CODESYS® in Factory Automation

The leading IEC 61131-3 system with sophisticated fieldbus support, visualization, motion control, safety and cloud-based controller administration.
CODESYS in Factory Automation

The CODESYS Development System is the market-leading IEC 61131-3 software platform for the automation of serial and customized machines independent of the product category. No matter if it is for programming a low-end machine or a complete assembly line – CODESYS is used for all kinds of applications in factory automation. There are good arguments for choosing CODESYS. It is a powerful IEC 61131-3 development environment with numerous user-friendly functions for the programming and configuration of automation projects. Furthermore, it contains fully integrated backend functions, such as compilers, debuggers and variable trace. Thus, the application can be developed, tested and commissioned without any additional tools. The latest version of CODESYS can be downloaded free of charge from www.codesys.store.

Many tasks in factory automation can be performed in a single tool:

- Fieldbus configuration
- Creation of modern visualization screens for machine operation
- Planning and execution of complex motion control or CNC movements
- Programming of safety applications according to DIN IEC 61508 SIL3

Complete automation projects can be implemented without the user having to leave the familiar development interface.

With a cloud-based server solution that significantly simplifies the most important automation tasks, you can conveniently manage all controllers in your network. Numerous interfaces (standard / proprietary) to other tools are available for the almost 1,000 different controller types from different manufacturers worldwide. This provides machine and plant manufacturers with a comprehensive range of devices for their automation projects.
A selection of CODESYS applications in factory automation:

- Polymeric machines
- Glasshaping machines
- Rolling machines
- Machinetools
- Laser & Plasmacutting machines
- Assembly machines
- Textile machines
- Paper and Paperhandling machines
- Packaging machines
- Cigarette machines
- Printing machines
- Industrial handling machines
- Woodworking machines
- Coating machines
- Engraving machines
- Labeling machines
- Filling machines
- Tyre modelling machines
Examples of application configurations with CODESYS
CODESYS for customized machines

- Tablet with CODESYS WebVISU for Diagnosis
- IPC with CODESYS Control SL and CODESYS EtherCAT Master
- EL6900/EL6910/EL1960 with Safety
- CODESYS Development System
- EtherCAT / FSoE
- EL6731
- PROFIBUS I/Os
- Image: © Drazen Lovric – iStockphoto.com
What advantages does CODESYS offer in factory automation?

Everything integrated in one single user interface – the CODESYS Development System:

- Complete IEC 61131-3 development system for programming PLCs, PACs or motion controllers: From combining simple logic function blocks through to complex object-oriented programming
- Remote application access directly from the CODESYS Development System: Debugging and application update without additional software
- Development of user-friendly operating interfaces and operator displays with modern visualization elements: Integrated visualization editor in the CODESYS Development System used for machine operation, testing, commissioning, and diagnostics
- Extension for implementation of safety-related protection controllers in compliance with IEC 61508 SIL3 and EN13849PLc available as integrated product
- Device-independent application development: CODESYS supports numerous exchangeable devices, fieldbus systems and standard protocols
- Fully integrated configurator for local inputs and outputs and classic fieldbus systems such as CANopen, Modbus RTU, PROFIBUS, or IO-Link
- Support for Realtime-Ethernet-Systems such as PROFINET, EtherCAT, EtherNET/IP, Modbus TCP or Sercos with integrated configurator and protocol stacks
- Integrated planning and programming of movements for single and multi axis motion and CNC applications with the help of PLCopen certified motion FB libraries
- CODESYS is expandable through add-on software from the CODESYS Store with plug-in components, application libraries, sample programs and templates
- Highly sophisticated library functions for example for reading and writing CSV files or for sending, receiving and deleting emails
- Industrial and communication standards immediately available: Data exchange, among other things via OPC/OPC UA, http/https, or MQTT without implementation effort and costs
- Direct connection to the cloud-based administration platform CODESYS Automation Server, e.g. for filing and rolling out projects/applications, quick overview of the controller landscape, support during device replacement, or simplified collection and evaluation of data (big data).

Power and usability for the effective realization of all kinds of automation projects:

- Fast machine code for all controllers: Industrially proven compilers for different CPU platforms on the target exploit the device performance to the optimum
- Functional and object-oriented programming within one project possible: Software developers may encapsulate methods, interfaces and inheritance within easily reusable functions and function blocks
- Finding application problems with powerful features: Debugging using flow control, conditional and unconditional breakpoints/execution points and core dump
- Short turnaround times: Online change during runtime of the application and incremental compile/download
- A wide range of integrated security features to protect intellectual property: Signing and encryption of application source, executable code, and controller communication to protect against Internet attacks
- Seamless integration into existing engineering platforms: Connection to third-party tools like Git, Apache Subversion® or Matlab/Simulink
- Visualization for remote control, diagnostics or maintenance by any webbrowser with HTML5:
  - Function monitoring and supervision running on PCs, tablets and smartphones
- Well-thought-through concept of libraries: High reusability of functions and function blocks with automatic generation of documentation out of source code comments
- Optional: Systematic software development with integrated add-on tools for UML, profiling, static code analysis, or automated system, regression, and unit tests
- Industry 4.0 / IIoT on board: All essential technologies and features already included that make a CODESYS-compatible controller an „industrial thing with Internet connection“ (IIoT).
Ideal conditions for factory automation applications:

- CODESYS is a worldwide proven system platform:
  - Used by far more than 10,000 application developers
  - In over 100,000 different applications
  - On all continents
  - Programming interface for approx. 1,000 different industrial controllers or over 1 million sold devices each year
- Today, CODESYS is used in applications with:
  - > 50,000 OPC items,
  - 25 MB of application source code,
  - 800 MB of PLC data,
  - Approximately 200 synchronized drives.
- Wide acceptance in educational institutions: CODESYS is used by schools and universities for training future technicians and engineers.
- Large know-how community worldwide: Competent third-party support for application development by independent programmers, engineering offices, and system partners
- Driven by an innovation leader: The CODESYS Group, the company behind CODESYS is one of the technological drivers for software in the automation industry. In cooperation with other companies and universities, research projects lead to new products. Being part of standardizing committees, we ensure that automation companies benefit from progress, for example by exploiting current Internet technologies or innovations in information technology.

Large marketleading machine manufacturers strategically use CODESYS:

- ASYS Automatisierungssysteme GmbH
- Eisenmann Anlagenbau GmbH & Co. KG
- Homag Holzbearbeitungssysteme GmbH
- Koenig & Bauer AG
- Robert Bosch GmbH PA-ATMO
- SIG Combibloc Systems GmbH
- Voith Paper GmbH & Co. KG
Product components for factory automation applications

Integrated fieldbus support in CODESYS

- Extensive fieldbus support directly within the CODESYS Development System: Including everything from communication POUs to configurators and portable protocol stacks:
  - Fully integrated configurators for all common fieldbus systems: PROFIBUS, CANopen, J1939, Modbus RTU, and IO-Link
  - Comprehensive support for industrial Ethernet: EtherCAT, EtherNet/IP, Modbus TCP, Sercos, PROFINET including configurators
  - Automatic insertion, compilation and loading of libraries for the used bus protocol
- Integrated diagnostics functionality: Monitoring the system at runtime without additional tools directly in the CODESYS Development System as well as in the running IEC 61131-3 application
- Multiple benefits thanks to integration:
  Just one single tool for programming and fieldbus configuration, reduced risk of errors, simplifies configuration and fast engineering

CODESYS EtherCAT

- EtherCAT master integration in the CODESYS Development System
- Comprehensive integrated configurator with simplified or expert settings, supporting device scan, different bus topologies, EtherCAT redundancy, etc.
- Portable protocol stack in the form of a CODESYS library
- Support of CODESYS Motion CNC Robotics
- Optional support of EtherCAT modules:
  For safety applications according to IEC 61508 SIL3 (EL6900/6910/EK1960) or as a gateway from EtherCAT to other fieldbus systems, such as IO-Link, CANopen, or PROFIBUS
CODESYS Visualization for Factory Automation

- Integrated visualization in the IEC 61131-3 tool: Development of graphical visualization screens in parallel to the application code generation within one single tool
- Due to integration: Ideal for testing, commissioning, and operation of the PLC application
- Modern visualization elements and practical controls: For fast and easy creation of industrially applicable operating and diagnostics screens

- Standard visualization functions: Integrated alarm and user management, user-friendly styles, language and image switch, import/animation of bitmaps and SVGs, data recording, flexible communication concept, and multitouch support
- View adaptable to different display sizes (responsive design)

- Extended functionality compared to conventional visualization systems:
  - Real-time trace and trend recording
  - Visualizations to instantiate for usage in library and application modules (“visualization FBs”)
  - Direct access to PLC functions
- Display variants for the most diverse platforms: One source file for
  - CODESYS HMI on remote terminals – for the operation of machines with control panels
  - CODESYS TargetVisu on panel controllers – operation and logic control with one single device
  - CODESYS WebVisu on HTML5 web browsers – ideal for remote operation, diagnostics, or unattended operation, for example on mobile devices
CODESYS SoftMotion CNC Robotics

- Proven motion toolkit for processing coordinated motion, CNC, or robot programs: Single-axis or multi-axis traversing motions created in the CODESYS Development System
- Turns the device into a motion controller: Execution of motions directly on the target controller
- Platform-independent libraries included: For single- and multi-axis-control according to PLCopen, for coordinated interpolations and kinematical transformations in CNC systems and robot kinematics
- Comfortable motion planning: Integrated cam and 3D-CNC editor with G-Code according to DIN66025 including import of CAD data
- Easy axis group configuration: Parameterization of robot axis groups for predefined kinematics in a convenient configurator
- Effortless motion communication with the drive: Integrated fieldbus connection for example for CANopen, EtherCAT and Sercos with numerous supported drives
- Flexible application development through integration in the CODESYS Development System: Adjusting the motion application within the graphical interface, dynamically during the machine runtime
- CODESYS SoftMotion Light: Independent add-on product for commanding multi axis without coordination at a reduced load of the controller and fieldbus
CODESYS Application Composer

- Integrated add-on tool in the CODESYS Development System for the efficient creation of application variants
- Functional program units for mechatronic system components or pure software functions are combined into intelligent modules that can be used to configure a complete machine application
- Automated generation of application source code including visualization and device configuration through integrated generators
- Users benefit from improved re-usability and quality of application elements
- Perfect solution for series-produced machines that are customer-specifically equipped/set up as well as for special machines/plants that are constructed from recurring units

CODESYS Professional Developer Edition

- Seamlessly integrated add-on tools for the CODESYS Development System to optimize the development process:
  - CODESYS UML: UML class diagram and state chart for advanced application design and programming
  - CODESYS SVN: Source code and version management of the application code based on Apache Subversion®
  - CODESYS Static Analysis: code analysis for detection of possible application errors, check of coding rules, software metrics etc.
  - CODESYS Profiler: Measurement of application execution times
  - CODESYS Test Manager: Test automation for system and unit tests to increase quality
- All additional tools can be downloaded as a bundle or individually from the CODESYS Store and installed in the CODESYS Development System.
CODESYS Communication

- Fully integrated: Multiple standard and lean proprietary communication protocols/services
- Communication between the CODESYS Development System and the target controller via portable gateway service: Remote debugging/editing/optimizing directly in the source code without additional software
- Data exchange between CODESYS-compatible controllers: With proprietary UDP protocol (global network variables), for safety controllers even with protected safety protocol (safety cross communication via Safety NetVars)
- Certified OPC 2.0 server (Data Access Specification): Included in the delivery of the CODESYS Development System
- Platform-independent communication: OPC UA Server already included in SoftPLC systems in the CODESYS Store, and as an additional runtime system component for device manufacturers. OPC UA Client in preparation.
- Proprietary access to controller variables: Data access from any external software via CODESYS PLCHandler, e.g. for specific diagnostic clients or commissioning devices
- Numerous IEC 61131-3 libraries: Integrated protocols, e.g. MQTT, http/https, TCP/UDP, POP3/SMTP, SMS, as well as auxiliary functions, e.g. for JSON or XML processing
CODESYS Safety for SIL3 Controllers

- Realization of safety-related protection controllers (dual channel 1oo2) for mechanical engineering in compliance with IEC 61508 SIL3 and EN13849 PLe as an add-on to standard controllers
- Additional functions for the protection of the safety application: change tracking, safe signal flow, safe versioning (pinning), separation of safe operation/debug mode, and more
- Safe cross-communication between safety controllers
- TÜV-approved and certified according to IEC 61508 SIL3: safety plug-ins for the CODESYS Development System, safety manual for users, safety runtime system and integration manual for device manufacturers
- Fieldbus support with separately certified implementations for FSoE (Failsafe over EtherCAT) and PROFIsafe/F-Host, as well as for F-Device.

User benefits

- Integrated solution for functional and safety relevant applications within one single project
- Application-oriented function modules in accordance with PLCopen Safety for typical safety devices in factory automation, for example emergency off two-handed operation, safety door, etc.
CODESYS Security

Know-how protection for source code/boot application through signing/encryption using the CODESYS Security Key (USB dongle) and X.509 certificates

Signed/encrypted communication between controller and CODESYS Development System, as well as CODESYS WebVisu

Integrated user and access management for application code, target control, and visualization

Numerous additional functions, e.g. interactive login, operating mode switching, simple backup/restore mechanism, activation of application functions

Image: © Voith Paper GmbH & Co. KG
Why do manufacturers of controllers for factory automation rely on CODESYS?

Support for the commonly used CPUs / operating systems in PLCs, PACs, programmable drives, and other industrial controllers:
- CPUs for decentralized controllers such as Tricore, ARMx/Cortex Mx with or without proprietary operating system
- High-performance CPUs for complex or motion control applications, such as Intel Atom or Cortex Ax, for example with Windows/WinCE, QNX, VxWorks or Linux

Software components that are pre-certified to IEC 61508 SIL3 (development system, runtime system, FSoE/PROFISafe F-Host master and F-Device Slave stack) simplify the realization and certification of SIL3 safety controllers.

Development costs for the programmable controller can easily be precalculated due to defined interfaces, integration manual for the runtime system and qualified adaptation support.

Expandability of the CODESYS Development System by adding device-specific or manufacturer-specific plug-in components and libraries

Simple porting and scaling of the runtime system on the basis of a runtime toolkit: With defined interfaces for device-specific functions and easy extensibility

Embedding of specific technology functions/visualization elements in CODESYS libraries – with licensing if necessary

Proven interfaces for the connection to additional software or hardware systems

High market acceptance due to widespread use of CODESYS in Factory Automation

Original equipment manufacturers in the factory automation industry using CODESYS technology:
- ABB Automation Products GmbH
- Berghof Automation GmbH
- Bosch Rexroth AG
- Eaton Industries GmbH
- Festo AG & Co. KG
- Hitachi Industrial Equipment Systems Co., Ltd.
- KEBA AG
- Lenze Automation GmbH
- Parker Hannifin GmbH
- Schneider Electric Automation GmbH
- Hans Turck GmbH & Co. KG
- WAGO Kontakttechnik GmbH & Co. KG
CODESYS – the manufacturer-independent IEC 61131-3 automation software.

CODESYS for further industries:

- Factory Automation
- Mobile Automation
- Energy Automation
- Embedded Automation
- Process Automation
- Building Automation

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