

The Space-Time (and Cost) Continuum of Programmable Switches

A Back to the Future Look at ROI

By NKK Switches

When Marty McFly jumped into the DeLorean, Dr. Emmett Brown had already programmed the car to travel back in time to November 5, 1955. Fans of the fictional movie Back to the Future will remember that Doc Brown spent 30 years creating the technology – including programmable pushbuttons – needed to make this possible. However, 27 years later, many in the industry are still using archaic pushbutton switches and outdated methods for their programmable switch technology.

Like Doc Brown, today's design engineers are urged to understand the finer points of the theories of relativity and the space-time (and cost) continuum. However, unlike Doc Brown, design engineers no longer have to create their own solutions. Today's programmable switches, such as NKK's SmartSwitch line of products, can result in significant return on investment. This ROI can be achieved through the money, time and space saving benefits of programmable switches when implemented into human machine interfaces.

The Problem: Money, Time and Space

Like the rotary switch on Marty McFly's AMP or the toggle switches in the DeLorean, traditional electromechanical switches certainly have their place in modern electronics design. There are numerous situations where their use is perfectly sufficient. However, as the demand for greater functionality from devices and equipment continues to increase, many engineers have found that the use of traditional switches in certain designs is no longer a feasible option.

In some situations, the use of traditional electromechanical switches on increasingly complex devices and equipment can result in three specific issues: running out of panel space; increased time to train and increased time for users to do their job effectively and without error; and finally, the financial cost of implementing dozens, hundreds or even thousands of traditional switches.

The Solution: Programmable Switches

In contrast to traditional switches, such as function keys that have one hardwired purpose and touch screen displays that lack tactile feedback, programmable switches incorporate a changeable graphical display on the actuator surface of an electromechanical switch. Typically, this display is either a simple LCD screen – with or without LED backlighting – or a more advanced OLED display. LCD programmable switches are typically capable of displaying graphics, alphanumeric characters and animated sequences. OLED switches add the ability to display full motion video, among other benefits.

Regardless of screen type, the core principle and benefit behind programmable switches is to create a device that is dynamic, combining dedicated function keys with those of versatile touch screen displays.



Programmable switches also come in a variety of options based on size and actuator type. NKK's SmartSwitch line of programmable devices includes the following switches:

- OLED Pushbutton Switch
- OLED Monochrome Rocker Switch
- 64 x 32 Pushbutton Switch
- 64 x 32 Compact Pushbutton Switch
- 36 x 24 Bicolor Pushbutton Switch
- 36 x 24 Compact Pushbutton Switch

In addition, NKK offers a full range of supporting solutions, such as process indicator and control devices, development kits, accessories and custom products.

From audio and broadcast and communications to security, aerospace and military applications, implementing programmable switches into panel designs and redesigns can help engineers overcome the challenges associated with traditional electromechanical switches and their effect on money, time and space.

The Impact of Programmable Switches on Financial Cost

While an individual programmable switch will typically cost more when compared to a single traditional switch, it is important to remember that just one programmable switch is capable of performing many functions.

For example, a control panel with 100 functions would require 100 traditional switches. At a typical price of \$5 dollars for each traditional switch, the total cost of the switches alone for the panel would be \$500. However, the same 100 functions could easily be achieved with a maximum of 2 keystrokes through the use of just 10 traditional switches at an average price of \$25 each, coming to a total of \$250. This represents a 50 percent reduction in the direct financial cost of the switches needed for the panel. An additional cost benefit can be achieved due to the cost savings on enclosures, PCB and wiring of fewer switches.

While the above is simply a theoretical example, it is worth noting that an actual NKK customer has been able to achieve \$5,000 in switch cost savings per system as a result of using NKK's SmartSwitch product line.

Not only do programmable switches pay dividends when it comes to cutting down on the total number of switches necessary, but their usable lifespan (actuations) is on par with traditional switches. In fact, the U.S. Navy has included NKK's programmable switches in several ship-based applications. Before implementing the SmartSwitches they put the devices through some of the most rigorous testing imaginable. They passed with flying colors.

Another example of the cost savings possible through programmable switches comes from the maker of in-cab control panels for emergency vehicles, such as police cruisers and ambulances. The control panels feature a touch screen combined with several NKK SmartSwitch devices. Each programmable switch allows the operator to simply and safely select from a multitude of possible menus on the screen.

These control panel manufacturers sell their devices to customers around the world. The use of programmable switches rather than traditional electromechanical switches gives them the ability to quickly and inexpensively customize the label on each switch to meet language and custom functionality requirements. If traditional switches – which would each have to be permanently labeled for their specific functionality – were used, logistical, inventory management and customization costs would increase.

Many other NKK clients with similar global reach – from water treatment system manufacturers to a commercial air filter system maker – have realized the benefits of using programmable switches to make serving a global customer base simple and cost effective.

The Impact of Programmable Switches on Time

Increased functionality from a single device or piece of equipment is a good thing, but it naturally results in the need to train users on more complex processes related to the increased functions. However, if hundreds of traditional switches are used on a complex device or piece of equipment, users must also memorize the location of each switch needed to do their job.

For example, a recent nuclear power plant application required 1,600 different switch functions from a single control panel. Imagine the immense expense of traditional switches and the time consuming training to memorize the layout and functionality of each panel. Instead, designers of the panel chose to incorporate just 116 programmable LCD switches. The panel has five rows of switches, 16 in the top row and 25 in the bottom four rows. The 16 switches on the top row are assigned and labeled with specific functions. Pressing any one of these 16 switches changes the lettering or graphic of the 100 switches below. As a result, each of the 1,600 functions is accessible in just two keystrokes. Valuable time is saved in training employees on a much smaller, much simpler interface.

Another important ROI element in the above example is the increased ability users have to do their job effectively and without error once trained. In today's fast-paced environments, operators of equipment

are faced with a barrage of distractions. From environmental interruptions to diversions on the control panel itself, the commotion can seem never ending. In many situations, this can lead to not only delays and lost productivity, but also serious safety concerns, such as in the case of a nuclear power plant.

Operators need all the help they can get in cutting through the clutter; programmable switch technologies that interact with the complete system or design provide ease-of-use and simplify multi-decision operations. With the capability to display changeable full-motion video, animated sequences, graphics and alphanumeric characters, confusion about the task at hand is dramatically decreased and mitigates risk, positively impacting the user's ability to perform complex multi-decisional operations.

Another example of the time saving benefits of programmable switches comes from the broadcast industry. Programmable switches are commonly used to help control the various elements of television broadcasts, including the use of NKK's SmartSwitch during live sporting events such as the Super Bowl and Olympics telecasts.



Typically, different sets of operators requiring different sets of functions from the same control panel in quick succession are a hallmark of such sporting event broadcasts. For example, during the Super Bowl broadcast one set of operators requiring specific functions from a primary broadcast control panel will run the pre-game show, while over a short commercial break an entirely new set of operators requiring different functions from the same control panel will take over to run the game broadcast. Using programmable switches means the entire control panel can be reconfigured for the new crew in just seconds, saving valuable time and making sure one of the most watched annual television broadcasts goes smoothly.

The Impact of Programmable Switches on Space

From simple computer keyboards to complicated test instrumentation and medical devices, many applications heavily rely on switches with one single, hard-wired function as input devices. Each switch cap is etched or printed with the appropriate letter, number or symbol, and assigned a specific function and unless rewired and relabeled it only performs that single function.

However, such dedicated switches have limitations. For example, as additional functionality is added to a console, so too must the number of switches increase. This subsequently adds complexity and can quickly result in already complicated equipment becoming littered with dedicated function keys. Instead, programmable switches can be used to simplify control panels.

Programmable switches also allow for more functionality from a smaller panel size. Thus, an additional benefit of programmable switches when adding functions to an existing board is that panel size does not necessarily have to be increased because a single programmable switch is capable of accomplishing the same functions as multiple dedicated function keys.

Did you know that flight simulator manufacturers have long used programmable switches in their control panels? In one case, a 6x3 matrix of switches is used on a remote handheld device to control the instrumentation inside a simulated airplane cockpit. The operator advances through the switches until the desired test effect is found. Once the effect has been located, a simple push of the switch launches the function and initiates a change in the flight instrumentation inside the cockpit. Operators have access to over 100 different simulation conditions in a single 6x3 switch control panel on a handheld controller.

Another example is a concept computer design by an NKK customer that uses only one programmable switch per panel. The switch is used to indicate critical CPU characteristics quickly and conveniently. As the operator pushes the switch, the LCD key cap indicates processor speed, CPU temperature, critical errors and hard drive space. This compact design utilizes only one switch yet performs many functions.

Thus, by implementing even just a few programmable switches, an engineer is able to reduce the number of individual switches needed overall since each dynamic programmable switch is capable of multiple individual dedicated function keys while increasing functionality and lowering design costs.

Conclusion

As the need to increase the performance and functionality of devices and equipment mounts, design engineers don't need to travel to the past to get yesterday's costs while sacrificing today's space and time saving technology. Nor does one need to be Doc Brown to see that the use of traditional switches is only efficient and effective to a certain point. Once the right usage threshold is reached, engineers should consider the ROI related that can result from implementing programmable switches into their designs.