

PC-based control platform for deep hole drilling machines

Machine performance enhanced, costs reduced

- Gun drill technology is used in a wide range of industries such as automotive, aerospace, medical industries, etc. – basically any application that requires precision holes. Kays Engineering is a provider of high precision deep hole drilling systems. In order to meet the high precision requirements and diverse drilling needs of its customer base, the company uses PC-based control technology from Beckhoff for its drilling machines.



The DeHoff gun drill from Kays Engineering now features a Beckhoff control system with the CX1010 Embedded PC. The PC-based controls cost well over 50 percent less than the machine's previous PLC-based system.

Kays Engineering, located in Marshall, Missouri, USA, has two well established deep hole drilling systems for bore diameters between ¾-inch (Eldorado) and 2-inch (DeHoff). The DeHoff line incorporates control of the coolant system, fixturing system, automation system and many other optional components in the machine control according to the specifications required by the customer. A major differentiator with the DeHoff machines is the use of flat ground ways rather than using linear guide ways. This provides peerless stability and helps minimize vibration in the drilling process, which could otherwise cause numerous quality problems in the finished product. DeHoff machines also offer a vast range of spindle speeds to provide maximum drilling flexibility.

More flexibility with the help of PC Control

In addition to maximum precision, key customer requirements for a deep hole drilling machine are to be highly adaptable and flexible to every unique applica-

tion. "While Kays offers a job shop-oriented and standardized machine with the Eldorado line, the DeHoff line of drills is often subject to requests for rather high levels of customization," Brandon Snell, Controls Engineer, Kays Engineering said. "Usually our customers have already finished the design and dimensions of their parts that are to be drilled, with nearly limitless variance in shape and size." The DeHoff gun drill line has some standard elements such as the servo drives, motors and other standard motion components, but the machine is very application-specific. In the past, Kays Engineering utilized a traditional PLC to control both a servo drive and Variable Frequency Drive (VFD) via an analog interface. A grayscale, low-resolution display panel served as the operator interface. In early 2006, Kays first started looking for new controls packages and weighed six different vendor options, seeking a highly flexible controls platform that could efficiently accommodate a wide range of customizations and provide a hardware platform that could scale in processing power.

6.5-inch CP7829 Control Panel
with custom DeHoff logo



Compact and cost-effective control platform with Embedded PC

"With the Embedded PC from Beckhoff we found a solution that exactly matched our requirements," Snell said. For the Eldorado series drills, Kays Engineering selected the CX9010. The higher performance DeHoff machines feature a CX1010. The CX controllers utilize EtherCAT as the high-speed Industrial Ethernet communication system. "Another major benefit to the Embedded PCs is that they utilize Compact Flash for boot and memory instead of a hard drive," Snell noted. "Many Motion Control alternatives we evaluated were typically priced quite a bit more than the PC-based approaches. Simple economics was a major deciding factor in favor of PC-based control," Snell said.

The previous displays were replaced with full color 6.5-inch Beckhoff CP7829 Control Panels with custom DeHoff and Eldorado logos integrated into the front. The CP7829 also features numerous function keys and a numeric keypad, adding to the flexibility of the new display. The panels connect to the CX Embedded PCs via DVI/USB. The Control Panels can help reduce cost and required space when compared to a standard IP 20 rated touch screen.

Optimized programming

With TwinCAT, the Embedded PCs have integrated Motion Control functionality. "TwinCAT has built-in Motion Control libraries, which saves a tremendous amount of programming time – we're able to simply drop in the standard blocks of code we need," Snell said.

"The ability to choose Structured Text (ST) with TwinCAT has greatly streamlined our programming. While we can still use it, we are not restricted to Ladder logic and can program in all the languages established in IEC 61131-3," Snell said. The system Kays Engineering created includes a "drilling parameters calculator" that allows end users to simply enter data on the material to be drilled, the required hole diameter, and the system automatically generates the appropriate feed rate and spindle speed for the materials to be drilled.

EtherCAT for ultra fast control

AX2000 Servo Drives with EtherCAT interface are used as drive system. "One of the biggest factors that led to selecting EtherCAT was the almost 'plug and play' functionality it brings to our machine design," Snell said. Previously, the Servo Drives and VFDs on the Eldorado and DeHoff machines required an analog 4 – 20 mA loop and excessive cabling to communicate the machine load. That method was not as reliable as Kays Engineering wanted, especially considering the long cable runs that were required.

"EtherCAT constitutes a major improvement because it offers deterministic performance and provides much higher speed and reliability. Troubleshooting cabling

that consists of basic CAT 5e Ethernet cables is also inherently simple and cost-effective. It's just one type of cable to manage rather than having to worry about six different types," Snell explained.

Higher performance at a lower cost

"Overall, the new Eldorado and DeHoff control systems have become more economical than the previous systems," Snell said. "In addition to the higher performance, energy usage has been reduced by using more efficient Servo Drives. Today, there's a more compact Beckhoff motor controlling the gun drill's axis slide that can generate the same level of torque as the larger motor in our previous system."

This improved flexibility and efficiency did not come at an increased cost for Kays Engineering. "We saw a dramatic controls cost optimization with the DeHoff machine – the Beckhoff control system with the CX1010 costs well over 50 percent less than the previous traditional PLC-based system. The Eldorado system with CX9010 costs over 10 percent less than the lower performing system it replaced. I'll pay less for higher performance any day!" Snell said.

The savings Kays Engineering experienced did not stop at hardware cost. Using EtherCAT and standard Ethernet cabling, the company was able to cut two entire work days from the required wiring time of its control cabinets.

Customer reception for the new Eldorado and DeHoff machines has been equally positive and highly encouraging to Kays Engineering. "As a result of the strong feedback for these redesigned machines, at least 90 percent of the Eldorado and DeHoff machines will be fully equipped with Beckhoff PC-based control systems and EtherCAT going forward," Snell said.

Kays Engineering has by no means reached the end of their PC-based control evolution. The CX1020 and CX1030 Embedded PCs from Beckhoff provide even higher performance options and room to grow when the company decides to add more axes of motion and further enhance the system features of their deep hole drilling systems. "We have the ability to simply scale up to the next controller in the CX Family," Snell said. "Most of the existing programming and controls design will remain the same for each new machine variant. We've optimized our machine design flexibility today and well into the future."

→ Kays Engineering www.kays-dehoff.com

→ Beckhoff USA www.beckhoffautomation.com