CODESYS STORE

Data Sheet CODESYS SoftMotion

CODESYS SoftMotion is an additional option for CODESYS compatible SoftPLC systems. CODESYS SoftMotion extends the functional scope of these systems from a purely logical controller to a motion controller, optionally also with CNC and robotics support.

Product description

CODESYS SoftMotion enables

- the control of single-axis and synchronized multi-axis movements (electronic cams, electronic gears), and
- the control of coordinated, spatial CNC and robotic motion

on qualified CODESYS compatible SoftPLC systems.

CODESYS SoftMotion Light allows to command CiA 402 compatible drives for single axis movements (not synchronized).

Functional principle:

- Project engineering of motion using function library modules
- Configuration of drives with fieldbus support integrated in the CODESYS Development System
- Parameterization of axis groups for predefined kinematics in a separate object
- Decoupling of application creation from the applied hardware by abstracting the drives with drive group names in the device tree
- Motion planning with cam editor

- Integrated motion planning:
    - with 3D CNC editor according to DIN 66025 (G code) and tabular editor
    - with coordinate values for robot positions in different coordinate systems

- Processing of CNC motion, robotic motion, or other motion tasks in the runtime system on the controller with the IEC 61131-3 logic application
- Online editing of CNC programs in CODESYS Visualization

Typical applications of CODESYS SoftMotion:

- As an additional option for powerful, CODESYS compatible control systems with good real-time behavior (FPU recommended)
- Actuation of single-axis and multi-axis movements, for example with position and velocity definitions, drive functions, or phase actuation
- Implementation of electronic cams
- CNC motion with modifications by the end user (for example, in metal and woodworking machines)
- Robotic systems including SCARA, tripod, and palletizing robots such as in assembly and loading automation

A note on SoftMotion Light: In contrast to SoftMotion and SoftMotion CNC+Robotics, the calculation of the axis movements is not done within the controller. With SoftMotion Light movements of the drive are just commanded and supervised (status) by the PLC and executed by the drive. The trajectory calculation is done in the drive.

SoftMotion Light is suitable for applications with multiple axes for single axes movements and for controller tasks requiring a low bus and computing load (CPU).

CODESYS SoftMotion extends the CODESYS Development System with the following elements:

- Extensive library with blocks for control of axes, handling and processing CNC paths, axis groups, as well as kinematic transformations for the most popular use cases

- Visualization templates
- Examples and templates for creating specialized blocks in the CODESYS Development System for CNC, robotic, and motion handling in IEC 61131-3
- Integrated cam editor
- Axis and drive configuration with the fieldbus configurators, as well as for stepper drives and encoders
- Integrated 3D CNC editor according to DIN 66025 (G-Code)
- Axis group configurator for different kinematic systems (customizable for own kinematics)
- Convenient commissioning of axes ("Online Configuration Mode") without any special IEC 61131-3 application code

Scope of the SoftMotion library

- Certified function blocks according to PLCopen MotionControl, Part 1 (V20):
    - Absolute and relative positioning (MC_MoveAbsolute, MC_MoveRelative)
    - Superimposed positioning (MC_MoveSuperimposed)
    - Movement at constant velocity (MC_MoveVelocity)
    - Consistent support of jerk-limited profiles (continuous acceleration for any kind of interruption of the current motion)
    - Drive-guided homing (MC_Home)
    - Blocking stop (MC_Stop)
    - Control release (MC_Power)
    - Read and write parameters (MC_Read/WriteParameter)
    - Read actual position (MC_ReadActualPosition)
    - Position, velocity, and acceleration profiles (MC_*Profile)
    - Probe (MC_TouchProbe, MC_AbortTrigger)
    - Set and move position (MC_SetPosition)
    - Read actual velocity and actual torque (MC_ReadActualVelocity, MC_ReadActualTorque)
    - Cam switch (MC_DigitalCamSwitch)
    - Electronic gear with synchronization position (MC_GearInPos)
    - Full stop (MC_Halt)
    - Additional blocks
    - Control and query of the static deceleration
    - Monitoring of the drag error, a position window, or maximum values
    - Distance measurement (also of modulo axes)
    - External definition of position, velocity, and target value from the application
    - Management of errors in the function blocks
    - Controller-guided homing
    - Operation of cams and cam switches
    - Definition of the specified target torque
    - Commissioning the drive
    - Absolute and relative positioning with transitional velocity (SMC_MoveContinuousAbsolute and SMC_MoveContinuousRelative)
    - Setting control mode to position, velocity, or torque

- Visualization templates for the most important function blocks for fast commissioning with the visualization integrated in the CODESYS Development System
- Documentation of the library functions in the online help

Scope of the CNC library

- Decoder for converting G-code for further processing
- Support for sub-programs and expressions in G-code
- Limiter for restricting the dynamic values of velocity and acceleration for one or more axes
- Block for testing velocities at transitions
- Interpolator for computing the path points based on the velocity profile (bidirectional interpolator for forward and reverse gear)
- Interpolator override
- Blocks for coordinate transformation (example: SMC_ScaleQueue3D and SMC_CoordinateTransformation3D)

- Help modules for path preprocessing and modulation:
    - Tool-radius correction 2D

- Angle rounding (with circular arc) and angle smoothing (with 3rd and 5th order splines)
  - Loop suppression
  - Limitation of dynamics
  - Range limit test
  - Path shifting and twisting
  - Velocity and acceleration definition for each axis

- Transformation blocks (including inverser) for popular kinematic designs:
  - Portal systems 2D / 3D
  - Portal systems with axes of orientation and tool offset
  - Portal systems with belt drive (H-portals and T-portals)
  - Polar transformation
  - 2/3-arm SCARA
  - Bipod
  - Tripod with linear and joint axes
  - 5-axis kinematics for 3-axis portal with rotating and tilting tool
  - 4-axis kinematics for palletizing robots
  - 6-axis kinematics for articulated arm robots

- Blocks for reading and processing CNC paths from a file (for paths created and processed externally)
- Path velocity modes trapezoid / sigmoidal / quadratic (jerk-limited) / quadratic_smooth (jerk-limited with continuous jerk curve)
- Any definition of the lookahead buffer
- Odometer function
- Parameterizable 3D coordinate transformation (including inverse)
- Computation of a coordinate system from six scanning points
- Visualization templates for the most important function blocks for fast commissioning with the visualization integrated in the CODESYS Development System (for example, kinematic transformations)
- Visualization elements for 3D CNC operation and online editing for creating CNC machines by using CODESYS HMI or CODESYS TargetVisu

Scope of robotics library

- Axis group editor in the "Axis group" object with mapping of axes to kinematics and their parameterization

- Certified function library with program blocks according to PLCopen Motion Part 4 (Coordinated Motion)
  - Administrative blocks: MC_GroupEnable/Disable/Reset/ReadError, etc.
  - Motion commands: MC_MoveDirectAbsolute, MC_MoveDirectRelative, MC_MoveLinear*, MC_MoveCircular*, MC_GroupHalt, MC_GroupStop
  - Fast and path invariant mode for PTP movements (MC_MoveDirect*): fast mode will perform the fastest possible movement in axis space, path invariant mode will perform a movement whose path does not change if the override changes.
  - Tracking: MC_TrackConveyorBelt, MC_TrackRotaryTable, MC_SetDynCoordTransform
  - Jog mode in any coordinate system: SMC_GroupJog
  - Support of different coordinate systems: world coordinates (WCS), machine coordinates (MCS), several product coordinates (PCS_1, PCS_2), tool coordinates (TCS), and axis coordinates (ACS)

- Support for waiting on the path with waiting time (SMC_GroupWait)
- Public documented interface for creating user-specific kinematics in the IEC 61131-3 languages

- Supported kinematics with convenient configuration:
  - 5-axis gantry robot
  - 2/3-axis gantry robot
  - 2/3-axis H gantry robot
  - 2-axis T gantry robot
  - Bipod robot
  - Tripod robot with linear /rotary axes
  - Polar kinematics
  - 2/3-arm SCARA robot with auxiliary axes
  - 4-axis kinematics for palletizing robots
  - 6-axis kinematics for articulated arm robots

- Additional orientation kinematics, which can be combined with the other kinematics listed above, such as

gantry and tripod kinematics.

- Tools with orientation and position offset (full 6D)

Scope of the SoftMotion Light library

- MC_MoveAbsolute / MC_MoveRelative
- MC_MoveVelocity
- MC_Stop / MC_Halt
- MC_Home
- MC_Power / MC_Reset / MC_ReadStatus
- SML_ReinitAxis / SML_ChangeAxisConfig
- Visualization templates (analogue to SoftMotion)
- Commissioning assistance (SML_StartupDrive)

Configuration and commissioning of the drives is described in detail in CODESYS online help (chapter "SoftMotionLight").
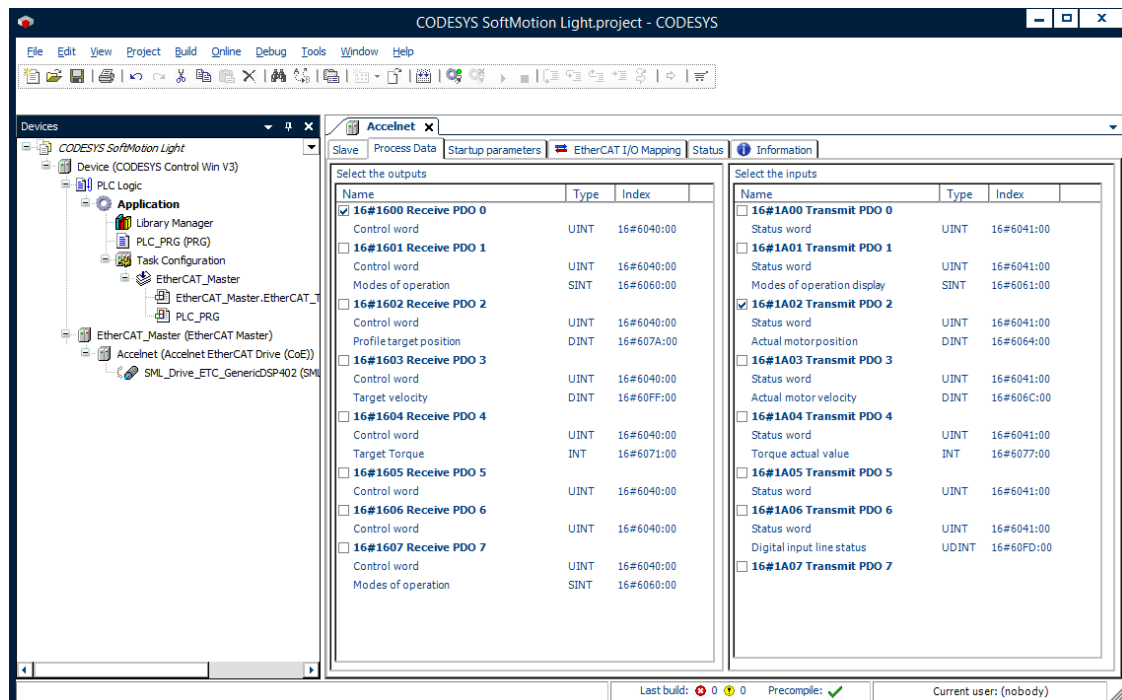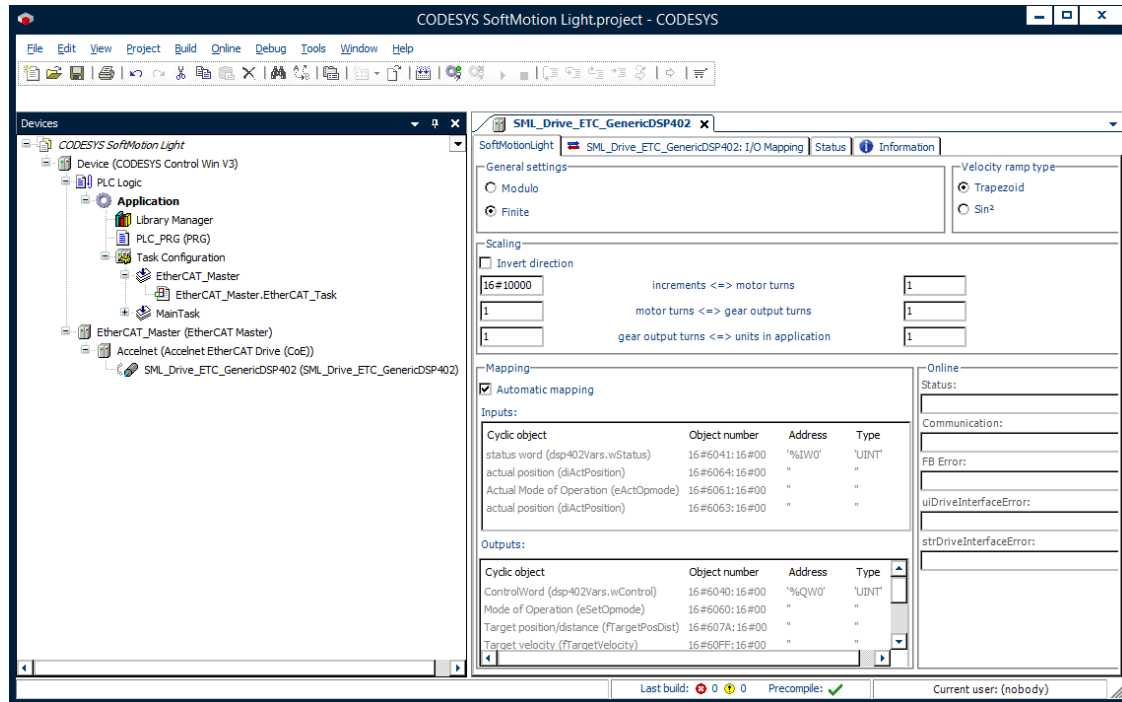
Range of functions for the cam editor

- Graphical and numerical planning for the cam using any base in representation of the distance, velocity, acceleration, and jerk

- Linear or polynomial interpolation (5th order polynomial)
- Configuration of tappets and their switching behavior in the cam
- Configuration of the cam regarding dimension, period, and continuity requirements


Cam editor of distance, velocity, acceleration, and jerk

Call of the motion block within the logic program

Drive configuration
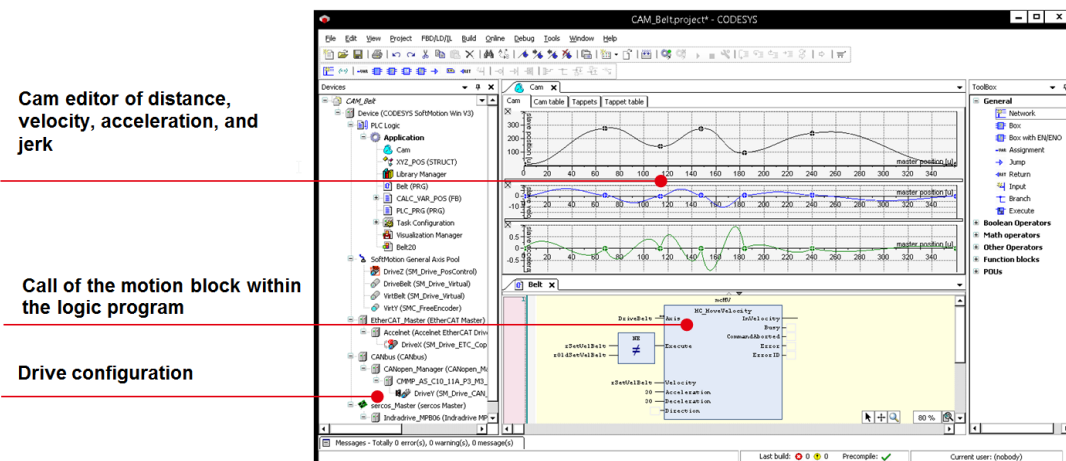
Picture 1: Using cam planning to create a motion project in the CODESYS Development System

Scope of functions for 3D CNC editor according to DIN 66025 (G-Code)

- Simultaneous graphical and textual editors
- Path preprocessing (offline preview of the effects, for example angle smoothing)
- Path pre-interpolation (offline preview of the resulting position, velocity, acceleration, and jerk curves of all supported axes)
- DXF import
- Read from and save to file
- Program transformations (rotate, shift, scale in G-code)
- Conversion to tables
- Program information (path length, path duration, number of objects, etc.)

G-code command set

- Linear interpolation (G1), Circular interpolation (G2/G3)
- Dwell (G4)
- Spline interpolation (G5, G10)
- Parabola interpolation (G6), Ellipsis interpolation (G8, G9)
- Interpolation plane selections for circular arcs (G16 to G19)
- Conditional jumps (G20)
- Variable write/increment (G36, G37)
- Tool radius compensation (G40 to G42)
- Angle rounding and smoothing (G50, G51, G52)
- Coordinate system shift (G53 to G56)
- Loop suppression (G60, G61)
- Timing synchronization with interpolator (G75)
- Absolute and relative coordinates (G90, G91)
- Position setting (G92)
- Absolute and relative coordinates (G98, G99)
- M-Functions (M), Path tappets (H)
- Velocity and acceleration definition (F, E)
- Use of IEC variables
- Supported dimensions: X, Y, Z (primary interpolation axes)
- A, B, C (orientation axes — splined)
- P, Q, U, V, W (additional axes — linear)
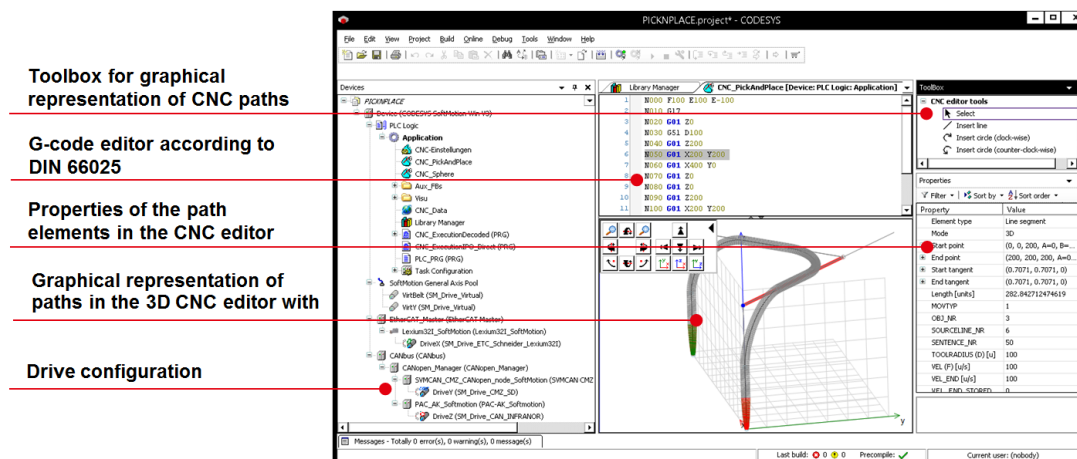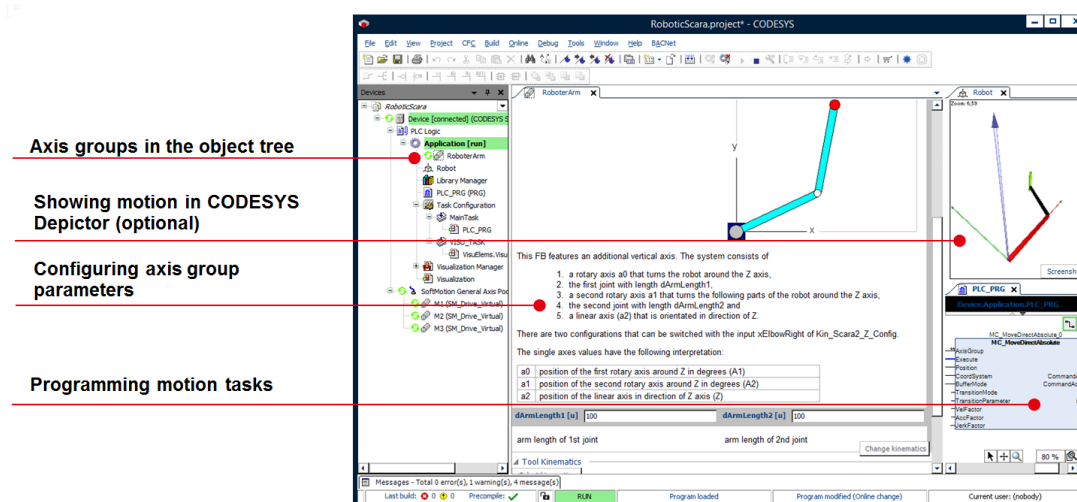
Toolbox for graphical representation of CNC paths

G-code editor according to DIN 66025

Properties of the path elements in the CNC editor

Graphical representation of paths in the 3D CNC editor with

Drive configuration

Picture 2: Using the CNC editor to create a CNC application in the CODESYS Development System

Axis groups in the object tree

Showing motion in CODESYS Depictor (optional)

Configuring axis group parameters

Programming motion tasks

Picture 3: Project engineering of a SCARA robot with an axis group and program block in CODESYS

Supported fieldbus systems and drive connections

- EtherCAT
- CAN/CANopen
- Sercos
- Virtual drives (for virtual axes and tests)
- Position control in the PLC by using PTt control for velocity-controller axes with position feedback (for example, frequency converter with encoder feedback, hydraulic axes with proportional valve, and position feedback)
- Logical axes as copies of other axes with independent offset and on-demand dead-time compensation / actual value smoothing
- Configuration of encoder axes that form any analog signal (for example, as the master axis for cams)

Tested drivers for the following drives

- EtherCAT:
  - Beckhoff EL2521 / EL5101 / EL72x1 / EL703x / EL704x
  - Bonfiglioli iBMD
  - CMZ BD / LBD
  - Control Techniques Digitax / Mentor / Unidrive
  - Copley Accelnet
  - Delta ASDA A2 / A3 / B3
  - Delta R1-EC5621
  - Festo CMMP EtherCAT
  - Generic CiA 402 (also for multi-axis drives)
  - Generic SoE (also for multi-axis drives)
  - Hitachi ADV series
  - Infranor XtrapulsPac

- JAT Ecovario
- KEB F5 / H6
- Kollmorgen AKD / AKD Servodrive
- Metronix ARS 2000 series
- Omron G5
- Panasonic MINAS A5B / A6B
- Parker compax3 / SBC / PSD
- Sanyo Denki RS2
- Schneider Electric Lexium32 / Lexium32i
- Servotronix CDHD
- Stäubli uniVAL
- Stöber Posidrive, SD6, SI6/SC6
- Yaskawa Sigma7 series

- CAN/CANopen
  - Bonfiglioli iBMD
  - CMZ BD / SD / LBD
  - Festo EMCA / CMMP
  - Generic CiA 402 (also for multi-axis drives)
  - Infranor cd1-k / XtrapulsPac
  - KEB F5 / Stepless Technology
  - Metronix ARS 2000 series
  - Nanotec PD4C
  - Schneider Electric Lexium05 / Lexium23 / Lexium28 / Lexium32 / Lexium32i / SD-3
  - JAT Ecovario

- Sercos
  - Bosch Rexroth IndraDrive C/M/Cs/ML/Mi

General information

Vendor:

CODESYS GmbH
Memminger Strasse 151
87439 Kempten
Germany

Support:

https://support.codesys.com

Item:
CODESYS SoftMotion
Item number:
TODO
Sales:

CODESYS Store
https://store.codesys.com

Included in delivery:
- Extended device description for SoftSPS
- License key

System requirements and restrictions

Programming System	CODESYS Development System V3.5.11.0 or higher
Runtime System	CODESYS Control Version 3.5.5.0 or higher
Supported Platforms/ Devices	All supported by CODESYS: • Real-time capable operating system platforms • CPU platforms with available FPU (Floating Point Unit) • Devices with integrated fieldbus (EtherCAT, CAN/CANopen, or Sercos) Note: Use the project "Device Reader" to find out the supported features of your device. "Device Reader" is available for free in the CODESYS Store.
Additional Requirements	WIBU Codemeter Support **SoftMotion CNC+Robotics requires CODESYS SoftMotion as a basis license.** SoftMotion Light works with CiA 402 compatible drives with CANopen or EtherCAT Compatibility can be checked with the test project *SML_CompatibilityCheck_DS402.project*
Restrictions	-
Licensing	License activation optional on CODESYS Key or Soft Key (Soft Key: free of charge component of CODESYS Controls)
Required Accessories	Optional: CODESYS Key

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

Note: Technical specifications are subject to change. Errors and omissions excepted. The content of the current online version of this document applies.