CODESYS® in Mobile Automation

CODESYS is the number one development system for ECUs in mobile machines.
**CODESYS in Mobile Automation**

**CODESYS is the market leader in automation software for electronic control units (ECUs) in mobile machines.**

CODESYS compatible controllers are found in construction machines, cranes, rail vehicles, forklift trucks, surface mining machinery, and agricultural machinery. One excellent reason for this is its flexible application in ECUs and mobile controllers of various designs and performance classes. Other reasons include the integrated support of the most important fieldbus systems in mobile applications, the visualization function suitable for mobile applications, as well as the certified suitability for programming IEC 61508 SIL2 compliant safety applications.

**Just some of the applications of CODESYS in various industrial sectors**

- Construction cranes and loading cranes for containers
- Diggers and dredgers
- Excavators, rock crushers, and other utility vehicles for underground and surface mining
- Automated logistics systems
- Forklift vehicles
- Tractors, harvesters, and mobile feed systems
- Aircraft tow vehicles
- Ship and yacht automation
- Street sweepers
- Marine diesel engines
- Road finishers, graders, bulldozers and other machinery for road construction
- Mobile forestry harvesters
- Transport and utility vehicles, such as dump trucks and other trucks
- Control and operating units in trains and trams
- Mobile industrial compressors
- Snow grooming vehicles
Typical application configurations using CODESYS

**CODESYS in construction machines**

- Programming environment for application software: CODESYS Development System
- Operating panel/display: CODESYS TargetVisu
- CANopen J1939
- ECU/mobile controller: CODESYS Control Embedded
- Fieldbus configuration and protocol stack: CODESYS CANopen/J1939

**CODESYS in cranes**

- Programming environment for safe application software, SIL2: CODESYS Development System certified to SIL2
- HMI Panel: CODESYS HMI
- Fieldbus protocol stack: CODESYS CANopen Safety according to EN 50325-5
- CANopen Safety
- SIL2 ECU/mobile controller: CODESYS Control certified to IEC 61508 SIL2
- Mixed operation of CANopen and CANopen Safety slave modules

**CODESYS in fork lift trucks**

- IEC 61131-3 programming environment: CODESYS Development System with application libraries e.g. for direct CAN access
- External diagnostics systems: CODESYS PLC Handler
- CAN
- ECU/mobile controller: CODESYS Control Embedded for 16-/32-bit CPUs
Why use CODESYS in mobile industrial applications?

Everything integrated in a single user interface: the CODESYS Development System

- Complete IEC 61131-3 development system (free of charge for end users): linking of simple logic modules up to complex object-oriented programming of industrial ECUs and mobile controllers
- Comprehensive debugging and commissioning functions: troubleshooting and optimization on-site directly from within the application code and without any additional software
- Commissioning and machine operation on different platforms: in the CODESYS Development System, directly on the device display of a mobile controller, or on operator displays
- Fully integrated configurator for local inputs and outputs, for CANopen, J1939, EtherCAT and other fieldbus systems: declaration and use of sensors, actuators, signals, and joysticks
- Layer 7 master protocol stacks for CANopen, J1939 and EtherCAT; possible use as portable CODESYS libraries without any implementation expenses
- Raw CAN access with proprietary protocol; can be encapsulated in own function libraries
- CODESYS Store: access to application libraries as well as tested add-on tools for the methodically supported project engineering of mobile machines

Power and usability for effective implementation of complex automation projects

- Fast machine code for all ECUs: industrially proven compilers for compact mobile controllers up to high-performance central controllers to exploit maximum device performance.
- Scalable functionality of the CODESYS Development System:
  - Use of simple editors/configurators
  - Powerful add-on tools for static code analysis, runtime measurements, integrated UML diagrams; source control with Apache Subversion or automated application tests; suitable for safety-critical applications
- Sophisticated design for reusing function blocks in libraries
**Ideal conditions for mobile industrial applications**

- Established system platform: CODESYS runtime environments in more than 500,000 mobile control applications
- Large selection of ECUs and mobile controllers, programmable with the CODESYS Development System
- List of compatible devices in the CODESYS Device Directory: www.codesys.net
- Large community for mobile industrial machines: know-how support for the creation of applications by CODESYS system partners or engineering offices
- Compatible additional equipment: suitable HMI devices, diagnostic tools, etc.

**CODESYS in mobile industrial applications**

- Alstom Transport
- E&K Automation GmbH
- Goldhofer AG
- Jungheinrich AG
- Liebherr Mining Equipment Co.
- MAN Diesel & Turbo SE
- Rolls Royce Marine AS
- Sandvik Mining and Construction Oy
- Trepel Airport Equipment GmbH
Product components for mobile applications

CODESYS CANopen Master

- CANopen Master/Slave configurator fully integrated in the CODESYS Development System: integration of slaves based on EDS or DCF files, without external tools for the configuration of the bus system
- Mapping of the I/O data in the integrated configurator
- Configuration of PDOs without additional tool

- CIA 301 CANopen communication stack in the form of a CODESYS library: dynamically compiled and linked to the application
- Application interface according to CIA 405 for diagnosis and use of SDO

A CANopen network is configured directly from the CODESYS Development System: bus parameters, I/O data of the slave, PDO messages, etc.

CODESYS SAE J1939

- SAE J1939 configurator for ECUs fully integrated in the CODESYS Development System: definition and mapping of signals and parameter groups (PG)
- Complete PG database including SAE signal documentation: direct access to the documentation of the signal specifications
- Portable SAE J1939 communication stack in the form of a CODESYS library: dynamically compiled and linked to the application
- Functional scope of the stack: simulation of ECUs; dynamic address claiming; Arbitrary Address Capable; support for parameter groups > 8 bytes; optional signal conversion, etc.
- Intelligent signal processing: Raw signal and implicit conversion with automatic data type detection; consistent I/O channel generation

Access to the complete PG database, including signal documentation of SAE. A J1939 configurator with protocol stack is fully integrated in CODESYS.
CODESYS Visualization for mobile applications

- **Visualization editor fully integrated into the CODESYS Development System:** project engineering of logic programs, visualizations, and spatial animations in a single interface

- **Thanks to the integration:** Visualization integration provides simplified engineering and advanced functionality as compared to conventional visualization systems

- **Modern visualization elements and controls included in delivery:** fast and easy creation of practical operating and diagnostic views with responsive design

- **Reusability by means of one source file for different display platforms:**
  - Directly from within the CODESYS Development System – ideal for testing and commissioning
  - On remote terminals – for classic machine operation with HMI panels
  - On panel controllers – operation and logic control with a single device
  - In a web browser (HTML5) on tablets and smartphones – ideal for diagnosis and remote maintenance

- **Comprehensive functionality:**
  integrated alarm management; advanced user administration; convenient switching of styles, languages, and images; slim data recording modules; and a flexible communication design

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The integrated visualization makes it possible:

Convenient project engineering of operating interfaces can be performed in CODESYS at the same time as programming machine functions. These operating interfaces are ideal for the first functional tests and commissioning the machine. ECU's with operating panels are equipped with these kinds of operating interfaces for machine operation. At the same time, they can be used for diagnostics and remote maintenance, for example on remote devices with a web browser. A single CODESYS project as the source is sufficient for displaying in the different variants.
CODESYS Safety SIL2

- Certification by TÜV Süd for the development of software applications on safety controllers in accordance with EN ISO 13849 to PL d, Category 2 or 3/IEC 61508 SIL2 d
- CODESYS Development System validated with editors for structured text (ST), function block diagram (FBD), and ladder diagram (LD)
- Certified CANopen safety master stack based on the established CODESYS CANopen
- Parallel operation of CANopen safety and standard CANopen devices (if necessary)
- Data monitoring of the safety application during safe operation
- Debugging of the safety application as well as forcing or writing of values by switching to a special debug mode
- Simplified certification of safety applications by means of the language according to the specifications of the PLCopen Safety work group
- Shorter development time of a safety controller by means of a pre-certified runtime system, including test framework for many parts of the firmware
- Display of the control data of the safety application in a standard CODESYS web visualization or HMI

CODESYS Security

In the application project:
- Know-how protection of project files and libraries by means of encryption (physical security key, password)
- Protection of objects and individual object properties by means of project-specific user administration

On the mobile controller/ECU:
- Protection when commissioning and during operation by means of different operating modes
- Linking and encryption of the boot application by means of assigned security keys
- Access protection for applications, controllers, and visualizations by means of customized user profiles
- Unlocking of optional controller functionality, such as calibration or service functions via license detection
- Encrypted communication with the running application

CODESYS C-Integration

- New, pre-certified code, or code generated from tools such as Matlab/Simulink can be integrated dynamically into the IEC 61131-3 application and called from there.
- CODESYS controls the compilation of linked C objects based on an external toolchain.
- This toolchain from the device manufacturer links the C code to the runtime system as dynamic components.
CODESYS Professional Developer Edition

Benefits:
- Use of common methods from high-level development languages
- Creation of high-quality and powerful applications
- Increased productivity by means of efficient tool support
- Seamless integration into the CODESYS Development System
- Easy access and installation from the CODESYS Store

CODESYS UML
Model-based application development: The integrated class and state diagrams improve the legibility and overall clarity of the project and provides a common basis for technologies and developers.

CODESYS SVN
Management of the application project based on objects: an integrated interface for the Apache Subversion (SVN) version control system

CODESYS Static Analysis
Detection of potential application errors: source code test based on defined metrics; coding guidelines; rules and threshold values; in addition to the compiler syntax check for early detection of weaknesses in the application code.

CODESYS Profiler
Dynamic runtime analysis of the application: Measurement of the runtime performance of individual IEC 61131-3 POUs on the mobile controller for optimizing the source code

CODESYS Test Manager
Automated application tests: Comprehensive functions for system tests, module tests, and regression tests to create, manage, and perform automated recurring tests before commissioning and releasing an IEC 61131-3 control application.
Why should manufacturers of mobile controllers choose CODESYS?

- Optimized support for popular CPUs and operating systems in ECUs and mobile controllers:
  - CPUs for small controllers, such as the Tricore, ARMx/Cortex Mx with or without a proprietary operating system
  - High-performance CPUs for mobile applications, such as Intel Atom or Cortex A8/A15 running on WinCE, VxWorks, or Linux

- Simple porting and scaling of the runtime system based on a runtime toolkit. This toolkit contains defined interfaces for device-specific functions.

- Embedding of specific technological functions and visualization elements in CODESYS libraries - with licensing if necessary

- Proven interface for connecting any additional operating devices, diagnostic devices, or software systems

- Pre-certified IEC 61508 SIL2 software components (development system, runtime system, and CANopen safety master stack) for simplifying the certification of SIL2 mobile controllers

- Plannable development expenses for the implementation of a programmable ECU: defined interfaces, integration manual for the run time system, and qualified adaptation support

- Extensibility of the development system with device-specific and manufacturer-specific plug-in components

- Increased market acceptance thanks to widespread use in mobile applications

Grader control with CODESYS
CODESYS is employed in the control and operation of hydraulics, leveling, and gears of roadwork machines.

Mobile concentrated feed station for agriculture
The demands on grain processing, feed preparation, and automatic feeding require precise control that is achieved with a mobile computer system and a CODESYS SoftPLC.
**Steps for implementing a mobile controller**

- Select a CPU and operating system
- Implement or adapt the runtime system by means of a toolkit (SDK):
  - Customize system-specific functions of the runtime system with tool support according to a detailed integration manual
  - Configure the communication drivers to the CODESYS Development System
  - Integrate special device libraries to be called from the IEC 61131-3 application
  - Integrate customized add-on functionality based on defined interfaces
  - Compile adapted runtime system and embed it into the device
  - Qualified adaptation support from experienced project engineers in all phases
- Validate and test the system with the CODESYS Test Manager (optional)
- Market the mobile controller with the CODESYS Development System; with customized plug-in extensions (optional)

**Manufacturers of mobile controllers with CODESYS technology**

- Bosch Rexroth AG Mobile Hydraulics
- CrossControl AB
- EPEC Oy
- Hirschmann Automation and Control GmbH
- ifm electronic gmbh
- INTER CONTROL Hermann Köhler Elektrik GmbH & Co. KG
- Janz Tec AG
- MOBA Mobile Automation AG
- STW Sensor Technik Wiedemann GmbH

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**Horizontal directional drilling system with dual drill pipes** for trenchless underground installation of pipes in soil and rock. The system is automated and visualized with CODESYS.
CODESYS – the manufacturer-independent
IEC 61131-3 automation software.

CODESYS for further industries:

Factory Automation

Energy Automation

Embedded Automation

Process Automation

Building Automation

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