Note 1: Number of axes based on [PositionControlSimple](#) (standard PID feedback control) with [Feedforward](#)

Note 2: Licensed feature

Note 3: Dependent on hardware configuration

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