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## **Five Things to Think About Before Using Hardwired Controls Again**

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## Overview

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There are Original Equipment Manufacturers (OEMs) across many industries who build products that use small control systems with traditional, simple hardwired controls such as cube relays, timers and counters. These small control systems are commonly found on assembly equipment, conveyors, machine tools, presses and pumping equipment used for both commercial and consumer applications such as industrial manufacturing, HVAC equipment, door/gate controls, commercial appliances, vending machines and amusement equipment. OEMs in all business sectors continue to struggle justifying the use of legacy control designs to meet current and future business objectives.

Today, many of these OEMs are migrating their traditional hardwired control designs toward alternative control systems. In fact, for most OEMs, programmable relays can serve as a very cost effective controller for their products due to not only their increased flexibility and reduced physical size, but also because they offer a lower total cost solution with quicker assembly and installation compared to hardwired controls.

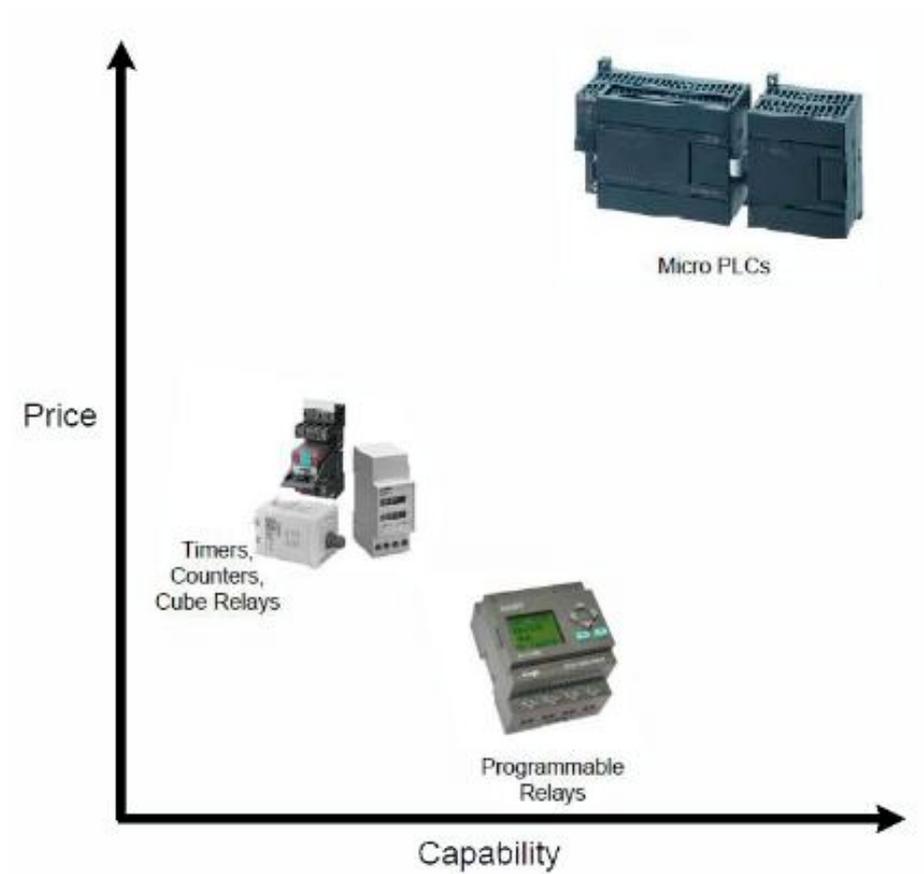
This report is written to help OEMs determine the 'real cost' of using traditional hardwired controls by comparing it to the 'real cost' of using commercially available programmable relays.

## Background

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Programmable relays are microprocessor-based controllers that have similar capabilities to a PLC (Programmable Logic Controller) with built-in timers, counters and compare instructions, but can be programmed more easily like wiring simple hardwired controls. In the past, OEMs were forced to choose between simple hardwired controls or internally developed and designed custom controllers for their products. In either case,

very small systems often could not justify the cost of a PLC, or similar controller, until the programmable relay became available.



#### **Programmable Relay Market Position**

Programmable relays are used in many industries and are now being used in new applications that previously were cost, technology or size prohibited. For example, programmable relays are replacing hardwired timers, counters and cube relays in applications ranging from ventilator controls in office buildings to sequential control systems for industrial manufacturing. Additionally, programmable relays are now penetrating a wider variety of non-manufacturing or commercial OEM applications as OEMs become more aware of the importance of the total cost of their products.

# Top 5 Reasons for Programmable Relays over Hardwired Controls

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## 1. Number of Components

The basic design of a programmable relay includes common control functions as built-in features to eliminate the purchase of separate control devices. Multiple timers, counters and cube relays can be replaced with a single programmable relay, greatly reducing the number of required components. This helps OEMs control costs and reduce component inventory levels and purchasing overhead.

## 2. Enclosure Size

The size of an enclosure required for multiple hardwired devices is much larger than that of a single programmable relay. The compact mechanical footprint of a programmable relay, with standard DIN rail or panel mounting clip options, significantly reduces the required electrical enclosure size. The size of an enclosure not only affects the individual enclosure cost, but more importantly the size of the machine and location to mount the enclosure.

## 3. Engineering and Configuration Effort

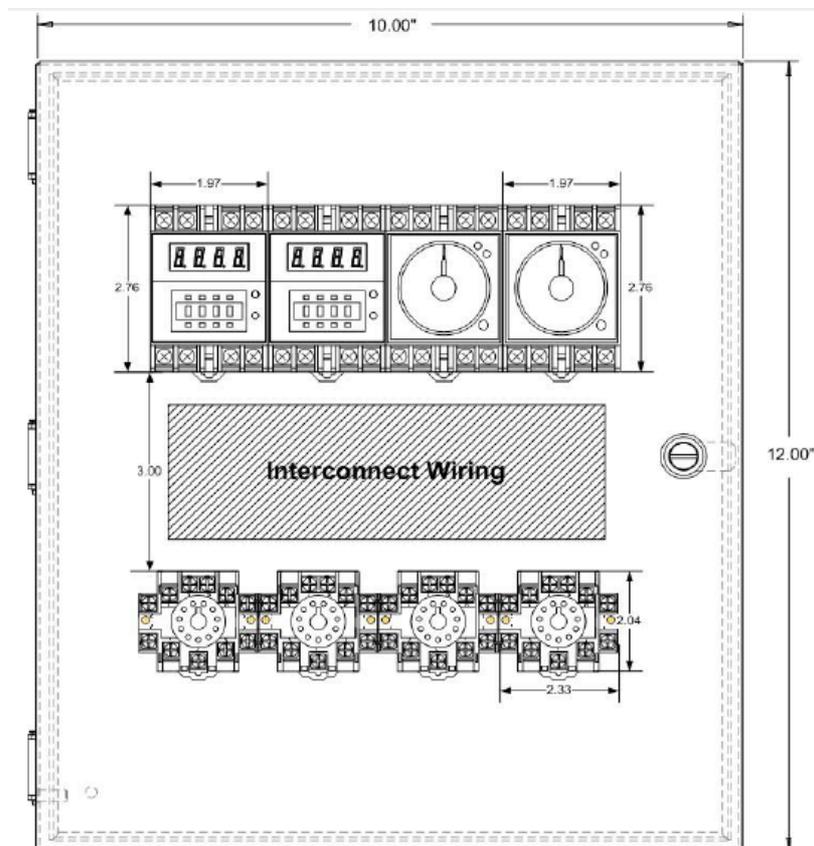
The programmable relay, as a single integrated and configurable device, greatly improves the OEM's process of design and configuration. Easy to understand drawings can be developed quickly using provided CAD templates from the programmable relay suppliers. Simple programming commands based on hardwired principles make configuring a programmable relay easy and eliminate the need for an engineer or trained programmer to configure it.

#### 4. Manufacturing and Installation Cost

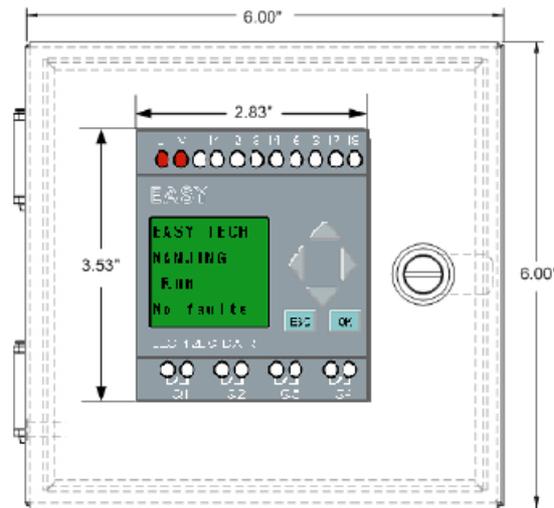
Assembly and testing of a system with hardwired controls requires a significant amount of interconnect wiring between individual devices, increasing material costs such as wire, terminal blocks, wire duct, DIN rail, etc., and labor costs. Installing and wiring a single programmable relay with a built-in power supply and screw terminals greatly reduces wiring time and testing with fewer connections and fewer possible points of failure.

#### 5. Maintenance and Modification Support

A control system based on programmable relays helps an OEM reduce the amount of time for commissioning and maintenance. An integrated display and keypad on a programmable relay provides alarm messages and I/O status for easy troubleshooting, often eliminating the need for a multi-meter or logic probe, which is used to maintain hardwired controls. Customizing a programmable relay system to meet changing customer needs only requires programming changes without additional devices.



**Hardwired Controls Electrical Panel**



**Programmable Relay Electrical Panel**

## Design Cost Analysis



**Design and Cost Value Chain**

Total cost in any control system has a mix of fixed costs and variable costs. Simple hardwired controls such as start/stop inputs, run lights, timers or counters, and loads may have lower fixed product costs in a very small system, but in larger systems the fixed component costs, interconnect wiring costs and electrical enclosure costs increase significantly. Programmable relays may have a slightly larger initial capital investment for software, a programming cable and a memory cartridge, but it greatly reduces the cost of wiring and the enclosure size when compared to simple hardwired controls.

For example, compare a typical control system with two timers, two counters, and four cube relays to control four load devices such as motors, actuators, etc.

<b>Device</b>	<b>Description</b>	<b>Number Used</b>
Timers	Rotary adjustable timers in pluggable sockets	2
Counters	Thumbwheel adjustable counters in pluggable sockets	2
Relays	Double-Pole/Double-Throw cube relays in octal sockets for start/stop, pilot light, and load circuits	4
Loads	Two single-phase motors and two actuators	4

### **Example Parts List – Hardwired Controls System**

#### **Product Unit Cost**

The recurring product cost for a hardwired-based simple controls system, configured as previously described, will actually be more in most cases than an equivalent programmable relay system. This is often because of the increased required enclosure size for the hardwired controls, higher costs for individual timer/counter devices, and the additional labor required for interconnect wiring. Material costs for electrical enclosures have probably experienced the largest price increases in recent years when compared to other control products, with many enclosure suppliers raising their prices more than once per year. Additionally, the footprint size for most industrial timers and digital counters, when combined with typical cube relays, can increase the enclosure size significantly with addition of only a few components. The total hardware and manufacturing costs for this example system results in a 60 percent savings when using a programmable relay design instead of hardwired controls.

<b>Component &amp; Enclosure Cost Comparison</b>			
<b>Device</b>	<b>Qty</b>	<b>Est. Cost each</b>	<b>Total</b>
Timers	2	\$35	\$70
Counters	2	\$50	\$100
Relays	4	\$8	\$32
Enclosure 12"Hx10"Wx8"D	1	\$75	\$75
<b>Hardwired Controls Total Cost</b>			<b>\$277</b>
Programmable Relay	1	\$85	\$85
Enclosure 6"Hx6"Wx4"D	1	\$33	\$33
<b>Programmable Relay Total Cost</b>			<b>\$118</b>

### **Component and Enclosure Cost Comparison**

#### **Design and Development Cost**

A simple hardwired control design requires a prototype capital investment, as well as some additional costs for design and development. This is because of the amount of schematic engineering for interconnecting wiring, along with additional design engineering to validate compatibility between the individual devices. In a comparable programmable relay system, the capital investment for developing hardware and software is slightly more, but significant savings are seen in the engineering effort, estimated at nearly a 60 percent savings over hardwired controls. The only engineering required on a programmable relay system is writing the application program. No hardware engineering needs to be performed by the OEM on the internal components such as timers, counters, contacts, and coils when using a programmable relay system.

<b>Wiring Comparison</b>			
<b>Device</b>	<b>Total Terminations</b>	<b>Est. Cost each</b>	<b>Total</b>
Timers (2)	10	\$3	\$30
Counters (2)	10	\$3	\$30
Relays (4)	20	\$3	\$60
<b>Hardwired Controls Total Wiring Cost</b>			<b>\$120</b>
Programmable Relay (1)	18	\$3	\$54
<b>Programmable Relay Total Cost</b>			<b>\$54</b>

### **Wiring and Manufacturing Cost Comparison**

#### **Product Support Cost**

Depending upon the complexity and quality of the control system design, an OEM may dedicate 7-10 percent of their resources to support tasks. These costs may increase if a hardwired component becomes obsolete, or if customers have special I/O requirements and re-engineering of a simple control system is required. With an equivalent programmable relay system, re-engineering and internal support only requires a programming change, or the addition of an expansion I/O module. Additionally, the support of a programmable relay system is most often a shared responsibility between the OEM and the programmable relay supplier, of which the leading suppliers have a combination of technical phone support personnel and local application engineering staff.

## Additional Benefits

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Beyond higher processing power, compactness and reduced hardwiring, programmable relays offer a number of benefits to OEMs:

**Broader application span:** Extensive flexibility and simple programming language standards allow programmable relays to meet a wide variety of OEM product requirements.

**Easy re-use of software:** The scalability of programmable relays and their common programming software can be easily re-used and reloaded to accommodate the changing needs of the users of the OEM products.

**Low implementation cost:** Built-in common control functions such as timers, counters, real-time clocks, high speed counters, temperature controls, etc. provide the capability of solving complex tasks with minimal programming.

**Built to Industrial Standards:** Programmable relays are designed to operate in harsh industrial manufacturing environments, which provides manufacturing grade reliability for any non-manufacturing application at no additional cost.

### Preferred Features and Functions of Programmable Relays

- ✧ Scalable and portable application programs
- ✧ Built-in functions for common control needs
- ✧ Wide variety of I/O connecting the most common digital or analog signals
- ✧ Built-in display & keypad for user messages, I/O status and parameter changes
- ✧ Password protection for software and keypad & display

- ✧ Ability to make program changes from built-in display & keypad
- ✧ Rugged industrial design for maximum electrical and temperature Reliability
- ✧ It's optional for xLogic to act as slave or master in certain Modbus communication network
- ✧ Standard Modbus RTU/ASCII/TCP communication protocol supported
- ✧ Powerful communication interface optional : RS232/RS485/Ethernet and SMS

## Programmable Relay Use Growing in

### OEM Applications

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Use of programmable relays in the OEM market is growing rapidly. OEMs have begun embracing programmable relays in a variety of applications as they continue to face challenges that require lower costs, greater functionality, and smaller product sizes, which has expanded the role of programmable relays beyond traditional markets.

On-time delivery of their equipment to the market is extremely critical to OEMs today. Any delay can result in lost sales. The environment of continuously changing demands from customers frequently translates into shorter product lifecycles for OEM products, which is why some early adopter OEMs now have begun to look into commercially available programmable relays instead of hardwired controls or a custom control board. These OEMs are able to use programmable relays to enable faster time to market and quicker updates of their existing products to meet customer demands. The resulting use of programmable relays increases the agility and flexibility of OEM products and reduces life cycle costs.

The trend in the programmable relay market is to offer a product with rich functionality in a compact size. One unique feature is a built-in LCD display with keypad for changing function parameters and programming directly on the device, along with the ability to display configurable text messages and I/O status.

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A programmable relays' display can provide users with a variety of important information. When programming the device through the front panel, the display shows the connected function blocks. When in operating mode, the display can show text messages, the status of inputs and outputs, and variable and current values, as well as time and date information. The display can also show the parameter values being changing from the front panel such as timer and counter set points, PI control parameters for temperature applications, etc.

### **Examples of Applications for Programmable Relays**

- ✧ Assembly
- ✧ Pumping
- ✧ Compressors
- ✧ Small machine control
- ✧ Lifts/Hoists
- ✧ Press/Stamping
- ✧ Signaling/Annunciators/Alarming
- ✧ Tank level control
- ✧ Material handling & packaging
- ✧ Environmental chambers

### **Emerging Programmable Relay Market: Building Automation**

Lighting control by modern programmable relays provides building automation solutions for:

- ✧ Daylight / time dependent light control
- ✧ Group lighting control
- ✧ Peak load minimization
- ✧ Energy management
- ✧ Heater / Climate / Ventilation control by modern programmable relays

provides building automation solutions for:

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- ✧ Temperature control
- ✧ Energy management
- ✧ Time / temperature dependent control
- ✧ Environmental and weather condition based control
- ✧ Safety and security alarming for air quality control

Rich functionality, ease of use and the compact size of modern programmable relays is beneficial to OEMs. It is expected that an increasing number of OEMs will begin using programmable relay solutions in their products to reduce overall costs, speed up time to market and provide product performance improvements.

OEMs will continue facing challenges to raise productivity, lower product costs, reduce operating costs and increase return on investment (ROI) to remain competitive in the global market. This is expected to result in the increased use of programmable relays in place of hardwired controls and custom boards across many industries.

### **Examples of OEM Applications in Building Automation**

- ✧ Lighting controls
- ✧ HVAC/Climate controls
- ✧ Door/Gate controls
- ✧ Automated window blinds
- ✧ Security controls
- ✧ Entertainment/Theatrical controls
- ✧ Vending

### **Recommendations**

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- ✧ An OEMs decision to either buy programmable relays or design a system with hardwired controls must be weighed against its goal of lowering total costs while fulfilling business objectives to quickly produce product variants to meet changing market demands.
- ✧ OEM engineering should focus on investing in core product competencies rather than distracting its efforts to maintain a custom hardwired controls system design for which effective packaged solutions such as programmable relays are available.
- ✧ OEMs must focus on improvements in their products that bring their customers higher productivity at a lower cost and carefully evaluate the contribution of programmable relays, in comparison to hardwired controls, toward reduced design and support time, smaller product sizes, and lower total costs.
- ✧ Once the requirement for programmable relays is determined, OEMs should work with a programmable relay supplier that has a proven track record for supporting their products for many years throughout their lifecycle changes, as some suppliers may not be able to fulfill such a commitment.
- ✧ At the end of the day, application fitness and total cost of ownership is what must guide the controls product selection for OEMs.

#### **Programmable Relay Suppliers focused on OEM needs**

Suppliers of programmable relays offer a wide variety of programmable products along with many related electro-mechanical control products.

All products are developed according to common electrical standards for a wide range of OEM industrial and commercial applications. Programmable relay suppliers are able to leverage the vigorous required reliability of their products through the testing they have performed, along with the field experience of thousands of customers. Leading programmable relay suppliers also place high importance on providing both global and local support of their control products. Through sophisticated call centers, OEMs are able to contact experts at the programmable relay supplier for both

technical and transactional support, often 24/7, from anywhere in the world. The OEM benefits from the supplier's resources of technical expertise along with worldwide inventory and shipping capabilities, so the OEM can concentrate more on developing equipment and serving their customers. Many larger suppliers also offer extensive local application support that can help OEMs in the new design phase of their product. OEMs can also be confident that leading programmable relay suppliers will provide availability and support for their products for many years throughout their life cycle changes. Additionally, the innovation of future programmable relay products will be driven by the whole industrial community of competing suppliers seeking to improve their products.

For more information about xLogic, please refer to :

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