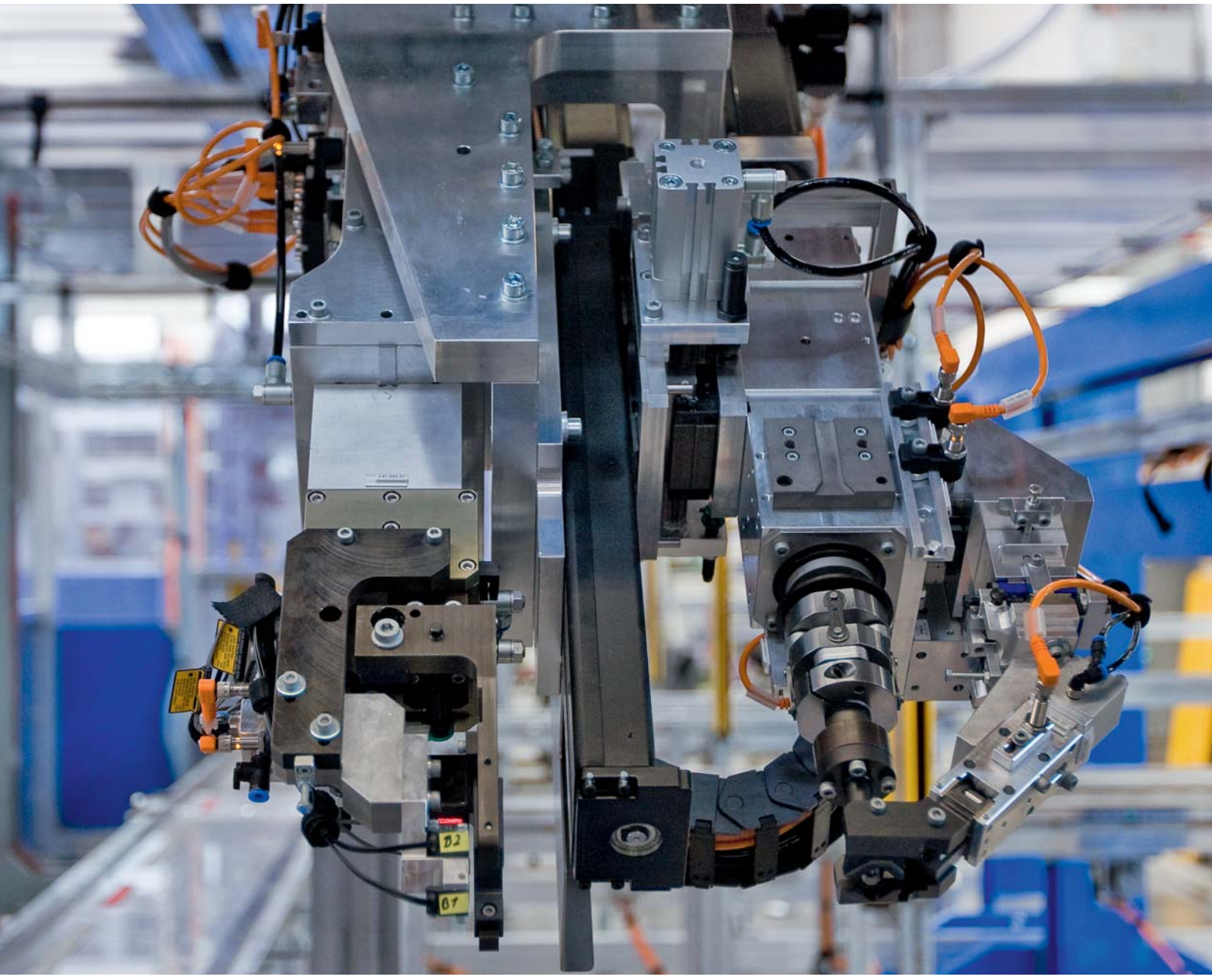
EtherCAT Box modules form the basis of an innovative assembly concept

STIWA high-performance laser welding plant for gearbox component manufacturing

The core competence of the Austrian STIWA Group, with headquarters in Attnang-Puchheim, is product and assembly automation. Where the production of complex and high-quality assemblies with fast throughput is concerned, as in the case of the high-performance laser welding machine for manufacturing gearbox components used in the automotive industry, STIWA relies on control technology from Beckhoff. The backbone of the plant is a fast, intelligent transport system, which is a proprietary development by STIWA. It is tailor-made for high-performance assembly and uses all the advantages of Beckhoff's modular system of EtherCAT components and TwinCAT automation software.



STIWA is one of the leading suppliers in high-performance assembly automation: a new milestone has been set with a flexible transport system based on EtherCAT.

Peter Sticht, Managing Director of STIWA Holding GmbH

STIWA Automation GmbH, a manufacturer of automation systems, and APF Produktionsdienstleistungs GmbH, which manufactures system assemblies, belong to the STIWA Group, a renowned European supplier in the business of product and assembly automation. A new high-performance laser welding machine with an integrated fast transport system recently went into production that manufactures gearbox components for a leading car manufacturer.

In conventional assembly plants the workpiece carriers are cycled through the plant by means of friction belts. The attainable speeds are usually insufficient for high-performance manufacturing. In addition to the units that are necessary for stopping and positioning, a code reader must also be used to ensure that the correct workpiece carrier is processed.

Added value integrated in the system

STIWA successfully implemented the transport of parts in its assembly plant using a servo motor and toothed belt as an NC axis, which allows very precise positioning of the workpiece carriers. Transport speeds of up to almost 3 m/s are possible with a total weight of up to 10 kg. Beyond that, the trick lies in the identification of the workpiece carriers. Using just a simple proximity switch, a laser-cut code plate on the underside of the workpiece carrier is scanned and recorded via the EP1258 digital EtherCAT Box. By means of the EtherCAT timestamp function, which works with resolutions in the nanosecond range, the workpiece carrier can be identified as it drives past. Intelligent code algorithms tolerate up to three read errors.

The drive belts are driven by stepper motors at manual workstations. Through the use of the Beckhoff EP7041 Stepper Motor Box Module – and through intelligent design – workstations can be implemented with safely limited speeds and safely limited torques.

Transport system – more than just a means to an end

"The transport system is one of the keys to flexible high-performance automation. In addition to the system used here, we also have another version that is designed for payloads of up to 100 kg. This enables us, for example, to transport complete engine blocks through manufacturing plants – with the same performance values regarding speed and safety," says Peter Sticht, Managing Director of STIWA Holding GmbH, outlining the in-house developments. "Transport is not a necessary evil for us, but rather a part of the value creation chain, since we have full-value NC axes at our disposal with TwinCAT NC."

The individual components are clamped and welded in the laser welding modules. The centering platforms and the positioning units for the lasers form the heart of the plant. Each of the two cells contains two independent servo kinematics with five degrees of freedom each for the laser optics. The centering platforms underneath each contain eight servo axes for the precise clamping of the parts. For process reliability, measurement systems are mounted on the exchangeable tool platforms. These systems are connected to the controller via the EP5101 EtherCAT Box with incremental encoder interface and by the EP1018 and EP3174 EtherCAT Box modules.

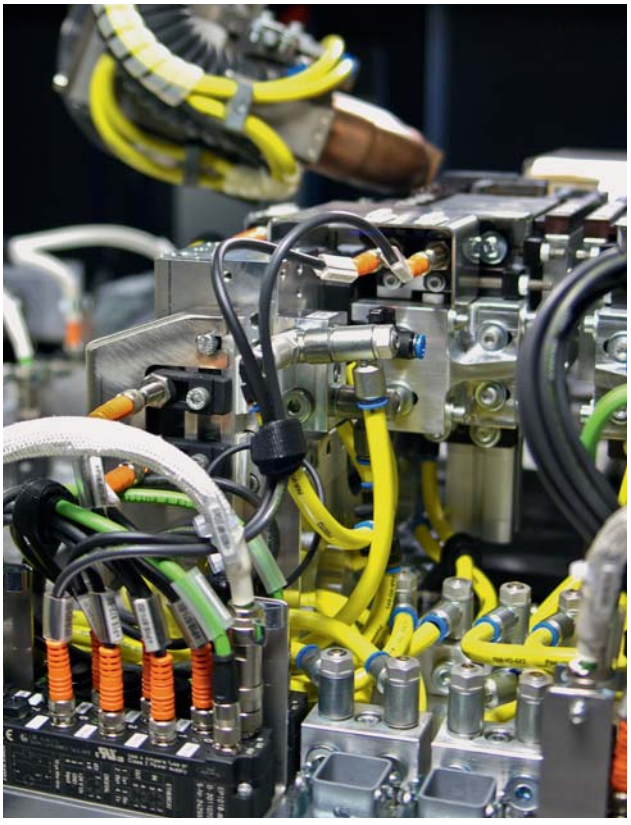
All tools are parameterized as EtherCAT Hot Connect groups in TwinCAT System Manager and are exchangeable during operation. This permits the most diverse assemblies to be welded in the flexible plant. The tools are identified via the EtherCAT Hot Connect groups, ensuring that the plant is always equipped with the correct tool kit. A total of more than 260 EtherCAT Box modules are installed in the plant. All 180 servo axes are controlled as full-value NC axes and require corresponding computing power, which is provided by 14 Beckhoff C6240-0030 Industrial PCs with Intel® Core™2 Duo processors.

The plant has a sophisticated workpiece carrier logistics concept which is imaged by a data server. This ensures that each processing module always "knows" precisely which recipe parameters are to be used for the current workpiece. Processing results such as measured values, processing status, quality criteria and process evaluation are always kept consistent.

Using dissipated heat for building services

Although a TwinCAT software function block ensures that – depending on the dynamic condition of the plant – as little as possible of the available laser power is converted into heat in the absorber, the building services

The workpiece carriers are identified as they drive past with the help of the digital EP1258 EtherCAT Box. Up to 623 different part carriers can be detected on the transport system.



The gearbox components are welded in the laser cells. The signals from the flexible clamping units are all acquired via EtherCAT Box modules, enabling optimal installation.

nevertheless benefit from the resulting dissipated heat: The STIWA company building, which is also controlled by Beckhoff equipment, uses the heat dissipated by the laser to heat the factory buildings and offices.

Controlling the integration of technology

The basis of the high-performance assembly machines from STIWA is the control and integration of the technologies. "We don't build the automation around a technology or a process; instead, we develop the process as part of the automation," says Peter Sticht, describing the concept. "This enables us not only to implement very complex assembly processes, but also to achieve cycle times of less than 0.7 s per gross finished part – despite quite demanding processes such as those in the manufacturing of fittings."

Data acquisition is the key to value creation

STIWA Automation's range of products is rounded off by mature software solutions from the groups's own software company, AMS Engineering GmbH. Detailed acquisition of production data – as an integral component of the plants – identifies existing bottlenecks quickly and consistently. This makes a fact-based Continuous Improvement Process (CIP) possible. With the machine data acquisition (MDA), production data acquisition (PDA) and quality data acquisition (QDA), all data from plant production can be acquired and made transparent. The virtual real-time traceability function can not only determine error causes; it can also make production processes transparent. It determines in an instant whether the problem is a product, process or batch error. By linking batch and process data, i.e. attributing the process parameters to an individual component, complete traceability is ensured. Holistic data acquisition and a version-controllable recipe form the backbone of this traceability. The software spectrum is completed with a universal and expandable visualization system. It extends from the signal to the warehouse and makes deviations between the ideal and the momentary production immediately visible. The industry-standard parameters (e.g. OEE, TEEP and many others) are represented clearly and help avoid or minimize plant downtime and malfunctions. This is made possible by a sophisticated and integrated interface between the function blocks in TwinCAT and the analysis software. The concept behind the visualization is based on a client/server architecture, which displays the Z-Point CI – the tried-and-tested user interface from AMS Engineering – on the Beckhoff CP7702 15-inch mounting arm terminal.

STIWA Managing Director Peter Sticht is certain of one thing: "With this plant we have set a new milestone in flexible automation and not only made high-performance possible in this high-wage part of Europe, but also redefined it."

STIWA Automation GmbH **www.STIWA.com**
Beckhoff Austria **www.beckhoff.at**