



MCS2

Modular Control System for
High Performance Positioning

One Controller System - Three Drive Technologies

The MCS2 series is based on a highly modular system concept which allows SmarAct to provide you with a perfectly adapted and pre-configured control system.

MCS2 controllers are available in product variants for different drive technologies with a variable number of channels. Technology-specific power amplifiers are integrated into the controller. Different interface options are available. Optional I/O modules may be integrated for external trigger and synchronization tasks. A hand control module may be integrated into 3-channel controllers or may be connected externally. Table-top and rack module housing options are possible.

The MCS2 is designed to support positioning stages with the following drive technologies:

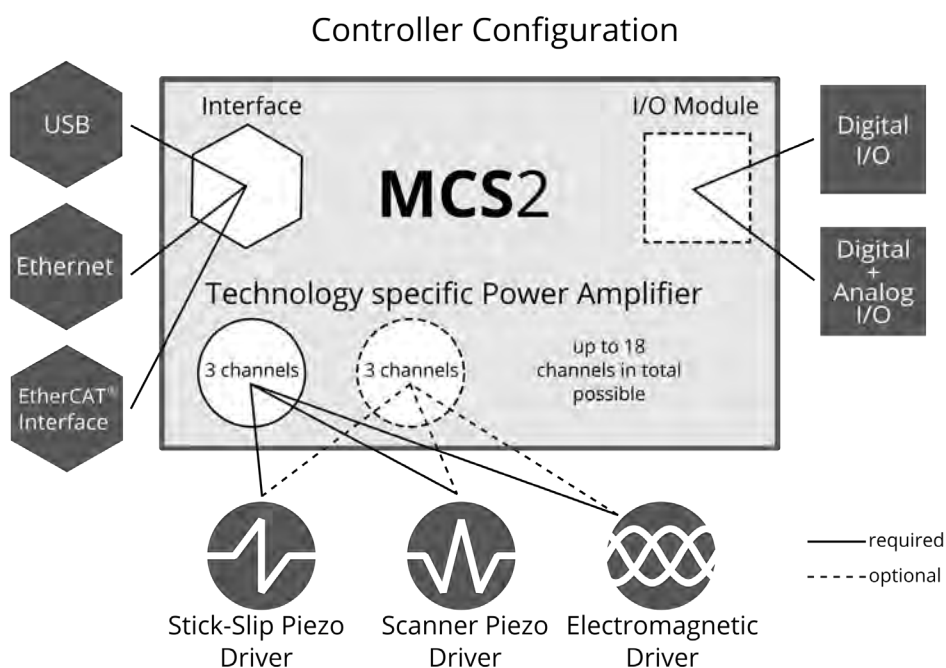
🌀 Stick-Slip Piezo Drives

📡 Scanner Piezo Drives

🌀 Electromagnetic Drives

All MCS2 variants share the same basic control concepts and the same application programming interface. Available operating modes as well as specialized firmware features may vary between drivers.

The driver modules are the core components of every MCS2 configuration. These modules contain the technology specific power amplifiers. They connect to the host interface and to optional I/O modules. These modules perform signal processing of the sensor data from the sensor modules, they host the control loops to perform closed-loop position control and output signal generation as well as control logic, etc.



Key Features

Powerful

- **Compatible with all SmarAct stages** with stick-slip piezo drives, scanner piezo drives and electromagnetic direct drives with or without integrated positioning sensors
- 3 to 18 channels in one controller
- Integrated technology specific power amplifiers
- Support for S, L, I position sensors with nanometer resolution
- Fast control loop with up to 50 kHz
- Can utilize the SmarAct **PICOSCALE Interferometer** as a high-resolution position sensor with picometer resolution

Smart

- Well documented property-based Application Programming Interface (API) for Linux and Windows
- SCPI based ASCII command protocol for ethernet interface
- Different closed-loop trajectory generators for point-to-point, streaming and waveform generator movements:
 - Synchronous motion of multiple axes
 - Closed-loop positioning with velocity and acceleration control and high-resolution positioning accuracy
 - Complex customizable trajectories with up to 1 kHz trajectory point frequency
 - Open-loop scan modes for sub-nm motion of piezo driven stages
 - Waveform Generator for trajectory generation based on predefined wave forms
- Sensor power save mode for thermal management in vacuum applications
- Positioner ID System to automatically detect and configure connected stages

Versatile

- USB and Ethernet interface available
- EtherCAT® interface enabling integration of the SmarAct-products into a larger sensor/actuator system of the customer with real-time performance
- Intuitive Hand Control Module for precise, manual control with graphical display and tactile control via 2D joysticks, buttons and knobs
- Optional I/O Modules with digital and analog inputs and outputs for external triggering and synchronization







User Friendly

- Service Tool for easy setup and quick testing
- Comprehensive Programmers Guide
- Programming examples for C/C++, Python® and LabVIEW™

Upgradeable

- In the field firmware update system
- Sophisticated firmware modules

MCS2 Components

Module	Variant	Description
Driver	SMARSLIDE  (Stick-Slip Piezo)	These modules are the core component of every MCS2 configuration. They each include power circuits to drive up to three attached positioning stages and read sensor data from a sensor module to perform closed-loop position control. Several modules may be combined to control multiple of three stages.
	SMARSHIFT  (Electromagnetic)	
	SMARFLEX  (Piezo Scanner)	
Interface	USB	Provides connectivity to a control PC via USB.
	Ethernet	Provides connectivity to a control PC via Ethernet.
I/O	Digital	This module provides low-level digital interfaces, including the following functionalities: <ul style="list-style-type: none"> • Input Trigger (Emergency Stop, Trajectory-Streaming Synchronization, Command Group Trigger) • Output Trigger (Position Compare, Target Reached, Actively Moving, In Position, In Range) • High Speed Data Reader
	Digital + Analog	This module provides low-level digital and analog interfaces, including the following functionalities: <ul style="list-style-type: none"> • Input Trigger (Emergency Stop, Trajectory-Streaming Synchronization, Command Group Trigger) • Output Trigger (Position Compare, Target Reached, Actively Moving, In Position, In Range) • High Speed Data Reader • General Purpose Digital Outputs • General Purpose Analog Outputs • Fast Analog Inputs, which may be feed into the control-loop
	EtherCAT®	Provides connectivity via EtherCAT® for a single Driver Module.
Sensor	SMARSLIDE  (Stick-Slip Piezo)	A sensor module is required to connect positioning stage with integrated sensors to the main controller. The sensor module converts the analog sensor data into digitized data which is processed by the main controller. This way the transmission of analog data via long cables is prevented which results in better noise immunity even in noisy environments.
	SMARSHIFT  (Electromagnetic)	
	SMARFLEX  (Piezo Scanner)	
Hand Control	Internal	The hand control module offers a touchscreen, physical buttons and two analog joysticks for manual interaction with the positioning system. Physical axes of the positioning system can be easily mapped to joystick axes for easy manual positioning. If the stages are equipped with position sensors, the actual position of the stage can be read on the module's touchscreen.
	External	

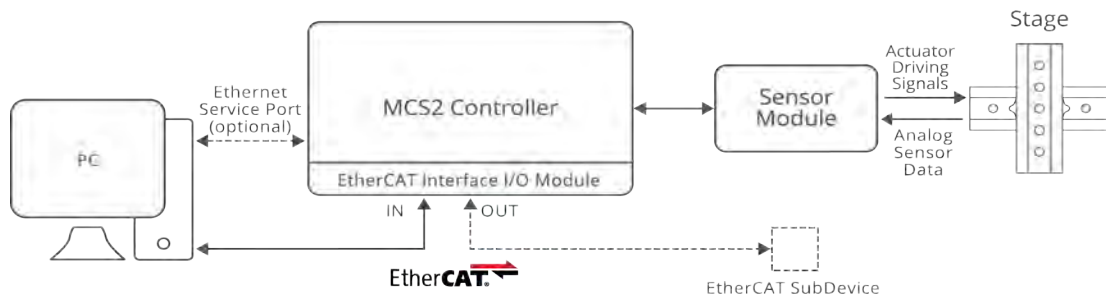
MCS2 Software Integration

The SmarAct Application Programming Environment (API) allows the **MCS2** to be controlled in a number of ways. Dynamic and shared libraries are available for text-based programming languages such as C and C++.

A Python module allows fast and easy script-based development. Graphical programming using LabVIEW™ is also supported.

The API is available for Windows and Linux. Detailed programming examples in C/C++, Python and LabVIEW™ are provided for a quick and easy introduction to programming the **MCS2** controller. The Ethernet interface also provides an SCPI-based ASCII command protocol for clear text communication, making the **MCS2** independent of additional libraries or operating systems. Integrating an **MCS2** into your own application is therefore easy and guarantees very short implementation times.

MCS2 EtherCAT® Interface



EtherCAT® is an Ethernet-based fieldbus system suitable for real-time communications requirements. The EtherCAT® interface extends the MCS2 with a DS402 device profile compatible interface.

MCS2 variants with EtherCAT® interface are available for all driver technologies to support all of SmarAct's positioning stages with stick-slip piezo drives, scanner piezo drives and electromagnetic direct drives.

The MCS2 EtherCAT® interface implements the DS402 device profile with the following features:

- DS402 operating modes: PP, CSP, HM for closed-loop operation
- Additional operating modes for open-loop Scan- and Step-movements and calibration routines
- EtherCAT® cycle rate: 1 kHz
- Factor Group support for position value scaling

Advantages of using MCS2 EtherCAT® for your setup include:

- Low cycle time and low jitter make MCS2 EtherCAT® the ideal solution for synchronizing a SmarAct nano-positioning stage to external hardware
- The stable industrial standard protocol makes your setup reliable, maintainable and future-proof
- The scalable architecture allows for easy and unbound integration of further devices into your setup

Integrated Handheld



The integrated handheld is equipped with a main controller module including a communication interface and a human machine interface module. All together combined in a small and light tabletop housing.

Tabletop Housing



Tabletop housings are equipped with a main controller module including a communication interface in the most basic configuration. Variants for controlling up to 12 positioning stages or integrated I/O modules are available within one compact desktop device.

Rack Housing



The modular rack housing with 6 slots is equipped with a main controller module including a communication interface and a backplane. It is compatible with 3-channel main control modules encapsulated into module carriers, each requiring one slot. Consequently, up to six main controller modules can be mounted into the three height unit rack housing making it possible to control up to 18 positioning stages.

Hand Control Module



Manual operation of MCS2 controllers in rack and tabletop housings is optionally possible via an external hand control module, featuring the same user interface as the integrated handheld version.

With the development and production of market-leading solutions in the field of high-precision positioning, automation and metrology, the SmarAct Group reliably accompanies their customers in achieving their goals. The broad product portfolio – from single positioning stages to complex parallel kinematics, miniaturized robots, control systems and measurement technology – is complemented by automated microassembly solutions. Even the most challenging customer requirements can be met by maximum adaptability and complete in-house production.

Since its founding in 2005, SmarAct has steadily grown from a small team of engineers to a group of companies with three independent business units and over 270 highly skilled members. Today, SmarAct relies on years of experience and, above all, on a very passionate team with unconditional customer focus.

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