**Laser ablation machine
for solar cell production**

© DR Laser

PC- and EtherCAT-based control technology in solar cell production

Upgraded motion control doubles throughput in laser ablation process

Wuhan DR Laser Technology Co. Ltd (DR Laser) in Wuhan's East Lake High-Tech Development Zone (also known as China's 'Optical Valley') focuses on the application of laser systems and technologies for solar cell production. Using PC-based control and EtherCAT instead of dedicated motion control modules, the company has more than doubled the production throughput rate by upgrading and simplifying the control structure of laser ablation machines.

The machines made by DR Laser are used to ablate the crystalline dielectric passivation layer on the back of PERC solar cells (PERC stands for 'passivated emitter rear contact'). Compared to the conventional solar cell production process, the aluminum is not removed directly on the back of the silicon wafer, but the dielectric AL_2O_3 /SiN layer is selectively opened with a laser. In addition to minimizing the metal contact surface on the back and the cross-resistance, this reduces the area between the metal and the semiconductor interface. The short-circuit current and the no-load voltage are thus increased.

Advantages through PC-based control and EtherCAT

DR Laser's relationship with Beckhoff China goes back to 2018, when the company decided to use PC-based control and EtherCAT communication to standardize the control technology in its main systems for solar cell production. In the laser ablation machine, a CX5120 Embedded PC serves as the main controller. It is connected to digital HD EtherCAT input and output terminals as well as EtherCAT servo amplifiers, resulting in the typical control architecture for automated systems with compact and simplified wiring. As Dr. Ai Hui, Technical Director at DR Laser, explains: "Conventional motion control modules

use high-performance microprocessors and large programmable devices to implement coordinated multi-axis control. While they integrate the underlying software and hardware to supply the functions required to control speed and position, their axis scalability is limited to a certain extent. In addition, the layout within the control cabinet as well as its maintenance can become quite complicated."

To eliminate these problems, DR Laser opted for PC- and EtherCAT-based control technology from Beckhoff, as Dr. Ai Hui explains: "With the EtherCAT I/O system from Beckhoff, a broad spectrum of peripherals and subsystems can be integrated very easily. Due to the openness of the PC-based control technology and the high speed of EtherCAT, we were able to increase the production significantly. In addition, the system structure and wiring are simplified, and the extensive diagnostic functions of EtherCAT reduce the costs of system installation and maintenance."

Integrated PLC logic and motion control

The fanless, DIN-rail-mountable CX5120 Embedded PC controls the PTP movements of 20 to 30 servo axes while also handling the processing of the downstream I/Os. In combination with the digital high-density (HD) EtherCAT input and output terminals, this makes an extremely compact control cabinet layout possible. According to DR Laser, the single-core Intel® Atom™ processor meets all the requirements for complex multi-axis motion control and the conventional I/O logic processing. The Embedded PC also features a 1-second UPS for backing up persistent data in case of a power failure.

The machine programming is performed via the TwinCAT software platform, for which the integrated PLCopen motion control modules provide extensive functional interfaces for programming the multi-axis motion control logic, as Zhang Hao, Technical Manager of the Electrical Department of DR Laser, explains: "The powerful multi-axis motion control performance of the CX5120 Embedded PC impressed us just as much as the powerful interfaces of TwinCAT software and its open programming environment. The open programming framework provided by Beckhoff makes the entire application development more efficient. In addition, TwinCAT features extensive communication interfaces, resulting in a high level of system compatibility. And with ADS, TwinCAT provides a highly efficient protocol for communicating with the higher-level HMI."

Efficient and open solutions

DR Laser offers a series of complete process solutions ranging from machines for laser ablation to fully automated laser scribers, laser drills and sintering systems for solar cells. The company has successfully worked with Beckhoff in many of these fields already, as Zhang Hao confirms: "The software compatibility and the various functional interfaces of the Beckhoff control technology provide us with a control platform for machine retrofits as well as for the development of new processing systems. In addition to the PLC and PTP motion control functions, the Beckhoff controllers have multi-axis coupling functions

as well as powerful cam and NC-I interpolation functions that support further cooperation in the development of new machines such as laser scanners. Having a standardized software platform is particularly important when you design new machines. In addition, the open EtherCAT fieldbus architecture enables the widest possible optimization of the machine solutions. All of these factors deliver a high degree of flexibility and sustainability and represent added value for the development of the company."
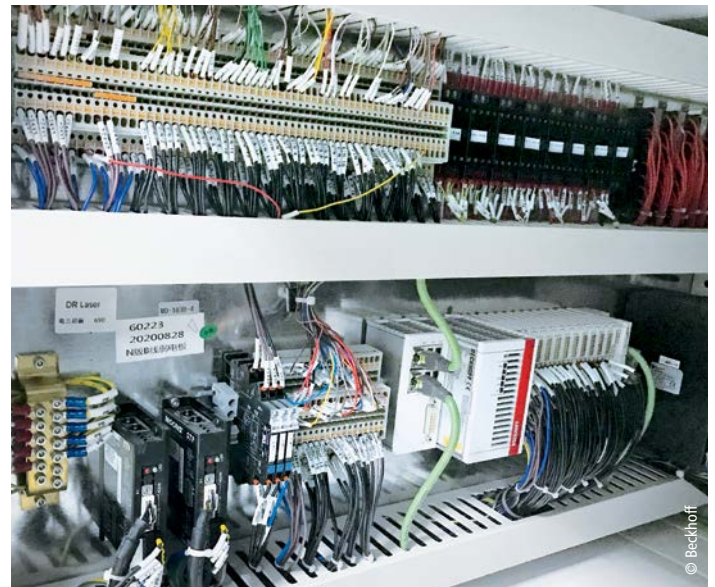
The Beckhoff CX5120 Embedded PC (below, center) forms the core of the control solution for the modernized laser ablation machines.

More information:
www.drlaser.com.cn
www.beckhoff.com/machine-tools