Laser machining with open, fast data communication and dynamic motion control

When speed and flexibility are critical in machine tool applications, laser machining is often the technology of choice. Lasers are capable of cutting, welding, and perforating metal and non-metal parts while eliminating the high cost of tools. The increased use of modern materials such as carbon-fiber or fiberglass composites in high-volume manufacturing requires the use of laser machine tools. These are the types of applications for which Wieser Automation has developed an advanced new machine, leveraging the openness and high speed of the Beckhoff control platform.
Established over 20 years ago as a one-person metalworking shop, Wieser Automation – Maschinenbau GmbH, based in Scheffau, Austria, now provides complete customized solutions and serves as a systems integrator. The company’s services range from mechanical and control engineering, to production and assembly, as well as commissioning the equipment and linking it to the customer’s IT systems. About half of Wieser Automation’s customers are in the automotive industry, followed by the packaging, woodworking, steel and electronics industries. In addition to complete production lines, Wieser Automation makes custom-designed circulating systems, rotary indexing tables, assembly and machining cells, as well as production, testing, and measuring equipment.

Recently, according to Ronald Hotter, sales manager for laser machining equipment, Wieser Automation is receiving more and more inquiries for laser machining systems: “There is a clear trend toward using lasers for processes such as marking, welding or cutting. For non-metal products such as plastics, fiberglass-enforced plastics, leather or wood, the choices are limited. This is the gap we plan to fill with our newly developed W:Laser machine. This solution was designed as a standard system with many customization options, including the input and output of the parts being processed, as well as the option to integrate different laser types for different materials. It is also available as a modular or standalone system.

TwinCAT and EtherCAT form the foundation for powerful machines

The “laser machining” project was initiated roughly two years ago, as was the search for capable suppliers. Ronald Hotter recalls: “In the automation technology field, we identified Beckhoff as an extremely capable supplier of control and drive components, particularly since in laser machining, the individual components move at very high speeds. These speeds must be implemented with stable mechanical components, as well as with a specialized, powerful software platform. TwinCAT automation software from Beckhoff provided us with simple programming and operation, short training periods, and extremely quick commissioning.”

TwinCAT CNC provides the necessary performance to enable the multi-layered movements and 5-axis kinematics of the W:Laser machine. This is ideal for the W:Laser application, as the CNC functionality is fully PC- and software-based. The TwinCAT real-time kernel and the powerful PC platform provide the ideal foundation for software-based CNC, as the complex machine kinematics and difficult processing tasks in laser machining require real-time transformation in the CNC to ensure flexible operation and programming. For instance, the user can define different coordinate systems or automatically generate compensating motions for rotational axes. The 3D machining offered by Wieser Automation with its 5-axis processing is a classic example of such an application.

Wieser Automation also notes that the ability to connect different I/O modules through any of today’s popular fieldbus systems was a key benefit. This is especially critical, as the laser is sourced from a supplier and operates within an existing fieldbus system. And since Wieser Automation selects the laser based on a customer’s specific application, absolute openness regarding the I/O periphery was crucial.

Open communication standard is a must

The laser machining system uses the EtherCAT fieldbus system to enable I/O communication. Roland Hotter points out the importance of the protocol’s openness: “We transmit a significant amount of data in a very short period of time. In addition, the machine must also fit seamlessly into the end user’s production environment. EtherCAT solves both challenges. The fact that EtherCAT is open – in our case integrating with PROFIBUS – is particularly important for us, since many of our suppliers use laser sources with this particular fieldbus. For our in-house developments, we were independent of any customer’s specifications and could choose any fieldbus system. This is a great advantage, and we are very satisfied with our choice, because EtherCAT gives the greatest possible flexibility.”
PROFIBUS is integrated via the EL6731 master/slave terminal, which is fully compatible with all PROFIBUS features, making it possible to include any PROFIBUS device in the EtherCAT network. The safety functions, i.e. the drive and safety gate monitoring, are handled by the EL6900 TwinSAFE PLC in connection with EL1904 and EL2904 TwinSAFE terminals and two EP1908 TwinSAFE box modules that are installed in the system. In addition to safety-relevant data, the Beckhoff system collects numerous analog and digital signals via EtherCAT Terminals in the control cabinet, as well as via the EP2338 and EP3184 IP 67 box modules.

Dynamic drives as essential control technology components

In addition to the powerful individual components, the highly efficient interaction between TwinCAT and EtherCAT ensures fast, flexible operation of the laser machine. Its high precision, paired with very short cycle times and the accurate control of the drives, provides significant functionality that Wieser Automation puts to good use. Ronald Hotter explains: “We don’t employ a robot for our laser machine tool, instead opting for a drive with three linear axes, as well as two optional rotational axes that must be controlled quickly and precisely. Our goal is to focus on these types of 3D machines for components with complex structures.”

That is also why Wieser Automation’s engineers selected the AX5000 series servo drives with EtherCAT communication for maximum performance. These work in concert with AM8000 servomotors that feature One Cable Technology (OCT), which combines the power supply and the feedback system into one cable. Ronald Hotter continues: “The TwinCAT drive technology and motion control solutions provide the best possible foundation for our single- or multi-axis positioning tasks, providing an effective solution for the inherently high dynamic requirements.”

In addition to the TwinCAT CNC, TwinCAT Kinematic Transformation makes it possible to implement various robotic functions. The movements are programmed in Cartesian coordinates, either with DIN-66025 commands or with the PLCopen-compliant components from the PLC. An integrated dynamic pre-controller ensures very precise movements, even at high accelerations and speeds. Of particular benefit for Wieser Automation’s laser machine is the fact that the TwinCAT Kinematic Transformation is optimized for the Beckhoff AX5000 Servo Drives.

A Beckhoff CX2030 Embedded PC with a dual-core Intel® Core™ i7 processor running at 1.5 GHz serves as the core of the control system. This unit was an obvious choice for Wieser Automation, as the engineers wanted a powerful, DIN rail-mountable PC with extensive interface expansion options. The laser machine tool is operated via a built-in CP2916 multi-touch Control Panel with a 15.6-inch screen, linked to the Embedded PC via DVI/USB Extended.

Service makes the difference

To test the machinability of materials, Wieser Automation keeps one of its laser machines in-house, enabling the design of optimally configured systems for each customer’s specific requirements. Additional services are also available, such as process flow animations, training, production support, process optimization, and service calls. According to sales manager Roland Hutter, these are precisely the services his company likes to use itself when new projects are being developed: “For our laser machine tool, we worked closely with our suppliers’ experts from the start. Particularly for complex automation technology, we held many meetings with Beckhoff and continue to rely upon them for on-site support and help.”

Further information:

www.laserautomation-wieser.com
www.beckhoff.at