

PC- and EtherCAT-based control technology for sintering, annealing and sorting in the photovoltaic industry

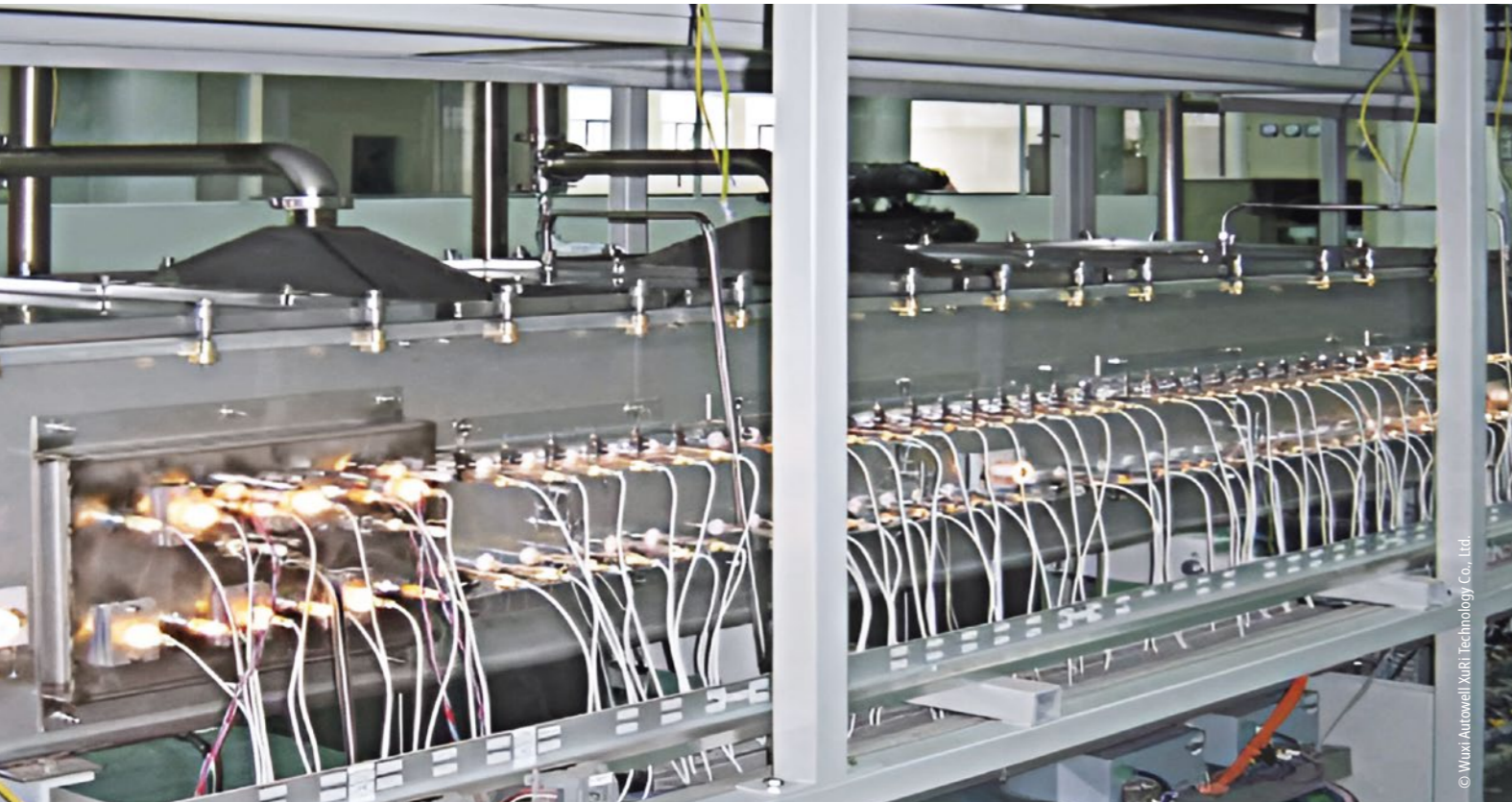
# High connectivity and high performance for the future-oriented solar cell production

XuRi of the Chinese Autowell Group provides advanced production technologies for the photovoltaics industry and other regenerative energy sectors. In order for manufacturers to stay competitive in these dynamic markets, their equipment must achieve a high degree of automation. With EtherCAT and PC-based control, XuRi seamlessly integrates all third-party systems in its solar cell production lines and ensures high productivity for the end customer through short cycle times.

Founded in 2010, Wuxi Autowell Technology Co., Ltd. (ATW), is a well-known intelligent equipment manufacturer in the PV, Li-ion battery and semiconductor industries with currently more than 4,000 employees. ATW Group has several subsidiaries, such as Autowell Intelligent Equipment, SCEC, ATW Coshin, Leddo and ATW XuRi. Its expanding portfolio serves the

four major sectors of the photovoltaic (PV) industry chain: rod, wafer, cell and module production. Subsidiary Wuxi Autowell XuRi Technology Co., Ltd. was founded in August 2021 and is engaged in the R&D, implementation and manufacturing of equipment for PV cell production. In the year of its establishment, Autowell XuRi already succeeded in winning the project

For the solar cell production lines developed by XuRi Autowell, EtherCAT- und PC-based control technology helped accelerate the commissioning phase and ensure high productivity in daily operation.



During initial equipment commissioning, EtherCAT diagnostic capabilities helped solve communication issues with third-party slave devices (here the sintering furnace during the debugging process at the plant of Autowell XuRi).

of implementing Runyang's N-type solar cell screen printing production line, with a contract value of approximately 130 million yuan. The controllers for each of the production lines are all sourced from Beckhoff. According to customer requirements, the C6015 and CX9020 Industrial PCs were chosen for the sintering and annealing processes, as well as C6030 IPCs for the sorting process. In terms of I/Os, in addition to basic digital and analog input and output modules of the EtherCAT Terminal portfolio from Beckhoff, EL5152 incremental encoder interface terminals are used, which can accommodate two encoders each for motion control. EL6022 EtherCAT Terminals enable communication with third-party instrumentation via Modbus RTU, while EL6652 support real-time communication via EtherNET/IP with other third-party PLCs in the production line. Communication with a third-party touchscreen is implemented via TCP/IP, and real-time communication with another third-party HMI is based on the ADS protocol from Beckhoff. While up to now, TwinCAT 2 automation software is being used, the customer intends to use TwinCAT 3 software in the future for projects with a sufficient number of implementations.

**Flexible and scalable control platforms**

For the sintering and annealing processes of end customer LONGi in Ordos, the customer selected the C6015 ultra-compact Industrial PC and the CX9020

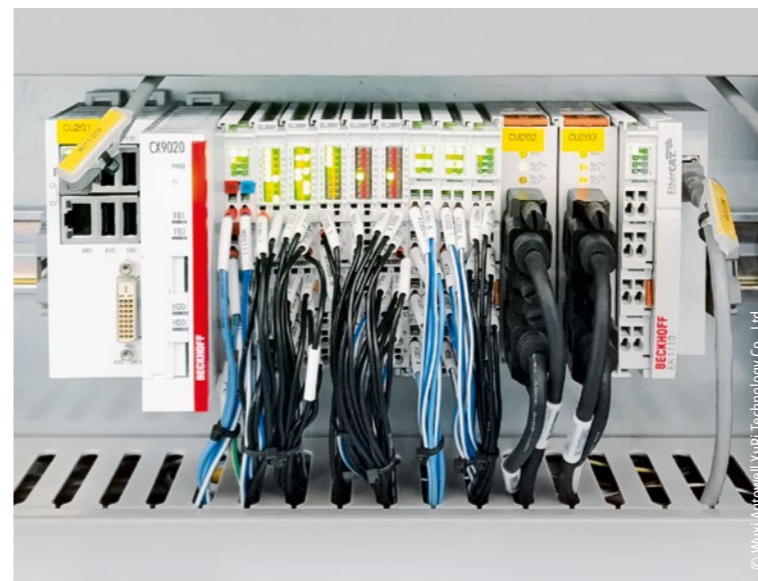
Embedded PC as control platforms. The C6015 features a robust housing made from aluminum and provides advantages such as small size, low power consumption, high performance, and space-saving installation in the electrical cabinet combined with flexible installation options. The two USB ports and two Gigabit Ethernet ports satisfy the user's interfacing needs for daily operation. The CX9020 is a cost-effective embedded controller, which in addition to its RAM integrates 128 KB NOVRAM as non-volatile memory. The DIN rail-mountable Embedded PC allows the direct connection of a great variety of I/O modules, so it is very easy to configure for use in different environments.

For their solar cell sorting process, Tongwei Solar utilizes the C6030 ultra-compact control cabinet PC. This controller is equipped with a 3.3 GHz Pentium® dual-core processor from Intel®, four USB 3.0 ports and four Gigabit Ethernet ports. It uses two Ethernet ports for EtherCAT communication, providing connectivity for dozens of different modules and 80 servo drives, achieving real-time control of all connected slaves in the automation network. When compared to traditional PLCs, the control system from Beckhoff is more open and flexible, and features a higher performance in real-time control. As a result, it can better meet the customer's needs in terms of short cycle times corresponding to a high production output.



The open and flexible ultra-compact C6030 Industrial PC controls a great variety of third-party devices acting as slaves in the EtherCAT automation network.

With directly connected EtherCAT Terminals, the CX9020 Embedded PC forms a fast all-in-one backbone for all automation functions of the comprehensive solar cell production lines.



**Effective troubleshooting and commissioning**

Persistent data storage is used for a small number of commonly used parameters. In addition to that, other device and motor parameters are saved by writing XML files. This prevents the loss of device information during system failures and ensures reliable machine operation.

With the EtherCAT communication technology, Beckhoff provides comprehensive diagnostic functions. In addition to the basic "emergency scan" function, users can quickly check for hardware defects in the EtherCAT network topology. It also allows diagnostics of the hardware of EtherCAT ports, enabling fast and accurate identification of the malfunctioning port of a specific slave. During the initial equipment commissioning, these diagnostic capabilities helped the customers solve many communication issues with third-party slave devices and accelerate the commissioning process by quickly eliminating problems at an early stage.

**User-friendly programming with TwinCAT**

TwinCAT supports all IEC 61131-3 programming languages, allowing users to choose their preferred programming language according to their own experience. In this project, for example, the engineers from Autowell XuRi chose to combine the two programming methods Structured Text (ST) and Function Block Diagram (FBD).

Beckhoff provides feature-rich software libraries for user-friendly programming. The Modbus library, for instance, contains suitable templates to enable convenient communication with frequency converters. The NC library facilitates the programming of motion control functions for the most diverse servo drives. Moreover, for libraries that users frequently call up, the programming efficiency can be further enhanced by creating custom libraries.

The powerful logging system automatically records every detail of machine operation. In case of an unplanned system shutdown or the occurrence of errors during operation, all information on such events can be found in the system, ensuring traceability of production and machine data and providing a basis for future optimization.