Welding machines are among the most important items of process equipment in modern industry. More than 740,000 electric welding machines were produced in 2007 in China alone. The welding machine manufacturer Huaheng Welding is one of the market leaders in the Chinese market and can look back on 15 years of experience. Huaheng uses a Beckhoff Panel PC and EtherCAT as the control platform in its latest generation of welding power supplies.

Huaheng Welding Co. Ltd., based in the ‘Kunshan Enterpark for Overseas Chinese Scholars’ (KEOCS), is one of the pioneering companies in China devoted to developing complete NC welding devices. Huaheng mainly manufactures welding power supplies, arc welding machines and welding robots. As a technology-driven company, Huaheng owns 66 technology patents and holds a very high share of the market in plasma, TIG and MIG welding machines.

Huaheng has relied on Beckhoff solutions in the field of special machine construction since late 2006. The company has now decided to equip its new generation of welding power supplies with a PC-based control platform from Beckhoff.

High performance in a compact design
In addition to high performance, Huaheng expected from the new control system an efficient realization, a convenient HMI interface and a compact size. “The control system from Beckhoff features compact I/O terminals that combine reliable performance with openness and expandability and are thus ideally suited to our application,” explains Liu Xiaolan, electrical supervisor of the arc welding machines department of Huaheng.

The control platform of the welding power supply is made up of a Beckhoff Panel PC from the CP66xx series, the TwinCAT NC PTP automation software, Bus Terminals and EtherCAT Terminals. Since the welding current causes significant interference when switching on, the PC must be insensitive to electromagnetic interference. The peripheral devices are connected via EtherCAT.
The high performance of the EtherCAT system and its good EMC compatibility guarantee the accuracy of the current pulse and waveform required by Huaheng. Another reason for using the EtherCAT bus system is its outstanding diagnostic capability.

**Full system performance of TwinCAT exploited**

Welding power supplies must meet the various requirements of the applied welding procedures, such as AC/DC and impulse welding. In the case of high-frequency impulse welding, the formation of the welded seam is greatly influenced by overheating. Therefore, the precise control of the pulse current is one of the main requirements that the equipment controller has to meet. To meet the requirements for the accuracy of the pulse, a high-speed task needs to be generated for pulse processing. The peak and base times of the current amplitude can be flexibly adjusted and adapted in order to generate the pulse waveform. The synchronization of the peak and base times of the current and the peak value of the rotational speed are also easily attainable using TwinCAT NC. Simultaneously, the current pulse edge can also be blocked.

**Motion Control in miniature**

During welding, a rapid oscillating movement must be made with precise positioning. After the welding process, this movement can be automatically ended and stopped at the starting position. Powerful features such as motion and PLC control are part of the TwinCAT system, so that servo, stepper and hydraulic axes can be controlled simultaneously. The Beckhoff KL2541 stepper motor terminal in a double terminal format is built very small and is therefore tailor-made for the compact Huaheng control cabinet.

**Software function blocks offer maximum functionality and flexibility**

Motion control functions such as positioning and speed control can be implemented via standard TwinCAT NC and MC function blocks. Since the arc changes during the welding process, the tracking of the arc length and the fast adjustment of the distance between the welding electrode and the workpiece are implemented in TwinCAT in order to achieve greater welding uniformity. This is where PC-based control proves its superiority: because of the high cycle frequency between speed and distance in the dynamic real-time motor adjustment, it would be very difficult for a traditional PLC-based motion control system to realize this function.

If end customers select different welding guns locally, the parameters such as current and microstep of the stepper motor must be adjusted accordingly. TwinCAT allows the stepper motor terminal to be switched flexibly via a single function block. End customers can exchange welding guns at the push of a button without having to update the program code. In this way, the efficiency of the equipment is vastly improved.

**Flexible adaptation to customer needs and market requirements**

Huaheng manufactures a wide range of products, such as welding power supplies, special pipe welding machines and welding robots, many of which need to be adapted to suit specific customer needs. Therefore, the question of improving the recyclability of the system controller was crucial. The openness and extendibility of the PC-based control platform from Beckhoff meets all of Huaheng’s machine-specific requirements. In this way, for example, the positioning of peripheral devices can be done by simple configuration of the servo motor and by programming the power supply. The machine can easily be converted into a welding machine for large special pipes. TwinCAT NC I and CNC functions are achievable via the software update. Machines can thus implement complex motion contours, such as lines, curves, profiles, etc. By integrating the corresponding software libraries, the machine becomes a complete robot, and expansion to multiple axes is also very easy to achieve. In this way, costs and development times can be drastically reduced for large plants. “In the future, we plan to develop our own CNC system using this equipment,” explains Chen Guoyu, special machine department manager at Huaheng.

**Advantages and prospects of PC-based control technology**

Thanks to PC mass storage, more than one hundred process parameters can be stored in the controller without additional costs. The manufacturing program created on a normal PC with special programming software can be transferred to the welding power supply via a network or a removable data storage device. The process data from the power supply is saved as a file and evaluated. PDF files are subsequently generated that meet the requirements for quality tracing. Huaheng intends to offer appropriate interfaces for ERP or MES applications.