

IndraMotion MLC

The complete system for all control tasks and rapid engineering



IndraMotion MLC

Efficient implementation of modern machine automation

Ever-shorter product lifecycles are resulting in new challenges for mechanical engineering. Machine manufacturers have to develop their products more and more rapidly and more cost-effectively. This requires exceptional flexibility, incredibly fast time-to-market, and an extremely customer-centered approach: Engineering efficiency has to be maximized and software engineering must be much more open in order to develop customized machine functions cost-effectively and with a focus on the customer's needs. That's exactly where we come in.

The control system with comprehensive capabilities

IndraMotion MLC is the first truly complete automation system. It combines motion control, robot control and logic control to create a uniform complete system for any control task in almost any industry.

Thanks to high-performance control hardware, rapid signal processing and innovative control cross communication, you can choose freely between centralized and decentralized structures. You can easily adapt IndraMotion MLC to your application thanks to flexible hardware and software extensions. Standardized design and open standards allow you to synchronize all your drive technologies with maximum efficiency.

Unified motion control, robot control and logic control

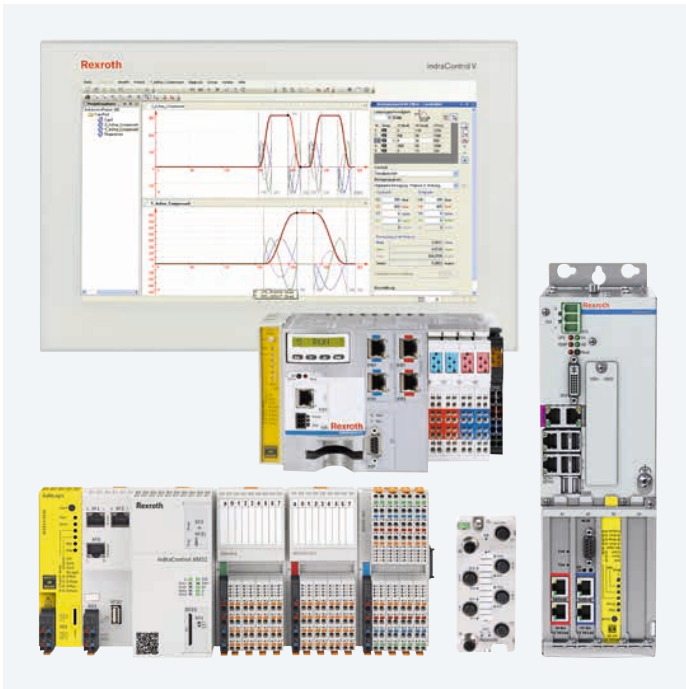
IndraMotion MLC offers comprehensive PLC functions as well as a full range of functions for motion and robotic applications, including certified safety technology. FlexProfile implements complex, non-linear motion sequences. Robot Control offers all the functions you need for multi-axis path interpolation in space. Hydraulic axes can also be just as quickly and easily integrated into the automation system with the same tools and functions.



Open Core Engineering connects PLC and IT

Through Open Core Engineering, IndraMotion MLC connects what have up to now been the separate worlds of PLC and IT automation. This combination offers more freedom, flexibility and efficiency in automation than ever before. Open Core Interface allows you to access all elements of both worlds for the first time in parallel.

Motion and PLC functions as well as variables can easily be modified and configured. System extensions by own real-time functions can be done independently. Innovative software and firmware functions, straightforward engineering, and open interfaces guarantee maximum flexibility in any application.



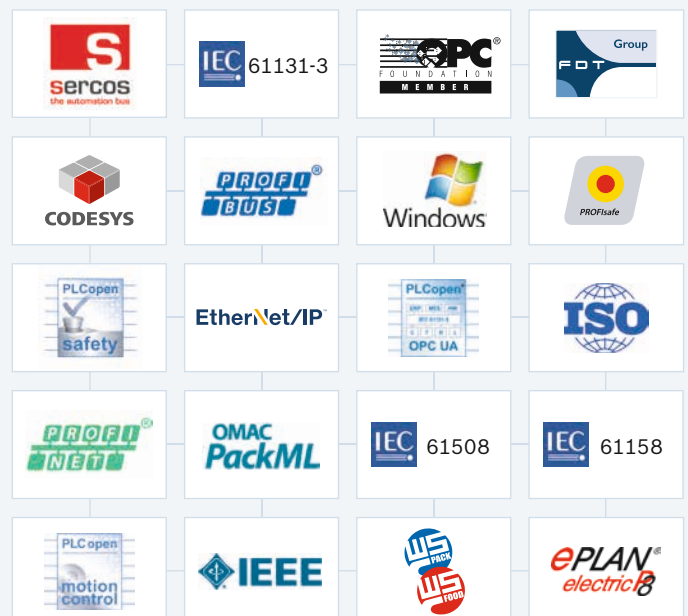
Benefits due to special product features

- ▶ Integrated runtime system for motion, robot and logic control compliant with the IEC 61131-3 open PLC standard based on CODESYS V3
- ▶ Universal framework IndraWorks for all engineering tasks
- ▶ Scaled IndraControl hardware platform with flexible expansion options for centralized and decentralized automation topologies
- ▶ Open Core Interface for high-level language-based applications
- ▶ Easy integration into an extremely wide variety of different topologies using the Sercos automation bus or via Multi-Ethernet and PROFIBUS
- ▶ Support of electrical, hydraulic and hybrid drives
- ▶ Can be expanded with safety controller up to PL_e/Cat. 4 (EN ISO 13849-1) or SIL3 (IEC 62061)

Open standards for open software solutions

Open communication standards allow you to perfectly integrate your automation solution and ensure maximum data availability and consistency at the field level as well as the control level.

Open engineering standards accelerate processes. Data throughout the engineering workflow can be easily reused in different tools. Consistent use of open programming standards increases software quality, facilitates reusability and minimizes the need for training, troubleshooting and service.



Scalable hardware Centralized and decentralized control, flexible enhancement

IndraMotion MLC encompasses a wide range of scalable control components for flexible enhancement of any centralized and decentralized automation topology, from an entry-level embedded controller to a high-end PC-based real-time solution with an additional Windows operating system. The solution can be easily integrated into different automation topologies using the Sercos automation bus and other fieldbus and Ethernet-based systems.

IndraControl L embedded control hardware

IndraControl L is the proven control platform in Inline format for easy DIN rail mounting. It provides all functions for automation in a cost-effective, integrated and transparent solution. Rapid signal processing and the high performance of the most powerful CPU enable up to 64 centrally controlled axes with maximum synchronicity and signal accuracy.

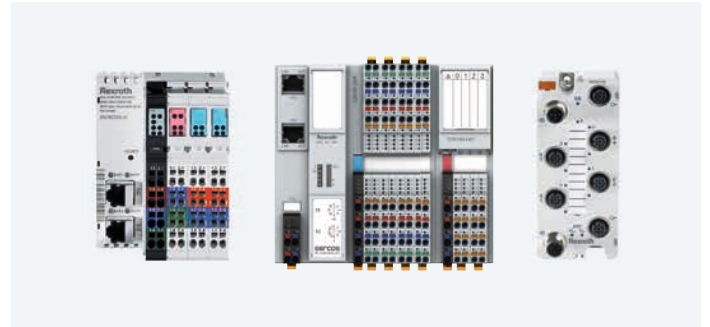
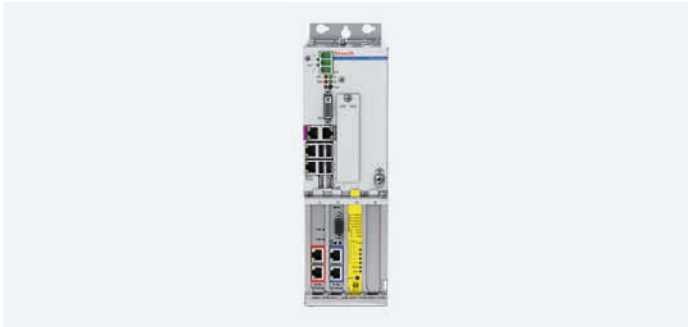
- ▶ Scalable performance and functionality
- ▶ Easy functionality extension thanks to function modules (communication, technology)
- ▶ Easy I/O integration through direct side by side arrangement of inline I/O modules or through integration of decentralized I/O stations via different fieldbuses
- ▶ Up to 64 axes with synchronized and coordinated movements on one controller

IndraControl XM embedded control hardware

The compact IndraControl XM control platform offers the latest hardware technology in a rugged housing in the IndraControl S20 format. It combines the excellent real-time-capabilities of the Sercos automation bus and the flexibility and high performance of the IndraControl S20 I/O line to create a modular and complete automation system.

- ▶ Scalable performance and functionality
- ▶ Rugged design with an expanded temperature range, minimal EMC emissions and high vibration resistance
- ▶ Easy functionality extension thanks to extension modules
- ▶ Easy I/O integration through direct side by side arrangement of IndraControl S20 I/O modules or through integration of decentralized I/O stations via a range of fieldbus couplers
- ▶ Motion control for synchronized and coordinated moves





IndraControl V PC-based controller hardware

Based on IndraControl VPB40, IndraMotion MLC is a powerful and flexible Industrial PC control solution. In addition to the motion logic application, you can also run powerful software tools for visualization, process data processing, analyses or reporting on the same controller hardware.

A subordinate hypervisor distributes the hardware resources of the Box PC designed for control cabinets to the IndraMotion MLC real-time-capable motion logic system and to the Windows 7 standard operating system. As a result, IndraMotion MLC gives you even more performance and flexibility for maximum efficiency in any application.

- ▶ Complete control system with fast process data processing
- ▶ Windows 7 and motion logic firmware on one single hardware
- ▶ Up to 99 axes with synchronized and coordinated movements
- ▶ Modular extension options for communication and safety

Modular I/O systems rated at IP20 or IP67:

Inline, IndraControl S20 and IndraControl S67

The fully modular design of our IP20 or IP67 rated I/O components gives you maximum flexibility for cost-effective implementation of your custom machine concepts.

- ▶ Inline is the freely scalable IP20 rated I/O system with for fast control cabinet installation, either locally in the IndraControl L or as a remote I/O station
- ▶ IndraControl S20 is the freely scalable IP20 rated I/O system for fast cycle times and maximum precision, whether installed locally in the IndraControl XM or as a remote I/O station
- ▶ IndraControl S67 is rated at IP67 and allows for reliable installation close to the machine and without a control cabinet
- ▶ Fieldbus coupler for Sercos, PROFINET, PROFIBUS, EtherNet/IP
- ▶ Technology and communication modules for many applications

More detailed information:
www.boschrexroth.com/dcc



System functions make the difference

Safety on board: SafeLogic safety controller for complex machines and plants

SafeLogic is the high-performance, freely programmable safety controller for certified solutions compliant with IEC 61508 up to SIL3, EN 62061 up to SILCL3, and EN ISO 13849-1 up to Cat. 4 and PLe. It is especially well suited to complex machines and large-scale systems with a decentralized distributed periphery.

In terms of hardware, SafeLogic upgrades the standard IndraControl control components through the addition of a function module or an extension module. This enables the non-safe and safe application to be centrally processed using only one control system. Standard and safety peripherals such as input/output modules and drives are uniformly connected to the control system via the identical communications interfaces. Safety programming is uniformly carried out using IndraWorks in accordance with the PLCopen Safety standard.

In combination with the Sercos automation bus, the CIP Safety on Sercos safety protocol, and the IndraDrive range of drives incorporating SafeMotion, the simple interaction takes place in the form of certified, complete motion logic solutions.

- ▶ Cost-effective solution for machines with a wide range of functions or plant with widely distributed safety peripherals
- ▶ Consistent and side-effect-free engineering of standard and safety applications with IndraWorks
- ▶ Multi-master support (CIP Safety on Sercos and PROFISAFE)
- ▶ Seamless, complete motion-logic solution incorporating IndraDrive with SafeMotion
- ▶ Holistic engineering in IndraWorks for standard and safety application

Sercos, Multi-Ethernet and PROFIBUS for optimal fieldbus communications

Open standards for fieldbus communications mean that all relevant standards are supported, including Sercos, Multi-Ethernet and PROFIBUS. This is the only way to combine the automation products of different manufacturers in one topology.

With the on-board Sercos Master, IndraMotion MLC is an open, mature and independent real-time system offering maximum data throughput rates, easy commissioning and clear diagnostics.

As a non-proprietary organization, Sercos is continually improving further development in order to offer advanced, open solutions for the automation tasks of the future.



WebAssistant:
Web-based analysis and optimization

The WebAssistant has an easy-to-use web interface for diagnosis, maintenance and service. The redesigned front end in responsive design automatically adjusts to the resolution of the target device and is therefore very suitable for mobile phones or tablets. Any necessary information can be assessed with only a few clicks through a navigation menu optimized for touch operation.

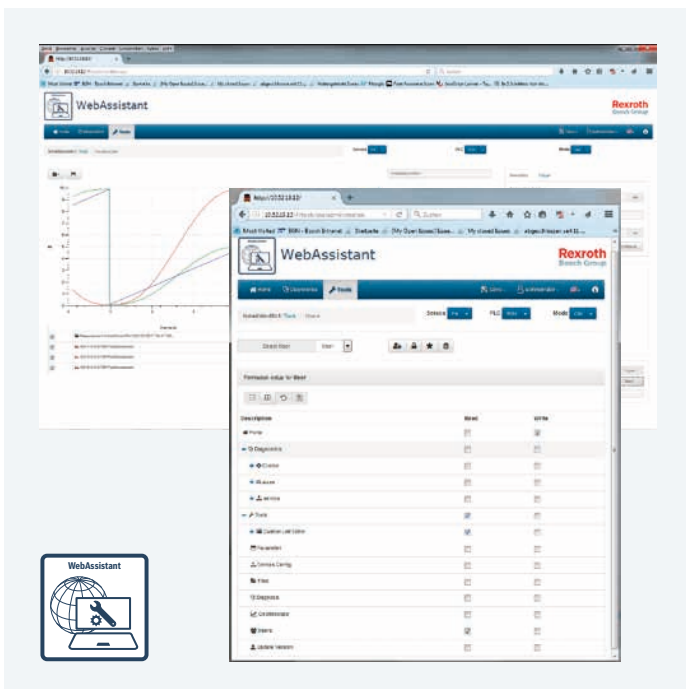
This helps the diagnosis logbook, for example, to find and correct errors quicker. For a detailed machine analysis, the current status is saved in the parameter sets and compared with an archive. The integrated multichannel oscilloscope optimizes the display and logging of movement processes. The optionally activatable application area with customizable screens turns the WebAssistant into an individualized analysis and optimization tool for machines.

OPC UA:
The standard for vertical integration

The IndraMotion MLC runtime system includes a standard OPC UA server. OPC UA is the cross-platform communication standard for Industry 4.0 environments.

OPC UA offers a standardized and reliable way of ensuring that any information can be accessed at any time and location. It is not only used for connecting HMI systems: Other applications include connecting or integrating control technology to higher-level systems such as MES and ERP.

In addition to basic information models and technology specific information models, Rexroth specific information models are also available for easy access to all variables and parameters of IndraMotion MLC.



Open Core Engineering Freedom and efficiency redefined

Software engineering is assuming a larger share of the value added in mechanical engineering and is increasingly determining the time it takes to develop new, innovative machine concepts. IndraMotion MLC significantly increases the engineering efficiency with the Open Core Engineering solution and offers an unparalleled degree of freedom, flexibility and efficiency in automation.

Engineering – complete and efficient

Open Core Engineering accelerates the engineering process crucial through software tools, function packages and multi-technological solutions. The most important tool is the IndraWorks Engineering Framework for efficient planning, programming and commissioning of different applications. As a result, IndraMotion MLC has a perfectly coordinated tool chain for all phases of the engineering workflow throughout the entire product lifecycle of a machine.

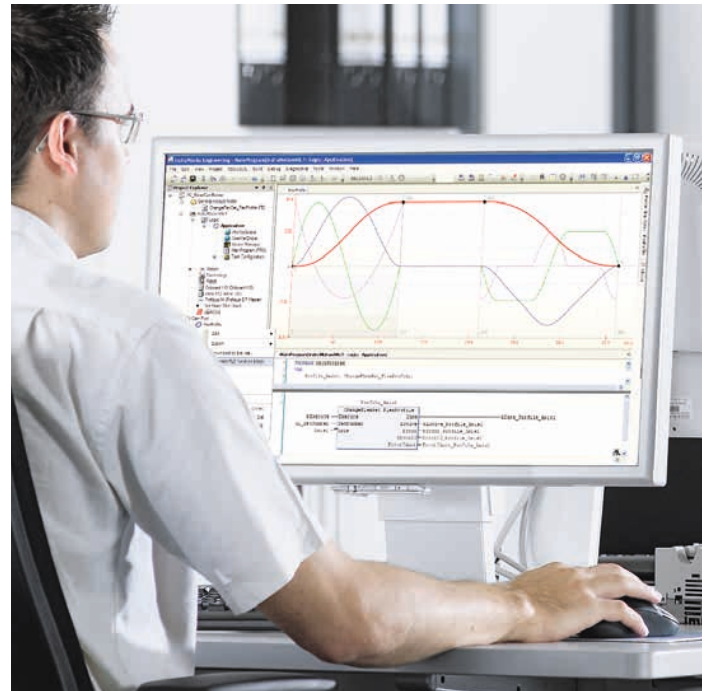
Motion made easy

The high-performance motion logic runtime system in IndraMotion MLC allows you to implement motion sequences in your application more quickly. IndraWorks provides extensive PLCopen-compliant function libraries, transparent data structures and intuitive wizards.

Technology-centered function toolkits for technology, robot control, hydraulics and FlexProfiles as well as axis interfaces accelerate the implementation of complex machine processes and increase the productivity of the application to ensure optimal production efficiency.

The bridge to Industry 4.0

Open Core Interface is the bridge between PLC-based engineering and IT automation and represents a key advancement in our range of solutions for machine automation. Direct access to all core functions of controls and devices means that you can integrate smart devices as



modern HMI for automation applications. It provides functions for PC-based IT automation and simplifies simulations for Rapid Control Prototyping or model-based system engineering. Open Core Interface also makes it easier to create individual functions in IndraMotion MLC, giving you even more freedom.



Your advantages

- ▶ Greater efficiency in software engineering
- ▶ Unique flexibility in programming and the device platform
- ▶ Customer oriented individualization of machine functions
- ▶ Extremely future-proof thanks to consistent use of open standards and technologies

Open Core Engineering:

New possibilities for new software engineering challenges



More detailed information:

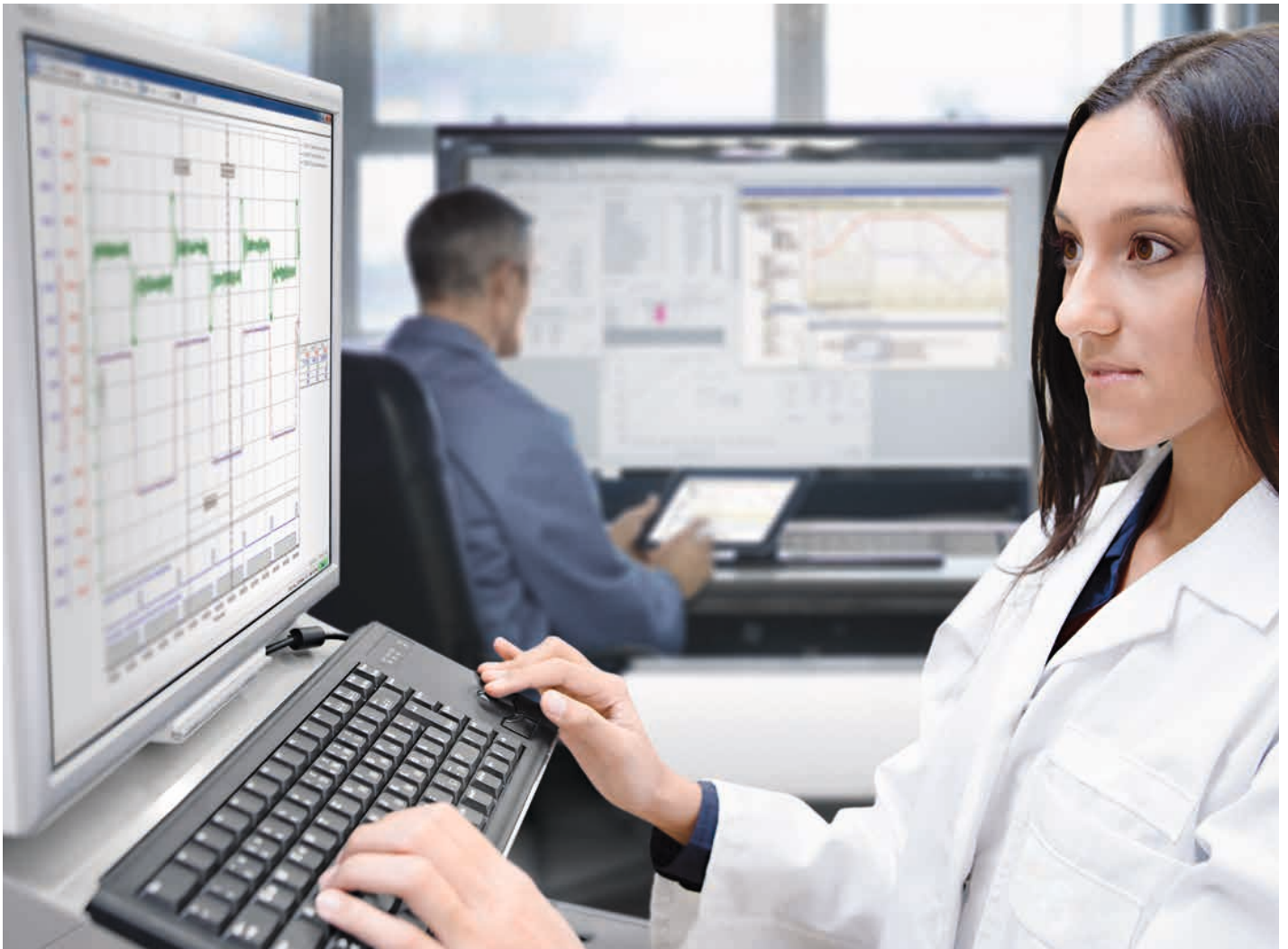
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IndraWorks

A universal framework for all applications

Open Core Engineering offers a perfectly coordinated tool chain for all phases of the engineering workflow throughout the entire product life cycle of a machine. IndraWorks is the central software application for efficient planning, programming and commissioning of IndraMotion MLC and accompanying peripherals.



All tools for easy commissioning on board

The IndraWorks engineering framework provides all the necessary tools for commissioning your drives and controls in a single package. Project management with central data management for device configuration, visualizations and the PLC program ensure that your data is transparent and consistent.

Intuitive programming and configuration

Thanks to the integrated CODESYS V3 software, IndraWorks provides all editors for easy programming of your PLC application (compliant with IEC 61131-3 3rd Edition). Intuitive wizards and comprehensive online tools guide you through each engineering step, from device configuration using the Generic Application Template to parameterization of technology functions.

Easy modular extension, control and diagnostics

The Generic Application Template supports systematic creation of machine software. Software can be easily expanded while maintaining high quality, allowing for easy implementation of modular control concepts with different alternatives for machines and plants. A comprehensive range of tools for commissioning or service, such as a multi-channel oscilloscope, logic analyzer and debugging functions for PLC logic, allows for status messages and system diagnostics at the push of a button.



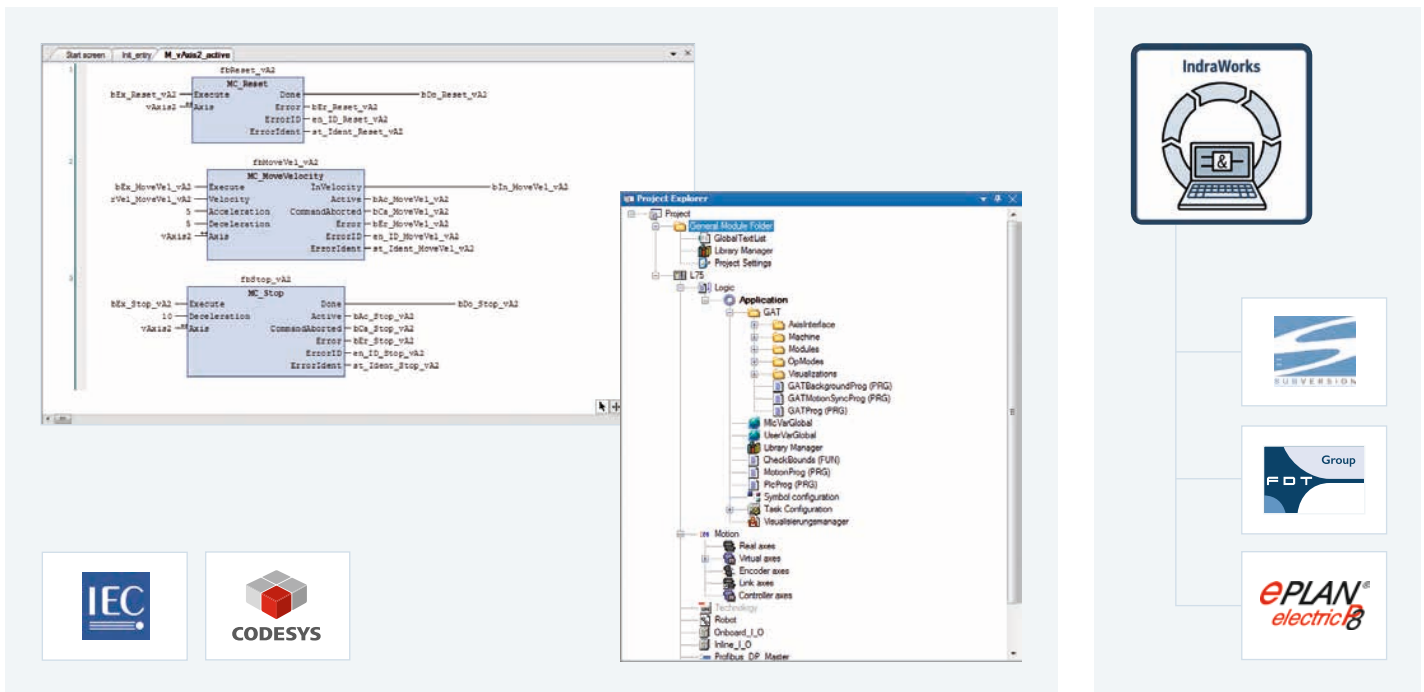
IndraWorks means efficient engineering

- ▶ The framework for all applications: Standardized engineering with a cutting-edge PLC system and extensive standard and technology libraries
- ▶ Complete set of basic functions: Design, parameterization, programming, diagnostics, visualization and a large number of multi-system engineering functions
- ▶ Consistent operation: Based on latest Windows technologies with central project management and wizards in a standardized environment
- ▶ Open architecture supports integration: Standardized IEC 61131-3 compliant interfaces, FDT/DTM, OPC, Version Control System (VCS) and automation interface for 3rd-party connectivity

The IndraWorks toolbox

- | | | | |
|--------------------------------------|--------------------------------|-----------------------------------|---------------------------------------|
| ▶ Cam and motion profile editor | ▶ Drive and motion programming | ▶ Multi-device project management | ▶ Robot configuration and programming |
| ▶ Cam editor | ▶ Firmware management | ▶ Online help | ▶ System configuration |
| ▶ Communication | ▶ HMI project planning | ▶ Oscilloscope | ▶ Team engineering |
| ▶ Configuration wizards | ▶ Library management | ▶ Periphery configuration | ▶ Testing and diagnostics |
| ▶ Control and drive parameterization | ▶ Logic analyzer | ▶ PLC programming | ▶ User management |
| | ▶ Machine operation | ▶ Project management | ▶ Visualization |

IndraWorks Engineering framework



Programming with open standards

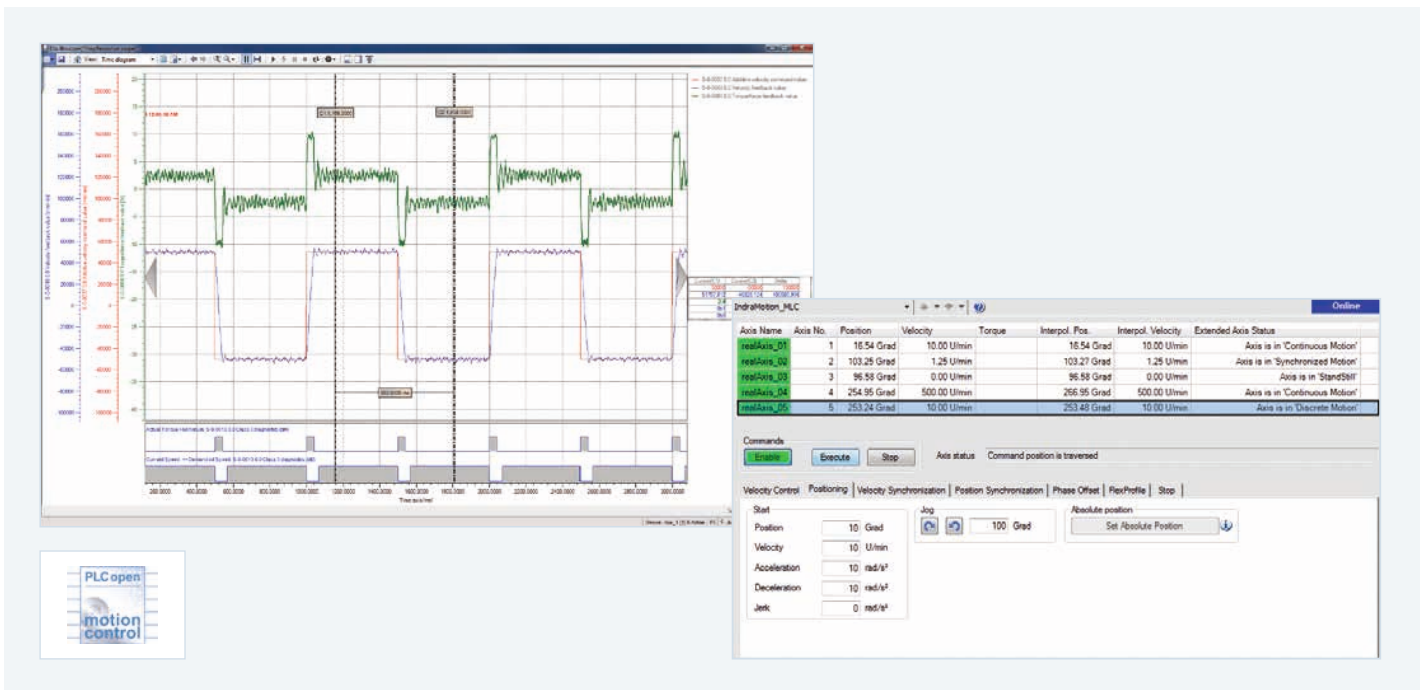
Standard PLC programming based on CODESYS V3 is seamlessly integrated into IndraWorks, ensuring easy sequence programming and optimal software quality. Depending on your programming task, you can use the IEC 61131-3 3rd Edition-compliant textual editors Instruction List (IL) and Structured Text (ST), or the graphical editors Ladder Diagram (LD), Function Block Diagram (FBD), Sequential Function Chart (SFC) and Continuous Function Chart (CFC).

Object-oriented language extensions facilitate modularization and enable easy extensibility, ensuring software quality and minimizing errors. A range of convenient functions such as auto-complete, semantic coloring or precompile ensure easy and reliable programming.

Interfaces for optimized workflows

IndraWorks integrates perfectly into your existing engineering tool environment thanks to a variety of open interfaces. Subversion, the free version control software, can be directly integrated via an integrated adapter. Development and service tools for field units from many different manufacturers can be integrated via FDT/DTM. A third-party field unit can be parameterized, configured and analyzed directly from IndraWorks via the manufacturer's user interface.

The Automation Interface for scripts provides direct access to IndraWorks functionality for automation of recurring engineering tasks. The ECAD data interface enables bi-directional exchange of project data between EPLAN Electric P8 and IndraWorks Engineering so that circuit diagram data can be easily reused in PLC engineering.



Intelligent assistants for commissioning and diagnostics

Intuitive wizards for device configuration and parameterization systematically guide you through the configuration of field units and drives and help prevent errors. Whenever necessary, you can modify the default values to optimize your application. For commissioning and first tests of mechanical setups IndraWorks can move axes and robots without the need of a PLC program.

Standardized PLCopen-compliant function modules for motion control facilitate the integration of drive functions.

The intelligent axis and kinematics interface reduce the PLC code appreciably. Detailed online comparison functions allow you to compare any desired IndraWorks project with the project on the live controller. Comprehensive trace and oscilloscope functions in IndraWorks deliver a wealth of information for troubleshooting and enhancing the application.

Function toolkits

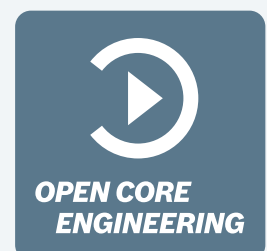
Boost productivity and efficiency in engineering

Function toolkits are technology-orientated solutions that expand the standard functionality of the IndraWorks PLC Engineering Framework. These function packages accelerate the implementation of complex machine processes, optimize the project workflow in the machine manufacturing through additional engineering interfaces or increase productivity through the homogeneous integration of advanced machine functionality.



A selection of IndraMotion MLC function toolkits

- ▶ Generic Application Template (GAT)
- ▶ Technology
- ▶ FlexProfile
- ▶ Robot Control
- ▶ Best in Class Control (Hydraulics)
- ▶ Automation Interface
- ▶ Visualization
- ▶ Safety Manager
- ▶ Team Engineering



Generic Application Template: Automatic creation of modular machine programs

The Generic Application Template "GAT" function toolkit is used for automatic creation of modular machine programs. The GAT provides a library of highly functional application templates that contain status machines, operating modes, diagnoses and data interfaces. This toolkit features object-oriented templates based on the IEC 61131-3 and PLCopen PLC standards, enabling interactive, application-specific creation of a complete project.

The GAT minimizes your initial work when you create new projects. The result is a modular machine program with high-quality software that you can easily adjust to accommodate changes or create new machine versions.

Technology: Instant PLC function modules

The Technology function toolkit helps you implement process-oriented functions in form of ready to use function blocks. As toolbox solutions, they cover a range of different applications and assist you in function-oriented engineering so that you can simplify complex machine processes.

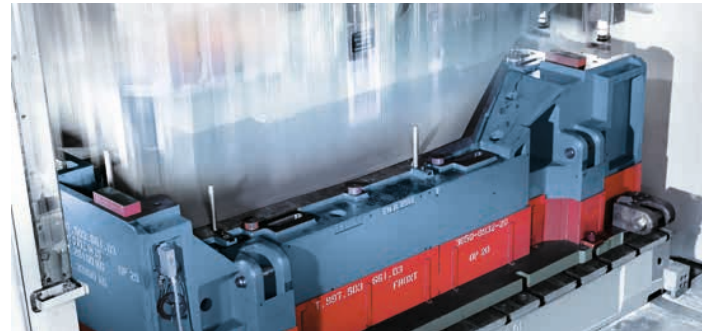
All modules are based on the IEC 61131-3 and PLCopen PLC standards and are provided in the form of comprehensive function libraries. More complex functions allow for easy adjustment and parameterization via wizards. The Technology function package is the basis for modular machine software with increased quality, efficiency and adaptability. It also minimizes the time and effort required for creating new versions of machines.

FlexProfile: Easy implementation of complex, non-linear motion control

The FlexProfile function toolkit offers easy parameterization as an alternative to complex programming for implementation of sophisticated, non-linear motion control. Profiles are created graphically from a library of over 20 movement sets using the CamBuilder toolbox in IndraWorks. Instead of static cam points, individual segments are assembled into a profile using a different motion laws and transition conditions. For a detailed analysis, the engineering software simulates multiple profiles by displaying position, speed and acceleration values. The toolkit also enables a fast response to events during profile processing in the controller. At the press of a button, the profile parameters are imported into the controller and the PLC function module is generated for integration into the application program.

The advantage: FlexProfile provides an easy way of implementing process-optimized motion sequences in your machine for maximum productivity and efficiency.

Function toolkits for almost any task



Robot Control:

Easy implementation of multi-dimensional motion control

The Robot Control function toolkit allows you to operate robots using the IndraMotion MLC control system. It provides a large number of pre-defined kinematics and transformations for use with standardized robots that are freely combined in one project.

Dialogs for configuration and parameterization help you set up the robot. The IndraWorks commissioning dialog for robots allows for robot movement without additional programming effort. Individual mechanisms integrate with their own transformations in the control system via PLC blocks. Comprehensive function libraries allow complex 3D movements with full band synchronization.

PLCopen, the kinematics interface and the Open Core Interface for high-level programming language, gives the user full freedom in application development. The recent addition of Lua scripting language allows for complex robot movements that can be customized by a service user or end user using simple tools such as a text editor. The machine program features fully integrated robot control that increases the overall efficiency of the automation solution through fast and transparent exchange of process data and perfect synchronization of all movement types.

Best in Class Control:

Homogeneous integration of electrical-hydraulic axes

The Best in Class Control function toolkit provides extensive library functions and project templates to enable homogeneous integration of electrical-hydraulic axes into the IndraMotion MLC control system. They allow for centralized or decentralized control in accordance with PLC standard IEC 61131-3.

An extended command set for the structured text (ST) language allows you to easily program sequential procedures using IndraWorks. Project planning and software quality are significantly improved when the toolkit is used in combination with the Generic Application Template (GAT) function toolkit.

Software interfaces enable open integration of controller models and simulation data for application-specific customization. Fluid control technology, combined with the latest motion logic functions, can then be used.

Automation Interface: Control IndraWorks remotely

The Automation Interface function toolkit is an open programming interface for IndraWorks Engineering. You can use VBA, .Net or JavaScript to create new projects, configurations and other routines as well as execute a full range of commands that you would normally have to execute manually. In this way, you can automate



regularly recurring tasks, save a lot of time and prevent errors. You also improve software quality while simultaneously saving time.

Visualization: Implementation of HMI-based visualization and operation

The Visualization function toolkit is used for implementing HMI-based visualization and operation of production machinery. The WinStudio HMI toolbox in IndraWorks offers an extensive range of graphic elements and commands for easy creation of Windows-based HMI applications, including web-based clients. Thanks to open data interfaces, all control information in the HMI project is available at all times.

The function toolkit supports visualization devices ranging from compact control panel and compact embedded PC to IPC and modern multi-touch displays. It allows you to easily adapt your project to different applications, without the need for high-level programming skills, and integrate ActiveX or .NET Controls into customer-specific HMI solutions.

Safety Manager: Programming for safety

The Safety Manager function toolkit lets you quickly and easily create the Safety application for the SafeLogic certified safety controller. Programming is carried out in accordance with the principles of the PLCopen safety

specification. The approach is to design the programming similarly to the wiring of discrete safety relays. Certified function modules take the place of the switching devices, and the discrete wiring is replaced by the graphic connections (programming) of the function blocks.

Team Engineering: Perfect engineering with version control for multiple users

The Team Engineering function toolkit allows you to integrate version control systems (VCS) for project versioning and multi-user engineering with IndraWorks. The data server of IndraWorks enables connection to "Visual SourceSafe and Subversion" and therefore to server-assisted project management with central data management.

An extensive set of commands such as compare, update, merge, analyze and report simplifies engineering. Access management allows individual project elements to be processed by different users at the same time. The current status of each element is visualized in the IndraWorks Project Explorer and changes are checked for version conflicts. The ability to track versioned project states ensures greater transparency and software quality and supports modular engineering.

Open Core Interface

The bridge to Industry 4.0

Open Core Interface technology opens up new possibilities for development of machines and plants. The Open Core Interface for Controls gives you direct access to all elements of the control system. Take advantage of this freedom.

More options, more flexibility

Open Core Interface is the bridge between PLC-based engineering and IT automation. Direct access to all control and drive functions is the key: Open Core Interface allows for integration of smart devices as modern HMI for automation applications, provides functions for PC-based IT automation, facilitates simulation and Rapid Control Prototyping and simplifies creation of customized functions using a range of high-level languages and software tools. Your benefit: Complete freedom and a new level of flexibility.

Easy programming in any environment

Open Core Interface is an innovative technology interface for creating a high-level language-based applications. The comprehensive Software Development Kit contains a wide variety of libraries for functional access to controllers and drives. It can be seamlessly integrated into a range of development environments for different high-level languages such as Microsoft Visual Studio or Eclipse, allowing for easy programming.

Open Core Interface
For independent development of
unique functions

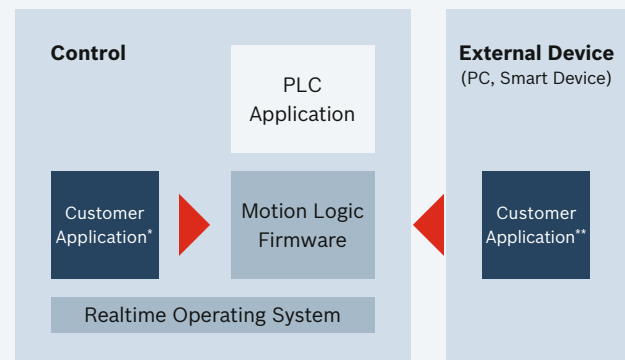


Customized, high-level language applications on the control

- ▶ Competitive advantage through differentiation
- ▶ Intellectual property protection for machine manufacturers
- ▶ Simultaneous execution to controller firmware and PLC application

Direct access to all functions, including the system core of the control

- ▶ Complete access to all control and drive functions by external devices
- ▶ New operating and diagnostics concepts with smart devices
- ▶ Easy integration of simulation applications



* Realtime or non-realtime ** Non-realtime ▶ Open Core Interface



Smart devices

After permeating the consumer market, handheld devices are now gaining a foothold in industry, especially in many disciplines of mechanical engineering, such as planning, production, service and quality management. In so doing, they have entered the standard application areas typically reserved for HMIs and offer new possibilities for production scenarios that are growing ever more complex. The challenge is to design applications that feature an intuitive and reliable user interface with a variety of new graphical controls.

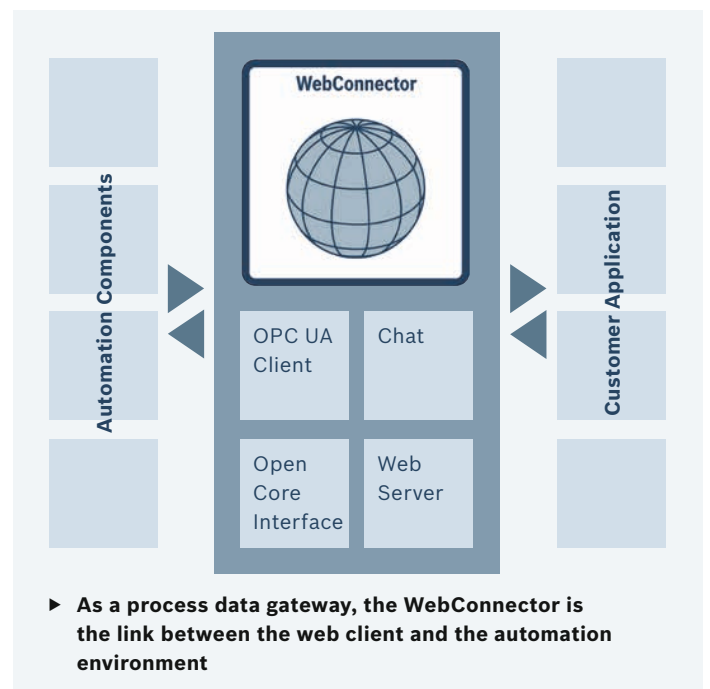
Open Core Interface supports Android and iOS, the dominant operating systems for tablets and smartphones. By integrating smart devices, machine manufacturers can develop new operating concepts for their plants and create unique selling propositions. At the same time, they can increase usability by offering mobile apps.

To ensure user acceptance and success, the app must be adapted to the specific features of the operating system and support typical interactions such as gestures and swiping. This is only possible with native apps, which can be developed using Open Core Interface. Native apps are independent apps that are developed especially for smart devices and run directly on these devices. This means that you do not require a web server to display the data.

WebConnector

For Industry 4.0 applications, you need to have the right control centers in key places. Cross-platform, fast and easy-to-program communication interfaces ensure perfect dialog between the controller and the HMI application.

The WebConnector connects web-based applications to the machine: The efficient Websockets protocol gives you quick access to controllers and drives, without having to know the underlying protocol. JavaScript, HTML5, Node.js and Node-RED are used for creating applications. The integrated web server allows you to add your own HTML webpages with full connectivity to system information, e.g. PLC variables, motion and robotic states. The WebConnector is completely platform-independent and runs on all operating systems supporting a Java Virtual Machine.



Open Core Interface Applications

Rapid Control Prototyping and Model-Based System Engineering

Open Core Interface offers the full range of capabilities for Rapid Control Prototyping and Model-Based System Engineering, a design method for control system development. It is used for developing single processes as well as simulating the whole lifetime cycle without a real machine, thereby minimizing cost and risk in engineering.

Common software for Rapid Control Prototyping include LabVIEW by National Instruments, MATLAB or Simulink from MathWorks and tools that use Modelica-based languages such as OpenModelica. Open Core Interface for Controls offers libraries that seamlessly integrate into these development environments. Prototypes can be developed independently of the PLC machine program. With Open Core Interface, newly developed applications can be easily connected and ported to the target system.

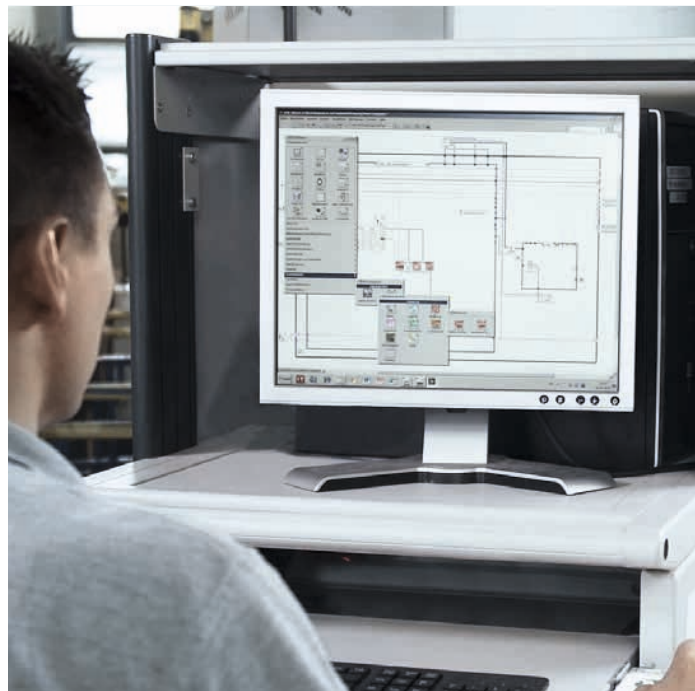
Programming machine movements with LabVIEW – without a single line of PLC code

More and more users are depending on safe, mostly automated testing processes. Machine manufacturers have to tailor their testing and measuring machines to the specific needs of customers. LabVIEW by National Instruments is a popular software solution in this industry.

Motion sequences directly from LabVIEW

The IndraMotion MLC motion logic system simplifies the implementation of complex multi-axis configurations in LabVIEW: Instead of programming PLC for the specific machine workflow and developing then a LabVIEW program for entering and displaying measurement data and integrating measurement sensor technology, Open Core Interface avoid these duplications of work.

Open Core Interface allows you to program machine movements via the LabVIEW graphical user interface, without having to write a single line of PLC code. This is possible thanks to LabVIEW's extended, direct access to control functions. This simplifies and accelerates commissioning of customer-specific testing and measuring machines and reduces engineering costs.



◀ **Instead of working in two development environments, the machine manufacturer can now program machine processes directly in LabVIEW using Open Core Interface and significantly reduce engineering costs.**

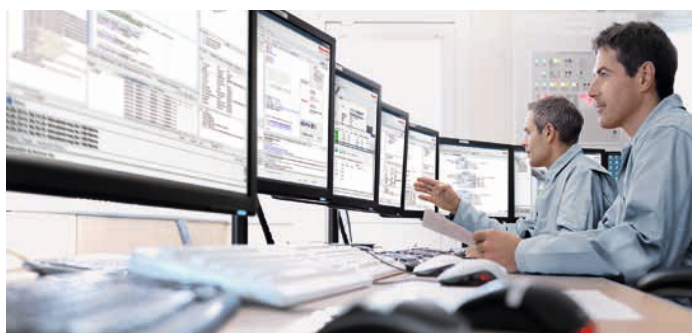
PC-based IT automation

Open Core Interface for IT automation involves the use of PC-based solutions in the automation environment of a production machine. It enables rapid data exchange through easy integration with Windows-based tools using specialized libraries in different high-level languages such as Java, C, C++ and C#.

Open Core Interface allows for easy entry of process and production data for subsequent evaluation in higher-level systems. This enables dynamic resource planning or control of production processes in a manufacturing execution system.

Open Core Interface provides a COM*-based interface for systems and can be integrated into standard office applications using this technology. It also allows for convenient tracking of diagnostics, system states and process data.

*COM (Component Object Model): An object-oriented communication interface developed by Microsoft for networking processes and programs.



Flexible control functions

By offering "Individual Functions," Open Core Interface opens up a new area of development for control systems. High-level language-based applications can run on the same hardware at the same time as the PLC application and allow system functionality to be easily enhanced using C/C++, Lua and Java as programming languages. Both applications use the same range of functions. The high-level language-based application and the PLC application are created using the same principle. System functions can be obtained via interfaces or libraries during programming in the development environment. After compilation, the application is installed directly on the hardware and executed there.

PLC languages and high-level language applications can interact in different ways. The high-level language application is a functionality extension of the PLC in passive mode. Controller algorithms created in MATLAB are integrated into the system in this way. As an active application, it runs independently of the PLC in independent tasks, allowing a machine to be implemented without a PLC program.

In a combination of both variants, the PLC application transfers application data to the high-level language-based application, which processes the data in a separate task.



Open Core Interface Applications

C/C++

Software components in C/C++ expand conventional PLC programming and easily solve complex logical and mathematical problems.

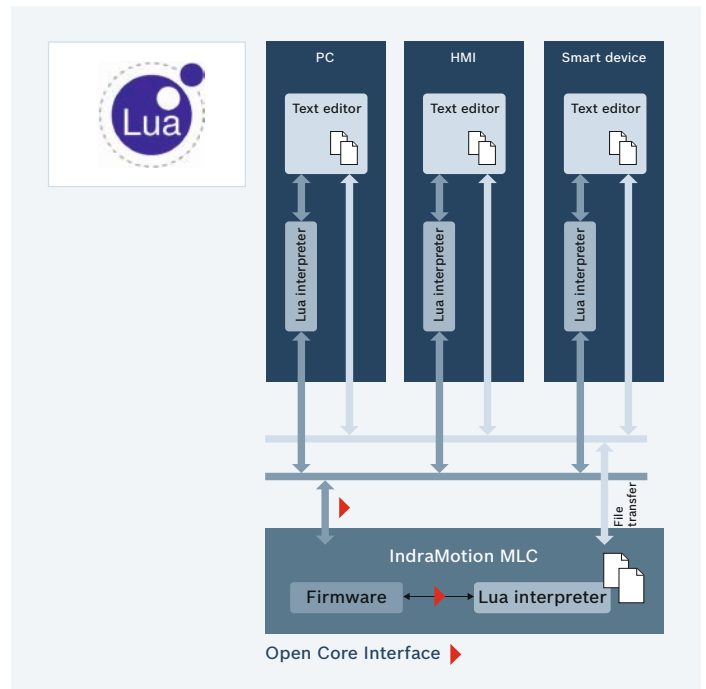
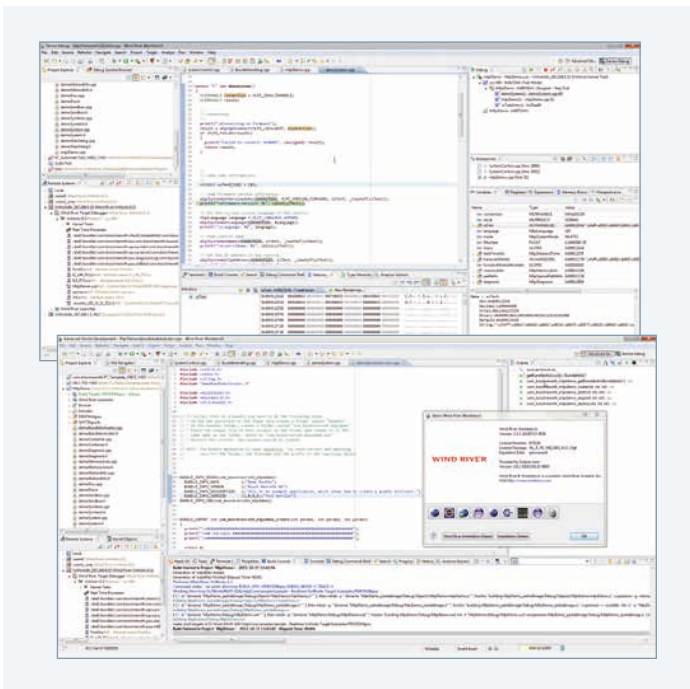
The "Wind River Workbench 3.3 Bosch Rexroth" allows you to create real-time-capable applications and functions in high-level languages for the IndraMotion MLC control system. The workbench is based on the open Eclipse framework and is an integrated solution for device software, including design, development, debugging, testing and management.

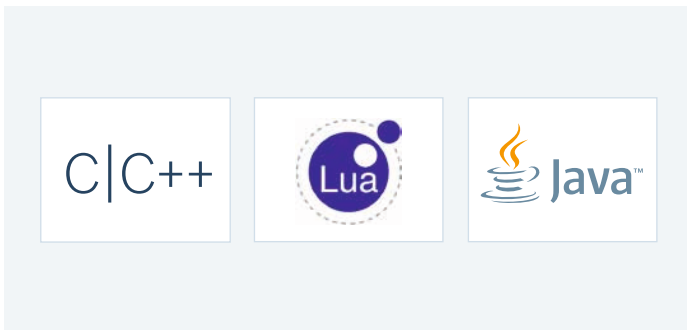
Lua

Procedural processes can be programmed easily and clearly using the cross-platform scripting language Lua.

The Lua interpreter is integrated into IndraMotion MLC via Open Core Interface so that mechanical engineers require absolutely no PLC code (except for cyclic processing of I/O modules) and can significantly lower engineering costs. In this way, axis movements can be programmed in a very clear and comprehensible fashion. End users also benefit because they can easily integrate robots and other machines into plants and tailor them to their needs without the need for PLC skills.

To define multi-axis configurations such as a pick-and-place process in Lua, the design engineer must simply write a basic script in a conventional text editor and send it to the controller via file transfer.





To make the engineering process even more efficient, Rexroth also provides an abstraction layer as part of the Software Development Kit (SDK) in Open Core Interface.

A function library provides predefined, fully annotated commands with syntax based on object-oriented programming languages. This makes it easier for users to switch from Rexroth's Robot Control Language (RCL) to Lua for new software versions.

Java

IndraMotion MLC offers Java, a key technology and a stable, secure and open platform for creating Internet of Things (IoT) applications. Open Core Interface allows you to run multiple Java applications directly on the controller in parallel with the PLC runtime system in order to integrate web- and cloud-based services.

The controller can also be more easily integrated into higher-level business process such as databases or MES systems. Processes peripheral to the machine applications are directly implemented using predefined Java applications and not in the PLC application.

Advanced machine and system functions implemented in Java for applications such as HMIs or service/maintenance strategies can also be installed without changing the PLC code.

Engineering Network:

Engineering community for software developers

IndraMotion MLC with Open Core Engineering and Open Core Interface provide the basis for a range of new software solutions and innovations. In order to put product ideas into practice quickly, specific programming issues also need to be solved quickly.

In this respect, the Rexroth Engineering Network offers users a modern information portal “from developer to developer”. There is a discussion forum where answers to general or application-specific issues can be found regarding tools, functions and interfaces.

Practical example programs and online documentations on Open Core Interface make it easier to get started and provide valuable tips on programming with different high-level languages. Open Core Engineering and the Engineering Network therefore enable efficient engineering and quick implementation of innovative products.

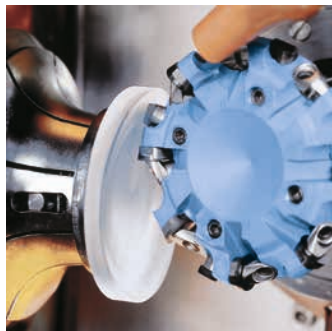
More information:

www.boschrexroth.com/network



At home in demanding applications around the world

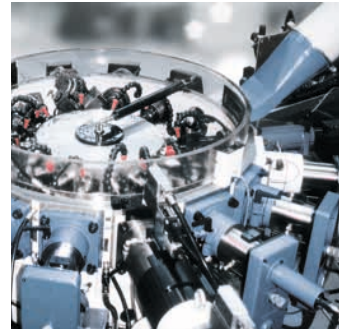
The IndraMotion MLC automation solution is developed and used in almost every industry around the world with the assistance of a global network of product, application and service specialists.





IndraMotion MLC guarantees unprecedented flexibility for integration into many different types of machines, plants and processes. For a wide variety of applications:

- ▶ Assembly and handling
- ▶ Automotive
- ▶ Drilling rigs for oil and gas (land based)
- ▶ Forming machine tools and presses
- ▶ Glass making machinery
- ▶ Marine technology
- ▶ Materials handling
- ▶ Ocean energy
- ▶ Offshore
- ▶ Packaging machines
- ▶ Printing machinery
- ▶ Plastic and die-casting machines
- ▶ Pulp and paper machinery
- ▶ Rubber processing
- ▶ Semiconductors and electronics
- ▶ Solar
- ▶ Stage technology
- ▶ Testing technology
- ▶ Wind energy
- ▶ Wood working



Comprehensive services

The intelligent choice: drive and control solutions from a single source. We offer a complete range of drive and control solutions backed up by in-depth consultancy expertise and a tailored service portfolio ranging from conceptual development and commissioning to modernization. We help you maximize the lifecycle and efficiency of your machines.



Industry-focused engineering and applications support

Our experienced team of industry experts provides advice and support to assist you during conceptual development and design of your solution:

- ▶ Selection of specific automation components (hardware and software) for your application
- ▶ Detailed description of drive and control components, interfaces and data management
- ▶ Development of sample applications
- ▶ Active involvement in initial applications at your site
- ▶ Support during integration of Ethernet-based Sercos automation bus real-time communication
- ▶ Tailored support to help you develop systematic, compliant safety strategies.



Software and hardware engineering

Rexroth provides expert advice and support to assist you during development of your production systems and networks. IEC-compliant PLC function modules for almost all industries are available in our software library.



Commissioning

Our technical support experts are right at your side whenever you need fast, professional assistance during the commissioning phase. Each of our teams is made up of service engineers who specialize in a particular industry.



Service

Our service team supports you throughout the planning, installation, commissioning, operation and extended life phases:

- ▶ Technical support/help desk
- ▶ Field service
- ▶ Repair service
- ▶ Spare parts service
- ▶ Retrofit and modernization
- ▶ Training

