

The Calmar control electronics are also used in the Techma 4 digital printing machine.

EtherCAT and XFC as foundational technologies for open control platform in industrial digital inkjet printing

Extremely fast, highly precise data communication for state-of-the-art printing applications

The printing industry is facing a dramatic shift in technology worldwide. All globally operating vendors of industrial printing machines are looking for an entry into the world of digital inkjet printing. Swiss company, Wifag-Polytype Technologies AG has developed Calmar – industrial-strength control electronics for a wide range of commercial inkjet print heads. EtherCAT and eXtreme Fast Control (XFC) technologies from Beckhoff provide the foundation for the open and fast control platform.

Traditional high volume printing methods such as gravure and web offset printing are battling against economic challenges; sheet-fed offset printing can look to the future only with cautious optimism today. Digital printing, on the other hand, promises better prospects, with the largest potential for inkjet printing. This is confirmed by Florian Fässler, Product Manager of Digital Printing at the Digital Competence Center (DCC) of Wifag-Polytype Technologies AG in Fribourg, Switzerland. He says: "As one of the three most renowned manufacturers worldwide, the former Wifag machine factory developed and manufactured newspaper printing machines. Since very few companies buy newspaper printing machines these days, the company decided not to develop any further new models in this area. In fact, digital inkjet printing is set to become the future for all departments of Wifag-Polytype Holding."

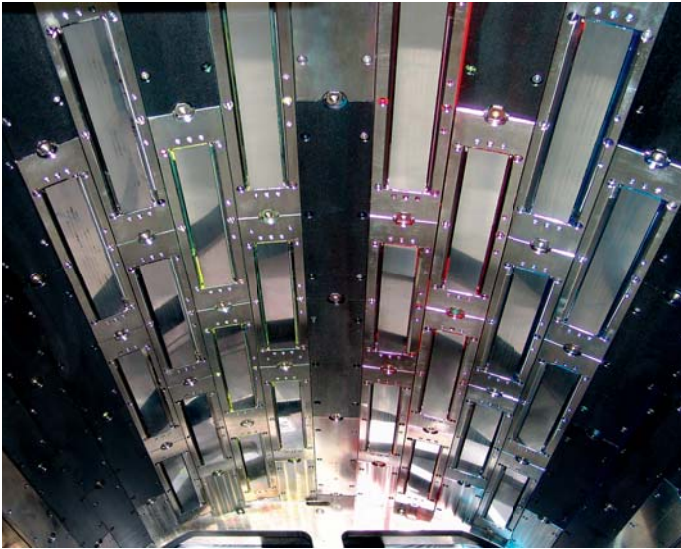
In Florian Fässler's estimation, the major challenges associated with digital printing are flexibility, on the one hand, and the productivity of printing, on the other. Only in finding balance here can printers profitably address the current trend towards individualization and personalization of materials. Digital inkjet printing is a matrix print method that generates a printed image consisting of

a dot matrix. These matrix printers are familiar from office and home environments, where they are widely used as photo printers. However, these devices are characterized by slow printing speed, which is not acceptable for industrial printing.

Ultra-fast technology for sensitive print heads

The heart of an inkjet printer is the print head, through which a print image is generated by the targeted shooting or deflection of small ink droplets. "The print head is a commercially available system that is connected to our own printing units and the special Calmar electronics," Florian Fässler explains. The print heads have quite a primitive interface. For example, there are no print heads with a USB interface. The Calmar project group's particular achievement is the realization of control electronics that are industrially compatible and usable for all printing machines.

"The systems available on the market consisted of very complex electronic systems," says Florian Fässler. "These were difficult to adapt, and scaling was not a simple process. Above all, they were not necessarily suitable for industrial



The Techma 4 printing machine has print heads arranged cubically to the print direction (left to right), as well as linearly to the print width (front to back). The control electronics on the Techma 4 are synchronized over EtherCAT and XFC.

integration." However, the Calmar project team had planned to develop a robust electronic control system that could be integrated with a fieldbus. This was coupled with the goal of developing a platform of products that could enable simple and flexible usage.

In the evaluation phase, the project team decided to integrate EtherCAT and eXtreme Fast Control (XFC) from Beckhoff. Florian Fässler explains: "The reason we chose Beckhoff and EtherCAT is the openness of the technology. When we started our development activities three years ago, there was no comparable deterministically designed, fast and open system. This technology concept could be implemented into an FPGA, and the EtherCAT communication was simple to integrate and execute."

From interface to automation module

An important reason for the integration of EtherCAT and XFC into the Calmar electronics is the extremely fast operation of the bus and control system. EtherCAT is a deterministically operating bus with short cycle times and high data rates. The XFC technology from Beckhoff supplements this functionality with Distributed Clocks for a synchronized system time and a maximum deviation of less than 100 ns, as well as with highly precise Time Stamp functions for process data. Florian Fässler says, "For the synchronization of print heads, all associated controllers must be started at the same time. That means that all the tasks in every controller have the same time base and start simultaneously with the control sequence. The Distributed Clocks system ensures that all devices receive the Time Stamp within one cycle. The cycle time of 2 ms is evaluated by the system simultaneously."

For the integration of the Calmar electronic system, the project team created its own EtherCAT interface based on the EtherCAT IP Core ET1810 or ET1811. This enables both EtherCAT communication and application-specific functions to be implemented on an FPGA – all in a simple and convenient way, according to Florian Fässler: "The acquired tool made implementing the EtherCAT interface easy; it is very well documented." The result is a notable success, and



Philippe Abt, Manager of the Beckhoff branch office in Yverdon, Switzerland, along with Florian Fässler, Product Manager of Digital Printing at Wifag-Polytype Technologies AG, and Philippe Monnin, member of the management board of Beckhoff Switzerland (from left to right)

Wifag-Polytype now has a flexible and robustly usable automation module in the Calmar electronics. Florian Fässler continues: "We can now conveniently engineer the print system with a configurator, regardless of whether it has two, 40, or even more Calmar cards. It is now much simpler to design and automate inkjet printing machines. In addition, there are more extensive diagnostic options available to us. Ultimately, we have an automation module that is ideal for industrial applications."

Secure on the inside, yet open to external connections

The Calmar control solution serves as an automation module for the digital printing machines from Wifag-Polytype Technologies AG, and is also marketed as an individual device within the framework of an OEM business model. The company's own expertise is also available to OEM customers as a service. Florian Fässler explains: "The PLC architecture and the source code are open for OEM customers; the Calmar-specific libraries as well as the control room application can be adapted and extended on request. Connections to the outside world are also open, whether to ERP, MES, or other databases."

Wifag-Polytype Technologies AG acts with similar consistency within the Calmar project group: the team, which consists of both hardware and software specialists, works with .NET technology. The visualization is based on Microsoft Visual Studio®, into which TwinCAT 3 is integrated. "Visual Studio® is considered by some as perhaps something new or a special application for standard automation, but for us it's a part of daily business. Our machines communicate over TwinCAT with the control room application, which was developed in .NET/Visual Studio®. The control room application takes care of the visualization," comments Florian Fässler.

Further information:

www.wifag-polytype.com

www.beckhoff.ch