English

# CODESYS® Motion + CNC


**Logic and motion control integrated in one IEC 61131-3 system: Development kit for convenient engineering of motion, CNC and robot applications**

# CODESYS Motion + CNC

**CODESYS, a product from 3S-Smart Software Solutions, is the established market standard for programming IEC 61131-3 compliant industrial controllers. Thousands of different standard and special-purpose machines for manufacturing engineering are automated with CODESYS, as well as other industrially controlled applications in a wide range of different industries.**

Numerous machines and plants require a versatile controller for motion sequences in addition to the logic program. Thanks to the high performance of modern processor platforms, motion control, CNC, and robotics tasks can be processed on the same devices as the logic control. With the open architecture of CODESYS, it is possible to link and even integrate external engineering tools for motion planning and control.

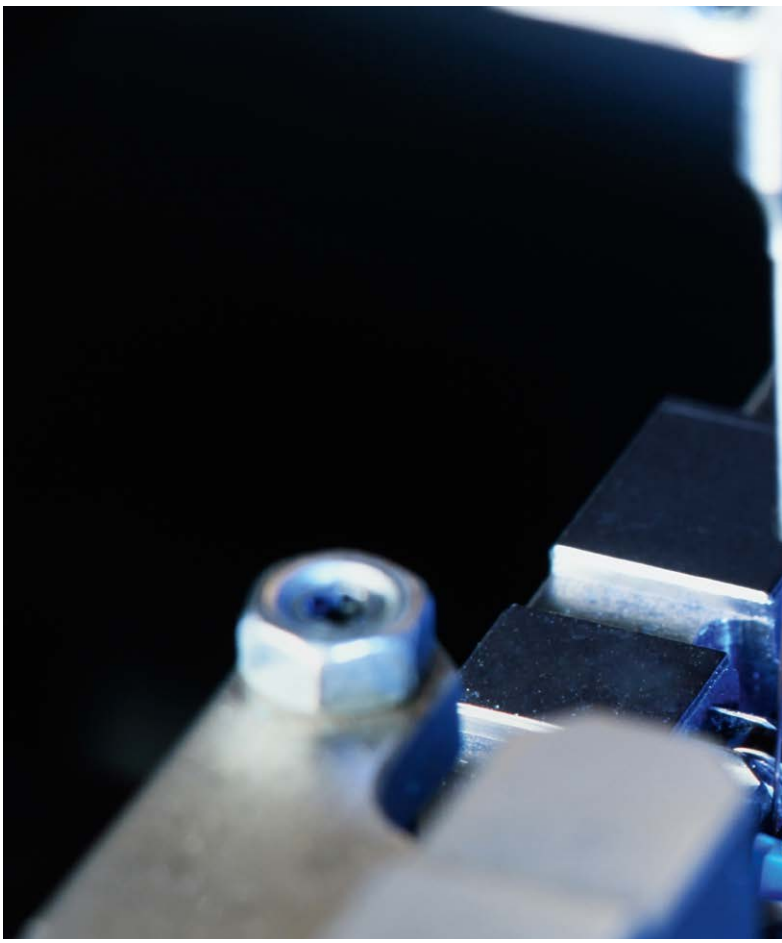
**CODESYS Motion + CNC makes it easier.**
Manufacturers of automation devices can integrate CODESYS SoftMotion and CODESYS SoftMotion CNC+Robotics into the CODESYS platform. In this way, the logic controller takes on the role of a motion controller with all of the required components, such as motion editors, kinematic transformations, standardized function blocks for robotics functions, and the CNC kernel.

**Application developers benefit in two ways.**
Only a single hardware device is required for logic and motion control, and both application components can be engineered with one and the same development system. The consistent operating structure makes the engineering of motion tasks significantly easier and more flexible as compared to conventional systems.

## CODESYS Motion + CNC

From single-axis motion to multi-dimensional CNC path interpolation and robot control – with CODESYS Motion + CNC, users can implement various motion control tasks for the logic controller in the familiar development interface.

CODESYS Motion + CNC provides motion functionality in the form of a development kit in the PLC development system. This can be used for resolving any complex task with the IEC 61131-3 language tools.



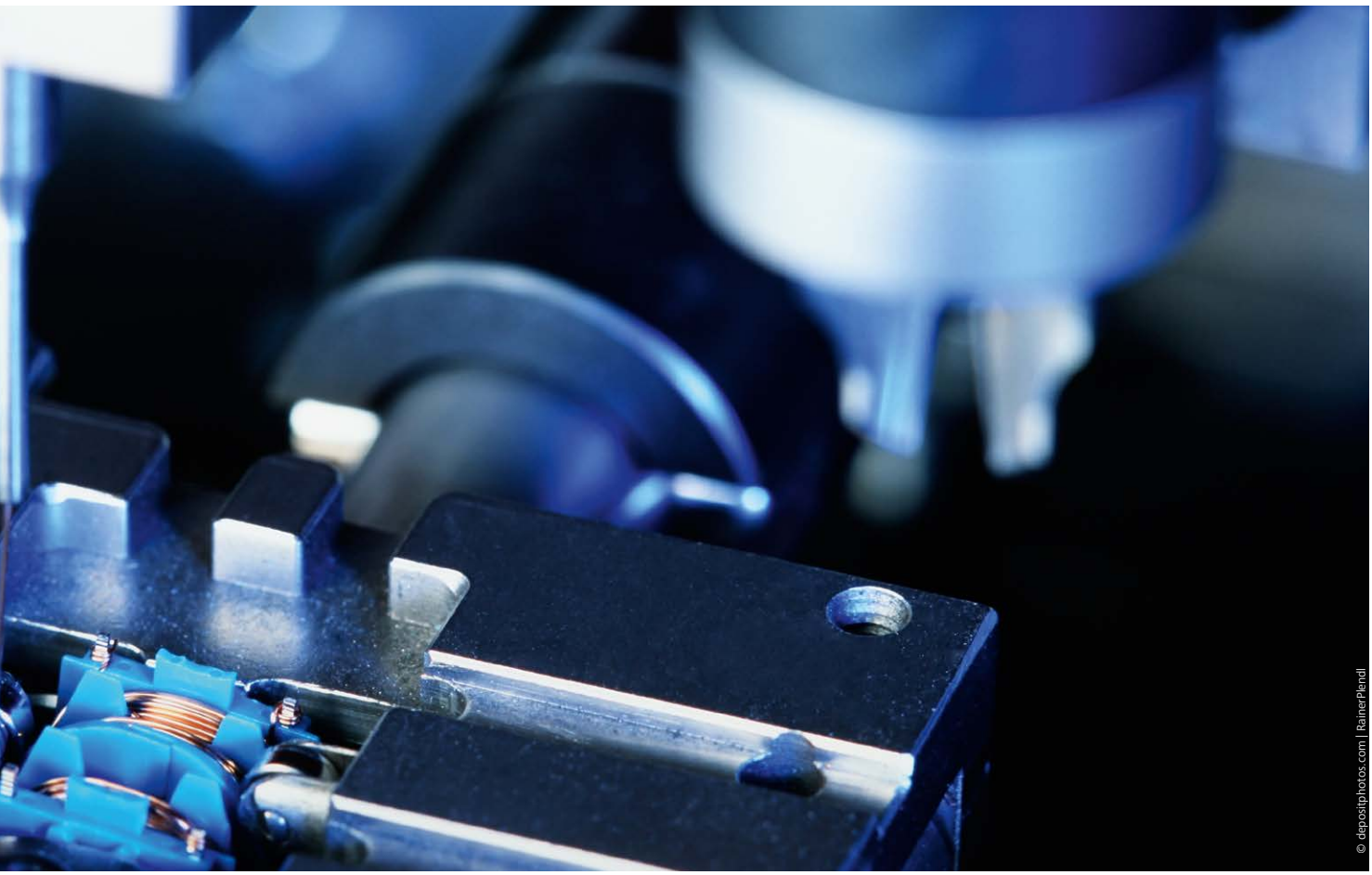
## Ideal platform for motion control – from an experienced partner

CODESYS provides all core properties for Motion + CNC:

- Integrated library design ⇨ Dynamic and easy linking of motion functions depending on the application
- Integrated compilers for various processor platforms ⇨ Cross-system deployment of products without any need for customization
- Integrated fieldbus support ⇨ Configuration of the employed drives and I/O components
- Motion engineering abstracted from drive and bus systems and based on the IEC 61131-3 data structure ⇨ Ideal for simulation, testing, commissioning, and machine refitting
- Easy integration of additional configuration and planning tools from the device manufacturer thanks to plug-ins, e.g. for motion editors or specific drives ⇨ Full integration of all engineering components
- Integrated visualization facilitates simulation, testing, and commissioning ⇨ No additional components required

## 3S-Smart Software Solutions is an experienced motion partner.

The makers of CODESYS have over 15 years of experience in software development for coordinated motion control. Expert motion specialists from the departments of product management, development, testing, support, and training pass on their knowledge and experience to customers.



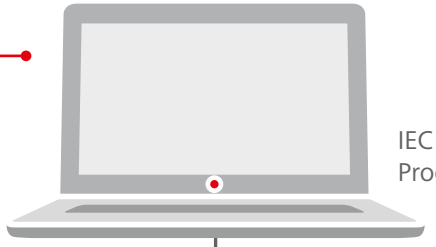
# Overview on CODESYS Motion + CNC

## CODESYS Development System

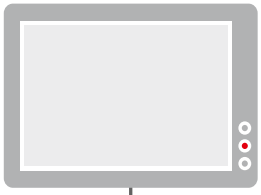
- Programming the logic controller (IEC 61131-3)
- Motion planning with graphical editors
- Motion control using IEC 61131-3 function blocks
- Engineering of optional machine visualization and diagnostics

## CODESYS Visualization (optional)

- Commissioning functions
- Machine visualization
- CNC operation
- Diagnostics



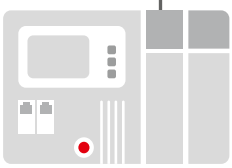
IEC 61131-3-Programming PC



HMI-/Panel Control

## CODESYS Runtime

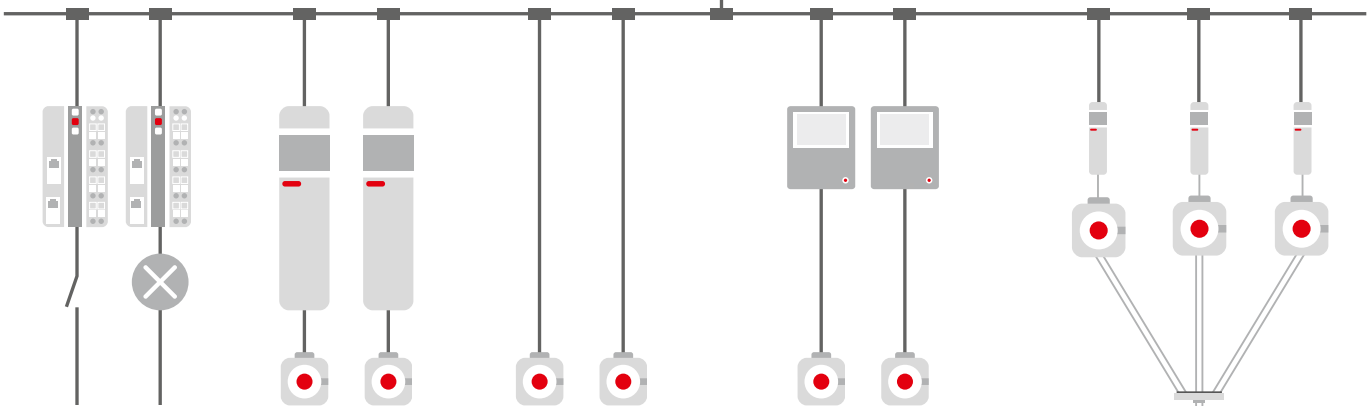
- Processing of logic and motion control
- Communication with I/O and drive systems
- Deployment of debugging features



Motion Controller/CNC

## CODESYS Fieldbus

- Portable protocol stacks implement communication with CANopen, EtherCAT, and Sercos
- Fieldbus-specific configurators for system and drive configuration



I/Os | Servo drives | Stepper drives | Frequency converters | Robotics axis groups

### Available control methods

**For servo drives**

- Motion controller delivers trajectory bases to servo drive in cycles
- Drive control by servo drive

**For stepper drives**

- Motion controller controls stepper drives via pulse/direction interface
- Pulse counter reports position to motion controller
- Position control in the motion controller

**For frequency converters**

- Motion controller specifies the expected rotational speed of the frequency converter
- Sensors, such as rotary encoders, report the position
- Position control in the motion controller

**For robotics axis groups**

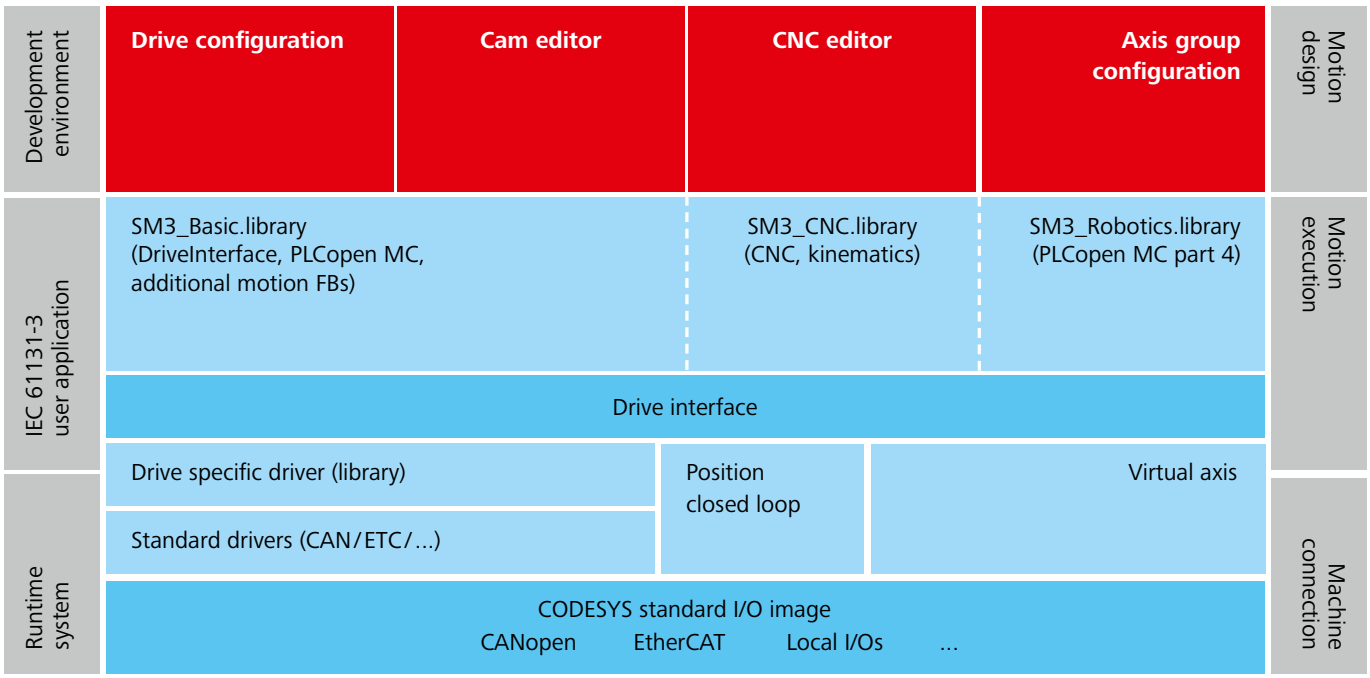
- Motion controller delivers target points and constraints for the axis dynamics to the axis group servo drive
- Drive control by servo drive

## Structure of CODESYS Motion + CNC

CODESYS Motion + CNC is seamlessly integrated into the CODESYS Development System as a development kit and thus benefits from the available functions of the platform. Movement is processed in the controller within the context of CODESYS Control (IEC 61131-3 runtime system).

### Components included in the development kit:

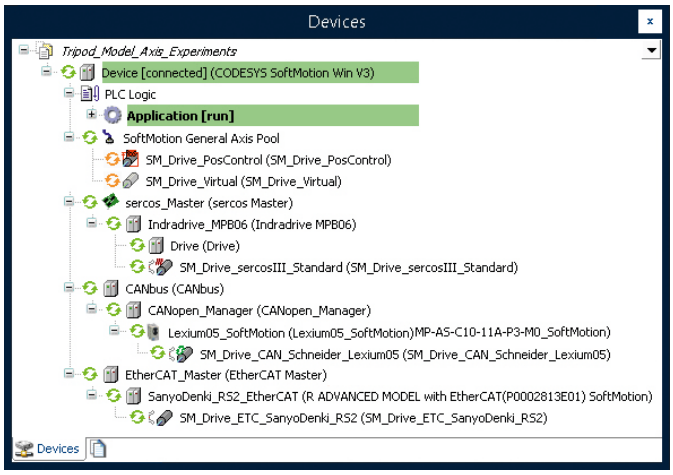
- Editors/configurators for motion planning (cams, CNC, robotics axis groups)
- Extensive library with IEC 61131-3 POUs for implementing motion and for help functions
- Corresponding visualization templates for simplified engineering and commissioning
- Support for the most widely used fieldbus systems
- Generic CiA 402 and special drivers for the most popular servo drives, e.g. from Schneider Electric Automation GmbH, KEB Karl E. Brinkmann GmbH, Bosch Rexroth AG, Control Techniques Ltd., Festo AG & Co. KG, and STÖBER ANTRIEBS-TECHNIK GmbH & Co. KG (complete list at codesys.com).
- Samples and documentation for creating motion applications



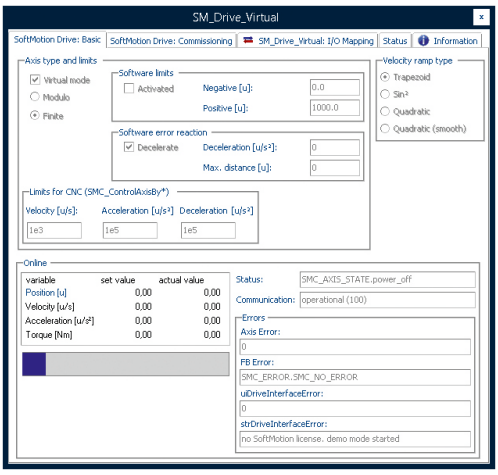
# Using CODESYS Motion + CNC

## Configuration and commissioning of drives

- Adding the necessary bus system to the CODESYS project: support of CANopen, EtherCAT, and Sercos, as well as standard systems, such as stepper drives and drives with analog control; more upon request
- Adding the required drives
- The device name represents implicitly provided IEC data structure with abstracted data for each drive, allowing smooth exchange of drives and drive buses.
- Drive commissioning with integrated "Online Config Mode"
- Configuration of the bus-specific and drive-specific parameters via the object directory of the devices




The fieldbus and I/O configurators integrated in CODESYS allow for a clear configuration of supported drives.



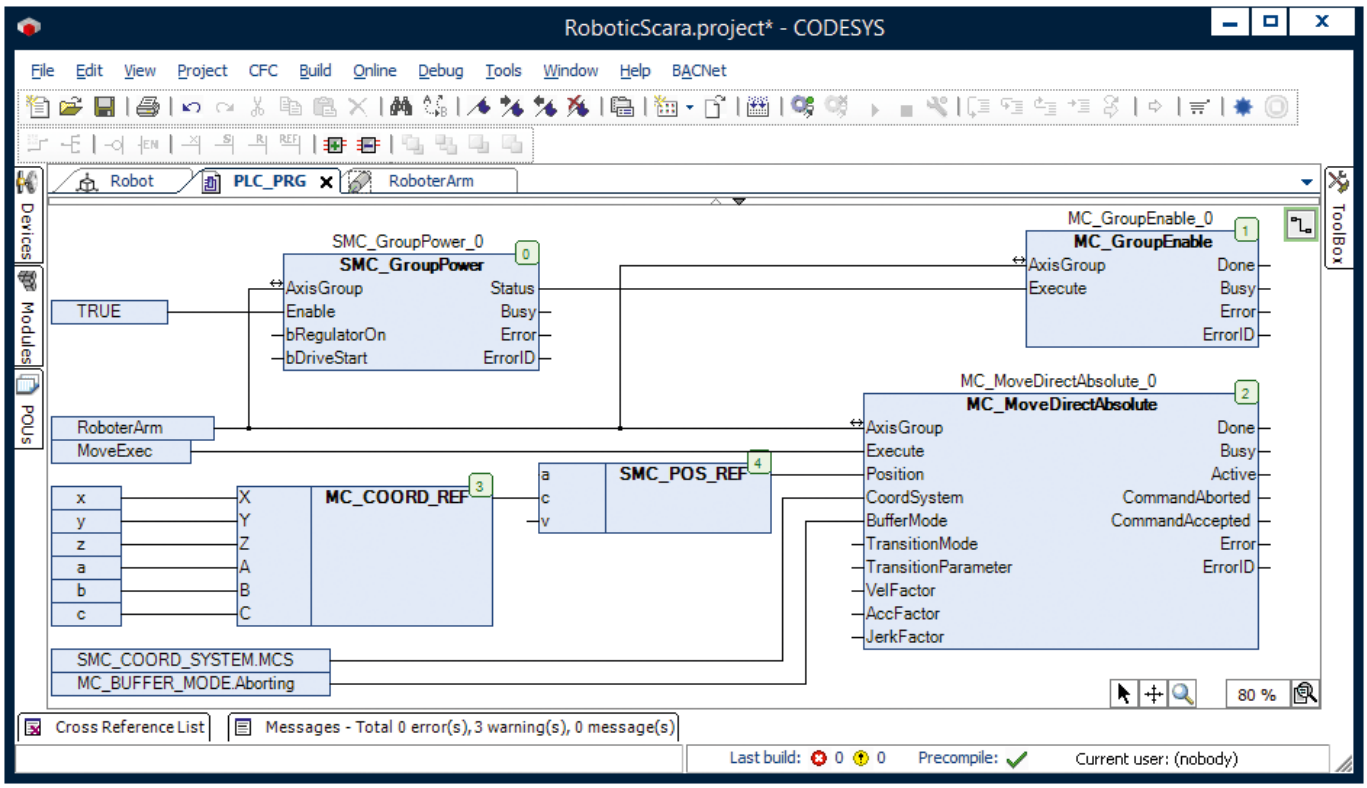

In online mode, the configurators provide valuable information, such as status, operating mode, and current parameter values.

## Commissioning of the motion application on the motion controller

- Compiling, downloading, and executing the application
- Additional tools:
  - Visualization templates for POUs allow for easy online operation and parameterization.
  - CODESYS Depictor objects allow for easy 3D visualization of motion in the CODESYS Development System by means of the actual control application.
- Commissioning of the motion application by means of the CODESYS Development System – The motion program runs as subtask of the controller.


## Motion planning and execution

- Calling of POUs according to PLCopen for MotionControl for motion control in CODESYS projects (e.g. MC_Power, SMC_GroupPower, MC_MoveAbsolute, MC_MoveVelocity, and MC_MoveDirectAbsolute)
- POU parameters are IEC 61131-3 variables that can be changed during runtime (e.g. by the logic application, sensor values, or user input from the user interface).
- Optional call of included add-on POUs (e.g. for diagnostics or error handling)
- Convenient motion planning of cams, CNC movements, and robotics axis groups with special editors/configurators. Information about CODESYS SoftMotion and CODESYS SoftMotion CNC+Robotics begin on page 8.




Thanks to the function library for PLCopen for Motion Part 4, the programming of robot tasks is possible with just a few block calls.

## Selected references for CODESYS Motion + CNC

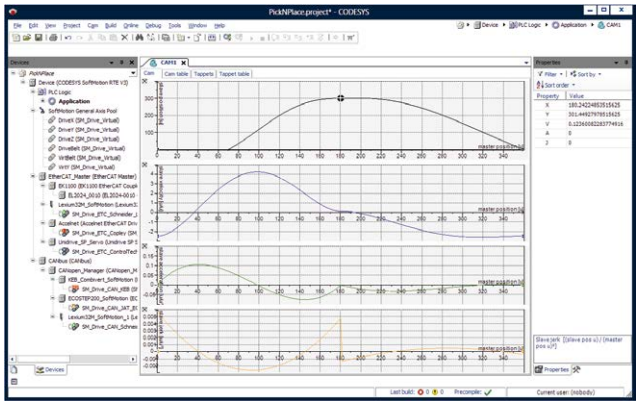
- ASYS Automatisierungssysteme GmbH
- Baumann GmbH
- Bosch Packaging Technology B.V.
- Festo AG & Co. KG
- Grossenbacher Systeme AG
- KEBA AG
- KEB Karl E. Brinkmann GmbH
- Lenord, Bauer & Co. GmbH
- Kendrion Kuhnke Automation GmbH
- MITSUBISHI ELECTRIC EUROPE B.V.
- Parker Hannifin Manufacturing Germany GmbH & Co. KG
- ROFIN-BAASEL Lasertech GmbH & Co. KG
- Schneider Electric Automation GmbH
- STÖBER ANTRIEBSTECHNIK GmbH & Co. KG
- Trumpf-Laser GmbH + Co. KG

# CODESYS Motion + CNC – Available products

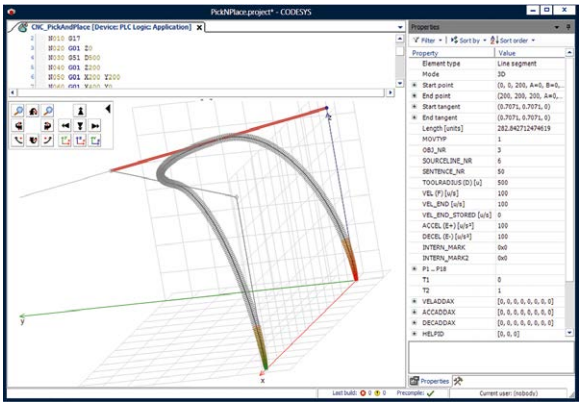
## CODESYS SoftMotion:

For **single-axis and coordinated multiple-axis traversing motion** (e.g. master/slave functions and cams):

- Use of available library POUs and programming of motion functions
- Any interconnection of the function possible within the logic application
- Graphical planning of cam functions by means of integrated cam editor
- Numerous POU-specific visualization templates for easy commissioning with the CODESYS Development System
- Additional visualization templates for online editing of cams in runtime mode with the optional products CODESYS HMI, CODESYS TargetVisu, and CODESYS WebVisu



Motion planning with integrated cam editor in CODESYS SoftMotion



Convenient definition of CNC curves with integrated graphical 3D editor and associated G code (according to DIN 66025)

## CODESYS SoftMotion CNC+Robotics:

Includes the complete functionality of CODESYS SoftMotion, as well as additional functions for coordinated motion control.

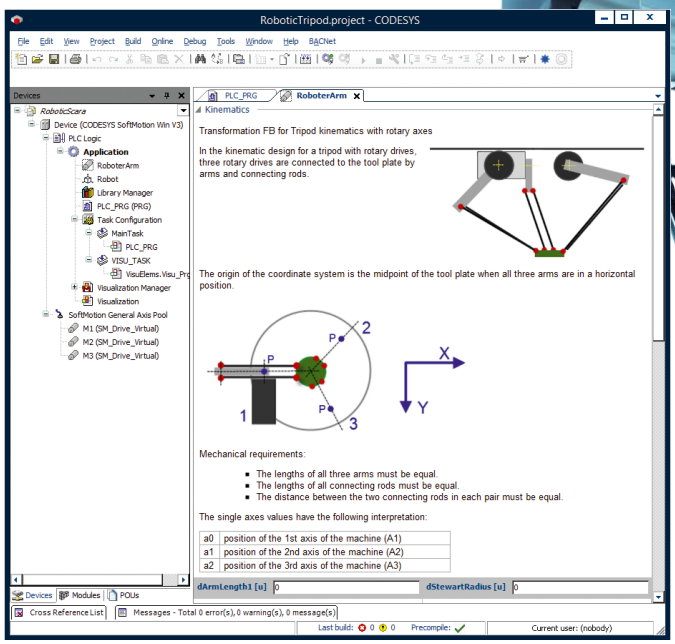
For **CNC motion** with multiple coordinated axes and precisely defined motion path:

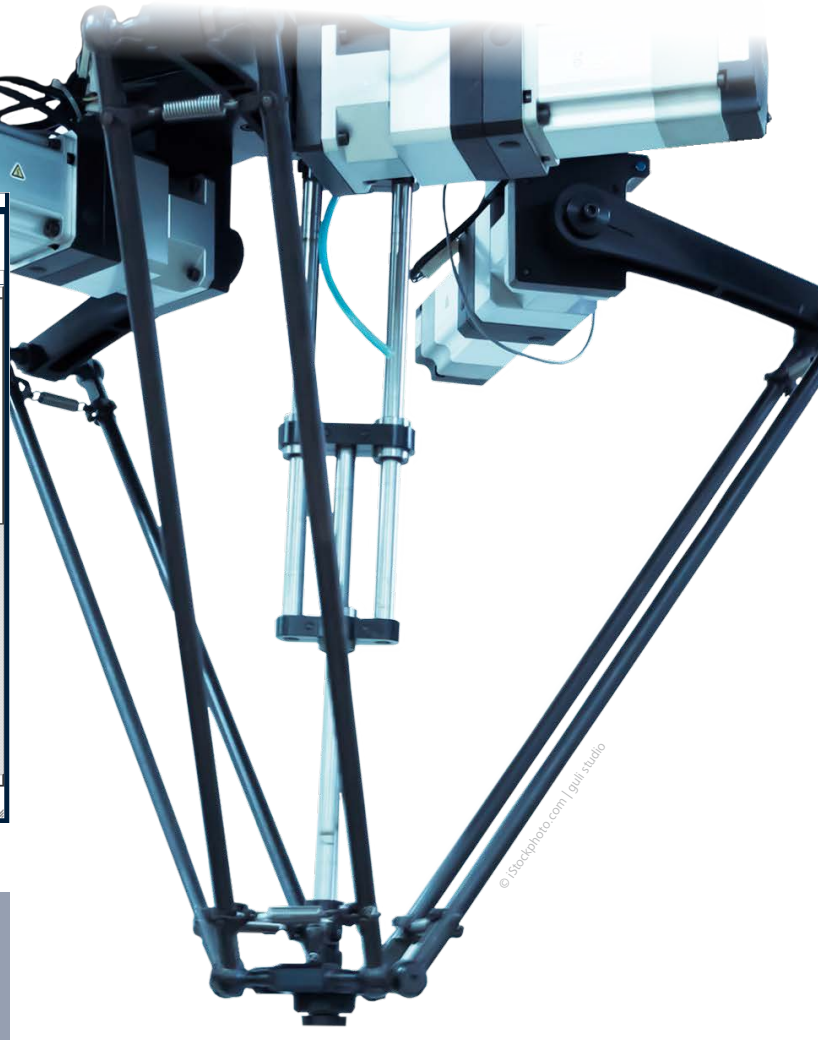
- CNC motion planning in the integrated DIN 66025 editor with graphical 3D display
  - Step-by-step by means of an extensive set of G code motion commands (e.g. line, circle, spline)
  - By data input in a tabular editor
  - Graphically in the 3D editor with numeric post-editing of the G code
  - By reading existing G code files in ASCII format
  - By importing DXF files for automated generation of matching G code
- Support of different speed profiles: Trapezoidal, sigmoidal, quadratic (jerk-limited, S profile)
- Definition of necessary path velocity (feed) and limits for acceleration, deceleration, and jerk
- POUs for limiting the dynamics of spatial and additional axes
- Processing of CNC motion by POUs
- Numerous additional functions, such as tool radius compensation, edge smoothing, and limited curve velocity ▸

- Creation of customized POUs by means of IEC 61131-3 for own functions (e.g. application-specific angle rounding for laser cutting)
- Decoder and interpolator as portable IEC 61131-3 library POUs
- Numerous kinematic transformations for different task areas (e.g. gantry systems and robots)
- Visualization templates for online editing of CNC projects in runtime mode, as well as for diagnostics and testing of kinematics with optional products (e.g. CODESYS HMI, CODESYS TargetVisu, and CODESYS WebVisu)

**For robotics applications** with PTP (point-to-point) or CP (continuous path) interpolation:

- Parameterization of axis groups for predefined kinematics in a convenient configurator
- Integrated motion planning with coordinate values for robot positions in different coordinate systems
- Function library with program blocks according to PLCopen for MotionControl Part 4, such as SMC_GroupPower, MC_GroupEnable/Disable/Reset/ReadError, MC_MoveDirectAbsolute, MC_MoveLinearAbsoulte, MC_MoveCircularAbsolute, MC_GroupHalt, MC_GroupStop, MC_TrackConveyorBelt, and MC_TrackRotaryTable
- Numerous supported kinematics with convenient configuration, for example various gantry robots (2/3/5 axes), bipod/tripod robots, and SCARA robots
- Additional tool kinematics




**The integrated axis group configurator allows for easy parameterization of different types of robot kinematics.**

# CODESYS Motion + CNC – Turning intelligent devices into motion controllers

## PC-based motion controller

### Requirements

- Suitable industrial PC with Microsoft Windows 7/8/10
- Fieldbus interface for drive actuation (CAN or Sercos) or available Ethernet port (EtherCAT)

### Real-time capable SoftPLC with motion control

- CODESYS Control SoftMotion RTE SL for IPCs (available in the CODESYS Store at **codesys.store**)
- License purchase and single licensing by means of software or USB security key per PC-based motion controller

### Options: Additional licenses for

- CODESYS SoftMotion CNC+Robotics
- CODESYS TargetVisu: Visualization on the motion controller
- CODESYS WebVisu: Monitoring and diagnostics by means of HTML5 web browser

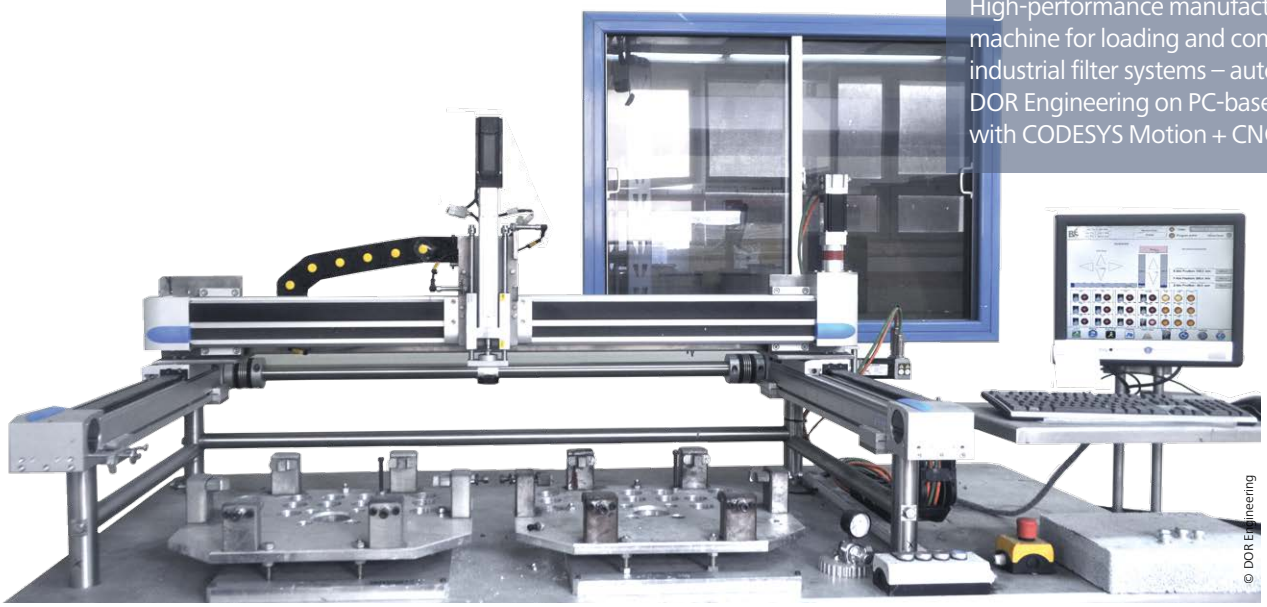
## Motion controllers – also integrated in mechatronic controllers and intelligent drives

### Requirements

- Real-time capable system
- Hardware with appropriate performance resources depending on planned use
- FPU recommended
- Appropriate communication links to drives and standard fieldbuses (CANopen, EtherCAT, Sercos)

### Business model

- Purchase of the CODESYS Control Runtime Toolkit
- Implementation of the runtime system for CODESYS SoftMotion or CODESYS SoftMotion CNC+Robotics with complete motion kit for distributing the motion controller to the end user
- Optional purchase of the relevant fieldbus support
- Purchase of runtime licenses for CODESYS SoftMotion or CODESYS SoftMotion CNC+Robotics for each delivered motion controller; price dependent on quantity and device platform



High-performance manufacturing machine for loading and completion of industrial filter systems – automated by DOR Engineering on PC-based controllers with CODESYS Motion + CNC

# Typical use cases for CODESYS Motion + CNC

**CNC application**

- Use of the CNC editor
- Jogging the axes with PLCopen blocks
- Gantry kinematics with stepper drives

**Pick & Place application**

- Use of PLCopen blocks for positioning (tool plate) and for belt-synchronous placement of an object on a moving target.
- Depiction of the process with visualization templates

**Tripod robots and palletizing robots**

- Robot kinematics (transformation and parameterization)
- 3D visualization with CODESYS Depictor in the CODESYS Development System
- Configuration of the axis group with the integrated configurator

**Labeling / cam application**

- Use of cam editor
- PLCopen POUs and virtual axis as master shaft
- Use of touch probe / latching function

# CODESYS Motion + CNC – Benefits at a glance

- **Versatile motion planning:**
  - Motion control via status of the logic application and vice-versa, simple scaling of trajectories.
  - Control of trajectories and motion from the optional visualization
- **CNC and robotics programming regardless of the kinematics:**
  Change of kinematics by intuitively parameterizable objects in the device tree and library POUs.
- **Generic implementation of robotics applications** with axis group configurator and PLCopen for MotionControl Part 4 function blocks
- **No fixed restrictions:** Limitation of number of axes or update rate only by available computing power, employed fieldbus, and available memory
- **Motion programming regardless of drive:** Change of drives without a software change
- **Portable to different platforms:**
  - Libraries and application created in IEC 61131-3 languages
  - CODESYS compiles motion program for the respective target system
- **Integration in the CODESYS Development System:**
  - One hardware and interface for logic application, motion application, and visualization
  - Consistent engineering as well as cost-efficient implementation

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10/2016

**CODESYS** – the manufacturer-independent IEC 61131-3 automation software.

**CODESYS Product Families:**




**Note:** Not all CODESYS features are available in all territories. For more information on geographic restrictions, please contact support@codesys.com.

**Inspiring Automation Solutions**