

# *ITW ActiveTouch in the Medical Industry: Applications and Advantages for Advanced Interface Technology*

By: Donald Sweeney

**Buffalo Grove, IL.** – The Medical Industry has a number of demands that require special attention, including user interface design as well as extremely accurate sensing capabilities. ITW ActiveTouch, a division of Illinois Tool Works Inc. (ITW), has introduced an innovative technology that provides solutions to these demanding industry needs. From environments such as clean rooms to the advanced capabilities required for critical life supporting equipment, the ActiveTouch technology exceeds the demands and raises the bar for switch design within Medical Applications.

*Think about the possibilities...with ActiveTouch*

**Sterile capability / clean room applications** – Designers now have the ability to eliminate switch mounting holes / cut-outs, cracks, and crevices, resulting in completely seamless interfaces. This can help prevent bacteria and other contaminants from getting trapped, and can also ease the cleaning and sterilization process. Disposable/washable overlays can also be used while the electronics stay fully sealed and protected.



**Diagnostics/Reliability for Critical Applications** – The fundamental ‘Active’ nature of the technology allows devices to output a real-time diagnostic ‘heartbeat’ to a main control, providing feedback to ensure proper performance. Diagnostic testing can be easily performed by programming the electronics to output key operating characteristics at the touch of a button. Designing a switch into a critical application...would you want to rely on a piece of equipment that didn’t have ActiveTouch...?

**Unaffected by EMI/RFI** – A device that is unaffected by EMI/RFI and not emitting any interference is an absolute necessity in any hospital or medical environment. ActiveTouch panel-mount switches (ActiveMetal) and user interface panels boast electronics shielded in metallic (aluminum or stainless steel) housings. In environments and applications where EMI/RFI requirements limit other solid state technologies, ActiveTouch’s use of shielded components can make all the difference.

**Liquid Level** – Liquid level sensors today can be unpredictable, providing insufficient reliability, producing false indications, exhibiting high susceptibility to corrosive fluids, along with a host of other concerns. ITW can now produce liquid level sensors for commercial food equipment, industrially corrosive environments and fuel containers, and continues to develop the ActiveTouch technology for expanded capabilities. Applications requiring reliable liquid level sensing of various fluids within the medical industry are sure to add to demand for ActiveTouch’s unsurpassed benefits..

## *How does it Work...?*

### Overview:

ActiveTouch is a solid-state technology that uses the piezoelectric effect, but in a truly revolutionary manner. First, using the indirect piezoelectric effect of converting an electrical charge into mechanical energy, a piezo element bonded to a switch/sensor surface is energized to introduce a mechanical vibration into the medium in the MHz frequency range. The piezo element is then de-energized, and as the material continues to resonate, the direct piezoelectric effect works to convert the mechanical energy back into electrical energy. A microprocessor is used in the system to send and receive these electrical signals to and from the piezo element, as specified by the governing firmware. The returned electrical signal has a distinct decaying electrical waveform that is processed. Based on the acoustic properties of the medium and specific material geometries, the waveform has minimal loss under normal untouched circumstances. In order to create an activation, the user must dampen the mechanical energy in the material – typically by a fingertip, gloved hand, or other acoustically absorbing material.

### Advantages:

One of the great advantages is that the technology is always ‘Active’ – i.e., sending, receiving, and interpreting the electrical signals (once every microsecond). The microprocessor-based nature of the technology provides a number of advanced features.

*Input/Output:* The ActiveTouch technology offers a number of input/output combinations based on the application. Inputs can vary in voltage from standard offerings of 5VDC or 10-24VDC to custom electrical requirements (i.e., overload protection). Outputs are typically either digital or sinking open collector with the particular switch function easily modified. Controlled by firmware, switch activation can be normally open (NO), normally closed (NC), normally high (NH), normally low (NL), momentary, latched (maintained), or proportional (i.e., 0.5-4.5V), CAN bus, serial, in series or in parallel, or a number of customer specified outputs. Signal processing also eliminates the need to perform contact bounce analysis or have complicated algorithms within a control system. The advanced input/output offerings provided by ActiveTouch require wiring to accommodate power, ground, and signal. Although the ActiveTouch technology must be constantly powered, the power consumption is minimal with 25 microamps typical of most designs; there is also the capability for power saving features within the microprocessor. ActiveTouch can handle logic level loads whereas high current applications can be driven with the addition of a relay or other circuitry.

*Material Properties:* The ActiveTouch technology is offered as an individual switch module in ITW’s ActiveMetal product line, but can also be integrated directly into custom metal panels. This mounting provides advantages such as no moving parts, fully sealed, highly aesthetic appearance, and seamless design.



*Figure 1: ActiveMetal 22mm Aluminum Switches*

Many other benefits can be seen with the ActiveTouch over competing technologies. First, the panel can be quite thick (up to 0.500”), creating an extremely robust system. Switch locations can be placed closely together (six within a linear inch), have high sensing accuracy that can be defined by the user, and are independent of adjacent switch elements. With a grounded metallic enclosure, electrostatic discharge (ESD) is of no concern due to the Faraday cage effect. In addition to metals, ActiveTouch can be applied to glass, some rigid plastics, ceramic, and other resonating materials. ActiveTouch, however, is not limited to a small switch diameter. Large, curved, or irregularly shaped surfaces can be made touch sensitive providing unmatched design freedom.

*Adaptability and Diagnostics:* The activation by a user is not related to ‘force’ but rather ‘dampening’ which can prevent a number of inadvertent switch activations. Software can even identify a length of time that the switch must be dampened before outputting a signal. Similarly, if the sensor identifies a change in state, it can calibrate to adjust (i.e., changes in temperature, deformation of the material surface, etc.). The sensitivity threshold can be modified to meet customer desires (from zero force to much higher levels). Again, being always ‘Active’, the sensor can communicate with a controller its present state (working, loss of connection, mean time until failure, etc.). This makes the technology ideal for mission critical applications, allows for fast troubleshooting and repair, and can reduce or eliminate down time.



*Can't Compete:* There are certain features of the ActiveTouch that make it one of a kind and therefore ideal for many products and applications. First, there are no known technologies that can offer a proportional output with no moving parts. By using multiple threshold levels in processing the waveform, ActiveTouch can output a linear signal with no moving parts simply by dampening further. Second, many technologies are adversely affected by liquids, ruling them out for outdoor, underwater, or similar applications where liquids may be present. Liquids, however, do not affect the ActiveTouch technology which can even be used in underwater applications. Third, the technology can not only be a ‘switch’, but a sensor as well. Operator presence detection, ice detection, fluid level, and a number of other potential sensing capabilities make the technology attractive. Finally, the ActiveTouch technology is a proprietary technology to ITW making it nearly impossible for competitors to duplicate design efforts – providing a potentially a huge competitive advantage.



*Costing Analysis:* The ActiveTouch technology is a value-add solution that can provide functionality not available by other technologies, improved reliability due to durability and diagnostic capabilities, and a strong competitive advantage.

## *Other Technologies and where they Lack...*

**Membrane** – This technology is used extensively throughout the medical market in addition to many other industries. This low cost solution works well for many applications, but also presents a number of concerns. First, moisture, wet environments, and corrosive chemicals can cause peeling of overlays, causing potential failure of electronics and an aesthetically unappealing user interface. The technology lacks in robustness and component life and can be easily punctured, scratched, and damaged. This can create the need for new interfaces, costly service, downtime of equipment, and immediate or unexpected failures.



*Figure 2: ITW Switches Keyboards Using ActiveTouch Technology*

**Piezo** – Piezo electric switches offer electronics located behind a metallic surface but only provide a discrete “pulse” output when the surface is strained. The need for minimal surface thickness reduces the robustness of this technology and because output is related to a force or strain, false activations are common. With ActiveTouch, surfaces can be wiped down for cleaning / sterilization without inadvertently indicating an actuation. Piezo just doesn’t offer the advanced capabilities found in the ActiveTouch technology.

**Hall/Capacitive** – These solid-state technologies are highly susceptible to EMI and RFI which can have unpredictable and detrimental results in a medical environment. Capacitive user interface devices can be falsely actuated if liquids come into contact with the switch surface, making them unsuitable for wet environments. In addition, capacitive sensors cannot always be reliably actuated by a gloved hand and are extremely susceptible to accidental actuation by unintended contact or wipe-down during cleaning.

## *The Final Word*

Next time you are evaluating technologies for your medical application, consider the advantages offered by ITW’s ActiveTouch technology. In clean rooms, sterile environments, high reliability controls, and well beyond, ActiveTouch beats the competition hands down.

For more information on this analysis or the ActiveTouch technology, please contact ITW ActiveTouch online at [www.itwactivetouch.com](http://www.itwactivetouch.com) or by calling 800-544-3354.

ITW ActiveTouch is a division of Illinois Tool Works Inc., (ITW)  
ActiveTouch™ is a registered trademark of ITW

**Author(s):** Donald Sweeney ([dsweeney@itwactivetouch.com](mailto:dsweeney@itwactivetouch.com))