



Universal automation concept for 3-axis CNC machining center that automates the machining of control cabinets

The demands on control cabinet construction are the same all over the world: custom manufacturing or very small series dominate. For that reason, automating the machining of control cabinets was long considered to be a challenge. With various material machining options, short tooling times, high scalability and the extensive range of accessories, the fully automated eCAB WorkCenter developed by STEINHAUER Elektromaschinen AG offers a profitable alternative to time-consuming and cost-intensive manual work. The control concept of the machining center is based on Beckhoff PC control technology with TwinCAT software.

The eCAB WorkCenter from STEINHAUER is a 3-axis CNC machining center for the all-round machining of control cabinet housings and mounting plates.

STEINHAUER Elektromaschinen AG, based in Würselen, Germany, develops, designs and manufactures automation technology for control cabinet construction. The product range encompasses machining centers for the fully automatic machining of sheet metal, metal and plastics, trimming machines, handling systems for final assembly and wiring assistants.

Fully automated manufacturing of control cabinets

The eCAB WorkCenter from STEINHAUER is a 3-axis CNC machining center for the all-round machining of control cabinet housings and mounting plates. It is equipped with an integrated tool change system and takes over the processing steps that are typically performed manually, such as drilling, thread-molding, milling and engraving. The necessary information for the machining of a work piece, e.g. a mounting plate, is either entered on the PC workstation on the machine or imported directly from control cabinet construction software via a network connection. In the first step, the view of the mounting plate and the doors is created with the CAD program. Extensive user-extendable libraries facilitate the creation of the layout. Transformers, cable ducts, mounting rails and frequency converters can thus be selected and simply placed on the drawing surface. Alternatively, digitized construction diagrams can be read in directly from industry-specific CAD software. The layout is subsequently converted into a machine program and loaded into the controller of the machining center. "Our customers can achieve a very high rationalization effect with little expenditure," says Robert Nagel, Technical Director of STEINHAUER Elektro-

maschinen AG, describing the charm of his machines. "They are quick to install, since no elaborate integration measures are necessary. We make our customers more competitive, because our range includes everything required for well-organized control cabinet manufacturing. So far we have sold over 200 units of the eCAB WorkCenter." "We take pride every day in the reliability and precision of the STEINHAUER machines," confirms Andreas Hülshorst, Plant Technology Sales, Beckhoff. "At present, two eCAB WorkCenter CNC machining centers and two eCAB NC-CUT cutting systems are in use in our control cabinet manufacturing plant. Without these machining centers we would not be able to maintain the quality and short delivery times demanded today."

High degree of automation and versatile functionality with minimum use of hardware

Importance was attached to established quality features even at the mechanical design stage: the eCAB WorkCenter is equipped with a 7.5 KW tool spindle and feeding drives on linear guides and ball screws. In harmony with the brushless Beckhoff servomotors, that corresponds precisely to the requirements of stable machine construction for the fast, low-noise and precise machining of the work pieces.

The control platform of the eCAB WorkCenter consists of a Beckhoff C6920 Industrial PC with TwinCAT NC I software, an I/O system consisting of Bus Terminals and a motion system that includes three Servo Drives from the AX5100 series. The Bus Terminal system with its wide range of digital I/O terminals

Robert Nagel, Technical Director of STEINHAUER Elektromaschinen AG, in front of the high frequency tool spindle of the eCAB WorkCenter



The control platform of the eCAB WorkCenter consists of a Beckhoff C6920 Industrial PC with TwinCAT NC I software, the BK1120 EtherCAT Bus Coupler and three Servo Drives from the AX5100 series.

serves the integration of various functional elements, for example the automatic extraction of milling swarf, the light curtain for monitoring the work area or the control of pneumatic work piece holding clamps. The drive technology is designed according to the tasks: Beckhoff AM3000 synchronous servomotors are used for the X and Y-axes of the eCAB WorkCenter and position the main spindle motor with a rated torque of 3.5 Nm. Since the tool drive is fed only to a small degree via the Z-axis due to the two-dimensional working plane, an AM3000 with 1.2 Nm torque suffices for the Z-axis.

The asynchronous high frequency spindle (C-axis) installed in the eCAB WorkCenter offers speeds of up to 24,000 rpm in speed-controlled mode. The high frequency makes ultra-fine machining and high surface qualities possible. The integrated, fast drive technology of the AX5000 is ideal for the operation of the HF spindle, particularly in the maximum speed range: The AX5118 single-channel 18 A version controls current and speed with a cycle time of 62 or 125 μ s. Complete integration of the AX5000 in the TwinCAT System Manager makes parameterization very simple.

The software concept of the eCAB WorkCenter is also uniform and is written in the established standards of IEC 61131 for PLC programming and DIN 66025 for CNC machines. "Our software runs 'on top,' so to speak" says Robert Nagel, explaining the concept, "so that machine operators do not need to have any experience with G-Code and programming. They either use the graphic user interface and place the components on the mounting plate like macros, or they use an E-CAD user interface." In practice this leads to further

savings potentials and competitive advantages in terms of staffing and training. STEINHAUER has developed a CAD/CAM interface for the coupling of TwinCAT. The CAM data are available as CNC code for TwinCAT. The graphic user interface is based on Visual Basic.

Universal concept with plug-and-play in case of service

STEINHAUER Elektromaschinen AG has relied on Beckhoff products since 2004. For Robert Nagel, the 'one-stop shopping concept' and acceptance across international markets were decisive for the choice: all control components had to be procured from just one manufacturer in order to design a universal machine concept that does entirely without proprietary technology. "The challenge with the eCAB WorkCenter lay in the many details. The universality of the Beckhoff product range is one of the big tricks in the implementation: no other manufacturer – whether large or small – was able to offer us a solution based on a small number of high performance standard components." The utilization of the full drive power of the AX5100 over the entire speed range was a further important factor.

In addition, where service is concerned, international business places particular demands on small companies that cannot be met without a strong partner. Robert Nagel relies on the strong local presence of Beckhoff in markets worldwide, and cites as an example a machine breakdown at an Indian customer's site: "We were able to access the machine by remote maintenance via the Ethernet connection and locate the fault. Beckhoff's Indian representative sent the spare part unparameterized to the customer, who was then able to connect it 'out of the box' and very shortly the machine was up and running again." This feature is made possible by TwinCAT: the automatic download of the last valid configuration of each EtherCAT device is stored in the TwinCAT start-up list and makes plug-and-play possible in cases of required service.

The revised control concept of the eCAB WorkCenter is so universal that existing experience and know-how is used in the in-house development of further machines. "It is no problem for employees who are proficient with the WorkCenter to also accompany all further developments based on the same control environment." An example of this is the eCAB PWA, a fully automatic wiring assistant that significantly reduces the time required for wiring a control cabinet. That is the next project that STEINHAUER Elektromaschinen AG will be implementing with Beckhoff.