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Issue

of Sercos News

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Bridging the gap between planning and online data via QR code

Dear readers,

Sercos News is celebrating its birthday! This 25th edition of Sercos News informs you about exciting applications, innovative new products, and news about the Sercos® automation bus.

The strengths that have made Sercos what it is today are also ideally suited as a pacesetter for the future: a superior communication solution – trimmed for real time and performance – and the proven ability to adapt quickly to changing market demands.

During the transition from Sercos as a digital drive interface (Sercos I/II) to the Ethernet-based Sercos III, the focus was on the machine-internal networking of machine peripherals. Important criteria were universality, performance and safety. However, in times of Industry 4.0 and the Internet of Things (IoT), machine and plant builders must provide solutions that go far beyond these features. Consistent, secure communication with higher-level automation and IT systems is needed, as well as horizontal networking with other machines and systems within a production plant.

The fact that Sercos has a particularly simple answer ready for this is not in the least due to the vision of its developers. Already in 2005, the definition of Sercos III had anticipated that in the future it could become important that, in addition to the bandwidth for the real-time Ethernet Sercos communication, enough bandwidth would be required for the open asynchronous communication for TCP/IP or any other Ethernet protocol. Thus, the Sercos time-slot method was used, which today proves to be extremely important, because it allows for example the transport of huge amounts of data to higher levels, without restricting the real-time communication of the Sercos bus.

This will drive the long-awaited convergence of traditional real-time Ethernet solutions by users and manufacturers to a single, standardized, end-to-end network infrastructure.

Peter Lutz
Managing Director
Sercos International e. V.

Content

Sercos-on-a-Stick: Experience Sercos in minutes

With the Sercos-on-a-Stick live demo system, Sercos International, in cooperation with Bosch Rexroth and TenAsys, offers a particularly simple means to evaluate the Sercos SoftMaster.

Within minutes, Sercos®-on-a-Stick converts almost every x86-based PC to a Sercos master test system, making it possible to realize real-time communication without hardware extensions. Using a Time-triggered-Send-enabled (TTS) Ethernet controller (Intel® i210 or Texas Instruments PRU-ICSS), even the requirements of demanding motion applications are met. The system uses the TenAsys INtime® multicore real-time operating system, which serves as the basis for future-proof control solutions.

For this purpose, the INtime Distributed RTOS has been configured to serve the Sercos master as a powerful, royalty-free and time-limited test platform. The Sercos-on-a-Stick live system is designed such that no changes to the target platform are made, and therefore a backup of the target system is not required. The live system runs on any machine that meets the following hardware requirements: x86 architecture, two free USB ports for the USB flash drive and a keyboard, an Intel, Broadcom® or Realtek® Ethernet controller, a screen as a console and the bootability of USB. Apart from CPU, memory and the aforementioned components, no other hardware is used on the target platform. Its hard drive is guaranteed to remain untouched.

The live system is provided as an image, which is transferred to a sufficiently large USB flash drive using a freely available software tool.

The target platform is started via USB boot with this application. The boot loader first generates a RAM disk and then loads a system image consisting of INtime RTOS and the Sercos application into a RAM disk. When the INtime instance is started on the RAM disk, the Sercos-on-a-Stick application is started.

To work with as many target platforms as possible, the live system supports both traditional and newer Ethernet controllers (such as Intel i210) that support timed transmission of Ethernet telegrams according to the new Ethernet TSN standard. Sercos-on-a-Stick is available via Sercos International.

Sercos specification update available

Sercos International has released the specification update V1.3.2 for the Sercos III real-time Ethernet-based automation bus.

On request by users and suppliers, the working groups of Sercos International have specified several profile and protocol extensions, which accommodate the continuously increasing application diversity and market acceptance. The specification enhancements are fully compatible with the previous specification so that a high level of standardization and the best possible interoperability of devices from different manufacturers can be ensured.

Among the innovations is an extended functional profile for power and control sections for electrical servo drives, an IO-Link mapping specification to support the vendor-independent integration of IO-Link devices into Sercos®, as well as extensions of the functional profiles for I/O peripherals, encoders, as well as hydraulic, pneumatic and electrical drives. The specification update also includes the Sercos OPC UA Companion Standard, which was already released in July 2017 by the OPC Foundation. This standard describes the mapping of the Sercos device model and the Sercos device profiles to OPC UA, so that the functions and parameters provided by Sercos devices are made available via OPC UA in a vendor-independent way. This simplifies data exchange between machine peripherals and higher-level IT systems and supports the requirements of Industry 4.0 for semantic interoperability.

New date: Machine Communication Forum to take place in June!

In response to many requests, the Machine Communication Forum will take place on June 12, 2018!

Together with our media partner, the SPS-MAGAZIN from TeDo Verlag, we are inviting users and providers from the machinery and plant engineering sector as well as equipment and automation manufacturers to this event. It will take place at the Audi Forum, Neckarsulm, Germany, from 9.30 a.m. to 4.30 p.m. Most of the presentations will be in the German language.

Attendees can expect a diverse and exclusive program covering many aspects of machine communication. There is, of course, sufficient time to network with colleagues, speakers, the team from Sercos International and from SPS-MAGAZIN.

Save the date today, as this event is limited to a maximum of 50 attendees. More information can be found under „News & Events" on www.sercos.org.


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sercos news
the automation bus magazine
Perfect Harmony in Real-Time
Innovative sercos® III Control Solutions for Varied and Demanding Automation Tasks
Cost-Effective
Blended sercos® III and EtherNet/IP Infrastructure
Interactive
"Smart" Handheld Operator
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Drive Profile for sercos® III
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Evolution or revolution?
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SERCOS inside: First SERCOS III Conformance Test Certificates issued
Product-News: RZA-Ethernet Monitor – A powerful tool for analysis
Application: Virtual machine on the SERCOS real-time bus
SERCOS interface
Revolutionary
25 Jahre SERCOS: Mit Tradition Innovation in die Zukunft
Sehen, erkennen, identifizieren
SERCOS goes Ethe

Looking back to the future

The 25th edition of Sercos News concludes an eventful chapter in the Sercos success story – and opens a new one. The strengths that make the system what it is today are also excellent pacesetters for the future: superior base technology and the often demonstrated ability to adapt quickly to increasing requirements of the market, such as now in times of Industry 4.0.

Considered through the glasses of the machinery and equipment manufacturer, three trends in particular have influenced the market in the last 10 to 15 years. One is that the end users have demanded ever shorter time-to-market times from their suppliers – a demand that could be fulfilled only through vigorous modularization of the machines. "We have now almost reached the point of module kits, similarly to how the automotive industry demonstrates it," says Hans Michael Krause, Director of Market and Product Management PLC and IoT Systems at Bosch Rexroth.

The second biggest driver besides the speed from equipment order to delivery was the flexibility of the machines in use. This led to the mechanics being simplified quickly and continuously, and to more and more servo drives being used; which, among other things, made it easier to handle the ever smaller batch sizes in production. Trend number three also has to do with flexibility: the growing requirements with regard to the connectivity of the machines, for example in order to connect them to cloud systems.

In times of Industry 4.0 and the Internet of Things (IoT), the mechanical engineer must understand networks – not just those into which a system is integrated, but also the links between the individual devices within the machine. Because one thing is already certain today: The proportion of software in the systems is continuing to increase at a rapid pace. The same applies to the number of interested parties for the data of fieldbuses at the level of superordinate IT systems. And it is a crucial matter of industrial communication to bring this data to where it is needed in the most efficient manner possible.

The fact that Sercos® has a particularly simple answer to this is thanks in no small part to the farsightedness of its developers. When Sercos III was defined in 2005, they anticipated that one day it could become important to reserve sufficient bandwidth for open, asynchronous communication in accordance with TCP/IP or any other Ethernet protocol, in addition to the bandwidth for the real-time Ethernet communication of the fieldbus. Following this consideration, the so-called time-slot process came into being, which has proved today to be of immense value, as it allows the transportation of huge data quantities at higher levels without restricting the real-time communication of the fieldbus.

Having the simplest and most coherent solutions possible available as quickly as possible when the requirements of the end users and thus the mechanical engineers change has actually always been one of Sercos' strengths. When Peter Lutz, Managing Director of Sercos International, looks back at the time between the first and the 25th edition of Sercos News, he mainly sees two important phases: "Initially, the main focus was on making the system itself more universal – for example, through higher bandwidths, via Ethernet as a widely accepted interface technology; through a large number of new profiles; and, last but not least, through extended semantics that describe data not just for I/Os and encoders but also for safety communication. Then, in phase two, eliminating the boundaries between systems was right at the top of the agenda, in order to enable continuous communication."

With regard to the interior of a system, this is basically already a reality; and with regard to the connection to superordinate IT systems, things are also moving forward very well. Here, the Industry 4.0 standard OPC UA and time-sensitive networking (TSN) play a leading role. "With the Sercos OPC UA Companion Standard, the foundation has already been created to make the functions and parameters provided by Sercos devices accessible horizontally and vertically on a cross-manufacturer basis," states Hans Michael Krause from Bosch Rexroth as a man with experience. His summary: "Today, I consider Sercos to be technologically the best Ethernet-based fieldbus system on the market. That is perhaps no guarantee for an even more successful future – but it is surely an outstanding foundation."

Hans Michael Krause, Director of Market and Product Management PLC and IoT Systems at Bosch Rexroth

Industry 4.0/ smart factory application

Simulation and the use of VR and AR glasses in production

The use of simulation software during the project planning process has already proved its worth at many companies. However, simulation software, such as industrialPhysics, is also there to assist the mechatronics team when the actual production of a machine or system begins.

Simulate every step

Each individual step during the production process can be simulated using the simulation software. Even if this already happened during the planning phase, it's a huge security gain for the whole team to start up the machine again on a virtual basis immediately before production. Thus, there can be no unpleasant surprises. It's irrelevant whether this virtual start-up takes place on a screen or a power wall or by using VR (virtual reality) and AR (augmented reality) glasses. With AR glasses, such as the Microsoft HoloLens, the machine currently under construction can be brought to life on the spot and projected as a hologram based on actual data. Thus, later workflows can be blended into the virtual machine as well. Then the mechatronics team can be sure that the different steps in the operation will work during production.

Expansion without risk

This is a particularly good option when additions to existing machines are implemented. System downtime is to be kept as low as possible, risks minimized as far as possible, and the expansion implemented as quickly and uncomplicated as possible. This saves a great deal of time and money. New machines used in operations can also be virtually tested in advance. It can also be seen in advance what the machine (also as a CAD model) looks like in an existing production. If the machines are available as simulation models, the process can even be visualized and started up virtually in combination with the new system. Process transitions and output quantities are thus checked with the highest precision. Using augmented reality, employees can be familiarized with the new machine in advance, so that after it has been assembled it can be started up smoothly.

Simplified support

Use of AR glasses results in an additional huge advantage for manufacturers and operators of a machine – support becomes location-independent! Previously, when a machine was first commissioned, support was expensive and time-consuming, especially in overseas business. However, AR glasses such as the industrialPhysics-linked HoloLens provide a remedy. If everyone involved wears the glasses, the same data is blended into the environment at the same time. It's almost as if everyone were standing together in front of the actual machine. If customer service assistance must be requested, the support team can connect to the AR glasses and guide the employee live, because they see the same thing that the production employee sees. With HoloLens, the employee can thus be guided step-by-step to resolve the problem. Support thus helps the employees help themselves! Staff work instructions or technical documentation could also be transmitted via AR glasses, although this could still result in a problem at present due to the nature of the HoloLens. Because of its high weight, small battery duration of approximately one hour, and small visual field, long-term use is not yet possible. However, this technology is certain to develop further in the near future.

Conclusion

Simulation has arrived in machine construction as well as in other industries. Since VR and AR glasses began to be used not just in the gaming but also in the industrial environment, an increasing number of people have been discovering the enormous advantages this development entails. There are still a few aspects that must be scrutinized. The glasses are still relatively heavy, AR glasses in particular are expensive, and the low battery duration times can be improved. However, machineering experts are very hopeful that the technology will be improved. The more frequently these systems are used in the industrial environment, the quicker they will develop positively. But machineering experts have no doubt that this technology will establish itself.

Dr. Georg Wünsch, Managing Director & Founder, machineering GmbH & Co. KG

Machine communication in times of ubiquitous computing

Today, countless different systems need to be networked for Industry 4.0 and cyberphysical systems (CPS) though they rarely have been provided by one manufacturer alone. Instead, an industrial plant consists of components from various manufacturers, because each manufacturer specializes in a specific technique.

At present, systems are networked, but for Industry 4.0 and CPS it's necessary that these systems are connected in order to communicate, i.e., all need to communicate on the same interface. For more than 10 years now, proprietary fieldbuses have been successfully replaced in industrial automation by industrial Ethernet. However, this development is not enough, because each manufacturer can use "his" communication protocol in addition to or in preference of the TCP/IP stack for good reasons, e.g., for product-specific or vendor-specific features (such as real-time communication) that require non-open protocols.

The core idea of CPS is that the communication is not hierarchical, therefore the levels of the pyramid from a direction flow – tasks from ERP to automation, results from automation to ERP – will no longer exist. Nevertheless, the different systems that currently exist all are needed from the functionality point of view. In addition, software-based value-added systems will continue to be implemented to increase the efficiency of industrial processes. Experience with centralizing the data in one ERP system was a key factor in developing MES as a dedicated system. These facts show that neither a centralization scenario will occur, nor will other systems like MES be needed.

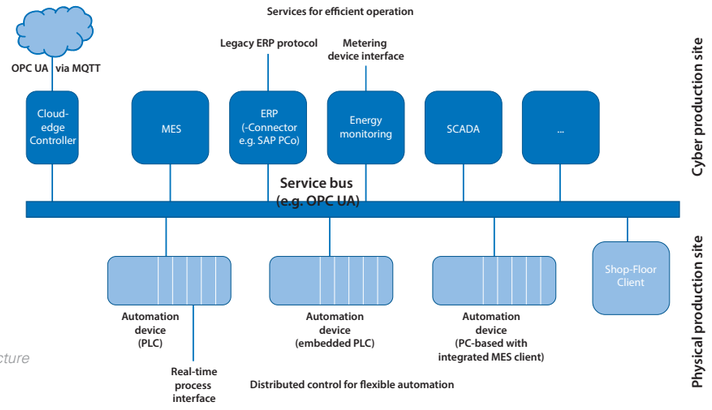
When we consider the smartphone – the incubator of all Internet-of-Things devices – we can see that the major advantage we use every day is the decentralization of information, which all can easily be found, used, combined, and sent to another device. This model must, because of its success, be a blueprint for the digital transformation process in the manufacturing field. New hardware features (physical) are easily integrated with new software features (cyber). New software features which increase the efficiency of our daily life processes are published every day in form of new apps. This ubiquitous computing scenario of our daily lives is the blueprint providing the underlying conditions for the manufacturing company's information model:

Author

Prof. Dr.-Ing. Clemens Faller,
Automation Technology
University of Bochum

- Different software systems will exist, all specialized in their domain. These will continue to be implemented to increase a company's efficiency (e.g., big-data analytics, predictive maintenance, etc.).
- These software systems – the physical part – provide and receive information to fulfill tasks, i.e. they provide services (publisher) and use services (subscriber).
- The services are nonhierarchical and can publish and subscribe equally.
- Many systems will be installed on-site. Nevertheless, some value-added services for data analytics or remote services will be cloud-based, because the business processes will also be influenced by the opportunities that cloud-services enable.
- Automation systems become equal participants in the communication model – they deliver and use services.
- Changing the control system hardware from proprietary CPUs and operating systems to a powerful and open platform enables this evolution because the control system does not have to be responsible for just one automation application and vice versa.

The service-oriented approach based on these underlying conditions is shown in the figure above. The model considers that all systems are equal and able to provide their services and use other services. The services can be on-site or cloud-based. The connection to the physical process



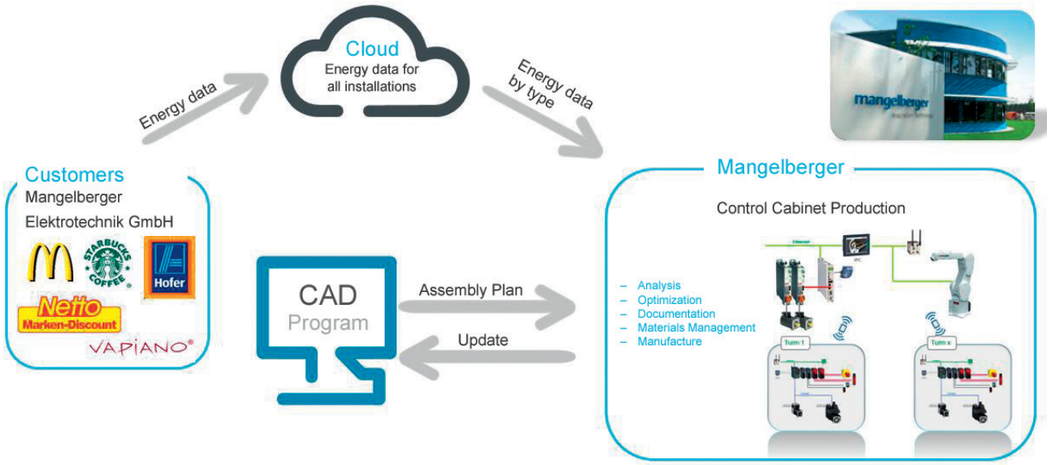
Service-oriented communication architecture

is part of the control system. The controlling functionality can be realized today in a huge number of different devices (not necessarily a "classic" PLC), depending on the requirement of real-time and technical processes.

Open standards should be used for the realization of a system which is based on the described model to ensure interoperability and extensibility. OPC UA enables communication between different service providers and consumers. No vendor-specific drivers are needed. This facilitates scalability of existing facilities and the replacement of components. The complete networking of all plants with each other results in stronger networking between all participants.

Bridging the gap between planning and online data via QR code

Mangelberger Elektrotechnik GmbH, headquartered in Roth near Nuremberg, is a leading solution provider for building automation, with a focus on the retail, discount and fast food chain segments. The company has achieved a unique position through its innovative services based on self-developed technologies for Internet-based remote maintenance, remote control, energy management, and smart metering.



In the next step, the automated transfer of individual data for every installed component will enable updates and optimization. Other designs to generate added value for customers are currently in development.

Switchboard construction and manufacturing is a mainstay of Mangelberger. For the decentralized collection of data in a cloud and its further use, each switchboard is equipped with a self-developed communication technology which supplies the consumption, referencing and status data from the control cabinet in the field in XML format to a cloud. From there, Mangelberger can call online worldwide to obtain current measured values and other measured variables located in an object for individual consumers. More than 5,000 switch cabinets equipped with the technology are already in the field worldwide.

With its Acti 9 program, Schneider Electric has long been a partner of Mangelberger for the installed products and technologies for distributing and switching energy. Both companies have now launched a pilot project to further exploit the potential of an Industry 4.0 strategy at Mangelberger. The aim is the automated, robot-assisted assembly of complete switch cabinets. Schneider handles the automation part with its comprehensive program for the automation of complete machines and systems as well as with its own engineering specialists. A PacDrive LMC, based on Sercos® III architecture, controls the robot.

Schneider Electric also launched a special QR code on Acti 9 assemblies specifically for this project. Mangelberger is the first company in the world to receive assemblies with the QR code intended for later inclusion in series production. The QR code is one of the key elements for further exploiting the potential of an Industry 4.0 strategy at Mangelberger.

Each Acti 9 component is identified by the applied QR code and other features. The code is recorded in each case before insertion in the magazines of the assembly plant and again before installation on a DIN rail. On the one hand, the product data form the basis for an automated supply of the assemblies from the magazines for the assembly process per the CAD data, and on the other hand they serve for the automated assembly test.

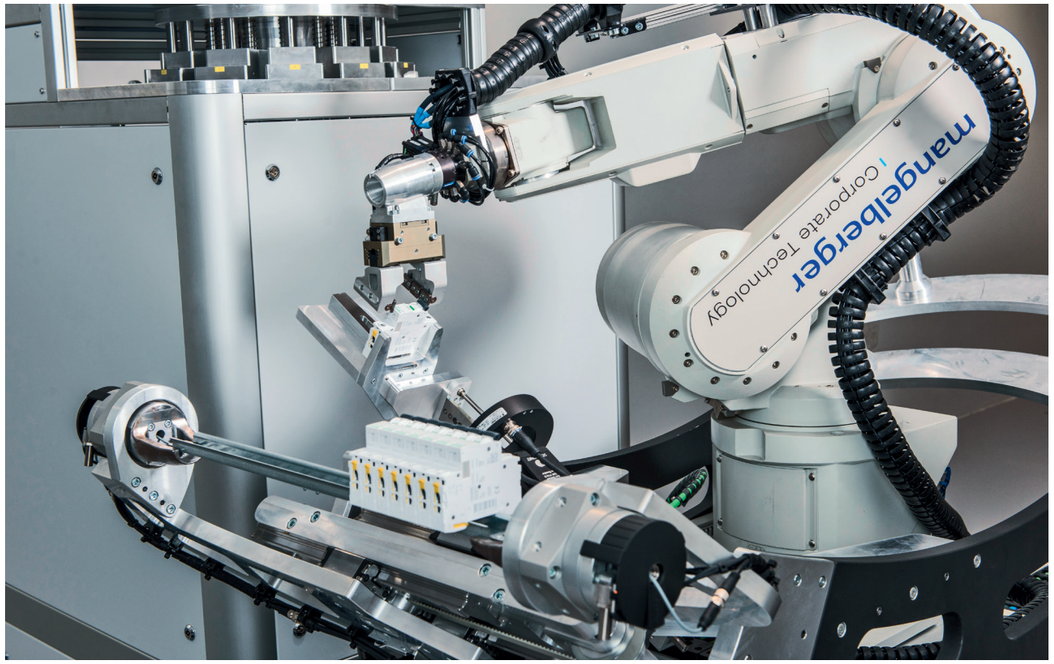
An additional aspect is the automated transfer of the module-specific data defined in the QR codes to the EDP. By scanning the QR code of each installed component, a bridge is created for the bidirectional data exchange between the production automation, the CAD system and the documentation.

"Together with our partners E-Braun and Schneider Electric, we have launched a cutting-edge project for production automation in switchgear production and automated updates using Internet technologies," Jürgen Mangelberger, CEO Mangelberger Elektrotechnik GmbH, Roth

The resulting potential is immense: Measured values of a real assembly in the field can in future be linked via cloud with the documentation data of the assembly in the CAD data and compared with the underlying operating values. For example, the referencing of online actual values with setpoints defined in the planning allows automated revisions and optimizations in the planning and analysis software.

In addition, the door is open for a coupling of the module data and the associated measurement data with solutions for energy management and databases of all kinds – whether ERP system for storage and ordering, shop solutions or other online databases. The way is then open for automated management of component data in planning and materials management.

Thus, the project is a milestone in the development of the partnership. Schneider Electric will become the single source for Mangelberger due to the ability to integrate its products into Industry 4.0 projects. In addition, Schneider Electric is also Mangelberger's partner for the automation of future production technology.



Initial standalone testing setup of the robot-assisted assembly machine; a tensioned DIN rail with Acti 9 components is visible at the bottom of the picture. A PacDrive LMC, based on a Sercos III architecture, controls the robot.

FAST: The largest eye for skywatch in the world

The feed cabin of FAST is using a Sercos-based drive control solution.

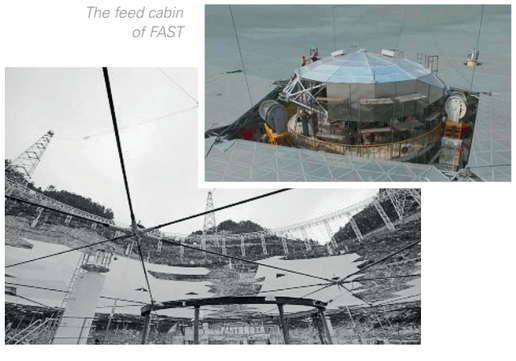
On July 3, 2016, the last reflecting surface unit of the Five-hundred-meter Aperture Spherical radio Telescope (FAST for short) located in Pingtang County of Guizhou Province, was installed by means of crane hoisting. FAST is currently the biggest radio telescope in the world. At the same time, its ability for receiving radio waves from the universe will be of the best. Via a set of data, let's first see how powerful FAST will be as the champion of the world:

- Aperture: 500 m, around which a person will need 40 min to walk;
- Steel consumption of the outer ring: More than 5,000 t, which is enough for building another Eiffel Tower
- Steel cables at the bottom: More than 9,000, each of which can support 500 adult men
- Total reflection area: 250,000 m², amount to 30 standard football fields

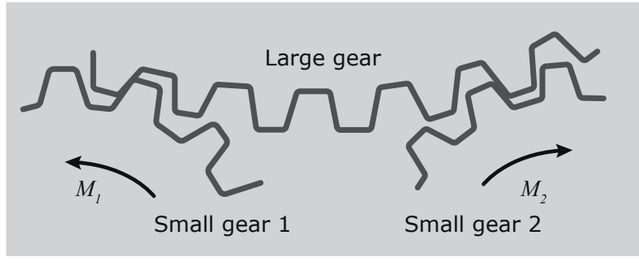
The giant skywatch eye brings not only visual impact and shock, but also the highest sensitivity in the world. If you compare FAST to an eye, the feed cabin acts as the pupil of this huge skywatch eye, which plays the role for focusing. The higher sensitivity and the more accurate positioning of the feed cabin, the stronger its capability to detect weak radio signals from the universe, which is the most important criteria of radio telescopes.

The feed cabin of FAST weighs up to 30 t, and is hung in the air via the cables from six feeding source towers, which can be positioned accurately along up-down and left-right directions. However, since it is hung in the air, the disturbance of wind is the biggest enemy for the positioning and focusing of the telescope.

The feed cabin of FAST



The drive control system of the feed cabin of FAST



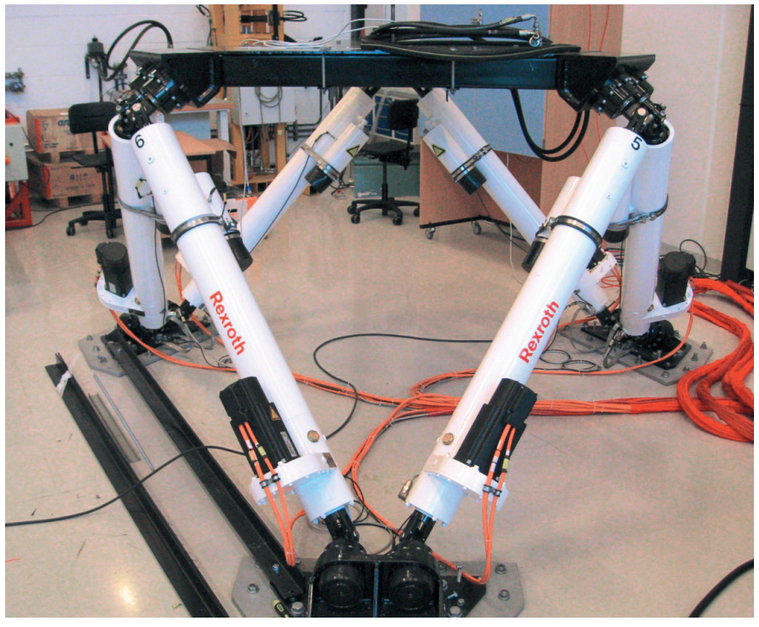
The gears of the feed cabin of FAST

The disturbance of wind is unpredictable, paroxysmal, eddying and inhomogeneous. In order to solve this difficult problem, the feed cabin is equipped with servo control systems, to complete real-time anti-jamming and position compensation. Firstly, the drive control system being composed of four servo axes do coarse adjustment to X and Y directions. Secondly, two servo axes are equipped for each of these two directions respectively, forming the master-slave relationship, driving two small gears, and then driving a big gear by means of speed coupling via the motion controller and Sercos® bus thus, it is able to complete the position compensation. The positioning accuracy is 48 mm.

Another six servo drive axes drive the electric poles to form the Stewart parallel mechanism, which accomplish computing and compensation for six degrees of freedom in real-time with the motion controller, and send the position command via the Sercos bus, to complete the fine-tuning for the position compensation of the feed cabin. With a cycle time of 1 ms, the cyclic command value input of the drives for position control can be transferred quickly in real time. The positioning accuracy of the feed cabin can be 10 mm or less. Finally, with the 10 servo axes, the position compensation of the feed cabin is achieved in real-time, making the telescope as solid as rocks and mountains during the course of positioning and focusing.

Theoretically, FAST can receive electromagnetic signals 13 billion 700 million light years away, which is close to the edge of the universe that human beings can observe. It extends the space measurement and control ability of China from the moon to the outer edge of the solar system! It will find things we've never seen before. At the same time, its extremely high detection sensitivity is 2.5 times higher than the currently most advanced telescope in the world, the American Arecibo, and will maintain world top-class status in the next 20 to 30 years.

The successful design and operation of this excellent application system benefit from the excellent Sercos-based control and drive products provided by Bosch Rexroth – the globally leading drive and control expert.



The Stewart parallel mechanism of the feed cabin of FAST


(Source: Schreiber/FKFS)

Keeping on track with Sercos

eMotion-4000-8DOF from Bosch Rexroth is the basis for Europe's largest driving simulator. True-to-life vehicle movements enable realistic driving behavior.

Most simulation systems are very costly tools. Examples include numerical models calculated on high-performance computers for the predetermination of crash situations, flight simulators for the training of airplane staff, and the simulation of ocean waves for hydrodynamic research. They are not an end in themselves, but an economically optimized methodology, used instead of tests on real objects in real environments. It's similar in the research and optimization of driver/vehicle interaction in driving simulators. The more realistic the simulation, the better the results.

The largest driving simulator in Europe was commissioned in summer 2012 at the University of Stuttgart. The simulator was developed to improve the energy efficiency and safety of road vehicles. Bosch Rexroth was chosen to provide the advanced motion system, the heart of which is eMotion-4000-8DOF with its nerve cord, the Sercos® ring.

The Bosch Rexroth Boxtel (NL) location has accumulated decades of experience in the development of vehicle simulation systems. The company has worked with airplane and automobile manufacturers since 1986 to simulate movements as realistically as possible. Since then, a large number of hydraulically and electrically operated systems have been built. These systems offer two to eight degrees of freedom and handle loads of up to 14,000 kg (electrical eMotion systems).

Driving simulator for research

In 2009, the University of Stuttgart first approached Bosch Rexroth regarding the development and setup of the largest driving simulator in Europe. The intention was to employ this simulator for the automotive industry and other research institutes in order to conduct detailed research without having to carry out actual road tests. Examples include research on driving characteristics of new vehicle types, or the influence of assistant systems on driving style. Such systems include brake controls and collision-prevention functions which contribute to reduced fuel consumption and increased safety.

A key advantage of a driving simulator compared to actual road tests is the fact that test drivers always drive under identical conditions. For example, they are not exposed to different weather and traffic conditions. Thus, the necessary measurements are more precise and reliable and allow better comparison studies. Additionally, simulators allow situations to be simulated that would be too dangerous with real people and vehicles.

To draw accurate conclusions from the test results, it is important that the simulated world perceived by the test person is as realistic as possible. For vehicle tests, this requires the complex interplay of visualization (what the driver sees inside and outside the vehicle) and motion (what the driver feels during the execution of the driving actions).


(Source: Schreiber/FKFS)

Europe's largest driving simulator is housed at the University of Stuttgart and can handle a payload of 4,000 kg. This allows tests with a complete vehicle.

Structure

To implement both visualization and vehicle motion as realistically as possible, the simulator contains a passenger car that is placed in a dome. The car's engine compartment is filled with electronics. The internal equipment is identical to that of its real counterpart. LED projectors project a 360° panorama of the virtual environment onto the inside of the dome.

Motion system

An eMotion-4000-8DOF motion system from Bosch Rexroth is installed in the simulator to ensure that the driver convincingly feels acceleration, deceleration, and other forces as a result of his actions in the test vehicle. This is an 8-axis system, comprised of a powerful hexapod and an XY table combined with an advanced control system. The structure of the complete system begins with three parallel rails (X direction), anchored to the concrete floor. A gantry is then positioned that can move along these rails, driven by four synchronous AC motors and a rack and pinion drive. Two parallel rails (Y direction) are then mounted atop the gantry, creating an XY table. Linear rail guides are used for motion along the rails to optimize the movement of the XY table and ensure a low noise level. Synthetic bearing cages also contribute to the low noise level. Mechanical end stops are mounted to prevent the gantry from running off the rails, and to absorb simulator movement in an emergency situation.

The eMotion-4000 hexapod is mounted on the gantry system. It moves over the gantry system in the Y direction, driven by two AC servomotors (and likewise employs a rack and pinion principle). The hexapod includes six electric-powered actuators, on which the dome is mounted via six universal joints. Thus, the entire electrical system ultimately results in eight degrees of freedom: two from the XY table, and the other six from the hexapod itself. The complete system can carry a maximum mass of 4,000 kg; including the dome, the vehicle, the projectors, and the test driver. Within a movement envelope of 10 m x 7 m, a maximum speed of 3 m/s and a maximum acceleration of 5 m/s² can be achieved.


(Source: Schreiber/FKFS)

In the dome. The projectors can be seen above the vehicle

AC servomotors move the hexapod over the gantry system in the Y direction.

Realistic simulation

The combination of the XY system and hexapod makes it possible to simulate the accelerations and forces described. Because all degrees of freedom of the hexapod are supported by the six electric motors, the movements can be executed in a particularly powerful fashion. This results in strong, immediate accelerations that the driver experiences as forces with a magnitude and timing that closely resemble the forces experienced in a real-world driving situation.

An acceleration or deceleration (braking) process is simulated by combining two movements: forward/backward motion and tilting. This tilting makes use of gravity to press the driver into his seat when accelerating or to lift him out of his seat when braking. If the hexapod alone was used to create these two movements, a 'dip' would be created in the sense of acceleration, potentially disrupting the illusion. This is prevented by having the XY table take over the forward or backward movement from the hexapod before it reaches the end of its stroke. At the same time, it is important that the takeover of the movements be very carefully controlled, so that the test driver does not simultaneously experience being tilted.

System control

The system can make every required movement needed to simulate a realistic environment. The trick is to translate all movements, speeds, and accelerations of the vehicle into movement and positioning of the motion system. Two control cabinets are used: one for the eMotion-4000 hexapod and one for the XY table. Both control cabinets facilitate signal exchange with customer-specific systems, and of course with the actuators of each system. The drive controllers in the cabinets are connected via Sercos to the motion control, which runs special software developed by Bosch Rexroth. This software forms the heart of the system and ensures that the driver's actions immediately lead to the correct response from the motion system. Its response is defined by the application-specific S-parameter values (standardized Sercos parameters), which are sent to the drive controllers via the relevant service channel during configuration or system start. This response is arranged through the motion system settings, otherwise known as motion cuing. This motion cuing is based on models from NASA and TU Delft, but has been extended by Bosch Rexroth such that the movements are significantly more realistic. Establishing the correct settings for this motion cuing is a special task that can be carried out only on a joint basis with the customer. In addition to the motion cuing, the software incorporates various special effects, for example to convincingly simulate unevenness in the road surface.

Realism and comfort during the operation of the hexapod (eMotion-4000) and the XY table depends significantly on the synchronicity of the distributed drive controllers. The Sercos bus is the only automation bus that guarantees synchronicity well below 1 µs. This is achieved via hard, real-time scheduling of the Sercos telegrams. The bus was invented in the 1980s and still represents the most efficient method of highly synchronized data transmission, independent of the number of devices in the Sercos ring.

To further improve the motion quality, the Bosch Rexroth control software not only uses target positions during the motion production, but also uses additive moment target values in order to specifically compensate for the inharmoniousness for each part of the motion profile.

All data pertaining to a specific vehicle can be entered via the customer's host software (running on a separate computer), so that the motion system knows how to respond to the test driver's actions. This software is also responsible for projecting the correct images inside the dome.

Final result

The driving simulator is an advanced system that enables a variety of research to be carried out. The combination of true-to-life simulation of vehicle movement and the 360° panoramic view from the driver's position behind the steering wheel evoke realistic behavior on the part of the driver, so that serious research can be performed into specific aspects such as safety and energy-efficient driving. For the future, Bosch Rexroth is working on reaching even higher speeds and accelerations in order to make the system even more dynamic.

The reliability of the eMotion-4000 will be increased in the future through the ring redundancy function of the Sercos III network. The eMotion-4000 benefits from the expansion to include the Sercos automation bus. Due to the high usable bandwidth, all other peripheral devices, such as fast I/O for acceleration sensors or safety controls, can be operated via the Sercos ring. The whole system can be operated in a very energy-efficient manner using the native Sercos drive profile functions and the energy-saving and monitoring functions defined by Sercos Energy for all devices.

Future eMotion-4000 automation system structure based on Sercos III

Ethernet communication protocol

- Ethernet-based
- 100 Hz communication

Hypcos (RTLinux-based control system)

- Advanced Motion Control
- Motion cueing
- Test features
- Troubleshooting and error handling
- Interface between customer and motion

Sercos III

- Ethernet-based
- 1 kHz communication

Control cabinet

- IndraDrive HCS01
- Relays and I/O connections
- Design in accordance with EMC
- Designed for 4EE
- Safety onboard

Motors

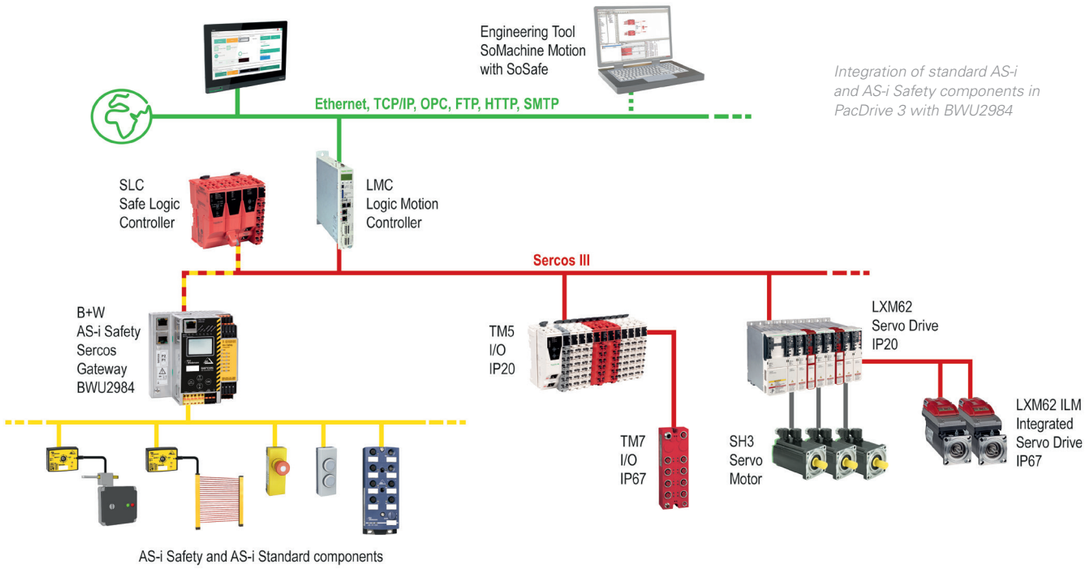
- MSK motors
- Multiturn encoder
- Brake

From 1,000 kg to 4,000 kg

Bosch Rexroth has an interesting history when it comes to the development of affordable alternatives for XY/hexapod motion systems. Their first 1,000 kg system was installed at Renault in 2003, as part of the Ultimate simulator. A 2,500 kg system followed in 2005 at Leeds University, a 1,000 kg system at PSA (Peugeot Citroën), and a 2,500 kg system at VTI in Sweden. An additional system was installed at the University of Tongji, China. The system at the University of Stuttgart is the first 4,000 kg XY/hexapod system installed by Bosch Rexroth. A system with even higher performance and a 6,000 kg hexapod will be installed in Korea in 2018.

AS-i Safety enhances the PacDrive 3 world

Economical wiring, topology freedom, great flexibility – AS-i Safety at Work, the safety solution from AS-Interface, offers many benefits. Now PacDrive 3 users can also benefit from this simple safety technology. How is that possible? By using the new AS-i 3.0 Sercos Gateway BWU2984 from Bihl+Wiedemann. This gateway integrates AS-i Safety into the Schneider Electric automation solution for motion-control-based machines that run on the Sercos III automation bus.



Integration of standard AS-i and AS-i Safety components in PacDrive 3 with BWU2984

Many Sercos® users have long been using AS-i technology with the AS-i 3.0 Sercos Gateway BWU2588 – for example for push buttons or for the simple linking of sensors and actuators. They benefit with AS-i among other things from low installation costs and efforts, simple diagnostics, and cable routing that corresponds to the mechanical structure of the system. Until now, however, it was not possible to incorporate AS-i Safety components such as E-Stop buttons or interlocks into the PacDrive 3 world. The reason: The old AS-i gateway could not communicate with the Schneider Safe Logic Controller (SLC).

To solve this problem the AS-i specialists from Bihl+Wiedemann worked with Schneider Electric to develop the AS-i 3.0 Sercos Gateway BWU2984.

Gateway simplifies the safety technology

The new gateway BWU2984 now makes it possible to use AS-i safety technology in parallel with the standard AS-i technology. The device features two AS-i masters for two AS-i networks and acts as a Sercos slave in the Schneider Electric automation solution. The gateway can then exchange data with the SLC safely through Sercos. This greatly simplifies the safety technology. The safety monitor integrated into the gateway monitors the safety technology in both AS-i networks and safely passes the data on to the SLC. If for example an E-Stop button is pushed in one of the AS-i networks, the AS-i Sercos gateway reports this to the SLC. The safety controller can then initiate the direct shut-off of the servo drives. Also integrated in the new gateway is the Bihl+Wiedemann Safe Link technology. This lets you link the safety technology from different applications or systems with each other.

Get the advantages of AS-i Safety in your automation technology

When it's a matter of safety in automation technology, safe monitoring and controlling of drives and shutting them off safely are the chief concerns. But also important is safety around the drives. Interlocks, E-Stop buttons, light barriers or safety mats ensure that there is no hazard to personnel from packaging machines or robots. Incorporating such components into safety applications using AS-i Safety at Work is easier than with any other wiring or bus system. Features include the use of an unshielded, two-conductor cable, the greatest possible topology freedom, and the piercing technology that allows the safety modules to be positioned exactly where they are needed.

PacDrive 3: Automation platform with Sercos III

The PacDrive 3 system from Schneider Electric is a scalable automation platform for motion-control-based machines using Sercos III which allows controlling of a wide range of production and packaging machines as well as automated handling machinery. PacDrive 3 LMC controllers combine the PLC, motion and robotics control functionality on one hardware platform. The system can handle up to 130 synchronized servo axes centrally via Sercos III. Safety applications are implemented with the Safe Logic Controller (SLC). The SLC, a Sercos slave, exchanges safe data with safe in- and outputs as well as safe servo drives over the Sercos AT channel. Safe I/Os and safe drives are available in both IP20 and IP67. Programming and archiving of projects is done using the Schneider Electric Engineering Tool SoMachine Motion with SoMove. PacDrive 3 supports TCP/IP communication to higher level systems as well as incorporation of other fieldbus systems and AS-i components.

AS-i 3.0 Sercos Gateway BWU2984 from Bihl+Wiedemann for integrating AS-i and AS-i Safety in PacDrive 3 applications

Convergence of traditional real-time Ethernet solutions with Ethernet TSN

Ethernet TSN has the potential to lift the hitherto strict separation of IT and automation networks and to bring about a convergence of network technologies.

With TSN, real-time communication and normal Ethernet communication can be transmitted via a uniform and vendor-neutral network standard. This provides an ideal basis for the implementation of Industry 4.0 and IIoT concepts. Since Ethernet TSN finds acceptance not only in automation, but also in other industries, such as automotive. This results not only in low costs, but also a wide range of manufacturers and products. At the same time, manufacturers and users benefit from the technical advancements, such as higher transfer rates.

Even devices that do not or only partially support TSN functions can operate in an Ethernet TSN network infrastructure and benefit from the properties of Ethernet TSN. Ethernet TSN is based on a time-slot method, which Sercos® has been using for more than 25 years for real-time communication. Thus, the basic requirement is that the Sercos III protocol can be transmitted unmodified via a TSN network infrastructure, without affecting the real-time characteristics and the synchronization between all connected Sercos III devices.

In a multimanufacturer working group under the roof of Sercos International (Task Force TSN), integration and migration concepts for Sercos and TSN are currently being developed. The works refer to the following three scenarios:

1. Integration of conventional (unmodified) Sercos devices (master and slave) into an Ethernet TSN network infrastructure
2. Extension of the Sercos master with TSN functions without modifying or extending slave devices
3. Extension of the Sercos master and Sercos slave devices with TSN functions, but without changing the Sercos III protocol

At the Annual General Meeting of Sercos International in April 2018, the results of the TSN Task Force will be presented to all member companies.

	Scenario 1	Scenario 2	Scenario 3
Sercos protocol	Unmodified	Unmodified	Unmodified
Sercos master	Unmodified	SoftMaster with TSN functionality	SoftMaster with TSN functionality
Sercos slave	Unmodified	Unmodified	Sercos slave with TSN functionality
Flexibility of network topology	Low	Medium	High
Flexible positioning of Sercos master	No	Yes	Yes
Flexible positioning of Sercos slaves	No	No	Yes

Sercos and TSN scenarios without modifying the Sercos protocol

Wernerwerkstrasse 2
93049 Regensburg, Germany
: +49 (0)941 2978-4120
www.avagotech.com

AFBR-2555ARZ optical 650 nm receiver with reinforced metal housing for Sercos applications

Product features:

- Design ensures highest mechanical stability for the harsh industrial environment
- Enhanced mechanical stability during installation and usage in end applications
- Immune to electromagnetic disturbances from external devices
- Significantly improved signal integrity

The Broadcom® AFBR-2555ARZ receiver is housed in solid dual-in-line metal package. For reinforcement, an approx. 0.3 mm thick and 3 mm wide stainless steel brace was introduced. This design ensures highest mechanical stability for the harsh industrial environment.

The stainless steel brace has a surface treatment for easy wave soldering to the PCB, which significantly enhances the mechanical stability during installation and the usage in end applications.

Due to the integrated photodiode and a symmetrical layout, the receiver not only convinces with its mechanical stability. The new fully-symmetrical IC with an integrated photodiode is inherently immune to electromagnetic disturbances from external devices such as neighboring switchgears. With an average optical input power sensitivity of -23 dBm, the new receiver component shows significantly improved signal integrity compared with a legacy receiver component. Supported are Sercos® applications with a data rate of 4, 8 and 16 MBd. We recommend using the receiver AFBR-2555ARZ together with the mechanically reinforced transmitter AFBR-1555ARZ.

Gewerbering 5
86510 Ried, Germany
: +49 (0)8233 7916-11
www.cannon-automata.com

L1/C1 automation panels with integrated control and Sercos master

Product features:

- Single- and multitouch panels with display sizes from 7" to 21.5"
- 16:9 or 4:3 display format
- Integrated PLC and motion control
- Intel® Atom™ to Core™-i CPU, CAN, onboard IOs
- Sercos master
- CODESYS V3

L1/C1 automation panels combine proven single-touch technology with a PCAP multitouch glass front panel for user interfaces with innovative gesture control. There are variants available in 4:3 or widescreen (16:9) display formats in various sizes.

Combined with the xA system unit, L1/C1 panels are operator panels with integrated PLC and motion control. The xA system unit is equipped with onboard IOs, Sercos® master, as well as a CAN interface. PLC and visualization are programmed with CODESYS. The integrated OPC UA server allows ERP, MES and SCADA systems the access to application data and serves as an interface for M2M communication.

Harburger Str. 2–4
27383 Scheessel, Germany
: +49 (0)4263 985480
www.eurolan.de

Modular IP 66 FO wall boxes for optical fiber Sercos cabling

Product features:

- If the fiber optic network must be expanded on-site, you can order the modules prefabricated by Eurolan at any time.
- A 25% larger patch area is offered due to the modular technology compared to the previous model.

The modular IP 66 FO wall boxes can accommodate up to four pre-assembled modules with deposed 12 MM or SM fiber pigtail, six ST, SC or LC duplex adapters, a splice cassette with one fiber clamp, a splice holder, a splice cassette cover and 12 splice protection, as well as a cassette for excessive lengths of pigtails and loose tube which is mounted on a rack. An M20 screw is included.

Assembly:

- In harsh industrial environment
- High humidity or dust
- Wind turbines onshore or offshore
- Solar park, bio gas plants
- Interior or outdoor area

Rheinstrasse 15
65795 Hattersheim, Germany
: +49 (0)6190 9907-0
www.hilscher.com

netSHIELD

Product features:

- Host microcontroller connected via SPI to the netX system on chip
- One hardware for all industrial Ethernet systems
- Arduino™ Uno compatible pin out
- netX firmware flash programming via USB

netSHIELD is an extension board for development and evaluation purposes providing Real-Time Ethernet (RTE) connectivity for Arduino-compatible host devices.

Due to its Arduino header footprint, the netSHIELD can be easily plugged onto your development/evaluation board (i.e. the host device), enabling your application to communicate in industrial RTE networks like Sercos® without any further hardware development efforts.

The netX SoC on the netSHIELD thus serves as "companion chip" for the microcontroller (MCU) of your host device.

netSHIELD is equipped with the Hilscher netX 52 SoC (System on Chip) that features an ARM 966 CPU for protocol execution, coupled with a flexible communication controller subsystem (xC) for multiprotocol hardware access.

Am Hardtanger 10
82256 Fuerstenfeldbruck, Germany
: +49 (0)8141 4030
www.schleifring.de

Modular slipring system MIA

Product features:

- Modular slipring series
- Transmission of electrical power, signals and all common databus
- An online product configurator supports you to define your own individual slipring system
- Modular adaptions to extend the system
- Gigabit-Ethernet adapter
- Power adapter (5 x 630 V / 63 A)
- Media rotary joints (1-channel | 2-channel | 4-channel)
- Flange

Our innovative modular slipring system MIA achieves the transmission of Sercos®, further common databus, electrical power and signals. You can choose between two basic unit options (MIA1 and MIA2 – each of them available in different lengths). Your personal slipring system can be extended with a media rotary joint, flange, power adapter and Gigabit-Ethernet adapter.

Start with your own configuration and receive the technical datasheets of your chosen requirements right now.

Industriestrasse 6b
9552 Bronschhofen, Switzerland
: +41 71 913 98 88
www.telsonic.com

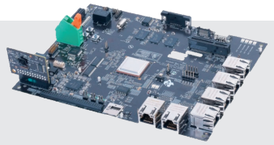
Ultrasonic welding generator MAG

Product features:

- Ultrasonic welding of plastics, packaging and non-ferrous metals
- Cut and seal of textiles, nonwovens and films
- Portioning of food
- Cutting of high-strength and tough materials such as fibres, rubber and leather

Flexible and powerful for production integration. The MAG ultrasonic generator range from Telsonic is predestined for simple and complex welding and cutting tasks in production lines, individual workstations and special systems.

The functional design and the low level of heat generation meet the high requirements of modern plant engineering. The generator can be controlled with analogue or digital signals with integration into a PLC system easily achieved with the usual proven state-of-the-art fieldbus interfaces such as, Sercos®.



Texas Instruments
Haggertystr. 1
85356 Freising, Germany
: +49 (0)8161 84516
www.ti.com

AM571x Industrial Development Kit (IDK)

Product features:

- Single core ARM® Cortex™-A15 microprocessor and single core C66x DSP
- Includes two programmable real-time units and industrial communication subsystem (PRU-ICSS) interfaces
- Enables real-time industrial communications capability (master and slave)

AM571x Industrial Development Kit (IDK) from TI is available for $899.

The Sitara AM571x family with single core ARM® Cortex™-A15 microprocessor and single core C66x DSP include two programmable real-time units and industrial communication subsystem (PRU-ICSS) interfaces created specifically to enable real-time industrial communications capability (master and slave) supporting popular protocols, such as Sercos® III.

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: +49 (0)3681 7974-34
www.vision-control.com
presse@vision-control.com

New pictor® N series with web interface

The units in the new pictor® N series are the youngest members of the product family of intelligent cameras from Vision & Control. Small, compact and robust – yet still extremely capable: the 80 x 45 x 20 mm3 of space on offer is still enough for an ARM® Cortex® A9 dual-core processor and integrated FPGA. Innovative CMOS sensors offering the ultimate in precision and performance to round off the capable interior workings of the new series.

The six models in the pictor N series (403M-ETH, 403C-ETH, 413M-ETH, 413C-ETH, 420M-ETH, 420C-ETH) offer sensor sizes ranging from 1/4¨ to 1/1.8¨. They can handle resolutions from 752 x 480 to 1,600 x 1,200 pixels, which correspond to 0.3 to 2 megapixels. The pixel size varies from 4.5 x 4.5 µm² to 5.3 x 5.3 µm². With up to 120 fps (frames per second), the pictor N series offers impressive control options.

Communications to the outside world take place via optodecoupled digital I/Os, via Ethernet, and in the near future via Sercos® interface. The web interface that is already integrated in the basic model not only allows live images to be displayed, but also represents a capable interface for Industry 4.0.

The pictor N range of cameras is ideal for any application requiring high flexibility and large image processing capability in a tiny package – directly in the machine environment. The range of functions available with the pictor N is compatible with the functions of the vicosys® multicamera systems. This means that the system is equipped with the integrated functional and operating concept of vision systems from Vision & Control – so these cameras are perfectly set up for all image processing tasks!

Attractive application areas of the Sercos technology drew visitors to the booth at the SPS show

Sercos International attracted visitors with a rally-racing simulator during the recent SPS IPC Drives Show in Nuremberg, Germany. The simulator, based on Bosch Rexroth eMotion technology, offered more than 150 visitors a particularly realistic racing simulation. Real high-frequency movements delivered an authentic rally-racing experience for the driver.

Visitors to the Sercos booth learned more about the latest trends and technologies such as the transmission of the Sercos® III real-time protocol via IEEE 802.1 TSN (time-sensitive networks) via a Sercos TSN demonstrator. It showed the possibilities for providing a real-time and multi-protocol-capable network infrastructure based on TSN for automation technology. The demonstrator was developed at the Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW) at the University of Stuttgart with the support of several industrial partners, such as TenAsys.

Another highlight was an Industry 4.0 demonstrator that showed how process and device data are made available both locally via the real-time bus and also via OPC UA for a range of application scenarios in a uniform and cross-manufacturer manner. This makes data exchange between machine peripheries and superior IT systems easier and also supports the requirements of Industry 4.0 regarding semantic interoperability.

The multiprotocol capability of Sercos makes various implementation options possible. One option is the integration of the OPC UA server functionality that can be integrated into a machine control, where the control acts as a gateway in which the mapping of Sercos services and data is implemented. With Sercos III it is also possible to integrate an OPC UA server directly into a Sercos field device (drive, I/O station or sensor). In this case, the OPC protocol is routed directly to the relevant Sercos slave device. The gateway functionality of the control is thus reduced to the function of an Ethernet switch. Due to the Sercos transmission process (no tunneling!), the ability of an OPC client and an OPC UA server to communicate with each other is preserved even without continuous Sercos communication running.

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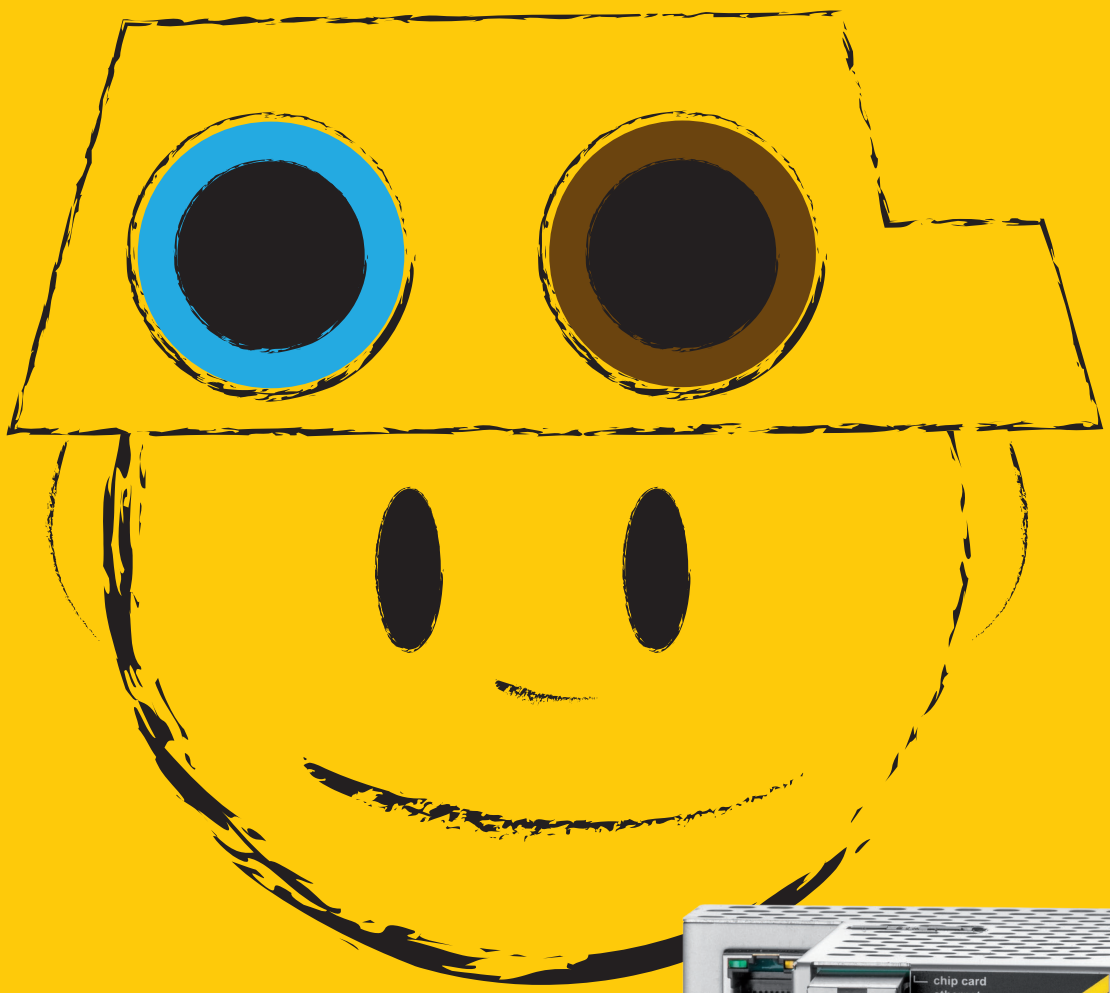
Safety@work!



HANNOVER MESSE

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23. – 27.04.2018

Simple safety technology for greater efficiency

- Safety technology with AS-i Safety at Work: only one cable for data and power - easy to use, independent of system and manufacturer, approved
- PLC connection via all common fieldbuses, all diagnostic data in the controller, safety and standard signals mixed
- Safety Gateways for use as Safety Slave (in combination with a safety controller) and as Safety Master (for safely controlling drives without an additional safety PLC)
- Safe Link over Ethernet: The simplest way of coupling many safe signals
- Universally expandable with Safety I/O Modules + Standard I/O Modules in IP20 or IP67 and with a multitude of other modules for a wide range of applications

More information on your application safety at:
www.bihl-wiedemann.com

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THE AS-INTERFACE MASTERS