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Create Value with More Integration in Building Automation Controllers

Michal Raninec, Systems Applications Engineer

Building automation systems (BAS) integrate lighting, energy, HVAC, safety, and security into a single intuitive system, balancing the optimum efficiency of the building's operation with the productivity and comfort of its occupants. While the building automation market is very conservative, it has seen considerable growth mostly driven by rising energy prices, increasing awareness regarding energy conservation, and growing government initiatives in areas of fire safety and security. New standards and regulations, such as the UL 217 standard for smoke alarms, have taken effect to make buildings safer, more efficient, and more comfortable. Trends like these stimulate the development of new building automation products and solutions, pushing manufacturers to deliver new technology in shorter development cycles. This change of pace creates opportunities for BAS companies to meet these needs with flexible system solutions that are platformized, offering lower power and smaller size.

Building automation controllers are a typical example of a product that often lacks the innovative agility so valued in today's fast-changing markets. The controllers are the brains of the BAS. They take the data from the sensors deployed throughout the building and execute the system's response. That means the controllers need to have a certain number of input and output channels. Some controllers only offer fixed channel functionality, resulting in architectures with unused channels. These extra unused channels have an associated cost that cannot be recouped from the customer; however, enabling full reconfigurability of each channel ensures all channels can be used. In an ideal scenario, the BAS should have a limited number of spare, unused channels so that the customer does not pay for functionality that is not utilized. Enabling full configurability of the channel function provides the most flexibility in the design and deployment of a BAS.

Traditionally, building automation controllers have used discrete implementations for both fixed and configurable channels. However, the bill of materials (BOM) of discretely implemented configurable channel controllers can include hundreds of components. After years of development, the discrete solutions have become very efficient and optimized to reduce BOM cost in order to match the expectations of this cost-sensitive market. Nonetheless, new trends and more demand for agile development underline some major drawbacks of this approach, such as the complexity of the planning, design, production, and logistics of too many product variants in the building automation controllers. Therefore, the BAS solutions must be assessed based on total cost of ownership rather than on a simplified BOM cost point of view.

Integrated vs. Discrete

The ability to reconfigure the channel as required is the right approach to eliminate unused channels, but this alone does not address the other shortcomings of controller design. The key concept is the integration that enables the channel design to be simplified, with a smaller footprint and better performance. With an integrated solution, the function of any channel can be easily configured using software commands. Software-configurable input/output (I/O) technology opens up possibilities of easy design reuse and platformization that ultimately reduce the total cost of ownership of a BAS solution and create value throughout the product life cycle of the building automation controllers (see Figure 1).

The first stage of a controller development is the system architecture. At this point, all the customer requirements are considered and a new product is defined. The inflexibility of a discrete solution is a notable disadvantage even in this early

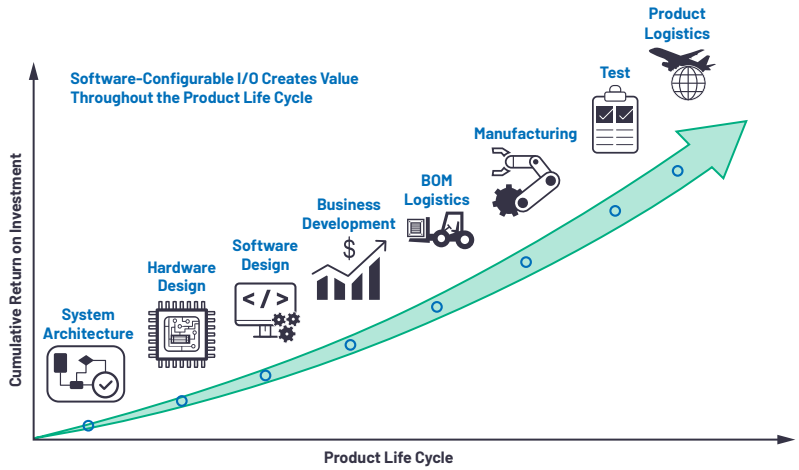


Figure 1. Improving return on investment at every stage of development with the AD74412R.

phase of development. Various needs of the customers—for instance, the ratio or the number of input and output channels—may lead to multiple designs, which increases the cost and hinders agile responses to market needs. Integrated, software-configurable I/O enables the platformization and reusability of a proven design in different applications. Reusability is essential for reducing design and production cost, as discussed later in this article.

Following the product definition, the design kicks off. In this phase, the design reuse fully reveals its importance. Unlike discrete realization, the integrated and configurable I/O enables quick iterations, reduces time, and frees up valuable resources. In both hardware and software design, the shift from resource-intensive, lengthy, multiple product variant developments toward a single design fulfilling numerous requirements reduces R&D time and cost while maintaining high reliability and robustness of a proven architecture. Meeting the needs of different applications is much easier with the "any function on any pin" approach of an integrated, reconfigurable design (see Figure 2).

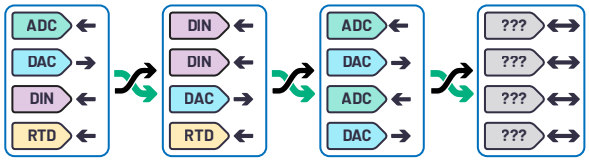


Figure 2. Any function on any pin with software-configurable I/O.

From a business development perspective, the slow response of a conventional development strategy creates unnecessary risk for lost opportunities or missed customer deadlines. The flexibility and ease of use of the integrated, configurable I/O helps maximize the return on investment (ROI) while keeping the time to market and time to revenue as short as possible.

Moving on from the design phase, the production phase is the next step. Starting with the purchasing and management of the BOM, the integrated solution soon shows its advantages. The discretely implemented, universal controllers often include hundreds of components, which must be purchased, stored in a warehouse, and transported to the production facility. Managing such a large quantity of different components naturally contributes to the overall cost. With a single-chip solution and reusable design, the BOM logistics are simplified—the purchasing department deals with fewer suppliers, and less storage space is required.

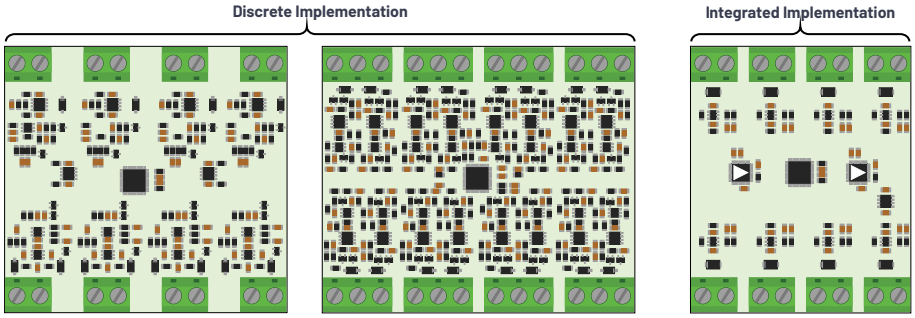
Thanks to the smaller number of components, the PCBs can be up to 40% smaller, and the pick and place cost in production is also significantly reduced. Moreover, because the software-configurable I/O enables design reuse, the controller manufacturers will require more PCBs of the same type. Therefore, volume discounts on the boards also contribute to cost savings. Figure 3 summarizes the comparison of discrete and integrated channel function implementations.

Last but not least, the testing in production follows unified procedures and takes less time to set up in comparison with the multiple variant, discrete implementation. Increased design complexity might even raise the risk of test failure. Certification is just another example of aspects where integrated, reusable solutions can save cost and other resources, and the list goes on when it comes to finished product logistics, installation, and technical support. The training of sales, technical support teams, and installation technicians is much more extensive when numerous different designs are based on multiple platforms, as opposed to universal, reusable solutions based on integrated software-configurable I/O.

Conclusion

Software-configurable I/O brings innovation to the building automation market, that, while being traditionally conservative, is now being pushed to become more agile and respond to ever-changing customer needs more rapidly. Integration and design reusability are key features that enable this transition. Some may see the integrated solution as a simple BOM replacement that could actually increase the cost, but in fact, when looking at the bigger picture and considering the overall value created throughout the whole product life cycle, the integrated solution quickly outweighs any doubts.

To tackle the shortcomings of a discrete design, Analog Devices created the AD74412R, a fully software-configurable I/O. It integrates the discrete signal chain in a single chip and provides four fully configurable channels. The AD74412R creates value throughout the controller life cycle, from product definition, through design and production, to installation and operation. It is the first such product in the market and offers customers an easy way to increase their return on investment while shortening time to market and time to revenue.



	Channel Function Implementation		
	Discrete Fixed	Discrete Universal	Integrated Universal
Universal Channel Function	✗	✓	✓
Reduced Bill of Materials	✓	✗	✓
Inexpensive Production	✓	✗	✓
Physically Smaller Solution	✗	✗	✓
Design Reuse Between Products	✗	✗	✓
Agile Development	✗	✗	✓

Figure 3. Comparison of discrete and integrated channel function implementations.

Figure 4. Integrated, fully software-configurable I/O—the AD74412R.

About the Author

Michal Raninec is a former systems applications engineer in the Industrial IoT Solutions Group within the Automation and Energy Business Unit at Analog Devices. His areas of expertise include electrochemical gas sensing and wireless sensor networks. Michal received his M.Eng. degree in electronic engineering from Brno University of Technology, Czech Republic.