



Bailey Controls Uses Megafunctions to Solve the PCI Challenge

Bailey Controls, part of the international Eltag Bailey Process Automation N.V. group, needed a PCI bus to create a new industrial controls product that enabled processor upgrading without imposing costly product redesign burdens. They found the solution by working with Eureka Technology, an independent megafunction developer specializing in architecture-independent PCI megafunction solutions.

Industry:	Industrial Automation
End Product:	Processor I/O Card
Design Application:	Industrial Control for Factory Automation
Altera Products:	EPF10K20, EPF8636

bandwidth to create a new design and develop a new product every year.”

Managers and engineers decided they needed to develop an entirely new product line. Designing in the ability to upgrade without obsoleting the entire printed circuit board

(PCB) would require uncoupling all custom elements from the microprocessor, including proprietary networks and I/O channels. At the same time, the Bailey Controls staff decided to use off-the-shelf hardware as much as possible

The Challenge

The engineers at Bailey Controls were caught in a difficult situation: they needed the ability to easily upgrade the microprocessors in their industrial control products but did not have the resources to completely redesign their single-board system. For years, Bailey Controls designed products based on Motorola 68000 family of microprocessors and proprietary ASICs. “Up to a certain point, our typical product life cycle was five to eight years using a specific processor,” said Bill Mohat, a senior design engineer. “But new and faster processors started hitting the market every 11 months or so, and we just didn’t have the engineering





and remain with the Motorola 68000 family. On top of these requirements, they faced limited engineering resources.

To meet the basic criteria, the design needed a bus that was both processor and clock-rate independent. The peripheral component interconnect (PCI) bus—a common, but complex bus technology—fit the criteria, but was unfamiliar to Bailey engineers. Finally, the Bailey staff settled on a PCI-to-68030 bridge that would enable them to create a modular system enabling easy upgrades.

Bailey engineers looked at a number of alternatives for implementing the PCI interface. However, general-purpose devices failed to provide the necessary flexibility. They also studied hardware solutions developed by other divisions in their parent company Eltag Bailey Process Automation, but found these solutions took too many engineering resources to meet the specific needs of the project.

The Megafunction Solution

An Altera field applications engineer (FAE) had worked with Bailey on programmable logic solutions and was familiar with the companies participating in the Altera Megafunction Partners Program (AMPPSM), an alliance of independent developers. The FAE suggested Bailey work with Eureka Technology of Los Altos, California, a company that specializes in PCI and PowerPC bus controller megafunctions.

“We wanted as generic an interface as possible and no one else had it,” said Mohat. “Eureka took a PCI bus interface and de-multiplexed it. They had about a dozen or so registers inside the megafunction instead of the 200 we had found in standard products. And, they had the software and

hardware to get this project up off the ground with a minimum of trouble. We talked to Simon Lau (Eureka President) and asked for some changes. We wanted multiple base address registers and the interrupt set up in a certain way. In just two days we had a megafunction—containing all of our requirements—that could be dropped into an Altera device to turn it into a PCI interface.”

As with most new products, there were final questions to answer before the new system was ready for production. “Our PowerPC processor is very abusive of the PCI bus and when there were back-to-back transfers to different boards, Eureka’s megafunction mistakenly forwarded the wrong data byte,” said Mohat. “We made one phone call to Simon and three hours later we had the new code via e-mail. One day later we had the new design running.” The entire relationship with Eureka was conducted through e-mail and over the telephone. Figure 1 shows the prototyping and end-product hardware developed by Bailey using Eureka’s PCI megafunction.

Looking Forward

Mohat knows that megafunctions will be vital to future Bailey products. “Megafunctions are the way designs are going to be created over the next few years,” he said. “As more and more people start selling larger pieces of intellectual property—either in the form of megafunctions, or VHDL or Verilog HDL source code—designers will buy more pieces and integrate them. It appears easier to grab an ASSP at \$25 per piece, but unless you’ve worked with a PCI bus, you don’t understand how fiendishly complex it is, and standard products don’t eliminate all that complexity. It’s far cheaper to use megafunctions when all the costs are considered.”

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