



On a success course with CANopen

Cost-optimised drive interface with CANopen

"Which drive and control concept is the solution of my choice?" Many a machine maker will be faced with this question and must find his way around in the abundance of different vendors and systems. It all starts with a fundamental decision between a proprietary complete solution in which one vendor offers the control and drive integrated and the neutral solution in which components from different vendors are combined. In the latter case, you also have to choose the suitable communication interface between the controller and the drive.

Especially with the CAN bus, a low-cost system is available which is becoming increasingly attractive for the automation of plant and machines thanks to a high data transfer rate and insusceptibility to faults. For its customers in the machine construction business, ECKELMANN AG also increasingly frequently develops contouring or positioning controls featuring the digital CAN interface under the CANopen communication profile. For example, this is the case with the high-speed sample cutting systems of the Lasercomb firm which feature ECKELMANN CNC controllers and also motors and associated drive electronics from Jenaer Antriebstechnik (JAT).

Situated in the German town of Notzingen, Lasercomb Laser Combination Systems GmbH is an internationally renowned vendor and supplier of system solutions for the packaging industry and for punch die making. Together with its control systems partner ECKELMANN AG, the company particularly concentrates on the development and manufacture of user-oriented software and hardware solutions for solid-fibre and corrugated board packaging manufacturers and for makers of punching dies.

The new plotter generation FSP was also specially conceived for the high demands of the packaging industry. The units are used not only as plotters, but also with diverse tools in quite diverse functions, for example for the production of folding boxes that have to be cut out of cardboard and into which folding edges are embossed by means of a groover. Notching of adhesive films is another application area.

By use of the most up-to-date components, in particular for the control and drive, a low-cost unit was to be developed to offer a great degree of user-friendliness and flexibility, while operating at a maximum machining speed. The order for delivery of the control system was placed with ECKELMANN AG which, in the course of software and hardware development, was able to take recourse to its many years of experience as a control systems partner for the predecessor models of the FSP from Lasercomb. For the mechatronics systems, Jenaer Antriebstechnik received an order to develop a lightweight XY portal with a high contour rigidity together with the mechanical construction from Lasercomb.

The new Lasercomb high-speed sample cutting system is not available on the market in three sizes as the models FSP 2113 (2100 x 1300 mm), FSP 1613 (1600 x 1300 mm) and FSP 0813 (800 x 1300 mm).



Fig1. The new FSP from Lasercomb

Recourse to proven and flexible standards

The FSP consists of a vacuum table over which the tool head is positioned in the X and Y directions by means of steel strips that are driven directly by small torque drives (encoder-commutated stepper motors). The tool head itself possesses two tool holders, which can be equipped with a highly diverse range of tools. This enables a particularly fast and convenient tool change, even during machining. The Z-axis for height adjustment and the C-axis for tangential slaving of the tool are driven by DC motors. Possible tools consist of cutters (fixed or oscillating with a frequency of 23,000 strokes/min), grooving tools (fixed or oscillating, also with a frequency of 23,000 strokes/min) and plotting pens.



ECKELMANN uses its low-cost and proven E•NC55 as the contouring control. The ENC55 is a high-performance CNC in standard rail format. It possesses the most up-to-date communication interfaces such as Ethernet TCP/IP for networking and a PC MMI interface as well as two CANopen interfaces for connection of field bus terminals and digital drive amplifiers. Additional RS232 interfaces are also available for linking further machine facilities such as identification systems. Therefore, the •ENC55 is predestined for use as a centrally and decentrally distributed machine and motion control system.



Fig.2: The ECKELMANN E•CNC55

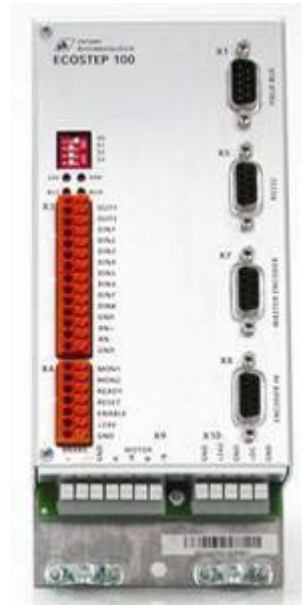


Fig3.: ECOSTEP® 100 drive amplifier from Jenaer Antriebstechnik

Saving costs with the right drive and bus technology

The predecessor model of the FSP was still realised with analog control (for the X and Y-axes) and with analog axis control (for the Z and C-axes of the tool carrier). In view of the technical and economic advantages of the digital drive interface, though, it was decided to replace the analog axis control completely in the current model.

So, the new FSP runs fully digitally on the CAN bus. The X and Y-axes possess ECOSTEP® systems from Jenaer Antriebstechnik. The two Z and C-axes are equipped with DC motors featuring brushes and an encoder, and are controlled by an ECOSTEP® controller from Jenaer Antriebstechnik. This is possible because the ECOSTEP® controller is capable of controlling two phases and two encoders separately. Therefore, one interface was additionally saved.

Especially due to the changeover from the combined to the completely digital design, its advantages in terms of control and drive aspects become quite clear.



Lasercomb FSP application report

The CAN bus is not only one of the low-cost bus systems, but also one of the particularly reliable systems. This is because the special way in which the messages on the CAN bus are structured makes it possible to check them very precisely in relation to their error-free transfer. Jenaer Antriebstechnik exploits this characteristic to implement extensive error monitoring (32-bit) with a high reliability level for its ECOSTEP® drives.

But especially recourse to the CANopen protocol signifies substantial advantages for development and for actual machine operation. The CANopen communication profile (CiA DS-301) supports both direct access to device parameters and also time-critical process data transfer. The CANopen device profiles (CiA DS-40x) define fundamental device functionality standards and at the same time offer wide-ranging possibilities for additional manufacturer-specific features. The network management functions specified in CANopen simplify project design, implementation and diagnosis by providing standard mechanisms for network initialisation and error handling.

A complete specification of a drive interface is available with the device profile DS-402. JAT already supports this profile and so no adjustments are necessary in the control system. This enormously reduced the costs of implementation. Adjustment of the drive-specific parameters is nevertheless possible in the case of drives which obey the underlying protocol level in accordance with DS-301, but do not keep to DS-402.

DS-402 already provides for use of the CAN interface for contouring axes with the interpolated position mode. This mode was also realised for the FSP control. Thus, the E•CNC55 cyclically communicates new contouring data finely interpolated by the drive controller to the ECOSTEP® units. Via the SDO protocol, there is a way, besides transfer of the process data, to configure the drives and to read diagnostic information. SDO stands for Service Data Objects and serves to transfer any volumes of data between individual devices on the CAN bus. With the aid of an OPC server, the data can be made transparently available for the drive's specific configuration and diagnostic programs.

The required simple and low-cost interface for implementation of the machine manufacturer's requirement was therefore available in the form of the CAN interface. As far as the line requirements are concerned, the Lasercomb application fits ideally into the spectrum of CANopen solutions that focus on applications with two to eight axes. But applications with more than eight axes can also certainly be realised. The interpolation clock pulse, which depends on the number of axes, is a possible bottleneck. With a data transfer rate of 1MBit/s and four axes, the minimum interpolation clock pulse is 1.21<\q>ms. The value for eight axes is 2.10<\q>ms. Ultimately, therefore, it is the demands on the dynamics and precision of the axes that crucially influence the possible application areas of the CAN bus.



Lasercomb FSP application report

In total, the use of the CAN bus and the CANopen protocol has substantially contributed towards achieving the endeavoured development goal of a particularly favourable price/performance ratio. The costs of the E•CNC55 with its exclusively digital interfaces are also clearly less than those of a classical CNC design.

Convenient operation and application-specific NC functions

Together with ECKELMANN, Lasercomb chose a low-cost, but convenient colour touch screen control unit as the operator control interface. All operating modes (automatic, manual, tool database, diagnostics and data transfer) can be handled conveniently via the ergonomic user interfaces.



Fig.4 The FSP touch screen control unit

Thanks to the many years of cooperation between ECKELMANN and Lasercomb, it was possible to integrate NC functions in the control system of the FSP that are specially tailored to the requirements of sample cutting systems. Thus, the NC function library not only offers automatic tangential slaving of the tools, but also material and tool-dependent expansion of the track and special intake functions. It goes without saying that the FSP also features automatic height correction of the tool carrier on the basis of the desk surface geometry data saved during commissioning.

Successful realisation of the new Lasercomb system's drive and control doubly underscores the great importance attached to solid partnerships in machine construction. The reason for this is that, firstly, the new control solution of the FSP profits from the typical experience in the trade that ECKELMANN developers have been able to gather in the course of many years of good cooperation with Lasercomb. And, secondly, in Jenaer Antriebstechnik, Lasercomb was able to find a new partner that trusts in the same technical trends as ECKELMANN AG, namely the CAN bus and the CANopen protocol, and establishes the right connection to the mechanical systems. So, the motto "on a success course with the CAN bus" applies not only to machine makers, but also to drive manufacturers and control system partners.