

More than 120 PLCs using Codesys with CANopen

Company

3S-Smart Software
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The company's main focus is the development and distribution of the Codesys programming environment and PLC runtime software compliant to IEC 61131-3 programming languages. The offered software is more than a development system: It also includes extensions for motion control or visualization for example. From the start the PLC software features support of different communication systems. In the beginning Profibus was the most requested bus system, nowadays it is CANopen and Ethercat.

Links

www.3s-software.com
forum.3s-software.com
www.plcopen.org
www.dor1.co.il
www.humiq.nl



Figure 1: The 3S directors Manfred Werner (left) and Dieter Hess (right)

When Dieter Hess and Manfred Werner started in 1994 the 3S - Smart Software Solutions company, the internationally standardized programming languages for PLCs (programming logic controller), known as IEC 61131-3, were just two years old. The PLCopen non-profit association was promoting this standard against proprietary solutions. In those days, so-called Soft-PLCs were quite rare. Nevertheless, the first version of the IEC 61131-3 compliant Codesys (Controller Development Environment) programming environment was released already in 1994. Today is Codesys one of the market-leading PLC software solutions. More than 350 OEM customers have implemented Codesys in their host controllers. The 104-employees company, headquartered in the South of Germany close to the Alps, achieved in the last year a turnover of 10,7 million €. In 2011, there were sold more than 500 000 runtime licenses.

The Codesys software supports all five programming languages defined in IEC 61131-3:

- ◆ IL (Instruction list) is an assembler like programming language
- ◆ ST (Structured text) is similar to programming in Pascal or C
- ◆ LD (Ladder diagram) enables the programmer to virtually combine relay contacts and coils
- ◆ FBD (Function block diagram) enables the user to rapidly program both Boolean and analogue expressions
- ◆ SFC (Sequential function chart) is convenient for programming sequential processes and flows

In addition, a graphical editor is provided: The CFC (Continuous Function Chart) is a sort of freehand FBD editor. Other than in the network-oriented FBD editor, where the connections between inputs, operators and outputs are set automatically they have to be drawn by the programmer. All boxes can be

placed freely which makes it possible to program feedback loops without interim variables.

The programming environment supports CANopen communication and configuration of CANopen NMT slave devices by means of SDO services. It is also possible to send and receive PDOs as well as EMCs. The runtime system manages and supervises

“CANopen is for us one of the most important networks.”

Hilmar Panzer

the CANopen NMT slave devices by means of NMT message, Node/life guarding, and Heartbeat. This means the PLC software includes a CANopen protocol stack. But the PLC itself is not a CANopen device, because it does not provide the mandatory SDO default server. This means, the implemented CANopen ob- ▶

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Figure 2: Wood processing machine using Codesys

ject dictionary is not accessible from the network by means of generic CANopen tools. The CANopen object dictionary is only accessible from the Codesys programming environment. Of course, the programming environment supports to read CANopen-EDS (electronic data sheets) to get knowledge on the connected CANopen devices. The currently implemented boot-up procedure for CANopen NMT slave devices does not read the error register (index 1001h), but follows in general the CiA 302 recommendations.

CANopen is one of the most used network technologies, in particular in mobile machinery. There are no detailed figures about the CANopen licenses available. But it is estimated that in the last year about 250 000 Codesys runtime licenses have been sold with CANopen functionality.

Typical examples for mobile machinery include hydraulic excavators by Terex/O&K, blast hole drill rigs by Sandvik, and harbor cranes by Liebherr. In several of these heavy-duty applications, there are proprietary CAN-based higher-layer protocols and CAN-based J1939 solutions are supported.

The CANopen option is also used in many embedded PLC systems (e.g. for medical devices) and in machine control systems. A typical example is the Vario-shuttle conveyor system by Eisenmann. Another one is the wood processing machinery by Homag. Atlas

Copco use Codesys with CANopen in its compressors. The Swedish company produces annually about 30 000 of them. Lenze uses another embedded PLC with CANopen in its programmable motion controllers.

Interesting is that the company's buildings are equipped with PLCs running Codesys and using CANopen networks to link the necessary I/O devices. Hilmar Panzer, the head of the application development department, uses also in his private home Codesys with CANopen.

On request from the market, the software house develops a CANopen Safety solution for SIL 2 (safety integrity level) according to IEC 61508. As an active CiA member, the company participates in CiA technical

working groups, especially in the IEC 61131 group jointly organized with PLCopen.

“ With the Codesys Application Composer users will experience a jump forward in engineering productivity. ”

Dieter Hess

The recently introduced Codesys Application Composer adds an application level to the IEC 61131-3 programming system. Pre-designed modules can be used to build complete automation applications. Such modules implement parts of machines or

plants like pneumatic cylinders, automatic tool changers or temperature controls as well as typical software functions like parts administration or user administration, process control or network management. All engineering aspects of Codesys are included in the modules: program code, I/O assignment, parameterization and visualization. The user structures his machine based on these POUs and connects them in special editors. Integrated generators then automatically produce complete, well-structured IEC 61131-3 applications including a visualization, which can directly be compiled and uploaded to the controller. The generated source code is visible to the user.

This approach opens the door to users, who do



Figure 3: Rock crushing machine with Codesys

Products

- ◆ Codesys programming environment: Development system running under Windows for creating PLC application programs compliant to IEC 61131-3.
- ◆ Codesys Control: PLC target software for embedded and PC-based controllers.
- ◆ Codesys HMI, Codesys Target Visualization, Codesys Web Visualization: Software add-on packages for creating display masks on different platforms.
- ◆ Codesys Softmotion: Tool-kit for motion control, which can optionally be integrated into the Codesys Control runtime system. A PLCopen motion control library is also part of the tool-kit.
- ◆ Codesys Professional Developer Edition: Provides additional tools for programmers to be used for high-level programming.
- ◆ Codesys Application Composer: Tool for machine and plant builders, who want assembling their applications on the base of pre-defined modules instead of programming them.
- ◆ Codesys Safety: The TÜV-certified PLC runtime software compliant to IEC 61508 (SIL 2) is under development, and will include a CANopen Safety option.

have a profound knowledge of the structure and the process of machines or plants but do not know how to program.

“ We have system partners and distributors supporting OEM customers and end-users. ”

Manfred Werner

The software supplier has established a worldwide representation by system partners and distributors. It is represented through their own office in China and distributors in 15 countries and supports its customers by 22 system partners, which offer consulting services. The company also organizes several events to update OEM customers and end-users. Recently, a distributor in Israel has been appointed: Dor Drive Systems specialized in motion control and renewable energy systems will take over the sales of

all Codesys products, will offer trainings, and will organize trade shows as well as customer events. In the Netherlands, Humiq Advanced Software has joined the system partner network. The Dutch company will provide technical consulting as well as support for application development and system integration. ◀



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