



The open Beckhoff application Machine control under Windows NT

## Functionality increased and expenses reduced

When the Windows PC changes its workplace and gets down to business, then mechanical engineers get a multiple talent, for their design, to control, communicate and visualise. Thanks to this open application by Beckhoff, the users can control the machine from their offices in future and bring them into the company network through open interfaces.

The medium sized and large machines at the packaging machine manufacturers, Koch now only receive their commands from the control software TwinCAT. Head of design, Heinrich Hornberger: "It has now taken over the tasks of the Programmable Logic Controller (PLC) and NC – (Numerical Control)". Instead of expensive control hardware, one PC processor manages the work. Hornberger is ready with an impressive example: "We have just finished producing a blister line for flashlights/torches and batteries for VARTA AG, Ellwangen, which is controlled by the Windows software TwinCAT".

From 15x PLC varieties to a standardised solution

The machine's automation system consists of four component groups of the Westphalian automation company Beckhoff from Verl: TwinCAT as software PLC and NC, industrial PC, Beckhoff Lightbus and Beckhoff Bus Terminals. The

core of the system is the real time software, TwinCAT. Heinrich Hornberger points out the main advantage compared to the common PLC: "Previously, every client wanted to have a special control system in his machine. In this case controls that were already in operation were preferred and for which the necessary know-how already existed. Overseas clients wanted controls that were widely used in their respective countries. This led to the fact that even with identical machines a high programming effort was required for the Koch developers in each case. "Over 15 different PLC products forced us to simplify", the head of design remembers. During this phase people decided for the open Beckhoff application of PC based control technology. This was possible by the increased capabilities of the Windows NT operating system on the one hand and by the high computing power of modern Pentium processors on the other. The software-PLC/NC

now replaces the hardware-PLC and hardware-NC at Koch. By using TwinCAT a single processor controls all axes of a machine in this way, for an exact positioning in the packaging sequence.

The commissioning durations are reduced considerably

But these are not the only performance characteristics of Beckhoff's TwinCAT software. It also simplifies the design and conception of Koch's machines. "The know-how for the programming does not always have to be structured afresh", observes Heinrich Hornberger. "We have worked continuously on this to design as much as possible in the same way on the machines", he says. Although there have been standardised operating consoles for a long time, which at least permits designing a standardised surface, the control technology behind it was always heterogeneous. "Thanks to TwinCAT we can adopt existing program modules for new

Packaging machine manufacturer Koch in Germany relies on PC-based automation solutions from Beckhoff. The Beckhoff Soft-PLC/NC TwinCAT, the Electronic Bus Terminals, the fast fieldbus Lightbus and the Industrial PC are used for packaging VARTA flashlights.



machines, alter them and use them further and save time and money in this way", according to the head of design. This was not possible in this way with the PLC languages such as IL, LD or FBD. Hornberger adds: "Thanks to Visual Basic and the TwinCAT interfaces we can program the operating surface easily". Error control, the so-called debugging, is also considerably more efficient now than previously. This is reflected in the short commissioning times enabling the plant to operate flawlessly.

Thus, several advantages result for Koch Maschinenbau when using PC control with Beckhoff software: The engineer does not have to constantly re-program the different PLCs. TwinCAT processes the machine data which the sensors send to the IPC via decentralised Bus Terminals and the fast Beckhoff Lightbus and sends the control commands from the computer to the actuators in real time. The Windows operating system kernel stays unaffected in this case, although Windows NT itself is not a real time operating system. This reaches TwinCAT through an integrated scheduler which divides the computing time between the operating system kernel and the control software.

#### Koch Maschinenbau, Pfalzgrafenweiler-Bösingen

#### This is how the packaging machine works



The flashlight and its batteries are packed in a transparent double blister together with information on the product.

The lower part of the blister and the upper part of the blister are drawn deeply and separately from a blister drawing machine. The products are placed into the lower part of the blister manually. The machine then places the upper part of the blister on top. Then both blisters are welded together using high frequency and in the next operation the outer form is punched out. Finally Euro perforations are punched in and the product is then ready for the shelf for selling.

The mechanical engineering company completed this complex plant within a few months as a product ready for supply. It should also be pointed out here that ten different types of flashlights can be packed in this plant with the option of extending this to more products.



The Human Machine Interface is done with the Beckhoff Control Panel, which can be installed up to 65 m away from the control PC.

#### Real time in Windows without an expansion card

Beckhoff's control software also brings all the possibilities from the world of Windows to the machine: Thus, thanks to Windows software, remote maintenance can be carried out on Koch's packaging machines. The manufacturer offers this service to his clients via modems or ISDN lines. This is possible with the remote control software PC Anywhere from Symantec. A further performance characteristic is the possible connection to the company network via an Ethernet card. Employees can also control and interrogate the machine in the network from the office. Error messages and operational messages are sent from the machine as reports and can be compiled and evaluated in Excel tables. An important advantage for Koch Maschinenbau lies in the programming as per the IEC 61131-3 standard.

This guarantees minimum standards and industrial compatibility. All standard languages can be used for the programming of a project using TwinCAT. Hornberger does admit, however, that the cost for programming and support increases using the Windows system since programming is more complex than with the usual PLCs. But the wide usage of Windows and

the generally existing know-how favour the Microsoft system technology.

Simple operation included Much is also made simpler for the operator of Koch machines: He can use a complete visualisation of the machine on the monitor screen, which is only possible using the graphic Windows interface. A machine diagram appears on the screen from which the individual stations can be selected directly. Karl Saile, responsible for technical documentation at Koch: "The operator has a graphical picture of the machine in front of him. Everything that previously had to be looked up on paper is now easily available on the screen". The system transmits error messages in plain text and immediately shows the location of the fault graphically. The operator can select the most important sub-assemblies and valve islands directly on the screen, locate errors quickly using the graphical representation and control individual valves on the touch screen using fingertips.

The introduction to the operating functions is compiled as a multimedia file. The complete operating instructions can be called for directly on the monitor as a PDF file.

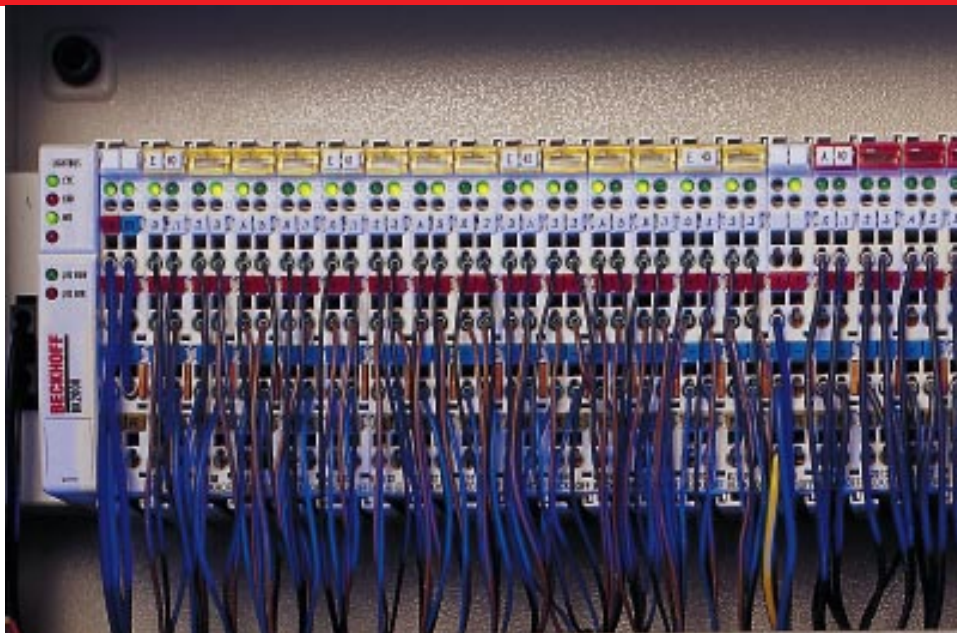
Peripheral equipment bought additionally, such as labellers and

printers, can be connected through standard interfaces. Heinrich Hornberger acknowledges that the work is made much easier in this case as well: "It is very time consuming with the commonly used PLC until the interface has been written for it. This can last up to two weeks".

Of course, the larger the plant is more off the above mentioned simplifications are counting in terms of cost savings, since correspondingly more PLC and NC hardware can be replaced. However, presently a control PC does not provide cost effectiveness for very small machines. "In this case we hope for operating systems Windows CE or Embedded NT", says Hornberger.

The head of design also makes use of the TwinCAT NC functionalities. They save considerably on investments for conventional NC hardware. "Previously with the conventional PLC hardware I needed intelligent and therefore expensive controllers for the machine axes", recalls Hornberger. The controllers then received commands through the bus connection from the PLC. Now, with TwinCAT, simple controllers are sufficient, which receive their commands from the PC. In this case there are eight axes at the VARTA plant. Cash is saved here in designing. Parallel data

The high granularity and decentralized placement of the Beckhoff Bus Terminals ensure an easy and flexible wiring at the Koch packaging machine.



traffic through dedicated bus lines is also not needed. The head of design is in raptures when he describes the advantages of multitasking: "We can define a task on the machine for every control step with a reaction time for example of one, ten or 100 milliseconds".

The entire software for the machine and peripherals is installed in an industrial PC from Beckhoff's Box-PC series. This is housed in a control cabinet next to the machine. The extremely flat Control Panel with the familiar Windows surface is attached to an arm bracket which can be swivelled.

Koch also relies on Beckhoff's technology for data transmission to the machine. The Lightbus is used on an fibre optical basis and the electronic Bus Terminals are used as the I/O interface. "Previously we had to wire all PLC and NC controls parallel to the axes. Now, with the Beckhoff Bus Terminals we can place the Lightbus at any point on the machine for the passage of control signals and measuring signals", says Hornberger. Bus Terminals in fine modules are used by Koch primarily for the distribution of signals. "The normal bus distributors with 8 or 16 or 32 terminal blocks in a box are not flexible enough. The individual terminal for the most diverse signal forms on

the mounting rail renders possible individual solutions". Consequently here, peripherals also contribute considerably to the desired standardisation of production. Bus Couplers that are available for all the known fieldbus systems, transmit the signals across the fibre optic conductor to the control PC.

#### Individual Bus Terminals make the wiring flexible

In practice the Bus Terminals have the advantage that the wiring can be carried out in a flexible manner on the field equipment at site and at the machine. When required a Bus Terminal is plugged in there and data exchange with the control is established in an uncomplicated way. "If different fieldbuses are operated, as it is the case with another machine, then only another Bus Coupler is used and the plant runs", reports Heinrich Hornberger. In this way different connecting methods are not needed at the same time in the case of Koch. All interfaces used, whether analogue or digital, as well as the serial PC interface RS232 can be connected to the open Bus Terminals. Previously great effort was needed for this: Everything had to be wired in parallel.

The Lightbus used by Beckhoff in the field for data transmission

has additional advantages compared to the standard cables used, according to Hornberger. He explains: "We have to reckon with continuous transmission disturbances with copper cabling, when, for example, the shielding is not placed properly or the plugs are badly fabricated".

The fibre optic conductor can be laid out easily and without problems. Once laid out, the Lightbus functions. "The search for errors often only begins with the cable transmission", Hornberger emphasises the advantage of the Beckhoff solution. In addition to this, signal transmission over long distances in the field is not a problem.

Differences in potential between the individual plant parts do not play a role. All signals are transmitted at a data rate of 2.5 megabits per second for a maximum distance of 300 metres between the individual decentralised stations and at the required intensity.