CODESYS® in Embedded Automation

Complete IEC 61131-3 IDE for industrial embedded applications.
### CODESYS in Embedded Automation

The CODESYS Development System is the market-leading integrated development environment (IDE) in accordance with IEC 61131-3 for programmable embedded devices in industrial automation applications. CODESYS compatible devices can be found among others in mobile processing machines, in stationary production machines where space is limited or in medical devices.

There are good arguments in favor of programming embedded devices with CODESYS. The tool offers extensive programming options – optimized for the development of application software for industrial tasks. In addition, CODESYS integrates complete debugging and monitoring options all the way to incremental code execution – without any add-on tools. The basis for this are integrated back-ends for the most important industrial CPU and operating system platforms. The generated machine code is comparable to the compilation product of C compilers and is executed by the runtime system in real time. Users can develop their complete application program with CODESYS, commission and operate it. Manufacturers of embedded devices implement a comfortable programming interface for their products with predictable expenditure. Device manufacturers and users benefit from integrated add-on functions such as fieldbus support or visualization.

CODESYS considerably lowers development time and risk for any sophisticated embedded application.

#### Sample application configurations with CODESYS

![Sample application configurations with CODESYS](image)

### The advantages of CODESYS at a glance

- Comfortable programming interface for drastic reduction of the development time for application software with application-oriented language elements and extensive, real time suitable debugging options
- Lowering of the development risk through numerous functions that are immediately available
- Significantly simplified certification of safety applications according to SIL2 in accordance with IEC 61508 in comparison to C development
- Ready to run support for many evaluation platforms, hardware modules and devices for prototype development available
- Free development environment with extensive diagnostic options
- Comprehensive development environment for application program, user interface, bus connection and diagnosis
- Large number of programmers/system partners with application know-how available
Why work with CODESYS on programmable embedded devices

1. An IDE for application programming and commissioning
   - Programming languages (graphical/textual) standardized according to IEC 61131-3: optimized for software development of industrial applications
   - Focusing on the development of application software: comfortable programming/projection of the devices by application specialists instead of computer scientists
   - Separation of system software (runtime system) and application: the application developer does not need to worry about system functions
   - Methodically formalized software development possible: with integrated add-on tools for UML and test automation as well as connection to external tools like Apache Subversion® or Matlab/Simulink
   - Integrated debugger: monitoring, troubleshooting, trace tool in real time etc. without add-on software
   - Faster application code through integrated compiler: support of all popular MCUs/CPUs for industrial applications
   - Programming access via CAN interface possible as a standard feature
   - Expandability through add-on software: CODESYS Store with access to application libraries, sample programs and templates
   - In comparison to C development drastically reduced turnaround times: with online change in single digit seconds without restart
   - CODESYS and the associated runtime system are IEC 61508 certified for the creation of SIL2 applications

2. Additional functions completely integrated
   - Support for industrial fieldbus systems and protocols: integrated configurator for CANopen, EtherCAT, IEC 61850, Modbus, BACnet etc.
   - Available master protocol stacks for OSI layer 7 portable CODESYS libraries for CANopen, EtherCAT, Ethernet/IP, PROFINET, J1939 and IEC 61850 can be used on different platforms
   - Raw-CAN access for proprietary protocols: encapsulable in customized function libraries
   - Development of practical user interfaces: graphical editor with modern visualization elements integrated in the IDE
   - User interfaces for tests, commissioning and operation on different platforms: in the IDE, on a remote PC or directly on the display of the embedded device
   - User interfaces for remote operation/maintenance or diagnostics by web browser with HTML5: function monitoring with tablet or smartphone
   - Industrial communication standards available immediately: data exchange via OPC/OPC UA without implementation and adaptation costs
   - Debugging in real time directly in the program editors: variable monitoring, extensive program changes during operation without stopping or loss of data, integrated “digital storage oscilloscope” at variable level (Trace), absolute and conditional breakpoints, call hierarchy, single stepping etc.
   - Optionally integrable add-on tools for even more comfortable application development:
     - CODESYS UML: generate/display program structure by class diagram or program function sequence by state machine diagram
     - CODESYS Static Analysis: detect potential function problems in advance or determine metrics for application software
     - CODESYS Profiler: analyze processing times without target system (in development)

3. Best prerequisites for industrial embedded applications
   - Proven system platform: CODESYS used throughout the world in several thousand industrial applications
   - Large selection of CODESYS compatible devices in different classes for prototyping or application variants in the CODESYS Device Directory under www.codesys.net
   - Large community of users: know-how and support in application development from engineering offices/System Partners
   - Compatible add-on equipment: suitable control units/displays, diagnosis tools etc.
   - CODESYS Forum for exchange in community, CODESYS Store for access to application libraries and add-on tools

Product components for embedded applications

CODESYS Development System
- Optimized editors (graphical/textual) for the development of application software: with numerous convenient functions such as syntax highlighting, input help, auto-complete, column selection, drag and drop
- Exchangeable target system description by XML file: programming different devices with one and the same interface
- Integrated compiler for the application software: high-performing code execution with native machine code without add-on tools

CODESYS CANopen master
- CANopen master/slave configurator fully integrated in the IDE: linking of slaves, configuration of the bus system on the basis of EDS or DCF files without external tool
- Mapping of I/O ports in the integrated configurator
- CIA 301 CANopen communication stack in the form of a CODESYS library: dynamically compile and link to application software
- Application interface in accordance with CI 405 for diagnosis and use of SDO
- Configuration of PDOs without add-on tool

CODESYS in embedded systems
- Atlas Copco
- B2ERBA
- BIVIATOR
- EBK Automation
- Hainzl Industriesysteme
- Kaeser Kompressoren
- Tornatec
- Weiss Klimatechnik

CODESYS Store for access to application libraries and add-on tools

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CODESYS Safety SIL2

- Certified platform: CODESYS Development System for the development of application software in accordance with EN ISO 13849, through PLd, Category 2 or 3
- Certified CANopen Safety master/slave stack: based on proven CODESYS CANopen implementation
- Shortened development time of a safety controller: pre-certified runtime system including test framework for large parts of the firmware
- Debugging of safety application: display/write/force safe data during safe operation by switching to special debug mode
- Parallel operation possible: CANopen as well as CANopen safety participants in one project tree
- User interface for safe data: display by CODESYS WebVisu or CODESYS HMI
- Simplified certification of the entire system: structuring of safe application software on the basis of a certified user manual, separation of entire application into safety and operation functions

Operation / observation / supervision of embedded devices

- Completely integrated editor for user interfaces: graphical projection of the operation/diagnosis interface in a single tool
- By virtue of the integration: efficient engineering with dynamic linking of application software and user interfaces
- Comes supplied with visualization elements and controls proven in industry: generate practical graphical user interfaces quickly and easily
- Different display platforms with one source file:
  - Directly in the CODESYS Development System – for tests, optimization and commissioning
  - CODESYS HMI: for classical systems for operation/observation/supervision on remote displays/terminals
  - CODESYS TargetVisu: for operation and processing of the application software on a single embedded device with display
  - CODESYS WebVisu: for diagnosis/remote operation/remote maintenance in the Web browser of PCs/tablets/smartphones
- Wide range of services available: alarm and user management, convenient style, language and image switching, data recording, flexible communication concept, multitouch support etc.

Information for manufacturers of programmable embedded devices

Technical properties of CODESYS

- Optimum support for popular CPUs / operating systems for industrial applications:
  - CPUs for small programmable devices such as Tricore, ARMx/Cortex Mx without or with proprietary operating system
  - High performance CPUs for compact high-end applications such as Intel Atom, PowerArchitecture or Cortex A8/A15 with WinCE, VxWorks or Linux
- Specific technology functions and visualization elements: embedding in CODESYS libraries possible – if required with licensing

Required implementation steps

- Selection of CPU and operating system
- Implementation/adaptation of the runtime system with the help of a toolkit (SDK):
  - Tool supported adaptation of system-specific functions of the runtime system according to integration manual, numerous reference implementations available
  - Configuration/adaptation of the communication drivers to the CODESYS Development System
  - If necessary integration of specific device libraries for calling from the application software
  - If necessary integration of customized additional functionality on the basis of defined interfaces
  - Compilation of the adapted runtime system and embedding in the device
  - Qualified adaptation support in all phases from experienced project engineers
- Validation and system test, optional with CODESYS Test Manager

Manufacturers of embedded devices, programmable with CODESYS:

- Beck IPC
- Christ-Elektronik
- Elektra Elektronik Störcontroller
- ESD Electronic System Design
- frenzel + berg electronic
- Hilscher Systemautomation
- Kontron
- Rafi
- Solvimus
- Sontheim Industrie Elektronik
- Beck IPC
- Christ-Elektronik
- Elektra Elektronik Störcontroller
- ESD Electronic System Design
- frenzel + berg electronic
- Hilscher Systemautomation
- Kontron
- Rafi
- Solvimus
- Sontheim Industrie Elektronik

Alternative:

- Use of system on chip or core modules with already ported CODESYS Runtime System from Beck IPC, Hilscher or frenzel + berg – no expenditure for the software implementation

Typical applications for CODESYS on programmable embedded devices

- Control device especially developed for a certain application, but with different application software
- Industrial devices whose application software is supposed to be modified upon commissioning or in the event of onsite maintenance
- Controllers whose application software is not supposed to be programmed by the system manufacturer
- Intelligent devices for use in the industrial environment, e.g. with fieldbus connection or standardized communication connection such as OPC/OPC UA
CODESYS – the leading manufacturer-independent IEC 61131-3 automation software.

CODESYS for further industries:

Factory Automation

Mobile Automation

Energy Automation

Process Automation

Building Automation

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