



EJ series EtherCAT plug-in modules: Combining the benefits of standard and custom I/O solutions

Bus Terminals for PCBs – with this I/O solution in a new form factor, Beckhoff caused a stir at SPS IPC Drives 2014. The plug-in I/O modules can be connected directly to a custom PCB. In this way, the advantages of a flexible standard and custom development are combined. ETZ discusses the background and application scenarios of this product innovation with Beckhoff product managers, Michael Jost and Torsten Budde.

Since finely modular, DIN rail-mountable I/O systems were introduced in 1995, automation engineers have become very comfortable with them. EtherCAT Terminals, which enable dramatically increased transmission performance, have been widely used since 2003. Why would a machine manufacturer think about replacing the tried and tested DIN rail-based I/O systems? "There has to be a certain external trigger," says Michael Jost, Product Manager, Beckhoff. In high-volume machine construction this may be price pressure, because the machine wiring represents the conventional connection between the I/O system and the sensor/actuator level. Many machine manufacturers use board solutions developed and built in-house and want to do without them in the future. Another key trigger is minimizing the risk of error. "Series machine manufacturers want their automation solutions to be reliably reproduced," notes Jost. Time may be another factor – although manual wiring in control cabinets offers maximum flexibility, it is error-prone and time-consuming. It can pay off to seek other solutions for machine production quantities as low as 50 units per year.

"We discussed this issue at great length with our customers," recalls Jost. "In our opinion, fully customized boards are not a solution, since standard products

always offer advantages." According to Jost, the decisive factor for the development of Bus Terminals for PCBs was a project for a major machine manufacturer in Europe. On the one hand, they were keen to ensure fast reproducibility at their plant in China, and on the other hand, they wanted to scale back their in-house development, since it is not part of their core business. "Around 800 units of the machine in question are produced per year," says Jost. "For this project, it was important to maintain the cable tree structure, not least because of the operations in China."

Scalable platform and module strategy

The result is a scalable platform and module strategy that perfectly combines the advantages of a custom board solution and the standards of a Bus Terminal system. The EJ series, which was presented to a global audience for the first time at SPS IPC Drives 2014, uses an application-specific signal distribution board. The I/O modules can be flexibly placed on this platform. The user can select EJ modules from a full product range. "The individual wiring is shifted to the distribution board, so to speak," notes Jost. "This ensures consistent quality for each machine and avoids the common mistakes associated with individual wiring of terminals." Torsten Budde, Product Manager, Beckhoff adds: "The



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standard modules are placed on the custom board. In the end, the solution is compiled and works like an auto configurator."

At SPS IPC Drives, a base signal portfolio was presented consisting of analog, digital, and motion control modules, which can be combined as required. "The I/O signal variety we are used to from Beckhoff is currently in the process of being expanded systematically," says Budde. "With many users we are in the prototype phase, although there are already customers who use this system in mass production."

Thanks to the coding mechanics of EJ modules, the risk of 'miswiring' is eliminated. Even staff without specialized knowledge can wire the machine correctly. This is particularly interesting for companies with locations around the world. "The time savings in production, workforce training, and also in testing are tremendous," adds Jost.

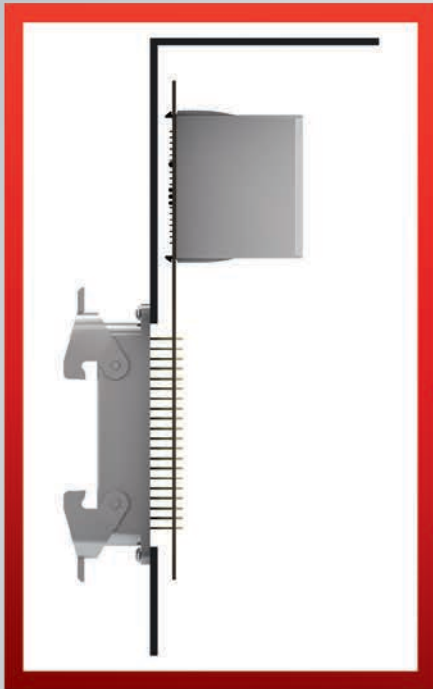
Budde mentions another advantage: "Functionally, the EJ series is 100 percent based on EtherCAT Terminals and EtherCAT Box modules. Since all the functionalities are already available in the EtherCAT Terminal system, these devices

simply have to be integrated in the new series in accordance with customer requirements."

In the short term, extensions for the existing portfolio of analog, digital, and motion control terminals will be presented at Hannover Messe 2015. Safety modules are also available already. "Today, more than 50 percent of our I/O terminal customers want an integrated safety solution," Jost stated, underlining the importance of this module type. Due to the new form factor, the safety modules still have to complete certification processes.

For series machine builders and more

What is the target group of the new system? "During the development we were mainly thinking of large-scale machine production," admits Jost. "This is a special system that could be of interest for 5 to 10 percent of users from the machine tools or in semiconductor industries, for example. In cleanrooms, for instance, there are strict requirements for saving space." The creation of identical parts and the associated space savings are the main drivers here. After that came SPS IPC Drives: "During the trade show new ideas emerged, and we are now far more optimistic about market penetration. In the past, certain



Control cabinet solution with EJ series and standard connectors greatly reduces installation effort.

industries have used custom black boxes as a control and I/O solution," according to Budde. This includes test equipment or robots, which may not exceed a certain weight. "Thanks to its design, the EJ series is compact and lightweight," Budde continues. Additional application scenarios arise from these examples.

"The motivation for using the EJ series may be different depending on each situation," says Jost, concluding that: "Possible reasons include error prevention, saving space, and reducing labor costs. The production quantity from which the use of the EJ series offers a rapid ROI for a series machine manufacturer can vary between 50 and 500 units per year."

Budde has this message for users of the EtherCAT Terminal system who are interested in switching to this new solution: "The software is fully interchangeable, although a new way of thinking is required when it comes to the hardware." For example, potential distribution is no longer required in the control cabinet.

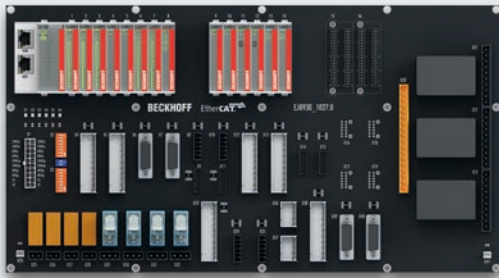
"Beckhoff can provide the signal distribution board," notes Jost. "We also provide a design guide, so that customers with relevant expertise can develop

the board themselves." The development of the distribution board is a one-time investment, which usually pays for itself within one year, thanks to the resulting time savings.

But the EJ system offers even more advantages: "One example is simpler installation in control cabinets with standard connectors or with IP 67 connectors." The connectors are soldered directly to the board which is pluggable on both sides, which saves further installation time. "This makes the interior of the cabinet more intelligently structured and much tidier," Jost says. As a result, maintenance efforts are reduced. "It is also possible to locate additional relays on the board," adds Jost. "This saves further installation services and electronics hardware."

Flexible for modification requests

Subsequent change requests can be taken into account easily, thanks to the high flexibility of the EJ system. In terms of both hardware and software, the EJ series can be seamlessly integrated with the EtherCAT Terminals and the EtherCAT Box modules. "You simply have to connect another cable to the EJ coupler," according to Budde. In this way, it is possible to cost-effectively



Basic version



Basic machine functionality



Option: transportation unit including safety functionality



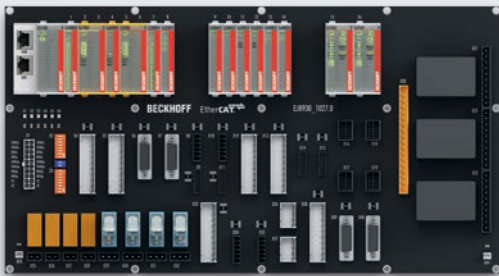
Option: robot unit



Option: fieldbus connectivity unit



Option: energy measurement unit



Extended version



Basic machine functionality



Option: transportation unit including safety functionality



Option: robot unit



Option: fieldbus connectivity unit



Option: energy measurement unit



High-end version



Basic machine functionality



Option: transportation unit including safety functionality



Option: robot unit



Option: fieldbus connectivity unit



Option: energy measurement unit

EJ modules on the signal distribution board

implement application-specific elements that are required infrequently, but are still important.

Another option is to provide a modular EJ slot, so that future extensions are easy to implement. A third option involves the use of a placeholder module, which can subsequently be replaced with a functional module, when required. A common distribution board can thus be used for different applications.

One possible implementation of the platform strategy of a company is classification of the entire machine portfolio based on different controller versions. A basic version could provide standard functions, for example, a platform for machine control. Integration of an EJ placeholder module permits the addition of I/O components at a later time. If machines with extended functionality are then to be realized based on this basic version, the placeholder modules can be easily replaced with safety modules or motion modules. A machine with such a configuration can feature a transport unit including safety functionality and a robot unit (extended version). Linking the EJ series with EtherCAT Terminals and EtherCAT Box modules retains the flexibility of the machine control, so that even functional enhancements that are not part of the platform can

be configured, if required by the customer (high-end version). The number of configuration stages of the machine portfolio can vary from customer to customer. Customers can implement platforms that are perfectly tailored to their machines, thereby creating identical parts and saving money.

The EtherCAT Terminal system has become well established in the global marketplace. The majority of new projects are implemented with EtherCAT I/Os, in preference to the Beckhoff Bus Terminal system. In this sense, the EJ system is the next logical progression, which will open up new markets and which will find its market. "We will consistently continue along this path and further develop the solution," concludes Jost.

Further information:

www.beckhoff.com/ej-series