

# **Intelligent Switches Pave Path To Optimum Human-Machine Interface**

With programmable displays, switches have evolved into a flexible, reliable, customizable interface that designers can acquire off the shelf.

**AS ELECTRONIC SYSTEMS** have become more advanced, sophisticated, and pervasive, designers are working to optimize the human-machine interface (HMI). While there are many options available, such as touchscreens and voice control, they fall short of user expectations for visibility and reliable, point of action, tactile feedback in critical applications. These applications range from live event video production to automotive infotainment systems and aerospace/defense control panels.

In such applications, there are space constraints and little time for deep menus and unclear legends, and there can be no confusion over whether or not the button has been pushed and that the signal has been switched.

What's required is an HMI technology that combines the text and image flexibility and context-awareness of displays, with the user familiarity, reliability, and tactility of electromechanical switches. To that end, designers are finding that the solution they need has been evolving quietly in the background to meet their needs in the form of smart or programmable switches.

As they have evolved, they have also been provided with extensive software and design services that allow designers to quickly move from experimentation to implementation, with various levels of customization.

### Getting smart about the HMI

Smart switches are essentially programmable displays atop electromechanical switches that can be arranged in arrays. The technology started out 20 years ago as a simple monochrome LCD with bi-color backlighting and required a certain level of programming skill. Still, these programmable, visually compelling, pushbutton switches caught the imagination of the broadcast industry who were quick to adopt the technology (Figure 1).

Smart switches continued to evolve as the microcontrollers behind them became more powerful. NKK Switches' SmartDisplay™ combines a pushbutton or rocker switch with a fully programmable display for a space-saving, simplified, multi-function device. The SmartDisplay family are the smallest multicolor



Figure 1. Smart switch technology was quickly adopted by broadcasters who found its context-aware content, flexibility, and usability saved on the total cost of ownership (TCO) while accelerating the users' learning curve.

modules available off the shelf and can be specified in OLED or LCD, or single, bi-color, or RGB LED backlight.

SmartDisplay variations include monochrome or full-color OLED Series, or LCD Series available in a range of pixel format from 36 RGB x 24 pixels to 96 RGB x 64 pixels.

A good example of available solutions is the SmartDisplay ISF15ACP4 Frameless OLED Pushbutton. The all-important tactile feel is provided using a smooth, short stroke of 0.07 inches. The device can survive over a million actuations, uses gold-plated twin contacts, and has a snap-in standoff for easy, secure mounting and alignment (Figure 2). This prevents dislodging during wave soldering.

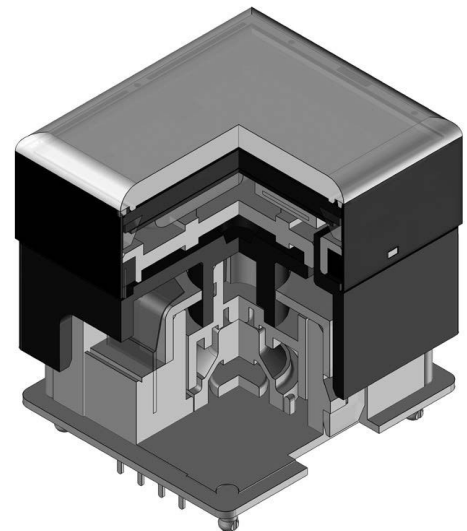


Figure 2: The ISF15ACP4 pushbutton has the visibility, contrast, low power, and flexibility of an OLED display while achieves the all-important tactile feedback using a smooth, 0.07-inch stroke. (Image source: NKK Switches)

The ISF15ACP4 Frameless OLED Pushbutton has a resolution of 96 RGB x 64 pixels and up to 65,536 colors in 16-bit mode, fits in a viewing area measuring 21.28 x 18.7 mm. The OLED display's operating life is 50,000 hours, minimum. Along with its long operating life and high visibility – including a 1000x improvement in contrast – the advantage of **SmartDisplay** technology is its flexibility, tactile-feel and low power consumption. This combines with the rapidly falling power consumption of the microcontrollers and associated driver electronics used to drive the display to minimize the switches' overall power consumption (Figure 3).

Along with electrical characteristics, the form factors and packaging for these smart, programmable switches have also evolved. The use of ultra-thin frames provides full-screen capacity so multiple units can be easily combined to form one screen, providing flexibility in size and layout. With regards to

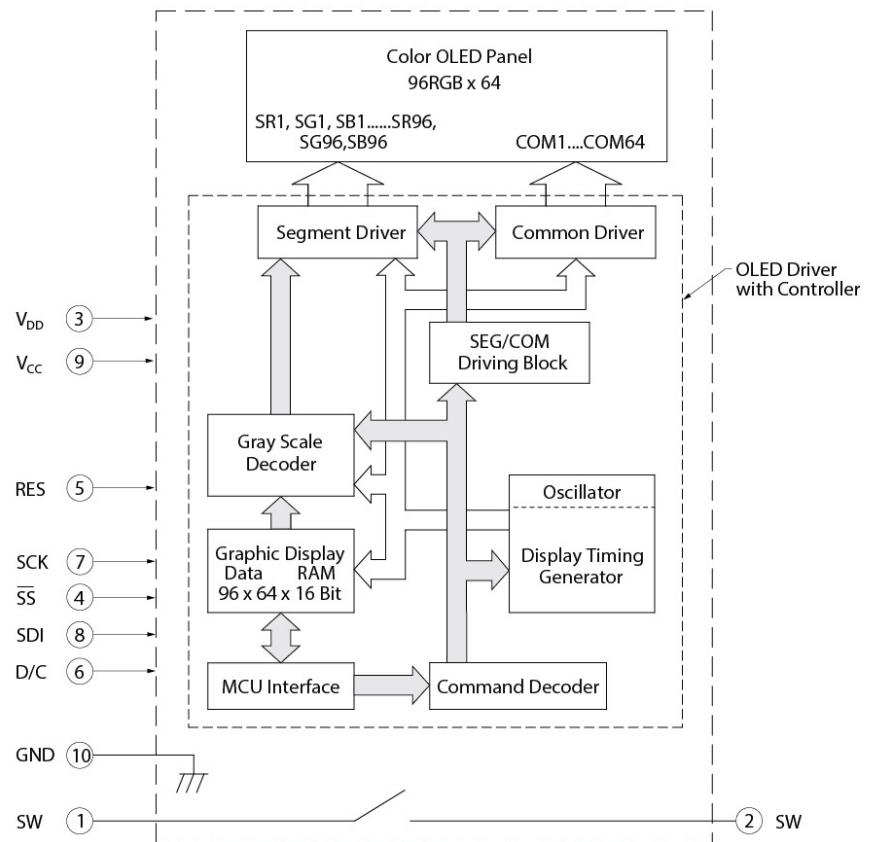


Figure 3: The **SmartDisplay** (inset) contains the low-power circuitry needed to drive the OLED display, all controlled over a serial interface to a microcontroller. (Image source: NKK Switches)

packaging, NKK Switches has developed its **SmartDisplay** solutions to the point that the technology can be supplied as a fully programmed module that can be embedded directly into a system (Figure 4). Control is via any serial communication such as USB, ethernet, RS232, or RS485.

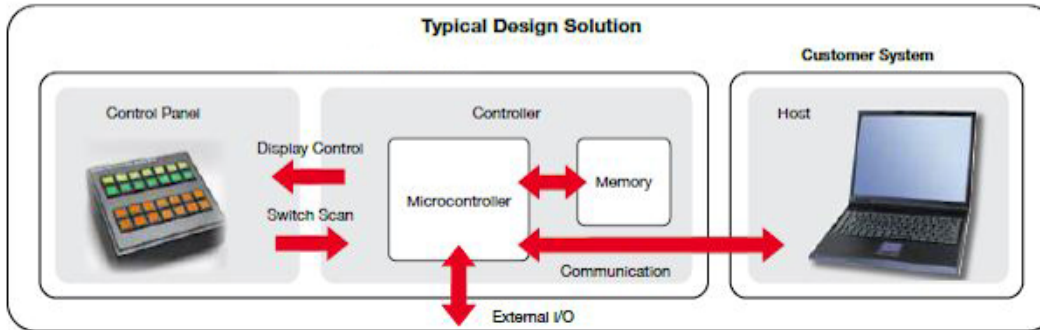


Figure 4: Ultra-low-power displays, combined with the rapidly falling power consumption of the driver electronics, have made programmable switches an increasingly viable solution for a widening array of applications. (Image source: NKK Switches)

The switches are dust tight, and in applications where liquids may be present, they can be protected using an available protective polyurethane splashproof overlay (Figure 5). The overlay comprises a 0.3 mm thick sheet of non-yellowing, 90% transmissive polyurethane with a water resistant, 10 mm wide perimeter of adhesive. Using the overlay and supporting bezel, SmartDisplay designs can achieve IP67 rating.

### Total cost of ownership greatly reduced

Despite the addition of a display and associated hardware and software, compared to typical switches or pushbuttons, the use of programmable switches actually reduces the total cost of ownership (TCO) of a control panel for the end customer. As the buttons can be

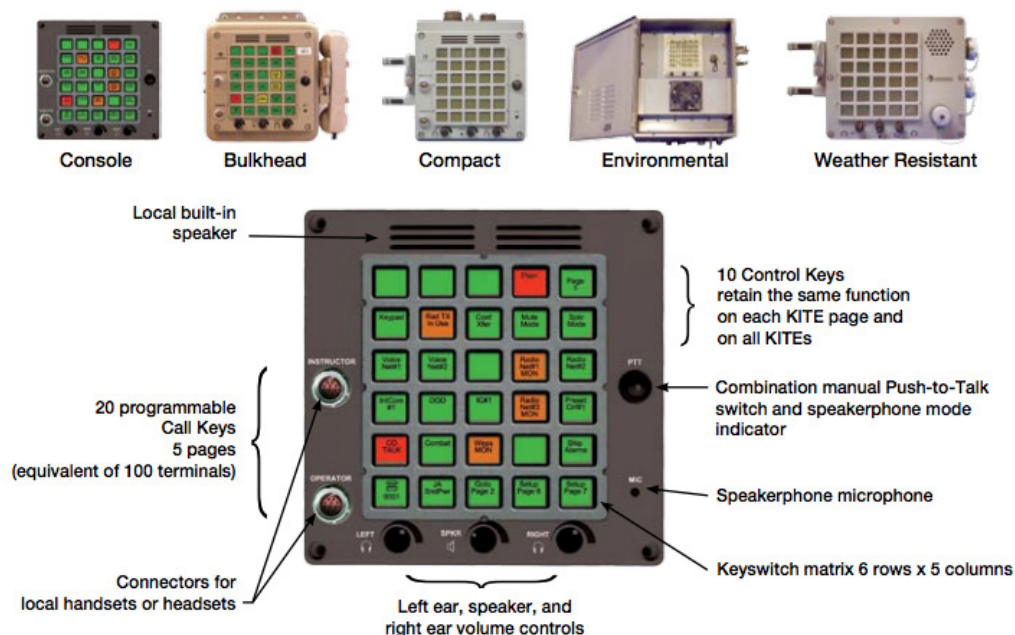


Figure 5: Control panels used as part of the U.S. Navy KITE program use an available protective polyurethane splashproof overlay to achieve IP67 rating (Image source: NKK Switches)



Figure 6: Each of the 10 Engineering SmartDisplay Development Kits includes schematics, firmware, software source codes, on-board memory, and a USB connection.

programmed for multiple functions, fewer buttons are required, and the language and legend content can be readily changed, customized per user, and updated for specific markets and cultural norms. This reduces inventory costs, increases reliability, and eliminates the cost of legend printing for the various markets.

While numbers vary depending upon the application, one customer's power plant control panel was reduced from 1600 illuminated switches to 116 SmartDisplays. This resulted in significant substantial savings due to lower switch cost, reduced panel size, and other associated costs, as well as reduced operator training time and fewer errors.

### Designing a SmartDisplay-based solution

With NKK's SmartDisplay technology, designers can purchase standard product from NKK or they can use NKK's design support team to develop a full embeddable solution based off custom requirements. Either option greatly reduces any barriers to entry. The design team is based in Arizona and can travel to a customers' location to define the requirements and develop the final solution.

Alternatively, designers can start experimenting on their own using the development kits that are widely available from distributors. Recently, the company

introduced a series of 10 simplified Engineering Development Kits (Figure 6).

Each SmartDisplay kit includes

schematics, firmware, software source code, on-board memory, and a USB connection. An auxiliary I/O port for user-design extensions is also included.

Once familiar with the kits and the concept of SmartDisplays, designers can move quickly to develop their own solution, using the resources that come with the kit, or take full advantage of NKK Switches' Design Solution Services to provide a full embedded solution/subsystem.

### Conclusion

By placing a vivid, programmable display on a highly reliable electromechanical switch or pushbutton intelligent HMI's such as NKK Switches' SmartDisplay bring flexibility, clarity, tactility, and low TCO to control panels. Improved form factors, custom solutions, development kits and extensive software and design services support also now enable rapid development and lower barriers to entry. **NKK**

