Spindle on Personal CNC goes digital with Commander SK

Along with ease of use came improved performance and reliability

Tormach produces a high-quality personal CNC machine for inventors, machinists, manufacturers and hobbyists. According to Greg Jackson, president of Tormach, affordability is what makes their PCNC 1100 truly personal, closely followed by ease of use.

Tormach's PCNC 1100 is accurate to ±0.001 inch. The base model 3-axis Vertical Milling Center retails for under $7,500 (US). The cost of the complete PCNC 1100 package – stand, computer, fourth axis, all the spindle tools and more, is about $17,000. Industrial equivalents can be many times that price, while providing precision not required for nearly 80 percent of CNC applications.

Jackson, who has been involved in machine building for over 30 years, speaks from experience when he says it's easy to produce an ultra-high performance machine when money is no object. He believes the challenge and satisfaction comes in creating a machine with the greatest possible value at the lowest possible cost. Something Tormach has accomplished.

Deciding on Digital

Like many OEMs, Tormach has had to deal with rising transportation costs and increased costs from suppliers. However, Tormach did not want to increase the price of the PCNC to its customers without adding to the machine's value in return. So, it looked inward for opportunities to cut costs and improve the product.

KEY BENEFITS

- MORE ACCURATE SPEED
- INCREASED LOW END TORQUE
- QUICKER DECELERATION/FASTER BRAKING
- GREATER OVERLOAD CAPABILITY
- TUNING NOW DIGITALLY PRECISE
- ELIMINATION OF TUNING DURING MANUFACTURING AND RECALIBRATION
- ELIMINATION OF POTENTIOMETERS AND ASSOCIATED VARIATION OVER TIME THAT IS SEEN WITH ANALOG ELECTRONICS
- HIGHER OUTPUT POWER FOR INCREASED CUTTING CAPACITY
- EASY INSTALL FOR RETROFITTING EXISTING MACHINES
- INCREASED MACHINE RELIABILITY AND REDUCED DOWNTIME

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A big part of Tormach's value proposition is no-cost telephone and e-mail support for the life of the PCNC. One of the most nagging, and therefore costly support issues involved the analog AC drive used for the spindle motor. The problem was repeatability – analog devices are subject to temperature drift, requiring manual tuning of the potentiometers by the customer. This issue was a hidden cost, and hours devoted to supporting the drive were at the expense of new product development.

Although more expensive than analog drives, the price differences have narrowed in recent years, and digital drives would solve the repeatability issue, and are much easier to use. As a result, moving to digital drives promised Tormach lower overall system costs due to decreased support time while delivering the customer better performance.

Deciding on the Drive

Tormach engineers began testing several of the leading digital drives on the market to find the drive that would provide the best cost/benefit ratio that could in turn be passed along to their customer. They focused their attention on Open Loop Vector drives for their ability to provide better slip compensation and more torque at low speeds than V/Hz drives as a result of the computing power of the drive and its knowledge of the motor and its load characteristics.

After two months of testing, the Commander SK proved to be the optimum drive. The factor that differentiated the Commander SK from all others was it was the only drive to provide additional programmability that allowed the drive to "sense" when the motor was encountering difficulty achieving the commanded speed. This additional intelligence enabled Tormach to program what it calls "fold back logic" into the drive, which gives the drive the ability to automatically "back-off" to highest sustainable speed when presented with too great a load. This feature allowed Tormach engineers to safely increase the top speed of the PCNC spindle without fear of a spindle fault

By selecting the Commander SK, Tormach achieved several performance enhancements: The speed range of 350 rpm – 4,500 rpm was expanded to 100 rpm – 5140 rpm. The drive's dynamic speed range changed from 5:1 to 20:1 for a 400% improvement.

Drive power capability was extended from 1.5 hp (5A continuous and 7A peak) to 2 hp. While the original drive had 150% overload capacity, the Commander SK provides the system with 230% overload capacity for outstanding carry through during tough cutting conditions. In testing, cutting speed was improved by nearly 100 percent, from 21 ipm (inches per minute) to 40 ipm at 1200RPM. Drilling capability was greatly enhanced and benefited from increased torque available at low speed that allows large diameter drills to be effectively used.

Other Benefits to Customers, and Tormach

The addition of a dynamic braking resistor enabled a 450% improvement in stopping time, from nine seconds at full speed to less than two seconds.This allowed Tormach engineers to develop a tension/compression tapping head, which had been high on customer wish-lists.

The Commander SK's extensive programmability also allowed Tormach engineers to provide three new features, a drive fault pilot light, an overload imminent pilot light, and an analog power meter.

An additional benefit to Tormach was that the Commander SK provides Intellectual Property protection, so that features such as "fold back logic" remain proprietary. Beginning in the Fall of 2008, PCNC 1100 vertical machine centers will include the new Commander SK, and current PCNC 1100 owners can receive a virtual plug-and-play upgrade.

A PDF of the Tormach's Spindle Drive Design Considerations (8/6/2008) can be downloaded from their web site, **www.tormach.com**.