LASAL ENGINEERING TOOL
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For modern machine manufacturing, clearly constructed and modular software is an essential factor for success.

**ALL-IN-ONE**

Modularity and reusability are cornerstones for efficient and flexible application development. These properties allow you to quickly program and configure customer-specific machine software.

The object-oriented engineering suite LASAL from SIGMATEK provides you with exactly this simple reusability of modularly constructed application code and the flexibility that comes with it. LASAL unifies all automation tasks on one platform and contributes to significantly reduce development times and time to market.

The consistent engineering tool provides clarity and simplifies the handling of modular machine and system concepts. A factor that is increasingly important in the current new era of the "Internet of things". LASAL also supports platform and manufacturer-independent data exchange via OPC UA.
The modern, consistent engineering environment expands the IEC 61131-3 standard with object-oriented programming (OOP) and graphic representation. LASAL enables the modularization of machine functions in the software and therewith mechatronic engineering.

In mechanics, proven constructions are often reused. Thanks to the modular structure of OOP, existing and tested application modules can also be easily reused. The software machine functions (objects) can be assembled in a toolkit system and simply "wired". New characteristics of machine components can therefore be implemented with minimum programming. Creating applications is thereby accelerated.

The advantage of OOP is its consistent modularity from the lowest level of the individual functions upwards to the complete project. Machine functions can be developed, tested, added, exchanged – individually or in groups. And when not used, an option can be hidden.

MODULAR AND FLEXIBLE THROUGH OOP

Parts of an application (machine functions) can be modularly assembled and easily tested. Once created, they can always be reused.
Using the Industry 4.0 and Smart Factories approach, small mechatronic units with their own processing intelligence are networked with one another in a flexible complete system. The LASAL Machine Manager enables the clear display of individual software projects. It also regulates the communication between distributed intelligences in a multi-CPU solution: Who can exchange which data with whom? The system configuration can therewith be customized and expanded at any time with optional function units (e.g. handling robots).

**CLEARLY AND QUICKLY TO THE APPLICATIONS SOFTWARE**

Graphic representation of the software components in LASAL encapsulates the complexity of the project and enables clear structuring of the software.

**Application Modules Ready-to-use**
The motto is "Program less – just configure". In extensive libraries, tested function components (classes) are available. In addition, ready-to-use application modules called „Add-Ons“ are provided. This simplifies engineering enormously.

**Comfortable Debugging**
The rapid development and comprehensive analysis of programs is possible with the integrated debugging tools, such as setting breakpoints, online diagnosis in the network, value changes directly in the network, sending entire command chains with parameters or the first diagnosis without confrontation with code.

**MACHINE MANAGER: FOR DISTRIBUTED INTELLIGENCES**

Using the Industry 4.0 and Smart Factories approach, small mechatronic units with their own processing intelligence are networked with one another in a flexible complete system. The LASAL Machine Manager enables the clear display of individual software projects. It also regulates the communication between distributed intelligences in a multi-CPU solution: Who can exchange which data with whom? The system configuration can therewith be customized and expanded at any time with optional function units (e.g. handling robots).

**OPC UA**

LASAL supports the OPC UA communications protocol. Standardized, manufacturer and platform-independent data exchange in a future-oriented intelligent control network of machines and systems can thus be easily implemented.

**HOT FACTS**

**CONSISTENT DEVELOPMENT**
All automation tasks unified in one software environment

**MODULAR OBJECTS**
that can be flexibly applied and reused

**CLARITY**
via graphic representation and efficient extras like the Machine Manager

**SUSTAINABLE CODE**
through the use of tested encapsulated function blocks with clear interfaces outward

The LASAL Machine Manager has the data flow for multi-CPU concepts well in hand.
LASAL CLASS
PROGRAM CONTROLS WITH OBJECT ORIENTATION

With LASAL CLASS, object-oriented programming is child's play. A consistent operating concept, graphic representation and ready-to-use function modules bring you quickly to your goal – whether the control task is simple or complex.

With LASAL, user-friendliness is the focal point. You should be able to use the advantages of object-oriented programming, such as modularity and simple reusability, without having to come into contact with the complex syntax. The code reads like conventional structured text and you can therefore concentrate on the implementation of the methods (functions). That saves a lot of time and worry.

WORK WITH OBJECTS

With object-oriented programming, the various components of a machine or system are represented in the form of objects. Behind each object, is a class. It is the blueprint of the object and defines the program code and the corresponding data elements. Each class can assume a specific task, for example, measuring and evaluating a temperature, regulation of a valve or controlling a conveyor belt. The classes defined by the programmer are stored in clearly organized libraries.
SUPPORTS MANY PROGRAMMING LANGUAGES such as ST, LD, SFC, ANSI-C, Interpreter

SIMPLE REUSABILITY of encapsulated objects (machine functions)

PREDEFINED SOFTWARE TEMPLATES for frequently used machine functions in extensive libraries

SHORT DEVELOPMENT TIMES through the graphic hardware editor, scripting, Matlab Simulink, debugging tools etc.
The real-time operating system maintains control over the tasks to process and ensures that all objects are processed exactly within the specified time slot. The user is also provided with three different task priorities: Real-time, Cyclic and Background.

Everything Under Control

The communication between the objects is based on client-server technology. This means that the client requests a service, which is provided or processed by the connected server. Read and write instructions are sent over ONE connection. Through this event control, a program component is only then active when it is "initiated". Unlike conventional systems, the CPU load can be considerably optimized.

Using inheritance, an object class can be duplicated and refined or specialized. Inheritance describes a relationship between a general class (base class) and a derived class. A derived class inherits the properties of the base class, but can be modified or expanded with additional information such as attributes or operations. Through aggregation (grouping), individual classes can be combined into a complex class. Tested classes can be clearly stored in libraries and combined into complex program structures using the toolkit principle.

The complex class "Heating Zone" is made into a concrete object with defined interfaces through integration into the network (via drag & drop). In technical jargon, this is called instancing.

The interior of the complex class "Heating Zone" consists of the base class "PID Regulator", which via aggregation (grouping), is made into a complex class with additional classes.
With the techniques "inheritance", "derivation" and "aggregation", it is possible to implement new versions of machine components with minimum programming.

Example
Transport route for goods with three sequential conveyor belts: each conveyor belt is driven by a motor, which has start and stop conditions and a cylinder at the end that pushes the package further. Three classes are therefore modeled: motor and cylinder control, as well as conveyor belt (start/stop conditions). Through aggregation (grouping), a complex class "Conveyor Belt Unit" can be created from these three classes.
In pure procedural programming, data or variables are managed separately from code. The missing definition, such as how the interaction between code and data is processed can lead to defective programs.

With object-oriented programming (OOP), code and data are combined into logical units and shielded from the outside world, so that unwanted influences are prevented.

What advantage does encapsulation bring? Every programmer knows the problem of sloppily implemented programming, where variable descriptions are across the project so that the effects of a change are practically unforeseeable. Completely different from OOP: Here, this variable is only manipulatable via corresponding methods. Clear interfaces are therefore predefined.

Graphic representation provides operator ergonomics with object-oriented programming. Using drag & drop, a class is integrated into the object network from the project tree. An instanced, real object is therewith constructed. The objects need only be connected to one another and an
Through graphic representation, you get a complete overview of the project at a glance: the functions, the relation between objects, the data traffic and the interfaces. Complex relationships are therefore more transparent and easier to check or change.

application is generated. LASAL CLASS creates all declarations and function bodies automatically. As a user, you must only program the individual methods, without having to worry about the declaration syntax.
The source code files in LASAL are not managed in databases. Instead, they are stored in a folder structure as pure text files (file system). This allows a simple connection to version management systems.

The version management allows multi-project and multi-user project structures for working in larger engineering teams: modules or program components can be developed separately and then combined into a complete whole. This increases the flexibility and the time to market cycles are shortened.

With LASAL, the actual program code of an object is implemented in the conventional program languages: structured text (ST), ladder diagram (LD), graphic sequential function chart (SFC) and instruction list (IL) – all four in compliance with the IEC 61131-3 norm – as well as ANSI-C and interpreter. The object-oriented programming methods are therefore available as an integrated extension of the trusted languages.

**LASAL Supports Matlab Simulink**

In Matlab Simulink, existing C code models can be directly inserted into LASAL. During import into the engineering tool, the C code is packed into a class automatically. Input and return values are defined by the user; LASAL generates the code automatically. Possible changes in the model can be made in Matlab Simulink and reimported into the LASAL project with the push of a button.

Whether ST, LD, SFC, IL or ANSI-C – you can program in the language that you are familiar with.
The hardware editor is a comfortable tool, which significantly reduces the development and programming time of applications. In addition to the tree display, it is also possible in the graphical editor to reproduce the hardware components analogous to the real control cabinet configuration. This enables simple and efficient project design, parameterization and diagnosis of the hardware elements connected to the control, such as I/Os, interfaces or drives for example. In addition to the hardware, the topology of the bus structures can be well represented with the graphical editor.

Diagnostic statements can be made with the hardware editor during active operation. Via the colored background, whether modules are in error status is visible at a glance. The online diagnosis is even possible up to the individual I/O points.

Finding and inserting a module is comfortably solved in the hardware editor. Possible control configurations can be run realistically. While comparing the configuration in the LASAL project with the actual hardware in the control, possible deviations are identified.

HARDWARE EDITOR SIMPLIFIES I/O PROJECTS AND DIAGNOSTICS
The data analyzer allows a real-time display of signal curves with an additional history function. The view can be toggled between trends and the classic oscilloscope display (with or without tracing). Individual bits can also be recorded from bit fields. Start and stop triggers can also be set and a hold function is integrated.

ONLINE DEBUGGER

With the online debugger, functions such as setting breakpoints and conditional breakpoints, scan counters, single-step processing and forcing are provided. Possible program errors can therewith be found quickly.
The feature VOV “Visual Object View” provides the ability to use objects from LASAL SCREEN with all their properties in the programming environment LASAL CLASS. The user can connect visualization objects and the corresponding program code to units. This has the advantage that especially in multi-user project structures, frequently used machine components such as a temperature regulator for example, always look the same – regardless of which software engineer works on the project. With the VOV, system components can be configured offline and visualized or tested over an online connection. Predefined VOV files such as initial start-up or parameterization of axes, controllers and timers can be integrated or edited. Naturally new, individual VOV elements can be created easily and quickly.

With the “PlcTraceView” tool, the time behavior of a project can be recorded. This tool is used to analyze, diagnose or measure the time of the task behavior.

LASAL SERVICE

Whether cross-platform data exchange, simulation, loading software updates or worldwide remote access for diagnostics and maintenance – the LASAL SERVICE tools make your life easier: see page 30.

ADVANCED DEBUGGING TOOLS

LASAL provides comfortable tools for online diagnostics and testing.

- File Commander
  File operations to/from the control
- RAM Image
  Save/restore remnant data
- PLC Trace View
  Recording of a project’s time response
- PLC Backup & Restore
  Save/restore files and remnant data in the control
“Less programming – more configuring” ist die Rezeptur für den Erfolg moderner Technologie-Werkzeuge wie LASAL. Sie erhalten unterstüzt bei der Implementierung Ihrer Maschinen- oder Systemsoftware mit fertigem Software- und getesteten Funktionenkomponenten, die eine breite Vielfalt von Maschinen abdecken.

**Function Blocks**
Die umfangreichen LASAL-Bibliotheken enthalten beispielsweise Funktionen wie PID-Regler, Temperaturüberwachung, komplexe Filter und Regulierungsalgorithmen, verschiedene Bewegungsmodule und Robotikkinematik oder Kommunikationsprotokolle wie Modbus TCP.

**Add-Ons**
In der LASAL Maschinen-Manager Add-Ons sind auch verfügbar, die neben den fertigen sequentiellen Steuerungsprojekten auch die passende Visualisierung enthalten. Beispiele hierfür sind Benutzer- und Rezeptorverwaltung, Ereignisseprotokoll oder Datenauswertung.


**EXAMPLES OF READY-TO-USE FUNCTION COMPONENTS & ADD-ONS**
- **Control Modules**
  - PID regulator, operating mode manager, filter algorithm
- **Access Control**
  - Login function and implementation of access authorizations
- **Data Analyzer**
  - Oscilloscope for recording multiple channels
- **Robot Kinematics**
  - Delta, SCARA, portal
- **Industry-specific Templates**
  - Synchronous feed, pick & place, print mark detection, unwinding, separating and grouping
SOFTWARE VARIANTS WITH A BUTTON PUSH

1 PROGRAM – ANY NUMBER OF VARIATIONS

Starting with a base project, different variations of an application can be managed in one project with the variant editor.

With a simple mouse click, variants can be activated or deactivated. Changeable for example are connections, I/O assignments or initialization values. The relationships between the individual objects can be configured as desired via so-called connection files. Since each variant is an independent file, recompiling is unnecessary. The active configuration need only be loaded into the control.

SCRIPTING: AUTOMATICALLY CREATE PROGRAMS

Based on the encapsulated software component of the OOP, various machine configurations can be easily modeled from a base project. The corresponding software can be automatically generated using the scripting language Python. Similar to the generation of parts lists, the program for the specific machine or system can be generated with the push of a button via scripting.

Example

A customer orders the base type A of a machine. With this type A, he would like to have the optional functions 1, 3, 6 and 7. The application software for this specific machine can be created fully automatically, without requiring the software engineer to manually change a program line. For this purpose, the library containing predefined classes is accessed, which contains all different modules. Starting with the basic program, the specific modules are selected for type A, the desired special functions for the options then added and the fitting application program generated with the push of a button.

BASE PROJECT
MACHINE TYP A

OPTIONAL MACHINE FEATURES

SCRIPT
CUSTOMER-SPECIFIC

SOFTWARE
CUSTOMER-SPECIFIC

SCRIPTING

AUTOMATICALLY CREATE PROGRAMS
FLEXIBLE
Visualization for all HMIs from SIGMATEK

PRACTICAL
Easy export and import of project components and graphics

CLARITY
Manage any number of languages in a project; text lists for translation purposes

PRACTICAL FEATURES
Alarm and event management
Operating and monitoring are essential components of every automation task. With LASAL SCREEN, a comfortable tool for hardware-independent visualization design is provided.

**SIMPLE – WITHOUT PROGRAMMING KNOW-HOW**

With LASAL SCREEN, programming knowledge is not required for creating the visualization. The user defines the variables in LASAL CLASS, which are then available for the visualization. A LASAL SCREEN project can visualize data from multiple LASAL CLASS projects.

**GRAPHIC OBJECTS**

LASAL SCREEN also offers the option, as in LASAL CLASS, to combine objects into complex “graphic objects” via grouping. Each graphic object can be linked to an object in LASAL CLASS.

Individually created objects can be placed and scaled as desired and referenced to a corresponding LASAL CLASS object. The display and operation of a temperature regulation zone, for example, is defined only once and then reused for any number of regulation zones.
With the LASAL SCREEN editor, you can easily create the visualization of your application in the corporate design of your company. For project development, design templates and a large graphic library are available. In addition, it is also possible to import existing or self-defined graphics (bmp and jpg). Through the definition of a global image and the individual images derived therefrom, the project development time can be significantly reduced.

Export and Import Project Components
Project components such as images, text lists or variables can be selectively exported and imported. User-defined libraries with reusable elements can also be created as required.

Many Features Available
In addition to numerous input elements, LASAL SCREEN offers the user a variety of functions such as alarm management, event logbook, trend display, bar diagrams, recipe management etc.
**CLEVERLY CONVERT LANGUAGE AND UNITS**

LASAL SCREEN can manage any number of languages in one project. Text information is entered in the form of ASCII or Unicode. Individual languages from one project can be reinstalled separately via text lists into an existing machine.

Text lists can be switched in online mode, whereby the units of measurement can be changed. For example, the length in "mm" is automatically converted to "inches". The programmer does not have to worry about unit conversion in LASAL CLASS, as all system values are available in the LASAL base unit.

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<th>Language Settings</th>
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<tr>
<td>Length</td>
<td>mm</td>
</tr>
<tr>
<td>Speed</td>
<td>mm/sec</td>
</tr>
<tr>
<td>Weight</td>
<td>kg</td>
</tr>
<tr>
<td>Temperature</td>
<td>kg</td>
</tr>
<tr>
<td>Pressure</td>
<td>pound</td>
</tr>
<tr>
<td>Deutsch</td>
<td>English</td>
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**CLEAR TEXT MANAGEMENT**

To integrate the appropriate label onto graphic elements such as softkeys for example, text lists are provided. Any number of lists with individual names can be created. Each text list can be exported separately, edited – for translation into a different language for example – and reimported into the project. The reusability, clarity and simple handling of the texts are thereby increased.

**VISUALIZATION UNDER WINDOWS**

With the DotNetKernel, or "Kernel" in short, the user can visualize individual machine data under Windows. The visualization project created in LASAL SCREEN is interpreted in the Kernel and displayed.

All visualization elements integrated into the LASAL SCREEN editor are supported by the DotNetKernel. Additionally, the entire scope of the Microsoft .NET framework is also available. The integration of user-defined elements, as well as the connection to networks, data banks, Internet, MS Office, e-mail etc. is thereby simplified. The DotNetKernel is based on the .NET framework 3.5 and is implemented in C# using the graphic framework WPF (Windows Presentation Form).

**USER-DEFINED GRAPHIC AREA "MYIO"**

With "MyIO", the user can specify screen areas in which self-defined visualization elements such as special diagrams can be comfortably integrated. The programmer is thereby supported with completed interfaces – e.g. touch events, redraw method.
LASAL MOTION simplifies the integration of motion control into the machine and system concept. Predefined, hardware-independent motion templates support you in the modular and yet, fully integrated development of your drive design.

The object orientation enables thinking in drive trains and mechatronic units, which can be flexibly combined depending on the application. LASAL MOTION is seamlessly integrated into the PLC programming and project development tool LASAL CLASS. In addition to the performance, the availability of the machine or system thereby increases.

Efficient Motion Control
Axial movements can be executed using simple data inputs or instructions without any programming. In LASAL CLASS, there are predefined parameter sets for the SIGMATEK DIAS drives and motors – that saves a lot of time, since only user-specific data has to be modified. Alternatively, you can of course store individual parameter sets.

SHORT START-UP AND DIAGNOSTIC TIMES
With the "Motion Diagnostic View", axes can be comfortably parameterized and started. Commands can be quickly sent and troubleshooting is simple. Graphical representation provides operating comfort and clarity. Start-up and diagnosis of the drive components are also reduced significantly.
AXIS MOVEMENTS
without programming

PLUG & PLAY
Extensive library with motion templates

EFFICIENT FEATURES
such as Data Analyzer, Motion Diagnostic View, CAM Designer

MOTION CONTROL
independent of the hardware
The SIGMATEK DIAS Drives contain an internal data analyzer, with which all configuration and controller data can be collected at a scan rate of up to 62.5 µs. This data is recorded in the converter in real-time. With the software tool, they can be displayed in one and the same screen view for analyzing and optimizing the controller behavior.

Current, rotation speed and position controller are displayed in the software graphically. All respective control parameters are visible at a glance and can be set individually. The controller can therefore be quickly and easily optimized. The configuration data of the drives are stored in the control system. The drive therefore always has the current parameters and an exchange is possible without effort and a software tool.
The LASAL MOTION library provides a broad selection of predefined objects and templates for typical motion functions. Motion control tasks can therefore be comfortably implemented, without having to be programed.

The spectrum ranges from simple one to complex multi-axis applications: positioning, cam discs, contouring control with transformations for robot kinematics, CNC functions and synchronization of up to nine axes in a space. Jerk-limited motion profiles or dynamic safety zone monitoring is also included.

Application technicians can simply integrate the fitting motion components or templates in their project and after setting a few parameters, start the application directly or run a simulation.

Whether synchronization of axes in a space, CNC code or complex robot kinematics – all motion functions can be easily simulated.
Safety applications can be easily programmed and configured with the SAFETYDesigner fully integrated into LASAL.

Comfortable and fast – that is how you can implement your Safety application with the LASAL SAFETYDesigner. An extensive library with function blocks is available, with which Safety-oriented processes can be easily configured. You select the appropriate function blocks such as "emergency stop" or "operation mode select switch" then place and wire them in the network.

Numerous Safety Function Blocks
In addition to certified standard function blocks such as logical, timer, trigger or counter, the library includes numeric and many typical, complex Safety function blocks – based on the PLCopen standard. Counted among these are for example, functions such as emergency stop, muting par, two-hand control or guard locking.

Flexible Concepts
In the SIGMATEK Safety concept, multiple Safety controllers with I/Os can be designed and managed per project. Machine options can be administered in one project.

Effort Minimized
The simple operation of the LASAL SAFETYDesigner and clear representation of the project reduce the time and effort for programming, maintenance, diagnostics and especially validation.

SAFE MOTION
With the LASAL SAFETYDesigner, Safe motion such as "Safe Position" or "Safe Speed" for example, can be implemented comfortably.

In the LASAL SAFETY library, numerous function blocks are provided. This increases programming comfort.
INTEGRATED
Simple programming & configuration of the Safety controller

READY-TO-USE SAFETY FUNCTION COMPONENTS
based on PLCopen standard

HIGH COMFORT
Comfortably create logic operations and I/O configurations

ONLINE-STATE DIALOG
Download, online monitoring and debugging via online interface
The LASAL SAFETYDesigner offers the same operating comfort as LASAL CLASS. In the graphical editor, function blocks, as well as in and outputs can be freely placed via drag & drop from the project tree. Connections of 2-channel functions are made in the network – also via drag & drop. With the SAFETYDesigner, a connection to a function-oriented control can also be made.
DEBUGGER INTEGRATED

The integrated debugger graphically displays all values and the signal flow. It is also possible to force inputs, outputs and constant values.

LOGIN AND PROGRAM DOWNLOAD

All online actions of every Safety controller available in a project are centrally listed in the online state dialog. Included in these actions are for example, login, error cancelling or downloading. In addition, status information from the Safety controller as well as diagnostic messages from inputs and outputs are displayed.

With the SAFETYDesigner, a safety-oriented application can also be implemented for the S-DIAS Safety system as stand-alone solution.
**LASAL32.DLL**

The LASAL32.dll provides the user with interfaces, through which control data can be accessed and changed in Windows programs.

**FTP CLIENT & SERVER**

The FTP server provides a folder in the control, in which CPU program files can be stored or read. These files can be retrieved by a SIGMATEK CPU or a third-party device with an FTP client function.

**VNC CLIENT & SERVER**

SIGMATEK controls support VNC server and VNC client functions. For tablets and smart phones, there are free client apps. The SIGMATEK VNC server has a repeater extension. Data exchange with controls that are protected by firewalls is therefore possible. VNC client and server thereby form a connection to a repeater, which performs the data exchange.
Whether cross-platform data exchange, simulation, loading of software updates or worldwide remote access for diagnostics and maintenance – LASAL supports you with efficient tools.

LARS SIMULATIONS TOOL

The LASAL Runtime System (LARS) provides a Windows-based simulation of control programs and visualizations, with which LASAL applications can be run without physical hardware. Application areas:

- Test system for application design
- PC-based visualization system

WEBSERVER WITH LRM VIEW

LRMView is an add-on software (Java-Applet) for the control system. It provides the option to display or control the on-site visualization with a standard web browser (password protected). This has the advantage that no additional software must be installed in the computer. The control can therewith be remotely serviced and operated from any PC with an Internet connection.

OPC UA CLIENT & SERVER

The OPC Unified Architecture communications protocol enables manufacturer and platform-independent data exchange, which makes a good choice for implementing Industry 4.0 concepts. OPC UA functions according to the client-server principle and is supported by LASAL. In LASAL CLASS the user can define which process data can be read or written.

BOOTDISK MANAGER

With the Bootdisk Manager integrated into LASAL CLASS, updating the software version of a machine is child’s play: simply configure the boot stick, insert it into the control or upload it via online remote maintenance and reboot. Depending on the configuration, the application, visualization, operating system, firmware, configuration or desired files can be updated.
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