PLCopening

for efficiency in automation

2006 / 1

PLCopen Benchmarking – Released for Comments

The technical specification of this PLCopen Task Force has been released to the community for comments till June 30, 2006. With this release PLCopen is seeking for feedback form a broader community about its usability for their environments before developing the applicable test software.
The released document is available at the PLCopen website www.plcopen.org under TC3 – Certification / Task Force Benchmarking for free-of-charge download.

More about benchmarking inside this Newsletter.

PLCopen TC5 Safety Specification Version 1.0 approved by BGIA

The TC5 Safety Specification provides guidelines, style guides, and basic specifications of function blocks for implementation and use in safety-related environments. For users this means an easier commissioning of their equipment. By using the specified function blocks together with the general aspects, the certification procedure of the application itself becomes much easier and faster.

The BGIA, based in Sankt Augustin, Germany, is an institute for research and testing of the German Berufsgenossenschaften (BG), the institutions for statutory accident insurance and prevention in Germany.

As a certification body it reviewed the PLCopen specification and confirmed that it meets the relevant aspects of IEC 61508 and the related standards and can be used as a part of a specific safety requirement specification. This will result in a certificate for PLCopen.
This supports the suppliers of the software environment with regard to the implementation of this specification. However, this document or a PLCopen certificate does not guarantee that the implementation meets the requirements of the safety standards. Therefore the implementation of the FBs, or their appropriate use, is the responsibility of the supplier and/or user, including safety certification.

Help to shape your future – your feedback needed

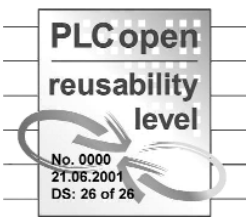
PLCopen focuses on efficiency in automation. With so many results, I hope that our work helped you and your company.

We are currently investigating new areas of work, which should help you in the future. I would appreciate if you would consider sharing your vision with me, and help identifying new work areas to solve your problems, especially if you are a user or system integrator.

Your help can shape our future.

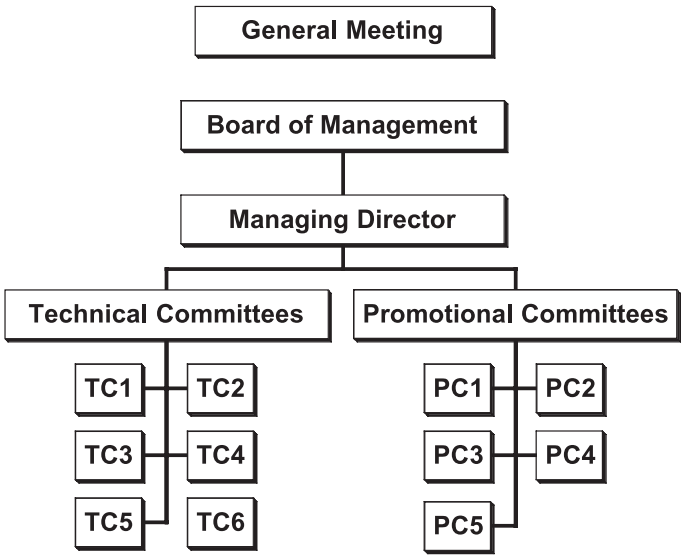
Kind regards,

Eelco van der Wal,
Managing Director PLCopen.



Contents of this issue

PLCopen organization



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Technical committees
- TC1 - Standards
- TC2 - Functions
- TC3 - Certification
- TC4 - Communications
- TC5 - Safe Software
- TC6 - XML

Promotional committees
- PC1 - Promotion Activities
- PC2 - Common Training
- PC3 - Promotion North-America
- PC4 - Promotion Japan
- PC5 - Promotion China

Upcoming events

Hanover Fair	April 24-28	Hanover	Germany
PLCopen Board meeting	April 26	Hanover	Germany
International Symposium Programmable Electronic Systems in Safety Related Applications	May 3-4	Cologne	Germany
PLCopen Motion Control meeting	May 11-12	Barcelona	Spain
PLCopen General Meeting	June 22	Amsterdam	The Netherlands
FA/PA	June 28 – July 1	Beijing	China
PLCopen Motion Control meeting	July 5-6		United Kingdom
PLCopen XML meeting	July 28	Bubenreuth	Germany
SPS/IPC/Drives	November 28-30	Nürnberg	Germany
MOF (Manufacturing Open Forum)	November 29 – December 1	Yokohama	Japan
SCS Automation & Control	December 5-8	Paris	France

Please check the website for up-to-date information www.plcopen.org,

Introduction into PLCopen

Software plays an ever-increasing role in industrial automation. With this, the associated software costs increase, even to the point that it becomes the highest part of the total system. And not all costs are directly visible: the required maintenance over the life cycle, adding new functionalities, coping with new governmental rules. To control these costs, one needs higher efficiency during the application development, while increasing the software quality. PLCopen, as an organization active in Industrial Control, is creating a higher efficiency in your application software development: in one-off projects as well as in higher volume products. As such it is based on standard available tools to which extensions are and will be defined.
With results like Motion Control Library, Safety, XML specification, Reusability Level and Conformity Level, PLCopen made solid contributions to the community, extending the hardware independence from the software code, as well as reusability of the code and coupling to external software tools.
Since its foundation in 1992, PLCopen has grown into a professional worldwide association with around 100 members and offices in Europe, USA and Japan. This is supported by a high percentage of user members, and our "one member - one vote principle", making the association independent of any single company.
One of the core activities of PLCopen is focused around IEC 61131-3, the only global standard for industrial control programming. It harmonizes the way people design and operate industrial controls by standardizing the programming interface. This allows people with different backgrounds and skills to create different elements of a program during different stages of the software lifecycle: specification, design, implementation, testing, installation and maintenance. Yet all pieces adhere to a common structure and work together harmoniously. The standard includes the definition of the Sequential Function Chart (SFC) language, used to structure the internal organization of a program, and four inter-operable programming languages: Instruction List (IL), Ladder Diagram (LD), Function Block Diagram (FBD) and Structured Text (ST). Via decomposition into logical elements, modularization and modern software techniques, each program is structured, increasing its re-usability, reducing errors and increasing programming and user efficiency.

PLCopen is a vendor- and product-independent worldwide association, headquartered in the Netherlands. As such we want to be the leading association resolving topics related to control programming to support the use of international standards in this field. As association, PLCopen is depending on its income through its membership fees. For this, PLCopen supports a multi-level membership, ranging from suppliers to educational institutes. PLCopen strongly supports the user community. For this it created additional membership categories. To achieve its goals, the organization PLCopen works on enhancements to industrial control programming, to generate more efficiency in industrial control. The committees working within PLCopen and their results are described in short form hereunder.

Technical results

The Technical Committees, TCs, with representatives of PLCopen members, work on specific items.

Within **TC1 - Standards**, PLCopen collects proposals from its members for the IEC 65B WG7 working group, develops a joint position, and distributes related information. This was specifically focused to the second edition of the standard, which was released at the beginning of 2003.

TC2 - Functions defines common libraries of Function (Blocks) for specific application areas. Examples are the library definitions of Function Blocks for Motion Control. This standardization integrates motion control with industrial control. As such, it provides a common look-and-feel towards the users: programmers, as well as installation and maintenance people. With multiple implementations of this library, reusability of software and scaling of the control system is much easier, even across different architectures and / or controller brands.

Certification & Conformity testing

TC3 - Certification defines a certification system for IEC 61131-3 PSEs, Program Support Environments (development environments). Each PSE can be tested to show that it complies with a PLCopen specified subset of the IEC 61131-3 standard. In addition, PLCopen extended the standard to support the reusability of user derived Function Blocks between different PSEs. **Conformity Level, CL** is the highest level. With the broad range of application areas for IEC 61131-3 not all implementations use exactly the same data types, 26 in total. To accompany this, the certification according to Conformity Level, CL, implies that the supplier of a PSE selects the data types supported by his product matching his compliance statement. All supported IEC features are tested. This means that although the test is a Yes/No test (conformant or non-conformant), there can be differences between two certified products. These differences can influence the reusability of user derived function blocks.

In addition **Reusability Level, RL**, is dedicated to making the programming units functions and function blocks reusable on a different PSE in the same programming language. This is a major, but natural, contribution of PLCopen to the IEC 61131-3 standard.
Historically there exists an entry level called Base Level, to show commitment to the standard. Although rather restricted, it is feasible to develop applications based on it. For the users it provides a normalized interpretation of the standard, especially important if they have to work with systems of different vendors. Detailed specifications of most of the IEC 61131-3 languages are already finished. Work is in progress for the remaining languages. The compliance test procedure and the accreditation procedure for test laboratories have been established. Independent test laboratories have been accredited and an increasing number of products have been certified. For a complete list please refer to the website www.plcopen.org .

TC4 - Communications works on the relation between communication and programming languages, like the mapping of Profibus and CANopen via IEC 61131-5 onto IEC 61131-3.

TC5 - Safe Software prepares recommendations for applying the IEC 61131-3 standard to safety related applications, esp. focused to machines, and the new safety standards IEC 61508 and 61511. In addition, it provides guidelines for the user to use safety aspects within their applications, supported by their development environments, as well as library definitions of Function Blocks for Safety applications.

TC6 - XML works on the specification of XML schemes for all languages, as well as full projects. This specification will provide the basis for exchange, as well as coupling to other software tools, including higher-level development tools, documentation tools, and verification tools.

Promotional Events

An important tasks of PLCopen is to inform users / programmers about the benefits of standardized industrial control programming. This is done via:

- the PLCopen website: www.plcopen.org ;
- publication of a free electronic and printed newsletter, called "PLCopening";
- publications in the press;
- participation at conferences and shows;
- organization of own conferences, and seminars.

The Promotional Committees **PC1, PC3, PC4 and PC5** support these activities.

PC2 - Common training has defined a common basis for training. This includes certification. In this way, certified training centers for training on IEC 61131-3 can be easily identified.

For on-going information, please check the website www.plcopen.org, as well as the electronic magazine to which you can subscribe at this website.

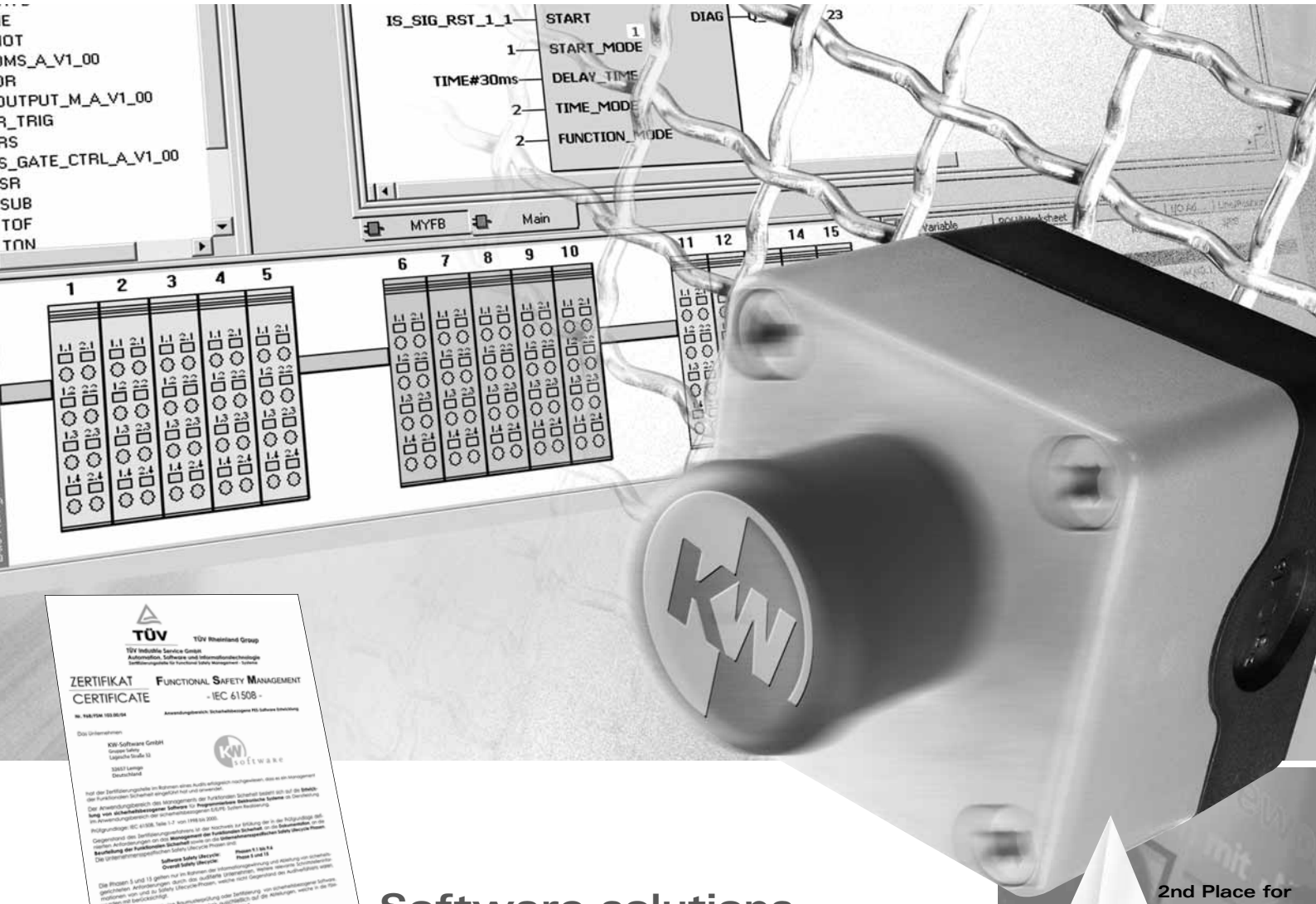
Benefits of Membership

A membership of PLCopen has many benefits for users, vendors, and institutes. By joining PLCopen, one makes a clear statement about your commitment to open architectures. In addition, one can participate in the committees, and as such have upfront information as well as influence on the work done, and use the PLCopen logo's.
The annual contribution depends on voting and non-voting rights, the number of relevant employees active in the field of Industrial Control, IC, and the nature of the organization. There are 3 different sizes: over 1,000 relevant employees, between 100 and 1,000 and less than 100. The different organizational types are:

- Companies: commercial organizations active in the IC
- Users: focused to the application and usage of IC
- System Integrators / Re-sellers: added value is not in the IC or its programming environment
- Non-profit organizations
- Educational institutes

For more information, please check the website www.plcopen.org . Here one can subscribe to the electronic newsletter, keeping you updated on the activities of PLCopen.

KW software



TÜV Rheinland Group

ZERTIFIKAT
CERTIFICATE

FUNCTIONAL SAFETY MANAGEMENT
- IEC 61508 -

Software solutions
for safety controls according to IEC 61508 (SIL 3)

2nd Place for SAFEPROG/ SafeOS

KW-Software offers an integrated software platform for drives and controls ranging from safe parameterization and configuration up to a freely programmable safety control.

SAFEPROG - the safe IEC 61131 programming system – and the safe runtime environment SafeOS have been developed according to strict requirements of the IEC 61508 (SIL 3). With these software solutions a programmable safety control can be realized, requiring significantly less effort.
Thanks to open interfaces, SAFEPROG and SafeOS can be adjusted to customer-specific hardware and different bus systems.

KW-Software is the first software company which has been certified by the TÜV Rheinland with regard to the development process for software components according to IEC 61508.

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Integrating safety functionality into the development system

The changing environments facing the machine building industry asks for new solutions.
The changes include:

- The availability of many safety standards, including IEC 61508 and IEC 62061;
- Additional governmental requirements increasing the liability issues;
- The tendency to move from one motor (master axis) to multiple axes, driven by mechatronic solutions;
- The availability and acceptance of digital networks with safety functionality built-in;
- The inherent move from hardwired safety functionalities to software solutions;
- The increasing importance of safety related issues regarding personnel and machines.

The solution includes standardization of the safety functionality on the software level, and integrating this in the development environment. This combination helps developers to integrate safety related functionality with more ease in their systems, even from the beginning of the development cycle. Also, it contributes to the understanding of safety aspects, as well as reducing the certification time and costs by relevant organizations.

The Rationale of a New Safety Standard

Machine builders are faced with a large set of safety-related standards. This makes it expensive and in some cases unfeasible for machine builders to understand them all fully. Yet in the end they are still responsible for their products and related safety aspects. This risk situation is not very healthy, especially since legislation imposes greater constraints on the equipment suppliers. And their liability increases.
Nowadays there is often a clear separation between the safety-related part and the functional application part. This separation can be made be using different systems for the environments, different tools, and even different people can be involved. This separation often results in the safety aspects being included at the end, and not integrated into the whole system philosophy from the beginning, and often with only limited tests performed. This clearly does not contribute to the overall safety aspects.
Also, the on-going technological innovation now provides safety-approved digital communication buses. This supports the trend away from hard-wired systems towards software-oriented solutions. A parallel can be drawn with the movement away from hard-wired relay logic towards programmable logic controllers, PLCs. Such a trend, of course, involves a change in the mindset. This type of change requires time, widespread support from the industry as a whole, support from educational institutes as well as from certification bodies.
In addition, governmental requirements add to the complexity. For instance, the US-based FDA, Food and Drugs Administration, has set strict regulations that must be complied with. Non-compliance can result in heavy financial penalties, again weakening the sustainability of the organization.

Standards enhance the safety aspects

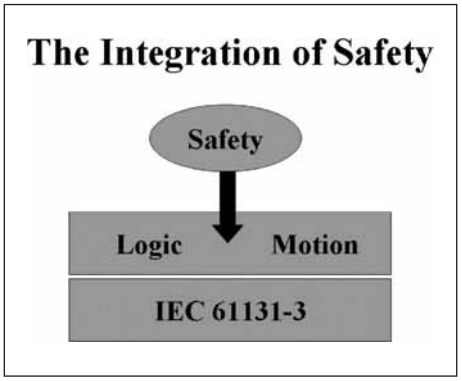
With so many standards already available, one needs to help the users to implement them, without inhibiting their functionality and performance, and without adding costs. Standardization in functionalities and the integration and support from the software tools should help the programmers to integrate safety functionality in their applications more easily.
The common basic requirements of a safety application for machine builders within all applicable safety standards are:

- Distinction between safety and non-safety functionalities
- Use of applicable programming languages and language subsets
- Use of validated software blocks
- Use of applicable programming guidelines
- Use of recognized error-reducing measures for the lifecycle of the safety-related software

Standardization in the look and feel

In order to help developers use safety-related functionalities, the comfort zone of users must be improved, thus making it easier to accept this way of working. This can be done by standardizing the look and feel of the safety function blocks. In this way the safety functionality can be better recognized and used independently of the applicable system. Re-training is not necessary and the tendency to create dedicated safety functionality is reduced.
In addition, this assists the certification bodies: specifying and checking the safety software becomes much easier, and therefore quicker, less risky, and less costly.
Providing function blocks at a higher level makes them less dependent on the underlying hardware architecture. Architectures such as hard-wired systems, systems containing safe input and output modules, and network-based systems can be supported with the same function blocks. With this higher-level solution the implementation details can be hidden from users, making the implementation of safety-related software much easier and less costly. This also improves the comfort zone of users.

In order to support this, the independent association PLCopen, together with its members and external safety related organizations, defined safety related aspects within the IEC 61131-3 development environments. With this, the safety aspects are transferred to a software tool, which is integrated in the software development tools. As such it combines the logic and motion application development with the related safety aspects. This combination helps developers to integrate safety-related functionality into their systems, even from the beginning of the development cycle. Also, it contributes to the overall understanding of safety aspects, as well as reducing the certification time and costs by relevant organizations.



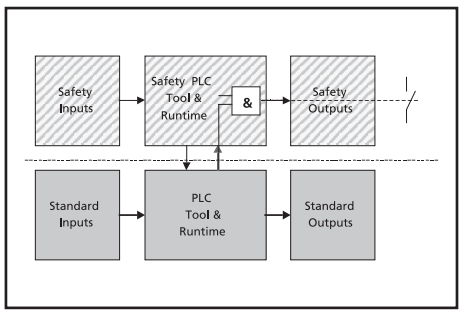
This PLCopen safe software specification includes:

- Representation of the software architecture
- Definition of the programming languages and user levels for easy programming and error prevention
- Presentation of safety-related data types
- Definition of language subsets
- Error handling and diagnostic concept
- Definition of a generic FB and a set of 20 safety-related function blocks
- The definition of a PLCopen compliance procedure combined with the use of the PLCopen Safety logo

This complete approach provides the user with a harmonized view to the total application with one environment. With this, a major contribution to the acceptance and usage of safety related functionality is made. This will take away several hurdles as they now exist, and are described above, for especially the machine building industry.

Representation of the software architecture

By integrating the functional application with the safety application in the same environment, one can exchange data between both. This goes beyond the diagnosis functionality. It can include confirmation by an operator. It can give general status information. Of course different rules apply for going from the safety environment to the operational application then vice versa. Again, the safety related software tool help to avoid errors here.



On the left side of the model, two sets of inputs are identified, and on the right side two levels of outputs. In the middle, the two environments are shown separately, both coupled to their related inputs and outputs.
Data exchange between the safety and the functional applications are shown in the middle.
The functional application has unrestricted read access to the safety inputs. The usage of non-safe inputs within the safety environment is limited to the non-SAFEBOOL input parameters, such as a 'reset', and limited to the AND function with a SAFEBOOL parameter for a safety related input.
The same is valid for the two sets of outputs.
This represents a major contribution to the acceptance and use of safety-related functions, thus eliminating several obstacles as they now exist, and are described above, especially for the machine building industry.

Definition of the programming languages and user levels for easy programming and error prevention

There are three levels of users identified, with different sets of experience and authority to manage the safety related aspects:

1. Basic / user level – focused to the safety-application programmer using the specified function blocks
2. Extended / Expert level – extended functionality giving the ability to define own extensions to the specified function blocks
3. System level – focused to the implementation by the suppliers of the (specified) function blocks. This level is not further described in the document

Without going into too much detail, we zoom in on the first group. For this, the safety standard IEC 61508, Chapter 7, defines a reduction in the preferred programming languages for the different SIL levels (Highly Recommended, Recommended or Not Recommended). Based on this, the preferred languages within this group are the graphical languages FBD and LD, with a defined subset of these. These graphical languages provide a clear overview of the safety program itself, and the tool suppliers can realize a much better support and guidance of the users.

Presentation of safety-related data types

Once the functionalities have been presented in function blocks, the next stage is to determine how to combine them into safety-related programs. At this level the software tool should help the user as much as possible. For this, a new BOOLEAN data type is introduced that is applicable within the safety-related environment, and provides a distinction between safety-related and non-safety-related Boolean variables. This provides the basis for the development tool to identify safety-critical program parts, and guide the user with permissible connections, while preventing incorrect connections. In this way, support can be implemented for the different levels of the various safety standards.
Although the "SAFE" data type cannot guarantee that the signal status is safe (e.g., in the event of incorrectly wired periphery), it is, however, an organizational tool used to minimize errors in the application program. Additionally, when releasing the application program, the safety-relevant signals can be clearly recognized. This simplifies and shortens signal flow verification.
Safe data types are data types applicable within the safety-related environment. These data types shall be used in order to differentiate between safe signals and non-safe signals for ease of validation and certification purposes.
Possible means of supporting safety-related data types in programming environments could be:

- Different means of display/representation of safe data types
- Compiler support of safe data types

SAFEBOOL is a data type that is applicable within the safety-related environment and represents a higher safety integrity level. It differentiates between safety-related and non-safety-related variables. A SAFEBOOL acts as a BOOL within the system, but can contain additional information (attributes) necessary for the safety status and level (could include categories/PL, SILs, PFD/PFH). Such information could be used to calculate the SIL with the programming tool.
The control system guarantees the Safety Integrity Level within the system limits. SAFExx variables are represented as "single-channel", regardless of the internal structure (which can be 1oo1, 1oo2D, 2oo2 or 2oo3). Therefore, such control systems, which execute FB's with SAFExx inputs and outputs, are to be certified, especially in respect of the generation of SAFExx signals.
Essentially there are (at least) two ways to get a SAFEBOOL variable in the application level:

1. The data is provided as a safe data type by the devices, either by the devices themselves or by the operating system or firmware. This can include a safe network.

2. The data is provided by combining safety inputs in the application itself (such as two safe single-channel inputs).

The safe value for SAFEBOOL must be FALSE. Application designers must ensure that all SAFEBOOL variables result in safe behavior when set to FALSE. SAFEBOOL variables are set to FALSE on initialization and following any faults.

•Definition of language subsets

Reduction in data types and declarations
(See IEC 61131-3; Table 10)

Description	User Level	Expert level	Comment
SAFEBOOL	X	X	Strong recommended new safety data type, only for binary safety signals. (For tools, where this data type cannot be implemented, BOOL is allowed. Hence, data type checking by compiler isn't possible. The user is then responsible for not mixing up safety and non-safety signals)
BOOL	X	X	As DiagCode and only for non-safety signals exchanged with application program,.
INT, DINT	X	X	User: only as constant FB input parameter or when derived from a Expert / System level FB. Arithmetic functions are not allowed in user level.
REAL	X	X	Same as INT, DINT
WORD	X	X	User: only as Diagnosis output
TIME	X	X	User: only as constant FB input parameter
Other ANY_BIT	-	-	
Other ANY_INT	-	-	
Other ANY_REAL	-	-	
ANY_DATE	-	-	
STRING	-	-	

Reduction in functions and function blocks
Standard functions: (See IEC 61131-3; Tables 22-30)

Description	User level	Expert Level	Comment
AND	X	X	Operation of both BOOL and SAFEBOOL allowed at both levels. (three types: S_AND, AND, and Confirmation functionality)
OR	X	X	Basic Level: Operation of SAFEBOOL only allowed. Extended Level: Operation of both BOOL and SAFEBOOL allowed, but not mixed. (S_OR and OR)
XOR, NOT	-	X	
ADD, MUL, SUB, DIV	-	X	No MOD, EXPT, MOVE
SHL, SHR, ROR, ROL	-	-	As binary information shall not be concatenated to BYTE/WORD, shift functions are not necessary
GT, GE, EQ, LE, LT, NE	-	X	
Selection functions	-	X	
Type conversion functions	X	X	For data types that are supported
String functions	-	-	No STRING available
Time Functions	-	X	Only ADD, SUB, DIV,MUL with operands of type TIME
Unary REAL functions	-	-	e.g. sin, sqrt, log,...

NOTE: Safe AND and OR functions will not have additional non-safe inputs. If needed (for User – Enable / 'Freigabe') this is done via the applicable FB.

Standard function blocks: (See IEC 61131-3; Tables 34-37)

Description	User Level	Expert level	Comment
TON, TOF, TP	X	X	Supplemented by additional timer FBs specified within this document
CTU, CTD, CTUD	X	X	Supplemented by additional counter FBs specified within this document
Bistable FB (SR, RS)	-	X	No SEMA
Edge Detection	-	X	

Error handling and diagnostic concept

A transparent and unique diagnostic concept forms the basis of all function blocks. For this, all safety-related function blocks have two error-related outputs: Error and DiagCode. These are provided for diagnostic purposes on the user application level, and not for diagnostics on the system/hardware level.
With this it is guaranteed, that, independent of the vendor's implementation, uniform diagnostic information in the form of a set of pre-defined DiagCodes per function block is available to the user. In case of no error the internal status of the function block (State Machine) is indicated. An error is indicated via a binary output (Error). One can retrieve detailed information on the function block internal or external errors via the DiagCode.
The rule for safety related environments is that the switching of a safety-related function has the highest priority, and following switching there is sufficient time for the diagnostics, either in the functional program or the operator interface.

Definition of a generic and a set of 20 safety-related function block

The PLCopen Technical Committee 5 – Safety has identified 16 safety functions, which are represented by 20 Function Blocks. These provide the basis for developing certified Function Blocks within an environment.

The specification itself provides a unified description of all the Function Blocks. Included elements are:

1. Applicable Safety standards, with reference to the sections of the relevant requirements
2. Interface description, including name of FB, and short description
3. Functional description, including Safe State description, in both
   a. textual form
   b. graphical form, including description of normal operation and start behavior
4. Error detection, with description of External signals, Internal signals, and External test signals

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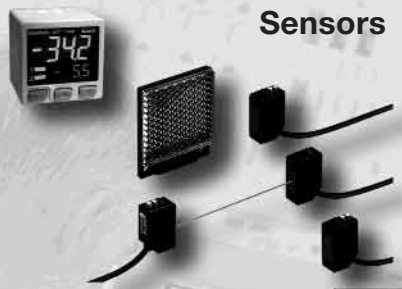

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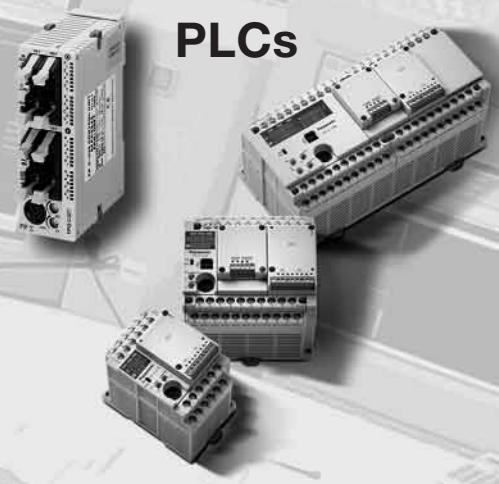

Servo Drives & Inverters

Limit Switches

Timers & Counters

Temperature Controllers

PLCopen CONFORMITY LEVEL
No. C-34
ST
04.04.2003
Datatypes supported: 10 of 26

PLCopen motion control

PLCopen reusability level
No. C-35
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DS: 10 of 26

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5. Error behavior
6. Function Block specific error and status codes

The full list of blocks is:

Equivalent	Converts two equivalent SAFEBOOL inputs (both NO or NC) to one SAFEBOOL output, including discrepancy time monitoring.
Complementary	Converts two antivalent SAFEBOOL inputs (NO/NC pair) to one SAFEBOOL output with discrepancy time monitoring.
Modes Selector	Selects the mode of operation of the system, such as Manual, Automatic, Semi-automatic, etc.
Emergency stop	This is a safety-related function block for monitoring an emergency stop button.
ESPE	This is a safety-related function block for monitoring an Electro-Sensitive Protective Equipment (ESPE).
Safe Stop 1	Initiates a controlled stop of an electrical drive in accordance with stop category 1 of IEC 60204-1.
Safe Stop 2	Initiates a controlled stop of an electrical drive in accordance with stop category 2 of IEC 60204-1.
Safety Guard Monitoring	Monitors relevant safety guard. There are two independent input parameters for two switches at the safety guard coupled with a time difference (MonitoringTime) for closing the guard
Safety Guard Interlocking with locking	Controls an entrance to a hazardous area via an interlocking guard with guard locking ("four state interlocking")
Safely Limited Speed	Provides the interface for the safely limited speed motion-axis-specific safety function. It does not initiate any movement of the motor, but activates the safely limited speed monitoring in the drive.
Two-Hand Control Type II	Provides the two-hand control functionality. (cf. EN574, chapter 4 Type II.)
Two-Hand Control Type III	Provides the two-hand control functionality. (cf. EN574, chapter 4 Type III. Fixed specified time difference is 500 msec.)
Testable Safety Sensors	Detects, for example, the loss of the sensing unit detection capability, the response time exceeding that specified, and static ON signal in single-channel sensor systems. It can be used for external testable safety sensors (ESPE: Electro-sensitive protective equipment, such as a light beam)
Sequential Muting	Muting is the intended suppression of the safety function (e.g. light barriers). In this FB, sequential muting with four muting sensors is specified.
Parallel Muting	Muting is the intended suppression of the safety function. In this FB, parallel muting with four muting sensors is specified.
Parallel Muting with 2 Sensors	Muting is the intended suppression of the safety function. In this FB, parallel muting with two muting sensors is specified.
Enable Switch	Evaluates the signals of an enable switch with three positions.
Safety Request	Provides the interface to a generic actuator, e.g. a safety drive or safety valve, to place the actuator in a safe state
Out Control	Control of a safety output with a signal from the functional application and a safety signal with optional start-up inhibits.
External Device Monitoring	Controls a safety output and monitors controlled actuators, e.g. subsequent contactors

The next step is implementing these function blocks on multiple platforms. At this level these FBs can be certified by independent organizations. With this, the standardized look and feel is supported on a broad set of software tools, adding again to the comfort feeling, and reducing the tendency to create own functionality which can contain errors.

PLCopen compliance information

For quick identification of compliant products, PLCopen has developed a logo for the Safety Specification:

In order to fulfill the requirements set, different levels of certification are applicable:

1. Certification of the software tool supplier, often part of the control supplier
2. Certification / Conformity of the application at the user and/or machine builder

Ad 1: Certification of the software tool supplier
The development environment, including the safety related function blocks, as well as the underlying hardware, have to be certified by the relevant safety related bodies. In order to be able to be certified, certain rules, like described in IEC 61508 and related standards like IEC 61511, are applicable. The PLCopen specification provides a framework for this; however the overall requirements are beyond the scope of PLCopen, and have to be dealt with by external dedicated organizations.

Ad 2: Certification / Conformity of the application
Within an application, a certification includes the safety related software combined with the infrastructure, like sensors, switches and actuators, connection schemes, etc, like described in standards like IEC 62061. Certification or approvals for the application software are made easier, however the full application have to be dealt with by external dedicated organizations.

The use of the PLCopen logo does not give any guarantee about any compliance or fulfillment. The use of the logo just refers to the inclusion of the ideas and guidelines as described in this document, within the relevant software environment, and the availability of this information in more detail on the relevant section of PLCopen website www.plcopen.org

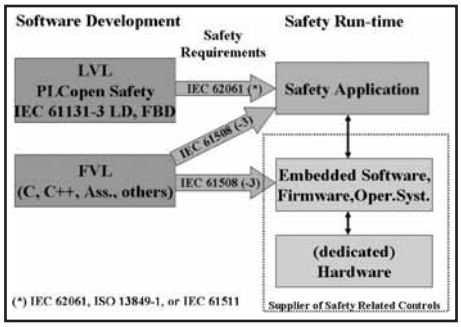
Integration of safety aspects in the application – a changing mindset

With the integration of safety in the development environment and the inclusion of many safety related standards, an organizational change is needed to add the safety aspects in the machine design from the beginning of the development.
Technology trends like the tendency to move from one motor (master axis) to multiple axes, the availability and acceptance of digital networks with safety functionality built-in, coupled to the inherent move from hardwired safety functionalities to software solutions, and the increasing importance of safety related issues regarding personnel and machines, of course includes a change in the mindset of the relevant people. A change that needs broad support from the industry as a whole, support from educational institutes, as well as certification and specification bodies, and last but not least - time.

Positioning of the work of PLCopen

IEC 61508 and IEC 62061, and companion and related standards, describe safety requirements at different levels. However, they are open on the implementation of this functionality in software development environments for the creation of the application software. Also, both standards are targeted to a somewhat different level: run time environment or application level. For both different tools are used. The following picture provides an overview:

The new safety related standards come with a new nomenclature. Some related terms are:



- FVL Full Variability Language. Application independent languages used by component suppliers for the implementation of (safety) firmware, operating systems, or development tools. Rarely used for the safety application itself. Typical languages are C/C++, Java, and assembler.
- LVL Limited Variability Language. Aimed at users to create their safety application functionality. Typical languages used are Ladder Diagram and Function Block Diagram
- SRAS Safety Related Application Software
- SRES Safety Related Embedded Software

PLCopen TC3 - TF Benchmarking – released for comments

The PLCopen Task Force Benchmarking released their technical specification to the community for comments till June 30, 2006. With this release we want feedback from a broader community about its usability for their environments before developing the applicable test software. The published version is 0.4, and is combined with a feedback form.

A benchmark is a reproducible, portable test to measure the performance of a given system in comparison to other systems. For PLC systems there are no defined benchmarks. The only common measurement for PLC performance is the execution speed of 1000 Boolean operations. This number provides not a good benchmark, because one cannot derive the performance of the PLC in a typical application from it, and as such it is not comparable between systems due to the lack of the definition of the test conditions.

There are two main objectives, when you use a benchmark:
1. To estimate the performance of the PLC in your own application
2. To compare the performance of the PLC with other PLCs and find out the specific strength and weakness of a given system

The paper defines two different sets of benchmarks to meet the objectives described above.

The first set of benchmarks defines five different types of applications, which are typical for the usage of a PLC. Most applications belong either to one of these types or consist of a mixture of them.

The second set of benchmarks measures each language feature of the IEC 61131-3 separately. The goal of this test is to exclude effects of other features to the most possible extent.

The released document is available at the PLCopen website under TC3 – Certification / Task Force Benchmarking for free-of-charge download. Please use the enclosed form for your feedback, to improve the usability of this for you.

PLCopen TC6 XML meets in Hamburg, Germany

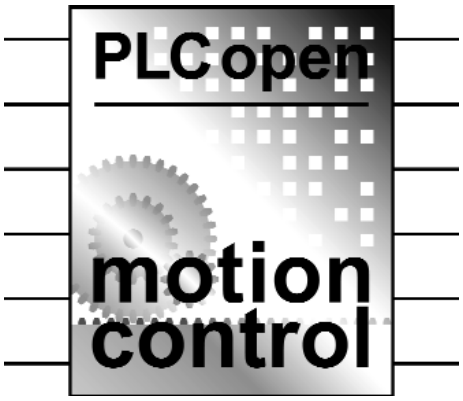
Although the TC6 - XML specification is finalized, there is a need amongst the members to discuss implementation topics, test procedures, certification topics, and transformations.
For this reason, the participants met at the university in Hamburg.
PLCopen Japan wants to popularize the IEC 61131-3 standard in Japan. For this, it plans 3 local developments based on open source tools: an XML Editor, an XML Simulator and an XML based Library of Function Blocks. Thes status of these developments were presented.
For this, four changes to the existing XML scheme were presented. They will be dealt with in a separate amendment of the XML schema.

PLCopen Japan suggested to use the developed tool as a PLCopen TC6 XML reference tool. The proposal was discussed. With various IEC 61131 tools being widely used in Europe, the situation in Europe is regarded different from the situation in Japan.

The University of Bilbao presented the results of an EU project which has been completed by the end of 2005. The basic idea was to start with UML as model, generate XML code from this, and transform these to the different development environments. PLCopen XML should help to reduce these transitions, and have more XML import functionality in the different systems. Among other results, it was showed that various kinds of conversions between different XML formats can be carried out easily by the help of XSLT. Furthermore, XSLT can serve to create documentation (html, doc, pdf) from the XML source.

Certification issues - the participants discussed how a certification of a tool being "TC 6 compliant" could be implemented. Since mutual import/export "without error messages" and / or comparison of XML Schemata and / or numerous test cases seem not sufficient to prove compliance, the participants felt that there is a lack of a certification methodology.
For this reason and additional meeting is planned for July 28, at infoteam Software.

PLCopen Motion Control – Status of the work



The success of the PLCopen Motion Control is clearly visible. With support from nearly 30 platforms, it unifies the access of motion control across platforms. The integration of motion control and logic on one platform helps users to add motion control functionality much easier.
Here we give you an overview of the different parts of the PLCopen Motion Control specifications. If you want to contribute in the work, contact us.

Part 1 - Basics - at version 1.1

With so many implementations, as well as the first applications, inconsistencies were found in the first specification, as well as additional features to be added. This resulted in an update of the basic document, Part 1, as originally published in 2001. This new update is Version 1.1 of Part 1, and includes an extension to the homing functionality, the addition of the output 'Busy' (signalling the status of the Function Block), and the capability to merge and blend function blocks.

Part 2 – Extensions – at version 1.0

Part 2 – Extensions, is the second document, and contains additional function blocks, adding to Part 1. It was published in September 2005 as version 1.0 – official release. This version includes the feedback, as well as the additional features as added in Part 1.
With this release, this part is ready for implementations at the suppliers, and ready for certification at PLCopen.

Part 3 – User Guidelines – as version 0.3

This part contains guidelines for users and examples. The current version 0.3 of April 16, 2004 needs an update with the additions of part 1 and the release of part 2. The update is back on the agenda, and hopefully will bring a new release with further examples before the end of this year.
This part was always intended to have multiple on-going releases. In this way new examples could easily be added. The focus now is on adding functionalities as described in the OMAC Packaging Workgroup software specification. This means that we will show users on how to create their own function blocks with these defined functionalities based on the existing function blocks and the standard IEC functionality. With this, users can easily adopt different control algorithms or routines in their own library, and make them available troughout their companies.

Part 4 – Interpolation – work under construction

Interpolation brings the work in Motion Control at a new level. Part 4 is focused to the coordinated multi-axes motion in 3D space. In order to work in 3D, several coordinate systems are applicable, as well as a kinematic model of the mechanics involved. The coordinate systems include the axes coordinate system, the machine coordinate system and the product related system.
The kinematic model normally comes out of a different software tool, like a CAD or simulation system. An interface is provided to incorporate such a model in the application program.
The work started in 2005, although several ideas were presented for other parts, and postponed at that time. The release for comments, version 0.99, is expected around the SPS/IPC/Drives this November.

Part 5 – Homing – going to version 1.0

Part 5 – Homing is a complete new document, which was published in November 2005 as Version 0.99 – release for comments. It is coupled to the extension of the homing function block, as defined in Part 1. It normalizes multiple homing procedures, as well as the description of a general homing software tool to add additional homing modes for applications not yet covered. We know that there are additional application areas, which have different needs for the homing functionality. Since it is impossible to define all homing modes upfront, it is more practical to define a homing tool combine with basic modes.
The status is that the feedback will be merged in the current version, and published as official release version 1.0 probably this year still.

New PLCopen Certificates

Two new certificates for the PLCopen Motion Control compliance were handed out recently. This includes the first certificate for the update of Part 1 – Basics, as version 1.1, for the company:

- ***Schneider Automation S.A.S for their product "MFB on Unity Pro", version 2.2 of January 2006.***

The second certificate is for the company:

- ***Berger Lahr GmbH Co. KG for their product "Motion library for TLC V2.002", of May 2005.***

For specific information on their support, check the PLCopen website under TC2 - Function Blocks. With this, the number of motion control certified products has now reached 25, as listed on the PLCopen website.

PLCopen would like to congratulate the following companies for becoming a PLCopen Certified Training Centre:

- ***University of Limerick, Ireland***

- ***Alexandria Technical College, USA***

For a complete list, as well as information on how to reach the PLCopen certified training institutes, check the PLCopen website under PC2 - Training

First Board Meeting held at PLCopen China

The first board meeting for PLCopen China 2006 was held on January 20th, 2006 in the Shanghai Institute of Automation Instruments. The meeting was attended by participants from over 20 member companies.

The meeting was opened by Mr. Fan, the Director of SIPAN, followed by a report from Mr. Peng Yu, the Chairman of PLCopen China, on the activities of 2005 and the plans for 2006. Supported by Mrs. Wang Jun, the Secretary General of CAMETA, the members of PLCopen China engaged in the discussions on the upcoming seminars on IEC61131-3 in 2006 in terms of the location and the joint booth for the 2006 FA/PA Fair. It was confirmed that the seminars on IEC61131-3 in the first half year of 2006 will be held in Guangzhou (or Shenzhen), Nanjing and Chongqin.
Due to the local-for-local concept of the Chinese organization, the membership fees were explained by the secretariat of PLCopen China. The membership fees are euro 1000 /year for standard members and euro 2000 /year for board members.
The Members of the Board of PLCopen China are:
Zhejiang Zheda Zhongzi Integrated Control Co., Ltd.,
Advantech of Taiwan (China) Ltd.,
Siemens (China) Ltd.,
Rockwell Automation Technical Support Center,
Beckhoff, Nanjing
Phoenix Contact Co., Ltd.,
KW-Software GmbH Shanghai Representative Office,
Fuji Electric FA(Shanghai) Co. Ltd.

On the FA/PA fair in 2006, there will be a joint booth of PLCopen China on which all the logos of the members will be displayed.

The secretariat of PLCopen China can be reached at plcopen@cameta.com.cn , and the PLCopen China web at www.plcopen.org.cn .

New activities in North America with Bill Lydon

The PLCopen Board of Management is pleased to welcome Bill Lydon of Marketing Solutions as the new Managing Director of PLCopen for the North American market. Based on his industry experience, knowledge of the industrial control markets, personnel recommendations, and his knowledge of PLCopen and IEC61131-3, they are confident that Bill Lydon will be successful in positioning PLCopen NA as a strong organization in the various control markets.

Bruce Buscher, PLCopen board member observed, "Everyday it becomes more apparent that efficient industrial automation based on worldwide standards is required for companies to compete globally, Bill is a great addition to PLCopen."
"I am excited to work with PLCopen; the concept of open architecture programming languages for controls has been discussed for years and is being realized today through the efforts of PLCopen and member companies. PLCopen North America plans to achieve the high awareness and adoption of IEC-61131-3 and other automation standards that are successful in Europe, Japan, and China." commented Bill Lydon.

About Bill Lydon

Bill Lydon has been at the forefront of controls technology for many years and now provides business development services to companies in the industrial, process controls, and Building Automation industries. Bill has a powerful combination of background including business development, enterprise software, engineering, marketing and sales. Bill's clients sell to a wide range of controls and automation applications including Building Automation, Process Controls, Programmable Logic Controls (PLC), and embedded controls.

Contacts:
Bill Lydon, Managing Director PLCopen North America
Franklin, Wisconsin, USA

PRESS

News from ESR Pollmeier: Function Blocks for Servo Drives

ESR Pollmeier offers comprehensive libraries with function blocks for their digital servo drives TrioDrive D, TrioDrive D/xS, MidiDrive D, and MaxiDrive. Function blocks simplify servo drive integration into automation systems.
The software libraries follow the PLCopen specification "Function blocks for motion control" (based on IEC 61131?3). They are available for controllers with IEC 61131?3 programming language and ProfibusDP, CANopen, or EtherCAT interface.
Many drive and control functions are directly accessible using the function blocks, e. g. positioning, I/O access, parameter transmission, or error handling. The servo drive can also run complete positioning sequences or velocity profiles autonomously using the integrated positioning control (part program), which can be selected and influenced by function blocks, too.
For more information check: www.esr-pollmeier.de

News from ICS Triplex: ISaGRAF 5.0 Wins Prizes for New Software

ICS Triplex ISaGRAF Inc. announces the official release of the IEC 61499 compliant ISaGRAF version 5.0. Users can now design powerful automation controllers and devices that meet the IEC 61131 and IEC 61499 standards.
The unique technology offers all the components to rapidly prototype and create a high quality control product. It provides a combination of the field-proven control engine software used by most PLC, DCS and RTU manufacturers worldwide; a toolkit to adapt it to any hardware platform and operating system; and an IEC 61131 and IEC 61499 programming environment that makes the automation solution easy to use for all engineers.
IEC 61499 redefines the way to configure and program automations systems and is a natural complement to the IEC 61131 methodology. The IEC 61499 standard is the result of 10 years of work by the IEC standards organization and defines the means to

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design and implement robust and efficient cooperating systems. ICS Triplex ISaGRAF was presented with the Grand Prize in Innovation award for the new ISaGRAF 5.0 software launched at the Automation Optimation tradeshow in Paris in October 2005. In addition it received the prestigious Control Engineering Editors' Choice Award.
For more information check: www.isagraf.com

News from ifak: changes within the Institut f. Kommunikation und Automation

The Institut f. Kommunikation und Automation (ifak) Magdeburg-Germany, as a founding member of PLCopen and an institute for applied research since 1991, has undertaken several changes over the past year. Previous to the successful change at the start of 2005 in management from Prof. Peter Neumann to Prof. Ulrich Jumar, there was a process of joint concept planning, new structural change of research areas and some structural changes within the institute itself. An event of "handing over the batton" in spring 2005 offered the opportunity to introduce the current profile as well as future perspectives. In comparison to the previous year, a significant increase of research projects with international and national funding could be reached in 2005. There was also a growth in the number and volume of industry orders. ifak researches in the following 4 departments: Information Management for Automation and Environmental Systems, Intelligent Transport Systems, Industrial Communication Systems and Mechatronic Systems.
The institute is again planning an event, which will take on a more festive character. On the 30th November 2006, ifak will celebrate its 15th anniversary of the founding of the institute at the Herrenkrug Parkhotel in Magdeburg. On the same day, it will also be the 65th birthday of Prof. Peter Neumann as founder and long-standing head of institute. The honorary colloquium is to include the institute's anniversary as well as the acknowledgement of Prof. Neumann.
For more information check: www.ifak-md.de

"Handing over the batton" Event, April 2005 (Prof. Ulrich Jumar (left), Prof. Peter Neumann (right))

News from kirchner SOFT: releases its new "Logic Comparision" for logiCAD V4.2

Changing POUs is a natural process during the development of PLC applications. The same is true for the maintenance of PLC applications over the years. Tracking changes is supported by logiCAD in multiple ways. Changes are recorded automatically by its change management module, and modifications can be stored in a version control system for later use. Changes are shown online and in the printed documentation as well.
With the new logiCAD version 4.2, a unique functionality will be provided: "Logic Comparison" shows the differences between the PLC applications interactively. Differences are shown in the graphical view of the FBD and SFC editor.
Comparing the graphically programmed logic of one POU with another POU, or with a revision of the same POU from the version control system, is possible.
Tracking changes in the project is made easy for e.g. project reviews supporting quality assurance and re-certification.
For more information check: www.kirchnersoft.com

News from KW-Software: Standard for safe application software

Well-known automation providers work out a standard for safe application software within the PLCopen. The PLCopen Safety Specification is a milestone on the way to the standardization of safety-relevant application software. The PLCopen compliance logo allows users to easily identify software, which fulfils the requirements defined by this, standard. This kind of software is characterized by a high standard of quality.
KW-Software offers already today a scalable safety platform according to IEC 61508 up to SIL3, which meets the quality standard of the PLCopen. On one hand, the PLCopen safety standard defines guidelines for safe programming user interfaces. These guidelines are already met by the safe programming system SAFEPROG provided by KW-Software. On the other hand, the most important safety functions are standardized by means of function blocks. KW-Software, the leading provider of safety-relevant software, will realize 17 of these PLCopen safety function blocks until autumn 2006.
For more information check: www.kw-software.com

More News from KW-Software: Automation Framework with FDT container and runtime system further expanded

KW-Software present the second generation of its component-based development and engineering platform Automation Framework. This platform, which is based on .NET technology, provides many advantages to its users regarding integration, openness and scalability.
KW-Software has developed an integrated development platform on the basis of Microsoft.NET standards with a standardized programming interface (MSIL), which covers functionalities from engineering (Automation Framework 2.0) up to the runtime system (Embedded CLR). Now, KW-Software further expands this platform by engineering and runtime components, such as PLC programming, HMI, Safety and ProConOS eCLR. At the SPS/IPC/Drives, KW-Software introduced an FDT container as Automation Framework component for the first time. The individual components of the entire platform can be used independently and supplemented by own components. The openness is demonstrated not only by the simple integration of own tools, but also by the free choice of the used programming language. KW-Software will further support IEC 61131 programming as well as object-oriented programming using C#. By using components as provided by KW-Software, as well as own components based on the Automation Framework, it is very easy to create scalable automation software applications by means of an XML configuration file.
For more information check: www.kw-software.com

News from Panasonic: New FP-Sigma CPUs available: faster, more flexible, more powerful!

Panasonic Electric Works presents a new generation of CPUs for their successful PLC FP-Sigma series. Technical improvements include: larger program and data memory, faster processing of instructions, expanded instruction set, improved temperature and motion control functions. These features allow you to solve even more complicated tasks and integrate more sophisticated func-

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tion blocks into your program. The FP-Sigma series combines state-of-the-art positioning technology with an extremely compact size and distinguishes itself by being able to communicate via all important media. It is compatible with all other Panasonic controllers and can naturally be programmed with FPWIN Pro, the premier PLC programming software designed according to IEC 61131-3.

The most important features: Large program memory of 32k instructions, large data memory of 32k words (expandable by 1024k words), the fastest processing speed of 0.32µs/basic instruction, communication abilities with up to 3 serial interfaces on the CPU and a compact size (W 30 x H 90 x D 60mm)
By combining the FP-Sigma with the Minas A and Minas A4 series servo drives, you can confidently conquer advanced positioning tasks. Included: software libraries for programming and motion control, certified according to PLCopen.
For more information check: www.panasonic-electric-works.com

News from SEW-Eurodrive: new MOVI-PLC advanced*

The new MOVI-PLC *advanced* from SEW-EURODRIVE, as available from fall 2006, is designed for demanding drive applications. It includes the full functionality of MOVI-PLC *basic* and also offers sufficient power reserves to execute complex online computations, for example, curves to be calculated during operation, multi-axis interpolation and kinematic transformations. Another advantage of the unit is the broad range of interfaces. Two CAN system busses and one Ethernet-based system bus allow optimized and universal control of up to 64 drives from SEW-EURODRIVE and additional CANopen I/O modules. Eight digital I/Os, five of them interrupt-capable, are integrated in the MOVI-PLC unit itself. Two RS485 serial interfaces allow, for example, a DOP (Drive Operator Panel) to be connected. Several interfaces (TCP/IP, Modbus/TCP, Ethernet/IP, PROFINET RT and PROFIBUS DP-V1) are available for communication with a higher-level controller. MOVI-PLC *advanced* is programmed in IEC 61131 in accordance with the PLCopen motion control specification. The IEC program has permanent access to the parameters of all the connected drives and to the complete area of the memory card reserved for the user. In this way, even extended curve or path data and recipes can be stored and managed by the MOVI-PLC. Engineering is possible via RS485, Ethernet or even USB.
For more information check: www.sew-eurodrive.de

News from Siemens: new version of SIMOTION

With its new Version V4.0 of SIMOTION, Siemens is offering a motion control system with new programming, testing and diagnostic functions, making engineering even more efficient.
In addition to the increase in performance, a high degree of significance was given to user-friendly engineering. This means that the engineering and commissioning have been simplified; for instance, the measuring functions in trace allow the position controller to be simply optimized.
The PLCopen functional scope for motion control - including the multi-axis functions – is included in Scout as system functions. These functions and the fact that PLC, motion control and technology have been merged in one environment, makes programming especially simple for the user. Further, it provides extensive system functions that form a flexible and high performance basis to implement all of the different types of production machines. The runtime as well as the associated engineering project can be directly saved on the memory card in the device. This means that the current engineering project in the plant is always available via PROFIBUS/PROFINET.
SIMOTION has 3 different hardware platforms – the controller, the panel PC and the drive. This permits a high degree of flexibility when designing the machine. The performance of the PC-based version has been significantly increased: the SIMOTION P350-3 controls machines with over 40 axes in 2 ms.
SIMOTION D, the drive-based version is directly integrated into the high-performance SINAMICS S120 drive system. In addition to the closed-loop drive control it includes all functions for a full machine control system. Reduced cycle times result in a higher dynamic performance and shorter I/O response times.
The communications performance can be significantly increased using PROFINET. This allows drives to be synchronized in real time in the µs range and at the same time allows standard communications with TCP/IP.
For more information check: www.siemens.com

More news from Siemens: Turnkey embedded automation Microbox 420-T – maintenance-free and rugged in operation

With Simatic Embedded Automation, Siemens Automation and Drives (A&D) has introduced a new control technology to the market. The turnkey and maintenance-free devices combine the openness of PC-based automation with the ruggedness of programmable controllers (PLCs). The controllers are operated without fans or hard disks and the data are stored on easy-to-exchange compact flash cards. The new devices in the compact Microbox PC or Panel PC format are equipped with the Windows XP Embedded operating system as well as a host of typical PC interfaces.
One important member of this new product group is the new Simatic Microbox 420-T, which is suitable for combined PLC and motion control tasks. The device contains the software PLC WinAC RTX with technology functions for dynamic motion control, as well as an isochronous Profibus DP (drive) interface. For engineering the technological tasks, PLCopen-compliant motion-control blocks are used for curve synchronization, say, or print-mark correction, path-dependent or time-dependent cam control and position-controlled hydraulic axes.
The S7 Technology V3.0 option package for Step 7 supports the configuration and parameterization of up to 64 technology objects, put together from up to 32 axes, 32 cam plates, 32 cams, 16 probes or 16 external sensors. In addition to the Profibus DP interface with DP drive profile, the device features another Profibus interface, and the standard PC interfaces Ethernet, USB, COM and DVI/VGA.
The Simatic Microbox 420-RTX is especially compact. With the integral WinAC RTX software PLC, specially designed for PLC applications, the device has two interfaces for Ethernet and one for Profibus, three PC/104-Plus slots, as well as connections for four USB devices, a flat-panel monitor (DVI/VGA) and an RS 232 device.
For more information check: www.siemens.com

PLCopen Voting Members - April 2006

ABB Automation Technologies	Sweden	G&L Motion Control	USA	Rockwell Automation	USA
Advantech	Taiwan	HIMA	Germany	3S Smart Software Solutions	Germany
AMC Europe	Hungary	Honeywell SMS	Netherlands	Schneider Electric	USA
Atos Automaçao Industrial	Brazil	ICS Triplex ISaGRAF	Canada	Selectron Systems	Switserland
ATS International	Netherlands	Industrial Control Systems	USA	SEW-Eurodrive	Germany
Baumüller	Germany	infoteam Software	Germany	SICK	Germany
Beckhoff	Germany	ISG	Germany	Siemens	Germany
Berger Lahr	Germany	Keba	Austria	SMS Demag	Germany
Bernecker & Rainer	Austria	kirchner SOFT	Austria	Stöber Antriebstechnik	Germany
Bosch Rexroth	Germany	KUKA Roboter	Germany	TEAM	Spain
Control Techniques	United Kingdom	KW-Software	Germany	Teco	Czech Republic
Danfoss Drives	Denmark	Lenze	Germany	TNI -Valiosys	France
Digital Electronics	Japan	Matsushita Electric Works	Japan	Toshiba	Japan
Eckelmann	Germany	Mitsubishi Electric Works	Germany	Triconex	USA
Elau	Germany	Omron	Netherlands	Vacon	Italy
ESR Pollmeier	Germany	Ormec	USA	Yokogawa	Japan
ETM profession control	Austria	Panasonic Electric Works Europe	Germany		
Fuji Electric	Japan	Parker Hannifin	Germany	...and Other Non-Voting Members and	
GE Fanuc	USA	Phoenix Contact	Germany	Educational Institutes	

PLCopen Certified Motion Control Suppliers

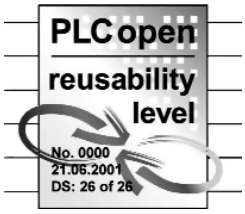
Name	*How to reach them*
Baumüller	www.baumueller.com
Beckhoff	www.beckhoff.com
Berger Lahr	www.berger-lahr.com
Bosch Rexroth	www.boschrexroth.de
B&R	www.br-automation.com
Elau	www.elau.de
G&L motion control	www.glcontrols.com
ICS Triplex ISaGRAF	www.isagraf.com
Infoteam	www.infoteam.de
ISG	www.isg-stuttgart.de
KW Software	www.kw-software.com
Omron	www.omron.com
Ormec	www.ormec.com
Panasonic	www.panasonic-electric-works.com
Parker Hannifin	www.parker-emd.com
Phoenix Contact	www.phoenixcontact.com
3S	www.3s-software.com
Schneider Automation	www.schneider-electric.com
SEW-Eurodrive	www.sew-eurodrive.de
Siemens	www.ad.siemens.com

PLCopen Certified Training Course for IEC61131-3 Programmers

Name	*How to reach them*
Alexandria Technical College	www.camc-online.org
ATS	www.ats.nl
Keba	www.keba.com
KTH Kista	www.kth.se
KW Software	www.kw-software.com
Manchester Metropolitan University	www.mmu.ac.uk
Ormec	www.ormec.com
Panasonic	www.panasonic-electric-works.com
Selectron	www.selectron.ch
Triconex	www.triconex.com
University of Limerick	www.ul.ie/~arc

Certified Products

Product name	*Base Level*	*CL & RL*	*Company*
Codesys	IL & ST		3S Smart Software Solutions
openDK	IL		infoteam Software
openPCS	IL & ST		infoteam Software
ISaGRAF	IL		ISC Triplex ISaGRAF
PUMA	IL & ST		KEBA
MULTIPROG wt	IL & ST		KW-Software
NAiS Control FPWIN Pro	IL,	CL-ST, RL-ST	Panasonic
Melsoft GX IEC Developer	IL, ST		Mitsubishi
MELSEC MEDOC plus	IL		Mitsubishi
RSLogix 5000 V.13		RL-ST	Rockwell Automation
Concept	IL, ST, FBD	CL-ST, RL-ST	Schneider Automation
SELECONTROL CAP 1131	IL		Selectron
S7-SCL	ST	RL-ST	Siemens
Simotion Eng. Sytem Scout-standard	ST		Siemens
S7-GRAPH	SFC		Siemens
Sisteam Servicer (IEC 1131-3)	ST		TEAM



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100 .. 1000	€ / US$ 5,500	€ / US$ 2,750	€ / US$ 1,100		
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				€ / US$ 900	€ / US$ 50

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Chinese version	15 / 19	15 / 19
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