

SERCOS.NEWS

The Real-Time Ethernet Magazine



***25 Years of SERCOS: With Tradition
and Innovation into the future***



Intelligent positioning system with
SERCOS III interface



Easy integration of robotics
into SERCOS III



Pneumatic valve system for
SERCOS III networks



SERCOS III Slave Stack



SERCOS III is a communications technology based on IEEE 802.3 and designed for 100 Mbps. A time slot method is used to transfer data deterministically and collision-free.

SERCOS has particular application where processes must run precisely and highly synchronous. A synchronization flag sent by the master is used for synchronization. All time-related activities in the master and the slaves are synchronized as per flag.

As one of the first stacks in general, the SERCOS III slave protocol stack, which already has been employed successfully in a variety of SERCOS III devices of well-known manufacturers, was made available as freeware after the Hannover Tradeshow 2010.

25 YEARS SERCOS
TECHNOLOGY:
CONGRATULATIONS!

25 years of SERCOS: The success story continues



The success of the SERCOS interface is certainly way beyond the wildest dreams of the pioneers of SERCOS 25 years ago: their results have been accepted across the world and repeatedly characterize innovative automation concepts in a large number of different industries and applications.

Initially there was a narrowly defined objective: the drive and control system suppliers wanted to define an open standard for the upcoming digital drive technology together with the machine manufacturers, with hard real-time capability as the ultimate benchmark.

The SERCOS founders consciously decided on an open, manufacturer-independent standard in order to provide for long-term future reliability. The plans worked out. In

only three generations the hard real-time mechanisms still mark the state of automation engineering. A constantly increasing number of drive, control, and peripheral manufacturers support this worldwide standard, providing designers with a unique degree of freedom for new ideas.

Although SERCOS was initially designed with a focus on machine tools, other industries recognized its advantages very quickly as well. Whether it's printing machines, the semiconductor industry, or applications in the food and packaging industries, designers repeatedly prefer and use SERCOS for innovative machine and automation concepts off the beaten track.

Naturally, SERCOS has developed further and incorporated technical advances at all times during its 25 years. For example, SERCOS III combines the approved real-time mechanisms with Ethernet physics, thus again increasing its acceptance in the fields of mechanical and plant engineering. As the universal and open automation bus, SERCOS combines powerful motion and logic applications with current safety concepts and a broad range of peripherals.

SERCOS International considers the 25th anniversary as recognition of past success and commitment to the future. We will continue the success story of this open real-time standard - and we are looking forward to pushing the limits of the technologically feasible together with machine and plant manufacturers in the upcoming years and decades as well.

Enjoy reading!

Dr. Bernd-Josef Schäfer



SERCOS International organizes seminars and workshops all over the world

With Tradition and Innovation into the future 25 Years of SERCOS – A glance into the past

For numerically controlled machines, digital intelligent drives offer maximum precision and speeds while minimizing equipment costs. A high performance digital interface is required to make use of these advantages. SERCOS was originally developed as a dedicated drive interface. However, during the last two decades SERCOS has advanced to become a universal real-time communication interface for all types of automation applications.

The history of SERCOS

The history of SERCOS goes back to the middle of the 1980s. In autumn 1985 the ad hoc working group "Machine Tool Interface" of the VDW (German Machine Tool Builders Association) and the ZVEI (German Electrical Standards Association) published an updated version of the analog drive interface, better known under the name ± 10 V command interface. At that time, this was the only standardized interface to connect speed-controlled drive units to numerical control systems.

As servos began to evolve into digital-based devices, they soon exceeded the capabilities of the ± 10 Volt interface. To circumvent the restrictions of the analog velocity command interface (e.g., high noise voltage, limited resolution, drift offset and lack of communication between NC and drive), various proprietary CNC-drive interfaces emerged. Although they each solved some of the problems, they also created new

ones. Foremost was that the openness and portability of the ± 10 Volt interface was lost. Products were developed that depended upon not just a particular type of servo technology, but even a particular vendor's product. The situation clearly demanded a new standard. The charter of the initiators of the "Digital Drive Interface" working group was to design and develop a next-generation open interface between drives and controls that included the expanded opportunities afforded by digital technology. A competent team consisting of machine tool builders plus drive and control manufacturers started the work and created the SERCOS interface concept as the first standardized bus system between the numerical control and the drives.

The SERCOS Organization

In 1988, the concept of a synchronous transmission system with the most important drive functions was defined. The common

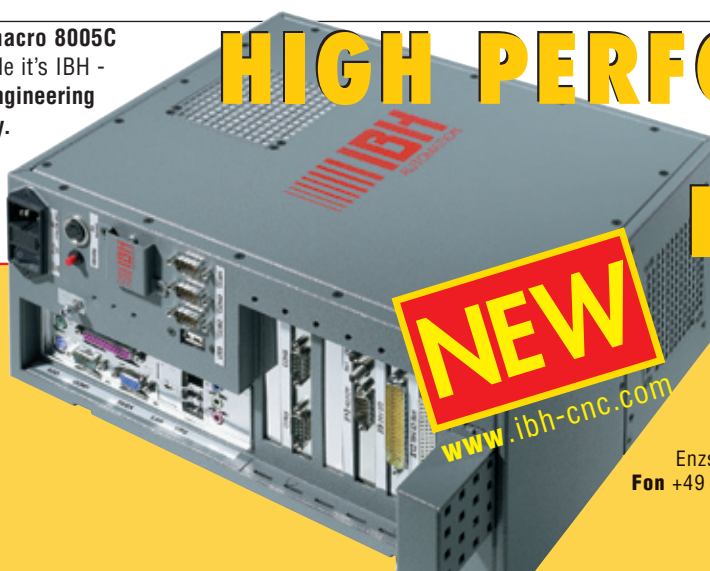
intention was to offer a standard ASIC controller as the basis for SERCOS master and slave implementations. Money was needed for this; therefore the SERCOS Association was founded. Its members committed to not only finance the SERCOS idea but also to jointly support the promotion of SERCOS. The worldwide SERCOS organizations today cooperate under the umbrella of SERCOS International (SI). As an association of users, manufacturers and research organizations, SI is responsible for the technical development, standardization, certification and commercialization of SERCOS technology. SI offers conformance testing to help ensure that products built to its specifications operate in multi-vendor systems. The organization, with its headquarters in Germany, presently has more than 60 member companies all over the world as well as branch trade associations in North America and Asia.

The three SERCOS generations

The first generation of SERCOS interface was presented to the public at the EMO tradeshow in Hannover, Germany in 1989. It supported transmission rates of 2 and 4 Mbit/s and was mainly used in advanced machine tool applications. In the following years SERCOS became more and more

OK, we agree that the new macro 8005C looks unspectacular, but inside it's IBH - to the core elaborated CNC-engineering in high class industry quality. The 8005C (compact) with scalable CPU accomplishment affords full performance in small space.

Due to the compact dimensions the macro 8005C is also optimally dedicated for retrofitting.



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	SERCOS I	SERCOS II	SERCOS III
Date implemented	1987	1999	2005
Physical media	Fiber optics	Fiber optics	Ethernet (twisted-pair copper or Fiber optics)
Network topology	Ring	Ring	Line or Ring
Transmission speed	2/4 Mbit/s	2/4/8/16 Mbit/s	100 Mbit/s
Cycle time	configurable, minimal 62,5 µs	configurable, minimal 62,5 µs	configurable, minimal 31,25 µs
Jitter	< 1 µsec	< 1 µsec	< 1 µsec
Synchronization	Hardware synchronization		
Basic protocol	HDLC		Ethernet
Real-time protocol	SERCOS		
Hardware redundancy	No	No	Yes, with ring topology
Direct cross communication	No	No	Yes
Comm. and Synchr. Between control systems	No	No	Yes
Service channels	Yes	Yes	Yes
Optional NRT channel	No	No	Yes
Hot-Plugging	No	No	Yes
Number of Masters	1 per ring	1 per ring	1 per ring/line
Number of Nodes	254 per ring, multiple rings possible	254 per ring, multiple rings possible	511 per ring/line, multiple rings/lines possible

Direct comparison of the SERCOS generations

accepted worldwide and was used in all kinds of different servo-driven applications. In 1995, the SERCOS interface was established as international standard IEC 61491. The second generation was launched in 1999. The transmission rate was increased to 8 and 16 Mbit/s and the service channel for the transmission of asynchronous data was extended. This new technology has been available since 2001, based on the

SERCON816 ASIC, while downward compatibility with the first generation was maintained.

The third generation of SERCOS (SERCOS III) was introduced into the market in 2005. Its recipe for success is the combination of the proven mechanisms of SERCOS with the physics and protocol of standard Ethernet. This offers new and innovative options for the automation technology of the future.

Thanks to its technical abilities and its widespread use, SERCOS has become the de-facto standard in many industries, especially for highly dynamic servo applications with many axes. The hardware-based synchronization is the indispensable prerequisite for the reliable implementation of challenging motion applications, such as electronic line shafts in printing machines, packaging machines and multi-axis machine tools. Although SERCOS was initially designed as a dedicated drive interface, it has since then mutated into a universally applicable automation network. This is because SERCOS not only defines a real time communication system, but also specifies a large number of parameters which provide vendor-neutral semantics for the interoperability of controls, drives, I/Os and other peripherals. Consequently, most standalone machines and systems using SERCOS do not require an additional fieldbus. Today, more than 2.5 Million SERCOS nodes are installed worldwide in over 350 thousand applications.

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Milestones:	
1985	Ad hoc "Machine Tool Interface" working group was formed
1989	Premiere of SERCOS at the EMO (European Machine Tool Show) in Hannover, Germany
1990	Foundation of the SERCOS Association (FGS), which is today SERCOS International. Founding members: ABB, AEG, AMK, Bosch, Indramat and Siemens.
1990	First SERCOS testing laboratory at the Technical University of Darmstadt, Germany
1994	Foundation of SERCOS North America
1995	Release of International Standard IEC 61491 (SERCOS I)
1998	Foundation of SERCOS Japan
2001	New testing laboratory at ISW, University of Stuttgart
2002	Release of 2nd Edition of International Standard IEC 61491 (SERCOS II)
2003	SERCOS III development begins
2005	20-year anniversary celebrated at EMO in Hannover, Germany
2006	Cooperation between SERCOS International and ODVA to develop CIP Safety on SERCOS
2007	Acceptance of SERCOS III as International Standards IEC 61784/61158 and IEC 61800-7
2007	Two million SERCOS real-time nodes installed worldwide
2007	Opening of SERCOS office in China
2008	Cooperation between SERCOS International and FDT Group, resulting in the FDT/DTM Annex for SERCOS III
2010	25 Years of SERCOS



*Semiconductor applications:
Time-stamping opens up new
communication options beyond
the fixed clock cycle and allows
the evaluation of a variety of
process parameters.*

SERCOS – a future-proof standard: broader, deeper, more universal



Additional functions and a broad selection of devices for new applications

New functions in the application layer for a variety of types of devices, and an ever larger availability of controllers; electrical, hydraulic and pneumatic actuators; and numerous peripheral devices expand the range of SERCOS III applications into a universal network for automation technology. This makes the internationally accepted standard for Ethernet-based real-time communication easier to use in complex applications such as semiconductor manufacturing and in entire production lines in the food and packaging industries.

The future has a past. Over twenty years ago, drive and control manufacturers developed SERCOS as a means to advance the benefits of decentralized automation structures through internationally standardized real-time communication. What nobody dared to hope for back then is that 20 years later, SERCOS III, the worldwide recognized standard, still uses the same hard real-time mechanisms that have since proven themselves in several million nodes. This goes to show that non-proprietary

systems are more stable and long-lived than proprietary systems. The state of the art for demanding real-time communication has been characterized by only three technology generations in two decades. In the third generation – SERCOS III – the proven real-time mechanisms are combined with the Ethernet physical layer, thereby opening up additional areas of application. At the same time, SERCOS has been changing from the original controller-drive communication into a universal bus for decentralized and centralized automation concepts.

Broad spectrum of industrial automation applications

While in the early stages the focus was mainly on the requirements of machine tools, newspaper printing presses were starting to take advantage of SERCOS' high synchronization performance as early as the mid 1990s. The electronic line shaft revolutionized web-fed printing press engineering by enabling the switch to a much more flexible and productive technology using individual drives. Likewise, numerous manufacturers of machines for the food and beverage industry and pack-

aging machines were quick to recognize the advantages of real-time communication and replaced mechanical solutions by software-controlled drives communicating via SERCOS. Software functions such as electronic cam switches, cams, print mark and tension controllers increase flexibility in automation technology and significantly reduce changeover times.

Currently, engineers developing robots, semiconductor manufacturing machines, and complex special applications are working on new concepts with SERCOS III as the universal bus of choice. Aside from the technology's proven long life-cycle and the resulting return on investment – with over 60 companies around the globe supporting SERCOS with controllers, drives using a variety of technologies, and peripheral devices – new functionalities and an expanded range of drives allow for a greater degree of freedom for innovative concepts.

Transparent data access to all drive technologies

Following the lead of electronic drives, hydraulics and pneumatics are also turning more and



Flexibility is the key. SERCOS is already well established in the food and packaging industries.

more towards digitally controlled modules. This increases flexibility and shifts tasks previously solved by mechanical means to software solutions. SERCOS translates these advances into consistent automation structures. Thus, hydraulic and pneumatic drives using SERCOS interfaces are unifying communication across different technologies.

New functions in the application layer

At the same time, SERCOS developers are working on increasing process stability and precision through new functions in the application layer. They are also focusing on new applications in robotics and semiconductor

manufacturing. Two areas of concentration are transmitting more information per clock cycle and transmitting event-controlled information independently from the fixed clock cycle.

The new oversampling function in SERCOS III makes it possible for the first time to transmit more than one target/actual value per clock cycle. This increases the process control intricacy in extremely time-critical laser applications for instance, because it allows for more data to be collected and communicated at a faster speed. Measurement methods are integrated directly into the protocol, thereby opening up the possibility to access these mechanisms across different manufacturer's

equipment and independently of the product. Likewise, time-stamping opens up new communication options beyond the fixed clock cycle. This function is event-controlled, promptly transmitting defined events such as certain measurement values to the controller and switching outputs independently from the clock cycle. This increases process stability in complex solutions such as those in semiconductor manufacturing for instance, where controllers tailored specifically to the semiconductor and solar industry process the signals from up to 120 digital and analog I/Os in real-time. Unlike most other industrial production processes, the production of semiconductors requires numerous process steps to be carried out in a vacuum or under inert gas. Automation solutions must therefore simultaneously record, evaluate and react to numerous sensor signals. Oversampling and time-stamping are important additional functions that increase process stability.

Straightforward engineering

In addition, SERCOS simplifies the entire engineering process by offering a harmonized and consistent semantic both for devices with a modular physical structure such as modular I/Os, and devices with a non-modular physical structure, such as drives. This functionally oriented device classification harmonizes engineering and diagnosis within industrial automation. It lets users and programmers simulate the automation offline prior to going live, which in turn shortens time to market.

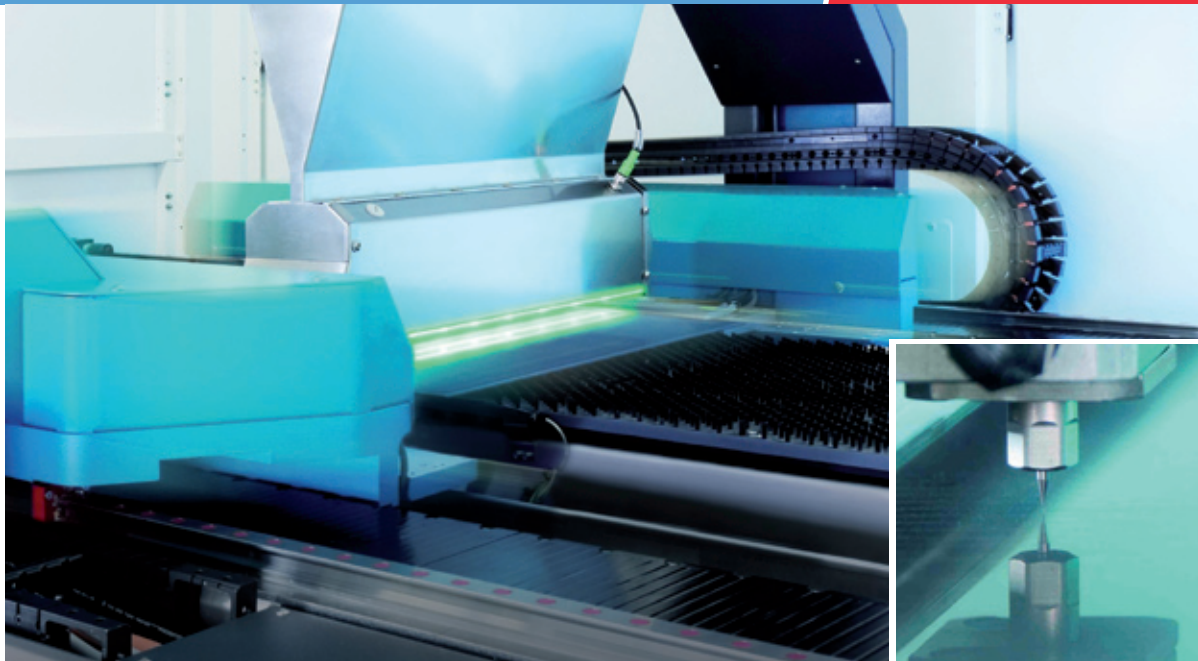
One special feature of SERCOS III is real-time cross-communication between controllers. This drives modularization in mechanical and plant engineering. The controllers of various modules and machines simply have to be connected through SERCOS III via an Ethernet cable in order to synchronize and exchange information with each other in real-time.

This even more intricate flow of information due to oversampling, time-stamping, and real-time cross communication between controllers points the way to the future. The broad support by many independent manufacturers continues to expand the technical performance and universal applicability of SERCOS on an ongoing basis. As a result, there will be further growth into new applications as the SERCOS organization enters its third decade.

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Manz laser and mechanical scribing systems

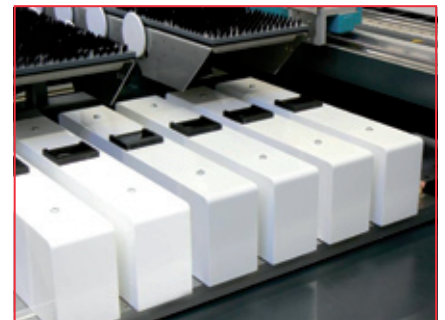


Manz scribing systems and SERCOS III – maximum thin-film module efficiency

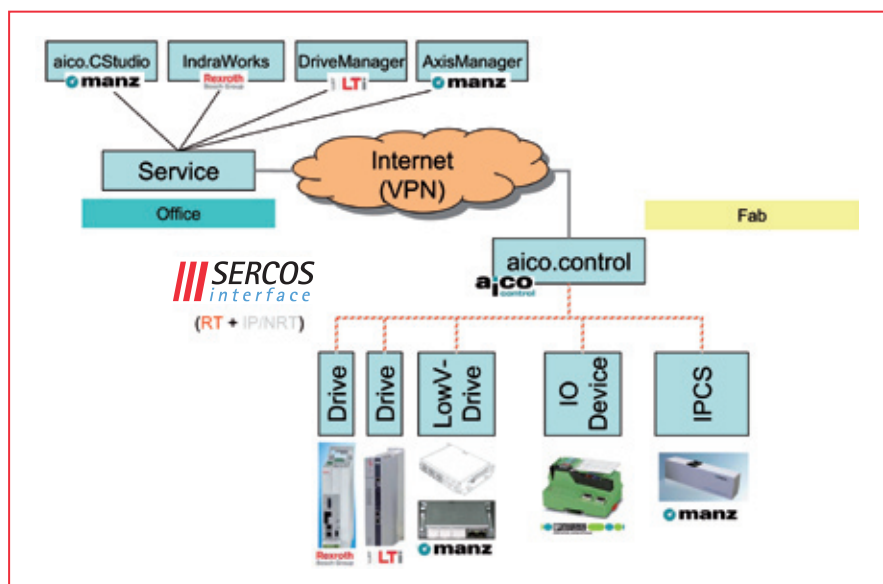
With an installation base of more than 100 machines, Manz Automation AG is a market leader in scribing systems for thin-film technology. In this technology, very thin layers are applied to a glass surface; two conductive layers as well as the absorber layer. This promises to be a leading in large scale photovoltaic modules. Manz scribing systems are available for various processes: not only mechanical (CI(G)S: P2, P3) but also laser-based (P1, P2 and P3) scribing operations can be performed with maximum precision on Manz systems.

Since efficiency of solar modules is key for a shortest return of investment, module manufacturers are strongly looking into process optimization. One approach for increased module efficiency is to minimize the dead area of solar modules. By using the Manz proprietary active tracking system IPCS (the Manz Inline Precision Control System), it is

possible to achieve a dead area of $< 200 \mu\text{m}$. This unique feature was introduced to the market in 2009 and has been successfully sold to numerous customers. This is a milestone compared with other systems on the market, where the dead area is approximately $150 - 300 \mu\text{m}$ above this figure. The other advantages of Manz scribing



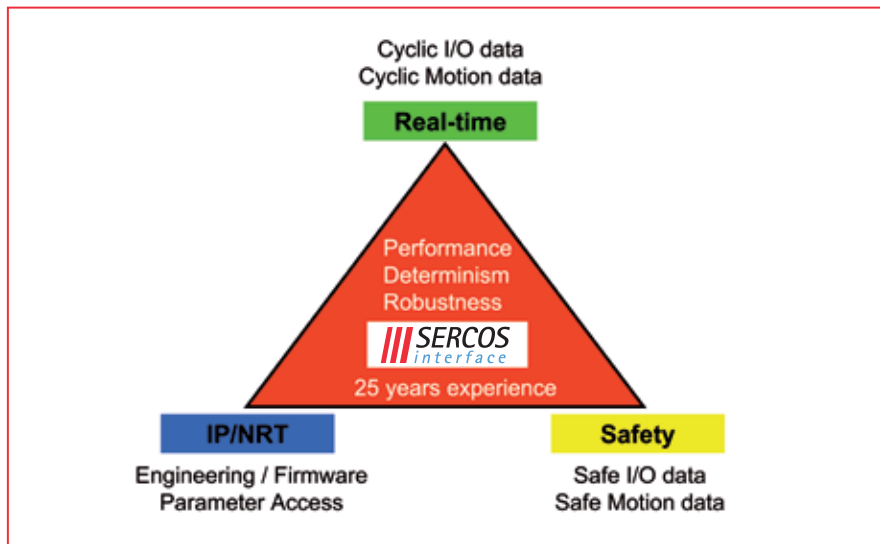
Manz Inline Precision Control System



Transparent access via SERCOS III IP/NRT channel

systems can be seen in their low operating costs. Highest throughput and maximum efficiency are highly appreciated by our long-standing clients. In particular, exact parallel processing, which guarantees a reduction in cycle times with consistently high quality, makes a major contribution here. Inline monitoring, which is important for purposes of quality assurance, reduces non-productive times to a minimum. Besides the highly accurate processes and the high quality of the products, the well thought-out and flexible design of the systems is remarkable. It allows easy integration into fully automated production lines as well as the use of our tools for different scribing applications (i.e., scribing of a semi-transparent pattern on a TF-solar module (BIPV) and scribing of "standard pattern").

The next logical step for Manz was to establish a comparable solution for mechanical scribing tools. With the newly developed M-IPCS (active tracking for me-



All data and signals transferred via SERCOS III

chanical scribes) a 100% online control of the scribing process takes place. Each mechanical scribing tip has its own camera & control system which aligns the P2 or P3 scribe to its corresponding P1 (P2) scribe. This active mechanism enables customers to minimize the dead area and compensate for substrate warp and distortion which might be induced by thermal treatment – during coating – of the glass substrates. This unique M-IPCS will immediately lead to an increased module efficiency of Cl(G) S coated thin-film solar panels.

The compact design of any individual M-IPCS scribing head offers the chance to use multiple needles operated in parallel. Consequently, this will lead to a much higher throughput in the fab.

In 2010 the SERCOS II motion bus has been replaced by the SERCOS III system bus to achieve higher realtime bandwidth and optimum integration of machine control, IPCS and other field devices. Along with its outstanding realtime performance, SERCOS III allows direct TCP/IP access with engineering and diagnostic tools from the desktop into the servo drives, IPCS and other field devices to achieve optimum service capabilities and minimum down times. Due to the available bandwidth SERCOS III provides the opportunity to integrate all fieldbus based devices on a single bus and is another contribution to clear system structure and reliability. SERCOS III is ready for the fieldbus-independent CIP Safety protocol relevant for safe control of servo drive systems and laser sources. It will reduce total cost of ownership and additionally increase system reliability.

Manz scribing systems are characterised by:

- Highest throughput and efficiency:
 - more than double the throughput of

most competitors due to number of tools in parallel and scribing speed

– lowest non-productive times due to on-line alignment, loading and unloading in parallel, and ease of maintenance

– accuracy/precision during scribing (alignment procedure; mechanical design of the stage; control)

- Most robust process due to active force adjustment of scribing needle
- Smallest dead area due to inline precision control (closed loop)
- Highest performance, serviceability and reliability due to SERCOS III system bus

Manz scribing systems have been a pilot project for the SERCOS III technology. Due to the positive experiences, the company is in progress to equip additional product lines using this technologically – leading Realtime-Ethernet fieldbus.

The main reasons to select SERCOS III as a system bus can be summarised as:

- Maximum realtime performance, practically jitter-free
- Most consistent fieldbus specification to achieve optimum interoperability
- Independent standard, technology belongs to the standardization organization
- Maximum Ethernet conformity on every device due to built-in switch

Through additional activities Manz is motivating device manufacturers to invest into this future-safe fieldbus standard for high-performance production machines.

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Heterogeneous SERCOS III servo drive configuration

Easy automation!

The image shows various Phoenix Contact automation components arranged on a light blue grid background with puzzle piece shapes. The components include: a silver monitor with 'PHOENIX CONTACT' on the bezel; a green terminal block; a green safety relay with a black push button; a yellow safety relay; a green safety relay with a black push button; and a green safety relay with a black push button. The components are arranged in a way that suggests they are easy to integrate into a system.

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Cimcorp TyrePick+ Makes Tire Manu- facturing Fit for Energy Efficiency

The tire industry is booming worldwide and manufacturers are building up new capacity in all the key markets. Finnish-based company Cimcorp Oy developed its new TyrePick+ gantry specially for tire handling and placed its faith in the SERCOS III open standard for the system. With a thirty percent boost in performance, it reduces energy consumption by forty percent.

Gantries are used in tire manufacturing for the task of stacking and transporting the blanks and finished tires. TyrePick+ from Cimcorp is the world's first plant of its kind that can feed the braking energy back into the DC link or supply system using Rexroth intelligent energy management. Designed as a gantry axis, the bridge can cover a maximum length of 14 meters. In the



The world's first gantry with energy recovery capability for the tire industry.

Z-axis the bridge holds the gripper, which can pick up between one and ten tires, depending on their diameter. The X-axis traverses a length of up to 80 m. The bridge is made entirely of aluminum. This results in considerable weight savings compared to the previous version in steel, without any sacrifices in rigidity. Less mass translates into less energy required for the drives and better dynamics.

Not only were the mechanical elements redesigned, Cimcorp also brought the automation up to the latest standard together with system supplier Rexroth. For the communication protocol the Finnish-based company opted for SERCOS III. Synchronization between the master drive of the drive-based IndraMotion MLD control system from Rexroth and the slave drives, of which there



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can be up to seven, and between several drive-based control systems, is realized in hard real time through Sercos III with a clock-pulse rate of up to 250 μ s. The real time rapid cross communication, C2C, allows control networks to be set up quickly without the need for a higher level central control unit. This provides greater freedom for the modularization of machine concepts and makes integration in existing automation environments easier.

In terms of engineering, the commissioning engineer has access to the NRT channel of SERCOS III at all times, irrespective of the cyclical communication process. Any free port can be used for engineering purposes. The IndraMotion for Handling system solution used by Rexroth supports this convenient function with consistent engineering tools for the control system and the drives. The drive-based control system implements a "point to point" movement. This allows users to execute larger blending movements

dling tasks by way of a PLC. Even complex motions for assembly and handling can be programmed and taught in by the user from a handheld control unit. Rexroth incorporates IndraLogic open sequence control, compliant to IEC 61131-3, in IndraMotion for Handling, as is the case with all of its controllers. The common elements of the IEC 61131-3 standard ensure that, once created, program components can be reused even at different levels of automation, from PLC in the drive to PC-based control. As a result, users can conveniently call the motor functions as finished function blocks and assign variables as required. These blocks enable cyclic and acyclic access to all Motion Control parameters, providing a very wide scope of freedom for material handling. As so often, SERCOS has once again managed to establish new applications beyond the boundaries of mainstream solutions through an innovative machine manufacturer, in this case Cimcorp. Particularly im-



IndraMotion MLD combines highly dynamic servo technology with powerful Motion Logic.

and therefore save time during positioning. In addition, Cimcorp is committed to energy recovery. Recuperation ensures that braking energy no longer simply goes to waste as heat. Instead the Rexroth servodrives with energy recovery capability switch the motors to generator operation during braking and feed the electricity that is generated back to the system or supply network. By harnessing this energy and leveraging the reduced weight of the bridge, 40 percent less energy is consumed than with the previous TyrePick robot. At the same time, the reduced weight, innovative motion control system and Rexroth drives boost performance by 30 percent compared to the predecessor model. The IndraMotion for Handling turn-key automation system resolves challenging han-

portant is the fact that the SERCOS open standard enables TyrePick+ to be integrated in both new and extended production plants for tire manufacturing equally quickly and, by increasing energy efficiency, helps to significantly reduce CO2 emissions.

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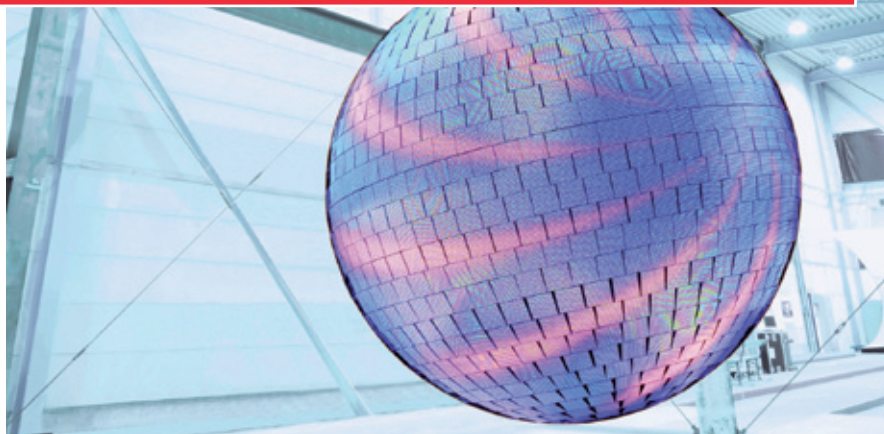


*High-tech pendulum
driven by SERCOS drives*



EXPO 2010 Shanghai China: Visitors get German Technology Swinging

Claps, shouts and screams – by making loud noises, visitors to the German pavilion at EXPO 2010 Shanghai, China can set a sphere on the end of a pendulum in motion. Clad with 400,000 LEDs and measuring three meters in diameter, the sphere delivers a scintillating flood of images to match its movements. The drive solution of the high-tech pendulum relies on proven drive and linear motion technology that has been designed for more than one million cycles – enough for the more than 10,000 shows during the world exposition.



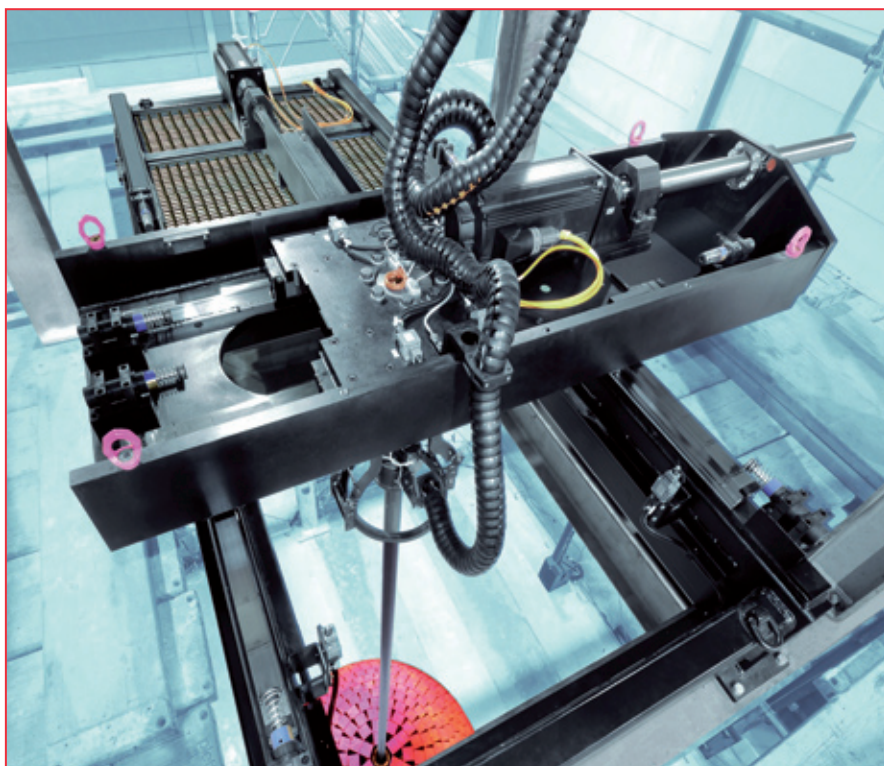
The German pavilion has adopted the EXPO motto "Better City, Better Life" and has presented its interpretation as "balancity" – a city in balance between renewal and preservation, innovation and tradition, urbanism

and nature.

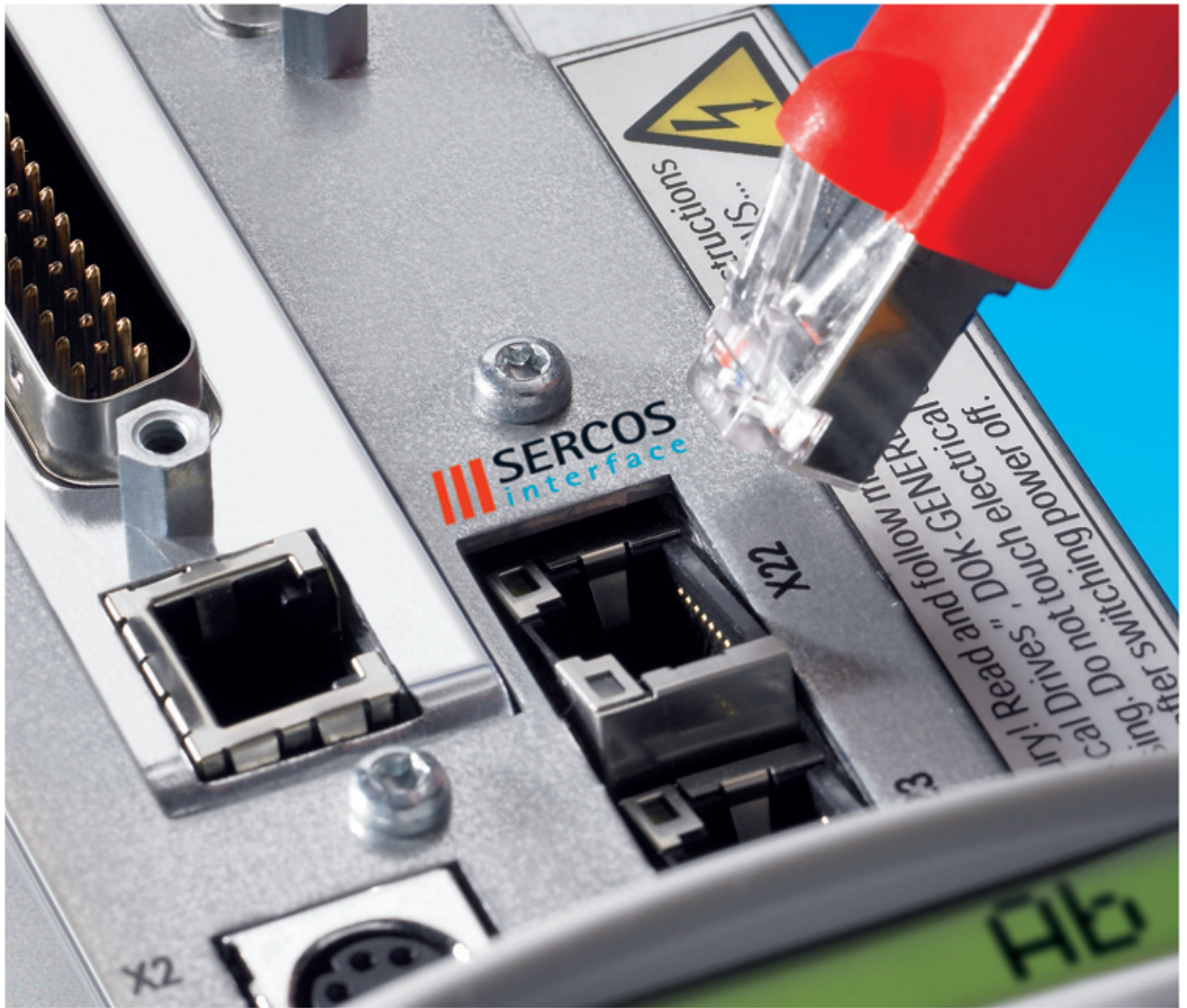
The crowning experience at the end of the circuit through the pavilion is the "Energy Source" with the interactive pendulum. From their positions on three galleries, the visitors

can initiate and steer the oscillations of the 1.2 ton interactive sphere by making noises, until the sphere ultimately swings along a perfectly circular path. This is enabled by an X-Y cross slide mounted under the roof, which moves the pendulum shaft via a cardan (universal coupling) joint. The slide consists of four roller rail systems measuring just under 1,800 mm long, each with two long size 65 runner blocks. They give the system its extremely high rigidity and ensure the long life required for travel at sometimes extremely short strokes. One of the guide rails in each axis features an integrated inductive measuring system for the ball and roller rail systems. The guide and the measuring system act as a single unit. A sensor on the runner block inductively measures the relative position in resolutions of up to 0.25 μm . Two servo drives position the two axes with high dynamics via ball screws and communicate in strict real time with the PC control system via SERCOS. The modular drive generation has many drive-integrated safety functions already certified per ISO 13849.

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X-Y cross slide consisting of roller rail systems with integrated measuring system and ball screw drives



What all have
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SERCOS III – the independent real-time high-performance fieldbus.

Our customers deservedly expect only the very best solutions for drive and control technology. The core for such solutions is a comprehensive communication system. This is why we actively support the development of SERCOS III. It incorporates two standards: the proven real-time mechanisms and the internationally established Ethernet technology.

Bosch Rexroth. The Drive & Control Company



Selection of connectors
for SERCOS III

Network cabling with SERCOS III



Synchronous drives, fast I/Os, comprehensive communication and the demand for consistent solutions determine today's production environment. SERCOS III provides an Ethernet-based communication system whose success is due, among other things, to the cabling concept with its design rules, components and adapted topology.

Experience with fieldbus systems has demonstrated the advantages of line topology that can be set up in Ethernet systems using the integrated switches within the devices. SERCOS III also makes use of a ring structure in order to increase network availability in demanding applications, for instance. The connection between two active devices and their passive components is defined as a channel whereby class D with components according to category 5 was specified for SERCOS III.

Two component classes

Industrial Ethernet is often subject to harsh operating conditions. Components for electrical connection must function perfectly under adverse conditions. Therefore, the envi-

ronmental conditions in which a system must function must be considered together with the transmission-related properties during selection of the cabling components. In the interest of safe planning, SERCOS III differentiates between two classes of components: light duty for installation in control cabinets and heavy duty for installation directly in the field.

Because of its simple planning possibilities, the reference installation model (figure 1) is often used in building installation. It stipulates that a certain quality is attained by the arrangement and use of certain components. For example, category 5 components for symmetrical cabling result in a class-D channel (figure 1) that is suitable for transmission of Fast Ethernet. In this case, the flexible lines – also known as cords – can have a maximum length of 10 m while permanently installed (fixed) lines can have a maximum of 90 m, for a total maximum channel length of 100 m. Since the transmission properties of flexible lines are inferior to those of fixed cables, length ratios must be complied with. The use of higher-quality components, for example category 6, or the reduction of channel length to compensate for longer more flexible lines

is theoretically possible, but is more difficult to calculate in practice.

Installation model with simple rules for SERCOS III

If the reference model described were to be applied to the diversity of situations in industrial communication, a much higher need for planning would be required and the result would also be a higher susceptibility to errors. For this reason, experts at the SERCOS International user organization have developed an installation model that allows the user to build his network using selected components with the help of simple rules, and without calculations. All channel lengths can be attained with fixed and flexible cables in any combination and partial lengths using the defined cable types. Plug-in connections within the channel can be implemented in a variety of ways according to industrial operating conditions, as long as the limit value of four plug-in connectors is not exceeded (figure 1).

In the case of SERCOS III, symmetrical data transmission is designed to ensure that one channel is always set up with an AWG22 wire cross section. Any combination of solid (type A), stranded (type B) or even special cables (type C) is possible. Furthermore, plug-in connectors, panel feed-throughs, couplers and installation boxes can be added as desired. Individual connector socket transitions such as those in outlet boxes in the structured building cabling are also possible. In addition, panel feed-throughs with two sockets – otherwise known as bulkheads – can also be implemented. They are considered as two plug-in socket transitions as long as the manufacturer has not classified them as one component.

Also suitable for drive technology

In contrast to generic cabling with eight wires in a twisted pair layout, SERCOS III uses a star quad optimized for 100Base-T, in which all four wires are twisted together.

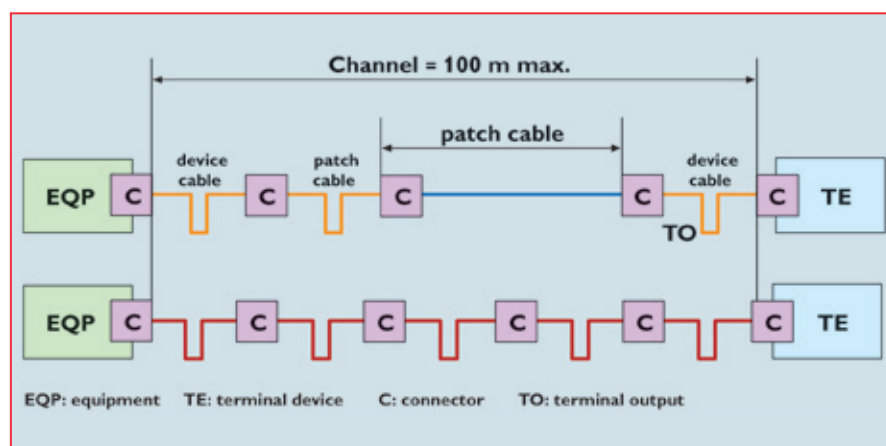


Figure 1: In the case of generic cabling, the structure of the channel is based on the reference installation model (above) – the structure of the channel in an industrial network with SERCOS III enables flexible topologies as well as simplified routing of cables between the active devices (below)

Industrial Ethernet Module

All cables are shielded and optimally adapted to the SERCOS III defined connector for immunity to interference.

EMC influences play an important role in the industrial environment. Cabling with SERCOS III is particularly demanding in drive technology with its strong electromagnetic fields, high currents and high-frequency interference from frequency inverters. High coupling attenuation of 80 dB for lines and connectors is specified to ensure a high level of noise immunity.

In the case of optical channels, the behavior is similar. The 1 mm polymer (POF), polymer-cladded silica (PCS, also referred to as HCS), glass fiber multimode (GOF-MM) and glass fiber singlemode (GOF-SM) fiber types used in industrial applications are all suitable for SERCOS III networks. Possible channel lengths range from 50 m (POF), 100 m (PCF), 2000 m (GOF-MM) up

versions suitable for the industrial market are able to accommodate the AWG22 wire cross section and comply with the required shielding properties. The rugged SC-RJ was selected as optical connector. Its narrow design with a ferrule diameter of 2.5 mm enables connection of all fiber types and faster connection methods for field assembly. For example, in the case of the POF fiber, it is only necessary to cut the fiber and fix it in a quick clamping sleeve. The compatibility of the SC-RJ with the widely available SC connector is also an advantage during startup and diagnostics. Remote automation in the field requires heavy duty components. In addition to the M12 connector that is popular for I/O modules because of its small design, the Push-Pull connector concept is supported for electrical and optical data transmission. Communication takes place via the

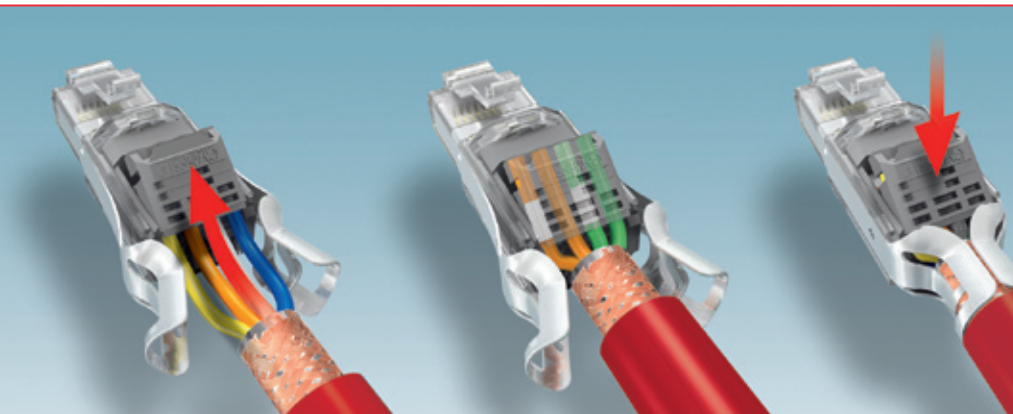


Figure 2: Insert wires, cut, close flap – the RJ45 connector is easy to assemble in the field

to 14,000 m (GOF-SM). Both optical connections at the connecting point of the active devices and passive connections in the channel contain optical transitions and, are therefore considered as a plug-in station. In the case of the POF channel, a reduction in length of 7.5 m per connector in the channel must be considered due to attenuation. The connectors and wires in the cable are marked with arrows indicating the direction of data transmission to avoid any confusion.

Solutions for light duty and heavy duty

The demand on SERCOS III cabling (figure 2) is that it handles all fields of application with a low variety of types. A further requirement is the on-site assembly, which plays an important role in industrial installations. In the case of light duty installations, the familiar RJ45 connector used in the office environment is also used for electrical data transmission using symmetrical cables. Note however that only

same RJ45 and SC-RJ systems as in the IP20 (light duty) installation. The components are also suitable for the IP67 degree of protection because of the additional protective housing. Assembly via fast connection methods is always the same and is convenient for the user (figure 3). A consistent installation system for all environmental situations considerably simplifies the work for all involved.

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Quick-Info 2-0008 ▼



andronic 3060 CNC now also supports SERCOS III

www.andron.de

CNC with SERCOS III interface

With its new CNC generation, the andronic 3060, andron offers a multi-processor system with modular power adjustment, integrated soft PLC and proven Microsoft® Windows XP technology. High reliability, openness and flexibility is provided through the use of selected industrial PC components, the standard digital SERCOS II or III real-time interface and standard fieldbus interfaces. The core of the andronic 3060 consists of two powerful Intel® processors that have a PCIe to PCIe bridge for communication with each other. One processor is responsible for controlling the NC kernel (NC machine) and the other is responsible for the operator interface (HMI-PC). The separation of functions allows a decoupling of the processes and guarantees an uninterrupted work flow at the NC level. At the HMI level, the required performance for data handling and other actions is available - independent and completely separated from the NC kernel. Thus, loss in speed or interruption of real-time processing is avoided.

andron®
 pioneering PCNC

Quick-Info 2-0009 ▼



Modular SERCOS III based axis control for linear motors and rotary drives

www.linmot.de

Linmot E1200 Servo Controllers with SERCOS III interface

Series E1200 servo controllers are modular axis controllers, with 32-bit position resolution and an integrated power stage, for linear motors and rotary drives. The controllers are suitable for simplest, standard, and high-end positioning tasks, across the entire force range of the LinMot product line. The controllers offer a compact form factor and maximum flexibility for integration in different controller and drive concepts. By supporting a wide range of different fieldbus systems, the Series E1200 servo controllers can be actuated by machine controls from any manufacturer. Since all controllers have the same motion command interface, and the control and status words are identical, software blocks that have been implemented once can be transferred to other controllers without a problem.

LinMot®

Quick-Info 2-0010 ▼



Intelligent Positioning with SERCOS III

www.halstrup-walcher.de

SERCOS III for intelligent positioning systems

SERCOS III drives from halstrup-walcher can be seamlessly integrated into real-time Ethernet solutions for industrial automation. More than 100 adjustable axes can be precisely synchronized with each other. The network coverage is almost unlimited and the handling is very easy. Due to the low cost of the controllers, the interface costs are low. halstrup-walcher positioning systems offer adequate solutions for the automatic adjustment of machine formats. In addition to higher productivity, setting errors are avoided and a high degree of accuracy in regard to process safety is guaranteed. A special feature is the stainless steel design for food and clean room applications. In protection class IP 68, the drives are washable and resistant to liquids such as bleach and therefore ideal for use in the food and beverage industry. In clean room applications, the premises need not be entered in case of format changes on machines, eliminating the need for related subsequent sterilization.

 **halstrup walcher**

Rexroth
Bosch Group

*IndraMotion MTX micro
CNC system from Rexroth*



SERCOS III for Compact Machine Tools

Rexroth now also brings the advantages of SERCOS III to compact lathe and milling machines in the form of the IndraMotion MTX micro CNC system solution. This segment is currently experiencing particularly strong growth in Asia.

Via SERCOS III, the compact CNC control system with integrated multi-axis controller can be used to run up to three additional drive units from the IndraDrive product portfolio. The drive and control manufacturer has thus broadened the range of applications for MTX micro to include machines with up to six fully-fledged NC axes.

As a result, the powerful CNC can be upgraded with IndraDrive controllers in compact or modular form, with capability for returning recovered energy to the system, for more powerful spindles and servo-axes.

The high-performance SERCOS III real time communication enables the full servo/spindle functionality to be used like in the integrated axis controllers. Also supported are direct measuring systems, the use of the Rexroth's complete range of motors and supplementary axis error corrections. IP communication via SERCOS III, which is optimized for high data throughputs, enables large data volumes to be efficiently transferred between the engineering system and drives and is therefore ideally suited for the CNC system solution which is optimized for fast commissioning.

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Quick-Info 2-0011 ▲

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www.anybus.de

Quick-Info 2-0012 ▼



Configure remote safety functions for SERCOS III easily with SafetyBridge technology.

www.phoenixcontact.de

SafetyBridge Technology for SERCOS III

SafetyBridge Technology is a new controller and network-independent Safety technology from Phoenix Contact. Without using a safety controller, functional safety can easily be integrated into a SERCOS III machine or system. The safe modules can be placed and distributed in any part of the SERCOS III network. The input modules exchange safe signals with the logic module via the standard SERCOS III network, which can control up to 8 safe outputs. The logic module monitors both the safe data exchange and the safety logic that was configured using the SAFECONF software. The standard controller has direct access to all safe I/O and diagnostics statuses of the safety module without additional wiring. SafetyBridge Technology is certified for use in safety applications up to SIL3 (IEC 61508, IEC 62061) and PLe (EN 13849-1).



Quick-Info 2-0013 ▼



SERCOS III as a design-in solution

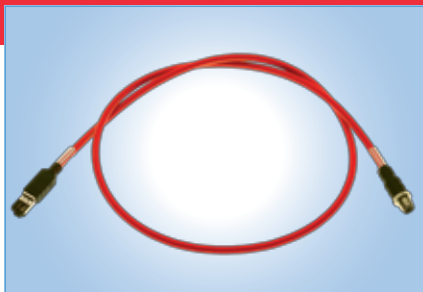
www.ixxat.de

Rapid and cost-effective realization of a SERCOS III interface

IXXAT offers the Industrial Ethernet Module (IEM) as a design-in solution especially for the implementation of a SERCOS III interface on systems with limited space or with specific form factor requirements. The IEM is based on the cost-effective Altera Cyclone III FPGA and provides a communication interface for SERCOS III as a complete Generic IO Device. For this, the bus communication is performed autonomously using the logic implemented within the FPGA. The communication stack runs on the Softcore, which is also located on the FPGA. As an Ethernet interface, two Ethernet ports are provided which can be equipped with RJ45, M12 connectors or optical transceivers, depending on the application. The design-in IEM is connected via an address/data bus or SPI to the microcontroller on the customer hardware. A function-based API is provided to control the design-in IEM. The design-in is also available for other protocols with the same API. Thus, with regard to the layout requirements, different Industrial Ethernet standards are supported by only one hardware.



Quick-Info 2-0014 ▼



Harting provides cabling solutions for both light duty and heavy duty use that satisfy the SERCOS III specification.

www.harting.com

Cabling Components for SERCOS III

The use of good active control components is important in order to guarantee fail-safe and robust operation of a SERCOS III communications network. It is furthermore important to employ certified and tested components for the passive infrastructure in order to ensure correct operation. Harting offers a comprehensive product range for this area, with RJ45 connectors for protected and unprotected environments (light duty and heavy duty), overmolded M12 connectors and various cable designs with the specified SERCOS III quality. All connectors are available in field-installable versions. Panel feed-through couplings for installation in the switch cabinet wall and termination outlets that guarantee easy maintenance of the structured cabling segment round out the product range. All products are tested according to Harting's high standards and additionally fulfill the requirements of the SERCOS III Cabling Guide, which helps the user to build up the SERCOS III network in a way that conforms to the standards in order to ensure solid operation.





SERCOS Energy – The energy profile for SERCOS III



SERCOS Energy allows the machine controls to switch connected components into energy-saving conditions, up to complete shut-down, in a targeted manner, considerably reducing their energy consumption. For this purpose, SERCOS Energy makes the components' energy consumption transparent allowing for an intelligent control of loads.

The climate discussion has raised the public awareness of the energy efficiency topic. Within the scope of this increased attention, more and more products are being promoted with reference to their energy efficiency. In this connection, the green image is in the foreground but energy costs play an important role as well. However, most current automation products focus mainly on the reduction of energy consumption through the permanent improvement of process chains, procedures and machine efficiencies via structural measures. Because machines and systems are operated under continuously changing requirements and boundary conditions, such "average optimization" only opens up a part of the energy efficiency potential. Thus, measures for energy-optimal operation and control of machines and systems are required for overall energy efficiency. These measures must optimize the energy consumption of machines and systems depending on the process and external influences as well as depending on the

operational situation.

SERCOS Energy is an application layer profile for SERCOS III devices that defines parameters for the reduction of energy consumption in a uniform and vendor-independent manner. The control reads out standard parameters of each SERCOS Energy component via the SERCOS III network, receiving status information and detailed consumption values. Depending on the situation (e.g., scheduled or unscheduled breaks, machine components not needed in the current production process) the control can switch connected components (drives, I/O, sensors) into energy-saving conditions, up to complete shut-down, in a targeted manner, considerably reducing their energy consumption. SERCOS Energy provides suitable measures for an energy-optimal operation and control.

The profile considers energy-saving conditions for predictable breaks such as lunch breaks and plant holidays. At pre-defined times, SERCOS Energy components are brought into a standstill condition in order to save energy. Shortly before the end of the interruption, SERCOS Energy provides for the reinitialization of the components into stand-by condition in order to make them available again with utmost precision. Apart from that, SERCOS Energy provides mechanisms for unintended breaks that may be caused by machine errors and missing parts. System components can be brought into energy-saving con-

ditions in a targeted manner while the errors are being remedied or during a wait for new parts. Furthermore, SERCOS Energy in combination with SERCOS III offers the possibility of saving energy while still achieving full productivity. Using intelligent controls, axes and components that are not necessary in current production processes can be switched off and/or target completion times can be adjusted. Especially with flexible production, the energy saving that can be achieved via SERCOS Energy is enormous.

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Quick-Info 2-0015 ▲

Impressum

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Pushing Performance

Quick-Info 2-0016 ▼



*Inline block module for axis control
in SERCOS III*

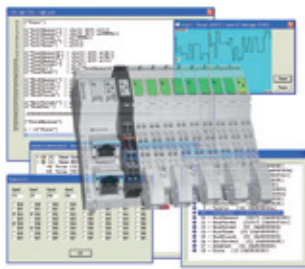
www.phoenixcontact.de

SERCOS III module for axis control

Phoenix Contact offers a variety of Inline modules with digital and analog inputs and outputs for SERCOS III. An Inline block module for axis control with SERCOS III allows flexible and cost-efficient control of two axes of motion independent of the respective drive hardware. Using a ± 10 V signal, two drive amplifiers and two rotary transducers can be connected via the incremental signal to the axis control module for position acquisition in combination with the digital I/Os for limit and home position switches. Therefore, the module is particularly well suited for controlling motion of devices which do not have control electronics with an integrated SERCOS III interface. In addition to servo valves for pneumatic and hydraulic cylinders, this also includes drive amplifiers for low-performance electrical motors as well as axes controlled by frequency inverters. This allows drives to be coupled in real-time to their PLC or motion control system.



Quick-Info 2-0017 ▼



*The new X-GO Version 3.2 now supports
the SERCOS III protocol*

www.sybera.de

SERCOS III meets X-GO

Version 3.2 of the X-GO Software from Sybera now supports the SERCOS III protocol. For this, the existing Sybera PC-based SERCOS III master library has been integrated into X-GO. When this software is used together with the Sybera X-Realtime engine there is no need for separate SERCOS III controller hardware, because the master protocol handling is accomplished directly by a PC with standard Ethernet adapter(s). More than 70 standard Ethernet adapters are supported. The X-GO software allows the control of fieldbus devices under real-time conditions using a convenient PLC-language. All stations can be controlled logically with a simple text-based script language. Different commands are provided for timers, counters, and conditional jumps, as well as for the evaluation of constants and station values. X-GO enables the complete administration of all fieldbus stations. The station-monitor displays the current input and output conditions in real time. Moreover, the input is checked for logical mistakes with a script checker. A separate programming interface is provided for the further processing of the user data.



Quick-Info 2-0018 ▼



*High Functionality and Modularity for
SERCOS III Compact Pneumatic Valves*

www.boschrexroth.com

Pneumatic valve terminal systems for SERCOS III

The Rexroth HF pneumatic valve terminal system family is ideally suitable for applications in which high flows are required but installation space is only minimal. Depending on the version, priority can be given either to flexible installation or to a particularly flat design. The valve terminal system is characterized by the fact that it is easy to handle: valves forming part of a unit can be removed and replaced without having to disassemble the unit. The valve terminal systems of the HF family with up to 32 valve solenoids can be actuated with the BDC bus module. The BDC module enables Rexroth to connect pneumatic components directly to the higher level control system via a standard and consistent network, the SERCOS III universal bus. Thanks to the use of standardized D-coded M12 plugs, the device complies with requirements for protection classes IP65 and NEMA 4. The device supports remote addressing for easy commissioning and is also suitable for automation solutions that offer high levels of availability because of the implementation of the redundancy principle.





High-end servo system ServoOne for SERCOS III

www.lt-i.com

SERCOS III in the ServoOne Family

The ServoOne high-end servo system from LTI DrIVES GmbH meets the highest demands for dynamism and smoothness. AC or DC fed controllers with rated currents of 2-450 A enable the optimum system to be configured for any power range. A variety of different cooling methods ensure high power density and optimum heat dissipation. DC supply modules with sinusoidal mains feedback convert surplus kinetic braking energy into electric power and feed it back into the supply grid. That is good for the environment and helps cut costs. Thanks to its outstanding control properties and its versatile, high-quality encoder evaluation, the ServoOne is ideal for demanding synchronous multi-axis motion control applications. With SERCOS III, the ServoOne enables users of existing SERCOS applications to easily upgrade to future-proof real-time Ethernet technology. Expanded bandwidth, advanced redundancy and hot-plug concept deliver higher precision and machine availability without losing tried and proven functionality. Seamless integration of IP communication in conjunction with the DriveManager PC software offers all customers the choice between centralized and decentralized parameter-setting and diagnostics. Functions such as IEC 61131-3 programming, pico-interpolation and observer structures greatly enhance the performance capability of the device and round off the added value achieved by switching to SERCOS III.

LTI | DRIVES

Motion and I/O: Together with SERCOS III

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www.wago.com

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Quick-Info 2-0020 ▼



*IndraDrive Cs ECONOMY from Rexroth –
Hard Real Time Capability for Low
Performance Ranges*

www.boschrexroth.com

Hard Real Time Capability for Low Performance Servo Drives

Rexroth now provides solutions for economical drive applications in the low performance range with the IndraDrive Cs ECONOMY compact converters with SERCOS III and multi-encoder interfaces for motors of between 0.05 and 3.5 kW. The multi-encoder interface supports a diverse spectrum of encoder systems such as EnDat, Hiperface, simple TTL incremental encoders, sine-cosine encoders, resolvers and the serial encoder system of the compact MSM motors from Rexroth. With electronic commutation and optional integration of digital Hall sensors, the IndraDrive Cs ECONOMY drives are suitable for a particularly wide range of motors, including coreless linear motors. IndraDrive Cs drives can be seamlessly integrated in SERCOS III architectures and, with their certified safety functions, they open up the advantages of the drive-integrated "Safety on Board." The drive supports several safety functions: a start inhibitor option (STO – Safe Torque Off) and a safe brake control (SBC – Safe Brake Control).

Rexroth
Bosch Group

Quick-Info 2-0021 ▼



*SERCOS III is the basis for the continuous
high-performance PacDrive 3 automation
bus with integrated safety solution*

www.elau.de/pacdrive3

PacDrive 3: Ethernet-based communication

With PacDrive 3, ELAU, a Schneider Electric subsidiary, introduces the follow-up technology for the PacDrive M automation solution that has been successful for more than 10 years. In PacDrive 3, tried and tested methods for reducing engineering, commissioning and service times have been ported to forward-looking technology. Existing PacDrive M projects can be easily transferred. As an Ethernet-based, continuous automation bus, SERCOS III forms the basis for integrated safety solutions and ensures that the bus is no bottleneck. Even higher performance with fine scalability mark the range of the new controllers and a modular drive concept for single and multi-axis applications reduces the costs for servo drive solutions. A workbench with all tools for engineering, commissioning and service as well as a multi-user concept, offers space for the design of interdisciplinary project processes.

Schneider
Electric

Quick-Info 2-0022 ▼



*Unified programming and operation
for plant and robot*

www.staubli.com

uniVAL Drive - A Plug-and-Play Solution for Complete Robotics Control via SERCOS III

Stäubli Robotics recently introduced its latest innovation in robotics control software: uniVAL Drive. Featuring an open, real-time interface for simple connection to external control systems, uniVAL Drive provides a simple tool for programming Stäubli's complete product line of four- and six-axis robots via generic industrial motion controllers. uniVAL Drive is a unique plug-and-play solution, meeting the user demand for an open interface, fully compliant with their existing industrial axis control protocols, for programming and operation of Stäubli robots. OEMs and machine builders are now able to drive Stäubli robots as standard machines suited to a wide range of applications, with no need for training in an external man-machine interface. Thanks to this real time tool, complete programming of the plant and robots can easily be done by the plant's central generic motion controller. Programmers wasting time working with two different programming systems to operate the plant and the robot is finally a thing of the past.

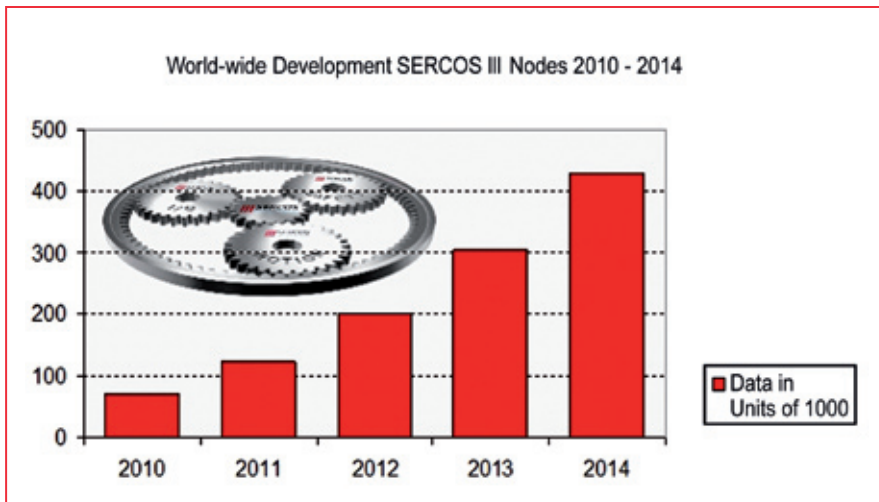
STÄUBLI

New study: SERCOS III is growing with strong momentum

www.sercos.de

The latest study by IMS (www.imsresearch.com) concludes that SERCOS III will grow until 2014 at about 35% per year. Thus, the SERCOS III Real-Time Ethernet technology is expected to grow at least a factor of 2-3 times faster than competitive technologies. „The estimation of IMS corresponds with our perception that more and more innovative machine builders recognize the advan-

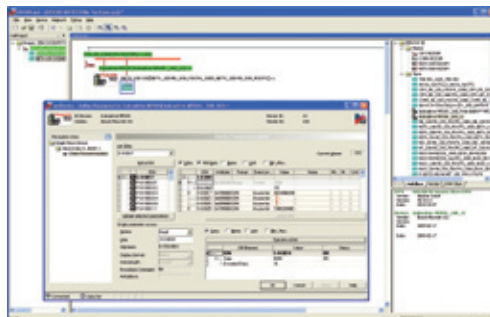
tages of SERCOS III and equip their facilities with this technology,” says Peter Lutz, managing director of SERCOS International. „One of the most recent examples is Manz Automation, which - as a technological and market leader for integrated system solutions in the solar and FPD industries - has selected SERCOS III as a system bus in their future installations.“



FDT/DTM for SERCOS III completed

www.sercos.de

With the completion of the FDT/DTM specification for SERCOS III, a unified and universally usable XML schema is now available to implement device managers (DTM) for SERCOS III devices in an automation network. During the past two years, a joint working group of the FDT Group and SERCOS International has developed a draft specification, which has been verified by two independent implementations of Hilscher GmbH and Bosch Rexroth AG. SERCOS III is thus the first high-performance Real-Time Ethernet communication standard to support the FDT Technology, used by many manufacturers to integrate field devices into a



wide range of software environments. The extension of the FDT specification reinforces the flexibility of SERCOS III as a universal bus for real-time systems in the field of automation.

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