



## COMBIVIS studio 6 INTEGRATED DEVELOPMENT ENVIRONMENT

The intelligent automation suite from KEB combines an assistant-guided component selection, fieldbus configuration, drive parameterisation, IEC 61131-3 project generation and motion control.

Throughout the planning and layout phase, implementation of control sequences and multi-axis movement profiles, to start-up and fine tuning, the user is supported by a tool developed by experienced application engineers. With a foundation built on libraries, devices and template databases, rapid and simple solutions can be generated for a wide range of applications.

# COMBIVIS STUDIO 6

## FREELY CONFIGURABLE TOOLBAR

and system information

## PROJECT ORGANISATION

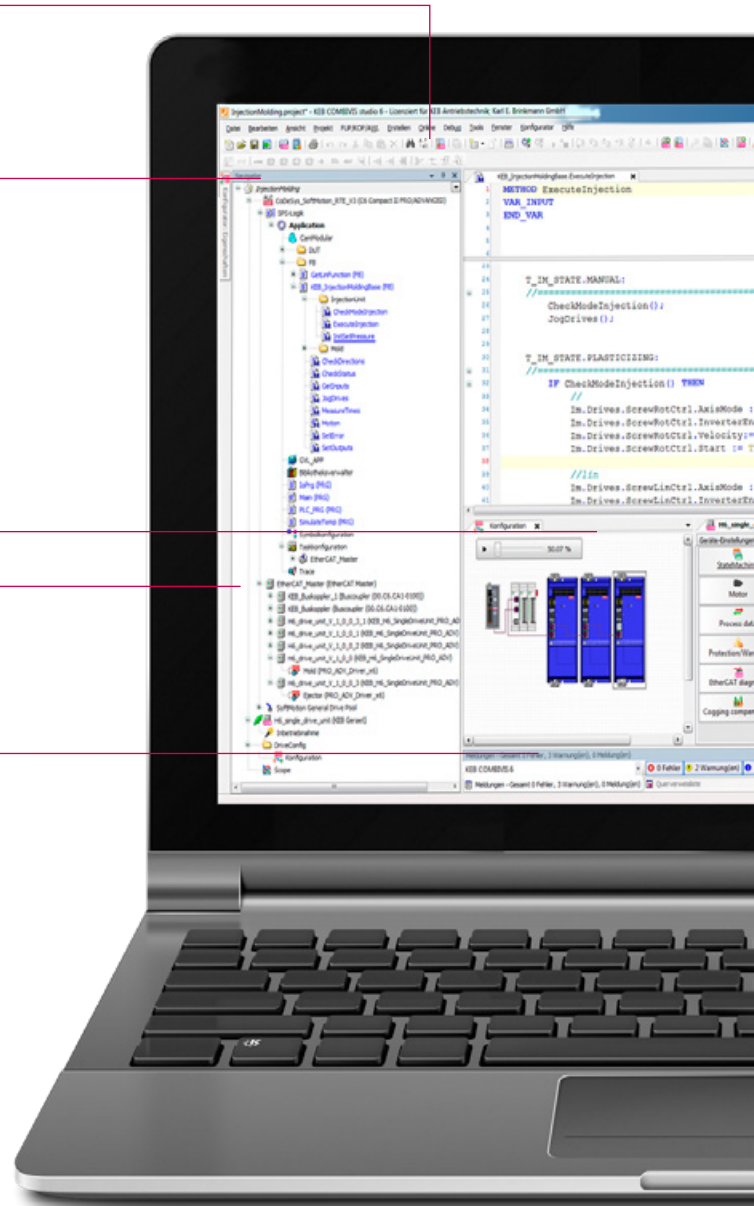
and application planning

## SYSTEM CONFIGURATION

## FIELDBUS CONFIGURATION AND DIAGNOSIS

Drive parameterisation  
Multi-channel oscilloscope

## CROSS REFERENCE LIST



In KEB COMBIVIS studio 6, IEC 61131-3 application development and drive parameterisation are combined into an efficient engineering tool for individual automation solutions.

The software allows easy access to programming to IEC 61131-3, and thus lays the foundations for independent and future-oriented source code with flexible choice of programming languages. Users benefit from comfortable "SmartCoding" with tools for declaration, error diagnosis, debugging and online data analysis.

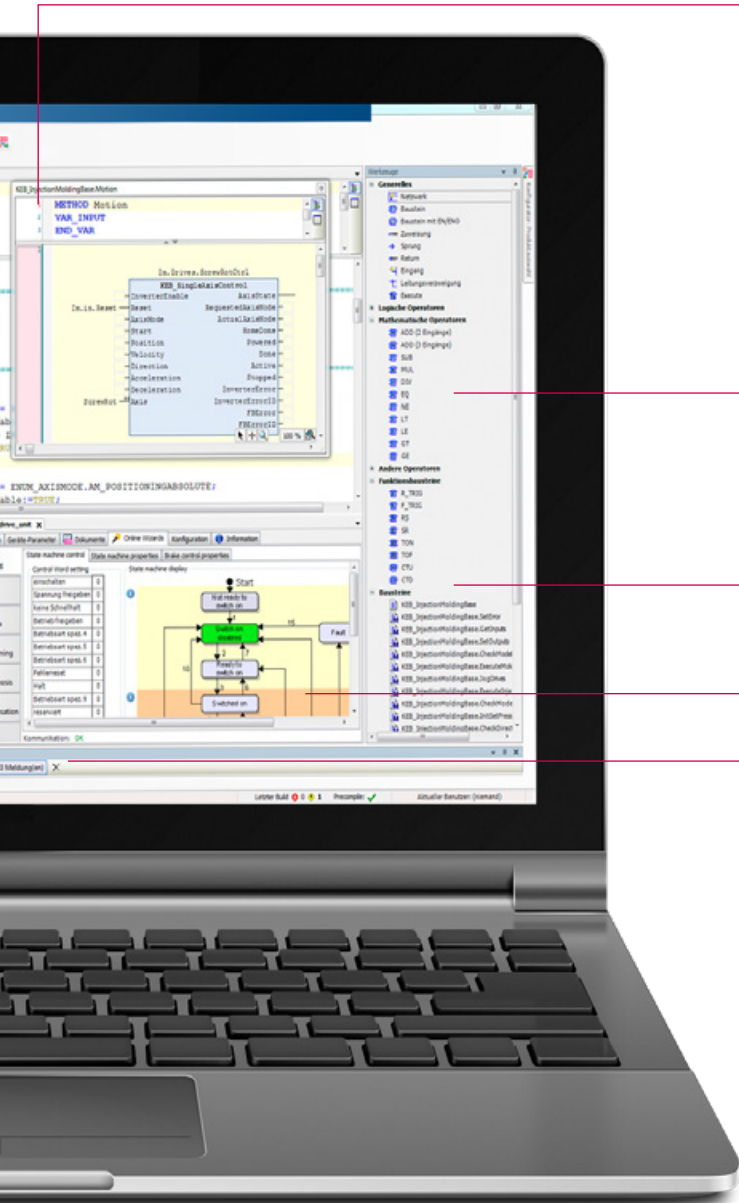
Access to the KEB database also results in time-saving access to operating instructions, technical drawings and datasheets for project production and documentation.

With the KEB Utilities, we offer direct access to motion programming for real-time compatible, synchronized action drives or even multi-axis systems.

Integrated editors provide support for profile production in the sectors of cam discs, electronic gears, angle synchronization and the integration of G codes. KEB COMBIVIS studio 6 simplifies both simulation and visualisation of movement processes in the office environment, together with start-up and plant optimisation on-site.

Intuitive start-up assistants, digital 16-channel oscilloscope, tools for data backup and recovery, and extensive expert tweaks for optimised fine tuning of systems, complete the engineering software from the development of automation to after-sales service.

OBJECT-ORIENTED PROGRAMMING



STANDARD IEC LIBRARIES

APPLICATION LIBRARIES

COMMISSIONING ASSISTANTS

MESSAGE WINDOW



HIGHLIGHTS

- IEC 61131-3 application development
- Device and library database
- Product configuration
- Start-up and diagnosis assistant
- COMBIVIS studio HMI integration
- Document database

## AUTOMATION WITH STANDARDS

The screenshot displays the project tree for a COMBIVIS studio 6 PLC project. The hierarchy is as follows:

- COMBIVIS studio 6
  - PLC (C6 Compact II PRO/ADVANCED)
    - COMBIVIS studio HMI project
      - PLC Logic
        - Application
          - CNC settings
            - CNC
            - CamCurveSlave1
            - CNC
          - Global
            - DataServer
            - ExternalFile
            - GlobalVariableList
            - ImagePool
            - Symbol Configuration
            - PersistentVars
          - POU
            - DUT
              - Alias1
              - ENUM\_1 (ENUM)
              - Structure1 (STRUCT)
              - Union1
            - Interface1
          - Languages
            - ContinuousFunctionChart (PRG)
            - FunctionBlockDiagram (PRG)
            - InstructionList (PRG)
            - LadderLogicDiagram (PRG)
            - SequentialFunctionChart (PRG)
            - StructuredText (PRG)
          - Types
            - Function1 (FUN)
            - MyClass (FB)
            - PLC\_PRG (PRG)
          - Library Manager
          - Task Configuration
            - DataServerTask
              - DataServer\_PRG
            - EtherCAT\_Master
              - EtherCAT\_Master.EtherCAT\_Task
            - MainTask
              - PLC\_PRG
          - Trace
        - EtherCAT\_Master (EtherCAT Master)
          - KEB\_H6\_SDU (KEB\_H6\_SingleDriveUnit\_PRO\_ADV)
        - EtherCAT\_Master (EtherCAT Master)
          - master\_drive (KEB\_S6K\_generic (MDP))
          - slave\_drive\_1 (KEB\_S6K\_generic (MDP))
          - slave\_drive\_2 (KEB\_S6K\_generic (MDP))
          - KEBIO\_ETHERCAT\_Bus\_Coupler (KEB\_Buscoupler (00.C6.CA1-0100))
            - KEBIO\_ETHERCAT\_DO\_16\_500MA (KEB\_DO 16 0.5A (00.C6.CB1-0500))
            - KEBIO\_ETHERCAT\_DI\_32\_1MS (KEB\_DI32 1ms (00.C6.CB1-0200))
            - KEBIO\_ETHERCAT\_EXTENDER\_2\_PORTS (KEB\_Extender 2 Port (00.C6.CF1-0100))
            - KEBIO\_ETHERCAT\_Bus\_Coupler\_1\_1 (KEB\_Buscoupler (00.C6.CA1-0100))
        - SoftMotion General Drive Pool
          - master\_drive (KEB Device)
            - Parameter list
            - Start-Up
          - slave\_drive\_1 (KEB Device)
            - Parameter list
            - Start-Up
          - slave\_drive\_2 (KEB Device)
            - Parameter list
            - Start-Up
        - CONFIG
          - Configuration

- CNC program...
- CNC settings...
- COMBIVIS Scope...
- COMBIVIS studio HMI project...
- Configuration...
- DUT...
- External File...
- Global Variable List...
- Image Pool...
- Interface...
- KEB Parameter list...
- Library Manager...
- POU...
- Text List...
- Unit conversion...
- Visualization...

- Application...
- Cam table...
- CNC program...
- CNC settings...
- Data Server...
- DUT...
- External File...
- Global Variable List...
- Image Pool...
- Interface...
- Network Variable List (Receiver)...
- Network Variable List (Sender)...
- Persistent Variables...
- POU...
- POU for implicit checks...
- Recipe Manager...
- Symbol Configuration...
- Text List...
- Trace...
- Unit conversion...

The screenshot shows the software interface with a graphical plot and a data table. The plot displays 'master position [mm]' on the x-axis, ranging from 200 to 340. The data table is as follows:

| Property | Value            |
|----------|------------------|
| X        | 131.83723448707  |
| Y        | 117.293240488203 |
| Z        | 0.87110703831789 |
| A        | 0                |
| B        | 0                |

Below the table, there is a 'Slave jerk [slave pos x] (master pos x)' section and a 'Toolbox' with options like 'can edit/starts', 'Select', and 'Add point'. The current user is identified as 'nsabdi'.

COMBIVIS studio 6 was developed so that even complex tasks could be programmed with ease. For example, simply right-clicking with the mouse adds objects, selects object properties and changes their settings. Using the software, users are able to work with standard development environments without further investment. These environments include the robust .NET framework.

Because KEB uses the same basic framework as Microsoft Visual Studio, worldwide language support, a standardised user interface, data access and Internet applications are already integrated. Working with the standardised languages of IEC 61131-3 clears the way for reusing previously developed code in future projects.

Because PLC Open Motion Control is used as the motion design standard, compatible devices which support clearly defined movement function blocks can be used. This continuity creates the basis for programming codes which are truly manufacturer-independent. The concept is flanked by faster engineering due to shorter integration and the reuse of already programmed codes.

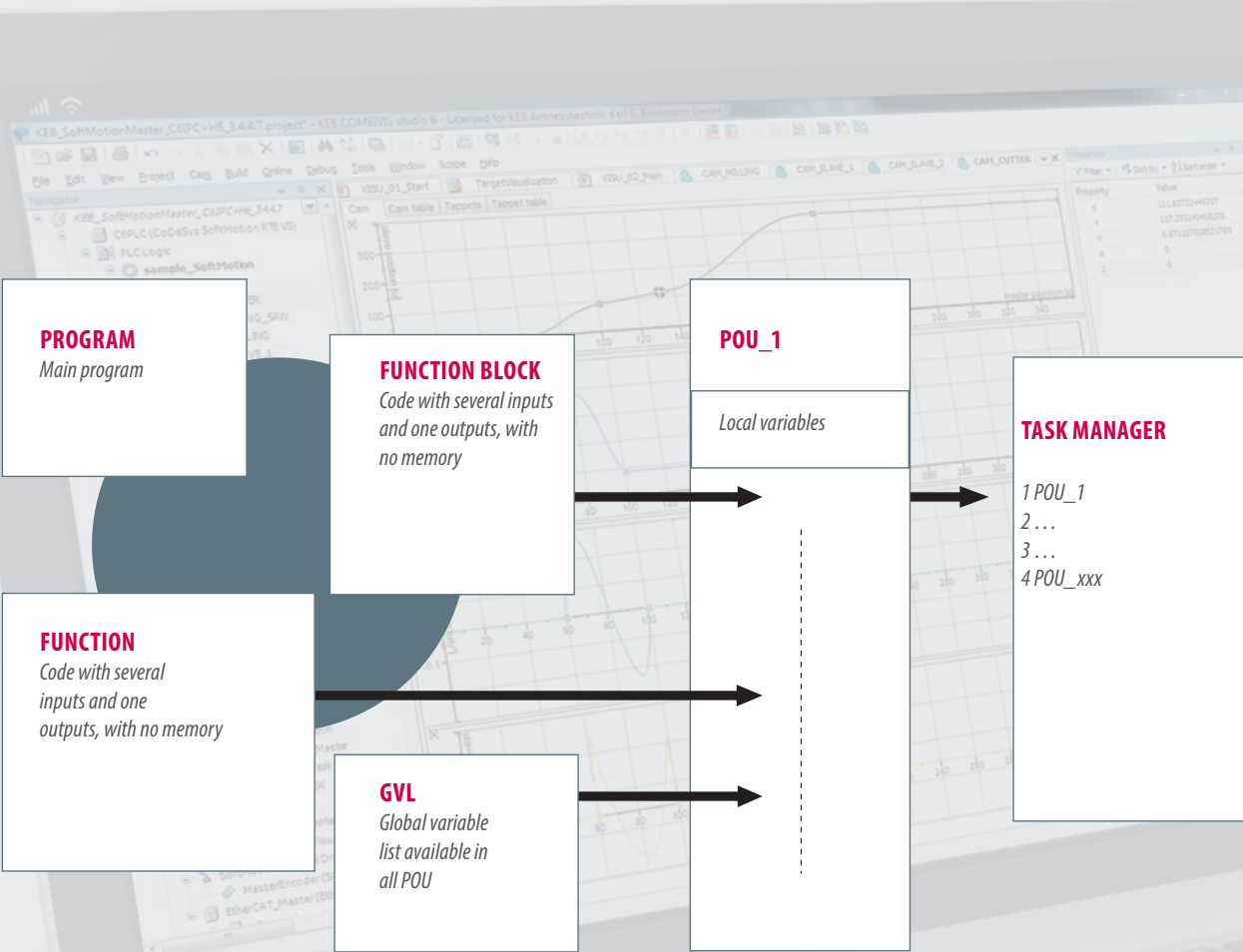
Designed for industrial automation, COMBIVIS studio 6 offers everything users need for programming control systems - including know-how protection. Our software securely encrypts the project codes running on the devices so that no one can read the process knowledge behind them at a later date.

For efficient, time-saving engineering, again source code must be archived in a way which allows later processing to re-use the original library and compiler versions without time-consuming searching. For example, when, during future maintenance and upgrades, a technician needs direct access to the control system on site, the password-protected archive will be directly available in the device memory.

The platform applies a user-friendly project navigator for this work, which allows simple access to multiple devices and the definition of data exchange between these. Directories for organizing all objects, user-defined toolbars, keyboard shortcuts and standard Windows functions such as Search and Replace, are just some examples of this user-friendly development environment...



IEC 61131-3: AUTOMATION WITH STANDARDS



## IEC 61131-3 EDITORS

The development level of COMBIVIS studio 6 offers flexible programming possibilities, complete on-line and off-line functions, compilers and components for configuration, visualisation and diagnosis. Thanks to user feedback, all editors are designed practically for simple and time-saving use. The KEB software uses the international standardised programming languages of IEC 61131-3 as a basis:

- Ladder Diagram (LD)
- Function Block Diagram (FBD)
- Instruction List (IL)
- Continuous Function Chart (CFC)
- Sequential Function Chart (SFC)
- Structured Text (ST).

In both on-line and off-line mode, the code can be switched between LD, FBD and IL at the press of a key - and is then converted automatically. Functions, actions and methods are supported and can be programmed in a different language from the higher-level program organisation unit (POE). Function blocks and commands can be accessed directly or via drag and drop from a toolbox.

In addition, COMBIVIS studio 6 offers intelligent input assistants, automatic fill-in functions and expanded IntelliSense functionality. Context-sensitive commands are available in development of the application by right-clicking with the mouse or by automatic production of language concepts. There are no POE limits within the platform - only the hardware resources set the limits.



### HIGHLIGHTS

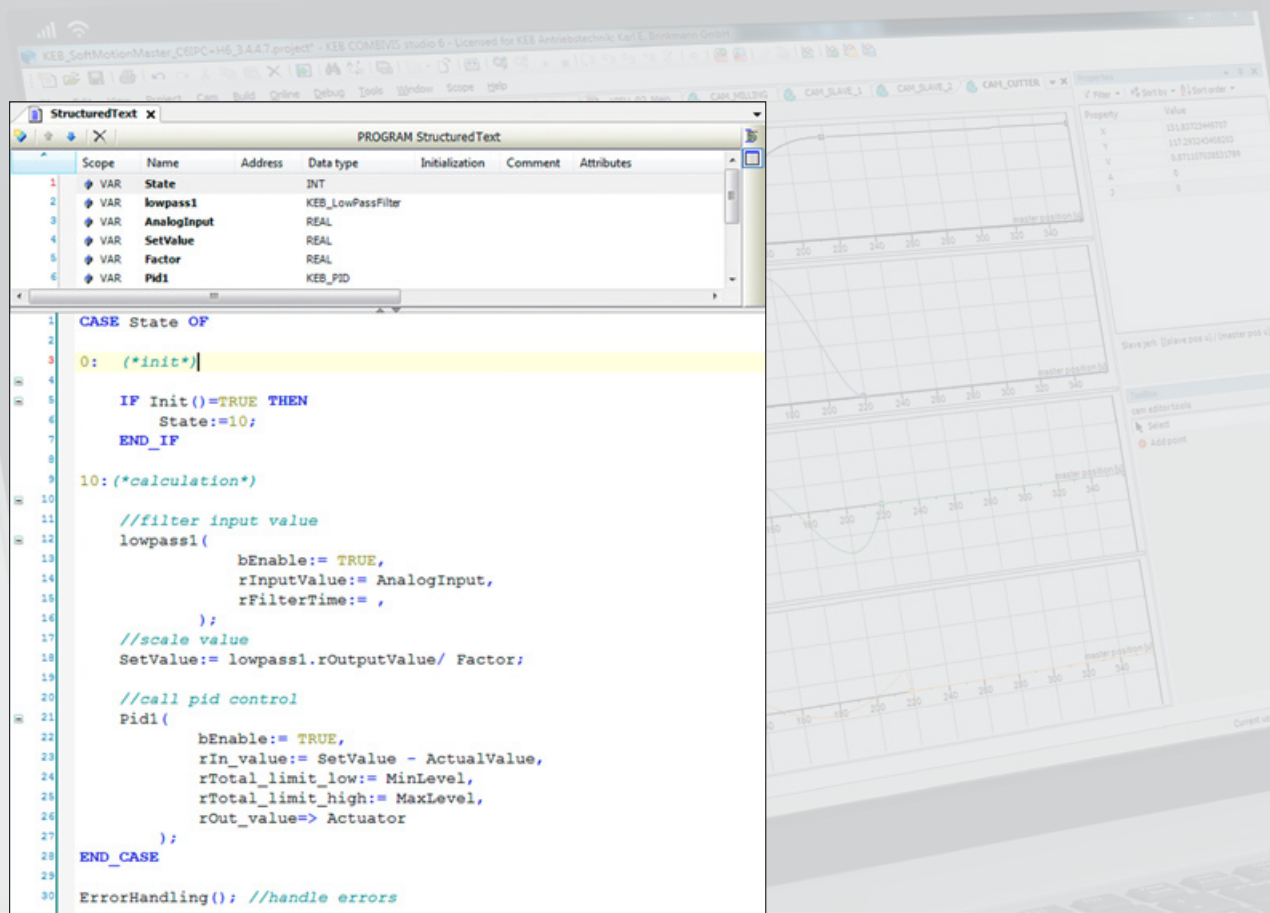
- The six most common programming languages worldwide
- Object-orientation at high language level
- Extensive toolboxes and standard libraries
- Modern Smartcoding functions



## STRUCTURED TEXT (ST)

Thanks to the high-level language concept, Structured text (ST) of IEC 61131-3 is mainly recommended for programming loops, state machines and process sequences. If programmers are already familiar with languages such as "C", "PASCAL" and "BASIC", they quickly become familiar with ST because the editor offers functions already known from other high-level language tools.

For example, if an IF code block must be produced, the editor automatically adds the necessary END\_ and includes the code place in the block, so that the next code line can be entered. If the programmer places the cursor on the IF keyword, the associated END\_IF is automatically highlighted which makes programming of long nested conditions much easier. In addition, code blocks can be flipped open and closed by simply clicking on the "-" or "+" symbols on the left next to the initial instruction.



Structured Text (ST)



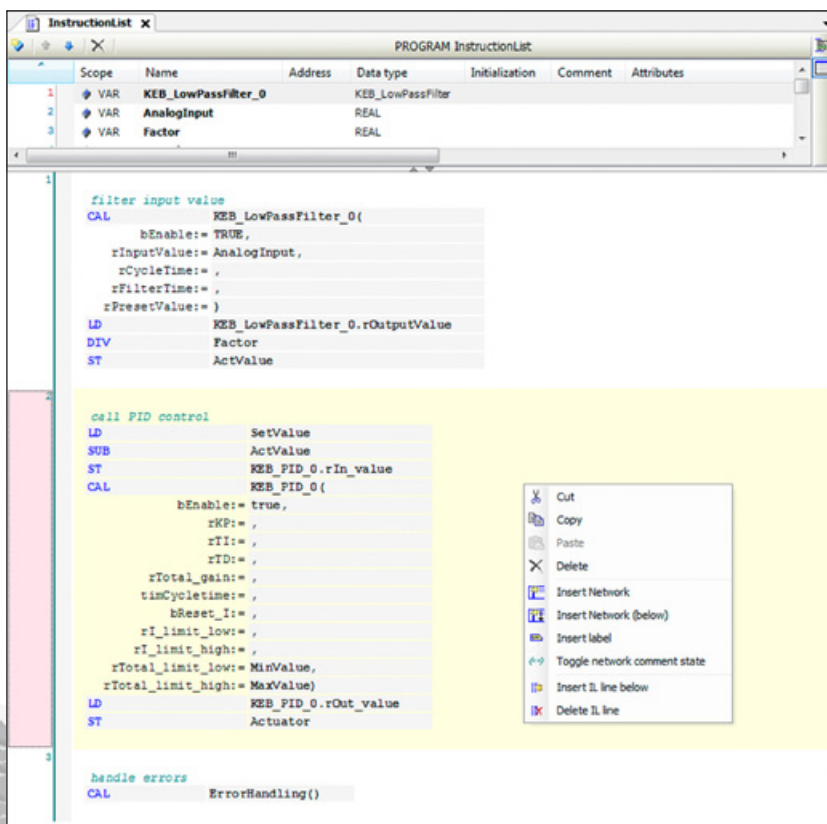
## HIGHLIGHTS

- Compact program code
- Programming of loops, state machines, process sequences
- All advantages of a modern high-level language

## INSTRUCTION LIST (IL)

The Instruction list (IL) in IEC 61131-3 is one of the best-known programming languages because it has been used since the very beginning of automation. IL is a simple language based on an Accumulator-Load-Save model. In each process, first via the LD command, a value is loaded into the accumulator and then the desired process is retrieved.

This result is then written to the accumulator and can be stored in a variable via the ST command. The IL Editor supports all IEC 61131-3 operators, irrespective of whether the processes have one or more inputs and outputs. As in the other standard languages, commands, negations, jumps and set/reset commands are available.



Instruction list (IL)



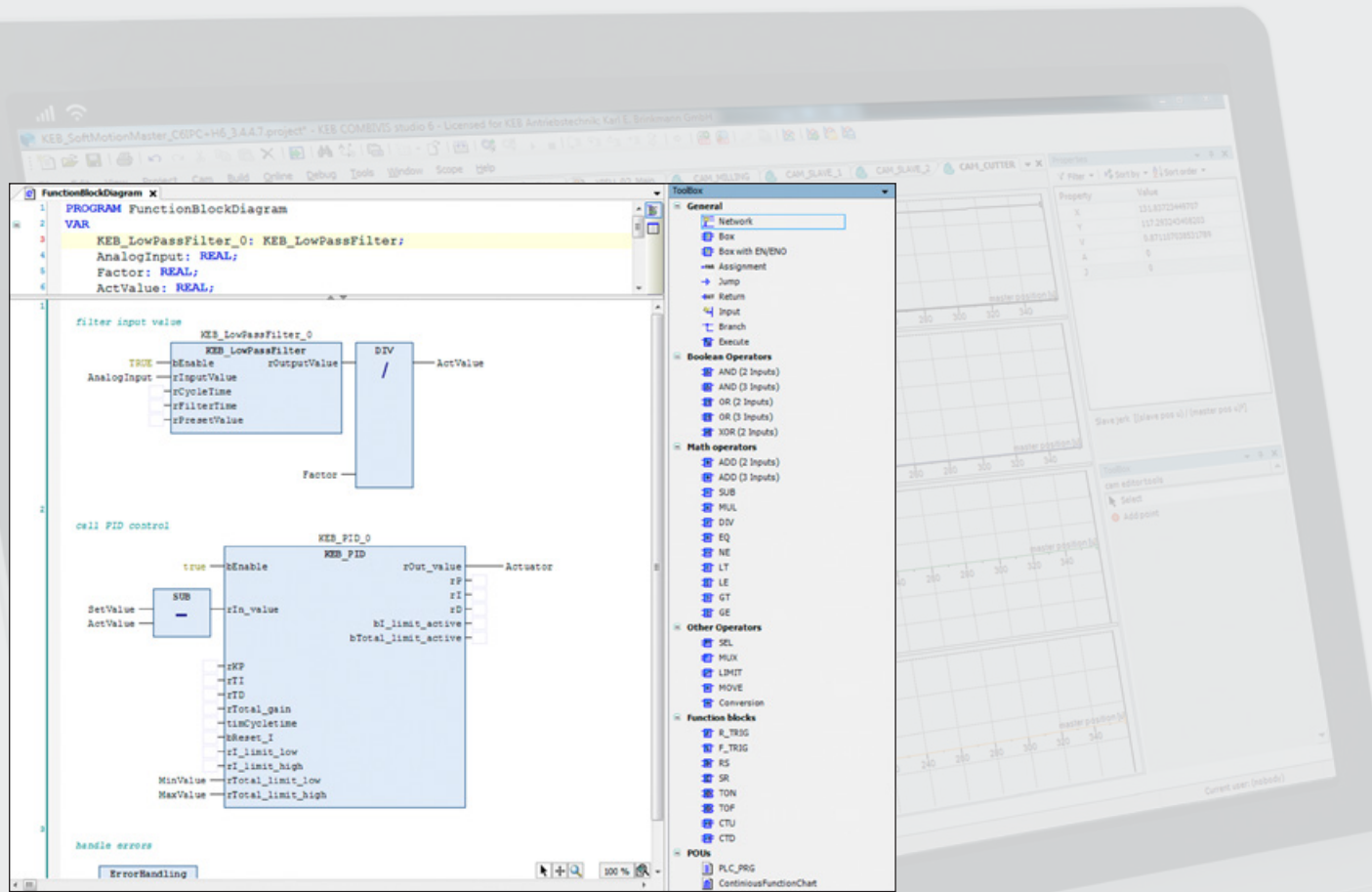
### HIGHLIGHTS

- Machine-level assembler language
- Register commands and jumps
- Retrofit applications

## FUNCTION BLOCK DIAGRAM (FBD)

The graphic editor of the Function block diagram language (FBD) is a combination of a step-like Ladder diagram and a compact function block diagram. If the user inserts a new element, the connecting lines are reated automatically. The FBD toolbox also allows programming by drag-and-drop.

Inputs can be defined or negated without additional function blocks for rising or falling edges. Outputs support set, reset and jump configurations. As in the LD editor, an activation input (IN/INO) can be added to the function block so that this is only executed if desired.



Function block diagram (FBD)



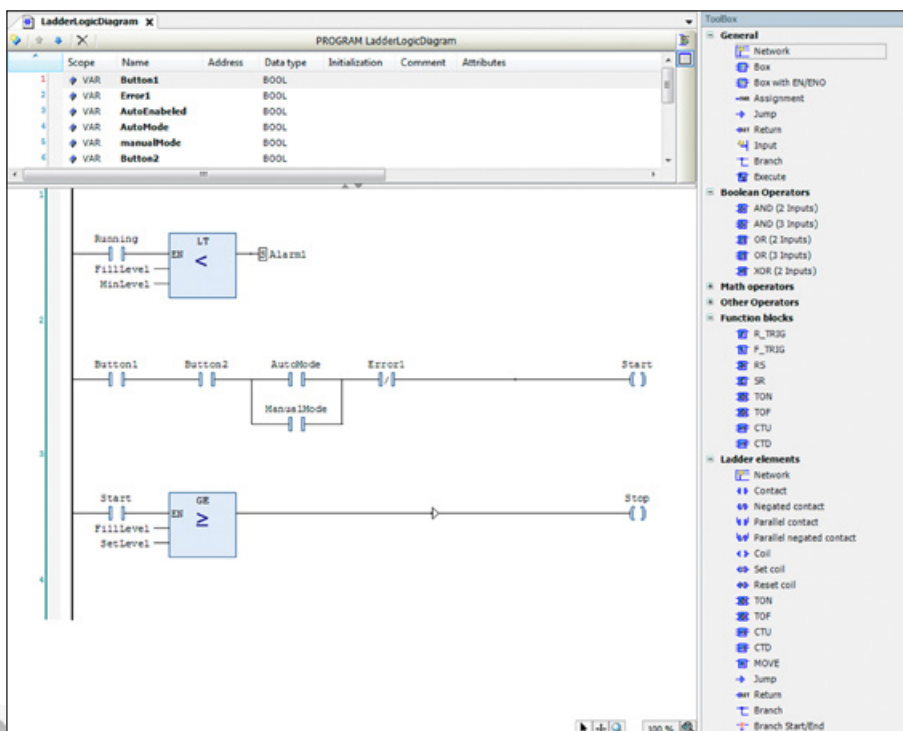
### HIGHLIGHTS

- Programming by drag-and-drop
- Clear graphic design
- Compact function block depiction

## LADDER DIAGRAM (LD)

Also known as contact logic or relay logic, Ladder diagram (LD) shows the code as electrical circuits. The easy-to-follow depiction of contacts and relays makes LD popular with control system programmers in particular. Boolean expressions are shown by the connection of relay contacts with coils from the "Power Rail" on the left to the "Common Rail" on the right.

A function-rich toolbox divided into Boolean, mathematical and logic operators, allows the programmer to use the KEB control system as a standard PLC - but with the performance ability of a programmable automation controller.



Ladder diagram (LD)



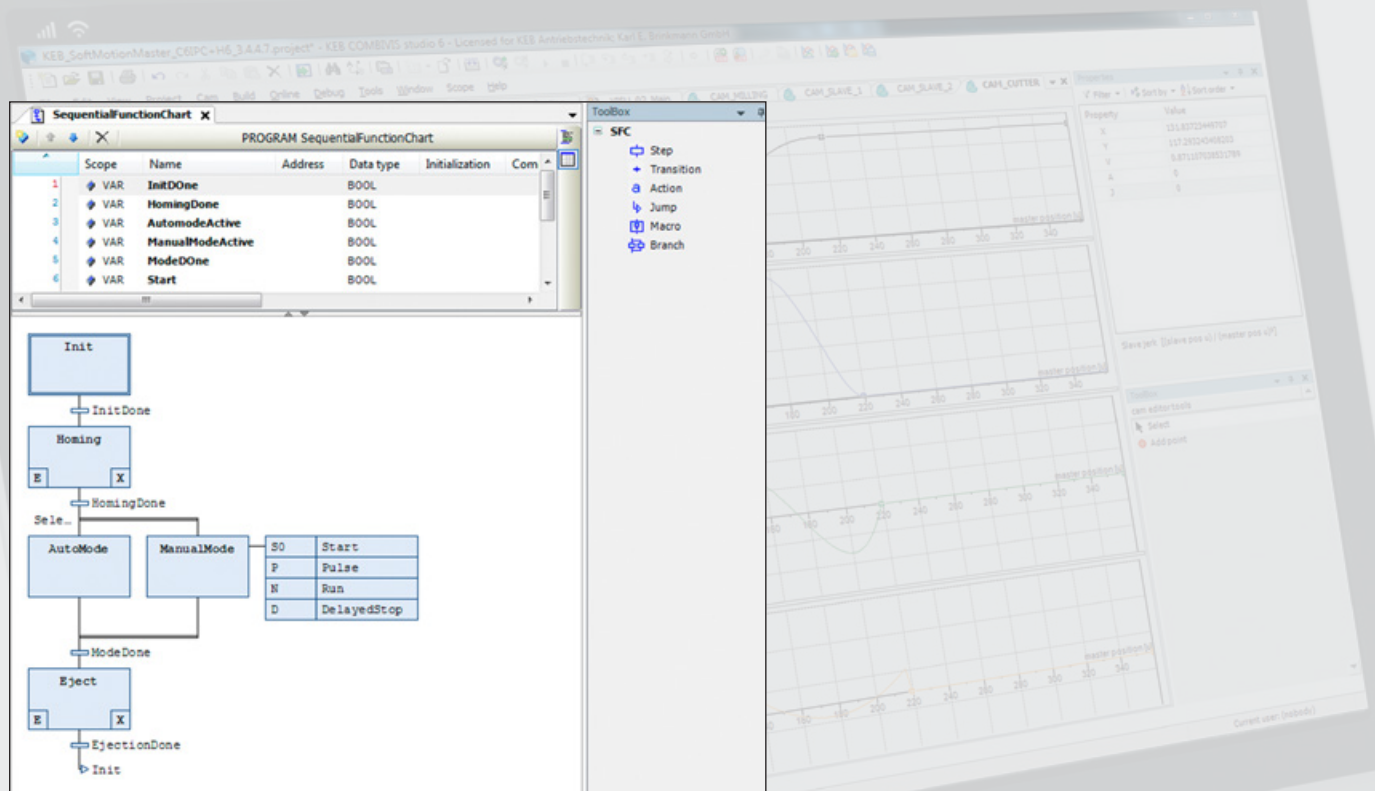
### HIGHLIGHTS

- Graphic, network-oriented
- Boolean terminology and switch conditions
- Perfect for I/O handling

## SEQUENTIAL FUNCTION CHART (SFC)

As a graphic language, Sequential function chart (SFC) in practice takes the form of a flow diagram. The tasks of a programming sequence are clearly broken down and shown as individual steps or blocks of program code. Defined actions are performed in the steps as long as the step is active within a program run-through.

Sequential function chart is used to define transitional conditions which must be resolved during the transition from one step to the next. Several steps can be performed in parallel or in alternative branches. The programming language can be selected independently between step and transition. KEB's SFC editor supports all instructions defined by the IEC standard for programming steps in sub-programs and transitions.



Sequential function chart (SFC)



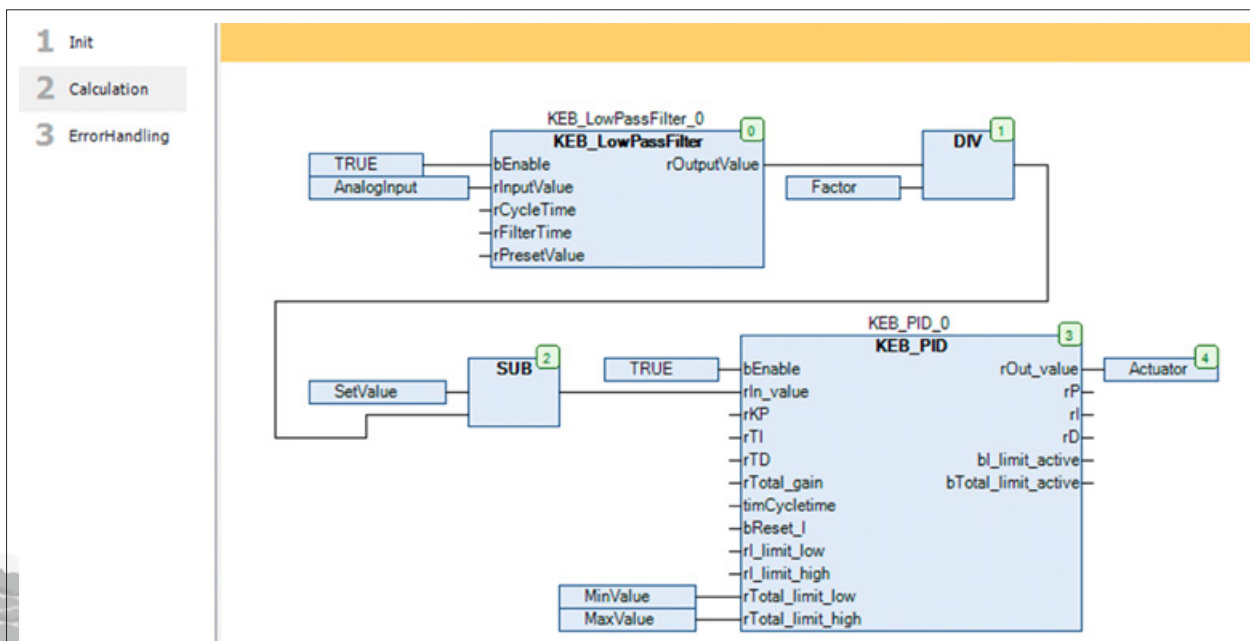
### HIGHLIGHTS

- Graphic state machines
- Definition of steps and transitions
- Programming of source codes of subprograms possible in any language

### CONTINUOUS FUNCTION CHART (CFC)

Continuous function chart (CFC) is primarily a different implementation of the Function block diagram (FBD). In comparison to other step-based editors, the CFC user can also program continuous connections, for example feedback loops. The connection between inputs, operators and outputs are not automatic but the result of individual programming. The execution sequence can be adapted so that the user always retains complete control of the program.

This is indicated by small green figures in the top right-hand corner of each function block. The toolbox contains common tools such as comments, set/reset outputs, negation and jumps. In general, as a graphic language within IEC 61131-3, CFC lays the foundation for developers to depict their code in the best visual form. Automatic instance recognition and connections between preselected pins are also available.



Continuous function chart (CFC)



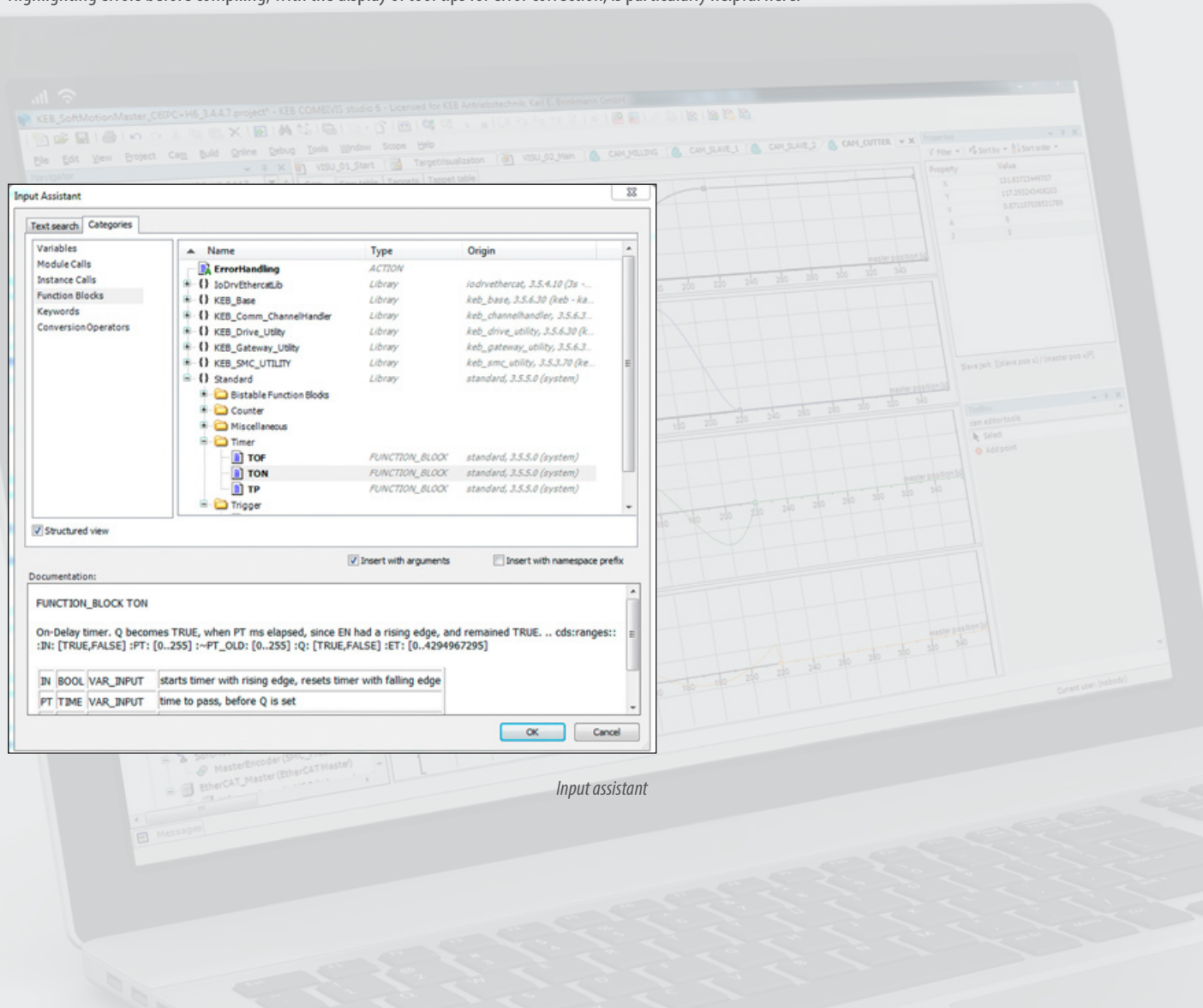
#### HIGHLIGHTS

- Flexible graphic layout over entire drawing surface
- Cross connection and feedback options
- Perfect for regulator structures and interlinked modules

## SMART CODING

KEB's COMBIVIS studio 6 automation platform offers the programmer numerous assistance systems. For example, the input and auto-declaration assistant shows the modules currently available and inserts these in compliance with the syntax. Thanks to functions such as auto-formatting, indentation, automatic code completion and syntax highlighting, KEB shortens the engineering times and at the same time makes it easier for beginners to learn IEC 61131-3 programming.

Highlighting errors before compiling, with the display of tool tips for error correction, is particularly helpful here.

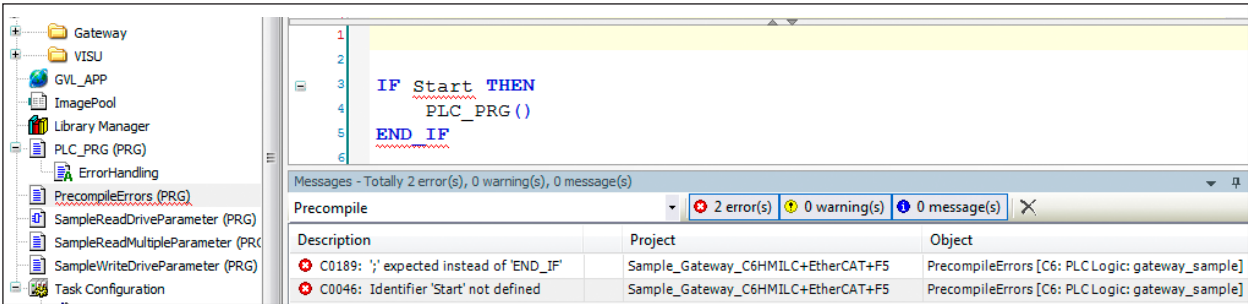


Input assistant



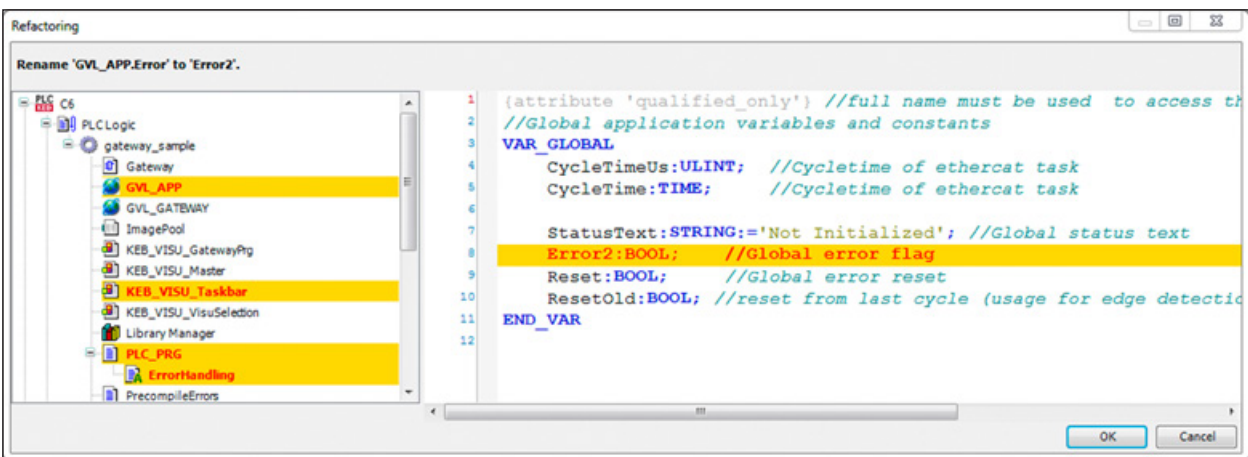
## HIGHLIGHTS

- Input assistant with automatic declaration, completion and formatting
- Static analysis
- Syntax and error highlighting
- Refactoring
- Project comparison



Error Highlighting

Via static analysis, the project can be checked for unused variables or duplicated memory access at any time. Refactoring makes it easier to change object-related module names and update programming standards at a later date.



Refactoring



## DEBUGGING AND WATCHING

In order for the programming developed in engineering to function securely in practice, intensive test routines are necessary. The function scope of COMBIVIS studio 6 includes, in parallel to user-friendly programming tools, powerful tools for debugging and start-up. Even in structurally sophisticated projects with a high number of subprograms and variables, rapid diagnosis and error correction is possible thanks to the debugging and watching function.

Programmable stop points allow step-by-step sequence analysis. The Call stack shows the retrieval order of different program parts. Sequence control allows the variable values for the runtime to be displayed simultaneously for each code line. If a variable is used in several program parts, the cross reference list helps switch directly between all points of use and also shows the access type, line number and declaration location.

The screenshot displays the COMBIVIS studio 6 interface. On the left, the 'Watch 1' window shows a list of variables being monitored, including expressions like 'Cs.gateway\_sample.GVL\_APP\_PD\_NO' and their current values. On the right, the 'Flow Control' window shows a ladder logic program with several lines of code, including a counter increment loop and conditional logic for checking limits and setting errors.

Cross Reference List

Name: bPowerDrives

| POU                | Variable     | Access      | Type | Scope  | Address | Location                                  | Comment |
|--------------------|--------------|-------------|------|--------|---------|---|---------|
| GVL_STATUS         | bPowerDrives | Declaration | BOOL | Global |         | Line 6                                    |         |
| INIT_ENTRY         | bPowerDrives | Write       | BOOL | Global |         | Line 1, Column 1                          |         |
| MOTION             | bPowerDrives | Read        | BOOL | Global |         | Line 16, Column 1 (Impl)                  |         |
| MOTION             | bPowerDrives | Read        | BOOL | Global |         | Line 93, Column 1 (Impl)                  |         |
| MOTIONMASTER       | bPowerDrives | Read        | BOOL | Global |         | Network 1 / Operand 'bPowerDrives' (Impl) |         |
| READYTOSTART_ENTRY | bPowerDrives | Write       | BOOL | Global |         | Line 1, Column 1                          |         |
| RESETERRORS_ACTIVE | bPowerDrives | Write       | BOOL | Global |         | Line 4, Column 1                          |         |

Cross reference list

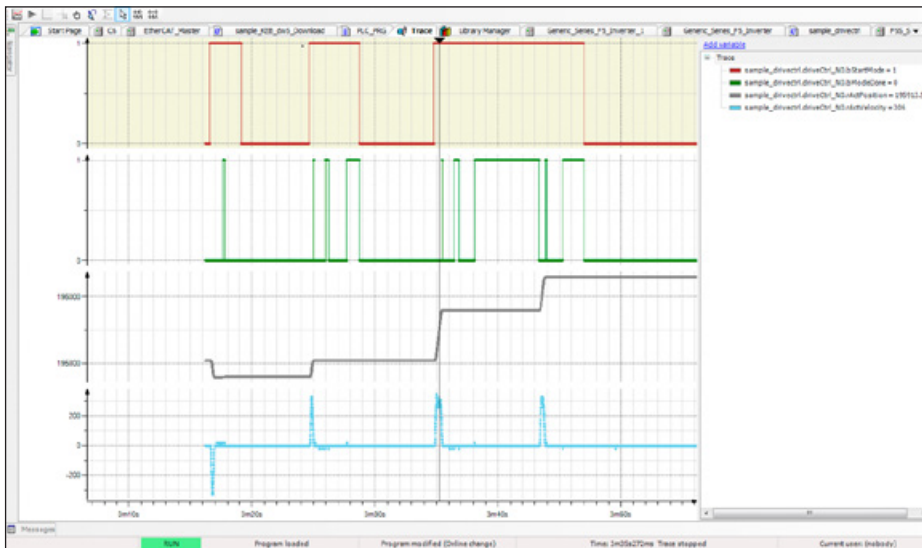


## HIGHLIGHTS

- Read, write and assign values on-line
- Programmable stop points
- Sequence control
- Project comparison
- Call stack
- Cross reference list
- Event logger
- User-defined watching window
- Binary, decimal and hexadecimal switching
- Multichannel trends with trigger function

The trace function is designed for further analysis of multichannel diagrams in a ring memory with cycle precision. This creates the basis for comparing displayed nominal and actual values, or optimising run profiles with simultaneous depiction of position, speed, acceleration and jump.

Arbitrary variable states can also be used as a trigger condition. Each channel is scaled automatically or manually. The value tables can be exported and imported for further processing or back-up.



Trace

Compare options:  Ignore whitespace: OFF  Ignore comments: OFF  Ignore properties: OFF

Compare statistics: 0 addition(s) 0 deletion(s) 6 change(s)

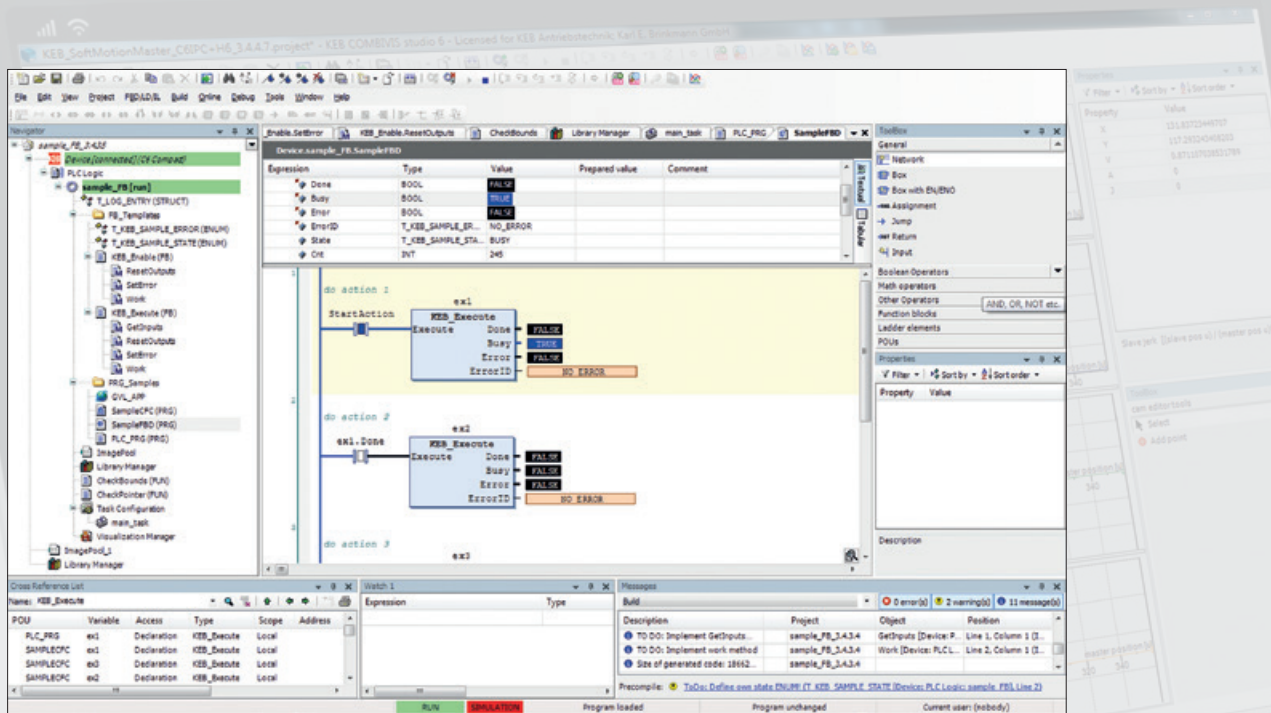
Project comparison

# COMBIVIS studio 6

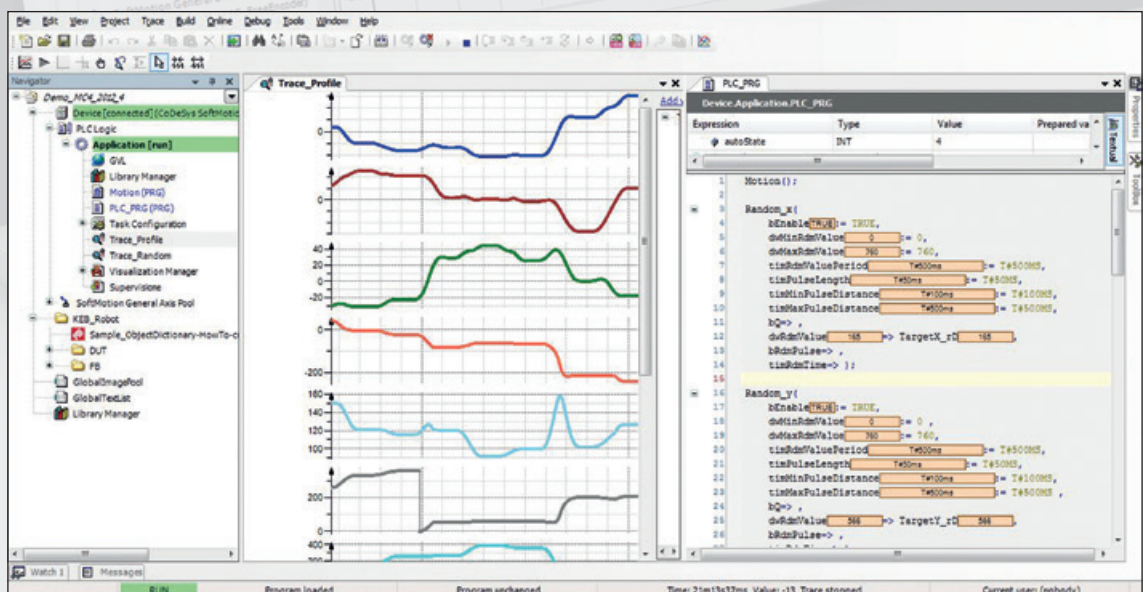
## SIMULATION

Early testing and error location, instead of only beginning code debugging on start-up in the customer's system: because the real hardware is not usually available during programming, simulation tools are more important than ever. They create the basis for concentrating on the performance of the machine during start-up, instead of on the reliability of the software. COMBIVIS studio 6 therefore provides several simulators.

One of these is tailored for PLC logic in which variable values and source code behaviour can be tested and validated. COMBIVIS studio 6 also offers modern tools for simulation of the axis movement on the same PC on which the IDE is located. So the programmer has the opportunity to test not only the PLC logic but also the machine behaviour - even when the motor and communication system are not connected.



Online depiction

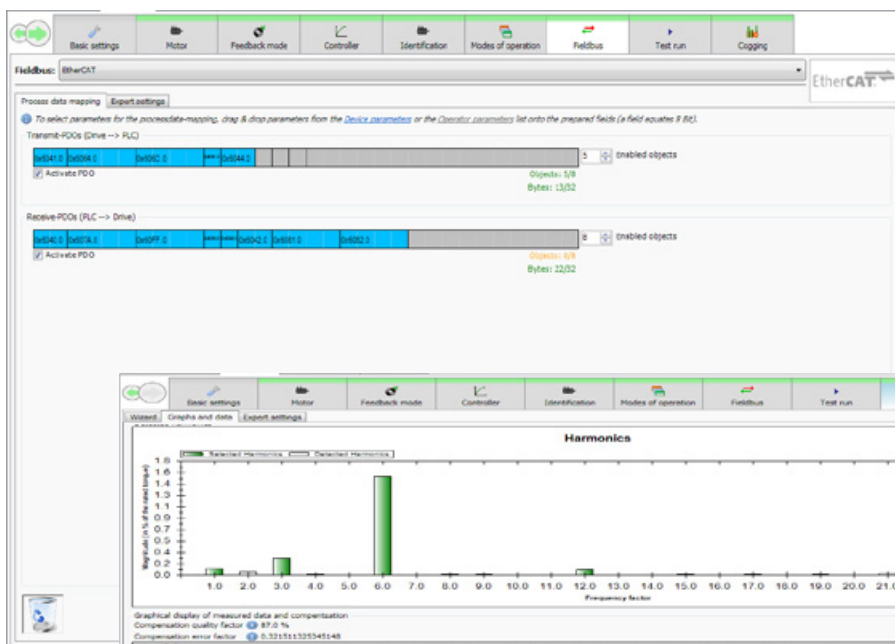


Trace recording

## ASSISTANTS

On-line and off-line assistants are a firm component of COMBIVIS studio 6 - above all to make the engineering easier and quicker. The Motor configuration assistant for example allows access to the KEB motor database, and databases of other manufacturers or programmers. Also third party databases can easily be shared with other COMBIVIS studio 6 users. In addition, the programmers can produce complete process data mapping configurations using the Process data start assistant.

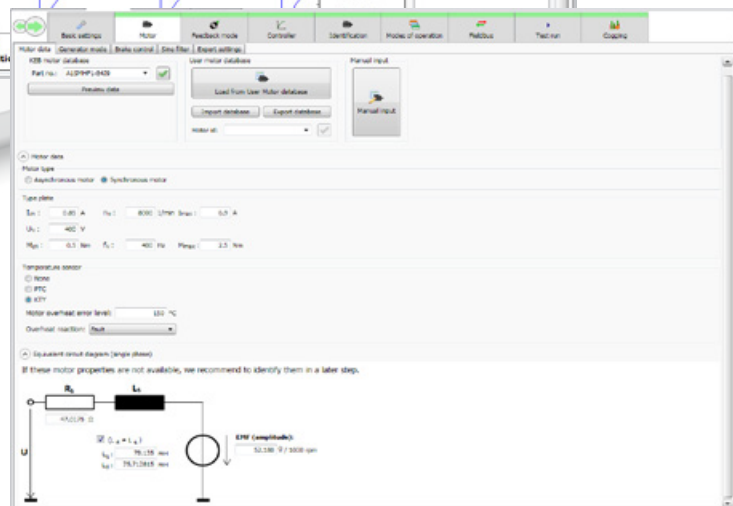
A second example of an efficiency-improving assistant is the Anti-cogging assistant, which was developed using KEB's full experience in the field of movement guidance. The background: in many cases, because of the internal structure and magnet alignment, cogging torque can occur in permanent magnet motors which is transmitted to the control loop and leads to instability or loss of precision. Using the Anti-cogging assistant, the user can effectively eliminate cogging torque in permanent magnet motors.



Process data mapping



Anti-cogging



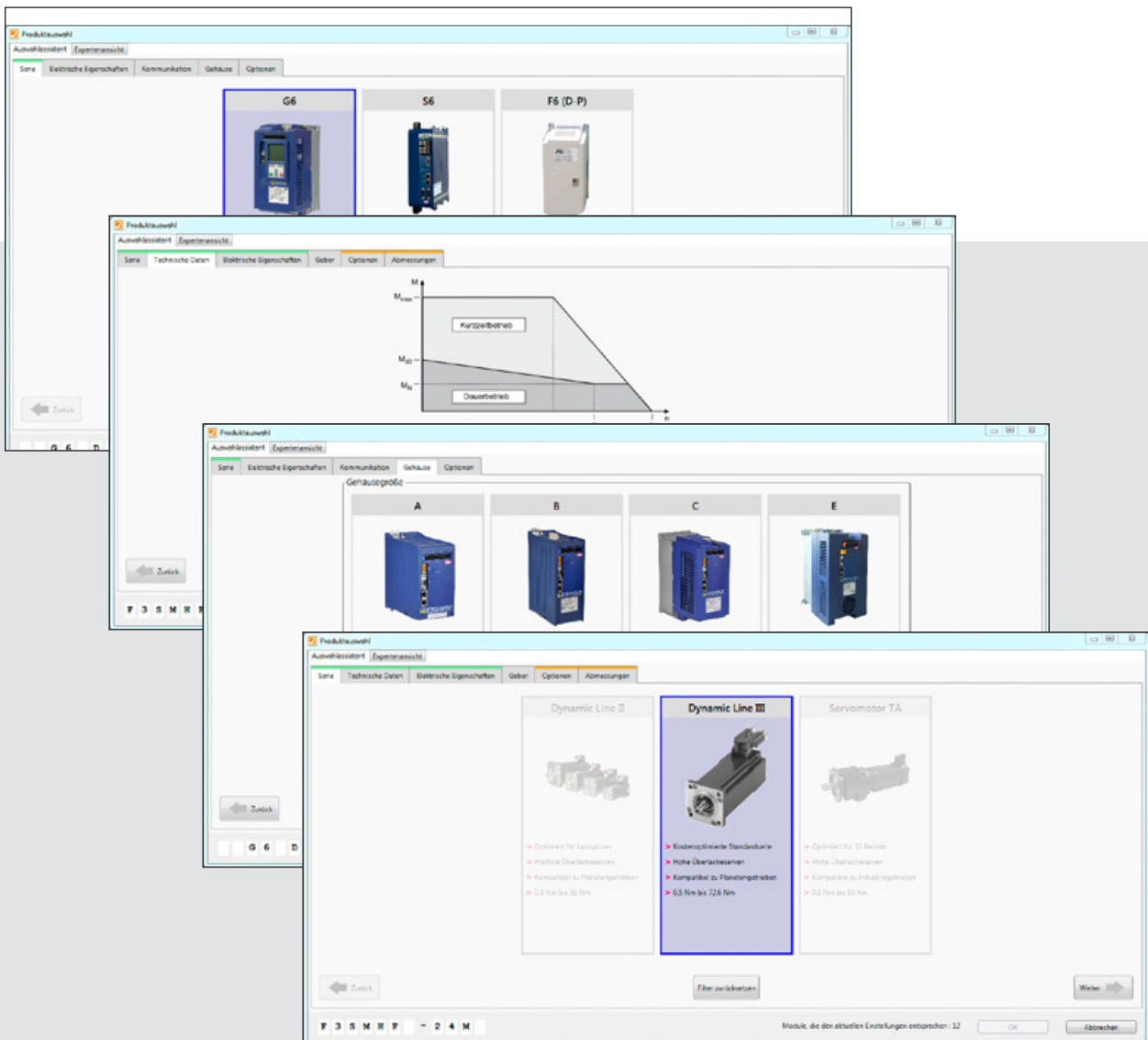
Motor database configurator

## COMBIVIS CONFIGURATOR

The COMBIVIS Configurator is a tool for simple modelling of KEB automation systems. Various assistants and the intuitive graphic user interface ensure comfortable and rapid working. The configuration produced can be used in various ways after completion. Firstly it can be integrated 1:1 into a technical documentation or the parts list for a bid. Secondly, COMBIVIS or COMBIVIS studio projects can be generated from this. The configurator also simplifies access to the technical data and documentation of all devices from the KEB world of drive and automation.

## PROJECT GENERATION

## TECHNICAL DATA





TOOLBOX

DESIGNER

DOCUMENTS



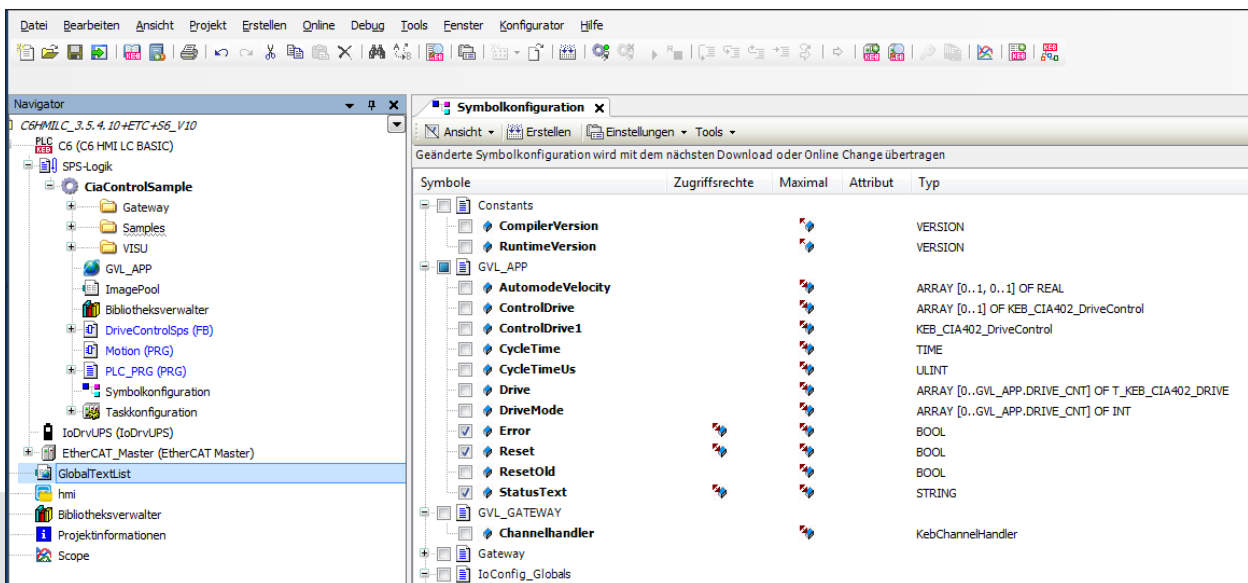
## HIGHLIGHTS

- Access to current product database
- Intuitive assistant for product selection
- Access to technical data and documentation
- Display of all interfaces and connection components
- Extensive export function for parts lists
- Automated project generation

## COMBIVIS STUDIO HMI: INTEGRATED VISUALISATION

With the aim of making professional visualisation as simple as possible, COMBIVIS studio HMI offers an extensive template library, powerful tools, and rapid and direct access to the process variables of the associated controller. At the same time, complex projects call for the facility for parallel processing of control and visualisation projects by several developers, beyond the limits of purely integrated solutions.

By linking visualisation and control projects, COMBIVIS studio 6 allows automated variable and driver exchange and parallel processing in our own SCADA designer COMBIVIS studio HMI.



CONTROL



HMI

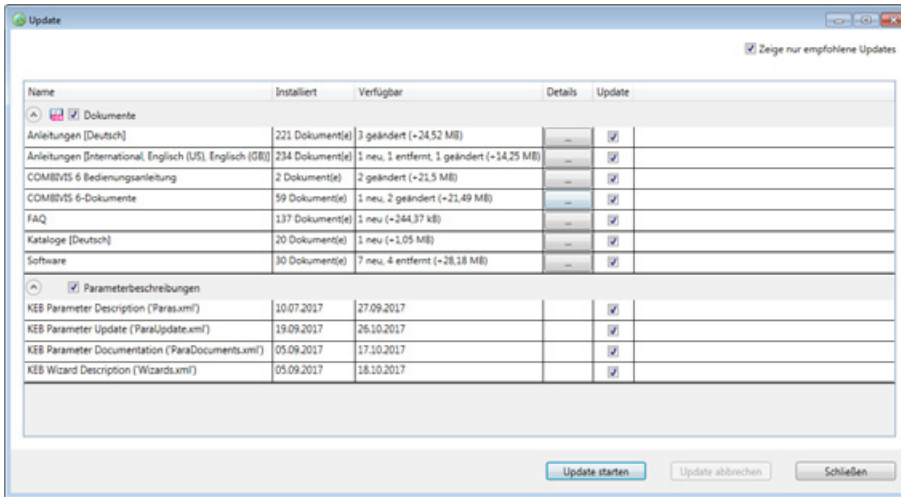


### HIGHLIGHTS

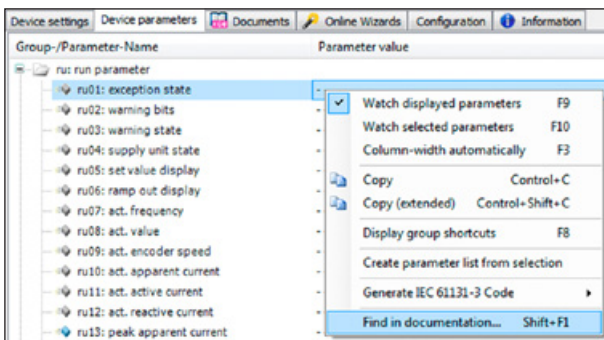
- Automated driver and variable exchange
- Parallel development of HMI and control projects
- One HMI and multiple control sources
- Higher-level archiving possibilities

## DOCUMENT DATABASE - ALWAYS UP-TO-DATE

**Two clicks to documentation:** The KEB document database gives the user a versatile and flexible knowledge database. Individually selected content is then also available off-line, for example during start-up. The database furthermore informs users of program updates and new content which can be updated automatically if required.



Simply right-clicking on a parameter immediately reveals the underlying detailed description. In addition all documents and files belonging to the product can be listed.



The faults are coded according to the following table:

| ru01 | Fault text               | Description  | st01   |
|------|--------------------------|--|--------|
| 0    | no exception             | No error   | 0x0000 |
| 3    | ERROR overcurrent PU     | Overcurrent detection at the power circuit has triggered (e.g. short circuit, power module defective)                            | 0x5400 |
| 4    | ERROR overcurrent analog | exceeded over current level on the control card (e.g. incorrect setting of the controller or the torque limiting characteristic) | 0x2300 |
| 5    | ERROR over potential     | Overvoltage in DC link (z.B. deceleration ramp too small, braking resistor not connected, braking transistor defective)          | 0x3210 |
| 6    | ERROR under potential    | Undervoltage in DC link  | 0x3220 |

1. Step

2. Step



### HIGHLIGHTS

- Automatic online update
- Individual selection of off-line content
- Direct search function by parameter documents



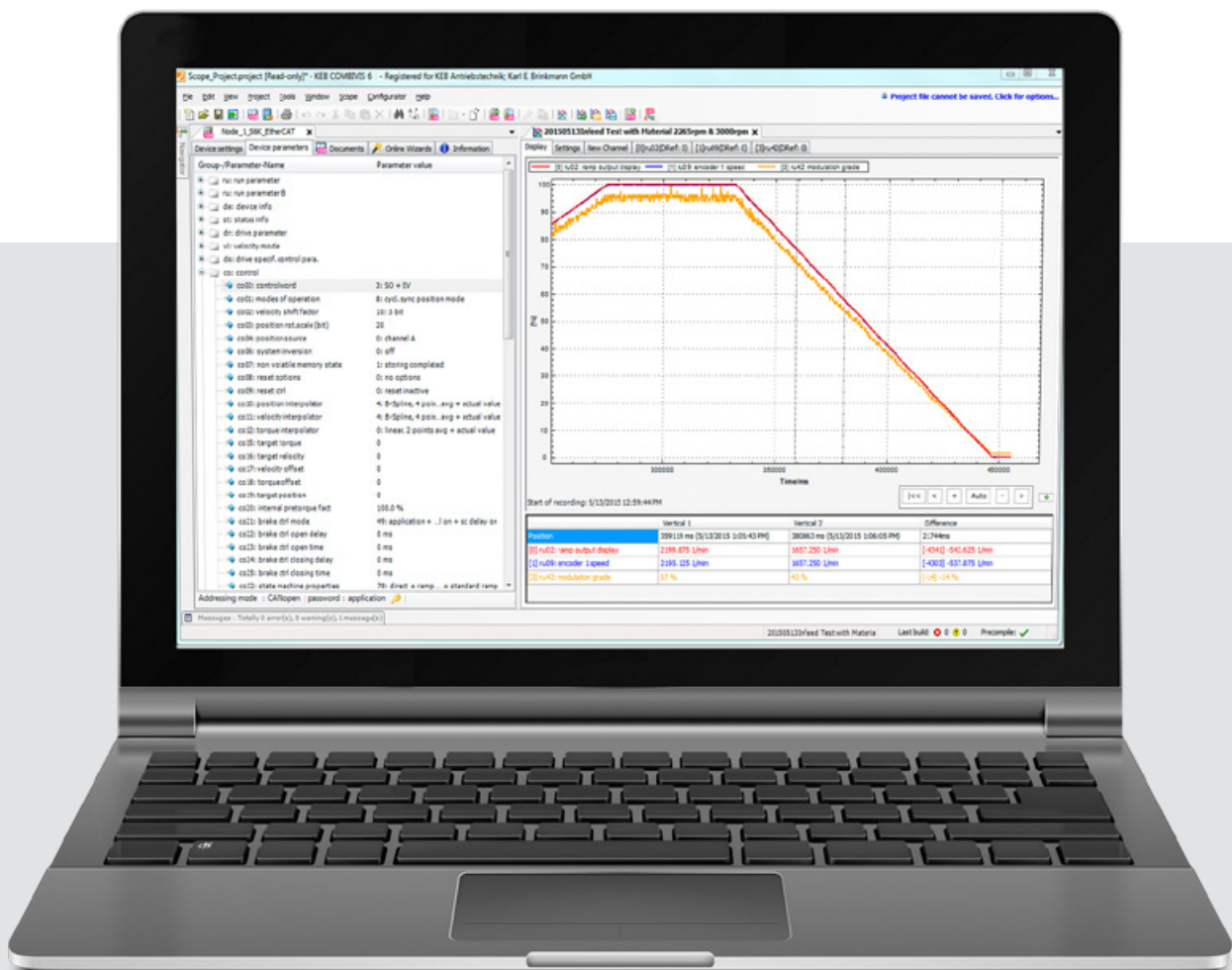
## COMBIVIS 6: START-UP, DIAGNOSIS AND OPTIMISATION OF DRIVES

Version 6 of the well-known KEB parameterisation diagnosis tool COMBIVIS 6 offers new tools for easier start-up and optimisation of drives.

Assistants guide the user intuitively through the basic set-up of a drive. In expert view, extensive additional settings also create the basis for further fine tuning, to adapt the drive more closely to the respective application. Assistants are available for:

- Start-up
- Motor
- Encoders
- Encoderless regulated operation
- Drive control
- Safety
- Fieldbus analysis
- Cogging compensation

COMBIVIS 6 also contains a 16-channel oscilloscope, back-up functions for parameter back-up, and rapid online/off-line comparison.



### KEB CHANNEL HANDLER - MULTI-FIELDBUS GATEWAY

It's always good to understand each other. The KEB channel handler overcomes potential language barriers as the gateway provides the translation between the Ethernet world and the various fieldbus telegrams. The idea is to be able to simply connect Ethernet-based controllers with fieldbus devices - independent of fieldbus and topology.

The KEB channel handler clears the way for routing through numerous network layers to allow comfortable access to all subscribers of an automation system.

For example, without additional hardware, the software converts Ethernet queries into fieldbus telegrams with the correct node address. This creates the basis for diagnosis or parameterisation. Also, modular IEC 61131-3 components can be embedded in the PLC program in parallel to the application.

Because the parameter channel is generally used for the translation, the contact functions even during a synchronous process data communication in multi-axis applications.



#### HIGHLIGHTS

- Direct access to drive parameters by the network and fieldbus topology
- Multi-fieldbus gateway for EtherCAT®, CAN open, HSP5, Ethernet, serial RS232 /RS458, Profinet, Profibus, Interbus, Powerlink
- Flexible software solution
- Access even in synchronous operation

